File: IW-250.60.014 Doc: IC20/22

ITEM 2 DRAFT KEIRAVILLE GWYNNEVILLE ACCESS AND MOVEMENT STUDY

The draft Keiraville - Gwynneville Access and Movement Study has been completed following the community-led development of the Keiraville - Gwynneville Implementation Plan. The study examines issues affecting the traffic and transport system within the precinct through extensive stakeholder engagement, data collection, literature review, site investigations and motor vehicle traffic analysis. It also proposes actions to improve the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development.

The draft study has been prepared with significant input from the local community and other key stakeholders. This report recommends public exhibition of the draft Keiraville - Gwynneville Access and Movement Study.

RECOMMENDATION

1 The draft Keiraville - Gwynneville Access and Movement Study Overview and Consultant Report be placed on public exhibition for a period of six weeks.

2 Following the public exhibition period, a final draft Keiraville - Gwynneville Access and Movement Study Overview incorporating community feedback be presented to Council for adoption.

REPORT AUTHORISATIONS

Report of: Mark Roebuck, Manager City Works
Authorised by: Andrew Carfield, Director Infrastructure + Works - Connectivity Assets + Liveable City

ATTACHMENTS

1 Draft Keiraville – Gwynneville Access and Movement Study Overview
2 Keiraville – Gwynneville Access and Movement Study - Consultant Report

BACKGROUND

Neighbourhood Forum 5, with input from the community, University of Wollongong and Council developed the “Keiraville - Gwynneville Community Planning Project Report”, which was considered by Council at its meeting of 28 April 2014. Council endorsed the report’s ten (10) vision statements for the precinct. On 24 August 2015 Council endorsed the subsequent “Keiraville - Gwynneville Implementation Plan” comprised of a number of key actions, in particular:

> *An Access and Movement Study to be prepared to investigate a range of matters relating to traffic in the area, with a focus on:*
>
> - *Traffic capacity in context of key destinations UOW; Hospital; Botanic Gardens; City Centre;*
> - *Parking;*
> - *Pedestrian Access and Safety.*

Council and the University of Wollongong allocated funding to commence a “Keiraville - Gwynneville Access and Movement Study” in 2017. Following a competitive tender process, Cardno (NSW/ACT) Pty. Ltd. were engaged to undertake the study based on the following key objectives:

- Examine and document the existing and future potential operation of the traffic and transport system within the suburbs of Keiraville and Gwynneville; and
- Develop strategies to improve the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development.

In order to identify issues affecting the traffic and transport system of Keiraville and Gwynneville, the consultant, with support from Council, carried out significant engagement with the local community and other key stakeholders (refer to the 'Consultation and Communication' section of this report). Furthermore, data was collected from a range of sources including on-site surveys of traffic and parking, site inspections, computer traffic simulations and reviews of other government plans and strategies. The study lists the following key issues relating to each of the transport modes:

Key Pedestrian Issues

- Lack of footpaths in various streets
- Uneven and cracked footpaths in several locations
- Pedestrian signage and wayfinding are limited
- Lack of safe pedestrian crossings
- Existing crossing facilities that don't meet current standards
- Limited connections exist to the east of the UOW campus
- Difficult to access Mount Ousley Area from UOW
- Street lighting is limited in some areas.

Key Cycling Issues

- Missing paths in a number of routes between key destinations
- Missing connection between Mount Ousley and UOW
- Missing connections between east and west of the rail line
- Lack of secure bike parking at key destinations
- Lack of end of trip facilities at UOW
- Wayfinding signs missing on some routes
- Existing roundabouts can be difficult for cyclists to use safely due to topography and vehicle speeds

Key Public Transport Issues

- Infrequent route bus services
- Poor levels of on-time running
- Bus services during peak periods are overcrowded
- Poor integration of bus services with train timetables
- Shuttle services are limited outside of peak and session
- Lack of shelter and accessible infrastructure at bus stops
- Poor connectivity of bus services with surrounding suburbs
- Poor frequency of train services in both directions
- Poor alignment of train services with UOW schedule.

Key Vehicle Network Issues

- There is congestion in various streets within the study area including:
    - Various University Avenue intersections
    - Queuing along Mount Ousley Road in the peak hours

  - The UOW Ring Road
  - Foley Street
- Some drivers use minor streets to avoid congestion
- Vehicles speeds are of concern to community members.

Key Car Parking Issues

- Parking utilisation is very high in the streets south of the UOW campus, including Keiraville village
- Two-hour parking spaces are not long enough for students attending lectures;
- Accessible parking is not provided in the village centres
- Lack of enough pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park
- Parking close to key destinations is often heavily utilised by employees
- Vehicles are often parked over driveways
- High amount of unrestricted parking provided in residential areas near the University
- Poor sightlines at some intersections within the precinct due to vehicles parking too close
- Multi occupancy dwellings and student accommodation generate street parking demand
- Significant numbers of vehicles parking illegally throughout the study area
- A number of residential streets throughout the study area which have been reduced to one lane in each direction due to parking on both sides of the road.

The study identifies a range of actions for the traffic and transport system in order to address the above issues. These actions, categorised by mode of travel, are provided below:

Pedestrian Actions

- Provide compliant pedestrian refuge island at roundabouts.
- Ensure that all crossing facilities comply with Australian Standards (upgrade where needed).
- Provide a direct pedestrian connection towards the north and east of UOW.
- Provide wayfinding to key destinations including train stations, UOW, key centres and recreation facilities.
- Provide increased pedestrian priority within the village centres.
- Provide increased marketing especially in schools, workplaces and town centres to show the benefits of walking and cycling.
- Review street lighting with respect to pedestrian needs
- Include suggested footpath locations in future programs.

Cycling Actions

- Include suggested shared path locations in future programs.
- Work with Transport for NSW (TfNSW) to investigate active transport connection across train line close to Beaton Park.
- Provide improved cycling wayfinding on the key regional cycle routes.
- Provide a widened shared path through Wiseman Park in line with the Fairy Creek Corridor Master Plan.

- Provide increased number of secure and undercover bicycle parking at key land uses such as the UOW, Keiraville and Gwynneville village centres, Beaton Park, the local schools and off-street parking locations.

Motor Vehicle Actions

- Realignment of roundabout at Murphys Avenue and Robsons Road.
- Undertake safety around schools assessments.
- Advocate for implementation of the Mount Ousley Interchange project.
- Investigate traffic calming measures on Robsons Road to manage vehicle speeds, particularly on the north and south downhill sections to the Gipps Rd intersection.
- Investigate intersection improvements
- Investigate traffic calming improvements
- Investigate roundabout installation at Braeside Avenue - Murphys Avenue to reduce vehicle speed
- Investigate safety improvements on University Avenue.

Car Parking Actions

- Investigate the provision of marked parking bays to increase the efficiency of parking spaces within the precinct.
- Review timed parking, pick up and drop off and special parking restrictions surrounding key destinations.
- Review ranger patrols to ensure all vehicles abide by the corresponding parking restrictions.
- Investigate introduction of paid parking in close vicinity of the University.
- Develop a special event parking and traffic management plan for significant events at Beaton Park.
- Monitor school kiss and ride zones to prevent parking and expand as required to support demand.
- Investigate wayfinding opportunities to parking at attractors such as Beaton Park and the Botanic Garden.
- Work with schools to manage parking and safe drop off/pick up.

Public Transport Actions

- Advocate for extension of bus service times and frequency.
- Work with TfNSW to:
    - investigate bus priority infrastructure
    - better integrate bus and train timetables
    - ensure adequate capacity of bus services.
- Provide improved bus stop facilities.
- Advocate for direct bus services between key trip attractors.
- Advocate for retention of local shuttle bus services.

PROPOSAL

It is proposed that Council endorse the draft Keiraville - Gwynneville Access and Movement Study to be placed on public exhibition for a period of six (6) weeks. Following community feedback, a final draft Keiraville - Gwynneville Access and Movement Study Overview incorporating public comments, will be reported to Council for adoption.

CONSULTATION AND COMMUNICATION

Council engaged with a range of stakeholders including residents, businesses and several organisations throughout the completion of this study via:

- Letters to tenants, owners and other stakeholders
- Visits to all businesses in the study area
- Face-to-face meetings with key stakeholders
- The Have Your Say web page which included a mapping tool, FAQ page, feedback form and document library.

Four workshops were also held with representatives from a range of stakeholders including community members at key points in the study process. The purpose of workshop one, was to present an overview of the existing transport network to the community and to capture any specific comments or concerns that the community and key stakeholders had. The key stakeholders were given the opportunity to comment on:

- Expectations for the transport network and the project;
- Any issues with the existing transport network; and
- Potential solutions to mitigate transport issues.

A second workshop provided stakeholders with an update of the project tasks completed, information on key deficiencies of the existing network and potential opportunities. At workshop three, stakeholders were updated on the progress of the project including issues analysis, solutions development, and the prioritisation process. Subsequently, a supplementary workshop was held to review, refine and add value to proposals that were put forward in previous sessions.

Overall, there were 242 issues raised by members of the community, the majority of which concerned car parking.

PLANNING AND POLICY IMPACT

This report contributes to the delivery of Our Wollongong 2028 goal “We have affordable and accessible transport”.

It specifically delivers on core business activities as detailed in the Transport Services Service Plan 2019-20.

FINANCIAL IMPLICATIONS

Costs associated with the public exhibition of the draft study will be funded from an existing operational budget allocation.

Implementation associated with the various actions listed in the study will be considered against city wide priorities through the city-wide annual planning and infrastructure delivery process. Actions may also be eligible for funding under various NSW Government and Australian Government grant programs.

CONCLUSION

The draft Keiraville - Gwynneville Access and Movement Study was undertaken in partnership with Neighbourhood Forum 5, the University of Wollongong and TfNSW and following the development of the community-led Keiraville - Gwynneville Implementation Plan. The study identifies a range of issues facing the various transport modes for the precinct and actions to address them following extensive stakeholder engagement, data collection, literature review, site investigations and motor vehicle traffic analysis. The public exhibition of the draft Plan will generate further valuable input from the community that will be incorporated into the final draft plan and reported to Council for adoption.

DRAFT
Keiraville - Gwynneville Access and Movement Study

Overview

wollongong
city of innovation

Contents

Background

Keiraville and Gwynneville will experience significant growth in the coming decades as a result of expansion of the education and health precinct in Wollongong. This future expansion will increase the number jobs and students in the region, therefore increasing demand for housing, infrastructure and transport.

Wollongong City Council commissioned a Keiraville–Gwynneville Access and Movement Study to improve understanding of existing and future access and transport demand in the area, and to mitigate the impacts of more growth through traffic and transport strategies to encourage sustainable travel behaviour and ease pressure on the transport network. Improvements for pedestrians, cycling, public transport, motor vehicles and car parking are recommended by this study.

Study Objectives

The University of Wollongong, Neighbourhood Forum 5 and Transport for NSW are partners in the study. These partners with Council jointly agreed to the objectives of the study that are to:

- Examine and document the existing and future potential operation of the traffic and transport system within the suburbs of Keiraville and Gwynneville; and
- Develop strategies to improve the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development.

Existing Parking Bay Linemarking

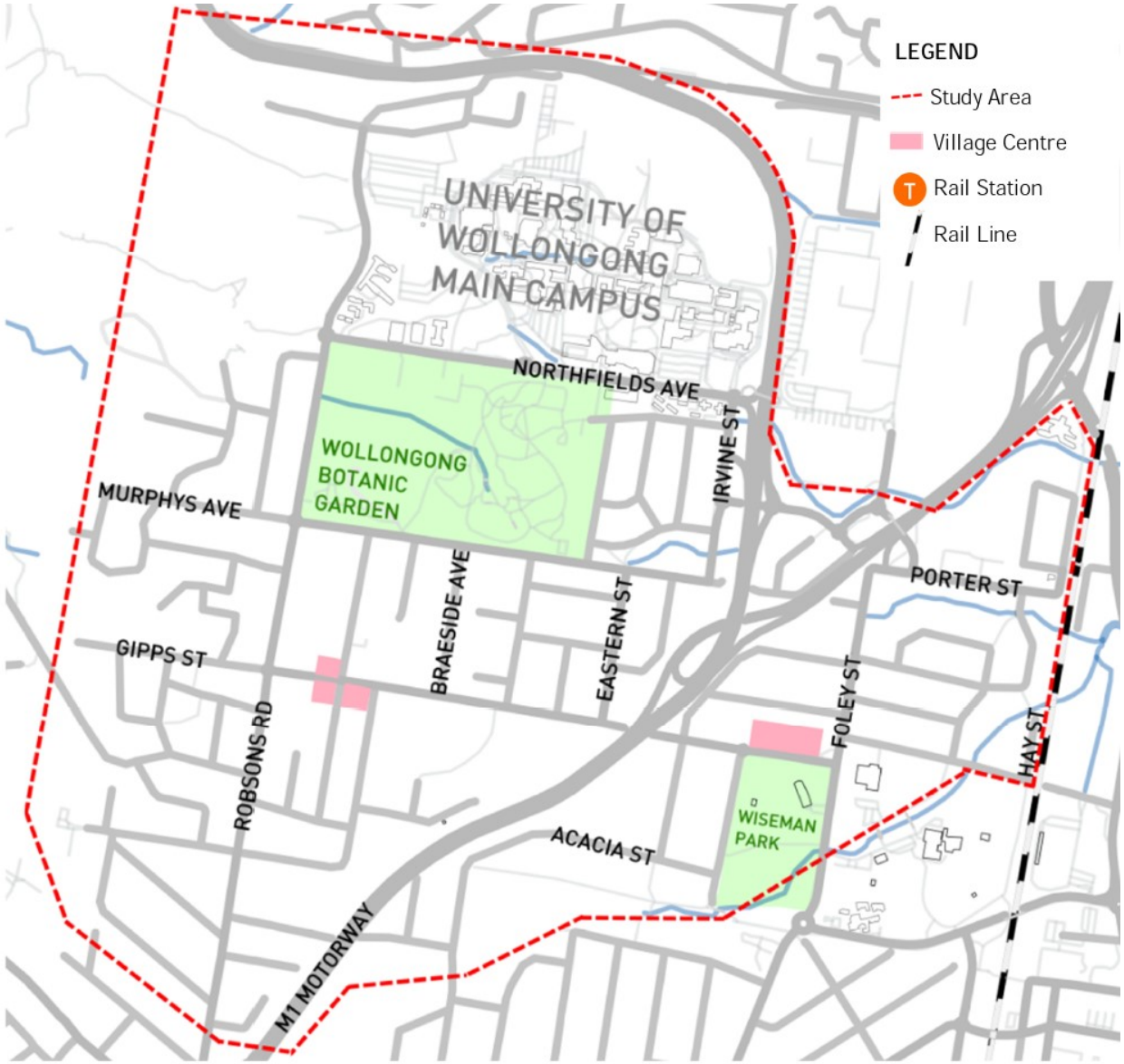
Keiraville Village Centre

Study Area

Keiraville and Gwynneville are located within the City of Wollongong, in the Illawarra region of NSW. The two suburbs lie between the Princes Motorway (M1) to the north and east, the Illawarra Escarpment State Conservation Area to the west, and extend south towards Mount Keira Road.

There are many important land uses that generate a high number of trips each day and influence access, movement demand and behaviour in the study area including:

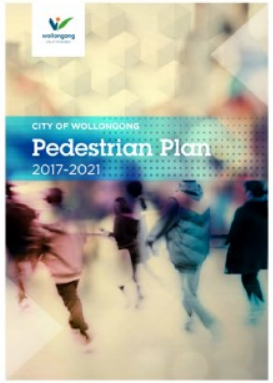
- Keiraville and Gwynneville village centres
- The University of Wollongong (UOW)
- Wollongong CBD
- Wollongong Hospital
- Wollongong Botanic Garden
- North Wollongong Railway Station
- TAFE Illawarra Wollongong Campus
- Mount Ousley residential area
- Local schools
- Sports and recreation facilities

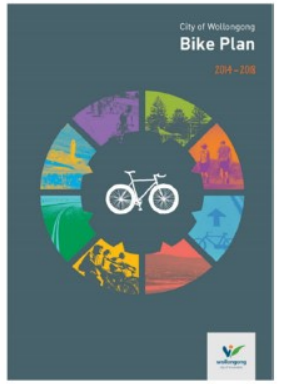


Strategic Context

The Keiraville and Gwynneville Access and Movement study was carried out in the context of planning work done for surrounding metro Wollongong area in order to recommend effective strategies to improve the overall transport network. Various Council and external plans, strategies and projects informed the study including:

- Keiraville – Gwynneville Implementation Plan
- Illawarra Shoalhaven Regional Plan
- Our Wollongong 2028 Community Strategic Plan
- City of Wollongong Bike Plan
- City of Wollongong Pedestrian Plan
- University of Wollongong 2016–2036 Wollongong Campus Master Plan
- Mount Ousley Interchange Project
- Beaton Park Regional Precinct Masterplan
- Fairy Creek Corridor Masterplan
- Wollongong City Centre Access and Movement Strategy





Existing Transport Network and Demand

The range of significant land uses both within and surrounding the study area are serviced by a transport network that includes walking, cycling, public transport and motor vehicle components. The network serves a range of trip purposes and has varying levels of demand.

Pedestrian Network

The footpath network in Keiraville–Gwynneville is limited, particularly away from UOW. The only roads that have footpaths on both sides of the road are Irvine Street, Northfields Avenue and Gipps Road. Most local streets have either a footpath on one side or no footpath at all.

On approach to Gwynneville village centre, footpaths are present on the north side of Gipps Road only. Keiraville village centre has footpaths provided on both sides of Gipps Road.

Pedestrian crossing facilities in the study area include a mixture of pedestrian refuges, zebra crossings, school crossings and signalised crossings. Pedestrian refuges are provided throughout the study area, particularly along Northfields Avenue, Robsons Avenue and Gipps Road. The majority of pedestrian refuges are located at roundabouts within splitter islands.

There are six zebra crossings, three school crossings, and six signalised pedestrian crossings located within the study area, four of which are located within the UOW campus.

Vickery Street Pedestrian Provisions

Public Transport Network

Bus routes servicing Keiraville and Gwynneville include three free shuttle buses and locally run services that provide connections throughout the study area and to nearby suburbs in the Illawarra and as far as Campbelltown and Port Kembla.

The free GK Shuttle bus service is operated by UOW and connects the campus with North Wollongong Station, the Wollongong CBD, Keiraville and Gwynneville. UOW also runs the free North Gong shuttle service which directly connects the UOW Northfields Avenue Bus Interchange with North Wollongong Station. This is the only bus route to service the bus stops on the UOW campus Ring Road; it connects passengers with trains arriving at North Wollongong Station.

The Gong Shuttle bus service is run by Transport for New South Wales, and connects the UOW campus with the Wollongong CBD, the Innovation campus and Fairy Meadow. This service is currently free, however a longer term decision on whether the service will remain free has yet to be made.

Local bus services connecting to Austinmer, Bulli, Campbelltown, Dapto and Shellharbour are provided by the following operators:

- Busabout, providing the 887 service to Campbelltown;
- Dion's Bus Service, providing services to Austinmer and Bulli;
- Premier Illawarra, providing services to the Wollongong CBD, Dapto, and Shellharbour.

Foley Street Gong Shuttle Stop

Road Network

The road network within and surrounding the study area consists of both major arterial and local roads. Local roads provide east–west access, while the Princes Motorway bisects the study area constraining connectivity. Access to the motorway is provided via on/off ramps located to the south east of the University, and to the north of North Wollongong station.

The traffic assessment of existing conditions found identified congestion at:

- Mount Ousley Road / Princes Motorway
- Irvine Street / University Avenue
- Princes Motorway / University Avenue

The impact of future traffic growth and the Mount Ousley Interchange upgrade roughly 10 years in the future was assessed using the AIMSUN computer simulation model. The Mount Ousley Interchange upgrade is predicted to remove congestion at Mount Ousley Road / Princes Motorway while providing a new access to the UOW campus. The modelling also predicts some reduction in traffic in the roads surrounding the University such as Robsons Road and Northfields Avenue. However, the results also indicate there could still be congestion issues at the Princes Motorway / University Avenue and nearby intersections, in future (2027) year with the Mount Ousley Interchange upgrade in place.

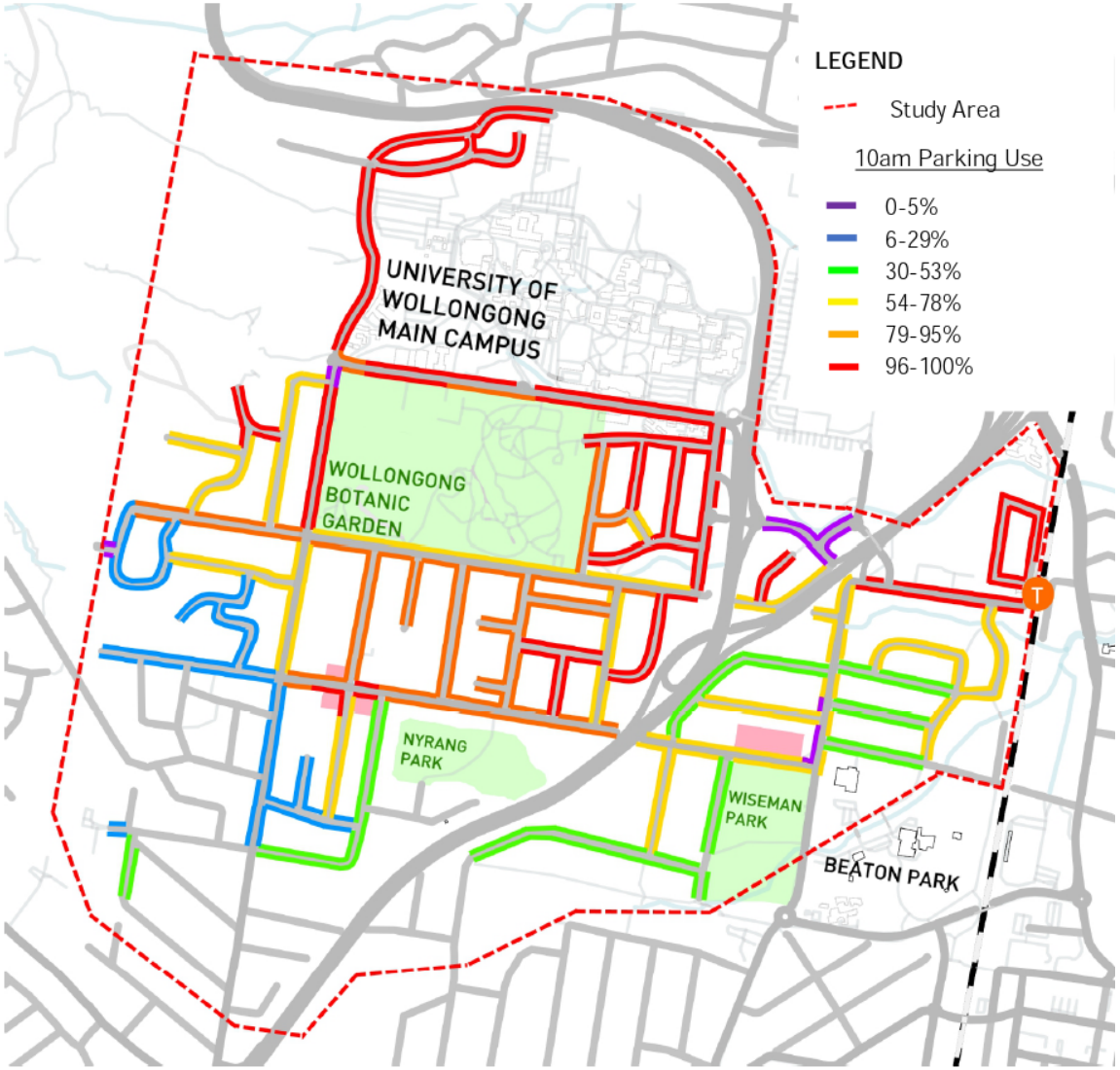
The modelling assessment also indicated that additional capacity is required at the Pacific Motorway / University Avenue and University Avenue / Porter Street intersections. Further investigations are recommended to investigate options to relieve congestion in this area.

University Avenue

Car Parking

High parking generating land uses within the study area include the UOW, Keiraville and Gwynneville village centres. A mixture of on and off-street options are available throughout the study area. Within the Keiraville village centre, one hour parking is available along Grey Street and Gipps Road. The parking situation is similar close to Gwynneville village centre, with one hour parking available along Gipps Road and Foley Street. Unrestricted parking is available further away from both village centres. Within the UOW campus, there are many parking options with varied capacities and parking types.

Surveys completed by UOW found that on average, both the carpool and ticketed car parks reached or exceeded capacity on all days. Reserved parking was found to be under-utilised on campus, with an average of 54% usage throughout the day. At the same time, ticketed, carpooling and permitted parking reached high levels of use.



Carparking Utilisation

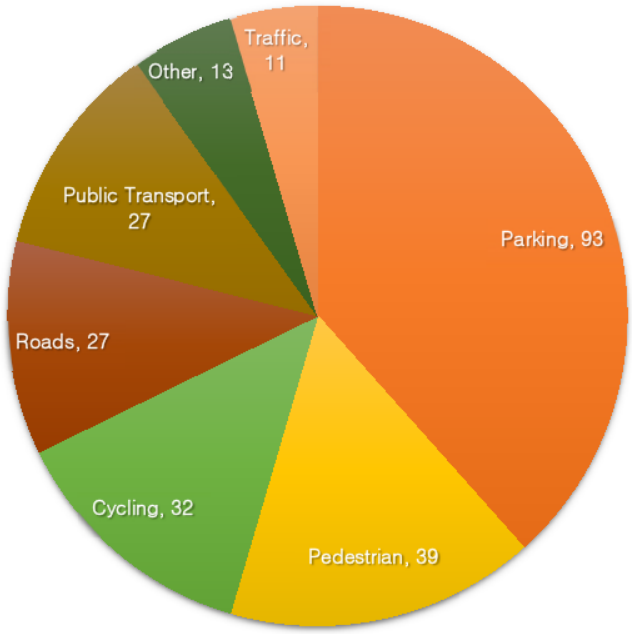
Stakeholder Engagement

Council engaged with a range of stakeholders including residents, businesses and several organisations throughout the completion of this study via:

- Letters to tenants, owners and other stakeholders
- Visits to all businesses in the study area
- Workshops and face-to-face meetings
- The *Have Your Say* web page which included a mapping tool, FAQ page, feedback form and document library.

Overall, there were 242 issues raised by members of the community, the majority of which concerned car parking.

Council, UOW, Transport for NSW, NF5 and other community members have worked together to draft up actions to address the issues identified during the study.



Types of issues raised by stakeholders

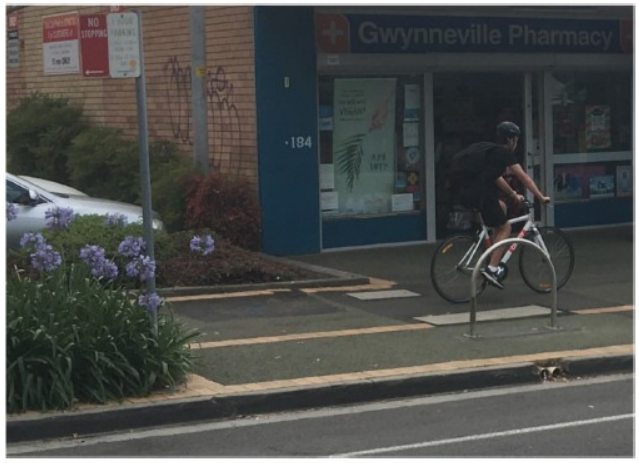
Key Transport Network Issues

In addition to issues raised by the community as part of the stakeholder engagement described above, data collected from a range of sources was used to identify key issues affecting the network including on site surveys of traffic and parking, site inspections, computer traffic simulations and reviews of other plans and strategies. The following sections of this document provide key issues identified.

Key Pedestrian Issues

- Lack of footpaths in various streets
- Uneven and cracked footpaths in several locations
- Pedestrian signage and wayfinding are limited
- Lack of safe pedestrian crossings
- Existing crossing facilities that don't meet current standards
- Limited connections exist to the east of the UOW campus.
- Difficult to access Mount Ousley Area from UOW
- Street lighting is limited in some areas

Gap in traffic island is too small to accommodate wheelchairs, prams or bicycles



Some cyclists ride on the footpath in lieu of a dedicated path or lane

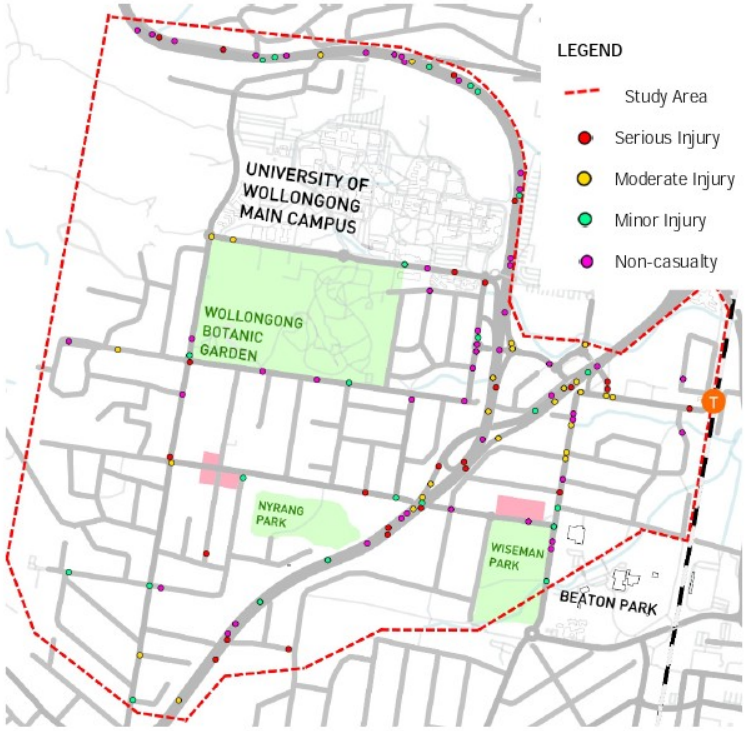
Key Cycling Issues

- Missing paths in a number of routes between key destinations
- Missing connection between Mount Ousley and UOW
- Missing connections between east and west of the rail line
- Lack of secure bike parking at key destinations
- Lack of end of trip facilities at UOW
- Wayfinding signs missing on some routes
- Existing roundabouts can be difficult for cyclists to use safely due to topography and vehicle speeds

Key Public Transport Issues

- Infrequent route bus services
- Poor levels of on–time running
- Bus services during peak periods are overcrowded
- Poor integration of bus services with train timetables
- Shuttle services are limited outside of peak and session
- Lack of shelter and accessible infrastructure at bus stops
- Poor connectivity of bus services with surrounding suburbs
- Poor frequency of train services in both directions
- Poor alignment of train services with UOW schedule

Few bus stops provide a boarding area or path that is accessible, the majority lack bus shelters



Crash data 2014 to 2018

Key Vehicle Network Issues

- There is congestion in various streets within the study area including:
  - Various University Avenue intersections
  - Queuing along Mount Ousley Road in the peak hours
  - The UOW Ring Road
  - Foley Street
- Some drivers use minor streets to avoid congestion
- Vehicles speeds are of concern to community members

Key Car Parking Issues

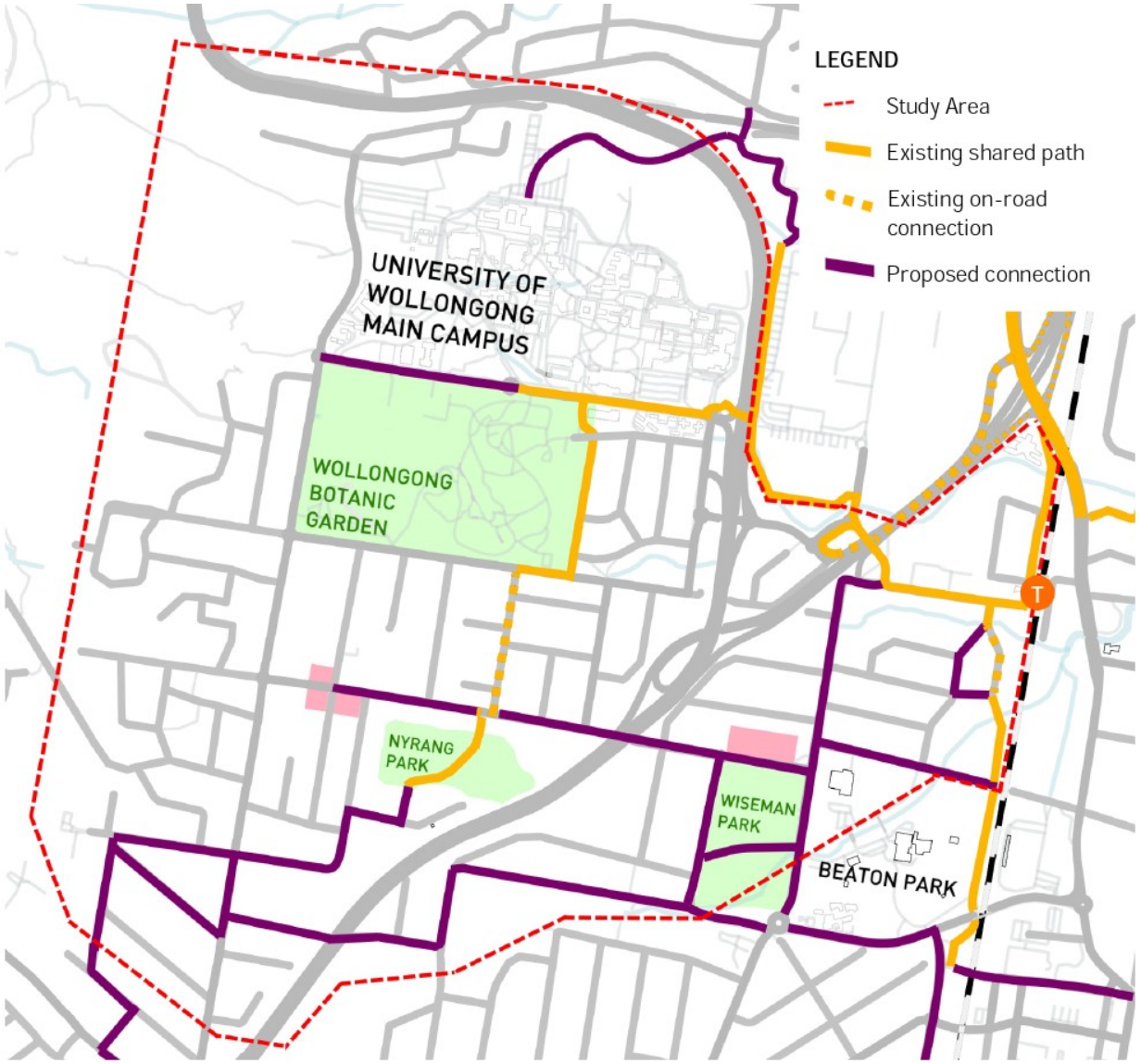
- Parking utilisation is very high in the streets south of the UOW campus, including Keiraville village
- Two-hour parking spaces are not long enough for students attending lectures
- Accessible parking is not provided in the village centres
- Lack of enough pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park
- Parking close to key destinations is often heavily utilised by employees
- Vehicles are often parked over driveways
- High amount of unrestricted parking provided in residential areas near the University
- Poor sightlines at some intersections within the precinct due to vehicles parking too close
- Multi occupancy dwellings and student accommodation generate street parking demand
- Significant numbers of vehicles parking illegally throughout the study area
- Number of residential streets throughout the study area which have been reduced to one lane in each direction due to parking on both sides of the road.

High street parking use associated with key destinations


Transport Network Actions
The study recommends a range of actions to address the identified issues affecting pedestrians, cycling, public transport, motor vehicles and car parking.
2P
8.30 AM - 4.30 PM
MON - FRI
NO STOPPING

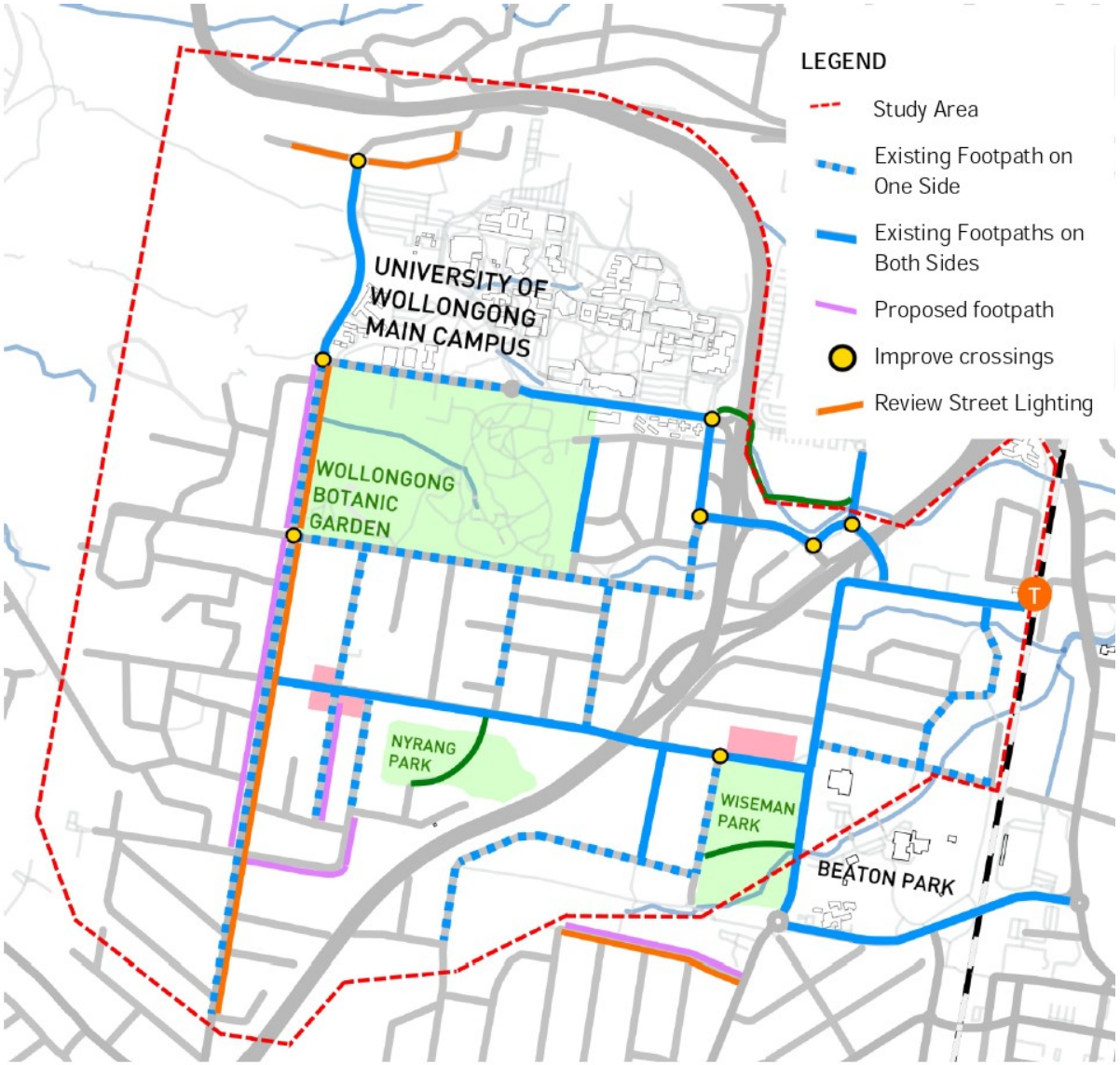
Cycling Actions

- Include suggested shared path locations in future programs.
- Work with TfNSW to investigate active transport connection across train line close to Beaton Park.
- Provide improved cycling wayfinding on the key regional cycle routes.
- Provide a widened shared path through Wiseman Park in line with the Fairy Creek Corridor Master Plan.
- Provide increased number of secure and undercover bicycle parking at key land uses such as the UOW, Keiraville and Gwynneville village centres, Beaton Park, the local schools and off-street parking locations.



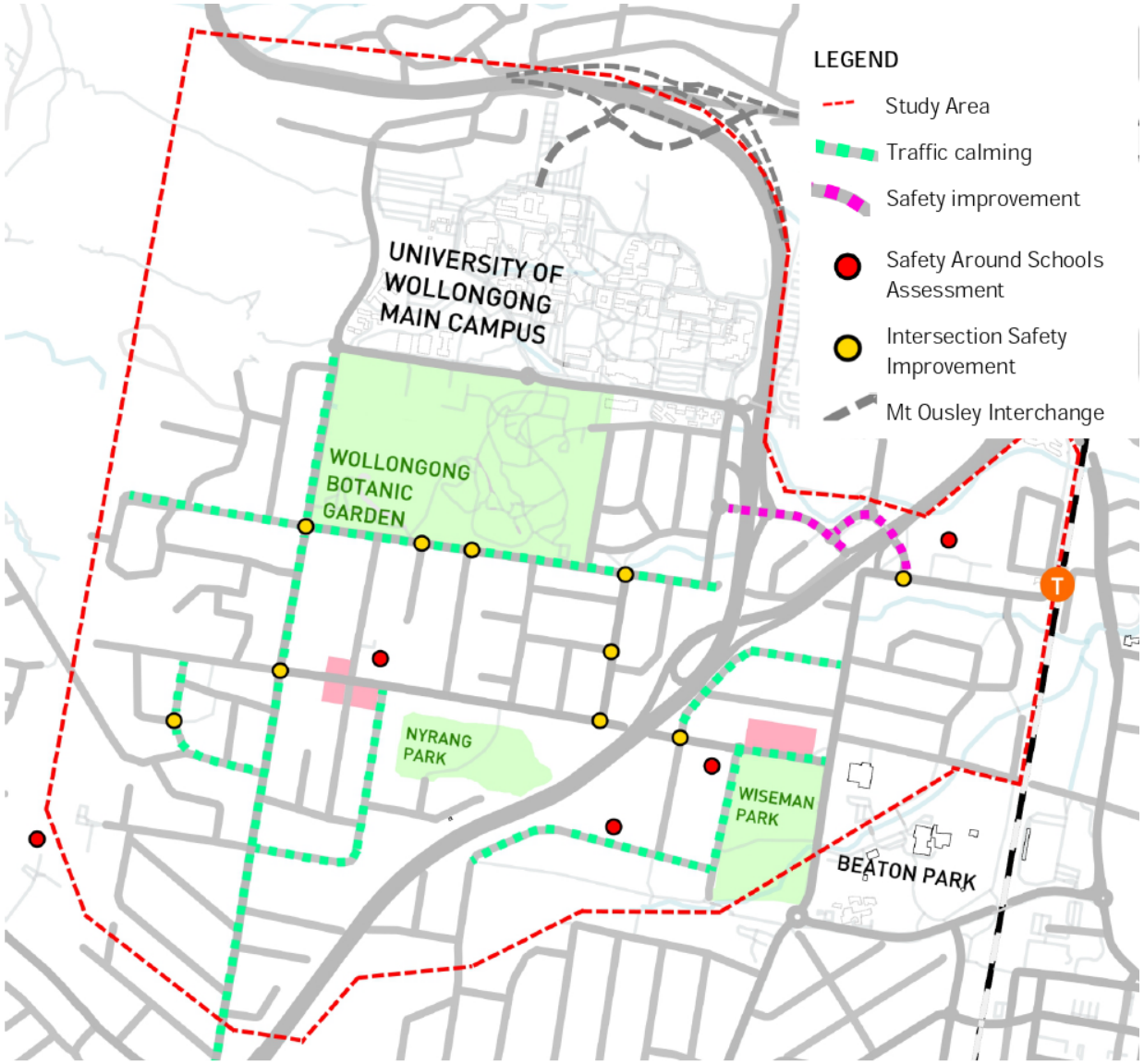
Pedestrian Actions

- Provide compliant pedestrian refuge island at roundabouts.
- Ensure that all crossing facilities comply with Australian Standards (upgrade where needed).
- Provide a direct pedestrian connection towards the north and east of UOW.
- Provide wayfinding to key destinations including train stations, UOW, key centres and recreation facilities.
- Provide increased pedestrian priority within the village centres.
- Provide increased marketing especially in schools, workplaces and town centres to show the benefits of walking and cycling.
- Review street lighting with respect to pedestrian needs
- Include suggested footpath locations in future programs.



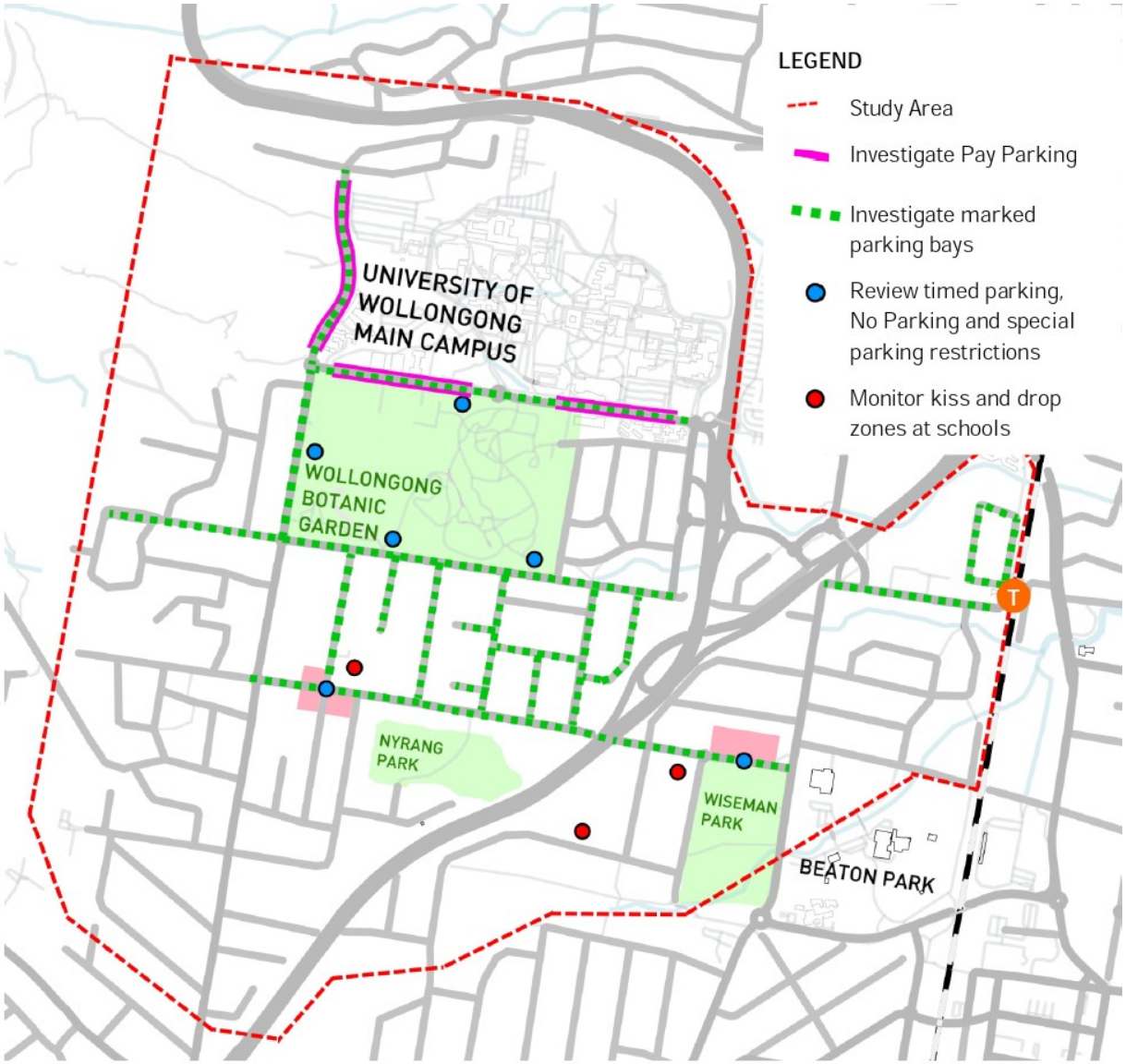
Vehicle Movement Actions

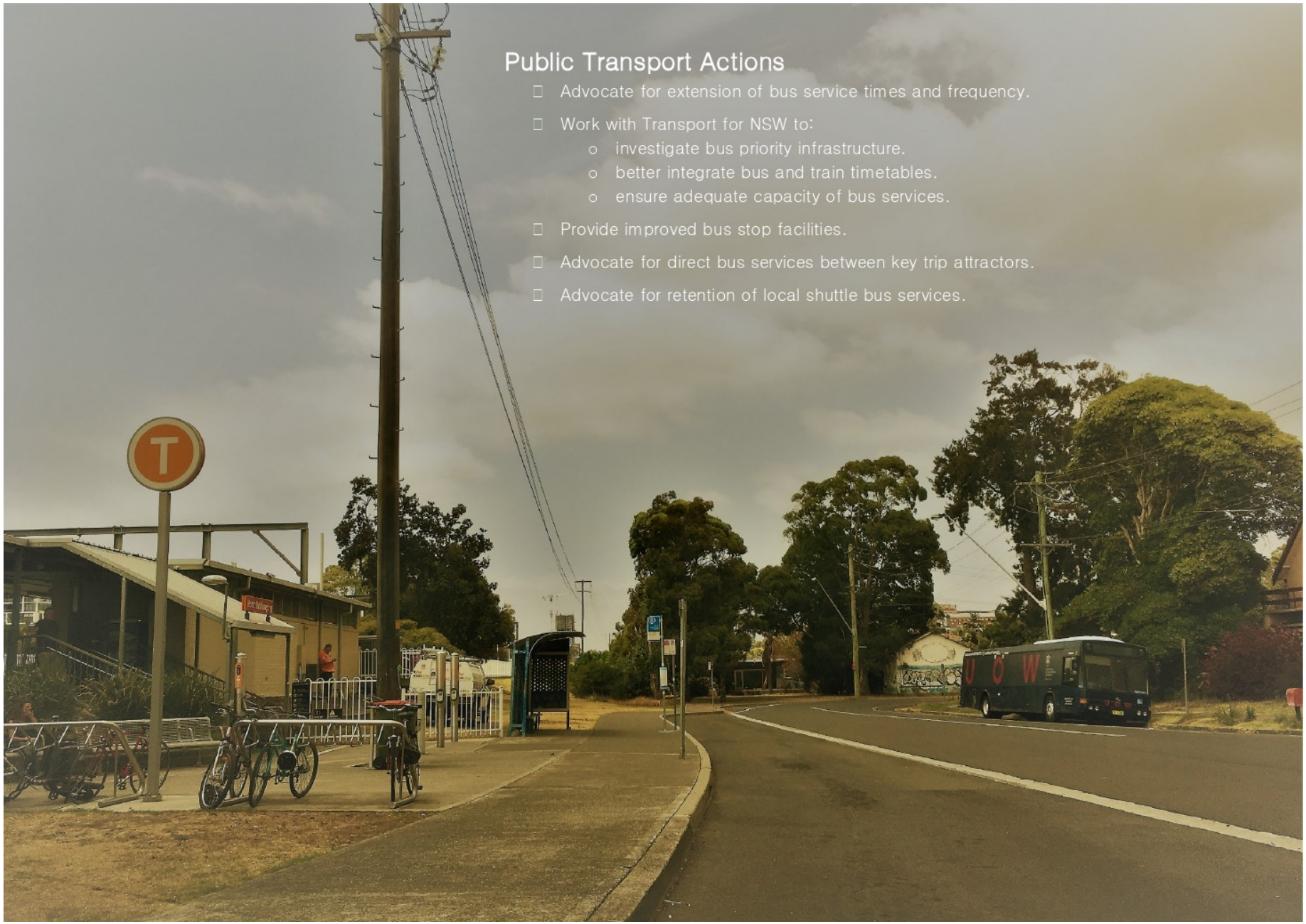
- Realignment of roundabout at Murphys Avenue and Robsons Road.
- Undertake safety around schools assessments.
- Advocate for implementation of the Mount Ousley Interchange project.
- Investigate traffic calming measures on Robsons Road to manage vehicle speeds, particularly on the north and south downhill sections to the Gipps Rd intersection.
- Investigate intersection improvements (refer to map).
- Investigate traffic calming improvements (refer to map).
- Investigate roundabout installation at Braeside Avenue – Murphys Avenue to reduce vehicle speed.
- Investigate safety improvements on University Avenue.



Car Parking Actions

- Investigate the provision of marked parking bays to increase the efficiency of parking spaces within the precinct.
- Review timed parking, pick up and drop off and special parking restrictions surrounding key destinations.
- Review ranger patrols to ensure all vehicles abide by the corresponding parking restrictions.
- Investigate introduction of paid parking in close vicinity of the University.
- Develop a special event parking and traffic management plan for significant events at Beaton Park.
- Monitor school kiss and ride zones to prevent parking and expand as required to support demand.
- Investigate parking wayfinding opportunities to parking at attractors such as Beaton Park and the Botanic Garden.
- Work with schools to manage parking and safe drop off/pick up.




Public Transport Actions
Advocate for extension of bus service times and frequency.
Work with Transport for NSW to:
investigate bus priority infrastructure.
better integrate bus and train timetables.
ensure adequate capacity of bus services.
Provide improved bus stop facilities.
Advocate for direct bus services between key trip attractors.
Advocate for retention of local shuttle bus services.

wollongong
city of innovation

Keiraville-Gwynneville Access and Movement Study

Access and Movement Study
80018018

Prepared for
Wollongong City Council

Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
Cardno (NSW/ACT) Pty Ltd
95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9496 7748

Document Information

Prepared for	Wollongong City Council
Project Name	Access and Movement Study
File Reference	200203 Keiraville - Gwynneville Access and Movement Study_Final Report.docx
Job Reference	80018018
Date	3 February 2020
Version Number	3.1

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
3.1	03/02/20	Cost estimates added	Lukas Labutis	Ivo Pais
3.0	19/12/19	Revised for Council comments	Lukas Labutis	Ivo Pais
2.0	06/08/19	Final	Elizabeth Muscat Jane Parker	Ivo Pais
1.0	10/12/18	Draft	Elizabeth Muscat	Jane Parker

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background and purpose

Keiraville and Gwynneville will experience significant growth in the coming decades as a result of expansion of the education and health precinct in Wollongong. This future expansion will increase the number jobs and students in the region, therefore increasing demand for housing, infrastructure and transport.

Wollongong City Council (WCC) commissioned a Keiraville–Gwynneville Access and Movement Study (the study) to improve their understanding of existing and future access and transport demand in the area, and to mitigate the impacts of more growth. This includes traffic and transport strategies to encourage sustainable travel behaviour and ease pressure on the transport network. Improvements for the pedestrian, cycling, bus, train, private vehicle and parking networks are recommended by this study.

1.2 Project objectives

The key objectives of this study are to:

> Examine and document the existing and future potential operation of the traffic and transport system within the suburbs of Keiraville and Gwynneville; and

> Develop strategies to improve the transport system, reduce impacts on Keiraville and Gwynneville and surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development.

1.3 Keiraville and Gwynneville study area

Keiraville and Gwynneville are located within the City of Wollongong, in the Illawarra region of NSW. The two suburbs lie between the Princes Motorway (M1) to the north and east, the Illawarra Escarpment State Conservation Area to the west, and extend south towards Mount Keira Road. The study area is shown in **Figure 1-1**.

There are many important land uses that generate a high number of trips each day and influence access, movement demand and behaviour in the study area. These land uses include:

> Keiraville and Gwynneville village centres;

> The University of Wollongong (UOW) Campus;

> UOW Innovation Campus (iC);

> Wollongong CBD;

> Wollongong Hospital;

> Wollongong Botanic Garden;

> North Wollongong Station;

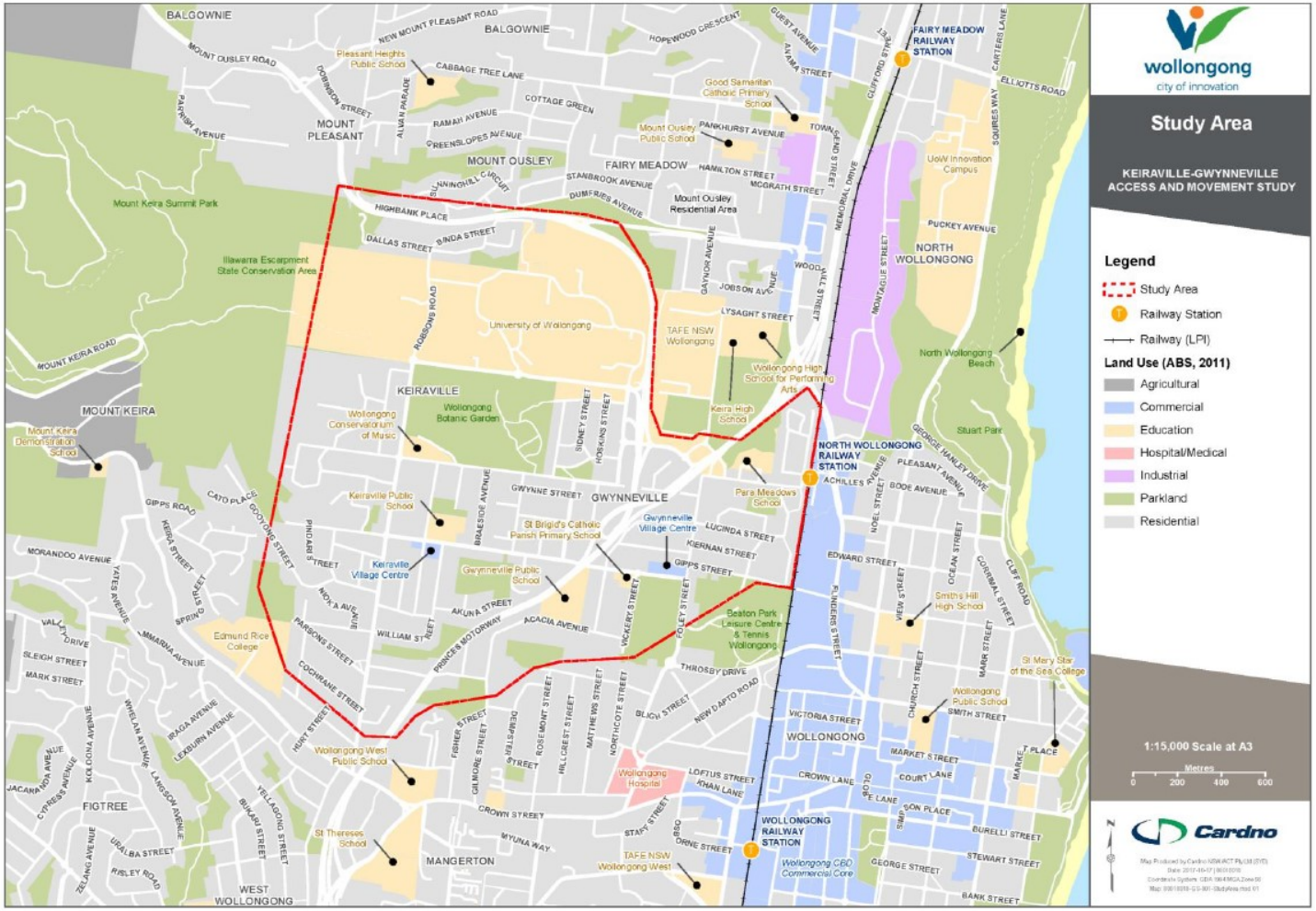
> TAFE Illawarra Wollongong Campus;

> Mount Ousley residential area;

> Local schools; and

> Sports and recreation facilities.

Figure 1-1 Study area



2 Strategic Context

Understanding the position of Keiraville and Gwynneville in the broader context of the greater Wollongong area is essential in order to recommend effective strategies to improve the transport network. This section provides an overview of the broader context, including Council plans, UOW strategies, regional plans and transport projects.

2.1 Regional strategic plans

This section outlines the strategies, policies and plans for the greater Illawarra region that play an important role in the transport network.

2.1.1 Illawarra-Shoalhaven Regional Plan, NSW Department of Planning and Environment, 2015

The Illawarra Shoalhaven Regional Plan provides the strategic policy, planning and decision-making framework to guide the region to sustainable growth over the next 20 years. The key principle of integrating transport and land use, and the support of improvements to the active and public transport networks are important components of the transport element of the plan.

Relevance for Keiraville – Gwynneville Access and Movement Study

The Plan includes a goal to maintain a region with communities that are strong, healthy and well-connected which could be achieved in part by:

- Investigating options to improve public transport service levels which better link centres, corridors and growth areas to Metro Wollongong;
- Improving access to centres, particularly in the northern corridor, to encourage development; and
- Investigating tourism-related transport services in Kiama and Shoalhaven.

2.1.2 Illawarra Draft Regional Growth and Infrastructure Plan, NSW Department of Planning and Environment, 2014

The Regional Growth and Infrastructure Plan for the Illawarra region is a framework that will guide development and growth to 2031, through integration with land use planning and the transport network.

Some of the particular transport challenges facing the Illawarra as it grows include growing demand for freight, the need for improved train travel times, heavy reliance on private vehicles, catering for peak tourism travel demand, pressure to complete road construction in the region, catering for an ageing population, ongoing investment in bus priority and funding regional cycling infrastructure.

Current infrastructure commitments from the NSW Government include upgrades to the Princes Highway, a safety upgrade of the Picton Road/ M1 intersection and slow vehicle climbing lanes on Mount Ousley Road that will also improve freight capacity.

Relevance for Keiraville – Gwynneville Access and Movement Study

Wollongong is classified as a regional city, providing higher order administration, education and health services, cultural and recreational facilities and higher density commercial and residential development for the region. Revitalisation of Wollongong will strengthen its economic and employment significance in the region.

2.1.3 Illawarra Regional Transport Plan, Transport for New South Wales, 2014

The Illawarra Regional Transport Plan 2014 contains a number of programs that may assist in the delivery of new infrastructure, services and information. It states that the population of the Illawarra region is expected to increase by more than 75,000 people in the next 20 years through development of employment, health, education and retail land uses. Some of the initiatives underway in the Illawarra region outlined in this plan are:

> $80 million commitment to maintenance and improvement of safety and reliability of the rail network;

> New timetabling of rail services in 2012 that delivered 7,000 additional seats on Illawarra and South Coast Services;

> Introduction of NSW TransLink, an operating division dedicated to improving regional rail services; and

> Introduction of new bus services in the Illawarra region.

Relevance for Keiraville – Gwynneville Access and Movement Study

The following plans and ideas will directly impact Gwynneville and Keiraville:

- The free shuttle buses and local access buses will continue to operate, with peak frequencies supporting convenient access;
- Providing free public transport will help to increase the mode share of public transport to and from the CBD and local centres will reduce congestion on roads and the pressure placed on parking capacity;
- New developments in the region will contain planning for active and public transport; and
- The improvement of walking and cycling infrastructure at transport interchanges will support mode change.

2.2 Wollongong City Council strategic plans

It is important to incorporate and build upon WCC's existing plans and strategies in the development of this study. Council's relevant transport directions are outlined in this section.

2.2.1 Keiraville Gwynneville Community Planning Project, Neighbourhood Forum 5, 2014

Neighbourhood Forum 5's (NF5) Keiraville Gwynneville Community Planning Project acknowledges population growth in the coming years and captures the community's concerns regarding future development and the transport network. The Project collated community consultation outcomes regarding the future of Keiraville and Gwynneville, for Council to consider in the development of an Implementation Plan.

Community consultation activities isolated four key themes identified as essential in planning for Keiraville and Gwynneville. These themes are parking and access, street safety, village protection and development, and building the community and relationships. The challenges identified by this project are the increasing population and visitors. Future opportunities for the study area include planning ahead for impacts on infrastructure, forecasting future growth, directing development to achieve sustainable outcomes, and working closer with UOW and with the community.

Relevance for Keiraville – Gwynneville Access and Movement Study

Prioritised actions arisen from this community consultation are:

- Construction of a walking track through the Botanic Gardens, TAFE and to the beach;
- Provision of bike parking at the Botanic Gardens;
- Lobby Council for a parking strategy that includes regular enforcement of parking regulations at shops to keep passing trade moving, and the provision of short term parking near shops;
- Lobby Council to provide bike parking and improved pedestrian facilities at shopping centres to improve access;
- Request Council to place more signage indicating availability of parking;
- Request Council to extend the areas with painted parking bays to help with dangerous parking and improve parking efficiency;
- Community liaison group to work on developing a parking strategy for new university accommodation;
- Improve cycling infrastructure to encourage increase in cycling trips;
- Expand shuttle buses to other areas to decrease parking demand;
- Collaboration with UOW, RMS and WCC to address Mount Ousley Road as a barrier to pedestrians and cyclists;
- Request a whole traffic management study beginning at Mt Keira Road and Robson Road, including review of sight lines for parking;
- Investigate traffic calming measures at the Gwynneville village centre; and
- Investigate full audit of footpaths to address safety and connectivity concerns.

2.2.2 Keiraville Gwynneville Implementation Plan, WCC, 2015

Refinement of NF5's Keiraville Gwynneville Community Planning Project led to the production of an Implementation Plan to carry out the visions emerging from the project. This Implementation Plan contains potential timeframes, responsibilities and estimated costs for each recommended action.

Relevance for Keiraville – Gwynneville Access and Movement Study

An implementation plan is provided for each of the actions:

- Commission of an Access and Movement Study, with a focus on traffic capacity in context of key destinations, parking and pedestrian access and safety;
- Regulation and enforcement, focusing on monitoring illegal parking and a review of timed parking at village centres;
- Investigation of bicycle parking, including a plan for bicycle parking facilities in village centres; and
- Investigation of parking signage, including signage and wayfinding at the Keiraville and Gwynneville village centres to ensure current parking supply is beneficial to the community and visitors.

2.2.3 Wollongong 2022 Community Strategic Plan, WCC, 2012

The Community Strategic Plan outlines the Wollongong community's prioritised standards and goals and how they are to be achieved. The relevant goals are to protect the natural environment, cultivate an innovative and sustainable economy, maintain a healthy community in a liveable city, and enjoy a sustainable, affordable and accessible transport network. The main identified issues for transport network are the need for improved public transport services and infrastructure, including a fast train to Sydney, and increased safety.

Relevance for Keiraville – Gwynneville Access and Movement Study

The Plan identifies that to achieve WCC's goal of a sustainable, affordable and accessible transport network, the following strategies must be implemented:

- Establish Wollongong as a bike friendly City;
- Extension of the free Gong Shuttle bus service;
- Delivery of interconnected and accessible cycleways and footpaths;
- Establish a 'Park and Ride' commuter bus network to encourage the community to use alternate transport modes;
- Provide an effective and integrated regional transport system with a focus on road, bus, rail and freight movement;
- Improve rail services and stations across the Local Government Area;
- Investigate opportunities to reduce travel time between Sydney and Wollongong;
- Improve availability of late night transport options; and
- Promote community transport options for people with disabilities.

2.2.4 Wollongong Local Environmental Plan, NSW Government, 2009

The Wollongong Local Environmental Plan (LEP) sets out planning provisions for land in Wollongong in accordance with the relevant zoning and development controls.

Keiraville and Gwynneville are mainly classified as (R2) Low Density Residential land, with areas of (RE1) Public Recreation land, such as the Botanic Gardens. To the east of Keiraville and Gwynneville, the Wollongong CBD is classified as (B3) Commercial Core land, and (B6) Enterprise Corridor, and the Wollongong Hospital precinct is classified as (SP1) Special Activities land. Land to the west of the UOW campus is classified as (E2) Environmental Conservation land, and (E1) National Parks and Nature Reserves land.

Relevance for Keiraville – Gwynneville Access and Movement Study

The transport related requirements for each land zone in the study area are as follows:

- R2 (Low Density Residential) classified land is required to maximise public transport patronage and encourage walking and cycling.
- B3 (Commercial Core) classified land is required to maximise public transport patronage and encourage walking and cycling.
- B6 (Enterprise Corridor) classified land is required to allow some diversity of activities that will not have an adverse impact upon the efficient operation of the surrounding road system.
- The remaining land types do not have transport related requirements.

2.2.5 Wollongong City Council Community Engagement Policy, WCC, 2013

The purpose of the WCC Community Engagement Policy is to show a commitment to engaging with and informing the community with decision-making processes. Council engages with the community via the following processes:

- Council communicates clearly with the community via Council's website and online media channels, Council's newsletters, letters and emails, fact sheets, customer service, events and festivals, kiosks and information sessions.
- Council seeks feedback from the community before final decisions are made through public access forums, ward meetings, community forums, kiosks, surveys and submissions, online engagement, communication channels and independent Hearing and Assessment panels.
- Council involves the community in designing possible solutions via ward meetings, community forums, kiosks, reference and advisory groups, focus groups, workshops, online engagements and communication channels.
- Council collaborates with the community to make decisions through focus groups, workshops, reference and advisory groups, online engagements and communication channels.

Relevance for Keiraville – Gwynneville Access and Movement Study

In this study, Cardno engages with the community via workshops to inform, consult, involve and collaborate, in accordance with Council's Community Engagement policy.

2.2.6 City of Wollongong Pedestrian Plan 2017 – 2021, WCC, 2017

WCC's Pedestrian Plan sets out Council's vision for walking and recommends a range of strategies to address key walking issues facing the City, and to promote walking as the preferred mode for short trips. The Plan identifies pedestrian safety and convenience as a major concern. Some of the main factors deterring people from walking as a key mode of transport are:

- Low pedestrian priority in areas of high pedestrian activity;
- Large distances between key locations and residential areas, as well as steep topography that is unsuitable for footpaths;
- Lack of wayfinding for pedestrians in village centres; and
- Presence of busy roundabouts that hinder safe crossing for pedestrians.

Relevance for Keiraville – Gwynneville Access and Movement Study

The following five goals will assist Council to achieve its vision for walking across the Local Government Area and address associated challenges:

1. Encourage walking;
2. Create pedestrian friendly places;
3. Makes walking safe;
4. Make walking easy and convenient; and
5. Work efficiently to implement the Pedestrian Plan.

2.2.7 City of Wollongong Bike Plan 2014 – 2018, WCC, 2014

The main objectives of the City of Wollongong Bike Plan 2014-2018 are increasing participation in cycling, developing a safe and connected network of bike routes, growing bicycle tourism and improving cycling awareness, safety and proficiency.

The plan identifies the benefits of cycling as health, reduced road congestion, recreation, travel time saving, environmental, financial, tourism and economic. A lack of safe cycling connections between the UOW campus, the Innovation Campus and the Wollongong City Centre is noted. A dramatic increase in cycling mode share is considered achievable in the Wollongong City Centre because of the high employment density and short travel distances between major trip generators. A key missing link in the cycling network was identified as the route between the UOW campus and the suburb of Figtree to the south-west.

Relevance for Keiraville – Gwynneville Access and Movement Study

This plan provides an understanding of:

- Council's vision for the cycling network, including construction of cycle way links on McGrath Street north of campus, Northfields Avenue, and south of the Botanic Gardens;
- The cycling constraints and opportunities that exist within the greater Wollongong area; and
- Council's priorities for proposed works.

2.2.8 Wollongong City Centre Access and Movement Strategy, WCC, 2013

The 2013 Access and Movement Strategy was developed to support the revitalisation of Wollongong's City Centre, as an update to the original 2005 Access and Movement Strategy. This study outlines the land use context, and pedestrian, cycling, vehicular, car parking and public transport access and movement.

This Strategy also outlines the vision for Wollongong Station and the railway precinct to be a fully integrated transport interchange with station access from elevated concourse access off Crown Street. The redevelopment of Piccadilly centre will allow for improved pedestrian access to the station and an interchange with buses, taxis and drop off zones.

Relevance for Keiraville – Gwynneville Access and Movement Study

Many issues regarding the transport network in the Wollongong City Centre are outlined in this report, as well as the following strategies to address these issues:

- Pedestrian strategies include a reduction in traffic speeds in the City Centre, a new footpath program, kerb ramp replacement program, a footpath replacement program, safety hazards program, and pedestrian crossing improvements.
- Key actions proposed to address cycling issues in the City Centre are developing a network of shared paths and road treatments, public bicycle parking in the City Centre and reduction in traffic speeds in the City Centre.
- Traffic management strategies include a road upgrade program with intersection modifications, new traffic signals within the City Centre, an extension to Ajax Avenue, road widening and extensions, City Centre West Precinct traffic calming measures, and parking bay line markings.
- The major elements of the car parking strategy are: encouraging developers to provide parking in consolidated off-street parking locations, improved parking guidance systems, improved pedestrian, cycling and public transport facilities, and a comprehensive on and off-street parking survey to be completed every three years.
- The bus operations strategy includes design modifications to the Wollongong Station interchange, bus priority programs, relocation of the bus terminal at Lang Park, implementation of an integrated ticketing system, installing bus priority measures where appropriate, and extending bus services to South Wollongong.

2.2.9 Beaton Park Precinct Needs Assessment Project, WCC, 2015

The Needs Assessment Project for Beaton Park contains extensive reviews of existing facilities and input from key precinct stakeholders, providing an overall strategic approach for the precinct and enhanced community access. This study arose from population trends that indicate greater local demand on the Beaton Park Precinct facilities.

Transport access related aims for the precinct are to maximise accessibility to the site for all transport modes and minimise conflicts between them, maximise car parking on site in a safe and environmentally friendly manner, and ensure access to the site is safe whilst minimising disruption to the surrounding neighbourhood.

Relevance for Keiraville – Gwynneville Access and Movement Study

WCC meeting minutes from 9 May 2016 indicate that a Beaton Park Traffic Management Plan is to be completed. This plan will include a redeveloped access point and internal road network with linked car parks at key activity nodes. This also may include a new entry and bridge link from Gipps Street and more parking at the Beaton Park Leisure Centre site.

2.2.10 Beaton Park Plan of Management, WCC, 2007

The Beaton Park Plan of Management outlines directions to transform the park into a major regional sporting complex in Gwynneville. However, major concerns for the park include the availability of car parking and transport access. Plans to construct a new car parking area, with 281 spaces, will also eliminate the existing causeway crossing and provide for a more practical vehicular and bus access between Foley Street and Gipps Street. Upgrades to access points are also included in these plans.

Relevance for Keiraville – Gwynneville Access and Movement Study

A number of actions are proposed to achieve the following transport related objectives and performance targets:

- Maximise car parking capacity on site within environmental, recreational and social constraints;
- Maximise site access while reducing congestion and conflict for all users;
- Improve traffic flow in and around the site;
- Improve public transport access to the site; and
- Improve pedestrian access.

2.3 University of Wollongong strategic plans

UOW's location within the study area places it as one of the key destinations influencing travel demand within Keiraville and Gwynneville. Expected growth in student population, expansion of student accommodation and evolving transport behaviour will heavily influence future transport demand for the area. It is crucial to understand and consider this adapting context for the Access and Movement Study.

2.3.1 Draft University of Wollongong Transport Strategy and Survey, Cardno, 2017

The 2017 Draft UOW Transport Strategy and Survey is the most recent edition of the biennial study. The 2017 Draft Transport Strategy aims to increase social and environmental sustainability at the UOW campus through encouraging a modal shift for staff, student and visitor travel towards public and active modes. The process of shifting travel behaviour should include understanding people's decision making processes, addressing their travel needs, and integrating the urban form with their desire lines.

A number of transport actions were recommended to support the achievement of each of the strategic transport objectives, listed in **Appendix A**.

Relevance for Keiraville – Gwynneville Access and Movement Study

A number of actions are proposed to achieve the following transport related objectives and performance targets:

- Improve existing campus access constraints to meet current and future demand;
- Improve active transport as a means of accessing the campus;
- Improve public and shared transport as a means of accessing the campus; and
- Maximise the use of UOW parking to meet current and future demands.

2.3.2 University of Wollongong Campus Master Plan 2016 – 2036, UOW, 2016

The UOW Campus Master Plan provides the vision for the campus from 2016 – 2036, which is due to have a growth in students and learning spaces by 2036. This Master Plan also provided a vision in terms of governance, landscape, access and sustainability which aligned with regional strategies for the area.

Key strategies and actions of this master plan are provided in **Appendix B**.

Relevance for Keiraville – Gwynneville Access and Movement Study

Key strategies from access and sustainability include:

- Introduce pedestrian friendly gateways to provide a welcoming entrance to the campus that connects to the neighbourhood;
- Introduce a series of pedestrian walks and improve pedestrian safety throughout the campus;
- Improve access to the campus for cyclists and upgrade bike infrastructure;
- Consolidate car parking on the periphery, providing easy access to the campus;
- Support the introduction of a new northern entrance to the campus; and
- Reduce car park to 1 space per 5.4 effective student full time load by 2036.

3 Existing transport network and demand

This section of the study outlines the existing and planned active transport, public transport, and road networks, the traffic and travel behaviour, and crash analysis for the study area. It identifies infrastructure and safety issues and opportunities for travel behaviour change.

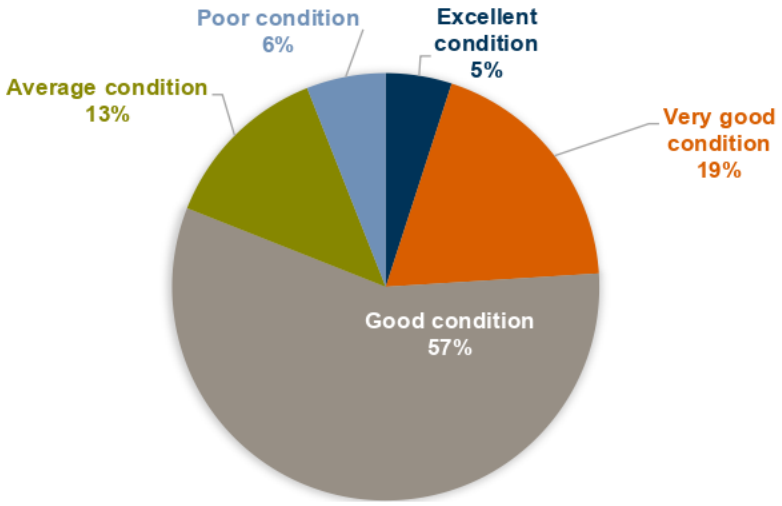
3.1 Pedestrian network

3.1.1 Footpaths

The active transport network within Keiraville-Gwynneville encompasses a combination of shared paths and footpaths.

