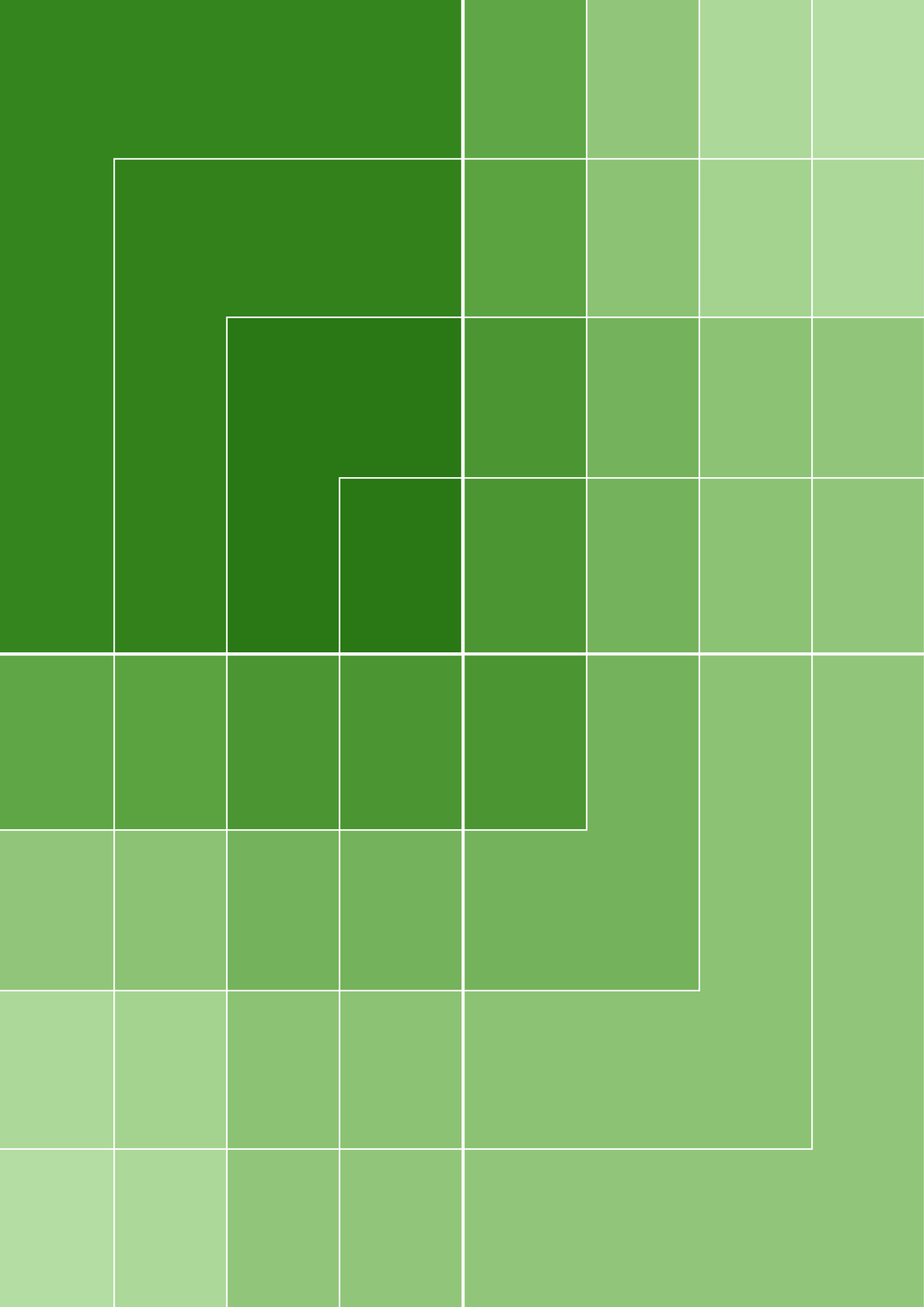


Technical Paper 2

**Operational Traffic
and Transport
Management Plan**



North West Rail Link

Operational Traffic and Transport Report

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1 Executive Summary

1.1 Purpose of this document

Environmental Impact Statements (EIS) for North West Rail Link (NWRL) have been planned to be delivered in two stages: EIS 1 and EIS 2. As part of EIS 2, this document has been prepared to consider the traffic and transport impacts of the operation of the NWRL in 2021 (the assumed first full year of operation). The document also describes the proposed precinct plans in the vicinity of each station.

Wherever possible, the analysis and conclusions have taken into account the Sydney's Rail Future plans announced in June 2012 by the NSW Government. Sydney's Rail Future will deliver a three-tiered rail system to respond to changing customer needs.

Under the new three tier system, the NWRL would operate as a Tier 1 rapid transit single deck train system, initially operating between the North West and Chatswood, with a cross-platform interchange at Chatswood to suburban services for those customers travelling on towards the Sydney CBD.

In line with the NWRL, an upgrade of the Epping to Chatswood Rail Link to a high capacity rapid transit system would be required as a separate project to the NWRL. It is acknowledged that the introduction of the Rapid Transit System may result in the need for additional environmental assessments to be undertaken as Tier 1 develops beyond the scope of the NWRL project.

1.2 The Rail Link

The NWRL comprises eight new stations and passenger services operating over a 23 kilometre addition to the rail network on a combination of tunnel, cutting and viaduct from Epping to Tallawong Road west of Rouse Hill in North West Sydney.

The new stations are proposed at Cherrybrook, Castle Hill, Showground (previously known as Hills Centre), Norwest, Bella Vista, Kellyville, Rouse Hill and Cudgegong Road. Bus, taxi, kiss and ride, pedestrian and cycling access facilities would be provided at all stations, with 4,000 park and ride spaces in total proposed at Cherrybrook, Showground, Bella Vista, Kellyville and Cudgegong Road stations.

1.3 Future Travel Demands

Travel demand forecasts have been prepared by the Bureau of Transport Statistics (BTS) using the Public Transport Project Model (PTPM), a module that has been added to the Sydney Strategic Transport Model (STM). These forecasts have been developed having regard to the changed project scope, operating as a high frequency shuttle service between Cudgegong Road and Chatswood.

More than 30 million trips a year are expected to be made on the rail link between Cudgegong Road and Chatswood within seven years of the rail link opening.

1.4 Future Road Network Demands

The development and operation of the NWRL will require changes to the road network and the existing bus network to accommodate the changed travel patterns for residents and workers of the north west areas of Sydney. These changes could include an increase and redistribution of local traffic around the stations but would also lead to a reduction in traffic and trips lengths on the regional road network as trips are re-oriented to access the NWRL.

NWRL analysis indicates that in 2021 there could be about 12,000 fewer car trips (2hr AM peak) made as a result of the NWRL project¹. This could equate to almost 14 million fewer car trips annually.

By 2036 the corresponding reductions could be about 18,000 fewer car trips (2hr AM peak) and almost 20 million fewer car trips annually. In this regard, the proposal is not a net generator of traffic but rather a means of accommodating sustainable growth in travel, while at the same allowing for deferral of otherwise required higher order road upgrades.

In conjunction with the operation of the NWRL, there are a number of residential and other developments proposed to occur in the north western area. Some of these developments are outlined in Section 7.30. As part of this work, traffic analysis has been carried out on key intersections that will provide access to the stations and, bus ranks, taxi ranks, parking areas and pick up/drop off areas located at the stations. This will assist in identifying works which may be required to accommodate these changes and how to best manage access to and from the rail network.

The likely future traffic and intersection impacts due to the operation of the NWRL were assessed with the aid of SIDRA and LINSIG modelling software programs. Analysis was based on Transport for New South Wales (TfNSW's) Bureau of Transport Statistics (BTS) supplied future (2021) strategic traffic flows in the NWRL corridor, with and without NWRL. As development in the North West Growth Centre continues, traffic forecasts and precinct planning will continue to evolve and supplementary analysis of future proposals may be required.

Under existing conditions and under forecast 2021 conditions in the absence of the NWRL, some higher order intersections operate at or close to capacity during peak periods, notably:

- Epping – Intersections of Beecroft Road and Carlingford Road and Carlingford Road and Rawson Street.
- Cherrybrook – Intersection of Castle Hill Road and County Drive.
- Castle Hill – Intersection of Old Northern Road and Crane Road.
- Norwest - Intersection of Norwest Boulevard and Windsor Road.
- Bella Vista – Intersections of Old Windsor Road and Memorial Avenue and Old Windsor Road and Celebration Drive
- Kellyville - Intersection of Old Windsor Road and Samantha Riley Drive.
- Rouse Hill - Intersections of Windsor Road and Rouse Hill Drive and Windsor Road and Commercial Road.

The precinct and station related infrastructure changes have been designed to mitigate these and other impacts where possible. Additionally, the NWRL project has been designed so as not to

¹ Source: Bureau of Transport Statistics, September 2012

preclude higher order road projects planned for the network in the immediate vicinity of the NWRL project, specifically:

- The upgrade of Schofields Road.
- The possible future grade separation of the Old Windsor Road / Memorial Avenue / Sunnyholt Road intersection.
- The possible future grade separation of the Windsor Road / Schofields Road / Rouse Hill Drive intersection.
- The possible future widening of Norwest Boulevard in the vicinity of the Brookhollow Avenue / Century Circuit Intersection.
- Upgrade of the two-way, two-lane section of Showground Road from Pennant Street to Carrington Road in the vicinity of the proposed station at Showground.
- The possible future northern extension of the North West Transitway (T-Way) across Rouse Hill Drive (the T-Way crossing is proposed to be undertaken as part of the NWRL project works).

1.5 Bus Transport Responses

The following main changes to the bus services in the North West are anticipated with the NWRL and will generally still apply with the revised rail operating strategy announced in June 2012:

- Replacement of long haul M2 Express bus services from the western part of the NWRL corridor, with rail services, while retaining some M2 Express bus services in the eastern part of the corridor (generally south from Castle Hill, including Baulkham Hills, and the M2 corridor itself, as well as from the Cherrybrook-Dural-West Pennant Hills Valley area). This would substantially reduce the number of M2 Express bus services entering Sydney CBD (however, total AM peak bus volumes entering the CBD are not expected to decrease in the medium to longer term due to growth in demand from the M2 and other corridors between now and when NWRL commences operating).
- A major bus-rail and bus-bus interchange at Rouse Hill, for buses from the North West Growth Centre (NWGC), T-Way services and the NWRL.
- Minor bus interchanges at Kellyville, Bella Vista and Norwest.
- A minor interchange at Showground station between NWRL and bus services from Kellyville including growth precincts of North Kellyville.
- A major interchange at Castle Hill between NWRL and bus services from the extensive central part of corridor including opportunities for interchange with cross-regional services to Parramatta and Hornsby as well as Baulkham Hills and other areas to the south.

1.6 Epping Services Facility

The Facility will house tunnel ventilation, power and emergency access facilities and will be accessed via a left in and left out access driveway on Beecroft Road. The facility will not be a generator of road based or pedestrian traffic.

1.7 Cheltenham Intermediate Services Facility

The Facility will house emergency access facilities and will be accessed via Castle Howard Road and an upgraded Oval access road. The facility will not be a generator of road based or pedestrian traffic.

1.8 Cherrybrook Station

This station would comprise the following key elements:

- 400 commuter car spaces accessed by an east-west running station access road that also provides access to the bus bays, taxi ranks and short term on street parking (kiss and ride).
- 14 kiss and ride spaces.
- 4 taxi spaces
- 40 bicycle parking spaces
- 6 bus spaces (total) in two bays on either side of the station access road.
- Widening of Robert Road between Castle Hill Road and the station access road.
- The intersection of Robert Road / Castle Hill Road will operate as an all movements signalised intersection with pedestrian crossing facilities.
- Widening of Franklin Road between Castle Hill Road and the Kayla Way intersection to provide for a right turn lane into the access road and through lanes in each direction.
- The intersection of Franklin Road / Castle Hill Road will operate as a left in / left out un-signalised intersection with left turn slip lane.
- Provision of traffic signals with pedestrian crossing facilities at the intersection of Glenhope Road and Castle Hill Road.
- Reconfiguration of parking and traffic lanes on Robert Road and Franklin Road to facilitate bus and car access to the station via John Road and Neale Avenue.

1.9 Castle Hill Station

This station would comprise the following key elements:

- No commuter car spaces.
- 17 kiss and ride spaces.
- 9 taxi spaces
- 20 bicycle parking spaces
- 8 bus spaces (total) in two bays on either side of the station interchange.
- Old Castle Hill Road will operate as a two-way road between Eric Felton Street and the Crane Road / Castle Street intersection.
- The provision of kiss and ride parking on the eastern kerb of Old Castle Hill Road adjacent to the station and to the north of the taxi ranks.
- Changes to the traffic signals at the intersection of Old Northern Road / Old Castle Hill Road / Crane Road / Castle Street to facilitate two-way traffic movements in Old Castle Hill Road at the intersection. These changes would include pedestrian crossings on the Old Castle Hill Road and Old Northern Road legs of the intersection.
- Safeguarding a possible future underground pedestrian link under Old Castle Hill Road.

- Relocation of all bus ranks to a new interchange in the section of Old Northern Road between the intersection with Crane Road / Castle Street and Terminus Street.
- A separate bus layover facility accessible to the core of the town centre.

1.10 Showground Station

This station would comprise the following key elements:

- 600 commuter car spaces.
- 15 kiss and ride spaces.
- 4 taxi spaces
- 40 bicycle parking spaces
- 4 bus spaces (total) on either side of Doran Drive.
- A new access road off Carrington Road to the west of the Ashford Avenue intersection. This road would provide access to the commuter parking proposed to the west of Doran Drive.
- Upgrading of Doran Drive to accommodate two traffic lanes at the intersection and provision for bus stands, kiss and ride spaces and taxi ranks close to the station entrance.
- In conjunction with the above, the signalisation of the intersection of Doran Drive with Carrington Road.
- Provision of a new road linking Doran Drive and Showground Road. The intersection on Showground Road would be between the existing signalised intersections of Gilbert and Carrington Roads and signalised and provide a bus-only right turn on to Showground Road.

1.11 Norwest Station

This station would comprise the following key elements:

- No commuter car spaces.
- 9 kiss and ride spaces in Brookhollow Avenue.
- 9 taxi spaces in Brookhollow Avenue.
- 30 bicycle parking spaces
- 4 bus spaces (total) on either side of Norwest Boulevard.
- Removal of the roundabout and signalisation of the intersection of Norwest Boulevard / Brookhollow Avenue / Century Circuit.
- Safeguarding a possible future underground pedestrian link under Norwest Boulevard.

1.12 Bella Vista Station

This station would comprise the following key elements:

- 800 commuter car spaces.
- 16 kiss and ride spaces.

- 4 taxi spaces.
- 30 bicycle parking spaces
- 6 bus spaces (total) on either side of the station access road.
- Removal of the roundabout and signalisation of the intersection of Celebration Drive and Lexington Drive.
- Provision of a pedestrian bridge across Old Windsor Road and the T-Way linking Glenwood with the station precinct.
- Provision for modified access to and from the McDonalds outlet and BP service station.

1.13 Bella Vista to Kellyville

The Pre-Concept Design for the Bella Vista to Kellyville corridor originally provided for a “boulevard” or “spine road” extending the full 2.5 km length as part of a robust street network to both facilitate road access (including buses) to Bella Vista and Kellyville stations, and to support future urban development between the rail corridor and Elizabeth Macarthur Creek to the east.

The rationalised ‘day one’ road network, now proposed, would involve deferring any through linking road in the section beyond Balmoral Road, apart from a short section at Kellyville to facilitate vehicular access to the station and car park. Any decisions on the final form and location of the intervening road network and associated intersections would be made as part of the future master planning process for the area.

Under the proposed rationalised road network, the only new roads to be constructed running parallel to Old Windsor Road between Bella Vista and Kellyville stations are between Celebration Drive and Balmoral Road, and between Kellyville station precinct and Samantha Riley Drive.

1.14 Kellyville Station

This station would comprise the following key elements:

- 1,200 commuter car spaces.
- 150-200 additional car spaces to replace existing T-Way parking.
- 10 kiss and ride spaces.
- 4 taxi spaces.
- 45 bicycle parking spaces
- 4 bus spaces (total) using existing T-Way stops.
- Construction of the station access road (new road A), running parallel to Old Windsor Road, off Samantha Riley Drive providing only left in and left out access at its intersection with Samantha Riley Drive.
- Provision of traffic signals at the intersection of Samantha Riley Drive and the new road close to Elizabeth Macarthur Creek, providing all movements.
- Kiss and ride and taxi parking would be provided in the station access road. Buses would operate via Samantha Riley Drive and the T-Way with pick up and set down at the existing T-Way stops.

- Provision of a pedestrian bridge across Old Windsor Road and the T-Way linking Stanhope Gardens with Kellyville station and the Riley T-Way stop.

1.15 Rouse Hill Station

This station would comprise the following key elements:

- No commuter car spaces.
- 25 kiss and ride spaces in Tempus Street.
- 6 taxi spaces in Tempus Street.
- 40 bicycle parking spaces
- 8 bus spaces (total) on either side of a linear bus interchange.
- Tempus Street will continue to operate as a two-way low speed road without bus access.
- Extension of the T-Way across Rouse Hill Drive towards Commercial Road to facilitate access to the north for buses.

1.16 Cudgegong Road Station

This station would comprise the following key elements:

- 1,000 commuter car spaces.
- 15 kiss and ride spaces in the station access road.
- 9 taxi spaces.
- 45 bicycle parking spaces
- 6 bus spaces (total) on either side of the station access road.
- Widening of Cudgegong Road from Schofields Road to just north of the rail corridor to provide two traffic lanes in each direction.
- Widening of Tallawong Road to provide two traffic lanes in each direction from Schofields Road to north of the rail corridor.

2 Introduction

2.1 Purpose of the report

This NWRL Operational Traffic & Transport Report documents the traffic and public transport associated with the NWRL in the vicinity of station precincts, identifies how traffic and transport integration would be managed within the station precinct master plans (in terms of providing access to the station for NWRL customers arriving by private vehicles, buses, foot and bicycle), and provides an assessment of traffic operations with the NWRL in place, intended as an input to environmental assessment for the NWRL project.

2.2 The project

The NWRL is a key priority railway transport infrastructure project. The project would provide eight new stations and services over a 23 kilometre addition to Sydney's rail network from Epping to Rouse Hill in North West Sydney. Stations are planned at Cherrybrook, Castle Hill, Showground, Norwest, Bella Vista, Kellyville, Rouse Hill Town Centre and Cudgegong Road. Bus, pedestrian and cycling access facilities would be provided at all stations, with 4,000 park and ride spaces in total proposed at Cherrybrook, Showground, Bella Vista, Kellyville and Cudgegong Road stations. Refer to Figure 2.1.

The new rail link would:

- Ensure customer needs are met through provision of a safe, high quality, integrated and affordable transport service.
- Link existing communities and new growth areas in north west Sydney with jobs and services in the Global Economic Corridor (Macquarie Park – Chatswood – North Sydney – CBD).
- Deliver a transport service that has been informed by engagement with communities and stakeholders and represents value for money.
- Improve transport network reliability by facilitating a shift from road to rail for trips to and from the north west, to reduce bus and road congestion and improve amenity in the Sydney CBD.
- Contribute to environmental and social sustainability by improving liveability and minimising impacts on the environment, stakeholders and the community.
- Support the Government's challenge to accommodate population growth in the north west by increasing the potential for a range of housing and employment opportunities.

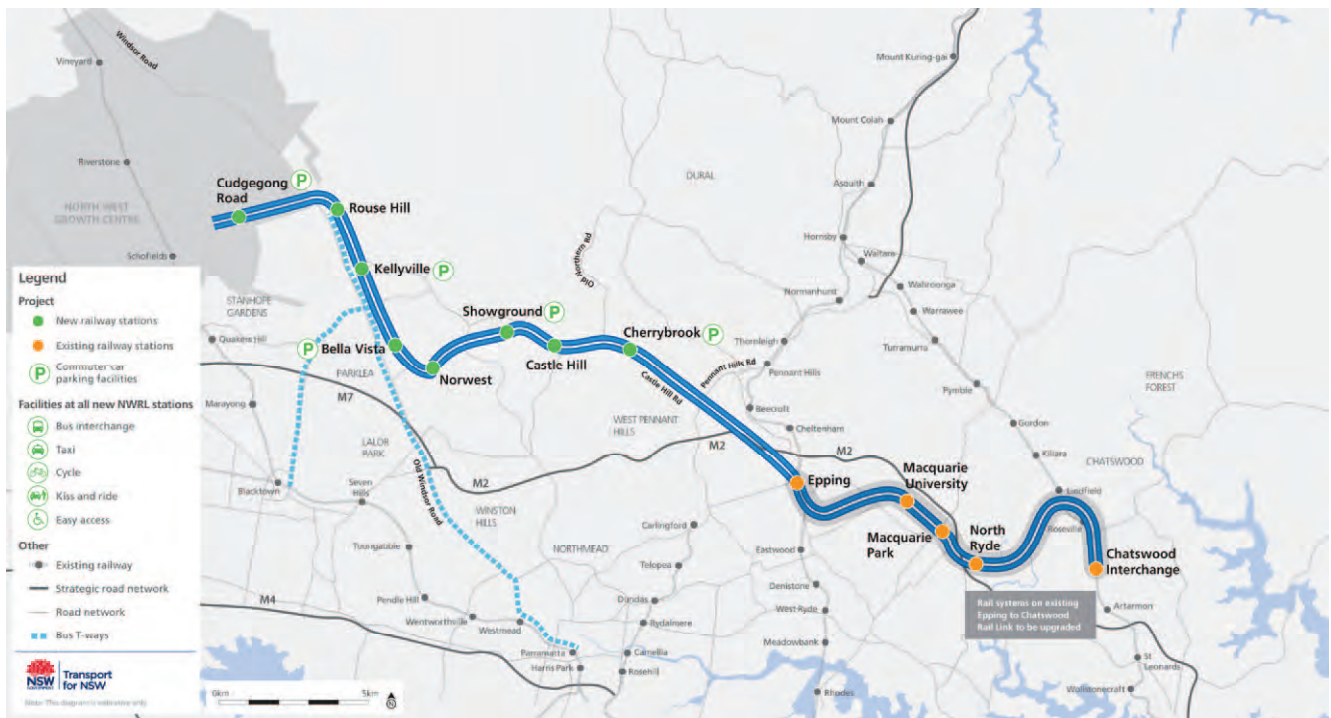
The new NWRL alignment (**Figure 1**) would extend from Epping to Cudgegong Road via Castle Hill, through the Hornsby, The Hills, and Blacktown local government areas (LGAs), linking at Epping into the existing Epping to Chatswood Rail Line (ECRL), which would become part of, and be solely used by, the NWRL.

The NWRL would be a two track rail corridor comprising the following main components:

- Total length 23 kilometres of new rail line between Epping and Cudgegong Road.
- Electrified heavy rail, twin track, bi-directional.

- A direct underground connection into the existing Epping to Chatswood Rail Line (ECRL) at Epping, with services operating between Cudgegong Road and Chatswood.
- A service facility at Epping.
- A service facility at Cheltenham.
- Safeguarded connection for the future Parramatta to Epping Rail Line.
- Eight new stations, located at:
 - Cherrybrook
 - Castle Hill
 - Showground
 - Norwest
 - Bella Vista
 - Kellyville
 - Rouse Hill
 - Cudgegong Road.
- An underground section of new route comprised of approximately 15.5km of two track railway in a twin tunnel configuration with cross passages at regular intervals between Epping and Kellyville.
- The remaining, approximately 7.5km, surface section of route from Kellyville to Tallawong Road stabling and maintenance facility would be a combination of viaduct, embankment, at grade and cutting including 4 km of elevated viaduct.
- Three stations (Castle Hill, Showground and Norwest) are fully underground (to be constructed using cut and cover technique), three are in cutting (open cut) (Cherrybrook, Bella Vista and Cudgegong Road) and two are elevated (Kellyville and Rouse Hill).
- A total of 4,000 parking spaces across five stations (Cherrybrook, Showground, Bella Vista, Kellyville and Cudgegong Road).
- Major bus interchange facilities at Rouse Hill and Castle Hill.
- Bus, taxi, pedestrian, car, cycling and easy access facilities at all stations.
- A stabling facility and maintenance depot at Tallawong Road for multiple train sets with provision for later expansion.
- Other infrastructure and services to complement the transport product and to meet customer transport expectations.

Figure 1 NWRL Alignment & Station Locations



Source: NWRL

2.3 North West Rail Link current status

The NWRL is a priority railway transport infrastructure project for the NSW Government.

In April 2011, a specialised project team was established within Transport for NSW (TfNSW) to fast-track the NWRL. Since then, the project team has commenced work on the definition phase of delivering the project. Analysis has been undertaken with regard to possible alignment options, station locations, asset configuration, operational scenarios, land use as well as the integration of the NWRL with the existing public transport network. Extensive consultation has been undertaken with key stakeholders and the community to assess the NWRL customer outcomes.

On 20 June 2012 the NSW Government announced Sydney's Rail Future. In line with the approach of focusing specifically on the different needs of customers, Sydney's Rail Future will deliver a three-tiered system to respond to changing customer needs, as outlined below:

TIER 1: Rapid Transit

- Frequent 'turn up and go' services without the need for consulting a timetable.
- Fast single deck trains with plenty of seats and more doors, designed for easy boarding and alighting.

TIER 2: Suburban

- Timetabled services.
- Double deck trains with more seats per train.

TIER 3: Intercity

- Timetabled services.
- Double deck trains for Central Coast, Newcastle, Wollongong and Blue Mountains services.
- Comfortable services for long distance commuting and leisure travel with on-board facilities for improved customer convenience.

Under the new three tier system, the NWRL would operate as a “Tier 1” rapid transit single deck train system, initially operating between the North West and Chatswood, with a cross-platform interchange at Chatswood to suburban services for those customers travelling to the CBD. In line with the NWRL, an upgrade of the Epping to Chatswood Rail Link to a high capacity rapid transit system would be required as a separate project to the NWRL.

2.4 Longer term vision

The NWRL will be part of an integrated transport network for Sydney. The development of that network in a strategic transport plan is currently underway in Transport for NSW. The plan is taking into account the NWRL and the options for operating the rail network once the new rail line is in place.

While there is no current plan to extend the NWRL beyond the Tallawong Road stabling and maintenance facility, further investigations into growth in the region and potential travel demand are also being undertaken by Transport for NSW. The outcomes of these studies will inform the development of the strategic transport plan for Sydney.

The longer term vision in Sydney’s Rail Future (**Figure 2**) is for NWRL to be extended under the harbour and to link with lines on the south side as part of a new discrete sector of the network.

Figure 2 Longer term vision for NWRL in Sydney's Rail Future



2.5 This report

This report considers the traffic and transport impacts of the operation of the NWRL in 2021 (its assumed first full year of operation) based on a scenario where the NWRL would provide 12 single deck trains per hour in the peak direction between Cudgegong Road and Chatswood. This is known as the 'Revised Rail Strategy' and is discussed in more detail in **Section 6.1**.

Note that this revised NWRL operating strategy was announced in June 2012, as part of the announcement that, under the Sydney's Rail Future, the NWRL would operate as a Tier 1 rapid transit single deck train system, initially operating between the North West and Chatswood, to connect there with North Shore trains to the Sydney CBD. The implications of this change from the previous 'interlined' rail strategy (involving a direct, but lower frequency, service of only 8 trains per hour), are noted, where appropriate.

Section 3 of this report discusses the transport planning principles and assumptions in the operation of the NWRL.

Section 4 describes the approach to the traffic assessment, while Section 5 summarises the existing traffic and transport situation.

Section 6 details future travel demand associated with the NWRL, while Section 7 discusses the future road network operation, planned works and urban development.

Section 8 documents the proposed NWRL stations, their transport interchange facilities and summarises station and interchange operation and documents the results of traffic modelling of critical intersections in the station precincts.

3 Transport Planning Principles

An overall guiding principle for NWRL stations and interchanges is the station access hierarchy, illustrated in **Figure 3** below.

This access hierarchy, expressed as proximity to station entrances for station access modes, aims to ensure that station precinct plans give highest priority to the most efficient and sustainable access modes. Pedestrians and cyclists are the highest priority access modes, followed by buses and taxis, kiss and ride, and lastly park and ride.

Figure 3 Station Access Hierarchy



Source: NWRL Product Strategy January 2012

3.1 Pedestrians

One of the key aspects in the provision of the stations for the NWRL is that adjoining residential and commercial areas have good access to the station precinct. This should be facilitated with the

provision of footpaths, kerb crossings, pedestrian links, pedestrian crossings (signalised or marked pedestrian crossing) providing a safe access on as direct alignment as possible to the station. The planning and design of pedestrian facilities within and immediately adjacent to the proposed stations needs to include:

- Accessibility to/from major pedestrian generators
- High level of priority compared to vehicular traffic
- Adequate lighting in accordance with relevant standards
- Passive surveillance
- At-grade movements where possible

This is a brief outline of the principles for planning for pedestrian access in and around the station precincts.

