Vineyard Precinct
Transport Study

Department of Planning & Environment

Rev B | November 2017

ARUP

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1 Introduction

1.1 Study Background

The Vineyard precinct is a major future urban release area which is proposed to be developed as part of Sydney's North West Growth Area (NWGA). Arup has been appointed by Department of Planning and Environment (DP&E) to undertake a transport assessment, one of a set of specialist studies that will inform the development of the draft Indicative Layout Plan (ILP) for the Vineyard Precinct.

1.2 Study Objectives

The purpose of this study is to provide an assessment of the Vineyard precinct by all modes of transport including walking, cycling, public transport and passenger vehicles. This will need to consider the development of adjacent precincts within the North West Growth Area, as well as upcoming infrastructure works such as Sydney Metro Northwest. The transport assessment will identify suitable facilities for Vineyard employees and residents to walk, cycle, access to public transport or use private cars.

Specific objectives of the study will be to:

- Provide a strategic overview of the existing and future transport network in the North West Growth Area;
- Assess and test the transport impacts of the proposed development of the study area as reflected in the Indicative Layout Plan (ILP), taking into consideration potential development staging;
- Recommend infrastructure upgrades and other measures to address those impacts within the vicinity of Vineyard;
- Prepare an agreed implementation framework, in negotiation with the NSW Government transport agencies and the local council (Hawkesbury) and DP&E, for the key infrastructure components;
- Ensure all modes of transport, including private vehicle, public transport (bus and rail), walking and cycling are considered in the planning and development of the Vineyard precinct.

1.3 Report Structure

This transport assessment for the Vineyard precinct is structured as follows:

- **Section 1: Introduction**

This section

- **Section 2: Summary of Proposed Development**

Overview of the future development of the North West Growth Area and Vineyard precinct

- **Section 3: Existing Transport Conditions**

Summary of existing transport services in the North West Growth Area, including roads, public transport, walking and cycling

- **Section 4: Precinct Planning Principles**

Identification of key criteria and objectives when planning for the development of the Vineyard precinct

- **Section 5: Road Network Assessment**

Analysis of future road network conditions following the development of the Vineyard precinct, including an analysis of intersection capacities

- **Section 6: Public Transport, Walking and Cycling**

Assessment of the future transport provision for non-car modes of travel, supporting the project objective of reducing car dependency for residents and employees of the Vineyard precinct.

- **Section 7: Summary and Conclusions**

Summary of the key findings of this document

2 Summary of Proposed Development

2.1 North West Growth Area

The North West Growth Area (NWGA), comprising 16 precincts, is approximately 10,000 hectares and will contain about 90,000 new dwellings for 250,000 people. 11 of these 16 precincts have been rezoned for development, those being

- North Kellyville
- Alex Avenue
- Riverstone
- Riverstone West
- Colebee
- Cudgegong Road Station (Area 20)
- Marsden Park Industrial
- Schofields
- Box Hill
- Box Hill Industrial
- Marsden Park
- Riverstone East (stages 1 and 2)

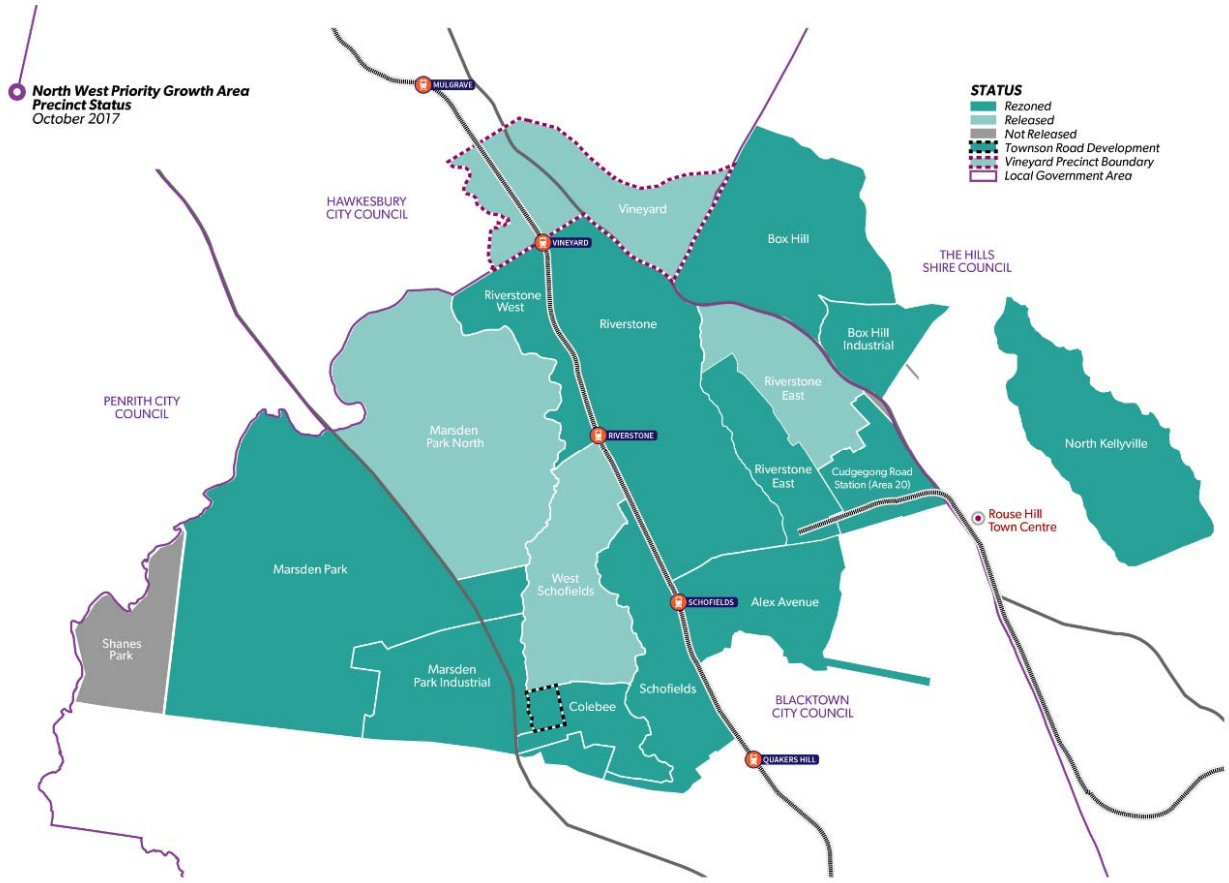

Figure 1 North West Growth Area precinct status

The NWGA spans three local government areas (LGA) – Blacktown, Hawkesbury and The Hills Shire. The NWGA is undergoing a streamlined planning process to enable land to be rezoned in a shorter period. Figure 2 illustrates the current North West Land Use and Infrastructure Plan.

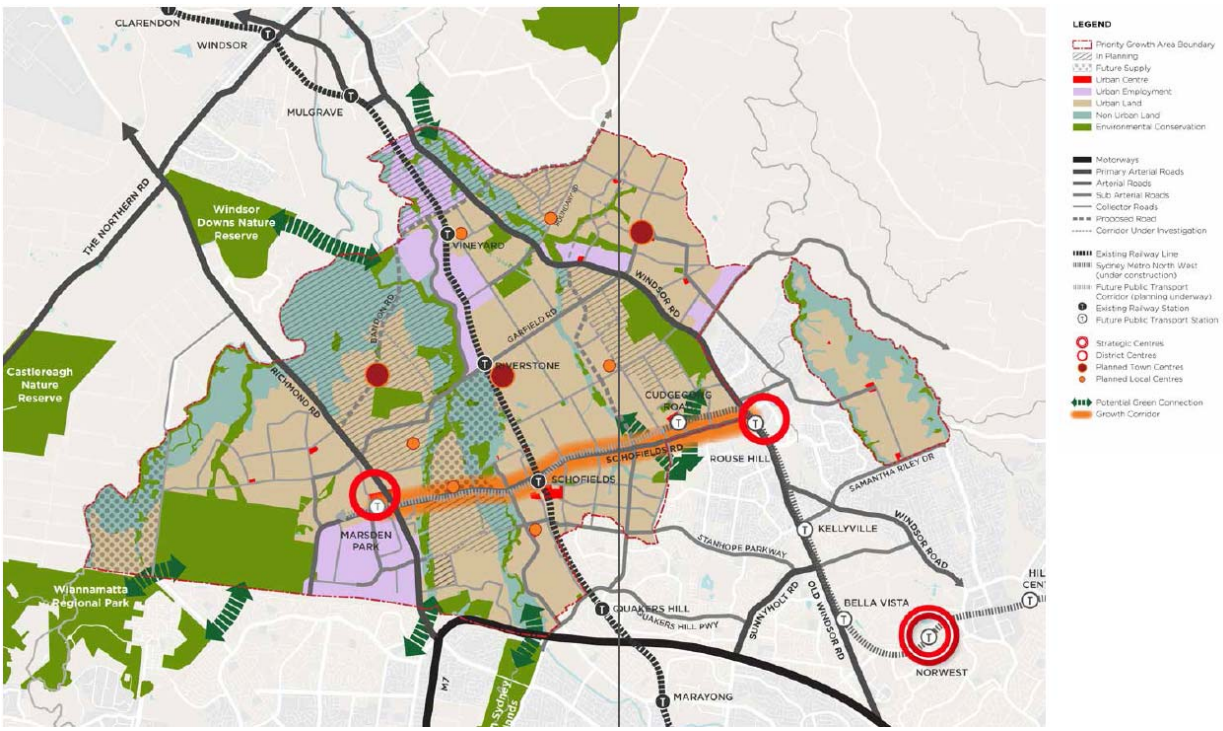

Figure 2 North West Growth Area Structure Plan

2.2 Vineyard Precinct

The Vineyard precinct is located in the northern portion of the NWGA, wholly within the Hawkesbury LGA. It is currently zoned for rural land uses under the Hawkesbury Local Environmental Plan 2012.

The precinct is located either side of Windsor Road and is bounded by Commercial Road to the north, Boundary Road to the east and Windsor Road / Bandon Road to the south. In the wider area, the precinct is located approximately 50km from the Sydney CBD, 20km northwest of Blacktown and 10km northwest of Rouse Hill.

It is comprised of 590 hectares in total; it is immediately surrounded by Box Hill, Riverstone and Riverstone West precincts.

Figure 3 Vineyard Precinct Aerial

2.3 Draft Indicative Layout Plan

The draft indicative layout plan (ILP) developed for Stage 1 of the Vineyard precinct is presented in Figure 4.

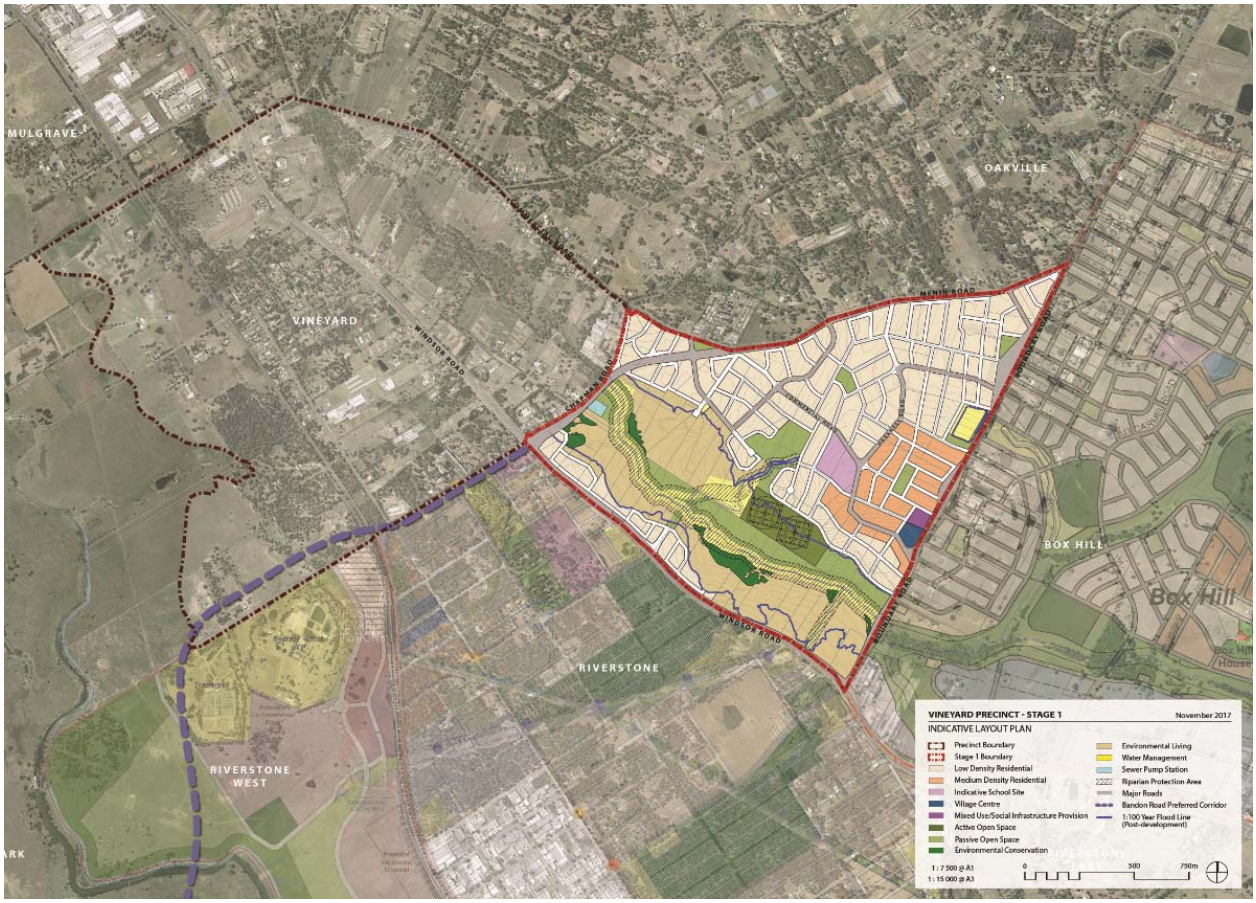

Figure 4 Draft Vineyard Stage 1 ILP

3 Existing Transport Conditions

3.1 Travel Patterns

Existing travel characteristics of residents in the North West Growth Area have been identified based on 2011 Journey to Work Census data[1] and 2012 Household Travel Survey Information[2]. The existing mode share of residents is illustrated in Figure 5.