An audit of the entire Wollongong Local Government Area (LGA), including the study area, completed by WCC identified that 19 per cent of all paths were in very good condition, and 57 per cent were in good condition. Six per cent were in poor condition. The breakdown of path condition is shown in **Figure 3-1**.

Figure 3-1 Condition of footpaths/ shared paths



Source: Draft City of Wollongong Pedestrian Plan, 2017

The footpath network in Keiraville-Gwynneville is limited, particularly away from UOW. The only roads that have footpaths on both sides of the road are Irvine Street, Northfields Avenue and Gipps Road. The majority of local streets have footpaths on one or no sides of the road.

On approach to Gwynneville village centre, footpaths are present on the north side of Gipps Road only. Keiraville village centre has footpaths provided on both sides of Gipps Road.

The locations of all footpaths are shown in **Figure 3-2**.

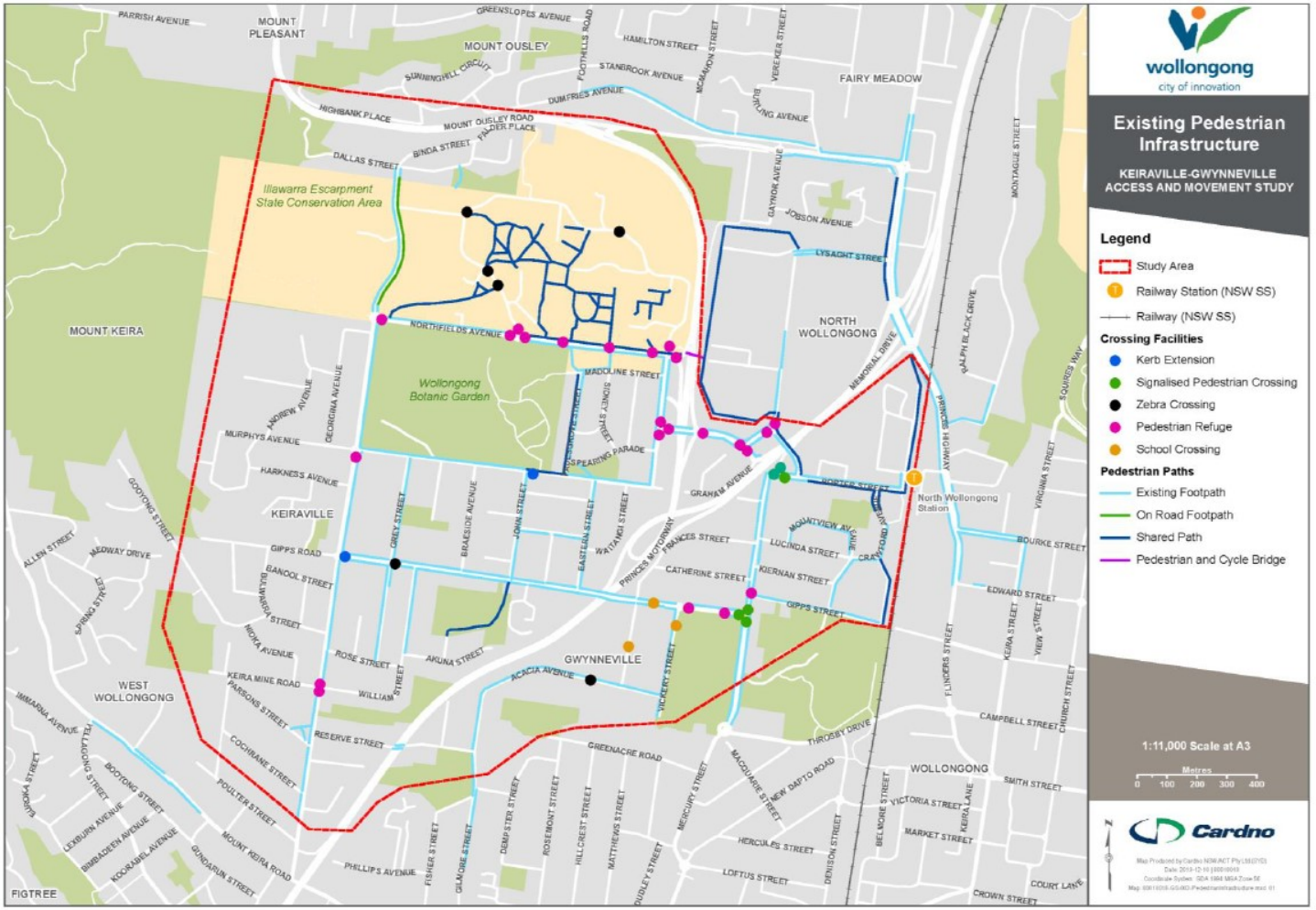
3.1.2 Crossings

Pedestrian crossing facilities in the study area include a mixture of pedestrian refuges, zebra crossings, school crossings and signalised crossing. Pedestrian refuges are provided throughout the study area, particularly along Northfields Avenue, Robsons Avenue and Gipps Road. The majority of pedestrian refuges are located at roundabouts (splitter islands).

There are six zebra crossings, three school crossings, and six signalised pedestrian crossings located within the study area, four of which are located within the UOW campus.

The locations of crossing facilities are shown in **Figure 3-2**.

Figure 3-2 Existing pedestrian infrastructure



3.2 Cycling network

There are a number of shared paths and separated cycleways within the study area. There are also on-road route options nominated as low or moderate difficultly by Roads and Maritime (Cycleway finder).

The majority of off-road cycle routes are located between North Wollongong Station and UOW. Shared paths are generally provided through parks and reserves.

The existing cycling infrastructure is shown in **Figure 3-3**.

Figure 3-3 Existing cycling infrastructure

3.3 Bus network

Bus routes servicing Keiraville and Gwynneville include three free shuttle buses and locally run services that provide connections throughout the study area and to nearby suburbs in the Illawarra and as far as Campbelltown and Port Kembla.

The free GK Shuttle bus service is operated by UOW and connects the campus with North Wollongong Station, the Wollongong CBD, Keiraville and Gwynneville.

UOW also runs the free North Gong shuttle service which directly connects the UOW Northfields Avenue Bus Interchange with North Wollongong Station. This is the only bus route to service the bus stops on the UOW campus Ring Road; it connects passengers with trains arriving at North Wollongong Station.

The Gong Shuttle bus service is run by Transport for New South Wales, and connects the UOW campus with the Wollongong CBD, the Innovation campus, Fairy Meadow, Wollongong TAFE, Wollongong and Keira High Schools, Wollongong Hospital, Wollongong Station, North Wollongong Station (on weekends only), Burelli Street and Wollongong Harbour. This service is currently free, however a longer term decision on whether the service will remain free has yet to be made.

Local bus services connecting to Austinmer, Bulli, Campbelltown, Dapto and Shellharbour are provided by the following operators:

> Busabout, providing the 887 service to Campbelltown;

> Dion's Bus Service, providing services to Austinmer and Bulli; and

> Premier Illawarra, providing services to the Wollongong CBD, Dapto, and Shellharbour.

Bus route destinations and frequencies are summarised in **Table 3-1.**

Table 3-1 Bus routes servicing Keiraville and Gwynneville

Service	Destinations	Frequency
Gwynneville Keiraville Shuttle (clockwise – GK-C and anti-clockwise – GK-A)	UOW to Keiraville, Gwynneville and Wollongong	The GK-C shuttle runs clockwise from 7:45am to 10:45pm on weekdays during session and exam periods. The GK-A shuttle runs anti-clockwise around the route, at peak times (7:30am to 10:15am and 3:45pm to 7:15pm) on weekdays during session and exam periods.
North Gong Shuttle (9/9N)	North Wollongong Station to UOW	Services run on weekdays between 7:30am and 10:00pm approximately every 10 minutes during the morning/ afternoon peaks, and every 15-25 minutes at non peak times. Reduced service on weekdays outside of session time and exam periods. Limited Saturday service during exam periods only.
Gong Shuttle (55A/ 55C)	Wollongong City to UOW (loop service)	Services run approximately every 10 minutes between 7:00am and 6:00pm and every 20 minutes between 6:00pm and 10:00pm on weekdays. On weekends and public holidays services run from 8:00am to 6:00pm approximately every 20 minutes. The route also stops at North Wollongong station on weekends.
887	Campbelltown to UOW and Wollongong via Appin	Services operate every 1-2 hours on weekdays between 6:45am and 6:45pm. No services stop at UOW on weekends or Public Holidays.
1U	Austinmer to UOW via Thirroul, Woonona, Bulli, Corrimal and Fairy Meadow	Services are limited, with 1-2 buses operating during the morning and afternoon peak periods. No services operate on weekends or Public Holidays.
4U	Bulli to UOW via Thirroul, Woonona, Bulli, Corrimal and Fairy Meadow	Weekday services operate every 1-2 hours between 8:45am and 6:00pm. No services operate on weekends or Public Holidays.
11	UOW to Wollongong via Keiraville, Westfield Figtree & Coniston	Services to and from UOW operate hourly between 7:30am and 7:45pm on weekdays, and between 7:30am and 6:00pm on Saturdays. Services run every two hours on Sundays between 8:30am and 6:45pm.

Service	Destinations	Frequency
41	Dapto to UOW via Kembla Grange, Unanderra, Figtree, West Wollongong and Keiraville	Services run on weekdays only, between 7:45am and 8:15pm. Services to UOW run hourly between 7:50am and 9:50am, and from 5:50pm to 6:50pm in the evening. Services from UOW run hourly between 9:40am and 10:40am and then again from 3:40pm to 7:40pm.
53	Stockland Shellharbour to UOW via Flinders, Shell Cove, Shellharbour Beach, Warilla, Primbee, Warrawong & Five Islands Road	Weekday services operate hourly between 8:30am and 9:00pm. Services on Saturday run hourly between 9:30am and 6:00pm. There are no services to UOW on Sundays or public holidays.

In general, across the study area bus stops are located adjacent to the footpath network. In many cases they consist of a shelter to provide weather protection, but they tend not to provide service information. However, on some routes such as along Gipps Road, the bus stop consists only of a yellow sign attached to an existing electrical pole.

The Keiraville and Gwynneville bus network, including bus stops, is shown in **Figure 3-4**.

3.4 Train network

The South Coast Line, operated by NSW TrainLink, links Sydney's CBD with Bomaderry, stopping at both Wollongong Station and North Wollongong Station.

North Wollongong Station is located two kilometres north-east of the Keiraville village centre, and 0.7 kilometres north-east of the Gwynneville village centre. The station is accessed via Station Street to the east and via Porter Street to the west. Bus services to the UOW campus operate from the bus stop outside the station on Porter Street, and pedestrian access to the station is via Porter Street.

Services to Sydney run approximately every 30 minutes during the morning and afternoon peak, and once an hour at other times. Local services stopping at all stations to Waterfall run approximately once an hour. Southbound services run approximately once an hour to Kiama and Port Kembla.

Wollongong Station is located approximately one kilometre south-east of the Gwynneville village centre, and two kilometres south-east of the Keiraville village centre.

The station locations within the study area is shown in **Figure 3-4**.

Figure 3-4 Public transport

3.5 Road network

The road network within and surrounding the study area consists of both major arterial and local roads. Local roads provide east-west access, while the Princes Motorway bisects the study area constraining connectivity. Access to the motorway is provided via on/off ramps located to the south east of the University, and to the north of North Wollongong station.

The key roads in the network are summarised in **Table 3-2**.

Table 3-2 Study area road characteristics

Road	Characteristics
Princes Motorway	Princes Motorway (M1) is a major motorway that connects Sydney to Wollongong through to Albion Park Rail. This route provides key access to destinations in the Wollongong, Illawarra and South Coast regions for tourists. It is also a major freight route from Port Kembla. This corridor is located around the south-west of the model study area, running in a north-south direction to the north-west. The number of lanes vary between two to three lanes in either direction within the study area. The speed limit is 80km/h, however, at the steep downhill grade further north of the motorway, trucks and buses are limited to 40km/h and all other vehicles to 80km/h.
Mount Ousley Road	Mount Ousley Road is an arterial road located in the north of the model study area that connects the Princes Highway and the Princes Motorway. Once the road joins the Princes Motorway through a right turn, the speed limit is 80km/h.
Princes Highway	Princes Highway is a highway that runs in a north-south direction that provides access from Mount Ousley Road, Memorial Drive and Princes Motorway. It runs almost parallel to the Princes Motorway and the coastline in the model study area. There are three lanes in both directions with speed limits that varies from 60km/h to 50km/h.
Memorial Drive	Memorial Drive is a major arterial road that runs in a north-east to south-west direction within the modelled area. Memorial Drive is connected to Princes Highway, Princes Motorway by ramps, which provides access to the Keiraville and Gwynneville area.
Robsons Road	Robsons Road is a collector road which operates as a north-south corridor connecting to the western entrance of University of Wollongong and West Wollongong residential suburbs.
Irvine Street	Irvine Street is a collector road which provides access to Princess Motorway ramps and connection to the University of Wollongong Ring Road, Northfields Avenue and Murphys Avenue.
Gipps Road	Gipps Road runs is a collector road which operates as an east-west corridor connecting to the Keiraville and Gwynneville village centres, the Beaton Park precinct and to Robsons Road.
University Avenue	University Avenue provides east-west road access between North Wollongong Station and Irvine Street. This collector road is one of the main connections between North Wollongong, Keiraville and Gwynneville.
Murphys Avenue	Murphys Avenue is a local road and runs east-west along the southern side of the Botanic Garden, and connects to Irvine Street and Robsons Road.
Northfields Avenue	Northfields Avenue is collector road located on the southern boundary of the UOW campus, running east-west and connecting between Robsons Road and Irvine Street. Two UOW campus access points and the Bus Bay are located on Northfields Avenue.

Traffic surveys of all key intersections in the study area were commissioned as part of the study, and the results are provided in **Appendix C**. These were used to understand peak demand, together with the traffic modelling detailed in **Section 3.8.5**.

3.6 Parking provision

High parking generating land uses within the study area include the UOW, Keiraville and Gwynneville village centres. A mixture of on and off street options are available throughout the study area.

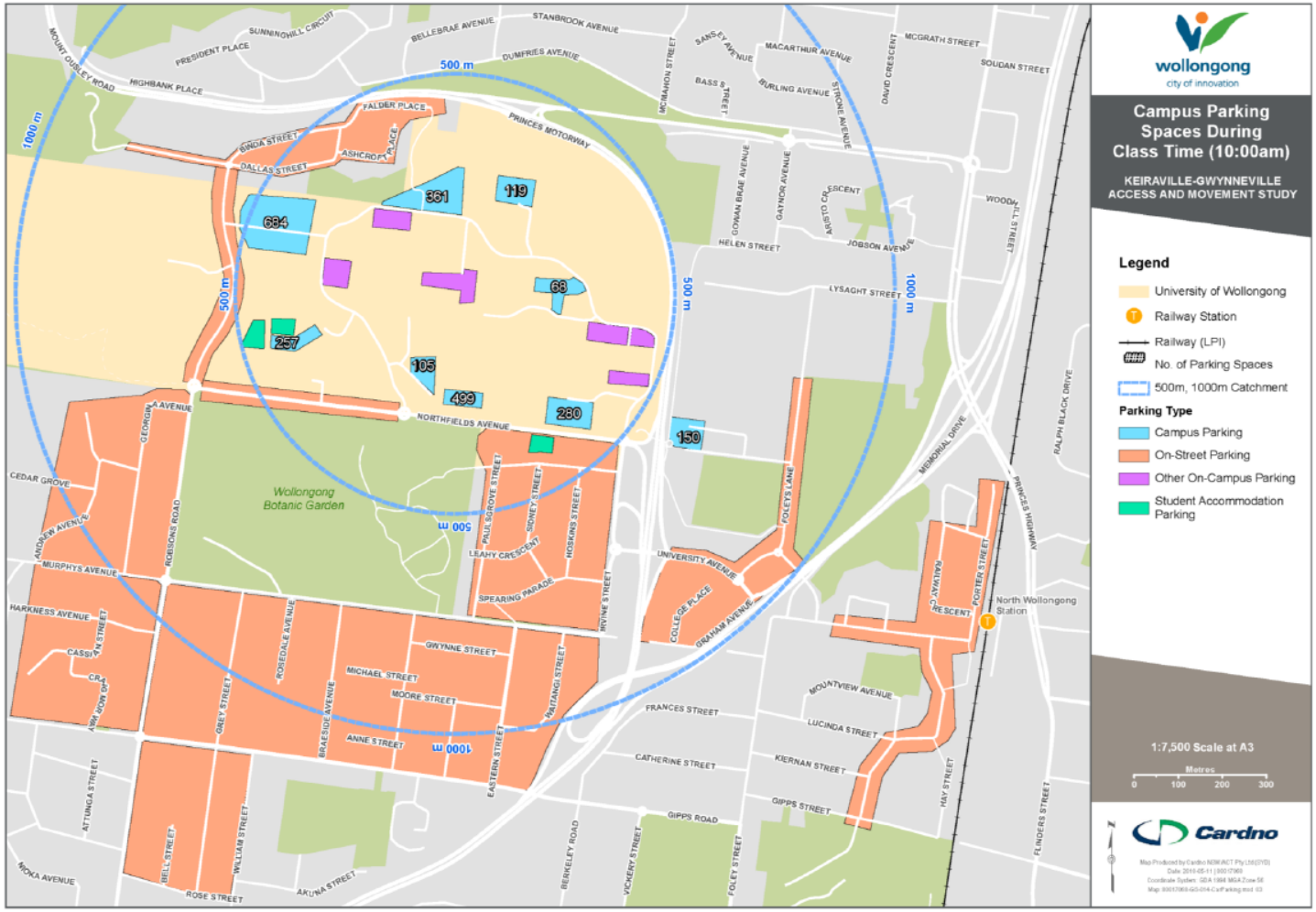
3.6.1.1 Keiraville and Gwynneville village centre parking

Within the Keiraville village centre, one hour parking is available along Grey Street and Gipps Road. The parking situation is similar close to Gwynneville village centre, with one hour parking available along Gipps Road and Foley Street. Unrestricted parking is available further away from both village centres.

3.6.1.2 UOW campus and surrounds parking

Within the UOW campus, there are many parking options with varied capacities and parking types, shown in **Figure 3-5**. In 2016, the ratio of car parking spaces per the Effective Full Time Student Load (EFTSL) was 5.4. Parking status reports for the UOW car parks during the week of 3 April and 7 April 2017 were obtained as part of previous studies. These reports indicated that on average, both the carpool and ticketed car parks reached or exceeded capacity on all days. The status reports showed that reserved parking was under-utilised on campus, with an average of 54 per cent usage throughout the day. Approximately 60% of all parking spaces at UOW are reserved. At the same time, ticketed, carpooling and permitted parking reached high levels of utilisation.

Figure 3-5 UOW parking locations



3.6.1.3 *North Wollongong Station parking*

Unrestricted parking near the North Wollongong Station is available on Railway Crescent, Porter Street, Crawford Avenue, Exeter Avenue, Achilles Avenue, Bourke Street, Wiseman Avenue and Edward Street.

3.6.1.4 *Parking near schools*

Parking arrangements for schools in the Keiraville and Gwynneville study area are shown in **Table 3-3**.

Table 3-3 School parking

School	Location	Parking availability
Keiraville Public School	At the north-eastern side of the intersection of Grey Street and Gipps Road	Parking is prohibited on Grey Street directly outside of Keiraville Public School between 8:30am and 9:00am on weekdays. There is also 1-hour parking on Gipps Road outside of the school between 8:30am and 6:00pm Monday to Friday. There is limited availability for parent drop-off and pick-up, which is provided for through No Parking zones from 8-9:30am and 2:30-4pm. Council works closely with Keiraville Public School to adjust these areas to suit the school's needs.
Keiraville Community Preschool	Gooyong Street	Parking is provided on-site for children to be safely picked up and dropped off. There are no parking restrictions on Gooyong Street outside of Keiraville Community Preschool, however the road is narrow, there is a steep grade and parents are not encouraged to park here.
Gwynneville Public School	At the intersection of Acacia Avenue and Berkeley Road	No parking is allowed on Acacia Avenue directly outside of Gwynneville Public School between 8:00am – 9:30am and 2:30pm – 4:00pm, however a bus zone and accessible parking is provided. Around 100m of the frontage on Acacia Avenue is unrestricted parking.
KU Gwynneville Preschool	Berkeley Road	This is an older preschool and no on-site parking is provided. No stopping is allowed on Berkeley Road directly outside of the KU Gwynneville Preschool between 8:00am – 9:30am and 2:30pm – 4:00pm. The street frontage is narrow and a children's crossing serving Gwynneville Public School is adjacent, so parking opportunities are limited and parents rely on on-street parking away from the entrance.
Tinkerbell Pre School and Long Day Care Centre	Gwynne Street, near the intersection of Eastern Street	There is adequate parking provided on-site. There is also unrestricted parking on Gwynne Street, Eastern Street and other nearby roads.
St Brigid's Catholic Parish Primary School	At the south-western side of the intersection of Vickery Street and Gipps Road	There is no parking on either Vickery Street or Gipps Road directly outside of the St Brigid's Catholic Parish Primary School. However, there is unrestricted parking on Vickery Street further south of the school.
Para Meadows School	Porter Street, near the intersection with University Avenue	All parking demand for students and visitors is accommodated on-site. There is also unrestricted parking is available on both sides of Porter Street directly outside of Para Meadows School, however parking demand is very high.

A summary of the on-street parking restrictions and the number of parking spaces across the study area is shown in **Figure 3-6**.

Figure 3-6 Parking restrictions and number of parking spaces

3.6.2 Parking utilisation

On-street parking utilisation data was analysed from two data sources. In 2017, a sub-contractor collected parking utilisation data at 10am on 14 February, 7 March and 4 April. On 19 September 2017, Cardno's audit team completed the parking utilisation audits for the remaining streets in the study area. The dates all fall within university session timeframes.

Parking audits of the study area reveal that the streets located closer towards the UOW campus reach capacity, such as Northfields Avenue, Robsons Road, Irvine Street, Madoline Street, Hoskins Street, Sidney Street, Spearing Parade, Dallas Street, Binda Street, Falder Place, Ashcroft Place and Waitangi Street.

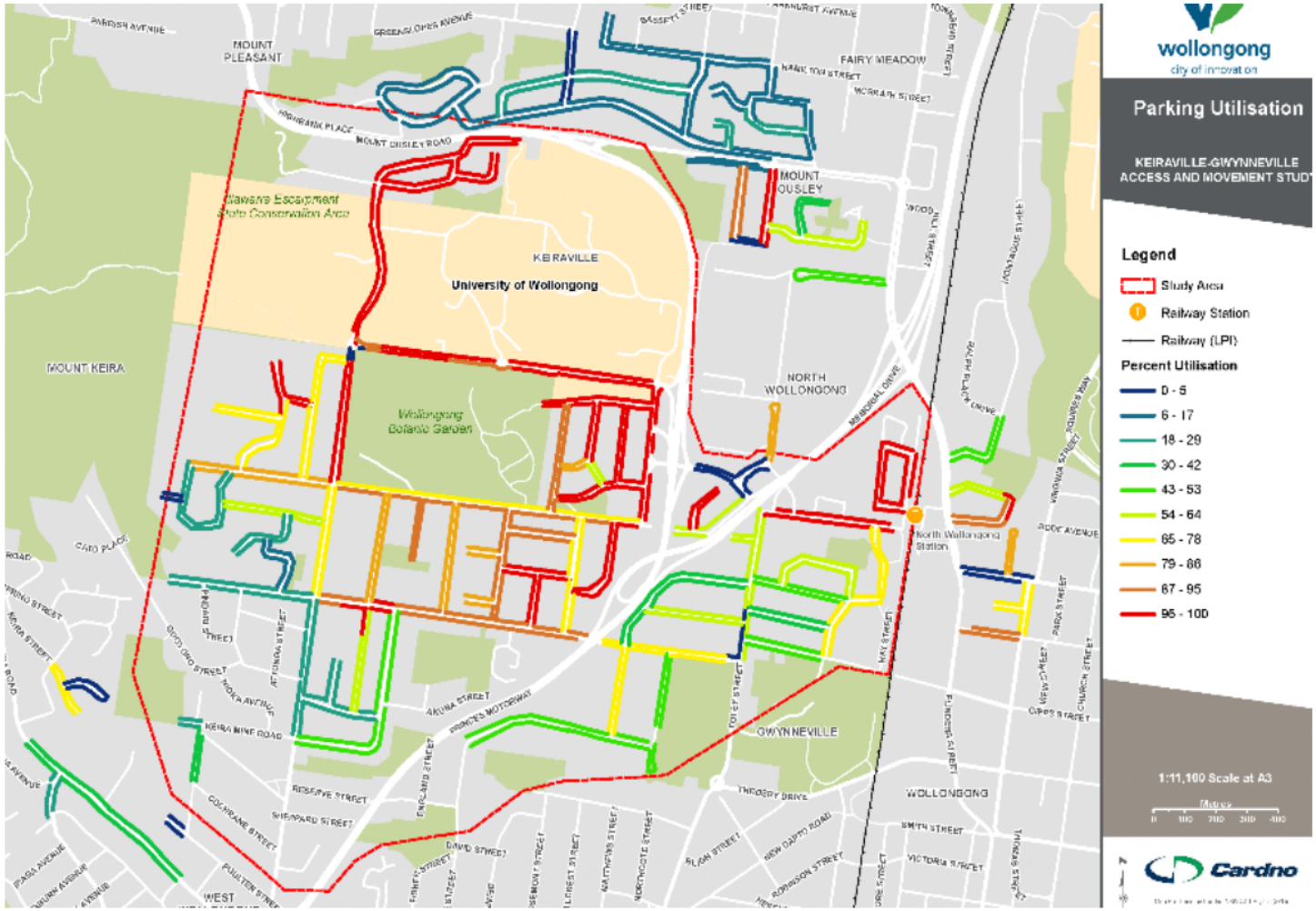
The streets in Mount Ousley, such as Dumfries Avenue and Sunninghill Circuit, achieve a low utilisation of below 20 per cent, despite close proximity to the UOW campus. This is because Mount Ousley Road forms a barrier to pedestrian movements north of the UOW campus.

The 1-hour parking spaces in the Keiraville village centre had high parking utilisation, reaching close to 100 per cent. There was less demand for parking in the Gwynneville village centre. Parking utilisation in the streets near North Wollongong Station was high.

Parking utilisation by street is shown in **Figure 3-7**, with key generators of parking demand discussed in the following sections. The results are based on spot counts generally undertaken on Tuesday 4 April 2017, with some counts undertaken on 19 September 2017 for areas not covered by the initial counts. The utilisation was calculated as the number of parked cars per available parking spaces on each street at the time of the audit. The parking management of these on-street bays does not greatly discourage use by students: nearby, on-street parking is generally unrestricted or reduced to 2-hour parking only within 400m of the campus (as shown in **Figure 3-6**). This parking is also free, in contrast to parking on-campus, which ranges from $3.50 (for up to 4 hours) to $9.60 (for 6+ hours).

Parking utilisation is discussed further in the Parking Analysis Technical Memorandum in **Appendix D**.

Figure 3-7 Parking utilisation for a typical weekday (based on spot counts undertaken at 10am on Tuesday 4 April and 19 September 2017)



3.6.2.2 *Keiraville and Gwynneville village centres*

The Keiraville and Gwynneville village centres are both located approximately one kilometre from the UOW campus, at the periphery of a 12 to 15 minute walking catchment. It is unlikely that there is a great deal of impact from students parking in the villages.

Retail centres generally must consider the needs of visitors and staff. The parking hotspot shown on the parking utilisation map near the Keiraville village centre suggests that this area is heavily used by visitors. It is noted that bays are generally restricted to 1-hour parking in this vicinity.

Additional off-street parking within the village centres is available for use by employees and visitors.

3.6.2.3 *UOW campus and surrounds*

Overall, UOW students make up the largest group for parking demand. Results from studies of other universities, such as the Curtin University Transport Study (2010), have shown that students are generally willing to walk further to obtain free parking, and are willing and able to move their vehicle multiple times to circumvent timing restrictions. Some of the parking demand is satisfied on-site by 1,029 ticket parking bays (plus approximately 350 car pool and 150 specialty bays). This ratio of student parking is significantly lower than that at other universities surveyed in the past, and is generally consistent only with City-Centre campuses at UNSW and University of Sydney (see **Table 3-4** below).

Table 3-4 Parking provision by student population – comparison statistics

University	Student Enrolment (EFTSL)	Total Parking	Students per Bay	Comments
Curtin Bentley	18,000	6,750	2.7	Much of the parking is unavailable to students – actual ratio 4.2 to 4.7
Macquarie	18,000	5,060	3.6	All parking shared with staff
UOW (2010)	13,000	2,700	4.8	Majority of parking unavailable to students – actual ratio 8.8
UOW (2016)	17,080	3,168	5.4	Majority of parking unavailable to students – actual ratio 12 to 16
ANU	13,300	5,870	2.8	Proportion of parking unavailable for students – actual ratio 3.6 to 4.1
USC	4,000	1,025	3.9	From ANU report
LaTrobe	22,900	5,500	4.2	From ANU report
UNSW	29,650	3,000	9.9	From ANU report
USyd	32,250	2,500	12.9	From ANU report
ECU	13,200	4,890	2.7	From ECU integrated transport plan
UWA	15,500	3,400	4.6	Actual ratio available to students - 6.4 to 9.6 (a large quantum of parking is available off-campus)
Murdoch			2.2	From ECU integrated transport plan

Source: Curtin University Transport Study (2010), UOW Campus Master Plan (2016)

3.6.2.4 *North Wollongong Station*

The North Wollongong Station is located at the edge of the study area. There are a small number of formal commuter parking bays immediately adjacent to the station (Porter Street, west of the station), but commuters appear to park on-street along Porter Street and within the local residential neighbourhood (Hindmarsh Avenue, Railway Crescent and Crawford Avenue).

Given that the North Gong Shuttle runs direct from the station to the UOW campus, a portion of these bays may be consumed by students and staff from the University, as well as other commuters taking the train from North Wollongong Station.

3.6.2.5 *Schools*

Demand for school parking is intense and short-lived, restricted to less than an hour in the morning and afternoon. Generally, staff parking is easily retained on-site, leaving only student pick up/drop off activities on-street. The high generation of demand during peak periods can create safety and network operation issues. Effective management requires extensive intervention from both the Local Government and the schools themselves.

There are several schools in the study area, including the Keiraville Public School, Gwynneville Public School, St Brigid's Catholic Parish Primary School, Para Meadows School and Kiera High School.

3.7 Future transport projects

This section highlights the importance of aligning any planned major transport projects with the Access and Movement Study for Keiraville and Gwynneville.

3.7.1 Mount Ousley Interchange

Road and Maritime are planning an interchange on the M1 Princes Motorway at the base of Mount Ousley. The upgrade will address safety concerns and traffic congestion challenges associated with the motorway. An artist's impression of Mount Ousley Interchange is shown in **Figure 3-8**.

Figure 3-8 Artist impression of Mount Ousley Interchange

Source: Roads and Maritime Mount Ousley Interchange (2017)

Planned upgrades to Mount Ousley Road and the M1 Princes Motorway include:

- A new access to the UOW campus;
- Separation of heavy vehicles to access Mount Ousley Road;
- A grade separated interchange on the M1 Princes Motorway at the base of Mount Ousley that replaces the existing intersection;
- An overpass from Mount Ousley Road to the M1 Princes Motorway;
- Pedestrian and cyclist bridges over Mount Ousley Road and the M1 Princes Motorway connecting suburbs to the north with the UOW campus;
- Provision for a future third southbound lane; and

> A preferred design option that provides an exit from the UOW campus onto the M1 Princes Motorway reducing congestion within the campus and surrounding local road network, particularly targeting the afternoon peak times.

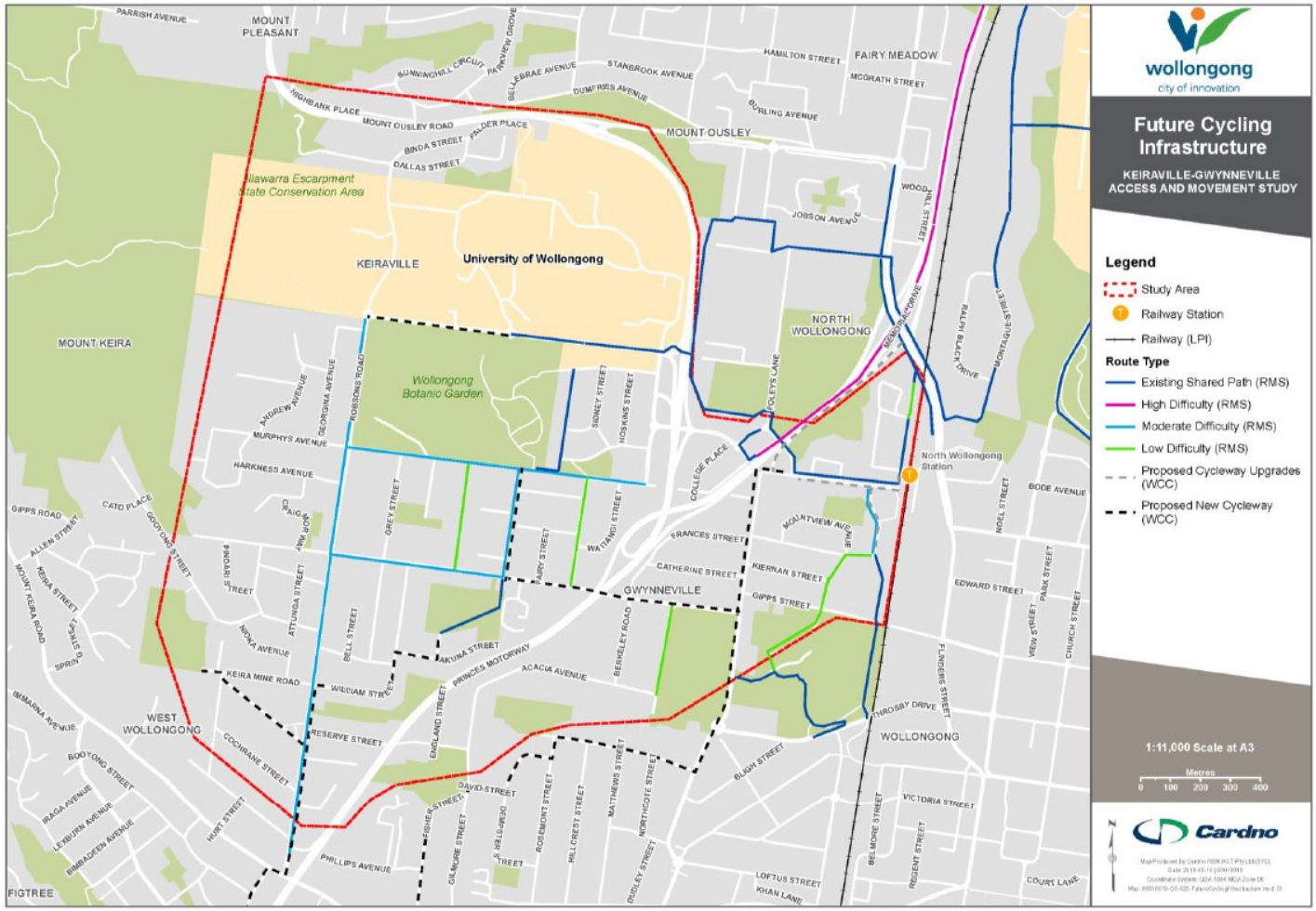
Once the interchange is completed, parking issues may emerge in Mt Pleasant and Mt Ousley due to the increased connectivity created by a pedestrian link to the north. On-street parking utilisation here is currently quite low due to the circuitous walking route to access the UOW, however the Mount Ousley Interchange upgrade will provide an additional link which will increase the walking catchment from the UOW and may increase parking demand on these local roads.

3.7.2 Future cycle network

The 2014 – 2018 Bike Plan recommended a number of infrastructure improvements. This was developed to improve cycling connectivity throughout the region.

Figure 3-9 provides a summary of the key cycleways infrastructure and upgrades that are proposed. The implementation of these cycleways will improve connections to UOW and North Wollongong Station.

Figure 3-9 Future cycling network



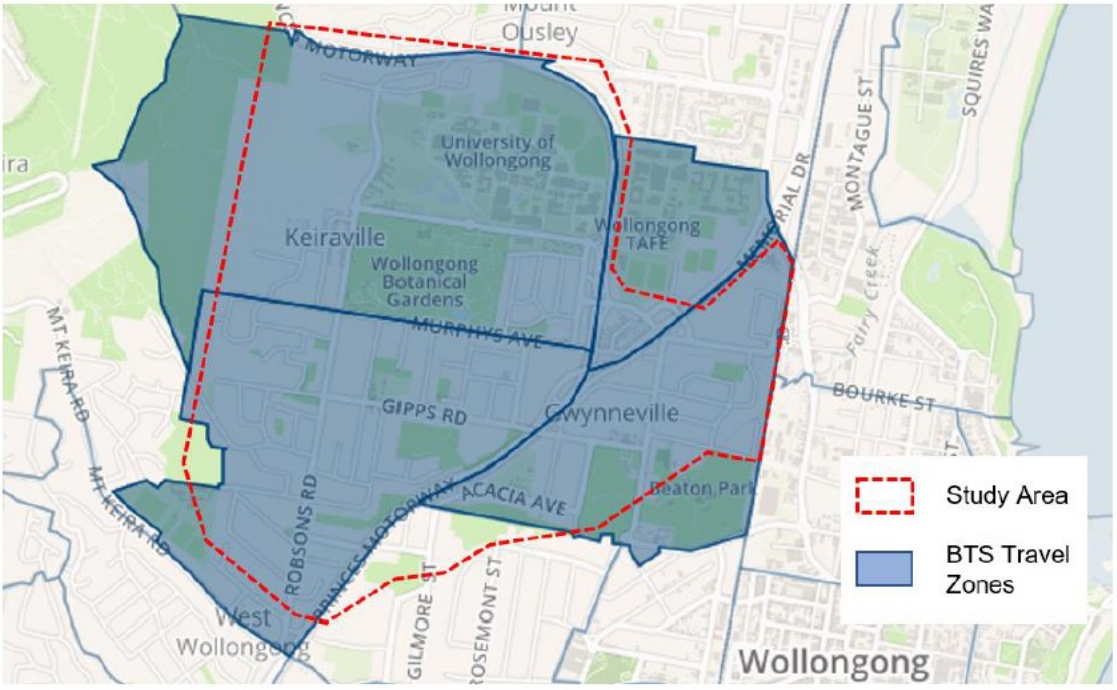
3.8 Travel behaviour

This section provides a summary of the residents and worker characteristics in the precinct to understand the link between population and trip generation. The data used is gathered from the Bureau of Transport Statistics (BTS) and the Census by the Australian Bureau of Statistics (ABS) in 2016.

3.8.1 Population and employment

The BTS travel zones to which the data described in this section applies are shown in **Figure 3-10**. These travel zones closely align with the study area and so are considered to represent the study area, but also include small areas of land outside.

Figure 3-10 BTS travel zones

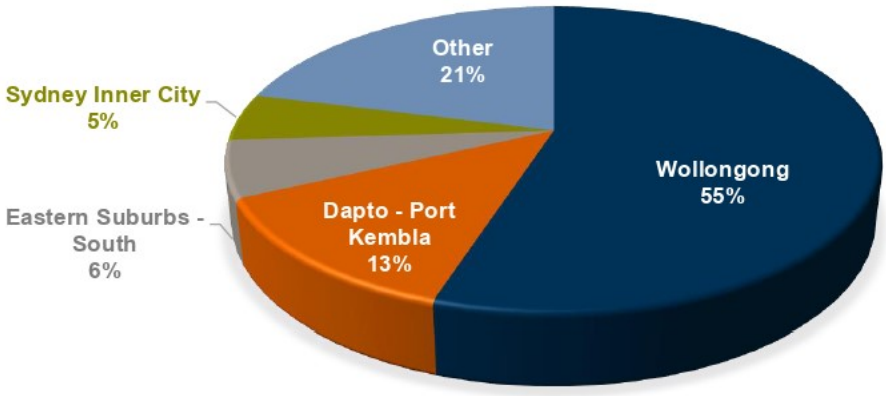


Source: Travel Zone Explorer, BTS

Approximately 8,000 people live within the selected travel zones (the study area) within Keiraville and Gwynneville (including campus accommodation students). Of these 8,000 residents, the workforce consists of 3,178 employed people. The employment location of study area residents shown in **Figure 3-11**.

The number of jobs located within the study area is 5,488.

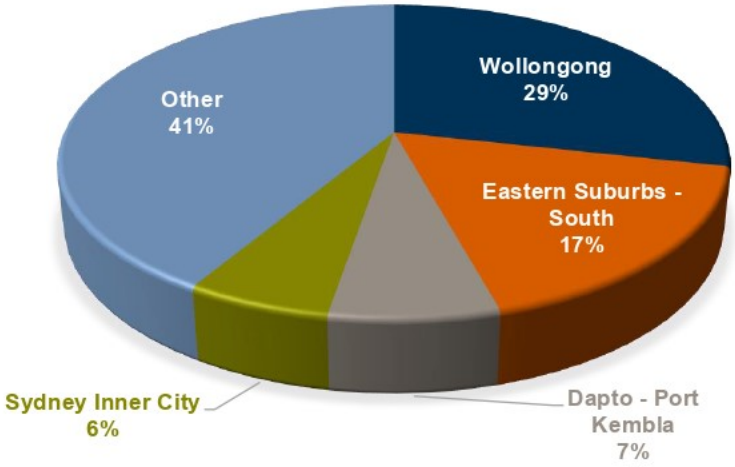
Figure 3-11 Employment location for residents in the study area



Source: Journey to Work, BTS

The home locations of workers who travel to jobs in the study area is shown proportionately in **Figure 3-12**.

Figure 3-12 Location of residence for workers in the study area



Source: Journey to Work, BTS

3.8.2 Dwelling types

The majority of dwellings in the study area are separate houses, followed by flats or apartments and semi-detached dwellings. The number and proportion of each dwelling type is shown in **Table 3-5**. The Illawarra Region dwelling proportions are also listed for comparison; the study area has higher proportions of high density dwellings.

Table 3-5 Dwelling types

Suburb	Separate house	Semi-detached	Flat or apartment	Other
Keiraville	764 (64.3%)	196 (16.5%)	228 (19.2%)	0 (0%)
Gwynneville	563 (55%)	198 (19.3%)	259 (25.3%)	4 (0.4%)
Illawarra Region	73%	13%	13%	1%

Source: ABS, 2016

3.8.3 Motor vehicle ownership

Vehicle ownership gives a good indication of mode share, as households with no vehicles will rely on other transport modes more heavily. The majority of households within the study area own one or two private vehicles, but there is also a high number of households that own no vehicle. This indicates that walking, cycling, and public transport are important modes of transport for many residents in the study area. The number and proportion of household vehicle ownership by households is shown in **Table 3-6**. The Illawarra Region vehicle ownership is also given for comparison.

Table 3-6 Motor vehicle ownership

Suburb	None	1 motor vehicle	2 motor vehicles	3 or more vehicles	Not stated
Keiraville	98 (8.2%)	463 (38.9%)	386 (32.4%)	193 (16.2%)	51 (4.3%)
Gwynneville	164 (16.0%)	431 (42.2%)	253 (24.8%)	141 (13.8%)	33 (3.2%)
Illawarra Region	7.9%	34.4%	35.7%	18.3%	3.7%

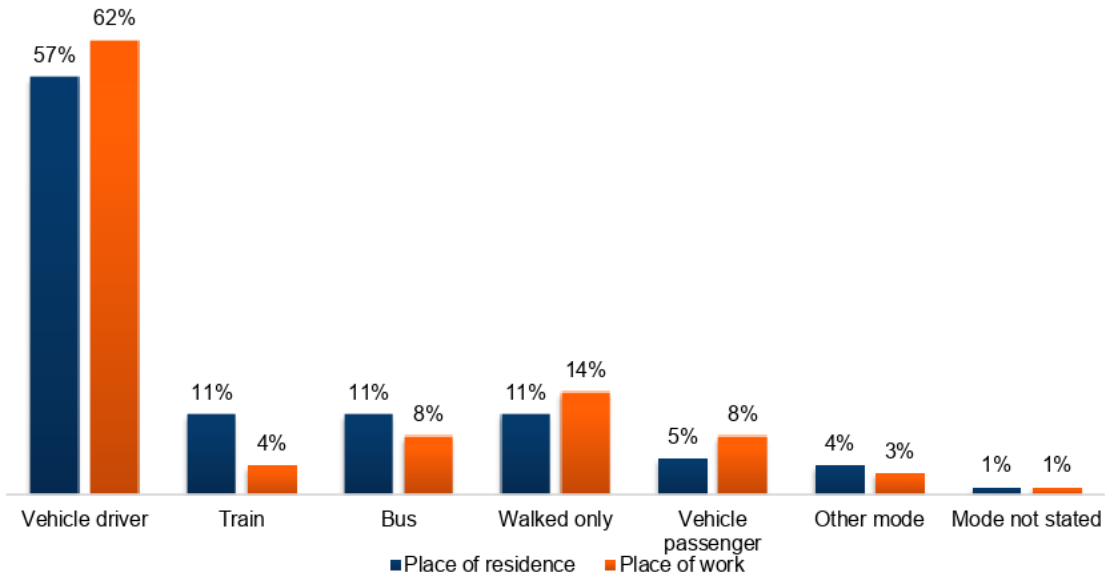
Source: ABS, 2016

3.8.4 Transport mode share

3.8.4.1 Study area

The Journey to Work survey from BTS, based on 2011 census data, shows that over half of the people who both live and work within the selected travel zones use private vehicles to access their workplace. Walking was the second most common mode choice for both residents and workers, followed by public transport. The mode share for both workers and residents of the travel zones is shown in **Figure 3-13**.

Figure 3-13 Transport mode share for people who live and work in the travel zones

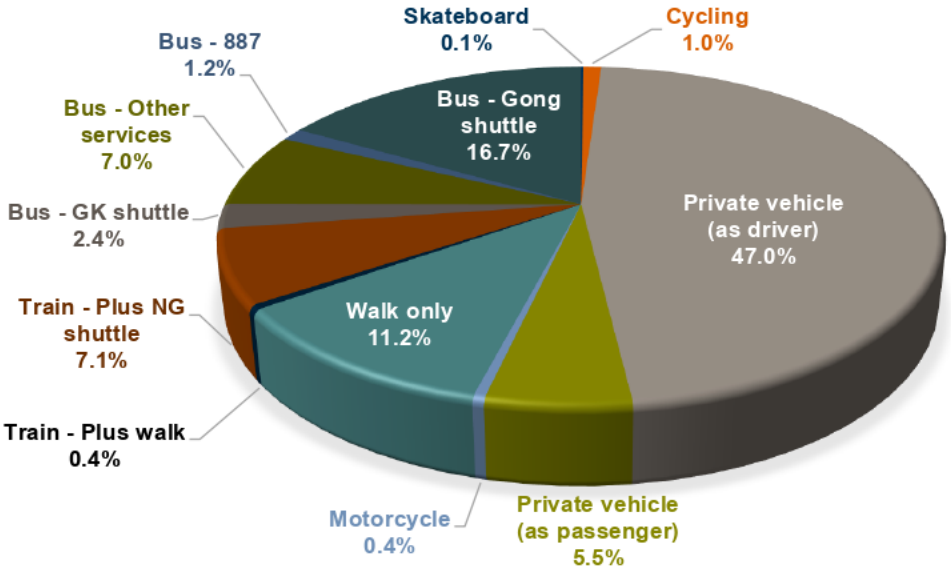


Source: Journey to Work, BTS

3.8.4.2 University of Wollongong

The transport mode share for accessing the UOW campus was calculated in the 2017 Draft UOW Transport Survey and Strategy (Cardno, 2017). A Headcount Access Survey indicated that the majority of people accessed the campus via a private vehicle, either as the driver or as a passenger; this was followed by access via bus services. The UOW campus mode share is shown in **Figure 3-14**.

Figure 3-14 UOW campus mode share



Source: Cardno, 2017

The Draft UOW Transport Survey results show that staff car-as-driver mode share is approximately 43%. In contrast to the student population, university staff have a much higher ratio of available parking, with over 1,500 dedicated staff parking bays located in Permit and Reserved areas, not including car pool and specialty bays, for a staff population of approximately 2,200 FTEs. The mode share result suggests that the existing 900 staff permit parking bays would be sufficient to accommodate this demand, potentially freeing up 600 reserved parking bays.

3.8.5 Traffic modelling

As part of this study, the existing and future operation of the Keiraville-Gwynneville traffic and transport network was examined with a view to developing strategies to reduce congestion and enable greater sustainable transport mode share in the area. The planned future development was assessed to determine the impact on traffic generation and flow, as well as accessibility, parking demand, and the overall operation of the network.

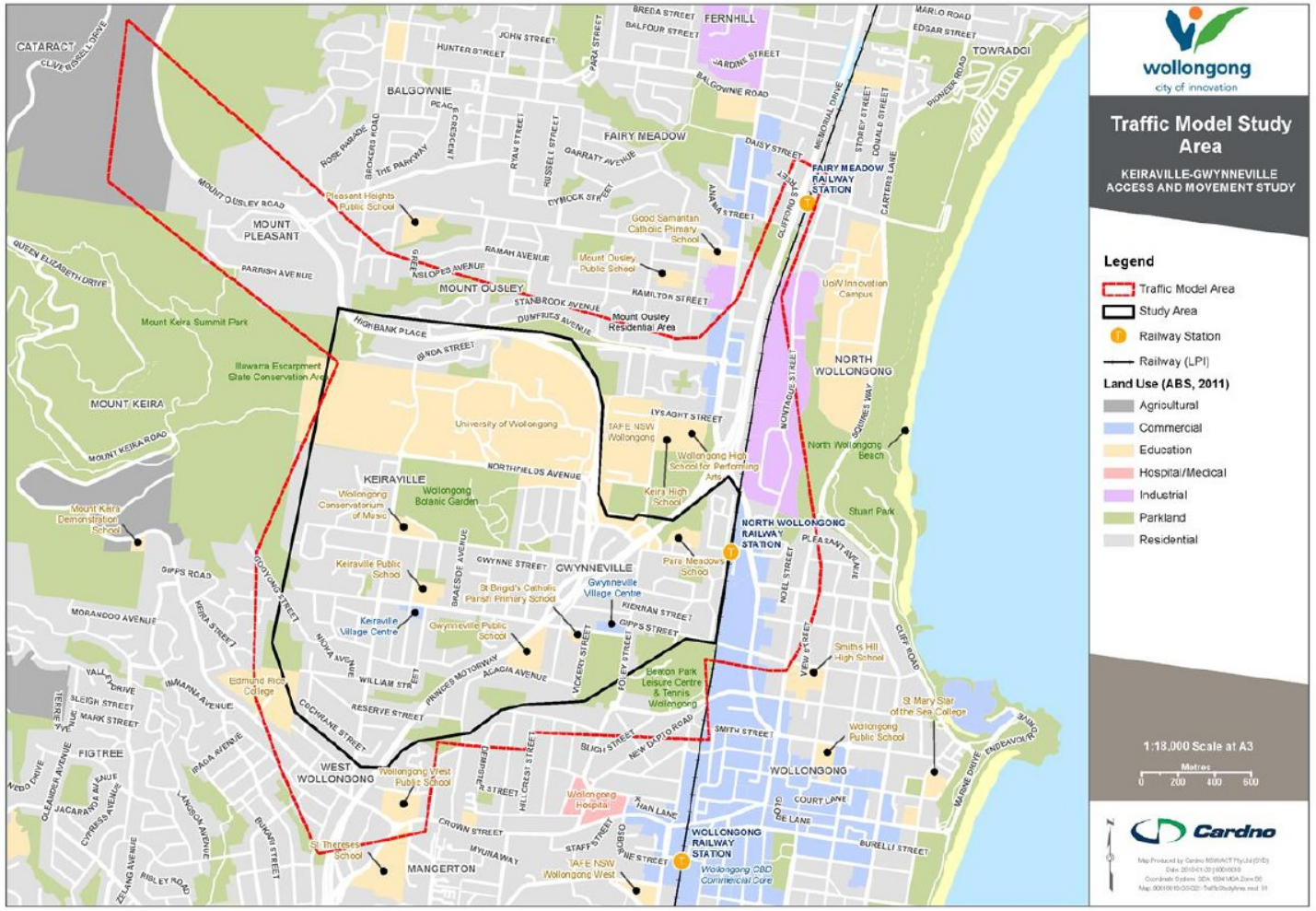
3.8.5.1 Objectives and scope of works

The aim of the traffic modelling was to test different future year scenarios in the study area. The modelling process involved the following steps:

- Assess the travel demand during the academic session (in-session) which is a characteristic for the month of August and the non-academic session (out-session) which is a characteristic for the month of September;
- Assess the impacts of potential developments on the study area and changes in road network and surrounding intersections;
- Evaluate existing and future year transport network performance; and
- Identify and evaluate mitigation measures to accommodate traffic likely to be generated from future developments and growth.

The traffic model study area is shown in **Figure 3-15**, and a full modelling report is provided in **Appendix C**.

Figure 3-15 Traffic model study area



The scope of works for the traffic modelling was as follows:

- Extract the study network from an existing Roads and Maritime Aimsun Mount Ousley Interchange hybrid model (which include the future (2022 and 2037) year scenarios) and develop a purpose built microsimulation model;
- Adjust the 2015 volumes at the interchange and surrounding junctions to balance the discrepancies between the 2015 and 2017 data;
- Determine the traffic demand for "in-session" and "out-session" AM and PM peak periods which consists of the peak academic session and the period outside of the academic session respectively;
- Calibrate and validate a microsimulation model in accordance with Traffic Modelling Guidelines (Roads and Maritime Services, 2013);
- Assess options regarding the Mount Ousley Interchange;
- Import intersection turning volumes from the Mount Ousley Aimsun Model (Jacobs, 2015) for the Memorial Drive / Princes Highway Interchange;
- Obtain outputs from the microsimulation model to be used for a SIDRA assessment of key intersections within the Keiraville-Gwynneville precinct.

3.8.5.2 Road demand and congestion locations

The road network performance can be largely determined by assessing the theoretical capacity of the mid-block and the average speed of traffic, as per the *Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis*. The performance of key roads within the precinct indicate the demand on the road network. The performance of the road network was measured using the following variables:

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

The key indicator of mid-block performance is the Level of Service (LoS). This is the average speed as a percentage of the base Free Flow Speed (FFS), where results are placed on a continuum from 'A' to 'F', as shown in **Table 3-7**.

Table 3-7 Austroads Mid-Block Criteria for Speed Level of Service Analysis

LoS	Description	Travel speed as a percentage of base FFS (%)
A	Good operation	> 85
B	Good with acceptable delays and spare capacity	67-85
C	Satisfactory	50-67
D	Operating near capacity	40-50
E	At capacity	30-40
F	Unsatisfactory and requires additional capacity	≤ 30

The data used for this analysis considers weekdays during in-session (August 2017) and out-session (September 2017). The roads which were assessed are Northfields Avenue, University Avenue, Porter Street, Robsons Road, Gipps Road, and Foley Street.

Areas of concern include Northfields Avenue and Robsons Road, which provide direct access to the University of Wollongong campus and local schools. However, overall performance at the route level shows that the speed performance is satisfactory, with the worst performance identified as the westbound direction of Northfields Avenue during the AM peak in-session period.

Observations made about congested intersections are summarised in **Table 3-8**.

Table 3-8 Congestion intersections in the study area

Intersection Location	Time of Day	Observation
Mount Ousley Road / Princes Motorway	AM	The ratio between the speed level of service and the posted speed is less than 30% at a 200 metres approaching distance of the intersection. On Mount Ousley Road the maximum queue length is around 15 vehicles between in the AM peak. This is partially captured in the image below.  Queuing is most likely caused by drivers having difficulty to find safe acceptable gaps between vehicles to turn right onto Princes Motorway. Vehicles are often reaching around 80km/hour along Princes Motorway and no queuing was identified on Princes Motorway.
	PM	The ratio between the speed level of service and the posted speed is 50% to 69% at a 200 metres approaching distance of the intersection. On Mount Ousley Road, the maximum queue length is roughly around the same length of the AM peak in the PM peak. There is no queuing on Princes Motorway.
Irvine Street / University Avenue	AM	The ratio between the speed level of service and the posted speed is 40% to 49% when approaching roundabout and interchange ramps. The figure below shows queuing on University Avenue in the AM peak.  The community gave feedback indicating that this intersection is a stoppage point on weekday mornings and the traffic moves very slowly, if not at all, with very long waiting times.
	PM	The ratio between the speed level of service and the posted speed is 50% to 69%. On the northern and southern sides of Irvine Street, extensive queueing can be observed in the PM peak.

Princes Motorway / University Avenue	AM	The ratio between the speed level of service and the posted speed is 50% to 69%. Queueing on the off ramp of Princes Motorway is mostly likely caused by the number of vehicles coming from the motorway at high speeds and giving way at the roundabout at the intersection. During the morning peak period, there will be a large proportion of vehicles using this intersection to access the University of Wollongong and schools. The figure below illustrates the queuing behaviour in the morning.  The community provided feedback that the traffic banks up around 8am exiting the freeway, heading south.
	PM	The ratio between the speed level of service and the posted speed is 70% to 85%. In comparison to the AM peak period, there may be less queues because people may not use the same route and may visit other destinations in the Keiraville – Gwynneville area.

The existing Level of Service for these roads is shown in **Figure 3-16** (AM peak) and **Figure 3-17** (PM peak). It is clear that the majority of the road network operates satisfactorily during the AM and PM peak periods. However, there are notable issues on approach to key intersections and roundabouts within the study area.

Figure 3-16 Road network speed level of service (AM period)

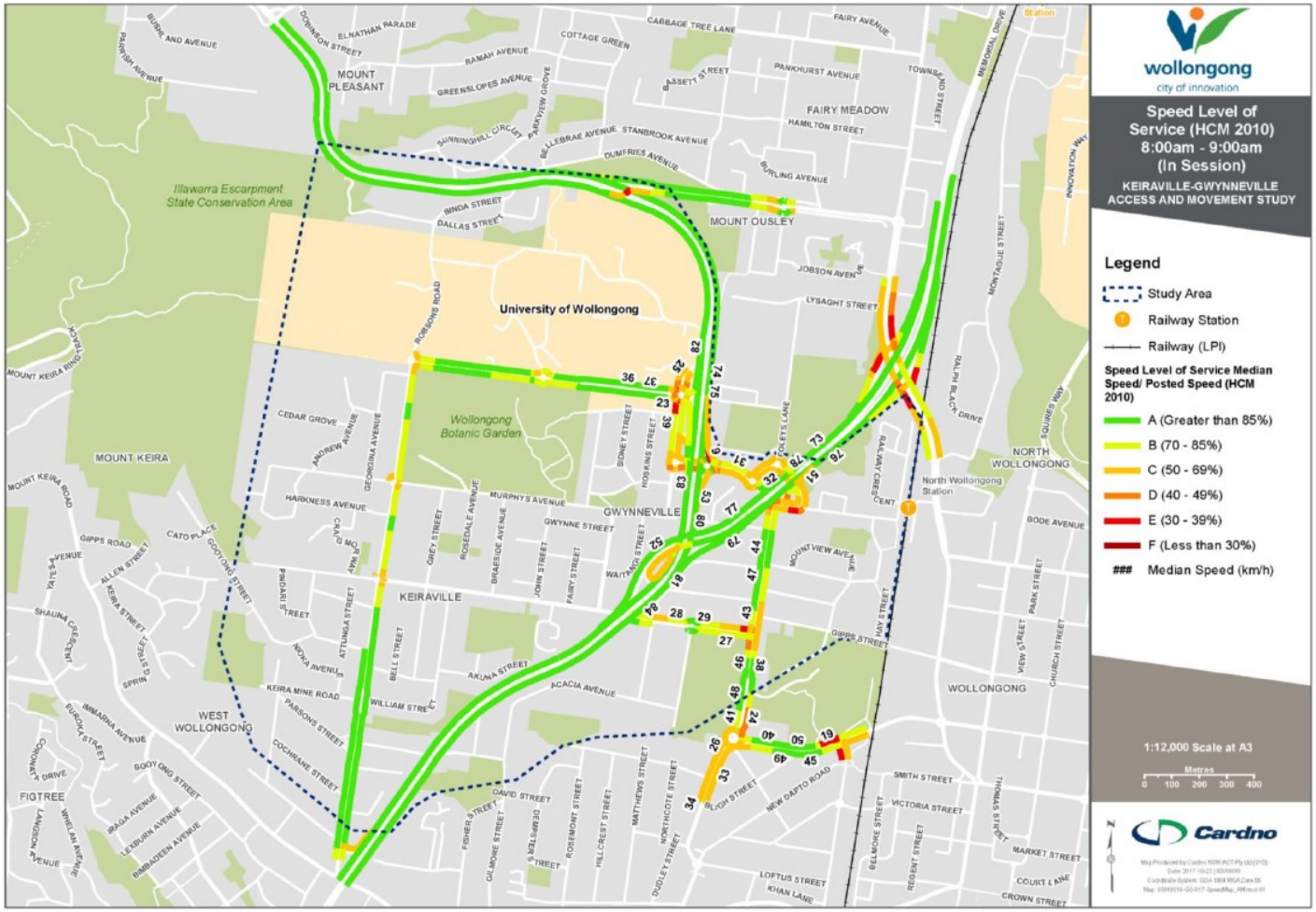
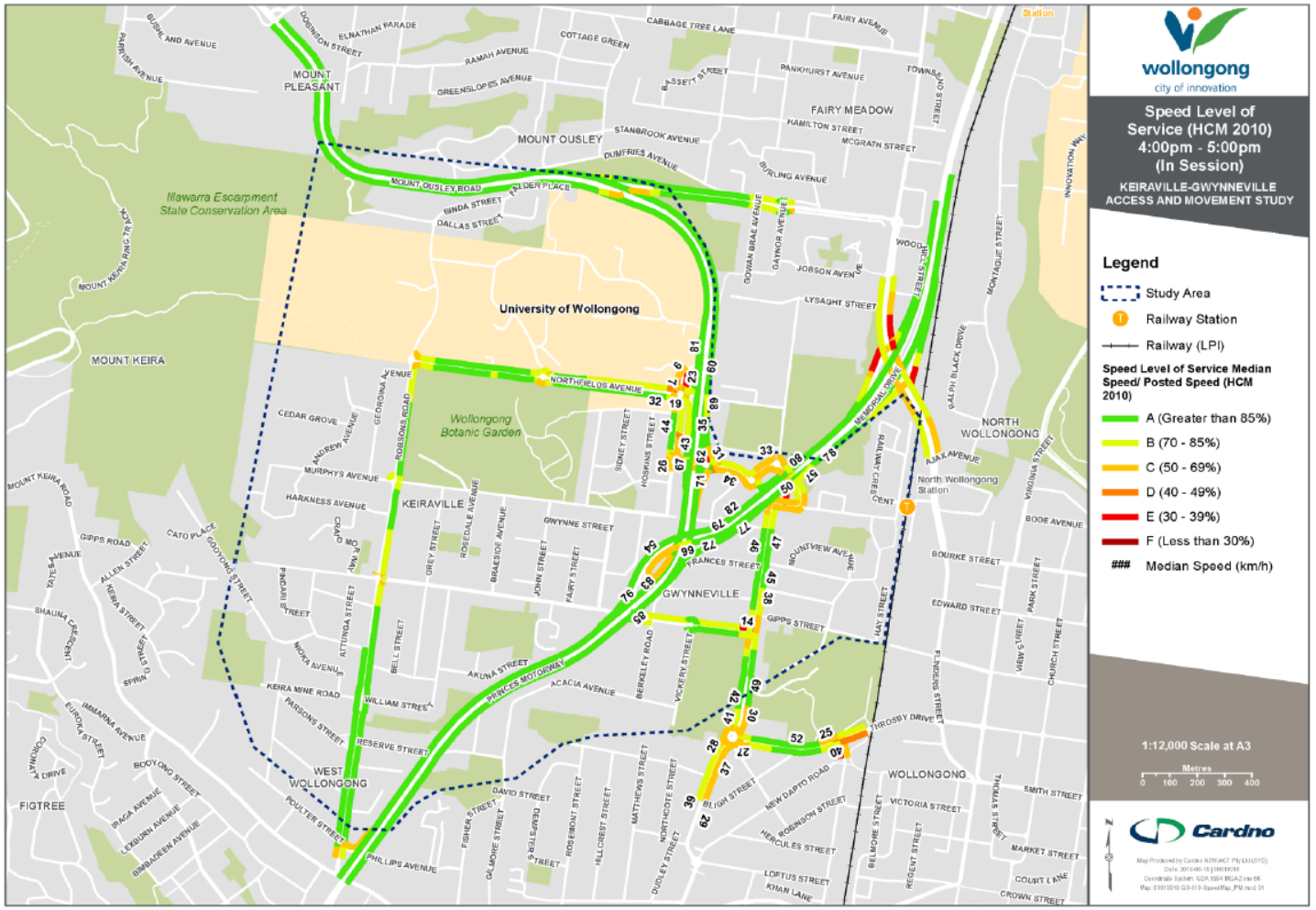


Figure 3-17 Road network speed level of service (PM period)



3.8.5.3 *Future year traffic modelling*

Microsimulation AIMSUN models were developed for the future (2022 and 2027) years with consideration of the following:

> University Avenue and Foley Street corridor.

> Mercury Street / Throsby Drive / Foley Street intersection.

> Foley Street / Gipps Road intersection.

> Impact of Mount Ousley Interchange in 2027.

3.8.5.4 *Future (2022) year traffic analysis*

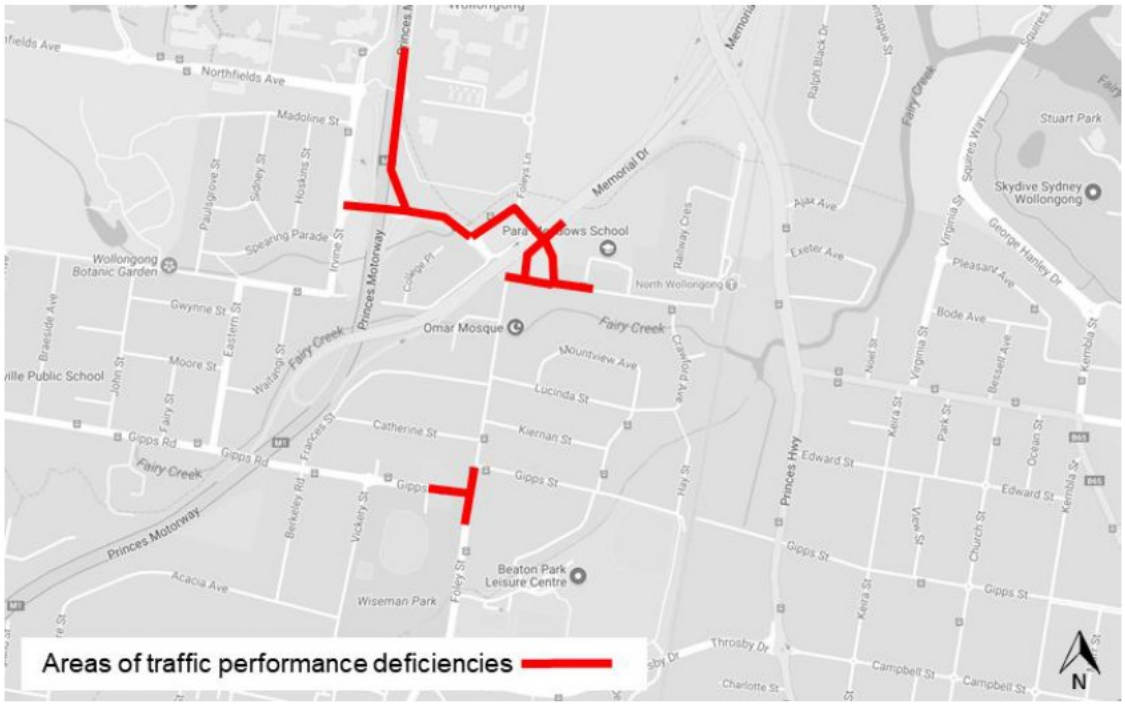
The future (2022) year traffic models identified traffic performance deficiencies at (see **Figure 3-18** for locations):

> University Avenue off-ramp, particular in the AM peak.

> University Avenue and Foley Street corridor in the PM peak.

> Foley Street / Gipps Road intersection in the PM peak.

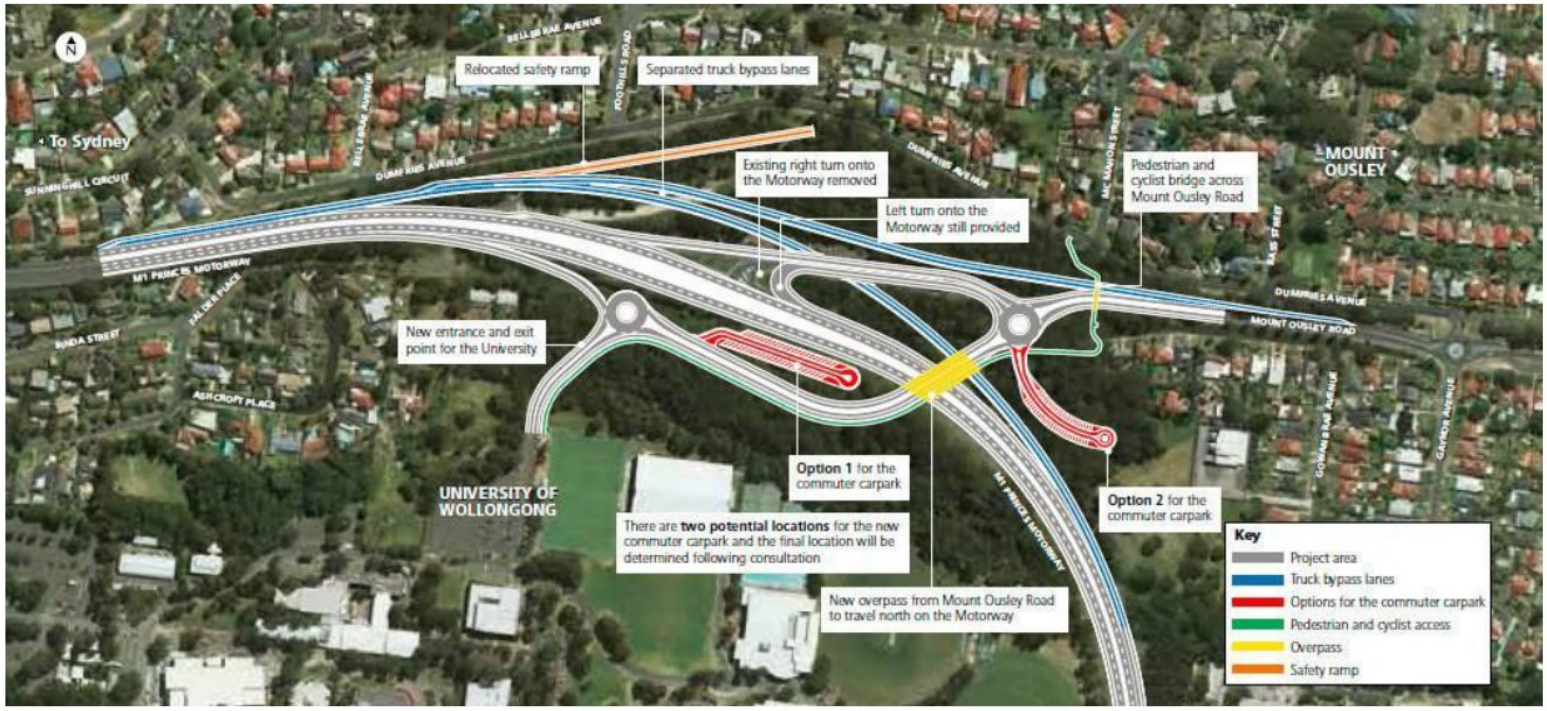
Figure 3-18 Traffic performance deficiencies in future (2022) year



3.8.5.5 *Future (2027) year traffic analysis*

The future (2027) year traffic models considered the impact of traffic growth and the upgrade of the Mount Ousley Interchange. As part of the Mount Ousley Interchange upgrade (**Figure 3-19**), the alignment of the University Avenue off-ramp is proposed to be modified so that southbound traffic will exit the motorway at the new interchange). The existing Mount Ousley Road right turn to Prices Motorway is proposed to be removed as part of the upgrade (this was identified as a traffic performance and safety issue in the existing and 2022 conditions).

Figure 3-19 Proposed Mount Ousley Interchange upgrade



Comparison of the future (2022) year and future (2027) traffic model results indicate the Mount Ousley Interchange (and traffic growth) will impact the following roads as shown in the respective figures:

- Robsons Road (**Figure 3-20**)
  - Significant reduction of vehicles per hour in the southbound direction during the AM and PM peak
- Gipps Road (**Figure 3-21**)
  - Minor reduction of vehicles per hour in both directions during the AM
  - Minor increase of vehicles per hour in both directions during the PM
- Murphys Avenue (**Figure 3-22**)
  - Reduction of vehicles per hour in the eastbound direction during the AM
  - Increase of vehicles per hour in the westbound direction during the PM
- Northfields Avenue (**Figure 3-23**)
  - Significant reduction of vehicles per hour in both directions during the AM and PM peak
- Irvine Street (**Figure 3-24**)
  - Reduction of vehicles per hour in the northbound direction during the AM
  - Increase of vehicles per hour in both directions during the PM
- Foley Street (**Figure 3-25**)
  - No significant difference in vehicles per hour.

