Submission No 83

INQUIRY INTO IMPACT OF THE CBD AND SOUTH EAST LIGHT RAIL PROJECT

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Date Received: 9 July 2018

The attachments comprise the submission. The focus is public transport vehicle capacity - a key issue for service delivery and benefit cost analysis. Two extracts from the US transit manual presenting level of service factors have been included for the committees information.

Comparison of public transport capacities to aid understanding of the operational capacities of the NWRL, CSELR and other transport projects

Peter Egan –

December 2014, revised August 2016 and July 2018

Summary

While much of the data used in this paper dates to 2011, it is useful in presenting the Sydney public transport environment and expectations when government changed at the 2011 election. Comfort, safety and personal security expectations have been built over decades. As neither Sydney Metro of CBD Light Rail services have commenced, these expectations are based on public transport vehicles and services that exist have existed for many decades.

Sydney buses and trains have focused on seating passengers in forward facing rows as these maximise comfort, safety and security while minimising vehicle volume required for service delivery.

Using measurements obtained from TfNSW and manufacturer websites, and by direct measure of vehicles, the area available for standing in buses, trams and trains has been calculated and vehicle capacity determined for a range of standing passenger densities.

Within a margin for error, the capacities correlate well with reported maximum capacities (nominal capacity) based on seats plus four passengers per square metre ($4P/M^2$) in standing areas (all space available to passengers not used for seating).

The operational experience of Sydney Trains and Sydney Buses has been applied to determine operational capacities of various trains, buses and trams. The operational experience equates to a maximum individual train/tram capacity (operational capacity) of seats plus $1.5P/M^2$ of standing room – a figure which allows for comfort and social factors like the desirability of bringing people of every age, size and gender, who are strangers to each other, in very close proximity.

Seating densities for Sydney public transport vehicles are:
--- Row seating buses: 3 passengers per square metre
--- Reversible row seating trains: 2.5 pass/sq.m
--- Fixed forward/rear-facing seats in trams: 2.0 pass/sq.m
--- Side facing seating all vehicles: 2.0 pass/sq.m - allowing for leg space

The operational capacity of a peak one-hour service, maximum line load, needs to consider additional factors like the sharp peak in morning peak one-hour demand, and the journey time of commuters. The previous service requirement of less than 5% of peak-hour trains exceeding 135% of seat capacity sought to limit the number of trains that exceeded operational capacity due to commuter resistance to this level of crowding.

Sydney Trains now bases short distance commuter capacity on 'seats + 15 passengers per vestibule + 5 passengers per aisle of the upper and lower decks' – for an 8-car double deck train 'seats + 320 passengers'. For a Waratah train '894 seats + 320 = 1214 pass – $1.52P/M^2$.

The maximum line load can be expressed in terms of a load factor – the maximum one-hour line load in proportion to the number of passenger seats provided by the trains performing one-hour of service, expressed as a percentage.

Maximum load factor varies with the type of vehicle. Vehicles with a higher portion of standing space segregated from seating areas, can have a higher load factor. The highest Sydney peak-one-hour public transport load factor (in 2011) is 111% of seat capacity on the Airport Line in the AM peak one-hour (Table 4).

TfNSW data (Appendix D) indicates 2011 load factors upto 150%. However, other TfNSW data (Appendix D) and the demand profile given by Douglas Economics (Appendix C) supports Table 4 figures.

The March 2015 BTS passenger load survey, the latest march survey published, reports higher load factors. However, the TfNSW auditor comparison of outside observation and onboard counting shows, for higher train loads, an average 15% over-measurement by BTS. A BTS measurement of 1500 may be 1300 or less, or even less as the error increases with increasing passenger loads. See separate paper entitled "Utilizing the TfNSW Bureau of Statistics and Analytics (BTS) passenger train load surveys to determine operational passenger limits for trains and other public transport vehicles". In the light of the BTS overstatement, the data for 2010 to 2012 likely better represents current demand. Due to the errors identified, Opal data should give a better indicator of train loads.

The 2011 load factor for:
--- trains and Harbour Bridge buses and Eastern Distributor express buses is approx. 100%;
--- Eastern Suburbs peak-hour non-express buses approaching the CBD is approx. 85%;
--- the 60 express buses from the south-eastern suburbs is approx. 100%;
--- other Sydney CBD bus approach paths have load factors of 70% to 85% of seat capacity.

A 162-metre long driverless single-deck train, with 506 side-facing seats has an operational capacity of 800. The vehicle capacity, at a maximum line load based on a load factor of 125%, is 633 passengers. At 30 services per hour, maximum line load is 19,000.

An otherwise similarly equipped double-deck train has an operational capacity of 1350 – two-thirds more. Vehicle capacity, at load factor of 110%, is 1070. At 27 services per hour, maximum line load is 28,900.

A similar driverless commuter train with alternating double and single deck carriages, has an operational capacity of 1210. Vehicle capacity, at a load factor of 110%, is 960. At 30 services per hour, maximum line load is 28,800.

For comparison, the shorter, less space efficient Waratah, has an operational capacity of 1210. Vehicle capacity, at a load factor of 110%, is 980. At 27 services per hour (with automated control), maximum line load is 26,450.

The 2012 City Centre Access Strategy shows 20,340 people typically entered the CBD on buses and trains in the peak one-hour from the eastern and south-eastern suburbs in 2011. They could all be carried by the Eastern Suburbs Rail Line if the service frequency was raised to 21 trains per hour with a load factor of 110%.

The nominal capacity of a single new 67-metre Alstom trams is 466 passengers is nearly twice the operational capacity of 240 passengers. At a load factor of 140% the CSELR has a one-hour capacity of 2,480, 165 per tram – 35% of the nominal capacity. The 15-trams-per-hour-service can replace buses at the ratios of – one tram replacing 4.6 standard buses or 3.0 articulated buses.

'Greenfield' light rail and metro rail are poor value for money in Sydney's environment as their costs are similar to heavy rail on a per kilometre basis, while their capacities are well below that of heavy rail. In an apple-apples comparison, Heavy rail has 1.6 times the seat capacity of metro rail and ten times the seat capacity of light rail in Sydney CBD style environments.

The availability of rubber-tyred battery-powered vehicles that that look like trams externally and internally (Appendix G), means the expensive rail infrastructure of trams is not required to achieve service outcomes, and services can be easily adjusted as cities grow.

Extending the Eastern Suburbs Rail Line in preference to the CSELR, will allow the removal of at least 80% of the 350 AM peak one-hour east and south-east Sydney buses from the Sydney CBD. 'Snaking' a commuter rail line through the Eastern Suburbs minimises journey times for far more people then more direct routes.

Sydney's rail network is cost efficient, but not service effective. It performs poorly on a passenger per carriage-kilometre basis when compared to 11 international networks. Using the NWRL to create a metropolitan railway grid will create the opportunity for many more rail journeys – particularly to and from Sydney's West – and improve service effectiveness.

1. Public transport service requirements and capacities of rail transport

The rail services contract TfNSW-RailCorp 1 July 2010 to 30 June 2015, Phase 1 (1 July 2010 – 30 June 2011) requirements, contains a crowding requirement of less than 4.0 standing passengers per square metre (see Appendix B).

Prior to that, the requirement was "no more than 5% of AM peak period (6.30AM to 9.30AM) services should exceed 135% of passenger seating capacity", and "passengers should not stand for more than 20 minutes" (see IPART and Douglas Economics extracts in Appendix B). Perhaps the change was made to accommodate Labor's CBD Metro project. However, IPART continued to monitor the 135% criteria for at least a year, and may still do so. There was no method to measure the 20 minute standing criteria.

RailCorp had an internal crowding limit of 1.9P/M^2 average for standing areas (Appendix B). This figure should not be used for operational capacity as it leaves the network at great risk of extended dwell times and lower service frequencies.

Nominal capacity, generally calculated as seats plus 4P/M^2 in standing areas, makes no allowance for passengers in wheelchairs and prams, and no allowance for baggage, bicycles, surfboards and other large objects passengers may have with them. It makes no allowance for the usability of 'standing' space, or the desirability of bringing men, women, girls and boys, who are strangers to each other, into such close proximity that they are in continual body contact with other passengers.

The operational capacity of a peak one-hour service must be based on operational experience and take close note of load factors achieved. An achievable load factor is generally expressed as demand as a percentage of seats available across the hour.

The operational capacity of a peak one-hour service, maximum line load, needs to consider additional factors like the sharp peak in morning peak one-hour demand, and the journey time of commuters. The previous service requirement of less than 5% of peak-hour trains exceeding 135% of seat capacity sought to limit the number of trains that exceeded operational capacity due to commuter resistance to this level of crowding.

The maximum line load can be expressed in terms of a load factor – the maximum one-hour line load in proportion to the number of passenger seats provided by the one-hour service, expressed as a percentage.

Maximum load factor varies with the type of vehicle. Vehicles with a higher portion of standing space segregated from seating areas, can have a higher load factor.

Due to the sharp demand peak, the highest 2011 Sydney peak-one-hour public transport load factor is just 111% of seat capacity on the Airport Line in the AM peak one-hour (Table 4). TfNSW data (Appendix D) indicates load factors upto 150%. However, other TfNSW data (Appendix D) and the demand profile given by Douglas Economics (Appendix C) supports Table 4 figures.

Average 2011 peak one-hour passenger loads for trains and Harbour Bridge buses and Eastern Distributor express buses is within a few percent of seat capacity (Table 4) – a few per cent of a load factor of 100%. The exception is the truncated Eastern Suburbs Rail Line which averages 48% load factor.

The 2011 load factor for Eastern Suburbs peak-hour non-express buses approaching the CBD is approximately 85%.

The load factor for the 60 express buses from the south-eastern suburbs is approximately 100%.

Other Sydney CBD bus approach paths have load factors of 70% to 85% of seat capacity.

Experience shows load factors in excess of 100% for the peak one-hour are difficult to achieve in practice. Matching seats to demand, measured hourly, or a rolling hour at ½ hour intervals, meets customer expectations. Standing room caters for peaks. Minimum service levels may govern off-peak service frequencies.

2. Vehicle operational capacity

The operational experience of Sydney Trains and Sydney Buses has been applied to determine operational capacities of various trains, buses and trams.

The long established operational capacity of a Waratah type train of 135% of seats is found, in Table 2, to correspond to seats plus 1.5P/M^2 in standing areas. This is the operational capacity of single train. The capacity across the peak one-hour considers additional factors such as the demand profile across the hour and crowding limits and can be expressed as the achievable load factor.

This operational capacity for a single train reflects comfort factors such as availability of handholds and relative positions of seated and standing passengers. By observation, there is a strong passenger preference for separate seated and standing areas. Peak-hour train passengers are regularly observed to crowd in doorways at 2.5P/M^2 to avoid standing in spaces between seats – the aisles and wider spaces.

In this context, while the proportion of doorway space to other standing space varies between vehicle types, seats plus 1.5P/M^2 in standing areas is a good measure of public transport vehicle capacity.

The NWRL metro is being promoted with images of passenger densities of about 20% of seat capacity (see Appendix E) – A customer expectation is being built for a service with practically no standing passengers.

A 162-metre long driverless single-deck train, with wide openings (gangways) between the carriages, and with 506 side-facing seats, has an operational capacity of 800. The vehicle capacity, at a maximum line load based on a load factor of 125%, is 633 passengers. At 30 services per hour, maximum line load is 19,000.

An otherwise similarly equipped double-deck train, with eight carriages, has an operational capacity of 1350 – two-thirds more. Vehicle capacity, at load factor of 110%, is 1070. At 27 services per hour (an extra 13.3 seconds dwell time per service compared to metro train), maximum line load is 28,900.

A similar driverless commuter train with Bombardier OMNEO features (see Appendix F), including articulated carriage joints, open gangways and alternating double and single deck carriages, with alternating double and single deck carriages, has an operational capacity of 1210. Vehicle capacity, at a load factor of 110%, is 960. At 30 services per hour, maximum line load is 28,800. The metro frequency of 30 trains per hour is justified by layout and number of door sets.

For comparison, the double-deck Waratah, which loses passenger cabin area due to its shorter length (156.6 metres), driver cabins and the unusable space between the carriages, has an operational capacity of 1200. Vehicle capacity, load factor 110%, is 983. At 27 services per hour (with automated control and an extra 13.3 seconds dwell time per service compared to metro train), maximum line load is 26,540.

Side-facing seating at the Waratah carriage ends has a density of 2.0 seats per square metre when row-end protection is included.

The high density seat layout, excluding aisles, of the Waratah upper and lower decks (row pitch 0.85 metres), where people can put their feet under the seat in front, results in a density of 2.5 seats per square metre – the same density as tolerated in doorways at the peak of the peak one-hour.

Standing passenger density in seat aisles and other spaces between seats is very low in operation – perhaps 0.5 passengers per square metre.

The City Centre Access Strategy shows 20,340 people typically entered the CBD on buses and trains in the peak one-hour from the eastern and south-eastern suburbs in 2011. They could all be carried by the Eastern Suburbs Rail Line if the service frequency was raised to 21 trains per hour with a load factor of 110%.

Extending the Eastern Suburbs Rail Line in preference to the CSELR, will allow the removal of at least 80% of the 350 AM peak one-hour east and south-east Sydney buses from the Sydney CBD. 'Snaking' a commuter rail line through the Eastern Suburbs minimises journey times for far more people then more direct routes.

3. Operational capacity of buses

Observed maximum capacity and licenced standing capacity in a 'standard' 12-metre bus is equivalent to 3 standing passengers per square metre of aisle and allowed rear doorway standing room (Table 3).

The high-density four-abreast bus seating (row pitch 0.75 metres) has a density of 3 seats per square metre.

Due to the generally very short time a bus is likely to experience maximum capacity, a licence to carry 3P/M^2 standing is acceptable. However, operational capacity should be limited to 2P/M^2 standing for the comfort of passengers.

It is notable that train doorway crowding matches that of the high-density seating compartments (2.5P/M^2), and that 'standard' bus aisle crowding matches that of the row seating (3.0P/M^2).

Articulated buses are closer to trams and trains in their operation in that passengers prefer to avoid standing next to seated passengers and prefer not to stand on the articulated joint.

Passengers are not permitted to stand on the upper-deck of a double-deck bus due to the single-point of access and the greater risk of bus overturning.

Standing on the lower-deck of the double-deck buses operated by Forest Coach Lines is limited to 20 passengers – similar to that of a 'standard' 12-metre bus.

The double-deck bus seated capacity is 90 – two-thirds of the seats are upstairs.

Bus service frequencies are based on a minimum service requirements with greater frequencies, when required, to ensure seats at least match demand measured hourly.

As with the trains, the peak one-hour demand can be matched to seats per hour, with standing room relied on cater for the peak of the peak one-hour.

4. Sydney Light Rail capacity

Steel-tyred trams have more in common with their steel-tyred cousins (trains) and articulated buses than the standard rigid bodied bus.

The train operational limit of 1.5P/M^2 in standing areas is appropriate for trams. The operational capacity of the Alstom 67-metre tram chosen for Sydney is, thus, 240 passengers (Table 2).

The nominal capacity of 466 passengers (based on 4P/M^2 in standing areas) is nearly twice the operational capacity. 16 seats in each tram can be folded up to create the standing area used in standing capacity calculations.

Sydney Light Rail operational capacity at 1.5P/M^2 is 240 passengers per tram. 15 trams per hour could carry 3,600 passengers, of which 1770 can be seated. However, the load factor is 203% - most unlikely to be achieved.

The highest average peak-hour public transport service load is the Airport Line at 111% of seat capacity. For the light rail, this load factor translates to 131 passengers per tram and 1965 passengers per hour. The trams can replace just 55 buses. One tram replaces just 3.7 standard buses.

Achieving a peak-hour load factor of 140% of seat capacity (118 for the 67M tram x 1.3 = 165 passengers) would be difficult. At this load factor, 15 services per hour would carry 2,480 passengers. The 15 tram per hour service can replace buses at the ratios of – one tram replacing 4.6 current standard bus services or 3.0 articulated bus services.

If the 2,480 passengers were diverted to Eastern Suburbs Rail Line for the journey to the city, maximum line load would lift from 48% of seat capacity to 65% of seat capacity.

That the 67 metre trams will operate at 15 services per hour across the day (7am to 7pm) says capacity is matched to demand between the peak periods, not the peak one-hour (see Appendix A).

5. Comparison to George St and Elizabeth St buses

Presently, 175 buses head north on George St, and 295 head north on Elizabeth St in the AM peak hour.

At seat capacity (~45 seats), the capacities are respectively 7,900 and 13,300 respectively.

When this is compared to the seat capacity of the trams (1770 seats), it is not surprising that Sydney did away with trams in the 1950s to replace them with buses.

6. Technology

Appendix G shows the technological convergence between articulated trams and buses.

Electric buses, with adequate battery capacity for typical bus operations, are appearing in the market place. As are electric buses with range extender power sources – fuel cells and internal combustion engines.

With barely perceptible differences in journey experience, steel-tyred trams and their very expensive railways and control systems, are poor value for service outcome compared to their rubber-tyred counterparts.

The impact of vehicle type on train service frequency has been analysed by Douglas Economics and Parsons Brinckerhoff, Cox, Hassell and AECOM (PB-CHA) – See Appendix C. The key finding is that metro style trains can alight and board passengers 10 seconds faster than double-deck style trains – i.e., the dwell time is 10 seconds less. Part of this is due the greater number of passengers per metre length of train in the double-deckers and the lower number of door-sets per side – 16 per side for the Waratahs and 24 for the single-deck cars.

The MI09 double-deck Paris commuter train has sacrificed seat capacity for extra doors to offer a dwell times on a par with single-deck trains.

A commuter version of the Bombardier OMNEO takes an approach that optimises seat capacity, door capacity and single deck area. It has six Waratah style double-deck compartments and 22 door-sets per side compared to 24 for the metro trains. As the large single-deck areas permit passengers to leave the double-deck compartments prior to the train arriving at the station, the dwell time difference between a commuter version of the OMNEO and a metro train is marginal.

Train acceleration and breaking is limited to ~1M/S^2 for passenger comfort reasons. Train control systems are applicable to all vehicle types. Platform access and concourse barrier capacity, rather than platform size, are the main station capacity issues at Wynyard, Town Hall and Central.

7. Value for money

Despite their differences, four projects and one current rail line illustrate that our rail planning is very poor, and why 'Heavy' is better than 'Metro' and 'Light' rail – see Table 1.

Based on NWRL and ECRL costs, the Eastern Suburbs Rail Line, and services, could have been extended to Bondi Beach and Maroubra Junction for similar costs to the CSELR ($2.2 bn) and a capacity of 18,000 seats per hour (20 trains) provided – 8 times that for light rail. At least 250 buses in the peak hour would have been removed from CBD streets and local eastern suburbs bus services much improved.

Table 1 – Comparison of light, metro and heavy rail costs and initial capacities

Line or project	Rail type	Cost $M	Cost/km $M	Initial peak capacity seats/hour	Comment
North Shore	Heavy	–	–	18,000	Current capacity comparator
Epping-Chatswood	heavy	2,350	164	3,600	IPART 2009 costing
South West	heavy	1,800	140	900	TfNSW and Minister
North West	metro	5,500	240	5,500-6,000	**
South East	light	2,200	180	1,770	***

** 15 trains with 5,500 to 6,000 seats per hour - http://www.smh.com.au/nsw/gladys-berejiklian-northwest-rail-link-trains-to-run-every-four-minutes-98-per-cent-on-time-20140916-10hiza.html#ixzz3DS0hFfX8. Cost has deducted Epping-Chatswood line costs.
*** Cost from Minister's media release (also IPART present value of payments over 19 years), capacity from Alstom website.

TfNSW says tram services, and thus seat capacity, can be doubled as demand increases to 30 per hour despite the 100 second cycle time for traffic lights at many busy intersections.

Automation of the heavy rail lines will raise the heavy rail service frequency to within a few percent of metro rail frequency (30 services per hour), while more efficient train designs can lift heavy rail seat capacity to 160% of the seat capacity of metro trains.

A paper** by Chi-Hong (Patrick) Tsai and Professor Corinne Mulley, of Sydney University's Institute of Transport and Logistics Studies (ITLS), demonstrates that Sydney Trains is cost efficient in a comparison with 12 international rail networks on a cost per carriage-kilometre basis, but is not service effective. It performs poorly on a passenger-km versus per carriage-km basis. Performance is partly explained by New World developed-country urban sprawl. However, the radial nature of the Sydney Trains network, and a desire to minimise journey times between a few centres for new lines, reduces service effectiveness.