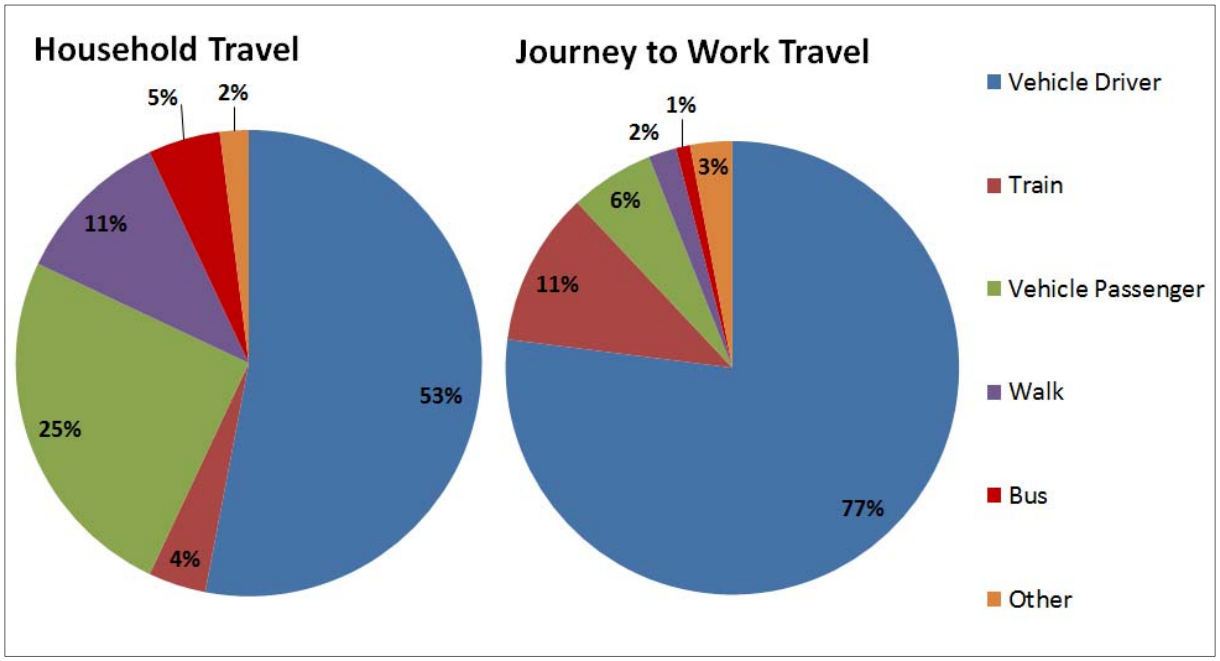

Figure 5 Existing Travel Patterns, North West Growth Area

Source: Bureau of Transport Statistics, 2014.
Other includes motorcycle, bicycle and mode not stated

The results indicate the significant majority of journey, irrespective of purpose, are made by private vehicle. Train travel accounts for 11% of total work trips, however this would be expected to increase following the completion of Sydney Metro Northwest (anticipated for 2019).

Walking and cycling account for low proportion of work related trips, household travel survey data indicates these modes account for a much higher proportion of household trips.

[1] Based on travel zones within the North West Growth Area
[2] Based on travel information for residents in the Blacktown LGA

3.2 Road Network

The existing road network supporting the Vineyard precinct, as well as potential future road infrastructure upgrades, is outlined in Figure 9. Details of key roads serving the precinct are described below.

3.2.1 Windsor Road

Windsor Road forms the primary access route into the precinct, running through the middle of the site. It is classified as a sub-arterial road, with two traffic lanes in each direction with provision of a third lane for right turn vehicles at certain intersections. East of Commercial Road (at Rouse Hill town centre) Windsor Road widens to three lanes in each direction, reflecting the increasing traffic demands at this location.

Photograph 1 Windsor Road

3.2.2 Boundary Road

Boundary Road is an unclassified regional road under the control of Hawkesbury and the Hills Shire Councils, currently configured with one traffic lane in either direction. Running along the southern edge of the site, Boundary Road forms a primary access route into both the Vineyard Precinct and the adjacent Box Hill and Box Hill North precincts (located within The Hills Shire Council).

Figure 6 Boundary Road

3.2.3 Bandon Road

Bandon Road is a two lane road which provides a level crossing of the Richmond Railway line. It is classified as a local road, and is located at the border of the Vineyard and Riverstone West precincts.

Figure 7 Bandon Road

3.2.4 Schofields Road

Schofields Road, at the southern edge of the North West Growth Area, was recently upgraded between Windsor Road and Tallawong Road to provide two traffic lanes in both directions. Further work along this road corridor is currently being carried out which will provide for a four lane divided road corridor along the full length of Schofields Road between Windsor Road and Richmond Road.

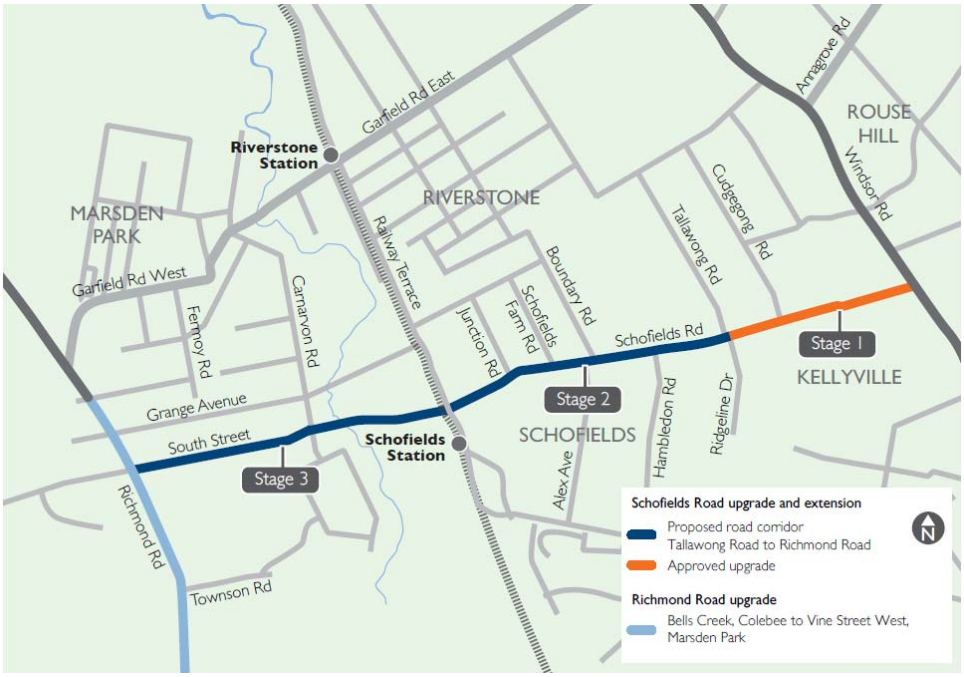

Figure 8 Schofields Road Upgrade

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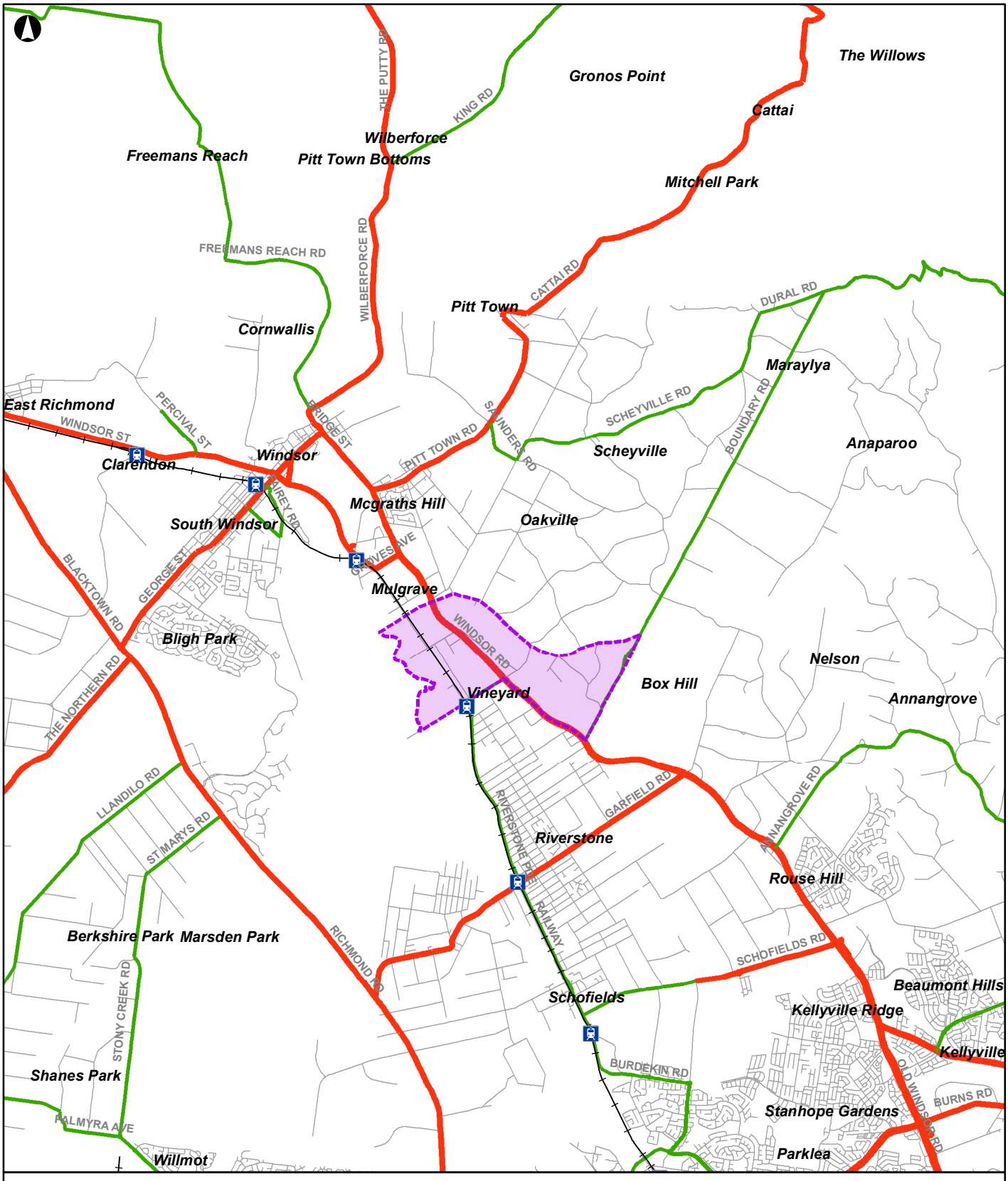

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Legend

Roads

- State Roads
- Regional Roads

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Level 10 | 201 Kent Street
Sydney NSW 2000

Job Title
Vineyard Precinct Transport Study

Client
Department of Planning and Environment

Issue	Date	By	Chkd	Appd
D1	2015-06-23	RW	JM	AH

Kilometres

0 0.5 1 2 3 4 5

Existing Road Network Vineyard Precinct

Scale at A4
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Job No	Drawing Status
234974-00	**Preliminary**

Drawing No	Issue
Figure 9	**D1**

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3.3 Traffic Volumes

Surveys were undertaken in March 2014 to understand the existing level of traffic in the vicinity of the Vineyard precinct and the wider NWGA. Intersection counts and seven day automated counts were undertaken a total 19 locations in the area as illustrated in Figure 10. These counts were used to calibrate and validate the traffic model developed for this study, further outlined in Section 5.

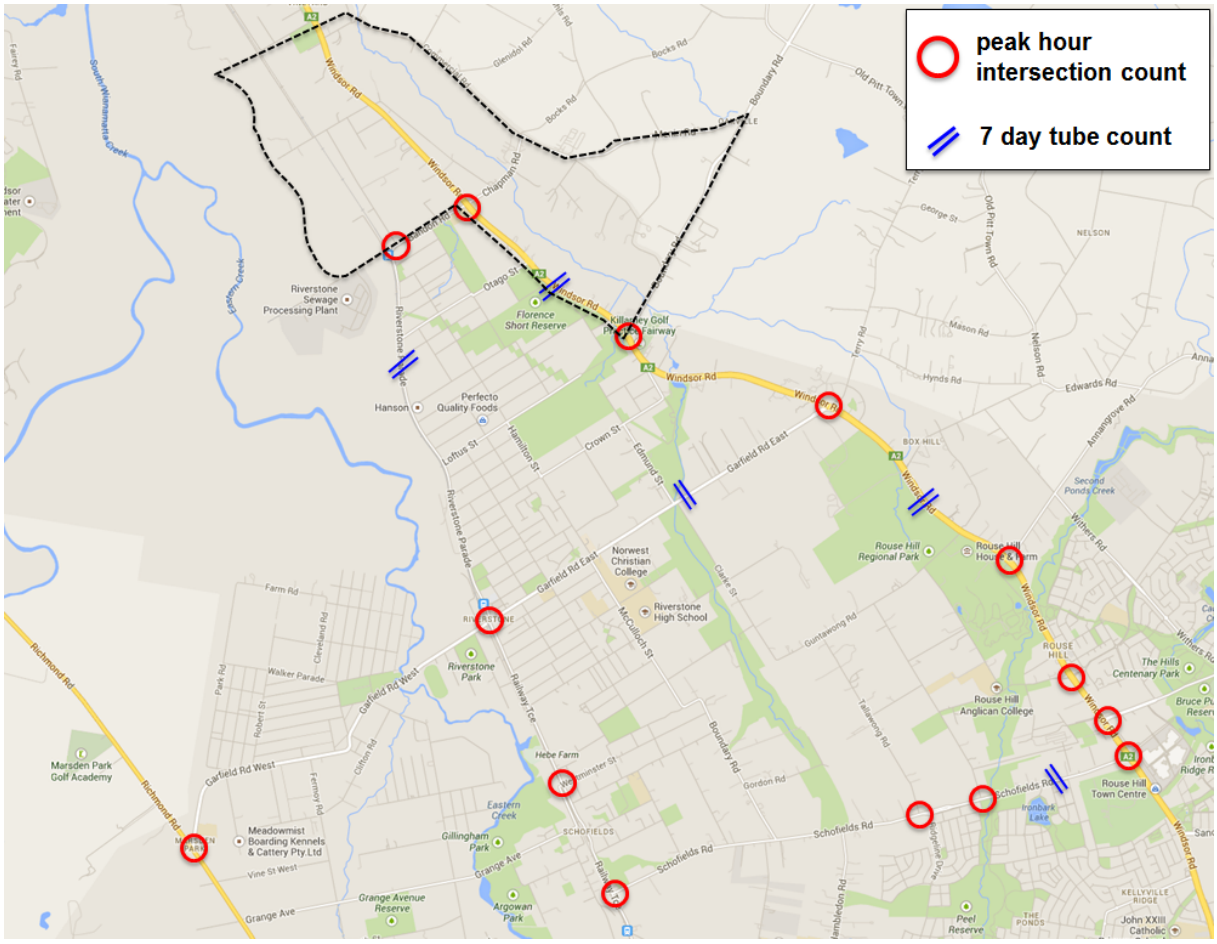

Figure 10 Traffic Survey Locations

The results of the surveys are shown in Figure 11 on the following page and indicate Windsor Road carries the majority of traffic in the precinct. Traffic volumes on Windsor Road progressively increase from north to south, attributable to the more densely developed areas around Rouse Hill and The Ponds.

