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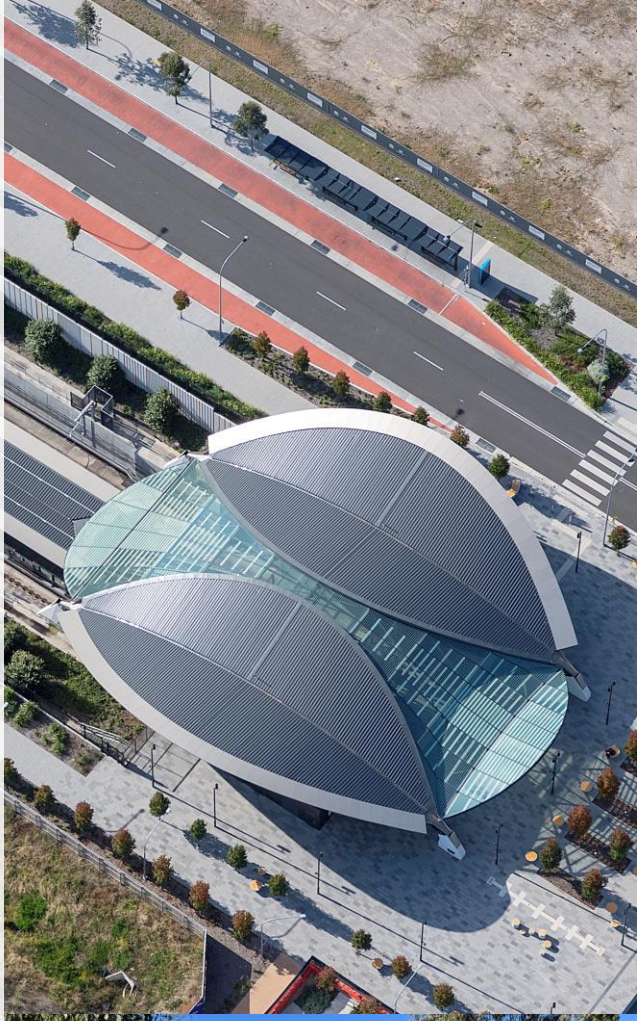
Precinct Transport Statement



Bella Vista & Kellyville Precinct TOD

IW312900-SPEC-REP-002

v3.1B

16 October 2024

For the NSW Department of Planning, Housing and Infrastructure

Jacobs

Precinct Transport Statement

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Executive Summary

Introduction

The Transport Oriented Development (TOD) Program is part of the NSW Government's plan to address the current housing crisis across the State. The objective of the project is to support the planning of transport infrastructure to facilitate rezoning and growth within the Bella Vista and Kellyville precincts, identified as two of eight accelerated precincts within the TOD Program. Using results from previous studies and additional modelling and planning work, this Precinct Transport Statement summarises the existing transport context, establishes a transport vision and objectives for the precinct, outlines key issues and opportunities, and identifies a transport response to support future growth.

Existing Transport Context

The existing land use within the Bella Vista and Kellyville Station Precincts is predominantly low density residential with commercial areas concentrated to the south and southeast of Bella Vista within Norwest Business Park. Residents are more likely to work in white-collar professions, with the most popular places of work being the employment centres of Norwest Business Park, Macquarie Park, Sydney CBD and Parramatta.

There is currently a high level of private vehicle usage in Bella Vista and Kellyville. This is coupled with the relatively high car ownership rates, an area with many families and children, low density development and distance from employment and major centres. Assessment of the existing road network in previous studies revealed that a number of intersections along the Old Windsor Road, Windsor Road and Memorial Avenue are at or approaching their design capacities during the peak periods. Further details on the existing road network performance in the peak periods are available in Section 2.6.1.

The existing residential developments in Bella Vista and Kellyville have been largely designed with low permeability to discourage vehicles traversing the local areas. Consequently, they limit accessibility of pedestrians and cyclists travelling between the local network and the wider regional network. At a broader level, there is a good level of connectivity provided by the Strategic Cycleway Corridors, including the cycleway along Old Windsor Road and the M7.

More recently in response to the delivery of Sydney Metro Northwest, planning for the area has focused on higher density development and a more permeable street network within the station catchment to transform the development patterns and leverage the excellent connectivity to jobs and services across Northern Sydney provided by the new rail line. The TOD Program is building on the recent planning to maximise the benefit for Government in the public transport investment and help to address the housing supply challenges.

The North-West Transitway and Sydney Metro Northwest are the key public transport infrastructure in the precinct, with residents able to directly travel to the Sydney CBD with the recently opened metro line from Chatswood to Sydenham.

Future Land Use

As part of the TOD program, transformational land-use changes are planned for Bella Vista and Kellyville precincts, reflective of the precincts' enhanced transport connectivity. Land use changes will be predominantly residential, with integrated supporting services and amenities.

The development scenario shown in Table ES 1 has been used as the basis for analysis in this report. The Future Project Case 2041 combines existing conditions and additional dwellings assumed to be completed up to 2041 enabled by the TOD rezoning, based on a percentage take-up of full capacity informed by the feasibility assessment.

Table ES 1: Dwelling projections in 2041 – Bella Vista and Kellyville Precincts

Density	Future Project Case 2041
Low density	6,265
Medium density	612
High density	13,183
Total	**20,060**

Future Road Network Performance

The current road network within the Bella Vista and Kellyville Station Precincts operates at or near capacity during peak periods, especially Old Windsor Road. Travel demand will continue to increase due to projected population growth in north-west Sydney by 2041, even without consideration of the additional demands due to development of these precincts near the two metro stations. Travel patterns will evolve over time as new local centres, services and transport investments are delivered and new communities are established. Based on current trends, further growth in traffic demand will result in more travel time delays. At this time people may choose to travel in different ways and at different times. It is critical that to support evolving travel behaviours, and to leverage the connectivity provided by the metro, that more transport choices are provided, such as public and active transport connections.

A first principles transport assessment was undertaken to provide an estimation of the traffic generation as a result of rezoning of the Bella Vista and Kellyville precincts and the utilisation of the roads by the additional traffic. Within the planning horizon of this study, the precincts are estimated to cumulatively generate approximately an extra 2,800 vehicles per hour (vph) outbound and 700 vph inbound trips in the morning peak hour. Key arterial roads such as Old Windsor Road, Windsor Road and Sunnyholt Road perform an important regional function connecting traffic and bus services through, to and from the area. The assessment revealed that a number of intersections in the study area are projected to be significantly congested in peak periods by 2041 due to increasing regional demands, as well as the estimated demands generated locally. The estimated local demand generation used in the assessment includes trips from assumed new developments in Glenwood which is no longer being rezoned.

The Transport Response

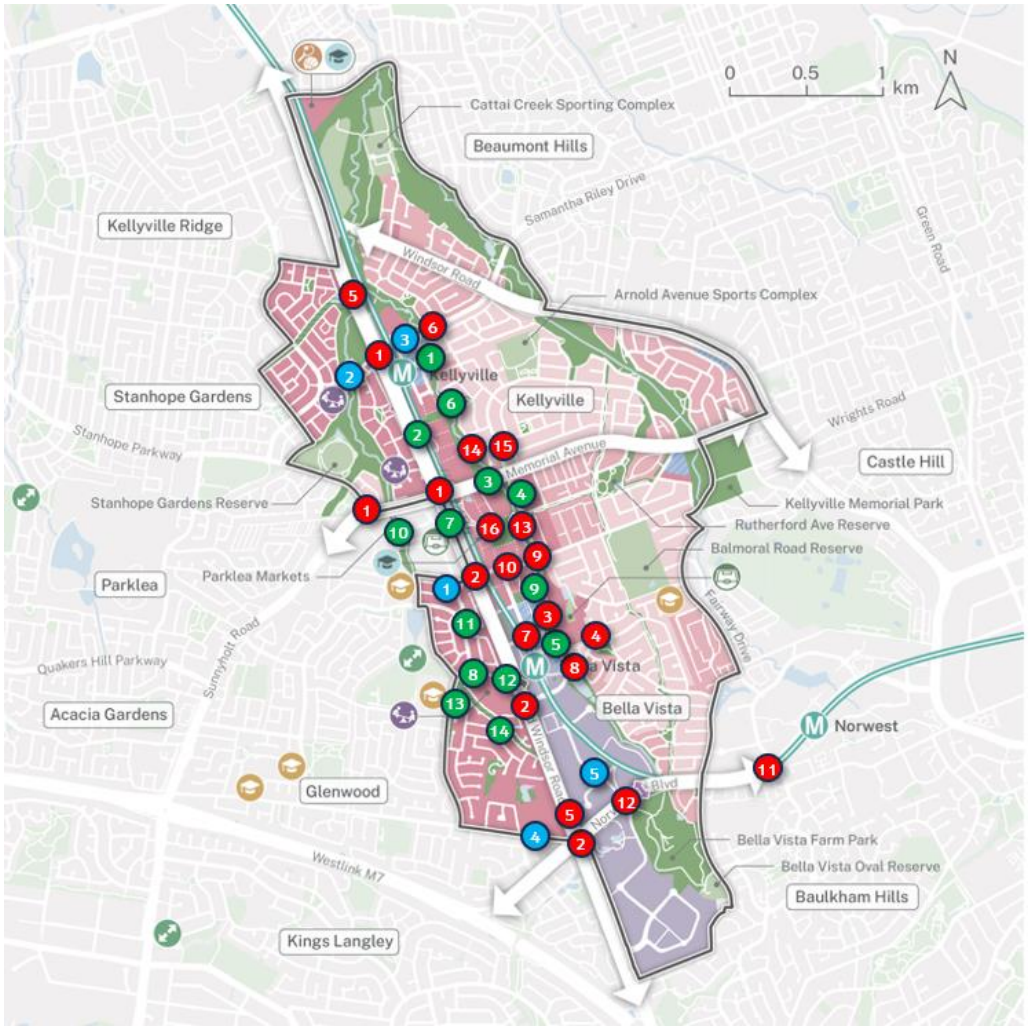
Prior to the delivery of the new rail line the focus has been on providing road infrastructure based on predicted future traffic demand, particularly for private vehicles, which has led to solutions that simply increase road capacity to accommodate anticipated growth. However, this has created a cycle of induced demand, encouraged further car use and ultimately led to unsustainable travel patterns. Additionally, building new road infrastructure may not represent good value for money and may simply shift congestion problems to other areas of the network.

To leverage the benefits of NSW Government investment in the Sydney Metro line, this assessment has focused on prioritising more sustainable transport modes, with the recommended initiatives and projects for the Bella Vista and Kellyville precincts shown in Figure ES 1. A range of measures have been explored to achieve this, including:

- **Enhancing active transport links** – develop safe and convenient walking and cycling infrastructure to encourage active travel options. This includes improving connectivity across the Elizabeth Macarthur Creek and arterial roads such as Old Windsor Road, which act as physical barriers to the metro stations.
- **Public transport integration** – explore opportunities to improve public transport accessibility and services within the precinct to encourage residents and workers to utilise these options, thereby reducing overall car traffic on the road network.
- **Demand management strategies** – investigate the feasibility of implementing demand management strategies, such as staff travel plans or parking controls, to discourage single-occupancy vehicle use and encourage more efficient travel choices.

While not a primary focus, this assessment acknowledges the potential need for medium to long-term infrastructure upgrades as part of a broader road network strategy. This could include increasing transport capacity along regional transport corridors, such as the Old Windsor Road corridor, and increasing capacity at key intersections to accommodate future traffic demand and facilitate improvements to local bus service travel times.

Overall, the proposed transport response aligns with the vision and objectives of the project as it will enable a connected and accessible precinct that integrates a wide range of transport modes and services. This is in line with the transport objectives of the precinct to provide Bella Vista and Kellyville residents better access to a sustainable and integrated network.



Active Transport Initiatives / Projects

1. Pedestrian bridge (across Elizabeth Macarthur Creek), Decora Dr to Wenden Ave
2. Upgrade Old Windsor Rd shared path (Newbury Ave to Norwest Blvd)*
3. Pedestrian bridge across Memorial Ave
4. Pedestrian/Cycle Path along Elizabeth Macarthur Creek
5. Pedestrian bridge, near Unaipon Ave / Celebration Dr intersection
6. Pedestrian bridge, near Lewis Jones Drive Reserve
7. Pedestrian bridge across Old Windsor Rd near Burns T-way station
8. Shared path – Cramer Place / Glenwood Park Dr / Forman Ave*
9. Pedestrian bridge near Byles Place / Celebration Dr intersection
10. Shared path – Caddies Creek (Glenwood Lake – Sunnyholt Rd)*
11. Pedestrian through site links – Glenwood (Miami St – Emmanuel Terrace – Sharrock Ave – Maley Grove)*
12. Access ramp (west) – Bella Vista pedestrian bridge across Old Windsor Road
13. Shared path across drainage corridor – Shaun St to Kidman St / Muriel Way*
14. Pedestrian through site link – Maley Grove to Bella Vista T-way Station; shared path on Darren Court to Kosmina St across drainage corridor*

Public Transport Initiatives / Projects

1. Bus priority – Miami St / Tarwin Ave eastbound to Old Windsor Rd*
2. Bus priority – Newbury Ave eastbound to Old Windsor Rd*
3. Bus priority – Samantha Riley Dr / Guragura St to Old Windsor Rd*
4. Bus priority – Meurants Ln bus only link*
5. Bus priority – Lexington Dr approaching Norwest Blvd

Road Network Initiatives / Projects

1. Old Windsor Rd Intersection Upgrades – Samantha Riley Dr, Memorial Ave, Sunnyholt Rd / Stanhope Pkwy
2. Old Windsor Rd Intersection Upgrades – Balmoral Rd, Celebration Dr, Norwest Blvd
3. Celebration Dr extension to Balmoral Rd
4. Brighton Dr extension to Mawson Ave
5. Progressive widening of Old Windsor Rd between Norwest Blvd and Windsor Rd
6. Intersection Upgrade – Samantha Riley Dr / Decora Dr
7. Signalisation – Unaipon Ave / Mawson Ave
8. Signalisation – Brighton Dr / Celebration Dr
9. Signalisation – Balmoral Rd / Celebration Dr
10. Signalisation – Balmoral Rd / Mawson Ave
11. Upgrade and signalisation – Norwest Blvd / Solent Cct*
12. Upgrade and signalisation – Norwest Blvd / Lexington Dr / Elizabeth Macarthur Dr
13. Vehicular bridge – Hodges Rd to Burns T-way station
14. Vehicular bridge near Colonial St
15. Roundabout – New road near Colonial St Vehicular Bridge
16. Roundabout – North of District Open Space in Bella Vista Precinct

Figure ES 1: Proposed transport initiatives and projects for the Bella Vista and Kellyville precincts

(* denotes** other **Strategic Transport Opportunities** in the area but does **not form part of the final rezoning)

Contents

Appendices

1. Introduction

1.1 Project Background

The Transport Oriented Development (TOD) Program is part of the NSW Government's plan to address the current housing crisis across the state. This will be addressed by delivering more housing in well-located areas that are close to planned and existing public transport, community services and open spaces.

The TOD Program has two parts:

- Part 1 – Focus on eight accelerated precincts to create infrastructure and capacity for 47,800 new dwellings over 15 years, including Bella Vista and Kellyville Station Precincts. Land within 1,200 metres of eight rail and metro stations will be rezoned by the NSW Government to allow for more new and affordable homes.
- Part 2 – Focus on precincts that have existing infrastructure and are located within 400 metres of 37 stations to create capacity for 138,000 new dwellings over 15 years.

1.2 Project Objectives

The objective of the project is to support the planning of transport infrastructure to facilitate rezoning and growth within the Bella Vista and Kellyville precincts. Previous work undertaken in the two precincts are used as a starting point to inform the analysis and recommendations in this study. This is supplemented by additional transport planning and supporting modelling work to inform and establish principles and strategies to guide subsequent detailed land use planning and policies in the precincts.

1.3 Report Purpose

The Precinct Transport Statement aims to:

- Establish the transport vision and objectives for the Bella Vista and Kellyville precincts.
- Understand the existing and planned transport network and how it is or will be integrated with surrounding land use (current and proposed).
- Report on the key issues, challenges and opportunities for the precinct and surrounds.
- Identify the transport response to support future growth, including potential priorities and an appreciation of responsibility for planning, funding and delivery.

1.4 Vision-led Approach to Precinct Transport Planning

The planning for Bella Vista and Kellyville precincts is based on a 'Vision-led' approach, in line with relevant planning policy and strategy. This approach identifies a long-term vision upfront, and tests measures and initiatives against their ability to meet the vision. It does not assume current travel habits or demand will materialise in future scenarios; recognising that demand and mode-choice can be influenced by land-use and transport provision.

The outcome of this approach is an assessment that balances the Movement and Place functions of the precincts on a corridor-by-corridor basis, seeking to reduce and avoid conflicts through careful planning and design to achieve the wider vision for the precinct. Traffic modelling is used as a validation tool within this exercise, not as a primary driver.

2. Existing Transport Context

The purpose of this section is to better understand the current travel patterns in the Bella Vista and Kellyville precincts based on existing land use and transport network conditions. This analysis contains a background review of previous studies on the precincts, including strategic plans from state and local government. Additional analysis is also undertaken for gaps identified in the background review or where conditions have substantially changed from previous studies.

2.1 Investigation Area

The investigation area for the Bella Vista and Kellyville precincts lies approximately 35 km north-west of the Sydney CBD and 14.5 km north of the Parramatta CBD. The two precincts are bounded by Sanctuary Drive to the north, Windsor Road to the east, CircaRetail Shopping Centre to the south, and Perfection Avenue and Glenwood Park Drive to the west.

Within the investigation area, each sub-area or block has been given a priority rating:

- Primary investigation – these areas include the Bella Vista and Kellyville Station State Significant Development (SSD) sites (K9, BV1 and BV7) currently undeveloped. There are also adjacent sites (K8, K10 and BV8) which can support housing densification, as well as BV14 site that includes part of the existing Norwest Business Park. K1 is a vacant site at the intersection of Windsor Road and Sanctuary Drive.
- Option to investigate – K3, K4, K5, K6, K11, BV9, BV11, BV17 and BV18.
- No change – K2, K7, K12, K13, K14, BV2, BV3, BV4, BV5, BV6, BV10, BV12, BV15, BV16, BV19.

The investigation area is shown in Figure 2-1.

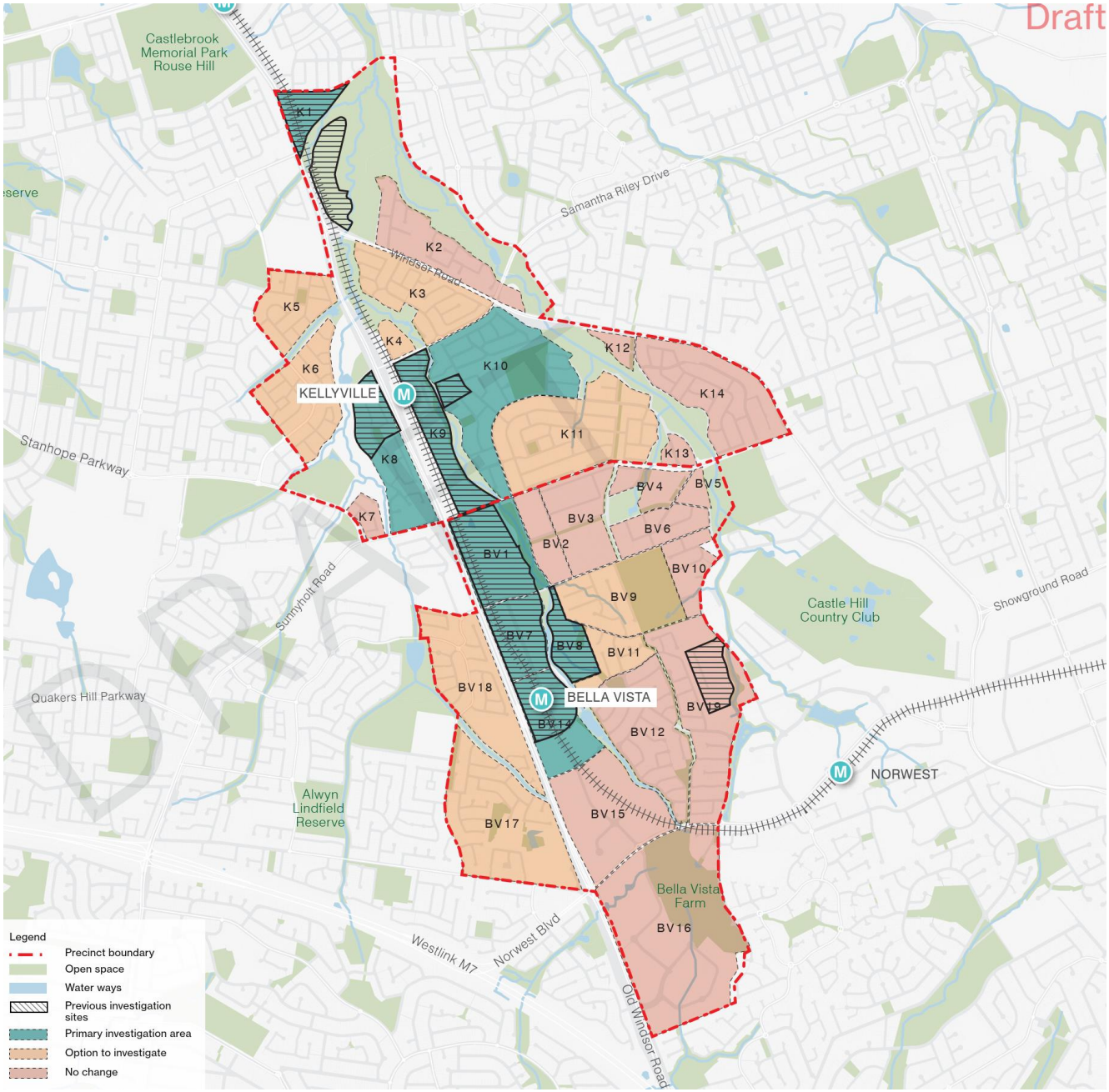


Figure 2-1: Bella Vista and Kellyville Precincts investigation area (Architectus 2024)

2.2 Land Use

2.2.1 Overview

The existing land use surrounding the Bella Vista and Kellyville Station Precincts is predominantly low density residential with business park employment situated to the south and south-east of the Bella Vista Station Precinct within Norwest Business Park. The opening of the Sydney Metro Northwest in 2019 served as a major catalyst for improved accessibility in the precinct, offering further opportunities for urban renewal to provide additional jobs and residential dwellings within proximity of the metro stations.

The Bella Vista and Kellyville Station Precincts have access to the broader retail and employment centres at Rouse Hill and Castle Hill, such as Rouse Hill Town Centre and Norwest Business Park. Sydney Metro Northwest and the North-West Transitway (T-way) also provides for more direct access to other strategic centres from the two precincts such as Macquarie Park, Parramatta, Westmead, Blacktown and the Sydney CBD. The regional context of the Bella Vista and Kellyville Station Precincts are shown in Figure 2-2.

