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Precinct Transport Statement

Kellyville & Bella Vista Precinct TOD

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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 Kellyville and Bella Vista 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 predominately 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 Kellyville and Bella Vista. 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 Kellyville and Bella Vista 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 soon being able to directly travel to the Sydney CBD by metro when the Chatswood to Sydenham component of the Sydney Metro opens in 2024.

Future Land Use

As part of the TOD program, transformational land-use changes are planned for Kellyville and Bella Vista 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.

Density	Future Project Case 2041
Low density	5,267
Medium density	612
High density	13,237
Total	19,117

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

Future Road Network Performance

The current road network within the Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 2,400 vehicles per hour (vph) outbound and 600 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 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 leading 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista residents better access to a sustainable and integrated network.

Precinct Transport Statement



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



Contents

Exec	utive S	Summary	iii
1.	Intro	oduction	9
	1.1	Project Background	9
	1.2	Project Objectives	9
	1.3	Report Purpose	9
	1.4	Vision-led Approach to Precinct Transport Planning	9
2.	Exist	ting Transport Context	10
	2.1	Investigation Area	10
	2.2	Land Use	11
		2.2.1 Overview	11
		2.2.2 Key Points of Interest	12
		2.2.3 Character	13
	2.3	Travel Behaviour	15
		2.3.1 Mode Share	15
		2.3.2 Local and Regional Trip Distribution	17
		2.3.3 Trip Distance	
		2.3.4 Trip Purpose	19
	2.4	Active Transport Network	20
	2.5	Public Transport Network	23
	2.6	Road Network	24
		2.6.1 Existing Road Network Performance	25
	2.7	Freight Network	26
	2.8	Planned Transport Initiatives and Infrastructure	27
3.	Tran	sport Vision and Future Land Use	
	3.1	Strategic Transport Planning Context	28
	3.2	Transport Vision and Objectives	29
	3.3	Assessment Overview	
	3.4	Land Use and Dwelling Projections	
	3.5	Movement and Place Framework	
4.	Futu	re Road Network Performance	34
	4.1	Modelling Methodology	34
		4.1.1 Trip Generation	34
		4.1.2 Trip Distribution	
		4.1.3 Mode Choice	
		4.1.4 Traffic Assignment	
	4.2	Performance Assessment	
	4.3	Capacity Assessment	

		4.3.1 Intersection Performance	.41
5.	Issue	s, Challenges and Opportunities	.43
6.	The T	ransport Response	.45
	6.1	Approach to Transport Needs	.45
	6.2	Alignment with Vision and Objectives	.45
	6.3	Prioritisation for Implementation	.46
	6.4	Transport Initiatives and Infrastructure Projects	.47
	6.5	Future Transport Planning	.53
7.	Sumr	nary	.54

Appendices

Appendix A. Existing Road Network Performance	55
Appendix B. Model Development Details	60
Appendix C. Dwelling and Typology	62
Appendix D. Trip Generation	66
Appendix E. Volume to Capacity Ratio – Future Project Case 2041	70

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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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.

Precinct Transport Statement



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

2.2 Land Use

2.2.1 Overview

The existing land use surrounding the Kellyville and Bella Vista Station Precincts is predominately 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.

Precinct Transport Statement

The Kellyville and Bella Vista 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 Kellyville and Bella Vista Station Precincts are shown in Figure 2-2.



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

2.2.2 Key Points of Interest

Within the Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 14,000m² and 150,000m² respectively for the Bella Vista Station Precinct and 10,047m² 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista Station Precincts to maximise their integration with surrounding areas.

2.2.3 Character

Based on 2021 Census data, there are approximately 3,839 and 7,381 dwellings within the Kellyville and Bella Vista SA2¹ 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 Kellyville and Bella Vista 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.

Cataburant Area (CAD)	Dwelling Type as Proportion of Total Dwelling					
Catchment Area (SA2)	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%		

Table 2-1: Dwelling type for	Kellyville and Bella Vista	by SA2 (ABS Census)	2021)
rable z 1. Dwelling type for	Religence and Della vista	by JAZ (ADJ Cellous	2021)

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 Kellyville and Bella Vista 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 predominately families with children.

The TOD Program will increase the number of high to medium density developments across Kellyville and Bella Vista 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.

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

Table 2-2: Car ownershi	p in Kellyville and Bella Vis	ta by SA2 (ABS Census 2021)
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2.3 Travel Behaviour

Travel behaviours in Kellyville and Bella Vista 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 data² 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 Kellyville and Bella Vista residents travelling to work is shown in Figure 2-4 and Figure 2-5 for 2016 and 2021 respectively.

Transport Mode Share Split by Location



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.





Transport Mode Share Split by Location

Transport Mode
Bicycle
Bus
Car
Other Mode
Train
Tram/Light Rail
Walked only

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 Kellyville and Bella Vista 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 8% and 7% of Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 eventually the Sydney CBD following the completion of Sydney Metro City and Southwest.

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 Kellyville and Bella Vista. 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 Kellyville and Bella Vista 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 pricing policies in commercial areas to drive the public transport mode share higher. The existence of an already well-established bus networks in Kellyville

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

and Bella Vista that connects 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista Station Precincts. Conversely, trips by residents in Kellyville and Bella Vista 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 Kellyville and Bella Vista) 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. Kellyville and Bella Vista), 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista) 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 passengers⁴ (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 predominate 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 provides 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista Stations to encourage users to adopt active transport as a mode of travel. The existing active transport network within the surrounding Kellyville and Bella Vista 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: <u>https://www.transport.nsw.gov.au/projects/current-projects/memorial-avenue-upgrade-kellyville</u>

Precinct Transport Statement



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 within 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 Kellyville and Bella 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).

