Transport Management and Accessibility Plan

Glenfield Precinct

80018022

Prepared for

Department of Planning and Environment and Property NSW

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Executive Summary

The NSW Government, through the joint land use and transport infrastructure strategies (*Our Greater Sydney 2056 – A Metropolis of Three Cities* and *Future Transport Strategy 2056*) has identified urban renewal opportunities for the Glenfield Precinct (the Precinct). The Precinct, nominated as a Planned Precinct by the Minister for Planning in June 2017 offers potential to create a vibrant, attractive and well-connected community that can accommodate significant growth in housing and jobs as a result of the following:

- Good access and connections to existing and planned transport infrastructure.
- Outlining the 30-minute strategic vision for Greater Sydney through co-locating new residential and employment populations in designated Metropolitan Clusters and Strategic Centres that can be accessed through good transport links.
- Relocation of the agricultural component of Hurlstone Agricultural High School and sale of surplus NSW Government owned land in the western portion of the Precinct, thus enabling rezoning and development.
- Rezoning and redevelopment of the eastern portion of the Precinct as part of the Glenfield to Macarthur Corridor Urban Renewal Strategy, thus offering government the opportunity to package the urban renewal of both eastern and western portions to deliver an integrated precinct.

This Transport Management and Accessibility Plan (TMAP) supports the Glenfield Precinct Plan by assessing the impacts to the transport network within and around the Precinct as a result of different development yield scenarios proposed over a 20-year timeframe. The TMAP identifies opportunities for improvements that balance local and community place needs with movement. This includes initiatives for new or adjusted services and infrastructure to reduce reliance on private vehicles and encourage people to use alternative transport modes such as walking, cycling and public transport. This will help manage travel demand and performance of the transport network, and future-proof travel capacity to and from the Precinct as it develops.

The key opportunities identified as likely to contribute to the success of the Precinct's transport network include:

- Land development and new transport infrastructure proposed in the Western Parkland City.
- Good public transport infrastructure, with connections provided to key destinations across Sydney.
- Majority of Journey to Work trip origins and destinations in surrounding travel zones to the Precinct.

Conversely, there are a number of constraints requiring consideration and addressing as development in the Precinct progresses; these include:

- High private vehicle mode share.
- Poor walking and cycling connectivity and limited supporting facilities for active transport.
- Journey times from the Precinct to key destinations by public transport.

The Glenfield Precinct

The Precinct is located approximately 31 kilometres south-west of the Sydney CBD and 20 kilometres south-west of the Parramatta CBD. The Precinct is contained around the Glenfield Station interchange, spanning both sides of the railway line. The suburb's village centre, located east of the train station, provides local cafes, shops, newsagents and health services for the surrounding local area.

Low-density residential housing and the Glenfield Public School are within the vicinity of the station to the east. Currently, by way of land use and density, the eastern side of the station is the higher trip generating area.

On the western side of the station, there is a commuter car park, the Hurlstone Agricultural High School and two schools for specific purposes; Ajuga School and Campbell House School. The Hurlstone Agricultural High School contains buildings that have heritage significance and is located within 400 metres of the station.

The Precinct is shown in **Figure 1**.

Figure 1 Glenfield Precinct

Source: Glenfield Precinct (DPIE, December 2017)

Approximately 9,200 residents were living in the Precinct in 2016, of which the majority were living on the eastern side of the railway line, accounting for 73 per cent of the precinct population. This is largely due to over half of the western side of Glenfield Station being represented by the Hurlstone Agricultural School and undeveloped land.

Overall, there are approximately 1,640 people employed within the precinct, with 66 per cent being located on the eastern side of the railway line.

Existing transport network

Walking

The Precinct has a well-developed footpath network, especially in close proximity to Glenfield Station. In residential areas, 1.2-metre-wide footpaths are generally provided, however these are often on only one side of the carriageway and connectivity is lacking. Where footpaths are provided, these are generally offset from the property boundary, increasing pedestrian sight distance at driveways and improving safety compared to paths adjacent to property boundaries/ fence lines. Footpaths are not provided in the lower order streets.

Signalised crossings are provided on all legs of the key intersections within the Precinct, except at the intersection of Campbelltown Road and Glenfield Road where two of the three legs have signalised pedestrian crossings provided. Pedestrian refuge facilities are also provided at roundabout intersections along Railway Parade.

Cycling

The Precinct provides both regional cycling links and local cycling routes. These cycling facilities provide some level of support for cycling as a mode of transport; however, the network is coarse and incomplete for cycling to be considered for many trips to and from the Precinct. The Precinct is connected to a regional cycling route north of Glenfield Station via the shared path network between Glenfield and Parramatta (as part of the Parramatta to Liverpool, and Liverpool to Campbelltown rail trail).

There are however, a number of key missing links in this cycle network, especially along Glenfield Road, which is classified as a high difficulty on-road route, as well as further connections to the Hume Highway shared path. There are also limited cycle routes south of the Precinct, towards the Campbelltown region, along Canterbury Road or Railway Parade.

Bus

The bus network servicing the Precinct includes a number of different routes. These routes include local shopping and residential loops, routes that traverse the surrounding suburban regions providing connectivity to sections east of the railway line and regional routes that provide connections to centres in other regions such as Minto, Prestons and Campbelltown. Bus connections to the western portion of the Precinct are limited. Bus priority measures such as bus lanes and signal priority are not provided in the Precinct.

Bus service frequencies are low during both the peak and off-peak periods. Weekend and late night services are also limited.

Train

The Precinct is serviced by Glenfield Station, located on the Sydney Trains T2 Leppington Line, T5 Cumberland Line and T8 Airport and South Line. NSW TrainLink Intercity trains on the Southern Highlands Line (SHL) also service the station. Overall, service connectivity with the rest of the rail network is good, providing direct links towards the Sydney CBD, Parramatta and Western Sydney areas. Peak hour services are also at 15-minute intervals to and from the CBD, with trains every 30 minutes towards Parramatta.

Road network and parking

The road network within and around the Precinct is generally well-developed, with connections provided to the major arterial and motorway corridors including the Hume Motorway, M5 and M7 Motorways, Campbelltown Road, Glenfield Road and Cambridge Avenue. There is only one opportunity to cross the railway line within the Precinct, via the Glenfield Road bridge.

Parking throughout the Precinct is provided through a combination of on and off-street parking. The Glenfield Station commuter car park is the largest off-street facility in the Precinct, providing 950 spaces. To the south-east, 180 off-street spaces are available for the nearby sports ground. A smaller facility east of the railway station is located off Magee Lane and services the nearby retail land uses.

On-street parking controls in the Precinct generally vary by distance to the Glenfield Station interchange; however, these have inconsistent times of operation.

Freight

The Precinct is located along the national freight network for freight movement between regional NSW, ACT and Victoria on rail and road. The freight network through the Precinct generally begins at Minto and extends through to Liverpool. It sits west of the railway line and extends west of the Hume Motorway.

The railway line through Glenfield Station also accommodates the South Sydney Freight Line (SSFL), which opened in 2013. The line consists of a third track through the rail corridor that is dedicated for freight services, allowing passenger services to operate separate to freight. There is no curfew on the line and services can operate 24 hours a day.

Existing travel behaviour

Journey to Work travel to and from the Precinct is heavily dependent on private vehicles, representing 63 per cent of trips for residents of the Precinct, and 85 per cent for those travelling to the Precinct. The train line is also well utilised by residents of the Precinct, with almost a third of all JtW trips completed by rail. Active transport mode share ranges from two to five per cent for walking, while cycle trips are counted within “Other mode,” which ranges from three to five per cent. Bus mode share was the lowest for both trips to and from the Precinct, representing one per cent.

For residents of the Precinct travelling to other locations, the top three destinations were Campbelltown (21 per cent), followed by the Sydney CBD (19 per cent) and Liverpool (12 per cent), all three of which are easily accessible from the existing train network. The majority of employees accessing the Precinct reside in the surrounding suburbs, with high proportions of origins including Campbelltown, Liverpool, Camden and Bringelly.

Future Precinct land use

The Draft Precinct Plan details the following layout:

- The land immediately adjacent to Glenfield Station on the eastern and western side has been identified as a combination of high density mixed use and employment.
- On the eastern side of Glenfield Station, the land is zoned as low density to high density with the density increasing with closer proximity to the station.
- On the western side of Glenfield Station, the land is zoned as low density to high density with the density increasing with closer proximity to the station.
- A new local centre is also located to the west of Glenfield Station adjacent to low-medium density residential.
- There are five schools zoned within the Precinct, five on the western side of the Glenfield Station, including three special schools, and two on the east.

The Draft Precinct Plan is presented in **Figure 2.**

Figure 2 Draft Glenfield Precinct Plan

Source: DPIE (2020)

Population projections for the Precinct include outputs from Transport for NSW's (TfNSW) Transport Performance and Analytics Travel Zone Projections 2016 (TZP2016) model, and three development scenarios (low, medium and high growth) prepared by DPIE and Property NSW. Between these projections, the future resident population is forecast to range:

- In 2026, between 11,957 under the TZP2016 model and 22,199 under a high growth scenario.
- In 2036, between 16,057 under the TZP2016 model and 32,929 under a high growth scenario.

The projections for employment in the Precinct range:

- In 2026, between 2,000 under the TZP2016 model and 3,601 under a high growth scenario.
- In 2036, between 2,270 under the TZP2016 model and 4,801 under a high growth scenario.

Future transport network

Recommendations for the future transport network build on the outcomes of:

- A multi-modal assessment of public transport utilisation, active transport routes and proposed designs for walking and cycling infrastructure, parking facilities for vehicles and bicycles, and strategic modelling of proposed east-west road projects and the impacts associated with the different development scenarios.
- Government strategies and policies, including the Western Sydney City Deal, the Greater Sydney Commission's *A Metropolis of Three Cities* and TfNSW's *Future Transport Strategy 2056*.

The recommendations aim to maximise accessibility for residents and visitors of the Precinct, and improve connectivity to significant destinations across Sydney and facilitate opportunities for travel to new centres as they are developed.

Walking

The recommended initiatives for the walking network in the Precinct include:

- A well-defined walking network with improved connectivity and increased permeability;
- Providing wide (1.8 metres minimum) footpath facilities on both sides of all roads (new and existing) in the Precinct for improved accessibility.
- Activating frontages along higher order streets to encourage pedestrian activity and passive surveillance.
- On higher order streets with mixed land uses, designating separate activity areas and sufficient effective width to minimise conflicts between pedestrians.
- Provide improved east-west connectivity across the railway line, to link existing communities and facilities with new communities and facilities, including new active open spaces.
- Investigating appropriate locations for new crossing facilities with pedestrian priority (such as zebra crossings) as well as other traffic calming measures to reduce vehicle speeds, particularly in denser, higher activity areas.

Cycling

The recommended initiatives for the cycling network in the Precinct include:

- Cycle routes should be direct in connecting to popular destinations. Long detours should be avoided where possible, but should also consider impacts of local topography such that a longer route along a shallower grade may be preferable to a shorter route along a steep street.
- The design of facilities should place emphasis on improving intersection layouts to accommodate cyclists, providing mid-block crossings at safe and convenient locations, and separating cyclist movements from pedestrians where possible, particularly at bus stops.
- Facilities should cater for east-west connectivity to link existing communities and facilities with new communities and facilities, including new active open spaces.
- Providing clearly signposted wayfinding and appropriate line marking provides guidance for users. Where development is occurring, this presents an opportunity to provide wide shared paths along street frontages with good lighting and security measures.
- Facilities should also be designed with consideration given to traffic volumes and speeds on the subject road. For example, fully separated off-road facilities are preferred along major arterial roads, whilst on-road or mixed traffic facilities are suitable for low-speed local roads.

Bus

The recommended initiatives for the bus network in the Precinct include:

- Review performance of buses using capacity and occupancy data representing travel post-implementation of the November 2017 timetable.
- Review the bus network and explore opportunities to provide improved connections to and from Glenfield Station and the Precinct, to provide improved interchange opportunity between public transport services and support new development as they come online.

- Improve regional connectivity for the Precinct to the Campbelltown-Macarthur, Liverpool and Western Sydney Airport-Badgerys Creek Aerotropolis Metropolitan Clusters.
- Collaborate with Council and TfNSW as part of the detailed planning and development of an Interim Bus Layover facility on the western side of Glenfield Station (immediately adjacent to the station entrance plaza). Options were developed for either an indented bus bay facility, or layover facility within the active northbound traffic lane.
- Investigate opportunities to improve the hours of operation of bus services within the Precinct.

Train

The recommended initiatives for the train network in the Precinct include:

- Review performance of train services using capacity and occupancy data representing travel post-implementation of the November 2017 timetable.
- Investigate providing rail connections from the Precinct to new employment growth areas including the Western Sydney Airport-Badgerys Creek Aerotropolis, and new land release precincts west of Leppington.
- Investigate providing improved service frequency along all lines in off-peak periods to encourage mode shift to train services.
- Investigate opportunities to provide full separation of freight and passenger rail on the T2 Inner West and Leppington Line, and T8 South Line to provide additional capacity.

Road network

The recommended initiatives for the road network in the Precinct include:

- Undertake further modelling and a cost-benefit analysis on the requirements for the Precinct's road network based on the outcomes of the modelling and analyses completed as part of this study, being:
  - Implementation of the Full Cambridge Avenue Extension
  - Confirm and progress concept and detailed designs for the preferred infrastructure.

Freight

The recommended initiatives for the freight network in the Precinct include:

- Accommodate freight vehicle movements along major arterial roads only, discouraging use of local streets in the Precinct.
- Investigate the needs of new developments in the Precinct as they come online for service and delivery vehicles.
- Investigate new road links from the Precinct to the Western Sydney Airport-Badgerys Creek Aerotropolis due to open in 2026.
- Investigate the requirements for freight access to the Moorebank Intermodal Terminal and the allocation of the freight task to road and rail.

Parking

The recommended initiatives for parking in the Precinct include:

- Investigate management measures for commuter car park facilities, such as integration with the Opal card system and providing free parking for Park & Ride customers who live beyond an 800-metre catchment of the station or have special needs.
- Investigate reducing demand for vehicular parking for short trips and encouraging greater adoption of active transport through improved facilities.
- Adjusting and rationalising the on-street parking controls to align with the density of the adjacent land use and associated level of activity.
- Investigate opportunities to introduce a resident parking permit scheme for the Precinct.
- Providing an adequate supply of spaces for Kiss & Ride, taxis and buses at transport interchanges to prevent overflow into adjacent short-term spaces.

Summary

The proposed transport network responds to the existing environment future demand, and structure plan development. The walking and cycling networks have the potential to be implemented prior to the structure plan completion through NSW Government and Council programs. The recommended initiatives for the train network are in line with the initiatives outlined in Future Transport 2056 and therefore will be implemented or investigated as proposed. The proposed bus routes in the region will be considered as part of upcoming regional bus network reviews. The potential road links identified require detailed meso-modelling and cost-benefit analysis to ensure no adverse impacts arise as a result of their implementation, for example induced local demand and/or congestion.

This TMAP identifies further actions to be undertaken to analyse and plan for the delivery of transport infrastructure and services to support development of the Precinct. These actions are:

- Undertake detailed traffic modelling on the impacts of the planned east-west road upgrade options;
- Costing and prioritisation of the recommendations for the future transport network;
- Working with stakeholders including TfNSW and public transport providers and operators to deliver new public transport services and infrastructure, with consideration given to:
  - Outcomes from the Western Sydney City Deal;
  - The City-shaping and City-serving networks outlined in Future Transport 2056; and
  - Initiatives that are committed and nominated for investigation in Future Transport 2056.
- Confirm and progress concept and detailed design of the preferred east-west road upgrade options.

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1 Introduction

1.1 Background

The Glenfield Precinct (the Precinct) forms part of the Greater Macarthur Priority Growth Area within the Growth Area State Environmental Planning Policy (SEPP), guiding urban renewal, land release, new infrastructure and development over the next 20 years.

The Precinct was nominated as a Planned Precinct by the Minister for Planning in June of 2017. Planned Precincts are identified as areas with good access to existing or planned transport infrastructure and that have the potential to provide for significant growth in housing and jobs.

The Precinct is one of seven within the Glenfield to Macarthur Urban Renewal Corridor. The focus of revitalisation and urban renewal in the Precinct comprises the following key sites:

1. The Hurlstone Development Project, made up of two parcels of NSW Government owned land:
    a. Hurlstone Agricultural High School; and
    b. Office of Strategic Lands;
2. Dwellings located to the east of Glenfield Station.

The NSW Government is seeking to create a vibrant, attractive and well-connected community in Glenfield. Excess Department of Education land within the precinct has been identified as having the opportunity for housing, jobs and community infrastructure within the precinct. These lands have been subject to comprehensive investigation and consultation. DPIE has prepared a draft precinct plan for consultation.

1.2 The Glenfield Precinct

The Precinct is located approximately 31 kilometres south-west of the Sydney CBD and 20 kilometres south-west of the Parramatta CBD. The Precinct is contained around the Glenfield Station interchange, spanning both sides of the railway line. The suburb's village centre, located east of the train station, provides local cafes, shops, newsagents and health services for the surrounding local area. Low-density residential housing and the Glenfield Public School are within the vicinity of the station to the east. Currently, by way of land use and density, the eastern side of the station is the higher trip generating area.

On the western side of the station, there is a commuter car park, the Hurlstone Agricultural High School and three schools for specific purposes; Ajuga School, Campbell House School and Glenfield Park School. The Hurlstone Agricultural High School is an item of heritage significance and is located within 400 metres of the station. The area to the north of the education precinct was released for low-density housing in 2008.

Within the precinct boundary there are two links providing connections between the western side and eastern side of the railway line. These are:

- The Glenfield Station interchange, featuring an overpass facility integrated within the station concourse. This can be used by pedestrians and cyclists only; and
- Glenfield Road bridge – for use by vehicular traffic only.

The Glenfield Precinct is shown in **Figure 1-1**.

Figure 1-1 Glenfield Precinct

Source: Glenfield Precinct (DPIE, December 2017)

1.3 TMAP purpose

A Transport Management and Accessibility Plan (TMAP) is being developed to support and inform the future uplift of the Precinct. The TMAP will assess development yield scenarios as well as the transport impacts to the precinct and surrounds. The TMAP will provide a government-led approach to provide the appropriate transport network for the Precinct, with consideration of both movement capacity requirements and place function.

The key objectives of the TMAP are to:

- Confirm and set the transport vision and objectives for the precinct;
- Align and integrate with strategic plans and policies (including Transport for NSW's (TfNSW) Future Transport 2056 Strategy and the Greater Sydney Commission's (GSC) Greater Sydney Region Plan and Western City District Plan) and reference planned projects;
- Identify and manage the increased demand on the public transport and road network associated with the proposed growth in residents and workers;
- Identify improvements to the transport network, including adjustments to existing infrastructure as an opportunity to create places and encourage people to use alternative transport modes including public transport, walking and cycling;
- Present a clear strategy for planning transport infrastructure to support the urban renewal and to take advantage of existing and planned transport networks; and

> Reduce the demand for travel by private car and commercial vehicle.

The TMAP will outline the integrated infrastructure needs and costs for the Precinct over the next 20 years. As well as considering trip generation within the Precinct, the TMAP will recommend infrastructure provision to enable residents, workers, and visitors to make more sustainable transport choices. This will help to manage travel demand and network capacity, and future proof travel to and from the Precinct as it develops.

1.4 Opportunities and constraints

This section provides an overview of the opportunities and constraints applicable to the Precinct determined through the review of the strategic context (covered in **Section 2**) and the existing transport conditions (covered in **Section 3**).

The summary of the opportunities within the precinct are presented in **Table 1-1**.

Table 1-1 Precinct opportunities

Category	Summary of opportunity	Description	Report section reference
Infrastructure and services	30 minute city	Committed initiatives in the Greater Sydney Region Plan, Future Transport 2056 and the Western Sydney City Deal will aim to improve travel times to and from the Western Parkland City and Aerotropolis.	**2.1.5**
	Rail network service coverage is good	Service coverage with the rest of the rail network is good, with easy connections to key centres of Sydney CBD, Parramatta, Liverpool, and Campbelltown regions.	**3.1.2**
	Rail patronage increasing	Rail patronage from Glenfield Station has been increasing at 1.5 per cent per year since 2011.	**4.4.1.2**
	Good bus to rail interchange	Bus to rail interchange is good at Glenfield Station, with undercover paths and wayfinding provided between the two modes to encourage multimodal public transport use.	**3.1.1** **3.2.1**
	Good commuter amenities at northbound bus stop	Undercover seating area at Glenfield Station for bus commuters travelling northbound.	**3.1.1**
	Good feeder bus service	Eastern side of Glenfield Precinct is serviced by feeder bus route S9.	**3.2.2**
	Good suburban bus route connections	Suburban bus routes service major centres of Campbelltown and Liverpool, through suburban streets, also providing interchange possibilities at a number of railway stations along their routes.	**3.2.2**
	Pedestrian footpaths provide on major pedestrian thoroughfares	Footpaths have been provided on the majority of pedestrian thoroughfares on at least one side of the road.	**3.3.1**
	Shared path network has good connectivity to centres	The shared path network in proximity to the Precinct provides connections towards Liverpool and Parramatta. Glenfield Station is well integrated with the shared path network.	**3.3.2**
	Crossing facilities provided close to Glenfield Station	Pedestrian crossing facilities have been provided on all legs at the signalised intersection at Glenfield Station. Pedestrian refuges have also been provided on roundabouts along Railway Parade.	**3.3.1**
	Cycle parking provided at Glenfield Station	A total of 20 bicycle racks and 12 bicycle lockers have been provided on both sides of Glenfield Station.	**3.1.1**
	The Precinct is close to major roads	The Precinct is in close proximity to the Hume Highway, M5 and M7 Motorways. This reduces the need for freight movements along local streets within	**3.4.1**

Category	Summary of opportunity	Description	Report section reference
Infrastructure and services		the Precinct. Easy access enhances the accessibility of Glenfield to the wider road network.	
	Road demand not at capacity	All roads within the Precinct still have additional capacity during peak times, assuming a Level of Service D.	**3.4.9**
	Park & Ride facilities provided at Glenfield Station	950 parking spaces are provided at Glenfield Station. Strategic modelling shows this facility caters for commuters outside of the precinct.	**3.1.1** **4.5.1.2**
	Freight network runs on the extremities of The Precinct.	The main freight routes are along the Hume Highway, M5 and M7 motorways. Freight routes within the Precinct proceed along the northern boundary, along Glenfield Road and Cambridge Avenue. These routes provide efficient freight connections around the Precinct without the need to interact with local streets.	**3.5**
	Southern Sydney Freight Line reduces heavy vehicle movements	The Southern Sydney Freight Line (SSFL) reduces the heavy vehicle movements along the highway network. This freight line also provides efficient freight movements from industrial centres. Future Transport 2056 outlines a plan to investigate enhancements to the SSFL to support anticipated growth in the freight task.	**3.5.1**
Travel demand	Residents of the Precinct work in the Campbelltown area	21 per cent of residents in the Precinct work in the Campbelltown area, which is easily accessible by public transport through bus or train.	**3.7.5.1**
	Workers of the Precinct live in the Campbelltown region	52 per cent of workers of the Precinct live in the Campbelltown region, which is easily accessible by bus and train.	**3.7.5.2**
Land uses	Retail close to Glenfield Station	Retail provided is provided in close proximity to Glenfield Station, within the local centre on the eastern side.	**1.2**
	Land release area on the western side is close to Glenfield Station	The Hurlstone Agricultural High School and Office of Strategic Lands, to be relocated and land redeveloped is located in close proximity to Glenfield Station (on the western side).	**1.2**

A summary of the Precinct constraints are presented in **Table 1-2**.

Table 1-2 Precinct constraints

Category	Summary of constraint	Description	Report section reference
Infrastructure and services	Frequency of service on T5 Cumberland Line	Rail services on the T5 Cumberland Line, which connects Glenfield to Leppington, Parramatta and Richmond, run services at 30-minute frequencies throughout the day.	**3.1.1**
	Public transport travel time to the Sydney CBD is long	Long journey times may discourage motorists to shift their travel mode to train.	**3.1.2.5**
	Bus stop infrastructure is limited	A number of bus stops on the eastern side of the railway line do not have TfNSW standard timetables and flags. They are only marked as bus stops by the regulatory Bus Zone signage. Potential bus customers may not know the routes and direction of bus travel.	**3.2.1**
	Low frequency of bus services	Bus service frequencies are low during both the peak and off-peak periods. Weekend and late night services are also limited.	**3.2.2**
	Limited bus connections to the west of The Precinct	There are limited bus service connections to the west of the Precinct.	**3.2.2**
	Bus routes are indirect	Bus routes that service the Precinct are indirect and slow which may discourage regular use.	**3.2.2**
	Limited bus priority	There are no bus priority measures within the Precinct. With increasing traffic in the area, bus services are likely to experience congestion, which will increase travel times and reduce bus patronage.	**3.2**
	Shared path network not integrated	A number of shared path routes have been constructed in isolation by various developments, especially to the western areas. Lack of an integrated shared path network will affect the ability to increase walking and cycling mode share.	**3.3.1**
	Glenfield Road shared path gap	The route along Glenfield Road has a gap between the shared path at Glenfield Creek and the Old Glenfield Road intersection. This section of the route is classed as high difficulty.	**3.3.2**
	Poor connectivity of cycle network to regional network	There is no connectivity to the shared path on the Hume Highway, which links to the M7 Motorway and Camden Valley Way cycleways.	**3.3.2**
	No cycle connections south of Glenfield Station	No dedicated cycling facilities are provided south of Glenfield Station, particularly on the eastern side of the railway line.	**3.3.2**
	No footpaths on lower order roads	There are no footpaths provided on lower order streets with the Precinct, which may result in pedestrians walking on the road.	**3.3.1**
	Lack of connections between the eastern and western side of railway line	There are only two connections between the eastern and western side of the corridor. One is via the Glenfield Station overpass (pedestrian and cyclists only), and the other via Glenfield Road.	**1.2**
	Average travel speeds along Railway Parade are high	The average travel speeds for Railway Parade during the PM peak periods are higher than the posted speed limits.	**3.4.9**

	On-street parking restriction are not consistent	On-street parking restrictions throughout the precinct are not consistent, with changes in restrictions observed close to Glenfield Station.	**3.6.1**
Travel demand	High private vehicle mode share	Private vehicle usage is high, especially for those commuting to the Precinct.	**3.7.5.2**
	Poor walkability	Walkability in the Precinct is likely reduced due to the lack of accessibility and connectivity in the existing pedestrian infrastructure and generally car-dependent environment.	**3.3.1** **3.7.5**
	Low bus mode share	Bus mode share in the Precinct is low for both residents and workers.	**3.7.5**
	Low active transport mode share	Active transport mode share in the Precinct is low for both residents and workers.	**3.7.5**
	Crashes along certain roads	Intersection of Belmont Road and Canterbury Road has a high number of crashes. Investigating potential treatments to improve safety may reduce this statistic.	**3.8.1**
	Pedestrian crashes close to Glenfield Station	Two pedestrian crashes occurred in close proximity to the Glenfield Station interchange.	**3.8.2.1**
	Pedestrian crashes at intersection of Belmont Road and Canterbury Road.	Two pedestrian crashes occurred close to Belmont Road and Canterbury Road.	**3.8.2.1**
Land uses	Low density residential close to Glenfield Station	Low-density residential land uses are provided close to Glenfield Station. Increasing densities close to Glenfield Station may help to increase usage of active and public transport.	**1.2**
	Limited major retail	There is a lack of major retail services within the Precinct, which may encourage local residents to travel to other areas for basic goods and services.	**1.2**

2 Strategic context

A number of state and local plans and policies are relevant to the development of the TMAP. These documents provide objectives and frameworks for development and transport within the regional and local area.

2.1 Strategic planning

2.1.1 NSW State Plan – NSW 2021 (2011, NSW Department of Premier and Cabinet)

The NSW State Plan 2021 is the NSW Government's ten-year plan to rebuild the economy, provide quality services, renovate infrastructure, restore accountability to government, and strengthen the local environment and communities in NSW. The plan sets priority goals for action and provides guidance for NSW Government resource allocation in alignment with the NSW Budget. There are five strategy areas outlined in NSW 2021, of them two are directly relevant to the TMAP:

- Return quality services: by providing the best transport, health, education, policing, justice and family services, with a focus on the customer.
- Renovate infrastructure: by building the infrastructure that makes a difference to both our economy and people's lives.

Sitting underneath the five strategy areas of the NSW State Plan 2021 are 32 goals that explicitly state desired outcomes from each strategy. They include the following four 'return quality services' and two 'renovate infrastructure' goals that are relevant to the transport considerations of this study:

- Goal 7 – Reduce travel times (Strategy area: Return quality services).
- Goal 8 – Grow public transport by making it a more attractive choice (Strategy area: Return quality services).
- Goal 9 – Improve customer experience with transport services (Strategy area: Return quality services).
- Goal 19 – Invest in critical infrastructure (Strategy area: Renovate infrastructure).
- Goal 20 – Build liveable centres (Strategy area: Renovate infrastructure).
- Goal 29 – Restore confidence and integrity in the planning system (Strategy area: Return quality services).

Implications for the TMAP

- The NSW State Plan 2021 supports the uptake of public and active transport. It has set goals for travel mode share that should be referenced when setting travel targets for the Precinct.
- A clear and transparent strategic planning framework and transparent planning system will support the development of the Precinct and provide certainty for residents and developers as to the aims of the priority precinct's urban renewal.
- Industrial land use intensity will increase in the Freight Activity Precinct creating greater volumes on the freight road and rail networks.

2.1.1.1 South Western Sydney – Regional Action Plan (2011, NSW Department of Premier and Cabinet)

The South Western Sydney Regional Action Plan is a regional sub-report of the NSW State Plan. It contains a two-year action plan that sets out the initiatives and projects that will help achieve the 2021 goals in the south-western areas of Sydney.

A key regional priority for the south-western area is improvement of road and public transport connections to and from other regions of Sydney. The upgrade and construction of public transport links and infrastructure such as the South West Rail Link (completed in 2015) and Glenfield Transport Interchange upgrade (completed in 2012) are acknowledged as major projects that will support the area.

Implications for the TMAP

- Upgrades to public transport infrastructure and services will reduce travel times and will enhance public transport in the study area.
- Upgrades to the freight rail infrastructure will lead to an improvement in reliability for both passenger and freight services.

2.1.2 Our Greater Sydney 2056 – A Metropolis of Three Cities Greater Sydney Region Plan (2018, Greater Sydney Commission)

Our Greater Sydney (A Metropolis of Three Cities) is the Greater Sydney Commission's Plan for Greater Sydney Region. The Plan is aligned with the NSW Government's Future Transport 2056 and Infrastructure NSW's State Infrastructure Strategy to benchmark transport and infrastructure outcomes for Greater Sydney. The purpose of the plan is to:

- Set a 40-year vision (up to 2056) and establish a 20-year plan to manage economic, social; and environmental growth for Greater Sydney;
- Inform district and local plans and provide guidance to the assessment of planning proposals;
- Assist government agencies to plan and deliver for growth and change and to align their infrastructure plans to place-based outcomes;
- Inform the private sector of the vision for Greater Sydney and infrastructure investments required to manage growth; and
- Inform and engage the wider community so the Plan can best reflect the values and aspirations of all.

The Plan puts a focus for the Western Parkland City on planning growth and sequencing new infrastructure and services to support shaping a new city that is connected to the north, east and south. The Western Parkland City requires a place-based approach that starts with public and open spaces and transit oriented developments.

Implications for the TMAP

- The population of the Western Parkland City is projected to grow from 740,000 in 2016 to 1.1 million in 2036 and to well over 1.5 million by 2056.
- The Western Parkland City will be established on the strength of the new Western Sydney Airport and Badgerys Creek Aerotropolis. It will be a polycentric city capitalising on the established centres of Liverpool, Greater Penrith and Campbelltown-Macarthur (referred to as Metropolitan Clusters in the Plan).
- With fewer jobs than workers in western Sydney, many residents are likely to have to travel outside the area to access employment.
- As Campbelltown-Macarthur is one of three Metropolitan Clusters within the Western Parkland City, efficient transport connections between the areas located on the east and west sides of the Hume Motorway will be needed, and this may increase traffic volumes in the Precinct.
- More jobs will be available in or close to the south-west corridor through development of Leppington, Western Sydney Airport and enhancement of Campbelltown-Macarthur as a Metropolitan Cluster centre.
- New public and active transport connections will be needed to support this growth in the currently underutilised and poorly connected areas and it is logical that transport links between Campbelltown and Leppington will require strengthening.

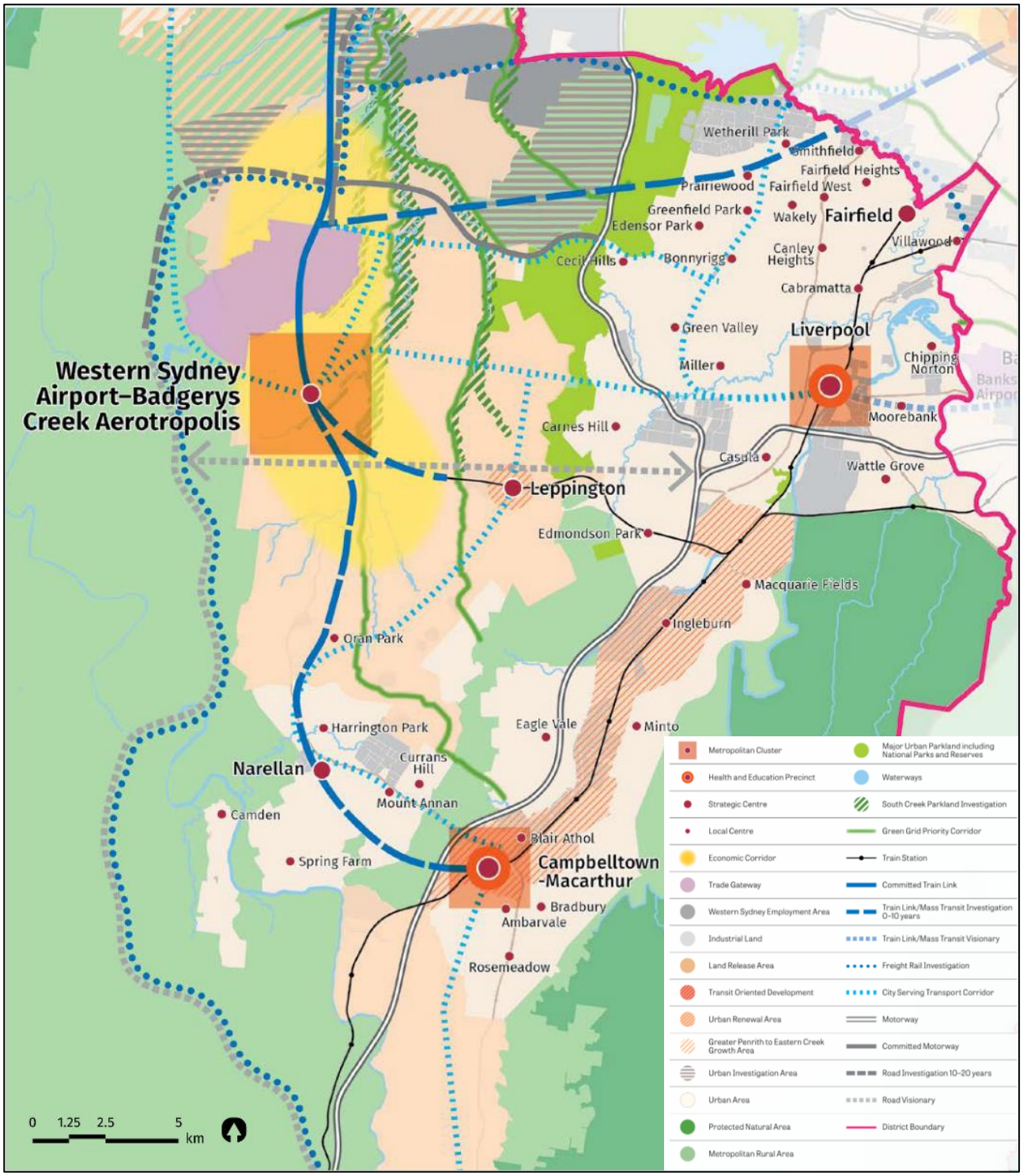
2.1.3 Western City District Plan (2018, Greater Sydney Commission)

The Western City District Plan sets a 20-year plan to manage economic, social and environmental growth to achieve the 40-year vision for Greater Sydney. The Plan is a guide for implementing the Greater Sydney Region Plan at a district level and is a bridge between regional and local planning.

The Western City District has multiple centres at Liverpool, Greater Penrith, Campbelltown-Macarthur and the emerging Badgerys Creek Aerotropolis. The Plan recognises that Planned Precincts within the study area will need to be consistent with the objectives and strategies outlined in the Greater Sydney Region Plan. Planned Precincts will be supported by a special infrastructure contribution or similar satisfactory arrangement to help fund the delivery of essential community infrastructure such as health services, schools, open space and roads.

Transport investments will provide major links for people and freight between the District's strategic centres, and to Greater Sydney's north and south, in addition to traditional economic anchors in the east. The Western City District Plan (Urban Area South) is shown in **Figure 2-1**, including significant transport projects for investigation.

Figure 2-1 Western City District – Urban area south



Source: Western City District Plan (Greater Sydney Commission)

Implications for the TMAP

Significant transport projects include:

- A North-South Rail Link;
- Leppington to Western Sydney Airport and Badgerys Creek Aerotropolis Rail Link;
- Outer Sydney Orbital; and
- Western Sydney Freight Line.

2.1.4 NSW State Infrastructure Strategy (2018, Infrastructure NSW)

The *NSW State Infrastructure Strategy* (SIS), prepared by Infrastructure NSW, presents a vision for NSW in 2038 and makes recommendations for infrastructure investment over the next 20 years that align with the outcomes of the Greater Sydney Region Plan and Future Transport 2056. The 2018 SIS provides detail of the proposed funding strategy for infrastructure projects, the Restart NSW Fund, and identifies additional priorities for transport infrastructure. The SIS outlines the objective for the Western Parkland City as "Developing a new city built on new knowledge industries." More broadly, the objectives outlined for transport infrastructure relevant to the Precinct include:

- Supporting the plan for a Metropolis of Three Cities and the 30-minute city;
- Encouraging new travel behaviours that maximise efficient use of the transport network's capacity through initiatives such as demand management and pricing reform;
- Reallocating road space on key corridors for use by more productive and sustainable transport modes;
- Encouraging greater use of high productivity freight vehicles and rail freight;
- Further development of Sydney's motorways and public transport including the rail network, integrated with good rapid transit and active transport links; and
- Preserving future transport infrastructure corridors in the Western Parkland City and prioritising rail and on-road mass-transit systems to support growth in the area.

These objectives aim to address inefficiencies in the wider transport network, and reduce congestion and the associated impacts on productivity and liveability.

Implications for the TMAP

- The prioritisation of rail and on-road mass transit projects in Western Sydney will encourage greater mode shift from private vehicle to public and active transport to achieve the 30-minute city vision.
- The proposal to extend the South West Rail Link to St Marys via Western Sydney Airport will encourage rail travel for travellers using the Airport, and connecting future residents of the Precinct with new employment opportunities at the Aerotropolis as the area develops into a key centre.

2.1.5 Future Transport Strategy 2056 (2018, Transport for NSW)

The Future Transport Strategy 2056 is an update to the NSW Long Term Transport Master Plan. It presents the 40-year vision for mobility in NSW developed in coordination with the Greater Sydney Commission, the Department of Planning and Environment, and Infrastructure NSW. The Strategy sets out the plan, strategic directions and customer outcomes, and infrastructure plans for Greater Sydney and Regional NSW to complete the vision across the state.

Key outcomes for the Greater Sydney area are:

- Efficient, reliable and easy-to-understand journeys for customers, enabled by a simple hierarchy of services;
- An efficient and reliable freight network supported by all hour rail access between key freight precincts and centres;
- A safe transport system for every customer with zero deaths or serious injuries on the network by 2056;
- 30-minute access for customers to their nearest metropolitan or strategic centre by public transport during all times of the week;
- Fast and convenient transport interchanges, with walking times of no longer than five minutes between modes;
- Walking or cycling becoming the most convenient option for short trips around centres and local areas, supported by a safe road environment and accessible infrastructure;
- Vibrant centres supported by streets that balance the need for convenient access with enhancing the attractiveness of places;
- Fully accessible transport for all customers;
- New technology is harnessed to provide an integrated experience for customers from origin to destination;
- Future forms of mobility are available to customers and are integrated with existing modes of transport;

> Transport infrastructure is delivered, operated and maintained in a way that is affordable for customers and the community;

> A resilient transport system that contributes to the NSW Government's objective of net-zero emissions by 2050;

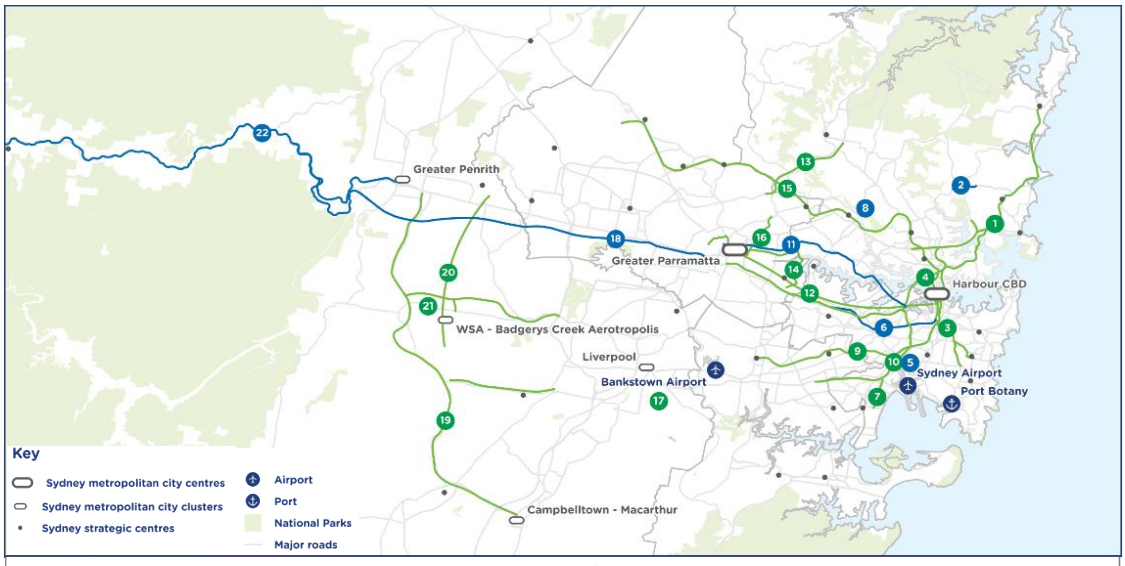
Implications for the TMAP

- Future Transport 2056 emphasises that developing the Western Parkland City will require investment in mass transit. To support this, the strategy supports a new north-south rail train link through the Western Sydney Airport-Badgerys Creek Aerotropolis, followed by east-west connections to the Central River City.

2.1.6 Greater Sydney Services and Infrastructure Plan (2018, Transport for NSW)

The Greater Sydney Services and Infrastructure Plan sets a 40-year vision for transport in the Greater Sydney Region. The Plan creates a vision of a better-integrated transport system that will support the productivity, liveability and sustainability of Sydney. The plan outlines the initiatives required to deliver the broad arching vision set for Greater Sydney, including committed initiatives (over the next 10 years), initiatives for investigation (in the 0-10 year and 10-20 year timeframes) and visionary initiatives (in the 20+ year timeframe). Committed initiatives for investigation are shown in **Figure 2-2**.

Figure 2-2 Initiatives for investigation (0 – 10 year timeframe)



NEW INFRASTRUCTURE

1. Northern Beaches B-line
3. CBD & South East Light Rail
4. Western Harbour Tunnel and Beaches Link*
7. F6 Extension - Stage 1 West Connex to President Ave, Kogarah*
9. Sydney Metro City and Southwest
10. WestConnex
12. Sydney Metro West*
13. NorthConnex
14. Parramatta Light Rail - Stage 2ˇ
15. Sydney Metro Northwest
16. Parramatta Light Rail - Stage 1
17. Access to Moorebank Intermodal Terminal†
19. Western Sydney Infrastructure Plan including the new M12°
20. North-south Rail link in Western Parkland City: St Marys - Western Sydney Airport - Badgery's Creek Aerotropolis°
21. Western Sydney Growth Roads Program

SYDNEY-WIDE PROJECTS/PROGRAMS

- Priority Cycleway links in the Central River City
- Ferry Fleet Replacement Program, including upgraded services on Parramatta River Ferries
- Priority Cycleway links in inner Sydney
- New Intercity Fleet
- Priority Cycleway links in the Western Parkland City
- New and replacement buses

MAJOR INFRASTRUCTURE UPGRADES

2. Northern Beaches Hospital road upgrade
5. Sydney Airport road upgrades
6. Parramatta Road public transport improvements
8. Macquarie Park Interchange and precinct improvements†
11. Victoria Road public transport improvements
18. M4 Smart Motorway
22. Upgrade to Blue Mountains Line

SYDNEY-WIDE PROJECTS/PROGRAMS

- Transport Access Program (Improve access to train stations and ferry wharves)
- Cycling and Pedestrian Infrastructure
- Public Transport passenger service improvements
- Pinch Point Program
- Council partnership program to improve local walking and cycling connections
- Safer Roads Program
- Bus Priority Infrastructure Program

* Subject to final business case and funding
° Subject to final business case and funding in collaboration with the Commonwealth
† In collaboration with the Commonwealth
‡ For priority planning in collaboration with the Commonwealth

Source: Greater Sydney Services and Infrastructure Plan (Transport for NSW)

Implications for the TMAP

The Plan makes the following commitments for the Western Parkland City:

Committed initiatives (0-10 years):

- Investment in road-based transport to support the growth of Western Sydney Airport (WSA)-Badgerys Creek Aerotropolis and surrounding areas.
- Supporting the efficient movement of goods between the Western Parkland City and Port Botany by investing in access to Moorebank Intermodal Terminal.

Initiatives for investigation (0 – 10 years):

- Early investment in strategic links, such as the north/south train link through the Western Parkland City, the train linking WSA Badgerys Creek Aerotropolis to Parramatta and the train link from Leppington to the WSA-Badgerys Creek Aerotropolis.
- Infrastructure to support rapid bus links between centres, to shape a sustainable urban form and support access to WSA.
- Supporting freight with upgrades to the Southern Sydney Freight Line.
- Protection of future transport corridors to support the affordable delivery of passenger and freight infrastructure in the future.

Initiatives for Investigation (10-20 years):

- Supporting population and jobs growth in the Western Parkland City through higher capacity public transport and road links.
- Supporting the efficient movement of freight to ports by investing in the Maldon-Dombarton freight rail link to the Illawarra and further increasing capacity on the Southern Sydney Freight Line.

Visionary Initiatives (20+ years):

- Higher capacity transport connections between centres to support population and jobs growth, including extension of Sydney Metro City and Southwest to Liverpool.
- Supporting the efficient movement of road freight from Moorebank Intermodal Terminal by extending the M5 to the Outer Sydney Orbital.

2.1.7 NSW Freight and Ports Plan 2018-2023 (2018, Transport for NSW)

The NSW Freight and Ports Plan, provides a framework to guide collaboration between government and industry, with the aim of providing a freight system that moves goods in an efficient, accessible, safe and environmentally sustainable manner. This would provide successful outcomes for communities, producers and customers state-wide. The Plan outlines more than 70 initiatives across new infrastructure and technologies which seek to achieve five key objectives:

1. **Economic growth:** Provide confidence and certainty to encourage continued growth and investment in the freight industry;
2. **Efficiency, connectivity and access:** Improve efficiency of existing infrastructure and greater connectivity and access along key freight routes;
3. **Capacity:** Maximising infrastructure investment and increasing infrastructure and land use capacity to accommodate growth;
4. **Safety:** Creating a safe freight supply chain through safe networks, transport, speeds and people; and
5. **Sustainability:** Developing a sustainable supply chain that delivers benefits to the environment and continued future operations.

In the Western City, the total freight task (inbound and outbound movements) is expected to grow by 67 per cent by 2036. The road and rail corridors between Liverpool and Campbelltown-Macarthur are also identified as a key freight activity precinct.

The strategy identifies Intermodal terminals (IMTs) as playing a critical role in the transport of containerised and bulk freight, facilitating improved productivity and efficiency across the network, and acting as a key enabler for increasing rail share. By facilitating rail and road efficiencies, IMTs also ease capacity constraints at NSW ports and the surrounding road network resulting from increased containerised freight volumes.

The key initiatives for freight services and infrastructure around the Precinct include:

> New north-south and east-west rail links to support growth in the freight task and encourage transfer from road to rail.

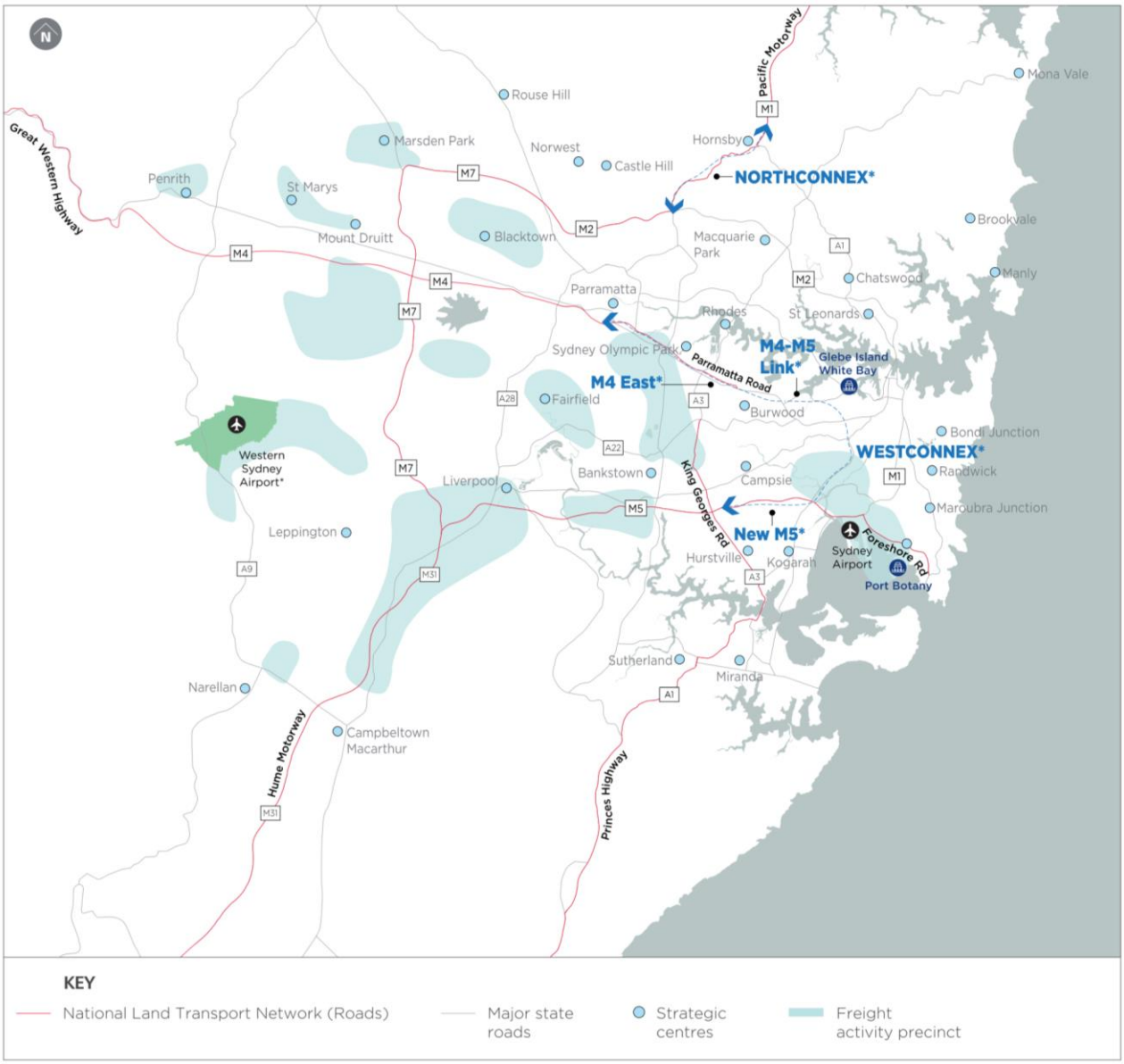
> The Outer Sydney Orbital to improve accessibility to new intermodal facilities, as well as new distribution and consolidation facilities in key urban centres to manage the growth in smaller-scale urban freight

movements such as e-commerce, retail and residential deliveries whilst maintaining good amenity for the surrounding environment.