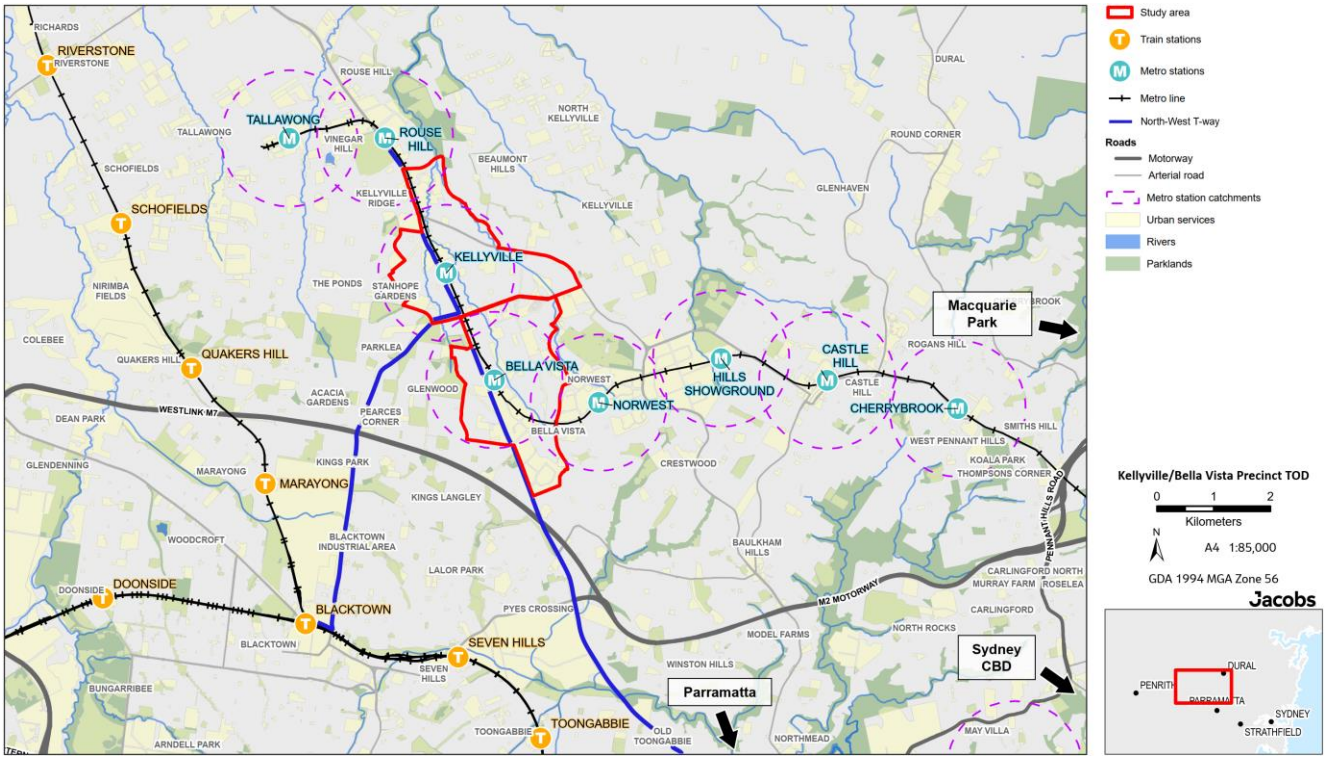


Figure 2-2: Existing regional context of the Bella Vista and Kellyville precincts

2.2.2 Key Points of Interest

Within the Bella Vista and Kellyville Station Precincts, the zoning caters mainly for residential with some retail, education and commercial developments near Celebration Drive in Bella Vista and Windsor Road in Kellyville. Currently, there are several retail centres within the area including Parklea Markets, Stanhope Village and Norwest Marketown, with local shops and retail facilities for residents. The precincts are also home to Norwest Private Hospital and several sports facilities including Caddies Creek Reserve, Stanhope Gardens Reserve and Valentine Sports Park. The existing land use of the study area is shown in Figure 2-3.

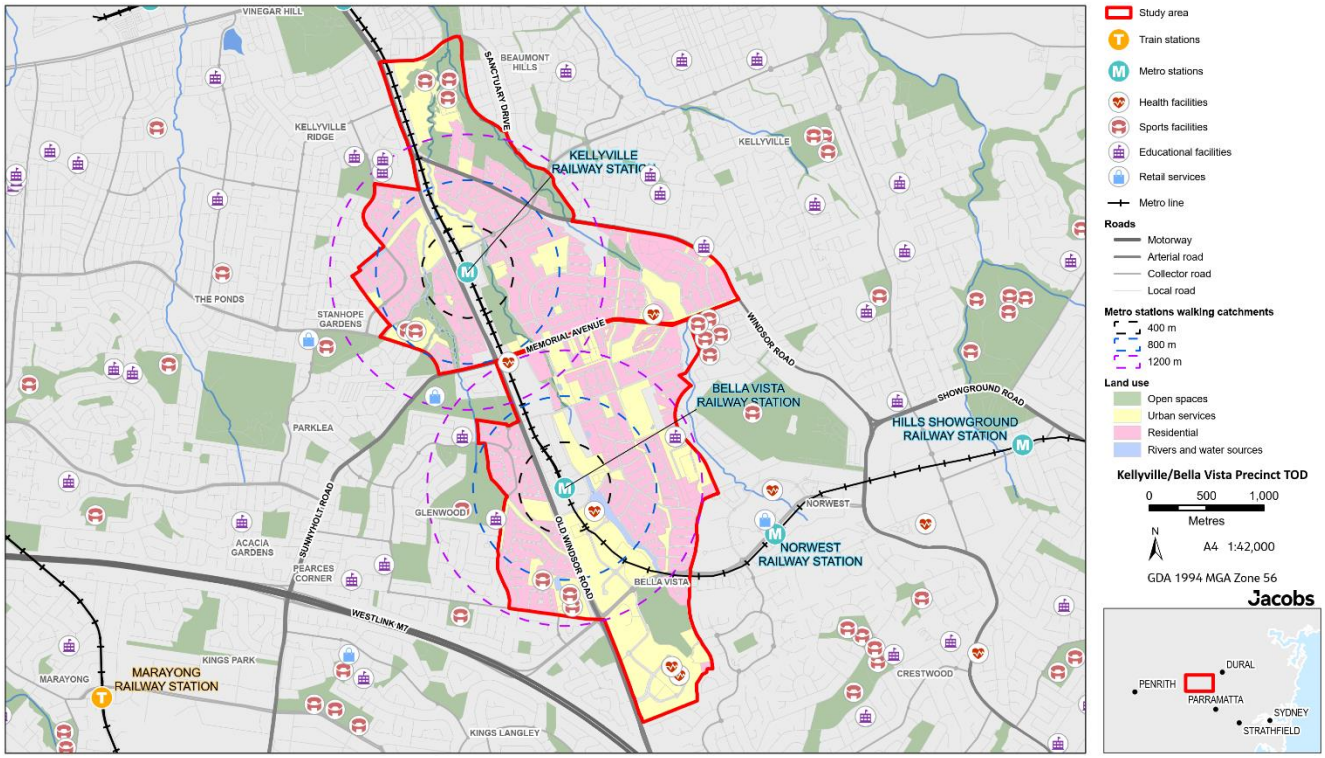


Figure 2-3: Existing land use of the Bella Vista and Kellyville precincts

There are several urban services and employment areas within the precincts. The Norwest Business Park contains the highest concentration of employment in the area with over 20,000 jobs across Bella Vista and Norwest. The business park contains several medium to large commercial enterprises such as Woolworths Group and ResMed. The approved concept SSD application sites will increase the total retail and commercial space by a further 14,000m^2 and 150,000m^2 respectively for the Bella Vista Station Precinct and 10,047m^2 of retail space for the Kellyville Station Precinct.

The concept SSD within the Bella Vista application site includes land reserved for a primary school for the new Bella Vista and Kellyville communities situated within proximity of the residential plots to encourage walking to the school. Other schools, health and community related facilities within the surrounding area include the Norwest Private Hospital, Parklea Public School, John XXIII Catholic Primary School, Kellyville Public School and Bella Vista Public School. Safe access to these destinations is an important component of the design of Bella Vista and Kellyville Station Precincts to maximise their integration with surrounding areas.

2.2.3 Character

Based on 2021 Census data, there are approximately 7,381 and 3,839 dwellings within the Bella Vista and Kellyville SA2[1] catchment areas respectively. They primarily consist of separate houses and semi-detached housing with small proportions of medium and high-density dwellings as shown in Table 2-1.

Table 2-1 outlines the existing dwelling mix in the Greater Sydney Area and existing locations with high and medium density developments close to rail. The delivery of housing in the Bella Vista and Kellyville Station Precincts is expected to increase the number of medium and high-density dwellings closer to the metro stations.

[1] Statistical Areas Level 2 (SA2) are medium-sized geographical areas that represent communities that interact together socially and economically. SA2 data was used where possible for consistency during the analysis.

Table 2-1: Dwelling type for Bella Vista and Kellyville by SA2 (ABS Census 2021)

Catchment Area (SA2)	Dwelling Type as Proportion of Total Dwelling			
	Flat or apartment	Semi-detached	Separate house	Other dwelling
Kellyville – West	**21%**	**8%**	**72%**	**0%**
Stanhope Gardens - Parklea	**0%**	**15%**	**84%**	**0%**
Glenwood	**0%**	**3%**	**97%**	**0%**
Baulkham Hills (West) - Bella Vista	**13%**	**8%**	**78%**	**0%**
North Parramatta	70%	14%	16%	0%
Rosehill - Harris Park	80%	6%	13%	2%
Macquarie Park - Marsfield	59%	26%	14%	0%
Chatswood - East	71%	4%	24%	0%
Greater Sydney	33%	13%	54%	1%

Place of Work analysis suggest that a large proportion of the existing population work in major centres with accessible public transport connections such as the Sydney CBD, Parramatta CBD, North Sydney and to a lesser extent Macquarie Park. Despite this, the level of car ownership in Bella Vista and Kellyville shows a higher proportion of cars per dwellings than the Greater Sydney average which may also reflect the demographics and travel behaviours of areas that are predominantly families with children.

The TOD Program will increase the number of high to medium density developments across Bella Vista and Kellyville that would have access to mass public transport connections due to their proximity to metro stations. As such, future car ownerships are expected to be lower than their existing averages for the two areas and more likely similar to other rail station precincts such as Rosehill – Harris Park and Chatswood - East, as shown in Table 2-2.

Table 2-2: Car ownership in Bella Vista and Kellyville by SA2 (ABS Census 2021)

2021 Census (SA2)	Kellyville - West	Stanhope Gardens - Parklea	Glenwood	Baulkham Hills West - Bella Vista	North Parramatta	Rosehill - Harris Park	Chatswood - East	Greater Sydney
Total Population	11,375	13,034	15,829	21,683	22,878	9,034	19,601	5,231,147
No. Private Dwellings	3,839	3,788	4,646	7,381	10,561	4,169	8,591	2,076,284
Average Motor Vehicles per Dwelling	2	1.9	2.1	2.1	1.2	1.2	1.1	1.7

2.3 Travel Behaviour

Travel behaviours in Bella Vista and Kellyville have been benchmarked against existing station precincts around Greater Sydney to evaluate future travel patterns and behaviours that result from TOD rezoning.

The current mode share has been assessed using both 2016 and 2021 Census data[2] at the suburb level. Work related trip origin and destinations are based on the latest available Place of Usual Residence vs Place of Work by Statistical Area Level 2 (SA2), which was collected in 2021.

2.3.1 Mode Share

The latest available mode share data for Bella Vista and Kellyville residents travelling to work is shown in Figure 2-4 and Figure 2-5 for 2016 and 2021 respectively.

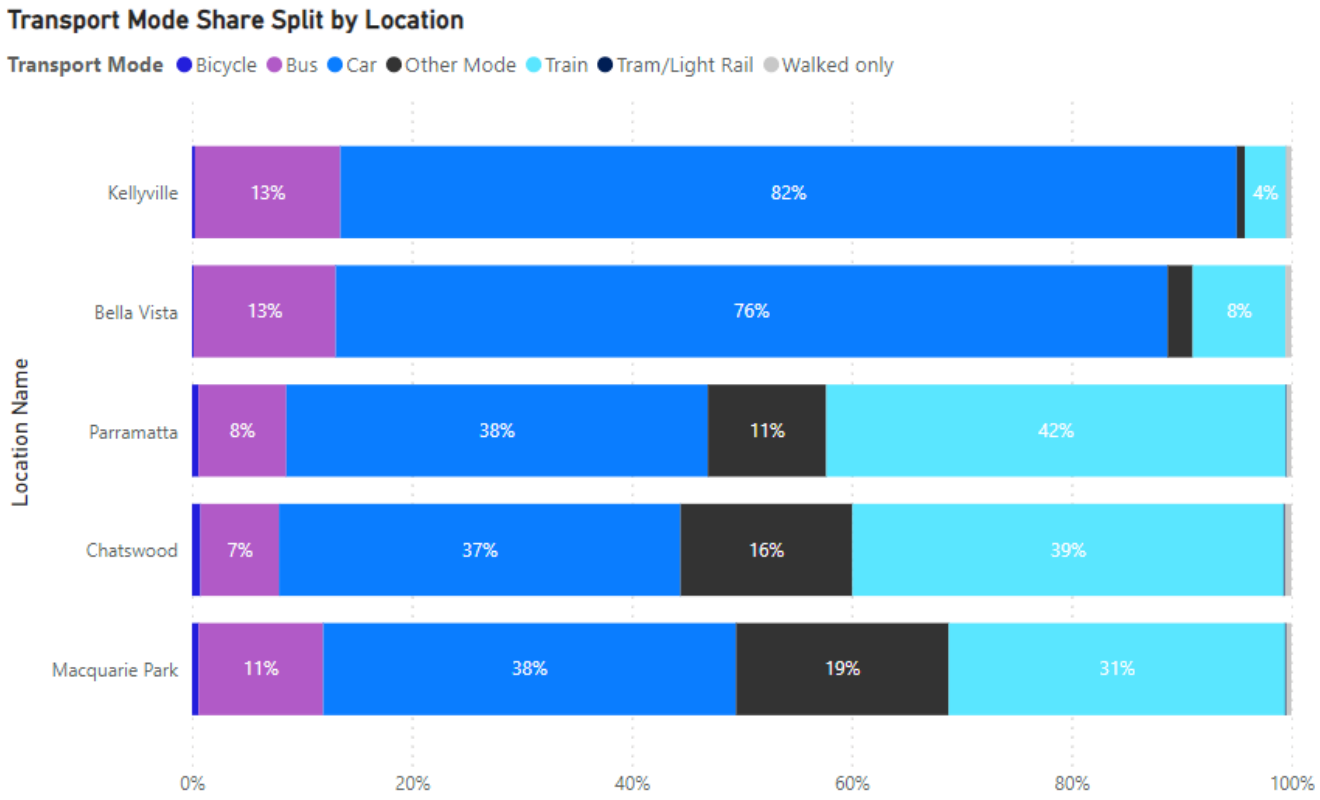


Figure 2-4: Method of Travel to Work by Suburb (ABS Census 2016)

[2] Note the 2021 Census was conducted during the COVID-19 pandemic, so may not necessarily reflect current conditions due to changes in travel patterns, increase in working from home and other changes arising from COVID-19.

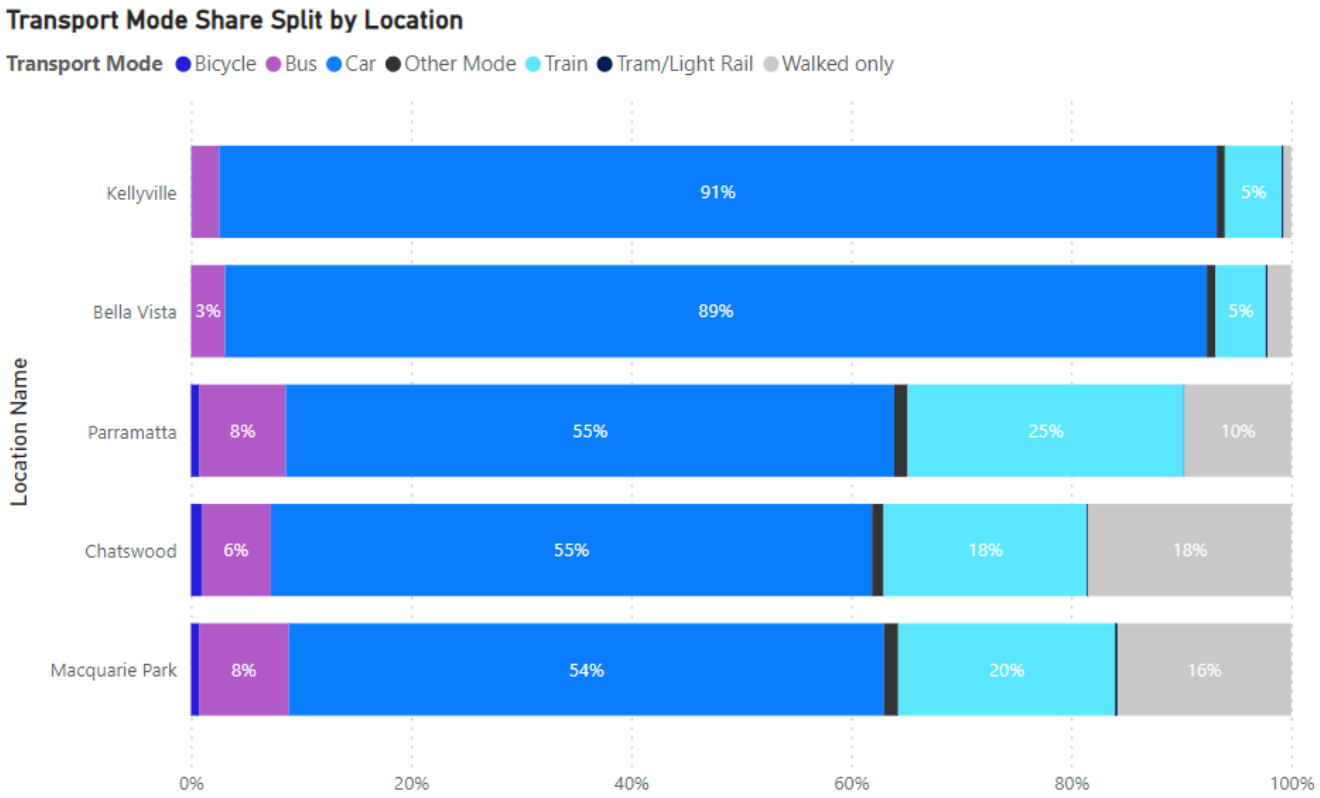


Figure 2-5: Method of Travel to Work by Suburb (ABS Census 2021)

As 2021 travel data is significantly impacted by COVID-19, work from home was excluded from this analysis. Specifically, over 55% of people either did not travel to work or worked from home in Bella Vista and Kellyville during 2021. It should be noted that all types of trips were affected at the time of the 2021 Census and unlikely to be indicative of actual travel behaviour. Prior to COVID-19, only 7% and 8% of Bella Vista and Kellyville employed people did not travel to work and 5% of workers worked from home.

Before the opening of Sydney Metro Northwest, over 75% of work trips reported were undertaken by private vehicle in Bella Vista and Kellyville in 2016. Despite the opening of Sydney Metro Northwest in 2019, the proportion of private vehicle usage for work trips in 2021 increased to over 89%, however this is likely to be largely attributed to the travel restriction imposed in response to COVID-19. Public transport usage in Bella Vista and Kellyville is expected to gradually recover to or exceed pre-COVID levels after 2021 given the easing of travel restrictions, the return to in-office work, and the availability of the Metro Northwest which offers direct travel to Chatswood and the Sydney CBD.

Active transport across 2016 and 2021 accounted for a low proportion of work related travel with less than 3% of trips undertaken by either walking or cycling in Bella Vista and Kellyville. However, promising trends were exhibited in Parramatta and Chatswood with significant uptake in active transport modes in 2021 as the primary choice for travel, which indicates that walking is a viable primary travel option for some trips if safe and adequate pedestrian infrastructure is provided.

An assessment of mode choice in Parramatta and Chatswood demonstrates the importance of proximity to rail as being a key factor in determining how people choose to travel. In Parramatta and Chatswood, the number of work-related trips by train are high while private vehicle usage is significantly lower than Bella Vista and Kellyville due to combination of better public transport accessibility, greater mix of different land use and planning controls that regulate parking provisions for new developments and parking pricing policies in commercial areas to drive the public transport mode share higher. The existence of an already well-established bus network in Bella Vista and Kellyville that connect to larger centres shows higher bus usage for travel to work

than Parramatta and Chatswood. This demonstrates the willingness of residents in the area to use public transport when attractive alternative is provided.

2.3.2 Local and Regional Trip Distribution

The main work destinations (SA2) for persons residing in Bella Vista and Kellyville based on 2021 census are outlined in Figure 2-6.

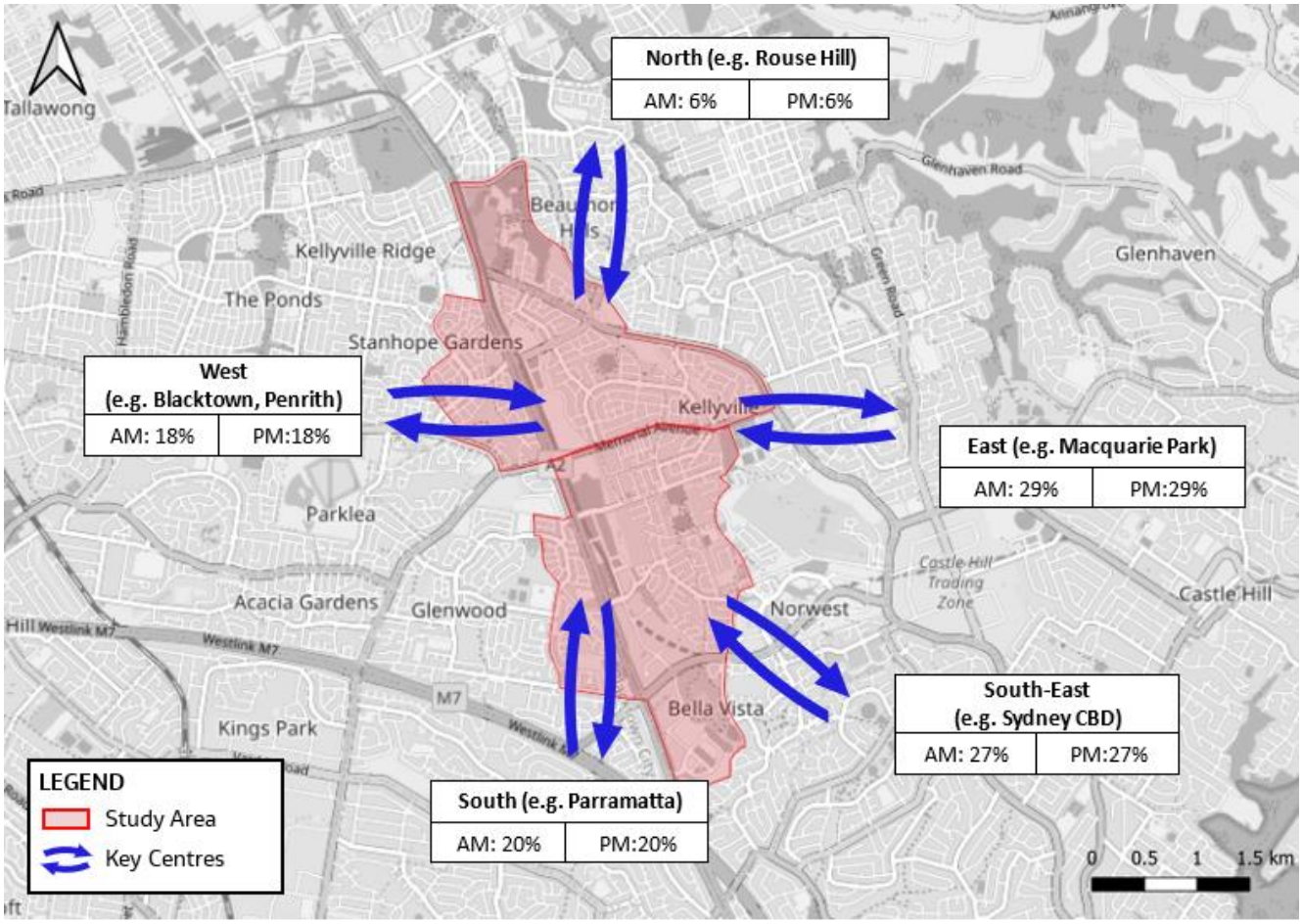


Figure 2-6: Key Place of Work Centres by SA2 (ABS Census 2021)

For persons residing in Bella Vista and Kellyville the proportion of external work destinations by directionality are:

- East – e.g. Macquarie Park, Castle Hill, North Sydney, St Leonards (29%)
- South-East – e.g. Sydney CBD, Redfern, Ermington (27%)
- South – e.g. Parramatta, Westmead, Northmead, Baulkham Hills (20%)
- West – e.g. Blacktown, Lalor Park, Prospect Reservoir, Penrith (18%)
- North – e.g. Rouse Hill, Richmond, Dural (6%)

For persons residing in Bella Vista and Kellyville the top three internal work destinations are:

- Baulkham Hills (West) - Bella Vista (15%)
- Kellyville – West (7%)
- Stanhope Gardens – Parklea (2%)

It is clear that work-based journeys coming into the precinct are predominantly from locations within or adjacent to the Bella Vista and Kellyville Station Precincts. Conversely, trips by residents in Bella Vista and Kellyville to their employment are more varied, with some short trips within the Station Precincts but most are regional trips towards the Sydney CBD, Parramatta, and Macquarie Park employment hubs. Note, the majority of work-related trips travelling to and from Baulkham Hills (West) - Bella Vista (SA2) are associated with employment in the Norwest Business Park.