Precinct Transport Statement



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

2.5 Public Transport Network

The existing public transport network surrounding the Kellyville and Bella Vista 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 with a driverless metro train every four minutes in the peak. This is complemented by Park & Ride facilities next to metro stations, allowing commuters 18 hours free parking using the Opal ticketing system to drive, park and catch the metro to their destination. Before introduction of the Sydney Metro Northwest, on average approximately 6% of total residents in Kellyville and Bella Vista 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 Kellyville and Bella Vista. When the Sydney Metro line from Chatswood to Sydenham opens in 2024, it will allow Kellyville and Bella Vista residents 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 Kellyville and Bella Vista precincts which provides access to:

- Local destinations such as:
 - Kellyville and Bella Vista Stations;
 - Norwest Business Park; and
 - Norwest Private Hospital.

- Regional connections such as:
 - Rouse Hill, Norwest and Castle Hill;
 - Blacktown, Seven Hills, Parramatta and Westmead;
 - North Sydney; and
 - Sydney CBD.

The North-West T-way runs beside Old Windsor Road with stops at both Kellyville and Bella Vista stations between Rouse Hill and Beaumont Hills/Kellyville to Parramatta and Blacktown. There is also the 607X bus route from Bella Vista to the Sydney CBD via the M2, Lane Cove Tunnel, and Gore Hill Freeway, as well as the 602X peak-only service from Bella Vista to North Sydney via the M2 and St Leonards. These provide services from areas without direct access to the Sydney Metro. Currently, Kellyville and Bella Vista residents have direct access to the Sydney CBD via bus without any transfers required. However, the existing bus services may change once the Chatswood to Sydenham section opens as this will allow commuters to directly access the Sydney CBD by metro.

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)

2.6 Road Network

The Kellyville and Bella Vista 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 Kellyville and Bella Vista 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: <u>https://www.movementandplace.nsw.gov.au/place-and-network/built-environment-indicators/bus-and-strategic-freight-reliability</u>

Precinct Transport Statement



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 results are 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 Kellyville and Bella Vista 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 / 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 Kellyville and Bella Vista Station Precincts consists of the Westlink M7 Motorway, Old Windsor Road and Windsor Road.

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: <u>https://www.movementandplace.nsw.gov.au/place-and-network/built-environment-indicators/bus-and-strategic-freight-reliability</u>

- 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista Precincts under the urban design framework (Architectus 2024) is:

"Transformed by Metro and unified by Elizabeth Macarthur Creek, Kellyville and Bella Vista 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:

Kellyville and Bella Vista 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.

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 Kellyville and Bella Vista 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 T-way 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, care-giving 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 transitway 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 principle 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 Kellyville and Bella Vista 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 proposed structure plan for the Kellyville and Bella Vista 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.

Precinct Transport Statement



Figure 3-1: Proposed Structure Plan for Kellyville and Bella Vista Precincts (Architectus 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.

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.

Density	Base Case	Future Project Case (Full)	Future Project Case 2041
Low density	5,779	6,453	5,267
Medium density	612	3,853	612
High density	0	31,521	13,237
Total	6,391	41,827	19,117

Table 3-3: Dwelling	projections in	2041 - Kelly	ville and Bell	a Vista Precincts

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 19,117 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: <u>https://www.movementandplace.nsw.gov.au/about/about-movement-and-place</u>



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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 guidelines⁹, 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: <u>https://www.transport.nsw.gov.au/system/files/media/documents/2022/guide-to-generating-traffic-developments.pdf</u>

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

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

Table 4-1: Vehicle	Trip G	Generation	rates for	Residential	Dwellings
	inp c	acticiation	races for	Residentiat	Directings

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. 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 14,105 dwellings combined for both Kellyville and Bella Vista 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.

Table 4-2 also includes the total number of trips generated by the Kellyville and Bella Vista 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**.

AM Peak	Hour (Trips)	PM Peak Hour (Trips)		
Inbound	Outbound	Inbound	Outbound	
600	2,400	1,900	500	

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

Based on the number of dwellings proposed, the Kellyville and Bella Vista TOD precincts are estimated to cumulatively generate approximately 2,400 vehicles per hour (vph) outbound and 600 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 1,900 inbound and 500 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista precincts were determined by aggregating total trips generated from all blocks.

Figure 4-1 outlines the overall projected trip distributions for the Kellyville and Bella Vista 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 18% of the total trips whilst those travelling south to Parramatta, Kemps Creek and Wetherill Park industrial area etc constitute 20% of total trips. The relatively low proportion of northerly trips (6%) 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 T-way 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 Kellyville and Bella Vista precincts are shown in Table 4-3.

Table / 2. Mada abava		امام: ما بر ما بر ما	المناهد والمناور والمستحد والم	بليفيد مترمية المريحات	
Table 4-3: Mode share	proportions assu	imea for high a	ensity residential	l development ir	11005

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. Draft Guide to Transport Impact Assessment (TfNSW 2024), Table 5.10. Mode share for 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 ratios¹¹ 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. 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 and Sunnyholt Road are projected to experience high traffic demand 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-bylane 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.

	АМ			РМ		
Intersection	Average delay / vehicle (sec)	LoS	DoS	Average delay / vehicle (sec)	LoS	DoS
Old Windsor Rd / Windsor Rd	35	С	0.9	35	С	0.7
Old Windsor Rd / Samantha Riley Dr / Newbury Ave	130	F	1.1	95	F	1.1
Old Windsor Rd / Memorial Ave / Sunnyholt Rd	145	F	1.1	150	F	1.1
Old Windsor Rd / Balmoral Rd / Miami St	575	F	1.3	145	F	1.0
Old Windsor Rd / Celebration Dr	435	F	1.4	360	F	0.9
Old Windsor Rd / Norwest Blvd	95	F	1.1	40	D	0.9
Windsor Rd / Samantha Riley Dr	105	F	1.1	60	E	1.0
Windsor Rd / Memorial Ave	205	F	0.7	25	В	0.6
Stanhope Pkwy / Sunnyholt Rd	35	С	0.8	115	F	1.2

Table 4-4: SIDRA	Performance -	2041	Project	Case

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 Kellyville and Bella Vista 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.

