NSW DEPARTMENT OF PLANNING AND ENVIRONMENT

JANUARY 2018

Camellia Precinct

Transport and Traffic Assessment

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Camellia Precinct
Transport and Traffic Assessment

NSW Department of Planning and Environment

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REV	DATE	DETAILS
-	12/12/2016	Advanced Copy
A	23/12/2016	Draft
B	06/01/2017	Updated Draft
B3	23/02/2017	Updated Cost Estimates
C	19/12/2017	Final Draft – Revised Master Plan
D	18/01/2018	Final Draft Report
E	31/01/2018	Final Report

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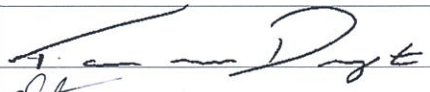
Prepared by:	Tom van Drempt	31/01/2018	
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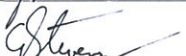
Approved by:	Graeme. Steverson	31/01/2018	

Source: Cover image – Parramatta Light Rail 'An artist's impression showing light rail at Camellia', Transport for NSW.

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EXECUTIVE SUMMARY

The Camellia Precinct is located within the Greater Parramatta growth area. It offers the opportunity to capitalise on its proximity to Parramatta CBD and Sydney Olympic Park, access to walking and cycling facilities and public transport proposals to reduce trip lengths and switch more trips to sustainable modes. However, the capacity of the surrounding arterial road network is likely to constrain its capacity to support large-scale development.

This study assesses the impact of the proposed rezoning of the Camellia Precinct, including the Camellia Town Centre Master Plan, and the capacity of the surrounding transport network to accommodate the additional trips it will generate. Preliminary traffic modelling has been undertaken to provide an understanding of the magnitude of road network improvements required to support the rezoning. However, a more detailed assessment is required to assess the proposed upgrades in the context of wider traffic congestion and growth in regional trips, which will place pressure on the arterial road network regardless of the Camellia Precinct rezoning.

The proposed creation of a town centre will introduce a large number of additional trips adjacent to the intersection of James Ruse Drive and Hassall Street, which is already operating with a poor level of performance. A Transit-Oriented Development (TOD) is proposed to reduce the number of car trips created, while still supporting a vibrant community along the proposed Parramatta Light Rail. To support this rezoning a package of transport improvements are proposed, shown in Figure ES.1

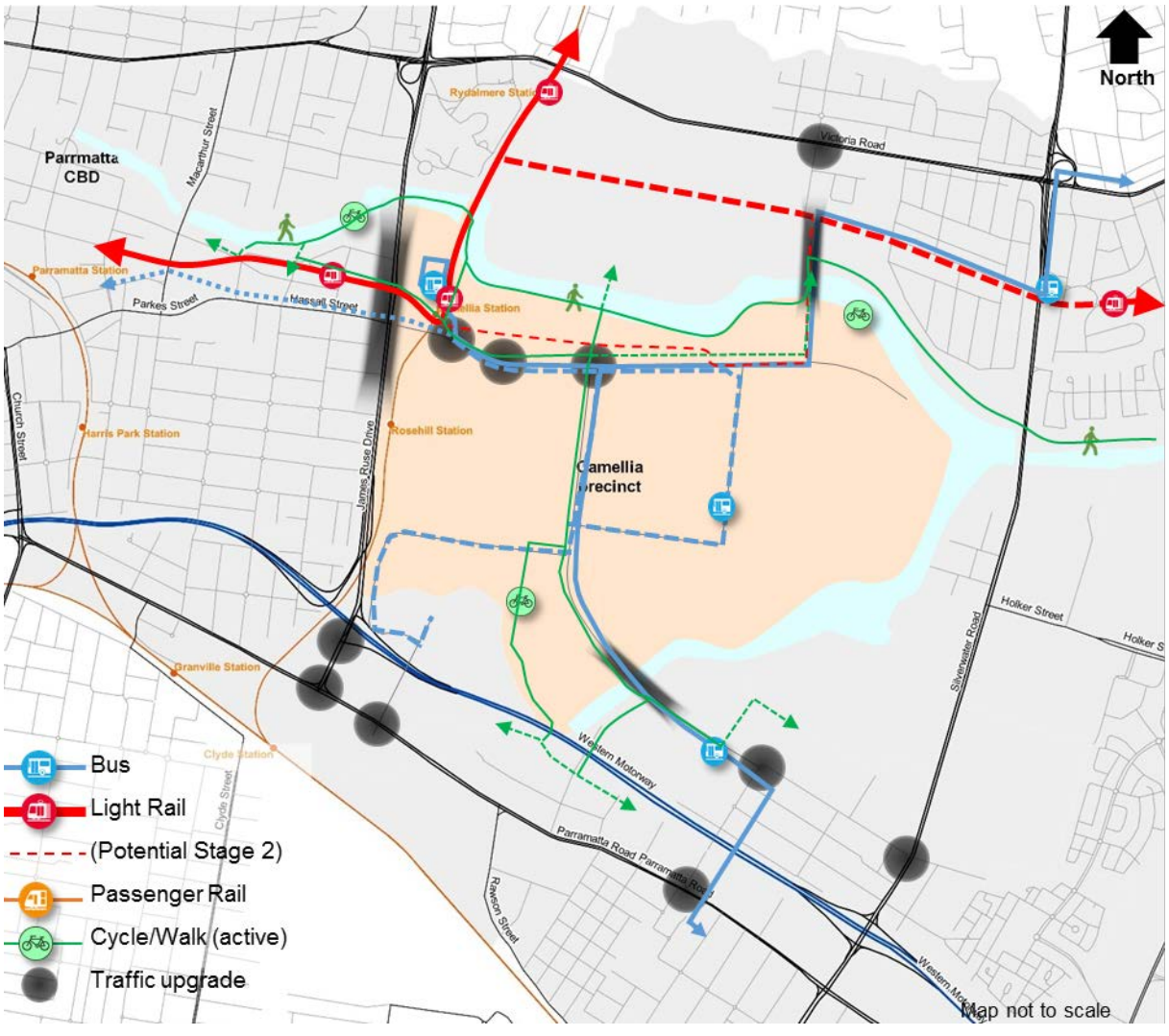


Figure ES.1 Proposed transport network to support the proposed Camellia Precinct rezoning

Achieving behaviour change

A change in travel behaviour is critical for the success of the precinct. The introduction of light rail is critical to achieving this behaviour change. However, it also needs to be supported by complementary local policies that encourage the use of walking, cycling and public transport, whilst not encouraging the use of private car travel. These policies include a constrained supply of on and off-street parking and travel demand management techniques. Support from City of Parramatta Council and Transport for NSW to ensure that these policies are delivered is import to the realisation of the transport vision for the Precinct.

The benchmarking of parking supply has indicated that flexible rates, in line with that of Parramatta CBD for some land uses would assist in achieving the transit-oriented development (TOD) principles of the development.

Mixing of industrial and town centre land uses

Separation of freight traffic and town centre activity is required to provide the expected level of amenity for the new community and maintain the efficiency and competitiveness of local industry. Road network improvements are proposed that offer improved routes for freight traffic to the southern portion of the Precinct without reliance on Grand Avenue and Hassall Street, which pass through the southern boundary of the town centre.

Major infrastructure items proposed, other than the Parramatta Light Rail include:

- Grade separation of James Ruse Drive over Grand Avenue North/Tramway Avenue and Hassall Street intersections.
- A new bridge over Duck River, connection to Silverwater Road and Parramatta Road via Carnarvon Street and Stubbs Street – to reduce the number of trucks passing the town centre.
- A new connection from Unwin Street to the intersection of James Ruse Drive and the M4 Motorway to provide a connection to the primary fright route, reducing trucks passing the town centre.
- A new bridge over Parramatta River at Thackeray Street and upgrade of the intersection of Victoria Road and Park Road.

Capacity of transport network

The impact of two land use scenarios were tested to determine the amount of additional development that could be supported with a reasonable range of transport improvements. These include a Medium scenario with 10,000 dwellings and 8,850 jobs; and a High scenario with 14,000 dwellings and 12,550 jobs.

The results of the assessment indicate that the High land use scenario cannot be accommodated without a larger-scale public transport improvement to create an even larger change in travel behaviour than the Parramatta Light Rail. It indicates that the upgraded road network can support the traffic generated by the Medium land use scenario. However, the impact of the Paramatta Light Rail Stage 2 route, the capacity for additional traffic on South Street and the upgrade of the intersection of Victoria Road and Park Road requires further assessment.

The forecast extra passenger loads on public transport are within a range that could be accommodated on the network depending on the loads from other parts of the route. However, further detailed analysis is recommended to confirm these conclusions in the light of wider pressures on the transport network.

An estimate of the cost of the proposed minimum package of transport infrastructure improvements of $498.3 million has been made. The delivery of infrastructure and the release of land will need to be staged to balance the funding of the upgrades with the capacity needs of the new development. Further investigation into developer contributions and other sources of funding is required (e.g. Special Infrastructure Contributions levy), along with liaison with the relevant transport and planning agencies.

1 INTRODUCTION

This report documents the results of a strategic traffic and transport assessment of the potential revitalisation of the Camellia Precinct (the Precinct). The purpose of the report is to assess the impacts of the proposed future rezoning of the Precinct, including the Camellia Town Centre Master Plan, by the Department of Planning & Environment (the Department) in partnership with City of Parramatta Council (Council) and provide advice on a range of transport measures that are potentially required to support the levels of growth under the proposed rezoning.

1.1 BACKGROUND

The Camellia Precinct is located within the Greater Parramatta growth area identified in the Department's **A Plan for Growing Sydney (2014) and the District Plans.** The growth area is expected to grow significantly over the next 20 years and build upon Parramatta's status as Sydney's second CBD.

In 2014, City of Parramatta Council released a Discussion Paper on the Camellia Precinct titled **Camellia – 21st Century Business, Industry and Entertainment Precinct**. The Strategy responds to Council's vision for the precinct, redefines land use identified in the Discussion Paper and provides a high-level infrastructure capacity analysis.

The Department, together with City of Parramatta Council (Council), prepared a Land Use and Infrastructure Strategy (the Strategy) to underpin the future redevelopment of the area. The Strategy identifies future land uses for the Precinct and identifies areas for renewal as well identifying the necessary infrastructure requirements to support this projected growth. It also considers the opportunity to integrate plans for future light rail routes to and from Parramatta, which supports increased development resulting from a rezoning.

In August 2015, the Strategy was released for public comment. The public exhibition of the Land Use and Infrastructure Strategy closed on 18 September 2015. The results of the consultation to date have been reviewed and used to inform the more detailed rezoning proposal.

The Camellia Town Centre Master Plan advances the Strategy by proposing specific land uses, height and density controls that guide the magnitude of development within the Precinct. It includes further technical studies including the more detailed analysis of transport infrastructure and local access, contained in this report including a list of recommended infrastructure improvements.

1.2 STUDY OBJECTIVES

The key objective of the study is to assess the transport implications that would arise from the revitalisation of the Camellia Precinct to be included in an application for the land to be rezoned. This report outlines the travel requirements of the Camellia Precinct by road, public transport, walking and cycling, for passenger and freight movement. The objective of this report is to:

- identify and manage the transport impacts of the Precinct on the surrounding area and transport networks and future transport projects in the vicinity
- develop strategies to reduce reliance on the private car.

1.3 STUDY AREA

The Camellia Precinct is strategically located approximately 2 km east of Parramatta CBD. A map of the study area is shown in Figure 1.1. The Precinct is positioned with good access to four arterial roads (James Ruse Drive, Parramatta Road, Silverwater Road and Victoria Road) and the M4 Western Motorway. It is served by existing and recently disused rail lines. The Parramatta River and Duck River run along the northern and eastern sides of the Precinct.

Figure 1.1 Study area

Currently, the Camellia Precinct is mainly zoned for IN3 heavy industry and RE2 private recreation (racecourse and speedway). The nearby Silverwater and Rydalmere industrial areas offer the potential for agglomeration of business if new roadway connections can be established. Camellia Town Centre is located in the north-west area of the Camellia Precinct, north of Grand Avenue.

1.4 THIS REPORT

This report is structured as follows:

- Section 2 contains a review of the relevant State and Local government plans and strategies, and recent studies for other developments.
- Section 3 outlines planned and proposed transport infrastructure improvements in the vicinity
- Section 4 presents information on existing transport conditions
- Section 5 briefly outlines the development potential to realise the Camellia Precinct
- Section 6 contains a summary of constraints and opportunities for the revitalisation of the precinct and presents a high-level assessment of the options for future road connections
- Section 7 proposes a strategy for each mode of transport requiring access to the Camellia Precinct
- Section 8 summarises the ability of the transport network to accommodate the proposed rezoning with the proposed upgrades
- Section 9 outlines the infrastructure timing, funding and possible delivery strategy
- Section 10 discusses the next steps for the Precinct and the projects identified.

2 LOCAL AND STRATEGIC CONTEXT

The Camellia Precinct has been identified as a potential location for urban renewal due to its proximity to the Parramatta CBD and the arterial road network. It is one of several potential development areas in and around Parramatta, and in the corridor between Parramatta and Sydney Olympic Park. The concentration of urban renewal opportunities places additional pressure on surrounding transport infrastructure, but also offers an opportunity to use the scale of development to realise substantial improvements in transport.

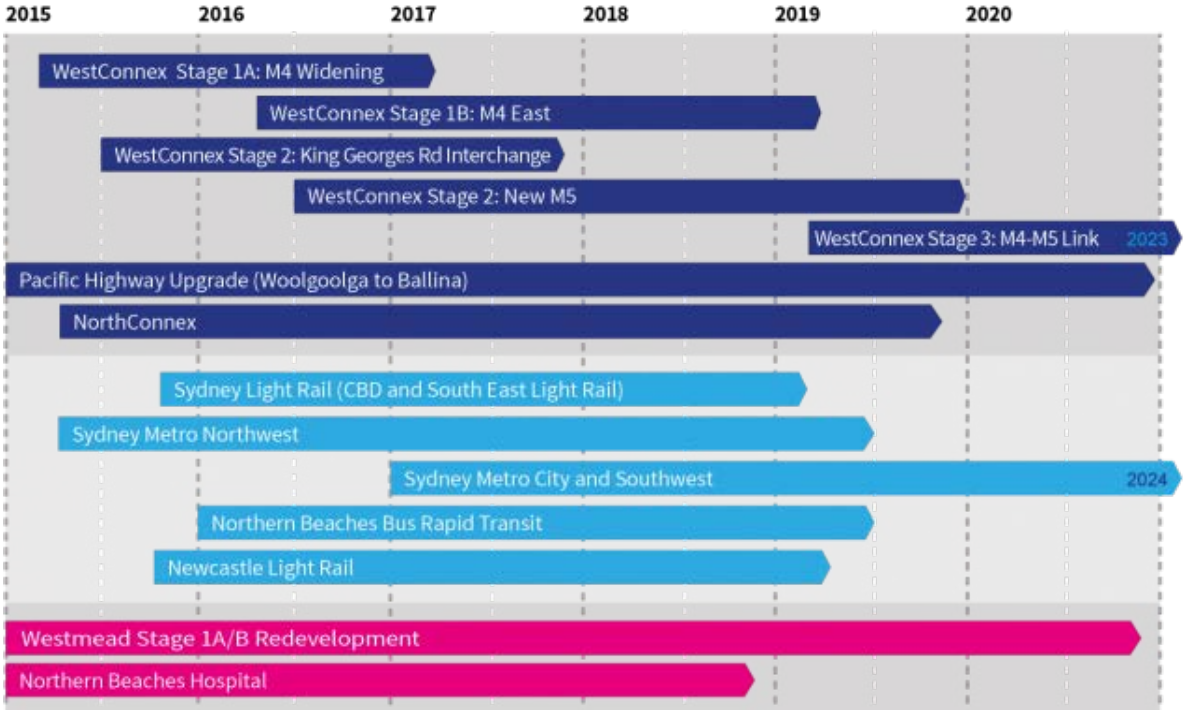
2.1 STATE PLANNING CONTEXT

The proposed review of land uses within the Camellia Precinct is supported by State Government strategies and planning documents. The most relevant documents are reviewed in this section.

2.1.1 NSW PREMIER'S PRIORITIES

In September of 2015, NSW Premier announced *30 New Priorities for NSW*. Among these priorities, to deliver key infrastructure projects is a plan to support 40% more train trips, 30% more car trips and 31% more households over the next 15 years because of the growing population in NSW. In combination with the Long Term Transport Master Plan and Sydney modal plans (and the draft *Future Transport Strategy 2056*[1]), it will locate more people within easy access of improved transport services in the future.

The WestConnex project (Stages 1 and 3 in particular) will potentially benefit the Camellia Precinct. Stage 1A, near the Precinct, as shown in Figure 2.1, was opened in July 2017. Along with the main WestConnex projects, other improvements are planned that will link the Precinct to them more easily.



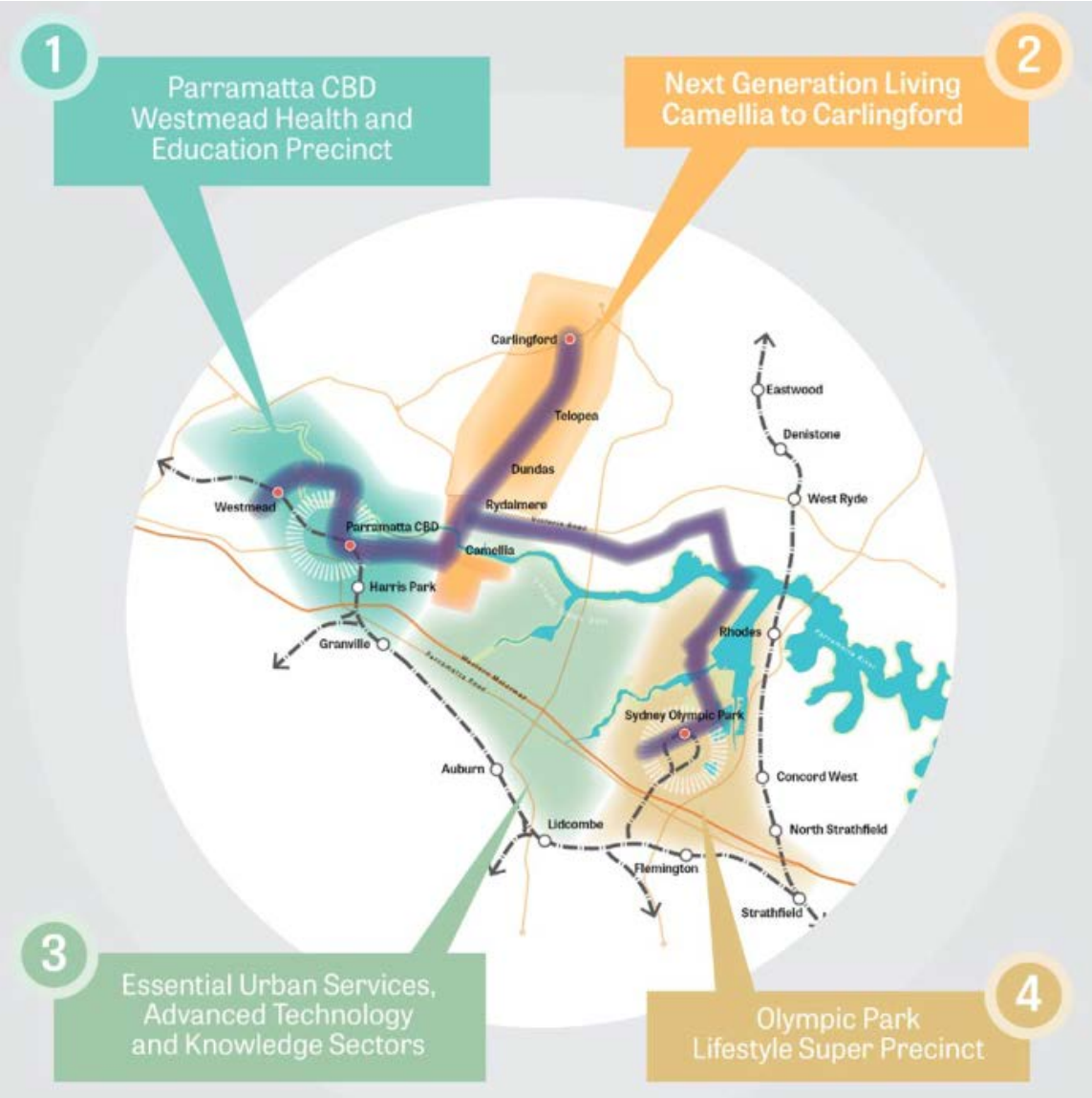
Source: Infrastructure NSW https://www.nsw.gov.au/premiers-priorities-list/building-infrastructure

Figure 2.1 Key Infrastructure Projects announced on the Premier's Priorities

[1] Draft Future Transport Strategy 2056, NSW Government October 2017

2.1.2 *Draft Greater Sydney Region Plan*

The Draft Greater Sydney Region Plan, was released by the NSW Government in October 2017, to guide land use planning decisions over the next 40 years. It identifies the location of future urban development, the strategic transport corridors and major centres, including a vision to support the growth of the Greater Parramatta and the Olympic Peninsula (GPOP) area as a key part of the Central River City. Camellia is identified as part of a 'Next Generation' living area extending to Carlingford as shown in Figure 2.2.



Source: Draft Greater Sydney Region Plan, NSW Government, October 2017

Figure 2.2 Greater Parramatta and the Olympic Peninsula area

The Parramatta Light Rail and Sydney Metro are identified as key projects to link an economic activity area with up to 370,000 jobs by 10 to 15-minute travel on public transport. The Plan identifies the need for 'high quality, new places for people to enjoy a more urban lifestyle'. To achieve this, collaboration is sought between State and local government agencies, as well as businesses and the community. It identifies the development by December 2018 of a 'growth infrastructure compact to outline the order, priority and funding of local and regional infrastructure aligned to growth.

Camellia is seen to offer the opportunity for clean technology employment. Industry and research institution participation is encouraged to create a "clean-tech" cluster around Camellia, Rydalmere, Silverwater and Auburn.

The Plan mentions the potential new train link between the Western Sydney Airport – Badgerys Creek Aerotropolis and Greater Parramatta. Also mentioned are improvements to public transport connectivity, including to Sydney Olympic Park and Bankstown, and infrastructure investments which enhance walkability and cycling. The walking and cycling improvements would be focused on access to the transport network, the quality of links along the Parramatta River and within 10 kilometres of Greater Parramatta.

The Plan retains the Green Grid, a concept for an interconnected system of natural landscapes, local open spaces and strategic parks. The Green Grid will promote more walking and cycling for healthy lifestyles. The Green Grid will be supported with the planning of a network of landscaped shared pathways within the Precinct, and river trails along Parramatta River and Duck River. Specific projects contained in the supporting document (*Sydney Green Grid Spatial Framework and Project Opportunities West Central District*, Tyrrell Studio March 2017) are identified at:

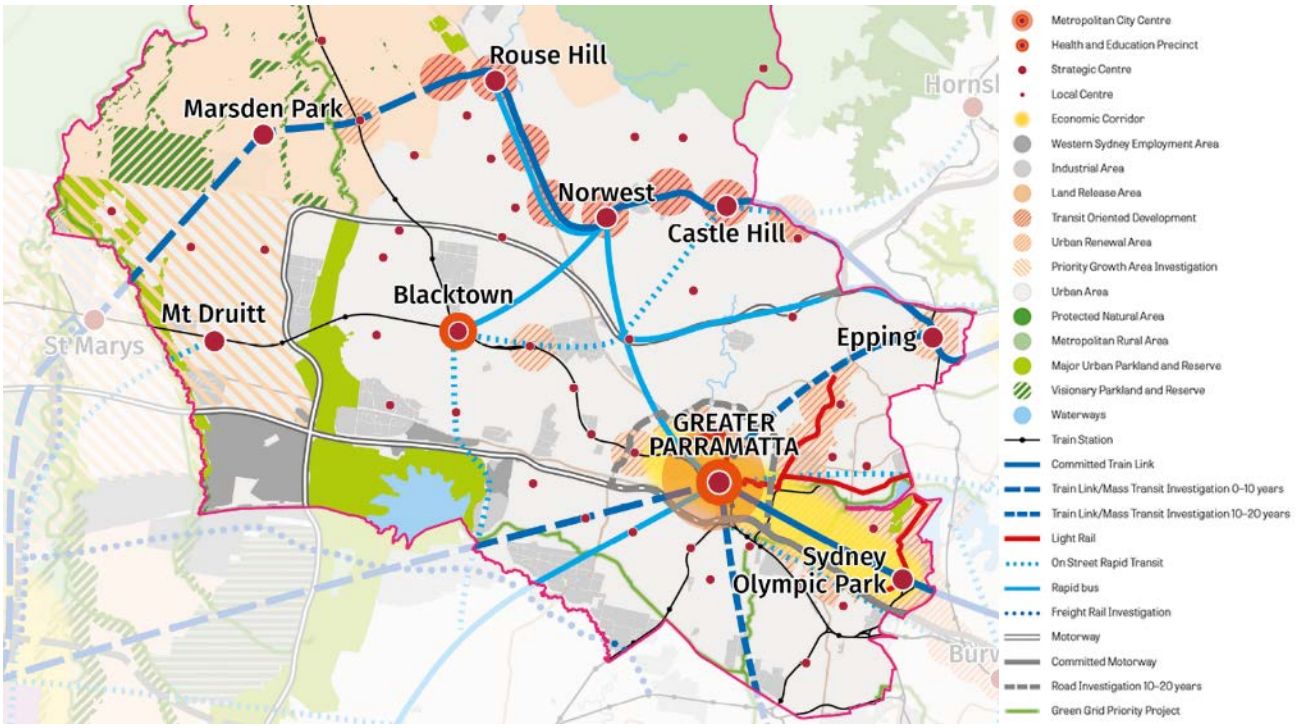
- Parramatta River Corridor:
  - Carlingford Rail Line, Subiaco Creek and Rydalmere Industrial Area;
  - Subiaco Creek and Camellia Waterfront, Duck River and;
  - Camellia Wetlands, Camellia;
- Duck River Corridor:
  - Parramatta River and Silverwater Park, and;
  - Parramatta Road crossing.

2.1.3 DISTRICT PLANS

The NSW Government released five draft District Plans that set out how the *Draft Greater Sydney Region Plan* will be applied to local areas. They are also designed to assist the coordination of integrated planning for land use, transport and infrastructure. The Revised Draft Central City District Plan (Greater Sydney Commission, October 2017) covers the Greater Parramatta area as well as areas of Blacktown, Cumberland and The Hills local government areas.

The Camellia Precinct is one of the key economic generators of the area, which in turn is one of the main employment areas within the Central River City. In addition, the GPOP area is strategically located between Western Sydney Airport and Sydney CBD, and therefore has the potentially to act as a gateway/hub between the two.

In terms of transport, the District Plan and GPOP supporting documents focus on improving access to jobs and the efficiency of freight movement. Traffic congestion and parking provision are identified as key local issues, with a resulting strategy to increase the use of walking, cycling and public transport to combat these issues. Several projects are identified, shown in Figure 2.3.



Source: Revised Draft Central City District Plan, Greater Sydney Commission, October 2017

Figure 2.3 Central City District Plan

From an active transport perspective, priority projects are identified on the Green Grid, including the Parramatta River and Duck Rover Corridors. For the Camellia Precinct, this means providing continuous corridors east–west on both sides of Parramatta River from Westmead to Sydney Olympic Park and Rhodes and north-south linking Parramatta, Camellia, Granville, Auburn, Regents Park and south to Bankstown.

2.1.4 INTERIM GREATER PARRAMATTA LAND USE AND INFRASTRUCTURE IMPLEMENTATION PLAN

The Interim Greater Parramatta Land Use and Infrastructure Implementation Plan (LUIIP) for the Greater Parramatta Growth Area (GPGA) was exhibited in July 2017 and is currently being finalised. The LUIIP identified how more jobs, homes and essential services will be accommodated in the GPGA over the next 20 years. It includes a land use framework to guide the future redevelopment of the priority growth area, identifies key actions for the short term and allows the Department and other government agencies to identify and plan for the infrastructure required to unlock its potential. The LUIIP currently forecasts more than 72,000 additional dwellings and more than 113,000 additional jobs within the priority growth area over the next 20 years. The LUIIP identifies projected growth in Camellia to 2036 will be limited to 10,000 dwellings and is expected the precinct will accommodate 8,850 jobs. The LUIPP recognises the importance of planning for Camellia holistically and the significance of the role of the Department working with Transport for NSW and Roads and Maritime Services to develop traffic and transport solutions for Camellia, so that planning for additional homes and jobs can progress.

2.1.5 NSW LONG TERM TRANSPORT MASTER PLAN

The NSW Long Term Transport Master Plan (LTTMP) (Transport for NSW, December 2012) provides a framework for addressing transport challenges over the next 20 years. It supports the strategies of *A Plan for Growing Sydney* by integrating land use and transport planning, locating increased development in locations with increased transit capacity to make more efficient use of the transport infrastructure. A mixture of land uses is encouraged to balance the movement of people into and out of an area. For the Camellia Precinct, it seeks to improve the frequency of public transport services to Parramatta CBD through Westmead, Rydalmere, Camellia, Granville and Merrylands.

It identifies the Parramatta Road to CBD via Strathfield as a corridor under pressure, with trains on the T1 Western Line experiencing high congestion and the M4 Western Motorway and Parramatta Road operating at capacity during peak periods. Proposed key actions include increasing rail frequency and capacity for east-west rail journeys, primarily to Parramatta and Sydney CBD and M4 widening and connection to Port/Airport through the WestConnex project. The Parramatta Road to CBD via Strathfield corridor is identified as a corridor for protection, in part due to the need to support future urban growth.

The LTTMP also identifies the development of Parramatta Valley Cycleway from Westmead to Sydney Olympic Park. At the moment, this route travels along the northern bank of the Parramatta River near Camellia. However, there is scope for the Camellia Precinct to connect to this cycleway, and in the long-term a route on the southern bank should be considered.

DRAFT FUTURE TRANSPORT STRATEGY 2056

A revision to the LTTMP is currently on public exhibition for comment (until 3 December 2017), which as part of a five-yearly update to the Plan. The Strategy contains a wide range of planning visions, directions and outcomes to guide the progression of transport in Sydney over the next 40 years. It builds on the three cities concept contained within the District Plans.

With its position in Greater Parramatta, the Camellia Precinct will benefit from mass transit initiatives designed to achieve a 30-minute access journey to Greater Parramatta. These initiatives will also act to strengthen the connection between Camellia and Parramatta CBD, which is key to the Precinct achieving a lower level of car use. The new Parramatta light rail network for Greater Parramatta will also support local access and urban renewal. For Camellia, it will deliver public transport connections to the north-east and west, reducing the current dependence on car travel to access the precinct.

The Strategy plans efficient and reliable freight journeys with 24/7 (rail) access between key freight precincts and convenient access to centres. Camellia's continuing use as an employment and industry area will create the need for it to compete successfully with other areas of Sydney with 24/7 access that doesn't interfere with its new residential uses.

It advocates the application of the 'movement and place' approach to match road function with user groups and create better places and communities. This is important for Grand Avenue, which will be asked to perform multiple roles for industry, resident, town centre and special event access.

The Strategy forecasts that by 2056, two thirds of people will like within 2 km of a centre. In terms of travel choices, this requires strong pedestrian and cycle connections from Camellia into the cycle network surrounding Parramatta CBD. It also requires Camellia to become part of the network for other areas as they connect to the Parramatta network.

GREATER SYDNEY DRAFT SERVICES AND INFRASTRUCTURE PLAN

The Greater Sydney Draft Services and Infrastructure Plan supports the concept of a 30-minute city, where people can reach their nearest Metropolitan and Strategic Centres within 30 minutes 7 days a week to access education, jobs and services by public transport regardless of where they live.

The Strategy outlines increases in service levels on existing public transport corridors as well as the following transport initiatives that could affect travel to the Camellia Precinct:

- Committed initiatives (0–10 years)
  - Parramatta Light Rail Stages 1 and 2
  - Sydney Metro West
  - WestConnex
- Initiatives for investigation (0–10 years)
  - Victoria Road Public Transport Improvements
  - WSA–Badgerys Creek Aerotropolis to Parramatta Train Link
- Initiatives for investigation (10–20 years)
  - Parramatta Outer Ring Road (incorporating James Ruse Drive)
  - Parramatta to Epping train/mass transit link
  - Parramatta to Kogarah train/mass transit link
- Visionary initiatives (20 + years)
  - Parramatta to Norwest train/mass transit link
  - Central City Strategic Road Corridor from NorthConnex to Southern Sydney

2.1.6 STATE INFRASTRUCTURE STRATEGY, 2014 UPDATE

The State Infrastructure Strategy (SIS) outlines the priorities for NSW Government infrastructure funding for the next 20 years. The latest update[2] indicates the projects to be prioritised for the second round of funding.

One of the SIS's main goals is to support population and economic growth in Greater Sydney, including Parramatta. The report recognises the additional pressure on infrastructure that population and employment growth in Western Sydney will create. Projects to assist in achieving this include $1 billion for the Western Sydney Rail Upgrade Program as part of the implementation of Stage 2 of *Sydney's Rail Future* (see section 2.2.1).

The potential creation of a public transport (light rail or metro rail) corridor between Parramatta and Strathfield (now proposed as Sydney Olympic Park/Carter Street), via Camellia would allow people to access Camellia without relying on the Western Line. The SIS also announces $600 million for the Parramatta CBD Public Transport Improvement Program, in addition to $400 million previously reserved in the 2014 Budget.

[2] State Infrastructure Strategy 2014 Update, Infrastructure NSW, November 2014.

2.1.7 NSW DRAFT FREIGHT AND PORTS PLAN

The NSW Draft Freight and Ports Plan provides the structure for a freight and port system that caters for a potential doubling of the freight task within Greater Sydney over the next 40 years.

Priority areas for investment include:

1. Strengthen freight industry and government partnerships
2. Increase access for freight across the road and rail network – including 24/7 access for freight
3. Protect existing freight precincts and ensure sufficient future land use
4. Facilitate introduction of technologies that reduce freight costs and impacts
5. Reduce the regulatory burden on industry
6. Ensure safe, efficient and sustainable freight access to places.

The Plan identifies a trend of urban encroachment into industrial areas as a risk to the efficiency of freight movement, including restricted access to key freight corridors and limited ability to meet future demand. With development proposed near the remaining industrial areas of the Camellia Precinct, consideration needs to be given to the preservation of 24/7 access to the road network and mitigation of traffic congestion. Projects included in the Plan that are relevant to access to Camellia include: a future Western Sydney Freight Line and Western Sydney Fuel Pipeline, and completion of WestConnex.

The types of materials that could require transporting will be dictated by the types of businesses that locate themselves within the precinct. The existing transport of petroleum products, waste and construction materials is likely to continue. The movement of waste and construction materials (across NSW) is currently dominated by road (92% and 95% respectively) with a small remaining percentage moved by rail. The movement of fuel is split between 73% by road and 27% by pipeline. Potential opportunities for the movement of construction materials include increased use of high performance vehicles (HPVs).

The Clyde and Camellia areas have good access to the M4 Western Motorway (and WestConnex) which will provide motorway access to freight and port facilities at Port Botany. These connections to intermodal facilities increase the attractiveness for the Camellia Precinct to be used by freight-generating industries. The completion of WestConnex will provide improve access within the vicinity of the Camellia Precinct. However, 24/7 connections to the Motorway network and the preservation of larger vehicle routes through Camellia are required to take advantage of this improvement.

For the movement of fuel, the Plan recommends that the NSW pipeline network is the safest and most efficient network strategy for the future. For Camellia, this means maintaining its current access to the fuel pipes from Gore Bay and to Newcastle and Sydney Airport. However, road transportation of fuel will remain important for Camellia in the future.

The Viva Energy (formerly known as Shell) site no longer operates as a refinery and is currently being converted to a finished fuels storage terminal. The terminal receives fuel from Gore Bay. From Clyde, it is transported by road to individual customers, by pipeline to Sydney Airport (jet fuel), Newcastle and the nearby Caltex and Mobil Silverwater Terminal. These pipelines are proposed to remain operational into the future. The Clyde Terminal distributes around 40% of the refined petroleum product requirements of NSW[3]. The EIS estimates that approximately 250 heavy vehicle fuel tanker movements in each direction are generated each day and that this is expected to continue in the future.

Camellia is located immediately north of a freight activity precinct that stretches from Chullora to the Clyde Intermodal Terminal. Disused freight rail lines exist between Camellia and Clyde. The Clyde Intermodal Terminal is located on a shared section of the rail network adjacent to the T1 Western Line and T2 South passenger line near the Northern Sydney Freight Corridor and Southern Sydney Freight Line.

Clyde Intermodal Terminal is used to move containerised waste to Woodlawn by rail. The terminal receives 500,000 tonnes of waste per annum from central, inner west and some northern Sydney council areas. Clyde also receives sugar and cement by rail for distribution by road.

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[3] Clyde Terminal Conversion Project Environmental Impact Statement, Prepared for the Shell Company of Australia Ltd, November 2013

2.1.8 WESTERN SYDNEY RAIL NEEDS SCOPING STUDY DISCUSSION PAPER

The Western Sydney Rail Needs Scoping Study Discussion Paper (Australian Government Department of Infrastructure and Regional Development, September 2016) is a study to better understand the need, timing and service options for rail investment to support Western Sydney and the proposed Western Sydney Airport. The study is predominantly interested in passenger rail requirements for Western Sydney, but freight requirements are also being considered.

Current projections indicate high levels of overcrowding on T1 Western Line services by 2051. Some of the options for reducing this overcrowding being considered for further investigation include:

- A new western metro-style service
- Increasing capacity of existing network (including T1 Western Line)
- New higher speed rail linking Parramatta and the Sydney CBD.

Due to the early stage of the study, any potential alignments or station locations for a new metro-style service are not known. However, the Camellia Precinct is within the broader corridor being considered in this scoping study. Further discussion is provided in section 3.5.

2.2 SYDNEY'S TRANSPORT MODE PLANS

2.2.1 SYDNEY'S WALKING FUTURE

Sydney's Walking Future (Transport for NSW, 2013) is an action plan aiming to promote more walking in Sydney. This will be provided for through:

- design and development principles for interchanges prioritising walking routes
- provision for walking links from the surrounding suburbs
- a focus on safety and access for disabled persons or the mobility impaired
- the walkability index which will lead to improved standards, guidelines and benchmarks for walking solutions
- improved design of pedestrian infrastructure
- education programs and conferences
- involvement with community events and initiatives
- improved trip planning information on the ground and online.

Sydney's Walking Future targets the removal of barriers to pedestrian movement within approximately 2-kilometres of activity centres. The north-west corner of the Camellia Precinct is located within 2 km of Parramatta CBD. This part of the Camellia Precinct would be the site for the greatest density of development, boosting the need for pedestrian facilities. Walking connections to Parramatta CBD increase transport mode choice and complement future plans for light rail.

2.2.2 SYDNEY'S CYCLING FUTURE

Sydney's Cycling Future (Transport for NSW, 2013) is a long term plan for cycling in Sydney that proposes to create safe, connected cycling networks by:

- creating new or improve existing infrastructure and facilities, particularly within 5 km of major centres or near key destinations
- fixing missing links
- creating hierarchy of safe cycling routes
- delivering improvements with major infrastructure projects.

The Camellia Precinct lies within 5 km of both Parramatta and Sydney Olympic Park (both identified as major centres), and hence provides an opportunity to gain additional benefit from the cycle improvements identified. The cycle network for Parramatta CBD includes the Parramatta Valley Cycleway, M4 Motorway, and Duck River corridors, all of which pass by but do not directly serve the Camellia Precinct. Opportunities exist to connect to these routes through the Camellia Precinct.

The plan identifies that cycling links which feel safe and match cyclists' abilities are key to promoting increased cycling trips. These links are required outwards from centres, connecting to key routes and destinations, like other centres. Also identified is the importance of providing adequate end-of-trip facilities at key destinations.

2.2.3 SYDNEY'S BUS FUTURE

Sydney's Bus Future (Transport for NSW, 2013) is the NSW Government's long term plan to redesign Sydney city's bus network. It proposed a three-tiered bus network comprising:

- rapid bus routes (high frequency, all-day, linking centres)
- suburban bus routes (high-frequency, more closely spaced stops, link suburban areas to major centres)
- local bus routes (increased coverage, daytime services, less frequent, more closely spaced stops).

None of the proposed rapid or suburban routes currently proposed (see Figure 2.4) would serve the Camellia Precinct. However, a new high frequency (suburban) bus or light rail route between Parramatta and Sydney Olympic Park could be established if the road network can be completed between the two with a bridge crossing of Duck River.

Source: Sydney's Bus Future, (Transport for NSW, December 2013)

Figure 2.4 Rapid and Suburban bus routes supporting Parramatta, Western Sydney's major CBD

2.2.4 SYDNEY'S LIGHT RAIL FUTURE

The NSW Long Term Transport Master Plan, Sydney's Light Rail Future and Sydney's Bus Future identified strategic transport corridors in Western Sydney to be considered for upgrading to Rapid bus routes or light rail. Transport for NSW looked at a number of these potential light rail corridors and undertook detailed studies. Each route was assessed against key criteria including the potential to improve accessibility, the ability to improve transport services, current and planned land use in each region, the potential to minimise congestion, avoid impacts to the community and support Parramatta as Sydney's second CBD.

The Plan indicates that the levels of cumulative development proposed in the Parramatta to Olympic Peninsula Priority Growth Area cannot be accommodated solely on the road network and the existing public transport network. Investment in high-capacity and frequent public transport would assist several urban redevelopment precincts.

The proposed employment growth targets for the Parramatta CBD (to further reinforce its role as Sydney's second CBD), Camellia, Sydney Olympic Park Precinct and Carter Street Priority Precinct, combined with new residential development will induce a large amount of travel east-west along this corridor in both directions. An analysis of trip patterns from 2011 indicates that there is a strong demand from employees living in the western suburbs to employment in Sydney Olympic Park and Carter Street Priority Precinct. An efficient rail to light rail interchange would provide an efficient alternative to car travel via the M4 Western Motorway or parallel routes.

Where a route has not been shortlisted for light rail, high-frequency and fast rapid bus routes will be progressively delivered to connect every regional major centre to Parramatta, as outlined in Sydney's Bus Future. Existing bus services will also be progressively upgraded on the shortlisted light rail routes while light rail is investigated to address customer needs and support growing demand. There is also the potential for a rapid bus service to be introduced along the future light rail route, and then converted to a light rail service once patronage has reach a sufficiently high level.

Since the production of this plan, the NSW Government has announced its preferred network. Further details are provided in section 3.4.

2.2.5 SYDNEY'S RAIL FUTURE

Sydney's Rail Future (Transport for NSW, 2012) aims to 'transform and modernise Sydney's rail network' and improve the customer experience through a long term plan. For the Parramatta area, the plan includes:

- a greater emphasis on express services from Sydney CBD to Parramatta, Blacktown and Penrith
- more efficient interchanges to other transport modes and services
- better connections to Liverpool and the south west, with all-day, frequent and reliable services.

2.3 LOCAL STRATEGIES

2.3.1 CAMELLIA 21ST CENTURY BUSINESS, INDUSTRY AND ENTERTAINMENT PRECINCT DISCUSSION PAPER

City of Parramatta Council, in consultation with land owners in the Camellia Precinct produced the Camellia Discussion Paper[4] as a first step towards developing a long-term vision for the Precinct. The NSW Department of Planning and Environment has responded to the Discussion Paper by undertaking a range of investigations, including this transport assessment, to test the development potential of the Precinct and inform a Land Use and Infrastructure Strategy for Camellia.

The Discussion Paper identifies the Precinct's strategic advantages as being one of the few remaining large industrial areas in the inner West, close to Parramatta CBD and close to major transport connections, including the M4 Western Motorway (near the start of the WestConnex motorway), James Ruse Drive, Parramatta Road, Silverwater Road, Victoria Road, the Carlingford Railway Line, disused industrial freight railway lines and the potential Parramatta Light Rail Corridors.

The Discussion Paper notes that the Precinct is currently served by two congested access points onto James Ruse Drive and Wentworth Street (joining to Parramatta Road), and that public transport options are limited. It also identifies that connections to nearby industrial areas such as Silverwater are missing. Several potential infrastructure improvements are proposed within the Discussion Paper to improve the current poor transport connections and allow the Precinct to develop, including:

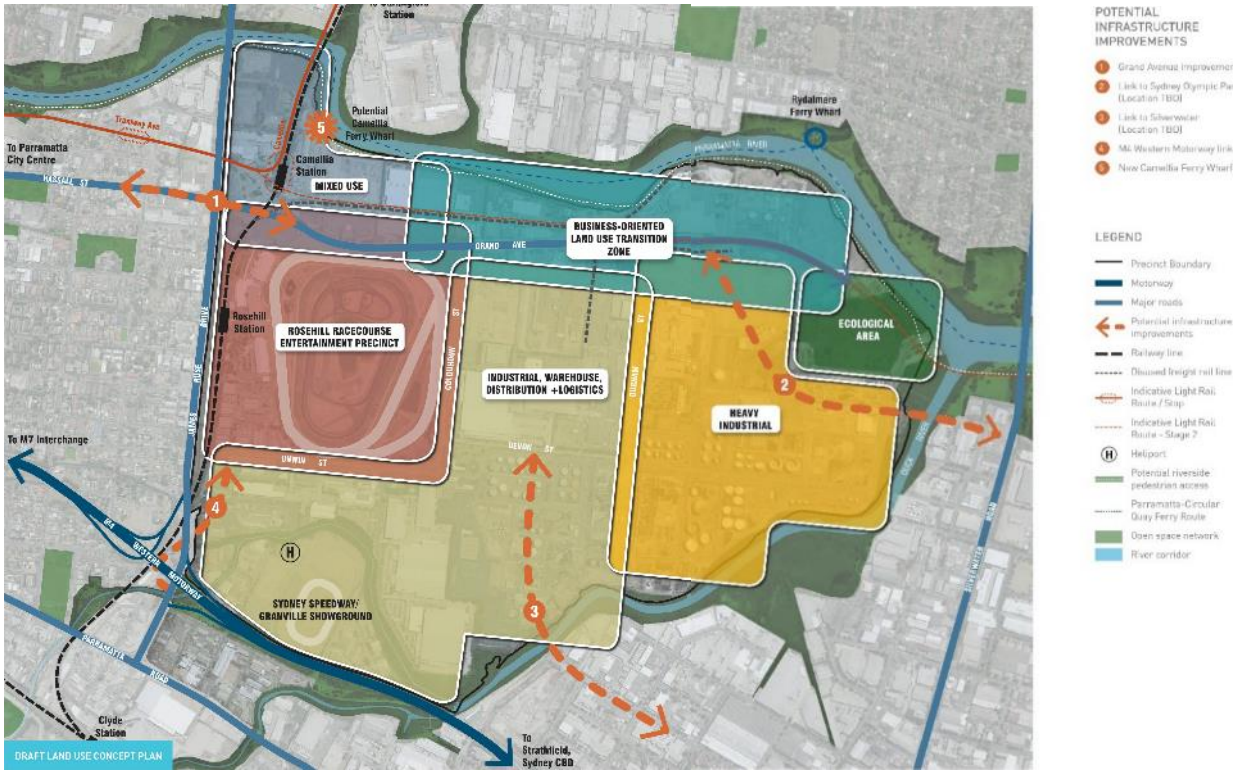
1. upgrade and improvements to Grand Avenue
2. new link to Sydney Olympic Park (bridge over Duck River)
3. new link to Silverwater (bridge over Duck River)
4. new direct link to the M4 Motorway (to southern part of precinct)
5. potential new Ferry Wharf on Parramatta River (in north-western part of precinct).

Transport for NSW has provided feedback on the proposed ferry wharf during a consultation workshop held with the Department. The ferry wharf is not supported due to significant environmental and operational constraints, shallow draft, narrow navigational channel and contamination that constrain additional ferry service provision.

The proposed road connections are considered further in this study. Alternative public transport improvements are also considered to reduce the amount of car travel to the Precinct and reduce the impact on the road network.

[4] Camellia 21st Century Business, Industry and Entertainment Precinct Discussion Paper, Version 1 (City of Parramatta Council, undated)

The Draft land use concept plan included in the Discussion Paper, shown in Figure 2.5, retains general industrial, heavy industrial, warehousing and logistics across most of the site. The existing recreational land uses are also retained. A new mixed-use area, with residential, retail and commercial is identified around Camellia Station in the north-west corner of the Precinct, and a new business use area is proposed on the northern part of the Precinct along Grand Avenue.



Source: Camellia Discussion Paper, (City of Parramatta Council)

Figure 2.5 Draft land use concept plan

2.3.2 LOCAL GOVERNMENT DEVELOPMENT CONTROL PLANS

Council's Development Control Plan (DCP) contains guidelines for developments occurring within the Parramatta local government area (LGA). These guidelines may influence transport-related aspects of the development including the road hierarchy and the amount of parking. The suitability of the current guidelines to the future development situation after associated improvements to public transport, walking and cycling are made in the area will need to be reviewed.

The current DCP promotes sustainable transport initiatives for new developments, including car share and travel plans. Car sharing spaces can be provided in lieu of three regular car parking spaces to give residents and businesses access to a car for short periods of time, typically on an hourly basis, while avoiding the cost of full-time ownership. Travel plans, including a package of measures designed to reduce car trips and encourage the use of sustainable transport is required for developments of at least 5,000 m^2 and businesses with at least 50 employees.

Car parking rates are provided for the LGA. However, special rates are provided for areas such as Parramatta CBD and Granville and Harris Park town centres. Given the precedent of special parking rates for particular areas of Parramatta LGA, and the identification of the Camellia Precinct (and the James Ruse Drive special area), it is recommended that the parking rate to apply to the new development in the Camellia Precinct be tailored to suit the transport objectives of the future Precinct. A comparison of rates for different land uses in different parts of Parramatta LGA is provided in Table 2.1.

Bike parking is required in the DCP at the rate of one bicycle space per 200 m^2 of floor space for business premises, office premises, retail and industrial developments, and one bicycle space per two dwellings for residential flat buildings. Trip end facilities including showers and lockers must be provided to adequately service the number of bicycle parking spaces required in business, office, retail and industrial development.

Table 2.1 Development Control Plan (DCP) parking rates

Land Use	Parramatta LGA (Minimum Rates)[1]	Granville and Harris Park Town Centres[1]	Parramatta CBD (Maximum Rates)[2]	Carlingford Town Centre (key sites)[3]	Epping Town Centre Core (Minimum Rates)[4]
Multi-unit residential	— 1 space per 1 or 2-bedroom unit — 1.2 spaces per 3-bedroom unit — 2 spaces per 4-bedroom unit — Plus 0.25 space per dwelling for visitor parking	-	— 1 parking space for every dwelling plus 1 parking space for every 5 dwellings for visitors	— 0.8 space per 1-bedroom unit — 1 space per 2-bedroom unit — 1.3 spaces per 3-bedroom unit — Plus 0.4 space per dwelling for visitor parking	— 0.5 spaces per studio — 0.75 space per 1-bedroom unit — 1 space per 2-bedroom unit — 1.5 spaces per 3-bedroom unit — Plus 0.1 space per dwelling for visitor parking
Business premises	— 1 space per 50 m^2 of gross floor area plus 1 loading bay per 400 m^2 of gross floor area	— Minimum of 1 space per 60 m^2 of GFA and a maximum of 1 space per 30 m^2 of GFA.	-	-	— Minimum of 1 space per 70 m^2 of gross floor area — Maximum of 1 space per 50 m^2 of gross floor area
Office premises	— 1 space per 50 m^2 of gross floor area plus 1 loading bay per 400 m^2 of gross floor area	— Minimum of 1 space per 70 m^2 of GFA and maximum of 1 space per 50 m^2 of GFA	— 1 parking space for every 100 m^2 of gross floor area	-	— Minimum of 1 space per 70 m^2 of gross floor area — Maximum of 1 space per 50 m^2 of gross floor area
Industrial	— 1 space per 70 m^2 of gross floor area plus 1 loading bay per 800 m^2 of gross floor area	-	-	-	-
Retail	— 1 space per 30 m^2 of gross floor area plus 1 loading bay per 400 m^2 of gross floor area	— Minimum of 1 space per 60 m^2 of GFA and a maximum of 1 space per 30 m^2 of GFA.	— 1 space per 30 m^2 of gross floor area	-	— Minimum of 1 space per 60 m^2 of gross floor area — Maximum of 1 space per 30 m^2 of gross floor area
Warehouses or distribution centres	-	-	— 1 parking space for every 300 m^2 of gross floor area	-	-

(1) City of Parramatta Council Development Control Plan 2011

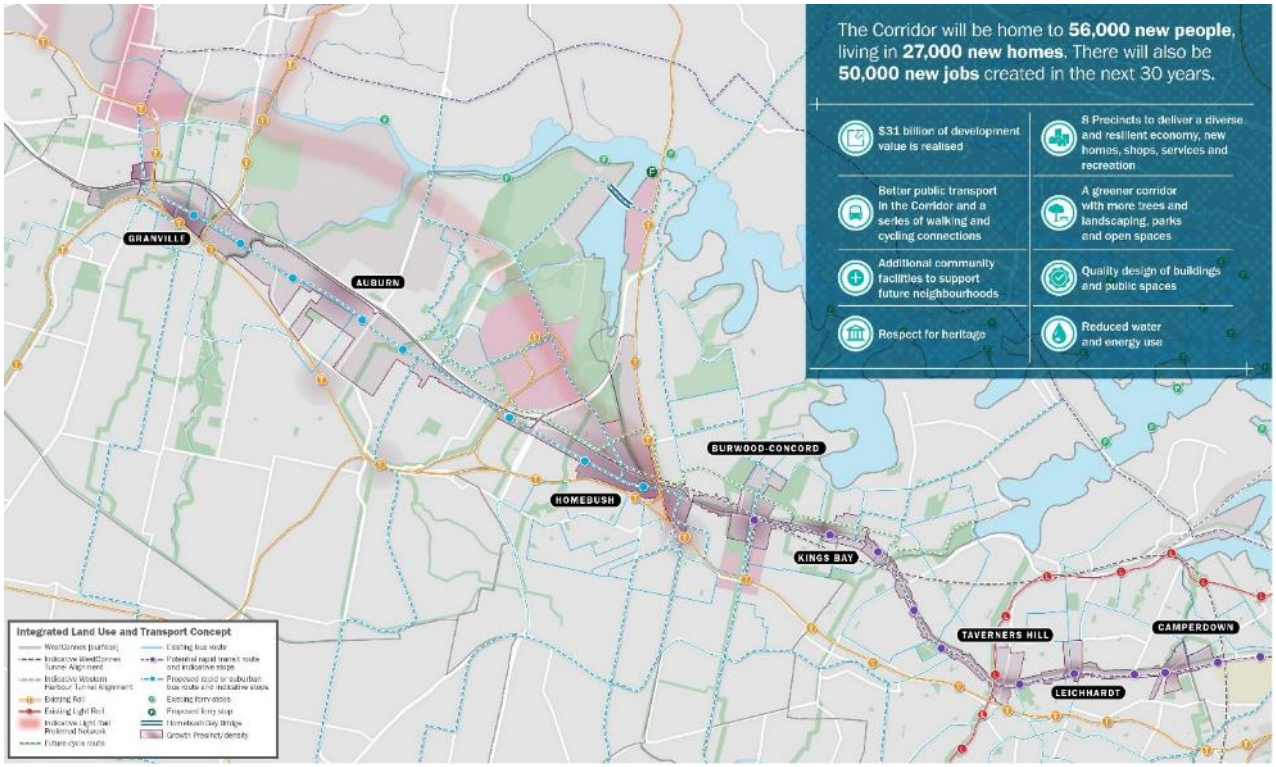
(2) Rates provided in Parramatta City Centre Local Environment Plan 2007

(3) The Hills Development Control Plan 2012 Part D Carlingford Precinct

(4) Hornsby Development Control Plan 2013 (Revision 30 November 2016) Table: 1C.2.1(e) On Site Car Parking Rates (Epping Town Centre Core)

2.4 PARRAMATTA ROAD CORRIDOR REVITALISATION

The removal of traffic from the Parramatta Road corridor associated with the WestConnex project (see section 3.1) is expected to create opportunities for urban renewal. The NSW Government is aiming for 27,000 new dwellings and 50,000 jobs in the Parramatta Road corridor. The corridor has been divided into eight urban renewal precincts, shown on Figure 2.6, including Granville, Auburn, Homebush, Burwood Concord, Kings Bay (which is part of Five Dock), Taverners Hill, Leichhardt and Camperdown.



Source: Parramatta Road Corridor Urban Transformation Strategy (UrbanGrowth NSW, November 2016)

Figure 2.6 Integrated Land Use and Transport Concept

The precincts closest to Camellia, the Granville and Auburn Precincts, have targets of approximately 6,400 new dwellings and 20,000 new jobs in the long term (year 2050+) out of the 27,000 and 50,000 respectively for the corridor as a whole. The development in the Parramatta Road corridor, combined with that planned for Parramatta CBD, the Camellia Precinct, Wentworth Point and Carter Street Priority Precincts and Sydney Olympic Park Master Plan 2030 represents a substantial increase in population and employment.

Accommodating the travel demands of this new population will be a challenge given the current capacity issues for the road network and T1 Western Line. The Parramatta Light Rail and Burwood to Sydney on-street rapid transit on Parramatta Road are key elements of the transport solution to support the development along the corridor.

2.5 OTHER DEVELOPMENT

A large amount of development is planned in the corridor between Parramatta and Sydney Olympic Park. The development precincts are at various stages of development, with some already partially inhabited with others only identified as potential future sites.

Parramatta CBD is expected to undergo a major change to cement its position as Sydney's second CBD. The development could include an additional 7,500 dwellings and 27,000 new jobs by 2036[5]. The nearby Parramatta North urban transformation area could include a further 2,700 dwellings and 2,000[6] plus adaptive reuse of historic buildings and new retail and commercial floor space.

The Olympic Peninsula includes three precincts with a combined yield of approximately 26,600 dwellings and depending on employment density, around 40,000 jobs, as outlined in Table 2.2.

Table 2.2 The Olympic Peninsula development and completion

Development		Residents	Dwellings	Retail (M^2 GFA)	Commercial (M^2 GFA)	Industrial (M^2 GFA)	Workers
Sydney Olympic Park[1]	Future	23,500	10,700	100,000	412,000	-	34,000
	Existing	1,860	840	6,260	105,000	-	6,650
Wentworth Point Priority Precinct[2]	Future	20,000	9,500	1,000	-	-	660
	Existing	2,800	1,200	-	-	39,000	50
Carter Street Priority Precinct[2]	Future	13,440	6,400	12,000	30,140	111,000	5,200
	Existing	-	-	-	-	245,000	3,000
Total	Future	56,940	26,600	113,000	442,140	111,000	39,860
	Existing	4,660	2,040	6,260	105,000	284,000	9,700
	Change	52,280	24,560	106,740	337,140	-173,000	30,160

(1) Sydney Olympic Park Master Plan 2030: Traffic and Transport Strategy (2016 Review) (WSP | Parsons Brinckerhoff, July 2016)

(2) NSW Department of Planning and Environment advice

The five-yearly review of the Sydney Olympic Park Master Plan 2030 was released for public consultation until November 2016. Following a review of the submissions, the updated Master Plan will be released.

As part of an approval to increase the development yield for the Wentworth Point Priority Precinct, the construction of the Homebush Bay Bridge (Bennelong Bridge) was recently completed. The bridge connects Wentworth Point to Rhodes for pedestrians, cyclists, buses and emergency vehicles only.

5 Parramatta CBD Planning Framework: Amendment to Parramatta LEP 2011, (City of Parramatta Council, April 2016)

6 Parramatta North Urban Transformation Program Fact Sheet, (UrbanGrowth NSW, March 2016)

3 PLANNED AND COMMITTED PROJECTS

The NSW Government is planning upgrades to transport near the Camellia Precinct that will improve transport conditions and options in the area. The planned and committed projects are outlined in this section.

3.1 WESTCONNEX AND MANAGED MOTORWAYS

WestConnex is a major road network infrastructure project that combines several motorway projects into a package of 34 kilometres of new and upgraded motorway links (See Figure 3.1). WestConnex is expected to[7]:

- Cut forecast travel times between several locations including between the Parramatta area, Sydney CBD and the Airport/Port Botany.
- Provide traffic reductions on some congested parts of the road network, including sections of Parramatta Road, the Eastern Distributor and Route A3 – King Georges Road.
- Provide an efficient motorway link between the M4 and M5 and improve traffic flow on the motorway network.
- Improve accessibility and reliability of commercial vehicle movement in the M4 and M5 corridors to economic centres, including to Sydney Airport and Port Botany economic zone.
- Improve traffic conditions and ease future congestion on the inner western and south-western network, including Parramatta Road, supporting urban regeneration and growth.
- Improve overall network productivity.

Source: *WestConnex M4–M5 Link Environmental Impact Statement Main Volume Chapters 1 to 8 (August 2017)*

Figure 3.1 Proposed WestConnex project

[7] WestConnex Updated Strategic Business Case Technical Paper 1Traffic Report (NSW Government, November 2015)

For the Camellia Precinct, the WestConnex will improve the efficiency of connections by road to key business markets of the Southern Sydney Economic Area Sydney Airport and Port Botany. The first stage, relieving the western portion of Parramatta Road was completed in July 2017. As part of this work, ramp accesses were modified at the existing junctions of the M4 Motorway with James Ruse Drive and Silverwater Road. The modifications are shown in Figure 3.2 and Figure 3.3.

Source: WestConnex Updated Strategic Business Case (November 2015)

Figure 3.2 WestConnex upgrade at James Ruse Drive – widening and new ramp configuration

Source: WestConnex Updated Strategic Business Case (November 2015

Figure 3.3 WestConnex upgrade at Silverwater Road – longer ramps

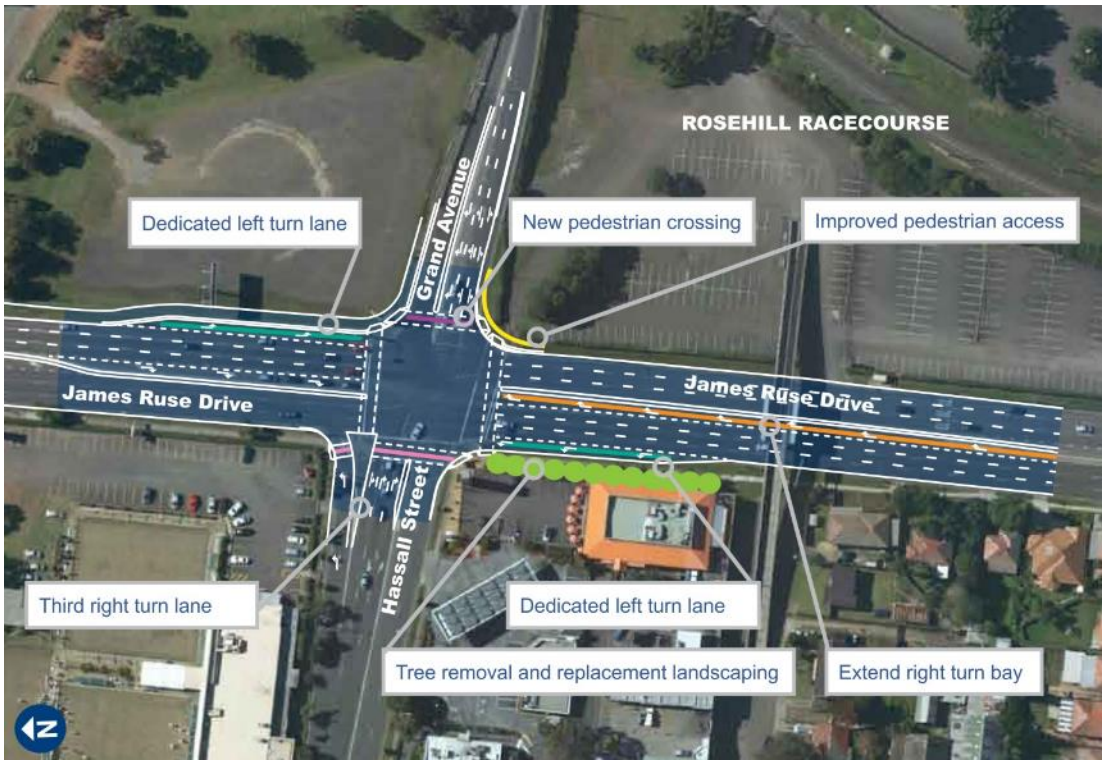
On Parramatta Road, large traffic reductions of traffic are forecast on some sections. However, the section closest to Camellia could experience a small increase from vehicles diverted due to the application of a toll on the Motorway.

As part of the WestConnex project, the WestConnex M4 Widening Road Network Performance Mitigation Plan (RNPMP) sets out how Roads and Maritime will manage the operational performance impacts of the M4 Widening on the adjoining road network; and identifies mitigation measures for areas where traffic performance may be unsatisfactory before and after opening. Within the vicinity of the Camellia Precinct, the works included the opening of the chevron at the stop line on James Ruse Drive southbound at the signalised intersection of the M4 Motorway eastbound entry ramp.

Roads and Maritime Services (Roads and Maritime) is proposing to undertake a trial of a Managed Motorways Scheme (MMS) on the M4 Western Motorway to make better use of the current motorway through the managing ('smoothing') of traffic demand to avoid/reduce the incidence of traffic flow 'breaking down'. The MMS would involve controlling the number and timing of vehicles entering the motorway to avoid stop-start conditions forming and improved detection of incidents and implementation of management strategies. Any proposals for new connections to the M4 Western Motorway proposed in Council's Camellia Discussion Paper are still being evaluated, it is likely that they would need to consider the requirements of the MMS, including additional vehicle storage (i.e. additional lanes) on the ramp until there is a suitable gap on the Motorway.

3.2 ROADS AND MARITIME PLANNED UPGRADE OF JAMES RUSE DRIVE AND HASSALL STREET INTERSECTION

Roads and Maritime has already identified potential intersection upgrades, as part of its Pinch Point Program, to address some of the existing congestion issues. These works (shown in Figure 3.4) were completed in July 2016, and include the addition of left-turn bays on James Ruse Drive, an extended right-turn bay on James Ruse Drive for the turn towards Camellia and lane changes on Hassall Street. This upgrade is expected to reduce delays in the short term. However, it was not designed for the future development within the Camellia Precinct.