2.3.3 Trip Distance

Trip distance was analysed for the Baulkham Hills SA3 region (which includes Bella Vista and Kellyville) based on 2018/19 Household Travel Survey (HTS) data and is shown in Figure 2-7, providing information about person's average trip distance over a 24-hour period.[3]

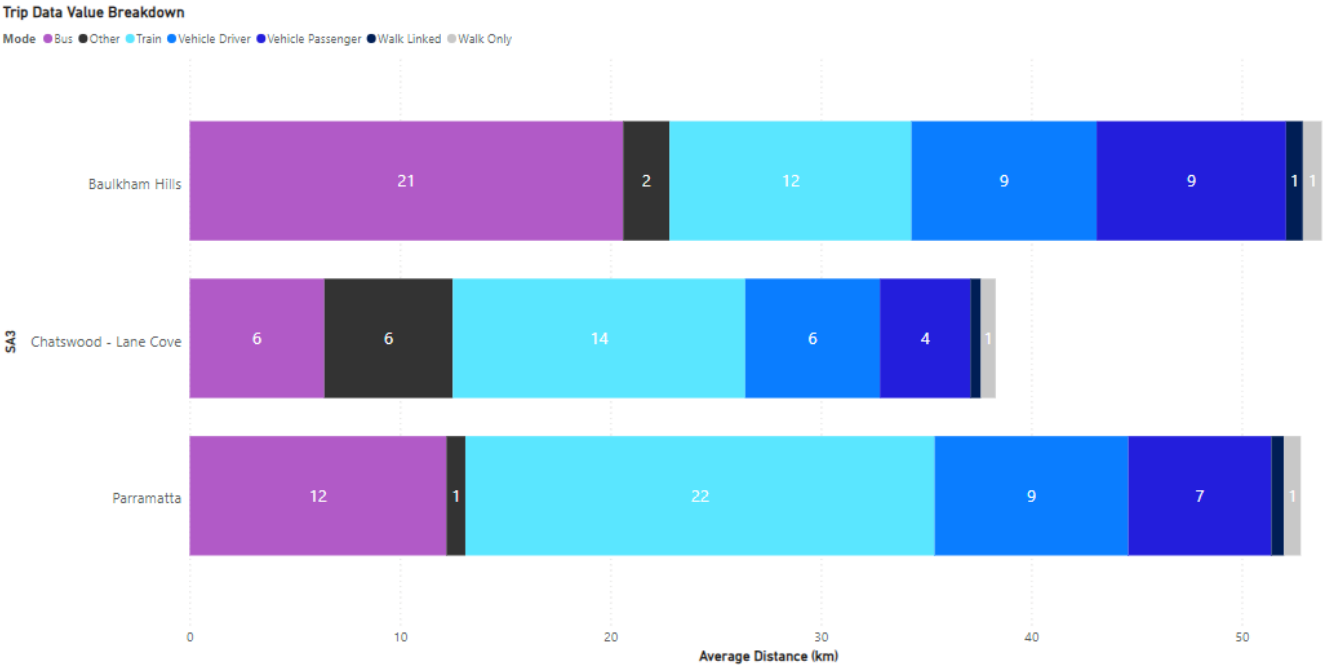


Figure 2-7: Average Distance (km) travelled by Mode SA3 (HTS 2018/19)

The data indicates that the average trip distance by bus (21km) exceeded those by train (12km) in the Baulkham Hills SA3. This trend was likely driven by the limited access to train and metro services prior to the opening of Sydney Metro Northwest. The opening of the metro line has resulted in a gradual transition towards the metro as the preferred transport mode for longer distance trips. This aligns with existing precincts already serviced by accessible train/metro networks such as Parramatta and Chatswood.

[3] Pre-COVID-19 HTS data was used as post-COVID estimates are not yet available for Baulkham Hills by SA3 due to low sample collection and impact of changed travel behaviours resulting from COVID-19. It is also important to note that HTS data is not available at a suburb level (e.g. Bella Vista and Kellyville), hence data is shown at a SA3 level.

The average distance of private vehicle trips was consistent at around 9km from 2012/13 to 2018/19 which shows that private vehicle remains as the default mode choice for short to medium trips. Similarly, the average distance of walk only trips remained consistent at below 1km between 2012/13 and 2018/19.

Planning for transport infrastructure and services in the Bella Vista and Kellyville Station Precincts will therefore need to cater for both local and longer distance trips.

2.3.4 Trip Purpose

Trip purpose was analysed for the Baulkham Hills SA3 region (which includes Bella Vista and Kellyville) based on 2018/19 HTS data and is shown in Figure 2-8 and Figure 2-9, providing information about person's average daily travel patterns over a 24-hour period.[3]

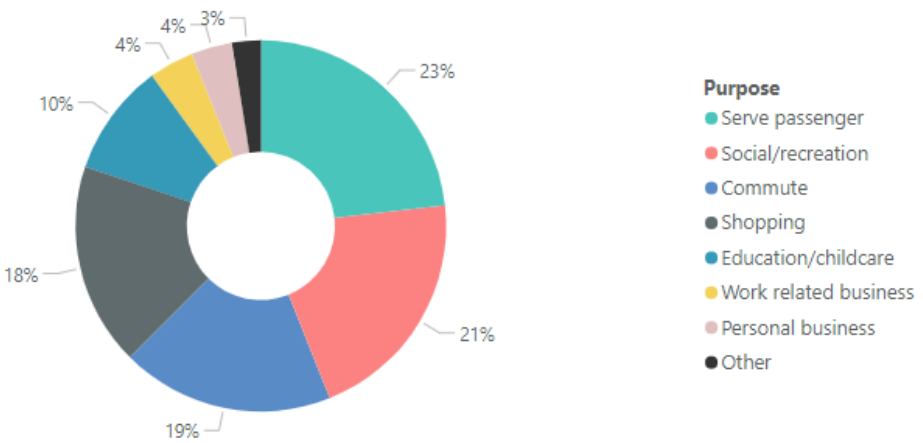


Figure 2-8: Trip Purpose Proportions – Baulkham Hills SA3 (HTS 2018/19)

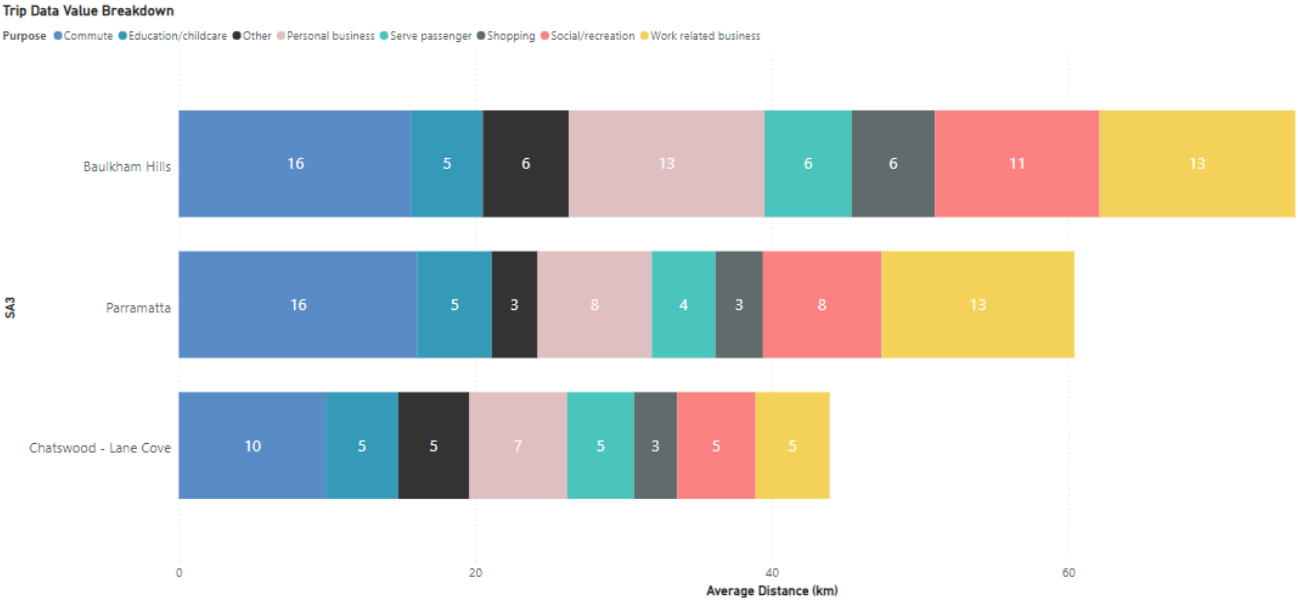


Figure 2-9: Average Trip Distance (km) by Purpose SA3 (HTS 2018/19)

The top four travel purposes during the day for residents in the Baulkham Hills SA3 region include, to serve passengers[4] (23%), social and recreation (21%), work commute (19%) and shopping (18%). Overall, 130,000 trips were made to serve passengers indicating a notable number of trips involved pick up/drop offs often involving short trips, carpools and ride-share services.

On average, peak hour commutes for residents involved a 35 minute trip at 16 km in length, with private vehicle being the predominant mode for most work trips. Commuting trips were also the longest based on distance amongst all trip purposes and are defined as the first trip to work of the day, usually from home (excluding trips to return to work). Generally, the average trip distance for personal business, social, and shopping purposes are longer for the Baulkham Hills SA3 region when compared with other train/metro SA3 regions indicating residents travel further on average to access shopping and recreational facilities.

Sydney Metro Northwest and Transitways provide the opportunity for public transport to take a greater share of everyday trips, especially as trip distances are currently averaging over 10 km for multiple purposes. There are also opportunities to activate the precincts as local destinations through the rezoning to reduce the average trip lengths. This would offer residents the choice to make more local trips within Bella Vista and Kellyville precincts, such as for shopping or education purposes, without needing to travel to neighbouring suburbs for the same trip purposes.

2.4 Active Transport Network

The existing residential developments in Bella Vista and Kellyville have been largely designed with low permeability to discourage vehicles traversing through residential streets. Consequently, they limit accessibility of pedestrians and cyclists travelling between the local network and the wider regional network, especially east-west connections. Combined with other barriers such as the topography of the local area, active transport mode share in The Hills Shire accounts for less than 3% (ABS Census 2016 and 2021). Among major roads, Samantha Riley Drive (between Macquarie Avenue / Gainsford Drive and Windsor Road) currently does not have any cycling facilities. Key routes such as Norwest Boulevard do not provide ideal walking or cycling environments as they lack adequate crossings and footpath widths.

At a broader level, there is already a reasonable level of connectivity provided on the Strategic Cycleway Corridors. This includes a segregated cycleway alongside the Westlink M7 Motorway and shared pedestrian and cycle paths provided on Old Windsor Road, Windsor Road, Schofields Road and Sunnyholt Road. The Memorial Avenue Upgrade Project, which is scheduled to be completed in late 2024, includes cycling facilities along the corridor (i.e. bicycle lanes and shared paths).[5]

In addition, there is a shared pedestrian and cycle path under the elevated metro sky-train viaduct that runs between Bella Vista and Rouse Hill. There are also bike sheds and lockers at Bella Vista and Kellyville Stations to encourage users to adopt active transport as a mode of travel. The existing active transport network within the surrounding Bella Vista and Kellyville Station Precincts is shown in Figure 2-10. The shown cycle routes are those identified as 'off-road' cycleways or with 'low difficulty' by Transport for NSW (TfNSW).

[4] 'Serve passenger' purpose is to drop-off, pick-up or accompany another person. Source: https://www.transport.nsw.gov.au/system/files/media/documents/2022/HTS%20Glossary%20of%20terms.pdf

[5] Source: https://www.transport.nsw.gov.au/projects/current-projects/memorial-avenue-upgrade-kellyville

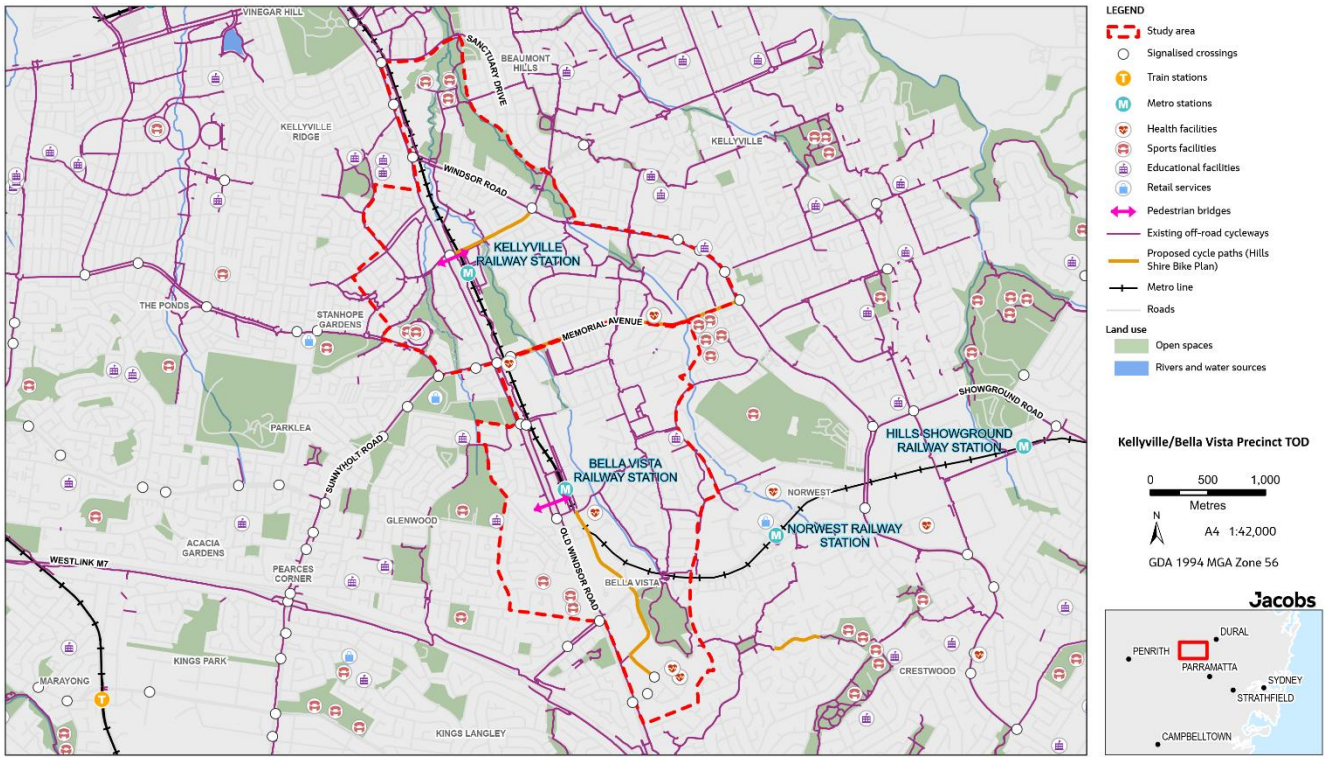


Figure 2-10: Existing active transport network.

The pedestrian bridge across Old Windsor Road and the North-West T-way at the intersection of Samantha Riley Drive and Newbury Avenue provides a key walking and cycling link to Kellyville Station. This bridge allows grade separated access over Old Windsor Road to provide safe and direct access for residents to Kellyville Station and the T-way bus stop. There is also a pedestrian bridge across Old Windsor Road north of Celebration Drive linking Glenwood to Bella Vista Station. This bridge coupled with Glenwood Pedestrian Link, delivered by Sydney Metro between Old Windsor Road and Sharrock Avenue, has improved opportunity for residents in the Glenwood area to walk to and from Bella Vista Station and the T-way bus stop.

The existing pedestrian links and the 400m, 800m and 1.2km catchments in the immediate area surrounding Bella Vista and Kellyville Station Precincts are shown in Figure 2-11. The catchments indicate the actual walking distance for a pedestrian based on the connections available (i.e. footpaths and pedestrian bridges).

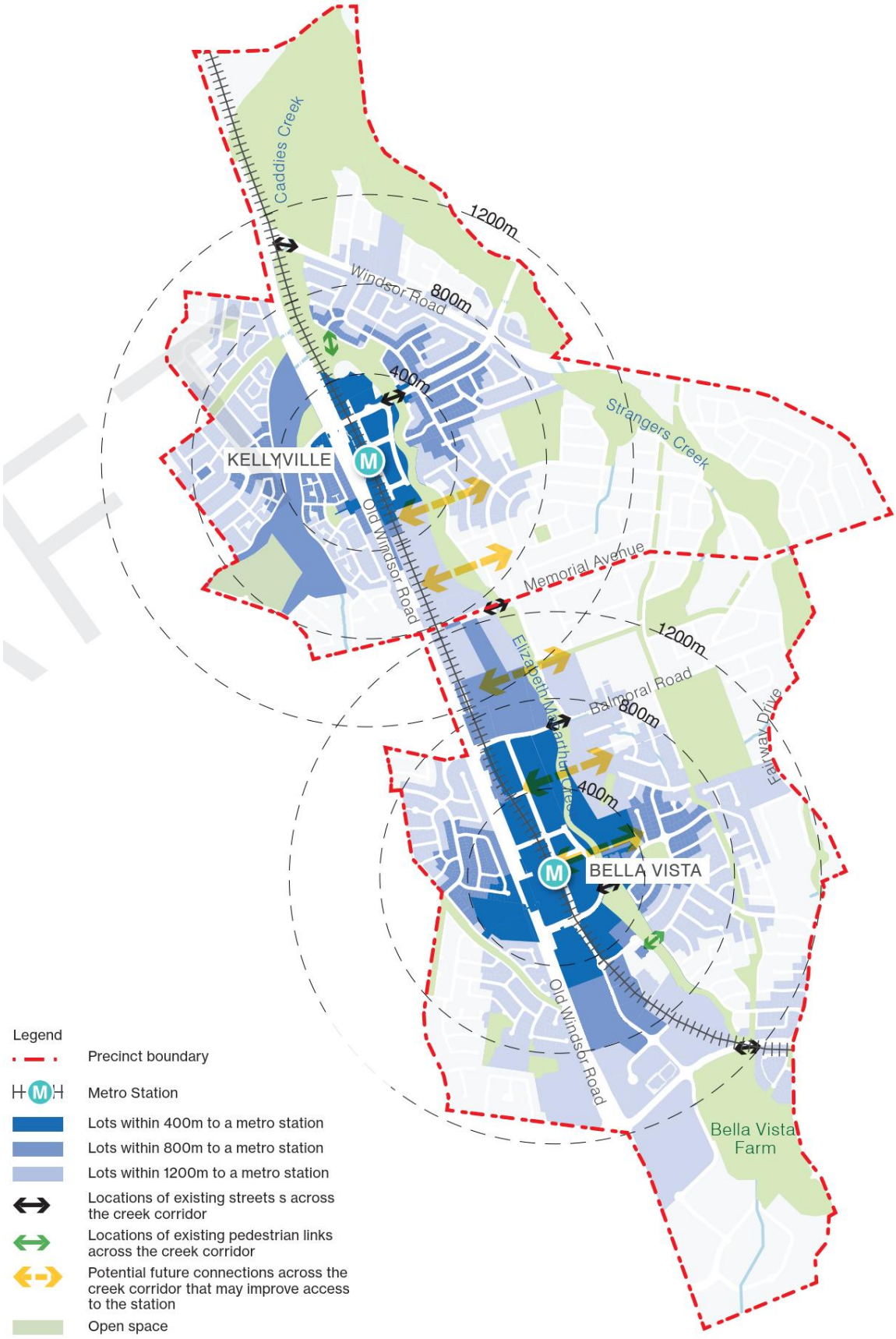


Figure 2-11: Existing Bella Vista and Kellyville Stations walking catchments (Architectus 2024)

2.5 Public Transport Network

The existing public transport network surrounding the Bella Vista and Kellyville Precincts is shown in Figure 2-12.

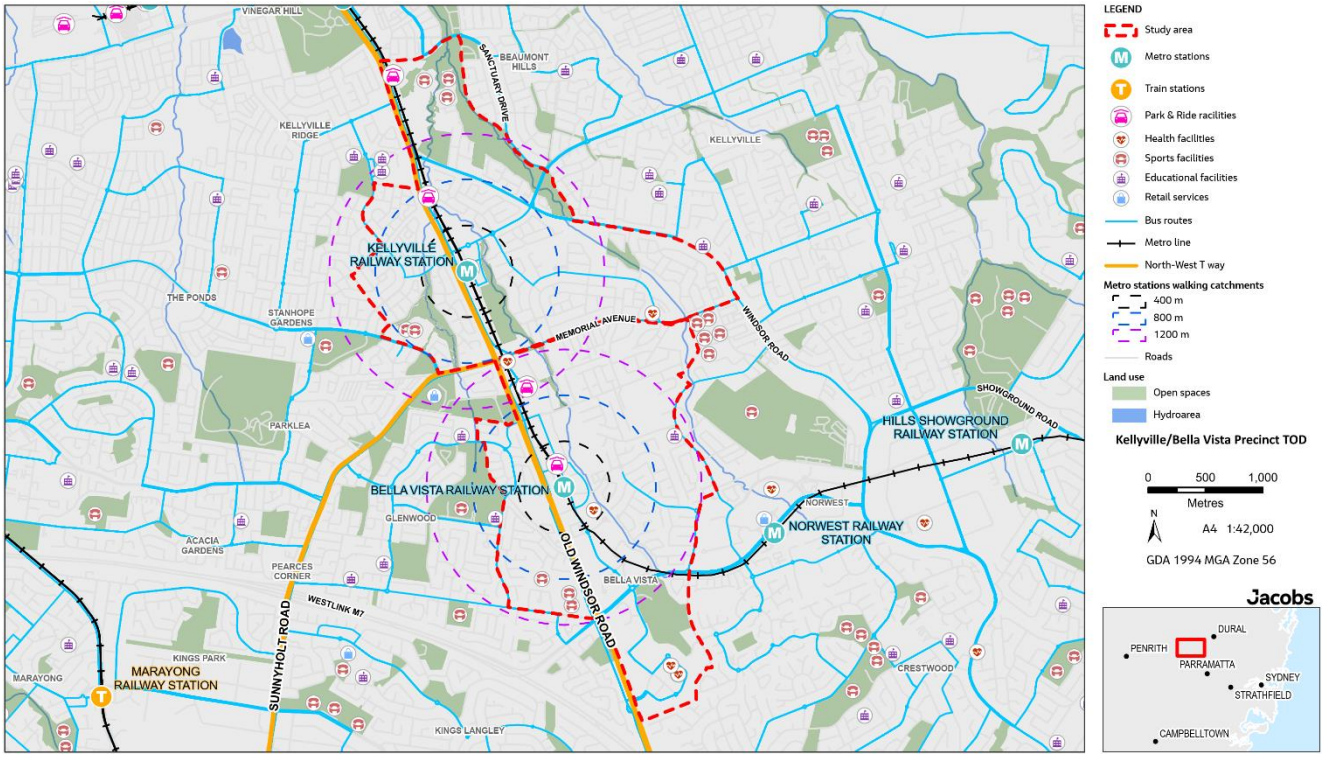


Figure 2-12: Existing public transport network

Passenger services on the Sydney Metro Northwest started in May 2019 between Tallawong and Chatswood, which was recently extended to the Sydney CBD and Sydenham as part of the Sydney Metro City and Southwest project. The Metro provide a driverless metro train service every four minutes during the peak, five minutes in the interpeak period and every 10 minutes off-peak. In future, there will be ultimate capacity for services to be increased to a metro train up to every two minutes in each direction under the city.