Figure 3-20 Robsons Road – future (2022) year vs future (2027) year

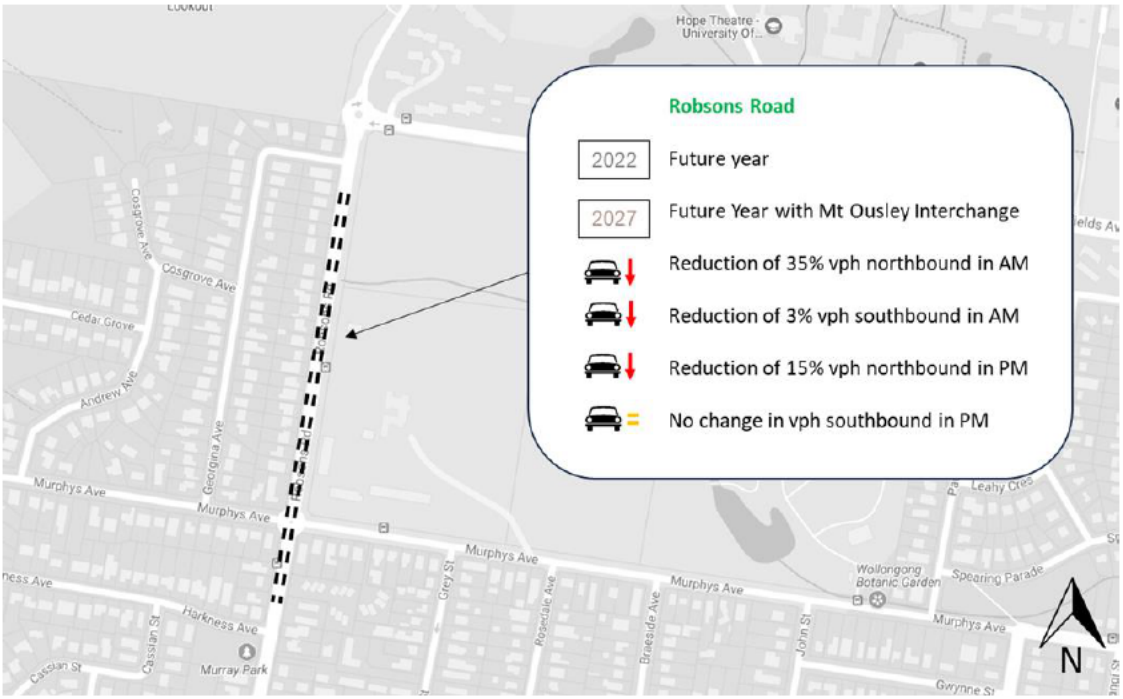


Figure 3-21 Gipps Road – future (2022) year vs future (2027) year

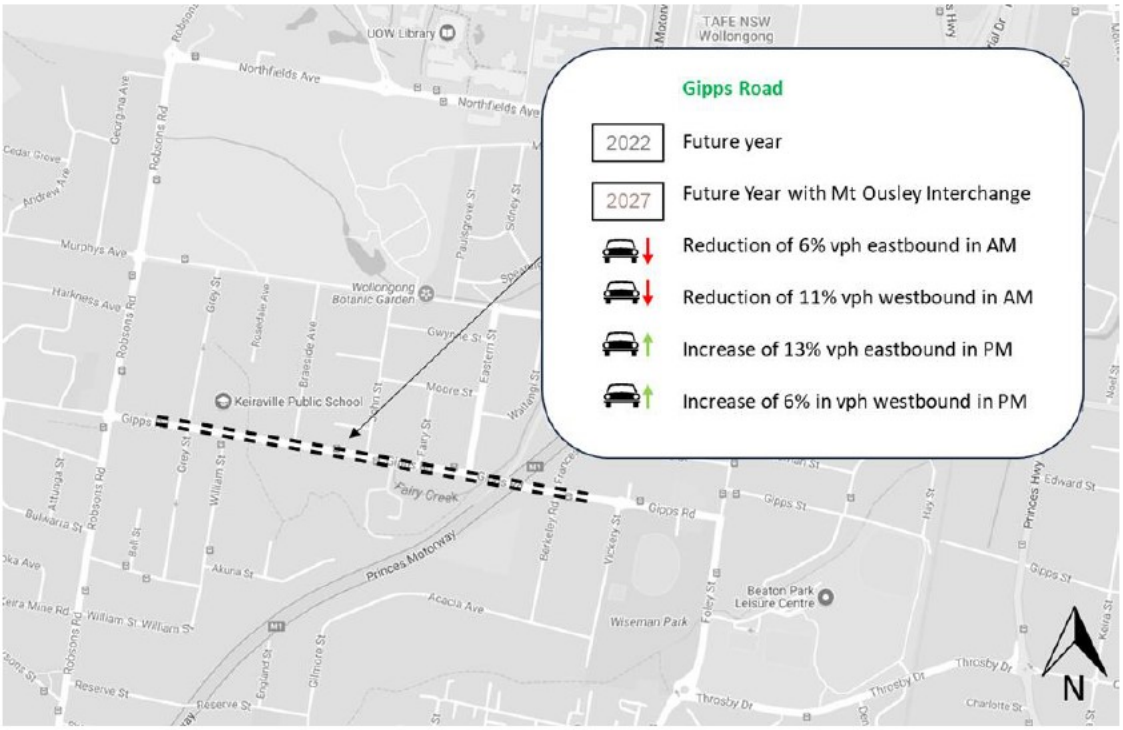


Figure 3-22 Murphys Avenue – future (2022) year vs future (2027) year

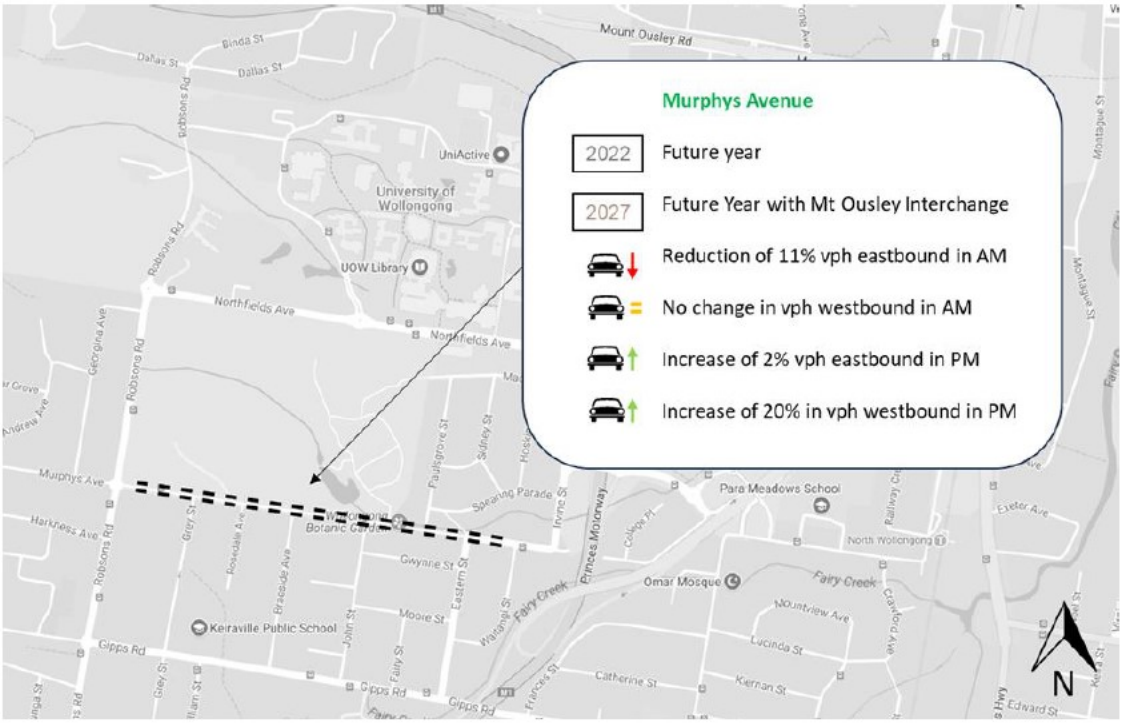


Figure 3-23 Northfields Avenue – future (2022) year vs future (2027) year

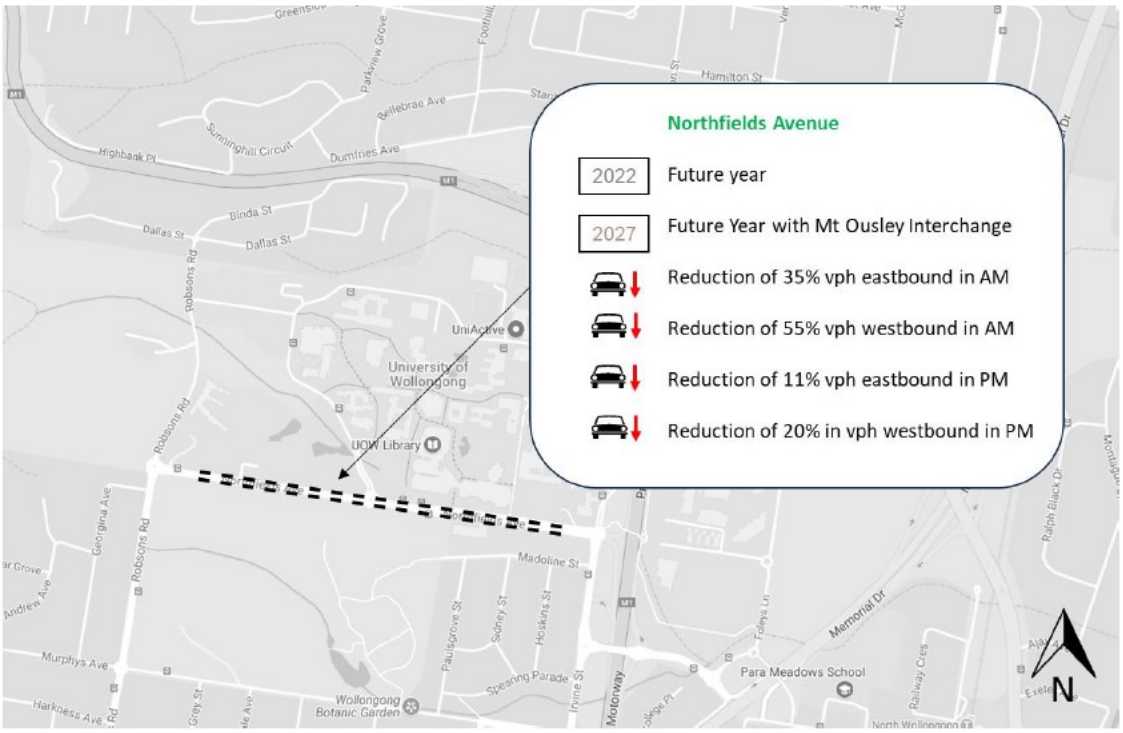
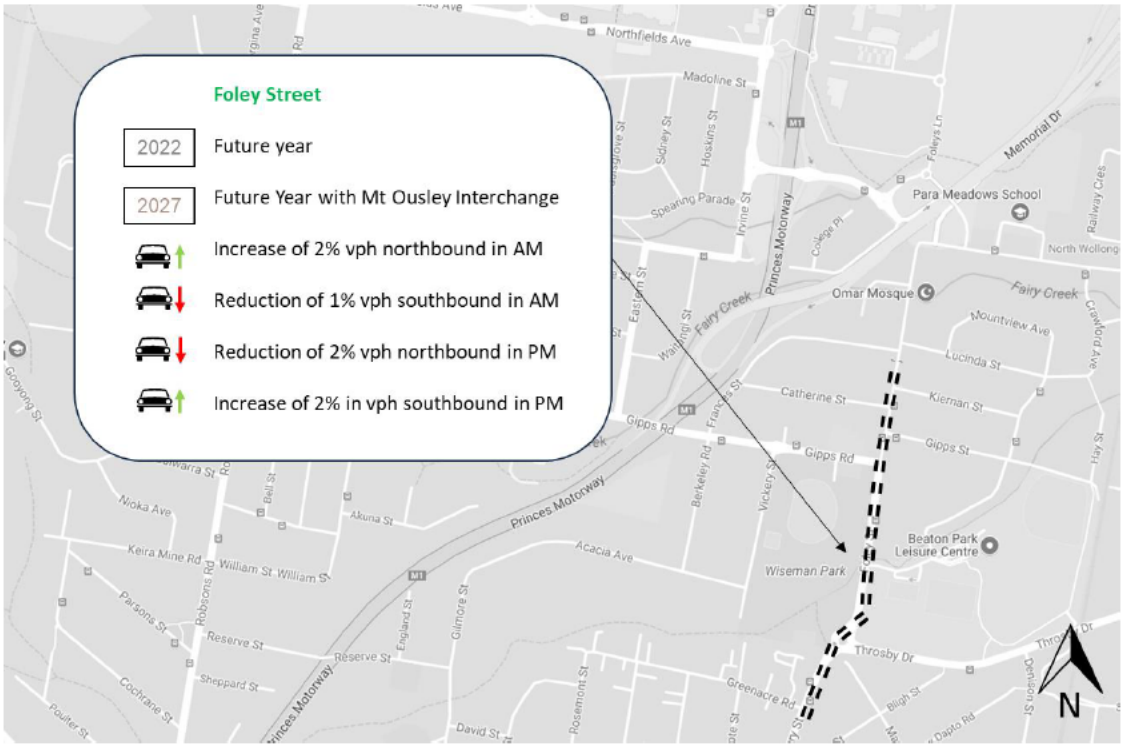


Figure 3-24 Irvine Street – future (2022) year vs future (2027) year

Figure 3-25 Foley Street – future (2022) year vs future (2027) year



3.8.5.6 Intersection performance

The future year model results indicated University Avenue / Pacific Motorway off-ramp and University Avenue / Porter Street intersections require additional capacity, with an intersection performance of LOS F during peak periods in 2022 and 2027 (even with the Mount Ousley Interchange upgrade).

No significant issues are anticipated for the other assessed intersections in 2022 or 2027, which have a satisfactory intersection performance of LOS C or better:

- University Avenue / Irvine Street
- University Avenue / University Avenue
- University Avenue / Foleys Lane
- Foley Street / Gipps Road
- Foley Street / Throsby Drive
- Foley Street / Gipps Street
- Porter St signals
- Gipps Road / Eastern Street.

A summary of the intersection performance of the assessed intersections are shown in **Figure 3-26**, **Figure 3-27**, **Figure 3-28** and **Figure 3-29** for the future (2022 and 2027) years.

Figure 3-26 Intersection performance – future (2022) year AM peak

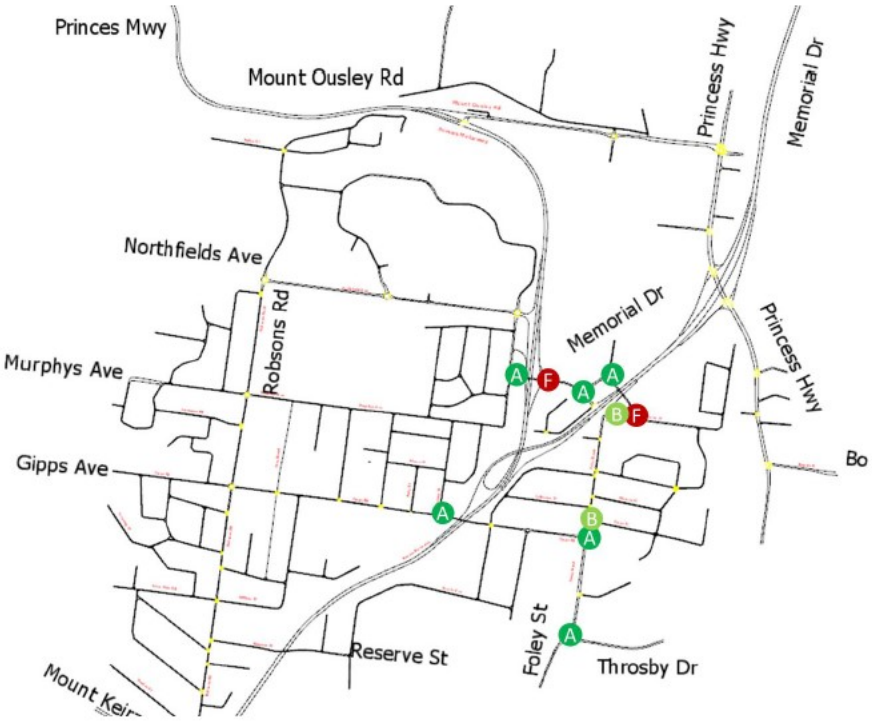


Figure 3-27 Intersection performance – future (2022) year PM peak

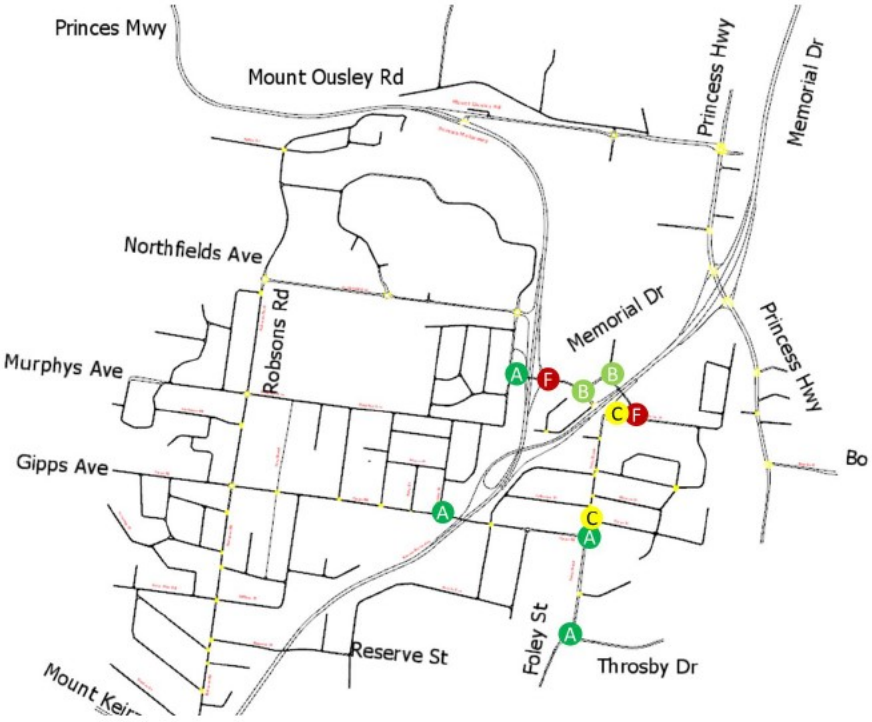


Figure 3-28 Intersection performance – future (2027) year AM peak

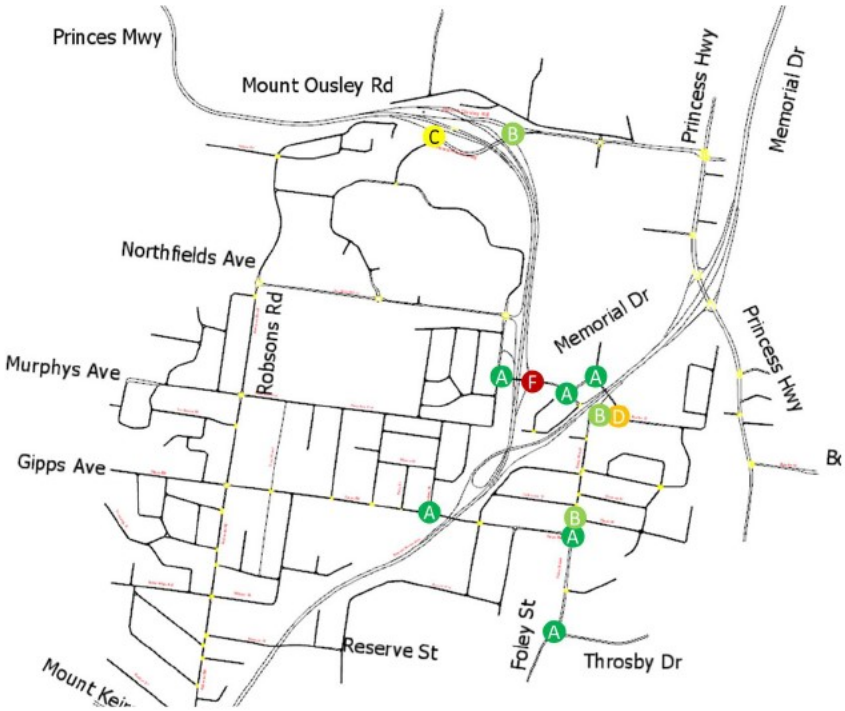


Figure 3-29 Intersection performance – future (2027) year PM peak

3.8.5.7 Summary

The traffic assessment identified existing (2018) congestion locations at:

> Mount Ousley Road / Princes Motorway

> Irvine Street / University Avenue

> Princes Motorway / University Avenue.

The impact of future traffic growth and the Mount Ousley Interchange upgrade in the future (2027) year was assessed using the AIMSUN models. The Mount Ousley Interchange upgrade removes the congestion at Mount Ousley Road / Princes Motorway (by realignment) and provides a new access to the UOW campus. The AIMSUN models indicate there is some reduction of vehicles per hour in the roads surrounding the University such as Robsons Road and Northfields Avenue. However, the modelling results indicate there would still be congestion issues at the Princes Motorway / University Avenue and nearby intersections, in future (2027) year with the Mount Ousley Interchange upgrade.

Detailed intersection assessment in SIDRA confirmed the conclusions from the AIMSUN model. Additional capacity is required at the Pacific Motorway / University Avenue and University Avenue / Porter Street intersections. Further investigations are recommended to propose and assess either strategic or localised options to relieve congestion in this area.

3.8.6 Crash analysis

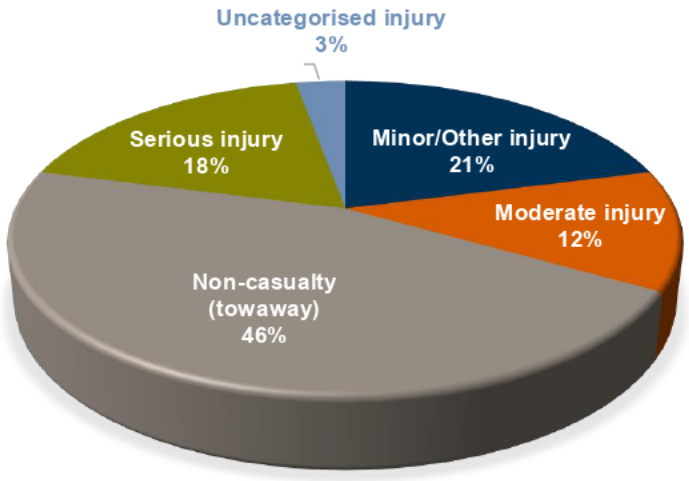
105 crashes occurred between 19 January 2010 and 28 May 2016 within the study area. This included 94 crashes involving cars, 7 involving motorcycles, 7 involving cyclists, 9 involving pedestrians, 8 involving light trucks and 4 crashes involving a bus.

A basic tool for understanding the context of a vehicle crash is Road User Movement (RUM) coding, which describes the first cause of every recorded crash. Vehicle crashes in Keiraville and Gwynneville were analysed by identifying RUM codes and trends.

Of the total 105 crashes, 54 per cent caused either a serious, moderate, minor or uncategorised injury, shown by the crash data in **Figure 3-30**. No vehicle collisions during this time caused a fatality.

The location and type of crashes within the study area during the six year period are shown in **Figure 3-31**.

Figure 3-30 Injuries from vehicle crashes



Source: TfNSW Crash Data, 2016

Figure 3-31 Crashes by vehicle type

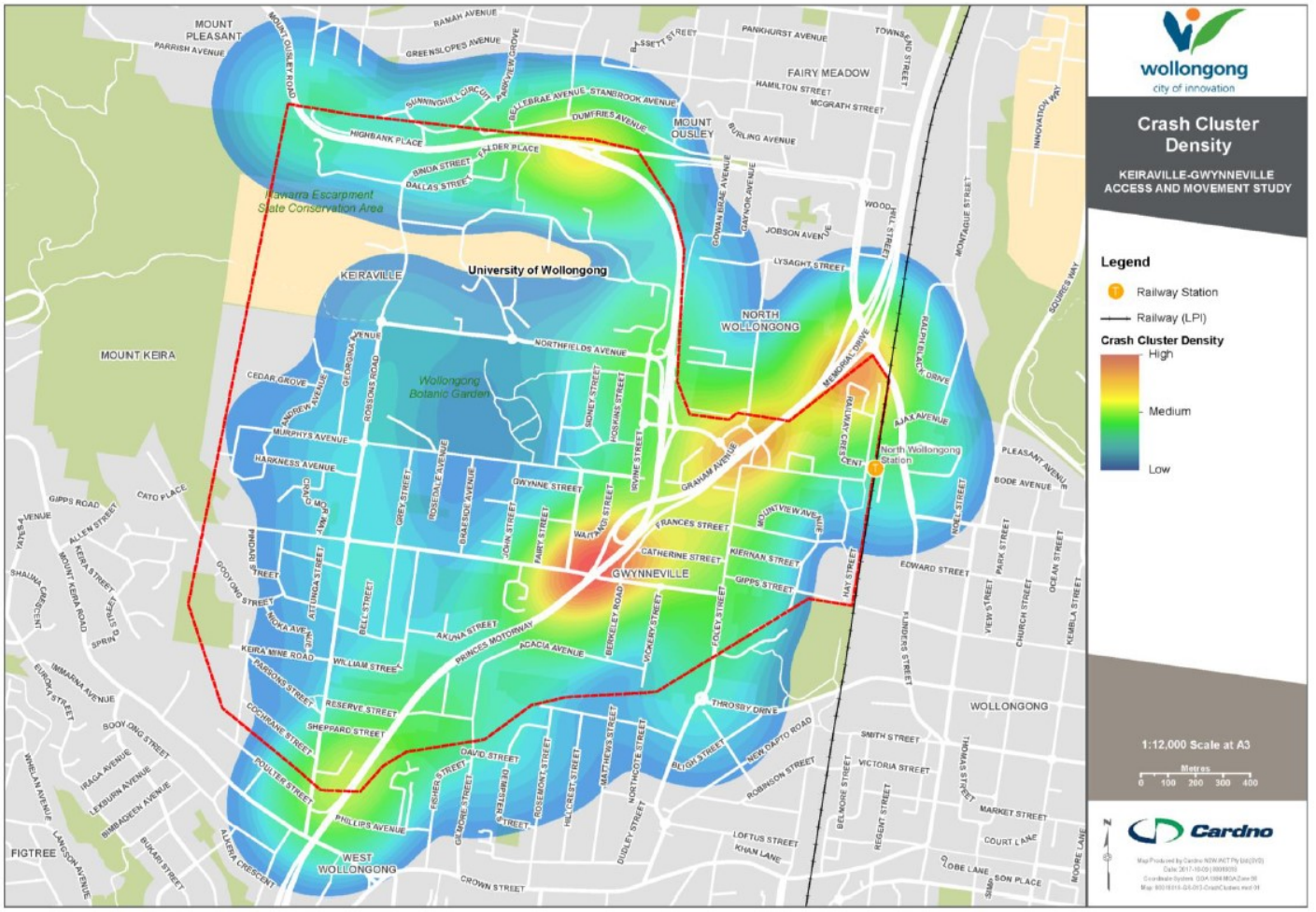
3.8.6.2 Crash clusters

The most densely clustered vehicle crashes occurred at the following locations:

- 20 crashes on the Princes Motorway near the Gipps Road Bridge;
- 29 crashes on the Princes Highway off and on ramps at the eastern side of the intersection with Memorial Drive; and
- 33 crashes on Memorial Drive near the intersection with University Avenue.

Four serious injuries occurred on Foley Street, and three occurred on both Northfields Avenue and Gipps Road. A density map summarising crashes in the study area is shown in **Figure 3-32**.

Figure 3-32 Crash clusters density



3.8.6.3 Vehicle crashes

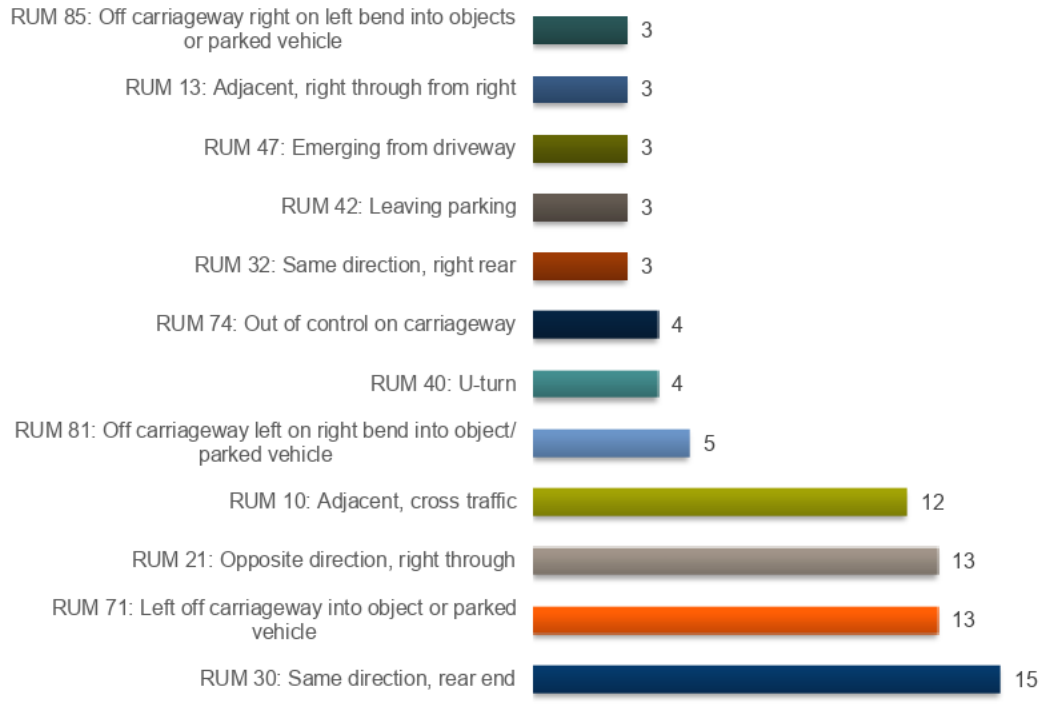
The most common crash type overall was rear end collisions between vehicles travelling in the same direction, accounting for 14 per cent of all crashes. This type of collision is common on heavily trafficked roads and can be caused by distracted drivers, tailgating, unexpected braking and loss of tracking in poor weather. These crashes mainly occurred on Robsons Road, Northfields Avenue and Foley Street.

Other common crash types were:

- Right through collisions occurring between vehicles travelling in opposite directions (12 per cent of all crashes);
- Left off carriageway into object or parked vehicle crashes (12 per cent of all crashes); and
- Cross traffic collisions between vehicles travelling in adjacent directions (11 per cent of all crashes).

The top 12 most common crashes are shown in **Figure 3-33**.

Figure 3-33 Vehicle crash type

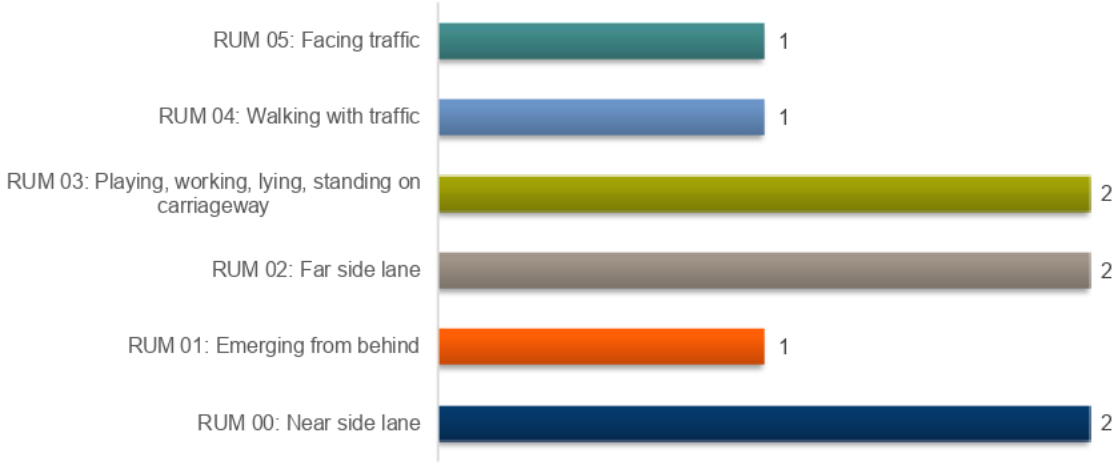


Four crashes in the study area involved a bus, located on Mount Ousley Road, University Avenue, Princes Highway and Memorial Drive.

3.8.6.4 *Pedestrian crashes*

A total of nine crashes involving pedestrians occurred in the study area between 2010 and 2016. The most common pedestrian crash types involved pedestrians playing, working, lying or standing on the carriageway, pedestrians hit in the far side lane, and pedestrians hit in the near side lane. These occurred on Murphys Avenue, Northfields Avenue, Grey Street, Gipps Road, Eastern Street, Frances Street, Gipps Street and Foley Street, where the speed limit is 50 kilometres per hour for all streets except Irvine Street, which is 40 kilometres per hour. Five of these crashes resulted in serious injuries, and the rest resulted in minor or other injuries. The number and types of pedestrian crashes are shown in **Figure 3-34**.

Figure 3-34 Pedestrian crash type



3.8.6.5 *Cyclist crashes*

Seven crashes within the study area involved cyclists. These occurred on Gipps Road, William Street, Northfields Avenue, Waitangi Street, Paulsgrove Street and Foley Street. Four of these crashes involved another vehicle, and three did not. The number and type of cyclist crashes are shown in **Figure 3-35**.

Figure 3-35 Cyclist crash type

4 Consultation

Stakeholder engagement and consultation for this project informed understanding of the key issues affecting both WCC as well as the community.

4.1 Key stakeholders

The key stakeholders for this study included:

- WCC Infrastructure Strategy & Planning Division;
- TfNSW Roads and Maritime Services;
- Neighbourhood Forum 5 (NF5);
- University of Wollongong;
- Department of Planning and Environment;
- Transport for NSW;
- WCC Active Transport Reference Group;
- Botanic Gardens;
- Department of Defence;
- Residential community;
- Bicycle User Group;
- Business operators;
- TAFE Illawarra; and
- Schools.

4.2 Communication and engagement objectives

The stakeholder engagement for this study aimed to ensure that:

- Information on the progress of the project is communicated to key stakeholders in a timely and appropriate fashion;
- Any key issues from stakeholder groups are identified early and are captured in the study during its development; and
- The findings and recommendations of the study are comprehensive and address stakeholder inputs.

The Stakeholder Engagement Plan for this project is attached in **Appendix E**.

4.3 Survey

Community feedback was collected via the following sources:

- Keiraville-Gwynneville Access and Movement Study Workshop #1;
- Wollongong City Council's Have Your Say forum; and
- Neighbourhood Forum 5 KEG workshop.

Overall, there were 242 issues raised by members of the community, the majority of which concerned parking. The number of issues logged per category is broken down below:

- 93 Parking issues
- 39 Pedestrian issues
- 32 Cycle issues

> 27 Roads issues

> 27 Public Transport issues

> 13 Other issues

> 11 Traffic issues

4.4 Consultation outcomes

The issues, expectations, and proposed solutions were captured in a single Consolidated Community Comments spreadsheet, attached as **Appendix F**. The spreadsheet is organised according to the structure shown in **Table 4-1**.

The community and stakeholder issues are reflected in **Section 5**.

Table 4-1 Consolidated Community Comments – spreadsheet structure

Category	Notes
WS1 Community Expectations	This tab contains the expectations of the Keiraville-Gwynneville Access and Movement Study identified by the community in Workshop #1 held on 29 November 2017.
WS1 Transport Solutions	This tab contains the transport solutions proposed by the community in Workshop #1 held on 29 November 2017.
Road	This tab contains the community's road related issues. These were collated from the following three sources: ▪ Community in Workshop #1 held on 29 November 2017; ▪ WCC's online portal; and ▪ Neighbourhood Forum 5 workshops.
Parking	This tab contains the community's parking related issues. These were collated from the following three sources: ▪ Community in Workshop #1 held on 29 November 2017; ▪ WCC's online portal; and ▪ Neighbourhood Forum 5 workshops.
Public Transport	This tab contains the community's public transport related issues. These were collated from the following three sources: ▪ Community in Workshop #1 held on 29 November 2017; ▪ WCC's online portal; and ▪ Neighbourhood Forum 5 workshops.
Pedestrian	This tab contains the community's pedestrian related issues. These were collated from the following three sources: ▪ Community in Workshop #1 held on 29 November 2017; ▪ WCC's online portal; and ▪ Neighbourhood Forum 5 workshops.
Cyclists	This tab contains the community's pedestrian related issues. These were collated from the following three sources: ▪ Community in Workshop #1 held on 29 November 2017; ▪ WCC's online portal; and ▪ Neighbourhood Forum 5 workshops.
Other	This tab contains the community's pedestrian related issues. These were collated from the following three sources: ▪ Community in Workshop #1 held on 29 November 2017; ▪ WCC's online portal; and ▪ Neighbourhood Forum 5 workshops.

4.5 Workshops

As part of the stakeholder engagement, three workshops were completed to discuss each stage of this study. A summary of each workshop is provided below.

4.5.1 Workshop 1 – Brainstorm

The purpose of workshop 1, held on 29 November 2017 was to present an overview of the existing transport network to the community and to capture any specific comments or concerns that the community and key stakeholders may have. The key stakeholders were given the opportunity to comment on:

- Expectations for the transport network and the project;
- Any issues with the existing transport network; and
- Potential solutions to mitigate transport issues.

Individuals also provided photos of various issues.

4.5.2 Workshop 2 – Refining

The purpose of Workshop 2, held on 23 February 2018 was to provide the key stakeholders an update of the project, and key deficiencies of the existing network and potential opportunities.

4.5.3 Workshop 3 – Prioritisation

The final workshop was held on 5 June 2018. At this workshop, the community was updated on the progress of the project including issues analysis, solutions development, and the prioritisation process.

4.5.4 Workshop 4 – Supplementary Workshop

A supplementary community workshop was held following the initial three workshops. The purpose of this workshop was to give the community an additional opportunity to provide comments on the proposed actions for Council.

5 Transport network issues and opportunities

This section outlines the issues with the existing transport network gathered from background review, stakeholder and community consultation, and the transport analysis.

5.1 Pedestrian network issues and opportunities

The majority of issues within the pedestrian network involve missing and non-compliant infrastructure. This includes missing footpaths and crossing facilities that contribute to poor connectivity within the study area.

Some of the key issues noted during the site visit, as well as through community and stakeholder consultation are as follows:

Footpaths

> Footpaths are missing on Murphy's Avenue, Eastern Street, Grey Street, Williams Street, Throsby Drive, and Robsons Road.

> There is no footpath on Gooyong Street.

> Uneven footpaths are dangerous for pedestrians.

Signage

> Signage and wayfinding is limited within the study area.

> Poor wayfinding throughout the precinct.

Crossings

> Lack of safe pedestrian crossings within Keiraville and Gwynneville.

> Kerb ramps missing at the Vickery Street children's crossing.

> A number of non-compliant crossing facilities throughout the study area.

Connectivity

> Limited connectivity to the east of the UOW campus.

> Traffic signal timings and phasings in the Keiraville and Gwynneville retail village centres are focused on vehicle movements.

> A pedestrian path is needed linking the UOW campus and suburbs to the north.

> It is difficult to access the Mount Ousley area from UOW.

Safety

> The community expressed concern regarding insufficient street lighting in some areas.

> There are opportunities for Council to review street lighting along key routes such as Robsons Road, Dallas Street and Greenacre Road to improve safety.

Behavioural

> Walking rates to school have been in decline for decades despite increases in footpaths, suggesting that families are choosing other transport modes to access schools.

The criteria used to assess the compliance of pedestrian crossing facilities were adopted from Australian Standards 1742.10 – Pedestrian Control and Protection, RMS supplements to the Australian Standards and RMS technical directions and included:

> Crossing width and length;

> Sightlines (at a high level);

> Signage;

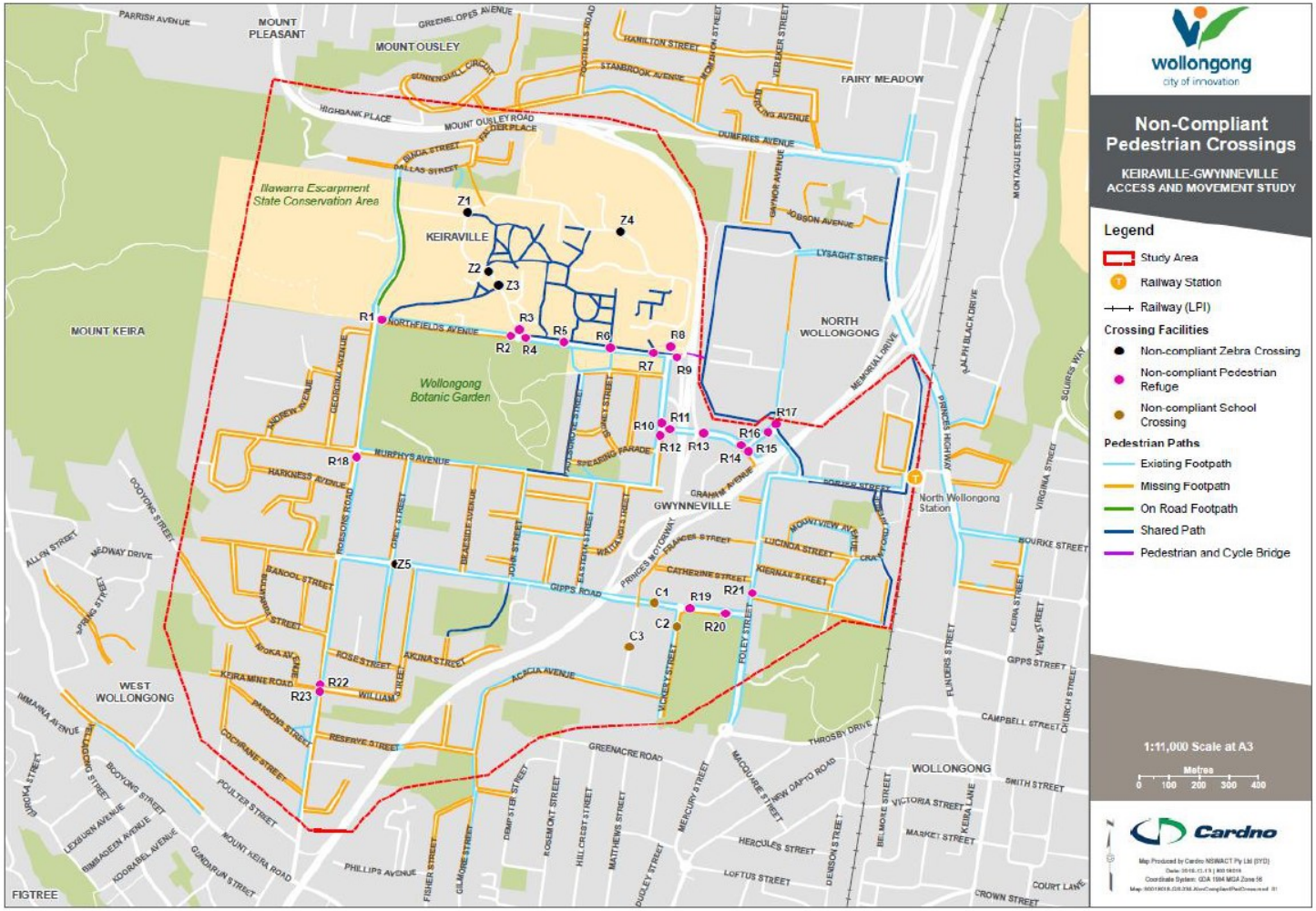
- Linemarking;
- Crossing and kerb ramp alignment;
- Provision of signalised crossings at each leg of an intersection;
- Presence of push-buttons at signalised crossings; and
- Posts for children's crossings.

A summary of the key non-compliant and missing pedestrian footpaths is shown in **Figure 5-1**. The labels correspond to the schedule of non-compliant pedestrian crossing facilities presented in **Appendix H**.

5.1.1 Opportunities

The key opportunities for the pedestrian network include addressing crossing facilities, pedestrian priority and connectivity, and wayfinding to important destinations. The associated actions are detailed in **Section 6**.

Figure 5-1 Pedestrian infrastructure issues



5.2 Cycling network issues and opportunities

Cycling network issues include gaps in the off-road network (not proposed by the WCC Bike Plan) and lack of end of trip facilities at key land uses:

- Missing link in off-road network along Gipps Road, between Robsons Road and John Street;
- Missing strategic connections between Mount Ousley and UOW;
- Missing strategic connections between east and west of the railway line, particularly close to Beaton Park;
- Lack of end of trip facilities at Keiraville and Gwynneville village centres; and
- Dangerous roundabouts for cyclists at intersection of Robson Road and Murphys Avenue and Robson Road and Gipps Road.

The key issues are shown in **Figure 5-2**, overlaid on the existing cycle network.

5.2.1 Opportunities

The key opportunities for the cycling network include shared path infrastructure, bicycle parking, and wayfinding, and include:

- Opportunity for an off-road cycle link along Robsons Road between William Street and Northfields Avenue;

The associated actions are detailed in **Section 6**.

Figure 5-2 Key cycling missing links

5.3 Bus network issues and opportunities

Bus issues are focused on poor service quality, frequency and infrastructure around the study area. The key issues are as follows:

- Infrequent bus services;
- Poor levels of on-time running;
- Bus services, particularly during peak periods are overcrowded;
- Poor integration of bus services with train timetables;
- Shuttle services are limited outside of peak times and out of session time;
- Wet weather shelter is not provided at all bus stops within the study area; and
- Poor connectivity of bus services with surrounding suburbs.

5.3.1 Opportunities

The key opportunities for the bus network include improved bus stop facilities, integrating bus and train timetables, and investigating bus priority infrastructure. The associated actions are detailed in **Section 6**.

5.4 Train network issues and opportunities

The key issues related to the train network are:

- Poor frequency of services in both directions;
- Poor integration of services with buses; and
- Poor alignment of services with UOW schedule.

5.4.1 Opportunities

The key opportunities for the train network include integrating bus and train timetables, and increasing service frequency. The associated actions are detailed in **Section 6**.

5.5 Road network issues and opportunities

The key issues for road network were largely around increasing congestion and unsafe locations. A summary of these issues are as follows:

- There is heavy traffic in many of the streets within the study area;
- The roundabout at the intersection of the M1 Princes Motorway offload ramp and University Avenue is congested and dangerous in peak times;
- Intersection of Irvine Street / University Avenue has extensive queuing in the PM peak.
- Queuing at Mount Ousley Road in the AM and PM peaks;
- University Avenue / Pacific Motorway off-ramp and University Avenue / Porter Street intersections require additional capacity by 2022;
- The UOW Ring Road is congested during the afternoon peak period;
- Foley Street experiences high traffic congestion;
- There is a community perception of high vehicle speeds prevalent throughout the study area; and
- There is a community perception that local roads near the UOW are used as rat runs for UOW students during congested periods.

5.5.1 Opportunities

The key opportunities for the road network include increased traffic calming measures, and working with schools to increase the efficiency of kiss and ride locations. The associated actions are detailed in **Section 6**.

5.6 Parking network issues and opportunities

Parking was a significant issue discussed by the community and key stakeholders. Some of the key issues with parking include:

- Parking utilisation is very high in the streets south of the UOW campus, including Keiraville village;
- Two hour parking spaces on local roads such as Robsons Road, Paulsgrove Street and Sidney Street are not long enough for students attending lectures;
- Accessible parking is not provided in the village centres;
- Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park;
- Parking close to key destinations is often heavily utilised by employees;
- Vehicles are constantly parked over driveways;
- High amount of unrestricted parking provided in residential areas in close proximity to the University;
- Poor sightlines at some intersections within the precinct due to vehicles parking too close;
- Current and planned student accommodation generates parking demand;
- Multi occupancy dwellings where each occupant owns a car generates greater on-street parking demand;
- High number of vehicles parking illegally throughout the study area; and
- Number of residential streets throughout the study area which have been reduced to one lane in each direction due to parking on both sides of the road.

5.6.1 Opportunities

The key opportunities for the parking network include investigating paid and resident parking schemes in certain areas, and increasing enforcement of parking restrictions. The associated actions are detailed in **Section 6**. However it is noted that resident parking schemes are not supported by Council, especially given how most residential properties in the area have off-street parking.

6 Actions and prioritisation

6.1 Key actions

The transport network opportunities were used to inform the proposed actions for the study area. These opportunities are complemented by Council identified actions in response to additional community comments, some of which have already been completed by Council. The full list of actions is provided in **Table 6-1**. Detailed locations for the Council identified actions are included in **Appendix G**.

Table 6-1 Transport actions

ID	Mode	Issue	Action	Details
1	Bus	Poor bus service times and frequency	Extend bus timetables and frequency.	WCC to work with bus operators to increase operation times and frequency of existing bus services.
2	Bus	Poor reliability of bus services.	Work with RMS to provide bus priority infrastructure at key points.	WCC could work with RMS to provide bus queue jumps and priority at key intersections to increase reliability of bus services.
3	Bus	Poor integration of public transport.	WCC to work with bus operators to better integrate bus and train timetables.	WCC should work with bus operators to ensure bus services provide good interchange times for commuters to encourage interchanges between modes.
4	Bus	Poor bus stop facilities.	WCC to work with bus operators to provide improved bus stop facilities.	WCC should work with bus operators to ensure at a minimum DDA compliance of all bus stops are provided. Potential for bus stop relocation to allow for DDA compliance, and placed close to key land uses.
5	Bus	Poor bus capacity.	WCC to work with bus operators to ensure adequate capacity is provided to bus services.	WCC should work with bus operators to ensure safe use of all bus services. Bus operators should ensure that the demand for bus services is being provided.
6	Bus	Poor bus service coverage.	Provide direct bus services between key trip attractors.	All major centres within the precinct should be catered for by direct bus services - WCC to work with bus operators to provide additional services to key destinations.
7	Bus	Shuttle bus services.	Maintain and further promote the local shuttle bus services.	WCC to work with TfNSW and UOW to maintain Keiraville/Gwynneville Shuttle, the North Wollongong Shuttle, and the Wollongong Shuttle.
8	Cyclist	Limited safe off-road cycle path facilities throughout the precinct.	Include suggested shared path locations in future programs.	Various locations identified across the study area – see Appendix H for details.
9	Cyclist	Limited direct cycle and pedestrian facilities across railway line.	WCC to work with TfNSW to investigate active transport connection across train line close to Beaton Park.	WCC could work with TfNSW to provide an active transport connection across the railway line close to Beaton Park. This could be a shared pedestrian and cyclist bridge linking Gipps Street east and west of the train line.
10	Cyclist	Poor cycling wayfinding to key destinations.	WCC to provide improved cycling wayfinding on the key regional cycle routes.	WCC to provide improved signage and wayfinding as per NSW Bicycle Guidelines to key destinations including the University of Wollongong, Keiraville, Gwynneville, Wollongong CBD etc.
11	Cyclist	Poor lighting and footpath width along Wisemans Park (Vickery Street) shared path.	WCC to provide a widened shared path and lighting through Wisemans Park as per the Fairy Creek Master Plan.	WCC to provide a 2.5m wide shared path within Wisemans Park in accordance with the adopted Fairy Creek Master Plan.
12	Cyclist	Lack of secure or undercover bicycle parking at key land uses.	Provide increased number of secure and undercover bicycle parking at key land uses such as the UOW, Keiraville and Gwynneville village centres, Beaton Park, the local schools and especially off-street parking locations.	WCC to work with key land uses and town centre to provide an increased number of secure or undercover cycle parking.
13	Pedestrian	Roundabouts within the precinct do not have pedestrian refuges.	Provide compliant pedestrian refuges at all roundabouts.	WCC to investigate provision of compliant pedestrian refuges at all roundabouts within the precinct.
14	Pedestrian	Number of crossing facilities not to Australian Standards.	Ensure that all crossing facilities comply with Australian Standards (upgrade where needed).	All pedestrian, signalised crossings as well as pedestrian refuges should be provided to Australian Standards. Adequate lighting should also be provided.
15	Pedestrian	Poor pedestrian connectivity to the north and east of UOW.	Provide a direct pedestrian connection towards the north and east of UOW.	WCC to investigate the provision of pedestrian/ cyclist connections across Mt Ousley Road and Princes Motorway towards the north and east of UOW. It is believed that this is part of the proposed Mt Ousley interchange design
16	Pedestrian	Poor wayfinding within the precinct.	Provide wayfinding to key destinations including train stations, UOW, key centres and recreation facilities.	WCC to develop a wayfinding strategy similar to that of the City of Sydney to encourage walking and cycling. Wayfinding to be provided to key locations.
17	Pedestrian	Vehicle priority in key centres across the precinct.	Provide increased pedestrian priority within the town centres.	WCC to work with RMS to update signal phasings. WCC could also provide lower speed limits in key centres to provide increased pedestrian/ cyclist priority. Traffic calming could also be provided in these centres.
18	Pedestrian	Poor walking rates throughout the precinct.	Provide increased marketing especially in schools, workplaces and town centres to show the benefits of walking and cycling.	WCC to develop marketing tool to present the benefits of active transport, especially to schools and University.
19	Pedestrian	Poor lighting along streets impacting security.	WCC to review street lighting.	Key routes for investigation: > Robsons Rd, Dallas St, Greenacre Rd.
20	Pedestrian	Missing footpath links in study area.	Include suggested footpath locations in future programs.	Various locations identified across the study area – see Appendix H for details.
21	Vehicles	Vehicles speed down slope on Gooyong Street, in close proximity to the preschool.	Provide traffic calming along Gooyong Street	Provide warning signage and traffic calming along Gooyong Street to help regulate speed along this slope, which could include road narrowing, kerb extensions, linemarking and pavement treatments.
22	Vehicles	Poor safety at the Murphys Avenue and Robsons Avenue roundabout.	Realignment of roundabout at Murphys Avenue and Robsons Road	The Murphys Avenue and Robsons Road roundabout is too small, and may not slow vehicles down enough. WCC should investigate the enlarging of this roundabout to slow vehicles down.
23	Not used	-	-	-
24	Vehicles	High vehicle speed throughout the study area.	WCC to investigate extending school zones on the northern and southern sides of Robsons Road near the intersection with Gipps Road.	
25	Not used	-	-	-
26	Not used	-	-	-
27	Vehicles	High vehicle speed throughout the study area.	WCC to investigate traffic calming measures on Robsons Road to manage vehicle speeds, particularly on the north and south downhill sections to the Gipps Rd intersection.	This was mentioned by a number of members of the community.

ID	Mode	Issue	Action	Details
28	Vehicles	Safer crossings needed across study area.	Council has identified a number of intersections where improvements will be investigated.	Various locations identified across the study area – see Appendix H for details.
29	Not used	-	-	-
30	Vehicles	High vehicle speed throughout the study area.	WCC to investigate traffic calming improvements.	Various locations identified across the study area – see Appendix H for details.
31	Vehicles	High vehicle speed throughout the study area.	WCC to investigate roundabout installation.	Consider a roundabout for Braeside Ave/Murphys Ave intersection to slow traffic.
32	Vehicles	Safety issues close to schools.	Council has identified a number of locations where safety improvements close to schools will be reviewed.	Various locations identified across the study area – see Appendix H for details.
33	Vehicles	Safety issues on University Avenue.	Investigate safety improvements on University Avenue.	Guardrail installed on University Avenue between Memorial Drive and Porter Street (east) in 2018/2019.
34	Parking	Poor line marking of parking spaces.	WCC to investigate the provision of marked parking bays to increase the efficiency of parking spaces within the precinct.	Focus on high-demand roads without existing linemarking, including: - Northfields Avenue - O'Leary Road - Robsons Road north of Gipps Road - Murphys Avenue - Gipps Road - Local roads between Murphys Avenue and Gipps Road - Porter Avenue - Railway Crescent
35	Parking	Parking restrictions.	Review timed parking.	Various locations identified across the study area – see Appendix H for details.
36	Parking	Poor monitoring of parking in the precinct.	Review ranger patrols to ensure all vehicles abide by the corresponding parking restrictions.	Focus on all suburbs within the study area. Key areas for investigation: > Increase the number of parking rangers to ensure vehicles do not park for longer than they should and parking in designated parking spaces only. Consider varying patrol locations at the start of the University session. > Enforce current parking restrictions. > Enforce parking bay restrictions on weekends as well.
37	Parking	Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park.	WCC to review parking restrictions on the western side of Grey St and consider amendments to match those on the eastern side with school zone timing restrictions.	
38	Parking	High amount of unrestricted parking provided in residential areas in close proximity to the University.	WCC to investigate introduction of paid parking in the vicinity of the University, with pricing generally be highest adjacent to the university.	Pricing is recommended to start at about $2.00 per hour (equivalent to or slightly higher than the student rate on-campus), decreasing to zero based on distance and demand. Pricing should be set at a level such that peak occupancy is maintained at around 90%.
39	Not used	-	-	-
40	Parking	Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park.	WCC to consider developing a special event parking and traffic management plan to manage events at Beaton Park and other locations.	A combination of parking wardens, event parking permits for organisers, drop off/pick up points, wayfinding tools and temporary traffic management measures can be used to ensure a satisfactory experience for visitors. Council could also consider improving the opportunities for overflow parking (through facilitating agreements with demand generators) to improve peak accessibility and increase safety in the area.
41	Parking	Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park.	WCC to consider implementing parking restrictions such as timed or paid parking in certain areas, to relocate staff to the periphery of these land uses or off-site.	Facility users may not be aware of alternative parking locations and parking congestion occurs in the immediate vicinity, causing safety issues for both users and residents.
42	Parking	Accessible parking is not provided in the village centres.	WCC to consider implementing parking user priority system in commercial centres.	The two village centres of Keiraville and Gwynneville should have parking signage modified to include loading zones, motorcycle parking, disability and short-term drop-off/pick-up.
43	Not used	-	-	-
44	Parking	Safety at school crossings.	WCC to advocate for the Department of Education and local schools to consider appointing wardens to assist parents with considerate and formalised kiss and ride facilities, as well as coordinating safe passage of children from the roadside into schools.	Wardens should be school teachers if possible to increase authority. If such an approach does not produce compliance, rangers can attend the school and issue warnings or infringements as necessary. Enforcement should be used as a tool to ensure compliance in conjunction with more positive approaches to parking management.
45	Parking	Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park.	Local schools could consider monitoring kiss and ride parking to prevent parking, and expand it as required to support demand.	
46	Parking	Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park.	Local schools could consider staggering start and finish times to help alleviate parking issues.	The fact that school start and finish times are so clearly defined means that hundreds of people are arriving and departing a single location within a very short period of time.
47	Parking	Lack of sufficient pick up/drop off zones at key destinations such as schools, UOW, and Beaton Park.	WCC to work with UOW to investigate pick up and drop off locations along Northfields Avenue.	Requested by UOW in their review of the Parking Tech Memo.
48	Parking	Signage and wayfinding is limited within the study area.	WCC to consider developing a wayfinding strategy to help manage parking at schools and other attractors such as Beaton Park and the Botanic Garden.	Council could also provide some guidelines to assist schools/local attractions in communicating parking availability to parents.

ID	Mode	Issue	Action	Details
49	Parking	Uniform approach to kiss and ride facilities does not suit every location.	WCC to work with schools to manage parking and safe drop off/pick up.	Key areas for investigation: > Meet with Schools and School Crossing Supervisors/Rangers/RMS/Police to determine the best option for that specific location; Investigate drop off zones for set times of the day; Consider 'Slow Down' signage as part of the kiss and ride strategy; Consider that parents may want to get out of their car to pick up younger children, so a kiss and ride solution may not work for everyone; Ensure drop off/pick up issues are considered in the rebuild of Gwynneville Public School; Work towards long term reduction in demand for kiss and ride zones by encouraging walking/riding by students through provision of extra pedestrian crossings and bike paths; Consider staggering start/finish times to better manage traffic.
50	Miscellaneous	High vehicle mode shared from UOW.	Potential for UOW to increase student accommodation close to the main campus to reduce the need to travel to the University.	UOW to investigate providing additional student accommodation close the main campus to reduce student travel to the University.

6.2 Prioritisation

The transport network actions were assigned a priority, based on planning principles developed in consultation with WCC. The principles are:

- Safety;
- Accessibility / Connectivity;
- Travel mode sustainability;
- Cost / Constructability;
- Addresses impacts to local community;
- Addresses impacts to UOW operation;
- Parking management;
- Improves access for vulnerable user groups; and
- Aligned with government strategies.

The actions were prioritised using a multi criteria analysis (MCA), and by scoring each action against the planning principles. Each principle was assigned a weighting of 10 per cent, except for safety, which was assigned a higher weighted score of 20 per cent. The actions with the highest score are the highest priority actions. Priority is categorised according to high, medium, and low priority, as shown in **Table 6-2**.

Table 6-2 Priority Level

Priority Level	Score
High Priority	4.0 and above
Medium Priority	3.5 to 4.0
Low Priority	0 to 3.5

The prioritisation matrix is presented in **Table 6-4**. Actions are listed in order of highest priority.

6.3 Implementation

Based on the results of the prioritisation matrix, the timeframe for the implementation of works for each priority level is presented in **Table 6-3**. The timeframes are based on short term (0-2 years), medium term (2-6 years) and long term (6-10 years) implementation. The higher priority actions are assigned the shortest timeframe.

Table 6-3 Priority rating and implementation timeframe

Priority	Timeframe
High Priority	Short term: 0 – 2 years
Medium Priority	Medium term: 2 – 6 years
Low Priority	Long term: 6 – 10 years

6.4 Cost estimates

Strategic cost estimates were developed for each action involving improvement works and are presented in **Table 6-4**. The costs are based on unit rates provided by Council, include a 50% contingency and have been rounded to the nearest $100. The costs do not allow for elements such as:

- Project management;
- Design;
- Property acquisition;
- Temporary works or traffic control;
- Site establishment or disposal of material costs;
- Relocation of services or drainage; or
- Provision of barriers and fences.

The total cost of the works is estimated to be **$10,611,700**.

Table 6-4 Prioritisation matrix

ID	Mode	Action	Safety	Accessibility / Connectivity	Travel mode sustaina-bility	Price / Constr-uctability	Address impacts to local community	Address impacts to UoW operation	Parking Manage-ment	Improve access for vulnerable user groups	Aligned with government strategies	Total Score (out of 5)	Priority	Timeframe	Estimated cost
		Weighting	**20%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**100%**			
8	Pedestrian / Cyclist	WCC to include suggested shared path locations in future programs.	5	5	5	3	5	4	2	5	5	4.4	High	Short-term	$990,000
14	Pedestrian	WCC to ensure that all crossing facilities comply with Australian Standards (upgrade where needed).	5	5	5	5	5	2	2	5	5	4.4	High	Short-term	$75,000
13	Pedestrian	WCC to provide compliant pedestrian refuges at all roundabouts.	5	5	5	4	5	2	2	5	5	4.3	High	Short-term	$1,312,500
30	Vehicles	WCC to investigate traffic calming improvements in key locations.	5	5	3	3	5	3	4	5	5	4.3	High	Short-term	N/A
32	Vehicles	WCC to investigate identified locations for safety improvements close to schools.	5	5	4	3	5	2	4	5	5	4.3	High	Short-term	N/A
33	Vehicles	Investigate safety improvements on University Avenue.	5	5	3	3	5	4	3	5	5	4.3	High	Short-term	N/A
20	Pedestrian	WCC to include suggested footpath locations in future programs.	5	5	5	3	4	3	2	5	5	4.2	High	Short-term	$1,875,000
12	Cyclist	WCC to provide increased number of secure and undercover bicycle parking at key land uses.	4	4	5	5	4	3	4	4	4	4.1	High	Short-term	$225,000
28	Vehicles	WCC to investigate identified intersection improvements.	5	4	5	3	5	2	2	5	5	4.1	High	Short-term	$97,500
34	Parking	WCC to investigate the provision of marked parking bays to increase the efficiency of parking spaces within the precinct.	4	3	3	5	5	5	5	3	4	4.1	High	Short-term	$16,800
36	Parking	WCC to review ranger patrols to ensure all vehicles abide by the corresponding parking restrictions.	4	3	3	5	5	5	5	3	4	4.1	High	Short-term	N/A
49	Parking	WCC to work with schools to manage parking and safe drop off/pick up.	5	5	2	4	4	4	5	4	3	4.1	High	Short-term	N/A
3	Bus	WCC to work with bus operators to better integrate bus and train timetables.	3	5	5	4	5	4	2	4	5	4.0	High	Short-term	N/A
4	Bus	WCC to work with bus operators to provide improved bus stop facilities.	4	4	5	4	4	3	2	5	5	4.0	High	Short-term	N/A
11	Pedestrian / Cyclist	WCC to investigate widening shared path and lighting along Wisemans Park shared path.	5	5	5	4	4	2	2	4	4	4.0	High	Short-term	$1,342,500
15	Pedestrian	WCC to work with stakeholders to provide a direct pedestrian connection towards the north and east of UoW.	3	5	5	2	4	5	3	5	5	4.0	High	Short-term	N/A
17	Pedestrian	WCC to provide increased pedestrian priority within the town centres.	5	5	5	4	4	2	2	4	4	4.0	High	Short-term	N/A
44	Parking	WCC to advocate for the Department of Education and local schools to consider appointing wardens to assist parents with considerate and formalised kiss and ride	5	5	2	3	4	2	5	5	4	4.0	High	Short-term	N/A

ID	Mode	Action	Safety	Accessibility / Connectivity	Travel mode sustaina-bility	Price / Constr-uctability	Address impacts to local community	Address impacts to UoW operation	Parking Manage-ment	Improve access for vulnerable user groups	Aligned with government strategies	Total Score (out of 5)	Priority	Timeframe	Estimated cost
		facilities, as well as coordinating safe passage of children from the roadside into schools.													
16	Pedestrian / Cyclist	WCC to work with stakeholders to provide wayfinding to key destinations including train stations, UoW, key centres and recreation facilities.	3	5	5	5	3	4	3	4	4	3.9	Medium	Medium-term	N/A
24	Vehicles	WCC to investigate extending school zones on the northern and southern sides of Robsons Road near the intersection with Gipps Road to calm traffic.	5	3	2	4	5	3	2	5	5	3.9	Medium	Medium-term	$9,900
5	Bus	WCC to work with bus operators to ensure adequate capacity is provided to bus services.	3	4	5	4	5	4	2	4	5	3.9	Medium	Medium-term	N/A
10	Cyclist	WCC to provide improved cycling wayfinding on the key regional cycle routes.	3	4	5	5	4	4	2	4	5	3.9	Medium	Medium-term	$24,000
37	Parking	WCC to review parking restrictions on the western side of Grey St and consider amending these to match those on the eastern side with school zone timing restrictions.	3	5	2	5	5	3	5	4	4	3.9	Medium	Medium-term	N/A
7	Bus	Maintain and further promote the local shuttle bus services.	3	4	5	4	5	4	2	4	5	3.9	Medium	Medium-term	N/A
46	Parking	Local schools could consider staggering start and finish times to help alleviate parking issues.	3	5	2	4	4	3	5	5	4	3.8	Medium	Medium-term	N/A
27	Vehicles	WCC to investigate traffic calming measures on Robsons Road to manage vehicle speeds, particularly on the north and south downhill sections to the Gipps Rd intersection.	5	3	2	3	5	3	2	5	5	3.8	Medium	Medium-term	$114,200
40	Parking	WCC to consider developing a special event parking management plan to manage events at Beaton Park and other locations.	4	5	2	4	4	3	5	4	3	3.8	Medium	Medium-term	N/A
19	Pedestrian	WCC to review street lighting, particularly along Robsons Road, Dallas Avenue, and Greenacre Road.	5	4	2	3	4	3	3	5	4	3.8	Medium	Medium-term	N/A
18	Pedestrian / Cyclist	WCC to work with stakeholders to provide increased marketing especially in schools, workplaces and town centres to show the benefits of walking and cycling.	3	4	5	5	4	2	3	3	5	3.7	Medium	Medium-term	N/A
1	Bus	WCC to work with stakeholders to extend bus timetables and frequency.	2	5	5	4	4	4	2	4	5	3.7	Medium	Medium-term	N/A
47	Parking	WCC to work with UoW to investigate pick up and drop off locations along Northfields Avenue.	3	5	2	3	3	5	5	4	3	3.6	Medium	Medium-term	N/A
45	Parking	Local schools could consider monitoring kiss and ride usage to prevent parking, and expand it as required to support demand.	3	5	2	4	3	2	5	5	4	3.6	Medium	Medium-term	N/A
48	Parking	WCC to consider developing a wayfinding strategy to help manage parking at schools and other attractors such as Beaton Park and the Botanic Garden.	3	5	2	3	3	4	5	3	4	3.5	Medium	Medium-term	N/A
42	Parking	WCC to consider implementing parking user priority system in commercial centres.	2	5	2	4	4	2	5	4	4	3.4	Low	Long-term	N/A

ID	Mode	Action	Safety	Accessibility / Connectivity	Travel mode sustaina-bility	Price / Constr-uctability	Address impacts to local community	Address impacts to UoW operation	Parking Manage-ment	Improve access for vulnerable user groups	Aligned with government strategies	Total Score (out of 5)	Priority	Timeframe	Estimated cost
35	Parking	WCC to review timed parking.	2	5	3	3	4	4	5	2	3	3.3	Low	Long-term	N/A
2	Bus	WCC to work with RMS to provide bus priority infrastructure at key points.	2	5	5	2	4	3	2	3	5	3.3	Low	Long-term	N/A
9	Pedestrian / Cyclist	WCC to work with TfNSW to investigate active transport connection across train line close to Beaton Park.	3	5	5	1	3	3	2	5	3	3.3	Low	Long-term	$3,924,300
21	Vehicles	WCC to investigate centre line marking and traffic calming along Gooyong Street.	5	3	2	4	4	1	1	4	4	3.3	Low	Long-term	$114,200
31	Vehicles	WCC to investigate roundabout installation at Braeside Avenue/Murphys Avenue intersection.	5	4	3	2	4	2	2	3	3	3.3	Low	Long-term	$225,000
50	Parking	UoW to investigate increasing student accommodation close to main campus to reduce the need to travel.	2	5	5	1	4	5	4	3	2	3.3	Low	Long-term	N/A
41	Parking	WCC to consider implementing parking restrictions such as timed or paid parking in certain areas, to relocate staff to the periphery of these land uses or off-site.	2	4	3	4	4	2	5	3	3	3.2	Low	Long-term	N/A
6	Bus	WCC to work with stakeholders to provide direct bus services between key trip attractors.	2	5	5	2	4	3	2	3	4	3.2	Low	Long-term	N/A
38	Parking	WCC to investigate introduction of paid parking in the vicinity of the University, with pricing generally be highest adjacent to the university.	2	3	2	3	3	5	5	3	4	3.2	Low	Long-term	N/A
22	Vehicles	WCC to investigate realignment of roundabout at Murphys Avenue and Robsons Road.	5	3	2	3	3	1	1	4	4	3.1	Low	Long-term	$225,000

The structure plans indicating the actions to be undertaken for each mode are presented in **Figure 6-1**, **Figure 6-2** and **Figure 6-3** for the active transport, vehicle and parking actions respectively. A public transport structure plan was not developed since the related actions are not location-specific.

Figure 6-1 Active transport structure plan

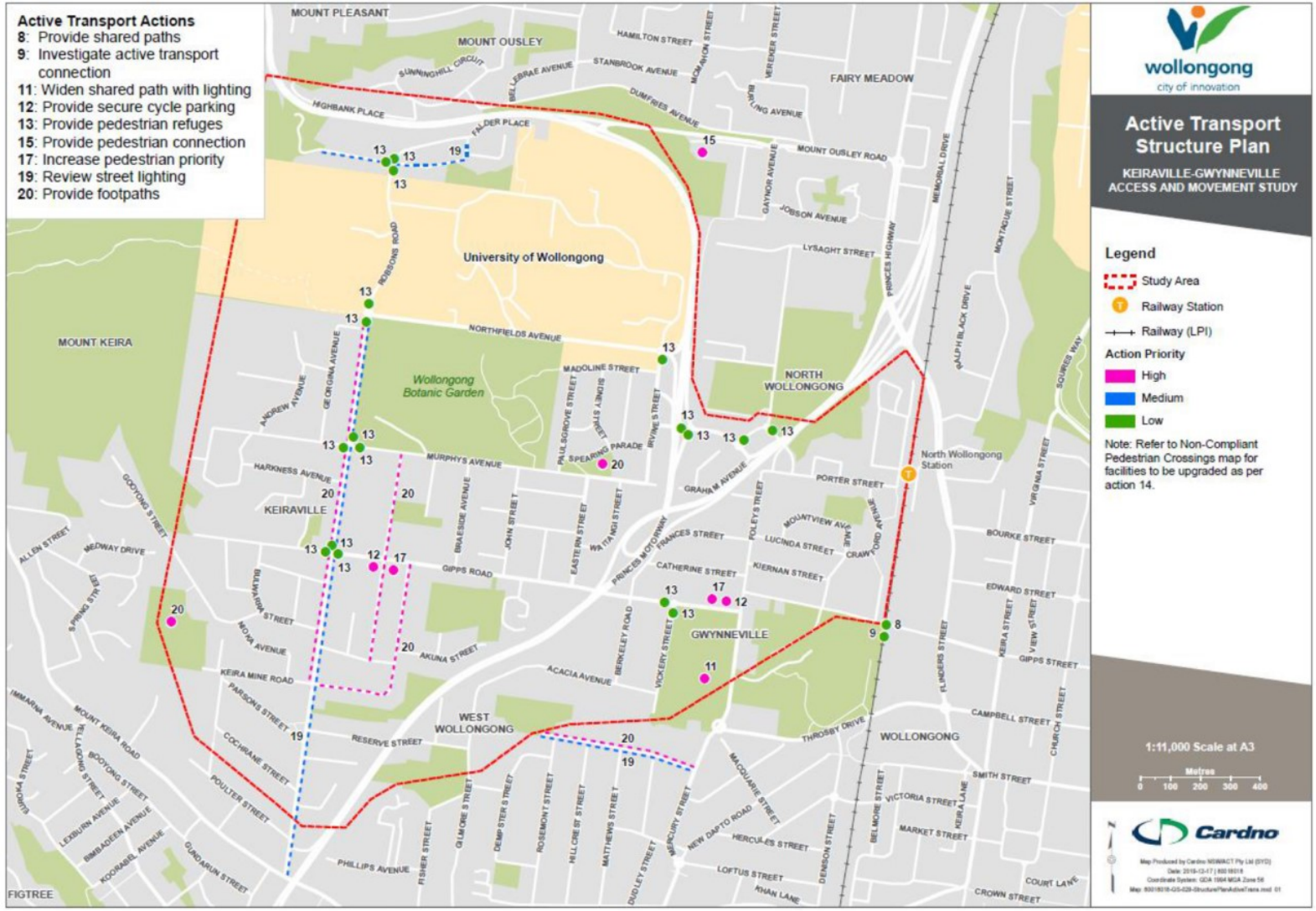


Figure 6-2 Vehicle structure plan

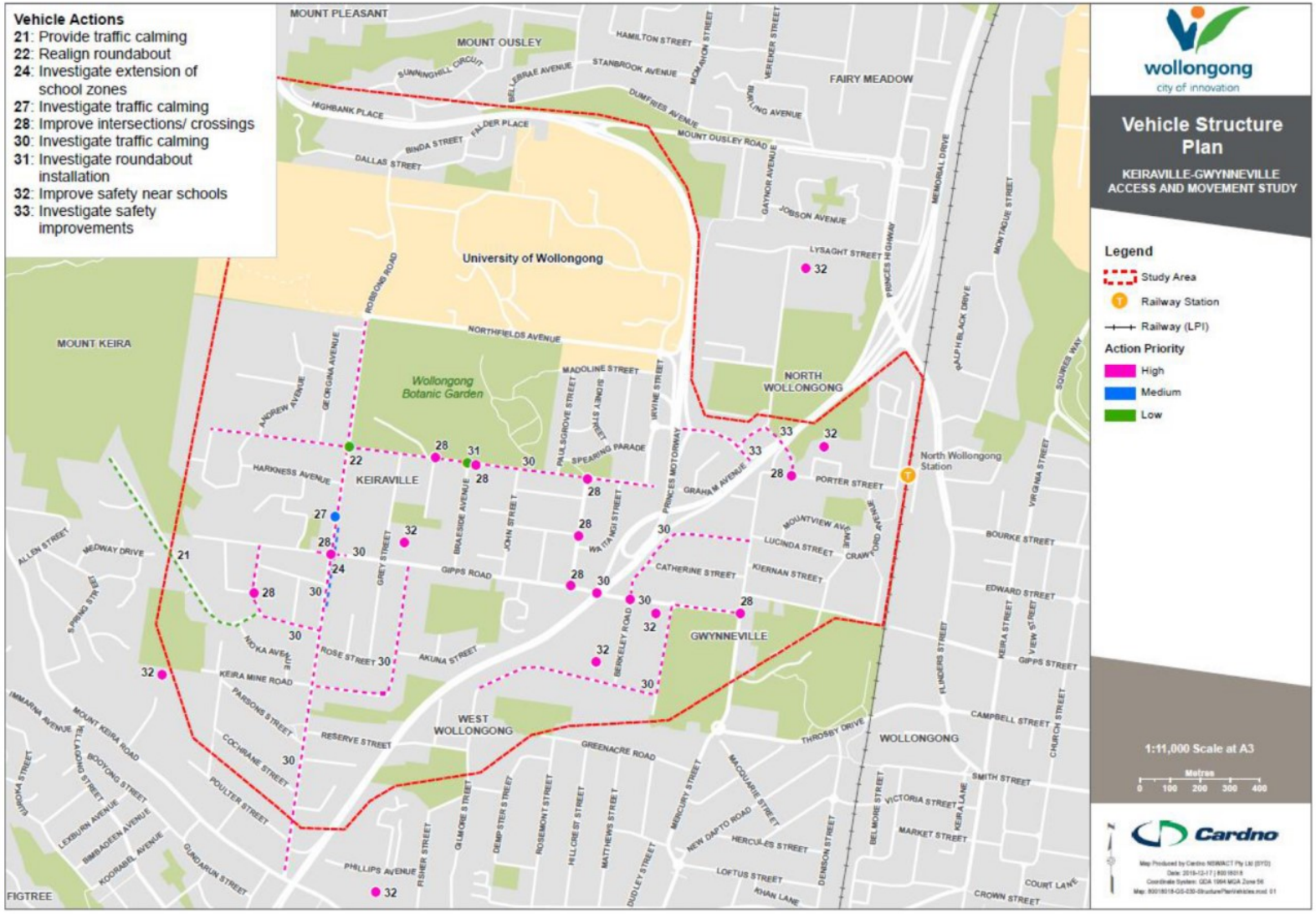


Figure 6-3 Parking structure plan

Conclusion

The Keiraville-Gwynneville Access and Movement Study highlights a number of issues with the traffic and transport network in the precinct, which will become more challenging as land use changes in the area and further development increases the number of daily trips made by residents, workers, students, and visitors.

At the same time, the study has identified a number of opportunities to make improvements to the network and facilitate easier movement of people in the precinct, through better parking management, optimised public transport connections, and enhanced infrastructure to improve safety for pedestrians and cyclists.

The proposed actions provide a comprehensive framework to assist Council in addressing the issues and capitalising on the opportunities to support access and movement in Keiraville and Gwynneville. The Access and Movement Study:

- Discusses the strategic context and the relevance of other plans and strategies to the study;
- Examines the existing transport network and travel behaviour;
- Summarises the results of community consultation activities;
- Outlines the issues observed through the existing network analysis, and highlighted by community members;
- Identifies the opportunities to improve access and movement;
- Proposes actions to address the issues and capitalise on the opportunities, covering the whole transport network; and
- Recommends 50 actions to enable better access and movement in the precinct, and a timeframe for implementation to help Council achieve these actions.

6.5 Next steps

The next steps to implement the Access and Movement Study should include:

- Working with internal stakeholders to develop a detailed implementation plan;
- Consulting with external stakeholders to gather input for the implementation plan;
- Developing detailed cost estimates of the proposed actions;
- Aligning the proposed actions with other planned capital works and available budget, and delivering on these actions;
- Continuing to work with external stakeholders to engage the community in sustainable travel behaviour; and
- Continuing to work with external stakeholders on the proposed actions that will need their input and assistance to deliver.