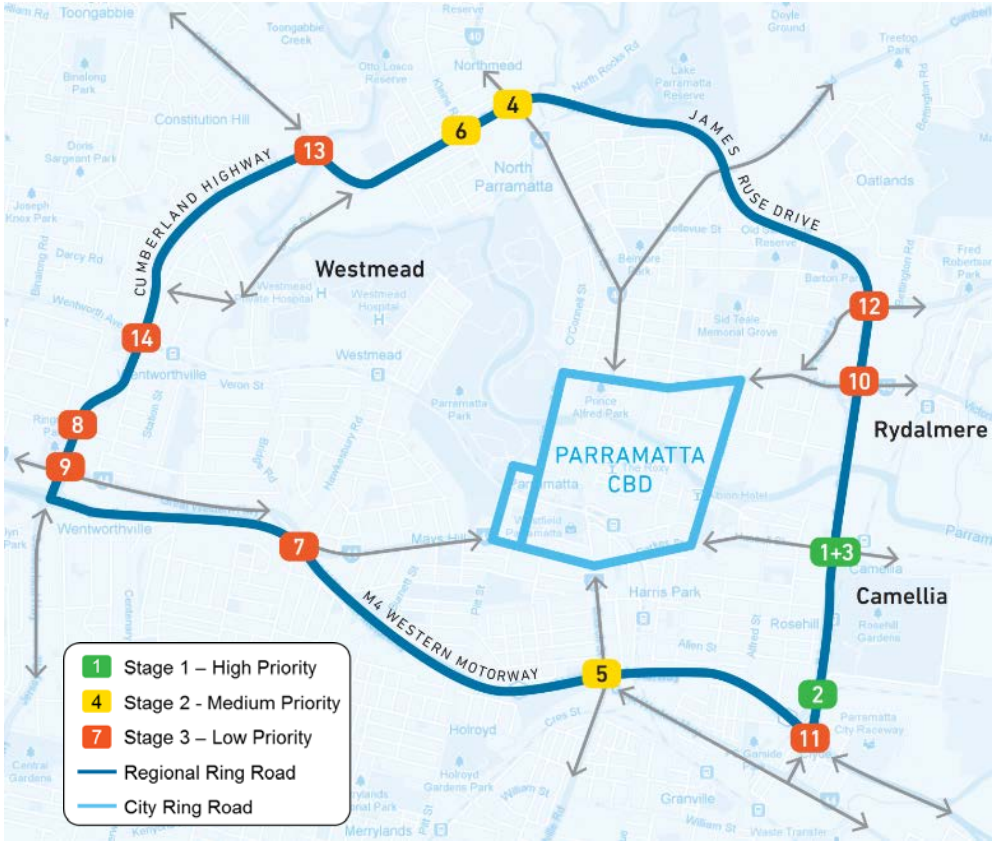


Source: Roads and Maritime Services *Community Update, November 2012*

Figure 3.4 Planned intersection upgrade at the intersection of James Ruse Drive and Hassall Street

3.3 WESTERN REGIONAL RING ROAD CONCEPT

The Western Sydney Regional Ring Road is a concept of connected arterial roads developed by Council that distribute traffic around Parramatta CBD and protect it from large volumes of through traffic. Two ring roads are proposed including an outer ring comprising the M4 Western Motorway, James Ruse Drive and Cumberland Highway, and an inner ring road comprising Great Western Highway/Parkes Street, Harris Street/Macarthur Street, Victoria Road and Pitt Street/O'Connell Street. A map of the ring roads is included in Figure 3.5.



Source: Western Sydney Regional Ring Road, (City of Parramatta Council, October 2012)

Figure 3.5 Western Sydney Regional Ring Road and City Ring Road

The Ring Road Concept proposes a series of road upgrades in the short, medium and long-term to allow the ring roads to function effectively. Those that directly affect access to the Camellia Precinct include:

Short-term

1 Extend right turn bay from James Ruse Drive to Grand Avenue (to reduce congestion on James Ruse Drive).

2 Camellia Link Road (under James Ruse Drive to Unwin Street) to provide a direct connection to the M4.

3 Grade separate James Ruse Drive from Grand Avenue/Hassall Street to remove delay to James Ruse Drive traffic.

Long-term

10 New ramps between James Ruse Drive and Victoria Road.

11 New on-ramp from James Ruse Drive to M4 Motorway.

12 Improve right turn from Kissing Point Road to James Ruse Drive.

City of Parramatta Council is currently working with Roads and Maritime to evaluate the merits of the scheme and considering this and other ways to improve access to Parramatta CBD. As mentioned in section 2.1.5, the inner ring road and outer ring road concepts have been identified as initiatives for investigation in the 0 to 10 and 10 to 20-year timeframe respectively in the Greater Sydney Draft Services and Infrastructure Plan.

3.4 PARRAMATTA LIGHT RAIL

The Parramatta Light Rail project is over 20 km of light rail track connecting Westmead, Parramatta, Carlingford, and Sydney Olympic Park. The light rail system is being developed as part of an integrated transport network linking precincts within Greater Parramatta (including Camellia) and connecting them with key centres.

It will be developed in two stages. The first from Westmead to Carlingford (approximately12 km and 16 stops) and the second extending from Stage 1 at Camellia/Rydalmere to Sydney Olympic Park/Carter Street (approximately 9 km and approximately 10 to 12 stops).

Within Camellia, the aim is to create an active and vibrant new town centre with open green space, restaurants and shops. Parramatta Light Rail will provide frequent and reliable services and would link residents to jobs and education facilities in Westmead and Parramatta, and leisure opportunities at Sydney Olympic Park. Parramatta Light Rail would also be integrated into the new town centre, helping to create a place in which people want to spend time.

Parramatta Light Rail Stage 1 will include a core spine linking precincts within Greater Parramatta including Westmead health precinct, Parramatta CBD and Camellia. Existing heavy rail service between Camellia and Carlingford will be replaced with a more frequent light rail service.

Transport interchanges at Westmead, Parramatta, Carlingford and Olympic Park Stations will be designed to facilitate access to the wider network, while a light rail spine between Westmead and Camellia will complement rail, bus, ferry and active transport modes to create legible routes through Parramatta.

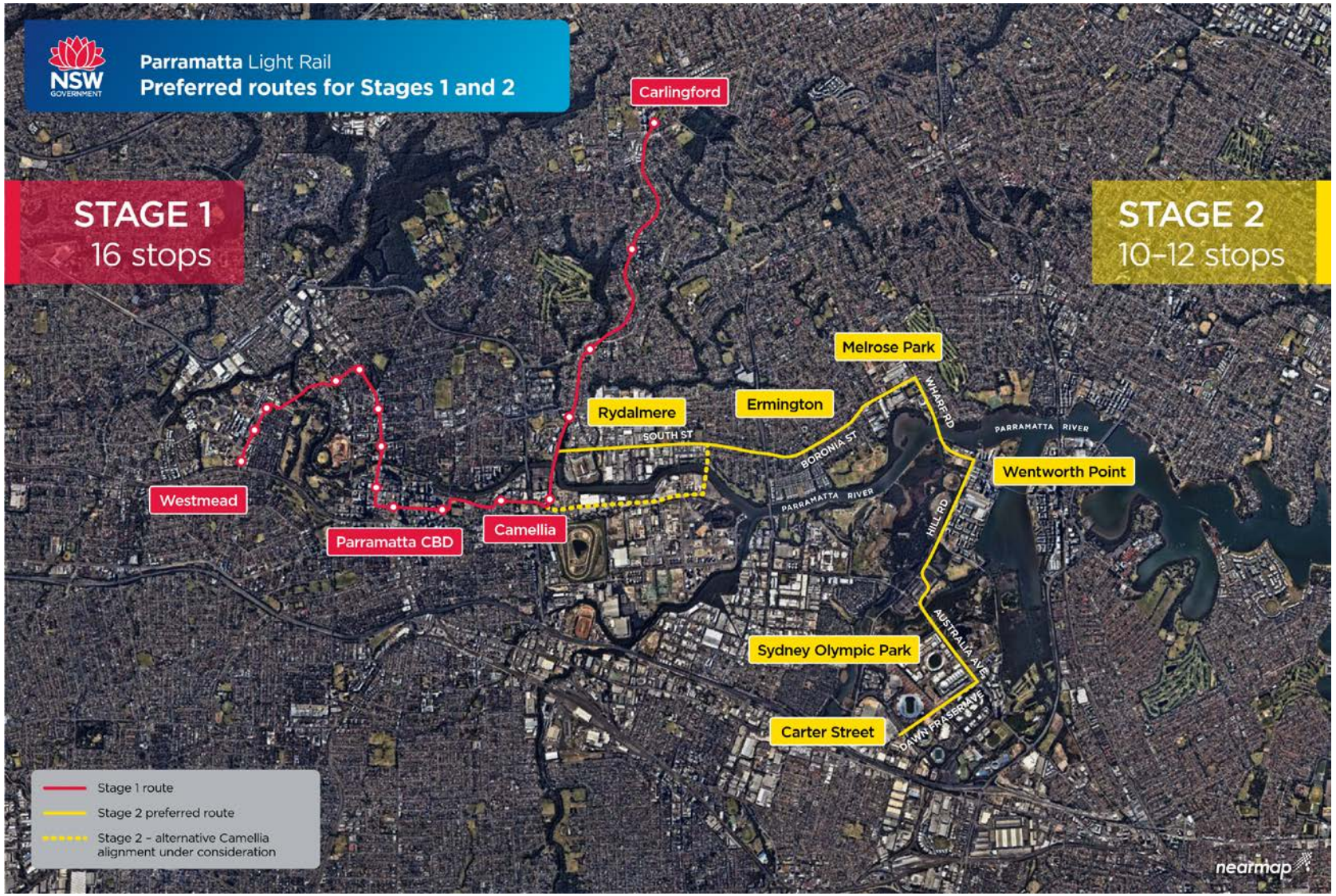
The key features of the light rail include:

- Reliable public transport link connecting major urban renewal areas.
- Up to five interchanges with connections to the wider rail network, ferries or buses.
- Improved accessibility to new and existing communities and precincts.
- Modern, comfortable air-conditioned driver operated vehicles, 45 metres long carrying up to 300 passengers.
- The network will operate seven days a week from 5.00 am to 1.00 am, with services approximately every 7.5 minutes from 7.00 am to 7.00 pm weekdays.
- Well-designed and legible connections to bus, train, ferry and active transport links.
- Integrated with the Opal ticketing system to provide a seamless journey for customers.
- A new shared pedestrian and cycle path from Tramway Avenue, Parramatta to Carlingford along the light rail route.
- Estimated travel times from Camellia are 8 minutes to Parramatta CBD and around 25 minutes to Olympic Park.

The key aspects of the light rail through the Camellia Precinct will be its integration with the town centre, adjacent racecourse and the ability to transfer between lines as the network branches out to Carlingford, Parramatta CBD and Westmead. This will significantly increase the public transport accessibility to Camellia above what the existing T6 Carlingford Line provides. The preferred network for the Parramatta Light Rail is shown in Figure 3.6.

Access to the Rosehill Gardens Racecourse will also be a key consideration in the introduction of light rail into the precinct. In addition to regular race meetings, the racecourse also operates as an event and function centre.

The preferred route for Stage 2 was announced by the NSW Government in October 2017. It will run north of the Parramatta River through Ermington, Melrose Park and Wentworth Point to Sydney Olympic Park. An option for extending east through Camellia before crossing the Parramatta River to Rydalmere is also being considered. Stage 2 will be further developed through consultation with the community and stakeholders. A Final Business Case for Stage 2 is expected to be completed in 2018.



Source: Transport for NSW *Parramatta Light Rail Fact Sheet, October 2017*

Figure 3.6 Parramatta Light Rail preferred network

3.5 SYDNEY METRO WEST

To address planned overcrowding on the T1 Western Line, a new metro rail line connecting Parramatta and Sydney CBD is being planned. It will also serve growth at Sydney Olympic Park and The Bays Precinct, as shown in Figure 3.7. The new line will provide additional capacity and is likely to provide faster and more frequent services.

Source: Transport for NSW Projects website, viewed 03/01/2017

Figure 3.7 Key precincts linked by the Sydney Metro West concept

It is expected to be mostly underground and largely built by the second half of the 2020s. Transport for NSW is currently working on identifying station locations, with community consultation planned in 2017. The Camellia Precinct has not been identified as a key precinct, but may be considered as a possible station location.

As a minimum, the Sydney Metro West line would offer the Camellia Precinct increased rail capacity and improved services from nearby Parramatta to Sydney CBD. If a station were to be built within the precinct, it would have the potential to have a significant impact on the transport choice for people living and working in the Precinct. However, given the preliminary nature of the project, this is still uncertain.

4 EXISTING CONDITIONS

This section describes the existing situation in the study area regarding the road network, traffic conditions, public transport services, intersection performance, parking, pedestrian and cyclist facilities.

4.1 TRIP PATTERNS

The travel behaviour of existing nearby residents and employees can provide a guide to how the future residents and employees of the Camellia Precinct may travel. Two sets of data exist for assessing these travel characteristics:

- Census results for NSW are further analysed by the Transport Performance and Analytics (TPA), within Transport for NSW. The Journey to Work (JTW) data set analyses work commuting trips and links their origin and destination zones, creating a matrix of movements around the Sydney Greater Metropolitan Area (GMA). This is useful to determine the current directions of travel to and from an area and mode share.
- TPA also undertakes a continuous Household Travel Survey (HTS) which samples households in the GMA. The survey involves respondents completing a diary of their travel patterns for all trip purposes. The results are compiled on an annual basis, but can be combined to form a large pool of data. While there is summary information for more recent HTS data, the 2011/12 dataset has been used as a full set of detailed data is available.

Due to the sample size, only certain types of data are available from each data set.

4.1.1 MODE SHARE

The choice of travel mode varies depending on the range of transport services available, car availability, need for predictable arrival, the length of the journey and the reason for travelling. The mode split for trips to work during the AM peak to employment precincts in the area surrounding Camellia are shown in Table 4.1. The mode split percentages are calculated using data from the JTW dataset for commuting trips (including residential commute trips, and the HTS dataset for residential discretionary trips (including personal business, serve passenger, shopping and social/recreation) and other non-discretionary trips (education/childcare and work-related business).

Table 4.1 Existing mode share for Camellia and adjoining residential area

Transport Mode	Employment		Residential		
	Industrial[1]	Mixed Use[1]	Commute[1]	Other Discretionary and Non-Discretionary Travel[2]	All Trips
Walk only	1%	5%	8%	19%	16%
Other (incl. cycle)	1%	1%	1%	1%	1%
Bus	1%	3%	3%	3%	3%
Ferry/Tram	0%	0%	0%	0%	0%
Train	5%	7%	23%	4%	8%
Car driver	87%	77%	59%	50%	52%
Car passenger	5%	7%	6%	23%	20%
Total	100%	100%	100%	100%	100%

(1) 2011 Journey to Work (TPA, 2013), selected travel zones (1061 and 1070 for Rosehill residential and mixed-use employment, Camellia (1068, 1071, 1222), Rydalmere (1120) and Silverwater (1322 and 1323) for industrial)

(2) Household Travel Data 2011–2012 Release, (TPA 2014) Parramatta LGA

4.1.2 TRIP DIRECTIONS

The trip distribution for journey to work trips (all modes) in the AM peak to and from the Camellia Precinct is listed in Table 4.2. Trips within the Parramatta Local Government Area (LGA) represent the largest share of all destinations/origins.

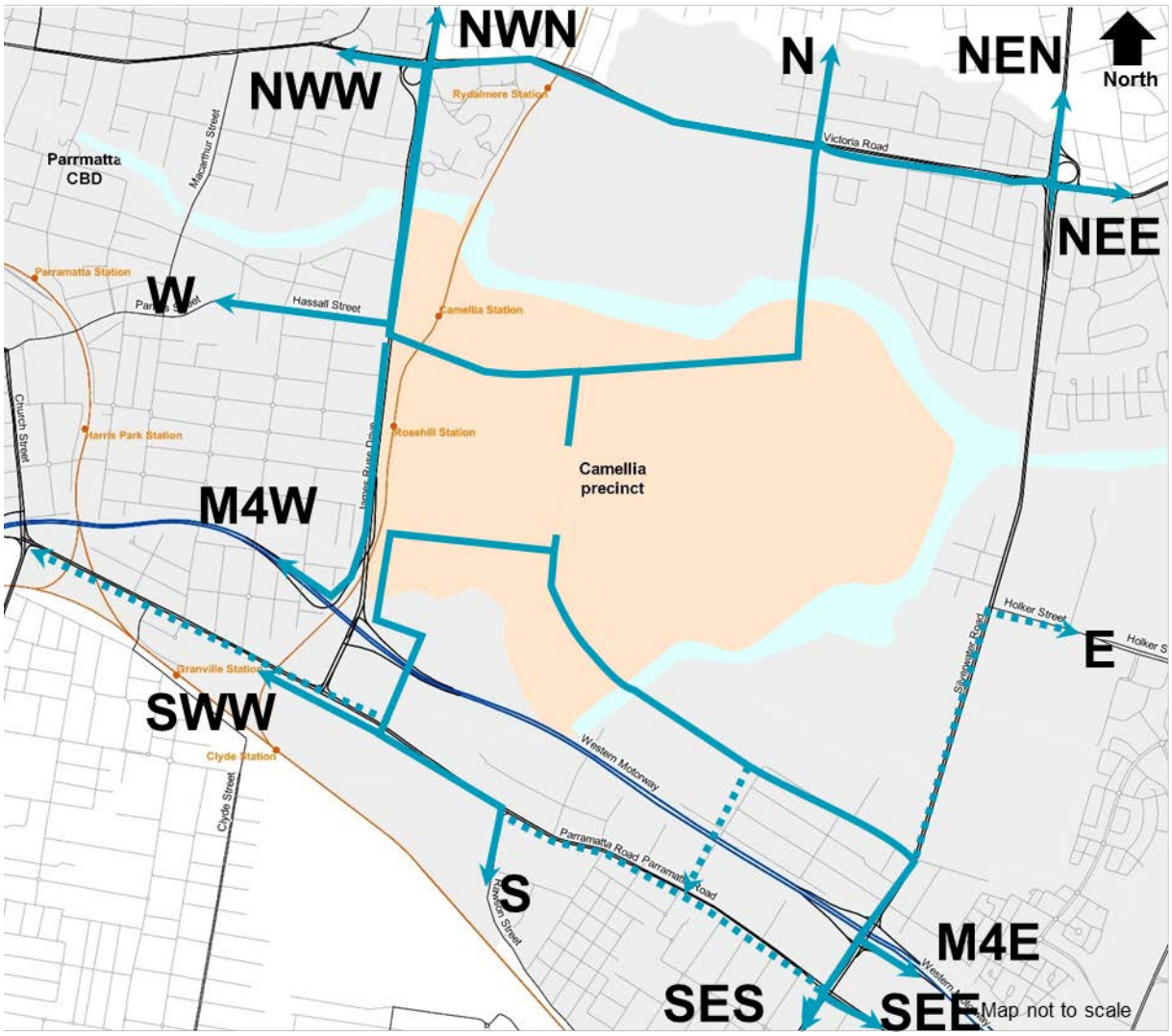
Employees of Camellia, Silverwater, Rydalmere and Rosehill currently travel from a dispersed set of locations:

- the highest number from Parramatta, Merrylands – Guildford, Blacktown, The Hills, Fairfield and Penrith
- a similar pattern exists for car driver and all modes as most trips are made as car driver.

Rosehill residents:

- for trips of any mode, about 25% of Rosehill residents commute within the Parramatta LGA, while 17% travel to Sydney Inner City, 7% to Ryde/Hunters Hill and 6% to Merrylands/Guildford
- for car driver trips, 18% drive within the Parramatta LGA, 8% each drive to Auburn, Ryde/Hunters Hill and Merrylands/Guildford, while 6% drive to Sydney Inner City.

The JTW data for the movement to and from the identified areas have been assigned to a major route to/from the study area, as shown in Figure 4.1.



Notes See Table 4.2 for direction codes.

Figure 4.1 Travel directions to/from Camellia

Table 4.2 Travel direction to/from Camellia and surrounding areas

Transport Mode	Employment		Residential		
	Industrial[1]	Mixed Use[1]	Commute[1]	Non-Discretionary Travel[2]	Discretionary Travel[2]
North (N)	4.3%	5.2%	1.2%	0.0%	0.0%
North East North (NEN)	3.7%	2.9%	4.3%	1.1%	0.2%
North East East (NEE)	8.1%	5.8%	13.1%	7.7%	5.7%
East (E)	1.1%	0.8%	3.0%	0.0%	0.0%
East via M4 Motorway (M4E)	11.0%	9.6%	25.7%	12.7%	4.3%
South East East (SEE)	1.1%	0.8%	2.0%	0.0%	0.0%
South East South (SES)	9.9%	4.3%	3.1%	4.8%	1.7%
South (S)	1.4%	1.5%	1.4%	4.2%	4.0%
South West West (SWW)	13.6%	18.7%	8.0%	12.0%	10.6%
West via M4 Motorway (M4W)	28.8%	26.7%	9.6%	14.4%	5.8%
West (W)	1.6%	7.8%	20.8%	31.1%	55.0%
North West West (NWW)	1.4%	2.1%	1.5%	0.0%	0.0%
North West North (NWN)	14.0%	13.8%	6.1%	11.9%	12.7%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

(1) 2011 Journey to Work (TPA, 2013), selected travel zones (1061 and 1070 for residential and mixed-use employment, 1068, 1071, 1222, 1120, 1322 and 1323 for industrial)

(2) Household Travel Data 2011–2012 Release, (TPA 2014) Parramatta LGA, Non-Discretionary travel includes commute.

The dominance of trips to/from Parramatta for residential trips, matches the education, shopping, recreation and employment trips nearby. The surveys for this data were taken whilst new employment centres such as Sydney Olympic Park were still reaching their full potential.

These travel patterns may be influenced by the current public transport network. For example, travelling from Rosehill to Sydney Olympic Park can take approximately 50 minutes by public transport whereas driving can take 15 minutes for the 7 km journey. It is expected that with increasing employment in strategic centres such Parramatta CBD and Sydney Olympic Park, and if a high-quality public transport line between Parramatta and Sydney Olympic Park could be created, the travel destinations especially for commuting could change significantly.

4.2 WALKING

Figure 4.2 shows that the existing pedestrian facilities are limited, reflecting the large-scale industrial nature of the eastern portion of the Camellia Precinct. The western side of Camellia has the highest pedestrian-generating land uses (Rosehill Racecourse and Rosehill and Camellia Stations), however, James Ruse Drive still acts as a barrier to its integration to the land immediately west.

Figure 4.2 Existing pedestrian connections to the Camellia Precinct

From the west direction, pedestrians can access the study area:

- signalised junction of James Ruse Drive with Hassall Street and the overbridge crossing railway line to Grand Avenue
- Oak Street bridge crossing James Ruse Drive, and then an at-grade crossing of the Carlingford rail line to Rosehill Racecourse
- signalised intersection of James Ruse Drive and Prospect Street, and then a walkway across the Carlingford rail line to Rosehill Racecourse.

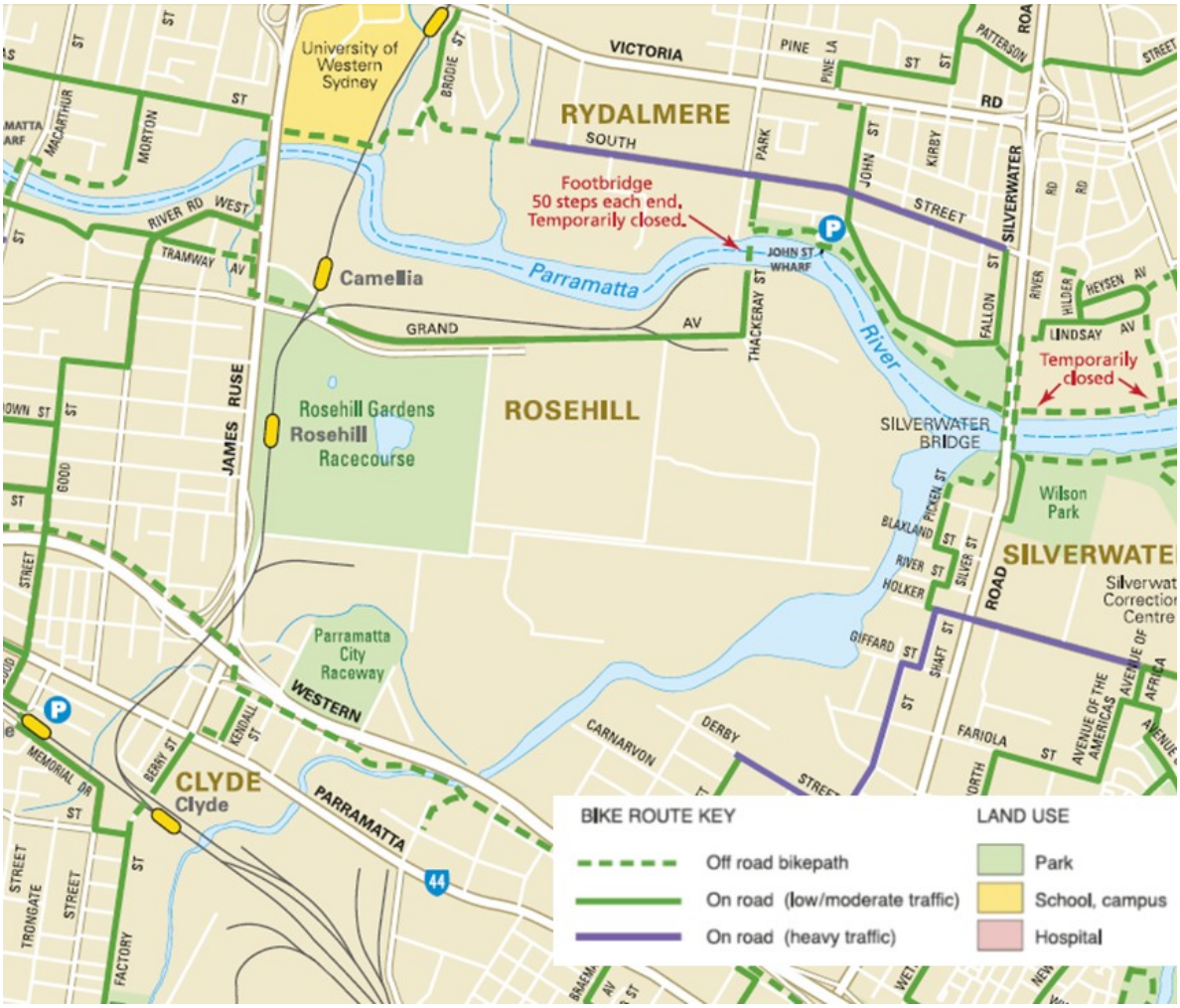
From the north, pedestrians can access the Precinct via a bridge over the Parramatta River at Thackeray Street or a footpath on the side of the James Ruse Drive bridge. However, the Thackeray Street bridge, has steep, narrow and high stairs, which makes access virtually impossible for mobility impaired people.

From the south, pedestrians can access the Camellia Precinct via Wentworth Street, which has a footpath connected with Parramatta Road, although there is currently no pedestrian crossing of Parramatta Road at the Wentworth Street traffic signals. The M4 cycleway also provides convenient access for pedestrians and cyclists across Duck River linking to Adderley Street West, Duck Street and Martha Street. There are currently no pedestrian connections to the Precinct from the east due to the presence of the Viva Energy fuel refinery and the industrial areas on the eastern side of Duck River.

Within the precinct, Grand Avenue has a footpath on its northern side. Pedestrian crossings are marked across the many wide driveways that provide access to the industrial properties to reinforce the right-of-way of pedestrians walking along the footpath.

4.3 CYCLING

Cycle routes on the network surrounding the Camellia precinct are shown in Figure 4.3. The map shows that cyclists can access the study area through two key cycle routes alongside M4 Western Motorway and Parramatta River. The Hassall Street overbridge crossing the T6 Carlingford Line has a separated shared footpath/cycle route, although grades are steep and the path is narrow.



Source: Getting to Work in Parramatta & Westmead brochure (2008), City of Parramatta Council website

Figure 4.3 City of Parramatta Council cycle network

The M4 Motorway Viaduct Route links Auburn, Granville, Holroyd and the Parramatta CBD via Good Street or Mays Hill, which is good route for cyclists to travel between Parramatta and the southern part of the Precinct. The road within the Precinct can be used by cyclists, although no separated facilities are provided and the mixture of cyclists and large trucks does not create an atmosphere conducive to cycling. A future on-road cycle route is identified in the Parramatta Bike Plan[8] on Durham Street, Devon Street, Unwin Street, Kay Street and Wentworth Street.

[8] City of Parramatta Council, 2008

4.4 BUS

The bus network serving the Camellia Precinct (see Figure 4.4 and Figure 4.5) is currently limited due to low demand from the surrounding land use and its position on the boundary of three bus service regions. Route M92 operates along James Ruse Drive, and routes M92 and 909 operate along Parramatta Road. Metrobus route M92 runs from Parramatta to Sutherland via Lidcombe and Bankstown. It allows interchange with the Sydney Trains at services at Parramatta, Rosehill, Lidcombe, Bankstown, Padstow and Sutherland stations. Other services operated by Sydney Buses travel north of the Parramatta River and currently have low levels of accessibility for Camellia Precinct.

Route M92 provides 71 northbound and 66 southbound services daily between Sutherland Interchange and Parramatta Interchange. The headway between buses is approximately 10–15 minutes between 7.30 am and 8.00 pm. Buses operate on a weekday from approximately 6.00 am to 8.50 pm.

4.5 TRAIN

The western side of the Camellia Precinct is served by two railway stations on the T6 Carlingford Line, Camellia Station in the north and Rosehill Station in the south. Both stations are located immediately adjacent to the Camellia Precinct. The T6 Carlingford Line runs from Carlingford to Clyde where passengers must interchange to T1 Western Line trains.

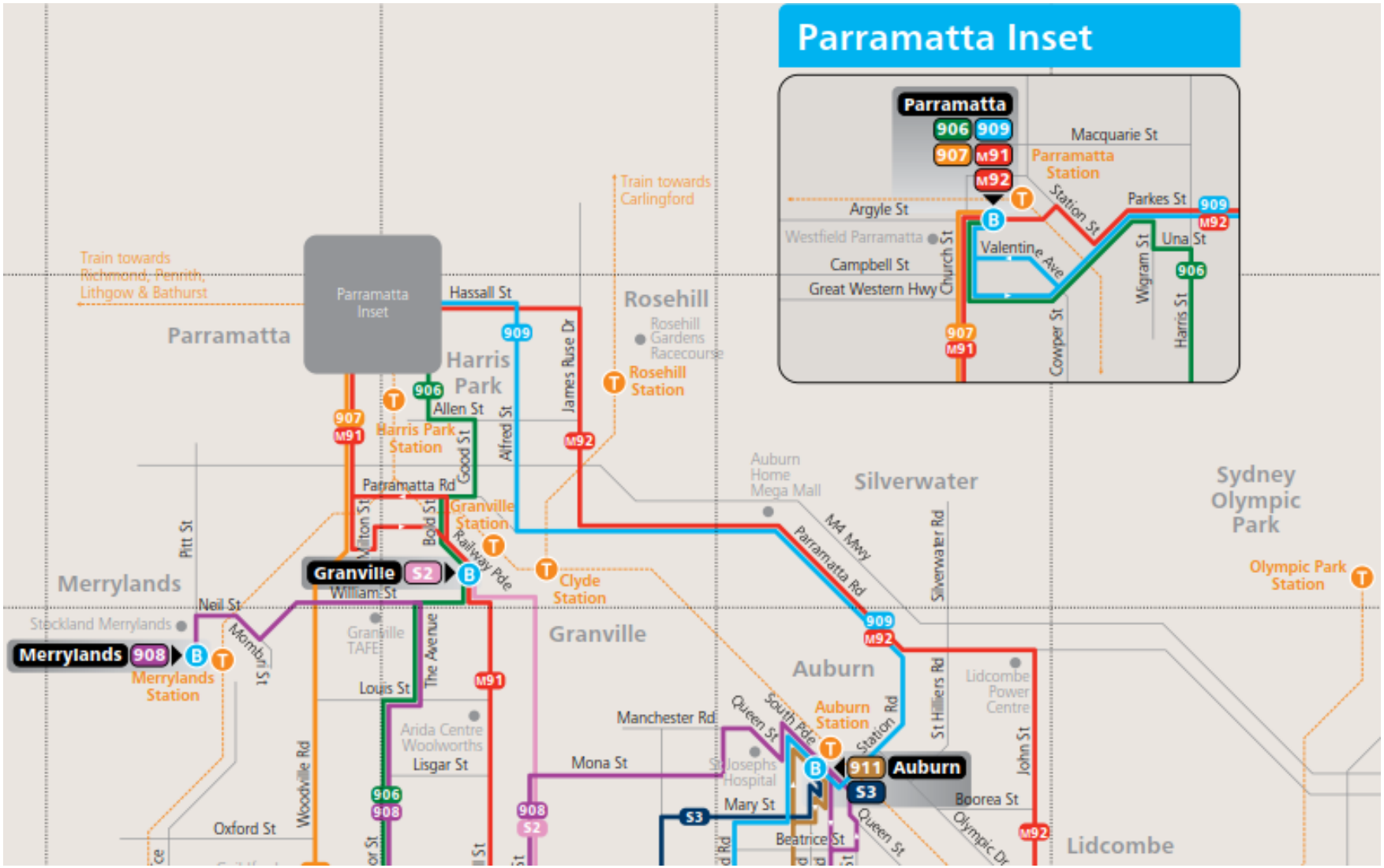
The service pattern across a typical weekday on the T6 Carlingford Line is shown in Table 4.3. The headway between trains is between 30 and 50 minutes during the peak periods. The service reduced slightly on weekends from 25/26 to 21 services per day. The irregular timing, low frequency and forced interchange at Clyde are not as convenient as the service provided at many other stations in the Sydney metropolitan area. As a result, current patronage of these stations is low, with only 70 people using Camellia and 100 people using Rosehill Station per day. Special event services operate for some events at Rosehill Racecourse.

Table 4.3 Weekday train services at Camellia Station

Direction	Number of Services			First Train at Camellia Station	Last Train at Camellia Station
	Per Weekday	Between 7.00 am and 9.00 am	Between 4.00 pm and 6.00 pm		
From Carlingford to Clyde	25	4	3	04: 58	00: 28
From Clyde to Carlingford	26	3	3	04: 37	01: 02

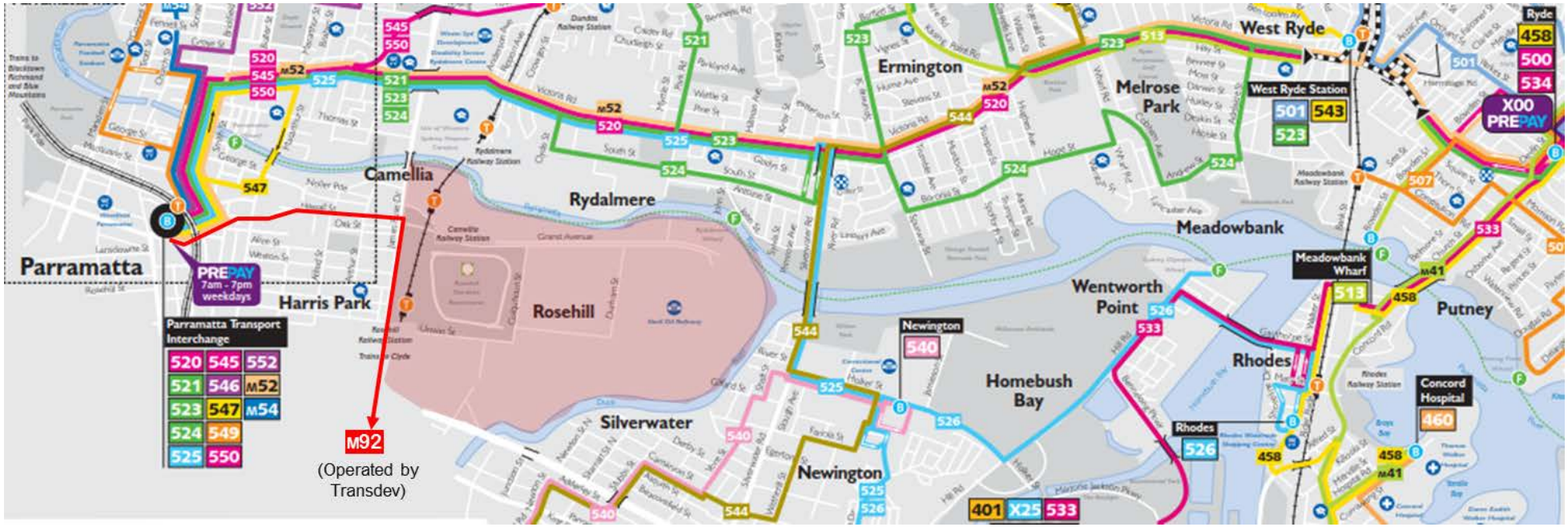
Source: Sydney Trains Timetable, Effective from 20 October 2013 with minor amendments from January 2015

Despite the walk distance of 1.5 km, many residents of Rosehill currently walk to Parramatta or Harris Park Stations, where the service frequency is substantially higher, and direct and/or express services are provided to many locations.



Source: *Parramatta, Bankstown and Liverpool bus network map (Transdev NSW, dated: 20 November 2016)*

Figure 4.4 Bus network near Camellia – Region 13



Source: North Shore and West Network Map (State Transit, dated: 26 November 2016)

Figure 4.5 Bus network near Camellia – Region 7

4.6 ROAD

4.6.1 ROAD NETWORK

The Camellia Precinct is bound by four regional roads (James Ruse Drive, Silverwater Road, Victoria Road and Parramatta Road), and a motorway (M4 Western Motorway) that are important elements of the Sydney's road network. While at non-peak times of the day this is a significant advantage, during peak periods, congestion on these roads limits their value. Two of these regional roadways are north-south crossings of the Parramatta River/Sydney Harbour, of which there are only five between Parramatta and Sydney. This attracts a significant amount of cross-regional through traffic to these two crossings. The road network within the vicinity of the study area is shown in Figure 4.6.

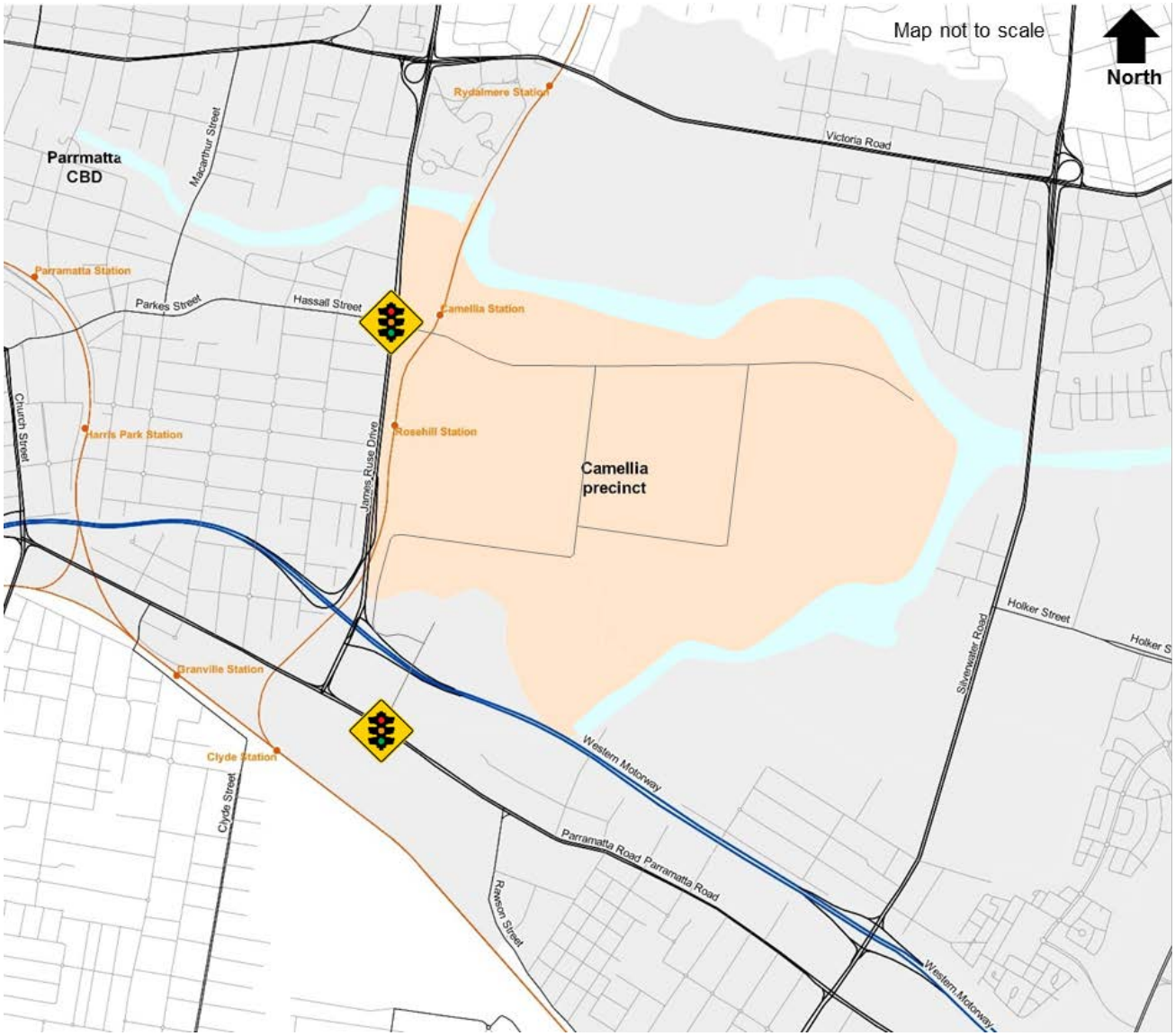


Figure 4.6 Surrounding road network

The Camellia Precinct currently has two road gateways including Hassall Street/Grand Avenue which accesses James Ruse Drive via a signalised intersection and Wentworth Street which accesses Parramatta Road at a signalised intersection.

James Ruse Drive is an arterial road running south to north along the western border of the Camellia Precinct. It stretches from Windsor Road, Northmead in the north to Parramatta Road, Granville in the south, and forms part of the

Western Regional Ring Road (identified by Council). It carries traffic volumes of approximately 70,500[9] vehicles per day. The road provides access to the M4 Western Motorway via directional ramps. James Ruse Drive has a bridge over Parramatta River and connects with Victoria Road via a grade-separated interchange. It is a six-lane, two-way divided road with a posted speed limit of 70 km/h. This route is approved for use by B-doubles.

Parramatta Road (route A4) is an arterial road linking Sydney CBD and Parramatta. Despite running parallel to the M4 Western Motorway for much of its length, it continues to carry a large volume of traffic (approximately 45,500 vehicles per day[10]). The section near Camellia precinct generally provides a divided road configuration with two lanes per direction. Additional turn lanes are provided at major intersections. Parramatta Road is designated as a B-double route and allows vehicles with a maximum vertical height clearance of 4.6 m. This route is generally signposted as a 60 km/h speed zone.

Silverwater Road (route A6) is an arterial road running north to south to the east of the Camellia Precinct. It forms signalised cross intersections with Parramatta Road and has a diamond interchange with M4 Western Motorway. It is a six-lane, two-way divided road with a posted speed limit of 70 km/h. At the bridge over the Parramatta River, it carries approximately 55,200 vehicles per day[11] in four traffic lanes. This route is approved for use by B-doubles.

Victoria Road (route A40) is a major arterial road connecting Parramatta with the western end of Anzac Bridge. Victoria Road runs to the north of Camellia precinct and Parramatta River. It is a four or six-lane, two-way divided road with a posted speed limit of 70 km/h. During peak hours, the road includes a dedicated bus lane. This route is designated as a B-double route. It carries approximately 41,400 vehicles per day[12].

The **M4 Western Motorway** is an arterial road that extends from Strathfield in the east to Emu Plains in the west. It is one of Sydney's major motorways, providing high standard alignment and high-speed driving conditions. It has a dual carriageway configuration with limited access through grade separated interchanges. Near Camellia, the M4 Western Motorway has a diamond interchange with Silverwater Road and two separated half-diamond interchanges with James Ruse Drive. This road is designated as a B-double route and allows vehicles with a maximum vertical height clearance of 4.6 metres with variable speed limit, typically of 90 km/h or more.

Grand Avenue is a major internal road that runs in the north of Precinct with its eastern end at Duck River and crossing James Ruse Drive. It has two lanes for each direction with wide central median. It is signposted with a 60 km/h speed zone. It is approved for use by B-doubles. There is no restriction on roadside parking.

Hassall Street is a regional road directly to the west connecting to Parkes Road which leads to the centre of Parramatta City. Its eastern section forms a signalised cross intersection with James Ruse Drive, and runs further east before with merging with Grand Avenue. Hassall Street generally has two lanes in each direction with a posted speed limit of 60 km/h. It is approved for use by B-doubles and short combination Higher Mass Limit (HML) vehicles.

Wentworth Street is a distributor to connect Parramatta Road to the south part of Camellia precinct and only runs from the south end at Parramatta Road to the north end at Duck River bank. Most of sections of the road are one traffic lane plus a parking lane in each direction. The speed limit is 60 km/h. The road has a low clearance height 4.6 metres when crosses below M4 Western Motorway. The road is approved for use by B-doubles and has no restriction on roadside parking.

4.6.2 TRAFFIC VOLUMES

The midblock traffic flow during the AM and PM peak periods are summarised in Figure 4.7 and Figure 4.8. These midblock flows are based upon the traffic survey and SCATS detector count data. Given the midblock traffic volumes and the number of lanes on the key roads, it is likely that the major roads (James Ruse Drive, Parramatta Road, Silverwater Road and Victoria Road) are operating at or near capacity during the peak periods.

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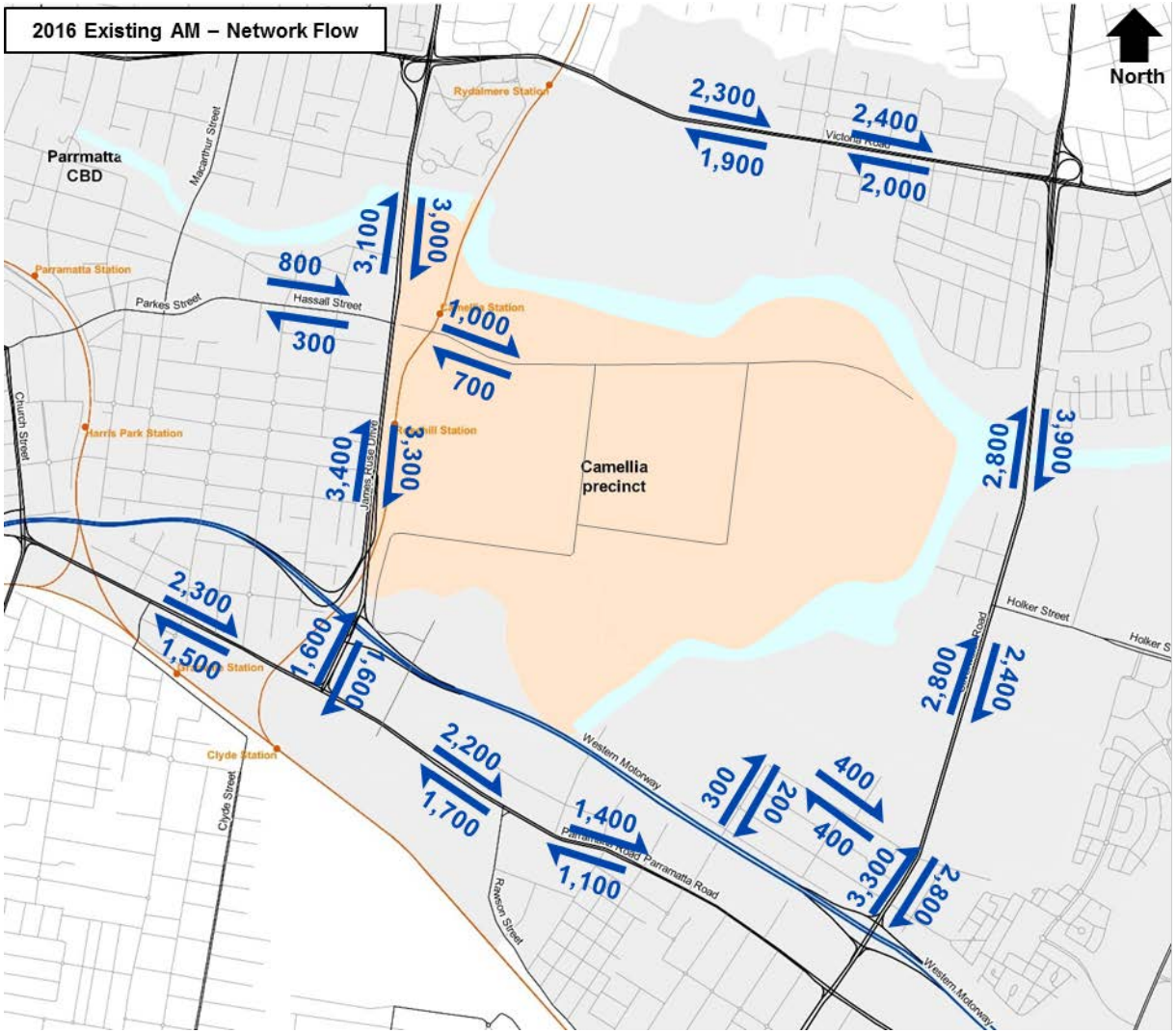
9 Roads and Maritime Average daily traffic volume map 2013, station 49.095, 120 m south of Thomas Street, Parramatta

10 Roads and Maritime Average daily traffic volume map 2016, station 49.002, 140 m east of Harbord Street, Auburn

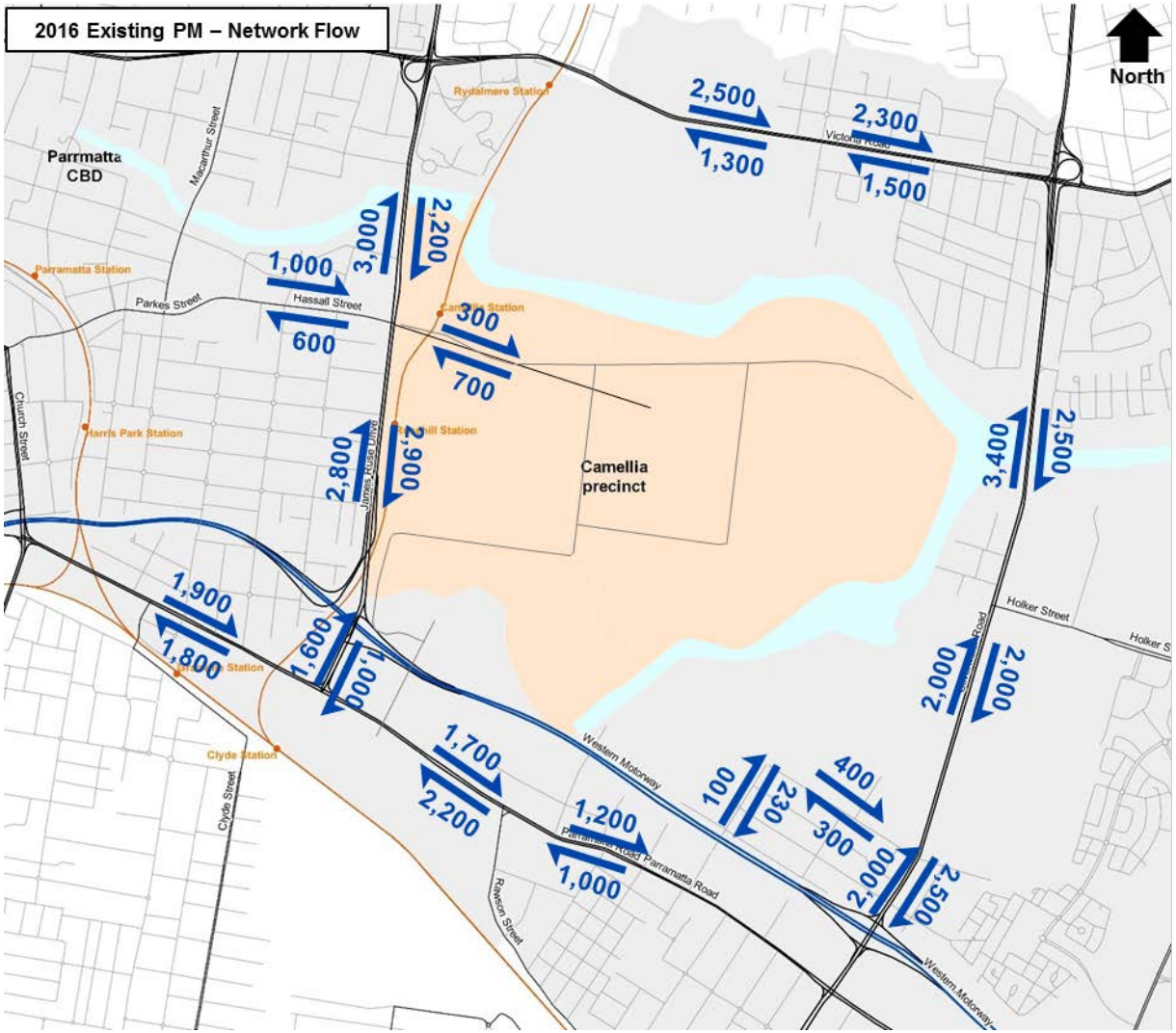
11 Roads and Maritime Average daily traffic volume map 2016, station 50.001, 110 m west of Allambie Street, Rydalmere

12 Roads and Maritime Average daily traffic volume map 2016, station 50.234, 80 m west of Myrtle Street, Rydalmere



Source: Roads and Maritime *SCATS data for 20, 21 and 22 October 2015*

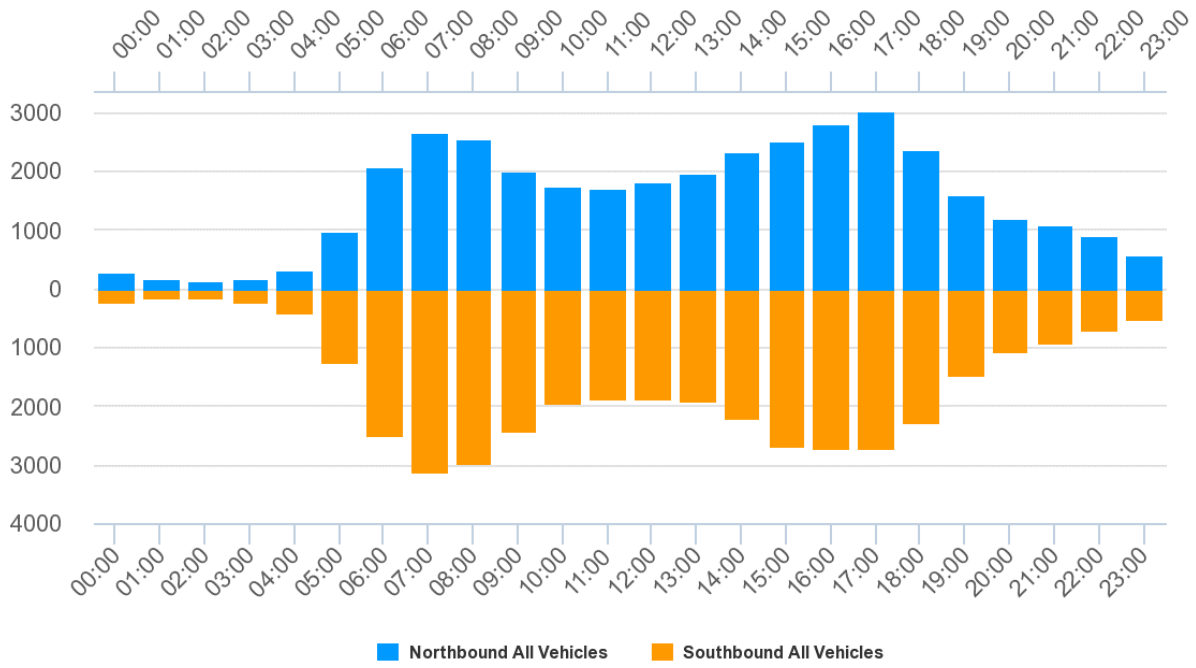
Figure 4.7 AM peak hour traffic volumes (in PCU)



Source: Roads and Maritime *SCATS data for 20, 21 and 22 October 2015*

Figure 4.8 PM peak hour traffic volumes (in PCU)

The weekday profile of traffic on James Ruse Drive is shown in Figure 4.9. It shows peaks in both directions during the morning and afternoon periods. There is a slight tidal bias towards southbound travel (towards Parramatta and the M4 Motorway) in the AM peak and northbound in the PM peak.



Source: *Roads and Maritime Average daily traffic volume map 2013, station 49.095, 120 m south of Thomas Street, Parramatta, at Parramatta River Bridge, weekdays excluding public holidays and school holidays*

Figure 4.9 Weekday profile of traffic on James Ruse Drive

Roads and Maritime traffic data also indicates:

- Counts on Parramatta Road and Silverwater Road indicate roughly 7% to 8% heavy vehicles.[13]
- The traffic demand at the bridge section of James Ruse Drive crossing the Parramatta River has been increasing since 1993 with an increasing average annual rate of approximately 1.5%.
- Since 2006, traffic volumes on the Silverwater Road Bridge over the Parramatta River have stayed approximately constant.
- Traffic demand on Parramatta Road has been affected by the operation of M4 Western Motorway, including its opening in 1991, and the removal of the toll charge in 2010, which reduced in a switch of traffic from Parramatta Road to the M4 Motorway.

4.6.3 INTERSECTION PERFORMANCE

SIDRA modelling was undertaken for key intersections based on classified count information and SCATS traffic volume data. A summary of the results is presented in Table 4.4, Figure 4.10 and Figure 4.11. While most of the intersections within the study area perform at satisfactory Levels of Service (LoS D or better) during both AM and PM peaks, some intersections are performing with congestion conditions. The following intersections operate with a DoS > 1.00 or LoS E or above, and extended queue lengths:

- James Ruse Drive and Hassall Street

[13] Roads and Maritime Average daily traffic volume map (2016) sites 47.024 Parramatta Road 30 m west of Junction Street, Auburn, and 7,112 Silverwater Road, 80 m south of Western Motorway, Auburn.

- James Ruse Drive and Parramatta Road
- Parramatta Road and Wentworth Street
- Silverwater Road and Carnarvon Street
- Victoria Road and Park Road.

Table 4.4 Summary of existing intersection performance

Site ID	Intersection	Peak period	Degree of Saturation (V/C)	Average Delay Per Vehicle (sec)	Intersection Level of Service	Maximum Intersection Queue Length (m)
I-01	James Ruse Drive/ Hassall Street	AM	**1.1**	170	**F**	> 500
		PM	**1.2**	140	**F**	> 500
I-02	James Ruse Drive/ Prospect Street	AM	0.9	25	B	490
		PM	0.8	25	B	420
I-03A	James Ruse Drive/ M4 Eastbound on ramp	AM	0.7	10	A	130
		PM	0.6	10	A	60
I-03B	James Ruse Drive/ M4 Eastbound off ramp	AM	0.9	25	B	200
		PM	0.6	15	B	80
I-04	James Ruse Drive/ Parramatta Road	AM	**1.0**	45	C	340
		PM	**1.1**	45	D	250
I-05	Parramatta Road/ Wentworth Street	AM	**1.0**	35	C	> 500
		PM	**1.0**	20	B	310
I-06	Parramatta Road/ Stubbs Street	AM	0.8	15	B	180
		PM	0.9	20	B	120
I-07	Carnarvon Street/ Stubbs Street	AM	0.3	10	A	20
		PM	0.3	10	A	20
I-08	Silverwater Road/ Carnarvon Street	AM	**1.2**	150	**F**	> 500
		PM	**1.0**	45	D	260
I-09	Silverwater Road/ Clyde Street	AM	0.9	20	B	> 500
		PM	0.8	15	A	360
I-10	Victoria Road/ Park Road	AM	**1.1**	100	**F**	> 500
		PM	0.9	40	C	410
I-11	Grand Avenue/ Colquhoun Street	AM	0.2	10	A	20
		PM	0.3	5	A	20

Source: SIDRA 6.1 Intersection Modelling, WSP, 2016)

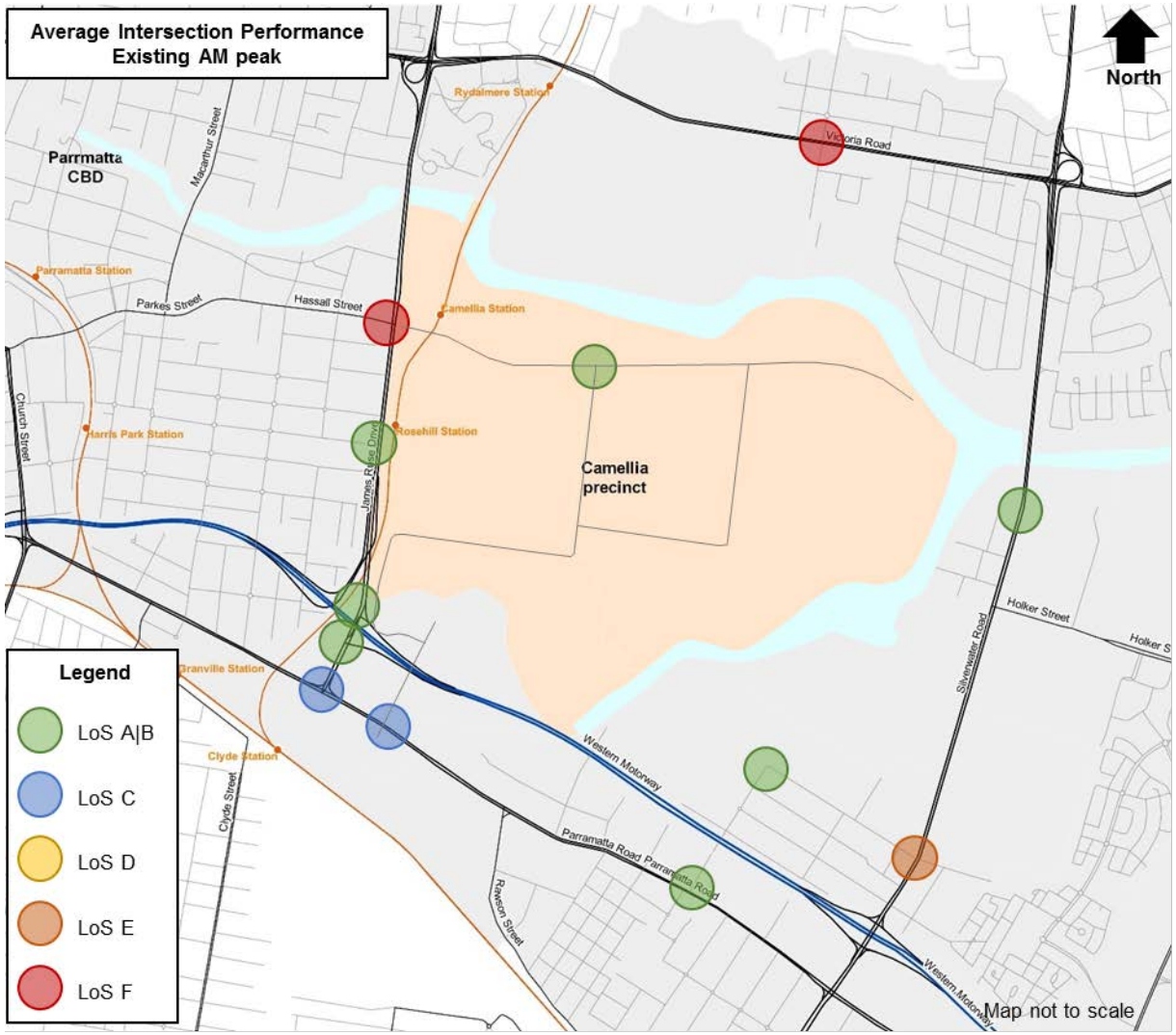


Figure 4.10 Existing intersection performance – AM peak

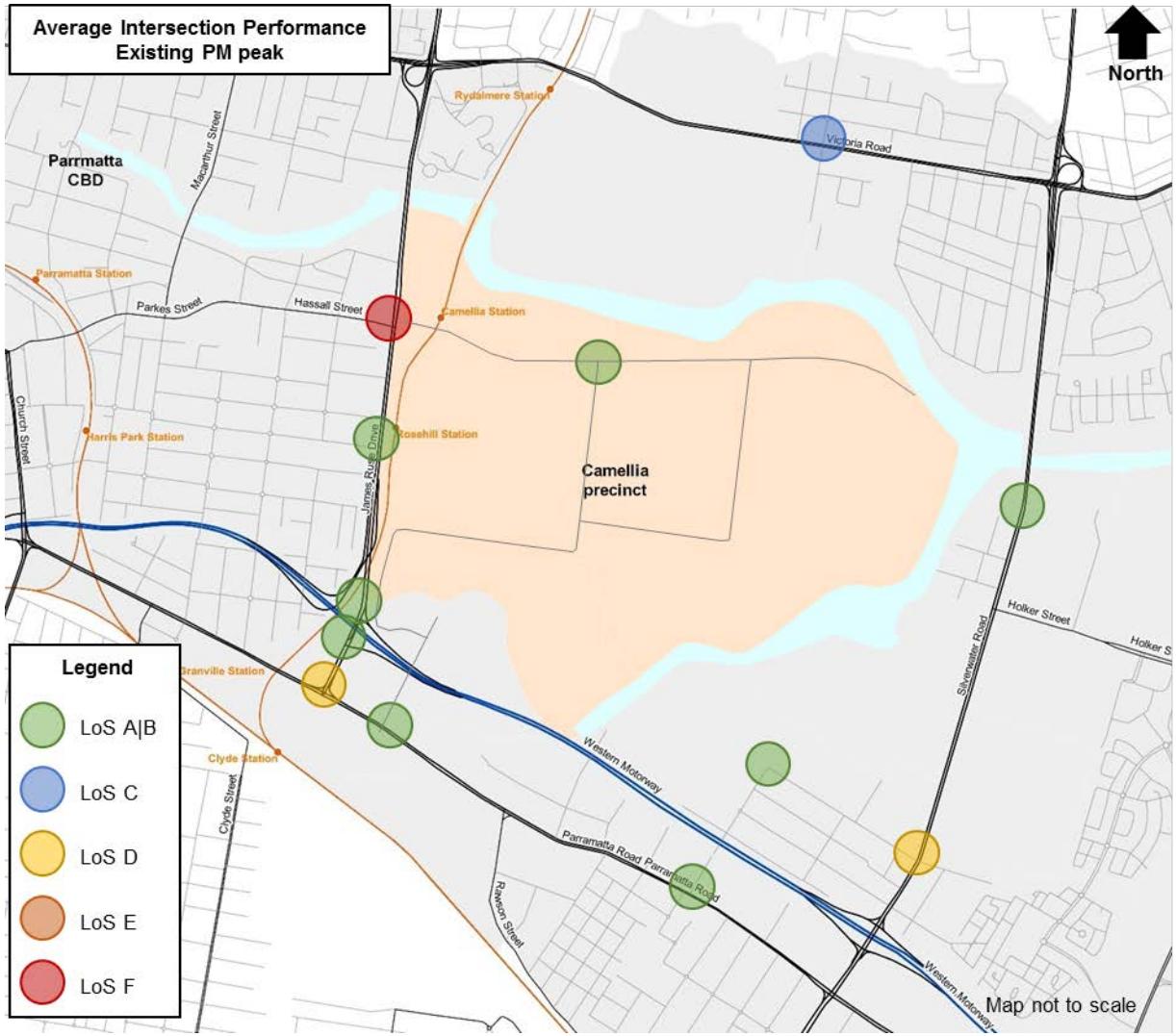


Figure 4.11 Existing intersection performance – PM peak

4.6.4 TRAVEL TIME AND SPEED

Roads and Maritime monitors travel speeds on its key road corridors. The surveyed average speed is compared to the posted speed limit as a relative measure of performance for high and lower speed roads. Table 4.5 shows the available data for the arterial road corridors surrounding the Camellia Precinct.

Table 4.5 Travel times and average speeds on arterial roads and motorways surrounding Camellia

Route Name	Peak	From	To	Speed Average (km/h)	Percentage of Speed Limit	Travel Time Average (minutes)
James Ruse Drive	AM	Northmead	Clyde	38	52%	9.3
		Clyde	Northmead	44	61%	7.4
	PM	Northmead	Clyde	31	43%	11.1
		Clyde	Northmead	42	58%	7.8
Parramatta Road	AM	Harris Park	Concord	30	56%	20.7
		Concord	Harris Park	47	87%	12.3
	PM	Harris Park	Concord	32	58%	19.6
		Concord	Harris Park	36	68%	16.9
M4 Motorway	AM	Clyde	Concord	52	60%	10.8
		Concord	Clyde	56	65%	10.1
	PM	Clyde	Concord	49	57%	11.9
		Concord	Clyde	35	41%	16.2
Silverwater Road	AM	Dundas	Auburn	40	53%	8.4
		Auburn	Dundas	48	65%	7.0
	PM	Dundas	Auburn	40	54%	8.9
		Auburn	Dundas	43	58%	7.7
Victoria Road	AM	Parramatta	Hunters Hill	32	58%	29.1
		Hunters Hill	Parramatta	41	74%	23.0
	PM	Parramatta	Hunters Hill	37	67%	25.1
		Hunters Hill	Parramatta	29	52%	32.2

The data indicates that:

- The M4 Motorway moves relatively well, apart from the PM peak in the westbound direction.
- James Ruse Drive experiences slower conditions, with northbound speeds lower than southbound. The PM peak in the northbound direction is congested as traffic existing Parramatta CBD joins the already large volume of northbound traffic.
- Parramatta Road has a mixture of congestion levels, with the westbound direction moving better than the eastbound. Travel times can vary by up to 8 minutes (out of a slowest total of 20.7 minutes).
- Silverwater Road performs relatively consistently with speeds and times varying slightly.
- Victoria Road also exhibits is slowest conditions in the PM peak in the westbound direction.

