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**Western Sydney Airport Fast
Train - Discussion Paper**

**2 March 2016
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**Parramatta City Council &
Sydney Business Chamber -
Western Sydney**

Deloitte.



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1 Executive Summary

Aurecon, in partnership with Deloitte (collectively, the **Consultant** team) was engaged by Parramatta City Council (PCC) and the Sydney Business Chamber (SBC) (collectively, the **Client**) to prepare a high level discussion paper with respect to a potential Fast Train connection between the new Western Sydney Airport (WSA), Parramatta and Sydney CBD (**Discussion Paper**).

1.1 Purpose of the Discussion Paper

The key purpose of the Discussion Paper is to present viable options of new rail corridors for further consideration, exploration and assessment. The Discussion Paper presents the merits for Fast Train connectivity between the Western Sydney Airport (WSA), Parramatta and Sydney CBD centres and to better understand the high level technical limitations and opportunities. The Consultant team understands that beyond the proposed Rail Project corridor (WSA, Parramatta CBD and Sydney CBD), there are a number of factors which will affect and influence the Options proposed and potential funding arrangements. Some of these external factors are outlined below.

The purpose of this Discussion Paper is to understand the opportunities of a Fast Train service linking the new WSA, Parramatta and Sydney CBD's. The context of the study is initial high level considerations of technical limitations and opportunities, high level economic benefits and opportunities and discussion of potential funding arrangements.

The Objectives of the Discussion Paper include:

- Better understand and explore the current technical and capacity constraints on the existing western rail line from Sydney CBD to Western Sydney
- Identify alternate options for a Fast Train connection between the new WSA and Parramatta CBD
- Develop alternate options for a Fast Train connection between Parramatta and Sydney CBD's
- Explore the potential opportunities with respect to Sydney Metro
- Determine broad economic benefits for the Western Sydney Region by connecting the new airport, Parramatta and Sydney CBD's
- Determine potential funding sources for further consideration.

These Objectives reflect the common goal of the Client to:

- Encourage increased residential and worker population growth in Parramatta and the corridor to WSA

- Significantly reduce travel times between WSA, Parramatta CBD and ultimately Sydney CBD to encourage this growth, with the physical connection being via a Fast Train

1.2 Fast Train Concept

The concept of the Fast Train is to provide a transport link between centres, such as the WSA, Parramatta and Sydney CBD in safe, fast and efficient manner, which meets the needs of the customers origin and destination requirements and is attractive to customers.

Passenger experience is a key 'guiding' principle that has wider benefits in terms of urban regeneration and development. The safe, reliable, convenient and pleasurable experience of the passengers is a primary objective. A successful transit system will encourage commuter use and bring increased activity to the area. It is imperative that the connectivity with the broader transport network is carefully considered and offers a complete journey experience; importantly, plans for future expansion to outer western Sydney centres.

To maximise the customer experience the service must provide frequent, all day, every day services which are safe, fast and reliable. These services are not timetabled but rather operate at sufficiently regular intervals to support walk up and go. Headways in the range of 5 to 10 minutes are considered ideal. To achieve this level of service a dedicated line in each direction would be required which is exclusively used by the Fast Train service.

The Fast Train concept in the context of this study is defined as modern metro style rolling stock (trains), single deck with limited type gallery seating, six or eight car sets with capacity of approximately 1,000 to 1,200 passengers per train. Provision for luggage for airport customers can be easily accommodated. Such trains enable shorter dwell times at stations and contribute to an improved customer experience. Train speeds in the range of 140 to 160 km/h are possible.

Existing examples of similar services include Hong Kong Airport Express and Heathrow Express.

1.3 Three hubs

The development of an efficient transport system for Sydney requires the integration of; land use planning, corridor preservation and transport modal choice. To achieve the maximum opportunity for Sydney, a fast and efficient transport spine will be required that links strategic job, recreational, health and education centres. Traditional network planning has created radial networks, meaning people travel in and out of one selected destination. Government planning has now changed, with planning now focused around creating polycentric cities which enable a connected network to adapt to future demand.

Given the change in planning, the polycentric cities will become major job and recreational hubs in Sydney. A Fast Train connection through the core of Sydney would connect three major economic hubs across the two major corridors:

- Eastern Link (Sydney CBD to Parramatta)
- Western Link (Parramatta to WSA)

This Discussion Paper focuses on the three hubs, which have distinct characteristics. Those characteristics include Sydney CBD being the more established out of the three, the Parramatta hub is growing and the WSA hub is earmarked as an emerging hub. Fast Train will service as the back bone connecting the three hubs to facilitate and enable the mobility of people as they travel for work and recreational purposes.

1.4 Summary of Findings

1.4.1 Route Options: Two links

The Western link of the Fast Train between the new WSA and Parramatta would be a new line primarily through a partially developed landscape with no significant technical constraints. Two options are considered viable; Blacktown LGA and Liverpool LGA.

Travel times of less than 25 minutes between WSA and Parramatta CBD are considered achievable and will benefit both the airport and Parramatta as follows:

- WSA will be better for business or personal travellers whose destination is western Sydney. This will increase both domestic and international patronage for the airport
- Parramatta will be a better place to stay for people travelling through WSA. This will stimulate demand for hotel accommodation in Parramatta.

The Eastern Link of the Fast Train is between Parramatta and Sydney CBD's through a very developed setting with many technical constraints and challenges. Four options are considered including the upgrade of the existing western line and three tunnel options.

Travel times approaching 15 minutes are considered achievable and will provide the following benefits:

- Significantly improved level of service as compared to existing services with travel times of approximately 30 minutes
- Encouraging employers to locate in Parramatta due to the much improved connectivity to Sydney CBD
- Provide additional capacity to alleviate the existing train services on the western line and contribute to meeting the increasing capacity needs of the public transport link
- Realise opportunities for value uplift and value capture around stations on a Fast Train line
- Parramatta will be more attractive for businesses and governments to locate as commercial rents are lower and the shorter Fast Train travel time is comparable with travel times within the Sydney CBD. This will stimulate demand for office space and labour in Parramatta

Table 1-1 and Table 1-2 summarise Western Link and Eastern Link Options. The options comprise of two potential links connecting WSA to Parramatta (Western link) and four potential links connecting Parramatta to Sydney CBD (Eastern link) including the base case (existing, above ground rail line), and three alternate options that all involve tunnelling.

Locations of potential new stations have considered the following primary factors:

- Potential Value Capture around station
- Potential population growth and or patronage
- High level technical considerations

Table 1-1: Western link summary

	Southern Liverpool LGA	Northern Blacktown LGA
Western Sydney Airport (WSA)	WSA terminal	WSA terminal
Western Intermediate Station	Liverpool LGA	Blacktown LGA or New station near M4 / M7
Parramatta	Parramatta Station (or near)	Parramatta Station (or near)

Table 1-2: Eastern link summary

	Option 1: Existing rail corridor	Option 2: Current Route	Option 3: Olympic Park	Option 4: Ryde
Parramatta	Parramatta Station (or near)	Parramatta Station (or near)	Parramatta Station (or near)	Parramatta Station (or near)
Eastern Station 1	Lidcombe	Lidcombe	Olympic Park, to enable value capture and improve access	Ryde, to improve access to area north of Parramatta River
Eastern Station 2	Strathfield Station, for connection to Northern Line	Croydon	White Bay, to improve access to Bays Precinct	White Bay, to improve access to Bays Precinct
Sydney CBD	Central Station	Sydney Metro Pitt St Station	Sydney Metro Pitt St Station	Sydney Metro Barangaroo Station

Notes on Options

- **Option 1**, the existing rail corridor, has significant and multiple constraints and is unlikely to provide travel times significantly less than the current minimum of 25 minutes. Even with extensive upgrades, at best this may be reduced by a few minutes
- **Option 2**, a tunnel essentially underneath the existing rail lines both to Parramatta and then south to Liverpool LGA before turning west to Leppington, has longer length, so has longer journey times than options 3 and 4. Based on the proposed station locations, it also has less scope for value capture. However this option appears to have the most favourable ground conditions for tunnelling.
- **Option 3**, a tunnel just south of the Parramatta River is the shortest and therefore the fastest Eastern Link option. It also has best scope for value capture. However it has the most challenging ground conditions of the Options proposed in this Discussion Paper.

- **Option 4**, a tunnel north of the Parramatta River, is longer than Option 3, but passes through more existing centres. It has less scope for value capture but better patronage at least in the medium term.

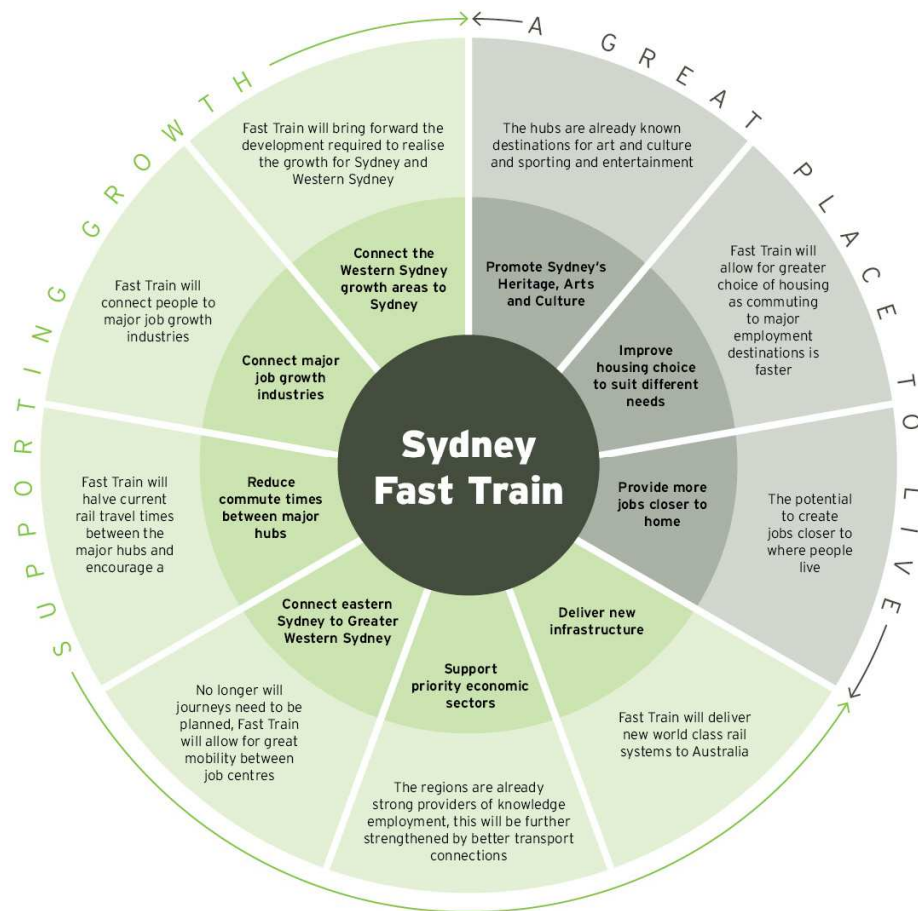
Refer to sections 5 to 8 for further analysis of the four options.

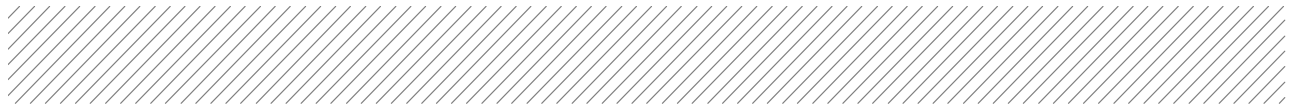
1.4.2 Economic potential

The NSW Government's Metropolitan Strategy, A Plan for Growing Sydney, highlights Parramatta's status as the dual CBD on par with the City of Sydney. To meet the challenges facing Sydney, A Plan for Growing Sydney responds by setting four goals to deliver on Sydney's growth potential, these goals include:

1. A competitive economy with world class services and transport
2. A city of housing choice with homes that meet our needs and lifestyles
3. A great place to live with communities that are strong, healthy and well connected; and
4. A sustainable and resilient city that protects the natural environment and has a balanced approach to the use of land and resources

The diagram below highlights how the directions and actions from the Plan align with a Fast Train proposal and how they will help make Sydney a strong global city and a great place to live.



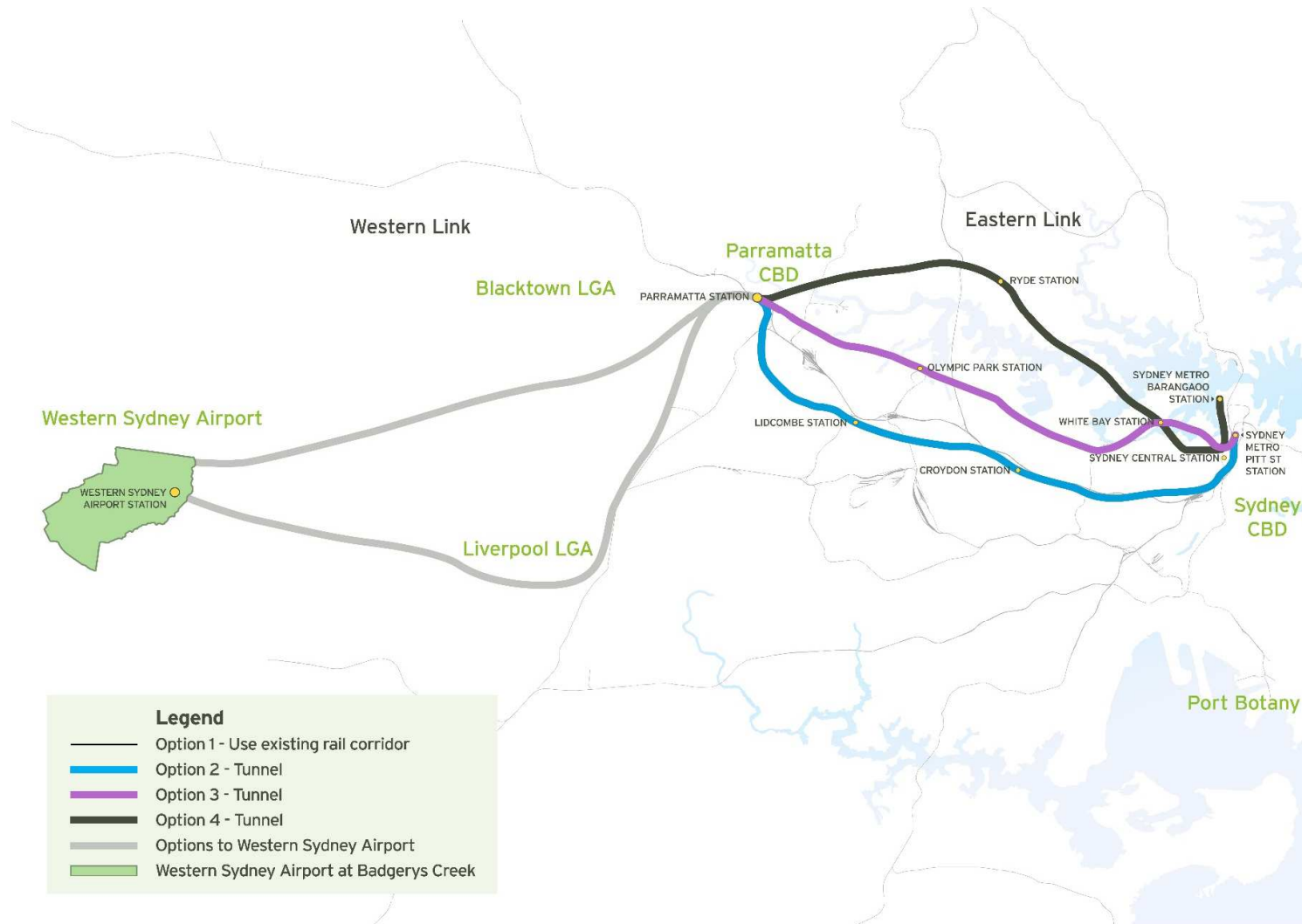


1.5 Next Steps and key take aways

The Consultant team considers this study provides a compelling case for a Fast Train link with many potential opportunities worthy of further exploration and investigation. The next steps include a pre-feasibility phase with more detailed technical assessment and survey of potential corridors, in depth stakeholder consultation, economic analysis and modelling, and broad cost planning.

Figure 1-1 below shows the Western and Eastern Link Options considered.

Figure 1-1: PCC Fast Train connection Options





1.6 Limitations of Discussion Paper

The limitations of the Discussion Paper include:

- This is a limited Discussion Paper, using publicly available information
- Possible routes have been assessed in broad terms only
- Patronage and value capture benefits have not been modelled
- Environmental factors have not been considered

Stakeholder Engagement

This is a desktop study with the purpose to propose potential route options, which include and identify both high level technical and economic limitations and opportunities. As such, and given the timing and scope of the report, external and detailed stakeholder engagement has not been undertaken. It is envisaged that when a more detailed pre-feasibility study and investigation into potential options is undertaken, that a much more comprehensive and targeted stakeholder engagement process is undertaken.

Project Costings

This study is a desktop study for which the purpose is to propose potential route options, which include and identify both high level technical and economic limitations and opportunities. As such, and given the timing and scope of the Discussion Paper, detailed costings for potential project costs are not provided. It is envisaged that when a more detailed pre-feasibility study and investigation into potential options is undertaken, that these project costs will be identified and investigated further.

Further work on each of the above will be necessary in order to develop a more detailed pre-feasibility for the Project.



2 Introduction

The aim of this Discussion Paper is to present the merits for Fast Train connectivity between the WSA, Parramatta and Sydney CBD centres and to better understand the high level technical limitations and opportunities. The Consultant team understands that beyond the proposed Rail Project corridor (WSA, Parramatta CBD and Sydney CBD), there are a number of factors which will affect and influence the Options proposed and potential funding arrangements. Some of these external factors are outlined below.

The following section of the report discusses the strategic context of Sydney; outlining the both the Federal and State Government planned investment for the region. Included is a brief overview of the projects that would be enhanced by a Fast Train connection. Presented is the potential demand to be generated from the WSA, based on the WSA Environmental Impact Statement (EIS) and the current demand forecast by the Bureau of Transport Statistics (BTS). The chapter also present the potential economic benefits associated with Fast Train and growth job growth forecast for Western Sydney. The merits of connecting the hubs along the identified routes is discussed and their strategic importance.

2.1 Project background

The overarching objective of this report is to demonstrate the nature and magnitude of growth and benefit opportunities that Fast Train in Western Sydney would generate for the region.