'Snaking' a commuter rail line through the Eastern Suburbs would minimise journey times for far more people then would more direct routes.

Using the NWRL to create a metropolitan orbital railway connecting Sydney's existing and new airports will create the opportunity for many more rail journeys – particularly to and from Sydney's West – and improve service effectiveness.

** How does the efficiency performance of Sydney CityRail compare with international urban rail systems, Chi-Hong (Patrick) Tsai[a], Corinne Mulley[b]
a,b Institute of Transport and Logistics Studies, Business School, The University of Sydney, 2006, Australia
a E-mail for correspondence: chi-hong.tsai@sydney.edu.au
Publication website: http://www.patrec.org/atrf.aspx 1

Table 2 – Comparison - Double- & single-deck trains with metro train features with the Waratah and light rail

Standing density	Train	Capacity seated	standing	total	% of driverless double-deck capacity
4P/M²	Driverless double-deck	976	1005	1981	100%
	Waratah	894	838	1732***	87.4%
	Driverless Bombardier OMNEO	802	1082	1884	95.1%
	INSW driverless single-deck A	492	906	1398	70.6%
	Alstom Metropolis (Sydney Metro)	506	774	1280	64.6%
	INSW driverless single-deck B	400	1057	1457	73.5%
3P/M²	Driverless double-deck	976	754	1730	100%
	Waratah	894	629	1523	88.0%
	Driverless Bombardier OMNEO[5]	802	812	1614	93.3%
	INSW driverless single-deck A	492	680	1172	67.7%
	Alstom Metropolis (Sydney Metro)	506	581	1087	62.8%
	INSW driverless single-deck B	400	793	1193	69.0%
2P/M²	Driverless double-deck	976	503	1479	100%
	Waratah	894	419	1313	88.8%
	Driverless Bombardier OMNEO	802	541	1343	90.8%
	INSW driverless single-deck A	492	453	945	63.9%
	Alstom Metropolis (Sydney Metro)	506	387	893	60.4%
	INSW driverless single-deck B	400	529	929	62.8%
1.5/M²	Driverless double-deck	976	377	1353	100%
	Waratah	894	314	1208****	89.3%
	Driverless Bombardier OMNEO	802	406	1208	89.3%
	INSW driverless single-deck A	492	340	832	61.5%
	Alstom Metropolis (Sydney Metro)	506	290	796	58.9%
	INSW driverless single-deck B	400	396	796	58.8%
1P/M²	Driverless double-deck	976	251	1227	100%
	Waratah	894	210	1104	90.0%
	Driverless Bombardier OMNEO	802	270	1072	87.4%
	INSW driverless single-deck A	492	238	730	59.5%
	Alstom Metropolis (Sydney Metro)	506	194	700	57.0%
	INSW driverless single-deck B	400	264	664	54.1%
4P/M²	Alstom Citadis Casablanca 64.7M	102	336	438[7]	
3P/M²	Alstom Citadis Casablanca 64.7M	102	252	354	
2P/M²	Alstom Citadis Casablanca 64.7M	102	168	270	
1.5P/M²	Alstom Citadis Casablanca 64.7M	102	126	228	
1P/M2	Alstom Citadis Casablanca 64.7M	102	84	186	
4P/M²	Alstom Citadis 'Sydney 67M'	102	364	466[6, 8]	
3P/M²	Alstom Citadis 'Sydney 67M'	102	273	375	
2P/M²	Alstom Citadis 'Sydney 67M'	102	182	284	
1.5P/M²	Alstom Citadis 'Sydney 67M'	102	137	239	
1P/M²	Alstom Citadis 'Sydney 67M'	102	91	193	

Table notes: Except for the Waratah (existing train), the other trains have the following metro style features. Tram dimensions are over page. No allowance in the calculations for people with wheel chairs, prams or other bulky objects.

Trains

-- Driverless train** 162M long, 3.035M wide, with internal dimensions 160.0Mx2.89M = 462.4 M²
Single-deck - less 7 carriage 'joints' that each occupy 2M² = 14M² cabin area = 462.4 – 14 = 448.4 M²
Double-deck - add 8 upper-decks internally 9.05x2.89 x 8 = 209.2M² cabin area = 209.2 + 448.4 = 657.6 M²
Bombardier OMNEO style 'articulated' 11-segment train with 6 'standard' upper decks =161.8+448.4 = 610.2 M²
Side-facing seats – 1.0M from wall required to allow 0.3M for legs/feet. Allow for glass end wall and handrails at doors – allow 0.5M width per seat. Allow 0.5M² for each side facing seat = 2.0 seats/M²
Single-deck assumed to have 24 door-sets per side, double-deck 16 per side, OMNEO 22 per side
Single-deck and double-deck have 16 bogies per train, OMNEO has 12 bogies per train

-- Driverless double-deck 816P@ 0.40 = 326.4M² plus 160 side @ 0.5= 80M² Seating uses 406.4M² leaving 251.2M² stand

-- Driverless OMNEO 'metro' has single-deck (~18M long) with 4 door-sets/ side alternating with double-deck (~9M long) six double-decks including end-segments and five single-deck segments
612 seats @ 0.40 = 244.8M² plus 190 seats @ 0.5 = 95M² Seating uses 339.8M² leaving 270.4M² for standing

-- Alstom Metropolis (Sydney Metro) – 506 side-facing seats only. 1.0 M² lost to equipment cabinets at each end
506 x 0.5 = 253.0M² plus 2.0 M² equipment = 255 M² leaving 193.5 M² for standing
Equates to a six-car capacity of 378 seats giving a 15 train/hour total of 5670 - complies with Minister Berejiklian's statement[1] to SMH that initial NWRL service will have 5500 to 6000 seats per peak hour

-- INSW metro A (492 seat) 268 x 0.41 = 109.9M² plus 224 @ 0.5 = 112M² Seating uses 221.9M² leaving 226.5M² stand

-- INSW metro B (400 seat[4]) 176 x 0.41 = 72.2M² plus 224 @ 0.5 = 112M² Seating uses 184.2M² leaving 264.2M² standing

-- NWRL website capacity 40,000[2] in 30 trains per hour = 1333/train – achieved in Alstom train with 3.65P/M² standing

-- Waratah seats 0.45M wide. Seat pitch 0.85M. But shared leg room of end seats gives average seat pitch 0.823M.
Movable seatback mechanisms 1.43M & 0.99M wide=2.42/5=0.484M/seat, 0.823x0.484=0.40M²/seat, 2.5P/M²
156.6M long with ~4M driver cabins, 1.5M car joints and 4 shorter upper decks – 657.6 - 78.9 = ~579M²
776 seats @ 0.40 = 310.4M² + 118 side seats @ 0.5M² = 59M² Seating uses 369.4M² leaving 209.6M² standing

PB-CHA 'crush capacity' Waratah 2100 – 894 seats plus 1206 standing in 209.6M^2 = 5.75P/M^2 standing

*** 1732 at 4P/M^2 is 1% less than the Waratah maximum capacity for special events of 1750 - within margin of error. 1750 capacity source - Footnote 8

**** Waratah operational capacity, by experience, has been shown to be 135% of 894 seat capacity = 1207. The table shows this to be an average of 1.5 passengers/M^2 in standing areas.

1200 'nominal' capacity – 894 seats plus 306 standing in 209.6M^2 = 1.46P/M^2 standing, however, most of these passengers are standing in doorways at densities up to 2.5P/M^2

**Sydney Trains data[3]: Millenium, OSCAR, C-Set, K-Set all 163.1M long, Tangara 162.2M, S-Set161.8M, Waratah 156.6M

Train internal dimensions obtained by directly measuring Waratah internal spaces

Trams

102 seats requires 96 forward/rear seats x 0.43M^2*****= 41.3M^2 plus 6 'end' seats x 0.5M^2=3M^2 Total 44.3M^2

***** Bombardier Gold Coast tram measure by author.

Alstom Citadis Casablanca[7] tram 64.7Mx2.65M Standing room in two cabins = 2x62M^2 – 43.9M^2 = 80.1M^2

Internal cabin – 32.2M (overall) – 2.0M (drivers cabin), – ~0.6M (rear) = 29.6M (int) x 2.5M wide**= 74.0M^2 less ~8M^2 (4 flex joints), 3M^2 (4 fold-up 3-seat banks), 1M^2 (narrow rear of cabin) total 12M^2 62M^2

Alstom brochure capacity of 438 implies 336/4 = 84 M^2 – 4.3M^2 than calculated is available.

Increasing average internal width from 2.5M to 2.573M would provide the additional space

Alstom Citadis[6] 'Sydney' tram 67Mx2.65M Standing room in two cabins = 2x65 M^2 – 43.9 M^2 = 86.1M^2

Internal cabin – 33.4M (overall) – 2.0M (drivers cabin), – ~0.6M (rear) = 30.8M (int) x 2.5M wide**= 77.0M^2 less ~8M^2 (4 flex joints), 3M^2 (4 fold-up 3-seat banks), 1M^2 (narrow rear of cabin) total 12M^2 **65M^2**

Alstom brochure capacity of 2x233 implies 364 stand/4 = 91 M^2 standing – 4.9M^2 more than calculated available

Increasing average internal width from 2.5M to 2.58M would provide the additional space.

-- **Bombardier Gold Coast tram seats in bogie car** measure 0.475M wide with average 0.43M^2 per seat = **2.33 seats/M^2**

Internal width at front/back facing seats = 2.5 metres. Use 0.43M^2 for Alstom seats as well

Table 1 footnotes:

1 Ministerial statement -15 trains with 5,500 to 6,000 seats per hour - http://www.smh.com.au/nsw/gladys-berejiklian-northwest-rail-link-trains-to-run-every-four-minutes-98-per-cent-on-time-20140916-10hiza.html#ixzz3DS0hFfX8.

2 http://nwrail.transport.nsw.gov.au/The-Project/Trains#2

"At the start of operations, the North West Rail Link will use six-carriage trains. However more carriages and trains can be added as demand increases, with the platforms to be built long enough for eight-carriage trains. When the Sydney Rapid Transit network is extended from the end of the North West Rail Link at Chatswood, under Sydney Harbour and through the CBD to Bankstown, it will have the capacity to run up to 30 trains per hour in each direction through the city."

"Sydney's rapid transit target capacity of about 40,000 customers per hour is comparable to the average hourly capacity of rapid transit trains worldwide. Sydney's current suburban trains can reliably carry 24,000 people an hour per line."

3 http://www.sydneytrains.info/about/fleet/a_sets

4 http://www.infrastructure.nsw.gov.au/media/16985/sis_report_section8.0_print.pdf

Compare with INSW SIS Table 8.5 Indicative passenger capacity of double deck and single deck train systems

	Train capacity(1)	Seats per train	Trains/hour	Total passengers/hour
Double deck	1,200	890	20	24,000
Single deck – comfortable(1)	1,200	600	30	36,000
Single deck metro – max(2)	2,000	400	30	60,000

(1) Double deck assumes a nominal capacity of 1200 people with seating in line with Waratah train specifications. Planned frequency of 20 tph across the harbour bridge from Sydney's Rail Future. Single deck 'high seating' capacity could have 500-600 seats (Source: Halcrow 2011), single deck would be based on standard international design with 3 doors per side.

(2) Source: MTR for Transport for NSW.

5 http://www.bombardier.com/en/transportation/products-services/rail-vehicles/commuter-and-regional-trains/double-deck-electric-multiple-units.html

6 http://www.alstom.com/products-services/product-catalogue/rail-systems/trains/products/citadis/ http://www.alstom.com/Global/Transport/Resources/Documents/brochure2014/Citadis%20-%20Sales%20brochure%20-%20Eng%20-%20Sept%202014%20-%20LD.pdf?epslanguage=en-GB Page 6

7 http://www.alstom.com/Global/Transport/Resources/Documents/brochure2014/Casablanca%20-%20Morocco%20Tramway%20-%20Case%20Study%20-%20EN%20-%20LD.pdf?epslanguage=en-GB P2

8 http://images.smh.com.au/file/2013/09/23/4770519/trains.pdf

Modelling Train & Passenger Capacity - Report to Transport for NSW By DOUGLAS Economics July 2012

Neil Douglas, DOUGLAS Economics www.douglaseconomics.co.nz

3.3 Single Deck Rolling Stock PB-CHA operation simulation evaluated a hypothetical single deck with nominal capacity of 900 based on 400 seats and 500 standing, Table 3.3. This compares with a nominal capacity of 900 seats and 300 standing for a Waratah double deck train.

Table 3.3: Rolling Stock Capacity

Capacity	Waratah	Single-deck	Comment
Seated	900	400	Rounded figures (Waratah has 896 seats)
Nominal	1200	900	Standing in double deck vestibules (19/vestibule) only approximately 2P/M^2 for single deck
Peak	1400	1120	Double deck maximum load observed on Western Line Standing at 3P/M^2 for single deck
Maximum	1750	1350	Only observed at special events Standing at 4P/M^2 for single deck.

Source: Parsons Brinckerhoff, Cox, Hassell and Aecom (PB-CHA) (2011)

Table 3 Bus capacities

Standing passengers in available standing area (based on Sydney Buses fleet)

Standing density	**~10.7M***	**~11.0M***	**~12.0M***	**~14.0M***	**~17.5M***
4P/M^2	21	22	24	29	58
3P/M^2	16	17	18	22	43
2P/M^2	11	11	12	15	29
1.5P/M^2	8	8	9	11	22
1P/M^2	5	5	6	7	14
Licenced standing passengers	**??**	**??**	**18**	**30**	**63**

Licenced bus capacities – observation at Wynyard Nov 2014

	Seats	**Standing**	**Total**
Sydney Buses articulated bus	52	63	115
Forrest Lines double-deck bus	96	20	116
Rigid single-deck dual axle	61	34	95
Rigid single-deck	44	18	62
Rigid single-deck	47	18	65
Rigid single-deck	47	22	69
Rigid single-deck dual rear axle	56	30	86

Table notes

Measure of rear section late model 'standard' bus

Internal width 2.35M. Seat frames 0.80M wide. Wall to double-seat edge 0.875M. Aisle 0.60 metres wide.

Seat pitch 0.75M. Average area per seat = 0.33M^2. 3.0 seats/M^2 average.

* A measure of bus lengths at Mona Vale, Brookvale, Neutral Bay, Randwick and Botany bus depots via Google Earth (with a control measure of 40 foot (12.19M) containers), reveals Sydney Buses have exterior cabin roof lengths of:

~10.7M, ~11.0M ~12.0M ~14.0M ~17.5M

Allow 3.0M of bus length for driver and luggage areas, sloping front of buses, and rear panel of bus. The buses have passenger areas of:

18.1M^2 18.8M^2 21.2M^2 25.9M^2 34.1M^2

Assume the aisle is 0.6M wide, and ends 1M from rear wall

4.0M^2 4.2M^2 4.8M^2 6.0M^2 8.7M^2

Seats, rear door area (space of 4 seats) and articulated bus flexible joint occupy

14.1M^2 14.6M^2 16.4M^2 19.9M^2 25.4M^2

Seat capacity (@3/M^2 reduced by 4 seats for rear door-set rigid bus, & 16 for articulated bus joint & 2nd rear door)

38 39 45 56 60

Articulated bus has 52 seats – thus pace for 8 seats (2.7M^2) devoted to standing room at rear.

Space available for standing passengers – Aisle + 0.7M^2 in front of seating area + 0.6M^2 at rear door. For articulated bus, also add 1.4M^2 at flexible joint, 0.3M^2 at second rear door and 2.7M2 for 8 seat reduction

Area available for standing

5.3M^2 5.5M^2 6.1M^2 7.3M^2 14.4M^2

The intent of this table is a comparison. There is considerable variation in bus layouts to be found in Sydney and thus in the size and quality of standing areas. The table does indicate that the licenced standing capacity of 63 for the articulated buses is grossly excessive.

Table 4 Public transport vehicles and their passengers entering the City Centre between 8AM and 9AM weekdays

CBD entry direction	passengers 2011/12	vehicles 2011	average per vehicle 2011	vehicles post changes	ave per vehicle
Buses					
Harbour Bridge	14,484	379 (-55)	38.2	324	44.7
(60 buses to be diverted to Cahill Expressway – in peak hour?)					
(160 buses to be replaced by NWRL)					
Anzac Bridge	2,788	113 (-28)	24.7	85	32.8
William St	1,194	45 (-7)	26.5	38	31.4
Broadway*	5,378	175 (-33)	30.7	142	37.9
Eastern Distributor	3,116	56 (+4)	55.6	60	51.9
Total of above	***26,960***	***768 (-119)***	***35.1***	***649***	***41.6***
* At Goubburn St 5,900 bus passengers with 900 people in 720 cars (Access strategy)					
Elizabeth/Chalmers Sts	3,025	85 (-49)	35.6	36	36
Albion/Forveaux Sts	2,095	56 (-32)	37.4	24	36
Oxford St	3,535	99 (-27)	35.7	72	36
Total above 3	***8,655***	***240 (-108)***	***36.0***	***132***	
Total	***35,615***	***(1008 -227 = 781)***			
Light Rail					
Wentworth Park	473 (this is before the Dulwich Hill extension)				
Ferries					
Circular Quay	4,000				
Trains				**Load factor % 894 seats**	
Harbour Bridge NS/Nor	16,257	18 (Northern 4 via Chats)		903	101%
Eastern Suburbs Line	7,375	17		434	48.5%
Airport Line	7,959	8 (via M)		995	111%
Redfern (west and south)	65,521	69		950	106%
Illawarra		19 (2 to CT)			
Bankstown		6 (4 TH, 2 M)			
IW/South		12 (via TH, 6 South)			
EH		4 (via M)			
Northern		8 (4 via Strat, 4 CT)			
Western		20 (Rich 2, Scho 4, EP 2, Penrith 5, St Marys 1, Black 2, EP-CT 4)			
HB, Air, Red	***89,737***	***95***		***945***	***107%***
HB, ES, Air, Red	***97112***	***109***		***891***	***99.7%***

14 trains city circle CQ to W. W to CQ 17
Carlingford 1 to CT (arrive 7.45)

Data source: City centre access strategy for passenger and bus numbers. Sydney Trains timetable for train numbers. See Appendix H.

Appendix A – December 2014 Light Rail service frequencies

Table 3.2 Comparison of LRV service headway (in minutes) for the approved project and proposed modified design

Time of day	CBD/Surry Hills/ Moore Park		Kensington/Kingsford		Randwick	
	Opening	Future	Opening	Future	Opening	Future
LRV service frequency in minutes (approved project)						
10.00 pm to 7.30 am[1]	10	10	20	20	20	20
7.30 am to 9.30 am	3	2.5	6	5	6	5
9.30 am to 5.00 pm	4	3	8	6	8	6
5.00 pm to 7.00 pm	3	2.5	6	5	6	5
7.00 pm to 10.00 pm	5	5	10	10	10	10
LRV service frequency in minutes (proposed modification)[2]						
5.00 am to 7.00 am[1]	6	5	12	10	12	10
7.00 am to 7.00 pm	4	3.25	8	6.5	8	6.5
7.00 pm to 10.00 pm	5	5	10	10	10	10
10.00 pm to 1.00 am[2]	6	6	12	12	12	12

Note: Table above is for regular services only

Note 1: Operating hours for regular services do not include 1.00 am and 5.00 am. Special event services may occur during these times.

Note 2: With respect to slight increases between the approved and proposed headways in the early morning and late evening (such as the 10.00 pm to 1.00 am period), off-peak service were reviewed by Transport for NSW as part of the ongoing development of the proposed operation of the project and it was determined that 20 minute headways on the branch lines during the early morning and late evening were not consistent with Transport for NSW customer service obligations. As such, frequencies during this time have been increased slightly as part of the proposed modification.

Note 3: While this table shows proposed opening service frequency, more frequent services may be operated in the future where necessary. The modification has assessed the worst case from a noise impact perspective of 3.25 minutes in the peak. Future operation will be 10 or more years after opening).

Appendix B – Changes in TfNSW crowding requirements

The rail services contract TfNSW-RailCorp 1 July 2010 to 30 June 2015, Phase 1 (1 July 2010 – 30 June 2011) requirement contains a crowding requirement of less than 4.0 standing passengers per square metre (see extract below).

Prior to that, the requirement was "no more than 5% of AM peak period (6.30AM to 9.30AM) services should exceed 135% of passenger seating capacity", and "passengers should not stand for more than 20 minutes" – see IPART and Douglas Economics extracts below.