3.2 Cyclists

The provision of cycle storage facilities at stations increases the opportunity and catchment for non-motorised forms of transport to and from the stations. The provision of specific cycle facilities is an important aspect in increasing the attractiveness of this sustainable mode of transport. Cycle paths (whether as shared cycle pedestrian paths or separate cycle paths), on-road cycle lanes and storage facilities will be required at the stations.

3.3 Public transport

The commissioning of the NWRL will bring a number of changes to the travel patterns of residents of the north west and to the bus route network. In some cases it will require only a minor modification to existing bus routes in order to access the stations. In other cases it will require changes to existing routes or development of new routes to provide good access between surrounding residential areas to the interchange stations.

A key objective in regards to bus access to stations from the surrounding suburbs is that the bus trip portion of the trip should be as short and direct as possible. Some of these services will operate purely as local services, providing the link between nearby suburbs and the stations, while others will be more regional or cross regional services which perform a multi-functional role in providing access to the stations and then continuing to provide transport links to other centres or public transport nodes.

At the stations, bus ranks should be clearly signposted and adequate facilities provided for passengers to wait for the next available service or when alighting from the bus to access the station. In most cases shelters and seating with lighting and timetable information/contact numbers should be considered.

Where necessary, priority should be provided for buses approaching and departing the station precincts to ensure that delays are minimal in order to maintain connections between the bus services and rail services. However, as discussed below in the 'Interchange places' **section 3.7**, buses serving NWRL stations will also largely have a role serving the centres the stations will be located in, so within station precincts, buses should be part of a street based centre. It is not intended to provide bus priority within station precincts, and bus interchange facilities will largely be street-based, rather than off-street.

3.4 Taxis

Taxis play an important role in the public transport system, providing a transport service for: the less mobile; those for whom time is at a premium; and times when other transport services are not available. They also provide a door-to-door transport service, especially important for those with luggage, or during poor weather.

In this regard, there is a need to provide rank space at stations so that they are visible and reasonably close to the station entry/exit and that the facilities provided on the rank are similar to those that would be provided at bus ranks i.e. shelters and seating as appropriate with local taxi providers contact details.

The ranks should also be located such that taxis can depart easily in most directions to reduce any unnecessary travel to reach the passengers' destinations.

3.5 Kiss and ride

Kiss and ride will be an important car-based station access mode. Non-availability of a designated kiss and ride areas could result in motorists stopping in unsafe locations to pick up or set down customers. This would have the potential to cause traffic delays and traffic incidents. The kiss and ride area needs to be designed to provide a quick turnover with minimum dwell time. The sign posting should discourage vehicles from stopping for extended periods at the kiss and ride area.

An adequate kiss and ride parking area needs to be provided to minimise queuing at the kiss and ride area and to avoid re-circulation of traffic movements through the station precinct. In NWRL station precincts, kiss and ride parking can double as short-term parking to support the commercial and retail activities in centres outside peak times.

3.6 Parking

Provision of commuter parking would expand the catchment area of the proposed stations and provide the opportunity for existing car drivers and passengers to shift part of their car journey to the train and thus reduce private vehicle trips on the wider regional road network. The NWRL has the potential to significantly alter existing car based travel patterns. In this regard the provision of commuter parking areas at selected stations is a key component in the transport network.

Fundamentally, the NWRL is not a traffic generating development but an important means of curbing growth in car-based travel in western Sydney. While there will be local change and redistribution of traffic around stations, NWRL will help to reduce traffic volumes on the arterial road network by diverting or truncating longer car trips to become either park and ride or kiss and ride trips.

The provision of dedicated commuter parking would also have the potential to reduce the impact of parking on adjacent local streets. The commuter parking area needs to be designed within a suitable walking distance to the railway stations with adequate lighting to provide good safety and security during night time. Access to and from the surrounding arterial road network needs to be provided that delays are minimised and that access to the car parks is not circuitous or difficult to identify. Scope exists to incorporate dynamic parking management systems into the car park facilities.

Notwithstanding the identification and provision of commuter parking at selected stations, there may still be a degree of commuter parking on local streets surrounding the stations. In the first instance this parking demand should be managed by the provision of suitable alternatives to driving to the station i.e. good pedestrian and cycling links, adequate bike parking at stations, frequent and direct bus services from the surrounding residential areas. In addition to these positive measures,

consultation should be undertaken with the local councils to ensure that, should parking on-street occur, it does not adversely impact on local residents and businesses.

3.7 Interchange places

Transport for NSW's draft *Making Interchange Places Product Strategy* and its new refocus on Customer Service has evolved the thinking of transport interchanges as 'interchange places'. This comes from the recognition that transport interchanges need to be more than just a stand-alone facility where people go – by walking, cycling, driving, or as a passenger – to catch a train, bus, or taxi or to change between these modes. TfNSW recognises that its 'customers' are all who use the transport services; as well as those who need to or want to pass through; or who live, work, or visit near the interchange area.

The draft *Making Interchange Places Product Strategy* recognises the important role that transport interchanges play in the economic life of centres and proposes that interchange planning and design must put more emphasis into recognising and addressing that aspect – placemaking – while still catering for the needs of commuter customers.

Another key message in the *Making Interchange Places Product Strategy* is that transport interchanges should be "places for people, not facilities for vehicles". Interchanges should serve people first, and accommodate convenient movement to/from/between modes as part of a person's whole journey.

Applying this approach for NWRL stations requires a new perspective on transport interchange modal provision, as well as a new set of interchange objectives as follows:

- A high degree of integration of the interchange with its surroundings – at many NWRL stations, the transport interchange facilities must carry out a dual role – providing access to the station for commuters, and enhancing access to the centres around the stations (this function will occur due to new development (TOD) and growth in employment at key stations such as Showground, Castle Hill, Norwest, Bella Vista and Rouse Hill). In addition, interchange facilities that are dual use (such as commuter car parking facilities that can be used to support weekend or night time community activities, or kiss and ride parking that can revert to short term centre parking);
- Interchange facilities that balance access to the station with access to surrounding development – this suggests street-based interchange facilities rather than formal off-street facilities that are found at many conventional transport interchanges. At some locations, interchange modal hierarchy may need to be compromised to achieve a better interchange place;
- Transport interchange layouts that do not present barriers to station access from surrounding residential areas, particularly by foot. Interchanges which are part of precinct movement networks rather than which introduce new movement paths; and
- "Long life, loose fit" – a strategy for ensuring that transport interchange facilities continue to operate and contribute to station and centre functions as the station precinct changes and develops over time (such as the integration of commuter parking areas into centre development).

Particularly for transport interchanges in centres, interchange facilities are best located 'where the action is', and as such do not have to be a single dedicated structure – which can be difficult to fit in a developed or developing town centre and may indeed act as barriers to station precinct integration.

Instead, the transport interchange should be focussed around a plaza or along a street, with good legibility between transport services and the surrounding town centre facilities. Locating transport interchange facilities on major roads should be avoided. Not only do major roads in the NWRL

corridor act as barriers to station access, their intensity of traffic use represent safety issues for interchange users.

3.8 Road network

The traffic and road safety impacts due to the operation of the NWRL were assessed based on the RTA (now RMS) *Guide to Traffic Generating Developments* and other relevant Austroads guidelines. The measures to mitigate these impacts are proposed in order to facilitate access to, and around, the stations.

The station precincts are generally located within an urban environment and the traffic capacity of the road network immediately adjacent to the station precincts is primarily governed by the operation of the intersections located on the road network. The performance of the intersections was assessed using the SIDRA and LINSIG modelling software programs.

The level of service analysis of the intersections was undertaken based on the Level of Service (LOS) criteria for intersections specified in the RMS *Guide to Traffic Generating Developments*. **Table 1** provides the descriptions of the level of service.

Table 1 Level of Service Criteria for Intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop signs
A	Less than 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study is required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode

Source: RTA Guide to Traffic Generating Developments (Oct. 2002)

The RTA's (now RMS) *Guide to Traffic Generating Developments*, which provides the definitions in the above table, has a definition for Level of Service 'F' as follows:

"This service level is the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow break-down occurs and queuing and delays occur."

"Although in some situations additional traffic does not alter the level of service, particularly where the level of service is 'E' or 'F', additional capacity may still be required. This is particularly appropriate for service level 'F', where small increases in flow can cause disproportionately greater increases in delay. In this situation, it is advisable to consider means of control to maintain the existing levels of absolute delay." (RTA, 2002)

4 Traffic Assessment

An important consideration for this report is that the NWRL will not be a traffic-generating development in its own right, in the sense that customers accessing NWRL stations will not generate additional traffic by virtue of the rail line's operation. Rather, the NWRL is intended to reduce and redistribute traffic in the NWRL corridor that is, and will be, generated by commercial, retail and residential development, by providing an alternative to use of the private car (the North West has the highest levels of car ownership in Sydney) for customers accessing destinations along the rail line, including Macquarie Park, the lower North Shore and the City; as well as centres at NWRL stations including Castle Hill, Showground, Norwest, Bella Vista and Rouse Hill.

NWRL analysis indicates that in 2021 there could be about 12,000 fewer car trips (2hr AM peak) made as a result of the NWRL project². This could equate to almost 14 million fewer car trips annually. By 2036 the corresponding reductions could be about 18,000 fewer car trips (2hr AM peak) and almost 20 million fewer car trips annually.

In addition, the NWRL will offer an alternative public transport access mode to M2 Express buses which presently provide the bulk of public transport access to Macquarie Park, the lower North Shore and the City for residents of the north west. These bus services make use of the M2 motorway including the partial busway (with different routes making use of greater or lesser sections of the M2 motorway), and enter the City across the Sydney Harbour Bridge. In 2011 some 90 M2 express buses entered the city in the AM peak hour, and TfNSW forecasts a growth of 144% in M2 Express buses entering the city by 2021.

The volume of buses entering the City across the Sydney Harbour Bridge in the AM peak period (which, in addition to the M2 Express buses, includes buses serving the Northern Beaches, the lower North Shore and Frenchs Forest area) results in substantial congestion within the City and on the Harbour Bridge Bus Lane. Since M2 Express buses are expected to be the greatest source of growth in bus numbers entering the City in the next 10 years and beyond, the introduction of the NWRL will have a positive benefit within the City. As well, a reduction in buses operating from the north west into the lower north shore and the City will permit bus route kilometres saved to be reinvested into higher frequency station feeder buses.

In its initial years of operation, the NWRL will therefore result in the redistribution of traffic (and buses) already on the road network, as well as traffic generated by residential and commercial growth expected to take place in the next 10 years.

Thus some commuters driving in the NWRL corridor to their final destination will instead use the NWRL, accessing the station by foot, bicycle, bus and private car; and new residents and workers in the north west will use NWRL to travel instead of private car and bus. While this may result in changes in traffic flows around station precincts, within the north west, the overall impact of the NWRL will be to reduce the number and length of car and bus trips in the north west corridor.

These wider benefits (including reductions in future bus flows to the City across the Harbour Bridge) are not considered in this report, which focuses on traffic and transport at the station precinct level. This report is intended to ensure the adequacy of provision for traffic and transport operation of NWRL stations, and particularly the accommodation of passenger access to stations at peak times, by foot and bicycle, bus and car (park & ride, and kiss & ride).

² Source: Bureau of Transport Statistics, September 2012

4.1 Strategic traffic modelling

TfNSW's Bureau of Transport Statistics (BTS) undertook strategic traffic modelling to determine future (2021) strategic traffic flows in the NWRL corridor with and without NWRL. BTS's modelling made use of the Public Transport Project Model (PTPM) and Strategic Travel Model (STM) models (it should be noted that the current 2021 STM model, while including a version of the NWRL project - differing substantially from the current proposal - does not include a vehicle access model for NWRL stations).

The NWRL team supplied control totals for kiss & ride and park & ride demand by NWRL stations. BTS factored estimates of kiss & ride and park & ride from the PTPM to match the control totals (this was required because of differences between PTPM and NWRL team demand figures for bus versus car access to NWRL stations). Car only trips were added and a combined car trip table was assigned to the STM road network. Plots of strategic traffic flows in the 2-hour AM peak were supplied by BTS for 2021 without NWRL and 2021 with NWRL, as well as 2011 base traffic for comparison purposes.

It is noted that the STM road network was unchanged for the modelling – i.e. some station access road network modifications associated with the NWRL project or related town centre developments were not included. The NWRL team undertook local assignments to account for these changes; and also added planned bus flows to the model outputs for LINSIG modelling of station precinct level traffic. It should be noted that under a proposed rationalisation of the 'day one' works, the section of the "spine" road between Balmoral Road and Kellyville has been deleted.

NWRL will have a transformative effect in the vicinity of the new stations. This will include changes in travel patterns and changes in travel demand on the road network around each station. It is important to understand whether these changes can be accommodated without major disruption to traffic operations during the peak periods. Traffic modelling of the key intersections in the vicinity of the NWRL stations was conducted to estimate the effects of the altered vehicle demand on the road network. The traffic modelling was undertaken using SIDRA and LINSIG.

SIDRA is an intersection modelling program and was used to determine phasing and cycle times for individual intersections. LINSIG is a program which can assess a number of linked intersections, taking into account the potential co-ordination of traffic signals across a network. Both traffic modelling packages are used widely for traffic analysis. They are regularly maintained and updated. Both programs are considered appropriate for performing this analysis.

SIDRA was used to establish the most efficient signal phasing plan and green signal times for those intersections that will be signal controlled in the future or to re-estimate the green signal time for existing intersections to reflect the changes in traffic demand. This was done as SIDRA has a well-developed signal optimisation process. The signal phasing plan and phase times were transferred to LINSIG. The advantage of LINSIG is that it can coordinate a number of intersections in order to minimise queue lengths and traffic delay. Outputs from the LINSIG model were used to assess the performance of the intersections and estimate the future traffic operations. Signal plans and signal times were adjusted where necessary to ensure the intersections operated satisfactorily. Intersection performance was measured against queue lengths and traffic delay. The analysis seeks to minimise both metrics.

A summary of the results of the modelling for each of the stations is provided in the respective sections of this report. The results summary provided for each of the stations includes the overall intersection Level of Service (LOS) however the degree of saturation (DoS) provided is for the DoS for the leg of the intersection with the worst operation. In some cases, this may not be representative of the intersection as a whole as the worst DoS may be for a minor movement; however, the major movement may be operating at a satisfactory DoS.

A review of the BTS strategic traffic model outputs shows that there will be substantial increases in traffic flows in the NWRL corridor between 2011 and 2021, driven by planned growth in the corridor (North West Growth Centre etc.), irrespective of NWRL. These include:

- An effective doubling of traffic on Schofields Road west of Windsor Road.
- An approximate 30% increase in traffic flows on Windsor Road and Old Windsor Road south of Schofields Road.
- An increase in traffic on Samantha Riley Drive of some 13%.
- A more than 40% increase in westbound traffic in Memorial Avenue east of Old Windsor Road.
- Little increase in traffic on Norwest Boulevard (likely driven by limited capacity on that link), but increasing use of the limited secondary access roads to the business park. The plots suggest a 60% increase in traffic using Edgewater Drive for access to Norwest Business Park, and a reduction in traffic in Lexington Drive.
- A 30% increase in traffic on Showground Road approaching Castle Hill.
- Substantial increases in traffic on approach roads to the Showground employment area and towards Castle Hill – in the order of 55% in Victoria Avenue and an increase of some 300% in eastbound traffic on Carrington Road (flows remain modest however).
- Increases in traffic on the Castle Hill ring road, reflecting growth in the centre.
- In the eastern parts of the NWRL corridor, existing traffic levels and limited road network capacity constrain the potential for growth in traffic in peak periods. However, the modal outputs suggest there would still be traffic growth of some 15% along Castle Hill Road east of Castle Hill. However, in the vicinity of Cherrybrook, forecast traffic growth is more modest, in the order of 12%.

5 Existing Situation

5.1 Traffic data

As part of the assessment carried out for the construction traffic management plan traffic data was collected for a number of key intersections and roads along the NWRL proposed corridor in the last week of November and first week of December 2011. This data was collected for a weekday AM and PM peak hour for intersections and 24 hour / 7 day mid-block classification counts along selected roads. This data is shown in **Table 2** and provides a summary of current traffic levels and the level of service at intersections.

In conjunction with the classification counts, intersection counts were carried out at a number of intersections in the vicinity of the proposed stations.

A review of this data highlights that a number of key intersections experience a poor level of service during peaks, causing traffic congestion and leading to delays for commuters. The continued development within, and adjoining, the new release areas in the north west will mean that traffic levels will increase over the period to the opening of the NWRL.

Table 2 Existing Levels of Service (LoS) at selected intersections

Worksite	Intersection	Control	Existing conditions							
			AM peak				PM peak			
			Total (vph)	DoS	AVD (sec)	LoS	Total (vph)	DS	AVD (sec)	LoS
Cherrybrook station	Castle Hill Rd / Coonara Ave / Edward Bennett Dr	Signals	2,718	0.75	45	D	3,168	0.85	42	C
	Castle Hill Rd / Glenhope Rd	Priority	1,971	1.00	7	NA	2,626	1.00	6	NA
	Castle Hill Rd / County Dr / Highs Rd	Signals	4,046	1.01	64	E	4,418	1.01	63	E
Castle Hill station	Old Northern Rd / McMullen Rd	Signals	4,121	0.89	36	C	4,347	0.74	30	C
	Old Northern Rd / Crane Rd / Castle St	Signals	967	0.44	28	B	1,028	0.46	27	B
	Crane Rd / Terminus St	Signals	3,178	0.88	43	D	2,941	0.68	40	C
Showground	Showground Rd / Carrington Rd	Signals	2,735	0.75	32	C	3,078	0.92	44	D

Worksite	Intersection	Control	Existing conditions							
			AM peak				PM peak			
			Total (vph)	DoS	AVD (sec)	LoS	Total (vph)	DS	AVD (sec)	LoS
station	Victoria Ave / Carrington Rd	R'bout	2,088	0.42	9	A	2,776	0.57	10	A
	Showground Rd / Gilbert Rd	Signals	3,955	0.80	34	C	3,798	0.66	24	B
Norwest station	Norwest Blvd / Windsor Rd	Signals	5,107	0.90	40	C	5,038	0.92	49	D
	Norwest Blvd / Columbia Cct / Brookhollow Ave (East)	R'bout	3,545	0.77	7	A	3,827	1.04	20	B
	Norwest Blvd / Brookhollow Ave (West)	R'bout	3,213	0.60	8	A	3,207	0.57	8	A
Bella Vista station	Old Windsor Rd / Celebration Dr	Signals	4,257	0.82	24	B	4,181	0.83	38	C
	Lexington Dr / Celebration Dr	R'bout	1,962	1.02	35	C	1,892	0.95	20	B
Balmoral Road & Memorial Avenue	Old Windsor Rd / Balmoral Rd	Signals	4,011	0.67	31	C	4,051	0.89	27	B
	Old Windsor Rd / Memorial Ave / Sunnyholt Rd	Signals	5,437	1.07	64	E	5,669	1.02	64	E
Kellyville station	Old Windsor Rd / Samantha Riley Dr	Signals	4,106	1.00	66	E	4,015	0.94	55	D
Windsor Road Site	Old Windsor Rd / Windsor Rd	Signals	3,567	0.46	22	B	4,061	0.55	32	C
Rouse Hill station	Windsor Rd / White Hart Dr	Signals	3,492	0.65	27	B	4,399	0.66	25	B
	Windsor Rd / Schofields Rd / Rouse Hill Dr	Signals	3,863	0.95	49	D	4,491	0.93	44	D
Schofields Road Sites	Schofields Rd / Cudgegong Rd	Priority	1,084	0.51	7	NA	1,118	0.37	5	NA
	Schofields Rd / Tallawong Rd	Priority	1,013	0.30	2	NA	1,226	0.33	2	NA

Peak Hours - 8.00-9.00am and 5.00-6.00pm; vpd – Vehicles per day; DoS – Degree of saturation; AVD – Average vehicle delay; LoS – Level of service

Note: For priority intersections, LoS=NA: Intersection LoS and Major Road Approach LoS values are not applicable for two-way sign control since the average delay is not a good LoS measure due to zero delays associated with major road movements.

Table 3 provides an outline of the average daily traffic volumes recorded on key roads along the corridor. These volumes were determined from RMS Annual Average Daily Traffic (AADT) data provided by RMS or from counts undertaken as part of this work. Also included in the table is the percentage of total traffic that was recorded as being heavy vehicles i.e. rigid trucks, semi-trailers, B-doubles, buses, coaches.

Table 3 Average Annual Daily Traffic Volumes 2009 & 2011

Road	Agency Responsibility	Data source	2009 AADT	2011 AADT	Heavy vehicles (%)	Intersection/Location
Castle Hill Road	RMS	RMS	43,331	-		Between Old Northern Rd & Glen Rd
		ITLU 2011		26,169	7.5%	Between Glenhope Rd & Franklin Rd
Old Northern Rd	RMS	RMS	35,491	-		Between Crane Rd & Showground Rd
		ITLU 2011	-	44,947	7.8%	Between McMullen Ave & Castle Hill Rd
Terminus St	RMS	ITLU 2011	-	27,694	5.6%	Between McMullen Ave & Crane Rd
Old Castle Hill Rd	Hills Shire Council	ITLU 2011	-	8,042	8.0%	Between Castle St & Eric Felton St
Showground Rd	RMS	RMS	44,913*	-		Between Gilbert Rd & Victoria Ave
		ITLU 2011	-	43,444	6.2%	Between Gilbert Rd & Kings Rd
Carrington Rd	Hills Shire Council	ITLU 2011	-	15,409	5.2%	Between Middleton Ave & Victoria Ave
Gilbert Rd	Hills Shire Council	RMS	16,134*	-		Between Ridgecrop Dr & Lisa Cr
Norwest Bvd	RMS	ITLU 2011	-	26,417	5.9%	East of Century Cct/Brookhollow Ave
Brookhollow Ave	Hills Shire Council	ITLU 2011	-	2,726	• 5.1%	
Windsor Rd	RMS	RMS	34,782*	-		Between Showground Rd & Salisbury Rd
Old Windsor Rd	RMS	RMS	49,004	-		South of Balmoral Rd
Celebration Dr	Hills Shire Council	ITLU 2011	-	14,533	3.1%	West of Lexington Dr
Memorial Ave	RMS	RMS	21,327*	-		West of Windsor Rd

Road	Agency Responsibility	Data source	2009 AADT	2011 AADT	Heavy vehicles (%)	Intersection/Location
		ITLU 2011	-	21,660	4.8%	East of Old Windsor Rd
Sunnyholt Rd	RMS	RMS	39,433	-		
Samantha Riley Dr	Hills Shire Council	ITLU 2011	-	13,165	5.4%	East of Old Windsor Rd
Sanctuary Dr	Hills Shire Council	ITLU 2011	-	3,657	6.6%	East of Old Windsor Rd
Windsor Rd	RMS	RMS	48,001	-		North of Merriville Rd
White Hart Drive	Hills Shire Council	ITLU 2011	-	10,820	3.4%	Between Windsor Rd & Tempus St
Rouse Hill Dr	Hills Shire Council	ITLU 2011	-	9,319	2.6%	Between Windsor Rd & Tempus St
Commercial Rd	Hills Shire Council	ITLU 2011	-	5,676	4.8%	Between Windsor Rd & Caddies Bvd
Schofields Rd	RMS	ITLU 2011	-	11,594	4.3%	Between Cudgegong Rd & Ponds Bvd
			-	12,069	4.4%	West of Cudgegong Rd
Cudgegong Rd	Blacktown City Council	ITLU 2011	-	1,461	7.4%	North of Schofields Rd
Tallawong Rd	Blacktown City Council	ITLU 2011	-	950	10.8%	North of Schofields Rd

*Axle pairs. Some RMS permanent counters measure in axle pairs rather than vehicles. A value measured in axle pairs is typically 10-20% higher than a value measured in vehicles

In addition to the traffic data collected to inform this report, data from the Sydney Strategic Transport Model (STM) has been provided by Roads and Maritime Services (RMS) in order to assess the impacts on traffic with the opening of the NWRL and the potential changes to travel patterns that may result (though it is noted that the version of the STM supplied is different to the current NWRL proposal and does not simulate the operation of the planned park and ride facilities at five stations).

Demand forecasts have also been prepared and these have been utilised in assessing the traffic movements around the immediate station precincts. While every effort is made to ensure that the forecasts provide a reasonable assumption of future traffic volumes and mode splits, external forces not yet known may have an impact on future travel patterns. However, it is expected that the opening of the NWRL will see a substantial shift by residents and workers of the north west in how they travel to work, school, and leisure activities.

Most of the proposed stations are located close to the arterial road network, which will provide access from many of the surrounding suburbs to the NWRL. In some cases there are local roads in place or planned as part of the NWRL development surrounding the stations and these could be expected to

see an increase in traffic. This traffic would primarily be traffic from within the suburb itself accessing the station facilities.

5.2 Bus services

As buses form the main public transport mode for the north west area, there is a comprehensive network of services operating at the local level and regional services to other centres across Sydney. This includes services to the Sydney CBD, North Sydney and Macquarie Park operating as cross-regional services and M2 Express buses. There are also a number of connections provided to regional centres such as Parramatta, Hornsby and Blacktown and, connections to the rail network at those centres and Riverstone, Seven Hills, Epping, Beecroft and Pennant Hills.

As described in Sydney Rail Future, the NWRL services would operate between Cudgegong Road and Chatswood at a higher frequency than previously proposed (12 trains per hour instead of 8). This is expected to result in a slight increase in rail demand overall than originally forecast under the 'interlined' rail operating strategy as a result of the compensating higher service frequency and the availability of cross-platform interchange at Chatswood. Those using NWRL to travel to Macquarie University, Macquarie Park, North Ryde and Chatswood will continue to have a direct rail service, and at a higher frequency than they would have otherwise had under the 'interlined' rail scenario.

Comfort Delgro Cabcharge (CDC), operating as Hillsbus, and Busways are the providers of bus services in the area surrounding the NWRL alignment under contract to TfNSW. **Figure 4** provides a graphical representation of the bus routes that operate in the area of the NWRL alignment. Hillsbus currently provides the majority of services in and around the NWRL corridor. As can be seen in **Figure 4** these services cover the suburbs around the proposed Cherrybrook, Castle Hill, Showground, Norwest, Bella Vista, Kellyville and Rouse Hill Stations.

Busways generally operates in the western area of the NWRL corridor providing services within the residential areas of Stanhope Gardens, Glenwood, Kellyville Ridge and the vicinity of Schofields Road. These services provide links from these areas to Blacktown, Riverstone, Castle Hill and Macquarie Park.

A significant volume of buses currently operate from the Hills District to the Sydney CBD and North Sydney. The main routes of the 610/M61 services operate between Castle Hill and the Sydney CBD on a high frequency basis during the peak periods with services also operating to early morning on most days and 24 hours on Friday and Saturday nights. A high level of park and ride currently occurs for passengers using the Hills-City services, particularly around Baulkham Hills intersection, Barclay Road and Oakes Road bus stations.

There are approximately 40 services which operate through Baulkham Hills intersection toward the City between 7:00am and 8:00am on a weekday. It is understood that Hillsbus is also seeing significant growth on services that operate from around the Kellyville/Rouse Hill area travelling via the North West Transitway to the M2 and onto the City or North Sydney. TfNSW forecasts a 140% growth in M2 Express buses into the Sydney CBD between 2011 and 2021.

In addition to this it has also been reported that passenger numbers on Transitway services to and from Parramatta are continuing to increase year on year at the rate of 10-20%.

Castle Hill and Rouse Hill are the two major bus interchanges currently operating where significant bus layover occurs. At the present time in Castle Hill the majority of the bus layover, for meal or crib breaks occurs in Old Castle Hill Road, north of the Crane Road/Castle Street intersection.

There is also some shorter term layover occurring in the 'Bus Only' section of Old Northern Road. The Old Castle Hill Road layover provides space for approximately 7-8 buses, with a further 2-3 buses accommodated in Old Northern Road.

The Rouse Hill layover area was specifically constructed as part of the Rouse Hill Transport Interchange for the North West T-Way. The bus layover area is located between the bus interchange and Windsor Road with driver facilities (toilets, meal room) provided in the interchange. The bus layover area provides for approximately eight buses to stand during breaks for the drivers.

5.3 North-West Transitway

The Northwest Transitway was opened in 2007 and provides a high priority bus link from the north west to Parramatta and Blacktown.

The North West T-Way includes the following Transitway sections:

- Parramatta and Rouse Hill – This section includes 14 kilometres of bus only roads and three kilometres of bus lanes on existing roads
- Blacktown and Parklea – This section provides seven kilometres of bus only road.

Both Transitway sections intersect at Burns interchange at Parklea. A total of 30 bus stations are provided for North West T-Way.

The following Transitway bus stations are located along the NWRL corridor.

- Celebration
- Balmoral
- Burns (Memorial Avenue)
- Riley (Samantha Riley Drive)
- Merryville
- Sanctuary
- Rouse Hill

Busways and Hillsbus (CDC) operate North-West T-Way services.