The Metro is complemented by Park & Ride facilities next to metro stations with 800 spaces at Bella Vista and 1360 spaces at Kellyville, allowing commuters 18 hours free parking using the Opal ticketing system to drive, park and catch the metro to their destination. Before the introduction of Sydney Metro Northwest, on average approximately 6% of total residents in Bella Vista and Kellyville used trains for travel to work (refer to Section 2.3.1) with the closest train station located over four kilometres away at Seven Hills.

The Sydney Metro Northwest has provided direct connections to jobs and services across the north-west region, as well as indirect connections with other parts of Sydney via interchanging with other public transport services. This includes Rouse Hill, Castle Hill, Norwest, Macquarie Park, Chatswood and Sydney CBD, which make up a significant proportion of work trips travelling into and out of Bella Vista and Kellyville. With the extension from Chatswood to Sydenham, Bella Vista and Kellyville residents are able to travel to additional destinations without needing to change services thus increasing attractiveness of public transport.

In addition to the Sydney Metro, there is an established bus network serving Bella Vista and Kellyville precincts which provides access to:

- Local destinations such as:

  - Bella Vista and Kellyville Stations;
  - Norwest Business Park; and
  - Norwest Private Hospital.
- Regional connections such as:
  - Rouse Hill, Norwest and Castle Hill;
  - Blacktown, Seven Hills, Parramatta and Westmead.

The North-West T-way runs beside Old Windsor Road with stops at both Bella Vista and Kellyville stations between Rouse Hill and Beaumont Hills/Kellyville to Parramatta and Blacktown.

According to TfNSW, there is poor bus travel time reliability (where buffer time per km and/or delay time per km are over 80%)[6] at the following road segments:

- Parts of Perfection Avenue
- Newbury Avenue
- Parts of Samantha Riley Drive
- Parts of Glenwood Park Drive
- Miami Street
- Greenhill Drive (southbound)
- Norwest Boulevard (eastbound)

TfNSW plans bus services to support future residential, employment and school growth to deliver the best outcomes for the majority of passengers. TfNSW is currently developing a proposal for a state-wide Medium Term Bus Plan in response to recommendations by the Bus Industry Taskforce. The Medium Term Bus Plan is a 10-year roadmap that will outline service improvements across NSW and will prioritise restructuring the bus network, increasing service frequency and expanding network coverage over the next 10 years.

2.6 Road Network

The Bella Vista and Kellyville precincts are serviced by two key arterial roads: Old Windsor Road and Windsor Road. Old Windsor Road (between Sanctuary Drive and Westlink M7 Motorway) is a four to six lane arterial road that provides a north-south connections between Greater Parramatta and Rouse Hill, with a posted speed limit of 80 km/h along most of its length. Windsor Road (between Old Windsor Road and Showground Road) is a four-lane arterial road linking Rouse Hill to Castle Hill and has a variable posted speed limit from 60 km/h up to 80 km/h, with a school zone operating around Kellyville Public School during school periods.

Adjacent to the Bella Vista and Kellyville station precincts, Celebration Drive, Balmoral Road, Memorial Avenue and Samantha Riley Drive provide east-west connectivity between Old Windsor Road and Windsor Road. These roads have posted speed limits that vary from 50 km/h to 70 km/h. The existing road network within the investigation area is shown in Figure 2-13, with road network hierarchy based on planning documents from The Hills Shire Council and Blacktown City Council.

[6] Source: https://www.movementandplace.nsw.gov.au/place-and-network/built-environment-indicators/bus-and-strategic-freight-reliability

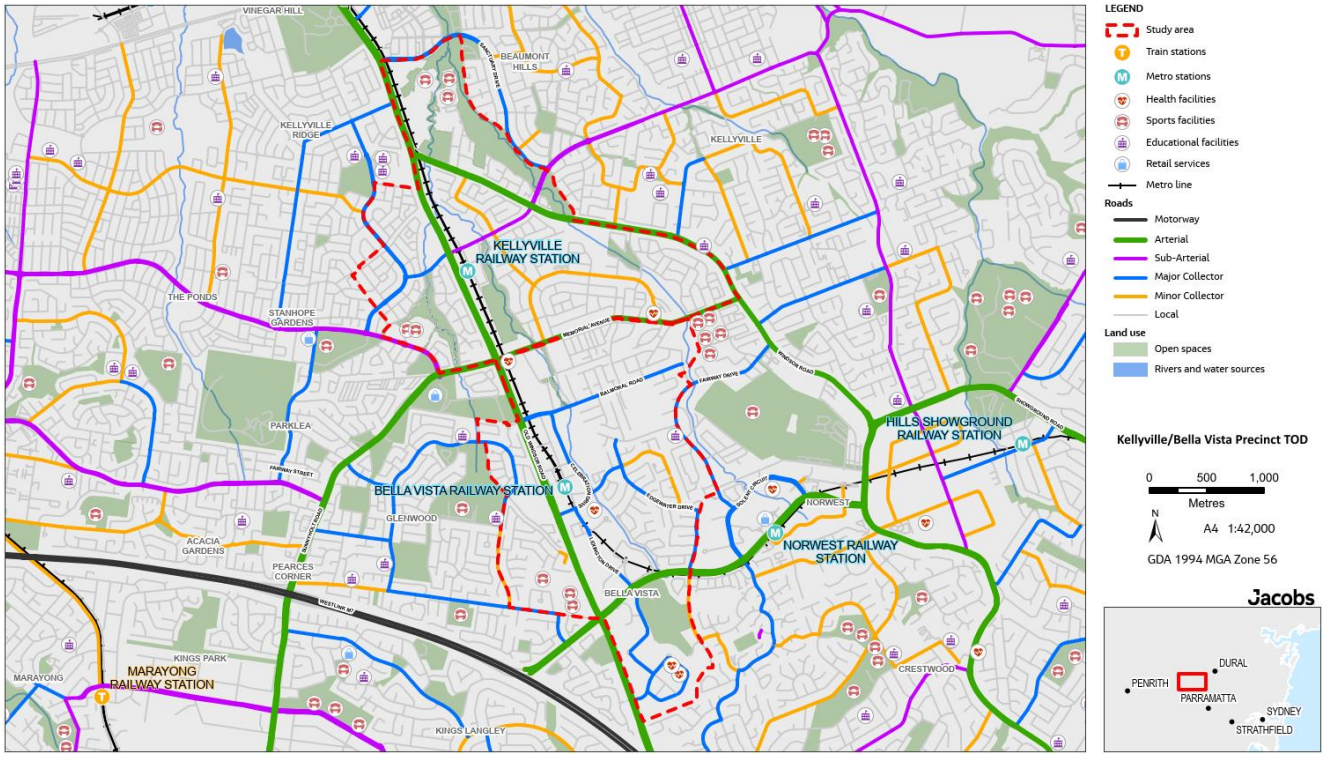


Figure 2-13: Existing road network

The design and operating environment of the regional roads through and across the precinct act as barriers to high connectivity and convenient access within the area for residents.

Within the metro station precincts, the internal road structure surrounding the metro stations are being provided for enhanced connectivity for pedestrians and cyclists. This includes sub-features that enable these streets to offer high connectivity and amenity, such as wide paths, kerb ramps, regular seating and significant planting to provide shade.

2.6.1 Existing Road Network Performance

The intersection operational performances, travel times and links average speeds have been assessed in previous studies to determine the existing road network performance. The relevant studies include:

- The Hills Metro Station Precincts Traffic and Transport Study (Stantec 2023)
  - Study area: Norwest / **Bella Vista**, Hills Showground and Castle Hills Station Precincts (but not Kellyville Station Precinct).
- Landcom Bella Vista and Kellyville Station Precincts – Concept SSD Application (Jacobs 2022)
  - Study area: **Bella Vista and Kellyville Station Precincts**.

Hence, the existing road network performance results for the Kellyville Station Precinct are taken from the *Landcom Bella Vista and Kellyville Station Precincts – Concept SSD Application*, while the existing road network performance results for the Bella Vista Station Precinct are taken from *The Hills Metro Station Precincts Traffic and Transport Study*. A summary of the results is provided below, with the detailed results available in **Appendix A.**

2.6.1.1 Intersection Performance

Kellyville Station Precinct

The *Landcom Bella Vista and Kellyville Station Precincts – Concept SSD Application (Jacobs 2022)* study assessed the performances of intersections near Bella Vista and Kellyville Stations.

The modelling results showed that majority of signalised intersections surrounding the two precincts operate at or are approaching their capacities in the peak periods. In particular, key intersections at Old Windsor Road / Samantha Riley Dr / Newbury Ave intersection and Old Windsor Rd / Memorial Ave / Sunnyholt Rd are both operating near capacity and experiencing travel delay in peak hours. The highest flows are in the southbound direction along Old Windsor Road and Windsor Road in the AM peak and in the northbound direction in the PM peak hour. The intersections of Old Windsor Road / Windsor Road and Sunnyholt Road / Stanhope Parkway operate better as both intersections are T-junctions and operate fewer phases and therefore provide higher lane capacities compared to full intersections.

Bella Vista Station Precinct

The Hills Metro Station Precincts Traffic and Transport Study (Stantec 2023) assessed the existing intersection performances surrounding the Bella Vista Station. The intersection and network performance results from the Rebased traffic Model (Aimsun) have been used to represent the 2020 traffic conditions for this assessment (on a typical day outside of the COVID-19 lockdown). The modelling results showed extra capacity is required for the Windsor Rd / Memorial Ave / Sunnyholt Rd and Old Windsor Rd / Balmoral Rd / Miami St intersections in the AM and PM peak hours. In addition, the Old Windsor Rd / Celebration Dr intersection is at capacity in the PM peak hour.

2.6.1.2 Travel Time and Average Speed

The Hills Metro Station Precincts Traffic and Transport Study (Stantec 2023) assessed the travel times and average speeds of key routes in the precincts. The travel times on key routes were validated in the development of the Rebased Model. The morning (AM) peak hour is considered to be between 8:30am – 9:30am, while the afternoon (PM) peak hour is between 5:00pm – 6:00pm.

The modelling results indicated Windsor Road experiences relatively satisfactory travel speeds in both directions in AM and PM peak hours. Old Windsor Road is operating at capacity in the northbound direction during PM peak hour. Norwest Boulevard also operates at capacity in the eastbound direction in both AM and PM peak hours. With the increased high density residential proposed in Glenwood, there is increased traffic demand from Glenwood to Norwest Boulevard via Greenhill Drive especially during the AM peak.

2.7 Freight Network

The existing freight network surrounding the Bella Vista and Kellyville Station Precincts consists of the Westlink M7 Motorway, Old Windsor Road, Windsor Road, Sunnyholt Road and Memorial Avenue.

Freight reliability has been identified as low (buffer time per km and delay time per km are over 80%)[7] at the following road sections:

- Westlink M7 Motorway between Abbot Road and Norwest Boulevard (Tier 1).

[7] Source: https://www.movementandplace.nsw.gov.au/place-and-network/built-environment-indicators/bus-and-strategic-freight-reliability

- Sunnyholt Road between Quakers Hill and Westlink M7 Motorway (Tier 2).
- Windsor Road between Showground Road and Samantha Riley Drive (Tier 3).
- Old Windsor Road between Norwest Boulevard and Abbot Road (Tier 3).

This means unexpected delays and longer travel times due to variable traffic condition are expected along these routes. The rest of the freight network has generally moderate freight reliability (buffer time per km and delay time per km are between 40-60%).[5] Poor journey time reliability is noted to occur on higher order movement corridors for both freight and general traffic because of congestion at mid-block locations and at intersections.

Since COVID-19, there has been an increase in urban freight and servicing by Light Commercial Vehicles (LCVs) which handle last-mile deliveries, transport goods and provide household services. LCVs are important for different sectors including council operations, postal services and construction, all of which will increase as the population grows. As the Bella Vista and Kellyville precincts are rezoned with higher density housing, it is important to plan for a network that prioritises people safety by minimising the conflicts between LCVs and pedestrians/cyclists. Consideration must also be given to accessibility to loading and unloading zones, both on-street and on site/off-street, to ensure efficient freight operations, especially within mixed-use areas to accommodate both residential and commercial needs.

2.8 Planned Transport Initiatives and Infrastructure

A range of transport initiatives and potential infrastructure investments associated with the precinct had been identified in previous infrastructure analysis for the Metro SSD sites, by TfNSW, and by councils including those in existing local contribution plans. The timing, justification and details on their scope, funding and delivery will be subject to planning, design and capital investment programming as part of further investigations by councils and relevant agencies. These were considered and contributed to the list of transport initiatives and infrastructure projects relevant to the precincts in Section 6.3 and Section 6.5.

3. Transport Vision and Future Land Use

3.1 Strategic Transport Planning Context

The TfNSW Future Transport Strategy (2022) sets out the vision for the transport network in New South Wales to promote a 'Vision and Validate' approach to planning. It sets out the aspiration to achieve more choice and better access, especially for public transport, walking and cycling to maximise the use of the existing network by prioritising the most 'productive' vehicles (like those that carry multiple passengers or goods). The Strategy is complemented by TfNSW's Movement and Place framework, which guides transport practitioners in balancing the place functionality of an area with its role in moving people and goods.

The Strategy introduces the concept of 15-minute neighbourhoods; a principle that prioritises people's ability to meet day-to-day needs locally and create thriving, healthy communities. For Transport, this means activating local places and offering travel choices by prioritising place making, walking, cycling, micromobility and last mile freight within 15 minutes of precincts and local destinations. In new developments, 15-minute neighbourhoods can be supported by co-locating housing and relevant local services.

The Strategy also sets out the concept of 30-minute cities; where planning should ensure that key destinations (strategic centres, major health precincts, tertiary education precincts and cultural or leisure destinations) are accessible 24/7 within 30 minutes by public transport for the majority of residents.

The Hills Shire Integrated Transport and Land Use Strategy (2019) outlines the strategic planning priorities for the transport network to achieve the vision in the *Hills Future 2036*:

"To shape exceptional living, working and leisure places where expected growth brings vibrancy, diversity, liveability and prosperity for The Hills."

At a project level, the vision for the Bella Vista and Kellyville Precincts under the urban design framework (Architectus 2024) is:

"Transformed by Metro and unified by Elizabeth Macarthur Creek, Bella Vista and Kellyville will become vibrant, green and connected communities where people can live, work and play amid the bushland setting of north-west Sydney."

This precinct vision is accompanied by the following guiding principles:

- Provision of a range of housing, employment and retail services close to transport connections.
- Creation of attractive, convenient and walkable local centres around the stations, providing shops, cafes, restaurants, a village square and jobs.
- Provision of a high quality, pleasant network of public, green open space areas including new sports fields, local parks and enhanced riparian corridors.
- Delivery of more homes close to the stations to meet growing demand and increase housing choice to reflect changing household sizes and lifestyles.
- Improving access and connections to the new stations and throughout the precincts through new access roads, improved bus services, pedestrian and bicycle paths, and crossing over creek corridors.
- Managing impacts on natural environment including protection of remnant ecological communities in the creek corridors running through the precinct.
- Expansion of employment and business opportunities through the revitalisation of the existing Norwest Business Park, and the creation of new business locations adjoining the stations.

3.2 Transport Vision and Objectives

To align with the overall precinct vision, emerging user priorities and strategic objectives of state and local government, this Precinct Transport Statement has been developed in line with the following transport vision:

Bella Vista and Kellyville precincts will provide seamless connections locally and beyond, offering accessible and user centred transport services as part of a sustainable and integrated network.

This will be guided by the following transport objectives:

- Connected
- Accessible
- User Centred
- Sustainable

These provide a focus for the precinct that aligns broader strategic goals. To support these objectives, a number of desired outcomes have been identified, as set out in Table 3-1.

Table 3-1: Transport objectives and desired outcomes

Transport Objectives	Desired Outcomes
Connected: People and places are connected across key strategic and local centres to enable access to social and economic opportunities; supporting the vision for 15-minute neighbourhoods and 30-minute cities.	▪ The precincts will connect residents of Bella Vista and Kellyville with local services and other strategic centres, improving connectivity through an integrated and efficient transport network. ▪ Residents will be able to meet the majority of their day-to-day needs locally using active transport, and access key destinations and centres using the metro and bus connections.
Accessible: The precincts are accessible to all, providing gateways to the wider transport network.	▪ The precincts will improve public transport accessibility, ensuring compliance with the Disability Discrimination Act 1992 (DDA) and associated standards where existing infrastructure is impacted to improve universal access. ▪ A range of trip types will be catered for by the transport network, including education, leisure, caregiving and work trips; ensuring the full range of community needs are represented.
User Centred: Transport services across the precincts provide a high-quality user experience, offering easy and reliable movement through and within the network to meet user needs.	▪ A high-quality user experience provides reliable, safe and predictable travel for trips between Kellyville, Bella Vista and other key destinations. ▪ Residents are empowered to make more sustainable travel choices without compromising on user experience.
Sustainable: The transport system supports sustainable and liveable regions while promoting more walkable, higher density communities around stations, in line with policy objectives.	▪ Residents will be able to meet the majority of their day-to-day needs locally using active transport, and access key destinations and centres using the local metro and bus connections. ▪ Residents are empowered to make more sustainable travel choices without compromising on user experience.

3.3 Assessment Overview

Analysis of the transport requirements is guided by principles of Vision and Validate. That is, a vision for the precinct is set consistent with aspirations for the precinct and transport options are then tested against this vision and ability to achieve the desired outcomes at the highest value for money.

Active transport and public transport assessments are undertaken qualitatively focusing on the level of access and connectivity provided and the balance of Movement and Place in each corridor per travel mode to support uptake. Whilst mode shares have been estimated, capacity assessments have not been undertaken for active transport or passenger crowding on public transport as these modes do not experience capacity issues in the same way that vehicles do on the road network.

Thus, whilst the primary objective of the study is to develop and support sustainable travel through the provision of attractive active and public transport connections, there would be road network impacts as a result of the changes being proposed. To support the proposed rezoning, a first principles trip generation spreadsheet model of the area and major connecting roads was developed to identify the potential road network impacts. The model applies a first principles approach to the generation of vehicle demand using existing and proposed dwellings numbers within the study area. Trips are then assigned to the road network to estimate the level of utilisation by vehicles. Demand on the road network includes new trips generated from Bella Vista and Kellyville precincts, through traffic and other local traffic (i.e. not related to the TODS when assessing performance). Performance metrics include mid-block capacities (i.e. volume to capacity ratios) and modelling of key intersections using the SIDRA intersection modelling program as part of assessment of the road network.

3.4 Land Use and Dwelling Projections

The exhibited draft structure plan for the Bella Vista and Kellyville Precincts is shown in Figure 3-1.

The majority of dwellings fall within a 1,200m catchment of the metro stations generally considered a viable walking/cycling distance for residents between their dwellings and rail stations. Whilst this is a useful guide for strategic consideration of likely catchment to a rail station, the relative attractiveness of access to the metro by walking or cycling will ultimately be determined by a range of factors, of which distance is just one. In particular, the provision of attractive and safe walking and cycling infrastructure will be imperative to the uptake of these modes.

The inclusion of mixed-use developments in the precincts, particularly along the rail corridor will enable activation of '15-minute neighbourhood' amenity for residents; meaning that many day-to-day commercial and urban services can be provided and accessed locally within a walking/cycling catchment without the necessity to use a car. These services may also attract people from outside the precinct and as part of multi-purpose trips.

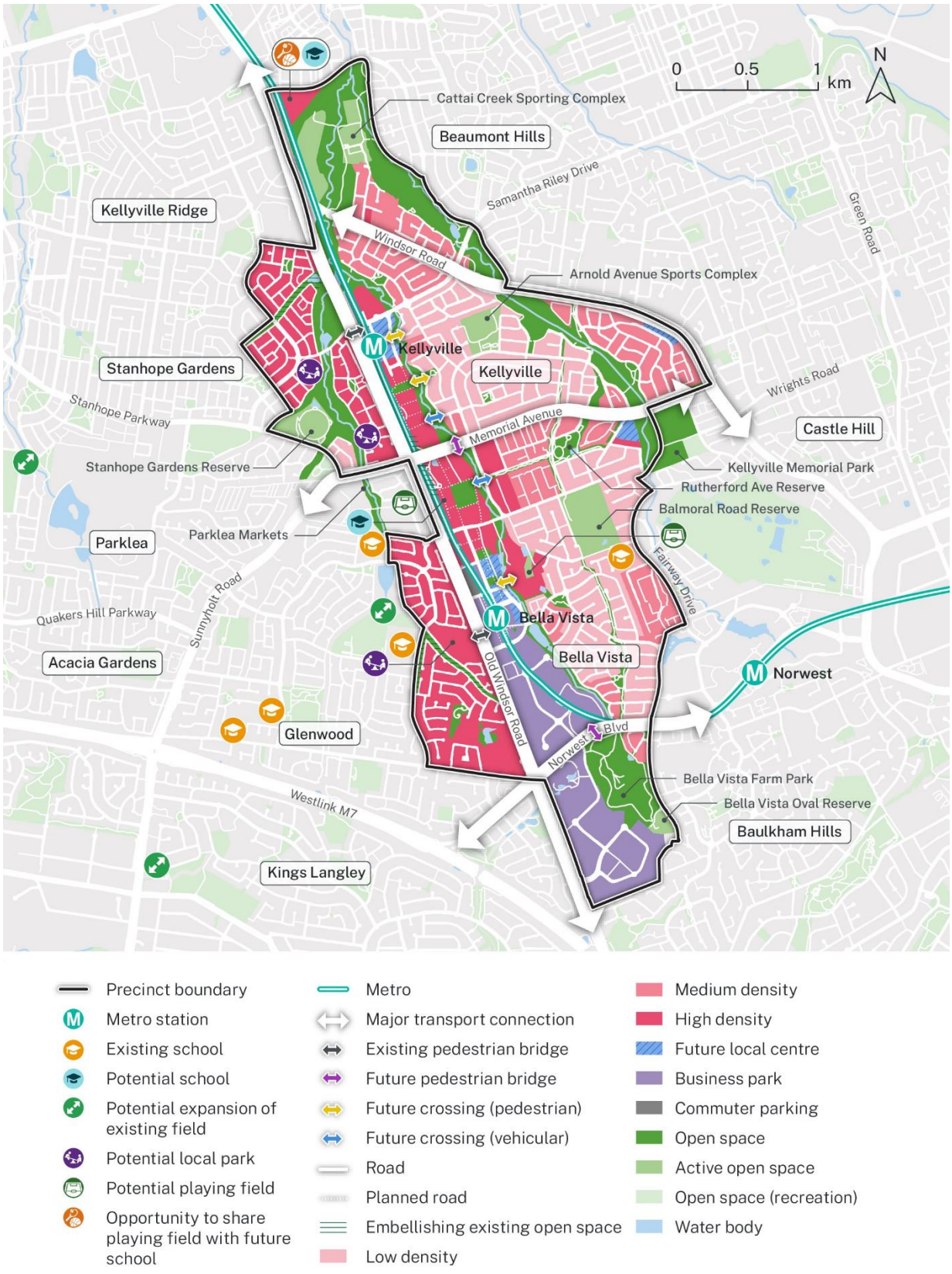


Figure 3-1: Exhibited Draft Structure Plan for Bella Vista and Kellyville Precincts (DPHI 2024)

The three dwelling scenarios that formed the basis for the performance assessment of traffic impacts are defined in Table 3-2. 2041 has been chosen as the project case assessment year. This scenario looks at the additional dwellings assumed to be completed by 2041 due to TOD rezoning, based on a percentage take-up of full capacity informed by the feasibility assessment. This future project case 2041 scenario includes about 600 additional high density dwellings in Glenwood which were subsequently removed in the final rezoning.

Table 3-2: Analysis Scenarios

Scenario	Definition
Base Case	Existing dwellings only.
Future Project Case (Full)	Projected dwellings at full development from existing dwellings, existing and proposed planning controls.
Future Project Case 2041	Projected dwellings with take-up until 2041, excluding expected existing dwellings lost to enable new developments Refer to **Appendix C** for take-up assumptions.