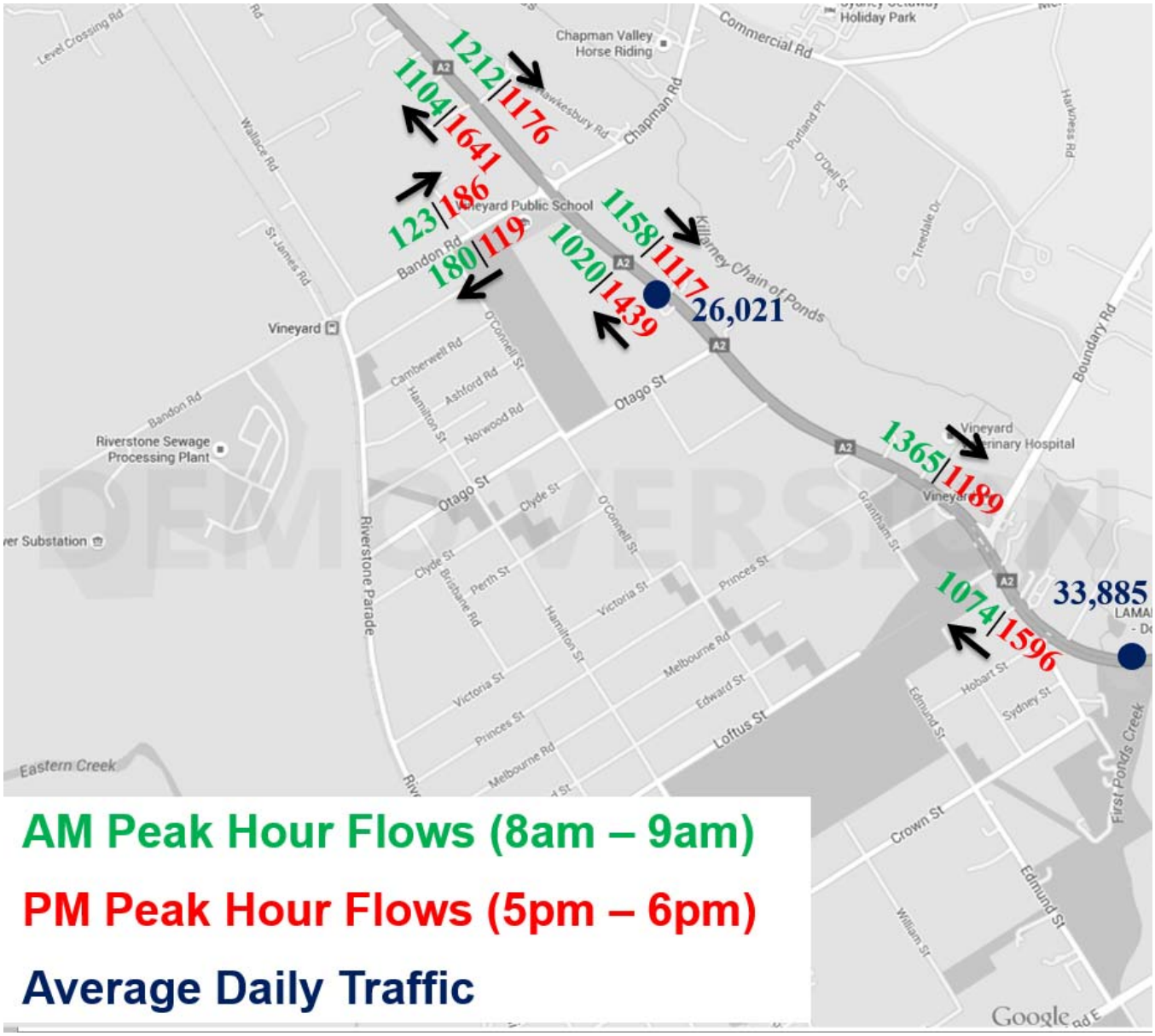

Figure 11 Existing Traffic Volumes

3.4 Heavy Vehicles

Traffic surveys conducted for this study identified the existing level of heavy vehicles utilising key roads supporting the study area. Key findings from the surveys, with respect to heavy vehicle traffic, were as follows:

- Heavy vehicles currently account for approximately 14% of all vehicles utilising Windsor Road adjacent to the precinct.
- 12% of traffic (approximately 1,100 vehicles per day) were identified as heavy vehicles along Garfield Road (within the Riverstone East precinct). This is a significant number and reflects the current function of Garfield Road as the predominant east-west link between Windsor Road and Richmond Road.
- On Riverstone Parade to the south of the study area, 16% of all vehicles surveyed were identified as heavy vehicles. This reflects the number of light industrials uses in this area and relatively low number of local residents.

The outcomes of the surveys with respect to heavy vehicles are illustrated in Figure 12.

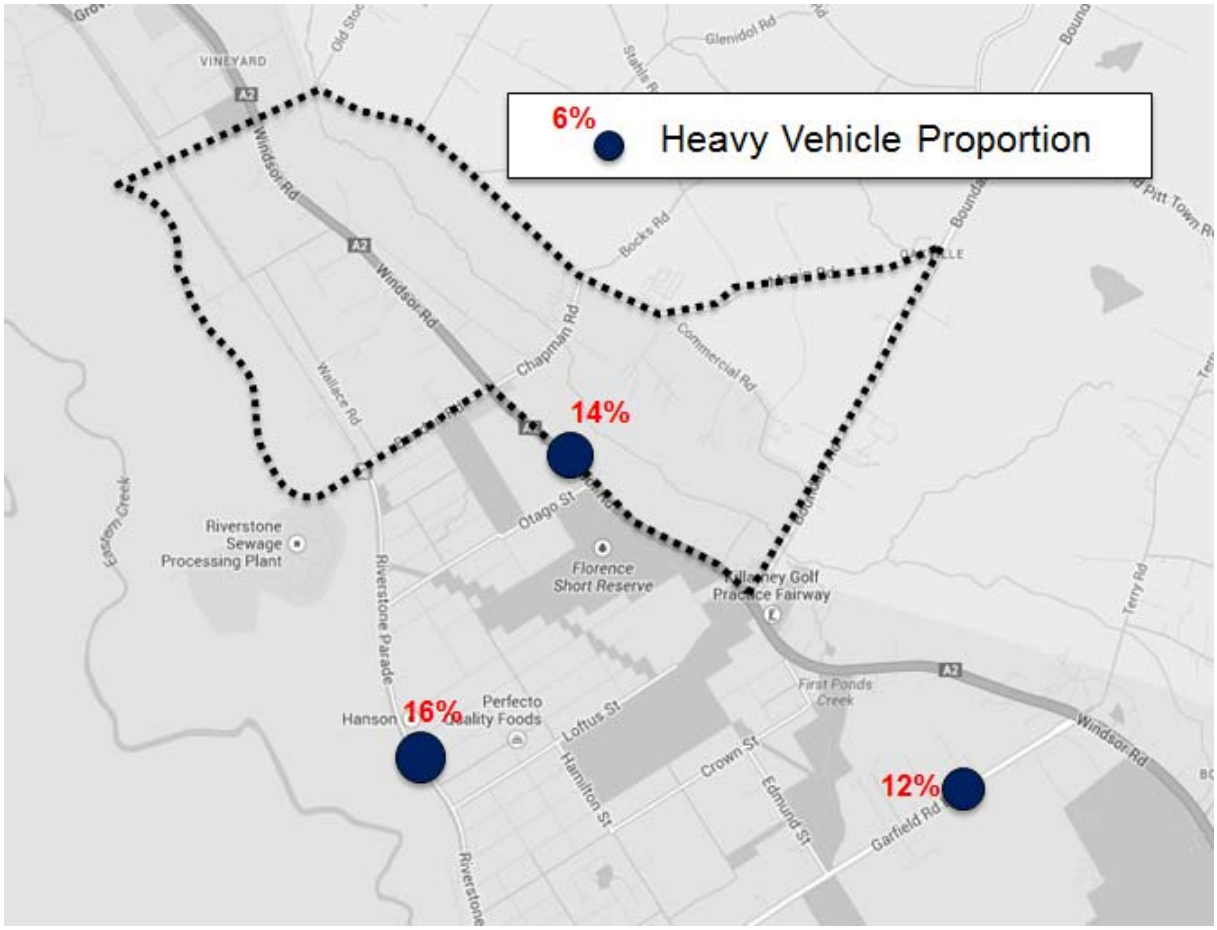

Figure 12 Existing Heavy Vehicle Proportions

The relatively high numbers of heavy vehicles on local roads within the Vineyard Precinct is largely the result of the light industrial uses focused to the east of Windsor Road. A major generator of heavy vehicle traffic is White Prince Mushrooms, located at 61 Wallace Road (Figure 13). The Mulgrave Industrial Precinct to the north of Vineyard also generates a significant number of truck movements on a daily basis.

Figure 13 Vehicle entrance to White Prince Mushrooms
Source: Google Street View, 2014

3.5 Rail Services

3.5.1 Richmond Rail Line

The Vineyard precinct is currently served by the Richmond railway line, a branch of the main western line. The Richmond Line currently provides access to key centres located throughout Sydney via both direct links and onward connections. A summary of the existing services along the Richmond Line is shown in Table 1.

Table 1 Existing services along the Richmond rail line

Departing Station	**Direction**	**Average Frequency of Services (Weekday)**		
		AM Peak (7am – 9am)	PM Peak (4pm – 6pm	Off Peak (10am – 3pm)
Vineyard	Northbound	30 minutes	30 minutes	30 minutes
	Southbound	30 minutes	30 minutes	30 minutes
Schofields	Northbound	20 minutes	15 minutes	15 minutes
	Southbound	12 minutes	15 minutes	15 minutes

In 2011 a duplication of the rail line was completed between Quakers Hill and Schofields, including the opening of the new Schofields Station. This duplication has allowed for more frequent train services travelling to and from Schofields. The new station at Schofields includes 230 park and ride spaces and a new bus interchange servicing residents of the North West Growth Area.

A second stage of the project includes a new and relocated Vineyard station and an upgrade of the existing Riverstone Station. This second stage of the project is not presently proceeding, however the planning of the Riverstone Precinct considered a new station location at Vineyard.

3.5.2 Sydney Metro Northwest

Sydney Metro Northwest (previously the north west rail link), scheduled for completion in 2019, will deliver eight new railway stations to Sydney's North West, providing a connection into Chatswood and the CBD. Passenger will be provided with rail services every 5 minutes during peak periods and every 10 minutes across the day.

The rail line will connections between the NWGA and major destinations such as Norwest, Castle Hill, Macquarie Park, Chatswood, North Sydney and the Sydney CBD.

Future residents of the North West Growth Area will be provided with a high quality rail interchange via a new station at Cudgegong Road. Located between Tallawong Road and Cudgegong Road, the new station will provide for 1,000 commuter car parking spaces and space for 6 buses. The station design will include pedestrian linkages to these areas as well as secure parking and storage for up to 45 bicycles. The station layout is shown in Figure 14.

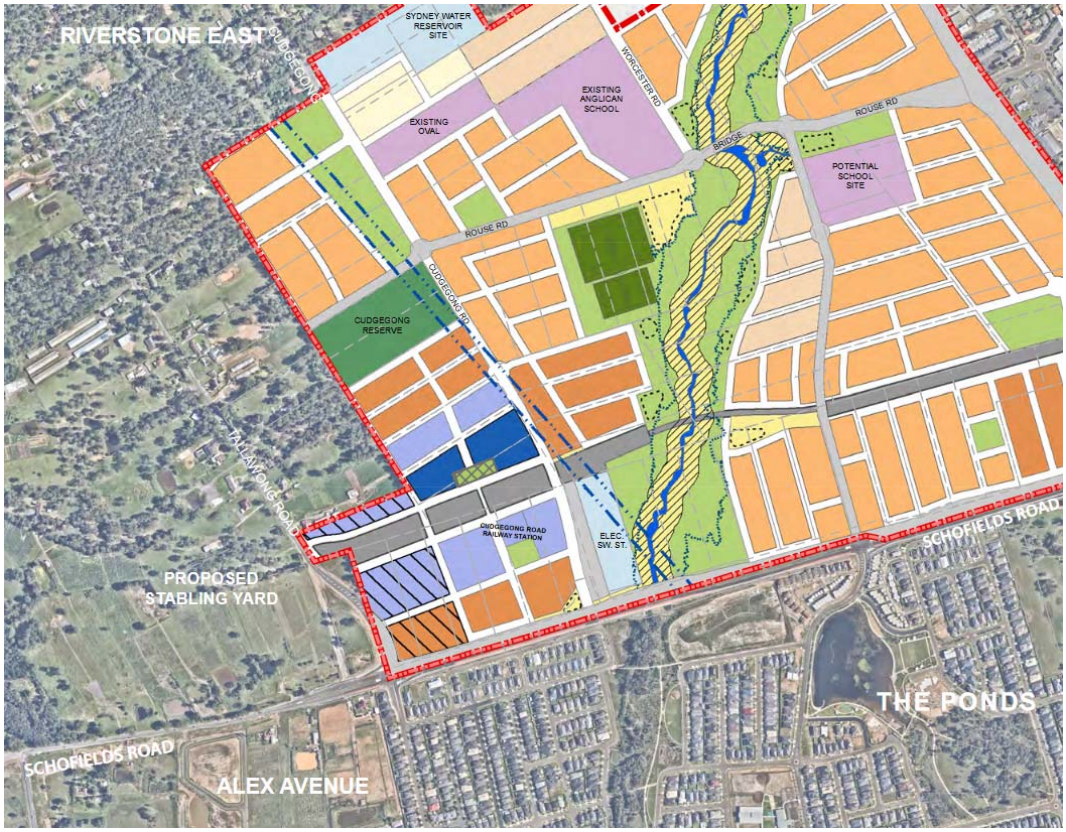

Figure 14 Cudgegong Road Station Layout

An overview of the proposed link is shown in Figure 15

Figure 15 Sydney Metro Northwest

Source: Transport for NSW, 2016

3.6 Bus Services

Due to the current low level of development, there are currently limited bus services within the vicinity of the Vineyard precinct. These typically run at low frequencies throughout the day, and include the following routes:

- **Route 608**: Windsor to Rouse Hill (via Windsor Road)
- **Route 661**: Windsor to Riverstone via McGraths Hill (via Commercial Road and Crown Street)
- **Route 662**: Riverstone to Maraylya and Oakville (via Boundary Road)
- **Route 663**: Windsor to Wisemans Ferry via Pitt Town
- **Route 746**: Riverstone to Box Hill (via Crown Street and Windsor Road)
- **Route 752**: Blacktown to Rouse Hill via Quakers Hill & The Ponds
- **Route 757**: Mt Druitt to Riverstone via Rooty Hill Rd North & Marsden (via Richmond Road to Riverstone Station)
- **Route T75**: Blacktown to Rouse Hill and Riverstone (via Schofields Road, Tallawong Road and Cudgegong Road)
- **Route T74**: Blacktown to Riverstone via The Ponds (via Burdekin Road and Railway Terrace)

A summary of the existing bus routes in the vicinity of the Vineyard precinct are illustrated in Figure 16 on the following page.