Passenger Services			
Crowding / Comfort	Satisfaction with punctuality (continuous improvement above 2009 levels)	73% (2009), 79% (2010)	Annual (ITSR Survey)
	Passengers standing per square metre	<4.0 per square metre	Half-Yearly (Peak Load Survey)
	Improve journey comfort (air-conditioned carriages, improved hand holds)	100% delivery of planned sets	
	Percentage of trains air-conditioned	> 70%	Monthly
	Operating Fleet < 10 years old	>16%	Quarterly

IPART 4 The quantity and quality of CityRail's services 4.4 Crowding on trains[1]

Prior to CityRail's services contract its performance targets were set under the Rail Performance Agreement[32] which stated that no more than 5% of AM peak period services should exceed 135% of passenger seating capacity. Although this is not the official loading target for CityRail it is still a good measure of crowding on the network.

In the past 4 years, CityRail has improved its performance against this measure, but still did not meet its target in some hours of the peak periods.

During the hours 7am to 10am, services exceeding 135% seating capacity fell from 16% in March 2008 to 11% in March 2012.

The highest levels of overcrowding occurred between 8am and 9am. In September 2011, the latest period for which we have hourly data, 12% of services exceeded 135% of seating capacity during this hour.

During the hours 4pm to 7pm, services exceeding 135% seating capacity fell from 9% in March 2008 to 5% in March 2012, with the highest levels of overcrowding between 5pm and 6pm. In September 2011, 6% of services exceeded 135% of seating capacity during this hour.

32 Until 31 December 2008, RailCorp was a state owned corporation with benchmarks and targets set in a Statement of Corporate Intent and in the Rail Performance Agreement which was agreed to by the board and the portfolio Minister. On 1 January 2009 RailCorp became a statutory authority subject to the direction and control of the Minister for Transport. From 1 July 2009 the Statement of Business Intent and Rail Services contract are the relevant agreements with Treasury and Transport NSW.

1 https://www.google.com.au/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=quantity%2Band%2Bquality%2Bof%2BCityRail%2Bs%2Bservices Original source - www.ipart.nsw.gov.au/

2012 Douglas Economics – modelling train line passenger capacity – 4.2 Train Capacity

CityRail surveys passenger loads on trains during the AM and PM peak periods twice a year. The survey results are used to assess average passenger density, train load versus seat capacity and length of stand. Three capacity standards are referenced in the NSW Auditor General's report.

Average Passenger density: measures the number of passengers per square metre (PSM) of standing space for the peak hour. The observed densities are compared against an international benchmark of 4 PSM and an internal RailCorp threshold of 1.9 PSM. Between 2007 and 2011 (Figure 4.2.1), CityRail comfortably met both targets with a peak hour passenger density of 1 PSM in four five years only approaching the internal threshold in 2008 with a density of 1.8.

Individual Train Loads: The Rail Service Contract drawn up by the Minister of Transport sets a standard that no more than 5% of AM peak hour suburban trains (trains arriving Central 8-9am excluding intercity) exceeding passenger loads of 135% of seat capacity.6 In fact, since September 2005 the target has been met only once in September 2011.7

Length of Stand: The third crowding standard is that passengers should not stand for more than 20 minutes. Definitive assessments would require monitoring of individual passengers although indicative assessments have been made from the loading surveys. For instance, the September 2011 Auditor General's report gave a figure of 47 morning trains with passengers standing for longer than 20 minutes.

Reviewing the three targets, the 135% train load implies a lower carrying capacity than the 1.9 PSM target whilst length of stand is the most difficult to measure. All three targets will depend on where the observations are taken.

Footnotes:
6 The 135% target is an average for a train and does not allow for load variations between cars.
7 The percentage has generally declined since March 2005 and reached a maximum in March 2007 with 16% of AM peak hour suburban trains exceeding passenger loads of 135%.

Appendix C Douglas Economics Rolling Stock capacity comparison
Douglas Economics http://images.smh.com.au/file/2013/09/23/4770519/trains.pdf

3.3 Single Deck Rolling Stock

PB-CHA operation simulation evaluated a hypothetical single deck with nominal capacity of 900 based on 400 seats and 500 standing, Table 3.3. This compares with a nominal capacity of 900 seats and 300 standing for a Waratah double deck train.

Table 3.3: Rolling Stock Capacity

Capacity	Waratah	Single Deck	Comment
Seated Capacity	900	400	Rounded figures (Waratah has 896 seats)
Nominal Capacity	1200	900	Standing in double deck vestibules (19/vestibule) only and at approximately 2P/M^2 for single deck
Peak Capacity	1400	1120	Double deck maximum load observed on Western Line; Standing at 3P/M^2 for single deck
Max Capacity	1750	1350	Only observed at special events Standing at 4P/M^2 for single-deck

Source: PB-CHA (2011) via Douglas Economics
(Note by author - 19/double-deck vestibule is equivalent to 2.5P/M^2 in the vestibule)

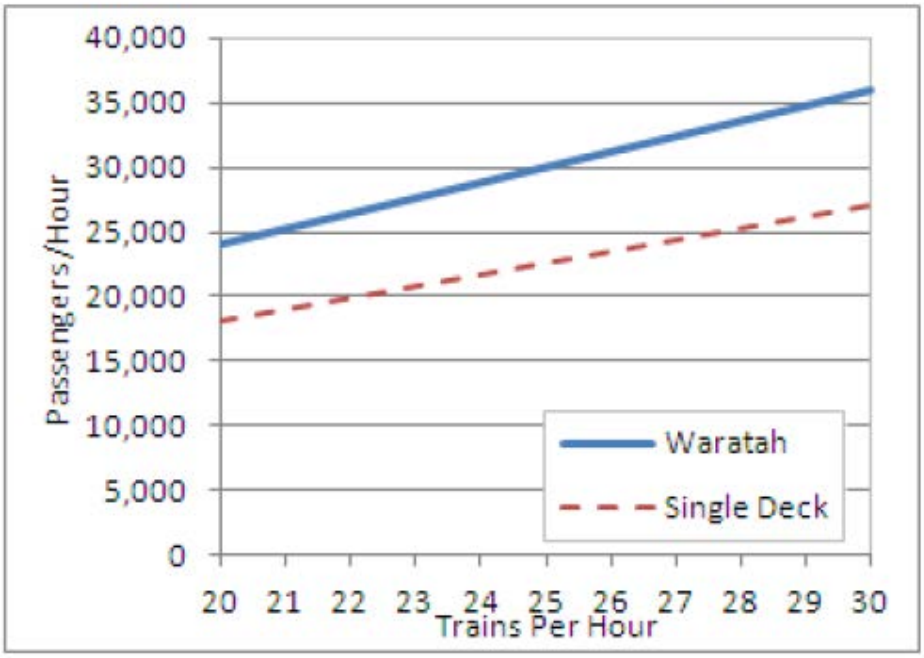
PB-CHA assumed that the train would have three doors per side per car: the extra set of doors per car offering the potential to speed up boarding and alighting, reduce dwell times and allow more trains per hour. PB-CHA considered that the capacity of existing stations would limit the reduction in dwell time.

(Train frequency comparison)

For Town Hall, the critical station, PB-CHA assumed a 10 second reduction in dwell time**. Dwell times were assumed to reduce from 70 seconds with double deck trains to 60 seconds with single deck trains.
(** For single-deck trains compared to double-deck trains due to the lower number of people per train)

The small reduction in dwell time would be offset by a reduction in carrying capacity however. With the passenger assumptions in Table 3.3, the 25% lower single deck capacity would require 28 trains per hour to match the current capacity provided by 20 double deck trains per hour as shown in Figure 3.3.

Figure 3.3: Nominal Train Line Passenger Capacity



Assessment of Train Type & Signalling Control

Passenger Capacity (Pax/hr) Alternative train types

(Existing Signalling)

Double-deck	20tph	Normal load	24,000
		Peak load	28,000
Single-deck	22tph	Normal load	19,800
	22tph	Peak load	25,000

Passenger Capacity (Pax/hr) with enhanced Signalling

(ETCS Level 2)

Double-deck	24tph	Normal load	28,800
Double deck		Peak load	33,600
Single-deck	26tph	Normal load	23,400
	26tph	Peak load	29,200

Passenger train capacity is the maximum number of passengers able to be carried per train (seated plus standing). For example, the "commonly accepted" capacity for an eight car double-deck train (e.g. Tangara or Waratah) for design purposes is 1,200 passengers (PB-CHA, 2011).[1]

Train line capacity is determined by the minimum headway between services. In Sydney, the planned headway is three minutes which is based on a signalling clearance time of two minutes plus a station dwell time of one minute.[2] This gives a figure of 20 trains per hour as the train line capacity.

1 The crush laden capacity is around 2,100 passengers, which represents a theoretical maximum occupancy**. The maximum practical load is around 1750 passengers. This occupancy value was derived from real loading tests undertaken by RailCorp in 2007, representing how many people can actually fit into the train and is commonly used in evacuation analysis. At this occupancy movement within the carriage is almost impossible, the only time actual services would be laden to this level without impact would be for terminating services at Olympic Park, where the whole train load alights (PB-CHA, 2011). BY way of comparison, TMG adopted a lower figure of 1,050 passengers for a standard 8 car train with 956 seats as a practical carrying capacity, (TMG International, 2004).
((** Equates to about 5.75 passengers per square metre standing in a Waratah – see Table 2 notes))

2 Wardrop derived a different figure based on observations of the North Shore. He estimated an intrinsic signalling clearance time of 100 seconds and a station dwell time of 80 seconds.

TMG has suggested a practical maximum of 8,400 passengers per hour per platform for Sydney CBD stations. This was based on a theoretical maximum of 12,000 which was then factored down by 0.7 to 8,400 to allow for that *"passengers do not distribute themselves evenly down the lengths of platforms, nor do they depart in equal numbers on successive Trains"*

PB-CHA (Parsons Brinckerhoff, Cox, Hassell and Aecom (PB-CHA) considered that 20 trains per hour was the "practical train capacity". They calculated a higher "theoretical" capacity of 22 trains per hour which implies a minimum headway of 2 mins 43 secs. In their simulations, running 22 trains per hour 'passed' their simulation tests.

Dividing 20 by 22 trains (practical/theoretical) gives an 'utilisation rate' of 91%. PB-CHA noted that at 91%, the utilisation rate was above the recommended figure of 85% given in UIC 406 guidelines for peak hour suburban train operations (UIC, 2004).3 In fact, practical train capacity would need to reduce to 19 trains per hour if limited to an 85% utilisation rate.

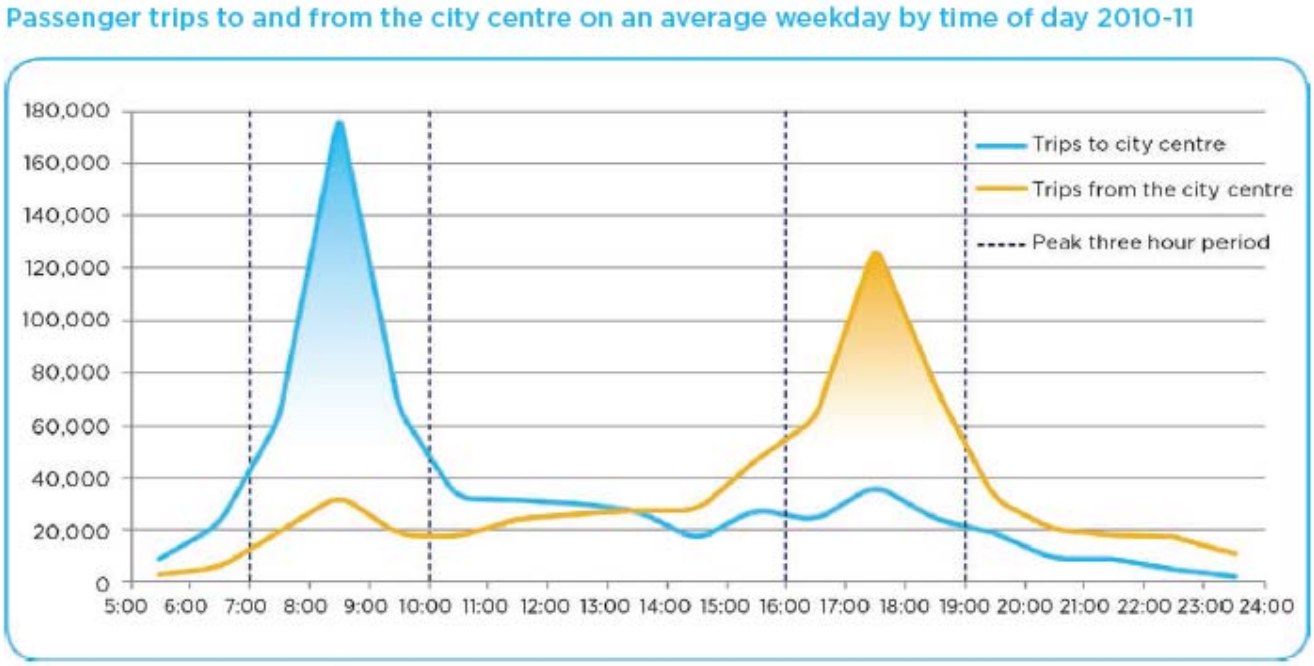
Douglas Economics findings

Douglas Economics, Neil Douglas (a New Zealand based UK expert in transport economics), "was engaged by Transport for New South Wales (TfNSW) in October 2011 to (i) assist in specifying TfNSW engaged Douglas Economics, to assist in specifying a model to assess the interaction of rail passenger demand and train and station capacity for the Redfern to Chatswood rail corridor and (ii) review available computational packages worldwide to determine the degree to which they fit TfNSW's requirements." His report 'Modelling Train & Passenger Capacity was sent to TfNSW in July 2012. It was published by Fairfax Media in 2013*. Douglas Economics drew on expertise from TfNSW and other consultants in preparation of the report.

The report notes "The CBD Rail Capacity Program is supporting the LTRP (Long Term Rail Plan) by identifying engineering works at key stations, and upgrades to rail systems. One of the key constraints is the dwell time at each of the main stations. Whilst capacity modelling has been done for individual stations, the interaction of the stations when combined with line/train capacity has not been fully understood at a network level. The cumulative impacts of how delays on the network, including how interchanging passengers impact station/operational capacity, needs to be understood in more

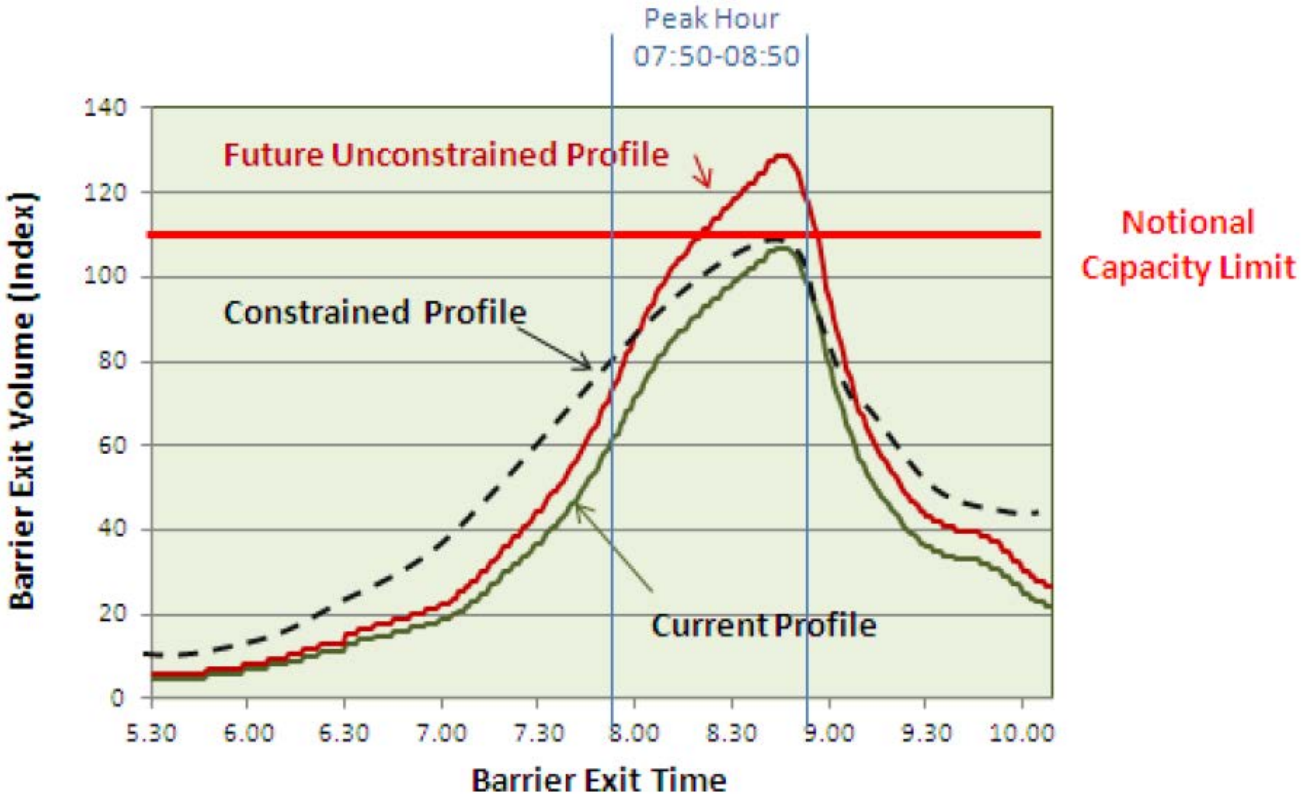
detail. Such an understanding of capacity limitations will assist with the development of infrastructure upgrades for the CBD stations and lines.

"It has been identified so far that RailCorp and TfNSW have information on:
- Operational modelling for the North Shore
- Dwell time measurements on the North Shore and CBD stations.
- Pedestrian modelling
- Architectural and operational station capacity studies, in particular for Town Hall, Wynyard and Central
- Fire & life safety studies for the main stations
- Passenger Allocation models for the CBD stations."



City Centre Access Strategy – travel demand profile

Figure 3.4: Constrained and Unconstrained Temporal Patronage Profiles

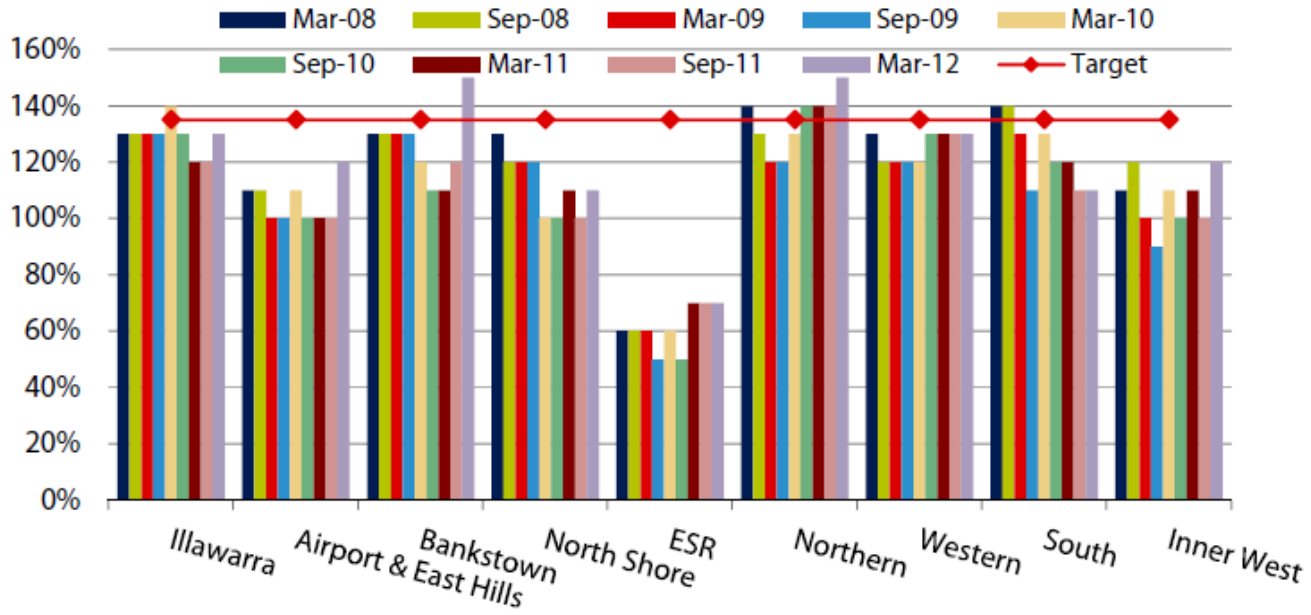


Douglas Economics – Sydney CBD AM peak-hour demand profile

APPENDIX D Crowding and safety on CityRail services – Bureau of Statistics and Analytics (BTS), TfNSW

Separate paper entitled "Utilizing the TfNSW Bureau of Statistics and Analytics (BTS) passenger train load surveys to determine operational passenger limits for trains and other public transport vehicles" indicates that BTS measurement significantly over states the number of passengers on crowded trains with the overstatement increasing with the level of crowding. BTS use two counters standing on a platform to count passengers onboard a train in the time between the last person boarding and the train leaving the platform. The TfNSW Auditor had its counters on board the same trains.

