

**Submission  
No 27**

## **SYDNEY METRO WEST PROJECT**

**Name:** Mr Peter Egan

**Date Received:** 19 September 2023

## **Sydney Metro West project LA inquiry – submission by Peter Egan**

### **Terms of Reference b) The establishment of the route and selection of station locations**

From the expansion of the Legislative Council in 1942 to WW2, this was an activity in which MPs were heavily involved through the Public Works Committee. 'Professional' planning largely removed MPs from this activity and thus the opportunity to learn about the economic potential of the regions of the state and the infrastructure desired to support that economic activity. The key infrastructure was rail until motor vehicles were invented and became affordable. WW2 bought a lot of trucks to Australia and road transport could provide a better service than rail in many instances. MPs disengaged from economic planning as the competitive advantages of road and rail transport modes were being radically changed.

Rail has not received the attention it needs to contribute most effectively to our economy and society. Labor was right to shut down the tram network in the 1950s. On-street rail transport should never have been brought back, but the new Labor ploughs on with it indicating they, and the parliament as a whole, understand little about deployment of transport modes. The Departments of Planning and Transport are unable to aid that understanding as senior executives are not chosen with that role in mind.

Rail has far greater capacity to transport people and goods compared to road transport, but it is more expensive per linear metre of track/lane. Rail is the best means to increase the density of cities above the sprawl that results from road transport due to the low density of people in vehicles on roads.

It appears the selection of the Metro West route, though similar to that in the 1974 Sydney Area Transportation Study, arose from conversations Premier Baird had with one or more people. A company executive has been reported in the media as saying it was adopted after he spoke to the premier. Premier Perrottet went to the election with a rail network outline plan that appears to have no geographic analysis to support it. A politician can say where they want infrastructure built then modify land zoning to ensure it gets used. Land use planning should fall from iterative geographic analysis of where people and businesses desire to be based and the transport services needed to support that desire. The entire NSW coast has a similar moderate climate as the 'eastern Sydney' where the new Labor government wants to increase density. Some inland mountainous regions of the state are also desired from a climate perspective. More important than climate, is access to goods, services and jobs. After the Great Depression and WW2 debt surge, and the permanent handover of Income Tax powers to the Commonwealth in 1946(??), they state does not have the funds to maintain population share in the regions, so growth occurs mainly in Sydney.

Today's Labor Budget increases operating expenditure and winds back capital expenditure – Labor favours its heartland which Metro West passes through, and also the near useless Parramatta tramway stage two (it serves the same area as Metro West, and should be an electric bus service).

### **A measure of government land use and transport performance in addressing affordability**

State population share is a measure of economic performance. The NSW performance since WW2 has been tragic compared to Victoria.

NSW population share tells the story of what good and poor infrastructure policy delivers. We can only have the economy enabled by well-planned access (transport) services.

NSW grew its share of the Australian Population from 33% in 1856 to ~40% in 1940, which then declined to 31.3% in 2023.

NSW consistently grew faster than Victoria after the Gold Rush to surpass it in population in the 1890s and go on to greatly exceed it. Victoria's population was about 27% of Australia's in 1940, and is 25.5% now – barely a decline.

Around the world, the larger cities and states in a country have tended to grow their population share due to better services. If not the dominant state in 1940, the decline of NSW population share would have been far greater. 31.3% of Australia's population in 2023 is flattery of the post-war transport policies of all sides of politics.

The NSW population share rise and fall was no accident. NSW success to 1940 was due to superior policy in funding and deploying transport infrastructure and services from the start of representative government in 1856 to the Great Depression and WW2. Under investment in infrastructure in and outside Sydney creates affordability issues - it is a lose-lose strategy from every perspective.

The switch from the Public Works Committee effectively planning major infrastructure, to planning by public servants left MPs out of the loop and out of the information flow. Prior to the County of Cumberland Plan, the community made representations to the PW Committee about the economic opportunities of regions, and the public service informed the Committee on best corridors to realise the opportunities and costs. Out of the transport planning loop, MPs have turned their attention to other matters.

Draft government transport network and land use plans should be subject to yearly public review by parliamentary committees even if government plans are not changed.

### **Broadening our thinking about land use and transport**

Transport corridors are our way to link 'lots' of land controlled by people or entities for economic, social and environmental purposes. Transport corridors, which includes streets, use about one-third of urban land. Therefore, efficient corridors and services are essential if we are not to 'waste' land. The state manages our main roads and railways which are equivalent in many ways but have different strengths and weaknesses.

We should also think more broadly about funding. Conservatives around the world are fond of a 'user-pays' mantra. This means most beneficiaries of infrastructure and services avoid paying for them. The beneficiaries of a person going to work are the person, the employer and businesses where the person spends their income. Economies are wealthier when all beneficiaries pay for public infrastructure and services.

While we use government bond sales to finance infrastructure, general economic taxes should fund public infrastructure. We have also found significant economic benefit in general taxes part-funding public transport services for the mobility it offers the young to travel for education and work purposes and from the benefits flowing from public transport being a higher density form of transport – our cities sprawl less. The former **Coalition government** recognised the taxes that flow from development around railway stations will fund a lot of infrastructure, and **sought to build new railway lines for new CBDs**, as we no longer trust government to increase density of existing CBDs in a sensible fashion.

The intent with road tolls was user pays 100%. The tolls were turned into an income stream unrelated to our economic needs and sold at a huge discount when measured against the market values of government bonds with those income streams. The tolls are eating our economy. Toll income must go to government to allow it to vary tolls for social and economic purposes. Essentially, we now have the government paying tolls to Transurban on behalf of a large number of NSW residents.

**Increasing density in existing CBDs requires a suit of policies that** remove through traffic from CBD cores, street infrastructure built around people rather than traffic and vehicles, lowering railways where they split CBDs in half, property zoning rules that enable poor streetscape, such as longitudinal stairs in footpaths to be eliminated by changes to lot and footpath levels. Artarmon is just one centre where significant benefits would flow from lowering the railway and changes to lot and footpath levels. Many CBDs in Sydney are cut in half by railways.

### **Transport network structures**

Public transport in NSW is delivered by a number of different vehicle types on road, rail, water and by air. Some public transport is directly provided by the private sector – air travel in particular.

Transport for NSW research shows people in metropolitan areas travel in every direction. There are essentially two ways to support travel in every direction:

--- The first – radial transport corridors to a centre and then to a destination on another radial.

--- The second – a grid structure. Adopted for our main roads post WW2, but not yet for railways.

Generally, we use both structures. Radial structures tend to congest at the centre, and have longer service times, but the centre often has better facilities for public transport interchange. Our bus network radiates from multiple points.

Until WW2 Sydney's main roads and railways were essentially radial. After the war, many tangential roads 'A' roads were built to give the network a grid structure. Roads are lower density than rail when transporting people and goods.

Rail cannot be an end-to-end service for goods transport in most circumstances, thus we generally rely on road transport for shorter freight journeys.

Our railways effectively radiate from the city of Sydney which is now displaced from the centre of the metropolitan area as the city has grown.

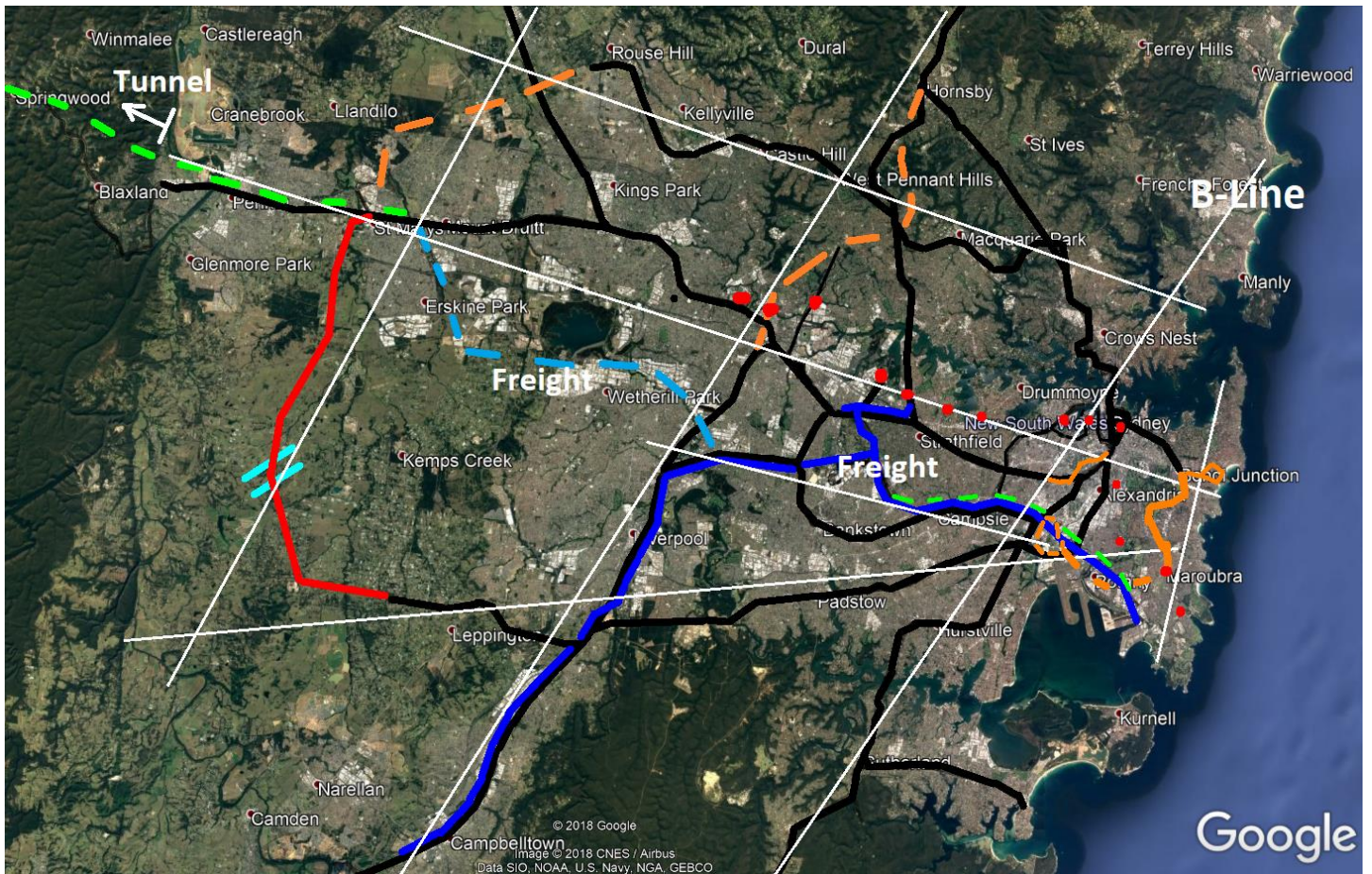
Western Sydney must make greater use of private vehicles as our radial rail structure is essentially east-west by the time it reaches Western Sydney – railways in the west are poor in north-south travel options. The wealth and jobs in the north west are less accessible to those living in the south west.

We have been very reluctant to use rail grids and offer public transport services that take advantage of grid structures to reduce journey times.

Radial structures were favoured by the Coalition for Sydney's future. Their plan envisaged railways radiating out from each of its six Greater Sydney cities. The policy would gradually divide Greater Sydney on education and job opportunities and thus opportunities to create personal wealth over time. It was an 'us and them' policy and is currently the policy of the new Labor government, which did not use the Budget to change the policy.

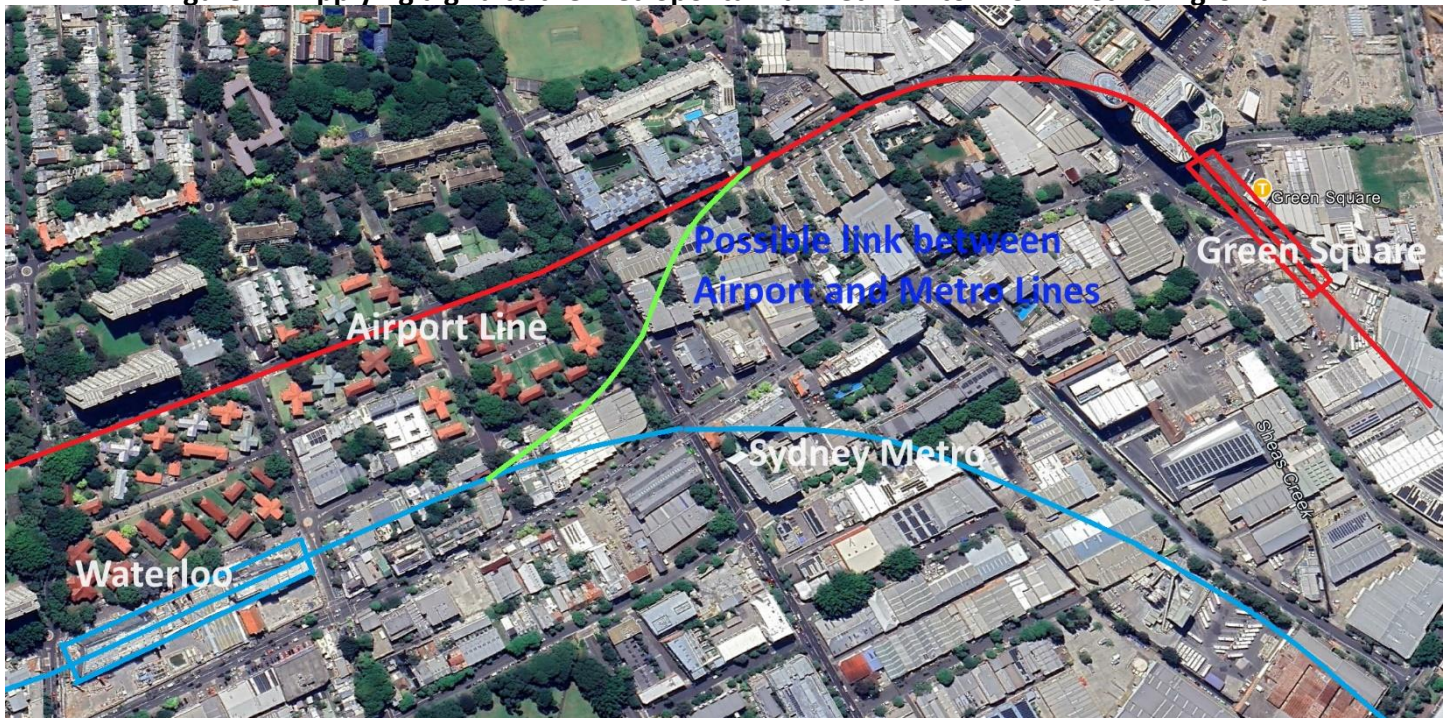
Figure 1 demonstrates a simple geographic analysis to ensure coverage of the metropolitan area such that people can travel in all directions when supported by local personal and bus transport. The grid is based on existing rail lines, local and regional centres, and high demand nodes such as airports. The radial railways we have built, and some that are planned or under construction, contribute to grid structure. Metro West is effectively in the same corridor as the Western Line, thus Metro West should be a low priority. Olympic Park could be served with tunnels from Homebush to Olympic Park and Granville which effectively adds to tracks to the Western Line corridor at a fraction of the cost. Olympic Park could also be served by a diversion of the Northern Line to the existing Olympic Park station. The evidence points to very little thought having gone into additional capacity for the Western Line corridor.

Proposed links for the Western Airport Line would effectively create a Sydney Orbital Railway. Figure 2 shows how the missing link in an orbital railway between the Sydney Metro and Airport Lines can be filled between Waterloo and Green Square stations. Our highest priority rail link should be Merrylands-Parramatta-Epping-Hornsby to give both direct east-west and north-south rail access to Parramatta, which also permits direct rail services between Newcastle and the Southern Highlands. Other rail proposals are presented in Appendix 1.



- Black lines – current passenger network
- Light blue line – Western Freight Line
- Red line – Government's WSA connections to Western and Leppington Lines
- Red dots – Government locations for Metro West stations
- Broken orange lines north-south – St Marys-Rouse Hill, Merrylands-Parramatta-Epping-Hornsby
- Broken orange lines east west – Bondi Junction-Bondi Beach, Sydenham-Airport-Botany-Maroubra
- Solid orange line – Eastern Suburbs Line extension due to weak north-south links
- Green lines – Passenger & freight rail lines under Blue Mtns – 46 km tunnels Emu Heights-Hartley Vale
- Dark blue line – current freight lines
- Aqua lines – Western Sydney Airport runways
- Dark blue line – Inner West diversion tunnel – Enmore, Newtown, Sydney University-Central
- Green lines – Proposed freight rail tunnel – Botany-Sydenham-Enfield yard – 14 km

**Drawing grids is about ensuring geographic coverage and connections between regions**  
**Figure 1 – Applying a grid to the metropolitan rail network to inform network growth**



**Figure 2: At grade 350-metre long connection between Sydney Metro and Airport Lines diverting Sydney Metro to Airport and South West Lines to enable a Sydney Orbital Railway that serves the metropolitan area and Sydney two airports.**

**Western Harbour Tunnel – a project we should cancel at this late stage.**

While the new government is continuing the Western Harbour Tunnel (WHT), it is an unnecessary project.

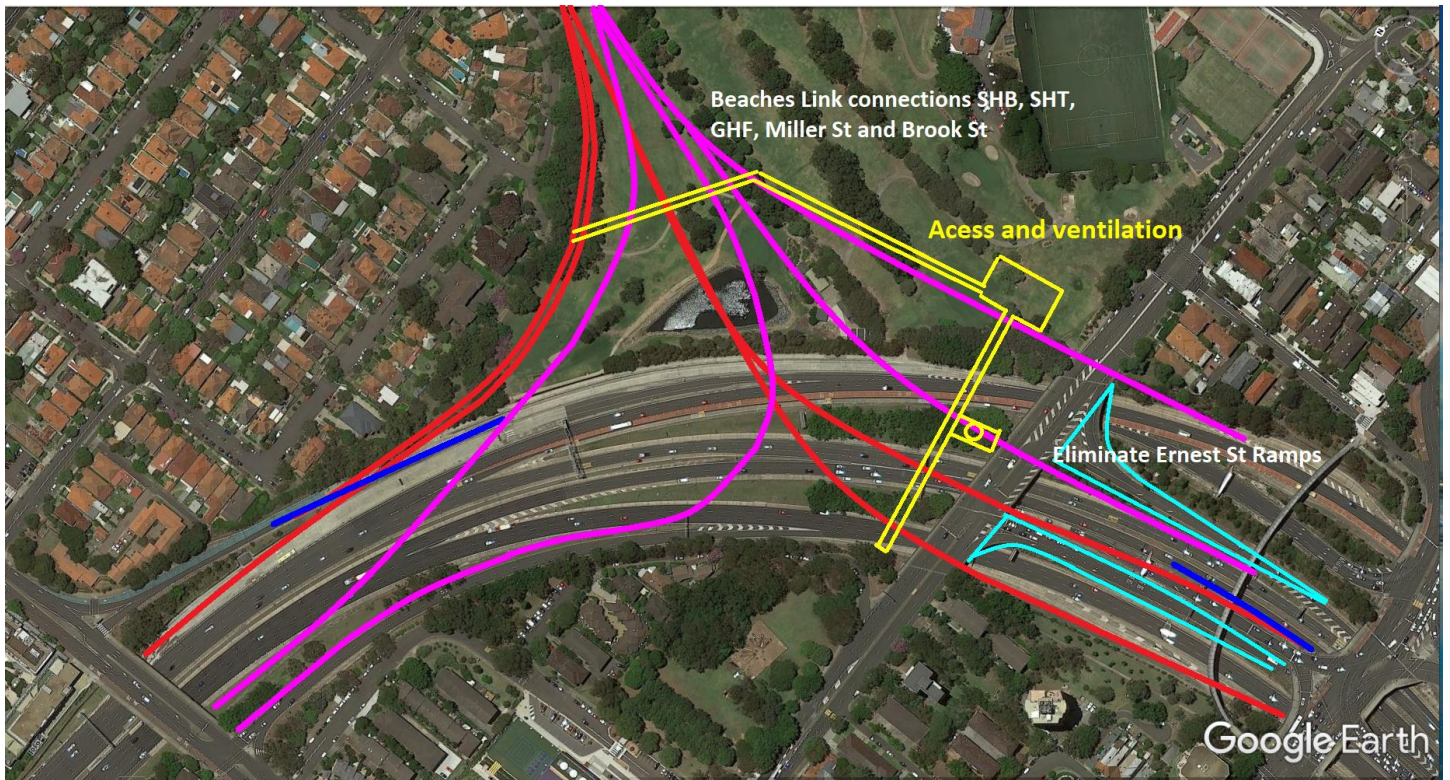
We should complete the North Western Motorway (NWM) between the Sydney CBD and Hornsby. It is currently 70% complete and the remaining works are tunnels and bridges.

The Lane Cove Tunnel (LCT) was built with just four through lanes on the understanding the NWM would be completed. The WHT requires a second LCT otherwise 18 cross-harbour traffic lanes reduce to four at the LCT.

With the WHT cancelled, Beaches Link Tunnel (Warringah Freeway Stage 2) can utilise the current excavations at Cammeray for a far cheaper project with ~6% main tunnel grade that would see the initial tunnel as a cut-and-cover tunnels under the Cammeray Golf Course as shown in Figures 3 and 4.

The WHT-WF-BL, in the initial EIS as a common programme of works, if completed will force more traffic through North Shore CBDs in an entirely unnecessary fashion. The reduction from 6% to 4% for main tunnel grade to make inconsequential reductions in diesel truck pollution added 50% to the cost of the Beaches Link project. If the WHT-WF works continue, a future government cannot significantly change the Beaches Link.

The committee should investigate the project.



**Figure 3: If the WHT is cancelled, the works at Cammeray can be repurposed as shown above for a Beaches Link with a ~6% main tunnel grade that is below the surface of the golf course.**



This route save billions as it avoids the link to Artarmon.

**Figure 4: Beaches Link revised route with ~6% main tunnel grade and ~350-metre radius curves under cammeray and Tunks Park**

Legislative Assembly Committee on Transport and Infrastructure

**The Committee will inquire into and report on the Sydney West Metro project. The Terms of Reference are detailed below.**

Referred 15 Aug 2023

19 Sep 2023 Submissions closing

That the Committee on Transport and Infrastructure inquire into and report on the Sydney Metro West project, with reference to:

- a) The original business case for the project
- b) The establishment of the route and selection of station locations
- c) The cause of blowouts in project cost and timelines
- d) Whether the Minister at the time considered any other consequential benefits that could be achieved from the project
- e) Other matters relevant to the Sydney Metro West project.

Chair: Voltz, Lynda (ALP, LA Member)

Deputy  
Chair: Hagarty, Nathan (ALP, LA Member)

Members: Hannan, Judy (IND, LA Member)

Kirby, Warren (ALP, LA Member)

Williams, Ray (LIB, LA Member)

## Sydney Metro West project LA inquiry – submission Peter Egan Appendix 1 – Increasing the capacity of the Greater Sydney Region Rail network –

### Key points

- The government's 2056 transport plan seeks to break the metropolitan area into three cities, served by 'hub and spoke' transport networks, at the expense of the metropolitan wide jobs and business-to-business markets – for which 70 years have been spent building road and rail grids.
- The transport grid has yielded over 30 competing regional and specialist centres. As foreseen by the Urban Taskforce, about 40 regional centres, with railway stations, will be the future metropolitan structure.
- local and regional centres exist to provide consumer goods and services at economic scale and in a timely manner. The centres are supported by local and regional road grids and bus/taxi public transport which generally operates on the hub and spoke model.
- the jobs and business-to-business markets exist on a metropolitan/state/national scale. In addition to local and regional transport, these markets are supported by metropolitan scale grids of roads (main/arterial roads) and railways. Most of our cities have a strong grid structure for their roads, and a poor grid structure to their railways. Our major cities still have inefficient hub and spoke structures to their rail networks.
- Property taxes contribute 52% of state and local government taxes.
- Transit oriented development at existing and new stations delivers the best return to the community in the form of more taxes and less road congestion.
- Infrastructure Australia has 19 NSW rail projects on its priority list - all presented to IA at different times from different perspectives. NSW should have one passenger and freight rail service statement driving a related set of rail projects that have one economic and business case. Passenger and freight rail can use the same infrastructure. Separation of passenger and freight rail is desirable, but not always economic.
- Sydney Metro adds no new capacity to Sydney CBD until 2024 and then it primarily serves new markets.
- Sydney Metro to Bankstown, or Sydney Airport, releases just 10 train paths for other services, but airport service does much more to reduce cross-harbour traffic.
- Metro West primarily serves a new market and will do little to relieve existing capacity constraints.
- Government plans have Western Sydney Airport served by Leppington and Western Lines.
- CBTC signalling for the Sydney Trains network, combined with more trains and platform capacity increases at Central (Central Walk), Town Hall, and Wynyard (including a new North Shore station at Observatory Hill), is the most economical way to improve the capacity and reliability of the Sydney Trains network.
- Rail tunnels: 36 km Hornsby-Woy Woy-Point Clare; 39 km under Blue Mountains; 22 km Waterfall-Thirroul are needed to bring the regions around Sydney into full participation in its economy and reduce the housing unaffordability problem.
- A second City Circle line will permit a two-thirds capacity increase for the metropolitan arc from Parramatta to Cronulla. It could serve Sydney University.
- Light rail has one-tenth the capacity of heavy-rail. The Eastern Suburbs, including UNSW/POWH need the under-used ES line extended to serve this in-demand metropolitan region.
- More passing capacity should be added at stations between Sutherland and Central, and two extra tracks added between Sydenham and Erskineville (~3 km) if Sydney Metro is paused at Sydenham.
- The Intercity Line from Strathfield to Central Terminal is at half capacity in the peak. It should be extended 9 km to Granville to provide ultra-express services to Parramatta, Western Sydney Airport and Blue Mountains with provision made for Parramatta-Central Coast services.
- Newcastle, Central Coast, Northern Line services should be consolidated to the Intercity line to Central Terminal due to the great connections to the North Shore, Sydney Metro, Western and Inner West lines.
- North Shore line should terminate at the Hornsby turnback, the Lavender Bay stabling yard should be replaced by a stabling yard at St Leonards, and the Wollstonecraft curves replaced by a tunnel and new Waverton-Wollstonecraft station to reduce journey time and fleet requirement by five trains.
- While Central Coast and Newcastle line major stations have been improved, other stations are presently serviceable but old, undersized and outdated, and will not attract new customers. 7 new stations are needed due to metropolitan growth away from existing stations.
- The 1 million population Central Coast-Newcastle-Hunter region needs a transit-oriented-development strategy to avoid Sydney style road congestion.
- Sydney Metro lines are ECRL (heavy rail) transit space compliant – they can operate double-deck trains. Interoperability requires signalling and electrical upgrades.

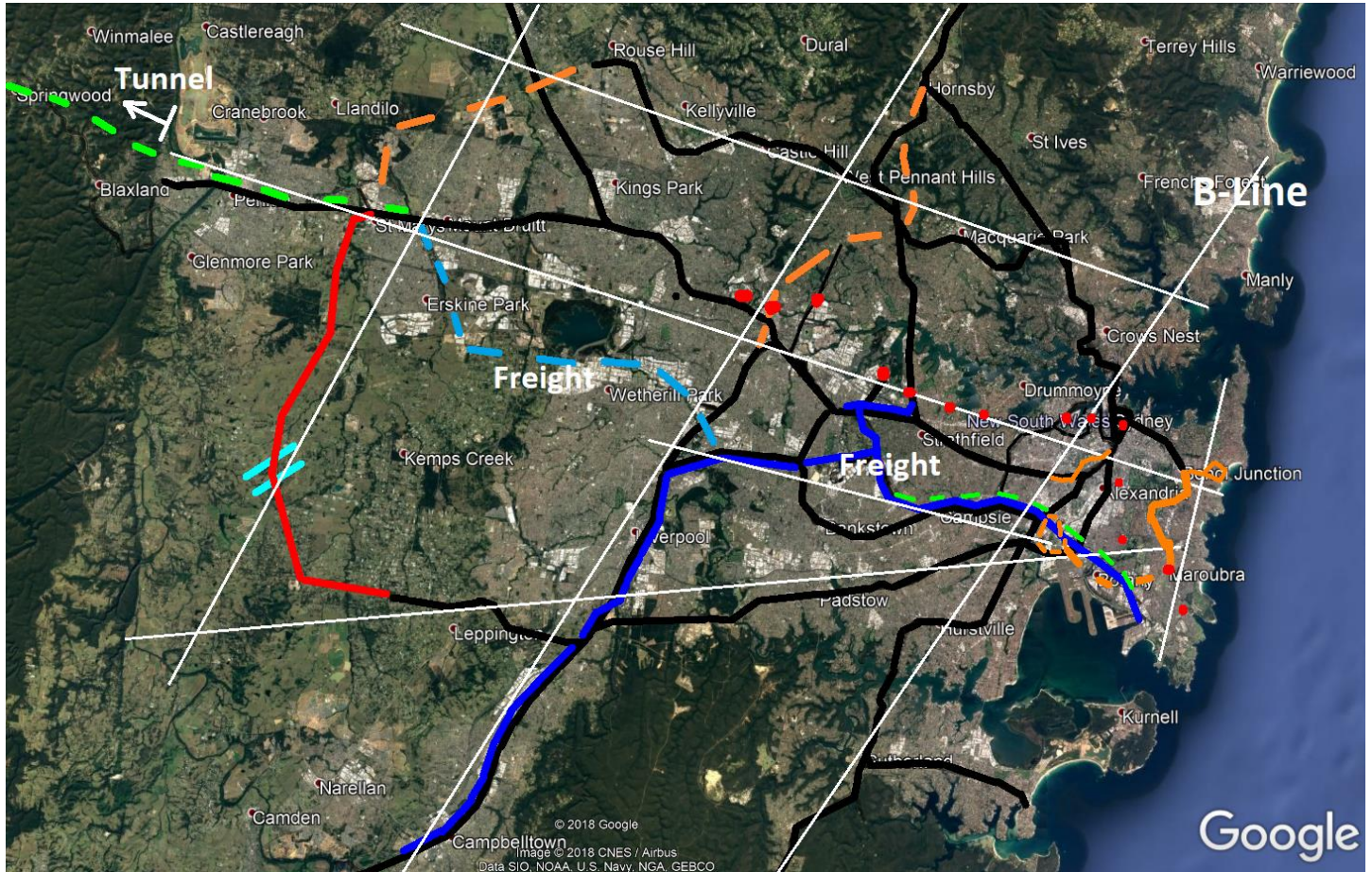


## Summary

The Epping-Chatswood line will close at the end of September 2018 and Sydney Metro North West to Chatswood is planned to open early to mid-2019. This forces service changes on the heavy rail network for which the government has yet to release a service plan. The focus of this paper is rail service and investment strategy post the opening of Sydney Metro North West.

**Chapter 1** outlines the NSW government's 2056 Transport plan as it applies to rail. The plan envisages a 'hub and spoke' public transport network model for a connected network within each of the three cities - WSA-Badgerys Creek Aerotropolis, Central River City and Eastern Harbour City. However, the plan has major inconsistencies around the fundamental question of what 'hub and spoke' (radial) means. The plan contains interpretations that are more 'grid' in nature.

Public transport services and infrastructure should be differentiated by markets served. The jobs and B2B markets are metropolitan in scale and need the support of a metropolitan wide rail grid – [Figure A](#).



See Section 1.3 for legend

### Figure A - Applying a grid to the metropolitan rail network to inform network growth

Social issues, like those represented by the 'latte line' will respond to well-structured transport networks.

Consumer access to goods and services must be more local – accessed at regional and local CBDs. Sydney has over 30 regional and special purpose centres. The Urban Taskforce believes 40 centres, based around railway stations, are essential in the metropolitan area for services to be accessed in reasonable time – often well inside the 30-minutes adopted by government. Buses generally serve this market.

Due to the risk of economic damage from 'rent-seeking' and 'warehousing', there must be a strong element of competition between centres and this must be supported by the structure of the transport network.

Competition is achieved by metropolitan road and rail grids. Public transport to access consumer goods and services at local and regional centres is best delivered by electric 'buses' with 'hub and spoke' routes.

The Infrastructure Australia project list includes 13 Sydney rail projects and six regional rail projects - submitted at different times and from different perspectives by TfNSW agencies. These 19 projects should relate to a single service analysis updated yearly. The analysis would result major improvements to the list.

'Public' infrastructure should be collectively valued as a percentage of the private infrastructure served. Taxation is return to government for service provided. The private sector business case approach under values public services, and their supporting infrastructures, and starves the private sector of public services.

**Chapter 2** discusses the capacity of commuter public transport vehicles. Manufacturers design for safety and contract obligations. Operational capacity is far lower for passenger comfort and security reasons. Where weight limits do not govern:

- Manufacturer capacity is given by the formula “seats + 4 passengers per square metre in standing areas”.
- Operational capacity is given by the formula “seats + 1.5 passengers per square metre in standing areas”.

Seating density of commuter public transport vehicles is:

- Bus row seating - 3.0 passengers per square metre.
- Reversible train row seating - 2.5 passengers per square metre.
- Seating over a tram bogie - 2.2 passengers per square metre.
- Side-facing seating all public transport - 2.0 passengers per square metre.

Operational capacity comparisons for Sydney Metro and Sydney Trains vehicles:

- 6-car metro, 620 passengers with 378 seated,
- 8-car metro, 830 passengers with 506 seated,
- aging Waratah layout, 1210 passengers with 894 seated,
- ‘modern’ 160-metre 8-car double-deck train layout, 1284 passengers with 944 seated.
- 160-m Bombardier Regio 2N style articulated train, 6 double- & 5 single-deck cars, 1163 pass, 788 seated.