APPENDIX A

DRAFT UOW TRANSPORT SURVEY AND STRATEGY - SUMMARY OF RECOMMENDED ACTIONS

APPENDIX B

UOW CAMPUS MASTER PLAN - SUMMARY OF KEY STRATEGIES AND ACTIONS

APPENDIX C

BASE MODEL DEVELOMPENT REPORT

APPENDIX D

PARKING ANALYSIS TECHNICAL MEMORANDUM

APPENDIX E

STAKEHOLDER ENGAGEMENT PLAN – DRAFT

APPENDIX F

CONSOLIDATED COMMUNITY COMMENTS

APPENDIX G

COUNCIL IDENTIFIED ACTIONS IN RESPONSE TO COMMUNITY COMMENTS

APPENDIX A

DRAFT UOW TRANSPORT SURVEY AND STRATEGY - SUMMARY OF RECOMMENDED ACTIONS

Table 1-1 Key Actions from University of Wollongong Transport Strategy and Survey

Code	Actions
Active Transport	Work with authorities to provide an active transport bridge into the University from the M1 Princes Motorway on the south eastern side and improve cycle connectivity on the Ring Road.
	Work with authorities surrounding any planned increase to residential densities at North Wollongong Station, aiming to increase walking catchment for UOW but also achieve state government objectives for increased density around transport and employment nodes.
	Work with authorities to prioritise missing pedestrian and cycling links to the north of campus, to align with the timing of the proposed northern entry and Mount Ousley interchange.
	Work with authorities to prioritise missing cycleway links on Foley Street, Church Street and Bourke Street to improve connections to the Wollongong campus from UOW accommodation sites.
	Work with authorities to prioritise proposed cycleway upgrades on Porter Street and Crawford Avenue, to improve the cycling connection between North Wollongong Station and the Wollongong campus.
	Investigate shared zone within the campus core.
	Develop wayfinding strategy.
	Enhance existing pedestrian refuge at the Western Entrance of Northfields Avenue.
	Install pedestrian refuge at roundabout at Northfields Avenue and Irvine Street (southern leg).
	Investigate bike share scheme expansion.
	Provide new Bike Bases and end of trip facilities in new developments.
	Consider including a bidirectional cycleway as part of the planned upgrade of Northfields Avenue.
	Run cycling skills workshops and Bike Buses.
Public Transport	Investigate increase to UOW Shuttle services during peak and off peak travel times.
	Analyse Opal data to lobby State Government for additional services during peak times e.g. Gong Shuttle.
	Consider target student growth areas for UOW and review existing public transport connections to determine whether these are sufficient.
	Provide bus shelters for all stops on campus.
	Lobby State Government to provide sufficient bus shelters for stops on routes which service the Wollongong campus, including at North Wollongong Station.
	Trial queuing system for UOW shuttle buses at Northfields interchange and North Wollongong Station.
Private Transport	Investigate options to manage parking capacity including carpooling, reserved parking and options for staff engagement car share.
	Increase carpooling numbers by offering reduced parking rates for vehicles with two people.
	Model anticipated northern entry vehicle trips to determine appropriate parking provision.

Code	Actions
All Modes	Investigate automated parking management and dynamic price structuring to improve parking management across campus.
	Reallocate Bus Bay to east of bus interchange on Northfields Avenue to alternative location, to increase capacity for a pick up and drop off zone.
	Investigate opportunity to add pick up/drop off zone close to Robsons Road entry.
	Investigate opportunity for smart bus stops with digital signage to improve wayfinding and provide advertising revenue opportunities.
	Investigate opportunities to streamline travel information and improve efficiency for UOW.
	Review course delivery modes and timings to ease demand on the transport network.
	Nominate Sustainable Transport Student Ambassadors and staff liaisons to educate peers about sustainable transport options to campus.
	Investigate lighting improvements on campus to improve safety for all modes, particularly active transport and public transport.

Table 1-2 Relevant UOW Master Plan strategies and directions

Master Plan Strategy	Directions	Actions
Access to the campus strategy: The vision presented in the Master Plan is to continue an ongoing modal shift away from private vehicle travel to the campus and reduce vehicular reliance on the roundabout at Northfields Avenue and Irvine Street.	Reduce congestion on Northfields Avenue	Northfields Avenue currently provides most of the campus' vehicle arrivals, and given UOW's growing population, this will become highly congested in the future. A new northern access point to the campus is proposed that will reduce vehicular reliance on Northfields Avenue. The following actions are proposed: ▪ Increasing on-campus accommodation to reduce the number of people using private vehicles and public transport to access the campus; ▪ Congestion on Northfields Avenue can be reduced by introducing a new western entrance on Robsons Road to the P3 multi-deck car park, making arrivals at this entry point more attractive to drivers; ▪ Supporting carpool programs as well as Park-and-Ride locations to reduce the number of private vehicles parking in and around campus; ▪ Increasing active transport mode share to the campus, improving footpaths and shared path links, and ▪ Student accommodations in the Wollongong area should be equipped with bike share systems to increase active travel mode share.
	Improve road safety along Irvine Street	Work with WCC and RMS to improve road safety at the Northfields Avenue/ Irvine Street Roundabout and the M1 southbound exit at University Avenue. The following actions are proposed: ▪ Installation of a bypass left turn lane from Irvine Street into Northfields Avenue to increase road safety; and ▪ Replace the parking lane between Irivine Street and the UniCentre Lane on the southern side of Northfields Avenue with a traffic lane.
	Introduce a new pedestrian and cycle link to the north	The M1 Princes Motorway restricts pedestrian and cyclist movement to the north and northeast of the campus. A new link to this area would significantly increase accessibility to the north and north eastern suburbs, and ultimately promote a mode shift towards active transport. UOW will enter into discussions with WCC and RMS to ensure that the proposed link aligns with plans for an M1 Princes Motorway/ Mt Ousley Road interchange.
Student accommodation strategy: The vision presented in the Master Plan is to provide 500 beds on campus over the next 20 years. Existing student accommodation will be upgraded and consolidated into key locations well served by public and active transport and facilities.	Consolidate existing housing stock	Existing housing stock that is outdated and in need of repair will be progressively decommissioned, renovated or replaced. Housing will be consolidated into strategic locations with good access to public and active transport facilities.
	Introduce additional beds to the campus	Additional beds will be located at existing accommodations on campus, with half replacing ageing stock on Robsons Road and the other half replacing the at-grade car parking at the Northfields Avenue housing.
	Redevelop Weerona housing	The ageing student accommodation at Beaton Park will be renewed in alignment with the upgrades to the area currently planned by WCC.
	Increase diversity of housing on offer	Diversifying the offer of student housing will accommodate different types of students on campus. The following actions are proposed: ▪ Introducing housing that transitions undergraduate students to adult life; and ▪ Short-stay accommodation for block learning students, conference guests and visiting scholars.
Pedestrian and cycling strategy:	Introduce a hierarchy of key pedestrian paths	Typologies will be introduced to create a hierarchy of pedestrian paths through campus. These will include:

Master Plan Strategy	Directions	Actions
The vision presented in the Master Plan is to improve pedestrian and cycling priority on campus, and improve signage and wayfinding. Intuitive, direct paths will be introduced as well as high quality shared zones, increasing overall pedestrian and cycling amenity.		▪ Primary civic walks leading people directly into the campus and to key locations. Civic walks should be aligned between buildings and be characterised by generous widths, integrated furniture and lighting. These will also function as pedestrian gateways, welcoming visitors to the campus; ▪ Primary green walks that work with the existing vegetation on campus, and that are aligned with existing trees; and ▪ A secondary network of quality paved laneways that will connect to buildings, open spaces and primary walks.
	Improve signage and wayfinding on campus	A wayfinding strategy will be developed for the campus that will build upon the directions of the primary and secondary pedestrian walks.
	Improve pedestrian safety on the Ring Road and key service roads	Shared zones within the campus will be introduced to increase pedestrian and cyclist safety. These shared zones will have capacity for low speed vehicles of service, delivery and maintenance. The look and feel of the low speed environment will make drivers more aware of their speed and the presence of pedestrians.
	Limit access for private vehicles in the core campus	The pedestrian and cycling environment within the campus core could be compromised if the existing car priority and unrestricted access is left unchanged.
	Introduce bike hubs in prominent new buildings	Bike hubs should be provided in prominent locations, such as student accommodation sites, and new buildings. Showers and lockers should also be provided in the hubs.
	Increase pedestrian safety on Northfields Avenue	Increasing pedestrian safety on Northfields Avenue is a priority for UOW. A previously suggested skybridge is not recommended due to the additional time required to cross the road compared to crossing at ground level. Construction of an elevated skybridge would also give the impression that the road network is for vehicles only. Actions that can achieve increased safety for pedestrians and cyclists without the construction of the skybridge include: ▪ Introducing traffic calming measures such as raised pedestrian crossings that increase visibility for approaching vehicles; ▪ Introducing improved signage and flashing lights to increase visibility of the crossing; and ▪ Maintaining median strips and narrow lane widths to slow traffic.
<u>Public transport and vehicular access strategy:</u> The vision presented in the Campus Master Plan is to enhance the public transport arrival experience and restrict private vehicle access to the Wollongong campus' inner core.	Improve the arrival experience for bus passengers	The arrival experience for bus passengers should be enhanced by including improvements to pedestrian amenities from the terminus to the campus core (via the existing access path between P1 and P2 car parks). The proposed development at the P2 car park presents an opportunity to repurpose the corridor as a welcoming arrival space for bus passengers.
	Extend the capacity of the existing bus terminus	The anticipated increase in UOW population in the future will place strain on the bus terminus. To accommodate this growth, an expansion of the terminus is required. UOW should consider consolidating the UniCentre loading bay to University Hall, to accommodate an additional bus bay at the terminus. For additional capacity requirements, the University should collaborate with Wollongong City Council to add additional bays south of the bus terminus to maintain a consolidated terminus area.
	Limit vehicular access in the campus core	Vehicular access to the campus core will still be provided to those that need it, for example service, delivery and emergency vehicles. However, tighter control will be placed on the vehicles that enter campus through control methods such as rising bollards that minimise unnecessary movements in shared zones. Large vehicle loading zones should be limited and consolidated where possible.

Master Plan Strategy	Directions	Actions
	Maintain taxi pick up area	The taxi drop off zone to the south of UniHall on Northfields Avenue should continue to be used for this purpose, and a general drop-off zone should be investigated.
Car parking strategy: The vision presented in the Master Plan is to maintain the campus' current ratio of car parking spaces to the Effective Full Time Student Load (EFTSL). Parking on site will be consolidated into key locations that free up the core campus for new academic buildings and public spaces. Parking will still be supplied for service and contractor vehicles, disabled users and regional students.	Maintain current ratio of car spaces to students	The existing local road network currently experiences heavy congestion in peak periods, hence provision for additional car parking will only exacerbate road congestion even further. The current ratio of 5.4 car parking spaces per EFTSL at the Wollongong campus will decrease slightly during the key construction period, but will be restored by 2036. At the same time, a number of actions will be introduced to reduce car parking demand: ▪ Improving walking, cycling and public transport infrastructure, facilities and services; ▪ Increasing the on-campus residential population, and providing car and bike sharing facilities at all student accommodations; ▪ Encouraging the use of carpooling with priority parking; and ▪ Introducing new parking pricing methods.
	Consolidate car parking to outside the Ring Road	The provision of consolidated parking locations outside of the Ring Road will make finding a car parking space more reliable and reduce unnecessary movements from car park hunting. Two potential locations for increased parking are the Sports Precinct and at the P4 Western car park.
	Continue to provide car parking for those who need it	Car parking access will be given to those who need it, such as vehicles servicing specific facilities, people with disabilities and UOW operations vehicles. The following actions are proposed: ▪ Continue to provide drop off spaces and convenient parking access for those accessing the Kids' Uni and Early Start Discovery Space; and ▪ Maintain access and contractor and disabled parking next to buildings.
	Collaborate with external stakeholders to reduce the impact of on-street parking	UOW should support Wollongong City Council to reduce the impact of on-street parking on the local community and for the convenience of other road users.

APPENDIX B

UOW CAMPUS MASTER PLAN - SUMMARY OF KEY STRATEGIES AND ACTIONS

Strategy Review	Area	Strategies	Directions/Actions	Status	Covered in Transport Strategy (Y/N)	Relevant Objective (# and Title)	Relevant Action #	Comments
UOW Campus Master Plan - directions	The University Village	Communications and technology strategy	Integrate audio visual and virtual classroom technologies	For completion as part of Master Plan implementation	Y	Objective 1: Improve existing campus access constraints to meet current and future demands	ALL 3: Review Course delivery modes and timings to ease demand on the transport network	N/A
			Introduce online courses	For completion as part of Master Plan implementation	Y	Objective 1: Improve existing campus access constraints to meet current and future demands	ALL 3: Review Course delivery modes and timings to ease demand on the transport network	N/A
			Upgrade digital campus management	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 5: Develop wayfinding strategy	N/A
	Access and Wayfinding	Access to the campus strategy	Reduce congestion on Northfields Avenue	For completion as part of Master Plan implementation	Y	Objective 4: Maximise the use of UOW parking to meet current and future demands	PRT 1: Investigate options to increase carpool and other parking capacity PRT 2: Increase carpooling numbers by offering reduced parking rates for vehicles with two people PRT 4: Investigate automated parking management and dynamic price structuring to improve parking management across campus. PRT 5: Reallocate Bus Bay to east of bus interchange on Northfields Avenue to alternative location, to increase capacity for a pick up and drop off zone. ALL 3: Review Course delivery modes and timings to ease demand on the transport network	N/A
			Improve road safety along Irvine Street	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 7: Install pedestrian refuge at roundabout at Northfields Avenue and Irvine Street (southern leg)	N/A
			Introduce a new pedestrian and cycle link to the north	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 5: Develop wayfinding strategy ACT 1: Lobby Council to prioritise missing pedestrian and cycling links to the north of campus, to align with the timing of the proposed northern entry and Mount Ousley interchange. ACT 2: Lobby Council to prioritise missing cycleway links on Foley Street, Church Street and Bourke Street to improve connections to the Wollongong campus from UOW accommodation sites. ACT 3: Lobby Council to prioritise proposed cycleway upgrades on Porter Street and Crawford Avenue, to improve the cycling connection between North Wollongong Station and the Wollongong campus.	N/A
		Pedestrian and cycling strategy	Introduce a hierarchy of key pedestrian paths	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 5: Develop wayfinding strategy	N/A
			Improve signage and wayfinding on campus	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 5: Develop wayfinding strategy	N/A
			Improve pedestrian safety on the Ring Road and key service roads	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus Objective 3: Improve public and shared transport as a means for accessing the campus	ACT 4: Investigate shared zone within the campus core ACT 6: Enhance existing pedestrian refuge at the Western Entrance of Northfields Avenue ACT 7: Install pedestrian refuge at roundabout at Northfields Avenue and Irvine Street (southern leg) PUT 4: Provide bus shelters for all stops on campus PUT 6: Trial queuing system for UOW shuttle buses at Northfields interchange and North Wollongong Station PRT 5: Reallocate Bus Bay to east of bus interchange on Northfields Avenue to alternative location, to increase capacity for a pick up and drop off zone. PRT 6: Investigate opportunity to add pick up/drop off zone close to Robsons Road entry	N/A
			Limit access for private vehicles in the core campus	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 4: Investigate shared zone within the campus core	N/A
			Introduce bike hubs in prominent new buildings	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 9: Provide new Bike Bases and end of trip facilities in new developments	N/A
		Public transport and vehicular access	Improve the arrival experience for bus passengers	For completion as part of Master Plan implementation	Y	Objective 3: Improve public and shared transport as a means for accessing the campus	PUT 4: Provide bus shelters for all stops on campus PUT 5: Lobby State Government to provide sufficient bus shelters for stops on routes which service the Wollongong campus, including at North Wollongong Station PUT 6: Trial queuing system for UOW shuttle buses at Northfields interchange and North Wollongong Station	N/A
			Extend the capacity of the existing bus terminus	For completion as part of Master Plan implementation	Y	Objective 3: Improve public and shared transport as a means for accessing the campus	PUT 4: Provide bus shelters for all stops on campus PUT 6: Trial queuing system for UOW shuttle buses at Northfields interchange and North Wollongong Station	N/A

Strategy Review	Area	Strategies	Directions/Actions	Status	Covered in Transport Strategy (Y/N)	Relevant Objective (# and Title)	Relevant Action #	Comments
		strategy	Limit vehicular access in the campus core	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 4: Investigate shared zone within the campus core	N/A
			Maintain taxi pick up area	For completion as part of Master Plan implementation	Y	Objective 3: Improve public and shared transport as a means for accessing the campus	PRT 5: Reallocate Bus Bay to east of bus interchange on Northfields Avenue to alternative location, to increase capacity for a pick up and drop off zone. PRT 6: Investigate opportunity to add pick up/drop off zone close to Robsons Road entry	N/A
			Consolidate car parking to outside the Ring Road	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 4: Investigate shared zone within the campus core	N/A
			Continue to provide car parking for those who need it	For completion as part of Master Plan implementation	Y	Objective 4: Maximise the use of UOW parking to meet current and future demands	PRT 1: Investigate options to increase carpool and other parking capacity PRT 3: Model anticipated northern entry vehicle trips to determine appropriate parking provision.	N/A
	Landscape and Public Realm	Landscape and public realm strategy	Create a hierarchy of Paths	For completion as part of Master Plan implementation	Y	Objective 2: Improve active transport as a means of accessing the campus	ACT 5: Develop wayfinding strategy	N/A

APPENDIX C

BASE MODEL DEVELOMPENT REPORT

Base Model Development Report

Keiraville – Gwynneville Access and Movement Study

80018018

Prepared for
Wollongong City Council

7 February 2018

Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9496 7748

Document Information

Prepared for	Wollongong City Council
Project Name	Keiraville – Gwynneville Access and Movement Study
File Reference	Base Model Development Report v3.docx
Job Reference	80018018
Date	7 February 2018
Version Number	0 (DRAFT)

Author(s):

Name Sergio Daher Garcia
Job title: Senior Traffic Engineer

Effective Date 7/02/2018

Approved By:

Name Ivo Pais
Job title: Traffic Engineering and Modelling Manager

Date Approved 7/02/2018

Document History

Version	Effective Date	Description of Revision	Prepared by	Reviewed by
0	7/02/2018	Draft	Sergio Garcia Isabella Kim	Ivo Pais

Table of Contents

Tables

Figures

Appendices

1 Introduction

1.1 Background

Cardno was commissioned by Wollongong City Council to examine the existing and future operation of the Keiraville-Gwynneville traffic and transport system, and develop strategies to reduce congestion and increase sustainable transport mode share to accommodate growth in the area. The study includes assessing the impact of planned development and infrastructure upgrades on traffic generation, accessibility, parking demand, and the overall transport network operation. The ultimate purpose of this study is to develop strategies to improve the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development in the area.

The study includes the development of a purpose built microsimulation model to assess the existing traffic issues and manage future traffic demands in Keiraville and Gwynneville. This report outlines the assumptions and methodology adopted in the development of the base model, together with some key results. The model will be used as part of the subsequent stages of the project, including the creation of future year scenarios and option testing.

1.2 Project Objective

The Keiraville and Gwynneville traffic model is to test a number of transport infrastructure options in different future year scenarios. The outputs of the model will be used to inform design and assist with the economic appraisal of transport investments within the study area.

The main objectives of the access and movement study are as follows:

- Examine and document existing and future potential operation of the traffic and transport system within Keiraville and Gwynneville
- Develop strategies to reduce congestion
- Increase sustainable transport mode share
- Understand impact of planned development and infrastructure upgrades.

The key objectives of the traffic modelling exercise are to:

- Assess the travel demand during the academic season (in-session) which is a characteristic for the month of August and the non-academic season (out-session) which is a characteristic for the month of September.
- Assess the impacts of potential developments on the study area and changes in road network and surrounding intersections
- Evaluate existing and future year transport network performance
- Identify and evaluate mitigation measures to accommodate traffic likely to be generated from future developments and growth.

1.3 Scope of Work

The scope of work is as follows:

- Extract the study network from an existing RMS Aimsun Mount Ousley Interchange hybrid model and develop a purpose built microsimulation model;
- Adjust the 2015 volumes at the interchange and surrounding junctions to balance the discrepancies between the 2015 and 2017 data;
- Determine the traffic demand for “in-session” and “out-session” AM and PM peak periods which consists of the peak academic season and the period outside of the academic season respectively;
- Calibrate and validate a microsimulation model in accordance with *Traffic Modelling Guidelines* (Roads and Maritime Services, 2013);
- Assess options regarding Mount Ousley Interchange;

- Import intersection turning volumes from the Jacob's Mount Ousley Aimsun Model (2015) for Memorial Drive / Princes Highway Interchange;
- Obtain outputs from the microsimulation model to be used for a SIDRA assessment of key intersections within Keiraville – Gwynneville precinct.

1.4 Study Area

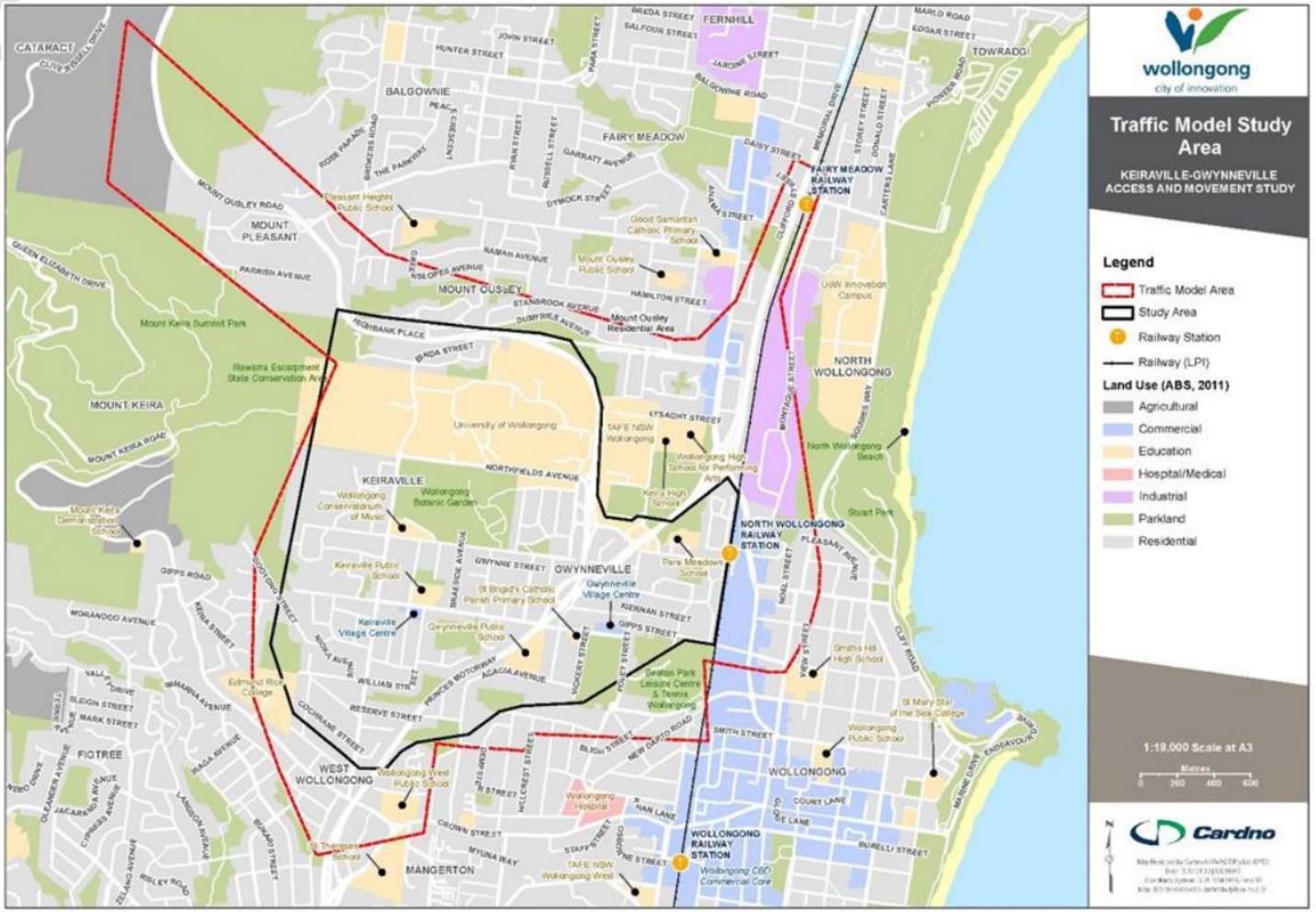
The model is centred around Keiraville and Gwynneville, which is located northwest of the Wollongong city centre, in the Illawarra region of New South Wales. The study area is bounded by the Princes Motorway (M1) north-west of the University of Wollongong to the rail corridor in the east, including the Mount Ousley Road / Princes Highway intersection, to Beaton Park in the south and to Edmund Rice College in the west. The study area land use is predominantly characterised by residential and educational areas, an illustration is shown in **Figure 1-1**.

There are a number of important trip generators in and around the Keiraville-Gwynneville area which generate a high number of trips per day, traffic demand and behaviour. These include:

- Keiraville and Gwynneville village centres
- The University of Wollongong (UOW) Campus
- UOW Innovation Campus (iC)
- Wollongong CBD
- Wollongong Hospital
- Wollongong Botanic Garden
- North Wollongong Station
- TAFE Illawarra Wollongong Campus.
- Mount Ousley residential area
- Local schools
- Student accommodation centres
- Beaton Park sports and recreation facilities.

Access to these destinations via the road network is supported by major routes such as the Princes Motorway (M1), Princes Highway (A1) and Mount Ousley Road.

Figure 1-1 Study area



1.5 Report Outline

The general structure for this report is outlined below:

- Section 1 – Introduction: outlines the background, project objectives, scope of work and the study area
- Section 2 – Existing Conditions: outlines and assesses the current traffic and transport conditions
- Section 3 – Model Assumptions: outlines the assumptions behind the base model development and the methodology
- Section 4 – Model Stability: outlines the statistical analysis of the model's stability
- Section 5 – Model Calibration and Validation: summarises the results from the base model calibration and validation process
- Section 6 – Conclusion: summarises the recommendations, main outcomes and fitness for purpose of the base year model

2 Existing Conditions

2.1 Traffic Surveys

Intersection counts were commissioned between 6:00am to 10:00am and 3:00pm to 7:00pm. For the in-session period, the counts were conducted on Thursday 24 August 2017 and for the out-session period, the counts were conducted on Thursday 28 September 2017. The locations of the surveys are shown in **Figure 2-1** and the intersection ID descriptions are summarised in **Table 2-1**.

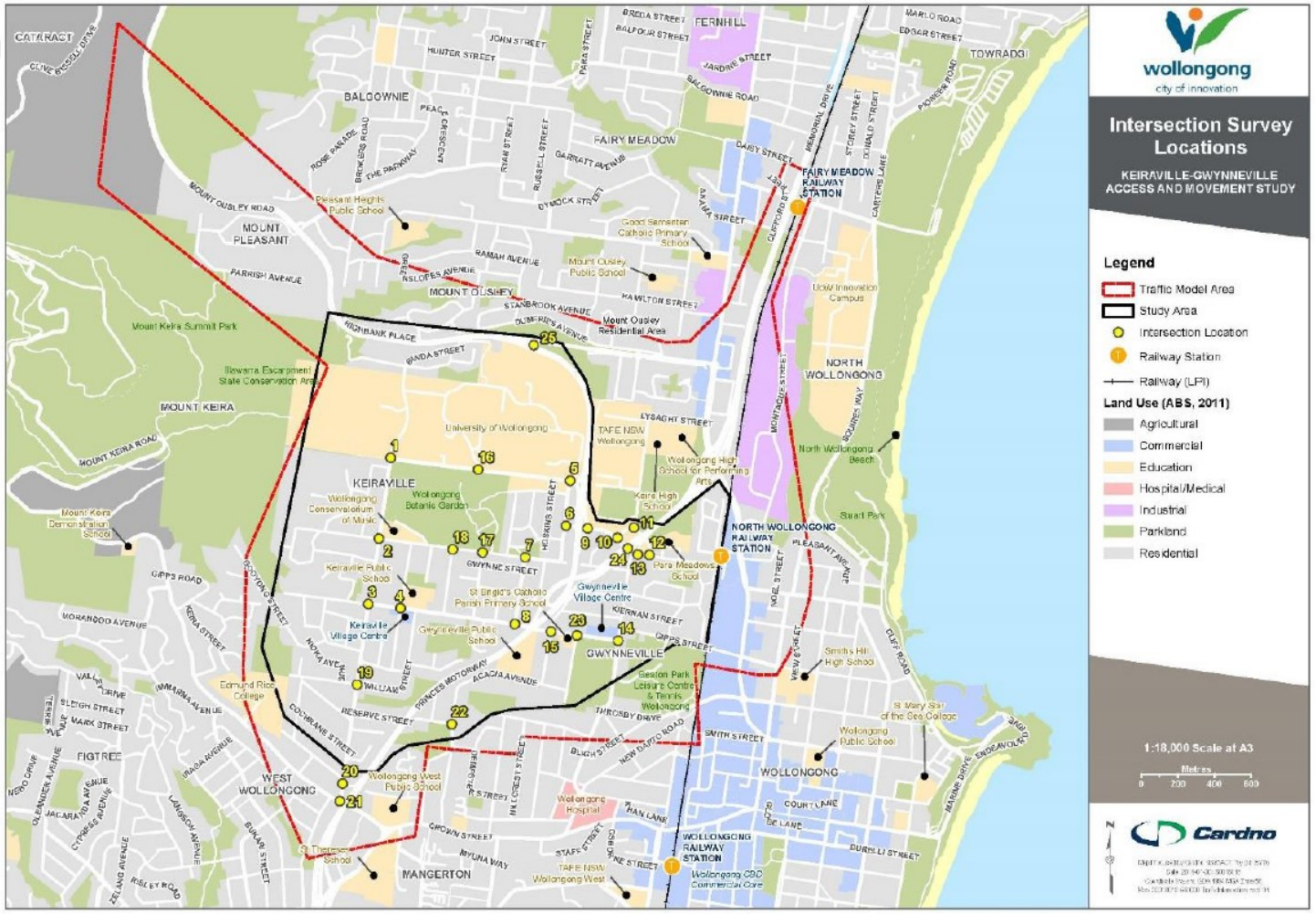
During the in-session period, the peak AM period is identified between 8:00am to 9:00pm and the peak PM period is identified between 4:00pm to 5:00pm.

During the out-session period, the peak AM period is identified between 8:15am to 9:15am and the peak PM period is identified between 4:30pm to 5:30pm.

Table 2-1 Intersection ID Description

Intersection ID Description			
1	Robsons Road / Northfield Avenue	**14**	Foley Street / Gipps Road
2	Robsons Road / Murphys Avenue	**15**	Frances Street / Gipps Road
3	Robsons Road / Gipps Road	**16**	Ring Road / Northfields Avenue
4	Grey Street / Gipps Road	**17**	Murphys Avenue / John Street
5	Ring Road / Northfields Avenue	**18**	Murphys Avenue / Braeside Avenue
6	Irvine Street / University Avenue	**19**	Robsons Road / William Street
7	Murphys Avenue / Eastern Street	**20**	Robsons Road / Princes Highway
8	Eastern Street / Gipps Road	**21**	Robsons Road / Mount Keira Road
9	Princes Highway / Princes Highway exit	**22**	Gilmore Street / Reserve Street
10	University Avenue / Graham Avenue	**23**	Gipps Road / Vickery Street
11	Foleys Lane / University Avenue	**24**	Memorial Drive On Ramp / University Avenue
12	University Avenue / Porter Street	**25**	Mount Ousley Road / Princes Motorway
13	Memorial Drive Off Ramp / Porter Street		

Figure 2-1 Location of Intersection Count Surveys



2.2 Journey Travel Time Analysis

Speed and travel time data was extracted from TomTom's real-time data for vehicles travelling within the Keiraville and Gwynneville area.

TomTom captures 3.5 million km of floating car data (FCD) every day in Australia. The data is collected from a combination of TomTom devices (fleet and consumer), third party Auto Original Equipment Manufacturers (OEMs) and phone handsets. FCD provides a new method for measuring speeds, travel times and thus road performance. Probe devices in vehicles, which may be cellular phones, or more commonly GPS devices, provide this data.

All the TomTom data in the reports used by Cardno has been conducted through a quality assurance and data cleansing process. TomTom processes the raw GPS information received from customers in a number of ways in order to protect privacy, filter out possible inaccurate measurements and create geographic databases which can be queried. The most important part of this process algorithm is called map-matching.

In the map-matching process, the GPS measurements are matched to a digital map using a map-matching algorithm. This process assigns each GPS speed measurement to a road segment with the highest possible confidence level. The algorithm looks at the path of consecutive GPS points in a journey file to define the path of a vehicle in order to produce the most accurate speed information possible.

For example, the map-matcher filters out traces which could not be matched to a map (due to, for example, changes in the road infrastructure, the use of the GPS device outside a vehicle, etc.), detects U-turns and losing GPS signals in tunnels.

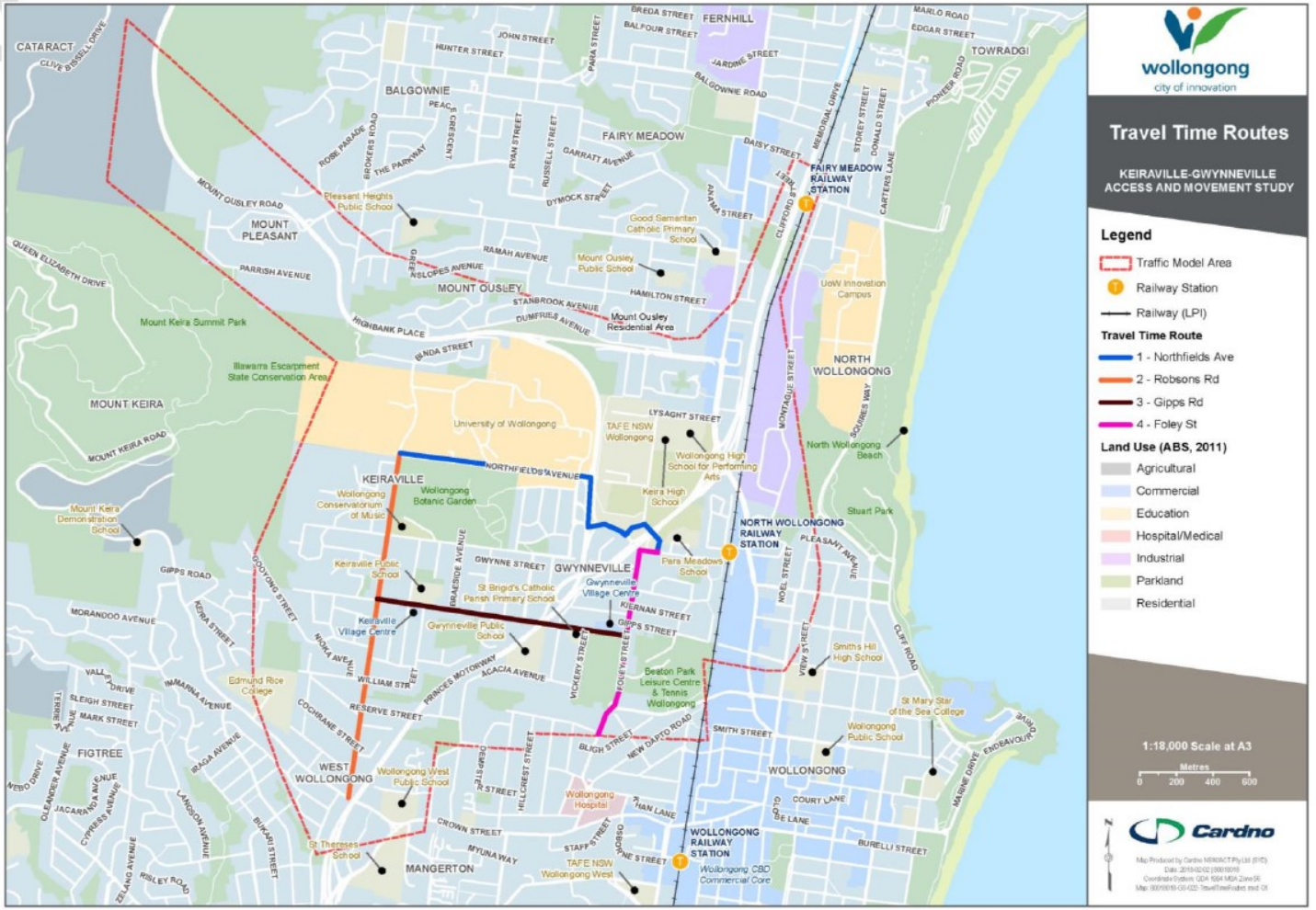
When the map-matching is done, an aggregated geographic database (geobase) of measured road speeds is produced. These geobases are updated regularly for each map of each region or country to take into account the growing historical GPS speed database as well as updates and changes in the road network.

Average travel times were collected for weekdays between 8:00am to 9:00am and 4:00pm to 5:00pm during August 2017 and September 2017. This data was collected for four routes in both directions. The routes and respective lengths are summarised **Table 2-2**. The location of these routes are illustrated in **Figure 2-2**.

Table 2-2 Routes of Interest for Journey Travel time Analysis

Route ID	Route	Direction	Length of Route (m)
1	Northfields Avenue via Irvine Street, via University Avenue from Robsons Road to Porter Street	Eastbound	1,813
		Westbound	1,813
2	Robsons Road from Mount Keira Road to Northfields Avenue	Northbound	1,881
		Southbound	1,878
3	Gipps Road from Robsons Road to Foley Street	Eastbound	1,362
		Westbound	1,363
4	Foley Street from Greenacre Road to University Avenue	Northbound	1,128
		Southbound	1,137

Figure 2-2 Location of Routes



The average travel times for in-session and out-session between 8:00am to 9:00am and 4:00pm to 5:00pm are summarised in **Table 2-3** and **Table 2-4** respectively.

Table 2-3 Average Travel Time: 8:00AM to 9:00AM

Route	Direction	Average Travel Time (mm:ss)	
		In-Session	Out-Session
Northfields Avenue	Eastbound	04:23	04:25
	Westbound	04:25	04:26
Robsons Road	Northbound	03:22	03:13
	Southbound	03:34	03:11
Gipps Road	Eastbound	03:09	02:59
	Westbound	02:40	02:50
Foley Street	Northbound	02:33	02:19
	Southbound	02:42	02:29

Table 2-4 Average Travel Time: 4:00PM to 5:00PM

Route	Direction	Average Travel Time (mm:ss)	
		In-Session	Out-Session
Northfields Avenue	Eastbound	04:20	03:45
	Westbound	03:25	03:53
Robsons Road	Northbound	03:05	03:06
	Southbound	03:02	03:04
Gipps Road	Eastbound	03:01	02:35
	Westbound	02:35	02:42
Foley Street	Northbound	02:23	02:18
	Southbound	04:20	03:45

2.3 Existing Condition Analysis

2.3.1 Princes Motorway

Princes Motorway (M1) is a major motorway that connects Sydney to Wollongong through to Albion Park Rail. This route provides key access to destinations in the Wollongong, Illawarra and South Coast regions for tourists. It is also a major freight route from Port Kembla.

This corridor is located around the south-west of the model study area, running in a north-south direction to the north-west. The number of lanes vary between two to three lanes in either direction within the study area. The speed limit is 80km/h, however, at the steep downhill grade further north of the motorway, trucks and buses are limited to 40km/h and all other vehicles to 80km/h.

2.3.2 Mount Ousley Road

Mount Ousley Road is an arterial road located in the north of the model study area that connects the Princes Highway and the Princes Motorway. Once the road joins the Princes Motorway through a right turn, the speed limit is 80km/h.

2.3.3 Princes Highway

Princes Highway is a highway that runs in a north-south direction that provides access from Mount Ousley Road, Memorial Drive and Princes Motorway. It runs almost parallel to the Princes Motorway and the coastline in the model study area. There are three lanes in both directions with speed limits that varies from 60km/h to 50km/h.

2.3.4 Memorial Drive

Memorial Drive is a major arterial road that runs in a north-east to south-west direction within the modelled area. Memorial Drive is connected to Princes Highway, Princes Motorway by ramps, which provides access to the Keiraville and Gwynneville area.

2.3.5 Robson Road

Robson Road is a collector road which operates as a north-south corridor connecting to the western entrance of University of Wollongong and West Wollongong residential suburbs.

2.3.6 Irvine Street

Irvine Street is a collector road which provides access to Princess Motorway ramps and connection to the University of Wollongong Ring Road, Northfields Avenue and Murphys Avenue.

2.3.7 Gipps Road

Gipps Road runs is a collector road which operates as an east-west corridor connecting to the Keiraville and Gwynneville village centres, the Beaton Park precinct and to Robsons Road.

2.3.8 University Avenue

University Avenue provides east-west road access between North Wollongong Station and Irvine Street. This collector road is one of the main connections between North Wollongong, Keiraville and Gwynneville.

2.3.9 Murphys Avenue

Murphys Avenue is a local road and runs east-west along the southern side of the Botanic Garden, and connects to Irvine Street and Robsons Road.

2.3.10 Northfields Avenue

Northfields Avenue is collector road located on the southern boundary of the UOW campus, running east-west and connecting between Robsons Road and Irvine Street. Two UOW campus access points and the Bus Bay are located on Northfields Avenue.

2.3.11 Road Demand and Congestion Locations

The performance of key roads within the precinct indicate the demand on the road network. The performance of the road network was measured by three variables, as follows:

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

The road network performance can be largely determined by assessing the theoretical capacity of the mid-block and the average speed of traffic, as presented in the Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis, acceptable traffic conditions associated with levels of service D. The average speed is a mean of all the vehicle speeds travelling along a road in a particular timeframe. The percentage of speed limit is a measure of how many vehicles are travelling at the designated speed for the road, the higher the percentage of speed limit the better flow along the road.

The key indicator of the mid-block performance is the Level of Service (LoS). This is the average speed as a percentage of the base Free Flow Speed (FFS), where results are placed on a continuum from 'A' to 'F', as shown in **Table 2-5**.

Table 2-5 Austroads Mid-Block Criteria for Speed Level of Service Analysis

LoS	Description	Travel speed as a percentage of base FFS (%)
A	Good operation	> 85
B	Good with acceptable delays and spare capacity	67-85
C	Satisfactory	50-67
D	Operating near capacity	40-50
E	At capacity	30-40
F	Unsatisfactory and requires additional capacity	≤ 30

The data used for this analysis considers weekdays during in-session (August 2017) and out-session (September 2017). The roads which were assessed are Northfields Avenue, University Avenue and Porter Street corridor, Robsons Road, Gipps Road and Foley Street.

A summary of the performance data is shown in **Table 2-6**.

Table 2-6 AM Peak Period Road Network Performance

Route	Direction	Vehicles per hour (veh/hr)		Median speed (km/h)		FFS (%)	
		August	September	August	September	August	September
Northfields Avenue	Eastbound	727	557	33	33	0.7	0.7
	Westbound	796	474	31	32	**0.6**	**0.6**
Robsons Road	Northbound	827	530	42	42	0.8	0.8
	Southbound	414	233	42	42	0.8	0.8
Gipps Road	Eastbound	409	322	30	32	**0.6**	**0.6**
	Westbound	415	301	36	33	0.7	0.7
Foley Street	Northbound	408	316	36	37	0.7	0.7
	Southbound	840	688	32	34	0.6	0.7

Table 2-7 PM Peak Period Road Network Performance

Route	Direction	Vehicles per hour (veh/hr)		Median speed (km/h)		FFS (%)	
		August	September	August	September	August	September
Northfields Avenue	Eastbound	1,087	876	33	35	0.7	0.7
	Westbound	777	554	34	35	0.7	0.7
Robsons Road	Northbound	552	434	44	44	0.9	0.9
	Southbound	531	414	44	45	0.9	0.9
Gipps Road	Eastbound	358	296	34	34	0.7	0.7
	Westbound	404	407	37	37	0.7	0.7
Foley Street	Northbound	508	437	38	38	0.8	0.8
	Southbound	767	616	36	37	0.7	0.7

This shows that during the in-session period, there are significantly more vehicles utilising these routes in comparison to the out-session period.

Key areas of concern are Northfields Avenue and Robsons Road which provide direct access to the University of Wollongong campus and other schools, however, overall performance at the route level the speed performance is satisfactory with the worst performance being identified as the westbound direction of Northfields Avenue corridor during the AM peak during in-session period.

Other areas of congestion were identified using TomTom travel time data and camera footage during the in-session period. The areas of main interest are focused on the major interchanges and ramps of the study area to supplement the overall road network performance analysis.

As already stated, there will be more traffic on the network in comparison to the out-session period and it is important to accurately identify these areas to represent the traffic operation and behaviour in the AM and PM peak to validate the base model.

The observations made at the intersections are summarised in **Table 2-8**. The median speeds and speed level of service for both peak periods are shown in **Figure 2-3** and **Figure 2-4**. The LoS is calculated using the Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis, speed level of service methodology.

Table 2-8 Congestion Locations in the Study Area

Intersection Location	Time of Day	Observation
Mount Ousley Road / Princes Motorway	AM	The ratio between the speed level of service and the posted speed is less than 30% at a 200 metres approaching distance of the intersection. On Mount Ousley Road the maximum queue length is around 15 vehicles between in the AM peak. This is partially captured in the footage below.  Queuing is most likely caused by drivers having difficulty to find safe acceptable gaps between vehicles to turn right onto Princes Motorway. Vehicles are often reaching around 80km/hour along Princes Motorway and no queuing was identified on Princes Motorway.
	PM	The ratio between the speed level of service and the posted speed is 50% to 69% at a 200 metres approaching distance of the intersection. On Mount Ousley Road, the maximum queue length is roughly around the same length of the AM peak in the PM peak. There is no queuing on Princes Motorway.
Irvine Street / University Avenue	AM	The ratio between the speed level of service and the posted speed is 40% to 49% when approaching roundabout and interchange ramps. Figure below shows queuing On University Avenue in the AM peak.

Intersection Location	Time of Day	Observation
		 The community gave feedback indicating that this intersection is a stoppage point on weekday mornings and the traffic moves very slowly, if not at all, with very long waiting times.
	PM	The ratio between the speed level of service and the posted speed is 50% to 69%. On the northern side of Irvine Street and southern side of Irvine Street , extensive queueing can be observed in the PM peak.
Princes Highway / University Avenue	AM	The ratio between the speed level of service and the posted speed is 50% to 69%. Queueing on the off ramp of Princes Highway is mostly likely caused by the number of vehicles coming from the highway at high speeds and giving way at the roundabout at the intersection. During the morning peak period, there will be a large proportion of vehicles using this intersection to access the University of Wollongong and schools. The figure below illustrates the queuing behaviour in the morning.

Intersection Location	Time of Day	Observation
		 The community gave feedback saying that the traffic banks up around 8am exiting the freeway, heading south.
	PM	The ratio between the speed level of service and the posted speed is 70% to 85%. In comparison to the AM peak period, there may be less queues because people may not use the same route and may visit other destinations in the Keiraville – Gwynneville area.

Figure 2-3 Network Performance: AM peak period

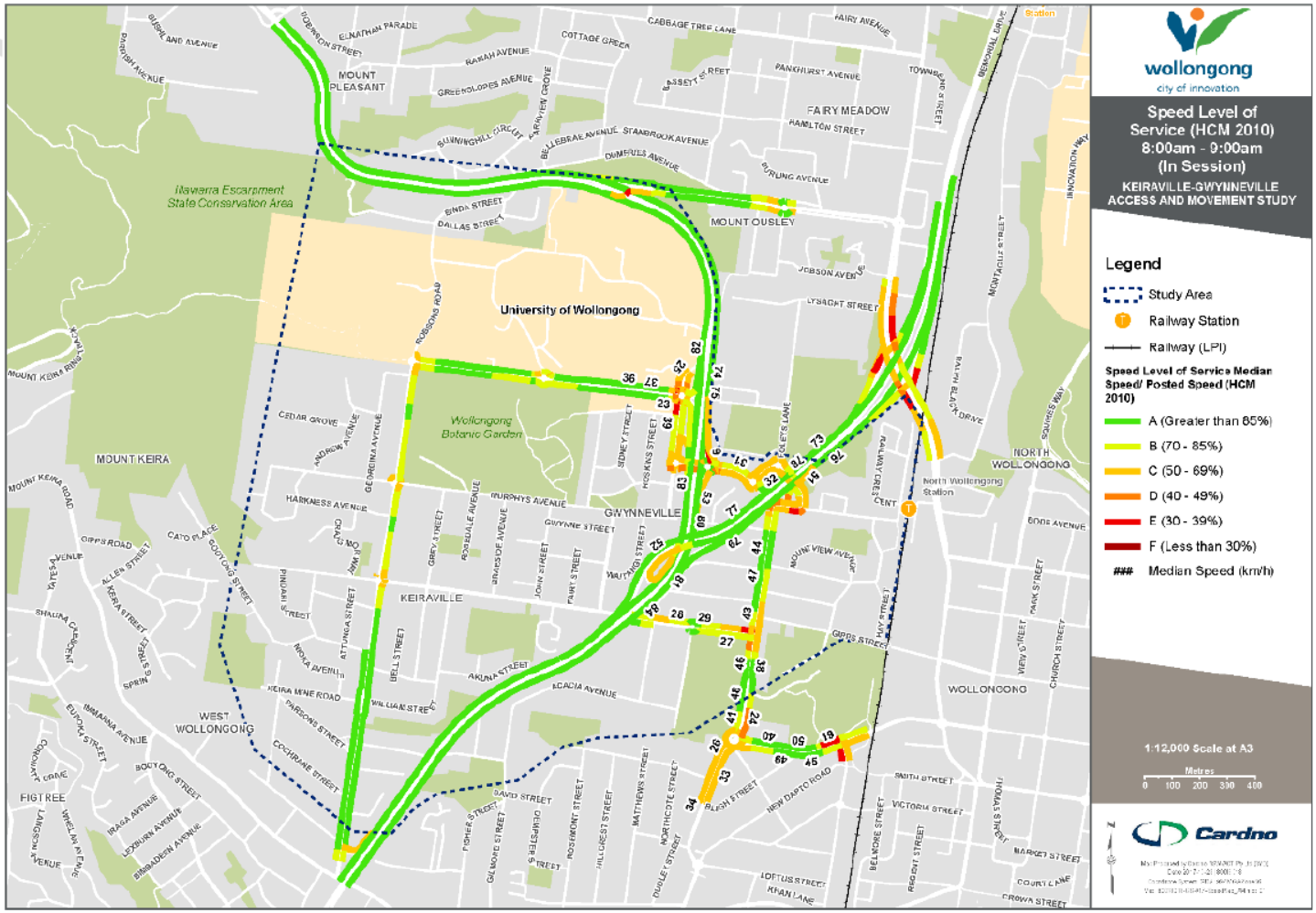
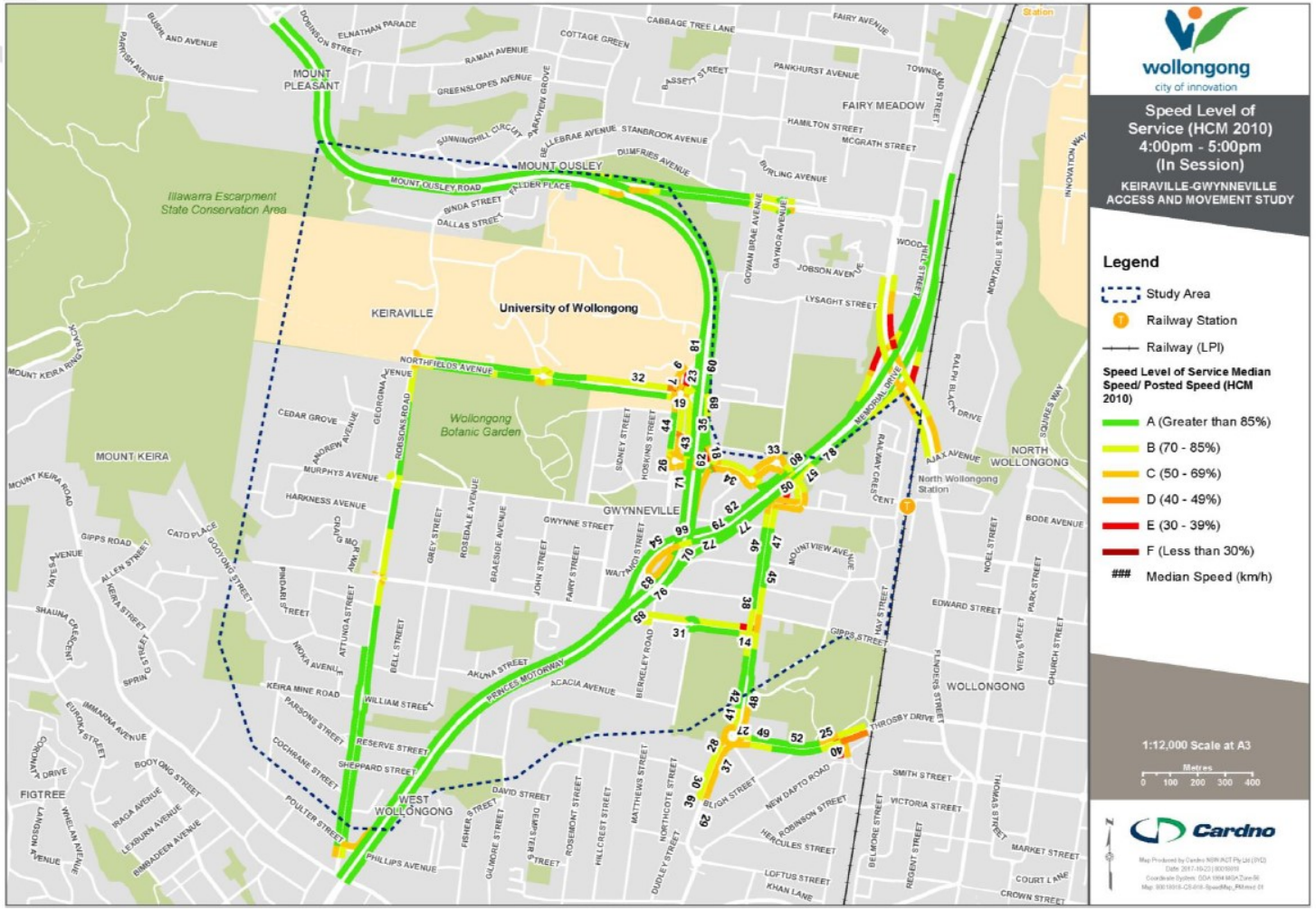


Figure 2-4 Network Performance: PM peak period



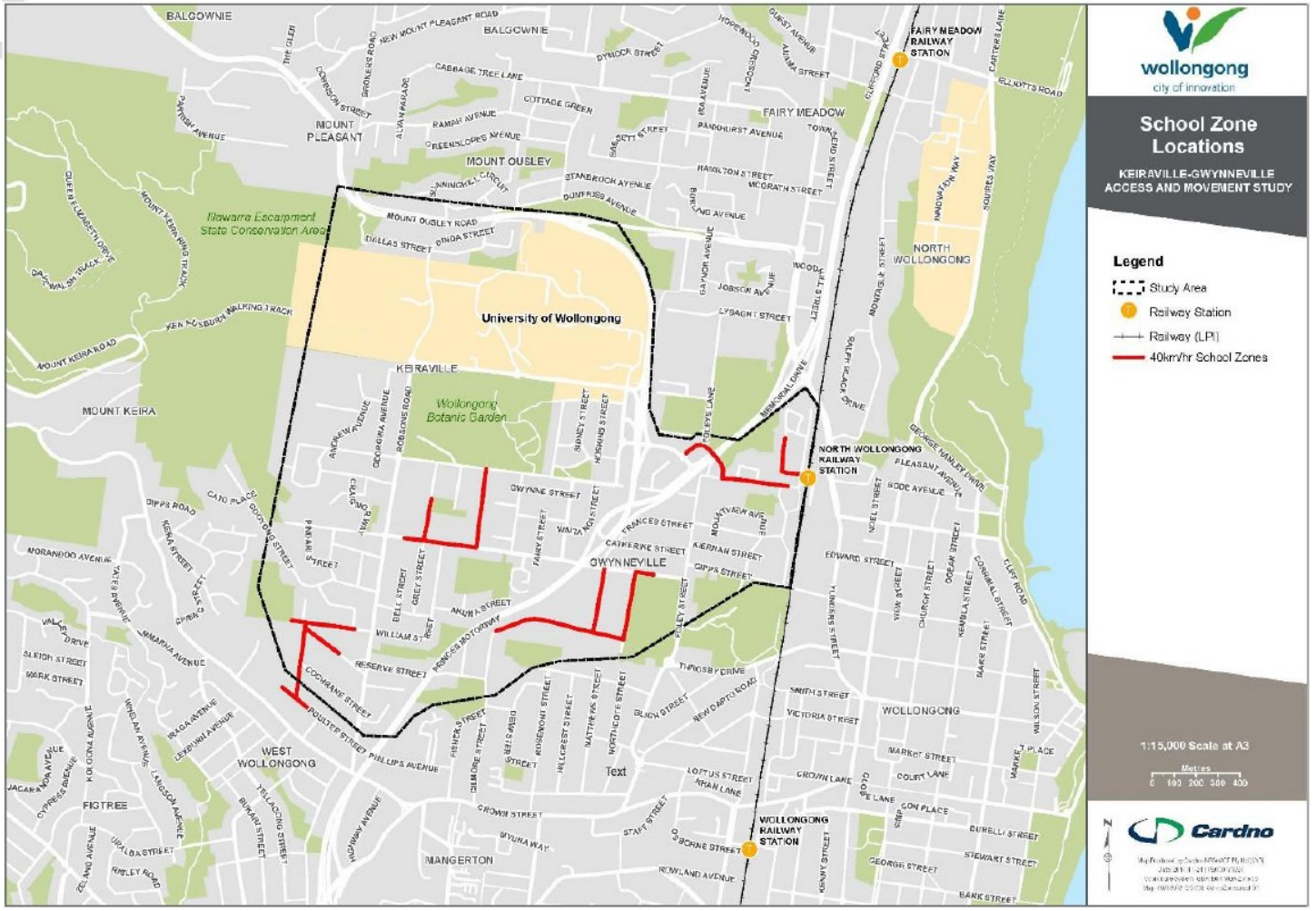
2.4 School Zones

There are five 40km/h school zones located within the study area during 8:00am to 9:30am and 2:30pm to 4:00pm during school days. The roads that are affected are:

- Railway Crescent
- Porter Street
- University Avenue
- Gipps Road
- Grey Street
- Braeside Avenue
- Berkeley Road
- Acacia Avenue
- Vickery Street
- Keira Mine Road
- Armstrong Street
- Parsons Street
- Poulter Street

The location of the school zones are shown in **Figure 2-5**.

Figure 2-5 School Zones



2.5 Public Transport

In the proximity of the model study area there are train services that can be accessed through the North Wollongong train station at the eastern end of traffic model, Fairy Meadow train station north of the model and Wollongong train station in the south. Since the train lines do not interact with the road network, train services have not been modelled in the study area.

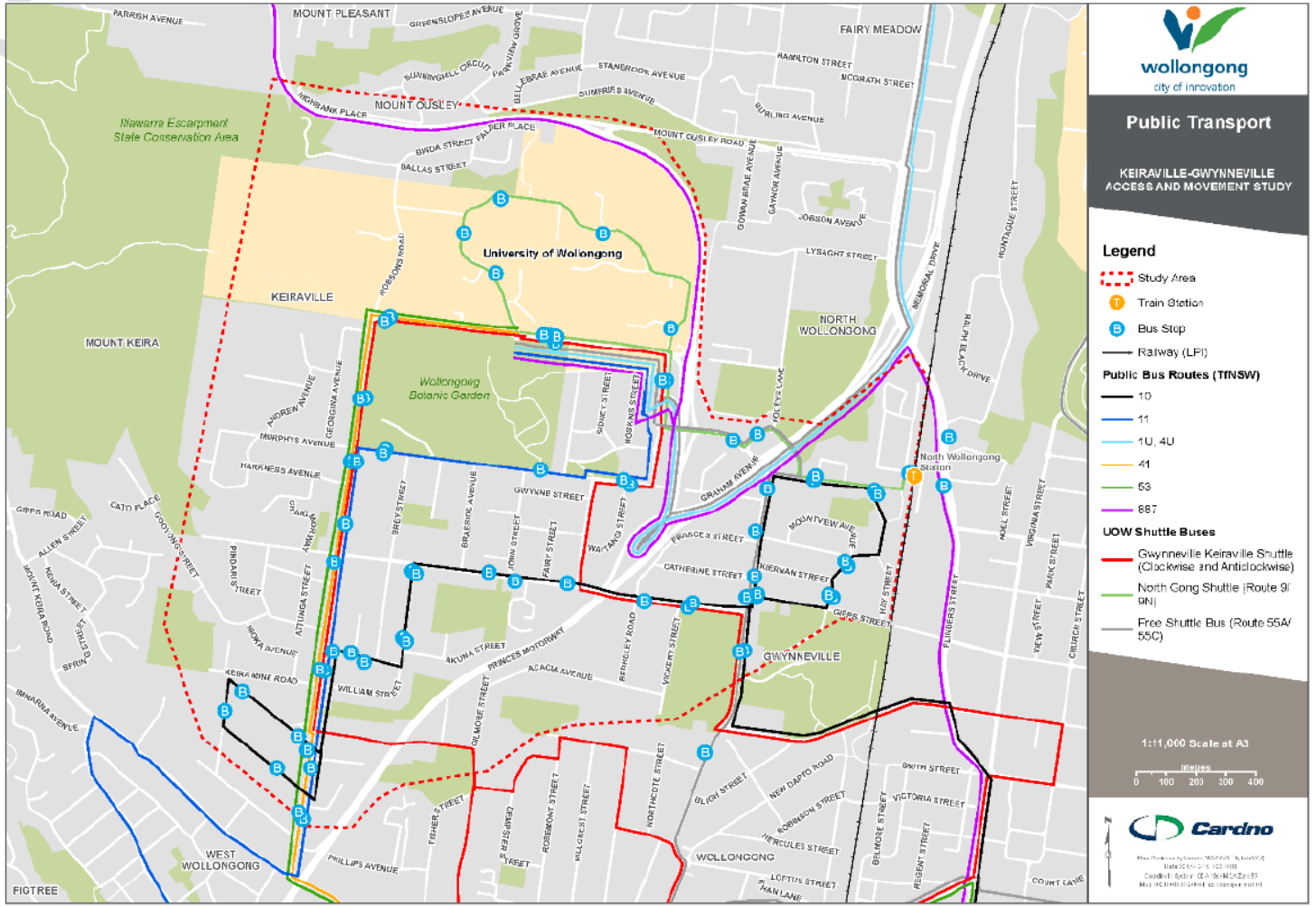
There are also a number of bus routes in the area providing connections to the Wollongong CBD, Wollongong and North Wollongong train stations, Figtree, Dapto and Shellharbour to the south, Fairy Meadow, Corrimal, and Campbelltown to the north, and the Innovation Campus to the east. The majority of these services operate within the Keiraville area, with some also travelling through Gwynneville.

There are seven major bus services for the public and five shuttle bus services that goes to the University of Wollongong. These bus routes coded in the microsimulation model are:

- 10 – Wollongong to West Wollongong Loop
- 11 – Wollongong to University of Wollongong
- 1U – Austinemer to University of Wollongong
- 4U – Bulli to University of Wollongong
- 41 – Dapto to University of Wollongong
- 53 – Shellharbour to Wollongong
- 887 – Wollongong and Appin to Campbelltown
- 9 (North Gong Shuttle) – Ring Road Loop (anti-clockwise)
- 9N (North Gong Shuttle) – North Wollongong Station to University of Wollongong Terminus
- 55A / 55C (Free Shuttle Bus) – University of Wollongong to North Wollongong Station
- Gwynneville Keiraville Shuttle – University of Wollongong to Wollongong Station (loop)

The bus routes are shown in **Figure 2-6**.

Figure 2-6 Bus Routes in the Study Area



3 Model Assumptions

3.1 Modelling Platform

The Keiraville – Gwynneville Access and Movement Study microsimulation model was developed using Aimsun 8.2.0 (R48406).

3.2 Modelled Time Periods

Four model time periods were assessed in this study - Weekday AM and PM peaks during in-session academic period (August 2017) and Weekday AM and PM peaks during the out-session academic period (September 2017).

The modelled peak hour periods were determined from the obtained traffic survey data, with separate model scenarios developed for each peak period. For each peak period, a 'warm-up' period of 60 minutes was added before the modelled peak hour, with overall modelled periods assumed in Aimsun as follows:

> Weekday AM (in-session and out-session)

Warm-up:	07:00 to 08:00
AM peak	period: 08:00 to 09:00

> Weekday PM (in-session and out-session)

Warm-up:	15:00 to 16:00
PM peak	period: 16:00 to 17:00

Although the in-session and out-session network morning and afternoon peak periods were identified on different intervals, the one hour peak periods defined in Aimsun were the same to ease analysis and Aimsun file set-up.

3.3 Vehicle Type

Three vehicle types have been modelled in the Aimsun microsimulation model and they are:

- Light vehicles (cars)
- Heavy vehicles (trucks); and
- Buses.

Default values of vehicle type parameters (e.g. vehicle dimensions and driving behaviour) from Sydney Aimsun Foundation Network (SAFN) were utilised for this modelling exercise.

3.4 Road Types

The road types used within the study area are consistent with the Sydney Aimsun Foundation Network (SAFN). The model road types and associated typical parameters adopted within the Keiraville-Gwynneville microsimulation model includes the following road types:

	Road Types Used in the Model					
	Local Road	Sub-arterial	Arterial (Divided)	Arterials (Undivided)	Freeway Ramp	Freeway
Maximum Speed (km/h)	40 – 50	60	60	60 – 80	45 – 80	80 – 110
Capacity (per lane) (PCUs/h)	800 – 900	900 – 1,000	1,000 –1,200	1,200 –1,400	1,000 –1,500	1,800 –2,000

3.5 Model Road Network Extent

The microscopic model covers approximately 8.37 km² within the Keiraville and Gwynneville precinct. The model was developed at microscopic level with finer detail accounting for many of the minor local roads within the study area. The Aimsun microscopic model road network coverage is presented in **Figure 3-1**.

Figure 3-1 Road Network in Model Study Area

3.6 Slope Modelling

The effect of grade on heavy vehicle types can result in speed reduction. Slope modelling and its use is required on gradients in excess of 3% where there are significant volumes of heavy vehicles or for high speed roads. The Queensland Department of Transport and Main Roads, Road Planning and Design Manual, Chapter 12 (2012) highlights the expected behaviour of light and heavy vehicles when slope modelling is considered in traffic studies (see **Table 3-1)**.

For consistency, Cardno used LiDAR grid elevation data and imported slopes into the base model to be used during the dynamic simulations. This allows slope modelling in AIMSUN to reflect the real-world effects of gradients, particularly in relation to heavy vehicles.

Table 3-1 Effect of Grade on Vehicle Speed

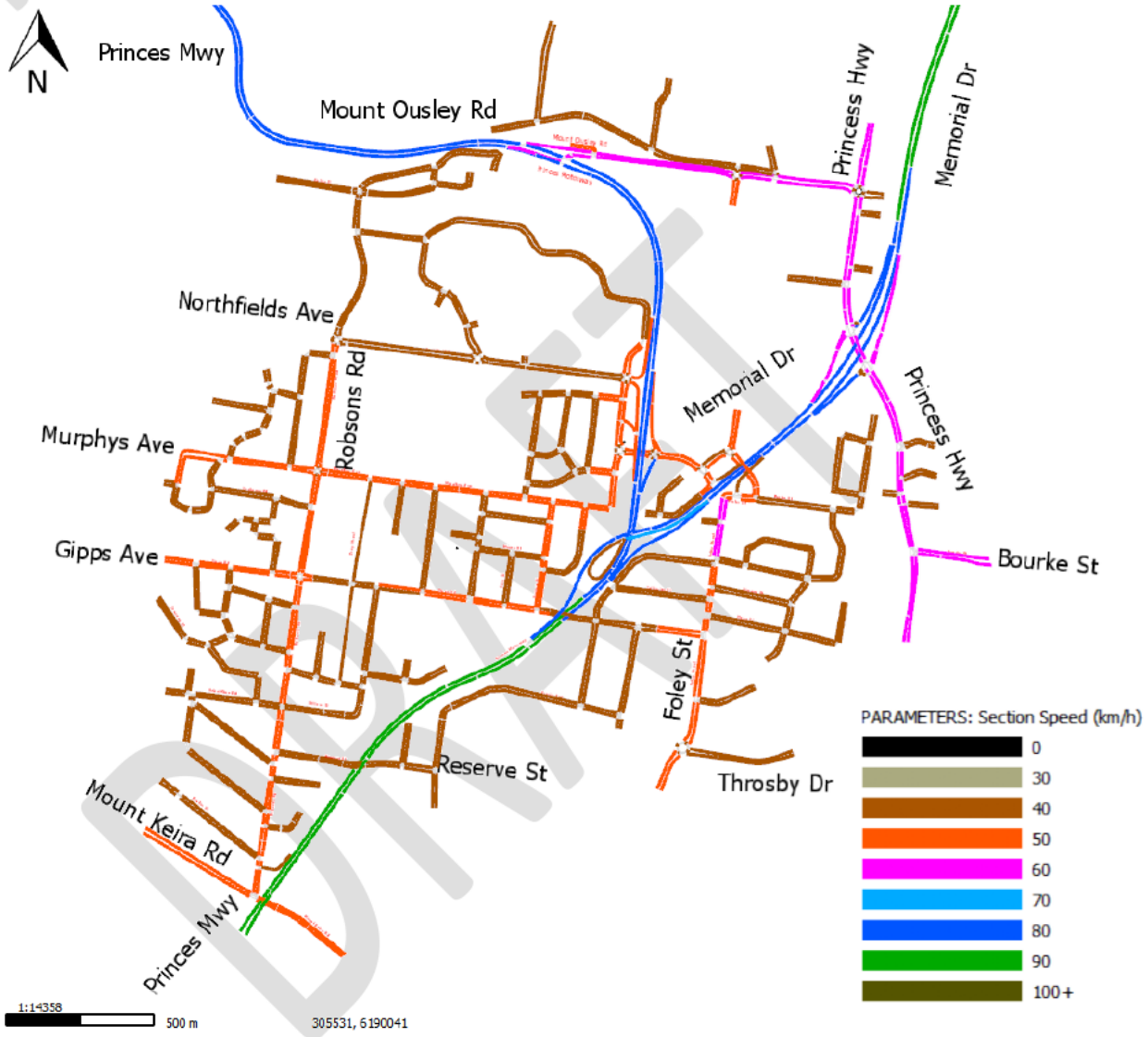
Reduction in Vehicle Speed compared to Flat Grade					
Grade	Uphill		Downhill		Road Type Suitability
	Light Vehicle	Heavy Vehicle	Light Vehicle	Heavy Vehicle	
0-3	Minimal	Minimal	Minimal	Minimal	For use on all roads.
3-6	Minimal	Some reduction on high speed roads	Minimal	Minimal	For use on low- moderate speed roads (incl. high roads traffic volume roads).
6-9	Largely unaffected	Significantly slower	Minimal	Minimal for straight alignment. Substantial for winding alignment.	Need to provide auxiliary lanes for moderate – high traffic volumes. Need to consider run-away vehicle facilities if the number of commercial vehicles is high.
9-12	Slower	Much slower	Slower	Significantly slower for straight alignment. Much slower for winding alignment.	Satisfactory on low volume roads (very few or no commercial vehicles).
12-15	10 – 15 km/h slower	15% max. negotiable	10 – 15 km/h slower	Extremely slow	Only to be used in extreme cases and be of short lengths (no commercial vehicles).
15-33	Very slow	Not negotiable	Very slow	Not negotiable	

Source: Queensland Department of Transport and Main Roads, Road Planning and Design Manual, Chapter 12 (2012)

3.7 Speed Profiles

The desired speed of a vehicle is determined by the minimum of the maximum desired speed of a vehicle and the posted speed limit. The posted speed limits are shown in **Figure 3-2**.

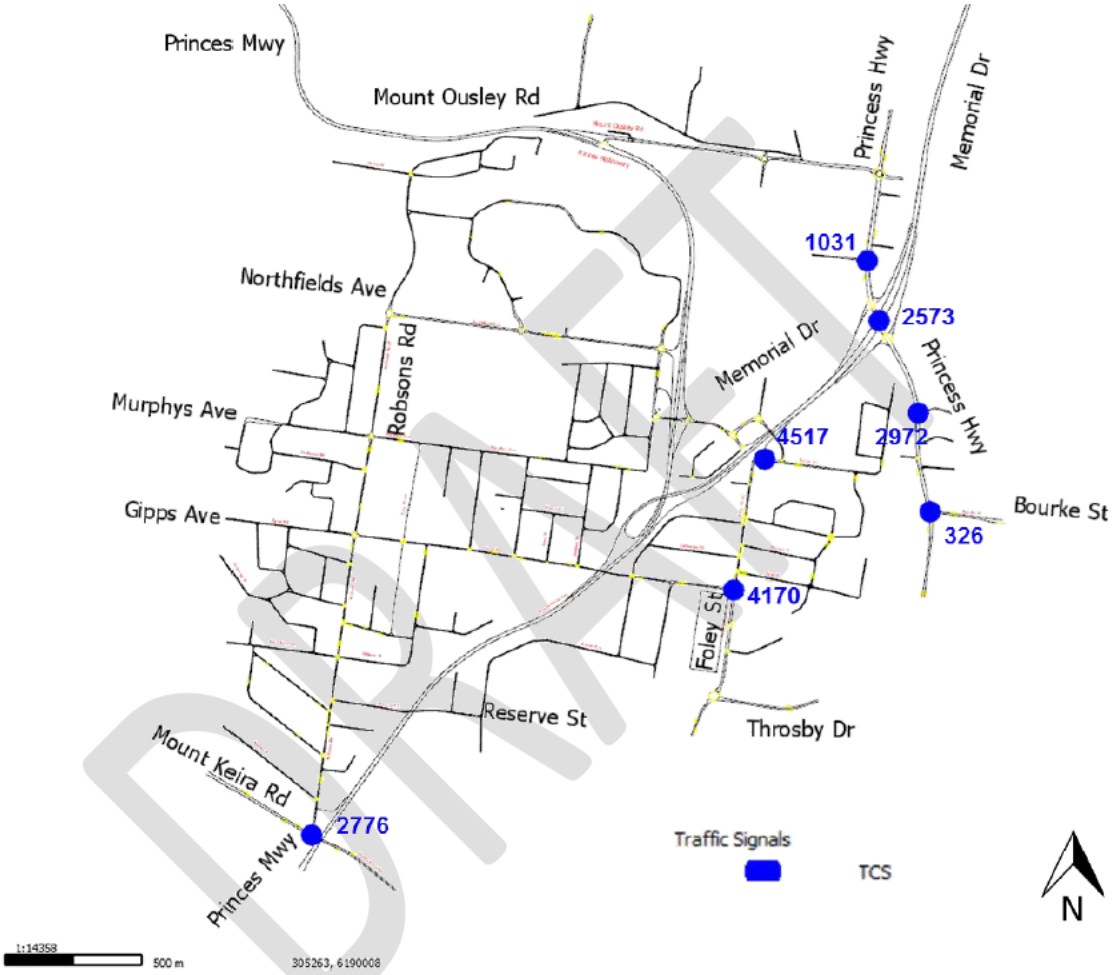
Figure 3-2 Posted Speeds in the Model Study Area



3.8 Traffic Signals

There are 7 signalised intersections within the Keiraville and Gwynneville study area as shown in **Figure 3-3**. These signalised intersections are implemented in Aimsun using historical Intersection Diagnostic Monitor (IDM) data obtained from the Sydney Coordinated Adaptive Traffic System (SCATS). The SCATS Traffic Control Signal (TCS) plans are used in conjunction with the IDM data to determine the phase times associated with each traffic signal phase.

Figure 3-3 Signalised Intersection Locations in the Model Study Area



The TCS IDs found at the labelled intersections in **Figure 3-3** are summarised in **0**

Table 3-2 TCS IDs

TCS ID	Intersection
1031	Lysaghy Street / Princes Highway
2573	Princes Highway / Memorial Drive
2972	Princes Highway / Ajax Avenue
326	Princes Highway / Bourke Street
4517	Memorial Drive Off Ramp / Porter Street
4170	Foley Street / Gipps Road
2776	Robsons Road / Mount Keira Road

The signalised intersections within the study area were implemented in the microsimulation model as fixed time. These signalised intersections were based on the Roads and Maritime Mount Ousley REF (2015) Traffic Model which were developed based on the SCATS average signal timing.