Western Sydney is the engine room of the NSW economy. Fuelled by both major private and government investment, the region can play a key role in providing the necessary jobs, homes, services and recreational options for Sydney's growing population. Development in Western Sydney is far greater than simply the investment in infrastructure. Land for more than 95,000 new homes has been rezoned in the Western Sydney growth centres. Crucially, there is also rising investment in the region's metropolitan urban centres with surging commercial office development in Parramatta and Liverpool LGA. Sydney's grand vision as a City of Cities is being realised across Western Sydney.

Announced in August 2015, the Jobs for NSW fund will provide \$190 million over four years to grow jobs across NSW. This fund is being directed to areas where it will have the biggest economic impact. It's estimated that this fund could support the creation of up to 150,000 jobs in NSW by 2019. Further, in the recent Shaping Future Cities report, Deloitte set a blueprint for the creation of 200,000 jobs in Western Sydney by 2020. Nevertheless, government-led initiatives like Jobs for NSW will be important in growing the number of jobs in Western Sydney.

Realising the growth potential in Greater Sydney is constrained by efficient transport connectivity to and within Sydney, Parramatta and WSA, priority will need to be given to connections that enable the mobility of people moving for business, work or recreational purposes between and within these hubs.



2.2 Strategic context

At present there are a range of complementary projects and initiatives happening in and around greater Western Sydney transport and infrastructure. A summary of how these projects align with and could leverage of the Fast Train connection is presented below.

2.2.1 Western Sydney Airport (WSA)

The proposed WSA, at Badgerys Creek, is expected to deliver world-class transport systems, improving business links and providing economic benefits. Construction has already started on the Western Sydney Infrastructure Plan of major road upgrades to meet the needs of the community and service the proposed airport. Works on the airport site could start in 2016, with operations at the proposed airport planned to begin in the mid-2020s.

The Western Sydney Employment Area that adjoins the site for the new WSA at Badgerys Creek is Australia's largest employment release area. Based on estimates from the WSA Environmental Impact Statement (EIS), this site alone could accommodate 60,000 jobs over the next 25 years.

Crucially, there is also rising investment in the region's metropolitan urban centres with surging commercial office development in Parramatta and Liverpool LGA. Sydney's grand vision as a City of Cities is being realised across Western Sydney.

2.2.2 Federal Government

The Australian Government has announced a number of major infrastructure investments aimed at creating a stronger and more prosperous Western Sydney. In doing so, the Federal Government plans to invest \$2.9 billion over ten years in major infrastructure upgrades.


Further to the current works scheduled to unlock the potential around WSA, the Australian and NSW governments are currently undertaking a joint study to define the need, timing and service options for rail investment to service Western Sydney and WSA. The study will form a key part of the NSW Government's planning and investment strategy for the Sydney region and the Australian Government's planning for rail service connections for a WSA. Rail connectivity would be a part of the broader transport network needed to support an airport and Western Sydney's growth. A rail options plan was announced late 2015 and will be completed over the next 12 months.

Additionally, Infrastructure Australia recently released the Australian Infrastructure Plan, which sets out the infrastructure challenges and opportunities facing Australia over the next 15 years and the solutions required to drive productivity growth and enhance our standard of living. Included in the Plan are 78 recommendations. Two of the recommendations link directly to improving the connectivity between Sydney CBD and Parramatta and improving public transport access to the Parramatta CBD. The Plan has proposed that in order to better connect two CBDs, faster and more frequent rail services are required.

2.2.3 State Government Priority

- **Long Term Transport Master Plan**

The NSW Long Term Transport Master Plan (LTTMP) presented the NSW Government's 20-year vision for the delivery of public transport, roads and freight network to NSW. The LTTMP highlighted the short, medium and long-term actions required to integrate, grow, modernise and manage the transport system of NSW. The LTTMP recognises the importance of better transport connections for Parramatta and Greater Western Sydney to support productivity and economic growth in Sydney. Outside the CBD, Sydney's Regional Cities of Parramatta, Penrith and Liverpool will need better transport connections locally and across Greater Sydney to grow, prosper and serve their communities. Demand modelling for the LTTMP indicated that peak road travel times between



Parramatta and Sydney, via Ryde or Strathfield was approximately 75 minutes in 2011. Under a 'do nothing' scenario commuters will face travelling over 90 minutes between the two cities by 2031.

A key challenge facing Sydney is the requirement of stronger transport connections to other parts of Greater Sydney to provide for commuters travelling from Greater Sydney and to support business-to-business connections. In addition, more efficient connections to the west of Parramatta will be important to serve the Parramatta CBD's primary catchment area.

The key actions out of the plan are to improve connectivity between Sydney and Greater Western Sydney and alleviate pressures on Sydney's road and rail network. Transport for NSW is currently planning to refresh the LTMMP to include a great focus on the connectivity required between Sydney and Western Sydney and the north-south transport corridor of outer Western Sydney.

- **Parramatta Light Rail**

In recent announcements the NSW Government has detailed its vision for Greater Parramatta to be a hub of commerce, industry, community and learning linked to other centres of jobs and housing. Enabling that vision is support for infrastructure development, particularly transport infrastructure, to support the job and dwelling growth for the region. A new light rail network is proposed for Western Sydney which will connect Parramatta's CBD to Sydney Olympic Park, Westmead Hospital, Western Sydney University and Strathfield and provide frequent low capacity hop on hop off services. Light Rail in Western Sydney will activate priority growth areas in the region. The government will benefit from the value uplift that will occur along the corridor. This project will see the introduction of a Special Infrastructure Contribution implemented with the levy expected to be set at around \$200 per square metre of gross floor area of new residential developments subject to consultation.

- **Sydney Metro**

The NSW Government's major rail initiative is Sydney Metro, which is planned to link the eastern Sydney business district to Bankstown (and likely beyond to WSA). The only announced plan for the Western (T1) rail line is to upgrade signalling. Faster rail services of the T1 line are therefore consistent with the Government's land transport plans, even if not directly supported.

The Sydney Metro Stage 2 City & Southwest project extends a metro style train service from Chatswood to Sydney CBD and then to Bankstown. Further plans being are being considered to extend the line to Liverpool.

It is considered that this proposed metro line will not compete with a Fast Train service from WSA via Parramatta to Sydney CBD in that it serves a different catchment and is a metro all stops type service as opposed to a fast direct link between the centres. The two systems provide necessary but different types of services and would very much complement each other.

However, Sydney Metro does present opportunities to share the new infrastructure within the Sydney CBD. This has key benefits of providing seamless connectivity between the two train services, consolidation of access points to underground stations, avoids unnecessary duplication of infrastructure and provides operational benefits for accessing common stabling and maintenance facilities on other parts of the network.

Figure 2-1: Sydney Metro



Source: Transport for NSW

2.2.4 Overall Transport Network

To support the growth of Western Sydney an overall integrated transport network will be required. The proposals included in this Discussion Paper are considered worthy of further exploration and assessment and supplement a wider transport plan for Western Sydney and WSA. In particular interface with outer Western Sydney north-south rail line as well as broader Western Sydney light rail.

As the NSW Government continues to deliver on its 'Decade of decentralisation' policy¹, improving the north-south corridor as well as the east-west corridor becomes a key enabler for the government departments moving to western Sydney will be fast transport connectivity.

Specific to Parramatta, the NSW Department of Education has announced it will move its head offices to Western Sydney. The relocation would see 1,800 jobs relocated from Sydney City from 2018 to 2020. Transport Roads and Maritimes Services have also announced it will relocate 500 staff to Parramatta who were previously located at the North Sydney Road and Maritime Services office.

Other agencies that have already begun or announced relocating staff to Western Sydney include:


- Ambulance Service of NSW, moving from Rozelle to North Parramatta;
- Department of Sport and Recreation, moving from Sydney Olympic Park to Penrith;
- Community Relations Commission and divisions within Family and Community Services, moving from Sydney's CBD and Ashfield to Liverpool; and
- Office of Environment and Heritage, EPA and Office of State Revenue, moving from Hurstville, the CBD and existing Parramatta offices to be co-located in Parramatta.

¹ <http://www.industry.nsw.gov.au/invest-in-nsw/why-sydney-and-nsw/economic-development-framework/invest-in-critical-infrastructure/nsw-government-decentralisation-policy>

2.3 Strategic alignment to other projects

A vast number of projects and investment within the identified corridors would be further enhanced by a Fast Train connection between WSA, Parramatta and Sydney. To take advantage of the demand that these projects will generate, a strong east/west connecting spine is required to maximise the potential of the projects below. A fast and efficient transport connection will enable the ease of movement between the major job, recreational, health and education centres in Sydney.

- **Parramatta Square** – The Parramatta Square redevelopment is a \$2 billion proposal to transform the heart of Parramatta into a suburban office hub. The three hectare area is a mixture of Council-owned and privately held space. The first phases of the Parramatta Square redevelopment are anticipated to be completed by the end of 2016, including the “One Parramatta Square” development. The One Parramatta Square development will alone offer over 24,500 m2 of new commercial space and will include a new campus for the University of Western Sydney that will accommodate 10,000 students.
- **The Western Sydney Innovation Corridor** – The corridor was identified by Western Sydney University as a future economic development zone that could build upon a number of current and proposed economic infrastructure projects. New, innovative industries are drawn to regions with low start-up costs, a pool of young, highly skilled people and connections to the broader knowledge economy. Affordable and flexible rent or lease options, potential tax breaks and regulatory concessions can help add to the attraction, creating an environment where highly educated, entrepreneurial people at the start of their career work together to create a commercial zone known globally for its innovative practices and outcomes. The Western Sydney Innovation Corridor would be a hotbed of highly adaptable, internationally competitive and technology-engaged industries of the future. It would also support the north-south orientation of Sydney’s transport networks that governments and stakeholders in the region have sought for so long. The Corridor would be based on the region’s existing innovation entities, which (from south to north) include Campbelltown Integrated Health Hub, South West Growth Centre, Oran Park Town, Camden Veterinary Science, Western Sydney Aerotropolis, Sydney Science Park, Western Sydney Science Centre, Sydney IQ, North West Growth Centre and Hawkesbury AgriPark.
- **Sydney Metro** – The NSW Government is delivering a new standalone railway network. The new North West Rail Link (opening in 2019) will be the first part of the metro railway network to be delivered. Following this will be the Sydney Metro City & Southwest alignment. The Metro City alignment will deliver new stations at Barangaroo, Martin Place and Pitt Street.
- **Western Sydney Stadium Upgrades** – The NSW Government has allocated over \$1 billion to invest in upgrading sporting venues. The package of works includes the redevelopment of Stadium Australia in Olympic Park, the development of a new stadium in Parramatta and a new outer Western Sydney sporting venue. The proposed stadium for Parramatta will have 30,000 seats increasing the stadium’s seating capacity by almost 40%. Construction expected to be completed by 2019.
- **Museum of Applied Arts and Science (Powerhouse Museum)** – In February 2015, the Government announced the proposed relocation of Sydney’s Museum of Applied Arts and Science to Parramatta, as part of the new arts and cultural precinct planned for Western Sydney. The Government has allocated \$30 million for the development of arts and culture in Western Sydney. Historically, Sydney’s Museum of Applied Arts and Science has averaged over 480,000 visitors annually to the Ultimo building. The relocation to Western Sydney would further enforce the requirement of transport investment to allow for a faster journey between Parramatta and Sydney.
- **The Bays Precinct/White Bay** – The Bays Precinct consists of 95 hectares of government owned land and 94 hectares of harbour waterways, and sits within 2km of the Sydney CBD



and 18km of Parramatta. It includes sites such as the heritage-listed White Bay Power Station, Wentworth Park, Glebe Island, White Bay, Rozelle Bay, Rozelle Rail Yards and Blackwattle Bay, including the Sydney Fish Market. Currently, White Bay operates as Sydney's second cruise ship terminal, supporting around 1,500 jobs, and more than 100 cruise ships and 200,000 passengers each year. The state government has earmarked the former industrial Bays Precinct, which takes in White Bay, Glebe Island and Rozelle, for redevelopment into a technology and innovation hub. It will be of importance to connect the planned hub to other technology hubs.

- **Barangaroo** – The urban renewal of Barangaroo is well underway and once complete more than 24,000 people are expected to live and work at Barangaroo, and another 33,000 people will visit every day. Economic activity within Barangaroo is expected to generate approximately \$2 billion per annum to the NSW economy and provide over 11 hectares of newly accessible public domain. As part of the Stage 2 Sydney Metro development, a metro stop at Barangaroo will be built at Barangaroo connecting the North West Rail Link through Sydney; however there is no planning to suggest the precinct will receive an east west connection, connecting the precinct to Western Sydney and the WSA.
- **Liverpool City** – Liverpool is a strong emerging capital of the South West Sydney region. Strong transport connections between Sydney, Parramatta and Liverpool would further support the economic growth of Western Sydney and allow for better job creation and mobility in the future. Already Liverpool supports over 240,000 and is home to over 40,000 businesses. Liverpool's population is predicted to increase by over 75% by 2036. It also has a well-developed education and health precinct which would serve the needs of greater Western Sydney if connected to Sydney and Parramatta.


2.4 Transport context

Sydney is a city on the move with over 1 million people traversing its road, rail and water ways a day to partake in business and recreational activities. While the Long Term Transport Master Plan originally regarded new infrastructure investment in Outer Western Sydney as a lower State priority, a surging population and an every expanding urban footprint is making inter and intra transport connectivity in the west a priority. An overview of the transport drivers for a Fast Train connection with Outer Western Sydney is provided below.

2.4.1 Western Sydney travel to Sydney CBD

In the 2011 Journey to Work Data, 337,523 worked in the City of Sydney Local Government Area (LGA) but lived outside of the City of Sydney. With respect to the workers place of residence, over 77,000 live in the greater Western Sydney region and commute daily to the City of Sydney for work. Fast Train connections between Western Sydney and Sydney will reduce travel times for commuters and enable a vastly improved work life balance for those who have chosen to take advantage of Sydney's Green Belt and the suburban community environment.

With the selection of a corridor that would best service Sydney's transport needs, Fast Train would promote a modal shift away from private vehicles which would have direct benefits on easing congestion on Sydney roads. Further, Fast Train would increase accessibility to a wider range of education, employment and recreational opportunities that would improve social inclusion and address contributing factors of inequality in the community. With the changing landscape in land use policy, Fast Train can relieve the shortfall of housing supply in Sydney by broadening the housing supply to greater Western Sydney and giving working access to more affordable housing in Sydney.



Such a connection through the core of Sydney would create the opportunity for job growth and business development as connectivity between the Parramatta and Sydney CBD would provide quick and seamless travel for workers. This would further create better allocation of skills to job opportunities across the city.

2.4.2 Likely Airport travel requirements

The 2015 Tourism Research Australia statistics highlighted visitation to Sydney from international, domestic overnight and domestic daytrip visitors was over 31 million. The split between those travelling to Eastern Sydney and Western Sydney was 70% and 30% respectively. Of this the international visitation was 3.3 million visitors per annum with 90% travelling to the Eastern suburbs with the remainder travelling to Western Sydney. The dataset is not transparent in identifying the mode visitors use for domestic overnight and domestic daytrip visits. However we do know that 33%, or 9.3 million, of these trips travel to Western Sydney. In the absence of detailed datasets which would highlight visitation to Eastern Sydney and Western Sydney we have used the assumption that the same proportion of international visitor trips to Western Sydney, i.e. 10%, could be used to estimate the domestic visits to Western Sydney via the airport. Hence estimating that 930,000 domestic trips per annum coming to Western Sydney would come through the airport.

Evident in the dataset analysed is that within all three of the above mentioned categories the major reason for travel to Eastern Sydney and Western Sydney was for holiday, visiting friends and relatives or business travel. With respect to visitation to total visits to Western Sydney, the three purposes accounted for 85% trips to Western Sydney.

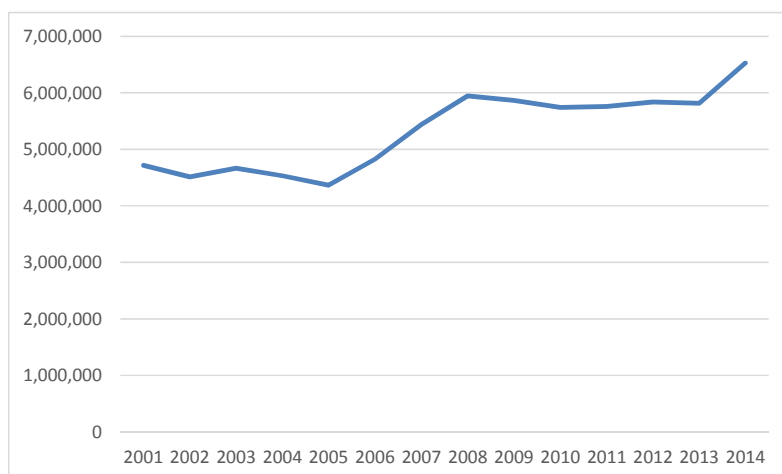
The WSA is predicted to cater for 10 million passengers per year by 2030, increasing to 82 million by 2063. Based on the EIS, it understood that a WSA would operate without a curfew, which would create the opportunity for domestic and international flights to land at WSA during the curfew periods of the current Kingsford Smith Airport. Further to the passenger estimates, the EIS estimates that the WSA will generate 8,730 direct jobs by 2031 with jobs generated expected to grow to 61,500 by 2036.

A Fast Train connection to WSA will not only connect airport passengers travelling to the airport, but will also service as a connection to the job opportunities the airport will bring with it during its operation.

2.4.3 Current rail demand

Parramatta Railway Station is currently the fourth busiest rail station in Sydney, after Town Hall, Central and Wynyard, with more than 6.5 million journeys in 2014. Many of these are journeys between Parramatta and CBD, although NSW Bureau of Transport Statistics doesn't publish detail about specific origin-destination travel.