Metro line capacity is  $830 \times 30 = 24,900$ /hr. Waratah capacity is 24,200/hr. A ‘modern’ double-deck train with automated train control has a capacity of  $1,284 \times 27 = 34,670$ /hr.

Hybrid overhead-electric/diesel trains are available for routes like southern highlands and Canberra to underground stations in city centres.

Sydney Metro is built to Epping-Chatswood Rail Line (ECRL) transit space standards. Interoperability requires:

- trains having both signalling systems;
- double-deckers require automated control equipment, and possibly an electric power upgrade for Metro’s short lengths of 4.4% grade (Sydney trains network max grade 3.3%);
- the Metro trains require a drivers compartment; and
- the Metro line may require an electrical upgrade for the heavier double-deck trains.

**Chapter 3** summaries current heavy rail AM peak-hour mainline services. Metropolitan rail services are running close to capacity except for the truncated Eastern Suburbs line and Intercity line to Central Terminal.

The politically sensitive 23 km Central-Parramatta corridor has express service times ranging from 26 to 32 minutes. Metro West will not have faster train speeds and will suffer a delay of one minute for each intermediate station served. Greater use of the Intercity line would deliver the fastest Express services between Paramatta and Sydney CBDs.

The 8 and 13-year gestation period for the first two stages of Sydney Metro (opening mid-2019 and 2024), demonstrates that new underground lines are a medium to long term proposition that serve new markets and don’t address capacity issues on existing lines.

Based on budget allocations, the Sydney Trains component of the government’s 2056 Transport Plan is largely longer term rather than short and medium term as listed. Capacity enhancements for the Sydney Trains network should be a priority.

With the major lines of the Sydney Trains network nearing capacity, a communications-based train control (CBTC) signalling system is urgent. It will lift capacity from 20 to 27 trains per hour in conjunction with capacity enhancement works to Wynyard, Town Hall and Central (e.g., Central Walk).

The completed voice network is a major stage of the CBTC project which has delivered the radio system that forms the communications backbone of the network. New trains, additional to those on order will need to accompany this project for a network-wide increase in services.

**Chapter 4** presents some options for extra rail capacity for Sydney Trains South and South-West Sydney services. Services are constrained by City Circle and ES line capacity.

Sydney Metro Stage 3 will free just 10 train paths/hour for other services. Thus, Stage 3 should be reviewed for connection to Metro West to limit capacity constraints of, and the need for, a very expensive Metro West terminal station in the Sydney CBD.

If Sydney Metro is paused at Sydenham, Sydney Trains network tracks should be increased from 4 to 6, over the 2.8 km from Sydenham to Erskineville, to separate express and all-stops services, and thus reduce the service time of Express trains.

As suggested in the government’s forward plans, extra capacity should be added between Sutherland and Hurstville for separation of Express and All Stops services. An indicative allocation of remaining capacity is made, however there is flexibility to respond to demand.

A second City Circle line should follow a CBTC network and CBD stations project to increase capacity across the arc from Cronulla to Parramatta.

**Chapter 5** presents some options for extra rail capacity for Sydney Trains Western Sydney (Parramatta and west) services. Metro West plans will take at least a decade and service a new market, adding little to existing corridor capacity after the new passengers are accounted for.

Infrastructure Australia's priority list (Appendices 1 & 2) has rail lines to Western Sydney Airport connecting to the Leppington and Western Lines. Due to the distance of WSA from Sydney CBD (60 km), and the undesirability of passengers standing with baggage all the way to, and from, the Sydney CBD, it is preferable that passengers travel on Waratah style trains with their high-density seating.

The CBTC project is urgent to ensure sufficient train paths for growing demand in the medium term. In a similar timeframe, two extra tracks should be added between Granville and Homebush to permit ultra-express services from Western Sydney Airport and Parramatta to the Sydney CBD.

The Northern Line and Intercity line will have extra capacity which could be devoted to services between Parramatta and Central Coast-Newcastle.

An indicative allocation is made of existing and proposed new capacity in the corridor.

**Chapter 6** presents some options for extra rail capacity for Northern Sydney, Central Coast and Newcastle.

The closure of the Epping Chatswood line at the end of September 2018 forces change on Northern and North Shore line services. The opening of Sydney Metro North West to Chatswood creates services new opportunities due to the excellent connections the Northern Line will possess – North Shore Line at Hornsby, Sydney Metro at Epping, Western and Inner West lines at Strathfield/Burwood, and all lines at Central.

The Northern Line connections create an opportunity to run Central Coast and Newcastle services via the Northern Line to take advantage of the connection opportunities.

Also, by consolidating Northern Line, Central Coast/Newcastle Line and the Strathfield-Central Intercity Line, network reliability will improve. Northern Line passengers will lose direct access to the Town Hall, Wynyard and the North Shore, but will see at least a doubling of services and the best connections to other lines in NSW.

North Shore Line services should be terminated at Gordon, Lindfield and Hornsby as required to meet demand, to minimise the fleet requirement.

Eliminating the Wollstonecraft curves, and the Waverton and Wollstonecraft stations will also reduce fleet requirement. The new works entail 940 metres of new track, a 650 metre Wollstonecraft tunnel and a Waverton-Wollstonecraft station. It will save 500 metres of track distance, 4.5 minutes off the timetabled journey, and a fleet saving of 4 to 6 trains (\$200 million to \$300 million over the 30-year life of a train).

The Lavender Bay day-time stabling yard should be relocated to St Leonards Station to free up development opportunities and reduce maintenance costs.

The proposed North Shore line investment reduces the fleet requirement, and operating and maintenance costs, while improving services and creating development opportunities.

An indicative allocation is made of existing and proposed new capacity in the corridor.

**Chapter 7** presents infrastructure to support high-frequency services on the Intercity-Newcastle Line.

The Central Coast, Newcastle and Hunter region has 1 million people and is growing at 1% per year. For comparison, the 5.1 million Sydney population grows at 1.7%. If we are to address housing affordability in Sydney, we need far higher growth in the regions of which the 80 km long Central Coast-Newcastle metropolitan area is by far the largest. A major upgrade to its passenger rail infrastructure and a focus on transit-oriented development will assist make the region attractive and spur its growth rate.

Much of the Central Coast and Newcastle station infrastructure, while serviceable, is old, generally lacks disability access, and is far from the many new suburbs.

CBTC signalling is essential for a higher frequency of services due to the cost of upgrading the current fixed block signalling system.

7 new Central Coast-Newcastle railway stations are proposed in addition to the Glendale Station supported by the Lake Macquarie Council.

7 existing stations are proposed for review with a view to closure based on the new station proposals and changes to economic development.

An increase in stations receiving Express services is proposed due to the new stations. Express service stations, preferably, should have double island platforms to enable cross-platform transfer between Express and All Stops services.

The NSW government is funding a business case for reducing Newcastle-Sydney train travel time from "3 hours to 2 hours" – assumed to mean Central to Newcastle-Interchange. The fastest service is presently 2 hours 23 minutes – a one-off service per day.

This goal can be achieved with a framework of CBTC signalling, the Northern Sydney Freight Corridor (NSFC) program, track canting, new trains, better scheduling, passing loops at express stations and more freight train passing loops. Track canting is tilting the track into curves to ensure the overturning vector remain directed towards the centre of the track at higher speeds.

The NSFC program, which now includes a stage two, is essentially a quadruplication of the Northern Line, and parts of the Central Coast-Newcastle line, to enable a higher frequency of All Stops and Express services, which includes freight services. Freight services have a low power to weight ratio causing freight trains to slow on even moderate grades.

Epping-Thornleigh and Brooklyn-Cowan have long stretches of steep track that slows freight trains and will receive NSFC funding.

NFSC Stage 2A includes:

- Lower Main North Quadruplication Lite (2.4km);
- Rhodes to West Ryde Section Quadruplication (3.6km);
- Berowra to Hawkesbury River Section Triplication (13km - total length of 19km including a 6.3km-long tunnel).

The Project also includes:

- 5 stations requiring modifications and adapted to new rail configuration (Rhodes, Meadowbank, West Ryde, Cowan, Hawkesbury River),
- 6 complex bridges and overbridges (Parramatta Rd bridge, Second John Witton bridge (second half of the bridge deck??), Bank Street overbridge (Meadowbank Station, Victoria Rd bridge, F3 Motorway ramp bridge, Pacific Highway overbridge Cowan),
- a long and complex tunnel (6,3km) with diameter of 11.2m to be excavated by TBM and duplicated in a second construction stage.

Following these works, full quadruplication between Strathfield and Berowra is necessary to support a high frequency of All Stops and Express services, while making allowance for freight train paths for all but the busiest hours of the day.

Planned works include the Kangy Angy train maintenance and stabling facility, new fleet, completion of the electrical power system upgrade, elimination of 4 level crossings, and additional freight train passing loops.

A 2,200-metre, 1% grade) bypass of Booragul commencing at Teralba, including a 650-metre tunnel (Teralba Tunnel), will save 1,800 metres and three to 4 minutes from train services.

**Chapter 8** proposes extra capacity for Western and Northern Sydney via a Merrylands-Parramatta-Epping-Hornsby tunnel. It will strengthen Parramatta's capacity to grow into a major city. Parramatta has strong east-west rail services, but poor north-south rail services. The Government plan leaves better north-south services to the very long term.

This tunnel would direct a portion of Campbelltown and Leppington services to Parramatta (Western Line interchange), Epping (Sydney Metro Interchange), Hornsby (North Shore Line interchange) and Central Coast Newcastle. It will also enable Newcastle-Parramatta-Canberra services.

**Chapter 9** presents four options for Hornsby-Woy Woy-Gosford tunnels to reduce Hornsby-Gosford travel time by 30 minutes. Along with the changes proposed in Chapter 7, the preferred option would deliver a 90-minute Express service between Central and Newcastle.

The NSW Government "Faster rail to Central Coast and Newcastle" options are focused on a 2-hour Central-Newcastle travel time, and present far less ambitious time savings with Berowra to Woy Woy and Narara to Ourimbah works.

**Chapter 10** proposes a new 140 km line between Penrith and Blayney to save over 90 km from the existing line. It will support rapid services to the Blue Mountains and Central West, and interstate freight services.

It proposes a 4.35 km viaduct from the Penrith railyard to Emu Heights, and a 39 km tunnel from Emu Heights to Springwood and Blackheath before emerging in the Blackheath Creek valley.

From there, a 92 km to 100 km, 200 km/h standard line to Blaney is proposed. It will have two spurs to the existing line – the second to serve Bathurst. Lithgow would be served by an interchange with the existing line at Blackheath and a station on the new line 30 km south of Lithgow. The Springwood and Blackheath interchange stations are, respectively, 200 metres and 450 metres below ground requiring lift access.

**Chapter 11** proposes a 22 km (1% grade) Waterfall-Thirroul tunnel to save at least 20 minutes from existing express services. Combined with infrastructure upgrades proposed in earlier chapters, it is expected to deliver a 1-hour Wollongong-Central express service.

A mixture of existing line upgrades and new rail corridor is proposed to deliver a 2-hour Canberra-Central service on a 200 km/h standard line. A tunnel under the Illawarra escarpment is proposed to deliver a 2.5 hour service via Wollongong.

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# 1 Government 2056 Transport Plan – March 2018 – Extracts (indented)

## 1.1 Strategic rail network criteria

The 2056 transport Plan advises:

“Trains form the backbone of Greater Sydney’s public transport system, enabling large numbers of customers to access centres reliably and efficiently.

The future vision for our train system is to build on this role, supporting 30-minute access for customers to their nearest Metropolitan City Centre and providing high capacity transport between these centres.

Train/mass transit links identified based on their ability to support key outcomes:

- Improved accessibility to one of the three cities or strategic centres
- Customer benefits: reduced travel times between key destinations, improved accessibility, frequency, reliability
- Productivity drivers:
  - supporting existing and future growth areas,
  - contribution to economic development,
  - opportunity to facilitate employment growth
- Support for urban renewal, future housing needs, creation of safe and successful places
  - Train crowding relief, improve sustainable travel choices, increase network efficiency
- Separation of freight and passenger rail movements across the metropolitan train network
- land use and city-shaping objectives within the Greater Sydney Region Plan.
- WSA-Badgerys Creek Aerotropolis and improved accessibility through the Central River City

Key trade-offs:

- long lead times of large scale rail projects
- travel time savings
- city-shaping opportunities
- cost of delivering an operating both the existing and new train/mass transit links

For these reasons the focus of the train/mass transit is on city-shaping and city-serving corridors.”

## 1.2 Infrastructure Australia priority lists

Every community has similar transport service needs which are generally met by similar supporting infrastructure – e.g., local roads, footpaths and buses. Metropolitan areas support many communities and need service modes that serve many communities at once – arterial roads, railways.

Service analysis should be done by mode and market served by the mode. Roads have a hierarchy – local, district, sub-arterial, arterial, motorways. Motorways support arterial roads and should be considered jointly in a service analysis for a metropolitan area.

Commuter railways are metropolitan or provincial and scale. The jobs and B2B market correspond to this scale. Due to cost and history, trunk bus routes often substitute for rail lines. Service analysis should consider how well the rail network, and substitute components, serve the metropolitan/provincial area.

Infrastructure NSW and Infrastructure Australia business case summaries make no reference to service analysis beyond line congestion, so appropriate service analysis is unlikely to exist.

Appendix 2 gives the NSW items on the March 2018 priority list. In Appendix 1, this list has been recategorised by service mode. It is apparent submissions have been made to Infrastructure Australia at different times, and in support of unrelated to service strategies.

There 13 Sydney rail projects on the list and 6 regional rail projects. Freight and passenger rail can use the same infrastructure. Freight rail projects in Sydney can generally support passenger services. These 19 projects should relate to a single service analysis updated yearly.

In the absence of a TfNSW service analysis, the proposals in this paper focus mainly obtaining more value from existing infrastructure.

‘Public’ infrastructure should be collectively valued as a percentage of the private infrastructure served. Taxation is return to government for service provided. The private sector business case approach under values public services and their supporting infrastructure, and starves the private sector of public services.

### 1.3 Public transport network models – Hub and Spoke versus Grid

“The long-term network vision provides for a connected network within each of the three cities and addresses long-term capacity constraints.”

The 2056 Transport Plan has many independent authors who don't agree on the basic principles of what Hub and Spoke means– see [Figures 1.1, 48, 18 and 24](#) below.

[Figure 48](#) is more reflective of a grid structure. [Figure 24](#) reflects Hub and Spoke. [Figure 24](#) has strong elements of both.

[Figure 24](#) – 30-minute access to a regional centre – has six regional centres which are clearly insufficient. It illustrates that many more than three 'city' centres are required for 30-minute access to good and services in a metropolitan area the size of Sydney. It ignores the many regional centres of similar scale to Parramatta.

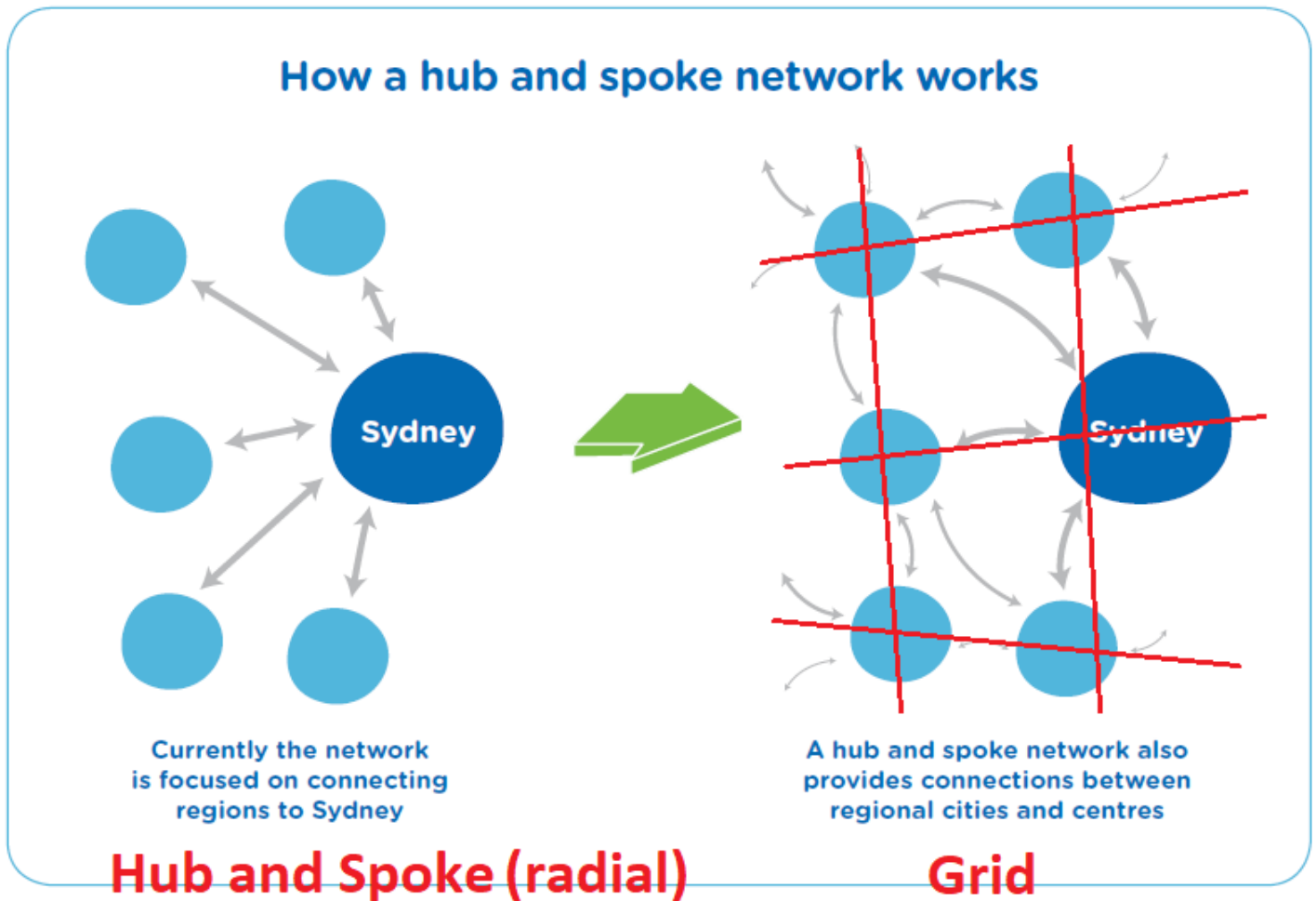


Figure 15: Moving from a Sydney-focused network to a focus on your local regional city

#### Figure 1.1 – Government confusion over basic transport principles

The Hub and Spoke model is appropriate for local and regional centres – in support of consumer access to goods and services. Generally, public transport services to these localities are served by bus for efficiency, flexibility and cost reasons. Buses are currently 44% of all public transport journeys in Sydney. Buses also fill trunk service roles where rail is absent.

Jobs and Business-to-Business delivery of goods and services are a metropolitan, state, national and international scale activity. A 'Grid' is more efficient connector at metropolitan and state scale. Generally, public transport for these markets is provided by rail due to greater capacity and speed. A grid can foster many 'city' centres and competition between them.

Eastern Sydney has milder climate with twice the rainfall of Penrith. Living in the Eastern Harbour City is preferred, and likely always will be preferred. The metropolitan development strategy needs to reflect this preference. Coastal NSW has a similar climate to Sydney. NSW development should mainly focus on coastal cities.

The emergence of a line of division in the Sydney metropolitan area separating better-off and less-well-off areas – the 'Latte Line' (Sydney Airport to Rouse Hill) – threatens both the social and economic fabric of the city (see [Appendix 6](#)).

Parramatta, Penrith, Liverpool, Campbelltown, and many other local and regional centres in Western Sydney, where both government and community want to see economic growth, are all on the wrong side of the Latte Line. As a relatively straight line, improved access across the line will lead to better social and economic outcomes.

The Hub-and-spoke model envisages only one extra crossing of the Latte Line – Metro West – which runs parallel to the far higher capacity Western Line. Parramatta has strong east-west connections and poor north-south connections.

The Urban Taskforce, representing the apartment builders implementing housing growth across metropolitan NSW, want the present 30+ regional and specialised centres, increased to about 40 centred around railway stations (see below). These economic agents have the economic power, supported by seven decades of government policy and LEP making, to implement their vision for Sydney at the expense of the government's ill-considered hub-and-spoke (radial) plan for three cities in one metropolitan area.

“There seems to be confusion over just what a 30-minute city means for Sydney. The Deloitte study looked at 313 Sydney neighbourhoods to test the 30-minute concept, yet the Greater Sydney Commission seems wedded to three 30-minute cities. The reality for Sydney's growth will be that about 40 railway stations will be the new polycentric structure as we approach 8 million people. These high-density nodes will be mixed use with walkable communities close to jobs, homes and public transport.”

Chris Johnson, CEO Urban Taskforce, SMH Letters 28 March 2018 — 12:05am

<https://www.smh.com.au/national/on-board-with-infrastructure-australia-plan-for-highspeed-rail-20180327-h0y03g.html>

[Figure 1.2](#) applies a grid to the Sydney metropolitan rail network.

The network, with the completion of Metro North West, will have 3 strong east-west gridlines.

The grid is very poor in the north-south direction.

The north-south rail line through Western Sydney Airport will strengthen the grid in the west.

The B-Line bus route substitutes for rail in north-east Sydney.

A Merrylands, Parramatta, Epping, Hornsby line in conjunction with the South Line, will strengthen the grid in the centre of the metropolitan area. It is critical to Parramatta's development that it has strong east-west and north-south public transport lines (rail lines) running through it.





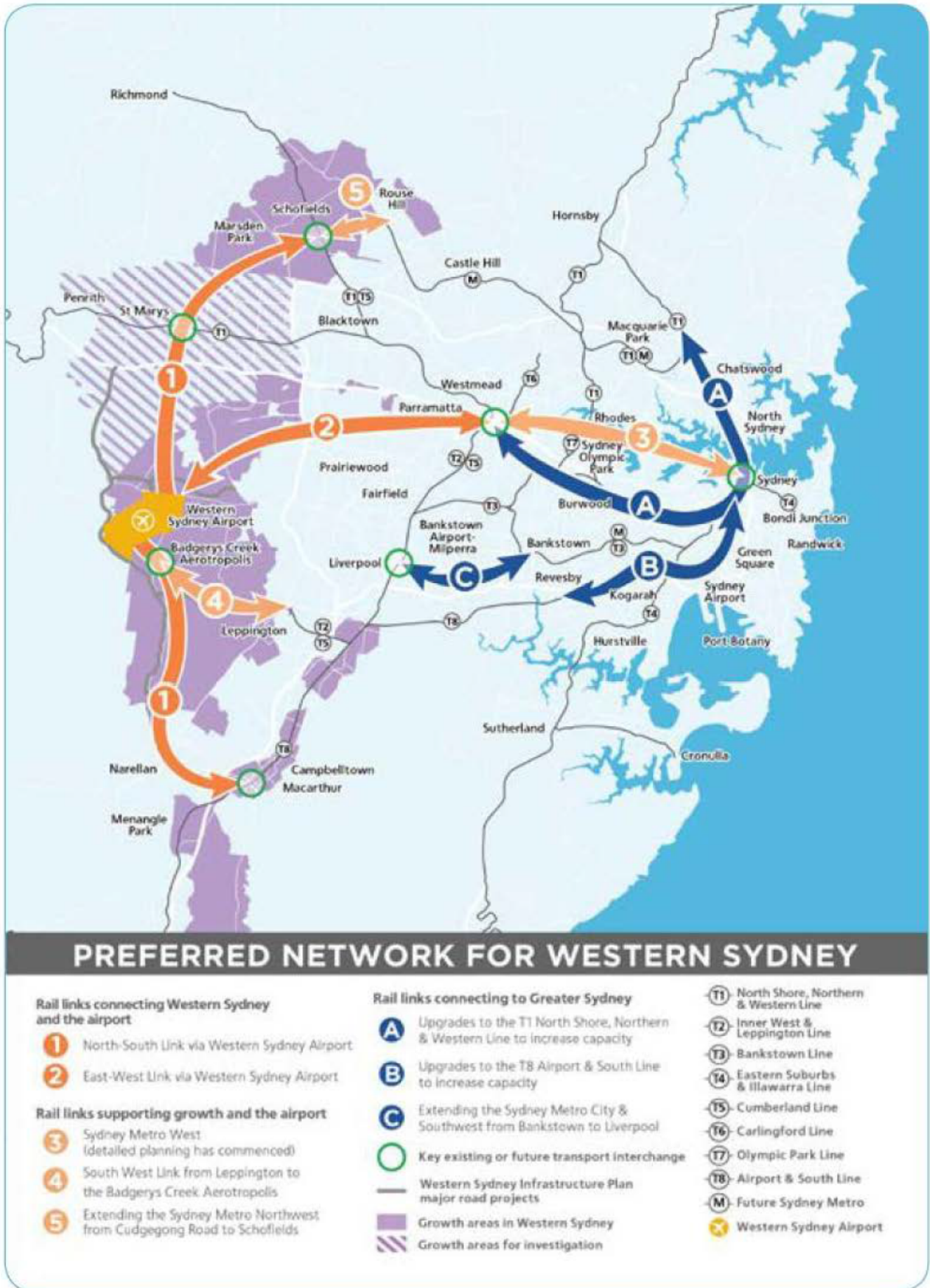


Figure 48: Western Sydney Rail – Preferred network

# Greater Sydney Strategic Transport Corridors

Corridors represent the way people & goods move around using multiples modes of transport

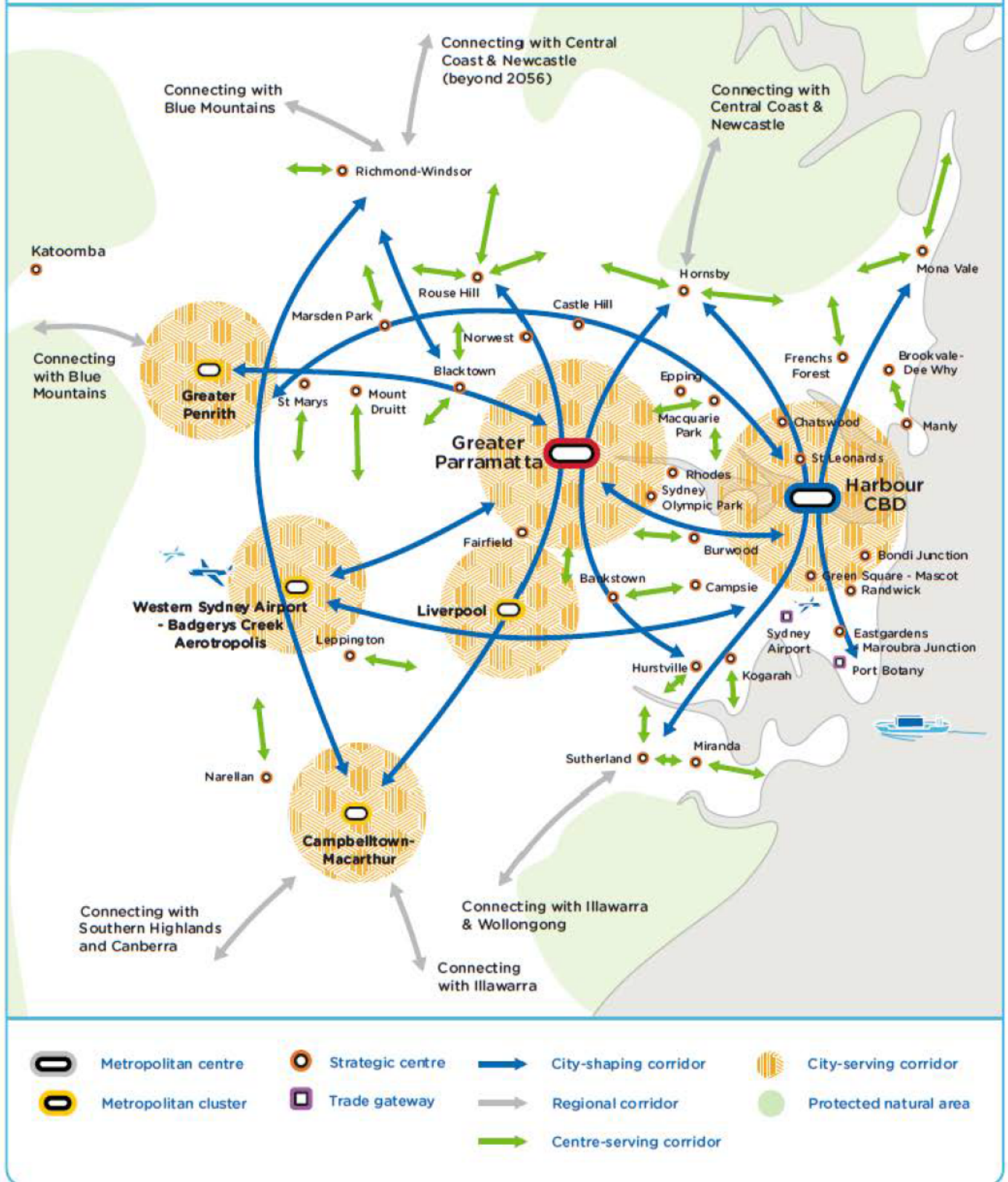


Figure 18: Greater Sydney strategic transport corridors

# 30 minute access to the metropolitan centres

Public transport catchment areas

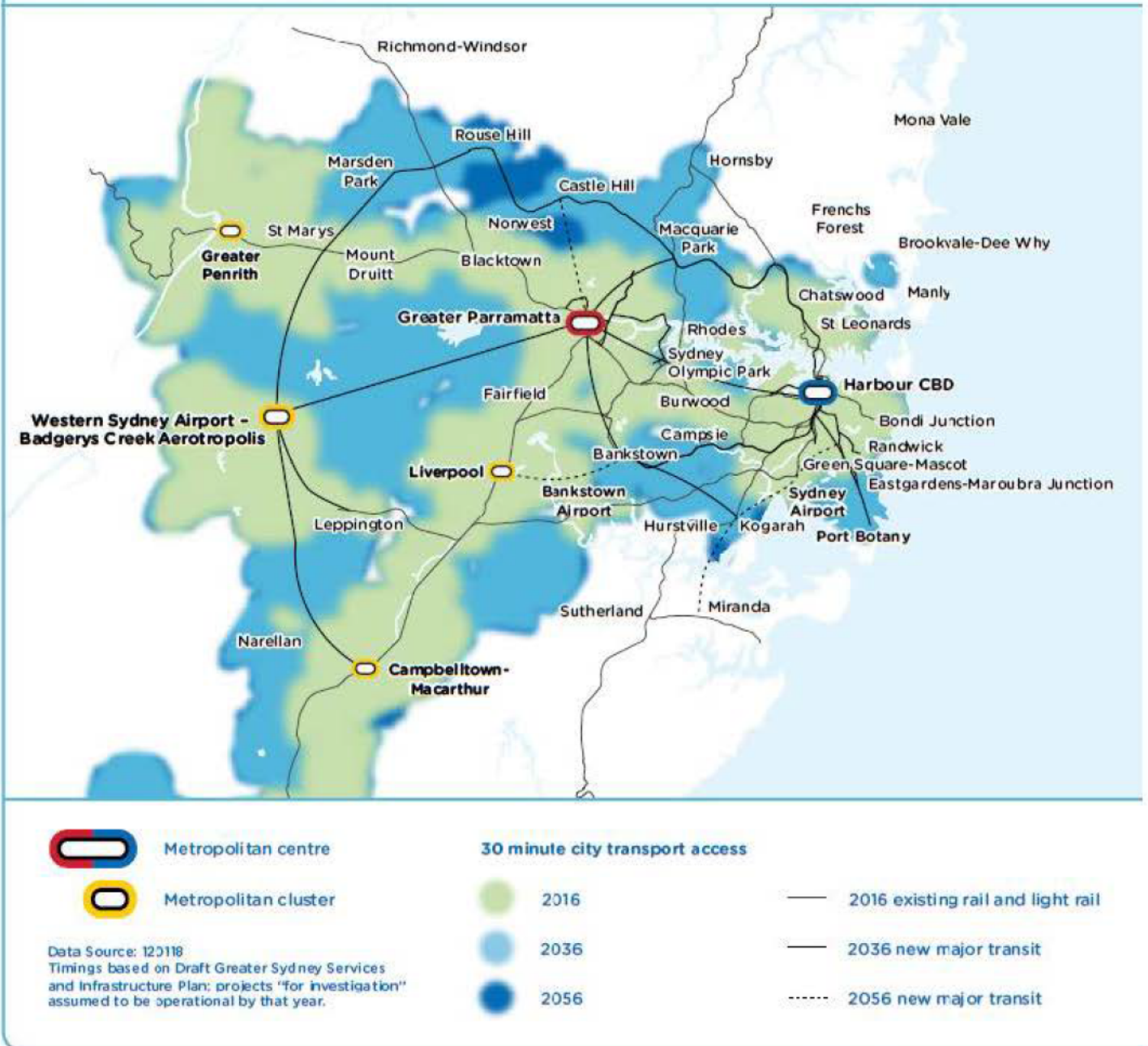
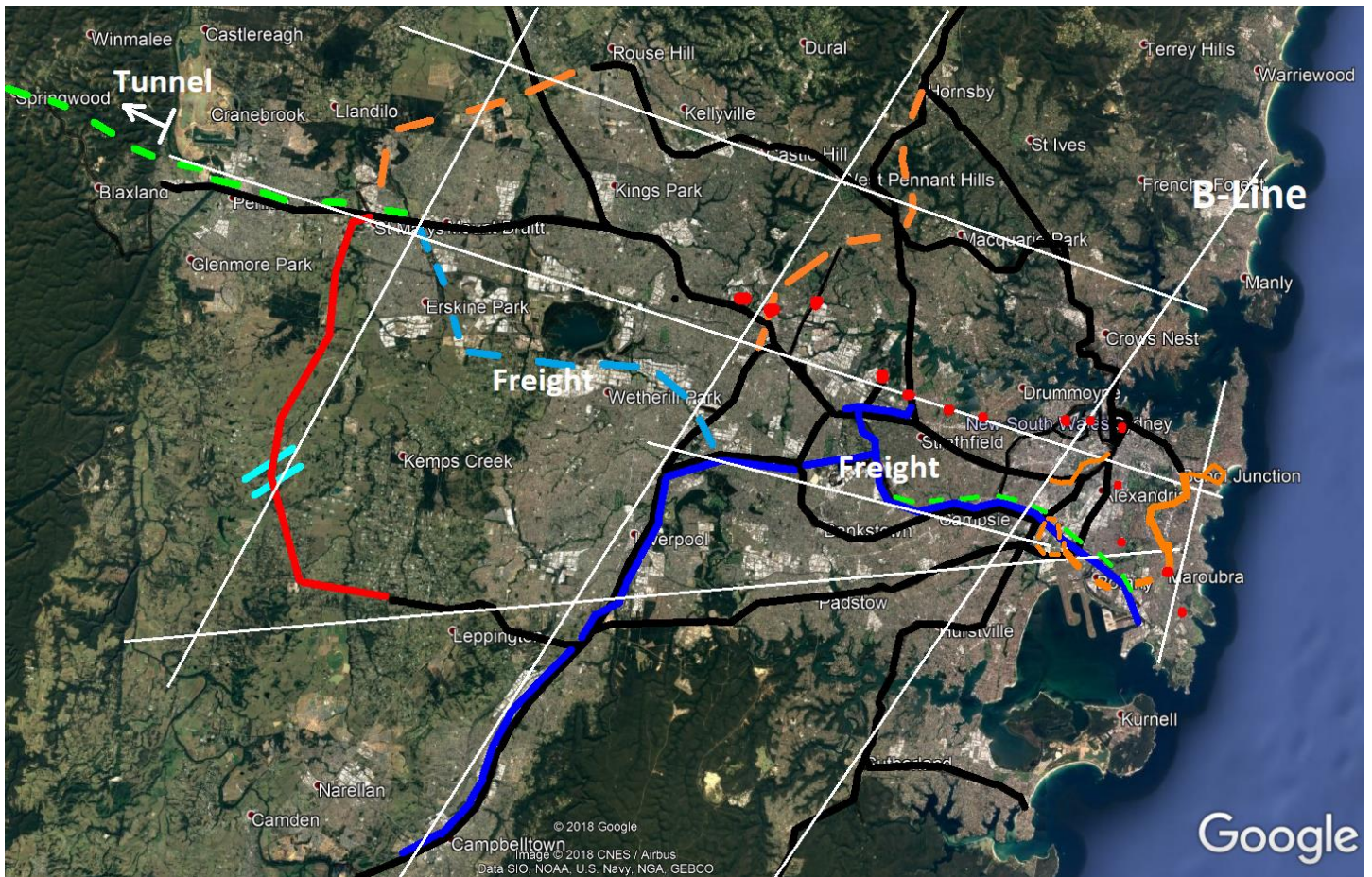