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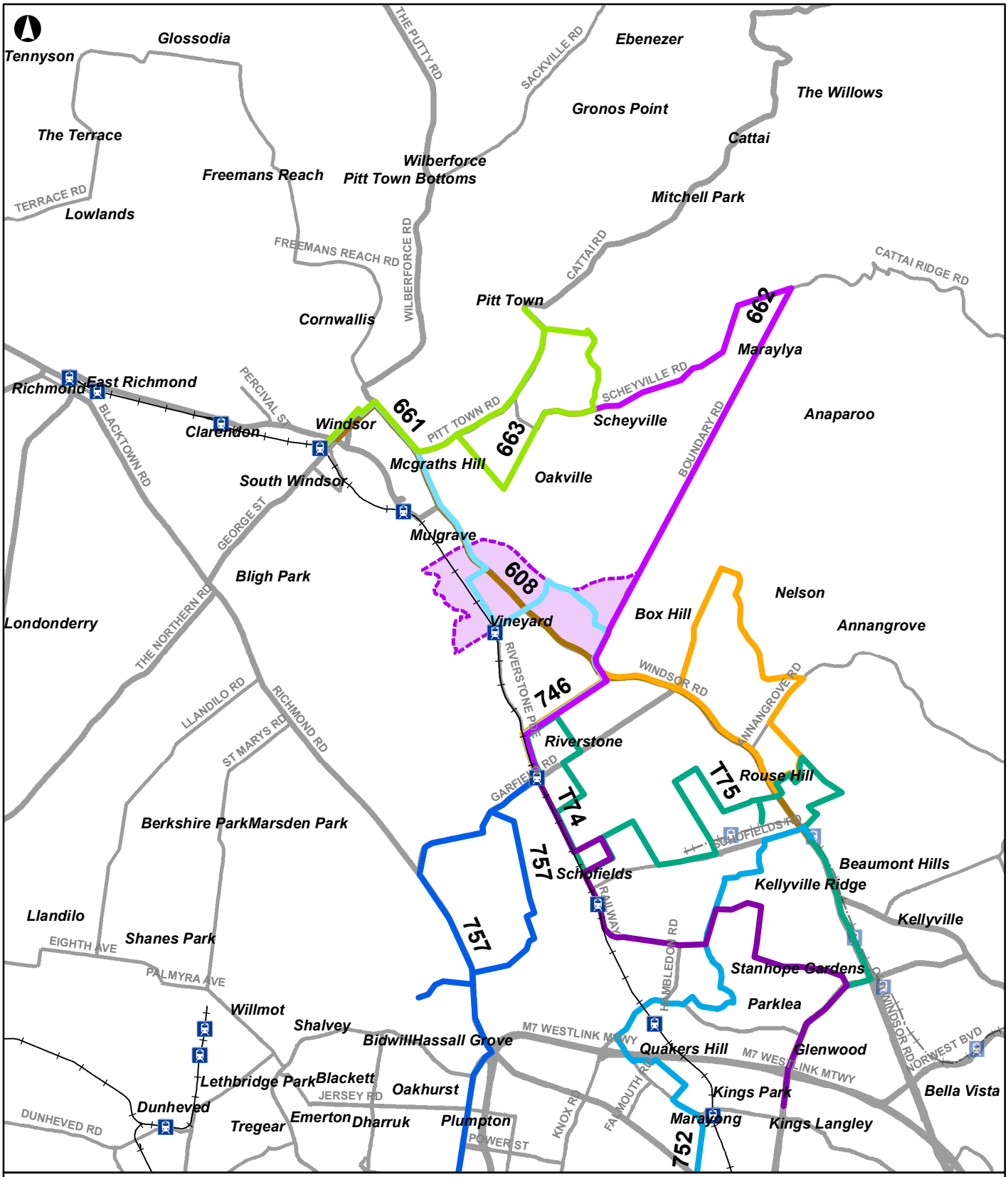

Legend

Bus_Routes_Existing

Existing Bus Routes

- 608
- 661
- 662
- 663
- 746
- 752
- 757
- T74
- T75

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Sydney NSW 2000

Job Title
Vineyard Precinct Transport Study

Client
Department of Planning and Environment

Issue	Date	By	Chkd	Appd
F1	2015-06-17	RW	JM	AH

Kilometres
0 0.5 1 2 3 4 5

Existing Bus Routes Vineyard Precinct

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Job No	Drawing Status
234974-00	**Preliminary**

Drawing No	Issue
Figure 16	**F1**

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3.7 Walking and Cycling

Due to the current undeveloped, primarily rural nature of Vineyard, existing pedestrian and cycling routes and facilities within and surrounding the precinct are limited.

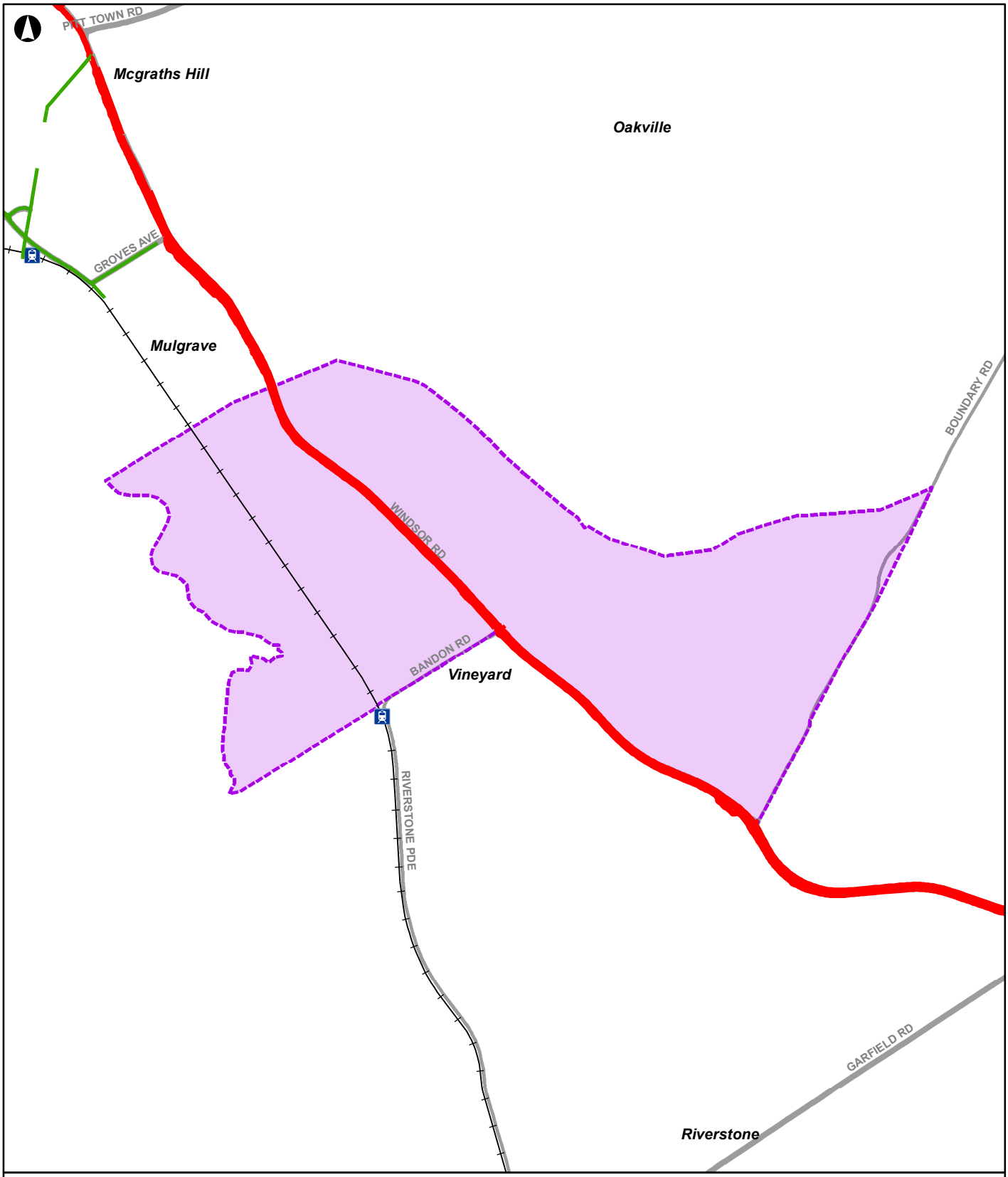
Pedestrian crossing facilities are provided at signalised intersections of Windsor Road at Park Road, Bandon Road and Boundary Road. It is uncommon for streets in the precinct to contain footpaths, with the majority of streets simply consisting of unpaved verged / road shoulders.

A shared pathway is provided on the western side of Windsor Road which facilitates regional cycling movements. Regional cycling links are also provided on the surrounding network, including cycle lanes on the M7 Motorway and on-road cycle lanes on Quakers Hill Parkway.

No dedicated cycle facilities are provided on local roads in the Vineyard precinct. To the south there are a number of roads classified as cycle routes, however include no dedicated bicycle facility and are generally only appropriate for confident riders.

A summary of the existing off-road bicycle paths in the vicinity of the study area is shown in Figure 17 on the following page.

A4



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Legend

Off-road Cycleways

- Local Cycleways
- Regional Cycleways

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Job Title
Vineyard Precinct Transport Study

Client
Department of Planning and Environment

Issue	Date	By	Chkd	Appd
F1	2015-06-23	JT	JM	AH

Kilometres
0 0.5 1

Existing Bicycle Network

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Job No	Drawing Status
234974-00	**For Issue**

Drawing No	Issue
Figure 17	**F1**

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4 Precinct Planning Principles

This following section presents the overall principles and objectives that contributed to the development of the proposed transport network for the Vineyard Precinct.

4.1 Transport Planning Objectives

In developing the preferred transport network, in conjunction with the precinct master planners, the following key transport objectives have been considered. These aim to provide for a coherent, legible transport network that supports movement both to, and within, the Vineyard precinct.

- Provide a road network that allows for good access to all modes of transport, particularly public transport, walking and cycling;
- Design a physical site layout which encourages walking and cycling, particularly to key land uses and public transport nodes;
- Ensure the road network for Vineyard provides suitable connections to adjacent development precincts in the North West Growth Area;
- Integrate transport and land use planning so that high intensity land uses have strong accessibility to public transport;
- Provide high quality access to public transport stops to reduce the dependence on private vehicles. Future residents of Vineyard should be located within at least a 400m radius of a bus stop;
- Develop an appropriate road hierarchy which provides adequate carrying capacity on higher order roads to meet reasonable community expectations; and
- Protect residential areas from through traffic intrusion, particularly heavy vehicles.

4.2 Road Classification and Capacity

Guidelines for road network design can be allocated into three main categories:

- Road classification (road hierarchy) – how will traffic move through the precincts and are roads designed to accommodate particular function in mind?
- Road capacity – are adequate lanes provided on the streets to accommodate traffic without significant congestion?
- Intersection performance – are delays at intersections acceptable?

The Growth Centres Development Code (Growth Centres Commission, 2006) classifies the hierarchy based on anticipated levels of daily traffic as summarised in Table 2. The classification of each road will dictate its physical form (i.e. number of lanes, road reserve width), function (what types of vehicles utilise the road) and the speed limit.

Table 2 Functional Classification of Roads

Road Type	AADT*	Functions and Connections	Speed Limit
Arterial/ Freeway	>35,000	Connects large urban areas	80km/hr +
Transit Boulevard	30,000 – 35,000	Located close to centres, Pedestrian friendly environment Allows for long term upgrades and dedicated busways	60 - 80km/hr
Sub-Arterial	10,000 – 35,000	Arterial roads to town centres Carries major bus routes	Up to 70km/hr
Collector	3,000 – 10,000	Connects neighbourhoods Can accommodate public transport	Up to 60km/hr
Local	1,000 – 3,000	Priority to pedestrians and cyclists Designed to slow residential traffic	Up to 50km/hr

* Annual Average Daily Traffic

4.3 Road Cross Sections

Typical road corridor cross sectional design requirements for future urban development have been determined as a standard to be adopted throughout the NWGA. They are summarised in Table 3.

Table 3 GCC Standard Road Types and Road Corridor Widths

Road Type	Traffic Load (Vehicles/Day)	Road Corridor Width	Road Carriageway Lanes, Number and Width
Arterial Road	35,000 +	To be determined by the RMS	To be determined by the RMS
Sub Arterial Road	10,000-35,000	35 metres	4 Lanes divided, 1*2.5m shared path and 1*1.5m footpath
Collector Road	3,000-10,000	20.8 metres	4 traffic lanes (13 metres carriageway)
Local Road	1,000-3,000	16 metres	9 metres

In general all future road cross sections, as summarised in Table 3, should be reviewed at the precinct master planning Development Control Plan (DCP) stage to minimise any un-necessary “land take” requirement.

4.4 Heavy Vehicles

As identified in Section 3.4, heavy vehicles presently comprise a significant proportion of total traffic through the precinct. The ILP for Vineyard should aim to minimise heavy vehicle intrusion to enhance the amenity of the area. Measures to achieve this objective include:

- Introducing load limits on certain roads within the precinct (buses excepted);
- Restricting certain left turn movements from Windsor Road into the precinct for vehicles over 9m; and
- Providing advisory signposting that requires that heavy vehicles use major arterial routes such as Windsor Road and Schofields Roads.

4.5 Public Transport Provision

For new precincts within the NWGA, where private vehicles historically dominated the transport landscape, it is vital that strong public transport linkages are provided at an early stage when new residents establish their travel habits. As illustrated in Figure 5, private vehicles are the dominant mode of travel in the NWGA. Reducing this dependence on private vehicles must form one of the key objectives of this transport study.

Local bus routes should be planned so that they run through the core of the precinct, as opposed to along arterial roads with poor pedestrian connectivity. This provides a higher level of public transport accessibility to future residents of Vineyard. Regional bus routes should be provided which allow more direct, time efficient services to key regional centres such as Rouse Hill and Blacktown. A number of local bus services would also service stations on Sydney Metro Northwest to encourage multi-modal public transport trips.

Adequate facilities will need to be provided for public transport users to encourage a mode shift away from private vehicles. This includes infrastructure items such as bus shelters, waiting areas and other bus priority measures. The provision of a good quality, permeable footpath network will be critical in ensuring users are able to easily access public transport stops.

Land use planning will also play a vital role in facilitating increased use of public transport. High density developments should be located close to public transport nodes as these will be the areas where the highest mode shares to public transport will be achieved. Consideration should also be given to major pedestrian attractors such as schools and their proximity to the public transport network. Streets and roads containing public transport stops should be activated wherever possible to enhance the amenity and attractiveness for pedestrians waiting for services.

4.6 Walking and Cycling

Walking and cycling will play an important role in meeting the future transport needs of the Vineyard precinct. Providing a mix of uses within the precinct, in close proximity to the village centre, will promote the use of sustainable travel modes.

It is important walking and cycling routes are integrated with those provided in adjacent growth centre precincts and regional cycle routes such as the Windsor Road shared path and Westlink M7 cycleway. Linkages to major land uses such as schools, retail and public transport nodes should also form a key consideration when planning pedestrian and cycle routes.

4.6.1 Pedestrian Connectivity

Footpaths should be provided on both sides of the road carriageway in accordance with the standard road cross sections described in Section 4.3. Appropriate pedestrian crossing facilities should be incorporated at intersections and along key desire lines to ensure safe and efficient pedestrian movements. Signalised intersections should provide crossing legs on all approaches, while pedestrian refuges should be integrated in the design of any roundabout within the precinct. Associated infrastructure such as pram ramps and bike lanterns at all traffic signals should be installed

Bus stops should be located to allow for good pedestrian accessibility. Where possible, stops should be positioned close to traffic signals or alternative safe pedestrian crossing facilities (e.g. pedestrian refuges, zebra crossings). Adequate shelter and seating should be provided, particularly to service less mobile users.

4.6.2 Cycling

The NSW Bicycle Guidelines (Roads and Traffic Authority, 2003) summarises the needs and requirements of bicycle users by the following five design principles:

- **Safety**: A good quality route enhances the safety of all users, including cyclists, pedestrians and motorists. Streets and intersections along key bicycle routes should be designed to a standard which incorporates cyclist movements.
- **Coherence**: The bicycle network should link popular destinations with local residential streets via a mix of both local and regional routes. The network should be continuous and easily identifiable to both novice and experienced cyclists.
- **Directness**: Bicycle routes should be as direct as possible, having consideration for major barriers such as road intersections and steep topography. The rider should ideally be able to maintain a safe and comfortable consistent riding speed throughout their journey.
- **Attractiveness**: The bicycle network must be designed so that it complements and enhances its environment in such a way that cycling is attractive. Clear and strategically placed wayfinding information should indicate distances and times to major destinations.
- **Comfort**: Bicycle routes must be comfortable and easy to use for all cyclists. Depending on the road environment and topography, some level of separation (e.g. clearly marked bicycle lanes, painted green) may be required.