> Amplification of the Southern Sydney Freight Line and completion of a passing loop at Cabramatta to support the Moorebank Intermodal Terminal.

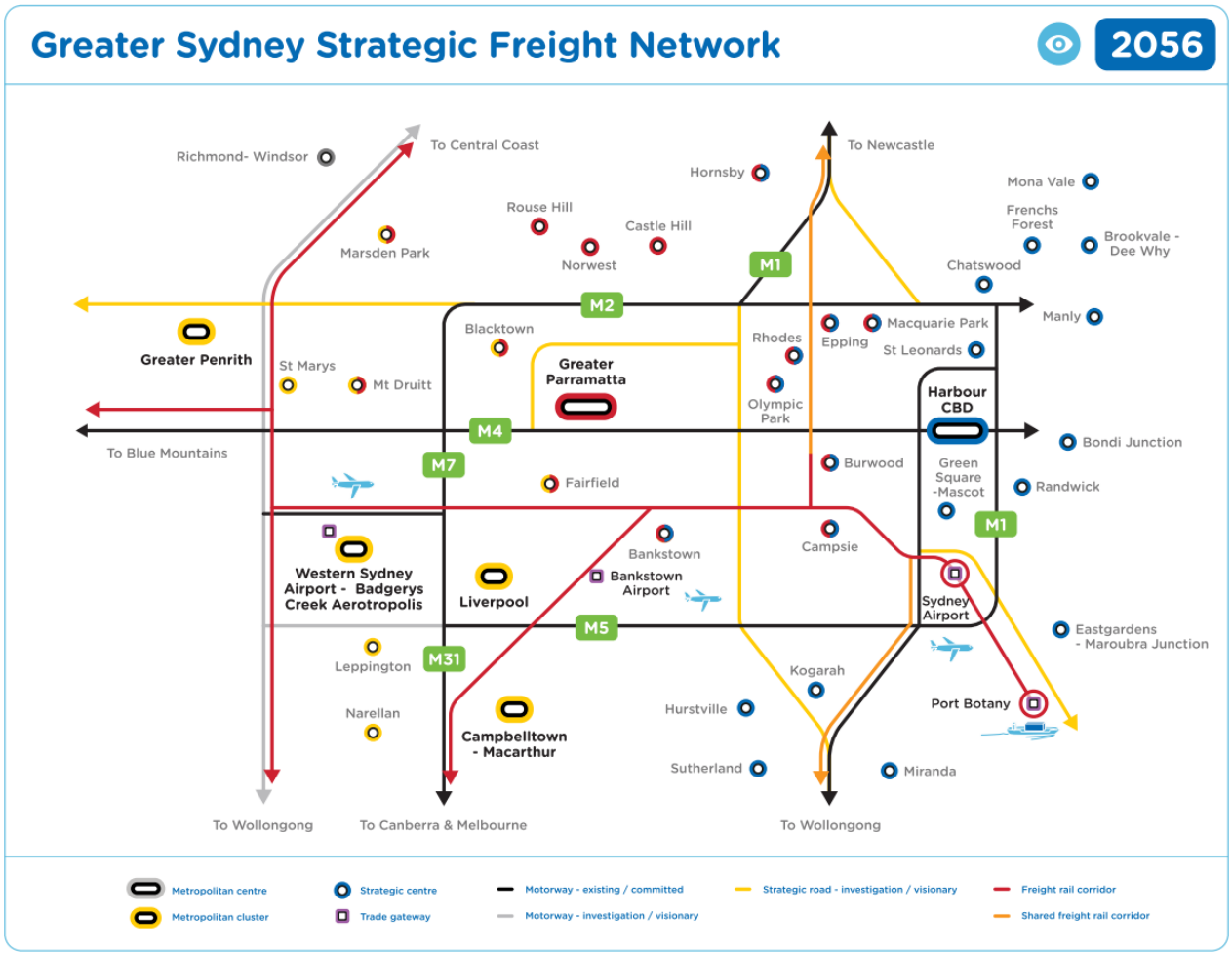
The Sydney metropolitan freight network and freight precincts are shown in **Figure 2-3**, and the visionary 2056 Greater Sydney Strategic Freight Network from the Greater Sydney Services and Infrastructure Plan is shown in **Figure 2-4**.

Figure 2-3 Sydney Metropolitan Freight Network



Source: NSW Freight and Ports Plan 2018-2023 (Transport for NSW)

Figure 2-4 Greater Sydney strategic freight network – Initiatives for investigation (20+ years)



Source: Greater Sydney Services and Infrastructure Plan (Transport for NSW)

Implications for the TMAP

- One key strategic IMT identified in the Plan is the Moorebank Logistics Park, which is currently under construction near the Precinct. It will provide an integrated service offering including IMEX and interstate terminals, warehousing, retail and service offerings, and rail connection to the Southern Sydney Freight Line, which also provides dedicated freight rail access through to Port Botany.

2.1.8 Metropolitan Road Freight Hierarchy

The Metropolitan Road Freight Hierarchy identifies where the need for freight movement is greatest, and assists in land use planning. The objectives of the Metropolitan Road Freight Hierarchy are:

> To support the pattern of industrial lands and activities that lead to varying freight flows on the road network by providing suitable road infrastructure.

> To provide for the specific needs of freight vehicles in operating the road network as a safe, sustainable and efficient road transport system for all road users.

> To supplement the administrative classification of roads by recognising the varying intensity of freight generating activities and heavy freight vehicle demand on roads within the State Road classification.

Implications for the TMAP

- The Hume Motorway and Hume Highway forms part of the primary road freight network, which connects to Glenfield Road and Cambridge Avenue along the northern boundary of the Precinct. The anticipated increase in freight movements because of the future Moorebank Intermodal Terminal will likely use these connections.

2.2 Regional strategic planning

2.2.1 Western Sydney City Deal

The Western Sydney City Deal, announced in March 2018 represents an agreement between the Federal Government, NSW Government and Local Government representatives from councils to coordinate development of the Western Parkland City and Aerotropolis over the next 20 years. The Deal includes initiatives for the delivery of new residential, education and employment areas (including 464,450 new residents and 200,000 new jobs), infrastructure and local community projects, supported by the new Western Sydney Airport at Badgerys Creek.

The Deal incorporates a commitment to the 30-minute city initiative of the Greater Sydney Region Plan and Future Transport 2056. To support this commitment, the Deal has outlined a new north-south rail link between the proposed airport and the T1 Western Line at St Marys and Schofields, which represents Stage 1 of a new rail network for the area. Future plans include an extension of the existing South West Rail Link to the airport and another north-south alignment which will extend from the airport south through the South West Growth Area (SWGA) to connect with the T8 South Line at Macarthur. The extension of the rail catchment within the region will assist in reducing the reliance on private vehicles.

2.2.2 South West Growth Area (SWGA)

The SWGA is a largely new greenfield development area included in the Sydney metropolitan region. It is located adjacent to and the south of the Western Sydney Employment Area (WSEA), and west of the Glenfield Precinct. New communities were developed for suburbs including Oran Park, Leppington, Austral, Edmondson Park, Catherine Fields and South Creek West.

2.2.2.1 South West Growth Centre Road Network Strategy

The South West Growth Centre Road Network Strategy for Roads and Maritime Services (formerly RTA) was completed in June 2011. The strategy is based on three major road categories developed by Roads and Maritime for growth centres, which are principal arterials, transit boulevards, and sub-arterials.

Bicycle and pedestrian network integration is to be planned and provided for all road categories, linking key land uses.

The planning of the road network is intended to maximise integration with land use planning, resulting in better outcomes for the regional transport network and its customers. The SWGC Road Network Strategy identified a number of major roads, both existing and proposed that could provide links towards the Precinct. This strategy, along with other road planning proposals will be considered through the District Planning process.

2.2.3 Precinct Planning

The Glenfield Planned Precinct is located in the Campbelltown Local Government Area (LGA). Strategic planning, local planning, land use, land zoning and development controls are all governed by the Campbelltown City Council.

The following documents listed below are relevant controls and policy for transport provision for the Precinct.

- Campbelltown Local Environmental Plan 2002;
- Campbelltown Local Environmental Plan 2015;
- Campbelltown (Sustainable City) Development Control Plan 2015;
- Glenfield Road Urban Release Area Development Control Plan 2002; and
- The Link Site Development Control Plan 2002.

Each of the transport plans' components generally align with the state, metropolitan and regional plans regarding integration of land use and transport, with objectives aligned with providing higher density developments close to existing public transport facilities and improving transport networks including pedestrian, cyclist and road.

The Draft LEP 2014 has a number of objectives that will affect the Precinct:

Implications for the TMAP

- Provide a comprehensive planning framework for the sustainable development of land in Campbelltown LGA.
- Facilitate Campbelltown LGA's development as the compact and vibrant primary business centre for the Macarthur Region, with distinct limits to urban growth and a clearly defined separation between urban and non-urban areas.
- Reinforce a hierarchy of centres and strengthen the role of the Campbelltown – Macarthur Centre as the primary business centre for the Macarthur Region.
- To optimise the integration of land use and transport and encourage safe, diverse and efficient means of transport throughout Campbelltown LGA.
- Medium and high-density residential housing is to be placed in close proximity to commercial centres, transport hubs and routes.
- Neighbourhood, local and community centres are planned to provide retail, business and community uses, which will support public and active modes of transport.
- Building floor space ratio and heights are to reflect their proximity to public transport facilities.

2.2.4 Glenfield to Macarthur Urban Renewal Corridor Strategy (2015, NSW DPIE and Campbelltown City Council)

The Glenfield to Macarthur Urban Renewal Corridor Strategy was developed in coordination with the NSW Government and Campbelltown City Council to establish a strategic planning framework to guide future development and infrastructure delivery over the next 20 years. The Strategy includes detailed analysis for seven precincts along the south-west corridor. The seven precincts include Glenfield, Macquarie Fields, Ingleburn, Minto, Leumeah, Campbelltown and Macarthur station precincts.

The future vision for each of the precincts is outlined including the number of new homes, jobs, improvements to community spaces, facilities and transport infrastructure that is required to achieve sustainable growth. The Strategy outlines what could be achieved by 2036.

The Strategy aims to:

> Identify the environmental and built form constraints and opportunities for renewal;

> Develop a vision and land use plan for each precinct;

> Project appropriate housing and employment growth to 2036;

> Be informed by market demand and economic feasibility analysis;

> Incorporate a high level infrastructure capacity analysis;

> Identify the infrastructure required to support projected growth;

> Develop a framework to guide future land use change;

> Provide an evidence base for more detailed precinct planning; and

> Establish an implementation and monitoring framework.

The future vision outlined by the Strategy for the Precinct is to achieve "a vibrant local centre and transport interchange for the south-west". The goals set for the Precinct to achieve this vision are set out into categories within the Strategy including built form, movement network, housing, jobs and open space and public domain.

Implications for the TMAP

- Consistent outcomes of the Precinct Transport Management and Accessibility Plan with the vision outlined in the Strategy for the Priority Precinct.
- The Strategy will address the Precincts movement network goals, impacting the Precinct in the following ways:
  - Capitalising on the Glenfield Station upgrades to provide an accessible station for residents and commuters.
  - The development of the cycleway between Glenfield and Macarthur for commuter and recreational usage.
  - Implementation of new local cycling routes to existing networks and improve connections with Glenfield Station and the surrounding area.
  - Maximising pedestrian and cyclist linkages along open space networks.
  - Identification new green connections that link existing open spaces to increase their amenity and accessibility.
  - Encourage and promoting walking and cycling by implementing shared pathways, separated cycle ways, footpaths, pedestrian refuges, street tree planting, bicycle storage facilities and lighting.

2.2.5 Glenfield to Macarthur Integrated Transport Strategy (2017, Cardno)

The Integrated Transport Strategy (ITS) supports the Glenfield to Macarthur Urban Renewal Corridor Strategy (URCS) by proposing development outcomes for transport and identifying opportunities and risks to the transport system by proposed future growth.

The ITS outlines a framework to support an increase in population and employment within the study area. Further planning and analysis will be required in the following areas.

- Strategic road network: Further consideration of key regional road links as part of broader planning processes such as the SWGC structure plan review, Western Sydney airport planning, and Greater Macarthur land release investigations.
- Detailed local area road network analysis: to understand local road network performance.
- Local area transport network: detailed planning and design of the street network to support a safe low-speed environment, including investigation of 40km/h high pedestrian activity areas and local area traffic management facilities.
- Consideration and analysis of the land use and freight conflicts including Southern Sydney Freight Line duplication, noise impacts, and future viability of industrial business with shifting land use profile.

The Precinct plans were further refined and Cardno was engaged to complete a transport strategy update to the Precinct. This related to the changes at West Glenfield from the proposed relocation of the Hurlstone Agricultural College. The ITS was updated to reflect the changes, ensuring the ITS was current. In summary, the ITS identified a concept transport network with planning and policy considerations to support the projected increase in population and employment in the study area.

Implications for the TMAP

- This TMAP is an update to the transport strategies outlined in the ITS for the Precinct.

3 Current transport conditions

This section describes the current transport conditions within the Precinct. It also describes the population demographics and Journey to Work travel patterns. This will provide an initial indication of the strengths and opportunities for each mode.

3.1 Rail

3.1.1 Glenfield Station

Glenfield Station is located in the centre of the Precinct and has two entrances, one located on the eastern side of the railway line at the intersection of Railway Parade and Hosking Crescent, and another located on the western side on Glenfield Road. The station has four platforms on two islands, accessed by stairs or lifts. The interchange facilities consist of:

- 20 bike racks and 12 bike lockers;
- Sheltered bus stops;
- 10 weather protected Kiss & Ride spaces, with locations as follows:
  - Eastern side: 100 metres north and south of the station entry on Railway Parade;
  - Western side: Close to the carpark on the western side of the station;
- Two taxi zones, on either side of the railway line; and
- Approximately 950 car parking spaces.

These features are shown in **Figure 3-1**.

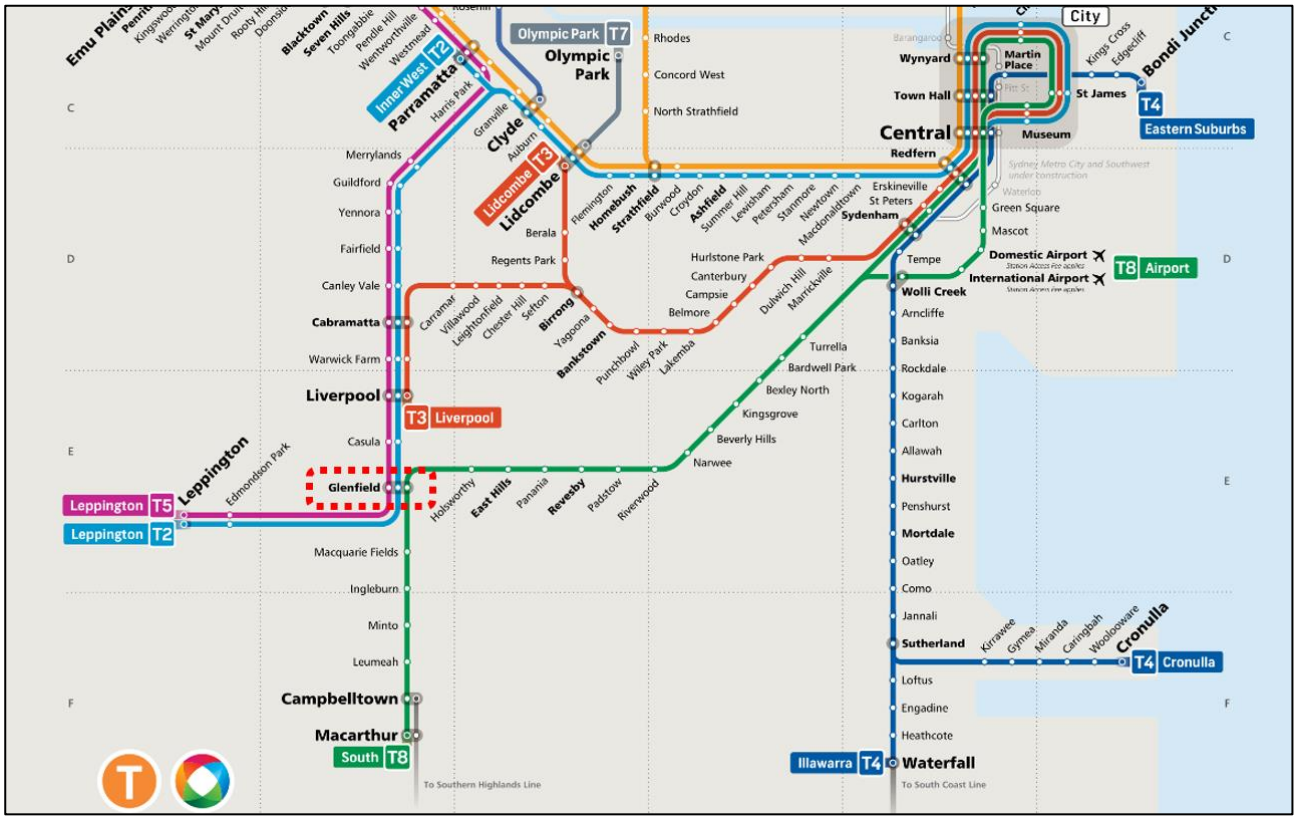
Figure 3-1 Glenfield Station interchange facilities

Basemap source: Nearmap (October 2017)

3.1.2 Network and services

The Precinct is serviced by Glenfield Station, located on the Sydney Trains T2 Leppington Line, T5 Cumberland Line and T8 Airport and South Line. NSW TrainLink Intercity trains on the Southern Highlands Line (SHL) also service the station. The context of Glenfield Station within the Sydney Trains network is shown in **Figure 3-2**.

Figure 3-2 The Precinct in Sydney Trains suburban network context



Source: Sydney Trains (November 2017)

3.1.2.1 T2 Inner West and Leppington Line

The T2 Line runs services between Leppington and the City, or Parramatta and the City via the Inner West.

3.1.2.2 T5 Cumberland Line

The T5 Cumberland Line provides a north-south train connection through Sydney's western regions, between Leppington and Richmond via Liverpool, Parramatta and Blacktown.

3.1.2.3 T8 Airport and South Line

The T8 line runs services between the City and Macarthur via:

- Sydney Airport (International and Domestic), Green Square and Mascot, or
- Sydenham and Redfern (these services only operate during peak periods, with inbound services during the AM peak and outbound during the PM peak).

3.1.2.4 Summary of passenger rail services

A summary of train services along each line that service the Precinct is provided in **Table 3-1**. The table provides the total number of daily services as well as services per hour during peak and off peak times.

Table 3-1 Passenger rail service summary

Line	Direction	Daily Services	AM Peak (/hr)	Off-peak (/hr)	PM Peak (/hr)
T2 Leppington	To Sydney CBD	119	9	6	6
	From Sydney CBD	121	6	6	9
T5 Cumberland	To Richmond via Parramatta	37	2	2	2
	From Richmond via Parramatta	36	2	2	2
T8 South (Via Airport)	To Sydney CBD	85	5	4	4
	From Sydney CBD	86	5	4	4
T8 South Line (via Sydenham)	To Sydney CBD	6	6	-	-
	From Sydney CBD	8	-	-	4

Source: Sydney Trains timetables, viewed March 2018

Overall, service connectivity with the rest of the rail network is good, providing direct links towards the Sydney CBD, Parramatta and Western Sydney areas. Peak hour services are also at 15-minute intervals to and from the CBD, with trains every 30 minutes towards Parramatta.

3.1.2.5 Travel times

Trains generally operate closer to their scheduled time due to the advantage of being separated from other transport systems. Sydney Trains have established a benchmark target of 92 per cent of trains arriving within five minutes of their scheduled timetable during peak periods. Recent data indicates this target is generally achieved and travel times are consistent throughout the day.

The timetabled trip times to key destinations from Glenfield Station are:

- Central – 41 minutes (via T8 Airport and South Line) or 64 minutes (via T2 Inner West and Leppington Line);
- Town Hall – 47 minutes (via T8 Airport and South Line) or 67 minutes (via T2 Inner West and Leppington Line);
- Strathfield – 44 minutes (via T2 Inner West and Leppington Line);
- Parramatta – 33 minutes (via T5 Cumberland Line);
- Leppington – 10 minutes (via T2 Inner West and Leppington Line); and
- Campbelltown – 16 minutes (via T8 Airport and South Line).

3.2 Bus

The bus network servicing the Precinct includes a number of different routes. These routes include local shopping and residential loops, routes that traverse the surrounding suburban regions providing connectivity to sections east of the railway line and regional routes that provide connections to centres in other regions such as Minto, Prestons and Campbelltown. Bus priority measures such as bus lanes and signal priority are not provided in the Precinct.

3.2.1 Bus stop infrastructure

Bus stop infrastructure at the Glenfield Station includes undercover seating and TfNSW signage and timetables on plinths. Along Railway Parade and Glenfield Road, TfNSW signage and timetables on plinths are also used, however no shelters are provided.

On the eastern side of the railway line, the majority of bus stops not on Railway Parade only have bus zone signs. No signage, timetables or plinths are provided at these bus stops.

3.2.2 Network and services

There are six bus routes within the Precinct, which provide interchange opportunities at Glenfield Station. Bus routes 864 and 867 begin and terminate at Glenfield Station, and service the north-western quadrant of the Precinct. Routes 870, 871 and 872 continue through the Precinct and provide connections between Campbelltown and Liverpool. Bus route S9 is a local loop service, which provides connections to the eastern area of the precinct.

An overview of the six bus routes is provided in **Table 3-2**, along with the key land uses they service. A summary of bus frequencies and operating times is shown in **Table 3-3**. Public transport facilities in the Precinct are shown in **Figure 3-3**.

Table 3-2 Bus route descriptions

Route No.	Route	Route Description	Significant key land use connections
864	Carnes Hill to Glenfield (weekday only)	A relatively direct bus route providing a link from Glenfield Station to the north west of the Precinct. This route passes through the suburbs of West Hoxton, and along the border of Horningsea Park, Edmondson Park, Prestons and through the south-west corner of Casula. The route falls short of providing a connection to Carnes Hill Marketplace.	Crossroads Homemaker Centre
867	Prestons to Glenfield (weekday only)	A local service providing a link between the residential areas of Prestons, via the north west of the Precinct corridor to Glenfield Station.	Prestons Shops
870	Campbelltown to Liverpool	A parallel route to the railway line between Campbelltown and Liverpool. It operates on the east side of the railway line between Campbelltown and Glenfield and the western side north of Glenfield to Liverpool. While similar to routes 871 and 872, this route services the eastern parts of Glenfield.	Glenquarie Shopping Centre
871	Campbelltown to Liverpool	Similar to Route 870 and 872. This route has a deviation in Casula (outside of the study area) to service additional residential areas.	Glenquarie Shopping Centre, Minto Marketplace, Campbelltown Hospital
872	Campbelltown to Liverpool	Similar to Route 870 and 871, this route deviates at Leumeah, Ingleburn and Macquarie Fields to service a different catchment. The Macquarie Fields diversion is extensive, servicing the outer eastern precincts of the suburb.	Glenquarie Shopping Centre, Minto Marketplace, Campbelltown Hospital
S9	Glenfield Loop	A local loop and Glenfield Interchange feeder service that also services Macquarie Fields to the south east of the railway line.	Glenquarie Shopping Centre

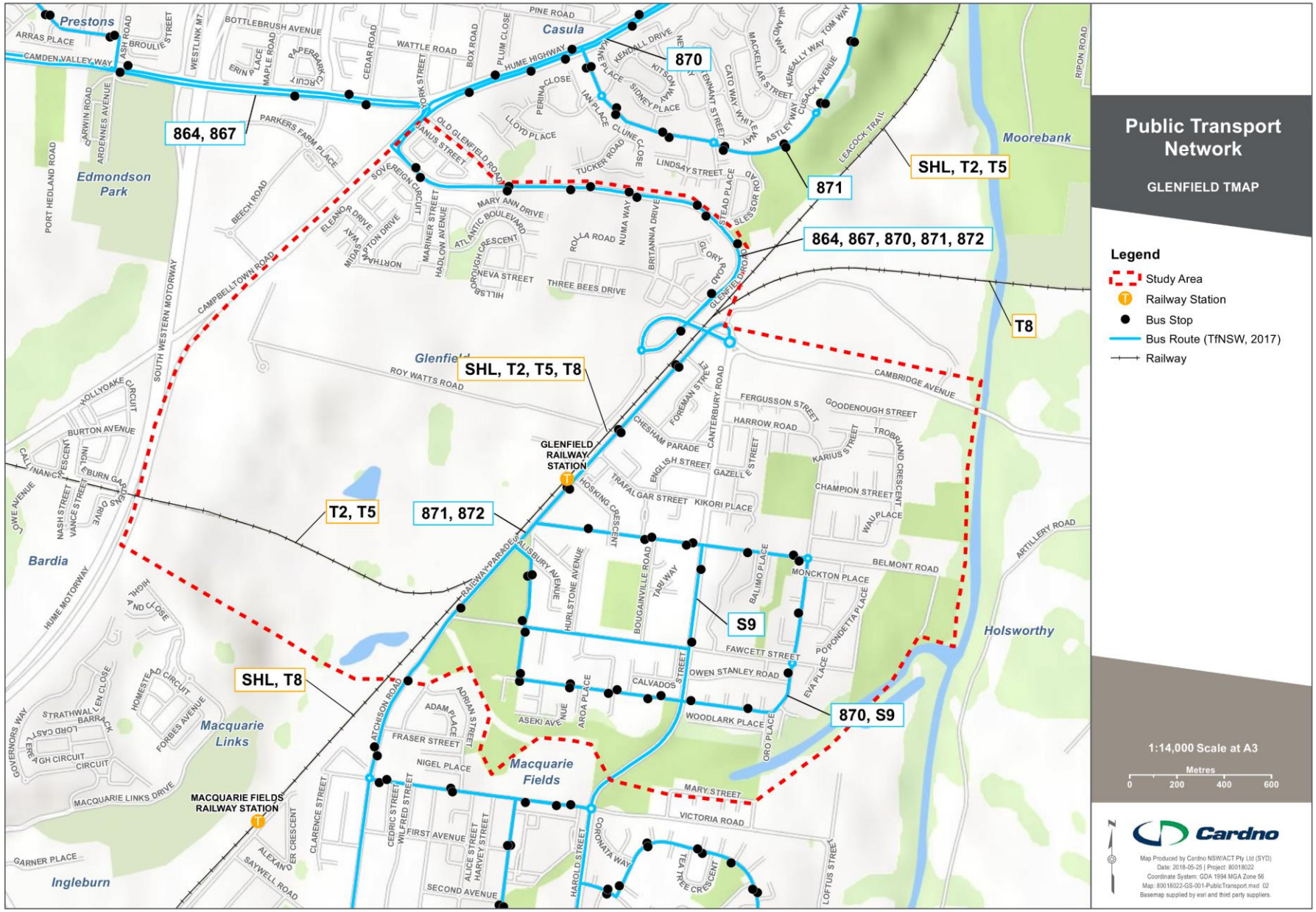
Source: Bus timetables (Transportnsw.info, viewed May 2018)

Table 3-3 Bus route operations

Route No.	Route	To	Service span	Bus frequency per hour			Number of Services		
				AM Peak	PM Peak	Off-peak	Weekday	Saturday	Sunday
864	Carnes Hill to Glenfield (weekday only)	Carnes Hill	4:18pm - 6:53pm	0	2	0	6	0	0
		Glenfield	5:02am - 7:35am	3	0	0	6	0	0
867	Prestons to Glenfield (weekday only)	Prestons	4:18pm – 7:12pm	0	3	2	7	0	0
		Glenfield	5:06am - 7:24am	4	0	0	6	0	0
870	Campbelltown to Liverpool	Campbelltown	5:25am - 10:41pm	2	2	1	27	16	10
		Liverpool	5:59am - 10:51pm	2	2	1	26	18	10
871	Campbelltown to Liverpool	Campbelltown	8:42am - 7:57pm	<1	<1	1	8	12	6
		Liverpool	5:35am – 2:42pm	<1	0	1	6	11	6
872	Campbelltown to Liverpool	Campbelltown	5:15am – 10:21pm	2	2	2	32	32	16
		Liverpool	5:24am – 11:17pm	2	2	2	36	32	19
S9	Glenfield Loop	via Glenquarie Shops	9:10am - 2:08pm	0	0	<1	4	0	0

Source: Bus timetables (Transportnsw.info, viewed May 2018)

Figure 3-3 Precinct public transport network



3.3 Active transport

3.3.1 Walking

The Precinct has a well-developed footpath network, especially in close proximity to Glenfield Station. Full kerb to property boundary width paths are provided adjacent to business/ retail land uses opposite the interchange and adjacent to the interchange. Path facilities are also provided on both sides of streets connecting to all interchange facilities, including car parks, bus stops, taxi zones, Kiss & Ride areas and bicycle storage/parking areas.

In residential areas, 1.2-metre-wide footpaths are generally provided, however these are often on only one side of the road and connectivity is lacking. Along Glenfield Road, path facilities are only provided on the northern side of the carriageway between the intersections of Atlantic Boulevard and Old Glenfield Road, which limits accessibility for residents on the southern side, requiring pedestrians to make unsafe crossing movements to access the footpath network. South of the Atlantic Boulevard intersection, a stretch of shared path is provided, however no pedestrian connectivity is provided past the bridge overpass, as either a path or a crossing facility. Along Railway Parade, footpath facilities are limited to the eastern side south of Glenfield Station.

Where footpaths are provided, these are generally offset from the property boundary, increasing pedestrian sight distance at driveways and improving safety compared to paths adjacent to property boundaries/ fence lines. Footpaths are not provided in the lower order streets.

Signalised crossings are provided on all legs of the key intersections within the Precinct, except at the intersection of Campbelltown Road and Glenfield Road where two of the three legs have signalised pedestrian crossings provided. Pedestrian refuge facilities are also provided at roundabout intersections along Railway Parade.

3.3.2 Cycling

The Precinct provides both regional cycling links and local cycling routes. These cycling facilities provide some level of support for cycling as a mode of transport; however, the network is coarse and incomplete for cycling to be considered for many trips. Reference in the following sections has been made to the online RMS Cycleway Finder, which is continually updated.

Regional cycling routes provide connections to surrounding local and regional centres. The Precinct is connected to regional cycling route, north of Glenfield Station via the shared path network between Glenfield and Parramatta and various other centres including Hoxton Park, Cabramatta, Liverpool and Cecil Hills. The Precinct is also located in close proximity to, but not connected to the regional cycling network along the M5 and M7 motorways. There is an off-road cycle path located along the M7 Motorway.

Local cycling routes provide an easy way to get to the local shops, school, public transport or main activity centres. They are generally not intended as regional connectors, although at times they do serve a dual purpose. Within the Precinct, there are a number of new shared paths, which have been constructed within the past two years. These shared paths are predominantly in the new residential areas on the western side of the railway line, which link to the north-south shared path between Glenfield and Parramatta.

There are however, a number of key missing links in this cycle network, especially along Glenfield Road, which is classified as a high difficulty on-road route, as well as further connections to the Hume Highway shared path. There are also limited cycle routes south of the Precinct, towards the Campbelltown region, along Canterbury Road or Railway Parade.

A summary of the active transport network is provided in **Figure 3-4**.

Figure 3-4 Precinct active transport facilities

3.4 Road

3.4.1 Hume Motorway

The Hume Motorway is a state road, also known as both the Hume Freeway and Hume Highway in various sections, and is one of Australia's major inter-city highways between Sydney and Melbourne. The Hume Motorway begins north of Glenfield, where it is linked to the M5 and M7 Motorways. The M5 and M7 Motorways form part of Sydney's orbital motorway network. The Hume Motorway is the south-western connection into Sydney's orbital motorway network. It provides access from the Southern Highlands, Goulburn and Canberra.

The motorway is located to the west of the Precinct, and is four lanes in each direction. The posted speed limits along this motorway are 100km/h between the M5/M7 Motorways and Glenfield, and 110km/h to the south of the Glenfield area.

The major exits that affect the local traffic network in the Precinct are:

- Camden Valley Way northbound entry and exit and southbound entry; and
- Campbelltown Road, Glenfield southbound entry only.

These exit roads are all designated as state roads under the governance of Roads and Maritime.

3.4.2 Campbelltown Road

Campbelltown Road is a state road that links Campbelltown to Casula and provides regional north-south access to the Precinct. This road follows a similar alignment to the Hume Motorway.

Adjacent to the Precinct, this road is three lanes in each direction. South of the Precinct, the road is predominantly one lane in each direction. Most of the intersections close to the Precinct are signalised and the speed limit varies from 70 to 80km/h. As discussed in the Hume Motorway section, there are is an entry onto the Hume Motorway from Campbelltown Road. On-street parking is generally not permitted along Campbelltown Road.

3.4.3 Glenfield Road

Glenfield Road is a state road that provides an east-west connection between Campbelltown Road and the railway line. The road generally has a single lane in each direction, except close to the Campbelltown Road intersection where it becomes two lanes in each direction. The posted speed limit is 60km/h. This road is the main bus corridor for services arriving at or departing from Glenfield Railway Station. On-street parking is permitted kerbside.

Glenfield Road also provides the only overpass between the eastern and western side of the railway line. It is a key corridor for commuters to access the station.

3.4.4 Canterbury Road

Canterbury Road is a state road, which provides north-south connections from Glenfield towards the Campbelltown region. Within the Precinct, this road is generally two lanes in each direction, however further south it varies from one to two lanes in each direction. The speed limit along the length of this corridor is 60km/h. This corridor has limited on-street parking no parking restrictions in place during the AM peak (6:30am – 9:30am) for northbound traffic and PM peak (3:30pm – 6:30pm) for southbound traffic.

Approximately 19,000 vehicles use this road on an average weekday in both directions, with peak hour traffic flows of between 1,400 – 1,500 vehicles per hour in both directions.

3.4.5 Railway Parade

Railway Parade is a regional road that runs parallel to the Canterbury Road. The road is predominately one lane in each direction. Parking is permitted kerbside along this stretch of the road, and the speed limit is 50km/h close to Glenfield Station, and 60km/h for the rest of its length.

Approximately 8,000 vehicles use this road on an average weekday in both directions, with peak hour flows of between 600 to 750 vehicles in both directions.

3.4.6 Belmont Road

Belmont Road is a local road, which runs in the east-west direction and provides connections close to Glenfield Station through the residential areas of Glenfield. This road is single lane in each direction, with

kerb side parking permitted. The speed limit of this road is 50km/h. Two bus services use this road, which services Glenfield Station.

3.4.7 Cambridge Avenue

Cambridge Avenue is a local road, which provides a link south of Glenfield Road towards Moorebank Avenue, which delivers connections to Liverpool and destinations further north of the Precinct. Cambridge Avenue is one lane in each direction with a speed limit of 60km/h. The road incorporates a bridge crossing of the Georges River, which is prone to flooding due to its low-lying elevation above the waterline. No parking restrictions are provided on this road; however, it is unlikely vehicles park on this road as there are no accessible adjacent land uses.

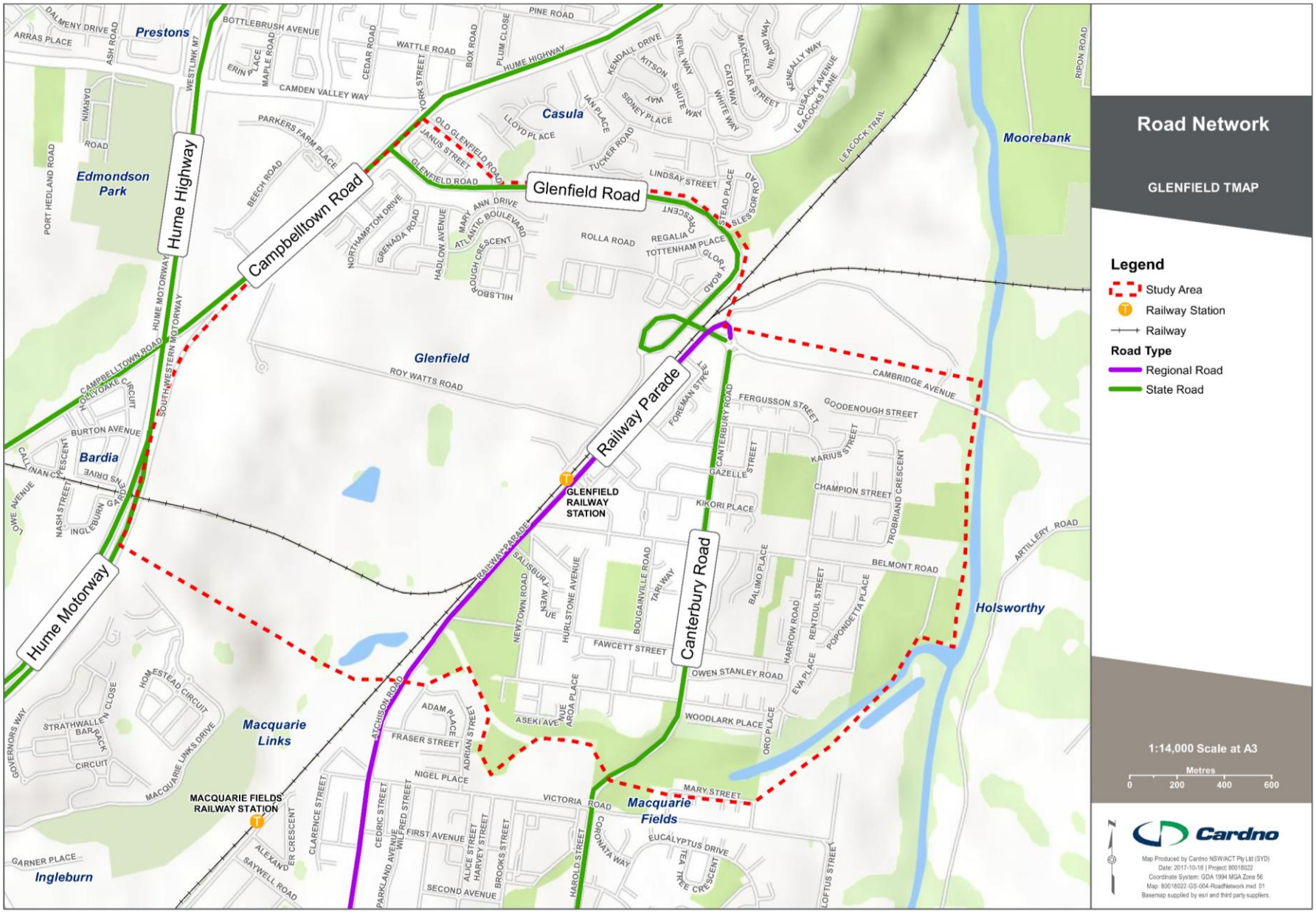
Approximately 16,000 vehicles use this road on an average weekday in both directions, with peak hour flows of approximately 1,400 vehicles per hour in both directions.

3.4.8 Harrow Road

Harrow Road is a local road with travels generally in a loop around Glenfield residential areas on the eastern side of the railway line. The road is single lane in each direction with a speed limit of 50km/h. Kerb side parking is permitted along this road. Buses service this road south of Belmont Road, providing access to Glenfield Station.

The Precinct key road network is shown in **Figure 3-5**.

Figure 3-5 Precinct road network



3.4.9 Road demand

The performance of key roads within the Precinct indicate the demand on the road network. The performance of the road network was measured by four variables, including:

- Peak period volumes (veh/h);
- Capacity of road (veh/h);
- Average speed (km/h); and
- Percentage of speed limit (%).

The capacity of the road network is calculated based on Austroads 2013 guidelines, taking into account a maximum level of service D operation, as well as number of lanes and speed limit of each road.

The average speed is a mean of all the vehicle speeds travelling along a road in a particular timeframe. The percentage of speed limit is a measure of how many vehicles are travelling at the designated speed for the road, the higher the percentage of speed limit the better flow along the road. The data used for this analysis only considers weekdays during November 2014 traffic counts. The three roads that were assessed are Cambridge Avenue, Railway Parade, and Canterbury Road.

This analysis shows that Railway Parade and Canterbury Road are flowing within 90 per cent of designated speed, with PM traffic along Railway Parade travelling on average above designated speed limits, which indicates sufficient road capacity. Cambridge Avenue during the peak periods is travelling between 68 per cent to 82 per cent of designated travel speeds, showing signs of increased traffic congestion during peak periods. Eastbound in the AM peak and westbound in the PM peak are beginning to approach capacity.

A summary of the performance data is shown in **Table 3-4**.

Table 3-4 Road network performance

	Cambridge Avenue				Railway Parade				Canterbury Road			
	Eastbound		Westbound		Northbound		Southbound		Northbound		Southbound	
Peak Period	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Vehicles per hour (veh/hr)	1,104	448	324	1,031	359	307	371	392	1,017	590	486	1,035
Capacity (veh/hr)	1,300	1,300	1,300	1,300	1,000	1,000	1,000	1,000	2,600	2,600	2,600	2,600
Average speed (km/h)	41.0	47.6	47.5	48.9	45.4	50.9	45.5	51.1	56.6	60.0	54.9	56.4
Percentage of speed limit (%)	68%	79%	79%	82%	91%	102%	91%	102%	94%	100%	92%	94%

Source: Mid-block traffic counts - Roads and Maritime Services (2014)

3.5 Freight

The Precinct is located along the national freight network for freight movement between regional NSW, ACT and Victoria on rail and road. The freight network through the Precinct generally begins at Minto and extends through to Liverpool. It sits west of the railway line and extends west of the Hume Motorway.

3.5.1 Southern Sydney Freight Line

The Southern Sydney Freight Line (SSFL) is a 36-kilometre freight line connection between Sefton and Macarthur. The line consists of a third track through the rail corridor that is dedicated for freight services, allowing passenger services to operate separate to freight. The SSFL opened in early 2013.

There is no curfew on the freight line and services can operate 24 hours a day.

Future corridor widening may be required to increase capacity on this freight line through the addition of an extra freight track. This must be considered in future land use planning in terms of retaining an easement for expansion, and the noise impacts of more regular freight train services. Future Transport 2056 outlines an

initiative for investigation (within 10 to 20 years) to provide additional capacity along the SSFL south of Liverpool and provide greater separation of freight and passenger rail, and support greater capacity for the latter.

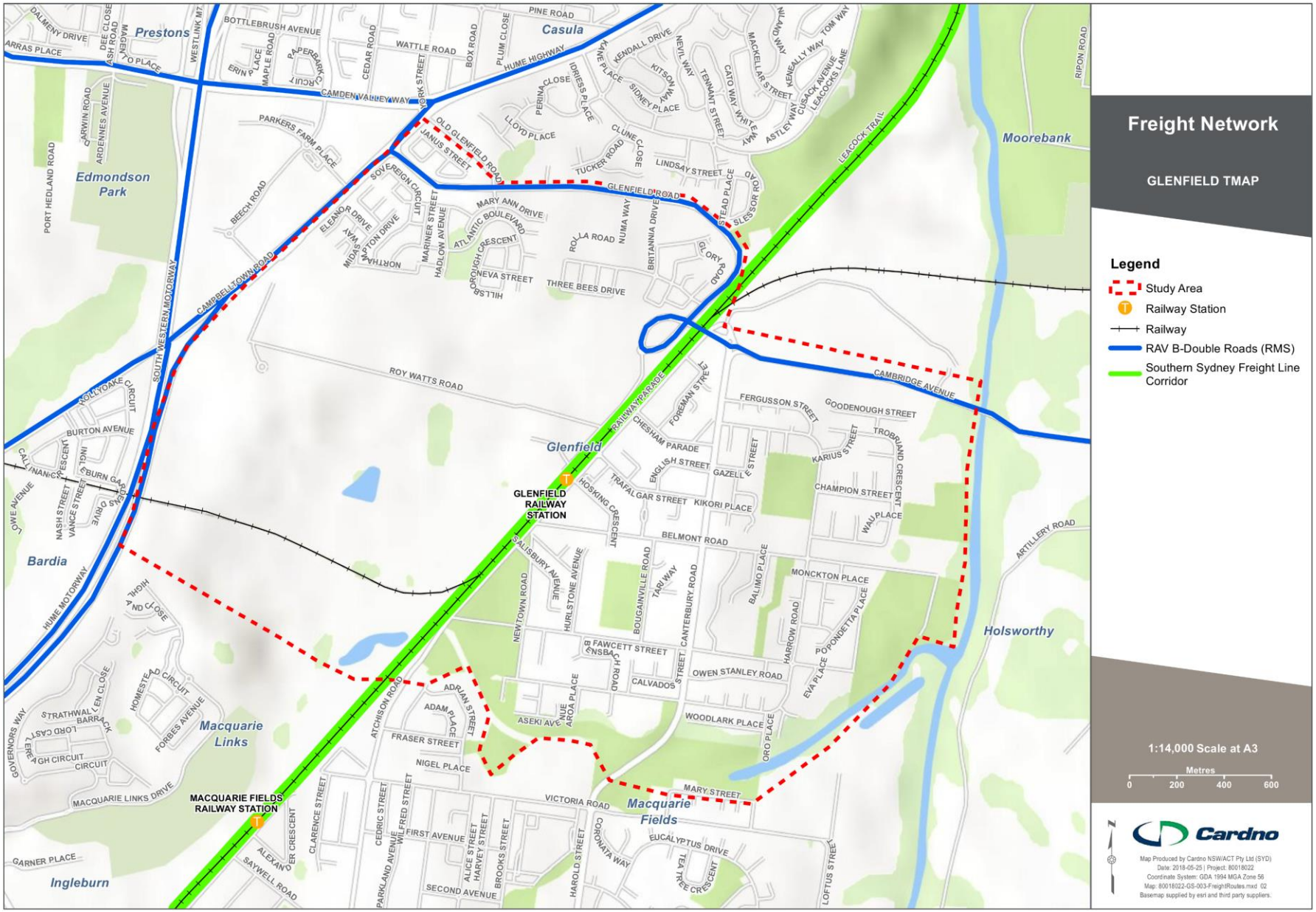
3.5.2 Hume Motorway

The Hume Motorway forms part of the national road network, and is the primary road freight link between Sydney and Canberra, Melbourne, Adelaide and beyond. It also links to the M7 orbital motorway, providing a bypass route away from the Sydney CBD.

3.5.3 Local freight roads

Roads and Maritime Services have delegated Restricted Access Vehicle routes for B-double trucks and high vehicles. Within the Precinct, the delegated routes are towards the northern and western fringes of the Precinct, along Cambridge Avenue, Glenfield Road, Campbelltown Road and the Hume Motorway. The Precinct freight network is shown in **Figure 1-2**.

Figure 1-2 Precinct freight network



3.6 Parking

Parking is a key transport facility for use by vehicles and bicycles that can support access to the public transport network in key strategic locations. An excessive supply of vehicle parking is not economically efficient, can affect the viability of public transport, contributes to congestion and improves the attractiveness of driving. Large vehicular parking areas occupy land that could be better utilised for other purposes.

This section details the existing on and off street parking provisions within the Precinct and the controls that affect parking supply for new developments.

3.6.1 Existing vehicular parking

The Precinct has three primary demands for vehicular parking, these are residential, educational and commuter. These demands are currently catered for through on-street and off-street facilities.

Residential demands are accommodated for on each respective property and supplemented by on-street parking. Residential visitor demand is generally accommodated for through a mix of unrestricted and restricted on-street parking controls to manage a variety of demands simultaneously. The majority of on-street parking is restricted within 400 metres of Glenfield Station; the parking controls in these areas generally have a time limit of two hours' maximum to cater for the main street demand. Further away from the station, controls are generally three hours and longer. The on-street parking controls have inconsistent times of operation in the Precinct.

The off-street vehicular parking supply is provided via commuter, retail and sporting ground car parking. The largest facility is the Glenfield Station commuter car park with approximately 950 spaces, which is located to the north of the station. Stakeholder observations have noted that this carpark is regularly full on weekday mornings.

The sporting ground provides 180 spaces and is located to the south of the station. The retail parking is a council-owned facility that provides additional parking for people visiting the main street and is accessible from Magee Lane.

Existing Kiss & Ride facilities are located on both sides of Glenfield Station.

3.6.2 Council DCP rates

Off-street vehicular and cycle parking in the study area is generally controlled by the Campbelltown Development Control Plan (CDCP) 2015, and the relevant objectives of the CDCP for parking and access are to:

- Provide adequate on-site car parking for residents and visitors that is convenient, secure and safe having regard to the traffic generated by the development; and
- Provide safe convenient access for vehicles, pedestrians and cyclists whilst minimising conflict between them.

CDCP outlines parking requirements based on the type of land use (e.g. retail) and the density of the land use. The combination of these two attributes results in the determination of the minimum amount of parking to be provided on-site by a development. The CDCP uses minimum parking controls, which result in a development requiring a set amount of parking spaces as a minimum. In areas of higher density in Sydney, parking rates are often set as maximums to reduce trips by private vehicles and to encourage more people to walk, cycle and catch public transport.

Controls for the provision of bicycle parking are currently limited to residential flat developments. A summary of the CDCP rates are shown in **Table 3-5**.