Figure 24: Areas accessible within 30 minutes by public transport in Greater Sydney - 2016, 2036 and 2056





- Black lines – current passenger network
- Light blue line – Western Freight Line
- Red line – Government’s WSA connections to Western and Leppington Lines
- Red dots – Government locations for Metro West stations
- Broken orange lines north-south – St Marys-Rouse Hill, Merrylands-Parramatta-Epping-Hornsby
- Broken orange lines east west – Bondi Junction-Bondi Beach, Sydenham-Airport-Botany-Maroubra
- Solid orange line – Eastern Suburbs Line extension due to weak north-south links
- Green lines – Passenger & freight rail lines under Blue Mtns – 46 km tunnels Emu Heights-Hartley Vale
- Dark blue line – current freight lines
- Aqua lines – Western Sydney Airport runways
- Proposed freight rail tunnel – Botany-Sydenham-Enfield yard – 14 km

**Figure 1.2 – Applying a grid to the metropolitan rail network to inform network growth – government and other proposals**

**1.4 Public transport infrastructure/vehicles in progress**

The 2056 Transport Plan advises:

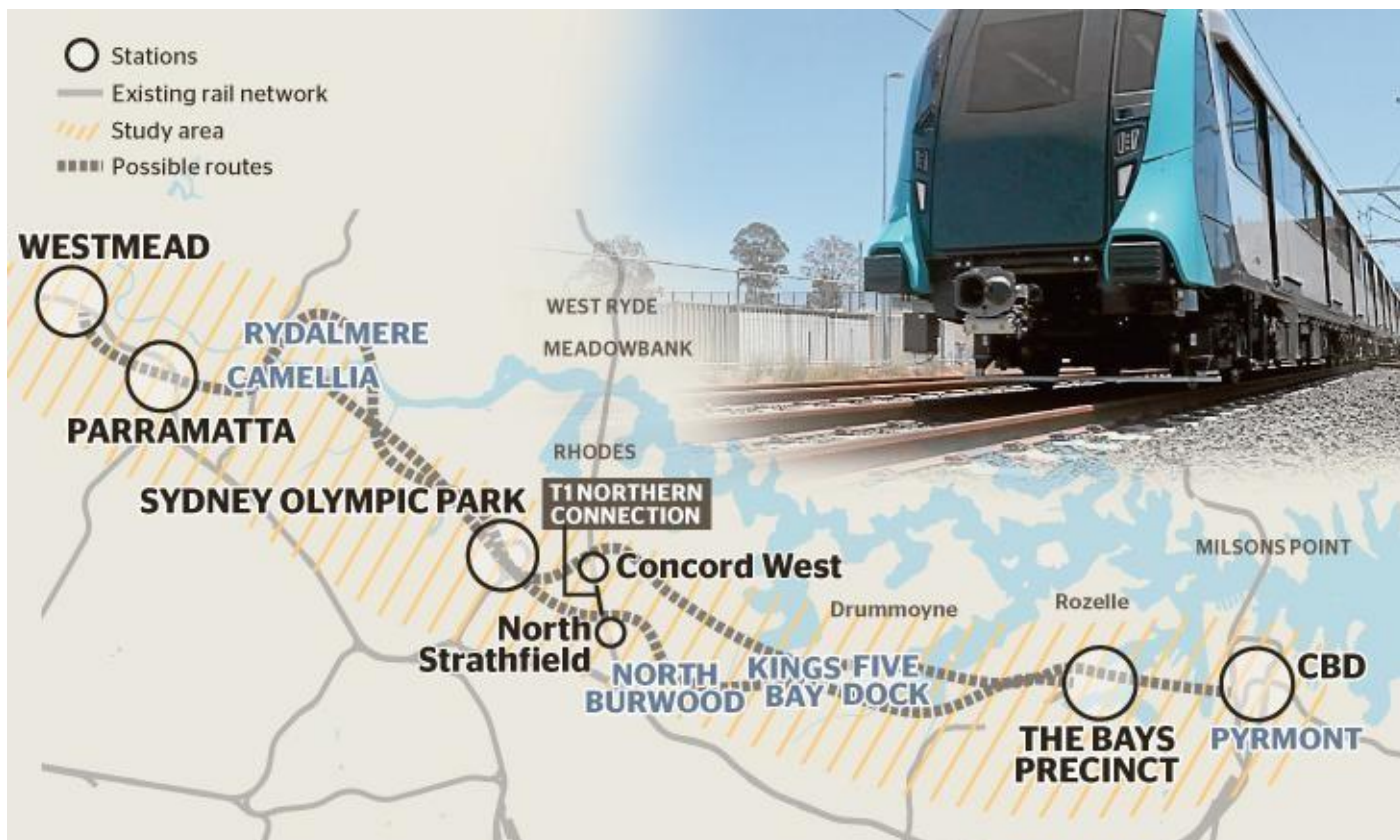
- Sydney Metro - Schofield-Rouse-Hill-Sydenham.
- Sydney Metro South West in planning.
- 24 Waratah Series 2 trains – by early 2019 replace the non-air-conditioned S-sets - Sydney’s south-west priority. Constance – “safe and comfortable journey for customers”.
- 512 car Intercity fleet with 4-abreast seating for extra comfort.
- XPT/Explorer fleet replacement

**1.5 Metro rail plans**

- Sydney Metro West – start 2022, finish 2026-2029 – Figure 1.3
- Reduce journey times between Central River City and Eastern Harbour City,
- Support corridor growth Bays Precinct, Greater Parramatta, Olympic Peninsula,
- help to manage crowding on the T1 Western Line
- Constance - Everyone is well aware that demand for trains is going through the roof and we need to act now to ensure we can continue to provide our customers with the services they need. T1 Line would be at capacity in just over a decade – media comment.
- McKay - welcoming discussion about station sites, opposition concerned about project timing.
- Hurstville and Macquarie Park via Rhodes



- Greater Parramatta to Epping
- Greater Parramatta Kogarah via Bankstown
- CBD to Malabar via Zetland, Eastlakes and Maroubra Junction
- Eastlakes to Sydney Airport, Kogarah and Miranda



**Figure 1.3 - Metro West route as presented in the Sydney Morning Herald**

The Sydney Metro technical staff confirm the Metro has adopted ECRL (Epping-Chatswood Rail Line) transit space requirement. The key technical differences are the signalling system and a maximum grade of 4.4% compared to 3.3% for the Sydney Trains Network.

Sydney Metro operates using a radio system in the Wi-Fi frequency range, while Sydney Trains has installed a system in the mobile phone frequency range for greater radio range. To use both networks, trains will need a communications package for both. A diagrammatic representation of the communication is given in Appendix 3. The Waratah trains may need a motive power system upgrade to climb the steepest Metro grades. The single-deck Metro trains are light compared to the 400 tonne Waratahs. The Metro substations likely needs an upgrade for a high frequency of double-deck train operation.

### 1.6 Heavy rail

The 2056 Transport Plan advises:

- Extension from Leppington to WSA Aerotropolis 2026 - additional public transport in south west Sydney
- North-South Rail Link through Western Parkland City 2026 - St Marys to WSA Aerotropolis – 30-minute city
  - Efficient, reliable and high capacity transport between the three Metropolitan centres
- Suburban passenger train services extended south of Macarthur
- More Trains, More Services
  - Separate suburban passenger services from intercity/freight
    - Sutherland and Hurstville – 2 extra tracks 10 km with 6 stations
    - Penrith and St Marys – 2 extra tracks 8 km line with 2 stations
  - Improvements T1 Western Line, T8 Airport Line, T4 Illawarra Line (including South Coast Line)
  - implementation modern Train Control & Signalling technology across network - in planning
- Northern Sydney Freight Corridor Stage 2 – Strathfield-Berowra, Berowra-Brooklyn tunnel – passenger services infrastructure

- Regional Rail Fleet, New Intercity Fleet, Kangy Angy Train Maintenance Facility
- Upgrade Blue Mountains Line, Main West Line (St Marys-Penrith)
- Electrify intercity to Bomaderry/Nowra, Goulburn, Bathurst
- Faster Rail Improvement
  - Sydney-Wollongong – (Waterfall-Thirroul – 22 km, 0.97% grade??)
  - Sydney-Canberra – (Maldon-Mittagong, Exeter, Tarago-Canberra??)
  - Sydney-Central Coast-Newcastle (Australian Government matched funding strategic business case)
- Corridor Preservation for Higher Speed Connections (east coast)

### 1.7 2036 proposals

- South East of the Eastern Harbour City will support urban renewal initiatives, 30-minute access
- New north-south mass transit/ train links to Greater Parramatta - Central River City within 30 minutes. helps manage pressure on transport links in the east by spreading demand across the city.

### 1.8 2056 network with visionary initiatives

- Mass transit/train link Sydney CBD to Miranda and Malabar to facilitate higher frequencies expected on the mass transit/ train network between the Central River City and the Eastern Harbour City.
  - Kogarah to Miranda - longer-term capacity relief T4 Illawarra Line supporting urban renewal.
  - Eastlakes-Maroubra-Malabar
- Parramatta-Norwest mass transit/ train link - currently served by bus services – 30-minute access
  - Extension of the existing train line from Bankstown to Liverpool - higher capacity transport connections between Strategic Centres, additional public transport capacity in south west Sydney.
- Potential Macquarie Park to Hurstville via Rhodes mass transit/ train link - cross city connectivity Metro, Northern Line-Illawarra Line.

### 1.9 Bus trunk route development

- Central Coast - Bus Headstart, Rapid Bus package ---- Buses can serve trunk routes. Trunk routes should be developed with buses.
- Trials of day-return services, in March 2018, to better connect regional communities:
  - Tamworth to Newcastle coach & rail day return
  - Tamworth to Dubbo coach day return
  - Tamworth to Port Macquarie coach day return

### 1.10 Rail freight

- Southern Sydney Freight Line increased capacity
- Maldon to Dombarton line completion
- Lower Hunter Freight Corridor protection
- Port Botany and South East long-term capacity constraints

### 1.11 Intercity motorways

- Great Dividing Range corridor preservation, long term solution,
- Outer Sydney Orbital from Great Western Highway to Central Coast
- Solution for crossing the Blue Mountains

### 1.12 In focus: Bus Services - page 65 - Greater Sydney Services and Infrastructure

“Buses are a key enabler of an integrated multimodal public transport system and currently make up approximately 44 per cent of all public transport trips in Sydney.

Buses are a versatile mode that can meet a range of customer needs when provided with the right infrastructure and services.

At the local scale, buses provide public transport services to communities using general traffic lanes and standard size or even smaller buses.

Buses can however also serve an efficient mass transit function, where demand is greater and reliability is important.

To perform this function, larger buses and dedicated fleet and infrastructure, such as double-decker buses, bus-only lanes, and bus-only bridges are used to allow for high capacity, frequent, and reliable bus journeys.

Achieving the 30-minute city vision of Future Transport requires a variety of public transport modes and services working in unison to provide a high level of service to meet the diverse needs of our customers.”

### **1.13 In focus: Improved separation of freight and passenger trains - page 66**

“Better separation of freight and passenger trains is a key area of investigation within our plans for the future freight network.

One of the limitations on more freight being carried by train both within Greater Sydney and on the corridors connecting it to other regions is that freight trains mainly rely on tracks that are shared with passenger trains.

As passenger trains are prioritised, this means moving freight by rail is often less reliable and efficient than other forms of transport.

The NSW Government will address this by investing in more dedicated freight rail lines and providing dedicated links between Port Botany and intermodal terminals in Greater Sydney and regional NSW.

This includes:

- upgrading the Port Botany rail line to increase capacity, and
- investigating delivery of the Western Sydney Freight Line to provide 24/7 dedicated freight rail access between the port and intermodal terminals.

To improve the reliability of connections between Greater Sydney and regional NSW, we will also investigate capacity improvements to:

- the Northern Sydney Freight Corridor, and
- Southern Sydney Freight Line and
- protection of a Lower Hunter Freight Corridor.”



## 2 Public transport vehicle capacity and types

### 2.1 Capacity formula

In developed western countries, commuter public transport vehicle manufacturers quote passenger capacity based on axle weight limits (buses in the main), or the formula – “seats + 4 passengers per square metre in allowable standing areas”. It is a safe load figure to ensure passenger safety, and vehicle performance for contract purposes.

This information is not provided for Sydney’s double-deck trains. The double-deck trains have bespoke body dimensions to take full advantage of the transit space established in 1912, and full advantage of high-density seating and passenger desire to travel facing forward. But it is available on company websites for articulated buses, trams and metro trains.

The capacity of standard buses was established by decades of service. However, the RMS preference is to regulate axle weights.

The NSW government uses manufacturer information in comparisons with the operational capacity of double-deck trains and standard buses. Double-deck buses are axle-weight limited for passenger numbers.

Operational capacity of Sydney’s double-deck trains is stated by the government as 135% of seat capacity – a figure arrived at after long service experience of customer satisfaction levels. This translates to “seats + 1.5 passengers per square metre in allowable standing areas”. This formula can be applied to all public transport with a mix of seated and standing passengers. The figure allows for passenger circulation and uneven density of standing passengers. It is a figure arrived at from operational experience.

### 2.2 Capacity of Sydney’s single- and double-deck trains

Where weight limits do not govern:

- Manufacturer capacity is given by the formula “seats + 4 passengers per square metre in standing areas”.
- Operational capacity is given by the formula “seats + 1.5 passengers per square metre in standing areas”.

Seating density of commuter public transport vehicles is:

- Bus row seating - 3.0 passengers per square metre.
- Reversible train row seating - 2.5 passengers per square metre.
- Seating over a tram bogie - 2.2 passengers per square metre.
- Side-facing seating all public transport - 2.0 passengers per square metre.

Operational capacity comparisons for Sydney Metro and Sydney Trains vehicles:

- 6-car metro, 620 passengers with 378 seated,
- 8-car metro, 830 passengers with 506 seated,
- aging Waratah layout, 1210 passengers with 894 seated,
- ‘modern’ 160-metre 8-car double-deck train layout, 1284 passengers with 944 seated.
- 160-m Bombardier Regio 2N style articulated train, 6 double- & 5 single-deck cars, 1163 pass, 788 seated.

Metro line capacity is  $830 \times 30 = 24,900$ /hr. Waratah capacity is 24,200/hr.

A ‘modern’ double-deck train with automated train control has a capacity of  $1,284 \times 27 = 34,670$ /hr. Metro line capacity is  $830 \times 30 = 24,900$ /hr. Waratah capacity is 24,200/hr. A ‘modern’ double-deck train with automated train control has a capacity of  $1,284 \times 27 = 34,670$ /hr.

The greater passenger numbers for a double-deck train require 30% to 50% more dwell time (standing at the station with doors open), and thus lose 10% of train paths compared to single-deck trains.

Like metro trains, the carriage ends of ‘modern’ double-deck trains should be open to neighbouring carriages.

The Waratahs have 776 seats in the customer preferred reversible row seating. The metros have none of this preferred seat layout.

The WSA would be better-served by a train like the Bombardier Regio 2N train which has alternating single- and double-deck carriages. A 160-metre version would have 6 double-deck compartments the size of the largest Waratah compartments. The greater single-deck space is better for passenger baggage. As the train has an open gangway between carriages, access between carriages is far easier.

Hybrid overhead-electric/diesel trains are available for routes like southern highlands and Canberra to underground stations in city centres.

The primary difference between single- and double-deck trains is the double-deck cabin between the bogies – the rest of the carriage can be largely the same. Double-deck bogies do need more powerful electrical systems in line with extra train weight.



Passengers prefer to focus on travelling companions, mobile devices and the route ahead, not other passengers. Side-seating has seated passengers bumping neighbouring passengers every change of vehicle speed. Standing passengers on a full train are likely to trip over the feet of seated passengers.

The metro is designed for short distance travel in compact cities with frequent stopping and high passenger turnover. It is unsuitable for journeys such as those between Western **Sydney** Airport, Parramatta and Sydney CBD.

The acceleration of both single- and double-deck passenger trains is limited to about 1 m/s.s for the safety of standing passengers. The initial 'jerk' motion, experienced in buses and older generation trains, that can cause standing passengers to fall, can now be controlled.

### **2.3 Hybrid overhead-electric/diesel trains**

These are available in single-deck multiple-unit format and are great for routes like that from Southern Highlands and Canberra to underground CBD stations. They could operate on a route Canberra to Newcastle via a Merrylands/Parramatta/Hornsby tunnel.



### 3 Current heavy rail AM peak-hour mainline services

#### 3.1 Services per line

Suburban network AM peak one-hour services:

- a) Inner West-Leppington line 20 services Including 4 services from Parramatta
  - b) Airport-South line 18 services
  - c) Illawarra-Eastern Suburbs Line 18 services
  - d) Western-Northern-North Shore line 20 services each way with just 4 Northern Line services.
  - e) Northern/Intercity line 8 services – 4 each Blue Mountains and Central Coast-Newcastle
- Parramatta also has 2 Leppington services.

The network is operating close to the maximum 20 services per hour without a signalling upgrade, or an acceptance of greater unreliability. Planning of the signalling upgrade is underway.

#### 3.2 Parramatta-Sydney journey time – key political issue

The key journey time of concern is Parramatta-Sydney. Journey times for the 23.1 km trip are:

- Blue Mountains to Central Terminal stopping at Strathfield – 26 minutes
- Western Line 6 intermediate stops – 30 minutes
- Western Line 7 intermediate stops – 32 minutes

Stops add about 1 minute to journey time. On this basis a non-stop journey would take 25 minutes at an average speed of 55.5 km/h – very low in a corridor where much of the running from Redfern is at 80 km/h, with higher speeds at times. An 80 km/h average running speed would permit 2 or 3 stops and still achieve a 20-minute journey time.

#### 3.3 Intercity and long-distance trains

Long distance trains (Interstate and country) use Central Terminal platforms for 10/11 services per day each way. The long-distance peak is counter to the Intercity peak. Platforms 1 to 3 handle the longer trains.

Pre-Am peak services to Central Terminal are as follows:

Long distance:	Departures: 7.08, 7.12, 7.18 and 7.42	Arrivals: 6.58, 7.01
CCN:	Departures: 6.45, 7.15 and 7.45	Arrivals: 6.55, 7.12, 7.26, 7.42, 7.56
Blue Mountains:	Departures: 6.53, 7.23, 7.48	Arrivals: 7.06, 7.33, 7.50 (4/hour 8-10AM)
South Coast Line:	Departures: 10.23	Arrivals: 10.02 and 10.32
At Central CBD:		
Northern Line:	Departures: 7.01, 7.16, 7.31, 7.46	Arrivals: 6.54, 7.09, 7.21, 7.36, 7.51

Based on the above table, the Intercity line to Strathfield presently operates a maximum 10 services per hour.

6 Blue Mountains and 6 CCN services that arrive in the morning peak do not make a return journey. Three 4-car CCN trains are held on two platforms during the day. The rest are stabled elsewhere.

The Macdonaldtown stabling yard, (9 train capacity) is only accessible to the Inner-West and Illawarra Lines. The Flemington stabling facility (~40 spaces, 15 km from Central), the Auburn mega-facility (19 km from Central), and the Hornsby facility (35 km from Central) could lay-over trains during the day.

The peak-hours for the CCN services are 7AM-10AM Sydney-bound and 3PM-6PM Newcastle-bound, with four services operating supplemented by 6 North Shore line service from/to Gosford and Wyong in the peak 90 minutes. Outside of this, one Express and one All-Stops service per hour operate, reducing to one All-Stops service per hour overnight. The Blue Mountains Line has similar peak services.

In the AM peak, six North Shore services (3 each from Gosford and Wyong over 75 minutes) supplement CCN services. In the PM peak, similar services supplement CCN services over 90 minutes.

6 All Stop Newcastle-bound CCN trains passing Hornsby at 15.25, 16.07, 16.37, 17.37, 18.07, 18.37 are delayed 15 to 20 minutes at Gosford to allow express trains to pass.

5 All Stop Sydney-bound CCN trains passing through Hornsby at 6.35, 7.05, 7.35, 8.05, 8.35 are delayed at Gosford for 20 minutes to allow other trains to pass.

One South Coast service per hour enters the Intercity line at the western end of the Redfern platforms after the morning peak – post 10 AM.

## 4 Extra rail capacity for South and South-West Sydney

### 4.1 Government plans

To supplement Sydney Metro to Bankstown services, the government intends the region between Lidcombe, Liverpool and Bankstown be served by double-deck train shuttle services – [Figure 4.1](#).



**Figure 4.1 – Government service plan for Lidcombe-Liverpool-Bankstown region once Metro services commence to Bankstown**

The 'More Trains, More Services' programs includes separation of suburban and intercity/freight services (All-Stops and Express services) between Sutherland and Hurstville.

One option to achieve this is - allowing through-trains to pass all-stops trains by increasing, from 2 to 4, the number of platforms/tracks at the 5 intermediate stations, and adding a fourth track and platform at Sutherland. All Stops services take 5 minutes longer Express services.

A better option is, in addition to the above option, add 2 extra tracks over the full 10 km between Sutherland and Hurstville.

### 4.2 Alternate line connections for Sydney Metro

The Metro could have connected to the Airport-East Hills Line - freeing 10 services for allocation to other lines. Comparing connections:

- Metro connected to the Bankstown Line, virtually all passengers arriving in the CBD will get off in the CBD.
- Metro connected to the Airport Line, likely 25%, or more, passengers will be travelling to and from Northern and Western Sydney and Sydney Airport, taking a significant proportion of traffic off cross-harbour road links.

### 4.3 Macdonaldtown station closure

Macdonaldtown station should be closed as it is 300 metres from Erskineville Station, and 600 metres from Newtown Station (with new entry off Erskineville Rd).

Given the service alternatives, this station is excess to requirements. It's closure will save a minute from every Inner-West train journey and perhaps cut the fleet demand by one train.

### 4.4 If Sydney Metro is built to Bankstown – indicative allocation of services to other lines

The 10 Bankstown passenger services would flow to the Airport-South Line and Inner West-Leppington Line with each having 20 services per hour. Two, or four services to the City Circle Line could be allocated to the Illawarra Line at the expense of one, or both, of the other lines – however, for service reliability, there is a strong preference to minimise the interconnection between the Illawarra-ES line and other lines.

With a total capacity of 60 services, these three lines would reduce from 56 services to 46 services – freeing 17% of capacity. The Metro takeover of the Bankstown, or other line, delays for a few years the need for a second City Circle Line.

#### **Illawarra Line**

With limited extra capacity (18 of 20 paths already in use), an indicative allocation of the Illawarra Line full 20-services capacity is:

- 6 Hurstville-Central-ES – All Stops – 29 minutes (to Central)
- Express from Hurstville services – indicative only – presently only 2 services from Kiama
  - 6 Cronulla-Hurstville All-Stops express Sydenham-Redfern-ES – 52 minutes
  - 2 Port Kembla All-Stops Sutherland express Hurstville-Sydenham-ES, 1 hours, 28 min
  - 4 Kiama All Stops North Wollongong, Express Sutherland-Hurstville-Sydenham-ES – 2 hours, 8 min
  - 2 Kiama All Stops Sutherland, Express Sutherland-Sydenham-ES, 2 hours, 27 min

#### **Inner West-Leppington Line (20 services per hour, currently 14 + 6 Bankstown)**

- 4 services Liverpool, Warwick Farm, Cabramatta, Carramar, Villawood, Leightonfield, Chester Hill, Sefton, Regents Park, Berala, Lidcombe – then All Stops to Central Inner West Line (part Bankstown Line) (currently 0)
- 10 Leppington-Central Central (currently 8),
- 4 Leppington-Blacktown (currently 2),
- 4 Parramatta-Central (unchanged),
- 2 Ashfield-Central (unchanged),
- 6 Liverpool-Bankstown (unchanged)

#### **Airport-South Line (20 services per hour, currently 14 + 4 Bankstown)**

- Increase Airport service to:
  - 7 from Macarthur (currently 5),
  - 7 from Revesby (currently 5),
- 6 from Campbelltown via Sydenham (currently 4) – Uses Illawarra Line, does not serve Airport.

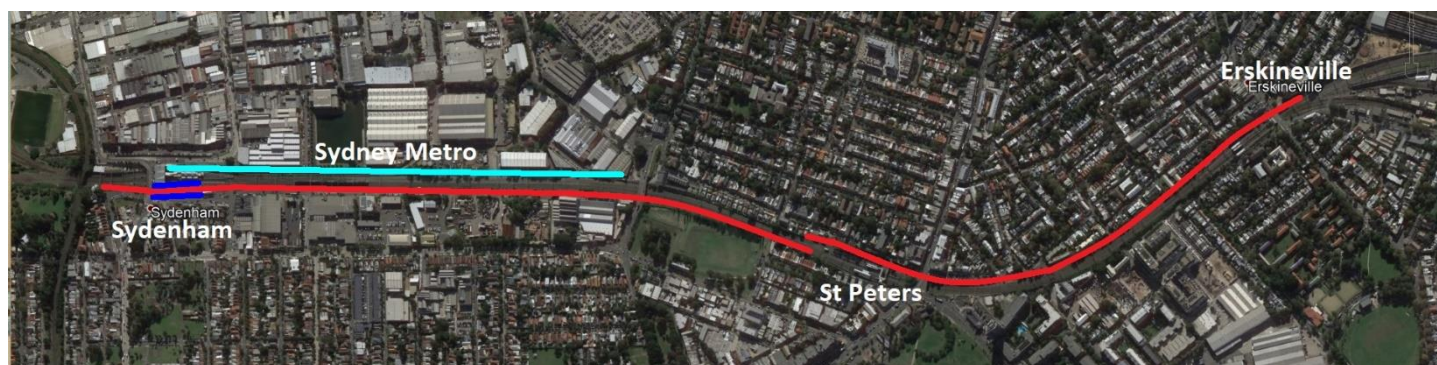
#### **4.5 If Sydney Metro paused at Sydenham – indicative allocation of remaining capacity**

Metro works to Bankstown envisage a line closure of several years – highly detriment to the region. Political demand is greater for a Metro West line. The Bankstown Line could be upgraded at a slower pace that maintained services during construction.

Not extending the Metro to takeover another rail line increases the urgency of a second City Circle Line.

If the Metro is paused, to separate through and stopping trains:

- In Sydenham-Erskineville corridor, add 2 extra tracks – Eastern side Sydenham Station to St Peters Station (1.5 km), and western side from St Peters to Erskineville, (1.3 km) – [Figure 4.2](#).
- Modify Sydenham's 2 eastern platforms to give the station a total of 8 platforms and tracks. Retain heritage buildings. Burrows Ave reduced to 3 lanes.



North to south side transition south of St Peters

**Figure 4.2 - Two extra tracks in corridor – Sydenham to Erskineville**

Indicative services (with actual services based on demand) are:

#### **Illawarra Line**

With limited extra capacity (18 of 20 paths already in use), an indicative allocation of the Illawarra Line full 20-services capacity is:

- 6 Hurstville-Central-ES – All Stops – 29 minutes (to Central)
- Express from Hurstville services – indicative only – presently only 2 services from Kiama
  - 6 Cronulla-Hurstville All-Stops express Sydenham-Redfern-ES – 52 minutes

- 2 Port Kembla All-Stops Sutherland express Hurstville-Sydenham-ES, 1 hours, 28 min
- 4 Kiama All Stops North Wollongong, Express Sutherland-Hurstville-Sydenham-ES – 2 hours, 8 min
- 2 Kiama All Stops Sutherland, Express Sutherland-Sydenham-ES, 2 hours, 27 min

**Bankstown Line (10 services per hour – equivalent to 15 Metro single-deck trains, unchanged)**

--- 10 Bankstown services

- 6 City Circle West - Express from Sydenham
- 4 City Circle East - Express from Sydenham

Liverpool 64 min, Liverpool Express 53 min, Lidcombe 50 min, Bankstown 35 min

**Inner West-Leppington Line (20 services per hour, currently 20)**

- 8 Leppington-Central Central (unchanged),
- 4 Leppington-Blacktown (currently 2),
- 4 Parramatta-Central (unchanged),
- 2 Ashfield-Central (unchanged),
- 6 Liverpool-Bankstown (unchanged)

**Airport-South Line (20 services per hour, currently 18)**

--- Increase Airport service to:

- 6 from Macarthur (currently 5),
- 6 from Revesby (currently 5),

--- 4 from Campbelltown via Sydenham (unchanged) – Uses Illawarra Line to Erskineville.

#### 4.6 Second Circle Line

The current City Circle Line has a capacity of 20 trains per hour in each direction.

This could be increased to 24, or 27, services per hour with a moving block signalling system and increased platform capacity at Town Hall and Wynyard, and possibly Central.

The need to improve reliability of current services, and the age of the current signalling system, drive a need for a modern moving block signalling system.

Central Walk will likely prove adequate extra platform access capacity for Central.

Town Hall and Wynyard could be given extra stairs at their northern and southern ends with expensive under-busy-roads work.

An extra station, 700 metres north of Wynyard, at Observatory Hill (under the Bradfield Hwy) will likely cut Wynyard demand by 30%. The platforms would be at track grade ~3.3%. The growth of demand in the Northern CBD likely justifies a new station. The width of the Bradfield Hwy, and the removal of the mechanical toll gates, provide space for construction of a station 'box' enveloping the station location over which traffic can run.

Both Town Hall and Wynyard can have extra platforms added, with little disruption to current operations, to enable peak-hour alighting from one side and boarding from the other in a similar set-up to Olympic Park Station.

Other service needs that should be considered in planning for a second city circle line is services to Sydney University. University of NSW should be served by an extension of the underused Eastern Suburbs Line.

A second city circle line could be used to increase the Inner-West, East Hills, Airport, Illawarra line capacity from 60 to 100 services.