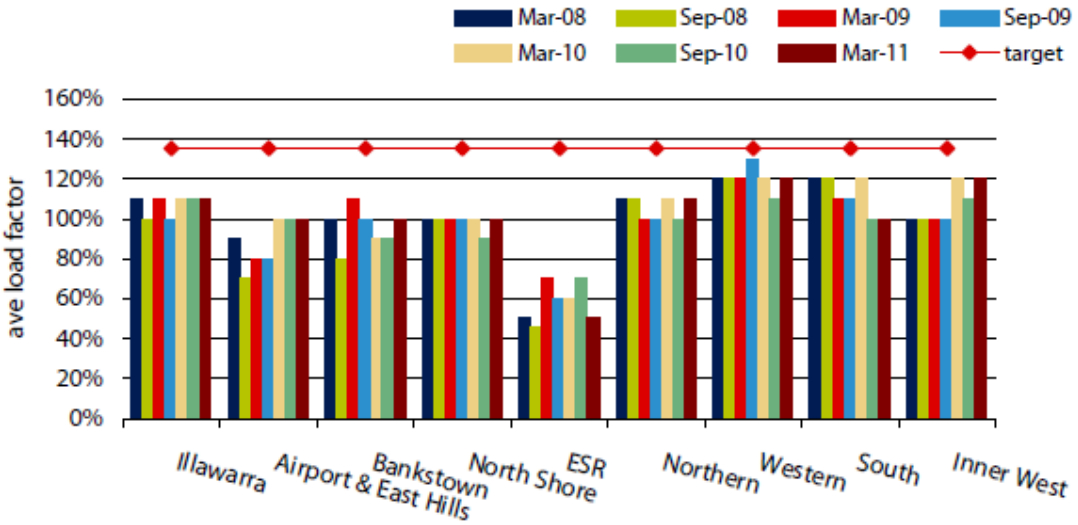
Figure C.13 Average load factors by suburban line in busiest am peak hour, March 2008 to March 2012



Note: March 2012 values were sourced from the CityRail website.

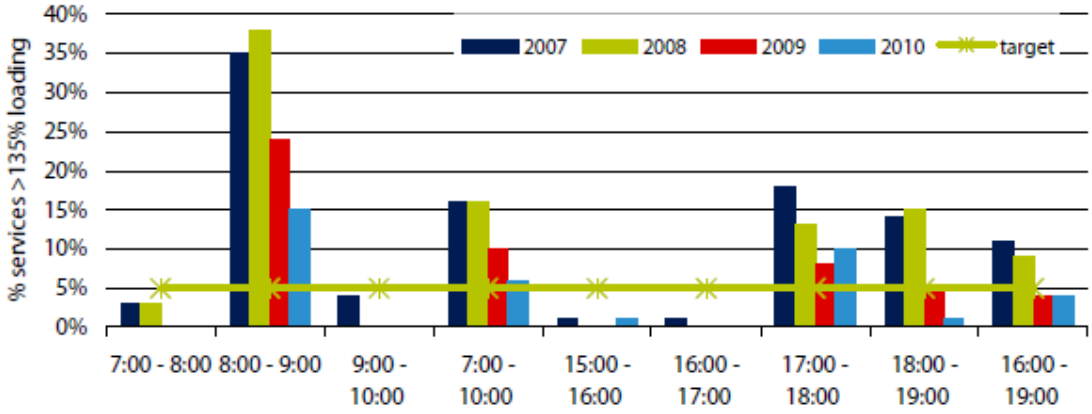
Data source: Transport for NSW and CityRail website.

Figure 4.15 Average load factors by suburban line in busiest pm peak hour, 2008 to 2011



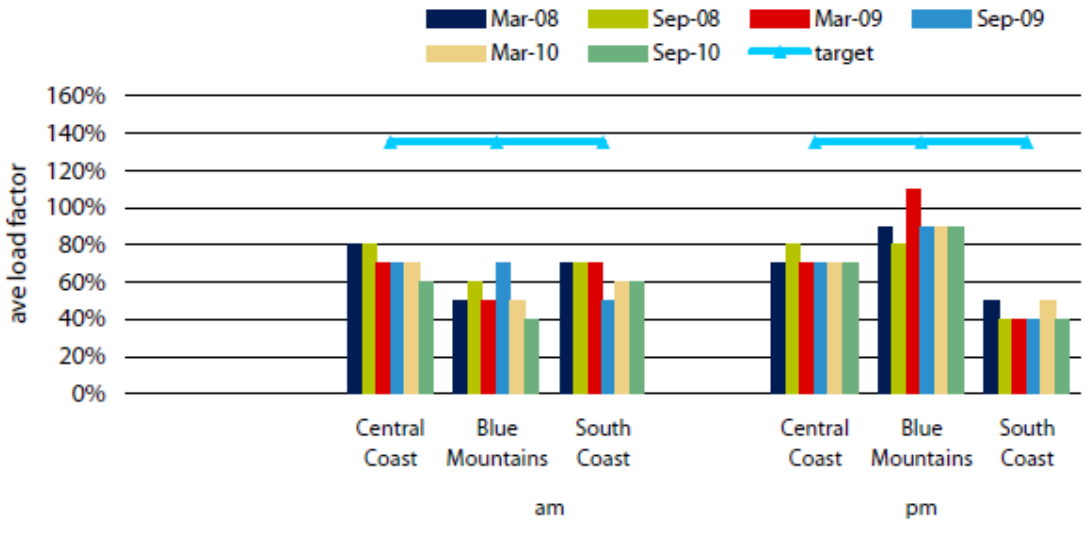
Data source: Transport for NSW.

Figure 4.14 CityRail crowding of services by time of day 2006/07-2009/10



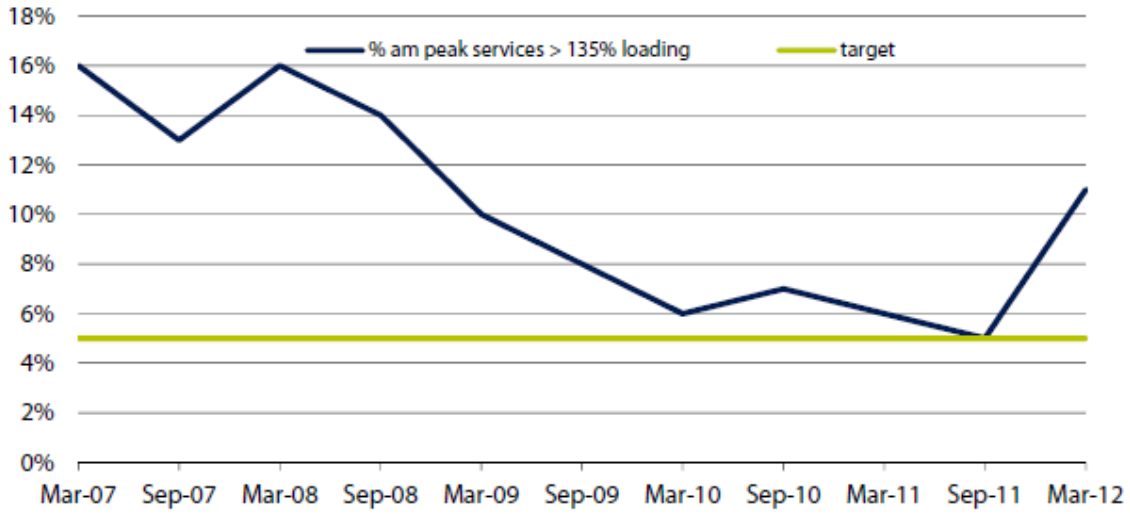
Note: Crowding is measured twice per year, in March and September. This graph is based on March data.
Data source: RailCorp.

Figure 4.17 Average load factors by intercity line in busiest am and pm peak hours



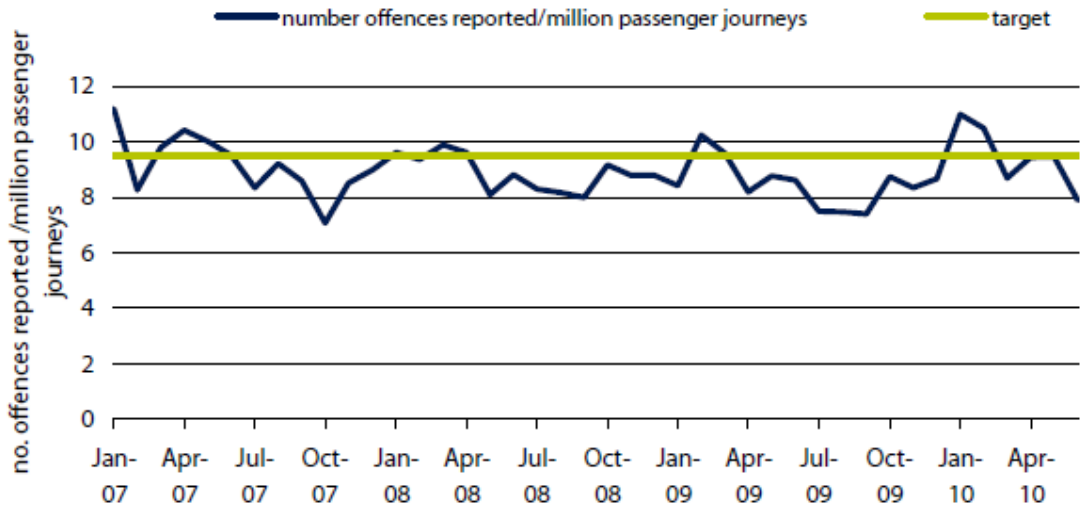
Data source: RailCorp.

Figure C.11 Crowding of CityRail services in the am peak 2007-2011



Note: AM peak services above 135% loading are measured in March and September.
Data source: Transport for NSW.

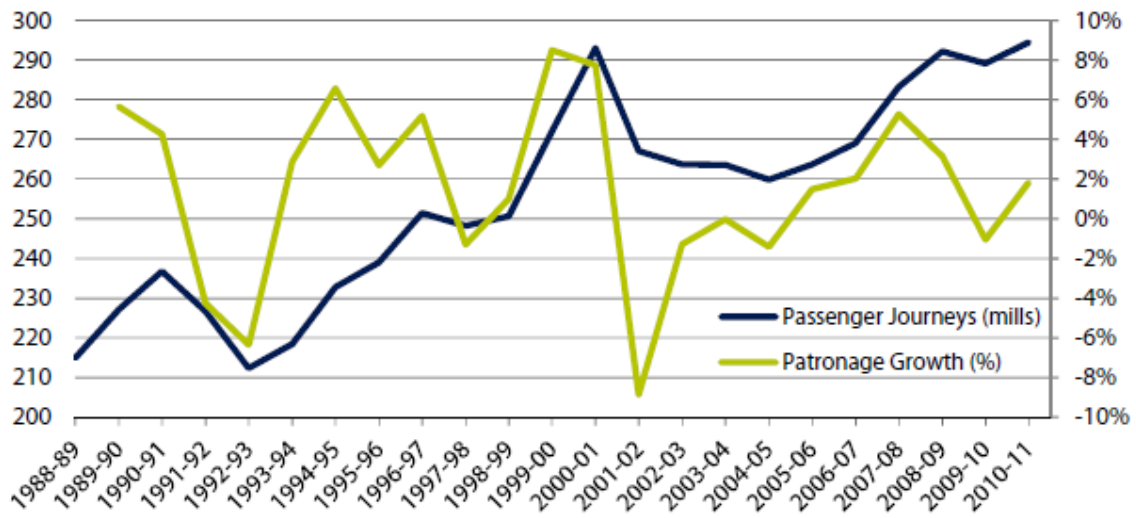
Figure 4.18 CityRail reported offences against persons, 2006/07-2009/10



Note: Offences against persons includes assault, robbery, sexual offences and stealing from a person which occurs on or next to railway property. Statistics reflect incidents reported and recorded by NSW Police.

Data source: RailCorp, based on Bureau of Crime Statistics and Research data.

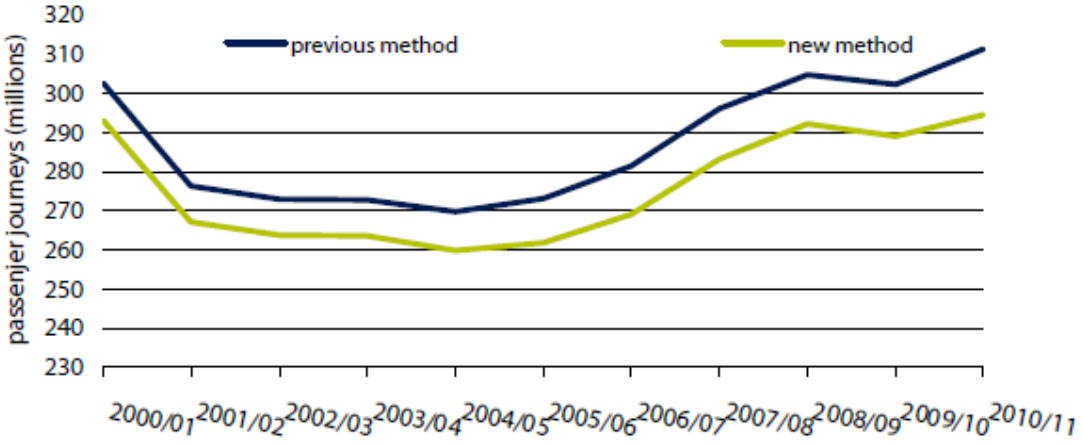
Figure 6.1 CityRail passenger journeys, 1988/89 to 2010/11



Note: Rail journey numbers have been updated to reflect BTS's new method of estimating journeys for certain ticket types. We also note that the peak in 2000/01 was caused by the Sydney Olympics and as such is considered anomalous.

Data source: BTS, 2010/11.

Figure 4.1 CityRail passenger journeys 2000/01 to 2010/11



Data source: Bureau of Transport Statistics, *Infosheet - Enhanced methodology for rail patronage measurement*, 2011.

APPENDIX E NWRL website images with the number of passengers barely worthy of a bus

APPENDIX F – Bombardier Regio 2N modified for Sydney commuter services

Region 2N is a double-deck articulated train for regional intercity services with open gangways between carriages. Double-deck carriages, with high-density Waratah style seating, are separated by short metro-style carriages.

A train of this style for Sydney would have 6 double-deck cars separated by five metro style cars, be ~162 metres long, and have 22 doors per side (6 more than the Waratahs, and 2 less than an equivalent Sydney Metro train). In an automated version, the drivers compartments are replaced by additional seating for passengers.

Figure F1 – Bombardier Regio 2N modified for Sydney commuter services

APPENDIX G – Comparison of a modern 43 metre tram with a bi-articulated 25 metre hybrid bus

Figure G1 – Bombardier Flexity 2 conventional tram – same model as Gold Coast tram

15 CNG-fueled, 78-foot ExquiCity 24 hybrid buses by Belgiumâs Van Hool for BRT service in Malmo, Sweden will have new Euro6 MAN engines, series hybrid electric drivelines by Siemens, and Type III carbon fiber-on-aluminum fuel cylinders by Luxfer-Dynetek.

Figure G2 – Van Hool hybrid bus for Malmo Sweden

Appendix H – CBD access strategy - people and public transport vehicles entering the CBD by vehicle between 8AM and 9AM

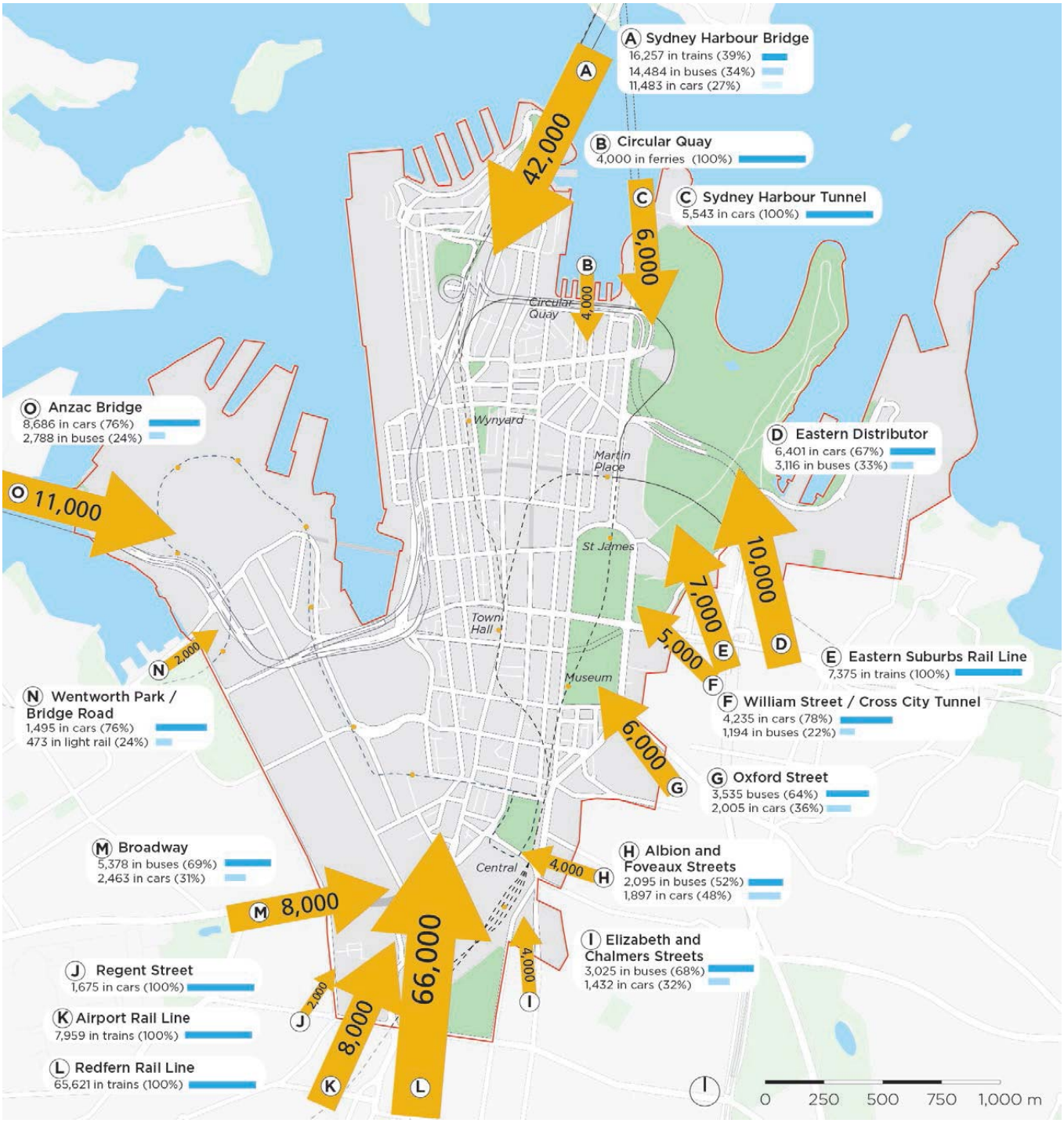


Figure H1 – CBD access strategy - people entering the CBD by vehicle between 8AM and 9AM

Existing bus network am peak hour (8:00 to 9:00am) bus volumes

Light rail and redesigned bus network am peak hour (8:00 to 9:00am) change in bus volumes