Table 3-5 Campbelltown parking rates

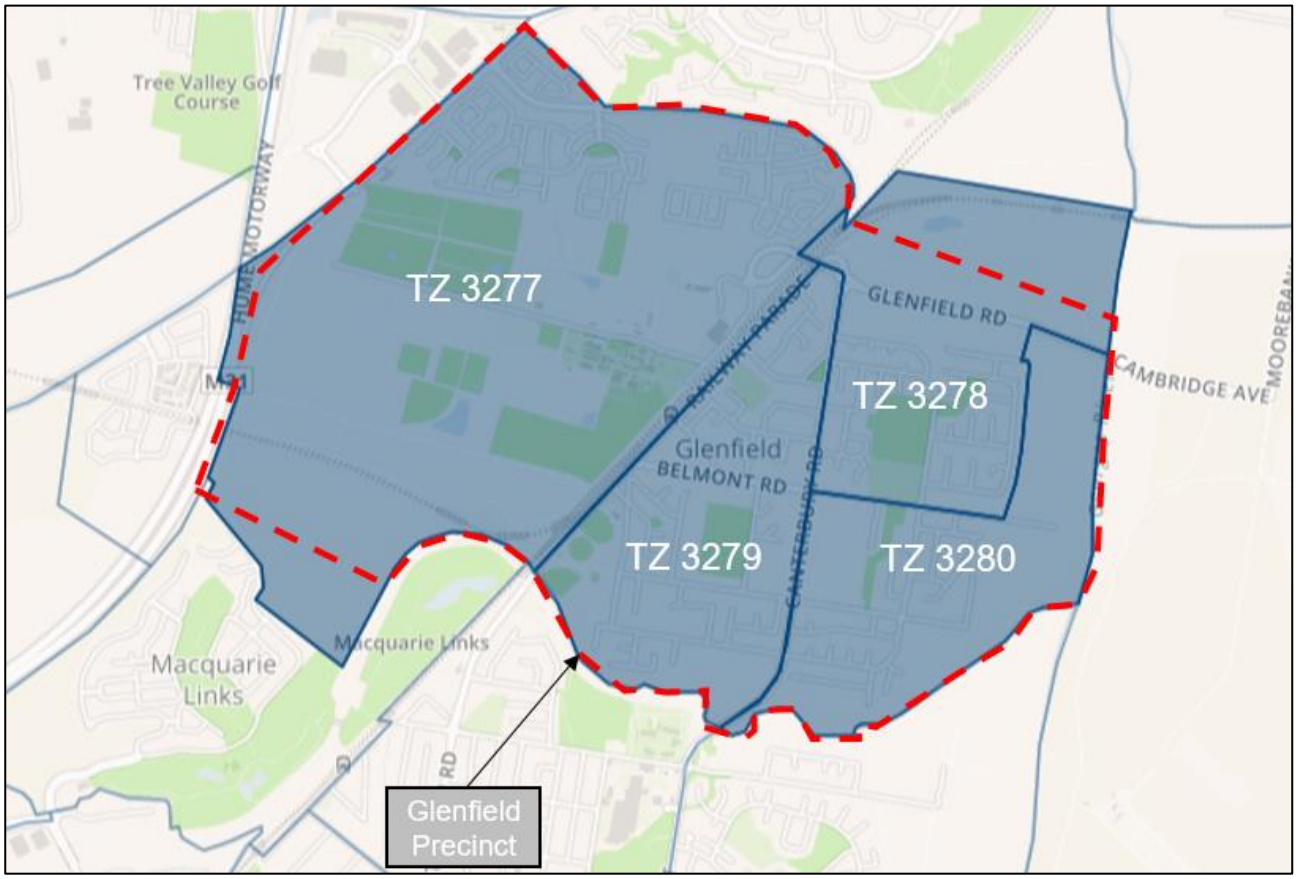
Development type	Campbelltown Council rates
Dwelling houses, domestic outbuildings, swimming pools/ spas and secondary dwellings	A dwelling house shall be provided with a minimum of one undercover car parking space.
Multi dwellings	One (1) external additional visitor car parking space shall be provided for every two (2) units (or part thereof), unless all dwellings within the development have direct frontage to a public street.
Residential subdivision	All required visitors car parking spaces within a Strata Title subdivision shall be within common property.
Residential flat buildings	Each dwelling shall be provided with a minimum of one car parking space, and: ▪ An additional car parking space for every 4 dwellings (or part thereof); and ▪ An additional visitor car parking space for every 10 dwellings (or part thereof). Each development shall make provision for bicycle storage at a rate of 1 space per 5 dwellings within common property.
Mixed use development	In addition to residential car parking rates the development shall provide one (1) car parking space per 25sqm of leasable floor space at ground level and one (1) car parking space per 35sqm of floor space at upper levels for all commercial/retail parts of the building. The development shall provide adequate space for the on-site parking, loading and unloading of all delivery/service vehicles as detailed in Part 6.4.2 of the DCP.
Retail premises	Ground level - 1 space per 25m² GFA Upper level(s) - 1 space per 35m² GFA
Commercial premises	Ground level - 1 space per 25m² GFA Upper level(s) - 1 space per 35m² GFA
Medical facilities	Ground level - 1 space per 25m² GFA Upper level(s) - 1 space per 35m² GFA
Shopping centres	Ground level - 1 space per 25m² GFA Upper level(s) - 1 space per 35m² GFA
Restaurants, cafés and hotels	1.5 spaces per 10m² GFA
Convenience stores	1 space per 25m² GFA Plus 5 spaces per work bay (for vehicle servicing facilities)
Bulky goods / industrial	1 space per 60m² GFA
Squash and tennis courts	3 spaces per court
Gymnasiums, recreational and sports facilities	for indoor facilities: 1 space per 25m² GFA for outdoor facilities: 1 space per 50m² of site area
Childcare centre	A minimum of one (1) on-site car parking space shall be provided for every four (4) children approved to attend the childcare centre.
Religious establishments	A minimum of one (1) car parking space shall be provided for every 3.5 site users.
Glenfield Urban Release Area (North-east area of the Precinct)	Accommodation on-site for 2 cars provided for single detached dwelling-houses. Number of bedrooms/ dwelling and rate: ▪ Bedsitter of 1 bedroom – car parking spaces/ dwelling = 0.75 ▪ 2 bedroom – car parking spaces/ dwelling = 1 ▪ 3 or more bedroom – car parking spaces/ dwelling = 1.5 ▪ Visitor spaces – car parking spaces/ dwelling = 0.2

3.7 Travel behaviours

It is important to understand who is living in and accessing the Precinct, and the existing travel behaviour when planning for future movements in the Precinct. This section provides a summary of the population and employment, dwelling types and motor vehicle ownership, as well as how people are travelling and where they are coming from. Crashes in the precinct are also analysed.

The data is from TfNSW Transport and Performance Analytics (TPA) website and uses Travel Zone explorer and Journey to Work data based on the Census by the Australian Bureau of Statistics (ABS) and further refined by TPA. The travel zones used for this analysis are shown in **Figure 3-6**. These travel zones combined form the Glenfield SSC, which is taken from the ABS data for the demographic analysis.

Figure 3-6 Travel zones within the Precinct



Base map source: Transport Performance and Analytics, 2017

3.7.2 Population and employment

This section provides a summary of the existing, population and jobs for the Precinct as it has a direct relationship with trip generation.

Approximately 9,200 residents were living in the Precinct in 2016, of which the majority were living on the eastern side of the railway line, accounting for 73 per cent of the precinct population. This is largely due to over half of TZ 3277 being Hurlstone Agricultural School and undeveloped land.

Overall, there are approximately 1,640 people employed within the precinct, with 66 per cent being located on the eastern side of the railway line. A breakdown of the employment and residential numbers for 2016 by travel zone is summarised in **Table 3-6**.

Table 3-6 Population and employment - 2016

Travel zone	Residential		Employment	
	Number	Percentage	Number	Percentage
TZ 3277	2,387	26%	555	34%
TZ 3278	1,532	17%	343	21%
TZ 3279	3,432	37%	396	24%
TZ 3280	1,814	20%	343	21%
Total	9,165		1,637	

Source: Transport Performance and Analytics, Travel Zone explorer

3.7.3 Dwelling types

Within the Precinct, the majority of dwelling types are separate housing and semi-detached housing, which account for 98 per cent of dwellings. A comparison of the Precinct with the Sydney metropolitan region is provided in **Table 3-7**. It is clear that the Precinct is predominantly a low-density residential area in comparison to the rest of Sydney, largely due to its locality.

Table 3-7 Dwelling types within the Precinct

Dwelling Structure	Glenfield		Sydney Metropolitan
	Number	Percentage	Percentage
Separate house	2,045	70%	70%
Semi-detached, row or terrace house, townhouse etc.	814	28%	13%
Flat or apartment	27	0.9%	26%
Other dwelling	8	0.3%	0.5%

Source: ABS Census Data – Glenfield (SSC)

3.7.4 Motor vehicle ownership

Vehicle ownership is a key indicator of mode share. The portion of non-ownership indicates the need to rely on other transport modes. Overall, the Precinct has relatively similar motor vehicle characteristics to that of the rest of Sydney. The main discrepancy is only 7 per cent of residents within the Precinct do not own a car, compared to the average of 12 per cent across metropolitan Sydney. The motor vehicle ownership is summarised below in **Table 3-8**.

Table 3-8 Motor vehicle ownership within the Precinct

Number of registered motor vehicles	Glenfield		Sydney Metropolitan
	Number	Percentage	Percentage
None	199	7%	12%
1 motor vehicle	1,141	39%	38%
2 motor vehicle	1,051	36%	33%
3 motor vehicle	425	15%	14%
Not stated	85	3%	3%

Source: ABS Census Data – Glenfield (SSC)

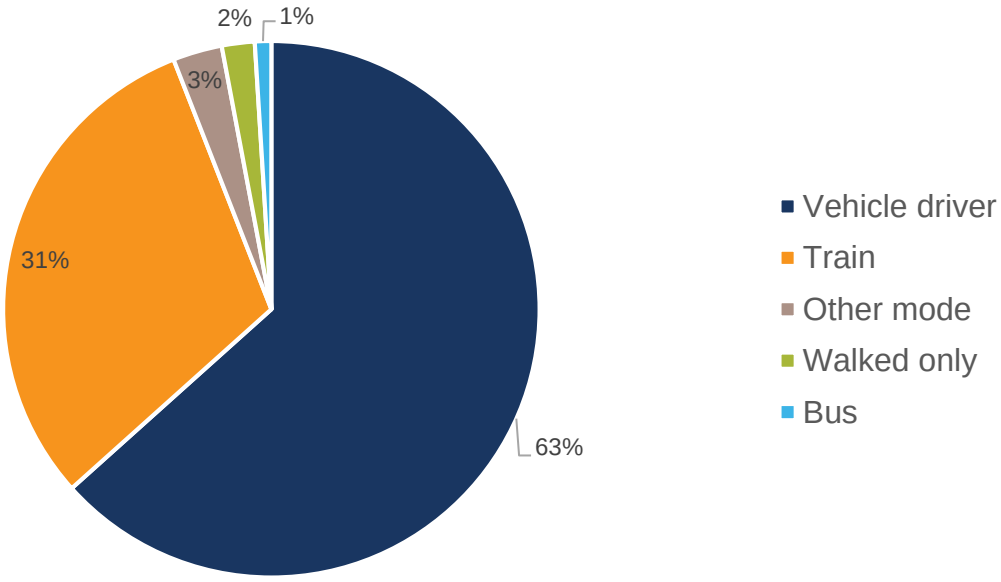
3.7.5 Journey to Work

Journey to Work (JTW) information is collected as part of the ABS's Census of Population and Housing. This data set provides detailed information about the inferred travel between home and work, including modes of travel used as part of the journey. This section provided JTW information for several different geographies based on TPA's travel zones (TZ 3277, 3278, 3279, 3280) from the 2011 Census data.

3.7.5.1 Residents of the precinct

A large proportion of residents who live in the Precinct travel to work via private vehicle, which includes driver and passenger (63 per cent), 31 per cent travel by train, with small number of residents walking, or taking a bus. A summary of the journey to work mode split is shown in **Figure 3-7**.

Figure 3-7 Mode share of commuting residents from Glenfield



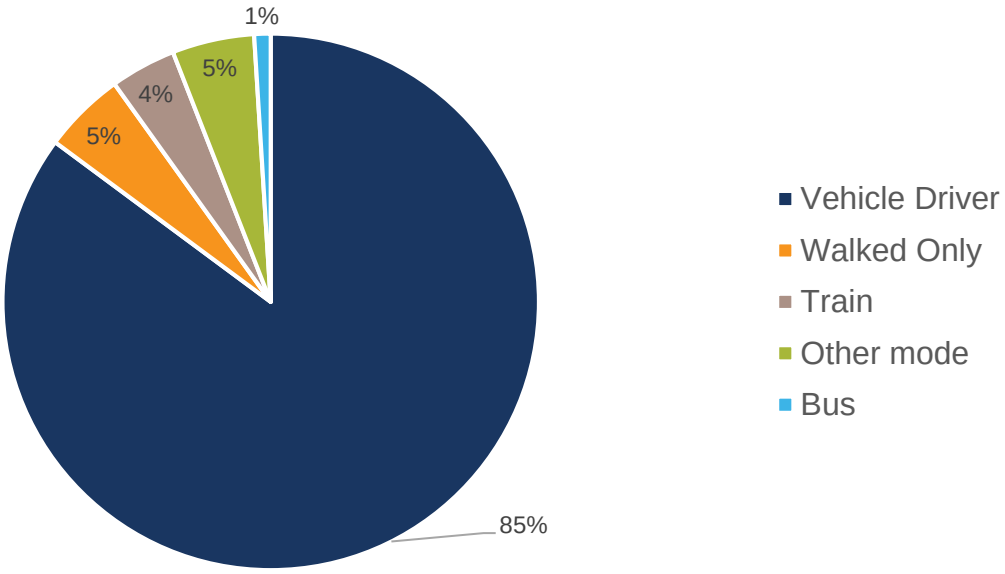
Source: Journey to Work Explorer (Transport Performance and Analytics)

Of these residents, the majority travel to Campbelltown for work (21 per cent), with 19 per cent travelling to employment in the Sydney CBD and 12 per cent in Liverpool. These locations are easily accessible via the public transport network; however, travel distances and times vary significantly between them. A map of resident locations is shown in **Figure 3-9**.

3.7.5.2 Workers of the Precinct

A large proportion of workers who are employed in Glenfield travel to work via private vehicle, as either a passenger or a driver (85 per cent). Only five per cent of workers use public transport to arrive in the precinct, of which four per cent arrive by train and the remaining from bus services. A summary of the journey to work mode split is shown in **Figure 3-8**.

Figure 3-8 Mode share of commuting workers to Glenfield



Source: Journey to Work Explorer (Transport Performance and Analytics)

Of all these workers, the majority of workers are from Campbelltown, accounting for 52 per cent, with smaller amounts of workers from surrounding areas including Liverpool, Camden, and Bringelly. It is clear that the majority of workers in the Precinct live in the surrounding suburbs. A map of resident locations is shown in **Figure 3-10**.

Figure 3-9 Commuting from the precinct

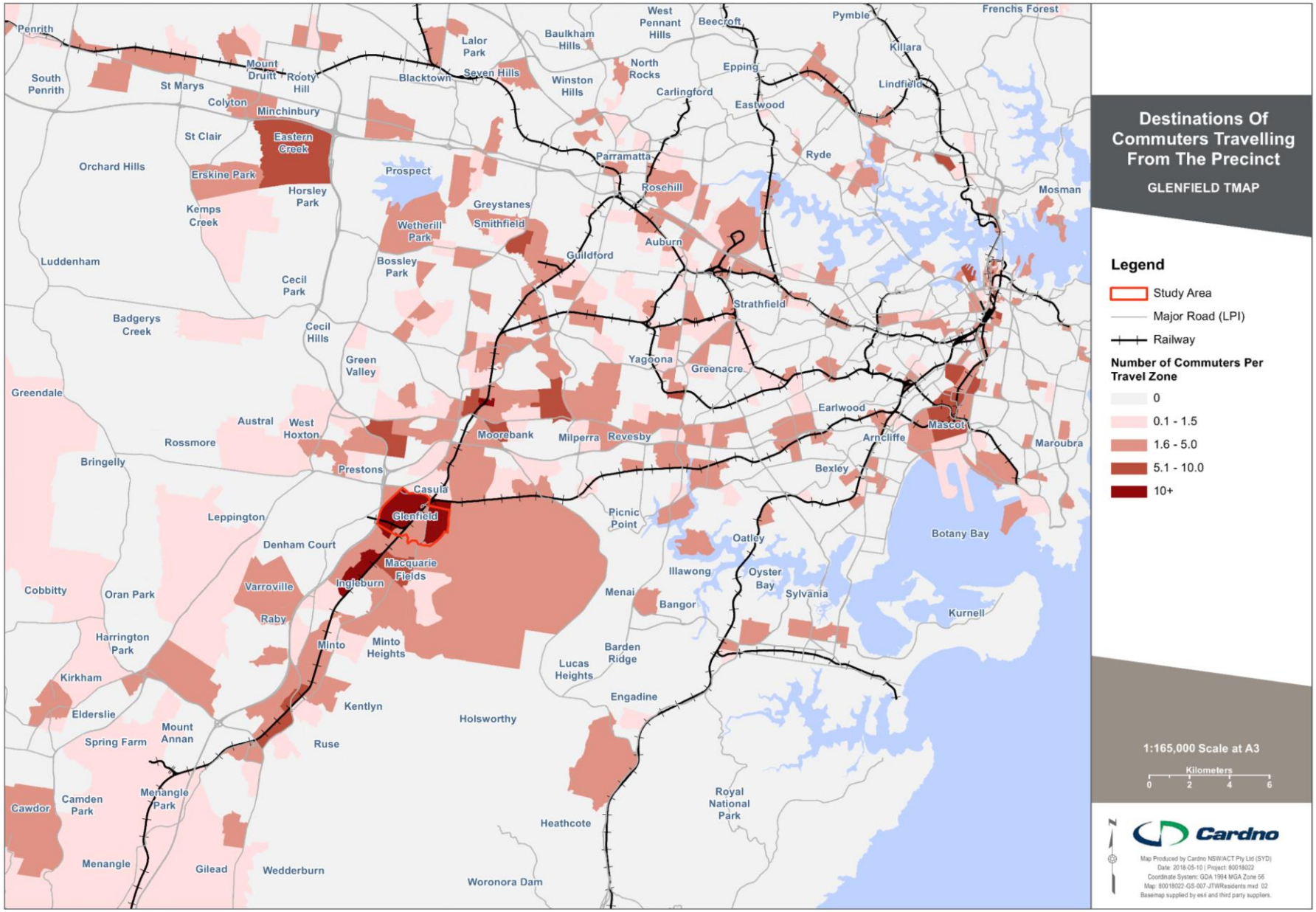
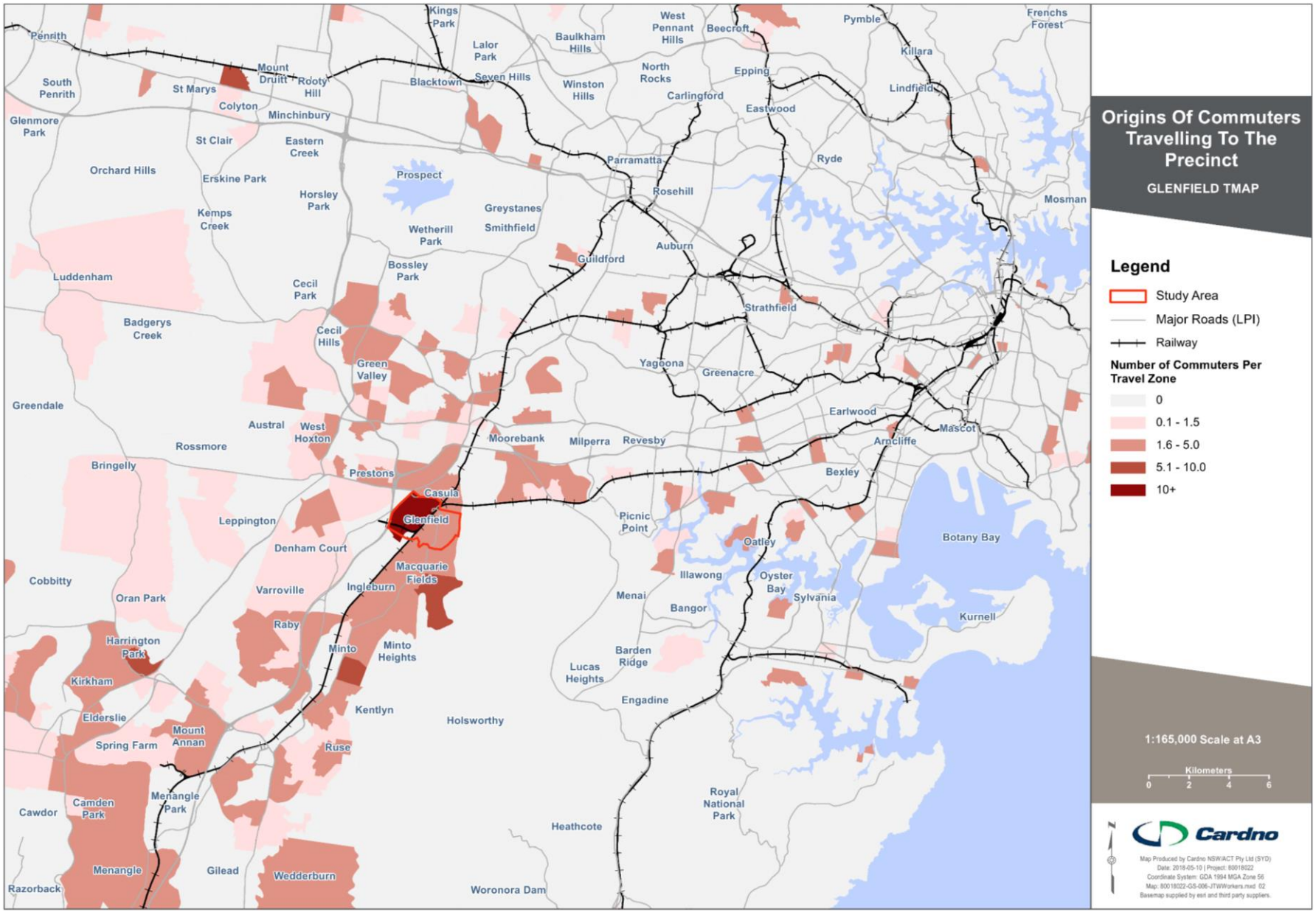


Figure 3-10 Commuting into the precinct



3.8 Crash analysis

There were 107 reported crashes in the Precinct in the five-year period from 2012 to 2016 inclusive. This analysis excludes crashes that occur on the Hume Motorway. No fatalities occurred within the Precinct during this time-period. A summary of the crash locations is provided in **Figure 3-11**.

3.8.1 Crash clusters

There are several crash clusters within the precinct, which involve a high number of crashes between 2012 and 2016 inclusive. These crash clusters occur along key intersections on Campbelltown Road and Glenfield Road. The intersections with the highest crash rates were at Campbelltown Road/ Glenfield Road and Canterbury Road/ Belmont Road. A density map summarising crashes in the Precinct is shown in **Figure 3-12**.

Figure 3-11 Crash locations

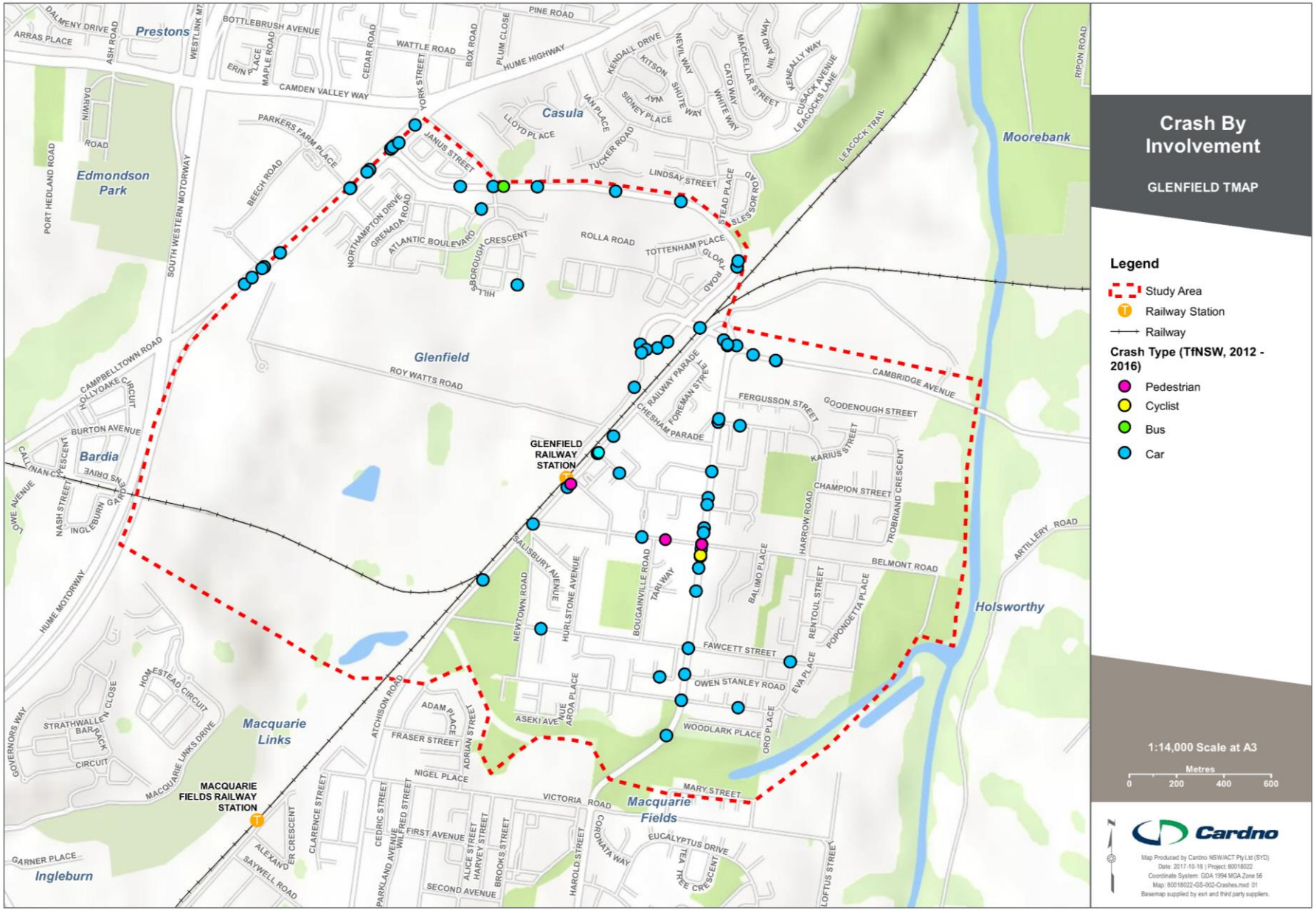


Figure 3-12 Crash cluster locations

3.8.2 Crash types

One of the basic tools for understanding what happened in a crash is the road user movement (RUM) code that describes the first cause for the crash.

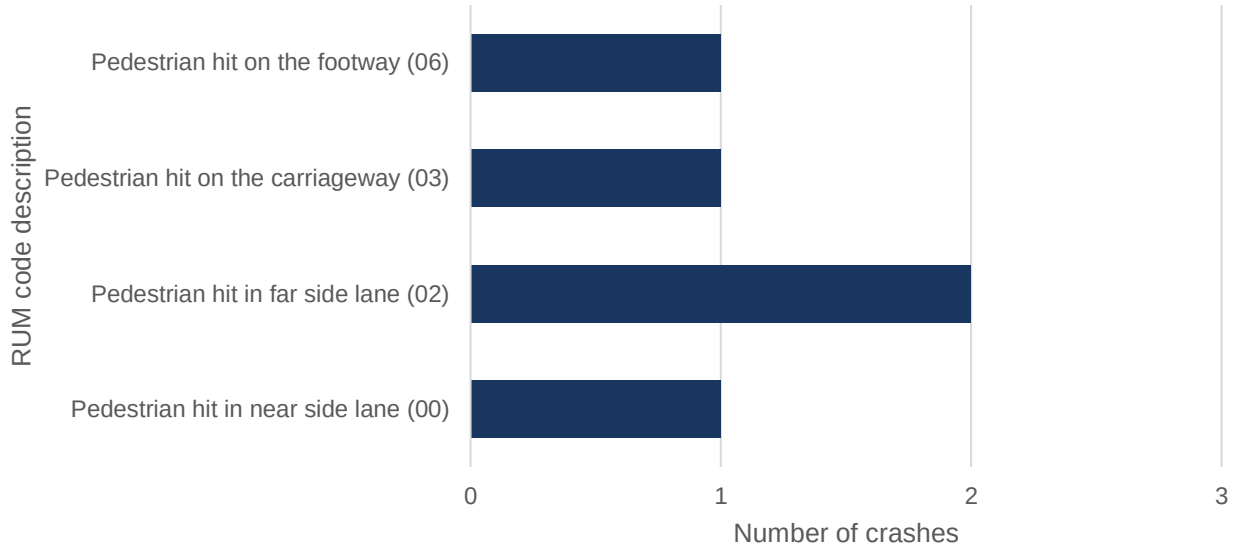
3.8.2.1 Pedestrian crashes

The crash types, which involve pedestrians, are identified in the Roads and Maritime accident database under RUM codes 00 to 09.

There were five pedestrian crashes within the Precinct between 2012 and 2016 inclusive. The most common occurring crash types is RUM crash code 02, where a pedestrian is hit in the far side lane, which occurred twice. All the pedestrian crashes occurred on the eastern side of the railway line, with two occurring on Railway Parade resulting in moderate injury. These two crashes were the result of pedestrian stuck on footpath and pedestrian hit in far side lane. Two pedestrian crashes also occurred on Belmont Road, in close proximity to Canterbury Road indicating poor crossing facilities at this location.

The number of pedestrian crashes by RUM code is shown in **Figure 3-13**.

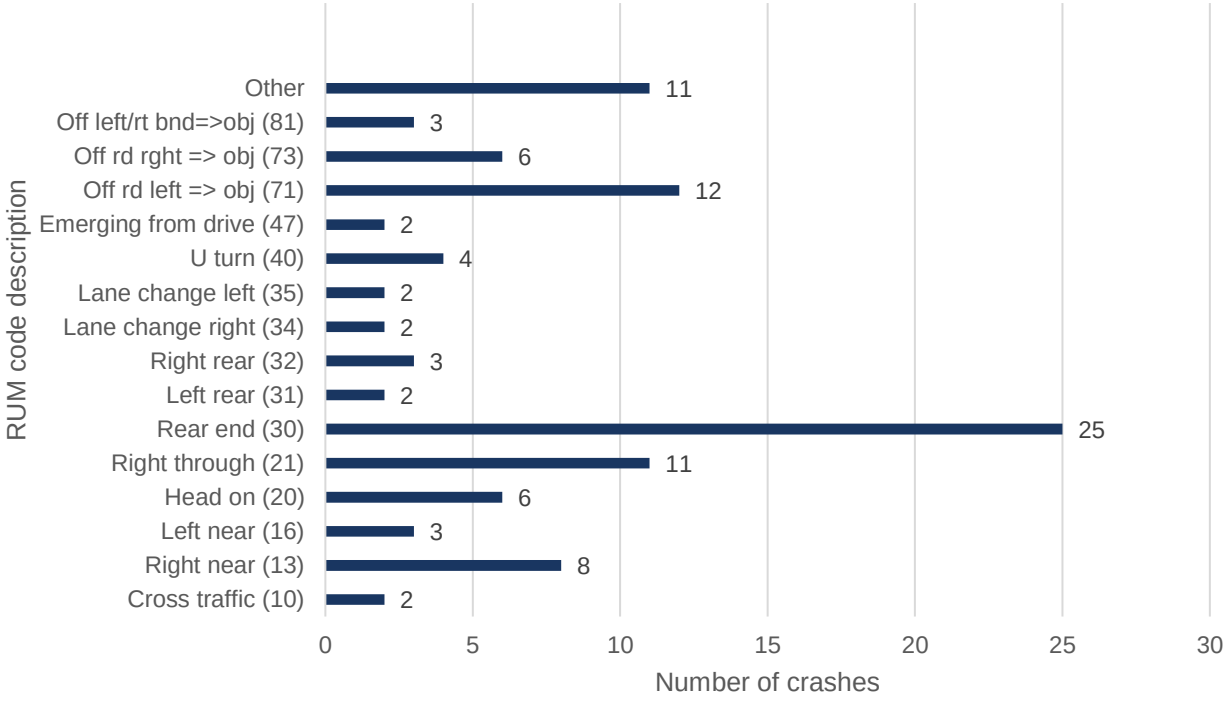
Figure 3-13 Pedestrian crash types



3.8.3 Vehicle crashes

There were 101 reported vehicle crashes not involving pedestrians in the five-year period from 2012 and 2016 inclusive. In relation to vehicle crashes, rear ending (RUM 30) was the most common crash type across the Precinct with 25 occurrences in the past five-year period. This was followed by vehicles crashing left off the road into an object or parked vehicle (RUM 71). This was closely followed by a vehicle being hit turning right by through traffic (RUM 21). A summary of the crashes by RUM is shown in **Figure 3-14**.

Figure 3-14 Vehicle crash type



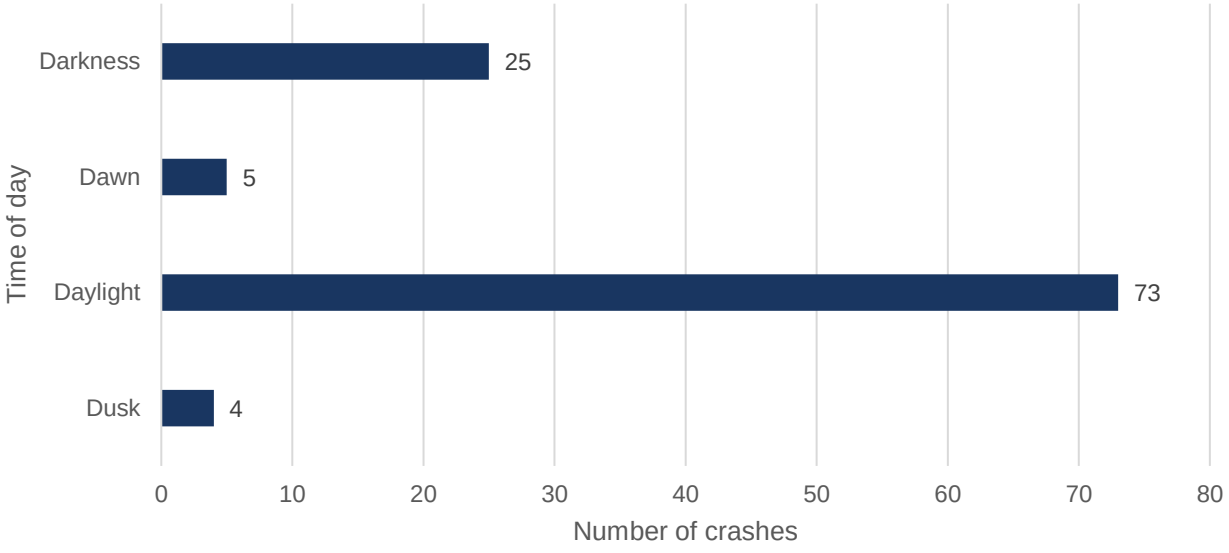
3.8.4 Bicycle crashes

Two bicycle crashes occurred within the study area in between 2012 and 2016. The first crash occurred north of Cambridge Avenue, where a cyclist came off a footpath and onto the carriageway (RUM 48). This crash resulted in a serious injury. There was also another crash north of Cambridge Avenue at the corner of Belmont Road and Canterbury Road where a rear end crash (RUM 30) occurred, resulting also in serious injury.

3.8.5 Crash time of day

The majority of crashes occur during daylight hours (73), with 25 occurring during night-time hours. Only nine crashes occurred during the dawn and dusk periods. This is likely due to more vehicles driving during day light hours. A summary of time of day crashes is shown in **Figure 3-15**.

Figure 3-15 Time of day crashes



4 Future land use and infrastructure analysis

4.1 Precinct development

The focus of revitalisation in the Precinct encompasses three parcels of land, being:

- The Hurlstone Agricultural High School;
- The Office of Strategic Lands (OSL); and
- The rezoning and redevelopment surrounding Glenfield Station (to the east of the station).

4.1.1 Draft Precinct Plan

The Draft Precinct Plan details the following layout:

- The land immediately adjacent to Glenfield Station on the eastern and western side has been identified as a combination of high density mixed use and employment.
- On the eastern side of Glenfield Station, the land is zoned as low density to high density with the density increasing with closer proximity to the station.
- On the western side of Glenfield Station, the land is zoned as low density to high density with the density increasing with closer proximity to the station.
- A new local centre is also located to the west of Glenfield Station adjacent to low-medium density residential.
- There are seven schools zoned within the Precinct, five on the western side of the Glenfield Station and two on the east.

The current Draft Precinct Plan is presented in **Figure 4-1**.

Figure 4-1 Glenfield Draft Precinct Plan

Source: DPIE (2020)

4.2 Future land use

DPIE have identified urban activation and intensification opportunities in the Precinct to support population and economic growth.

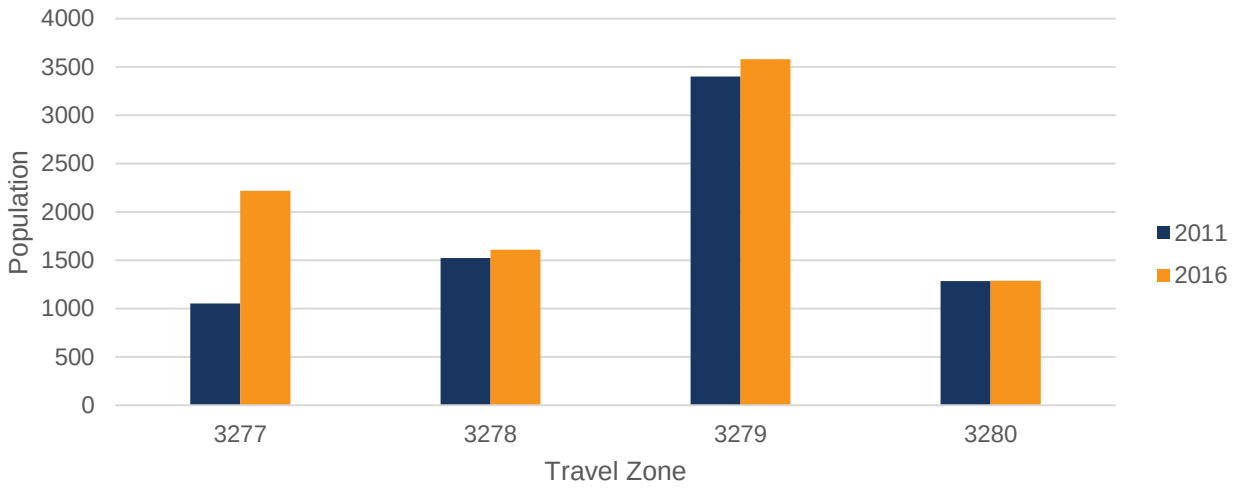
Resident population growth is generally proposed around Glenfield Station, with higher density land use than the current zoning. Leveraging the existing rail infrastructure to accommodate new residents will reduce the required investment in new transport infrastructure and services.

4.2.1 2011 versus 2016 land use comparison

According to 2011 census data applied TfNSW's Transport Performance and Analytics (TPA) division, each of the four travel zones in the Precinct was projected to grow over the five years from 2011 to 2016.

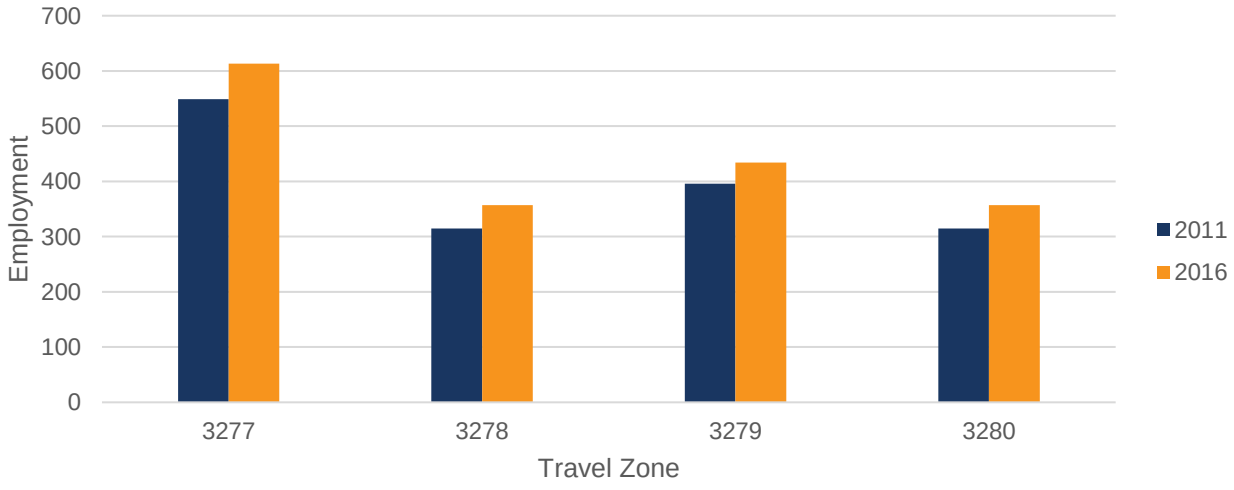
Across the Precinct, the population was projected to increase by 1,800 residents and 266 jobs. The highest growth was projected in the area west of Glenfield Station (TZ 3277) accounting for over 62 percent of population growth and 35 percent of job growth. The travel zone furthest to the east of the precinct (TZ 3280) had the second highest population growth projection (23 percent), but with the smallest growth in employment across the precinct (18 percent). The projected growth in population and employment by travel zone over the five years from 2011 to 2016 is shown in **Figure 4-2** and **Figure 4-3** respectively.

Figure 4-2 Population growth projections by travel zone



Data source: TPA (2018)

Figure 4-3 Employment growth projections by travel zone



Data source: TPA (2018)

4.2.2 Future land use scenarios

To meet population and employment growth requirements, additional housing and employment is required in the South-west area of Sydney. This precinct presents an opportunity to provide housing and jobs. Notwithstanding this, there is an assumed amount of growth that is planned for this area. This is referred to as the Travel Zone Projections (TZP2016) scenario. Separate to this and as part of the Planned Precinct program for Glenfield, DPIE and PNSW developed low, medium and high growth scenarios for population and employment for consideration. The sections below provide a summary of the key forecasts under each scenario.

4.2.2.1 Low growth scenario

In 2026, the low growth scenario forecasts a population that is 49 percent higher and employment that is 58 percent higher than the 2026 forecast captured in the TZP2016 scenario.

In 2036, the low growth scenario forecasts a population that is 52 percent higher than the 2016 base case, and employment growth of 83 percent within the Precinct. The low growth scenario forecasts are presented in **Table 4-1**.

Table 4-1 Low growth scenario forecasts

2026	2036
▪ A population of 17,779; ▪ 3,173 jobs; and ▪ 850 dwellings.	▪ A population of 24,479; ▪ 4,161 jobs; and ▪ 5,750 dwellings (1,750 on the eastern side of the railway line and 4,000 on the western side).

Data source: DPIE and PNSW (2017)

4.2.2.2 Medium growth scenario

In 2026, the medium growth scenario forecasts a population uplift of 65 percent and employment uplift of 75 percent on the 2026 forecast outlined in the TZP2016 scenario.

In 2036, the medium growth scenario forecasts a population demand that is 81 percent higher than the 2016 base case, and employment growth of 111 percent within the Precinct. The medium growth scenario forecasts are presented in **Table 4-2**.

Table 4-2 Medium growth scenario forecasts

2026	2036
▪ A population of 19,729; ▪ 3,501 jobs; and ▪ 1,000 dwellings.	▪ A population of 29,029; ▪ 4,801 jobs; and ▪ 7,500 dwellings (2,500 on the eastern side of the railway line and 5,000 on the western side).

Data source: DPIE and PNSW (2017)

4.2.2.3 High growth scenario

In 2026, the medium growth scenario forecasts a population uplift of 86 percent and employment uplift of 75 percent on the 2026 forecast outlined in the TZP2016 scenario.

In 2036, the high growth scenario forecasts a population demand that is 105 percent higher than the 2016 base case, and employment growth of 111 percent within the Precinct. The medium growth scenario forecasts are presented in **Table 4-3**.

Table 4-3 High growth scenario forecasts

2026	2036
▪ A population of 22,199; ▪ 3,601 jobs; and ▪ 1,350 dwellings.	▪ A population of 32,929; ▪ 4,801 jobs; and ▪ 9,000 dwellings (3,000 on the eastern side of the railway line and 6,000 on the western side).

Data source: DPIE and PNSW (2017)

Table 4-4 and **Table 4-5** provide a breakdown of each of the low, medium and high population and employment growth forecasts by travel zone.

Table 4-4 Future population forecasts

	TZP2016			Low Scenario		Medium Scenario		High Scenario	
Travel zone	**2016**	**2026**	**2036**	**2026**	**2036**	**2026**	**2036**	**2026**	**2036**
TZ 3277	2,218	3,805	4,022	8,458	12,618	10,018	15,218	11,578	17,818
TZ 3278	1,609	2,023	2,986	1,709	1,809	1,709	1,809	1,709	1,809
TZ 3279	3,579	4,444	6,496	5,789	8,129	6,179	10,079	7,089	11,379
TZ 3280	1,723	1,685	2,553	1,823	1,923	1,823	1,923	1,823	1,923
Total	**9,129**	**11,957**	**16,057**	**17,779**	**24,479**	**19,729**	**29,029**	**22,199**	**32,929**

Data source: TPA (2017 – for TZP2016), and DPIE with PNSW (for Low, Medium and High Growth Scenarios – 2017)

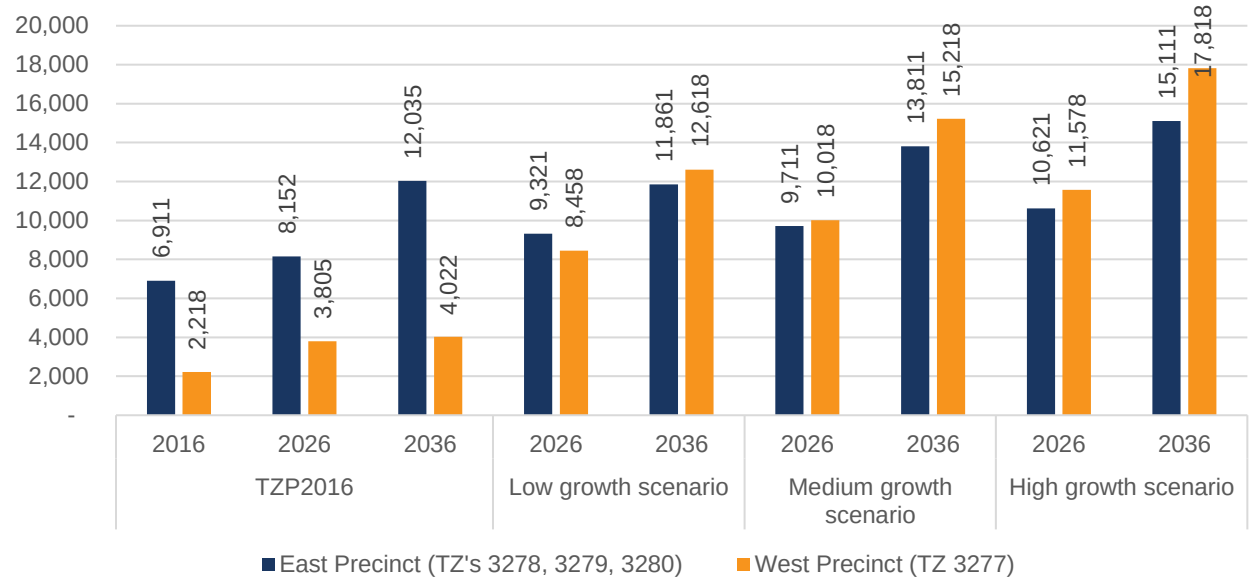
Table 4-5 Future employment forecasts

	TZP2016			Low Scenario		Medium Scenario		High Scenario	
Travel zone	**2016**	**2026**	**2036**	**2026**	**2036**	**2026**	**2036**	**2026**	**2036**
TZ 3277	613	702	793	1,585	2,233	1,813	2,613	1,813	2,613
TZ 3278	357	409	475	367	377	367	377	367	377
TZ 3279	434	480	527	854	1,174	9,54	1,434	1,054	1,434
TZ 3280	357	409	475	367	377	367	377	367	377
Total	**1,761**	**2,000**	**2,270**	**3,173**	**4,161**	**3,501**	**4,801**	**3,601**	**4,801**

Data source: TPA (2017 – for TZP2016), and DPIE with PNSW (for Low, Medium and High Growth Scenarios – 2017)

In the TZP2016 scenario, the western side of the Precinct has significant population growth compared to the eastern side, with a difference of over 4,000 residents in 2026 and 8,000 in 2036. However, in each of the low, medium and high growth scenarios, the difference in residential population is significantly reduced and, in general, there will be more residents living on the eastern side of the Precinct in 2026 and 2036. There is a 30 percent increase in future population demand between the low growth scenario and the high growth scenario. The population for each future growth scenario is shown in **Figure 4-4**.

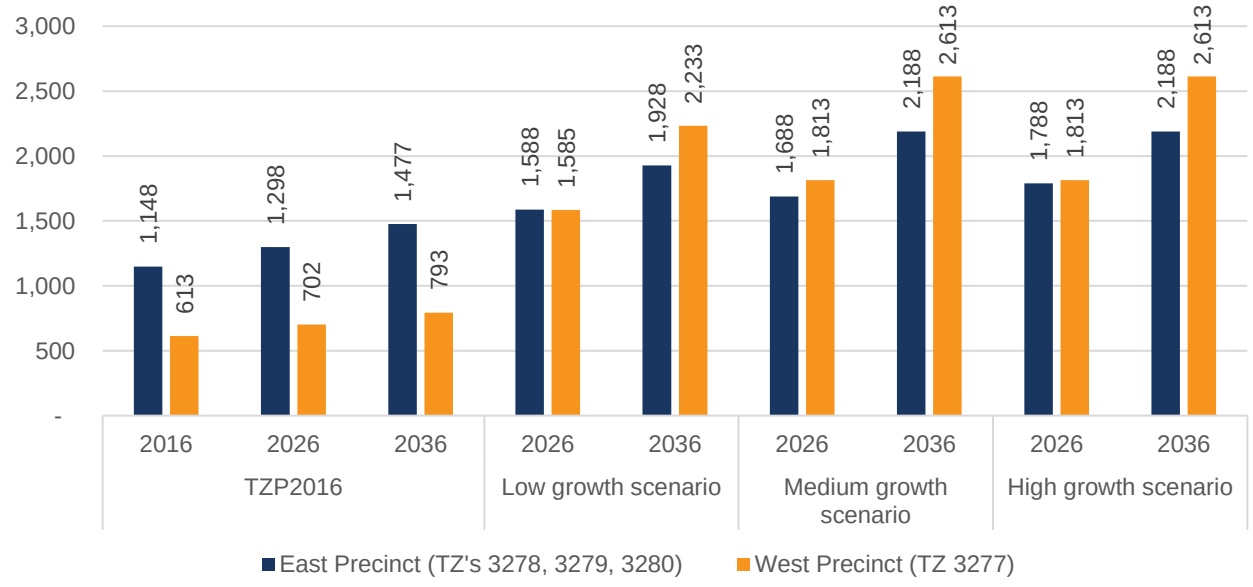
Figure 4-4 Population forecast



Data source: TPA (2017 – for TZP2016), and DPIE with PNSW (for Low, Medium and High Growth Scenarios – 2017)

Future employment opportunities follow a similar pattern to population growth. In the TZP2016 scenario, there are significantly more employment opportunities on the western side of the Precinct. However, with the planned development on the eastern side of the station, the future employment opportunities significantly increase and are comparable to the western side of the station. There is a 12 percent difference in future employment opportunities between the low growth and the high growth scenarios. The employment opportunities for each future growth scenario are shown in **Figure 4-5**.

Figure 4-5 Future employment opportunities



Data source: TPA (2017 – for TZP2016), and DPIE with PNSW (for Low, Medium and High Growth Scenarios – 2017)

4.3 Transport network

4.3.1 Committed projects

The following projects presented in **Table 4-6** have been identified for consideration and incorporated into the strategic modelling as assumed for implementation.