Figure 2-2: Annual number of train journeys starting or ending at Parramatta



Source: NSW Bureau of Transport Statistics

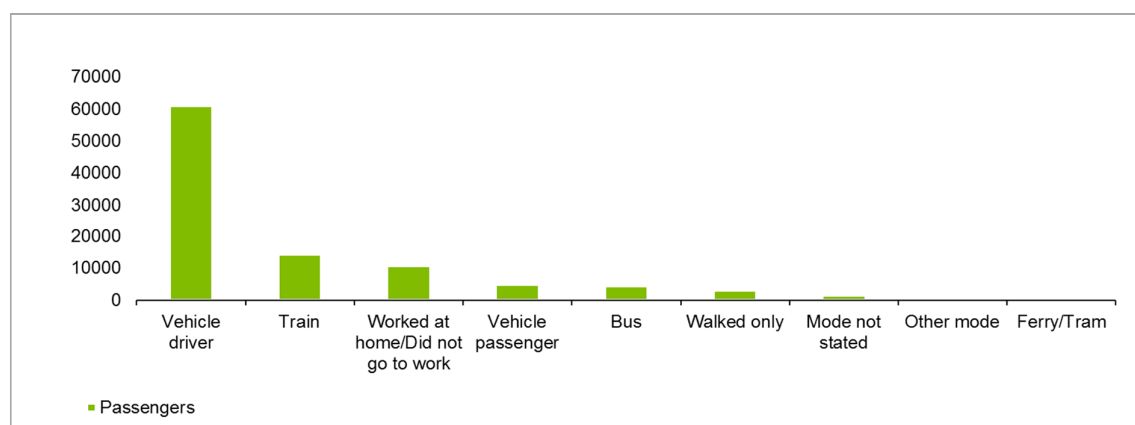
The number of rail journeys has increased as population increased and roads became more congested (see Figure 2-2). This trend is expected to continue over time.

Depending on the train configuration and timetabled services, a Fast Train could have the capacity to move in excess of 7,000 passengers per hour in both directions.

2.4.4 Travel segmentation/patterns

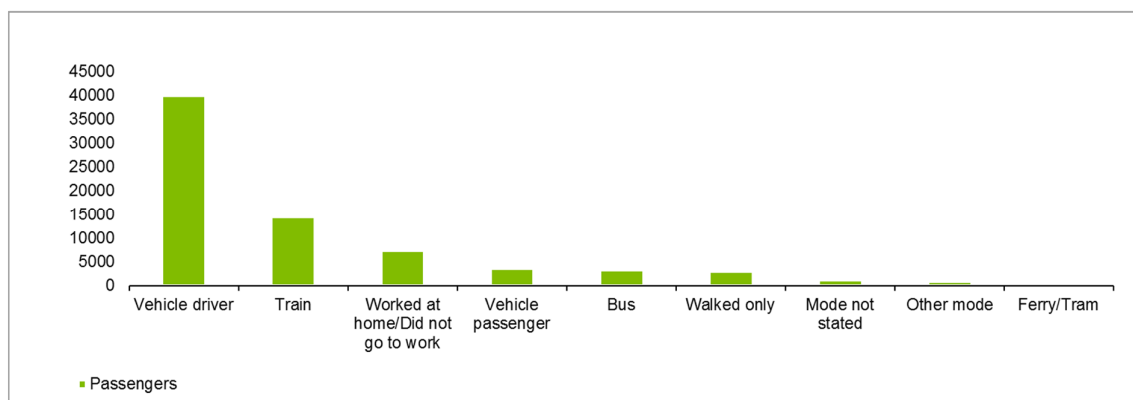
The most common modality for commuting both to and from Parramatta is vehicle (refer to Figure 2-3 and Figure 2-4 below). Only a fraction of these are ride sharing - over twelve times as many people drove to work as were passengers in another vehicle. Commuting via train was the second most frequent mode of transport behind vehicles. Train travel was utilised more by those travelling from Parramatta than to Parramatta – 20% of travellers from Parramatta used the rail network compared to 14% travelling to Parramatta.

Figure 2-3: Travel patterns to Parramatta – Transport type, 2011



Source: BTS, Deloitte analysis

Figure 2-4: Travel patterns from Parramatta – Transport type, 2011



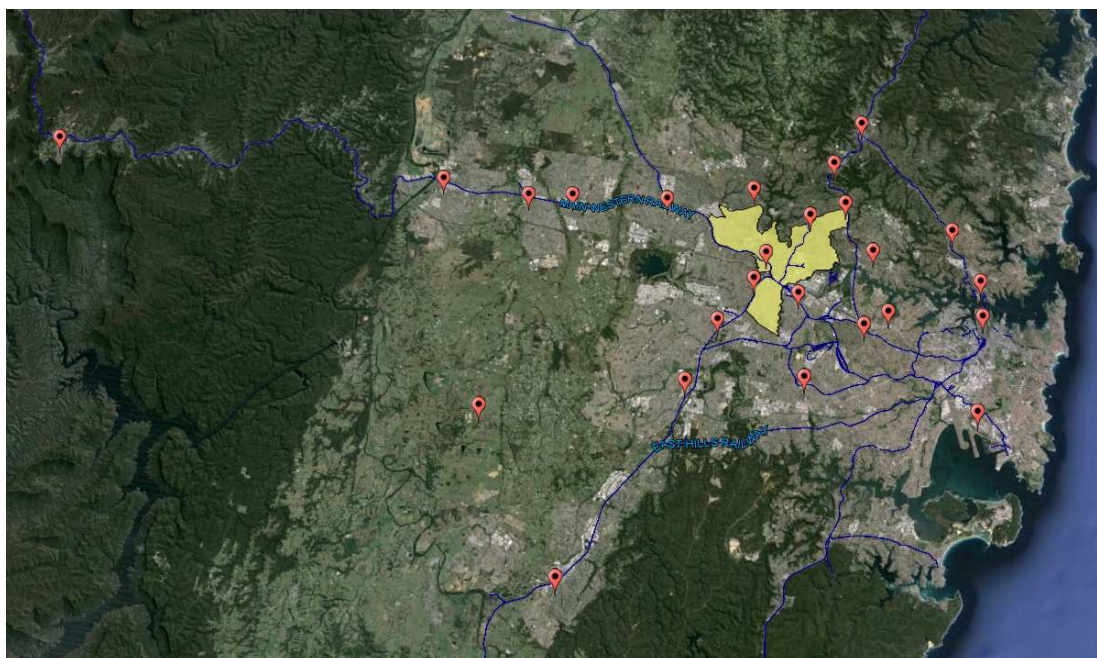
Source: BTS, Deloitte analysis

Currently, 81% of commuters travelling to Parramatta come over twenty suburbs, in the broader Sydney metropolitan area (Figure 2-5 below). These are dominated by suburbs in the west of Sydney (Parramatta, Merrylands, Blacktown and Baulkham Hills). All of these suburbs are located in the west, north-west, inner-west, or south-west of Sydney. Sydney Inner City is the most prominent suburb of origin (21st amongst all suburbs) from outside of the west of Sydney.

Of the commuters travelling from Parramatta, 88% come from the top twenty suburbs. People travelling from Parramatta go to a wider cross section of Sydney suburbs than those commuting to Parramatta. Within the twenty most prominent suburbs are those from the west, inner city, north west, lower north shore, inner west, south west, south east, and upper north shore.

Of the most common suburbs that commuters were travelling to and from, there is a high correlation between suburbs and major commuter networks. 17 of the top 20 suburbs to be commuted to and 17 of the top 20 suburbs to commute from had commuter train stations within the suburb.

Figure 2-5: Twenty most common commuter suburbs to and from Parramatta and commuter rail networks



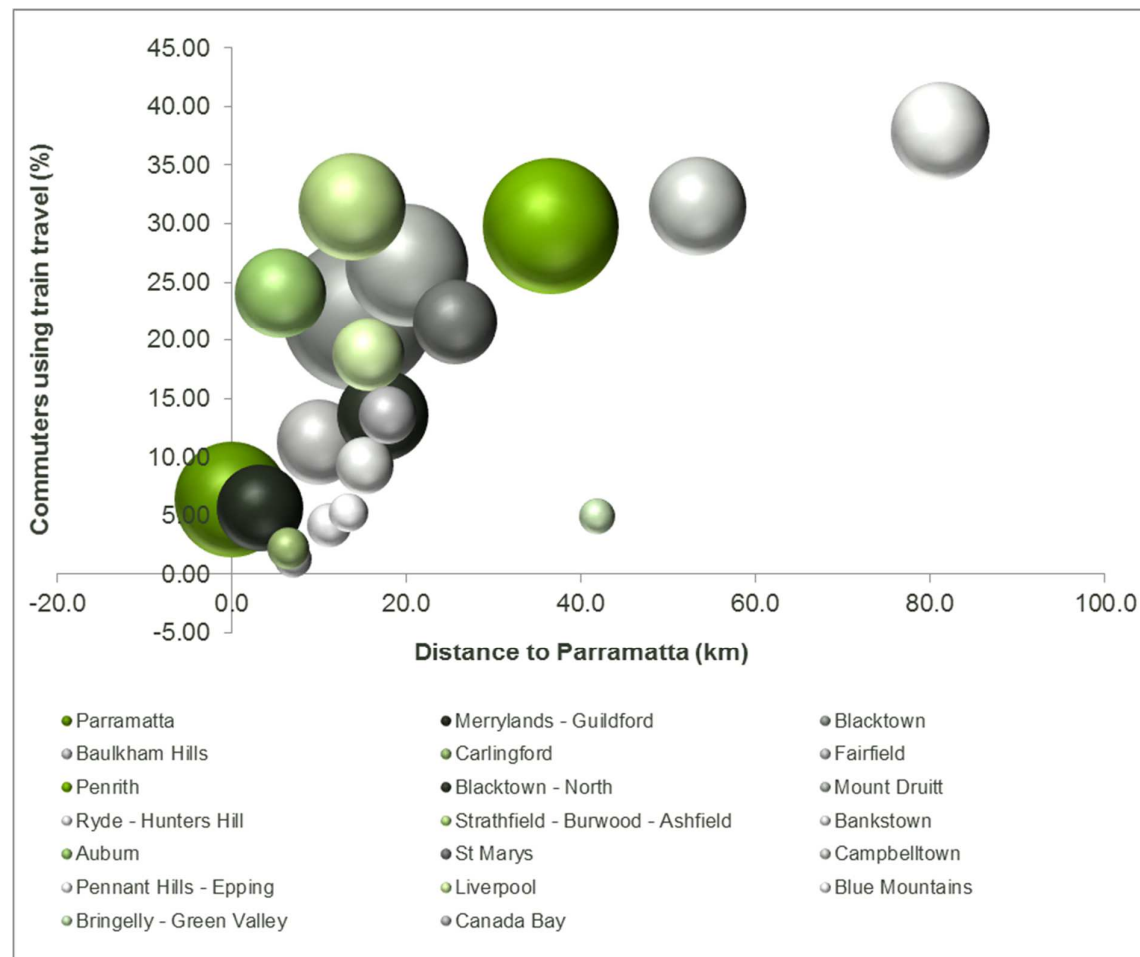
Source: BTS, Deloitte analysis

There is a strong positive correlation between the distance commuters are willing to travel to- and from- Parramatta and the proportion of commuters using train travel. The closest commuters to Parramatta are those travelling from within Parramatta itself. These are amongst the least likely to utilise train travel at only 6.39% of commuters from this suburb.

Commuters from some of the furthest suburbs from Parramatta – The Blue Mountains, Campbelltown and Penrith are amongst the highest percentage of train users at 37.88%, 31.47% and 29.77% respectively. These three cohorts are amongst the largest commuter groups as well.

Commuters travelling from Parramatta are more likely to use vehicles for medium-length commutes than those travelling to Parramatta, however for the longest commutes (for example, to the Sydney CBD) up to 70% of commuters were opting for rail transportation. Over 7,000 residents in Parramatta are commuting to inner Sydney each day, representing over 50% of total train commuters from Parramatta.

Figure 2-6: Commuter profile travelling to Parramatta

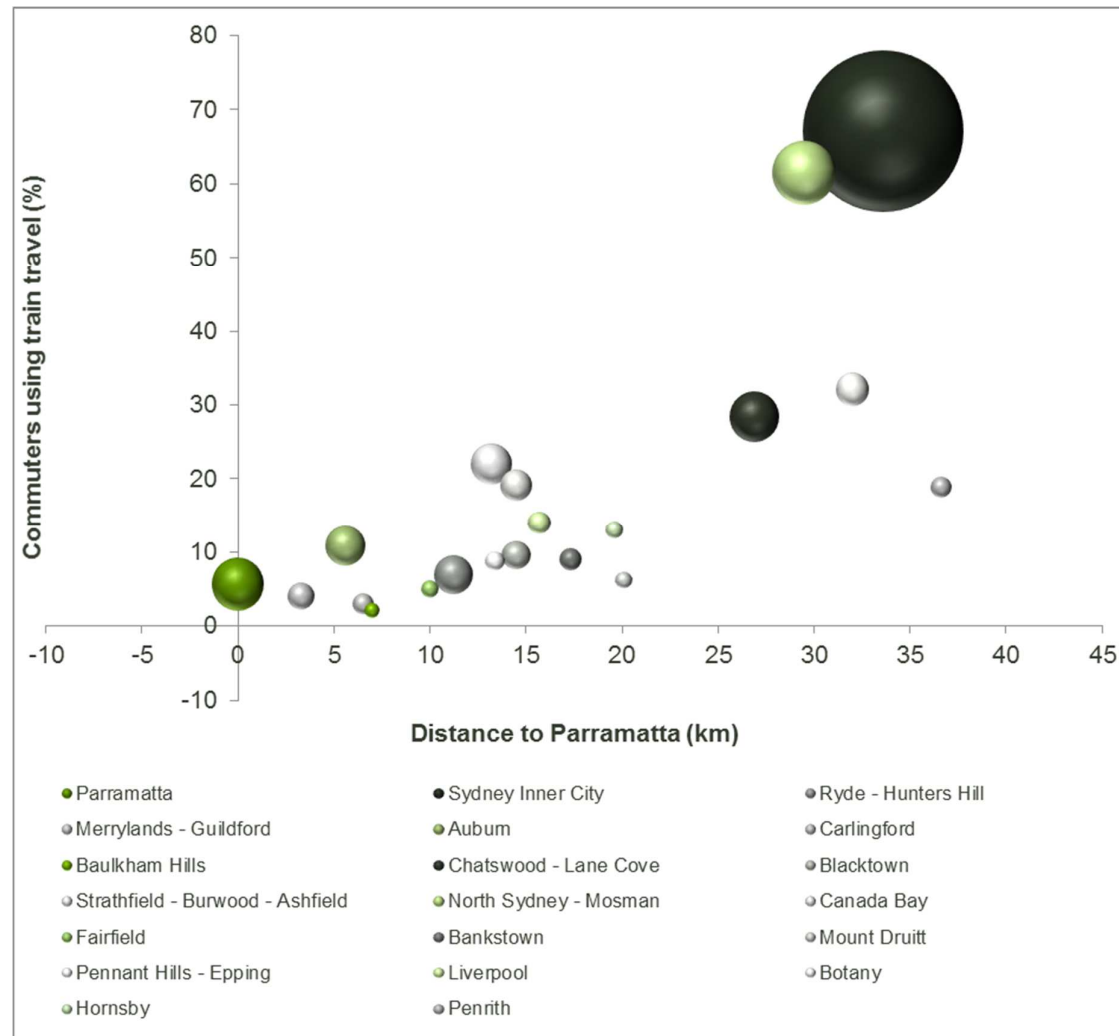


Source: BTS, Deloitte analysis

The analysis of daily commutes to and from Parramatta (see Figure 2-6 and Figure 2-7) suggests that uptake of rail transportation is greatest amongst commuters travelling far to work and who live close (within a suburb) to a train station.

Conversely, the above analysis may also suggest that workers are more mobile, willing to travel further distances to and from Parramatta when there is a convenient rail network close to both their residence and their work. Further analysis would be needed to confirm this hypothesis.

Figure 2-7: Commuter profile travelling from Parramatta



Source: BTS, Deloitte analysis

2.4.5 Western Sydney Gross Regional Product (GRP)

Western Sydney is a significant economic growth centre for Australia, accounting for 8% of gross domestic product (GDP). In 2015, Western Sydney's Gross Regional Product (GRP) was \$127 billion, which is just over a quarter of the total GRP for the Greater Metropolitan Sydney region and about 18% of NSW's total GSP (See Table 2-1 below).

Parramatta contributed significantly to the GRP of Western Sydney. Its economy was worth \$16,041 million in 2015, equivalent to 12.6% of Western Sydney's economic output.

Table 2-1: Gross Regional Product forecasts for LGAs (\$ millions)

LGA	2014	2015	2020	2030
Auburn	9,156	9,859	11,922	14,676
Bankstown	8,886	12,003	13,826	16,790
Blacktown	13,616	17,314	24,972	30,932
Blue Mountains	2,150	3,555	4,323	5,481
Camden	2,552	2,622	3,572	4,848
Campbelltown	5,268	8,821	11,611	15,103
Fairfield	6,773	8,231	10,520	13,510
Hawkesbury	2,877	2,643	3,241	4,061
Holroyd	4,712	5,544	6,821	8,391
Liverpool	8,386	11,591	18,182	21,241
Parramatta	16,928	16,041	19,562	24,715
Penrith	7,608	7,589	9,080	11,139
The Hills Shire	9,143	16,239	18,868	23,832
Wollondilly	1,616	5,082	6,847	8,755
Total	99,671	127,133	163,348	203,475

Source: Deloitte Access Economics

2.4.6 Western Sydney population

Western Sydney is the site of Australia's most significant urban growth. In the next 25 years, the region will account for 60% of Sydney's and 15% of the nation's population growth. Already, it is home to over 45% of all Sydney residents, and over two-thirds of the population is of working age. The region's population growth is expected to continue and by 2036 its population is forecast to be nearly 3 million (Table 2-2)

Parramatta's population, at around 190,000 in 2015, is equal to about 10% of Western Sydney's population, or 3.9% of Greater Sydney's population. As a total Western Sydney's population is over 2.3 million people and growing, equal to approximately 10% of Australia's population.

Table 2-2: Population forecasts by LGA

LGA	2006	2011	2021	2031
Auburn	67,819	77,779	104,150	130,600
Bankstown	175,789	190,851	214,750	240,800
Blacktown	278,894	312,346	388,050	473,300
Blue Mountains	75,600	78,553	86,950	97,300
Camden	50,628	58,439	107,700	162,350
Campbelltown	146,538	151,173	186,750	215,750
Fairfield	186,117	196,479	217,900	239,900
Hawkesbury	61,725	64,353	71,750	80,650
Holroyd	92,752	104,079	120,600	136,000

Liverpool	169,868	188,088	236,950	288,950
Parramatta	152,948	174,783	211,400	253,900
Penrith	176,067	184,589	223,900	261,450
The Hills Shire	164,132	177,014	227,900	280,900
Wollondilly	40,969	44,607	50,800	57,700
Total	183,9846	2,003,133	2,449,550	2,919,550

Source: Deloitte Access Economics

The anticipated population growth in Western Sydney is going to place increased pressure on the existing commuter network. If Parramatta's commuter profile remains constant, then by 2031 we can expect to see an extra 98,300 daily commuters from Parramatta, including an additional 19,300 train users. There would be an additional 14,600 commuters from Parramatta to the Sydney Inner City each day.