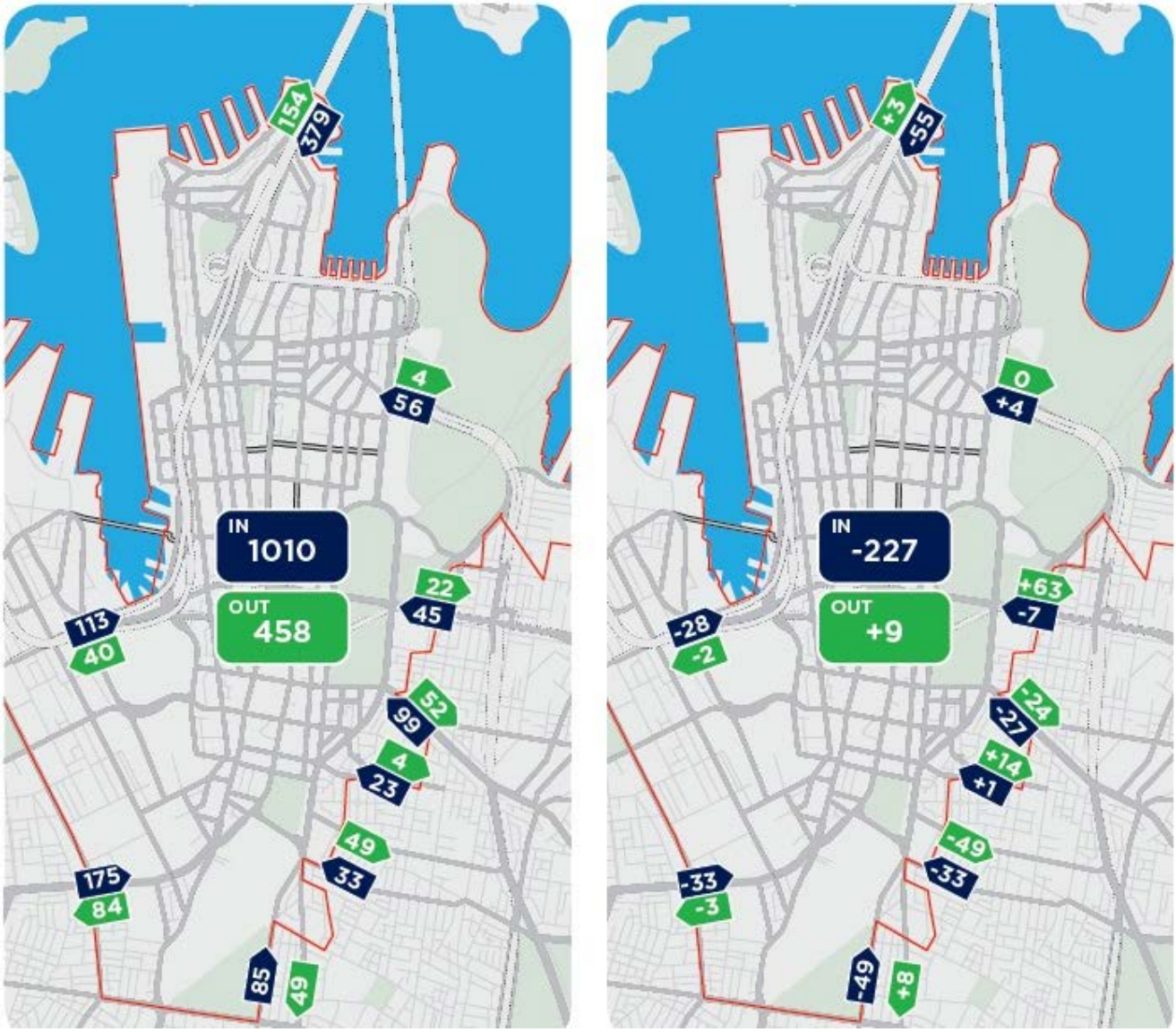


Figure H2 – CBD access strategy – changes to buses entering the CBD by vehicle between 8AM and 9AM

Transit Capacity and Quality of Service Manual (published by United States Transportation Research Board)

Part 2 – Bus transit capacity Pages 2-25, 2-26

http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_6-b.pdf

2. OPERATING ISSUES

BUS OPERATIONS

Passenger Loads

From a capacity perspective, the allowed passenger load on a bus (set by policy) constrains the number of people that a given number of buses can carry. From a passenger's perspective, loading reflects the comfort level of the on-board portion of a bus trip—both in terms of being able to find a seat and in overall crowding levels within the bus. From a transit operator's perspective, liability concerns and the desire to provide every customer with a seat for high-speed or long-distance services may cause the operator to set the allowed loading at levels lower than what riders might tolerate.

The impacts of all three of these perspectives on transit capacity are addressed in this section. The quality of service impacts of passenger loading are addressed in Part 5 of this manual.

Guidelines

Load factor

The passenger load is simply the number of passengers on a single transit vehicle. Much work uses the occupancy of the vehicle relative to the number of seats, expressed as a load factor. A factor of 1.0 means that all of the seats are occupied. The importance of vehicle loading varies by the type of service. In general, bus transit provides load factors below 1.0 for long-distance commute trips and high-speed, mixed-traffic operations. Inner-city service can approach a load factor of 2.0 (but more typically 1.5), while other services are in between. Typical bus vehicle types, dimensions, and passenger capacities are given in Exhibit 2-23.

Exhibit 2-23 Characteristics of Bus Transit Vehicles—United States and Canada

Bus Type	Length (m)	Width (m)	Typical Capacity		
			Seats	Standees	Total
Small Bus/Minibus	5.6 – 9.1	2.0 – 2.4	8-30	0-10	8 – 40
Transit Bus	10.7	2.4 – 2.6	30 – 35	20 – 30	50 – 60
	12.2	2.6	35 – 50	30 – 40	65 - 75
(low floor)	12.2	2.4	30 – 40	25 – 40	55 – 70
(articulated)	18.3	2.4 – 2.6	65	55	120

NOTE: In any transit vehicle, the total passenger capacity can be increased by removing seats and by making more standing room available; however, this lowers the passengers' quality of service. The upper ends of the total capacity ranges represent crush capacity and should not be used for transit capacity calculations.

A typical 12-meter urban transit bus can normally seat 43 passengers and can carry up to 37 additional standees if all of the aisle circulation space is filled. Similarly, an 18-meter articulated bus can carry 65 seated passengers and 55 standees. However, bus operator policy often limits the number of standees to levels below this theoretically offered, or crush capacity.

Maximum schedule loads.

Maximum schedule load is synonymous with "capacity," assuming a reasonable number of standees. It represents the upper limit for scheduling purposes. Maximum scheduled loads are typically 125 to 150 percent of a bus' seating capacity (e.g., 54-64 passengers on a typical 12-meter).

Crush loads

Crush loads, typically loads above 150 percent of a bus' seating capacity, subject standees and other passengers to unreasonable discomfort. Such loads are unacceptable to passengers. Crush loads prevent circulation of passengers at intermediate stops and so induce delay and reduce vehicle capacity. Although crush loading represents the theoretically offered capacity, it cannot be sustained on every bus for any given period, and it exceeds the maximum utilized capacity. Therefore, crush loads should not be used for transit capacity calculations. Note, however, that when maximum schedule loads are used, some buses will experience crush loading, due to the peaking characteristics of passenger demand.

Minimum passenger space requirements.

Design guidelines for seats and passenger areas in transit vehicles are based on human factors. Part 5 addresses the quality of service aspects of passenger loading. For buses, comfortable loading for design should provide at least 0.50 m^2 /passenger (2.0P/m^2) and maximum schedule loads should provide a minimum of 0.40 m^2/p (2.5P/m^2), where relatively short trips allow standees.(R9) The "comfortable loading" figure provides a reasonable balance between operating economy and passenger comfort and is consistent with the value suggested by Pushkarev and Zupan for a realistic passenger capacity for rapid transit lines. [R27] However, high-speed express bus service should not allow standees; hence, their scheduling should be guided by the number of seats provided.

Transit Capacity and Quality of Service Manual

TCRP report 100, the Transit Capacity and Quality of Service Manual, gives comprehensive definitions of capacity and quality of service for transit and specific methods to evaluate them. It deals with bus, rail ferry and transit stop and terminal capacity. Level of service id defined on scale of A-F similar for highways as given below[1]:

Exhibit 3-12. Fixed-Route Service Frequency LOS

LOS	Avg. Headway (min)	veh/h	Comments
A	<10	>6	Passengers do not need schedules
B	10-14	5-6	Frequent service, passengers consult schedules
C	15-20	3-4	Maximum desirable time to wait if bus/train missed
D	21-30	2	Service unattractive to choice riders
E	31-60	1	Service available during the hour
F	>60	<1	Service unattractive to all riders

Exhibit 3-13. Fixed-Route Hours of Service LOS

LOS	Hours of Service	Comments
A	19-24	Night or "owl" service provided
B	17-18	Late evening service provided
C	14-16	Early evening service provided
D	12-13	Daytime service provided
E	4-11	Peak hour service only or limited midday service
F	0-3	Very limited or no service

Exhibit 3-14. Fixed-Route Service Coverage LOS

LOS	% TSA Covered	Comments
A	90.0-100.0%	Virtually all major origins & destinations served
B	80.0-89.9%	Most major origins & destinations served
C	70.0-79.9%	About ¾ of higher-density areas served
D	60.0-69.9%	About two-thirds of higher-density areas served
E	50.0-59.9%	At least ½ of the higher-density areas served
F	<50.0%	Less than ½ of higher-density areas served

The manual can be obtained from the TCRP web site:
http://www.tcrponline.org/publications_home.html

The first chapter of the manual gives and overview and is included on the following pages

[1] Source: *Transit Capacity and Quality of Service Manual,* 2nd ed., Transportation Research Board, Washington, DC, 2003, pp. 3-30 – 3-34.

CHAPTER 1. INTRODUCTION

PURPOSE OF THE MANUAL

The *Transit Capacity and Quality of Service Manual* (TCQSM) provides transportation practitioners with a consistent set of techniques for evaluating the quality of service and capacity of transit services, facilities, and systems. The TCQSM does not set policies regarding a desirable or appropriate quality of service or capacity related to such transit elements. The manual's objectives include providing a logical set of methods for assessing transit services, facilities, and systems; assuring that practitioners have access to the latest research results; and presenting example problems illustrating the application of different procedures. The TCQSM is the primary source document incorporating research findings on transit capacity and quality of service. A companion document, the *Highway Capacity Manual 2000*, presents methods for evaluating the quality of service of roadway, pedestrian, and bicycle facilities.

SCOPE OF THE MANUAL

This manual is divided into nine parts:

- Part 1, *Introduction and Concepts,* summarizes the content and intended application of the manual and presents an overview of transit quality of service and capacity concepts.
- Part 2, *Transit in North America,* presents an overview of the various transit modes, services, and facilities provided in the United States and Canada.
- Part 3, *Quality of Service,* describes the factors that influence passengers' perceptions of their quality of travel on transit and provides quantitative methods for evaluating these factors.

Quality of service focuses on the passenger point of view.

- Part 4, *Bus Transit Capacity,* provides procedures for evaluating bus loading area (berth), stop, and facility (including busway, freeway high occupancy vehicle lane, arterial street bus lane, and mixed traffic lane) capacity.
- Part 5, *Rail Transit Capacity,* provides both generalized and more detailed procedures for evaluating the capacity of heavy rail (rapid) transit, light rail, commuter rail, automated guideway transit, and ropeways.
- Part 6, *Ferry Capacity,* addresses the capacity of passenger and auto ferries, focusing particularly on potential constraints at the dock.
- Part 7, *Stop, Station, and Terminal Capacity,* provides procedures to evaluate the capacity of and design passenger comfort level for various elements of bus stops, transit centers, transit stations, intermodal terminals, and similar facilities.
- Part 8, *Glossary,* presents a comprehensive glossary of terms used in the transit industry.
- Part 9, *Index,* provides an overall index to the TCQSM.

Capacity addresses the number of people and/or transit vehicles that can be served consistently in a given amount of time.

USE OF THE MANUAL

The TCQSM is intended for use by a range of practitioners, including transit planners, transportation planners, traffic engineers, transit operations personnel, design engineers, management personnel, teachers, and university students. To use the manual effectively and to apply its methodologies, some technical background is desirable, typically university-level training or technical work in a public agency or consulting firm.

The material from this document that is relevant to traffic engineers is also included in Chapter 14, "Transit Concepts," and Chapter 27, "Transit," of the *Highway Capacity Manual 2000,* which is available from TRB in printed and CD-ROM versions.

The quality of service section of the manual is intended to provide a comprehensive look at transit quality of service from a passenger's point-of-view, and a set of performance measures are provided. These measures can be applied to assess existing and projected quality of service as an aid in identifying transit service, facility, and system performance and improvement needs.

Level of service used to quantify quality of service.

The TCQSM uses the concept of *level of service* (LOS) to quantify quality of service. LOS is used for two main reasons: to ease the explanation of transit service quality concepts to laypeople and for consistency with how other modes already measure quality of service. Fixed-route transit LOS is based on an "A" (highest quality) through "F" (lowest quality) system similar to, but not exactly the same as, letter grades in school. Because of fundamental differences both between fixed-route and demand-responsive services, and among different types of demand-responsive service, a 1 through 8 scale is used to describe demand-responsive LOS.

The TCQSM provides guidance and not standards.

LOS standards are not identified in this manual, because individual agencies develop these related to their individual system and area characteristics. The TCQSM is not intended to set a national standard regarding the amount or level of service that should be provided for a given situation. In recognition of the fact that LOS may not be appropriate for all applications, the TCQSM also discusses alternative ways of measuring transit quality of service.

The capacity sections of the manual provide both planning and more detailed operations analysis procedures for assessing capacity for bus, rail, and ferry transit modes, and transit stops, stations, and terminals. A building-block approach to capacity analysis is presented, initially addressing the capacity characteristics of individual transit stops and station components, and then expansion of the concepts to address the capacity of broader transit services, facilities, and systems. The estimation of transit ridership in sizing transit services and facilities is not addressed in the manual.

The TCQSM does not address ridership estimation.

MEASUREMENT UNITS

This edition of the TCQSM has been published in dual units, U.S. customary and metric. U.S. customary units are presented as the primary units, with metric units as supplemental units.

NORTH AMERICAN AND INTERNATIONAL APPLICATIONS

In producing the TCQSM with metric units, TRB has taken a step toward making these methods and procedures more applicable to international work. However, the user of the manual is cautioned that the majority of the research base, the default values, and the typical applications are from North America, particularly the United States. Although there is considerable value in the general methods presented, their use outside of North America will likely require calibrating the procedures to local conditions, particularly in regard to user expectations of service quality. International

Unless otherwise specified, "North America" in the TCQSM refers to the United States and Canada.

users should also recognize major differences in the composition of traffic in on-street, mixed-traffic transit operations, and in typical geometrics and passenger processing measures.

TCQSM MEDIA

The TCQSM is provided in two forms: a printed document and an electronic version available on an accompanying CD-ROM or by downloading from the TCRP online publications website. The electronic version is hyperlinked, allowing users to jump immediately to related material within the manual. In addition, the references section of each part of the manual contains links to other related documents available on the Internet at the time the TCQSM was published.

Internet links are subject to change.

Calculation Software

The accompanying CD-ROM provides Microsoft® Excel spreadsheets that assist with the rail transit capacity procedures. In addition, spreadsheets have been provided that were used to develop the planning graphs presented in Part 4, Bus Transit Capacity. **Neither TRB nor the project team that developed the TCQSM provides support for these spreadsheets.**

For the other sections of the TCQSM, no software is provided to replicate the quality of service or capacity procedures; however, in most cases, the procedures can be worked out by hand or with the assistance of a spreadsheet. Over time, vendors may develop software packages to implement the TCQSM procedures, but TRB does not produce, review, or endorse any such software.

Other Reference Material on the CD-ROM

The accompanying CD-ROM also contains a library of related TCRP documents on transit capacity and quality of service. The introductory screen on the CD lists all of the documents that are included.

TYPOGRAPHIC CONVENTIONS

The following conventions are used in this manual:

Margin notes look like this.

- Margin notes are used to highlight certain points and to facilitate finding specific topics within a particular section.
- Blue underlined text indicates hyperlinks in the electronic version of the TCQSM.
- References are indicated by the letter "R" and a number, like this.[R1] Clicking on these numbers in the electronic version of the TCQSM takes the reader to the appropriate reference. Once there, clicking on the hyperlink provided below the reference (if available) opens a copy of that document, assuming that the document is still located on the Internet and in the same location as when the TCQSM was developed. Each part is treated as a separate document; therefore, the references cited in the text refer to the reference list at the end of each part. For example, [R1] in Part 2 refers to the references at the end of Part 2 and [R1] in Part 5 refers to the references at the end of Part 5.

Equation numbers, exhibit numbers, and appendices in text refer to the specific part they are used in (e.g., Exhibit 3-1). Clicking on an equation number or exhibit number reference in the electronic version of the TCQSM takes the reader to that equation or exhibit.

WHAT'S NEW IN THE SECOND EDITION

This Second Edition of the TCQSM represents a reorganization and expansion of material presented in the First Edition. A total of nine parts have been prepared, with a total of 43 chapters. The changes to the TCQSM are summarized below.

Part 1: Introduction and Concepts

Part 1 has been reorganized to include an overview of the content and application of the TCQSM. In addition, the overview of transit quality of service and capacity concepts has been expanded.

Part 2: Transit in North America

Part 2 has been formatted to focus on North American transit applications, with the quality of service and capacity concept discussions moved to Part 1. Transit mode statistics have been updated whenever data were available, including using the most recent National Transit Database information.

Part 3: Quality of Service

Quality of service has been moved in front of capacity in the Second Edition of the TCQSM to reflect user interest in this concept and the importance of quality of service related to all transit services. Part 3 includes an expanded quality of service discussion that provides a new framework for demand-responsive transit. This new framework—which describes quality of service on a "1" through "8" scale—was developed to better reflect the fundamental differences between the fixed-route and demand-responsive transit modes. The fixed-route quality of service framework presented in the First Edition has been retained, but enhancements and/or adjustments have been made to most of the measures.

Part 4: Bus Transit Capacity

Two significant additions to the Bus Transit Capacity part have been made. The first is a new "Planning Applications" chapter that, through the use of default values and graphs, allows users to quickly evaluate capacity issues related to broader planning applications. The second is the incorporation of research from TCRP Project A-7A that refines the arterial street bus lane speed estimation techniques.

Other enhancements to Part 4 include expanded sections on transit signal priority and bus rapid transit, given the increased application of these treatments to facilitate bus operations. The transit priority treatment discussion includes a presentation of the effects of different treatments on travel time and delay to both transit and general traffic.

Part 5: Rail Transit Capacity

Part 5 provides rail transit capacity analysis procedures. In addition to a new "Planning Applications" chapter, this entire part was rewritten to better flow with the rest of the TCQSM, as this part in the First Edition was developed by extracting material directly from the previous *TCRP Report 13*[R5] document on rail transit capacity.

Other enhancements in this part include a new section on ropeway capacity. Ropeways are defined as including aerial tramways, funiculars, and cable-hauled people movers. The commuter rail capacity section has also been expanded. Finally, the heavy rail, light rail, and commuter rail route statistics for lines in North America were updated to reflect the latest route development and ridership statistics, based on a survey of agencies providing these services.

Part 6: Ferry Capacity

For the first time, passenger and auto ferry capacity is addressed in the TCQSM. This part initially discusses different types of ferry services, vehicles, and docking/terminal facilities. This is followed by an assessment of how berth and dock capacity impact vessel capacity and how overall passenger and auto capacity on ferry routes may be calculated. As with other parts of the manual, example problems illustrating the ferry capacity analysis procedures are included.

Part 7: Stop, Station, and Terminal Capacity

Part 7 now focuses on an expanded discussion of stop, station, and terminal capacity, the title reflecting consideration of analysis procedures related to different types of transit facilities. Major enhancements to this part include a broader discussion of the relationship of different passenger processing elements in larger stations and terminals in impacting overall facility capacity, and discussions about sizing station facilities to address passenger demands, ADA requirements, and emergency evacuation requirements.

Part 8: Glossary

Part 8 includes an expanded glossary of terms from that presented in the First Edition, with more than 2,000 terms defined.

Part 9: Index

Part 9 includes a comprehensive alphabetical index of terms used in the manual.