3.9 Bus Network

3.9.1 Public Transport Services and General Transit Feed Specification (GTFS) Data

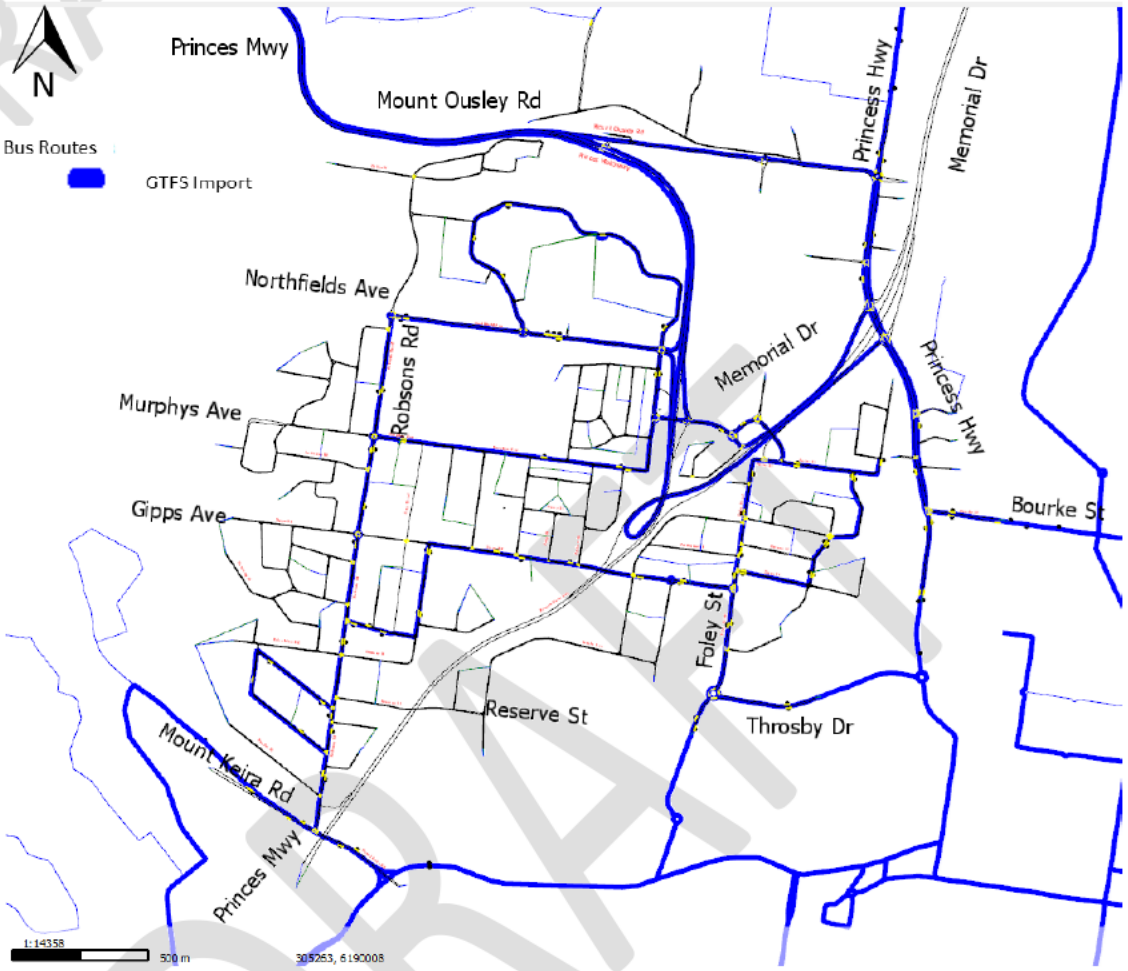
The purpose of the GTFS bus timetable feed is to publish, in advance, the schedules and route information of Bus services that operate under the Sydney Metropolitan, Outer Sydney Olympic Park Major Events Bus Contracts, Sydney NightRide and Sydney Olympic Park Major Events Bus Contracts.

GTFS data is typically used for TfNSW Transport Info, Realtime transport app developers and online map services (e.g. Google Maps and Apple Maps). GTFS data is provided in nine (9) data files:

- Agency.txt – Defines one or more transit agencies (Operators) that provide the data in this feed
- Calendar_dates.txt – Defines exceptions for the service IDs defined in the calendar.txt file
- Calendar.txt – Defines dates for service IDs using a weekly schedule. It also provides the start and end dates as well as the days of the week the service is available
- Routes.txt – Defines transit routes
- Shapes.txt – Defines rules for drawings lines on a map to represent a transit organisation's routes
- Stop_times.txt – Provides the times that a vehicle arrives at and departs from individual stops for each trip
- Stops.txt – Provides individual locations where vehicles pick up or drop off passengers
- Trips.txt – Provides the trips for each route. A trip is a sequence of two or more stops that occurs at a specific time
- Notes.txt – This file is an extension on the GTFS Fileset standard. It contains a list of notes referenced from trips.txt and stop_times.txt.

To utilise this data, Aimsun has incorporated a GTFS importing function in their latest version of Aimsun (v8.2). To incorporate the data into the base model, GTFS data from September and August 2017 was sourced from TfNSW and imported into the base model to match the model area extents. **Figure 3-4** highlights in blue the bus routes coded in Keiraville-Gwynneville microscopic which is overlayed with the modelled road network.

Figure 3-4 Bus Routes in the Model Study Area



3.10 Model Zoning System

The Roads and Maritime Services' TRACKS model referred on *Traffic Modelling for the Proposed Interchange at Mt Ousley Road on the M1 Princes Motorway, Roads and Maritime Services, 2015,* was reviewed to understand the strategic level zoning structure within this area. The *Roads and Maritime Services Mount Ousley REF (2015) Traffic Model* Aimsun file was also used as reference, to preserve the Mount Ousley Aimsun model existing centroid configuration.

Further zone disaggregation process was carried out to ensure traffic was accurately allocated to specific locations in the Keiraville and Gwynneville study precinct model but still respecting Aimsun and TRACKS naming conventions according to Roads and Maritime guidelines. The Keiraville and Gwynneville microsimulation model was completed with a total 77 child travel zones after further disaggregation of the 41 parent travel zones identified in the Roads and Maritime Mount Ousley REF (2015) Traffic Model.

Table 3-3 summarises the zoning system in the models, their disaggregation in the Keirvaville-Gwyneville traffic models and their description.

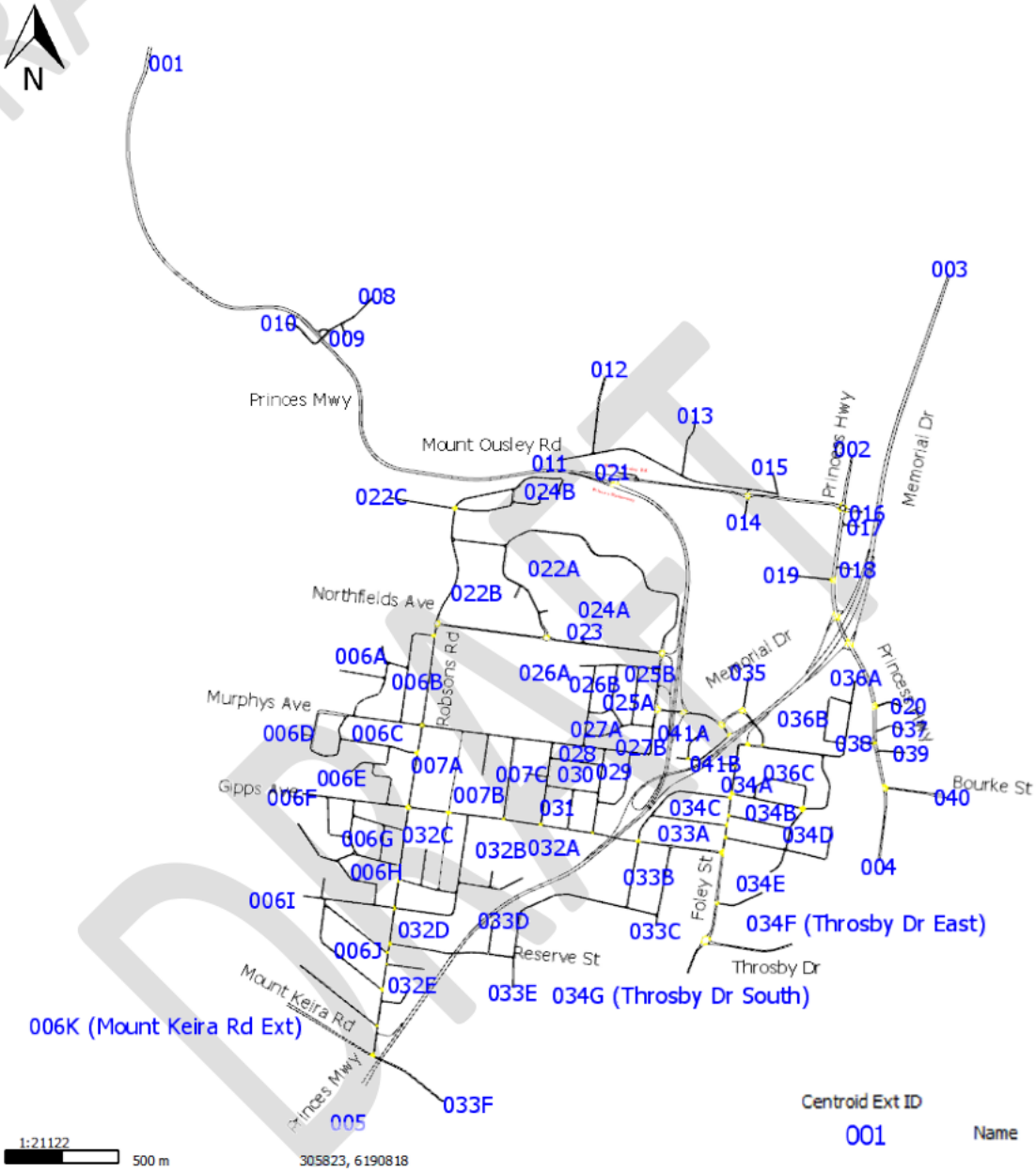
Table 3-3 Model Zoning System Description

Parent Zone	Child Zones	Description	Parent Zone	Child Zones	Description
1	1	Princes Motorway north of Mt Pleasant Road	22	3	Ring Road north of Northfields Avenue
2	1	Princes Highway north of Mt Ousley Road	23	1	Car park north of Northfields Avenue
3	1	Memorial Drive north of Princes Highway	24	2	Ring Road east north of Northfields Avenue
4	1	Princes Highway south of Bourke Street	25	2	Madoline Street west of Princes Highway
5	1	Princes Motorway south of Gipps Road	26	2	Paulsgrove Street north of Murphys Avenue
6	11	Murphys Avenue west of Paulsgrove Street	27	2	Spearing Parade west of Princes Highway
7	3	Northfields Avenue east of Ring Road	28	1	Gwynne Street west of Eastern Street
8	1	New Mt Pleasant Road north of Princes Motorway	29	1	Waitangi Street south of Murphys Avenue
9	1	Dobinson Street east of New Mt Pleasant Road	30	1	Moore Street west of Eastern Street
10	1	New Mt Pleasant Road south of Princes Motorway	31	1	Fairy Street north of Gipps Road
11	1	Dumfries Avenue west of Foothills Road	32	5	Gipps Road west of Fairy Street
12	1	Foothills Road north of Dumfries Avenue	33	6	Gipps Road east of Eastern Street
13	1	McMahon Street north of Dumfries Avenue	34	7	Foley Street south of Porter Street

Parent Zone	Child Zones	Description	Parent Zone	Child Zones	Description
14	1	Gaynor Avenue south of Mt Ousley Road	35	1	Foley Lane north of University Avenue
15	1	Strone Avenue north of Mt Ousley Road	36	3	Porter Street east of University Avenue
16	1	Mt Ousley Road east of Princes Highway	37	1	Exeter Avenue east of Princes Highway
17	1	Woodhill Street east of Princes Highway	38	1	Station Street west of Princes Highway
18	1	Woodhill Street south east of Princes Highway	39	1	Achilles Avenue east of Princes Highway
19	1	Lysaght Street west if Princes Highway	40	1	Bourke Street east of Princes Highway
20	1	Ajax Avenue east of Princes Highway	41	2	Graham Avenue west of University Avenue
21	1	Car park north of Mount Ousley Road			

The key external zones remain as the ones from the Princes Motorway, the Princes Highway, Memorial Drive, Mount Keira Road, Bourke Street and Throsby Street. All the minor streets (including the car parks) within the defined study area were included as the connection between the major roads and the local traffic demand zones such as the University of Wollongong, TAFE, commercial and the residential precincts in Keiraville and Gwynneville areas. The Keiraville and Gwynneville Aimsun microsimulation model centroid configuration layout is illustrated in **Figure 3-5**.

Figure 3-5 Centroid Configuration Layout in the Model Study Area



3.11 Behaviour Parameters

Vehicle behaviour parameters were adopted from the calibrated Roads and Maritime Services Mount Ousley REF (2015) Traffic Model and SAFN default settings.

3.12 Traffic Demand Development

The demand estimation for the study area relied on Roads and Maritime Services Mount Ousley REF (2015) Traffic Model for Keiraville - Gwynneville Microsimulation Study. More information on the base demand and modelling approach can be found in *Traffic Modelling for the Proposed Interchange at Mt Ousley Road on the M1 Princes Motorway, Roads and Maritime Serivces, Appendix B – Model development, calibration and validation, 2015*

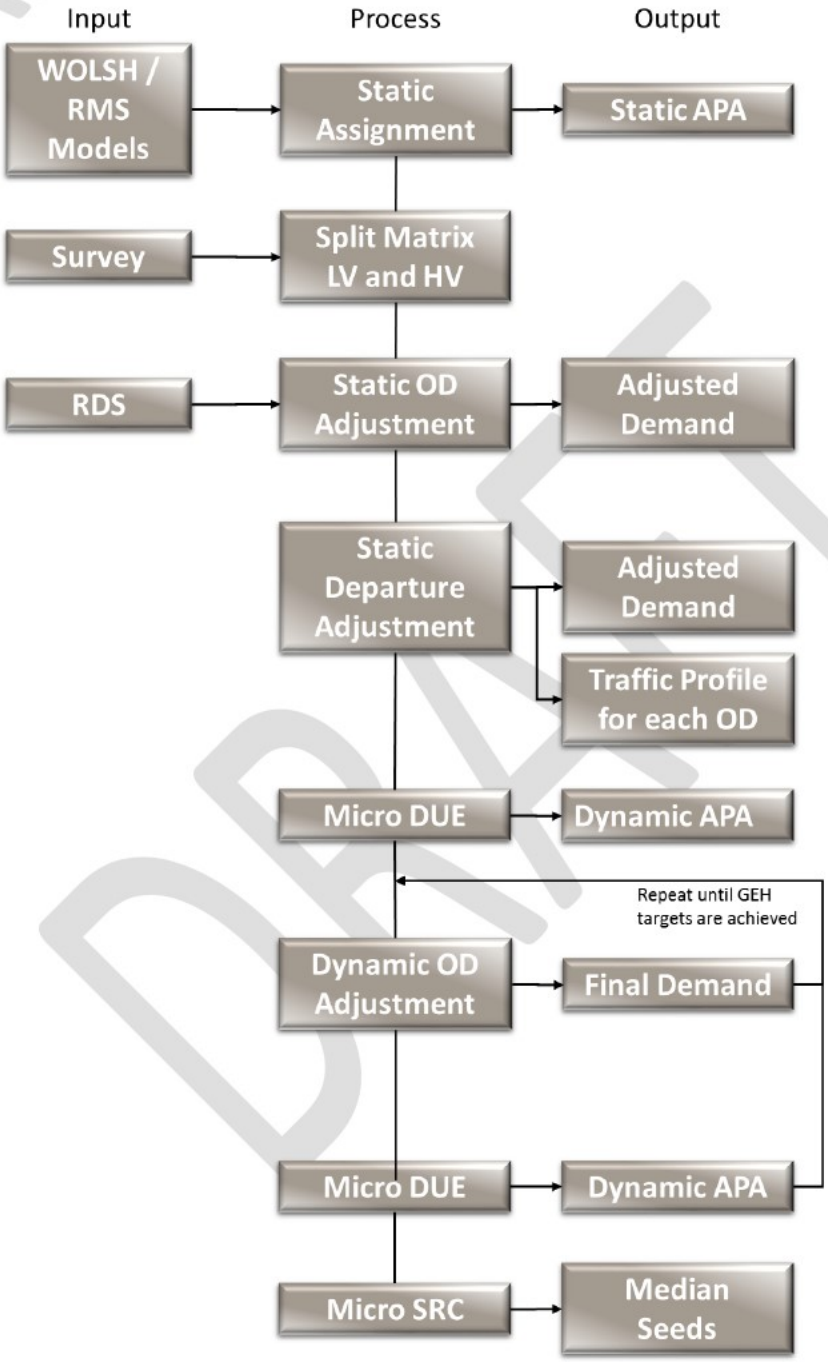
Four (4) base models were developed (in-session / out-session & AM / PM) with respective demand estimation and calibration process undertaken separately. This used the 2015 AM and PM peak one hour matrices for cars, trucks and heavy trucks derived from the Roads and Maritime Services Mount Ousley REF (2015) Traffic Model. This formed the base pattern matrix for demand adjustment undertaken in Aimsun.

The methodology for the development of the trip demand matrices for each of the modelled periods and its adjustments are detailed below.

- Static assignment of strategic model demand to the Keiraville - Gwynneville network.
- Static Assignment Adjustment: Further development and demand estimation was undertaken using static equilibrium assignment. This was used to calibrate the initial traffic demand (derived hourly matrices demands to peak AM and PM peak periods and initially constant over time) across the entire network and provide a starting point for more detailed microscopic simulation.
- Manual Adjustment: Matrices were then restructured to fit the microscopic model zone system. This consists of analysis of turning movement counts on a network wide basis and link total comparisons between surveyed intersections. Where necessary, minor adjustments were made to balance trip totals between intersections for the base year. This also consisted of vehicle type demand aggregation (i.e. heavy trucks and trucks combined) and splits review according to observed traffic composition (e.g. heavy vehicles and light vehicles only) of the study area using 2017 traffic surveys information dated of August (in-session) and September (out-session)
- Departure Time Adjustment: Traffic demand release profiles were applied to dispense traffic demands in defined time intervals over the model periods. These profiles were developed based on the traffic survey data which was collated in 15 minute intervals (refer to Traffic Profile section for traffic demand release percentages of the two-hour trip demand matrices).
- Dynamic Traffic Assignment Adjustment: The resulting sliced trip demand matrices from the departure adjustment process were applied to the model and an iterative loop of testing and matrix refinement undertaken to achieve an appropriate level of model calibration.

Figure 3-6 summarizes the demand estimation process and all steps used within the Aimsun platform.

Figure 3-6 Demand Estimation and Adjustment Process



As stated in the previous section, the model covers the weekday AM and PM peak periods including a warmup period of one hour to generate sufficient demand on the network at the start of each analysis period.

Figure 3-7 to **Figure 3-10** presents the AM and PM network traffic demand profiles respectively.

Figure 3-7 In-session - AM Network Traffic Demand

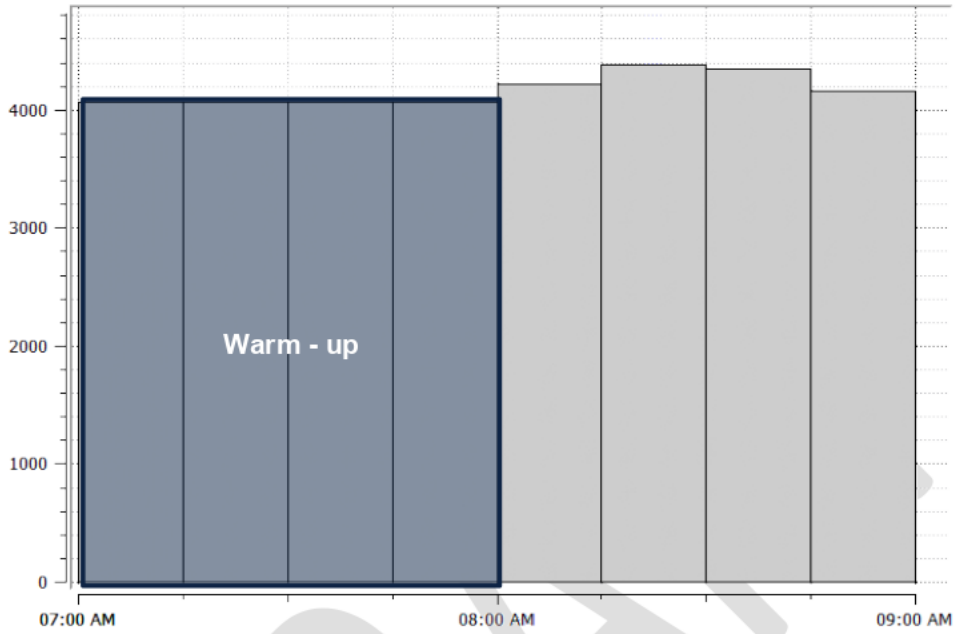


Figure 3-8 In-session - PM Network Traffic Demand

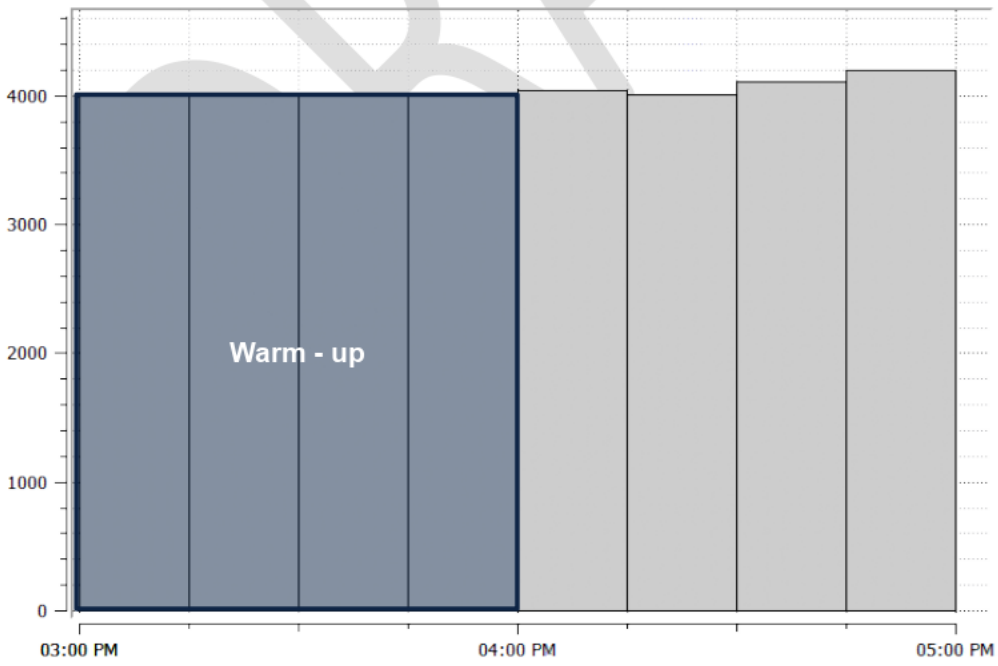


Figure 3-9 Out-session - AM Network Traffic Demand

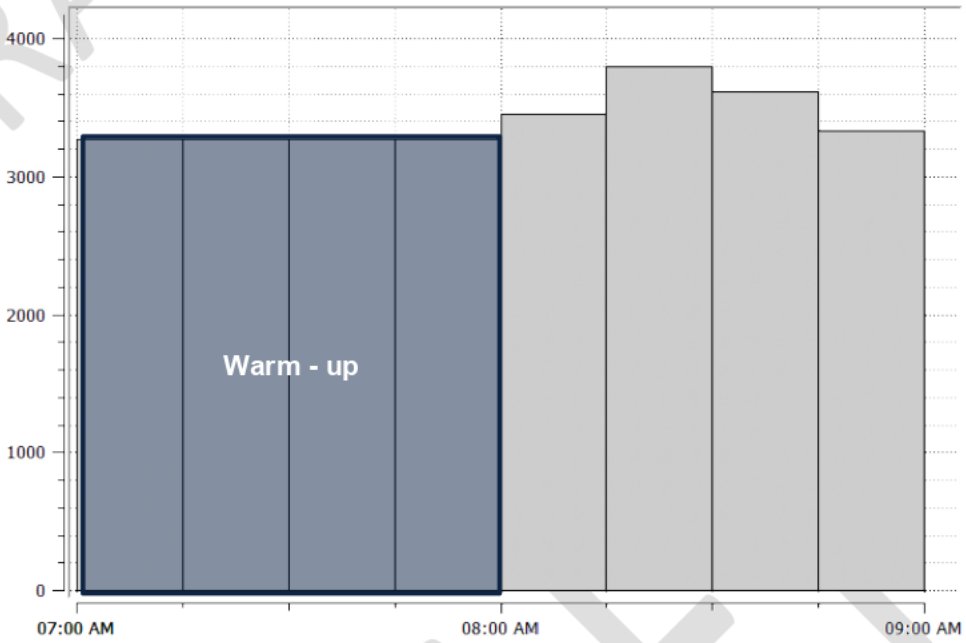
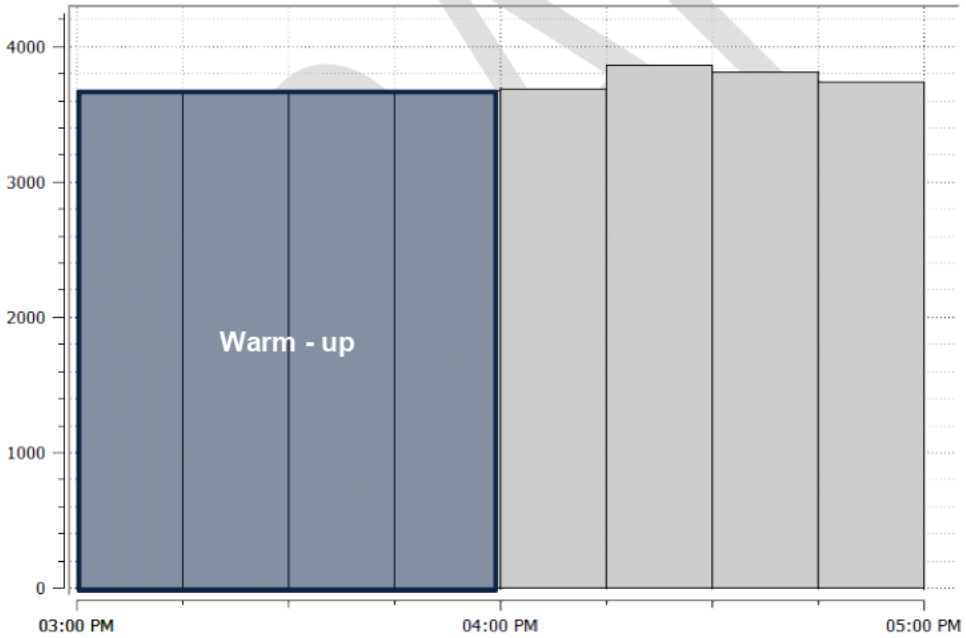


Figure 3-10 Out-session - PM Network Traffic Demand



A quick assessment of the in-session and out-session traffic demands shows that during the morning peak (08:00AM to 09:00AM), there are more trips (17,000 trips) during academic season than non-academic season (14,000), which consist of around 20% difference.

The traffic demand also shows an increase of roughly 10% more trips when comparing academic season (16,300 trips) to non-academic season (15,000 trips) during the afternoon peak (04:00PM to 05:00PM).

It was also identified through the travel demand patterns that during academic season there are more trips within the model area being completed during the morning peak than afternoon peak. In contrast, there are more trips completed during the afternoon peak than morning peak for the non-academic season.

3.13 Assignment Type

After static assignment and adjustments two assignment methods were mainly used in the microsimulation model and are summarised in **Section 3.13.1** and **Section 3.13.2.**

3.13.1 Dynamic User Equilibrium Assignment

The dynamic user equilibrium (DUE) assignment is a form of traffic assignment that uses an iterative process to determine the traffic flows across the network based on the costs of travel routes between origin and destination (OD) pairs derived in previous iterations until it converges to an equilibrium state.

The underlying principle for this assignment is that travellers will try to minimise their individual travel times and travel on the route which they perceive to be the shortest path in their traffic conditions. In order for a dynamic user equilibrium to be achieved, the travel times of each OD pair for vehicles departing at the same time on all used routes are equal and less than any unused route experienced by a single person (Ran and Boyce's dynamic version of Wardrop's user equilibrium).

3.13.2 Stochastic Route Choice Assignment

The stochastic route choice (SRC) assignment is based on discrete route choice models or on a user-defined assignment. The discrete route choice models are based on discrete choice theory and emulates a driver's decision of selecting a path from those that are available.

This model utilises probability for choosing alternative paths from those available as a function of disutility, which is often travel time or travel cost.

In the Keiraville-Gwynneville base model, paths are provided from the DUE assignment and route choice is set to follow 80% of the DUE paths and the remaining 20% to follow the SRC assignment.

4 Model Stability

The stochasticity of a micro-simulation model can cause instability in the model, which can undermine the reliability of the model to forecast future traffic conditions. Thus, it is important to develop a base model that is stable and has an appropriate degree of accuracy for future options assessment. To determine the stability of a model, a total of 5 seed values and the default time-step value in Aimsun are initially used, as recommended by the *Traffic Modelling Guidelines* to iteratively determine the required number of runs.

The statistic chosen as a summary measure to determine the model's stability is the vehicle hours travelled (VHT). The VHT results are a single figure summary used as an indication of the whole network performance by identifying whether or not the model has unrealistic gridlocks and excessive delays. VHT consists of the sum of travel time for every single vehicle across the whole network and therefore can identify congestion within a network.

In Aimsun, VHT is calculated only for the vehicles which were able to complete the respective trips from origin to destination. Any vehicles remaining in the system during the simulation period are excluded from the total system travel-time as they are unable to generate a complete travel time.

The number of seed runs required to determine the stability of the model is calculated iteratively by:

$$N = \left(\frac{t\sigma}{\Delta}\right)^2$$

Where:

N = number of runs

t = two-tailed inverse of Student's t-distribution

σ = standard deviation

Δ = acceptable error (precision multiplied by sample mean)

The number of simulation runs required is below the initial 5 seeds used, therefore it is sufficient to retain the initial 5 seeds for a confidence interval of 95%.

The results of the VHT stability for the AM and PM peak are summarised in **Table 4-1**.

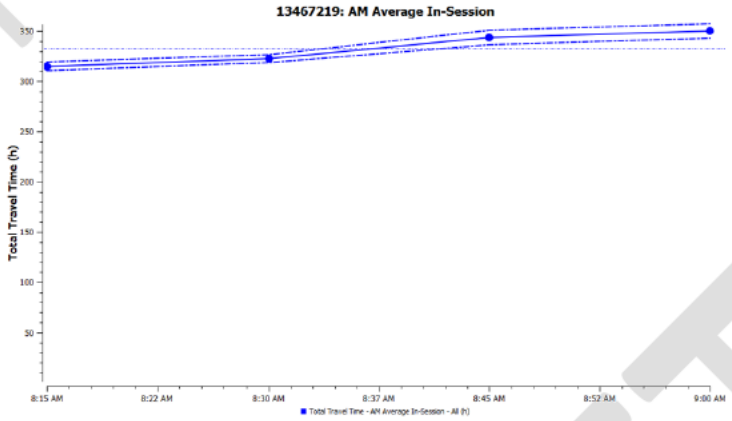
Table 4-1 Number of Simulation Runs Required

Parameter	In-Session Models		Out-Session Models	
	AM	PM	AM	PM
t	2.776	2.776	2.776	2.776
σ	25.003	50.718	13.428	24.557
Δ	67.090	63.629	54.118	59.663
N	1.070	4.896	0.474	1.305

The VHT during the AM and PM models are consistent and independent across different 5 seed values, which confirms that one seed value for the model runs can be representative of a general model run. On this basis, the peak hour models are considered stable and show the model remains robust under varying conditions and can be used to reliably forecast future scenarios.

The average total travel time is illustrated in **Figure 4-2** and **Figure 4-3** for the in-session period, and **Figure 4-4** and **Figure 4-5** for the out-session period.

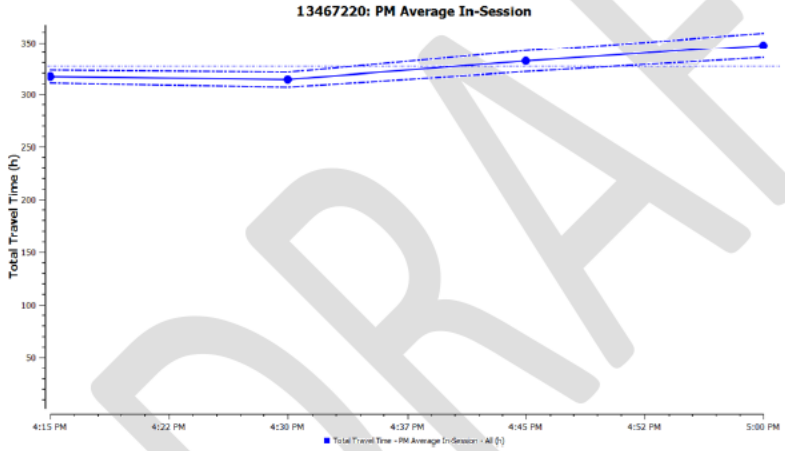
Figure 4-2 Average AM In-session Vehicle Hours Travelled



Time	Vehicle Hours Travelled (VHT)	5 Seeds Standard Deviation
8:15	315.04	4.50
8:30	322.90	4.02
8:45	343.52	7.21
9:00	350.08	7.32

The aggregated vehicle hours travelled is 1331.34 and the mean vehicle hours travelled is 332.89.

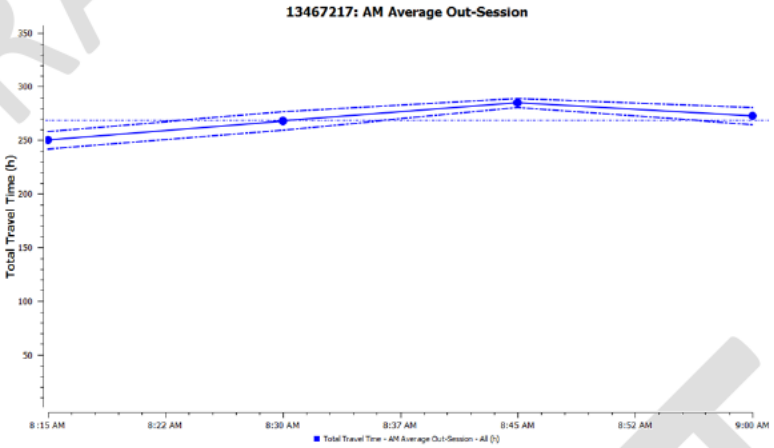
Figure 4-3 Average PM In-session Vehicle Hours Travelled



Time	Vehicle Hours Travelled (VHT)	5 Seeds Standard Deviation
4:15	316.61	6.11
4:30	313.70	7.04
4:45	331.34	10.12
5:00	346.84	11.79

The aggregated vehicle hours travelled is 1308.48 and the mean vehicle hours travelled is 327.12.

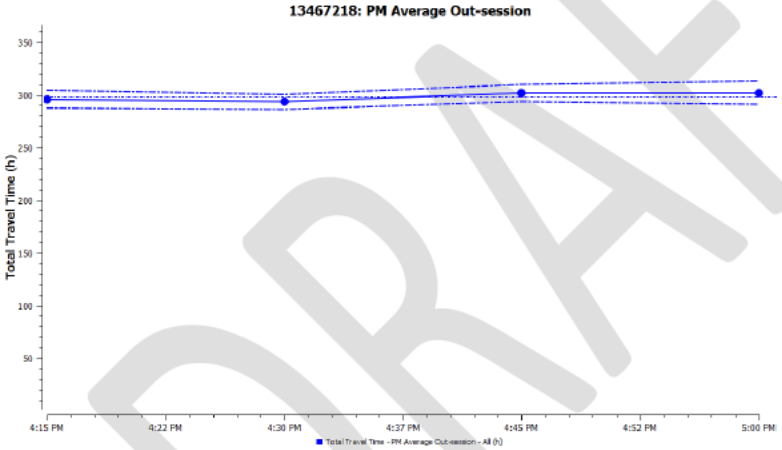
Figure 4-4 Average AM Out-session Vehicle Hours Travelled



Time	Vehicle Hours Travelled (VHT)	5 Seeds Standard Deviation
8:15	250.09	8.07
8:30	267.88	8.51
8:45	284.91	4.03
9:00	272.94	7.91

The aggregated vehicle hours travelled is 1075.83 and the mean vehicle hours travelled is 268.96.

Figure 4-5 Average PM Out-session Vehicle Hours Travelled



Time	Vehicle Hours Travelled (VHT)	5 Seeds Standard Deviation
4:15	295.95	8.63
4:30	293.35	7.17
4:45	301.98	8.10
5:00	301.99	11.22

The aggregated vehicle hours travelled is 1193.26 and the mean vehicle hours travelled is 298.31.

The resulting model performance is summarised by the total vehicle hours travelled comparisons above. The general network statistics for both periods show a substantial low level of variability in the peak hours of both the AM and PM peaks. Overall, the statistical analysis of the model runs demonstrates the modelled network and output results are stable.

5 Model Calibration and Validation

This section sets out the key calibration statistics from the preparation of the base (existing conditions) model. The calibration of a base model is important to ensure a robust base from which to test options and provide statistical comparisons of existing layouts against options.

Calibration for this model has been based on the following:

- Model Convergence: Assessing the relative gap between iterations is a measure of how close the assignment is to the "optimal" equilibrium assignment
- Turn Counts: Comparing observed and modelled turning movements for general traffic over the modelled peak hour periods.

The Keiraville - Gwynneville microsimulation base model turn counts calibration has been undertaken in two stages:

- Calibration of the static assignment parameters iteratively alongside demand adjustment to ensure that the adjustment is undertaken using valid static assignment routing
- Calibration of the traffic signals, microsimulation and DUE assignment parameters.

The calibration and validation statistics are outputted from a single seed run determined as the median seed from the VHT assessment of model stability (**Table 5-1**).

Table 5-1 Median Seeds used for Calibration and Validation Results

Median Seed	In-Session Models		Out-Session Models	
	AM	PM	AM	PM
	2849	560	28	560

5.2 Calibration Criteria

A turning count calibration was used to compare observed on-site traffic volumes with equivalent outputs from the model. Turning count calibration was undertaken for each of the major intersections and the purpose of this calibration was to ensure that simulated traffic volumes in the models were representative of traffic volumes observed on site for each traffic movement at each intersection.

The calibration process was done on both a network-wide level and in the core area, each with its own criteria. The core area of the microscopic model not the entire Keiraville-Gwynneville study area and key locations will be treated as core area as per Wollongong City Council and Roads and Maritime Services advice after microscopic network wide calibration.

5.2.1 Network-Wide Calibration Criteria

The model was calibrated using the criteria provided in the modelling guidelines to ensure the model reflects the observed traffic conditions to a statistically high level of accuracy. The method of calibration recommended by the modelling guidelines is the modified Chi-Square empirical formula that Geoffrey E. Harves invented it in the 1970s, commonly known as the GEH statistic, for individual flows. The R-Square (R^2) statistical measure is used for the correlation of the entire data set.

The GEH formula is:

$$GEH = \sqrt{\frac{(V_o - V_m)^2}{0.5(V_o + V_m)}}$$

Where:

V_o is the observed traffic flow; and

V_m is the modelled traffic flow.

A GEH of 5.0 or less is considered to provide a good match between the modelled and observed traffic flows. According to the *UK Highways Agency Design Manual for Roads and Bridges (DMRB)* a model should be calibrated with at least 85% of links or turns to have a GEH no greater than 5.0.

The following criteria were used during the turning count calibration process for the whole network:

- 95% of turn and link flow comparisons with GEH less than 10
- 85% of turn and link flow comparisons with GEH less than 5
- R^2 statistics should be between 0.95 and 1.05 for a flow plot of observed vs modelled turn volumes (where R^2 = 1.0 is a perfect correlation).

5.2.2 Core Area Calibration Criteria

The following criteria is to be used during the turning count calibration process for the core area:

- Turn or link flows to be within 10 vehicles for flows <99
- Turn of link flows to be within 10% of observed values for flows between 100 and 999
- Turn or link flows to be within 100 vehicles for flows between 1000 and 1999
- Turn of link flows to be within 5% of observed values for flows >2000
- 100% of observations to be within tolerance limits
- Regression of modelled and observed counts to show R2>0.95.

5.3 Calibration Results

5.3.1 Network Wide

The network wide calibration was undertaken by comparing the modelled turn flows with observed counts at 110 locations within the study area. As described in **Section 5.2.1**, a GEH statistic of less than 5.0 is considered to be a good match when comparing the observed turning counts with modelled turning volumes. The GEH calibration statistics for the whole network is shown in **Table 5-2.**

Table 5-2 Network Wide Calibration Summary

	In-session				Out-session			
Time Period	8:00 – 9:00 AM		4:00 – 5:00 PM		8:00 – 9:00 AM		4:00 – 5:00 PM	
Vehicle Type	LV	HV	LV	HV	LV	HV	LV	HV
GEH < 5	91%	98%	87%	97%	94%	98%	92%	95%
GEH < 10	100%	100%	100%	100%	100%	100%	100%	100%
R^2	0.98	0.98	0.98	0.98	0.99	0.99	0.99	0.99

The network wide calibration results show that the model is sufficiently calibrated according to the Roads and Maritime Services *Traffic Modelling Guidelines*.

Figure 5-1 and **Figure 5-2** highlights the GEH statistics by location of the modelled peak period for the AM peak and PM peak during in-session and out-session periods respectively.

Figure 5-1 In-session AM Peak and PM Peak GEH Statistic by Location

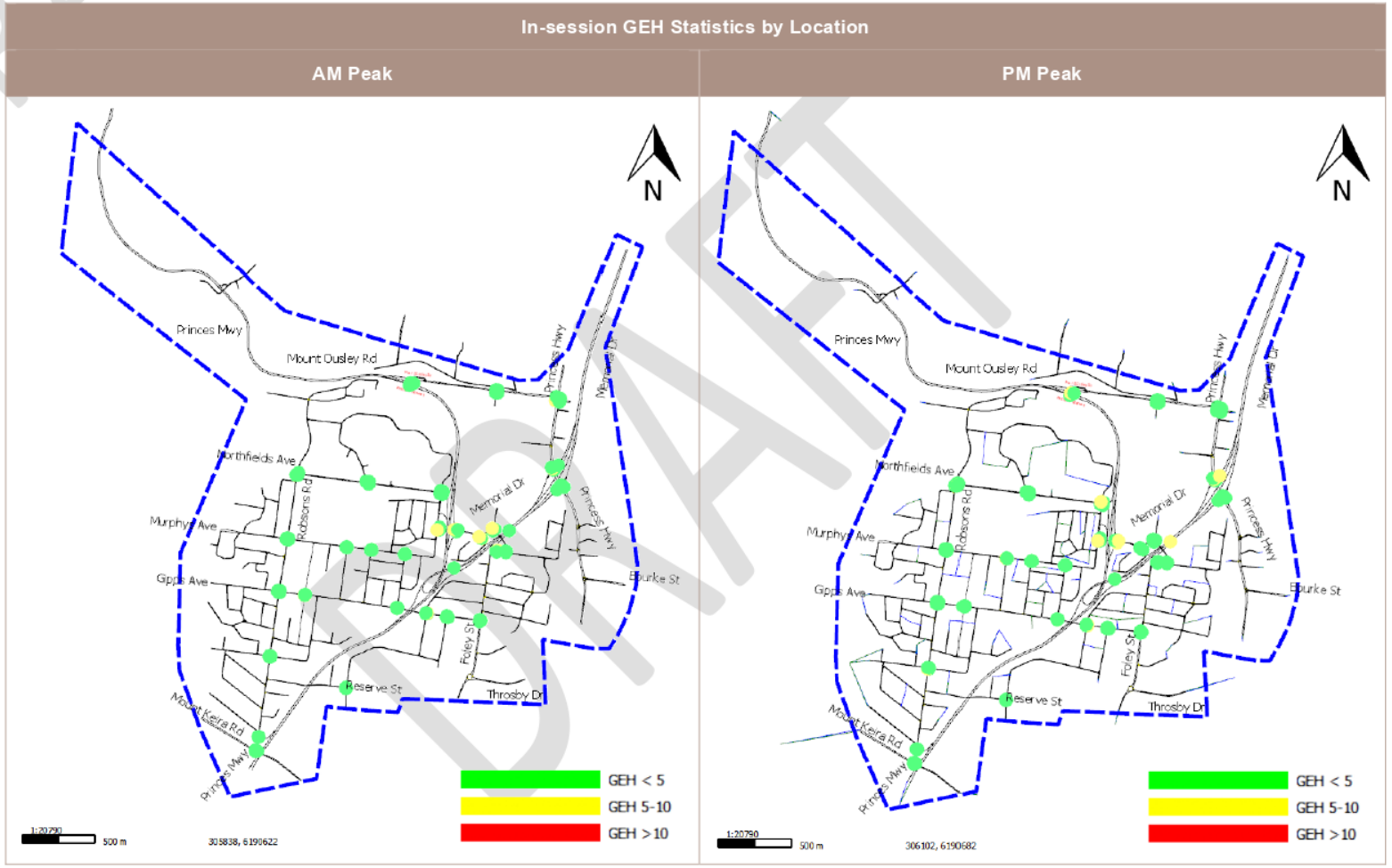


Figure 5-2 Out-session AM Peak and PM Peak GEH Statistic by Location

The turning count comparison between the observed and modelled flows are shown in **Figure 5-3** to **Figure 5-6.** The regression plots were generated with a trend line intercept of zero for the AM peak and PM peak in both in-session and out-session periods.

Figure 5-3 In-session 08:00 - 09:00 AM Regression Analysis

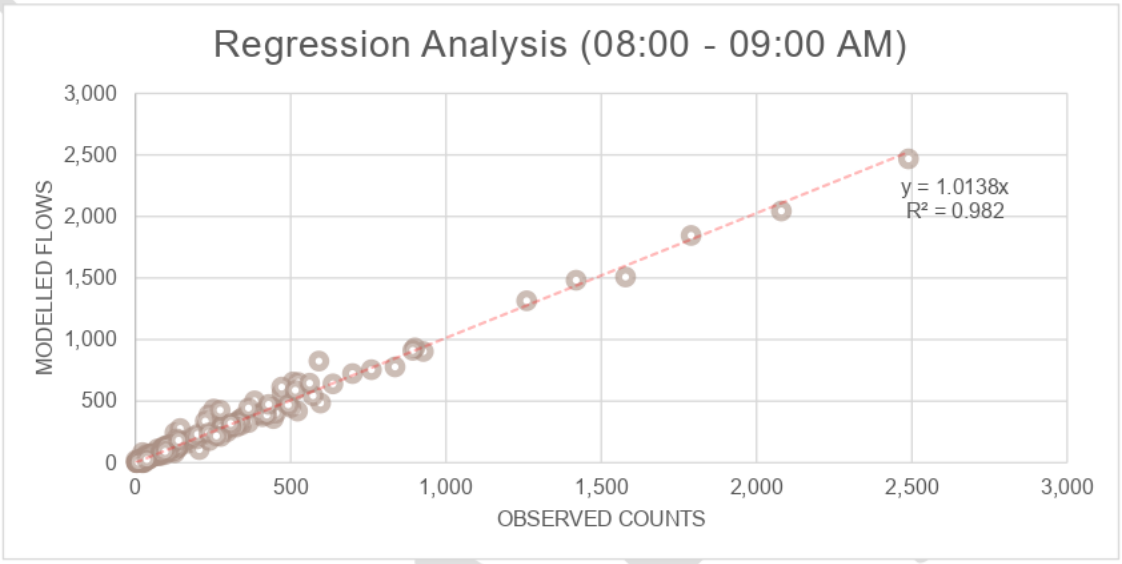


Figure 5-4 In-session 04:00 - 05:00 PM Regression Analysis

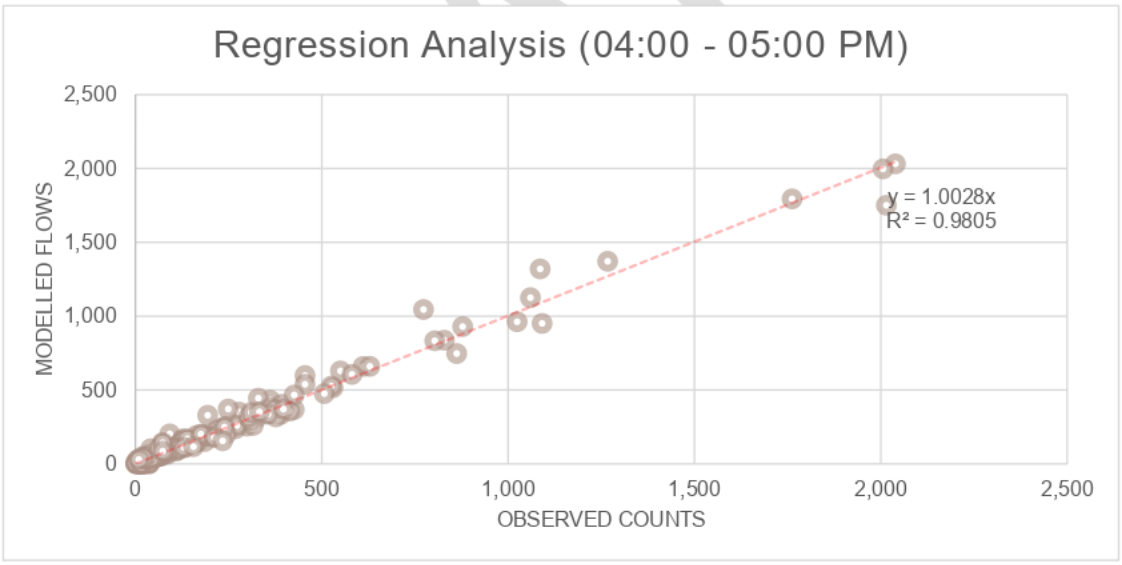


Figure 5-5 Out-session 08:00 - 09:00 AM Regression Analysis

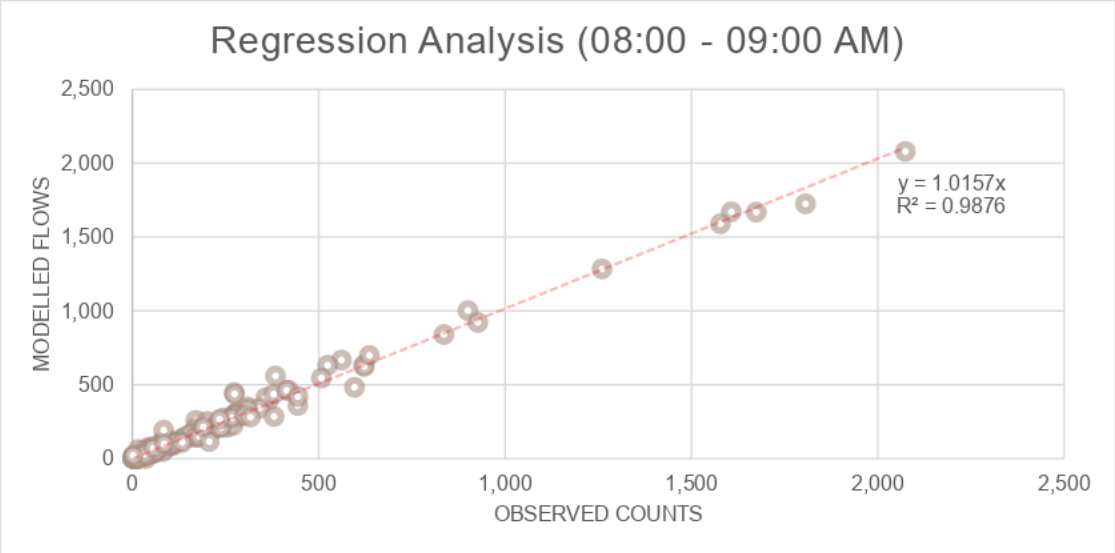
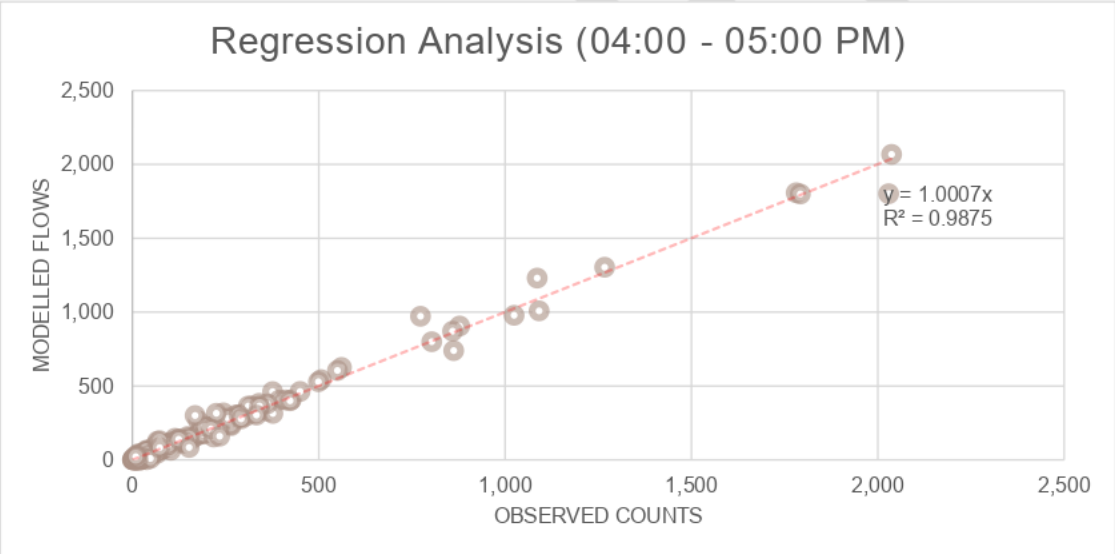


Figure 5-6 Out-session 04:00 - 05:00 PM Regression Analysis



5.4 Validation Criteria

The Roads and Maritime Services Traffic Modelling Guidelines set the travel time validation criteria for traffic models as the average modelled travel time to be within 15% or one minute (whichever is greater) of average observed travel time for full length of route for 95% of observed travel time routes.

5.5 Validation Results

Table 5-3 to Table 5-6 and Figure 5-7 to Figure 5-10 summarize travel time data extracted from Keiraville-Gwynneville microscopic model for both in-session and out-session scenarios. After identifying the median seed, the average travel times for the routes within the study area were used for the validation comparison of median travel times from TomTom journey travel time's data set and the microscopic model outputs.

Figure 5-7 In-session Travel Time box-plot for routes within study are AM peak

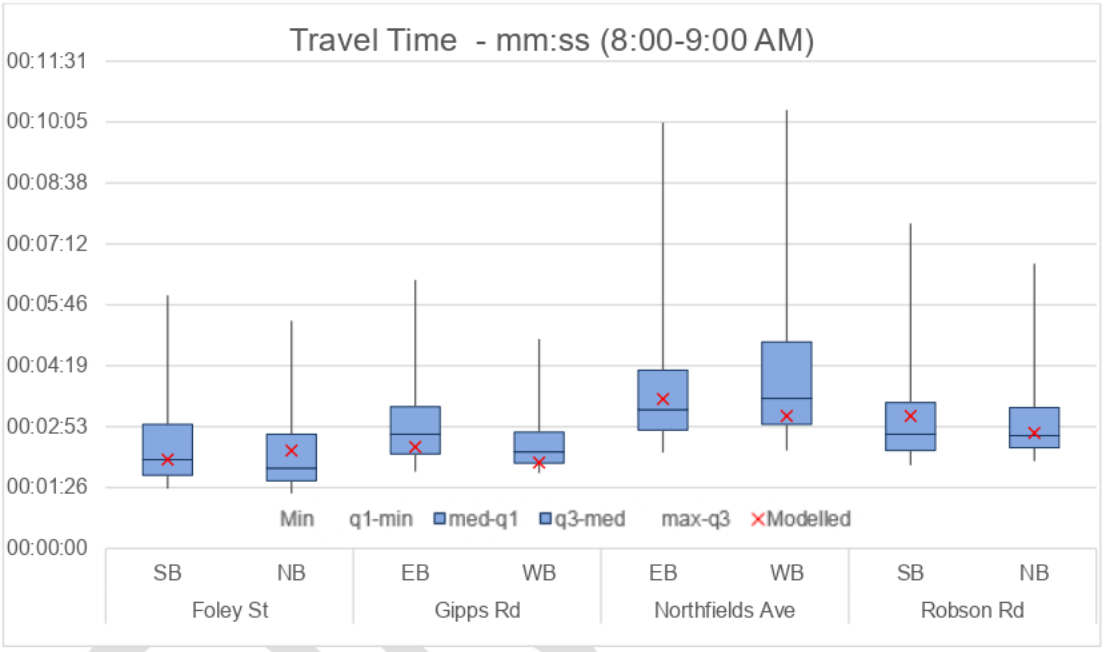


Table 5-3 In-session Travel Time Validation Results for AM peak

	08:00-9:00 AM							
	Foley St		Gipps Rd		Northfields Ave		Robson Rd	
	SB	NB	EB	WB	EB	WB	SB	NB
Min	01:25	01:18	01:49	01:47	02:16	02:19	01:58	02:04
1st Quartile	01:44	01:36	02:14	02:01	02:48	02:56	02:19	02:23
Median	02:06	01:54	02:42	02:17	03:17	03:33	02:42	02:40
3rd Quartile	02:56	02:42	03:21	02:45	04:13	04:53	03:27	03:20
Max	05:59	05:23	06:21	04:57	10:04	10:22	07:41	06:44
Modelled	02:06	02:19	02:24	02:02	03:32	03:08	03:08	02:44
Difference	00:00	00:25	00:18	00:15	00:15	00:25	00:26	00:04
Pass	✓	✓	✓	✓	✓	✓	✓	✓

Figure 5-8 In-session Travel Time box-plot for routes within study are PM peak

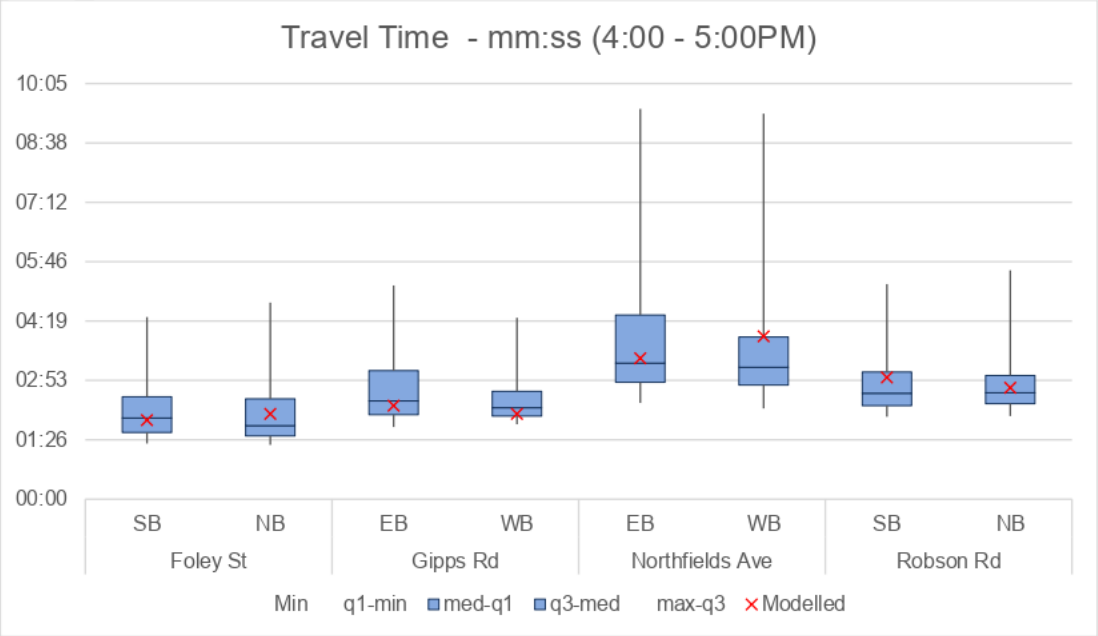


Table 5-4 In-session Travel Time Validation Results for PM peak

	04:00 - 5:00PM							
	Foley St		Gipps Rd		Northfields Ave		Robson Rd	
	SB	NB	NB	SB	EB	WB	SB	NB
Min	01:21	01:19	01:45	01:49	02:20	02:12	02:00	02:01
1st Quartile	01:37	01:32	02:03	02:01	02:50	02:46	02:16	02:19
Median	01:58	01:47	02:23	02:13	03:18	03:12	02:34	02:35
3rd Quartile	02:29	02:26	03:07	02:37	04:28	03:56	03:05	03:00
Max	04:25	04:46	05:11	04:24	09:28	09:21	05:13	05:33
Modelled	01:55	02:04	02:16	02:04	03:25	03:57	02:57	02:42
Difference	00:03	00:17	00:07	00:09	00:07	00:45	00:23	00:07
Pass	✓	✓	✓	✓	✓	✓	✓	✓

Figure 5-9 Out-session Travel Time box-plot for routes within study are AM peak

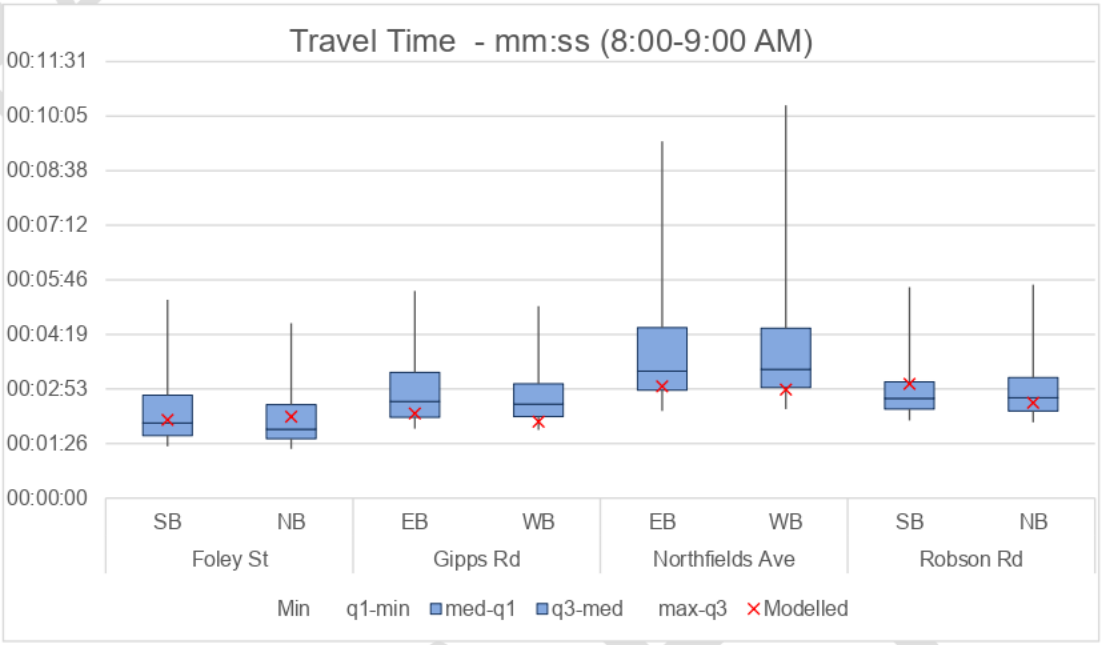


Table 5-5 Out-session Travel Time Validation Results for AM peak

	08:00-9:00 AM							
	Foley St		Gipps Rd		Northfields Ave		Robson Rd	
	SB	NB	EB	WB	EB	WB	SB	NB
Min	00:01:22	00:01:18	00:01:50	00:01:48	00:02:18	00:02:21	00:02:03	00:02:00
1st Quartile	00:01:39	00:01:34	00:02:08	00:02:09	00:02:51	00:02:55	00:02:21	00:02:18
Median	00:01:59	00:01:49	00:02:33	00:02:29	00:03:21	00:03:24	00:02:38	00:02:39
3rd Quartile	00:02:43	00:02:28	00:03:19	00:03:01	00:04:30	00:04:29	00:03:04	00:03:11
Max	00:05:14	00:04:37	00:05:28	00:05:04	00:09:25	00:10:22	00:05:34	00:05:38
Modelled	00:02:04	00:02:09	00:02:14	00:02:01	00:02:57	00:02:52	00:03:01	00:02:31
Difference	00:00:05	00:00:20	00:00:19	00:00:28	00:00:24	00:00:32	00:00:23	00:00:08
Pass	✓	✓	✓	✓	✓	✓	✓	✓

Figure 5-10 Out-session Travel Time box-plot for routes within study are PM peak

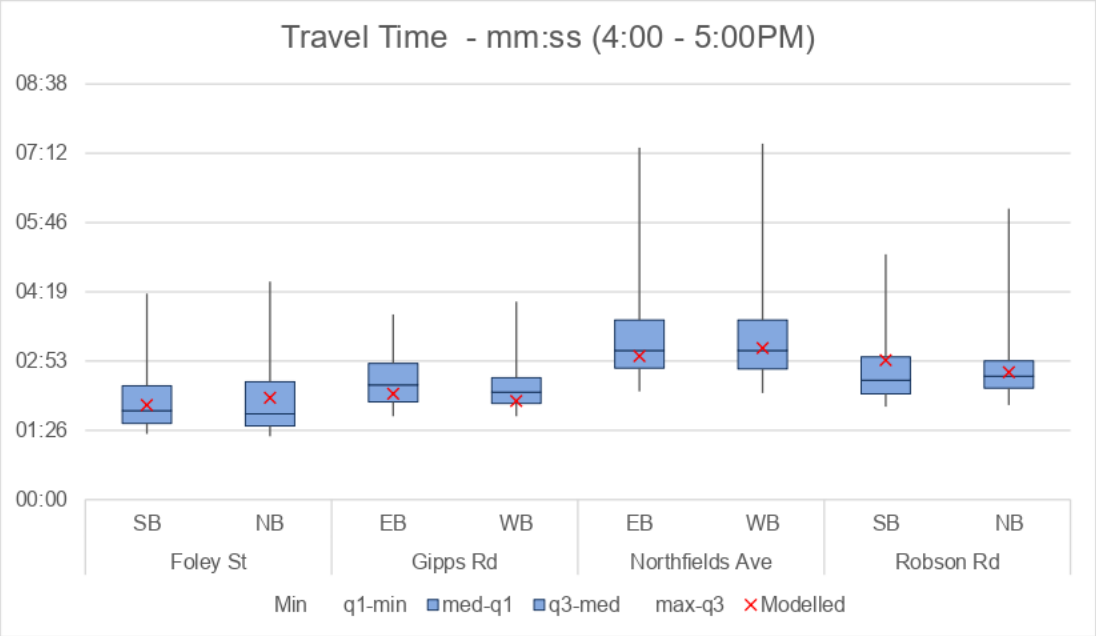


Table 5-6 Out-session Travel Time Validation Results for PM peak

	04:00 - 5:00PM							
	Foley St		Gipps Rd		Northfields Ave		Robson Rd	
	SB	NB	NB	SB	EB	WB	SB	NB
Min	01:22	01:19	01:44	01:44	02:15	02:13	01:56	01:58
1st Quartile	01:35	01:32	02:02	02:00	02:44	02:43	02:12	02:19
Median	01:51	01:47	02:23	02:14	03:06	03:06	02:29	02:34
3rd Quartile	02:22	02:27	02:50	02:32	03:44	03:44	02:58	02:53
Max	04:17	04:32	03:51	04:07	07:19	07:24	05:06	06:03
Modelled	01:58	02:07	02:12	02:03	02:59	03:09	02:54	02:39
Difference	00:07	00:20	00:11	00:11	00:07	00:03	00:25	00:05
Pass	✓	✓	✓	✓	✓	✓	✓	✓

The travel times modelled in Aimsun closely reflected the travel times recoded indicated by the TomTom data.

6 Conclusion

The Base Weekday AM and PM models, both for in-session and out-session periods, conform to Roads and Maritime Services Traffic Modelling Guidelines for microsimulation traffic modelling. The modelling results show that the models have:

- 100% of the turning counts had a GEH of less than 10
- High regression value with R2 > 0.99
- Travel time results within one minute of median observed travel times
- Stable performance amongst five seeds run
- Replicated traffic operation and behaviour at identified hotspots in the study area.

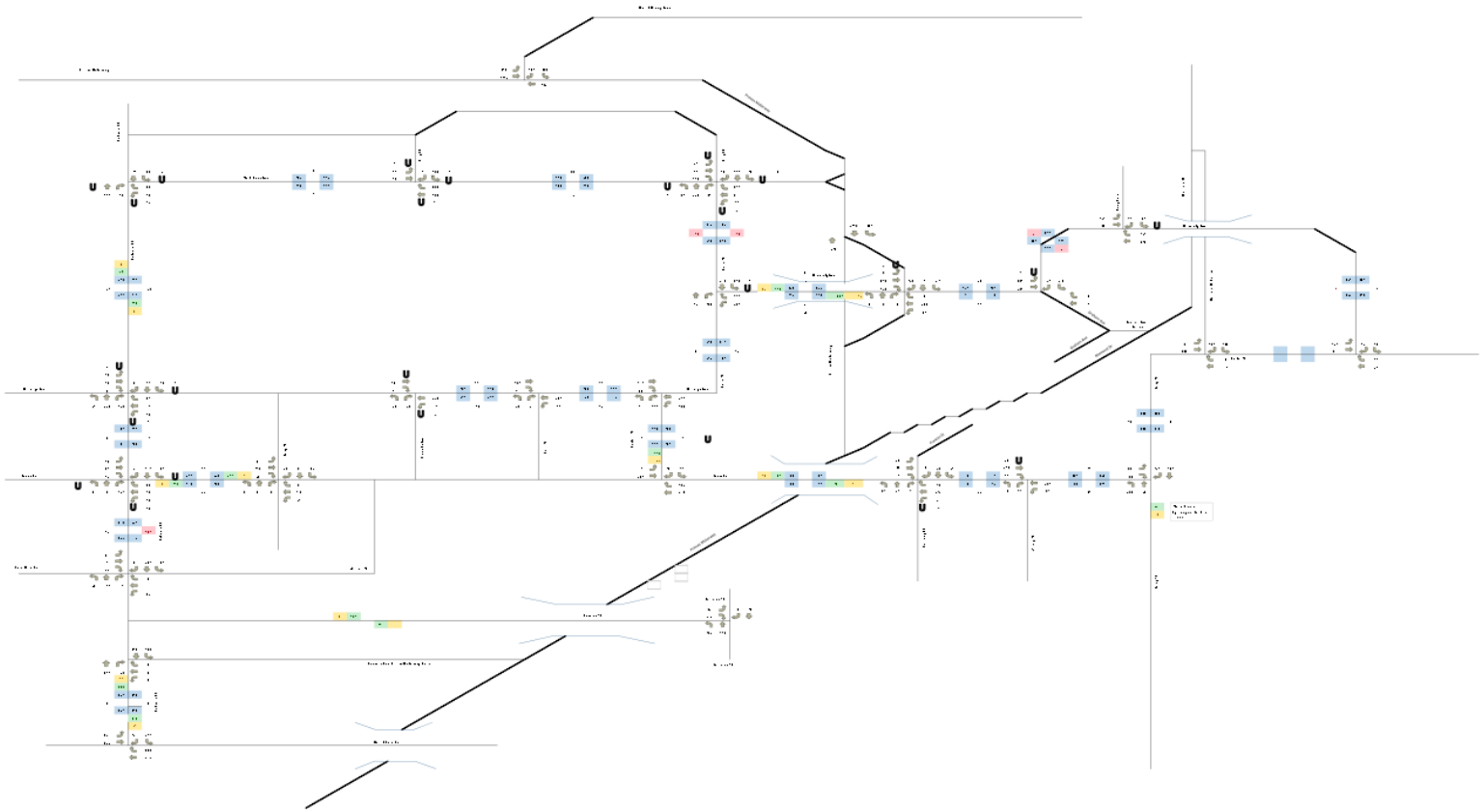
It is concluded that the four (4) peak base models appropriately reflect existing year conditions and provide a suitable basis for the development of present and long term infrastructure upgrades and subsequent performance assessment for the respective future year horizon.