2.4.7 Western Sydney employment


As highlighted in *Shaping Future Cities – Designing Western Sydney* 881,493 jobs are located in Western Sydney while 1,088,013 workers are living in Western Sydney, leaving a jobs deficit of about 200,000 jobs. However, Parramatta currently employs 124% as many people as it has working residents, that is, Parramatta is a large net employer for the entire region. Parramatta, along with Auburn, is one of only two LGAs in the region that is a net employer. This creates a net migration coming to Parramatta each day.

Table 2-3: Forecasted number of jobs as a percentage of working residents in Western Sydney LGAs

LGA	2015	2020	2030
Auburn	173%	170%	164%
Bankstown	94%	96%	95%
Blacktown	70%	66%	62%
Blue Mountains	56%	60%	62%
Camden	54%	38%	37%
Campbelltown	72%	72%	70%
Fairfield	82%	84%	84%
Hawkesbury	84%	88%	88%
Holroyd	88%	87%	83%
Liverpool	85%	89%	91%
Parramatta	124%	130%	129%
Penrith	74%	76%	78%
The Hills Shire	79%	76%	75%
Wollondilly	54%	57%	57%
Total	84%	82%	81%

Source: Deloitte Access Economics

The NSW Government's Metropolitan Strategy, 'A Plan for Growing Sydney', highlights Parramatta's status as the dual CBD on par with the City of Sydney. This plan forecasts that the Parramatta CBD



alone may employ over 100,000 people within 20 years. The role of Parramatta will increasingly be that of a central business district, stimulating opportunities for investment along the Olympic corridor.

A plan to renew North Parramatta through the Parramatta North Urban Transformation project is expected to create an additional 2,000 jobs and 6,000 dwellings in the precinct. The renewal is to be undertaken by UrbanGrowth, with an emphasis on catalysing opportunities for adaptive re-use of the several cultural institutions and assets in the North Parramatta area including Australia's first farm and water mill and Parramatta Female Factory.

The expansion and renewal of the Westmead Health Precinct and planned development of Rydalmere as a university precinct also present significant opportunities in neighbouring areas to expand employment.

Based on the Environmental Impact Statement (EIS) for WSA (Department of Infrastructure and Regional Development, 2015) the development of WSA is expected to direct construction employment would peak at 758 full-time equivalent (FTE) jobs in 2022 in Western Sydney. Once operational, WSA would generate 8,730 FTE jobs in airport operations and a further 4,440 FTE jobs in the expected commercial development in business parks on the airport site in 2031. Connecting the airport to Parramatta and Sydney would be a key enabler for businesses to transition to Western Sydney.

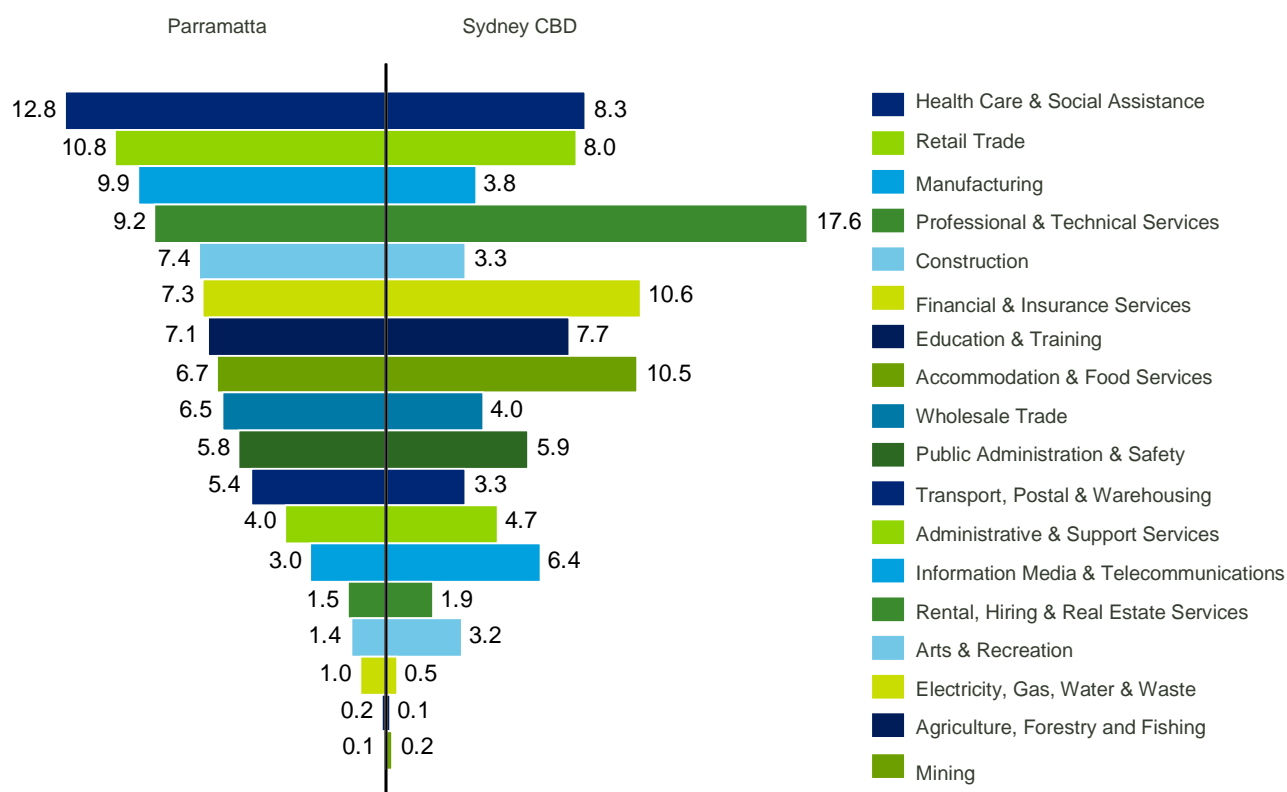
Furthermore, a recent Deloitte study assessing the broader economic impacts of the WSA, forecasted by 2050, the WSA would have generated over 35,000 jobs for the broader region.

2.4.8 Parramatta and Sydney Industry

2.4.8.1 Employment by Industry

Residents of Parramatta are employed primarily in the health care and social assistance industry (12.8%), retail (10.8%), manufacturing (9.9%) and professional, scientific and technical services (9.2%). This differs somewhat to residents of Sydney CBD who are concentrated within professional, scientific and technical services (17.6%), financial and insurance services (10.6%) and accommodation and food services (10.5%).

Figure 2-8: Comparison of Parramatta and Sydney employment by industry, place of usual residence, 2011



Source: ABS, Deloitte Access Economics

2.4.8.2 Business Profile

Mirroring current resident population employment, there is a larger concentration of professional, scientific and technical service businesses, as well as financial and insurance services firms in Sydney City when compared with the Parramatta CBD (see Table 2-4 below).

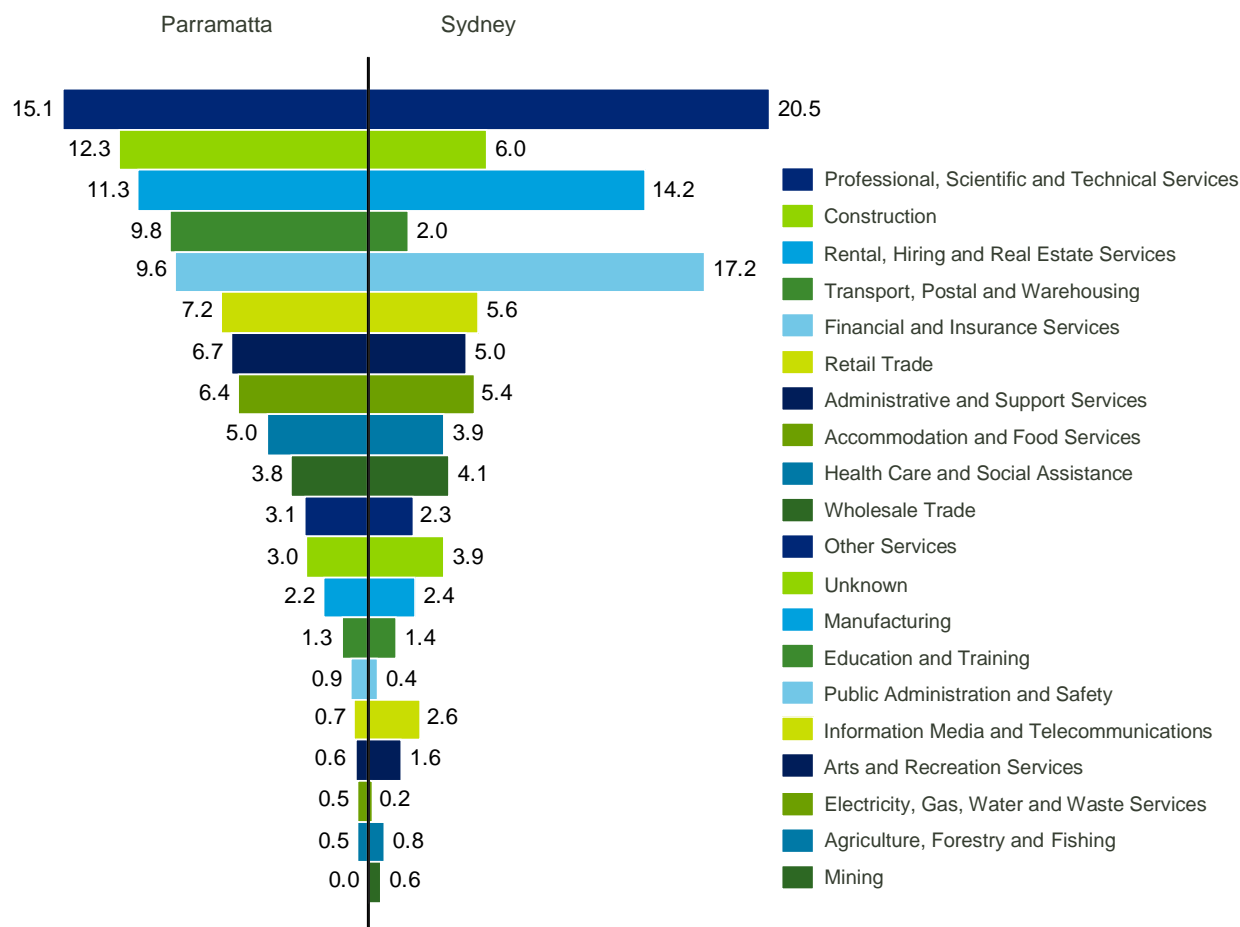
This is reflective of the comparative weakness of Western Sydney in high-value jobs in sectors like professional and business services, which have been driving Sydney's economic growth. As a result of this comparative weakness, these jobs remain concentrated in eastern Sydney.

Whilst Parramatta's relatively young population is becoming increasingly skilled, with post-school qualification rates on the incline, there is still a differential between eastern Sydney and Western Sydney in this respect. Increasing the mobility of Greater Sydney's labour force through increased connectivity and accessibility was identified through the *Shaping Future Cities* consultation process as one way of encouraging more businesses to locate in Western Sydney to service the growing Western Sydney market – by providing greater access to a highly skilled and talented workforce.

Table 2-4: Total Businesses in operation, June 2014

Parramatta CBD	Parramatta Area	Sydney City	Croydon	Berala/Lidcombe	White Bay	Olympic Park	Top Ryde
4,302	38,038	62,223	3,041	3,035	2,259	1,602	2,404

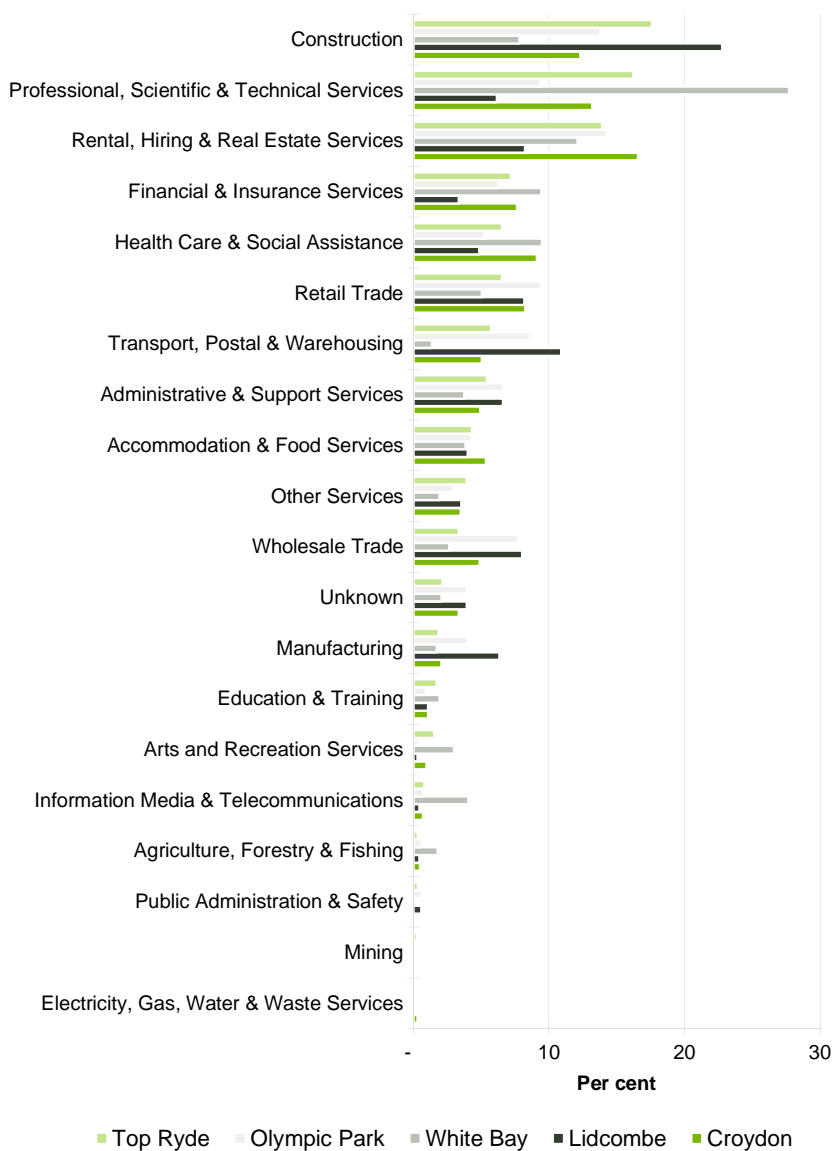
Figure 2-9: Percentage of businesses by Industry – Parramatta-Sydney comparison, June 2014



Source: ABS, Deloitte Access Economics

Amongst the interchange options proposed for the Fast Train, the White Bay (Balmain) region has a noticeably high proportion of professional, scientific and technical businesses (27.7% of total businesses operating in the area). Increasing connectivity between the Parramatta and White Bay areas may encourage information and skills transfers between these two areas, fostering the development of the Parramatta professional services industries. Further it may encourage these businesses to locate to Parramatta to service the growing, local market, or alternatively increase the benefits of establishing a subsidiary business or branch in the Parramatta area.

Figure 2-10: Percentage of businesses by Industry – Interchange comparison, June 2014



Source: ABS, Deloitte Access Economics

2.5 Comparative advantages of Western Sydney: the three hubs

The development of an efficient transport system for Sydney requires the integration of; land use planning, corridor preservation and transport modal choice. To achieve the maximum opportunity for Sydney, a fast and efficient transport spine will be required that links strategic job, recreational, health and education centres. Traditional network planning has created radial networks, meaning people travel in and out of one selected destination. Government planning has now changed, with planning now focused around creating polycentric cities which enable a connected network to adapt to future demand.

Given the change in planning, the polycentric cities will become major job and recreational hubs in Sydney. A Fast Train connection through the core of Sydney would connect three major economic hubs across the east/west corridor:

1. Sydney CBD
2. Parramatta
3. Western Sydney Airport

The three hubs have distinct characteristics being that the Sydney CBD is more established out of the three, the Parramatta hub is growing the WSA hub is earmarked as an emerging hub. Fast Train will service as the back bone connecting the three hubs to facilitate and enable the mobility of people as they travel for work and recreational purposes.

The Sydney CBD has historically been the primary job centre, with transport planning in recent decades focusing on the provision of more services to get people to Sydney for mainly work purposes. Given the shift in transport planning and the growing nature of Parramatta and a second CBD, planning is now focussed on creating easier connection for people wanting to either relocate their employment or travel between the two cities.

Between the two hubs of Sydney and Parramatta are smaller hubs which Fast Train will provide a catalyst for improved economic activity. Recent government announcements have highlighted the potential of job growth in White Bay and Sydney Olympic Park.

The announcement to redevelop White Bay will see the upgrade of the cruise terminal and a new hub for technology start-ups. The White Bay redevelopment will drive job growth and tourism for Sydney. A Fast Train connection will support growth in the tourism and technology sector, as White Bay will be better connected to WSA and the major education precincts in eastern and western Sydney.

The Sydney Olympic Park (SOP) hub has been held back by poor transport connectivity. Even with the poor transport connectivity, SOP receives of 10 million visits per year. Currently SOP is connected by a spur line from Lidcombe station with majority of the commuters traveling to SOP by private vehicle transport. Parramatta Light Rail will connect SOP to Parramatta, however by connecting SOP to Sydney and WSA, there is an opportunity to realise greater economic benefits and create a better connection into SOP.

2.5.1.1 Real Estate growing hubs

The recent growth and availability of real estate has been a strong proxy for the emergence of the hubs in and around WSA, Parramatta and Sydney. The North West and South West growth centres have driven job and housing growth. Combined they span over 27,000 hectares in size and will have the capacity to house over 500,000 residents and have almost 200,000 new dwellings. As a comparator, the current population of Canberra is approximated 390,000.

To date, seven South West Growth Centre Precincts -- Oran Park, Turner Road, Edmondson Park, Austral, Leppington North, Catherine Field (part) and East Leppington -- have been rezoned to allow urban development. Collectively, these Precincts have potential for 42,560 homes to accommodate approximately 130,200 residents and capacity for 22,120 jobs.

Given the current forecast growth for the North West and South West growth centres, a strong transport connection is required to connect the emerging growth centres to major places of employment such as WSA, Parramatta and Sydney.