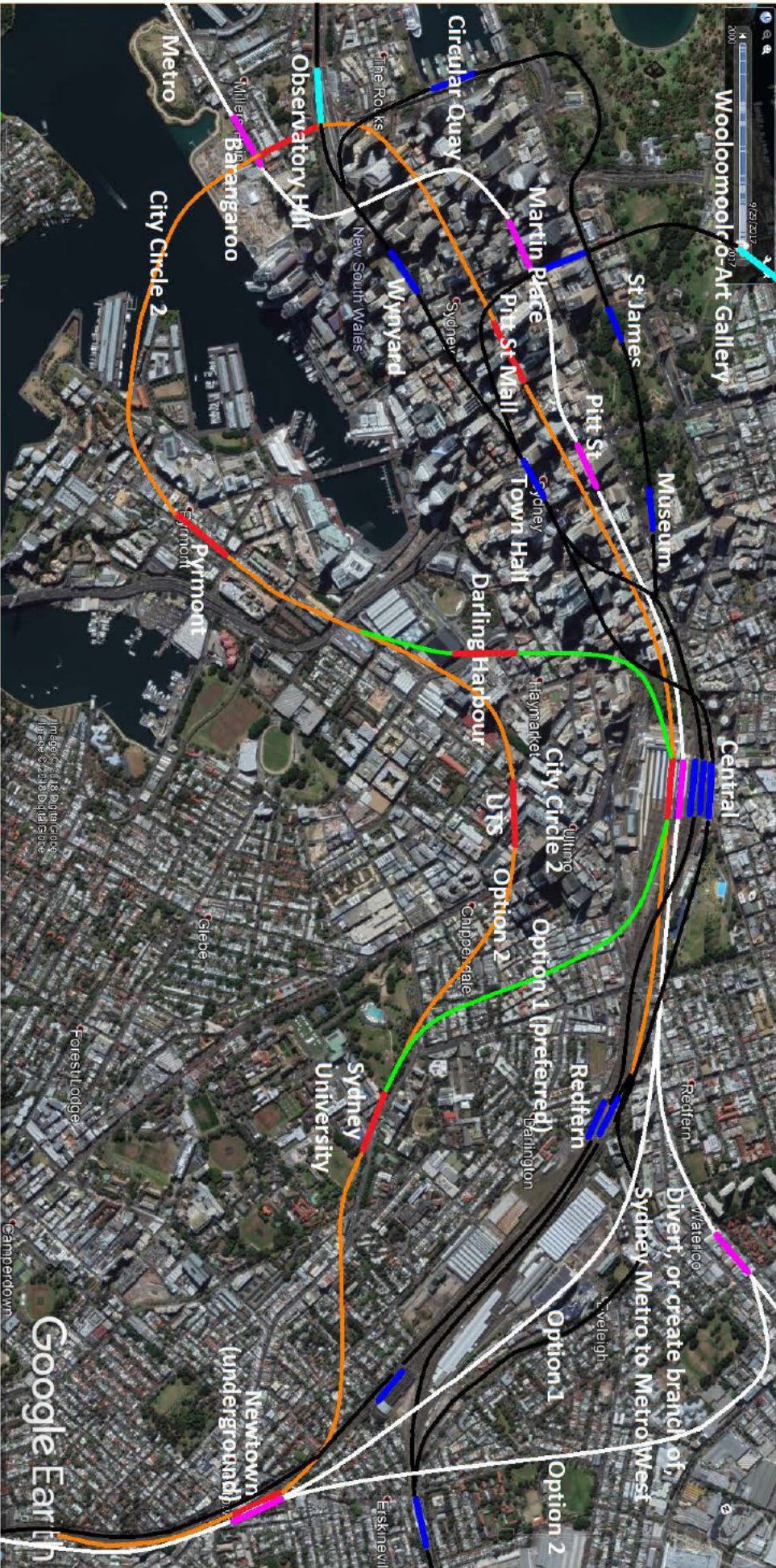
A second city circle could also be used, in part, to provide CBD extensions for Intercity services.

A second city circle line should seek to serve areas in, and close to, the Sydney CBD, not currently served. See [Figure 4.3](#) for possible second city circle options.

Given the planning and construction time required for CBD works, planning should commence in the near future for a second City Circle Line.

#### 4.7 Waterfall-Thirroul tunnel

See Chapter 11 for proposal to reduce Central-Wollongong Express services to one hour.



4.3 Second City Circle option



## 5 Extra rail capacity for Western Sydney (Parramatta and west)

Parramatta has 24 peak hour services to the city and 2 to Leppington. This is the maximum citybound unless train paths are taken away from Inner West Leppington services. There is spare capacity for at least 2 more services per hour to Leppington.

There is unused capacity for Parramatta-Central Coast services, but Parramatta has no direct services to the Northern Line corridor and Central Coast-Newcastle.

A Metro West project will take at least 8 years to complete and cost many billions of dollars. Completion in a decade is the government's timetable. The government envisages up to 10 stops on Metro West's 21 km journey. With an 80 km speed between station, a non-stop journey would take 16 minutes, plus one minute per stop - up to 26 minutes - slower than express services via the current Intercity line.

During peak-hour, half of all Metro West passengers will be expected to stand for their entire journey. The service is thus a lower quality service than that provided by double-decker trains with high-density seating.

Western Sydney Airport will be served by double-decker trains under the plan agreed with the Commonwealth - passengers will not be forced to stand for the long journey from WSA to Sydney City.

Two extra Granville-Homebush tracks will allow WSA trains to travel express to Parramatta and Sydney with few stops - faster than a metro service (see Figures 5.1 to 5.3, and Table 5.1). 6 tracks on the existing corridor (23.1 km) will allow one- or two-stop express services to Central in 20 minutes.

Over a Granville-Homebush corridor distance of 9.3 km, a total of 15 km of new track is required. Two extra tracks will meet WSA and Parramatta needs for some years allowing more time to build Metro West.

With the continued diversion of 4 services to the Inner West Line, and 8 services on the Northern-Newcastle Line, Parramatta will have a capacity of 36 trains per hour to the city – a 50% increase. This requires the transfer of Northern Line services to the Intercity-Central Terminal tracks.

While demand will determine service allocation, an indicative Parramatta service allocation is:

- 4 Blue Mountains to Central Terminal (unchanged) – Intercity line
- 4 Richmond to North Shore (currently 2)
- 4 Schofield to North Shore (unchanged)
- 8 Penrith to North Shore (unchanged)
- 4 St Marys to North Shore (currently 2)
- 4 Blacktown-Leppington (currently 2)
- 4 Parramatta to Inner West (currently 4)
- 1 Parramatta-Wyong (currently 0) – Intercity line
- 1 Parramatta-Gosford (currently 0) – Intercity line
- 2 Parramatta-Berowra (currently 0) – Intercity line

At St Marys and Blacktown, these services would be allocated to tracks based on destination and All Stops/Express services. At Parramatta an indicative service split is:

<u>Southern platform</u>	<u>Northern Platform (all Express services)</u>
4 Blacktown-Leppington	4 Blue Mountains to Central Terminal
4 Parramatta to Inner West	1 Parramatta-Wyong
4 Penrith to North Shore	1 Parramatta-Gosford
4 Schofield to North Shore	2 Parramatta-Berowra
4 St Marys to North Shore	4 Richmond to North Shore
	4 Penrith to North Shore

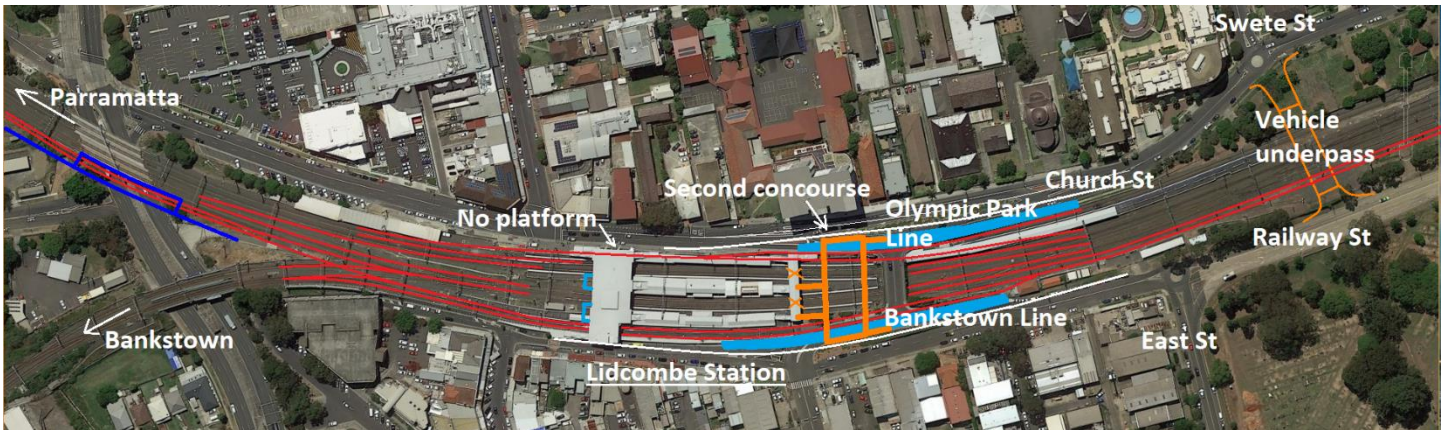
To provide a 10-minute interval service to Western Sydney Airport, the 4 St Mary's services could be extended, and 2 Penrith services diverted, to the airport.

Extra services to Leppington and Central Coast would require turnbacks at Parramatta unless these services were commenced at Blacktown (Figures 5.4 and 5.5).



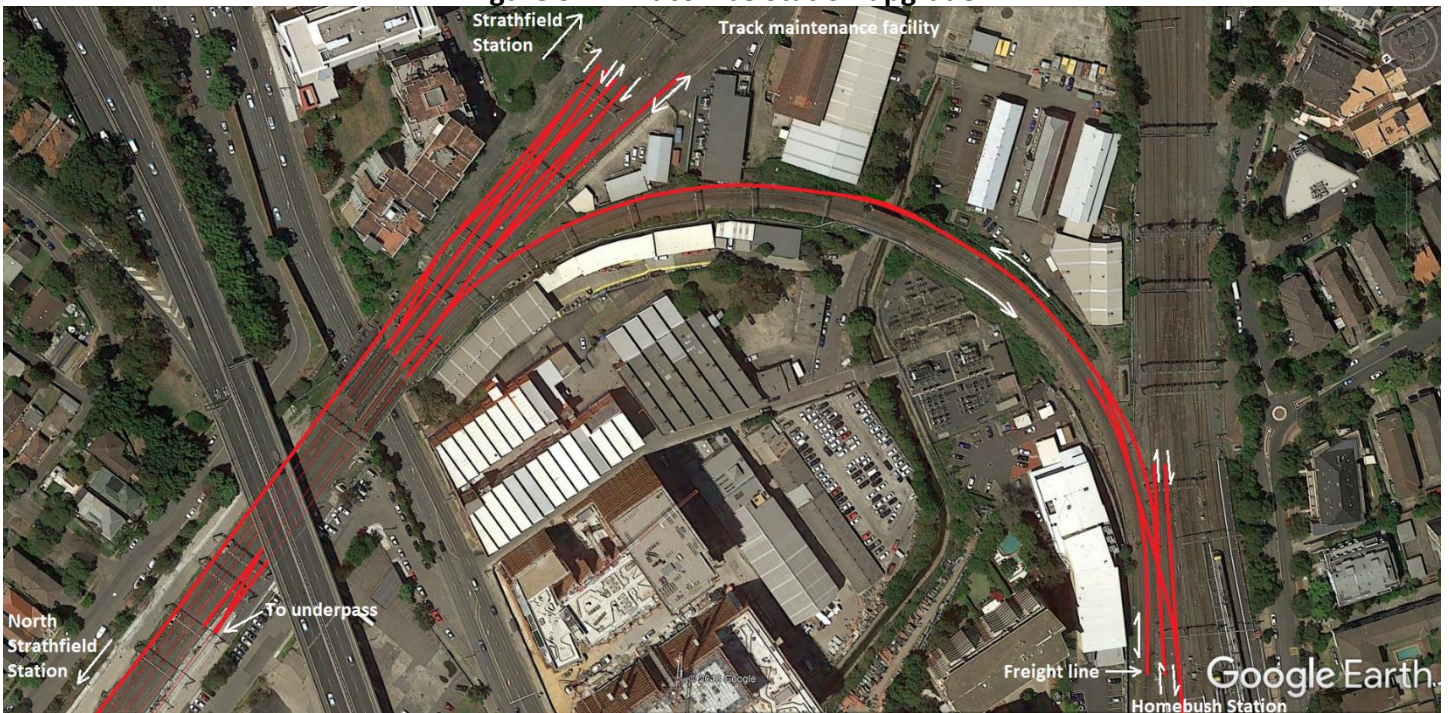
The extra tracks are generally added on the southern side. At 7 locations, marked with a 'T', the extra tracks transition either to one each side of the station/corridor, or from one side of the corridor to the other.

**Figure 5.1 - Extra tracks between Granville and Homebush**



The road overpass is replaced by an underpass at Swete St. Bankstown and Olympic Park Line turnback platforms are located to the east end of the current station, and all platforms linked by an eastern concourse.

**Figure 5.2 – Lidcombe Station upgrade**



**Figure 5.3 – Additional track between Northern and Western lines**



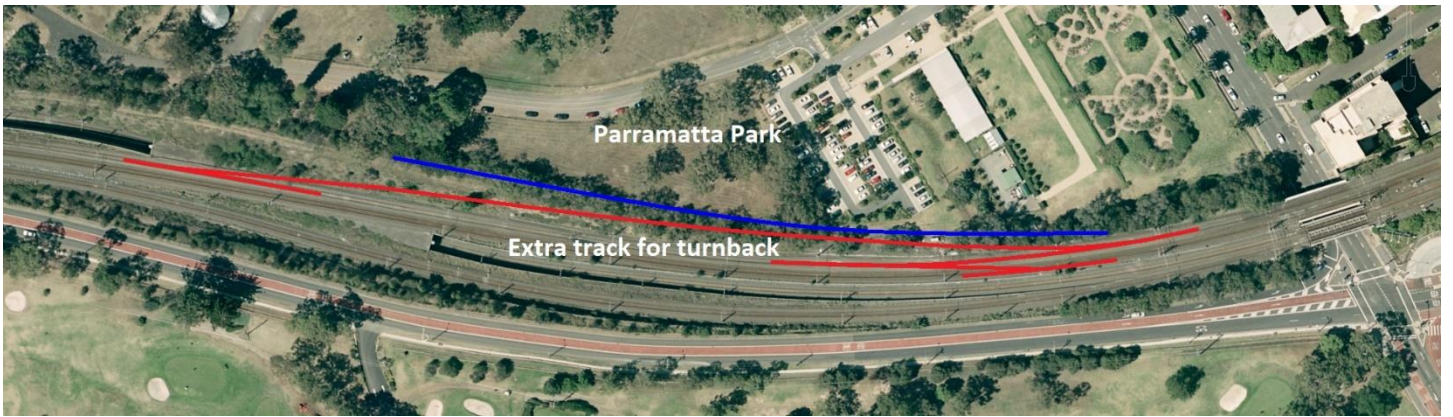


**Table 5.1– Indicative works to increase the Granville to Homebush corridor (9250 metres) from 4 to 6 tracks**

Works	Distance metres	Work class
--- Bridge Street Granville to Granville Station– 2 extra tracks southern side in-corridor <u>transitioning</u> to an extra track each side at Granville Station	250	Track
--- extra track both sides of the station with a new platform on southern side for Inner-West services.	150	Track, platform
--- Extra track on northern side to connect with sixth track at Clyde Station.	400	Foundation, track
--- New seventh platform at Clyde for Cumberland Line services turnback if Light rail delivery is late.	150	Platform
--- Widen rail culvert across Duck River for seventh (freight) track to freight yard	250	Foundation, track
--- Convert one freight yard track to sixth passenger track through the Auburn freight yard	1400	Track
--- 2050-metre existing extra track south side between Granville Station and Auburn Stabling Yard entry	---	None
--- Realign and add tracks between the Stabling yard and Auburn Station to <u>transition</u> to 6 passenger tracks and 1 track to Stabling Yard.	400	Track
--- Extra track both sides of Auburn station, with extra platform for Inner West line on southern side.	150	Foundation, track, platform
--- <u>Transition</u> tracks to additional tracks on southern side east of Station Rd overpass.	250	Foundation, track
--- Extra two tracks on southern side including crossing of Olympic Drive. (4- metre wide strip, 200 metres long, of Auburn Central Industrial Estate required.)	1400	Foundation, track, cable relocation, 50-metre bridge
--- Realign tracks from Olympic Drive to Lidcombe Station	200	Track
--- Demolition north and south sides of the station. New tracks each side of station. New concourse at east end of station.	200	Demolition, foundation, track, building
--- New track and platforms for Bankstown and Olympic Park Lines. Transition to additional tracks on south side. Demolish vehicle overpass.	150	Demolition, foundation, track, platform
---Build 50-metre vehicle underpass at Swete St.	---	Foundation, structure, track
--- Extra two tracks on southern side between East St Lidcombe and Centenary Drive.	1700	Foundation, track, cable
--- Transition to extra tracks on north side before Flemington Station.	250	Track
--- Extra two tracks and realigned two freight tracks Flemington Station to Smallwood Ave.	700	Track, cable
--- Transition to an extra track each side (6 passenger and 1 freight track) Smallwood Ave to Bridge St Homebush.	200	Foundation, track
--- Extra track each side Bridge St to underpass Subway Lane. Two single track rail bridges required at Subway Lane.	550	Foundation, track, bridge
--- Transition tracks to Homebush Station and existing freight track.	100	Track
--- Add second track to existing chord to Northern Line and connect to the northern passenger tracks.	400	Foundation, track
<b>Total track works ~15,000 metres</b>	<b>9250</b>	



**Figure 5.4 - Parramatta Southern Turnback for high frequency services**



**Figure 5.5 - Parramatta Northern Turnback for high frequency services**



## 6 Extra rail capacity for Northern Sydney, Central Coast and Newcastle

### 6.1 Services changes forced by Sydney Metro works and Epping-Chatswood Line closure

With construction of Central Station's Metro platforms and 'Central Walk' getting underway, 4 Central Terminal platforms will be lost until 2022. Until then, Terminal platforms 1 to 11 and their 4 lay-over tracks are still available for management of arrivals and departures.

The closure of the Epping-Chatswood line at the end of September 2018, for conversion to Sydney Metro services, enforces a service simplification.

The Northern/North Shore Line service pattern in the peak one-hour is currently:

--- 4 Northern Line train paths via Strathfield to Epping;

--- 20 North Shore line train paths destinations:

2 Gordon-Hornsby-Berowra

6 Gordon-Hornsby

4 Gordon

4 Macquarie Park-Epping-Hornsby

4 Macquarie Park-Epping

Service pattern is MP-Hor, Gor, Gor-Ber, Epp, Gor-Hor, MP-Hor, Gor, Gor-Hor, Epp, Gor-Hor - repeat

--- 20 North Shore line train paths sources:

2 Wyong,

2 Gosford,

2 Berowra

4 Gordon,

4 Hornsby via North Shore,

4 Hornsby via Macquarie Park.

Services pattern is Wy, MP-Hor, Gor, Gor-Hor, Gor-Ber, Gos, MP-Hor, Gor, Gor-Hor, Gor-Hor - repeat

Closure of the Chatswood-Epping line in mid-2018, forces Northern Line service consolidation, to a train every 15 minutes from Central CBD to Strathfield and Hornsby.

A minimal service change would see the 4 Northern Line services continue to Hornsby and turnback, with the North Shore line peak service pattern:

Destinations Hor, Gor, Ber, Hor, Hor, Hor, Gor, Hor, Hor, Hor – repeat Town Hall-Hornsby 44/46 min

Sources Wy, Hor, Gor, Hor, Ber, Gos, Hor, Gor, Hor, Hor – repeat Hornsby-Town Hall 47/48 min

Hornsby has a 6-track turnback for the North Shore line which should be sufficient to turnback 20 North Shore trains per hour. However, turning trains back at Gordon and Lindfield will reduce the fleet requirement.

### 6.2 Opportunities created by Sydney Metro opening in early 2019, and need for better Central Coast-Newcastle services

The opening of the Metro line to Chatswood in early 2019 (and Sydenham in 2024) allows further service simplification and is an opportunity for better support to Central Coast-Newcastle and Parramatta economies.

Central Coast-Newcastle needs metropolitan style service if transit-oriented-development is to suppress demand for road space as the region grows towards 1 million people. Metropolitan style means a minimum of 4 All-Stops services per hour across the day.

The region also needs Intercity Express services to allow residents to participate in the Sydney economy.

Central Coast-Newcastle will need direct services to Parramatta if we are to achieve the goal of Parramatta being one of 3 major CBDs in the Sydney metropolitan area.

The housing affordability problem in Sydney requires a multi-pronged approach which should include improved access to services and jobs such that the cheaper regions outside Sydney have a population growth rate that exceeds Sydney. Better access to services and jobs requires better inter-region and intercity transport by road and rail.

Central Coast-Newcastle (CCN) metropolitan area has, in 2018, 700,000 people, 305,000 dwellings, and 550,000 vehicles. If we add in the "Hunter (excluding Newcastle) region", there are 980,000 people, 427,000 dwellings and 770,000 vehicles. Population growth forecasts are based on 1% per annum.

For comparison, Sydney has 5.1 million people and growing at 1.7% per annum. The Illawarra has 300,000 people and is growing at 1.2%. The Blue Mountains has 80,000 people and is growing at just 0.25%. Canberra-Queanbeyan has 440,000 people and Gold Coast-Tweed has 650,000.

The Blue Mountains are heavily constrained by terrain, and appropriately, national parks. Both Wollongong and Central Coast-Newcastle are isolated from Sydney by rugged terrain and national parks – creating distinct metropolitan regions north and south of Sydney.

While it can be considered three distinct regions, the 80 km coastal strip between the Hawkesbury and Hunter regions, with its motorway, railway and highways, functions as a single economic region as travel times are not impacted to the same degree by traffic congestion as the Sydney metropolitan area.

A failure to co-ordinate development with the availability of rail services, has seen development in the Central Coast-Newcastle (CCN) region that overly relies on road travel. The Central Coast-Newcastle-Hunter region has one-fifth of the Sydney population and far less than one-fifth of the passenger rail services.

The government has released its 'Draft Greater Newcastle Future Transport Plan – see [Appendix 7](#) for extracts. [Figure 7 of the plan](#) reveals public transport has a small share of journeys in Newcastle. Without improved services that draw new customers, and a transit-oriented development strategy, the Central-Coast-Newcastle region will enjoy Sydney-like road congestion at much lower population levels.

Access, using personal and commercial vehicles, is being addressed, but roads will be overwhelmed unless the development focus changes to 'transit-oriented-development' and public transport trunk routes greatly improved.

As with the Sydney Northern Beaches B-Line, quality buses and bus stops with carparks can function like railway stations and train lines for people commuting to CBDs. However, trunk bus routes use roads and do not have the capacity of rail lines.

A 15-minute interval service is a minimum for a metropolitan service that will attract transit-oriented development - a 10-minute interval is far better.

The proposed Lake Macquarie Transport Interchange at Glendale is an example of local government planning development around future train services.

The NSW government is funding a business case for reducing Newcastle-Sydney train travel time from "3 hours to 2 hours" – a relatively easy task given actual service times and records. Additional capacity is a harder task.

### **6.3 Journey times informing route selection**

North Shore Line services take 48 minutes for Hornsby Central, and 44 minutes Hornsby-Town Hall.

The Central Coast-Newcastle (CCN) services take:

- 35 minutes for Hornsby-Central, and
- 37 minutes for Central-Hornsby.

With a connection to Town Hall, the CCN services would be a few minutes faster than services via the North Shore.

All-Stops Northern Line services would take longer:

- Town Hall-Hornsby 53 minutes,
- Hornsby-Town Hall 56 minutes,
- Town Hall-Berowra 63 minutes,
- Hornsby-Town Hall 66 minutes.

Connections to other services are also important to door-to-door journey time. The Northern/Newcastle Line offers better connections than the North Shore Line. Northern services will connect with:

- North Shore Line services at Hornsby (20 per peak-hour, but only 16 if Gordon turnback retained)
- Sydney Metro services at Epping (15 per peak-hour) – 25 minutes Epping-Martin Place
- Western Line services (20 per hour) at Strathfield/Burwood
- Inner West/Leppington services (11 per hour) Burwood/Strathfield (Burwood preferred as regional centre)
- All lines at Central.

A CCN service to Epping, then a Metro, gives a Hornsby-Martin Place journey time under 40 minutes.

Woy Woy-Berowra is 28 km by rail through rugged terrain with minimal rail travel demand. All-Stops takes 29 minutes. Express takes 25 minutes. A split of All-Stops services into two zones – Berowra-Strathfield (64 minutes) and Newcastle-Woy Woy (98 minutes), allows a more efficient use of resources and more services. All Stops services can be organised to arrive at Woy Woy a few minutes before Express services. This means All Stops services would arrive at Gosford about 5 minutes before Express services.

With the service split, the three stations between Woy Woy and Berowra can be served as follows:



- Wondabyne: a request-stop (with just 15 metre platforms) for a few customers whose alternate access is via a 7 km boat journey along Mullet Creek to Brooklyn. 1 service per hour is adequate.
- Cowan: 250 dwellings with possibly 700 people who, in the main, have a 400-metre to 1,100-metre walk, or drive, to station, or a 4.5 km drive (taking 5 minutes) to Berowra. Close station or reduce to 1 service per hour.
- Hawkesbury River (Brooklyn), an important tourism destination, can be made a regular Express service stop for the addition of one minute to the journey.

If Northern Line services are transferred to the underused Intercity Line to Central Terminal, services between Central and Parramatta can be increased by 4 in the peak-hour.

#### **6.4 Integrated Northern Line – Central Coast Newcastle services**

As indicated above, Central Coast-Newcastle services, via the Northern Line, have far better connections for similar journey times. Therefore, Northern Line-CCN services should be integrated. The 8 operating Central Terminal platforms can serve as a turnback for 20 services per hour if trains are laid-over at a stabling facility.

On this basis, indicative peak-hour services on an integrated Intercity-Northern-CCN line, assuming adequate passing opportunities are in place, are:

- 4 Newcastle-Central Express (currently 2)
  - 4 Newcastle-Woy Woy All-Stops (currently 2 to Central)
  - 3 Wyong-Woy Woy All-Stops, then Express to Central (currently 2 via North Shore)
  - 3 Gosford Express to Central (currently 2 via North Shore)
  - 4 Berowra All-Stops to Strathfield, then Express to Central (currently 2 via North Shore)
  - 1 Wyong-Woy Woy All-Stops, then Express to Parramatta (currently 0)
  - 1 Gosford Express to Parramatta (currently 0)
  - 2 Berowra All-Stops Concord West\*, then Express Parramatta (currently 0)
- \* Southbound underpass track to Homebush passes under North Strathfield station.

Northern Line, Berowra-North Strathfield, in the AM peak hour will have:

- 6 All Stops services (currently 4)
- 12 Express services (currently 4)

Intercity Line – Granville-Homebush will have 8 Express services (currently does not exist)

Intercity Line – Strathfield-Central Terminal will have 18 Express services (currently 8)

Parramatta has a capacity for 4 more express services using the Intercity line. If, 4 Northern-CCN services were turned back at Strathfield, using the most northern platform for passenger transfers, the extra Parramatta Station capacity could be utilized. This can occur because Strathfield Station devotes:

- 2 platforms to Inner West services,
- 3 platforms to Western/Northern services, and
- 3 northern most platforms to Intercity services.

To allow turnback trains to reverse west from the northern platform, without crossing Western Intercity train paths, an additional 'S' connection is required on the northern Intercity Express tracks, 50 metres west of the Cooper St/Leicester Ave intersection.

A 1.1 km seventh track from Strathfield's northern platform to Burwood Station would allow 14 Northern-CCN services per hour to reach the regional centre of Burwood, and for Burwood Station (the heart of the regional centre) to act as a major junction for northern and western services. Burwood Station would require a 'Central Walk' 60 metres east of the current confined entrance to allow passengers an easy interchange of platforms.

#### **6.5 Cutting journey time and resources required for North Shore Line, and development opportunities**

The Wollstonecraft curves and Waverton and Wollstonecraft stations add 4.5 minutes to journey time compared to a Wollstonecraft tunnel and a new combined Waverton-Wollstonecraft station – see [Figure 6.1](#). Such a journey time saving will lead to a fleet saving of 4 to 6 trains (\$200 million to \$300 million over train life) – more if the frequency is increased with the introduction of moving block signalling.

The proposed station location offers considerable above station development opportunity (2.4 Hectares)

The closure of the current Waverton station would create two more development opportunities for a total of 0.76 Ha.

The Lavender Bay daytime stabling yard is a significant site (1.9 Ha) for CBD development ([Figure 6.3](#)). The stabling yard could be transferred to St Leonards Station ([Figure 6.2](#)) creating operational efficiencies. There is considerable community demand to repurpose the rail line to Lavender Bay as a 'high line' pedestrian-cycle path. The change from industrial activity – train operation and storage – to activity that supports residential and retail activity should see an increase in property values and commercial acidity.

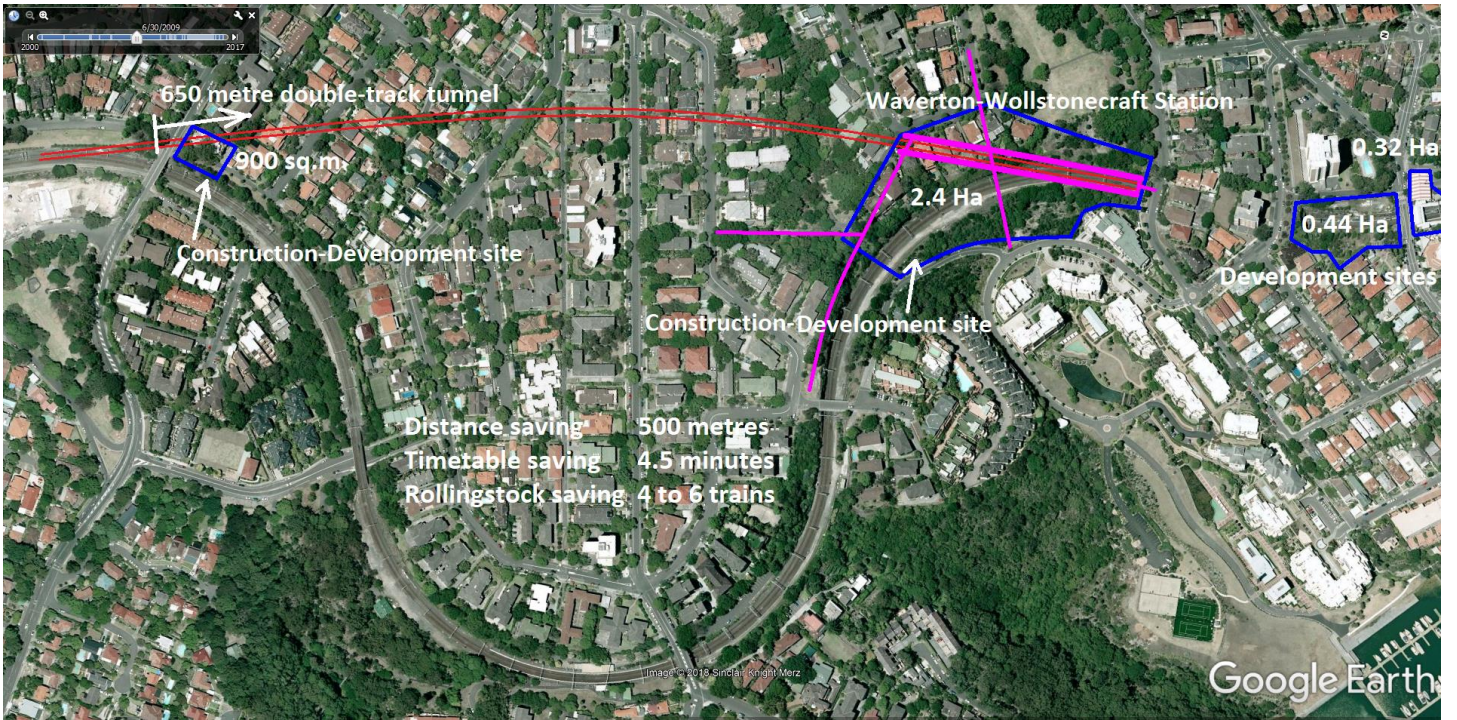


Figure 6.1 - Wollstonecraft tunnel to save 500 metres, 4.5 minutes and 4 to 6 trains in the fleet



Figure 6.2 - St Leonards Station turnback to replace Lavender Bay train store (stabling yard)

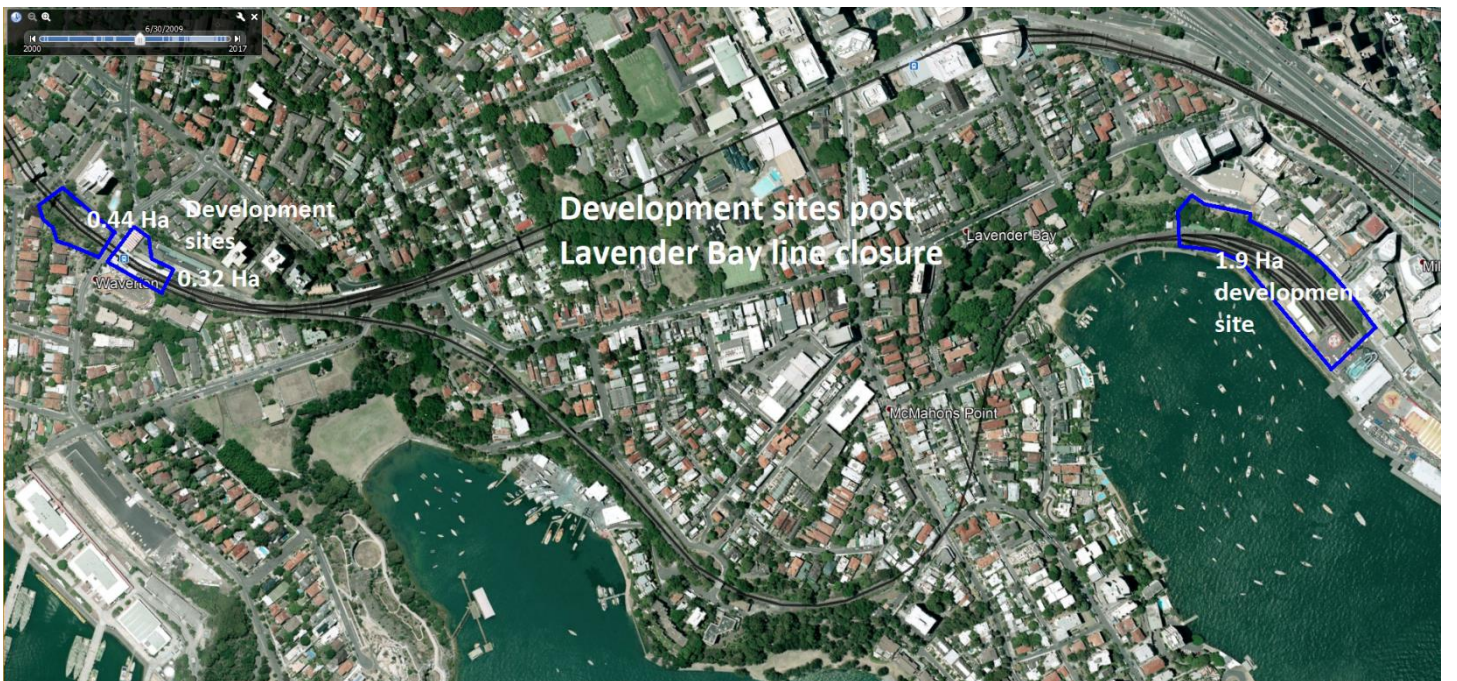


Figure 6.3 – development opportunities with closure of Lavender Bay train store (stabling yard) and the creation of 'High Line' pedestrian-cycleway to Bay Rd Waverton



## 7 Infrastructure to support high frequency services on the Northern-Intercity-Newcastle Line

### 7.1 Stations

Growth of suburbs and commercial areas away from existing stations requires new stations in the Central Coast Newcastle region. The current distribution of stations is given in [Figure 7.1](#).