The dwelling projections for each dwelling scenario provided by DPHI are shown in Table 3-3.

Table 3-3: Dwelling projections in 2041 – Bella Vista and Kellyville Precincts

Density	Base Case	Future Project Case (Full)	Future Project Case 2041
Low density	5,779	6,197	**6,265**
Medium density	612	3,853	**612**
High density	0	22,459	**13,183**
Total	6,391	32,509	**20,060**

Key inputs into calculation of development for the future project case 2041 include:

- Existing dwellings in the precincts;
- A percentage take-up of the existing dwelling capacity permitted under current planning controls;
- A percentage take-up of the additional dwellings as a result of TOD rezoning; and
- The redevelopment of existing low-density dwellings as high-density apartments.

In future project case 2041, there will be a total of 20,060 dwellings in the precincts, as compared with 6,391 dwellings currently. A breakdown of the dwellings numbers and typologies by block is provided in **Appendix C**.

3.5 Movement and Place Framework

The NSW Movement and Place Framework outlines a multi-disciplinary, place-based approach to the planning, design, delivery and operation of transport networks.[8] It provides a cohesive approach to aligning the integrated and efficient movement of people and goods with amenity and quality of places.

The four street environments of the NSW Movement and Place Framework are civic spaces, main streets, local streets and main roads. This is illustrated in Figure 3-2.

[8] Source: https://www.movementandplace.nsw.gov.au/about/about-movement-and-place

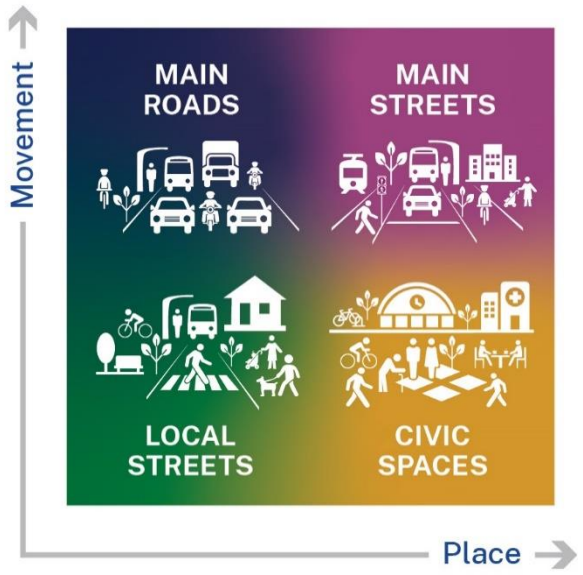


Figure 3-2: Four street environments in the NSW Movement and Place Framework (NSW Government 2023)

As part of this study the Movement and Place principles have been applied to develop aspirational classifications for key corridors in the precincts, relative to local land use. Appreciating the desired function of future road and street network as per the Movement and Place classification will enable the design of new infrastructure and upgrades to roads and streets in the precincts to be guided by this framework.

The existing internal corridors in the Bella Vista and Kellyville precincts are primarily designed for access to and from properties. As a result, their desired function remains as 'Local Streets' with limited place and movement functionality. In these areas, lower vehicle speeds combined with sensitive infrastructure design will support active local and last mile trips for pedestrians and cyclists. However, the low permeability of these local street, including many cul-de-sacs and no through roads, also means increased travel time for walking and cycling trips. Local streets and roads also provide a starting point for vehicular access to higher order movement corridors in the precincts. The design of direct connections to these higher order corridors will reduce the number of vehicle kilometres travelled on Local Streets by enabling vehicles to leave the local road network; preserving its function for local trips.

Guragura Street and Mawson Avenue are envisioned as the 'Main Streets' within Bella Vista and Kellyville station precincts due to their place as well as movement functions connecting mixed use precincts, retail and open spaces. Movements along these streets will range across different modes and will need to be balanced through strong design principles that take into account the needs of individual modes and place functionality.

'Civic Spaces' will be found in the immediate vicinity of the two station precincts through new station plazas that would provide space for local communities to congregate amongst urban services and retail facilities. Movement functionality will focus on connections to and from these Civic Spaces, rather than providing direct routes *through* them.

The function of Westlink M7 Motorway, Old Windsor Road and Windsor Road would remain 'Main Roads' as they are vital to the efficient movement of people and goods with limited place activity levels. Maintaining good strategic connectivity on these routes for public transport, freight and general traffic will reduce pressure on Local Streets and Main Streets by providing a direct, convenient alternative; preserving the place functions of these areas.

4. Future Road Network Performance

4.1 Modelling Methodology

A bespoke trip generation model has been developed to provide an estimation of the likely level of traffic generation of the Bella Vista and Kellyville TOD precincts for the assessment year 2041 as well as the expected utilisation of by other traffic in the study area.

The methodology is based on application of first principles using vehicle trip generation rates obtained from published RTA/RMS guidelines[9],[10] and adjusted to account for different car mode shares based on precincts walking distances to the Metro stations. Vehicle trip generation of each precinct are then calculated using the numbers of dwellings and their typology e.g. houses, high-density apartments.

To provide an indication of the scale of traffic that is expected to use the road network, the additional traffic from the proposed rezoning is then assigned to the surrounding roads to determine the new traffic demand in the AM and PM peak hours. In addition to TOD traffic, an estimation of through traffic has also been calculated and included. Estimation of through traffic is based on data from traffic surveys from a previous transport study that was carried out for the two Sydney Metro station precincts (Jacobs 2022).

Finally, a high-level assessment of the performance of the road network is conducted to inform on the projected outcomes for major roads in the vicinity of the precincts with the TODs included. The assessment relies on reporting of mid-block capacities (i.e. volume to capacity ratios) and modelling of major intersections using the SIDRA intersection modelling software program. This methodology is described in greater detail in the next sections.

Details of the modelling methodology and spreadsheet model is provided in **Appendix B.**

4.1.1 Trip Generation

The estimation of traffic generation of residential dwellings is based on RTA/RMS vehicle trip rates for different dwelling types and adjusted to account for different car utilisation based on distance of the precincts to nearby Sydney Metro stations.

Table 4-1 shows the vehicle trip generation rates adopted for the assessment. These rates are applied to each dwelling type to calculate the scale of traffic generated in each precinct.

[9] RTA Guide to Traffic Generating Developments (2002).
Source: https://www.transport.nsw.gov.au/system/files/media/documents/2022/guide-to-generating-traffic-developments.pdf

[10] RMS Updated Technical Direction (2013). Source:
https://standards.transport.nsw.gov.au/_entity/annotation/0b980694-a835-ed11-9db1-000d3ae011f9

Table 4-1: Vehicle Trip Generation rates for Residential Dwellings

Zone		Dwelling type	AM trip rate	PM trip rate	Morning direction factor		Evening direction factor	
					Inbound	Outbound	Inbound	Outbound
Residential Dwellings	Station Precincts - K4, K9, BV1, BV7, BV14	Low Density	0.95	0.95	0.2	0.8	0.8	0.2
		Medium Density	0.55	0.45	0.2	0.8	0.8	0.2
		High Density	0.22	0.17	0.2	0.8	0.8	0.2
	Close to Station (within 800m radius) - K3, K5, K6, K7, K8, K10, BV2, BV8, BV9, BV11, BV12, BV15, BV17, BV18	Low Density	0.95	0.95	0.2	0.8	0.8	0.2
		Medium Density	0.55	0.45	0.2	0.8	0.8	0.2
		High Density	0.25	0.20	0.2	0.8	0.8	0.2
	Far from Station (>800m radius) - K1, K2, K11, K12, K13, K14, BV3, BV4, BV5, BV6, BV10, BV13, BV16	Low Density	0.95	0.95	0.2	0.8	0.8	0.2
		Medium Density	0.60	0.50	0.2	0.8	0.8	0.2
		High Density	0.25	0.20	0.2	0.8	0.8	0.2

Specification of trip rates for low and medium density dwelling types is included in the table to capture trip generation of the existing dwelling stock and background growth in secondary dwellings. They are not a part of the TOD proposal which entirely includes provision of high-density residential developments provided within catchments of the stations.

Table 4-2 shows the AM and PM peak hour traffic generations calculated for the future project case 2041 comprising an additional 13,860 dwellings combined for both Bella Vista and Kellyville TOD areas in 2041. It is expected that overall pattern of development would be incremental, initially around the two metro stations where accessibility to transport and amenities is highest and gradually expanding outward. The timing of full realisation of the developments will be driven by market demand and is likely to occur over a long period as each new supply is absorbed as well as consideration that a proportion of existing houses would remain in the near to medium term due to some properties not turning over for redevelopment. For the purpose of this assessment, it is assumed that full development would occur post-2041 and is not captured in the current assessment due to many uncertainties and assumptions associated with long term forecasting. This assessment also assumed about 600 additional high density dwellings in Glenwood by 2041 which were subsequently removed in the final rezoning. As such, trip generation in this assessment slightly overestimates the local demand on the road network enabled by this rezoning.

Table 4-2 also includes the total number of trips generated by the Bella Vista and Kellyville precincts for a 'business as usual' future scenario in which current day travel behaviours and choices are maintained. These estimates are based on assumptions with respect to the number of new dwellings as a portion of total potential development, trip generation characteristics of existing and future dwellings, future land use mix and transport

network provision and performance, all of which impact travel behaviour and the magnitude of traffic generated. A breakdown of the trips calculated to be generated by individual development blocks is provided at **Appendix D**.

Table 4-2: Total additional vehicle trip generation of Bella Vista and Kellyville precincts due to TOD

AM Peak Hour (Trips)		PM Peak Hour (Trips)	
Inbound	Outbound	Inbound	Outbound
700	2,800	2,300	600

Based on the number of dwellings proposed, the Bella Vista and Kellyville TOD precincts are estimated to cumulatively generate approximately 2,800 vehicles per hour (vph) outbound and 700 vph inbound trips in the AM peak hour. A slightly lower number of trips are expected to be generated in the PM peak with approximately 2,300 inbound and 600 outbound trips. The difference in level of traffic generated in the two peak hours is consistent with typical traffic profiles across Sydney where the morning peak period experiences higher peak volumes whereas the PM peak has a slightly lower peak as trip generally spread over a longer duration resulting in a less intense peak.

4.1.2 Trip Distribution

Having derived an estimate of the likely trip generation of both Bella Vista and Kellyville precincts, these trips have been distributed to the surrounding road network based on likely directionality of travel to/from place of residence to work, education and other destinations.

In traffic planning analysis, the distribution of trips relating to future development is commonly informed by outputs from a strategic travel demand forecasting models (such as TfNSW's Strategic Travel Model, STM) which use future land use and transport networks within the modelled areas such as the Sydney Greater Metropolitan Area (GMA) to determine the directionality of trips between origins and destinations across the city. As region-wide land use assumptions associated with the TOD proposals are yet to be finalised for input into STM, the trip distributions for the Bella Vista and Kellyville precincts have instead been estimated using 2021 Census data released by the Australian Bureau of Statistics (ABS). The Census place of Usual Residence by SA1 was used as origin data and Place of Work by SA2 was used as destination data for this analysis. This enabled the calculation of the number of trips in each block by aggregating data from the relevant SA1s that make up each block.

Trip distribution proportions for each block were then determined by analysing both the directionality of the Places of Work relative to each block in conjunction with the number of trips taken from the blocks. As a check, trip distribution proportions using the 2016 census data were also examined and similar results were obtained. The overall trip distribution for both Bella Vista and Kellyville precincts were determined by aggregating total trips generated from all blocks.

Figure 4-1 outlines the overall projected trip distributions for the Bella Vista and Kellyville precincts.

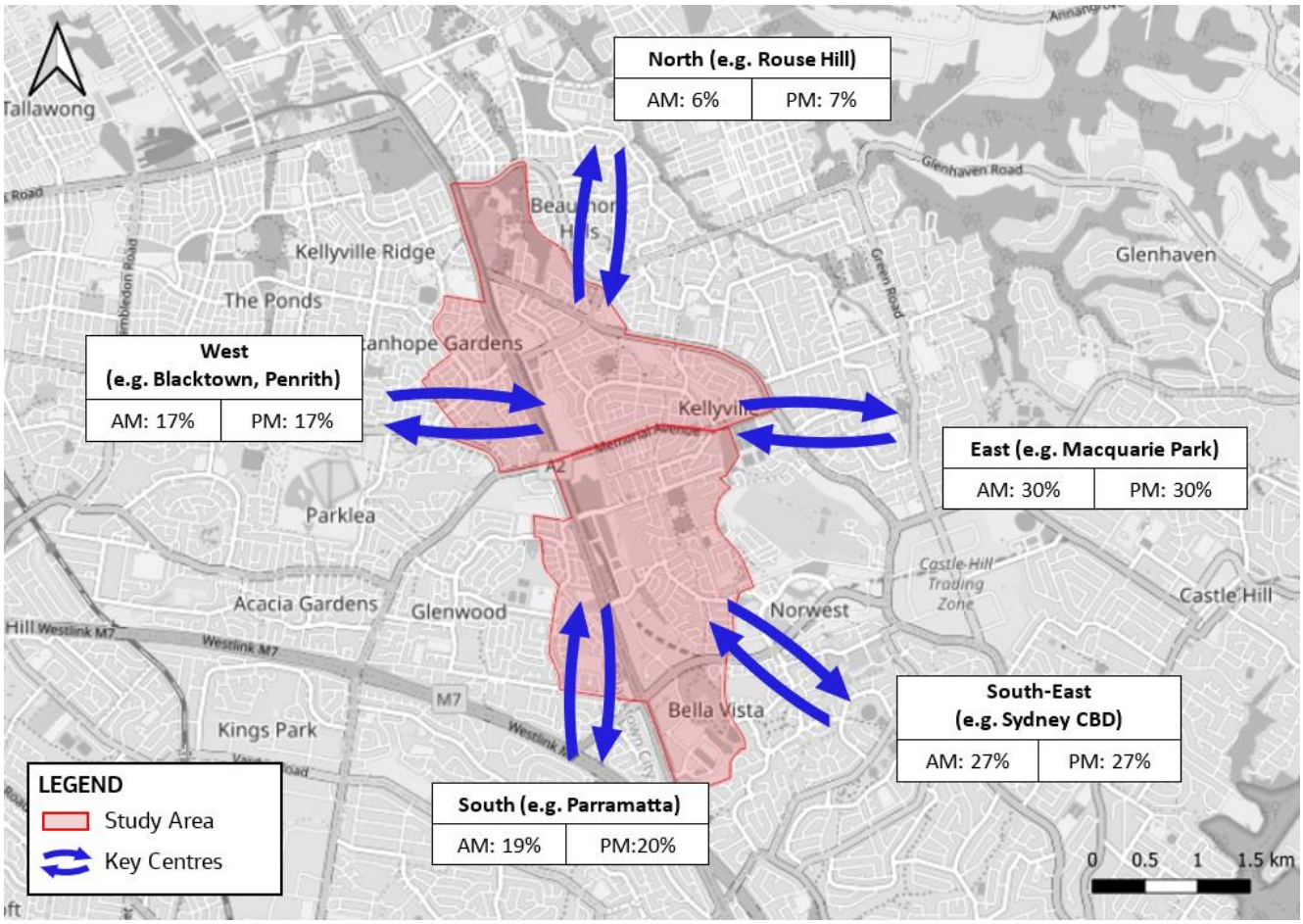


Figure 4-1: Overall Trip Distribution for 2041 Project Case

More than half of trips leaving the study area are projected to travel toward the east and south-east in the AM peak. This reflects the location of majority of existing jobs located within Sydney and the fact that many residents need to access major employment centres including the Sydney CBD, Macquarie Park and Parramatta.

Trips to/from the west such as Blacktown and Penrith cover 17% of the total trips whilst those travelling south to Parramatta, Kemps Creek and Wetherill Park industrial area etc constitute approximately 20% of total trips. The relatively low proportion of northerly trips (6-7%) is due to greenfield nature of areas to the north and northwest of the TOD which are situated close to the north-west fringe of the Sydney metropolitan area.

4.1.3 Mode Choice

Mode choice is the process of identifying what mode of transport a traveller is likely to choose for travel to either their destination or as an access mode to a metro station or a bus stop. The choice of mode relates to the attractiveness of each mode available to the traveller, proximity to public transport at the home and work ends as well as other factors such as car ownership, driver licence holding and frequency of public transport.

Considering the focus of this study is estimation of vehicle generation of TOD and the impact of this traffic on the road network, the vehicle trip rates shown in Table 4-1 that are based on published trip generation rates have but adjusted to account for relative higher car usage due to the location of TOD precincts. The mode share proportions assumed for TOD residential developments in the Bella Vista and Kellyville precincts are shown in Table 4-3.

Table 4-3: Mode share proportions assumed for high density residential development in TODs

Precinct Component	Peak Hour Car Mode Share
Station Sub-areas - K4, K9, BV1, BV7, BV14	47.5%[1]
All other sub-areas	56%[2]

Notes:

1. SSDA for Kellyville/Bella Vista metro station (Landcom 2022)
2. Guide to Transport Impact Assessment (TfNSW 2024), Table 5.10. Mode share summary for car based high density residential

For the precincts nearer to the metro precincts car utilisation is assumed to be lower than those located further away. This is due to better mix of land uses around the metro stations that would allow more trips to be internalised and undertaken via walking, cycling as well as ease of access to public transport that would negate need to use car. For precincts located further from the stations higher car utilisation is expected for more trip purposes therefore a higher car mode share should be expected.

Note that the above car mode shares are lower than existing car utilisation in Bella Vista and Kellyville using historical ABS data reported for these areas. This is due to the low density and predominantly residential nature of land use in these areas that offer residents with fewer destination choices for their trips. This is in contrast with TODs that are specifically planned to integrate residential with retail and commercial uses positioned within walking distances of residential to reduce a need to undertake motorised trips. Furthermore, TODs provide the opportunity to introduce tighter control of off-street parking supply and better management of on-street parking via time restricted or paid parking that would better control the number of vehicles that residents can own. This is in sharp contrast to low density environments where majority of households with children who may own two or even more cars to accomplish their day to day activities.

4.1.4 Traffic Assignment

The traffic volumes estimated to be generated by the Bella Vista and Kellyville precincts are assigned to the surrounding road network to determine the size of the increase in traffic volumes on each road. The assignment of the TOD traffic has been done based on desired directionality of trips departing or entering the area using the distribution of trips discussed in Section 4.1.2 and applying shortest travel distance to/from each precinct to other areas.

Appendix D shows the volume of additional traffic projected to be generated by the TOD proposals on the key roads in the area. Note that these volumes do not include existing trips (i.e. trips generated from the existing dwelling capacity (do nothing)), through traffic from other areas passing through the precinct or existing traffic from other land uses such as employment, schools or retail that are within the study area. These trips would be in addition to the flows shown in this report.

The roads that expected to experience the largest increases in extra trips are those that would be serving precincts with a higher number of dwellings within their catchment areas, such as Miami Street, Balmoral Road, Glenwood Park Drive, Celebration Drive, Greenhill Drive and Meurants Lane. Much of the additional trips assigned to these roads are then funnelled to Old Windsor Road as it is the key arterial road that bisects the precincts and separates the areas to the west from those to the east and the metro stations and as such comparatively would see high volumes of additional trips.

4.2 Performance Assessment

To understand the performance of the road network with the project case, volume to capacity (V/C) ratios and SIDRA modelling of key intersections have been carried out with the additional travel demand generated from the TODs included. This assessment allows locations with likely congestion to be identified and helps to guide network and intersection management measures for potential upgrades in the future to achieve the transport vision for the precincts. To identify the network performance, the assessment needs to include traffic generated outside and unrelated to the TOD which also use these roads for their travel. This means the 2041 demand would need to incorporate demand from:

1) Existing dwellings in the precincts minus dwellings replaced to enable development;
2) Plus additional dwellings projected to take-up at 2041 as a result of TOD rezoning and from capacity in existing planning controls;
3) Plus through trips (i.e. external to external trips).

A nominal growth factor of 15% to 2041 equivalent to 1.53% p.a. linear growth has been applied to traffic volumes using the arterial roads to account for expected future growth in background traffic travelling through the area via for example Old Windsor Road. Note that the model only captures trips from existing residential dwellings and the increase in residential dwellings in Bella Vista and Kellyville from the TOD Program. It does not capture trips generated for significant approved but not yet developed retail and commercial developments which may undergo changes prior to final implementation. Further details on the methodology and assumptions are provided in **Appendix B**.

4.3 Capacity Assessment

Traffic demand for the 'business as usual' scenario with current day travel behaviours has been determined from the trip generation model and surveyed count data from the previous work carried out as part of SSDA for the two metro precincts. Traffic volume carrying capacities of different road types have been adopted from the TfNSW's Strategic Motorway Planning Model (SMPM) based on link capacities for different road types within urban core areas.

For the purposes of understanding the performance of the future road network, the volume to capacity (i.e. V/C ratios)[11] for affected roads have been calculated. The impact of trips generated from TOD developments is also calculated but reported separately to show the incremental change in V/C ratios. Figure 4-2 and Figure 4-3 provide an illustration of the V/C ratios projected for key roads in the study area during the AM and PM. Link colours denotes performance with all traffic included whilst the labels on the links provide the V/C ratios due to the traffic generated by the TOD precincts.

[11] Volume to capacity (V/C) ratio is a metric used to express the relationship between traffic demand and road capacity. A ratio greater than 0.9 suggests volume is reaching the roadway capacity with values of 1.0 or higher representing no spare capacity available with demand exceeding roadway capacity.