Shared pedestrian/cycle paths (minimum 3m wide) are recommended to be provided along one side of major roads (roads with forecast future traffic volumes of over 10,000 vehicles per day), as well as roads serving certain land uses including schools and open space areas. Shared paths act a safe, convenient bicycle facility where physical separation between cyclists and vehicles is necessary on roads with high vehicles speeds and volumes.

Directional signage should be installed to improve connectivity and wayfinding, with regulatory signs and lines to be installed as per NSW Bicycle guidelines. Street lighting along cycleways should be considered in reserve areas

Bicycle parking facilities should be provided at key destinations (e.g. train stations, village centres and major developments) to accommodate the needs of both short and long term cyclists. Parking for short stay cyclists should be provided in areas with passive surveillance - if the parking is visible it will be perceived as more secure and achieve greater utilisation. Parking for long stay cyclists should be in secure, lockable facilities which provides weather protection and conveys a sense of high priority for the treatment of riders.

5 Road Network Assessment

This section provides an assessment of the future road network that will support the development of the Vineyard precinct and meet future traffic demands. It also evaluates the performance of key intersections within the precinct during the critical commuter peak hours. This assessment has informed the master planning team in the development of the draft ILP for the precinct.

5.1 Assessment Criteria

5.1.1 Road Capacity

Mid-block capacity requirements (for interrupted flow conditions) for roads supporting the Vineyard precinct have been based on Austroads Guide to Traffic Management[3]. These are outlined in Table 4.

Table 4 Mid-Block Capacities of Urban Roads

Lane Type		**One-way mid-block capacity (veh/hour)**
Median or inner lane	Divided road	1,000
	Undivided road	900
Middle lane	Divided road	1,000
	Undivided road	900
Kerbside lane	Adjacent to parking lane	900
	Occasional parked vehicles	600
	Clearway conditions	900

Based on the mid-block capacities outlined above, in conjunction with future traffic volumes, roadway levels of service of service can be determined. This is summarised in Table 5 on the following page (as outlined in Austroads Guide to Traffic Management[4]).

[3] Part 3: Traffic Studies and Analysis, Section 5.2.1, Table 5.1
[4] Part 2: Roadway Capacity

Table 5 Roadway levels of service definition

Level of Service	Volume / Capacity Ratio	Description (interrupted flow conditions)
A	0.00 to 0.34	Primarily free flow operations at average travel speeds
B	0.35 to 0.50	Reasonably unimpeded operations at average travel speeds
C	0.51 to 0.74	Stable operations; however, ability to manoeuvre and change lanes in mid-block locations may be more restricted
D	0.75 to 0.89	Small increases in flow may cause substantial increases in delay and decreases in travel speed.
E	0.90 to 0.99	Significant delays and average travel speeds of 33% of the free flow speed or less
F	>1.00	Characterised by urban street flow at extremely low speeds. Intersection congestion is likely at critical signalised locations

5.1.2 Intersection Capacity

The performance of intersections in an urban environment is measured in terms of its Level of Service (LoS). Levels of service ranges from A (very good) to F (over capacity with significant delays). This is described in the RTA Guide to Traffic Generating Developments as summarised in Table 6. In peak hours at intersections controlled by traffic signals on key regional and arterial routes, a Level of Service D is generally acceptable.

Table 6 Intersection level of service

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

5.2 Traffic Generation

Traffic generation estimates for the precinct have been sourced from the recently updated Roads and Maritimes (RMS) '*Guide to Traffic Generating Developments*'. These rates are summarised Table 7 below.

Table 7 Traffic generation rates

Land Use	**Traffic Generation Rate (vehicles / hour)**	
	AM Rate (8am – 9am)	**PM Rate (5pm – 6pm)**
Large lot residential	0.99 / dwelling	0.95 / dwelling
Low density residential	0.99 / dwelling	0.95 / dwelling
Medium density residential	0.50 / dwelling	0.50 / dwelling
High density residential	0.19 / dwelling	0.15 / dwelling
Commercial (office)	1.6 / 100^2 GFA	1.2 / 100^2 GFA
Retail	1.94 / 100^2 GFA	9.84 / 100^2 GFA
Business Park / Light Industrial	0.52 / 100^2 GFA	0.56 / 100^2 GFA

5.3 Land Use Assumptions

The trip generation assumptions used for the traffic modelling was informed by the land uses incorporated in a preliminary master planning team and economic feasibility study undertaken by the wider project team for the Vineyard precinct. Population and employment forecasts for the wider North West Growth Area area were adopted from current estimates provided by the Bureau of Transport Statistics (BTS), following consultation with the DP&E.

For the Stage 1 and ultimate development of the Vineyard precinct, the following land uses have been assumed.

Table 8 Vineyard precinct dwelling assumptions

Dwelling type	**Stage 1 development (dwelling range)**	**Ultimate development**
Large lot / environmental living	93	557
Low density	1470-1764	2877
Medium density	380-570	605
Total	**2,400 (max)**	**4,039**

In addition, the ultimate development may include 1,100m^2 retail floor space (within a village centre) and 1,200m^2 non-retail floor space

The traffic modelling undertaken for this study has considered the traffic generated from the ultimate development of the Vineyard precinct and other precincts in the North West Growth Area.

5.4 Traffic Distribution

The future year trip tables, produced by BTS, have been developed from a 4-step travel model based on forecast population, employment and the transport network. Generally, the traffic distribution utilised in the NETANAL modelling for the future year trip tables of the Sydney Metropolitan Region has been retained from the BTS trip matrices.

Route selection is determined on the basis of the shortest travel time or cost, considering the inherent route delays incurred along possible link.

5.5 Road Network Hierarchy

The road network hierarchy supporting the Riverstone East precinct has been developed based on the future traffic demands arising from the development of the area, consistent with the transport planning objectives outlined in Section 4.1 of this study.

Bandon Road Corridor

The RMS has developed a strategy for the provision of grade-separated road crossings across the Richmond rail line. The locations of the new road crossings were selected following detailed traffic modelling, consultation with key stakeholders and community feedback.

The strategy has identified Bandon Road as one of five suitable grade separated crossings of the Richmond railway line (north of the Quakers Hill Parkway). The RMS has noted that a crossing at Bandon Road was identified as a suitable option because:

- The area is flatter, which would be easier for vehicles to use.
- It would provide an additional route for heavy vehicles away from the Riverstone town centre. This was a community preference, expressed during consultation.
- It could be developed as part of the precinct planning currently being carried out by the Department of Planning and Environment for Vineyard and Marsden Park North precincts.
- It could directly connect to the already approved intersection at Richmond Road, reducing traffic congestion on Garfield Road West and creating an additional direct east-west connection between Windsor Road and Richmond Road.

The strategy has recommended an upgrade of Bandon Road (including an underpass of the Richmond railway line) which would provide a high quality road connection between Windsor Road and Richmond Road. This upgrade would be completed by the time the NWGA reaches approximately 25% of its population and employment development. This will provide connectivity for Vineyard residents and visitors travelling west of the railway line.

In addition, the strategy has recommended the construction of a grade separated crossing at Garfield Road, replacing the existing level crossing. This infrastructure would be delivered by the time the NWGA reaches approximately 75% of its population and employment development.

An overview of the Bandon Road and Garfield Road crossing alignments are illustrated in Figure 18.

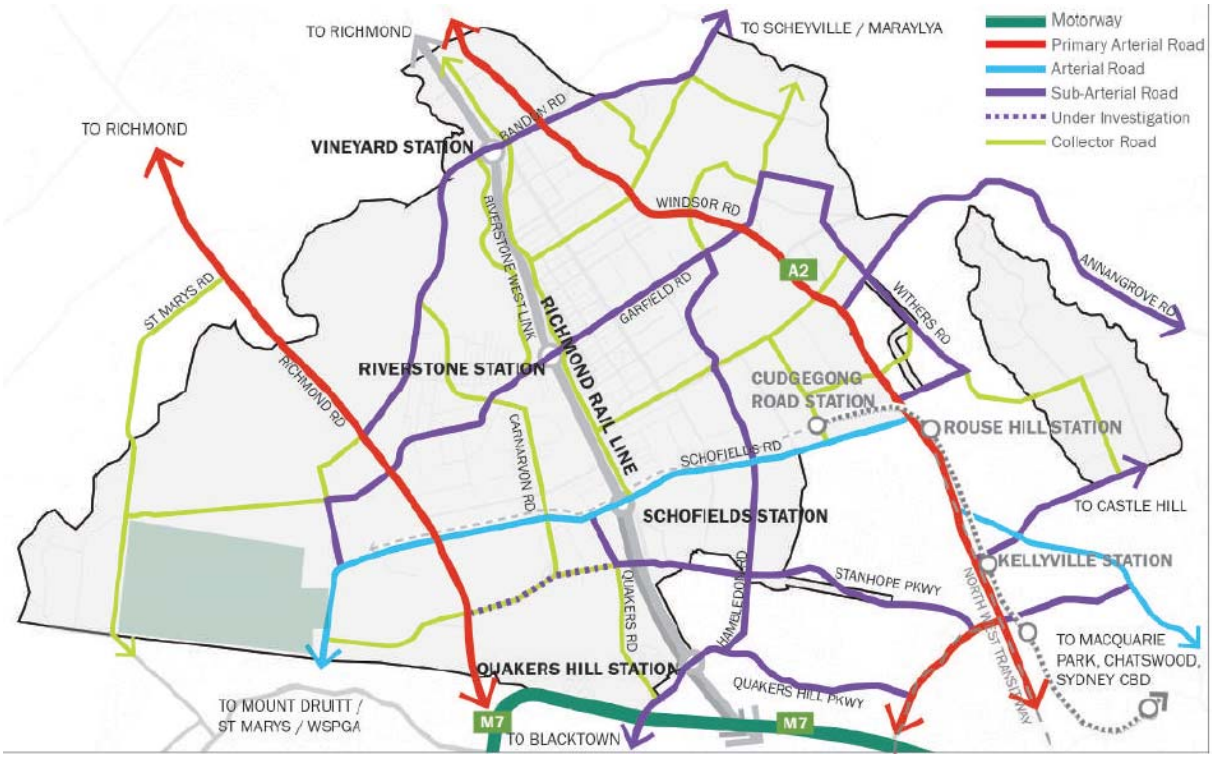

Figure 18 Road hierarchy and rail crossing alignments

Source: North West Growth Area structure plan review (Jacobs, 2017)

Access to residential precinct fronting Windsor Road

Vehicular access to the proposed residential precinct fronting Windsor Road within the Stage 1 development is constrained due to the presence of the riparian corridor to the east and a major state road to the west. Arup and the DP&E has undertaken consultation with Hawkesbury Council and the RMS in relation to providing the most suitable access locations to this precinct.

The preferred access strategy for the precinct fronting Windsor Road is illustrated in Figure 19. This involves two access points as follows:

- On Chapman Street through a new left in / left out intersection.
- Directly off Windsor Road through a new priority controlled intersection. The interim intersection layout would provide for both left in / left out movements, as well as right turn movements into the precinct from Windsor Road. The left in movement from Windsor Road would be supported by a deceleration lane into the precinct so as not to detrimentally impact traffic operations along Windsor Road.

  The ultimate intersection layout would provide for a signalised intersection which allows full traffic movements from Windsor Road, Otago Street and the new residential precinct.

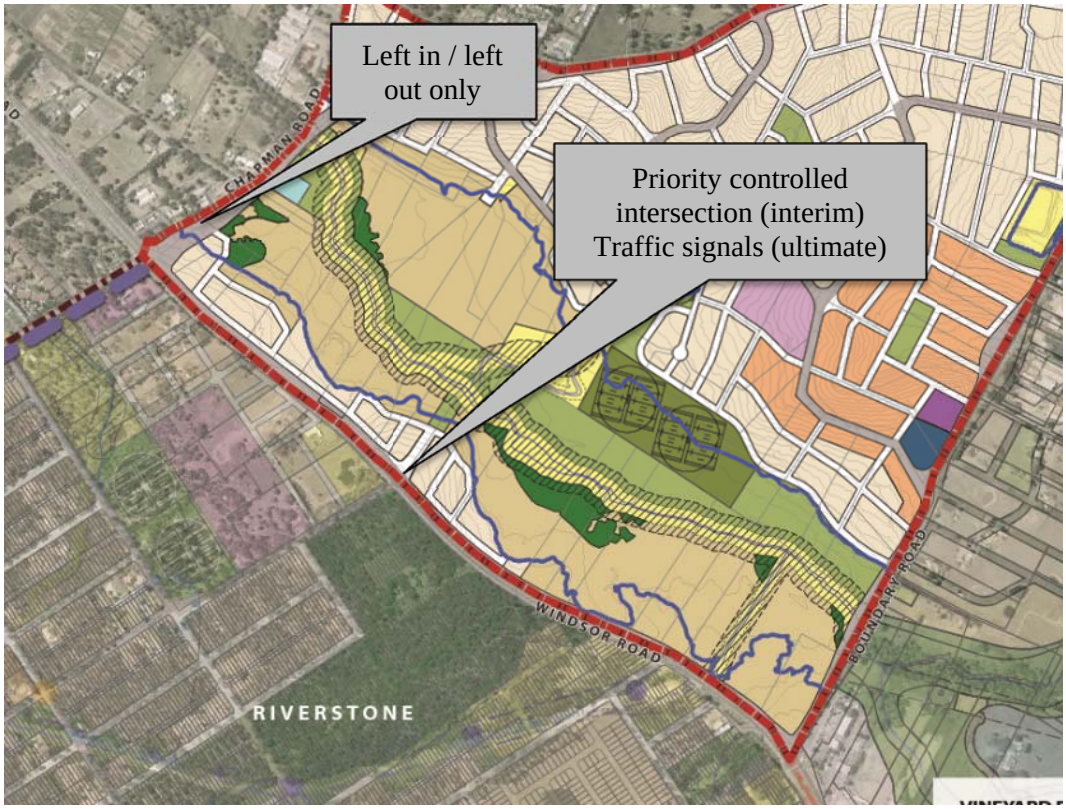

Figure 19 Proposed vehicular access to residential precinct fronting Windsor Road

Preferred Road Network Hierarchy

The preferred road network structure to support the full development of the Vineyard precinct as envisaged under the draft master plan is illustrated in Figure 20.

This network considers the functional road type as described in Section 4.2 to support the future land uses envisaged for the Vineyard precinct. It is consistent with previous road network planning for adjacent growth centre precincts and recent road upgrade works such as Schofields Road.

These routes provide connectivity to key town and regional centres, as well as major road links including Richmond Road and the M7 motorway. The existing roads within the Vineyard precinct will form the structure of the road network. The primary traffic routes (arterial and transit boulevards) serving the precinct include:

- Windsor Road; and
- Bandon Road (west of Windsor Road)

A number of existing internal roads have been identified for improvement and form the framework for the higher-order (sub-arterial / collector) road network. These roads will accommodate internal traffic, bicycle and pedestrian movements, and include:

- Boundary Road;
- Menin Road;
- Commercial Road; and
- Chapman Road.

Supporting this higher order road network will be a number of local roads which provide access into individual lots. These local roads would typically include traffic calming devices (e.g. raised thresholds, roundabouts) to reduce the instances of through traffic intrusion.

Roads and Maritime have advised of their intention to close the existing road level crossing at Level Crossing Road. The strategic model has excluded Level Crossing Road from the analysis, with existing traffic utilising the traffic redistributed either south to Bandon Road or north to Mulgrave Road.