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 <i>The Hills Shire Bike</i> <i>Plan</i>. 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

Table	5-1:	Issues	challenges	and	opportunities
Tuble	J 1.	155405,	chattenges	unu	opportunities

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 Kellyville and Bella Vista 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 Kellyville and Bella Vista residents better access to a sustainable and integrated network as outlined in Table 6-1.

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 Kellyville and Bella Vista 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.				

Table 6-1: Alignment with transport objectives

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.
- 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.

#	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	Blacktown City Council	TfNSW / Blacktown City Council	Long term	Low / \$\$
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	Low / \$\$

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

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
				population east of the metro stations)	
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	Short-term (to meet the needs of the existing population east of the metro stations)	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	Kellyville and Bella Vista 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	Kellyville and Bella Vista 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	Shared path – Meurants Ln, with extensions on Greenhill Dr to Norwest Blvd/M7, and improved access to Meurants T- way station	Kellyville and Bella Vista State- led TOD Rezoning	Blacktown City Council	Medium-term (to meet the needs of the existing population and as development progress)	Low / \$\$
10	Shared path – Caddies Creek (Glenwood Lake – Stanhope Gardens Reserve – Connor Greasby Park)	Blacktown City Council	Blacktown City Council	Medium-term (to meet the needs of the existing population and as development progress	Low / \$\$
11	Upgrade Samantha Riley Dr/Old Windsor Rd intersection - Pedestrian and cycling facility	Blacktown City Council	TfNSW / Blacktown City Council	Medium-term (to meet the needs of the existing population and as development progress	High / \$\$
Public	Transport Network				
1	Bus priority – Miami St / Tarwin Ave approaching Old Windsor Rd	TfNSW	TfNSW / The Hills Shire Council	Medium-term (as development progress)	High / \$\$\$

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
2	Bus priority – Perfection Ave approaching Newbury Ave; Newbury Ave eastbound towards Old Windsor Road	TfNSW	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / \$\$
3	Bus priority – Samantha Riley Dr, Guragura St to Old Windsor Road	TfNSW	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / \$\$
4	Bus priority – Meurants Lane approaching Greenhill Dr; Greenhill Dr to Norwest Blvd	TfNSW	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / \$\$
5	Bus priority – Lexington Dr / Elizabeth Macarthur Dr approaching Norwest Blvd	Bella Vista Transport Plan (TfNSW 2015); Norwest Innovation s7.12 Contributions Plan (THSC November 2021)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / \$\$
Road I	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 / \$\$
2	Old Windsor Road 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	Upgrade – Additional left slip lane in Celebration Dr east of the T-Way including new shared path	Bella Vista and Kellyville Station Precincts - Concept SSD Application (Landcom 2022)	TfNSW / The Hills Shire Council	Medium-term (as development progress)	Medium / \$\$
6	Intersection upgrade - Samantha Riley Drive/ Decora Drive	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 / \$\$

#	Initiative / Project	Source / Reference	Agency	Indicative Priority	Complexity / Relative Scale of Cost
7	Signalisation – Unaipon Avenue/Mawson Avenue	TfNSW	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 / \$\$
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.



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

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.

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 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 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.
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 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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 draft Guide to Transport Impact Assessment (TfNSW 2024).

LoS	Average delay per vehicle (seconds / vehicle)	Traffic signals and roundabouts
А	Less than 15	Good operation
В	15 to 28	Good with acceptable delays and spare capacity
С	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

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

Source: Draft 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 Kellyville and Bella Vista 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.

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

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

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 Kellyville and Bella Vista 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.	Intersections	Existing									
No.		A	M 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	В	24	E	63						
42	Old Windsor Rd / Norwest Blvd	С	33	С	30						
49	Windsor Rd / Memorial Ave	С	30	С	28						
61	Celebration Dr / Lexington Dr / Mawson Av	В	23	В	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.

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

Table A-4: LoS Criteria for Midblock Sections

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.

Route	Dir.	AM Pea	nk Hour	PM Pea	ık 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	NB	02:53	53	06:12	25
Road	SB	02:30	61	02:22	64
Norwest	EB	05:53	25	05:28	27
Boulevard	WB	04:10	37	04:04	38