Currently, the only proposed new station is for Glendale (Newcastle) where Lake Macquarie Council propose \$120 million be spent on a station as per its business case. [Six other new stations are needed – Table 7.1](#).

The cost of the Glendale infrastructure is partly due to associated works. Glendale should be a joint venture with neighbouring commercial property owners. The cost to government for new stations should be far lower.

[Seven stations are proposed for review for closure](#) due to new stations, or due to a small market with alternate rail access – [Table 7.2](#)

The new stations would see changes to Express service stations – [Table 7.3 and Appendix 4 \(Part 2\)](#).

As All-Stops and Express trains can travel at the same speed between stations, passing opportunities for Express trains are mainly required at stations.

There is a greater benefit/cost ratio in first upgrading stations that serve large communities. These stations need Express and All-Stops services and are an appropriate place for changing between All Stops and Express services. Thus, Express stations should be served by double-island platforms to allow cross-platform interchange.

With the exception of Brooklyn, the Express stations outside Sydney should have interchange facilities that include multi-story carparking, bus stops and cycle storage.

Virtually all Northern-Central Coast-Newcastle stations between Central and the newly built Newcastle Interchange need major upgrades. Indicative upgrade proposals for each 'All Stops' station are given in Appendix 8 (Part 3).

#### Table 7.1 - Proposed new stations

- Kotara bulk goods shopping centre, a 600 metre walk from Westfield Kotara (159.7 km),
- West Newcastle Regional Interchange Newcastle Inner City Bypass A37 (157 km),
- North Cardiff State Road 128 Interchange (154 km),
- Glendale (next to Glendale shopping Centre – 152.5 km) - perhaps as envisaged in Lake Macquarie Council's \$120 million proposal,
- Toronto Awaba Rd (139 km)
- Doyalson Link Rd (111.7 km)
- Warnervale Sparks Rd (106.8 km)
- West Woy Woy Interchange (69.0 km) – proposed as part of a Hornsby-Gosford passenger rail tunnel.

#### Table 7.2 - Stations proposed for closure review

- Kotara (158.8 km) – near proposed new station
- Booragul (146.3 km) – cut off by proposed Teralba tunnel to save 1.8 km from route
- Awaba (137.2 km) – near proposed new station
- Tascott (77 km) – small market served by proposed high frequency trunk bus route
- Koolewong (74.8 km) – small market served by proposed high frequency trunk bus route
- Wondabyne (65.2 km) – micro market requiring boat access, with alternate is Brooklyn 7 km away.
- Cowan (48.8 km)

#### Table 7.3 - Proposed Express service stations

- Newcastle Interchange (165.5 km),
- Broadmeadow (163 km),
- West Newcastle Regional at Inner City Bypass A37 (new - 157 km),
- North Cardiff SR 128 (new - 154 km),
- Glendale (new - 152.5 km),
- Toronto – Awaba Rd (new – 139 km),
- Morisset (123 km),
- Warnervale Sparks Rd (new 107 km),
- Wyong (101 km),
- Gosford (81 km),
- Woy Woy (72.5),
- West Woy Woy Interchange (new - 69 km),
- Hawkesbury River (Brooklyn – 57.5 km),
- Berowra (44.5 km), Hornsby (34 km),
- Epping (23.5 km),
- Strathfield (11.8 km)/Burwood (10.6 km),
- Central Terminal (0 km).



Fig 7.1- CCN line stations



## 7.2 Corridor upgrades to reduce travel time and increase capacity

### 7.2.1 Recent works

The \$1.1 bn Northern Sydney Freight corridor program delivered:

- Hexham freight train passing loop for Newcastle bound trains (1.7 km for 1.55 km trains?)
- 2 parallel Gosford freight train electrified passing loops (2.5 km each)
- Epping-Hornsby (Thornleigh) electrified third track (6.0 km)
- North Strathfield electrified underpass (3.0 km).

Under 16 km of track for \$1.1 bn of investment - \$70 million/km. Nearly twice that of a 4-lane divided road. The Sydney and Gosford loops include track electrification and perhaps other corridor works.

There are also refuges at Cowan and Broadmeadow capable of accommodating 1,500 metre trains.

There are shorter loops at Hawkesbury River, Gosford, Morisset and Awaba but these are not capable of accommodating the longer freight trains.

### 7.2.2 Capacity constraints

Capacity on the Northern-CCN line is constrained due to:

- a) insufficient passing loops for freight trains (2,000 metre loops);
- b) insufficient passing loops for passenger trains (400 metre loops);
- c) two and three Sydney trains sharing single train paths in Sydney to provide Chatswood-Epping services;
- d) sharing Intercity tracks between Central and Strathfield with Blue Mountains services;
- e) long steep grades (>2%) at Cheltenham-Pennant Hills and Brooklyn-Cowan that cause freight trains to run slower than passenger trains;
- f) Newcastle-Woy Woy service frequency tied to train paths in Sydney.

### 7.2.3 Northern Sydney Freight Corridor (NSFC) Program

“The Northern Sydney Freight Corridor (NSFC) Program is a joint Australian and NSW Government initiative to improve the capacity and reliability of freight trains between Strathfield and Newcastle (155 km).

Enhanced capacity of the rail freight network through the NSFC Program will allow rail to be more competitive with road transport for certain types of freight and improving reliability of passenger services.

NSFC Stage 2A includes:

- Lower Main North Quadruplication Lite (2.4km);
- Rhodes to West Ryde Section Quadruplication (3.6km);
- Berowra to Hawkesbury River Section Triplication (13km - total length of 19km including a 6.3km-long tunnel).

The Project also includes:

- 5 stations requiring modifications and adapted to new rail configuration (Rhodes, Meadowbank, West Ryde, Cowan, Hawkesbury River),
- 6 complex bridges and overbridges (Parramatta Rd bridge, Second John Witton bridge (second half of the bridge deck??), Bank Street overbridge (Meadowbank Station, Victoria Rd bridge, F3 Motorway ramp bridge, Pacific Highway overbridge Cowan),
- a long and complex tunnel (6,3km) with diameter of 11.2m to be excavated by TBM and duplicated in a second construction stage.

The project includes complete track definition, OHW system, signalling, communication, HV and LV definition. All civil works and trackworks will be executed in presence of railway traffic, so a particular attention is paid on definition of construction phases. <http://www.geodata.it/en/rail/67-rail/australia/219-northern-sydney-freight-corridor-nsfc-stage-2a-australia>

A rail freight service between Port Botany and western Sydney intermodal terminals, including Moorebank, the NSW government is required to spend more than \$7 billion: \$1 billion is required for a new rail freight line into Port Botany; \$1 billion is required for the Western Sydney Freight Line, between Chullora and Eastern Creek; and \$5 billion is required for stages 2 and 3 of the Northern Sydney Freight Corridor, between Newcastle and Strathfield.”

<https://www.tandlnews.com.au/2015/09/23/article/nsw-freight-at-the-crossrailroads/>

### 7.2.4 Trains

The XPT holds a speed record of over 183 km/h during testing along the Central Coast. Implying it can operate at 160 km/h along the relevant track section – a basic industry speed for which many electric locomotives and passenger trains are designed. However, many older freight car bogies operate at lower speeds.

125 km/h has been experienced by passengers on delayed electric-multiple-units All-Stops services near Ourimbah in recent times, while 90 km/h to 110 km/h is more usual in normal service speed at this location.

The \$2.3 bn contract to the Rail Connect consortium (Hyundai Rotem (train manufacturer)/UGL (maintenance)/Mitsubishi Electric(technology)) includes 512 intercity rail cars, the design and fit-out of the maintenance facility at Kangy Angy, and 15 years of train maintenance (to 2034). The UGL component is \$570 million.

The government will spend another \$500 million of construction on the maintenance facility and its procurement activities. The trains are due to enter service between 2019 and 2022.

The trains have high quality interiors, but may only have the performance of the OSCAR trains they replace.

Passenger trains with tilt mechanisms can go around tight bends up to 30% faster than non-tilt trains. Some trains tilt 2 degrees rather than the 8 degrees for standard tilting trains. A 2-degree tilt can be used in most bends. Perhaps 5 to 10 minutes may be gained from using trains with tilting mechanisms.

Freight trains are limited to 115 km/h in good conditions. The low power to weight ratio of freight trains see them lose time to passenger trains on hills and tight corners which cause extra wheel-rail friction. Routing interstate freight trains would allow a speed increase for mixed traffic freight paths.

Tilting mechanisms cannot be applied to freight wagons. A passenger train with Tilt will gain significant time on freight trains.

### 7.2.5 Track cant

A train journey to Newcastle reveals the track is not canted – tilted into corners to keep overturning forces directed towards the track centre. Canting the tracks in tight corners between the Parramatta River and Newcastle will likely save 5 to 10 minutes of journey time. This journey time is also saved for freight trains.

Time savings for track cant are in addition to those for Train tilt.

### 7.2.6 Electrical power system

Replacement of the aging electrical substations and power wire support structures has been underway for many years. The bulk of the work appears complete, but further investment is required.

The electrical system may need a further capacity increase for a higher frequency of services.

### 7.2.7 Signalling system and capacity

During daily travel peaks, 6 All-Stops services arrive at Gosford 5 to 6 minutes before a following Express train and are delayed until 1 or 2 Express trains have passed. A delay of 15 to 20 minutes. The minimum gap between trains is 5 to 6 minutes likely due to the length of the ‘fixed-block’ signalling sectors.

Investing in a ‘moving-block’ system allows train separation to be reduced to the minimum required to safely stop the train based on constant monitoring of train position and speeds. At slow speeds, the separation may only be 30 seconds. A ‘moving block’ signalling system will raise capacity to at least 20 trains per hour with time lost to a passing train down to as little as 2 minutes – [Appendix 3](#).

‘Moving-block’ systems require less infrastructure with a whole network operated from one control room – the one under construction, or recently finished, by Sydney Trains. Largely automated systems require no trackside signalling lights.

### 7.2.8 Level crossings and safety

The Central Coast Newcastle Line has 4 level-crossings, at Woy Woy, Koolewong, Warnervale and Adamstown, which should be closed on safety grounds.

The Woy Woy crossing has a newly built pedestrian underpass. The vehicle crossing (Rawson Rd) should be closed in favour of an upgrade of the underpass at Shoalhaven Drive – see [Appendix 5](#).

The Koolewong crossing should be closed in favour of an overhead pedestrian crossing at the station and a vehicular overpass 300 metres to the south – see [Appendix 5](#).

The Warnervale crossing should be replaced by an overhead pedestrian crossing, with vehicles using Sparks Rd. The station should move to Sparks Rd to serve a larger market – see [Appendix 5](#).

The Adamstown crossing should be replaced by an overhead pedestrian crossing at the station and a vehicle underpass of the rail yard – see [Appendix 5](#).

### 7.2.9 Passing loops for freight trains

Freight trains are significantly slower on long steep climbs (>2%) due to significantly lower power to weight ratios compared to passenger trains. Freight trains are also slower on steep descents to ensure control of the wagons behind the locomotive. The slower journeys require multiple train paths reducing line capacity.

Freight trains are regularly suffering breakdowns delaying passenger services and other freight trains. A 1500-metre train has 75 wagons and locomotives with a total of 600 wheels travelling ‘non-stop’ Brisbane-Sydney, a journey of 1,000 km each way. By comparison, the passenger trains have 64 wheels and travel just 165 km each way. More reliability measures are needed for freight trains to achieve reliability levels closer to passenger trains.

The Northern-CCN Line has major climbs up to the Hornsby-Berowra ridge. A third track has been built on the southern side (Epping-Pennant Hills) to allow passenger train to pass freight trains on the climb. A third track has not been added on the northern side (Brooklyn-Cowan).

To address slow freight train travel:

--- a fourth track should be added between, and inclusive of, Epping and Thornleigh stations – a length of 6.6 km.

--- third and fourth tracks should be added between the Long Island tunnel (Hawkesbury River southern side) and Berowra Station (inclusive of the station) – a length of 13.7 km.

The peak hours are also the peak hours for freight trains – a situation that cannot be reconciled. Freight trains will have 21 hour a day access the CCN line for at least 2 services per hour each way and 3 per hour at night. However, freight train paths arriving/leaving Sydney are only saleable for the hours 4AM to 10PM.

The above works, and works proposed for Adamstown to Hamilton, create pairs of passing loops for freight trains at:

--- North Strathfield to Rhodes	(12.5 km to 15.7 km – 3.2 km)
--- West Ryde to Thornleigh	(19.4 km to 29.6 km – 10.2 km)
--- Berowra to Long Island	(44.4 km to 58.1 km – 13.7 km)
--- Gosford to Narara	(81.2 km to 83.5 km – 2.3 km)
--- Adamstown to Hamilton	(160.8 km to 163.7 km – 2.9 km)

Another loop of 2.3 km could be created south of Morisset at approximately 120 km from Central.

In the Strathfield-Berowra corridor, these works would leave double-track in three sections – 3.7 km between Rhodes and West Ryde, 4.1 km between Thornleigh and Hornsby, and 10.0 km between Hornsby and Berowra.

Over time, the intent should be 4 tracks between Berowra and Strathfield to ensure a high frequency of Express services to Central are not impeded by All-Stops services and freight trains.

### 7.2.10 Passing loops for passenger trains

The Express service station proposals above, likely provide sufficient passing capacity when trains run to schedule.

For improved reliability, stations designated for All-Stops services should be upgraded with platforms on side tracks to ensure the main line is free for passing Express services – see [Appendix 8](#).

Stations designated for Express services should be upgraded with double-island platforms where possible to permit cross-platform transfers between Express and All Stops services – see [Appendix 4](#).

### 7.2.11 Reducing track length

At Booragul, the track goes around a 400-metre radius horseshoe bend. Trains travel an extra 1,800 metres over a 4,000-metre length of track. A 2,200-metre bypass of Booragul commencing at Teralba, including a 650-metre tunnel (Teralba Tunnel), could carry trains at speeds in excess of 120 km/h in normal service compared to 60 km/h at present. A 3-minute journey saving can be made here.

### 7.2.12 NSW Business Case for 2-hour journey time

The NSW government is funding a business case for reducing Newcastle-Sydney train travel time from “3 hours to 2 hours”. A 2-hour Express service is addressed below, while a 90-minute service between Central and Newcastle Interchange is addressed in Chapter 9.

The fastest service today (only one per day), the 5.03AM from Newcastle, takes 2 hours 23 minutes and has 10 stops which add 10 minutes to the journey. The regular intercity services take another 10 minutes – 2 hours 33 minutes.

In October 1988 an XPT train set a record for the Central-Newcastle journey that likely reached the site of the Newcastle Interchange in 1 hour 53 minutes. The XPT set an Australian train speed record of 183 km/h on an approved section of track.

The effective time difference between record and the 5.03 AM service (30 minutes) is due to:

- an environment of train paths for a mix of All-Stops, Express and freight services;
  - at least two freight train paths per hour are scheduled outside the morning and afternoon peaks;
  - the need for a buffer in the timetable for drivers to ensure they do not exceed speed limits;
  - occasional issues with boarding and alighting;
  - other possible delays along the route which are relatively common for freight trains;
  - spare time for trains to recover from delays to reduce the impact on passengers with planned connections to other services and arrival times.
- In Sydney, a Central-Strathfield-Epping, a North Shore-Macquarie Park-Epping-Hornsby, and a North Shore-Gordon-Hornsby-Berowra service share a single train path. Path sharing needs a wider path time band.

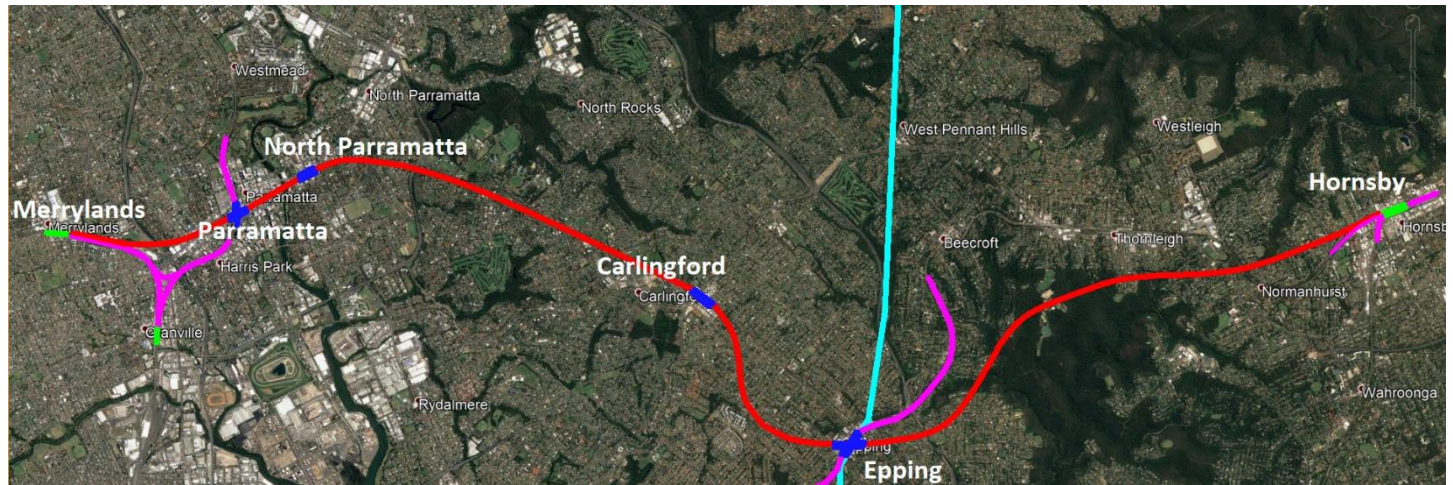
The XPT is a diesel-powered train. A higher-powered electric train may achieve a 2-hour journey time, with the 15 Express stops proposed above, under similar circumstances to the record non-stop journey. However, the operational circumstances described above would likely result in a 2-hour 20-minute journey.

The use of track cant, Teralba Tunnel, tilt trains, passing opportunities at all Express stations, and 'moving block' signalling will likely result in a 2 hour travel time for an Express service in an environment where Express Trains can pass All-Stops trains at Express Stations and no freight trains are running on the line (as per the existing peak-hour restrictions).



## 8 Extra capacity for Western and Northern Sydney via a Merrylands-Parramatta-Epping-Hornsby tunnel

A tunnel from Merrylands to Parramatta, Epping and Hornsby has benefits for western and northern Sydney. It strengthens Parramatta's capacity to grow into a major city – [Figure 8.1](#).



--- Red Merrylands-Hornsby tunnel    --- Pink – existing track    --- light blue – Sydney Metro

**Figure 8.1 – Indicative Merrylands-Parramatta-Epping-Hornsby Line**

Suburbs in the 40 km corridor from Merrylands will have direct access to Parramatta with a high frequency of Services.

Sydney Metro is fostering development in an arc to Parramatta's north and east which includes Sydney's North Shore. A direct connection to Epping will give Parramatta easy access to the arc.

Parramatta currently has poor connections to the Central Coast. Central Coast residents need to change at Strathfield to reach Parramatta. Hornsby-Parramatta presently takes a minimum of 40 minutes, but with low service frequencies on the Northern-CCN line, the journey can easily take an hour.

Parramatta already has a high frequency of service with the outer-west, inner-west, Sydney CBD and North Shore.

Indicative journey time comparison given no other upgrades apart from the proposed tunnel:

Parramatta-Leppington	current	42 minutes
	via tunnel	35 minutes
Parramatta-Leppington-WSA		43 minutes
Parramatta-Hornsby	via tunnel	17 minutes
	via Strathfield	40 minutes to an hour
Parramatta-Gosford	via tunnel	60 minutes (min 23 min saving)
Sydney-Gosford		80 minutes
Parramatta-Wyong	via tunnel	78 minutes (min 23 min saving)
Sydney-Wyong		98 minutes
WSA-Hornsby	via tunnel	60 minutes
WSA-Gosford	via tunnel	103 minutes
WSA-Wyong	via tunnel	120 minutes

### Indicative Leppington Line (20 trains per hour capacity without signal upgrade) service allocation:

--- if Sydney Metro is completed to Bankstown:

- 4 services Liverpool via Berala-Lidcombe to Central
- 16 services split between
  - 6 Leppington-Parramatta-Hornsby-Central Coast (currently 0 services)
  - 10 Granville-Lidcombe-Central (currently 8 services)

--- if Sydney Metro is NOT completed to Bankstown:

- 6 services Bankstown Line
- 14 services split between
  - 6 Leppington-Parramatta-Hornsby-Central Coast (currently 0 services)
  - 8 Granville-Lidcombe-Central (currently 8 services)

Parramatta city direction services would take over the 2 Blacktown-Leppington services.

If 2 extra tracks are added to Granville-Homebush corridor, 16 train paths are available for the new tracks.

If Northern Line services are increased to 12 services to Central (Terminal), 8 train paths are available for Parramatta-to Central Terminal services. 4, or more, of these will be Blue Mountains services.

Of the remaining 8 train paths remaining, 4 could be allocated to Parramatta-Hornsby via Homebush All-Stops services.

WSA Express services could also use Central Terminal if train paths permit.

A signalling upgrade over the next decade to lift train paths per line from 20 to 27 paths per hour, a 35% increase, would take the pressure off train path allocation.



## 9 90-minute journey time Central to Newcastle Interchange

A 90-minute Express journey time will require a significant section of new train corridor.

Due to its many tight curves, Cowan-Brooklyn 9 km steep track (>2%), rugged terrain and few customers, Hornsby-Gosford affords the best opportunity to reduce travel time. 47 km are currently travelled in 43 minutes with a stop at Woy Woy – an average of 66 km/h.

4 options (Figure 9.1) were modelled assuming a train speed of 250 km/h (70 m/s) for new line, and a 1-minute dwell at a Woy Woy station. The options are summarised in the table below. Option 2 is preferred.

A saving of 30 minutes can be achieved over existing service times, but likely only a 23-minute saving over that for the 2-hr journey.

Another 7 minutes of saving could be expected from curve easing and use of the higher speed train over the rest of the journey.

Figure 9.3 shows options evaluated, on behalf of the Government, in arriving at the NSFC 2 scope of works. They include a Narara-Ourimbah option (tunnel??). A tunnel bypass of Narara, Niagara and Lisarow station of 5.22 km would save 1,400 metres and 2 to 3 minutes of journey time.



Figure 9.1 – 4 Hornsby-Woy Woy-Gosford upgrade options

### Table - Hornsby-Gosford options for 90-minute Central-Newcastle Interchange

#### 1. Hornsby – Woy Woy– existing line to Gosford

(Woy Woy station below and to the side of the existing station)

--- Total time Hornsby-Gosford 16 min 50 sec (current time 43 min), saving 26 min 10 sec

#### 2. Hornsby – Brooklyn – new Woy Woy ground level station– Point Clare tunnel end – Gosford

--- Station in former quarry next to Woy Woy Creek, off Woy Woy Rd, 3.6 km west of Woy Woy Station (Figure 9.2)

--- Total time Hornsby-Gosford 12 min 37 sec (current time 43 min), saving 30 min 23 sec – save 50 seconds per km of tunnel.

--- Saves 4 min 17 sec over Option 1, 8 min 8 sec over Option 3, and loses 9 seconds to Option 4

#### 3. Hornsby – Brooklyn – West Woy Woy tunnel end – existing Woy Woy station – existing line to Gosford

--- Total time Hornsby-Gosford – 18 min 45 sec, saving 24 min 15 sec off CCM (43 min).

--- 1 Minute 55 sec slower than Option 1, but far easier to construct.

#### 4. Hornsby – Brooklyn – new Woy Woy underground station – Point Clare tunnel end – Gosford

--- Underground West Woy Woy station located 1.6 km into the Brisbane Water National Park.

--- Total time Hornsby-Gosford 12 min 28 sec (current time 43 min), saving 30 min 32 sec on CCM

Note: At a 250 km/h (70 m/s) service speed, 2 min 10 seconds is lost to a stop, compared to 17.5 sec for slowdown to 125 km/h (35 m/s) through the station.



Figure 9.2 – Option 2 – West Woy Woy Interchange

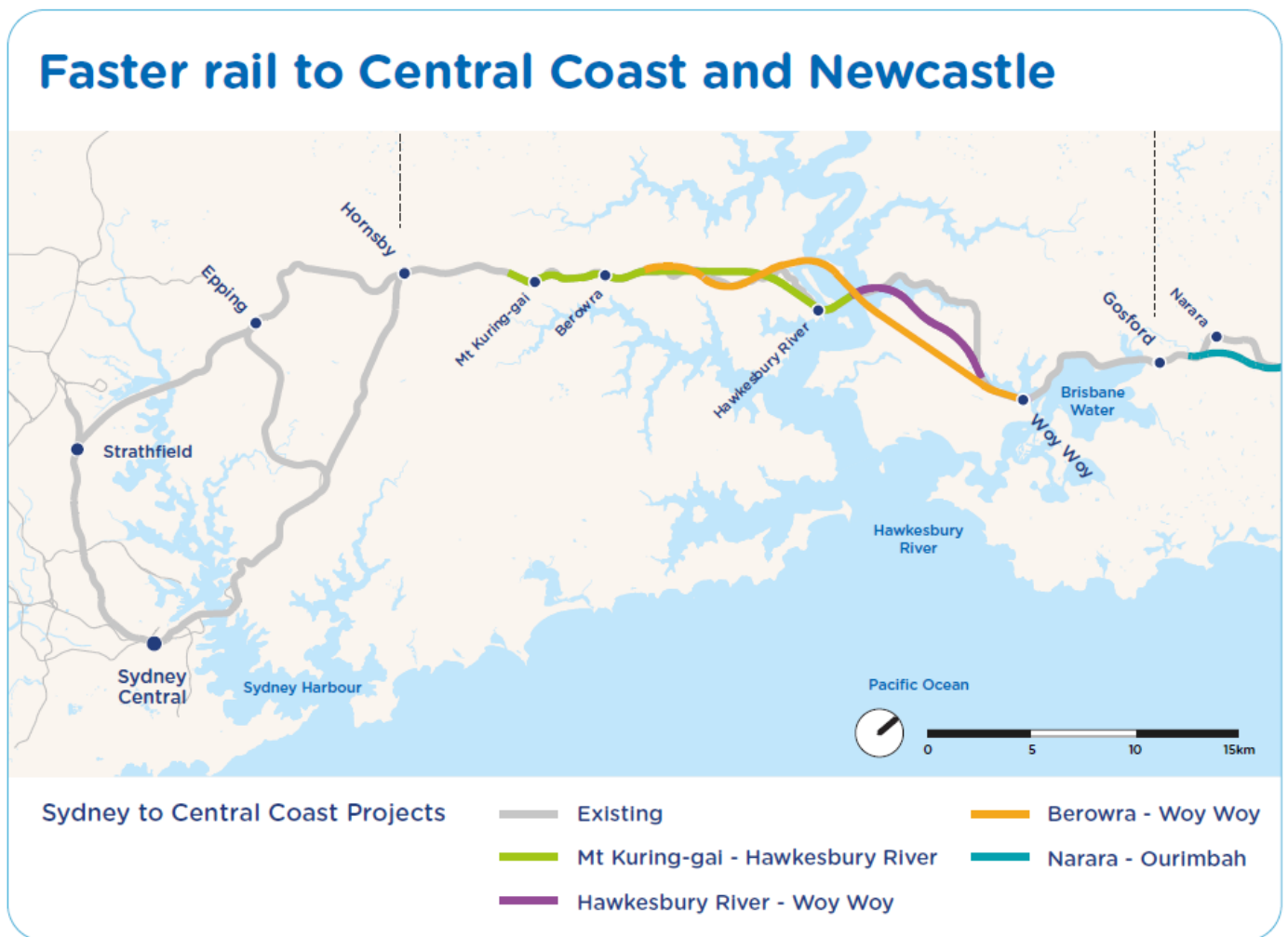


Figure 54: Potential Faster Rail improvements Central Coast and Newcastle rail line

Figure 9.3 - NSW 2056 Transport Plan faster rail options





## 10 Serving the Blue Mountains, Central West and Brisbane-Sydney-Melbourne freight

While the Blue Mountains are a key part of the NSW natural heritage, and development should be restricted, the Central West of NSW commencing just 100 km from the Sydney CBD (50 km from Penrith), is largely prevented from daily participation in the Sydney economy at significant scale due to the Blue Mountains.

The Great Western Hwy through the Blue Mountains serves as a metropolitan four-lane divided road for the Blue Mountains community. It has many sets of traffic lights and traffic speed is little better than that of arterial roads in Sydney.

The alternative Bells Line of Road is only a winding two-lane undivided highway, that is often a faster route.

The service offered by the rail line is very slow:

- Lithgow-Central, 2 hours and 42 min, 156 km (58 km/h ave), As-the-crow-flies 107 km (39.6 km/h ave).
- Lithgow-Penrith, 1 hour 52 min, 101 km (54 km/h ave), As-the-crow-flies 58.3 km (31.2 km/h ave).
- Penrith-Central, 51 min, 55 km (65 km/h ave), As-the-crow-flies 49.45 km (58.2 km/h average).

By motorway, 107 km could take as little as one hour. However, metropolitan road congestion means commuters from the Central West and Blue Mountains should access the significant CBDs of the Sydney metropolitan area by rail.

Current rail time/distances: Central 0 km, Penrith 55 km 48 min, Lithgow 156 km 2 hr 22 min, Bathurst 239 km 3 hr 34 min, Blayney 289 km 4 hr 20. Penrith-Blayney 234 km 3 hr 32 min.

The Blue Mountains rail line has grades up to 1 in 60 (1.67%), reaches a height of 1100 metres above sea level near Bell, and tight curves – causing both freight and passenger trains to travel slowly. The Main Western Railway crosses the Great Dividing Range 3 km north of Rydal at a height of 985 metres. Lithgow Station has a height of 930 M. It has a low point of 900 M at the historic Bowenfels viaduct 3 km west of Lithgow Station.

A new, shorter route is needed across the Blue Mountains and Great Dividing Range that, preferably, does not exceed a grade of 1 in 60 (1.67%). The new route would end at Blayney – an appropriate point to meet a Melbourne-Brisbane line.

The indicative route, shown in [Figure 10.1](#), commences at Penrith Station, becomes a 4.35 km viaduct at Castlereagh Rd, crosses the Nepean River, skirts to the north of McCarthy Catholic College, crosses the gravel pits, skirts to the north of the Emu Plains Corrections Centre, overpasses Riverside Rd at Lapstone Creek and enters a 1.63% grade tunnel at 27-35 Riverside Rd at a height of about 30 metres.

At 8.6 km into the tunnel, it would pass 200 metres below Springwood Station, where large lifts would connect with the existing platform for interchange and town access.

At 35.5 km into the tunnel, it would pass 455 metres below Blackheath Station, where large lifts would connect with the existing station for interchange and town access.