Table 4-6 Committed project summary

Assumed Implementation Year	Road project	Rail / Light Rail project	Bus project
2016	▪ Hunter Motorway (F3 to Branxton) ▪ M2 Widening ▪ M5 Widening ▪ Western Sydney Employment Hub ▪ Great Western Highway Widening	▪ Dulwich Hill Light Rail Extension	▪ CBD Bus Plan
2021	▪ WestConnex Stages 1 & 2 ▪ Kingsford Smith Airport Upgrades ▪ M2 to F3 Tunnel (NorthConnex) ▪ Southern Connector Motorway to President Avenue	▪ 2018 Rail Timetable ▪ NWRL / Sydney Metro Northwest (Chatswood to Tallawong) ▪ CBD and South East Light Rail ▪ CBD and South East Light Rail extension to Malabar	▪ Northern Beaches B-Line ▪ Western Sydney Bus Network ▪ NWRL bus adjustments
2026	▪ WestConnex Stage 3 ▪ North West Growth Centre	▪ Sydney Metro City and Southwest (Chatswood to Bankstown) ▪ Parramatta Light Rail Stage 1 - to Epping ▪ Parramatta Light Rail Stage 2 - to Strathfield	
2031	▪ South West Growth Centre ▪ M7 and M2 widening ▪ B53 upgrades ▪ M12 ▪ Western Harbour Tunnel		
2041	▪ Castlereagh Motorway ▪ Beaches Link		
2051	▪ Outer Sydney Orbital Stage 1	▪ South West Rail Link Extension	
Ongoing across all years	▪ Fuel and toll costs rise with CPI	▪ Opal fare system. Fares rise with CPI	▪ Opal fare system. Fares rise with CPI

Source: TPA (2017)

4.4 Multi-modal assessment

4.4.1 Rail network

A performance assessment of the rail network was completed using data that reflects the most recent (where possible) timetabling arrangements and infrastructure. No data is currently available for rail services following the implementation of the new Sydney Trains network and timetable changes in November 2017 – the assessment presented in the sections below draw on data representing the network and timetabling arrangements prior to this time.

The new network and timetable implemented in November 2017 resulted in a few changes to line designations and train operations through the south-west area, these are:

> Extension of the T5 Cumberland Line north to Richmond and diverting to Leppington in the south instead of Campbelltown.

> Splitting of the T2 Airport, Inner West and South Lines – the new T2 Inner West and Leppington Line connects the City Circle with Parramatta and Leppington via the Inner West and Granville.

> Designation of the Airport and East Hills component of the former T2 Line as the new T8 Airport and South Line, connecting the City Circle with Sydney Airport and Macarthur via East Hills. The peak hour alternative via Sydenham is also retained in this line.

The current (November 2017) and superseded Sydney Trains networks near the Precinct are presented in **Figure 4-6** and **Figure 4-7**.

Figure 4-6 Sydney Trains network (Before November 2017)

Source: Sydney Trains (2017)

Figure 4-7 Sydney Trains network (Current)

Source: Sydney Trains (2017)

The key changes in timetabled services following the implementation of the November 2017 timetable were as follows:

> An additional 20 services across the day on the T8 Airport and South Line – no change in the number of services proceeding via Sydenham.

> An additional 50 services across the day on the T2 Leppington Line.

> An additional 14 services across the day on the T5 Cumberland Line.

Table 4-7 presents a summary of the performance attributes assessed for the rail network and the data sources used to inform these assessments.

Table 4-7 Summary of rail network assessment components

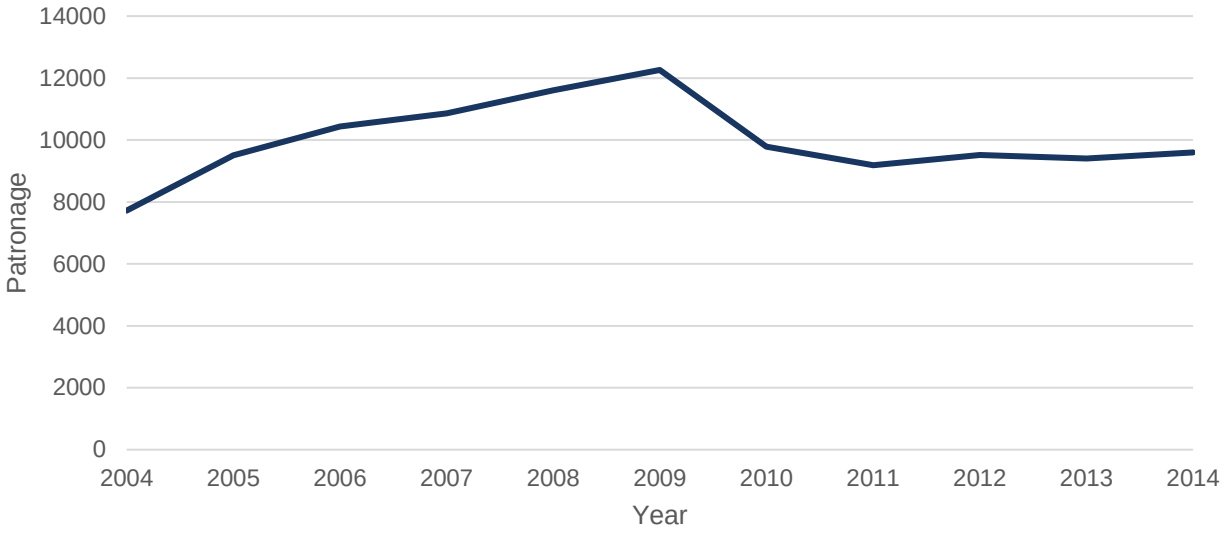
Performance attribute assessed	Time period	Data source
Glenfield station usage – station barrier counts	2004 to 2014	Bureau of Transport Statistics – Station Barrier Counts
Glenfield station usage – Opal card tap on and off trends	August 2016	Opal card data
Capacity analysis – Glenfield Station	February 2017	OpenData – Train Occupancy February 2017
Capacity analysis – key stations on the Sydney Trains network accessible from Glenfield Station	February 2017	OpenData – Train Occupancy February 2017

The AM peak defined for this assessment is from 6:00 AM to 9:30 AM.

4.4.1.2 Glenfield Station usage – station barrier counts

The patronage at Glenfield Station between 2004 and 2014 is shown in **Figure 4-8**. This graph shows the changes in station movements (entry and exit) over an average 24-hour weekday period.

Figure 4-8 Glenfield Station patronage (Total entries and exits for an average 24-hour weekday period)



Source: Bureau of Transport Statistics – Station ins & outs

Overall, patronage at Glenfield Station has been increasing between 2004 and 2009, and from 2011 to 2014. There was a significant decrease in commuters from 2009 to 2011 of approximately 3,000 movements (25 percent). This was likely due to the impact caused by construction of the Southern Sydney Freight Line (SSFL) and the upgrade of Glenfield Station as part of the Transport Access Program (TAP) that occurred during this period. Since 2011, rail patronage has been increasing on average by 1.5 percent per year.

Table 4-8 presents a summary of patronage at Glenfield Station for the following time-periods and movements:

- Average weekday AM peak period entries;
- Average weekday AM peak period exits; and
- The proportion of entries as a percentage of total movements for the weekday AM peak.

Table 4-8 Glenfield Station patronage (Total ins and outs for the AM peak period)

Time period and scenario	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
AM Peak Entries	2,150	2,480	2,660	2,770	2,960	3,080	2,720	2,930	3,050	3,150	3,180
AM Peak Exists	530	900	1,080	1,100	1,140	1,230	1,010	790	800	830	830
Proportion of AM Peak Ins vs total	80%	73%	71%	72%	72%	71%	73%	79%	79%	79%	79%

During the AM peak, the dominant customer movement is entries the station, representing 79 percent of all movements in 2014. This is likely due to the predominately-residential land uses in the precinct compared to education and commercial facilities and indicates a strong demand for outbound rail services leaving Glenfield.

Between 2004 and 2005 there was a significant increase in the number of exits from the station in the AM peak and this has remained consistent until 2011, when the proportion of movements returned close to 2004 levels. This proportion has remained consistent for the most recent four years for which data was available.

Again, this is likely due to the construction of the Southern Sydney Freight Line (SSFL) and the upgrade of Glenfield Station as part of the Transport Access Program (TAP).

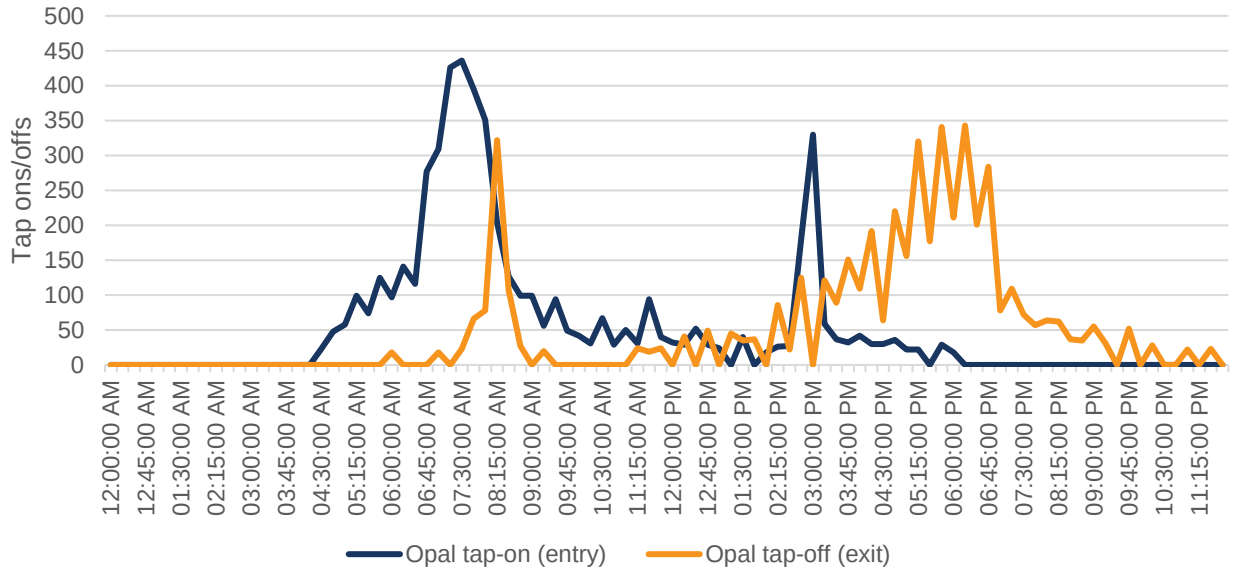
4.4.1.3 Glenfield Station usage – time of day and week

Opal data was analysed for station entries (tap-ons) and exits (tap-offs) at Glenfield Station and time of day of tap on. The data is on Tuesday 9th August 2016. This was the first month following the withdrawal of all paper tickets for public transport services. During this day, 5,231 tap-on movements and 4,891 tap-off movements were recorded.

The time distribution of Opal card tap-ons and tap-offs at Glenfield Station for Tuesday 9th August 2016 are shown over 15 minute periods in **Figure 4-9**. Overall, there is a significant influx during the morning peak, with the highest number of tap-ons occurring between 7:30 AM and 7:45 AM, with 436 movements. A peak in tap-off movements is also recorded between 8:15 AM and 8:30 AM, with 322 movements. This is likely due to school students travelling to the Precinct prior to the commencement of the school day.

Significantly fewer customers tap-on at the station in the evening peak than the morning peak. The afternoon peak tap-ons was recorded between 3:00 PM and 3:15 PM with 330 movements, likely representing school students moving through the station at the end of the school day. The lower proportion of tap-on movements in the evening peak is likely due to the more predominant residential than employment land uses in the Precinct; people leave in the morning and return in the evening.

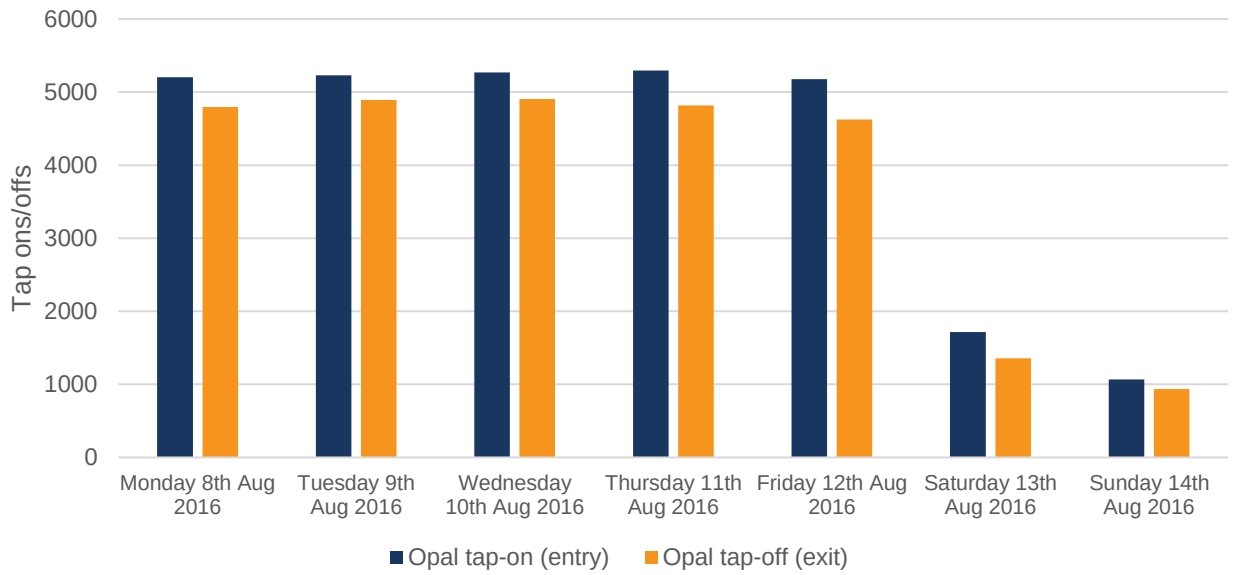
Figure 4-9 Rail – time of day of tap-ons and tap-offs (Tuesday 9th August 2016)



Source: Opal card data (OpenData)

The days in which customers access the train network are relatively similar. Over the week period from Monday 8th August to Sunday 14th August 2016, Wednesday was recorded as the busiest day and Sunday the quietest. **Figure 4-10** presents the data for a day of travel across the week in August 2016, broken down by tap-on and tap-off movements.

Figure 4-10 Rail – day of tap-ons and tap-offs (August 2016)



Source: Opal card data (OpenData)

4.4.1.4 Capacity analysis – Glenfield Station

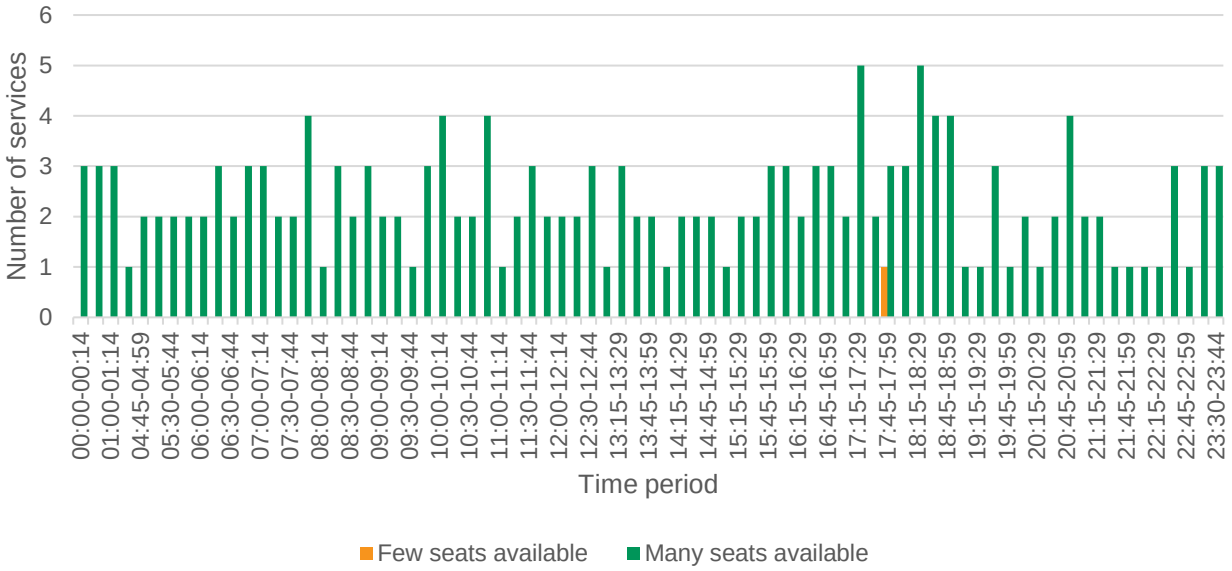
A capacity analysis was completed for train services as they arrive at Glenfield Station over a 24-hour period. The analysis was informed by historical train occupancy data provided by TfNSW through the OpenData portal, with the most recent data available for the month of February 2017. The occupancy of each service is assessed as the train arrives at the station (prior to the opening of doors and boarding/alighting movements) and is based on the capacity of the train set type used to form the service. An occupancy status is then allocated to each service from a choice of three ranges, defined as follows:

- Many seats available: This indicates occupancy less than 65 percent of the available train capacity.
- Few seats available: This indicates occupancy more than, or equal to 65 percent of the available train capacity.
- Standing room only: This indicates occupancy more than, or equal to 105 percent of the available train capacity.

The occupancy status and available capacity of train services arriving at Glenfield Station over a 24 hour weekday period in February 2017 are presented in **Figure 4-11**. The data is presented for services in the Up direction – that is, inbound services towards the following destinations:

- Central Station and the City Circle on the T2 South, Airport and East Hills Lines; and
- Schofields Station on the T5 Cumberland Line.

Figure 4-11 24-hour train service occupancy and available capacity at Glenfield Station (Up direction)



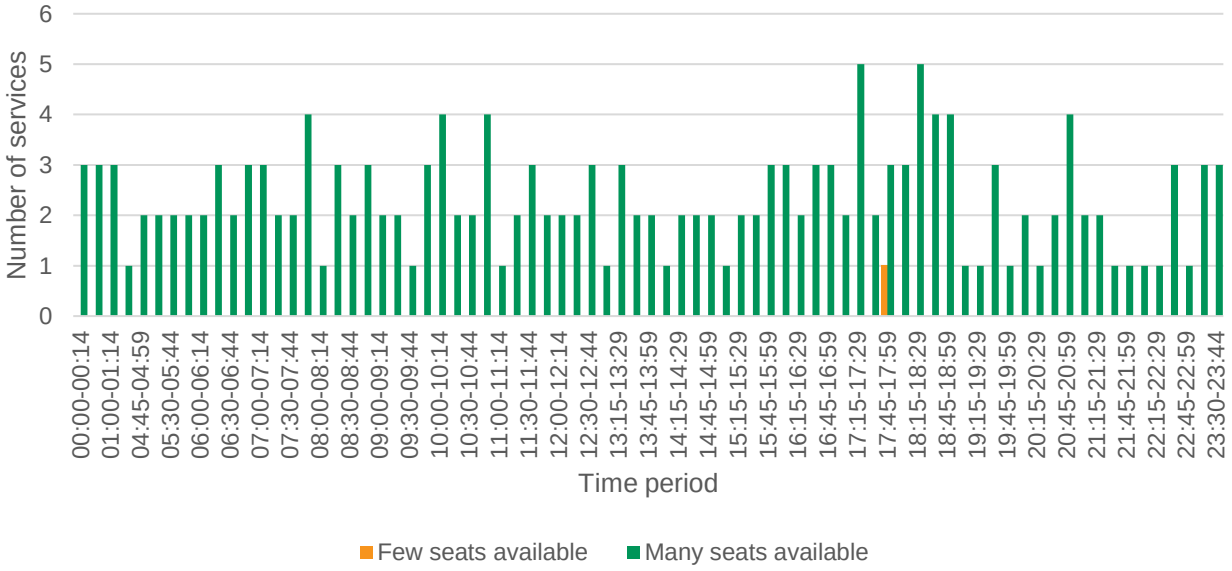
Source: OpenData Historical Train Occupancy – February 2017 (TfNSW)

The overall capacity of train services is sufficient at Glenfield Station, with the majority of city-bound or northbound services having many seats available as they arrive. There is a constraint in available capacity observed in the AM peak, with one service between 7:00 AM and 7:14 AM, and two services between 7:30 AM and 7:44 AM indicating few seats available.

Figure 4-12 presents an analysis of the occupancy status and available capacity of train services over a 24-hour weekday period travelling in the Down direction– that is, outbound services towards the following destinations:

- Campbelltown on the T2 South, Airport and East Hills Lines and T5 Cumberland Line;
- Macarthur on the T2 South, Airport and East Hills Lines; and
- Leppington on the T2 South Line.

Figure 4-12 24-hour train service occupancy and available capacity at Glenfield Station (Down direction)



Source: OpenData Historical Train Occupancy – February 2017 (TfNSW)

The overall capacity of outbound train services from Glenfield Station is sufficient for current population levels, with all services having many seats available in the AM peak. Available capacity is reduced on one service in the PM peak arriving between 5:45 PM and 5:59 PM, with few seats available.

4.4.1.5 Capacity analysis – key stations accessible from Glenfield

The capacity analysis was also extended to key stations accessible on trains departing Glenfield Station to gain an understanding of occupancy trends of services as they move through the network. The assessment was completed for the AM weekday peak using data for the February 2017 period with the Sydney Trains network and line structure operational at the time.

The stations nominated for occupancy and capacity assessments are presented in **Table 4-9**. Services that had not proceeded through Glenfield Station and instead had originated at other stations (for example from Revesby towards the City) were omitted from the assessment.

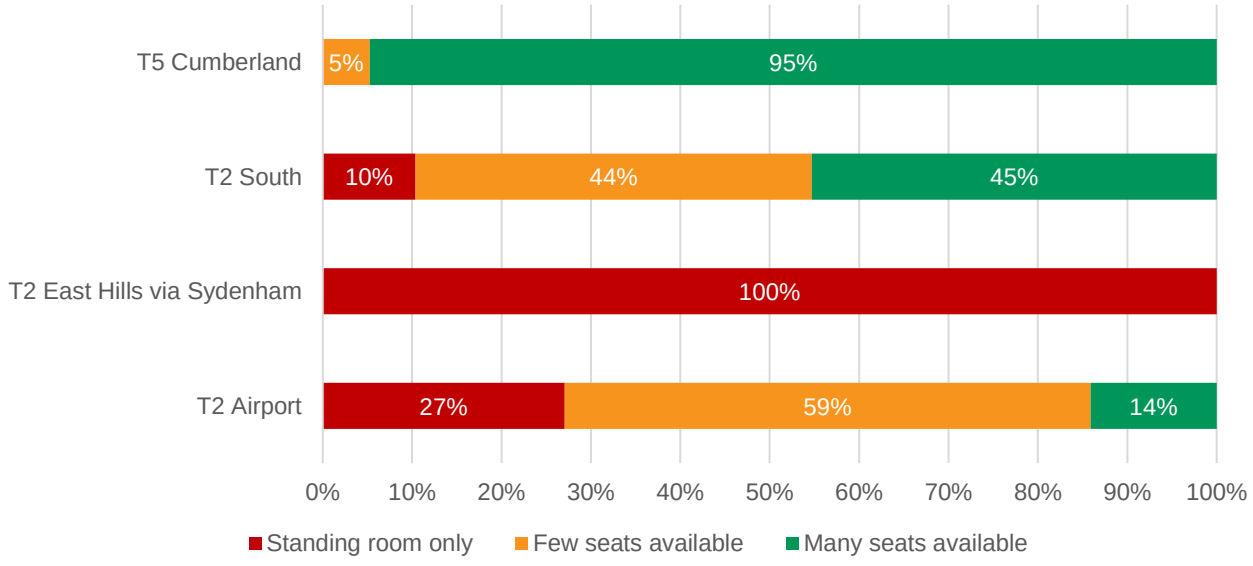
Table 4-9 Key train stations nominated for capacity assessment

Line as assessed (before November 2017 network)	Line (November 2017 network)	Nominated stations for assessment	
T2 Airport and East Hills	T8 Airport and South	▪ Macarthur ▪ Campbelltown ▪ Ingleburn ▪ Revesby ▪ Riverwood	▪ Sydenham ▪ Wolli Creek ▪ International Airport ▪ Domestic Airport ▪ Green Square
T2 South	T2 Inner West and Leppington T8 Airport and South	▪ Liverpool ▪ Cabramatta ▪ Granville ▪ Lidcombe ▪ Strathfield ▪ Ashfield	▪ Redfern ▪ Edmondson Park ▪ Leppington ▪ Ingleburn ▪ Campbelltown
T5 Cumberland	T5 Cumberland (new alignment)	▪ Liverpool ▪ Cabramatta ▪ Parramatta	▪ Blacktown ▪ Ingleburn ▪ Campbelltown

Note: Stations that appear more than once were accessible from Glenfield along more than one line

Figure 4-13 presents a summary of the service occupancy and available capacity at the key stations nominated in **Table 4-9**, across the four service lines (in the Up direction) that connect to Glenfield Station.

Figure 4-13 AM peak train service occupancy and available capacity – by Line (Up direction)



Source: OpenData Historical Train Occupancy – February 2017 (TfNSW)

From a capacity perspective, the T5 Cumberland was the best performing overall with 95 percent of services having spare capacity of 35 percent or more. T2 services that proceed through Sydenham towards the Sydney CBD had no available capacity, with space limited to standing room only. Services along the T2 South Line offered the greatest likelihood of seats being available for customers intending to travel towards the Sydney CBD.

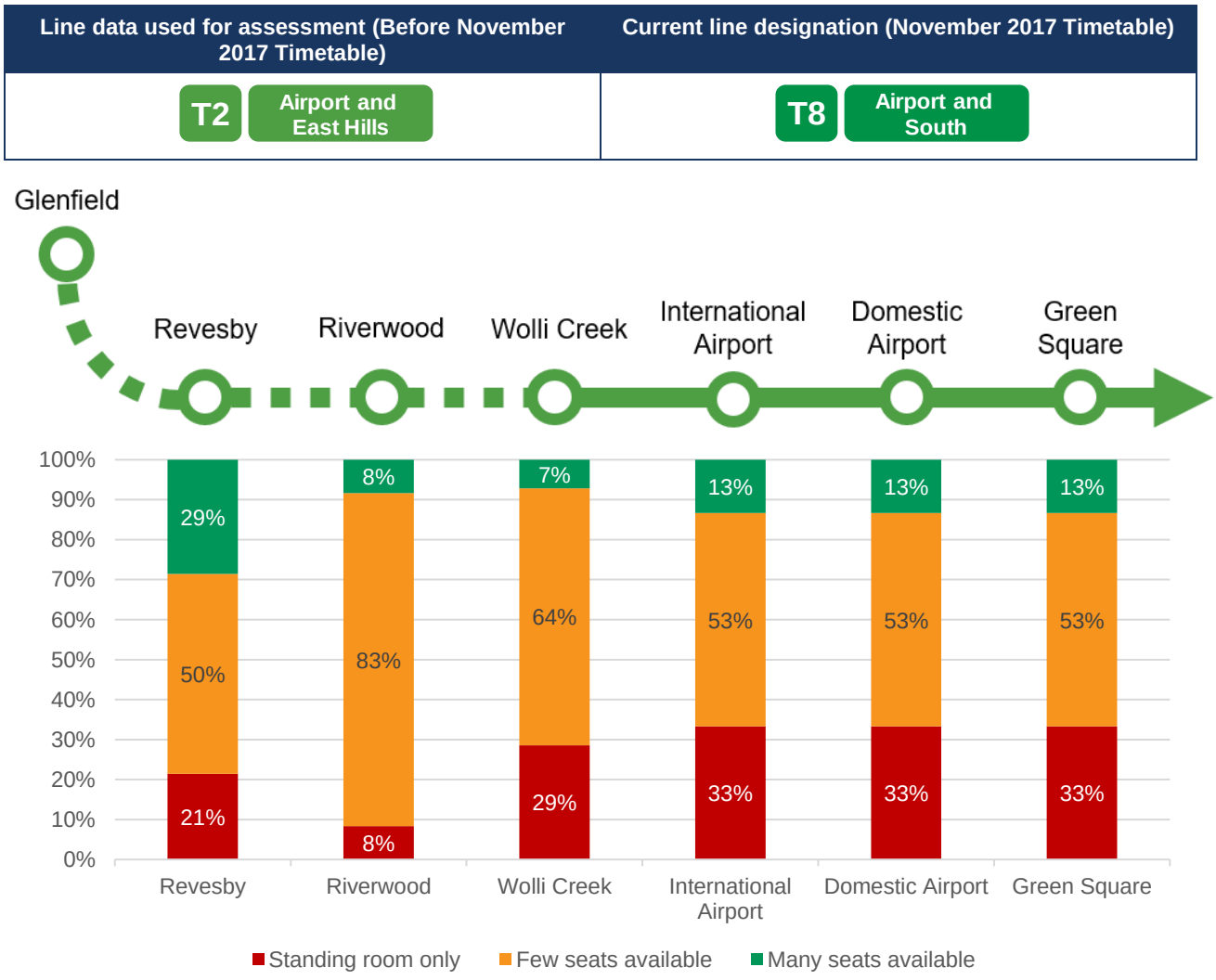
The results are reflective of the travel time benefits offered by T2 services via Sydenham compared to those via the Airport or Inner West line – the indicative travel times between Glenfield and Central Station via the three route options are as follows:

1. Via East Hills and Sydenham – 39 minutes.
2. Via East Hills, Wolli Creek and Airport – 41 minutes.
3. Via Granville and Strathfield – 68 minutes.

Capacity analysis – Glenfield to City via Airport

Figure 4-14 presents a breakdown of the occupancy status of city-bound train services as they arrive at key stations (before doors are opened and customers are allowed to board or alight) along the T2 Airport and East Hills Line (now the T8 Airport and South Line).

Figure 4-14 AM peak train service occupancy and available capacity – T2 Airport Line (Up direction)



The assessment shows capacity continues to reduce between Revesby and Wolli Creek; services are most constrained as they arrive at Wolli Creek Station, with only seven percent having many seats available. Capacity increases slightly as services proceed through the Airport Link and remain consistent towards Green Square. This is likely due to increased interchange movements at Wolli Creek as customers transfer between the T2 and T4 Lines.

Capacity analysis – Glenfield to City via Granville

Figure 4-15 presents a breakdown of the occupancy status of city-bound train services arriving at key stations along the T2 South Line (now the T2 Leppington Line).

Figure 4-15 AM peak train service occupancy and available capacity – T2 South Line (Up direction)

Source: OpenData Historical Train Occupancy – February 2017 (TfNSW)

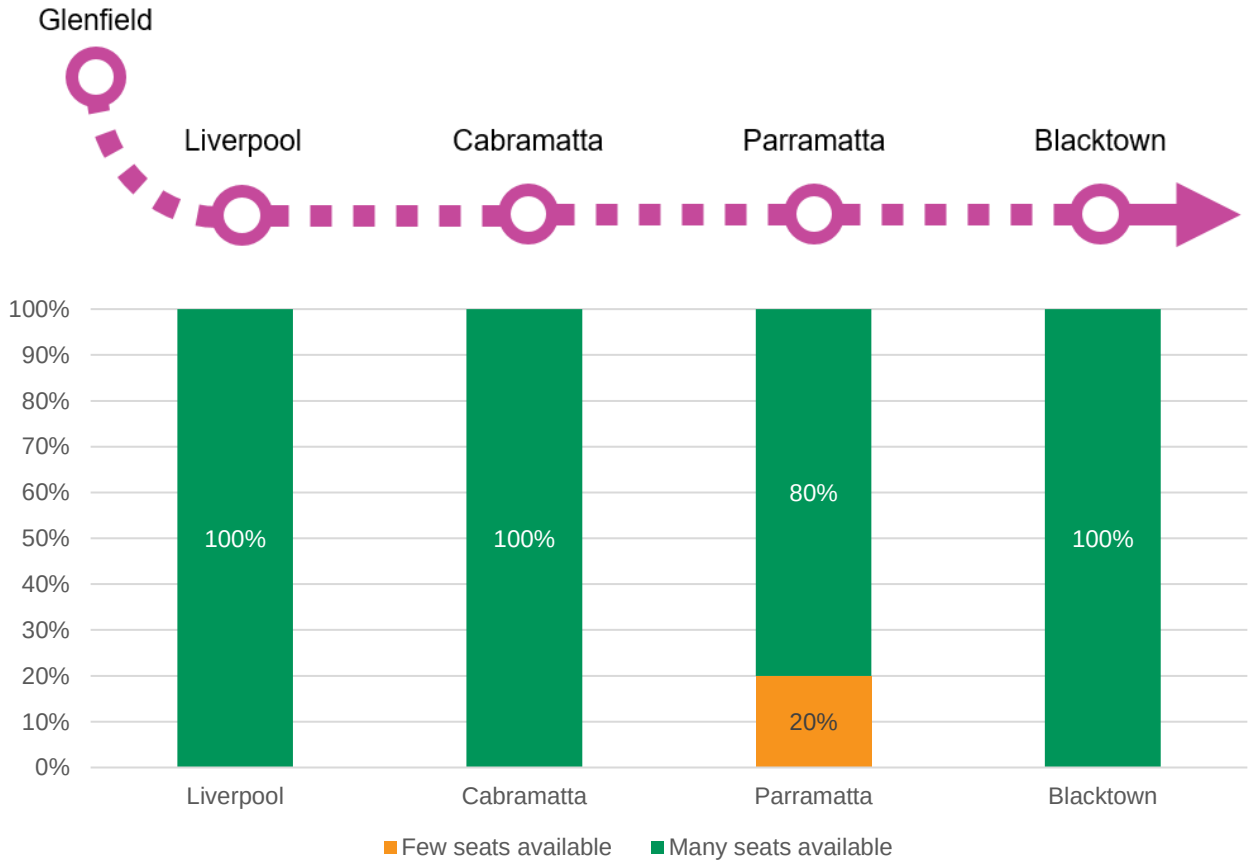
The assessment shows capacity is available for all services as they arrive at both Liverpool and Cabramatta stations. Occupancy rates progressively increase as services proceed past these stations towards Granville and Lidcombe. Capacity is most constrained at Strathfield Station, with most services having few seats available. However, capacity increases again as services proceed along the Inner West Line. More than a third of services are standing room only as they arrive at Redfern.

Capacity analysis – Glenfield to Schofields via Parramatta

Figure 4-16 presents a breakdown of the occupancy status of northbound train services arriving at key stations along the T5 Cumberland Line.

Figure 4-16 AM peak train service occupancy and available capacity – T5 Cumberland Line (Up direction)

Line data used for assessment (Before November 2017 Timetable)	Current line designation (November 2017 Timetable)
T5 Cumberland Services operated between Campbelltown and Schofields	T5 Cumberland Services operate between Leppington and Richmond



Source: OpenData Historical Train Occupancy – February 2017 (TfNSW)

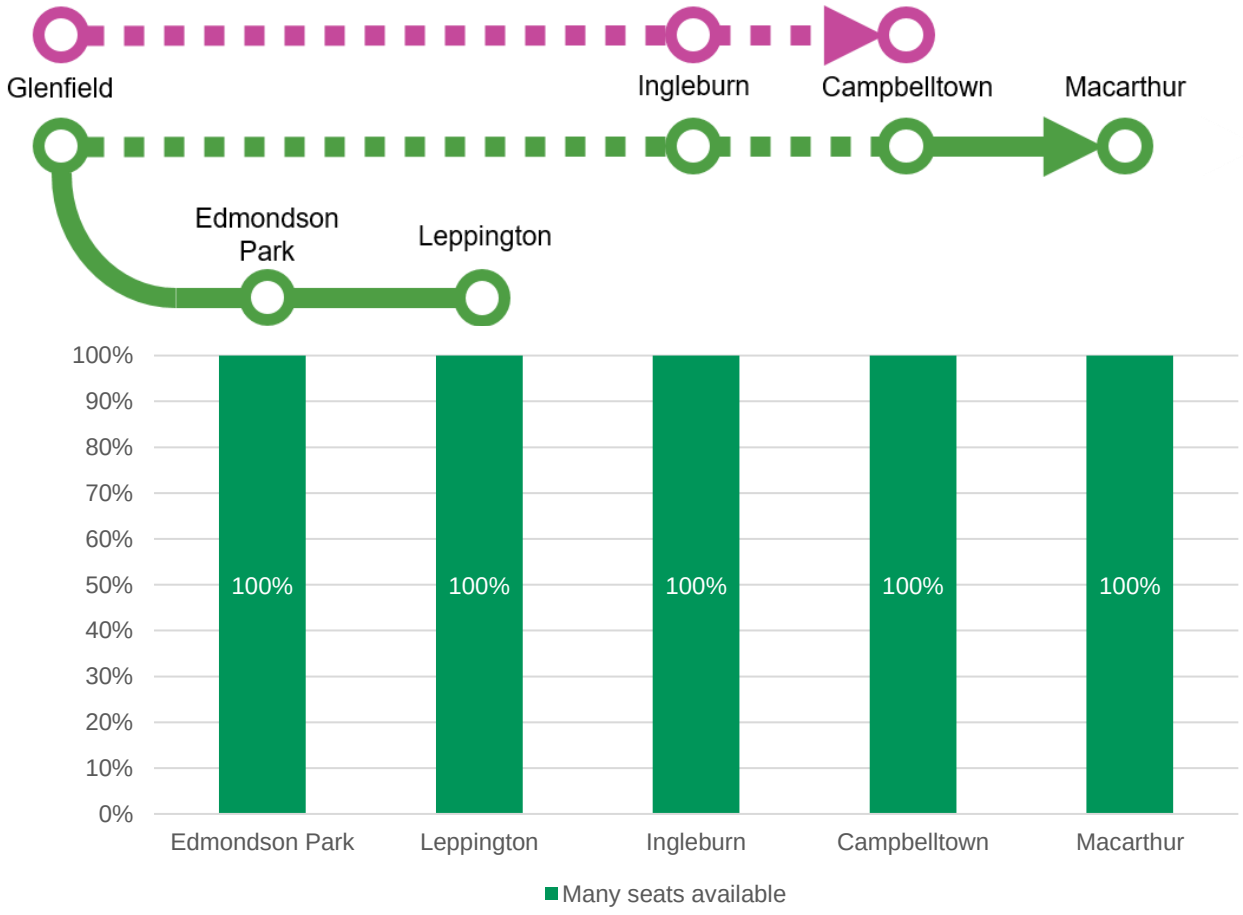
Occupancy rates are generally low along the T5 Cumberland Line, with all services having many seats available as they arrive at Liverpool, Cabramatta and Blacktown stations. One-fifth of services arriving at Parramatta are between 65 and 105 percent capacity.

Capacity analysis – Glenfield to Macarthur, and Glenfield to Leppington

Figure 4-17 presents a breakdown of the occupancy status of southbound train services arriving at key stations along the T2 Airport, East Hills and South Lines (now split into the T2 Inner West and Leppington Line and T8 Airport and South Line) and T5 Cumberland Line.

Figure 4-17 AM peak train service occupancy and available capacity – T2 Airport, East Hills and South Line and T5 Cumberland Line (Down direction)

Line data used for assessment (Before November 2017 Timetable)	Current line designation (November 2017 Timetable)
T5 Cumberland Services operated between Schofields and Campbelltown	T5 Cumberland Services operate between Richmond and Leppington
T2 South Assessment of services between Glenfield and Leppington	T2 Leppington T5 Cumberland Customers can travel from Glenfield to Leppington using a T2 or T5 service
T2 Airport and East Hills Assessment of services between Glenfield and Macarthur	T8 Airport and South Services proceed along the same alignment as the former T2 Airport and East Hills Line



Source: OpenData Historical Train Occupancy – February 2017 (TfNSW)

All southbound and westbound services departing Glenfield had a significant proportion of available capacity.

4.4.1.6 Summary and considerations

The analyses outlined above represent the performance of the rail network in the context of the superseded network and timetable. Some of the issues identified may have been addressed because of the network and timetable changes implemented in November 2017. Further analysis would be required to understand the impact of these changes on rail patronage, service capacities and occupancy rates.

The heavy rail network will continue to provide the primary public transport service to and from the Precinct for district and regional travel. Where trips are taken for commuting purposes, rail patronage represents the highest mode share when compared to buses (approximately one-third of all Journey to Work trips when leaving the Precinct, and four percent of all Journey to Work trips when travelling to the Precinct).

Glenfield Station will continue to evolve and establish its role as a primary interchange facility, with travel options currently available for services to the east (towards Sydney Airport and the Sydney CBD), north towards the Parramatta CBD, west towards Leppington and south towards Campbelltown.

A significant number of train services proceeding through Glenfield Station have the available capacity to accommodate increased customer numbers, anticipated as development occurs in the Precinct. Capacity rates are highest on services travelling away from the Sydney CBD and Parramatta CBD. Whilst capacity is available towards the Sydney CBD for customers boarding at Glenfield Station, these services progressively lose capacity as the trains approach stations closer to the Sydney CBD, with some services operating at standing room only.

The following considerations are suggested for further investigation as a means to support the growth of the Glenfield Precinct and associated trips. These have been developed with consideration given to the network and timetable changes implemented in November 2017, and the initiatives outlined in Future Transport 2056. Where references to specific rail lines are given, these are in the context of the current (November 2017) Sydney Trains network.

- Investigate improving travel times from the Precinct to destinations including the Sydney CBD, Parramatta CBD and Campbelltown through the provision of express train services, particularly in peak periods to improve the competitiveness of public transport against private vehicles. Stations that are skipped as a result can be serviced by trains commencing at stations where turn back facilities are available.
- Provide increased service capacity on the T2 Inner West and Leppington Line and T8 Airport and South Line in the AM peak period towards the Sydney CBD to address the increasing pressure on city-bound services. The introduction of the Sydney Metro City and Southwest alignment to Bankstown in 2024, and potentially further west will provide an opportunity to operate more trains along the City Circle because of the T3 Bankstown Line transferring to the new Metro alignment, with associated services removed from the Sydney Trains network.
- Provide increased service capacity along the T5 Cumberland Line towards Parramatta to support its growth as the second CBD. Services along the T5 line currently operate at 30-minute headways in peak periods.
- Provide increased service frequency along all lines connecting through Glenfield Station in off-peak periods to increase the attractiveness of the train service as an all-day mode option.
- Investigate new rail connections from the Precinct to the future Western Sydney Airport at Badgerys Creek, due to open in 2026, drawing on plans announced as part of the Western Sydney City Deal.
- Deliver the infrastructure required to provide full separation of freight rail and passenger rail services through the precinct to improve service reliability. This can include duplication of the Southern Sydney Freight Line to support increased freight rail movements both to the north and south, especially as the Moorebank Intermodal Terminal comes online.

4.4.2 Bus network

A performance assessment of the bus network was completed using data that reflects the most recent (where possible) timetabling arrangements and infrastructure. No data is currently available for bus services following the implementation of the new bus timetable changes in November 2017. **Table 4-10** presents a summary of the performance attributes assessed for the bus network and the data sources used to inform these assessments.

Table 4-10 Summary of bus network assessment components

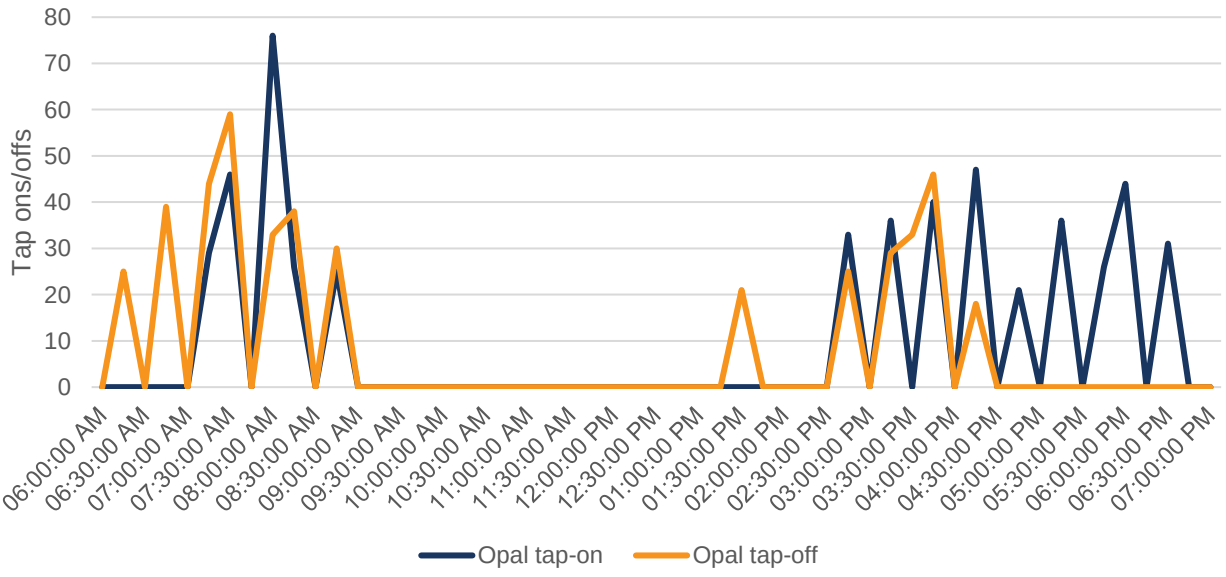
Performance attribute assessed	Time period	Data source
Bus stop patronage (Glenfield suburb)	August 2016	Opal card data
Capacity analysis – two bus stops at Glenfield Station	November 2016	OpenData – Bus Occupancy November 2016

4.4.2.1 Patronage (suburb of Glenfield)

Opal data was analysed for tap-on and tap-off movements for all bus routes operating in the suburb of Glenfield and time of day of each tap on and tap-off. The data is for Tuesday 9th August 2016. This was the first month following the withdrawal of all paper tickets for public transport services. During this day, 516 tap-on movements and 440 tap-off movements were recorded.

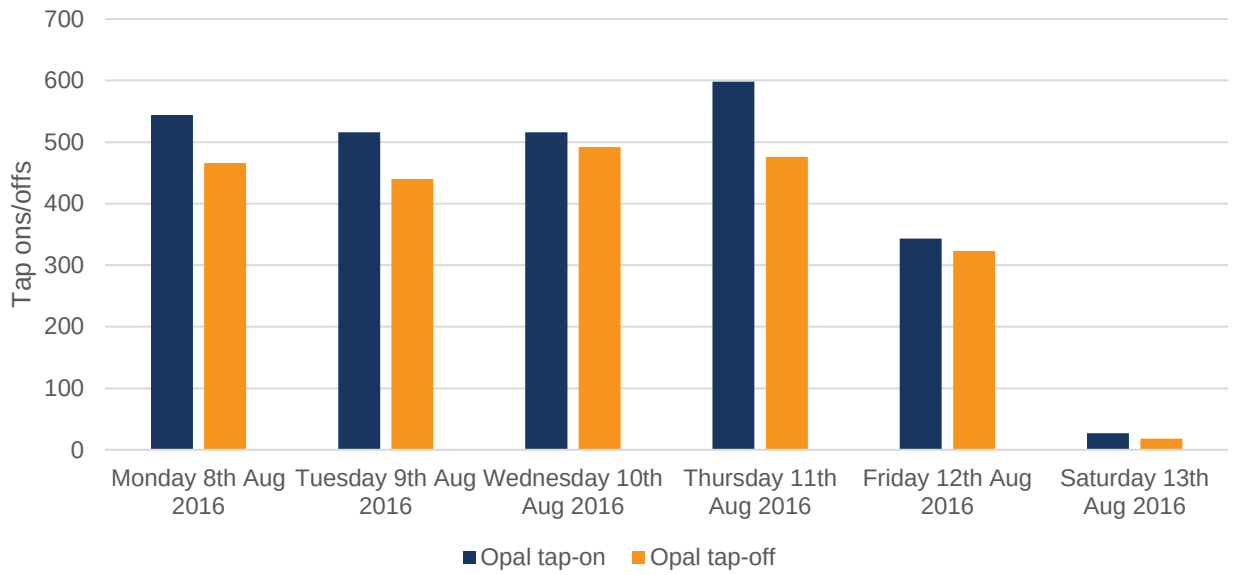
The time distribution of Opal card tap-ons and tap-offs on buses through Glenfield for Tuesday 9th August 2016 are shown over 15 minute periods in **Figure 4-18**. Overall, there are a number of peaks recorded during the AM period from 6:00 AM to 9:30 AM, with the highest peak 15-minute period occurring between 8:00 AM and 8:15 AM for tap-on, and between 7:30 AM and 7:45 AM for tap-offs. Smaller peaks were also observed in the afternoon, with 47 tap-ons between 4:15 PM and 4:30 PM and 46 tap-offs between 3:45 PM and 4:00 PM.

Figure 4-18 Bus – time of day of tap-ons and tap-offs (Tuesday 9th August 2016)



The days in which customers access buses are relatively similar during the working week. Over the week period from Monday 8th August to Saturday 13th August 2016, Thursday was recorded as the busiest day and Saturday the quietest. No patronage data was available on Sunday 14th August 2016. **Figure 4-19** presents the data for a day of travel across the week in August 2016, broken down by tap-on and tap-off movements.

Figure 4-19 Bus – day of tap-ons and tap-offs (August 2016)



4.4.2.2 Capacity – bus stops at Glenfield Station

Glenfield Station is served by two bus stops located on the eastern side of the rail corridor on Railway Parade. An occupancy and available capacity assessment were completed for the stops (Transit Stop Numbers 216711 and 216712) for the AM peak in November 2016. The results of the assessment are presented in **Table 4-11**.

Table 4-11 AM peak bus service occupancy and available capacity (Glenfield Station stops)

Transit Stop Number (TSN)	Timetabled Arrival Time	Actual Arrival Time	Timetable Variance (hours:mins)	Capacity Assessment
216711 (Glenfield Station, Railway Parade northbound)	7:49AM	7:50AM	0:01	Many seats available
	7:51AM	7:50AM	0:01	Many seats available
	8:05AM	8:08AM	0:03	Many seats available
	8:44AM	8:45AM	0:01	Many seats available
216712 (Railway Parade opposite Glenfield Station	7:20AM	7:21AM	0:01	Many seats available

Source: OpenData Historical Bus Occupancy – November 2016 (TfNSW)

AM peak bus services run close to their scheduled arrival time at both stops, with the reported variance not exceeding three minutes. All services assessed had many seats available as each arrived at the respective stops.

4.4.2.3 Future Transport Facility

Through consultation with TfNSW, the potential need for a facility to support the future public transport network was identified. This Future Transport Facility is located in the north of the Precinct and identified on the Draft Precinct Plan in **Figure 4-1**. The facility would provide a layover and turning point for local and regional bus services.

4.4.2.4 Interim bus layover

As the development of the Precinct, particularly the western sections, is expected to occur over several years, user demand to justify the development of the potential Future Transport Facility is unlikely to occur until the early to mid-2020's. As such, an indicative Interim Bus Layover Plan has been developed in consultation with TfNSW.