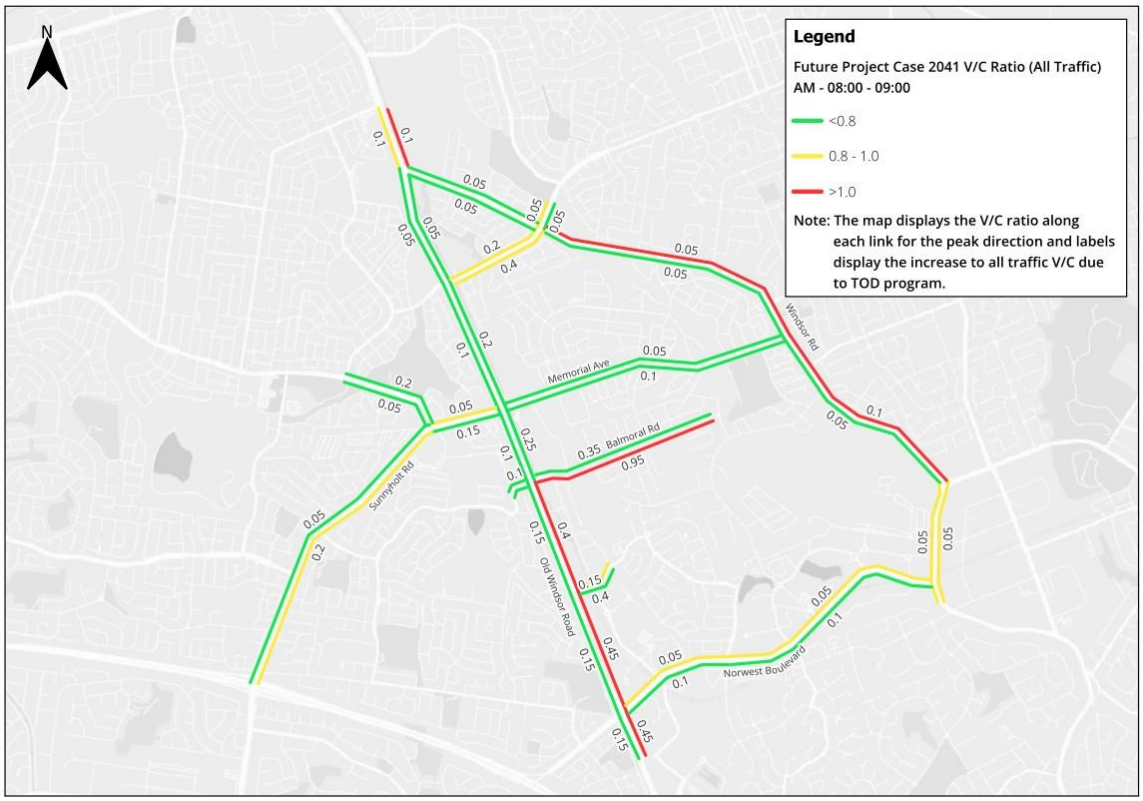


Figure 4-2: Volume to capacity ratio – Future Project Case 2041 (AM)

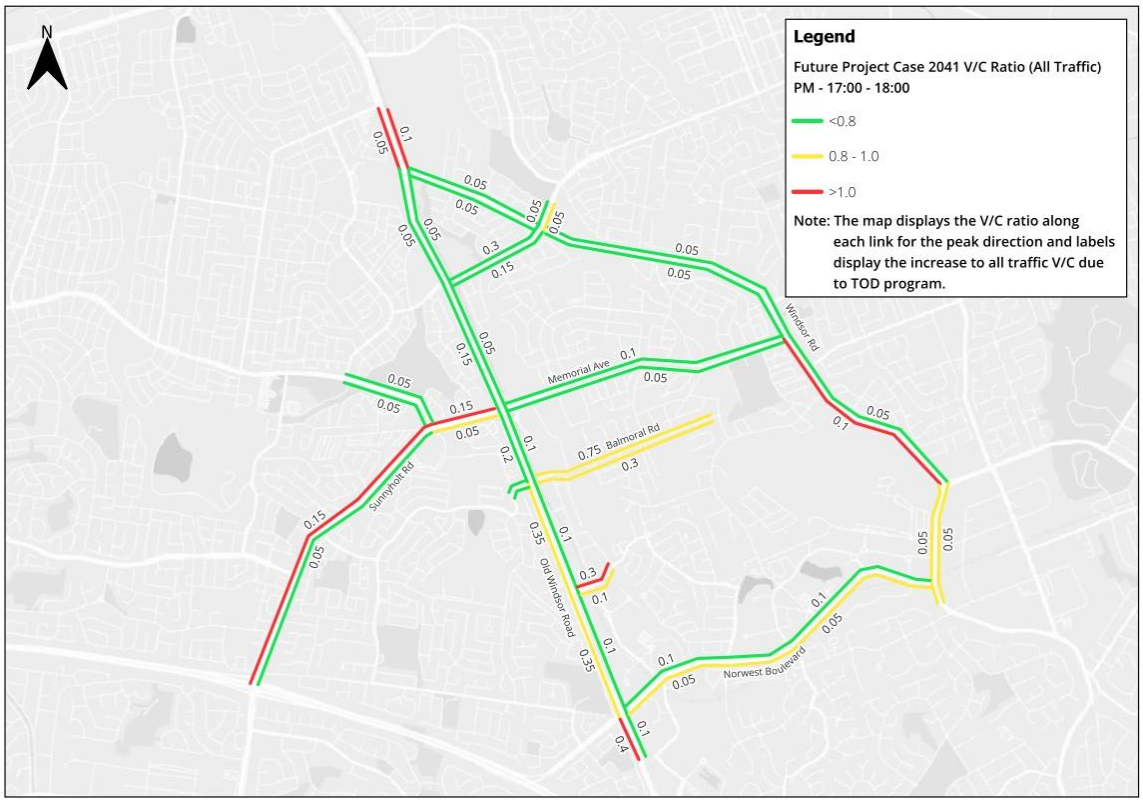


Figure 4-3: Volume to capacity ratio - Future Project Case 2041 (PM)

It can be seen from this assessment that the key arterials of Old Windsor Road, Windsor Road and Sunnyholt Road are projected to experience high traffic demand in some sections with their V/C ratios nearing or above their nominal mid-block capacities, indicating likely performance issues arising along these roads.

The incremental impact of TOD generated traffic on V/C ratios varies across different road types with the largest changes occurring on local and secondary roads. This is due to the access function of these roads to/from the TOD developments and the relatively low background traffic on these roads. In contrast, the V/C contribution of TOD traffic on higher order roads such as Old Windsor Road is generally low due to lower proportion of TOD traffic compared to other traffic using these roads. Full results of the volume to capacity ratios are available in **Appendix E**.

4.3.1 Intersection Performance

The commonly adopted metric for assessment of the traffic operational performance of intersections is the average delay faced by vehicles using the intersection. This is defined by TfNSW in 'Level of Service' (LoS) bands denoted LoS A (good) to LoS F (bad). A Level of Service D or better is generally considered to offer satisfactory performance for intersections in peak periods in Sydney. However, when assessing intersection performance for parts of the road network that already experiences substantial congestion over the course of the day or with future demand, achieving LoS D or better through upgrade works may not represent good value for money or be physically feasible within the constraints of the site. In these locations, consideration needs to be given to whether achieving LoS D is practical within the constraints of the subject project. If not, a minimum of LoS E is set as a performance target for intersections that are subject to consideration for the precinct.

In addition to average vehicle delay, Degree of Saturation (DoS) is another metric used to undertake a lane-by-lane assessment of capacity. It uses the ratio of the arrival flow (demand) to the capacity of the approach during the same period to identify where capacity constraints occur and effectiveness of a geometric or phase changes in more detail. The overall intersection DoS is defined as the highest DoS of all individual movements for an intersection. A DoS less than 0.90 for a movement or approach is considered satisfactory operation.

Table 4-4 summarises the projected 2041 peak period performance for key intersections in the study area calculated through the SIDRA analysis. The intersection layouts modelled incorporate the upgrades identified in the SSD for the two Metro station precincts as these improvements are likely to be delivered by 2041 in support of development of the Metro precincts even though there is currently no committed delivery date for them.

Table 4-4: SIDRA Performance – 2041 Project Case

Intersection	AM			PM		
	Average delay / vehicle (sec)	LoS	DoS	Average delay / vehicle (sec)	LoS	DoS
Old Windsor Rd / Windsor Rd	40	C	0.9	35	C	0.8
Old Windsor Rd / Samantha Riley Dr / Newbury Ave	130	F	1.2	115	F	1.1
Old Windsor Rd / Memorial Ave / Sunnyholt Rd	185	F	1.1	170	F	1.1
Old Windsor Rd / Balmoral Rd / Miami St	695	F	1.5	190	F	1.1
Old Windsor Rd / Celebration Dr	490	F	1.4	550	F	0.9
Old Windsor Rd / Norwest Blvd	85	F	1.1	45	D	0.9
Windsor Rd / Samantha Riley Dr	110	F	1.1	65	E	1.0
Windsor Rd / Memorial Ave	180	F	0.7	25	B	0.6
Stanhope Pkwy / Sunnyholt Rd	35	C	0.8	130	F	1.3

The assessment shows majority of the key intersections in the study area are forecast to operate poorly in peak periods in 2041, with average delay and demand exceeding desirable performance target levels. The poor performance is primarily due to high demand generated by heavy background traffic travelling through the area using the arterial road corridors, existing land uses and uplift in travel demand as a result of the TOD rezoning that contribute to demands.

5. Issues, Challenges and Opportunities

The key issues, challenges and opportunities as they relate to the achievement of the vision, objectives, and Movement and Place aspirations are outlined in Table 5-1. The transport planning response supporting the rezoning proposal for the Bella Vista and Kellyville precincts considers these challenges and opportunities and is outlined in Section 6.

Historically, the planning and assessment of transport projects has worked to 'predict' future travel demand on the network, particularly for private cars. Where the predicted demand cannot be accommodated by existing infrastructure, this challenge is met with remedial options that are developed to provide additional capacity for this demand. This 'Predict and Provide' approach often leads to induced traffic demand and reinforces car dependency, which can lead to oversized infrastructure that negatively impact place outcomes and impose a high capital cost for funding requirements. This can then lead to a vicious cycle creating issues in the long term requiring further intervention and investment.

In adopting a vision and validate approach, a more balanced outcome in transport provisions can be achieved that are context appropriate, sustainable and more economical to provide. Potential intervention opportunities would generally be less single mode focused and vary in both scope and scale. These can include improvements to metro and bus network connectivity and frequencies, safer and more direct connections between precincts to key nodes to encourage greater levels of walking and cycling, and targeted road upgrades on key movement routes that collectively improve the outcome for a new precinct.

Table 5-1: Issues, challenges and opportunities

Issue / Challenge	Category	Opportunity
High existing car dependency and need to accelerate behaviour change to achieve the vision for the precincts.	Mode Shift	▪ Make sustainable modes the primary choice for majority of journeys through integrated land-use (15-minute neighbourhoods), reliable and direct public transport connections and a clear strategy for communicating transport choices to potential customers.
Access to existing services may be outside of many residents' walking and cycling catchment.	Land Use	▪ Land-use changes will include mixed-use development which will bring many services within new residents' walking and cycling catchment ▪ Improve permeability of new block layouts and consider suitable infrastructure provision when designing the masterplan .
Limited pedestrian and cycling connections and permeability within existing precincts.	Mode Shift	▪ Identify suitable designs and protect appropriate road widths to implement active travel infrastructure that is aligned with the Movement and Place classification for each corridor and the broader cycling strategy for the area including *The Hills Shire Bike Plan*. This includes enhancing walking and cycling trails via a continuous connection along Elizabeth Macarthur Creek. ▪ Focus on providing new east-west links and enhancing existing ones across the Elizabeth Macarthur Creek and to/from/across arterial roads such as Old Windsor Road to ensure end-to-end pedestrian and cycling connectivity to the metro stations and T-way. ▪ Integrate active transport permeability within identified open spaces and ensure the design of new streets account for high

Issue / Challenge	Category	Opportunity
		public domain amenity including generous footpaths, safe pedestrian crossings and adequate lighting. ▪ The undulating topography offers opportunity for greater use of micromobility, such as e-bikes and e-scooters, to extend the accessibility and comfort of active transport routes. ▪ Improve the quality of existing pedestrian and cycling infrastructure and provide similar treatment on contiguous links ▪ Provide a new north-south local street spine connecting both station precincts. ▪ Improve walking and cycling connections to Norwest Business Park from Bella Vista Station. ▪ Potential for collaboration between The Hills Shire and Blacktown City Council to provide cycling network connections east-west across Old Windsor Road.
Many existing residents travel towards major employment centres such as Sydney CBD, Macquarie Park and Parramatta. This places pressure on roads such as Old Windsor Road and Windsor Road, which are modelled to experience poor performance in future years.	Demand Management	▪ Due to large volumes of trips heading in a similar direction, 'critical mass' may be achieved to support the running of express bus services with limited stops linked to Sydney Metro Northwest stations to achieve a 30-minute city target.
Additional trips from the TOD rezoning will exacerbate traffic congestion and delays in the road network if the current mode share continues, particularly along key arterials, such as Old Windsor Road, Sunnyholt Road and Windsor Road.	Demand Management	▪ Encourage residents to re-think, re-time or re-mode their journeys to manage demand: - Re-Think: Reduce need to travel outside of the precinct by providing access to everyday services within the precinct. Parking controls in both residential and commercial areas may also support a reduction in overall car ownership and use. - Re-Time: Future consideration of communications/pricing strategy around off-peak travel. - Re-Mode: Provision of alternative transport options that are of equal or higher perceived value than private vehicles.
Congestion on the road network may also impact the attractiveness of buses.	Mode Shift	▪ Opportunities to investigate further bus priorities along Old Windsor Road at the following locations: - Miami St / Tarwin St approaching Old Windsor Rd - Perfection Ave approaching Newbury Ave; Newbury Ave eastbound towards Old Windsor Rd - Samantha Riley Dr, Guragura St to Old Windsor Rd - Meurants Ln to Greenhill Dr; Greenhill Dr to Norwest Blvd - Lexington Dr / Elizabeth Macarthur Dr to Norwest Blvd

6. The Transport Response

6.1 Approach to Transport Needs

The transport needs assessment has been conducted on the basis of achieving the vision, objectives, and Movement and Place aspirations set out in Section 3 by investigating and resolving the issues identified in Section 5.

The current road network within the Bella Vista and Kellyville Station Precincts experiences performance issues in peak periods, with key arterials such as Old Windsor Road, Windsor Road, Memorial Avenue, and Sunnyholt Road regularly experiencing poor reliability and slow speeds. This situation is expected to worsen due to projected background traffic growth by 2041, even without the additional demands generated by the TOD precincts.

Measures to reduce car dependency through the provision of high-quality active and public transport options, combined with reducing the need for external trips to access day-to-day needs, will be able to reduce further traffic network pressures and support the vision and objectives that have been established for the precincts.

Travel patterns are also expected to evolve over time as new local centres, services and transport investments are delivered and new communities are established. It is critical that to support evolving travel behaviours and needs that more transport choices are provided.

This assessment therefore has adopted an approach that prioritises active and public transport as the mode of choice for a greater proportion of trips. A range of measures explored to achieve this objective, include:

- **Public transport integration** – explore opportunities to improve public transport accessibility and service within the precinct to encourage residents and employees to use these options.
- **Enhance active transport links** – develop safe and convenient walking and cycling infrastructure to encourage active travel options and improve connectivity across the Elizabeth Macarthur Creek and arterial roads such as Old Windsor Road, which act as physical barriers to the station precincts.
- **Demand management strategies** – investigate the feasibility of implementing demand management strategies, such as staff travel plans or parking controls, to discourage single-occupancy vehicle use and encourage more efficient travel choices such as off-peak travel.

While not a primary focus, the assessment has identified need for ongoing infrastructure upgrades, such as upgrades to Old Windsor Road and at the key intersections to accommodate future traffic demand and manage negative externalities associated with congestion and poor accessibility to for example jobs and education. Even with a reduction in car mode share from the high value of 90% to 47.5 – 56% and the anticipated growth in population in the northwest region, there is still a need to address network needs into the future to accommodate non-discretionary vehicle trips.

6.2 Alignment with Vision and Objectives

The proposed transport response aligns with the vision and objectives in Section 3.2 and supports a connected and accessible precinct that integrates a wide range of transport modes and services. This is in line with the transport objectives of the precinct to provide Bella Vista and Kellyville residents better access to a sustainable and integrated network as outlined in Table 6-1.

Table 6-1: Alignment with transport objectives

Transport Objectives	Transport Response Alignment
Connected	An integrated network servicing the precinct will improve connectivity to strategic centres and destinations through the provision of a wide range of transport modes and services for Bella Vista and Kellyville residents.
Accessible	Provision of active transport infrastructure and with design compliance with the DDA to improve universal access, the improved public and active transport network will enable all residents to have equal access to the range of transport modes and services without the need for a car.
User Centred	Demand management strategies will align to the needs of the transport customers, enabling all residents to have more reliable and predictable travel times for trips within the precinct and to destinations external to the precinct.
Sustainable	By reducing private vehicle dependence, integrating public transport services and enhancing the active transport network, the precinct will support more sustainable travel choices to and from key destinations.

6.3 Prioritisation for Implementation

Prioritisation is essential so that resources can be focused on measures that would help to deliver on the desired land use and transport outcomes, provide greatest value for money, support delivery of housing in a sustainable manner, so that new developments would not burden existing infrastructure, and ensure proposed initiatives are capable of meeting the needs of existing and new communities. An important consideration needs to be that implementation priorities should be set out so that they do not have to compete across different modes for funding and delivery. For example, active transport would not have to compete with public transport or road network improvements but rather each improvement is prioritised within its own mode and independent of priority of other modes.

The general approach on the timeframe for implementing the proposed response would follow:

Short Term (Day One)

- Focus on measures that can be implemented quickly and with minimal disruption.
- Existing and previous studies have shown that Old Windsor Road and sections of Windsor Road experience congestion in peak periods. Hence, there needs to be consideration for planning and upgrades of these roads at key locations as part of the ongoing development of the northwest region.
- Prioritise initiatives that address existing needs independent of the TODs. Examples include:
  - Public transport integration: enhance bus stop infrastructure and explore potential route extensions or increased service frequency.
  - Demand management strategies such as parking management strategies.
  - Enhance active transport links: develop low-cost walking and cycling infrastructure improvements within the precinct, such as dedicated lanes or improved signage.

Medium Term (Partial Build-out)

- Focus on measures aligned with the take-up and sequencing of the precinct.
- Implement strategies that require a moderate level of investment and planning. Examples include:

- Enhance east-west active transport links: construct permanent walking and cycling infrastructure across the creek and key arterials.
- Intersection improvements: conduct optioneering and implement improvements at key intersections identified.
- Local area traffic management measures and targeted local street network capacity enhancements
- Public transport integration: collaborate with public transport authorities to explore potential infrastructure upgrades near the precinct, such as new dedicated bus lanes or transit corridors.

Long Term (Full Build-out)

- Focus on major infrastructure upgrades that require significant planning, funding, and construction time.
- Consider these options only after further investigation and consultation with councils. Examples include:
  - Capacity improvements along Old Windsor Road, Windsor Road and Sunnyholt Road and other impacted key arterials (subject to further feasibility studies and community engagement).
  - Increased intersection capacity at key locations (subject to further detailed traffic analysis).

The specific timeframe for implementing each strategy will be further refined as there is more certainty of development and with ongoing input from agencies and councils. Community feedback and potential modifications to the proposed masterplan may necessitate adjustments to the recommended delivery schedule.

6.4 Transport Initiatives and Infrastructure Projects

Table 6-2 lists the transport initiatives and infrastructure projects relevant to achieving the transport objectives for the precinct and implementing the aims of the TOD Program in delivering more housing in well-located areas close to public transport. This list is not exhaustive but rather intended to guide further planning and technical investigation that can then be used to develop, plan and prioritise investment and delivery as TODS are activated. All initiatives and projects are subject to funding availability and technical studies, and investment decisions by relevant agencies and councils. The locations of these proposed initiative and projects are shown in Figure 6-1. The indicative priority identified reflect the approach in Section 6.3. Items with an asterix (*) are other Strategic Transport Opportunities in the area that could be worthwhile consideration as part of other planning and investment processes, but do not form part of the final rezoning under the TOD Program.

Table 6-2: Proposed initiatives and projects for the Bella Vista and Kellyville precincts

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
Active Transport Network					
1	Pedestrian bridge (across Elizabeth Macarthur Creek), Decora Dr to Wenden Ave	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council / Sydney Water	Short-term (to meet the needs of the existing population east of the metro stations)	Low / $$
2*	Upgrade Old Windsor Rd shared path (Newbury Ave to Norwest Blvd)	Blacktown City Council	TfNSW / Blacktown City Council / The Hills Shire Council	Long-term	Low / $$

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
3	Pedestrian bridge across Memorial Avenue	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council / Sydney Water	Medium-term (as development progress)	High / $$
4	Pedestrian/Cycle Path along Elizabeth Macarthur Creek	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council / Sydney Water	Short-term (to meet the needs of the existing population east of the metro stations)	Low / $$
5	Pedestrian bridge (across Elizabeth Macarthur Creek), near Unaipon Ave/Celebration Dr intersection	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council / Sydney Water	Medium-term (as development progress)	Low / $$
6	Pedestrian bridge (across Elizabeth Macarthur Creek), near Lewis Jones Drive Reserve	The Hills s7.12 Contributions Plan (THSC October 2020)	The Hills Shire Council / Sydney Water	Medium-term (as development progress)	Low / $$
7	Pedestrian bridge across Old Windsor Rd near Burns T-way station	Bella Vista and Kellyville State-led TOD Rezoning	TfNSW / The Hills Shire Council / Blacktown City Council	Medium-term (as development progress)	High / $$$
8*	Shared path – Cramer Place / Glenwood Park Dr / Forman Ave	Bella Vista and Kellyville State-led TOD Rezoning	Blacktown City Council	Medium-term (to meet the needs of the existing population east of the metro stations and as development progress)	Low / $$
9	Pedestrian bridge (across Elizabeth Macarthur Creek), near Byles Place / Celebration Dr intersection	Bella Vista and Kellyville State-led TOD Rezoning	The Hills Shire Council / Sydney Water	Medium-term (as development progress)	Low / $$
10*	Shared path – Caddies Creek (Glenwood Lake – Sunnyholt Rd)	Blacktown City Council	Blacktown City Council	Medium-term (to meet the needs of the existing population and as development progress	Low / $$
11*	Pedestrian through site links – Glenwood (Miami St – Emmanuel Terrace – Sharrock Ave – Maley Grove)	Bella Vista and Kellyville State-led TOD Rezoning	Blacktown City Council	Long-term (as development progress)	Low / $$

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
12	Access ramp (west) – Bella Vista pedestrian bridge across Old Windsor Road	Bella Vista and Kellyville State-led TOD Rezoning	TfNSW / Blacktown City Council	Long-term (as development progress)	High / $$
13*	Shared path across drainage corridor – Shaun St to Kidman St / Muriel Way	Bella Vista and Kellyville State-led TOD Rezoning	Blacktown City Council / Sydney Water	Long-term (as development progress)	Low / $$
14*	Pedestrian through site link – Maley Grove to Bella Vista T-way Station; shared path on Darren Court to Kosmina St across drainage corridor	Bella Vista and Kellyville State-led TOD Rezoning	TfNSW / Blacktown City Council	Long-term (as development progress)	Low / $$
Public Transport Network					
1*	Bus priority –Tarwin Ave and Miami St eastbound to Old Windsor Rd	TfNSW	TfNSW / Blacktown City Council	Medium-term (to meet the needs of the existing population and as development progress)	High / $$
2*	Bus priority – Newbury Ave eastbound towards Old Windsor Road	TfNSW	TfNSW / Blacktown City Council	Medium-term (to meet the needs of the existing population and as development progress)	Medium / $$
3*	Bus priority – Samantha Riley Dr, Guragura St to Old Windsor Road	TfNSW	TfNSW / The Hills Shire Council	Medium-term (to meet the needs of the existing population and as development progress)	Medium / $$
4*	Bus priority – Meurants Lane bus only link	TfNSW	TfNSW / Blacktown City Council	Long-term (to meet the needs of the existing population and as development progress)	High / $$
5	Bus priority – Lexington Dr approaching Norwest Blvd	Norwest Innovation s7.12 Contributions Plan (THSC November 2021)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / $$
Road Network					
1	Intersection upgrades - Old Windsor Road / Samantha Riley Dr; Sunnyholt Rd and Stanhope Pkwy)	Bella Vista and Kellyville Station Precincts - Concept SSD Application (Landcom 2022)	TfNSW	Short-term	High / $$$

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
2	Old Windsor Rd intersection upgrades (Balmoral Rd, Celebration Dr and Norwest Blvd)	Bella Vista and Kellyville Station Precincts - Concept SSD Application (Landcom 2022)	TfNSW	Short-term	High / $$$
3	Celebration Dr extension to Balmoral Rd	Bella Vista and Kellyville Station Precincts - Concept SSD Application (Landcom 2022)	The Hills Shire Council / developer	Medium-term (as development progress)	Low / $$
4	Extension of Brighton Dr to Mawson Ave	Bella Vista and Kellyville Station Precincts - Concept SSD Application (Landcom 2022)	The Hills Shire Council / developer	Medium-term (as development progress)	Low / $$
5	Progressive widening of Old Windsor Rd between Norwest Blvd and Windsor Rd (in conjunction with intersection upgrades)	Bella Vista and Kellyville State-led TOD Rezoning	TfNSW	Medium-term	Medium / $$$
6	Intersection upgrade - Samantha Riley Dr / Decora Dr	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Low / $$
7	Signalisation – Unaipon Ave / Mawson Ave	Bella Vista and Kellyville Station Precincts - Concept SSD Application (Landcom 2022)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Low / $$
8	Signalisation – Brighton Dr / Celebration Dr	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Low / $$
9	Signalisation – Balmoral Rd / Celebration Dr	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / $$
10	Signalisation – Balmoral Rd / Mawson Ave	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / $$
11*	Upgrade and signalisation – Norwest Blvd / Solent Cct	The Hills Metro Stations Traffic and Transport Study (Stantec 2023)	TfNSW	Long term	High / $$$
12	Upgrade and signalisation – Norwest Blvd / Lexington Dr / Elizabeth Macarthur Dr	Norwest Innovation s7.12 Contributions Plan (THSC November 2021)	TfNSW	Long term	High / $$$
13	Vehicular bridge (across Elizabeth Macarthur Creek) – Hodges Rd to Burns T-way station	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council / Sydney Water	Medium-term (as development progress)	Medium / $$