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

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 Kellyville and Bella Vista 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 Kellyville and Bella Vista 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-Vis	ta Land Use Summar	у			Values o	an be change	ed by user																											
Future Base Case (2024 Existing Dvelling	gs – 2041 Existin	g D v elling De	molished)																														
	Landlise	Area																																
	Land OSC	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	8
Residential	Low Density	0	279	342	0	176	273	53	224.2	0	463	478	57	53	394	0	0	385	181	0	122	0	0	150	96	114	309	392	0	0	44	354	304	<u>.</u>
Dwellings –	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	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	0	U	0	U	U	U	0		_
A	L.::h L.: 2041	5855.38) 8																													
Assumed aveilings	built by 204 Las a res	uit of TUD rezon	ing (arter app	iy take up rate	j - ocenario z														-				-			-	-	-	-	-	-	-	+	-
	Land Use	k'i	K2	K3	KA	K5	K6	K7	K8	1/9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV19	BV14	BV15	BV16	BV17		8
	Low Density	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	13	0015	0014	0	000	0		-
Residential	Medium Density	ň	ň	ň	ň	ň	ň	ň	ň	1 ň	Ó	ň	- ň	ň	ň	l ñ	ň	ň	1 ň	ň	ň	ň	l ñ	ň	1 ň	1 ñ	1 n	Ť	Ť	1 ň	Ť	1 ň	Ť	-
Dwellings	High Density	0	0	0	803	621	1002	0	221	2549	0	ō	0	Ō	Ō	1371	0	Ō	Ō	0	Ō	1374	941	Ō	Ō	Ō	Ō	Ō	1371	Ō	Ō	1262	1727	2
																																		_
Future Project Cas	e 2041 (including TOD	uplift up to 204	1)																							-	-					-		_
	Land Use	Area	1/2	1/2	KA	KE	KC	K7	KO	1/0	1/10	1/11	1/12	1/10	1/14	DUI	DUD	DUO	DUA	DUE	DUC	DUZ	DUO	DUO	DUIO	DUH	DUHO	DUHO	DU14	DUIE	DUIC	DU17		_
	Lou Donsitu	KI –	<u>KZ</u> 279	KJ 342	K4	K0 176	272	- K(224	KJ	464	479	57	K 13 52	294	DVI	DVZ	200	191	DVD	122	DVI	DVO	150	DVIU	124	322	292	DV 14	DVID	010	0010		<u>)</u>
Residential –	Modium Donsitu		213	J42		110	213		224		404	410	31		334	-	500	303	101	112	166		-	130	30	124	322	. 332	-		44	. 33	+ 30	-
Dwellings –	High Density	-	-	-	803	621	1002	-	221	2 549	-	-	-	-	-	1371	- 500	-	-		-	1374	941	-	-	-	-	-	137	1 -	-	126	2 17	22
	ngnocnaty					021	1,002			2,010												0011	011						0.01			1,40		
					Morning dire	ection factor	Evening dire	ction factor																	Notes: I	Owelling da	ita provide	d by DPHI/	Architectu	s/Atlas from	m			
1	Zone	Component	AM trip rate	PM trip rate	Inbound	Outbound	Inbound	Outbound							No	otes									202406	06 TA testi	ing of take	up dwellin	g numbers	file.				
		Low Density	0.95	0.95	0.2	0.8	0.8	0.2						0.95	5 based on	RTA guid	lelines								The 'Fut	ure Project	t Case 204:	1' dwelling	data inclu	des the sur	m			
1	Station Precincts - K4, K9 BV1 BV7 BV14	Medium Density	0.55	0.45	0.2	0.8	0.8	0.2			R	TA rates fi	or medium	n density b	ut reduced	to accou	nt for close	er distance	e to the sta	tion					of dwel	lings from '	Future Bas	e Case' and	d 'Scenario	2:Possible				
1	1(3,001,001,0014	High Density	0.22	0.17	0.2	0.8	0.8	0.2			Av	erage Sydr	ney high de	ensity resid	lential trip r	rates (2013	BRMS Upd	lated Tech	nical Dire	tion)					BV13 is	renamed t	o 6V19.							
1 5	Close to Station (within	Low Density	0.95	0.95	0.2	0.8	0.8	0.2						0.95	5 based on	RTA guid	lelines																-	
Residential O	K7, K8, K10, BV2, BV8,	Medium Density	0.55	0.45	0.2	0.8	0.8	0.2			B	TA rates fe	or medium	n density bi	ut reduced	to accou	nt for close	er distance	e to the sta	tion													-	
Uwellings	BV9, BV11, BV12, BV15,	High Density	0.25	0.20	0.2	0.8	0.8	0.2			Av	erage Sudr	neu hiah de	ensitu resid	lential trip r	rates (2013	BRMS Upd	lated Teck	nical Dire	tion)													-	
	BV17. BV18 Far from Station (>800m	Low Density	0.95	0.95	0.2	0.8	0.8	0.2						- 0.95	5 based on	BTA quid	lelines .			· ·														
	radius) - K1, K2, K11, K12,	Medium Densitu	0.60	0.50	0.2	0.8	0.8	0.2	0.2 04.05/or 2BR h 05.055/or 3BB - From BTA nuidelines																									
	<13, K14, BV3, BV4, BV5, BV6, BV10, BV19, BV16	High Doposity	0.00	0.00	0.2	0.0	0.0	0.2			6 11	erane Sudr	on high de	ancitu recid	lantial trin r	rates (201	RMSLInd	lated Teck	nical Dire	tion										-		-		
	210,2110,2410,2410	right bensity	0.20	0.20	0.2	0.0	0.0	0.2				an agar ogur							intera bires	,														
																																	-	
% of residents trips																																		

Modelling Methodology, Assumptions and Limitations

- The purpose of the analysis is to estimate the traffic generation and impact of the increase in dwellings in Kellyville and Bella Vista precincts from the TOD program. Commercial, retail and school trips are not captured in the model.
- 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 predominately 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 Kellyville and Bella Vista precincts are shown below.