The tunnel end in the Blackheath Creek valley, 1,300 metres north of Centennial Lodge Cottage, Kanimbla 2790. Tunnel length 39.15 km. New line would cross the Great Dividing Range (1,000 metres above sea level) at the Rydal-Hampton Rd 20 km further west. From the tunnel end to Blayney is 93 km as-the-crow-flies.

Possible rail distances: Central 0 km, Penrith 55 km, tunnel start 60.15 km, Springwood 68.75 km, Blackheath 95.65 km, tunnel end 99.3 km, Blayney 192 to 200 km – a potential saving of 90 km. Penrith-Blayney 137 to 145 km – 42 to 50 min on 200 km/h train. Blayney-Central ~90 min – a 2 hr 50 m save. Penrith-Bathurst 112 to 120 km – 35 to 45 min on 200 km/h train. Bathurst-Central ~85 min – 2 hr 10 m save. Penrith-Lithgow stn Jenolan Caves Rd (~30 km sth of Lith) - ~56 km - 20 min. Lith-Cent ~60 min, 1hr40m save.

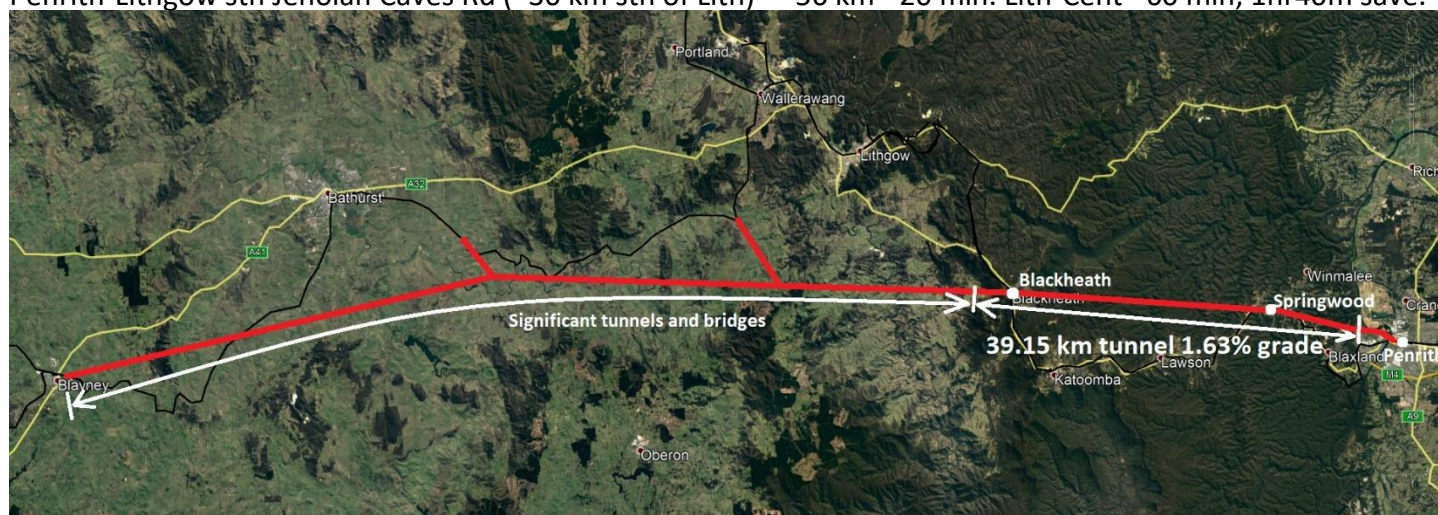


Figure 10.1 – New crossing of Blue Mountains and Great Dividing Range

## 11 Serving the southern Highlands, Illawarra and ACT

### 11.1 One-hour Central-Wollongong service with a Waterfall-Thirroul tunnel

Government plan: --- Faster Rail Improvement --- Sydney-Wollongong

The government's faster rail improvement plan includes Sydney-Wollongong. It is assumed that Waterfall-Thirroul tunnels are envisaged by the plan – Figure 11.1. The tunnel would be designed for a service speed of 200 km/h – medium speed rail. This is just above the maximum service speed for conventional rail of 160 km/h.

Current Waterfall-Thirroul route distances is 31.3 km with a non-stop journey time of 32 minutes – 59 km/h average speed.

All-Stops journey time is 41 minutes with 8 intermediate stations – 9 minutes lost for 8 station stops.

At an average speed of 120 km/h, the 22 km tunnel will be covered in 11 minutes for a 21-minute saving.

Current 1 hour 27-minute Express services from Central to Wollongong would be reduced to 1 hour 6 min.

Other savings could deliver a 1-hour Central-Wollongong Express service.



**Figure 11.1 Waterfall-Thirroul tunnel**

### 11.2 Canberra-Sydney-Wollongong medium speed rail.

Even if high-speed rail is built between Canberra and Sydney, it will need the support of other rail services to bring it customers. It will not be able to serve many intermediate communities as the effectiveness of the service will be lost to stopping time – trains generally limit acceleration/de-acceleration to 1 m/s.s for passenger comfort. One, or two, minutes are generally allowed for “dwell at platform with doors open” time.

As overturning forces for a train relate to the square of velocity, 200 km/h rail has far less costly infrastructure requirements compared to 350 km/h to 400 km/h rail.

Canberra CBD to Sydney CBD is about 287 km by road – longer by rail. Road travel takes approximately 3 hours. Rail travel takes 4 hours 12 minutes with just one service each way per day.

The aim should be a 2-hour commuter service between Canberra and Central with stops at major centres like Goulburn, Bowral, Mittagong and Campbelltown. The aim should also be Canberra-Central commuter services via Wollongong in 2.5 hours.

A two-hour commuter service will require replacement of most of the track infrastructure and probably three-quarters of the rail corridor. Indicative route location is given in Figure 11.2.

The aim would be to construct new infrastructure in segments such that new infrastructure can be put to use immediately a segment is completed.

The aim should also be for the rail line to approach Canberra from the north to maximise the benefit for Sydney -Melbourne freight and passenger services.

We need to keep in mind that high-speed rail does not replace the need for medium speed rail with its many more stops. Medium speed rail can carry freight services.

Freight services are not compatible with high-speed passenger services due to the speed differential exhausting most of the train paths.

High-speed passenger trains can have passenger cars converted to carry light-weight freight normally carried by express couriers and aircraft, but this is a separate market to current rail freight.

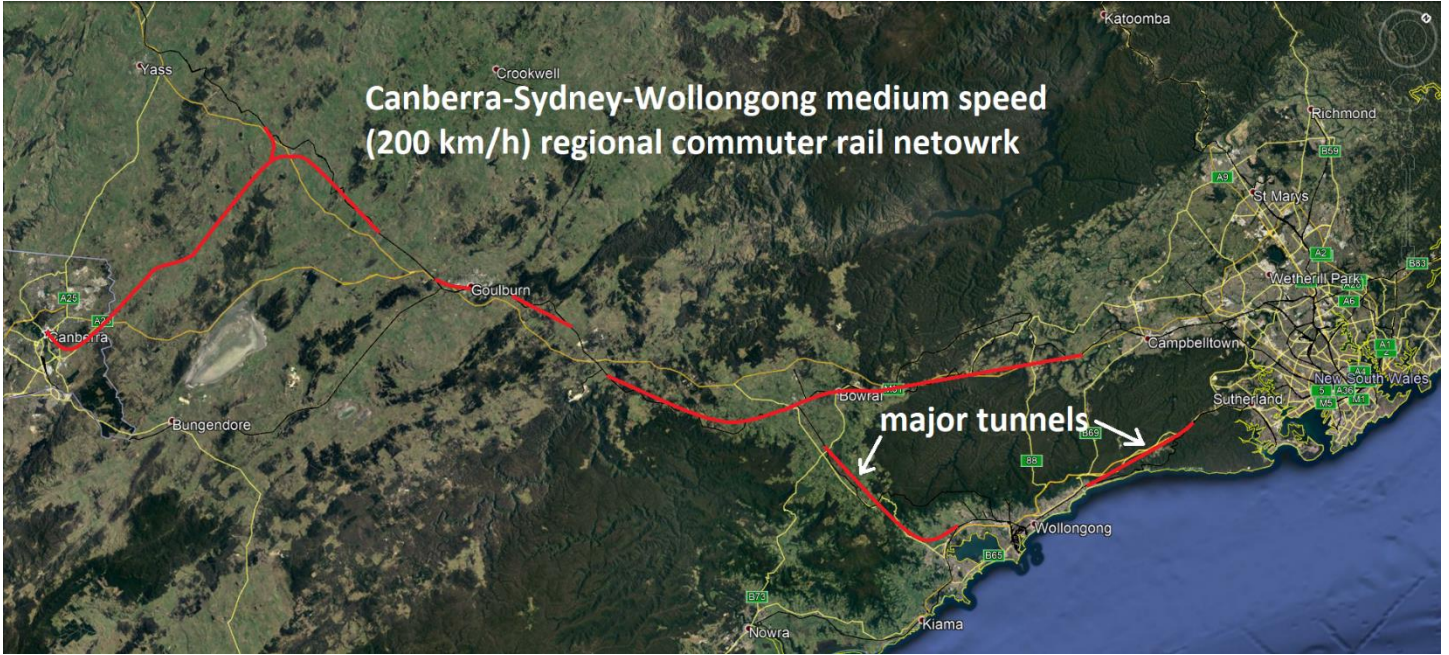


Figure 11.2 Canberra-Sydney-Wollongong medium speed rail



## Appendix 1- Infrastructure Priority List as at 10 April 2018 - New South Wales – organised by mode for service delivery

Proposed project	Description	Timescale	Category
<b><u>Sydney main roads</u></b>			
<b><u>Motorway</u></b>			
HPP	M4 Motorway upgrade (Parra to Lapstone)	Capacity - Outer western Sydney	Near term Urban Congestion
HPI	Sydney Gateway	Connectivity - WestConnex St Peters to Airport/Port Botany	Near term Urban Congestion
PI	F6 Extension	Connectivity - Wollongong to Sydney CBD Should be - Wollongong to Sydney metro area	Medium term Urban Congestion
PI	Western Harbour Tunnel and Beaches Link	Connectivity - Cross-harbour and Northern Beaches	Long term Urban Congestion
HPI	Preserve corridor - Outer Sydney Orbital Castlereagh Connection - M9 motorway & rail	Connectivity - Western Sydney to Central Coast/Illawarra	Near term Corridor Preservation
<b><u>Arterial Road</u></b>			
PP	The Northern Road upgrade	Capacity - S.W. Sydney growth area & WSA construct access	Near term National Connectivity
PI	Western Sydney Infrastructure Plan	Connectivity - Western Sydney and WSA	Near term National Connectivity
HPP	WestConnex	Capacity - Sydney inner west road	Near term Urban Congestion
HPI	Network Optimisation Program – Roads	Capacity - Congestion National urban road network	Near term Urban Congestion
PI	Moorebank IMT road upgrade	Capacity - Roads to Moorebank Intermodal Terminal	Near term National Connectivity
HPI	National Freight and Supply Chain Strategy	Capacity - National strategic planning - freight initiatives	Near term Urban Congestion
<b><u>NSW regional highways</u></b>			
PI	Pacific Hwy (M1) - extend to Raymond Tce	Capacity - Sydney to Brisbane	Near term National Connectivity
PI	Pacific Highway (A1) Coffs Harbour bypass	Capacity - Sydney to Brisbane	Near term National Connectivity
PI	Newell Highway (A39) upgrade	Capacity - Melbourne to Brisbane	Near term National Connectivity
PI	New England Highway (A15) upgrade	Capacity - Sydney to Brisbane	Medium term National Connectivity
<b><u>Sydney heavy rail</u></b>			
HPP	Sydney Metro: City and Southwest	Capacity - Sydney rail network	Medium term Urban Congestion
HPI	Sydney Metro West: Parra to Sydney CBD	Connectivity - Parramatta to Sydney CBD	Medium term Corridor Preservation
HPI	Preserve corridor - WSA rail connection	Connectivity - Rail to Western Sydney Airport	Near term Corridor Preservation
PI	WSA public transport connection	Connectivity - Western Sydney Airport	Long term National Connectivity
PI	Northern Sydney Freight Corridor Stage 2: Additional track West Ryde to Rhodes and Thornleigh to Hornsby	Capacity - Sydney freight rail network	Long term National Connectivity
PI	Central Station redevelopment	Connectivity - Urban & intercity rail, buses, light rail and metro	Medium term Urban Congestion
HPI	Sydney rail network capacity	Capacity - Sydney rail network	Near term Urban Congestion
HPI	Network Optimisation Program – Rail	Capacity - Increasing congestion urban corridors Aust cities	Near term Urban Congestion
HPI	Port Botany freight rail duplication	Capacity - Sydney Port Botany rail freight	Near term Opportunity for Growth
PI	Southern Sydney Freight Line upgrade	Capacity - Sydney South to Moorebank rail freight	Long term National Connectivity
HPI	Chullora Junction upgrade	Capacity - Sydney freight rail network	Near term Opportunity for Growth
HPI	Preserve corridor - West Syd Freight Line & IMT	Connectivity- Future Eastern Creek IMT & Main West Line	Near term Corridor Preservation
HPI	Preserve corridor - Outer Sydney Orbital/ Castlereagh Connection – rail & M9 motorway	Connectivity - Western Sydney to Central Coast/Illawarra	Near term Corridor Preservation

**NSW regional heavy rail**

PI	<b>Newcastle–Sydney line upgrades</b>	Connectivity - Newcastle to Sydney CBD	Long term	National Connectivity
PI	<b>Wollongong–Sydney line upgrades</b>	Connectivity - Wollongong to Sydney CBD	Long term	National Connectivity
PP	<b>Inland Rail (Melb-Bris via inland NSW)</b>	Connectivity - Freight, Melbourne to Brisbane	Long term	National Connectivity
HPI	<b>Preserve corridor - East Coast High Speed Rail</b>	Connectivity - rail between east coast capital cities	Near term	Corridor Preservation
PI	<b>Advanced Train Management System implementation on ARTC network</b>	Capacity - ARTC National Rail freight network	Near term	National Connectivity
PI	<b>Freight rail access to Port Kembla</b>	Connectivity - Freight rail to Port Kembla (Maldon-Dombarton?)	Near term	National Connectivity

**Sydney Buses-Light Rail**

HPI	<b>Southern Syd to CBD public trans enhance</b>	Connectivity - Inner south urban growth area to Sydney CBD	Medium term	Urban Congestion
HPI	<b>Public transport capacity (Parramatta Road and Victoria Road corridors)</b>	Capacity - Sydney corridors - North Beaches, Parra Rd, Vict Rd	Near term	Corridor Preservation
PI	<b>Public transport access to Parramatta CBD</b>	Connectivity - Public transport to Parramatta CBD	Medium term	Urban Congestion

**Active transport**

PI	<b>Walking and cycling access to Sydney CBD</b>	Connectivity - Inner city to Sydney CBD	Near term	Urban Congestion
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**Sydney ports/airports**

HPP	<b>Western Sydney Airport</b>	Capacity - Sydney aviation	Medium term	National Connectivity
HPI	<b>Preserve corridor - WSA fuel pipeline</b>	Connectivity - fuel to WSA	Near term	Corridor Preservation

**National gas grid**

PI	<b>Connect gas suppliers to eastern gas markets</b>	Connectivity - East Coast gas supply	Near term	Efficient Markets
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**Hawkesbury-Nepean River flood management**

PI	<b>Waste Water Treatment Hawkesbury-Nepean Valley flood management</b>	Capacity - Flood mitigation in Hawkesbury-Nepean Valley	Near term	Resilience
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**Legend**

**Timescale: Near term 0-5 years, Medium term 5-10 years, Long term 10-15 years**

**HPP - High Priority Projects** are potential infrastructure solutions for which a full business case has been completed and been positively assessed by the Infrastructure Australia Board. A High Priority Project addresses a major problem or opportunity of national significance.

**PP - Priority Projects** are potential infrastructure solutions for which a full business case has been completed and been positively assessed by the Infrastructure Australia Board. A Priority Project addresses a nationally-significant problem or opportunity.

**HPI - High Priority Initiatives** are potential infrastructure solutions for which a business case has not yet been completed. A High Priority Initiative seeks to address a major problem or opportunity of national significance.

**PI - Priority Initiatives** are potential infrastructure solutions for which a business case has not yet been completed. A Priority Initiative seeks to address a problem or opportunity of national significance.


## Appendix 2- Infrastructure Priority List as at 10 April 2018 - New South Wales

Proposed project	Problem description	Proposed delivery timescale	Problem category
<b>Near term 0-5 years, Medium term 5-10 years, Long term 10-15 years</b>			
<b>High Priority Projects</b>			
High Priority Projects are potential infrastructure solutions for which a full business case has been completed and been positively assessed by the Infrastructure Australia Board. A High Priority Project addresses a major problem or opportunity of national significance.			
<b>M4 Motorway upgrade (Parramatta to Lapstone)</b>	Connectivity - in outer western Sydney	Near term	Urban Congestion
<b>WestConnex</b>	Congestion - Sydney inner west road	Near term	Urban Congestion
<b>Sydney Metro: City and Southwest</b>	Capacity - Sydney rail network	Medium term	Urban Congestion
<b>Western Sydney Airport</b>	Capacity - Sydney aviation	Medium term	National Connectivity
<b>Priority Projects</b>			
Priority Projects are potential infrastructure solutions for which a full business case has been completed and been positively assessed by the Infrastructure Australia Board. A Priority Project addresses a nationally-significant problem or opportunity.			
<b>The Northern Road upgrade</b>	Connectivity - to S.W. Sydney growth area and construction access to WSA	Near term	National Connectivity
<b>Inland Rail (Melbourne to Brisbane via inland NSW)</b>	Connectivity – Freight, Melbourne to Brisbane	Long term	National Connectivity
<b>High Priority Initiatives</b>			
High Priority Initiatives are potential infrastructure solutions for which a business case has not yet been completed. A High Priority Initiative seeks to address a major problem or opportunity of national significance.			
<b>Sydney Gateway</b>	Connectivity - WestConnex St Peters to Sydney Airport/Port Botany	Near term	Urban Congestion
<b>Sydney rail network capacity</b>	Capacity - Sydney rail network	Near term	Urban Congestion
<b>Southern Sydney to CBD public transport enhancement</b>	Connectivity - Inner south urban growth area to Sydney CBD	Medium term	Urban Congestion
<b>National Freight and Supply Chain Strategy</b>	Capacity - National strategic planning - future freight initiatives	Near term	Urban Congestion
<b>Network Optimisation Program – Roads</b>	Capacity - Congestion National urban road network	Near term	Urban Congestion
<b>Network Optimisation Program – Rail</b>	Capacity - Increasing rates of congestion in urban areas across multiple corridors in Australian cities	Near term	Urban Congestion
<b>Preserve corridor - Western Sydney Freight Line and Intermodal Terminal access</b>	Connectivity - Future freight rail to Eastern Creek Intermodal and Main West Line	Near term	Corridor Preservation
<b>Public transport capacity (Parramatta Road and Victoria Road corridors)</b>	Congestion - Sydney corridors - Northern Beaches, Parramatta Road, Victoria Road	Near term	Corridor Preservation
<b>Preserve corridor - Outer Sydney Orbital road and rail / M9, and Castlereagh Connection</b>	Future connectivity - Western Sydney to Central Coast/Illawarra	Near term	Corridor Preservation
<b>Preserve corridor - Western Sydney Airport fuel pipeline</b>	Future connectivity - fuel to Western Sydney Airport	Near term	Corridor Preservation
<b>Preserve corridor - Western Sydney Airport rail connection</b>	Future connectivity - rail to Western Sydney Airport	Near term	Corridor Preservation
<b>Sydney Metro West (Mass transit between Parramatta and Sydney CBD)</b>	Connectivity - Parramatta to Sydney CBD	Medium term	Corridor Preservation

<b>Proposed project Priority Initiatives</b>	<b>Problem description</b>	<b>Proposed delivery timescale</b>	<b>Problem category</b>
<b>Preserve corridor - East Coast High Speed Rail</b>	Future connectivity – rail between east coast capital cities	Near term	Corridor Preservation
<b>Port Botany freight rail duplication</b>	Capacity - Sydney Port Botany rail freight	Near term	Opportunity for Growth
<b>Chullora Junction upgrade</b>	Capacity - Sydney freight rail network	Near term	Opportunity for Growth
<p>Priority Initiatives are potential infrastructure solutions for which a business case has not yet been completed. A Priority Initiative seeks to address a problem or opportunity of national significance.</p>			
<b>Active transport (walking and cycling) access to Sydney CBD</b>			
<b>F6 Extension</b>	Connectivity - Inner city to Sydney CBD	Near term	Urban Congestion
<b>Public transport access to Parramatta CBD</b>	Connectivity - Wollongong to Sydney CBD	Medium term	Urban Congestion
<b>Central Station redevelopment – rail and station infrastructure</b>	Connectivity - Public transport to Parramatta CBD	Medium term	Urban Congestion
<b>Western Harbour Tunnel and Beaches Link</b>	Connectivity - Urban and intercity rail, buses, light rail and metro	Medium term	Urban Congestion
<b>Western Sydney Infrastructure Plan</b>	Connectivity - Sydney road network cross-harbour and Northern Beaches	Long term	Urban Congestion
<b>Pacific Highway (M1) - extend to Raymond Terrace</b>	Connectivity - to Western Sydney and Western Sydney Airport	Near term	National Connectivity
<b>Moorebank Intermodal Terminal road connection upgrade</b>	Connectivity - Sydney to Brisbane	Near term	National Connectivity
<b>Newell Highway upgrade</b>	Connectivity - Road network to Moorebank Intermodal Terminal	Near term	National Connectivity
<b>Pacific Highway (A1) – Coffs Harbour bypass</b>	Connectivity - Melbourne to Brisbane	Near term	National Connectivity
<b>Freight rail access to Port Kembla</b>	Connectivity - Sydney to Brisbane	Near term	National Connectivity
<b>New England Highway upgrade</b>	Connectivity - Freight rail to Port Kembla (Maldon to Dombarton)	Near term	National Connectivity
<b>Northern Sydney Freight Corridor Stage 2: Additional track West Ryde to Rhodes and Thornleigh to Hornsby</b>	Connectivity - Sydney to Brisbane	Medium term	National Connectivity
<b>Southern Sydney Freight Line upgrade</b>	Capacity - Sydney freight rail network	Long term	National Connectivity
<b>Newcastle–Sydney and Wollongong– Sydney rail line upgrades</b>	Capacity - Sydney South to Moorebank rail freight	Long term	National Connectivity
<b>Western Sydney Airport public transport connection</b>	Connectivity - between Newcastle, Wollongong, Sydney CBD	Long term	National Connectivity
<b>Advanced Train Management System implementation on ARTC network</b>	Connectivity - to Western Sydney Airport	Long term	National Connectivity
<b>Waste Water Treatment Hawkesbury-Nepean Valley flood management</b>	Capacity - ARTC National Rail freight network	Near term	National Connectivity
<b>Connect gas suppliers to eastern gas markets</b>	Capacity - Flood mitigation in Hawkesbury-Nepean Valley	Near term	Resilience
	Connectivity - East Coast gas supply	Near term	Efficient Markets

### Appendix 3– Sydney trains and Sydney Metro Signalling systems

The life of the Sydney network signalling system is limited as indicated by the TfNSW slide below.



#### System rollout: significant coming events

- Pilot trial of ETCS L2 between Arncliffe and Oatley, likely to commence in 2015?
- Subsequent network 'events' that may influence the potential next stages of rollout:

2019	Commissioning of North West Rail Link <ul style="list-style-type: none"> <li>- Operational need to establish reliable high frequency services to meet additional demand from NWRL between Sydney CBD and Chatswood.</li> </ul>
2020	Nominal life expiry of Sydney Interlocking.
2022	Nominal life expiry of Strathfield Interlocking



#### Anticipated benefits

Strategic Business Requirement	Advanced Train Control Systems Contribution
<b>Safety</b>	<ul style="list-style-type: none"> <li>• SPAD protection</li> <li>• Overspeed protection</li> <li>• Maintenance worker safety</li> </ul>
<b>Cost</b>	Simplified trackside infrastructure leads to <ul style="list-style-type: none"> <li>• Lower capital costs</li> <li>• Lower operational and maintenance costs</li> </ul>
<b>Capacity</b>	<ul style="list-style-type: none"> <li>• Consistency in train behaviour</li> <li>• Reduced platform re-occupation times</li> <li>• Increased capacity</li> </ul>
<b>Carbon</b>	<ul style="list-style-type: none"> <li>• Optimised energy consumption for trains</li> <li>• Reduced energy consumption by trackside infrastructure</li> </ul>
<b>Customer Satisfaction</b>	<ul style="list-style-type: none"> <li>• Higher performance / higher reliability services</li> <li>• Lower operational impact during project work</li> <li>• Reduced journey times</li> </ul>

The network currently uses 'fixed-block' signalling (Figure 1 below). The block length on the Western-North Shore line is currently being reduced to increase service reliability - 20 trains per hour is requiring a reduction in block length. Block length is a significant constraint on capacity. Intercity capacity may be as low as 12 trains per hour due to block length. Decreasing block size to increase service frequency is subject to the law of diminishing returns.

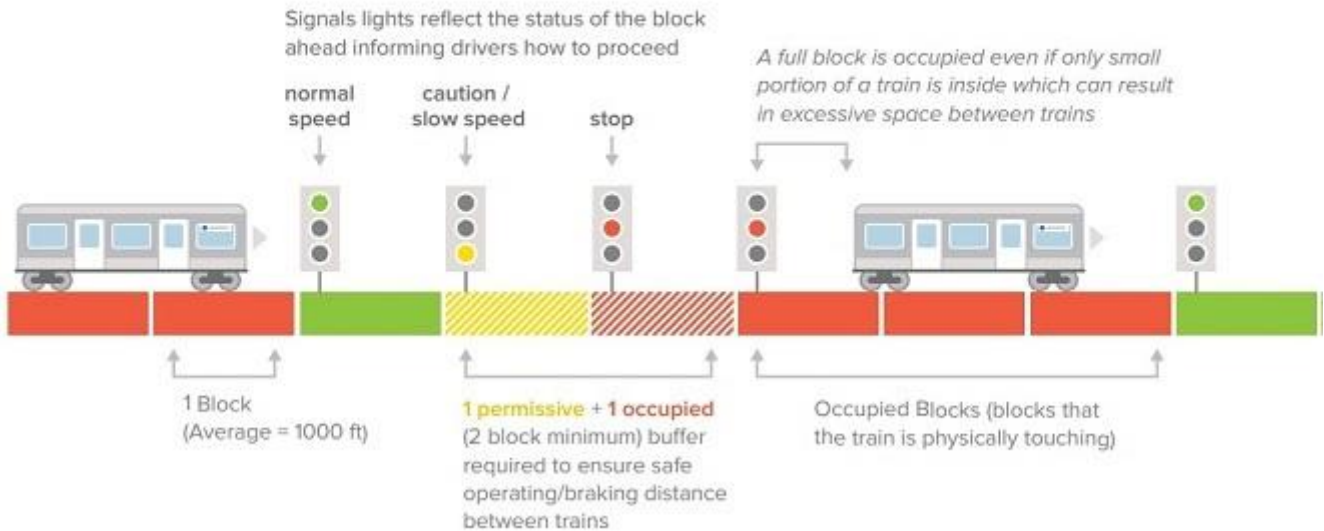
Capacity for rail lines with automated 'moving block' signalling (Figure 3 below), with single-deck trains (Sydney Metro), is 30 services per hour. This reduces to about 27 services per hour for 'higher-capacity' double-deck trains provided platforms have adequate capacity.

Higher-capacity trains require greater dwell time. A 50% increase in dwell time will lead to a 10 to 15% increase in train cycle time. Central, Town Hall and Wynyard need upgrades for high-capacity boarding and alighting.





**Figure 1: Diagram of a Conventional Fixed Block Signal System**



**Figure 3: Diagram of a Moving Block (CBTC) Signal System**

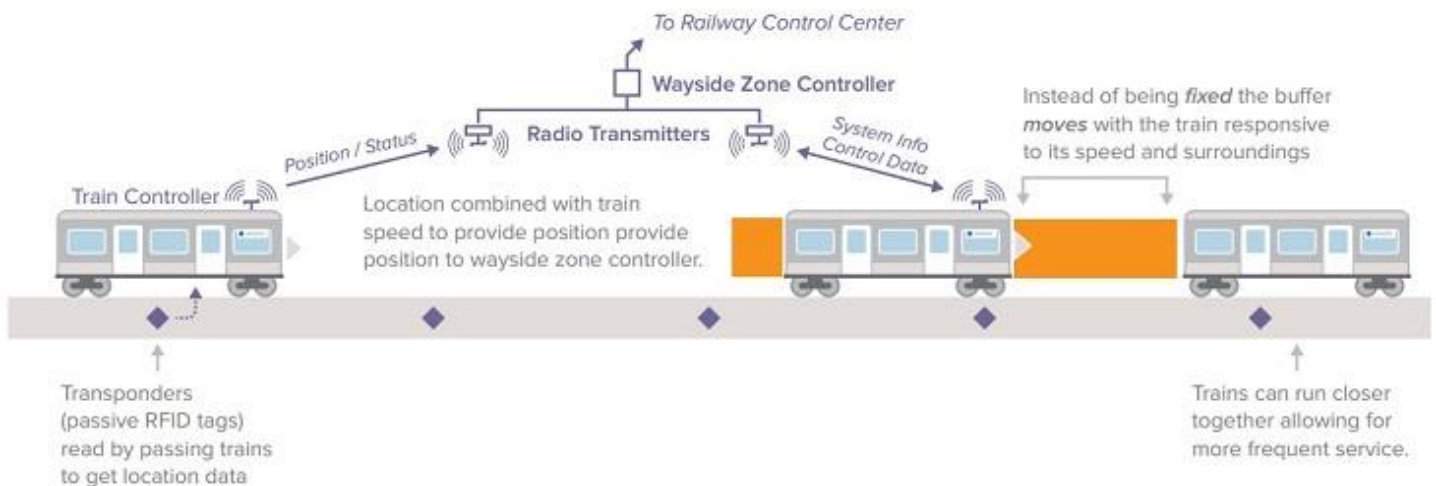


Figure A3.1 compares braking distance for fixed and moving block signalling systems. Figure A3.2 shows the simplified track infrastructure of a CBTC system. Figure A3.5 shows the TfNSW long-term vision for signalling systems.

The 2056 Transport plan says: "Implementation of modern Train Control & Signalling technology across network in planning". It appears government planning underway will deliver a moving block system.

In terms of automation, Sydney Metro will operate at level 4, while TfNSW is planning level 2 for the Sydney Trains network (Figure A3.3). These plans are also represented in Figure A3.4 – Table of increasing efficiency and train management and TfNSW plans.

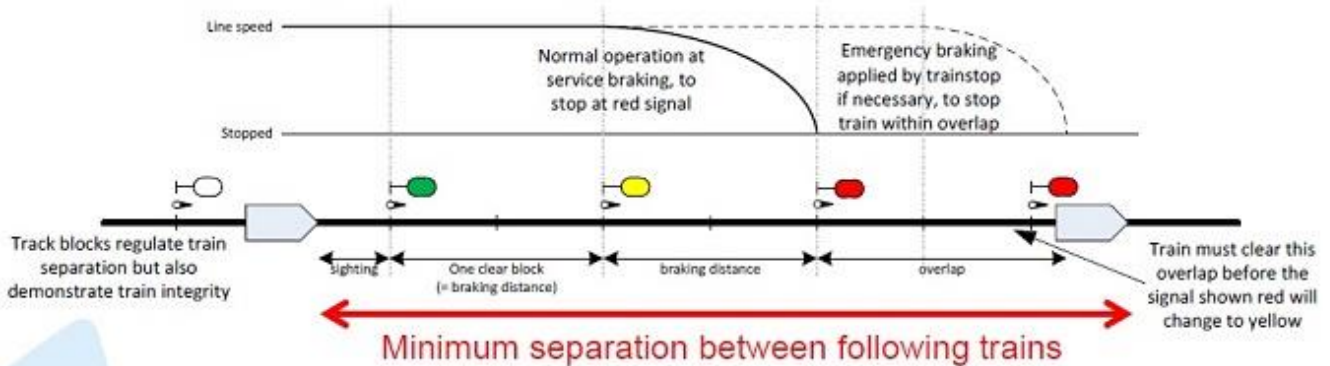
Sydney Metro uses Wi-Fi frequency communications due to its narrow corridor, and high data rates for live video from train carriages.

Sydney Trains uses lower frequency mobile phone frequency communications due to its longer and wider corridors.

A train can easily be equipped with both systems.