4.7 FREIGHT

The Camellia Precinct is currently a predominantly industrial area located in the centre of Sydney, at the northern end of the Clyde to Chullora/Enfield freight precinct. It is surrounded by the Silverwater Industrial Area and other smaller precincts to the north (Rydalmere) and south (Clyde). The Camellia Precinct is located within 1.5 km of the Clyde Intermodal Terminal and Waste Transfer Station.

There are three methods of transporting freight in and out of the Camellia Precinct, including by road, by rail and by pipeline. Under the road freight hierarchy[14] shown in Figure 4.12, the M4 Motorway, Pennant Hills Road/ Cumberland Highway and Homebush Bay Drive/Centennial Drive are identified as primary freight roads, meaning they serve the highest role in the road freight network. Silverwater Road and James Ruse Drive are secondary freight roads. Parramatta Road and Victoria Road are tertiary freight roads.

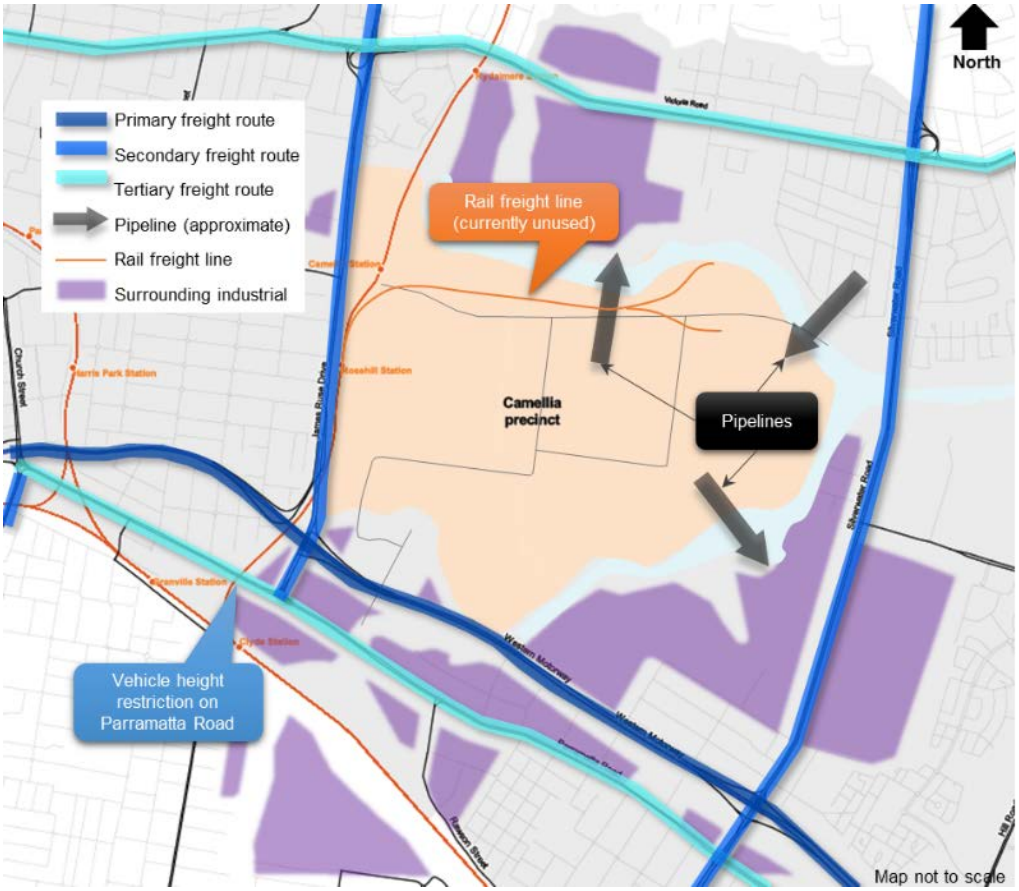


Figure 4.12 Freight routes and industrial areas

The Sandown Rail line is a spur extending from the T6 Carlingford passenger rail line, north of Rosehill Station. The line is currently disused, but remains in existence as far east as Thackeray Street. Another disused rail spur extends into the Downer EDI site in the southern part of the Precinct, however sections have been paved over.

The Camellia Precinct included businesses that generally have large numbers of heavy vehicle road freight trips as well as employee and light commercial trips. This includes industrial businesses such as Viva Energy, Veolia, Boral, as well as building materials suppliers and recycling plants.

[14] Metropolitan Road Freight Hierarchy on the State Road Network Practice Note, Department of Transport, 2011

The two access points to the Precinct (Hassall Street and Wentworth Street) currently accommodate all truck access. However, Wentworth Street has a 4.6 m low clearance bridge at the M4 Motorway. Based on the results of intersection traffic surveys at the intersections of James Ruse Drive with Hassall Street and Parramatta Road with Wentworth Street undertaken in November 2014, the percentage of heavy vehicles (including trucks and buses) is relatively high:

- Hassall Street, east of James Ruse Drive:
  - AM peak (6.00 am to 10.00 am) – 28% heavy vehicles (999 out of 3,510 total vehicles counted)
  - PM peak (3.00 pm to 7.00 pm) – 15% heavy vehicles (482 out of 3,159 total vehicles counted).
- Wentworth Street, north of Parramatta Road:
  - AM peak (6.00 am to 10.00 am) – 27% heavy vehicles (424 out of 1,589 total vehicles counted)
  - PM peak (3.00 pm to 7.00 pm) – 15% heavy vehicles (195 out of 1,333 total vehicles counted).

Roads within the Camellia Precinct are approved for use by B-Double trucks. However, only Grand Avenue is approved for use by higher mass limit (HML) short combination vehicles[15].

4.8 ROSEHILL RACECOURSE EVENTS

The Rosehill Gardens Racecourse is located on the eastern side of James Ruse Drive, and is operated by the Australian Turf Club. The racecourse hosts horse races and is considered one of the two premier racecourses in Sydney, with the main events being the Golden Slipper. The Racecourse also operates as a function centre which hosts events including the Caravan, Camping, RV and Holiday Supershow.

The racecourse is served by trains on the T6 Carlingford line stopping at Rosehill station. At Rosehill Station, two platforms are provided one four-car long platform on the T6 Carlingford Line track and one platform which is approximately sixteen-cars long on the Sandown line track which is used for special events.

On race days or for special events held at Rosehill Gardens Racecourse, a special bus service which combines regular public transport services with the free Rosehill Gardens shuttle bus service is offered from Parramatta Station to Parramatta Wharf, then on to Rosehill Gardens Racecourse. A designated set-down and pick-up area for private coaches is located along the western side of Arthur Street. Mini-buses use the Grand Avenue entry bus stop and park.

Taxis enter Rosehill Gardens Racecourse through the Grand Avenue gates. The set-down point is at the taxi rank. Taxis pick-up area is in Oak Street over the Equine Bridge (over James Ruse Drive).

There is limited free car parking in P4 and P5 car park, which are located on James Ruse Drive and Prospect Street, and the Infield car park. The entry to the Infield car park is via Unwin Street. Limited Disabled car parking is available in car park areas with entry via James Ruse Drive and Grand Avenue.

The Caravan, Camping, RV and Holiday Supershow is a nine-day event that attracts around 80,000 visitors each year. Aside from the regular transport options, a free shuttle bus is provided from Parramatta Station and Wharf.

4.9 SYDNEY SPEEDWAY

The Sydney Speedway car park caters for approximately 500 vehicles during events and parking is free of charge. On street parking is also available on Wentworth Street and Deniehy Street.

Clyde Station, with services the T1 Western Line and T6 Carlingford Line, is approximately 10 minutes' walk from the speedway. Granville Station is a further 5 minutes' walk from Clyde Station and services the Blue Mountains Line, the South Line and the Western Line.

[15] Roads and Maritime NSW Combined Higher Mass Limit and Restricted Access Vehicle Map, viewed 6 December 2017

5 CAMELLIA PRECINCT REVITALISATION

The proposed rezoning of the Camellia Precinct is the next step in a process to realise the development potential of the Camellia Precinct. The precinct planning process has provided analysis on projected growth, zoning and planning controls. Following a preliminary round of consultation on the *Camellia Land Use and Infrastructure Strategy* (DP&E, August 2015), further consultation will be undertaken with relevant agencies, service providers, landowners and the surrounding community based on the mode detailed information contained in the Rezoning Proposal.

The Camellia Town Centre Master Plan identifies the Department's vision for the town centre by proposing land uses, indicative heights and floor space ratio controls. Following consultation on the Master Plan, a detailed rezoning package will be prepared for exhibition.

5.1 RESULTS OF CONSULTATION

The *Land Use and Infrastructure Strategy for Camellia*, including the *Strategic Transport Assessment* (Parsons Brinckerhoff, July 2015) was released on 18 August 2015. The Strategy was publicly exhibited from 18 August until 18 September 2015. Information was provided to the public and stakeholders via the website, email notification, briefings and locations where printed copies of the documents could be viewed.

An on-line survey to seek community feedback on the vision for Camellia, infrastructure priorities, employment considerations and community facilities to inform the finalisation of the Strategy was completed by 181 respondents. In addition, 20 written submissions were received, of which 10 were submitted by landowners within the Precinct.

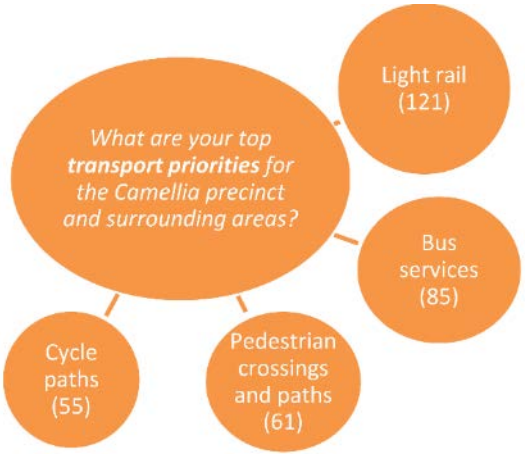
The on-line surveys and written submissions were reviewed and summarised in the 'Camellia Precinct Land Use and Infrastructure Strategy Consultation Update' (DP&E, March 2016). The top vision concern for the respondents was for improved public transport. Walking and cycling links and car parking were also priorities.

There was strong support for light rail and improved bus connections, as well as for walking and cycling paths.

For road improvements to support the Precinct rezoning, the top responses were for James Ruse Drive and new connections over the Parramatta River and Duck River. Upgrades to Grand Avenue, Hassall Street and Wentworth Avenue were also considered important.

For public transport, there was:

- Support for light rail in Camellia
- Preference for Sydney Olympic Park as the preferred route
- Support for the re-alignment of the Carlingford rail line closer to James Ruse Drive
- Support for a new ferry wharf at Camellia (Transport for NSW advise that due to significant environmental and operational constraints, a new ferry wharf at Camellia is not feasible)
- Future investment in existing heavy rail (only raised once)
- Proposed modifications to suggested bus networks.



These responses have been taken into consideration in developing the transport strategies outlined in the remaining chapters of this report.

5.2 VISION

The land use vision for the Camellia Precinct, as outlined in the Camellia Precinct Land Use and Infrastructure Strategy (DP&E, July 2015) is for Camellia to become a:

> **21st Century Living and Business District, Comprising Industry, Research, Education, Employment, Retail, Recreation, Entertainment and Residential Uses.**

The Strategy also outlines several planning principles, of which the following two are relevant to this transport strategy:

6. Provide for vehicular connections between Camellia, Silverwater, Rydalmere and the M4.
7. Improve access to public transport by focusing new development around transport nodes.

5.3 MASTER PLAN

Significant areas of employment generating land uses are to be retained across the Precinct to create opportunities to further develop Camellia primarily as an 'Innovation Precinct'. The eastern part of the Precinct is to be retained as a heavy industry zone, with the remainder to be transformed into an employment zone where job density is expected to increase.

Mixed use transit-oriented development including residential, is to be concentrated in the north-western quadrant, to act as a catalyst for the redevelopment of the Precinct. Grand Avenue is to be transformed into a tree lined boulevard. Entertainment uses are to be accessible from James Ruse Drive and the town centre and integrated with public transport.

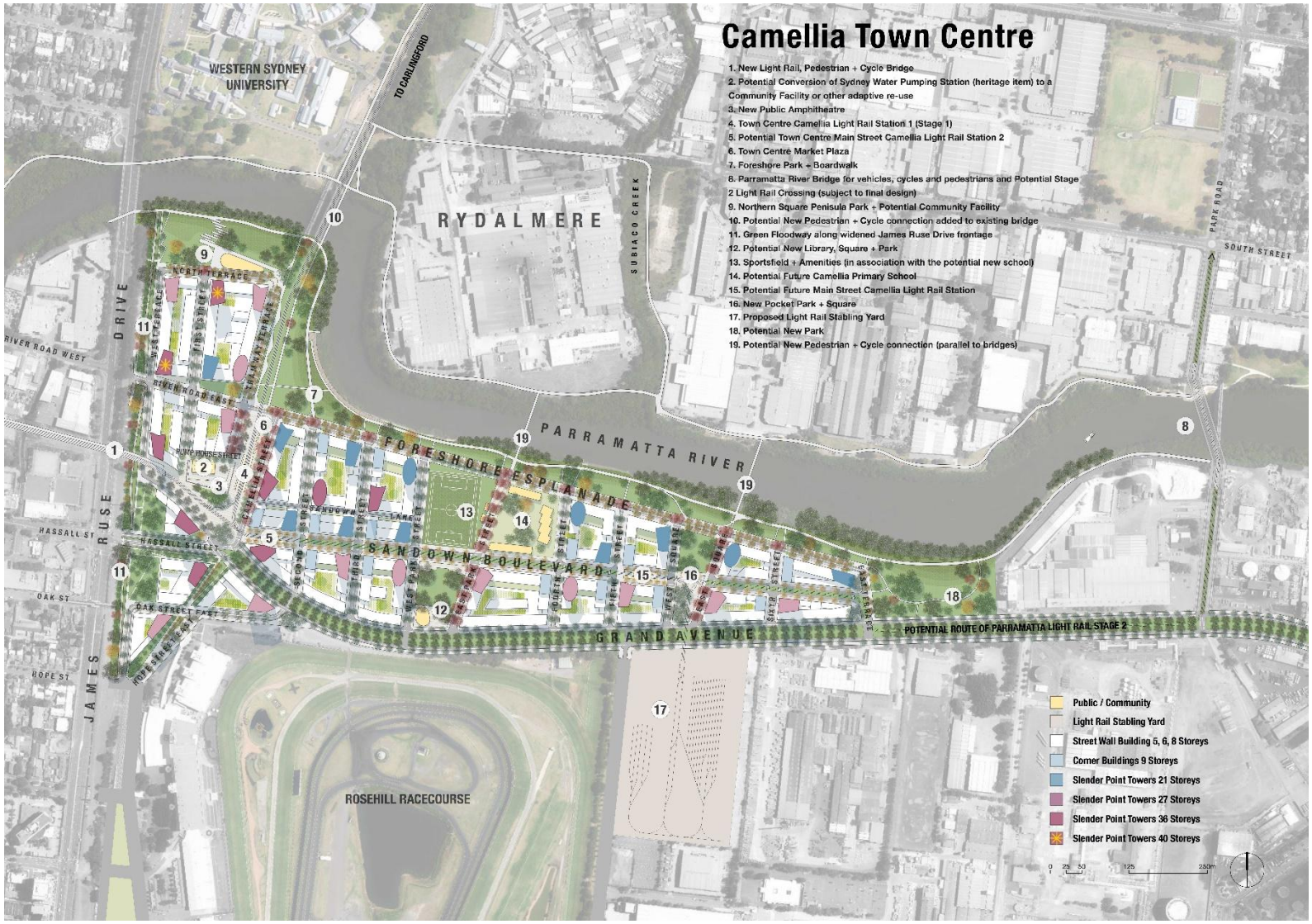
Business uses are to be located adjacent to the mixed-use zone to provide a buffer between residential and industrial uses. Business park development along the waterfront could act as a hub for research, innovation and emerging technologies to support other industries in the precinct and potentially link to Western Sydney University.

The proposed master plan for the Camellia Town Centre is shown in Figure 5.1. The road layout is indicative only and requires further refinement as part of future precinct planning. Areas to be revised include:

- Ensure sufficient pedestrian crossing capacity at the intersection of Hassall Street, Camellia Street and Grand Avenue for race day crowds from Rosehill Racecourse to the Parramatta Light Rail Stop;
- Ensure sufficient traffic capacity for access into/out of the Town Centre;
- Revised access from Oak Street East and Hope Street East to avoid rat-running through Rosehill Racecourse;
- Provision of sufficient traffic capacity for industrial land access on Grand Avenue at the intersections with Colquhoun Street and Thackeray Street (leading to the Bridge over the Parramatta River);
- Revised intersection configuration on River Road East at the entry from James Ruse Drive and intersection with West Terrace;
- Apply truck load/size limits and introduce local area traffic management along River Road East to reduce rat-running;
- Improve pedestrian and cycle access from the industrial area to the Town Centre.

The above refinements will be explored in more detail in collaboration with Council and RMS. The refinements will inform the future rezoning of the Camellia Town Centre, including the development control plan and Section 94 Contributions Plan.

The proposed land use plan assists the achievement of the transport vision by separating the town centre and continuing industrial land uses. It also places the town centre closest to the Parramatta CBD, planned public transport improvements, Rosehill and Harris Park suburbs and the Parramatta River walking and cycling facilities, promoting the use of sustainable modes.



Source: Department of Planning and Environment, Hill Thalis Architects,31 January 2018

Figure 5.1 Camellia Precinct Illustrative Master Plan

The mix of land uses and the transit-oriented nature of the development offers the potential for a contained living and working lifestyle, with Parramatta CBD entertainment facilities and Sydney Olympic Park recreational facilities accessible by public transport, walking and cycling.

The position of the industrial land uses closes to the M4 Motorway creates the potential for efficient road freight access to the primary freight corridor without trucks having to travel past the residential and town centre area.

5.4 PROPOSED DEVELOPMENT

Various scenarios for the proposed urban regeneration of the Camellia precinct have been assessed. The potential residential and employment development yields for each of these scenarios are summarised in Table 5.1 and Table 5.2. Option 1 assesses an intermediate development yield in 2021 prior to proceeding to either Option 2 or Option 3 in 2031.

Table 5.1 Residential development scenarios

	Option 2 – Medium	Option 3 – High
Dwellings		
Town Centre	8,050	11,500
ATC	1,950	2,500
Total dwellings	**10,000**	**14,000**
Population	**21,000**	**29,400**

Source: NSW Department of Planning and Environment (November 2015)

Table 5.2 Retail/Commercial/Industry development scenarios

	Option 2 – Medium		Option 3 – High	
	GFA	Jobs	GFA	Jobs
Heavy industry				
Viva Energy (as per EIS)	–	60	–	60
Remaining land	–	340	–	510
Sub-total		**400**		**570**
Other employment outside town centre - General industrial, warehousing, transport, construction employment				
Outside town centre	–	3,500	–	5,000
Total non-town centre		3,900		5,570
Town Centre Mixed Use				
Town centre retail	25,000	500	25,000	500
ATC retail	50,000	1,000	110,000	2,200
ATC showroom	25,000	250	26,000	260
ATC commercial	60,000	2,400	80,000	3,200
ATC club/hotel	40,000	800	41,000	820
Total town centre	200,000	4,950	282,000	6,980
Total Camellia		**8,850**		**12,550**

Source: NSW Department of Planning and Environment (November 2015)

6 TRANSPORT VISION

The review of government policies and plans in section 2 showed the compatibility of development in the Camellia Precinct with the investigation of transport improvements currently being undertaken. The commitment to urban renewal at locations such as Camellia responds to the need to accommodate population growth in Sydney. However, the retention of the industrial precinct will contribute to a well-functioning and competitive international city. The success of urban renewal will also have a positive transport outcome in that it should lead to shorter trips and greater use of non-car modes both of which will assist in managing the transport task from existing and new residents.

This section considers the constraints and opportunities that the existing transport network and services in the study area has for urban renewal in the Camellia Precinct. This considers the implications that urban renewal could have for the performance and management of the transport network.

Based on the overall vision for the Precinct, the planning principles, the results of the *Strategic Transport Assessment* and the community feedback, the following vision for transport is proposed for the Precinct:

To promote sustainable travel to the new town centre and efficient freight transport to the continuing industrial land uses in a manner that reinforces residential amenity and economic competitiveness.

6.1 TRANSPORT OBJECTIVES

The strategic transport objectives have been developed to the transport vision for the Camellia Precinct. The strategic transport objectives align with NSW Government targets, support a range of desired transport outcomes and address customer needs. The strategic transport objectives are outlined in Table 6.1.

Table 6.1 Camellia transport objectives

	Transport Objective	Precinct Outcome
Improve quality of service	Prioritise public and active transport modes.	— More reliable public transport network. — Connected active transport network. — Reduced demand for private vehicle travel.
	Support efficient interchange between transport modes.	— Reduce the need for long-distance trips whose reliability can be affected by arterial road congestion.
	Improve bus services within the precinct and align them with rail services.	
	Provide consistent and effective wayfinding and legible public transport access.	— Moving around the Precinct is easy. — Large block sizes in industrial area are not a barrier to movement.
Improve liveability	Make the precinct an attractive place to travel to, from and move within.	— Public transport and active transport offer a fast and reliable trip even if the road network is congested.
	Encourage healthy and active lifestyles through provision of safe, direct and legible infrastructure for walking and cycling, including cycle parking and other end-of-trip facilities, as well as paths.	— Take advantage of the extensive recreational facilities in Sydney Olympic Park. — Maximise the benefits of Parramatta River position and links to Parramatta CBD.
	Improve land use integration to increase trip containment, improve liveability and stimulate social/economic activity.	— Reduce demand for trips at the Precinct gateways by offering live and work opportunities through mixed land use.

	Transport Objective	Precinct Outcome
	Establish a street network with defined function, hierarchy and modal priority.	— Reduce the impacts of freight on residential land uses and vice versa by prioritising walking, cycling and public transport within the mixed-use area and traffic movement on the new road connections.
Support economic growth and productivity	Reduce traffic congestion through provision of real and convenient transport alternatives to private vehicles.	— Preserve road space for high-value freight movement by providing high-quality alternatives for residents and employees.
	Support economic growth and productivity by providing a transport system that increases freight efficiency.	— Reduce time to access the arterial road network for freight vehicles through new connections.
Improve safety and security	Make active commuting trips to the precinct safer for the workers who also live in the area.	— Provide well-lit paths between employment and residences with passive surveillance.
	Reduce pedestrian and vehicle conflict through design of infrastructure.	— Consider pedestrian and cyclist safety in intersection design. — Direct cycle and pedestrian crossing points to intersections or grade separate.
	Reduce traffic accidents.	— Provide clear intersection layout and signage at light rail and freight rail level crossing points. — Provide pavement type, colour and vertical difference to guide pedestrians and cyclists when crossing light rail corridor. — Design cycle and pedestrian paths to cross light rail at perpendicular angle.
	Improve personal security for active transport users and those waiting for public transport, particularly at night.	— Design passive surveillance of Camellia Station and other light rail and bus stops where possible in the industrial area.
Improve sustainability	Support sustainable modes of transport throughout the precinct.	— Reduce road congestion and vehicle emissions by reducing demand for private vehicle trips.
	Increase containment and reduce the need to travel by locating complementary land uses close to each other, e.g. residential close to essential shopping/other services, and to varied employment opportunities.	— Reduce demand for trips at the Precinct gateways by offering live and work opportunities through mixed land use.
Strengthen transport planning processes	Work with businesses, Council and transport operators to achieve an integrated transport network that addresses all customer needs.	— Work with industrial tenants to tailor needs of future industrial uses.
	Support new developments to encourage an attractive and safe street environment for pedestrians, cyclists and public transport customers with active street frontages and human scale buildings.	— Provide a street environment, especially within mixed use area, that is conducive to walking and cycling trips.
	Establish appropriate parking supply rates and parking policy to align with transport objectives for the precinct.	— Reduced opportunity for private vehicle travel. — Reduce the cost of providing parking structures.

6.2 CONSTRAINTS AND OPPORTUNITIES

Table 6.2 draws on the conclusion of the assessment of existing transport conditions and strategic transport assessment. The conclusions from these chapters are presented in the format of constraints and opportunities that the transport system affords urban renewal in the Precinct.

Table 6.2 Strategic-level constraints and benefits assessment

	Constraints	Opportunities
Land use	— Conflicts between industrial traffic and new residential development proposed near the Grand Avenue/James Ruse Drive intersection.	— Maximise opportunities for trip containment by providing a mixture of land uses (residences within walking distance of employment). — Separate industrial and residential/commercial traffic to avoid noise impacts on residences and protect the efficiency of the freight network.
Walking	— Limited pedestrian opportunities due to combined barrier effect of arterial roads and rivers.	— Maximise pedestrian connections to Parramatta CBD and Sydney Olympic Park. — Replace Grand Avenue/Hassall Street overbridge with at-grade pedestrian paths to Parramatta. — Upgrade footpaths and pedestrian crossing opportunities within Precinct.
Cycling	— Limited cycle access opportunities due to combined barrier effect of arterial roads and rivers. — Fragmented land ownership restricts ability to provide cycle path along the Parramatta River bank.	— Maximise cycle connections to Parramatta CBD and Sydney Olympic Park. — Piggyback off improvements for road and light rail to remove gaps in cycle network. — Connect to substantial recreational cycle network and sporting facilities in Sydney Olympic Park.
Bus services	— No bus network within Precinct, limited service on James Ruse Drive and Parramatta Road.	— Maximise public transport connections to Parramatta CBD and Sydney Olympic Park. — Use reverse loading of residences and employment to extend bus services into the Precinct. — Overcome wide distances between light rail and industrial sites by providing an internal shuttle bus.

	Constraints	Opportunities
Light Rail Transit	— The alternative option alignment for PLR Stage 2 traverses the exclusion zone for high-density development around the ongoing Viva Energy petroleum depot, reducing its potential patronage.	— Facilitate the route for light rail to Parramatta CBD and Sydney Olympic Park/Carter Street across the site for improved public transport access. — Improve priority for light rail across James Ruse Drive connections, reducing delays due to arterial road traffic. — Stage delivery of light rail by building up east-west corridor demand through high-frequency bus route.
Train services	— T6 Carlingford Line with forced interchange, low frequency and inconsistent headway, misses Parramatta CBD.	— Conversion to light rail enables connection to Parramatta and higher-frequency service without disrupting T1 Western Line services.
Road network	— Current capacity at two access intersections insufficient for future revitalisation. — Existing Hassall Street/Grand Avenue overbridge slows trucks reducing its capacity further. — Congested major intersections on arterial network in all directions. — Parramatta River road bridges at Silverwater Road and James Ruse Drive at or close to capacity. — Opening new road links increases the potential for large volumes of vehicles rat-running through the Precinct.	— Improve road capacity for James Ruse Drive and access for Camellia Precinct traffic. — Make provision for Camellia traffic by addressing arterial road congestion issues along the James Ruse Drive corridor. — New road bridges to disperse impact on the road network.
Freight	— High truck volumes generated by current and continuing industrial land uses. — Sandown Line currently disused, conflict with light rail if reactivation is required in the future.	— Protect pipelines to minimise truck trips on the road network. — Improve freight access to M4 Western Motorway through new ramps to accommodate high truck volumes with retention of the large industrial land uses
Travel patterns	— Existing travel patterns established based on poor levels of access to public transport.	— Take advantage of strategic position between Parramatta CBD and Sydney Olympic Park to reduce trip lengths for new residents and employees. — Public transport and active transport improvements for the revitalisation areas of Camellia to improve transport options for existing industrial employees. — Early introduction of travel demand management measures to influence travel patterns of new residents and employees before they are set.

6.3 TRANSPORT PLANNING TOOLS

Enshrining sustainable transport planning principles in the redevelopment assists in achieving the achievement of the transport vision and minimises its impact on the surrounding road network. Table 6.3 outlines some of the transport planning tools that could be employed for the Camellia Precinct.

Table 6.3 Transport planning tools

Tool	Description
Road network hierarchy	— Link the role of the road to its required function in providing access and moveability. — Encourage vehicles to use the appropriate connections between individual lots and the arterial road network by applying street designs that reflect their position in the hierarchy. — Protect amenity and improve road safety in residential areas and town centre by encouraging traffic around high pedestrian areas. — Reduce through trips when supported with appropriate directional signage. — Ensure that vehicles are required to give way at certain points, i.e. no direct through paths.
Modal priority	— Prioritise modes that relate to the surrounding land use – e.g. walking and cycling in residential areas, bus and light rail on public transport corridors and traffic on industrial roads. — Reduce the number of times active and public transport passengers are required to wait for general traffic. — Plan space and paths for active transport to avoid conflicts and the need to retrofit facilities.
Early provision of bus services	— Influence travel behaviour for residents as they move in rather than trying to change later. — Establish demand for future light rail corridor. — Allow new residents and workers to explore their travel choices before their travel patterns are set. — Make residents aware of their travel choices before they invest in a car.
Information about active and public transport	— Resident and workplace travel plans. — Wayfinding signage throughout precinct. — Facilitate real-time information for public transport services.
DCP planning conditions to provide active transport infrastructure	— Provide end of trip facilities within each new development. — Plan for permeable pedestrian and cycle network. — Appropriate parking provision, balanced with provision for active and public transport.

6.4 TRANSPORT MODELLING

Transport modelling has been undertaken to assess the impact of the proposed rezoning on the surrounding network, to assess whether the magnitude of the proposed yield can be supported by the transport network, and to test several improvements to the transport network to minimise the impact of the development. Traffic modelling has been undertaken using a combination of strategic travel demand models, spreadsheet models and SIDRA Intersection models. Given the low levels of existing public transport, requiring new services to support the proposed rezoning, the impact on the transport network has been estimated by estimating the number of public transport trips and assessing an appropriate service level to accommodate this impact.

Method of assessment

Transport modelling for the Camellia Precinct used three types of models to assess the wider regional transport influences, the impact of the Camellia Precinct and intersection operation at a local level. The modelling approach is outlined in Figure 6.1.

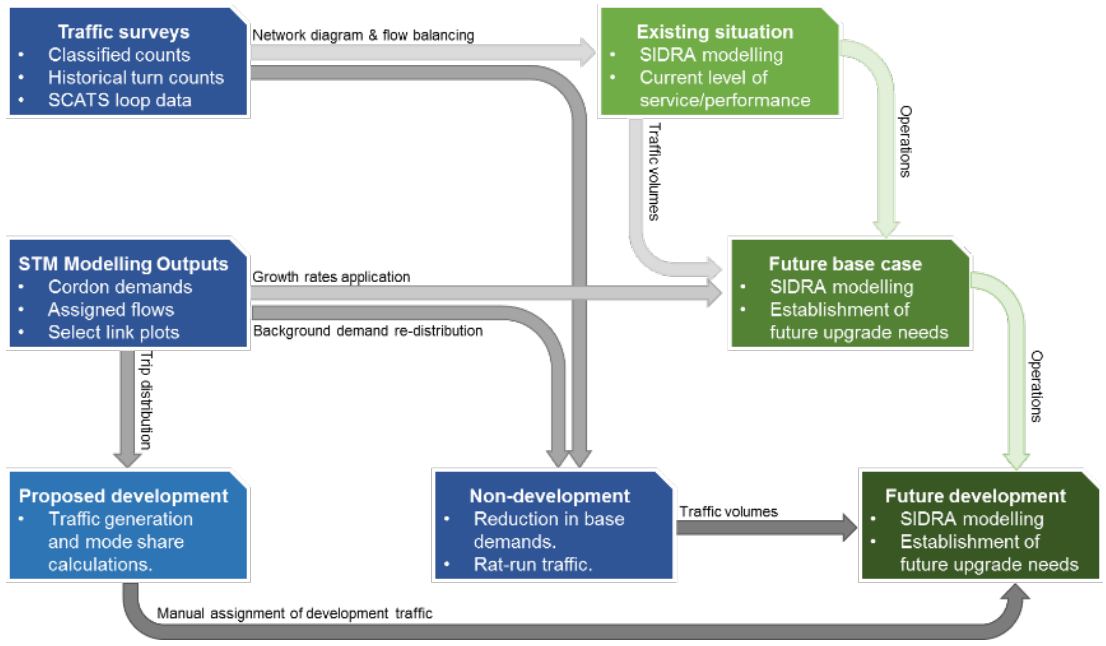


Figure 6.1 Modelling approach

The steps undertaken were:

1. Analyse traffic and travel data for the existing conditions to calibrate existing situation models for the spreadsheet and SIDRA intersection models.
2. Develop Future Base models using travel demand forecasts from the Sydney Strategic Travel Model (STM), analyse within the spreadsheet model, extract turn volume forecasts and model in SIDRA Intersection models.
3. Estimate trip generation from the Camellia Precinct rezoning using published rates and benchmark against the current travel behaviours of surrounding areas and the anticipated impact of future transport upgrades, and consider in comparison to estimates from STM.
4. Model future with development scenarios to assess their relative impact on the road network.
5. Test the impact of road network upgrades to assess their ability to mitigate the impacts of the rezoning on network performance.
6. Assess the ability of the road network to accommodate the additional demand associated with the development scenarios.
7. Recommend a minimum package of upgrades to support the development.

A more detailed description of the modelling process and the results is provided in Appendix A.

Study area analysis

For the purposes of the analysis, the study area has been divided into three broad areas:

- core study area covers the Camellia Precinct itself
- road study area
  - this encapsulates the roads/intersections surrounding the core study area which are subject to modelling in SIDRA Intersection
  - this study area has been further subdivided to consider the major directions of travel within the vicinity of the Camellia Precinct
- strategic study area
  - this covers the wider area demands which are most likely to influence the travel demand and travel model to/from the core study area, such as the proposed Light Rail line/s, Parramatta CBD and Sydney Olympic Park
  - this study area has been further subdivided to consider potential differences in demand for key trip generators and attractors, both within the strategic study area and at the external gates.

The study area, including its subdivisions, are presented in Figure 6.2.

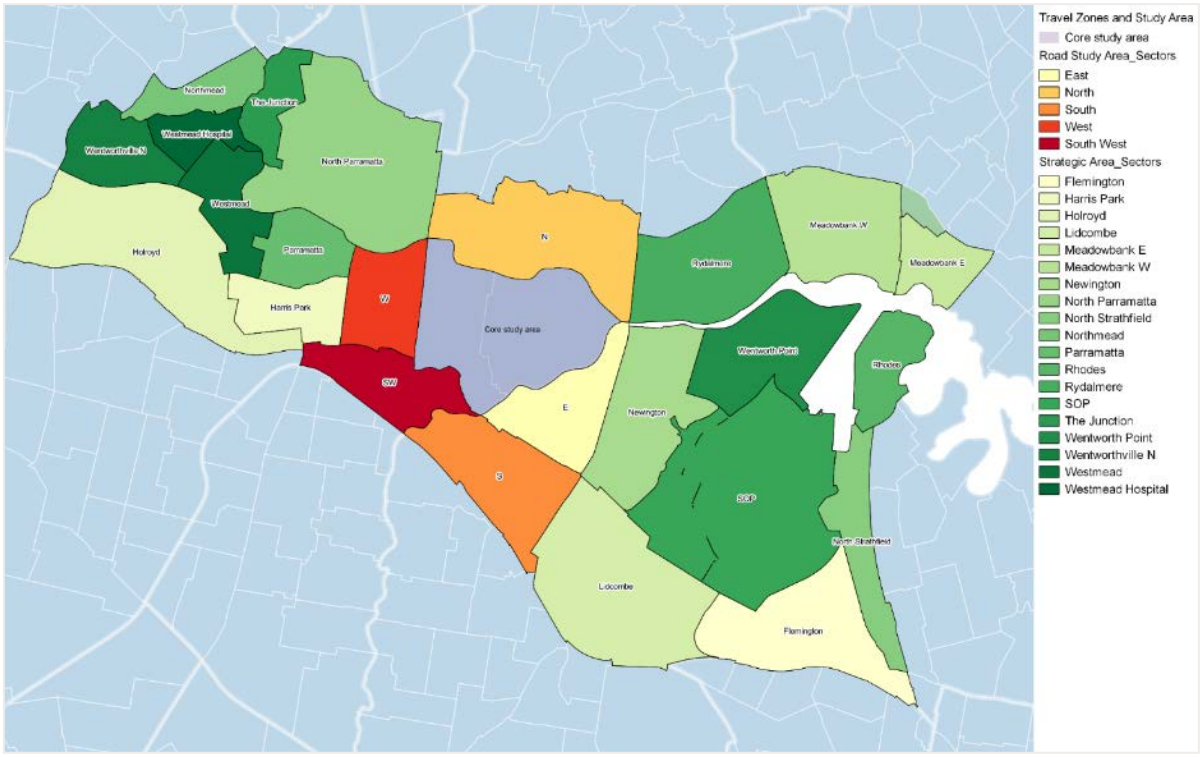


Figure 6.2 Study area sector definition

Modelling assumptions

Key assumptions made during the modelling process include:

- Modelling for 2015 existing situation, 2021 and 2031 with and without rezoning for the AM and PM peak
- A high-level assessment of the STM land use assumptions indicated that other urban renewal projects around Parramatta, along Parramatta Road and at Sydney Olympic park had been included.
- Modifications to the local bus network and inclusion of the Parramatta Light Rail project to Camellia and Sydney Olympic Park.

- Inclusion of the WestConnex project and upgrade James Ruse Drive/Hassall Street at-grade, as outlined in section 3. Western Ring Road upgrades and accommodation of light rail tested where appropriate.
- Distribution of trips was based on output from STM.

Camellia Precinct trip generation

The development yield summarised in section 5.4 has been combined with the person trip rates published in the Roads and Maritime *Guide to Traffic Generating Developments v2.2 (2002)* and the subsequent technical direction *TDT2013/04a (2013)*. The resultant trip generation and mode splits are summarised in Figure 6.3 and Figure 6.4.

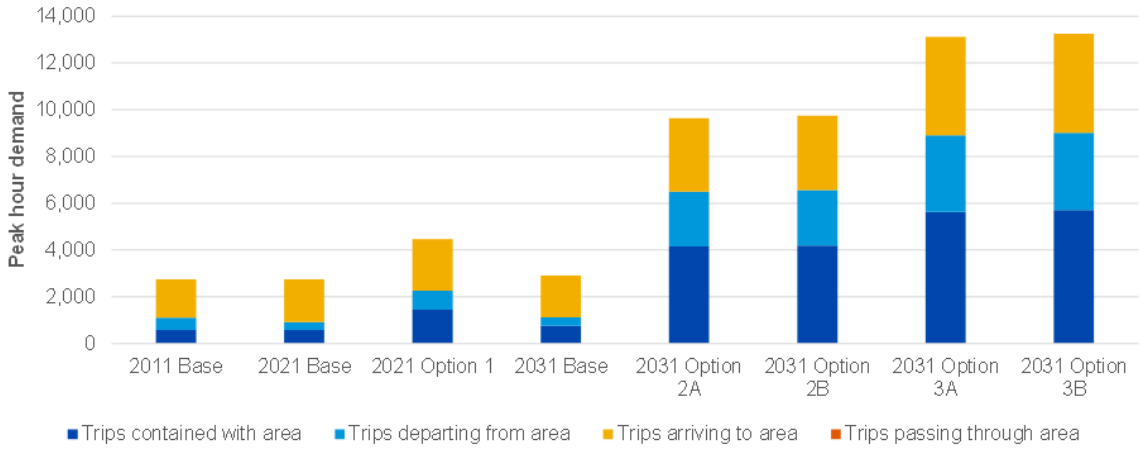


Figure 6.3 Camellia Precinct trip distribution – AM peak

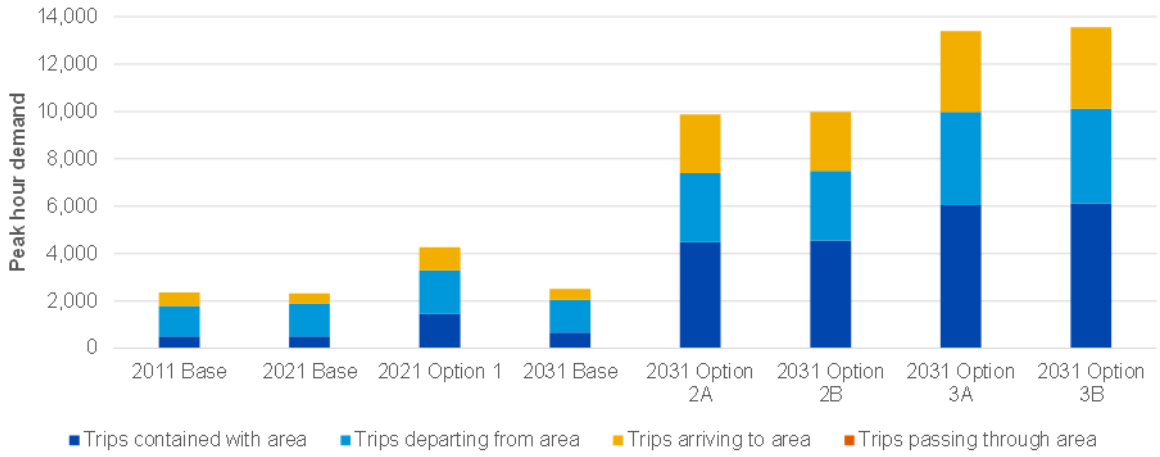


Figure 6.4 Camellia Precinct trip distribution – PM peak

These figures show that there is a large increase in the number of trips with the proposed Camellia rezoning compared to that generated by the current level of development. The Medium land use scenario represents a four-fold increase in trip numbers, while the High land use scenario would create a five-fold increase.

Summary of results

- The analysis of the existing situation indicates that some key intersections are currently operating with poor performance, or are operating close to capacity, as outlines in Section 4.6.
- Congestion on the arterial road network is forecast in the future base scenario, i.e. regardless of whether the Camellia Precinct is rezoned. Issues such as the capacity of Parramatta Road, Silverwater Road (including the Silverwater Road bridge over the Parramatta River) and Victoria Road have been treated as wider road network issues. Upgrades have been modelled to allow the road improvements that address the impacts of the Camellia Precinct to be tested without being masked by these wider issues. Further assessment is required regarding the strategy to address or manage traffic congestion along these roads.

- The opening of new road connections across the Parramatta River and Duck River are likely to introduce a large volume of through trips (i.e. those with no origin or destination within the Camellia Precinct). Some links would carry a majority of non-Camellia trips. While reducing congestion on the arterial roads, this increases trips within Camellia, is contrary to the transport vision and reduces value of the infrastructure for the Camellia Precinct.
- The additional trips from the Camellia Precinct affect congestion levels on the surrounding arterial roads causing a redistribution of through trips away from the Precinct (in the order of magnitude of 5–10% in 2021 and 10–20% in 2031).
- The performance and capacity of the James Ruse Drive intersection with Hassall Street is critical to the ability of the network to accommodate the additional traffic generated by the Camellia rezoning due to its proximity to the highest trip generating land uses – within the town centre. Intersection modelling indicates:
  - The at-grade intersection cannot accommodate the traffic demand within a feasible footprint for either the Medium or High land use scenarios.
  - A grade separation of the intersection can provide suitable capacity to accommodate the traffic demand of the Medium land use scenario with an appropriate upgrade of the remaining at-grade intersection. The grade separation of James Ruse Drive north-south through movements are considered to be the most feasible given the limited frontage access (compared to Hassall Street).
  - Even with the grade separation of the James Ruse Drive through movements, the size of the resulting at-grade intersection at Hassall Street for the High land use scenario is considered un-realistic, with triple right and left-turn lanes required on some movements. This intersection configuration would compound the separation impact of James Ruse Drive on the surrounding land use and would not be conducive to pleasant urban design or the accommodation of walk trips towards Parramatta CBD.
  - To accommodate the High land use scenario, additional high-capacity public transport upgrades are required to reduce the mode share for cars to reduce its generation to similar levels as that for the Medium land use scenario.
- Access ramps from Unwin Street to the intersection of James Ruse Drive and the M4 Western Motorway were tested compared to a network with access via Hassall Street and James Ruse Drive or a new bridge over Duck River at Carnarvon Street and the existing Silverwater Road and M4 Motorway interchange. The modelling indicated that these ramps has a positive impact on the road network, reducing pressure on James Ruse Drive and the turns in and out of Hassall Street. They also draw through traffic (especially truck traffic) away from the proposed town centre, allowing access for trucks to James Ruse Drive and the M4 Motorway without noise impacts on residents in the town centre.
- Three new bridges across Parramatta River (connecting to Park Road) and Duck River (at Carnarvon Street and Clyde Street, Silverwater) were tested. The results indicated that:
  - The provision of all three bridges resulted in an oversupply of road infrastructure and a large amount of through traffic entering the Camellia Precinct.
  - Different combinations of two bridges resulted in differing levels of through traffic – and therefore value for the Camellia Precinct:
    - Bridge over Duck River at Clyde Street and Bridge over Parramatta River at Park Road created a convenient route for vehicles bypassing the Victoria Road and Silverwater Road interchange. In combination with the M4 Ramps, it placed a large volume of through traffic on Park Road and South Street Rydalmere (both local collector roads).
    - Bridge over Duck River at Carnarvon Street and Bridge over Parramatta River at Park Road encouraged less through traffic than the option above and had less impact on intersections such as Victoria Road and Park Road.

- Bridge over Duck River at Carnarvon Street and Bridge over Duck River at Clyde Street has less impact that the Parramatta River Bridge and Duck River at Clyde Street Bridge. However, the value for the development of two east-facing bridge connections is lower.
- Of the one bridge scenarios, the bridge over Duck River at Carnarvon Street is the most beneficial in terms of improved access as it spreads the load onto two arterial roads instead of one and it improves connections to the M4 Motorway for the industrial areas of the Camellia Precinct, drawing trucks away from the Camellia Town Centre. However, only providing one bridge places additional load on the other gateway intersections are reduces the flexibility of the Camellia Road network.
- The bridge over Duck River at Clyde Street was originally proposed to run alongside one of the previously considered alignment options for the Parramatta Light Rail. With the announcement of the route north of Parramatta River, the justification for a bridge at this location as a road link is reduced.
- Other smaller intersection improvements are required depending on the land use scenario and package of new river crossings to mitigate the impact of the Camellia rezoning.

Minimum road network improvement package to mitigate impact of Camellia Precinct rezoning

Based on the results of the traffic modelling analysis, a minimum level of road infrastructure improvement is required to mitigate/support the additional traffic generated by the rezoning includes:

1. Grade separation of James Ruse Drive over Grand Avenue North/Tramway Avenue and Hassall Street intersections.
2. Removal of freight line and replacement of Hassall Street/Grand Avenue Bridge over the T6 Carlingford Link with new road at surface level.
3. New bridge over Duck River linking to Carnarvon Street.
4. Upgrade intersection of Carnarvon Street and Stubbs Street.
5. Upgrade intersection of Silverwater Road and Carnarvon Street.
6. Upgrade intersection of Parramatta Road and James Ruse Drive.
7. Upgrade intersection of Parramatta Road and Wentworth Street.
8. Upgrade intersection of Parramatta Road and Stubbs Street.
9. Signalise new intersection of Grand Avenue and Town Centre Road.
10. Signalise new intersection of Grand Avenue and Precinct Collector Road.
11. Upgrade intersection of Grand Avenue and Colquhoun Street to traffic signals.
12. Upgrade intersection of Colquhoun Street and Unwin Street to traffic signals.

The proposals for the signalisation of intersections are subject to the locations meeting the Roads and Maritime warrants for traffic signals.

In addition, it is highly recommended that the following be completed to reduce the impact of trucks on the town centre, reduce the improve the efficiency of the M4 Motorway connection:

13. New ramps from Unwin Street to M4 Western Motorway off-ramp intersection with James Ruse Drive.

These are suggestions to support the Camellia Precinct revitalisation only and have not been endorsed in principle or otherwise by the NSW Government.

7 PROPOSED TRANSPORT SOLUTIONS

The Camellia Precinct currently has a low level of access to public transport, with an underutilised rail line and two bus routes on the periphery, as well as limited cycle and pedestrian opportunities. However, with high-frequency public transport corridors surrounding it, and a new light rail/bus rapid transit corridor proposed through it, there are significant opportunities to connect the new development in to the wider network. These connections have the potential to provide the service improvement and capacity required to achieve the necessary changes in travel behaviour.

The recommended future public transport network is shown in Figure 7.1. This network includes a new corridor between Parramatta Light Rail preferred corridors. The recommendations made in this section are suggestions to Government to support the Camellia Precinct revitalisation. They require further investigation as part of a broader regional transport assessment. The details of each mode are discussed individually in this section.

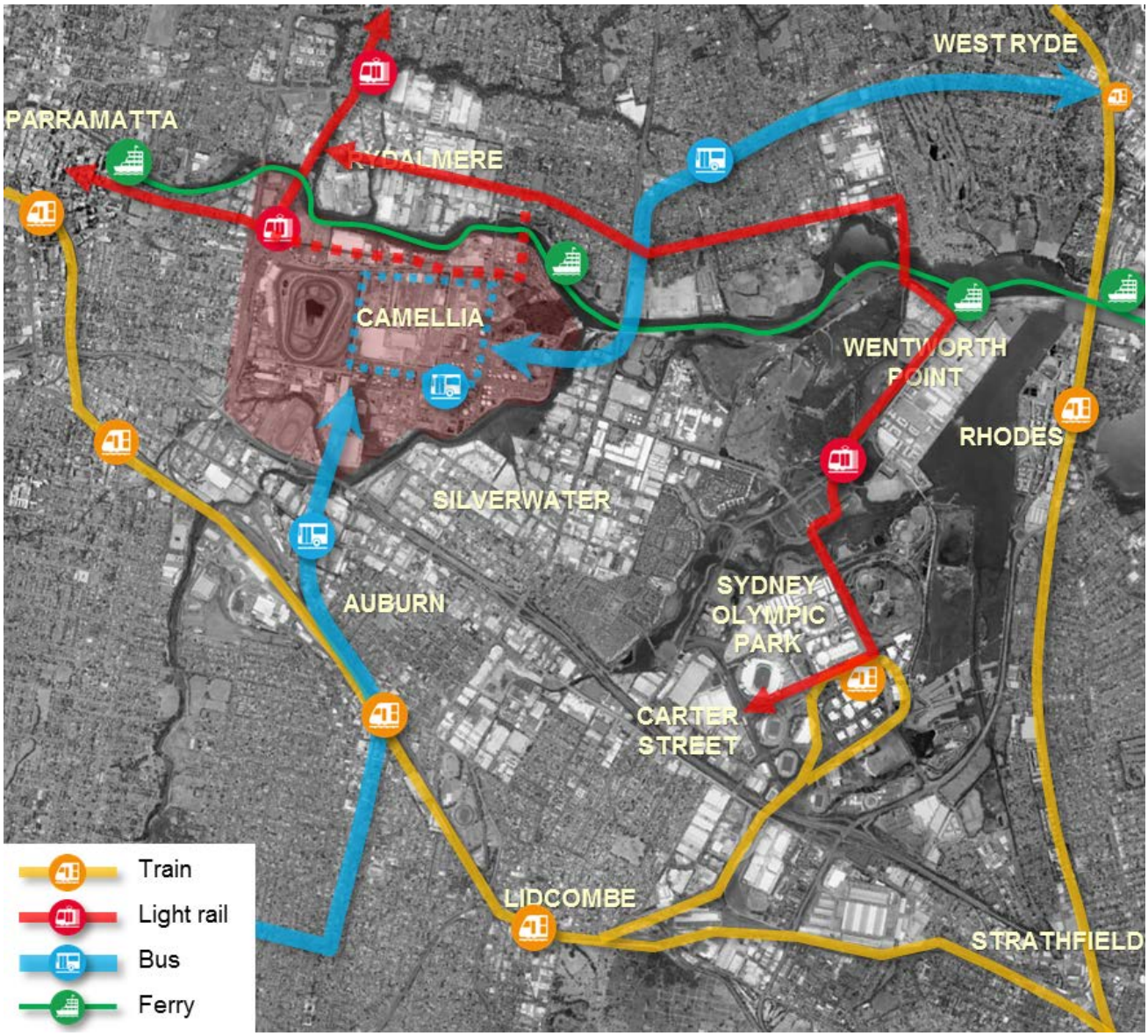


Figure 7.1 Proposed public transport network

7.1 FUTURE TRAVEL DEMAND

Mode share

The potential mode shares for the development in the area was based on the percentages for surrounding areas, calculated from 2011 JTW and HTS data presented in section 4.1. These were adjusted for the existing transport conditions in the surrounding area, including:

- increasing road congestion making travel via other modes more competitive
- constrained levels of parking provided on-site, especially for workers
- a new high capacity, frequent public transport service increasing the capacity and convenience of the public transport network
- increased living/working within the area, making walking, cycling and local bus trips more feasible.

JTW mode shares for existing centres around Granville, Auburn and Lidcombe train stations were used as a benchmark. While these centres have access to the Western Rail Line which has a direct service to a wider portion of Sydney than the proposed Parramatta to Camellia Light Rail, they do not have the constrained parking and high density mixed use development and travel demand management initiatives.

The proposed mode shares for the area by land use, trip purpose and time of day are shown in Figure 7.2. In general, these represent a 10% to 15% reduction in car driver mode share due to the potential new light rail service, improved walking opportunities encouraged by the mixed land use, improved cycling connections and an improved bus services.

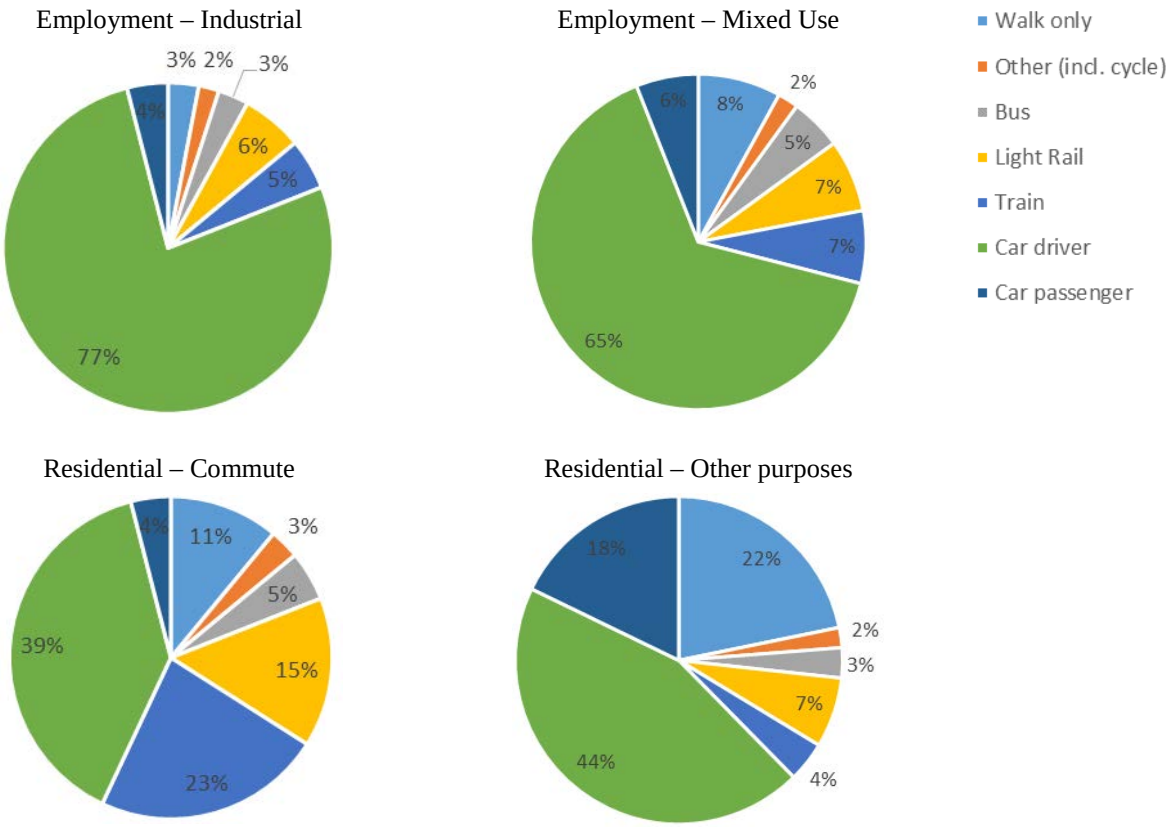


Figure 7.2 Estimated future mode share for Camellia Precinct

The transport network required to achieve this mode share is discussed further in this section. It assumes that parking will be constrained for residential and commercial land use and reduced for industrial land uses to reflect the improved public and active transport options.

Number of trips by mode

The number of trips by mode by time period for the Medium land use scenario is shown in Table 7.1.

Table 7.1 Estimated Camellia Precinct trip generation by mode Medium land use scenario

Transport mode	AM peak hour		PM peak hour		Weekday	
	In	Out	In	Out	In	Out
Vehicle Driver	3,060	3,650	2,930	3,780	33,510	33,510
Vehicle Passenger	570	970	820	720	8,960	8,960
Train	320	540	430	430	3,170	3,170
Light Rail	410	630	510	520	4,820	4,820
Bus	210	270	220	260	2,310	2,310
Walk	680	1,240	1,050	880	11,280	11,280
Cycle	110	160	130	140	1,380	1,380
Total	5,360	7,460	6,090	6,730	65,430	65,430

Trip direction

The direction of trips has been assessed based on the STM results for public transport and the results of the traffic modelling for car travel. The car results in turn used analysis of JTW trip patterns for surrounding suburbs as an input assumption. The car trip patterns are shown in Figure 7.3.

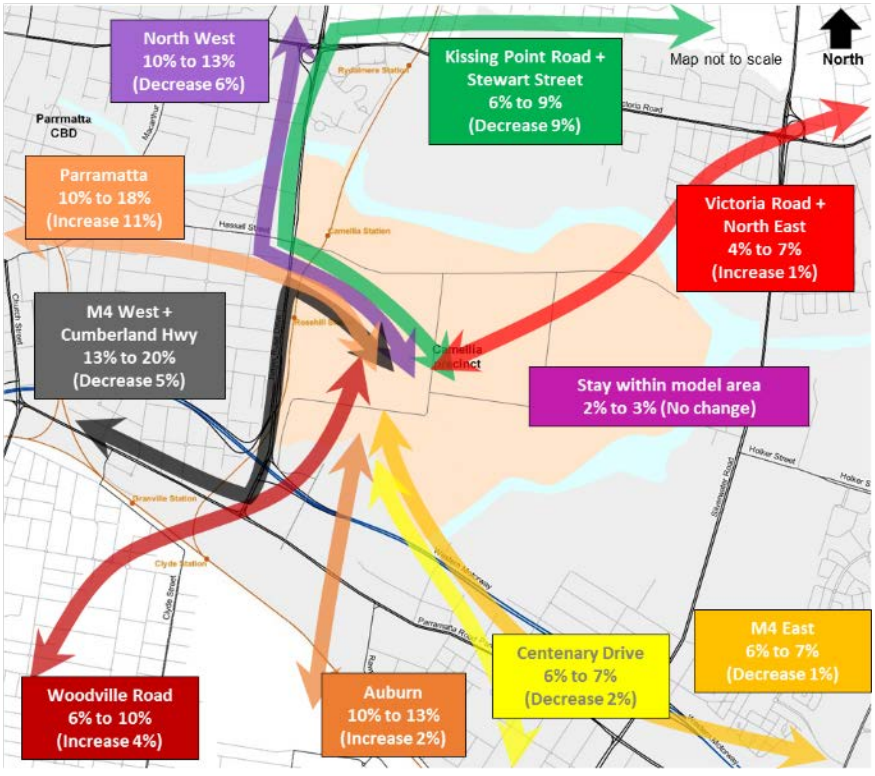
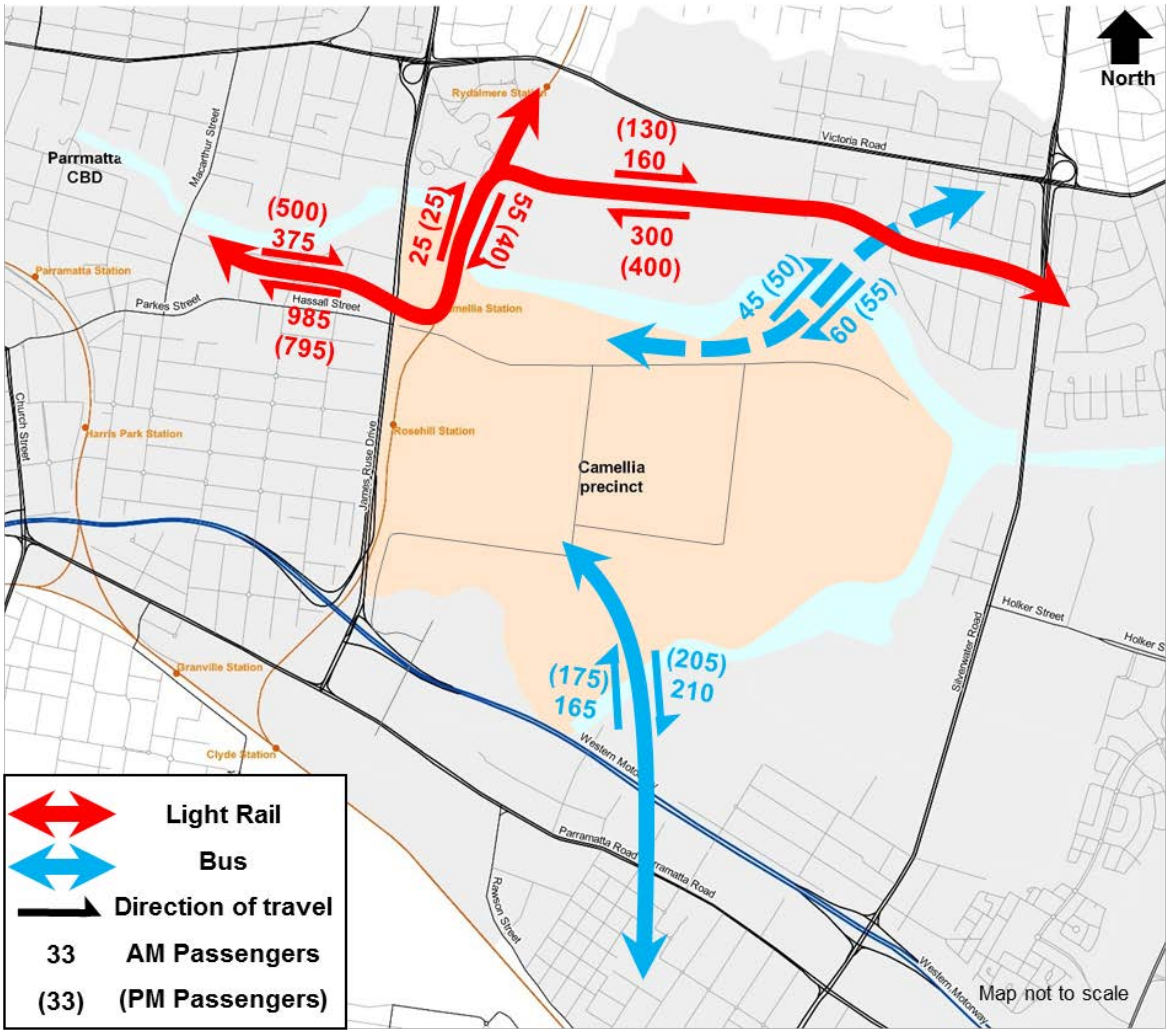


Figure 7.3 Camellia private vehicle distribution (future, with development)

Figure 7.3 also shows the potential changes from current trip directions. The main changes relate to a greater connection to Parramatta CBD, and residential and employment areas to the south and south-west.

For light rail and bus, trip directions are guided by the destinations of the available services. The number of public transport trips shown in Table 7.1 has been allocated to directions based on the results of STM modelling with the Camellia Precinct and the public transport improvements. The indicative numbers of passengers by mode and direction are shown in Figure 7.4. Train passengers have been assumed to travel to a train station using the most convenient connecting service (i.e. the Parramatta Light Rail to/from Parramatta Station). These trips are indicative only and are not the result of detailed public transport modelling.



Source: WSP spreadsheet forecasts

Figure 7.4 Indicative public transport trip directions for Medium land use scenario

Travel needs

Existing industrial trips made by employees, business and freight will continue. The new land uses within the Camellia Precinct will introduce trips with new purposes as follows:

- Employment trips can be satisfied by internal trips to the new commercial and existing industrial land uses. Greater Parramatta and Sydney Olympic Park are likely to be significant external employment areas.
- Local retail trips will be made to the retail component of the Town Centre, with regional shopping available in Parramatta.
- The primary school and potential child care will satisfy some education trips. High school and tertiary education are available to the north and west.
- Recreation trips will be attracted to the Parramatta River pedestrian and cycle network and entertainment trips are likely be directed at Parramatta.

The opening of Parramatta Light Rail Stage 2 will make recreation and employment trips to the east more convenient. Until this time, the road connection via Carnarvon Street, local bus network and cycle network will be the main options.

7.2 TRANSPORT POLICIES

Transport policies can be applied at the precinct level through development controls, and local planning instruments At a high level they can enshrine the integration of land use and transport planning. At a practical end they can influence people's transport choices towards sustainable modes.

7.2.1 TRAVEL DEMAND MANAGEMENT STRATEGY

Whilst commercial office-related vehicle trips are generally the sector which generates the highest volume of traffic, for the Camellia Precinct to be sustainable and successful in supporting the scale of development proposed, travel demand management (TDM) would need to be applied.

TDM measures are based upon four objectives:

- reduce the need to travel beyond walking distances
- support public transport and active transport options
- reduce reliance on private vehicle (particularly single-occupancy)
- improve accessibility of information.

Mixture of land uses

The location of the proposed mixed-use area closest to Parramatta takes advantage of the established community west of James Ruse Drive, including providing access to schools and parks. The location of residences near retail and employment increases the potential for trip containment. This mixture ban be enacted by the application of minimum and maximum floorspace ratios for different land uses within the B4 Mixed land use zoning, as well as the location of the residential zonings.

Provide new residents and employees with a transport package including information and discount

One of the objectives of the study is to reduce the level of private car usage in favour of more sustainable modes of travel such as walking, cycling and public transport. The Parramatta DCP already requires the creation of travel plans for developments over 5,000 m^2 GFA. These personalised marketing strategies to assist in modifying travel behaviour through communicating relevant travel choice information to the community.
They include:

- travel access guides for residents
- workplace travel plans for employees.

The challenge for transport authorities is to ensure that the supply of information is maintained and updated, and that the people living and working in the Precinct actually receive this information. Other areas, such as the Macquarie Park Specialised Centre and Green Square area have encouraged this process by tasking a person to work with employers, property owners and tenants to instigate and implement green travel plans. It is recommended that Transport for NSW and Council work together to establish this role.

Install wayfinding and directional signage throughout the development and at site entry points

Wayfinding signage would be installed at entry points to allow people to navigate their way around the Precinct. Maps would also be installed to allow people to know about the pedestrian and cycle connections through the Precinct.

Available but constrained parking

To achieve a successful, transit-oriented design, some of the key principles needed:

- creating a defined centre
- active across the day (18-hour)
- mix of uses, horizontally and/or vertically
- compact pedestrian-oriented design
- moderate to higher density development, especially near transit
- limited parking.