Keiraville – Gwynneville Access and Movement Study

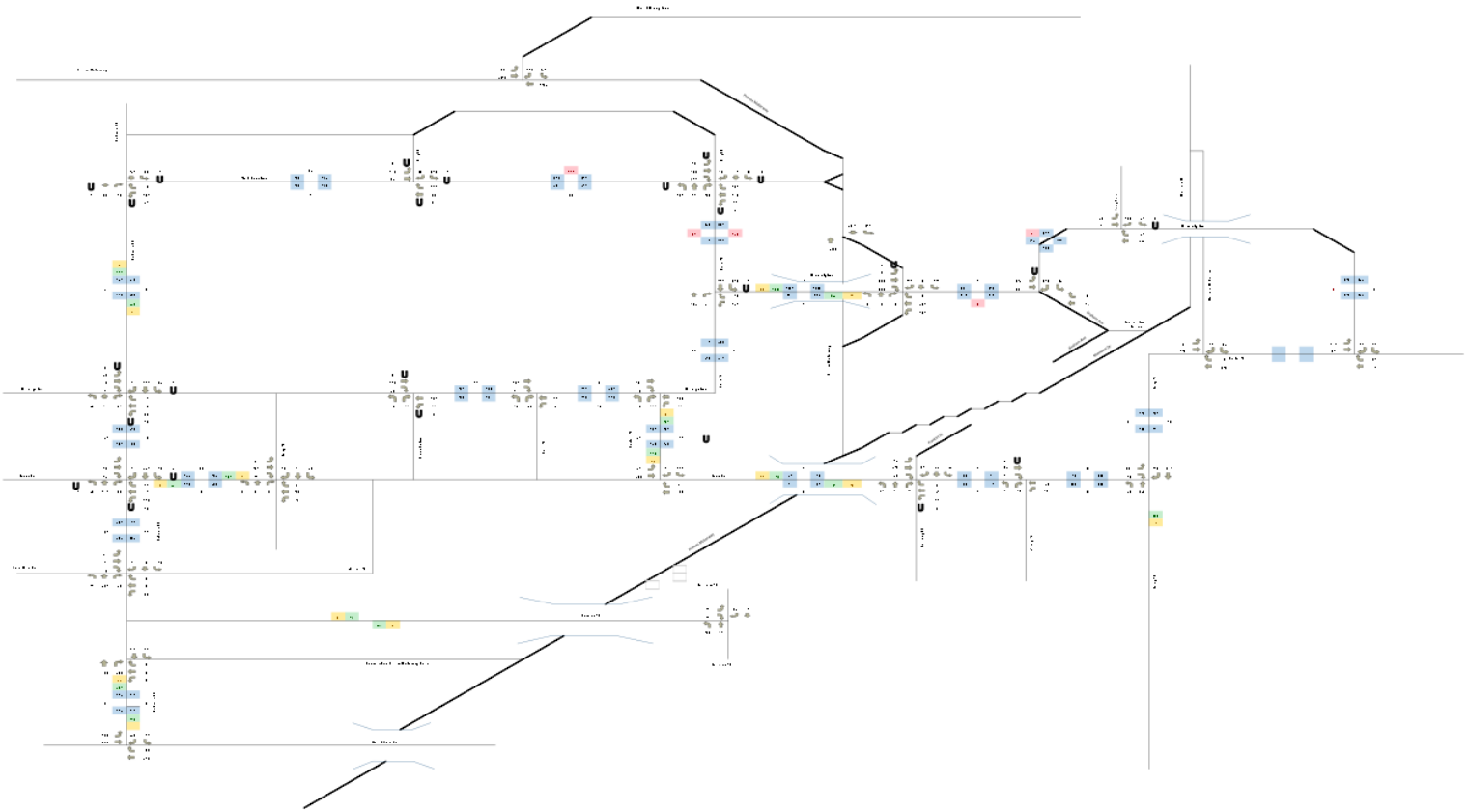
APPENDIX A

TRAFFIC FLOW DIAGRAMS

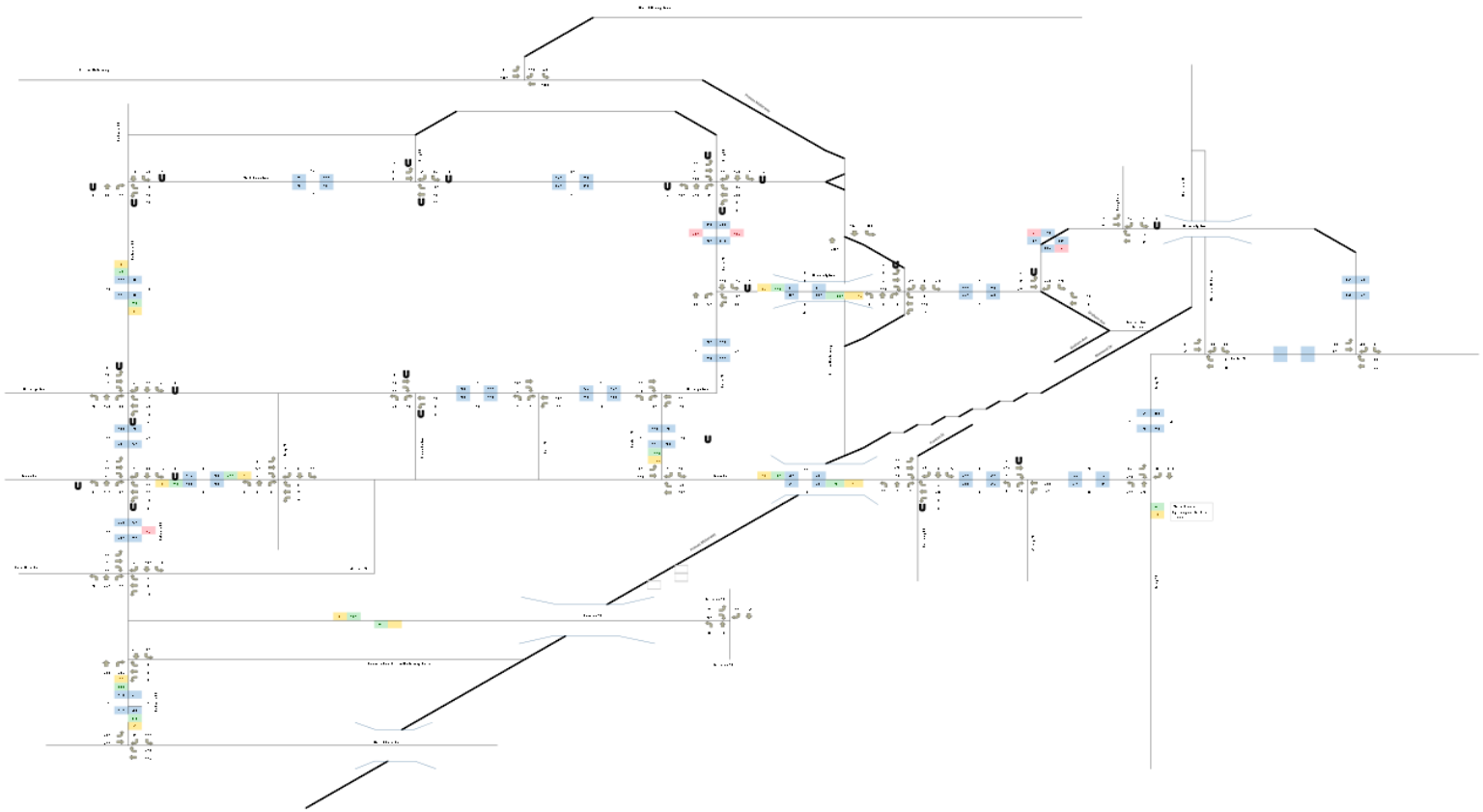
In-session AM Peak



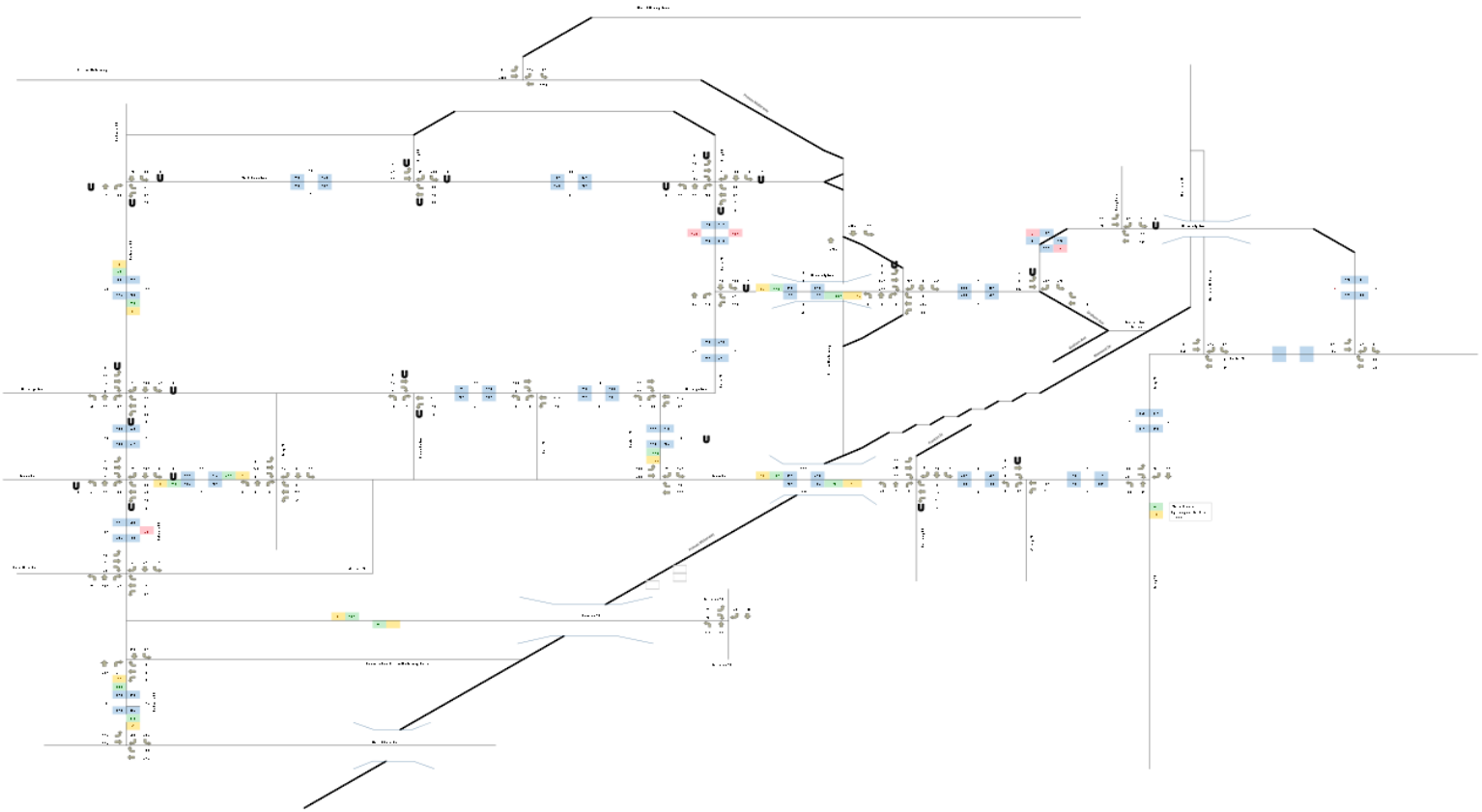
In-session PM Peak



Out-session AM Peak



Out-session PM Peak



Keiraville – Gwynneville Access and Movement Study

APPENDIX B

TRAFFIC SIGNAL DATA

Princes Hwy and Ajax Avenue
AM Peak 4/03/2015

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
6:00	6:15	76%	3%	21%	65	3	18	85	100%
6:15	6:30	80%	4%	15%	68	3	13	85	99%
6:30	6:45	77%	7%	16%	69	6	14	90	100%
6:45	7:00	77%	3%	20%	93	4	24	121	100%
6:00	**7:00**	**78%**	**4%**	**18%**	**74**	**4**	**17**	**95**	100%
7:00	7:15	70%	2%	28%	82	2	33	117	100%
7:15	7:30	67%	7%	26%	71	7	28	106	100%
7:30	7:45	66%	12%	22%	83	15	28	126	100%
7:45	8:00	64%	14%	22%	95	21	33	148	100%
7:00	**8:00**	**67%**	**9%**	**25%**	**83**	**11**	**30**	**124**	100%
8:00	8:15	62%	16%	23%	93	24	35	150	101%
8:15	8:30	64%	14%	22%	97	21	33	152	100%
8:30	8:45	65%	15%	21%	96	22	31	147	101%
8:45	9:00	60%	19%	22%	88	28	32	146	101%
8:00	**9:00**	**63%**	**16%**	**22%**	**93**	**24**	**33**	**149**	101%
9:00	9:15	63%	17%	20%	94	25	30	149	100%
9:15	9:30	64%	18%	19%	85	24	25	133	101%
9:30	9:45	62%	15%	23%	74	18	27	119	100%
9:45	10:00	61%	17%	22%	71	20	26	117	100%
9:00	**10:00**	**63%**	**17%**	**21%**	**81**	**22**	**27**	**130**	100%

PM Peak

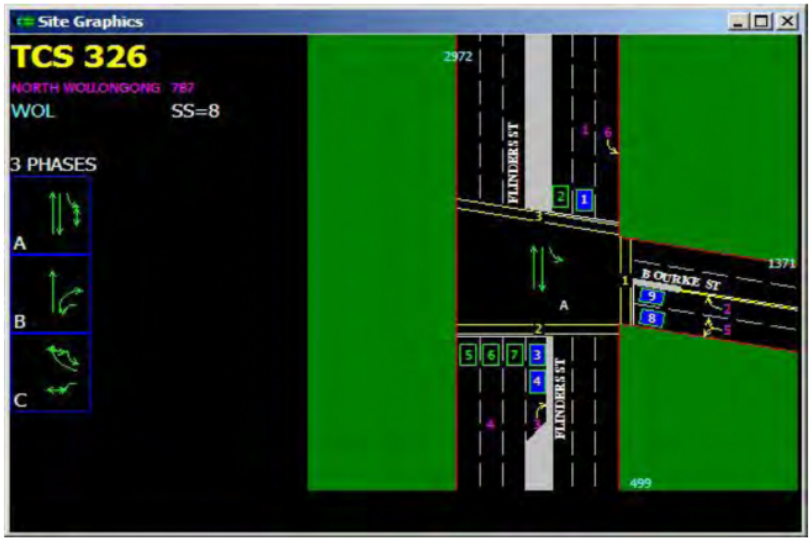
From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
15:00	15:15	58%	17%	25%	62	18	27	107	100%
15:15	15:30	55%	19%	25%	69	24	32	126	99%
15:30	15:45	53%	19%	29%	68	24	37	128	101%
15:45	15:00	62%	17%	21%	82	23	28	133	100%
15:00	**16:00**	**57%**	**18%**	**25%**	**70**	**22**	**31**	**124**	100%
16:00	16:15	60%	17%	23%	86	24	33	143	100%
16:15	16:30	63%	14%	23%	85	19	31	135	100%
16:30	16:45	51%	20%	29%	68	27	39	133	100%
16:45	17:00	53%	22%	26%	67	28	33	127	101%
16:00	**17:00**	**57%**	**18%**	**25%**	**76**	**24**	**34**	**135**	100%
17:00	17:15	45%	25%	30%	54	30	36	120	100%
17:15	17:30	53%	21%	26%	73	29	36	138	100%
17:30	17:45	59%	16%	25%	73	20	31	124	100%
17:45	18:00	60%	18%	22%	74	22	27	124	100%
17:00	**18:00**	**54%**	**20%**	**26%**	**69**	**25**	**33**	**127**	100%
18:00	18:15	68%	12%	20%	87	15	26	128	100%
18:15	18:30	72%	13%	16%	86	16	19	120	101%
18:30	18:45	68%	10%	22%	79	12	26	116	100%
18:45	19:00	69%	14%	17%	79	16	19	114	100%
18:00	**19:00**	**69%**	**12%**	**19%**	**83**	**15**	**22**	**120**	100%

Flinders Street and Bourke Street
AM Peak 4/03/2015

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
6:00	6:15	72%	0%	28%	60	0	24	84	100%
6:15	6:30	68%	0%	32%	58	0	27	85	100%
6:30	6:45	68%	1%	31%	61	1	28	90	100%
6:45	7:00	71%	3%	26%	86	4	31	121	100%
6:00	**7:00**	**70%**	**1%**	**29%**	**66**	**1**	**28**	**95**	100%
7:00	7:15	64%	3%	34%	60	3	32	94	101%
7:15	7:30	64%	4%	32%	68	4	34	106	100%
7:30	7:45	56%	10%	34%	76	14	46	135	100%
7:45	8:00	56%	10%	34%	76	14	46	135	100%
7:00	**8:00**	**60%**	**7%**	**34%**	**70**	**9**	**39**	**118**	100%
8:00	8:15	54%	12%	34%	80	18	50	148	100%
8:15	8:30	61%	12%	27%	92	18	41	151	100%
8:30	8:45	58%	10%	32%	86	15	48	149	100%
8:45	9:00	59%	11%	30%	89	17	45	150	100%
8:00	**9:00**	**58%**	**11%**	**31%**	**87**	**17**	**46**	**150**	100%
9:00	9:15	57%	13%	30%	84	19	44	148	100%
9:15	9:30	52%	11%	37%	70	15	50	135	100%
9:30	9:45	54%	13%	33%	63	15	38	116	100%
9:45	10:00	58%	12%	30%	68	14	35	118	100%
9:00	**10:00**	**55%**	**12%**	**33%**	**71**	**16**	**42**	**129**	100%

PM Peak

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
15:00	15:15	50%	16%	34%	60	19	41	120	100%
15:15	15:30	53%	13%	34%	69	17	45	131	100%
15:30	15:45	48%	15%	37%	60	19	46	125	100%
15:45	15:00	47%	15%	38%	63	20	51	134	100%
15:00	**16:00**	**50%**	**15%**	**36%**	**63**	**19**	**46**	**128**	100%
16:00	16:15	55%	13%	32%	79	19	46	143	100%
16:15	16:30	49%	16%	35%	67	22	48	136	100%
16:30	16:45	52%	16%	32%	70	22	43	135	100%
16:45	17:00	50%	16%	34%	63	20	43	126	100%
16:00	**17:00**	**52%**	**15%**	**33%**	**70**	**21**	**45**	**135**	100%
17:00	17:15	44%	17%	39%	52	20	46	119	100%
17:15	17:30	42%	16%	41%	57	22	56	136	99%
17:30	17:45	42%	17%	41%	53	21	51	125	100%
17:45	18:00	46%	15%	39%	57	19	48	124	100%
17:00	**18:00**	**44%**	**16%**	**40%**	**55**	**20**	**50**	**126**	100%
18:00	18:15	42%	17%	41%	54	22	52	128	100%
18:15	18:30	37%	16%	47%	44	19	56	120	100%
18:30	18:45	49%	16%	34%	56	18	39	114	99%
18:45	19:00	43%	15%	42%	50	17	49	116	100%
18:00	**19:00**	**43%**	**16%**	**41%**	**51**	**19**	**49**	**120**	100%



Princes Hwy and Lysaght Street
AM Peak 4/03/2015

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
6:00	6:15	93%	1%	6%	82	1	5	88	100%
6:15	6:30	96%	0%	4%	82	0	3	85	100%
6:30	6:45	94%	0%	6%	97	0	6	103	100%
6:45	7:00	93%	0%	7%	115	0	9	124	100%
6:00	**7:00**	**94%**	**0%**	**6%**	**94**	**0**	**6**	**100**	100%
7:00	7:15	78%	4%	18%	69	4	16	89	100%
7:15	7:30	77%	2%	21%	81	2	22	105	100%
7:30	7:45	77%	0%	23%	97	0	29	126	100%
7:45	8:00	69%	4%	27%	103	6	40	149	100%
7:00	**8:00**	**75%**	**3%**	**22%**	**88**	**3**	**27**	**117**	100%
8:00	8:15	65%	5%	30%	99	8	46	152	100%
8:15	8:30	51%	8%	40%	75	12	59	147	99%
8:30	8:45	48%	14%	37%	72	21	55	149	99%
8:45	9:00	55%	13%	32%	84	20	49	152	100%
8:00	**9:00**	**55%**	**10%**	**35%**	**82**	**15**	**52**	**150**	100%
9:00	9:15	78%	1%	20%	118	2	30	151	99%
9:15	9:30	73%	1%	26%	96	1	34	131	100%
9:30	9:45	79%	0%	21%	93	0	25	118	100%
9:45	10:00	70%	0%	30%	83	0	35	118	100%
9:00	**10:00**	**75%**	**1%**	**24%**	**97**	**1**	**31**	**130**	100%

PM Peak

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
15:00	15:15	67%	2%	31%	80	2	37	119	100%
15:15	15:30	59%	6%	35%	74	8	44	125	100%
15:30	15:45	66%	5%	29%	88	7	39	133	100%
15:45	15:00	71%	2%	26%	96	3	35	135	99%
15:00	**16:00**	**66%**	**4%**	**30%**	**84**	**5**	**39**	**128**	100%
16:00	16:15	67%	4%	30%	95	6	43	142	101%
16:15	16:30	66%	4%	30%	88	5	40	134	100%
16:30	16:45	69%	2%	29%	92	3	39	133	100%
16:45	17:00	74%	1%	25%	95	1	32	128	100%
16:00	**17:00**	**69%**	**3%**	**29%**	**93**	**4**	**38**	**134**	100%
17:00	17:15	73%	3%	24%	88	4	29	120	100%
17:15	17:30	75%	7%	18%	105	10	25	140	100%
17:30	17:45	76%	2%	21%	94	2	26	124	99%
17:45	18:00	81%	1%	18%	101	1	23	125	100%
17:00	**18:00**	**76%**	**3%**	**20%**	**97**	**4**	**26**	**127**	100%
18:00	18:15	81%	1%	18%	103	1	23	127	100%
18:15	18:30	86%	1%	13%	104	1	16	121	100%
18:30	18:45	80%	1%	19%	90	1	21	113	100%
18:45	19:00	82%	0%	18%	94	0	21	115	100%
18:00	**19:00**	**82%**	**1%**	**17%**	**98**	**1**	**20**	**119**	100%

Phase D was not activiated through 8 hours.

Princes Hwy and Memorial Dr
AM Peak 4/03/2015

From	to	Phase A %	Phase B %	Phase C %	Phase D %	Phase E %	Phase A	Phase B	Phase C	Phase D	Phase E	Cycle time	
6:00	6:15	46%	18%	2%	28%	6%	39	15	2	24	5	84	100%
6:15	6:30	45%	20%	2%	31%	2%	38	17	2	26	2	84	100%
6:30	6:45	45%	16%	8%	29%	2%	41	14	7	26	2	90	100%
6:45	7:00	33%	16%	4%	37%	10%	39	19	5	43	12	117	100%
6:00	**7:00**	**42%**	**18%**	**4%**	**31%**	**5%**	**39**	**16**	**4**	**30**	**5**	**94**	100%
7:00	7:15	39%	9%	4%	34%	14%	37	9	4	32	13	95	100%
7:15	7:30	28%	17%	6%	35%	15%	29	18	6	36	15	103	101%
7:30	7:45	34%	16%	10%	30%	10%	41	19	12	36	12	120	100%
7:45	8:00	20%	15%	0%	43%	21%	29	22	0	63	31	147	99%
7:00	**8:00**	**30%**	**14%**	**5%**	**36%**	**15%**	**34**	**17**	**5**	**42**	**18**	**116**	100%
8:00	8:15	20%	19%	0%	39%	22%	30	29	0	59	33	150	100%
8:15	8:30	16%	19%	0%	43%	22%	24	29	0	65	33	150	100%
8:30	8:45	16%	19%	0%	44%	21%	24	29	0	66	32	150	100%
8:45	9:00	17%	19%	0%	44%	20%	25	28	0	66	30	149	100%
8:00	**9:00**	**17%**	**19%**	**0%**	**43%**	**21%**	**26**	**28**	**0**	**64**	**32**	**150**	100%
9:00	9:15	20%	19%	0%	39%	22%	30	29	0	59	33	151	100%
9:15	9:30	31%	13%	6%	34%	16%	42	17	8	46	21	134	100%
9:30	9:45	33%	19%	11%	28%	8%	39	22	13	33	9	118	99%
9:45	10:00	36%	15%	13%	28%	9%	42	18	15	33	11	117	101%
9:00	**10:00**	**30%**	**17%**	**8%**	**32%**	**14%**	**38**	**22**	**9**	**43**	**19**	**130**	100%

PM Peak

From	to	Phase A %	Phase B %	Phase C %	Phase D %	Phase E %	Phase A	Phase B	Phase C	Phase D	Phase E	Cycle time	
15:00	15:15	31%	15%	10%	30%	14%	38	18	12	36	17	121	100%
15:15	15:30	29%	17%	12%	28%	14%	36	21	15	35	17	124	100%
15:30	15:45	26%	17%	11%	32%	14%	35	23	15	43	19	134	100%
15:45	15:00	24%	20%	13%	33%	10%	32	27	17	44	13	133	100%
15:00	**16:00**	**28%**	**17%**	**12%**	**31%**	**13%**	**35**	**22**	**15**	**39**	**17**	**128**	100%
16:00	16:15	32%	21%	12%	24%	11%	46	30	17	35	16	144	100%
16:15	16:30	24%	20%	15%	30%	11%	32	27	20	40	15	133	100%
16:30	16:45	30%	15%	12%	30%	13%	40	20	16	40	17	134	100%
16:45	17:00	26%	19%	15%	32%	8%	32	23	18	39	10	123	100%
16:00	**17:00**	**28%**	**19%**	**14%**	**29%**	**11%**	**38**	**25**	**18**	**39**	**14**	**134**	100%
17:00	17:15	27%	20%	15%	30%	9%	32	24	18	36	11	120	101%
17:15	17:30	26%	22%	14%	27%	11%	36	30	19	37	15	138	100%
17:30	17:45	24%	15%	12%	33%	17%	30	19	15	41	21	125	101%
17:45	18:00	26%	18%	16%	29%	11%	33	23	20	36	14	125	100%
17:00	**18:00**	**26%**	**19%**	**14%**	**30%**	**12%**	**33**	**24**	**18**	**38**	**15**	**127**	101%
18:00	18:15	28%	20%	14%	30%	8%	36	26	18	39	10	129	100%
18:15	18:30	31%	22%	15%	28%	4%	37	26	18	33	5	119	100%
18:30	18:45	38%	15%	10%	28%	9%	43	17	11	32	10	113	100%
18:45	19:00	35%	20%	6%	30%	10%	41	23	7	35	12	116	101%
18:00	**19:00**	**33%**	**19%**	**11%**	**29%**	**8%**	**39**	**23**	**14**	**35**	**9**	**119**	100%

Phase F and G were not activated through 8 hours.

Princes Hwy and McGrath Street
AM Peak 4/03/2015

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
6:00	6:15	95%	1%	4%	28	0	1	29	100%
6:15	6:30	96%	0%	4%	31	0	1	32	100%
6:30	6:45	93%	0%	7%	38	0	3	41	100%
6:45	7:00	95%	0%	5%	50	0	3	53	100%
6:00	**7:00**	**95%**	**0%**	**5%**	**37**	**0**	**2**	**39**	100%
7:00	7:15	85%	2%	13%	36	1	5	42	100%
7:15	7:30	87%	1%	12%	58	1	8	67	100%
7:30	7:45	89%	0%	11%	70	0	9	79	100%
7:45	8:00	86%	0%	14%	75	0	12	87	100%
7:00	**8:00**	**87%**	**1%**	**13%**	**60**	**0**	**9**	**69**	100%
8:00	8:15	76%	0%	24%	72	0	23	95	100%
8:15	8:30	70%	2%	27%	61	2	23	87	99%
8:30	8:45	72%	1%	27%	64	1	24	89	100%
8:45	9:00	72%	1%	26%	74	1	27	103	99%
8:00	**9:00**	**73%**	**1%**	**26%**	**68**	**1**	**24**	**94**	100%
9:00	9:15	70%	3%	28%	71	3	28	101	101%
9:15	9:30	83%	3%	14%	85	3	14	103	100%
9:30	9:45	83%	1%	16%	78	1	15	94	100%
9:45	10:00	83%	2%	15%	77	2	14	93	100%
9:00	**10:00**	**80%**	**2%**	**18%**	**78**	**2**	**18**	**98**	100%

PM Peak

From	to	Phase A %	Phase B %	Phase C %	Phase A	Phase B	Phase C	Cycle time	
15:00	15:15	73%	3%	24%	77	3	25	105	100%
15:15	15:30	74%	3%	23%	78	3	24	106	100%
15:30	15:45	82%	5%	13%	88	5	14	107	100%
15:45	15:00	82%	3%	15%	82	3	15	100	100%
15:00	**16:00**	**78%**	**4%**	**19%**	**81**	**4**	**20**	**105**	100%
16:00	16:15	81%	1%	18%	83	1	18	102	100%
16:15	16:30	78%	4%	18%	81	4	19	104	100%
16:30	16:45	82%	1%	17%	84	1	18	103	100%
16:45	17:00	80%	2%	18%	81	2	18	101	100%
16:00	**17:00**	**80%**	**2%**	**18%**	**82**	**2**	**18**	**103**	100%
17:00	17:15	83%	2%	15%	90	2	16	108	100%
17:15	17:30	85%	2%	13%	90	2	14	106	100%
17:30	17:45	80%	3%	17%	83	3	18	104	100%
17:45	18:00	82%	1%	17%	83	1	17	101	100%
17:00	**18:00**	**83%**	**2%**	**16%**	**86**	**2**	**16**	**105**	100%
18:00	18:15	83%	1%	16%	85	1	16	103	100%
18:15	18:30	82%	3%	15%	79	3	14	96	100%
18:30	18:45	80%	4%	16%	75	4	15	94	100%
18:45	19:00	90%	2%	8%	86	2	8	95	100%
18:00	**19:00**	**84%**	**3%**	**14%**	**81**	**2**	**13**	**97**	100%

Phase D was not activiated through 8 hours.

Keiraville – Gwynneville Access and Movement Study

APPENDIX C

CALIBRATION - GEH TABLES

In-session AM peak: Light Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Through	13452423	23	9	-14	3.50	-60.87
	East	Left	13452422	18	8	-10	2.77	-55.56
	East	Right	13452424	285	282	-3	0.18	-1.05
	North	Through	13452421	21	0	-21	6.48	-100.00
	North	Right	13452429	36	67	31	4.32	86.11
	North	Left	13452430	25	23	-2	0.41	-8.00
	South	Right	13452426	49	72	23	2.96	46.94
	South	Through	13452428	9	12	3	0.93	33.33
	South	Left	13452427	29	48	19	3.06	65.52
	West	Left	13452419	19	13	-6	1.50	-31.58
	West	Right	13452425	37	43	6	0.95	16.22
	West	Through	13452420	296	250	-46	2.78	-15.54
Gipps Road and Eastern Street	East	Through	173239	139	181	42	3.32	30.22
	East	Right	173237	234	241	7	0.45	2.99
	North	Left	173241	96	90	-6	0.62	-6.25
	North	Right	173236	10	4	-6	2.27	-60.00
	West	Through	173238	37	26	-11	1.96	-29.73
	West	Left	173240	260	216	-44	2.85	-16.92
Gipps Road and Foley Street	North	Through	13452242	126	80	-46	4.53	-36.51
	North	Right	13452241	695	722	27	1.01	3.88
	South	Through	13452243	284	292	8	0.47	2.82
	South	Left	13452244	320	309	-11	0.62	-3.44
	West	Left	13452239	75	56	-19	2.35	-25.33
	West	Right	13452240	341	305	-36	2.00	-10.56
Gipps Road and Grey Street	East	Through	13451443	21	0	-21	6.48	-100.00
	East	Left	13451444	133	122	-11	0.97	-8.27
	North	Right	13452492	42	25	-17	2.94	-40.48
	North	Left	13452493	24	1	-23	6.51	-95.83
	North	Through	13451445	5	4	-1	0.47	-20.00
	West	Through	13451441	28	0	-28	7.48	-100.00
	West	Right	13451442	197	192	-5	0.36	-2.54
Gipps Road and Vickery Street	East	Through	13452654	85	84	-1	0.11	-1.18
	East	Left	13452653	273	285	12	0.72	4.40
	South	Left	13452649	28	15	-13	2.80	-46.43
	South	Right	13452650	112	105	-7	0.67	-6.25
	West	Through	13452644	288	264	-24	1.44	-8.33
Memorial Drive and Porter Street	East	Through	13449030	330	337	7	0.38	2.12
	North	Right	13449029	144	266	122	8.52	84.72
	North	Left	13449031	497	448	-49	2.25	-9.86
	West	Through	13449025	450	402	-48	2.33	-10.67
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	55	67	12	1.54	21.82
	North	Through	13449737	1234	1277	43	1.21	3.48
	South	Right	13449738	128	114	-14	1.27	-10.94
	South	Through	13449735	513	635	122	5.09	23.78
	West	Left	13449736	879	905	26	0.87	2.96
	West	Right	13449734	618	608	-10	0.40	-1.62
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	430	349	-81	4.10	-18.84
	East	Right	168314	98	128	30	2.82	30.61
	North	Through	168311	354	412	58	2.96	16.38
	North	Right	168316	1543	1469	-74	1.91	-4.80
	South	Left	13448825	568	457	-111	4.90	-19.54
	South	Through	168315	544	623	79	3.27	14.52
Mount Keira Road and Robsons Road	East	Through	13451237	391	386	-5	0.25	-1.28
	East	Right	13451238	127	154	27	2.28	21.26
	North	Right	13451235	283	281	-2	0.12	-0.71
	North	Left	13451236	119	92	-27	2.63	-22.69
	West	Through	13451233	415	394	-21	1.04	-5.06
	West	Left	13451234	414	420	6	0.29	1.45
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	55	54	-1	0.14	-1.82
	East	Through + Right	13449231	370	457	87	4.28	23.51
	North	Through + Right	13449226	68	87	19	2.16	27.94
	North	Left	13449227	267	239	-28	1.76	-10.49
	South	Left	13449232	26	22	-4	0.82	-15.38
	South	Through + Right	13449233	51	46	-5	0.72	-9.80
	West	Through + Right	13448727	2	14	12	4.24	600.00
	West	Left	13448709	426	415	-11	0.54	-2.58
Murphys Ave and Braeside Ave	East	Left	13451989	30	16	-14	2.92	-46.67
	East	Through	13451990	222	244	22	1.44	9.91
	South	Left	13451991	26	9	-17	4.06	-65.38
	South	Right	13451992	26	18	-8	1.71	-30.77
	West	Right	13451987	12	2	-10	3.78	-83.33
	West	Through	13451988	138	145	7	0.59	5.07
Murphys Ave and Eastern Street	East	Left	168003	107	86	-21	2.14	-19.63
	East	Through	167998	273	210	-63	4.05	-23.08
	South	Right	167999	53	75	22	2.75	41.51
	South	Left	168001	114	148	34	2.97	29.82
	West	Right	168002	39	55	16	2.33	41.03
	West	Through	168000	132	130	-2	0.17	-1.52
	East	Left	13452001	75	62	-13	1.57	-17.33
	East	Through	13452002	241	269	28	1.75	11.62

Murphys Ave and John Street	South	Right	13452003	26	28	2	0.38	7.69
	South	Left	13452004	23	82	59	8.14	256.52
	West	Right	13452000	12	20	8	2.00	66.67
	West	Through	13451999	137	128	-9	0.78	-6.57
Murphys Ave and Robsons Road	East	Left	13452577	72	67	-5	0.60	-6.94
	East	Through + Right	13452574	92	132	40	3.78	43.48
	North	Through + Right	13452570	53	55	2	0.27	3.77
	North	Left	13452571	79	57	-22	2.67	-27.85
	South	Through + Right	13452579	25	20	-5	1.05	-20.00
	South	Left	13452578	336	332	-4	0.22	-1.19
	West	Through + Right	13452585	6	3	-3	1.41	-50.00
	West	Left	13452584	73	66	-7	0.84	-9.59
Northfields Ave and Princes Ramps	East	Through + Right	13452617	11	21	10	2.50	90.91
	East	Left	13452616	889	904	15	0.50	1.69
	North	Left	13452610	16	28	12	2.56	75.00
	North	Through + Right	13452613	132	191	59	4.64	44.70
	South	Left	13452621	323	289	-34	1.94	-10.53
	South	Through + Right	13452620	282	309	27	1.57	9.57
	West	Through + Right	13452624	25	17	-8	1.75	-32.00
	West	Left	13452625	175	205	30	2.18	17.14
Northfields Ave and Uni Entrance	East	Through + Right	13449191	754	752	-2	0.07	-0.27
	North	Left	13449199	102	142	40	3.62	39.22
	North	Right	13449200	35	47	12	1.87	34.29
	West	Left	13449196	90	95	5	0.52	5.56
	West	Through	13449197	68	77	9	1.06	13.24
Princes Hwy and Mt Ousley Road	East	Through + Right	13448774	85	104	19	1.95	22.35
	East	Left	13448773	103	64	-39	4.27	-37.86
	North	Through + Right	13449243	48	40	-8	1.21	-16.67
	North	Left	13449240	900	884	-16	0.54	-1.78
	South	Through + Right	168304	269	409	140	7.60	52.04
	South	Left	168309	811	754	-57	2.04	-7.03
	West	Left	13449238	119	107	-12	1.13	-10.08
	West	Through + Right	13449239	493	645	152	6.37	30.83
Princes Hwy-Princes Hwy Exit	North	Through	168171	1979	1946	-33	0.74	-1.67
	South	Through	173227	2402	2377	-25	0.51	-1.04
Princes Motorway and Mount Ousley Road	East	Through	173116	1194	1247	53	1.52	4.44
	North	Left	13448693	390	391	1	0.05	0.26
	North	Right	13448695	165	135	-30	2.45	-18.18
	West	Through	173118	1610	1649	39	0.97	2.42
Reserve Street and Gilmores Street	North	Through	13451327	34	32	-2	0.35	-5.88
	North	Right	13451328	57	63	6	0.77	10.53
	South	Left	13451324	159	174	15	1.16	9.43
	South	Through	13451325	111	113	2	0.19	1.80
	West	Right	13451326	41	38	-3	0.48	-7.32
	West	Left	13451329	137	138	1	0.09	0.73
Robsons Road and Gipps Road	East	Left	13452558	74	69	-5	0.59	-6.76
	East	Through + Right	13452553	61	54	-7	0.92	-11.48
	North	Through + Right	13452552	134	114	-20	1.80	-14.93
	North	Left	13452557	47	48	1	0.15	2.13
	South	Through + Right	13452559	4	1	-3	1.90	-75.00
	South	Left	13452554	421	387	-34	1.69	-8.08
	West	Through + Right	13452555	13	14	1	0.27	7.69
	West	Left	13452556	53	70	17	2.17	32.08
Robsons Road and Northfields Ave	East	Left	13452598	93	64	-29	3.27	-31.18
	East	Right	13452597	84	109	25	2.54	29.76
	North	Left	13452605	45	32	-13	2.10	-28.89
	North	Through	13452607	58	55	-3	0.40	-5.17
	South	Through + Right	13452600	268	329	61	3.53	22.76
Robsons Road and Princes Motorway On Ramp	North	Through	13451189	99	127	28	2.63	28.28
	North	Left	13451190	402	371	-31	1.58	-7.71
	South	Through	13451186	316	311	-5	0.28	-1.58
	South	Right	13451185	490	469	-21	0.96	-4.29
Robsons Road and William Street	East	Left	13451281	61	61	0	0.00	0.00
	East	Through	13451282	4	2	-2	1.15	-50.00
	East	Right	13451289	3	0	-3	2.45	-100.00
	North	Right	13451286	6	0	-6	3.46	-100.00
	North	Left	13451287	41	36	-5	0.81	-12.20
	North	Through	13451285	272	276	4	0.24	1.47
	South	Through	13451277	28	25	-3	0.58	-10.71
	South	Right	13451288	31	36	5	0.86	16.13
	South	Left	13451278	362	325	-37	2.00	-10.22
	West	Through	13451279	43	41	-2	0.31	-4.65
	West	Left	13451280	55	57	2	0.27	3.64
	West	Right	13451290	7	13	6	1.90	85.71
University Ave and Foleys Lane	North	Right	13449252	45	45	0	0.00	0.00
	North	Left	13449015	59	64	5	0.64	8.47
	South	Right	13449008	470	554	84	3.71	17.87
	South	Left	13449009	125	103	-22	2.06	-17.60
	West	Right	13449253	342	365	23	1.22	6.73
	West	Through	13449012	127	243	116	8.53	91.34
University Ave and Graham Ave	East	Right	13452674	307	288	-19	1.10	-6.19
	East	Left	13452673	224	326	102	6.15	45.54
	North	Through	13452665	467	610	143	6.16	30.62
	North	Left	13452666	231	385	154	8.77	66.67

University Ave and Irvine St	East	Right	13452636	199	226	27	1.85	13.57
	East	Left	13452637	569	539	-30	1.27	-5.27
	North	Through	13452634	422	468	46	2.18	10.90
	North	Left	13452632	232	234	2	0.13	0.86
	South	Through + Right	13452638	251	434	183	9.89	72.91
University Ave and Porter Street	East	Right	168188	83	77	-6	0.67	-7.23
	East	Through	168183	26	24	-2	0.40	-7.69
	North	Right	168186	84	94	10	1.06	11.90
	North	Left	168184	304	317	13	0.74	4.28
	West	Through	168187	513	577	64	2.74	12.48
	West	Left	168185	81	88	7	0.76	8.64
University Ave and Princes Ramps	East	Left + Through	13448974	335	351	16	0.86	4.78
	North	Left	13448972	225	302	77	4.74	34.22
	North	Through + Right	13448973	518	410	-108	5.01	-20.85
	West	Through + Right	13448977	584	819	235	8.87	40.24
Mean				239.82	247.43	7.60		3.17

In-session AM peak: Heavy Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Through	13452424	2	0	-2	2.00	-100.00
	East	Left	13452423	0	0	0	0.00	0.00
	East	Right	13452422	0	0	0	0.00	0.00
	North	Through	13452430	1	0	-1	1.41	-100.00
	North	Right	13452429	0	0	0	0.00	0.00
	North	Left	13452421	0	0	0	0.00	0.00
	South	Right	13452428	0	0	0	0.00	0.00
	South	Through	13452427	0	0	0	0.00	0.00
	South	Left	13452426	0	0	0	0.00	0.00
	West	Left	13452419	1	0	-1	1.41	-100.00
	West	Right	13452425	0	0	0	0.00	0.00
	West	Through	13452420	0	1	1	1.41	inf
Gipps Road and Eastern Street	East	Through	173237	2	0	-2	2.00	-100.00
	East	Right	173239	0	0	0	0.00	0.00
	North	Left	173241	0	1	1	1.41	inf
	North	Right	173236	0	0	0	0.00	0.00
	West	Through	173240	1	0	-1	1.41	-100.00
	West	Left	173238	0	0	0	0.00	0.00
Gipps Road and Foley Street	North	Through	13452241	4	1	-3	1.90	-75.00
	North	Right	13452242	0	0	0	0.00	0.00
	South	Through	13452244	1	0	-1	1.41	-100.00
	South	Left	13452243	1	0	-1	1.41	-100.00
	West	Left	13452239	0	0	0	0.00	0.00
	West	Right	13452240	0	1	1	1.41	inf
Gipps Road and Grey Street	East	Through	13451444	3	0	-3	2.45	-100.00
	East	Left	13451443	0	0	0	0.00	0.00
	North	Right	13452493	0	0	0	0.00	0.00
	North	Left	13452492	0	0	0	0.00	0.00
	North	Through	13451445	0	0	0	0.00	0.00
	West	Through	13451442	0	0	0	0.00	0.00
	West	Right	13451441	0	0	0	0.00	0.00
Gipps Road and Vickery Street	East	Through	13452653	4	0	-4	2.83	-100.00
	East	Left	13452654	0	0	0	0.00	0.00
	South	Left	13452649	1	0	-1	1.41	-100.00
	South	Right	13452650	0	0	0	0.00	0.00
	West	Through	13452644	1	1	0	0.00	0.00
Memorial Drive and Porter Street	East	Through	13449030	3	1	-2	1.41	-66.67
	North	Right	13449031	4	0	-4	2.83	-100.00
	North	Left	13449029	0	11	11	4.69	inf
	West	Through	13449025	2	0	-2	2.00	-100.00
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	1	0	-1	1.41	-100.00
	North	Through	13449737	26	38	12	2.12	46.15
	South	Right	13449738	6	8	2	0.76	33.33
	South	Through	13449735	11	16	5	1.36	45.45
	West	Left	13449736	21	27	6	1.22	28.57
	West	Right	13449734	18	32	14	2.80	77.78
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	14	9	-5	1.47	-35.71
	East	Right	168314	0	2	2	2.00	inf
	North	Through	168316	35	39	4	0.66	11.43
	North	Right	168311	10	31	21	4.64	210.00
	South	Left	13448825	28	27	-1	0.19	-3.57
	South	Through	168315	17	22	5	1.13	29.41
Mount Keira Road and Robsons Road	East	Through	13451238	3	0	-3	2.45	-100.00
	East	Right	13451237	6	4	-2	0.89	-33.33
	North	Right	13451236	2	0	-2	2.00	-100.00
	North	Left	13451235	5	3	-2	1.00	-40.00
	West	Through	13451234	2	0	-2	2.00	-100.00
	West	Left	13451233	4	9	5	1.96	125.00
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	0	0	0	0.00	0.00
	East	Through + Right	13449231	14	45	31	5.71	221.43
	North	Through + Right	13449227	0	0	0	0.00	0.00
	North	Left	13449226	3	25	22	5.88	733.33
	South	Left	13449232	0	0	0	0.00	0.00
	South	Through + Right	13449233	0	11	11	4.69	inf
	West	Through + Right	13448709	18	35	17	3.30	94.44
	West	Left	13448727	0	6	6	3.46	inf
Murphys Ave and Braeside Ave	East	Left	13451989	1	0	-1	1.41	-100.00
	East	Through	13451990	0	3	3	2.45	inf
	South	Left	13451991	1	0	-1	1.41	-100.00
	South	Right	13451992	0	0	0	0.00	0.00
	West	Right	13451987	1	0	-1	1.41	-100.00
	West	Through	13451988	1	1	0	0.00	0.00
Murphys Ave and Eastern Street	East	Left	168003	0	0	0	0.00	0.00
	East	Through	167998	2	3	1	0.63	50.00
	South	Right	168001	0	0	0	0.00	0.00
	South	Left	167999	0	0	0	0.00	0.00
	West	Right	168002	0	0	0	0.00	0.00
	West	Through	168000	0	1	1	1.41	inf
	East	Left	13452001	0	0	0	0.00	0.00

Murphys Ave and John Street	East	Through	13452002	2	3	1	0.63	50.00
	South	Right	13452004	0	0	0	0.00	0.00
	South	Left	13452003	0	0	0	0.00	0.00
	West	Right	13452000	1	0	-1	1.41	-100.00
	West	Through	13451999	0	1	1	1.41	inf
Murphys Ave and Robsons Road	East	Left	13452577	4	3	-1	0.53	-25.00
	East	Through + Right	13452574	0	0	0	0.00	0.00
	North	Through + Right	13452571	1	0	-1	1.41	-100.00
	North	Left	13452570	0	1	1	1.41	inf
	South	Through + Right	13452578	1	0	-1	1.41	-100.00
	South	Left	13452579	0	0	0	0.00	0.00
	West	Through + Right	13452584	1	0	-1	1.41	-100.00
	West	Left	13452585	0	0	0	0.00	0.00
Northfields Ave and Princes Ramps	East	Through + Right	13452616	4	8	4	1.63	100.00
	East	Left	13452617	0	7	7	3.74	inf
	North	Left	13452610	0	0	0	0.00	0.00
	North	Through + Right	13452613	0	3	3	2.45	inf
	South	Left	13452621	2	0	-2	2.00	-100.00
	South	Through + Right	13452620	1	3	2	1.41	200.00
	West	Through + Right	13452625	10	2	-8	3.27	-80.00
	West	Left	13452624	0	0	0	0.00	0.00
Northfields Ave and Uni Entrance	East	Through + Right	13449191	6	3	-3	1.41	-50.00
	North	Left	13449199	2	1	-1	0.82	-50.00
	North	Right	13449200	0	0	0	0.00	0.00
	West	Left	13449196	0	0	0	0.00	0.00
	West	Through	13449197	4	1	-3	1.90	-75.00
Princes Hwy and Mt Ousley Road	East	Through + Right	13448773	103	42	-61	7.16	-59.22
	East	Left	13448774	0	12	12	4.90	inf
	North	Through + Right	13449240	27	19	-8	1.67	-29.63
	North	Left	13449243	0	0	0	0.00	0.00
	South	Through + Right	168309	25	24	-1	0.20	-4.00
	South	Left	168304	4	17	13	4.01	325.00
	West	Left	13449238	119	72	-47	4.81	-39.50
	West	Through + Right	13449239	14	11	-3	0.85	-21.43
Princes Hwy-Princes Hwy Exit	North	Through	168171	101	98	-3	0.30	-2.97
	South	Through	173227	87	91	4	0.42	4.60
Princes Motorway and Mount Ousley Road	East	Through	173116	225	235	10	0.66	4.44
	North	Left	13448693	7	13	6	1.90	85.71
	North	Right	13448695	4	23	19	5.17	475.00
	West	Through	173118	179	197	18	1.31	10.06
Reserve Street and Gilmores Street	North	Through	13451328	1	0	-1	1.41	-100.00
	North	Right	13451327	0	0	0	0.00	0.00
	South	Left	13451324	1	0	-1	1.41	-100.00
	South	Through	13451325	1	0	-1	1.41	-100.00
	West	Right	13451329	0	0	0	0.00	0.00
	West	Left	13451326	0	0	0	0.00	0.00
Robsons Road and Gipps Road	East	Left	13452558	2	0	-2	2.00	-100.00
	East	Through + Right	13452553	1	0	-1	1.41	-100.00
	North	Through + Right	13452552	3	3	0	0.00	0.00
	North	Left	13452557	0	0	0	0.00	0.00
	South	Through + Right	13452554	2	0	-2	2.00	-100.00
	South	Left	13452559	0	0	0	0.00	0.00
	West	Through + Right	13452556	0	0	0	0.00	0.00
	West	Left	13452555	0	0	0	0.00	0.00
Robsons Road and Northfields Ave	East	Left	13452598	1	0	-1	1.41	-100.00
	East	Right	13452597	0	1	1	1.41	inf
	North	Left	13452605	1	0	-1	1.41	-100.00
	North	Through	13452607	0	1	1	1.41	inf
	South	Through + Right	13452600	1	0	-1	1.41	-100.00
Robsons Road and Princes Motorway On Ramp	North	Through	13451190	7	3	-4	1.79	-57.14
	North	Left	13451189	1	5	4	2.31	400.00
	South	Through	13451185	2	0	-2	2.00	-100.00
	South	Right	13451186	8	13	5	1.54	62.50
Robsons Road and William Street	East	Left	13451281	1	0	-1	1.41	-100.00
	East	Through	13451289	0	0	0	0.00	0.00
	East	Right	13451282	0	0	0	0.00	0.00
	North	Right	13451287	0	0	0	0.00	0.00
	North	Left	13451286	0	0	0	0.00	0.00
	North	Through	13451285	6	7	1	0.39	16.67
	South	Through	13451278	2	0	-2	2.00	-100.00
	South	Right	13451288	0	0	0	0.00	0.00
	South	Left	13451277	0	0	0	0.00	0.00
	West	Through	13451290	0	0	0	0.00	0.00
	West	Left	13451279	0	0	0	0.00	0.00
	West	Right	13451280	0	1	1	1.41	inf
University Ave and Foleys Lane	North	Right	13449015	1	0	-1	1.41	-100.00
	North	Left	13449252	0	0	0	0.00	0.00
	South	Right	13449009	0	0	0	0.00	0.00
	South	Left	13449008	2	11	9	3.53	450.00
	West	Right	13449253	4	4	0	0.00	0.00
	West	Through	13449012	0	0	0	0.00	0.00
University Ave and Graham Ave	East	Right	13452674	1	0	-1	1.41	-100.00
	East	Left	13452673	1	11	10	4.08	1000.00

[illegible]	North	Through	13452666	5	3	-2	1.00	-40.00
	North	Left	13452665	4	4	0	0.00	0.00
University Ave and Irvine St	East	Right	13452637	3	5	2	1.00	66.67
	East	Left	13452636	1	4	3	1.90	300.00
	North	Through	13452632	2	0	-2	2.00	-100.00
	North	Left	13452634	7	5	-2	0.82	-28.57
	South	Through + Right	13452638	1	1	0	0.00	0.00
University Ave and Porter Street	East	Right	168188	0	0	0	0.00	0.00
	East	Through	168183	0	0	0	0.00	0.00
	North	Right	168184	3	1	-2	1.41	-66.67
	North	Left	168186	1	3	2	1.41	200.00
	West	Through	168185	0	0	0	0.00	0.00
	West	Left	168187	2	11	9	3.53	450.00
University Ave and Princes Ramps	East	Left + Through	13448974	1	0	-1	1.41	-100.00
	North	Left	13448972	5	1	-4	2.31	-80.00
	North	Through + Right	13448973	4	9	5	1.96	125.00
	West	Through + Right	13448977	7	6	-1	0.39	-14.29
Mean				7.32	7.92	0.59		8.09

In-session PM peak: Light Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Left	13452423	17	0	-17	5.83	-100.00
	East	Right	13452422	4	1	-3	1.90	-75.00
	East	Through	13452424	317	341	24	1.32	7.57
	North	Left	13452421	15	0	-15	5.48	-100.00
	North	Right	13452429	40	67	27	3.69	67.50
	North	Through	13452430	11	14	3	0.85	27.27
	South	Left	13452426	25	35	10	1.83	40.00
	South	Right	13452428	15	15	0	0.00	0.00
	South	Through	13452427	13	15	2	0.53	15.38
	West	Left	13452419	12	28	16	3.58	133.33
	West	Right	13452425	28	37	9	1.58	32.14
	West	Through	13452420	269	239	-30	1.88	-11.15
Gipps Road and Eastern Street	East	Right	173239	92	145	53	4.87	57.61
	East	Through	173237	295	302	7	0.41	2.37
	North	Left	173241	112	114	2	0.19	1.79
	North	Right	173236	9	6	-3	1.10	-33.33
	West	Left	173238	27	20	-7	1.44	-25.93
	West	Through	173240	203	190	-13	0.93	-6.40
Gipps Road and Foley Street	North	Right	13452242	115	112	-3	0.28	-2.61
	North	Through	13452241	628	607	-21	0.85	-3.34
	South	Left	13452243	324	319	-5	0.28	-1.54
	South	Through	13452244	413	315	-98	5.14	-23.73
	West	Left	13452239	87	65	-22	2.52	-25.29
	West	Right	13452240	316	258	-58	3.42	-18.35
Gipps Road and Grey Street	East	Left	13451443	18	3	-15	4.63	-83.33
	East	Through	13451444	183	162	-21	1.60	-11.48
	North	Left	13452492	20	12	-8	2.00	-40.00
	North	Right	13452493	14	1	-13	4.75	-92.86
	North	Through	13451445	5	1	-4	2.31	-80.00
	West	Right	13451441	15	11	-4	1.11	-26.67
	West	Through	13451442	147	150	3	0.25	2.04
Gipps Road and Vickery Street	East	Left	13452654	76	93	17	1.85	22.37
	East	Through	13452653	323	340	17	0.93	5.26
	South	Left	13452649	9	3	-6	2.45	-66.67
	South	Right	13452650	56	75	19	2.35	33.93
	West	Through	13452644	299	250	-49	2.96	-16.39
Memorial Drive and Porter Street	East	Through	13449030	394	374	-20	1.02	-5.08
	North	Left	13449029	62	132	70	7.11	112.90
	North	Right	13449031	355	315	-40	2.19	-11.27
	West	Through	13449025	505	464	-41	1.86	-8.12
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	72	136	64	6.28	88.89
	North	Through	13449737	1082	978	-104	3.24	-9.61
	South	Right	13449738	374	299	-75	4.09	-20.05
	South	Through	13449735	762	952	190	6.49	24.93
	West	Left	13449736	867	880	13	0.44	1.50
	West	Right	13449734	350	349	-1	0.05	-0.29
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	207	203	-4	0.28	-1.93
	East	Right	168314	51	55	4	0.55	7.84
	North	Right	168311	422	409	-13	0.64	-3.08
	North	Through	168316	1007	922	-85	2.74	-8.44
	South	Left	13448825	845	716	-129	4.62	-15.27
	South	Through	168315	1075	1227	152	4.48	14.14
Mount Keira Road and Robsons Road	East	Right	13451237	361	339	-22	1.18	-6.09
	East	Through	13451238	268	283	15	0.90	5.60
	North	Left	13451235	302	298	-4	0.23	-1.32
	North	Right	13451236	212	199	-13	0.91	-6.13
	West	Left	13451233	181	196	15	1.09	8.29
	West	Through	13451234	187	196	9	0.65	4.81
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	35	37	2	0.33	5.71
	East	Through + Right	13449231	539	567	28	1.19	5.19
	North	Left	13449226	37	43	6	0.95	16.22
	North	Through + Right	13449227	138	140	2	0.17	1.45
	South	Left	13449232	19	47	28	4.87	147.37
	South	Through + Right	13449233	31	34	3	0.53	9.68
	West	Left	13448727	9	26	17	4.06	188.89
	West	Through + Right	13448709	323	263	-60	3.51	-18.58
Murphys Ave and Braeside Ave	East	Left	13451989	17	19	2	0.47	11.76
	East	Through	13451990	147	120	-27	2.34	-18.37
	South	Left	13451991	38	5	-33	7.12	-86.84
	South	Right	13451992	19	1	-18	5.69	-94.74
	West	Right	13451987	23	0	-23	6.78	-100.00
	West	Through	13451988	147	173	26	2.06	17.69
Murphys Ave and Eastern Street	East	Left	168003	69	62	-7	0.86	-10.14
	East	Through	167998	158	123	-35	2.95	-22.15
	South	Left	167999	34	25	-9	1.66	-26.47
	South	Right	168001	113	90	-23	2.28	-20.35
	West	Right	168002	38	47	9	1.38	23.68
	West	Through	168000	160	174	14	1.08	8.75
	East	Left	13452001	23	20	-3	0.65	-13.04

Murphys Ave and John Street	East	Through	13452002	151	132	-19	1.60	-12.58
	South	Left	13452003	9	2	-7	2.98	-77.78
	South	Right	13452004	28	22	-6	1.20	-21.43
	West	Right	13452000	12	15	3	0.82	25.00
	West	Through	13451999	161	190	29	2.19	18.01
Murphys Ave and Robsons Road	East	Left	13452577	82	72	-10	1.14	-12.20
	East	Through + Right	13452574	65	49	-16	2.12	-24.62
	North	Left	13452570	62	60	-2	0.26	-3.23
	North	Through + Right	13452571	178	174	-4	0.30	-2.25
	South	Left	13452579	28	26	-2	0.38	-7.14
	South	Through + Right	13452578	133	122	-11	0.97	-8.27
	West	Left	13452585	9	9	0	0.00	0.00
	West	Through + Right	13452584	56	79	23	2.80	41.07
Northfields Ave and Princes Ramps	East	Left	13452617	11	20	9	2.29	81.82
	East	Through + Right	13452616	223	194	-29	2.01	-13.00
	North	Left	13452610	44	38	-6	0.94	-13.64
	North	Through + Right	13452613	390	358	-32	1.65	-8.21
	South	Left	13452621	122	103	-19	1.79	-15.57
	South	Through + Right	13452620	278	322	44	2.54	15.83
	West	Left	13452624	18	0	-18	6.00	-100.00
	West	Through + Right	13452625	611	637	26	1.04	4.26
Northfields Ave and Uni Entrance	East	Through + Right	13449191	239	208	-31	2.07	-12.97
	North	Left	13449199	455	500	45	2.06	9.89
	North	Right	13449200	80	72	-8	0.92	-10.00
	West	Left	13449196	42	35	-7	1.13	-16.67
	West	Through	13449197	130	140	10	0.86	7.69
Princes Hwy and Mt Ousley Road	East	Left	13448774	72	82	10	1.14	13.89
	East	Through + Right	13448773	117	129	12	1.08	10.26
	North	Left	13449243	50	57	7	0.96	14.00
	North	Through + Right	13449240	793	825	32	1.13	4.04
	South	Left	168304	336	364	28	1.50	8.33
	South	Through + Right	168309	1251	1254	3	0.08	0.24
	West	Left	13449238	109	107	-2	0.19	-1.83
	West	Through + Right	13449239	309	345	36	1.99	11.65
Princes Hwy-Princes Hwy Exit	North	Through	168171	1970	1792	-178	4.10	-9.04
	South	Through	173227	2001	1994	-7	0.16	-0.35
Princes Motorway and Mount Ousley Road	East	Through	173116	1645	1639	-6	0.15	-0.36
	North	Left	13448693	425	386	-39	1.94	-9.18
	North	Right	13448695	153	92	-61	5.51	-39.87
	West	Through	173118	1857	1851	-6	0.14	-0.32
Reserve Street and Gilmores Street	North	Right	13451327	41	52	11	1.61	26.83
	North	Through	13451328	53	50	-3	0.42	-5.66
	South	Left	13451324	165	157	-8	0.63	-4.85
	South	Through	13451325	75	66	-9	1.07	-12.00
	West	Left	13451326	15	13	-2	0.53	-13.33
	West	Right	13451329	73	74	1	0.12	1.37
Robsons Road and Gipps Road	East	Left	13452558	107	92	-15	1.50	-14.02
	East	Through + Right	13452553	86	70	-16	1.81	-18.60
	North	Through + Right	13452552	237	233	-4	0.26	-1.69
	North	Left	13452557	58	54	-4	0.53	-6.90
	South	Left	13452559	24	0	-24	6.93	-100.00
	South	Through + Right	13452554	170	165	-5	0.39	-2.94
	West	Left	13452555	3	3	0	0.00	0.00
	West	Through + Right	13452556	30	29	-1	0.18	-3.33
Robsons Road and Northfields Ave	East	Left	13452598	105	95	-10	1.00	-9.52
	East	Right	13452597	36	0	-36	8.49	-100.00
	North	Left	13452605	65	78	13	1.54	20.00
	North	Through	13452607	127	145	18	1.54	14.17
	South	Through + Right	13452600	119	107	-12	1.13	-10.08
Robsons Road and Princes Motorway On Ramp	North	Left	13451189	58	63	5	0.64	8.62
	North	Through	13451190	514	501	-13	0.58	-2.53
	South	Right	13451186	242	231	-11	0.72	-4.55
	South	Through	13451185	300	308	8	0.46	2.67
Robsons Road and William Street	East	Left	13451281	64	59	-5	0.64	-7.81
	East	Right	13451282	0	6	6	3.46	inf
	East	Through	13451289	8	13	5	1.54	62.50
	North	Left	13451286	1	1	0	0.00	0.00
	North	Right	13451287	18	19	1	0.23	5.56
	North	Through	13451285	375	391	16	0.82	4.27
	South	Left	13451277	16	0	-16	5.66	-100.00
	South	Right	13451288	18	4	-14	4.22	-77.78
	South	Through	13451278	241	240	-1	0.06	-0.41
	West	Left	13451279	13	11	-2	0.58	-15.38
	West	Right	13451280	37	1	-36	8.26	-97.30
	West	Through	13451290	5	24	19	4.99	380.00
University Ave and Foleys Lane	North	Left	13449252	29	30	1	0.18	3.45
	North	Right	13449015	180	159	-21	1.61	-11.67
	South	Left	13449008	579	581	2	0.08	0.35
	South	Right	13449009	21	57	36	5.76	171.43
	West	Right	13449253	370	365	-5	0.26	-1.35
	West	Through	13449012	24	29	5	0.97	20.83
	East	Right	13452674	402	345	-57	2.95	-14.18

University Ave and Graham Ave	East	Left	13452673	359	383	24	1.25	6.69
	North	Left	13452665	388	395	7	0.35	1.80
	North	Through	13452666	453	579	126	5.55	27.81
University Ave and Irvine St	East	Left	13452636	125	136	11	0.96	8.80
	East	Right	13452637	300	264	-36	2.14	-12.00
	North	Left	13452634	827	828	1	0.03	0.12
	North	Through	13452632	114	122	8	0.74	7.02
	South	Through + Right	13452638	330	420	90	4.65	27.27
University Ave and Porter Street	East	Right	168188	72	113	41	4.26	56.94
	East	Through	168183	38	32	-6	1.01	-15.79
	North	Left	168186	43	55	12	1.71	27.91
	North	Right	168184	356	344	-12	0.64	-3.37
	West	Left	168187	528	536	8	0.35	1.52
	West	Through	168185	39	62	23	3.24	58.97
University Ave and Princes Ramps	East	Left + Through	13448974	248	311	63	3.77	25.40
	North	Left	13448972	194	286	92	5.94	47.42
	North	Through + Right	13448973	176	189	13	0.96	7.39
	West	Through + Right	13448977	1058	1130	72	2.18	6.81
Mean				235.01	234.00	-1.01		-0.43

In-session PM peak: Heavy Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Left	13452423	1	0	-1	1.41	-100.00
	East	Right	13452422	0	0	0	0.00	0.00
	East	Through	13452424	2	1	-1	0.82	-50.00
	North	Left	13452421	0	0	0	0.00	0.00
	North	Right	13452429	1	1	0	0.00	0.00
	North	Through	13452430	0	0	0	0.00	0.00
	South	Left	13452426	0	0	0	0.00	0.00
	South	Right	13452428	0	0	0	0.00	0.00
	South	Through	13452427	0	0	0	0.00	0.00
	West	Left	13452419	0	0	0	0.00	0.00
	West	Right	13452425	0	0	0	0.00	0.00
	West	Through	13452420	0	0	0	0.00	0.00
Gipps Road and Eastern Street	East	Right	173239	0	1	1	1.41	inf
	East	Through	173237	3	1	-2	1.41	-66.67
	North	Left	173241	0	0	0	0.00	0.00
	North	Right	173236	0	0	0	0.00	0.00
	West	Left	173238	0	0	0	0.00	0.00
	West	Through	173240	1	0	-1	1.41	-100.00
Gipps Road and Foley Street	North	Right	13452242	0	0	0	0.00	0.00
	North	Through	13452241	1	3	2	1.41	200.00
	South	Left	13452243	2	0	-2	2.00	-100.00
	South	Through	13452244	1	0	-1	1.41	-100.00
	West	Left	13452239	0	0	0	0.00	0.00
	West	Right	13452240	0	0	0	0.00	0.00
Gipps Road and Grey Street	East	Left	13451443	0	0	0	0.00	0.00
	East	Through	13451444	3	5	2	1.00	66.67
	North	Left	13452492	0	0	0	0.00	0.00
	North	Right	13452493	0	0	0	0.00	0.00
	North	Through	13451445	0	0	0	0.00	0.00
	West	Right	13451441	0	0	0	0.00	0.00
	West	Through	13451442	0	0	0	0.00	0.00
Gipps Road and Vickery Street	East	Left	13452654	0	0	0	0.00	0.00
	East	Through	13452653	2	0	-2	2.00	-100.00
	South	Left	13452649	0	1	1	1.41	inf
	South	Right	13452650	0	0	0	0.00	0.00
	West	Through	13452644	0	0	0	0.00	0.00
Memorial Drive and Porter Street	East	Through	13449030	3	3	0	0.00	0.00
	North	Left	13449029	0	4	4	2.83	inf
	North	Right	13449031	1	1	0	0.00	0.00
	West	Through	13449025	2	1	-1	0.82	-50.00
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	1	0	-1	1.41	-100.00
	North	Through	13449737	9	15	6	1.73	66.67
	South	Right	13449738	3	0	-3	2.45	-100.00
	South	Through	13449735	11	8	-3	0.97	-27.27
	West	Left	13449736	11	12	1	0.29	9.09
	West	Right	13449734	12	9	-3	0.93	-25.00
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	4	3	-1	0.53	-25.00
	East	Right	168314	0	0	0	0.00	0.00
	North	Right	168311	4	13	9	3.09	225.00
	North	Through	168316	17	10	-7	1.91	-41.18
	South	Left	13448825	17	23	6	1.34	35.29
	South	Through	168315	11	9	-2	0.63	-18.18
Mount Keira Road and Robsons Road	East	Right	13451237	3	1	-2	1.41	-66.67
	East	Through	13451238	4	0	-4	2.83	-100.00
	North	Left	13451235	5	13	8	2.67	160.00
	North	Right	13451236	7	2	-5	2.36	-71.43
	West	Left	13451233	2	0	-2	2.00	-100.00
	West	Through	13451234	3	0	-3	2.45	-100.00
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	0	0	0	0.00	0.00
	East	Through + Right	13449231	11	49	38	6.94	345.46
	North	Left	13449226	0	26	26	7.21	inf
	North	Through + Right	13449227	1	0	-1	1.41	-100.00
	South	Left	13449232	0	0	0	0.00	0.00
	South	Through + Right	13449233	0	0	0	0.00	0.00
	West	Left	13448727	0	1	1	1.41	inf
	West	Through + Right	13448709	10	26	16	3.77	160.00
Murphys Ave and Braeside Ave	East	Left	13451989	0	0	0	0.00	0.00
	East	Through	13451990	1	1	0	0.00	0.00
	South	Left	13451991	0	0	0	0.00	0.00
	South	Right	13451992	0	0	0	0.00	0.00
	West	Right	13451987	0	0	0	0.00	0.00
	West	Through	13451988	0	0	0	0.00	0.00
Murphys Ave and Eastern Street	East	Left	168003	0	8	8	4.00	inf
	East	Through	167998	1	1	0	0.00	0.00
	South	Left	167999	0	0	0	0.00	0.00
	South	Right	168001	0	0	0	0.00	0.00
	West	Right	168002	0	0	0	0.00	0.00
	West	Through	168000	0	0	0	0.00	0.00
	East	Left	13452001	0	0	0	0.00	0.00

Murphys Ave and John Street	East	Through	13452002	1	1	0	0.00	0.00
	South	Left	13452003	1	0	-1	1.41	-100.00
	South	Right	13452004	0	0	0	0.00	0.00
	West	Right	13452000	1	0	-1	1.41	-100.00
	West	Through	13451999	3	0	-3	2.45	-100.00
Murphys Ave and Robsons Road	East	Left	13452577	1	1	0	0.00	0.00
	East	Through + Right	13452574	0	0	0	0.00	0.00
	North	Left	13452570	0	0	0	0.00	0.00
	North	Through + Right	13452571	0	0	0	0.00	0.00
	South	Left	13452579	0	0	0	0.00	0.00
	South	Through + Right	13452578	0	0	0	0.00	0.00
	West	Left	13452585	0	0	0	0.00	0.00
	West	Through + Right	13452584	0	0	0	0.00	0.00
Northfields Ave and Princes Ramps	East	Left	13452617	0	0	0	0.00	0.00
	East	Through + Right	13452616	0	4	4	2.83	inf
	North	Left	13452610	0	0	0	0.00	0.00
	North	Through + Right	13452613	0	0	0	0.00	0.00
	South	Left	13452621	0	7	7	3.74	inf
	South	Through + Right	13452620	0	1	1	1.41	inf
	West	Left	13452624	0	0	0	0.00	0.00
	West	Through + Right	13452625	0	0	0	0.00	0.00
Northfields Ave and Uni Entrance	East	Through + Right	13449191	0	6	6	3.46	inf
	North	Left	13449199	0	0	0	0.00	0.00
	North	Right	13449200	0	0	0	0.00	0.00
	West	Left	13449196	0	0	0	0.00	0.00
	West	Through	13449197	0	0	0	0.00	0.00
Princes Hwy and Mt Ousley Road	East	Left	13448774	1	12	11	4.31	1100.00
	East	Through + Right	13448773	117	47	-70	7.73	-59.83
	North	Left	13449243	0	0	0	0.00	0.00
	North	Through + Right	13449240	10	1	-9	3.84	-90.00
	South	Left	168304	4	3	-1	0.53	-25.00
	South	Through + Right	168309	16	10	-6	1.66	-37.50
	West	Left	13449238	109	50	-59	6.62	-54.13
	West	Through + Right	13449239	2	4	2	1.15	100.00
Princes Hwy-Princes Hwy Exit	North	Through	168171	45	44	-1	0.15	-2.22
	South	Through	173227	38	19	-19	3.56	-50.00
Princes Motorway and Mount Ousley Road	East	Through	173116	117	138	21	1.86	17.95
	North	Left	13448693	1	20	19	5.86	1900.00
	North	Right	13448695	3	24	21	5.72	700.00
	West	Through	173118	149	177	28	2.19	18.79
Reserve Street and Gilmores Street	North	Right	13451327	0	0	0	0.00	0.00
	North	Through	13451328	0	0	0	0.00	0.00
	South	Left	13451324	1	0	-1	1.41	-100.00
	South	Through	13451325	0	0	0	0.00	0.00
	West	Left	13451326	0	0	0	0.00	0.00
	West	Right	13451329	0	0	0	0.00	0.00
Robsons Road and Gipps Road	East	Left	13452558	3	5	2	1.00	66.67
	East	Through + Right	13452553	0	0	0	0.00	0.00
	North	Through + Right	13452552	0	1	1	1.41	inf
	North	Left	13452557	0	0	0	0.00	0.00
	South	Left	13452559	0	0	0	0.00	0.00
	South	Through + Right	13452554	0	0	0	0.00	0.00
	West	Left	13452555	0	0	0	0.00	0.00
	West	Through + Right	13452556	0	0	0	0.00	0.00
Robsons Road and Northfields Ave	East	Left	13452598	0	0	0	0.00	0.00
	East	Right	13452597	0	0	0	0.00	0.00
	North	Left	13452605	0	0	0	0.00	0.00
	North	Through	13452607	0	0	0	0.00	0.00
	South	Through + Right	13452600	0	0	0	0.00	0.00
Robsons Road and Princes Motorway On Ramp	North	Left	13451189	1	1	0	0.00	0.00
	North	Through	13451190	12	14	2	0.55	16.67
	South	Right	13451186	2	1	-1	0.82	-50.00
	South	Through	13451185	3	0	-3	2.45	-100.00
Robsons Road and William Street	East	Left	13451281	0	1	1	1.41	inf
	East	Right	13451282	0	0	0	0.00	0.00
	East	Through	13451289	0	0	0	0.00	0.00
	North	Left	13451286	0	0	0	0.00	0.00
	North	Right	13451287	0	0	0	0.00	0.00
	North	Through	13451285	2	6	4	2.00	200.00
	South	Left	13451277	1	0	-1	1.41	-100.00
	South	Right	13451288	2	0	-2	2.00	-100.00
	South	Through	13451278	0	0	0	0.00	0.00
	West	Left	13451279	0	0	0	0.00	0.00
	West	Right	13451280	1	0	-1	1.41	-100.00
	West	Through	13451290	0	0	0	0.00	0.00
University Ave and Foleys Lane	North	Left	13449252	0	0	0	0.00	0.00
	North	Right	13449015	1	0	-1	1.41	-100.00
	South	Left	13449008	2	4	2	1.15	100.00
	South	Right	13449009	0	0	0	0.00	0.00
	West	Right	13449253	4	3	-1	0.53	-25.00
	West	Through	13449012	0	0	0	0.00	0.00
University Ave and Graham Ave	East	Right	13452674	0	0	0	0.00	0.00
	East	Left	13452673	2	4	2	1.15	100.00

[illegible]	North	Left	13452665	4	3	-1	0.53	-25.00
	North	Through	13452666	2	11	9	3.53	450.00
University Ave and Irvine St	East	Left	13452636	2	6	4	2.00	200.00
	East	Right	13452637	0	8	8	4.00	inf
	North	Left	13452634	2	0	-2	2.00	-100.00
	North	Through	13452632	0	3	3	2.45	inf
	South	Through + Right	13452638	0	0	0	0.00	0.00
University Ave and Porter Street	East	Right	168188	0	0	0	0.00	0.00
	East	Through	168183	0	0	0	0.00	0.00
	North	Left	168186	1	0	-1	1.41	-100.00
	North	Right	168184	3	3	0	0.00	0.00
	West	Left	168187	2	4	2	1.15	100.00
	West	Through	168185	0	1	1	1.41	inf
University Ave and Princes Ramps	East	Left + Through	13448974	1	3	2	1.41	200.00
	North	Left	13448972	0	14	14	5.29	inf
	North	Through + Right	13448973	0	22	22	6.63	inf
	West	Through + Right	13448977	2	0	-2	2.00	-100.00
Mean				4.73	5.25	0.52		10.99

Out-session AM peak: Light Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Left	13452423	0	3	3	2.45	inf
	East	Right	13452422	2	3	1	0.63	50.00
	East	Through	13452424	202	193	-9	0.64	-4.46
	North	Left	13452421	12	0	-12	4.90	-100.00
	North	Right	13452429	24	40	16	2.83	66.67
	North	Through	13452430	4	11	7	2.56	175.00
	South	Left	13452426	15	33	18	3.67	120.00
	South	Right	13452428	5	6	1	0.43	20.00
	South	Through	13452427	5	15	10	3.16	200.00
	West	Left	13452419	15	58	43	7.12	286.67
	West	Right	13452425	10	20	10	2.58	100.00
	West	Through	13452420	254	208	-46	3.03	-18.11
Gipps Road and Eastern Street	East	Right	173239	87	122	35	3.42	40.23
	East	Through	173237	156	144	-12	0.98	-7.69
	North	Left	173241	103	110	7	0.68	6.80
	North	Right	173236	4	0	-4	2.83	-100.00
	West	Left	173238	26	28	2	0.38	7.69
	West	Through	173240	183	174	-9	0.67	-4.92
Gipps Road and Foley Street	North	Right	13452242	81	46	-35	4.39	-43.21
	North	Through	13452241	616	618	2	0.08	0.32
	South	Left	13452243	214	201	-13	0.90	-6.07
	South	Through	13452244	244	246	2	0.13	0.82
	West	Left	13452239	57	38	-19	2.76	-33.33
	West	Right	13452240	266	220	-46	2.95	-17.29
Gipps Road and Grey Street	East	Left	13451443	15	0	-15	5.48	-100.00
	East	Through	13451444	97	90	-7	0.72	-7.22
	North	Left	13452492	15	11	-4	1.11	-26.67
	North	Right	13452493	7	2	-5	2.36	-71.43
	North	Through	13451445	4	0	-4	2.83	-100.00
	West	Right	13451441	13	0	-13	5.10	-100.00
	West	Through	13451442	125	115	-10	0.91	-8.00
Gipps Road and Vickery Street	East	Left	13452654	25	48	23	3.81	92.00
	East	Through	13452653	186	195	9	0.65	4.84
	South	Left	13452649	2	5	3	1.60	150.00
	South	Right	13452650	51	49	-2	0.28	-3.92
	West	Through	13452644	234	213	-21	1.40	-8.97
Memorial Drive and Porter Street	East	Through	13449030	299	291	-8	0.47	-2.68
	North	Left	13449029	83	187	104	8.95	125.30
	North	Right	13449031	376	279	-97	5.36	-25.80
	West	Through	13449025	315	281	-34	1.97	-10.79
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	55	72	17	2.13	30.91
	North	Through	13449737	1234	1242	8	0.23	0.65
	South	Right	13449738	128	107	-21	1.94	-16.41
	South	Through	13449735	513	620	107	4.50	20.86
	West	Left	13449736	879	980	101	3.31	11.49
	West	Right	13449734	618	672	54	2.13	8.74
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	430	356	-74	3.73	-17.21
	East	Right	168314	98	87	-11	1.14	-11.22
	North	Right	168311	354	357	3	0.16	0.85
	North	Through	168316	1543	1557	14	0.36	0.91
	South	Left	13448825	568	457	-111	4.90	-19.54
	South	Through	168315	544	653	109	4.46	20.04
Mount Keira Road and Robsons Road	East	Right	13451237	266	296	30	1.79	11.28
	East	Through	13451238	105	109	4	0.39	3.81
	North	Left	13451235	164	150	-14	1.12	-8.54
	North	Right	13451236	68	65	-3	0.37	-4.41
	West	Left	13451233	257	263	6	0.37	2.33
	West	Through	13451234	275	304	29	1.70	10.55
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	55	47	-8	1.12	-14.55
	East	Through + Right	13449231	370	530	160	7.54	43.24
	North	Left	13449226	68	58	-10	1.26	-14.71
	North	Through + Right	13449227	267	277	10	0.61	3.75
	South	Left	13449232	26	25	-1	0.20	-3.85
	South	Through + Right	13449233	51	49	-2	0.28	-3.92
	West	Left	13448727	2	16	14	4.67	700.00
	West	Through + Right	13448709	426	377	-49	2.45	-11.50
Murphys Ave and Braeside Ave	East	Left	13451989	6	4	-2	0.89	-33.33
	East	Through	13451990	91	98	7	0.72	7.69
	South	Left	13451991	24	7	-17	4.32	-70.83
	South	Right	13451992	10	11	1	0.31	10.00
	West	Right	13451987	15	4	-11	3.57	-73.33
	West	Through	13451988	94	108	14	1.39	14.89
Murphys Ave and Eastern Street	East	Left	168003	52	40	-12	1.77	-23.08
	East	Through	167998	108	90	-18	1.81	-16.67
	South	Left	167999	33	53	20	3.05	60.61
	South	Right	168001	85	89	4	0.43	4.71
	West	Right	168002	36	39	3	0.49	8.33
	West	Through	168000	87	81	-6	0.65	-6.90
Murphys Ave and John Street	East	Left	13452001	11	5	-6	2.12	-54.55
	East	Through	13452002	102	116	14	1.34	13.73
	South	Left	13452003	5	4	-1	0.47	-20.00
	South	Right	13452004	12	27	15	3.40	125.00
	West	Right	13452000	2	10	8	3.27	400.00
	West	Through	13451999	106	112	6	0.57	5.66