Growth in commercial spaces is also an underlying driver in the development of hubs. Drawing on the WSA EIS, there is approximately 320 hectares of land on the WSA site allocated for business development which will enable a mix of business, retail and industrial uses in locations that are close to and that support the functioning of the airport. Similarly, the rezoning of land in Liverpool LGA has seen the city's economy transform with \$658 million in projects currently being planned in the Liverpool CBD. The transformation of Liverpool has seen it emerge as a major job creator for the South West and it is recognised as one of Sydney's health precincts. Businesses are continuously making the move to hubs in Western Sydney to take advantage of newer commercial space offerings, cheaper rents and the ability to create job closer to where their staff live.

Parramatta is the fifth largest suburban office centre in Australia with 682,907 square metres of stock as at December 2015 (Savills 2015)². The Parramatta CBD is set to increase with more than \$8 billion in investments in building and construction. Parallel to this increase in office space is the continued development and urban renewal of dining, shopping, sporting and events destinations in the Parramatta area. Of the investment in Parramatta real estate, \$2 billion of this alone is committed to the Parramatta Square development in the historical, commercial and entertainment heart of Parramatta. With the NSW Government recognising Parramatta as the dual CBD of Sydney, investment and growth in Parramatta is set to continue – underpinned by record infrastructure development. This will lead to the creation of more employment opportunities in Parramatta and a stronger regional economy.

Whilst Parramatta is a large and growing offices centre, it still offers lower rents than many other hubs in Sydney. This presents the opportunity for businesses in Sydney to relocate closer to their customer base in Western Sydney while reducing their business costs. It also presents the opportunity for existing businesses to open offices in Parramatta to serve clients.

Commercial investment is forecast to grow with a number of new commercial offices planned to come online in the next few years and delivering over 100,000 square meters of new commercial space.

The table below summarises the commercial average rent in the Sydney market:

Table 2-5: Sydney Office Sub Market, rental costs, 2014

Sydney Market	Average net face rent (A\$/annum/sq.m)
North Sydney	625
Crows Nest/St Leonards	455
Chatswood	455
Parramatta	405
South Sydney	395

² <http://pdf.savills.asia/asia-pacific-research/australian-research/australia-office-/savillsresearch-briefing-parramatta-office-q4-2015.pdf>

Sydney Market	Average net face rent (A\$/annum/sq.m)
Rhodes	380
North Ryde/Macquarie Park	323

Source: NSW Department of Industry, CBRE Research, Colliers International

The growth in planned office space is mirrored by other real estate developments. The Parramatta CBD currently has 10,000 apartments and 400,000 sqm of commercial floor space that are the subject of planning proposals and development applications. Some of the developments under construction in the Parramatta CBD include:

- The development of 733 residential apartments at 142-154 Macquarie Street
- A mixed use development including 425 apartments at 189 Macquarie Street
- A development of 108 apartments at 29 Hunter Street

Growth in the Parramatta real estate market will be lifted by the NSW Government's commitment to relocate and consolidate 3,000 public sector jobs in Western Sydney. Already several agencies have begun to increase their presence in Western Sydney, including the Roads and Maritimes Services, while the Office of State Revenue and the Office of Environment and Heritage are to be consolidated within the Parramatta Justice precinct by 2019, bringing 2,500 jobs.

2.5.1.2 Comparative Advantages

As Western Sydney is big and growing fast, the WSA hub is identified as an emerging hub of economic development. Already, it is home to over 45% of all Sydney residents, a large number of whom are of working age. Furthermore, the region is expected to grow substantially faster than other areas of Sydney, offering much greater potential for economic expansion.


Today, an estimated 2.2 million people live in the region, spread across 14 local government areas (LGAs), according to the Australian Bureau of Statistics (ABS). Between 2006 and 2011 alone, Western Sydney's population grew by 7.5%, compared to the overall NSW growth rate of only 5.6%.

In *Shaping Future Cities – Designing Western Sydney*, Deloitte identified a number of advantages that will underpin industry growth in Western Sydney in the short to medium term. These include:

- A healthy economic outlook
- Integration with Australia's global city – Sydney
- Strong population growth, including a larger proportion of working-age people than Australia's overall population
- Migrant communities with the ability to engage with business and markets abroad, particularly in Asia
- Capacity for expansion, with large areas of the region rapidly urbanising
- Over 35 billion dollars of investment in infrastructure over the next decade
- Well-established or growing industries in key growth sectors, including tourism, education, agribusiness, health, and building and infrastructure construction.

Based on these advantages the following industries have been identified that are going to catalyse growth in Western Sydney in the coming years:

- **Health:** Like other developed nations, Australia is facing the challenges associated with an aging population and lifestyle-related chronic diseases are also increasing. Parramatta is well placed to cater for this demand giving its proximity to the Westmead Health Precinct. Currently Westmead employs over 14,000 people and provides housing for almost 9,000



residents. Currently, the Westmead precinct is undergoing a redevelopment that will increase staff and patient numbers, jobs supported by the precinct, and integration with the broader Parramatta area.

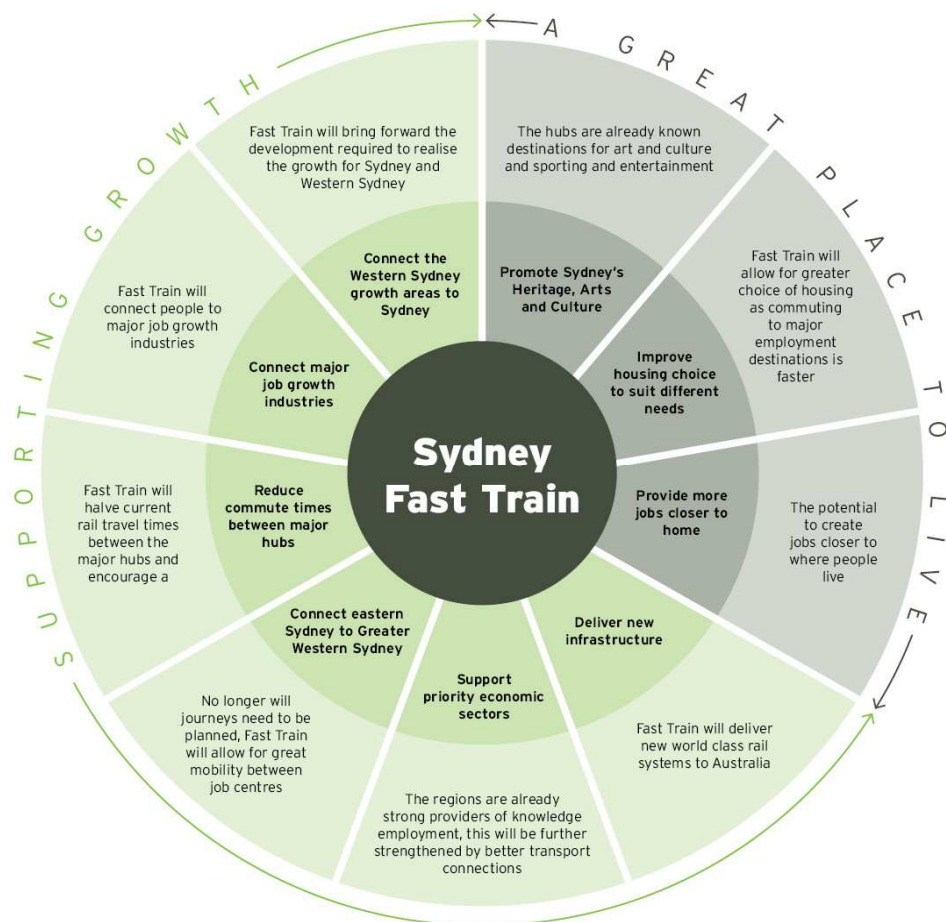
- **International education:** Most major Australian tertiary institutions are active in Western Sydney. Of the local institutions, TAFE NSW Western Sydney Institute's international student enrolments grew by more than 30% between 2006 and 2011, while many private education providers are also active in the international education market. Western Sydney University's 2014 international student population was 4,706, representing more than 10% of the total student population. The University of Western Sydney is currently constructing a new campus in the heart of Parramatta that will accommodate 10,000 students to cater for forecasted increases in student numbers.
- **Tourism:** Accommodation and food services currently account for 6.4% of total businesses in Parramatta – reflecting the growing and important nature of the tourism industry for Parramatta. As one of Sydney's oldest colonial settlements, it is home to a range of heritage sites and parklands, as well as food, shopping, events, festivals, clubs and theatres that capitalise on Parramatta's multicultural population. Tourism in Parramatta will be bolstered by the redevelopment of North Parramatta. This will include adaptive re-use of heritage sites, the creation of more residential areas, a village centre, and the rejuvenation of parks and recreational areas to increase local amenity.
- **Cultural industries:** cultural industries in Parramatta have benefited from increased government focus and investment in recent years. The Government has allocated \$30 million for the development of arts and culture in Western Sydney. The relocation to Parramatta will further enforce the requirement of transport investment to allow for a faster journey between Parramatta and Sydney.

2.6 Economic potential

The NSW Government's Metropolitan Strategy, A Plan for Growing Sydney, highlights Parramatta's status as the dual CBD on par with the City of Sydney. To meet the challenges facing Sydney, A Plan for Growing Sydney responds by setting four goals to deliver on Sydney's growth potential, these goals include:

5. A competitive economy with world class services and transport
6. A city of housing choice with homes that meet our needs and lifestyles
7. A great place to live with communities that are strong, healthy and well connected; and
8. A sustainable and resilient city that protects the natural environment and has a balanced approach to the use of land and resources

The diagram below highlights how the directions and actions from the Plan align with a Fast Train proposal and how they will help make Sydney a strong global city and a great place to live.





3 Approach and assumptions

3.1 Overview

The Discussion Paper for a Fast Train connection between WSA, Parramatta and Sydney CBD's has considered key factors as follows:

- Key objectives and service expectations of Fast Train services
- High level constraints,
- The existing and planned Sydney & NSW network
- Intermodal connectivity with other forms of transport
- Station locations and urban design
- Development objectives along potential routes and surrounding precincts
- Technological advances and applicability.

The Fast Train link has been considered in two discrete Links; the Western Link from WSA to Parramatta; and the Eastern Link from Parramatta to Sydney CBD.

3.2 Fast Train Concept

3.2.1 Level of Service

The primary objective for a Fast Train link between WSA and Parramatta is to provide a rail link to the new airport and access to western and eastern Sydney and the wider rail network. Furthermore the link will provide connectivity between Parramatta and Sydney CBD's in addition to the existing train services. This connectivity is not limited to commuting but provides reliable and frequent train services to facilitate business activities throughout the day and access to recreational and event facilities.

The key to providing an airport rail link and maximising the connectivity benefits between CBD's is to provide frequent, all day, every day services which are safe, fast and reliable. Such a service is not timetabled but walk up and go. Headways in the range of 5 to 10 minutes are ideal.

To achieve this level of service a dedicated line in each direction would be required which is exclusively used by the Fast Train service. Mixed running with the current Sydney Train services will impose constraints on the service and potentially reduce reliability, frequency and increase the journey times, particularly in peak times.

Stabling of the train fleet could be within the route itself in sidings or within an existing Sydney rail network facility. At this stage maintenance is expected to be carried out within existing or currently under construction facilities, whether Sydney Trains or Sydney Metro.



3.2.2 Customer Experience

We consider that passenger experience is a key ‘guiding’ principle that has wider benefits in terms of urban regeneration and development. The safe, reliable, convenient and pleasurable experience of the passengers is a primary objective. We recognise that a successful transit system will encourage commuter use and bring increased activity to the area.

It is imperative that the connectivity with the broader transport network is carefully considered and offers a complete journey experience; importantly, plans for future expansion to outer western Sydney centres.

3.2.3 Urban Realm

The urban design of station interfaces and solutions will focus on seamless connection to existing pedestrian networks and desire lines, integrate appropriately with civic spaces and activate the immediate surroundings. The potential of the Fast Train to be an urban renewal catalyst is substantial, however this does not form part of the Discussion Paper scope and should be further investigated.

3.2.4 Rolling Stock

The Fast Train concept in the context of this Discussion Paper is defined as modern metro style rolling stock (trains), single deck with limited type gallery seating, six or eight car sets with capacity approximately 1000 to 1200 passengers per train. Provision for luggage for airport customers can be easily accommodated. Such trains enable shorter dwell times at stations and contributing to an improved customer experience. Consistency with the Sydney Metro proposed rolling stock should be explored.

Modern rolling stock is ever improving in terms of speed, deceleration, and acceleration in and out of stations and permitted vertical grades and horizontal curves. This provides greater flexibility in considering portal locations, track alignments and station depths.

The frequency of the service will be high and the journey time short such that standing passengers are becoming more acceptable and the norm. Train speeds in the range of 140 to 160 km/h are possible.

This Fast Train concept is not high speed rail which travels at speeds in excess of 250km/h and requires specialised rolling stock and rail infrastructure.

3.3 Technical approach


3.3.1 WSA to Parramatta

The Fast Train link from WSA to Parramatta has considered two options; a northern Blacktown LGA option and southern Liverpool LGA option. Due to the lower density of development and the green field nature of the potential corridors the technical constraints are not considered particularly challenging.

3.3.2 Parramatta to Sydney CBD

The Fast Train link from Parramatta to Sydney CBD poses much greater technical challenges due to the highly developed and constrained corridor.

For this element of the Fast Train the existing western rail line corridor is considered as the quasi base case for the Discussion Paper.



Alternatives to the base case were then explored. For the purposes of the study and considering the densely populated and developed wider Sydney precinct, underground solutions are highly likely for at least significant sections of any proposed route corridors.

The route corridors have been primarily defined by the proposed intermediate station locations and any significant engineering constraints along the corridors.

The Discussion Paper has relied on publicly available information and the experience and knowledge within the Aurecon design team.

The key purpose of the Discussion Paper is to present viable options of new rail corridors for further consideration, exploration and assessment.

The options which are proposed have been developed giving consideration to significant known and future transport infrastructure projects including but not limited to:

- Sydney Metro
- WestConnex
- Sydney Light Rail
- Inner West Light Rail
- Parramatta Light Rail
- High Speed Rail between Brisbane, Sydney, Canberra and Melbourne
- Western Sydney north south connection

3.4 Economic approach

The analysis of the economic constraints and opportunities of the proposed Fast Train was largely informed by a high level desktop study.

We have considered the benefits of the potential Fast Train link through the lens of different travellers, different purposes of travel (i.e. between job centres, health precincts, sporting precincts and education precincts). Although not quantified, transport benefits such as travel time savings, reduced congestions and reduced externalities are considered.

3.4.1 Desktop Study WSA to Parramatta

The high level desktop study undertaken identified the economic benefits of providing a safe, fast and reliable public transport link to the WSA. The analysis and information presented in this report is drawn from the WSA EIS.

3.4.2 Desktop Study Parramatta to Sydney CBD

The high level desktop study undertaken was conducted to identify the commercial limitations and opportunities presented by the proposed Fast Train link. Specifically the Discussion Paper undertook to:

- Review existing and future rail service capacity servicing Parramatta and the Sydney CBD
- Investigate new rail corridor options
- Identify broad economic benefits

3.4.3 Economic Objectives

The following key objectives of the Discussion Paper have been met:

- Investigate the connection of Parramatta and Sydney CBD's with a Fast Train connection
- Investigate connection between WSA with the wider Sydney Region and onto the Sydney CBD via Parramatta
- Determine the broad economic benefits for Western Sydney.

There is a limited amount of forecasting, statistical and special analysis in order to meet these objectives as the availability to data at the stage of the investigation is constrained. Data collected is underpinned primarily by data made available by the Australian Bureau of Statistics and the 2011 survey of Journey to work.

3.4.4 International Considerations

Our desktop analysis included drawing on research and consideration for Fast Train internationally. Recent research carried out by the World Bank shows that at the current stage of development, transport projects such as high speed rail can trigger significant agglomeration benefits; however there is limited data to support a robust quantification of the impact on jobs. Given this, our review of international research, indicated business operations in the service industries as well as the management and sales industries have been adapting rapidly to the significantly raised accessibility – with a sharp increase in trip frequencies of the existing travellers.

There is almost no evidence on how the arrival of high-speed trains (or transport infrastructure more generally) affects individual firm performance. Most work instead focuses on the location of economic activity and aggregate income and welfare benefits by the increased job growth and accessibility to jobs. Research indicated that a Fast Train link substantially reduces travel time, allowing firms to search more efficiently across locations for new and higher quality suppliers as they innovate in their businesses. The improvement and expansion of the supply network can reduce costs and improve measured productivity in the economy.

3.5 Tunnelling Considerations


3.5.1 Geology

Sydney's geology is predominately sedimentary, with two major units. The Ashfield Shale, a horizontally bedded siltstone and mudstone unit sits above the Hawkesbury Sandstone, the sandstone unit (which has some shale beds) for which Sydney and the Blue Mountains are famous.

These sedimentary rocks were formed in a shallow basin, but have since been uplifted and then eroded. The rivers and streams that form Sydney Harbour and the Parramatta River have been cut by water flow, exploiting pre-existing weaknesses in the rocks.

The sea levels worldwide have varied significantly over time, with low water levels associated with ice-ages, and high water levels in the warmer periods in between. We are currently in a warmer period. During ice-ages, the sea level has been more than 100m lower. What we see in Sydney today is commonly described as a "drowned coastline". The cycle of ice age with low sea level, removal of sediment and continuing down-cutting of river valleys is followed by deposition of sediments filling the rivers and bays.

Sydney's rock is world famous in tunnelling as being an excellent material to build tunnels in. However, the valleys in Sydney are deceiving, being (as described above) filled with clay, silt, sand and rock boulders. Because the true rock surface was formed in previous times of low sea level (during ice ages) and now obscured, the true rock surface is called a palaeochannel. Finding the true depth and location of a palaeochannel is difficult. Various technical difficulties exist for geophysical



and probing methods, meaning that borehole confirmation is often the only way to be reasonably sure of the correct location.

Because the materials in a palaeochannel are weak and water charged, palaeochannels are a constraint on any tunnel option. For the purposes of this Discussion Paper, we have used geological mapping to try to estimate the location of these, and avoid them where possible.

Tunnelling technology exists to cross palaeochannels, but there are additional costs and risks. To date, the Airport Rail Link is the only Sydney driven tunnel that has crossed a major palaeochannel (the Sydney Harbour Tunnel used an immersed tube). All other driven tunnels in Sydney have stayed in the rock beneath.

3.5.2 Other constraints

Other significant constraints on underground solutions include; other tunnels (road, rail, and water), existing utilities and submarine cables, sewers, communication services, potential settlement etc. These types of constraints have not been explored as part of this Discussion Paper but often can have significant impact on any tunnel alignment.