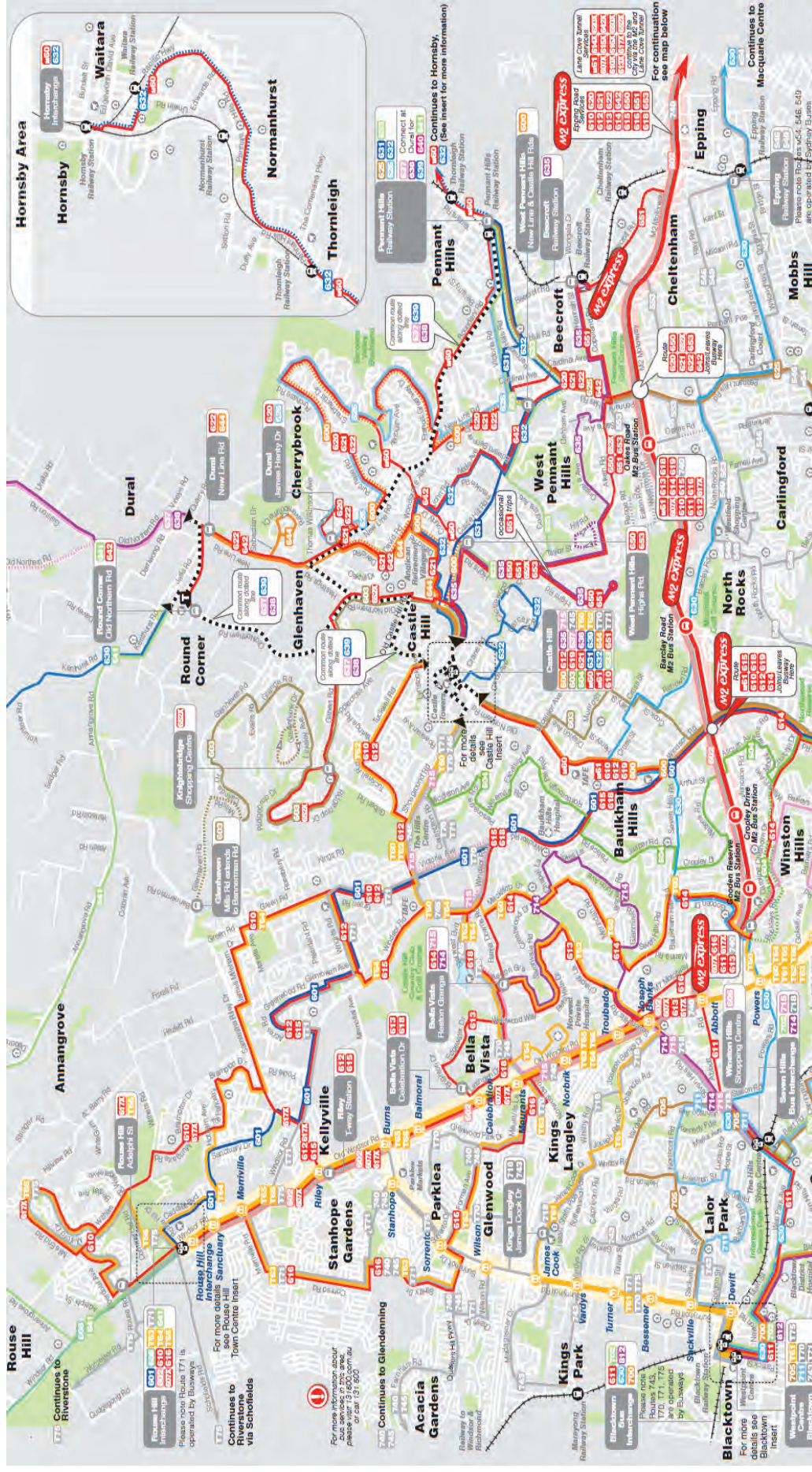
Hillsbus routes that are travelling along the NWRL corridor are T63, T64, T65, T66, 602, 607X and 617X.

Busways routes are T71, T75 and 740.

The frequency of bus services are provided below:

- Weekday - every 3-4 minutes during peak period and 7-8 minutes during off peak period
- Weekend and public holidays – every 10 minutes

Figure 4 Existing bus route network, North West Sydney



Source: www.cdbus.com.au (2012)

5.4 Cycling

There is a limited network of on-road and off-road cycleways in the vicinity of the proposed stations at the present time, with only the stations of Showground, Bella Vista, Kellyville and Rouse Hill having any cycle paths or lanes in close proximity.

The proposed Cherrybrook station is located within the Hornsby Shire LGA. Council has produced a Cycling Map indicating on and off road paths and difficulty levels although none are shown in the area of the station.

The Hills Shire Council completed The Hills Shire Bike Plan Review in 2009. This Review identified an extensive proposed off-road cycleway network with many identified routes that could be linked to the proposed NWRL stations.

In 2011, Blacktown City Council commenced a revision of its bike plan. As at September 2012, the bike plan remains a draft.

While the only proposed NWRL station in Blacktown City LGA is Cudgegong Road station, Blacktown City's boundary with the Hills Shire Council is along Old Windsor Road, and hence there would be key opportunities for cycle routes in Blacktown City LGA to connect with the proposed NWRL stations of Rouse Hill, Kellyville, and Bella Vista (within the Hills Shire LGA).

5.5 Pedestrians

Existing and upgraded pedestrian facilities such as sealed footpaths, pedestrian crossings, pedestrian refuges, kerb ramps would be required to facilitate pedestrian movements to and from the NWRL stations. The safe and easy access to stations from the surrounding areas would encourage and facilitate future rail passengers choosing to walk to the stations where possible.

Pedestrian facilities are proposed as part of the station developments for those walking from the surrounding area, from the park and ride car parks, bus stands, taxi stands and kiss and ride parking spaces. In some cases this involves a fully signalised crossing, particularly where there is the need to cross a major road, to the provision of a marked crossing or pedestrian refuge. Pedestrian protection at busy locations will be required, however, the use of fencing will be generally avoided in the immediate vicinity of the station precincts.

Advice from RMS is that, on state roads, and where a marked pedestrian crossing is warranted, is that it should be crossing only one traffic lane in each direction. This has been accepted as a design principle for the NWRL and on those roads surrounding the stations where pedestrian crossings have been identified, then the road will be narrowed, where feasible, to conform to this requirement.

The principal aim is to ensure that the pathways are clearly marked and provide a reasonable amount of all weather access so that they minimise any potential conflicts between vehicles and pedestrians.

RMS officers also advise that, because of ongoing maintenance and access issues, it is a preference to provide ramps, rather than lifts, with pedestrian/cycle bridges built across classified arterial roads under RMS care and control.

6 Future Travel Demands

With the announcement of Sydney's Rail Future, the revised rail operating strategy shown in figure 7 has now been adopted as the rail operating strategy for NWRL upon opening.

More than 30 million trips a year are expected to be made on the rail link between Cudgegong Road and Chatswood within seven years of the rail link opening.

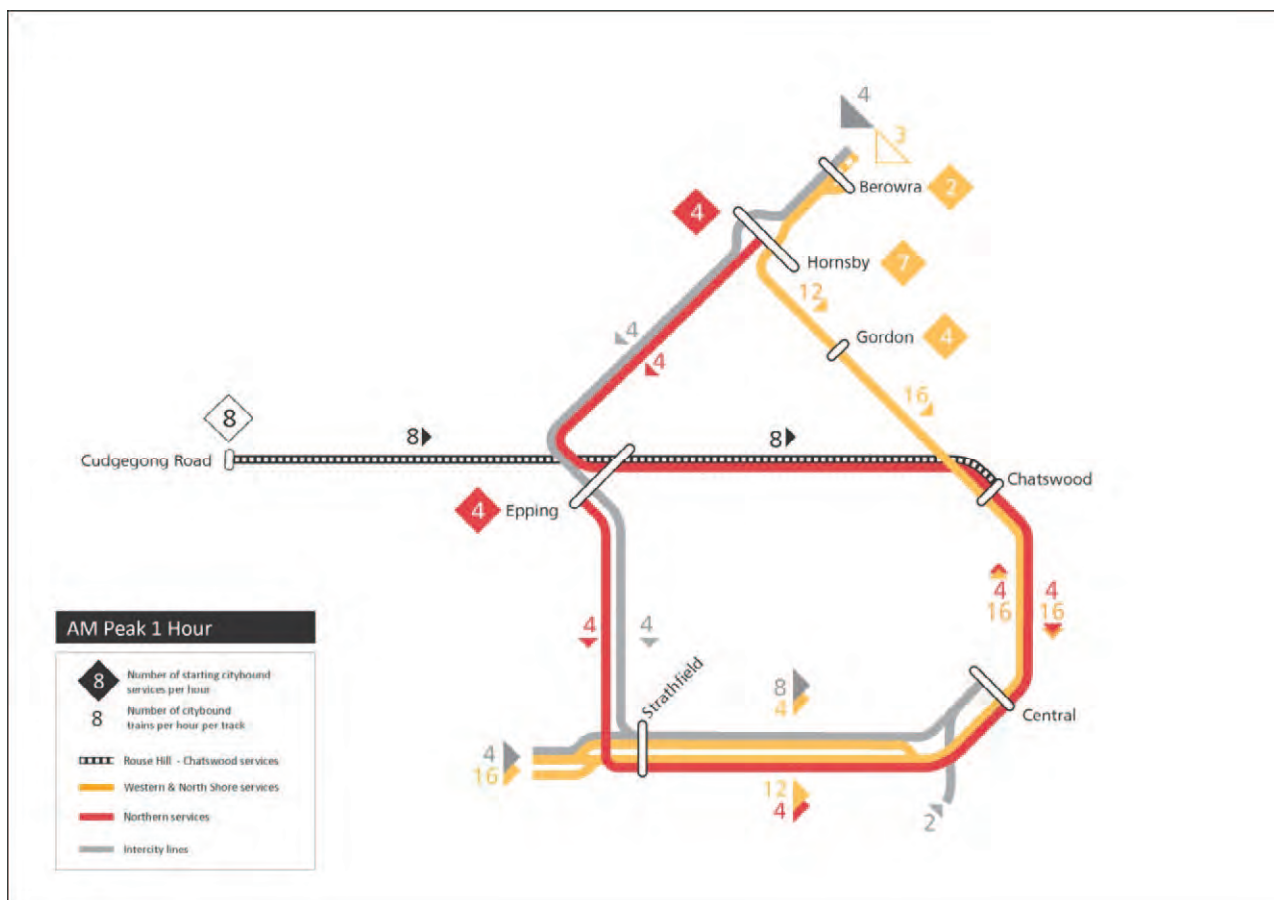
6.1 Rail service strategy

A number of rail service pattern options have been considered in the development of the NWRL, each with a different pattern and level of accessibility to key destinations, particularly the Sydney CBD.

From the perspective of initial bus network planning and the potential for bus interchange, these involved two strategies including:

- An initial service in which NWRL services (8 trains per hour in the peak direction) would operate between Cudgegong Road and Chatswood. Passengers would be required to transfer at Chatswood for journeys to the lower North Shore and the City. This service was likely to be an introductory stage for the NWRL for a short period. This is illustrated in **Figure 5**.

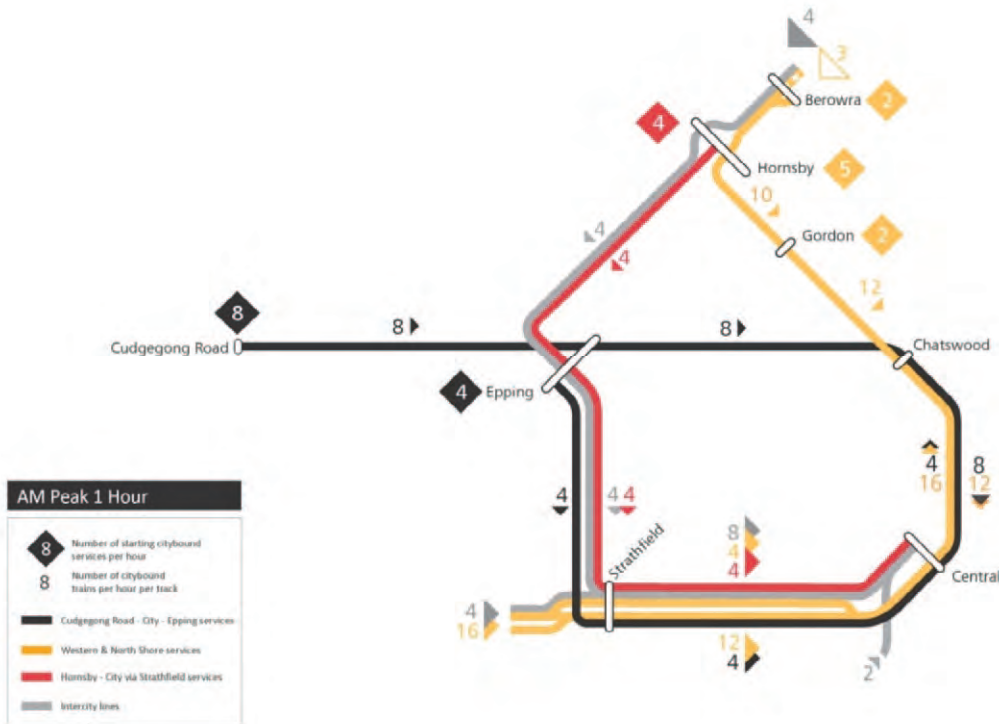
Figure 5 Previous NWRL Initial Rail Service Strategy (prior to announcement of Sydney's Rail Future)



Source: Transport for NSW (2012)

- A second ‘interlined’ option providing 8 trains per hour in the peak direction between Cudgegong Road and the City via Chatswood (see **Figure 6**).

Figure 6 Previous NWRL Interlined Rail Service Strategy (prior to announcement of Sydney’s Rail Future)



Source: Transport for NSW (2012)

Under the Sydney’s Rail Future, announced in June 2012, NWRL is foreshadowed as ultimately part of a future discrete Tier 1 (rapid transit) train operating sector connecting with lines to the south by a new line under the harbour.

As the first step towards this, NWRL will initially operate as a shuttle service between Cudgegong Road and Chatswood using single deck rolling stock at a peak frequency of 12 trains per hour (a service every five minutes). Existing CityRail services running via ECRL will be re-routed via Strathfield, and the Epping-Chatswood line will effectively become part of the NWRL service.

The revised rail service strategy is shown in **Figure 7**.

AM Peak 1 Hour

- 12 Number of starting citybound services per hour
- 12 Number of citybound trains per hour per track
- NWRL service
- Western & North Shore and Northern line services
- Northern Line (to Central) services
- Intercity lines

All stations on the NWRL would experience the same service level – there would be no express or limited stops trains on the NWRL. It is therefore likely that most NWRL customers will use the station nearest to them, rather than choosing one station over another because of a perceived superior service.

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Table 4 Forecast NWRL Travel Times to Key Destinations

From station	Travel time (mins) to:			
	Macquarie Park	Chatswood	North Sydney	Wynyard
Cudgegong Road	28	37	51	57
Rouse Hill	26	35	49	55
Kellyville	24	33	47	53
Showground	17	26	40	46
Castle Hill	15	24	38	44
Cherrybrook	12	21	35	41

Source: Transport for NSW (2012)

Note: Travel times are based on the NWRL Revised Rail Service Strategy (see **Figure 7**). Outside peak hours, times beyond Chatswood would at times be slightly longer than those shown due to a slight reduction in frequency of connecting services on the North Shore Line.

6.2 Study area

In some parts of the catchment area the NWRL may not be the primary choice (e.g. areas along the Richmond Line) particularly for travel to the Sydney CBD. But in these locations the NWRL will be an important choice for travel to destinations such as Macquarie Park and the Lower North Shore.

The catchment area is bounded by:

- Berowra Creek and Pennant Hills Road to the east
- M2, M7 and NWGC boundary to the south
- NWGC boundary to the west and north west
- Indicative boundary of Dural to the north

This catchment area consists of 138 travel zones covering an area of 330 square kilometres.

Key population and employment statistics based on the Bureau of Transport Statistics (BTS) Travel Zone (TZ) forecasts (October 2009) for the catchment area include:

- 2006 population = 226,000
- 2021 population = 335,000 (48 % increase from 2006)
- 2036 population = 457,000 (103 % increase from 2006)
- 2006 employment = 72,000
- 2021 employment = 98,000 (36 % increase from 2006)
- 2036 employment = 124,000 (72 % increase from 2006)

The statistics in relation to the Journey to Work (JTW) trips in 2006 are provided below:

- Average transit mode share for JTW trips out = 13 %

- Average transit mode share for JTW trips in = 3 %
- Proportion of JTW trips to Global Sydney (Sydney CBD + North Sydney) = 11 %
- Proportion of JTW trips to Global Economic Corridor = 17 %

6.3 Station catchments

In order to assess future travel demand, each travel zone in the full catchment area is assigned to a unique NWRL station for walk, bus, park and ride and kiss and ride access – this defines the catchment area for each station. Separate modal station catchment areas have been defined for:

- Walk
- Bus
- Park and ride
- Kiss and ride

In reality, rail demand for a particular access mode from a travel zone may spread across different NWRL stations depending on location within the travel zone and destination. The assumptions in the station demand estimates are for the station considered most likely to be accessed for travel to destinations in the eastern sector of Sydney.

Station walk catchments are defined as portions of travel zones adjacent to the NWRL station deemed to be within a reasonable walk distance of the station – the portion can be defined separately for population and employment. The walk catchment is broadly defined as an 800 m straight line catchment without detailed consideration of the impact of road barriers, gradients etc. on the extent of the actual catchment. The remainder of travel zones which partly lie within the walk catchment of a station are assigned to bus, park and ride and kiss and ride catchments.

Bus catchments for each station are based on assumptions regarding existing bus services passing proposed stations and future bus connections to NWRL stations from surrounding areas.

Park and ride catchments are based on assumptions about the likely choice of park and ride station given that most travel in the morning peak is to the south and east, and the availability of off-street parking at the NWRL station. Lower park and ride demand is assumed for Rouse Hill, Norwest and Castle Hill stations based on limited availability of both off-street and on-street parking.

Kiss and ride catchments are based on assumptions about the likely choice of kiss and ride station given that most travel in the morning peak is to the south and east.

6.4 Land use assumptions and trip generation

The BTS land use forecasts are used as the basis for current and future population in the station catchment areas.

Some intensification beyond current BTS forecasts is assumed in some station walk catchments.

However, this is modest – analysis suggests that major land use intensification resulting from the NWRL project (such as new land use in the corridor between Bella Vista station and Kellyville station), would take place well into the future – generally beyond 2036.

The following parameters are used across the full catchment area for estimating the number of AM peak 3.5 hour work trips generated per population and employment:

- 0.42 work trips per head of population (based on 2006 JTW data)
- 0.66 work trips per job (based on 2006 JTW data)
- 90 % of work trips made in the AM peak 3.5 hour (assumed)

NOTE: A work trip is defined as the trips from the 2006 JTW data that involved travel on census day – that is, it excludes “did not travel”.

6.5 Forecast demand

Demand forecasts have been developed for NWRL by the Bureau of Transport Statistics using the PTPM, a module of the Sydney Strategic Travel Model (STM).

It is estimated that more than 30 million trips per annum will be made on NWRL between Cudgegong Road and Chatswood within seven years of opening.

6.6 Pedestrian/Cycle

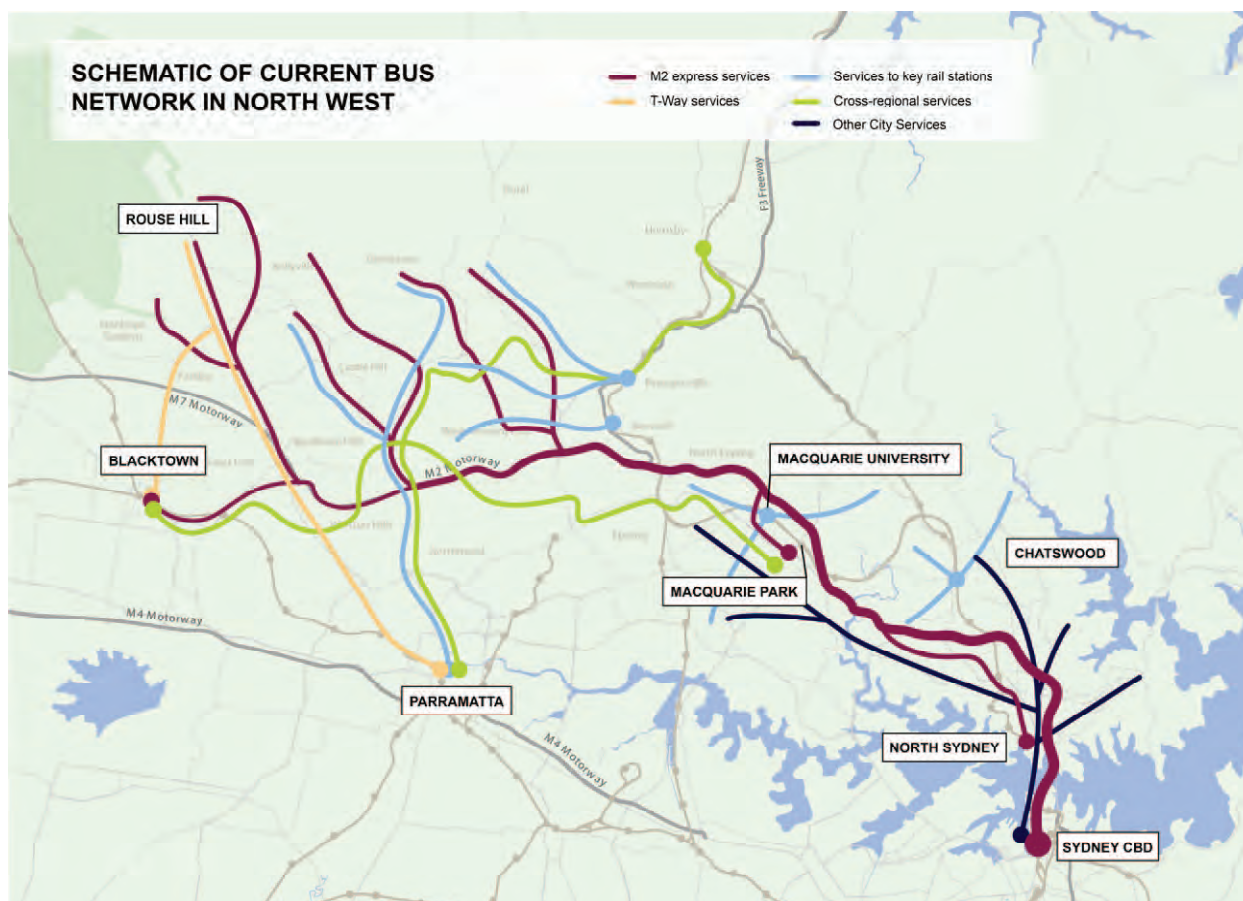
Pedestrian and cyclist movements will increase immediately adjacent to the station precincts with the operation of the NWRL. Adequate pedestrian/cyclist related facilities need to be provided to cater for the future pedestrian/cyclist demand.

These facilities may include pedestrian and cyclist scale wayfinding signage and visual cues, footpaths/shared paths, good street lighting, and sufficient rest stops, high quality bicycle ‘hub’ facilities including secure bicycle parking and overnight storage, shower/ change facilities, lockers for personal items, and even bike maintenance services.

6.7 Bus

The current bus network in north west Sydney is built around a number of different service types, including M2 express services from a wide range of suburb origins (many operating in peaks only), T-Way services to Blacktown and Parramatta, local feeder services to rail stations and cross-regional services. (See **Figure 8** below)

Figure 8 Schematic of current bus network in North West Sydney



Source: NWRL, 2012

It is anticipated that the majority of the M2 city express bus services which currently perform the trunk line haul service to North Sydney and the Sydney CBD could be withdrawn from those suburbs with good access to the NWRL once the NWRL is operational. These buses would then be used more efficiently to provide enhanced feeder services into NWRL stations and increased frequency to key centres such as Castle Hill and Macquarie Park. Parramatta and Blacktown T-Way services, which perform a different but complementary function, would be retained with the NWRL in operation. (See **Figure 9** below)

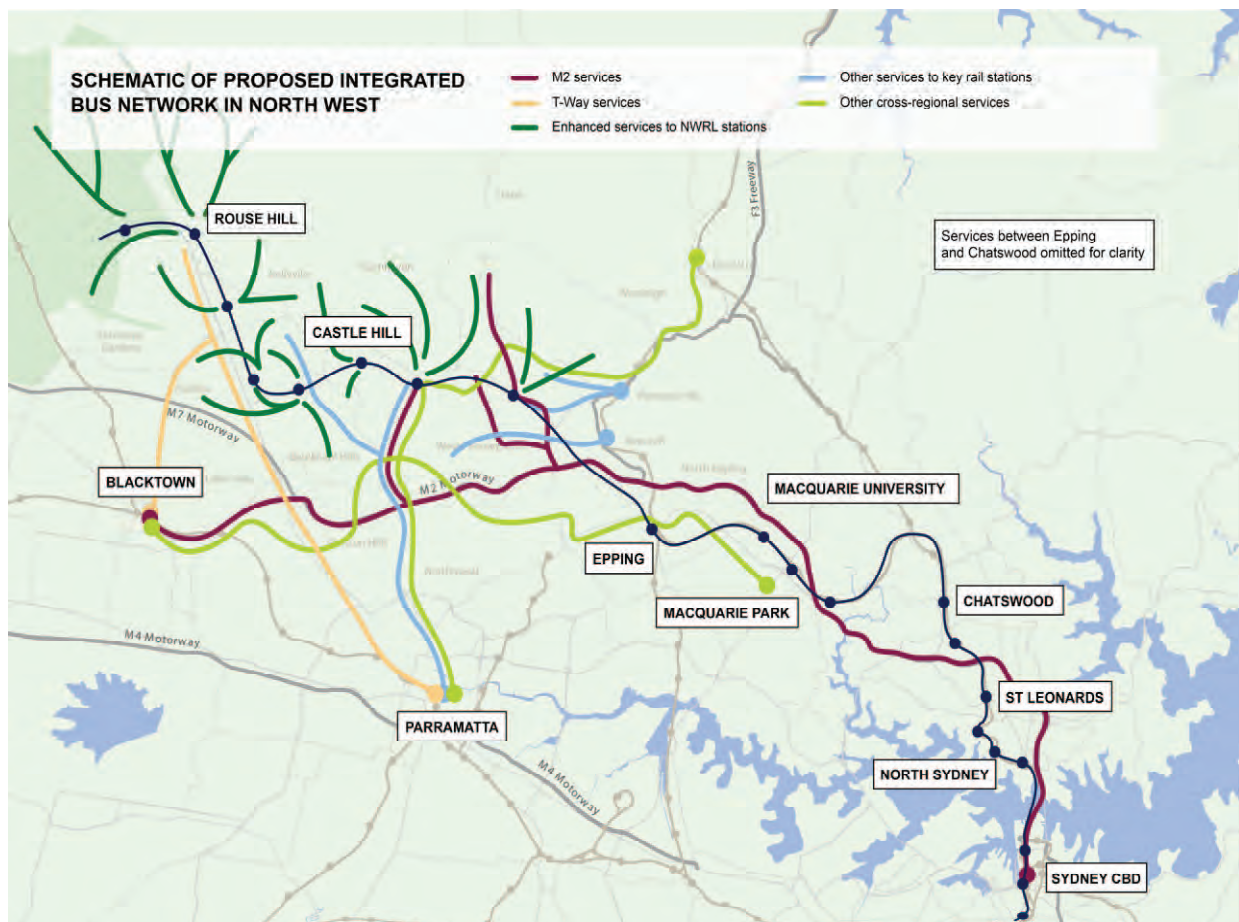
Under the revised (shuttle) rail operating strategy, the higher frequency rail service compared with the interlined strategy, generally compensates for the required interchange for those travelling beyond Chatswood. However, some minor changes to the bus strategy are envisaged at the eastern end of the NWRL corridor (where bus travel times are more competitive with rail) in order to minimise any disadvantage as a result of the change to the operating strategy.

The following main changes to the bus services in the north west are proposed:

- Replacement of long haul M2 express bus services from the west of the NWRL corridor, with train, while preserving some M2 Express bus services in the eastern part of the corridor (generally south from Castle Hill, including Baulkham Hills and the M2 corridor itself, as well as from the Cherrybrook-Dural-West Pennant Hills Valley area). This would substantially reduce the number of M2 express bus services entering Sydney CBD (however, total AM peak bus volumes entering the CBD are not expected to decrease in the medium to longer term due to growth in demand from the M2 and other corridors between now and when NWRL is operating).

- A major bus-rail/bus-bus interchange at Rouse Hill with buses from NWGC and T-Way services
- Minor bus interchanges at Kellyville, Bella Vista and Norwest
- A minor interchange at Showground between NWRL and bus services from Kellyville including growth precincts of North Kellyville
- A major interchange at Castle Hill between NWRL and bus services from the extensive central part of corridor including opportunities for interchange with cross-regional services to Parramatta and Hornsby as well as Baulkham Hills and other areas to the south.