The concept and location of the proposed town centre, if designed well, can achieve the first five principles. However, parking is one of the most challenging aspects of any TOD. Over provision of parking discourages public transport use. An appropriate amount of short stay parking is needed to support retail activity. The limited amount of parking provided would be made available for shared use, where possible, to maximise efficiency and reduce the total amount of parking required.

In the early stages of development, higher rates could be allowed using off-street supply, but as more opportunities for land use with lower parking demand arise, the rate should be diminished. This then generates more sustainable and profitable on-site behaviour.

The aim is to provide pedestrian access to all areas of the TOD, while minimising vehicle and pedestrian conflicts and visual intrusion of parking into the public environment. Parking standards should be changed to establish a maximum rather than minimum parking ratio amount. The parking standards should ideally cater for people who choose this location because of its sustainable transport options and do not need a car, or to pay for a car space, i.e. some dwellings without parking.

7.2.2 PARKING RATE METHODOLOGY

The parking rate policy should seek to achieve the following outcomes that support a transit-oriented development:

- Provide for the needs of residents and their visitors, while encouraging them to take advantage of public and active transport opportunities. Cater for people who choose not to own a car.
- Support retail land uses with short-term parking to achieve a liveable and active (18-hour minimum) community.
- Support commercial business to locate themselves within the precinct while encouraging employees to use public and active transport.
- Acknowledge the range of transport choices available and their strengths and limitations in providing for the transport needs of people living and working in the Camellia Precinct.
- Maintain the productivity of existing industrial land uses, understanding the extended distances between their businesses and public transport services and that their employees may travel at non- peak public transport times.
- Encourage visitors to the area to use the public and active transport options available.
- Reduce the risk of parking spill-over into adjacent areas.

The use of the Camellia Precinct as a commuter parking area is not encouraged given its proximity to the Parramatta CBD and the congested road conditions forecast on its surrounding arterial road network. The amount of parking provided at the Parramatta Light Rail stations is currently being assess by the team planning the new service.

It is envisaged that the available on-street parking would be available for use by visitors to the businesses and residents of the Precinct. To discourage the use of on-street parking for park and ride, short and medium stay parking restrictions could be applied. Short-stay parking (e.g. one and two-hour time limit) should be concentrated around the retail component of the town centre. Medium-stay parking (e.g. four-hour limit) could be located within the residential areas away from the town centre.

A mixture of on-street and off-street visitor parking is envisaged to encourage shared use of the on-street parking for residential and retail visitors. The total amount of parking (on and off-street) should be tailored to meet the needs of the community. Shared public parking could be consolidated within an off-street location. This could be provided in a vacant lot initially and replaced within the lot when it is development (i.e. land-banked) rather than requiring a specific parking structure.

Consideration should be given to charging a fee for on-street parking to encourage use of sustainable modes of transport.

Benchmarking of parking provision

The existing City of Parramatta Council DCP/LEP parking rates are outlined in section 2.3.2. The DCP has an established precedent for specific rates to be applied to special areas that are tailored to achieve sustainable transport objectives. These are compared to parking rates from other areas in Table 7.2.

It is noted that Table 7.2 reflects the current parking rates for Parramatta CBD. However, it is understood that City of Parramatta Council are seeking to reduce those rates, as indicated in the Parramatta CBD Strategic Transport Study (AECOM and City of Parramatta Council, 20 March 2016). Specific rates are not proposed in the study, however, the study benchmarks against Sydney CBD and North Sydney rates. The study recommends there is a need to move towards these lower rates.

In considering an appropriate parking rate, the access to public transport also needs to be considered in addition to density and the mixture and magnitude of land uses. Other TOD developments such as Green Square, North Ryde and the Sydney Olympic Park town centre are planned around rail stations and high-frequency bus corridors. For the Camellia Precinct, the Parramatta Light Rail (and the higher capacity public transport line if implemented in the future) provide for east-west travel. However, lower frequency bus services would provide the alternative in the north-south direction.

Table 7.2 Comparison of parking rates

Land Use Type	Parramatta (General)[1]	Granville and Harris Park Town Centres[1]	Parramatta CBD[2]	SOPA Master Plan 2030[3]	North Ryde[4]	Carlingford Town Centre[5]	Epping Town Centre Core[6]	Green Square[7]	Roads and Maritime Guide to Traffic Generating Developments[8]
max/min	minimum	minimum	maximum	maximum	maximum		minimum	maximum	minimum
	Residential	**per dwelling**							
Studio	1	-	1 per dwelling in total across development	-	0	-	0.5	0.5	-
1 bedroom	1	-		1	0.6	0.8	0.75	0.5	0.4
2 bedrooms	1	-		1.2	0.9	1	1	0.8	0.7
3 bedrooms	1.2	-		1.5	1.4	1.3	1.5	1.2	1.2
4 bedrooms	2	-		2	1.4	-	-	1.2	-
Visitors	0.25	-	0.2	0.25	0.1	0.4	0.1	0.2	0.14 (1 per 7)
	Other								
Commercial	1/50 m^2	1/70 m^2	1/100 m^2	1/80 m^2	1/90 m^2	-	Min. 1/70 m^2 Max. 1/50 m^2	1/125 m^2	-
Retail	1/30 m^2	Min. 1/60 m^2 Max. 1/30 m^2	1/50 m^2	1/50 m^2	1/100 m^2	-	Min.1/60 m^2 Max. 1/30 m^2	1/50 m^2	-
Supermarket	-	-	1/25 m^2	4/100 m^2	1/60 m^2	-	-	-	-
Industrial	1/70 m^2	1/70 m^2	-	-	-	-	-	1/100 m^2	-

(1) City of Parramatta Council Development Control Plan 2011

(2) Parramatta City Centre Local Environment Plan 2007

(3) SOPA Master Plan 2030 (2016 Review)

(4) North Ryde Station Precinct Development Control Plan 2013

(5) The Hills Development Control Plan 2012 Part D Carlingford Precinct

(6) Hornsby Development Control Plan 2013 (Revision 30 November 2016) Table: 1C.2.1(e) On Site Car Parking Rates (Epping Town Centre Core)

(7) Sydney Local Environment Plan 2012

(8) Roads and Maritime Services Guide to Traffic Generating Developments, Version 2.2, October 2002

7.2.3 PROPOSED PARKING RATES

Off-street parking

Based on the results of the benchmarking exercise, and taking into consideration the available public transport opportunities and frequencies, the proposed off-street parking rates are shown in Table 7.3. For residential uses, these are similar to those of Epping Town Centre. They preserve flexibility between the size of dwelling, balance the needs of larger families, and catering for those people who do not need to own a vehicle.

Table 7.3 Proposed Camellia Precinct parking rates

Land Use	Camellia Precinct (Maximum Rates)
Multi-unit residential	— 0.75 space per 1-bedroom unit — 1 space per 2-bedroom unit — 1.5 spaces per 3-bedroom unit Plus 1 parking space for every 10 dwellings for visitors
Commercial premises	1 space per 70 m^2 of gross floor area plus 1 loading bay per 400 m^2 of gross floor area
Industrial	1 space per 100 m^2 of gross floor area plus 1 loading bay per 800 m^2 of gross floor area
Retail	1 space per 50 m^2 of gross floor area
Supermarket	1 space per 25 m^2 of gross floor area
Warehouses	1 parking space for every 300 m^2 of gross floor area

On-street parking

Kerb-side parking can stimulate street activity, manage speed by providing friction, can contribute to casual surveillance and provide a buffer between the verge/footpath and the moving traffic. Limited on-street parking would be used to support local businesses within the village centre and provide for visitor parking beyond the provisions in the recommended parking rates. On-street parking with a range of purposes and time limits is recommended to provide flexibility and avoid undesirable use:

- disabled parking – 3% to comply with AS2890.1 (1993) (the 2004 edition did not include recommend percentages for accessible parking)
- loading zones – whilst most would occur in off-street loading docks, some on-street space is proposed to facilitate short-stay deliveries. Loading zones would be time limited to 1 hour
- short-stay parking (1-hour limit 7.00 am to 6.00 pm Monday–Friday and 8.30 am to 12.30 pm Saturday) in the retail area
- short stay parking (2-hour limit 7.00 am to 6.00 pm Monday–Friday and 8.30 am to 12.30 pm Saturday) in the predominantly commercial/office areas
- Medium stay parking (4-hour limit 7.00 am to 6.00 pm Monday–Friday and 8.30 am to 12.30 pm Saturday) in residential areas.

Cycle parking

Bike parking should be provided at a rate higher than the DCP to take advantage to the improved connections to the Sydney Olympic Park cycle network:

- one bicycle space per 150 m^2 of floor space for business premises, office premises, retail and industrial developments
- two bicycle spaces per three dwellings for residential flat buildings
- end of trip facilities including showers and lockers to adequately service the number of bicycle parking spaces required in business, office, retail and industrial development. Based on the City of Sydney DCP[16], this could include:
  - one personal locker for each bike parking space
  - one shower and change cubicle for up to 10 bike parking spaces
  - two shower and change cubicles for 11 to 20 or more bike parking spaces are provided
  - two additional showers and cubicles for each additional 20 bike parking spaces or part thereof.

7.3 WALKING

As the population of residents and workers within the Precinct increases, convenient pedestrian paths will become increasingly important. The following principles are proposed to maximise the walkability of the Precinct:

- focus walk links on key nodes such as light rail stops, the village centre and bus stops
- provide higher capacity pedestrian links between the Camellia light rail stop and Rosehill Gardens Racecourse
- use pedestrian crossings as a traffic calming device on access streets within the proposed mixed-use area (does not include Grand Avenue or Hassall Street)
- provide safe crossing locations along Grand Avenue
- increased footpath provision within all areas, including mixed use (both sides of street) and industrial areas (at least one side of street).

In terms of external connections, the greatest need is to connect the proposed mixed-use area towards Parramatta and to connect to facilities outside the Precinct.

- all new bridges across Duck River and Parramatta River to include pedestrian and cycle paths and/or provide separate pedestrian and cycle bridges from the vehicle bridge
- connect to pedestrian paths within Silverwater Park, leading to The River Walk
- revised James Ruse Drive/Hassall Street and Grand Avenue intersections to include signalised pedestrian crossings
- ensure that the Grand Avenue/Hassall Street overbridge is replaced with an at-grade pedestrian path
- add shared pedestrian/cycle path across pipeline bridge or existing Carlingford rail bridge to connect the mixed-use area to the University of Western Sydney Rydalmere Campus
- upgrade Thackeray Street pedestrian bridge across Parramatta River to provide easy access to connect Camellia to Rydalmere Wharf and Rydalmere to the proposed light rail
- provide a pedestrian and cycle bridge over Duck River to connect to The River Walk and the Parramatta Valley Cycleway.

[16] Sydney DCP 2012 – December 2012

7.4 CYCLING

The area surrounding the Camellia Precinct has a high-quality and well-connected cycle network. The key task will be to connect Camellia to this wider network and creating cycle-friendly conditions within the Precinct. This should be consistent with the network envisaged for the Green Grid, outlined in A Plan for Growing Sydney. Way-finding at key decision points would assist in-frequent cyclists.

Connection to the M4 Motorway east-west route is consistent with Council's cycle plan. Colquhoun Street is proposed as the route alongside Rosehill Racecourse has improved amenity for cyclists and minimises the interaction with side streets and driveways. The Colquhoun Street path would also open the long-term possibility to connect to a bridge over Parramatta River at Clyde Street (Rydalmere).

The Parramatta Valley Cycleway is a recreational facility that has the potential to connect Camellia to Parramatta CBD and The River Walk which has paths connecting to Sydney Olympic Park. Figure 7.5 shows the existing and proposed additions to the route. The existing Parramatta Valley Cycleway route is shown in red, other routes in the Parramatta cycle network are shown in solid blue. The proposed new sections of the route and some long-term options are shown in dashed and dotted blue.

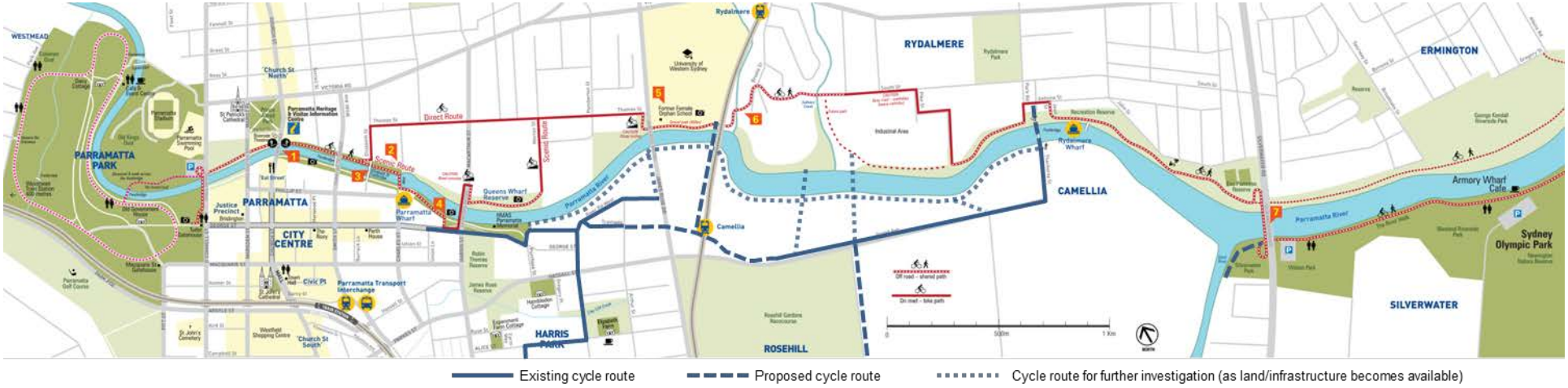


Image base source:City of Parramatta Council, May 2010

Figure 7.5 Connection of the Camellia Precinct in to the Parramatta Valley Cycleway

The preferred route for cycles follows the proposed public transport corridor along Grand Avenue. The new bridge over Duck River would complete the connection to *The River Walk*. At the western end, the proposed treatment at the intersection of James Ruse Drive and Grand Avenue would include cycle facilities in both directions. The Parramatta River bank route could be delivered by reserving land over time as sites are redeveloped.

At Camellia Station, appropriate and secure end-of-trip facilities would be an important effort to encourage cyclists, including:

- toilets and change rooms
- ample secure parking for anticipated future demand
- bike maintenance and repair stations – could be as small as a short stand fitted with air pressure pump, tap and basic tools or a 'bicycle hub' with air pumps, water, tools and vending machines under a shelter
- secure lockers located near bicycle parking and W/C
- benches and sheltered areas.

Cycle parking within the town centre should be provided within the street to facilitate local cycle trips. Off-street cycle parking is discussed in section 7.2.3, and includes Development Controls that require cycling end-of-trip facilities within commercial developments.

7.5 LIGHT RAIL

TfNSW is currently planning the Parramatta Light Rail along the corridor shown in Figure 3.6. It will be delivered in two stages, both of which travel through the Camellia Precinct. Stage 1 will connect the Camellia Precinct to Parramatta in the west and the WSU Parramatta Campus and residential areas to Carlingford in the north. TfNSW has also announced that the depot for light rail operations would be within the Camellia Precinct on the southern side of Grand Avenue, east of Colquhoun Street.

One stop on Stage 1 is planned near the existing Camellia Station within the proposed Town Centre. This stop would serve the densest part of the Precinct in terms of resident and employee numbers, and is considered essential. This stop could also serve as the stop for the Rosehill Gardens Racecourse, as would the current Rosehill Station if the line to the south was converted to light rail use.

If the alternative route option for Stage 2 is selected, the corridor would travel through low-density industrial businesses. While the number of workers within easy walking distance is low, a shuttle bus (see section 7.6) would allow a greater number of people to be connected to the light rail.

7.6 BUSES

The bus network is currently limited, and hence the revitalisation offers the opportunity to tailor new services to the needs of the area. The role of the future bus network is seen as:

- integrate/compliment the proposed light rail services
- connect the industrial areas outside the walk catchment of light rail sops to the light rail via internal shuttle services
- improve the connection of Camellia to the wider public transport network.

The analysis of HTS and JTW trip directions presented in section 4.1 indicated that Parramatta, Ryde, Auburn, Merrylands and Sydney Inner City are currently major destinations/origins for car drivers from Camellia. Parramatta would be served by the light rail or an interim bus equivalent. Travel to Sydney CBD is facilitated by the T1 Western rail line.

Two routes to Auburn and the Ryde area are proposed with the dual purpose of attracting car drivers to public transport for particular origin/destination pairs and to connect the Camellia Precinct in to the rail network more extensively:

1. Assuming a new bridge across the Duck River to Silverwater, a new/extended service from Camellia and Silverwater to Auburn Station would also are also supported. Following initial consultation with TfNSW, a potential candidate route for extension could be route 911 that currently travels between Bankstown and Auburn.
2. Assuming a new bridge across the Parramatta River to Rydalmere, a new bus link from Camellia to the Northern rail line could be created to improve the connection of the Precinct in to the public transport network. This connection would most logically be made at West Ryde, Eastwood or Epping as the terminus of the new/extended bus route.

An internal shuttle that could distribute workers from the light rail corridor to the front gate of their business would overcome the extended distance to fixed route of the light rail, opening its benefits up to the whole precinct. It is envisaged that it would loop around the precinct, connecting to the light rail stop(s), as a hail and ride service. This type of service is not currently provided within Transport for NSW's public bus network. Other examples in Sydney have been funded by businesses or Council's to achieve a positive transport outcome that is tailored to the needs of the development.

The frequency of bus routes would depend on the type of development provided within the precinct and the number of residents/workers. However, it is suggested that a 15-minute frequency during peak periods should be the ultimate minimum target.

7.7 ROAD NETWORK

The Camellia Precinct is ringed by arterial roads and the M4 Motorway that are currently operating in congested conditions during peak periods. The Precinct currently has two road connections that would concentrate the impact of the potential redevelopment and limit travel options unless additional connections are provided. Section 6.4 recommended a list of road upgrades.

The new connections across Duck River and Parramatta River and to the M4 Motorway ramps at James Ruse Drive, will open new routes for traffic. These new routes would offer an alternative to the congested James Ruse Drive, Silverwater Road, Parramatta Road and Victoria Road, including establishing a new route from Sydney Olympic Park to Parramatta. Separating freight traffic from the town centre and discouraging through traffic will be important strategies to providing amenity to the town centre.

7.7.1 STREET FUNCTIONS

A road hierarchy is proposed to recognise the role the street that connect to arterial road will play in linking the new and existing land uses to the wider road network, while designating road with local and pedestrian movement functions. The proposed road hierarchy is shown in Figure 7.6. In addition to this network will be local streets within the residential/town centre and industrial areas. The streets have been classified using the 'movement and place' classification advocated in the *Draft Future Transport Strategy 2056*. This classification is preliminary and requires further consultation with TfNSW.

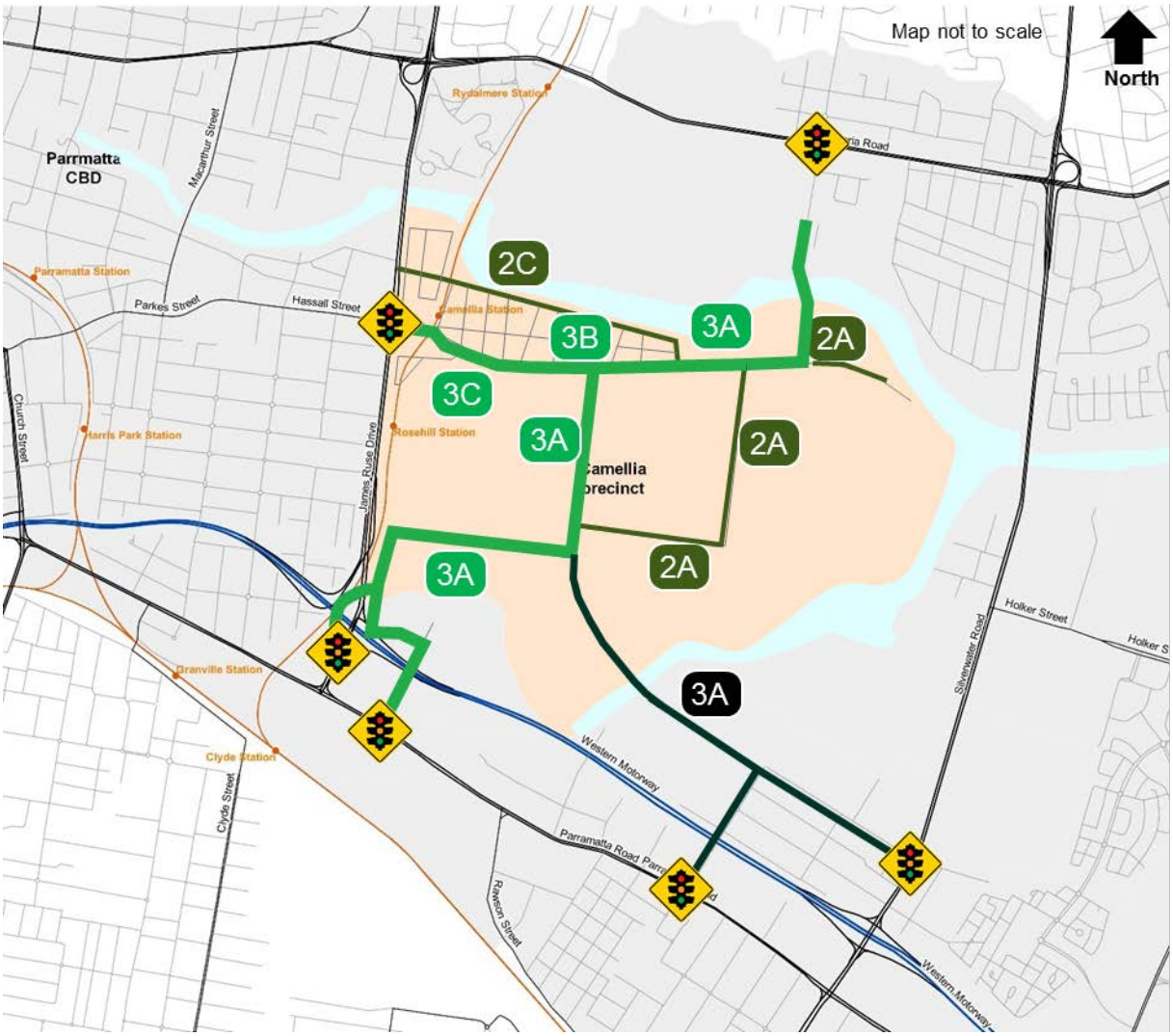


Figure 7.6 Proposed road hierarchy

This road network is proposed with the following principles:

- Current connections to James Ruse Drive (Hassall Street) and Parramatta Road (Wentworth Street) assume the highest order within the Precinct and are connected to the new ramp to the James Ruse Drive/M4 Motorway connection.
- Wentworth Street and the M4 connection will become the primary freight route, with secondary routes to Hassall Street at James Ruse Drive and Carnarvon Street at Silverwater Road.
- The Hassall Street/Grand Avenue corridor will be the primary access route for the town centre and business enterprise area.
- An entry from James Ruse Drive will direct local trips around the town centre, deflecting traffic to its edges. This road will be a local street in the road hierarchy.
- Other streets will be either local (town centre) or local (industrial).

7.7.2 STREETSCAPE

The proposed streetscape will be designed to reflect the roads position within the road hierarchy. Detailed cross-sections for each of the streets are yet to be designed. As preliminary guidance, the following points are made:

- Grand Avenue will cater for two lanes of traffic in each direction, in line with its current configuration. Two lanes in each direction are required on traffic volume ground between James Ruse Drive and Colquhoun Street. East of Colquhoun Street, the width is recommended to facilitate truck movements and to provide sufficient capacity to the Parramatta River bridge.
- Streets within the town centre should, in general, incorporate one through lane and one parking lane in each direction.
- The entry roads from the town centre onto Grand Avenue should be wide enough to accommodate two traffic lanes in the block approaching Grand Avenue.
- Through lane widths entering the town centre and the loop road on the northern side of the town centre should be a minimum of 3.2 m to accommodate buses, garbage trucks and removalist trucks.
- Single lanes without kerbside parking should be 3.5 m to allow larger vehicles to move safely.
- The width of local streets can be narrower to reduce speeds, but should retain the possibility for two large vehicles to pass each other. A desirable through lane width of 3.0 m is recommended.
- Streets and intersections should be designed to accommodate City of Parramatta Council ’s nominated garbage truck.
- As parking is likely to be at a premium, local streets should be designed with parking lanes and one travel lane in each direction (minimum 10.6 m).
- As a minimum, 1.5 m wide footpaths within a 4.0 m verge are recommended on each side of internal streets, with wider footpaths to be provided within the town centre and on access routes to light rail stops, to enable convenient movement for pedestrians.

The junction of Grand Avenue/Hassall Street/light rail/racecourse road/local town centre road is complex, which could affect traffic efficiency and road safety. This would become a particular issue when large numbers of pedestrians are moving between the light rail stop and Rosehill Racecourse. It is recommended that some movements be prohibited and relocated east along Grand Avenue. For example, right-turns to/from the town centre could be relocated east of the town centre.

7.8 FREIGHT

The importance of the Camellia Precinct as an employment area, and its unique position as a location for light and heavy industry within the heart of Sydney CBD means that industry needs to be supported and planned for in the future.

The Camellia Precinct will continue to operate as a high-value light and heavy industrial, warehousing and business park area and hence freight access in the future is essential. The Precinct has an advantage over other industrial areas at the moment with access to the road, rail and pipeline network to move freight.

7.8.1 FREIGHT USES AND DEMANDS

The Viva Energy (formerly Shell) Clyde refinery ceased production in 2012, and has been converted to a Storage and Distribution facility for petroleum products. The Environmental Impact Statement (EIS)[17] for the conversion indicated that truck numbers would stay approximately the same as during refinery operation (approximately 250 truck movements per day in and out), but that car trips would reduce from approximately 238 trips per day during refinery operation, to 40 currently to 32 after the conversion is complete due to a reduction in the workforce. The land vacated by the refinery has the potential to be redeveloped for industrial purposes, and therefore has the potential to generate additional freight and workforce trips.

[17] Clyde Terminal Conversion Project Appendix B Transport Impact Assessment, AECOM 2013

The continuation of petroleum storage on the Viva Energy site will mean continuing movement of hazardous goods. The proposed new connections across Duck River and the M4 Motorway connection will reduce the number of hazardous goods vehicles moving past the new residential development.

Veolia Environmental Services is proposing to develop a Materials Recycling Facility capable of processing up to 200,000 tonnes per annum of non-putrescible waste at 37 Grand Avenue, Camellia. The Traffic Impact Assessment for the EIS[18] indicates that as the site would operate 24 hours per day and due to the nature of operations, the peak traffic generation of the site would not coincide with the peak periods on the surrounding road network. As a result, the net impact during the road network peak would be an additional nine trips during the AM peak and two additional trips during the PM peak.

The TfNSW freight movement model (FMM) forecasts changes in the number of trips made by light commercial vehicles, rigid trucks and articulated trucks (including B-doubles and road trains), based on the land use changes forecast by TfNSW in the future (in five-year time periods). The model forecasts that in the 20 years between 2011 and 2031, light commercial vehicle travel to the Camellia Precinct will increase by 9%, rigid truck trips will increase by 16% and articulated truck trips will increase by 17%.

The data indicates that:

- For light commercial vehicles, local trips to Parramatta and Auburn will continue to grow, whilst areas such as Blacktown and The Hills Shire will have increasing importance.
- For rigid trucks a similar pattern is expected, but with trips to/from Fairfield and Holroyd becoming more prominent at a higher rate than those to/from the Hills Shire.
- Whilst articulated truck trip numbers are smaller in number, trips to/from Randwick (mainly Port Botany) dominate, making up approximately 30% of trips. Other origins/destinations are more dispersed, with Wingecarribee, Gosford, Auburn, Blacktown and Botany Bay making up a further 40%.

This highlights the importance of the M4 Motorway in both east and west directions as the primary freight route. Other roads receiving higher truck numbers are likely to be roads to the Silverwater area, James Ruse Drive to the north-west and Parramatta Road to the south-west.

7.8.2 FREIGHT NETWORK AND INTERFACE MANAGEMENT

With the addition of new residential, retail and office to the current industrial precinct, care will be needed to protect the safety and amenity of the new population whist maintaining the efficiency of the freight network. To achieve this, it is recommended that separate access be provided for freight and mixed-use land to James Ruse Drive.

With freight vehicles potentially moving 24 hours per day, residential amenity will be protected by providing alternative routes to the arterial road and motorway network. To achieve efficiency for road freight movement, the following improvements are proposed:

- roads within Camellia industrial area to be designed for HML vehicles, B-doubles and vehicles up to 4.6 m high
- new crossing of Duck River at Carnarvon Street
- new connection from Unwin Street to the M4 Western Motorway at James Ruse Drive
- removal of steep Hassall Street/Grand Avenue bridge over rail line.

Parramatta Road, west of James Ruse Drive is currently restricted to vehicles under 4.3 m high due to the overhead wires for the T6 Carlingford Line. Conversion of the T6 Carlingford Line to light rail may allow height restriction on Parramatta Road for vehicles over 4.3 m to be removed. Future connections to Victoria Road and Silverwater Road could be opened with additional bridges over Parramatta River and Duck River.

The overhead wires across Grand Avenue at the new light rail depot require verification to determine whether a vehicle height restriction is required on the eastern end of Grand Avenue, east of Colquhoun Street. If it does, alternative routes exist via Durham Street, Devon Street, Unwin Street and Colquhoun Street.

[18] Environmental Impact Statement prepared by CH2MHILL (2013) and Traffic Impact Assessment (Halcrow, 2012)

The alternative route option for Stage 2 of the Parramatta Light Rail may also impose a height restriction on the same section of Grand Avenue. Similarly, clearance under James Ruse Drive for the new Unwin Street to James Ruse Drive/M4 Motorway ramps needs to be checked for 4.6 m high vehicle access. No change is proposed to the height restriction on Wentworth Street.

Any new roads and bridges should be constructed such that they do not restrict the operation of the existing pipelines in to the Precinct, and minimise the disruption to other underground utilities. Any Duck River bridge downstream of Holker Street would need to maintain navigation by the barge traffic to Lubrizol's terminal.

The new infrastructure provided to carry freight vehicles need to be designed to accommodate the requirements of the National Heavy Vehicle Register Performance Based Standards Class 2 and HML network, which includes vehicles up to the size of B-doubles. This applies to infrastructure such as the potential new bridges over Duck River and Parramatta River, the upgraded intersection of James Ruse Drive and Hassall Street and the proposed new connection to the M4 Motorway. This standard influenced the design of road cross-sections, bridge structure, intersection design and parking design within industrial sites.

7.8.3 LOCAL FREIGHT

The creation of a new town centre will create the need for local freight deliveries – i.e. vans, deliveries, removalist trucks and waste collection. The road network within the town centre needs to be designed to calm traffic to improve pedestrian safety, but also needs to facilitate the movement delivery and waste collection vehicles. The on and off-street parking allocation needs to provide sufficient loading and unloading for deliveries and tradespeople's vehicles.

7.8.4 FREIGHT RAIL LINE

The Sandown freight rail line is currently not in service, and has been inactive since 2010. Feedback received during the exhibition of the *Land Use and Infrastructure Strategy for Camellia* was that there are no currently plans to reactivate use of this line.

Given this and the proposed conversion of the T6 Carlingford Line to light rail, the abandonment of this heavy rail line is currently being assessed by the NSW Government. If this line is abandoned and removed, it would have many advantages for the development of the town centre, including:

- Allowing the removal of the steep Hassall Street bridge over the rail line;
- Reduced severance of land either side of the line, especially within the core of the town centre; and
- At-grade road crossings and more frequent pedestrian paths.

The alternative option for Stage 2 of the Parramatta Light Rail would replace the heavy rail with the light rail on part of the Sandown Line, as was done along the Dulwich Hill to Leichhardt section of the Lilyfield light rail line.

7.9 RACECOURSE AND SPEEDWAY EVENTS

Along with the creation of the mixed-use area, changes to Rosehill Racecourse are envisaged that will allow it to adapt to the new road and public transport network. However, its large events are expected to continue and will need to function in the new context of adjoining residences and businesses.

The Parramatta Light Rail Environmental Impact Statement includes the decommissioning of the T6 Carlingford line to accommodate conversion to light rail. It is anticipated that the Parramatta Light Rail will play a role in providing mass public transport services for events at Rosehill Racecourse. While this makes communication to patrons easier, it requires management to accommodate event and regular passenger loads.

Depending on the size of the crowd, this may require consideration of the operation of special shuttle services to and from Parramatta Station before and after events. The current special event bus service could continue or could be replaced by special event light rail services.

Changes to coach, minibus, taxi and car passenger drop-off/pick up may be required. Entry to event car park areas may also need to change to accommodate the new road network and public transport corridor.

Both the Speedway and Racecourse would benefit from the improved bus services, pedestrian and cycle infrastructure planned as part of the revitalisation.

8 TRANSPORT NETWORK ASSESSMENT OF ADEQUACY

The adequacy of the proposed infrastructure for each transport mode is discussed in this section.

8.1 WALKING

The walking facilities in the Camellia Precinct requires substantial improvement to become an easily walkable area to live and work in. The Precinct is approximately 2.0 km from the north end of Parramatta CBD from the town centre via the riverside path, which is a walkable distance.

The proposed walking infrastructure improvements are shown on Figure 8.1. Many are shared facilities with cycles, although consideration of the requirement for parallel separated facilities is required during design.

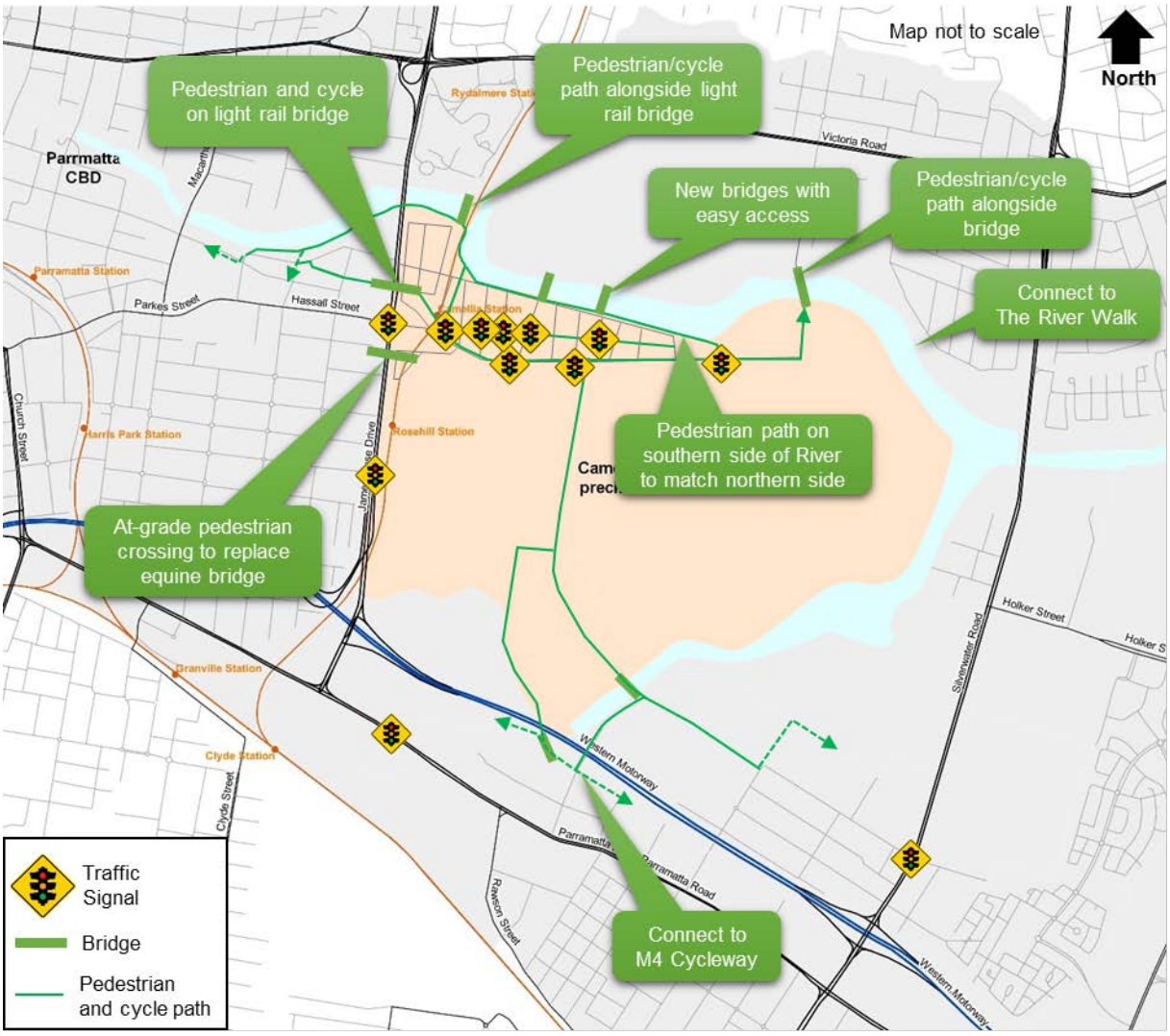


Figure 8.1 Proposed pedestrian and cycle network

The walking network within the town centre will be key to the success of increasing the number of trips made on foot. Incorporation of walking as the priority mode of transport will guide the design treatment of intersections. Guiding traffic around rather than through the highest pedestrian activity areas will reduce conflict.

Connections to the suburb of Rosehill will be made easier by the grade separation of the through movement of James Ruse Drive. While the inclusion of a pedestrian and cycle path on any upgrade of the rail bridge over Parramatta River to the University of Western Sydney, Rydalmere Campus and the light rail bridge over Duck River will improve the connection to local education and recreation facilities.

8.2 CYCLING

The proposed cycle network is also shown on Figure 8.1.

At present the Camellia Precinct has a low level of provision for cycles. However, a small number of key investments in cycle paths, plus the co-locating of facilities with new transport projects (e.g. Parramatta Light Rail would benefit the Camellia Precinct and fill gaps in the wider cycle network. This would also assist in achieving the NSW Government's 'Green Grid' concept.

The Precinct is likely to experience a mixture of commuter and recreational cycling. The parallel paths of Grand Avenue and the Riverside Promenade offers the opportunity to prioritise one for commuting and the other for recreation.

Infrastructure to assist the use of cycling trips include locking facilities and repair facilities within the town centre, focussed on the interchange with light rail, as well as end-of trip facilities incorporated into all commercial buildings and bike racks in public locations within retail spaces.

The Precinct is 2 km from Parramatta CBD (from the town centre) and approximately 7 km from Sydney Olympic Park (assuming the construction of the light rail bridge over Duck River with a cycle and pedestrian facility). These distances are within the range of a reasonable commuting ride, opening the potential for increased cycling trips to the two growth employment districts to the east and west.

Cycling through the industrial part of Camellia is planned. However, the safety of road crossings needs to be considered during design to protect the safety of cyclists. Separated cycle lanes are recommended to improve safety for cyclists given the volume of trucks moving through the industrial area.

8.3 BUS

The bus network within the Camellia Precinct would provide a support role to the Parramatta Light Rail, connecting areas further away from the line to light rail stops and taking advantage of the new bridge over Duck River to provide public transport to/from the south, which is not accessible by light rail. Buses may perform an interim service until the light rail line(s) can be competed.

The proposed bus network is shown in Figure 8.2.

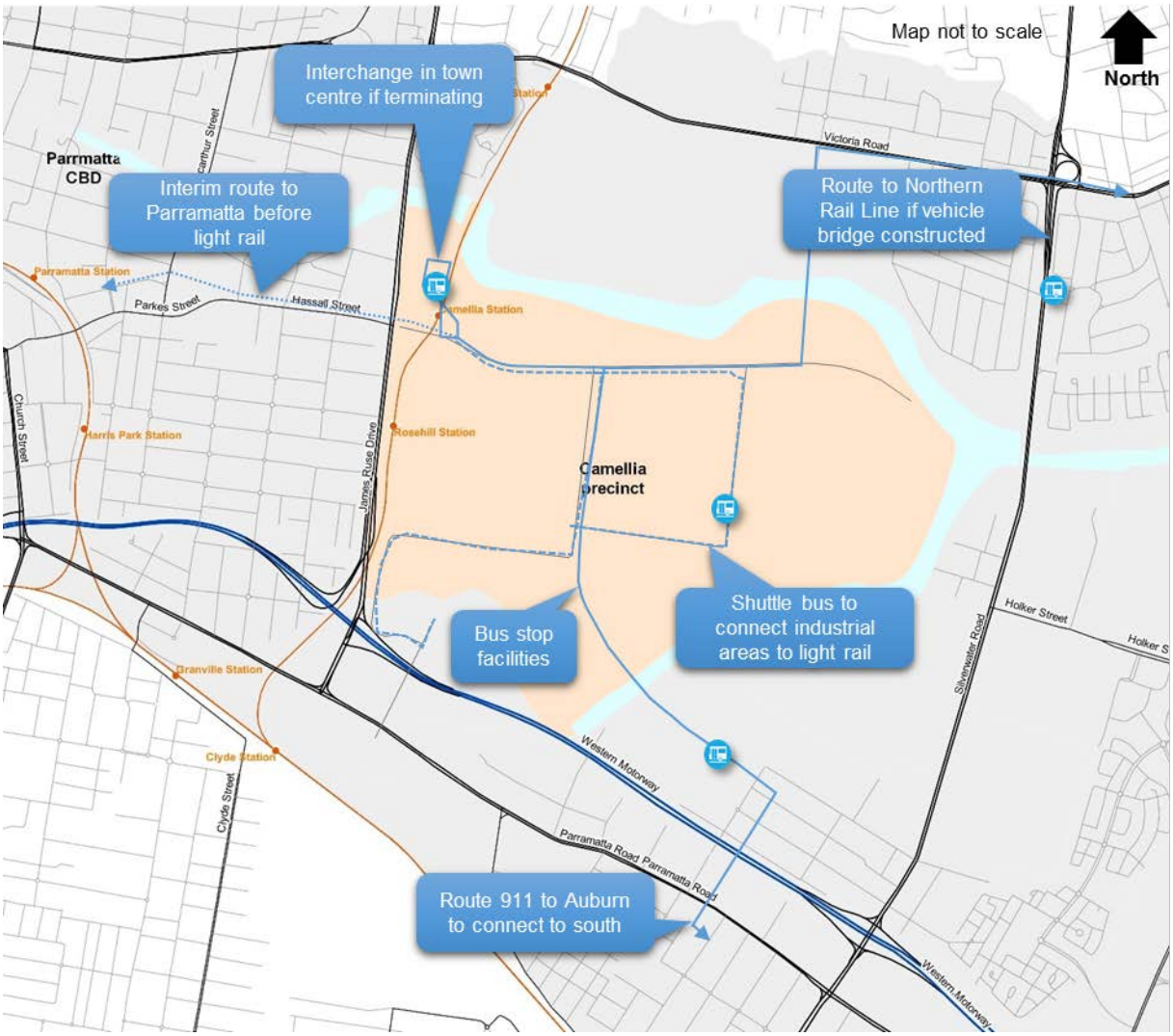


Figure 8.2 Proposed bus network

Considering the potential passenger number shown in Figure 7.4, and assuming a bus capacity of 50 passengers per bus, the route to Auburn could generate up to four bus loads in the peak period in each direction. Allowing for additional capacity for other passengers along the route, and turnover of seating, a peak frequency of up to a bus every 10 minutes could be required.

Considering the route to connect to the Northern Rail Line at West Ryde, Eastwood or Epping, the potential volume is up to a bus load in each direction during the peak. Allowing additional capacity, this may justify a 30-minute service in each direction. This route is dependent on either a vehicle bridge in parallel with the light rail over Duck River or the bridge over Parramatta River to Park Road.

Bus stop facilities to improve passenger comfort and security are proposed. These would include lit bus shelters, seating, a bicycle rack and bus timetable information.

8.4 LIGHT RAIL

The Parramatta Light Rail or a bus rapid transit alternative is considered essential to achieve the magnitude of mode shift change that will reduce reliance on private car travel. Without this service, the Camellia town centre will effectively become isolated from the wider public transport network and the road constraints will reduce the scope for development further.

The Parramatta Light Rail introduces a high frequency, high capacity service to Parramatta CBD and Westmead in the west and Sydney Olympic Park town centre in the east. In addition, it would be the primary connection to the heavy rail network in each direction (with secondary connections to the south and north by bus). This opens up interchange with Sydney Trains services to Sydney CBD.

The Camellia light rail stop will become a focus of transport for the Town Centre. It would be served by both Stage 1 and Stage 2 of the Parramatta Light Rail. If the alternative option is chosen for Stage 2 additional stops in the Camellia industrial area may be considered.

An indicative route through Camellia is shown in Figure 8.3.

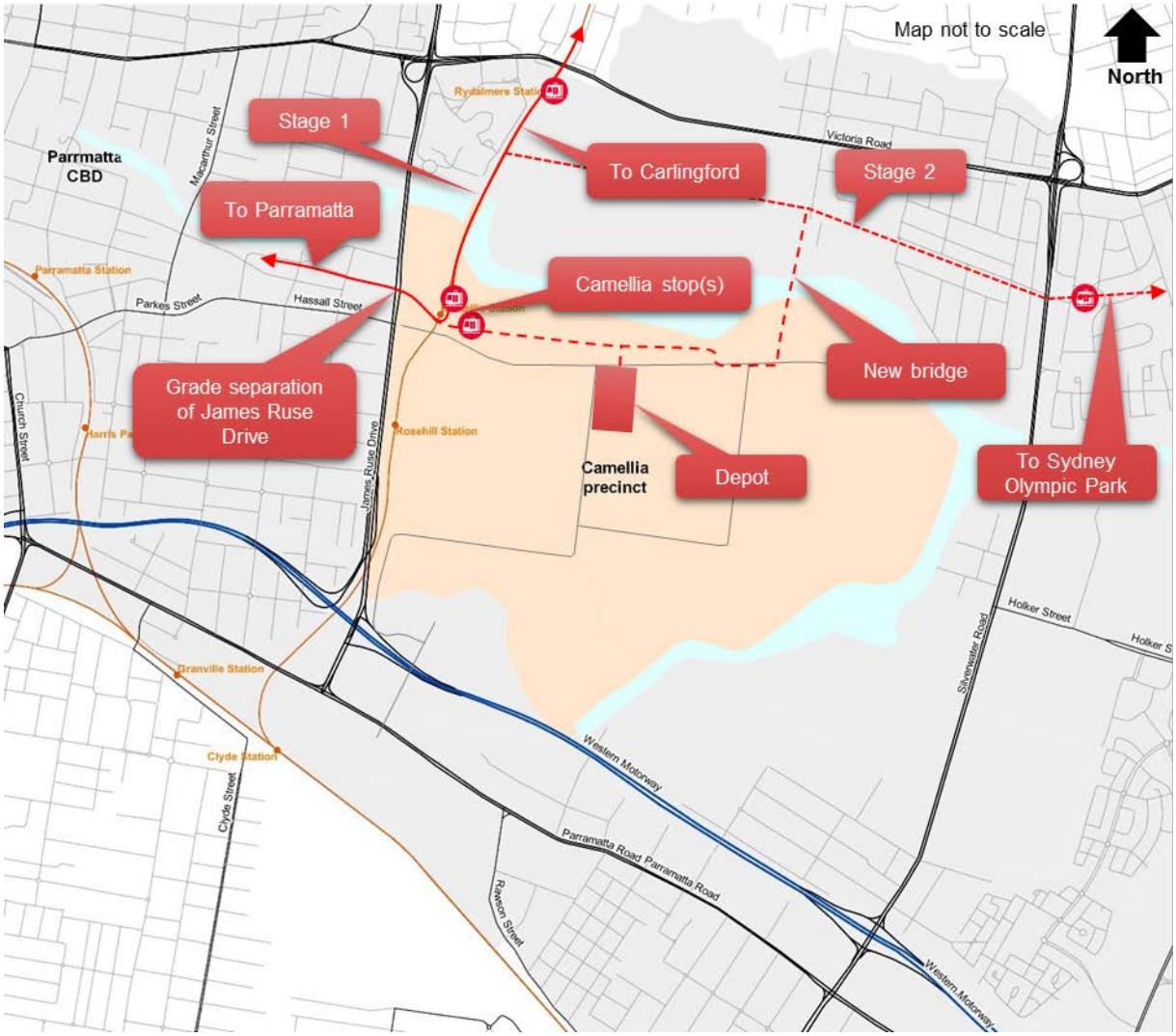


Figure 8.3 Indicative light rail route through Camellia

If a potential capacity of 300 people per light rail vehicle is assumed along with a 5-minute combined frequency, the potential passenger numbers shown in Figure 7.4 could occupy up to 27% of the available passenger capacity in each direction. However, this relies on light rail vehicles being at most 80% full when arriving at Camellia for services to Parramatta to ensure that there is enough capacity for Camellia residents.

8.5 ROAD

The road network surrounding the Camellia Precinct is forecast to experience increases in congestion regardless of whether the rezoning occurs or not. However, this restricts the ability to mitigate the impacts of the Camellia traffic.

A minimum package of road works is proposed that largely addresses these issues, shown in Figure 8.4. Further traffic modelling of the package of road works using more detailed traffic modelling tools is required to assess the feasibility of the upgrades in the context of wider changes in traffic levels on the arterial road network.

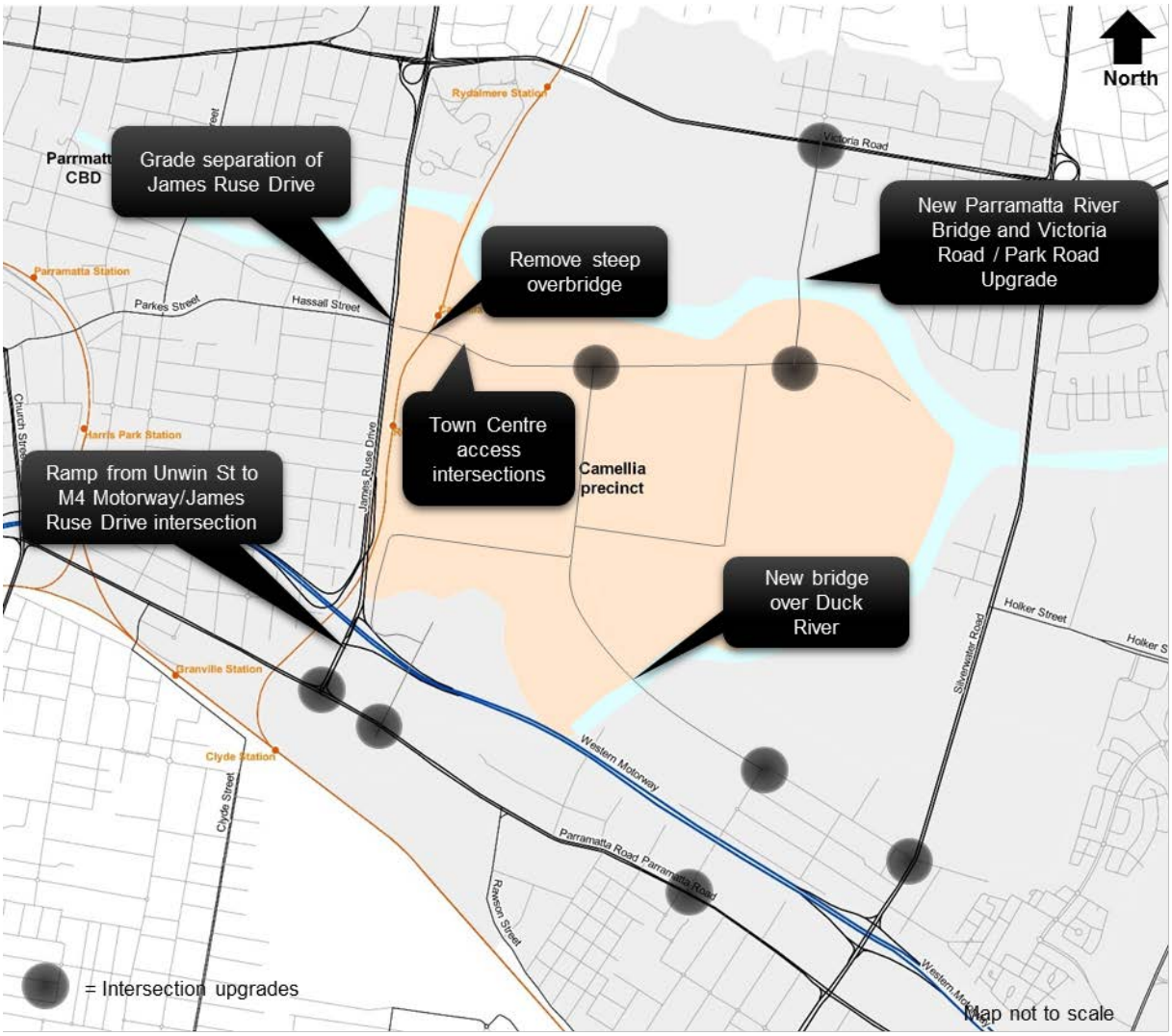


Figure 8.4 Proposed road network upgrades

If the issues of background traffic growth and increasing congestion on the arterial road corridors is considered separately from the ability of the gateway intersections to accommodate the Camellia Precinct traffic, the following restrictions on the amount of traffic would match the volume of traffic generated to the capacity of the road network with the minimum road upgrade package in place:

- James Ruse Drive/Hassall Street – **118%** of assigned development traffic plus traffic diverted from Victoria Road/ Park Road.
- M4 Ramps – **100%** of assigned development traffic based on the assumption that the modelled excess in traffic using the new ramp between James Ruse Drive and Unwin Street will discourage through traffic rather than Camellia Precinct traffic.

- Wentworth Street/Parramatta Road – **100%** of assigned development traffic.
- Stubbs Street/Parramatta Road – **100%** of assigned development traffic.
- Carnarvon Street (or Derby Street)/Silverwater Road – **100%** of assigned development traffic.
- Victoria Road/Park Road – **46%** of development traffic for minimum package of infrastructure (assumes the remainder of traffic diverts via Hassall Street, James Ruse Drive and Victoria Road).

The restriction on the amount of traffic using the Parramatta River Bridge and Park Road is due to the environmental capacity of South Street and the constraints at the intersection of Victoria Road and Park Road. Given the proposed route of Stage 2 of the Parramatta Light Rail, further analysis is required to determine if either of these constraints can be addressed, allowing more Camellia Precinct traffic to use this route.

Based on the following assigned yield from the strategic model run for Option 2B, and the SIDRA analysis for the intersections, it is recommended that the road network with the recommended list of upgrades could accommodate the development yield, as outlined in Table 8.1.

Table 8.1 Estimate of traffic reduction required to match capacity provided by minimum road upgrade package

Gateway	Full Development Traffic Volume	Percentage	Reduced Development Traffic Volume
Hassall Street	3,980	118%	4,708
Wentworth Street	1,260	100%	1,260
Carnarvon Street	1,232	100%	1,232
Parramatta River	1,349	46%	621
M4 Ramp	1,247	100%	1,247
Total	**9,068**		**9,068 (100%)**

(1) Assumes traffic reduction applies equally to all land uses

(2) Assumes traffic displaced from over-capacity links/intersections will reassign itself to other gateways

8.6 CAPACITY TO ACCOMMODATE CAMELLIA DEVELOPMENT

From a transport perspective, the development has several constraints to overcome. However, currently planned improvements would provide an important start in overcoming them. At a high-level they include:

- the position between Parramatta CBD and Sydney Olympic Park is likely to reduce the length of work and non-work trips
- the containment of trips within the development, through a mixture of land uses
- measures targeted at the proposed mixed-use area in the north-west corner of the site are likely to produce the greatest change due to the density of development
- public transport services need to be improved (from a low base) if the development of the Precinct is to proceed with a substantial change in land use
- Parramatta Light Rail would be a major improvement that will open a large capacity for additional development
- the Precinct has the potential for good levels of connection to the surrounding pedestrian and cycling networks.

The Precinct does have the potential for revitalisation with an increase in land use intensity. However, improvements to the transport network are required to support this increase. Projects currently being investigated are an important start. However additional improvements need to be considered.

The analysis of the bus and light rail services indicated that the number of trips generated by the Precinct could be accommodated on these networks with a reasonable service level. However, additional modelling of the light rail corridor is required to verify the available capacity when the light rail arrives at Camellia.

The analysis of the road network indicated that the recommended package of works can accommodate the traffic generated by the Medium land use scenario. The High land use scenario is considered unrealistic based on the currently proposed improvements to the public transport network.

To achieve the High land use scenario, a much higher capacity public transport service is required to reduce the mode share for car use. Subject to further assessment this could be addressed by adding extra public transport lines and infrastructure for pedestrians and cycles. This could include the addition of a Metro-style rail line with a station at Camellia.

It is noted that the major infrastructure items (i.e. grade separation of James Ruse Drive, ramp from Unwin Street to the intersection of James Ruse Drive and the M4 Motorway off-ramp and new bridges over Duck River and Parramatta River) are not committed. A further project of engineering design, business case development, funding allocation and government approvals are still required.

It is envisaged that once released, a Special Infrastructure Contribution for the Greater Parramatta Growth Area will account for some of the required infrastructure items to support the development of Camellia.

9 TRANSPORT MEASURES

The transport assessment for this study has identified several pieces of infrastructure to provide for future development within the Precinct and attempt to change travel behaviour to reduce road network upgrades. It is envisaged that the development in the Precinct would contribute to the cost of this infrastructure. In some instances, where the infrastructure provides a regional benefit, this contribution may be for only a part of the full cost.

9.1 INTEGRATED TRANSPORT NETWORK

A list of the transport infrastructure projects suggested for the Camellia Precinct has been compiled based on the analysis in sections 6, 7 and 8. The list does not include local infrastructure such as internal roads, footpaths and internal intersection treatments, as these will be dealt with at the master plan stage. The list shown in Table 9.1 is based on the assessment (including traffic modelling) undertaken to date. It is understood that a more detailed, wider traffic modelling exercise may be undertaken that could change the items on the list.

9.2 INFRASTRUCTURE TIMING

An assessment of potential timeframes for the suggested transport upgrades is also included in Table 9.1. The assessment considers the need for the infrastructure based on the delivery of residential dwellings (from first residences to 100% completion) as well as coordination with other major projects. These development thresholds are approximate, based on the strategic nature of the assessment. This list requires further consultation with the relevant agencies and are not government policy.

9.3 FUNDING AND DELIVERY

The delivery of the package of road and public transport upgrades outlined in Table 9.1 may require funding from a range of sources including State government, City of Parramatta Council and contributions from developers. To provide a preliminary understanding of the possible contributions to the cost of works, high-level strategic cost estimates have been prepared for the items not being delivered as part of another project. Further details of the contributions required will be included in the, which will inform the Growth Infrastructure Plan to be developed at a later date.

Table 9.1 List of transport infrastructure suggestions for the Camellia Precinct

Item		Delivery	Timing	Cost estimate	Assumptions
Pedestrians					
P.1	Pedestrian path along south side of riverbank	TfNSW	Staged from first residences	$4.5 million[3]	2,700 linear metres from James Ruse Drive to re-join Grand Avenue at wetlands.
P.2	Pedestrian path and crossing of Duck River	TfNSW	50% of residences	To be determined	Accommodated on southern bank of Parramatta River and a new bridge over Duck River.
P.3	Add shared pedestrian/cycle path across Carlingford rail bridge to connect to University of Western Sydney Rydalmere Campus.	TfNSW	With delivery of light rail	To be determined	Accommodated alongside light rail on bridge.
P.4	Replace Equine Bridge over James Ruse Drive to Rosehill Racecourse with at-grade crossing	Council	25% of residences	Included in James Ruse Drive overpass budget	Replace with at-grade traffic signals coordinated with Hassall Street signals.
P.5	Upgrade Thackeray Street bridge over Parramatta River to easy access	TfNSW	50% of residences	$12.9 million[2]	Ramps either side plus new bridge crossing.
Cycles					
C.1	Separated cycle route alongside Stage 1 and Stage 2 Alternative light rail corridor	TfNSW	25% of residences	To be determined	Combined with pedestrian path.
C.2	Cycle facilities at village centre and light rail stops	Council	With construction of pubic open space	To be determined	Lockers and racks. Tyre inflating/repair spot mid-way between Parramatta and SOP.
C.3	Completion of City of Parramatta Council cycle route connecting to M4 Motorway route	TfNSW	50% of residences	$4.0 million[3]	New bridge across Duck Creek. Bi-directional path alongside Shirley Street. 1,800 linear metres.
Buses					
B.1	Bus stops with shelters on dedicated bus routes	TfNSW	Staged from first residences	$0.3 million[3]	Assume four pairs (i.e. eight total) of new bus shelters with seating and bike rack.

Item		Delivery	Timing	Cost estimate	Assumptions
Light Rail					
L.1	Conversion of sections of T6 Carlingford Line to light rail	TfNSW	Based on delivery of Parramatta Light Rail Stage 1	Included in light rail budget	As per Parramatta Light Rail specifications.
L.2	New track on Grand Avenue	TfNSW			
L.3	New stops (Camellia Town Centre) and potential stop in industrial area if alternative option is selected	TfNSW			
Road					
R.1	Grade separation of James Ruse Drive over Grand Avenue North/Tramway Avenue and Hassall Street intersections	TfNSW	25% of residences	$222.5 million[2]	Based on Roads and Maritime plan with two lanes in each direction bridge with breakdown lanes. Two surface lanes in each direction. 1,370 m^2 property acquisition for temporary construction works. 5,748 m^2 permanent property acquisition.
R.2	Removal of freight line and replacement of Hassall Street/Grand Avenue Bridge over the T6 Carlingford Link with new road at surface level	Council	From first residences	$28.7 million[2]	Land to be made available for other uses. 1,230 m^2 permanent property acquisition.
R.3	New bridge over Duck River linking to Carnarvon Street	TfNSW	From first residences	$55.7 million[1]	Includes connecting road from Unwin Street to Duck River. Includes signalisation and upgrade of intersection of Silverwater Road and Derby Street.
R.4	Upgrade intersection of Carnarvon Street and Stubbs Street	Council	From first residences	$1.5 million[3]	Conversion to traffic signals. No additional lanes or acquisition.
R.5	Upgrade intersection of Silverwater Road and Carnarvon Street	Council	From first residences	Included in R.3 as intersection of Silverwater Road and Derby Street	525 m^2 land acquisition for intersection of Silverwater Road and Derby Street.
R.6	New ramps from Unwin Street to M4 Western Motorway	TfNSW	25% of residences	$24.7 million[2]	As per preliminary sketch provided by Roads and Maritime. No allowance for land acquisition (assumed Roads and Maritime-owned land). New traffic signals on Unwin Street, connect to James Ruse Drive/M4 off-ramp signals. New bridge over Duck Creek. Assumes clearance sufficient under James Ruse Drive. 3,288 m^2 permanent property acquisition.

Item		Delivery	Timing	Cost estimate	Assumptions
R.7	Upgrade intersection of Parramatta Road and James Ruse Drive	TfNSW	N/A	Not part of this project	Potential need for additional lanes on Parramatta Road – requires whole of corridor solution.
R.8	Upgrade intersection of Parramatta Road and Wentworth Street	Council	N/A	Not part of this project	Potential need for additional lanes on Parramatta Road – requires whole of corridor solution.
R.9	Upgrade intersection of Parramatta Road and Stubbs Street	TfNSW	N/A	Not part of this project	Potential need for additional lanes on Parramatta Road – requires whole of corridor solution.
R.10	Signalise new intersection of Grand Avenue and Town Centre Road	Council	From first residences	$7.5 million[3]	Complicated by light rail phasing. Assumed to be accommodated within road reservation.
R.11	Signalise new intersection of Grand Avenue and Precinct Collector Road	Council	25% of residences	$4.5 million[3]	Right-turn bay into Town Centre from east alongside light rail. Assumed to be accommodated within road reservation.
R.12	Upgrade intersection of Grand Avenue and Colquhoun Street to traffic signals	Council	25% of residences	$5.3 million[2]	Traffic signals and turn bays required. 606 m^2 permanent property acquisition.
R.13	Upgrade intersection of Colquhoun Street and Unwin Street to traffic signals	Local	25% of residences	$1.5 million[3]	Conversion to traffic signals. Within road reservation.
R.14	New bridge over Parramatta River linking to Park Road	TfNSW	Long-term option to be considered further	$120 million[1]	Bridge may also need to accommodate light rail. Does not include possible grade separation of Victoria Road.
R.15	Upgrade intersection of Grand Avenue and Thackeray Street	TfNSW	Long-term option to be considered further	$4.5 million[3]	Conversion to traffic signals
R.16	Upgrade intersection of Victoria Road and Park Road	TfNSW	Long-term option to be considered further	Long-term upgrade if required	Scope of upgrade could range from additional turn bays to possible grade separation. Further assessment required.

(1) North Projects cost estimate, May 2015, factored up to 2016 value using Australian Bureau of Statistics 6427.0 Producer Price Indexes, Australia, Table 17 Index 3101 Road and bridge construction New South Wales; Jun-2015 to Sep-2016 increase = 1.2%

(2) North Projects cost estimate, December 2016

(3) Transport for NSW generic transport infrastructure costs with additional 40% contingency added

A summary of the cost estimate for the minimum package of works is shown in Table 9.2.

Table 9.2 Summary of cost estimates – minimum upgrade package

Transport Mode	Infrastructure Cost Estimate ($'Million)
Walk	17.6
Cycle	4.0
Bus	0.3
Road	476.4
Total	498.3

Notes regarding cost estimates

1. These cost estimate is high level strategic only for option comparison purposes
2. Design and Investigation cost included
3. The costs in this estimate are to be used for comparative pricing only of the options. Further design development is recommended before attempting to establish a project budget

Inclusions

1. A 50% contingency factor to reflect the level of certainty regarding the definition of the project quantities and unknown items.
2. Overheads – These are construction over heads (indirect contractor costs) – 35%. They include:
   - Supervision
   - Vehicles
   - Accommodation and allowances (hotels etc.)
   - Plant and equipment in addition to plant specified on cost build-ups
   - Site services
   - Small tools
   - Material testing (primary testing)
   - Site services
   - Buildings
   - Establishment and disestablishment
   - Fees and insurances
   - Contingencies/risk
   - Risk at 7% of overheads
   - Rise and fall (3.5%) each year.

Exclusions:

1. Costs exclude GST and escalation
2. Includes an estimate of temporary property acquisition for construction and permanent property acquisition
3. Client Side Project overheads as below:
   - Based on construction including contingency:
     - Client-side project management costs during construction 4–6%
   - Based on property acquisition costs:
     - Professional fees/client costs on property acquisition 8–10%
   - Percentage on the Total item 1 above before client cost:
     - Project investigation 1.5–2%
     - Investigation and design 5–7%
     - Finalisation and handover 1–2%.

The estimates are based upon information made available to WSP and North Projects at the time of preparing the estimates. The estimates have been prepared for this specific Client and Project, and should not be used or relied on for any other use. WSP and North Projects accept no liability for actual costs varying from those estimated.

10 NEXT STEPS

Following the public exhibition of the Camellia Town Centre Master Plan, the Department of Planning and Environment will assess the matters raised in the submissions and prepare a rezoning package to be placed on exhibition. Once finalised, the planning proposal will be forwarded to the Minister for Planning for determination.

Approval and publication of the rezoning would enable the lodgement of development applications for individual development proposals with Council for processing and assessment. During the development application process, when staging, delivery and detailed urban form are proposed, further detailed transport modelling will be required to understand the impact and mitigation measures required on the local transport network.

The planning controls proposed allow for greater yields to be delivered. Any development beyond the assumed yield will require further assessment to augment the transport response. As proposed development proceeds, Transport for NSW and Roads and Maritime Services will continue to monitor the performance of the transport network and the timing of initiatives proposed in this report.