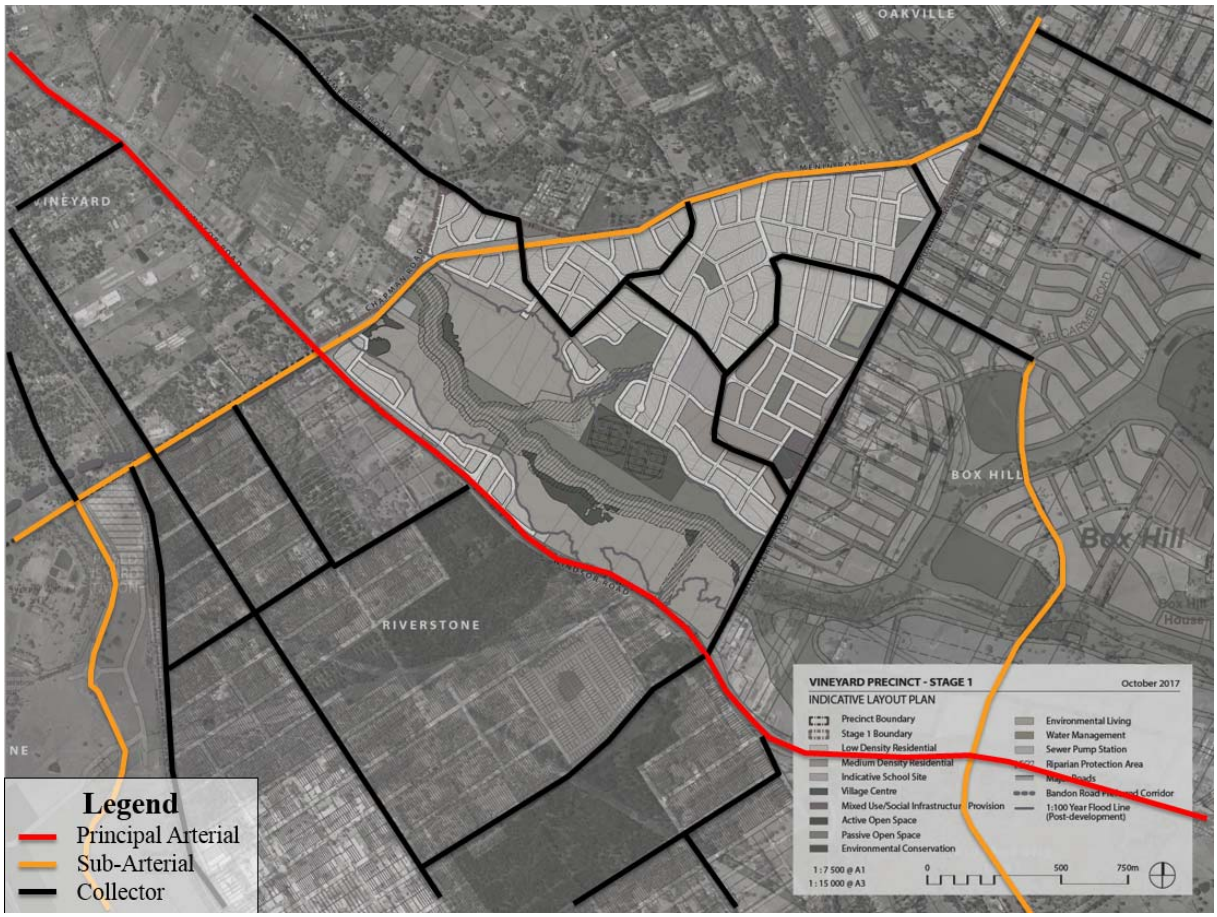

Figure 20 Vineyard Road Hierarchy

Stage 1 Road Network

To support the staged development of the precinct, Boundary Road will be upgraded to collector status between Windsor Road and Menin Road. In addition, Roads and Maritime is progressing with planning for the Bandon Road sub-arterial link (between Richmond Road and Windsor Road) to be extended through the Vineyard Precinct to meet Boundary Road, along Commercial Road and Menin Road.

This sub-arterial road will provide a key connection into the (maximum) 2300 dwellings within the Stage 1 Vineyard precinct via a number of new intersections. The layout and configuration of these intersections, including permissible turning movements, will be the subject of further detailed investigations as planning for the precinct progresses. At this stage the following intersections on the sub-arterial road are planned, as illustrated in Figure 21.

- Location 1: Left in / out intersection approximately 150m east of Windsor Road (priority control)
- Location 2: Left in / left out intersection immediately east of riparian corridor
- Location 3: All movements intersection at Commercial Road (major/controlled intersection)
- Location 4: All movements intersection at Stahls Road (major/controlled intersection)
- Location 5: Left in / left out intersection at Harkness Road
- Location 6: All movements intersection at realigned Boundary Road (major/controlled intersection)

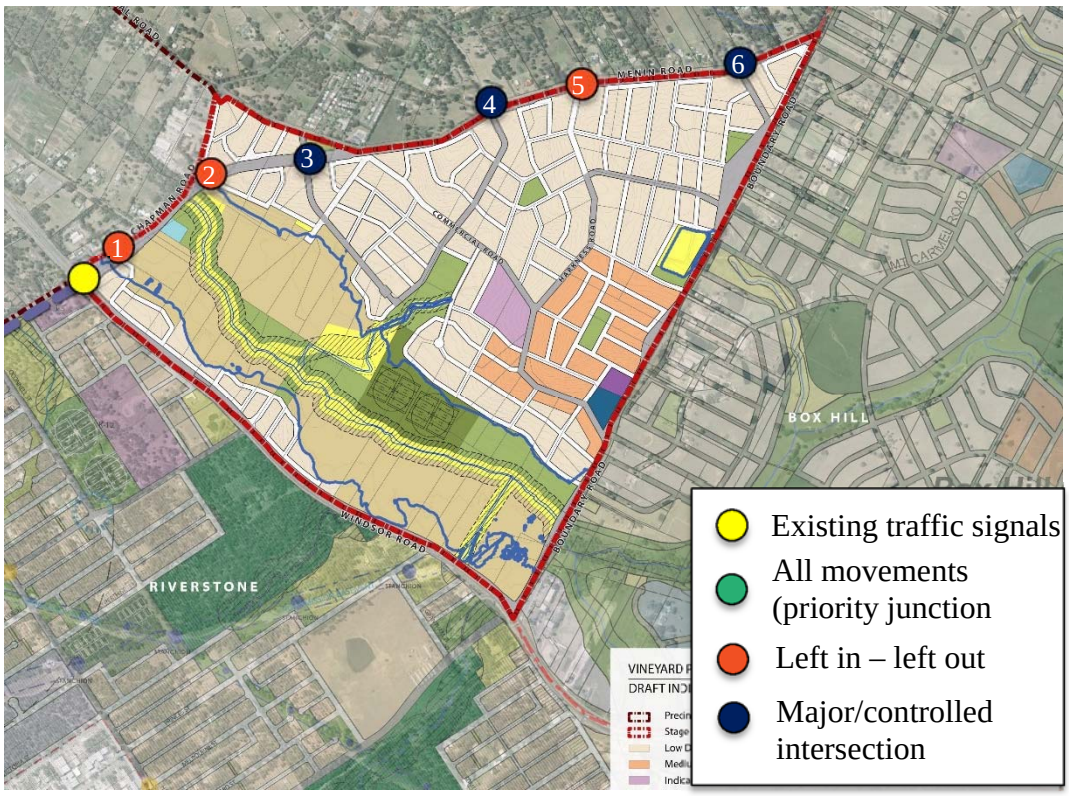

Figure 21 Planned intersections on sub-arterial

As a result of the road alignment at the intersection of the new sub-arterial / Menin Road / Box Hill collector road, it is proposed to realign Boundary Road to link with the new sub-arterial. The northern end of Boundary Road would be a cul-de-sac serving local traffic movements only. The realigned Boundary Road would connect with the sub-arterial at a new set of traffic signals.

Outside of these road upgrades, the existing road network is considered appropriate to support the level of development envisaged under the Stage 1 ILP for Vineyard. Complementary intersection will also be required to accommodate the additional traffic movements arising from the proposed development.

As the level of urban development in growth precincts adjacent to Vineyard (e.g. Box Hill) increases, the necessity to upgrade existing roads which lie outside the Stage 1 boundary will need to be reviewed.

5.6 Traffic Modelling

5.6.1 Strategic Traffic Modelling

A strategic transport network model has been developed for the NWGA, which utilises a NETANAL model set up for appraising the traffic generated by each of the precincts. It was also used to assess various ILP options in terms of identifying impacts associated with varying levels of generated traffic. This traffic model has been used as the basis to forecast future year traffic volumes in the vicinity of the Vineyard Precinct.

The model was calibrated utilising traffic data collected in March 2014 (as outlined in Section 3.3 of this document). Travel time surveys were also conducted to assist in the calibration process.

The NETANAL model utilises defined travel demand between travel zone pairs, represented as assimilated traffic movements, throughout the Sydney Metropolitan Area. The model incrementally assigns vehicular traffic onto a computer-based road network developing link demand forecasts on each modelled section of road. To be consistent with transport modelling undertaken for a number of key planning studies and documents, the year 2036 was taken as the design year for assessing network performance, with 2014 used as the base year.

The NETANAL modelling considers the cumulative impacts of the planned development within the North West Growth Area, including the recently rezoned Box Hill North precinct which is planned to contain 4,000 residential dwellings.

As part of the strategic transport model, travel zones (TZs) within Vineyard were structured using areas of the precinct delineated by road classification. This process assists in assigning generated traffic onto relevant parts of the network for each traffic zone.

A summary of the forecast traffic volumes for the future year 2036 at key intersections within the Vineyard precinct, extracted from the NETANAL model, is provided in Table 9.

Table 9 2036 Traffic Volumes Summary – Vineyard

Intersection	Approach	Approach Traffic Volumes	
		AM Peak Hour	PM Peak Hour
Windsor Road / Boundary Road	Windsor Road W	1,193	1,405
	Windsor Road E	1,264	1,296
	Boundary Road N	1,069	1,037
	Boundary Road S	320	664
Boundary Road / Commercial Road	Boundary Road E	626	1,359
	Boundary Road W	624	763
	Commercial Road N	664	367
	Commercial Road S	N/A	N/A
Boundary Road / Menin Road	Boundary Road E	574	681
	Boundary Road W	938	524
	Menin Road N	546	520
	Old Pitt Town Road S	410	1,105

5.6.2 Operational Modelling

The traffic volumes forecast in the strategic NETANAL model were extracted and inputted into local area intersection (SIDRA) models. It should be recognised however that since the development of the strategic model for Vineyard, a number of road network changes have been committed to or are still in planning. These include:

- The provision of a sub-arterial road link along the Bandon Road / Chapman Road / Menin Road corridor;
- The upgrading of Garfield Road to include an overpass of the Richmond Railway Line
- The planning for the Outer Sydney Orbital

Each of these projects will have a significant impact on traffic patterns and movements in the North West Growth Area, including the Vineyard Precinct. In particular, the Outer Sydney Orbital has the potential to significantly alter travel patterns for residents of the Vineyard precinct.

Given the continued planning for major road projects in the precinct, and the uncertainty regarding the alignment of the Outer Sydney Orbital, detailed operational traffic modelling has not been undertaken for the Stage 1 Vineyard Precinct. This modelling will be undertaken at a later date in consultation with Council, RMS and Transport for NSW.

At key intersections (i.e. the junction of collector / sub-arterial roads), traffic signals will generally required to manage the high traffic movements expected following the development of the area. Signalised intersections provide benefit not only with respect to traffic capacity but also to support pedestrian and bicycle movements across major roads.

The RMS has specific requirements relating to vehicular and pedestrian volumes where it will consider the installation of traffic signals at an intersection. These are commonly referred to as signal warrants. Section 2 of the RMS Traffic Signal Design Manual outlines five different warrants for the installation of traffic signals at intersections. These are summarised in Table 10.

Table 10 Warrants for Traffic Signals at Intersections

Warrant	Requirements
Traffic Demand	For each of the four one-hour periods of an average day: (i) The major road exceeds 600 vehicles/hour in each direction; and (ii) The minor road exceeds 200 vehicles/hour in one direction
Continuous Traffic	For each of the four one-hour periods of an average day: (i) The major road flow exceeds 900 vehicles/hour in each direction; and (ii) The minor road exceeds 100 vehicles/hour in one direction; and (iii) The speed of traffic on the major road or limited sight distance from the minor road causes undue delay/hazards to the minor road vehicles; and (iv) There is no other nearby traffic signal site easily accessible to the minor road vehicles
Pedestrian Safety	For each of the four one-hour periods of an average day: (i) The pedestrian flow crossing the major road exceeds 150 persons/hour; and (ii) The major road exceeds 600 vehicles/hour in each direction or, where there is a central median at least 1.2m wide, 1000 vehicles/hour in each direction
Pedestrian Safety – high speed road	For each of the four one-hour periods of an average day: (i) The pedestrian flow crossing the major road exceeds 150 persons/hour; and (ii) The major road exceeds 450 vehicles/hour in each direction or, where there is a central median at least 1.2m wide, 750 vehicles/hour in each direction; and (iii) The 85th percentile speed on the major road exceeds 75km/hr
Crashes	(i) The intersection has been the site of an average three or more reported tow-away or casualty traffic accidents per year over a three year period, where traffic signals could have prevented the accidents; and (ii) The traffic flows are at least 80% of the appropriate flow warrants

Source: Roads and Maritime Services

Based on previous traffic modelling undertaken for the precinct, new or upgraded traffic signals may be required in future years at the following locations:

- Chapman Road / Commercial Road
- Chapman Road / Stahls Road
- Windsor Road / Chapman Road
- Windsor Road / Boundary Road
- Boundary Road / Commercial Road

As operational traffic modelling for the precinct is completed, the layout of these new/upgraded intersections will be finalised.

New traffic signals are recommended at the Boundary Road / Commercial Road intersection which provides access into the Vineyard precinct and directly serves the neighbourhood centre. These signals are required to support the expected volume of traffic through this intersection as well as facilitate pedestrian movements across Boundary Road between Vineyard and Box Hill.

The installation of traffic signals will be delivered based on the development of the precinct and following demonstration that the above warrants may be met. This will be considered during detailed planning for the precinct as the land uses are further defined. The layout for the new or upgrade signalised intersections in the precinct will be developed (in consultation with Roads and Maritime) as planning for the Vineyard precinct progresses.

Relevant local councils (Hawkesbury and Hills Shire Council) will continue to be consulted with regard to the proposed intersection and pedestrian treatments on local roads.

Intersection treatments identified at this stage to support the growth of the Vineyard precinct is illustrated in Figure 22.