Kellyville and Bella Vista Precincts

Existing capacity			TOD rezoning develo	capacity at full pment	full 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.	2041 take-up assumptions				
K1	0	684	684		0	0			0	Potential school site				
K2	279	1,072	1072		279	0				No change to existing				
К3	342	1,162	1162		342	0		High Density		No change to existing				
										100% take-up				
K4	0	650	803	153	803	803	0	High Density	1	100% take-up				
K5	252	501	2658	2157	797	545	76	High Density	0.3	30% take-up				
										30% take-up				
K6	391	841	4250	3409	1275	884	118	High Density	0.3	30% take-up				
К7	53	106	159		53	0				No change to existing				

Existing capacity			TOD rezoning develo	capacity at full pment	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 Existing scenario 2041 dwellings (add. demolished dwellings) 2041		Uplift density category	2041 take-up % of full devt add.	2041 take-up assumptions				
										24% take-up				
K8	295	613	1855	1242	445	150	71	High Density	0.24	24% take-up				
К9	0	1,503	2549	1046	2549	2549	0	High Density	1	100% take-up				
K10	463	992	1195	203	464	1		High Density		No change to existing				
K11	478	902	902		478	0				No change to existing				
K12	57	123	123		57	0				No change to existing				
K13	53	140	140		53	0				No change to existing				
K14	394	1,271	1271		394	0				No change to existing				
BV1	0	786	1371	585	1371	1371	0	High Density	1	100% take-up				
BV2	500	865	865		500	0				No change to existing				
BV3	385	885	885		385	0				No change to existing				

Existing capacity			TOD rezoning develo	capacity at full pment						
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.	2041 take-up assumptions
BV4	181	267	267		181	0				No change to existing
BV5	112	194	194		112	0				No change to existing
BV6	122	237	237		122	0				No change to existing
BV7	0	788	1374	586	1374	1374	0	High Density	1	100% take-up
										100% take-up
BV8	3	816	944	128	941	938	3	High Density	1	100% take-up
BV9	150	280	280		150	0		High Density		No change to existing
BV10	96	208	208		96	0				No change to existing
BV11	114	178	178		124	10		High Density		No change to existing
BV12	309	829	829		322	13				No change to existing
BV14	0	786	1371	585	1371	1371	0	High Density	1	100% take-up

Existing capacity TOD rezoning capacity a 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.	2041 take-up assumptions		
BV15	0	0	0		0	0				No change to existing		
BV16	44	204	204		44	0				No change to existing		
										25% take-up		
BV17	472	1,048	6463	5415	1616	1144	118	High Density	0.25	25% take-up		
BV18	454	824	6140	5316	2026	1572	150	High Density	0.33	33% take-up		
BV19	392	1,194	1194		392	0				No change to existing		

Appendix D. Trip Generation

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

IIIDOUIIU - MPI																																	
	Landurga													INBOU	ND																		
	Landuse	К1	K2	К3	K4	K5	K6	K7	K8	К9	K10	K11	K12	K13	K14	BV1	BV2	BV3	BV4	BV5	BV6	BV7	BV8	BV9	BV10	BV11	BV12	BV19	BV14	BV15	BV16	BV17	BV18
	Low density	0	53	65	0	33	52	10	43	0	88	91	11	10	75	0	0	73	34	0	23	0	0	29	18	24	61	74	0	0	8	67	58
Residential dwellings	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	0	0	0	35	31	50	0	11	112	0	0	0	0	0	60	0	0	0	0	0	60	47	0	0	0	0	0	60	0	0	63	86
Total re	esidential trips	0	53	65	35	65	102	10	54	112	88	91	11	10	75	60	55	73	34	13	23	60	47	29	18	24	61	74	60	0	8	130	144
Total residential tr	ips factoring internal trips	0	50	62	34	61	97	10	51	107	84	86	10	10	71	57	52	69	33	13	22	57	45	27	17	22	58	71	57	0	8	124	137
Uutbound - AM																																	
	Land use		1/0				1/0			1/0	1/40	1/44	L	JUIBU		BUA		- DUO	DUA	-	DUG			DUO	DUMO	Dua	DUMO	DUKO	BUAA	DUME	DUKO	DUM 2	DUMO
		<u></u>	KZ	K3	<u>K4</u>	K5	<u>K6</u>	<u>K7</u>	K8	KS	K10	K11	K12	K13	K14	BAI	BAS	BV3	BV4	BA2	BAR	BVI	BAR	BAA	BVIU	BVII	BVIZ	BAIA	BV14	BAIP	BAIP	BVII	BVI8
Desta de la las	Low density		212	260	0	134	207	40	170		353	363	43	40	299	0	0	293	138	0	33	0	0	114	13	34	245	238	U	0	33	269	231
Residential dweilings	Medium density	<u> </u>	0	0		0	0	0	0	140	0	0	- 0	<u> </u>	0	0	220	0	0	54	U	0	100		0	<u> </u>			0		U	050	
T . I	High density	<u> </u>	0	0	141	124	200	10	44	449	050	0	40	40	0	241	0	0	100	- 0	0	242	100	U	70	04	045	0	241		0	252	344
Totaire	esidential trips	0	212	260	141	250	408	40	215	443	353	363	43	40	233	241	220	233	100	54	33	242	100	114	73	34	245	230	241	<u> </u>	33	521	5/0
l otal residential tr	ps ractoring internal trips	0	201	247	154	245	301	30	204	420	335	345	41	30	204	223	203	210	101	51	00	230	113	100	03	30	232	203	223	0	32	435	
Inhound - PM																																	
														INBOU	ND												-						
	Land use	K1	К2	K3	КА	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	BV1	BY2	BV3	BV4	BY5	BY6	BY7	BV8	BV9	BV10	BV11	BV12	BV19	BV14	BY15	BV16	BV17	BV18
	Low density	0	212	260	0	134	207	40	170	1.0	353	363	43	40	299	0	0	293	138	0		0	0	114	73	.94	245	298	0	0	33	269	231
Residential dwellings	Medium density	ň	0	0	ň	0	0	0	0	ň	0	0	0	0	0	ň	180	0	0	45	0	ň	ň		n n	0		0	ň	ň	ñ	0	
-	High density	Ő	0	0	109	99	160	0	35	347	Ō	0	0	Ō	0	186	0	Ō	0	0	Ō	187	151	Ō	Ō	0	Ō	Ō	186	Ö	Ō	202	276
Totaln	esidential trips	Ō	212	260	109	233	368	40	206	347	353	363	43	40	299	186	180	293	138	45	93	187	151	114	73	94	245	298	186	Ō	33	471	507
Total residential tr	ips factoring internal trips	Ö	201	247	104	222	349	38	195	329	335	345	41	38	284	177	171	278	131	43	88	178	143	108	69	90	232	283	177	Ō	32	447	481
Outbound - PM																																	
	Landurge												0	DUTBO	UND																		
	Lanu use	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
		0	50	05									44	10	75	0	0	70	24	0	00								0	0	0	67	58
	Low density	U	53	65	0	33	52	10	43	0	88	91	11	10	10	0	0	10		0	23	0	0	29	18	24	61	74	U	0	0	01	
Residential dwellings	Low density Medium density	0	53	65 0	0	33	52	10	43 0	0	88 0	91	0	0	0	0	45	0	0	11	23	0	0	29 0	18 0	24	61	0	0	0	0	0	0
Residential dwellings	Low density Medium density High density	0	0	0 0	0 27	33 0 25	52 0 40	10 0	43 0 9	0 0 87	88 0 0	91 0 0	0	0	0	0 47	45 0	0	5 0 0	11 0	23 0 0	0 0 47	0 0 38	29 0 0	18 0 0	24 0 0	61 0 0	/4 0 0	0 47	0	0 0	0	0 69
Residential dwellings Total re	Low density Medium density High density esidential trips	0 0 0 0	53 0 0 53	0 0 65	0 0 27 27	33 0 25 58	52 0 40 92	10 0 0 10	43 0 9 51	0 0 87 87	88 0 0 88	91 0 0 91	0	0 0 10	75 0 75	0 47 47	0 45 0 45	0 0 73	5 0 0 34	11 0 11	23 0 0 23	0 0 47 47	0 0 38 38	29 0 0 29	18 0 0 18	24 0 0 24	61 0 0 61	74 0 0 74	0 47 47	0	0 0 8	0 50 118	0 69 127