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
14	Vehicular bridge (across Elizabeth Macarthur Creek) near Colonial St	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council / Sydney Water	Medium-term (as development progress)	Medium / $$
15	Roundabout – New Road near Colonial St Vehicular Bridge	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council	Medium-term (as development progress)	Low / $$
16	Roundabout – North of District Open Space in Bella Vista Precinct	Bella Vista and Kellyville Station Precincts s7.11 Contributions Plan No. 18 (THSC June 2022)	The Hills Shire Council	Medium-term (as development progress)	Low / $$

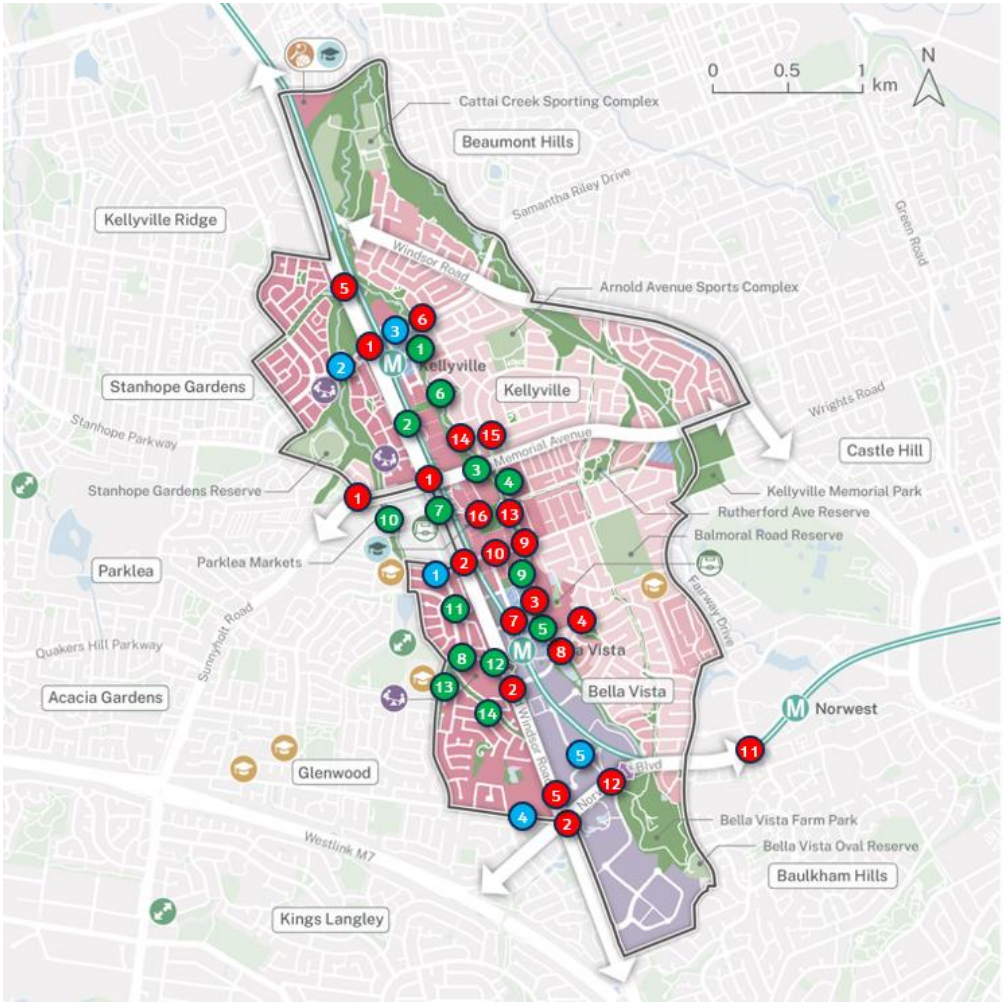
Definitions for level of complexity:

- High – expected to be a large scale or complex project, involving significant infrastructure changes and extensive stakeholder engagement. Generally multi-year in nature.
- Medium – involves some complexity, or reconfiguration of road space on complex streets. Projects require detailed studies and public consultations to integrate with development.
- Low – local-scale changes to streets – generally refer to local-scale changes aimed at enhancing neighbourhood accessibility and safety.

Definitions for relative scale of cost

- $$$ – Projects that involve investments greater than $10 million require a business case to justify the expenditure and outline the projected returns or benefits.
- $$ – Projects between $250,000 - $10 million typically involve moderate to significant financial investments and may encompass a range of improvements or developments.
- $ – Projects costing less than $250,000 fall into this category, generally involving smaller-scale financial commitments and could be funded out of operational budgets.

The cost estimates provided are indicative and for preliminary planning purposes only. They are based on previously published sources or high level initial evaluations. Detailed analyses will refine these estimates as the project progresses, and adjustments are dependent on wider factors, project scoping and market forces. Detailed design and cost estimates are beyond the scope of this project.



Active Transport Initiatives / Projects

1. Pedestrian bridge (across Elizabeth Macarthur Creek), Decora Dr to Wenden Ave
2. Upgrade Old Windsor Rd shared path (Newbury Ave to Norwest Blvd)*
3. Pedestrian bridge across Memorial Ave
4. Pedestrian/Cycle Path along Elizabeth Macarthur Creek
5. Pedestrian bridge, near Unaipon Ave / Celebration Dr intersection
6. Pedestrian bridge, near Lewis Jones Drive Reserve
7. Pedestrian bridge across Old Windsor Rd near Burns T-way station
8. Shared path – Cramer Place / Glenwood Park Dr / Forman Ave*
9. Pedestrian bridge near Byles Place / Celebration Dr intersection
10. Shared path – Caddies Creek (Glenwood Lake – Sunnyholt Rd)*
11. Pedestrian through site links – Glenwood (Miami St – Emmanuel Terrace – Sharrock Ave – Maley Grove)*
12. Access ramp (west) – Bella Vista pedestrian bridge across Old Windsor Road
13. Shared path across drainage corridor – Shaun St to Kidman St / Muriel Way*
14. Pedestrian through site link – Maley Grove to Bella Vista T-way Station; shared path on Darren Court to Kosmina St across drainage corridor*

Public Transport Initiatives / Projects

1. Bus priority – Miami St / Tarwin Ave eastbound to Old Windsor Rd*
2. Bus priority – Newbury Ave eastbound to Old Windsor Rd*
3. Bus priority – Samantha Riley Dr / Guragura St to Old Windsor Rd*
4. Bus priority – Meurants Ln bus only link*
5. Bus priority – Lexington Dr approaching Norwest Blvd

Road Network Initiatives / Projects

1. Old Windsor Rd Intersection Upgrades – Samantha Riley Dr, Memorial Ave, Sunnyholt Rd / Stanhope Pkwy
2. Old Windsor Rd Intersection Upgrades – Balmoral Rd, Celebration Dr, Norwest Blvd
3. Celebration Dr extension to Balmoral Rd
4. Brighton Dr extension to Mawson Ave
5. Progressive widening of Old Windsor Rd between Norwest Blvd and Windsor Rd
6. Intersection Upgrade – Samantha Riley Dr / Decora Dr
7. Signalisation – Unaipon Ave / Mawson Ave
8. Signalisation – Brighton Dr / Celebration Dr
9. Signalisation – Balmoral Rd / Celebration Dr
10. Signalisation – Balmoral Rd / Mawson Ave
11. Upgrade and signalisation – Norwest Blvd / Solent Cct*
12. Upgrade and signalisation – Norwest Blvd / Lexington Dr / Elizabeth Macarthur Dr
13. Vehicular bridge – Hodges Rd to Burns T-way station
14. Vehicular bridge near Colonial St
15. Roundabout – New road near Colonial St Vehicular Bridge
16. Roundabout – North of District Open Space in Bella Vista Precinct

Figure 6-1: Proposed transport initiatives and projects for the Bella Vista and Kellyville precincts

(denotes other Strategic Transport Opportunities in the area but does not form part of the final rezoning)*

6.5 Future Transport Planning

To build on the listed transport initiatives and infrastructure projects specifically needed to support the development in these precincts, ongoing transport planning by councils and TfNSW to service these station precincts should focus on several areas identified through this assessment and previous studies. The recommendations for next steps are shown in Table 6-3.

Table 6-3: Recommendations for next steps

Network	Recommended Next Steps
Within the Study Area	
Active Transport Network	▪ Investigate and plan new walking and cycling routes to connect with existing and planned active transport links. ▪ Investigate providing more on-street bicycle parking at key locations such as the Metro stations and retail precincts, and encourage more bicycle parking within developments. ▪ Identify potential routes to enhance first and last mile connectivity in the precincts for micromobility modes, such as e-bikes and e-scooters, to tackle the undulating topography particularly in the east-west direction. This will extend the accessibility and comfort of active transport routes.
Public Transport Network	▪ Investigate bus network and service improvements including potential new bus routes and stops to increase the bus and metro station catchments. ▪ Increase frequencies of existing services to connect to the metro stations and nearby strategic centres to encourage higher uptake of public transport. ▪ Investigate how car share schemes can complement and increase use of public transport. Such schemes have a higher chance of success in higher density areas with limited off-street parking availability and access to high quality public transport. ▪ On street parking is the responsibility of Councils and TfNSW should work with Councils to limit on street parking especially all day parking.
Road Network	▪ Investigate options to manage impacts of congestion on productivity at locations identified in this report, including non-infrastructure and traffic capacity based initiatives. ▪ Investigate the performance of other key intersections, including roundabouts, to determine whether any improvements are required. ▪ Investigate and plan for local traffic managements schemes that help to achieve the desired movement and place outcomes on the local street network.
Outside of the Study Area	
Active Transport Network	▪ Review the regional cycling network and Strategic Cycleway Corridors (Kellyville to Rouse Hill, Castle Hill and Norwest) to see how to best integrate with the planned active transport network in the study area.
Public Transport Network	▪ Monitor how the opening of Sydney Metro from Chatswood to Sydenham impact public transport mode share of Bella Vista and Kellyville residents and its influence on future public transport planning.
Road Network	▪ Monitor the wider road network operations impacts as increased development occurs, including the Old Windsor Road and Sunnyholt Road corridors, and implement strategic, tactical and operational improvements in response to evolving travel patterns.

7. Summary

This Precinct Transport Assessment establishes the transport vision, objectives, and Movement and Place aspirations for the Bella Vista and Kellyville precincts through an assessment of the existing and future land use and transport network. Previous studies undertaken in the two precincts have been used to inform the analysis and develop further recommendations in this study. This investigation is supplemented by additional transport planning and modelling work that is used to guide subsequent land use planning and policies for the precincts. The road network impacts have been assessed through development of a bespoke trip generation model to estimate the trip generation of the TODS and intersection modelling using SIDRA to assess performance of key intersections.

The need for interventions are driven by the following issues:

- Population growth in the northwest including the Bella Vista and Kellyville TOD rezoning.
- Access to day to day services are outside of many residents' walking and cycling catchment. There is limited pedestrian and cycling connections and permeability across the existing neighbourhoods.
- High car dependency and need to bring about behavioural changes for greater sustainability and to achieve the intended vision for the precincts. Maintaining the current high car mode share with the addition of demand generated from the TOD rezoning will only exacerbate traffic congestion along Old Windsor Road, Sunnyholt Road and Windsor Road.

The transport response to these issues is primarily related to demand management to support future growth of the precincts (see Section 6.3), and aligns to the following opportunities identified from the assessment:

- Make sustainable modes the primary choice for greater proportion of journeys through integrated land-use (15-minute neighbourhoods), reliable and direct public transport connections and a clear strategy for communicating transport choices to potential customers.
- Identify suitable designs and protect appropriate road widths to implement active travel infrastructure that is aligned with the Movement and Place classification for each corridor and the broader cycling strategy for the area including *The Hills Shire Bike Plan*.
- Focus on providing new east-west links and enhancing existing ones across the Elizabeth Macarthur Creek and arterial roads such as Old Windsor Road to ensure end-to-end pedestrian and cycling connectivity to the metro stations and T-way.
- Encourage residents to re-think, re-time or re-mode their journeys to manage demand:
    - Re-Think: Reduce need to travel outside of the precinct by providing access to everyday services within the precinct. Parking controls in both residential and commercial areas may also support a reduction in overall car ownership and use.
    - Re-Time: Future consideration of communications/pricing strategy around off-peak travel.
    - Re-Mode: Provision of alternative transport options that are of equal or higher perceived value than private vehicles.

Appendix A. Existing Road Network Performance

The detailed results of the existing road network performance are available in the following sections.

Intersection Performance

The assessment of the road network is based on the operational performance of the intersections surrounding the two precincts using the criteria outlined in Table A-1 and defined in the Guide to Transport Impact Assessment (TfNSW 2024).

Table A-1: LoS (LoS) Criteria for Intersections

LoS	Average delay per vehicle (seconds / vehicle)	Traffic signals and roundabouts
A	Less than 15	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At capacity; at signals, incidents will cause delays Roundabouts require other control mode
F	Over 70	Extra capacity required

Source: Guide to Transport Impact Assessment Roads (TfNSW 2024)

The average vehicle delay used in the assessment of signalised intersections is that for all movements and that of the worst movement for priority (sign-controlled) intersections and is expressed in seconds per vehicle. It is generally accepted that the target LoS (LoS) for intersection performance should be D or better. However, when assessing intersection performance for parts of the road network that already experience substantial congestion over the course of the day or with future demand, achieving LoS D or better may not represent good value for money, or not be physically possible due to the land use and constructability constraints. In these locations, consideration needs to be given to whether achieving LoS D is practical. If not, a minimum of LoS E is set as a performance target for intersections that are subject to consideration for the precinct.

Kellyville Station Precinct

The *Landcom Bella Vista and Kellyville Station Precincts – Concept SSD Application (Jacobs 2022)* study assessed the existing intersection performances of both Bella Vista and Kellyville Stations. However, the modelling was undertaken using data from traffic surveys in February 2019 (before the opening of the Sydney Metro Northwest). Hence, these intersection results are unlikely to be representative of the intersection performances of the precincts after the opening of the metro. The morning (AM) peak hour is considered to be between 7:30am – 8:30am, while the afternoon (PM) peak hour is between 5:30pm – 6:30pm.

The performance of an urban road network is largely dependent on the operating performance of its intersections which are the critical capacity control points. SIDRA Intersection 8 was used to model the existing performance of the intersections and measured against the LoS performance criteria shown in Table A-1. The key intersection results within the study area are summarised in Table A-2.

Table A-2: Intersection performance from the Landcom study (Jacobs 2022)

Int. No.	Intersections	Existing			
		AM Peak Hour		PM Peak Hour	
		LoS	Average Delay (sec/veh)	LoS	Average Delay (sec/veh)
1	Old Windsor Rd / Windsor Rd	C	29	C	33
2	Old Windsor Rd / Samantha Riley Dr / Newbury Ave	E	62	E	70
3	Old Windsor Rd / Memorial Ave / Sunnyholt Rd	E	57	E	66
4	Old Windsor Rd / Balmoral Rd / Miami St	D	52	C	42
5	Old Windsor Rd / Celebration Dr	D	45	B	23
6	Old Windsor Rd / Norwest Blvd	D	48	C	39
8	Windsor Rd / Samantha Riley Dr	E	57	D	48
9	Windsor Rd / Memorial Ave	D	52	E	63
14	Celebration Dr / Lexington Dr / Mawson Av	D	43	C	38
15	Sunnyholt Rd / Stanhope Pkwy	C	40	D	50

The SIDRA modelling shows that majority of signalised intersections surrounding the two precincts are currently operating at capacity or are approaching their nominal capacities during the peak periods. As expected, the highest flows are in the southbound direction along Old Windsor Road and Windsor Road in the AM peak and in the northbound direction in the PM peak hour. The exceptions are the intersection of Old Windsor Road / Windsor Road and Sunnyholt Road / Stanhope Parkway both operating at LoS of C/D. Both intersections are T-junctions and operate fewer phases and therefore have higher lane capacities compared to full intersections.

The existing performance of the intersections in the AM and PM peaks in the study area is shown in Figure A-1.

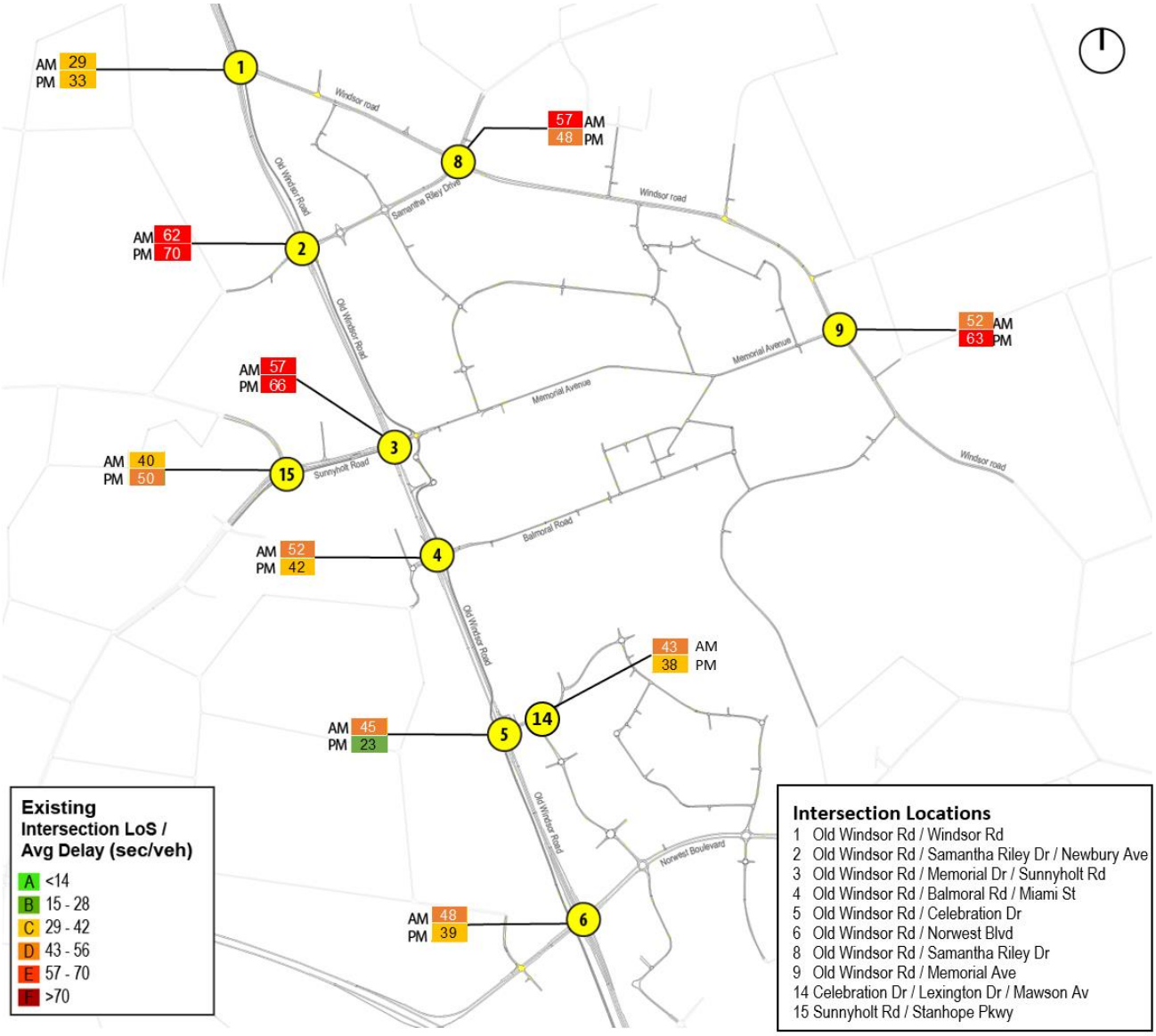


Figure A-1: Existing intersection performances surrounding Bella Vista and Kellyville Station Precincts

Bella Vista Station Precinct

The Hills Metro Station Precincts Traffic and Transport Study (Stantec 2023) assessed the existing intersection performances surrounding the Bella Vista Station. The intersection and network performance results from the Rebased Model (Aimsun) have been used to represent the 2020 traffic conditions for this assessment (on a typical day outside of the COVID-19 lockdown). The morning (AM) peak hour is considered to be between 8:30am – 9:30am, while the afternoon (PM) peak hour is between 5:00pm – 6:00pm.

The key intersection results within the study area are summarised in Table A-3.

Table A-3: Existing intersection performance from The Hills Metro Station Precincts study (Stantec 2023)

Int. No.	Intersections	Existing			
		AM Peak Hour		PM Peak Hour	
		LoS	Average Delay (sec/veh)	LoS	Average Delay (sec/veh)
58	Old Windsor Rd / Memorial Ave / Sunnyholt Rd	F	95	F	73
59	Old Windsor Rd / Balmoral Rd / Miami St	F	89	F	138
60	Old Windsor Rd / Celebration Dr	B	24	E	63
42	Old Windsor Rd / Norwest Blvd	C	33	C	30
49	Windsor Rd / Memorial Ave	C	30	C	28
61	Celebration Dr / Lexington Dr / Mawson Av	B	23	B	22

The Aimsun results show an LoS of F for the Windsor Rd / Memorial Ave / Sunnyholt Rd and Old Windsor Rd / Balmoral Rd / Miami St intersections in the AM and PM peak hours which means extra capacity is needed to meet demand. The Old Windsor Rd / Celebration Dr intersection (LoS E) is at capacity in the PM peak hour.

Travel Time and Average Speed

Travel times and travel speeds provide additional means of assessing the functional performance of a road network. Whilst intersection assessment provides an indication of the performance of a single intersection, travel time is an aggregate measure of the performance of a route that considers the time to travel the links and the intersections along that route. It provides a good indication of quality of a route relative to alternatives as drivers generally select routes that are faster and minimise their travel times.

The criteria for determining the LoS based on average travel speeds is defined in Austroads' Guide to Traffic Management, Part 3: Traffic Studies and Analysis (2013) and is shown in Table A-4.

Table A-4: LoS Criteria for Midblock Sections

Travel speed as a percentage of free-flow travel speed (%)	LoS
>85%	A
67-85%	B
50-67%	C
40-50%	D
30-40%	E
<30%	F

The Hills Metro Station Precincts Traffic and Transport Study (Stantec 2023) assessed the travel times and averages speeds of key routes in the precincts. The travel times on key routes were validated in the development of the Rebased Model, with modelled 2020 travel times and average speeds on each route shown in Table A-5. The morning (AM) peak hour is considered to be between 8:30am – 9:30am, while the afternoon (PM) peak hour is between 5:00pm – 6:00pm.

Table A-5: Base Model Travel Times and Average Speeds on key routes

Route	Dir.	AM Peak Hour		PM Peak Hour	
		Travel Time (mm:ss)	Average Speed (km/h)	Travel Time (mm:ss)	Average Speed (km/h)
Windsor Road	NB	04:20	45	04:28	44
	SB	04:54	40	04:58	40
Old Windsor Road	NB	02:53	53	06:12	25
	SB	02:30	61	02:22	64
Norwest Boulevard	EB	05:53	25	05:28	27
	WB	04:10	37	04:04	38

Windsor Road experiences relatively free-flow travel speeds in both directions for AM and PM peak hours. Old Windsor Road is operating at capacity in the northbound direction during PM peak hour which may impact access to Bella Vista and Kellyville Stations. However, Old Windsor Road generally experiences satisfactory travel speeds in the southbound direction. Norwest Boulevard also operates at capacity in the eastbound direction in both AM and PM peak hours, but this is not expected to impact access to Bella Vista and Kellyville Stations as it is relatively further away.

Appendix B. Model Development Details

An illustration of the modelling spreadsheet developed for the project is shown below.