3.5.3 Tunnel configurations

At the outset, a key decision to be taken is whether to use single track tunnels and stations with island platforms (examples being the Eastern Suburbs lines from Martin Place to Bondi Junction or the Epping Chatswood and new Sydney Metro Stage 1) or to use double track tunnels with side platforms (such as the Airport Rail Line). Both solutions have advantages and disadvantages. The former is the more common choice and allows for simpler and faster tunnelling. However station costs are often higher.

In all cases, emergency egress provisions are required. Emergency intervention may be required intermittently from the surface. These provisions require vertical stair access from the surface.

Ventilation facilities and smoke extract facilities will also be required at the surface intermittently along the tunnel. These are typically congregated around underground stations depending on the station spacing.

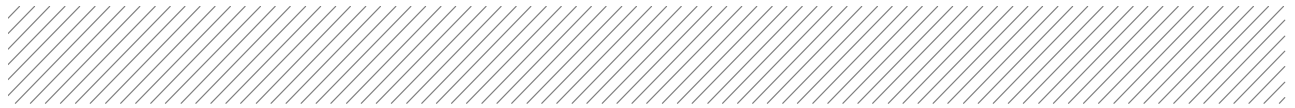
A key consideration for underground stations is the overall depth below surface and accessibility in terms of vertical transport. Operationally shallow stations are preferred but not always possible due to technical constraints.

3.5.4 Tunnel driving

Given the potential length of the emerging tunnel options and the expectation that the majority of the tunnelling will be in reasonable conditions, we would expect that the tunnel is mainly driven by a tunnel boring machine (TBM), using precast concrete lining segments. As has been recently demonstrated in the Sydney Metro Stage 1 project, this technology provides fast, reliable and high quality tunnels.

As discussed above, if the tunnel route involves the soft ground associated with a palaeochannel, the TBM would need to incorporate closed face technology. This technology is well proven, but tends to be slower, more expensive and more risky than TBMs which do not need this technology.

All tunnel projects involve minimal disruption to the surface, except at the worksites which are required to allow access to the tunnelling. These tunnel options would require a few significant worksites, from where tunnel boring machines are launched, spoil is removed, and segmental linings are delivered. Other worksites can be less significant; where TBMs are recovered and where permanent ventilation shafts might be required. The siting of worksites is a task that is usually done after the primary



strategic decisions are made (such as which intermediate stations are desirable). In some cases, the route may be deviated slightly to take advantage of an attractive location for a worksite.

During TBM driving, vibrations can be felt at the surface. Surface settlement also occurs. In every previous tunnel in Sydney, these effects have been minor and have been handled by suitable community engagement and treatment.

In service, rail-borne vibrations are treated by vibration-reducing track fixings.



4 Western Link: WSA to Parramatta link

As stated previously the study remit is to provide a Fast Train link between the three hubs, WSA, Parramatta and Sydney CBD. These two links have been considered separately and are not mutually exclusive. Each link can be explored and delivered separately and in staged manner if required. Both links are technically feasible and will deliver job, tourism and urban renewal benefits to the regions they connect between WSA and Parramatta.

This section presents the technical and economic considerations of the WSA to Parramatta link.

4.1 Technical Considerations

We understand that the provisional design for the WSA makes allowance for tracks beneath the airport terminal and connections from the south and north. Two options have been explored as part of this study.

As shown on the Overview Map in Appendix A, the Northern Blacktown LGA option takes a direct route from the proposed Parramatta Fast Train station to the WSA and the second option runs further south via Liverpool LGA. The land on both routes is already well-developed and may lead to an underground tunnel solution whereas closer to the airport some land is less well developed and may allow an at grade solution. Whilst we understand it is still undecided whether the airport will have an above or below ground rail provision, we expect the rail line will be predominantly underground through the airport site to avoid other infrastructure and to allow flexibility for one or more stations in the terminal precinct. It appears as if a Fast Train connection to either above or below ground stations would be feasible with both options.


As noted in the Draft Airport Plan - WSA (October 2015), “the main access to the Airport Site from the north will be via the new M12 Motorway, which is expected to run parallel with Elizabeth Drive and connect to the Airport. The proposed access corridor within the Airport Site is approximately 100m wide, with capacity for six traffic lanes, two bus lanes and a 40m rail reserve. The proposed entrance to the Airport has capacity to operate at up to approximately 5,100 vehicles per hour.

“Access to the Airport Site from the south-west will be via The Northern Road, which will be relocated and upgraded before the start of operations. This access point is anticipated as being primarily for secure commercial access to operational areas of the site, including freight and maintenance. This access road is expected to consist of a 50m wide corridor allowing four trafficable lanes.”

4.2 Economic Impacts of a Northern Connection

The northern route to the WSA is proposed to travel north-west of Parramatta before heading south to the Badgerys Creek site. This would take the Fast Train through the Blacktown LGA finishing at WSA.

Along this route there are two existing transport corridors – the T1 Western train line through Westmead, Seven Hills, Blacktown and St Marys, and also the M4 Motorway running north of Prospect Natural Reserve, through Prospect and St Clair.



The Northern Route will connect to existing and emerging tourism attractions. The new Western Sydney Zoo announced in September 2015, is expected to attract almost 745,000 people each year. Additionally, Sydney's Wonderland is expected to be redeveloped in Western Sydney, which will attract more tourism and visitation to the Northern region.

The alignment via Blacktown LGA has the opportunity to connect to a large park and ride facility at the M4/M7 junction which will further enhance connectivity with the Western Sydney employment lands.

By taking this alternative option, the Fast Train would pass through the Broader Western Sydney Employment Area. The Western Sydney Employment area is part of the NSW Government's plan to promote economic development and jobs in Western Sydney. The Western Sydney Employment Area is anticipated to employ 40,000 people. The NSW Government has already begun positioning for the Western Sydney Employment area by rezoning 800 hectares of land to accommodate 16,500 jobs. If a Fast Train station were to be included within the Western Sydney Employment Area, this would connect workers from the Penrith, Blacktown, and Parramatta areas, as well as the Inner West and Sydney CBD, directly to the employment area as well as the airport zone.


4.3 Economic Impacts of a Southern Connection

The Southern route to the WSA is proposed to travel south-west off Parramatta to Liverpool LGA before heading in a westerly direction to the Badgerys Creek site. This would take the Fast Train through the Holroyd, Fairfield and Liverpool LGAs. This will provide transport connectivity to the fast growing south west corridor and be a catalyst for urban renewal and development of missing cultural, recreational and business infrastructure, collaboration between major health and education precincts.

This route would allow the Fast Train to travel along the existing T5 Cabramatta-Granville railway corridor. It could then follow the T2 Leppington corridor towards the airport site. It may also travel along existing road corridors at Elizabeth Drive or Fifteenth Avenue.

By taking this alternative option, the Fast Train would pass through the South West Growth Centre (SWGC). This area is approximately 17,000 hectares in size, spanning areas of Liverpool LGA, Camden and Campbelltown. The SWGC will contain 18 precincts for urban development. At the heart of the SWGC is the Leppington Centre, with connections to the South West Rail Link. It is anticipated that 300,000 residents will reside in the SWGC, however collectively the precincts will only increase job capacity by 22,120. Therefore the Fast Train could be used as a mechanism to connect the resident population of the SWGC to the employment hubs at the new WSA as well as Parramatta and the CBD.

If the Fast Train were to follow the T5 and T2 transit lines, this would allow the Fast Train to pass through both Liverpool LGA and Leppington. The population is currently about 190,000 and is anticipated to reach approximately 290,000 by 2031. In 2015 there were enough jobs in Liverpool LGA for 85% of working residents. By 2030 this figure is intended to increase slightly to 91% - meaning that almost 10% of Liverpool LGA workers are still required to leave Liverpool LGA to find employment.



5 Eastern Link: Parramatta to Sydney CBD link - Option 1

For the Parramatta to Sydney CBD element the quasi base case for the purposes of this Discussion Paper is Option 1 which considers the use of the existing western line rail corridor between Sydney's Central Station and Parramatta Station for a Fast Train service.

The upgrade of the existing western line to incorporate a dedicated Fast Train link has significant and multiple constraints and is unlikely to provide travel times significantly less than the current minimum of 25 minutes. Even with extensive upgrades at best this may be reduced by a few minutes and degrade the existing congested services. On this basis this option is discounted from the study.

5.1 General

5.1.1 Overview

The existing western line is a critical section of the overall Sydney Trains suburban network. It carries a mix of services including suburban services with multiple stops, express services, regional services from Lithgow and beyond and some freight services.

Also on the corridor between Central and Parramatta stations are key rail infrastructure facilities such as Auburn Stabling Yard, Clyde junction, Flemington sidings etc. These facilities require regular access to the corridor.


Operationally the corridor is heavily congested particularly in peak periods. We understand that Sydney Trains has plans to continue to invest in the corridor to increase capacity and reliability just meet the current demands as well as future growth needs. Availability of train paths within the existing operations is considered very limited.

There are 17 stations on the corridor between Central and Parramatta typically with curved platforms. Also there are numerous over and under bridges and significant above and below ground lineside infrastructure.

It is acknowledged that some express services currently operate between Parramatta and Central Stations and achieve journey times between 25 and 30 minutes. Typically these services only stop at Lidcombe, Strathfield and Redfern stations. These services are provided at a reasonably regular frequency in peak times at every 10 to 20 minutes. It should be noted that Fast Train options 3 and 4 plan to connect to Town Hall and Barangaroo Sydney Metro Stations respectively within less than 15 minutes from Parramatta whereas the aforementioned express services currently take over 30 minutes to arrive at Town Hall.

To reduce travel times of these existing services several options could be explored as follows:

- Remove intermediate stops altogether. This will provide journey time savings by removing the dwell times at the stations and improving average journey time speeds by not having to decelerate and then accelerate. The impact is that customers wanting to alight at the



intermediate stations are then forced to use the multiple stops services, thereby degrading the existing service for these particular customers.

- Upgrade existing signalling to improve headways and reduce journey times
- Explore train speeds on the existing network. It is likely that current trains travel at speeds which are maximised considering the track infrastructure (horizontal alignment, cant etc.), within the train's traction power constraints and to suit the complex signalling system. .

The above options are for discussion purposes only at this stage as Sydney Trains have not been consulted as part of this Discussion Paper.

It is considered that at best the above options or combination of options may reduce the journey times by several minutes only.

If a dedicated Fast Train service was to be incorporated within the existing western line corridor two existing tracks would need to be dedicated to the Fast Train and separated from the current operations. The existing corridor is very spatially constrained and it does not have the space to install two new dedicated lines for the full length between Parramatta and Central Stations without significant property acquisition in places.


Taking two tracks out of the existing operations network would severely degrade the current operations and reduce capacity on an already heavily congested line. This acknowledges that the Fast Train will take some of the existing patronage away from the existing services but is considered to be marginal.

Of particular note is that any construction work within the live rail corridor must be carried out to very strict work practices in a track possession. Sydney Trains have four planned possessions each year over long weekends and holiday times. These possessions are typically heavily booked for general maintenance and some major and minor upgrade works. The significant level of construction activity associated with converting the existing rail line to Fast Train and/ or providing additional tracks will have significant service disruption impacts and result in extended construction periods and associated increased construction costs.

5.2 Technical Issues

Technical issues include, but are not limited to:

- The geometry of the existing track alignment in places is not suitable for Fast Train services. Some existing track radii are too tight for Fast Train speeds (the current maximum speed on the existing tracks is 120km/h whereas Fast Train is targeting approximately 140 to 180km/h)
- The existing corridor is highly constrained by public roads and residential/ commercial development for the majority of its length. There are also a significant number of overbridges crossing the corridor, underbridges over local roads, cuttings, embankments and water features. We consider adding additional tracks is not feasible as each of these infrastructure assets would need to be upgraded or replaced
- The corridor is already heavily congested particularly in peak periods with little or no spare train paths available. The train services on this corridor include a mix of local suburban services (multiple stops), express peak services with limited stops, regional services from the Blue Mountains and beyond and limited freight services. There is unlikely to be capacity to add a Fast Train service
- Line side infrastructure would likely be required to be upgraded to accommodate increased collision loads/ spatial requirements for faster trains
- If a Fast Train service was to be incorporated into the existing corridor it would have to be separated in at least an operational sense from the existing network. To provide the desired level of service the Fast Train would require a dedicated track in each direction as a minimum.



Separation could also extend to separate power requirements, signalling, and spatial separation with appropriate line side security etc. All these requirements will increase the required spatial needs

- Major signalling, track and general infrastructure upgrades would be required and causing unacceptable disruptions and delays to existing rail services for many years during construction which could be up to 8 to 10 years. For example a major corridor upgrade from Lidcombe to Granville (LGCUP) was recently completed over 6 years.

5.2.1 Signalling Constraints

Signalling constraints with utilising the existing corridor for Fast Train services include:


- Existing Lineside conventional Signalling and interlockings would require significant modifications to change to Fast Train services which are considered not to be feasible. Existing tracks are generally split into Mains (Fast Trains) and Suburban lines (all stop trains). Crossovers exist where trains can change between these lines safely to meet timetable and other operational movements. These lines are shared with Freight trains. A Fast Train using one of the existing lines e.g. the Mains line, would require all other timetabled services to move to the suburban lines. This would slow down the existing services which is considered unacceptable.
- There are multiple crossovers between the Suburban and Main lines, which are utilised at various times for moving from one track to another. If part of the corridor is to be dedicated to Fast Train services, this would result in the removal of those crossovers and would remove the flexibility currently available. This would also cause problems during possessions and perturbation recoveries.
- Currently four signal boxes control this section (Sydney, Strathfield, Homebush and Granville). Alterations will be required to all of them, in addition to massive changes to the different interlocking systems spread in the corridor.
- Depending on the signalling and the control systems for Fast Train, the entire dedicated section may have to be stripped of the signalling assets and fitted with proprietary systems. For example, as an enabler for the Sydney Metro NorthWest, the recently commissioned Epping Chatswood Rail Link (13km of twin tunnel) will be stripped of its assets to make way for the proprietary metro signalling system, under a full rack closure for over 6 months. This type of construction staging and duration wouldn't be acceptable for the Western line.

5.3 Economic

The existing Western line serves as the main public transport connection between Western Sydney and Sydney. TfNSW demand modelling indicates demand on the line is forecast grow by 4.5% annually. Existing capacity constraints will limit the opportunity for new benefits to be achieved on the route. Dedicating a line on the existing network to enable a Fast Train service would involve significant investment to upgrade the track alignment, stations and signally and would remove much needed capacity on the line servicing current demand.

The surface alignment currently serves as the main connection for commuters travelling from Penrith, Blacktown, Parramatta, Strathfield, Burwood, and Ashfield. The mode share for rail journeys from these stations to the Sydney CBD ranges from 73% - 88%. The T1 Western line utilises 16 trains and carries over 17,000 commuters in the one hour AM peak period³.

³ Bureau of Transport Statistics Train Statistics 2014: Everything you need to know about Sydney Trains and NSW TrainLink




The surface rail network is already met with capacity constraints as average load factors exceed 120%. With the population and travel demand growths, the line would need to add additional services stopping at a number of stations along the line to connect commuters to their travel destination.

5.4 Current development along route

Option 1 is in an existing rail corridor that connects existing points with a significant number of stops with major stops at centres (i.e. Burwood, Ashfield and Strathfield) and minor stops (i.e. Flemington) at a number of stations.

The majority of the stations are well developed with city and town centre features. Others have small transport node characteristics with the remainder being infrequent stopping destinations. The growth potential that Fast Train service would stimulate already exists on the corridor. If stations were being proposed at the major existing transport nodes, major uplift potential is limited. If they were proposed at medium nodes the potential would be greater.

If rezoning occurred at the semi-industrial areas, the potential for transforming and renewing would be greater and provide significant uplift. However, the availability of this land relative to the location of the stations would be limited. A review of building use and densities would need to be reviewed within their proximity.



6 Eastern Link: Parramatta to Sydney CBD link - Option 2

For the Parramatta to Sydney CBD element, Option 2 consists of a new tunnel between Sydney CBD and Parramatta Station with intermediate stops at Croydon and Lidcombe. The CBD station will connect and be adjacent to the new Sydney Metro Pitt Street station. This proposed alignment closely follows the existing rail alignment and would be continued on to WSA with a new rail corridor mostly/ completely in a tunnel.

6.1 Constraints

6.1.1 Technical

- The investigation identified there are no significant geological constraints along the proposed corridor. However middle harbour and the palaeochannels (historical river beds and channels) should be avoided as far as possible (lighter yellow areas shown on the constraints maps)
- The proposed corridor is mostly south of the existing rail corridor which has better ground conditions and follows the natural ridge line. It is suggested that the consideration of potential station locations to draw in patronage and maximise value capture may well define some variations to this corridor.
- Refer to section 8 for further details of the connection to the WSA.

6.1.2 Economic Considerations

An alignment which will run under the existing Western line will provide limited potential for value uplift contribution. Station locations such as Lidcombe, Burwood, and Ashfield are well developed with city and town centre features.

This option does not allow for the connectivity of the emerging job and tourism hub in SOP and White Bay. Option 2 has the opportunity to ease congestion on the Western Line and enable the potential to spread density along the existing line, moving away from Burwood and Strathfield.

As Option 2 is underneath an existing rail corridor that connects existing points with a significant number of stops with major stops at well densified suburbs (i.e. Burwood, Ashfield and Strathfield) and minor stops at less densified suburbs (i.e. Flemington). The major stops have transport node characteristics with the remainder being infrequent stopping destinations. Hence, growth potential that Fast Train services would stimulate already exists on the corridor. If stations were being proposed at the major existing transport nodes, major uplift potential is limited. Stations would need to be proposed at medium nodes as the potential for value uplift would be greater.

7 Eastern Link: Parramatta to Sydney CBD link - Option 3

For the Parramatta to Sydney CBD element, Option 3 consists of a new tunnel from Sydney CBD to Parramatta Station with intermediate stations proposed at White Bay and Olympic Park. The CBD station will connect and be adjacent to the new Sydney Metro Pitt Street station. This line would be continued on to the proposed WSA with a new rail corridor mostly/ completely in a tunnel.

7.1 Constraints

7.1.1 Technical

- Option 3 involves the crossing of a number of palaeochannels including Darling Harbour, White Bay, Iron Cove, Hen and Chicken Bay, Powells Creek, Haslams Creek and Duck Creek. Each of these will almost certainly require the use of closed face tunnelling technology. The combined length of the closed face technology would appear to represent up to 50% of the total route (based purely on the geological mapping). Tunnelling for Option 3 will be slower than for Option 2, and will involve a greater risk of settlement and blowouts (often caused when the TBM is driven into an unmapped well or water bore). More care and attention will be required to make sure that the final lining including the cross passages are watertight. While this requirement for additional care sounds forbidding, note that this technology is successfully used worldwide in cities with soft ground, for example Bangkok or Singapore.
- Refer to section 8 for further details of the connection to the WSA.