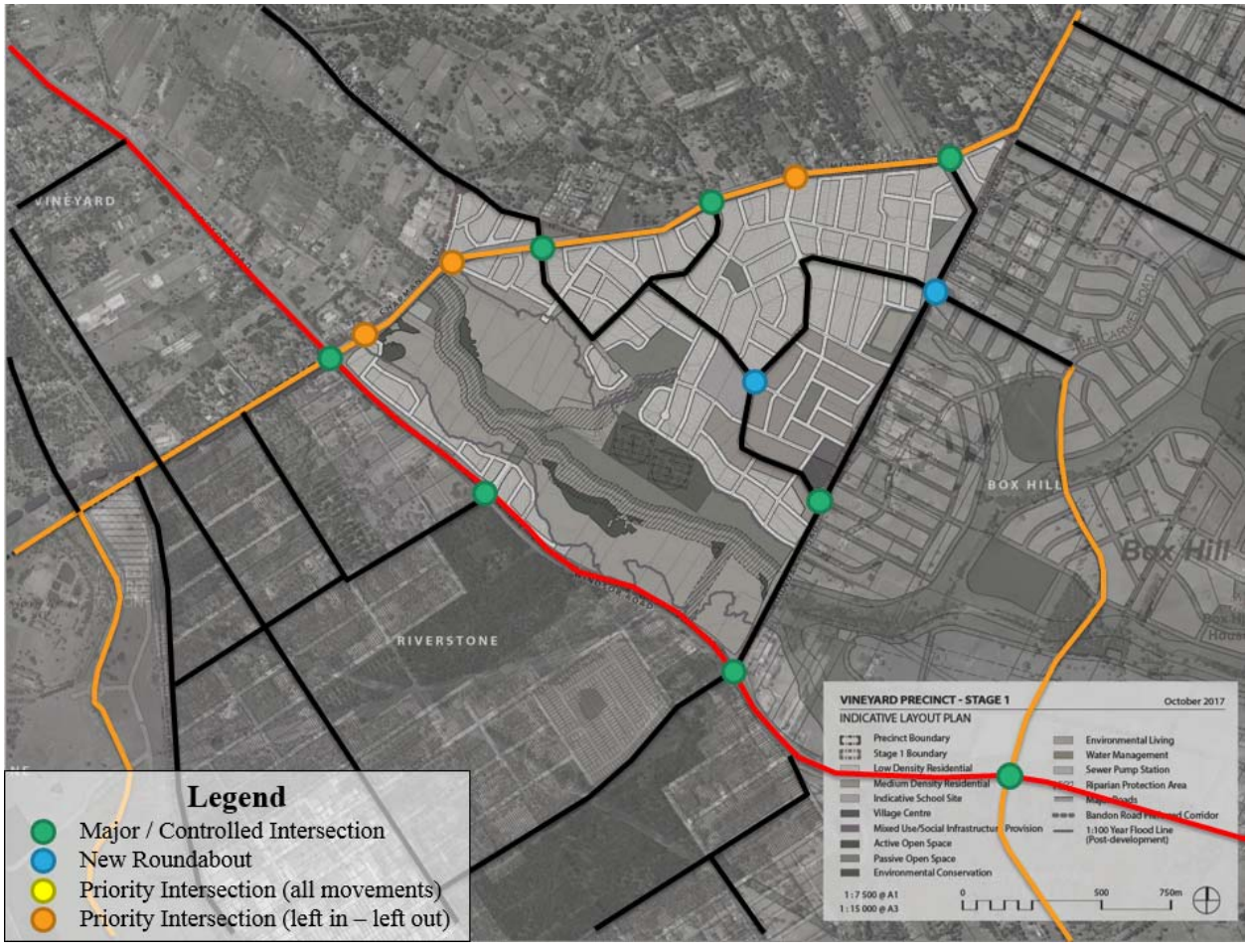

Figure 22 Traffic facilities – Vineyard Precinct

5.7 Heavy Vehicle Movements

The future residential and commercial/retail uses within the Vineyard Precinct are not expected to generate significant heavy vehicle movements. Existing light industrial uses west of Windsor Road however, as well as surrounding areas such as Mulgrave Industrial Precinct, are likely to continue to generate truck movements along arterial road corridors (e.g. Windsor Road). White Prince Mushrooms are one land owner which has indicated that they intend to remain in their current location on Wallace Road over the long term, and therefore heavy vehicle movements will continue to occur on some local roads in the Vineyard precinct.

With respect to road capacity, the continuation of heavy vehicle movements in the medium to long term along local and State roads are not forecast to induce unsatisfactory operational traffic issues.

Should White Prince Mushrooms (and other light industrial uses) continue to operate within the core of the Vineyard Precinct, measures which ameliorate the amenity issues arising from heavy vehicle movements will need to considered. This may include (but is not limited to):

- Implementation of heavy vehicle load limits on certain roads;
- Positioning the frontage of residential lots away from roads expected to carry heavy vehicle traffic;
- Providing noise attenuation devices on local roads to reduce the noise impacts arising from heavy vehicles
- Introducing local area traffic management (LATM) devices, e.g. raised speed tables, to discourage heavy vehicle intrusion into the precinct.

6 Public Transport, Walking and Cycling

6.1 Bus Services

6.1.1 Proposed Network of Routes

The North West Sector Bus Servicing Plan, produced in 2012 by McCormick Rankin Cagney for NSW Transport and Infrastructure, provides for a future bus network to service the entire NWGA. The proposed network consists of five regional and twelve district routes, as described below:

- Regional routes are high frequency services intended to connect town and regional centres. These routes were planned to ensure 90% of residents of the NWGA are within 800m of a service.
- District bus services are less frequent that typically run during the day only, providing further accessibility to village centres and extending bus service provision to the widest area practically possible.

The proposed bus network plan to service the Vineyard precinct (illustrated in Figure 23) builds upon the principles of the North West Sector Bus Servicing Plan (illustrated in Figure 24). This has been modified based on the proposed road network layout, maximising the potential patronage and coverage – ensuring the significant majority of the Vineyard precinct is located within 400m of a bus route.

The future bus network proposes a number of regional and district routes which run directly within the Vineyard precinct, as described below:

- **Route D1: Rouse Hill to Schofields**

  Within the Vineyard precinct, district route D1 runs along Wallace Road, Level Crossing Road and Commercial Road – therefore providing connectivity across both sides of Windsor Road. This route provides a direct service into the Box Hill and Rouse Hill town centres, as well as a connection to Riverstone railway station.

- **Route R2: Parramatta – Rouse Hill – Riverstone East – Vineyard**

  This route departs from Vineyard Station and runs along the Spine Road through the Riverstone West precinct. It provides connectivity to Riverstone Station and onwards through the Riverstone East precinct to the new railway station at Cudgegong Road.

- **Route D3: Rouse Hill to Box Hill**

  This route provides a connection for residents in the eastern portion of the Vineyard precinct – servicing the Box Hill, Riverstone East and Area 20 precincts. Passengers travelling on this service will be able to interchange to heavy rail at either Riverstone, Cudgegong Road or Rouse Hill railway stations.

- **Route 608: Windsor to Rouse Hill**

  This is an existing bus route running along Windsor Road through the Vineyard precinct. It provides a connection from Windsor and Mulgrave into Rouse Hill, servicing a wide catchment within the Vineyard precinct. The North West Sector Bus Servicing Plan envisages that this service will be upgraded to a regional route depending on future demand.

- **Route D7: Riverstone – Schofields**

  District route D7 runs along Clarke Street on the western boundary of the Riverstone East precinct. The service provides a connection between the Riverstone East, Cudgegong Road and Schofields railway stations.

An illustration of the future bus network serving the Vineyard precinct is shown in Figure 23 on the following page.

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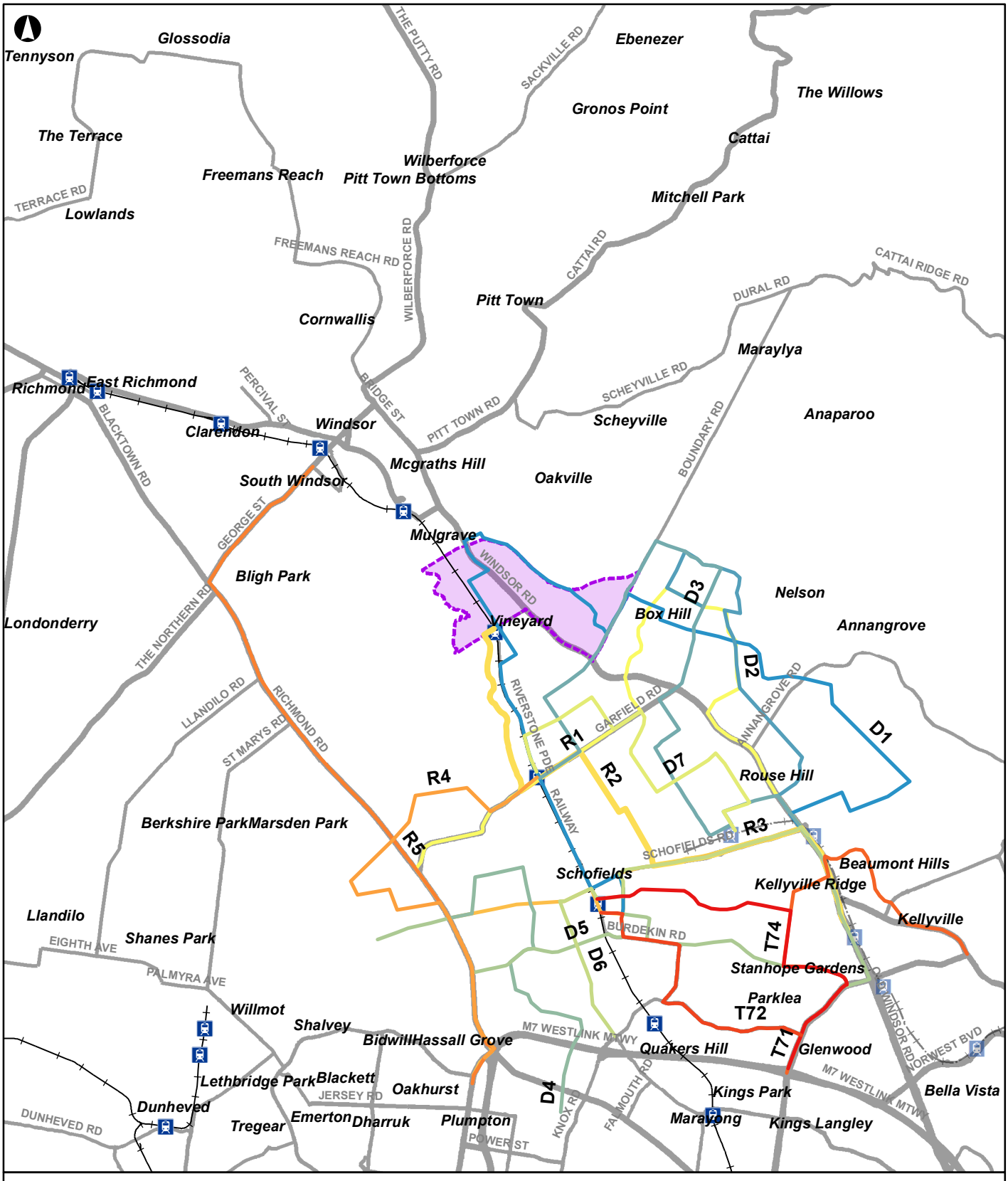

Legend

Future Bus Route

- 608
- D1
- D2
- D3
- D4
- D5
- D6
- D7
- R1
- R2
- R3
- R4
- R5
- T71
- T72
- T74

ARUP
Level 10 | 201 Kent Street
Sydney NSW 2000

Job Title
Vineyard Precinct Transport Study

Client
Department of Planning and Environment

Issue	Date	By	Chkd	Appd
P0	2015-06-23	RW	JM	AH

Kilometres
0 0.5 1 2 3 4 5

Future Bus Route Vineyard Precinct

Scale at A4
1:117,429

Job No	Drawing Status
234974-00	**Preliminary**

Drawing No	Issue
Figure 22	**P0**

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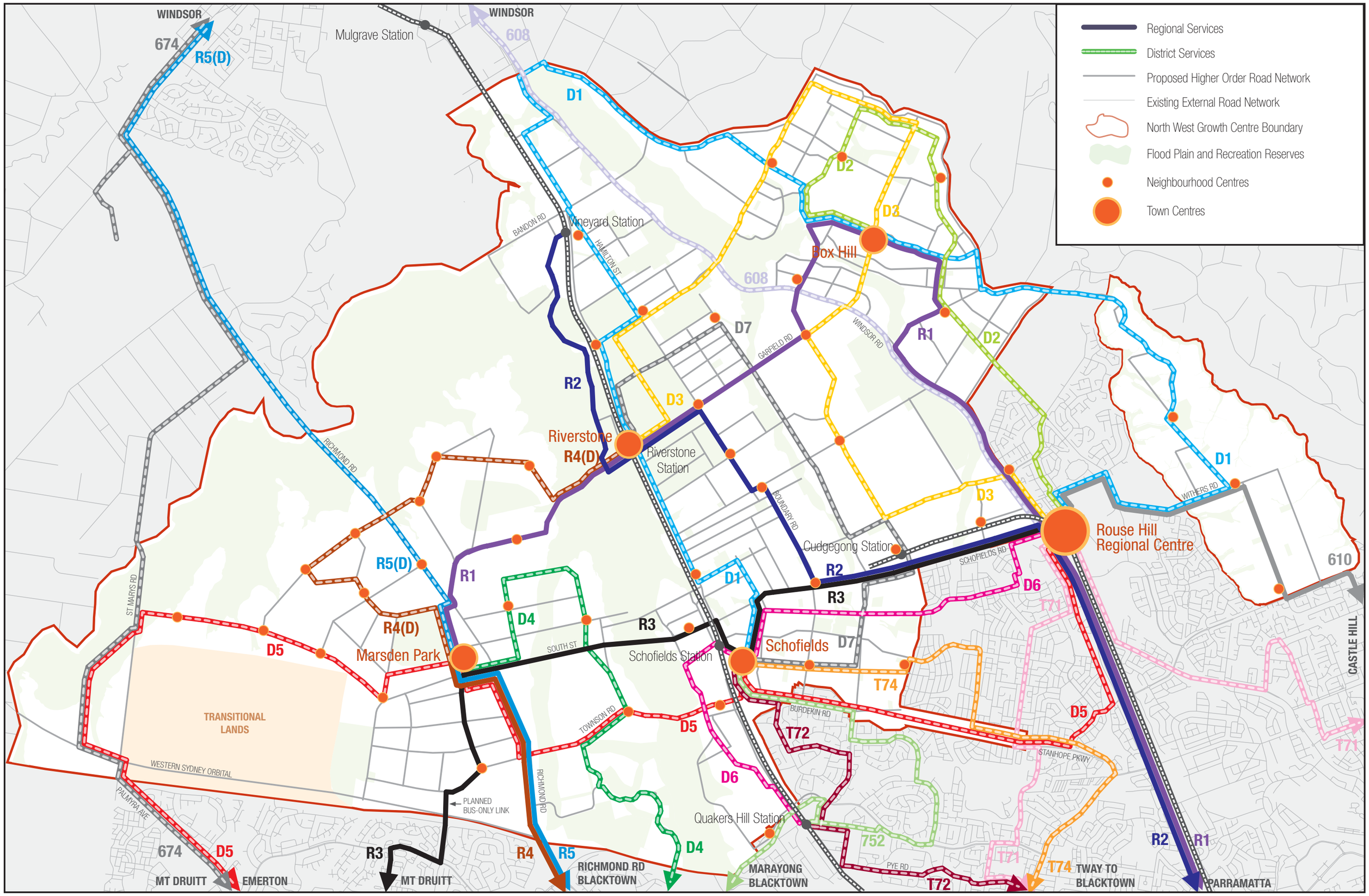

Figure 25: North West Growth Centre - Bus Servicing Strategy
Source: MRCagney, 2012

6.1.2 Bus Servicing

All routes identified as bus corridors would be required to provide a road reserve of sufficient width to accommodate bus stops, including shelters where appropriate. Lane widths for bus routes would need to be a minimum of 3.5m. Roads which accommodate bus routes are required to have two lanes in each direction so stopping buses will not adversely impact general traffic. Should it not be feasible to provide two traffic lanes, indented bus bays may be considered – although this option limits flexibility should bus stops need to be moved in the future.