Figure 9 Proposed integrated bus network with NWRL



In general, the effect of the NWRL bus strategy on bus flows in the corridor will be for southbound bus flows from Rouse Hill (with the exception of T-Way services to Parramatta and Blacktown) towards the City to reduce, while bus flows to Rouse Hill from the north and west will increase (as new routes are introduced to serve the NWGC).

The foreshadowed reduction in M2 Express buses in the western and northern part of the NWRL corridor after the NWRL is implemented will allow bus operators to reinvest bus kilometres into improved local feeder services and services to other regional destinations such as Parramatta, Blacktown and Hornsby. Restructured local bus routes will provide access to Kellyville and Bella Vista stations (and onward to Norwest), though both these stations will primarily provide for car access.

In the eastern part of the corridor (generally Castle Hill and east), reductions in M2 Express buses to the City will be more modest and Castle Hill and Cherrybrook stations will be served by existing and planned services (in the case of Castle Hill), and a slight diversion of existing routes (potentially supplemented by a new local shuttle bus route from the south) in the case of Cherrybrook.

The retained M2 Express bus services will particularly serve areas south of the NWRL corridor and are also required to maintain services from those locations beyond the practical NWRL catchment, including Baulkham Hills and stops along the M2 itself such as Gooden Reserve, Cropley Drive, Barclay Road and Oakes Road.

6.8 Car

NWRL analysis of forecast demand shows that overall, park and ride demand for NWRL will be about double the Sydney average for CityRail stations, while kiss and ride demand will be somewhat higher.

Park and ride and kiss and ride demand is likely to be high in the NWRL catchment area based on high underlying levels of car ownership and usage, particularly in the western part of the corridor with relatively recent residential developments. This is consistent with existing outer stations in the CityRail network where a relatively small proportion of rail users live within a walk catchment of a station.

These aspects of the NWRL corridor are an important foundation for the approach adopted on car access provisions – a different approach is proposed for eastern versus western stations. Eastern stations have more constraints on the provision of park and ride facilities and less capacity in the road network. They also have a stronger bus network to offer an alternative for car access.

In contrast, the western stations have less existing development around stations and less developed bus networks. As a result, a higher provision of park and ride spaces is targeted at the western stations of Kellyville and Cudgegong Road. The principles of this 'targeted' approach are illustrated in **Figure 10**.

Figure 10 Targeted approach to provision of car parking at NWRL stations

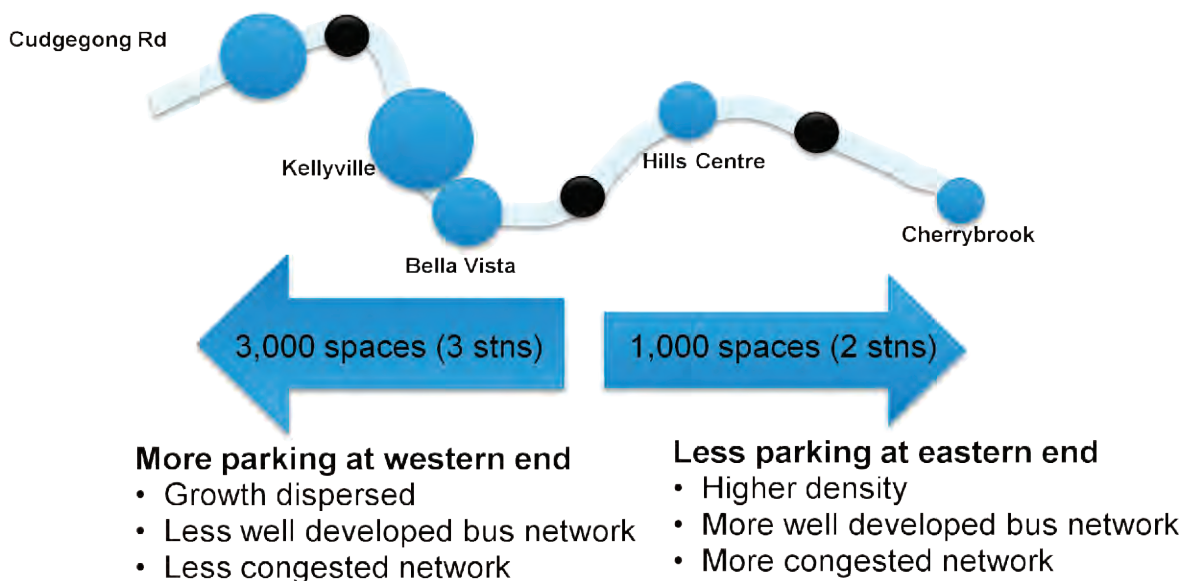


Table 5 Proposed number of commuter car spaces at NWRL stations

Station	No. of commuter car spaces
Cherrybrook	400
Castle Hill	Nil
Showground	600
Norwest	Nil
Bella Vista	800
Kellyville	1,200
Rouse Hill	Nil
Cudgegong Road	1,000
TOTAL	4,000

Source: NWRL, 2012

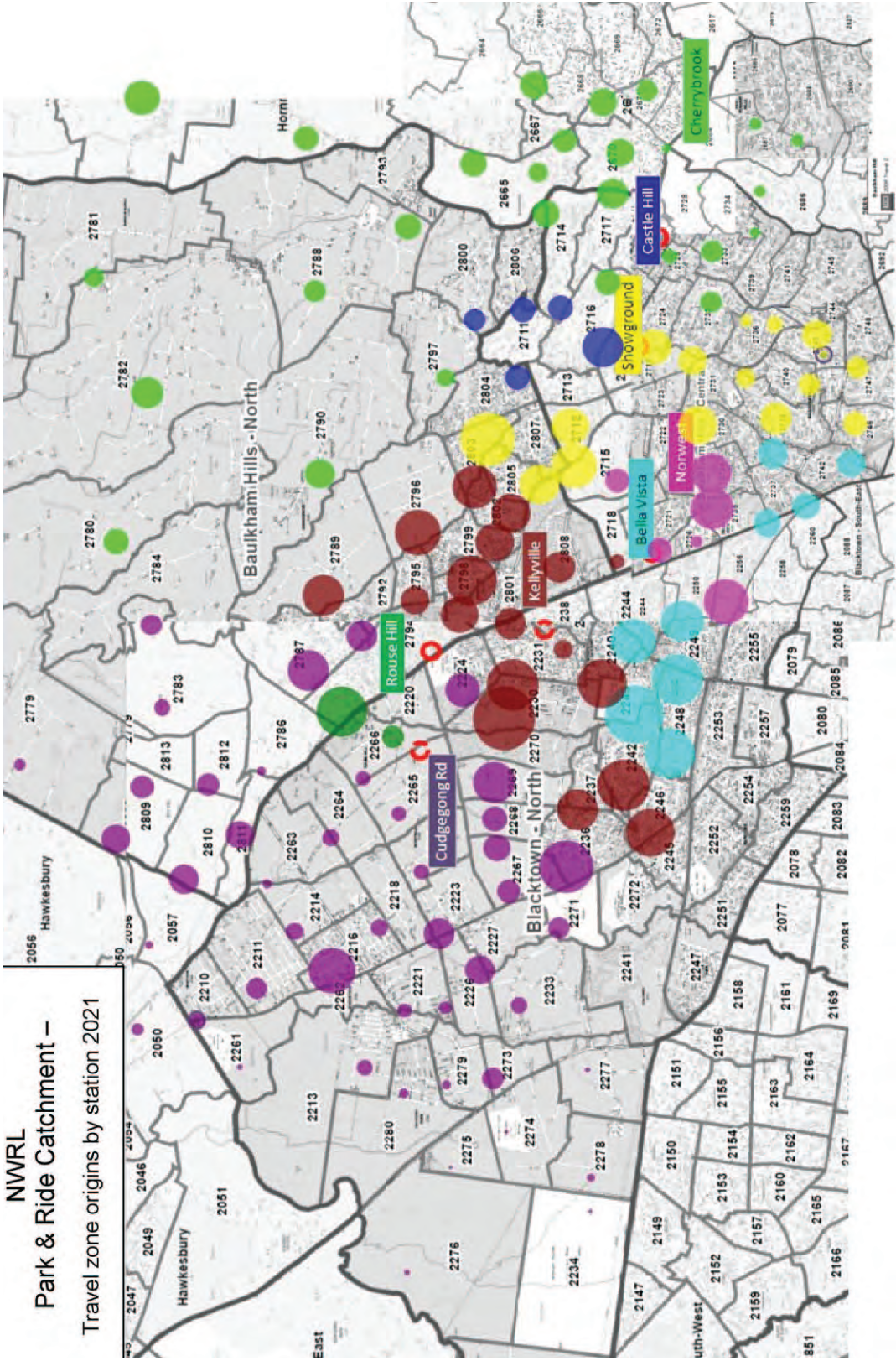
The provision of park and ride and kiss and ride facilities at the proposed NWRL stations will redistribute the traffic movements on the road network located immediately adjacent to the station precincts. The capacity and safety for the road network needs to be managed efficiently. However, overall, providing car parking at NWRL stations means that people can make shorter car trips to their local station and thus reduce traffic movements on the arterial road network, including Old Windsor Road and the M2.

The provision of park and ride and kiss and ride facilities at the proposed NWRL stations would potentially remove some of the parking demand at the existing stations that are currently servicing north west residents - in particular, railway stations located along northern line, Richmond line and western line. The provision of park and ride and kiss and ride facilities at the proposed NWRL stations will also reduce the vehicle trips for a wider area of road network. The expected catchment of each station for park and ride and kiss and ride is illustrated in **Figure 11** and **Figure 12**.

6.8.1 Park and ride

The park and ride trip origins for each station are shown in Figure 11 below.

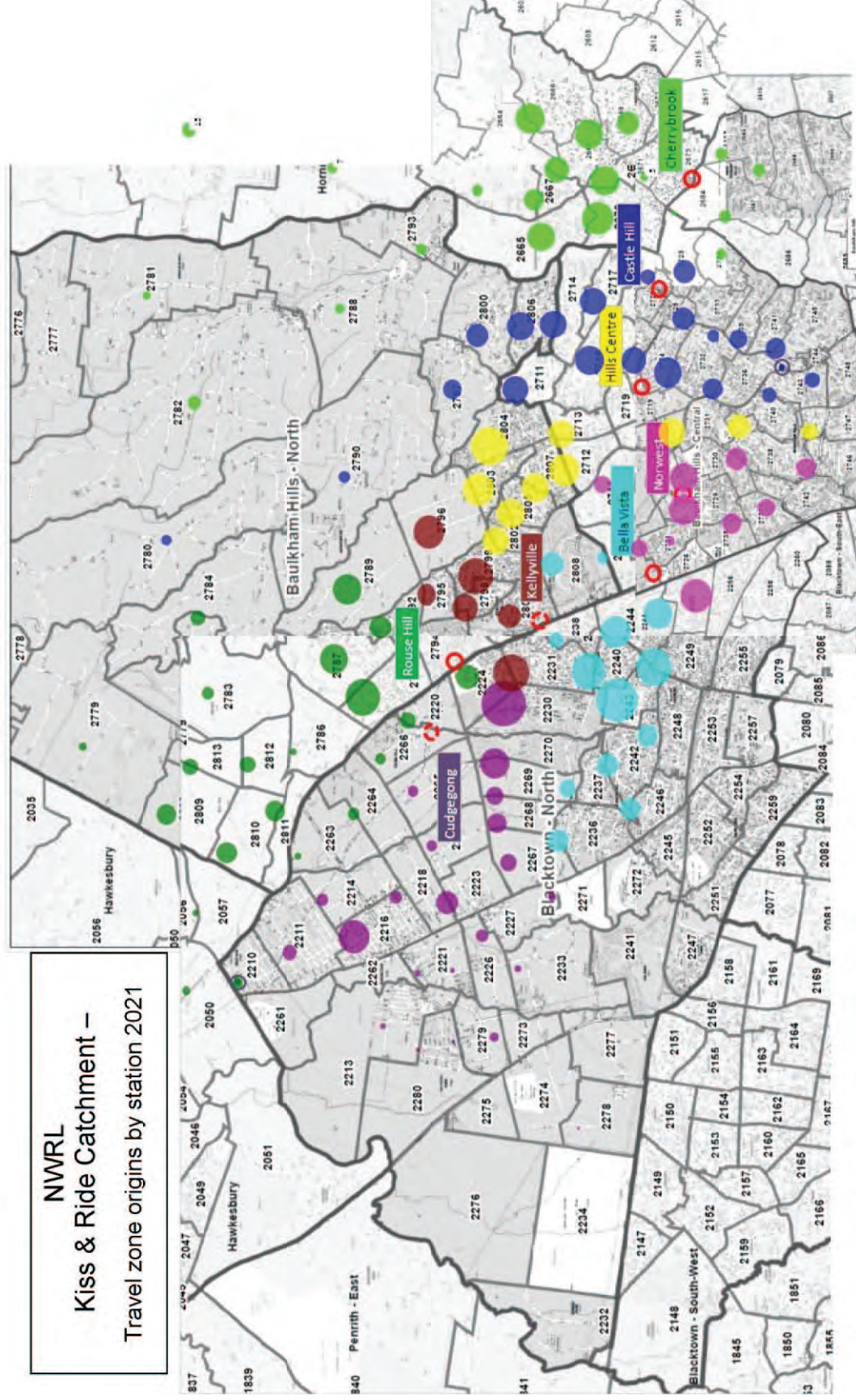
Figure 11 Park and Ride Origins



6.8.2 Kiss and Ride

The kiss and ride trip origins for each station are shown in **Figure 12** below.

Figure 12 Kiss and Ride Origins



7 Future Road Network Operation

7.1 Bureau of Transport Statistics (BTS) Strategic Travel Model outputs

The Strategic Travel Model (STM) is a strategic multi-modal modelling tool operated by the BTS for projecting travel patterns in the Greater Metropolitan Area of Sydney under different land use, transport and pricing scenarios. It incorporates the latest population and employment forecasts in the development of the model. This information has been used as a base for development of the expected patronage and transport impacts of the NWRL.

7.2 Planned upgrades/improvements

It is expected that there will be a number of scheduled and potential upgrades of the arterial road network in the north west over the next 10 years. The first stage of the Schofields Road amplification to four lanes from Windsor Road to Hambledon Road is to be constructed, substantially commencing toward the end of 2012. This will be followed by two subsequent upgrade stages of Schofields Road through to Railway Terrace at Schofields.

RMS is also investigating the potential widening of Norwest Boulevard in order to accommodate the existing and forecast traffic growth along this corridor. Memorial Avenue can be expected to undergo widening and intersection improvements as a result of the development of the Balmoral Road Release Area (currently under development).

TfNSW is undertaking initial investigations into options for increasing the capacity of the Old Windsor Road / Sunnyholt Road / Memorial Avenue intersection, including the potential for grade separating the intersection. The intersection of Windsor Road / Schofields Road / Rouse Hill Drive is also being reviewed for future improvements, including grade separation. Both of these grade separation options are in the early stages of review and have not yet been included in any future works programs.

Planning is also underway for the upgrade of the two-way, two-lane section of Showground Road from Pennant Street to Carrington Road in the vicinity of the proposed station at Showground.

The new developments occurring in the north west, Balmoral Road Release Area, North Kellyville, Box Hill, Alex Avenue and Area 20 will increase background traffic volumes and some road improvements and changes will occur as a consequence of these developments.

7.3 New development areas

These new release areas are located within the Blacktown Council LGA and the Hills Shire LGA. Area 20 and Alex Avenue release areas are located within the Blacktown Council area whilst Box Hill, North Kellyville and Balmoral Release areas are located within the Hills LGA.

7.3.1 Area 20

Area 20 is earmarked as the next major land release in the North West Growth Centre. Area 20 is located to the north and west of Schofields Road and Windsor Road and will provide for approximately 2,500 dwellings and a population of 6,400. The NSW Government finalised the rezoning of Area 20 Precinct on 21 October 2011. The Director General of the Department of Planning and Infrastructure approved the Growth Centres DCP Schedule for the Area 20 Precinct in November 2011.

Once developed, the precinct will include the following. Based on the information provided on the Blacktown City Council website:

- 19 hectares of local open space for recreation and sports
- Proposed NWRL corridor extension, including a new railway station at Cudgegong Road and associated facilities and Tallawong stabling facility
- A Village Centre linked to the Cudgegong Road station
- A 6 hectare light industrial area on land surrounding the proposed Tallawong stabling facility

Based on information obtained from the Blacktown City Council website, the approved Precinct Plan identifies land surrounding the proposed Cudgegong Road station area where development control provisions will be reviewed. The Department of Planning & Infrastructure (DoPI) will consult with the NWRL project team to determine when a new DCP can be expected for this area.

Development of the area is expected to commence in early 2013 and for the development to occur over the next 10 years.

A copy of the exhibited Area 20 indicative Layout Plan is provided in **Appendix A**.

7.3.2 Alex Avenue

The Alex Avenue Precinct is located to the west and south of the Schofields Road / Hambledon Road intersection. The rezoning of the Alex Avenue and Riverstone Precincts was approved by the Minister for Planning on 17 May 2010. The Blacktown City Council Growth Centre Precincts Development Control Plan 2010 ("the Growth Centres DCP") was also approved by the Director General of the Department of Planning in May 2010.

The 420 hectare Alex Avenue Precinct will provide more than 6,300 new dwellings and accommodation for approximately 18,000 residents. Once developed, the precinct will include the following based on information on the Blacktown City Council website:

- 32 hectares of open space
- 2 new schools with adjoining playing fields
- at least 25,000m² of retail space
- rail duplication
- upgrades to Hambledon, Burdekin and Schofields Roads, including new rail crossings at Burdekin and Schofields Roads
- walking and cycle paths along major roads and open space corridors

A copy of the Alex Avenue Precinct Layout Plan is provided in **Appendix B**.

7.3.3 Box Hill

Box Hill Precinct is one of the second release precincts in the North West Growth Centre. It is bounded by Windsor Road to the south west, Old Pitt Town Road and Boundary Road to the north west, Hynds Road and Killarney Chain of Ponds to the south east.

Box Hill is around 764 hectares and is expected to accommodate around 10,000 dwellings in the North West Structure Plan and provide accommodation for 28,000 residents. The Precinct will be supported by a Town Centre for the residents of Box Hill. The Box Hill Precinct currently consists of a mix of residential areas and rural land uses.

Box Hill Precinct is being planned in conjunction with the adjacent Box Hill Industrial Precinct. Box Hill Industrial Precinct has an area of approximately 245 hectares and is being investigated for employment and other urban uses based on The Hills Shire Council website.

A copy of the Box Hill Development Layout Plan is provided in **Appendix C**.

7.3.4 North Kellyville

North Kellyville Precinct has been rezoned from Rural 1(a) to allow a range of residential, commercial and community uses. North Kellyville was rezoned in December 2008 for residential development. It was one of the first release Precincts in the Growth Centres and the first in the North West Growth Centre to be placed on exhibition via the Precinct Planning process. The North Kellyville Precinct is approximately 707 hectares and is bounded by Smalls Creek to the west, Cattai Creek along the east and north, and Samantha Riley Drive to the south.

This area is expected to yield approximately 4,500 dwellings by 2024 with a population of approximately 11,000. The North Kellyville Release area is located close to existing residential areas and the new Rouse Hill Town Centre.

In summary, the proposed SEPP will:

- Provide for approximately 5,000 residential dwellings
- Provide for retail and commercial development, within one small Local Centre and two Neighbourhood Centres
- Provide for power, water and sewer infrastructure and local services
- Protect areas of environmental and cultural heritage
- Make provision for exempt and complying development provisions in the DCP

A copy of the North Kellyville Release Area Plan is provided in **Appendix D**.

7.3.5 Balmoral Road release area

This area bounded by Norwest Business Park in the south, Windsor Road to the east, Elizabeth Macarthur Estate to the north and the proposed NWRL and Old Windsor Road to the west is currently undergoing residential development. This area is expected to yield approximately 6,000 dwellings by 2021 and a population of approximately 12,000. As indicated above, this development will require upgrading of Memorial Avenue to accommodate the increased traffic movements wanting to access the road from these developments.

A copy of the Balmoral Road Release Area Plan is provided in **Appendix E**.

7.3.6 Strategic Traffic Modelling – NWRL Impacts

The effect of the NWRL project, with respect to the strategic road network during the AM peak period, is to reduce traffic flows on main roads in the corridor, as a result of transfers from car to train for commuter journeys.

At some station locations, the operation of commuter car parks and high passenger demand by kiss & ride, will result in localised increases in traffic in the vicinity of the station precinct, with some likely impact on main road intersections. These include:

- Kellyville station – a substantial increase in traffic using Samantha Riley Drive to access the station car park and kiss & ride area, located north and south of Samantha Riley Drive – an effective doubling of traffic eastbound in Samantha Riley Drive between Old Windsor Road and

the new station access road, much of which is expected to turn right from Old Windsor Road (northbound) into Samantha Riley Drive and then right into the station precinct. Note that with the proposed revised road network at Kellyville, traffic accessing the station from the west will now be required to turn right off Samantha Riley Drive further east at the new signalised intersection immediately west of Elizabeth Macarthur Creek, with additional parking available to the north of Samantha Riley Drive available by turning left immediately east of the rail corridor.

- Bella Vista station – a reduction in traffic flow on Edgewater Drive and Lexington Drive (southbound), but an increase in traffic (of some 24%) in Celebration Drive to access the station, and an increase in northbound traffic in Lexington Drive for the same reason; The revised car park location with direct access from Old Windsor Road southbound is likely to reduce traffic using Celebration Drive to access the station.
- Showground station – a substantial increase in traffic in Carrington Road (in the order of 80%) accessing the station precinct, with a modest increase in traffic in Showground Road, approaching the station from the north (and using Carrington Road to access the station). Note that if the precinct at Showground is changed to provide an alternative access on to Showground Road, midway between Carrington and Gilbert Roads, a proportion of the additional traffic predicted to use Carrington Road, would divert to Showground Road, and avoid negotiating the congested intersection of Showground Road and Carrington Road.
- Castle Hill station - a mix of modest increases and decreases in Castle Hill centre traffic on approach roads and the ring-road, with a focus of increased traffic in Old Castle Hill Road, where kiss and ride will be located (a potential tripling of traffic in the vicinity of the station in the AM peak)
- Cherrybrook station – a modest increase in eastbound traffic in Castle Hill Road in the vicinity of the station (3%); and an increase in westbound traffic on Castle Hill Road approaching the station (15%), but substantial increases in local access streets, particularly from the north (150% - though this is on a base of very low levels of traffic)

8 Proposed Stations and Precincts

8.1 Cherrybrook

8.1.1 Background

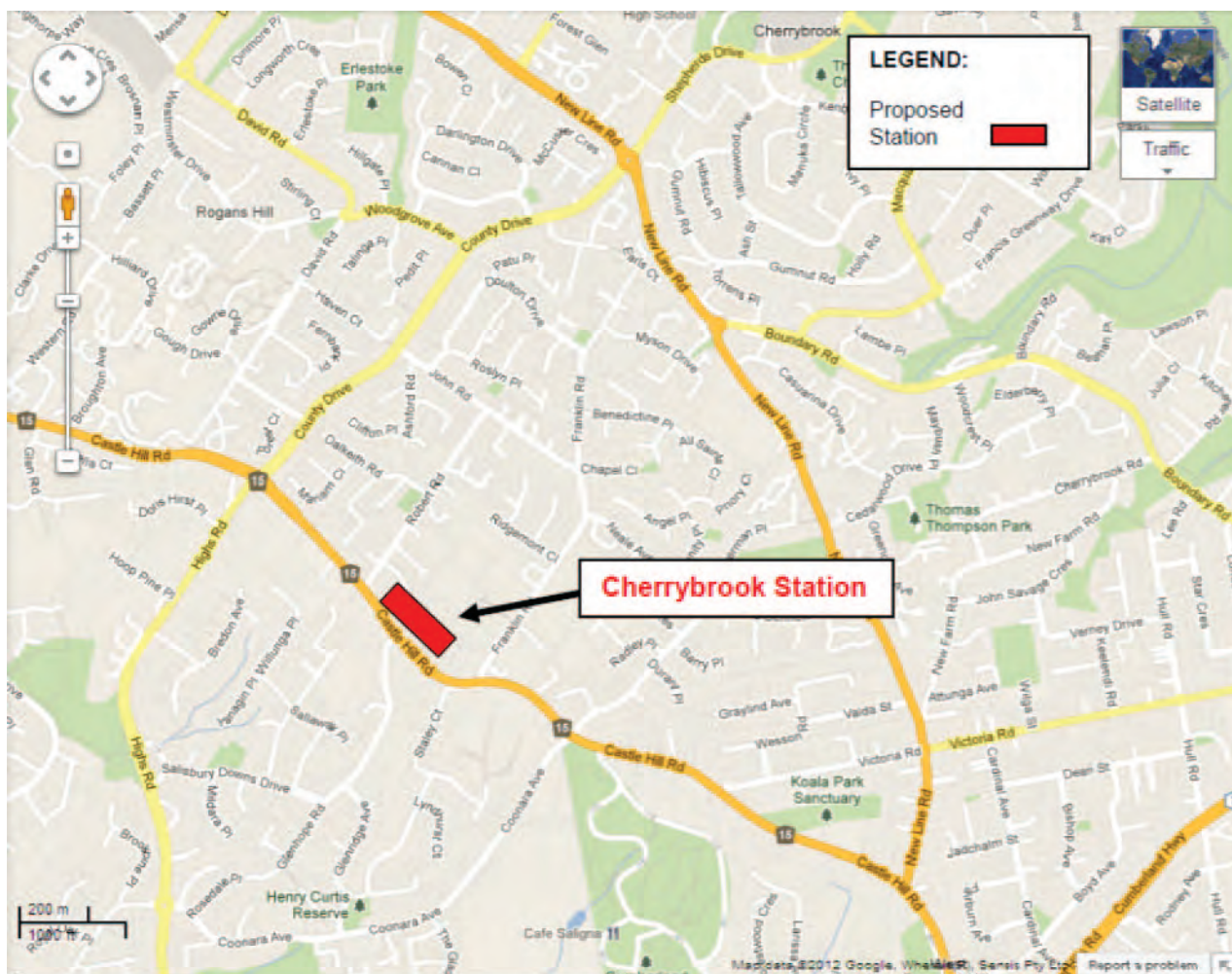
The proposed Cherrybrook station is located within the Hornsby Shire LGA. The proposed station would mainly serve the suburbs of Cherrybrook and West Pennant Hills which are currently being served by buses. Total population of these suburbs is approximately 35,000. Residents of these suburbs need to travel more than 2km to access a railway station. The rail patrons in these suburbs are currently using Beecroft, Cheltenham, Pennant Hills and Thornleigh railway stations on the Northern Line to access the rail services. The rail patrons accessing these railway stations need to travel using the road network which is congested during the peak periods.

The proposed Cherrybrook station would reduce the parking demand at Beecroft, Cheltenham, Pennant Hills and Thornleigh railway stations and would save travel time for Hills residents who are currently using these stations.

Cherrybrook is a major source of M2 express bus services which are popular, providing fast direct journeys to the City, joining the M2 at Pennant Hills Road. M2 Express services through Cherrybrook would largely be retained, but some routes would be diverted to pass the station on the way to the City or Pennant Hills. There are currently no regular route services on Castle Hill Road passing the station site, the nearest services being on John Road to the north.

The location of the proposed Cherrybrook station is shown in **Figure 13**.

Figure 13 Location of proposed Cherrybrook station



Copyright: Google, 2012

8.1.2 Existing conditions

Existing road network adjacent to the proposed station

The following roads are located immediately adjacent to the proposed station

- Castle Hill Road – This is a 4-lane undivided road and is classified as a State Road under the care and control of RMS. The section of Castle Hill Road between Old Northern Road and County Drive is part of the Strategic Bus Corridor between Hornsby and Castle Hill.
- Franklin Road and Robert Road – These roads are two-way, two-lane roads and are classified as local roads. These roads are currently maintained by Hornsby Shire Council
- Glenhope Road – This road is a two-way, two-lane road and is classified as a local road. This road is maintained by The Hills Shire Council

Table 6 shows the details of the roads located immediately adjacent to the proposed Cherrybrook station.

Table 6 Cherrybrook station – Roads summary

Road	Agency Responsibility	Lanes	AADT	2011 Peak Hour Volume	
Castle Hill Road	RMS	4	43,331	Eastbound	AM 1,309 (6-7am) PM 852 (5-6pm)
				Westbound	AM 855 (8-9am) PM 1,365 (5-6pm)
Franklin Road	Hornsby Shire Council	2	400 (approximately)	Northbound	0*
				Southbound	AM 41 (7.45-8.45am) PM 24 (4-5pm)
Glenhope Road	Hills Shire Council	2	2,000 (approximately)	Northbound	AM 136 (8-9am) PM 77 (4.45-5.45pm)
				Southbound	AM 63 (7.15-8.15am) PM 94 (5-6pm)
Robert Road	Hornsby Shire Council	2	700 (approximately)	Northbound	AM 20 (8-9am) PM 16 (5-6pm)
				Southbound	AM 54 (7-8am) PM 27 (4-5pm)

Source: RMS AADT Data & NWRL Traffic counts 2011

AADT: Annual average daily traffic

Note: * No vehicles were recorded as traffic restrictions currently prevent turning movements off Castle Hill Road into the street.