loband = 0M

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

Pead	Direction	Potwoon	Additional trips			
Rudu	Direction	Detween	AM	РМ		
Windoor Dd	North	Cabafialda Dd Marrivilla Dd	108	21		
Windsor Rd	South	Schonelas Ra - Merriville Ra	27	86		
	North	Marrivilla Dd - Windsor Dd	96	19		
willusor ku	South	Merrivitte ku - Windsof ku	24	76		
Old Windsor Rd	North	Windsor Rd - Samantha Riley Rd	80	16		

Deed	Direction	Daturan	Additional trips			
коаа	Direction	Between	АМ	РМ		
	South		20	63		
Derfection Ave	North	Marrivilla Dd. Navbury Ava	98	223		
Perfection Ave	South	Merrville ku - Newbury Ave	279	79		
Noubury Ave	East	Defection Ave. Old Window Dd	183	52		
Newbury Ave	West	Perfection Ave - Ota Willason Ka	66	147		
Windoor Dd	North	Old Windsor Dd Comontho Dilay Dr	16	3		
Willusof Ru	South	ota windsor ku - samantna kitey Di	4	12		
Samantha Riley Dr	East	Old Windsor Dd Windsor Dd	216	389		
	West	ota winasor ka - winasor ka	503	167		
Samantha Riley Dr	East	East of Window Dd	28	6		
	West		7	22		
Stanbong Diver	East	Wast of parfaction Ava	6	19		
зтапноре Ркму	West	west of penetion Ave	25	5		
Stanbong Diver	North	Defection Ave. Stanhone Diver	43	98		
зтапноре Ркму	South	Perfection Ave - Stannope Pkwy	123	34		
Old Windsor Dd	North	Samantha Bilay Dr. Mamarial Ava	193	474		
	South	Saniantila Kitey Di - Memorial Ave	608	152		
Windoor Dd	North	Comontho Dilay Dr. Mamorial Ava	13	40		
Willusof Ru	South	Samantia Ritey DF - Memorial Ave	52	10		
Suppubalt Dd	East	Staphone Dlaw, Old Window Dd	114	158		
Summyhott Ru	West	Stannope Pkwy - Otu Windsor Ku	203	90		
Momorial Ava	East	Old Windsor Dd Windsor Dd	28	26		
Memorial Ave	West	otu winasor ku - winasor ku	34	22		
Old Windsor Rd	North	Memorial Ave - Balmoral Rd	328	530		

Dead	Direction	Daturan	Additional trips			
коас	Direction	Between	AM	РМ		
	South		677	257		
Miami Ct	East	Classicand Dark Dr. Old Windson Dd	346	86		
Midfili St	West	Glenwood Park Dr - Old Windsor Ru	109	277		
Dalmaral Dd	East	Old Windsor Dd - Soven Vale Dr	204	420		
Datmoral Ru	West	ota windsor ka - Seven Vale Di	538	160		
Windoor Dd	North	Mamazial Ava Esinuar Dr	37	115		
winasor ka	South	Memorial Ave - Fairway Dr	147	29		
Falance: Dr	East		74	15		
Fallway Di	West	Fairway Dr - Windsor Rd	19	59		
Glenwood Park Dr	North	Niemi Ct. Farman Aug	360	130		
	South	Miami St - Forman Ave	162	288		
	North	Delaward Del Celebration De	368	1039		
ota windsor Ra	South	Balmoral RG - Celebration Dr	1323	289		
Current alt Dal	North	Charlenge Divers M7	91	286		
Sunnynolt Ra	South	Stannope PKwy - M7	364	72		
Malazara Dal	East		28	89		
Malvern Ro	West	Sunnynolt Ra - Glenwood Park Dr	112	22		
	East		14	43		
Forman Ave	West	Glenwood Park Dr - Glenwood Park Dr	54	11		
	East		72	193		
Celebration Dr	West	Ula Windsor Ka - Edgewater Dr	248	56		
Character of D.J	East	Free Chillenders Del	144	28		
Showground Rd	West	East of Windsor Kd	36	113		
Glenwood Park Dr	North	Malvern Rd - Meurants Ln	34	7		