Murphys Ave and Robsons Road	East	Left	13452577	33	24	-9	1.69	-27.27
	East	Through + Right	13452574	51	80	29	3.58	56.86
	North	Left	13452570	23	27	4	0.80	17.39
	North	Through + Right	13452571	53	53	0	0.00	0.00
	South	Left	13452579	14	33	19	3.92	135.71
	South	Through + Right	13452578	170	141	-29	2.33	-17.06
	West	Left	13452585	3	1	-2	1.41	-66.67
	West	Through + Right	13452584	55	53	-2	0.27	-3.64
Northfields Ave and Princes Ramps	East	Left	13452617	4	5	1	0.47	25.00
	East	Through + Right	13452616	616	628	12	0.48	1.95
	North	Left	13452610	5	11	6	2.12	120.00
	North	Through + Right	13452613	140	146	6	0.50	4.29
	South	Left	13452621	173	188	15	1.12	8.67
	South	Through + Right	13452620	278	312	34	1.98	12.23
	West	Left	13452624	17	9	-8	2.22	-47.06
	West	Through + Right	13452625	126	134	8	0.70	6.35
Northfields Ave and Uni Entrance	East	Through + Right	13449191	413	458	45	2.16	10.90
	North	Left	13449199	78	110	32	3.30	41.03
	North	Right	13449200	29	27	-2	0.38	-6.90
	West	Left	13449196	63	47	-16	2.16	-25.40
	West	Through	13449197	40	31	-9	1.51	-22.50
Princes Hwy and Mt Ousley Road	East	Left	13448774	85	88	3	0.32	3.53
	East	Through + Right	13448773	103	76	-27	2.85	-26.21
	North	Left	13449243	48	48	0	0.00	0.00
	North	Through + Right	13449240	900	900	0	0.00	0.00
	South	Left	168304	269	440	171	9.08	63.57
	South	Through + Right	168309	811	814	3	0.11	0.37
	West	Left	13449238	119	134	15	1.33	12.61
	West	Through + Right	13449239	493	536	43	1.90	8.72
Princes Hwy-Princes Hwy Exit	North	Through	168171	1714	1629	-85	2.08	-4.96
	South	Through	173227	1986	1992	6	0.13	0.30
Princes Motorway and Mount Ousley Road	East	Through	173116	1437	1425	-12	0.32	-0.84
	North	Left	13448693	220	291	71	4.44	32.27
	North	Right	13448695	182	203	21	1.51	11.54
	West	Through	173118	1391	1432	41	1.09	2.95
Reserve Street and Gilmores Street	North	Right	13451327	19	16	-3	0.72	-15.79
	North	Through	13451328	27	32	5	0.92	18.52
	South	Left	13451324	80	78	-2	0.23	-2.50
	South	Through	13451325	36	38	2	0.33	5.56
	West	Left	13451326	19	20	1	0.23	5.26
	West	Right	13451329	104	90	-14	1.42	-13.46
Robsons Road and Gipps Road	East	Left	13452558	30	45	15	2.45	50.00
	East	Through + Right	13452553	68	50	-18	2.34	-26.47
	North	Through + Right	13452552	85	69	-16	1.82	-18.82
	North	Left	13452557	31	29	-2	0.37	-6.45
	South	Left	13452559	5	0	-5	3.16	-100.00
	South	Through + Right	13452554	215	200	-15	1.04	-6.98
	West	Left	13452555	5	1	-4	2.31	-80.00
	West	Through + Right	13452556	32	32	0	0.00	0.00
Robsons Road and Northfields Ave	East	Left	13452598	49	30	-19	3.02	-38.78
	East	Right	13452597	36	0	-36	8.49	-100.00
	North	Left	13452605	28	15	-13	2.80	-46.43
	North	Through	13452607	35	52	17	2.58	48.57
	South	Through + Right	13452600	152	166	14	1.11	9.21
Robsons Road and Princes Motorway On Ramp	North	Left	13451189	56	68	12	1.52	21.43
	North	Through	13451190	229	215	-14	0.94	-6.11
	South	Right	13451186	275	285	10	0.60	3.64
	South	Through	13451185	239	272	33	2.06	13.81
Robsons Road and William Street	East	Left	13451281	33	31	-2	0.35	-6.06
	East	Right	13451282	1	3	2	1.41	200.00
	East	Through	13451289	4	0	-4	2.83	-100.00
	North	Left	13451286	2	0	-2	2.00	-100.00
	North	Right	13451287	6	6	0	0.00	0.00
	North	Through	13451285	182	181	-1	0.07	-0.55
	South	Left	13451277	13	8	-5	1.54	-38.46
	South	Right	13451288	15	12	-3	0.82	-20.00
	South	Through	13451278	216	216	0	0.00	0.00
	West	Left	13451279	15	12	-3	0.82	-20.00
	West	Right	13451280	14	11	-3	0.85	-21.43
	West	Through	13451290	7	10	3	1.03	42.86
University Ave and Foleys Lane	North	Left	13449252	7	9	2	0.71	28.57
	North	Right	13449015	12	4	-8	2.83	-66.67
	South	Left	13449008	376	431	55	2.74	14.63
	South	Right	13449009	32	31	-1	0.18	-3.13
	West	Right	13449253	308	332	24	1.34	7.79
	West	Through	13449012	35	17	-18	3.53	-51.43
University Ave and Graham Ave	East	Right	13452674	188	180	-8	0.59	-4.26
	East	Left	13452673	168	253	85	5.86	50.60
	North	Left	13452665	307	348	41	2.27	13.36
	North	Through	13452666	186	243	57	3.89	30.65
University Ave and Irvine St	East	Left	13452636	76	108	32	3.34	42.11
	East	Right	13452637	336	340	4	0.22	1.19
	North	Left	13452634	264	290	26	1.56	9.85
	North	Through	13452632	100	103	3	0.30	3.00
	South	Through + Right	13452638	168	204	36	2.64	21.43
	East	Right	168188	56	55	-1	0.13	-1.79
	East	Through	168183	21	20	-1	0.22	-4.76

University Ave and Porter Street	North	Left	168186	40	73	33	4.39	82.50
	North	Right	168184	278	270	-8	0.48	-2.88
	West	Left	168187	355	406	51	2.61	14.37
	West	Through	168185	43	63	20	2.75	46.51
University Ave and Princes Ramps	East	Left + Through	13448974	179	148	-31	2.42	-17.32
	North	Left	13448972	223	261	38	2.44	17.04
	North	Through + Right	13448973	267	406	139	7.58	52.06
	West	Through + Right	13448977	405	455	50	2.41	12.35
University Ave and Princes Ramps	East	Left	13454071	38	43	5	0.79	13.16
Mean				186.93	193.55	6.62		3.54

Out-session AM peak: Heavy Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Left	13452423	0	0	0	0.00	0.00
	East	Right	13452422	0	0	0	0.00	0.00
	East	Through	13452424	1	0	-1	1.41	-100.00
	North	Left	13452421	0	0	0	0.00	0.00
	North	Right	13452429	0	3	3	2.45	inf
	North	Through	13452430	0	1	1	1.41	inf
	South	Left	13452426	0	0	0	0.00	0.00
	South	Right	13452428	0	0	0	0.00	0.00
	South	Through	13452427	0	0	0	0.00	0.00
	West	Left	13452419	0	3	3	2.45	inf
	West	Right	13452425	0	0	0	0.00	0.00
	West	Through	13452420	2	5	3	1.60	150.00
Gipps Road and Eastern Street	East	Right	173239	0	0	0	0.00	0.00
	East	Through	173237	1	3	2	1.41	200.00
	North	Left	173241	0	5	5	3.16	inf
	North	Right	173236	1	2	1	0.82	100.00
	West	Left	173238	0	0	0	0.00	0.00
	West	Through	173240	2	3	1	0.63	50.00
Gipps Road and Foley Street	North	Right	13452242	2	2	0	0.00	0.00
	North	Through	13452241	6	6	0	0.00	0.00
	South	Left	13452243	3	0	-3	2.45	-100.00
	South	Through	13452244	3	0	-3	2.45	-100.00
	West	Left	13452239	2	0	-2	2.00	-100.00
	West	Right	13452240	4	5	1	0.47	25.00
Gipps Road and Grey Street	East	Left	13451443	0	0	0	0.00	0.00
	East	Through	13451444	2	2	0	0.00	0.00
	North	Left	13452492	0	0	0	0.00	0.00
	North	Right	13452493	0	0	0	0.00	0.00
	North	Through	13451445	0	0	0	0.00	0.00
	West	Right	13451441	0	0	0	0.00	0.00
	West	Through	13451442	2	3	1	0.63	50.00
Gipps Road and Vickery Street	East	Left	13452654	0	2	2	2.00	inf
	East	Through	13452653	3	0	-3	2.45	-100.00
	South	Left	13452649	0	0	0	0.00	0.00
	South	Right	13452650	0	0	0	0.00	0.00
	West	Through	13452644	3	5	2	1.00	66.67
Memorial Drive and Porter Street	East	Through	13449030	2	3	1	0.63	50.00
	North	Left	13449029	1	6	5	2.67	500.00
	North	Right	13449031	4	6	2	0.89	50.00
	West	Through	13449025	2	0	-2	2.00	-100.00
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	1	1	0	0.00	0.00
	North	Through	13449737	26	42	16	2.74	61.54
	South	Right	13449738	6	3	-3	1.41	-50.00
	South	Through	13449735	11	12	1	0.29	9.09
	West	Left	13449736	21	22	1	0.22	4.76
	West	Right	13449734	18	26	8	1.71	44.44
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	14	4	-10	3.33	-71.43
	East	Right	168314	0	1	1	1.41	inf
	North	Right	168311	10	35	25	5.27	250.00
	North	Through	168316	35	33	-2	0.34	-5.71
	South	Left	13448825	28	26	-2	0.38	-7.14
	South	Through	168315	17	14	-3	0.76	-17.65
Mount Keira Road and Robsons Road	East	Right	13451237	8	5	-3	1.18	-37.50
	East	Through	13451238	6	0	-6	3.46	-100.00
	North	Left	13451235	6	2	-4	2.00	-66.67
	North	Right	13451236	0	0	0	0.00	0.00
	West	Left	13451233	2	3	1	0.63	50.00
	West	Through	13451234	2	0	-2	2.00	-100.00
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	0	0	0	0.00	0.00
	East	Through + Right	13449231	14	30	16	3.41	114.29
	North	Left	13449226	3	18	15	4.63	500.00
	North	Through + Right	13449227	0	0	0	0.00	0.00
	South	Left	13449232	0	0	0	0.00	0.00
	South	Through + Right	13449233	0	16	16	5.66	inf
	West	Left	13448727	0	6	6	3.46	inf
	West	Through + Right	13448709	18	43	25	4.53	138.89
Murphys Ave and Braeside Ave	East	Left	13451989	0	0	0	0.00	0.00
	East	Through	13451990	2	1	-1	0.82	-50.00
	South	Left	13451991	0	0	0	0.00	0.00
	South	Right	13451992	0	0	0	0.00	0.00
	West	Right	13451987	0	0	0	0.00	0.00
	West	Through	13451988	0	4	4	2.83	inf
Murphys Ave and Eastern Street	East	Left	168003	4	4	0	0.00	0.00
	East	Through	167998	3	1	-2	1.41	-66.67
	South	Left	167999	0	0	0	0.00	0.00
	South	Right	168001	0	0	0	0.00	0.00
	West	Right	168002	0	1	1	1.41	inf
	West	Through	168000	1	1	0	0.00	0.00
	East	Left	13452001	0	0	0	0.00	0.00

Murphys Ave and John Street	East	Through	13452002	2	1	-1	0.82	-50.00
	South	Left	13452003	0	0	0	0.00	0.00
	South	Right	13452004	1	1	0	0.00	0.00
	West	Right	13452000	0	2	2	2.00	inf
	West	Through	13451999	0	2	2	2.00	inf
Murphys Ave and Robsons Road	East	Left	13452577	2	0	-2	2.00	-100.00
	East	Through + Right	13452574	0	0	0	0.00	0.00
	North	Left	13452570	0	4	4	2.83	inf
	North	Through + Right	13452571	3	1	-2	1.41	-66.67
	South	Left	13452579	0	0	0	0.00	0.00
	South	Through + Right	13452578	2	2	0	0.00	0.00
	West	Left	13452585	0	0	0	0.00	0.00
	West	Through + Right	13452584	0	0	0	0.00	0.00
Northfields Ave and Princes Ramps	East	Left	13452617	0	0	0	0.00	0.00
	East	Through + Right	13452616	4	5	1	0.47	25.00
	North	Left	13452610	0	0	0	0.00	0.00
	North	Through + Right	13452613	0	2	2	2.00	inf
	South	Left	13452621	3	1	-2	1.41	-66.67
	South	Through + Right	13452620	2	0	-2	2.00	-100.00
	West	Left	13452624	0	0	0	0.00	0.00
	West	Through + Right	13452625	7	3	-4	1.79	-57.14
Northfields Ave and Uni Entrance	East	Through + Right	13449191	6	5	-1	0.43	-16.67
	North	Left	13449199	3	2	-1	0.63	-33.33
	North	Right	13449200	0	0	0	0.00	0.00
	West	Left	13449196	0	1	1	1.41	inf
	West	Through	13449197	2	1	-1	0.82	-50.00
Princes Hwy and Mt Ousley Road	East	Left	13448774	0	12	12	4.90	inf
	East	Through + Right	13448773	103	39	-64	7.60	-62.14
	North	Left	13449243	0	0	0	0.00	0.00
	North	Through + Right	13449240	27	22	-5	1.01	-18.52
	South	Left	168304	4	7	3	1.28	75.00
	South	Through + Right	168309	25	26	1	0.20	4.00
	West	Left	13449238	119	75	-44	4.47	-36.97
	West	Through + Right	13449239	14	10	-4	1.15	-28.57
Princes Hwy-Princes Hwy Exit	North	Through	168171	92	96	4	0.41	4.35
	South	Through	173227	88	87	-1	0.11	-1.14
Princes Motorway and Mount Ousley Road	East	Through	173116	237	244	7	0.45	2.95
	North	Left	13448693	6	9	3	1.10	50.00
	North	Right	13448695	8	12	4	1.26	50.00
	West	Through	173118	216	239	23	1.52	10.65
Reserve Street and Gilmores Street	North	Right	13451327	0	0	0	0.00	0.00
	North	Through	13451328	0	0	0	0.00	0.00
	South	Left	13451324	0	0	0	0.00	0.00
	South	Through	13451325	0	0	0	0.00	0.00
	West	Left	13451326	0	0	0	0.00	0.00
	West	Right	13451329	1	0	-1	1.41	-100.00
Robsons Road and Gipps Road	East	Left	13452558	0	2	2	2.00	inf
	East	Through + Right	13452553	2	0	-2	2.00	-100.00
	North	Through + Right	13452552	2	0	-2	2.00	-100.00
	North	Left	13452557	1	1	0	0.00	0.00
	South	Left	13452559	1	0	-1	1.41	-100.00
	South	Through + Right	13452554	3	4	1	0.53	33.33
	West	Left	13452555	0	0	0	0.00	0.00
	West	Through + Right	13452556	0	0	0	0.00	0.00
Robsons Road and Northfields Ave	East	Left	13452598	0	0	0	0.00	0.00
	East	Right	13452597	0	0	0	0.00	0.00
	North	Left	13452605	0	1	1	1.41	inf
	North	Through	13452607	1	3	2	1.41	200.00
	South	Through + Right	13452600	3	2	-1	0.63	-33.33
Robsons Road and Princes Motorway On Ramp	North	Left	13451189	5	2	-3	1.60	-60.00
	North	Through	13451190	1	2	1	0.82	100.00
	South	Right	13451186	5	4	-1	0.47	-20.00
	South	Through	13451185	6	4	-2	0.89	-33.33
Robsons Road and William Street	East	Left	13451281	1	0	-1	1.41	-100.00
	East	Right	13451282	0	0	0	0.00	0.00
	East	Through	13451289	0	0	0	0.00	0.00
	North	Left	13451286	0	0	0	0.00	0.00
	North	Right	13451287	2	0	-2	2.00	-100.00
	North	Through	13451285	5	4	-1	0.47	-20.00
	South	Left	13451277	1	0	-1	1.41	-100.00
	South	Right	13451288	0	0	0	0.00	0.00
	South	Through	13451278	5	4	-1	0.47	-20.00
	West	Left	13451279	0	0	0	0.00	0.00
	West	Right	13451280	1	0	-1	1.41	-100.00
	West	Through	13451290	0	1	1	1.41	inf
University Ave and Foleys Lane	North	Left	13449252	0	0	0	0.00	0.00
	North	Right	13449015	2	0	-2	2.00	-100.00
	South	Left	13449008	3	6	3	1.41	100.00
	South	Right	13449009	0	0	0	0.00	0.00
	West	Right	13449253	2	3	1	0.63	50.00
	West	Through	13449012	0	0	0	0.00	0.00
University Ave and Graham Ave	East	Right	13452674	1	0	-1	1.41	-100.00
	East	Left	13452673	2	6	4	2.00	200.00

[illegible]	North	Left	13452665	2	3	1	0.63	50.00
	North	Through	13452666	15	9	-6	1.73	-40.00
University Ave and Irvine St	East	Left	13452636	3	7	4	1.79	133.33
	East	Right	13452637	5	1	-4	2.31	-80.00
	North	Left	13452634	8	5	-3	1.18	-37.50
	North	Through	13452632	2	1	-1	0.82	-50.00
	South	Through + Right	13452638	1	2	1	0.82	100.00
University Ave and Porter Street	East	Right	168188	0	0	0	0.00	0.00
	East	Through	168183	0	0	0	0.00	0.00
	North	Left	168186	0	0	0	0.00	0.00
	North	Right	168184	2	3	1	0.63	50.00
	West	Left	168187	3	6	3	1.41	100.00
	West	Through	168185	0	0	0	0.00	0.00
University Ave and Princes Ramps	East	Left + Through	13448974	1	0	-1	1.41	-100.00
	North	Left	13448972	11	5	-6	2.12	-54.55
	North	Through + Right	13448973	7	32	25	5.66	357.14
	West	Through + Right	13448977	9	7	-2	0.71	-22.22
University Ave and Princes Ramps	East	Left	13454071	1	0	-1	1.41	-100.00
Mean				7.80	8.11	0.31		3.99

Out-session PM peak: Light Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Left	13452423	13	0	-13	5.10	-100.00
	East	Right	13452422	0	2	2	2.00	inf
	East	Through	13452424	328	315	-13	0.73	-3.96
	North	Left	13452421	9	0	-9	4.24	-100.00
	North	Right	13452429	30	48	18	2.88	60.00
	North	Through	13452430	14	21	7	1.67	50.00
	South	Left	13452426	20	36	16	3.02	80.00
	South	Right	13452428	8	3	-5	2.13	-62.50
	South	Through	13452427	7	13	6	1.90	85.71
	West	Left	13452419	17	42	25	4.60	147.06
	West	Right	13452425	11	13	2	0.58	18.18
	West	Through	13452420	265	232	-33	2.09	-12.45
Gipps Road and Eastern Street	East	Right	173239	99	115	16	1.55	16.16
	East	Through	173237	285	286	1	0.06	0.35
	North	Left	173241	125	127	2	0.18	1.60
	North	Right	173236	15	15	0	0.00	0.00
	West	Left	173238	14	19	5	1.23	35.71
	West	Through	173240	170	159	-11	0.86	-6.47
Gipps Road and Foley Street	North	Right	13452242	101	65	-36	3.95	-35.64
	North	Through	13452241	505	540	35	1.53	6.93
	South	Left	13452243	304	296	-8	0.46	-2.63
	South	Through	13452244	362	329	-33	1.78	-9.12
	West	Left	13452239	66	43	-23	3.12	-34.85
	West	Right	13452240	263	239	-24	1.51	-9.13
Gipps Road and Grey Street	East	Left	13451443	21	0	-21	6.48	-100.00
	East	Through	13451444	174	171	-3	0.23	-1.72
	North	Left	13452492	15	13	-2	0.53	-13.33
	North	Right	13452493	12	0	-12	4.90	-100.00
	North	Through	13451445	6	5	-1	0.43	-16.67
	West	Right	13451441	7	0	-7	3.74	-100.00
	West	Through	13451442	124	141	17	1.48	13.71
Gipps Road and Vickery Street	East	Left	13452654	43	59	16	2.24	37.21
	East	Through	13452653	275	304	29	1.70	10.55
	South	Left	13452649	3	13	10	3.54	333.33
	South	Right	13452650	37	45	8	1.25	21.62
	West	Through	13452644	243	236	-7	0.45	-2.88
Memorial Drive and Porter Street	East	Through	13449030	340	362	22	1.17	6.47
	North	Left	13449029	67	126	59	6.01	88.06
	North	Right	13449031	290	277	-13	0.77	-4.48
	West	Through	13449025	423	400	-23	1.13	-5.44
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	72	130	58	5.77	80.56
	North	Through	13449737	1082	994	-88	2.73	-8.13
	South	Right	13449738	374	314	-60	3.23	-16.04
	South	Through	13449735	762	962	200	6.81	26.25
	West	Left	13449736	867	896	29	0.98	3.34
	West	Right	13449734	350	368	18	0.95	5.14
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	207	209	2	0.14	0.97
	East	Right	168314	51	61	10	1.34	19.61
	North	Right	168311	422	392	-30	1.49	-7.11
	North	Through	168316	1007	968	-39	1.24	-3.87
	South	Left	13448825	845	723	-122	4.36	-14.44
	South	Through	168315	1075	1221	146	4.31	13.58
Mount Keira Road and Robsons Road	East	Right	13451237	340	343	3	0.16	0.88
	East	Through	13451238	286	290	4	0.24	1.40
	North	Left	13451235	198	212	14	0.98	7.07
	North	Right	13451236	199	193	-6	0.43	-3.02
	West	Left	13451233	150	151	1	0.08	0.67
	West	Through	13451234	188	174	-14	1.04	-7.45
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	35	38	3	0.50	8.57
	East	Through + Right	13449231	539	551	12	0.51	2.23
	North	Left	13449226	37	50	13	1.97	35.14
	North	Through + Right	13449227	138	122	-16	1.40	-11.59
	South	Left	13449232	19	30	11	2.22	57.89
	South	Through + Right	13449233	31	26	-5	0.94	-16.13
	West	Left	13448727	9	21	12	3.10	133.33
	West	Through + Right	13448709	323	276	-47	2.72	-14.55
Murphys Ave and Braeside Ave	East	Left	13451989	16	14	-2	0.52	-12.50
	East	Through	13451990	131	128	-3	0.26	-2.29
	South	Left	13451991	38	1	-37	8.38	-97.37
	South	Right	13451992	6	9	3	1.10	50.00
	West	Right	13451987	7	0	-7	3.74	-100.00
	West	Through	13451988	89	95	6	0.63	6.74
Murphys Ave and Eastern Street	East	Left	168003	78	83	5	0.56	6.41
	East	Through	167998	130	112	-18	1.64	-13.85
	South	Left	167999	31	34	3	0.53	9.68
	South	Right	168001	79	86	7	0.77	8.86
	West	Right	168002	55	54	-1	0.14	-1.82
	West	Through	168000	88	87	-1	0.11	-1.14
	East	Left	13452001	18	18	0	0.00	0.00

Murphys Ave and John Street	East	Through	13452002	137	134	-3	0.26	-2.19
	South	Left	13452003	8	4	-4	1.63	-50.00
	South	Right	13452004	8	2	-6	2.68	-75.00
	West	Right	13452000	8	10	2	0.67	25.00
	West	Through	13451999	106	122	16	1.50	15.09
Murphys Ave and Robsons Road	East	Left	13452577	78	84	6	0.67	7.69
	East	Through + Right	13452574	62	52	-10	1.32	-16.13
	North	Left	13452570	21	18	-3	0.68	-14.29
	North	Through + Right	13452571	145	112	-33	2.91	-22.76
	South	Left	13452579	24	24	0	0.00	0.00
	South	Through + Right	13452578	117	122	5	0.46	4.27
	West	Left	13452585	0	0	0	0.00	0.00
	West	Through + Right	13452584	52	51	-1	0.14	-1.92
Northfields Ave and Princes Ramps	East	Left	13452617	9	17	8	2.22	88.89
	East	Through + Right	13452616	160	142	-18	1.46	-11.25
	North	Left	13452610	38	43	5	0.79	13.16
	North	Through + Right	13452613	301	315	14	0.80	4.65
	South	Left	13452621	63	61	-2	0.25	-3.17
	South	Through + Right	13452620	239	279	40	2.49	16.74
	West	Left	13452624	14	1	-13	4.75	-92.86
	West	Through + Right	13452625	391	402	11	0.55	2.81
Northfields Ave and Uni Entrance	East	Through + Right	13449191	124	139	15	1.31	12.10
	North	Left	13449199	284	305	21	1.22	7.39
	North	Right	13449200	49	37	-12	1.83	-24.49
	West	Left	13449196	25	20	-5	1.05	-20.00
	West	Through	13449197	96	99	3	0.30	3.13
Princes Hwy and Mt Ousley Road	East	Left	13448774	72	73	1	0.12	1.39
	East	Through + Right	13448773	117	110	-7	0.66	-5.98
	North	Left	13449243	50	56	6	0.82	12.00
	North	Through + Right	13449240	793	799	6	0.21	0.76
	South	Left	168304	336	380	44	2.33	13.10
	South	Through + Right	168309	1251	1295	44	1.23	3.52
	West	Left	13449238	109	110	1	0.10	0.92
	West	Through + Right	13449239	309	362	53	2.89	17.15
Princes Hwy-Princes Hwy Exit	North	Through	168171	1997	1771	-226	5.21	-11.32
	South	Through	173227	1749	1789	40	0.95	2.29
Princes Motorway and Mount Ousley Road	East	Through	173116	1699	1682	-17	0.41	-1.00
	North	Left	13448693	342	351	9	0.48	2.63
	North	Right	13448695	151	52	-99	9.83	-65.56
	West	Through	173118	1893	1897	4	0.09	0.21
Reserve Street and Gilmores Street	North	Right	13451327	28	30	2	0.37	7.14
	North	Through	13451328	44	28	-16	2.67	-36.36
	South	Left	13451324	137	131	-6	0.52	-4.38
	South	Through	13451325	57	48	-9	1.24	-15.79
	West	Left	13451326	19	26	7	1.48	36.84
	West	Right	13451329	50	64	14	1.85	28.00
Robsons Road and Gipps Road	East	Left	13452558	98	96	-2	0.20	-2.04
	East	Through + Right	13452553	83	75	-8	0.90	-9.64
	North	Through + Right	13452552	188	177	-11	0.81	-5.85
	North	Left	13452557	43	33	-10	1.62	-23.26
	South	Left	13452559	2	0	-2	2.00	-100.00
	South	Through + Right	13452554	147	158	11	0.89	7.48
	West	Left	13452555	5	6	1	0.43	20.00
	West	Through + Right	13452556	23	32	9	1.72	39.13
Robsons Road and Northfields Ave	East	Left	13452598	79	72	-7	0.81	-8.86
	East	Right	13452597	23	0	-23	6.78	-100.00
	North	Left	13452605	66	73	7	0.84	10.61
	North	Through	13452607	98	87	-11	1.14	-11.22
	South	Through + Right	13452600	80	71	-9	1.04	-11.25
Robsons Road and Princes Motorway On Ramp	North	Left	13451189	45	54	9	1.28	20.00
	North	Through	13451190	410	404	-6	0.30	-1.46
	South	Right	13451186	229	216	-13	0.87	-5.68
	South	Through	13451185	257	282	25	1.52	9.73
Robsons Road and William Street	East	Left	13451281	47	44	-3	0.44	-6.38
	East	Right	13451282	3	5	2	1.00	66.67
	East	Through	13451289	7	6	-1	0.39	-14.29
	North	Left	13451286	2	0	-2	2.00	-100.00
	North	Right	13451287	13	11	-2	0.58	-15.38
	North	Through	13451285	287	298	11	0.64	3.83
	South	Left	13451277	15	0	-15	5.48	-100.00
	South	Right	13451288	27	15	-12	2.62	-44.44
	South	Through	13451278	183	211	28	1.99	15.30
	West	Left	13451279	10	9	-1	0.32	-10.00
	West	Right	13451280	24	1	-23	6.51	-95.83
	West	Through	13451290	7	14	7	2.16	100.00
University Ave and Foleys Lane	North	Left	13449252	13	23	10	2.36	76.92
	North	Right	13449015	47	10	-37	6.93	-78.72
	South	Left	13449008	499	529	30	1.32	6.01
	South	Right	13449009	11	32	21	4.53	190.91
	West	Right	13449253	340	357	17	0.91	5.00
	West	Through	13449012	15	4	-11	3.57	-73.33
University Ave and Graham Ave	East	Right	13452674	199	226	27	1.85	13.57
	East	Left	13452673	244	318	74	4.41	30.33

[illegible]	North	Left	13452665	319	362	43	2.33	13.48
	North	Through	13452666	367	451	84	4.15	22.89
University Ave and Irvine St	East	Left	13452636	114	130	16	1.45	14.04
	East	Right	13452637	211	222	11	0.75	5.21
	North	Left	13452634	559	625	66	2.71	11.81
	North	Through	13452632	77	80	3	0.34	3.90
	South	Through + Right	13452638	174	263	89	6.02	51.15
University Ave and Porter Street	East	Right	168188	61	94	33	3.75	54.10
	East	Through	168183	25	23	-2	0.41	-8.00
	North	Left	168186	39	43	4	0.62	10.26
	North	Right	168184	315	338	23	1.27	7.30
	West	Left	168187	450	463	13	0.61	2.89
	West	Through	168185	40	64	24	3.33	60.00
University Ave and Princes Ramps	East	Left + Through	13448974	193	224	31	2.15	16.06
	North	Left	13448972	218	304	86	5.32	39.45
	North	Through + Right	13448973	166	270	104	7.04	62.65
	West	Through + Right	13448977	855	869	14	0.48	1.64
University Ave and Princes Ramps	East	Left	13454071	66	68	2	0.24	3.03
Mean				207.57	211.32	3.74		1.80

Out-session PM peak: Heavy Vehicles

Intersection	Direction	Movement	Aimsun TID	Survey Count	Modelled Flow	Difference	GEH	Relative Difference (%)
Gipps Road and Berkeley Road	East	Left	13452423	0	0	0	0.00	0.00
	East	Right	13452422	0	0	0	0.00	0.00
	East	Through	13452424	2	0	-2	2.00	-100.00
	North	Left	13452421	0	0	0	0.00	0.00
	North	Right	13452429	0	0	0	0.00	0.00
	North	Through	13452430	0	0	0	0.00	0.00
	South	Left	13452426	0	0	0	0.00	0.00
	South	Right	13452428	0	0	0	0.00	0.00
	South	Through	13452427	0	0	0	0.00	0.00
	West	Left	13452419	0	0	0	0.00	0.00
	West	Right	13452425	0	0	0	0.00	0.00
	West	Through	13452420	0	0	0	0.00	0.00
Gipps Road and Eastern Street	East	Right	173239	0	0	0	0.00	0.00
	East	Through	173237	2	0	-2	2.00	-100.00
	North	Left	173241	1	0	-1	1.41	-100.00
	North	Right	173236	0	0	0	0.00	0.00
	West	Left	173238	0	0	0	0.00	0.00
	West	Through	173240	0	0	0	0.00	0.00
Gipps Road and Foley Street	North	Right	13452242	2	0	-2	2.00	-100.00
	North	Through	13452241	1	3	2	1.41	200.00
	South	Left	13452243	0	0	0	0.00	0.00
	South	Through	13452244	1	0	-1	1.41	-100.00
	West	Left	13452239	0	0	0	0.00	0.00
	West	Right	13452240	0	0	0	0.00	0.00
Gipps Road and Grey Street	East	Left	13451443	0	0	0	0.00	0.00
	East	Through	13451444	1	0	-1	1.41	-100.00
	North	Left	13452492	0	0	0	0.00	0.00
	North	Right	13452493	0	0	0	0.00	0.00
	North	Through	13451445	0	0	0	0.00	0.00
	West	Right	13451441	1	0	-1	1.41	-100.00
	West	Through	13451442	0	0	0	0.00	0.00
Gipps Road and Vickery Street	East	Left	13452654	0	0	0	0.00	0.00
	East	Through	13452653	3	0	-3	2.45	-100.00
	South	Left	13452649	0	0	0	0.00	0.00
	South	Right	13452650	0	0	0	0.00	0.00
	West	Through	13452644	0	0	0	0.00	0.00
Memorial Drive and Porter Street	East	Through	13449030	1	2	1	0.82	100.00
	North	Left	13449029	0	0	0	0.00	0.00
	North	Right	13449031	2	1	-1	0.82	-50.00
	West	Through	13449025	0	0	0	0.00	0.00
Memorial Drive North Bound and M1 Princes Hwy	North	Left	13448802	1	0	-1	1.41	-100.00
	North	Through	13449737	9	15	6	1.73	66.67
	South	Right	13449738	3	0	-3	2.45	-100.00
	South	Through	13449735	11	10	-1	0.31	-9.09
	West	Left	13449736	11	10	-1	0.31	-9.09
	West	Right	13449734	12	11	-1	0.29	-8.33
Memorial Drive South Bound and M1 Princes Hwy	East	Left	13448816	4	1	-3	1.90	-75.00
	East	Right	168314	0	0	0	0.00	0.00
	North	Right	168311	4	15	11	3.57	275.00
	North	Through	168316	17	11	-6	1.60	-35.29
	South	Left	13448825	17	17	0	0.00	0.00
	South	Through	168315	11	10	-1	0.31	-9.09
Mount Keira Road and Robsons Road	East	Right	13451237	3	0	-3	2.45	-100.00
	East	Through	13451238	4	0	-4	2.83	-100.00
	North	Left	13451235	2	3	1	0.63	50.00
	North	Right	13451236	0	0	0	0.00	0.00
	West	Left	13451233	2	0	-2	2.00	-100.00
	West	Through	13451234	3	0	-3	2.45	-100.00
Mt Ousley Road and Gaynor Avenue	East	Left	13449230	0	0	0	0.00	0.00
	East	Through + Right	13449231	11	54	43	7.54	390.91
	North	Left	13449226	0	15	15	5.48	inf
	North	Through + Right	13449227	1	0	-1	1.41	-100.00
	South	Left	13449232	0	0	0	0.00	0.00
	South	Through + Right	13449233	0	0	0	0.00	0.00
	West	Left	13448727	0	1	1	1.41	inf
	West	Through + Right	13448709	10	27	17	3.95	170.00
Murphys Ave and Braeside Ave	East	Left	13451989	0	0	0	0.00	0.00
	East	Through	13451990	1	2	1	0.82	100.00
	South	Left	13451991	0	0	0	0.00	0.00
	South	Right	13451992	1	0	-1	1.41	-100.00
	West	Right	13451987	0	0	0	0.00	0.00
	West	Through	13451988	1	0	-1	1.41	-100.00
Murphys Ave and Eastern Street	East	Left	168003	0	17	17	5.83	inf
	East	Through	167998	1	2	1	0.82	100.00
	South	Left	167999	0	0	0	0.00	0.00
	South	Right	168001	0	1	1	1.41	inf
	West	Right	168002	0	0	0	0.00	0.00
	West	Through	168000	1	0	-1	1.41	-100.00
	East	Left	13452001	0	0	0	0.00	0.00

Murphys Ave and John Street	East	Through	13452002	1	2	1	0.82	100.00
	South	Left	13452003	0	0	0	0.00	0.00
	South	Right	13452004	0	0	0	0.00	0.00
	West	Right	13452000	0	0	0	0.00	0.00
	West	Through	13451999	0	0	0	0.00	0.00
Murphys Ave and Robsons Road	East	Left	13452577	1	2	1	0.82	100.00
	East	Through + Right	13452574	0	0	0	0.00	0.00
	North	Left	13452570	0	0	0	0.00	0.00
	North	Through + Right	13452571	0	0	0	0.00	0.00
	South	Left	13452579	2	0	-2	2.00	-100.00
	South	Through + Right	13452578	0	0	0	0.00	0.00
	West	Left	13452585	0	0	0	0.00	0.00
	West	Through + Right	13452584	2	0	-2	2.00	-100.00
Northfields Ave and Princes Ramps	East	Left	13452617	0	0	0	0.00	0.00
	East	Through + Right	13452616	0	0	0	0.00	0.00
	North	Left	13452610	0	0	0	0.00	0.00
	North	Through + Right	13452613	0	0	0	0.00	0.00
	South	Left	13452621	0	0	0	0.00	0.00
	South	Through + Right	13452620	2	3	1	0.63	50.00
	West	Left	13452624	0	0	0	0.00	0.00
	West	Through + Right	13452625	3	3	0	0.00	0.00
Northfields Ave and Uni Entrance	East	Through + Right	13449191	0	0	0	0.00	0.00
	North	Left	13449199	1	1	0	0.00	0.00
	North	Right	13449200	0	0	0	0.00	0.00
	West	Left	13449196	0	0	0	0.00	0.00
	West	Through	13449197	0	2	2	2.00	inf
Princes Hwy and Mt Ousley Road	East	Left	13448774	1	10	9	3.84	900.00
	East	Through + Right	13448773	117	50	-67	7.33	-57.27
	North	Left	13449243	0	0	0	0.00	0.00
	North	Through + Right	13449240	10	1	-9	3.84	-90.00
	South	Left	168304	4	3	-1	0.53	-25.00
	South	Through + Right	168309	16	9	-7	1.98	-43.75
	West	Left	13449238	109	44	-65	7.43	-59.63
	West	Through + Right	13449239	2	2	0	0.00	0.00
Princes Hwy-Princes Hwy Exit	North	Through	168171	32	31	-1	0.18	-3.13
	South	Through	173227	32	19	-13	2.57	-40.63
Princes Motorway and Mount Ousley Road	East	Through	173116	93	118	25	2.43	26.88
	North	Left	13448693	5	20	15	4.24	300.00
	North	Right	13448695	1	32	31	7.63	3100.00
	West	Through	173118	144	171	27	2.15	18.75
Reserve Street and Gilmores Street	North	Right	13451327	0	0	0	0.00	0.00
	North	Through	13451328	0	0	0	0.00	0.00
	South	Left	13451324	0	0	0	0.00	0.00
	South	Through	13451325	0	0	0	0.00	0.00
	West	Left	13451326	0	0	0	0.00	0.00
	West	Right	13451329	0	0	0	0.00	0.00
Robsons Road and Gipps Road	East	Left	13452558	0	0	0	0.00	0.00
	East	Through + Right	13452553	1	0	-1	1.41	-100.00
	North	Through + Right	13452552	1	2	1	0.82	100.00
	North	Left	13452557	0	0	0	0.00	0.00
	South	Left	13452559	0	0	0	0.00	0.00
	South	Through + Right	13452554	1	0	-1	1.41	-100.00
	West	Left	13452555	0	0	0	0.00	0.00
	West	Through + Right	13452556	0	0	0	0.00	0.00
Robsons Road and Northfields Ave	East	Left	13452598	0	0	0	0.00	0.00
	East	Right	13452597	0	0	0	0.00	0.00
	North	Left	13452605	0	2	2	2.00	inf
	North	Through	13452607	0	0	0	0.00	0.00
	South	Through + Right	13452600	0	0	0	0.00	0.00
Robsons Road and Princes Motorway On Ramp	North	Left	13451189	0	1	1	1.41	inf
	North	Through	13451190	1	2	1	0.82	100.00
	South	Right	13451186	4	0	-4	2.83	-100.00
	South	Through	13451185	0	0	0	0.00	0.00
Robsons Road and William Street	East	Left	13451281	0	0	0	0.00	0.00
	East	Right	13451282	0	0	0	0.00	0.00
	East	Through	13451289	0	0	0	0.00	0.00
	North	Left	13451286	0	0	0	0.00	0.00
	North	Right	13451287	0	0	0	0.00	0.00
	North	Through	13451285	2	2	0	0.00	0.00
	South	Left	13451277	0	0	0	0.00	0.00
	South	Right	13451288	0	0	0	0.00	0.00
	South	Through	13451278	1	0	-1	1.41	-100.00
	West	Left	13451279	0	0	0	0.00	0.00
	West	Right	13451280	0	0	0	0.00	0.00
	West	Through	13451290	0	0	0	0.00	0.00
University Ave and Foleys Lane	North	Left	13449252	0	0	0	0.00	0.00
	North	Right	13449015	1	0	-1	1.41	-100.00
	South	Left	13449008	0	0	0	0.00	0.00
	South	Right	13449009	0	0	0	0.00	0.00
	West	Right	13449253	1	2	1	0.82	100.00
	West	Through	13449012	0	0	0	0.00	0.00
University Ave and Graham Ave	East	Right	13452674	0	0	0	0.00	0.00
	East	Left	13452673	0	0	0	0.00	0.00

[illegible]	North	Left	13452665	1	2	1	0.82	100.00
	North	Through	13452666	9	11	2	0.63	22.22
University Ave and Irvine St	East	Left	13452636	0	16	16	5.66	inf
	East	Right	13452637	2	3	1	0.63	50.00
	North	Left	13452634	2	1	-1	0.82	-50.00
	North	Through	13452632	1	3	2	1.41	200.00
	South	Through + Right	13452638	3	1	-2	1.41	-66.67
University Ave and Porter Street	East	Right	168188	0	0	0	0.00	0.00
	East	Through	168183	0	0	0	0.00	0.00
	North	Left	168186	0	0	0	0.00	0.00
	North	Right	168184	1	2	1	0.82	100.00
	West	Left	168187	0	0	0	0.00	0.00
	West	Through	168185	0	0	0	0.00	0.00
University Ave and Princes Ramps	East	Left + Through	13454071	0	3	3	2.45	inf
	North	Left	13448974	0	3	3	2.45	inf
	North	Through + Right	13448972	7	11	4	1.33	57.14
	West	Through + Right	13448973	2	30	28	7.00	1400.00
University Ave and Princes Ramps	East	Left	13448977	4	2	-2	1.15	-50.00
Mean				4.34	4.72	0.38		8.83

Keiraville – Gwynneville Access and Movement Study

APPENDIX D

TRAVEL TIME DATA

AM Peak - 8:00AM to 9:00AM

Location / Direction	Month	Covered Route Length [meters]	Sample size [avg per segment]	Average Travel Time [hh:mm:ss]	Median Travel Time [hh:mm:ss]	Harmonic Average Speed [kph]	15th percentile Speed [kph]	85th percentile Speed [kph]
Foley St / Southbound	Aug	1,137.40	590.22	00:02:42	00:02:06	25.20	18.27	42.76
Foley St / Northbound		1,127.98	273.75	00:02:33	00:01:54	26.48	19.68	45.80
Foley St / Southbound	Sep	1,137.40	546.26	00:02:29	00:01:59	27.43	20.19	44.46
Foley St / Northbound		1,127.98	238.58	00:02:19	00:01:49	29.17	21.49	46.02
Gipps Rd / Eastbound	Aug	1,361.67	90.41	00:03:09	00:02:42	26.01	20.25	39.27
Gipps Rd / Westbound		1,363.00	77.74	00:02:40	00:02:17	30.63	24.84	42.21
Gipps Rd / Eastbound	Sep	1,361.67	69.56	00:02:59	00:02:33	27.43	20.55	41.00
Gipps Rd / Westbound		1,363.00	56.50	00:02:50	00:02:29	28.90	23.36	40.85
Northfields Rd / Eastbound	Aug	1,812.82	312.38	00:04:23	00:03:17	24.85	20.26	41.78
Northfields Rd / Westbolund		1,812.82	271.09	00:04:25	00:03:21	24.60	18.99	41.08
Northfields Rd / Eastbound	Sep	1,812.82	271.09	00:04:25	00:03:21	24.60	18.99	41.08
Northfields Rd / Westbolund		1,814.28	446.86	00:04:26	00:03:24	24.56	19.17	40.21
Robson Rd / Northbound	Aug	1,880.61	179.85	00:03:22	00:02:40	33.58	26.89	50.29
Robson Rd / Southbound		1,877.84	133.62	00:03:34	00:02:42	31.64	26.95	51.59
Robson Rd / Northbound	Sep	1,880.61	162.30	00:03:13	00:02:38	35.09	31.54	50.41
Robson Rd / Southbound		1,877.84	114.21	00:03:11	00:02:39	35.34	30.41	51.45

PM Peak - 4:00PM to 5:00PM

Location / Direction	Month	Covered Route Length [meters]	Sample size [avg per segment]	Average Travel Time [hh:mm:ss]	Median Travel Time [hh:mm:ss]	Harmonic Average Speed [kph]	15th percentile Speed [kph]	85th percentile Speed [kph]
Foley St / Southbound	Aug	1,137.40	513.78	00:02:20	00:01:54	29.16	22.62	45.28
Foley St / Northbound		1,127.98	315.67	00:02:23	00:01:47	28.33	22.15	46.57
Foley St / Southbound	Sep	1,137.40	473.37	00:02:17	00:01:51	29.91	23.65	45.64
Foley St / Northbound		1,127.98	322.63	00:02:18	00:01:47	29.36	22.88	46.67
Gipps Rd / Eastbound	Aug	1,361.67	69.94	00:03:01	00:02:23	27.14	23	42.19
Gipps Rd / Westbound		1,363.00	68.97	00:02:35	00:02:13	31.63	27.13	42.48
Gipps Rd / Eastbound	Sep	1,361.67	56.75	00:02:35	00:02:23	31.57	26.24	42.97
Gipps Rd / Westbound		1,363.00	65.47	00:02:42	00:02:14	30.23	28.71	42.74
Northfields Rd / Eastbound	Aug	1,812.82	513.72	00:04:20	00:03:18	25.1	19.29	41.16
Northfields Rd / Westbolund		1,812.82	431.47	00:03:45	00:03:06	29.02	24.02	42.23
Northfields Rd / Eastbound	Sep	1,812.82	431.47	00:03:45	00:03:06	29.02	24.02	42.23
Northfields Rd / Westbolund		1,814.28	326.36	00:03:53	00:03:06	28.03	24.67	42.76
Robson Rd / Northbound	Aug	1,880.61	108.78	00:03:05	00:02:35	36.57	32.35	51.66
Robson Rd / Southbound		1,877.84	185.9	00:03:02	00:02:34	37.2	32.34	52.15
Robson Rd / Northbound	Sep	1,880.61	82.23	00:03:06	00:02:34	36.45	34.51	51.68
Robson Rd / Southbound		1,877.84	143.51	00:03:04	00:02:29	36.8	33.54	53.8

APPENDIX D

PARKING ANALYSIS TECHNICAL MEMORANDUM

Our Ref: CW80018018
Contact: Jacob Martin

21 May 2018

Wollongong City Council
Locked Bag 8821
WOLLONGONG DC NSW 2500

Attention:

Dear

Cardno (WA) Pty Ltd
ABN 77 009 119 000

11 Harvest Terrace
West Perth WA 6005

PO Box 447
West Perth WA 6872
Australia

Phone +61 8 9273 3888
Fax +61 8 9486 8664
Email wa@cardno.com.au

www.cardno.com

KEIRAVILLE-GWINNEVILLE ACCESS AND MOVEMENT STUDY
CAR PARKING STRATEGY

Introduction

Wollongong City Council (WCC) has commissioned a Keiraville–Gwynneville Access and Movement Study to improve their understanding of existing access and transport demand in the area, and to mitigate the impacts of future growth.

This letter is provided in response to the parking component of this work, and concerns strategic recommendations to support the objectives of the overall Study, as follows:

> Examine and document the existing and future potential operation of the traffic and transport system within the suburbs of Keiraville and Gwynneville; and
> Develop strategies to improve the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development.

For the purpose of the parking component of the Study, we have reviewed the existing strategic and statutory planning frameworks. From this base we provide recommendations based on the observed function and behaviour of parking across the Study Area.

2

Background

For the purpose of parking, the University of Wollongong (UoW) campus dominates the study area. The parking demand from this source has an effect on the function of residential and commercial development, in addition to impacts on recreational amenity at the Wollongong Botanic Garden and Beaton Park facilities.

Other significant land uses include the Gwynneville and Keiraville commercial centres, Beaton Park Leisure Centre and surrounds, Botanic Gardens, North Wollongong Station and Wollongong Hospital. The requirements for, and impacts of parking, will be discussed in the context of these uses.

Literature Review

A short summary of planning documentation identifies the following components related to parking supply, parking management and enforcement.

Table 1 Parking relevance of strategic plans

Document	Parking-related recommendations
Wollongong 2022 Community Strategic Plan (2012)	▪ Expand shuttle bus service to support peripheral commuter 'Park and Ride'
Wollongong City Centre Access and Movement Strategy (2013)	▪ Encourage developers to provide parking in consolidated off-street parking locations, ▪ Improve parking guidance systems ▪ Comprehensive on- and off-street parking surveys
Keiraville Gwynneville Community Planning Project (2014)	▪ Increase provision of bike parking at the Botanic Gardens and retail centres ▪ Improve enforcement of parking ▪ Increase quantum of short-stay parking adjacent to retail ▪ Improve parking wayfinding signage ▪ Convert of informal to formal parking bays ▪ Expand shuttle bus service to reduce parking demand ▪ Undertake a Parking Strategy, including specifically for University accommodation
Keiraville Gwynneville Implementation Plan (2015)	▪ Undertake an Access and Movement Strategy that includes parking ▪ Improve regulation and enforcement of parking ▪ Increase quantum of short-stay parking adjacent to retail ▪ Increase provision of bike parking at retail centres ▪ Improve parking wayfinding signage
Beaton Park Precinct Needs Assessment Project (2015)	▪ Maximise on-site parking
University of Wollongong Campus Master Plan 2016-2036 (2016)	▪ Consolidate car parking on the periphery of the campus ▪ Maintain existing student/parking ratio (5.4 bays per FTE student) ▪ Increase on-campus accommodation ▪ Support carpooling programs ▪ Prioritise parking access to those with special needs: vehicles servicing specific facilities, people with disabilities and University operations vehicles ▪ UoW to support Wollongong City Council to reduce the impact of on-street parking on the local community
Draft University of Wollongong Transport Strategy (2017)	▪ Maximise the efficiency of on-site parking ▪ Investigate carpooling, reserved parking and car share ▪ Investigate automated parking management and dynamic price structuring ▪ Increase capacity for pick-up/drop-off parking

Current Travel Behaviour

Mode share data has been extracted from *ABS census data* (2016) and *Draft UoW Transport Survey Findings Report* (2017), suggesting that driving remains the primary mode for the majority of work or education trips. From these sources, car-as-driver mode share was determined to be 47% for UoW students, 57% for Keiraville and Gwynneville residents and 62% for employees within the Study Area. While mode share statistics are difficult to find for other trip purposes, research generally shows that retail, entertainment and regional recreation trips all exhibit higher driving mode shares than work trips (this is mitigated somewhat by the increased vehicle occupancy for these activities).

The results of statistical review shows that the majority of visitors to the Study Area still require a parking bay. Naturally, this demand is clustered around the destination, with consideration made for availability and price, walking distance and public transport interchange penalties.

While the provision of free shuttle bus services offers an alternative to driving, it also extends the range of viable parking locations. This can help to alleviate the intense pressures on parking adjacent to high-demand nodes (e.g. North Wollongong Station, Wollongong Hospital and the University of Wollongong). While this means that that a greater number of residents are affected (due to the wider distribution of parking demand), the impact is somewhat mitigated around these nodes.

Discussion

Within the Study Area, parking is generated by many sources, each of which are defined by different needs and behaviours. The following discussion is intended to generally frame these differences, for the purpose of determining an appropriate response.

In recommending parking interventions it is important to consider both the needs of the individual land uses, and the potential conflicts between them. The following describes a series of recommendations, in the context of the affected user groups.

University of Wollongong Parking

Current Student Behaviour

The UoW campus is attended by over 17,000 students (EFTSLs), according to the UoW Campus Master Plan (2016). Of these, 12% live in student accommodation, though only 4% on campus. Previous surveys have indicated that as many as 55% of students live within 2.5km of the campus.

Typically, students tend to park for periods of between 2 and 6 hours and are generally more price-sensitive than employees. Results from studies of other universities have shown that students are willing to walk further to obtain free parking, and are willing and able to move their vehicle multiple times to circumvent timing restrictions.

University students make up the largest group for parking demand, which is satisfied on-site by 1,029 ticket parking bays (plus approximately 350 car pool and 150 specialty bays). This ratio of student parking is significantly lower than that at other universities surveyed in the past, and is generally consistent only with City-Centre campuses at UNSW and University of Sydney (see **Table 2** below).

Table 2 Parking provision by student population – comparison statistics

University	Student Enrolment (EFTSL)	Total Parking	Students per Bay	Comments
Curtin Bentley	18,000	6,750	2.7	Much of the parking is unavailable to students – actual ratio 4.2 to 4.7
Macquarie	18,000	5,060	3.6	All parking shared with staff
UoW (2010)	13,000	2,700	4.8	Majority of parking unavailable to students – actual ratio 8.8
UoW (2016)	17,080	3,168	5.4	Majority of parking unavailable to students – actual ratio 12 to 16
ANU	13,300	5,870	2.8	Proportion of parking unavailable for students – actual ratio 3.6 to 4.1
USC	4,000	1,025	3.9	From ANU report
LaTrobe	22,900	5,500	4.2	From ANU report
UNSW	29,650	3,000	9.9	From ANU report
USyd	32,250	2,500	12.9	From ANU report
ECU	13,200	4,890	2.7	From ECU integrated transport plan
UWA	15,500	3,400	4.6	Actual ratio available to students - 6.4 to 9.6 (a large quantum of parking is available off-campus)
Murdoch			2.2	From ECU integrated transport plan

Source: Curtin University Transport Study (2010), UoW Campus Master Plan (2016)

This relative lack of student parking can act as a supply constraint, resulting in higher sustainable transport mode shares. However, in this case it appears that the free, unrestricted on-street public parking supply surrounding the University is providing capacity for students, off-setting the effect of on-campus parking restrictions.

As a benchmarking exercise, we have considered the following scenario, based on a reasonable approximation of existing behaviour:

> student attendance: 55% of weekdays*
> percentage of students on-campus during peak demand period: 75%*
> existing car-as-driver mode share: 43% (*Draft UoW Travel Survey 2017*)
> ***on-site student parking demand: 14,250 x 55% x 75% x 43% = 2,527***

** indicative benchmarks from other university surveys*

This can be compared with the on-site student parking supply of approximately 1,200 bays (assumed to include all ticket parking bays plus a 40% proportion of car pool and specialty bays).

Therefore, the existing consumption of parking when classes are in session is in the order of 2,500 bays, of which 1,300 are provided in the public realm. In contrast, the existing on-site student parking supply is sufficient to accommodate a car-as-driver mode share of approximately 20%.

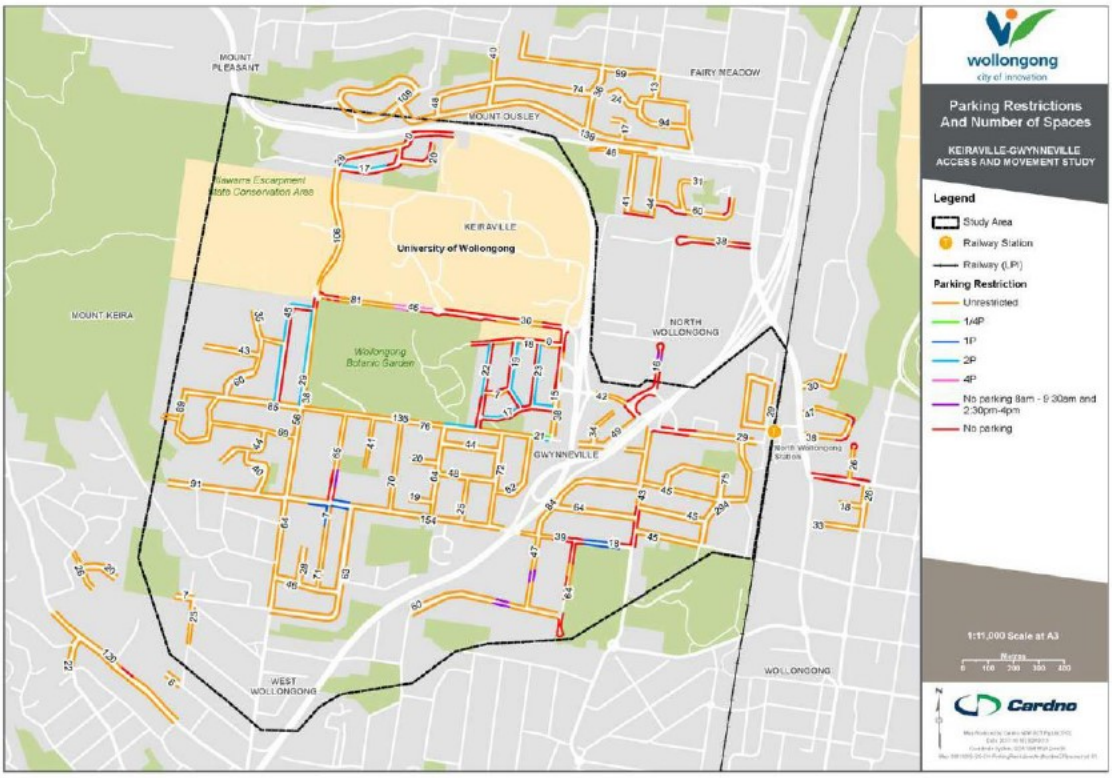
In 2017, parking utilisation data was collected from a sub-contractor at 10am on 14 February, 7 March and 4 April. On 19 September 2017, Cardno's audit team completed parking utilisation audits for the remaining streets in the study area. The overflow demand can be seen in the high occupancy of on-street parking up to 1,000m from the campus, as shown below:

5

Parking utilisation within 1km of the campus

The parking management of these on-street bays does not greatly discourage use by students: nearby, on street parking is generally unrestricted or reduced to 2-hour parking only within 400m of the campus (as shown below). This parking is also free, in contrast to parking on-campus, which ranges from $3.50 (for up to 4 hours) to $9.60 (for 6+ hours).

Note that there was very little parking demand observed to the north of the Princes Motorway. This further illustrates the extent of severance created by that road.



Parking restrictions within the Study Area

Current Staff Behaviour

In contrast to the student population, university staff have a much higher ratio of available parking. There are over 1,500 dedicated staff parking bays located in Permit and Reserved areas, not including car pool and specialty bays. This can be compared with a staff population of approximately 2,200 FTEs. Parking utilisation collected as part of the Draft UoW Transport Survey shows staff permit parking (over 900 bays) operates at or above practical capacity across the campus. However, the 600 reserved parking bays (dedicated and guaranteed for individual users) remain only 60% full.

The Draft UoW Transport Survey results show that staff car-as-driver mode share is approximately 43%. This would suggest that the 900 permit bays are sufficient to accommodate this demand and may be acting as a restraint on driving modes. Note that the needs of part-time and casual employees usually result in peak attendance figures being higher than FTEs, which accounts for the higher utilisation.

Recommended Response

The current UoW parking strategy maintains a ratio of approximately 5.4 bays per EFTSL (Effective Full Time Student Load). A review of other university provisions confirms that a ratio of 5.4 bays per student is generally consistent with benchmarking. However, the actual provision of parking for students is well below equivalent benchmarks, resulting in a substantial overspill of demand into the surrounding network.

The provision of permit staff parking appears to be creating a low driving mode share environment and is therefore consistent with the sustainability goals of the University.

Reserved parking is inherently inefficient. Recent parking occupancy survey results (*University of Wollongong Travel Survey, 2017*) suggest that only 60% of bays are occupied during peak periods. This would suggest that as many as 200 bays could be reallocated to student ticket parking without significantly impacting the

availability of reserved parking. It is understood that there are a number of complicating factors that may make reallocation infeasible in the short-term.

The *University of Wollongong Master Plan* (2016) rightly identifies that increasing the parking provision on-site will have an impact on trip generation and local congestion. However, the large number of unrestricted on-street bays in surrounding residential streets reduces the effectiveness of this constraint on trip generation.

It is not considered reasonable to introduce blanket parking restrictions in the area (i.e. 2-hour limits within 1km of the campus); existing demand is much too high to tackle with duration restrictions alone, and the needs of the adjacent land uses vary considerably across the Study Area. Instead, a combination of paid parking, timing restrictions and other management measures is recommended to maintain a controlled level of on-street parking demand.

It is recommended that paid parking be introduced in the vicinity of the University. Pricing would generally be highest adjacent to the university, and starting at about $2.00 per hour (equivalent to or slightly higher than the student rate on-campus), decreasing to zero based on distance and demand.

Pricing should be set at a level such that peak occupancy is maintained at around 90%.

The form of paid parking structure will depend on the individual street, but it is recommended that parking adjacent to the Botanic Gardens would retain a linear payment schedule, supporting relatively short-stay use for recreation purposes, while parking beyond this zone might use a 'fee capped' structure which supports use for long-stay and short-stay parking.

Northfields Avenue functions as a primary connection from the Keiraville area, and the University, to the Princes Motorway. This suggests that construction of high-quality pick-up/drop-off facilities could be highly attractive for drivers, improving traffic and pedestrian safety outcomes in the immediate vicinity.

The impacts of student parking occur only during session periods, with significantly less demand during non-session periods and on weekends. There is potential to vary parking restrictions or pricing to account for these differences, however there are a number of complications:

- Modifications using signage only create complicated regulations that are difficult to comply with. This results in confusion and reduces compliance by visitors, residents, staff and students.
- Manual modification is likely to be overly time-consuming for Council staff.
- Where paid parking is installed, pricing and duration restrictions can be modified as required – clear signage that states "Variable Prices – Check Machine" may be used to improve amenity for visitors outside of session times. However, there is likely to be a degree of additional non-compliance due to this variation.

TAFE NSW Wollongong

Current Behaviour

TAFE students typically attend fewer days on-campus, and attendance is distributed throughout the day and evening. However, students and staff may have a higher driving mode share due to the material requirements of training (equipment etc.).

The TAFE site appears to provide a higher rate of parking than UoW, with a corresponding decrease in the overspill effects into the surrounding residential catchment (as shown in parking surveys). However, the location of the TAFE is also not conducive to overspill, being surrounded by regional roads.

There is a relatively low parking fee of $2/day for student and staff permit parking which may assist to retain parking on-site.

Recommended Response

The TAFE has the potential to create overspill effects in the adjacent residential streets, particularly where evening classes overlap residential use of on-street bays. However, the location of the site geographically constrains parking availability and the nature of coursework limits the opportunity for students to move their vehicles to circumvent duration restrictions.

Therefore, should parking issues arise, a 2-hour parking limit (8am-6pm Mon-Fri) is considered to be sufficient to mitigate the impact.

Wollongong Hospital and Wollongong Private Hospital *(outside of the Study Area)*

Typical parking strategies are described below to assist with planning and management:

Hospitals are intense sources of visitor and staff parking. It is generally expected that parking demands will be catered for on-site and managed via paid parking. Overspill effects can be expected, and should be controlled through short-stay duration restrictions (2-hour parking) and paid parking mechanisms to support the needs of patients and visitors. A large number of residential streets in the vicinity provide unrestricted parking, suggesting that a proportion of all-day staff parking is accommodated in the public realm.

Hospital destinations include a range of shift-work roles, requiring parking on-site to offset reduced public transport opportunities and mitigate safety and security concerns. However, a large proportion of a hospital workforce are employed during standard office hours; high-quality public transport options along with on-site fee payment systems are effective at shifting transport to non-driving modes for these employees.

The close proximity of both hospitals to the Wollongong Station creates excellent opportunities for public transport access via bus, shuttle and rail.

The variable nature of hospital stays means fixed duration parking can create unnecessary stress for patients and visitors. Replacing duration limits with an escalating fee structure could be considered to shift long-stay demand out of nearby streets while allowing visitors to park as long as necessary. A mobile-pay system is suggested wherever length-of-stay is unknown to reduce the risk of unintentional overstays.

However, it is acknowledged that paid parking is unlikely to be supported by residents and this is therefore recommended as an opportunity to be considered in the medium to long-term with a transition phase rather than an immediate action.

Opportunity: Paid parking could be introduced in the vicinity of the Hospital, with duration restricted to 2 hours or with an escalating hourly fee.

Pricing should be set at a level such that peak occupancy is maintained at around 90%.

School Parking

Current Behaviour

Demand for school parking is intense and short-lived, restricted to less than an hour in the morning and afternoon. Generally, staff parking is easily retained on-site, leaving only student pick-up/drop-off activities on-street. The extremely high generation of demand during peak periods often creates safety and network operation issues. Effective management requires extensive intervention from both the Local Government and the schools themselves.

There are several schools in the Study Area, including the Keiraville Public School, Gwynneville Public School, St Brigid's Catholic Parish Primary School, Para Meadows School and Kiera High School.

Recommended Response

Issues with parking around educational establishments are centred around the parking behaviour of parents at drop off and pick up times and the safety issues that result from inconsiderate and illegitimate parking.

Parking around primary schools is generally more problematic than at high schools, although there are peaks and troughs in terms of the number of complaints received and infringements issued.

These issues are problematic for residents living in the vicinity of the schools, with relation to property access, verge and footpath parking, and visual obstructions; for the school children with regard to road safety, and for the parents in terms of the efficiency of their journeys.

The main issues are summarised as follows:

> The lack of parking close to Keiraville Public School meant that people parked on the verge and on the footpaths illegally.
> There is not always a crosswalk for the children and parking reduces the visibility of oncoming traffic.

If it is appropriate for parking to occur in locations further away from the school, it is necessary to ensure that it is safe for children and their parents to access the school, ensuring adequate **paths and crossing facilities** are provided.

> With parking on both sides of the road as well as the illegal parking, road narrowing occurred and resulted in congestion along Gipps Road and Grey Street, which creates significant delays.

Schools could consider appointing **wardens** to assist parents with considerate and formalised parking/drop off facilities, as well as coordinating safe passage of children from the roadside into schools. If such an approach does not produce compliance, rangers can attend the school and issue warnings or infringements as necessary. **Enforcement** should be used as a tool to ensure compliance in conjunction with more positive approaches to parking management.

> The kiss and drive is not effective as it only fits a small number of cars causing parents to circle around the block until the area is free, and people have been known to park in the facility.
This is somewhat mitigated by the 'no parking' in school times, but supply is currently less than demand.

Kiss and drive parking should be monitored to prevent parking, and expanded as required to support demand.

The fact that school start and finish times are so clearly defined means that hundreds of people are arriving and departing a single location within a very short period of time. Staggered start and finish times may help to alleviate parking issues.

It is recommended that Council engage with schools to support behaviour change trials and to monitor progress. Where trials are found to be successful, the Council can support other schools by creating guidance notes that illustrate a working process with case studies.

It is generally accepted that it is impossible to provide sufficient parking for pick up and drop off times. Therefore, the function and management of on street parking surrounding the site becomes more important.

Council could require all schools to produced **Green Travel Plans** and **Parking Management Plans**. Initially these may be secured through planning applications and development approvals however eventually it should be an aspiration that all schools have these plans in place, and the initiatives and outcomes are measured and monitored.

A more comprehensive study could be completed to support the Parking Management Plan. This would evaluate parking utilisation throughout the day in the areas surrounding each of the schools. The results would help identify locations that would be suitable for shared parking, for example outside shops which are not highly utilised until 10am and could be modified to school parking from 8-9am. Council could also provide some guidelines to assist schools in communicating parking availability to parents.

Parking management plans for each school will be very site specific; however, undergoing the process will help schools identify existing parking opportunities and may help them to implement **shared parking** arrangements with underused parking facilities in the vicinity of the school.

Parking for Recreation

Current Behaviour

Two generators are of particular interest within the Study Area, the Wollongong Botanic Garden and the Beaton Park Leisure Centre. These destinations cater for local and regional recreation and can be characterised by a high private vehicle mode share.

Demand can be expected to be highest on weekends and school holidays, outside of peak times for other high-generating sources. This reduces the potential for conflict with other land uses; however, parking demand extending from the UoW campus is likely to restrict access to the Botanic Gardens during weekdays.

Parking is provided in off-street parking areas at both of these destinations. However, peak usage is likely to overflow into the surrounding road network.

Recommended Response: Beaton Park Leisure Centre

Issues have been identified at this location related to the general availability of parking. This is particularly a problem on the weekend, due to sporting activities and during events. Observed informal parking even during weekdays illustrates the lack of sufficient on-site parking to cater for demand.

The proximity of the Beaton Leisure Centre, Wollongong Tennis Club and the Illawarra Basketball Association suggests that there may be opportunities to provide reciprocal parking, by agreement, to increase parking supply during peak periods. Alternatively, a formal arrangement could be maintained between these organisations, facilitated by Council, to create a common overflow car park for use during peak times.

When there are special events taking place that occur sporadically throughout the year, a **special event parking management plan** should be produced and implemented by the Council.

A combination of parking wardens, event parking permits for organisers, drop off/pick up points and way finding tools can be used to ensure a satisfactory experience for visitors.

The nature of this site is that peak demand for parking can often be limited to a couple of very specific times during the week. Although it is obviously important to provide a quantum of parking for these land uses, it is not efficient to aim to cater for peak demand.

Council should consider improving the opportunities for overflow parking (through facilitating agreements with demand generators) to improve peak accessibility and increase safety in the area.

The lack of parking availability during peak use can mean that heavy sports equipment needs to be transported long distances.

Improved drop off facilities should be considered for the existing facilities.

Facility users may not be aware of alternative parking locations and parking congestion occurs in the immediate vicinity, causing safety issues for both users and residents.

It may be appropriate to implement **parking restrictions** such as timed or paid parking in certain areas, to relocate staff to the periphery of the Centre or off-site.

Recommended Response: Wollongong Botanic Garden

The Wollongong Botanic Garden functions as a regional recreation area with a high level of demand both from local residents and visitors from other suburbs. The parking demand generated by these users can be relatively high, but generally occurs outside of other demand peaks.

Appropriate **wayfinding signage** and transport information is of high importance, as visitors may not be familiar with the area. This information will empower users to identify the most appropriate transport service or parking location.

In the event that sufficient parking cannot be provided to cater for the daily peak demand, **paid parking** should be introduced. This acknowledges that the area is an important and sensitive environment, and the provision of additional parking comes at a cost to amenity and natural heritage.

Retail Centre Parking

Current Behaviour

The Keiraville and Gwynneville Village Centres are both located approximately 1km from the UoW campus, and as such are at the periphery of the generated walking catchment. It is therefore unlikely that there is a great deal of impact from students parking in shopper zones.

Retail centres generally must consider the needs of visitors and staff. The parking hotspot shown on the parking utilisation map in the vicinity of the Keiraville Village Centre suggests that this area is heavily used by visitors. It is noted that bays are generally restricted to 1-hour parking in this vicinity.

Additional off-street parking within the Village Centres is available for use by employees and visitors.

Recommended Response

Parking issues in commercial centres are a concern for businesses; they fear loss of revenue as customers are turned away.

The Council should implement a **parking user priority** in its commercial centres to help support growth and intensification. This would involve prioritising parking among the following types:

- Loading
- Public Transport
- Drop-off/pick up
- Short to medium stay
- Motorcycle/Scooters/Cyclists
- Disability permit holders

Consideration for other specialty uses (e.g. banks, taxis, emergency vehicles, deliveries etc.) should be given, depending on the requirements of adjacent land uses.

Long stay commuter parking should be confined to off-street facilities, preferably in consolidated areas at the periphery of the Centre.

Issues resulting from of the amount of available parking and periods of high demand can be managed through timed restrictions and implementation of paid parking, where appropriate.

The primary use of on-street parking should be for short-stay visitor parking, particularly in and around activated streets. This **parking should be time-restricted** to avoid illegitimate commuter parking or priced on a demand-sensitive basis to promote vacancies. These could be altered during times of **peak demand** such as at Christmas to encourage turnover.

Longer restrictions beyond 2P are suitable **only** for the fringes of a retail centre and accompanied by regular and consistent **enforcement**. Non-compliance for free 3P and 4P parking bays is very high by employees, where these bays are located adjacent to the business.

Paid parking could be considered in areas of high demand, as a tool alongside parking restrictions.

Residents and Residential Visitors

Current Behaviour

It is expected that on-street parking requirements for resident vehicles are relatively minimal where the majority of residences are single-unit dwellings with ample on-site parking. However, multi-unit developments catering for University students from the UoW campus or other demographics may create on-street demand where vehicle ownership exceeds on-site supply.

Residential *visitor* parking is generally provided by the on-street environment, which is the main use of such parking in residential neighbourhoods. While there may be conflicts between residential visitors and other users, it should be noted that residential visitation primarily occurs in the evening, minimising the overlap of demand with other user groups.

Recommended Response

Issues related to parking in residential areas (particularly in high-density residential and mixed use areas) commonly falls under one of the following types:

> Residential parking in visitor bays
> Hazardous or illegitimate parking on verges, footpaths and crossovers.
> Infill in traditional low-density neighbourhoods resulting in an increased visitor demand for on-street parking.

It is recommended to **review enforcement practices** to ensure that regular patrols are taking place that encourage compliance with existing restrictions. Other regulatory practices such as **timed parking or limits on visitor parking** are likely to be necessary alongside rigid enforcement.

Residential parking permit schemes can be introduced where the availability of on-street parking has become an issue. It should be recognised that such schemes shift the burden of the cost to park the vehicle from the owner to the Council. However, during the transition to a paid parking scheme, a short-term (3-5 years duration) residential parking system is reasonable to allow residents an opportunity to adjust.

Opportunity: A short-term scheme would be attached to an escalating monthly fee, increasing at an agreed rate for the life of the permit system. (e.g. $50/month in year 1, $75/month in year 2, etc.).

If a long-term parking permit scheme is unavoidable, these permits should attract a fee commensurate with their value.

Strata bodies can and do issue their own permits to their tenants and this is seen as an effective way to enforce parking restrictions, and they should be encouraged to undertake this role wherever possible to alleviate pressure on City rangers.

It is recognised that resident parking schemes are unlikely to be supported by Council and residents, however will eventually be required to manage demand for limited on-street parking spaces. These recommendations should therefore be viewed as an ultimate plan, which could be achieved over time through a phased rollout. This could be implemented in critical sections at first to determine impacts, and utilisation surveys could be undertaken to monitor the outcomes.

Commuter Parking

Existing Behaviour

The North Wollongong Station is located at the edge of the Study Area. There are a small number of formal commuter parking bays immediately adjacent to the Station (Porter Street, west of the Station), but commuters appear to park on-street along Porter Street and within the local residential neighbourhood (Hindmarsh Avenue, Railway Crescent and Crawford Avenue.

13

Given that the North Gong Shuttle runs direct from the Station to the UoW campus, a portion of these bays may be consumed by students and staff from the University, as well as other commuters taking the train from North Wollongong Station.

Recommended Response

While there is generally an under-provision of parking adjacent to the North Wollongong Station, currently few land uses are adversely affected by commuter over-spill into the surrounding streets. However, future redevelopment of the Station surrounds could create a nexus for short-stay demand throughout the day. If this should occur, unrestricted parking should be converted into time-restricted and/or paid parking to support retail shopping, with consideration for an expansion of commuter parking either adjacent to the Station or in a peripheral location accessible by shuttle services.

Parking Management Plan

The following map depicts a potential on-street parking management plan reflecting the recommendations of the above sections.

The intent of this plan is to reduce on-street parking demand by UoW students through imposition of paid parking, simultaneously improving access to the Botanic Gardens. The time-restrictions in minor residential streets assist in increasing capacity for daytime visitation without additional costs. Minor changes adjacent to the Station relocate commuter parking away from minor streets

Overall, this Plan retains free all-day parking within the higher-order road network and areas beyond the influence of high-demand generators such as the UoW campus.

The plan demonstrates one way in which the recommendations could be achieved. The introduction of paid parking beyond the university frontage may not align with Council and community visions for the study area, and other alternative plans could be implemented if this particular plan is not deemed appropriate. The implementation of this plan could also be staged over time depending on changes in parking demand and community perceptions relating to paid parking to help transition to this arrangement.

15


wollongong
city of innovation
Potential Parking Management Plan
KEIRAVILLE-GWYNNEVILLE ACCESS AND MOVEMENT STUDY
Legend
Study Area
Railway Station
Railway (LPI)
Parking Restriction
Paid parking
$x/hr 8am-6pm
$x/hr 8am-6pm (capped fee)
Time restricted parking
1 hour
2 hours
No Parking (school times)
No Parking (all times)
1:11,000 Scale at A3
Metres
0 100 200 300 400
Cardno
MOUNT PLEASANT
FAIRY MEADOW
MOUNT OUSLEY
KEIRAVILLE
University of Wollongong
MOUNT KEIRA
Wollongong Botanic Garden
NORTH WOLLONGONG
North Wollongong Station
WOLLONGONG
WEST WOLLONGONG
PARRISH AVENUE
RAMAH AVENUE
GREENSLOPES AVENUE
HAMILTON STREET
BASSETT STREET
SUNNINGHILL CIRCUIT
STANBROOK AVENUE
HIGHBANK PLACE
MOUNT OUSLEY ROAD
DUMFRIES AVENUE
JOBSON AVENUE
LYSAGHT STREET
MONTAGUE STREET
MEMORIAL DRIVE
ALPHI BLACK DRIVE
SQUIRES WAY
VIRGINIA STREET
BOURKE STREET
EDWARD STREET
FLINDERS STREET
KEIRA STREET
VIEW STREET
CHURCH STREET
CAMPBELL STREET
SMITH STREET
VICTORIA STREET
MARKET STREET
THROSBY DRIVE
GREENACRE ROAD
MACQUARIE STREET
NEW DAPTO ROAD
MERCURY STREET
DENISON STREET
BELMORE STREET
HERCULES STREET
FISHER STREET
GILMORE STREET
DEMPSTER STREET
ROSEMONT STREET
HILLCREST STREET
MATTHEWS STREET
PHILLIPS AVENUE
ACACIA AVENUE
AKUNA STREET
KEIRA MINE ROAD
PARSONS STREET
RESERVE STREET
COCHRANE STREET
POULTER STREET
MOUNT KEIRA ROAD
IMMARNA AVENUE
BANOOL STREET
WOLA AVENUE
ALLEN STREET
MEDWAY DRIVE
GOOYONG STREET
BOOYONG STREET
IRAGA AVENUE
LEXBURN AVENUE
BIMBADEEN AVENUE
BANORA STREET

Principles of Parking

Parking management offers a broad and open field of discussion. Often cities try to solve the parking problem by increasing parking supply. By now it has been internationally proven that the provision of more parking spaces induces more traffic.

The following guiding principles have been applied in this Review:

Free parking

Free parking that is available for all has generally been perceived as an ideal objective for both policy and decision makers, with any proposed measures which have sought to constrain demand or determine priority for access bitterly resisted, often in an emotional and irrational way.

This level of emotional response is related to the availability of parking and its significant role and impact on the ability of private individuals to access employment and the range of services and facilities that the community offers. The attitude of many people is that if parking is not readily available and accessible to services and amenities, visitors will choose to go elsewhere.