Recommendations for further assessments include:

- More detailed mesoscopic traffic modelling to further validate network improvements and to assess the options for upgrades to the arterial road network to address regional traffic growth.
- Detailed public transport modelling of the Parramatta Light Rail to ensure sufficient capacity to accommodate the anticipated number of passengers travelling to/from the Camellia Precinct.

APPENDIX A

TRAFFIC MODELLING

A1 MODELLING APPROACH

The modelling approach as part of the assessment of the Camellia urban regeneration is shown in Figure 6.1.
The steps undertaken were:

- Existing classified traffic survey counts (2015) were analysed to obtain a basis for assessing future road network performance. They were also used to estimate parameters needed for the next modelling steps, including factors to change time periods between peak periods and peak hours and factors to convert existing classified and SCATS counts into Passenger Car Units (PCU):
  - comparison to 2016 SSTM demand
  - estimation of a Peak Hour Factor to convert the two-hour SSTM demands into one hour demands for the purposes of traffic assessments
  - estimation of a Passenger Car Unit (PCU) conversion factor to convert existing classified and SCATS counts into PCU's, providing a comparable base to the SSTM outputs.
- SCATS detector counts were reviewed to ensure count consistency between intersections and form basis of existing traffic volumes at remaining intersections.
- SIDRA Intersection models were developed for the existing situation and compared against previously reported performances.
- Sydney Strategic Transport Model (SSTM) and outputs reviewed for the following scenarios:
  - 2011 Base
  - 2021 Base
  - 2021 Option 1
  - 2031 Base
  - 2031 Option 2A
  - 2031 Option 2B
  - 2031 Option 3A
  - 2031 Option 3B.
- *Note: details of each of the scenarios will be provided throughout the transport modelling memo.*
- Travel demands (by mode) between key precincts within the study area were reviewed for each of the SSTM scenarios.
- SSTM person trip generation and mode splits were compared to the expected person trip generation from the work previously completed by WSP (adjusted for changes in yield):
  - the expected trip generation rates were based upon the published trip generation rates by Roads and Maritime.
- SIDRA Intersection models were developed for the various future scenarios to be assessed.

A1.1 TRANSPORT PROJECTS OF INFLUENCE

There are many permutations of land use and transport network scenarios. The list of assumptions is outlined in Table A.1.

Table A.1 Strategic model scenario assumptions

Topic	Range of Scenario Assumptions
Land use	— Medium scenario – as per DP&E current assumptions. — High scenario – in line with stated Councillor/developer position.
Public transport	— Bus – as confirmed in email on 12 November 2015 — Light rail – as per current TfNSW coding in 2036 (interim bus to Parramatta in 2021). — Metro rail – not part of current TfNSW planning. — Heavy rail – only improvements stated in *Sydney's Rail Future*.
Road network	— Upgrade James Ruse Drive/Hassall Street at-grade – to be tested in intersection model — Left-in/Left-out to Camellia Precinct – too detailed for strategic model, to be discussed with Roads and Maritime and included in meso model if considered viable. — Wentworth Road/Parramatta Road intersection upgrade – too detailed for strategic model, tested in intersection modelling. — Derby Street or Carnarvon bridge – in 2026 Base scenario, choice of Derby or Carnarvon is too detailed for strategic model, assume Carnarvon Street. — Silverwater Road/Derby Street upgrade – in 2026 Base scenario, check no turn movements banned. — M4 Ramps from Kay Street – option to be tested in WRTM. — Clyde Street light rail bridge with traffic lanes – option to be tested. — Parramatta River bridge – option to be tested, choice of connecting street is too detailed for strategic model, assume Park Road (Rydalmere).

A1.2 ROAD AND LAND USE ASSUMPTIONS

Realistically there is a limit to the amount of development and the amount of infrastructure that can be planned/funded in the medium-term. In the long-term there is a small set of scenarios that provide a logical progression/funding arrangement. The scenarios considered as part of this assessment, including a base scenario, is outlined in Table A.2.

Table A.2 Preliminary list of scenarios

Model Scenario	Road Network				Land Use		
	Base	Clyde Street Bridge	Parramatta River Bridge	M4 Ramps	Base	Medium	High
	Short-term (2021)						
Base	×	×	×	×	✓	×	×
1	✓	×	×	×	×	✓	×
	Long-term (2036)						
Base	×	×	×	×	✓	×	×
2A	✓	✓	✓	×	×	✓	×
2B	✓	✓	✓	✓	×	✓	×
3A	✓	✓	✓	×	×	×	✓
3B	✓	✓	✓	✓	×	×	✓

A1.3 BUS NETWORK ASSUMPTIONS

The network outlined in the 'Camellia Precinct – Land Use and Infrastructure Analysis Attachment A – Strategic Transport Assessment' has already had input from TfNSW. It includes:

1 Parramatta to Auburn via Camellia (curtailed at Camellia when light rail is operational

2 Camellia to Eastwood

3 Internal shuttle bus connecting to Granville and Camellia Town Centre.

Discussions with TfNSW have identified the following changes which could form the basis of network modifications:

- Modify route 911 to extend to Parramatta via Camellia (*requires bridge over Duck River at Carnarvon Street*)
- Add additional services on Route 911 between Auburn and Parramatta via Camellia (*requires bridge over Duck River at Carnarvon Street*)
- Modify Route 544 to travel via Clyde Street (Silverwater) bridge alongside light rail (*requires bridge over Duck River at Clyde Street Silverwater*)
- Modify Route 523 to take on route of old 544 between Silverwater and Auburn
- Add a new service, as a forerunner to the proposed light rail, between Parramatta and Sydney Olympic Park via Camellia and Silverwater and extended to Rhodes (*requires bridge over Duck River at Carnarvon Street and Homebush Bay Green Bridge*).

A potential shuttle bus operating around the Camellia Precinct has not been modelled, as the strategic model was too course to be able to assess its impact.

Potential bus route frequencies and average speeds for the new and modified services are shown in Table A.3. These routes are shown in Figure A.1.

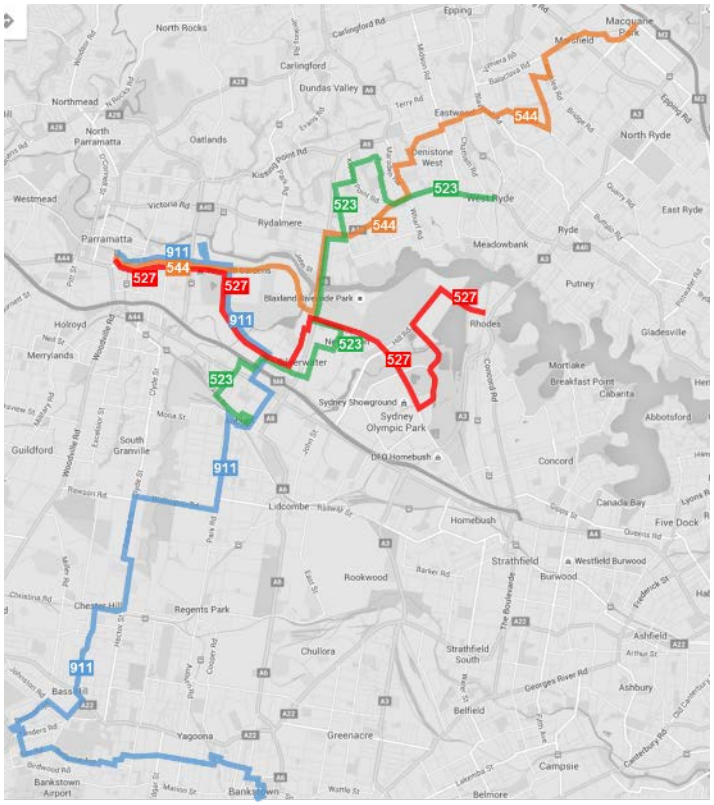


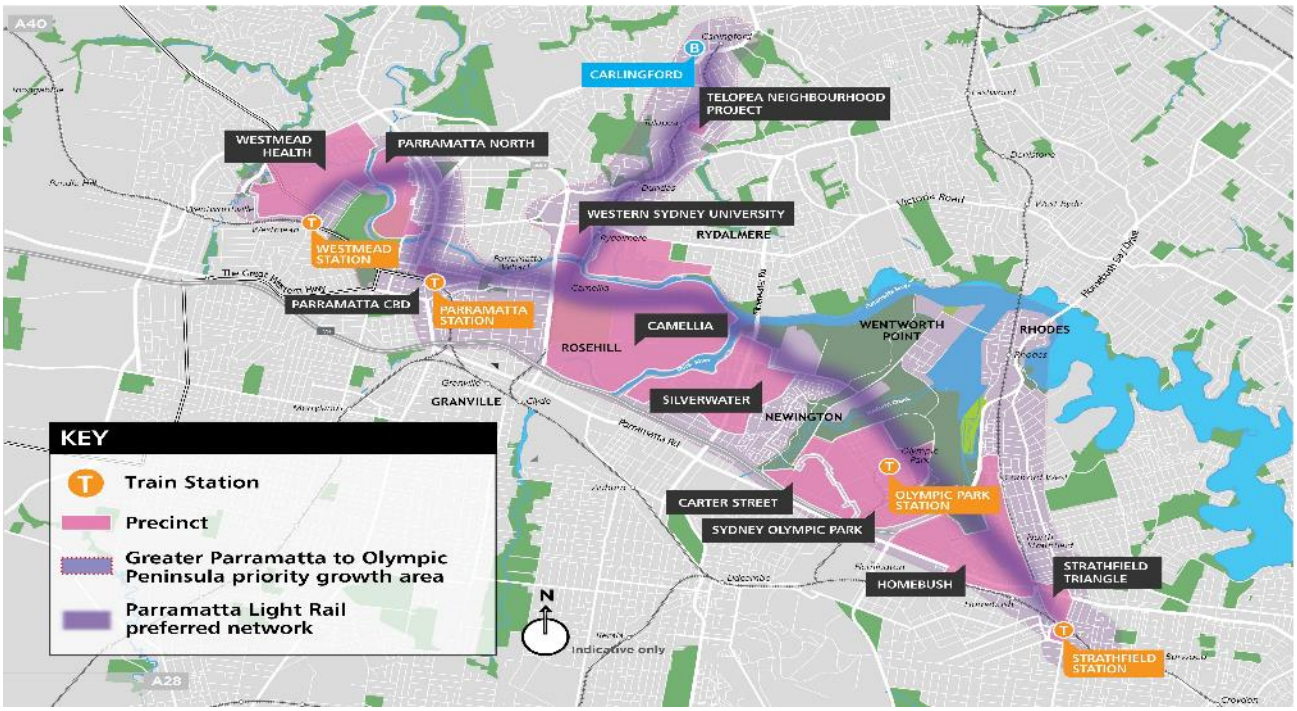
Figure A.1 Proposed bus network

Table A.3 Preliminary list of public transport scenarios

Route	Peak Frequency	Off-Peak Frequency	Average Speed
911 – Bankstown to Parramatta	2 per hour	1 per hour	20 km/h
911 – Auburn to Parramatta	2 per hour (in addition to above – i.e. 15 min headway)	1 per hour (in addition to above – i.e. 30 min headway)	20 km/h
523 – West Ryde to Auburn via Ermington and Newington	4 per hour	1 per hour	20 km/h
544 – Macquarie Park to Parramatta via Ermington and Camellia	4 per hour	1 per hour	20 km/h
527 – Parramatta to Rhodes via Camellia, Silverwater and Olympic Park	4 per hour	2 per hour	25 km/h

A1.4 LIGHT RAIL ASSUMPTIONS

The Parramatta Light Rail network currently being investigated by Transport for NSW is a key public transport improvement that could benefit the Camellia Precinct and allow it to be developed to a greater density. Transport for NSW is currently developing a plan for alignments, stop locations, service frequencies and priority for the light rail network. An indicative network is shown in Figure A.2.



Source: Transport for NSW Parramatta Light Rail website, viewed 23/12/2016

Figure A.2 Potential light rail service

A1.5 HEAVY RAIL ASSUMPTIONS

As part of the transport assumptions, the existing heavy rail networks remain and no future connections are considered. This position may change in the future.

A2 EXISTING SITUATION

A2.1 EXISTING TRANSPORT VOLUMES

Data sources

The existing traffic volumes within the Road Study Area are based upon the following data sources:

- classified traffic surveys at the following locations:
  - Silverwater Road/Parramatta Road (25/03/2015)
  - Silverwater Road/M4 Motorway ramps (25/03/2015)
  - Silverwater Road/Carnarvon Street (25/03/2015)
  - Silverwater Road/Fariola Street (25/03/2015)
  - Silverwater Road/Holker Street (25/03/2015)
  - Silverwater Road/Victoria Road (25/03/2015)
  - Silverwater Road/Clyde Street (20/11/2014)
  - James Ruse Drive/Grand Avenue (18/11/2014)
  - Parramatta Road/James Ruse Drive (28/05/2015)
  - Parramatta Road/Wentworth Street (28/05/2015)
  - Parramatta Road/Stubbs Street (28/05/2015)
- SCATS detector counts for all signalised intersections within the Parramatta and Ryde areas (20/10/2015–22/10/2015).

Transport volume methodology

As a result of the mix of data sources within the study area consisting of classified traffic counts and unclassified SCATS counts, in combination with the SSTM outputs which are provided in PCUs, the following analytical methodology has been applied:

- classified counts were reduced to two-hour peak periods, consistent with the SSTM outputs, of:
  - AM: 7.00 am–9.00 am
  - PM: 4.00 pm–6.00 pm
- classified counts were converted to PCU based upon the following conversion factors (derived from the Roads and Maritime *Traffic Modelling Guidelines*):
  - light vehicles:1.0
  - heavy rigid vehicles: 2.0
  - heavy articulated vehicles: 4.0
- peak flow factors were identified by comparing the one-hour peak period to the two-hour peak period. These were subsequently identified as being:
  - 0.51 in the AM peak period
  - 0.51 in the PM peak period
- the PCU and peak flow conversion factors were applied to the SCATS counts. These were subsequently identified as being:
  - 1.17 in the AM peak period
  - 1.06 in the PM peak period.

All subsequent modelling and traffic volumes will be reported as one-hour PCU values.

Comparison of Surveyed counts to SCATS detector counts

Based upon the converted traffic volumes (section 2.1.2), a comparison of the SCATS detector counts to the traffic survey counts was undertaken. This was undertaken to assess the correlation in traffic volumes between the two major data sources, in the context of the differences in survey day and year. This comparison is summarised in Table A.4.

Table A.4 Comparison of surveyed counts to SCATS counts

Intersection		AM peak (7.00 am–9.00 am)	PM peak (4.00 pm–6.00 pm)
I-01	James Ruse Drive/ Grand Avenue	— SB through movement is approximately 40% higher in the SCATS counts: — Note: SCATS southbound is factored by 50% to account for a broken detector in lane two. — Other than the movement indicated above, the remaining SCATS counts are approximately 15% higher than the survey: — Note: SCATS northbound is based upon the 2014 counts for GTA undertaken for the Viva energy site.	— On the western approach, the SCATS volumes are approximately 10% lower. — Other than the western approach, SCATS counts are approximately 10% higher. — Note: these movements were originally derived from the GTA counts for the Viva energy site.
I-04	Parramatta Road James Ruse Drive	— Left turn from James Ruse Drive is approximately 50% higher (900 pcu vs 600 pcu). — On the eastern approach, the SCATS volumes (T, R) are approximately 25% higher than the survey volumes. — On all other movements, the SCATS counts are within 10% of the survey volumes.	— The SCATS counts are approximately 10% higher than the survey volumes.
I-05	Parramatta Road/ Wentworth Street	— SCATS through movements on Parramatta Road are approximately 25% higher than the survey volumes. — On all other movements, the SCATS counts are within 10% of the survey volumes.	— WB through movement is approximately 25% higher in the SCATS count. — On all other movements, the SCATS counts are within 10% of the survey volumes.
I-06	Parramatta Road/ Stubbs Street	— Eastern approach: — Through movement is 20% higher in the SCATS — Right-turn is approximately 50% lower in the SCATS. — Western approach through movement SCATS volume is approximately 40% higher (1200 pcu vs 900). — On all other movements, the SCATS counts are within 10% of the survey volumes.	— SCATS counts are generally 10% lower compared to the survey volumes.
I-09	Silverwater Road/ Clyde Street	— Traffic volumes of all approaches are comparable to the SCATS counts. — SCATS counts are approximately 10% higher.	— Traffic volumes of all approaches are similar to the SCATS counts. — Variation between the two data sets is less than 5%.

Journey to Work

The 2011 Journey to Work statistics have been analysed for the Core study area, Road study area and key external sectors including Parramatta CBD and Sydney Olympic Park. This analysis is summarised in Table A.5 and Table A.6.

Table A.5 Journey to work – Residents

Sector	Number of Residents	Key Origins	Mode Split			
			Private Vehicle	Public Transport	Walk	Other
Camellia Core	< 10	Insufficient sample size	50%	50%	0%	0%
North Sector	1,500	Carlingford Ryde/Hunters Hill Sydney Inner City Parramatta	68%	17%	2%	13%
East Sector	500	Auburn Sydney Inner City Ryde/Hunters Hill Parramatta	69%	18%	3%	10%
South Sector	3,500	Auburn Sydney Inner City Parramatta Strathfield/Burwood	45%	38%	5%	11%
South-West Sector	500	Parramatta Sydney Inner City Merrylands/Guildford Auburn	50%	38%	4%	8%
West Sector	2,500	Parramatta Sydney Inner City Ryde/Hunters Hill Auburn	52%	31%	7%	10%
Parramatta CBD	2,000	Sydney Inner City Parramatta Auburn Merrylands/Guildford	28%	53%	11%	8%
Sydney Olympic Park	< 10	Sydney Inner City Ryde/Hunters Hill	0%	0%	0%	100%

Notes Analysis is based upon residents who work within the greater Sydney metropolitan area (i.e. trips interstate or to regional cities in NSW are excluded from the analysis)

Table A.6 Journey to work – Workers

Sector	Number of Workers	Key Origins	Mode Split			
			Private Vehicle	Public Transport	Walk	Other
Camellia Core	4,250	— Parramatta — Merrylands/Guildford — Blacktown — Penrith	85%	4%	1%	10%
North Sector	8,500	— Parramatta — Carlingford — Blacktown — Baulkham Hills	84%	7%	1%	8%
East Sector	6,500	— Auburn — Merrylands/Guildford — Parramatta — Blacktown	86%	6%	1%	7%
South Sector	4,500	— Auburn — Merrylands/Guildford — Parramatta — Fairfield	76%	10%	3%	11%
South-West Sector	2,500	— Merrylands/Guildford — Parramatta — Blacktown — Fairfield	78%	11%	2%	9%
West Sector	1,500	— Parramatta — Merrylands/Guildford — Blacktown — Carlingford	75%	9%	4%	11%
Parramatta CBD	37,500	— Parramatta — Merrylands/Guildford — Blacktown — Baulkham Hills	48%	36%	4%	12%
Sydney Olympic Park	11,000	— Parramatta — Strathfield/Burwood — Auburn — Merrylands/Guildford	70%	19%	1%	10%

Notes Analysis is based upon residents who work within the greater Sydney metropolitan area (i.e. trips interstate or to regional cities in NSW are excluded from the analysis)

Overall, the following commuting trends were identified:

- trips arriving to the Camellia core study area were generally by private vehicle, with approximately 85% of trips being as a vehicle driver or passenger
- residents living in the West, South-West and South sectors of the Road Study Area are observed to have a greater proportion of trips via public transport, at 30–40% of trips:
  - this is most likely related to the accessibility of Harris Park, Granville, Clyde and Rosehill Railway Stations
- most residents of the external sector of the Parramatta CBD commute via public transport:
  - this is most likely related to the accessibility of Parramatta Interchange
- employees in all the sectors analysed generally commute via private vehicle, which represents approximately 75–85% of trips as a vehicle driver or passenger:
  - the exception to this is Parramatta CBD, where approximately 50% of trips are via private vehicle and approximately one-third of trips are via public transport
- Parramatta CBD has a higher proportion of trips via walking compared to the other sectors at 5–10%.

A3 STM MODELLING

The Sydney Strategic Transport Models (SSTM) for each of the scenarios were provided by TfNSW Transport Performance and Analytics. The SSTM node / link structure and its correlation to the study area are illustrated on Figure A.3.

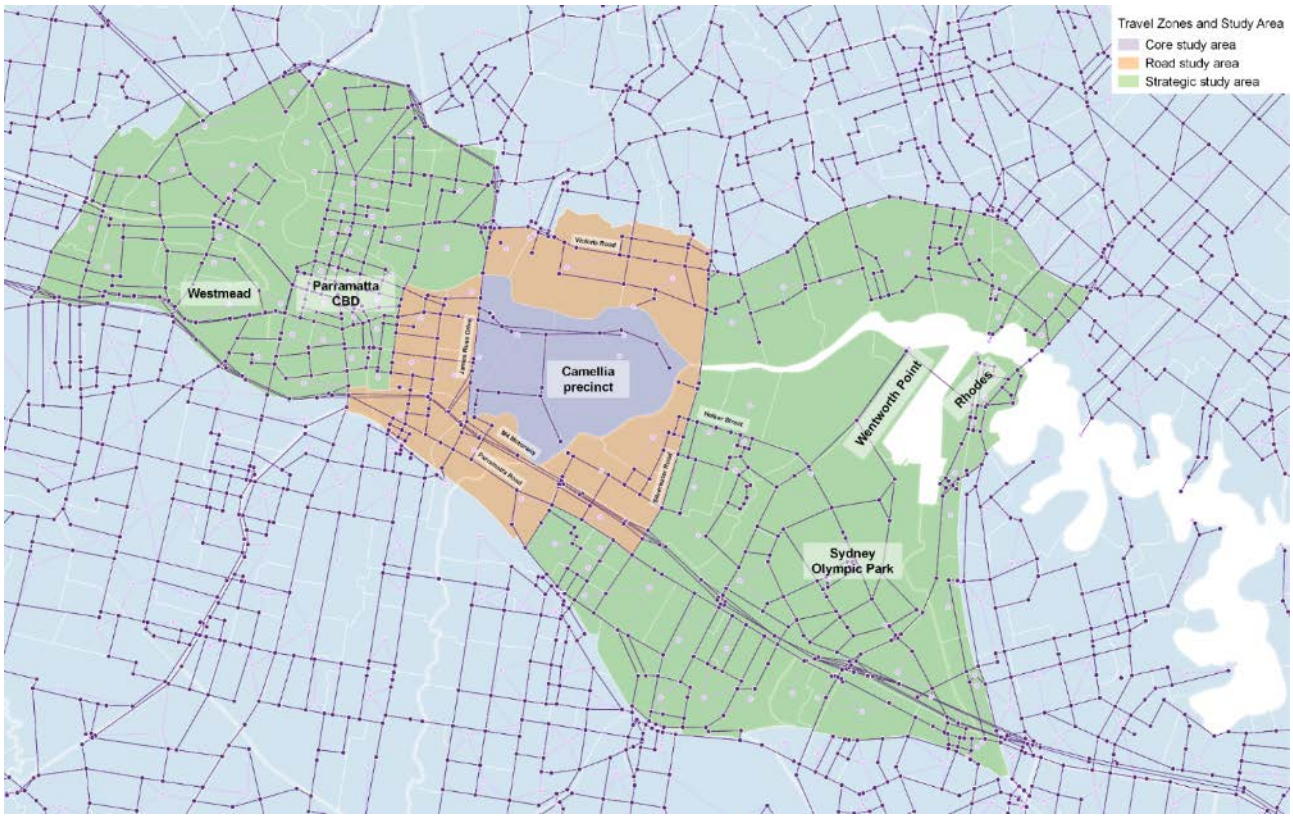


Figure A.3 SSTM network

A3.1 SSTM VOLUMES VERSUS OBSERVED VOLUMES

The link volumes from the observed traffic count data (SCATS and classified counts) were compared to the SSTM link volumes for 2016 (interpolated from the 2011 and 2021 base models). This comparison was undertaken in terms of PCU's and for the two-hour AM and PM peak periods. It is noted that the 2021 base model also incorporates the WestConnex motorway and that there will be consequences for traffic assignment, particularly within the vicinity of the M4 Motorway and WestConnex.

The analysis has been undertaken for the following road corridors surrounding the core study area:

- Silverwater Road
- Parramatta Road
- James Ruse Drive
- M4 Motorway (ramps)
- Carnarvon Street
- Fariola Street
- Holker Street
- Victoria Road.

The comparison indicates some differences in estimates of traffic flow on the key links surrounding the core study area. Scatter plots of the observed and modelled volumes are presented on Figure A.4 and Figure A.5 which indicate that on average:

- the SSTM over estimates traffic flow by approximately 8% in the AM peak period and 11% in the PM peak period
- whilst the R^2 value is approximately 0.7–0.8, there is a reasonable degree of variability between the two data sets.

However, there are some key corridors where the SSTM under-forecasts traffic flow in 2016, most notably:

- AM peak:
  - M4 Motorway ramps, westbound = 6%
  - Victoria Road, eastbound = 27%
- PM peak:
  - Parramatta Road, westbound = 6%
  - Holker Street, eastbound = 4%
  - Victoria Road, eastbound = 8%
  - Victoria Road, westbound = 9%.

It is noted that the comparison for Victoria Road is based upon the 2011 SSTM link volumes to the 2011 classified counts provided by TfNSW.

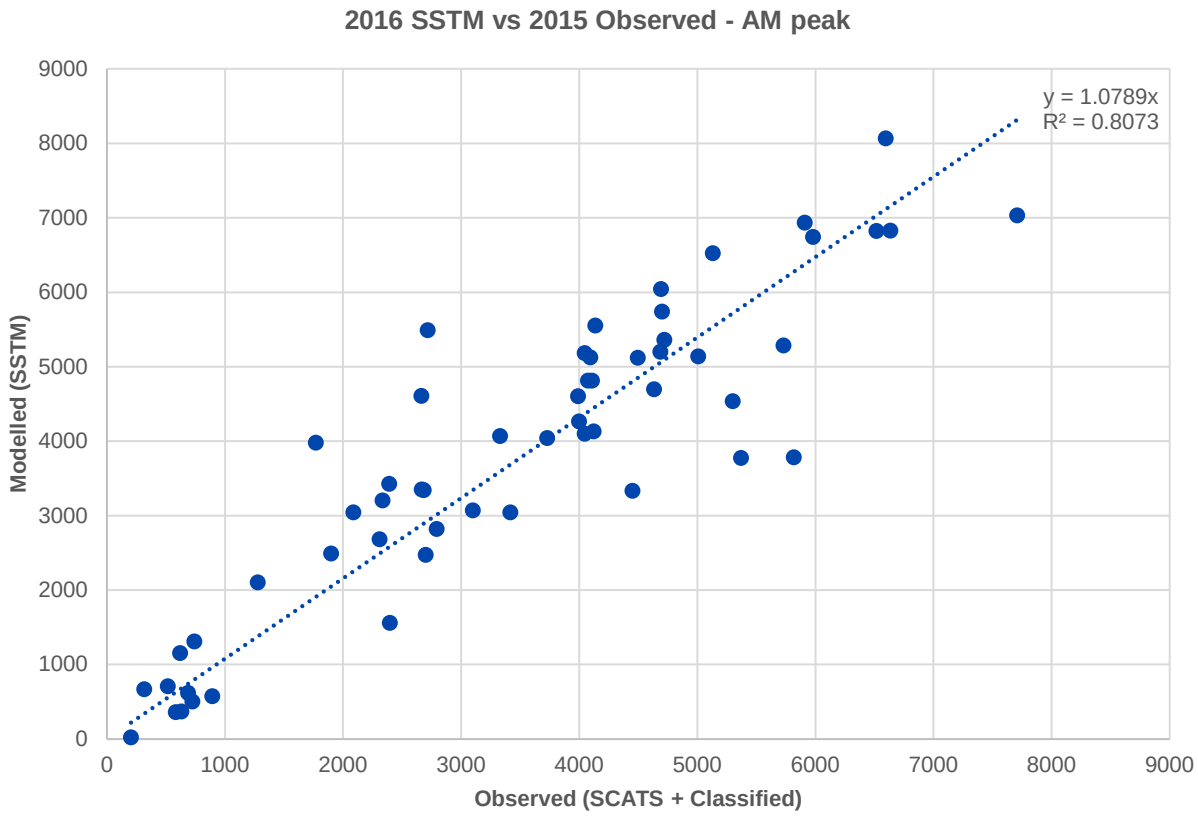


Figure A.4 Comparison of 2016 SSTM vs 2015 observed data – 2016 AM

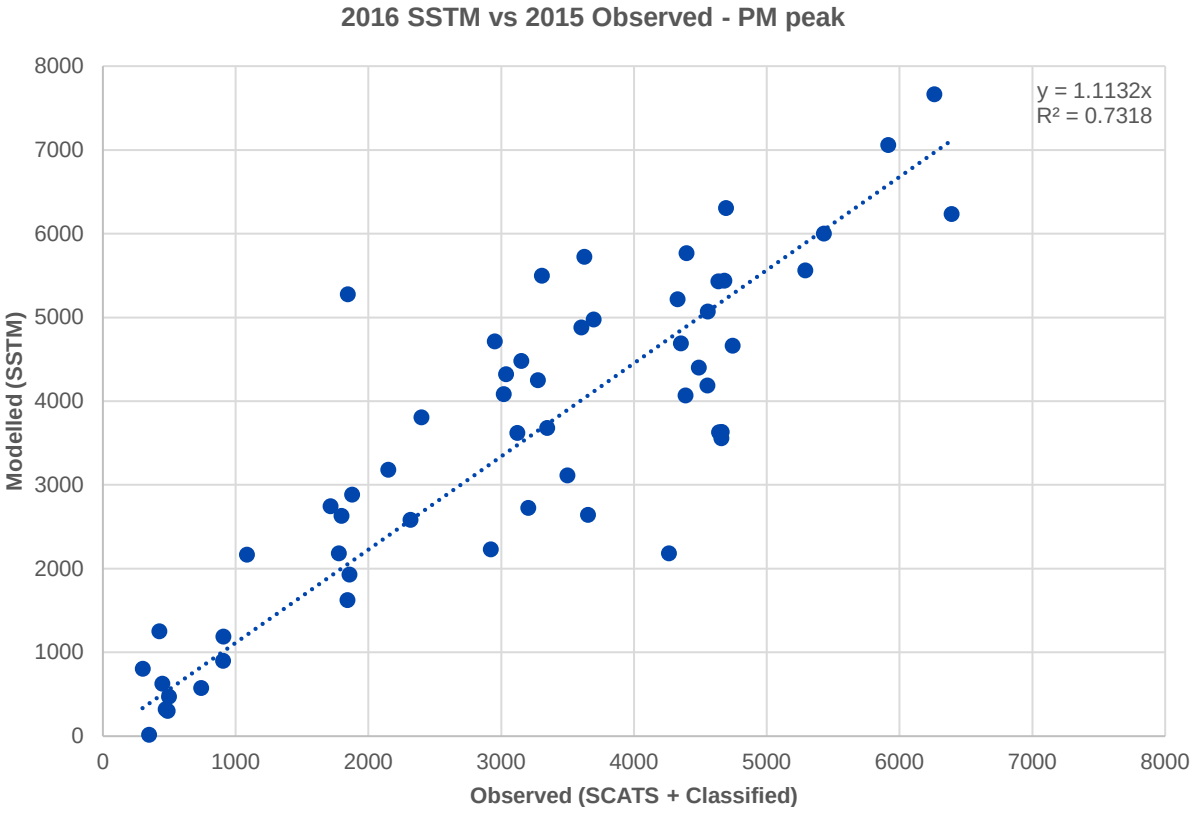


Figure A.5 Comparison of 2016 SSTM vs 2015 observed data – 2016 AM

A3.2 SSTM FORECAST TRIP PATTERNS

Overall demand trends

The overall vehicle demand trends in the AM and PM peak periods for each scenario are summarised in Figure A.6 and Figure A.7. These graphs indicate that the overall number of vehicle trips increases over the period 2011 to 2031, in line with the growth rates discussed previously in this appendix. The overall split between light vehicles and heavy vehicles remains consistent across the different scenarios, such that:

- HV% is approximately 4% in the AM and PM peak periods
- LCV% is approximately 9% in the AM peak period and 5% in the PM peak period.

The second major trend identified from the overall vehicle demand is that the difference in demand between the future base scenario and the corresponding 'with development' scenario are similar. The development of the Camellia Precinct is expected to generate approximately 10,000 additional vehicles in the peak periods, and is relatively small compared to the overall traffic demand.

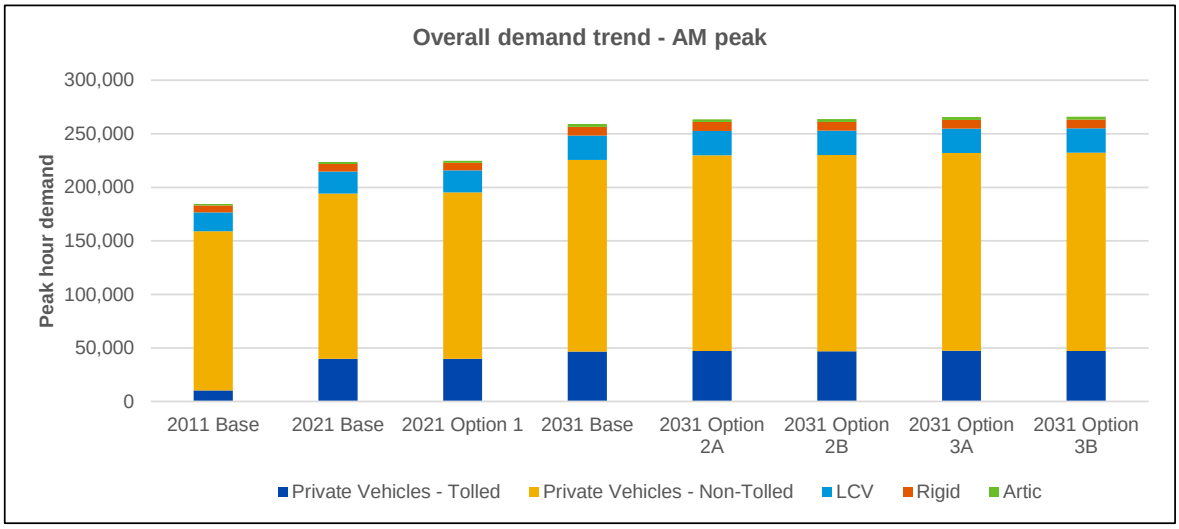


Figure A.6 Overall demand trend, by scenario – AM peak

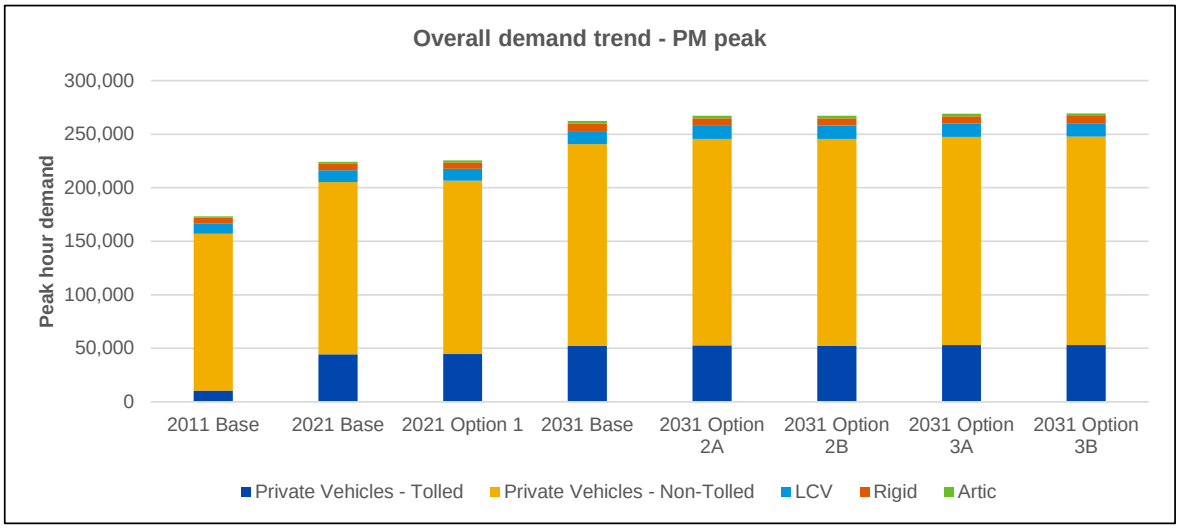


Figure A.7 Overall demand trend, by scenario – PM peak

Trip distribution

The trip distribution for the wider area traffic, summarised in Figure A.8 and Figure A.9, indicates that the number trips not passing the Camellia Precinct will increase over the period to 2031, and by a higher proportion compared to the number of trips that would pass the Camellia Precinct. The relatively large increase in non-passing trips is most likely a consequence of increasing traffic demands within the vicinity of the site, and therefore increasing levels of congestion. As a result, some drivers may seek to bypass the road corridor surrounding the Camellia Precinct to achieve faster travel times; possibly on new infrastructure such as WestConnex.

It is noted that there is no significant difference in the number of passing and non-passing trips, between the future base scenario and its future 'with development' scenario. This suggests that the Camellia development is not the main cause of the traffic diversion, and that it is most likely a consequence of the background growth in traffic demand.

The number of local trips, contained within the surrounding travel zones, is observed to increase slightly over the period of 2031. However, there is a small decrease in local trips in the 'with development' scenario compared to the future base scenario. This is most likely a result of trips diverting to the Camellia precinct to residential or employment purposes. This is correlated with increases in the number of site trips, particularly in the 'with development' scenarios.

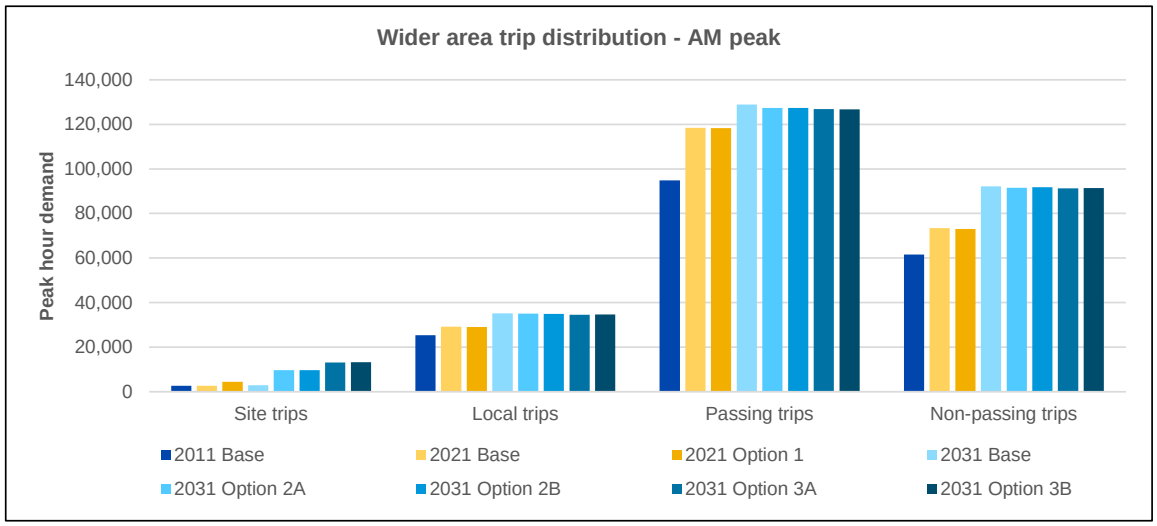


Figure A.8 Wider area distribution – AM peak

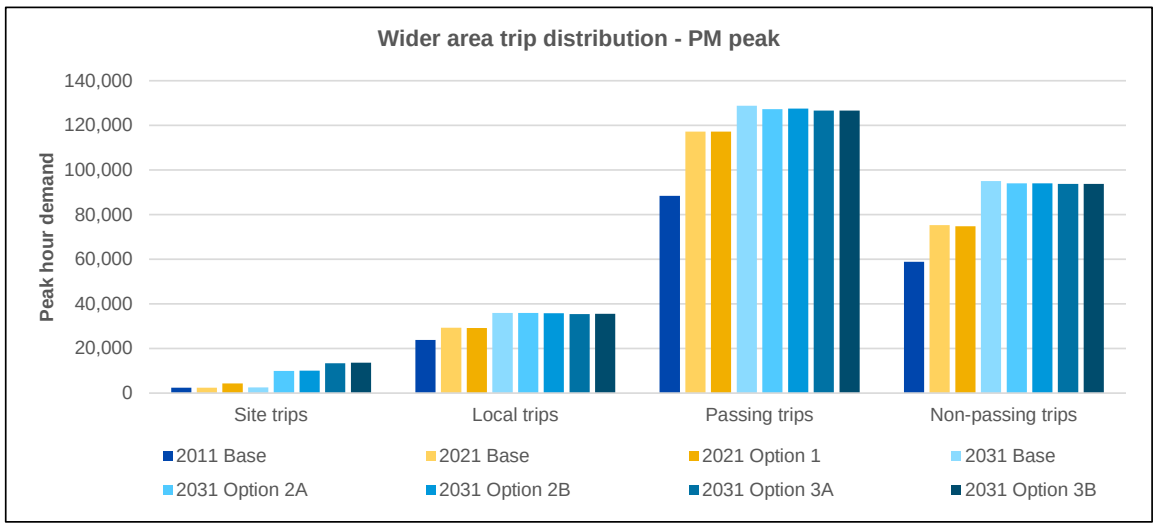


Figure A.9 Wider area distribution – PM peak

Heavy Vehicle (Freight)

The trip distribution of heavy vehicles (representing freight) to and from the Camellia Precinct is summarised in Figure A.10, and builds on the trip generation (including heavy vehicles) discussed earlier. The trip distribution patterns for heavy vehicles are consistent between the AM and PM peak periods, and also by direction (to and from Camellia). These patterns include the following:

- there are no significant differences between the future base and 'with development' scenarios
- significant decrease in heavy vehicle trips via Centenary Drive, by approximately half
- slight reduction in trips via Kissing Point Road and Stewart Street. It is noted that heavy vehicle movements are diverted away from Kissing Point Road and towards Silverwater Road and Park Road
- slight reduction in trips via the Cumberland Highway, by approximately one-third
- trips via the M4 Motorway towards western Sydney remain consistent over forecast years
- more than doubling of trips via the M4 Motorway towards the Sydney CBD
- the remaining travel zones are forecast to generate/attract heavy vehicle demand in the vicinity of 2% each and represent approximately 35–40% of the overall freight demand distribution.

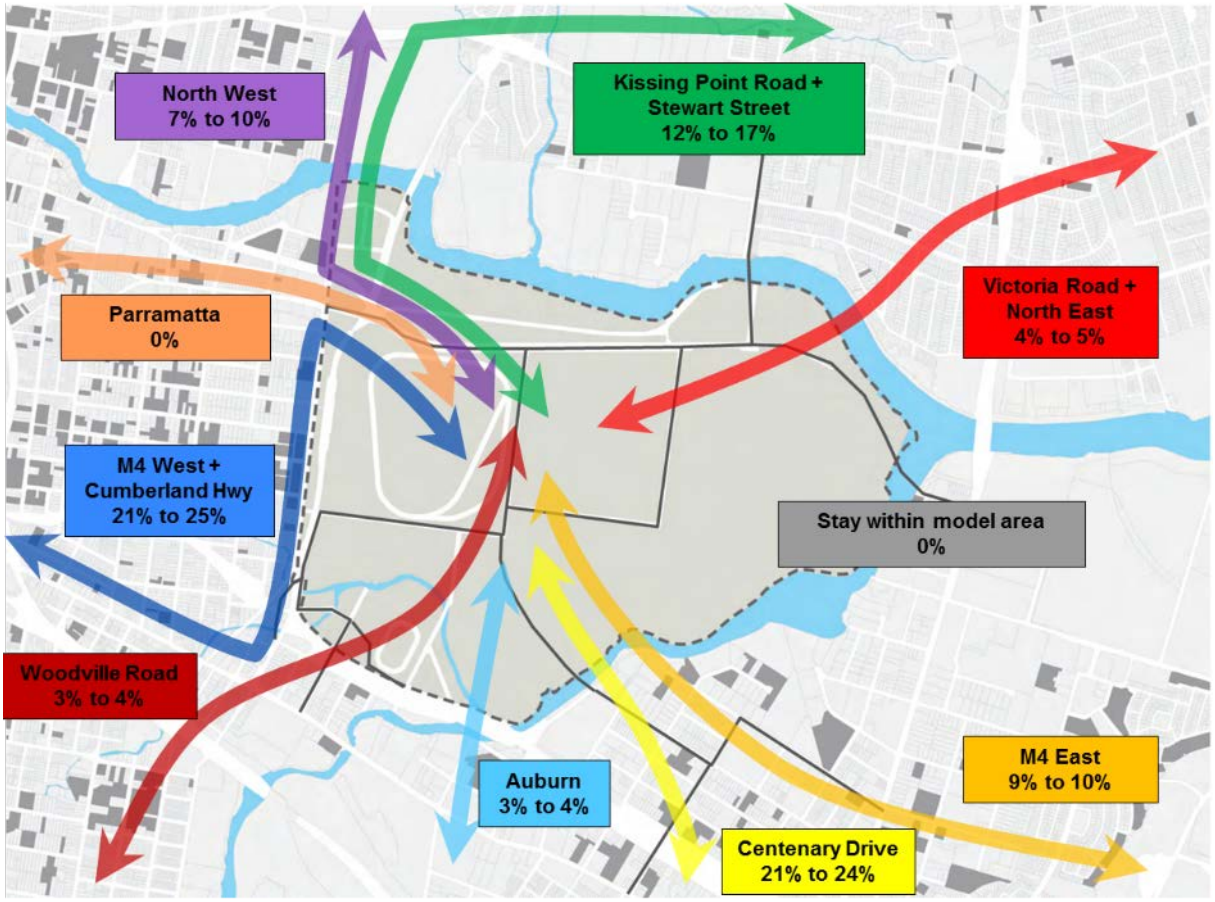


Figure A.10 2011 SSTM heavy vehicle distribution

A4 FUTURE TRANSPORT DEMAND

A4.1 WITHOUT CAMELLIA URBAN RENEWAL

Existing trip generation

Based upon the existing heavy industrial land use of the Camellia precinct, the existing trip generation is estimated to be approximately 275 trips/peak hour.

SSTM Forecast growth rates

The SSTM base models were analysed for the traffic growth over the periods 2011–2021 and 2021–2031.
These growth rates indicate the following:

- there are traffic reductions from 2011 to 2021 on James Ruse Drive and the M4 ramps of approximately 1% p.a.:
  - this traffic reduction is a result of reduced travel demand to/from the sectors adjacent to James Ruse Drive and consequently reduces the volumes of traffic utilising the M4 ramps
- traffic growth on the key corridors for 2011–2021 varies within a range of -1.1% p.a.–6.2% p.a.:
  - the highest growth rates are observed on Holker Street, Parramatta Road and Victoria Road
  - these growth rates are generally greater than 3.0% p.a.
- traffic growth on the key corridors for 2021–2031 is generally more consistent and is approximately 1% p.a.

For the purposes of this study, uniform growth rates have been applied in both directions of travel for each of the key corridors. For the side streets, the overall study area growth rate has been applied to the existing traffic volumes. The growth rates applied to the observed traffic volumes to establish future year scenarios is summarised in Table A.7.

Table A.7 Study traffic growth rates

Road	AM Peak		PM Peak	
	2011–2021	2021–2031	2011–2021	2021–2031
James Ruse Drive	0.5%	0.75%	0.5%	0.75%
Parramatta Road	3.0%	0.75%	4.5%	0.75%
Silverwater Road	1.5%	0.75%	2.0%	0.75%
Victoria Road	2.5%	0.75%	3.5%	0.75%
Hassall Street	1.5%	1.0%	3.0%	1.0%
Holker Street	5.0%	1.0%	5.5%	2.0%
M4 Ramps	0.5%	1.0%	0.5%	1.0%
Overall (side streets)	1.5%	1.5%	1.5%	1.5%

A4.2 WITH CAMELLIA URBAN RENEWAL

Vehicle Trip generation

The development yield summarised in Section 5 has been combined with the person trip rates published in the Roads and Maritime *Guide to Traffic Generating Developments v2.2 (2002)* and the subsequent technical direction *TDT2013/04a (2013)*. The resultant trip generation and mode splits are summarised in the Table A.8.

Table A.8 Estimated peak hour (AM/PM) vehicle trip generation – 1 hour

Land Use	Option 2A/2B (Medium Yield)		Option 3A/3B (High Yield)	
	AM	PM	AM	PM
Residential	2,861	2,863	4,006	4,009
Serviced apartment	39	39	39	39
Retail	1,097	1,097	1,766	1,766
Commercial	706	706	941	941
Industrial	2,249	2,249	3,212	3,212
Total	**6,952**	**6,954**	**9,964**	**9,967**
Existing	*-241*	*-241*	*-241*	*-241*
Net Total	**6,711**	**6,713**	**9,723**	**9,726**

A comparison to the trip numbers generation in SSTM concluded that the SSTM trip generation is approximately 15–20% lower than that expected under the published Roads and Maritime rates. As a result, the development trip generation outputted by the SSTM has been uplifted by approximately 20% for the purposes of intersection modelling.

Vehicle Trip distribution

The trip distribution for the Camellia Precinct under the future base and "with development" scenarios are summarised on Figure 6.3and Figure A.11. For comparison, the trip distributions for wider study area are summarised in Figure 6.4 and Figure A.12.

These graphs indicate that following the development of the Camellia Precinct, there is forecast to be an increase in the proportion of trips (by approximately 20% of overall trips in the AM and PM peak periods) which are contained within the precinct itself. This result is expected because of the proposals for employment generating land uses within the Precinct such as commercial, industrial and retail. There is also a similar scale increase in trips departing from the Precinct.

The change in the number (and proportion) of trips arriving to the Precinct is not forecast to significantly increase. It is considered that this may be a result of the increased number of trips which are contained within the Precinct and therefore offsets against any increase in trips arriving from external travel zones.

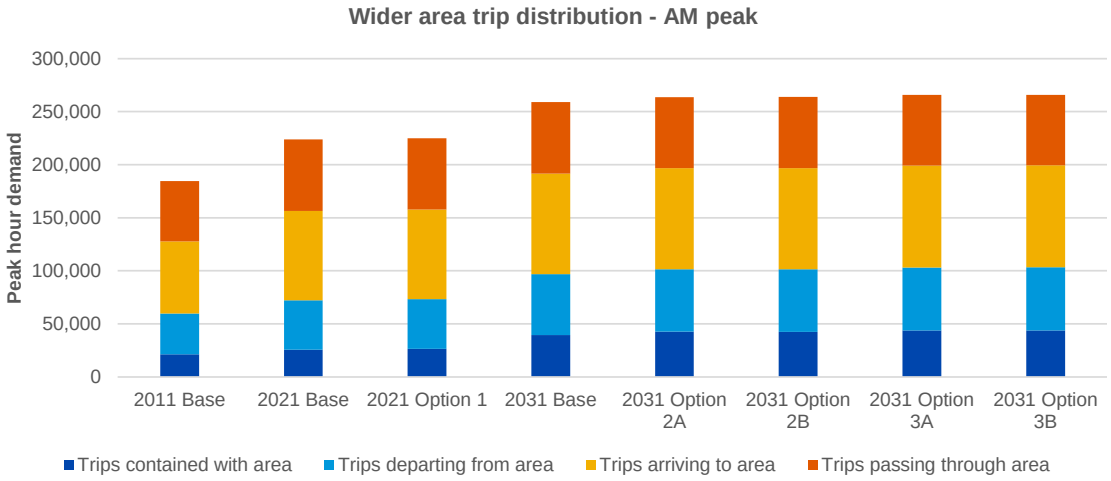


Figure A.11 Wider area trip distribution – AM peak

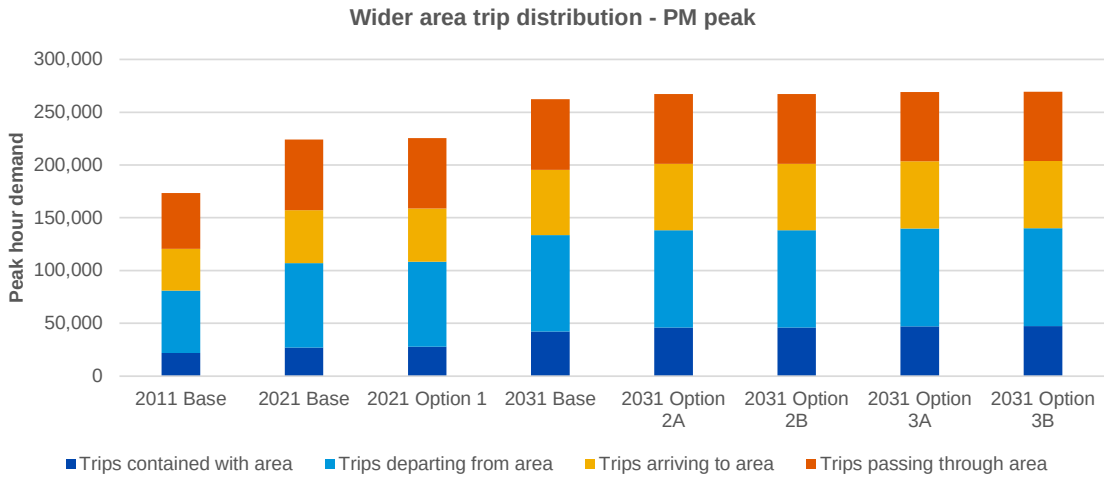


Figure A.12 Wider area trip distribution – PM peak

Vehicle access distribution

The volumes and proportion of traffic utilising each access point (inclusive of rat running) is summarised in Figure A.13 and Figure A.14 (Scenarios 2A and 2B used as examples), while the amount of non-Camellia traffic (i.e. rat-running traffic) is shown in Figure A.15 and Figure A.16.
The analysis has highlighted the following:

- Grand Avenue is the primary access point for trips entering and exiting the Camellia precinct, accommodating more than half of the traffic in 2021 Option 1 and approximately one-third of traffic in the 2031 Options
- the Unwin Street connection and M4 ramp connection primarily diverts development traffic away from the Grand Avenue access point
- the Park Road connection is the second most utilised access point in overall terms, however this access also includes a significant proportion of rat running traffic:
  - the impact of this rat-running is most evident in the Option 3A and 3B proportions, which show a reduction from the lower yield Option 2A and 2B flows
  - this reduction in rat-running traffic may be related to the increase in development traffic utilising the Park Road intersection
- the proportion of traffic utilising the Carnarvon Street connection decreases significantly upon the opening of the Clyde Street connection in 2031. This would imply a redistribution of demand between the two access points on Silverwater Road.

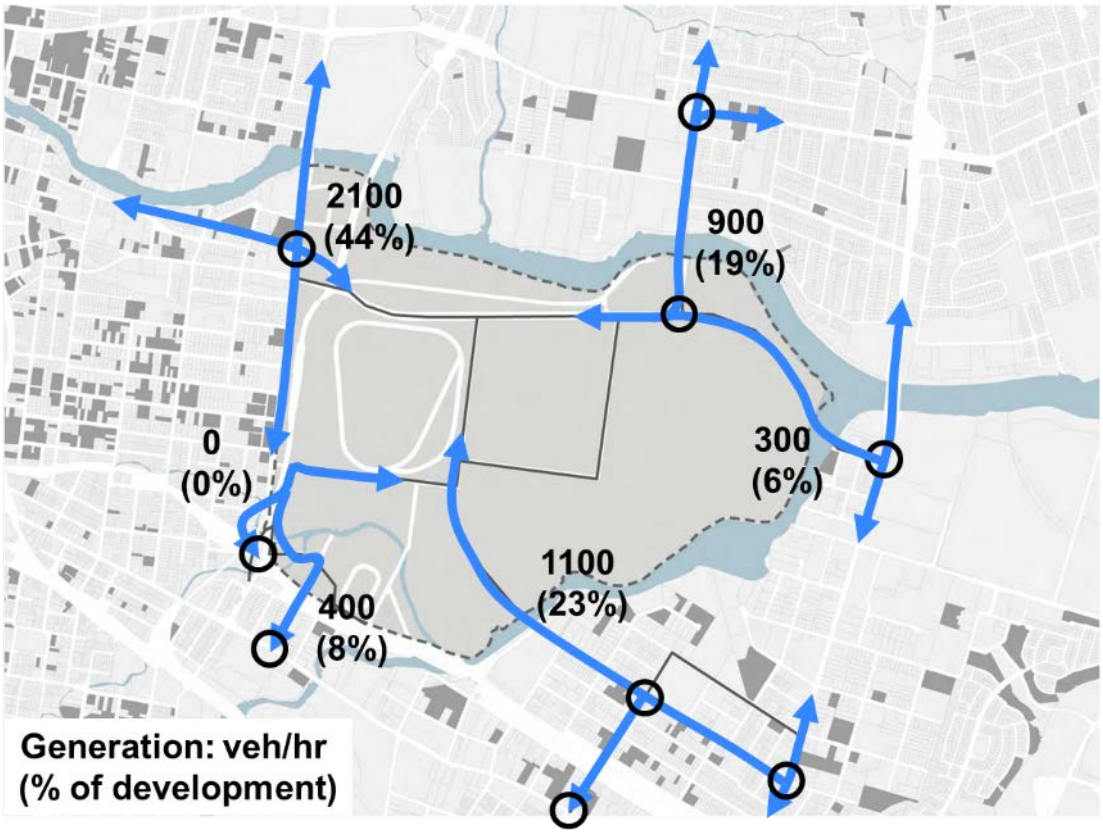


Figure A.13 2031 Option 2A AM access distribution

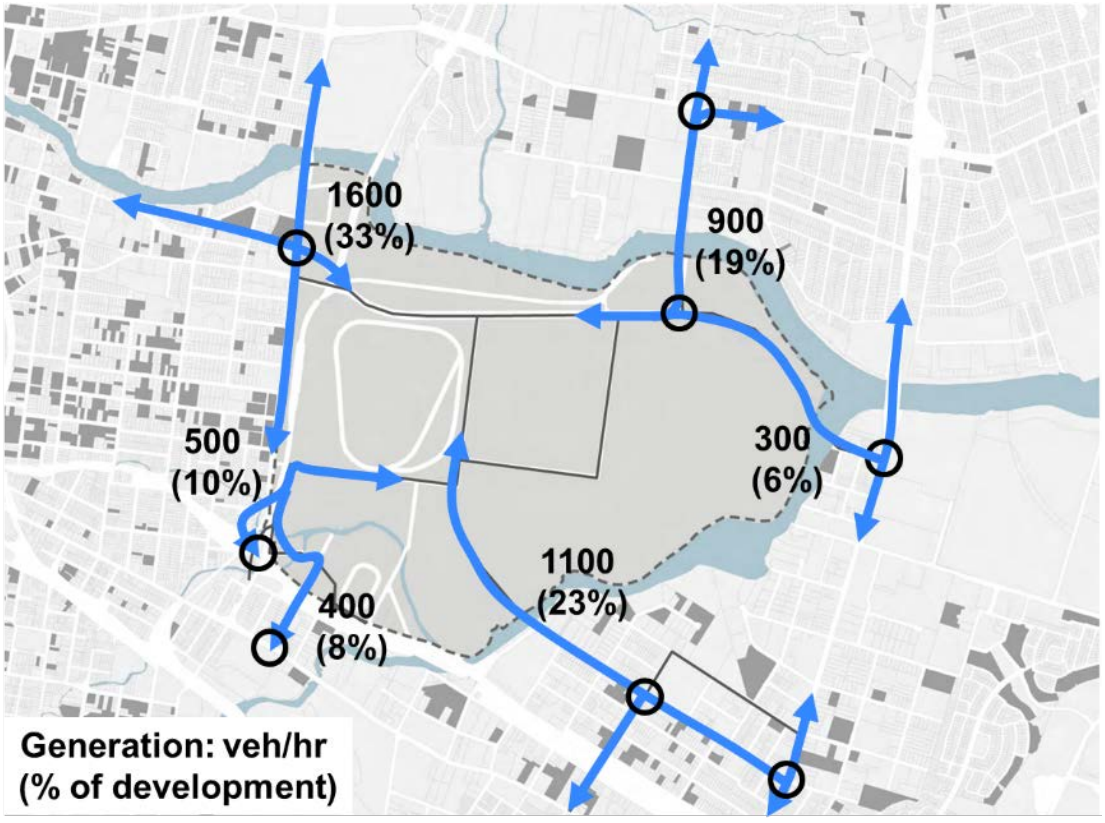


Figure A.14 2031 Option 2B AM access distribution

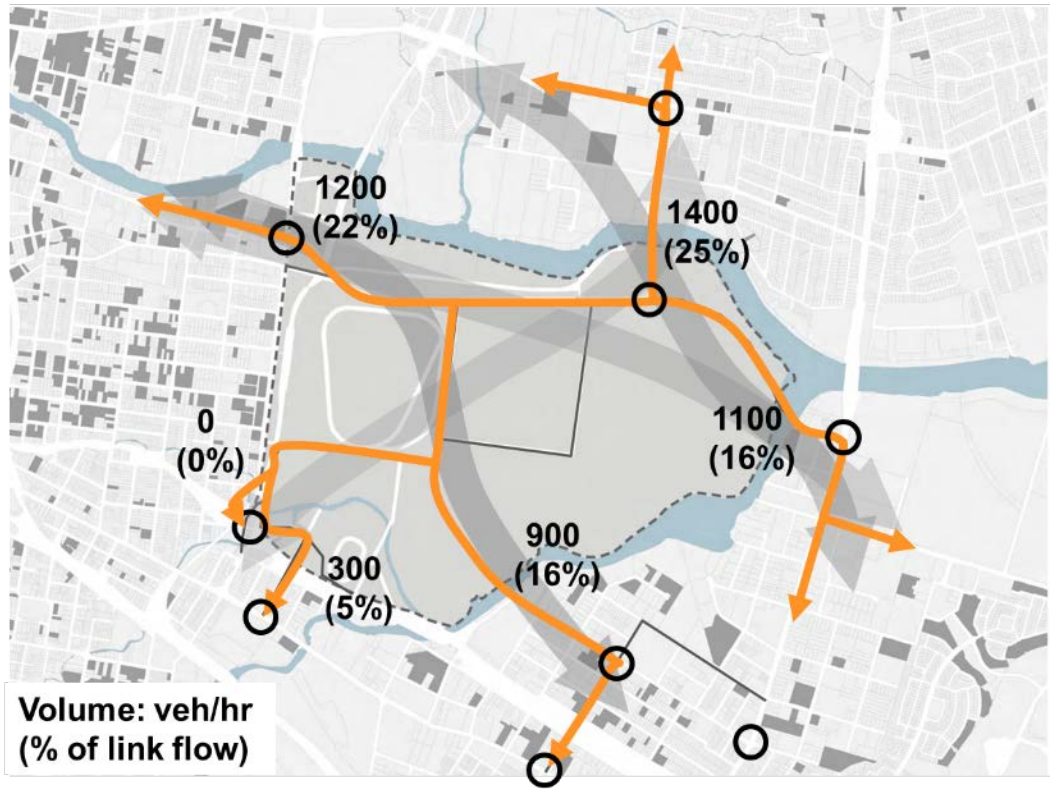


Figure A.15 2031 Option 2A AM rat-running access distribution

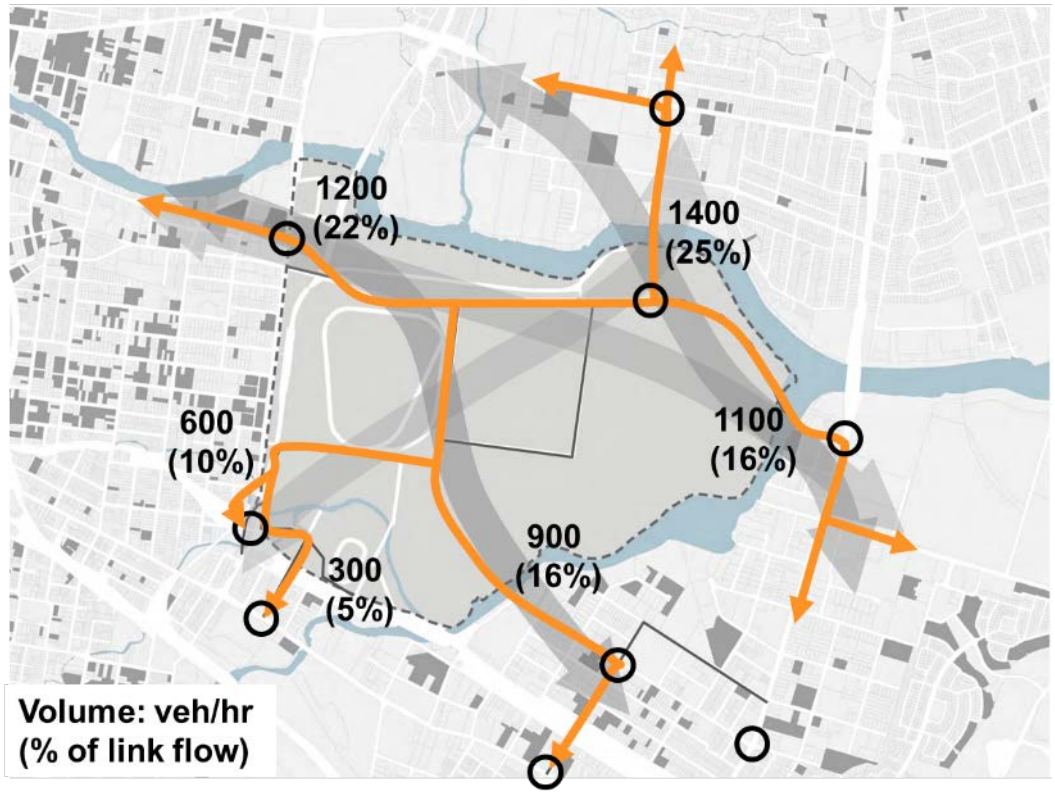


Figure A.16 2031 Option 2B AM rat-running access distribution

Development mode share

The development trip generation was combined with the Journey to Work (JTW) and Household Travel Survey (HTS) datasets to estimate the mode share for the Camellia precinct. This mode share is consistent across the AM and PM peak periods, and across the two development yield options. The estimated mode share for the camellia precinct is summarised on the graph shown in Figure A.17.

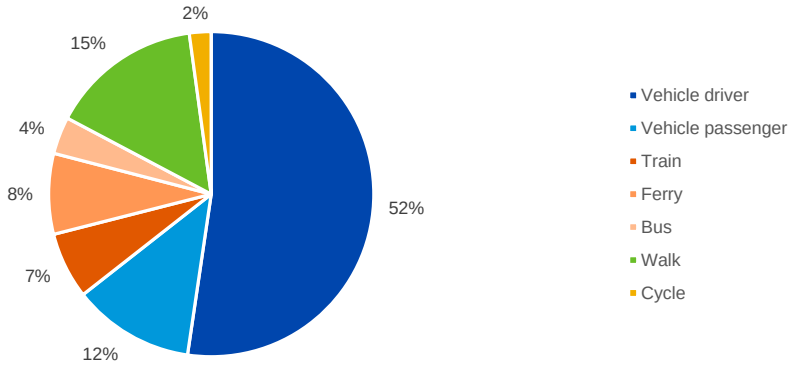


Figure A.17 Camellia development mode share

It is acknowledged that the implementation of the M4 connection in Options 2B/3B may result in induced traffic (which would increase the private vehicle share), however this has not been assessed at this stage of the process.

The mode share for the Camellia precinct has been estimated based upon the SSTM outputs for private vehicles, bus trips and rail trips. For the purposes of analysis, additional assumptions have been made to estimate the impact of car passengers and bicycle/walking. These assumptions are:

- 1.2 passengers/car
- 1% walking/bicycle.