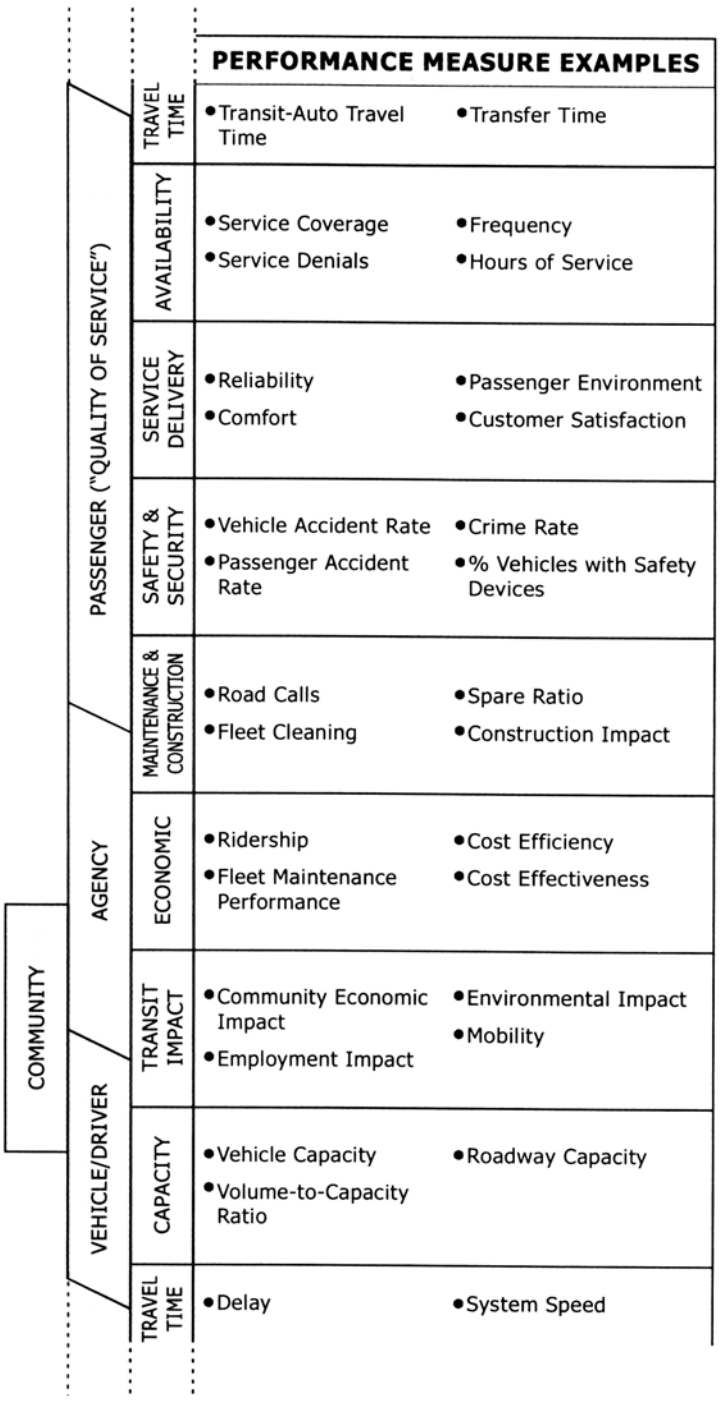
FUTURE UPDATES

In future years, other updates of the TCQSM will likely occur as research is conducted and new concepts and analytical procedures to assess transit capacity and quality of service are developed. The new TRB Committee on Transit Capacity and Quality of Service will take a leadership role in identifying research priorities and in helping shape further updates of the manual and the application of the document by the user community.

The committee welcomes user feedback on the TCQSM and has established a web site to solicit comments and suggestions that will be used to guide future editions of the manual.

http://webboard.trb.org/~tcqsm

Exhibit 3-3
Transit Performance Measure Categories and Examples[R17]



Transit performance measures can represent the passenger, agency, driver/vehicle, and/or community point of view.

Travel time overlaps the vehicle/driver and passenger points of view.

Infrastructure to transport support services – presentation

Peter Egan –

The body of this presentation presents in abbreviated form:
--- Problems with current processes,
--- Enablers for infrastructure delivery, and
--- Issues with current planning.

Evidence in support is presented in appendices:

Appendix 1 - Productivity Commission – 5-year productivity review – Nov 2017

Appendix 2 - The need for road funding and investment reform

Appendix 3 - NSW STATE PRIORITIES DEC 2017 AND PROCESSES

Appendix 4 - INFRASTRUCTURE AUSTRALIA processes and priority list

Appendix 5 – Examples of automated and electrified vehicles for various industries

Appendix 6 - Commission nationale du débat public - National Commission for Public Debate (France) processes

Appendix 7 - Infrastructure – What to build, how to proceed

Appendix 8 – Metropolitan Planning

Appendix 9 - Local and regional centre planning

Appendix 10 – local and regional centre traffic reduction measures

Appendix 11 – Metropolitan public transport grid

Appendix 12 – West Metro and other metropolitan rail service enhancements

Appendix 13 – Enhancing rail capacity in the Sydney CBD

Appendix 14 – Quadrupling Light Rail capacity in the Sydney CBD

Appendix 15 – National Stadium @ Central

The problems with current processes

Productivity Commission - Transport planning is poor!!!

Evidence - Appendix 1 - Productivity Commission – 5-year productivity review – Nov 2017

Declining government transport revenue

Evidence - Appendix 2 - The need for road funding and investment reform

Government priorities and planning poorly relate to transport services

Evidence - Appendix 3 - NSW STATE PRIORITIES DEC 2017 AND PROCESSES

Appendix 4 - INFRASTRUCTURE AUSTRALIA processes and priority list

Enablers for infrastructure delivery

Understanding the service provided is the key to understanding the effectiveness of Infrastructure. Infrastructure access points are a key aspect of service.

--- Vehicle automation

--- Cuts costs of services where salary costs are significant

--- Enables services like Uber (taxi) and Chariot (15 seat public transport) to offer services at reduced cost and extend mobility services to smaller communities.

--- enables much improved accessed to services in rural and regional areas.

--- will be another revolution in agriculture

--- Vehicle electrification

--- big variety of local travel vehicles possible – 1-, 2-, 3- & 4-wheel vehicles available

--- reduces noxious pollutants and CO2 from transport vehicles

--- improved bus service, buses better quality service than trams due a seat for every passenger.

--- better acceleration and energy recovery permit increased grades for rubber-tyred vehicles, and thus sharper grades to and from tunnels and bridges to reduce surface level impacts.

--- Vertical Take-Off and Landing (VTOL) small electric aircraft aerodromes across metro area.

--- can be combined with energy storage

Evidence - Appendix 5 – Examples of automated and electrified vehicles for various industries.

--- Consultation

--- Public debate on service demand and options, their supporting infrastructure and likely impacts. Debate led by French style independent authority (see attachment) appointed by parliament not government. Authority appoints independent debate commissioners. Authority to demand proponents provide information in standard format and not proceed with debate until information provided. Outcome is a report on options and impacts, but no recommendations made. Authority/government has 3 months to express its preference of the options. Debates are conducted where service specific infrastructure over a certain value, or large quantity of land is required – examples include water supply and energy storage dams, major hospitals, major education institutions, gaols, roads, railways, ports, airports, national parks.

--- Advantage to government is not committing to an option before knowing public response to service options.

--- Italian style project commissioner to lead interagency project control group and manage public engagement during construction. Report progress to community, undertake periodic review of project need, economic and social benefits and impacts and business case. “Come fare, cosa fare” – “How to do, what to do” by Iolanda Romano, government commissioner for A$10 billion Terzo Valico 53 km railway project in northern Italy.

--- Advantage to government is greater community trust that project issues that impact the community get addressed, that the service demand and business case get updated on a regular basis. As infrastructure is built, service and business opportunities generally expand.

Evidence - Appendix 6 - Commission nationale du débat public - National Commission for Public Debate
(France) - processes
- Appendix 7 - Infrastructure – What to build, how to proceed

--- Financing community services and supporting infrastructure

Government employing the private sector to do work is a good idea. But, for community services like transport, government should plan and finance the services and their supporting infrastructure.

Availability payments, not direct user charges, should be used when the government does not wish to finance community infrastructure.

Government should receive all road/public transport user payments and determine community/user funding mix.

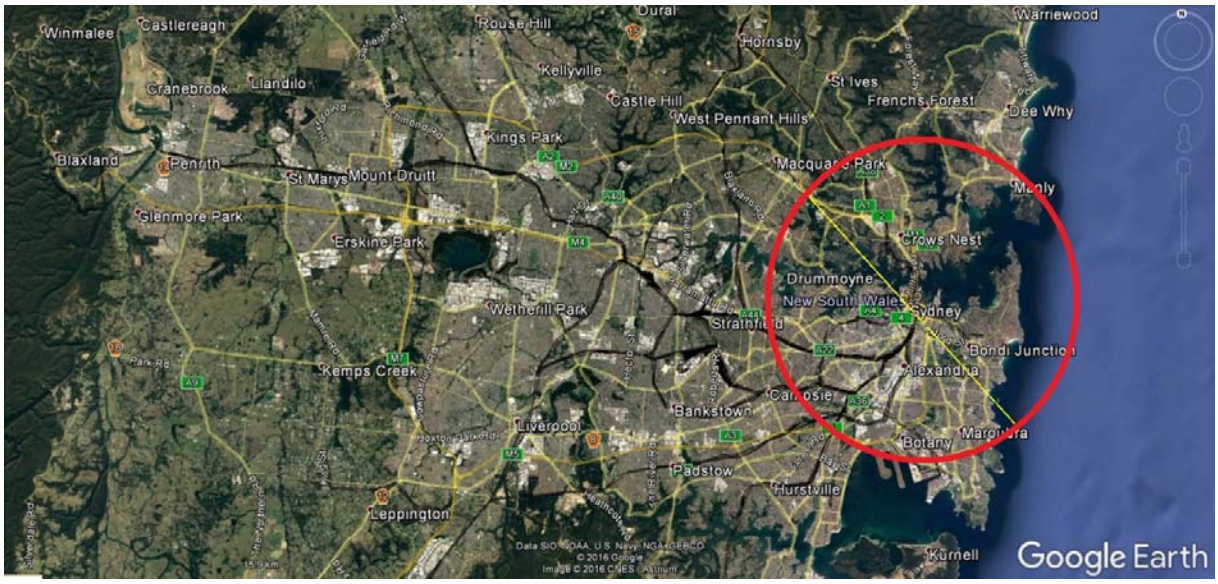
--- Tolling

In the light of the parliamentary report, commission a public enquiry of options for motorway funding.

"A CPI cap would also make it more difficult to attract private investment; reduce competition in the market; and would be likely to increase costs for government, taxpayers and road users," TfNSW submission.

A public inquiry would consider, among other options put forward by operators and community members:
--- reducing the cost burden on the community,
--- registration fees and other charges,
--- the Commonwealth fuel tax (not paid by electric vehicles, and less paid by new fuel-efficient vehicles),
--- an 'Opal' style fares for motorway use with its concessions for various community members,
--- relative availability of public transport alternatives,
--- restrictive covenants placed on the road network in toll concessions,
--- how toll road operators would be compensated if an Opal style fares, or other non-specific road, were introduced and covenants removed,
--- impact on motorway demand,
--- the needs of the economy.

Possible double-toll zone for vehicles in the wealthy east of Sydney metropolitan area with high transport infrastructure costs due to terrain



10 km radius for Sydney GPO double-toll zone

Issues with current planning

--- Metropolitan planning

--- GSC plans well, but is forced to accept TfNSW transport planning.

--- Transfer Priority Precinct planning to GSC.

--- Expand GSC to cover state and appoint additional district commissioners for rural and regional NSW.

--- Move transport planners and statistics agency – road, rail, marine, air, public transport – to a transport planning agency in department of planning. TfNSW becomes a delivery and regulatory agency.

--- Start full public debates on state and metropolitan transport networks for a 2060 timeline due to weaknesses in the current government plans - One each for Metro/Heavy Rail, Light Rail and Motorways.

--- Specifically, the government plan ignores arterial roads, the Sydney Trains network, intercity and interstate road and rail networks. The following projects would be subject to the debates: Sydney Metro, possibly Sydney Light Rail CBD & South East, Parramatta Light Rail, WestConnex, Western Harbour Tunnel and Beaches Link. The aim is for government to make decisions to improve these programs by end of 2019.

--- Each of the hierarchy of roads and railways should form a grid, adjusted for terrain, land use, specific services and environmental impacts, to best serve the economy and society.

--- Public enquiry into suitable locations for pumped hydro storage in the state, followed by a sale of licences for specific locations.

Evidence - Appendix 8 – Metropolitan Planning

---- Local and regional centre planning – public transport oriented development

--- LEPs seek to achieve appropriate development in, and around, each local and regional centre.

--- Every local and regional CBD also needs a local centre plan for a standard set of community service facilities such as parks, library, community centre, town squares. See Activate Turramurra plan.

--- Every local and regional CBD needs a transport plan that address access by walking, cycling to and between local centres, public transport access, parking for residents, local shops and public transport access.

--- Local and regional centres development uplift at railway stations – development uplift within radius of station entrances – radii 200 metres, 300 M, 400 M, 500 M, 600 M, 800 M with variation for terrain, environment, demand.

--- All apartments need a garage level space at least 3 m x 3.5 m for mobility vehicles. Electric bikes, scooters (two-wheel and wheelchair types). Local access vehicles. 98% of normal road vehicles won't fit.

Evidence - Appendix 9 - Local and regional centre planning

--- Traffic reduction measures

--- **Storage space for local mobility devices**, as described immediately above, for every dwelling.

--- **Encouraging small local travel vehicles** which need less road and parking space – reduce congestion. Vehicles include small 1-,2-, 3- & 4-wheel electric vehicles.

--- **Cycling**

--- Bike paths on footpath of district and arterial roads to link local and regional centres – 20 km/h limit. One footpath of the roads paved from gutter and property boundary to provide space. Cycle path indicated by texture change as in continental Europe, not white lines.

--- In heavy traffic areas, bike path on one footpath on every road - Sydney CBD exception. Bike path marked by different texture not white lines. 20 km limit on footpaths. 250-watt electric bikes allowed.
--- Helmets are always highly recommended, but drop legal requirement for footpaths, local roads, and dedicated cycle paths.

Evidence - Appendix 10 – local and regional centre traffic reduction measures

---- Resource allocation

--- While the degree of need varies, every community needs every mode of transport.

As with the broad government allocation between primary areas of service such as education, health and transport, allocation needs to be made between the various transport modes.

Choosing between modes to service a community, when the need is for all modes, has limited merit.

– transport growth and vehicle ownership 70% higher than population growth (Vehicle-kilometre growth likely lower) – see figure below. People are travelling further to access jobs and goods & services. Thus, more road travel is via State Government arterial roads whose widening is extremely disruptive in built up areas.

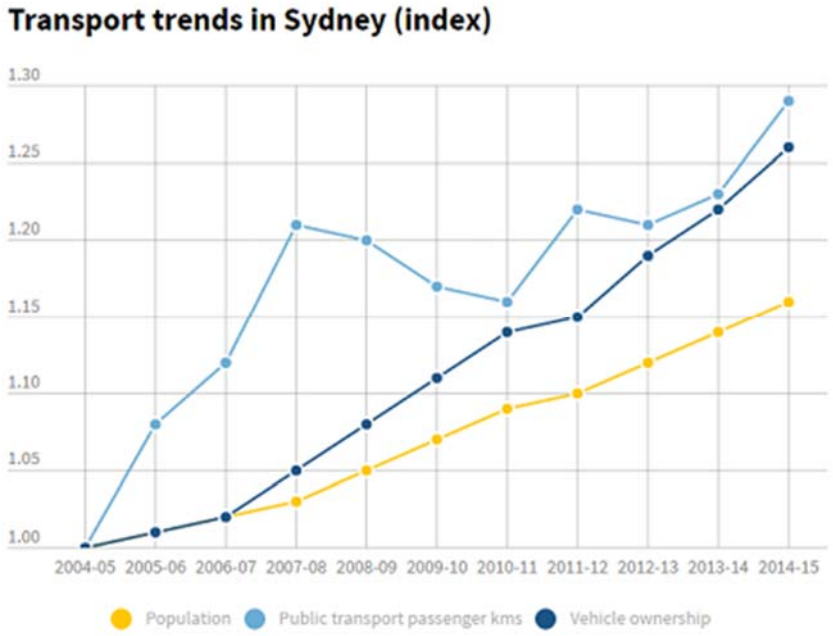


Figure - Trends in Sydney Transport

---- Dis-enabler

Ideological favouring of personal forms of travel over public forms, or vice versa. Service and economics should drive choice.

--- Grid versus radial (hub and spoke) networks

Most efficient structure for land transport networks – is a grid adjusted for demand, terrain and environment.

Generally, each mode (road, rail, cycle, etc) should form a grid, and each hierarchy of a mode should form a grid.

Public transport should have a grid-shaped trunk network supported by grid- and hub-and-spoke-shaped local networks. B-Line provides trunk services – it works with the Illawarra rail line and North Shore Line to provide an eastern – North-South public transport grid line.

--- Public transport

--- **Capacity issue** - Government using engineer's safe load capacity for operational capacity for Metro, trams and articulated buses. Operational capacity is just over half stated by government.
--- Double deck trains (900 seats) have twice seats as Metro equivalents (450 to 480 seats).
--- 67 metres of buses (5.5 standard buses) has 235 seats relative to 120 for tram).
--- Operational capacity formula – seats + 1.5 Passengers/sq.metre in standing areas
--- Engineers safe load formula – seats + 4 Passengers/sq.metre in standing areas
--- Commit to **a seat per passenger** for safety and comfort, except during the busiest 40 min of the AM peak.

--- Strategy **of trunk route services supported by local services** – in part due to bus congestion in Sydney CBD.

--- Invite services like Chariot (15 seat buses) to **supplement existing services on lower demand routes**.

--- **improve grid structure of transport services** – particularly rail. North-South services on Western Sydney
Airport and Hornsby-Epping-Parramatta-Liverpool-Campbelltown alignments.

Evidence - Appendix 11 – Metropolitan public transport grid

--- **Sydney Metro** - diverted to link with West Metro Express, combined with less disruptive Bankstown Line upgrade.

--- **Sydney Trains capacity upgrade**
--- Upgrade from 'fixed' block to 'moving' block signalling to improve reliability and capacity (Initial target of 24 trains per hour capacity.
--- Add platforms to Wynyard and Town Hall to permit alighting from one side and boarding from the other in peak hour.
--- Add 4 platforms at Central CBD platforms so 2 platforms serve each CBD platform.
--- Add North Shore line platforms at Observatory Hill to reduce demand at Wynyard.
--- Central Station CBD platforms-Sydney Metro **-** Pedestrian access review needed.

Evidence - Appendix 12 – West Metro and other metropolitan rail service enhancements
Appendix 13 – Enhancing rail capacity in the Sydney CBD
Appendix 14 – Quadrupling Light Rail capacity in the Sydney CBD

--- Sydney Motorway route options – focus on a strong grid structure to road network
--- **WestConnex St Peters Junction**
---- Study feasibility of burying it under park
--- **Western Harbour Tunnel and Beaches Link**
--- Government option
--- Maximum grade set at 4%, half that of western end of M5 tunnel – causes extended tunnel length – not justified due to vehicle electrification.
---offers poor access between Northern Beaches and North Shore,
--- forces motorway traffic at Macquarie Park (mainly heading to/from south side of harbour) to travel and extra 6 km via Neutral Bay.
--- By building the harbour crossing on a Rozelle-North Ryde corridor, more than enough traffic is removed from the Warringah Freeway to make room for motorway traffic from/to Northern Beaches.
--- a 6.5% grade at the southern end permits a shorter route with good north shore accessibility.
--- see attached plans

Evidence - Appendix 15 – Metropolitan Main roads grid (including motorways)
Appendix 16 - North East metropolitan road upgrade including Western Harbour Tunnel and Beaches Link changes

---- Address housing affordability with:
--- **NSW coast intercity passenger railway** due to climate on par with Sydney and number of regional cities.
200 kmh track standard suitable for 250 kmh tilting trains.
--- **Inland freight and passenger railway** linking Sydney's port to regional cities and interstate.
Private sector led project incorporating Inland rail project.
160 kmh standard suitable for 200 kmh tilting trains.
--- Upgrade Bells Line of Road to minimum 80 kmh 4-lane divided scenic drive.
--- Plan motorway under Blue Mountains for time when vehicles largely electrified.
--- Build second 2-lane carriageway 20 metres from main inland highways to address safety deterrent to living in regional and rural NSW.

Evidence - Appendix 17 - Addressing housing affordability and the inland economy with intercity rail
– Inland passenger and freight, and coastal medium- and high-speed
Appendix 18 – NSW highways for upgrade to 4-lane divided carriageways by addition of a second carriageway

---- Sydney Harbour Cruise Ship capacity

Garden Island and its surrounding waters has sufficient space for more wharves for both Navy and Cruise Shifts.