7.1.2 Economic

Whilst the Bays Precinct Transformation Plan has the potential to unlock large economic potential on the edge of the Sydney CBD, this potential is yet to be realised. As such, a demand based decision framework would likely demonstrate that this alignment is not justified.

At present, Leichhardt is the 31st most common area (SA3) where employed people are travelling from who work in Parramatta each day – over 700 commuters. It is the 23rd most frequent suburb to which Parramatta residents commute for work – over 430 commuters per day.

Commuters between Leichhardt and Parramatta are less likely than the average commuter to and from Parramatta to use train travel at present. 14.26% of commuters to Parramatta use train travel compared to 13.8% for those coming from Leichhardt. Similarly, while 19.60% of commuters from Parramatta use train travel, only 18.49% of those travelling to Leichhardt use this medium. In both instances, commuters are more likely than the average to be travelling by car.

This low level of current use of train for commutes between Leichhardt and Parramatta may be attributable to the lack of a convenient heavy rail station. From White Bay, the closest station is Town Hall – a 4.5km or 1 hour walk away. Most people are prepared to spend about 10 minutes walking or



riding to a high-frequency, direct public transport service such as a train (800 metres walking or two to three kilometres riding a bicycle) – and so White Bay is currently outside of threshold.

However, the inclusion of White Bay as part of a Fast Train has the potential to enhance the urban renewal already envisioned for the bays Precinct and increase connectivity and access between these two hubs. These opportunities are discussed in detail in the following section.

7.2 Opportunities

7.2.1 Opportunities

The Fast Train service CBD station would offer direct interchange with Town Hall station and Sydney Metro Pitt Street station as well as easy access to the Sydney Light Rail. The first intermediate stop is proposed at Olympic Park, which also interchanges with the Parramatta Light Rail, the second stop would be at White Bay, creating a 90 second transfer from White Bay to the CBD and also interchanging with an extended inner west light rail line and Victoria Road buses.


The western end of the Fast Train service would terminate at Western Sydney's Airport. That would create an interchange with the conventional rail line from the south and southwest, thus allowing faster journeys from the south and southwest to Parramatta in particular. The western Sydney Fast Train service station would become a satellite of the airport and attract airport related commerce, being only a few minutes from the terminal via Fast Train. This station would also serve as a transport hub for the Western Sydney Employment Area.

Option Three would look to support the population cohort of over 500,000 along the proposed corridor. Whilst only five stations are envisioned along the corridor, being Town Hall – White Bay – Olympic Park – Parramatta – Badgerys Creek, the faster travel time has the potential to see more people utilise connecting and proposed bus, rail and light rail services in greater number and frequency to access the Fast Train. Through this increased connectivity, it is anticipated that the entire corridor will be supported by the Fast Train option. The entire corridor is also anticipated to receive the economic benefits of the construction phase of the Fast Train project, including increased employment, business growth and economic growth.

The recent government announcements around the a Parramatta Light Rail route through the Olympic Corridor highlight the urban renewal, job growth and residential population growth that would be achieved through the corridor if better transport connectivity to major cities was achieved. The Olympic Park itself has over 10.9 million visitors each year, with over 2.6 million of those visitations being for work purposes. The Olympic Corridor route has the potential to house over 260,000 people and support over 230,000 jobs by 2036. A Fast Train link through Olympic Park would assist in achieving the population and job growth forecasted for the corridor.


Further to the above, this route will reduce public transport congestion along the existing T1 Western Line route. Currently commuters between the Sydney CBD and Parramatta are some of the most numerous commuters utilising the T1 Western Line (see Section 2.4.6 above for further detail). These commuters will now be able to access the Fast Train, increasing available capacity for small suburban commutes along the inner west.

White Bay and Homebush have been historically underserved by rail connectivity to Parramatta and CBD as land constraints limit a surface rail solution. Buses and limited light rail options have therefore been the only alternative to private car transport. The road network has limited capacity to continue to support the movement between Sydney CBD and Parramatta. As of 2011, 815 of the reported 1,154 daily commuters between Parramatta and the Leichhardt area were commuting by car. This was equivalent to 70.62% of total commuters between these two areas, whereas of the total number of



NSW commuters, only 62.55% travelled by car. There exists therefore an identified and large proportion of commuters who may divert from car to public transport under the Fast Train initiative between the White Bay and Parramatta precincts. This presents the opportunity for numerous private and social benefits including reduced car mileage, reduce car operating costs, reduced traffic congestion on roads between the Leichhardt area and Parramatta, reduction in car parking costs, increased availability of resources for car parking, reduced car ownership, positive environmental externalities (including less noise and air pollution).

By creating a rail interchange at White Bay, many residents within the White Bay, Balmain and Roselle areas will be transitioned from being outside of the “convenience threshold” discussed in Section 6.1.2, and will now be within 10 minutes’ walk or cycle of the new Fast Train connection. This makes it more likely that people will walk or cycle to the station rather than driving or using bus or light rail connections. This has the advantage of reducing congestion in road and parking facilities, as well as increased health benefits associated with the increased physical activity of walking and cycling.



8 Eastern Link: Parramatta to Sydney CBD link - Option 4

For the Parramatta to Sydney CBD element, Option 4 is a new tunnel from Barangaroo to Parramatta CBD. Intermediate stations are proposed at White Bay and Ryde. The Barangaroo station will connect and be adjacent to the new Sydney Metro station. This line would be continued on to the proposed WSA with a new rail corridor mostly/ completely in a tunnel.

8.1 Constraints

8.1.1 Technical

- Option 4 has the longest and deepest underwater tunnels which would cost more and require longer construction durations;
- Option 4 involves the crossing of a number of palaeochannels including Darling Harbour, White Bay, Iron Cove, and the Parramatta River (twice). Each of these will almost certainly require the use of closed face tunnelling technology. The combined length of the closed face technology would appear to represent up to 20% of the total route (based purely on the geological mapping). Much of Option 4, on the North Shore around Ryde will involve good tunnelling in rock.
- Refer to section 8 for further details of the connection to the WSA.


8.1.2 Economic

Option 4 presents a mature corridor; however it is majority low density and is not serviced by rail with and east west connection. The areas identified have significant urban renewal potential. If this line was to be pursued and value sharing was to be sought, seeking to maximise use and density that create vibrant and demandable spaces would be key to maximising the contribution possible.

Using BTS demand forecasts, population and dwelling growth is forecast grow by 1.3%, however if nodes were put in with greater densities, the potential for population and dwelling growth would be far greater.

8.2 Opportunities

Option 4 will enable transport connectivity through Ryde and White Bay. The population of Ryde was at 104,000, based on the 2013/14 BTS Household Travel Survey. The dataset also indicated that car driver mode share was 50%. A Fast Train connection through Ryde would present the opportunity for a mode shift to train. The closest rail connections are West Ryde and North Ryde. However the two



stations are on existing corridors and do not connect the residents of Ryde to either Parramatta or Sydney by means of a direct east west connection.

Currently the most direct trip to Parramatta is via the road network, with an average journey time of 25-30mins. Similar a car trip to Sydney has the same average journey time range. A Fast Train connection through Ryde would potentially more than halve the journey time for people travelling to either Parramatta or Sydney. As commuters move from road travel to rail travel, capacity would free up on the road network and potentially ease congestion on the road network.

Further, a station at Ryde will allow for a connection to one of Sydney's established shopping precinct, Top Ryde Shopping Centre. The shopping centre has key retail tenants and has key restaurants that contribute to the night time economy of Ryde. The shopping centre is also connected to 653 apartments that were developed on top and adjacent to the shopping centre.

The areas through this corridor have been historically underserved by rail connectivity to Parramatta and Sydney as land constraints limit a surface rail solution. Buses have therefore been the only alternative to private car transport. The road network has limited capacity to continue to support the movement between Sydney CBD and Parramatta.

Option 4 will connect the newly activated precincts in White Bay to the West, allowing for fast travel to health, education and employment precincts. Based on current government planning White Bay will be consider for smart jobs, further harnessing the need for a connection between such precincts and universities.

In reference to White Bay, the opportunities would be similar to those presented in Option 3, albeit the potential at Ryde would potentially drive different travel purposes and journey behaviours.



9 Funding Considerations

9.1 Funding options

9.1.1 Traditional Funding

There is a range of competing priorities in the transport portfolio and broader infrastructure portfolio for the limited available government funding. In the absence of the tax payers identifying this as the number priority, an alternate funding approach will be necessary to help deliver this project.

Investment in major infrastructure is difficult due to the limited amount of funding available from Federal and State Governments. Traditional funding mechanism have placed significant dependence on government budgets to fund infrastructure investment, however with increasing government commitments and limited availability of fund, the government's budgets are stretched thin.

The justification of infrastructure project needs to move beyond the traditional realms of demand led justification. Transport project justification needs to see transport project as enablers for larger scale economic growth and the role transport infrastructure plays in building the demands required.

More traditional models have used private sector funding in PPP arrangement, however the demand driven funding models make it difficult to justify rail projects, investor will carry the risk

Availability payment PPP an alternative which still carry an element of risk, but require the taxpayer to contribute.

9.1.2 Private Sector

The investment and delivery of Fast Train between Parramatta CBD and Sydney CBD will allow for changes in land use planning. As a result the government and private sector have the opportunity to share in the uplift associated with the additional density to support funding the development of Fast Train.

As demonstrated on the Parramatta Light Rail Project, the NSW Government has indicated it will explore value sharing mechanism to fund infrastructure developments. Fast Train presents the opportunity to part take in value sharing mechanism to contribute to the delivery of Fast Train. While this Discussion Paper does not seek to solve the best/most appropriate value sharing mechanism to use, it does indicate that there is greater potential for value sharing associated with Options 3 and 4 then the opportunity presented in Options 1 and 2.

Model such developer levies, value sharing mechanism with greater densities and seek contributions through rates per square metre, and other potential models, transport orientated development where land around stations is offered to proponents to assist in funding the project.



10 Summary

The options explored as part of this study, except for Option 1 the upgrade of the existing western line, present tangible opportunities for further assessment and development. The options for both the WSA to Parramatta and Parramatta to Sydney CBD elements could be used in various combinations and present opportunities for staged delivery to reflect funding options if needs be.

It is considered that this study presents an overriding case for a Fast Train link between the WSA, Parramatta and Sydney CBD with following key benefits;

- Provide safe, fast, frequent, reliable walk up and go services with the customer experience at the fore
- A service on a dedicated line, which is not subject to wider network delays
- Provide seamless interchanges with other transport modes
- Complement Sydney Rail Future planning
- Provide an essential rail link to the new WSA from Parramatta, Sydney and the wider existing suburban train network
- Stimulate urban regeneration around new and existing stations
- Support connectivity to renewal areas that can accelerate housing stock
- Significantly reduce rail travel times Provide another valuable link in Sydney's global transport system taking peak pressures off already strained east west connections
- Revitalise our cities by encouraging high density and mixed-use real estate development around the new and existing stations
- Investing in building and operating Fast Train can directly employ thousands of Australian's while indirectly providing more job opportunities throughout our cities
- Help progress the Government's strategy on connecting the major job centres
- Enable mobility between major sporting, recreational and cultural facilities and support tourism movement and visitation through the cities



11 Next Steps

The Consultant team considers this study provides a compelling case for a Fast Train link with many potential opportunities worthy of further exploration and investigation. The next steps include a pre-feasibility phase with more detailed technical assessment and survey of potential corridors, in depth stakeholder consultation, economic analysis and modelling, and broad cost planning.

Further analysis is required to develop the feasibility of a Fast Train connection between WSA, Parramatta and Sydney. The Business and Urban context will need to be explored further as the two will drive the demand required to support the development of a Fast Train connection, especially through areas with latent demand, such as White Bay.

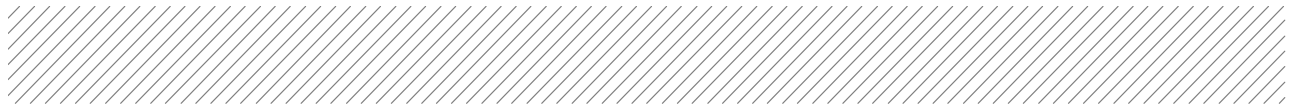
The Client is keen to improve the connectivity between the two main business districts in western and eastern Sydney by having faster rail services – ideally with journey approaching 15 minutes. For the benefit of business and public servant travellers, we consider rail journey time should be measured from Parramatta station to either Wynyard or Town Hall stations rather than Central Station. We have based this on the fact that currently there is relatively little business activity near Central Station. Further work will be required to understand the business context of the three hubs.



Appendices





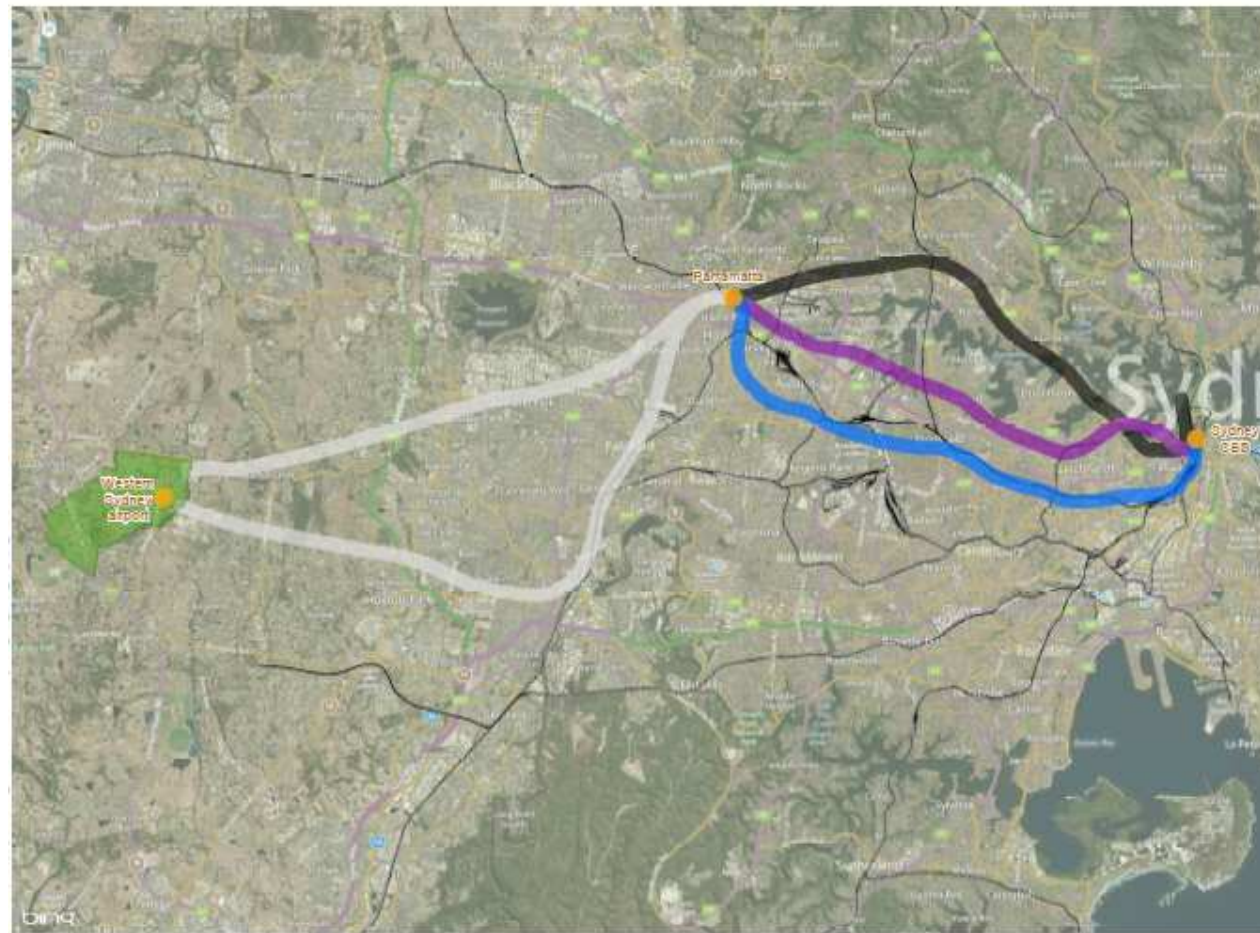


Appendix A

Maps: Overview map

Overview Map - Sydney CBD to Western Sydney airport via Parramatta

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Notes:

Option 1 - investigates the use of the existing rail corridor between Sydney's Central Station and Parramatta Station for Fast Rail by either using two of the existing tracks or by adding two new tracks.

Option 2 - consists of a new tunnel between Sydney's CBD (at Sydney Metro Pitt Street Station), via stations at Lidcombe and Cherryton.

Option 3 - is a tunnel from Sydney Metro Pitt Street Station to Parramatta CBD via stations at White Bay and Olympic Park.


Option 4 - is a tunnel from Sydney Metro Barangaroo Station to Parramatta CBD via stations at White Bay and Ryde.