The following intersections are located immediately adjacent to the proposed station and operate as priority intersections (all are unsignalised).

- Castle Hill Road / Franklin Road intersection – Left out movements from Franklin Road onto Castle Hill Road are the only turning movements allowed at this intersection
- Castle Hill Road / Glenhope Road – All movements are allowed at this intersection
- Castle Hill Road / Robert Road - Left in/left out movements are the only turn movements allowed at this intersection

The alignment of the Castle Hill Road section located immediately adjacent to the proposed station is undulating and includes multiple horizontal curves as shown in **Figure 14**.

Figure 14 Castle Hill Road adjacent to proposed Cherrybrook station site, looking west



Adjacent landuses

The adjacent landuses to the proposed station are predominantly residential. Tangara School and Inala, a facility providing residential and other services for people with disabilities, are located east of the proposed station on Franklin Road.

Inala provides residential and other facilities for intellectually disabled people on the site located at the southern end of Franklin Road. In conjunction with this residential site, a workshop is located further north on Franklin Road. Residents from the site at the intersection with Castle Hill Road access the workshop by walking along Franklin Road to the workshop site. The lack of pedestrian facilities along Franklin Road means that these residents often walk along the road pavement to access the workshop.

Tangara School is an independent school catering for Kindergarten to Year 12. The school is located on the eastern side of Franklin Road to the north of the proposed station site. The school generates both car and bus traffic during weekdays.

Proposed landuse and infrastructure developments

No major landuse/infrastructure developments are proposed adjacent to the proposed Cherrybrook station site. The area surrounding the station site is low density residential development with a number of cul-de-sacs running off Robert Road and Franklin Road.

Historical crash analysis

A historical crash analysis has been undertaken for the crashes that occurred between January 2006 and December 2010 within 400m radius of the proposed Cherrybrook station. **Table 7** shows the number of crashes recorded within 100m and 400m from the location of the proposed station site.

Table 7 Cherrybrook Station – Crash Summary

Distance from the Proposed station (radius)	Number of Pedestrian Crashes	Total Number of Crashes
100m	0	0
400m	0	21

Source: RMS Crash Data 2011

The following observations were made in relation to the crashes that occurred within 400m radius of the proposed Cherrybrook station.

- Of 21 crashes that occurred within 400m radius of the proposed station, 19 crashes were reported to occur on Castle Hill Road. Out of the 19 crashes, a total of 8 crashes occurred at the Castle Hill Road / Glenhope Road intersection which is located immediately adjacent to the proposed Cherrybrook station. The following crashes were reported to occur at this location:
 - 2 crashes were recorded as rear-end type and occurred between vehicles travelling east on Castle Hill Road.
 - 3 crashes were recorded as rear-end type and occurred between vehicles turning right from Castle Hill Road and vehicles travelling east along Castle Hill Road.
 - 2 crashes occurred during lane changing manoeuvre and involved a side swipe between vehicles.
 - A single crash occurred between a vehicle turning right from Glenhope Road and a vehicle travelling north on Castle Hill Road
- A total of 6 crashes occurred between Glenhope Road and Franklin Road on Castle Hill Road including 5 run-off road crashes and a head-on crash.

Traffic volumes at the Castle Hill Road / Glenhope Road intersection will increase with the proposed Cherrybrook station. The provision of traffic signals at this location (as proposed) would have the potential to reduce travel speed and enhance traffic safety. Traffic volumes along Castle Hill Road would also increase with, or without, the proposed Cherrybrook station. The run-off road crashes would have the potential to increase with the increase in traffic movements along Castle Hill Road. The run-off road crashes occurred at a location where pedestrian movements are expected to increase substantially along Castle Hill Road with the proposed Cherrybrook station.

The following measures proposed as part of the NWRL development have the potential to reduce the crashes and/or severity of the crashes immediately adjacent to the proposed Cherrybrook station.

- Signalisation of Castle Hill Road / Glenhope Road intersection with the provision of an exclusive right turn bay on the Castle Hill Road (west) approach.
- Advisory and regulatory signage.
- Provision of safety barriers at the bends between Franklin Road and Robert Road along Castle Hill Road to improve the safety for pedestrians walking along Castle Hill Road

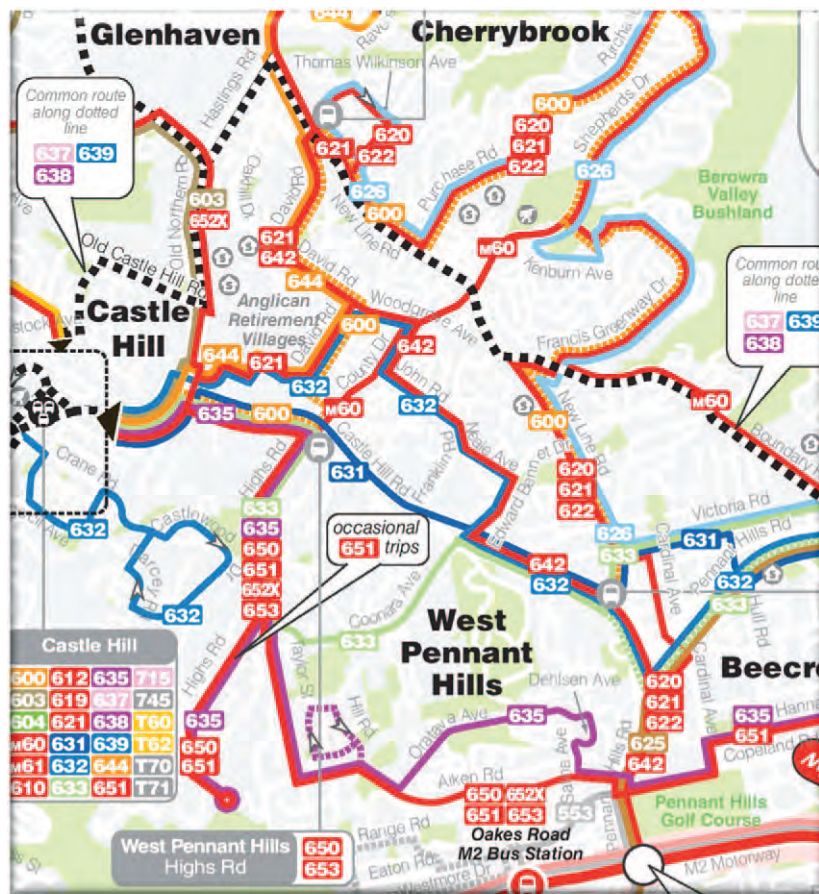
Bus operation

There are currently no scheduled bus services operating on Castle Hill Road or Franklin Road past the proposed station site, apart from two AM school days only trips between Castle Hill and Pennant

Hills station (Route 631, operated by Hillsbus). There are no corresponding services in the westbound direction. Franklin Road does accommodate minor weekday school bus services which turn left out of Franklin Road into Castle Hill Road.

Three bus routes access Castle Hill Road to the east of the site (at Edward Bennett Drive) to travel toward Pennant Hills Road. The route 632 (Castle Hill to Pennant Hills Station) and 642 (Dural to Sydney CBD via the M2) operate along John Road / Franklin Road / Neale Ave / Edward Bennett Drive to the north and east of the site. The route 633 (Castle Hill to Pennant Hills Station via West Pennant Hills Valley) operates along Coonara Avenue to the south east of the site.

Figure 15 Existing bus routes in the vicinity of the proposed Cherrybrook station



Source: www.cdcbus.com.au (2012)

Pedestrian and cyclists

Footpaths are provided on Castle Hill Road adjacent to the proposed site. However, there are currently no dedicated pedestrian crossing facilities across Castle Hill Road between Edward Bennett Drive and County Drive.

Access to the Inala residential facility on the eastern side of Franklin Road opposite the proposed station site, is via a driveway off Franklin Road near the intersection with Castle Hill Road. This entry provides both vehicle and pedestrian access.

No dedicated cyclist facilities are provided in the vicinity of the proposed Cherrybrook station. A small number of cyclists currently use Castle Hill Road.

Pedestrian access would be provided by way of pathways along Castle Hill Road, Robert Road and Franklin Road in the vicinity of the station and a connecting path from Blue Gum Way through to the station entrance. It is proposed to retain the signalisation of the Castle Hill Road / Glenhope Road intersection to facilitate pedestrian access from the Glenhope Road area to the station. These signals are dependent on the site meeting RMS requirements.

It is proposed to provide cycle storage facilities at the station with a combination of cycle lockers and racks located close to the station entrance. Cyclists would have the opportunity to access the station via the local road network along Robert Road, Franklin Road and Glenhope Road. The proposed pathway linking Blue Gum Close and the station would also provide for cyclists.

8.1.3 NWRL demand

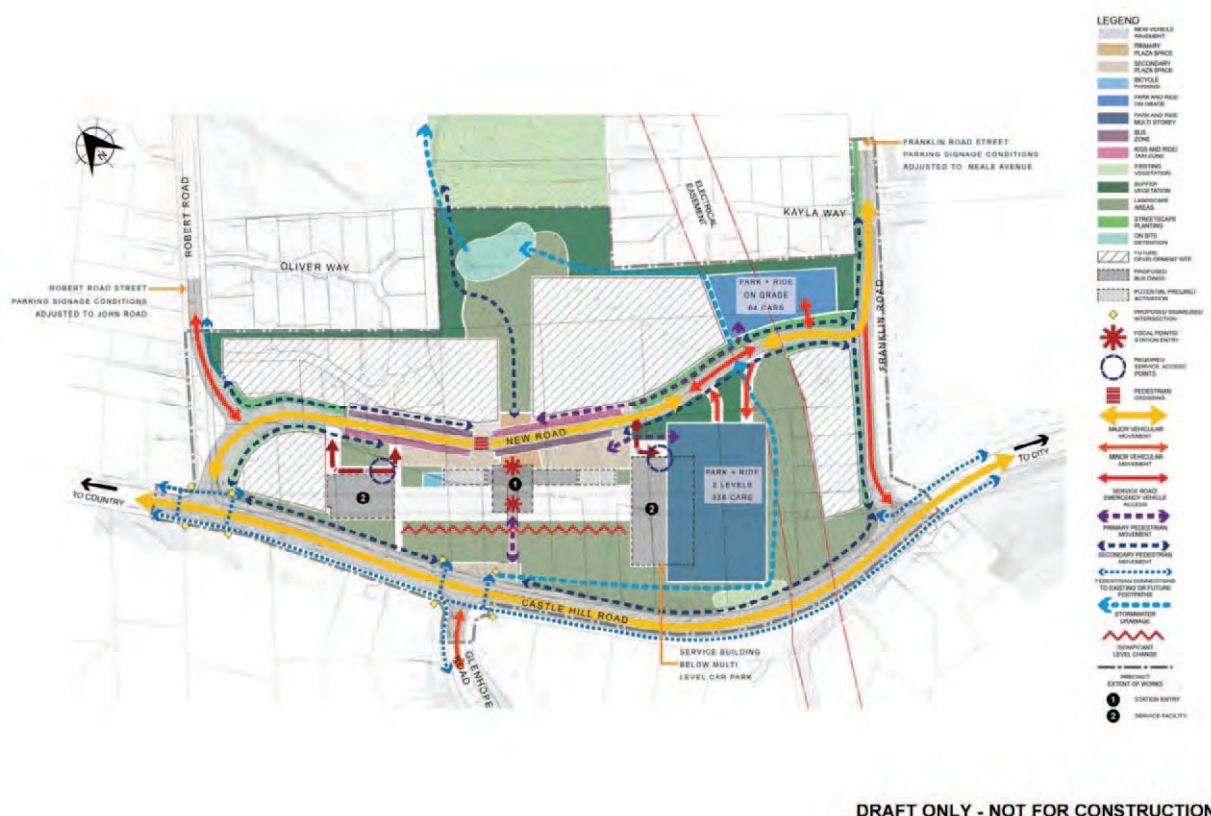
Figure 16 shows the facilities that would be provided during the operation of the Cherrybrook station. The proposed station would provide the following transport facilities for commuters to cater for 2021 forecast demand:

- 400 park and ride spaces
- 14 kiss and ride spaces
- 4 taxi spaces
- 40 bicycle parking spaces
- 6 bus spaces in two bays on either side of the access road

The provision of dedicated park and ride spaces is a balance between meeting morning peak hour demand for park and ride and encouraging access by more sustainable modes including bus, walking and cycling. As with almost every station on the Sydney rail network, some of those accessing the station by park and ride will park on-street, at distances ranging up to around one kilometre. Where required, NWRL will work with council to develop strategies to manage demand for on-street parking in order to reduce impacts on local residents.

Demand for kiss and ride parking spaces has been estimated on the basis of an average dwell time of 3 minute per vehicle during peak periods. Kiss and ride activities will be discouraged along Castle Hill Road by the use of appropriate advisory and regulatory signage. Fencing along the Castle Hill Road frontage to the station precinct is not proposed, nor would it be supported.

It is proposed to make changes to some of the bus routes that operate in the area to provide links from the suburbs to the north of the station and also from the West Pennant Hills Valley to the south.



Source: NWRL, 2012

Estimated traffic generation in 2021

Traffic volumes, pedestrian activity and other multi-modal activities will increase around the proposed station precinct once NWRL is operational. This vehicular activity will include park and ride, kiss and ride, taxis and buses, with park and ride and kiss and ride trips occurring mainly during the morning and afternoon peak hours. Pedestrian and cycle movements around the station will also increase.

It should be noted that the traffic modelling analysis in this report was undertaken using earlier demand forecasts. Supplementary analysis of future proposals may be required.

The majority of the park and ride traffic generated by the station is expected to be from the suburbs to the north and west of the station, such as Cherrybrook, Dural, Castle Hill and Glenhaven. A smaller volume of traffic is expected to be generated from the West Pennant Hills Valley to the south of the site. In most cases this traffic would approach the station precinct along Castle Hill Road from Old Northern Road or County Drive.

However, it is expected that approximately 50% of the local traffic generation from the residential areas south of New Line Road may approach along Robert Road or Franklin Road to the car parks or kiss and ride drop off points at the station. Some of the vehicles used for kiss and ride trips will continue on to other destinations, whilst others will return to the place of origin.

Kiss and ride traffic is generated from the same areas as park and ride, although at a lesser volume, and would be expected to follow similar routes to and from the station.

8.1.4 Integrating Cherrybrook station

Cherrybrook station's location close to Castle Hill Road provides good potential prominence for commuters driving on Castle Hill Road. However, as shown previously in **Figure 11** and **Figure 12**, the vehicle-borne customer catchment for the station is mostly to the north of the station; and is extensive. The customer catchment includes the established areas of Cherrybrook and Dural to the north, as well as West Pennant Hills to the south.

These areas have higher rates of public transport use for journey to work than the average of the NWRL corridor and so are candidates for changing their travel patterns to make use of NWRL.

Customer access to the station is complicated by the nature of residential sub-division in the area (which features culs-de-sac and so limits direct access through residential areas), limited north-south road links (particularly across New Line Road) and substantial peak period traffic congestion on arterial and sub-arterial roads.

It is considered that there will be a strong demand for commuters to make their way to the station via the most direct available route and this will see some park & ride, and kiss & ride commuters accessing the station via Robert and Franklin Roads.

It is proposed that buses will generally approach the station along Franklin Road and Robert Road from the north and access bus stops provided on the proposed access road located immediately north of the station. These buses would be originating from the areas of Cherrybrook, Castle Hill, Round Corner and Dural areas to the north of the proposed station.

This would be achieved through the diversion of existing routes which already pass in close proximity to the station precinct. In this way direct bus routes to the station will be provided, consistent with the TfNSW West/East split bus strategy which aims to have Cherrybrook station served by buses on their way to other existing destinations.

Because of the existing road network constraints, alternative bus routes to the station (which used Castle Hill Road for instance instead of Robert and Franklin Roads) would not be able to serve much of the identified bus catchment and would either require the introduction of entirely new bus routes or the lengthy diversion of existing routes, to the detriment of existing customers.

A key element of the station precinct is a new link road between Robert Road and Franklin Road. This will provide a 'front door' to the station and a high quality space for management of buses, kiss & ride and park & ride access, with commuter car parking spaces also accessed from the link road.

Accordingly, the integration of Cherrybrook station will involve providing access to the station precinct to and from Castle Hill Road (via Robert and Franklin Roads for vehicles; and from Glenhope Road for pedestrians from the south), as well as via Robert and Franklin Roads for local access.

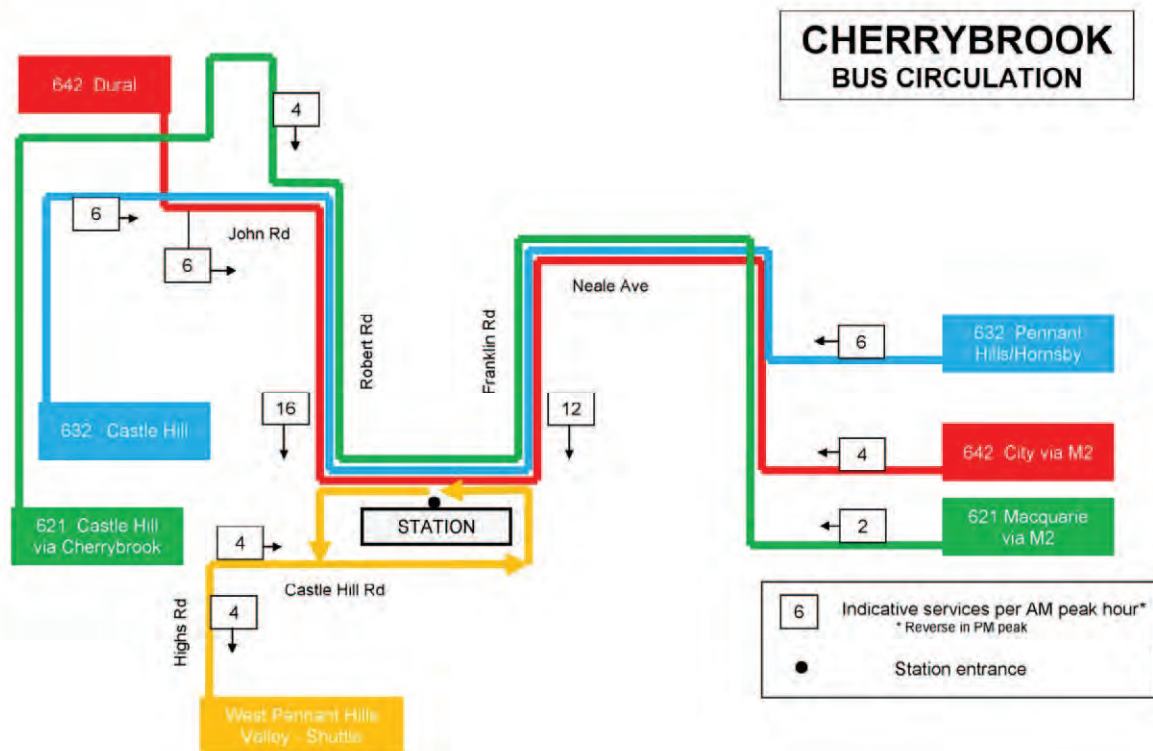
8.1.5 Proposed bus operations

As stated above, it is proposed that buses will generally approach the station along either Franklin Road or Robert Road from the north thereby providing a strong link between the station and its key catchments located mostly to the north of the station. These would then access bus stops provided on the proposed access road located immediately north of the station and close to the station entrance. These services would be originating from the areas of Cherrybrook, Castle Hill, Round Corner and Dural areas to the north of the proposed station and be achieved through a relatively minor diversion of existing established routes which already pass in close proximity to the station precinct, along John Road.

There is also the opportunity for a shuttle bus to service the West Pennant Hills Valley area and link to the station via Highs Road, Castle Hill Road and Franklin Road, returning via the station access road, Robert Road and Castle Hill Road to Highs Road.

Apart from the potential West Pennant Hills Valley shuttle bus service, it is envisaged that most if not all services will operate on a through-routing basis via Cherrybrook Station, and would not be finishing or starting their route operation at the station. The diagram below illustrates schematically, the indicative road network to serve Cherrybrook station.

Figure 17 Indicative future bus access to Cherrybrook station



Source: NWRL, 2012

8.1.6 Proposed traffic management facilities

Figure 18 illustrates the approach and departure routes for cars and buses at Cherrybrook. Once construction is completed and the station is operational, the preference is to provide access to and from the station as follows:

- Retain the signalised intersection at Glenhope Road and Castle Hill Road (to be provided during construction) but as a T-intersection accommodating pedestrian access across Castle Hill Road and vehicle movements to and from Glenhope Road, but no vehicular access to and from the station.
- Signalise the intersection of Robert Road and Castle Hill Road with all movements allowed.
- Remove the proposed construction phase traffic signals at the intersection of Franklin Road and Castle Hill Road and provide for left in / left out access only (currently left out only).

- Accommodate bus access to and from the station access road via Robert and Franklin Roads to/from the north with no bus access (bus stops) proposed on or from Castle Hill Road.

Car access to the station would be as follows:

- Castle Hill Road and left into Robert Road, then right into a new station access road.
- Castle Hill Road and left into Franklin Road, then left into a new station access road (this route would primarily be used by traffic approaching from the south via Glenhope Road).
- Castle Hill Road and right into Robert Road, then right into a new station access road.
- From the north via Robert and Franklin Roads and left and right respectively into the new station access road.

Car egress from the station would be as follows:

- To the north via Robert and Franklin Roads.
- To the south via Robert Road, left into Castle Hill Road and right into Glenhope Road.
- To the west via Robert Road, right into Castle Hill Road.
- To the east via either Robert Road or Franklin Road and then left into Castle Hill Road.

Buses would approach and depart the station via Robert and Franklin Roads and access bus stops in the new station access road close to the station entrance. Buses would operate two-way in both Robert and Franklin Roads as far as John Road and Neale Avenue respectively. Parking would need to be banned from both sides of both Robert and Franklin Roads to allow for safe bus operation.

Pedestrian crossings would be located at the intersections of Glenhope Road and Robert Road with Castle Hill Road, to provide access to the station precinct from the south.

As discussed above, Cherrybrook Station provides access for the local areas of Cherrybrook and West Pennant Hills to the NWRL. This development will require the provision of a number of traffic management measures to be implemented to accommodate the changed travel patterns. These can range from the provision of additional turning lanes, pedestrian facilities and, in some cases, traffic signals. Where traffic signals are proposed, these will have regard to RMS warrants, where appropriate.

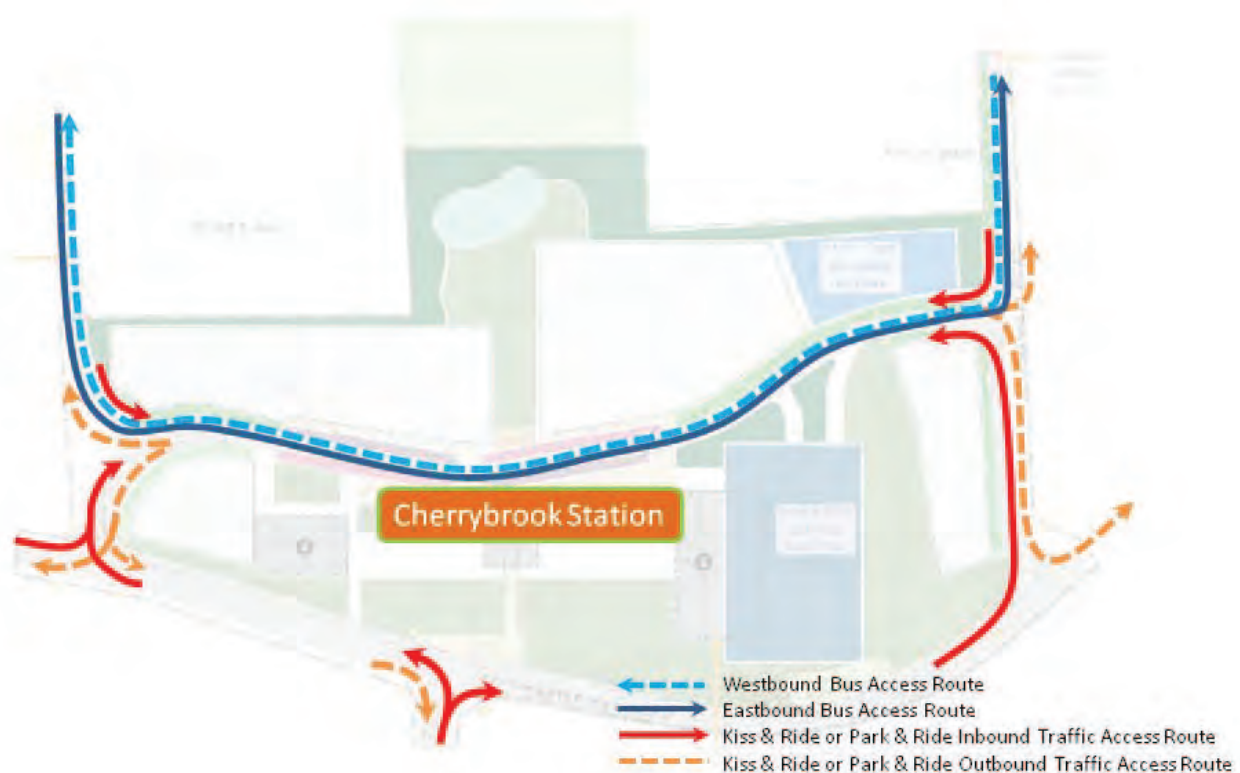
As part of the development of the station precinct at Cherrybrook it is proposed to carry out the following works:

- Widening of Robert Road from 7.5 metres to about 14 metres between Castle Hill Road and the station access road to provide two traffic lanes in both directions.
- The intersection of Robert Road / Castle Hill Road will operate as an all movements intersection under signalised control.
- Development of a two-lane access road running between Robert Road and Franklin Road, parallel to Castle Hill Road, to provide access to the car parks, bus bays, taxi ranks and short term on street parking (kiss and ride). Pedestrian facilities will be provided across the access road at the entrance to the station. This road will be provided with a traffic lane and parking lane in each direction.
- Widening of Franklin Road from 7 metres to 11 metres just south of the Kayla Way intersection to provide for a right turn lane into the access road and through lanes in each direction. South of the

access road intersection Franklin Road will be provided with two northbound lanes and one southbound lane.

- Provision for left in and left out traffic movements at the intersection of Franklin Road and Castle Hill Road under priority control (unsignalised). This work would include the provision of a 60 metre left turn lane into Franklin Road on Castle Hill Road. A zebra pedestrian crossing would be provided across Franklin Road at the intersection. No provision would be made for right turns into and out of Franklin Road.
- Provision of traffic signals (having regard to RMS warrants) with pedestrian crossing facilities at the intersection of Glenhope Road and Castle Hill Road. This work would include the provision of a right turn bay for vehicles turning from Castle Hill Road into Glenhope Road. The pedestrian crossing facilities will be provided across Castle Hill Road and Glenhope Road at the intersection with all traffic movements being allowed.
- Reconfiguration of parking and traffic lanes on Robert Road and Franklin Road to facilitate bus access to the station from John Road.