Evidence - Appendix 19 – Garden Island extra wharves for enhanced Sydney Harbour Cruise Ship and Navy capacity

Energy Storage – Pumped Hydro
Study best pumped hydro sites in NSW from a business and environmental perspective.
Sell licences to develop the highest-ranking opportunities.

Evidence - Appendix 20 – Potential areas for government sale of pumped-hydro site licences

Stadiums
Major stadiums should be next to major CBDs and main rail stations for synergies with neighbouring businesses and transport (trains). Patrons need before and after places to gather, and stadium needs year-round use of facilities.

The best Australian location for a national rectangular field stadium is above the tracks in the rail yard behind Central. This site is not suitable for office buildings as basement access is restricted by the layer of rail tracks. The rail tracks also make building construction uncompetitive.

Evidence - Appendix 21 – National Stadium @ Central

Appendix 1 - Productivity Commission – 5-year productivity review – Nov 2017

What is desired of cities from a productivity perspective?

PE - Access to public and private services in a timely manner.

Views on how well cities are functioning will inevitably reflect personal preferences.

In a dynamic sense, thriving cities would grow while retaining these features. Lately, this quality is being referred to as a city's 'resilience', meaning its ability to withstand and respond to chronic stresses (such as congestion, threats to public safety, and natural resource scarcity) and acute shocks including disease outbreaks or terrorist attacks.

Conversely, features that usually signal poor functioning include sustained overcrowding, transport congestion leading to significant wasted time and costs, high levels of social unrest and crime, large-scale homelessness and large, entrenched, disparities in opportunity that can contribute to widening dispersions in income and social tensions.

Policies that particularly matter in this context include:
--- migration
--- how land is used
--- seek to regulate movement and the use of shared or public spaces. Manage frictions associated with concentrations of activity
--- complementary land uses
--- affect the capacity of cities to absorb population growth; a function of the capacity of existing infrastructure, housing and services
---through their influence on the availability of amenities and quality of the built and natural environments

How are Australia's cities functioning?

--- indicators show Australia performs highly on many measurable indicators of wellbeing (OECD 2016b
--- volume and rate of individual crime have been decreasing (AIC 2015).
--- Australia also performs well on measures of social cohesion
--- there are signs of growing stress. Congestion on roads and other facilities has grown significantly
--- Poor zoning regulations hurt business investment

4.3 Many hands are at work in cities policy

--- State and Local Governments generally lead the policy and program delivery activity in cities
--- Networks of roads and public transport are their responsibility both legally and in a long-term investment sense.
--- Australian Government's most recent targeted intervention program, the *Smart Cities Plan*
--- Interventions still only sometimes feature both effective benefit/cost analysis driving project selection, and clarity about who is accountable in the event that significant risk events occur

4.4 Public infrastructure

2014 Commission Inquiry on Public Infrastructure

--- Recommended overhaul of processes for development and assessment of infrastructure investments
--- sound **cost–benefit** studies for large projects and **public consultation** on proposals (noting that a cost-benefit study is not a yes/no decision-making document, as is sometimes misrepresented. It is instead an **essential information source for those who are paying — usually taxpayers — and those who are deciding)**
--- more involvement in resource allocation processes by **those who pay**
--- ex-post **evaluation** of project outcomes
--- better **long-term planning** to avoid developments encroaching on transport routes and subsequent selection of sub-optimal routes or expensive alternatives.

Progress has been limited overall - there have been continuing instances of poor, very costly, infrastructure investment decisions - Adopt known good practice – and past lessons

Recommendation 4.1 IMPROVE GOVERNANCE ARRANGEMENTS FOR PUBLIC INFRASTRUCTURE

HOW TO DO IT

Proposed projects and alternatives are subject to benefit-cost evaluations, available for public scrutiny before decisions are made.

Appendix 2 - The need for road funding and investment reform

In 2014-15, **$24.2 billion was spent on road investment and maintenance**. Expenditure has risen by an average of 4.6 per cent per year over the decade to 2014-15.

Table 4.1 **Annual road fees and charges levied by governments a,b,c**
Per vehicle, average annual estimates

CHARGE TYPE	INDICATIVE COST ($2015-16)
Fuel excise (Australian Government)	607
Registration fees (State and Territory government)	270
License fees (State and Territory government)	22
Stamp duty (State and Territory government)	139
Other taxes (State and Territory and Australian Government)c	296
Total fees and charges	**1 334**

a Excludes all personal costs of vehicle ownership, including fuel costs, depreciation and maintenance costs, non-compulsory insurance policies and other costs. b Updated to $2015-16 using the consumer price index. c Includes Luxury Car Tax, Fringe Benefits Tax, and smaller discretionary items.
Sources: Originally from Infrastructure Australia's *Australian Infrastructure Plan* (2016), sourced from (BITRE 2014) *Yearbook 2014: Australian Infrastructure Statistical Report*.

Daily Telegraph report – <u>some people paying more than $8,000/year in tolls</u>

Prominent, and not infrequent, instances of poor decision-making on major projects have raised serious questions about project selection and delivery.

Surveys gauging user perception of transport quality and issues suggest that the substantial investments in new capacity that have been made in recent years may have provided some relief, but also induced greater use of roads. Governments have recognised the need for changes to road regulation but there has been, overall, little progress.

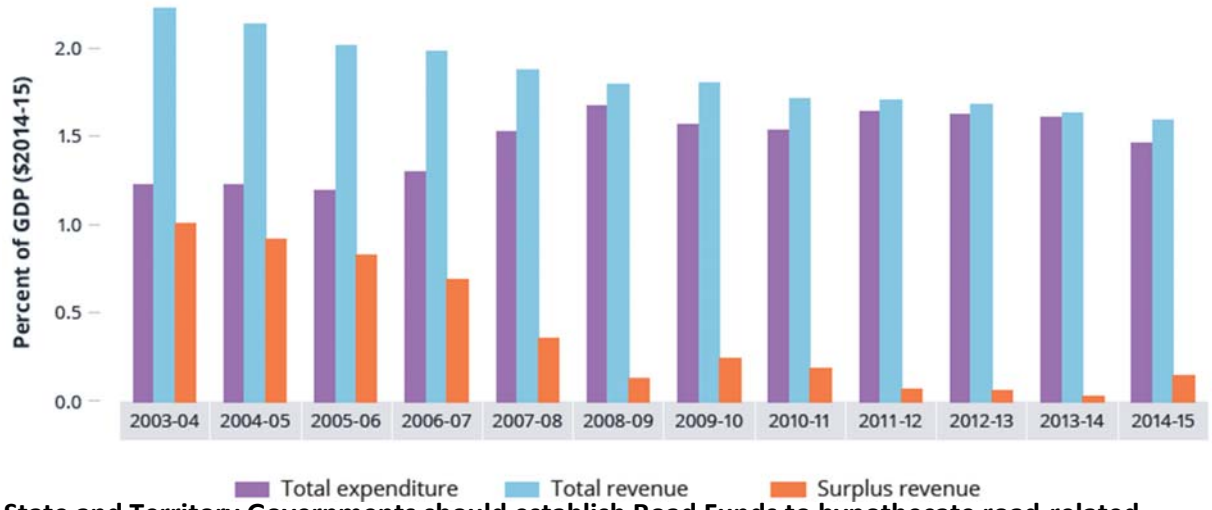
Technology now exists that could readily address the lack of price signals for road investment and complement other revenue sources. But the willingness to trial such developments requires a catalyst.

The most immediate driver of change is the continuing slowing of growth in road-related revenues, which will put pressure on current road supply models — since demand for improvements shows no such slowing.

ROAD FUNDING ARRANGEMENTS ARE UNSTABLE

Up until now, road-related fees and charges have generated sufficient revenues to meet road spending needs (figure 4.2). Looking forward, however, this will not be the case.

Figure 4.2 Road-related revenues are in structural decline - Road revenues & expenditure to GDP



State and Territory Governments should establish Road Funds to hypothecate road-related revenues to expenditures.

Recommendation 4.4 ROAD USER CHARGING PILOTS (PE - Worthy of consideration)

Appendix 3 - NSW STATE PRIORITIES DEC 2017 AND PROCESSES

https://www.nsw.gov.au/improving-nsw/premiers-priorities/

The 18 state priorities being actioned by the NSW Government will make this state of ours even better.

Priorities related to transport poorly express key service issues

Accelerating major project assessment

The government intends to halve the time taken to assess the most complex applications while ensuring the integrity and robustness of the assessment systems.

Increasing housing supply - Increase housing supply across NSW - Deliver more than 50,000 approvals every year

A Plan for Growing Sydney estimates that Sydney will need 664,000 new homes over the next 20 years.

Increasing the supply of housing will put downward pressure on prices. In the 12 months to July 2015, there were 61,057 building approvals in NSW, the highest result in more than 41 years and 64.5% above the decade average.

Building infrastructure - Improving road travel reliability - 90% of peak travel on key road routes is on time

Congestion across metropolitan Sydney is estimated to already cost up to $5 billion per annum, and will rise to $8 billion by 2021 if nothing is done.

To ensure consistency of journey times on key roads continues to improve, we are working to **make better use of existing road infrastructure, build extra road capacity and encourage commuters to use public transport and to undertake off-peak travel more often.**

This will enable business and the community to move around the city with greater ease, reducing travel times, boosting productivity and reducing business costs.

Reducing road fatalities - Reduce road fatalities by at least 30 per cent from 2011 levels by 2021

The government is committed to making NSW roads the safest in the country. While NSW has seen significant improvements in the level of road trauma over time, road crashes are still a leading cause of death for people under 44 years of age, costing the community around $5.4 billion in 2011.

Each year there are around 42,000 recorded road crashes in NSW, with more than 26,000 people injured.

To reduce road fatalities by at least 30 per cent, the government is putting more money into roads and working with local government to deliver road safety improvements.

Ensure on-time running for public transport - Maintain or improve reliability of public transport services over the next four years

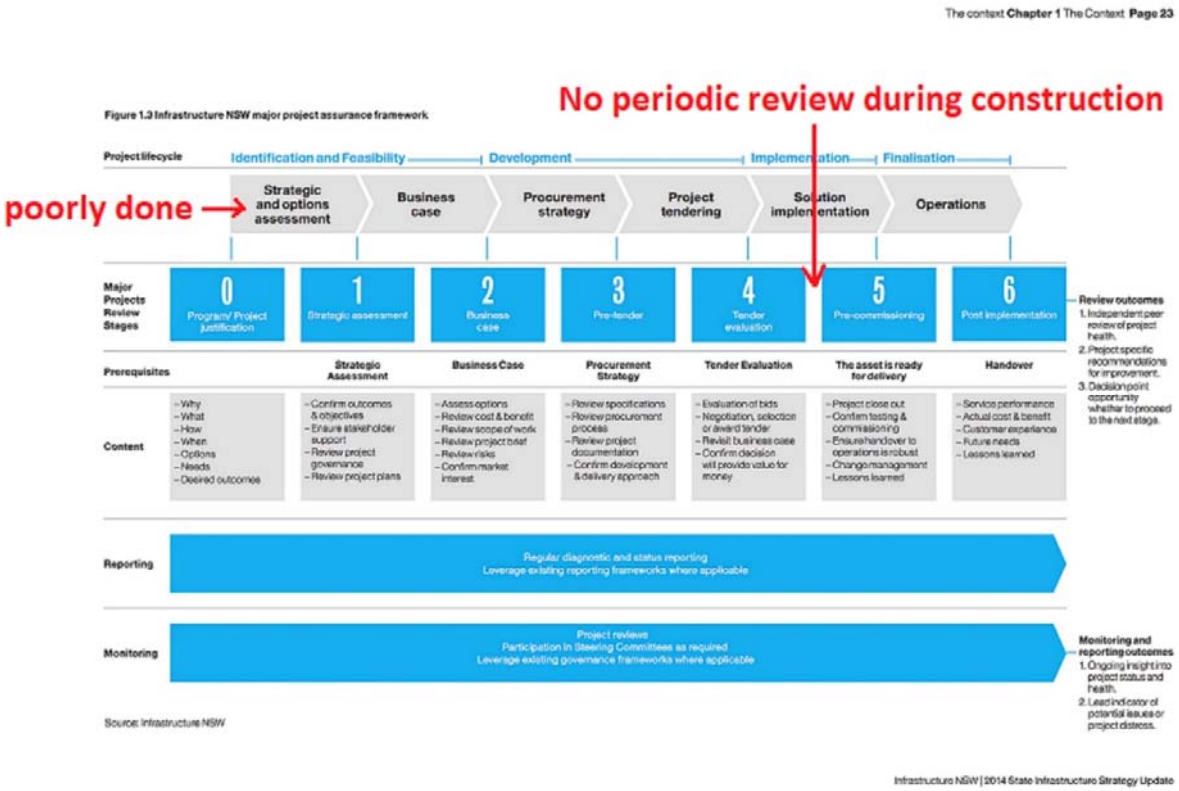
ensure that public transport services continue to run on time.

improving integration across public transport services, updating timetables and providing clear information to get people to their destinations on time.

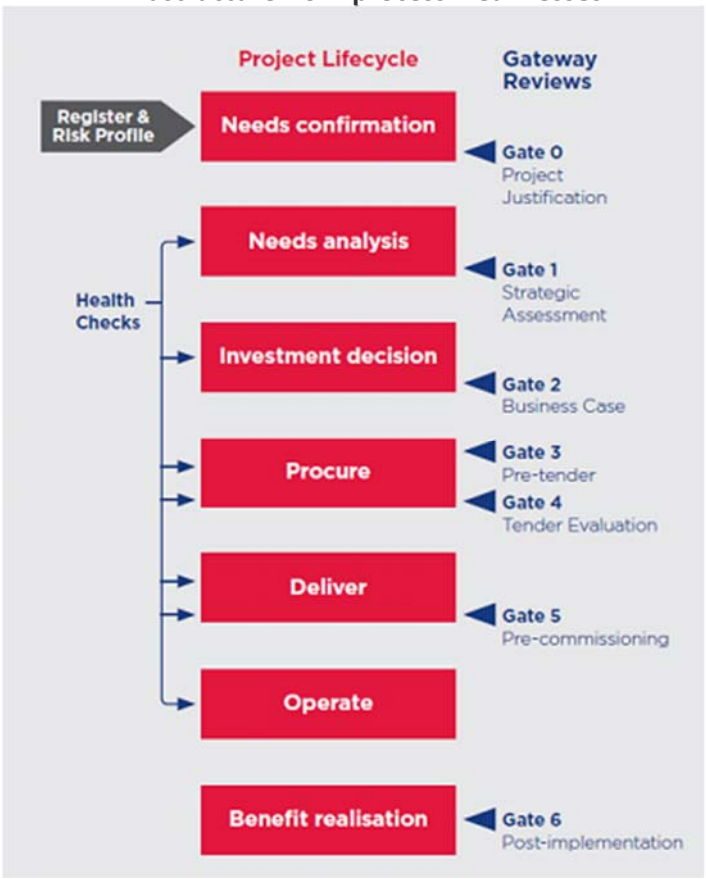
Better government digital services - 70% of government transactions to be conducted via digital channels by 2019

Approximately 44% of government transactions were carried out via digital channels in the financial year 2013-14. The government is working to increase the level of online transactions to 70% by 2018-19.

PE – little attention is paid to developing options to deliver services requiring infrastructure, and to using consultation measures that give the public (voters) a sense of ownership of the options as demonstrated in transport agency processes



Infrastructure NSW process weaknesses



NSW Government business plan process – needs confirmation poorly done

First step in the planning process

In NSW, projects of state significance follow the environmental assessment and approvals processes set out under the *Environmental Planning and Assessment Act 1979*.

All state significant projects require preparation of an Environmental Impact Statement (EIS) and approval from the Minister for Planning.

Following initial community and stakeholder engagement for the project, Roads and Maritime has now taken the first step in the planning process and made a State Significant Infrastructure (SSI) application for the project.

The application has been lodged with Department of Planning and Environment (DP&E), the agency responsible for directing the environmental assessment process.

The Secretary of DP&E will consult with other environmental agencies and councils before issuing Environmental Assessment Requirements (SEARs).

The SEARs will establish what topics need to be included in the environmental assessment.

RMS project process defined by EP&A Act – environment, not service process

Appendix 4 - INFRASTRUCTURE AUSTRALIA processes and priority list

- http://infrastructureaustralia.gov.au/projects/infrastructure-priority-list.aspx

PE - Infrastructure Australia processes (see below) fail at the first stage (problem Identification) as IA cannot direct nominating organisations in regard to the provision of a network service analysis to which all projects for that network are related. Each project is present individually, from the perspective of the author with the nominating organisation, and does not relate to other projects presented to IA.

The Infrastructure Priority List is a prioritised list of nationally significant investments. It provides decision makers with advice and guidance on specific infrastructure investments that will underpin Australia's continued prosperity.

CURRENT INFRASTRUCTURE PRIORITY LIST

The List is updated regularly and is made up of two broad groups:

- ***Projects*** are potential infrastructure solutions for which **a full business case has been completed by the proponent** and positively assessed by the Infrastructure Australia Board.
- ***Initiatives*** are potential infrastructure solutions for which a business case has not yet been completed. Initiatives are identified through a collaborative process between proponents and Infrastructure Australia Board, using Infrastructure Australia Board's Audit and other data as evidence.

The investments outlined in the list undergo a rigorous prioritisation process and are independently assessed by Infrastructure Australia's Board.

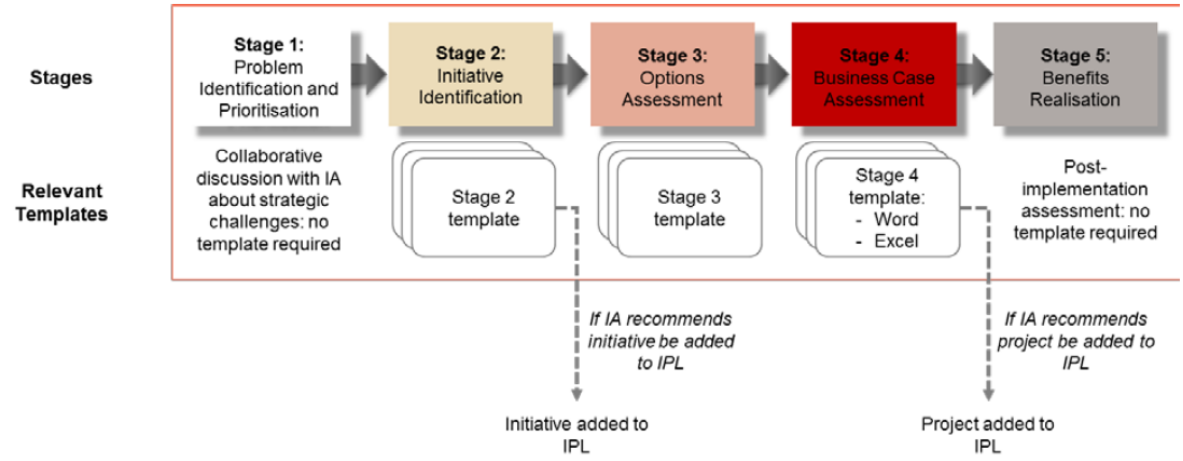
1.4. Stages of the Assessment Framework

The Assessment Framework comprises five sequential stages. These stages have been developed based on a logical grouping of activities that occur during the development of a project, and generally align with Gateway stages used by states and territories.

IA will advise and support proponents through the initiative and project development process, to ultimately deliver a business case which is strategically sound and takes a comprehensive and balanced economic, social and environmental perspective.

The five stages of the Assessment Framework are outlined below: In summary:

Figure 1: *IA's five-stage Assessment Framework*



--- **Stage 1 comprises a collaborative process between nominators and IA, to identify and prioritise evidence-based problems and opportunities of national significance**. In some instances, where a problem is identified but there is no nominator for an appropriate initiative, IA may act as nominator.

--- **Stage 2** requires nominators to further analyse the problems and opportunities identified in Stage 1, and develop initiatives that could suitably address these. At the end of this stage, nominators should submit the completed IA Stage 2 template to IA. IA assesses initiatives for strategic fit in the context of the problems and opportunities prioritised in Stage 1. If an initiative is positively assessed by the IA Board after Stage 2, the initiative is added to the IPL.

--- **Stage 3** requires potential project proponents to analyse the options available to address the problems and opportunities identified in Stage 1. At the completion of this stage, proponents should submit the completed Stage 3 template to IA. IA will engage with proponents in an advisory capacity to provide feedback on the options being taken into a full business case, and arrange access to relevant case studies.