Legend

- Option 1 - use existing rail corridor
- Option 2 - Tunnel
- Option 3 - Tunnel
- Option 4 - Tunnel
- Options to Western Sydney airport
- Western Sydney airport at Badgerys Creek

Source: Aurecon, Bing maps

Projection: GDA 1994 MGA Zone 56



Appendix B

Eastern Link: Options 1 and 2

Constraints Map - CBD to Central

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Map
1 of 5

Notes: refer Overview Map

Legend

- Option 1 - use existing rail corridor
- Option 2 - Tunnel
- New Railway Station
- Existing railway station
- Bridge structure
- Potential light rail alignment
- Indicative location of Sydney Metro City & Southwest alignment
- Roads
- 2m contours
- Natural drainage line
- Geological dyke
- Geological fold

Geological Identifier

Jv	Rab
Qha	Ram
Qhd	mf
Qhs	mfQha
Rh	mfTm
Rws	water

Source: Aurecon, Neamap, LPI, DPI NSW

Projection: GDA 1994 MGA Zone 56



Constraints Map - Central to Lewisham

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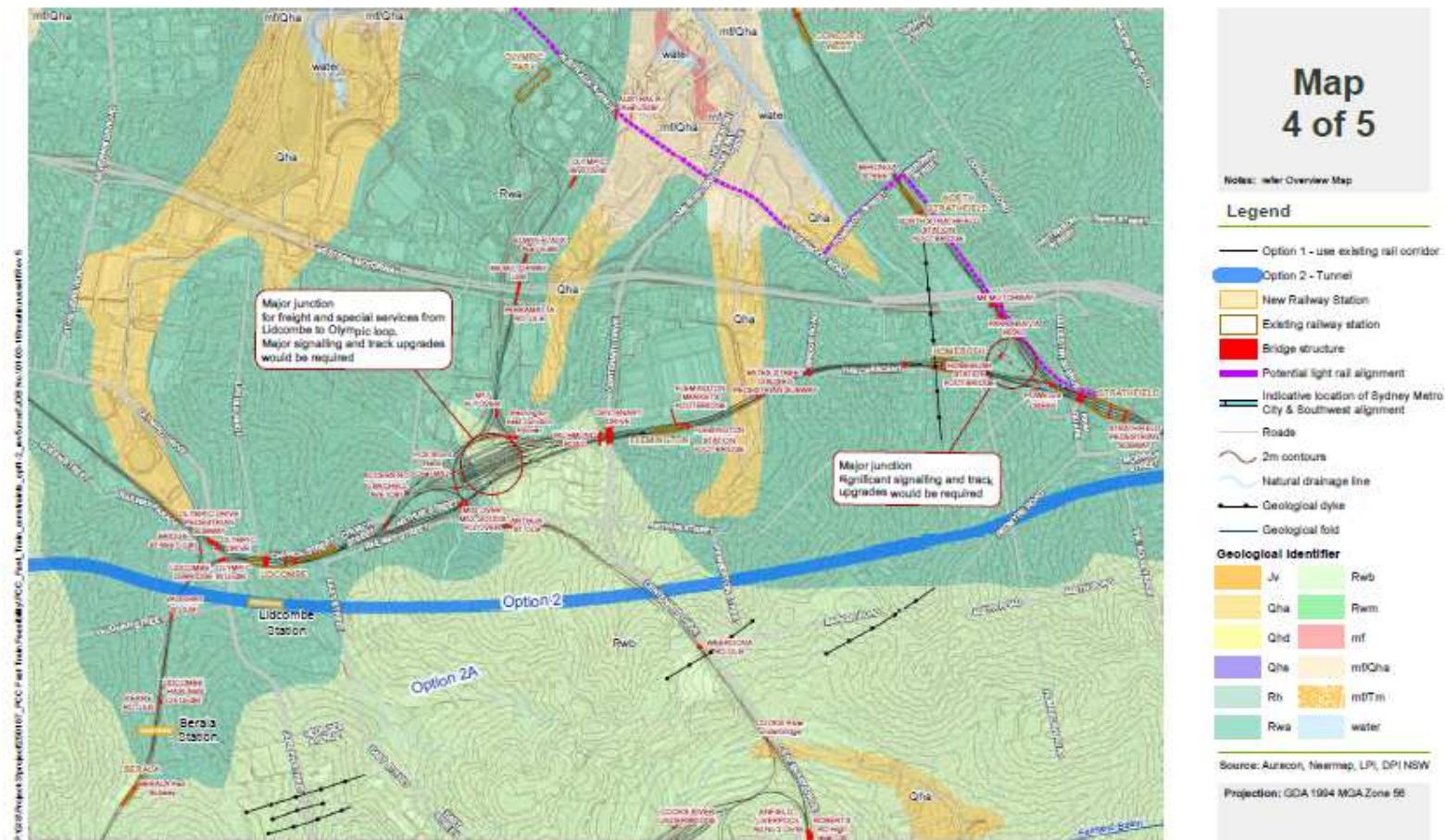
Constraints Map - Lewisham to Strathfield

aurecon



Constraints Map - Strathfield to Auburn

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Constraints Map - Auburn to Parramatta

aurecon

Map 5 of 5

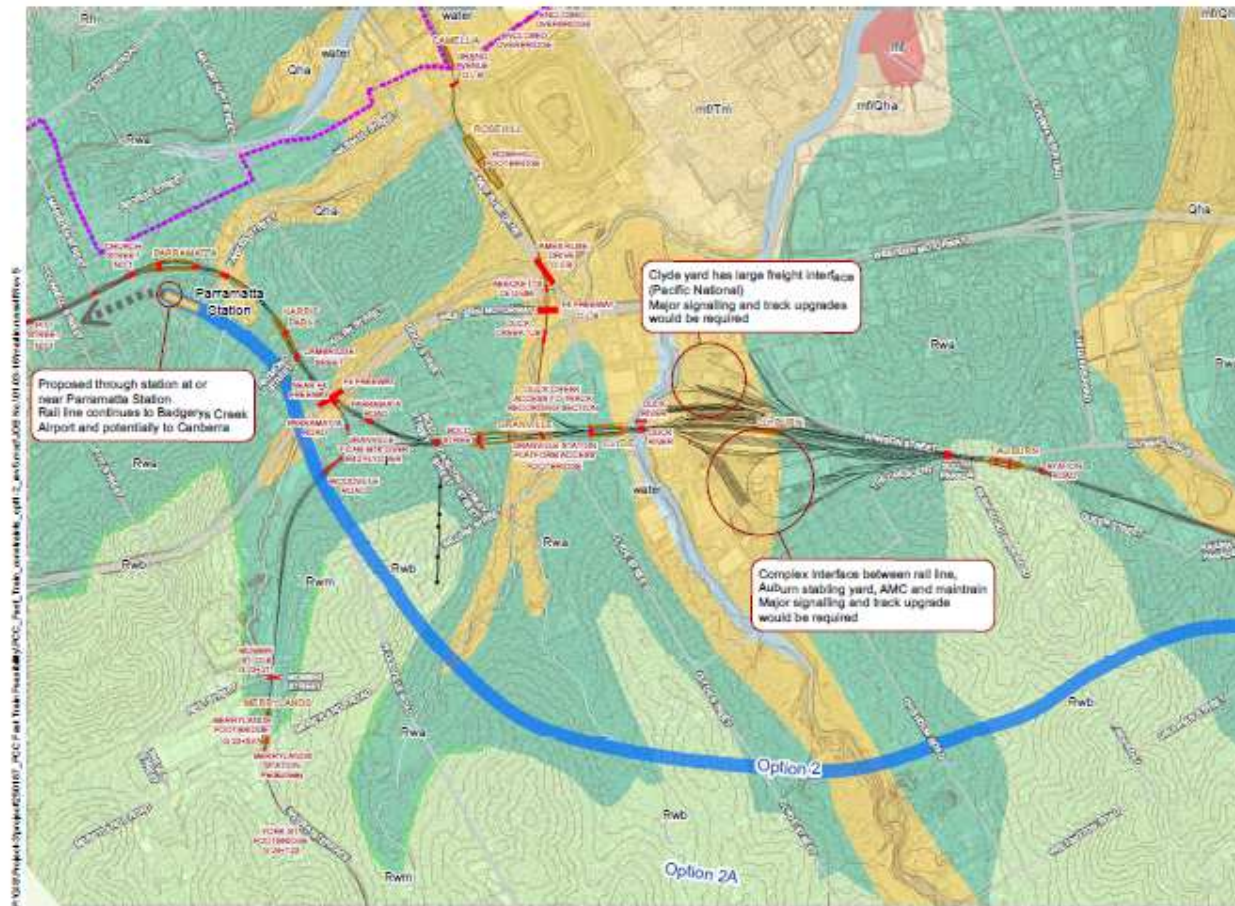
Notes: refer Overview Map

Legend

- Option 1 - use existing rail corridor
 - Option 2 - Tunnel
 - New Railway Station
 - Existing railway station
 - Bridge structure
 - Potential light rail alignment
 - Indicative location of Sydney Metro City & Southwest alignment
 - Roads
 - 2m contours
 - Natural drainage line
 - Geological dyke
 - Geological fold
- Geological Identifier**
- | | |
|-----|-------|
| Jv | Rwb |
| Qha | Rwm |
| Qhd | mf |
| Qha | mtQha |
| Rh | mtTm |
| Rwa | water |

Source: Aurecon, Neamap, LPI, DPI NSW

Projection: GDA 1994 MGA Zone 56





Appendix C

Eastern Link: Options 3 and 4

Constraints Map - Barangaroo to White Bay

aurecon



P:\08\Project\Sydney Metro City & Southwest\Rail\Map\Constraints\Map_1_of_4\Map_1_of_4_Constraints.mxd

Map 1 of 4

Notes: refer Overview Map

Legend

- Option 3 - Tunnel
 - Option 4 - Tunnel
 - New Railway Station
 - Existing railway station
 - Bridge structure
 - Potential light rail alignment
 - Indicative location of Sydney Metro City & Southwest alignment
 - Roads
 - ~ 2m contours
 - Natural drainage line
 - Geological dyke
 - Geological fold
- Geological Identifier**
- | | | |
|---|--|---|
| Jv | Qhs | mf |
| Qd | Qht | mtQha |
| Qha | Rh | mtRh |
| Qhb | Rwa | mtTm |
| Qhd | Rwb | water |
| Qht | Rwm | |

Source: Aurecon, Neamap, LPI, DPI NSW

Projection: GDA 1994 MGA Zone 56

Constraints Map - White Bay to Cabarita/Gladesville

aurecon

Map 2 of 4

Notes: refer Overview Map

Legend

- Option 3 - Tunnel
- Option 4 - Tunnel
- New Railway Station
- Existing railway station
- Bridge structure
- Potential light rail alignment
- Indicative location of Sydney Metro City & Southwest alignment
- Roads
- 2m contours
- Natural drainage line
- Geological dyke
- Geological fold

Geological Identifier

 Jv	 Qhs	 mf
 Qd	 Qht	 mt/Qhs
 Qha	 Rh	 mt/Rh
 Qhb	 Rwa	 mt/Tm
 Qhd	 Rwb	 water
 Qhf	 Rwm	

Source: Aurecon, Neamap, LPI, DPI NSW

Projection: GDA 1994 MGA Zone 56



Constraints Map - Cabarita/Gladesville to Silverwater Road

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Map 3 of 4

Notes: refer Overview Map

Legend

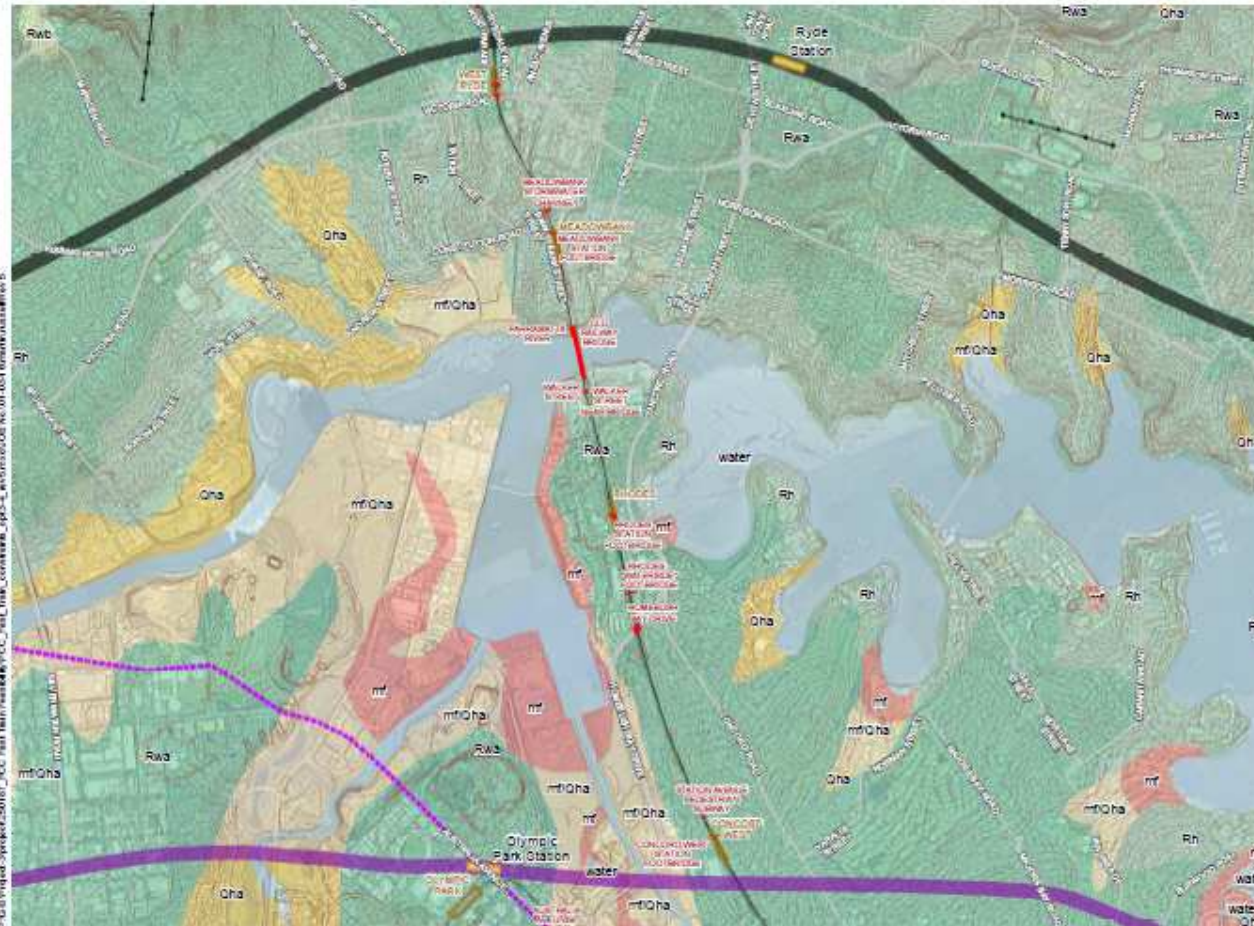
- Option 3 - Tunnel
- Option 4 - Tunnel
- New Railway Station
- Existing railway station
- Bridge structure
- Potential light rail alignment
- Indicative location of Sydney Metro City & Southwest alignment
- Roads
- 2m contours
- Natural drainage line
- Geological dyke
- Geological fold

Geological Identifier

Jv	Qhs	mf
Qd	Qht	mfQhs
Qha	Rh	mfRh
Qhb	Rws	mfTm
Qhd	Rwb	water
Qhf	Rwm	

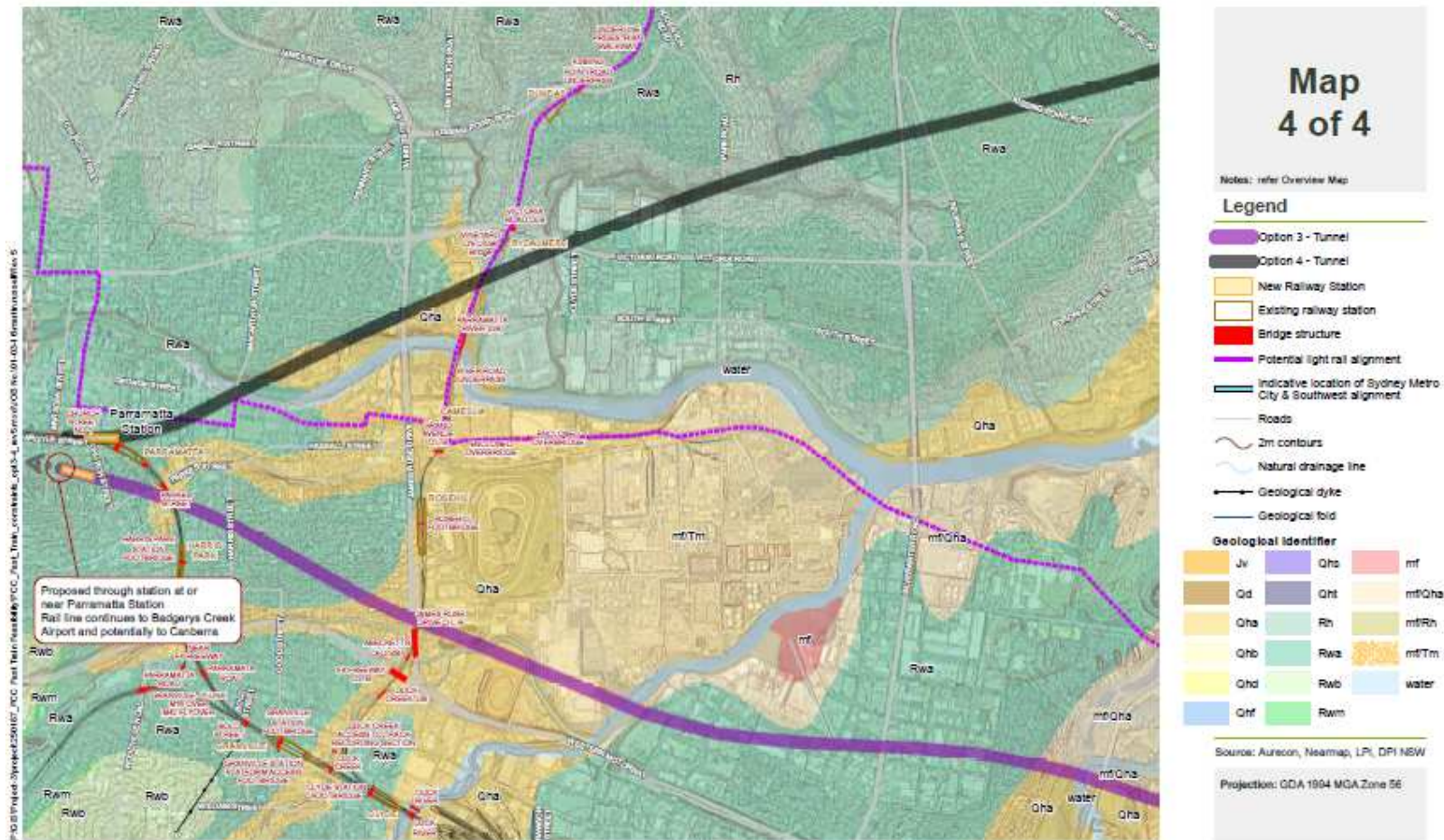
Source: Aurecon, Nearmap, LPI, DPI NSW

Projection: GDA 1984 MGA Zone 56

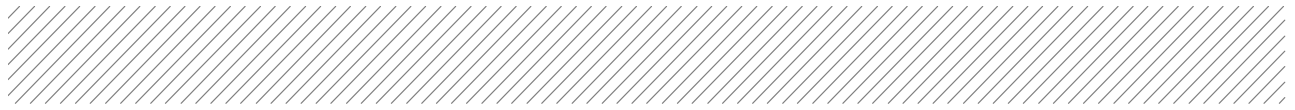


Constraints Map - Silverwater Road to Parramatta

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