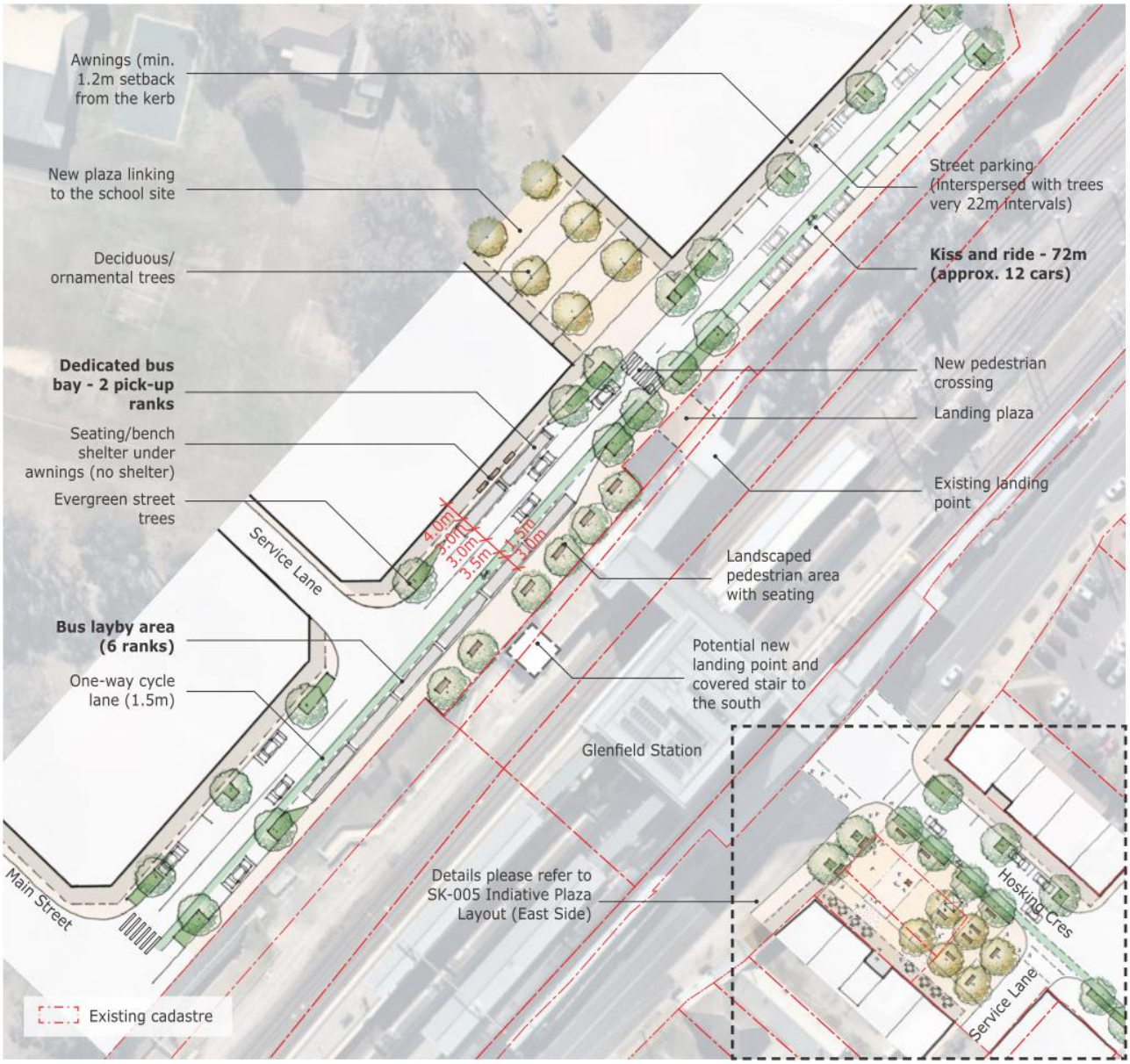
The Interim Layover will provide space through indented bays for up to six buses to load and unload passengers as well as layby between services. The Plan locates the pick and drop-off points for both

inbound and outbound bus routes on the western side of Glenfield Station immediately adjacent to the station plaza to maximise integration between the two modes. The Plan also includes provision for 12 Kiss & Ride spaces located to the north of the western station plaza.

Two options for the Interim Bus Layover were developed, and these are presented in **Figure 4-20** and **Figure 4-21**. Both options propose the indented bus bays for layover (six bus spaces) and 12 Kiss & Ride spaces; the difference between the options is captured in the design of the northbound pick-up stop as follows:

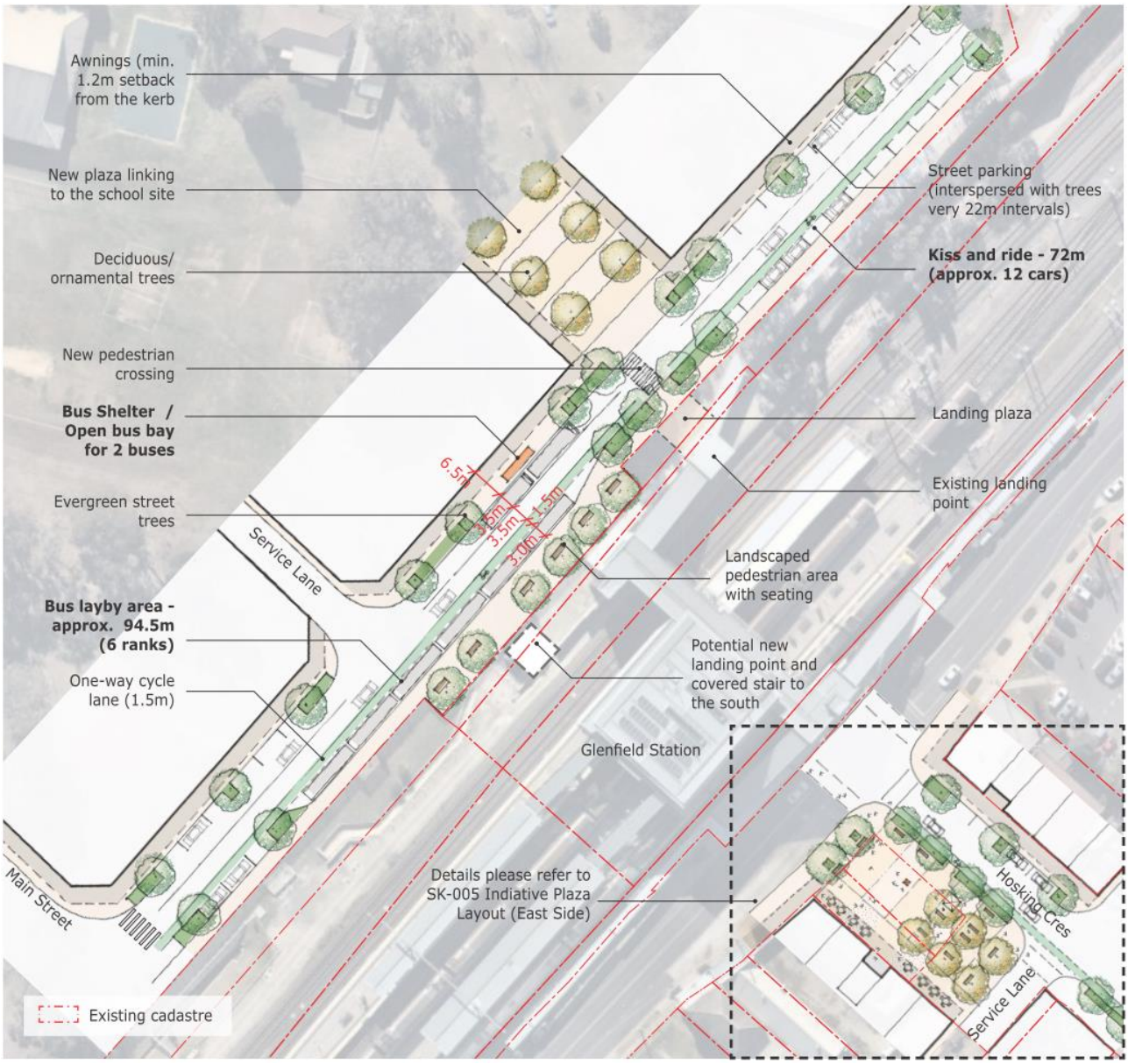
- Option 1 provides an indented bus bay for two buses. The footpath is narrowed in this area and no dedicated shelter is provided; seating for the bus stop will be provided beneath the adjacent building awnings.
- Option 2 provides locates the bus stop within the active northbound traffic lane. The adjacent footpath in this area is wider and a dedicated shelter will be provided for customers.

Figure 4-20 Interim bus layover facility – Option 1



Source: GM Urban Design and Architecture (August 2018)

Figure 4-21 Interim bus layover facility – Option 2



Source: GM Urban Design and Architecture (August 2018)

4.4.2.5 Summary and considerations

The analyses outlined above represent the performance of the bus network in the context of the superseded network and timetable. Some of the issues identified may have been addressed because of the network and timetable changes implemented in November 2017. Further analysis would be required to understand the impact of these changes on bus patronage, service capacities and occupancy rates.

The bus network will continue to perform a support role in the public transport space, complementing the rail network, which will serve as the primary public transport mode for trips into and out of the Precinct. The key functions of the bus network will be to:

- Provide connections to and from areas outside of the rail station catchment with Glenfield Station – these will function as feeder services to the station and support interchange between modes.
- Provide connections to and from regional destinations including Campbelltown, Macarthur, Liverpool and Leppington with a focus on directness and improved journey travel times.

The following considerations are suggested for further investigation as a means to support the growth of the Glenfield precinct and associated trips.

- Extend the hours of operation of the bus network servicing the Glenfield precinct and increase service frequency to encourage increased patronage and improve opportunities for interchange at Glenfield Station.
- Introduce new routes connecting to the planned development on the western side of Glenfield Station at the site of the Hurlstone Agricultural High School. New roads that are delivered in this area of the Precinct should be designed to accommodate the appropriate bus models.
- Investigate new routes connecting to Western Sydney Airport, planned for completion in 2026 and the supporting employment centres. As this project is being delivered in a staged approach, the bus network is anticipated to provide the primary public transport connection following the initial opening of the Airport, prior to the completion of new rail infrastructure.
- All bus stops in the Precinct are to be compliant with the requirements of the Disability Discrimination Act (DDA) 1992 and Disability Standards for Accessible Public Transport (DSAPT) (including hardstand boarding areas and tactiles), and consistent with TfNSW's wayfinding scheme ("B" Mode ID's and flags).
- It is recommended that Council consult TfNSW as part of detailed planning and development of the Interim Bus Layover. TfNSW will regularly review demand for bus services and the operational efficiency of the Interim Bus Layover in consultation with bus service providers to inform the need, planning and development of any potential Future Transport Facility.

4.4.3 Pedestrian network

As discussed in **Section 3.3.1**, the current pedestrian facilities in the precinct are well developed where provided, with footpath coverage improving towards the Glenfield Station interchange. The deficiencies identified in the existing conditions assessment are:

- A lack of footpaths on lower order streets.
- Footpaths provided on one side of the street only along some residential streets.
- No formal crossing of the railway line provided for pedestrians north of Glenfield Station (the current Glenfield Road overbridge does not include any footpath facilities).
- Crossing facilities not provided along each leg of a signalised intersection at Glenfield Road and Campbelltown Road.

New and upgraded pedestrian facilities are proposed in the Precinct by DPIE with a focus on improving connectivity to Glenfield Station. All streets in the Precinct will include provision for footpaths on both sides. The key proposals for pedestrian facilities include:

- Upgrade of streets running parallel to and on both sides of the railway line, characterised by wide footpaths on both sides and separate spaces for activation purposes such as outdoor dining and street furniture. Main street and accompanying active frontages would also extend along Hosking Crescent (on the eastern side) and along a new street south of the new high school (on the western side).
- On the eastern side, upgrades to Belmont Road, Canterbury Road and Fawcett Street to be designated as residential boulevards. These are characterised by footpaths on both sides, separate cycling facilities and provide the main connection from lower order residential streets to Railway Parade and Glenfield Station.
- Improved pedestrian connections with the connection of Cambridge Avenue to Glenfield Road.
- New footpath network on the western side of the railway line in accordance with the alignment of the road network as proposed in the Draft Precinct Plan. These include a combination of higher order boulevard and main streets that link to new local streets.
- Investigation of a new east-west connection spanning across the railway line to the south of the Precinct.

Pedestrian links are also proposed with new open space corridors; these are:

- On the eastern side, along the Precinct boundary connecting the Georges River Nature Reserve with Bunbury Curran Park, Kennett Park and Seddon Park.
- An east-west corridor parallel to the land reservation for a potential future Cambridge Avenue extension.

- On the western side, a north-south corridor is proposed immediately west of the current site of the Hurlstone Agricultural High School. To the south, this would proceed via the potential railway crossing facility to the open space corridor on the eastern side at Seddon Park. To the north, this would connect to the open space corridor parallel to the Cambridge Avenue land reservation.

4.4.3.1 Summary and considerations

Good practice in the development of the pedestrian network requires consideration to be given to the layout of the road network and function of individual streets and facilities for pedestrians. Pedestrian networks should be designed and implemented with a focus on improving accessibility and safety, whilst also enhancing the streetscape and encouraging walking as a means of transport and recreation. The following considerations have been adopted in the Glenfield Planned Precinct Development Control Plan that will support growth and development of the Precinct's pedestrian network:

- Providing wide (1.8 metres in high activity areas and 1.5 metres minimum) footpath facilities on both sides of all roads (new and existing) in the Precinct for improved accessibility.
- Activating frontages along higher order streets to encourage pedestrian activity and passive surveillance.
- On higher order streets with mixed land uses, designating separate activity areas and sufficient effective width to minimise conflicts between pedestrians.
- Installing kerb extensions where possible to maximise pedestrian space, shorten crossing distances and allow for new activity areas.
- Installing vegetation and wayfinding to improve visual amenity and pedestrian trip planning and movement.
- Providing a consistent material for footpaths that is slip-resistant and employing aids such as tactile ground surface indicators (TGSI) to support inclusivity.
- Providing awnings along higher order streets characterised by higher levels of activity for improved weather protection.
- Provide improved east-west connectivity across the railway line, to link existing communities and facilities with new communities and facilities, including new active open spaces.
- Investigating appropriate locations for new crossing facilities with pedestrian priority (such as zebra crossings) at locations with high crash rates, as well as other traffic calming measures to reduce vehicle speeds, particularly in denser, higher activity areas.

4.4.4 Cycling network

As discussed in **Section 3.3.2**, the existing cycling network incorporates regional and local routes predominately to the north of the precinct. While connectivity is provided to the regional cycle route network in some areas, there is a lack of local connectivity via lower order streets within the precinct itself.

New and upgraded cycle facilities are proposed in the Precinct by DPIE with a focus on improving connectivity to regional routes and introducing new local routes; these include:

- A new north-south regional route along Railway Parade combining on-road and shared path facilities to provide improved connectivity to Glenfield Station when approaching from the east.
- On the eastern side, new on-road facilities along Belmont Road, Harrow Road North, Canterbury Road , Fawcett Street and Newtown Road to connect to Railway Parade and the potential railway crossing in the south.
- On the eastern side, aligning with the open space corridor connecting the Georges River Nature Reserve with Bunbury Curran Park, Kennett Park and Seddon Park (along the Precinct boundary).
- On the western side, new separated facilities along higher order streets providing connections from all local streets to Glenfield Station and the north-south boulevard parallel to the railway line. Connections are also proposed along the east-west open space corridor reserved for a potential Cambridge Avenue extension and north along Glenfield Road to the shared path network proceeding towards Parramatta.

4.4.4.1 Summary and considerations

There is an opportunity to expand the cycle route network and provide new facilities as development occurs in the precinct. The RMS Bicycle Guidelines outline the key principles to deliver a successful cycle network that will support existing users and encourage new users to improve mode share. In the context of the Glenfield Precinct, the principles to consider include:

- The coherence in the network through consistent infrastructure that links regional and local routes to key destinations (such as Liverpool as the nearest Metropolitan Cluster to the Precinct). Different route options should also be available to users.
- The directness of the routes that comprise the network. Cycle routes should be direct in connecting to popular destinations. Long detours should be avoided where possible, but should also consider impacts of local topography such that a longer route along a shallower grade may be preferable to a shorter route along a steep street.
- The connectivity of the routes: Facilities should cater for east-west connectivity across the railway line, to link existing communities and facilities with new communities and facilities, including new active open spaces.
- The safety of route infrastructure. All facilities should maximise safety to all road users, including cyclists, pedestrians and motorists. The design of facilities should place emphasis on improving intersection layouts to accommodate cyclists, providing mid-block crossings at safe and convenient locations, and separating cyclist movements from pedestrians where possible, particularly at bus stops.
- The attractiveness of cycle infrastructure. Cycling is encouraged where facilities are visually appealing, clearly signposted wayfinding and appropriate line marking provides guidance for users. Where development is occurring, this presents an opportunity to provide wide shared paths along street frontages with good lighting and security measures.
- The comfort of the bicycle network. The facilities along each route should maintain a consistent comfort level for users and avoid changes in riding surface or introducing conflict points without appropriate separation measures. Facilities should also be designed with consideration given to traffic volumes and speeds on the subject road. For example, fully separated off-road facilities are preferred along major arterial roads, whilst on-road or mixed traffic facilities are suitable for low-speed local roads.

4.4.5 Parking

As discussed in **Section 3.6**, vehicle traffic generation is directly linked to the availability of car parking. Whilst each additional parking space provided in the Precinct can contribute to higher traffic generation and potentially congestion, it is acknowledged that decreasing parking supply must be balanced with improved access to and supply of alternative transport services.

As development occurs in the Precinct and new transport infrastructure is delivered, there is strong justification for minimising vehicular parking supply to encourage new and existing residents and employees to adopt sustainable transport modes for their trips, complemented by improved facilities such as bicycle parking and end-of-trip facilities. In particular, areas near Glenfield Station can provide lower vehicular parking rates as the railway network is able to offer a high level of public transport accessibility.

4.4.5.1 Summary and considerations

The initiatives proposed for the Precinct regarding the provision of parking facilities (both vehicular and bicycle) are:

- Providing high-quality bicycle infrastructure as a means of reducing vehicular parking, where short trips can be completed by cycling rather than driving. This includes providing bicycle parking in convenient and highly visible locations in the public domain to promote usage.
- Updating the parking controls in the Campbelltown DCP to include supply rates for bicycles. Currently, controls are only provided for residential flat buildings. Provisions should be included for all commercial, retail and mixed-use land uses, with recommendations for end-of-trip facilities to also be provided including showers and change rooms.
- Adopting reduced vehicular parking supply rates for developments that are located close to transport interchanges, and investigating the inclusion of controls for car share spaces. Both would need to be

subject to an economic analysis to test market sensitivity as often the economic success of a development can also rely on the parking supply.

- Reviewing on-street vehicular parking supply and restrictions to maximise utilisation and efficiency. A utilisation rate of 85 percent is recommended during peak periods to minimise the circulation of vehicles searching for a parking space. The implementation of restrictions for on-street parking is dependent on a number of factors and would require detailed investigation to understand the impacts and ensure a balanced approach is taken forward. The on-street parking controls should align with the catchment of the land use that is generating the parking demand – an example of potential controls for the Precinct are presented in **Table 4-12**.
- The considerations for on-street vehicle parking supply relevant to the Precinct include:
  - Discouraging long-term car parking use, particularly for those not accessing the adjacent land uses, as this generally does not support the local economy.
  - Ensuring adequate on-street facilities are provided for pick-up and drop-off movements near transport interchanges, including Kiss & Ride, taxis and buses to discourage overflow into other short-term parking areas.
  - Providing short-term parking close to local businesses that rely on high turnover in convenient locations.
  - Provide adequate opportunities for loading and delivery zones in convenient locations close to subject businesses to maximise efficiency in the zone's usage.
  - Rationalising the number of restrictions within the Precinct for coherence.
  - Investigating the rollout of a residential permit scheme as a means of sharing parking between visitors and residents, dependant on significant local demand.
  - Allocating spaces for exclusive use by car share vehicles.

Table 4-12 Potential neighbourhood on-street parking controls

Neighbourhood characteristic	Recommended control	Operating days
Areas with little to no parking demand, example low-density residential street.	Nil	Nil
Areas with limited parking demand, example residential areas on the fringe of town centres and stations	3P 8am-4pm	Mon-Fri
Areas with moderate to consistent parking demand, example town centre with railway station	1/2P-2P (depending on adjacent land use) 8am-10pm (dependent on demand times)	Mon-Sun (dependent on demand)

- Investigate implementation of management measures for commuter car park facilities at Glenfield Station. These car parks could be integrated with the Opal card system and provide free parking for Park & Ride customers who live beyond an 800-metre catchment of the station or have special needs. This would be detected when a person taps on at the station, thus enabling free parking and charge commercial rates for those who do not transfer to a public transport service.

4.4.6 Freight network

An analysis of the freight network was completed using outputs obtained from the Strategic Traffic Forecast Modelling (STFM) process (detailed in **Section 4.5.1.2**). The movements were derived from the freight matrix in the STM 3.3 model. The outputs provide a breakdown of vehicles (by class – light vehicles, light trucks, and rigid and articulated trucks) travelling through the road network under the medium growth scenario in 2026 and 2036 (for both the AM and PM peaks). The key observations from the analysis are:

- The majority of vehicles continue to travel along the existing Glenfield Road alignment when considering the Roy Watts Road extension infrastructure option in both 2026 and 2036, in line with existing behaviours captured in the 2016 base case.
- In 2026, the Interim Cambridge Avenue extension option results in a transfer of movements to this connection from Glenfield Road, with approximately 60 percent utilising Cambridge Avenue and 40 percent Glenfield Road.

- In 2036, the Full Cambridge Avenue extension options result in the majority of vehicles using the new alignment from Glenfield Road.

4.4.6.1 Summary and considerations

Freight movements will become a more prominent component of the transport network in the future, as development occurs in the Precinct and projects such as the Moorebank Intermodal Terminal are completed and operational. The current freight corridors generally proceed along the periphery of the precinct and avoid interactions with local roads. The Cambridge Avenue road infrastructure proposals for 2026 and 2036 accommodate increased traffic volumes compared when compared to the Roy Watts extension and Glenfield Road alternatives.

The key considerations for the freight network in the context of the Precinct are:

- Encouraging freight movements along major road corridors only, and avoiding interactions with local roads where possible.
- Considering the requirements of service and delivery vehicles travelling to and from new land uses in the Precinct.
- Investigating new road links from the Precinct to provide easy and convenient connections to the Western Sydney Airport precinct (due to open in 2026 as part of a staged approach).
- Considering the requirements of the Moorebank Intermodal Terminal (construction staged and progressively completed by 2030) and the proportion of freight movements to and from the facility by rail and road.

4.5 Transport modelling

Transport modelling was completed for the Precinct, testing the land use scenarios and transport network for the Precinct. The purpose of the transport modelling is to compare:

- The impacts of changes to land use assumptions and proposed development scenarios.
- Public transport and private vehicle demand associated with population and employment growth under different scenarios.
- The impacts of proposed roads and public transport network upgrades for existing and future travel demands.

The modelling framework developed for the Precinct consists of three components; these are:

- **Strategic Modelling:** which comprises of:
  - Strategic Travel Modelling (STM) using EMME in collaboration with TfNSW's Transport Performance and Analytics (TPA) Division; and
  - Strategic Traffic Forecasting Modelling (STFM) using EMME and a Roads and Maritime calibrated and validated assignment model.
- **Mesoscopic modelling:** Detailed analysis and refinement of the transport network by developing the "Glenfield Precinct Mesoscopic Model" (GPMM) using STFM demand cordon matrices and the AIMSUM modelling platform.
- **SIDRA intersection modelling:** Intersection performance assessment and road layout geometry recommendations using AIMSUN outputs and SIDRA.

4.5.1 Strategic modelling

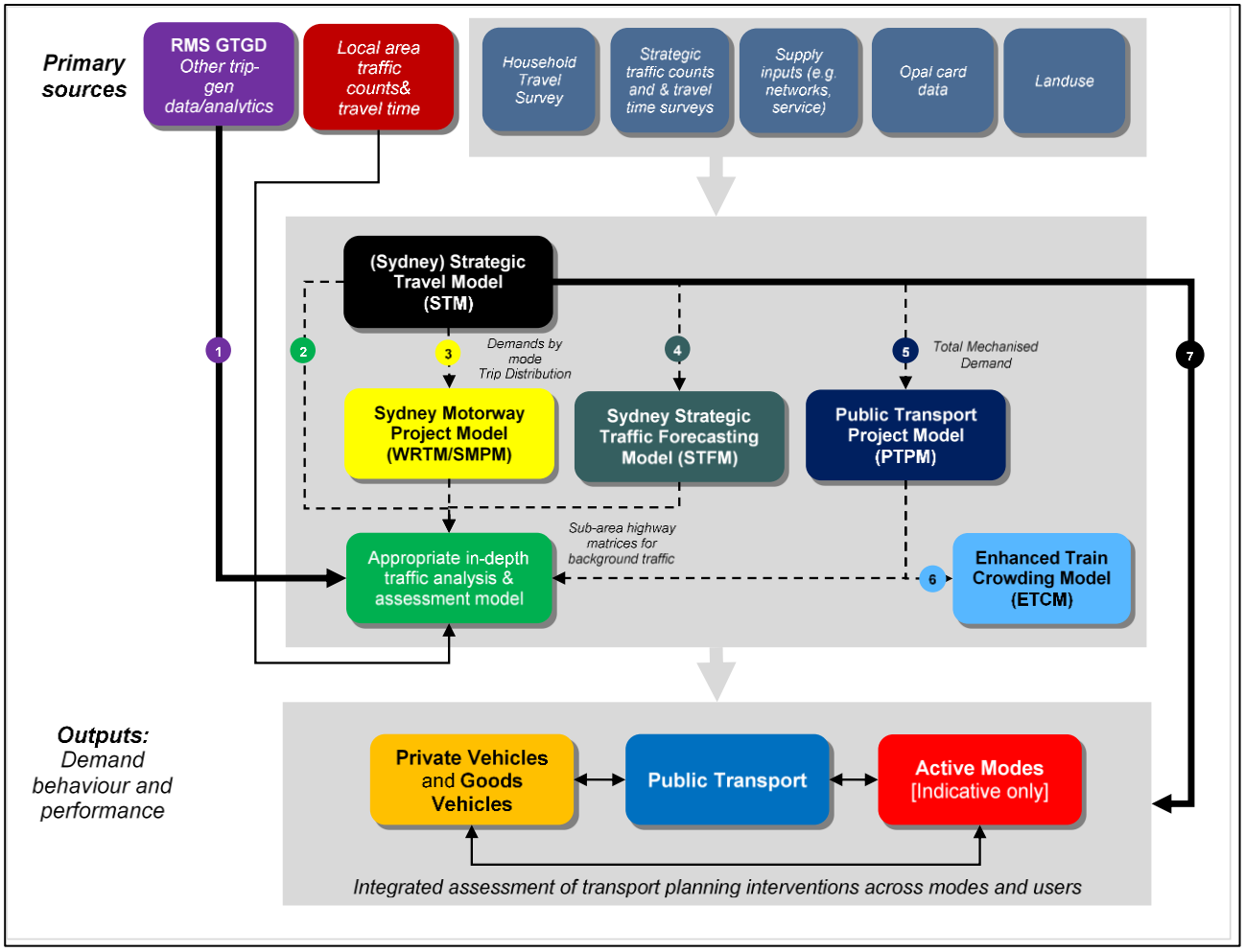
Strategic transport models generally cover large areas at a lower level of detail compared to other models. They provide a high-level view of transport networks. Strategic models are not suitable for the detailed design of transport infrastructure and do not provide detailed information such as the turning movements at an intersection.

They do not show the broader impacts of congestion such as queue extensions causing gridlock. There are also limitations to redistribute road movements when the demand on a section of a network exceeds its capacity.

Other lower level detail models such as mesoscopic (meso) and microsimulation (micro) models are suited for infrastructure testing. Meso and micro models use the forecast demand growth from strategic models rather than the absolute outputs; the absolute outputs are unlikely to match the actual volumes.

The strategic models applied to the Precinct (STM and STFM) used the travel zones as defined in **Figure 3-6**. The relationship between the STM and STFM in the broader transport modelling context is shown in **Figure 4-22**. While outputs from the STM have informed the STFM, the outputs from each of these models will not necessarily match. Each derivative model has a specific focus and benefits for assessment purposes.

Figure 4-22 Transport modelling context for STM and STFM



Source: Transport Strategy (TfNSW, May 2017)

4.5.1.1 Strategic Travel Model (STM)

The Strategic Travel Model (STM) was used to obtain forecast mode share splits and trip destinations over the AM peak period. The model incorporated planned transport network improvements (documented in **Section 4.3.1**) and the three development growth scenarios (documented in **Section 4.2.2**).

4.5.1.1.1 Mode share splits

The majority of trips to the Precinct are completed by private vehicle, and this is forecast to continue under all development scenarios in 2026 and 2036, but with a gradual decrease to 61 or 62 per cent depending on the growth scenario. There is a slight increase in active transport trips under all growth scenarios compared to the 2016 base, with a four per cent increase observed under the high growth scenario. The mode share splits for the two-hour AM peak period for the 2016 base year, 2026 and 2036 development scenarios are presented in **Table 4-13**.

Table 4-13 AM peak mode share splits – to the Precinct

Year	2016	2026	2026	2026	2036	2036	2036
Development scenario	**TZP2016**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Car Trips	69%	63%	63%	62%	62%	61%	61%
Bus Trips	3%	4%	4%	3%	4%	4%	3%
Rail Trips	9%	13%	12%	12%	13%	13%	12%
Walk / Cycle Trips	19%	21%	21%	23%	21%	22%	23%
Total Trips	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

For trips from the Precinct, the mode share of private vehicles is forecast to decrease from the 2016 level of 65 per cent to a minimum of 57 per cent under the medium and high growth scenarios in 2036. Bus mode share is anticipated to remain constant across all scenarios, while train mode share is expected to increase from 22 per cent to a maximum of 25 per cent in 2036. The greatest proportional mode share change is anticipated to occur in active transport, with growth from 12 per cent in 2016 to 17 per cent under the high growth scenario in 2036. The mode share splits for trips from the Precinct for the two-hour AM peak period for the 2016 base year, 2026 and 2036 development scenarios are presented in **Table 4-14**.

Table 4-14 AM peak mode share splits – from the Precinct

Year	2016	2026	2026	2026	2036	2036	2036
Development Scenario	**TZP2016**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Car Trips	65%	59%	59%	58%	58%	57%	57%
Bus Trips	2%	2%	2%	2%	2%	2%	2%
Rail Trips	22%	24%	24%	24%	25%	25%	25%
Walk / Cycle Trips	12%	15%	15%	16%	15%	16%	17%
Total Trips	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Transport Performance and Analytics (TPA)

4.5.1.1.2 Top trip origins and destinations

In the two-hour AM peak period in 2016, the top three origins to the Precinct for trips completed by all modes were from:

1. Sydney – South West;
2. Macquarie Fields – Glenfield; and
3. Ingleburn – Denham Court.

In 2026 and 2036, the top origins to the precinct have changed order when compared to the 2016 base case; however, they remain in the same order as follows under all three development scenarios:

1. Macquarie Fields – Glenfield;
2. Sydney – South West; and
3. Ingleburn – Denham Court.

Table 4-15 presents the top three origins and number of trips (for all modes) to the Precinct under the 2016 base case, and forecast 2026 and 2036 scenarios.

Table 4-15 AM peak top three origins – to the Precinct

	2016	2026	2026	2026	2036	2036	2036
Development scenario	**TZP2016**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Trips from Sydney - South West	820	2,049	2,253	2,353	2,992	3,411	3,516
Trips from Macquarie Fields - Glenfield	811	2,057	2,373	2,721	3,144	3,967	4,548
Trips from Ingleburn - Denham Court	302	562	601	626	736	822	844

Source: Transport Performance and Analytics (TPA)

In the two-hour AM peak period in 2016, the top three destinations of trips completed by all modes from the Precinct were:

1. Sydney – South West;
2. Macquarie Fields – Glenfield; and
3. Sydney – City and Inner South.

In 2026 and 2036, the top destinations have changed order only under the 2036 high growth scenario when compared to the 2016 base case. Under that scenario, the top destinations for trips from the Precinct are as follows:

1. Macquarie Fields – Glenfield;
2. Sydney – South West; and
3. Sydney – City and Inner South.

Table 4-16 presents the top three destinations and number of trips (for all modes) from the Precinct under the 2016 base case, and forecast 2026 and 2036 scenarios.

Table 4-16 AM peak top three destinations – from the Precinct

	2016	2026	2026	2026	2036	2036	2036
Development scenario	**TZP2016**	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
Trips to Sydney - South West	1,500	2,804	3,032	3,314	3,818	4,269	4,710
Trips to Macquarie Fields - Glenfield	891	2,138	2,455	2,830	3,246	4,098	4,771
Trips to Sydney - City and Inner South	540	1,170	1,303	1,471	1,732	2,051	2,337

Source: Transport Performance and Analytics (TPA)

4.5.1.2 Strategic Traffic Forecasting Model (STFM)

A total of 26 development scenarios were run as part of the STFM process, using population figures (residential and employment) supplied by DPIE. Two-hour peaks were modelled (AM and PM) across three target years (2016, 2026 and 2036). Land use and infrastructure in 2016 was selected for the base year scenario, followed by the low, medium and high growth scenarios (outlined in **Section 4.2.2**) for the 2026 and 2036 forecast years.

Within the low, medium and high growth scenarios, three different transport infrastructure layouts were considered. Each transport infrastructure has an east-west link to the north-west of the Precinct, linking the existing Glenfield Road rail overbridge with Campbelltown Road. The performance outputs obtained for each infrastructure option informed the road infrastructure recommendation and the year which implementation should be targeted (2026 or 2036). The scenarios considered were:

- Upgrade of Roy Watts Road to connect Glenfield Road to Campbelltown Road
- Extension of Cambridge Avenue from the eastern side of the railway line to Campbelltown Road (interim layout with one lane in each direction)

> Extension of Cambridge Avenue from the eastern side of the railway line to Campbelltown Road (full layout with two lanes in each direction).

The full Cambridge Avenue extension scenario provided acceptable network and intersection performance while accounting for access requirements to the development. The results presented in this report are from this scenario.

4.5.1.2.1 Travel times along key routes

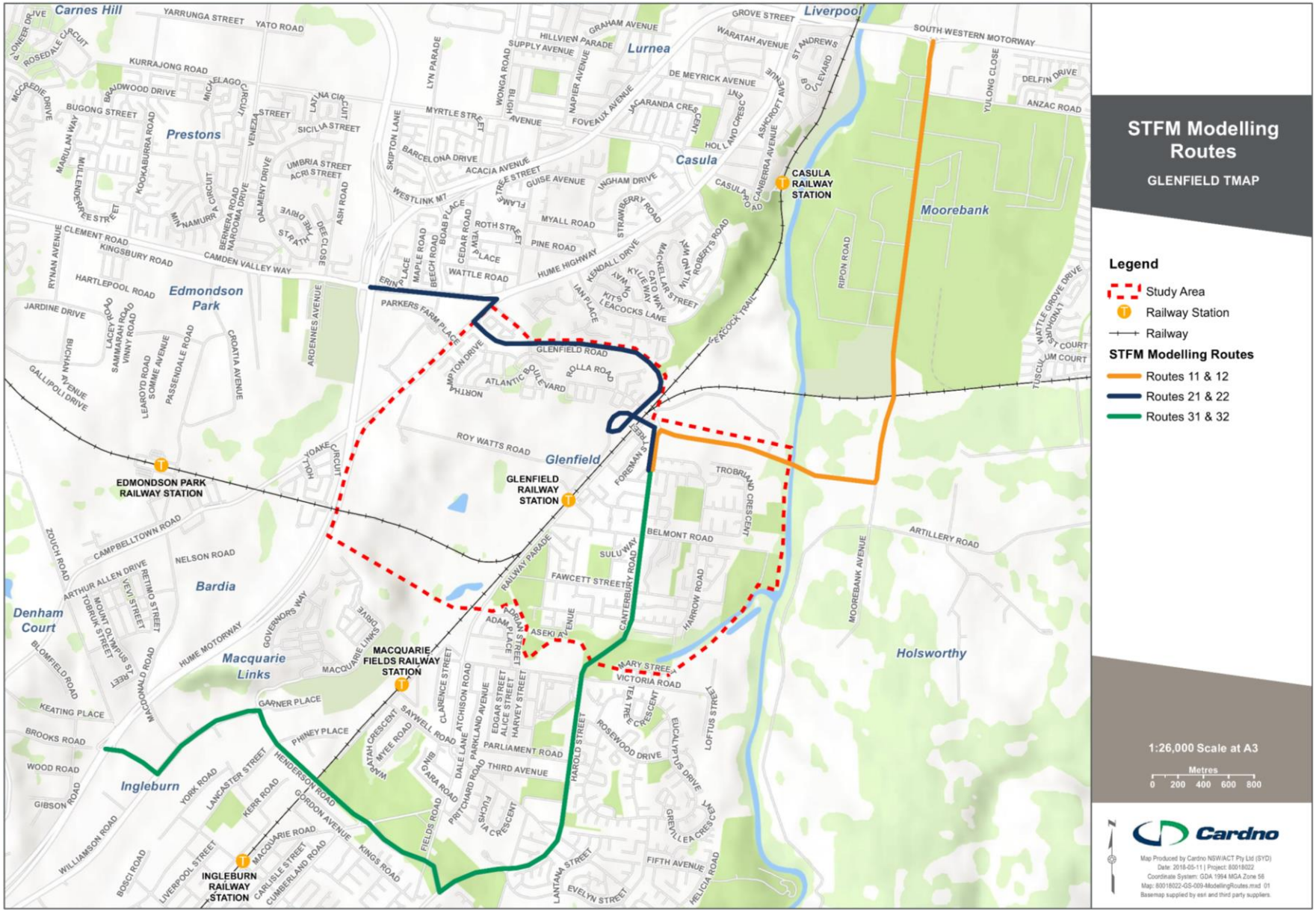
The impacts of the three infrastructure scenarios were assessed for each of the 2026 and 2036 land use scenarios (AM and PM peaks and Low, Medium and High growth scenarios). **Table 4-17** and **Figure 4-23** presents a summary of the routes assessed.

Table 4-17 Travel time assessment routes

Route number	Description of route
11	From Moorebank Ave/M5 via Moorebank Avenue, Cambridge Avenue, Canterbury Rd/Harrow Rd
12	Reverse of Route 11
21	From Camden Valley Way/M5 via Campbelltown Rd, Glenfield Rd, Canterbury Rd/Harrow Rd
22	Reverse of Route 21
31	From Brooks Rd/M31 via Williamson Rd, Henderson Rd, Harold St, Canterbury Rd/Harrow Rd
32	Reverse of Route 31

Source: TPA (2017)

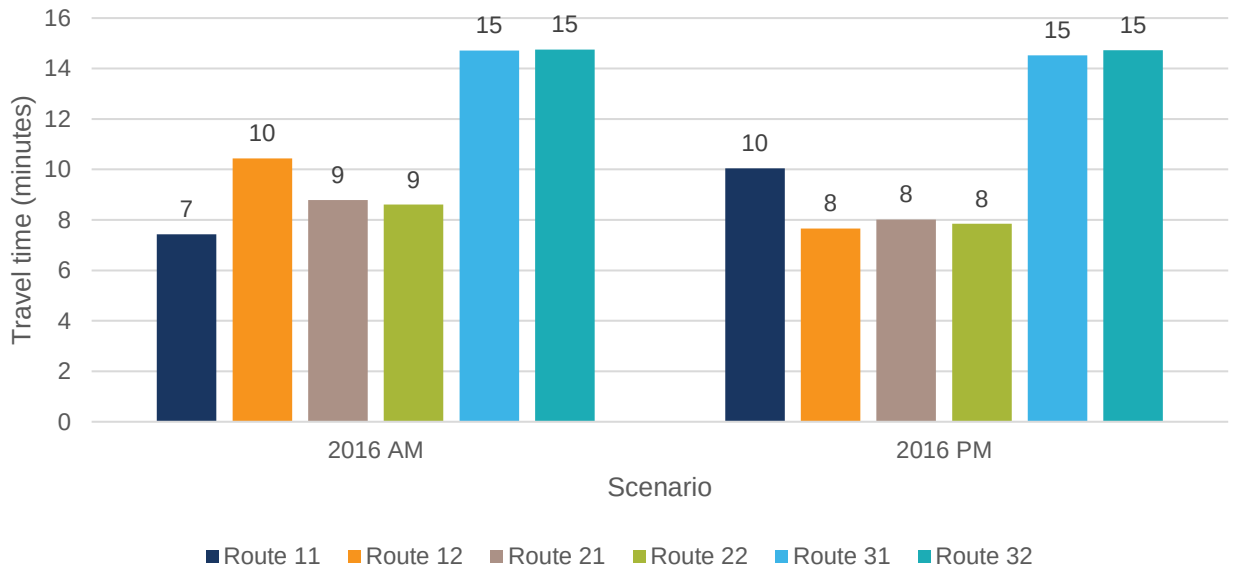
Figure 4-23 STFM modelling routes



Travel time comparison (2016)

Travel times in 2016 were comparable between the AM and PM peaks. The greatest variation in travel time was observed along routes 11 and 12 connecting the Precinct to the site of the future Moorebank Intermodal Terminal, with differences of three minutes and two minutes between the AM and PM peaks respectively. **Figure 4-24** presents the breakdown of travel time by route.

Figure 4-24 Travel times (minutes) – 2016 base case

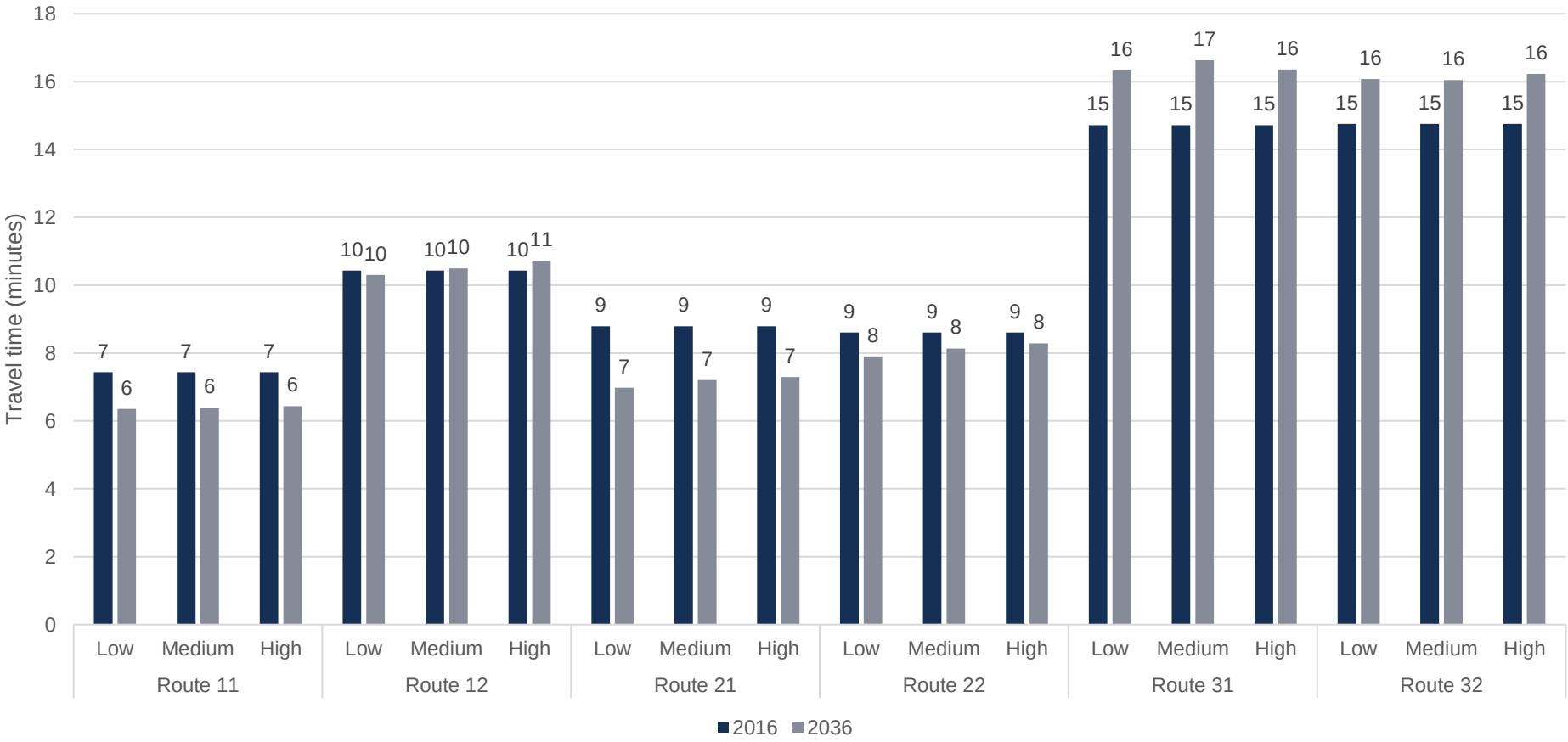


Data source: TPA (2017)

Travel time comparison by year

Travel times in minutes in the AM peak are shown in **Figure 4-25** for 2016 and 2036.

Figure 4-25 AM peak travel times (minutes) by year, route and growth scenario

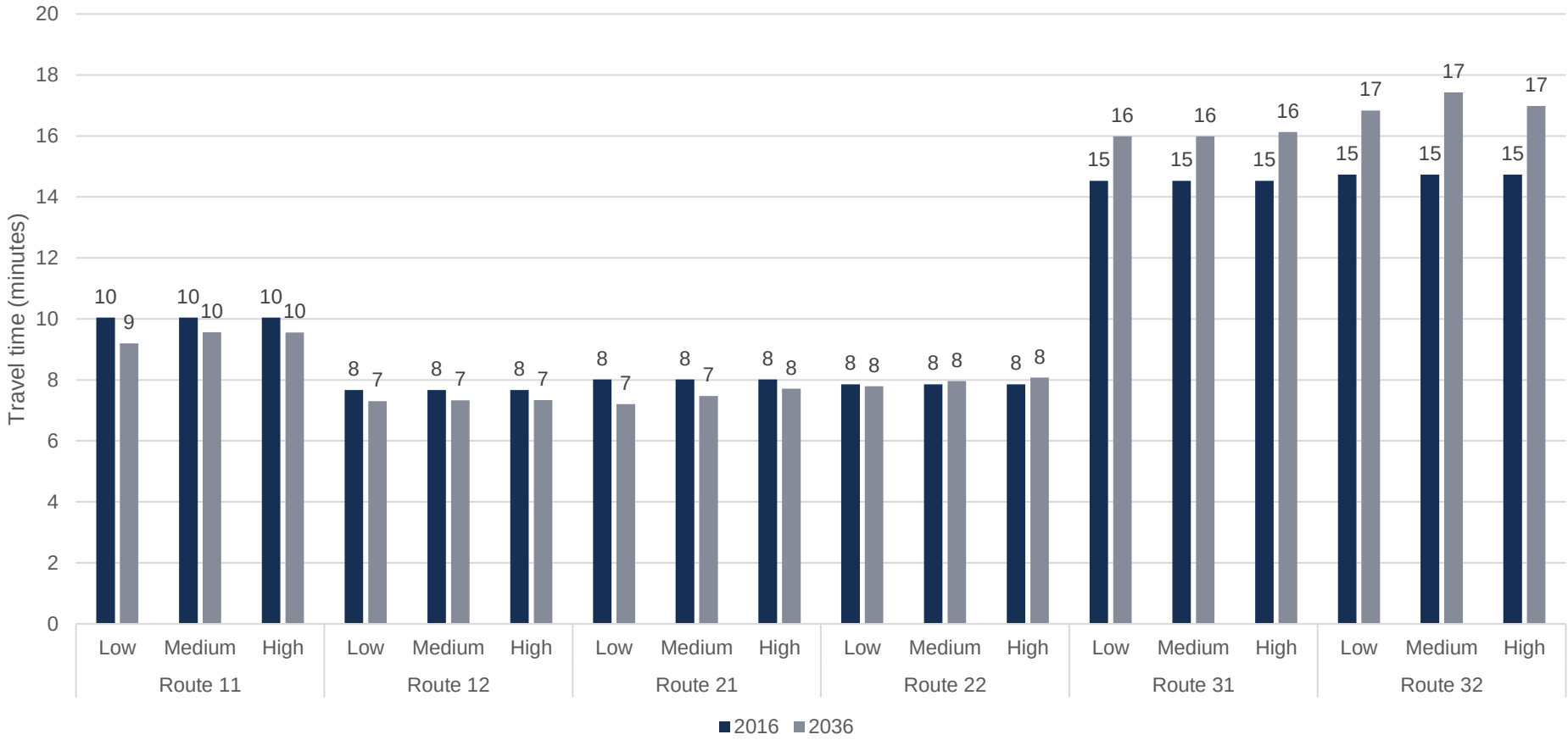


Data source: TPA (2017)
Note: 2016 was not modelled for the different infrastructure options; the outputs shown represent travel times assuming current infrastructure and are copied across for the purposes of comparison.

The Full Cambridge Avenue Extension provides travel time savings for three of the six routes (11, 21 and 22) with Route 21 observed to have a two-minute time saving between 2016 and 2036. By contrast, Routes 31 and 32 both record a one-minute increase in travel time, with the exception of Route 31 under the medium growth scenario where a two-minute increase is observed.

Travel times in minutes in the PM peak are shown in **Figure 4-26**.

Figure 4-26 PM peak travel times (minutes) by year, route and growth scenario



Data source: TPA (2017)
Note: 2016 was not modelled for the different infrastructure options; the outputs shown represent travel times assuming current infrastructure and are copied across for the purposes of comparison.

Travel times decrease between 2016 and 2036 for trips along Routes 11, 12 and 21 under all growth scenarios. Similar to the AM peak, increases are observed along Routes 31 and 32, ranging from one-minute for Route 31 and two minutes for Route 32 (for all growth scenarios). No change was recorded for Route 22.

4.5.1.2.2 Volume to capacity ratio – Glenfield Precinct

Volume to capacity (VC) ratios were created as part of the STFM modelling process. The ratio provides a proportional comparison of vehicular occupancy of each street in the road network to the nominated capacity at which the road is able to perform at an acceptable level of service. VC ratios range from zero (representing no occupancy and full available capacity) and 1 (representing full occupancy and no available capacity). A VC ratio exceeding 1 indicates that the assigned volume exceeds the available capacity.

VC ratios were obtained for all roads in the Precinct and related to the total vehicle hours travelled (VHT). The VC ratios were broken down into four level of service (LoS) ranges as presented in **Table 4-18**.

Table 4-18 Summary of volume to capacity ratio ranges

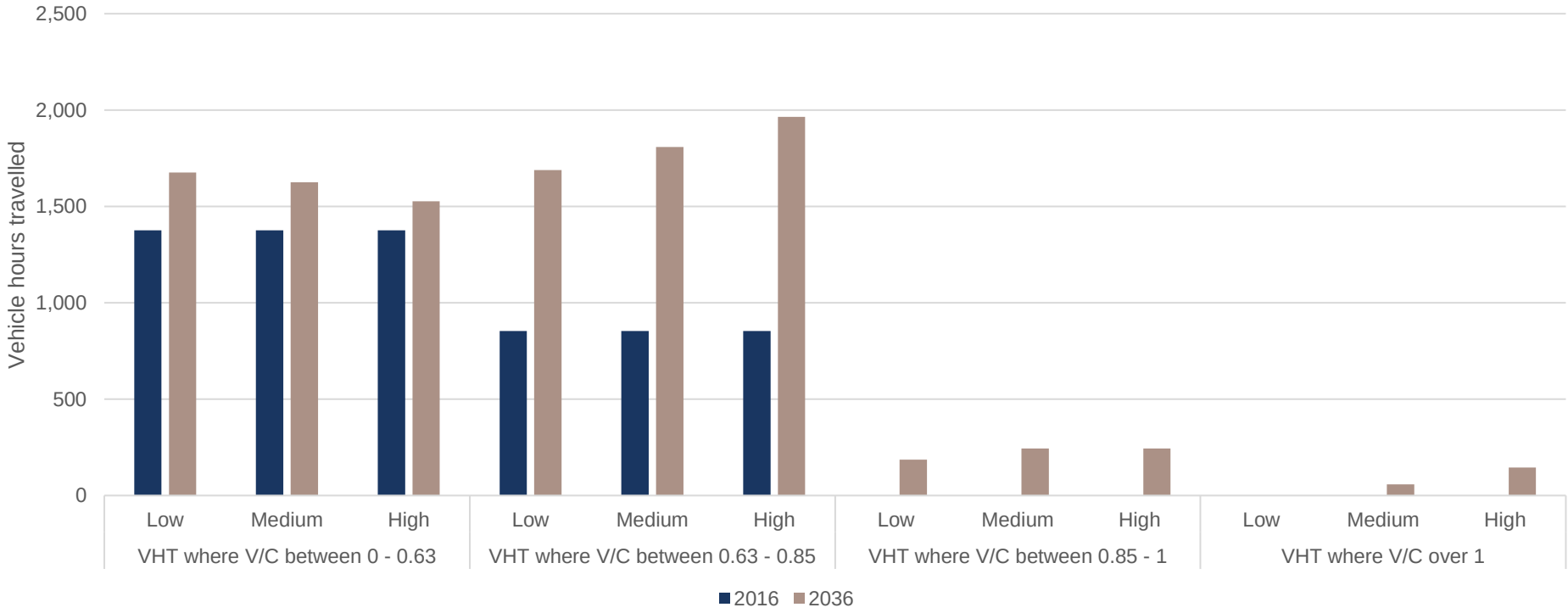
Level of Service	Description of performance indicator
A/B/C	Volume to Capacity Ratio less than 63%
D	Volume to Capacity Ratio greater than and equal to 63% and less than 85%
E	Volume to Capacity Ratio greater than and equal to 85% and less than 100%
F	Volume to Capacity Ratio greater than or equal to 100%

The total vehicle hours travelled within each of the four VC ratio ranges was obtained from the STFM modelling for 2036 AM and PM peaks.