# Increasing capacity

## Traditional signalling with trainstops



## ATP Level 2 (Continuous ATP)

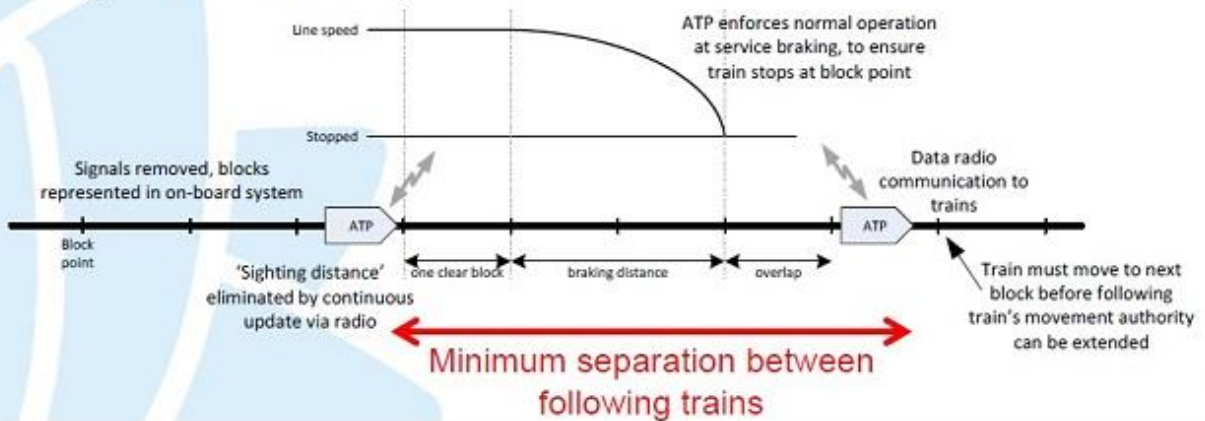


Figure A3.1 braking distance and signalling systems

## Simplified trackside infrastructure

### Level 2 ATP requires:

- Train detection (track circuits or axle counters)
- Balises (for odometry correction)
- Point machines and detection

### Level 3 ATP requires:

- Balises (for odometry correction)
- Point machines and detection
- But – also requires on-board train integrity management



Figure A3.2 Simplified trackside infrastructure



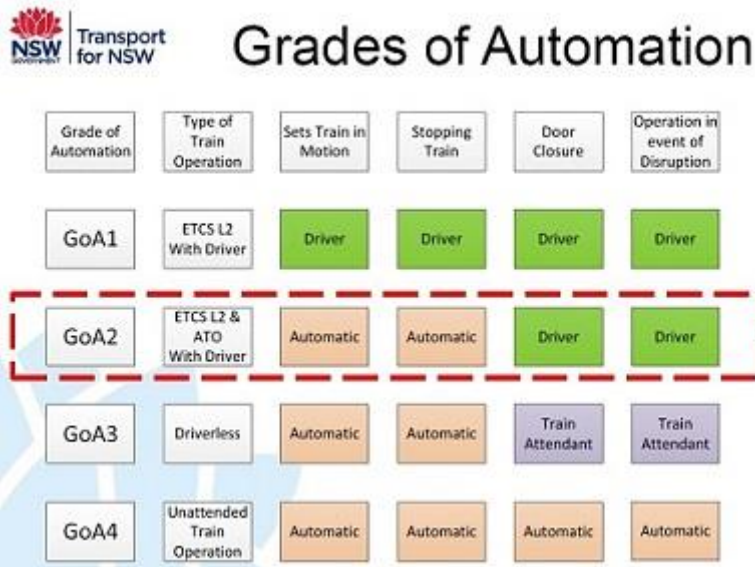


Figure A3.3 – Grades of automation and TfNSW selection for Sydney Trains network

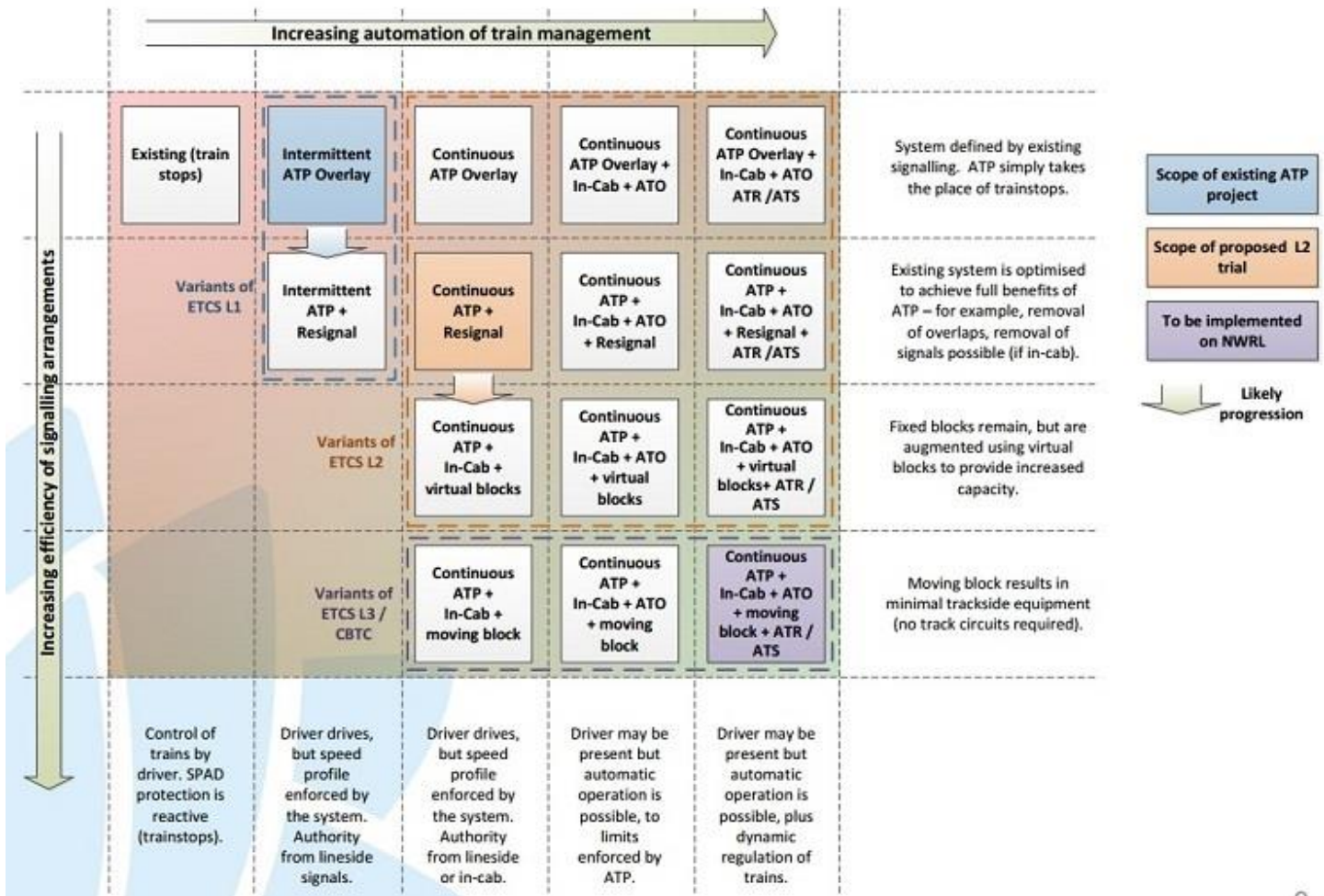


Figure A3.4 – Table of increasing efficiency and train management and TfNSW plans

# Long term vision for systems

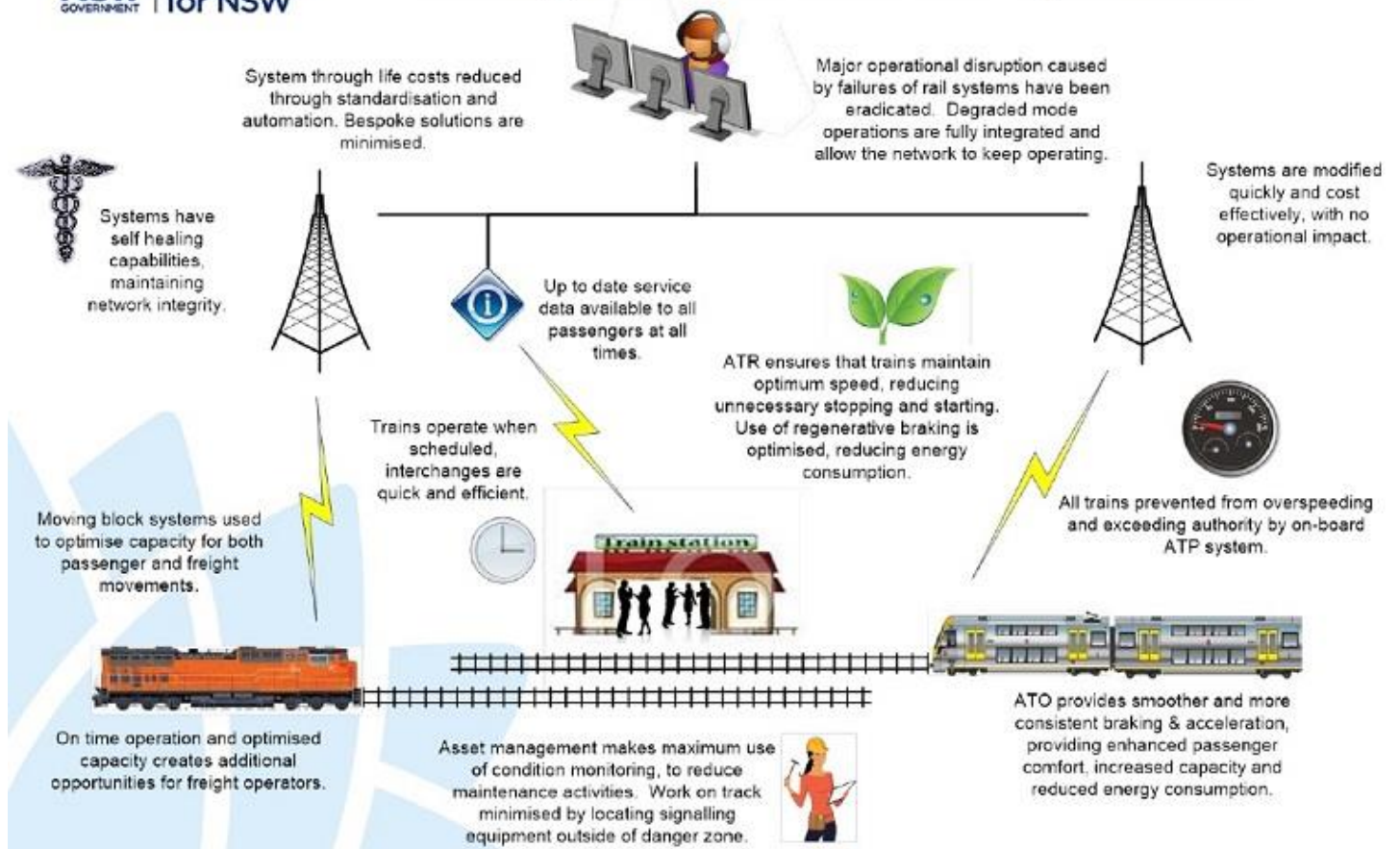


Figure A3.5 TfNSW long-term vision for signalling systems

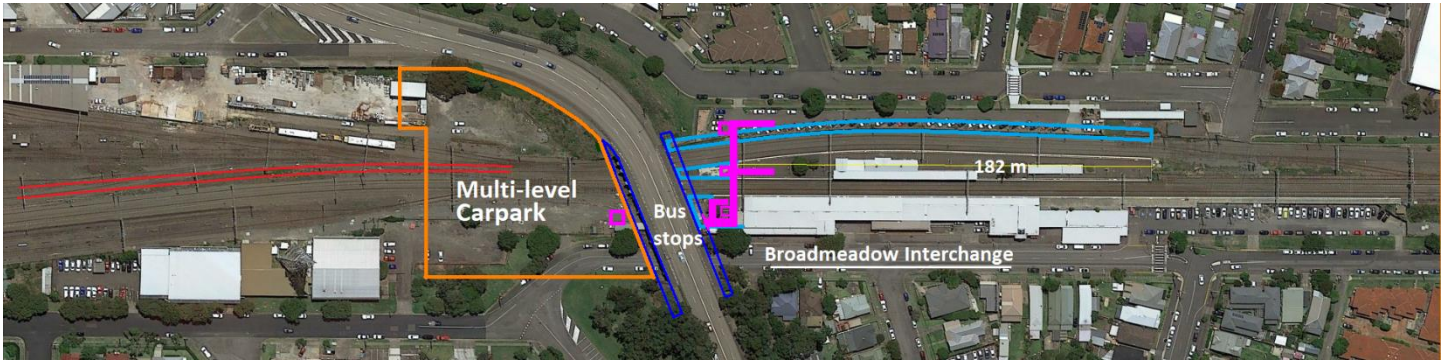


# Appendix 4 – Proposed upgrades for ‘Express’ stations Central to Newcastle Interchange

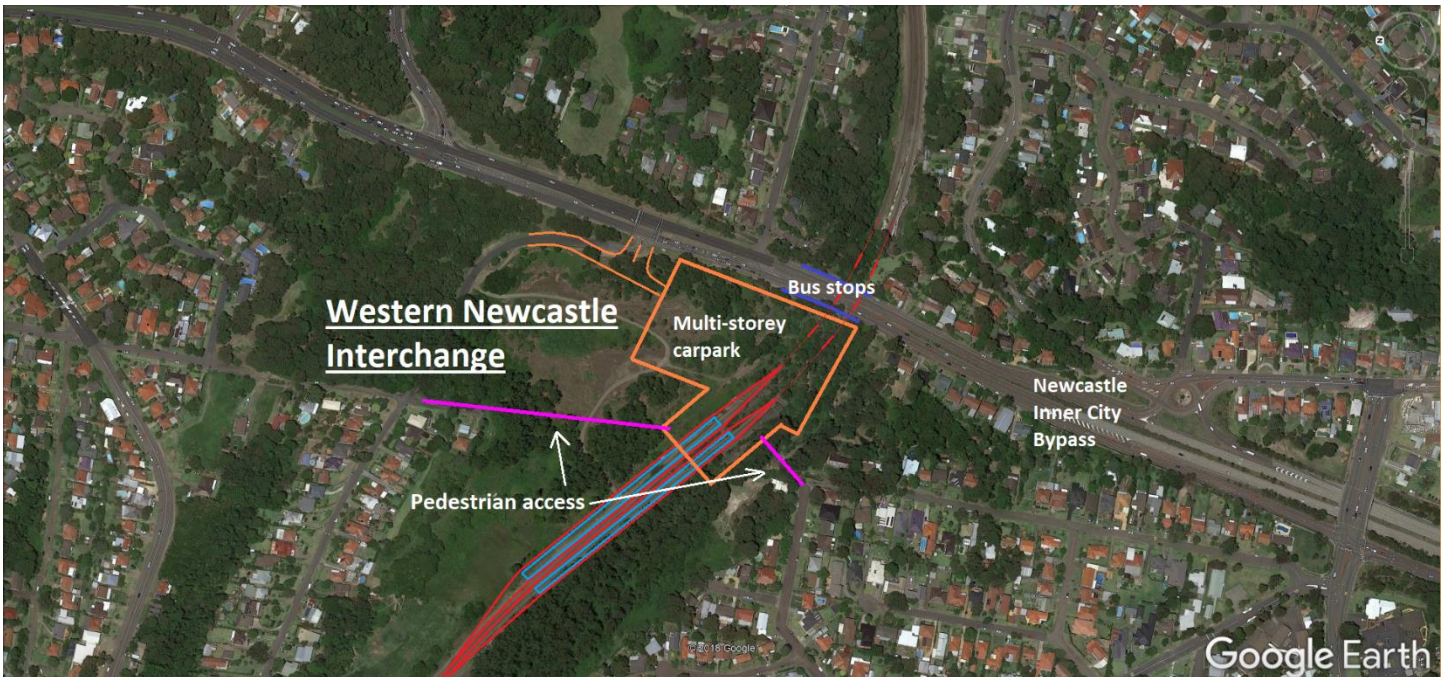
## Appendix – Northern-Central Coast-Newcastle line ‘Express’ station upgrades



Newcastle Interchange – requires tram track for completion



Broadmeadows – heritage station in need of a multi-story carpark and bus stops on road overpass

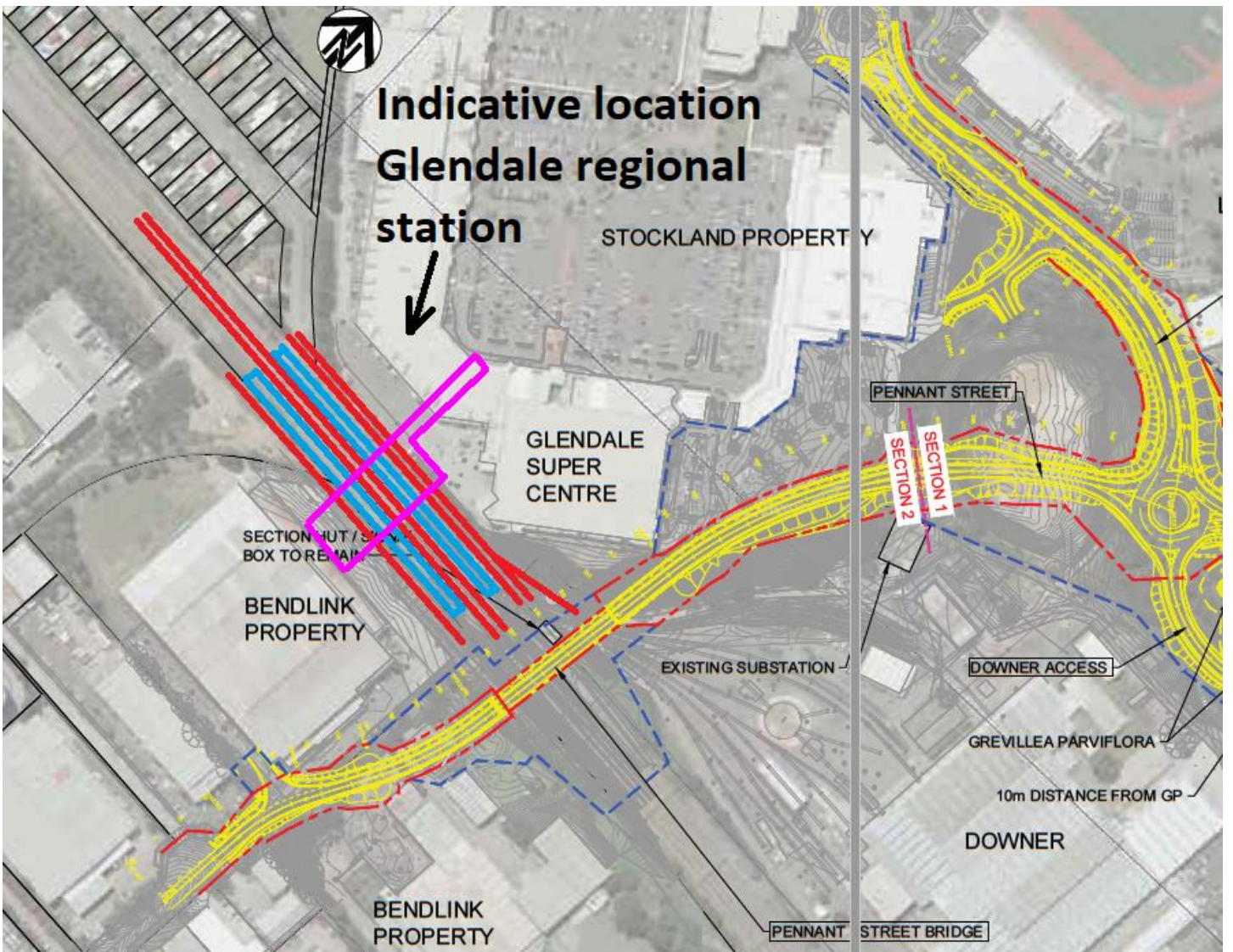


Western Newcastle Interchange – new station serving region linked by Inner City Bypass



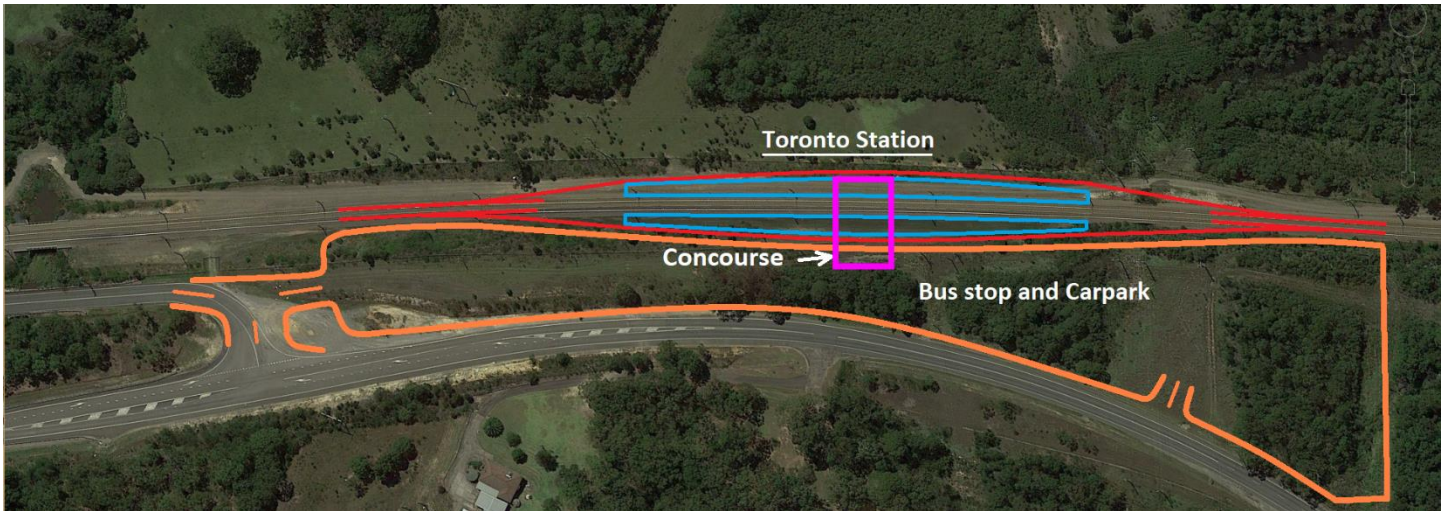


North Cardiff – new station serving region linked by State route 128

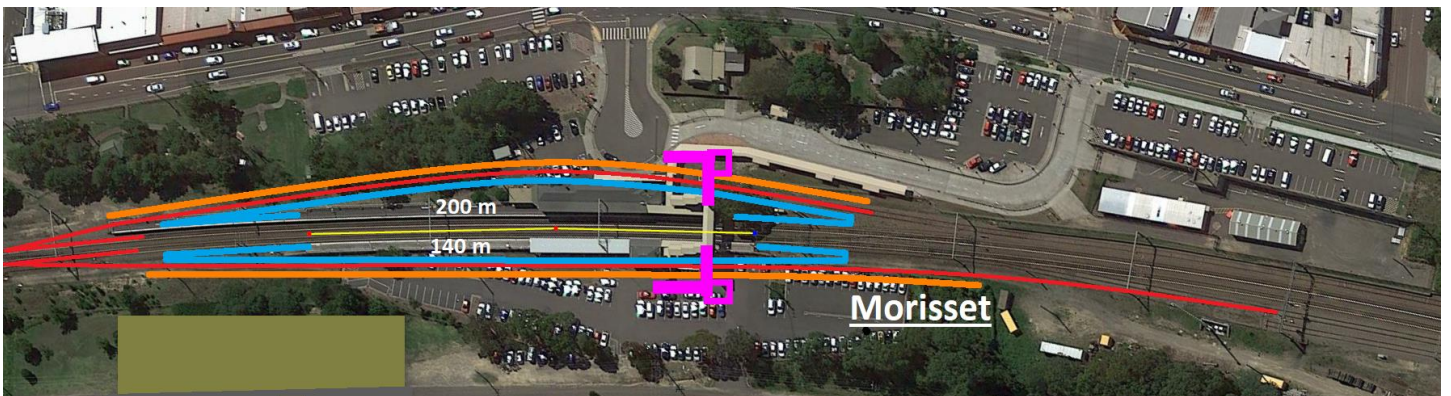


Glendale – new regional station supported by Lake Macquarie Council

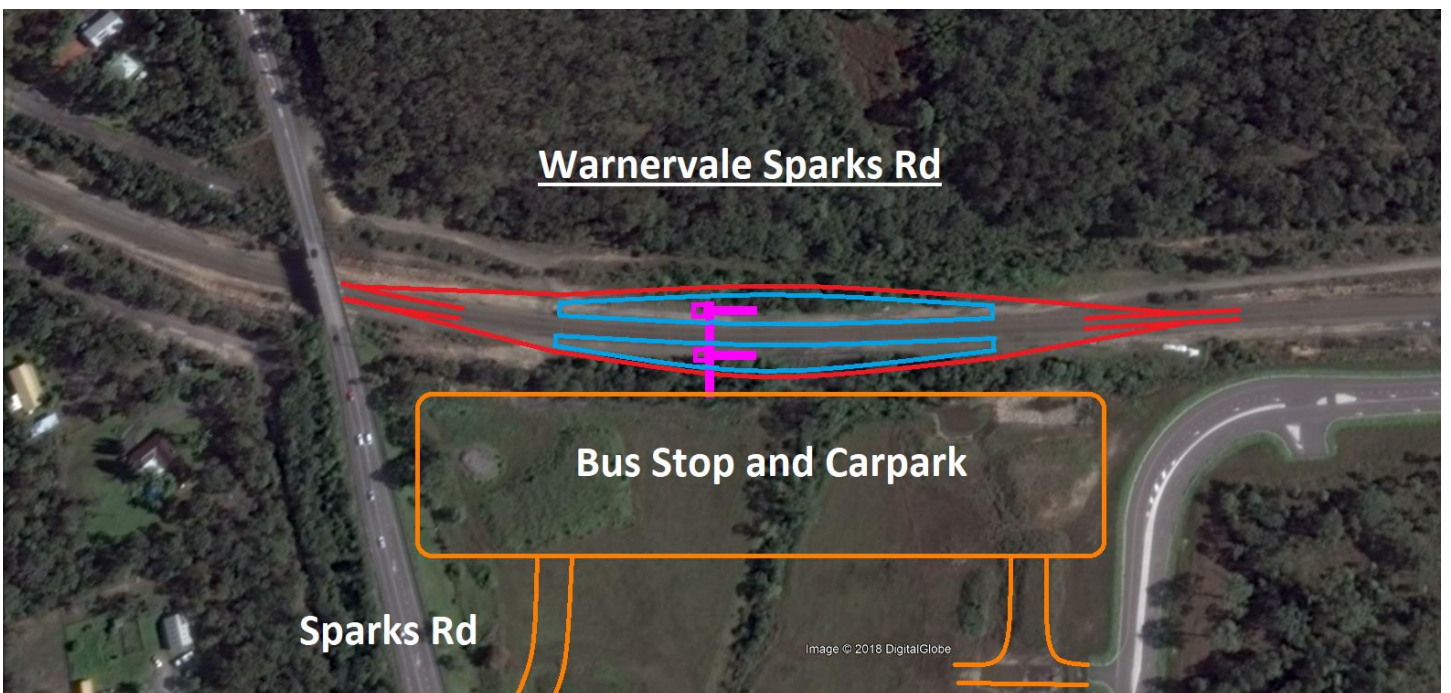




Toronto – new station on Awaba Rd to support this regional centre



Morisset – new platforms to create double-island platforms



Warnervale Sparks Rd – new station to serve the Gorokan-Toukley region

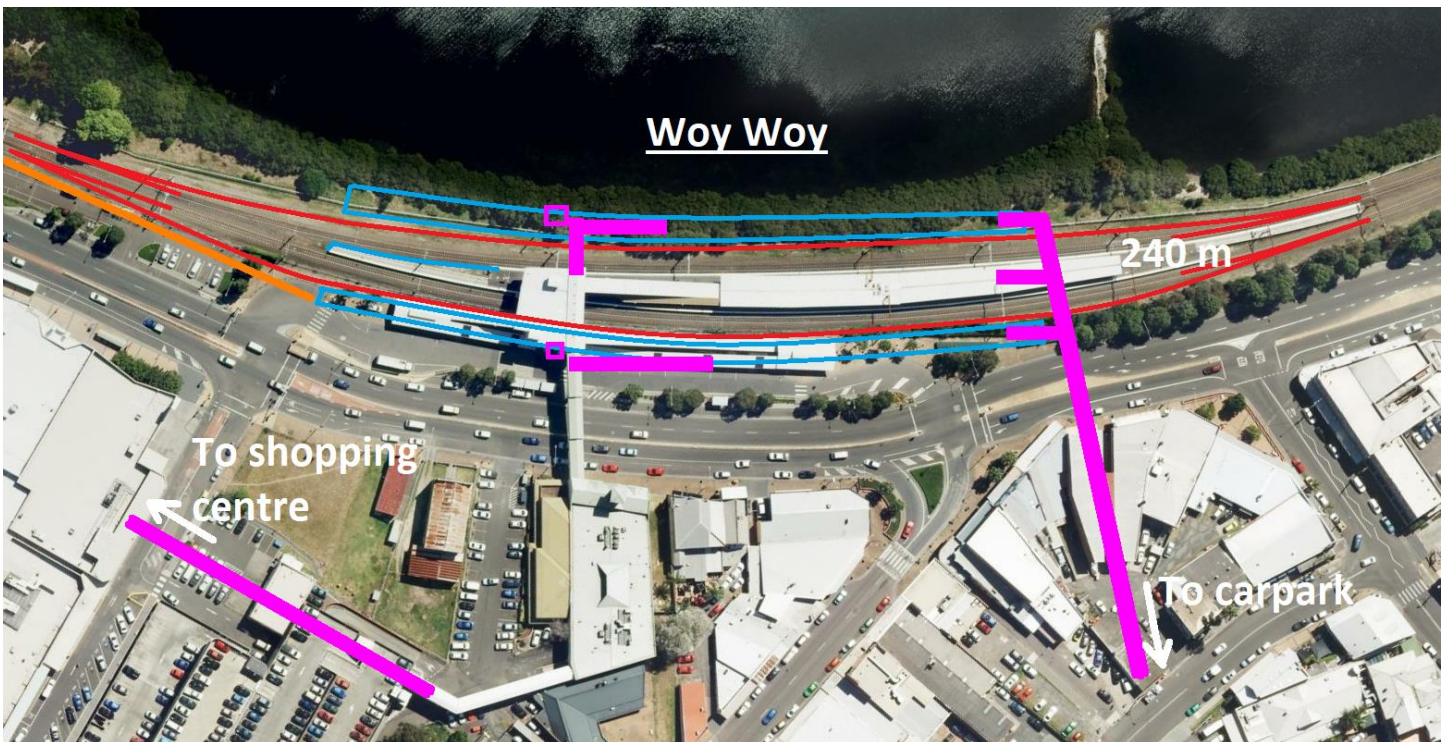




Wyong – new platform to create double-island platforms



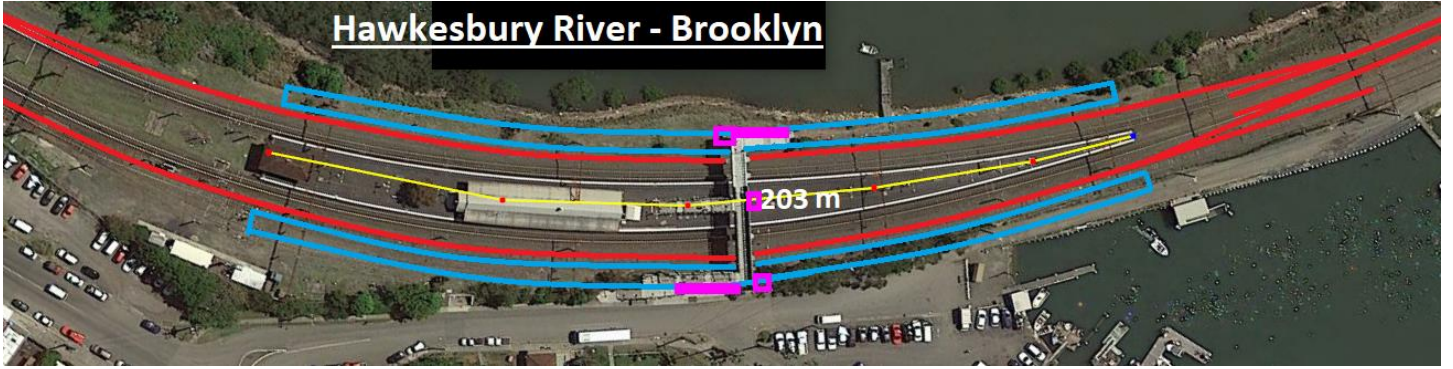
Gosford – new platform to create double-island platforms



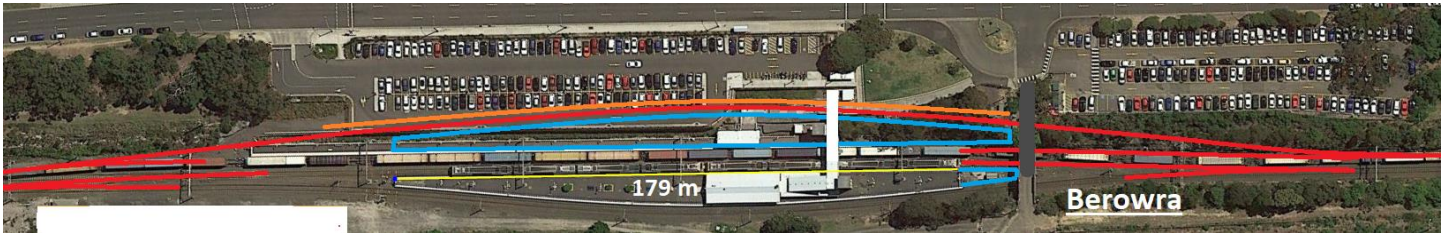
Woy Woy – add side tracks and side platforms to allow All Stops and Express trains to pass