The following trends were observed for the directional mode share for the Camellia precinct in 2011 and 2031:

- under the future base scenario, there is an increase in mode share via public transport in the peak flow direction (outbound in the AM peak and inbound in the PM peak) from 2% to 20%. This is most likely related to the inclusion of public transport infrastructure such as the Parramatta Light Rail project, which is expected to pass through the Camellia precinct
- under the future base scenario, the proportion of trips by private vehicle in the non-peak flow direction (inbound in the AM peak and outbound in the PM peak) are expected to remain similar over time
- under the development scenario in 2031, the mode share of public transport in the peak flow direction increases compared to the future base scenario, from 20% to over 30% in the peak flow direction. It is noted that the overall mode share of public transport for the precinct is approximately 22%
- there is no significant difference in the mode share between the 'A' and 'B' options. The implementation of the M4 ramp connections does not significantly distort the mode share, despite the increase in travel by private vehicle.

Comparing to the JTW/HTS dataset, the SSTM also assumes a significantly lower proportion of public transport trips in the 2011 base scenario (19% vs 4%). However, it is noted that the SSTM includes commercial vehicles which may not be captured as part of the JTW/HTS dataset.

A4.3 RAT-RUNNING

The proposed bridge connections provide the opportunity to pass through the Camellia precinct as part of a rat-running route between the following access points:

- Grand Avenue
- Wentworth Street
- Victoria Road/Park Road (via Parramatta River bridge)
- Silverwater Road/Clyde Street (via Duck River bridge)
- Silverwater Road/Carnarvon Street (via Carnarvon Street bridge)
- Parramatta Road/Stubbs Street (via Carnarvon Street bridge)
- Unwin Street (via new diverge on James Ruse Drive).

Under the existing road network, it is possible to travel internally between Grand Avenue and Wentworth Street (via Colquhoun Street).

The propensity for rat-running is observed in the outputs of the select link plots from the SSTM outputs. In particular, the combination of the Parramatta River and Duck River bridges appears to encourage rat-running through the development. This causes the diversion of traffic away from Victoria Road and Silverwater Road. In addition, the amount of rat-running traffic through the adjacent intersections would require significant increases in the scale of the intersection footprints.

The extent of the rat-running at each access point is summarised in Table A.9.

Table A.9 Proportion of rat-running trips at each access point (AM peak)

Access	2021 Base	2021 OP1	2031 Base	2031 OP2A	2031 OP2B	2031 OP3A	2031 OP3B
Grand Avenue	4%	46%	17%	34%	34%	22%	22%
Wentworth Street	9%	14%	27%	24%	9%	13%	1%
Carnarvon Street	n/a	74%	n/a	49%	60%	36%	44%
Clyde Street		n/a		81%	79%	69%	53%
Park Road				66%	68%	54%	56%
Unwin Street				n/a	45%	n/a	31%

This data highlights the following:

- most trips via the Clyde Street and Park Road accesses are rat-running trips
- there is a significant proportion of trips which utilise the Carnarvon Street connection as part of a rat-running route (typically via Grand Avenue)
- as the development scale increases in Option 3, and therefore the trips generated within the Camellia precinct increase, there is a decrease in rat-running through the precinct.

A4.4 EXTERNAL TRIPS AVOIDING CAMELLIA

Due to the high volume of traffic generated by the development of the Camellia precinct (see Table A.8), there is a subsequent decrease in the background traffic on the road network surrounding the Camellia site. The nature of this background traffic reduction is approximately:

- 5–10% in 2021
- 10–20% in 2031.

This reduction in the background traffic is a result of the high level of demand entering and exiting the precinct (including rat-running trips), which in-turn causes increased congestion at the access intersections. This congestion results in external traffic re-routing away from the precinct to avoid the additional congestion in the area.

APPENDIX B

LEVEL OF SERVICE CRITERIA

B1 INTERSECTION PERFORMANCE CRITERIA

LEVEL OF SERVICE (LoS)

Level of Service (Los) is a basic performance parameter used to describe the operation of an intersection. Levels of service range from A (indicating good intersection operation) to F (indicating over-saturated conditions with long delays and queues). At signalised intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled (give-way and stop controlled) and roundabout intersections, the LoS is based on the modelled delay (seconds per vehicle) for the most delayed movement.

Table B.1 Level of Service criteria for intersections

Level of Service	Average Delay (Seconds Per Vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents would cause excessive delays. Roundabouts require other control mode.	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: Roads and Maritime Services Guide to Traffic Generating Developments, 2002

DEGREE OF SATURATION (DoS)

The Degree of Saturation (DoS) is the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For a satisfactory situation, DoS should be less than the nominated practical degree of saturation, usually 0.9. The intersection DoS is based on the movement with the highest value.

AVERAGE VEHICLE DELAY

This is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. At signalised intersections and roundabouts, the average intersection delay is usually reported. At priority-controlled intersections, the average delay for the most delayed movement is usually reported.

QUEUE LENGTH

Queue length is measured in metres reflecting the number of vehicles waiting at the stop line and is usually quoted as the 95th percentile back of queue, which is the value below which 95% of all observed queue lengths fall. It reflects the number of vehicles per traffic lane at the start of the green period, when traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

APPENDIX C

SCENARIOS ASSESSED

C1 FUTURE TRAFFIC VOLUMES

Network traffic volume estimates (peak hour flows in PCU) are provided for the following scenarios:

1 2015 – BC is the Existing Situation

2 2021 – BC is the future demand without the Camellia development

3 2021 – OP1 is the 2021-year future demand with Scenario 1 development volume

4 2031 – BC is the future demand without the Camellia development

5 2031 – OP2A is the 2031-year future medium growth scenario demand with development volumes without new M4 ramps

6 2031 – OP2B is the 2031-year future medium growth scenario demand with development volumes with new M4 ramps

7 2031 – OP3A is the 2031-year future high growth scenario demand with development volumes without new M4 ramps

8 2031 – OP3B is the 2031-year future high growth scenario demand with development volumes with new M4 ramps

9 2031 – OP2B No Clyde is the 2031-year future medium growth scenario demand with development volumes with new M4 ramps, with the Parramatta River Bridge and the Carnarvon Street Bridge but without the Clyde Street Bridge to Silverwater Road

10 2031 – OP2B is the 2031-year future medium growth scenario demand with development volumes with new M4 ramps, with the Parramatta River Bridge and the Clyde Street Bridge but without the Carnarvon Street Bridge to Silverwater Road.

Note: Top left corner shows scenario being displayed, with year (2015, 2021 or 2031), AM or PM and Base Case (BC) or development yield scenario.

APPENDIX D

SIDRA INTERSECTION SUMMARY

D1 SIDRA INTERSECTION MODEL SUMMARY

D1.1 I-01 JAMES RUSE DRIVE AND HASSEL STREET

Without Rezoning

Table D.1 summarises the existing intersection performance in forecast years without the Camellia Rezoning. As previously identified, the intersection already operates at Level of Service F and with a degree of saturation greater than 1. Intersection upgrades are necessary to maintain flows along James Ruse Drive.

Table D.1 I-01 – Intersection of James Ruse Drive and Hassall Street (existing layout performance)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	150	**1.4**	290	**F**	1620	South-T
	PM	150	**1.2**	140	**F**	990	South-T
2031-BC	AM	150	**1.5**	440	**F**	1920	South-T
	PM	150	**1.3**	180	**F**	1140	South-T

One possible, but impractical solution is to provide additional lanes on critical approaches. The performance of the upgraded intersection as shown in Figure D.1 is highlighted in Table D.2.

Table D.2 I-01 – Intersection of James Ruse Drive and Hassall Street (at-grade upgrade)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – V3B	AM	150	0.8	40	C	300	South-T
	PM	140	**1.0**	60	**E**	375	South-T
2031-BC – V3B	AM	150	0.9	50	D	470	North-T
	PM	140	**1.1**	100	**F**	550	South-T

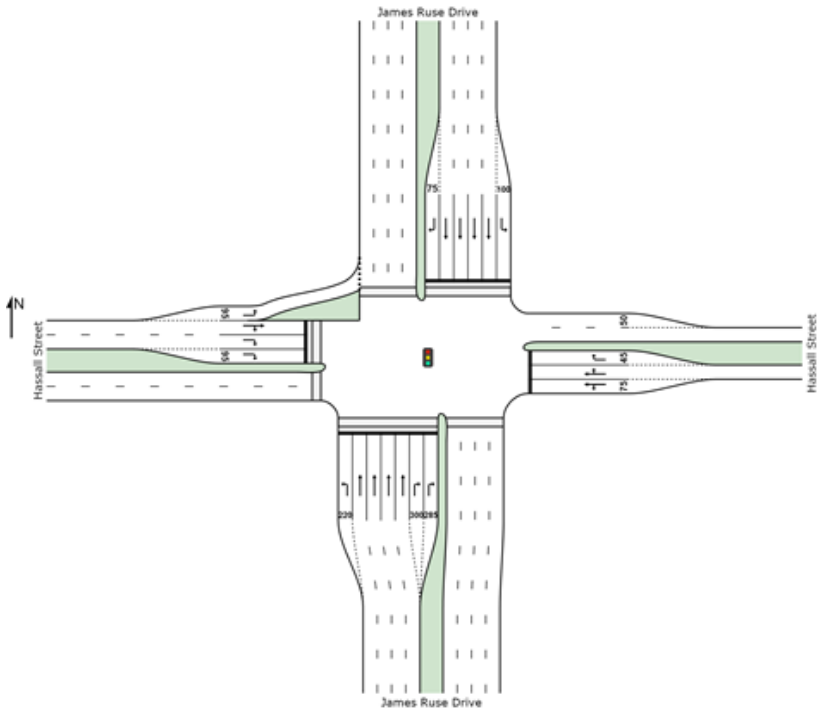


Figure D.1 At-grade upgrades of James Ruse Drive/Hassall Street intersection – V3B

An alternative solution is to grade separate the James Ruse Drive through movement, with the resulting intersection shown in Figure D.2. James Ruse Drive acts as a Parramatta CBD bypass. It is assumed that four lanes are grade separated and this grade separation would continue over the proposed Parramatta Light Rail to the Parramatta River. The layout matches the proposed overpass design and the results of the remaining at-grade intersection (interchange) are provided in Table D.3. The results show an improved outcome to both previous scenarios reported in Table D.1 and Table D.2.

Table D.3 I-01 – Intersection of James Ruse Drive and Hassall Street (grade separation upgrade)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – GS1	AM	100	0.8	36	C	160	South-T/L
	PM	80	0.7	31	C	95	West-R
2031-BC – GS1	AM	110	0.9	40	C	190	South-T/L
	PM	70	0.7	26	B	90	East-T/L

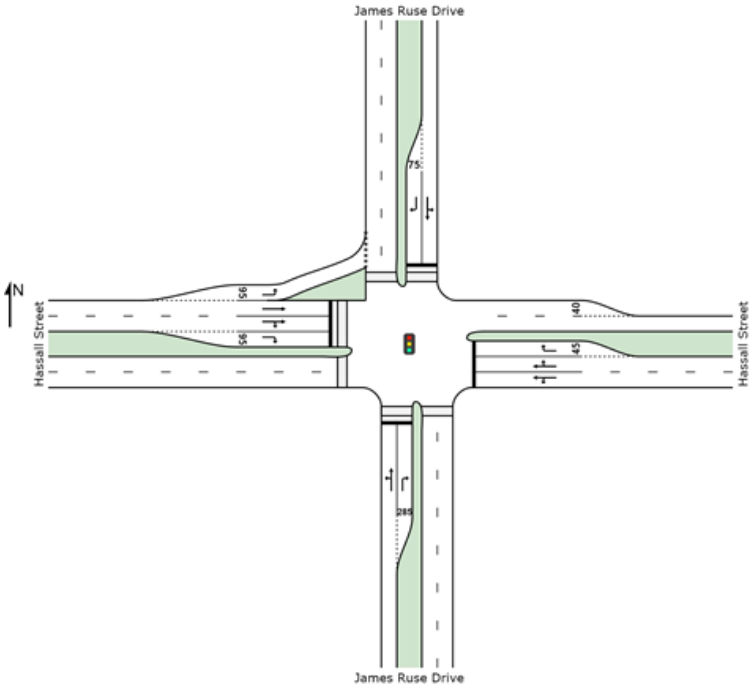


Figure D.2 Grade separation of James Ruse Drive/Hassall Street intersection layout – GS1

Key conclusions drawn from the analysis of the James Ruse Drive and Hassall Street intersection without the Camellia Rezoning are:

- The current at-grade intersection represents a primary point of capacity constrain on the network. Upgrades are necessary to accommodate future traffic volumes, which when considering the function of the road and proposed Parramatta Light Rail, the grade separation solution provides greater benefits to the network.
- The concept sketch of a grade separation design, identified by Roads and Maritime, provides sufficient capacity for background traffic volumes beyond 2031.

With Camellia Rezoning

Should the development of the grade separation solution be delayed, the assessment of the intersection was conducted for 2021 with development demands. Table D.4 outlines the results from this analysis and highlights that the intersection remains above capacity. Comparing results from Table D.4 and Table D.1 shows that there are marginal additional impacts because of the development at Camellia.

Table D.4 I-01 – Intersection of James Ruse Drive and Hassall Street (at-grade with development)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	150	**1.5**	440	**F**	1920	South-T
	PM	150	**1.3**	180	**F**	1140	South-T

Several grade separation solutions were assessed for the 2021 with the Camellia Rezoning. Table D.5 summarises the results of the Roads and Maritime concept for a grade separated upgrade as well as the additional upgrades (GS2) required to facilitate the development. Figure D.3 identifies the additional infrastructure necessary to allow the intersection to perform under capacity during the peak commuter periods.

Table D.5 I-01 – Intersection of James Ruse Drive and Hassall Street (2021 with development)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 GS1	AM	150	**1.5**	300	**F**	700	East-R
	PM	150	**1.1**	135	**F**	400	West-T/L
2021-OP1 GS2	AM	130	0.9	51	D	220	East-R
	PM	80	0.8	33	C	100	West-T

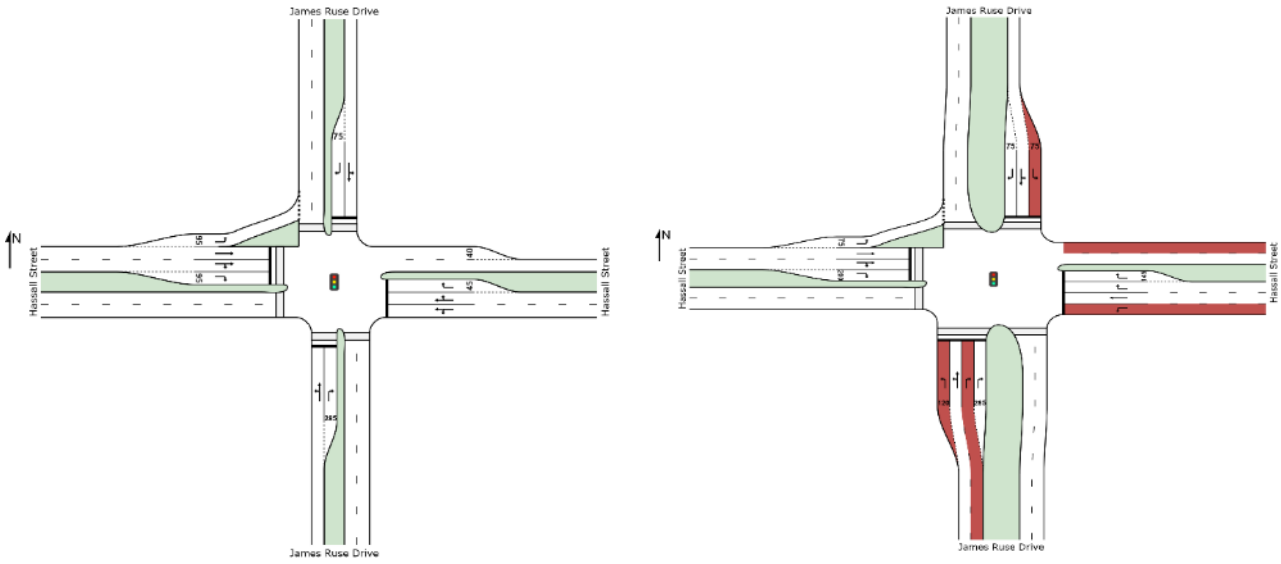


Figure D.3 2021 requirements for James Ruse Drive and Hassall Street intersection – GS1, GS2

For the four 2031 scenarios, Table D.6 outlines the performance of the intersection based on intersection upgrades necessary to achieve a Degree of Saturation of 1.0 or overall Level of Service E or better. Figure D.4 shows the two intersection geometries assumed to be necessary to achieve this level of performance.

Table D.6 I-01 – Intersection of James Ruse Drive and Hassall Street (2031 with development)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2A GS4	AM	150	0.9	57	E	300	East-R
	PM	150	0.9	57	E	240	West-R
2031-OP2B GS4	AM	150	0.9	50	D	275	North-T
	PM	150	0.9	51	D	220	West-R
2031-OP3A GS3	AM	150	**1.0**	69	**E**	415	East-R
	PM	150	0.9	56	D	215	East-T/L
2031-OP3B GS3	AM	150	**1.0**	70	**E**	420	East-R
	PM	150	0.9	52	D	215	West-R

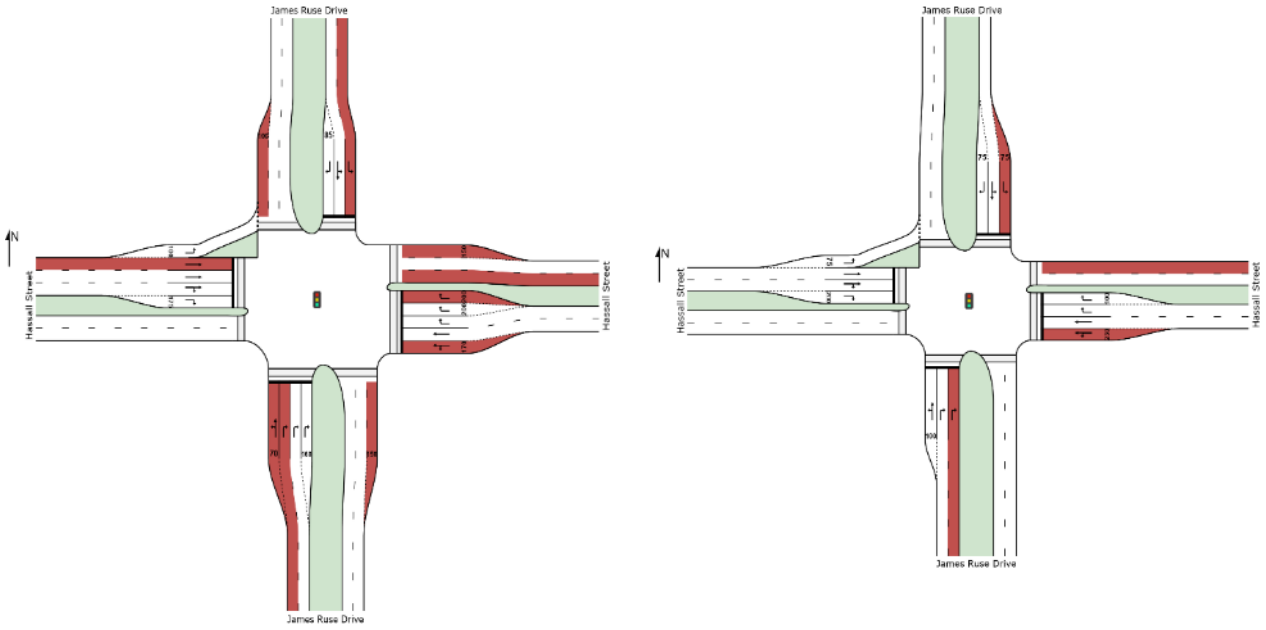


Figure D.4 2031 requirements for James Ruse Drive and Hassall Street intersection – GS3, GS4

Key conclusions drawn from the analysis of the James Ruse Drive and Hassall Street intersection with the Camellia Rezoning are:

- The proposed Roads and Maritime grade separation solution would operate at Level of Service F in 2021 with the Camellia Rezoning. Minor upgrades to the intersection including building short lanes, removing north and south through lanes, phasing and painting would be required to cater for the proposed developments by this timeframe.
- By 2031 however with additional land developments, it is likely that further upgrades would be necessary including adding extra short and full-length lanes, reallocating existing lanes, phasing upgrades and median upgrades would be required to cater for the proposed developments by this timeframe.
- The M4 ramps removes 700 to 800 vehicles per hour during the peaks from the James Ruse Drive and Hassall Street intersection with the reduction applied for movements between the South and East. However, for scenarios 2A, 3A and 3B, there will be little change in the required infrastructure to deal with the 11,500 vehicles per hour that this intersection must manage. Scenario 2B would require fewer upgrades.

D1.2 I-02 JAMES RUSE DRIVE AND PROSPECT STREET

Without Rezoning

Table D.7 summaries the existing intersection performance in forecast years without the Camellia Rezoning. This intersection can function with the future traffic volumes on the existing layout. As shown by Figure D.5, no upgrades are required and the intersection performs well at Levels of Service C and B in the medium growth, base condition.

Table D.7 I-02 – James Ruse Drive and Prospect Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	140	0.9	33	C	590	South-T/L
	PM	120	0.9	25	B	405	North-T/L
2031-BC	AM	140	**1.0**	67	**E**	890	South-T/L
	PM	140	0.9	24	B	465	North-T/L

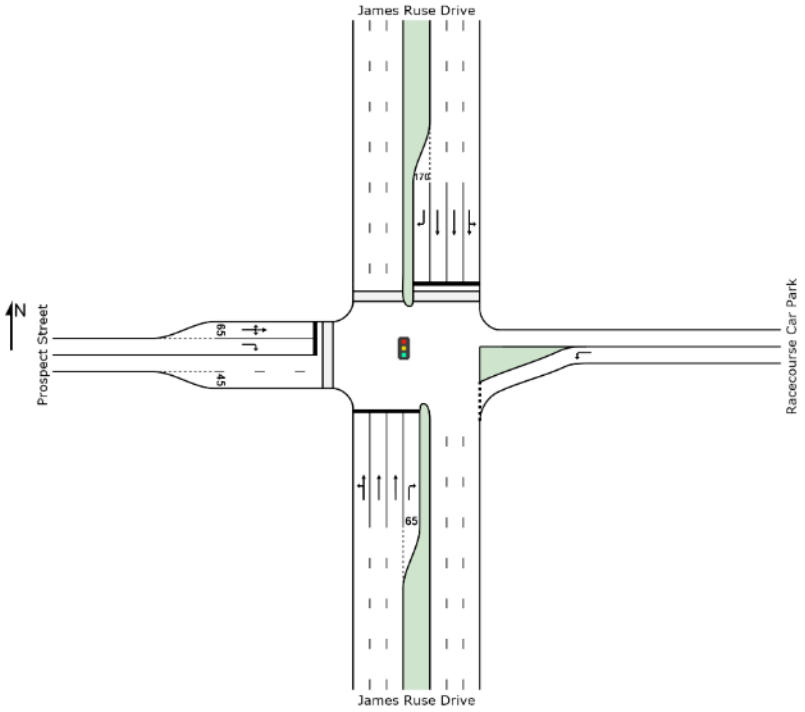


Figure D.5 At-grade intersection of James Ruse Drive/Prospect Street – upgrades not required

With Camellia Rezoning

As indicated by the below results in Table D.8, as the future volumes increase from 2021 to medium 2031 and high 2031, the intersection begins to fail. The existing layout must therefore be upgraded to handle the future development volumes.

Table D.8 I-02 – James Ruse Drive and Prospect Street: with Camellia Rezoning

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	0.9	23	B	470	South-T
	PM	100	0.9	27	B	345	North-T/L
2031-OP2A	AM	140	**1.0**	84	**F**	1000	South-T
	PM	140	0.9	25	B	480	South-T
2031-OP2B	AM	140	**1.0**	42	**C**	655	South-T
	PM	130	**0.9**	23	**B**	415	North-T
2031-OP3A	AM	140	**1.1**	109	**F**	1200	South-T
	PM	140	0.9	28	B	555	South-T
2031-OP3B	AM	140	**1.0**	43	**D**	680	South-T
	PM	120	0.9	25	B	400	North-T

The upgrades illustrated in Figure D.6 are required to produce the results in Table D.9. These results are better than the existing layout with Level of Service B for most scenarios.

Table D.9 I-02 – James Ruse Drive and Prospect Street: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V1	AM	140	0.8	17	B	370	South-T
	PM	140	0.7	16	B	250	North-T
2031-OP2A – V1	AM	140	**1.0**	32	C	690	South-T
	PM	140	0.8	18	B	370	South-T
2031-OP2B – V1	AM	140	0.9	18	B	435	South-T
	PM	140	0.8	17	B	335	North-T
2031-OP3A – V1	AM	140	**1.0**	48	D	910	South-T
	PM	140	0.8	18	B	400	South-T
2031-OP3B – V1	AM	140	0.9	19	B	445	South-T
	PM	140	0.8	17	B	310	North-T

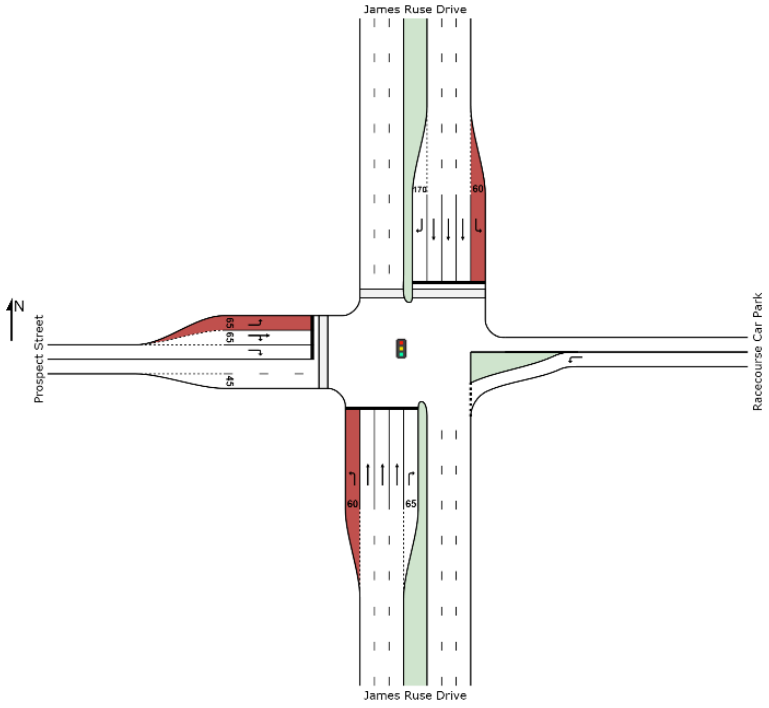


Figure D.6 At-grade upgrades of James Ruse Drive/Prospect Street intersection – V1

D1.3 I-03A JAMES RUSE DRIVE AND M4 RAMPS

Without Rezoning

As shown below by Figure D.7 and Table D.10, this intersection will handle the future base volumes without development. No upgrades are required.

Table D.10 I-03A James Ruse Drive and M4 Ramps: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	40	0.8	8	A	100	North-T
	PM	30	0.7	7	A	50	North-L
2031-BC	AM	40	0.8	10	A	120	North-T
	PM	30	0.8	8	A	60	North-L

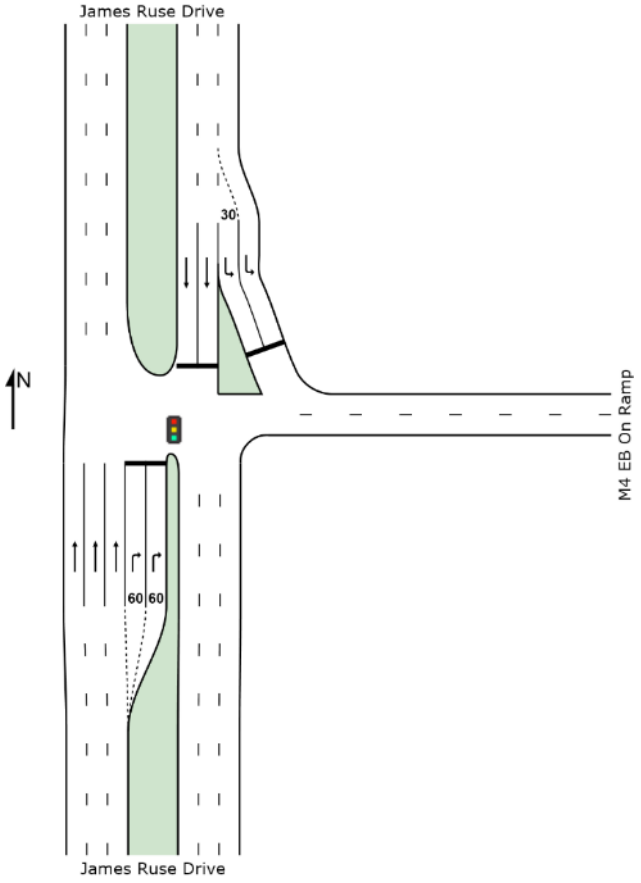


Figure D.7 At-grade intersection of James Ruse Drive/M4 Ramps – upgrades not required

With Camellia Rezoning

This intersection does not require upgrades as illustrated by Figure D.8 and Table D.11 where the Levels of Service across all scenarios are A. This indicates the intersections performs well with the development volumes.

Table D.11 I-03A James Ruse Drive and M4 Ramps: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	30	0.9	9	A	95	North-T
	PM	30	0.7	7	A	50	North-L
2031-OP2A	AM	40	0.8	8	A	110	North-T
	PM	30	0.7	7	A	55	North-L
2031-OP2B	AM	40	0.8	8	A	110	North-T
	PM	30	0.7	7	A	50	North-T
2031-OP3A	AM	40	0.8	8	A	120	North-T
	PM	30	0.7	6	A	50	North-T
2031-OP3B	AM	40	0.8	8	A	110	North-T
	PM	30	0.7	7	A	50	North-T

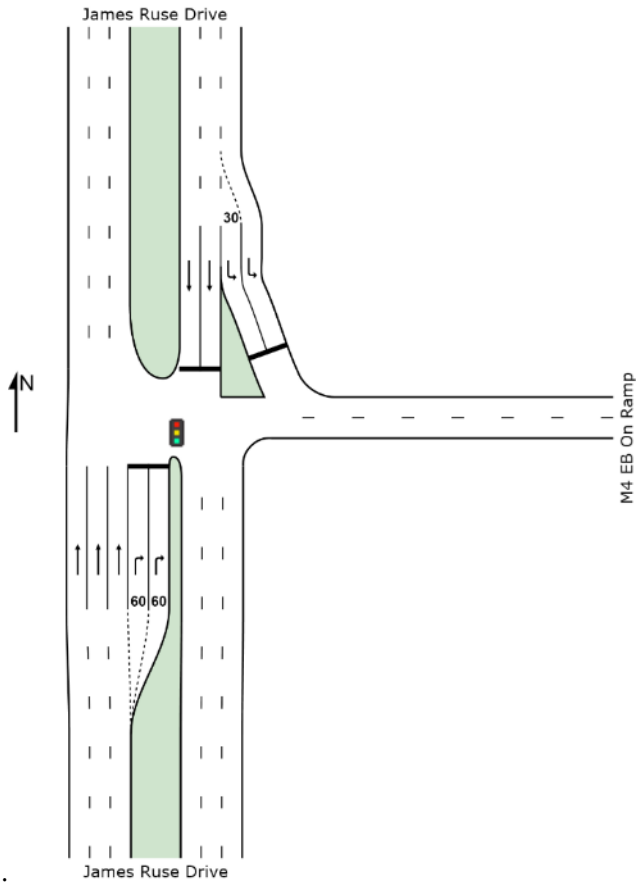


Figure D.8 At-grade intersection of James Ruse Drive/M4 Ramps – upgrades not required

D1.4 I-03B JAMES RUSE DRIVE AND M4 RAMPS

Without Rezoning

As shown below by Figure D.9 and Table D.12, this intersection will handle the future base volumes without development. No upgrades are required.

Table D.12 I-03B James Ruse Drive and M4 Ramps: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	40	0.9	23	B	105	South-T
	PM	30	0.8	15	B	70	South-T
2031-BC	AM	50	0.9	25	B	140	East-R
	PM	30	0.9	18	B	95	South-T

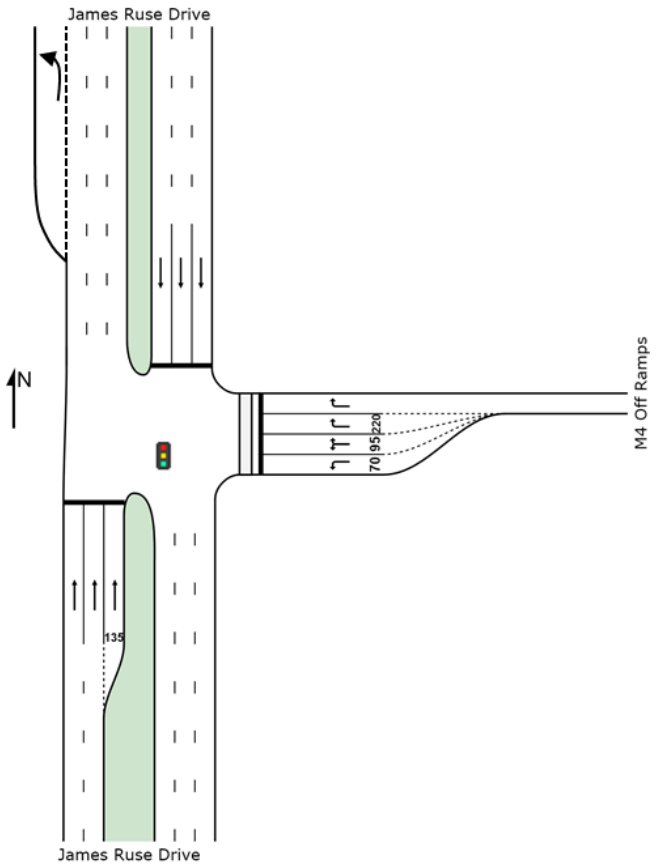


Figure D.9 At-grade intersection of James Ruse Drive/M4 Ramps – upgrade not required

With Camellia Rezoning

The introduction of the development and future M4 ramps will create higher traffic demand through this intersection. The existing layout will manage in the most part although with the introduction of the future M4 ramps upgrades will be required for 2031-OP2B and OP3B scenarios. Otherwise the intersection performs well in either Level of Service A or B at all times, as shown in Table D.13.

Table D.13 I-03B James Ruse Drive and M4 Ramps: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	40	0.8	13	A	55	South-T
	PM	30	0.9	20	B	90	South-T
2031-OP2A	AM	60	0.9	25	B	155	East-R
	PM	40	0.8	16	B	110	South-T
2031-OP2B	AM	150	**1.0**	105	**F**	830	South-T
	PM	40	0.8	16	B	104	South-T
2031-OP3A	AM	70	0.9	28	B	205	South-T
	PM	40	0.8	16	B	125	South-T
2031-OP3B	AM	150	**1.0**	105	**F**	825	South-T
	PM	40	0.8	15	B	100	South-T

The addition of M4 ramps will require upgrades as there will be an exit to the west of this intersection. Results for the upgraded scenario are shown in Table D.14 and Figure D.10.

Table D.14 I-03B James Ruse Drive and M4 Ramps: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – V1	AM	150	0.9	53	D	490	South-T
	PM	40	0.8	16	B	105	South-T
2031-OP3B – V1	AM	150	0.9	53	D	490	South-T
	PM	40	0.8	15	B	100	South-T

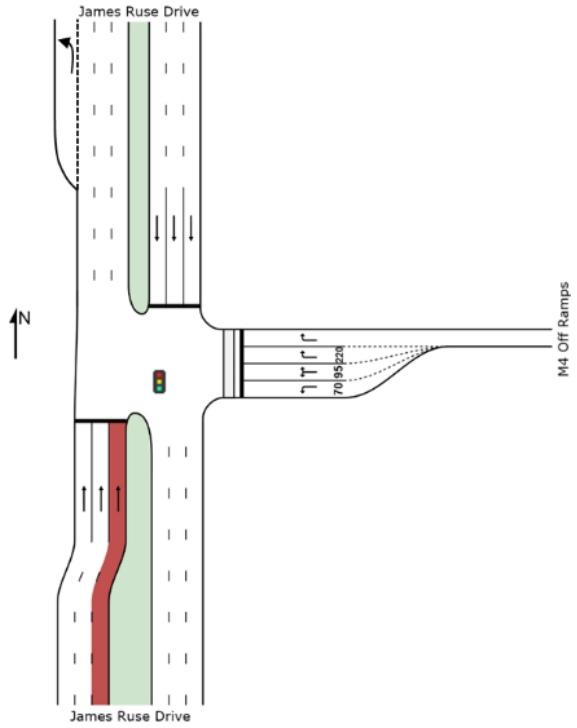


Figure D.10 At-grade upgrades of James Ruse Drive/M4 Ramps intersection – V1

D1.5 I-04 JAMES RUSE DRIVE AND PARRAMATTA ROAD

Without Rezoning

The existing layout will perform poorly when the future traffic volumes are applied, even without the development, as shown in Table D.15. Upgrades are required.

Table D.15 I-04 James Ruse Drive and Parramatta Road: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	140	**1.1**	81	**F**	775	West-T
	PM	140	**1.1**	68	**E**	615	West-T
2031-BC	AM	140	**1.2**	114	**F**	1000	West-T
	PM	140	**1.2**	127	**F**	790	West-T

The upgrades shown in Figure D.11 result in acceptable Levels of Service C and D for the future base scenario. The results of the upgraded intersection scenario are shown in Table D.16. The required upgrades are due to the high demand on Parramatta Road and are independent of the development – traffic volumes generated by the development will not affect this intersection significantly.

Table D.16 I-04 James Ruse Drive and Parramatta Road: without Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – V1	AM	120	0.9	34	C	255	West-T
	PM	130	0.9	40	C	450	East-T
2031-BC – V1	AM	140	0.9	41	C	315	West-T
	PM	140	0.9	47	D	300	West-T

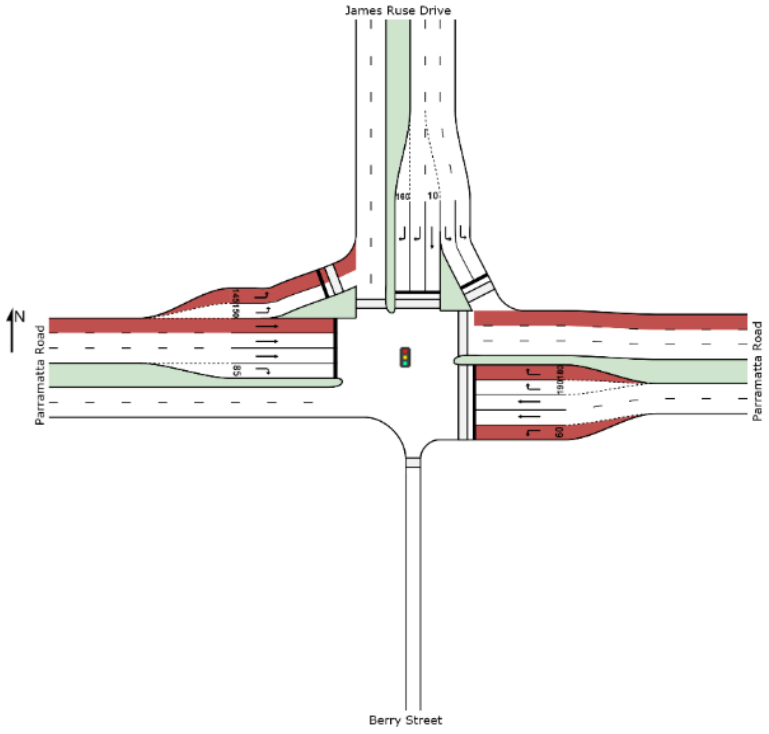


Figure D.11 At-grade upgrades required for James Ruse Drive/Parramatta Road intersection – V1

With Camellia Rezoning

Future development volumes applied to the existing layout will cause the intersection to perform poorly, as shown by the results in Table D.17. Upgrades required to ensure acceptable operating levels for this intersection are the same as the base case without development volumes. This is illustrated in Table D.18 and by Figure D.12.

Table D.17 I-04 James Ruse Drive and Parramatta Road: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	**1.0**	65	**E**	670	West-T
	PM	140	**1.0**	56	**D**	540	West-T

Table D.18 I-04 James Ruse Drive and Parramatta Road: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V1	AM	110	0.9	32	C	230	West-T
	PM	120	0.9	38	C	435	East-T
2031-OP2A – V1	AM	140	0.9	42	C	385	West-T
	PM	140	**1.0**	56	D	630	East-T
2031-OP2B – V1	AM	140	0.9	41	C	305	West-T
	PM	140	**1.0**	55	D	595	East-T
2031-OP3A – V1	AM	140	0.9	41	C	365	West-T
	PM	130	0.9	40	C	335	East-T
2031-OP3B – V1	AM	140	0.9	40	C	295	West-T
	PM	120	0.9	40	C	415	East-T

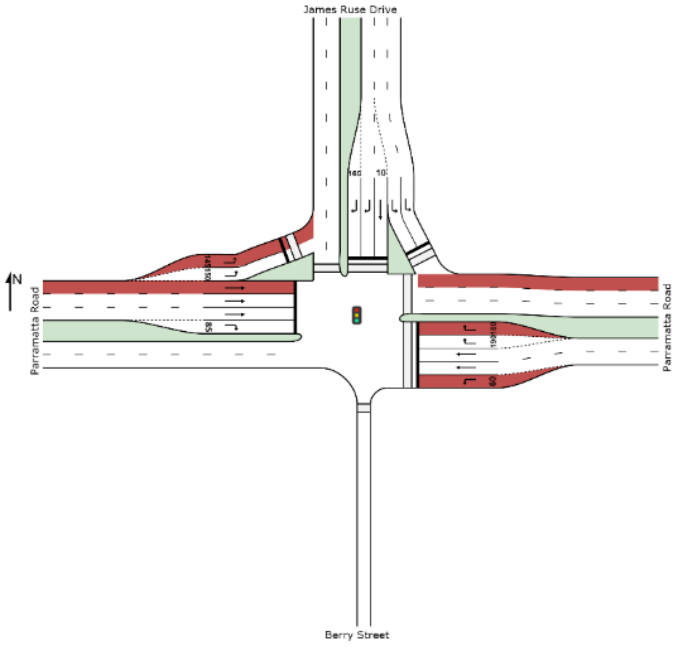


Figure D.12 At-grade upgrades required for James Ruse Drive/Parramatta Road intersection – V1

D1.6 I-05 PARRAMATTA ROAD AND WENTWORTH STREET

Without Rezoning

The future growth volumes applied to the existing layout will cause the intersection to perform poorly, as shown in Table D.19.

Table D.19 I-05 Parramatta Road and Wentworth Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	140	**1.0**	64	**E**	1135	West-T
	PM	140	**1.0**	42	**E**	870	East-T
2031-BC	AM	140	**1.1**	107	**F**	1510	West-T
	PM	140	**1.1**	102	**F**	1330	West-T

Upgrades required include extra lanes along Parramatta Road to cope with the extra demand. This can be seen in Figure D.13 producing results in Table D.20. as with the intersection of James Ruse Drive and Parramatta Road, the traffic demand along Parramatta Road is the cause of the required upgrades.

Table D.20 I-05 Parramatta Road and Wentworth Street: without Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – V1	AM	70	0.9	19	B	265	West-T
	PM	140	**1.0**	37	C	870	East-T
2031-BC – V2	AM	70	0.9	18	B	265	West-T
	PM	60	0.9	16	B	180	West-T

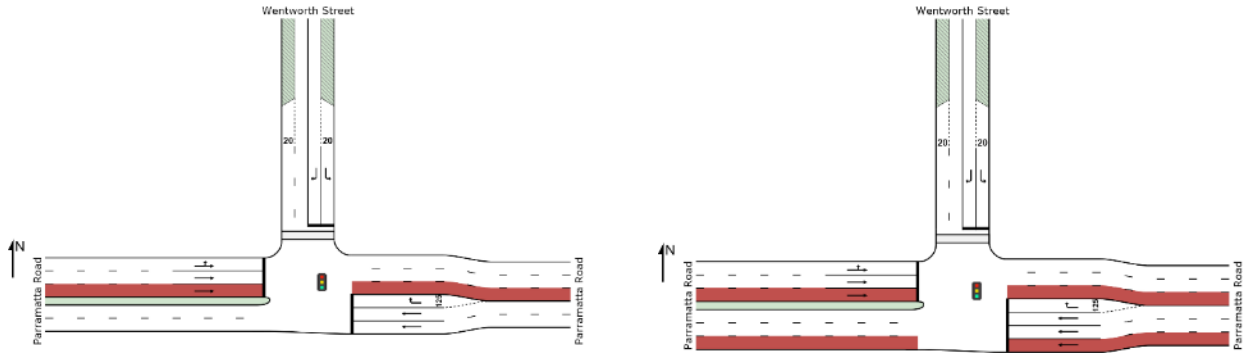


Figure D.13 At-grade upgrades required for Parramatta Road/Wentworth Street intersection – V1, V2

With Camellia Rezoning

2021 development volumes applied to the existing layout of the intersection would result in Levels of Service F in both the AM and PM peaks, as shown in Table D.21.

Table D.21 I-05 Parramatta Road and Wentworth Street: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	**1.1**	96	**F**	1,250	West-T
	PM	140	**1.0**	95	**F**	1,035	East-T

Upgrades are required for 2021 and 2031 for both medium and high growth scenarios. These are indicated in Figure D.14 and Table D.22. They are, as with the previous intersection, due to demand on Parramatta Road with the added north approach lane due to some residual traffic generated by the development.

Table D.22 I-05 Parramatta Road and Wentworth Street: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V2	AM	140	**1.0**	37	C	850	West-T
	PM	120	0.9	22	B	420	West-T
2031-OP2A – V3	AM	140	0.9	35	C	560	West-T
	PM	140	**1.0**	48	D	600	West-T
2031-OP2B – V3	AM	90	0.9	24	B	325	West-T
	PM	140	0.9	27	B	365	West-T
2031-OP3A – V3	AM	140	**1.0**	57	**E**	700	West-T
	PM	140	**1.0**	50	D	505	West-T
2031-OP3B – V3	AM	140	0.9	41	C	535	West-T
	PM	140	**1.0**	40	C	445	West-T

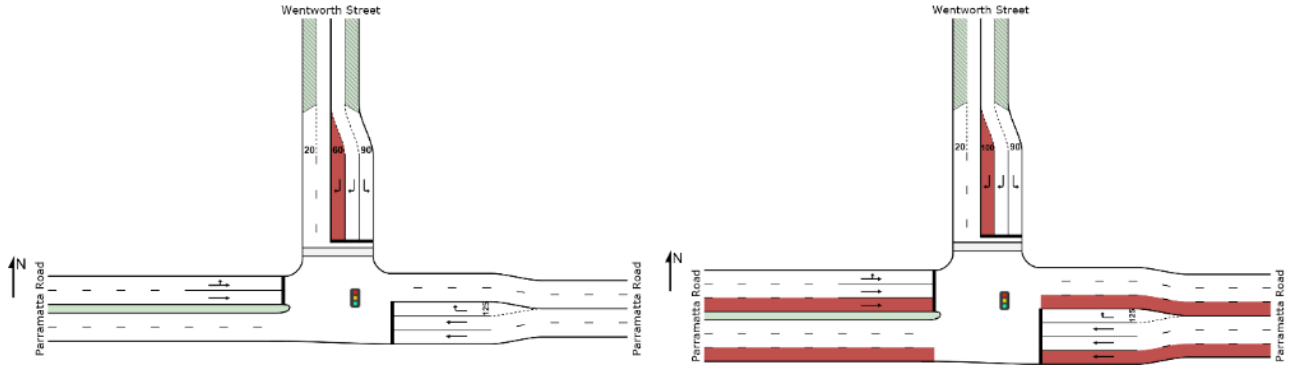


Figure D.14 At-grade upgrades required for Parramatta Road/Wentworth Street intersection – V2, V3

D1.7 I-06 PARRAMATTA ROAD AND STUBBS STREET

Without Rezoning

This intersection performs at acceptable levels with the future, no development volumes applied to the existing layout, shown in Figure D.15 and in Table D.23. No upgrades are required for this base condition.

Table D.23 I-06 Parramatta Road and Stubbs Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	80	0.8	18	B	230	West-T
	PM	110	08	13	A	155	West-T
2031-BC	AM	90	0.9	21	B	300	West-T
	PM	120	0.8	15	B	200	West-T

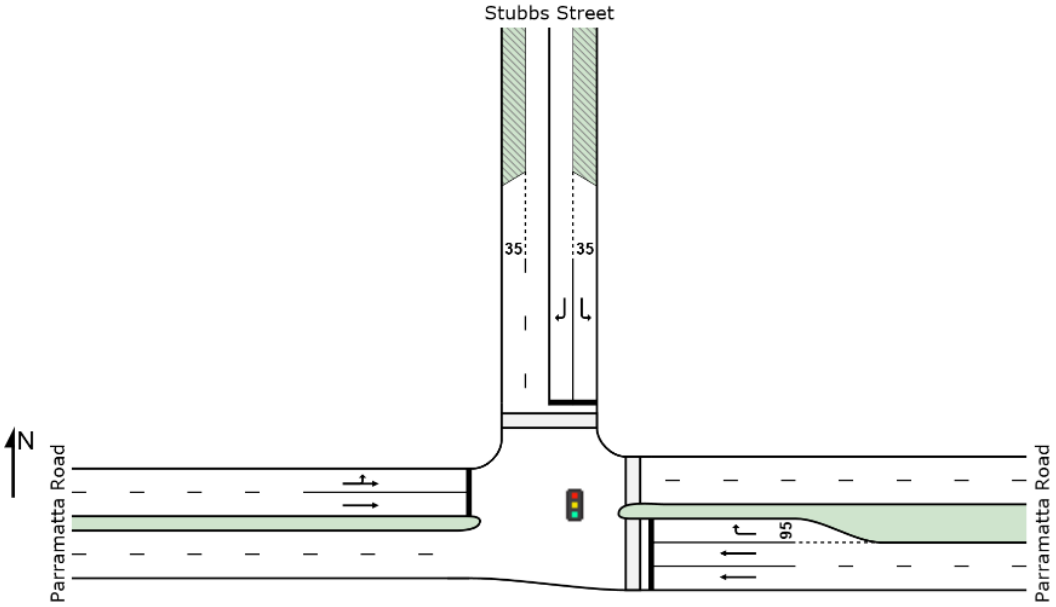


Figure D.15 At-grade intersection of Parramatta Road/Stubbs Street – upgrades not required

With Camellia Rezoning

Due to 2021 performing poorly with levels of service F and E in the AM and PM peaks respectively (shown in Table D.24), upgrades are required to improve the performance of this intersection with the development.

Table D.24 I-06 Parramatta Road and Stubbs Street: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	**1.1**	117	**F**	825	West-T
	PM	140	**1.0**	67	**E**	475	West-T/L

As with the previous two intersections of Parramatta Road and James Ruse Drive as well as Parramatta Road and Wentworth Street, most of the traffic will be located on Parramatta Road with some less significant number of vehicles due to the development. The upgrades in Figure D.16 are required to achieve accepted operations levels. Results are shown in Table D.25.

Table D.25 I-06 Parramatta Road and Stubbs Street: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V1	AM	140	**1.0**	46	D	525	West-T
	PM	100	0.9	27	B	260	West-T
2031-OP2A – V2	AM	140	**1.0**	47	D	410	West-T
	PM	90	0.9	27	B	185	West-T
2031-OP2B – V2	AM	140	**1.0**	46	D	410	West-T
	PM	100	0.9	30	C	205	West-T
2031-OP3A – V2	AM	140	**1.0**	67	**E**	500	West-T
	PM	140	0.9	43	D	310	East-T
2031-OP3B – V2	AM	140	**1.0**	70	**E**	500	West-T
	PM	140	**1.0**	48	D	345	East-T

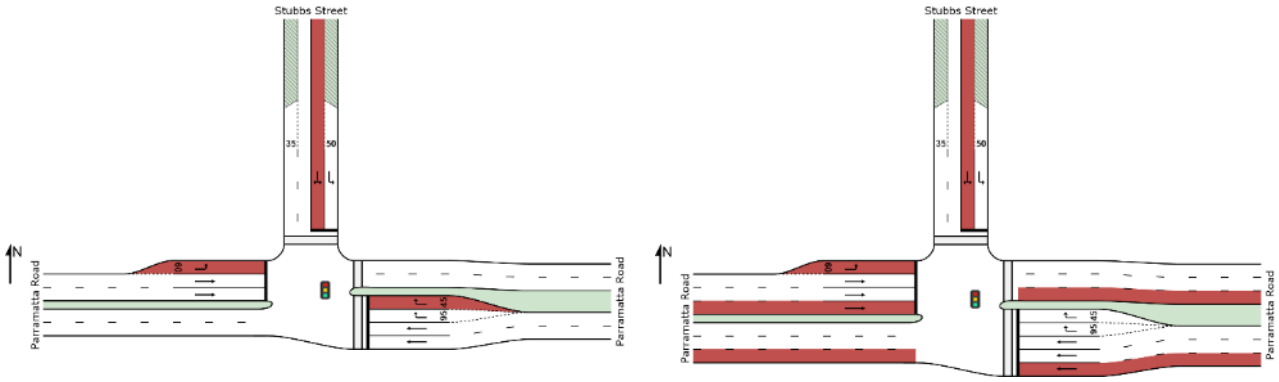


Figure D.16 At-grade upgrades required for Parramatta Road/Stubbs Street intersection – V1, V2

D1.8 I-07 CARNARVON STREET AND STUBBS STREET

Without Rezoning

No upgrades are required for this intersection for the base condition without development for future years. Results are shown in Table D.26. Upgrades illustrated in Figure D.17.

Table D.26 I-07 Carnarvon Street and Stubbs Street (roundabout): without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	-	**0.3**	6	**A**	15	East-All
	PM	-	**0.3**	6	**A**	15	North-All
2031-BC	AM	-	**0.4**	7	**A**	20	East-All
	PM	-	**0.4**	6	**A**	20	North-All

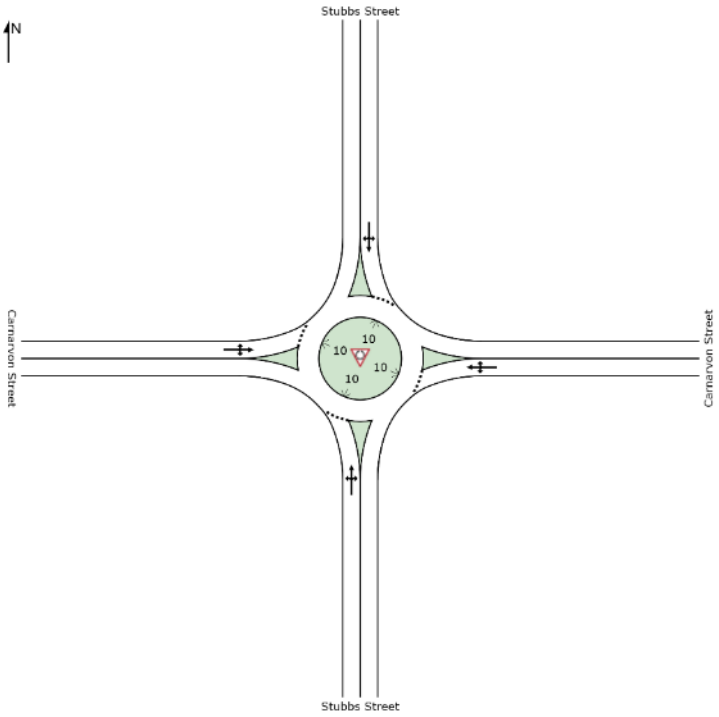


Figure D.17 At-grade intersection of Carnarvon Street/Stubbs Street

With Camellia Rezoning

The impact of 2021 development volumes applied to the existing roundabout layout indicates that the intersection requires upgrades, due to Levels of Service F in both AM and PM peaks (Table D.27).

Table D.27 I-07 Carnarvon Street and Stubbs Street (roundabout): with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	-	**1.7**	179	**F**	1450	East-All
	PM	-	**1.2**	89	**F**	870	North-All

Converting the existing single lane roundabout to a double lane roundabout along all approaches is the preferred solution with this intersection. With the required upgrades shown in Figure D.18 producing results in Table D.28, the intersection performs within desirable levels across all scenarios.

With the intersection requiring a double lane roundabout at a minimum, it is evident that this intersection must be upgraded with potential of further upgrades to become a signalised intersection.

Table D.28 I-07 Carnarvon Street and Stubbs Street (roundabout): with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V1	AM	-	0.8	30	C	205	West-T/L
	PM	-	0.7	28	B	130	West-T/L
2031-OP2A – V2	AM	-	0.9	39	C	330	West-T/L
	PM	-	0.8	29	C	140	West-T/L
2031-OP2B – V2	AM	-	**1.0**	49	D	430	West-T/L
	PM	-	0.9	34	C	160	East-T/R
2031-OP3A – V2	AM	-	**1.0**	56	D	310	West-T/L
	PM	-	0.8	29	C	210	West-T/L
2031-OP3B – V2	AM	-	**1.0**	66	**E**	365	West-T/L
	PM	-	0.9	32	C	230	West-T/L

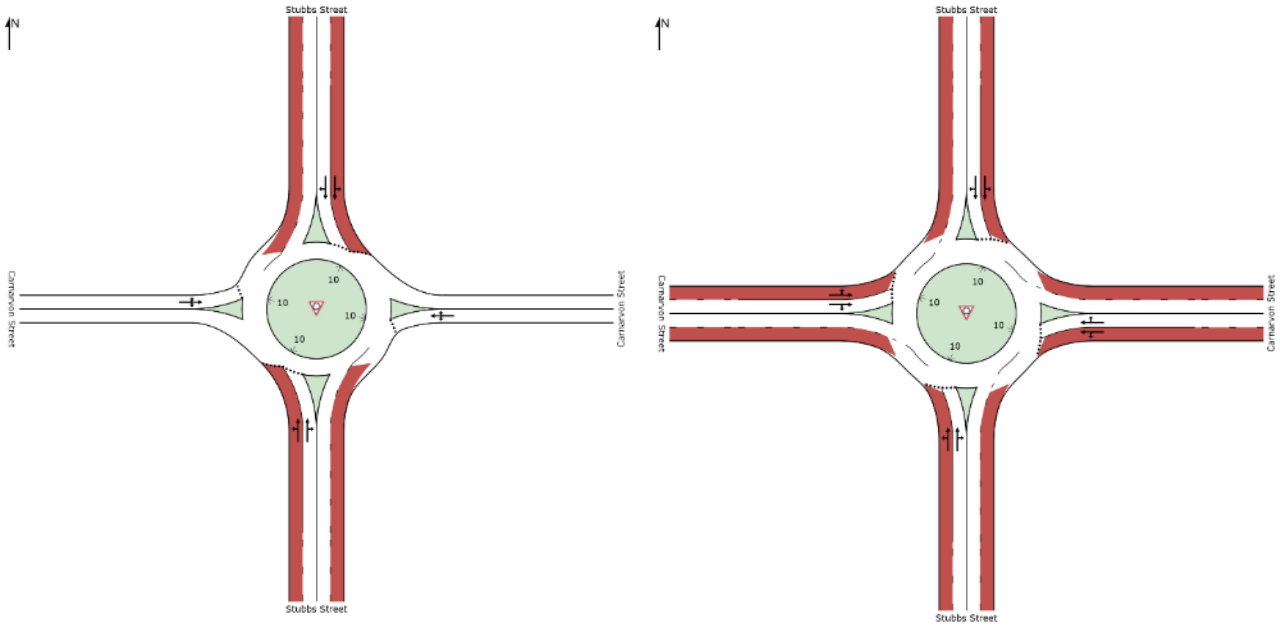


Figure D.18 At-grade upgrades required for Carnarvon Street/Stubbs Street intersection

D1.9 I-08 SILVERWATER ROAD AND CARNARVON STREET

Without Rezoning

The existing layout will perform poorly with future base volumes (no development) applied, as shown in Table D.29. Upgrades are therefore required.

Table D.29 I-08 Silverwater Road and Carnarvon Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	140	**1.3**	235	**F**	1500	South-T
	PM	140	**1.0**	81	**F**	475	North-T/L
2031-BC	AM	140	**1.4**	308	**F**	1800	South-T
	PM	140	**1.1**	122	**F**	630	North-T

To reach acceptable levels of operation, the upgrades shown in Figure D.19 are required. These upgrades produce results that are just acceptable, as shown in Table D.30. This is due to the excessive demand along the Silverwater Road corridor. With a combined total of 5,000 vehicles in the AM peak and 3,600 during the PM peak travelling north and south along Silverwater Road, this intersection will require extensive upgrades even without the introduction of the Camellia development.

Table D.30 I-08 Silverwater Road and Carnarvon Street: without Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – V1	AM	140	**1.0**	68	**E**	530	South-T
	PM	100	0.9	44	D	210	South-T
2031-BC – V1	AM	140	**1.1**	85	**F**	740	South-T
	PM	110	0.9	50	D	255	South-T

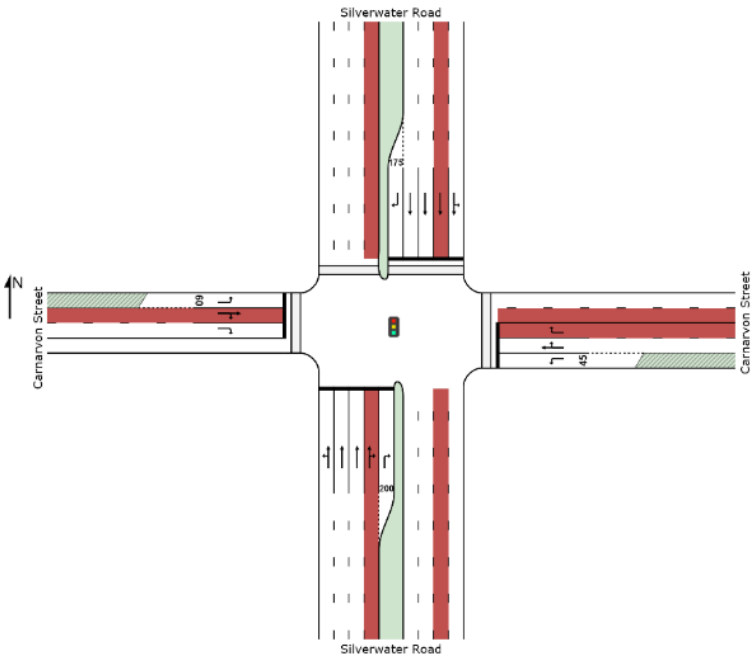


Figure D.19 At-grade upgrades required for Silverwater Road/Carnarvon Street intersection – V1

With Camellia Rezoning

Upgrade are required due to 2021 development volumes contributing to poor performance of existing layout, as shown in Table D.31.

Table D.31 I-08 Silverwater Road and Carnarvon Street: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	**1.8**	570	**F**	2000	South-T
	PM	140	**1.5**	460	**F**	1220	North-R

With the Camellia development adding up to 8,000 and 9,000 vehicles per hour through this intersection for the medium and high growth scenarios respectively, upgrades are required. The required upgrades in Figure D.20 are designed to accommodate the main issues, being are the through volumes on the Silverwater Road corridor and generated traffic volumes generated by the development. With these upgrades, intersection performance remains at capacity, as shown in Table D.32.

Table D.32 I-08 Silverwater Road and Carnarvon Street: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V2	AM	140	**1.0**	54	D	510	South-T
	PM	140	**1.0**	68	**E**	365	South-T
2031-OP2A – V1	AM	140	**1.0**	61	**E**	575	South-T
	PM	140	0.9	55	D	300	East-T
2031-OP2B – V1	AM	140	**1.0**	66	**E**	570	South-T
	PM	140	0.9	56	**E**	300	East-T
2031-OP3A – V1	AM	140	0.9	54	D	515	South-T
	PM	140	0.9	53	D	300	North-T
2031-OP3B – V1	AM	140	**1.0**	58	**E**	510	South-T
	PM	140	0.9	53	D	300	North-T

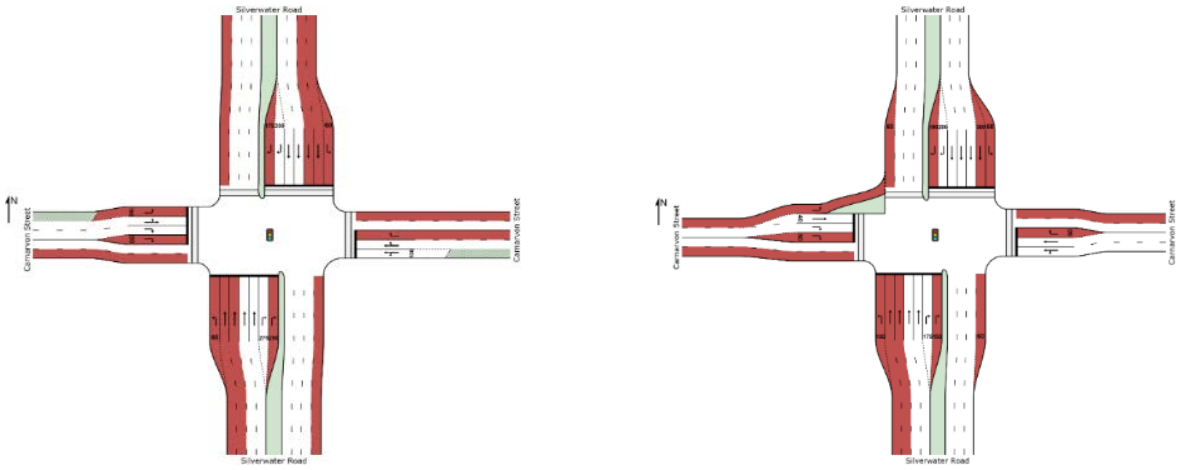


Figure D.20 At-grade upgrades required for Silverwater Road/Carnarvon Street intersection – V2, V1

D1.10 I-09 SILVERWATER ROAD AND CLYDE STREET

Without Rezoning

The future volumes applied to the existing layout will cause the intersection to perform poorly, as seen in Table D.33. Similarly, with previous intersections, the issue is the north-south volume on the Silverwater Road corridor hence upgrades will be required regardless of the Camellia development.

Table D.33 I-09 Silverwater Road and Clyde Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	140	**1.2**	124	**F**	1480	North-T
	PM	140	**1.0**	43	D	810	South-T
2031-BC	AM	140	**1.2**	172	**F**	1870	North-T
	PM	140	**1.1**	75	**F**	1120	South-T

Figure D.21 illustrates the required upgrades for the base condition. These upgrades are simple and required due to the demand along Silverwater Road totalling 6,800 and 6,100 vehicles per hour in the AM and PM peaks respectively. The results are shown in Table D.34.