VHT for V/C ratio comparison by year

VHT and corresponding V/C in the AM peak are shown in **Figure 4-27**.

Figure 4-27 AM peak vehicle hours travelled by year, volume-to-capacity ratio and growth scenario

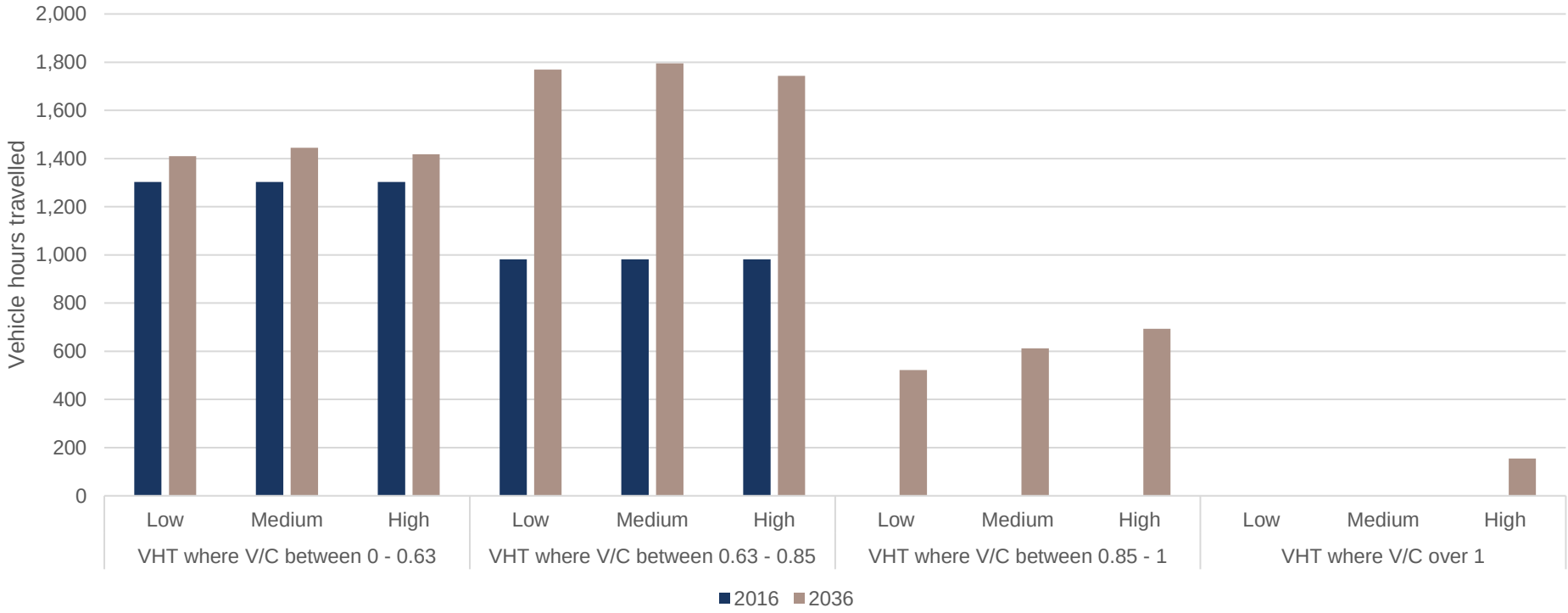


Data source: TPA (2017)

VHT where demand exceeds capacity only occurs under a medium or high growth scenario. Where V/C is reaching capacity (between 0.85 and 1), there is a difference of 58 VHT between the low and medium growth scenarios.

VHT and corresponding V/C in the PM peak are shown in **Figure 4-28**.

Figure 4-28 PM peak vehicle hours travelled by year, volume-to-capacity ratio and growth scenario



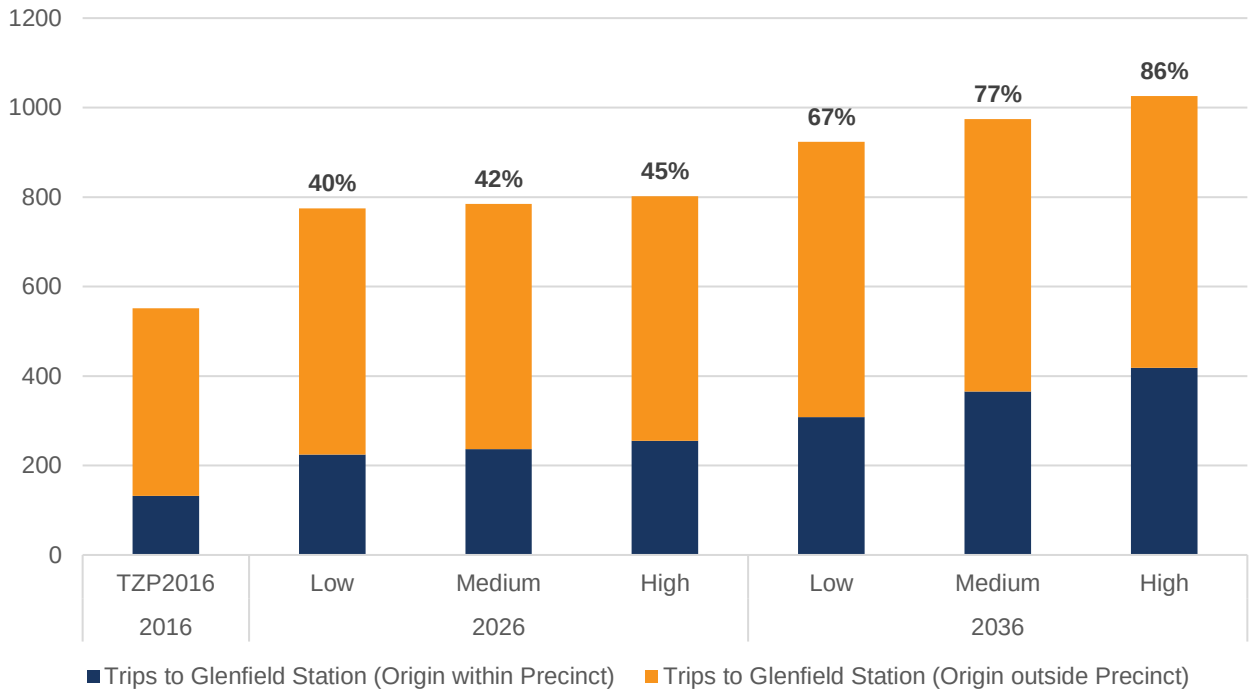
Data source: TPA (2017)

VHT where demand is reaching capacity (V/C between 0.85 and 1) is observed in 2036 under all growth scenarios, with a difference of 171 VHT between the low and high growth scenarios.

4.5.1.2.3 Commuter car parking demand at Glenfield Station

The quantum of vehicle trips accessing Glenfield Station from travel zones was extracted from the STFM for a two-hour AM peak from 7AM to 9AM, based on traffic count data taken on Railway Parade on the eastern side of Glenfield Station and the western access road. These volumes were used to determine potential commuter car parking demand across each of the land use development scenarios. The volumes are presented in **Figure 4-29**, broken down by the trip origin as either within the four travel zones representing the Precinct, or travel zones outside the Precinct.

Figure 4-29 Glenfield Station commuter car parking demand – 2-hour AM peak



Data source: TPA (2018). The percentages shown represent the proportional growth with respect to the 2016 trips.

Over a two-hour AM peak, the growth of total commuter car parking demand ranges from 40 to 45 per cent on 2016 volumes in 2026 (under the low to high growth scenarios respectively). The range increases to be between 67 and 86 per cent in 2036 under the same growth scenarios.

When considering trips originating from within the Precinct, the growth in trips ranges from 70 to 94 per cent in 2026, and between 134 to 217 per cent by 2036. This observed growth trend aligns with the population projections for the Precinct under each land use scenario, outlined in **Table 4-4**.

The STFM outputs indicate the commuter car park demand does not exceed the available supply of 950 spaces. Given the model is representative of a two-hour AM peak, it is likely that trips are made outside of this period which result in the demand reaching or exceeding capacity.

4.5.1.3 Strategic modelling: summary and considerations

- The vehicle hours travelled in the network with a VC ratio over 1 with the full Cambridge Avenue extension (high growth scenario) is 155, which represents less than four per cent of the total VHT. The vehicles hours travelled with a VC ratio over 1 for the low growth scenario is 0.
- A parking occupancy survey should be completed for the Glenfield Station commuter car park to confirm utilisation rates for different time-periods. This information can assist with decisions made to accommodate the future demand for commuter trips to and from the Glenfield Station interchange.
- Commuter car parking demand will generally grow proportionally with the resident population of the Precinct. Subject to a detailed parking occupancy survey of the Glenfield commuter car park, consider options to increase the parking supply proportionally, or investigation options to encourage mode shift to active and public transport through improved services and facilities connecting to the Glenfield Station interchange.

4.5.2 Mesoscopic modelling

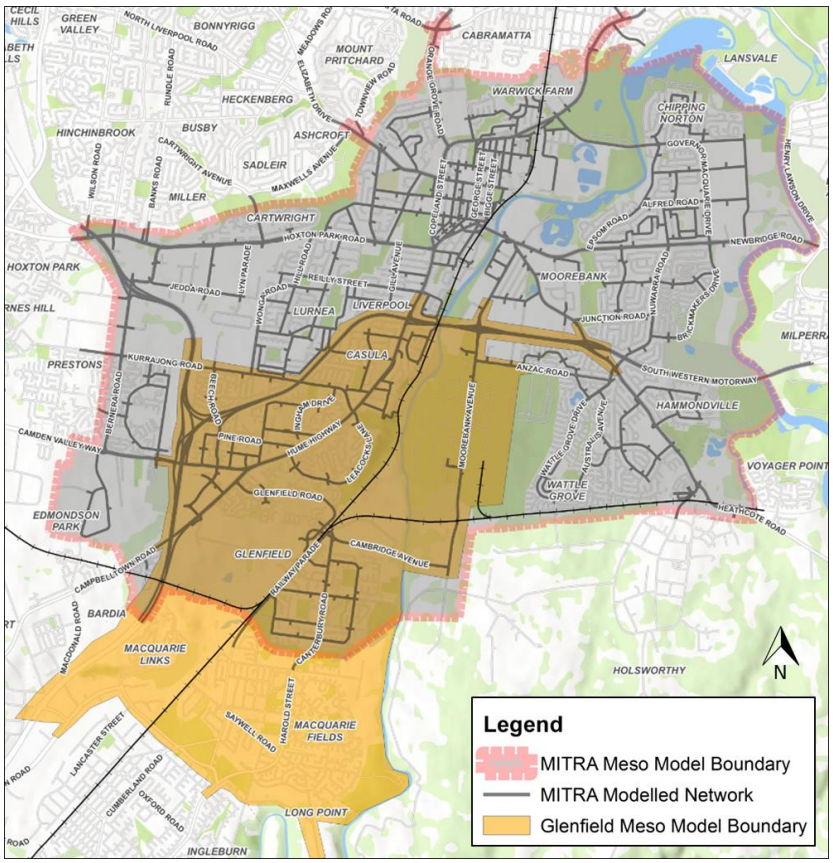
Mesoscopic traffic modelling seeks to bridge the gap between macroscopic (or strategic) modelling and dynamic micro-simulation modelling (typically at an intersection level). The function of mesoscopic modelling provides a dynamic traffic simulation framework that models the interactions of traffic in a manner similar to micro-simulation modelling, albeit at a lower level of detail.

This level of modelling will provide sufficient detail to determine the road network traffic statistics under proposed future land use scenarios and provides guidance on the need for further road infrastructure requirements. This provides more confidence than strategic models in relation to the modelled pattern of traffic, and a more realistic response to the delays and capacity constraints that would be experienced by traffic on a day-to-day basis.

As part of this stage, the Glenfield Precinct Mesoscopic Model (GPMM) was developed, using the Moorebank Intermodal Terminal Road Access Program Traffic Model (MITRA) as the parent model, which was developed by Roads and Maritime. The Precinct study area sits within this area, which extends from the M5 Motorway at Hammondville to the southern boundary at Macquarie Links. The expanded nature of the study area for this model is required to assess the broader impacts of the proposed development and land use scenarios on key corridors, including collector and arterial roads, in addition to assessing impacts on roads within the Precinct.

The GPMM and MITRA area boundaries are shown in **Figure 4-30**.

Figure 4-30 Glenfield Mesoscopic Model extents



Cardno developed a calibrated and validated Base Model using Aimsun. The Base Model was calibrated and validated to existing traffic conditions in 2016 for the AM and PM peak periods. The boundary of the traffic model, software platform and Base Model have been reviewed and endorsed by TfNSW and DPIE and considered ft for purpose of assessing the future performance of the network in and around Glenfield.

4.5.2.1 Scenarios tested

The calibrated and validated Base Model was used as the foundation to develop the future year traffic models. The future scenarios for the GPMM were based on the 2026 horizon year, and assume a medium land use growth plan is implemented in the Precinct. Details on the medium growth uplifts and forecasts are presented in **Section 4.2.2**. Two future scenarios were developed to assess the impacts of the following infrastructure assumptions, which are referred to as follows:

1. 2026 Do Minimum infrastructure model: extension to Roy Watts Road
2. 2026 Do Something infrastructure model: Interim Cambridge Avenue extension

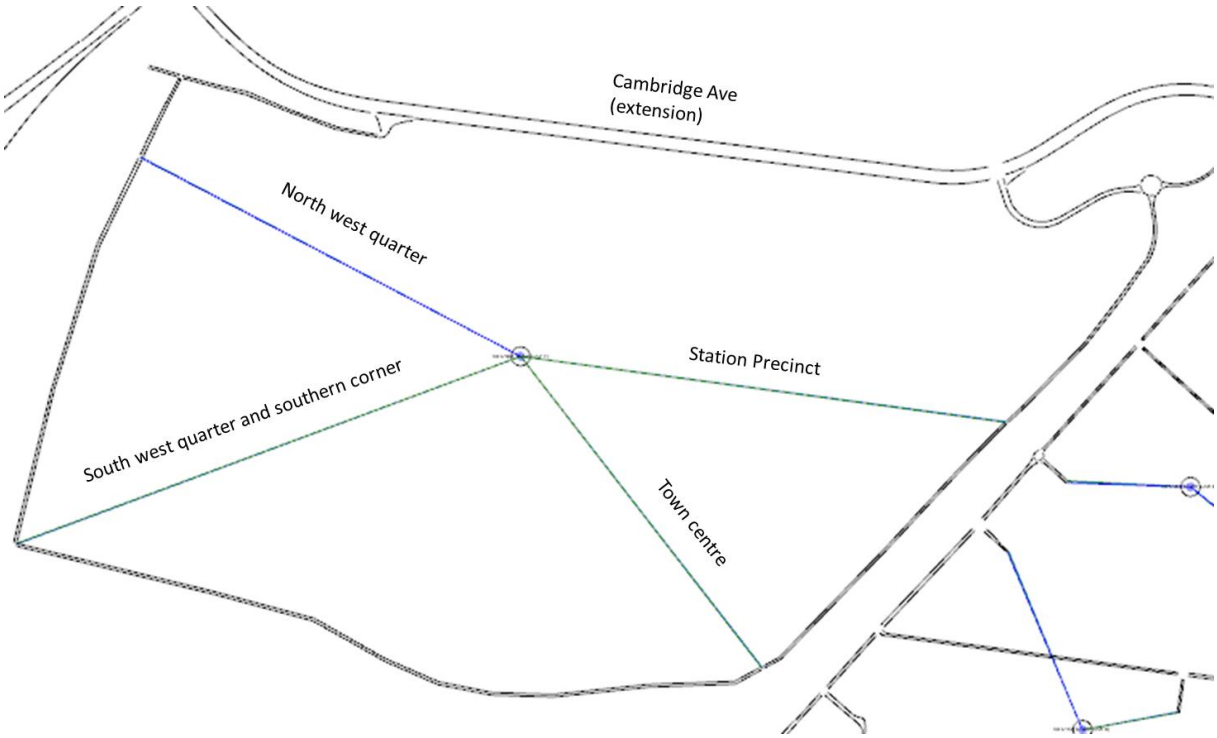
Subsequently, Cardno was engaged by DPIE to test an additional mesoscopic modelling scenario:

3. 2026 Do Ultimate infrastructure model: Ultimate Cambridge Avenue extension.

The Do Ultimate scenario includes the provision of two access points on the Cambridge Avenue extension, four internal access points for the development off Cambridge Avenue extensions, upgrading Cambridge Avenue extension to three lanes each way and the intersections with Beech Rd / Campbelltown Road and Canterbury Road / Railway Parade. The extension to Roy Watts Road (Do Minimum scenario) is not included in the Do Ultimate as it is not required with the full Cambridge Avenue extension. These changes are shown in **Figure 4-31**. The results of this scenario are presented in this report.

As changes to land use were minimal between the Do Something and Do Ultimate scenarios, the 2026 Do Ultimate scenario adopts the same forecast traffic demand as the 2026 Do Something scenario. This methodology was endorsed by TfNSW and DPIE

Figure 4-31 2026 Do Ultimate scenario infrastructure changes



4.5.2.2 Network results

The network link results present the results of the mesoscopic modelling along each of the road links prepared in the GPMM. The results are presented on density heat-maps for the following metrics:

- Traffic density: Presents the average number of vehicles per kilometre along each road link in the GPMM. Plotted on density heat-maps in vehicles per kilometre (along a colour-coded range).
- Speed ratio: Provides a comparison of the average speeds experienced by vehicles in the model against the posted speed limits. These allow for the identification of areas of severe congestion patterns along the road corridors. Speed ratios above 0.4 (or travel speeds at least 40 per cent of the posted speed limit represent a Level of Service of C and are considered acceptable). Plotted on density heat-maps as a ratio between zero and one (along a colour-coded range).

4.5.2.2.1 Traffic density

2026 AM peak

In the 2026 AM peak, the overall network capacity was determined to be sufficient for the modelled demand, which was 75,468 vehicles. Of these, there was a latent demand of 542 vehicles.The latent demand corresponds to the number of vehicles unable to enter the network for the modeled period as a result of congestion. For this model, the latent demand is within an acceptable range for the overall network capacity to meet the modelled demand.

2026 PM peak

In the 2026 PM peak, the overall network capacity was determined to be sufficient for the modelled demand, which was 79,404 vehicles. Of these, there was a latent demand of 887 vehicles. The latent demand is within an acceptable range for the overall network capacity to meet the modelled demand.

Density heat-maps representing the traffic density in the 2026 AM and PM peaks are presented in **Figure 4-32**. These include observations on congestion issues and their respective locations.

Figure 4-32 Simulated density in the 2026 Do Ultimate weekday AM and PM peaks

2026 Do Ultimate AM peak

Observations – Modelling area

Congestion was observed in the following locations:

- M5 Motorway eastbound – a simulated density of more than 80 vehicles per kilometre was observed due to weaving movements between the interchanges with the Hume Highway and Moorebank Avenue. Congestion decreases to 40 vehicles per kilometre beyond the Kurrajong Road overpass.
- Holston Street westbound – on approach to the Hume Highway intersection (more than 80 vehicles per kilometre).
- Leacocks Lane northbound – both approaches to the Hume Highway intersection (more than 80 vehicles per kilometre).
- Beech Road and Camden Valley Way intersection – southbound and eastbound approaches (more than 40 vehicles per kilometre).
- Campbelltown Road and Hume Highway intersection – northbound and westbound approaches (more than 40 vehicles per kilometre).
- Glenfield Road and Campbelltown Road intersection – southbound and north-westbound approaches (more than 40 vehicles per kilometre)

Observations – Glenfield Precinct

Roads in the Precinct are operating at an acceptable density, with most operating at less than ten vehicles per kilometre, including Cambridge Avenue westbound. Congestion was observed in the following locations:

- Cambridge Avenue eastbound– up to 30 vehicles per kilometre.

Glenfield Road northbound approach to Cambridge Avenue intersection – up to 20 vehicles per kilometre.

2026 Do Ultimate PM peak

Observations – Modelling area

Congestion was observed in the following locations:

- M5 Motorway westbound – a simulated density of more than 80 vehicles per kilometre was observed to begin at the Moorebank Avenue interchange and extending east beyond the modelling boundary due to weaving movements between the interchanges with Moorebank Avenue and Heathcote Road.
- Moorebank Avenue and Heathcote Road on-ramps to the M5 Motorway (more than 80 vehicles per kilometre).
- Holston Street westbound – on approach to the Hume Highway intersection (more than 80 vehicles per kilometre).
- Lancaster Street and Henderson Road roundabout – south eastbound and north eastbound approaches (up to 80 vehicles per kilometre).
- Brooks Road and Williamson Road roundabout – south eastbound and south westbound approaches.

Observations – Glenfield Precinct

Roads in the Precinct are operating at an acceptable density, with most operating at less than ten vehicles per kilometre, including Glenfield Road eastbound. Congestion was observed in the following locations:

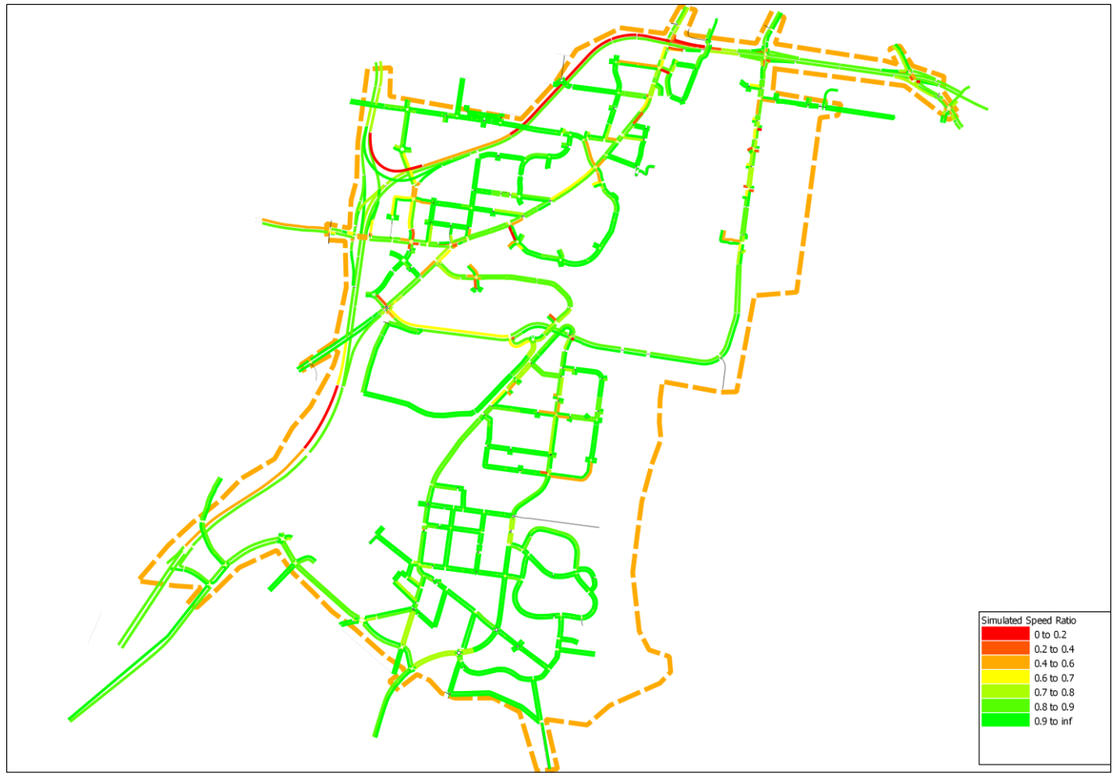
- Glenfield Road northbound approach to Campbelltown Road intersection – up to 30 vehicles per kilometre.

4.5.2.2.2 Speed ratio

Density heat-maps representing the speed ratio in the 2026 AM and PM peaks are presented in **Figure 4-33**. These include observations on congestion issues and their respective locations.

Figure 4-33 Simulated speed ratio in the 2026 weekday Do Ultimate AM and PM peak

2026 Do Ultimate AM peak



Observations – Modelling area

The majority of roads in the modelling area have observed speed ratios of 0.8 or higher. Areas of prolonged congestion include:

- M5 Motorway westbound – starting at the Moorebank Avenue interchange and extending back to the interchange with Heathcote Road and beyond (speed ratios less than 0.2).
- Heathcote Road and Moorebank Avenue on-ramps to the M5 Motorway westbound.
- Anzac Road westbound as an extension of congestion on the westbound M5 Motorway on-ramp.
- Localised areas on intersection approaches, including:
  - Beech Road and Camden Valley Way
  - Leacocks Lane and Hume Highway
  - Holston Street and Hume Highway

Observations – Glenfield Precinct

The majority of roads in the Precinct have observed speed ratios of 0.8 or higher. Areas of prolonged congestion include:

- Roy Watts Road and Beech Road approach to Campbelltown Road intersection.
- Old Glenfield Road approach to Glenfield Road intersection.
- Atlantic Boulevard approach to Glenfield Road intersection.
- Harrow Road eastbound approach to Canterbury Road intersection.

2026 Do Ultimate PM peak

Observations – Modelling area

The majority of roads in the modelling area have observed speed ratios of 0.8 or higher. Areas of prolonged congestion include:

- M5 Motorway westbound – starting at the Moorebank Avenue interchange and extending back to the interchange with Heathcote Road and beyond (speed ratios less than 0.2).
- Heathcote Road and Moorebank Avenue on-ramps to the M5 Motorway westbound.
- Localised areas on intersection approaches, including:
  - Beech Road and Camden Valley Way
  - Leacocks Lane and Hume Highway
  - Holston Street and Hume Highway

Observations – Glenfield Precinct

The majority of roads in the Precinct have observed speed ratios of 0.8 or higher. Areas of prolonged congestion include:

- Beech Road approach to Campbelltown Road intersection.
- Old Glenfield Road approach to Glenfield Road intersection.
- Atlantic Boulevard approach to Glenfield Road intersection.
- Harrow Road eastbound approach to Canterbury Road intersection.

4.5.2.3 Mesoscopic modelling: summary and considerations

- The areas of poorest performance observed in the models, corresponding to increased congestion and delays, occur outside of the Precinct boundaries and along the major road corridors where demand is expected to be highest (M5 Motorway, Hume Highway and Camden Valley Way).
- In the AM peak, weaving movements along the M5 Motorway between the Moorebank Avenue and Hume Highway interchanges is identified as an issue that has flow-on effects for both the Motorway and immediate surrounding roads.
- In the PM peak, congestion is concentrated along the M5 Motorway eastbound between the Moorebank Avenue and Heathcote Road interchanges.
- The completion of the Moorebank Intermodal Terminal and associated vehicle movements is more likely to result in congestion and delays around the M5 Motorway interchanges rather than along Cambridge Avenue and Glenfield Road within the Precinct.
- Within the Precinct, the majority of roads south of the Cambridge Avenue corridor continue to exhibit an acceptable performance.
- The Cambridge Avenue extension is likely to result in a balancing of vehicle movements in the east-west direction, as there is a choice between Cambridge Avenue and Glenfield Road. This causes a reduction in congestion along Glenfield Road.
- Areas exhibiting poor performance in traffic density and speed ratio are primarily located at intersections.

4.5.3 SIDRA intersection analysis

An intersection analysis was completed for seven intersections within and around the Precinct. This drew upon traffic volumes observed as part of the mesoscopic modelling process, summarised in **Section 4.5.2**. The traffic volumes were extracted from the Do Ultimate Aimsun scenario. The purpose of the intersection analysis process was to confirm the performance of key intersections, and test the implementation of mitigation measures to improve the intersection's capacity.

4.5.3.1 Intersection performance analysis criteria

In an urban area, the capacity of a road network is largely determined by the capacity of the controlling intersections. The intersection operating performance was assessed using the SIDRA software package to determine the Level of Service (LoS) and Degree of Saturation (DoS).

A key indicator of intersection performance is LoS, where results range from 'A' to 'F' as shown in **Table 4-19**. The Average Vehicle Delay (AVD) provides a measure of the operational performance of an intersection and determines the LoS when applying the methodology developed by Roads and Maritime Services. AVD's should be taken as a guide only as longer delays could be tolerated in some locations (i.e. inner-city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route). For traffic signals, the weighted average delay over all movements should be utilised. For roundabouts and priority control intersections (sign control), the critical movement for assessing LoS should be the movement with the highest average delay.

The Degree of Saturation (DoS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals, both queue length and delay increase rapidly as DoS approaches 1.0. It is usual to attempt to keep DoS to less than 0.9. DoS in the order of 0.7 generally represent satisfactory intersection operation. When DoS exceeds 0.9, queues can be anticipated.

Table 4-19 Intersection Level of Service (LoS) and Degree of Saturation (DoS)

Level of Service	Traffic conditions at signalised / roundabout intersections	Degree of Saturation	Theoretic road capacity used, 1 = 100%
A	Good operation.	**A**	Less than 0.6
B	Good operation with acceptable delays and spare capacity.	**B**	0.6 – 0.7
C	Satisfactory operation.	**C**	0.7 – 0.8
D	Operating near capacity.	**D**	0.8 – 0.9
E	At capacity. Incidents at signalised intersections will cause excessive delays.	**E**	0.9 – 1.0
F	Unsatisfactory operation and requires additional capacity. Roundabout intersections would require another control mode.	**F**	>1.0

4.5.3.2 Assessment of intersection layouts

Initially, five intersections were considered in the SIDRA analysis:

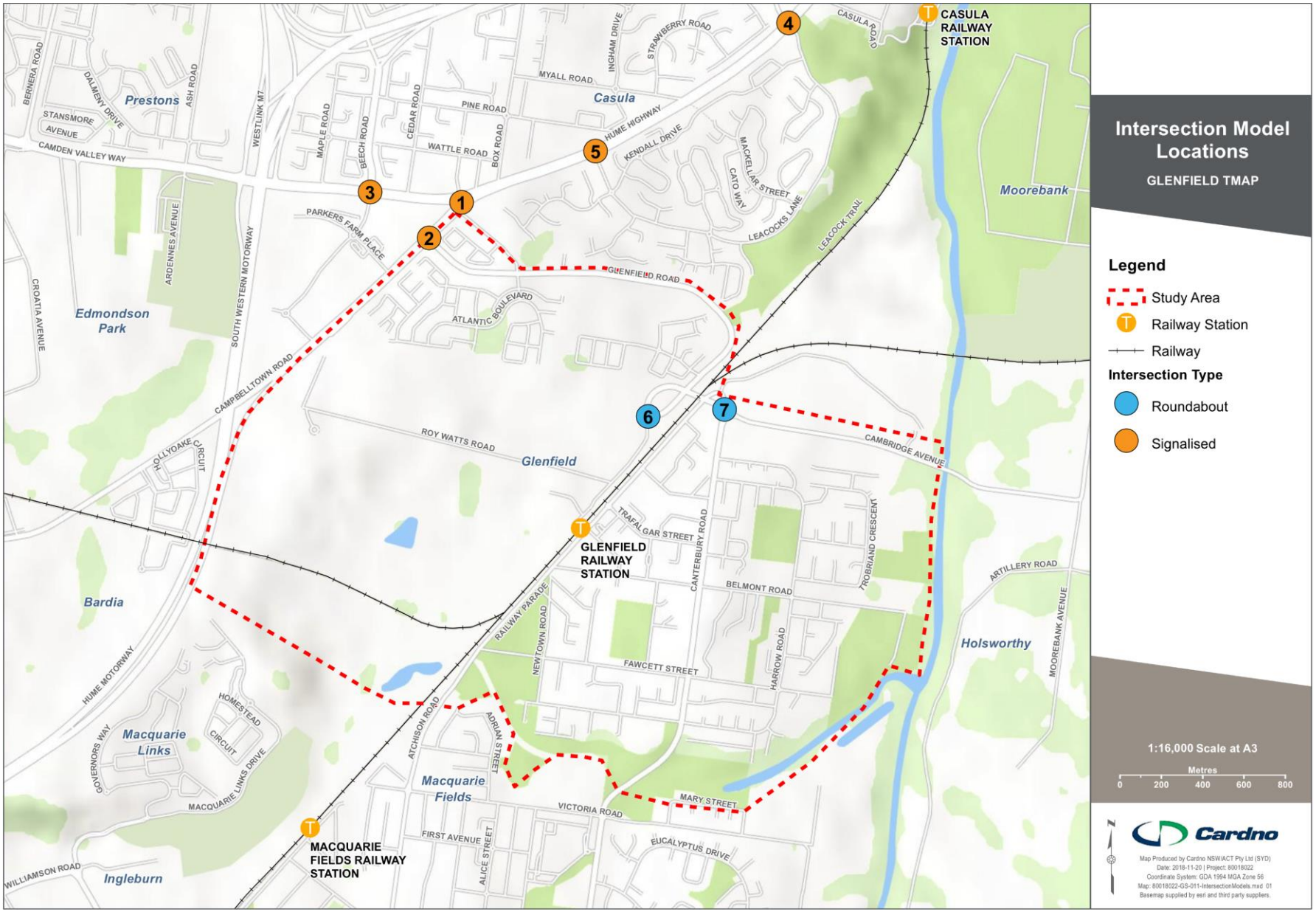
1. Campbelltown Road and Hume Highway;
2. Glenfield Road and Campbelltown Road;
3. Beech Road and Camden Valley Way;
4. Leacocks Lane (North) and Hume Highway; and
5. Leacocks Lane (South) and Hume Highway.

Following a review of the mesoscopic modelling results by Roads and Maritime Services, two additional intersections of concern were identified and included in this assessment:

6. Glenfield Road and Cambridge Avenue roundabout; and
7. Glenfield Road and Railway Parade roundabout.

The locations of these seven intersections with respect to the mesoscopic modelling area and Precinct boundaries is shown in **Figure 4-34**.

Figure 4-34 Intersections modelled in SIDRA micro-simulation software



4.5.3.3 Intersection performance results

The results of the intersection assessment are presented below. Detailed movement summaries generated by SIDRA for the seven intersections investigated are provided in **Appendix A**.

Table 4-20 2026 Do Ultimate intersection performance results

Intersection	Intersection type	Layout	AM Peak		PM Peak	
			DoS	LoS	DoS	LoS
Hume Highway / Campbelltown Road	Signalised	Existing	1.084	D	0.879	B
Campbelltown Road / Glenfield Road	Signalised	Existing	0.918	C	0.864	B
Camden Valley Way / Beech Road	Signalised	Existing	0.904	C	0.882	C
Hume Highway / Leacocks Lane (north)	Signalised	Existing with upgrades	0.973	D	1.130	D
Hume Highway / Leacocks Lane (south)	Signalised	Existing	0.906	C	0.910	C
Glenfield Road / Cambridge Avenue	Roundabout	Existing	0.575	A	0.741	A
Glenfield Road / Railway Parade	Signalised	Upgraded to signals	0.934	C	0.823	C

The intersections for which upgrades were suggested are outlined in greater detail below.

4.5.3.3.1 Leacocks Lane, Hume Highway and Kurrajong Road

The intersection of Leacocks Lane, Hume Highway and Kurrajong Road was identified as a pinch point in the mesoscopic model for the AM peak. In 2026, there was an increase observed in demand for the right turn movement, from Leacocks Lane into the Hume Highway (from 208 movements to 415 movements in the AM peak). The suggested mitigation measures involve a reconfiguration of the intersection layout to:

- Extend the right-hand turn lane from Leacocks Lane from 15 metres to 100 metres;
- Introduction of a new signal phase F3 that increases the allocated time to allow for right-turn movements from Leacocks Lane and Kurrajong Road; and
- Changed phase timings.

A diagrammatic summary of the current and proposed intersection layout is shown in **Figure 4-35**. A diagrammatic summary of the signal phase arrangement with new phase F3 is shown in **Figure 4-36**.

Figure 4-35 Leacocks Lane, Hume Highway and Kurrajong Road intersection layout – current (left) and proposed (right)

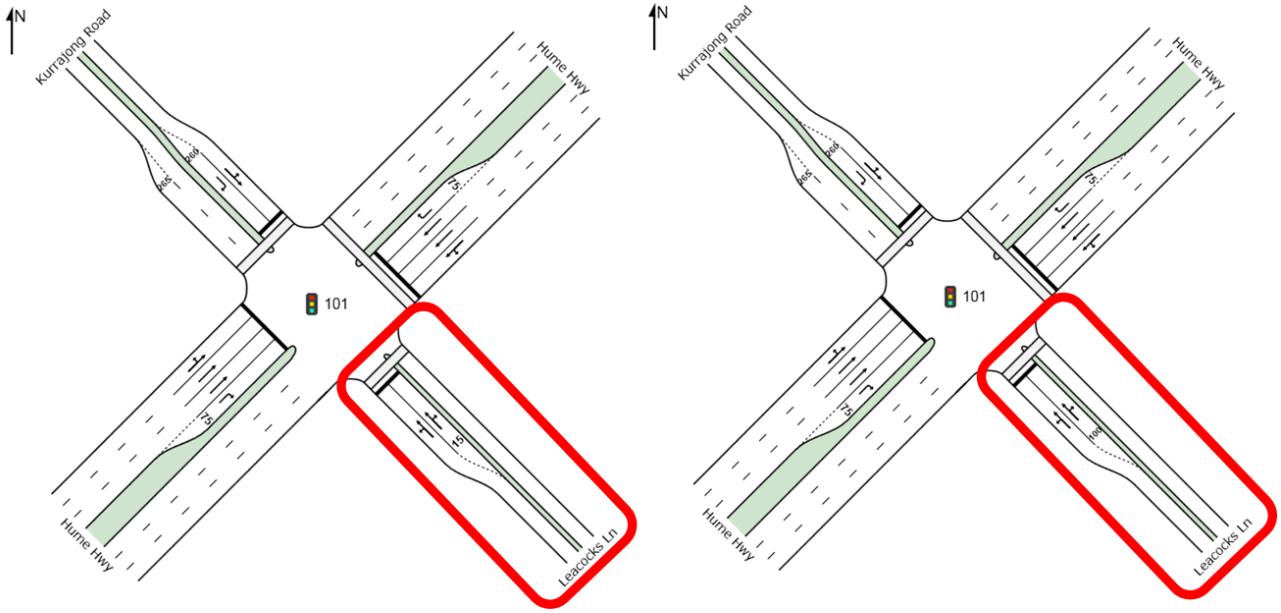
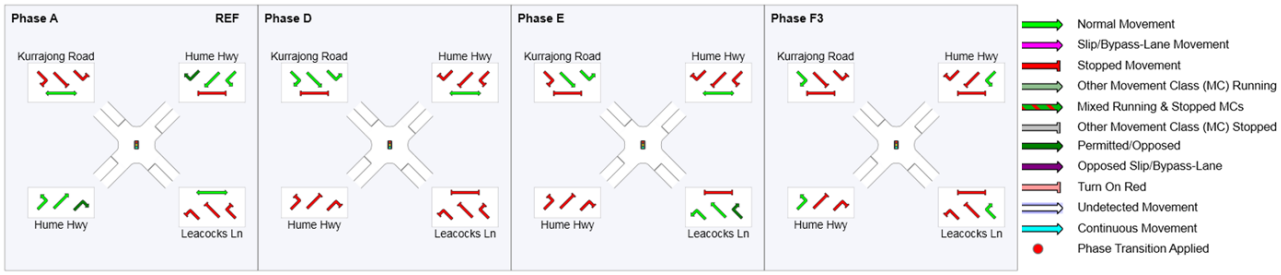


Figure 4-36 Leacocks Lane, Hume Highway and Kurrajong Road – signal phasing with new F3 phase



An assessment was completed in SIDRA using SCATS data and a summary of the LoS and DoS results is presented in **Table 4-21**.

Table 4-21 Leacocks Lane, Hume Highway and Kurrajong Road – 2026 intersection performance results

Scenario	Intersection type	DoS	LoS
Do Ultimate (AM Peak)	Signalised	0.973	D

The results indicate that the intersection operates satisfactorily with the development scenario traffic and the proposed mitigation measures.

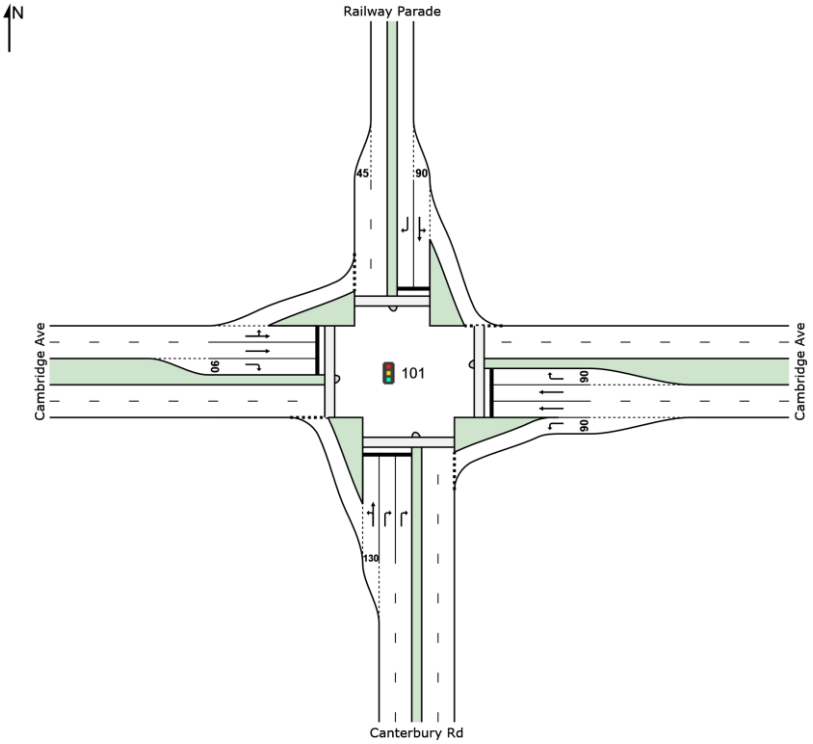
4.5.3.3.2 Glenfield Road, Canterbury Road and Cambridge Avenue

The intersection of Glenfield Road, Canterbury Road and Cambridge Avenue exhibited poor performance in the AM peak. In 2026, there was an increase observed in demand for the left turn movement, from Railway Parade to Cambridge Avenue (from 266 movements to 496 movements in the AM peak).

The upgrade of the intersection to traffic signals is required to accommodate the upgrade of Cambridge Avenue extension to three lanes each way in the Do Ultimate scenario.

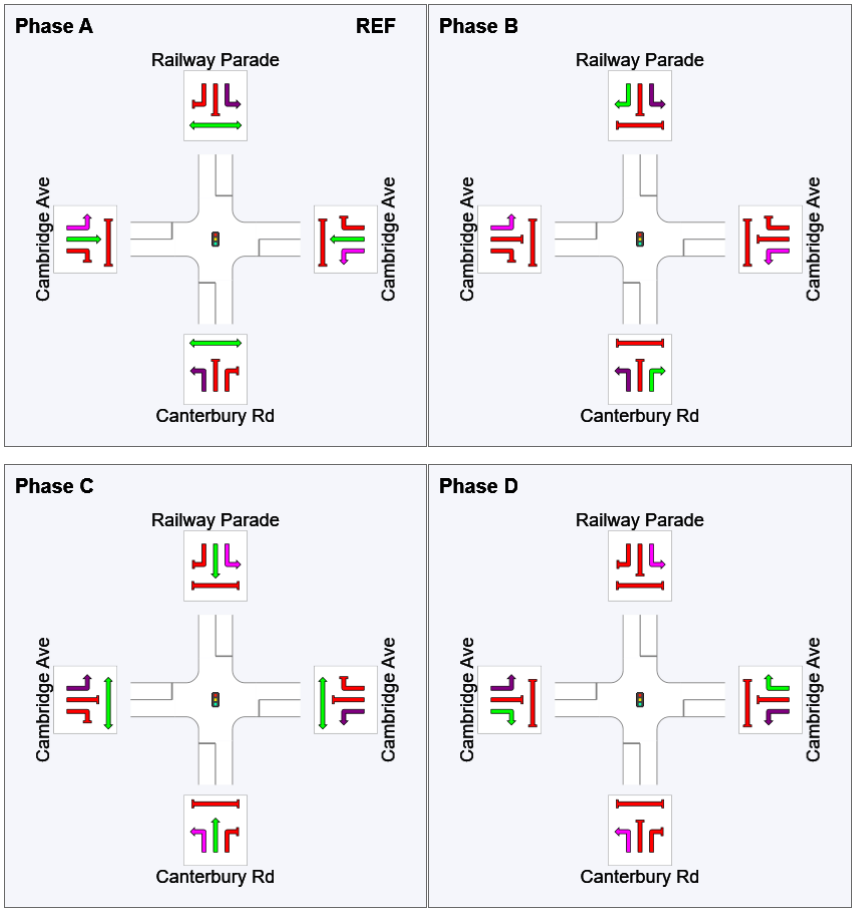
A diagrammatic summary of the proposed intersection layout for Option 3 is shown in **Figure 4-37**.

Figure 4-37 Glenfield Road, Canterbury Road and Cambridge Avenue layout – Option 3



The traffic signal phasing plan is shown in **Figure 4-38**. A cycle time of 80 seconds and 140 seconds was adopted for the AM and PM peak respectively.

Figure 4-38 Glenfield Road, Canterbury Road and Cambridge Avenue signal phasing summary – Option 3



The results of the intersection assessment following implementation of Option 3 are presented in **Table 4-22.**

Table 4-22 Glenfield Road, Canterbury Road and Cambridge Avenue – 2026 intersection performance results

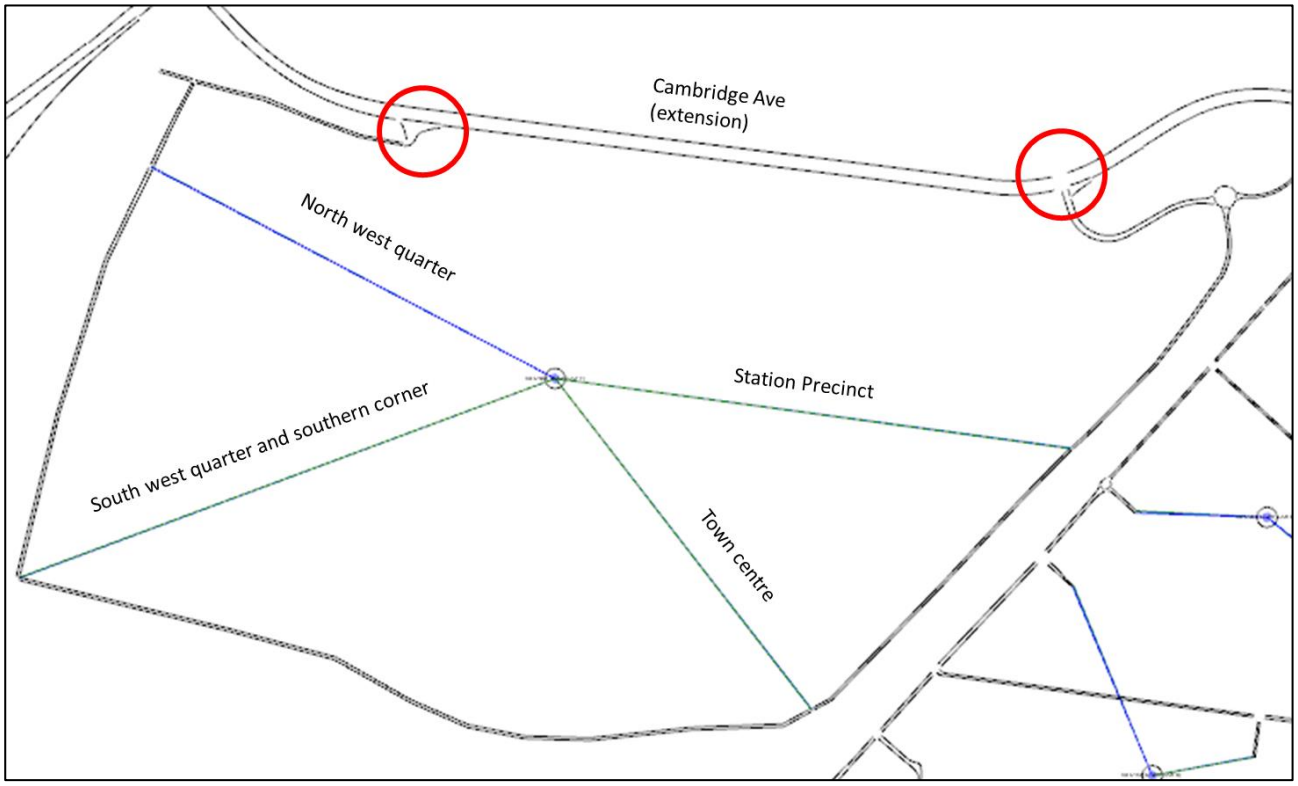
Scenario	Intersection type	DoS	LoS
Do Ultimate (AM Peak)	Traffic signals	0.934	C
Do Ultimate (PM Peak)		0.823	C

The results show the intersection performs satisfactorily with a LoS C or better.

4.5.3.4 Cambridge Avenue extension Western and Eastern Access intersections

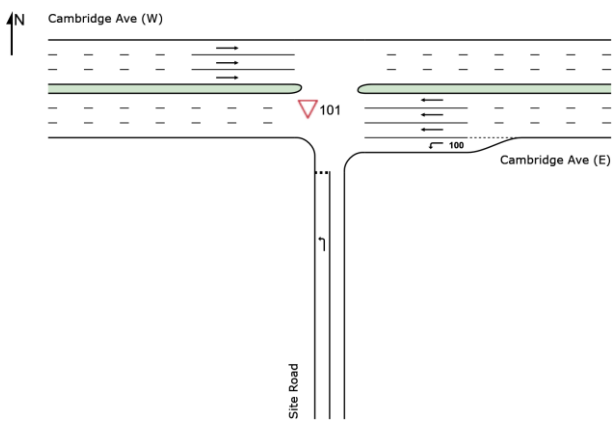
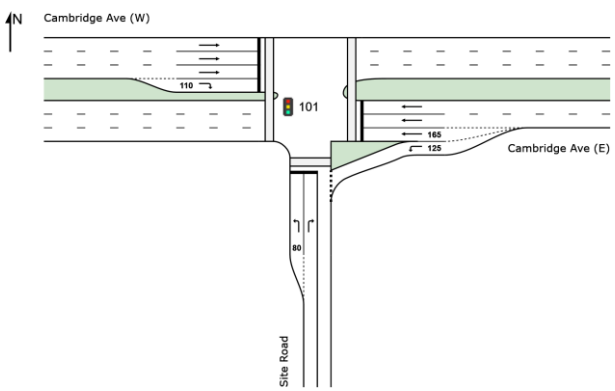
As part of the Do Ultimate scenario, Cardno assessed the two proposed access intersections on the Cambridge Avenue extension as circled in red in **Figure 4-39**.