Deed	Divertion	Daturan	Additional trips			
коаа	Direction	Between	АМ	РМ		
	South		9	28		
Clanwood Davk Dr	North	Forman Ave. Mourante La	151	160		
	South	Forman Ave - Meurants Lin	199	121		
Old Windsor Dd	North	Colobration Dr. Norwort Plud	379	1191		
Ota Winasor Ra	South	Celebration Dr - Norwest Blvd	1518	298		
Edecustor Dr	North	Coloburation Dr. Non-uset Dlud	6	19		
Edgewater Dr	South	Celeoration Dr - Norwest Blvd	22	5		
Windsor Rd	North	Chauseround Dd - Nerwest Dlud	28	24		
	South	Silowground Ru - Norwest blvu	31	22		
	East	Classified Dark Dr. Classified Dark Dr.	147	55		
Meurants Ln	West	Glenwood Park Dr - Glenwood Park Dr	69	117		
Crearkill Dr	North	Mauranta I.a. Namusat Diud	34	110		
Greennitt Dr	South	Meurants Ln - Norwest Blvd	138	28		
	North	Nowcest Divid 147	375	1181		
	South	NOTWEST DIVU - MT	1502	295		
Norwest Divid	East	Old Window Dd - Edgewater Dr	25	11		
Norwest blvu	West	ota Willasof Ra - Edgewater Di	12	21		
Nonvert Divid	East		31	6		
Norwest Blvd	West	Eugewater Dr - Fairway Dr	8	24		
ute desc Dd	North	New cost Divid 147	6	20		
Windsor Rd	South	Norwest Blva - M7	25	5		

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

Road	Dir.	Between	Hierarchy type	Capacity	V/C (Due to	o TOD only)	V/C (all traffic)		
				(pcu/tane/iii)	AM	РМ	AM	РМ	
Windsor Dd	North	Schofields Rd - Merriville	Arterial	2200	0.05	0.05	0.95	1.25	
WINUSOFKU	South	Rd		2200	0.05	0.05	1.55	1.10	
Windsor Dd	North	Merriville Rd - Windsor	Artorial	2200	0.05	0.05	0.95	1.25	
WINUSOF RU	South	Rd	Arterial	2200	0.05	0.05	1.55	1.10	
Old Windsor Rd	North	Windsor Rd - Samantha	Inner Urban	2600	0.05	0.05	0.60	0.60	
	South	Riley Rd	Highway/Major Arterial	2600	0.05	0.05	0.60	0.65	
Perfection Ave	North	Merriville Rd - Newbury	Collector	650	0.20	0.35	0.35	0.80	
	South	Ave		650	0.45	0.15	0.90	0.30	
Newbury Ave	East	Perfection Ave - Old	Sub artarial	900	0.25	0.10	1.10	0.65	
	West	Windsor Rd	Sub-artenat	900	0.10	0.20	0.65	1.00	
Wieders Dd	North	Old Windsor Rd -	Arterial	2200	0.05	0.05	0.35	0.60	
WINUSOF RU	South	Samantha Riley Dr		2200	0.05	0.05	0.65	0.40	
Samantha Dilou Dr	East	Old Windsor Rd -	Sub-arterial	2000	0.15	0.20	1.00	0.65	
Samantila Riley Di	West	Windsor Rd		2000	0.30	0.10	0.75	0.55	
Comonthe Dilou Dr	East	Fact of Windoor Dd	Cub antavial	2000	0.05	0.05	0.90	0.50	
Samanina Riley Dr	West	East of Windsof Ru	Sub-arteriat	2000	0.05	0.05	0.40	1.00	
Stanbana Diana	East	Wast of porfaction Ava	Artorial	2200	0.05	0.05	0.70	0.35	
Stannope Pkwy	West	west of perfection Ave	Artenat	2200	0.05	0.05	0.20	0.70	
Ctonhone Diana	North	Perfection Ave -	Antonial	2200	0.05	0.05	0.20	0.70	
Stannope Pkwy	South	Stanhope Pkwy	Artenat	2200	0.10	0.05	0.75	0.35	
Old Windsor Dd	North	Samantha Riley Dr -	Inner Urban	2600	0.10	0.20	0.75	1.10	
ota winasor ka	South	Memorial Ave	Highway/Major Arterial	2600	0.25	0.10	0.95	0.80	