Table D.34 I-09 Silverwater Road and Clyde Street: without Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – V2	AM	140	0.9	23	B	440	North-T
	PM	140	0.9	16	B	520	South-T
2031-BC – V2	AM	140	**1.0**	35	**C**	635	North-T
	PM	140	**1.0**	34	C	830	South-T

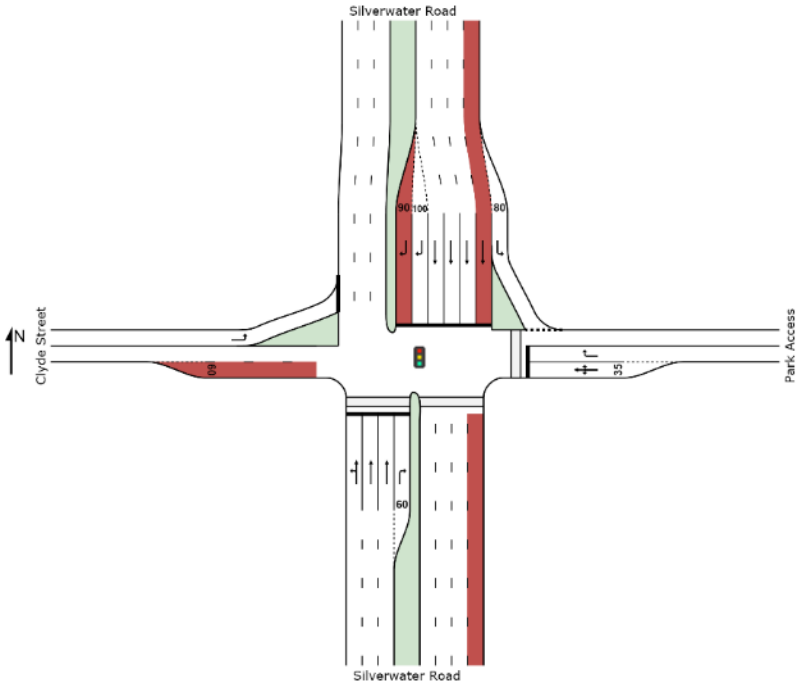


Figure D.21 At-grade upgrades required for Silverwater Road/Clyde Street intersection – V2

With Camellia Rezoning

Due to the future demand on Silverwater Road, it is evident that this intersection will perform poorly when the development volumes are added. 2021 results are shown in Table D.35.

Table D.35 I-09 Silverwater Road and Clyde Street: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	**1.1**	113	**F**	1425	North-T
	PM	140	**1.0**	52	D	910	North-T

With up to 10,000 vehicles during the AM peak and 9,000 vehicles during the PM peak, this intersection will be under significant stress with the addition of the Camellia development and requires significant infrastructure upgrades. With access proposed via Clyde Street, the single lane road must be converted to three lanes at intersection at a minimum. As illustrated in Figure D.22, extensive upgrades are required and still produce less than desired results (Table D.36).

Table D.36 I-09 Silverwater Road and Clyde Street: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V2	AM	140	**0.9**	24	B	455	South-T
	PM	140	**0.9**	21	**B**	615	South-T
2031-OP2A – V4	AM	140	**1.0**	66	**E**	625	South-T
	PM	140	1.0	57	E	660	East-T
2031-OP2B – V4	AM	140	**1.0**	65	**E**	630	South-T
	PM	140	1.0	55	**D**	630	East-T
2031-OP3A – V4	AM	140	1.0	65	E	620	North-T
	PM	140	1.0	55	D	645	South-T
2031-OP3B – V4	AM	140	**1.0**	64	**E**	630	North-T
	PM	140	1.0	53	D	620	South-T

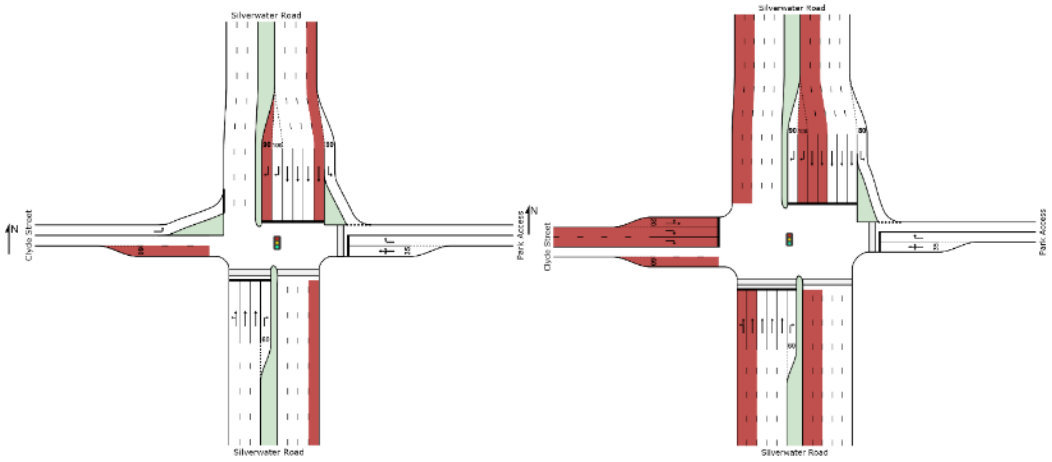


Figure D.22 At-grade upgrades required for Silverwater Road/Clyde Street intersection – V2, V4

Due to the extensive at-grade upgrades required, a grade separation solution where the north and south through movements along Silverwater Road have been removed has been tested and analysed with the following results. Table D.37 shows results with Figure D.43 illustrating the proposed intersection.

Table D.37 I-09 Silverwater Road and Clyde Street: with Camellia Precinct, upgraded with grade separation

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – GS1	AM	140	0.2	28	B	20	North-R
	PM	140	0.1	27	B	10	East-All
2031-OP2A – GS1	AM	140	0.9	49	D	460	West-R
	PM	140	0.8	37	C	265	South-T/L
2031-OP2B – GS1	AM	140	0.9	46	D	420	West-R
	PM	140	0.9	37	C	245	South-T/L
2031-OP3A – GS1	AM	140	0.9	49	D	445	West-R
	PM	140	0.9	37	C	250	South-T/L
2031-OP3B – GS1	AM	140	0.9	48	D	420	West-R
	PM	140	0.9	37	C	230	South-T/L

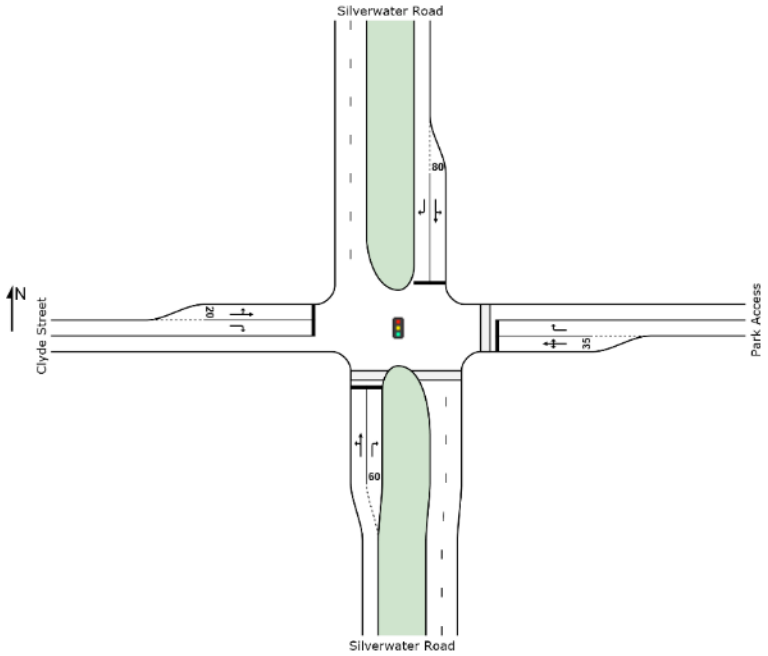


Figure D.23 Grade separation upgrades of Silverwater Road/Clyde Street – GS1

D1.11 I-10B VICTORIA ROAD AND PARK ROAD

Without Rezoning

With the future base volumes applied to the existing layout, Table D.38 shows poor performance across the intersection in 2021 and 2031. This indicated that upgrades are required.

Table D.38 I-10 Victoria Road and Park Road: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	150	**1.2**	216	**F**	1550	West-T
	PM	150	**1.1**	100	F	870	West-T
2031-BC	AM	150	**1.3**	300	**F**	1950	West-T
	PM	150	**1.1**	145	**F**	1080	West-T

To achieve acceptable levels of operation, a lane must be added in each of the east and west directions along Victoria Road. Figure D.24 and Table D.39 below reveal the required upgrades and results.

Table D.39 I-10 Victoria Road and Park Road: without Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC – V2	AM	150	1.0	55	D	715	West-T
	PM	150	1.0	56	D	635	West-T
2031-BC – V2	AM	150	**1.0**	55	**D**	685	West-T
	PM	150	**1.0**	69	E	720	West-T

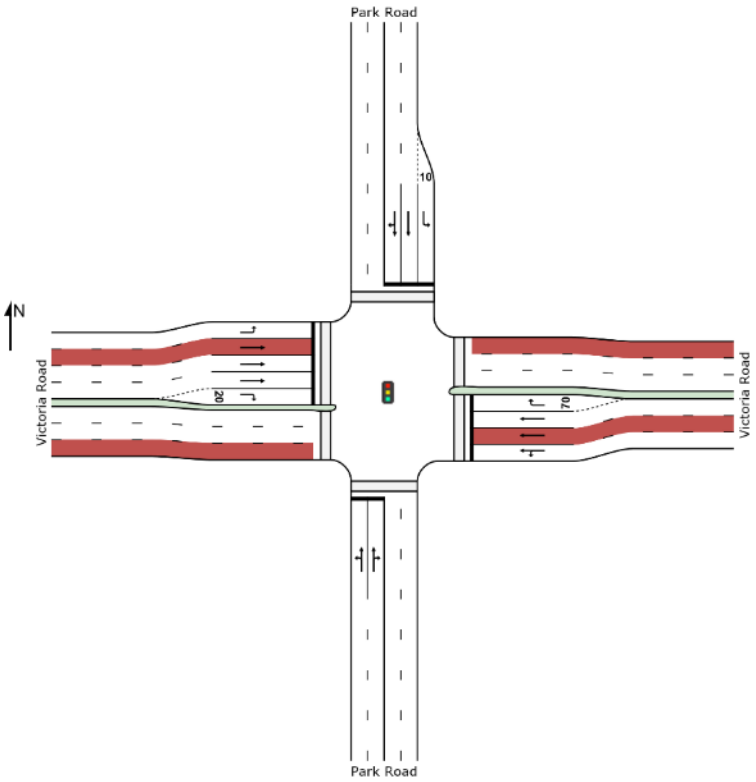


Figure D.24 At-grade upgrades required for Victoria Road/Park Road intersection – V2

With Camellia Rezoning

With the future development volumes applied to the existing layout, the intersection will experience significant congestion, as shown in Table D.40. At-grade upgrades are required.

Table D.40 I-10 Victoria Road and Park Road: with Camellia Precinct – existing layout

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	150	**1.1**	180	**F**	1230	West-T
	PM	150	**1.0**	85	F	780	West-T

With extensive upgrades tested for the intersection of Victoria Road and Park Road, an ideal or realistic solution is yet to be determined. With the layout shown in Figure D.25 giving the results shown in Table D.41, it is understood that at-grade upgrades are unrealistic due to the significant traffic demand across the entire intersection. This indicates that the Camellia development has an additional large impact on this intersection.

Table D.41 I-10 Victoria Road and Park Road: with Camellia Precinct – with upgrades

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V3	AM	150	**1.0**	61	**E**	550	West-T
	PM	150	0.9	47	D	550	West-T
2031-OP2A – V3	AM	150	**1.1**	133	**F**	880	West-T
	PM	150	1.0	73	F	710	West-T
2031-OP2B – V3	AM	150	**1.1**	134	**F**	880	West-T
	PM	150	1.2	137	**F**	1100	West-T
2031-OP3A – V3	AM	150	**1.2**	150	**F**	950	West-T
	PM	150	1.2	121	F	970	West-T
2031-OP3B – V3	AM	150	**1.2**	125	**F**	1000	West-T
	PM	150	**1.2**	150	**F**	950	West-T

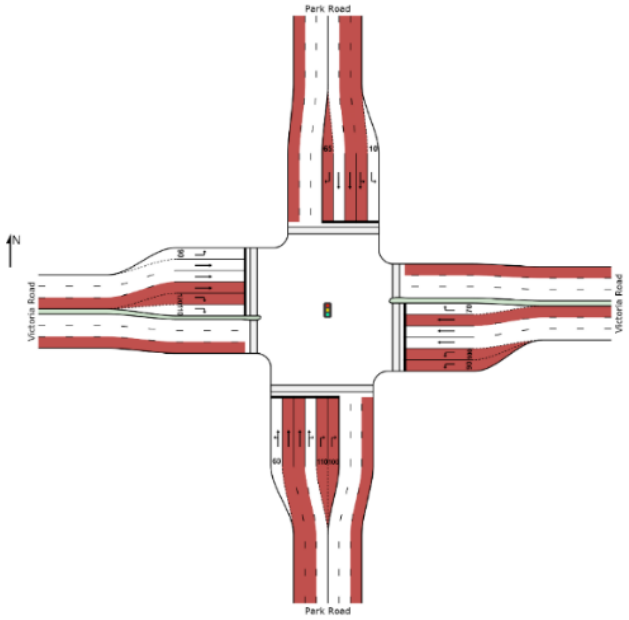


Figure D.25 At-grade upgrades required for Victoria Road/Park Road – V3

Due to the significant traffic volumes across this intersection (8,800 and 7,600 vehicles during AM and PM peaks respectively) causing poor performance at the intersection and at-grade upgrades, a grade separation solution has also been tested. The following Table D.42 and Figure D.26 results and upgrades.

Table D.42 I-10 Victoria Road and Park Road: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – GS1	AM	60	**0.7**	29	**C**	50	East-T/L
	PM	60	0.7	29	C	55	South-T/R
2031-OP2A – GS2	AM	90	**0.9**	35	**C**	145	South-R
	PM	80	0.9	30	C	140	South-R
2031-OP2B – GS2	AM	100	**0.9**	38	**C**	160	South-R
	PM	80	0.9	30	**C**	140	South-R
2031-OP3A – GS2	AM	80	0.9	34	C	165	East-L
	PM	80	0.9	30	C	140	South-R
2031-OP3B – GS2	AM	110	**0.9**	40	**C**	170	South-R
	PM	80	0.9	30	C	140	South-R

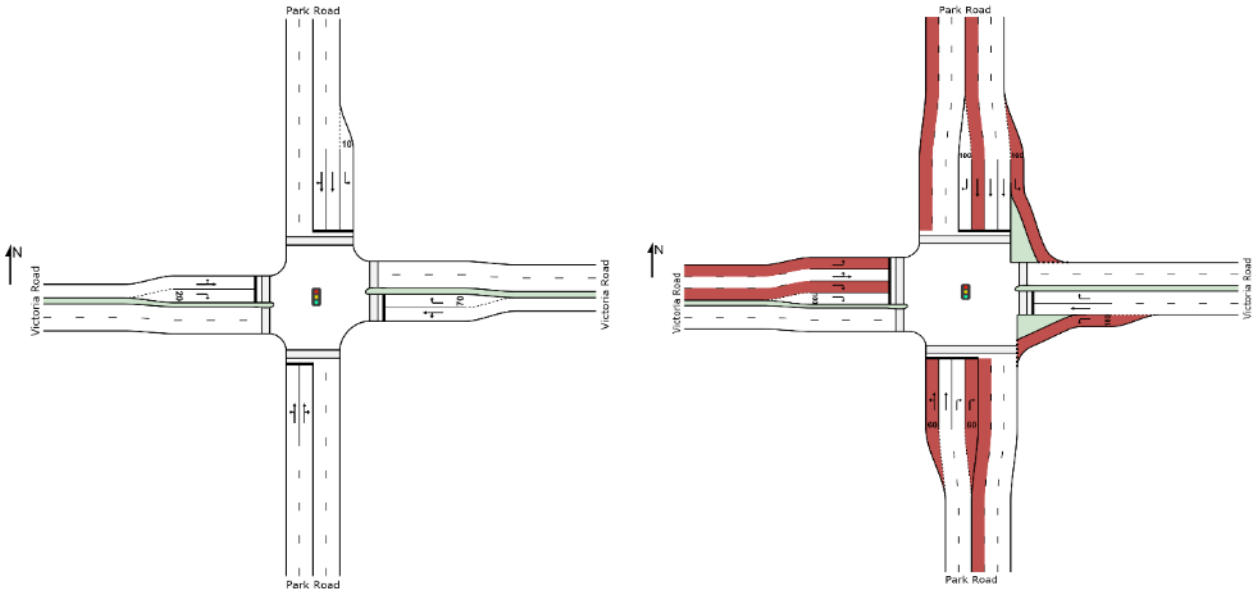


Figure D.26 Grade separation upgrade for Victoria Road/Park Road – GS1, GS2

D1.12 I-11 GRAND AVENUE AND COLQUHOUN STREET

Without Rezoning

Applying the future base volumes to the existing roundabout layout (see Figure D.27) at the intersection of Grand Avenue and Colquhoun Street will result in Level of Service A across both 2021 and 2031 for both AM and PM peaks, as shown in Table D.43. No upgrades are required for fix the base condition scenario.

Table D.43 I-11 Grand Avenue and Colquhoun Street (roundabout): without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-BC	AM	-	0.2	7	A	10	West-R
	PM	-	0.3	6	A	10	East-T/L
2031-BC	AM	-	0.3	7	A	10	West-R
	PM	-	0.3	6	A	15	East-T/L

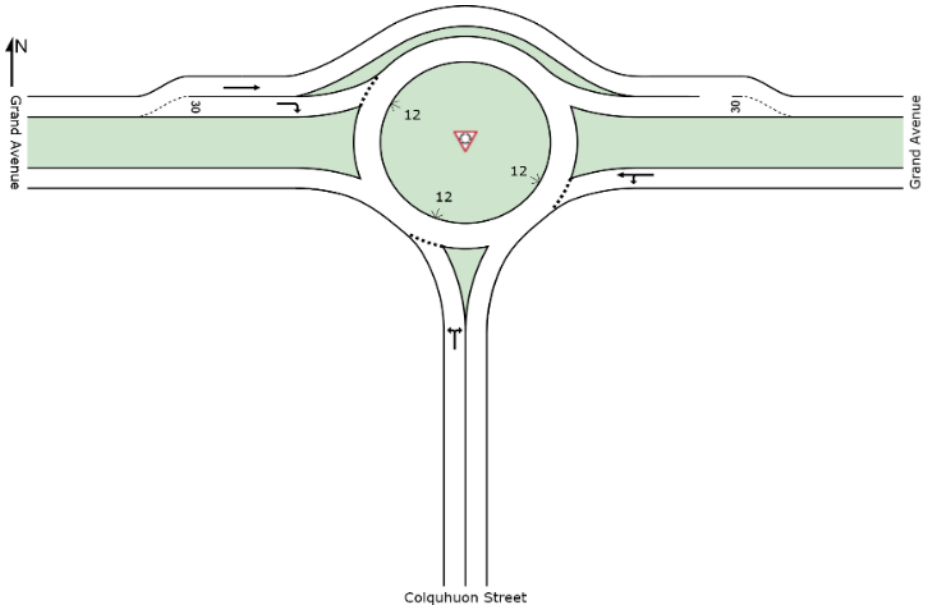


Figure D.27 At-grade upgrades required for Grand Avenue/Colquhoun Street – not required

With Camellia Rezoning

Applying future development volumes to this intersection will require an upgrade in the 2031 scenario. The without upgrade results are shown in Table D.44.

Table D.44 I-11 Grand Avenue and Colquhoun Street (roundabout): with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	-	0.9	21	B	600	West-T
	PM	-	0.7	7	A	60	South-L/R
2031-OP2A	AM	-	**2.8**	635	**F**	3200	East-All
	PM	-	**2.7**	580	**F**	3700	East-All
2031-OP2B	AM	-	**2.5**	640	**F**	3600	South-All
	PM	-	**2.2**	440	**F**	3400	East-All
2031-OP2A	AM	-	**3.2**	750	**F**	3700	South-All
	PM	-	**3.3**	700	**F**	3700	East-All
2031-OP2B	AM	-	**2.6**	700	**F**	4000	South-All
	PM	-	**2.3**	450	**F**	3200	East-All

The first proposed solution is to upgrade the existing roundabout. Figure D.28 illustrates the required upgrades with results presented in Table D.45. These results are below expectations with the AM peaks continually experiencing poor performance.

Table D.45 I-11 Grand Avenue and Colquhoun Street (roundabout): with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V1	AM	-	0.5	9	A	40	West-R
	PM	-	0.3	7	A	20	South-L
2031-OP2A – V1	AM	-	**1.1**	74	**F**	510	South-L
	PM	-	0.7	14	A	60	East-T
2031-OP2B – V1	AM	-	**1.1**	150	**F**	1110	South-L
	PM	-	0.6	12	A	50	East-T
2031-OP3A – V1	AM	-	**1.2**	110	**F**	880	West-R
	PM	-	0.8	20	B	100	East-T
2031-OP3B – V1	AM	-	**1.2**	110	**F**	900	South-L
	PM	-	0.7	13	A	60	East-T

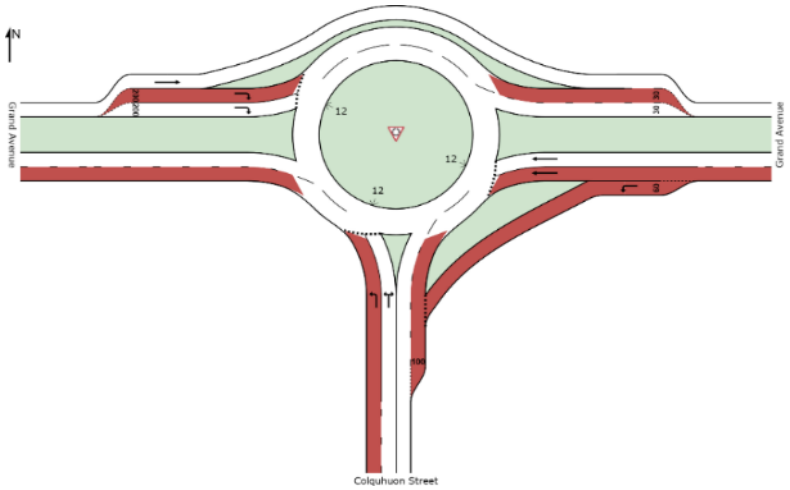


Figure D.28 At-grade upgrades required for Grand Avenue/Colquhoun Street – V1

An alternative and preferred solution is to convert the intersection to traffic signal control. Figure D.29 below shows the required intersection upgrade with Table D.46 showing the results.

Table D.46 I-11 Grand Avenue and Colquhoun Street (signalised intersection): with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V2	AM	70	0.8	21	B	165	West-R
	PM	40	0.7	15	B	50	West-R
2031-OP2A – V2	AM	150	**1.0**	62	**E**	430	West-R
	PM	90	0.9	35	C	220	East-T
2031-OP2B – V2	AM	150	**1.0**	74	**F**	420	West-R
	PM	90	0.8	33	C	220	East-T
2031-OP3A – V2	AM	150	**1.0**	69	**E**	500	West-R
	PM	90	0.9	36	C	215	East-T
2031-OP3B – V2	AM	150	**1.0**	67	**E**	400	West-R
	PM	80	0.9	33	C	200	East-T

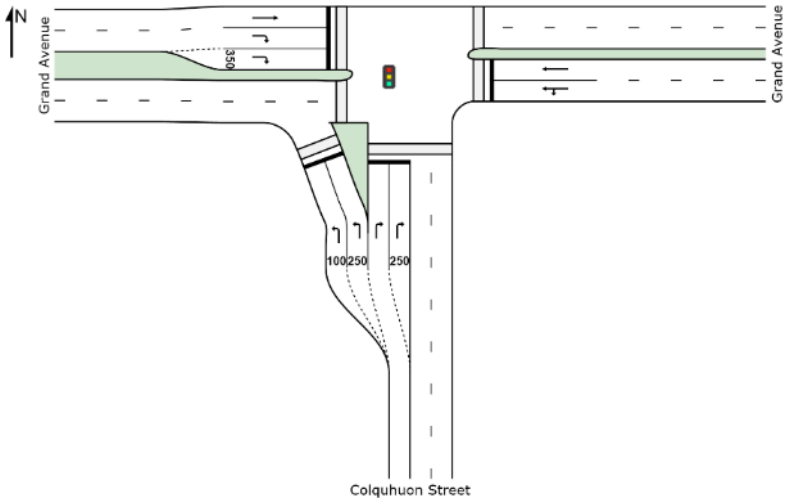


Figure D.29 At-grade upgrades of Grand Avenue/Colquhoun Street – signalised V2

D1.13 I-12 GRAND AVENUE AND TOWN CENTRE

Without Rezoning

No existing intersection. Future case analysed (with development) – 2021, 2031 with development volumes.

With Camellia Rezoning

With a basic intersection layout (see Figure D.30), the intersection of Grand Avenue and the Town Centre would have results shown in Table D.47.

Table D.47 I-12 Grand Avenue and Town Centre, simple

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	70	0.9	26	B	290	East-T
	PM	50	0.8	15	B	170	East-T
2031-OP2A	AM	130	**1.4**	367	**F**	2000	East-T
	PM	150	0.9	32	**C**	460	West-T
2031-OP2B	AM	150	**1.2**	262	**F**	1600	East-T
	PM	70	0.9	29	C	265	East-T
2031-OP3A	AM	150	**1.8**	690	**F**	2700	West-T
	PM	150	**1.2**	170	**F**	1300	West-T
2031-OP3B	AM	150	**1.6**	550	**F**	2050	West-T
	PM	150	**1.0**	70	**F**	635	West-T

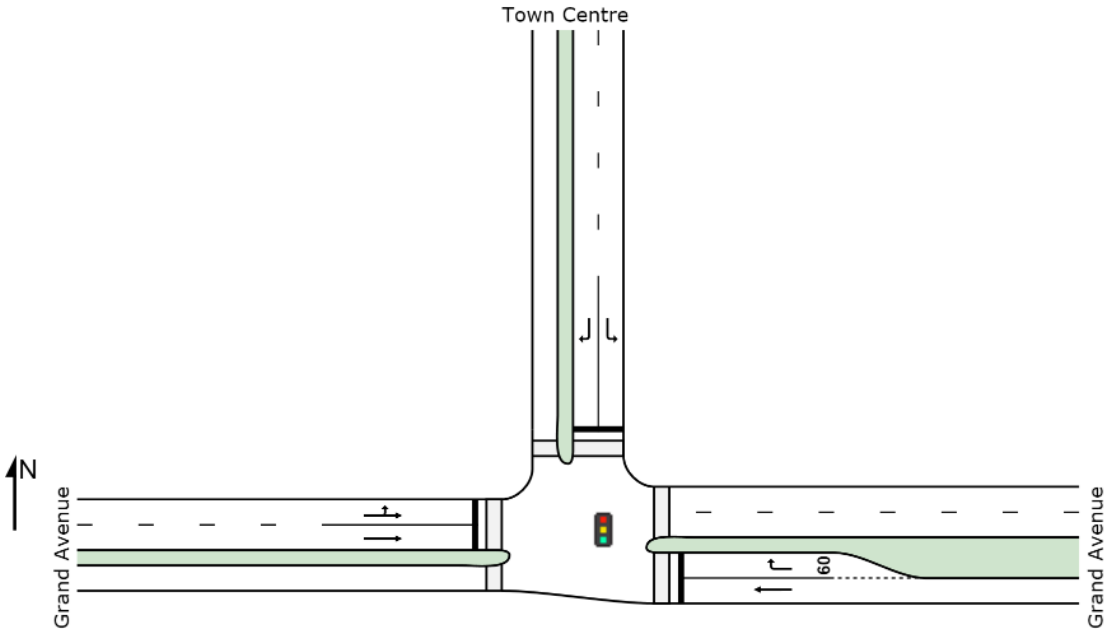


Figure D.30 Proposed intersection of Grand Avenue/Town Centre

The proposed base intersection performs poorly for the medium and high growth due to the significant traffic generated by the Camellia development. At-grade upgrades are required and shown below in Figure D.31 and Table D.48. An alternative solution would be to split the access into the Town Centre to two or more locations.

Table D.48 I-11 Grand Avenue and Town Centre, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1 – V2	AM	70	0.9	20	B	230	West-T
	PM	50	0.6	10	A	70	West-T
2031-OP2A – V2	AM	150	**1.0**	54	D	790	West-T
	PM	60	0.9	17	B	175	West-T
2031-OP2B – V2	AM	100	0.9	29	B	310	West-T
	PM	50	0.9	16	B	125	West-T
2031-OP3A – V3	AM	100	0.9	33	C	275	West-T
	PM	50	0.8	15	B	90	West-T
2031-OP3B – V3	AM	70	0.9	25	B	170	West-T
	PM	50	0.6	14	A	60	West-T

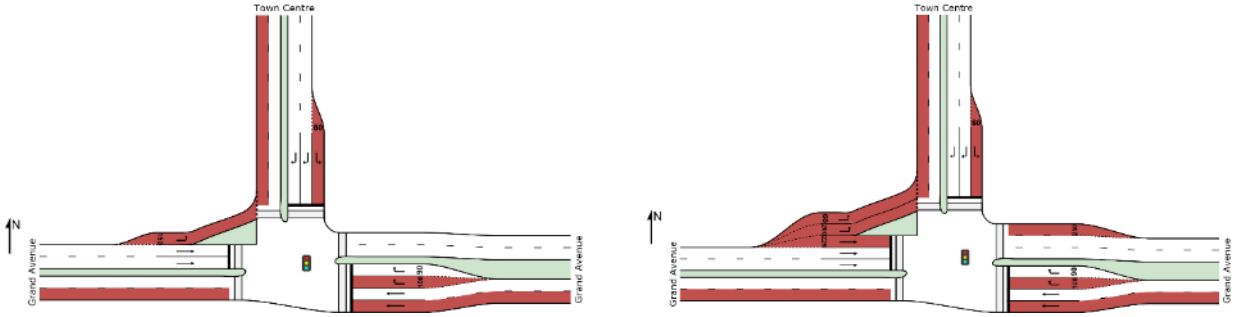


Figure D.31 At-grade upgrades required for Grand Avenue/Town Centre intersection – V2, V3

D1.14 I-13 WENTWORTH STREET AND KAY STREET

Without Rezoning

No existing intersection with possible M4 Ramp. Future case analysed (with development) – 2021, 2031 with development volumes.

With Camellia Rezoning

The proposed base intersection is shown with Figure D.32. Results are shown in Table D.49.

Table D.49 I-13 Wentworth Street and Kay Street (give-way intersection): with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	-	**1.0**	26	C	47	West-All
	PM	-	0.8	10	A	60	West-All
2031-OP2B	AM	-	**1.1**	50	D	480	West-All
	PM	-	0.7	8	A	40	West-All

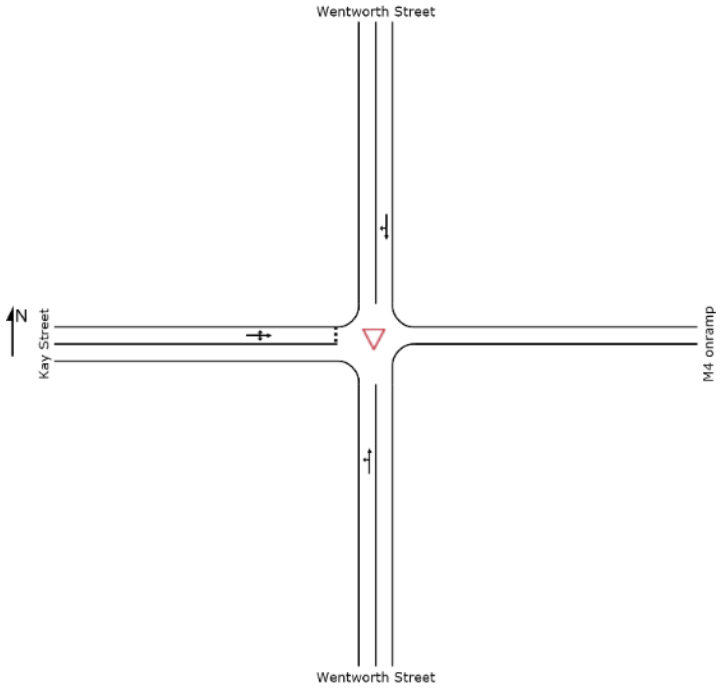


Figure D.32 Proposed intersection of Wentworth Street/Kay Street

The proposed intersection performs successfully although minor upgrades can be applied to achieve better performance. The below Figure D.33 and Table D.50 reveal results.

Table D.50 I-13 Wentworth Street and Kay Street (give-way intersection): with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – V1	AM	-	0.8	9	A	80	West-R
	PM	-	0.7	8	A	5	West-R
2031-OP3B – V1	AM	-	0.9	14	A	30	West-R
	PM	-	0.6	8	A	5	West-R

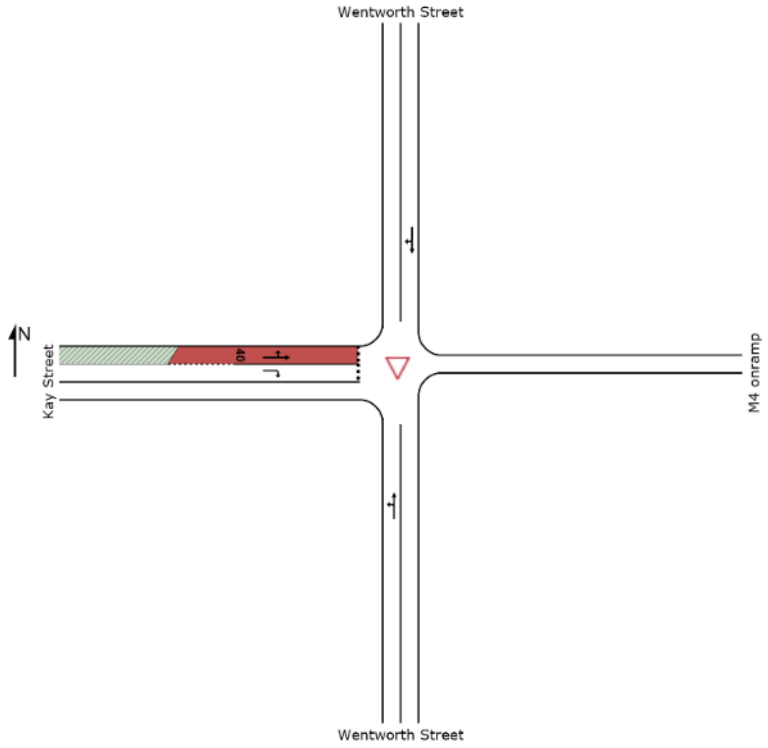


Figure D.33 At-grade upgrades required for Wentworth Street/Kay Street intersection – V1

D1.15 I-14 UNWIN STREET AND RAMP FROM JAMES RUSE DRIVE/M4 RAMP

Without Rezoning

No existing intersection. Future case analysed (with development) – 2021, 2031 with development volumes

With Camellia Rezoning

The proposed give-way intersection of the Unwin Street and ramp from James Ruse Drive/M4 off ramp (see Figure D.34) will manage successfully with future traffic volumes under both medium and high growth scenarios, as shown in Table D.51.

Table D.51 I-14 Unwin Street and ramp from James Ruse Drive/M4 Ramp

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – P1	AM	-	0.8	5	A	100	West-L
	PM	-	0.8	6	A	50	West-L
2031-OP2B – P1	AM	-	0.9	6	A	120	West-L
	PM	-	0.8	5	A	55	West-L

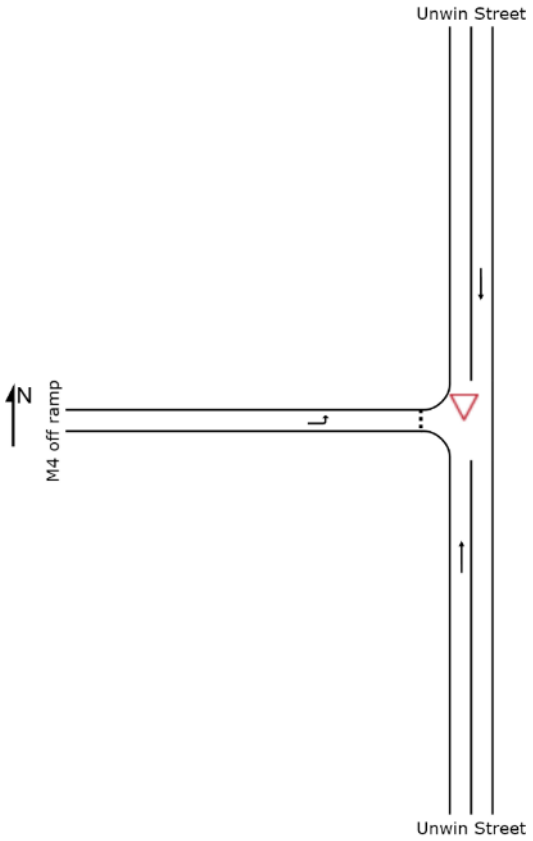


Figure D.34 At-grade upgrades required for Unwin Street and ramp from James Ruse Drive/M4 ramp

D1.16 I-15 GRAND AVENUE AND THACKERAY STREET

Without Rezoning

Not assessed. Future case analysed (with development) – 2021, 2031 with development volumes.

With Camellia Rezoning

The proposed base intersection (see Figure D.35) has poor performance (as shown in Table D.52) due to the significant traffic demands generated by the Camellia development. With over 3,000 vehicles during the AM peak and over 2600 during the PM peak, upgrades are required.

Table D.52 I-15 Grand Avenue and Thackeray Street (give-way intersection)

Scenario	Period	DoS	LoS
2031-OP2A	AM	4.3	F
	PM	8.1	F
2031-OP2B	AM	2.3	F
	PM	10.1	F
2031-OP3A	AM	7.3	F
	PM	8.0	F
2031-OP3B	AM	11.2	F
	PM	9.2	F

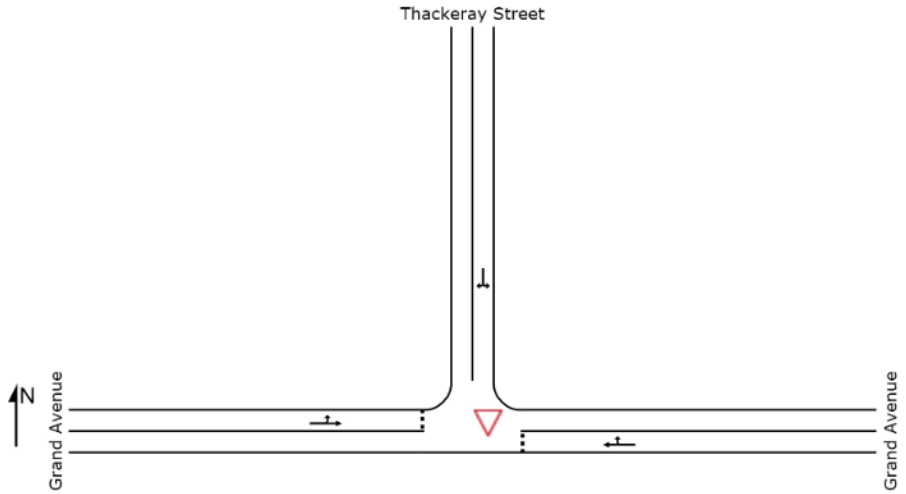


Figure D.35 Proposed intersection of Grand Avenue/Thackeray Street

A double lane roundabout is proposed and tested revealing the following results in Table D.53 with layout shown by Figure D.36. The intersection still requires upgrades.

Table D.53 I-15 Grand Avenue and Thackeray Street (roundabout)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2A	AM	-	0.6	6	A	55	West-L
	PM	-	**1.2**	64	**E**	640	East-R
2031-OP2B	AM	-	0.7	6	A	60	West-L
	PM	-	**1.5**	122	**F**	1070	East-R
2031-OP3A	AM	-	0.7	7	A	60	West-L
	PM	-	**1.1**	46	D	470	East-R
2031-OP3B	AM	-	0.7	6	A	75	West-L
	PM	-	**1.1**	55	D	555	East-R

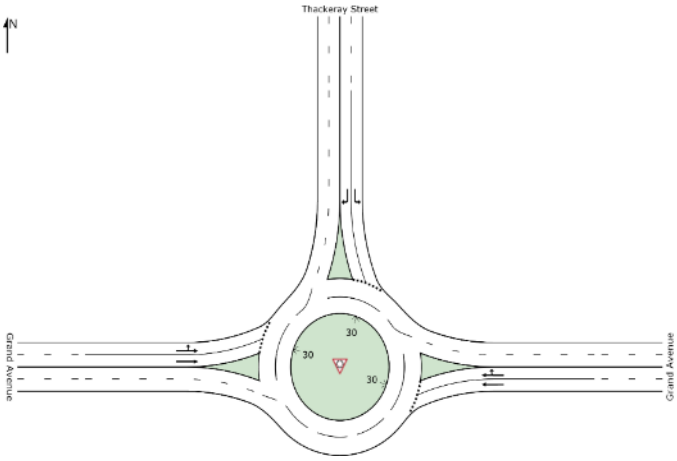


Figure D.36 Proposed double lane roundabout for Grand Avenue/Thackeray Street intersection

Further upgrades are required for 2031 for both medium and high growth scenarios. The intersection would be converted into a signalised intersection to accommodate the future traffic volumes forecast.

The following upgrades, shown in Figure D.37, are the proposed base intersection. The results shown in Table D.54 indicate that due to the demand travelling north to east/west and east/west to north in the AM and PM peaks respectively, the further intersection upgrades may be required.

Table D.54 I-15 Grand Avenue and Thackeray Street (signalised)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2A	AM	60	0.9	19	B	200	West-L
	PM	150	**1.1**	140	**F**	930	North-R
2031-OP2B	AM	70	0.9	20	B	250	West-L
	PM	150	**1.2**	180	**F**	1150	North-R
2031-OP3A	AM	60	0.8	19	B	175	West-L
	PM	150	**1.1**	143	**F**	915	North-R
2031-OP3B	AM	70	0.9	20	B	240	West-L
	PM	150	**1.2**	174	**F**	1100	North-R

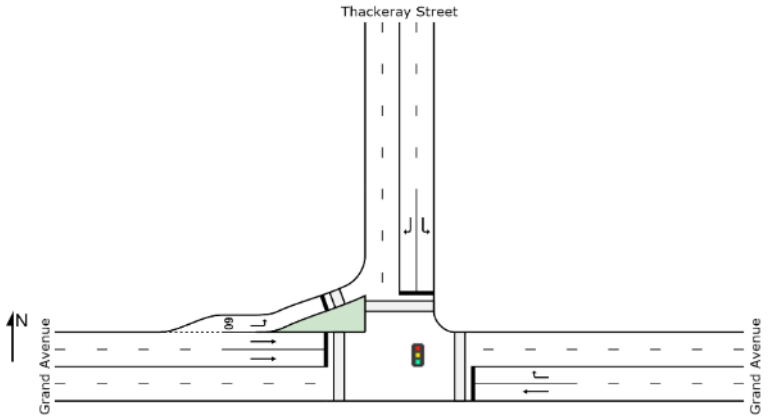


Figure D.37 Proposed signalised intersection for Grand Avenue/Thackeray Street intersection

These upgrades of the signalised intersection include reduction of west approach to one lane (plus slip lane) and conversion of north approach lane one to a shard left/right lane. These reductions from the base are due to most traffic travelling north to east and west as well as from the west to north during the AM peak. Furthermore, during the PM peak most traffic travels from east to north, north to west and west to north. The upgrades shown in Figure D.38 are employed to satisfy the generated demand. These upgrades perform well and results can be seen in Table D.55.

Table D.55 I-15 Grand Avenue and Thackeray Street (signalised), upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2A – V3	AM	80	0.9	25	B	195	North-L
	PM	105	**1.0**	59	**E**	350	East-R
2031-OP2B – V3	AM	100	0.9	21	B	225	West-L
	PM	110	**1.0**	69	**E**	370	East-R
2031-OP3A – V3	AM	70	0.9	21	B	175	North-L/R
	PM	130	0.9	50	D	325	North-R
2031-OP3B – V3	AM	90	0.9	22	B	225	West-L
	PM	150	0.9	54	D	360	East-R

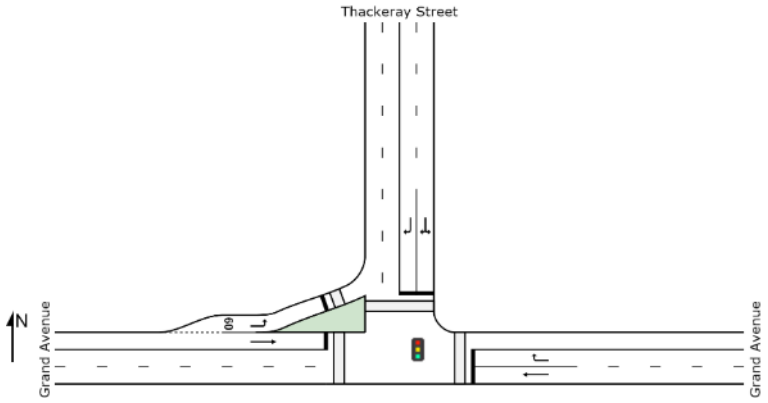


Figure D.38 At-grade upgrades required for Grand Avenue/Thackeray Street intersection

D2 ONE EASTERN BRIDGE SCENARIOS

This section presents the SIDRA Intersection modelling results for the following additional scenarios tested:

- 2031 – OP2B No Clyde is the 2031-year future medium growth scenario demand with development volumes with new M4 ramps, with the Parramatta River Bridge and the Carnarvon Street Bridge but without the Clyde Street Bridge to Silverwater Road
- 2031 – OP2B is the 2031-year future medium growth scenario demand with development volumes with new M4 ramps, with the Parramatta River Bridge and the Clyde Street Bridge but without the Carnarvon Street Bridge to Silverwater Road.

D2.1 I-01 JAMES RUSE DRIVE AND HASSEL STREET

The analysis indicates that the James Ruse Drive and Hassall Street intersection can perform with acceptable (Level of Service D) performance and a realistic configuration for the Medium Land Use scenario with grade separation of the north-south James Ruse Drive movement.

The differences between the bridge scenarios are small as shown in Table D.56. Of the three Option 2B scenarios, the No Clyde Street Bridge scenario has the best performance due to a reduction in rat-running through trips.

Table D.56 I-01 – Intersection of James Ruse Drive and Hassall Street (2031 with development)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B GS5	AM	130	0.91	50	D	292	East-T
	PM	135	0.87	49	D	282	West- T
2031-OP2B No Clyde Bridge GS5	AM	120	0.90	47	D	258	East-T
	PM	135	0.83	45	D	248	West- T
2031-OP2B No Carnarvon Bridge GS5	AM	140	0.89	51	D	316	East-T
	PM	135	0.82	44	D	259	West- T

The intersection lane configuration tested is shown in Figure D.39.

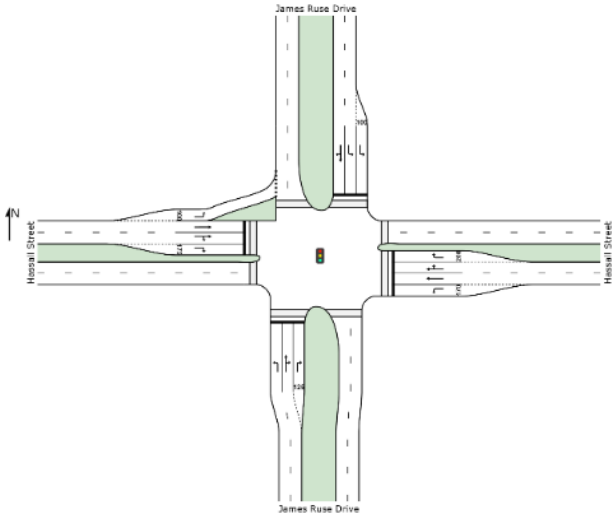


Figure D.39 Grade separation of James Ruse Drive/Hassall Street intersection layout – GS5

D2.2 I-02 JAMES RUSE DRIVE AND PROSPECT STREET

The impacts on the intersection of James Ruse Drive and Prospect Street are similar for all scenarios, as shown in Table D.57.

Table D.57 I-02 – Intersection of James Ruse Drive and Prospect Street (2031 with development)

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B V1	AM	140	0.88	18	B	434	South-T
	PM	140	0.78	17	B	335	North-T
2031-OP2B No Clyde Bridge V1	AM	140	0.87	18	B	423	North-T
	PM	140	0.80	17	B	347	North-T
2031-OP2B No Carnarvon Bridge V1	AM	140	0.87	18	B	423	South-T
	PM	140	0.80	17	B	350	North-T

The intersection lane configuration tested is shown in Figure D.40.

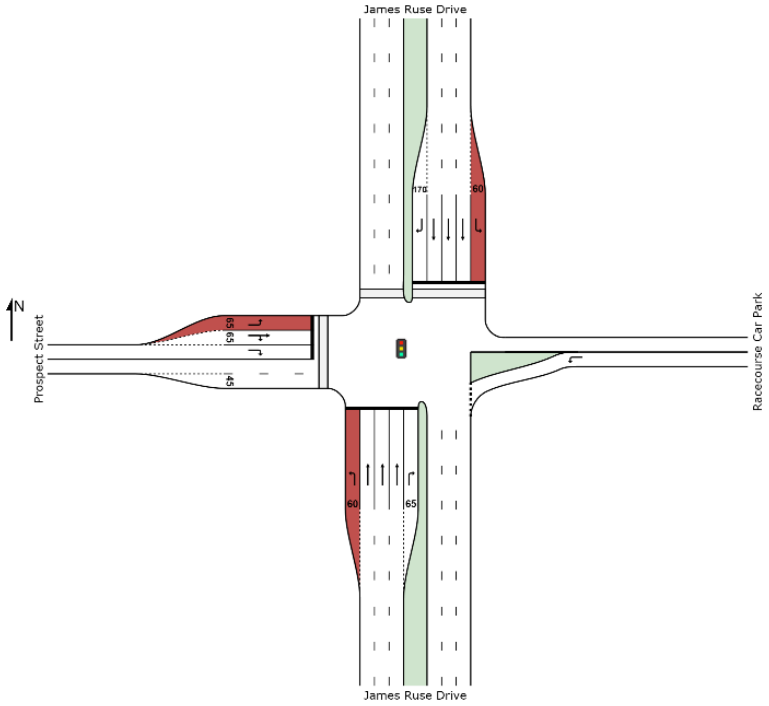


Figure D.40 At-grade upgrades of James Ruse Drive/Prospect Street intersection – V1

D2.3 I-03A JAMES RUSE DRIVE AND M4 EASTBOUND ON-RAMP

The impacts on the intersection of James Ruse Drive and the M4 Eastbound On-Ramp are similar for all scenarios, as shown in Table D.58.

Table D.58 I-03A James Ruse Drive and M4 Eastbound On-Ramp

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031–OP2B	AM	40	0.81	8	A	112	North-T
	PM	30	0.69	7	A	51	North-T
2031–OP2B No Clyde Bridge	AM	40	0.81	8	A	110	North-T
	PM	30	0.69	7	A	51	North-T
2031–OP2B No Carnarvon Bridge	AM	40	0.81	8	A	110	North-T
	PM	30	0.69	7	A	51	North-T

The intersection lane configuration tested is shown in Figure D.41.

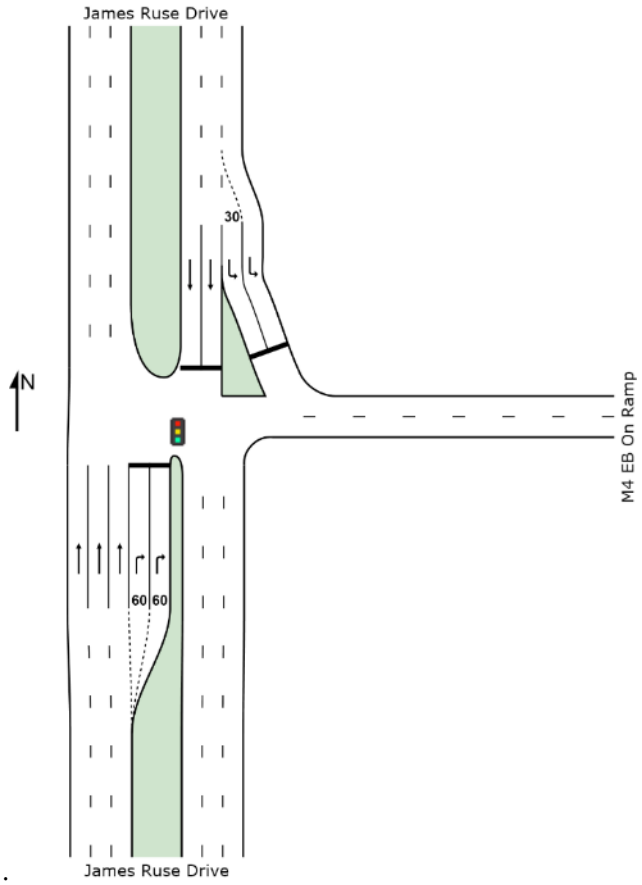


Figure D.41 At-grade upgrades of James Ruse Drive/M4 On-Ramp intersection

D2.4 I-03B JAMES RUSE DRIVE AND M4 OFF-RAMP

The impacts on the intersection of James Ruse Drive and the M4 Off-Ramp are shown in Table D.59. They indicate that the new ramp attracts too much traffic for its capacity, based on the results of the strategic model. Further assessment is recommended using a network model that can balance the intersection impacts with the time saving of the rat-run with the bridge across the Parramatta River.

Table D.59 I-03B James Ruse Drive and M4 Off-Ramp

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	150	0.99	61	E	>500	South-L
	PM	40	0.82	17	B	107	South-T
2031-OP2B No Clyde Bridge	AM	150	1.15	120	F	>500	South-L
	PM	40	0.85	18	B	120	South-T
2031-OP2B No Carnarvon Bridge	AM	150	1.12	109	F	>500	South-L
	PM	40	0.85	18	B	120	South-T

The intersection lane configuration tested is shown in Figure D.42.

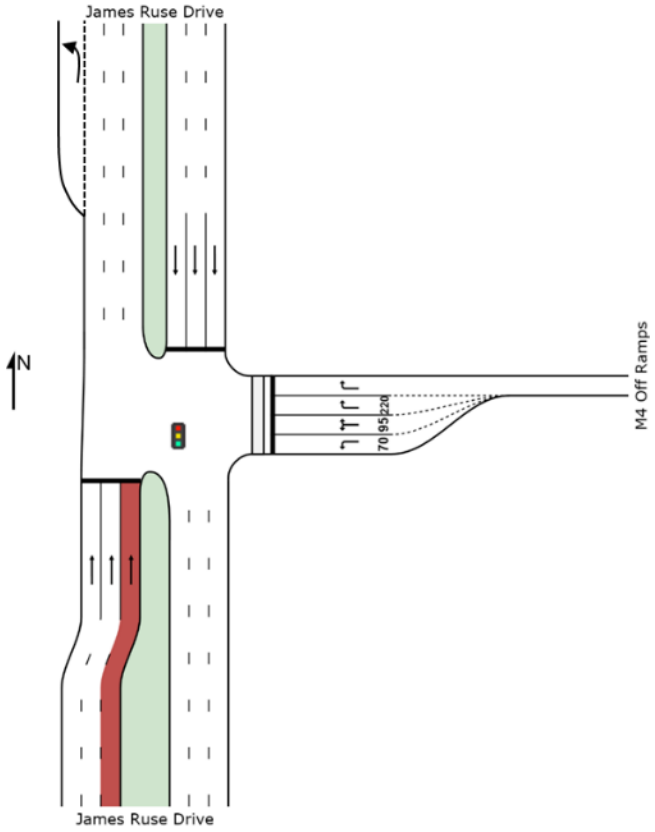


Figure D.42 At-grade upgrades of James Ruse Drive/M4 Off-Ramp intersection – V1

D2.5 I-04 JAMES RUSE DRIVE AND PARRAMATTA ROAD

The impacts on the intersection of James Ruse Drive and Parramatta Road are shown in Table D.60. The increased attractiveness of the M4 ramp to Unwin Street connection impacts the Parramatta Road intersection as well.

Table D.60 I-04 James Ruse Drive and Parramatta Road

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	140	0.92	41	C	304	West-T
	PM	140	0.98	55	D	594	East-T
2031-OP2B No Clyde Bridge	AM	140	1.02	55	D	505	West-L
	PM	140	0.91	41	C	486	East-T
2031-OP2B No Carnarvon Bridge	AM	140	0.99	57	E	442	West-L
	PM	140	0.94	45	D	558	East-T

The intersection lane configuration tested is shown in Figure D.43.

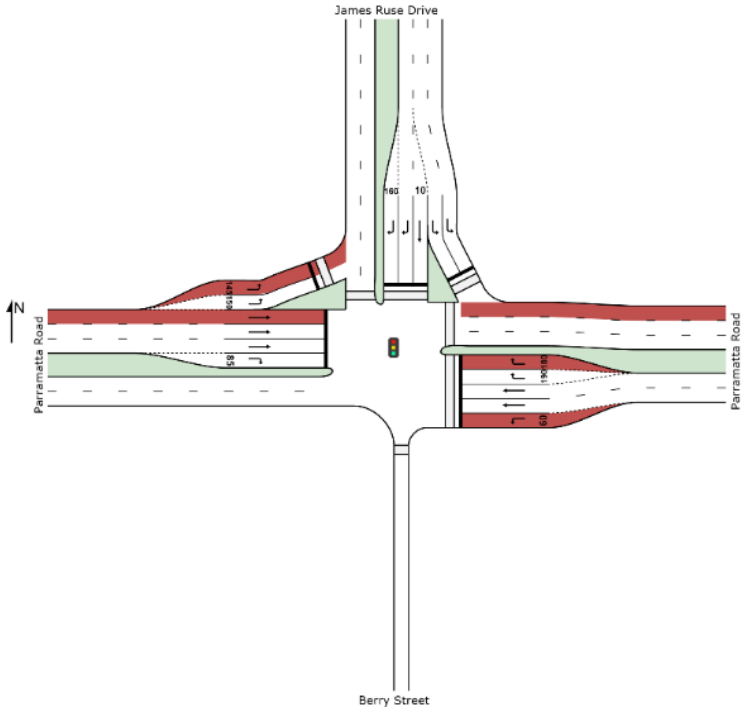


Figure D.43 At-grade upgrades required for James Ruse Drive/Parramatta Road intersection – V1

D2.6 I-05 PARRAMATTA ROAD AND WENTWORTH STREET

The impacts on the intersection of Parramatta Road and Wentworth Street are shown in Table D.61. The removal of the Carnarvon Street Bridge results in more traffic using the Wentworth Street intersection, increasing the impact on the right-turn into the Precinct, especially in the PM peak.

Table D.61 I-05 Parramatta Road and Wentworth Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	90	0.90	24	B	327	West-T
	PM	140	0.87	27	B	365	West-T
2031-OP2B No Clyde Bridge	AM	140	0.90	31	C	463	West-T
	PM	140	0.92	29	B	379	West-T
2031-OP2B No Carnarvon Bridge	AM	140	0.99	58	E	649	West-T
	PM	140	1.17	46	D	551	East-R

The intersection lane configuration tested is shown in Figure D.44.

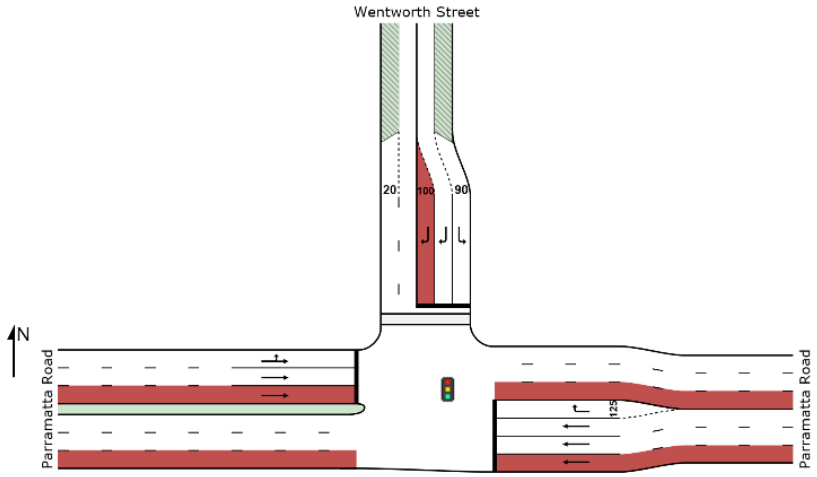


Figure D.44 At-grade upgrades required for Parramatta Road/Wentworth Street intersection – V3

D2.7 I-06 PARRAMATTA ROAD AND STUBBS STREET

The impacts on the intersection of Parramatta Road and Stubbs Street are shown in Table D.62. Without the Carnarvon Street Bridge the impacts of the development are negligible at this intersection. The No Clyde Street Bridge scenario results in slightly higher impacts at this intersection in the AM peak compared to Option 2B with all three bridges.

Table D.62 I-06 Parramatta Road and Stubbs Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	140	1.07	90	F	562	West-T
	PM	140	1.00	57	E	383	East-R
2031-OP2B No Clyde Bridge	AM	140	1.09	96	F	578	West-T
	PM	140	0.93	39	C	283	West-T
2031-OP2B No Carnarvon Bridge	AM	70	0.80	17	B	161	West-T
	PM	50	0.77	14	A	84	West-T

The intersection lane configuration tested is shown in Figure D.45.

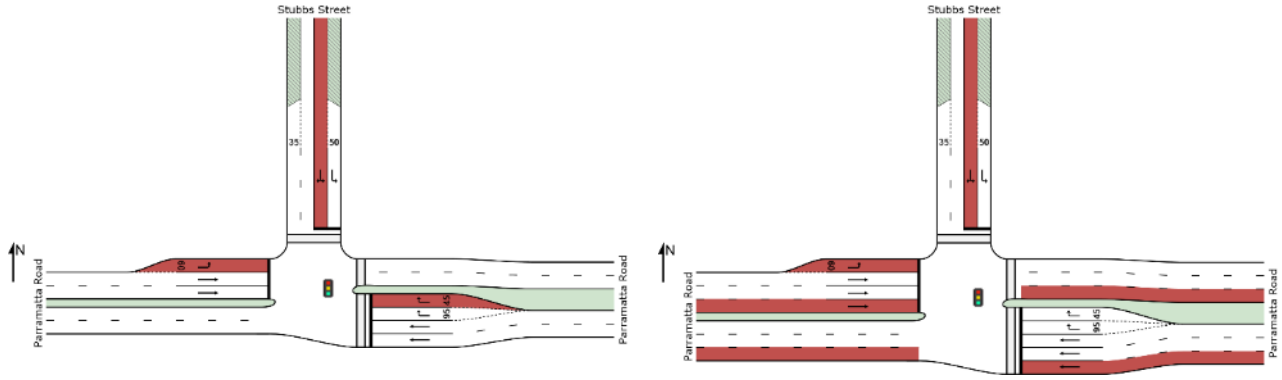


Figure D.45 At-grade upgrades required for Parramatta Road/Stubbs Street intersection – V1, V2

D2.8 I-07 CARNARVON STREET AND STUBBS STREET

The impacts on the intersection of Carnarvon Street and Stubbs are shown in Table D.63. Without the Carnarvon Street Bridge the impacts of the development are negligible at this intersection. The No Clyde Street Bridge scenario results in slightly higher impacts at this intersection in the PM peak compared to Option 2B with all three bridges.

Table D.63 I-07 Carnarvon Street and Stubbs Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	100	0.98	45	D	360	West-T
	PM	100	086	34	C	164	East-T
2031-OP2B No Clyde Bridge	AM	100	0.98	45	D	360	West-T
	PM	100	087	34	C	171	East-T
2031-OP2B No Carnarvon Bridge (Base Case results reported)	AM	-	**0.4**	7	**A**	20	East-All
	PM	-	**0.4**	6	**A**	20	North All

The intersection lane configuration tested is shown in Figure D.46.

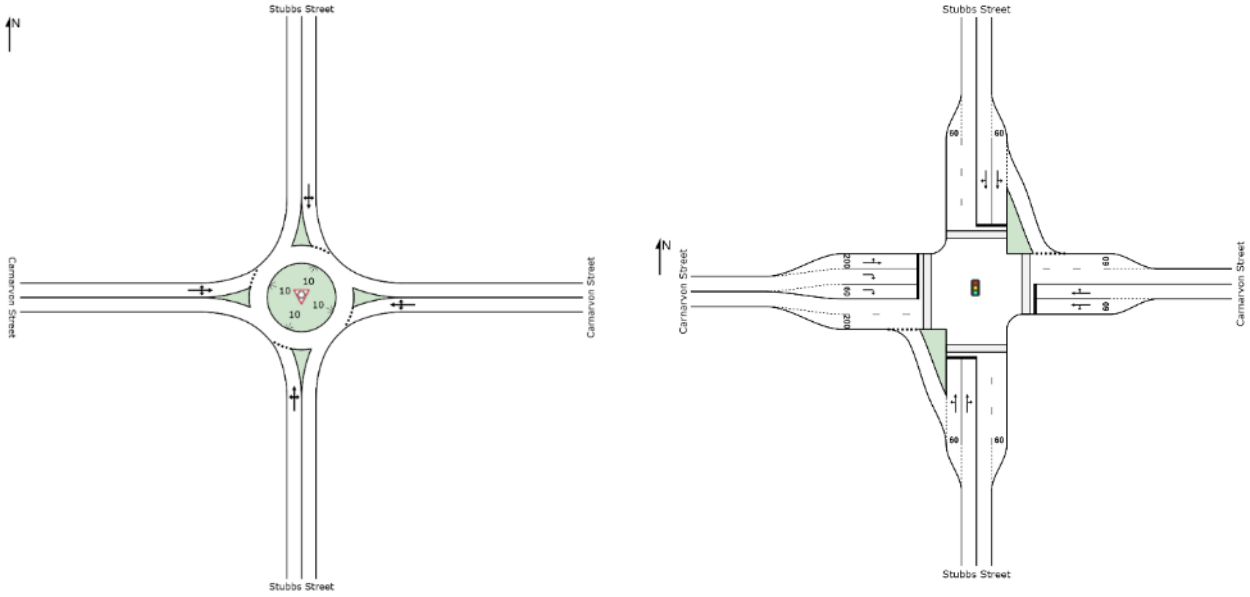


Figure D.46 At-grade upgrade required for Carnarvon Street/Stubbs Street intersection – Existing, V2

D2.9 I-08 SILVERWATER ROAD AND CARNARVON STREET

The impacts on the intersection of Silverwater Road and Carnarvon Street are shown in Table D.64. The largest cause of congestion along the corridor is the potential growth in north-south traffic along Silverwater Road, regardless of whether the Camellia Precinct is redeveloped or not.

Without the Carnarvon Street Bridge the impacts of the development are negligible at this intersection. The No Clyde Street Bridge scenario results in slightly higher impacts at this intersection in the AM peak compared to Option 2B with all three bridges.

Table D.64 I-08 Silverwater Road and Carnarvon Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B (V2)	AM	140	1.04	66	E	>500	South-T
	PM	140	0.90	56	D	296	East-T
2031-OP2B No Clyde Bridge (V2)	AM	140	1.03	54	D	409	South-T
	PM	140	0.93	54	D	296	East-T
2031-OP2B No Carnarvon Bridge (V1)	AM	140	1.07	91	F	>500	North-T
	PM	140	0.87	52	D	303	North-T

The intersection lane configuration tested is shown in Figure D.47.