Figure 18 Traffic access routes to Cherrybrook station

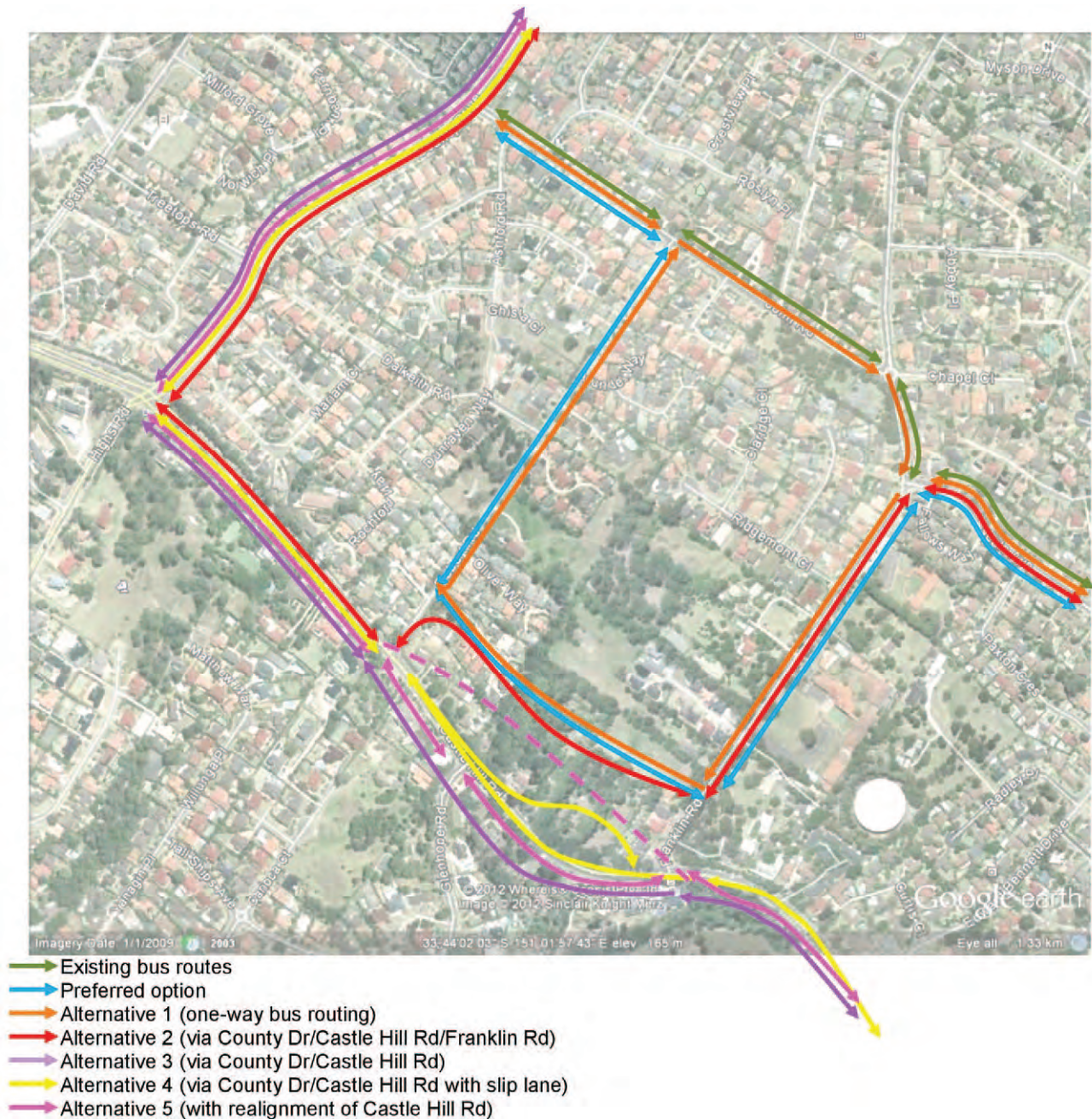


Source: NWRL, 2012

8.1.7 Access Rationale

A number of alternative options for buses accessing Cherrybrook station were considered. These are illustrated in **Figure 19**.

Figure 19 Alternative bus access arrangements considered for Cherrybrook station



Copyright: Google, 2012

Alternatives considered:

1. One-way bus circulation via Franklin and Robert Roads

The routing of buses one-way clockwise through the station precinct was considered. This would involve buses travelling eastbound along John Road, southbound along Franklin Road, westbound along the station precinct access road then northbound via Robert Road. The one-way routing of buses would mean buses need not pass one another thereby lessening on-street displacement (parking along one side of Robert and Franklin roads could be retained). For westbound buses, the section of John Road between Robert and Franklin Roads would not be serviced. However, in the eastbound direction, buses would be forced to traverse the same section of John Road twice. This arrangement would increase bus kilometres and create an inefficient bus route for services travelling east.

A further option of introducing new bus services operating in a single clockwise direction via John Road (eastbound), Franklin Road, the station precinct access road, Robert Road and back along John Road (westbound) rather than diverting existing services was also considered. However, this option would require significant duplication of bus services in order to serve a similar catchment to the preferred option, at a significant ongoing cost.

Main advantages

- Enables retention of some parking on western side of Franklin Road and eastern side of Robert Road.

Main disadvantages

- Requires inefficient duplication of bus services at significant ongoing cost.

2. Routing buses via County Drive, Castle Hill Road and Franklin Road

The routing of buses via County Drive, Castle Hill Road through the station precinct via the station precinct access road and onto Franklin Road was considered and found to have the following disadvantages. Diverting existing services in this way would weaken the servicing of key catchments to the north of the station and result in longer journey times for passengers, including both those travelling to or from the station as well as passengers continuing on to other destinations.

It would increase delays and safety concerns associated with bus patrons needing to cross Castle Hill Road from the station to and from westbound buses. It could adversely impact travel times and timetabling as buses would be subject to delays as a result of congestion on County Drive and Castle Hill Road. It would be likely to necessitate the augmentation of bus services in some parts of the catchment with consequent costs to government and the community.

Main advantages

- Avoids buses operating on Robert Road thereby removing requirement to remove on-street parking.

Main disadvantages

- Weakens bus service catchment.
- Longer bus travel times and greater likelihood of delays.
- Reduced pedestrian safety for bus users.

- Commuter and Kiss & Ride traffic will still use Franklin and Robert Roads.
- Increases congestion on County Drive and Castle Hill Road.

3. Routeing buses via County Drive and Castle Hill Road (bus stops on-street)

A further option of routeing buses via County Drive and Castle Hill Road was investigated to reduce the impacts of buses on Franklin and Robert Roads. This option would avoid buses operating via Robert and Franklin Roads (as well as John Road and Neale Avenue/Edward Bennett Drive) which would reduce traffic activity in these streets and lessen on-street car parking impacts.

However, it would also significantly weaken bus servicing of key catchments to the north of the station (and reduce access to the local centre of Castle Hill by bus). A large residential catchment area served by existing bus services would be left without access to any bus services unless additional bus routes were added which would largely duplicate existing routes and incur a significant on-going cost.

The routeing of buses via County Drive and Castle Hill Road would add to congestion on these already congested roads, causing delays to existing bus passengers as well as those wishing to transfer from bus to rail at Cherrybrook station. Pedestrian access and safety would also be compromised with buses dropping off and picking up passengers on Castle Hill Road, requiring a large number of passengers to cross Castle Hill Road during the morning and afternoon peaks.

In addition to the disadvantages associated with this option, commuter car parking and kiss and ride traffic from the north would still need to use Robert and Franklin Roads to access the station precinct.

Main advantages

- Avoids operation of buses on Robert and Franklin Roads
- Reduces impacts from loss of parking on Robert and Franklin Roads (although demand for on-street commuter parking would still require management)

Main disadvantages

- Eliminates bus services from a large residential catchment (including John Road, Neale Avenue and Edward Bennett Drive)
- Longer bus travel times and delays
- Reduced pedestrian safety
- Commuter and kiss & ride traffic will still use Franklin and Robert Roads.
- Adds to congestion on County Drive and Castle Hill Road

4. Re-routeing buses via County Drive and Castle Hill Road (Bus slip lane)

Re-routeing buses via County Drive and Castle Hill Road and providing a separate (eastbound) bus only slip lane off Castle Hill Road with an entry near the Glenhope Road intersection and an exit via a reconfigured Franklin / Castle Hill Road intersection was also considered. This was assessed in conjunction with the provision of an indented (westbound) bus bay along the southern side of Castle Hill Road.

Such an arrangement would create difficulties in safely managing eastbound bus access at speed into the station precinct. The poor sight lines to the eastern egress point of the slip lane back onto Castle Hill Road also creates concerns for safety and the consequent traffic flow efficiency impacts for eastbound traffic on Castle Hill Road.

It would weaken the servicing of key catchments to the north of the station and result in longer journey times for bus passengers. It would complicate the Castle Hill Road / Franklin Road / Glenhope Road intersection geometries. It could also encourage illegal use of the slip lane by kiss and ride traffic.

Conversely, it would avoid the need for routing buses via Robert and Franklin Roads which would reduce traffic activity and lessen on-street car parking impacts.

However, commuter car parking and kiss and ride traffic would still need to use Robert and Franklin Roads to access the station precinct and parking would most likely need to be managed.

Main advantages

- Avoids operating buses on Robert and Franklin Roads
- Removes requirement to remove parking on Robert and Franklin Roads, although parking controls would be likely in order to manage commuter parking demand.

Main disadvantages

- Creates safety concerns for buses entering and exiting the slip lane.
- Eliminates bus services from a large residential catchment in John Road / Neale Avenue / Edward Bennett Drive area.
- Longer bus travel times and delays due to congestion.
- Potential for increased pedestrian safety risks on Castle Hill Road.
- Commuter and kiss and ride traffic would still use Franklin and Robert Roads from the north and on-street parking demand would need to be managed.
- Increases traffic on County Drive and Castle Hill Road and impacts flow of traffic on Castle Hill Road.

5. Re-routing buses via County Drive and Castle Hill Road with realignment of Castle Hill Road

Under this option, Castle Hill Road would be realigned in the vicinity of Cherrybrook station to run along the northern side of the proposed station in combination with reconfigured (signalised) intersections at Robert/Castle Hill Road and Franklin/Castle Hill Road.

This arrangement is not favoured as it would place a significant physical barrier between the station and its key catchment to the north, compromising pedestrian access.

It would require major re-design of the railway, station entry and plaza and layout to accommodate the new road carriageway and station precinct. It would have similar adverse impacts on bus access to/from the station and on bus catchments. Access to and from the commuter car park would still impact Robert and Franklin Roads.

It would place the station precinct access road on the southern side of the realigned arterial road, remote from the key northern catchment. Pedestrian access to the station from the northern

catchment across the realigned arterial road would be via new four way signalised intersections at Robert and Franklin Roads which would be less direct and more constrained. It could also reduce pedestrian safety through increased pedestrian movements across the re-aligned Castle Hill Road between the station and commuter car parks.

Main advantages

- Avoids operation of buses on Robert and Franklin Roads.

Main disadvantages

- High capital cost with untested viability in terms of traffic and access functionality.
- Places a significant physical barrier between the station and key catchment to the north.
- Reduced pedestrian accessibility and increased safety risks.
- Eliminates bus services from a large residential catchment in John Road / Neale Avenue / Edward Bennett Drive area.
- Commuter traffic would still use Franklin and Robert Roads and on-street parking demand would need to be managed.

Station Access Rationale

The rationale for the preferred access arrangement is as follows:

1. It will minimise diversion of existing bus routes and avoid routeing buses along Castle Hill Road, which would increase congestion and lengthen journey times for existing bus passengers as well as those accessing Cherrybrook station.
2. The proposed bus diversions via Robert and Franklin Roads to the station precinct will actually increase the catchment area of existing services and enhance accessibility generally.
3. It will maximise safety and accessibility to and from the station precinct for both pedestrians and vehicles, minimising pedestrian movements across Castle Hill Road and allowing adequate sight distance for vehicles to turn safely into and out of Castle Hill Road.
4. It will protect traffic flow efficiency along Castle Hill Road whilst equitably balancing traffic change across the local road network.

8.1.8 Preliminary traffic assessment

Background

It should be noted that the traffic modelling analysis in this report was undertaken using traffic generation figures based on earlier demand forecasts. Supplementary analysis of future proposals may be required.

Intersections included within the modelling for Cherrybrook station are given below. The proposed configuration of some intersections has changed from the time this analysis was undertaken and may require supplementary analysis:

- Castle Hill Road / County Drive / Highs Road – This intersection has been modelled as for the existing intersection configuration and the traffic signal phasing.

- Castle Hill Road / Robert Road – This intersection has been assessed as an all movements signalised intersection. Provision has been made for marked pedestrian crossings across Robert Road at the intersection on all legs.
- Castle Hill Road / Glenhope Road - This intersection has been assessed as a signalised T-intersection with two through lanes in each direction on Castle Hill Road, along with a turning lane on each approach for traffic turning into Glenhope Road. The Glenhope Road approach was assessed with a right turn lane and left turn lane at the intersection. Pedestrian crossings are proposed to be provided across Glenhope Road and on the eastern side of the intersection across Castle Hill Road.
- Castle Hill Road / Franklin Road – This intersection was modelled as a unsignalised left in/left out T-intersection with Castle Hill Road. A zebra pedestrian crossing would be provided across Franklin Road only.
- Castle Hill Road / Edward Bennett Drive / Coonara Avenue – This intersection has been modelled as for the existing configuration and traffic signal phasing.

The key performance indicators for each intersection within the model area are provided in the following table:

Table 8 Cherrybrook Station – AM Peak Hour Intersection Performance (2021)

Location	Without NWRL		With NWRL	
	LOS*	DoS**	LOS*	DoS**
Castle Hill Road/ County Drive/ Highs Road	F	1.10	F	1.02
Castle Hill Road/ Robert Road	A	0.09	B	0.52
Castle Hill Road/ Glenhope Road	B	0.69	A	0.42
Castle Hill Road/ Franklin Road	A	0.48	A	0.50
Castle Hill Road/ Edward Bennett Drive	D	0.76	D	0.85

Source: ERSA (2012)

LoS – Level of service; DoS – Degree of saturation

Note: supplementary analysis of future proposals may be required. LINSIG analysis assumes signalisation of Robert Rd / Castle Hill Rd and left in / left out at Franklin Rd / Castle Hill Rd

* Overall intersection performance

** Worst performing approach

This analysis indicates that:

- The Castle Hill Road/ Country Drive/ Highs Road intersection is predicted to operate beyond capacity, either with or without the inclusion of the NWRL. The degree of saturation and level of service are essentially the same for these two scenarios. Given the similar performance of these two scenarios, it is concluded that the predicted congestion is a result of general forecast traffic growth rather than a result of the NWRL.

- From inspection of the modelling results for the Castle Hill Road / County Drive / Highs Road intersection, it is evident that a number of movements are predicted to operate over capacity, including the through movement on Castle Hill Road (west approach), the right turn movement from County Drive and the approach from Highs Road. Consequently it is evident that to improve the operation of this intersection to a more acceptable standard, additional capacity will need to be provided, perhaps through the addition of a further through lane on this section of Castle Hill Road and/or increased turning bay lengths.
- With the exception of the Castle Hill Road / County Drive / Highs Road intersection, all of the other intersections within the vicinity of the station are predicted to operate within capacity and with satisfactory levels of service.
- Some of these intersections are predicted to operate the same or slightly better with inclusion of the NWRL indicating that the positive effect of modal shift from vehicles to rail use is equal to or slightly greater than the impact of station precinct specific traffic.

The analysis assumes that at the intersection of Franklin Road and Castle Hill Road a 60 metre long deceleration lane is retained for eastbound traffic to access Franklin Road. The analysis suggests that the slip lane would function well as it is not opposed by any movements on Franklin Road.

The analysis assumes that in the AM peak hour, approximately 50 vehicles per hour will turn right from Castle Hill Road into Glenhope Road. During the same time less than 50 vehicles will turn right from Castle Hill Road into Robert Road. On this basis it is unlikely that there would be the need to provide dual right turn bays from Castle Hill Road into Robert Road. The assumed bays lengths are 60m for the right turn into Robert Road and 45m for the right turn into Glenhope Road. This will require further scrutiny.

8.2 Castle Hill

8.2.1 Background

The proposed Castle Hill station is located within the town centre of Castle Hill within the Hills Shire LGA.

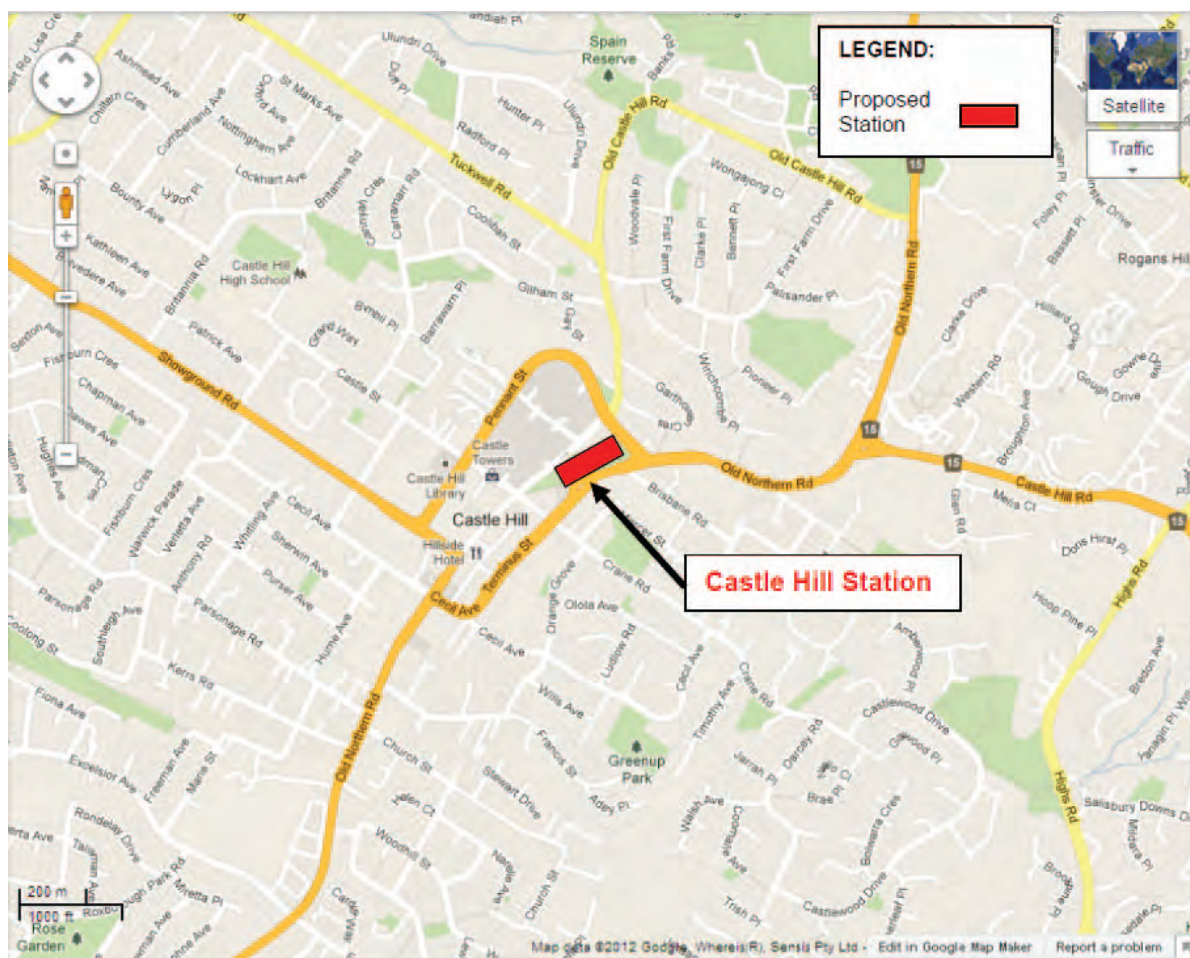
The proposed station would mainly serve the suburbs of Castle Hill and Baulkham Hills. Total population of these suburbs is approximately 70,000. The majority of rail patrons from these suburbs would currently need to travel more than 4km to access a railway station. The rail patrons of these suburbs are currently using Beecroft, Cheltenham Thornleigh, Seven Hills and Parramatta railway stations to access rail services.

The rail patrons accessing these railway stations need to travel using the road network which is heavily congested during the peak periods. The proposed Castle Hill station would reduce the parking demand for Beecroft, Cheltenham, Thornleigh and Seven Hills railway stations and would reduce travel time for Hills residents who are currently using these stations.

Based on Sydney Metropolitan Strategy-North West Subregion, Castle Hill is classified as a Major Centre which is defined as major shopping and business centre serving immediate subregional residential population usually with a full scale shopping mall, council offices, taller office and residential buildings, central community facilities and a minimum of 8,000 jobs. It is forecast that Castle Hill would increase employment by 3,000 additional jobs between 2001 and 2031.

The location of the proposed Castle Hill station is shown in **Figure 20**.

Figure 20 Location of proposed Castle Hill station



Copyright: Google, 2012

8.2.2 Existing conditions

Existing road network adjacent to the proposed station

The following roads are located immediately adjacent to the proposed Castle Hill station:

- Old Northern Road – The road section between Showground Road and Terminus Street is classified as a Collector Road whilst the road section between Terminus Street and McMullen Avenue is classified as a State Road. Traffic arrangements were reconfigured as part of the ring road development so that the section of Old Northern Road between Crane Road and Terminus Street is now a bus-only road. It is used as a bus stop and as a layover facility.
- Pennant Street, McMullen Avenue and Terminus Street – These roads are classified as State Roads and are under the care and control of RMS. These roads generally provide two traffic lanes in each direction with narrow median and provision of turn bays at key intersections.
- Crane Road and Old Castle Hill Road – These roads are classified as Collector Roads. These roads provide access to some of the Castle Towers Shopping Centre car parks. Old Castle Hill Road is a one-way (northbound) road between the Crane Road / Castle Street intersection and Eric Felton St. This section of road is also part of the bus interchange, catering for northbound services on the western side of the street and bus layover on the eastern side of the street.

Figure 21 Old Northern Road adjacent to the proposed Castle Hill station site, looking north



Table 9 shows details of the roads located immediately adjacent to the proposed Castle Hill station.

Table 9 Castle Hill Station – Roads Summary

Road	Agency Responsibility	Lanes	AADT	2011 Peak Hour Volumes
Old Northern Road	RMS/The Hills Council (within Castle Hill Town Centre)	4	44,947	Northbound AM 1,604 (7-8am) PM 1,801 (5-6pm) Southbound AM 1,861 (8-9am) PM 1,946 (6-7pm)
Terminus Street	RMS	4	27,694	Northbound AM 911 (8-9am) PM 942 (5-6pm) Southbound AM 1,295 (8-9am) PM 1,333 (4-5pm)
Old Castle Hill Road	The Hills Shire Council	2	8,042	Northbound AM 751 (10-11am) PM 771 (6-7pm)

Source: RMS AADT Data & ITLU Traffic counts 2011 AADT – Annual average daily traffic

The following key intersections are located immediately adjacent to the proposed Castle Hill station:

- Old Northern Rd / McMullen Ave (traffic signals) – This intersection is a T-intersection which is the convergence of the eastern and western ring roads around the Castle Hill Town Centre. Medians are provided on all approaches to the intersection.

Old Northern Road is provided with two through lanes and two right turn lanes on the northern approach and two through lanes and a left turn slip lane on the southern approach. Brisbane Road intersects with Old Northern Road approximately 30 metres south of the McMullen Avenue intersection. A median opening and short right turn bay is provided for vehicles turning from Old Northern Road into Brisbane Road. McMullen Avenue is provided with two right turn lanes and two left turn lanes at the intersection.

- Old Northern Rd / Crane Rd / Castle Street / Old Castle Hill Road (traffic signals) – There are five legs to this intersection. The southern approach of Old Northern Road provides a single through right lane and a short left turn lane. Old Castle Hill Road is one-way northbound at the intersection. Crane Road is provided with two lanes on approach with a shared left/through lane and shared right/through lane. Castle Street has two lanes on approach with a shared left/through lane and shared right/through lane. The northern leg of Old Northern Road is a Bus Only road with a single lane approach to the intersection.
- Crane Rd / Terminus St (traffic signals) – This is a four way intersection with Terminus Street having a divided four lane configuration providing a shared left/through lane, through lane and right turn bay on each approach. Crane Road is provided with two traffic lanes on each approach with the western approach having an exclusive left turn lane and shared right/through lane and the eastern approach having a shared left/through lane and shared right/through lane.
- Terminus Street / Old Northern Road intersection (priority controlled) – This is a T-intersection which provides for left in and left out movements from Terminus Street for buses only to the existing bus interchange. The right turn in from the northern section of Old Northern Road into the bus interchange is also permitted.
- Old Castle Hill Road / McMullen Avenue intersection – This is a signalised cross intersection allows all movements at the intersection. McMullen Avenue is provided with two through traffic lanes in each direction and separate right turn lanes. Old Castle Hill Road northbound is provided with two right turn lanes and a shared left/through lane. The southbound approach is provided with a right turn lane, through lane and a left turn slip lane which allows traffic to turn left at any time, with care.

Adjacent landuses

The proposed station would be located within the Castle Hill Town Centre and adjacent to Castle Towers shopping centre.

Proposed infrastructure developments

The Castle Towers shopping centre has a current approval for the extension of the shopping centre to the property located on the western side of Pennant Street between Showground Road and Castle Street.

It is proposed, separate from the NWRL project, to upgrade Showground Road from Pennant Street to Carrington Road from its current configuration of one traffic lane in each direction to provide two-lanes in each direction, as part of the Castle Towers development works. This work would also provide signalisation of the Showground Road / Kentwell Avenue and Showground Road / Rowallan Avenue intersections.

Historical crash analysis

A historical crash analysis has been undertaken for the crashes which occurred between January 2006 and December 2010 within 400m radius of the proposed Castle Hill station. **Table 10** shows the number of crashes recorded within 100m and 400m from the location of the proposed station.

Table 10 Castle Hill Station – Crash Summary

Distance from the proposed station (radius)	Number of pedestrian crashes	Total number of crashes
100m	0	16
400m	17	179

Source: RMS Crash Data 2011

The following observations were made in relation to the crashes that occurred immediately adjacent to the proposed station.

- Out of 17 pedestrian crashes that occurred during the analysis period, a total of 7 pedestrian crashes occurred on the road network located immediately adjacent to the proposed Castle Hill station (frontage of Arthur Whitling Park) as follows:
 - Old Northern Road / Crane Road / Old Castle Hill Road / Castle Street intersection – 2 pedestrian crashes
 - Old Castle Hill Road between Castle Street and McMullen Avenue – 1 crash
 - Old Northern Road between Crane Road and Terminus Street – 2 crashes
 - Old Northern Road and McMullen Avenue intersection – 2 crashes
- Out of 179 crashes that occurred during the analysis period, a total of 45 crashes occurred on the road network located immediately adjacent to the proposed Castle Hill station (frontage of Arthur Whitling Park) as follows:
 - Old Northern Road / Crane Road / Old Castle Hill Road / Castle Street intersection – 11 crashes
 - Old Castle Hill Road between Castle Street and McMullen Avenue – 5 crashes
 - Old Northern Road between Crane Road and Terminus Street – 13 crashes
 - Old Northern Road / Brisbane Road intersection – 6 crashes
 - Old Northern Road and McMullen Avenue intersection – 9 crashes
 - Old Northern Road between Brisbane Road and McMullen Avenue – 1 crash

It should be noted that Castle Hill Eastern Ring Road opened to traffic in May 2010. The majority of the analysis period includes the period prior to the opening of the Eastern Ring Road.

The recent changes to the Terminus Street and the reduction in the traffic volumes along the Old Northern Road section between Terminus Street and Showground Road with the eastern ring road has reduced the traffic volumes along Old Northern Road section located immediately adjacent to the proposed railway station. The Main Street program and the reduction in posted speed limit to 40km/h have reduced the travel speed of vehicles. The reduction in traffic volumes and travel speed are likely

to reduce the crashes on this section of the road in particular Old Northern Road section between Crane Road and Terminus Street.

The Old Northern Road / Crane Road / Old Castle Hill Road / Castle Street intersection will need to be monitored to assess the impact of the changes to the road network. The proposed intersection changes, including the provision of pedestrian crossing facilities across Old Castle Hill Road and the northern leg of Old Northern Road, will provide improved pedestrian safety at the intersection.

In relation to the Old Northern Road / McMullen Avenue and Old Northern Road / Brisbane Road intersections, the close proximity of these intersections and that Brisbane Road access is not signalised creates safety issues. This is an existing network issue to be addressed by the relevant roads authorities.

The following measures have the potential to reduce the crashes and/or severity of the crashes immediately adjacent to the proposed Castle Hill station.

- The changes to phasing/intersection arrangement to the Old Northern Road / Crane Road / Old Castle Hill Road / Castle Street intersection, including the provision of additional pedestrian crossings as part of the NWRL project to allow a safer pedestrian and vehicle movements at this intersection.
- Consideration needs to be given by The Hill Shire Council/RMS to signalise the Brisbane Road approach and include as part of the Old Northern Road/McMullen Avenue intersection.

Bus operation

Castle Hill forms a major terminus and bus services are currently provided from all directions and surrounding suburbs. Buses are currently operated by Hillsbus and Busways. Hillsbus routes are M60, M61, 600, 603, 604, 610, 612, 619, 621, 632, 633, 635, 637, 638, 639, 644, 651, 715, T60 and T62. Busways routes are T70, T71 and 745. The make-up of the bus operations is as follows:

- Terminating services from the west/south:
 - 603, 604, 619, 715, 745, M61, T60, T62, T70, T71.
- Terminating services from the north/east:
 - 621, 633, 635, 637, 638, 639, 644, 651.
- Through services:
 - 600, 610, 612, 632, M60.

Buses are currently departing from Old Castle Hill Road for northbound services and Old Northern Road for southbound services. Special Event buses for Sydney Olympic Park/Royal Easter Show (Route 5A) commence their journeys at the Hills Centre with the car parking occurring in the Hills Centre car park and the adjoining Showground. They then travel to Castle Hill as part of the route, then travel along Old Northern Road and Windsor Road towards Homebush Bay.