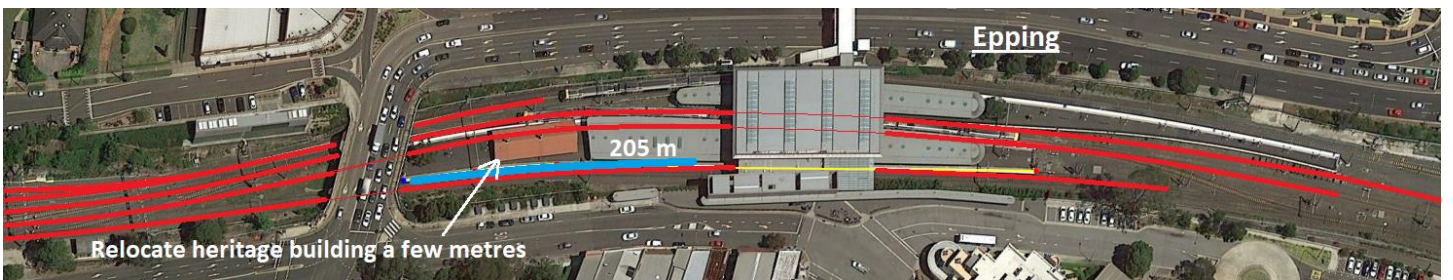
Hawkesbury River/Brooklyn – add side tracks and side platforms



Berowra – add platform to create double-island platforms



Hornsby Station – extra platforms and site development with heritage building preservation



Epping – modify platforms to create double-island platforms





Strathfield Station has sufficient platforms

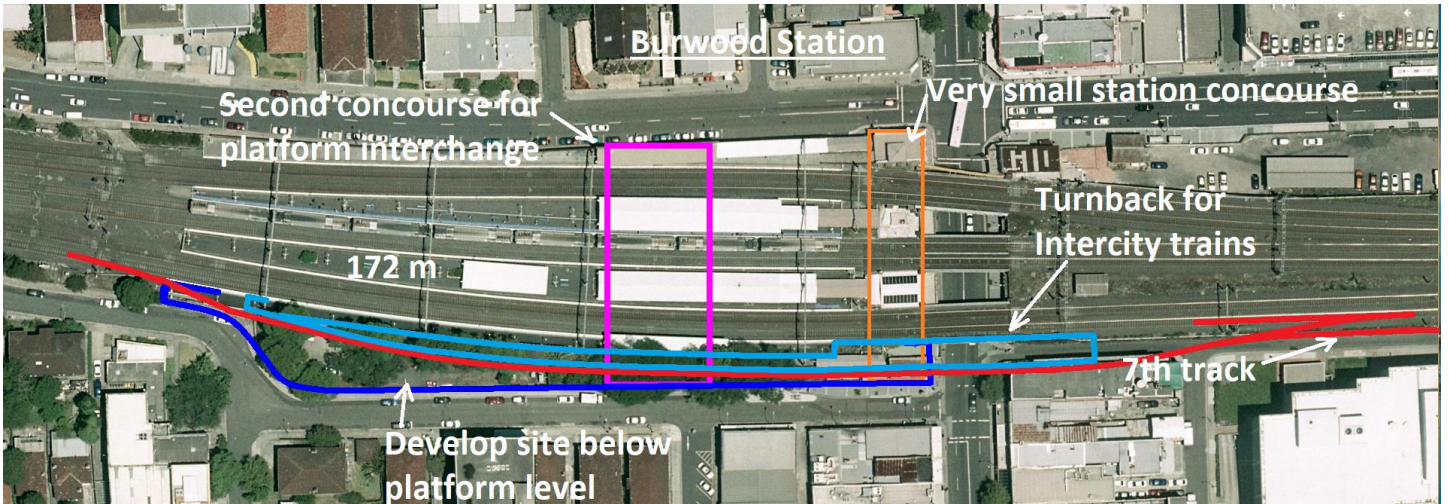


Possible 7<sup>th</sup> track Wentworth Rd to Strathfield 310 metres

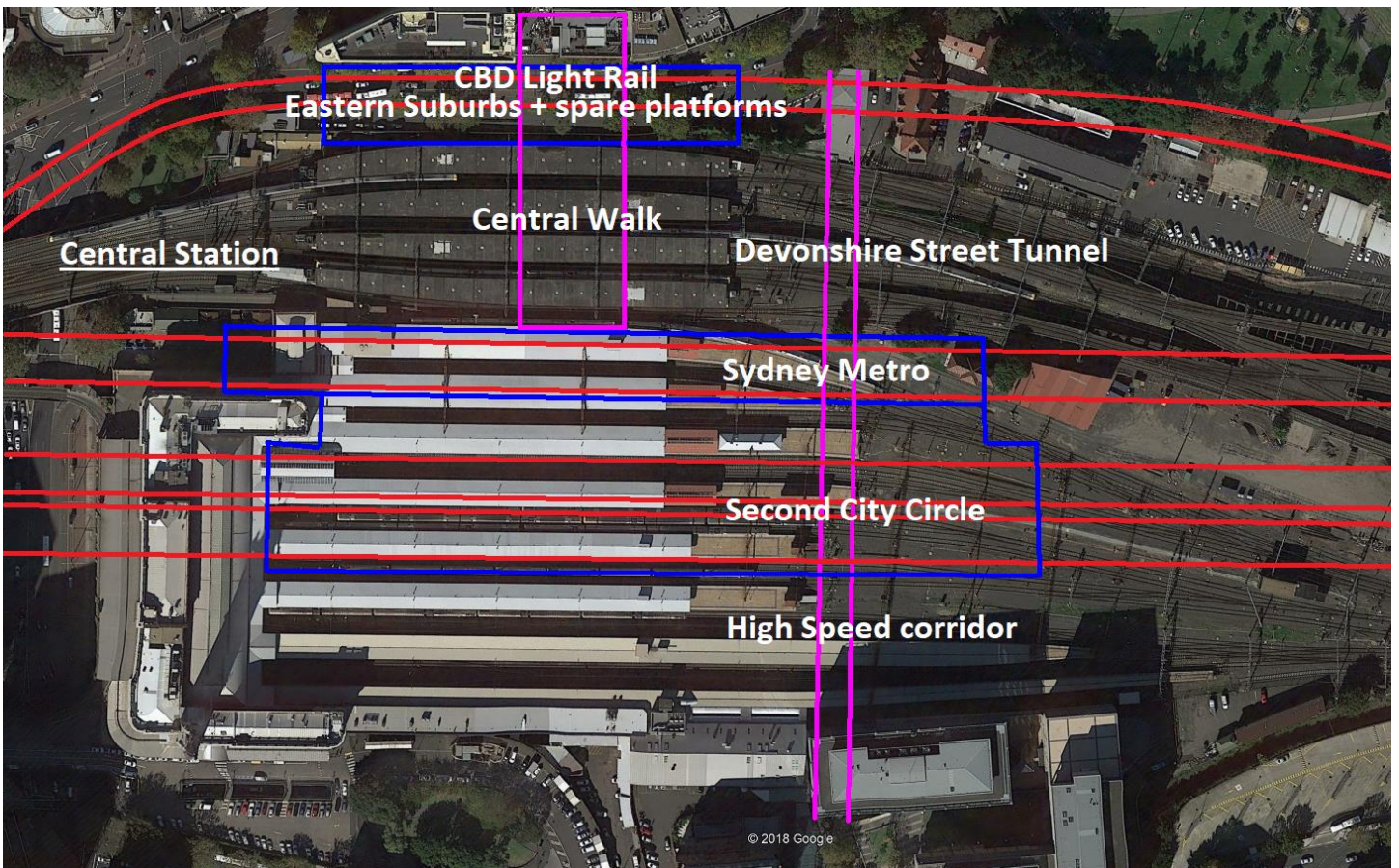


Possible 7<sup>th</sup> track Burwood to Wentworth Rd 630 metres





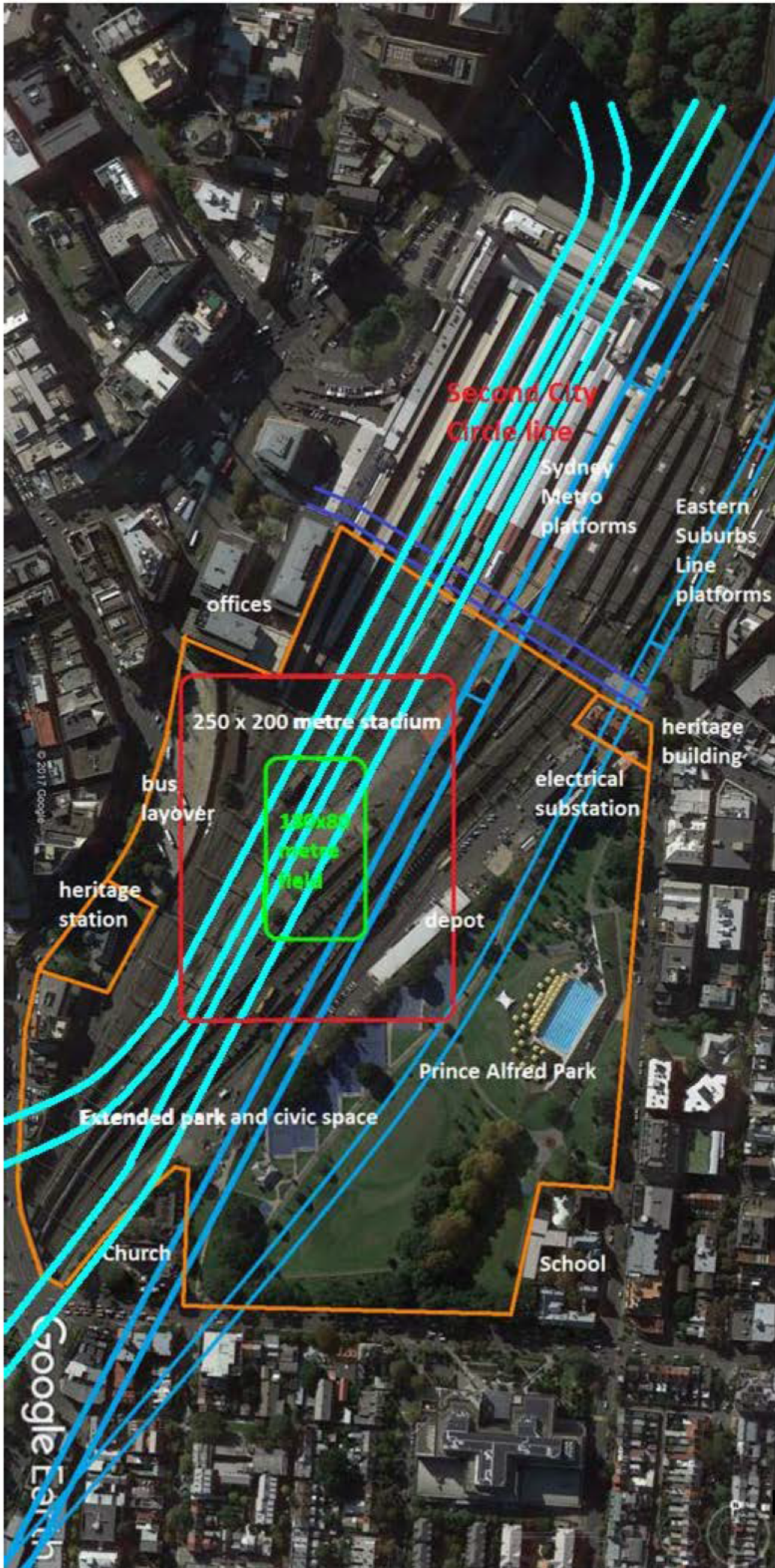
Burwood – add second concourse below platforms and a seventh platform to serve regional centre in place of Strathfield.



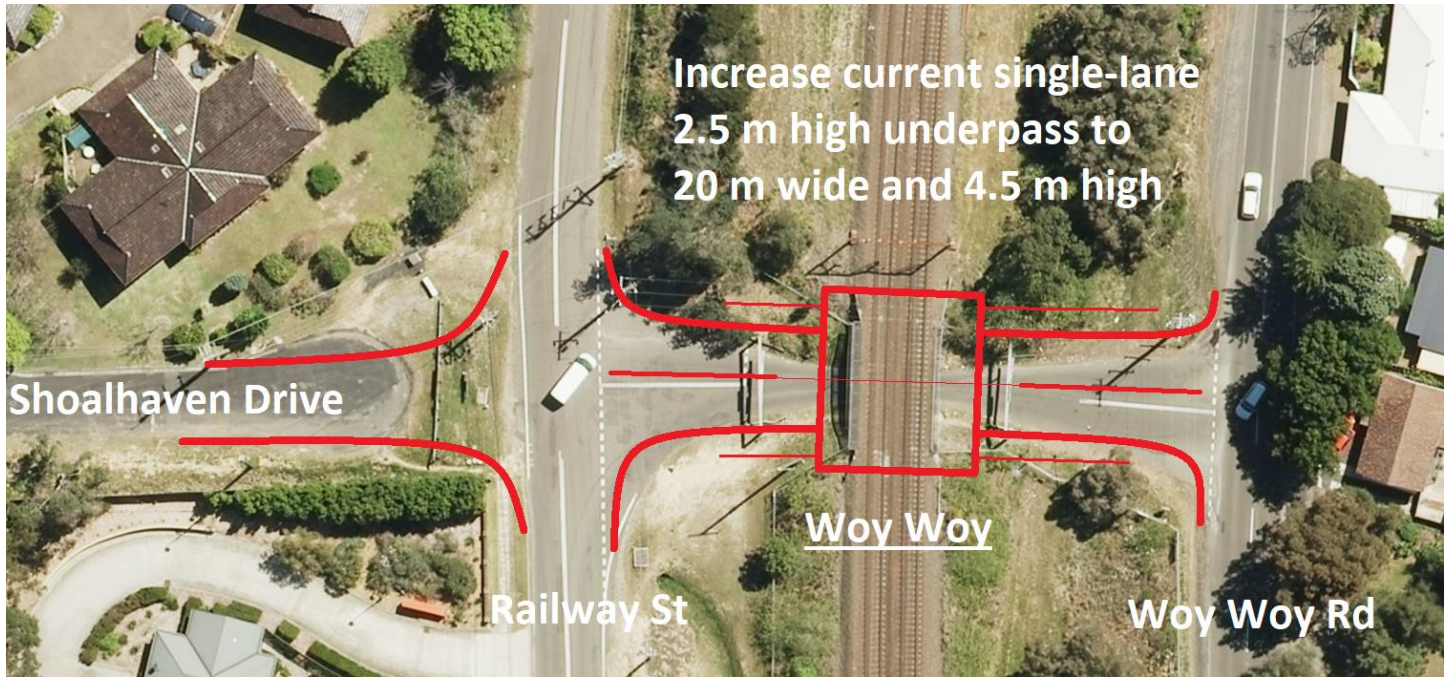
Add Second City Circle platforms under Central Terminal platforms once Metro platforms are complete.

Central Station – Central Walk and Metro platforms underway

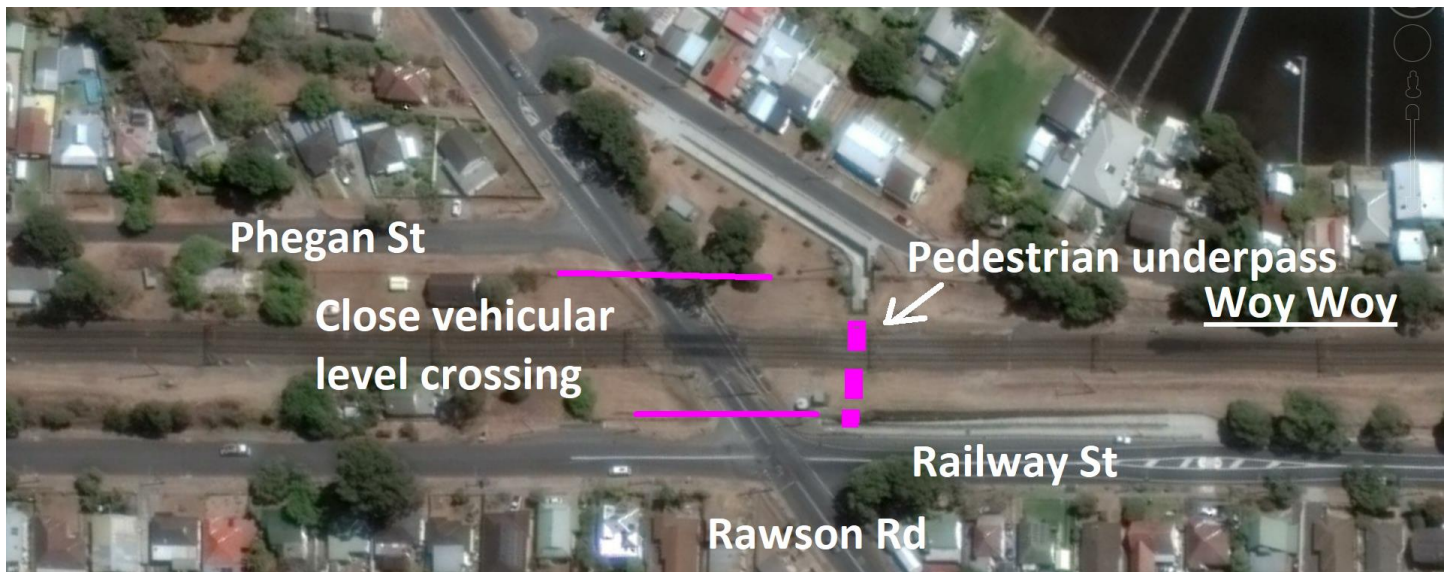




Appendix5 – Level crossing removals



Shoalhaven Drive Woy Woy full size underpass

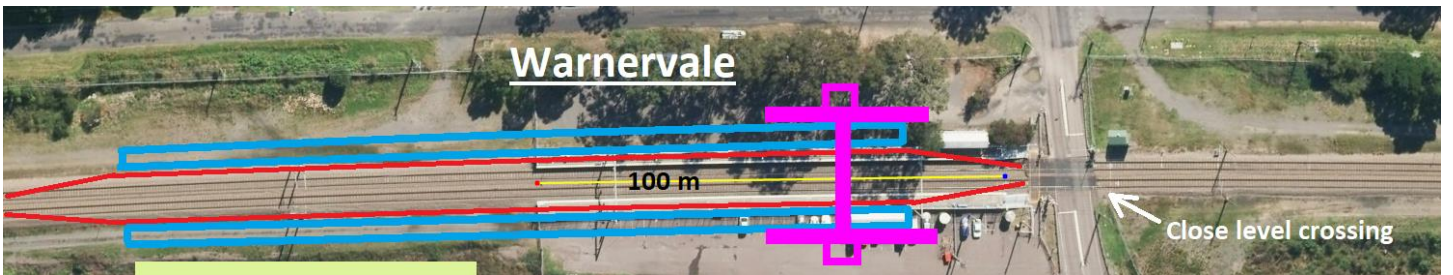


Rawson Rd Woy Woy level crossing closure





**Koolewong road over pass and level crossing closure**



**Warnervale level crossing closure with pedestrian crossing via station access**



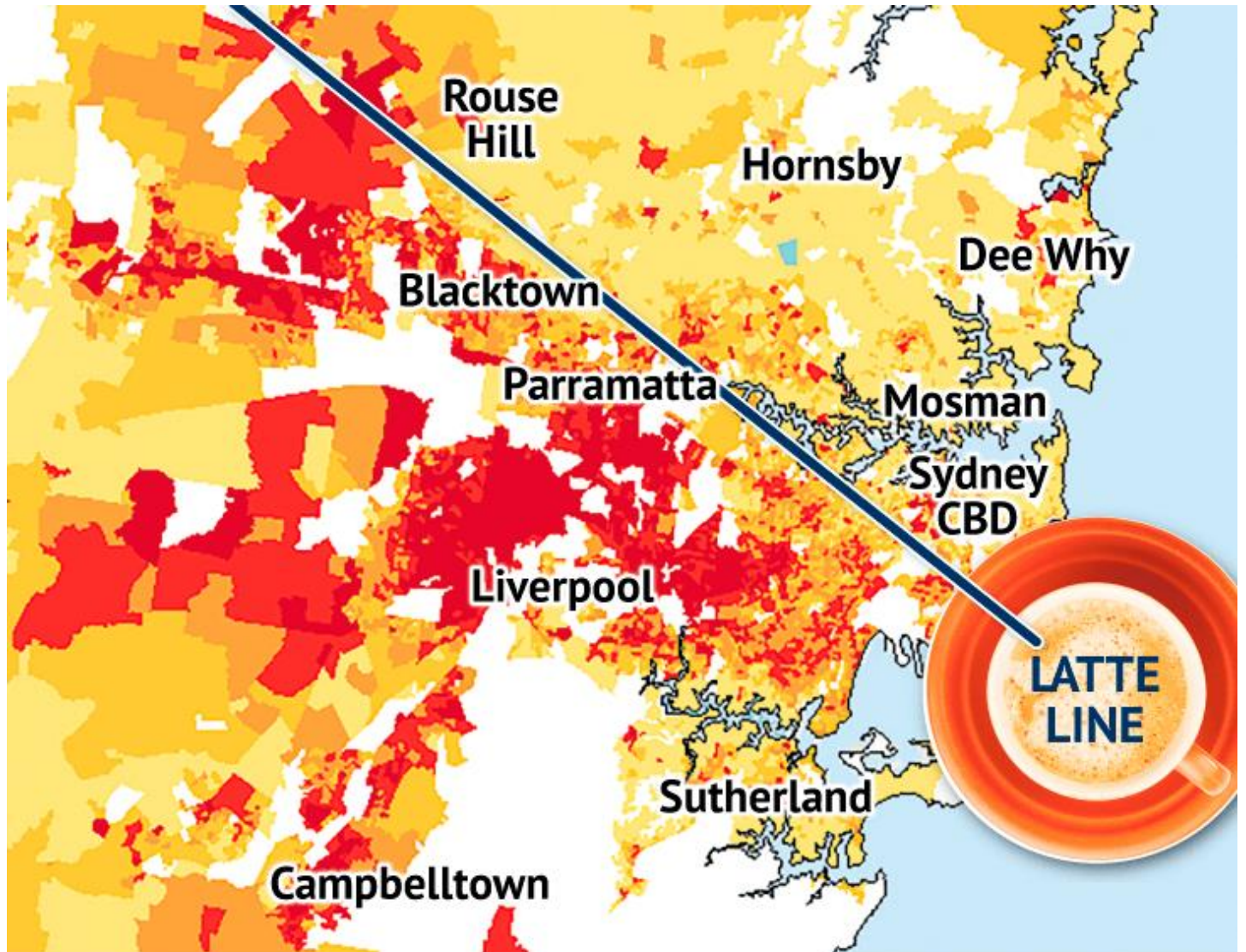
**Adamstown level crossing closure post construction of a road underpass with pedestrian crossing via station access**



## Appendix 6 - Sydney's latte line exposes a city divided

By Nigel Gladstone Updated 28 March 2018 — 9:01am first published at 12:01am SMH

<https://www.smh.com.au/national/nsw/sydney-s-latte-line-exposes-a-city-divided-20180327-p4z6et.html>



LEAST ADVANTAGED



MOST ADVANTAGED

Sydney's north shore is now the most advantaged area in the country to live but, several inner-city and outer suburban areas have been on a very different trajectory since 2006.

Sydney is home to seven of the 10 most advantaged postcodes in Australia, excluding military bases, with Northbridge, Pymble, Seaforth, Beecroft, St Ives, Castle Cove and West Pennant Hills all rising to the top of the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD). These places have all improved their rankings by more than 100 places since 2006. And none of the top 264 postcode areas has declined in these rankings since 2011 or 2006.

The so-called latte line, a border that splits Sydney down class and economic lines running from the airport north-west through Parramatta, is illustrated in new data from the Australian Bureau of Statistics that uses measures of income, occupation and other information to rank an areas' economic and social conditions as part of their Socio-Economic Indexes for Areas (SEIFA). Advantage is defined as access to "material and social resources", as well as the ability to participate in society.

The 10 most disadvantaged council areas in Australia were either in Queensland or the Northern Territory, but when the SEIFA data is analysed by postcode, Claymore near Campbelltown, is the country's fourth most underprivileged suburb and the most disadvantaged in NSW when measured by IRSAD.

Claymore had suffered from high rates of crime and stigma from its social housing estate when residents took to Facebook in 2016 with ideas to rename the area. It was set to be redeveloped as part of the Claymore Urban renewal project and their suggestions included South Mosman, Sunnyville, and Rainbow Valley.

The postcode area around Villawood was ranked 30 on the IRSAD measurements for disadvantage while Cabramatta had the 44th lowest score in Australia. The ranking of these areas and most of the bottom 200 postcodes have declined since both the 2011 and 2006 census. Villawood was 110 places lower and Cabramatta 95 places below where they were in 2006.

Some inner-city areas across the country have been on a rapid downward trend with the Ultimo, Chippendale, Redfern, Brisbane CBD, Melbourne CBD and Adelaide CBD postcode areas all falling more than 800 places in the IRSAD rankings since 2006.

But the reasons for these changes are different to those affecting suburban shifts over time. Distinctly different groups of people live in the inner city areas, with both a big proportion of unemployed people and a relatively high proportion of people with large incomes. Changes in the proportions of these groups may explain the dramatic changes to their scores over time, an ABS spokeswoman said.

More than 30 per cent of people born in South Africa, China and Malaysia were more likely to live in advantaged areas than disadvantaged areas while 40 per cent of Vietnamese-born Australians lived in disadvantaged areas.

People of Aboriginal or Torres Strait Islander origin were more likely to live in the most disadvantaged areas with 48 per cent living in the most disadvantaged council areas, compared to 18 per cent of non-indigenous people.





## Appendix 7 -Draft Greater Newcastle Future Transport Plan - Extracts

### Page 17

#### 3.1 Building an evidence base – understanding travel behaviour

##### How and why people in Greater Newcastle travel

To provide appropriate transport services and infrastructure into the future, an understanding of how, where and why people travel to, from and within Greater Newcastle is needed.

Most people travel in Greater Newcastle by private vehicle (over 80 percent of all trips). Public transport use is low. However, there are strong rates of active transport, with more than 13 percent of all trips made by walking or cycling.

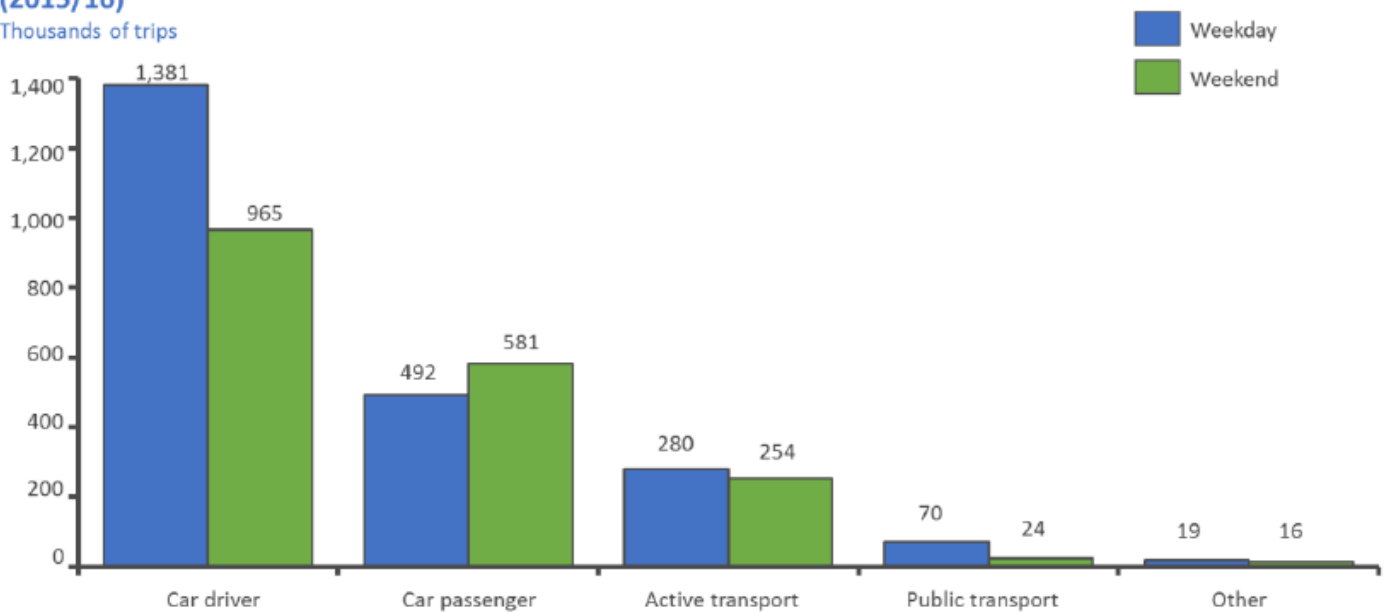
Most trips in Greater Newcastle are for discretionary purposes such as shopping, social and recreational trips. These are trips where people can choose the timing and/or destination for their travel. As these trips are generally shorter and within the region, there is an opportunity to support more sustainable travel options for these trips.

Commuting trips occur primarily in the AM and PM peaks. There is an opportunity for these to be provided by public or active transport, rather than private vehicle.

People tend to primarily make short journeys, between 0-5km in length. There is an opportunity for these shorter journeys to be taken by walking or cycling.

**Mode of Travel in Greater Newcastle (2015/16)**

Thousands of trips



**Figure 7: Mode of travel in Greater Newcastle**



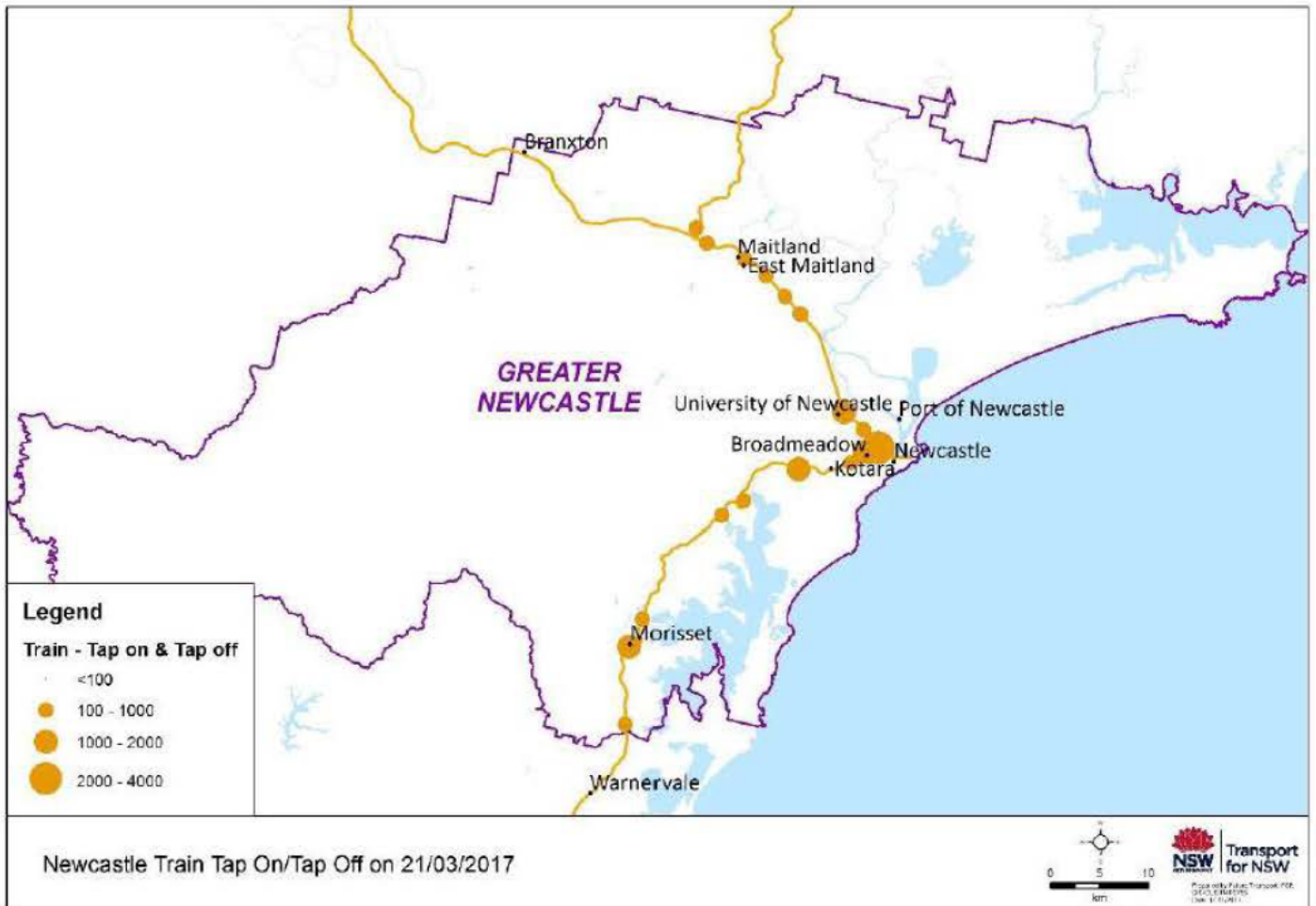


Figure 14: Daily Greater Newcastle train tap on/off counts