Figure 4-39 Western and Eastern Access intersections on the Cambridge Avenue extension



A diagrammatic summary of the proposed intersection layouts for the two accesses are shown in **Figure 4-40**.

Figure 4-40 Western and Eastern Access intersection layouts

Western Access	Eastern Access
	

The results of the intersection assessment are presented in **Table 4-23**.

Table 4-23 Glenfield Road, Canterbury Road and Cambridge Avenue – 2026 intersection performance results

Scenario	Type of intersection	AM Peak		PM Peak	
		DoS	LoS	DoS	LoS
Western Access	Priority	0.542	A	0.287	A
Eastern Access	Traffic signals	0.487	C	0.440	B

The results show the proposed access intersections perform satisfactorily with a LoS C or better.

4.5.3.5 SIDRA intersection analysis: summary and considerations

- Intersections identified as pinch points in the mesoscopic model were verified to be performing satisfactorily following the SIDRA analysis. This is due to SIDRA and SCATS capability in programming variable signal phases and adapting to provide the optimal phase and timing arrangements depending on the traffic demand scenarios. Any changes proposed to the phases and timings should be investigated and coordinated with Roads and Maritime Services.
- Subject to further analysis and design progression, adjustments to the layouts of the Leacocks Lane/Hume Highway/Kurrajong Road and Glenfield Road/Canterbury Road/Cambridge Avenue intersections will yield improvements to the overall intersection performance.
- The modelling results of the proposed access intersections on Cambridge Avenue extension and the upgrade of the Glenfield Road, Canterbury Road and Cambridge Avenue intersection to traffic signals showed that they would perform satisfactorily.

4.6 Recommendations

Table 4-24 provides a modal-based summary of the recommended considerations and initiatives for the future transport network required to support the planned development uplift in the Precinct. These outcomes follow the assessment of:

> The future land use scenarios and their impact on future mode share and the road network performance;

> Government policy and strategies for precinct and land use planning, and their interface with future transport projects (both committed and proposed); and

> The performance of the existing private and public transport network using available data.

Table 4-24 Summary of recommendations

Mode	Recommendations
Walking	▪ Provide footpath facilities on both sides of all roads (new and existing). ▪ Designating separate areas for through movements and pedestrian dwelling in areas with mixed land uses. ▪ Activating frontages along higher order streets to encourage pedestrian activity and passive surveillance. ▪ Provide improved east-west connectivity across the railway line, to link existing communities and facilities with new communities and facilities, including new active open spaces. ▪ Investigating new crossing facilities at locations with high crash rates that prioritise pedestrian movements.
Cycling	▪ Designating routes that are direct connect to key destinations (such as Liverpool as the nearest Metropolitan Cluster to the Precinct) and consider the topography of the environment. ▪ Designing facilities that improve safety for users, including separation from vehicles and pedestrians, both along the mid-blocks and at intersections. ▪ Provide clearly signposted wayfinding and appropriate line markings, and leveraging off new development to provide good lighting and security measures from adjacent land uses.
Bus	▪ Review performance of buses using capacity and occupancy data representing travel post-implementation of the November 2017 timetable. ▪ Review the bus network and explore opportunities to provide improved connections to and from Glenfield Station and the Precinct, to provide improved interchange opportunity between public transport services and support new development. ▪ Improve regional connectivity for the Precinct to the Campbelltown-Macarthur, Liverpool and Western Sydney Airport-Badgerys Creek Aerotropolis Metropolitan Clusters. ▪ Investigate opportunities to improve the hours of operation of bus services within the Precinct.
Train	▪ Review performance of train services using capacity and occupancy data representing travel post-implementation of the November 2017 timetable. ▪ Investigate providing rail connections from the Precinct to new employment growth areas including the Western Sydney Airport-Badgerys Creek Aerotropolis, and new land release precincts west of Leppington. ▪ Investigate providing improved service frequency along all lines in off-peak periods to encourage mode shift to train services. ▪ Investigate opportunities to provide full separation of freight and passenger rail on the T2 Inner West and Leppington Line, and T8 South Line to provide additional capacity and reliability for passenger and freight services.
Freight	▪ Accommodate freight vehicle movements along major arterial roads only, discouraging use of local streets in the Precinct. ▪ Investigate the needs of new developments in the Precinct for service and delivery vehicles. ▪ Investigate new road links from the Precinct to the Western Sydney Airport-Badgerys Creek Aerotropolis due to open in 2026. ▪ Investigate the requirements for freight access to the Moorebank Intermodal Terminal and the allocation of the freight task to road and rail.

Mode	Recommendations
General traffic	▪ Undertake detailed modelling, design optioneering and a cost-benefit analysis on the requirements for the Precinct and wider area road network based on the outcomes of the preliminary analysis, being implementation of the Do Ultimate Cambridge Avenue scenario by 2026. ▪ Progress concept and detailed designs for the preferred infrastructure. ▪ Coordinate any future changes to intersection signal phase and timing sequences with Roads and Maritime Services as required. ▪ Progress further investigation and assessment of the upgrades identified at the following intersections: – Hume Highway, Leacocks Lane and Kurrajong Road; and – Glenfield Road, Canterbury Road and Cambridge Avenue.
Parking	▪ Investigate reducing demand for vehicular parking for short trips and encouraging greater adoption of active transport through improved facilities. ▪ Adjusting and rationalising the on-street parking controls to align with the density of the adjacent land use and associated level of activity. ▪ Investigate opportunities to introduce a resident parking permit scheme for the Precinct. ▪ Providing an adequate supply of spaces for Kiss & Ride, taxis and buses at transport interchanges to prevent overflow into adjacent short-term spaces. ▪ Investigate provision of spaces for use by car share vehicles. ▪ Investigate opportunity to integrate parking supply for commuters with Opal; charging commercial rates for customers who are not travelling on public transport. ▪ Investigate commuter car parking supply and balance with opportunities to improve active and public transport connectivity to Glenfield Station, particularly for trips originating from within the Precinct.

5 Conclusion and next steps

The Glenfield Precinct is a significant growth area, officially designated as a Planned Precinct that forms part of the Glenfield to Macarthur Urban Renewal Corridor under coordination from DPIE.

The Glenfield Precinct is located within the proposed Western Parkland City, incorporating the future Western Sydney Airport – Badgerys Creek Aerotropolis. Over the next 20 years, an additional 464,450 residents and 200,000 jobs will need to be accommodated in the area. More broadly, the Western Sydney population is projected to grow from 740,000 in 2016 to 1.1 million by 2036 and over 1.5 million in 2056. This growth is anticipated to influence both travel demand and patterns to and from the Precinct.

The Department of Planning and Environment and Property NSW engaged Cardno to prepare a Transport Management and Accessibility Plan (TMAP) to determine the requirements of the transport network to support different land use development scenarios planned for the Glenfield Precinct, and prepared by DPIE and Property NSW.

Existing land use

The Precinct is centred on the existing Glenfield Station interchange, and spans both sides of the railway line. Development density in the Precinct is higher on the eastern side of the railway line and includes a combination of low-density residential, schools and Town Centre with small-scale retail and services for the surrounding local area. To the west, land uses consist primarily of parkland and education areas associated with the Hurlstone Agricultural High School and Office of Strategic Lands. The north-west portion of the Precinct is well-developed with low-density residential land uses. Because of the inherent land uses, trip generation is higher on the eastern side of the railway line.

Existing transport network

Existing walking and cycling links in the Precinct are well developed in the vicinity of Glenfield Station and some regional connectivity is available. However further from the interchange the network is not well-developed; footpaths are often located on only one side of the road and connectivity is lacking, with limited crossing opportunities and no paths present on lower-order streets. The cycling network is coarse and incomplete, with many routes designated along streets where no formal facility is provided. A shared path is provided on the western side of Glenfield Station, which proceeds north and runs parallel to the railway line.

The Precinct is serviced by the T2 Leppington Line, T5 Cumberland Line and T8 Airport and South Line, which provide connections to destinations including the Sydney CBD, Campbelltown-Macarthur, Leppington, Liverpool, Parramatta and Blacktown. Trains on the T2 and T8 Line run generally every 10 minutes in the peaks and 15 minutes off-peak. Trains on the T5 Line run every half an hour all day.

The Precinct is serviced by six bus routes, which provide connections between Glenfield Station, Campbelltown, Liverpool and the eastern portion of the Precinct. Service frequencies on the routes range between two to four services per hour in peak periods. There are no bus priority measures in the Precinct, and bus stop infrastructure ranges from only regulatory signage to signage, timetables and shelters (predominately around the Glenfield Station interchange).

The Precinct has an extensive road network with a clear hierarchy. Connections are provided to major arterial road corridors including the Hume Motorway, Campbelltown Road, Glenfield Road, Railway Parade, Canterbury Road and Cambridge Avenue.

Existing travel patterns

The Precinct relies heavily on private vehicles for Journey to Work trips. The majority of workers who live in the Precinct travel to work by private vehicle (63 per cent) with 31 per cent using the train. The largest proportion travel to Campbelltown (21 per cent) with 19 per cent travelling to the Sydney CBD and 12 per cent to Liverpool. For workers within the Precinct, 85 per cent arrive by private vehicle, with only five per cent using public transport (four per cent by train and one per cent by bus). For both residents and workers of the Precinct, the largest proportion of corresponding trip origins and destinations were located in surrounding suburbs.

Patronage at Glenfield Station has been increasing between 2004 and 2009, and from 2011 to 2014. There was a significant decrease in commuters from 2009 to 2011 of approximately 3,000 movements (25 percent). This was likely due to the impact caused by construction of the Southern Sydney Freight Line (SSFL) and the upgrade of Glenfield Station as part of the Transport Access Program (TAP) that occurred during this period. Since 2011, rail patronage has been increasing on average by 1.5 percent per year.

Bus patronage shows the highest volumes of Opal card tap-ons and offs occurred during the AM and PM peak periods.

Future road network performance

Traffic modelling for the future transport network in 2026 and 2036 indicated:

- Travel time savings on some key routes in the precinct, and no more than a two minute increase across all routes between 2016 and 2036 with the Cambridge Avenue extension
- Vehicle hours travelled on oversaturated roads (VC ratio > 1) was less than four per cent of the total VHT for the high growth scenario and 0 per cent for the low growth scenario in 2036
- The majority of roads in and around the development precinct continue to exhibit acceptable performance in 2026
- The Cambridge Avenue extension results in a balancing of vehicle movements in the east-west direction as there is a choice between Glenfield Road and Cambridge Avenue, which reduces congestion approaching Campbelltown Road
- The performance of all intersections in 2026 was acceptable (level of service ≤ D) with the suggested upgrades.

Precinct Plan and future transport network

The future transport network supports the Precinct's structure plans and were developed to ensure the recommended infrastructure and / or services are sustainable and align with NSW Government policy and strategies. Overall, the network recommends improvements to the walking, cycling, public transport and road networks to reduce reliance on private vehicles where possible, provide improved access for residents and employees of the Precinct (current and future), enhance the liveability of the local area.

The recommended future transport network includes:

- A well-defined walking network with improved connectivity and increased permeability;
- A well-defined cycling network and associated parking facilities;
- Improved service frequencies for public transport;
- Public transport connections to new employment centres as they are developed;
- Intersection improvements and new east-west connections;
- Planning and facilitation of freight movements to, from and through the Precinct through rail and road initiatives; and
- The implementation of new east-west road links, including the Full Cambridge Avenue extension (subject to an assessment of environmental capacity and amenity impacts) to support trips to, from and within the Precinct in line with development plans and growth scenarios.

Next steps and opportunities

This TMAP identifies actions to be undertaken to further analyse and plan for the delivery of transport infrastructure and services to support development of the Precinct. These actions are:

- Undertake detailed traffic modelling on the impacts of the planned east-west road upgrade options;
- Costing and prioritisation of the recommendations for the future transport network;
- Working with stakeholders including TfNSW and public transport providers and operators to deliver new public transport services and infrastructure, with consideration given to:
  - Outcomes from the Western Sydney City Deal;
  - The City-shaping and City-serving networks outlined in Future Transport 2056; and
  - Initiatives that are committed and nominated for investigation in Future Transport 2056.

Confirm and progress concept and detailed designs of the preferred east-west road upgrade options.

APPENDIX

A

SIDRA MOVEMENT SUMMARIES

Do-Ultimate scenario

AM Peak

MOVEMENT SUMMARY

Site: 101 [Hume Hwy/Campbelltown Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: RoadName											
4a	L1	1003	10.7	0.306	12.8	LOS A	7.7	59.1	0.51	0.69	48.5
5	T1	244	3.4	0.600	70.6	LOS F	8.8	63.1	1.00	0.80	27.8
Approach		1247	9.3	0.600	24.1	LOS B	8.8	63.1	0.60	0.71	42.3
North: RoadName											
7	L2	59	3.6	0.033	5.6	LOS A	0.0	0.0	0.00	0.58	53.5
Approach		59	3.6	0.033	5.6	LOS A	0.0	0.0	0.00	0.58	53.5
West: Hume Hwy											
10	L2	1	0.0	0.393	5.6	LOS A	0.0	0.0	0.00	0.00	58.3
11	T1	1897	6.4	0.518	0.1	LOS A	0.0	0.0	0.00	0.00	59.9
12b	R3	759	3.7	1.055	132.0	LOS F	37.7	272.1	1.00	1.16	16.6
Approach		2657	5.7	1.055	37.8	LOS C	37.7	272.1	0.29	0.33	34.3
SouthWest: Campbelltown Road											
30b	L3	501	3.2	0.315	6.9	LOS A	0.0	0.0	0.00	0.57	54.6
32a	R1	1335	5.8	1.084	122.2	LOS F	127.7	938.3	0.91	1.17	19.7
Approach		1836	5.0	1.084	90.8	LOS F	127.7	938.3	0.66	1.01	24.0
All Vehicles		5799	6.2	1.084	51.3	LOS D	127.7	938.3	0.47	0.63	31.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101 [Hume Hwy/Campbelltown Road]

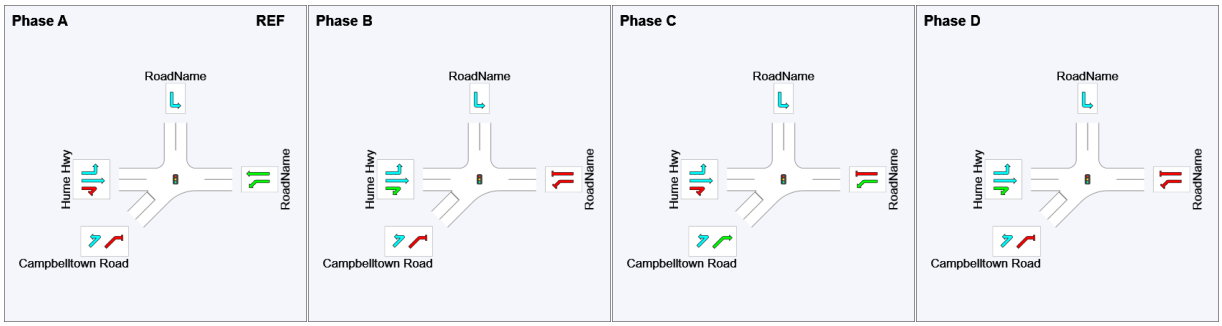
New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	22	37	119
Green Time (sec)	16	9	76	25
Phase Time (sec)	22	15	82	31
Phase Split	15%	10%	55%	21%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 101 [Campbelltown Road/Glenfield Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Glenfield Road											
21	L2	126	4.2	0.467	24.5	LOS B	2.9	21.0	0.96	0.77	42.4
23	R2	480	5.7	0.672	39.4	LOS C	9.1	67.1	0.98	0.85	36.1
Approach		606	5.4	0.672	36.3	LOS C	9.1	67.1	0.97	0.83	37.2
NorthEast: Campbelltown Road											
24	L2	338	1.2	0.918	55.6	LOS D	16.7	118.0	1.00	1.10	31.6
25	T1	1608	8.3	0.878	36.8	LOS C	25.4	190.8	0.98	1.05	37.5
Approach		1946	7.1	0.918	40.1	LOS C	25.4	190.8	0.98	1.06	36.3
SouthWest: Campbelltown Road											
31	T1	1152	4.7	0.312	6.5	LOS A	6.5	47.4	0.47	0.41	54.2
32	R2	226	0.9	0.818	30.2	LOS C	6.3	44.2	1.00	0.92	39.7
Approach		1378	4.0	0.818	10.4	LOS A	6.5	47.4	0.56	0.49	51.1
All Vehicles		3931	5.8	0.918	29.1	LOS C	25.4	190.8	0.83	0.83	40.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	24.9	LOS C	0.1	0.1	0.79	0.79
P5S	SouthEast Slip/Bypass Lane Crossing	53	5.0	LOS A	0.0	0.0	0.50	0.50
P6S	NorthEast Slip/Bypass Lane Crossing	53	18.3	LOS B	0.1	0.1	0.68	0.68
P8	SouthWest Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		211	20.6	LOS C			0.72	0.72

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

PHASING SUMMARY

Site: 101 [Campbelltown Road/Glenfield Road]

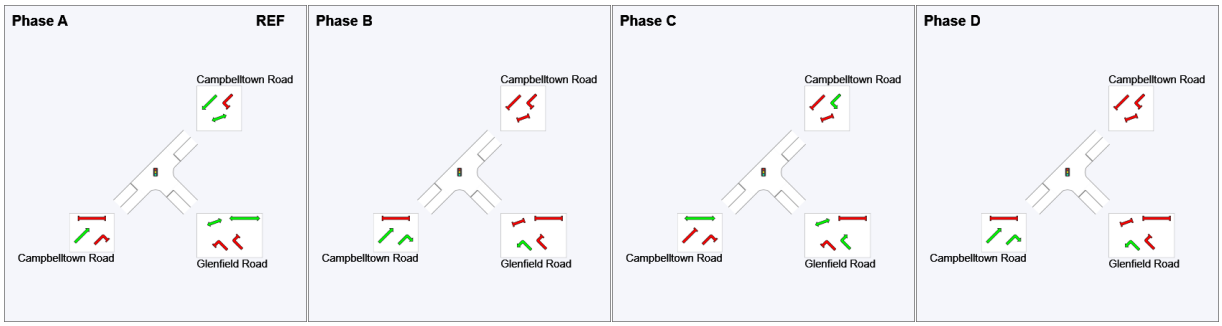
New Site
Signals - Fixed Time Isolated Cycle Time = 80 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	34	46	68
Green Time (sec)	28	6	16	6
Phase Time (sec)	34	12	22	12
Phase Split	43%	15%	28%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 101 [Camden Valley Way/Beech Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Beech Road											
1	L2	179	4.7	0.427	34.4	LOS C	7.2	52.2	0.90	0.79	37.6
2	T1	97	2.2	0.328	61.4	LOS E	6.4	45.4	0.94	0.74	30.0
3	R2	74	10.0	1.063	159.8	LOS F	8.3	63.0	1.00	1.13	16.2
Approach		349	5.1	1.063	68.3	LOS E	8.3	63.0	0.93	0.85	27.9
East: Camden Valley Way											
4	L2	29	3.6	0.407	86.6	LOS F	2.3	16.3	1.00	0.72	24.5
5	T1	503	2.5	0.660	57.6	LOS E	16.9	120.7	0.96	0.81	30.9
6	R2	71	1.5	0.240	45.8	LOS D	3.6	25.8	0.91	0.75	33.9
Approach		603	2.4	0.660	57.7	LOS E	16.9	120.7	0.96	0.80	30.8
North: Beech Road											
7	L2	86	12.2	2.930	1772.2	LOS F	66.1	494.0	1.00	2.00	1.9
8	T1	113	4.7	2.930	1766.6	LOS F	66.1	494.0	1.00	2.00	1.9
9	R2	502	12.8	0.922	85.1	LOS F	16.6	129.0	1.00	1.13	25.0
Approach		701	11.4	2.930	563.0	LOS F	66.1	494.0	1.00	1.37	5.7
West: Camden Valley Way											
10	L2	234	6.3	2.243	1159.7	LOS F	163.9	1203.5	1.00	2.57	2.9
11	T1	2418	5.3	2.243	1157.0	LOS F	299.3	2190.7	1.00	2.89	2.9
12	R2	300	9.8	0.370	34.1	LOS C	5.9	44.9	0.88	0.78	37.8
Approach		2952	5.8	2.243	1043.1	LOS F	299.3	2190.7	0.99	2.65	3.2
All Vehicles		4605	6.2	2.930	766.9	LOS F	299.3	2190.7	0.98	2.08	4.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	57.3	LOS E	0.2	0.2	0.88	0.88
P2	East Full Crossing	53	50.5	LOS E	0.2	0.2	0.82	0.82
P3	North Full Crossing	53	37.8	LOS D	0.1	0.1	0.92	0.92
P4	West Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	53.7	LOS E			0.90	0.90

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

PHASING SUMMARY

Site: 101 [Camden Valley Way/Beech Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

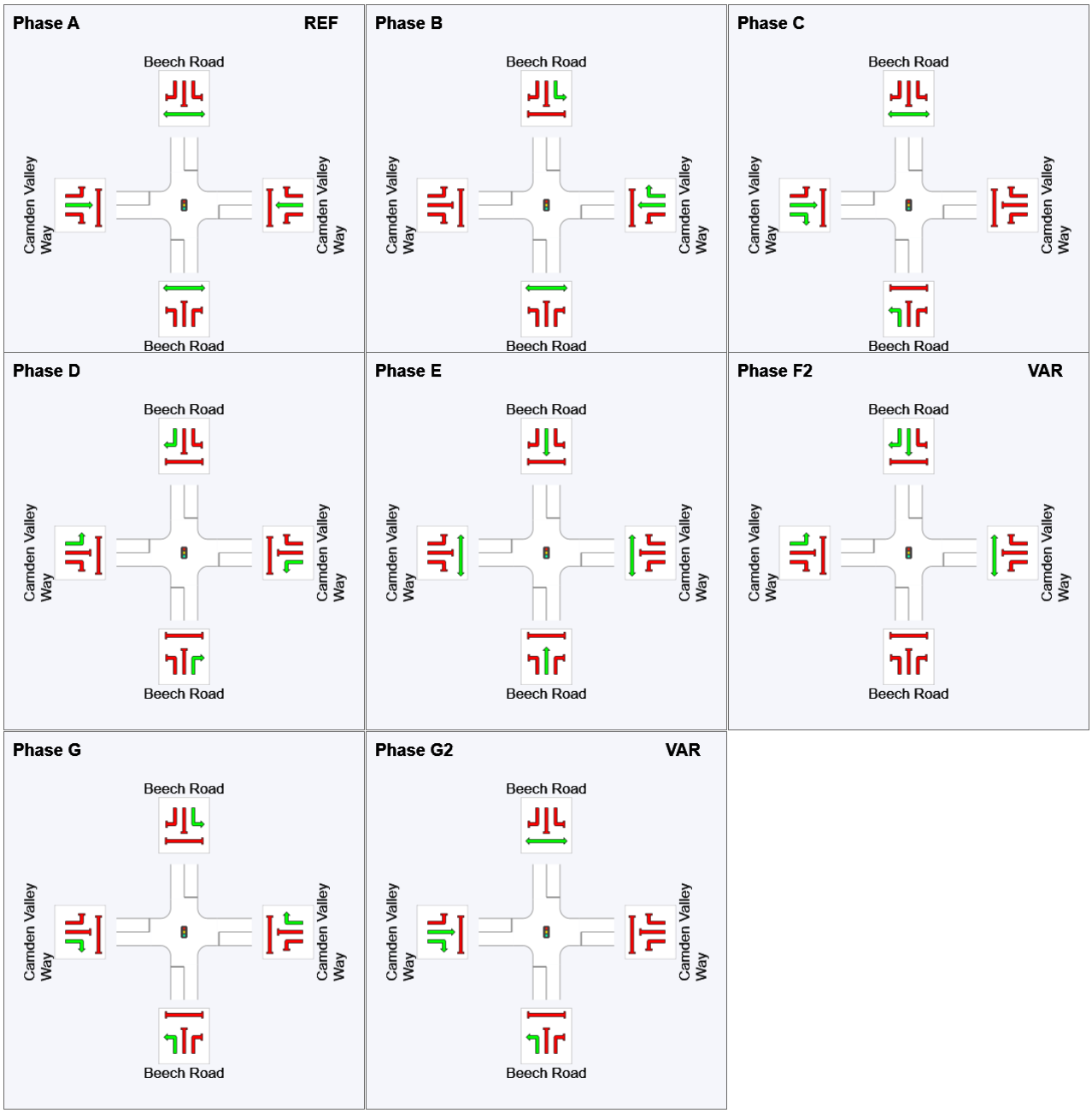
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, D1*, D2*, E, F1*, F2*, G, G1*, G2*
Output Phase Sequence: A, B, C, D, E, F2*, G, G2*
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D	E	F2	G	G2
Phase Change Time (sec)	0	20	38	65	77	106	130	148
Green Time (sec)	14	12	21	6	23	18	12	***
Phase Time (sec)	20	18	27	12	29	24	18	2
Phase Split	13%	12%	18%	8%	19%	16%	12%	1%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified.
If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 101 [Camden Valley Way/Beech Road - Modify]

New Site
Signals - Fixed Time Isolated Cycle Time = 136 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Beech Road											
1	L2	179	4.7	0.246	32.2	LOS C	6.0	43.8	0.70	0.81	38.5
2	T1	97	2.2	0.245	48.6	LOS D	5.4	38.3	0.88	0.70	33.5
3	R2	74	10.0	0.292	55.8	LOS D	4.2	32.0	0.89	0.77	31.0
Approach		349	5.1	0.292	41.7	LOS C	6.0	43.8	0.79	0.77	35.2
East: Camden Valley Way											
4	L2	29	3.6	0.055	42.1	LOS C	1.4	10.0	0.75	0.70	34.9
5	T1	503	2.5	0.446	41.8	LOS C	13.5	96.5	0.86	0.73	35.7
6	R2	71	1.5	0.163	43.8	LOS D	3.5	24.5	0.78	0.74	34.6
Approach		603	2.4	0.446	42.0	LOS C	13.5	96.5	0.85	0.73	35.5
North: Beech Road											
7	L2	86	12.2	0.267	33.7	LOS C	8.6	64.3	0.70	0.67	39.1
8	T1	113	4.7	0.267	28.0	LOS B	8.6	64.3	0.70	0.67	40.1
9	R2	502	12.8	0.545	36.9	LOS C	11.8	91.5	0.85	0.80	37.0
Approach		701	11.4	0.545	35.1	LOS C	11.8	91.5	0.81	0.76	37.7
West: Camden Valley Way											
10	L2	234	6.3	0.904	45.5	LOS D	61.0	447.1	0.98	0.97	35.1
11	T1	2418	5.3	0.904	40.0	LOS C	61.3	448.8	0.95	0.96	36.1
12	R2	300	9.8	0.560	54.9	LOS D	7.7	58.5	0.97	0.85	31.1
Approach		2952	5.8	0.904	42.0	LOS C	61.3	448.8	0.95	0.95	35.5
All Vehicles		4605	6.2	0.904	40.9	LOS C	61.3	448.8	0.91	0.88	35.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	43.8	LOS E	0.2	0.2	0.80	0.80
P2	East Full Crossing	53	36.8	LOS D	0.1	0.1	0.74	0.74
P3	North Full Crossing	53	22.4	LOS C	0.1	0.1	0.57	0.57
P4	West Full Crossing	53	60.4	LOS F	0.2	0.2	0.94	0.94
All Pedestrians		211	40.9	LOS E			0.76	0.76

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

PHASING SUMMARY

Site: 101 [Camden Valley Way/Beech Road - Modify]

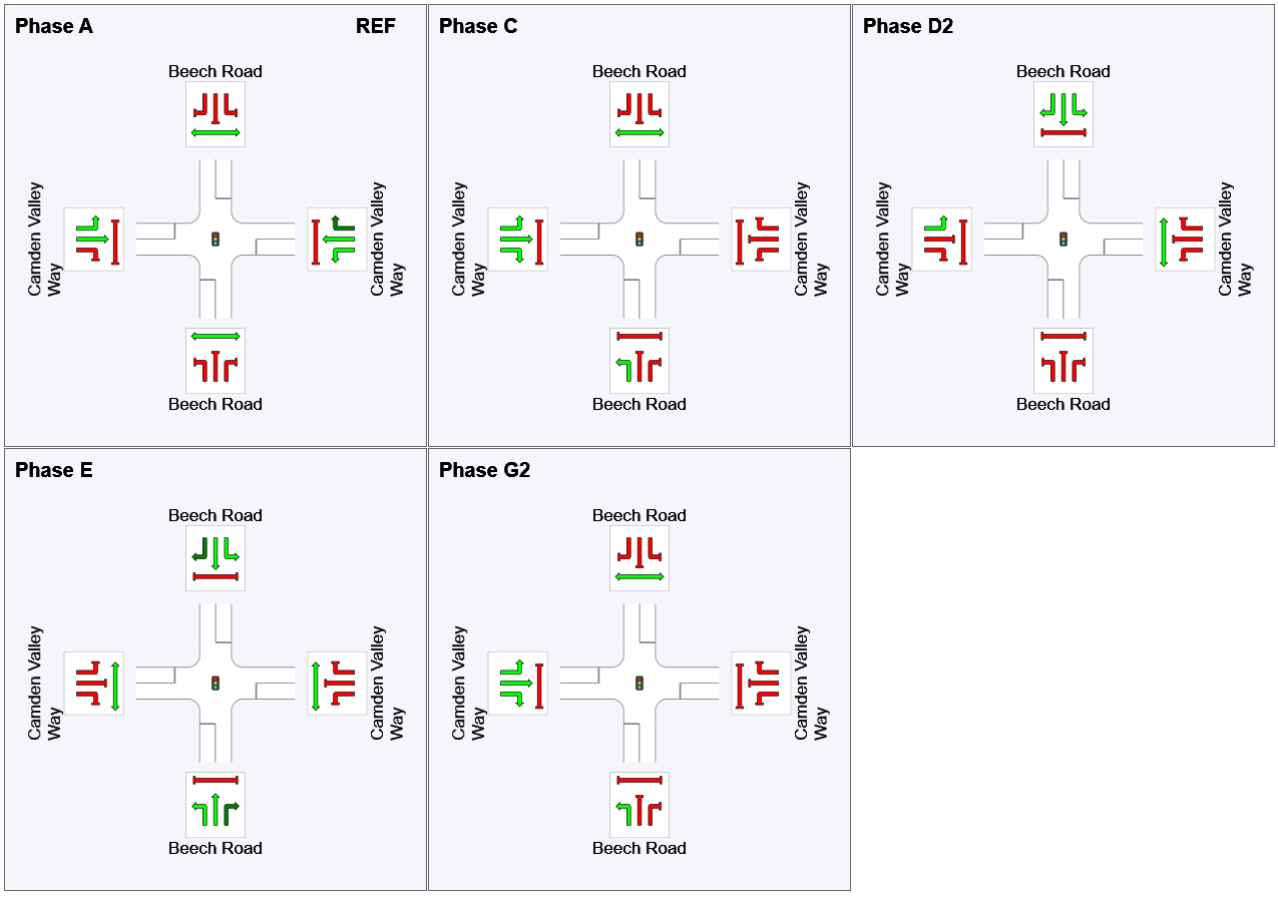
New Site
Signals - Fixed Time Isolated Cycle Time = 136 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, C, D2, E, G2
Output Phase Sequence: A, C, D2, E, G2

Phase Timing Results

Phase	A	C	D2	E	G2
Phase Change Time (sec)	0	46	54	77	111
Green Time (sec)	40	2	22	28	19
Phase Time (sec)	46	3	28	34	25
Phase Split	34%	2%	21%	25%	18%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



MOVEMENT SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N)]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Leacocks Ln											
21	L2	53	0.0	2.886	1733.8	LOS F	59.0	421.5	1.00	2.00	2.0
22	T1	120	3.5	2.886	1728.3	LOS F	59.0	421.5	1.00	2.00	2.0
23	R2	362	1.2	3.517	2311.1	LOS F	134.6	951.7	1.00	2.72	1.5
Approach		535	1.6	3.517	2123.5	LOS F	134.6	951.7	1.00	2.49	1.6
NorthEast: Hume Hwy											
24	L2	135	0.8	1.060	156.1	LOS F	38.9	288.8	1.00	1.35	16.7
25	T1	867	11.4	1.060	150.7	LOS F	38.9	288.8	1.00	1.38	16.9
26	R2	5	0.0	0.007	32.5	LOS C	0.2	1.5	0.61	0.63	38.6
Approach		1007	9.9	1.060	150.8	LOS F	38.9	296.9	1.00	1.37	16.9
NorthWest: Kurrajong Road											
27	L2	17	18.8	0.860	77.8	LOS F	4.7	34.6	1.00	0.90	26.8
28	T1	48	0.0	0.860	72.0	LOS F	4.7	34.6	1.00	0.90	27.4
29	R2	182	3.5	2.512	1408.2	LOS F	59.5	428.8	1.00	2.19	2.4
Approach		247	3.8	2.512	1056.1	LOS F	59.5	428.8	1.00	1.85	3.2
SouthWest: Hume Hwy											
30	L2	157	20.1	2.183	1122.4	LOS F	207.8	1559.3	1.00	3.24	3.0
31	T1	3115	5.0	2.183	1119.5	LOS F	392.6	2865.5	1.00	3.53	3.0
32	R2	4	0.0	0.004	21.1	LOS B	0.1	0.9	0.46	0.62	43.9
Approach		3276	5.7	2.183	1118.2	LOS F	392.6	2865.5	1.00	3.51	3.0
All Vehicles		5065	6.0	3.517	1028.9	LOS F	392.6	2865.5	1.00	2.90	3.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	58.2	LOS E	0.2	0.2	0.88	0.88
P6	NorthEast Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P7	NorthWest Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	65.6	LOS F			0.94	0.94

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

PHASING SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N)]

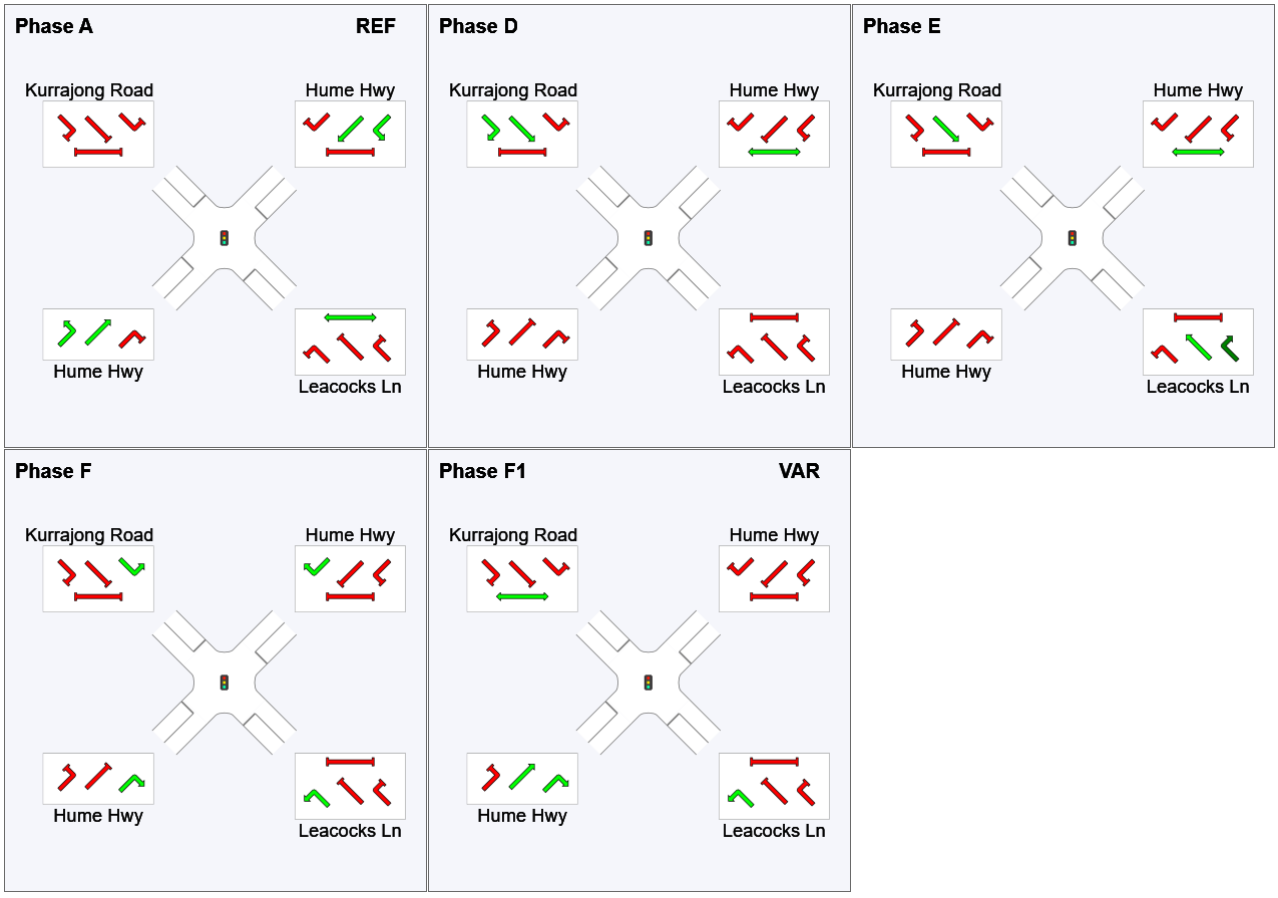
New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, D, E, F, F1*, F2*
Output Phase Sequence: A, D, E, F, F1*
(* Variable Phase)

Phase Timing Results

Phase	A	D	E	F	F1
Phase Change Time (sec)	0	32	44	61	129
Green Time (sec)	26	6	11	62	15
Phase Time (sec)	32	12	17	68	21
Phase Split	21%	8%	11%	45%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



MOVEMENT SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N) - upgrade]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Leacocks Ln											
21	L2	53	0.0	0.761	78.4	LOS F	12.9	92.0	1.00	0.88	26.8
22	T1	120	3.5	0.761	72.8	LOS F	12.9	92.0	1.00	0.88	27.1
23	R2	362	1.2	0.927	87.4	LOS F	28.6	202.3	1.00	1.14	24.5
Approach		535	1.6	0.927	83.2	LOS F	28.6	202.3	1.00	1.05	25.2
NorthEast: Hume Hwy											
24	L2	135	0.8	0.306	20.7	LOS B	11.6	85.8	0.52	0.57	45.6
25	T1	867	11.4	0.306	15.4	LOS B	11.7	89.6	0.52	0.49	47.6
26	R2	5	0.0	0.100	85.7	LOS F	0.4	2.8	0.99	0.66	24.7
Approach		1007	9.9	0.306	16.5	LOS B	11.7	89.6	0.53	0.50	47.1
NorthWest: Kurrajong Road											
27	L2	17	18.8	0.211	64.0	LOS E	4.1	30.2	0.90	0.71	29.8
28	T1	48	0.0	0.211	58.3	LOS E	4.1	30.2	0.90	0.71	30.5
29	R2	182	3.5	0.655	63.7	LOS E	10.6	76.1	0.99	0.93	29.1
Approach		247	3.8	0.655	62.7	LOS E	10.6	76.1	0.97	0.87	29.4
SouthWest: Hume Hwy											
30	L2	157	20.1	0.973	66.9	LOS E	92.5	687.4	0.98	1.08	29.1
31	T1	3115	5.0	0.973	62.0	LOS E	99.6	726.6	0.99	1.10	29.7
32	R2	4	0.0	0.016	24.8	LOS B	0.2	1.1	0.51	0.64	42.0
Approach		3276	5.7	0.973	62.2	LOS E	99.6	726.6	0.99	1.10	29.7
All Vehicles		5065	6.0	0.973	55.3	LOS D	99.6	726.6	0.90	0.96	31.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	15.4	LOS B	0.1	0.1	0.45	0.45
P6	NorthEast Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
P7	NorthWest Full Crossing	53	16.8	LOS B	0.1	0.1	0.47	0.47
All Pedestrians		158	33.9	LOS D			0.63	0.63

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

PHASING SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N) - upgrade]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, D, E, F3
Output Phase Sequence: A, D, E, F3

Phase Timing Results

Phase	A	D	E	F3
Phase Change Time (sec)	0	96	108	127
Green Time (sec)	90	6	18	17
Phase Time (sec)	96	7	24	23
Phase Split	64%	5%	16%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

MOVEMENT SUMMARY

Site: 101 [Hume Hwy/ Leacocks Ln(S)]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Leacocks Ln											
21	L2	196	4.3	0.248	21.2	LOS B	6.6	47.7	0.50	0.71	43.5
23	R2	348	1.5	0.906	74.3	LOS F	26.9	190.4	0.92	0.95	26.7
Approach		544	2.5	0.906	55.2	LOS D	26.9	190.4	0.77	0.86	31.0
NorthEast: Hume Hwy											
24	L2	104	0.0	0.566	48.7	LOS D	20.9	156.1	0.87	0.78	34.0
25	T1	947	11.3	0.566	43.2	LOS D	20.9	156.1	0.87	0.77	34.9
Approach		1052	10.2	0.566	43.7	LOS D	20.9	159.3	0.87	0.77	34.8
SouthWest: Hume Hwy											
31	T1	2964	5.9	0.903	31.8	LOS C	70.2	515.9	0.89	0.88	39.4
32	R2	247	6.0	0.579	59.9	LOS E	16.0	117.7	0.94	0.83	29.9
Approach		3212	5.9	0.903	34.0	LOS C	70.2	515.9	0.89	0.87	38.4
All Vehicles		4807	6.5	0.906	38.5	LOS C	70.2	515.9	0.88	0.85	36.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	38.2	LOS D	0.2	0.2	0.71	0.71
P8	SouthWest Full Crossing	53	52.2	LOS E	0.2	0.2	0.84	0.84
All Pedestrians		105	45.2	LOS E			0.78	0.78

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

PHASING SUMMARY

Site: 101 [Hume Hwy/ Leacocks Ln(S)]

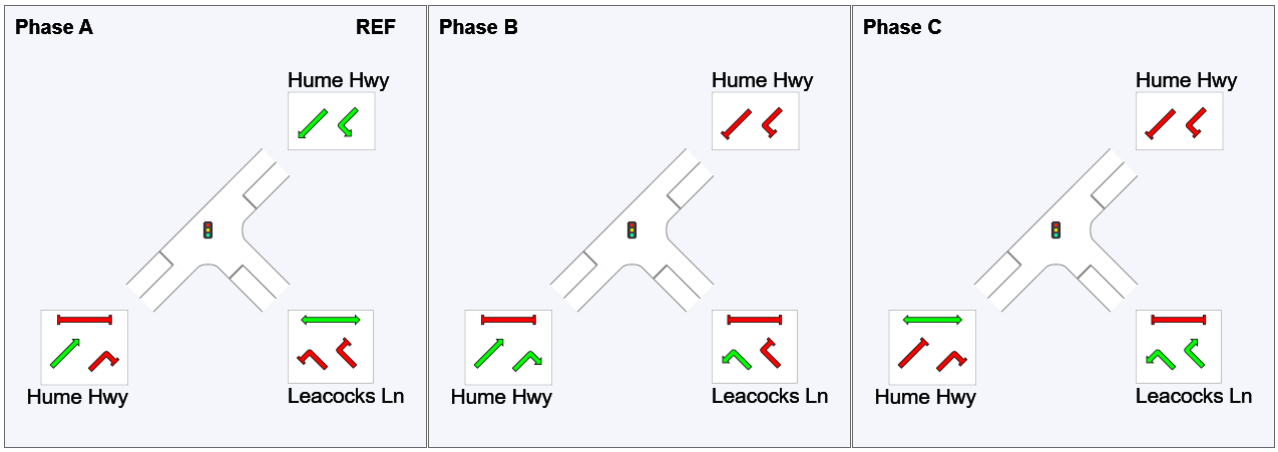
New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	57	99
Green Time (sec)	51	36	45
Phase Time (sec)	57	42	51
Phase Split	38%	28%	34%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 101 [Macquarie Road/Henderson Road]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Henderson Road											
21	L2	12	9.1	0.194	6.3	LOS A	1.1	8.2	0.73	0.58	54.1
22	T1	264	4.8	0.194	5.9	LOS A	1.1	8.2	0.73	0.64	56.0
23	R2	34	0.0	0.194	13.8	LOS A	1.0	7.2	0.73	0.73	56.5
Approach		309	4.4	0.194	6.8	LOS A	1.1	8.2	0.73	0.65	56.0
NorthEast: Macquarie Road											
24	L2	29	0.0	0.268	6.0	LOS A	1.3	9.6	0.70	0.58	54.5
25	T1	171	2.5	0.268	5.4	LOS A	1.3	9.6	0.70	0.58	56.8
26	R2	391	11.1	0.410	12.6	LOS A	2.5	19.1	0.74	0.84	53.0
Approach		591	8.0	0.410	10.2	LOS A	2.5	19.1	0.73	0.75	54.1
NorthWest: Henderson Road											
27	L2	483	6.3	0.575	4.5	LOS A	4.1	30.7	0.60	0.51	55.1
28	T1	417	8.1	0.575	4.1	LOS A	4.1	30.7	0.61	0.59	56.3
29	R2	489	5.4	0.575	11.9	LOS A	4.1	30.4	0.63	0.73	55.0
Approach		1389	6.5	0.575	7.0	LOS A	4.1	30.7	0.61	0.61	55.4
SouthWest: Macquarie Road											
30	L2	581	5.8	0.314	2.6	LOS A	0.0	0.0	0.00	0.33	58.3
31	T1	313	3.4	0.152	3.6	LOS A	0.8	6.0	0.56	0.39	57.4
32	R2	17	18.7	0.152	11.1	LOS A	0.8	6.0	0.56	0.38	58.1
Approach		911	5.2	0.314	3.1	LOS A	0.8	6.0	0.20	0.35	58.0
All Vehicles		3200	6.2	0.575	6.5	LOS A	4.1	30.7	0.53	0.57	55.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Glenfield Road/Cambridge Ave - Option 3]

New Site
Signals - Fixed Time Isolated Cycle Time = 80 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Canterbury Rd											
1	L2	408	2.8	0.383	9.4	LOS A	4.8	34.2	0.50	0.71	51.4
2	T1	4	0.0	0.383	3.8	LOS A	4.8	34.2	0.50	0.71	52.1
3	R2	540	1.9	0.786	43.6	LOS D	11.1	79.3	1.00	0.92	34.7
Approach		953	2.3	0.786	28.8	LOS C	11.1	79.3	0.78	0.83	40.4
East: Cambridge Ave											
4	L2	237	10.7	0.301	15.8	LOS B	4.7	35.6	0.67	0.73	46.9
5	T1	125	21.0	0.209	31.4	LOS C	2.2	17.9	0.89	0.68	39.7
6	R2	33	22.6	0.272	46.5	LOS D	1.3	10.9	0.98	0.72	33.2
Approach		395	14.9	0.301	23.3	LOS B	4.7	35.6	0.77	0.71	43.0
North: Railway Parade											
7	L2	606	5.4	0.686	15.0	LOS B	13.3	97.4	0.80	0.85	47.6
8	T1	2	0.0	0.686	9.3	LOS A	13.3	97.4	0.80	0.85	48.3
9	R2	224	3.3	0.659	39.9	LOS C	8.5	61.5	0.98	0.84	35.9
Approach		833	4.8	0.686	21.7	LOS B	13.3	97.4	0.85	0.85	43.8
West: Cambridge Ave											
10	L2	507	3.9	0.833	35.4	LOS C	18.1	131.3	1.00	1.07	37.9
11	T1	344	7.3	0.833	38.7	LOS C	18.1	131.3	1.00	1.01	36.4
12	R2	251	5.5	0.934	61.8	LOS E	6.2	45.6	1.00	1.08	29.4
Approach		1102	5.3	0.934	42.4	LOS C	18.1	131.3	1.00	1.06	35.2
All Vehicles		3282	5.5	0.934	30.9	LOS C	18.1	131.3	0.87	0.90	39.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P2	East Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P3	North Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
P4	West Full Crossing	53	34.3	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		211	34.3	LOS D			0.93	0.93

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

PHASING SUMMARY

Site: 101 [Glenfield Road/Cambridge Ave - Option 3]

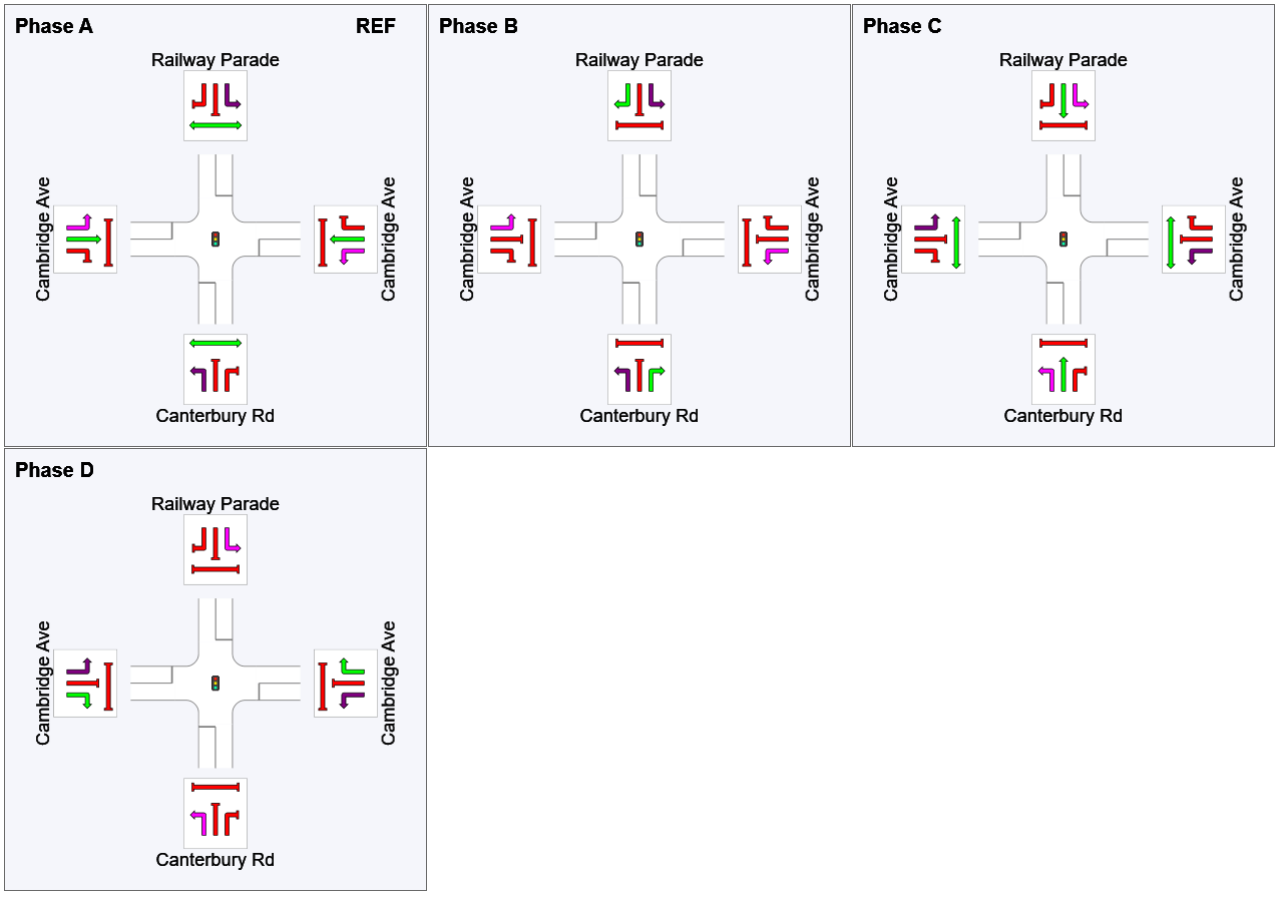
New Site
Signals - Fixed Time Isolated Cycle Time = 80 seconds (User-Given Cycle Time)