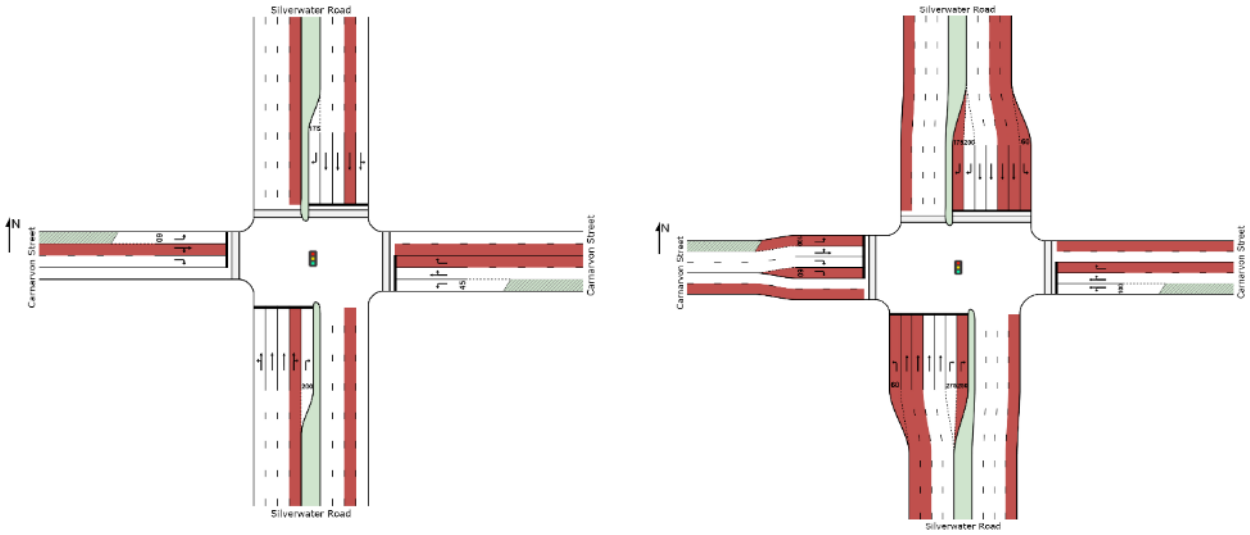


Figure D.47 At-grade upgrades required for Silverwater Road/Carnarvon Street intersection – V1, V2

D2.10 I-09 SILVERWATER ROAD AND CLYDE STREET

The impacts on the intersection of Silverwater Road and Clyde Street are shown in Table D.65. The largest cause of congestion along the corridor is the potential growth in north-south traffic along Silverwater Road, regardless of whether the Camellia Precinct is redeveloped or not.

Without the Clyde Street Bridge the impacts of the development are negligible at this intersection. The No Carnarvon Street Bridge scenario results in lower impacts at this intersection in the AM peak compared to Option 2B with all three bridges.

Table D.65 I-09 Silverwater Road and Clyde Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B (V5)	AM	140	1.24	177	F	>500	North-T
	PM	140	1.10	92	F	>500	South-T
2031-OP2B No Clyde Bridge (V2)	AM	140	0.97	47	D	>500	North-T
	PM	140	0.98	29	C	>500	North-T
2031-OP2B No Carnarvon Bridge (V5)	AM	140	1.18	148	F	>500	North-T
	PM	140	1.04	71	F	>500	South-T

The intersection lane configuration tested is shown in Figure D.48.

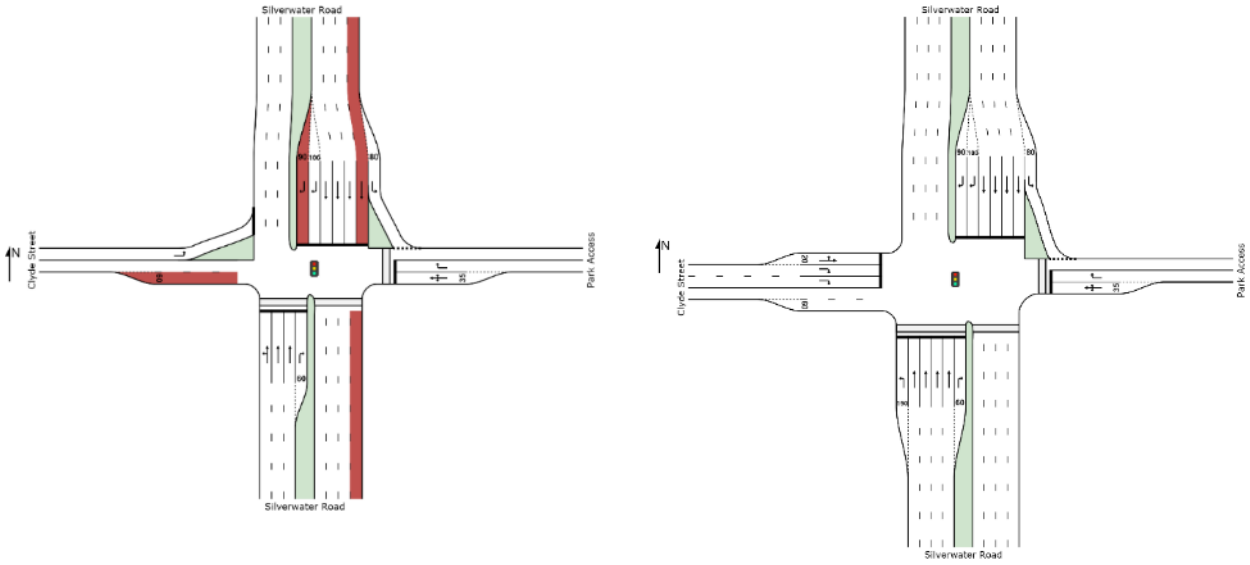


Figure D.48 At-grade upgrades required for Silverwater Road/Clyde Street intersection – V2, V5

D2.11 I-10B VICTORIA ROAD AND PARK ROAD

The impacts on the intersection of Victoria Road and Park Road are shown in Table D.66. The largest cause of congestion along the corridor is the potential growth in north-south traffic along Victoria Road, regardless of whether the Camellia Precinct is redeveloped or not. The No Carnarvon Street Bridge scenario results in lower impacts at this intersection in the AM peak compared to Option 2B with all three bridges.

Table D.66 I-010B Victoria Road and Park Road

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	150	2.14	>500	F	>500	East-T
	PM	150	5.06	>500	F	>500	East-T
2031-OP2B No Clyde Bridge	AM	150	2.00	>500	F	>500	East-T
	PM	140	5.93	>500	F	>500	East-T
2031-OP2B No Carnarvon Bridge	AM	150	2.08	>500	F	>500	East-T
	PM	140	5.40	>500	F	>500	East-T

The intersection lane configuration tested is shown in Figure D.49.

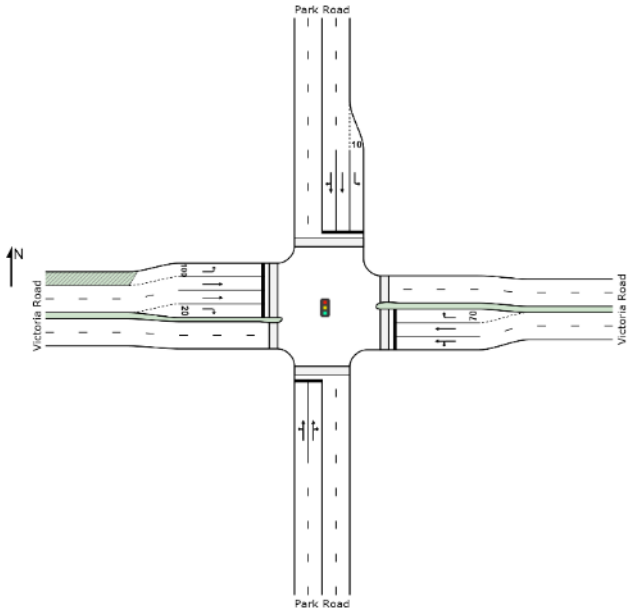


Figure D.49 At-grade upgrades required for Silverwater Road/Clyde Street intersection – V2

REDUCED DEVELOPMENT TRAFFIC GENERATION AND RAT-RUNNING

It is unlikely that vehicles would sit in the queue for severely congested intersections when alternative, less congested, routes are available. Taking a view that the future volumes estimated using the intersection for the proposed medium scenario are unsustainable given the future base levels of congestion and reducing the volumes using the bridge over the Parramatta River to **46%** of that forecast for the full development, results that are more in line with the Base Case performance can be achieved. Whilst still over capacity, the performance results in Table D.67 for Option 2B No Clyde with reduced demand are within realistic values.

Table D.67 I-010B Victoria Road and Park Road – Reduced traffic

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B No Clyde Bridge (Reduced demand)	AM	150	1.35	346	F	>500	West-T
	PM	140	1.24	246	F	>500	East-T

The traffic displaced would be re-assigned to the James Ruse Drive/Hassall Street intersection. Additional SIDRA modelling has indicated that the grade-separated James Ruse Drive/Hassall Street intersection could accommodate additional traffic displaced from the Victoria Road/Park Road intersections, which was travelling north.

There are concerns that traffic forecast to use South Street would be difficult to accommodate at the left-out only connection to Silverwater Road and would adversely affect the amenity along South Street. Further analysis is required of the impact and options to accommodate/discourage traffic headed to/from the north-east using the Parramatta River Bridge.

D2.12 I-11 GRAND AVENUE AND COLQUHOUN STREET

The impacts on the intersection of Grand Avenue and Colquhoun Street are shown in Table D.68. The reduced traffic using the intersection in both the No Clyde Street Bridge and No Carnarvon Street Bridge result in lower impacts at this intersection compared to Option 2B with all three bridges.

Table D.68 I-11 Grand Avenue and Colquhoun Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	150	1.0	74	F	420	West-R
	PM	90	0.8	33	C	220	East-T
2031-OP2B No Clyde Bridge	AM	150	0.98	52	D	411	West-R
	PM	50	0.88	24	B	89	East-T
2031-OP2B No Carnarvon Bridge	AM	150	0.78	37	C	318	West-T
	PM	70	0.86	26	B	147	East-T

The intersection lane configuration tested is shown in Figure D.50.

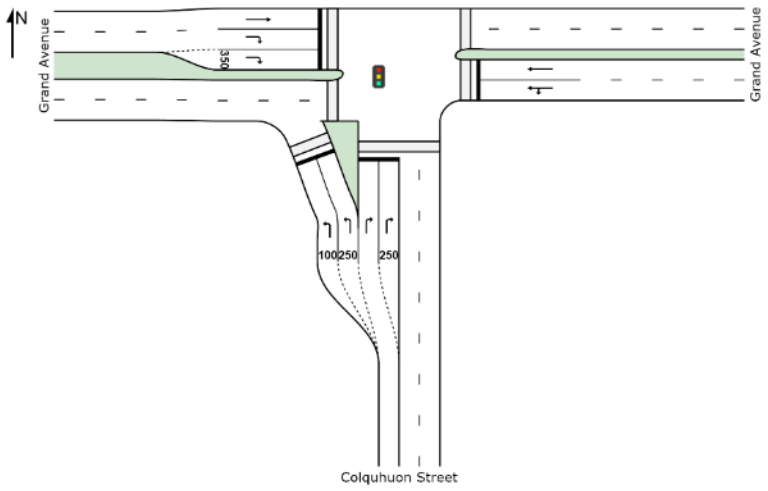


Figure D.50 At-grade upgrades of Grand Avenue/Colquhoun Street – signalised V2

D2.13 I-12 GRAND AVENUE AND TOWN CENTRE

The impacts on the intersection of Grand Avenue and the Town Centre entry are shown in Table D.69. The reduced traffic using the intersection in both the No Clyde Street Bridge and No Carnarvon Street Bridge result in slightly lower impacts at this intersection compared to Option 2B with all three bridges.

Table D.69 I-12 Grand Avenue and Town Centre

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	100	0.90	29	B	310	West-T
	PM	50	0.90	16	B	125	West-T
2031-OP2B No Clyde Bridge	AM	90	0.89	27	C	306	West-T
	PM	50	0.83	14	A	109	West-T
2031- OP2B No Carnarvon Bridge	AM	80	0.91	28	C	256	West-T
	PM	60	0.79	15	B	129	West-T

The intersection lane configuration tested is shown in Figure D.51. A smaller intersection footprint could be achieved if access to the Town Centre is split to more than one location.

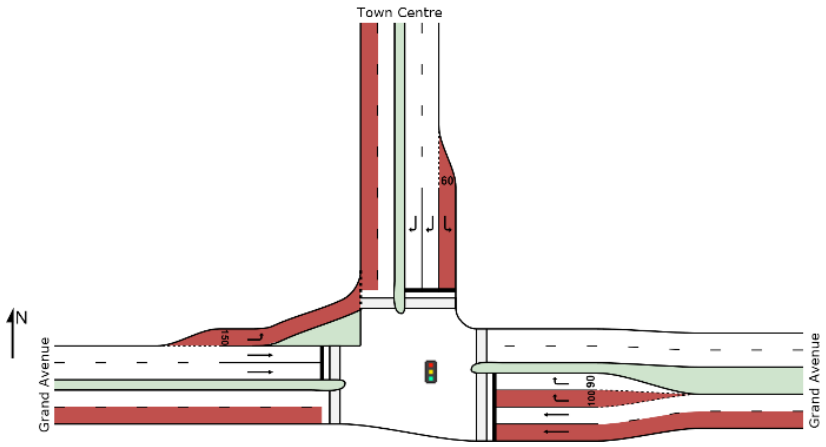


Figure D.51 At-grade upgrade required for Grand Avenue/Town Centre intersection – V2

D2.14 I-13 WENTWORTH STREET AND KAY STREET

The impacts on the intersection of Wentworth Street and Kay Street are shown in Table D.70. The results show that performance would be good for all three scenarios.

Table D.70 I-13 Wentworth Street and Kay Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	-	0.78	12	A	82	West-R
	PM	-	0.70	14	A	40	West-R
2031-OP2B No Clyde Bridge	AM	-	0.83	14	A	105	West-R
	PM	-	0.58	11	A	30	West-R
2031- OP2B No Carnarvon Bridge	AM	-	0.94	21	B	260	West-R
	PM	-	0.45	10	A	16	West-R

The intersection lane configuration tested is shown in Figure D.52.

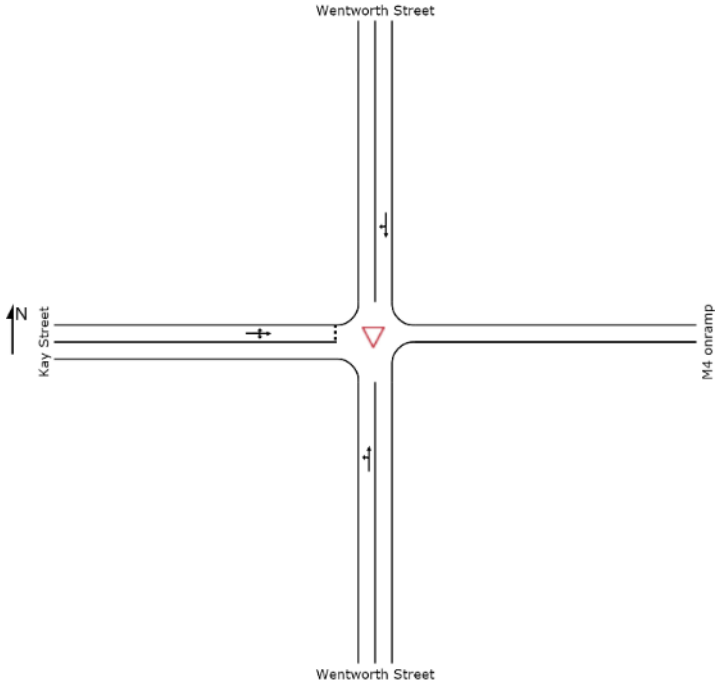


Figure D.52 Proposed intersection of Wentworth Street/Kay Street

D2.15 I-14 UNWIN STREET AND RAMP FROM JAMES RUSE DRIVE

The impacts on the intersection of Unwin Street the proposed new ramp from the intersection of James Ruse Drive and the M4 Off-Ramp are shown in Table D.71.

Table D.71 I-14 Unwin Street and ramp from James Ruse Drive

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B	AM	60	0.89	21	B	216	West-L
	PM	60	0.89	24	B	222	South-T
2031-OP2B No Clyde Bridge	AM	150	0.96	38	C	>500	West-L
	PM	50	0.86	23	B	133	South-T
2031- OP2B No Carnarvon Bridge	AM	100	0.90	19	B	362	West-L
	PM	70	0.94	26	B	218	South-T

The performance for Option 2B with all three bridges and for the Option 2B with No Carnarvon Street Bridge scenarios have approximately the same level of performance. An increased volume of traffic using the ramp in Option 2B with No Clyde Street Bridge result in higher delays in the AM peak.

However, as noted for Intersections I-03B (James Ruse Drive and M4 Off-ramp) and I-05 (James Ruse Drive and Parramatta Road), further assessment is recommended using a network model that can balance the intersection impacts with the time saving of the rat-run with the bridge across the Parramatta River. i.e. these delays may not be as high in reality, with constraints up-stream limiting the volume of traffic that can enter the ramp.

The intersection lane configuration tested is shown in Figure D.53.

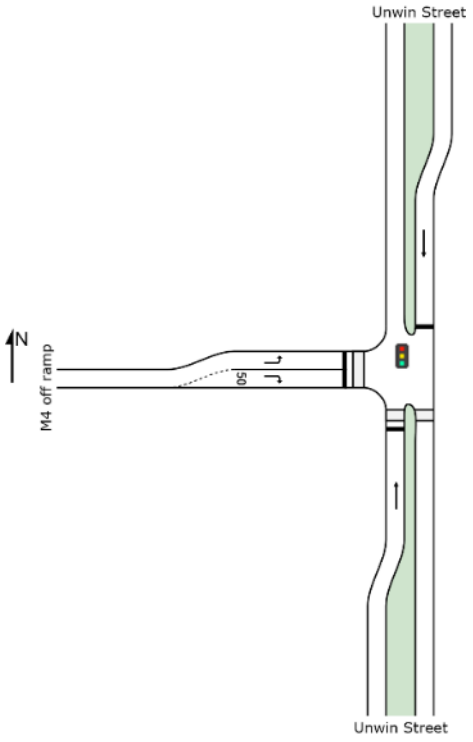


Figure D.53 At-grade upgrades required for M4 off ramps/Unwin Street – V1

D2.16 I-15 GRAND AVENUE AND THACKERAY STREET

The impacts on the intersection of Grand Avenue and Thackeray Street are shown in Table D.72.

The heavy right-turn movement from the Clyde Street Bridge towards the Parramatta River Bridge increases congestion at the intersection in the Option 2B (all three bridges) and Option 2B No Carnarvon Street Bridge option. The No Clyde Street Bridge has reduced through-traffic through this intersection, and performs better with a reduced intersection footprint.

Table D.72 I-15 Grand Avenue and Thackeray Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B (V5)	AM	150	0.89	32	C	82	North-L
	PM	150	1.08	134	F	>500	East-R
2031-OP2B No Clyde Bridge (V5)	AM	150	0.86	31	C	162	North-R
	PM	50	0.92	29	C	148	North-R
2031-OP2B No Carnarvon Bridge	AM	150	0.94	42	C	365	North-L
	PM	150	0.97	620	E	446	North-R

The intersection lane configuration tested is shown in Figure D.54.

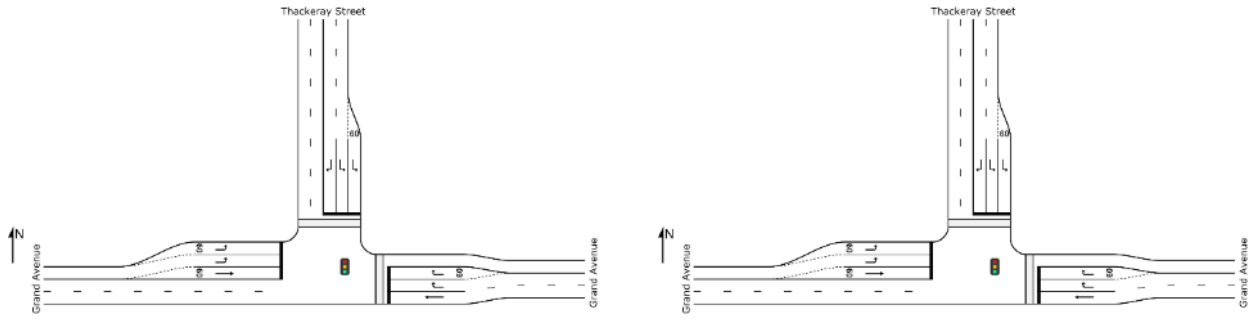


Figure D.54 At-grade upgrades required for Grand Avenue/Thackeray Street intersection –V5, V6

D3 ADDITIONAL INTERSECTION OPTIONS

SIDRA Intersection tests have considered the following options:

1 Silverwater Road G-Turn Options at the intersections with Carnarvon Street and Derby Street with the Light Rail

2 Silverwater Road G-Turn Options at the intersections with Carnarvon Street and Derby Street without the Light Rail

3 Silverwater Road/Clyde Street – reduced turn movement test. Reassess intersection capacity in current layout or with minor modifications as a second Duck River crossing.

D3.1 I-08 SILVERWATER ROAD AND CARNARVON STREET WITH CAMELLIA PRECINCT REZONING AND G-TURN

Without Rezoning

The existing layout will experience high congestion with future base volumes (no development), as shown in Table D.73. Upgrades are therefore required.

Table D.73 I-08 Silverwater Road and Carnarvon Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-BC	AM	140	**1.4**	308	**F**	1800	South-T
	PM	140	**1.1**	122	**F**	630	North-T

To reach acceptable levels of operation, the upgrades shown in Figure D.55. These upgrades produce results that are barely acceptably and are due to the excessive demand along the Silverwater Road corridor. With a combined total of 5,000 vehicles in the AM peak and 3,600 during the PM peak travelling north and south along Silverwater Road, it is concluded that this intersection will require upgrades even without the introduction of the Camellia development, as shown in Table D.74.

Table D.74 I-08 Silverwater Road and Carnarvon Street: without Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-BC – V1	AM	140	**1.1**	85	**F**	740	South-T
	PM	110	0.9	50	D	255	South-T

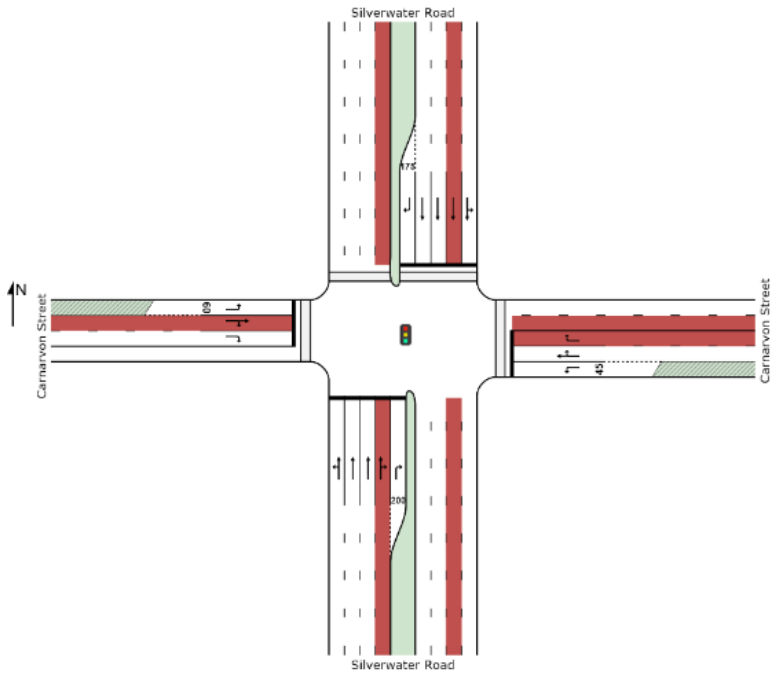


Figure D.55 At-grade upgrades required for Silverwater Road/Carnarvon Street intersection – V1

With Camellia Rezoning

Upgrade are required due to 2021 development volumes due to capacity limits of the existing layout. Results are shown in Table D.75.

Table D.75 I-08 Silverwater Road and Carnarvon Street: with Camellia Precinct

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2021-OP1	AM	140	**1.8**	570	**F**	2000	South-T
	PM	140	**1.5**	460	**F**	1220	North-R

With the Camellia development increasing volumes to 8,000 and 9,000 vehicles per hour through this intersection for the medium and high growth scenarios respectively, upgrades are required. The upgrades shown in Figure D.56 reveal that the main issues are the Silverwater Road corridor and generated traffic volumes due to the development. Together these will create large demands that the intersection requires additional upgrades. Results are shown in Table D.76.

Table D.76 I-08 Silverwater Road and Carnarvon Street: with Camellia Precinct, upgraded

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – V1	AM	140	**1.0**	66	**E**	570	South-T
	PM	140	0.9	56	**E**	300	East-T

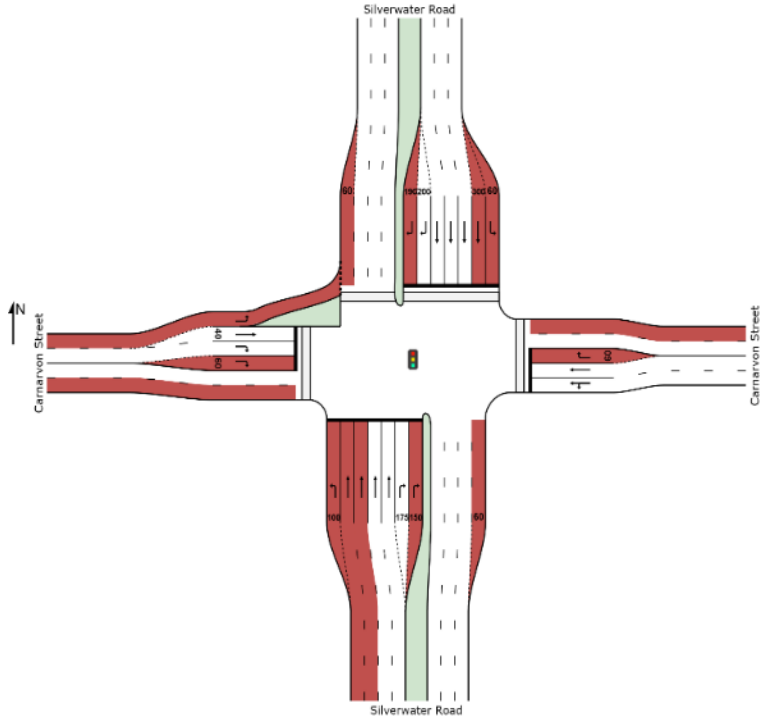


Figure D.56 At-grade upgrades required for Silverwater Road/Carnarvon Street intersection – V1

With Camellia Rezoning and G-Turn

The signalisation of the intersection of Silverwater Road and Derby Street conversion of the intersection with Carnarvon Street to through and left only (a G-turn arrangement) was tested. The network tested is shown in Figure D.57 below.

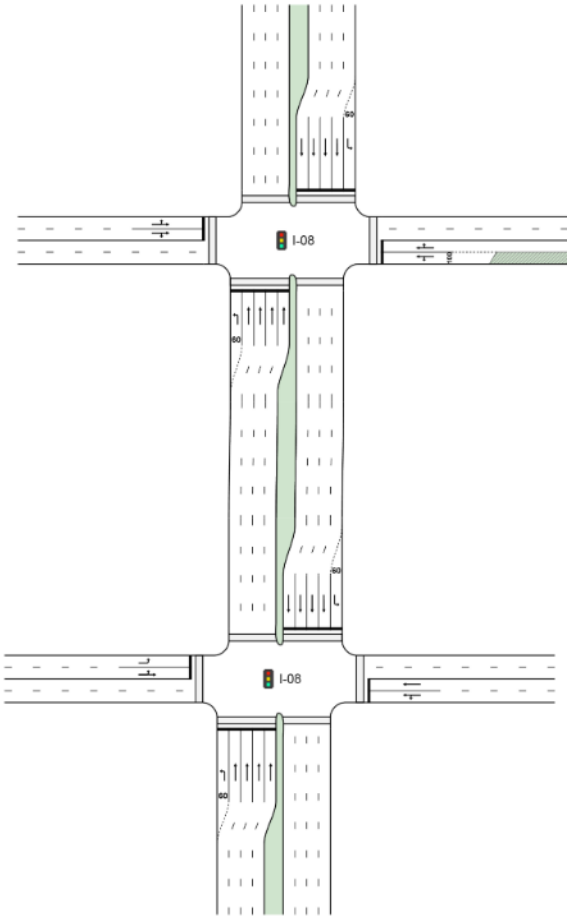


Figure D.57 G-turn upgrades required for Silverwater Road/Carnarvon Street intersection

The results are shown in Table D.77 and Table D.78. Some overall observations include:

- Overall delays for through movement decrease apart from the northbound direction in the AM peak, which increases by 100 seconds due to additional signals and delay source/queuing.
- Some left-turns become overloaded (turn movements to be confirmed using mesoscopic model).

Table D.77 I-08 Silverwater Road and Carnarvon Street: with Camellia Precinct, with G-Turn

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – G-Turn	AM	140	**1.1**	89	**F**	840	South-T
	PM	140	1.0	33	**C**	467	East-T

Table D.78 I-08A Silverwater Road and Derby Street: with Camellia Precinct, with G-Turn

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – G-Turn	AM	140	**1.4**	67	**E**	750	West-T
	PM	140	1.0	34	**C**	467	North-T

The G-turn option may have other benefits outside performance, including reduced road widening.

D3.2 I-08 SILVERWATER ROAD AND CARNARVON STREET WITH CAMELLIA PRECINCT REZONING, G-TURN AND LIGHT RAIL ON CARNARVON STREET

The signalisation of the intersection of Silverwater Road and Derby Street conversion of the intersection with Carnarvon Street to through and left only (a G-turn arrangement) and light rail lanes on Carnarvon Street was tested. The network tested is shown in Figure D.58 below.

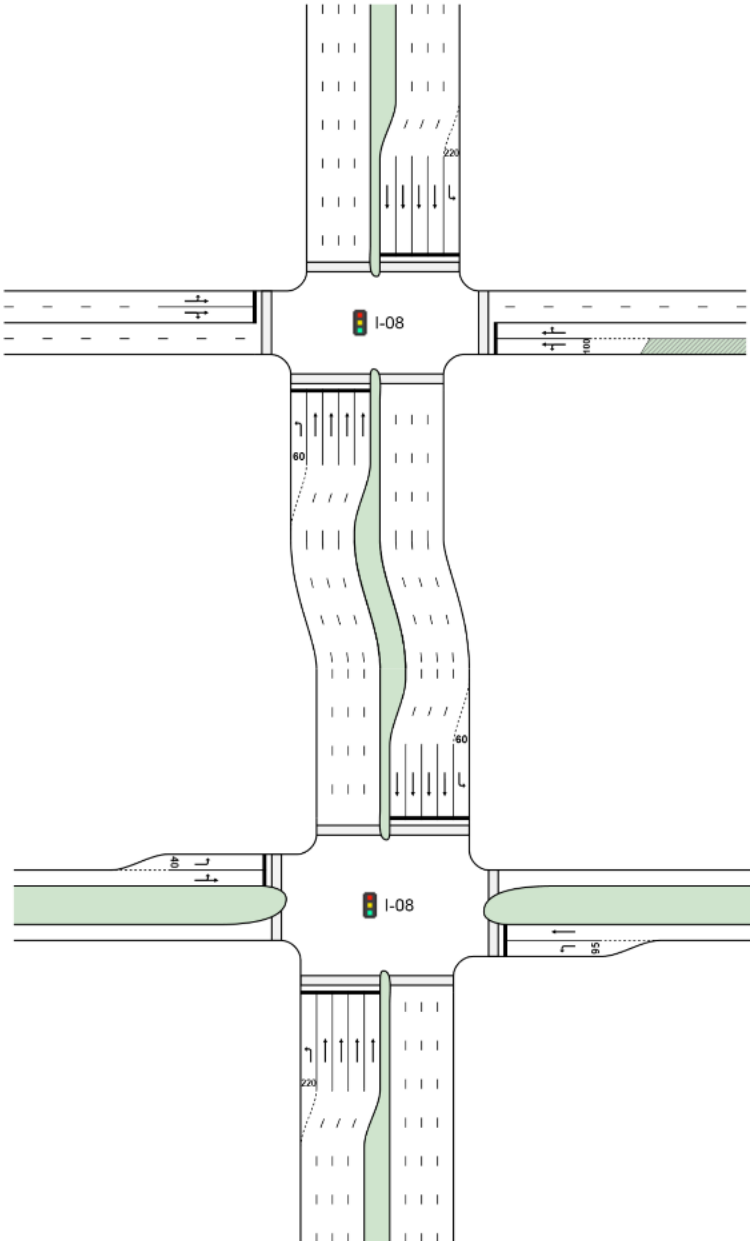


Figure D.58 G-turn and light rail upgrades required for Silverwater Road/Carnarvon Street intersection

The results are shown in Table D.79 and Table D.80. Some overall observations include:

- Delays deteriorate further with the light rail taking space from Carnarvon Street, especially in the PM peak
- Some left-turns become overloaded (turn movements to be confirmed through additional simulation modelling).

Table D.79 I-08 Silverwater Road and Carnarvon Street: with Camellia Precinct, with G-Turn and light rail

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – G-Turn	AM	140	**1.3**	157	**F**	1,040	South-T
	PM	140	**1.5**	89	**F**	1,410	East-T

Table D.80 I-08 Silverwater Road and Derby Street: with Camellia Precinct, with G-Turn and light rail

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B – G-Turn	AM	140	**1.5**	65	**E**	690	West-R
	PM	140	**1.2**	53	**D**	450	West-R

While overall performance is lower, this may still be better that attempting to accommodate all movements and right-turns at this intersection.

D3.3 I-09 SILVERWATER ROAD AND CLYDE STREET WITH CAMELLIA PRECINCT REZONING, AND ONE BRIDGE AT CLYDE STREET – REDUCED TURN MOVEMENT TEST

The impacts on the intersection of Silverwater Road and Clyde Street were previously shown in Table D.65.
The largest cause of congestion along the corridor is the potential growth in north-south traffic along Silverwater Road, regardless of whether the Camellia Precinct is redeveloped or not. The No Carnarvon Street Bridge scenario results in lower impacts at this intersection in the AM peak compared to Option 2B with all three bridges. However, performance was still poor.

However, if a reduced amount of movement is provided by making Clyde Street left-out only (i.e. by diverting right-turning and through movements to streets further south to Holker Street) a substantial improvement in performance can be achieved, as shown in Table D.81.

Table D.81 I-09 Silverwater Road and Clyde Street

Scenario	Period	Cycle	DoS	Ave. Delay	LoS	Max. Queue (m)	Queue Loc.
2031-OP2B (V5)	AM	140	1.24	177	F	>500	North-T
	PM	140	1.10	92	F	>500	South-T
2031- OP2B No Carnarvon Bridge (V5)	AM	140	1.18	148	F	>500	North-T
	PM	140	1.04	71	F	>500	South-T
2031- OP2B No Carnarvon Bridge, Clyde Street left only (V6)	AM	140	0.93	31	C	>500	North-T
	PM	140	1.08	38	C	>500	South-T

The intersection lane configuration tested is shown in Figure D.59.

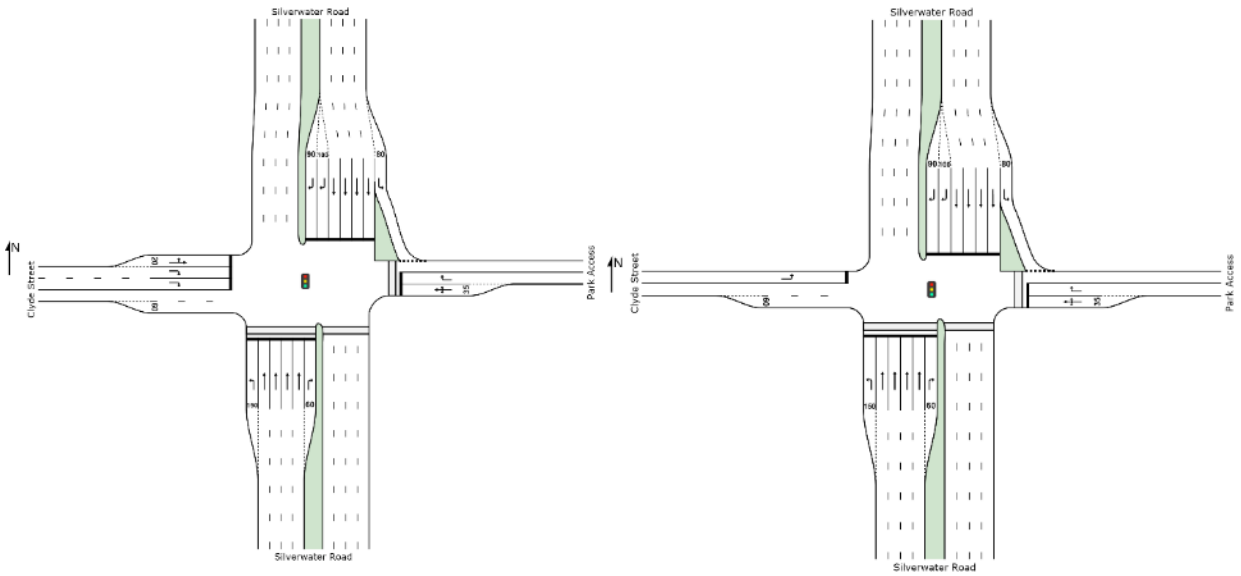


Figure D.59 At-grade upgrades required for Silverwater Road/Clyde Street intersection – V5, V6

Note that this still requires the upgrading of Silverwater Road, the Silverwater Road Bridge and intersection improvements. The impact on the operation of the intersection of Silverwater Road and Holker Street has not been tested. However, this intersection is already congested and is likely to experience increased delays on the Holker Street western approach due to this option.

APPENDIX E

POTENTIAL ROAD IMPROVEMENT LAYOUTS

E1 INDICATIVE PROPOSED ROAD UPGRADES

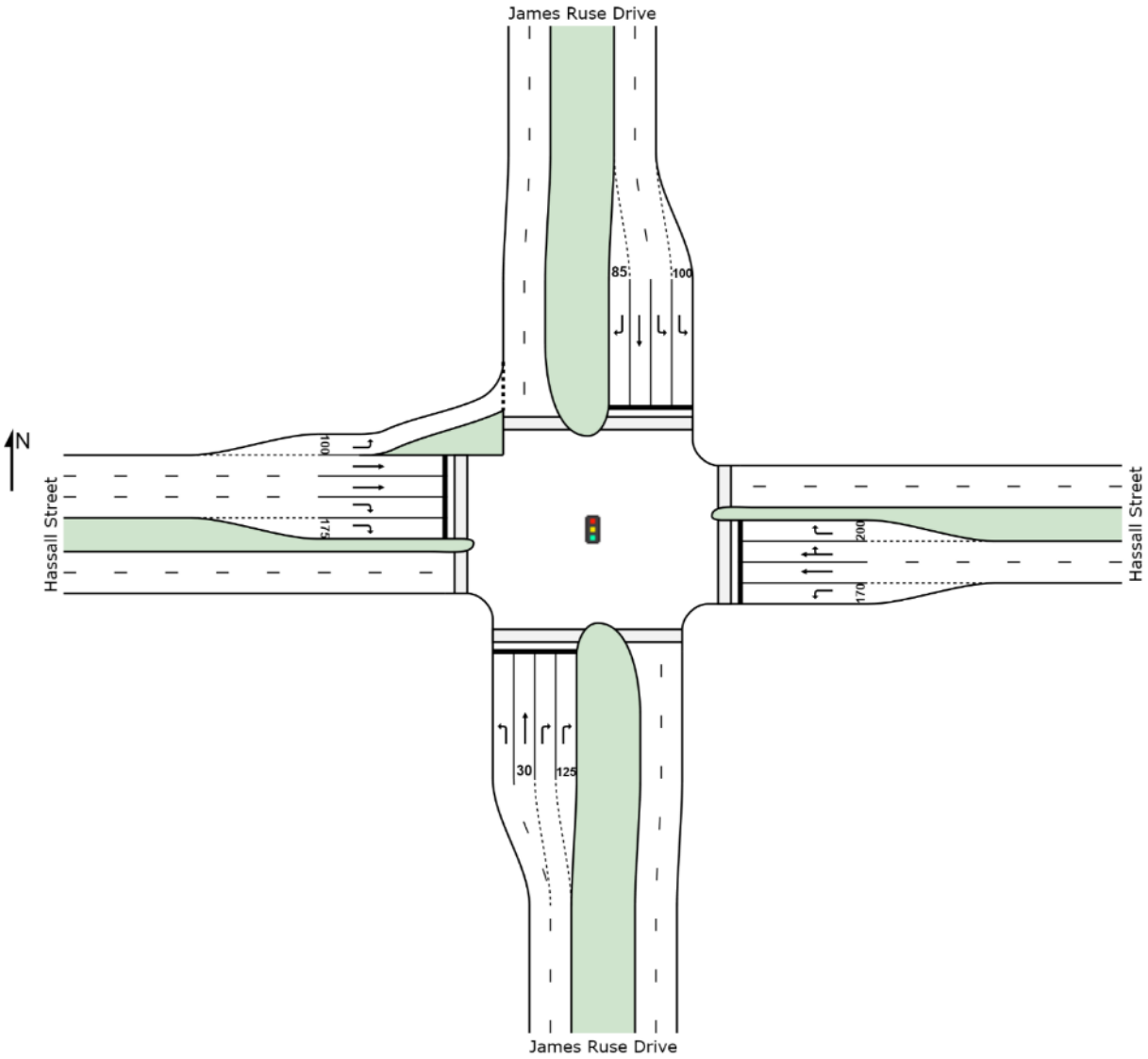


Figure E.1 Intersection of James Ruse Drive and Hassall Street (James Ruse Drive through movements grade separated)

Source: Roads and Maritime Services, 2016

Figure E.2 Proposed Roads and Maritime Grade Separation design

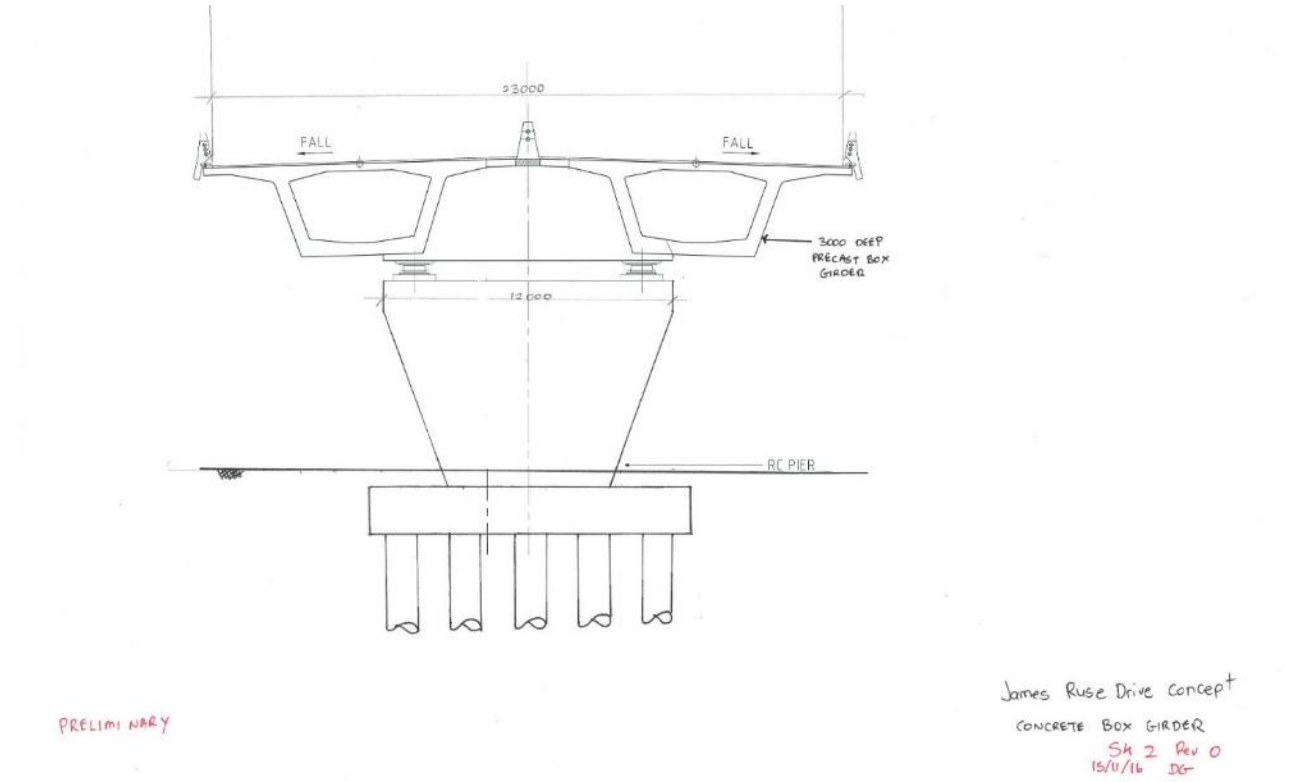
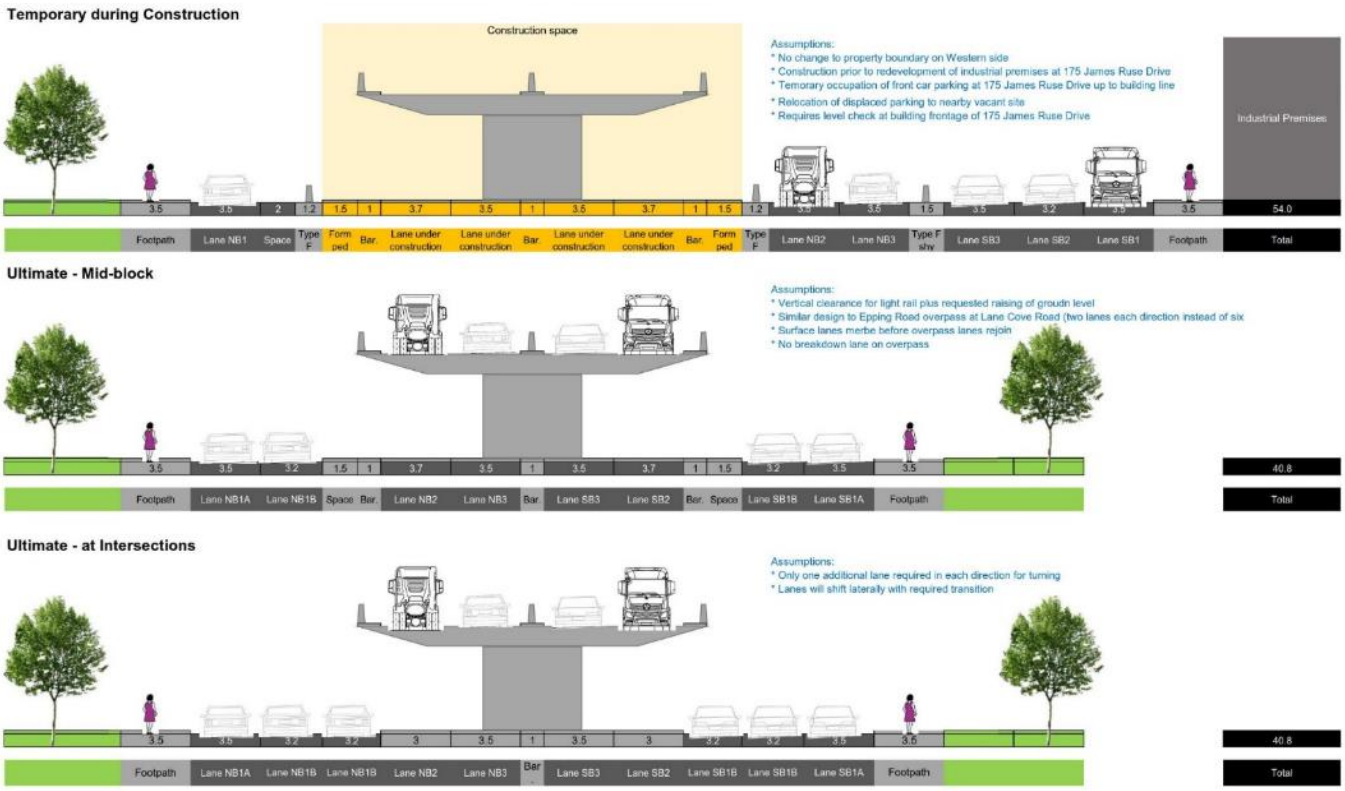


Figure E.3 Revised James Ruse Drive Overpass – Deck Cross-Section (Indicative only)



Notes Refer to Figure E.3 for detail of bridge deck section

Figure E.4 James Ruse Drive – Surface Road (Indicative only)

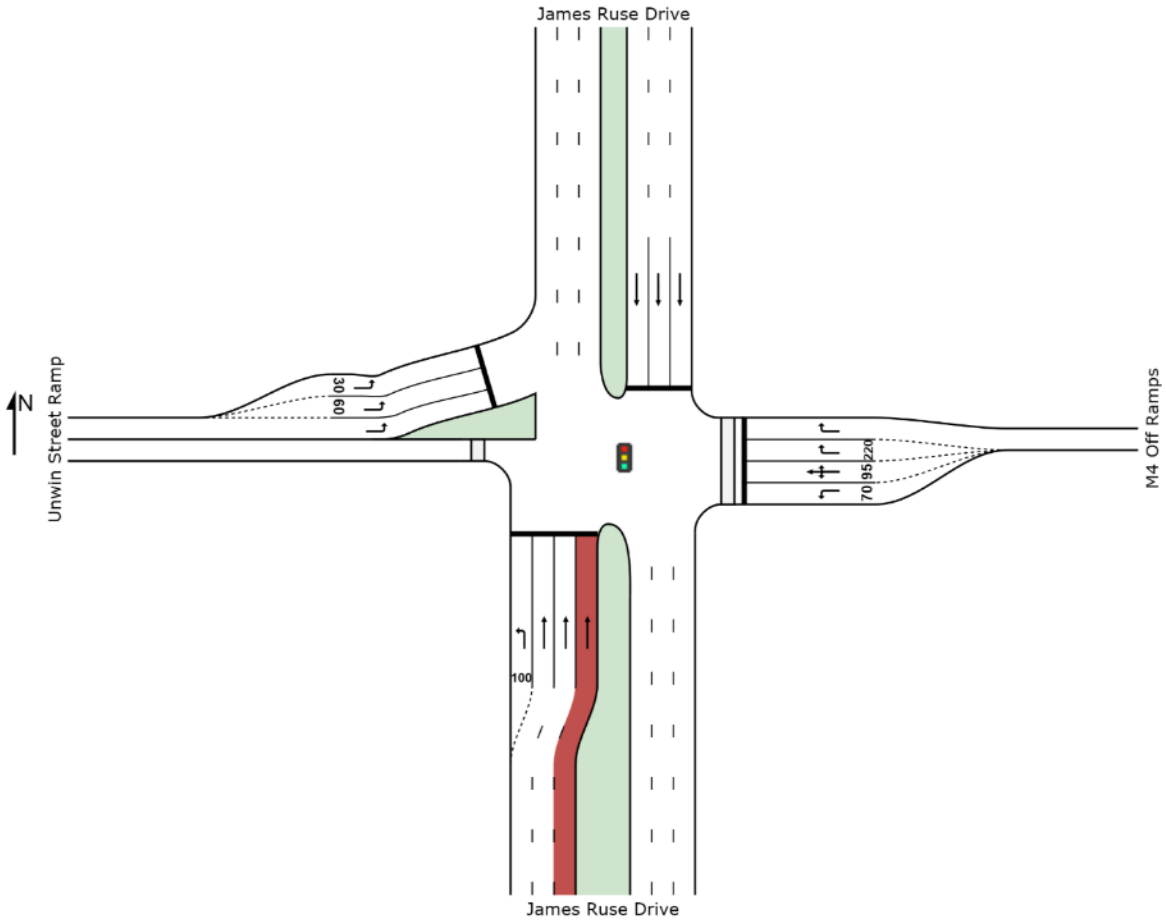


Figure E.5 Intersection of James Ruse Drive M4 Ramps and Unwin Street Ramp (Note – Geometry with WestConnex to be checked)

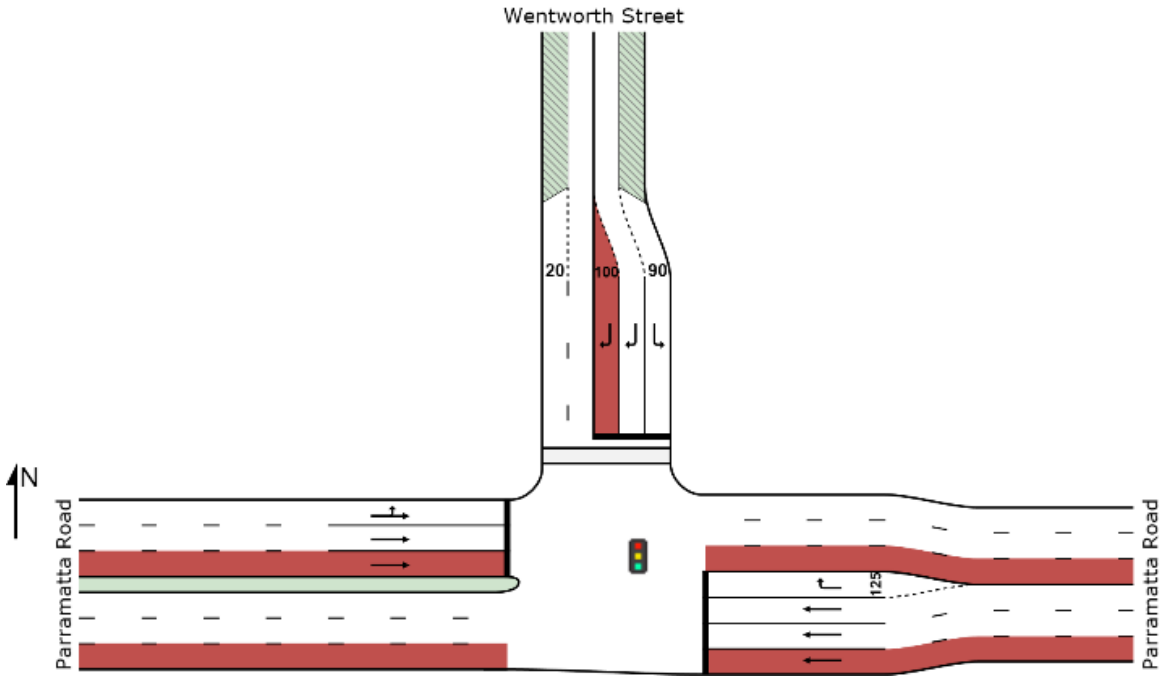


Figure E.6 Intersection of Parramatta Road and Wentworth Street

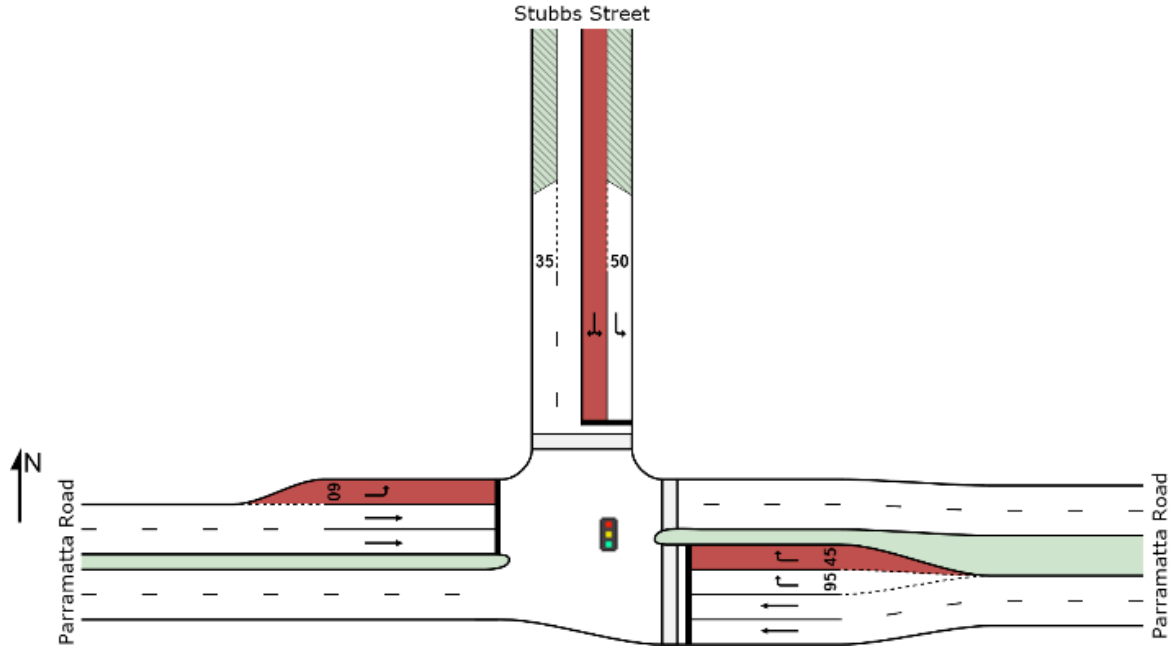


Figure E.7 Intersection of Parramatta Road and Stubbs Street

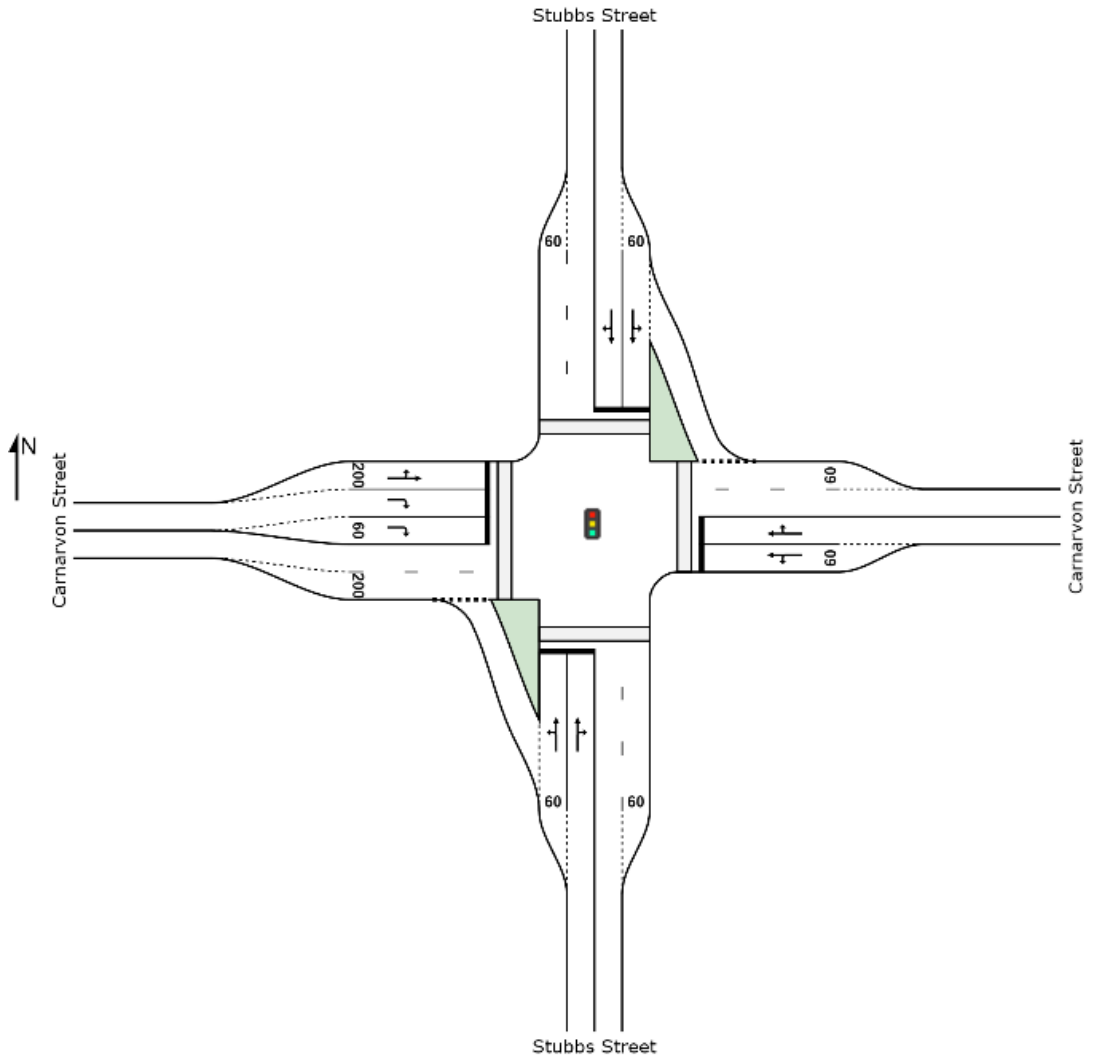


Figure E.8 Intersection of Carnarvon Street and Stubbs Street

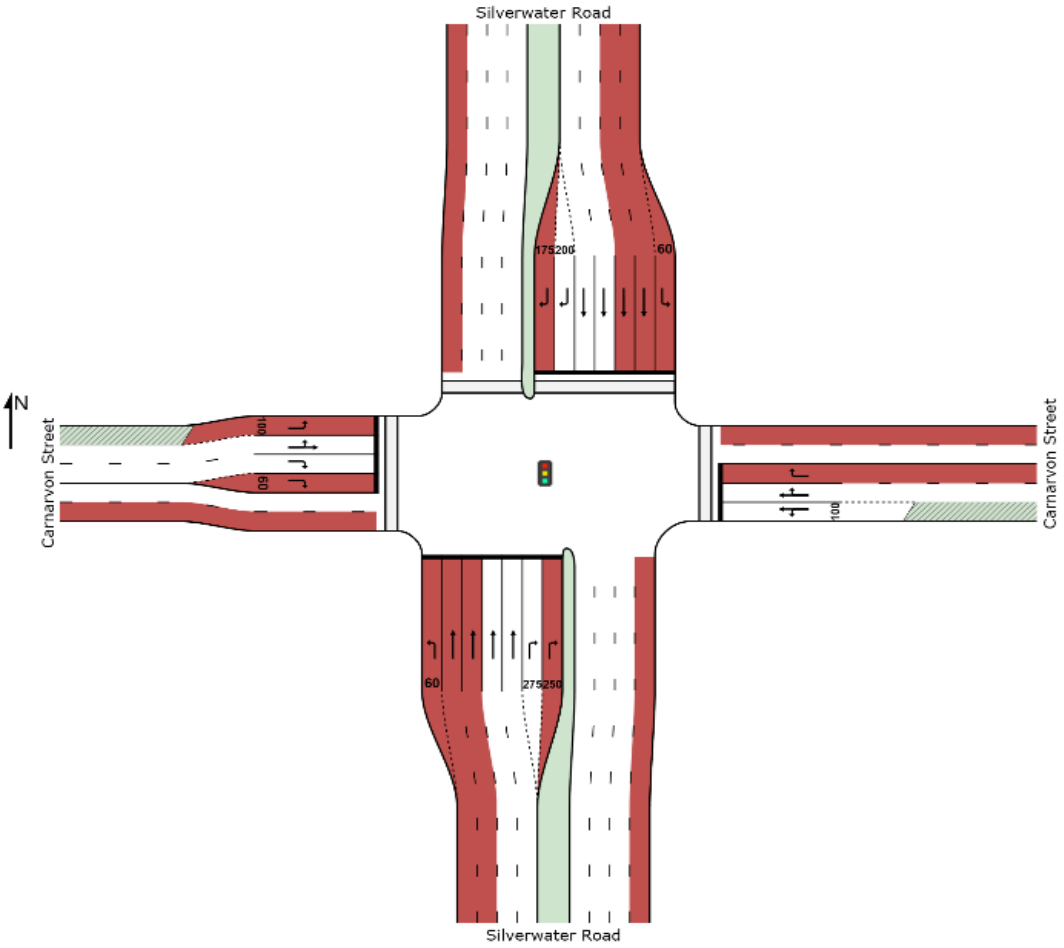


Figure E.9 Intersection of Silverwater Road and Carnarvon Street

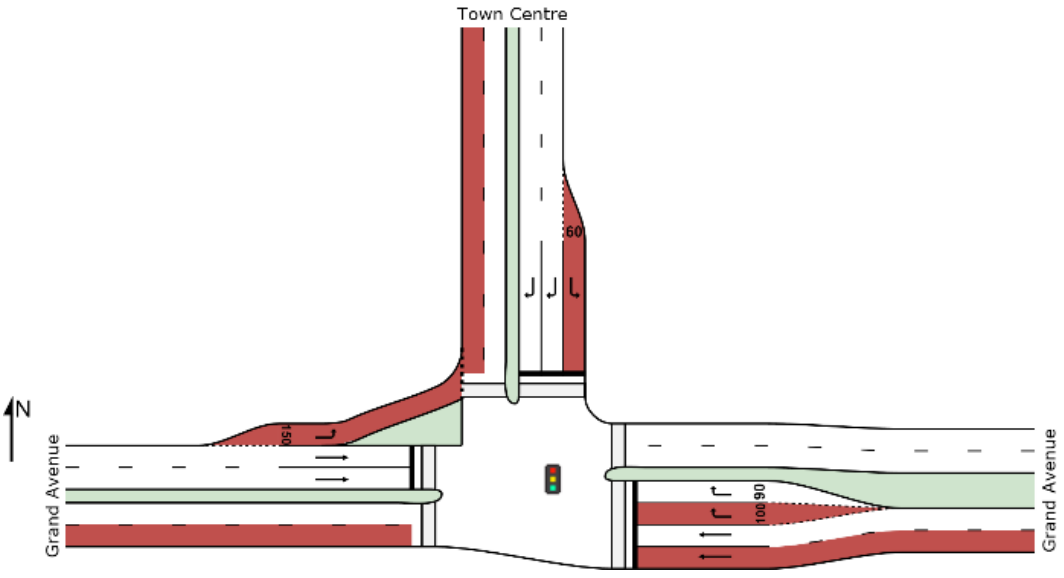


Figure E.10 Intersection of Grand Avenue and Town Centre Street

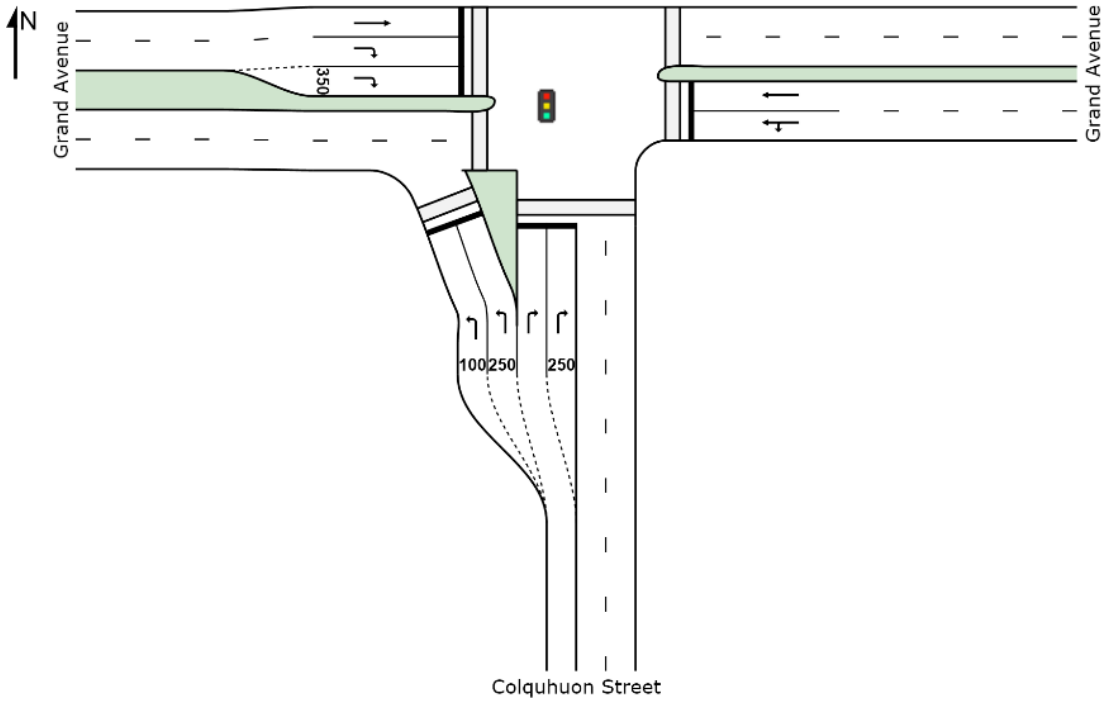


Figure E.11 Intersection of Grand Avenue and Colquhoun Street