There is currently provision for approximately four buses at the ranks located in Old Castle Hill Road for northbound buses and four ranks in Old Northern Road for buses travelling south. **Figure 22** shows existing bus routes operating to/from Castle Hill. The eastern kerbline of Old Castle Hill Road, north of the intersection with Castle Street / Crane Road provides layover space for approximately 7-8 buses.

on it is proposed to relocate

Shelters will be provided for the length of the proposed bus ranks and a pedestrian crossing will be provided at the midpoint of the Old Northern Road bus ranks to facilitate access between stops on the eastern side of Old Northern Road and the station entrance.

A bus layover facility will be provided in the vicinity of Castle Hill centre, at a site to be identified, in order to accommodate layover remotely away from the bus interchange.

A taxi rank with a capacity of approximately six taxis is provided to service Castle Towers Shopping Centre and Castle Hill Interchange on Old Castle Hill Road outside the entrance to Castle Towers.

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The station would provide the following transport facilities for customers based on 2021 forecast demand:

- 17 kiss and ride spaces
- 20 bicycle parking spaces
- 9 taxi spaces
- 8 bus bays (total) on Old Northern Road: 4 northbound & 4 southbound

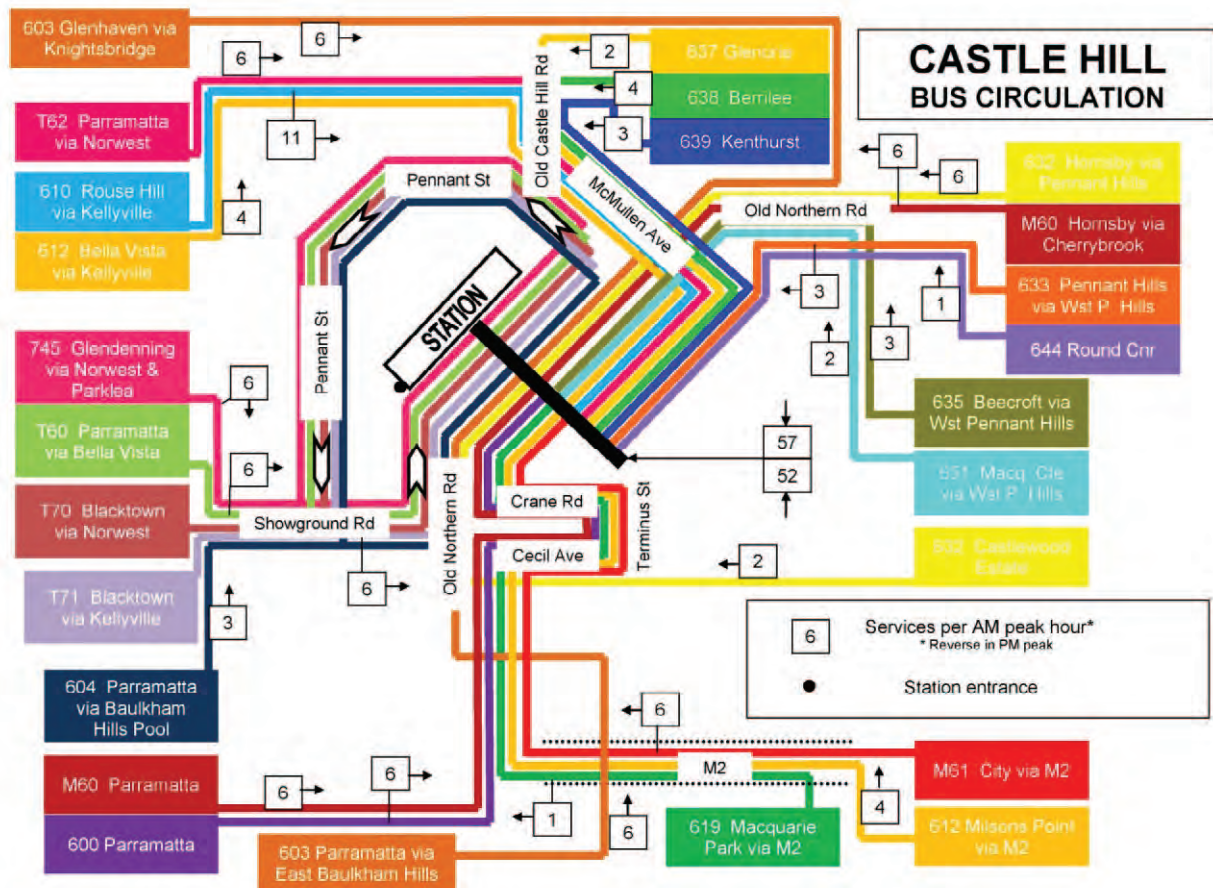
As no formal park and ride facilities are to be provided at this station, it is expected that the majority of park and ride patrons from around Castle Hill would use the proposed Showground commuter park where a total of 600 commuter parking spaces will be provided.

As at most stations across Sydney, some park and ride rail commuters are expected to park on-street, in the residential streets surrounding the town centre. Parking restrictions are already in place on a number of streets close to the town centre to discourage commuter parking for users of M2 express city bus services and these would be expected to remain in place with the advent of the NWRL.

Kiss and ride parking spaces have been estimated on an average dwell time of 3 minutes per vehicle during peak periods. This can be enforced with the provision of short term parking restrictions (5-10 minute) on the allocated kiss and ride spaces. Kiss and ride activities will be discouraged along Old Castle Hill Road by the use of appropriate advisory and regulatory signage (and possibly the use of violation cameras). Fencing along the Old Castle Hill Road frontage to the station precinct is not proposed nor would it be supported.

The bus hub at Castle Hill station will provide feeder bus services from surrounding suburbs. Some M2 express services from Castle Hill would be discontinued, reduced in frequency or redirected to provide high frequency local services to the station. See **Figure 24**.

Figure 24 Indicative future bus access to Castle Hill Station



Source: NWRL, 2012

Estimated traffic generation in 2021

Traffic volumes, pedestrian activity and other multi-modal activities will increase around the proposed station precinct. The increased traffic will be due to the activities of kiss and ride, taxis and buses mainly during the morning and afternoon peak hours.

It should be noted that the traffic modelling analysis in this report was undertaken using earlier demand forecasts. Supplementary analysis of future proposals may be required.

8.2.4 Integrating Castle Hill station

Castle Hill is a major centre with an established, mature road network, featuring a town centre ring route, to divert traffic from the heart of the centre, which is located on Old Northern Road around the Castle Towers shopping centre.

Castle Hill station is a major bus hub for buses serving the centre, and for M2 express and other trunk bus routes linking Castle Hill with other centres and Sydney CBD. Under the proposed NWRL project, Castle Hill will remain a major bus hub, but NWRL is expected to divert many commuter trips to Macquarie, Lower North Shore and Sydney CBD from bus to train.

Train will also provide opportunities for town centre workers, shoppers and other visitors to access the centre, walking to their final destination. In 2021, more than one-third of all station patronage at Castle

Hill is expected to be customers using train to access the centre (i.e. with Castle Hill station as a destination).

As a major centre, there will be no formal commuter parking provided at the station, so high quality provision for bus and kiss & ride (and foot) is needed to encourage these more sustainable access modes. Bus and kiss & ride together will represent almost 50% of customer access demand, with over one third of station customers walking or cycling to the station.

Accordingly, the highest priority for Castle Hill station integration is to ensure the station precinct is pedestrian and cyclist friendly.

As with other NWRL centres, buses and trains must serve the centre as well as meet outbound commuter needs. The current public transport access mode split to Castle Hill for journey to work is around 5% and while NWRL will help to improve that by making public transport access better, buses will also have an important role in providing access to the centre, as train and bus will serve different catchment areas.

The transport interchange arrangements for Castle Hill will be consistent with The Hills Shire Council's 2007 Town Centre Bus Interchange Study, with bus stops for both directions located in Old Northern Road between Old Castle Hill Road / Crane Road and Terminus Street. Kiss & ride parking and taxis would be located in Old Castle Hill Road.

To support a highly pedestrian and cyclist friendly 'interchange place' the bus interchange would be compact, with bus layover located off-site. During NWRL operation, bus layover for up to 20-30 buses is required at Castle Hill and this cannot be accommodated within the station precinct, as was also the case in the Council scheme. Locations for bus layover are being investigated and multiple locations may operate within 400 metres of the interchange.

The station precinct master plan provides a high degree of pedestrian accessibility and modal separation.

8.2.5 Proposed traffic management facilities

Figure 25 shows the expected vehicle approach and departure routes to Castle Hill station. Car routes (for kiss & ride customers) will be to and from Old Castle Hill Road from the Castle Hill town centre ring road. Old Castle Hill Road will operate two-way as a condition of approval for planned town centre changes and the NWRL project will adopt this configuration. A possible future closure of Castle Street, as part of Castle Towers redevelopment plans, will remove the potential for cars to approach the interchange via that route.

Buses will make use of a bus-only interchange in Old Northern Road between Crane Road and Terminus Street, effectively separating bus movements from cars in the heart of the interchange. Buses will operate two-way in Old Northern Road, accessing and egressing via Old Northern Road / Terminus Street intersection, or the Crane Road / Old Northern Road/Castle Street intersection, depending on routes and direction of approach/departure.

This interchange arrangement is largely consistent with The Hills Shire's future town centre bus interchange plans from 2007.

Under the current NWRL proposal, the Castle Hill bus interchange will operate with off-site bus layover, as there would be insufficient space within the station precinct to accommodate existing and future bus layover needs within the station precinct masterplan, which provides for a compact, highly pedestrian friendly station and interchange.

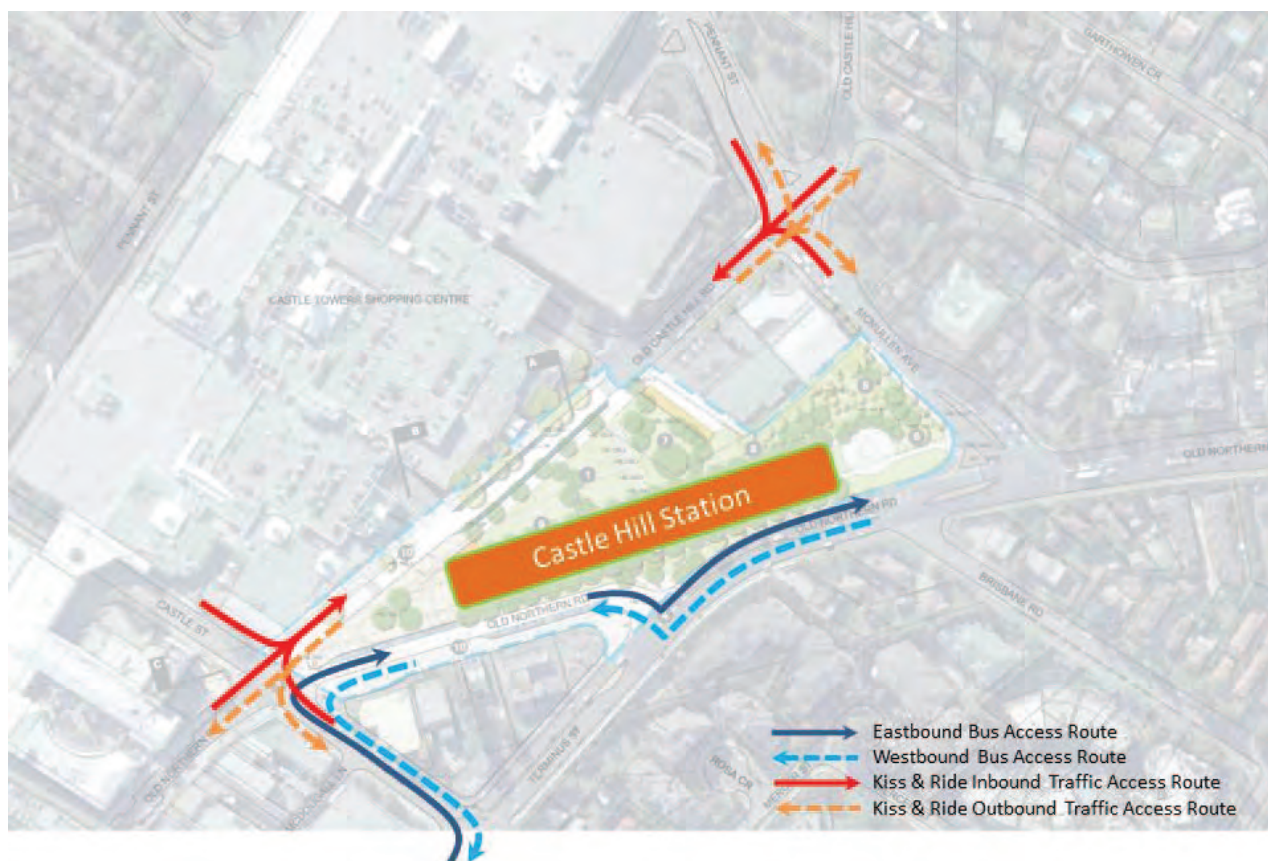
Final locations for bus layover at Castle Hill (see 'Bus layover at Castle Hill' below) are still being determined. After dropping off passengers in the interchange, terminating/laying over buses will leave the interchange to access a nearby layover parking location before returning to pick up passengers on the outbound journey. During peak times, a substantial proportion of buses (likely to be in the order of 40%) will arrive in, or depart from the interchange as "Special" – that is not carrying passengers.

It is not proposed to provide commuter parking spaces at Castle Hill although it is acknowledged that some rail commuters may choose to park on-street in the surrounding residential areas. The retention of existing parking restrictions in the streets surrounding the town centre will discourage commuters from parking all day and will increase the attractiveness of using the bus services that will be servicing the station.

This station would operate as an interchange station between buses serving the adjoining residential areas and for the residential areas located around the centre. Traffic changes will be minimal surrounding the station.

- Old Castle Hill Road would operate as a two-way road over the full length between McMullen Avenue and the Old Northern Road / Crane Road / Castle Street intersection. This would require some widening of the road to accommodate two traffic lanes and two parking lanes north of the Castle Towers vehicle entry. However, this work is proposed to be carried out as part of the construction works to provide for the relocation of the buses to Old Castle Hill Road during the construction phase. South of the Castle Towers vehicle entry it is proposed to provide two traffic lanes only (one in each direction) to the stop line at the Old Northern Road / Castle Street / Crane Road intersection.
- The intersection of Old Northern Road and Terminus Street will be signalised to facilitate access during NWRL construction. These signals will remain in place during NWRL operation.
- The provision of short term parking (kiss and ride) on the eastern kerb of Old Castle Hill Road adjacent to the station and to the north of the taxi ranks.
- Changes to the traffic signals at the intersection of Old Northern Road / Old Castle Hill Road / Crane Road / Castle Street to facilitate two-way traffic movements in Old Castle Hill Road at the intersection. These changes would include pedestrian crossings on the Old Castle Hill Road and Old Northern Road (north) legs of the intersection, thereby providing pedestrian crossings on all legs of the intersection.
- Relocation of all bus ranks, at the conclusion of NWRL construction works, to the section of Old Northern Road between the intersection with Crane Road / Castle Street and Terminus Street.

Figure 25 Castle Hill traffic access routes



Source: NWRL, 2012

Bus layover at Castle Hill

Bus layover is where buses are stopped for periods of between 15 minutes up to an hour to enable the driver to have a break. This is required either to conform with driving regulations and/or to enable the driver to take a scheduled meal break, or to enable buses to be in position in readiness to commence an onward trip on time. These breaks are best taken away from any passenger pick up/set down areas and it is generally required that, should suitable facilities not be provided in close proximity, that the layover area be provided with a suitable meal room and toilets. Currently, buses undertaking breaks at Castle Hill make use of the layover spaces provided in Old Castle Hill Road opposite the Castle Towers shopping centre, with drivers making use of the facilities provided in the shopping centre.

With the proposed changes to the way buses operate around the station and the conversion of the existing bus layover area provided in Old Castle Hill Road to short term parking/taxi ranks, it is necessary to determine a suitable location for bus layover close to the station precinct. The proposed bus interchange on Old Northern Road will not be of sufficient size to accommodate buses for any length of time, owing to the volume of buses that will be arriving and departing the interchange during the peak periods.

As a consequence of forecast growth and planned activities around the retail and transport functions at Castle Hill, a holistic assessment of changes to the bus and transport network would be facilitated by TfNSW, in conjunction with community and other stakeholders, as a lead up to the opening of the NWRL. Multiple sites have already been considered and assessed in consultation with bus operators and TfNSW.

8.2.6 Preliminary traffic assessment

Background

It should be noted that the traffic modelling analysis in this report was undertaken using traffic generation figures based on earlier demand forecasts. Supplementary analysis of future proposals may be required.

Intersections included within the modelling for Castle Hill station are as follows:

- Old Northern Rd / McMullen Ave (traffic signals) – This intersection is a T-intersection which is the convergence of the eastern and western ring roads around the Castle Hill Town Centre. Medians are provided on all approaches to the intersection.

Old Northern Road is provided with two through lanes and two right turn lanes on the northern approach and two through lanes and a left turn slip lane on the southern approach. Brisbane Road intersects with Old Northern road approximately 30 metres south of the McMullen Avenue intersection. A median opening and short right turn bay is provided for vehicles turning from Old Northern Road into Brisbane Road. McMullen Avenue is provided with two right turn lanes and two left turn lanes at the intersection.

- Old Northern Rd / Terminus St (priority control) – This is a priority T-intersection with Old Northern Road (eastern approach) and Terminus Street (western approach) having priority. A bus only right turn bay is provided on the Old Northern Road eastern approach, with two through lanes for general traffic. Two lanes are provided on the Terminus Street western approach consisting of a shared left/through and through lane. A single left turn is provided on the Old Northern Road northern leg, with right turns not permitted out of Old Northern Road.
- Old Northern Rd / Crane Rd / Castle Street / Old Castle Hill Road (traffic signals) – There are five legs to this intersection. The southern approach of Old Northern Road provides a single through right lane and a short left turn lane. Old Castle Hill Road is one-way northbound at the intersection. Crane Road is provided with two lanes on approach with a shared left/through lane and shared right/through lane. Castle Street has two lanes on approach with a shared left/through lane and through lane. The northern leg of Old Northern Road is a Bus Only road with a single lane approach to the intersection.
- Crane Rd / Terminus St (traffic signals) – This is a four way intersection with Terminus Street having a divided four lane configuration providing a shared left/through lane, through lane and right turn bay on each approach. Crane Road is provided with two traffic lanes on each approach with the western approach having an exclusive left turn lane and shared right/through lane and the eastern approach having a shared left/through lane and shared right/through lane.

The analysis results summarised in **Table 11** indicate:

- The Crane Road northern approach at the Crane Road / Terminus Street intersection is forecast to approach capacity with the operation of the NWRL. This is predominantly due to the additional kiss and ride traffic movements travelling southbound along Old Castle Hill Road and then left into Crane Road.
- The queue on the northern leg of the Crane Road / Terminus Street is forecast to extend back to the Old Northern Road / Crane Road / Castle Street intersection however it would clear every traffic cycle.
- All other intersections within the network are forecast to operate with spare capacity and at satisfactory levels of service under both scenarios.

Table 11 Castle Hill station – AM Peak Hour Intersection Performance (2021)

Location	Without NWRL		With NWRL	
	LOS*	DoS**	LOS*	DoS**
Old Northern Road / McMullen Avenue	C	0.92	C	0.86
Old Northern Road / Terminus Street	A	0.64	A	0.65
Old Northern Road / Crane Road / Castle Street / Old Castle Hill Road	E	0.71	E	0.75
Crane Road / Terminus Street	C	0.97	D	1.02

Source: ITLU (2012)

LoS – Level of service; DoS – Degree of saturation

Note: supplementary analysis of future proposals may be required.

* Worst performing lane

** Overall intersection performance

8.3 Showground

8.3.1 Background

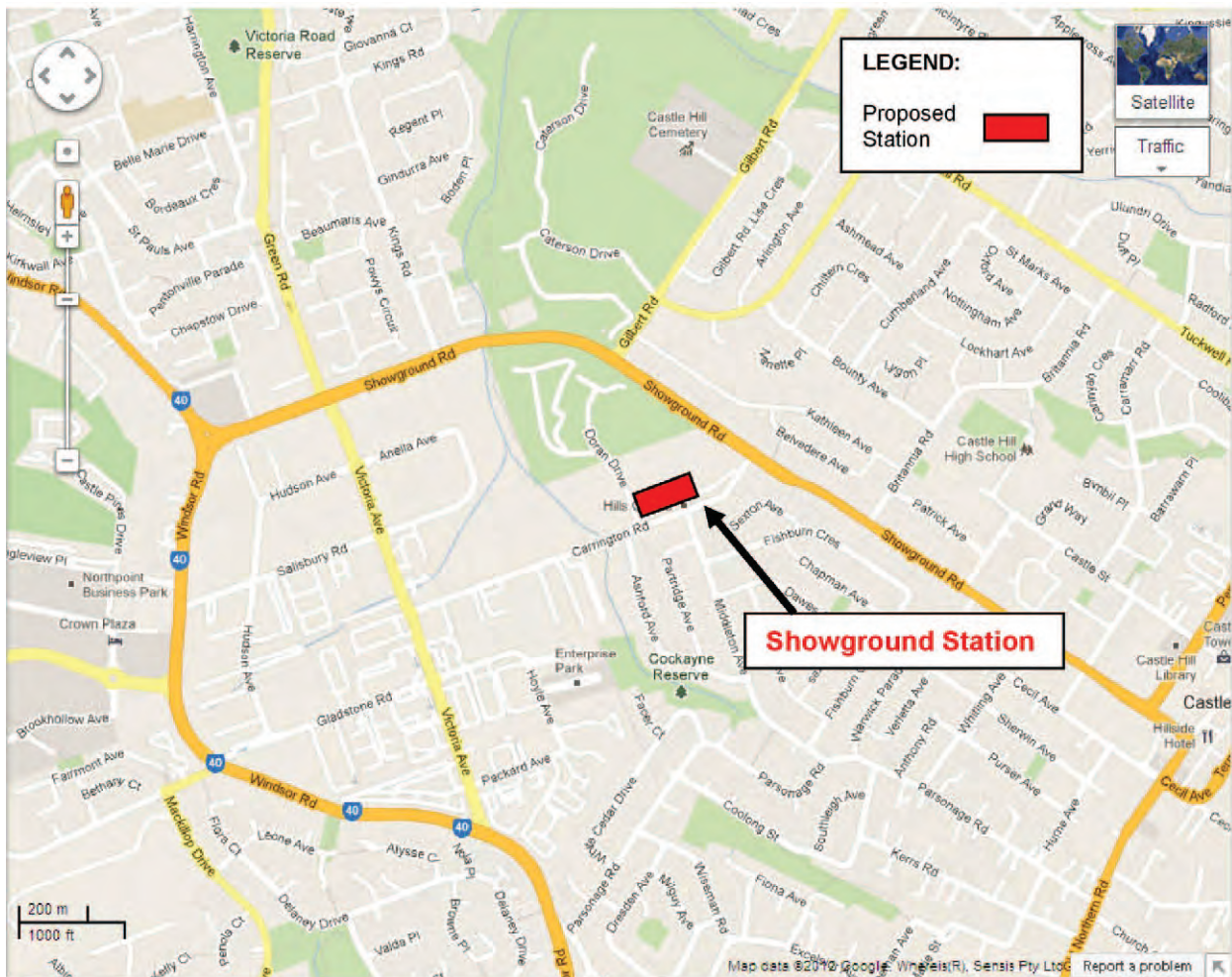
The proposed Showground station (previously known as Hills Centre) is located within the Hills Shire LGA. The proposed station would mainly serve the residential areas of Castle Hill located to the north and east and of the southern areas of Kellyville around the Green Road area. It would also provide access for workers to the industrial/commercial area located to the south of the station.

Showground station will complement Castle Hill station in that it would, to a degree, capture customers from the same catchment as the proposed Castle Hill station.

However, unlike Castle Hill, the proposed Showground station would provide a park and ride option, with less access by bus, relatively, than Castle Hill.

The location of the proposed Showground station is shown in **Figure 26**.

Figure 26 Location of the proposed Showground station



Copyright: Google, 2012

8.3.2 Existing conditions

Existing road network adjacent to the proposed station

The following roads are located immediately adjacent to the proposed Showground station:

- Carrington Road – This road is classified as a Collector Road and is a two-way, two-lane road with limited parking allowed along the road.
- Showground Road – This road is classified as a State Road. The road section between Windsor Road and Carrington Road is a 4-lane road whilst the road section between Carrington Road and Pennant Street is a two-way, two-lane road.

Table 12 shows the details of the roads located immediately adjacent to the proposed Showground Station.

Table 12 Showground station – Roads summary

Road	Agency Responsibility	Lanes	AADT	2011 Peak Hour Volume
Showground Rd	RMS	4	44,913	Eastbound AM 1,825 (8-9am) PM 1,882 (6-7pm) Westbound AM 1,631 (8-9am) PM 1,697 (3-4pm)
Gilbert Rd	The Hills Shire Council	2	16,134	Northbound AM 656 (7.45-8.45am) PM 1,077 (5-6pm) Southbound AM 1,221 (8-9am) PM 785 (4-5pm)
Carrington Rd	The Hills Shire Council	2	15,409	Eastbound AM 741 (11-12am) PM 1,075 (5-6pm) Westbound AM 802 (8-9am) PM 852 (3-4pm)
Victoria Ave	The Hills Shire Council	4	25,710	Northbound AM 1,263 (11-12am) PM 1,295 (4-5pm) Southbound AM 1,242 (11-12am) PM 1,142 (12-1pm)

Source: RMS AADT Data & ITLU Traffic counts 2011

AADT – Annual average daily traffic

The following key intersections are located immediately adjacent to the proposed Showground station:

- Showground Rd / Carrington Rd (traffic signals) – This intersection is a signalised T-intersection with Showground Road being a divided carriageway providing two lanes in each direction with the western approach having a right turn bay. Carrington Road is provided with two lanes on approach with a shared left/right lane and a right turning lane.
- Showground Rd / Gilbert Rd (traffic signals) – This intersection is a signalised T-intersection with Showground Road having a divided carriageway with two through lanes in each direction, a left turn slip lane on the western approach and a right turn bay on the eastern approach. Gilbert Road is provided with two right turn lanes on approach and a left turn lane.

- Victoria Ave / Carrington Rd (roundabout) – This intersection provides two lanes on each of the Victoria Avenue approaches and two lanes on the Carrington Road approach to the intersection.
- Carrington Road / Middleton Avenue / The Hills Shire Council access intersection – This intersection is controlled by a roundabout which provides a single lane approach on all legs.
- Carrington Road / Doran Drive intersection – This intersection is a priority intersection and provides access to Castle Hill Showground and Council's Works Depot.
- Carrington Road / Ashford Avenue intersection – This intersection is a priority intersection and left in movements from Carrington Road to Ashford Avenue only are allowed at this intersection.

Adjacent landuses

The proposed station will be located adjacent to residential and commercial land uses. The Hills Shire Council and Castle Hill Showground are located immediately adjacent to the location of proposed station. The Hills Centre is also located adjacent to the proposed railway station. Approximately 200 off-street parking spaces are currently provided in the existing "Hills Centre" car park.

Historical crash analysis

A historical crash analysis has been undertaken for the crashes occurred between January 2006 and December 2010 within 400m radius of the proposed Showground station. **Table 13** shows the number of crashes recorded within 100m and 400m from the location of the proposed station.

Table 13 Showground Station – Crash Summary

Distance from the proposed Station (radius)	Number of pedestrian crashes	Total number of crashes
100m	0	4
400m	0	41

Source: RMS Crash Data 2011

The following observations were made in relation to the crashes occurred within 400m radius of the proposed station:

- Out of 41 crashes, the highest number of crashes (21 crashes) occurred at the Showground Road / Carrington Road intersection and the details are provided below:
 - 9 crashes occurred between vehicles turning right from Showground Road onto Carrington Road and vehicles travelling west along Showground Road.
 - 6 crashes were reported as rear-end type crashes and occurred on Showground Road at the Showground Road / Carrington Road intersection.
 - 3 crashes occurred at the Showground Road / Carrington Road intersection when vehicles travelling on Showground Road collided with the vehicles travelling on Carrington Road.
 - 3 crashes occurred at the Showground Road / Carrington Road intersection during lane changing manoeuvre and due to side swipe between vehicles.
- Out of 41 crashes, a total of 13 crashes occurred on Carrington Road and the details are provided below:

- 9 crashes occurred on a 300m road section from 150m west of Ashford Avenue to Middleton Avenue including 6 rear-end type crashes and 3 run-off road crashes. Out of 9 crashes, a total 7 crashes were reported to occur for vehicles travelling east on Carrington Road.
- A single crash (type of crash is unknown) occurred at the Carrington Road / Middleton Avenue intersection and between Middleton Avenue and Showground Road
- Two crashes are related to vehicles accessing the driveways occurred between Victoria Avenue and 150m west of Ashford Avenue.

Traffic volumes at the Showground Road / Carrington Road intersection and on Carrington Road are expected to increase with the proposed Showground station.