Bus priority facilities (including bus lanes and bus jump stars) may be required at all signalised intersections, particularly along Windsor Road, to enable buses to maintain journey times and improve the attractiveness of public transport.

Bus stops should be provided with a minimum spacing of 400m to provide good accessibility to workers and residents of the Vineyard precinct. This bus stop spacing will maintain route speeds and minimise the impact of stopping buses on general traffic flows. The exact locations of bus stops within Vineyard will be identified during detailed planning for the precinct as the land uses are more accurately defined.

Bus stop locations will be identified and approved through the Local Traffic Committee at the earliest opportunity during the precinct planning phase. As a general principle, bus stops should be located to provide good access to key land uses including Cudgegong Road railway station, Area 20 town centre, Rouse Hill Regional Park and local schools.

Amenities for waiting passengers, including shading, seating and shelters, is recommended at bus stops located on key regional bus routes such as Windsor Road and Commercial Road. All bus stops should meet the latest requirements by the Disability Standards for Accessible Public Transport (DSAPT) and the Disability Discrimination Act (DDA).

6.1.3 Future Bus Services

In December 2013 Transport for NSW released the Sydney's Bus Future document, outlining a long term plan for bus services across Sydney. The bus plan indicates two future bus services within the NWGA (Figure 25). A rapid bus route is envisaged which will run between Rouse Hill and Blacktown along Schofields Road. A suburban bus route is planned between Penrith and Rouse Hill, again running along the Schofields Road transit boulevard.

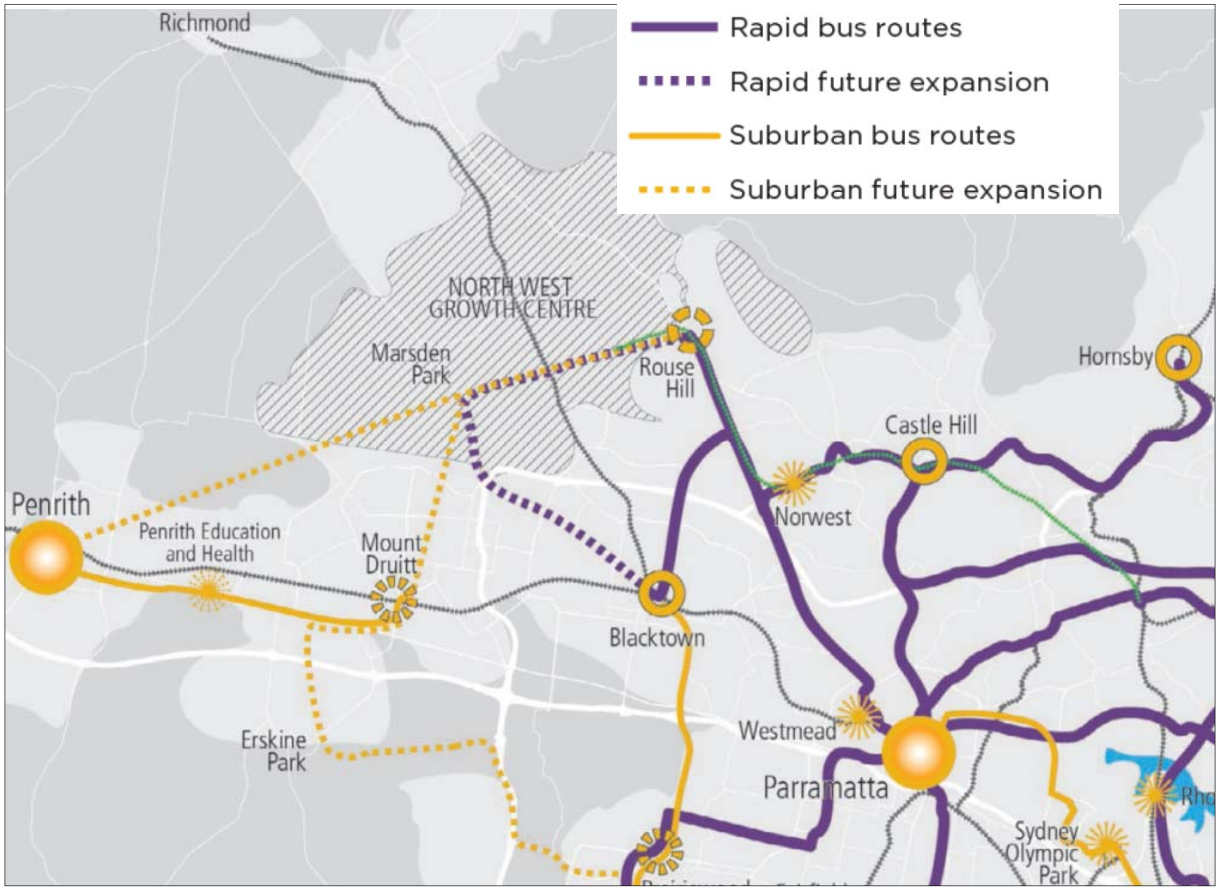

Figure 25 Sydney's Future Bus Network

Source: Transport for NSW, 2013

6.2 Rail Services

The Vineyard precinct is served by the Sydney Trains network via Vineyard Station on the Richmond Line. Approximately 10km south of Vineyard precinct, the future Cudgegong Road Station on Sydney Metro Northwest will provide residents with rail services to Macquarie Park, Chatswood and the CBD. Providing strong access to these rail stations through a permeable road and pedestrian network will be a key component in facilitating a mode shift away from private vehicle to public transport.

In December 2012 the NSW Government announced a public transport corridor had been preserved in the NWGA for future generations. Known as the Marsden Park Transport Corridor, the route runs from the end of Sydney Metro Northwest at Cudgegong Road Station, west to Schofields Station and then further on to Marsden Park, a distance of approximately 6.8km. The indicative alignment of the corridor is shown in Figure 26.

Figure 26 Marsden Park transport corridor

Source: Transport for NSW, 2013

Transport for NSW is currently undertaking detailed planning to define the alignment of the corridor – including the interface with existing and planned roads. A suitable public transport mode has not yet been determined, however the route of the corridor will be designed to accommodate a range of feasible modes including heavy rail, bus or light rail. The decision on the mode of selected transport mode will be based on detailed analysis to ensure the most appropriate mode is selected that best serves the corridor and the region in the longer term.

The NSW Government has postponed the second stage of the duplication of the Richmond Railway Line. This project, which would upgrade the existing tracks between Schofields and Vineyard stations, was initially announced in 2003 to increase capacity on the existing network. The project would benefit residents of the Vineyard precinct through construction of a new Vineyard Station with improved station facilities, a car park and bus interchange. The new station would be located approximately 600m south of the existing site.

6.3 Pedestrian and Cycling Network

The future design objectives of the local area pedestrian and cyclist networks for the Vineyard precinct should be to encourage residents, wherever possible to walk or cycle in preference to using motor vehicles for locally based travel and for access to public transport.

A number of intersection upgrades have been recommended in this strategy which will provide controlled pedestrian crossing across major roads – improving accessibility. Within the future village/neighbourhood centre within the Vineyard Precinct, additional pedestrian facilities such as zebra crossings and/or widened footpaths may be required to support the higher levels of pedestrian activity anticipated in this area. The exact form and location of these facilities would be determined at a later stage of the planning process.

Dedicated bicycle facilities (both on road and off road) are proposed to provide linkages to key land uses within Vineyard and surrounding precincts. These land uses including public transport nodes, retail, schools and open space areas.

Shared pedestrian/cycle paths are recommended to be provided along one side of major roads (roads with forecast future traffic volumes of over 10,000 vehicles per day), as well as roads serving certain land uses including schools and playing fields. Shared paths act a safe, convenient bicycle facility where physical separation between cyclists and vehicles is necessary on roads with high vehicles speeds and volumes.

The Vineyard precinct will need to have shared paths along one side of collector roads for pedestrian and cyclists. The collector road reserve width is to be increased to 20.8m to accommodate this plus a 13m carriageway for buses. Separate bike paths within the road reserve will make the collector road widths too wide.

A shared path already exists along the western side of Windsor Road. The following roads in the Vineyard precinct have been identified as suitable corridors for the introduction of shared paths to improve the cycling network:

- Boundary Road;
- Bandon Road eastern extension (Chapman Road and Commercial Road)
- Strahls Road

There is the opportunity to provide a recreational, off-road cycle route along the eastern riparian corridor in the Vineyard precinct. This cycle facility would service planned open space areas as well as the neighbourhood centre envisaged adjacent to Boundary Road.

Within any medium and high density residential development, or commercial development within the precinct, secure bicycle parking is recommended to be provided. Bicycle parking should be provided at rates consistent with those outlined in the *NSW Planning Guidelines for Walking and Cycling*.

Visitor bicycle parking should be provided in the public domain with the neighbourhood village in Vineyard to support local bicycle trips to retail shops.

Figure 27 illustrates the recommended pedestrian and cyclist measures.

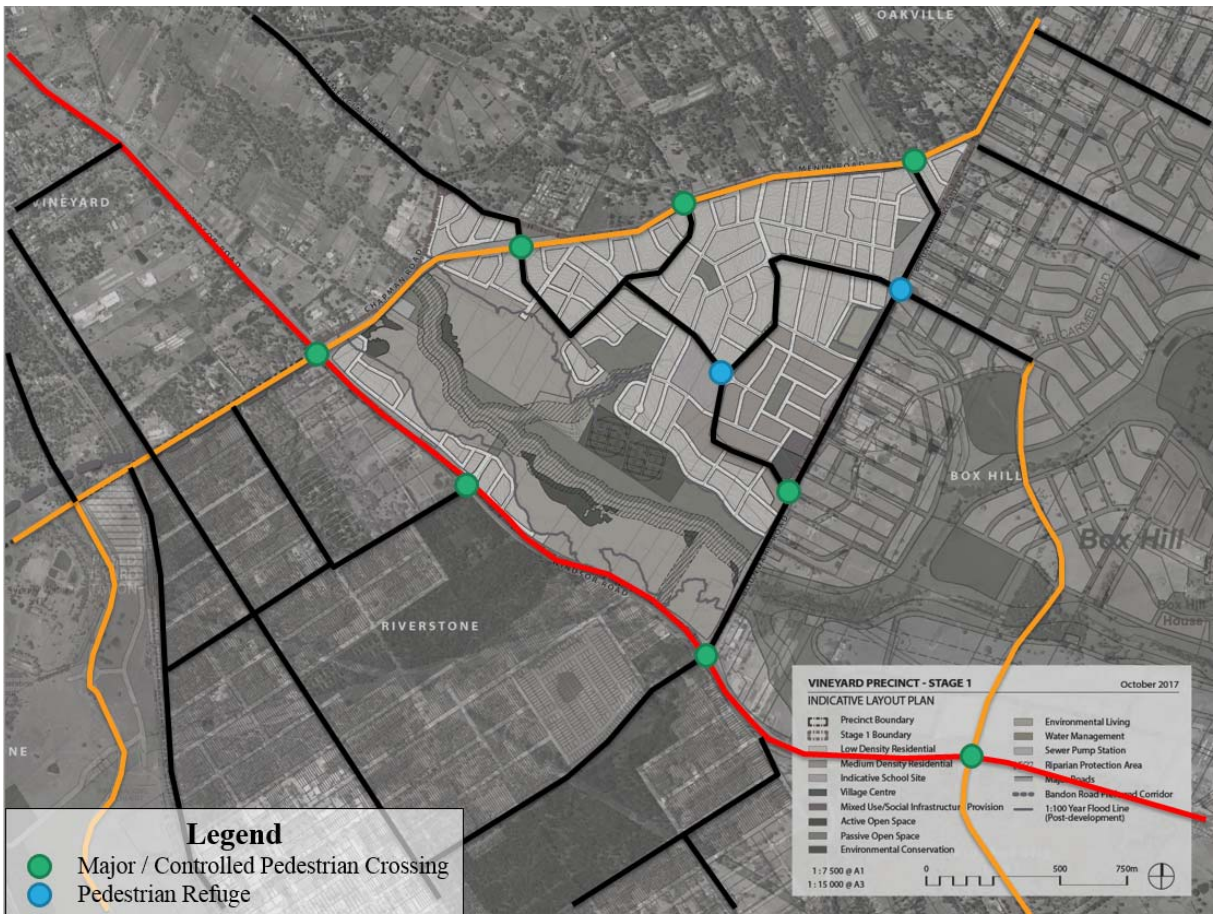

Figure 27 Proposed pedestrian / cycle network

7 Summary and Conclusions

This report has assessed the future traffic and transport requirements associated with the development of the Vineyard precinct - located in the northern portion of the North West Growth Area, wholly within the Hawkesbury LGA. The precinct ultimately has the capacity to accommodate approximately 2,300 residential dwellings with a small component of retail and commercial uses.

This report has provided an assessment of the future transport infrastructure components necessary to support the development of the precinct, based on a series of key objectives. These are summarised below:

- Provide a road network that allows for good access to all modes of transport;
- Design a physical site layout which encourages walking and cycling;
- Ensure the road network provides suitable connections to adjacent development precincts;
- Integrate transport and land use planning;
- Provide high quality access to public transport stops to reduce the dependence on private vehicles;
- Develop an appropriate road hierarchy which provides adequate carrying capacity; and
- Protect residential areas from through traffic intrusion, particularly heavy vehicles.

Road Network

A strategic transport network model was developed to forecast future year (2036) traffic volumes in the vicinity of the Vineyard Precinct. A road network hierarchy was developed to support the future land uses envisaged for the Vineyard precinct. Windsor Road is currently classified as an arterial road and will support the majority of traffic movements within Vineyard. A number of existing internal roads have been identified for improvement and form the framework for the higher-order road network. These roads will accommodate internal traffic, bicycle and pedestrian movements, and include:

- Boundary Road
- Bandon Road;
- Menin Road;
- Commercial Road; and
- Chapman Road.

Public Transport, Walking and Cycling

For new precincts within the North West Growth Area, where private vehicle has historically dominated the transport landscape, it is vital that strong public transport, walking and cycling linkages are provided at an early stage when new residents establish their travel habits.

The Vineyard precinct will be served by a number of new bus routes proposed as part of the North West Sector Bus Servicing Plan. Bus stops are recommended to be provided with a minimum spacing of 400m to provide good accessibility to workers and residents of the Vineyard precinct. Amenities for waiting passengers, including shading, seating and shelters, is recommended at bus stops located on key regional routes such as Windsor Road, Commercial Road and Wallace Road.

Future residents and employees of the Vineyard precinct will benefit from improved accessibility across major roads through the intersection upgrades (and complementary controlled pedestrian crossing) which have been recommended in this strategy. Footpaths should be provided on both sides of the road carriageway in accordance with the standard road cross sections for the NWGA.

A number of dedicated bicycle routes have been identified in association with the road upgrade works recommended in this strategy. Shared pedestrian/cycle paths (minimum 3m wide) are recommended for major roads including Boundary Road, Commercial Road and Bandon Road. The Vineyard precinct will need to have shared paths along one side of collector roads for pedestrian and cyclists. The collector road reserve width is to be increased to 20.8m to accommodate this plus a 13m carriageway for buses. Separate bike paths within the road reserve will make the collector road widths too wide.

There is the opportunity to provide a recreational, off-road cycle route along the eastern riparian corridor, which would service planned open space areas as well as the neighbourhood centre.