However, all parking has a cost; in space, in opportunity, in construction, maintenance and enforcement. Where parking is provided free of charge to users, the direct financial costs are borne by the Council and passed on to residents via increased rates, or by businesses and passed onto retailers and consumers through higher rents and prices. The opportunity costs are realised through reduced connectivity (land uses are further apart), decreased local amenity (pedestrian paths, trees), and a higher economic burden for development (the cost of parking infrastructure results in decreased investment in the area).

Support and encourage the use of a range of transport modes

Access for pedestrians, cyclists, public transport users and people with disabilities should be prioritised, and balanced with the needs of the road network, in order to minimise congestion. The support of these modes will help lessen the demand for parking in desirable and well-connected locations.

While the Council only has limited influence over local bus routes, the provision of convenient public transport is a very important aspect of the transport mix, especially if a reduction of traffic generated by private vehicles is desired.

Supply and availability of public parking

Public parking should be located in proximity to major generators and be managed according to a predetermined hierarchy of use. This hierarchy applies primarily to on-street parking but should be considered with respect to the off-street supply and specific provisions within public and private car parks for high priority users.

The use of public parking should be monitored to determine hotspots and low utilisation areas so that refinements to parking restrictions can be made. This will ensure a robust system that maximises efficient use of available parking and thereby minimise the capital investment required to accommodate demand.

Parking management should be used as a tool for traffic demand management

It is understood that a perceived lack of parking availability can create an emotional response in car drivers, particularly when there is no viable alternative to driving. Parking supply management therefore relies upon effective alternatives to driving, through high-quality path infrastructure and public transport, such that the

limitations on parking supply do not reduce the economic viability of the area, or create adverse impacts in the surrounding environment. Provision of wayfinding information can also help raise awareness of little-used parking areas a little further from desirable locations, which could be used if people are willing to walk.

In cities like London and Munich, core areas have relatively low levels of car ownership in spite of greater wealth. This reflects a decreased availability of residential and public parking, offset by a high degree of public transport accessibility and service.

Increases to parking supply

Construction of additional parking spaces should be considered where it facilitates desired activity within an activity centre, and where the associated trips are unlikely to be undertaken by alternative transport modes.

Any increases in public parking supply should be considered in the context of all existing parking, and should be managed in accordance with best-practice design principles.

Interactions with private parking supplies

Parking should be considered as an ecosystem consisting of public and private, on-street and off-street, and considering all of the many needs of those people who use those bays. The optimal parking system would be one where all parking is used efficiently, with the minimum amount of space devoted to parking activities. After all, parking itself only facilitates activity; it does not create any of its own.

Wayfinding and Signage

The effectiveness of parking is greatly improved through supplying better information to users. This information is typically provided in a range of media, including maps, mobile applications, static and dynamic signage and prominent parking information.

A coherent signage strategy is therefore recommended across the study area, identifying off-street car parking supplies and significant on-street parking. This may be implemented through static wayfinding signage displaying route/location and supply numbers, using a design of signage consistent for on-street and off-street.

Parking prices are a strong tool to manage demand

To improve parking management as a tool for traffic demand management, a parking fee structure can be used to preferentially benefit certain target groups, based on the ideal function for a particular car parking location.

For example:

- A one-hour free period supports short trips including shopping and café visits
- A linear per-hour rate effectively penalises long-stay parking while maintaining maximum flexibility for users
- A maximum fee can be used to support employee parking in selected locations – effectively giving them a discount beyond a given duration of stay.

These demand management tools can be used in combination, with restrictions on duration to narrow down the target market.

Parking pricing levels should ideally be set such that demand peaks at approximately 85-90% occupancy. Best-practice implementation involves ‘demand-responsive’ pricing, which increases or reduces fees based on occupancy. This can involve different fees at different times of day, or different days of the week, and

include a mechanism to modify prices on a periodical basis to maximise the utility of the parking. Demand responsive pricing relies on a high degree of good quality occupancy and duration of stay data.

On Street Parking Management

The following describes a methodology used to determine parking restrictions within the on-street environment. It is suggested that any implementation measures are reviewed annually.

- **1P Free Parking:** Time restricted 1-hour parking is best used in retail precincts adjacent to fee off-street parking. Employee usage tends to be very low, though enforcement is difficult given the high turnover.
- **2P Free Parking:** Time restricted 2-hour parking is best used in residential areas, to support visitation throughout the day. This form of parking may also be used where there is moderate commercial visitor demand, to limit use by employees. However, where there is a scarcity of employee parking, free 2-hour parking may be used illegitimately by employees (reparking their vehicle every 2 hours).
- **4P Free Parking:** Time restricted 4-hour parking supports medium-stay uses such as recreational and cultural facilities. However, such parking controls are generally not recommended where these areas are located close to businesses. The incentive for employees and other long-stay users to park in these zones illegitimately (reparking their vehicle every 4 hours), is strong.

4P parking has not been recommended for the Study Area.

- **All day Free Parking:** All-day free parking provides the maximum flexibility for users, but is appropriate only when there is ample parking supply to cater for everyone. Where demand begins to approach 85% or more of supply at peak times, alternative controls should be used to differentiate parking areas.
- **Time Restrictions:** It is recommended that all managed parking be restricted to the 8am-6pm period. For the majority of the network, this can be retained for Monday-Friday only, but in locations where weekend demand is high, parking restrictions should be set for Monday-Sunday. Limiting duration restrictions and or paid parking to daylight hours limits the potential impact on residents and visitors.
- **1P Paid Parking:** Used in retail areas to support high turnover business visitors, and to redistribute longer-stay activates to adjacent off-street public and private car parks.
- **2P Paid Parking:** Used in areas adjacent to retail to support business and medical visitors; specifically excludes use by employees and construction workers and all day parking.
- **4P Paid Parking:** Allows a mixture of short-stay uses; specifically excludes all day parking.

Time limited paid parking has not been recommended for the Study Area.

- **Capped Fee Parking:** Allows for hourly paid parking up to a set duration, with no additional cost beyond this duration. This is intended to create spaces for employees and students to park in the public realm, while still retaining viability for short-stay visitors.
- **First-Hour Free Parking:** Used to promote very short stay uses and encourage rapid turnover of parking. This is particularly valuable as a way to shift parking off-street, and away from the prime on-street locations. Private car parks often utilise this form of parking management to shift cars onto their site, ensuring that customers walk through their establishment and an increase in footfall. Its effectiveness can be diminished if there is free parking in close proximity.

  First-hour free parking does not provide the same level of advantage in on-street environments, particularly where demand is already high. It also has less utility in public car parks, where the trip destination is largely unknown.

First-hour free parking has not been recommended for the Study Area.

Hypothecation of parking revenue

Paid parking fees are an effective measure of managing parking, by increasing the efficient use of a shared resource. The revenue obtained from this form of parking management is, by definition, used to offset the cost of enforcement and installation. Beyond this maintenance cost, paid parking revenues may be 'hypothecated' to improvements in transport and local streetscapes.

This provides direct benefit to the community and additional value over and above the impacts of managed parking alone. International examples show that where revenue is hypothecated to local improvements, patronage of these businesses and land values increase markedly.

Conclusion

This work considers a series of strategic recommendations to support the objectives of the overall Study, as it pertains to parking. This includes consideration for policy, planning, management and enforcement changes as necessary to improve the function of the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development.

Yours faithfully

Jacob Martin
Team Leader, Transport Planning
for Cardno
Direct Line +61 8 9273 3819
Email: jacob.martin@cardno.com.au

APPENDIX E

STAKEHOLDER ENGAGEMENT PLAN – DRAFT

Stakeholder Engagement Plan

Keiraville - Gwynneville Access and Movement Study

80018018

Prepared for
Wollongong City Council

26 September 2017

Cardno
Shaping the Future

Contact Information

Cardno (NSW/ACT) Pty Ltd
Cardno (NSW/ACT) Pty Ltd
95 001 145 035

Level 9 - The Forum
203 Pacific Highway
St Leonards 2065
Australia

www.cardno.com
Phone +61 2 9496 7700
Fax +61 2 9496 7748

Document Information

Prepared for	Wollongong City Council
Project Name	Keiraville - Gwynneville Access and Movement Study
File Reference	K-G A&M Stakeholder Engagement Plan.docx
Job Reference	80018018
Date	26 September 2017
Version Number	1

Document History

Version	Effective Date	Description of Revision	Prepared by:	Reviewed by:
1	11/08/17	Draft	Elizabeth Muscat	Koosha Dehghan
2	26/09/17	Revised Draft	WCC	Jane Parker

Table of Contents

Tables

Figures

1 Introduction

1.1 Purpose

This Stakeholder Engagement Plan (SEP) has been developed for the Keiraville – Gwynneville Access and Movement Study. This SEP aims to describe the communication and consultation approach and activities for the review and assessment stages of the study, and keep key stakeholders informed during project tasks.

The objectives of the Keiraville – Gwynneville Access and Movement Study are:

- To examine and document the existing and future potential operation of the traffic and transport system within the suburbs of Keiraville and Gwynneville; and
- To develop strategies to improve the transport system, reduce impacts on surrounding suburbs, promote the use of sustainable travel modes and ensure that the transport network can adequately accommodate future development in the area.

1.2 Project background

Wollongong City Council (Council) is undertaking an Access and Movement Study for Keiraville – Gwynneville to improve understanding of existing access and transport demand in the area and to mitigate the impacts of future growth. This will be achieved through implementation of traffic and transport strategies to encourage sustainable travel behaviour and ease pressure on the network. Council needs to understand the impact of planned development and infrastructure upgrades on traffic generation, accessibility, parking demand, and the overall transport network.

Access and movement now and in the future is a key concern for Council, as well as local stakeholders. The University of Wollongong (UOW) has recently developed the Wollongong Campus Master Plan which provides a framework to guide the physical development of the campus to 2036. In addition, the community-led Neighbourhood Forum 5 (NF5) group has been heavily involved in a number of strategies and plans for the area including the Council endorsed Keiraville – Gwynneville Implementation Plan, and has been a key advocate for this study.

The Keiraville – Gwynneville area and surrounds will experience significant growth in the coming decades due to planned education and health precinct expansion to capitalise on the region's knowledge based assets, as well as increased housing supply in surrounding areas such as West Wollongong, Metro Wollongong, Figtree, Dapto and Fairy Meadow.

1.3 Study area

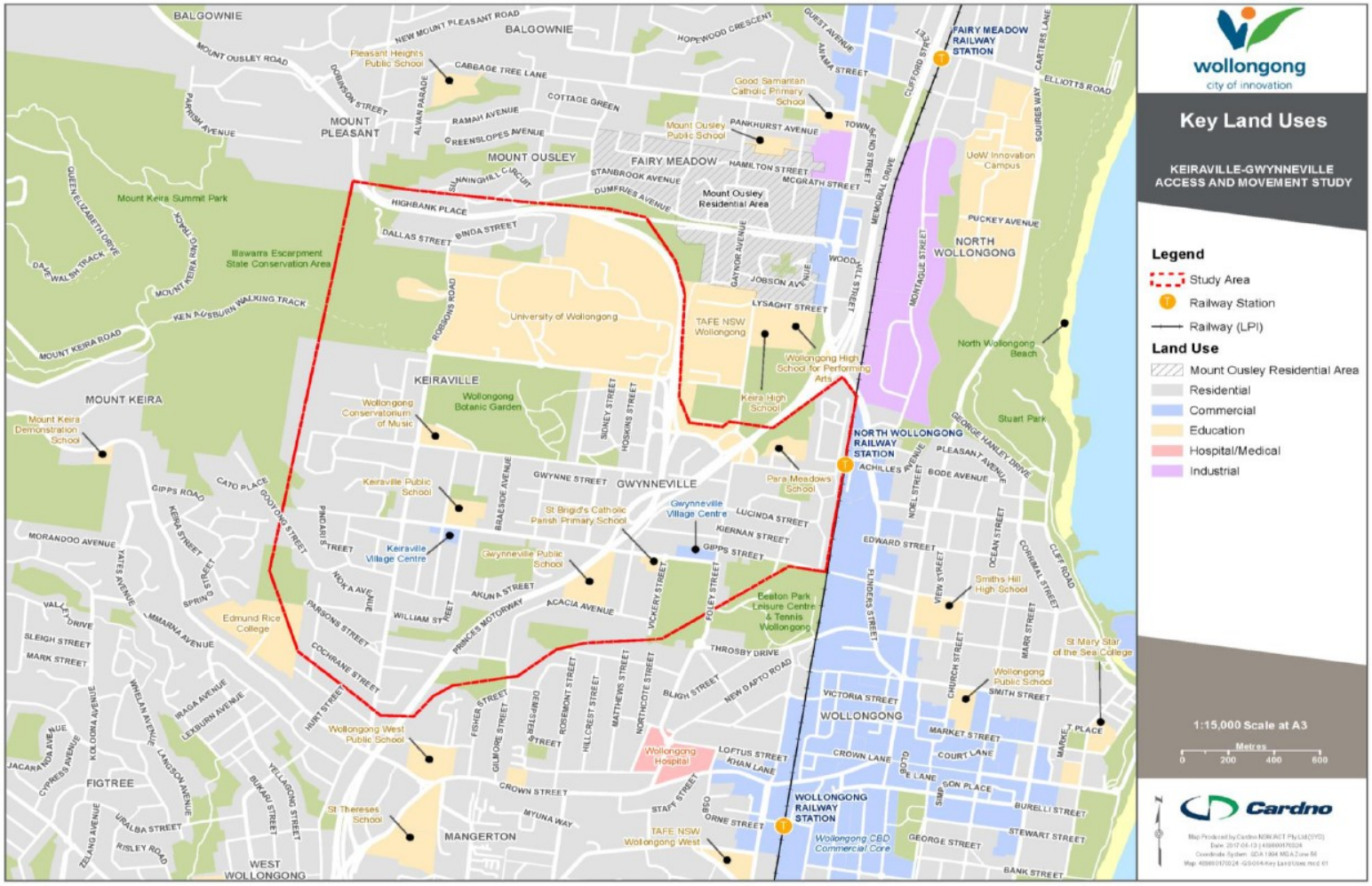
The study area encompasses the area between the Princes Motorway (M1), on the northern and eastern boundary of UOW extending south towards Mount Keira Road, east towards the rail corridor and North Wollongong Station, and west towards Mount Keira Summit Park. A number of important destinations in and around the Keiraville – Gwynneville area which generate a high number of trips per day, influencing access and movement demand and behaviour. These include:

- Keiraville and Gwynneville village centres;
- The University of Wollongong (UOW) Campus;
- UOW Innovation Campus (iC);
- Wollongong CBD;
- Wollongong Hospital;
- Wollongong Botanic Garden;
- North Wollongong Station;
- TAFE Illawarra Wollongong Campus;
- Mount Ousley residential area;
- Local schools; and
- Sports and recreation facilities.

Access to these destinations via the road network is supported by major routes such as the Princes Motorway (M1), Princes Highway (A1) and Mount Ousley Road. Active transport links exist to some key destinations, however in general the network is disconnected and contains a number of missing links for pedestrians and cyclists. There are also a number of bus routes in the area providing connections to key destinations.

The study area and the key land uses are shown in **Figure 1-1**.

Figure 1-1 Study area and key land uses



1.4 Project milestones

The inception meeting for the project was held on the 9th of August 2017. Three stakeholder workshops are to be held throughout the project to be attended by stakeholder. The future key project milestones are detailed in **Table 1-1**.

Table 1-1 Key project milestones

Milestone	Date
Inception meeting	8 August 2017
Stakeholder Engagement Plan for review by Council	Week starting 14 August 2017
Workshop 1	29 November 2017
Workshop 2	5 February 2017
Workshop 3	1 March 2017
Draft Access and Movement Study	13 March 2018
Presentation to Councillors	14 March 2018
Final Access and Movement Study	3 April 2018

2 Stakeholder Engagement

2.1 Communication and engagement objectives

The aim of stakeholder engagement for the Access and Movement Study is to ensure that:

- Information on the progress of the project is communicated to key stakeholders in a timely and appropriate fashion;
- Any key issues from stakeholder groups are identified early and are captured in the study during its development; and
- The findings and recommendations of the study are comprehensive and address stakeholder inputs.

2.2 Stakeholders analysis

Stakeholders that have an interest in this project are identified in **Table 2-1**. These stakeholders may either be impacted by the project or may influence or become advocates for the project.

Table 2-1 Stakeholder list

Stakeholder group	Stakeholder name	Level of impact	Level of influence	Required commitment	Roles and Responsibility	Issues/ potential issues	Recommended communication activities
Key stakeholders							
Government body	Wollongong City Council, Infrastructure Strategy & Planning Division	High	High	High	Project manage study, provide direction to consultant, facilitate communication between all stakeholders	▪ Parking issues ▪ Active transport issues ▪ Public transport issues ▪ Road congestion ▪ Environmental/ heritage constraints ▪ Planned transport upgrades	▪ WCC Project Manager to discuss issues as required
	NSW Roads & Maritime Services (RMS)	Medium	High	Medium	Invited to attend stakeholder workshops, advising on draft report and ongoing analysis, targeted feedback sought on matters affecting State road network operations	▪ Planned upgrades ▪ Bus performance ▪ Road congestion	▪ Face-to-face meeting to discuss known issues and options
Community	Neighbourhood Forum 5 (NF5)	High	High	High	Invite to attend stakeholder workshops, advising on draft report and ongoing analysis	▪ Parking issues ▪ Safety issues ▪ Public transport performance ▪ Road congestion ▪ Environmental/ heritage issues ▪ Active transport issues	▪ Face-to-face meeting prior to workshop to discuss the study broadly, review known issues (the map NF5 created) and invite for 2 reps to attend workshop
Education	University of Wollongong (UOW) – including various internal stakeholders (e.g. administration, student representatives, Sustainable Transport team, UniCentre, halls of residence)	High	High	High	Invite to attend stakeholder workshops, advising on draft report and ongoing analysis, targeted feedback sought on matters affecting access to and operation of campus	▪ Public transport performance ▪ Active transport issues ▪ Parking issues ▪ Road congestion	▪ Face-to-face meeting to discuss known issues and options ▪ Email communications
Stakeholders							
Government body	NSW Department of Planning and Environment (DPE)	Low	Medium	Low	Invited to attend stakeholder workshops, feedback sought on draft report and ongoing analysis	▪ Public transport ▪ Active transport issues ▪ Road congestion	▪ Letter and invite for 1 rep to attend workshops. ▪ Offer to meet to discuss known issues ▪ Email communications
	Public Transport Operators, including Transport for NSW (TfNSW)	Medium	High	Medium	Invited to attend stakeholder workshops, advising on draft report & ongoing analysis, feedback sought on matters affecting public transport operations	▪ Bus performance ▪ Train performance ▪ Active transport issues ▪ Road congestion ▪ Safety issues	▪ Letter and invite for 1 rep to attend workshops. ▪ Offer to meet to discuss known issues ▪ Email communications
	WCC Active Transport Reference Group	Medium	High	Medium	Invited to attend stakeholder workshops, advising on draft report & ongoing analysis, feedback sought on matters affecting active transport participation	▪ Active transport issues ▪ Safety issues	▪ WCC Project Manager to discuss issues as required ▪ Email communications

Stakeholder group	Stakeholder name	Level of impact	Level of influence	Required commitment	Roles and Responsibility	Issues/ potential issues	Recommended communication activities
	Other WCC divisions including Botanic Gardens, Waste, Senior Citizens Centre etc.	Medium	Medium	Medium	Attending stakeholder workshops, advising on draft report & ongoing analysis, targeted feedback sought on matters affecting operations & clients	▪ Environmental/ heritage issues ▪ Public transport issues ▪ Active transport issues ▪ Road congestion	▪ WCC Project Manager to discuss issues as required ▪ Email communications
	Department of Defence, Wollongong Army Reserve Hall & Depot	Low	Medium	Low	Invited to attend stakeholder workshops, feedback sought on matters affecting operations & clients	▪ Road congestion	▪ Letter as per above and invite for 1 rep to attend workshops. ▪ Offer to meet to discuss known issues ▪ Email communications
	Councillors of Wollongong City Council	Medium	High	Medium	Routine community consultation & representation, formal Council responsibilities including voting on resolutions	▪ Parking issues ▪ Active transport issues ▪ Public transport issues ▪ Environmental/ heritage constraints ▪ Planned transport upgrades	▪ Councillor presentation ▪ Project updates by enquiry
Transport operator	Private bus operators (e.g. Premier Illawarra, Dion's etc.), Wollongong Radio Cabs	Medium	High	Medium	Invited to attend stakeholder workshops, advising on draft report & ongoing analysis, feedback sought on matters affecting public transport operations	▪ Bus performance issues ▪ Public transport issues ▪ Road congestion	▪ Offer face-to-face meeting to discuss known issues and options, if cannot attend workshops.
Community	Keiraville - Gwynneville Residential community	Medium	Medium	Medium	Invited to attend stakeholder workshops, feedback sought on draft report & ongoing analysis	▪ Road congestion ▪ Parking issues ▪ Public transport issues ▪ Safety issues ▪ Environmental/heritage constraints	▪ Letter to all residents about study ▪ Have your Say page with mapping tool and feedback form ▪ EOIs invited to attend workshop (10 places available for residents)
	Bicycle User Group (iBug)	Medium	High	Medium	Invited to attend stakeholder workshops, advising on draft report & ongoing analysis, feedback sought on matters affecting bicycle use	▪ Active transport issues ▪ Safety issues ▪ Road congestion	▪ Letter to IBug, as per above and invite for 1 rep to attend workshops
	Community organisations & facility operators (e.g. Wollongong Workshop Theatre, Wisemans Park Bowling Club, St Brigid's Catholic Church, Omar Mosque, St John's Catholic Church)	Medium	Medium	Medium	Invited to attend stakeholder workshops, feedback sought on matters affecting operations & their community members	▪ Parking issues ▪ Active transport issues ▪ Public transport issues ▪ Environmental/ heritage constraints ▪ Planned transport upgrades	▪ Letter as per above and invite for 1 rep to attend workshops. ▪ Offer to meet to discuss known issues
	Friends of Wollongong Botanic Garden	Medium	Medium	Low	Invited to attend stakeholder workshops, feedback sought on matters affecting operations & clients	▪ Parking issues ▪ Active transport issues ▪ Public transport issues ▪ Environmental/ heritage constraints ▪ Planned transport upgrades	▪ Letter as per above and invite for 1 rep to attend workshops. Offer to meet to discuss known issues
Private business	Keiraville and Gwynneville business operators	High	Medium	Medium	Attending stakeholder workshops, advising on draft report & ongoing analysis, targeted feedback sought on matters affecting local business community	▪ Parking issues ▪ Road congestion ▪ Active transport issues ▪ Public transport issues	▪ Visit businesses with letter about study, gather any known issues on the spot. EOIs invited to attend workshop (10 places available)
Education	TAFE Illawarra (Wollongong campus)	Low	Medium	Low	Invited to attend stakeholder workshops, feedback south on draft report and ongoing analysis	▪ Parking issues ▪ Road congestion ▪ Public transport issues	▪ Letter as per above and invite for 1 rep to attend workshops.

Stakeholder group	Stakeholder name	Level of impact	Level of influence	Required commitment	Roles and Responsibility	Issues/ potential issues	Recommended communication activities
						▪ Pedestrian and cycling issues ▪ Safety issues	▪ Offer to meet to discuss known issues ▪ Email communications
	Schools (including Keiraville Public School, Gwynneville Public School, St Brigid's Catholic School, Para Meadows School, Keira High School, Wollongong Performing Arts High School)	High	Medium	Medium	Invited to attend stakeholder workshops, feedback sought on matters affecting school communities	▪ Parking issues ▪ Road congestion ▪ Public transport issues ▪ Active transport issues ▪ Safety issues	▪ Visit schools with letter and gather know issues. Invite to attend workshop.
	Other educational establishments (e.g. Wollongong Conservatorium of Music, child care centres)	Medium	Medium	Low	Invited to attend stakeholder workshops, feedback sought on matters affecting operations & clients	▪ Parking issues ▪ Road congestions ▪ Public transport issues ▪ Active transport issues ▪ Safety issues	▪ Visit with letter and gather known issues. Invite to attend workshop.

2.2.1 Consultation and approvals

The Cardno team, where appropriate, will consult with the above groups (and others as may be identified) regarding the project with the approval of WCC. Consultation outcomes will be recorded in meeting minutes and in a project comments log which will summarise comments, actions and responses.

2.3 Key messages

The key messages employed during the three stakeholder workshops include:

- Workshop 1:
  - The objectives of the Keiraville-Gwynneville Access and Movement Study;
  - Findings from the background review;
  - Identified issues and constraints relating to the current transport network; and
  - Findings of the crash analysis.

Workshop 1 will provide a brainstorming opportunity with the stakeholders. The Aimsun traffic model will also be summarised and presented at the workshop. The workshop will provide the stakeholders an opportunity to provide input into the study, issues and potential strategies.

- Workshop 2:
  - Presentation of initial analysis and obtain feedback from key stakeholders;
  - Draft strategies and plans for the transport network; and
  - Outputs from the traffic mode.

Workshop 2 is a refining session with stakeholders and will provide an opportunity for the stakeholders to provide input in draft strategies.

- Workshop 3:
  - Present findings of finalised strategies, upgrades and plans; and
  - Identify a prioritised scheme for recommended upgrades, which will then be fed into the development of an implementation plan.

Workshop 3 will provide an opportunity for stakeholders to prove input into the priorities scheme for recommended upgrades. This will then be fed into the implementation plan.

2.4 Communication and engagement tools and techniques

The engagement tools and techniques to be used to communicate include:

- Letter to residents and other stakeholders;
- Have Your Say page, with mapping tool, feedback from, document library (including a FAQ);
- Face-to-face meeting with key stakeholders via workshops and meetings; and
- Email correspondence and project comments log (as mentioned in Section 2.3 above).

2.5 Communication protocols

Communication with the stakeholders will be conducted in liaison with WCC and the WCC Community Engagement Team. The general protocol for the workshops is:

- WCC to invite all relevant stakeholders and organise workshop meeting times, location and venue;
- The WCC Project Manager and the Cardno Project Manager will attend some stakeholder meetings together, as agreed. Cardno will record meeting minutes and update the project comment log. For some stakeholders WCC alone will undertake the meetings.

2.6 Reporting and outcomes

Cardno will prepare a summary section in the Access and Movement Study, which will document all consultation activities throughout the project, including inputs received and the outcomes of stakeholder workshops.

A copy of all meeting minutes and the project comments log will be included as an appendix to the report.

APPENDIX F

CONSOLIDATED COMMUNITY COMMENTS

WS1 Community Expectations			
No.	Mode	Location	Expectations
1	Road	Gooyong St	Speed hump or school zone with speed camera
2	Pedestrian	Gooyong St	Footpath on the street
3	Road	Everywhere	"No parking" signs closer to corners of all streets to increase visibility
4	Parking	Rosedale Ave	School pick-up designated zones Residential only parking
5	Parking	Rosedale Ave	Residential only parking
6	All	UOW	University annually reviews/audits success of access movement strategies
7	Pedestrian + Cycling	All	Increase number of people walking and cycling - make it a priority over car use
8	Parking	Keiraville and Gwynneville	Better parking amenity for residents and businesses
9	All	Keiraville and Gwynneville	Connections from study area to north Wollongong
10	Parking	All	Resolve parking issues and more marked parking
11	NA	NA	A vision document of direction with proposed fixes and output to D.C.P
12	Road	University Avenue	Future major interchanges - what is the plan with University Avenue low bridge
13	Road	Keiraville and Gwynneville	Defining roadway so parking doesn't block traffic flow
14	NA	NA	Criteria for assessing priorities of projects
15	NA	NA	Issues are considered and addressed
16	Parking	UOW	Parking at the uni, commerical properties and multi-unit dwellings is accounted for in the D.C.P
17	NA	Keiraville and Gwynneville	Have livable suburbs
18	Public transport	Keiraville and Gwynneville	Support infrastructure for modal shift to active and public transport
19	NA	Keiraville and Gwynneville	Infrastructure list for state government investment and cooperation between government agencies
20	NA	NA	Set criteria to prioritise for these actions
21	Road	Keiraville and Gwynneville	Reduce traffic speed and volume through feeder streets
22	All	Keiraville and Gwynneville	Better communication with uni, council and community
23	Pedestrian	Keiraville and Gwynneville	Safer crossing at Keiraville and Robsons Rd, Gwyneville and Berkley Rd
24	Parking	UOW	Transparency from uni on student numbers, parking availability and survey results
25	Parking	Botanic Gardens	Parking for Botanic Garden tourists
26	Parking	UOW	University to take responsibility for affordable and sufficient parking for staff and students
27	All	Keiraville and Gwynneville	Balance resident and student needs equally
28	NA	Keiraville and Gwynneville	University recognises its important role as a member of the community
29	Parking	Keiraville and Gwynneville	Carrpark space marking on street to manage parking
30	Parking	Keiraville and Gwynneville	Resident permit parking scheme / lined markings on residental streets
31	Parking	Keiraville and Gwynneville	Greater ranging patrols
32	Cycling	Keiraville and Gwynneville	Improved shared cycleway network off road
33	Public transport	Keiraville and Gwynneville	Maintain free shuttle bus
34	All	Keiraville and Gwynneville	To ensure there is no conflict in planning with RMS projects
35	Road	Keiraville and Gwynneville	Change habits of driving
36	All	Keiraville and Gwynneville	Solutions don't create secondary problems
37	Cycling	Keiraville and Gwynneville	Improve cycle links
38	Parking	Keiraville and Gwynneville	Increase turnover near shops
39	Parking	Gwynneville/Keiraville shops	More parking needed
40	Parking	Vickery Street	More available parking

WS1 Transport Solutions			
No.	Mode	Location	Solutions
1	Parking	Gwynneville village centre	Optimise parking signage to increase parking and safety
2	Parking	Gipps Street	Widen street with angle parking on southern side
3	Pedestrian	Gipps Road, Gwynneville village	Remove pedestrian refugee island
4	Parking	Vickery Street	Optimise car parking (pave/lines) on eastern side
5	Parking	Keiraville and Gwynneville	Use technology / future technology for parking management - e.g. parking meters that give over-stay alters and automatic fines
6	Public transport	Keiraville and Gwynneville	Better integration of public transport network through better connections (links and transfers) - transport hub interchanges
7	Active transport	Keiraville and Gwynneville	Improve infrastructure to encourage active transport for main traffic generators - UOW, Gwynneville centre, Keiraville, hospital, TAFE, Botanical Gardens
8	Parking	Keiraville and Gwynneville	For business districts: - Parking meters for car turnover and control parking behaviour - Strategies to eliminate revenue raising notion e.g. have first 30 mins free
9	Parking	Keiraville and Gwynneville town centres	Resdiential parking solutions: - Timed parking - Residential parking scheme - One street side for short term parking and the other for residential sticker parking
10	Parking	Wollongong TAFE	Parking infrastructure: TAFE land parking multi-storey carpark for UOW, TAFE, north Wollongong station, Sydney commuters
11	Parking	UOW	Provide more parking or kiss 'n' ride at university
12	Pedestrian	Keiraville and Gwynneville	More footpaths e.g. port conservatorium
13	Road	Beaton Park	Various needs at Beaton Park like school carnival days very busy
14	Train	North Wollongong Station	Improve train timetabling to address car parking around station
15	Parking	Keiraville and Gwynneville	Ensure new developments have enough parking
16	Road	Keiraville and Gwynneville	Signage for drivers to increase awareness of other travel options
17	Parking	Keiraville and Gwynneville	Line marked spaces on streets with consideration of resident parking scheme
18	Pedestrian	Robsons Road	Assess crossing locations on Robsons Road junctions to provide additional safe crossing
19	All	Keiraville and Gwynneville	Think futuristically of using technology, for example – technology based parking meters which give over-stay alters and possible automatic fining
20	Road	John Street	Provide speed hump on John Street for traffic calming
21	Road	John Street	There should be no left turn from John Street to increase safety

Business Visit 06.11.2017

No.	Mode	Business	Issue	Solutions
1	Parking	Friendly Grocer	- Delivery truck / cleanaway trucks - No disabled access - BWS Delivery truck blocks access - Car park is not timed and parents of school children park there	
2	Pedestrian	Zanders Café	Condition of footpath on Gipps Road is a concern - people are tripping over especially the eldering	
3	Parking	The White Rabbit	- Parking on eastern side of Grey Street, adjacent to Zanders Café is untimed - Monday is bin day and impacts on parking - Liquor licence - disabled toliet and ramp (owner Martin Aguis would like someone to visit regarding this issue)	Parking near Zanders Café should be timed for at least 4 spots
4	Parking	Keiraville Pharmacy	- Parking is a problem particularly with compliance - Disabled parking needed - Timed parking on opposite side of Grey Street	Rangers to patrol area more often
5	Parking	Australia Post	- Parking enforcement - Poor parking practices	- Marked bays may help with poor parking practices - Shorter length for parking zones
6	Parking Road	BWS	- Truck access - Parking	
7	Parking	Gwynneville shops	- Increased traffice and no increase in parking - Extension of parking required - Masonic building was supposed to provide off street parking but not sure this is done - Private car parks - people visiting Senior Citizens Centre often stay longer than allowed	

Businesses that provided feedback were:
- Friendly Grocer
- Zanders Cafe
- The White Rabbit
- Keiraville Pharmacy
- Australia Post
- BWS

Issues - Road

No.	Location	Issue/Comment	Number of times issue raised	Suggested Solution
1	Eastern St and Gipps Rd	Speeding vehicles and high chances of traffic accidents	2	Roundabout needed in the corner of Gipps Road and Eastern Street
2	Gipps Rd rail crossing	Open up level crossing to north gong across Gipps St like Corrimal and Woonona	1	
3	All	Abandoned cars (primarily foreign uni students returning home)	1	Education at uni to repurchase and sell used cars
4	Robsons and Dallas	Need roundabout	1	
5	North of Gipps Rd	No standing sign on all street corners north of Gipps Rd	1	
6	Gooyong	Speeding cars uphill/downhill and cut corners - danger to preschoolers exiting driveways, children playing in the street and people walking to the park	6	Speed bump, draw a centreline marking, traffic calming needed
7	Gipps st Bridge	Speeding cars when entering Gwynneville Village	1	Speed humps at the western end of Bridge on Gipps St, Gwynneville, to slow down cars
8	Gipps Rd at Gwynneville shops	Road needs to be widened by 1200mm to accommodate increased traffic	1	Take some of Wisemen's Park to do this
9	College View	If there is an emergency evacuation from College View Estate the one road in/out is of concern	1	
10	Mt Ousley Rd	Monitor truck noise on Mt Ousley	1	
11	Mt Ousley	Major access to uni over Mt Ousley Rd is required	2	
12	Bulwarra	Wide dangerous junction, cars not following road markings, speeding through junction	1	Better junction marking, narrow junction and reduce speed
13	Gooyong	Long steep section of Gooyong St is a safety hazard with speeding vehicles	1	
14	Freeway at Gipps St overpass	Excessive and illegal use of exhaust brakes by trucks as they slow down because of no inbound speed cameras on freeway. The exhaust brake noise travels far since speed camera has been erected and increased truck movements from Port Kembla car terminal	1	Erection of sign outlining need to limit or do not use exhaust brakes in built up area's.
15	Porter and Foley	Keep Clear' on the intersection of Porter + University st near up coming traffic light	1	Keep Clear on the intersection of Porter+ University st near up coming traffic light
16	Murphys and Rosedale	Dangerous exit from Rosedale Ave to Murphy's Ave (accident inevitable) - have written to council	1	
17	Braeside at Murphys	Dangerous exit from Braeside Ave to Murphy's Ave	1	
18	Grey St	Traffic and parking	1	
19	Vickery St and Acacia Rd	Fast and dangerous drivers are endangering the lives of children and adults	1	Speed bumps
20	Eastern and Gwynne	Vision on right turn from Gwynne to Eastern limited by parking	1	Move no parking back further from the corner
21	Vickery St	Danger to children from road users - all schools will have flashing lights by 2015 but this is NOT enough. Keep all our kids safe	3	- Pedestrian crossing to keep kids safe - Children crossing St Brigid's Primary School - Zebra crossing - Speed humps - Clearer signage
22	John Street	John Street is narrow when cars park on both sides of street	1	John Street should be one-way only
23	Mt Ousley	The Mount Ousley Road exit ramp roundabout is congested and dangerous in peak times.	4	Build overpass from mt ousley rd to north side of uni
24	Northfields Avenue	Kiss and drop are needed at locations such as Northfields Avenue and library carpark.	4	
25	Keiraville and Gwynneville	Uni students are parking across driveways and it is difficult to see oncoming traffic when exiting driveways	2	
26	Keiraville and Gwynneville	The amount of available parking spaces are reduced by hap-hazard parking	1	Numerous more parking spaces could be achieved if parking parking line-markings were introduced as well as angled parking
27	Keiraville and Gwynneville	Many rural students use Keiraville/Gwynneville as a long term car park until they return home. Wollongong Council needs to develop a comprehensive policy around managing parking in Keiraville/Gwynneville.	1	
28	Keiraville and Gwynneville	Parking around Keiraville and Gwynneville shops at times is a challenge, more ranger patrols would assist with people parking long term.	1	
29	UOW	More building at the uni means that workmen are there at 6.30 and 7 am taking any of the on street parking available, pushing student parking further into our streets.	1	
30	Robsons Road	Street parking on robsons rd between gipps rd and murphy's ave is unattainable for residents during uni hours	1	
31	Keiraville and Gwynneville	Residents and their visitors cannot access parking in their own street	2	
32	Grey Street	Grey street is clogged up with cars from university students, cars there the whole day making it difficult for parents to park close to Keiraville public school to pick up their kids	1	
33	Keiraville and Gwynneville	There is a shortage of parking in the area which will only be exacerbated if the Gong Shuttle starts to charge full fares. This will encourage additional car usage.	1	
34	UOW	A multi-storey car park should be built on University land in the Mount Ousley Interchange project, which could be used by a variety of users and so it would be an excellent and enduring contribution to the local community by the University.	2	It would be an opportunity to encourage car pooling by commuters and reduce the pressure on other access points to the University. It could also be an alternative location for an additional bus interchange.
35	Keiraville and Gwynneville	Parking rangers are needed to regulate people parking across driveways	5	
36	Mountview Avenue	Students park here all days (sometimes for days) and walk through the park to the free bus from North Gong station. No available on street parking for residents or visitors during the week.	1	
37	Harkness Avenue	Harkness Avenue is effectively made one-way due to cars parked on both sides, forcing only one car at a time to pass	4	
38	All	Marked, time restricted parking needs to be extended to many more residential streets in the area.	1	
39	Murphys Avenue	entering and leaving driveways and side streets along the length of Murphys Avenue is extremely dangerous due to lack of line of sight because of parked cars	1	
40	Grey Street	Grey Street should have timed parking as uni Park here all day and hard to pick kids up during school times	2	Parking should be made to be 1 hr parking between 2:45pmo and 3:45pm on school days around Keiraville Public School
41	Eastern Street	Hard to see when turning out as cars park too close to corner and dangerous to cross road	2	
42	Cosgrove Avenue	Cosgrove Avenue is used as a parking lot by UOW students and has high vehicle speeds	1	
43	All	Some property owners have converted garages into student accommodation eliminating off street parking, creating multiple student occupancies with not enough off or no off street parking where every resident owns a car	1	
44	Hillview Avenue	Cars are parked regularly on the corner of Foley Street and Hillview Avenue, making it difficult to enter and leave the road	1	A "no stopping sign" should be placed here
45	Gipps Road at Gwynneville shops	Gipps rd needs to be widened by 1200mm to accommodate increased traffic - taking some of Wisemans park	1	
46	Gipps Rd and Vickery	Make Gipps Rd East/Frances St/Vickery St roundabout a one way system	1	
47	Gipps Road and Murphys Avenue	Make Gipps Road one way and Murphys Avenue the other way	1	
48	Porter Street roundabout	Heading north onto roundabout unable to proceed 8:30 - 9:30am	1	
49	Gipps Road		1	Open up Gipps road at rail crossing to ease traffic movement
50	Gipps Street near Gooyong Street	Maintain the 'No Through' state of Gipps Road past Pindari Street. Not joining with the side street of Gipps Road	1	
51	Gipps Road and Murphys Avenue		1	Marked parking bays on major traffic routes e.g. Murphys, Gipps, etc
52	Eastern Street and Murphys Avenue		1	Line parking bays in Eastern St and Murphys Ave
53	Gipps Road near Fairy Street	When unit/townhouse development involves numerous tenants, consider the number of garbage bins to be emptied as many end up as traffic hazards, not to mention the traffic flow on the busier streets when bins are being emptied	1	
54	Gwynne Street	Proposed development a no 6 Gwynne st Gwynneville - we believe it is a commercial development, traffic issues, sets a precident for boarding houses within residential areas, safety and privacy issues for residents and preschool, flood zone	1	
55	Foley Street and Gipps Road	Right turn lane from Foley Road into Gipps Road when travelling south	1	
56	Gipps Road and Vickery Street	Congestion around Gipps Road at St Brigids pick up time	1	
57	Robsons Road	Volume and speed of traffic especially on downhill sections on the north and south of Gipps Rd intersection	1	Extend school zone to to p of the hill on southern and northern side of the road
58	Robsons Road	Cars turning to head south on Robsons Rd from Gipps Rd intersection don't see pedestrians wanting to cross Robsons Rd on the southern side of roundabout	1	Extend school zone west on Gipps Rd to western side of the intersection with Robsons Rd
59	Gipps Rd	Poor road markings especially on pedestrian crossing next to the school and Keiraville shops	1	Road markings and repaint pedestrian crossing
60	Keiraville and Gwynneville	Road are very congested around early mornings, school drop offs and pick up times from 3pm to 5pm. The traffic can be chaotic and makes it difficult to enter or exit Gipps Road, Gwynneville.	1	
61	Keiraville and Gwynneville	Traffic congestion around Keiraville public and St Brigid school AND the villages. I see school parents doing illegal U-turns on the corner of Gipps & William St every day, also out front of St Brigid church, plus mothers driving up onto area reserved for funeral rehearsals. (The previous principal was quite involved and at odd with parents who breached the rules)	1	Dedicated 'drop and go' area at each school, in the side streets, not on Gipps Rd
62	Keiraville and Gwynneville	Parents crossing roads in heavy traffic with small children instead of using the lollipop crossings	1	Whole area as a 40 km per hour zone, not just school areas.
63	John Street		1	Set up John Street as a 40km/h speed zone
64	Robsons Road	There are sight distance issues on Robsons Road	1	
65	Foley Street	Foley Street has been observed to be a rat-run into town	1	

Issues - Parking

No.	Location	Issue/Comment	Number of times raised	Suggested Solution
1	Mauriview Avenue	No street parking for residents or visitors during the week because students park for the day or up to days Parking across driveways and too close to street corners	2	
2	Corner of Eastern and Moore St (especially around St John's Anglican Church) Dallas Street Murphy's Ave	Parking problem during the week in Autumn and Spring uni sessions	4	- Parking restrictions limited to Autumn and Spring uni session for students and staff - Park at the innovation campus
3	Harkness Street	Parking on both sides of road make it narrow and dangerous	2	
4	Gwynneville shops	Unknown parking under the Masonic Centre Gwynneville needs more parking	5	Masonic Centre- needs more advertisement/signposts
5	Keiraville shops	More parking needed or short term parking spaces to keep the cars moving and encourage those at the coles shops to park further away	2	Restricted parking limited to 1 hr reinforced radius 100m from Gipps rd and Grey street
6	Dallas Street Grey Street College View Georges Avenue	- Residents parking during no parking times - Resident only parking permits in college view estate - Resident parking permits on days off work cannot have friends/tradesmen/ect call as no parking spaces	5	Parking needs to be monitored on street outside school Resident parking permits in streets affected by uni parking
7	Porter Street			Use vacant land on Porter St at the railway for commuter parking
8	Dallas Street Grey Street College View Georges Avenue	2hr parking should be removed	4	
9	Greenacres Road	Parking - people parking and accessing buses preschool drop off	1	
10	Mt Ousley Road	Bring back the curtsey on Mt Ousley Road	1	
11	Gwynneville shops	Dedicated parking is required at Gwynneville shops	1	
12	Keiraville and Gwynneville	Boarding houses should be limited due to the impacts on street parking	5	STRATA regulations on boarding houses
13	Cosgrove Avenue	Residents have difficulty finding parking during the day Students parking illegally on the corner reducing visibility entering the street	2	
14	Rosedale Avenue	Rosedale Avenue never gets council sweeper due to cars parked - big tree litter issue	1	
15	Rosedale Avenue near entrance to Keiraville School		2	Children drop off and collect parking signs AM/PM
16	Vickery Street	There is little parking because illness people using oval uni students people visiting new shops on top of parents dropping off and picking up students More parking is needed for parents/staff and parishioners of St Brigids - parking is taken up by people at shops and illness at Woonona Park	2	
17	Vickery Street	Before and after school parents of children - complete bedlam usually - many park partially across driveways making it impossible for residents to get in or out	1	
18	Beaton Park Woonona Park Church Mosque UOW	Overflow of parking into local streets	4	Use The Snakepit Stadium for uni parking and make uni busses stop near here
19	Suburban streets	Competition for parking around free shuttle bus stops with uni students and CBD commuters	2	
20	Keiraville and Gwynneville including Crawford Avenue	Uni student/s are parking across driveways and it is difficult to see oncoming traffic when exiting driveways	7	
21	Keiraville and Gwynneville	The amount of available parking spaces are reduced by hap-hazard parking	1	Numerous more parking spaces could be achieved if parking parking line-marking's were introduced as well as angled parking
22	Keiraville and Gwynneville	Many rural students use Keiraville/Gwynneville as a long term car park until they return home Wollongong Council needs to develop a comprehensive policy around managing parking in Keiraville/Gwynneville	1	
23	Keiraville and Gwynneville	Parking around Keiraville and Gwynneville shops at times is a challenge more ranger patrols would assist with people parking long term	1	
24	UOW	More building at the uni means that workmen are there at 6:30 and 7am taking any of the on street parking available pushing student parking further into our streets	1	
25	Parsons Road	Street parking on parsons rd between gipps rd and murphy's ave is unutilisable for residents during uni hours	1	
26	Keiraville and Gwynneville	Residents and their visitors cannot access parking in their own street	3	
27	Grey Street	Grey street is clogged up with cars from university students cars there the whole day making it difficult for parents to park close to Keiraville public school to pick up their kids	1	
28	Keiraville and Gwynneville	There is a shortage of parking in the area which will only be exacerbated if the Gong Shuttle starts to charge full fares This will encourage additional car usage	1	
29	UOW	A multi-storey car park should be built on University land in the Mount Ousley Interchange project which could be used by a variety of users and as it would be an excellent and enduring contribution to the local community by the University	2	It would be an opportunity to encourage car pooling by commuters and reduce the pressure on other access points to the University It could also be an alternative location for an additional bus interchange
30	Mauriview Avenue	Student park here all days sometimes for days and walk through the park to the free bus from North Gong station No available on street parking for residents or visitors during the week	1	
31	Harkness Avenue	Harkness Avenue is effectively made one-way due to cars parked on both sides forcing only one car at a time to pass	4	
32	All	Marked time restricted parking needs to be extended to many more residential streets in the area	1	
33	Murphys Avenue	entering + leaving driveways and side streets along the length of Murphys Avenue is extremely dangerous due to lack of line of sight because of parked cars	1	
34	Grey Street	Grey Street should have timed parking as uni Park here all day and hard to pick kids up during school times Parking should be monitored	5	Parking should be made to be 1hr parking between 2.45pm and 3.45pm on school days around Keiraville Public School Provide a flat 25km road hump on Gipps Rd near Robsons Rd intersection when approaching from the east to slow traffic approaching roundabout Change parking signs opposite the school on western side of Grey St to No Parking / school zone times like the eastern side of Grey St
35	Eastern Street	Hard to see when turning out as cars park too close to corner and dangerous to cross road	1	
36	Cosgrove Avenue	Cosgrove Avenue is used as a parking lot by UOW students and has high vehicle speeds	1	
37	All	Some property owners have converted garages into student accommodation eliminating all street parking creating multiple student occupancies with not enough off or no off street parking where every resident owns a car	1	
38	Hillview Avenue	Cars are parked regularly on the corner of Foley Street and Hillview Avenue making it difficult to enter and leave the road	1	A "no stopping sign" should be placed here
39	Porter Street		1	Use vacant land on Porter st at the railway for commuter parking
40	Everywhere - Georgina Avenue College View Estate Parsons Road opposite Koolobong Oval Keiraville	Residents parking permit is required Keiraville Parking - mini system as in Sydney - residents get a permit for free parking and everyone else during the week has to pay	5	Resident stickers
41	Innovation campus		1	Have UOW students park at the Innovation Campus and get bus from there
42	Rosedale Avenue		1	Install parking signage to allow parents to drop off and pick up their kids
43	Georgina Avenue	Georgina Ave should become a one-way street - too difficult with the students parking outside of the homes for 2 cars on either side to drive down	1	
44	Dallas Street	Residents should receive parking stickers	1	
45	Keiraville and Gwynneville town centres		1	Make shorter parking times at the shops to increase turnover Widening of Gipps rd at Southern side of Gwynneville shops to accommodate more car spaces
46	Keiraville Primary	Make a designated drop off zone for school parents (such as 2 min drop off and pick up)	1	
47	Parsons Road - opposite Koolobong Oval Gipps Road	Rangers to check regularly for parking People park the wrong way here Should park near to kerb because it is a busy road but many don't Rangers to check where parking is timed	2	
48	Gipps Road Shops - Gwynneville	Angle parking is required opposite shops in Gipps Road Gwynneville	1	
49	Gipps Road near Terry Street	When units/townhouse development involves numerous tenants consider parking allotment not on street	1	
50	Gipps Road		1	Parking at Gipps Road Keiraville/Gwynneville painted lines as a guide to drivers parking. This would allow more cars to be parked
51	South of High schools- north and of Foley's Lane		1	Detention base behind the high school to be added parking and linked to free bus or uni local bus route
52	Gwynneville free bus stop	Lack of parking for free bus - bringing all day parking through Gwynneville	1	
53	John Street	Gipps Street to Murphy Avenue - parking especially on corner - not enough parking for parents at the gardens	1	
54	Keiraville and Gwynneville	Park and ride facilities should be considered in Keiraville and Gwynneville	1	
55	Pautigeore Street	Parking on one side of Pautigeore Street	1	
56	North Wollongong Station	Car parking at the station	2	
57	UOW	Uni should have to provide parking as part of any new development	1	
58	All	Limit the number of cars per household	1	
59	North-west corner of Gipps Street and Grey street		1	Use vacant land on NW cnr Greygipps for much needed parking
60	Corner of Murphys Avenue and Rosedale Avenue	Corner of Murphy's Avenue and Rosedale Avenue - due to parked cars both sides of rosedale and close to corners on Murphys Avenue very dangerous entering and leaving rosedale during peak uni hours - accident inevitable	1	
61	Rosedale Avenue	Parking should be only located on one side of Rosedale Avenue	1	
62	Eastern Street - St Johns	Give St Johns Church parking bays to use when they are expecting visitors on special occasions like funerals	2	
63	Keiraville and Gwynneville	Parking at Gwynneville on Gipps Road near Waterman's Parking Bowling Club as over-crowded and blocking driveways It is congested in the afternoons from 3pm to 5pm	1	
64	Keiraville and Gwynneville	Insufficient parking especially in Beaton Park and extra parking is needed most during events	2	
65	Keiraville and Gwynneville	Parking in the streets around the university areas is very congested making it difficult to drive in the area	1	The university should be providing more parking onsite for students and the Council should have better signage on streets in regards to parking areas and stopping
66	Keiraville and Gwynneville	Difficult to exit streets around the Botanical Garden because all the parked cars	1	
67	Keiraville and Gwynneville	Cycling too dangerous with university parking nightmare	1	
68	Keiraville and Gwynneville	Put in pad parking meters for maybe $5 per day around the university they need to provide additional free bus to encourage students onto public transport But not the village shops	1	
69	Masonic Centre		1	Parking signs should be dynamic at town centres and at Masonic Centre
70	North Wollongong Station		1	Recommend council buy out one of the used car sales yards on the princes highway and build a large scale car park on it for commuters travelling to sydney on train

Issues - Public Transport

No.	Location	Issue/Comment	Number of times issue raised	Suggested Solution
1	Crawford Avenue	Vehicles speed on Crawford Avenue	1	
2	Crawford Avenue	Bus (#10?) too large for the street, taking up both lanes, and the turns - runs residents off the road	1	
3	Crawford Avenue	Vehicles parked over white lines make it difficult for buses to maneuver on bends		
4	Everywhere	Changing free shuttle bus to paid service will add congestion	1	
5	Keiraville and Gwynneville	The free shuttle bus is an excellent innovation and should be maintained as it encourages public transport use rather than driving and congesting roads and parking	7	
6	Cochrane Street	Parked cars on both side of Cochrane Street make it difficult for buses to navigate	1	
7	Robsons Road	Bus stop shelters are needed on Robsons Road	1	
8	UOW	Centralise pick up - bus into the uni from outlaying areas for student travel	2	
9	North Wollongong Station	Train services are infrequent, and only arrive once per hour in both directions, causing many students to wait a long time for the next service. Extend the free bus service to Porter Street and North Wollongong station	2	
10	Keiraville Shops	Tram of shuttle bus to service retail areas in Keiraville and Gwynneville	1	
11	North Wollongong Station	Light rail between North Wollongong station and UOW	1	
12	South of High schools- north end of Foleys Lane		1	
13	Braeside Avenue area	Extend the free bus service to assist elderly and disables e.g Braeside close, Gipps Rd, or have more free bus routes	1	
14	Robsons Road and Gipps Road, Robsons Road and Northfields Avenue, Keiraville and Gwynneville	More free buses	3	
15	Gywnneville and Keiraville Shops	Shuttle bus does no service stops Free bus to service Gwynneville and Keiraville Shops	3	
16	North Wollongong Station	Shuttle bus to include North Wollongong Railway station on weekdays and weekends. It is very difficult to park on weekdays, especially after 9:00am.	2	
17	Botanic Garden - Gipps Road	Bus should go to Botanic Gardens - seen in other cities timetables from city to botanic gardens via…	1	Provide more park and ride locations in the surrounding suburbs Identify what percentage of staff/students would be willing to mode shift to using a bus if a 'free bus' connecting Keiraville/Gwyneville to say Figtree/Cordeaux Heights/Mount Keira was implemented
18	Foleys Street near Porter Street	Extra free bus stop near corner of Foleys Street/Porter Street - many students live in that area	1	
19	Everywhere	Bike racks on buses	1	Discuss with the bus company on whether re-routing the No.10 service would benefit more of the community and/or relocate the bus shelter in Cochrane Street to where it can be better utilised on Robsons Road.
20	Everywhere	Shuttle bus route extension via Keiraville (to Uni and Figtree/Mangerton/West Wollongong)	1	
21	Northfields Ave	Light rail between the uni and the city. The free bus wont be free forever as it is government funded	1	
22	John St area, Gipps Street	Buses for rate payers for John Strret and Gipps Street	2	
23	NW Cnr of Foleys Street and Gipps Road	Move bus stop up Foley Street or in front of Bowls. Too congested being too much traffic and foot traffic in servo carpark	1	
24	Everywhere	Even with better than average bus routes in Keiraville and Gwynneville its still hard to bus it on weekends and public holidays - can this be improved	1	Detention basin behind the high school to be added parking and linked to free bus or uni local bus route
25	Robsons Road and Gipps Road		1	Provide a tram/light rail up Gipps Road and Robsons Road
26	Beaton Park	Shuttle bus - put schematic diagram in buses which shows route and parking areas. Parking at Beaton park Basketball stadium should be promoted and get cars off the streets	1	
27	Everywhere	Appropriate bus stops are needed within suburbs of Keiraville and Gwynneville	1	
28	Keiraville and Gwynneville	Need additional services to the Illawarra. The trains are full on any given day, even Saturday and Sunday mornings at 7am, it's great to see our people traveling to Sydney for leisure, but standing for 1.5 hours is unacceptable. I commuted to Sydney 30 years ago and train travel has not improved here since then.	1	
29	North Wollongong Station	Stops have been removed at Fairy Meadow causing commuters to park at North Wollongong Station	1	

Issues - Pedestrian				
No.	Location	Issue/Comment	Number of times issue raised	Suggested Solution
1	Murphys Avenue	Pedestrians are forced to walk on road which is dangerous during the week due to traffic Footpath along the street to Sperring Park to Botanical Gardens and Conservatorium Footpath for strollers and wheelchair access to the Gardens Footpath on the botanic garden side of murphys ave	7	Footpath
2	Greenacres Road	Need footpath despite very high pedestrian volume and wheelchairs (Greenacres) Foothpaths needed to make Greenacres accessible in all weather for disabled access to Green bus	2	
3	Robsons Road	Footpath needed on western side of Robsons Road	3	
4	Vickery Street	Pedestrian crossing is needed for school children	1	- Pedestrian crossing to keep kids safe - Children crossing St Brigid's Primary School - Zebra crossing - Speed humps - Clearer signage
5	Gipps Road and Robsons Road	Safe crossing needed across Robsons road for school children and encourage walking/cycling in Keiraville generally	1	
6	Balgownie	Pedestrian access to UOW is needed from Balgownie	1	
7	Gwynneville town centre	Raised Crossings are needed at each end of Gwynneville shopping centre	1	
8	Botanic Garden	Improved footpaths are required for prams connecting to the gardens Access for elderly in car park of the South Coast Writers Centre is poor with uneven ground (south west end of the Gardens)	3	
9	Rail crossing between Throsby and North gong station	Another rail crossing between Throsby Drive and North Wollongong station for pedestrians and cyclists	2	
10	Keiraville Shops, Uni, City, Beach	Footpaths to university, city, and beach from Keiraville shops	1	
11	Throsby Drive	Foopath on northern side of Throsby Drive from traffic lights to Flinders St	1	Get rid of road island near bowling club
12	Eastern Street	More footpaths on the western side of Eastern St	1	
13	Gipps Road and Robsons Road	Footpath to the conservatorium of Music	1	
14	Gipps Road at railway	Limited opportunities for pedestrains and cyclists to cross railway line - open underpass at Gipps Road. Tramway bridge fails pedestrains. Only crossing points currently at Smith St underpass, tramway bridge, and North Wollongong rail stations overpass	1	
15	Throsby Drive and Flinders Street	Better connections from Gwynneville to the beach/city roundabout by bunnings cuts off pedestrian access	1	
16	Northwest corner of Foleys Street and Gipps Road	In this city of innovation couldn't we find something bettern than concrete and tar to surface our walkways. Big safety issue for aged walkers	1	
17	Murphys Road	Footpath on murphys rd from Robsons rd to Eastern St	2	
18	Everywhere	wayfinding signage between north gong station and iC for cyclists and pedestrians	1	
19	Everywhere - Murphys Avenue	Any new pedestrian or cycleways should be shared paths where practical Shared paths needed on Murphys Ave	2	
20	Northfields Avenue pedestrian overpass	Access to Northfields Ave 'Curly Whirly' overpass is dangerous for cyclists and pedestrians - extent curly whirly to other side of uni entrance	1	
21	Overpass from Uni to TAFE	Texture coat paint has worn off overpass bridge - extremely slippery	1	
22	Williams Street and Grey Street	Proper footpaths for walking on instead of the road - Williams St and Grey St	1	
23	Gipps Road at railway	Pedestrian Bike path under rail at Gipps street - doubles as flood bypass	1	
24	Everywhere	Fix pathways first but we need more Clean up footpaths etc - round Gwynneville shops - maintain plants etc	2	
25	Keira Oval	Very wet on hill and was used by uni students and residents for access to Mt Keira - would love a path	1	
26	Western corner of Robsons Road and Northfields Avenue	Maintain walking trails - Osborne track and trail to Mt Pleasant and trails to Mt Keira (this trail is part of Keiraville)	1	
27	Everywhere	A walk/path from the mountains to the sea - stroller and bike friendly	1	There is no underpass at this point - might mean that one is suggested
28	Spearing Park (is this the right name?) on Spearing Avenue	Needs footpath - too hard to push strollers, wheelchairs over this section	1	
29	Everywhere	Footpath that are even for the elderly, young & everyone. Bad accidents have happened due to uneven footpaths	2	
30	Greenacre Road	Street lighting along Greenacre rd is terrilbe and this is a popular pedestrian walkway - also need paths	1	
31	Western corner of Robsons Road and Northfields Avenue	Repair some of the track - widen if a it more so that more than one person can walk up there at a time	1	
32	Eastern end of Greenarce Road Reserve/Tramways near Vickery Street	Path through here is washed out and difficult to push a stroller through. Nearly toppled the stroller over going down to the bridge to Greenaoes Rd - cut through is very handy.	1	
33	Western corner of Robsons Road and Northfields Avenue	Remove the trees near the roundabout on 2 Robsons Road very difficult to walk along the track. Walking path - need to walk on the road because of the trees	1	Footpath that are even and flat. i.e. Safe to walk on
34	North Wollongong Station	Footpaths are disconnected	1	
35	Botanic Garden	Another entrance to Botanic Garden to encourage wider use East public access	3	
36	Greenacre Road	Street lighting along Greenacre rd is terrilbe and this is a popular pedestrian walkway - also need paths	1	
37	Keiraville and Gwynneville	There are insufficient pathways, almost zero	1	
38	Keiraville and Gwynneville	There are a lack of footpaths and the conditions of existing footpaths are in very poor condition, creating a trip hazard.	1	
39	Keiraville and Gwynneville	Would like to see more pathways around key areas. Wollongong university should PAY or at least contribute given that they are consuming the suburb		
40	Crawford Avenue	There are lacking footpaths at the northern end of Crawford Avenue	1	

Issues - Cyclist

No.	Location	Issue/Comment	Number of times issue raised	Suggested Solution
1	UOW	Greater integration of bike plans for the local community (idea from uni)	1	Promote cycling and create bikes paths and be supported in our plans
2	UOW		1	Promote UOW cycling promotions to local community and show support in local plans
3	Robsons Rd	Cycle path required all the way up and down Robsons Road to try and alleviate some of the traffic	1	
4	Everywhere - Gipps rd to Stuart Park, cnr of Robsons and Northfields Rd, Gipps Rd to City Beach, Uni,	Dedicated bicycle paths from Keiraville to City, Beach, and University Cycleway Uni - to CBD, Stuart Park, North and South Beach Cycleway down Gipps Rd throught to Stuart Park Innovation Campus	7	
5	Gipps Road		1	Proposed cycleway will prevent parking between 6am - 6pm on Gipps Rd
6	Mt Pleasant and Mt Ousley	New cycleway footbridge from Mt Pleasant over Mt Ousley road to University	1	
7	Gipps Road near Freeway overpass	Free bike exchange system around the suburbs	1	
8	Mt Keira	Plan summit access via adjoining suburbs that have interconnecting cycleways and footpaths Promote Mt Keira as cycle destination	2	
9	Entrance to Uni at Irvine & northfields, Everywhere	Bikes for hire - as per paris with their velo systems Free/Hire bike scheme - may need lockers, not just racks OR shop fron @ keiraville, gwynneville, uni	3	
10	Botanic Garden	Footpaths and cycleways to the Botanic Gardens	1	
11	Porter St	Footpaths needed in Porter st which can be used as a cycle path	1	
12	Keiraville Shops, Gwynnevill Shops, Gipps Road at the north-west corner with Grey Street	Parking for bikes	3	
13	Everywhere, Thorsby Drive	Cycle paths to continue rather than stop eg Throsby Drive - there is no footpath and no bicycle path Cycle paths on northern side of Throsby Drive from traffic lights to Flinders St	3	
14	Gipps Rd and Freeway	Create an on road bike land on Gipps road over the freeway	1	
15	Uni on Northfields	Bike path goes nowhere from here - stops at the Uni bus stop	2	
16	Gipps Road at railway	Limited opportunities for pedestrains and cyclists to cross railway line - open underpass at Gipps Road. Tramway bridge fails pedestrains. Only crossing points currently at Smith St underpass, tramway bridge, and North Wollongong rail stations overpass	1	
17	Everywhere	Council to clean bike paths more often of glass and low hanging trees	2	
18	Everywhere		1	Cyclepaths following watercourses could solve problem of disjointed cycle paths (away from roads). Waterways provide a direct route
19	Everywhere	Cycling connections from Uni to Figtree	1	
20	Everywhere	Cyclists ring your bell' signs	1	
21	Everywhere	wayfinding signage between north gong station and iC for cyclists and pedestrians	1	
22	Everywhere - Murphys Ave	Any new pedestrian or cycleways should be shared paths where practical Shared paths needed on Murphys Ave	2	
23	Northfields Curly Whirly - fwy overpass access	Access to Northfields Ave 'Curly Whirly' overpass is dangerous for cyclists and pedestrians - extent curly whirly to other side of uni entrance	1	
24	Botanic Garden	Support bike though botanic gardens on designated route	1	
25	Everywhere	Cyclists facilities between Gwynneville and coast, non existent, family friendly, cycles on bus (at least 4)	1	
26	Gipps Rd at railway	Pedestrian Bike path under rail at Gipps street - doubles as flood bypass	1	There is no underpass at this point - might mean that one is suggested
27	Nyrang Park	Link a cycleway through here to make a safe route to Beaton Park, North Gong station, Wollongong City, and beach etc	1	
28	Greenacre Rd Reserve	Cycleway through tramway. Repair potholes. Remove weeds to allow open park land environment	1	
29	Keiraville and Gwynneville	Have lived in Gwynneville for 25 years. Would love to see uni student riders wear helmets and use bike lights	1	
30	Keiraville and Gwynneville	Insufficient cycle ways for people to travel to and from Gwynneville to the hospital, university or Wollongong	1	
31	Keiraville and Gwynneville	Bicycles shouldn't be on roads because they are a danger	1	
32	Keiraville and Gwynneville	Cycling too dangerous with university parking nightmare	1	
33	North Wollongong Station	Cycling north on Porter Street from North Wollongong Station is dangerous for cyclists travelling to Tafe and UOW as they are required to cross dangerous intersections	1	Bicycle path should be relocated to other side of road for increased safety
34	North Wollongong Station	Bicycles get vandalised at North Wollongogn Station	1	Provide more secure bike parking at North Wollongong Station

Issues - Other

No.	Location	Issue/Comment	Number of times issue raised	Suggested Solution
1	Shared path next to TAFE oval	Clean up along freeway around uni and TAFE	1	
2	Keiraville Primary	Cars need to cross intersection before Lollipop lady steps into traffic	1	Training for Lollipop lady
3	Everywhere, College View area, Gywnne Street	Keep boarding house style out of small streets - we are a village Parking is a disaster Noise issues	5	
4	Everywhere	There should be a duty of care or an ombudsmen about the complaints for bad behaviour of uni students	1	
5	Gipps Road near Fairy Street	When unit/townhouse development involves numberous tenants, consider the number of garbage bins to be emptied as many end up as traffic hazards, not to mention the traffic flow on the busier streets when bins are being emptied	1	
6	Everywhere	Iconic walk from Mt Keira to the sea via Botanic Garden	2	
7	Gwynne St	Proposed development a no 6 Gwynne st Gwynneville - we believe it is a commercial development, traffic issues, sets a precident for boarding houses within residential areas, safety and privacy issues for residents and preschool, flood zone	1	
8	All	Limit number of car per house eg - we have local house with 6 cars belonging to boarders	1	
9	Everywhere	Bicycles and pedestrians should have right of way - not cars	1	
10	All	RMS/UOW/WCC/NF5 joint submission to Bike plan - source doc for future workshops from Jacqui @ UOW	1	
11	In the bushland north west from end of Gooyong St	Utilise the great features of the escarpment more effectively. Make Keiraville a hub for outdoor activities, such as proper (and maintained) mtb trails. Move 'lost' walking trails. Generate activities leading to revenue etc back to WCC to help pay for upkeep.	1	
12	Eastern end of Greenarce Rd Reserve/Tramways near Vickery St	The walk way which exits to Vickery Street needs to have 'bark chips' or gravel put down as becomes very muddy	1	
13	Western corner of Robsons Road and Northfields Avenue	Need to clear as much lantana as possible	2	
14	Gwynneville and Keiraville area, Throsby Drive to Acacia Ave via Wisemans Park	Keep traffic away from Beaton Park, Wisemans Bowling club and St Brigids School	1	Improve safety and access - give access to Keiraville and West Wollongong without having traffic going through Gwynneville shopping area
15	UOW		1	UOW should educate students on the best ways to travel to campus and promote the use of active and public transportr. This can be done especially for first year students.
16	All		1	Suggested strategies should align with future government
17	Koolabong Oval	Plans/Events at Koolabong oval are set to increase. Road network will suffer accordingly	1	
18	Everywhere	Car-centric community - students still choose to drive	1	
19	UOW		1	UOW should be responsible for reducing students parking in suburbs
20	Traffic model	Traffic model boundary is too limited - Greenacre Road, Vickery Street, Berkeley Road, Acacia Avenue - if parking spreads this will cause an issue for Gwynneville School	1	

APPENDIX G

COUNCIL IDENTIFIED ACTIONS IN RESPONSE TO COMMUNITY COMMENTS

Draft actions in response to community comments

Traffic

Potential intersection improvements

- Gilmore Street and Fisher Street - Pedestrian Refuges (Completed 2018/19)
- Robsons Road Gipps Road - Pedestrian Refuge (Completed 2018/19)
- Robsons Road and Northfields Avenue (University VPA)
- Eastern Street and Gipps Road
- Porter Street and University Avenue
- Bulwarra Street and Pindari Street
- Murphys Avenue and Rosedale Avenue
- Murphys and Braeside Avenue
- Murphys Avenue and Eastern Street
- Eastern Street and Moore Street
- Foley Street, Gipps Road and Porter Street
- Robsons Road and Gipps Road

Potential locations for traffic calming

- Gipps Road at Motorway bridge
- Vickery Street
- Acacia Avenue
- Robsons Road
- Gooyong Street
- Murphys Avenue
- Francis Street
- Gwynneville shops
- William Street
- Robsons Road and Murphys Avenue
- Robsons Road and Gipps Road
- Bulwarra Street
- Berkeley Road and Gipps Road

Review safety around schools

- St Brigid's School
- Keiraville Public School
- Gwynneville Public School
- Wollongong West Public School
- Edmund Rice College
- St Therese School
- Keira High School
- Wollongong High School for Performing Arts
- Para Meadows School
- Mount Keira Demonstration School

Guardrail – New

- University Avenue – Memorial Drive to Porter Street east side. (Completed 2018/19)

Public Transport

- Bus Shelter 113 Robsons Road (Construction 2019/20)

Maintain and further promote

- Keiraville/Gwynneville Shuttle
- North Wollongong Shuttle
- Wollongong Shuttle

Parking

Implement Marked Parking Bays

- All suburbs in study area

Review timed parking

- University of Wollongong
- Botanic Garden
- Keiraville shops
- Gwynneville shops
- North Wollongong Station
- Keira High School
- Wollongong Performing Arts High School
- Edmund Rice College

Review Ranger patrols

- All suburbs in study area

Cycling/Pedestrian

Include suggested footpath locations in future programs

- Botanic Garden Rainforest walk. (Completed 2018/19).
- Murphys Avenue - Robsons Road to Grey Street southern side. (Design completed 2018/19 Construction 2019/20).
- Robinson Park - Crawford Avenue to Mountview Avenue. (Construction 2020/21).
- Crawford Avenue – Porter Street to #3 east side. (Design completed 2018/19 Construction 2019/20).
- Railway Crescent - Porter Street to Hindmarsh Avenue; east side. (Design completed 2018/19 Construction 2019/20).
- Hindmarsh Avenue - Railway Crescent to Porter Street; south side. (Design 2018/19 Construction 2019/20).
- Kiernan St; Foley St to Crawford Ave; south side (Design 2018/19 Construction 2019/20).
- Murphys Ave – Robsons Rd to Grey St. (Construction 2019/20)
- Robinson Park – Crawford Ave to Mountview Ave. (Construction 2020/21)
- Reserve St – Gilmore to Robsons Rd south side (Construction 2021/22)
- Botanic Garden $100,00 (Included in University VPA)
- Robsons Road and Northfields Avenue – western side (Included in University VPA)
- Robsons Road – western side
- Greenacres Road
- Eastern Street – western side
- Gipps Road and Robsons Road – Conservatory of Music
- William Street and Grey Street
- Keira Oval
- Spearing Park

Include suggested shared path locations in future programs

- Keiraville Town Centre Bicycle Parking. (Completed 2018/19).
- Gwynneville Town Centre Bicycle Parking. (Completed 2018/19).
- Porter Street and Crawford Street. (Completed 2018/19).
- Fisher Street; Phillips Avenue to Gilmore Street; west side. (Completed 2018/19).
- Reserve Street; Gilmore to Robsons; south side. (Completed 2018/19).
- Crawford Avenue; Porter Street to Hay Street access. (Design 2019/20 Construction 2020/21, 2021/23).
- Porter Street: Hindmarsh Ave to Flinders St. (Construction 2019/20)
- Gipps Road at railway
- Gipps Road to Stuart Park
- Nyrang Park

APPENDIX H

SCHEDULE OF NON-COMPLIANT PEDESTRIAN CROSSINGS

Schedule of non-compliant crossings

ID	Type	Location	Non-compliance
Z1	Zebra crossing	UOW (NW of Building 38)	Lack of 'No Stopping' signs on the approaches and lack of pedestrian crossing signage.
Z2	Zebra crossing	UOW (South of Building 38)	Lack of 'No Stopping' signs on the approaches, width is less than 3.6m and the kerb ramps do not align.
Z3	Zebra crossing	UOW (adjacent to the Sydney Business School)	Lack of 'No Stopping' signs on the approaches and the width is less than 3.6m.
Z4	Zebra crossing	UOW (adjacent to "Uni Active")	Lack of 'No Stopping' signs on the approaches.
R1	Pedestrian refuge	Northfields Avenue at Robsons Road	Length is less than 3m and retroreflective markers are not provided.
R2	Pedestrian refuge	Northfields Avenue/UOW entrance (West approach)	Length is less than 3m, retroreflective markers are not provided and kerb ramps do not align.
R3	Pedestrian refuge	Northfields Avenue/UOW entrance (North approach)	Length is less than 3m and kerb ramps do not align.
R4	Pedestrian refuge	Northfields Avenue/UOW entrance (East approach)	Length is less than 3m retroreflective markers are not provided and kerb ramps do not align.
R5	Pedestrian refuge	Northfields Avenue east of the UOW bus stops	Insufficient 'No Stopping' signage at correct locations and kerb ramps do not align.
R6	Pedestrian refuge	Northfields Avenue adjacent to the P8 Unicentre Carpark	Width is less than 2m.
R7	Pedestrian refuge	Northfields Avenue/Irvine Street (West approach)	'No Stopping' signage at incorrect location on the approach.
R8	Pedestrian refuge	Northfields Avenue/Irvine Street (North approach)	Length is less than 3m and insufficient 'No Stopping' signage on the approach.
R9	Pedestrian refuge	Northfields Avenue/Irvine Street (East approach)	Length is less than 3m and insufficient 'No Stopping' signage on the approach.
R10	Pedestrian refuge	Irvine Street/University Avenue (North approach)	Length is less than 3m, insufficient 'No Stopping' signage on the approach and no kerb ramp on the western side.
R11	Pedestrian refuge	Irvine Street/University Avenue (East approach)	Length is less than 3m and insufficient 'No Stopping' signage length on the approach.
R12	Pedestrian refuge	Irvine Street/University Avenue (South approach)	Width is less than 2m and length is less than 3m .
R13	Pedestrian refuge	University Avenue/M1 Ramps (East approach)	Length is less than 3m, insufficient 'No Stopping' signage length on the approach and no kerb ramp on the northern side.
R14	Pedestrian refuge	University Avenue roundabout NE of College Place (West approach)	Width is less than 2m and length is less than 3m .
R15	Pedestrian refuge	University Avenue roundabout NE of College Place (East approach)	Width is less than 2m, length is less than 3m and kerb ramps are not aligned.
R16	Pedestrian refuge	University Avenue/Foleys Lane (West approach)	Width is less than 2m, length is less than 3m and insufficient 'No Stopping' signage length on the approach.
R17	Pedestrian refuge	University Avenue/Foleys Lane (North approach)	Length is less than 3m and kerb ramps do not align.
R18	Pedestrian refuge	Robsons Road/Murphys Avenue (South approach)	Length is less than 3m, incorrect linemarking, insufficient 'No Stopping' signage length on the approach and lack of retroreflective markers.
Z5	Zebra crossing	Gipps Road/Grey Street (East approach)	Insufficient 'No Stopping' signage length on approach.
C1	Children's crossing	Gipps Road between Berkeley Road and Vickery Street	Width is less than 3.6m and incorrect placement of 'No Stopping' signs, posts and linemarking.
R19	Pedestrian refuge	Gipps Road/Vickery Street (East approach)	Length is less than 3m and insufficient 'No Stopping' signage length on the approach.
R20	Pedestrian refuge	Gipps Road west of Foley Street	Length is less than 3m.
R21	Pedestrian refuge	Gipps Street/Foley Street (North approach)	Length is less than 3m, width is less than 2m, insufficient 'No Stopping' signage length on the approach and incorrect linemarking.
C2	Children's crossing	Vickery Street south of Gipps Road	Insufficient 'No Stopping' signage length on the southern approach.
C3	Children's crossing	Berkeley Road between Gipps Road and Acacia Avenue	Insufficient 'No Stopping' signage length on the southern exit.
R22	Pedestrian refuge	Robsons Road/William Street (North approach)	Length is less than 3m, missing retroreflective markers, lack of 'No Stopping' signage provided.
R23	Pedestrian refuge	Robsons Road/William Street (South approach)	Length is less than 3m, missing retroreflective markers, lack of 'No Stopping' signage provided.