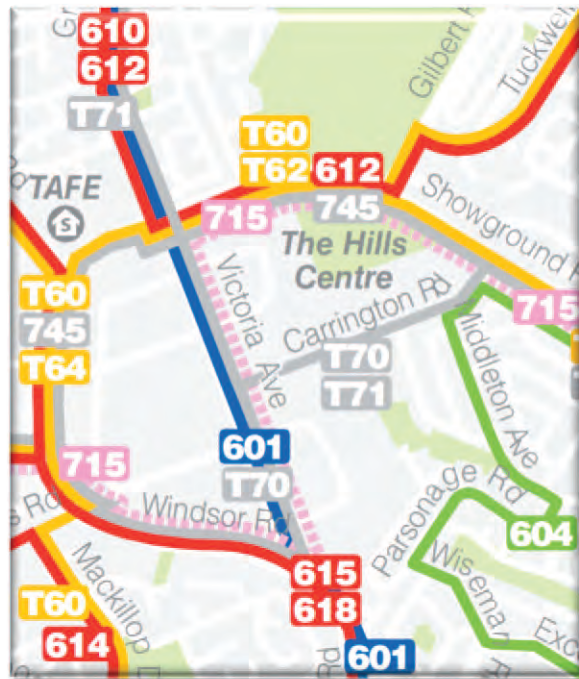
The following measures have the potential to reduce the crashes and/or severity of the crashes immediately adjacent to the proposed Showground station.

- The proposed improvements to Showground Road between Carrington Road and Pennant Street as part of the proposed Showground Road upgrade would have the potential to improve the safety at the Showground Road / Carrington Road intersection and on Showground Road east of Carrington Road.
- The provision of traffic signals as part of the NWRL project at the intersection of Carrington Road and Doran Drive will provide a safe exit for vehicles leaving the station precinct.

Bus operation

Bus services to Hills Centre area are currently provided via Carrington Road, Middleton Avenue and Showground Road. Buses are currently operated by Hillsbus and Busways. Hillsbus route T60 operates along Showground Road with the route 604 along Middleton Avenue and Carrington Road to Showground Road. Busways' routes T70, T71 operate along Carrington Road and the 745 along Showground Road. **Figure 27** shows bus movements adjacent to the proposed Showground station.

Figure 27 Existing bus routes in the vicinity of the proposed Showground station



Source: www.cdcbus.com.au (2012)

It is currently proposed to make a slight diversion of existing bus services to provide access to stops on Doran Drive, immediately adjacent to the station. Priority would be provided for buses with a bus-only movement right out on to Showground Road from the new station access road in order to minimise any delays to bus services diverted via the station. This would allow buses to avoid the congested Carrington Road approach to the intersection with Showground Road.

Pedestrian and cyclists

A pedestrian route from Carrington Road through the Castle Hill Showground to Showground Road is provided. Footpaths are provided along Carrington Road. A pedestrian refuge is currently provided between Middleton Avenue and Doran Drive on Carrington Road. A cycle path runs alongside Cattai Creek and under Showground Road into Fred Caterson Reserve (currently closed).

8.3.3 NWRL demand

Figure 28 shows the layout of the station and associated facilities that will be provided for the operation of the proposed Showground station. The proposed station would provide the following transport facilities for commuters to cater for 2021 forecast demand:

- 15 kiss and ride spaces
- 600 park and ride spaces
- 40 bicycle parking spaces
- 4 taxi spaces
- 4 bus bays on Doran Drive

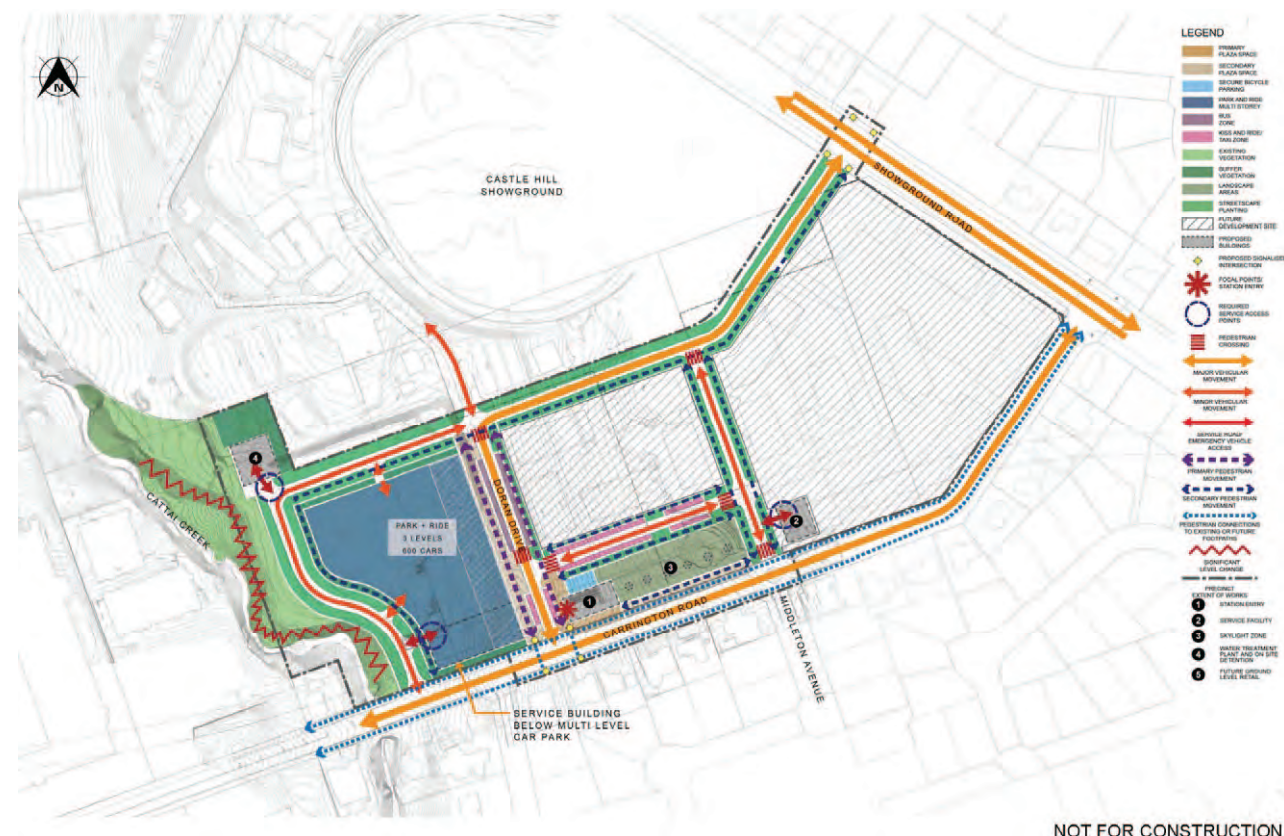
The Showground station is identified as a park and ride station with 600 vehicle spaces to be provided immediately adjacent to the station and accessible either off Carrington Road via a new road close to Cattai Creek or Doran Drive, or off Showground Road from the west via a new road into the station precinct.

Short term parking spaces for kiss and ride pick up and drop offs are proposed to be provided on both sides of the new east-west running street linking to Doran Drive.

Kiss and ride parking spaces have been estimated based on an average 3 minutes dwell time per vehicle during peak periods. This can be enforced with the provision of short term parking restrictions (5-10 minute) on the allocated kiss and ride spaces.

This station is not seen as a major bus-rail interchange and all buses passing the station will be through routing to other destinations, in particular Castle Hill, as the major centre for the region. There are three bus routes that currently operate close to the site and these will be provided with bus stops on Doran Drive, north of Carrington Road (see **Figure 28**).

Figure 28 Proposed Showground station



Source: ERSA Concept Design 2012

Estimated traffic generation in 2021

Traffic volumes, pedestrian activity and other multi-modal activities will increase around the proposed station precinct. It should be noted that, in the case of Showground station, the traffic modelling analysis was undertaken using the latest demand forecasts. Supplementary analysis of future proposals may be required.

Park and ride traffic is anticipated to originate mainly in the Kellyville area, to the north of Showground Road and these would access the station either via Victoria Avenue and Carrington Road, or Showground Road. To a lesser degree, park and ride traffic will also access the station from the Baulkham Hills and surrounding areas to the south, via Victoria Avenue and Carrington Road or via Middleton Avenue, and from Glenhaven to the north, via Gilbert and Showground Roads.

Kiss and ride traffic will principally originate from the Kellyville area and possibly even as far as Beaumont Hills. This is related to the principal traffic movements being toward the east during the AM peak and the Showground station being located in that eastbound corridor for those people who would be dropped off at the station while the car driver continues on their eastward journey.

8.3.4 Integrating Showground station

Showground station's proximity to Castle Hill influences its integration with bus networks. As Castle Hill is the major centre, with a strong need for effective bus access to the centre and the station, it is important that bus routes are not unnecessarily delayed en route to Castle Hill in order to serve Showground station, which will primarily be a park and ride station. It is therefore important to minimise the length of any diversion and provide appropriate priority for buses accessing the station. Showground station would provide park and ride and kiss & ride facilities for commuters bound for

other destinations, and will also serve the adjacent Castle Hill Showground (for which demand is expected to be mostly outside commuter peak periods, including weekends). Car parking activity associated with the Showground will supplement park & ride demand and provide for dual use of car parking provision.

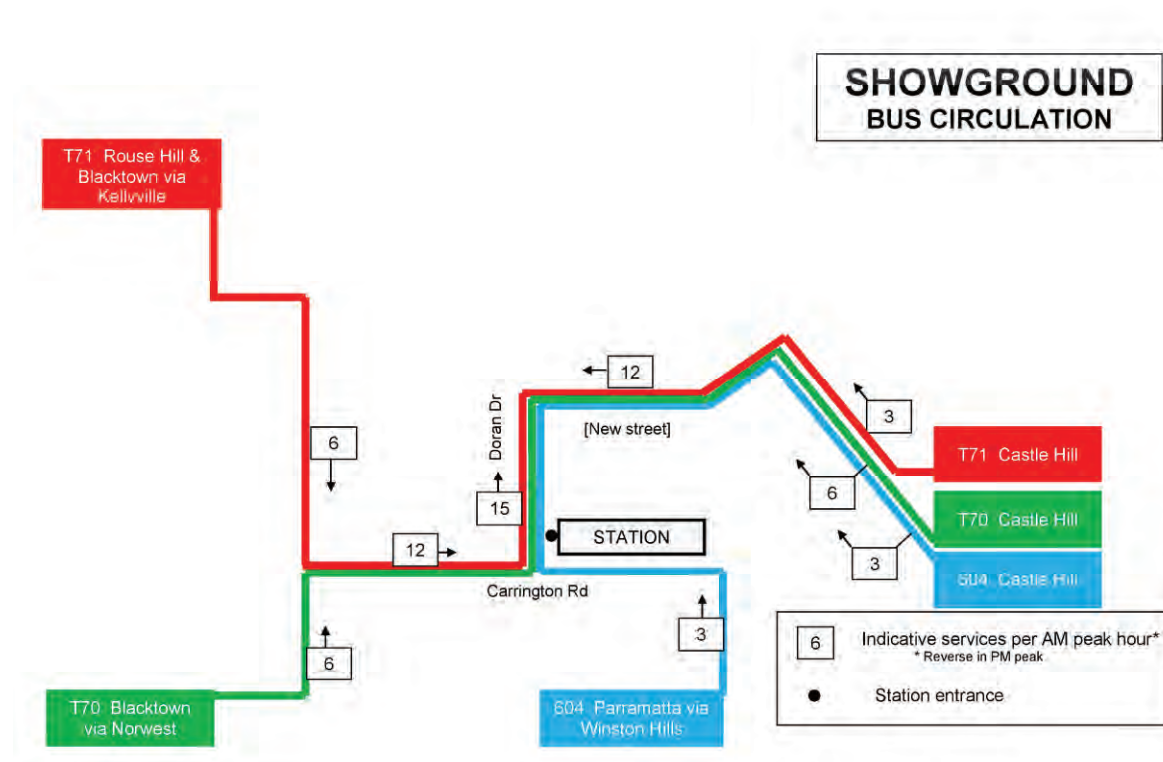
The station in this location will encourage redevelopment of surrounding land, including the Victoria Avenue industrial area to the west, which will be accessed via street and off-street pedestrian and cycle links.

The station precinct 'front door' will be to Doran Drive and internal new roads will manage kiss & ride and park & ride movements within the station precinct. Bus stops located in Doran Drive will provide for bus access to the station (expected to be around 10 per cent of peak period customers) while preserving bus links to Castle Hill.

While bus stops could be provided in Carrington Road, they are unlikely to be able to satisfy *Disability Standards for Accessible Public Transport 2002* without significant carriageway and footpath intervention.

The indicative bus services to access Showground station are shown in **Figure 29**.

Figure 29 Indicative future bus access to Showground station



Source: NWRL, 2012

8.3.5 Proposed traffic management facilities

Figure 30 shows provisions for car and bus access to and egress from the station. Showground station will attract park & ride and kiss & ride customers, as well as providing an on-street bus interchange focused on Doran Drive via Carrington Road and the proposed new access road via Showground Road.

Figure 30 Traffic Access Routes at Showground station



Source: NWRL, 2012

Kiss & ride and park & ride vehicles will access the station precinct from Doran Drive, Middleton Avenue and the new link road from Showground Road and circulate via internal roadways. An additional road link to Carrington Road will be located west of Doran Drive, most likely restricted to left in / left out movements only. The creation of 4-way cross intersection with this western link road at Ashford Avenue is not possible as the link road would be external to NWRL owned land.

The development of the Showground station will include the following traffic management measures to facilitate this station as one of the identified park and ride stations:

- Location of a new access road off Carrington Road to the west of the Ashford Avenue intersection. This road would provide access to the commuter parking proposed to the west of Doran Drive. This road will have one entry and exit lane at Carrington Road.

- Upgrading of Doran Drive to accommodate two traffic lanes at the intersection and provision for bus stands, kiss and ride spaces and taxi ranks close to the station entrance. Doran Drive would also provide access to the Showground area.
- In conjunction with the above, the signalisation of the intersection of Doran Drive with Carrington Road (subject to RMS approval).
- Provision of a new road linking Doran Drive and Showground Road. The intersection on Showground Road would be between the existing signalised intersections of Gilbert and Carrington Roads and signalised (subject to RMS approval). All movements would be allowed, except for right turns from the new road to Showground Road which would be restricted to buses only, operating in a special B-signal phase.
- Provision of two bus stands on each side of Doran Drive close to the station entrance.

8.3.6 Preliminary traffic assessment

Background

Traffic analysis for Showground station was undertaken using the latest demand forecasts.

Intersections included within the modelling for the Showground station are as follows:

- Showground Rd / Carrington Rd (traffic signals) – This intersection is a signalised T-intersection with Showground Road being a divided carriageway providing two lanes in each direction with the western approach having a right turn bay. Carrington Road is provided with two lanes on approach with a shared left/right lane and a right turning lane.
- Carrington Rd / Middleton Ave (roundabout) – This intersection provides one lane on each of the approaches, with the Middleton Avenue northern approach providing access to the Hills Shire Council car park.
- Carrington Rd / Doran Dr (traffic signals) – Traffic signals are proposed to be installed at this intersection, providing vehicular access to Showground station. All traffic movements are to be permitted at this signalised T-intersection, with pedestrian crossing legs provided on the northern and eastern approaches. A single approach lane is provided on the northern leg of Doran Drive, which is shared with right and left turning traffic. The eastern leg of Carrington Road has two lanes on approach with a right turn lane and through lane. A shared left/through lane and through lane is provided on the Carrington Road western approach.
- Carrington Rd / Site Access West (priority control) – This new intersection is a channelised T-intersection with Carrington Road having priority. The access road will be restricted to left in/left out movements at Carrington Road. A single approach lane is provided on the northern leg of the intersection.
- Showground Rd / new station road (traffic signals) – A new intersection on Showground Road between the Gilbert and Carrington Road intersections. The intersection comprises a 70 metre long right turn bay in Showground Road, a 30m long right turn lane in the new station road and a separate left turn lane in the new road.

The following assumptions were made in distributing the NWRL associated traffic on the local road network in the vicinity of the Hills Centre:

- 10% of the total vehicles will travel to/from Windsor Road (north) and access the station via the proposed intersection on Showground Road.

- 20% of the total vehicles will travel to/from Gilbert Road (north) and access the station via the proposed intersection on Showground Road.
- 10% of the total vehicles will travel to/from Middleton Avenue (east) and access the station via Middleton Avenue (west).
- 15% of the total vehicles will travel to/from Showground Road (east) and access the station via the proposed intersection at Doran Drive / Carrington Road.
- 25% of the total vehicles will travel to/from Victoria Avenue (south) and access the station via the proposed intersection at Doran Drive / Carrington Road.
- 20% of the total vehicles will travel to/from Green Road (north) and access the station via the proposed intersection on Carrington Road.

The analysis also assumes the following:

- A 70m long right turn bay on Showground Road (west) caters for the right turn access movement at the proposed Station Access / Showground Road intersection.
- A 30m long right turn bay on Station Access (south) caters for right turn bus movements only at the proposed Station Access / Showground Road intersection.
- A 60m long right turn bay on Carrington Road (north) caters for the right turn access movement at the Doran Drive / Carrington Road intersection.

The results are summarised in **Table 14** and indicate as follows:

- The Showground Road corridor cannot cater for either the future 2021 traffic or the NWRL associated traffic. The two intersections at Windsor Road / Showground Road and Green Road / Showground Road create a bottleneck which restricts city-bound flows along Showground Road. As a result, the capacity constraints at these intersections are fundamental to the operational performance of the wider road network. Due to the restriction of traffic, the downstream intersections along Showground Road at Gilbert Road, Station Access, and Carrington Road, operate with acceptable levels of delay. When viewing the modelling results, it is important to note that should the upstream capacity constraints be reduced, the operational performance at these intersections is likely to worsen
- Under existing 2012 AM peak conditions, modelling indicates the signalised intersection at **Windsor Road / Showground Road** operates at LoS C and with spare capacity, recording a DoS of about 0.88. Under the 2021 background growth traffic, modelling predicts the intersection will operate over capacity (DoS = 1.10) and at LoS F. Extended delays and long queues are predicted to occur on the northern and southern approaches. Modelling predicts the right turn eastbound queue can only just be accommodated in the existing right turn bay. The introduction of the NWRL associated traffic further deteriorates the performance at the intersection and sees the average delay per vehicle increase by approximately 4 seconds from about 107 to 111 seconds. The results indicate the intersection is unable to cater for either the predicted increase in background traffic or the NWRL associated traffic.
- The intersection of **Green Road / Showground Road** currently operates at capacity (an intersection is considered above capacity when the DoS exceeds 1.00) with an average delay per vehicle of about 107 seconds (LoS F). Modelling indicates the impact of the 2021 background growth traffic will increase the intersection's DoS to about 1.18 and the average delay per vehicle by in excess of 200 seconds. The modelling indicates the background growth traffic causes a dramatic increase in congestion at the intersection, and predicts the long queues on the northern and western approaches will impact on the adjacent intersections of Green Road / St Pauls Avenue and Showground Road / Windsor Road. The introduction of the NWRL associated traffic further deteriorates the operation of the intersection and sees the DoS increase to about 1.25. Modelling also indicates the average delay per vehicle will further increase by about 96 seconds.

The intersection's poor operation under future traffic volumes creates a significant bottleneck for the wider road network.

- In the AM peak the two intersections at **Gilbert Road / Showground Road and Carrington Road / Showground Road** operate at acceptable levels of delay. Under the 2021 background growth traffic and the NWRL associated traffic, modelling predicts both these two intersections will continue to operate with spare capacity and acceptable LoS. These performance results are a direct correlation to the upstream bottleneck caused by the intersections of Windsor Road / Showground Road and Green Road / Showground Road. As such, these intersections are seen to artificially accommodate the additional background growth and NWRL traffic. Should the effects of the upstream bottleneck be reduced the performance capabilities of these two intersections will reduce.
- The **proposed signalised station access on Showground Road** is located approximately 165m to the west of the Carrington Road / Showground Road intersection. Under the 2021 background growth traffic, modelling indicates the intersection operates with spare capacity, recording a DoS of about 0.61, and at LoS A. The introduction of the NWRL associated traffic sees the intersection continue to operate with acceptable levels of congestion and delay. Modelling predicts the DoS increases to about 0.73 and the LoS decreases to B. The longest predicted queue on the eastern leg of this proposed intersection is approximately 113m and hence is unlikely to impact on the adjacent intersection at Gilbert Road / Showground Road. As previously mentioned, these results should be viewed in conjunction with the effect of the network capacity restriction at the intersection of Green Road / Showground Road.
- Under existing 2012 AM peak conditions, modelling indicates the roundabout intersection at **Middleton Avenue / Carrington Road** operates at LoS B and with spare capacity, recording DoS of about 0.70. Under the 2021 background growth traffic, results indicate the intersection's DoS and LoS remain relatively stable. However, the introduction of the NWRL associated traffic causes the roundabout to fail, operating at LoS F and over capacity (recording a DoS of about 1.10). At these levels of congestion, the average delay of the worst approach is predicted to increase by about 230 seconds, from about 24 seconds. Modelling also predicts the queue on the eastern approach to reach about 290m which will impede on the adjacent intersections as far back as Middleton Avenue / Dawes Avenue.
- Under existing 2012 AM peak conditions, modelling indicates the intersection at **Doran Drive / Carrington Road** operates with acceptable congestion and delay. In the future AM peak, modelling predicts the introduction of signals at the intersection caters for the 2021 background growth traffic and also the NWRL associated traffic. Results show the intersection will operate with a DoS of about 0.62 and a LoS B. Modelling predicts the queue on the northern approach to reach approximately 135m which will impede on the adjacent intersection at Middleton Avenue / Carrington Avenue.
- In the future AM peak, modelling predicts the left in / left out station access caters for the 2021 background growth traffic and also the NWRL associated traffic. Modelling results show the intersection will operate with a DoS of about 0.34 and a LoS A.
- Under existing 2012 AM peak conditions, modelling indicates the roundabout intersection at **Victoria Avenue / Carrington Road** operates with acceptable delay and congestion, recording LoS B, and DoS of about 0.84. Under the 2021 background growth traffic, results indicate the intersection's DoS and LoS remain relatively stable. However, with the introduction of the NWRL and associated traffic volumes cause the roundabout to fail. Modelling predicts the roundabout will operate at LoS F and over capacity, recording a DoS of about 1.06. This is a result of an increase in the delay intensive right turn movement from Victoria Avenue (south). At these predicted levels

of congestion, the average delay of the worst approach (north) increases by about 141 seconds, from about 19 seconds. Modelling also predicts the queue on the northern approach to reach in excess of 450 metres which will impede adjacent intersections as far back as Victoria Avenue / Hudson Avenue.

The preliminary results reaffirm the need for the following:

- Checking of the base and forecast traffic volumes being used in the assessment
- Consideration of the impacts of converting the existing roundabout at Middleton Avenue / Carrington Road to a signalised intersection.
- Consideration of the impacts of converting the existing roundabout at Victoria Avenue / Carrington Road to a signalised intersection.

Table 14 Showground station – AM Peak Hour Intersection Performance (2021)

Location	Without NWRL		With NWRL	
	LoS*	DoS**	LoS*	DoS**
Windsor Rd / Showground Rd	F	1.10	F	1.10
Green Rd / Victoria Ave / Showground Rd	F	1.18	F	1.25
Gilbert Rd / Showground Rd	C	0.89	C	0.93
Station access / Showground Rd	n/a	n/a	B	0.73
Carrington Rd / Showground Rd	B	0.71	B	0.75
Middleton Ave / Carrington Rd	B	0.74	F	1.10
Doran Dr / Carrington Rd	A	0.52	B	0.62
Station access / Carrington Rd	n/a	n/a	A	0.34
Victoria Ave / Carrington Rd	B	0.85	F	1.06

Source: ITLU (2012)

LoS – Level of service; DoS – Degree of saturation

Note: supplementary analysis of future proposals may be required. LINSIG analysis assumes new link road to Showground Road between Gilbert and Carrington Road intersections is in place.

* Worst performing lane

** Overall intersection performance

8.4 Norwest

8.4.1 Background

Norwest Business Park is an industrial/commercial hub located at Baulkham Hills and currently provides employment for more than 20,000 people. There are more than 2,000 dwellings in the adjacent Bella Vista residential areas.

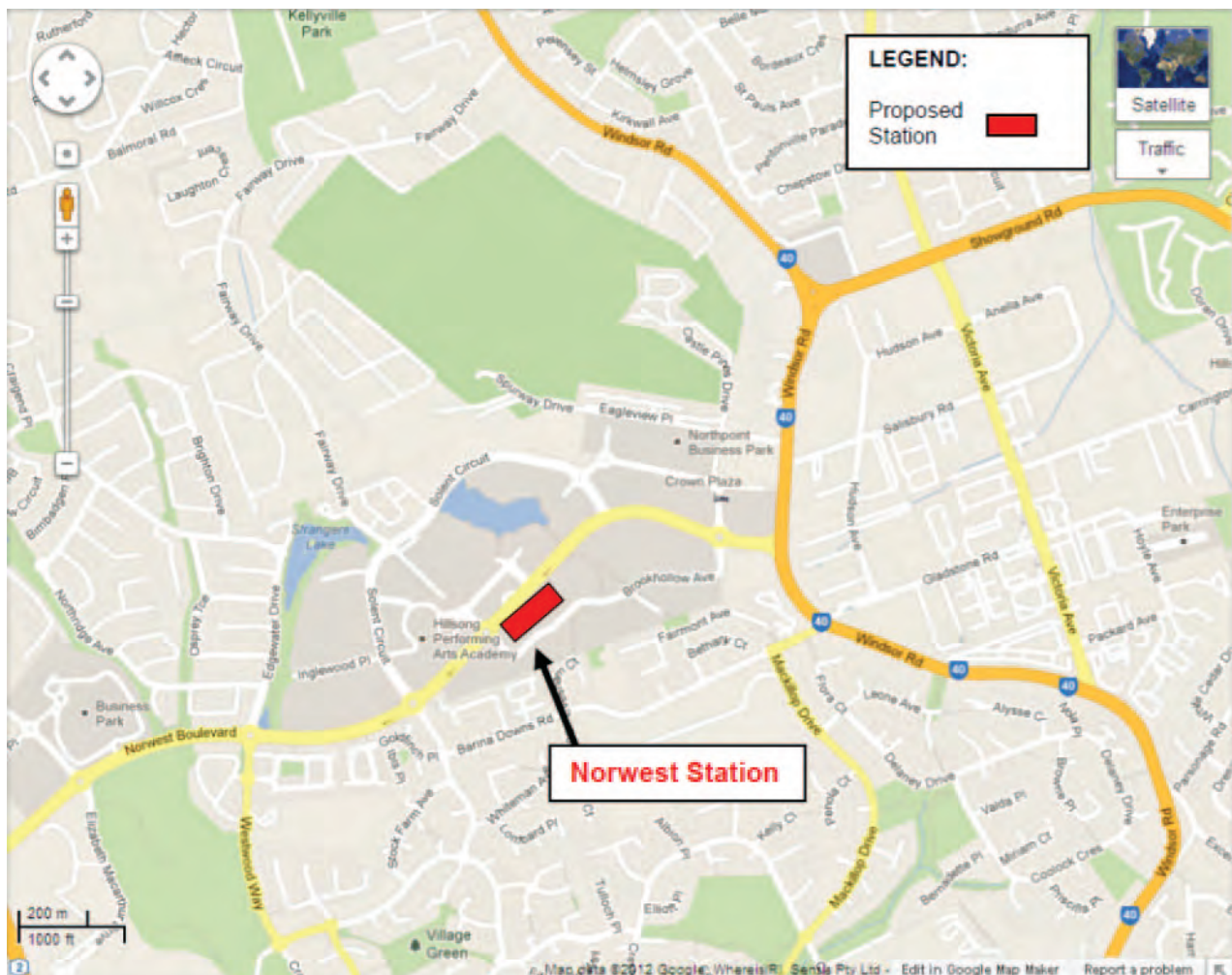
The proposed station would mainly serve the employees of the Norwest Business Park which is currently being served by buses. However, the existing bus services to the Norwest Business Park are limited, particularly outside peaks. As a result of this and the dispersed nature of trip origins, a majority of the employees of the business park commute to work using private vehicles. Due to the high number of employees arriving/leaving during the morning and afternoon peak periods, the existing road network located within and immediately adjacent to the Norwest Business Park is currently congested during the peak periods.

The proposed Norwest station would potentially reduce the congestion along Old Windsor Road and Norwest Boulevard by encouraging a shift from private car to public transport for workers in Norwest Business Park.

Based on the Sydney Metropolitan Strategy-North West Subregion, Norwest is classified as a Specialised Centre which is defined as areas containing major airports, ports, hospitals, universities, research and business activities. Specialised Centres play a vital economic and employment role which generates metropolitan-wide benefits. Norwest Specialised Centre is forecast to increase employment by an estimated 25,000 additional jobs between 2001 and 2031.

The location of the proposed Norwest station is shown in **Figure 31**.

Figure 31 Location of the proposed Norwest station



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