Phase Times determined by the program
Phase Sequence: New Traffic Signal
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	20	41	68
Green Time (sec)	14	15	21	6
Phase Time (sec)	20	21	27	12
Phase Split	25%	26%	34%	15%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



Do-Ultimate scenario

PM Peak

MOVEMENT SUMMARY

Site: 101 [Hume Hwy/Campbelltown Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: RoadName											
4a	L1	2288	3.3	0.730	12.7	LOS A	15.0	108.3	0.77	0.81	48.7
5	T1	547	3.1	0.608	34.9	LOS C	13.1	94.2	0.92	0.77	38.2
Approach		2836	3.3	0.730	17.0	LOS B	15.0	108.3	0.80	0.80	46.2
North: RoadName											
7	L2	21	10.0	0.012	5.7	LOS A	0.0	0.0	0.00	0.57	53.2
Approach		21	10.0	0.012	5.7	LOS A	0.0	0.0	0.00	0.57	53.2
West: Hume Hwy											
10	L2	1	0.0	0.220	5.6	LOS A	0.0	0.0	0.00	0.00	58.3
11	T1	1056	6.1	0.289	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12b	R3	497	5.1	0.877	40.5	LOS C	8.6	62.9	1.00	0.97	35.7
Approach		1554	5.8	0.877	13.0	LOS A	8.6	62.9	0.32	0.31	49.2
SouthWest: Campbelltown Road											
30b	L3	588	4.8	0.373	6.9	LOS A	0.0	0.0	0.00	0.57	54.6
32a	R1	687	4.9	0.879	45.2	LOS D	28.3	206.3	0.95	0.94	34.3
Approach		1276	4.9	0.879	27.6	LOS B	28.3	206.3	0.51	0.77	41.5
All Vehicles		5686	4.3	0.879	18.2	LOS B	28.3	206.3	0.60	0.66	45.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

PHASING SUMMARY

Site: 101 [Hume Hwy/Campbelltown Road]

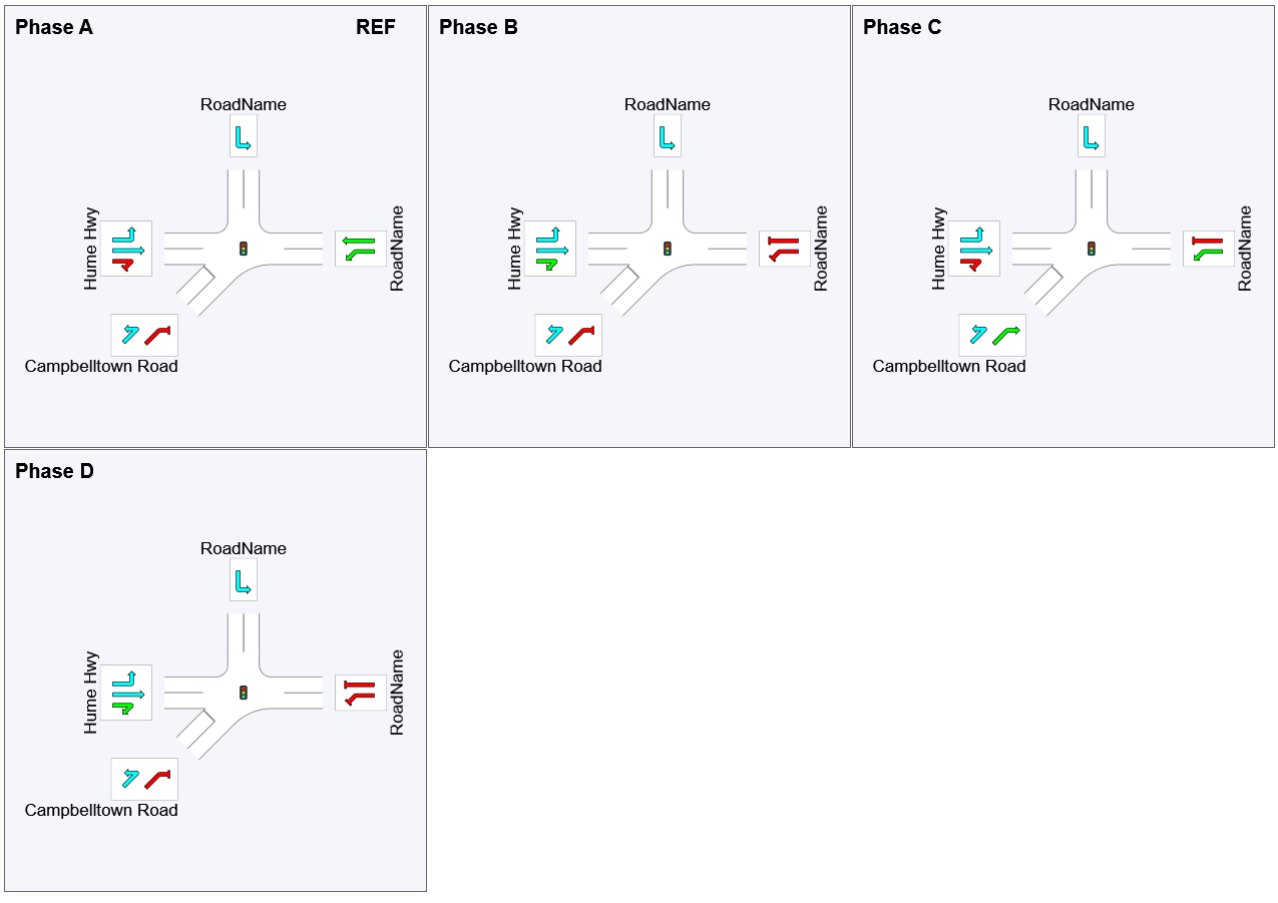
New Site
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	32	46	84
Green Time (sec)	26	8	32	10
Phase Time (sec)	32	14	38	16
Phase Split	32%	14%	38%	16%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



MOVEMENT SUMMARY

Site: 101 [Campbelltown Road/Glenfield Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Glenfield Road											
21	L2	89	1.2	0.486	40.0	LOS C	3.7	26.4	0.99	0.76	36.0
23	R2	488	3.2	0.769	60.2	LOS E	14.5	104.2	1.00	0.88	30.0
Approach		578	2.9	0.769	57.1	LOS E	14.5	104.2	1.00	0.87	30.8
NorthEast: Campbelltown Road											
24	L2	491	3.0	0.317	7.6	LOS A	5.7	41.3	0.22	0.61	53.3
25	T1	2280	3.9	0.864	31.6	LOS C	47.2	341.7	0.89	0.88	39.6
Approach		2771	3.7	0.864	27.4	LOS B	47.2	341.7	0.77	0.83	41.5
SouthWest: Campbelltown Road											
31	T1	799	5.9	0.196	5.5	LOS A	4.9	35.8	0.34	0.30	55.0
32	R2	120	1.8	0.654	41.4	LOS C	5.2	36.9	1.00	0.80	35.4
Approach		919	5.4	0.654	10.2	LOS A	5.2	36.9	0.43	0.36	51.3
All Vehicles		4267	4.0	0.864	27.7	LOS B	47.2	341.7	0.73	0.73	41.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	19.3	LOS B	0.1	0.1	0.57	0.57
P5S	SouthEast Slip/Bypass Lane Crossing	53	3.3	LOS A	0.0	0.0	0.33	0.33
P6S	NorthEast Slip/Bypass Lane Crossing	53	5.1	LOS A	0.1	0.1	0.29	0.29
P8	SouthWest Full Crossing	53	54.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	20.5	LOS C			0.54	0.54

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

PHASING SUMMARY

Site: 101 [Campbelltown Road/Glenfield Road]

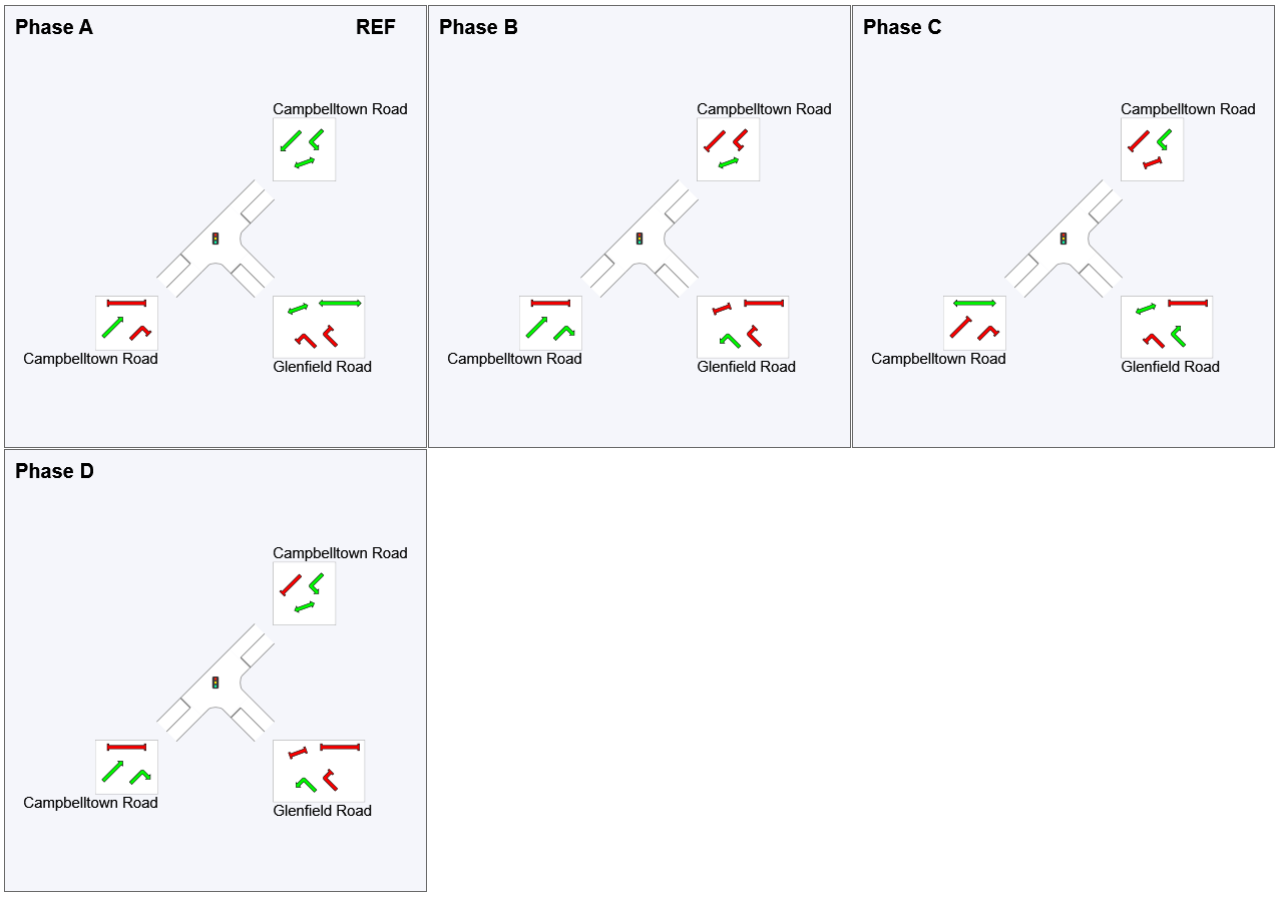
New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	69	81	108
Green Time (sec)	63	6	21	6
Phase Time (sec)	69	12	27	12
Phase Split	58%	10%	23%	10%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



MOVEMENT SUMMARY

Site: 101 [Camden Valley Way/Beech Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Beech Road											
1	L2	300	7.4	0.773	51.7	LOS D	16.3	121.3	1.00	0.92	31.9
2	T1	146	2.2	0.496	63.3	LOS E	9.9	70.7	0.97	0.78	29.6
3	R2	112	17.9	0.847	62.9	LOS E	6.5	52.9	1.00	0.93	29.2
Approach		558	8.1	0.847	57.0	LOS E	16.3	121.3	0.99	0.89	30.7
East: Camden Valley Way											
4	L2	68	3.1	0.471	49.5	LOS D	3.6	25.6	0.99	0.75	32.6
5	T1	667	2.1	0.745	55.2	LOS D	23.2	165.2	0.96	0.84	31.6
6	R2	29	3.6	0.064	32.4	LOS C	1.2	8.3	0.79	0.70	38.7
Approach		765	2.2	0.745	53.8	LOS D	23.2	165.2	0.96	0.83	31.9
North: Beech Road											
7	L2	107	5.9	4.455	3141.3	LOS F	117.4	847.1	1.00	2.14	1.1
8	T1	212	2.5	4.455	3135.6	LOS F	117.4	847.1	1.00	2.14	1.1
9	R2	767	7.0	1.284	333.8	LOS F	67.0	496.8	1.00	1.60	9.0
Approach		1086	6.0	4.455	1157.0	LOS F	117.4	847.1	1.00	1.76	2.9
West: Camden Valley Way											
10	L2	218	2.9	2.519	1441.6	LOS F	71.5	512.7	1.00	1.88	2.4
11	T1	1592	6.7	2.366	1270.5	LOS F	240.4	1779.0	1.00	3.00	2.7
12	R2	401	5.2	0.509	36.4	LOS C	7.7	56.6	0.93	0.81	37.0
Approach		2211	6.0	2.519	1063.4	LOS F	240.4	1779.0	0.99	2.49	3.2
All Vehicles		4620	5.7	4.455	796.7	LOS F	240.4	1779.0	0.99	1.85	4.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	52.2	LOS E	0.2	0.2	0.84	0.84
P2	East Full Crossing	53	64.5	LOS F	0.2	0.2	0.93	0.93
P3	North Full Crossing	53	45.9	LOS E	0.2	0.2	0.92	0.92
P4	West Full Crossing	53	69.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		211	58.0	LOS E			0.91	0.91

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

PHASING SUMMARY

Site: 101 [Camden Valley Way/Beech Road]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

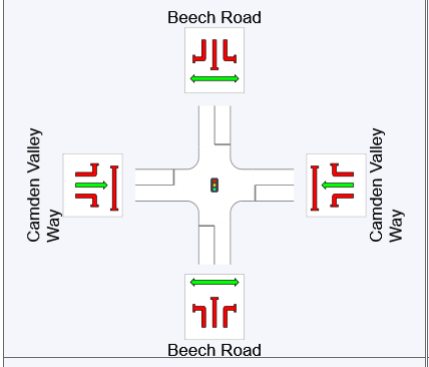
Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D, D1*, D2*, E, F1*, F2*, G, G1*, G2*
Output Phase Sequence: A, B, C, D, D2*, E, F1*, G
(* Variable Phase)

Phase Timing Results

Phase	A	B	C	D	D2	E	F1	G
Phase Change Time (sec)	0	27	44	56	68	88	105	117
Green Time (sec)	21	11	6	6	14	11	6	27
Phase Time (sec)	27	17	12	12	20	17	12	33
Phase Split	18%	11%	8%	8%	13%	11%	8%	22%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Phase A REF



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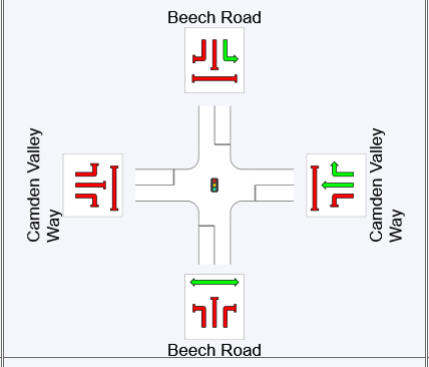

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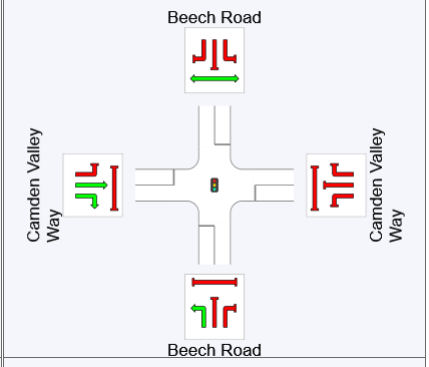
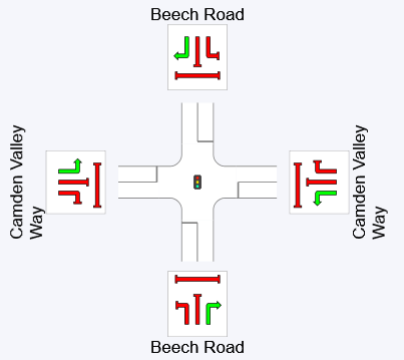
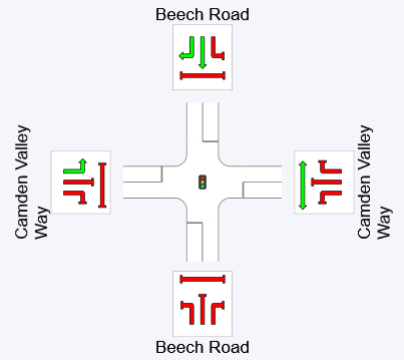


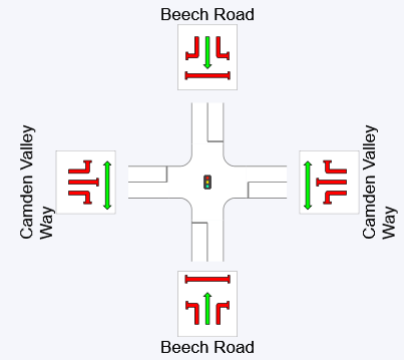
Phase D



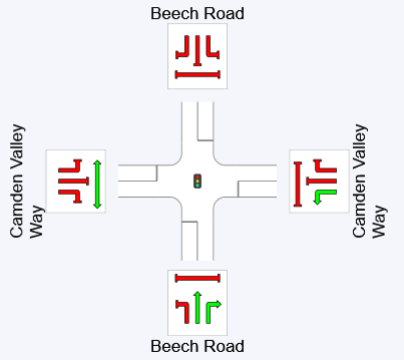
Phase D2 VAR



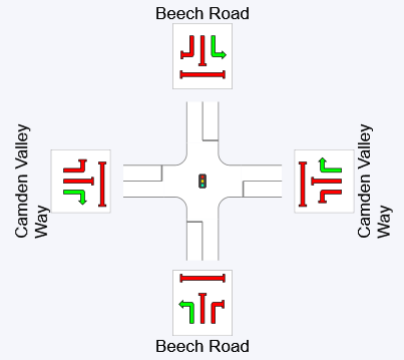
Phase E



Phase F1 VAR



Phase G



MOVEMENT SUMMARY

Site: 101 [Camden Valley Way/Beech Road - Modify]

New Site
Signals - Fixed Time Isolated Cycle Time = 126 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Beech Road											
1	L2	279	0.4	0.411	33.7	LOS C	10.2	72.0	0.78	0.86	38.0
2	T1	165	13.4	0.411	45.5	LOS D	10.2	72.0	0.90	0.75	34.4
3	R2	95	3.3	0.383	52.5	LOS D	5.1	36.9	0.90	0.78	32.0
Approach		539	4.9	0.411	40.6	LOS C	10.2	72.0	0.84	0.81	35.7
East: Camden Valley Way											
4	L2	68	3.1	0.136	42.1	LOS C	3.1	22.5	0.79	0.74	34.9
5	T1	667	2.1	0.647	42.8	LOS D	18.3	130.1	0.93	0.80	35.3
6	R2	29	3.6	0.072	41.6	LOS C	1.3	9.6	0.77	0.71	35.3
Approach		765	2.2	0.647	42.7	LOS D	18.3	130.1	0.91	0.79	35.3
North: Beech Road											
7	L2	107	5.9	0.384	30.5	LOS C	13.0	93.5	0.72	0.68	40.9
8	T1	212	2.5	0.384	24.9	LOS B	13.0	93.5	0.72	0.68	41.8
9	R2	767	7.0	0.823	41.0	LOS C	19.0	141.1	0.97	0.91	35.6
Approach		1086	6.0	0.823	36.9	LOS C	19.0	141.1	0.90	0.84	37.2
West: Camden Valley Way											
10	L2	218	2.9	0.644	29.1	LOS C	26.7	195.2	0.78	0.75	41.4
11	T1	1592	6.7	0.644	24.4	LOS B	26.9	199.3	0.79	0.73	42.6
12	R2	401	5.2	0.882	68.1	LOS E	12.2	89.0	1.00	1.01	28.0
Approach		2211	6.0	0.882	32.8	LOS C	26.9	199.3	0.83	0.78	38.9
All Vehicles		4601	5.3	0.882	36.3	LOS C	26.9	199.3	0.86	0.80	37.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	43.0	LOS E	0.2	0.2	0.83	0.83
P2	East Full Crossing	53	32.2	LOS D	0.1	0.1	0.72	0.72
P3	North Full Crossing	53	24.2	LOS C	0.1	0.1	0.62	0.62
P4	West Full Crossing	53	56.3	LOS E	0.2	0.2	0.95	0.95
All Pedestrians		211	38.9	LOS D			0.78	0.78

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

PHASING SUMMARY

Site: 101 [Camden Valley Way/Beech Road - Modify]

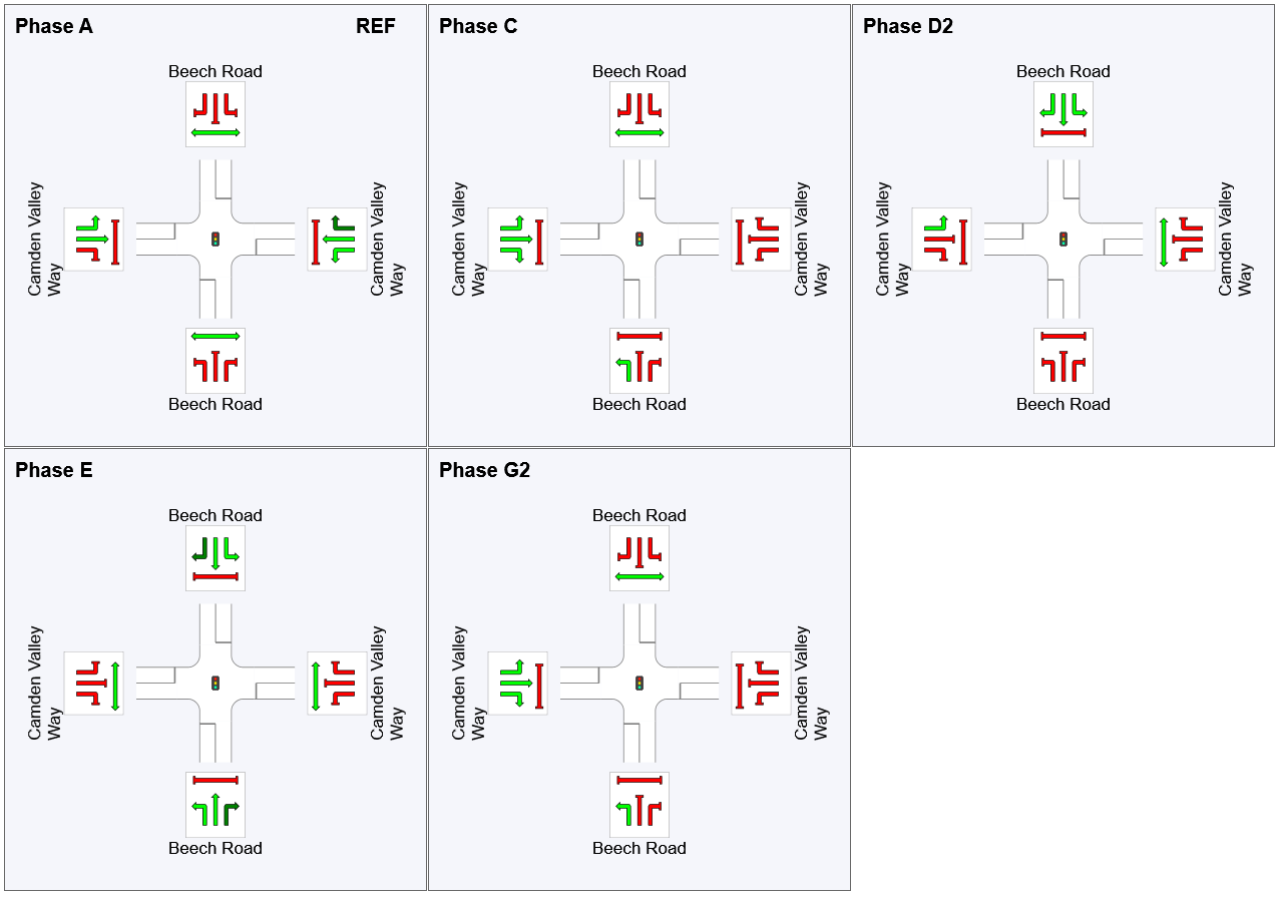
New Site
Signals - Fixed Time Isolated Cycle Time = 126 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, C, D2, E, G2
Output Phase Sequence: A, C, D2, E, G2

Phase Timing Results

Phase	A	C	D2	E	G2
Phase Change Time (sec)	0	41	49	73	106
Green Time (sec)	35	2	23	27	14
Phase Time (sec)	41	3	29	33	20
Phase Split	33%	2%	23%	26%	16%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



MOVEMENT SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N)]

New Site
Signals - Fixed Time Isolated Cycle Time = 135 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Leacocks Ln											
21	L2	21	5.0	1.528	531.3	LOS F	23.3	168.9	1.00	1.60	5.9
22	T1	112	3.8	1.528	527.3	LOS F	47.1	343.3	1.00	1.68	5.9
23	R2	199	4.8	1.528	540.6	LOS F	47.1	343.3	1.00	2.03	5.9
Approach		332	4.4	1.528	535.5	LOS F	47.1	343.3	1.00	1.89	5.9
NorthEast: Hume Hwy											
24	L2	177	2.4	0.917	47.0	LOS D	66.6	475.4	0.99	1.00	34.8
25	T1	2737	2.3	0.917	41.2	LOS C	67.0	478.6	0.98	1.00	35.7
26	R2	14	15.4	0.276	81.5	LOS F	1.0	7.7	1.00	0.68	25.4
Approach		2927	2.4	0.917	41.8	LOS C	67.0	478.6	0.98	1.00	35.6
NorthWest: Kurrajong Road											
27	L2	3	0.0	0.313	84.4	LOS F	10.7	78.0	0.89	0.75	26.0
28	T1	120	5.3	0.313	78.8	LOS F	10.7	78.0	0.89	0.75	26.3
29	R2	124	2.5	0.707	73.2	LOS F	8.4	60.0	1.00	0.84	27.1
Approach		247	3.8	0.707	76.0	LOS F	10.7	78.0	0.94	0.79	26.7
SouthWest: Hume Hwy											
30	L2	128	5.7	0.477	28.9	LOS C	18.3	133.8	0.70	0.67	41.6
31	T1	1412	5.4	0.477	16.3	LOS B	19.4	141.9	0.60	0.55	47.1
32	R2	18	0.0	0.100	66.6	LOS E	1.1	7.7	0.94	0.70	28.4
Approach		1558	5.3	0.477	17.9	LOS B	19.4	141.9	0.61	0.56	46.3
All Vehicles		5064	3.5	1.528	68.4	LOS E	67.0	478.6	0.87	0.91	27.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	17.2	LOS B	0.1	0.1	0.50	0.50
P6	NorthEast Full Crossing	53	53.5	LOS E	0.2	0.2	0.89	0.89
P7	NorthWest Full Crossing	53	61.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	44.1	LOS E			0.78	0.78

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

PHASING SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N)]

New Site
Signals - Fixed Time Isolated Cycle Time = 135 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, C, D, E, F1
Output Phase Sequence: A, C, D, E, F1

Phase Timing Results

Phase	A	C	D	E	F1
Phase Change Time (sec)	0	69	79	94	116
Green Time (sec)	65	4	13	16	13
Phase Time (sec)	71	6	19	22	17
Phase Split	53%	4%	14%	16%	13%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

MOVEMENT SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N) - Modify]

New Site
Signals - Fixed Time Isolated Cycle Time = 135 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Leacocks Ln											
21	L2	21	5.0	1.130	193.1	LOS F	15.2	109.8	1.00	1.28	13.6
22	T1	112	3.8	1.130	187.8	LOS F	25.6	186.8	1.00	1.28	13.6
23	R2	199	4.8	1.130	203.7	LOS F	25.6	186.8	1.00	1.37	13.4
Approach		332	4.4	1.130	197.7	LOS F	25.6	186.8	1.00	1.33	13.5
NorthEast: Hume Hwy											
24	L2	177	2.4	0.917	47.0	LOS D	66.6	475.4	0.99	1.00	34.8
25	T1	2737	2.3	0.917	41.2	LOS C	67.0	478.6	0.98	1.00	35.7
26	R2	14	15.4	0.276	81.5	LOS F	1.0	7.7	1.00	0.68	25.4
Approach		2927	2.4	0.917	41.8	LOS C	67.0	478.6	0.98	1.00	35.6
NorthWest: Kurrajong Road											
27	L2	3	0.0	0.313	84.4	LOS F	10.7	78.0	0.89	0.75	26.0
28	T1	120	5.3	0.313	78.8	LOS F	10.7	78.0	0.89	0.75	26.3
29	R2	124	2.5	0.707	73.2	LOS F	8.4	60.0	1.00	0.84	27.1
Approach		247	3.8	0.707	76.0	LOS F	10.7	78.0	0.94	0.79	26.7
SouthWest: Hume Hwy											
30	L2	128	5.7	0.477	28.9	LOS C	18.3	133.8	0.70	0.67	41.6
31	T1	1412	5.4	0.477	16.3	LOS B	19.4	141.9	0.60	0.55	47.1
32	R2	18	0.0	0.100	66.6	LOS E	1.1	7.7	0.94	0.70	28.4
Approach		1558	5.3	0.477	17.9	LOS B	19.4	141.9	0.61	0.56	46.3
All Vehicles		5064	3.5	1.130	46.3	LOS D	67.0	478.6	0.87	0.88	33.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	17.2	LOS B	0.1	0.1	0.50	0.50
P6	NorthEast Full Crossing	53	53.5	LOS E	0.2	0.2	0.89	0.89
P7	NorthWest Full Crossing	53	61.8	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	44.1	LOS E			0.78	0.78

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

PHASING SUMMARY

Site: 101 [Hume Hwy/Leacocks Ln(N) - Modify]

New Site
Signals - Fixed Time Isolated Cycle Time = 135 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, C, D, E, F1
Output Phase Sequence: A, C, D, E, F1

Phase Timing Results

Phase	A	C	D	E	F1
Phase Change Time (sec)	0	69	79	94	116
Green Time (sec)	65	4	13	16	13
Phase Time (sec)	71	6	19	22	17
Phase Split	53%	4%	14%	16%	13%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

MOVEMENT SUMMARY

Site: 101 [Hume Hwy/ Leacocks Ln(S)]

New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Leacocks Ln											
21	L2	158	2.7	0.319	39.7	LOS C	7.8	55.8	0.73	0.76	35.7
23	R2	206	2.6	0.884	81.0	LOS F	16.1	114.9	0.97	0.94	25.5
Approach		364	2.6	0.884	63.1	LOS E	16.1	114.9	0.87	0.86	29.1
NorthEast: Hume Hwy											
24	L2	294	0.4	0.910	47.7	LOS D	68.5	489.2	0.98	0.97	34.3
25	T1	2547	3.3	0.910	41.9	LOS C	69.0	496.3	0.98	0.97	35.4
Approach		2841	3.0	0.910	42.5	LOS D	69.0	496.3	0.98	0.97	35.2
SouthWest: Hume Hwy											
31	T1	1485	5.5	0.358	7.6	LOS A	12.7	93.4	0.39	0.35	53.4
32	R2	234	7.2	0.902	88.6	LOS F	19.4	144.0	1.00	0.97	24.2
Approach		1719	5.7	0.902	18.6	LOS B	19.4	144.0	0.47	0.44	45.8
All Vehicles		4924	3.9	0.910	35.7	LOS C	69.0	496.3	0.80	0.78	37.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P5	SouthEast Full Crossing	53	19.3	LOS B	0.1	0.1	0.51	0.51
P8	SouthWest Full Crossing	53	67.4	LOS F	0.2	0.2	0.95	0.95
All Pedestrians		105	43.3	LOS E			0.73	0.73

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

PHASING SUMMARY

Site: 101 [Hume Hwy/ Leacocks Ln(S)]

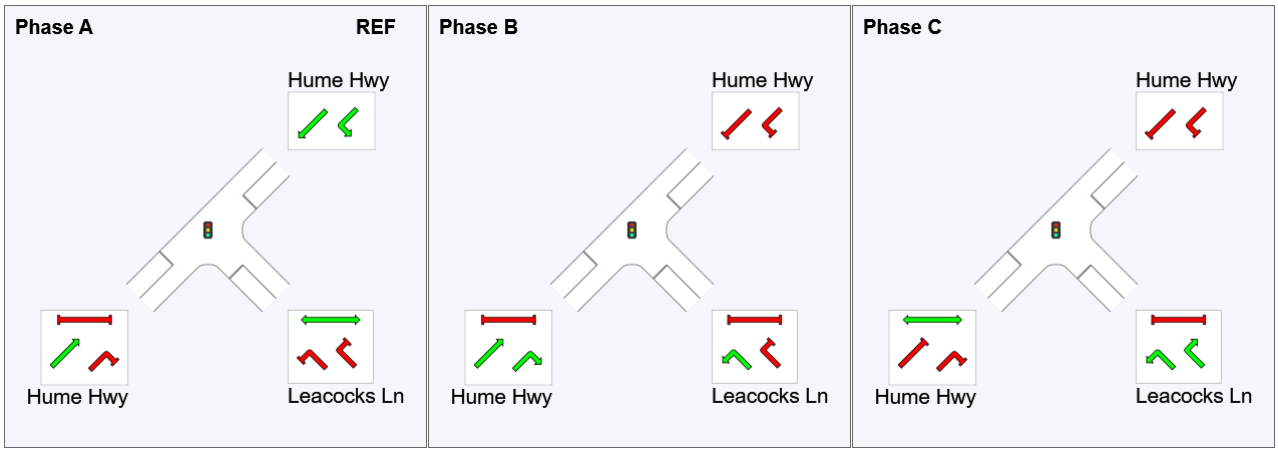
New Site
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Practical Cycle Time)

Phase Times determined by the program
Phase Sequence: Variable Phasing
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	88	116
Green Time (sec)	82	22	28
Phase Time (sec)	88	28	34
Phase Split	59%	19%	23%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



MOVEMENT SUMMARY

Site: 101 [Macquarie Road/Henderson Road]

New Site
Roundabout

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
SouthEast: Henderson Road											
21	L2	54	5.9	0.326	8.8	LOS A	2.2	15.9	0.89	0.85	53.2
22	T1	318	5.3	0.326	9.0	LOS A	2.2	15.9	0.88	0.88	54.7
23	R2	21	0.0	0.326	17.2	LOS B	1.9	13.6	0.86	0.91	55.1
Approach		393	5.1	0.326	9.4	LOS A	2.2	15.9	0.88	0.88	54.5
NorthEast: Macquarie Road											
24	L2	48	0.0	0.566	10.5	LOS A	3.8	26.8	0.89	1.00	52.4
25	T1	263	2.4	0.566	10.0	LOS A	4.4	31.7	0.89	1.00	54.4
26	R2	422	3.7	0.566	15.4	LOS B	4.4	31.7	0.91	1.05	52.1
Approach		734	3.0	0.566	13.1	LOS A	4.4	31.7	0.90	1.03	52.9
NorthWest: Henderson Road											
27	L2	493	3.2	0.741	5.7	LOS A	7.8	56.7	0.73	0.65	54.5
28	T1	594	4.3	0.741	5.2	LOS A	7.8	56.7	0.73	0.68	56.2
29	R2	742	3.8	0.741	13.4	LOS A	7.8	56.4	0.76	0.86	53.8
Approach		1828	3.8	0.741	8.7	LOS A	7.8	56.7	0.74	0.74	54.7
SouthWest: Macquarie Road											
30	L2	655	4.5	0.351	2.6	LOS A	0.0	0.0	0.00	0.33	58.3
31	T1	292	1.4	0.159	3.7	LOS A	0.9	6.6	0.60	0.43	56.9
32	R2	43	4.9	0.159	11.0	LOS A	0.9	6.6	0.61	0.44	57.8
Approach		989	3.6	0.351	3.3	LOS A	0.9	6.6	0.20	0.36	57.9
All Vehicles		3944	3.7	0.741	8.2	LOS A	7.8	56.7	0.65	0.71	55.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Glenfield Road/Cambridge Ave - Option 3]

New Site
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Canterbury Rd											
1	L2	535	2.2	0.493	12.5	LOS A	13.5	96.0	0.52	0.73	49.2
2	T1	3	0.0	0.493	6.9	LOS A	13.5	96.0	0.52	0.73	49.9
3	R2	46	4.5	0.060	52.3	LOS D	1.2	9.1	0.83	0.70	32.0
Approach		584	2.3	0.493	15.7	LOS B	13.5	96.0	0.55	0.73	47.2
East: Cambridge Ave											
4	L2	819	3.3	0.821	32.8	LOS C	37.6	270.4	0.89	1.00	38.7
5	T1	522	8.3	0.520	46.5	LOS D	15.1	113.2	0.90	0.77	34.1
6	R2	131	16.1	0.784	78.2	LOS F	9.4	75.1	1.00	0.88	25.8
Approach		1472	6.2	0.821	41.7	LOS C	37.6	270.4	0.90	0.91	35.5
North: Railway Parade											
7	L2	87	6.0	0.090	11.6	LOS A	1.6	11.8	0.41	0.64	49.9
8	T1	3	0.0	0.090	6.0	LOS A	1.6	11.8	0.41	0.64	50.6
9	R2	137	2.3	0.350	56.0	LOS D	8.0	56.8	0.90	0.79	31.0
Approach		227	3.7	0.350	38.3	LOS C	8.0	56.8	0.70	0.73	36.5
West: Cambridge Ave											
10	L2	387	3.5	0.386	21.5	LOS B	12.2	87.7	0.60	0.78	43.9
11	T1	104	19.2	0.221	42.3	LOS C	5.5	44.7	0.82	0.66	35.5
12	R2	296	4.6	0.823	79.6	LOS F	10.8	78.8	1.00	0.90	25.8
Approach		787	6.0	0.823	46.1	LOS D	12.2	87.7	0.78	0.81	33.9
All Vehicles		3071	5.2	0.823	37.6	LOS C	37.6	270.4	0.79	0.84	36.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	49.0	LOS E	0.2	0.2	0.84	0.84
P2	East Full Crossing	53	52.4	LOS E	0.2	0.2	0.87	0.87
P3	North Full Crossing	53	46.5	LOS E	0.2	0.2	0.82	0.82
P4	West Full Crossing	53	54.2	LOS E	0.2	0.2	0.88	0.88
All Pedestrians		211	50.5	LOS E			0.85	0.85

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

PHASING SUMMARY

Site: 101 [Glenfield Road/Cambridge Ave - Option 3]

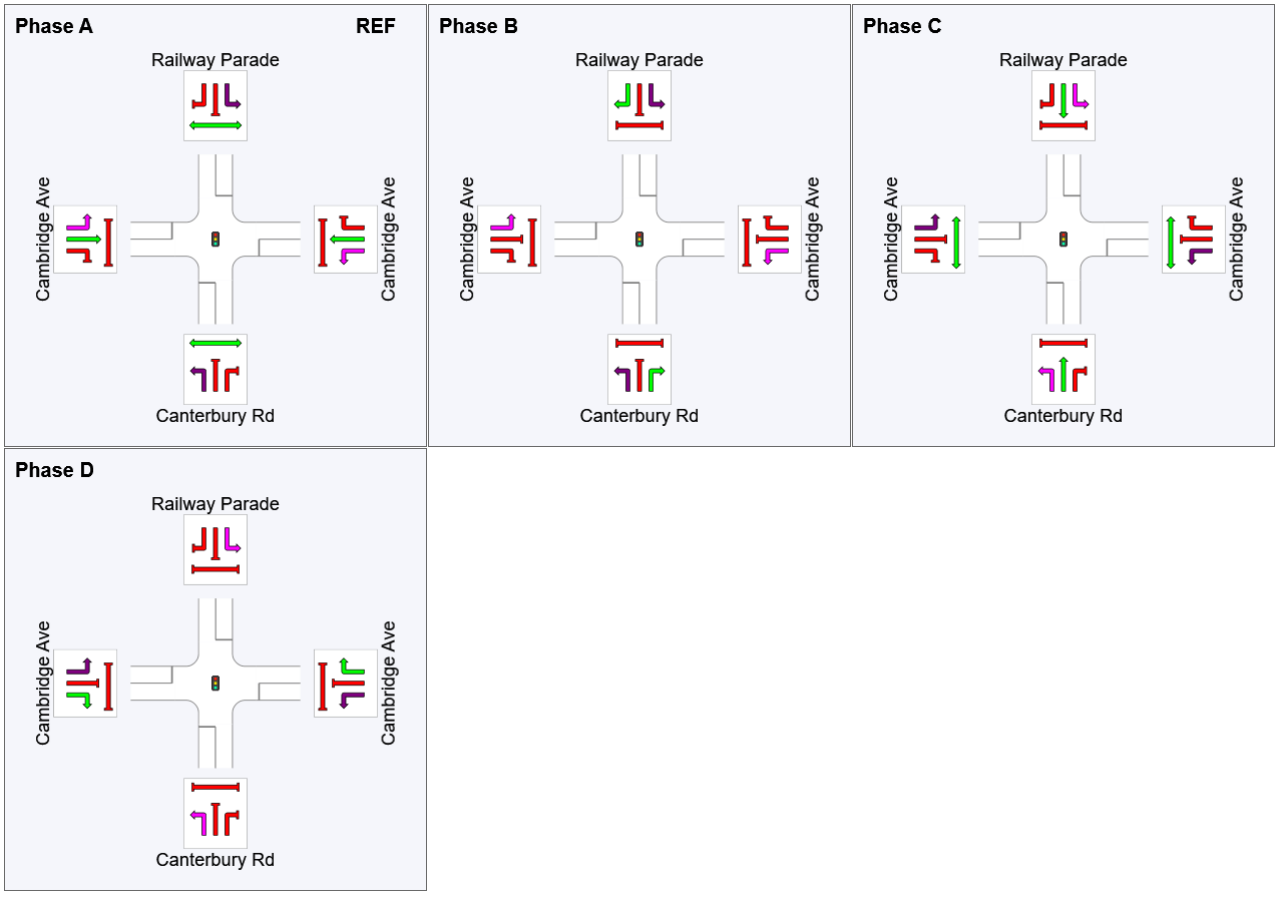
New Site
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Phase Times determined by the program
Phase Sequence: New Traffic Signal
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	44	80	120
Green Time (sec)	38	30	34	14
Phase Time (sec)	44	36	40	20
Phase Split	31%	26%	29%	14%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



Do-Ultimate scenario

Access Intersections

MOVEMENT SUMMARY

Site: 101 [Intersection 8 - 2026 AM]

Intersection 8 - 2026AM
Left In Left Out
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Site Road												
1	L2	648	1.1	0.542	5.4	LOS A	3.4	24.1	0.35	0.55	0.35	45.8
Approach		648	1.1	0.542	5.4	LOS A	3.4	24.1	0.35	0.55	0.35	45.8
East: Cambridge Ave (E)												
4	L2	316	0.7	0.171	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	46.6
5	T1	326	6.8	0.058	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		642	3.8	0.171	2.3	NA	0.0	0.0	0.00	0.26	0.00	48.3
West: Cambridge Ave (W)												
11	T1	945	5.7	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		945	5.7	0.168	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		2236	3.8	0.542	2.2	NA	3.4	24.1	0.10	0.23	0.10	48.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Intersection 8 - 2026 PM]

Intersection 8 - 2026AM
Left In Left Out
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Site Road												
1	L2	302	0.7	0.287	5.9	LOS A	1.2	8.7	0.39	0.61	0.39	45.7
Approach		302	0.7	0.287	5.9	LOS A	1.2	8.7	0.39	0.61	0.39	45.7
East: Cambridge Ave (E)												
4	L2	249	0.4	0.135	4.6	LOS A	0.0	0.0	0.00	0.53	0.00	46.6
5	T1	721	0.1	0.123	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		971	0.2	0.135	1.2	NA	0.0	0.0	0.00	0.14	0.00	49.1
West: Cambridge Ave (W)												
11	T1	782	4.6	0.138	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		782	4.6	0.138	0.0	NA	0.0	0.0	0.00	0.00	0.00	50.0
All Vehicles		2055	1.9	0.287	1.4	NA	1.2	8.7	0.06	0.15	0.06	48.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Intersection 9 - 2026 AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Site Road												
1	L2	206	1.0	0.149	9.7	LOS A	3.8	27.2	0.30	0.63	0.30	43.7
3	R2	368	2.3	0.487	36.5	LOS C	18.2	130.1	0.79	0.80	0.79	33.3
Approach		575	1.8	0.487	26.9	LOS B	18.2	130.1	0.61	0.74	0.61	36.4
East: Cambridge Ave (E)												
4	L2	326	7.4	0.267	6.7	LOS A	4.0	30.1	0.25	0.59	0.25	45.9
5	T1	440	4.8	0.472	57.7	LOS E	9.2	66.9	0.95	0.77	0.95	27.9
Approach		766	5.9	0.472	36.0	LOS C	9.2	66.9	0.66	0.70	0.66	33.5
West: Cambridge Ave (W)												
11	T1	727	7.2	0.285	25.1	LOS B	10.1	75.4	0.67	0.57	0.67	37.2
12	R2	220	0.5	0.475	52.6	LOS D	12.8	89.9	0.90	0.81	0.90	29.0
Approach		947	5.7	0.475	31.5	LOS C	12.8	89.9	0.72	0.62	0.72	34.9
All Vehicles		2288	4.8	0.487	31.8	LOS C	18.2	130.1	0.67	0.68	0.67	34.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	64.3	LOS F			0.96	0.96

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

PHASING SUMMARY

Site: 101 [Intersection 9 - 2026 AM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

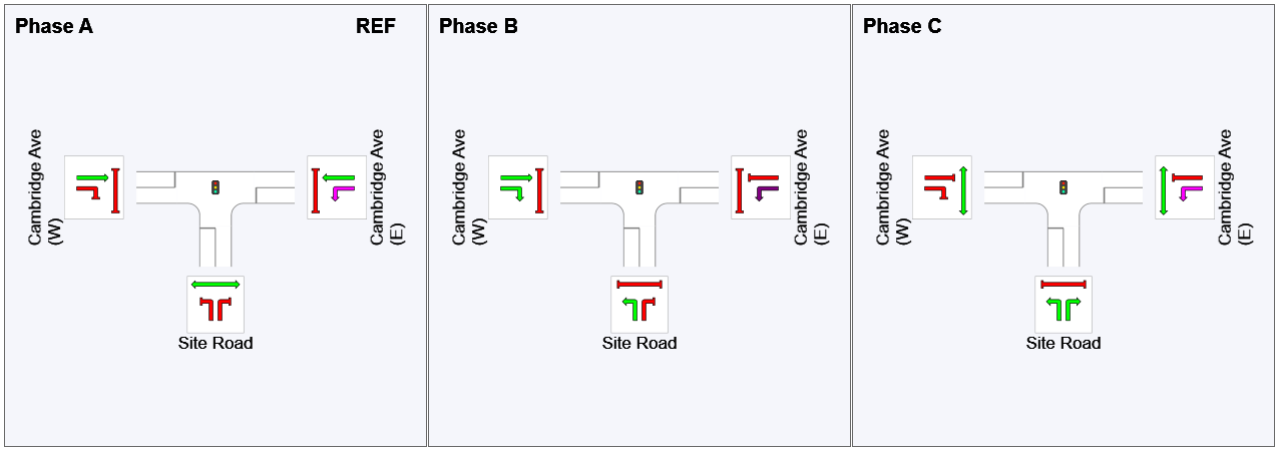
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Three Phases
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	29	70
Green Time (sec)	23	35	64
Phase Time (sec)	29	41	70
Phase Split	21%	29%	50%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

MOVEMENT SUMMARY

Site: 101 [Intersection 9 - 2026 PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Site Road												
1	L2	323	2.0	0.284	17.4	LOS B	9.9	70.5	0.49	0.70	0.49	40.1
3	R2	204	5.7	0.411	48.7	LOS D	11.3	83.2	0.86	0.79	0.86	30.0
Approach		527	3.4	0.411	29.5	LOS C	11.3	83.2	0.64	0.74	0.64	35.4
East: Cambridge Ave (E)												
4	L2	540	4.1	0.440	7.3	LOS A	7.5	54.2	0.35	0.64	0.35	45.6
5	T1	685	4.8	0.412	42.6	LOS D	12.5	90.9	0.85	0.72	0.85	31.6
Approach		1225	4.5	0.440	27.0	LOS B	12.5	90.9	0.63	0.68	0.63	36.6
West: Cambridge Ave (W)												
11	T1	584	5.9	0.175	13.6	LOS A	5.9	43.3	0.48	0.41	0.48	42.2
12	R2	198	0.5	0.416	51.0	LOS D	11.2	78.9	0.88	0.80	0.88	29.4
Approach		782	4.6	0.416	23.1	LOS B	11.2	78.9	0.58	0.51	0.58	38.0
All Vehicles		2535	4.3	0.440	26.3	LOS B	12.5	90.9	0.62	0.64	0.62	36.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P2	East Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
P4	West Full Crossing	53	64.3	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		158	64.3	LOS F			0.96	0.96

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

PHASING SUMMARY

Site: 101 [Intersection 9 - 2026 PM]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

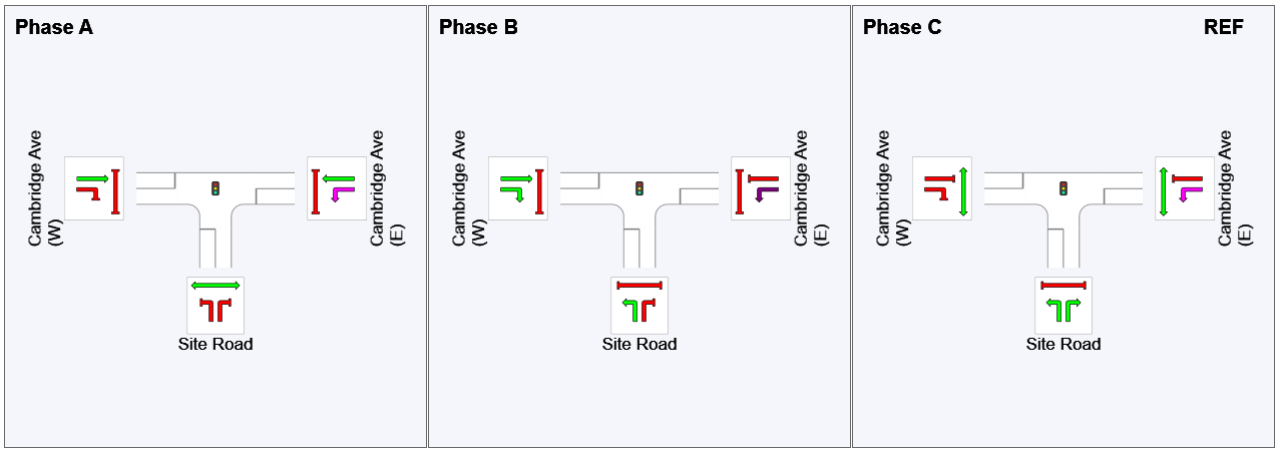
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: Three Phases
Reference Phase: Phase C
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	51	98	0
Green Time (sec)	41	36	45
Phase Time (sec)	47	42	51
Phase Split	34%	30%	36%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase