

OPERATIONAL TRAFFIC AND TRANSPORT

CHAPTER NINE

9 Operational traffic and transport

This chapter assesses the potential operational traffic and transport impact as a result of the project. In particular, it describes how each station would integrate into the surrounding traffic and transport facilities. Technical paper 1 – Traffic and transport provides further details.

9.1 Secretary’s environmental assessment requirements

The Secretary’s environmental assessment requirements relating to operational traffic and transport, and where these requirements are addressed in this Environmental Impact Statement, are outlined in Table 9-1.

Table 9-1 Secretary’s environmental assessment requirement – operational traffic and transport

Ref.	Secretary’s environmental assessment requirement	Where addressed
13. Transport and Traffic		
13.2	The proponent must assess the operational transport impacts of the project, including:	
13.2 (m)	forecast travel demand and traffic volumes for the project and the surrounding road, cycle and public transport network;	Patronage forecasts are provided in Section 9.4.
13.2 (n)	travel time analysis;	Travel time savings are provided in Section 9.4.1.
13.2 (o)	performance of interchanges and intersections by undertaking a coordinated level of service analysis at locations affected by stations;	Performance of nearby intersection which could be impacted by operation of the project are provided in Section 9.4.
13.2 (p)	wider transport interactions (local and regional roads, permanent loss of parking, the need for kiss-and-ride facilities, cycling, public and freight transport);	Wider transport impacts and benefits are described in Section 9.4.1. Integration with the road network for each station is provided in Section 9.4.
13.2 (q)	induced traffic and operational implications for public transport connected to stations sites (particularly with respect to strategic bus corridors and bus routes) and consideration of opportunities to improve public transport linkages;	Induced traffic is discussed in Section 9.4.2. Public transport integration with the project is addressed in Section 9.4.
13.2 (r)	impacts on pedestrian access in and around stations and connecting streets, capacity of streets at peak pedestrian times, including phasing of traffic lights, intersection crossing times and connectivity between stations;	Pedestrian impacts are addressed in Section 9.4.
13.2 (s)	assess the benefits to each station and the general vicinity of walking and cycling catchments and the provision of infrastructure to support sustainable transport options;	Active transport is addressed in Section 9.4.
13.2 (t)	impacts on cyclists, pedestrian access and safety; and	Impacts on pedestrian and cyclist access and safety are addressed in Section 9.4.

Ref.	Secretary's environmental assessment requirement	Where addressed
13.2 (u)	opportunities to integrate cycling and pedestrian elements with surrounding networks and in the project.	Integration of active transport elements with the project is addressed in Section 9.4.
10. Socio-economic, Land Use and Property		
10.3	3. Assess the likely risks of the project to public safety, paying particular attention to subsidence risks, bushfire risks and the handling and use of dangerous goods.	Public safety relating to operational traffic and transport is addressed in Section 9.4.

9.2 Assessment methodology

A qualitative assessment of the operation the project has been carried out, including a description of the transport integration of each station and assessment of the potential traffic and transport impacts.

Two patronage forecast models were configured and run to produce preliminary forecast passenger demand and their anticipated mode of arrival / departure from each station:

- The Public Transport Project Model (PTPM) is informed by a number of assumptions regarding future land and transport use and operations
- The Enhanced Train Crowding Model (ETCM) provides detailed rail modelling analysis for station entries and exits, line loading and platform crowding. Inputs to the ETCM are based on the outputs generated from the PTPM.

Cycling forecasts at each station were determined using the outputs of the patronage modelling and the Transport for NSW Bike and Ride initiative, identified in Sydney's Cycling Future (Transport for NSW, 2013c).

The patronage forecasts were produced for 2036 based on land use planning projections available from the Department of Planning and Environment. However, the design year adopted for the project is 2056 to ensure the design of the stations would be able to accommodate future growth.

9.3 Existing environment

The existing traffic and transport environment around each of the proposed stations, and the regional road network, is described in Chapter 8 (Construction traffic and transport). For the most part, this background environment status as described would also be applicable to the operation stage of the project. The regional transport network is described in Section 9.3.1.

Notwithstanding it is recognised that the traffic and transport environment is currently undergoing major changes particularly in the Sydney CBD as the Sydney City Centre Access Strategy is progressively implemented. This includes the expected operation of major transport projects such as the CBD and South East Light Rail, the pedestrianisation of George Street between Hunter Street and Bathurst Street, and the new CBD Bus Strategy. The implementation of these changes results in alterations to the existing baseline applicable to the operational traffic and transport assessment.

The assumed status of these projects (once Sydney Metro City & Southwest is operational) which was considered as part of the assessment are:

- CBD and South East Light Rail completed and operational
- George Street pedestrianised between Hunter Street and Bathurst Street
- Sydney CBD bus network consistent with the changes implemented on 4 October 2015
- Road network consistent with the changes required by CBD and South East Light Rail including:
 - ◆ conversion of Pitt Street to two-way operation between Bridge and Alfred streets
 - ◆ conversion of Hunter Street to two-way operation between Pitt and George streets
- Sydney CBD cycle routes implemented consistent with the Sydney City Centre Access Strategy (Transport for NSW, 2013a)
- Central Barangaroo completed and open
- Barangaroo Ferry Hub and Wynyard Walk completed and operational.

9.3.1 Regional transport environment

Regional active transport network

There is a relatively well defined cycle network across the lower North Shore which avoids the most heavily trafficked roads with marked and unmarked on-road cycle routes and off-road paths.

Key links in the cycle network include:

- The Sydney Harbour Bridge crossing, which is accessed from Alfred Street in Milsons Point (on the north) and Kent Street (in the south)
- The dedicated off-road Gore Hill Freeway cycleway, which provides a key regional link between Cammeray, Chatswood, Lane Cove, Macquarie Park and Epping.

Changes to cycle routes within the Sydney CBD are occurring as a result of the CBD and South East Light Rail project and the implementation of the Sydney City Centre Access Strategy (Transport for NSW, 2013a). The implementation of these cycle routes is likely to be ongoing during construction of Sydney Metro.

South of the Sydney CBD, the major cycle routes operate through Waterloo and Alexandria, particularly along Bourke Street.

Pedestrians are generally catered for locally through footpaths and dedicated road crossings. The areas surrounding the project generally have a high volume of pedestrians, especially within the North Sydney, Crows Nest and Sydney CBD areas.

Regional public transport network

Suburban rail

North of Sydney Harbour, the Sydney Trains rail network consists of the T1 North Shore Line. This line forms a key transport corridor connecting major and specialised centres both within Sydney's northern suburbs and south of Sydney Harbour. The T1 North Shore Line is currently constrained by the maximum number of services able to cross the Sydney Harbour Bridge. To the south of Sydney Harbour, the T1 North Shore Line continues through the Sydney CBD before connecting to the T1 Western and T1 Northern Lines.

South of the Sydney CBD, services operating on the T3 Bankstown Line merge with either the T2 Inner West and South Line or the T2 Airport Line. These lines continue through the Sydney CBD using the City Circle. This merging of rail lines to the south of Central Station creates a bottleneck, forcing trains to queue and causing backlogs in the west and southwest.

The T4 Eastern Suburbs and Illawarra Line also operates through the Sydney CBD from Bondi Junction to Cronulla and Waterfall.

Sydney Metro Northwest is currently being built and is due to open in 2019, providing metro services between Chatswood Station and Cudgegong Road Station in Rouse Hill. When it is completed, customers will be able to interchange at either Chatswood (to the T1 North Shore Line) or Epping (to the T1 Northern Line and the Newcastle & Central Coast Line) between metro services and suburban rail services.

Bus network

Buses generally perform two main roles, being cross-regional public transport and local services connecting residential areas to key transport interchanges.

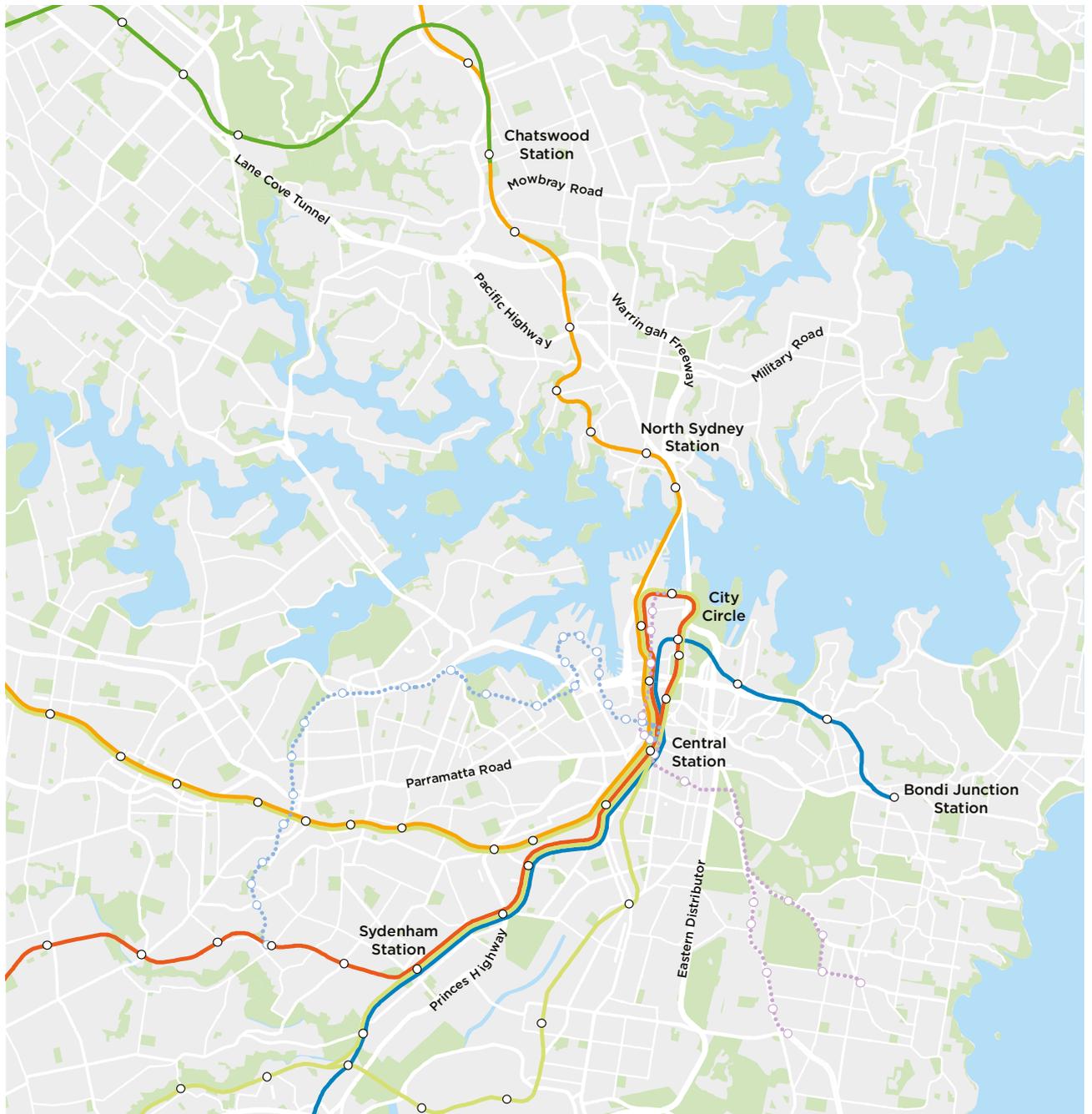
North of Sydney Harbour, major bus routes operate along the Hills M2 Motorway providing express services to the Sydney CBD and North Sydney. The Pacific Highway and Military Road / Spit Road also provide key bus corridors. The Pacific Highway connects areas to the north with key centres including Chatswood, St Leonards, North Sydney and the Sydney CBD. The Military Road / Spit Road corridor provides services from the Northern Beaches to the Sydney CBD via the Warringah Freeway and to the North Sydney CBD and providing links to St Leonards and Chatswood.

There are also a number of local services. These generally connect to rail stations, especially the key transport interchanges at Chatswood, St Leonards and North Sydney. These routes have frequent services both on and off peak.

Changes to the bus network that currently services the Hills District are anticipated following the opening of Sydney Metro Northwest in 2019. This is expected to result in a reduction in the number of buses crossing the Harbour Bridge.

Within the Sydney CBD, buses transport passengers from across Sydney into the CBD with many services running through the Sydney CBD in a north-south direction on Kent, Clarence, York, Castlereagh and Elizabeth streets, and in an east-west direction on Park and Druiitt streets. Many bus services have also been redirected away from the core of the Sydney CBD to minimise congestion. Key bus interchanges within the Sydney CBD are provided at Wynyard Station, Town Hall Station and Central Station.

South of the Sydney CBD, key bus routes operate along the Princes Highway and King Street. There are also cross-regional services between Marrickville and Bondi Junction, and a number of local and feeder services that generally connect to rail stations to provide interchange opportunities. These routes have services both on and off peak.



- T1 - North Shore, Northern & Western Line, and Central Coast & Newcastle Line
 - T2 - Airport, Inner West & South Line
 - T3 - Bankstown Line
 - T4 - Eastern Suburbs & Illawarra Line, and South Coast Line
- Sydney Metro Northwest (under construction)
 - ⋯ CBD and South East Light Rail (under construction)
 - ⋯ Inner West Light Rail
 - Road network



Figure 9-1 Overview of the existing and planned future rail and light rail network in the vicinity of the project

Light rail

The light rail network consists of one line between Dulwich Hill and Central via Lilyfield and Pyrmont (the Inner West Light Rail). It has frequent services over extended periods. Whilst its share of total passengers to the Sydney CBD is limited, it plays an important role in connecting the areas it serves to the Sydney CBD.

Light rail's role and function will be significantly increased following the introduction of the CBD and South East Light Rail (anticipated to begin operations in 2019). This will establish a new light rail network between Circular Quay and Randwick / Kingsford. The route will be along George Street, Eddy Avenue and Chalmers Street to Central Station, through Surry Hills to Moore Park, then to Kensington and Kingsford via Anzac Parade, and Randwick via Alison Road and High Street. Construction of the CBD and South East Light Rail is expected to occur concurrently with the construction of Sydney Metro, between the years of 2017 and 2019.

Ferry

Ferry services within Sydney perform two core functions – serving commuters and serving tourists / leisure customers. Most services connect to the Sydney CBD at Circular Quay. This includes services from the east (such as Watsons Bay), northeast (such as Manly), north (such as McMahons Point) and west (such as Parramatta River and Balmain). King Street Wharf on the western edge of the Sydney CBD is also served by Parramatta River services.

The Barangaroo Ferry Hub (expected to be open in 2016) will provide for new ferry services operating to and from the Barangaroo South area, and customers will have connections to Wynyard Station via Wynyard Walk.

9.4 Potential impacts

9.4.1 Strategic traffic and transport impacts

The design of the project would aim to avoid or reduce impacts associated with operational traffic and transport. It would improve road traffic conditions by providing a convenient and efficient travel alternative to the use of the private car.

Chapter 3 (Strategic need and justification) identifies the anticipated transport benefits following the implementation of the Sydney Metro network, as well as the specific benefits of the Chatswood to Sydenham project. The strategic traffic and transport related impacts and benefits of the operation of the project are outlined below.

Travel time savings

- The project would improve travel times by:
- Providing more direct routes to key destinations
- Reducing crowding on trains and stations, which would improve the reliability of services

Offering an alternative, faster and more reliable public transport trip to the Sydney CBD and North Sydney.

The largest travel time savings would be experienced in areas where new stations are provided (such as Crows Nest), where more direct routes are provided. Travel time savings would be experienced by existing rail customers (who would directly benefit from shorter travel times), new rail customers (who would transfer from road-based transport to rail).

Specifically, travel time savings enabled by the project would be experienced by:

- Sydney Metro Northwest and T1 North Shore Line customers who would have access to more direct Sydney Metro services to key activity areas in the Global Economic Corridor
- Central Coast customers travelling to North Shore and Sydney CBD stations would have significant travel time savings, with these services being able to take advantage of the more direct routes made possible by the introduction of the project
- North Shore and North Sydney customers who would have direct rail access to key destinations in the Global Economic Corridor such as Martin Place and Norwest Business Park
- Eastern suburbs customers who would have more direct access to key destinations in the Global Economic Corridor, interchanging to direct services at Martin Place Station instead of the crowded Town Hall Station.

Travel time savings are also likely to be experienced by road and remaining bus users who would experience less congestion.

Some key forecast travel time savings associated with the Chatswood to Sydenham project are:

- Martin Place to Chatswood – 19 minute savings
- Norwest Business Park to Central – 15 minute savings
- Martin Place to North Sydney (corner Miller Street and Pacific Highway) – 15 minute saving
- Macquarie Park to North Sydney (corner Miller Street and Pacific Highway) – 13 minute savings
- Crows Nest to Central – 21 minute saving
- Bondi Junction to North Sydney (corner Miller Street and Pacific Highway) – 11 minute saving.

Information on how indicative travel time savings have been calculated is provided in Chapter 3 (Strategic need and justification).

Decreased station crowding

The provision of new Sydney CBD stations and platforms at Barangaroo, Martin Place, Pitt Street and Central would spread station loading and decrease crowding at Wynyard and Town Hall stations, and at some platforms at Central Station. The project would also provide relief to North Sydney and St Leonards stations with alternative metro stations at nearby Victoria Cross and Crows Nest. The anticipated change in passenger demand at key platforms within the Sydney CBD and at North Sydney and St Leonards stations is shown in Figure 9-2.

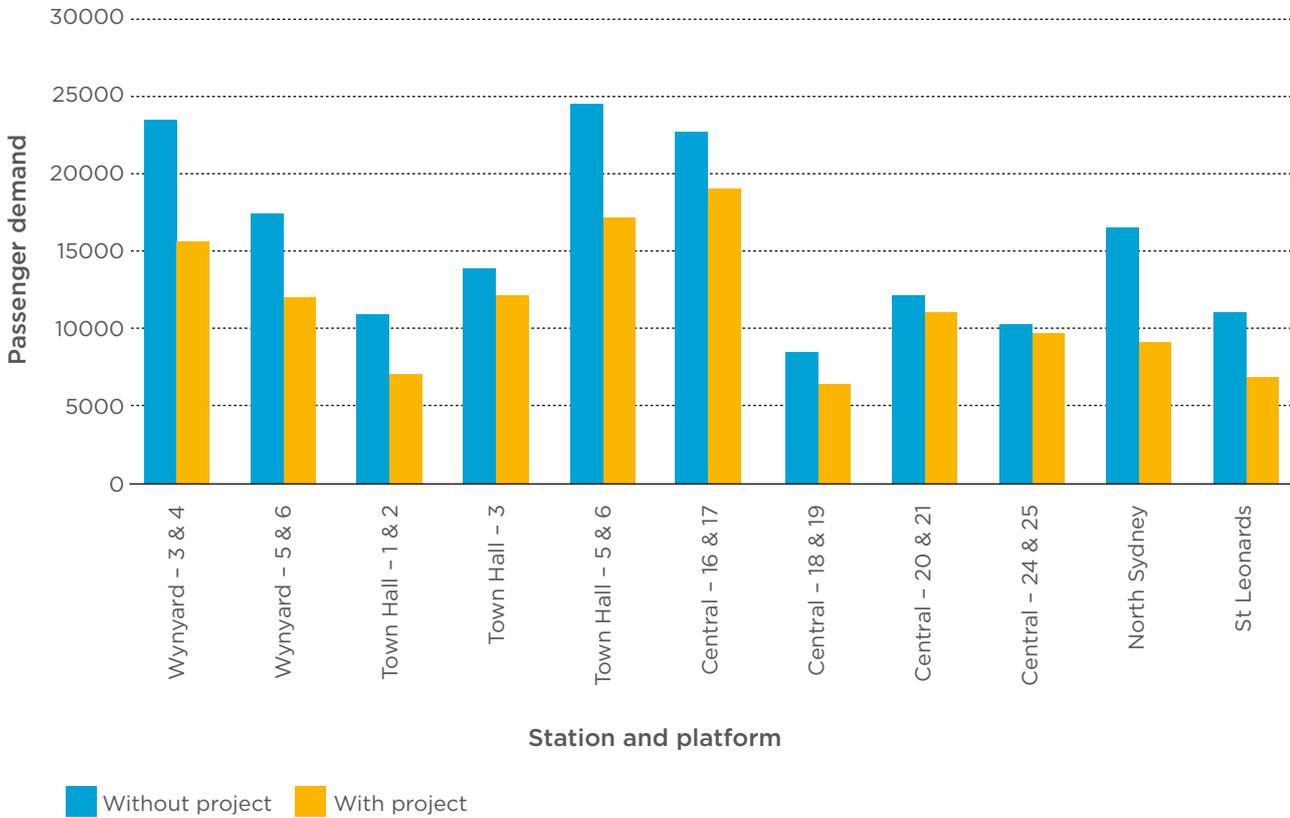


Figure 9-2 Decreased station crowding (AM peak one hour)

Increased rail network reach and use

The project would increase the use and reach of the rail network by providing:

- New stations at Barangaroo, Waterloo, Crows Nest and Victoria Cross would directly increase rail catchment areas
- More direct connections to high-capacity Sydney CBD stations at Martin Place and Pitt Street would increase Sydney CBD rail catchment areas
- Additional interchange capability at Central Station, Martin Place and Pitt Street (to Town Hall Station).

The project would also provide a direct link for Sydney Metro Northwest customers to the Sydney CBD.

Improved network resilience

Suburban rail access through the Sydney CBD and across the harbour is currently limited to the T1 North Shore, Northern and Western Line. Shutdowns during unplanned and planned events currently impact on customer service provision. Closures of the Harbour Bridge for example can cease the provision of public transport services linking the Sydney CBD to key destinations on the lower North Shore and Northern Sydney. The T1 North Shore Line is also subject to periodic maintenance which reduces access for passengers to key stations such as North Sydney, St Leonards and Chatswood.

The project would provide an additional, high-capacity public transport link through the Sydney CBD and across Sydney Harbour. This would provide an alternative option for customers during these unplanned and planned events which may force closure of other Sydney CBD and harbour links.

Bus network benefits

The project would provide bus network benefits by:

- Freeing of bus services by bus customers transferring to rail, enabling the opportunity to redeploy bus services from the north and north west
- Reducing demand for Sydney Harbour Bridge bus services, freeing capacity over the Harbour Bridge.

The project would also provide the opportunity for bus-rail interchange at the new metro stations which could reduce reliance on cross-regional bus routes and potentially reducing congestion and improving travel times for remaining bus customers. Bus network improvements potentially enabled by the project would be considered by Transport for NSW as part of future reviews of the bus network and associated timetabling.

Improved conditions for road users

By encouraging more people to use the rail network, the project would reduce congestion on the road network, including on key road corridors such as the Sydney Harbour Bridge, Sydney Harbour Tunnel and Eastern Distributor.

Erskineville and St Peters rail services

Erskineville and St Peters stations are currently served by trains on the T3 Bankstown Line. After opening of the project, trains on the T3 Bankstown Line would be moved to other lines such as the T2 Inner West and South Line. Erskineville and St Peters stations would continue to be served by Sydney Trains services. Customer demand levels at these stations would be taken into account when new train timetables are being designed over the coming years.

9.4.2 Transport integration strategy

The station access hierarchy identified in Figure 9-3 and described in Table 9-2 has been adopted during the development of the design and the transport integration strategy for each metro station. The objective of the hierarchy is to allow the most prominent locations within an interchange precinct to be allocated to the most efficient and sustainable transport modes.



Figure 9-3 Metro station access hierarchy

Due to the location of each station, particularly within the Sydney CBD area, in general metro customers are not anticipated to access the station by car and would be discouraged to do so by the absence of car parking facilities. Although where appropriate kiss-and-ride provisions would be made at some stations. As no car parking is to be provided at any of the metro stations, the project would not induce traffic demand once operational.

Table 9-2 Station access hierarchy

Transport mode	Description
Walking and cycling	<p>Walking and cycling are the highest priority access modes as they are the most sustainable, cost-effective, equitable and accessible. Pedestrians and cyclists have the lowest environmental impact and (typically) spatial requirements whilst they also contribute to personal safety, urban and commercial viability.</p> <p>As the stations are all located within established urban areas, walking and cycling access would be predominantly along existing paths and routes which are extensive around all stations.</p> <p>Given the importance of active transport access to the stations these modes have been expanded on further below.</p>
Public transport (bus and light rail)	<p>Public transport is the second highest priority in station planning and is typically focused on facilitating interchange to other public transport modes. These services expand the effective catchment area of the rail system. Seamless interchange is required in order to maximise the uptake of linked trips within the public transport network.</p>
Taxis	<p>Taxis are the highest ranked of the car-based modes, supplementing the public transport system for access to destinations separated from the public transport network.</p>
Kiss-and-ride	<p>Kiss-and-ride is the preferred mode of those accessing the station by private vehicle, but a relatively low priority. Kiss-and-ride supports the concept of car sharing and trip chaining and ride sharing, reducing the number of single-occupant trips and in some instances parking demand.</p>
Park-and-ride	<p>Park-and-ride is the lowest priority of all modes. Given the high accessibility to sustainable transport modes in Sydney, formal parking facilities are only suggested outside of major centres. All of the proposed stations within this project are within a 10 kilometre radius of the Sydney CBD, therefore park-and-ride facilities are not proposed for this project.</p>

Walking

The walking objectives include improving the customer experience by providing safe, direct, continuous, high quality and clearly-signposted walking paths to stations, and between the stations and other transport modes. Recent modelling forecasts show that an average of 66 per cent of customers would walk to stations outside the Sydney CBD in 2026 and at the Sydney CBD stations, most people would walk to their final destination.

Appropriate footpath widths and gradients would be provided outside of station exits and throughout the public domain altered at the metro station to link transport modes and provide safe and equitable pedestrian access. Vision and mobility impaired customers would be considered in the pavement designs, for example by keeping one side of the travel path clear of fittings and fixtures and providing Tactile Ground Surface Indicators on travel paths to warn of hazards and assist wayfinding where required.

Cycling

The amount and type of bike parking provided at stations would be based on the Transport for NSW Bike and Ride initiative, identified in Sydney's Cycling Future. The facilities are likely to be similar to those being introduced at several Sydney Trains stations, including Blacktown and Campbelltown. At these stations, secure bike spaces are provided in sheds which are free to use by train customers and can be accessed by OPAL cards.

The bike parking would be located close to the station, connect with the local cycle network and be in secure sheds and shelters so customers can safely leave their bikes and catch a train. The amount of parking would reflect forecast passenger demand at each station.

9.4.3 Chatswood dive

The Chatswood dive structure and tunnel portal would result in the demolition and permanent closure of the Nelson Street overbridge.

Pedestrians and cyclists

Nelson Street currently provides an active transport link between the Pacific Highway and Frank Channon Walk, a shared path running along the western side of the rail corridor from Nelson Street to Chatswood Station and the Chatswood commercial centre. Nelson Street also provides east-west connectivity across the T1 North Shore Rail Line between the Pacific Highway and Orchard Road, along with Mowbray Road to the south and Albert Avenue to the north. Surveys carried out in December 2015 identified in the AM peak hour a total of 16 pedestrians and five cyclists crossing Nelson Street bridge in both directions.

As part of the project, Frank Channon Walk (a shared path currently connecting Chatswood Station to Nelson Street) would be extended from Nelson Street to Mowbray Road on the western side of the rail line to provide an enhanced facility for pedestrians and cyclists and provide continued access between Chatswood Station and residential areas to the south. Those travelling from residential areas to the south-east of the rail line would need to use the underpass adjacent to Chatswood Oval to cross the rail line and access Frank Channon Walk. Orchard Road, running parallel to Frank Channon Walk on the eastern side of the rail line, could also be used as an alternative north-south route for journeys between the Chatswood retail areas and residential areas to the south.

For some pedestrians or cyclists travelling between Chatswood Station and residential areas to the south, this would result in an additional travel distance of around 50 to 100 metres; whilst for others it would result in a reduction in travel distances of around 50 to 100 metres.

Due to the extension of Frank Channon Walk and the availability of alternative facilities in the area the closure of Nelson Street bridge is not anticipated to result in significant impacts for pedestrians and cyclists.

The provision of new traffic signals at the Mowbray Road / Hampden Road intersections would provide additional pedestrian connectivity across Mowbray Road between the existing pedestrian crossings at the Pacific Highway and Orchard Road and a direct link to the extended Frank Channon Walk.

Road network

The primary role of Nelson Street overbridge is for use by motorists travelling southbound on the Pacific Highway to access Mowbray Road westbound via Orchard Road. To maintain this movement, an all vehicle right turn movement would be provided from the Pacific Highway southbound to Mowbray Road westbound and altered traffic light phasing to account for this new movement. For the purposes of this traffic assessment it is assumed that two right turn lanes would be provided. This would also require the localised widening of the Pacific Highway to the north of the Mowbray Road intersection.

Nelson Street also provides local access for properties located to the east of the T1 North Shore Rail Line. Following closure of the Nelson Street bridge, these residents would need to use alternative road to cross the rail line such as Mowbray Road or Albert Avenue which would result in a marginal increase to travel times.

In addition, it is anticipated that the traffic signals introduced at Mowbray Road / Hampden Road for the construction phase would be retained during operation.

Table 9-3 shows the intersection performance with and without the project. The Pacific Highway / Mowbray Road intersection is already operating over its theoretical capacity. The revised layout, including dual southbound right turn lanes from the Pacific Highway into Mowbray Road would result in a deterioration in the overall operational performance of the intersection from level of service E to level of service F. The operational performance in the PM peak would remain unchanged.

Introducing signals at the Mowbray Road / Hampden Road intersection would improve the operational performance in the AM peak from level of service F to level of service B, and improve the intersection from currently operating above its theoretical capacity, to be operating with a degree of saturation of 0.80.

The performance of the majority of the other intersections would remain unchanged.

Table 9-3 Chatswood drive intersection performance

Peak period	Without project			With project		
	Average delay	Degree of saturation	Level of service	Average delay	Degree of saturation	Level of service
Pacific Highway / Fullers Road / Help Street						
AM Peak	86	F	1.14	83	F	1.14
PM Peak	41	C	0.94	39	C	0.93
Pacific Highway / Victoria Avenue						
AM Peak	101	F	0.89	101	F	0.90
PM Peak	90	F	0.77	87	F	0.77
Pacific Highway / Centennial Avenue						
AM Peak	15	B	0.86	17	B	0.89
PM Peak	26	B	0.91	23	B	0.89
Pacific Highway / Albert Avenue / Oliver Road						
AM Peak	23	B	0.73	24	B	0.75
PM Peak	20	B	0.96	29	C	0.94
Pacific Highway / Mowbray Road						
AM Peak	57	E	1.02	72	F	1.06
PM Peak	89	F	1.10	119	F	1.14
Pacific Highway / Howarth Road / Norton Lane						
AM Peak	5	A	0.59	5	A	0.59
PM Peak	8	A	0.76	8	A	0.75
Pacific Highway / Gore Hill Freeway ramps						
AM Peak	74	F	1.09	77	F	1.12
PM Peak	79	F	1.15	74	F	1.13
Pacific Highway / Longueville Road						
AM Peak	32	C	0.80	31	C	0.83
PM Peak	27	B	0.74	27	B	0.77
Mowbray Road / Orchard Road / Elizabeth Street						
AM Peak	52	D	1.02	49	D	1.02
PM Peak	76	F	1.15	45	D	0.84
Mowbray Road / Hampden Road						
AM Peak	292	F	1.12	25	B	0.80
PM Peak	22	B	0.55	25	B	0.71

9.4.4 Crows Nest Station

The location and proposed transport integration of the Crows Nest Station is shown on Figure 9-4.



Figure 9-4 Crows Nest Station transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 4,600 customers would be entering and around 5,650 customers would be exiting the station, reflecting the mixed use nature of the area serving both residents and commercial workers.

The forecast arrival modes for the station are:

- Walking – 75 per cent
- Cycling – 1 per cent
- Bus – 17 per cent
- Kiss-and-ride – 7 per cent.

This demonstrates the need to provide appropriate pedestrian facilities in the vicinity of the site and efficient and seamless transfer between bus stops in the precinct and station entrances.

Pedestrian integration

Patronage forecasts indicate that the station would significantly increase pedestrian flows in the local precinct.

Patronage analysis of the station and streetscape indicates there would be limited impacts to pedestrians and road traffic due to the presence of the station. As a suburban station, the patronage is significantly lower than most Sydney CBD stations, with anticipated volumes being less than 10 people per minute along most footpaths and crossings.

With the exception of some locations, the majority of footpaths in the area would continue to operate at a level of service A. In both the AM and PM peak periods, the most heavily used footpaths and crossings to access the station would include:

- Oxley Street (southern side) between Clarke Street and Pacific Highway which would operate at a level of service D immediately around the station entry
- North-south pedestrian crossing at the intersection of the Pacific Highway and Oxley Street
- Pacific Highway (eastern side) north of Oxley Street which would operate at a level of service C.

Pedestrian arrivals and departures are expected to be the highest proportion of journeys to and from the station.

The following design features would be provided to accommodate the future pedestrian demand and ensure easy and safe interchange for pedestrians:

- Station entrance via plazas on the corner of Clarke and Hume streets, and the corner of the Pacific Highway and Oxley Street
- New crossing facilities around the Hume Street / Clarke Street intersection
- New crossing facility on Oxley Street near Clarke Street
- A midblock pedestrian crossing facility on Clarke Street between Hume Street and Oxley Street
- A new signalised crossing facility on the northern arm of the Pacific Highway at the Pacific Highway / Oxley Street intersection providing improved pedestrian connections to and from the west of the station
- Installation of wayfinding signage and Sydney Metro information.

Cyclist integration

An existing on-road marked bicycle route along Clarke Street, directly adjacent to the metro station would provide convenient connections to the cycle routes that are currently well used by cyclists.

The following would be provided to enable efficient cyclist access to the station:

- A new on-road marked cycle route along Hume Street between Clarke Street and Nicholson Street connecting to existing on-road marked cycle routes
- Bicycle parking at the Hume Street / Clarke Street entrance and the Pacific Highway / Oxley Street entrance.

Public transport integration

The existing bus network in the vicinity of the station currently has comprehensive coverage of the potential catchment for the proposed station. The existing bus network, with bus stops located on the Pacific Highway, within 100 metres of the station entrances would provide convenient access to Crows Nest Station. Short and convenient links between bus services and the station would be available via the existing bus facilities in the vicinity of the site.

Road network integration

Crows Nest currently experiences low to moderate levels of traffic congestion during peak periods, particularly along the Pacific Highway. Traffic forecasts indicate moderate growth between now and 2036, with traffic demand estimated to grow by approximately 16 per cent by 2036.

To cater for the expected low volume of customers wanting to kiss-and-ride at the station, facilities would be provided on both frontages of Clarke Street.

To meet the likely increase in demand for taxi and kiss-and-ride the following would be provided:

- A taxi rank on the south western side of Clarke Street
- Kiss-and-ride facilities on both sides of Clarke Street between Oxley Street and Hume Street.

Given the low forecast vehicular arrivals, the metro station is not anticipated to have a material impact on the operation of the road network in the vicinity of the station.

The predicted intersection performance with this signalised pedestrian crossing is provided in Table 9-4.

The operational performance of the Pacific Highway / Oxley Street intersection deteriorates marginally in the AM peak hour, however is unchanged in the PM peak hour. In both peak hours the intersection would operate at a level of service B with the new signalised pedestrian crossing. Therefore, it can be concluded that the introduction of a pedestrian crossing across the northern arm of the Pacific Highway in the vicinity of the station would have a minimal impact on the local road network. Further, the addition of a signalised pedestrian crossing on this arm of the intersection improves the level of access of pedestrians travelling to or from the north west corner of the intersection.

Table 9-4 Crows Nest Station operational intersection performance

Peak period	Without project			With project		
	Average delay	Degree of saturation	Level of service	Average delay	Degree of saturation	Level of service
Pacific Highway / Oxley Street						
AM Peak	13	A	0.63	17	B	0.74
PM Peak	15	B	0.73	21	B	0.70
Pacific Highway / Hume Street						
AM Peak	13	A	0.59	8	A	0.55
PM Peak	12	A	0.61	7	A	0.49
Pacific Highway / Falcon Street / Shirley Road						
AM Peak	50	D	0.86	51	D	0.86
PM Peak	52	D	0.91	52	D	0.91

9.4.5 Victoria Cross Station

The location and proposed transport integration of the Victoria Cross Station is shown on Figure 9-5.

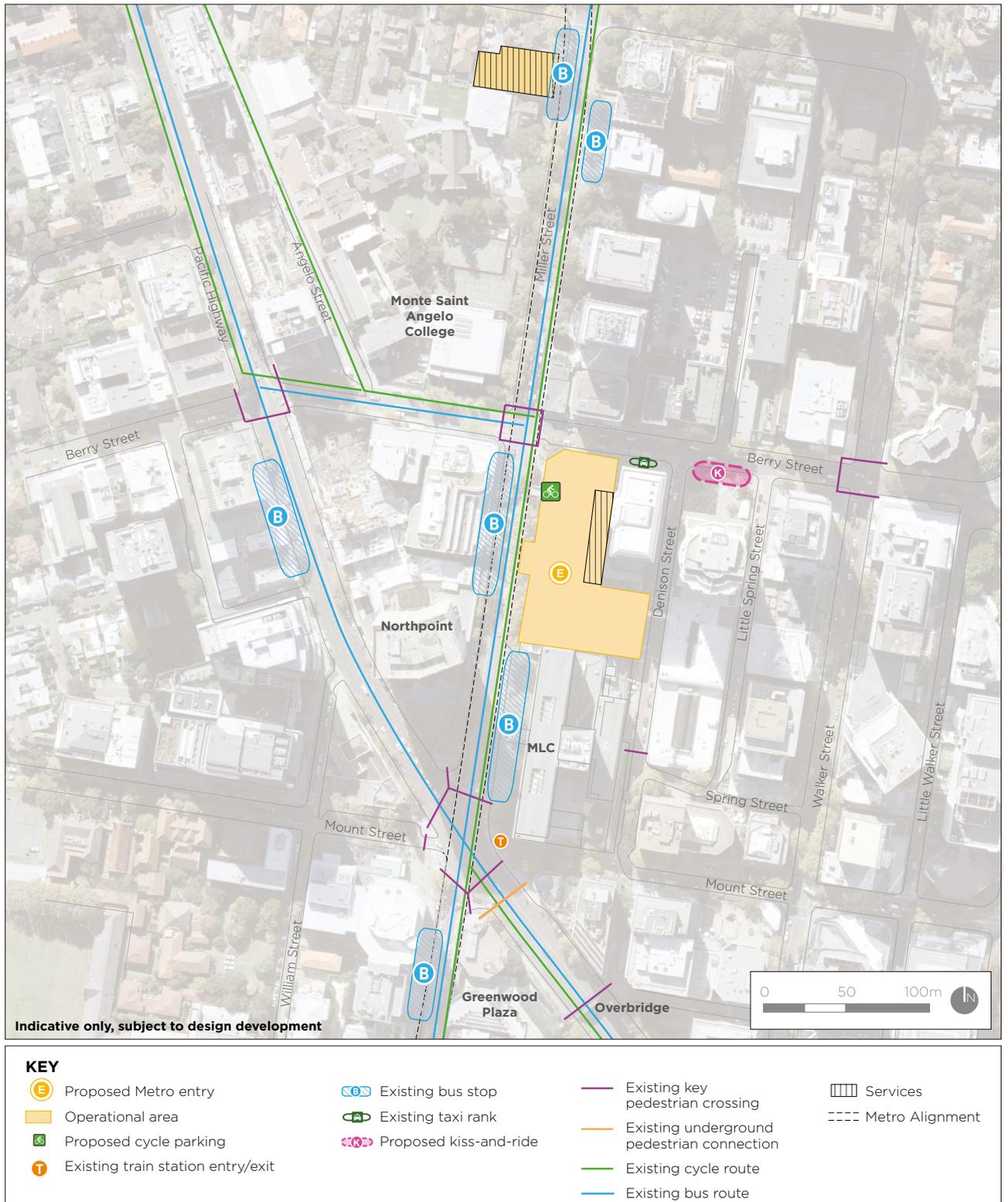


Figure 9-5 Victoria Cross Station transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 2,600 customers would be entering the station and around 12,550 customers would be exiting the station.

The forecast modes of arrival at the station are:

- Walking – 67 per cent
- Cycling – 1 per cent
- Bus – 26 per cent
- Kiss-and-ride – 6 per cent.

The forecasts indicate that for the relatively small portion of residents accessing the station in the morning, the majority would do so via walking.

The majority of morning exits (about 66 per cent) from the station are expected to travel to the south towards the commercial core while 12 per cent are expected to exit the station to the north to commercial and educational land uses, 10 per cent to the east and 12 per cent to the west.

Pedestrian integration

With a strong existing public transport network of bus and rail, the areas of employment, residential and educational land-uses generate a high volume of localised pedestrian trips accessing public transport modes.

Strong pedestrian desire lines are anticipated from the cluster of bus stops along Miller Street, and the educational facilities to the west. Mount Street also acts as a key pedestrian route to provide east-west access to the commercial uses on either side of the Pacific Highway.

The high proportion of walking journeys expected at the Victoria Cross Station means the pedestrian movement and access to the site has been considered a priority as part of the station design.

The following design features are proposed to ensure smooth interchange for pedestrians:

- A pedestrian plaza forming the access to the station from Miller Street and Berry Street
- Direct pedestrian links to Denison Street, providing access to and from the commercial area to the east of the station
- Wayfinding signage and Sydney Metro information within the North Sydney CBD.

Pedestrian modelling of the station and streetscape identified that the majority of the footpaths in the area would operate at a level of service B or better. However, two locations have been identified where there would be potential for safety risks or impacts to pedestrians and / or traffic due to the siting of the Metro station. These locations include:

- Intersection of Miller Street and Berry Street
- Denison Street which would operate at a level of service E.

At the intersection of Miller Street and Berry Street, pedestrian movements are increased due to the proximity of the station access to the intersection. Although the intersection is in a comparatively low-speed environment, if the crossing capacity is not increased there may be an increase in informal crossing, which may lead to pedestrian safety issues and delays to traffic.

Options to mitigate the impact may include:

- Widening of the pedestrian crossing, which would increase the pedestrian throughput without effecting cycle-times
- Increase the pedestrian green-time, which would increase the pedestrian throughput by extending the proportion of green-time per cycle at the intersection. However, this would consequently reduce green-time available for vehicle movements
- Providing a mid-block crossing on Miller Street immediately outside of the station entrance.

At the eastern access to the station, a large proportion of the station demand is expected to traverse along Denison Street. Currently Denison Street is a Shared Zone south of Spring Street, however between the proposed station exit and Spring Street, Denison Street only has a narrow footpath with several driveways. Consequently, with the significant increase in pedestrian volumes, the road may no longer be suitable for both pedestrians and vehicles without significantly compromising pedestrian safety and/or traffic delays.

To mitigate this potential risk, an option would be the pedestrianisation of Denison Street between Berry and Spring Streets, and if vehicle access is required for loading, vehicle movements could be limited to off-peak periods.

Additionally, the existing pedestrian islands located between the Pacific Highway and Miller Street to the north and south of the intersection currently experience high levels of pedestrian use. Their capacity to accommodate the anticipated increased demand would be further investigated during detailed design.

The above mitigation options would be investigated further in consultation with Roads and Maritime Services and North Sydney Council.

Cyclist integration

Existing on road bicycle routes along the Pacific Highway, Berry Street, Angelo Street and Miller Street would provide convenient cycle access to the station. Existing cycle parking facilities located on Mount Street (adjacent to the subsurface entrance to Greenwood Plaza) would also be available to metro customers.

These existing facilities would be complimented by additional cycle parking on Miller Street to the north of the station entrance.

Public transport integration

The North Sydney area is a major thoroughfare for buses with services connecting the area to the Northern Beaches and lower North Shore, including Mosman, Northbridge and Chatswood and to the Sydney CBD. The majority of these bus services operate along either Miller Street or the Pacific Highway.

Bus stops serving many of the routes to North Sydney are currently located on Miller Street between the Pacific Highway and Berry Street, immediately opposite and to the south of the metro entrance plaza.

Bus stops on the Pacific Highway are located around 250 metres walking distance from the metro entrance and would also provide interchange opportunity with the small number of buses on this route.

Road network integration

The existing taxi stands on Berry Street, to the west of Denison Street, would be maintained and provide taxi facilities adjacent to the station plaza.

To cater for the low volumes of customers anticipated to arrive at the station by car, kiss-and-ride facilities would be provided on the southern side of Berry Street to the east of Dennison Street.

Given the low forecast vehicular arrivals (around six per cent), the metro station is not anticipated to have a material impact on the operational performance of the road network in the vicinity of the site during operation.

9.4.6 Barangaroo Station

The location and proposed transport integration of the Barangaroo Station is shown on Figure 9-6.

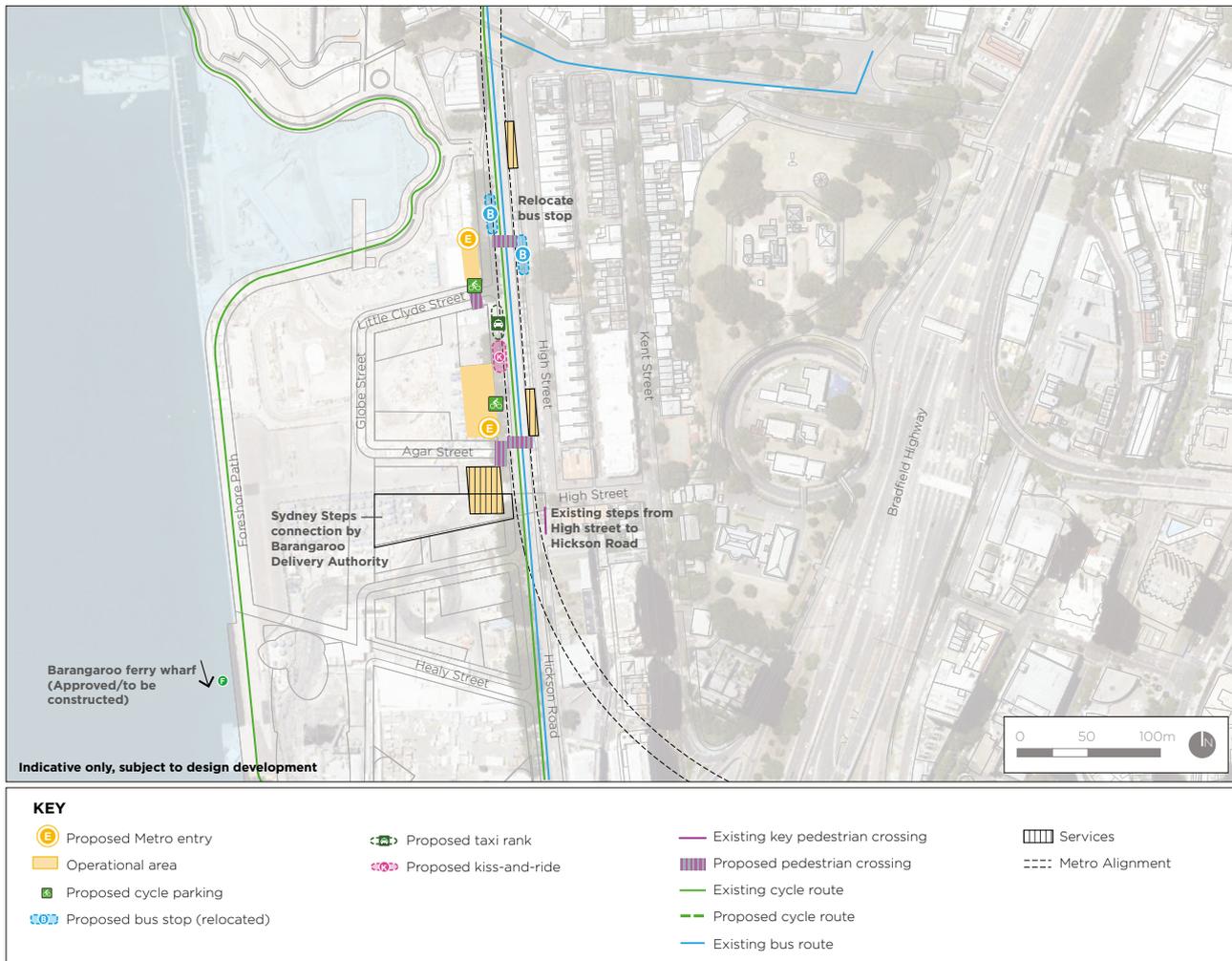


Figure 9-6 Barangaroo Station transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 900 customers would be entering the station and around 6,525 customers would be exiting station. This reflects the predominant commuter use of the station to access employment centres within Barangaroo and in the Sydney CBD

The forecast modes of arrival at the station are:

- Walking – 57 per cent
- Cycling – 3 per cent
- Bus – 39 per cent
- Kiss-and-ride – 1 per cent.

It is anticipated that the majority of the departures from the station would be walking trips to local commercial buildings, with minimal transfer to bus or ferry and negligible volumes by private vehicle.

Pedestrian integration

Based on the future residential and employment populations for travel zones within the walking catchment of the proposed station, the forecast direction of walk only arrivals and departures indicates that arrivals to the station would be primarily from the south from future residents of Central Barangaroo and Barangaroo South precincts. Ninety per cent of all station exits during the morning peak hour are anticipated to travel to the south towards the Barangaroo South commercial precinct.

Pedestrians would use the footpaths along Hickson Road, as well as the new network of footpaths through Central Barangaroo and Barangaroo South and the Foreshore Walkway. As part of the Barangaroo development, enhanced east-west pedestrian connectivity would be provided through improvements to the Sydney Steps, providing connectivity to the station from the east.

The high proportion of walking journeys expected at the Barangaroo Station means the pedestrian movement and access to the site has been considered a priority as part of the station design. Pedestrian facilities in the vicinity of the station would be developed in consultation with the Barangaroo Delivery Authority. At this stage, these are anticipated to include:

- Pedestrian crossing facilities on Hickson Road to the north of Agar Street and near the northern station entry
- Pedestrian crossing facility on Little Clyde Street adjacent to Hickson Road
- Pedestrian crossing facility on Agar Street adjacent to Hickson Road
- Wayfinding signage and Sydney Metro information within the Barangaroo area.

The northern station entry would also provide convenient access to special events at Barangaroo Reserve. During these events, pedestrian management would occur at street level to control the flow of pedestrians into the station environment.

As the streetscape surrounding the proposed Barangaroo Station is currently being redeveloped, pedestrian modelling concluded that the pedestrian infrastructure (including footpaths and crossings) designed as part of the redevelopment would provide a satisfactory pedestrian environment including flow, manoeuvrability and spacing between individuals.

Cyclist integration

An existing on-road cycle path exists along Hickson Road adjacent to the station. Cycle paths are also currently provided throughout Barangaroo Reserve and are planned to be integrated within the Barangaroo development along the foreshore to Pyrmont Bridge, which would provide additional cycle links to the station.

To enable integration of these cycle paths with the station, cycle parking facilities would be provided on Little Clyde and Agar streets at both station entry points.

Public transport integration

A number of bus services operate along Hickson Road which would provide interchange potential with metro. The closest bus stops to the north of the station would be relocated closer to the northern station entry.

Customer interchange would also be possible with the new Barangaroo Ferry Hub via pedestrian footpaths within Central Barangaroo including Foreshore Walk.

Road network integration

To cater for the very low volumes of customers anticipated to arrive or depart the station by car, the following design features are proposed at the station:

- A taxi stand on the western side of Hickson Road between to two station entries
- A kiss-and-ride facility located on the western side of Hickson Road between to two station entries.

The provision of these design features would be developed further in consultation with Barangaroo Delivery Authority.

The mode split of customers entering and exiting the station by car is anticipated to be very low. As such, impacts on the road network are expected to be negligible.

9.4.7 Martin Place Station

The location and proposed transport integration of the Martin Place Station is shown on Figure 9-7.

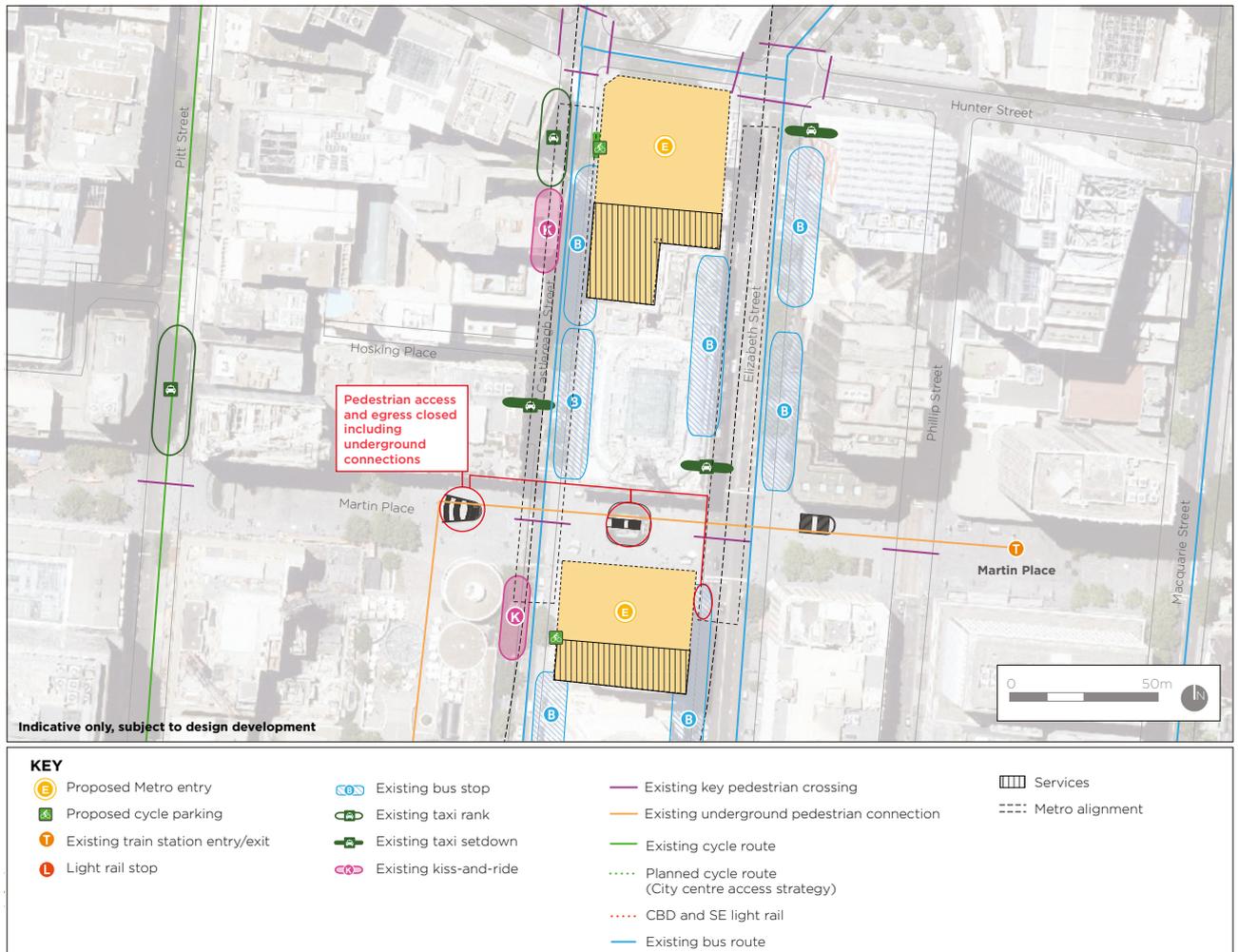


Figure 9-7 Martin Place Station transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 800 customers would be entering the station and around 14,500 customers would be exiting the station. This reflects the heavy employment density within the precinct.

The forecast modes of arrival at the station are:

- Walking – 32 per cent
- Cycling – 2 per cent
- Bus – 66 per cent.

It is anticipated that almost all exits would be walking trips to local commercial land uses, with some transfer to bus.

In addition, it is expected that around 4,100 customers would interchange between Sydney Metro and other rail services.

Pedestrian integration

Direct pedestrian access would be provided to Martin Place, which provides a pedestrianised east-west link. Existing footpaths on Castlereagh and Elizabeth streets form north-south connections in the vicinity of the station. Signalised pedestrian crossing facilities are located at Martin Place on Elizabeth Street and Castlereagh Street, as well as at the Hunter Street intersections with Elizabeth and Castlereagh Streets. In the vicinity of Martin Place, George Street will also be pedestrianised as part of the CBD and South East light rail project which would provide an additional pedestrian friendly link for passengers.

A new underground pedestrian link between the existing suburban Martin Place Station platforms and the metro station platforms would be provided to facilitate suburban train – metro interchange without the need for customers to travel to the surface.

The following design measures would be provided to accommodate the future pedestrian demand and ensure easy and safe interchange for pedestrians:

- Open plaza entrances to the station with ample footpath space within the site to accommodate the anticipated pedestrian demand
- A new underground pedestrian link between the suburban Martin Place Station platforms and the metro station platforms
- Installation of wayfinding signage and Sydney Metro information within the Sydney CBD.

Additionally, the existing access and egress points to the west of Elizabeth Street from Martin Place to the underground concourse connection to the existing Martin Place Station would be closed. Customers travelling to and from the west wishing to access the existing Martin Place Station would be able to use the remaining access points to the east of Elizabeth Street and the new southern metro entrance.

With the exception of some locations, the majority of footpaths in the area would continue to operate at a level of service B or better. However based on site observations and pedestrian modelling of the station and streetscape around Martin Place, three locations were identified where there is potential for safety risks or impacts to pedestrian flow and / or traffic as a result of the metro station.

These locations include:

- Intersection of Hunter Street, Castlereagh Street and Bligh Street
- Hunter Street (west of Castlereagh Street) which would operate at a level of service C in the AM and PM peak hours
- Martin Place mid-block crossing of Castlereagh Street.

At the intersection of Hunter and Castlereagh Streets, actions may need to be taken to provide additional pedestrian facilities to increase crossing capacity to reduce queue lengths, particularly on the southeast corner during the AM peak hour, and deter informal crossing. This includes the provision of an underground pedestrian connection from the station platforms to O’Connell Street and / or Bligh Street. The location of this underground connection is identified in Chapter 6 (Project description – operation). In addition, other treatments could include:

- Widening of the pedestrian crossing at Castlereagh Street, which would increase the pedestrian throughput without effecting cycle-times
- Increase the pedestrian green-time, which would increase the pedestrian throughput by extending the proportion of green-time per cycle at the intersection. However, this consequently reduces green-time available for vehicle movements
- Decrease overall cycle-time, which would increase the frequency of green-time for pedestrians over a given period of time. However, this could lead to losses in effective green-time for vehicles, as more time is lost in inter-green periods between movements.

With regard to the footpaths running along both frontages of Hunter Street west of Castlereagh Street, site observations and modelling indicate that pedestrian movements occur in platoons which are dependent on green-time at intersection crossings. This results in an uneven distribution over the hour, increased congestion and deterioration of the pedestrian environment.

To mitigate the impact to the footpath, an option may involve removing or reducing street furniture (such as trees) to increase the effective width of the footpath.

Towards the southern end of the station, the main impact from the project would be the Martin Place mid-block crossing with Castlereagh Street. The majority of existing Martin Place Station users use the pedestrian crossing to travel west in the AM peak, and the reverse in the PM peak. The metro station would result in a significant increase of these movements. Nevertheless, with 2026 and 2036 demands, the crossing was found to provide sufficient space for queuing without blocking background pedestrian flows, and the green-time allows the queue to clear each cycle.

The above mitigation options would be investigated further in consultation with the CBD Co-ordination Office, the City of Sydney Council and Roads and Maritime Services.

Cyclist integration

A number of cycle facilities are currently being implemented as part of the City Centre Access Strategy in the Sydney CBD area which would improve safety and convenience for cyclists.

Some on-street cycle parking facilities are currently available at the intersection of Martin Place and Castlereagh Street. This facility could be used by metro customers.

To enable cycle interchange with the station, new cycle parking facilities would also be provided on Castlereagh Street at both station entrances.

Public transport integration

The project would provide a new underground pedestrian link between the existing Martin Place train station platforms and the Martin Place Metro station platforms, ensuring convenient integration between suburban rail and the metro.

Following implementation of the new CBD Bus Network in 2015, Elizabeth Street is now a key north-south bus route through the Sydney CBD. Castlereagh Street is also a designated north-south bus route. These bus routes, and associated bus stops would provide convenient interchange opportunities between bus and metro services.

The northern station entrance on Castlereagh Street would provide a connection to the new light rail station located on George Street, near its intersection with Hunter Street. Alternatively, connections could be made from the southern station entrance, along Martin Place and the pedestrianised George Street. This would provide an appropriate connection for the small proportion of passengers expected to interchange between the metro and light rail.

Road network integration

Existing taxi facilities on Castlereagh and Elizabeth streets in the vicinity of the station entrances would be retained and could be used by metro customers to interchange between metro and taxi services.

As no customers are anticipated to access to station by vehicle, the impact on operational performance of the road network in the vicinity of the site would be insignificant.

9.4.8 Pitt Street Station

The location and proposed transport integration of the Pitt Street Station is shown on Figure 9-8.

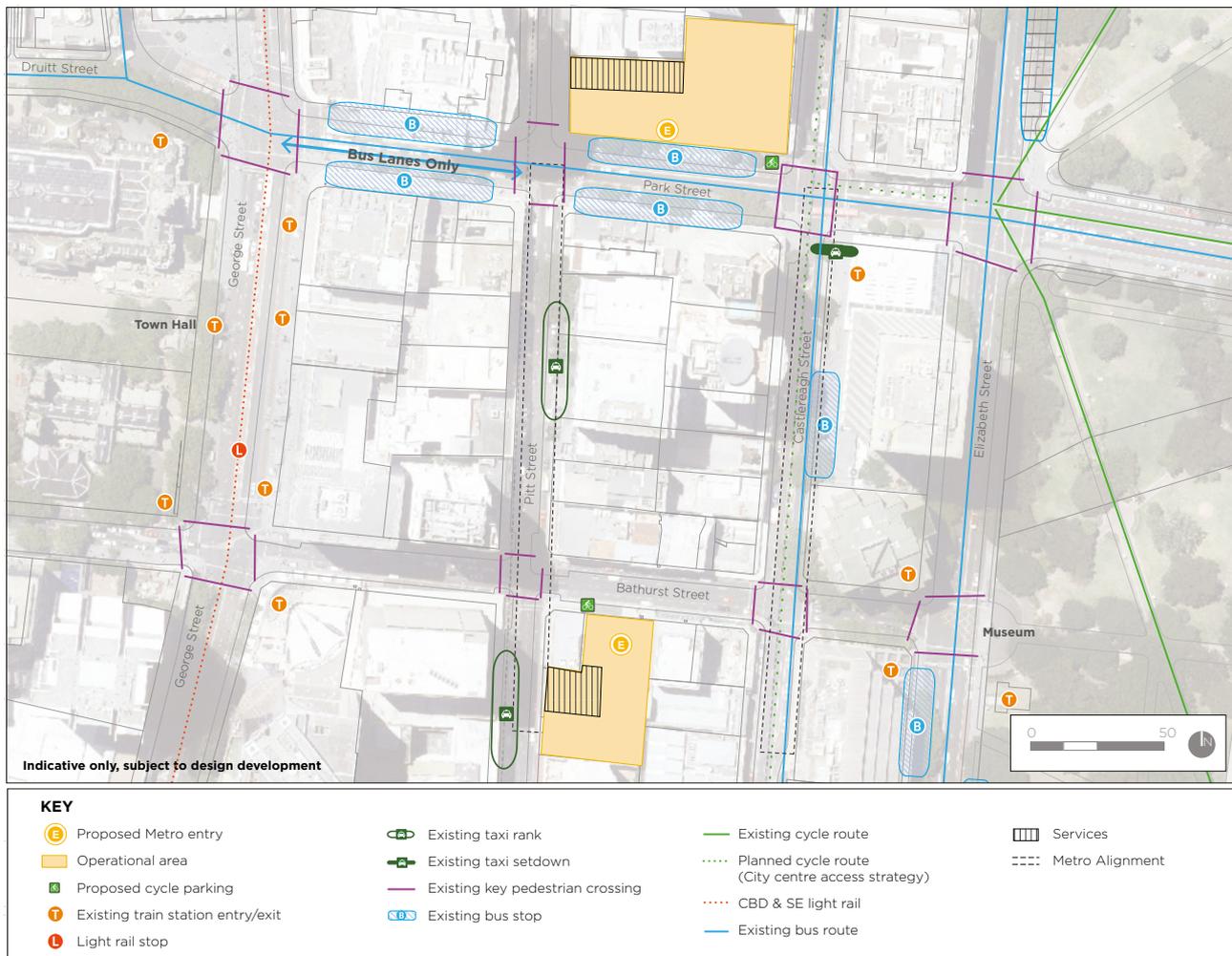


Figure 9-8 Pitt Street Station transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 1,500 customers would be entering the station and around 7,575 customers would be exiting the station. This reflects the mix of residential, commercial and retail uses within the area.

The forecast modes of arrival at the station are:

- Walking – 45 per cent
- Cycling – 2 per cent
- Bus – 52 per cent
- Kiss-and-ride – 1 per cent.

It is anticipated that almost all exits would be walking trips to local commercial land uses, with some transfer to bus.

Pedestrian integration

The northern station entrance would be a plaza entrance that would incorporate sufficient pedestrian space to accommodate the forecast number of entries and exits at the station. Similarly, the southern entrance off Bathurst Street would accommodate pedestrian space to accommodate the forecast customer numbers.

With the exception of some locations, the majority of footpaths in the area would continue to operate at a level of service B or better. However, patronage analysis and pedestrian modelling of the station and streetscape have identified three locations where there is potential for impacts to pedestrians and/or traffic due to the presence of the station. These locations are:

- Park Street mid-block near the station access due to the presence of a major bus interchange
- Intersection of Pitt Street and Park Street
- Intersection of Pitt Street and Bathurst Street.

The highest pedestrian volumes occur along the footpaths connecting to both the northern and southern station entries, particularly west of the station entries towards the Pitt Street intersections. These pedestrian volumes are however less than 100 people per minute in both directions, a flow rate typical of the Sydney CBD pedestrian environment.

This could however be a potential issue at the mid-block on Park Street between Pitt and Castlereagh streets, which acts as a major interchange with bus services. In addition to queuing and alighting customers, the bus stop infrastructure significantly reduces the effective width of the footpath, further reducing the space available to pedestrians.

At the Pitt Street intersections with Park Street and Bathurst Street, the east-west pedestrian crossing volumes nearest to the station entries may double in both peak periods. This however is not anticipated to be a significant issue as the crossing operates in parallel with the primary vehicle movement of the intersection and therefore pedestrian green time could be extended to the length of the east-west vehicle green time (if required) without compromising the intersection performance.

Wayfinding signage and metro information would be provided in the Sydney CBD to enable pedestrian interchange.

Cyclist integration

To enable cycle interchange with the station, cycle parking would be provided:

- At the northern station entrance near the Park Street / Castlereagh Street intersection
- At the southern station entrance near the Pitt Street / Bathurst Street intersection.

Public transport integration

Existing bus stops are located outside the northern station entrance on Park Street, which would provide direct interchange opportunities with the metro station. Bus stops are also located on Castlereagh and Elizabeth streets north and south of the station.

Direct connections would be possible to the new light rail station on George Street. The distance between this southern station entry and the light rail station would be less than 200 metres, providing an efficient interchange.

Road network integration

Existing taxi facilities are available on Pitt Street between Park and Bathurst streets, south of the intersection with Bathurst Street and on Castlereagh Street immediately south of the Park Street intersection. These provide easy and convenient taxi connections to both the northern and southern station entrances.

The mode split of customers entering and exiting the station by car is anticipated to be very low. As such, impacts on the road network are expected to be negligible.

9.4.9 Central Station

The location and proposed transport integration of the Central Station metro platforms is shown on Figure 9-9.