Kellyville Bella-Vista Land Use Summary — **Values can be changed by user**

Future Base Case (2024 Existing Dwellings - 2041 Existing Dwelling Demolished)

	Land Use	Area																													
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV19	BV14	BV15	BV16	BV17	BV18
Residential Dwellings	Low Density	0	246	304	0	252	391	53	295	0	463	478	57	53	394	0	0	385	181	0	122	0	0	150	96	114	309	392	0	0	0	472	381
	Medium Density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	500	0	0	112	0	0	0	0	0	0	0	0	0	0	0	0	0
	High Density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		6200																													

Assumed dwellings built by 2041 as a result of TOD rezoning (after apply take up rate) - Scenario 2

	Land Use	Area																													
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV19	BV14	BV15	BV16	BV17	BV18
Residential Dwellings	Low Density	0	0	0	0	17	17	17	17	0	57	55	55	55	55	0	0	48	0	0	34	0	0	24	22	17	17	130	0	0	0	40	0
	Medium Density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	High Density	684	128	128	1349	0	0	0	0	3169	0	0	0	0	0	2220	350	0	0	80	0	2031	944	0	0	0	0	0	1287	0	204	0	609

Future Project Case 2041 (including TOD uplift up to 2041)

	Land Use	Area																													
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV19	BV14	BV15	BV16	BV17	BV18
Residential Dwellings	Low Density	-	246	304	-	269	408	70	312	-	520	533	112	108	449	-	-	433	181	-	156	-	-	174	118	131	326	522	-	-	-	512	381
	Medium Density	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500	-	-	112	-	-	-	-	-	-	-	-	-	-	-	-	-
	High Density	684	128	128	1,349	-	-	-	-	3,169	-	-	-	-	-	2,220	350	-	-	80	-	2,031	944	-	-	-	-	-	1,287	-	204	-	609

	Zone	Component	AM trip rate	PM trip rate	Morning direction factor		Evening direction factor		Notes
					Inbound	Outbound	Inbound	Outbound	
Residential Dwellings	Station Precincts - K4, K9, BV1, BV7, BV14	Low Density	0.95	0.95	0.2	0.8	0.8	0.2	0.95 based on RTA guidelines
		Medium Density	0.55	0.45	0.2	0.8	0.8	0.2	RTA rates for medium density but reduced to account for closer distance to the station
		High Density	0.22	0.17	0.2	0.8	0.8	0.2	Average Sydney high density residential trip rates (2013 RMS Updated Technical Direction)
	Close to Station (within 800m radius) - K3, K5, K6, K7, K8, K10, BV2, BV8, BV9, BV11, BV12, BV15, BV17, BV18	Low Density	0.95	0.95	0.2	0.8	0.8	0.2	0.95 based on RTA guidelines
		Medium Density	0.55	0.45	0.2	0.8	0.8	0.2	RTA rates for medium density but reduced to account for closer distance to the station
		High Density	0.25	0.20	0.2	0.8	0.8	0.2	Average Sydney high density residential trip rates (2013 RMS Updated Technical Direction)
	Far from Station (>800m radius) - K1, K2, K11, K12, K13, K14, BV3, BV4, BV5, BV6, BV10, BV19, BV16	Low Density	0.95	0.95	0.2	0.8	0.8	0.2	0.95 based on RTA guidelines
		Medium Density	0.60	0.50	0.2	0.8	0.8	0.2	0.4-0.5 for 2BR & 0.5-0.65 for >3BR - From RTA guidelines
		High Density	0.25	0.20	0.2	0.8	0.8	0.2	Average Sydney high density residential trip rates (2013 RMS Updated Technical Direction)

% of residents trips internal to precinct	5%	Reduction factor to account for trips internal to the precinct. % shown can be changed for sensitivity analysis

Notes: Dwelling data provided by DPHI/Architectus/Atlas from '**20240606 TA testing of takeup dwelling numbers**' file.

The 'Future Project Case 2041' dwelling data includes the sum of dwellings from 'Future Base Case' and 'Scenario 2:Possible'.

BV13 is renamed to BV19.

Modelling Methodology, Assumptions and Limitations

- The purpose of the analysis is to estimate the traffic generation and impact of the increase in dwellings in Bella Vista and Kellyville precincts from the TOD program. Commercial, retail and school trips are not captured in the model.
- About 600 additional high density dwellings in Glenwood by 2041 had been included in the modelling analysis which were subsequently removed in the final rezoning. As such, local trip generation is slightly overestimated and future year network performance as modelled may appear slightly worst.
- Breakdown of dwelling numbers and local generation of TOD demands are based on the methodology described in the report. Estimation of through trips has been based on information from surveys that were undertaken for the two metro station precincts (Jacobs 2022). These surveys included counts of vehicle movements in the peak periods. To estimate the 2041 through traffic volumes and accounting for a level of growth due to background traffic, a nominal growth factor of 15% (i.e. V2018 X 1.15= V2041) has been assumed (i.e. 1.53% per annum linear growth). The small growth rate adopted is in consideration of the congested nature of Old Windsor Road and its inability to accommodate more traffic in the peak hours in the absence of upgrades to its capacity at key locations.
- The growth rate has been applied to movements that were identified facilitating through traffic and in consideration of their regional function and expected use by external traffic passing through the area. These movements are predominantly north-south through flows on Old Windsor Road, movements to/from Memorial Avenue, Sunnyholt Road and Windsor Road. No growth factors were applied to roads perceived to entirely serve a local function such as Newbery Avenue, Miami Street since these roads act as local access routes to local areas that are already well developed and unlikely to experience any major growth in population in the future.
- The adopted methodology serves as a high level assessment of the road network impacts of the TOD using available information. Ultimately, for a project of this size, more detailed analysis would be needed to develop improvement options. Future analysis is likely to include application of the strategic travel demand models (STM/PTPM) to capture regional travel and local demands. Outputs from strategic model would include consideration at a regional level of future population and employment, land use mix, accessibility to alternative modes, car ownership and other characteristics for each precinct.

Appendix C. Dwelling and Typology

The detailed dwelling and typology information for Bella Vista and Kellyville precincts are shown below.

Bella Vista and Kellyville Precincts

Existing capacity			TOD rezoning capacity at full development		TOD rezoning capacity in 2041				
Block	Existing dwellings	Do nothing scenario	Preferred scenario (full devt - total)	Preferred scenario (full devt - add.)	Preferred scenario 2041 (total)	Preferred scenario 2041 (add. dwellings)	Existing dwellings demolished 2041	Uplift density category	2041 take-up % of full devt add.
K1	0	684	684		684	684		High Density	100%
K2	279	1,072	1072		128	128	33		12%
K3	342	1,162	1162		128	128	38		11%
K4	0	650	1,349	699	1,349	699		High Density	100%
K5	252	501	501		17	17			3%
K6	391	841	841		17	17			2%
K7	53	106	106		17	17			16%
K8	295	613	613		17	17			3%
K9	0	2,102	3,169	1,067	3,169	3,169		High Density	100%

Existing capacity			TOD rezoning capacity at full development		TOD rezoning capacity in 2041				
Block	Existing dwellings	Do nothing scenario	Preferred scenario (full devt - total)	Preferred scenario (full devt - add.)	Preferred scenario 2041 (total)	Preferred scenario 2041 (add. dwellings)	Existing dwellings demolished 2041	Uplift density category	2041 take-up % of full devt add.
K10	463	992	992		57	57			6%
K11	478	902	902		55	55			6%
K12	57	123	123		55	55			45%
K13	53	140	140		55	55		High Density	39%
K14	394	1,271	1,271		55	55			4%
BV1	0	1,346	2,220	874	2,220	874		High Density	100%
BV2	500	865	865		350	350		High Density	40%
BV3	385	885	885		48	48			5%
BV4	181	267	267	0	0	0			0%
BV5	112	194	0	0	80	80		High Density	41%
BV6	122	237	237		34	34			14%
BV7	0	1,303	2,031	728	2,03	729		High Density	100%
BV8	3	816	1,517	701	944	944	3		62%

Existing capacity			TOD rezoning capacity at full development		TOD rezoning capacity in 2041				
Block	Existing dwellings	Do nothing scenario	Preferred scenario (full devt - total)	Preferred scenario (full devt - add.)	Preferred scenario 2041 (total)	Preferred scenario 2041 (add. dwellings)	Existing dwellings demolished 2041	Uplift density category	2041 take-up % of full devt add.
BV9	150	280	280	0	24		0	High Density	9%
BV10	96	208	208		22				11%
BV11	11	178	178		17	17	0	High Density	10%
BV12	309	829	829	0	17	17			2%
BV14	0	739	1,287	548	1,287	548		High Density	100%
BV15	0	0	0		0	0			
BV16	44	204	204		204	204		High Density	100%
BV17	472	1,048	1,048		40	40			4%
BV18	454	824	6,140	5,316	990	536	73	High Density	16%
BV19	392	1,194	1,194	0	130	130			11%

Appendix D. Trip Generation

The trip generation results are shown below. Note, that a 5% reduction factor was applied to account for internal trips.

Inbound - AM

	Land use	INBOUND																														
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV13	BV14	BV15	BV16	BV17	BV18
Residential dwellings	Low density	0	47	58	0	51	78	13	59	0	99	101	21	21	85	0	0	82	34	0	30	0	0	33	22	25	62	99	0	0	0	37	72
	Medium density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
	High density	34	6	6	59	0	0	0	0	139	0	0	0	0	0	38	18	0	0	4	0	89	47	0	0	0	0	0	57	0	10	0	30
Total residential trips		34	53	64	59	51	78	13	59	139	99	101	21	21	85	38	73	82	34	17	30	89	47	33	22	25	62	99	57	0	10	37	103
Total residential trips factoring internal trips		32	50	61	56	49	74	13	56	132	94	96	20	19	81	33	69	78	33	17	28	85	45	31	21	24	59	94	54	0	10	32	98

Outbound - AM

	Land use	OUTBOUND																														
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV13	BV14	BV15	BV16	BV17	BV18
Residential dwellings	Low density	0	187	231	0	204	310	53	237	0	395	405	85	82	341	0	0	329	138	0	119	0	0	132	90	100	248	397	0	0	0	389	290
	Medium density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	220	0	0	54	0	0	0	0	0	0	0	0	0	0	0	0	0
	High density	137	26	26	237	0	0	0	0	558	0	0	0	0	0	391	70	0	0	16	0	357	189	0	0	0	0	0	227	0	41	0	122
Total residential trips		137	212	257	237	204	310	53	237	558	395	405	85	82	341	391	290	329	138	70	119	357	189	132	90	100	248	397	227	0	41	389	412
Total residential trips factoring internal trips		130	202	244	226	194	295	51	225	530	375	385	81	78	324	371	276	313	131	66	113	340	179	126	85	95	235	377	215	0	39	370	391

Inbound - PM

	Land use	INBOUND																														
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV13	BV14	BV15	BV16	BV17	BV18
Residential dwellings	Low density	0	187	231	0	204	310	53	237	0	395	405	85	82	341	0	0	329	138	0	119	0	0	132	90	100	248	397	0	0	0	389	290
	Medium density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	180	0	0	45	0	0	0	0	0	0	0	0	0	0	0	0	0
	High density	109	20	20	183	0	0	0	0	431	0	0	0	0	0	302	56	0	0	13	0	276	151	0	0	0	0	0	175	0	33	0	97
Total residential trips		109	207	252	183	204	310	53	237	431	395	405	85	82	341	302	236	329	138	58	119	276	151	132	90	100	248	397	175	0	33	389	387
Total residential trips factoring internal trips		104	197	239	174	194	295	51	225	409	375	385	81	78	324	287	224	313	131	55	113	262	143	126	85	95	235	377	166	0	31	370	368

Outbound - PM

	Land use	OUTBOUND																														
		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV13	BV14	BV15	BV16	BV17	BV18
Residential dwellings	Low density	0	47	58	0	51	78	13	59	0	99	101	21	21	85	0	0	82	34	0	30	0	0	33	22	25	62	99	0	0	0	37	72
	Medium density	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
	High density	27	5	5	46	0	0	0	0	108	0	0	0	0	0	75	14	0	0	3	0	69	38	0	0	0	0	0	44	0	8	0	24
Total residential trips		27	52	63	46	51	78	13	59	108	99	101	21	21	85	75	59	82	34	14	30	69	38	33	22	25	62	99	44	0	8	37	97
Total residential trips factoring internal trips		26	49	60	44	49	74	13	56	102	94	96	20	19	81	72	56	78	33	14	28	66	36	31	21	24	59	94	42	0	8	32	92

The table below shows the additional traffic generated from the Bella Vista and Kellyville precincts for the future project case 2041.

Road	Direction	Between	Additional trips	
			AM	PM
Windsor Rd	North	Schofields Rd - Merriville Rd	138	99
	South		122	114
Windsor Rd	North	Merriville Rd - Windsor Rd	136	98
	South		122	112
Old Windsor Rd	North	Windsor Rd - Samantha Riley Rd	90	86
	South		107	73

Road	Direction	Between	Additional trips	
			AM	PM
Perfection Ave	North	Merriville Rd - Newbury Ave	12	22
	South		22	12
Newbury Ave	East	Perfection Ave - Old Windsor Rd	20	19
	West		22	19
Windsor Rd	North	Old Windsor Rd - Samantha Riley Dr	58	38
	South		47	48
Samantha Riley Dr	East	Old Windsor Rd - Windsor Rd	300	585
	West		744	235
Samantha Riley Dr	East	East of Windsor Rd	31	6
	West		8	25
Stanhope Pkwy	East	West of perfection Ave	9	29
	West		36	7
Stanhope Pkwy	North	Perfection Ave - Stanhope Pkwy	25	27
	South		28	21
Old Windsor Rd	North	Samantha Riley Dr - Memorial Ave	217	608
	South		768	173
Windsor Rd	North	Samantha Riley Dr - Memorial Ave	34	63
	South		80	29
Sunnyholt Rd	East	Stanhope Pkwy - Old Windsor Rd	95	249
	West		307	80
Memorial Ave	East	Old Windsor Rd - Windsor Rd	90	190
	West		205	84
Old Windsor Rd	North	Memorial Ave - Balmoral Rd	369	722
	South		881	299

Road	Direction	Between	Additional trips	
			AM	PM
Miami St	East	Glenwood Park Dr - Old Windsor Rd	109	50
	West		63	89
Balmoral Rd	East	Old Windsor Rd - Seven Vale Dr	287	664
	West		835	228
Windsor Rd	North	Memorial Ave - Fairway Dr	54	172
	South		207	45
Fairway Dr	East	Fairway Dr - Windsor Rd	92	19
	West		23	74
Glenwood Park Dr	North	Miami St - Forman Ave	106	42
	South		52	87
Old Windsor Rd	North	Balmoral Rd - Celebration Dr	434	1284
	South		1587	350
Sunnyholt Rd	North	Stanhope Pkwy - M7	89	289
	South		356	72
Malvern Rd	East	Sunnyholt Rd - Glenwood Park Dr	15	49
	West		61	12
Forman Ave	East	Glenwood Park Dr - Glenwood Park Dr	5	15
	West		19	4
Celebration Dr	East	Old Windsor Rd - Edgewater Dr	71	194
	West		248	56
Showground Rd	East	East of Windsor Rd	171	35
	West		43	140
Glenwood Park Dr	North	Malvern Rd - Meurants Ln	4	1
	South		1	4

Road	Direction	Between	Additional trips	
			AM	PM
Glenwood Park Dr	North	Forman Ave - Meurants Ln	24	29
	South		30	22
Old Windsor Rd	North	Celebration Dr - Norwest Blvd	449	1444
	South		1791	362
Edgewater Dr	North	Celebration Dr - Norwest Blvd	7	23
	South		25	6
Fairway Dr	North	Free Settlers Dr – Norwest Blvd	32	109
	South		109	32
Windsor Rd	North	Showground Rd - Norwest Blvd	28	46
	South		54	23
Meurants Ln	East	Glenwood Park Dr - Glenwood Park Dr	23	9
	West		10	21
Greenhill Dr	North	Meurants Ln - Norwest Blvd	6	20
	South		22	5
Old Windsor Rd	North	Norwest Blvd - M7	452	1475
	South		1804	370
Norwest Blvd	East	Old Windsor Rd - Edgewater Dr	55	124
	West		125	51
Norwest Blvd	East	Edgewater Dr - Fairway Dr	59	114
	West		115	52
Windsor Rd	North	Norwest Blvd - M7	13	43
	South		51	11

Appendix E. Volume to Capacity Ratio – Future Project Case 2041

The term volume to capacity ratio indicates the ratio of traffic volume to road capacity. A volume to capacity ratio of 1 indicates that the road or road segment is operating at capacity and therefore a value larger than 1 represents oversaturation.

V/C Ratio	Status
< 0.8	Operating under capacity
0.8 – 1.0	Operating near or at capacity
> 1.0	Oversaturated / over capacity

The following table shows the V/C ratios (due to TOD only and all traffic) along key road segments within the Bella Vista and Kellyville precinct.

Road	Dir.	Between	Hierarchy type	Capacity (pc/hr)	V/C (Due to TOD only)		V/C (all traffic)	
					AM	PM	AM	PM
Windsor Rd	North	Schofields Rd - Merriville Rd	Arterial	2200	0.10	0.05	0.95	1.30
	South			2200	0.10	0.10	1.55	1.10
Windsor Rd	North	Merriville Rd - Windsor Rd	Arterial	2200	0.10	0.05	0.95	1.30
	South			2200	0.10	0.10	1.55	1.10
Old Windsor Rd	North	Windsor Rd - Samantha Riley Rd	Inner Urban Highway/Major Arterial	4200	0.05	0.05	0.35	0.40
	South			4200	0.05	0.05	0.40	0.40
Perfection Ave	North	Merriville Rd - Newbury Ave	Collector	650	0.05	0.05	0.30	0.70
	South			650	0.05	0.05	0.70	0.30
Newbury Ave	East	Perfection Ave - Old Windsor Rd	Sub-arterial	900	0.05	0.05	0.90	0.60
	West			900	0.05	0.05	0.60	0.90
Windsor Rd	North	Old Windsor Rd - Samantha Riley Dr	Arterial	2200	0.05	0.05	0.35	0.65
	South			2200	0.05	0.05	0.65	0.45

Road	Dir.	Between	Hierarchy type	Capacity (pc/hr)	V/C (Due to TOD only)		V/C (all traffic)	
					AM	PM	AM	PM
Samantha Riley Dr	East	Old Windsor Rd - Windsor Rd	Sub-arterial	2000	0.20	0.30	1.00	0.75
	West			2000	0.40	0.15	0.85	0.55
Samantha Riley Dr	East	East of Windsor Rd	Sub-arterial	2000	0.05	0.05	0.90	0.50
	West			2000	0.05	0.05	0.40	1.00
Stanhope Pkwy	East	West of perfection Ave	Arterial	2200	0.05	0.05	0.70	0.35
	West			2200	0.05	0.05	0.20	0.70
Stanhope Pkwy	North	Perfection Ave - Stanhope Pkwy	Arterial	2200	0.05	0.05	0.20	0.70
	South			2200	0.05	0.05	0.70	0.35
Old Windsor Rd	North	Samantha Riley Dr - Memorial Ave	Inner Urban Highway/Major Arterial	4200	0.10	0.15	0.50	0.75
	South			4200	0.20	0.05	0.60	0.50
Windsor Rd	North	Samantha Riley Dr - Memorial Ave	Arterial	2200	0.05	0.05	0.40	0.50
	South			2200	0.05	0.05	1.30	0.60
Sunnyholt Rd	East	Stanhope Pkwy - Old Windsor Rd	Arterial	2200	0.05	0.15	0.95	1.05
	West			2200	0.15	0.05	0.65	0.95
Memorial Ave	East	Old Windsor Rd - Windsor Rd	Arterial	2200	0.05	0.10	0.65	0.65
	West			2200	0.10	0.05	0.55	0.55
Old Windsor Rd	North	Memorial Ave - Balmoral Rd	Inner Urban Highway/Major Arterial	4200	0.10	0.20	0.50	0.80
	South			4200	0.25	0.10	0.80	0.60
Miami St	East	Glenwood Park Dr - Old Windsor Rd	Collector	1400	0.10	0.05	0.55	0.30
	West			1400	0.05	0.10	0.20	0.55
Balmoral Rd	East	Old Windsor Rd - Seven Vale Dr	Sub arterial	900	0.35	0.75	0.65	0.90
	West			900	0.95	0.30	1.25	0.90
Windsor Rd	North	Memorial Ave - Fairway Dr	Arterial	2200	0.05	0.10	0.50	1.20
	South			2200	0.10	0.05	1.60	0.80

Road	Dir.	Between	Hierarchy type	Capacity (pc/hr)	V/C (Due to TOD only)		V/C (all traffic)	
					AM	PM	AM	PM
Fairway Dr	East	Fairway Dr - Windsor Rd	Collector	650	0.15	0.05	0.30	0.10
	West			650	0.05	0.15	0.10	0.25
Glenwood Park Dr	North	Miami St - Forman Ave	Collector	650	0.20	0.10	0.75	0.30
	South			650	0.10	0.15	0.35	0.70
Old Windsor Rd	North	Balmoral Rd - Celebration Dr	Inner Urban Highway/Major Arterial	4200	0.15	0.35	0.55	0.85
	South			4200	0.40	0.10	1.10	0.65
Sunnyholt Rd	North	Stanhope Pkwy - M7	Arterial	2200	0.05	0.15	0.65	1.20
	South			2200	0.20	0.05	1.00	0.75
Malvern Rd	East	Sunnyholt Rd - Glenwood Park Dr	Collector	650	0.05	0.10	0.10	0.25
	West			650	0.10	0.05	0.25	0.10
Forman Ave	East	Glenwood Park Dr - Glenwood Park Dr	Minor	500	0.05	0.05	0.05	0.15
	West			500	0.05	0.05	0.15	0.05
Celebration Dr	East	Old Windsor Rd - Edgewater Dr	Collector	650	0.15	0.30	0.85	1.05
	West			650	0.40	0.10	0.65	1.00
Showground Rd	East	East of Windsor Rd	Arterial	2200	0.10	0.05	0.20	0.05
	West			2200	0.05	0.10	0.05	0.20
Glenwood Park Dr	North	Malvern Rd - Meurants Ln	Collector	650	0.05	0.05	0.10	0.05
	South			650	0.05	0.05	0.05	0.10
Glenwood Park Dr	North	Forman Ave - Meurants Ln	Collector	650	0.05	0.05	0.35	0.50
	South			650	0.05	0.05	0.50	0.35
Old Windsor Rd	North	Celebration Dr - Norwest Blvd	Inner Urban Highway/Major Arterial	4200	0.15	0.35	0.60	0.90
	South			4200	0.45	0.10	1.10	0.65
Edgewater Dr	North	Celebration Dr - Norwest Blvd	Collector	650	0.05	0.05	0.15	0.45
	South			650	0.05	0.05	0.45	0.15

Road	Dir.	Between	Hierarchy type	Capacity (pc/hr)	V/C (Due to TOD only)		V/C (all traffic)	
					AM	PM	AM	PM
Fairway Dr	North	Free Settlers Dr - Norwest Blvd	Collector	650	0.05	0.20	0.25	0.80
	South			650	0.20	0.05	0.80	0.25
Windsor Rd	North	Showground Rd - Norwest Blvd	Arterial	2200	0.05	0.05	0.95	1.00
	South			2200	0.05	0.05	0.85	0.90
Meurants Ln	East	Glenwood Park Dr - Glenwood Park Dr	Collector	650	0.05	0.05	0.35	0.20
	West			650	0.05	0.05	0.20	0.35
Greenhill Dr	North	Meurants Ln - Norwest Blvd	Collector	650	0.05	0.05	0.30	0.60
	South			650	0.05	0.05	0.70	0.30
Old Windsor Rd	North	Norwest Blvd - M7	Inner Urban Highway/Major Arterial	4200	0.15	0.40	0.80	1.10
	South			4200	0.45	0.10	1.35	0.80
Norwest Blvd	East	Old Windsor Rd - Edgewater Dr	Sub arterial	2000	0.05	0.10	0.85	0.60
	West			2000	0.10	0.05	0.65	1.00
Norwest Blvd	East	Edgewater Dr - Fairway Dr	Sub arterial	2000	0.05	0.10	0.66	0.60
	West			2000	0.10	0.05	0.65	1.00
Windsor Rd	North	Norwest Blvd - M7	Arterial	2200	0.05	0.05	0.95	1.00
	South			2200	0.05	0.05	0.85	0.90

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