Road	Dir.	Between	Hierarchy type	Capacity	V/C (Due to	o TOD only)	V/C (all traffic)		
				(pcu/tane/ni)	AM	РМ	AM	РМ	
Windoor Dd	North	Samantha Riley Dr -	Artorial	2200	0.05	0.05	0.40	0.50	
WINUSOF RU	South	Memorial Ave	Artenat	2200	0.05	0.05	1.30	0.55	
Suppyholt Dd	East	Stanhope Pkwy - Old	Artorial	2200	0.10	0.10	0.95	1.00	
Sumynott Ku	West	Windsor Rd	Artenat	2200	0.10	0.05	0.60	0.95	
Memorial Ave	East	Old Windsor Rd -	Artorial	2200	0.05	0.05	0.60	0.55	
	West	Windsor Rd	Arterial	2200	0.05	0.05	0.50	0.50	
Old Windsor Dd	Old Windcor Pd	Memorial Ave - Balmoral	Inner Urban	2600	0.15	0.25	0.80	1.20	
	South	Rd	Highway/Major Arterial	2600	0.30	0.10	1.25	0.90	
Miami St	East	Glenwood Park Dr - Old	Collector	1400	0.25	0.10	0.75	0.35	
	West	Windsor Rd	Collector	1400	0.10	0.20	0.20	0.70	
Palmoral Dd	East	Old Windsor Rd - Seven	Sub artorial	900	0.25	0.50	0.55	0.65	
Datifiorat Ku	West	Vale Dr	Subartenat	900	0.60	0.20	0.90	0.85	
Windcor Dd	North	Memorial Ave - Fairway	Arterial	2200	0.05	0.10	0.50	1.15	
WINUSOFKU	South	Dr		2200	0.10	0.05	1.55	0.80	
Eairway Dr	East	Eainway Dr - Windsor Pd	Collector	650	0.15	0.05	0.25	0.10	
Fallway Di	West	Failway Di - Willusor Ru	Collector	650	0.05	0.10	0.10	0.25	
Glopwood Park Dr	North	Miami St - Forman Avo	Collector	650	0.60	0.20	1.00	0.40	
	South		conector	650	0.25	0.45	0.45	0.90	
Old Windsor Pd	North	Balmoral Rd -	Inner Urban	2600	0.15	0.40	0.80	1.25	
	South	Celebration Dr	Highway/Major Arterial	2600	0.55	0.15	1.65	1.00	
Suppubalt Dd	North	Stanbono Dkunu - M7	Artorial	2200	0.05	0.15	0.65	1.20	
Sunnyholt Ru	South	Stannope Pkwy - M7	Artenat	2200	0.20	0.05	1.00	0.75	
Malvorn Dd	East	Sunnyholt Rd -	Collector	650	0.05	0.15	0.10	0.25	
Malvern Ru	West	Glenwood Park Dr	Collector	650	0.20	0.05	0.30	0.10	

Road	Dir.	Between	Hierarchy type	Capacity	V/C (Due to	o TOD only)	V/C (all traffic)		
				(pcu/tane/iii)	АМ	РМ	АМ	РМ	
Forman Avo	East	Glenwood Park Dr -	Minor	500	0.05	0.10	0.05	0.20	
FUITIdil Ave	West	Glenwood Park Dr	MINOR	500	0.15	0.05	0.20	0.05	
Colobration Dr	East	Old Windsor Rd -	Collector	650	0.15	0.30	0.85	1.00	
	West	Edgewater Dr	Collector	650	0.40	0.10	0.65	1.00	
Showground Rd	East	Eact of Windcor Dd	Artorial	2200	0.10	0.05	0.20	0.05	
	West	East of Willusof Ru	Arterial	2200	0.05	0.10	0.05	0.20	
Clanwood Dark Dr	Cleave and Park Dr.	Malvern Rd - Meurants	Collector	650	0.10	0.05	0.15	0.05	
	South	Ln	Collector	650	0.05	0.05	0.05	0.10	
Glenwood Park Dr	North	Forman Ave - Meurants	Collector	650	0.25	0.25	0.50	0.60	
	South	Ln	Collector	650	0.35	0.20	0.65	0.45	
Old Windsor Dd	Old Windsor Pd	Celebration Dr - Norwest	Inner Urban	2600	0.15	0.50	0.95	1.35	
	South	Blvd	Highway/Major Arterial	2600	0.60	0.15	1.65	1.00	
Edagwater Dr	North	Celebration Dr - Norwest	Collector	650	0.05	0.05	0.15	0.40	
Eugewater Di	South	Blvd		650	0.05	0.05	0.45	0.15	
Epirwov Dr.	North	Free Settlers Dr -	Callester	650	0.00	0.00	0.20	0.60	
Fallway Di	South	Norwest Blvd	Collector	650	0.00	0.00	0.60	0.20	
Windcor Dd	North	Showground Rd -	Artorial	2200	0.05	0.05	0.95	1.00	
WINUSOFKU	South	Norwest Blvd	Artenat	2200	0.05	0.05	0.80	0.90	
Mourante In	East	Glenwood Park Dr -	Collector	650	0.25	0.10	0.50	0.20	
Meuralits Li	West	Glenwood Park Dr	Collector	650	0.15	0.20	0.25	0.45	
Croonbill Dr	North	Meurants Ln - Norwest	Collector	650	0.10	0.20	0.35	0.75	
Greenmitt Dr	South	Blvd	Collector	650	0.25	0.05	0.85	0.35	
Old Windoor Dd	North	Nonvost Dlud M7	Inner Urban	2600	0.15	0.50	1.25	1.70	
Old Windsor Rd	South	NOTWEST BLVU - M7	Highway/Major Arterial	2600	0.60	0.15	2.10	1.30	
Precinct Transport Statement

Road	Dir.	Between	Hierarchy type	Capacity (pcu/lane/hr)	V/C (Due to TOD only)		V/C (all traffic)	
					AM	РМ	AM	РМ
Norwest Blvd	East	Old Windsor Rd - Edgewater Dr	Sub arterial	2000	0.05	0.05	0.85	0.55
	West			2000	0.05	0.05	0.60	1.00
Norwest Blvd	East	Edgewater Dr - Fairway Dr	Sub arterial	2000	0.05	0.05	0.85	0.55
	West			2000	0.05	0.05	0.55	1.00
Windsor Rd	North	Norwest Blvd - M7	Arterial	2200	0.05	0.05	0.95	1.00
	South			2200	0.05	0.05	0.80	0.90

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