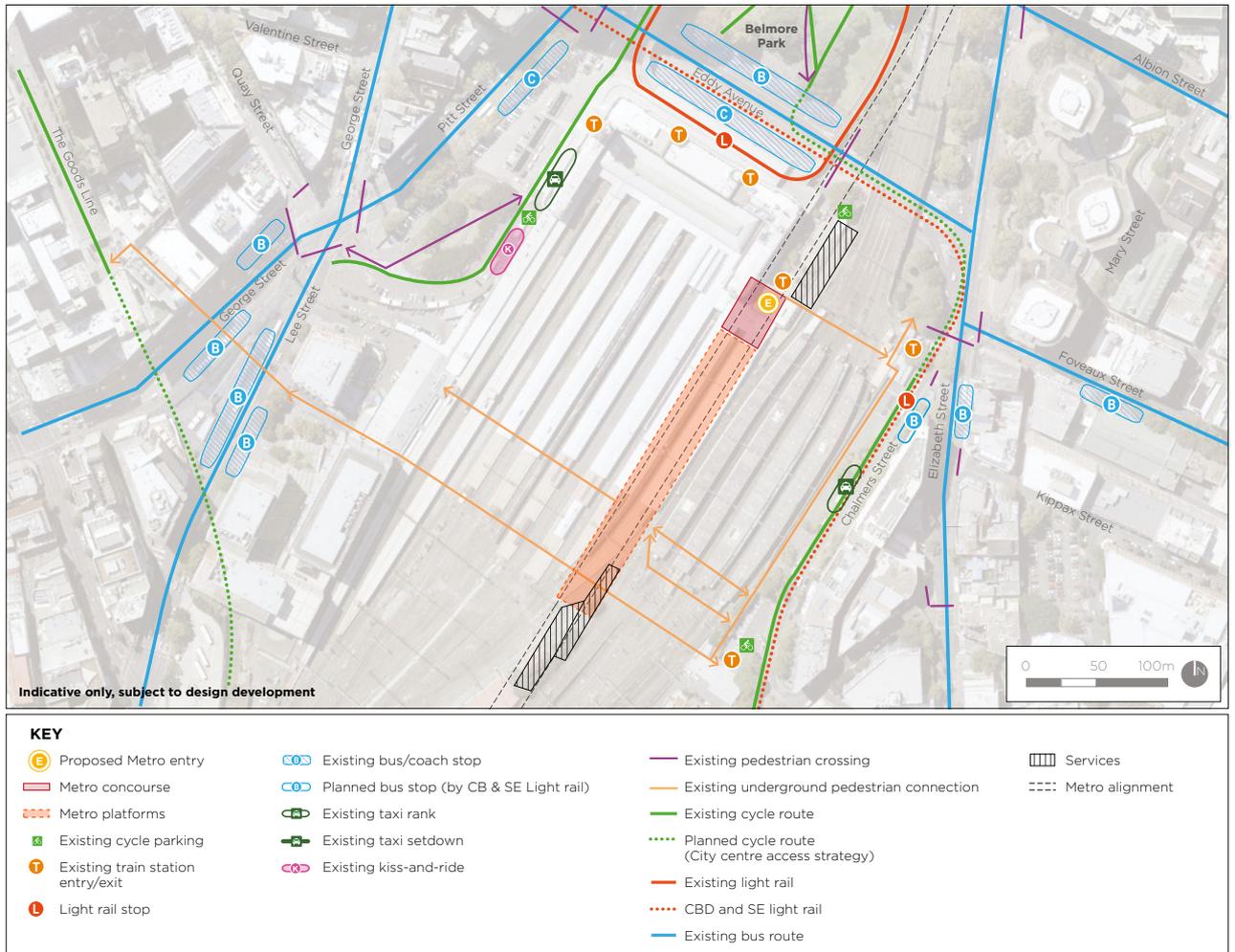


Figure 9-9 Central Station metro platform transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 2,100 metro customers would be entering at the station and around 9,650 metro customers would be departing the station.

The forecast modes of arrival at the station are:

- Walking – 46 per cent
- Cycling – 1 per cent
- Bus – 52 per cent
- Kiss-and-ride – 1 per cent.

It is anticipated that almost all exits would be walking trips to local commercial land uses.

In addition, it is expected that around 9,600 customers would interchange between Sydney Metro and other rail services.

Pedestrian integration

Pedestrians would be able to interchange between metro and suburban train lines via the existing northern concourse and the existing paid underground pedestrian connections at Central Station which would be connected to the metro concourse. The metro platforms and concourse have been designed using forecast patronage data and therefore would accommodate the anticipated pedestrian movements within Central Station.

Pedestrian analysis at Central concluded that a maximum of eight people per minute would be added to any exit during the AM peak hour and subsequent street level footpaths. Therefore, based on this relatively insignificant increase, it is unlikely that any issues related to pedestrian capacity on the local pedestrian network would arise as a result of the project.

Cyclist integration

A new cycle path has recently been completed along Castlereagh Street between Belmore Park and Liverpool Street, as well as along Liverpool Street from Castlereagh Street to Sussex Street. These paths improve the existing and any future north-south and east-west connections to and from the Central Station. Metro customers would be able to use the existing cycle parking facilities at Central Station.

Public transport integration

A high proportion of public transport interchange is expected at Central Station. Customers would be able to interchange with suburban and intercity train lines via the existing northern concourse and the existing underground pedestrian connections at Central Station which would be connected to the metro concourse.

Within Central Station, metro customers would be able to use existing access options to interchange with bus services in the vicinity of Central Station as well as with light rail services and coach services providing regional connections.

Road network integration

Customers accessing the metro platforms at Central Station would be able to use existing drop-off facilities such as the drop-off area within the western forecourt of Central Station.

The mode split of customers entering and exiting the metro platforms by car is anticipated to be very low. As such, impacts on the road network are expected to be negligible.

9.4.10 Waterloo station

The location and proposed transport integration of the Waterloo Station is shown on Figure 9-10.



Figure 9-10 Waterloo Station transport integration

Passenger demand

Preliminary forecasts for the 2036 AM peak hour indicate that around 3,700 customers would be entering the station and around 2,350 customers would be exiting the station. This reflects the residential and commercial catchment of the station.

The forecast modes of arrival at the station are:

- Walking – 76 per cent
- Cycling – 1 per cent
- Bus – 19 per cent
- Kiss-and-ride – 4 per cent.

It is anticipated that almost all exits would be walking trips, mainly to local commercial land uses.

Pedestrian integration

The station entrance would be a plaza entrance that would incorporate sufficient pedestrian space to accommodate the forecast number of entries and exits at the station. Adjacent to the station entry marked pedestrian crossing facilities would be provided across Raglan Street to provide a safe north – south pedestrian connection and across Cope Street to provide a safe east – west pedestrian connection to the station entry.

The highest pedestrian volumes are anticipated to occur along the southern Raglan Street footpath where the station entry would be located. Currently the footpath and the retail frontage provide sufficient width to accommodate the metro patronage demand.

Cyclist integration

A new on-road cycle route would be provided along Raglan Street and Henderson Street, between George Street to the east and the shared path through the Vice Chancellors Oval to the west. This would provide direct access past the station entry, connecting existing cycle route facilities to the east and west of the station. To the east of the station, George Street has a separated cycle route providing safe and convenient north – south connections and the shared path via the Vice Chancellors Oval provides cycle connections to the west of the station.

To enable easy cycle interchange, cycle parking would be provided near the station entry at Raglan Street.

Public transport integration

Existing bus stops on Botany Road between Raglan Street and Wellington Street are generally located within an easy walking distance of the station entry on Botany Road. To enable better integration with the metro station entry, the southbound bus stop on Botany Road would be relocated further north and the bus stops on Cope Street would be relocated to Botany Road. The northbound and southbound bus stops provide convenient interchange to and from the Sydney CBD to the north and Mascot, Matraville and East Gardens to the south.

Road network integration

To accommodate the small number (four per cent in the AM peak hour) of customers anticipated to access the station by road, kiss-and-ride facilities and a taxi rank would be provided on Cope Street, just south of its intersection with Raglan Street, providing convenient access to the station entry.

This volume of drop-off during the peak hour is not anticipated to have a material impact on the operation of the road network in the vicinity of the station.

9.4.11 Marrickville dive

Traffic signals would be introduced at the Edinburgh Road / Bedwin Road / Edgeware Road intersection to improve traffic safety during the construction phase. It is anticipated that these signals would be retained during operation.

Table 9-5 shows the intersection performance with and without the project. The Edinburgh Road / Bedwin Road / Edgeware Road intersection shows a deterioration in the degree of saturation, however it would continue to operate at a level of service A. All surrounding intersections in the vicinity maintain their existing level of operation.

Table 9-5 Marrickville dive intersection performance

Peak period	Without project			With project		
	Average delay	Degree of saturation	Level of service	Average delay	Degree of saturation	Level of service
Edinburgh Road / Murray Street						
AM Peak	4	A	0.48	4	A	0.48
PM Peak	6	A	0.66	6	A	0.66
Edinburgh Road / Edgeware Road						
AM Peak	3	A	0.38	3	A	0.38
PM Peak	3	A	0.40	3	A	0.40
Edinburgh Road / Bedwin Road / Edgeware Road						
AM Peak	4	A	0.12	11	A	0.55
PM Peak	12	A	0.49	11	A	0.66
Bedwin Road / Unwins Bridge Road / Campbell Street / May Street						
AM Peak	47	D	1.01	45	D	1.01
PM Peak	43	C	1.01	42	C	1.01
Princes Highway / Campbell Street						
AM Peak	34	C	1.00	34	C	1.00
PM Peak	30	C	0.86	30	C	0.86
Princess Highway / May Street						
AM Peak	33	C	0.81	33	C	0.83
PM Peak	25	B	0.81	25	B	0.81

9.4.12 Maintenance access

Vehicles would be required to access operational ancillary infrastructure, stations and tunnel portals to undertake periodic maintenance activities. The expected maintenance access frequency is outlined in Table 9-6. Due to the anticipated number of vehicles and the expected frequency of access, maintenance access is not expected to result in any impacts to the surrounding road network.

Table 9-6 Maintenance access requirements

Location	Access requirement	Vehicle type	Frequency
Stations and services buildings	Delivery of consumables and minor waste removal	Light and utility vehicles	Daily
	Maintenance inspections	Light and utility vehicles	Weekly to fortnightly
	Significant deliveries and waste removal	Tipper trucks	Weekly
	Major maintenance and replacement of large plant items	Heavy rigid trucks and cranes	Occasional
Substations (Artarmon substation, Victoria Cross Station, Barangaroo Station, Pitt Street Station and southern services facility)	Visual inspections	Light vehicles	Fortnightly
	Replacement of consumables	Light and utility vehicles	Quarterly
	Major maintenance and replacement of large plant items	Heavy rigid trucks and cranes	Yearly
Water treatment plant (southern services facility)	Delivery of consumables and waste removal	Light vehicles and heavy rigid trucks	Weekly
Tunnel portals	Inspections and testing of track and in-tunnel equipment	Light vehicles	Weekly
	Track and equipment maintenance	Light and utility vehicles	Occasional

9.5 Mitigation measures

The project has been designed to provide efficient interchange between Sydney Metro and other forms of transport. In addition to the measures which have already been applied to the project, mitigation measures that would be implemented to address potential operational traffic and transport impacts are listed in Table 9-7.

Table 9-7 Mitigation measures – operational traffic and transport

Ref	Mitigation measure	Applicable location(s) ¹
OpT1	Enhancement of pedestrian infrastructure in the vicinity of Victoria Cross and Martin Place stations would be investigated further in consultation with (as relevant to the location) the CBD Coordination Office, Roads and Maritime Services and the relevant local council.	VC, MP
OpT2	Access would be maintained to neighbouring properties.	All except metro rail tunnels

¹ STW: Surface track works; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement works; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; MDS: Marrickville dive site; Metro rail tunnels: Metro rail tunnels not related to other sites (eg TBM works); PSR: Power supply routes.