--- **Stage 4** requires project proponents to develop a full business case that objectively considers the shortlist of options available to address the problems and opportunities identified in Stage 1. At the end of this stage, proponents should submit the business case, together with supporting documentation and the completed Stage 4 templates (in both Word and Excel) to IA. IA will assess the business case consistent with relevant IA Guidelines. If a business case is positively assessed by the IA Board at this stage, the project is added to the IPL

Stage 5 occurs after a project has been delivered and is operational. Working with proponents and other key stakeholders, IA will seek to understand the outcomes from the project, as well as project delivery, against the benefits and costs described in the business case. Determining how well the project addressed the problems and opportunities identified in Stage 1 will, over time, help IA incorporate lessons learned from project development and delivery into future project assessments and other policy work.

Appendix 5 – Examples of automated and electrified vehicles for various industries

Self-driving tractors can work day and night, through rain, hail and shine.

Rolls Royce automated cargo ship

Autonomous 12-seater bus – Switzerland

Electric local travel vehicle

CRRC (China's main train and tram manufacturer) rubber-tyred tram-like electric vehicle

Electric buses at Sydney Airport

Train has alternating single and double-deck carriages

Bombardier Regio 2N modified for Sydney commuter services

Every regional centre needs a carpark with roof dedicated to VTOL electric aircraft

Lillium VTOL electric fan powered aircraft

Appendix 6 - Commission nationale du débat public - National Commission for Public Debate (France) - processes

http://www.debatpublic.fr/

2014 Annual Report extracts

THE CNDP, THE INSTITUTION OF A GUARANTEE FRENCH PUBLIC PARTICIPATION

The CNDP meets in plenary session, on the 1st Wednesday of each month.

Roles and missions the CNDP

Article L 121-1 of the Environmental Code provides the CNDP several roles and missions.

1 Ensure compliance with public participation in the process of developing development projects of general interest or equipment.

2 Determine the public participation procedures for all projects that are the subject of a saisine[1] (referral).

1 Participation can take the form of a public debate or consultation with guarantor.

3 Ensure, to the acceptance of work, good public information requirements on projects before it.

4 Advise relevant authorities and project owners at their request on any matter relating to consultation with the public throughout the development of a project.

5 Issue any notice and recommendation of a general or methodological nature likely to promote and develop consultation with the public.

6 Organize a public debate on general environmental options, sustainable development or development from a referral by the Minister of Ecology and the Minister concerned.

7 Follow the public debate until after the public inquiry.

The values of the CNDP

Independent and neutral institution, the CNDP embodies a number of essential values which are all principles required for the proper organization of public debates and consultations.

Independence

The CNDP is independent of both the government, local authorities, project leaders who have taken her, and all stakeholders.

Neutrality

The CNDP, as the special committees and sponsors, expresses no opinion or recommendation on the projects.

Transparency

The CNDP ensures that, through special commissions and guarantors, the owner makes available to the public all available information and studies on the project.

Equivalence

The CNDP uses all means to everyone, whatever their status, representativeness, they can express their opinion freely.

The argument

The CNDP guarantees the conditions for a fruitful and constructive public debate. The public debate is neither a survey nor a referendum, it is the expression of controversial and argumentative viewpoints.

Chart of ethics and professional conduct of members of special committees of public debate and guarantors

It must remain clear that the role of the CNDP as CNDP and guarantors is to organize the debate or consultation and to allow the expression of opinions without ever taking sides on the project background. To this end, a Code of Ethics and Professional Conduct was adopted by the CNDP[1]: it concerns the commitments of members and guarantors in favor of the debate, their independence, their duty of neutrality and reserve. Members of the PDCC, the guarantors of recommended and post public debate consultations, undertake to respect them.

1 New charter approved unanimously by the members present or represented the CNDP in early 2015

Each special committee member or guarantor agrees to:

Commitment to debate

1 Implementing the general guidelines, instructions and methodological recommendations of the CNDP;

2 work, as appropriate, under the responsibility of the president of the special commission, with impartiality, fairness and integrity

3 Book in the work of the special commission or guarantor time required for the preparation, conduct, and conduct a successful conclusion of the debate or consultation;

4 Ensure that all public information is complete, objective, honest and accessible;

5 Encourage the expression of the public and help them to obtain answers to questions;

6 Ensure compliance with each and refuse incivility;

7 Collaborate to sound management of human, material and financial resources used; Independence, impartiality, neutrality

8 Having no interest, personally or because of family ties or marriage or because of their duties, subject to the operation of public debate or consultation with the guarantor;

9 Porter without delay to the President of the national public debate any change in status or function capable of undermining its independence Commission;

10 Have taken over the past three years, no individual position in public on topics directly related to the subject under discussion or consultation, may create doubt on his impartiality. Refrain in debate or consultation and beyond, to express any opinion on the project background, for discussion or consultation;

11 Demonstrate, by his attitude and speaking out, of independence from the various stakeholders;

12 Abstain grant, solicit, accept any benefit, direct or indirect, for or on behalf of any organization or person involved in one way or another, by the project subject to debate or consultation; Reserve Duty

13 Do not speak publicly about the debate, including in the media and on social networks, without the agreement of the President of the Special Committee (for committee members);

14 Do not wear unduly as a member of a particular committee or guarantor.

CHARACTERISTICS OF THE PUBLIC DEBATE AND DIALOGUE

The public debate

The important difference with the traditional consultation conducted by the client is the organization of public debate is entrusted to an independent authority: the National Public Debate Commission.

Opening time and dialogue in a neutral and impartial framework, public debate gives assurance of public participation in the development of the project.

It takes place before the project principal characteristics are set and before the public inquiry stage.

On the opportunity, objectives and characteristics of a project presented by a client, the public debate is to:
1 to inform the public in its diversity,
2 to establish a dialogue between the audience and the client,
3 to provide all necessary light on the subject and before the client reaches its decision.

These are (les maîtres d'ouvrage) the contracting authority (public or private) captured by the CNDP. If it decides to organize a debate on a particular project, it delegates the animation to a CPDP (commission particulière du débat public - special committee of public debate), ephemeral emanation, composed of members whose origin and experience are sufficiently diverse to that neutrality and independence from the contracting authority or any other part of the project is guaranteed.

The special commission of the public debate is the guarantor of balance, honesty, transparency of public debate; it ensures the proper organization of the various phases of the debate, ensures the smooth, being attentive to all, ensuring the regular dissemination of information. Its role ends there, because as stated in the law, CPDP will not decide on the merits, it does not issue an opinion on the project.

Consultation under the aegis of a guarantor

If the CNDP recommends the project owner consultation, the mission of the guarantor is a variation of the missions of a president of CPDP.

The role is not that of a referee nor that of a conciliator.

It is that of a watchdog, responsible for ensuring compliance with the rules of consultation that give everyone an equal right to speak on the basis of a sincere and most **complete information possible**.

It is also responsible for ensuring that the positions exposed as the responses by the client are argued.

Finally, it ensures that the answers may be made to all matters within the limits of project knowledge at this stage.

The public debate, a privileged tool for information and public participation

ENRICH, DEMOCRATISE, LEGITIMIZE, THE FINAL DECISION

Inform the public about the project submitted for debate in an objective manner, complete and accessible to all, on its opportunity, its challenges, its technical aspects, impacts.

The owner informing within three months after the public debate, the owners decision on the project (surrender, suspension, modification or continuation).

Assuming continuation of the project, it must learn from the debate, identify stakeholders and the public to associate a result of the conciliation process.

Allow the expression of the public about the project he has the right to ask questions and the right answers; can comment, criticism, suggestions on all aspects of the project.

The decision-making process of the CNDP: organization of a public debate, procedures and maximum periods

The CNDP appreciate, for each project exceeding 300 million euros, if a public debate must be organized according to the national interest of the project, its territorial impact, its socio-economic issues and its impacts on the environment.

Referral (time commencement)

If a project exceeds the upper threshold*: mandatory referral to the CNDP by the owner from the folder with the objectives and characteristics of the project principals.

* The thresholds and criteria set by the table annexed to R121-2 of the environmental code of 22 October 2002 on the organization of public debate and the CNDP.

In the case of a project between the high threshold and the low threshold: Mandatory publication of the project by the client.

Optional referral of the CNDP

It must happen within two months of the publication of objectives and key features of the project by the client.

This referral may be made by:
- the owner,
- ten parliamentarians
- a regional council,
- a general council,
- a municipal council,
- a public intermunicipal cooperation (EPCI)
- one of the approved associations of environmental protection mentioned in Article L 141-1 operating on the entire national territory.

Month 2

Reasoned decision of the CNDP to organize a public debate with formation of a special commission of public debate (CPDP), responsible for the organization and the lively public debate.

Three other decisions of the CNDP motives are possible:
- no public debate organization (no action or referral inadmissible)
- recommendation to a client consultation,
- organization of public debate by the owner (procedure virtually used).

Month 3

Designation of the President of the CPDP and its members.

Month 8

Transmission by the owner of the file and the summary submitted to public debate.

The CNDP acknowledges receipt if considered complete.

Within two months, the CNDP fixed dates and debate organizational arrangements.

Month 10 - Month 14

Conduct of public debate (usually four months)

Possible extension of two months by a reasoned decision of the CNDP.

Month 16

Publication, within two months after the end of the debate, by the CPDP transcript of the debate and the CNDP balance debate.

These documents are attached to public inquiry.

Month 19

Decision of the client by an act issued on the continuation of the project within three months after the balance sheet debate.

If the project continues, the client must inform the CNDP to the terms of debate post consultation (until the public inquiry) and may request the appointment of a guarantor.

5 years

If the project continues, public inquiry within 5 years. After this period, new mandatory referral to the CNDP.

Special case: for the general options to the environment or regional planning, the Minister of Ecology and the minister concerned asking the CNDP to organize public debate with the special committee of public debate (CPDP).

BUDGET CNDP

The CNDP has a very small permanent team of ten people: 1 Chairman, 2 Vice Presidents, 1 Corporate Secretary, 3 project managers, 1 accountant, 2 secretaries.

This is one of the very few institutions that rely daily on members of civil society to carry out its missions, particularly through special committees of public debate (CPDP).

Its budget is registered with the program 217 of the Ministry of Ecology, Sustainable Development and Energy.

Personnel costs 1,187,211.74 Euro

Total budget CNDP 2,334,979.87 Euro

The cost of the debates

The Code specifies the environment in Article L121-9 III that expenditure relating to the material organization of the debate are the responsibility of the client, with the exception of expert, at the expense of the CNDP, as well as allowances and expenses of members of specific committees.

The table below summarizes the cost for the debates that took place in 2013-2014; it ranges from 466,500 to 1,415,000 euros (excluding taxes).

Three debates were above average of 1 million euros and comes close.

The president of the CNDP wants these costs decrease from 2015.

Monitoring of projects: referral to the realization of the work

Entering twelve records, the CNDP decided, in 2014, eight public discussions and recommended to master two consultation work. In one case, she did not respond to the referral and in another, it held initially the referral inadmissible.

Projects	referral	decision	Inadmissible	Without further	Public debate	Consultation
			referral	referral		recommended
Port Seine Metropole western sector						
	23/12/2013	08/01/2014			**X**	
New rail lines West Bretagne-Pays de Loire						
	13/12/2013	08/01/2014			**X**	
Port of Brest	21/02/2014	05/03/2014		**X**		
Fast rail link Lille Metropolis to mining basin						
	15/01/2014	05/03/2014	**X**			
	23/10/2014	05/11/2014			**X**	
Line B Lyon Metro						
	27/10/2014	05/11/2014				**X**
Line 1 extension Est Château de Vincennes to Val de Fontenay						
	13/05/2014	04/06/2014				**X**
Offshore wind farm between islands of Yeu and Noirmoutier						
	25/11/2014	03/12/2014			**X**	
Offshore wind farm Dieppe-Le Tréport						
	25/11/2014	03/12/2014			**X**	
Center Parcs in Saône-et-Loire						
	25/11/2014	03/12/2014			**X**	
Center Parcs in the Jura						
	11/25/2014	03/12/1014			**X**	
Autoroute A31bis						
	26/11/2014	03/12/2014			**X**	
Total	**12**		**1**	**1**	**8**	**2**

EXPERIMENT ON PUBLIC PARTICIPATION IN THE PREPARATION OF REGULATORY ACTS

Section 7 of the Environmental Charter provides that "everyone has the right, under the conditions and limits defined by law, access to information on the environment held by public authorities and to participate in the development of public decisions affecting the environment."

The application of Article 7 of the provision in the French legislative corpus was done in several steps, notably through Law No. 2012-1460 of 27 December 2012 and the 2013-714 Order of 5 August 2013.

Now every public decision (regulatory decision, species and individual) that affect the environment and have not been the subject of a specific consultation is made available to the public by electronic means, the latter having the opportunity to file comments electronically or by mail.

In addition, the Act of 27 December 2012 introduced an experimental device that providing for the development of certain regulatory acts, public comments are made publicly available as and when they are received and that a qualified person designated the CNDP is responsible to prepare a summary for the administrative authority to the origin of the text.

Originally scheduled to take place from 1 January 2013 to 1 October 2014, the experiment could not start until 1 January 2014 and involved some texts in three main areas:

the preservation of natural heritage: prohibitions when a particular scientific interest or the requirements of preserving the natural heritage justify the conservation of geological interest sites, habitats, non-cultivated non-domestic animal or plant species and their habitats (Articles L. 411-1 and L.411-2); introduction of bans in the wild animal or plant species (Articles L.411-3 and L.411-4)

Hunting: No hunting outside the opening periods of hunting (Article L.424-2); opening periods of the hunt, hue, cry and flying birds (R.4-4); the hunting of birds Periods opening passage and waterfowl (R.424-9); Nomenclature of waterfowl and birds of passage other than quail and suspension of the possibility to chase some game species that are in poor state of preservation (R.424-14)

classified installations for the environment: nomenclature of classified facilities (Article L.511-2); requirements for facilities subject to authorization (Article L.512-5); requirements for facilities subject to registration (Article L.512-7).

Two branches of the Ministry of Ecology, Sustainable Development and Energy (MEDDE) (ministère de l'Écologie, du Développement durable et de l'Énergie (MEDDE)):
- the management of water and biodiversity (DEB) (la direction de l'eau et de la biodiversité) and
- the Directorate General for Risk Prevention (DGPR) (la direction générale de la prévention des risques (DGPR))
were affected by this experiment.

However, while in the first nine months of 2014 these two directions have consultations 51 draft texts, pursuant to the above provisions, only 21 of them (9 for DEB and 12 for DGPR) were covered by the scheme experimental.

In accordance with the laws, the government should address the Parliament a report on this experiment. The CNDP has done the same in the matching of operational proposals.

While the results of this experiment clearly demonstrated the interest of the public consultation to express the elements of the controversy and its wish to be consulted on certain issues, especially those related to water issues, biodiversity, hunting and waste, it appears that the device can only be effective if significant progress is made in three directions:
- develop public information on the texts for consultation,
- improve the mechanism to allow, during the consultation, exchanges between users, like that allow the discussion of open spaces for public debate organized by the CNDP,
- made public at the time of the decision, all contributions from Internet users and clarify how it was taken into account.

Furthermore, it appears that this device is not justified for highly technical texts, including those relating to the nomenclature of classified installations, for which only professionals can provide advice.

Finally, the selected experimental conditions could not be generalized as they are. The process has shown its limits. In particular, the inclusion of this consultation in the course of the entire administrative process guiding the preparation of regulations, including consultations of various administrative commissions, must be specified. This new procedure should not lead to lengthen the time.

To date, no decision has been taken regarding the conditions under which the experimental procedure might be continued.

Experimentation in figures: Projects	**Projects DEB**	**DGPR**
% Consultations falling within experience	43	40
Number of projects involved	9	12
Number of projects commented	9	7[1]
Total comments	3,445[2]	31
Number of projects modified following the consultation	0	5[3]

1 Several projects have been no comments for others and almost all of the comments were from industry professionals.
2 Of which 3348 on two projects related to the regulation of wolf populations.
3 This is only modifications to the shape (correction of obvious errors) texts for consultation.

APPEALS TO ADMINISTRATIVE JUSTICE

Since 2002, a dozen decisions were the subject of one or more appeal before the Council of State, since 2010, before the Paris Administrative Court. In all cases, the validity of the decision of the CNDP was confirmed.

Lessons from judgments are instructive.

The jurisprudence of the State Council said, in 2002, the decisions by which the CNDP decides whether to organize a public debate may be appealed to the administrative court. These decisions are also the subject of a publication in the Official Journal to determine the time limits applicable. However, case law has consistently reaffirmed that the measures adopted by the CNDP to determine the procedures and rules of debate (calendar, folder contents, complementary expertise ...) do not constitute decisions adversely affecting.

In 2014, three cases were the subject of decisions.

Two of them[1], relating to LGV Poitiers-Limoges and Bordeaux-Toulouse, concerned decisions taken by the CNDP as part of a referral under Article L.121-12. In those cases, the applicants challenged the absence of circumstances of fact or law justifying substantial changes to the project.

1 In fact the judgments were made public in January 2015, but the investigation was closed late 2014.

The decisions were:
--- confirmed that the closure of the public inquiry prohibits organizing a public debate and consequently deprives use current relevance.
--- specify the nature of the substantial changes in law or fact entailing obligation to hold a new public debate.
--- confirmed that the CNDP to base its decision only the file of the client and that, consequently, substantial changes in law or fact to be invoked by the client to be considered.

In one case, the Administrative Court dismissed the application.

In the other case, the Administrative Court of Appeal dismissed the appeal on the grounds that the public inquiry had been completed and also cancelled the trial decision (rejection the request) because the public inquiry was closed when it had been taken and therefore the appeal was moot.

The third case concerned the decision of the CNDP to consider as inadmissible referral to the Northern Regional Council - Pas-de-Calais - on its proposed rapid rail link between Lille and the mining basin. The CNDP considered, after consulting lawyers, the Regional Council had not at that time the quality of public person responsible for the project. The procedure was abandoned following the passage of the law on the reform of the railway system and granting Regions project management for railway projects of regional interest, making de facto admissible referral.

Appendix 7 - Infrastructure – What to build, how to proceed

What to build - https://www.debatpublic.fr/ CNDP – **Commission Nationale du Debat Public (France)**

Design and construction community engagement process - http://commissarioterzovalico.mit.gov.it/

THE WORKING METHOD for engagement

(English translation of Italian original)

The method that the Commissioner has taken in carrying out her mandate is the mediation of public conflicts.

The basic elements of the method are:

- the conduct of the trial by an authority figure and independent (the Commissioner), tasked by the Government to carry out its activities in an impartial manner with respect to the interests at stake by the proposer, the general contractor, public administrations, local communities, economic interests and widespread social;
- listening to all the technical and non-technical, both local instances supra, with the commitment to include in the agenda of the work all the critical issues reported related to the realization;
- the promotion and coordination of an ongoing dialogue with major institutional and social actors, in order to improve the work itself and its impact on the territory: either through the supervision of measures taken to reduce risks to the environment, health and other possible factors, both through the development of the opportunities that the work can generate for the country in economic, social and environmental;
- find common solutions through mediation tables (stakeholder meetings), to address the critical issues related to the yards and the transformations of the territory related to the work;
- public restitution of the outcome of the process according to a principle of transparency of information, through forms of communication that foster understanding of the technical issues even by non-experts.

2017 Interview with: Il Commissario di Governo (Terzo Valico) – Iolanda Romano

For the 'Gronda' (Genova motorway bypass). I joined Professor Bobbio and the Municipality of Genoa, for public debate on the eaves, the first in Italy.

It was 2010. After that experience I wrote a book for 'Chiarelettere' "Come fare, cosa fare" "How do, what to do" supporting the battle for public debate utility.

Autostrade (road authority), after Genvoa ("Gronda" motorway project), also used it for the 'Bologna bypass'.

The solution now seems to find a new push. Is that so?

More than that. Delrio, the minister in the new Code of Contracts, indicated a mandatory public debate for all the great work. I consider it a momentous fact.

The decision-making processes must be inclusive, we must not dialogue with a view of antagonism, we must do what it takes.

In France, the debate there for 25 years, we begin now.

It is not easy to build, however, especially in fragile areas such as Liguria ...

The projects are planned and then they can be improved and public consultation is valuable from this point of view.

Think about how did the Turin-Lyon, clashes 2005, the government's reaction. It was another world. This government has chosen to prevent this, accompanying the yard in his work.

We cannot escape that the project for the third Genova rail crossing of the Apennines began in 2006, so it was necessary to review the compensatory works and new requirements.

We are facing a European corridor, so the comparison with RFI and the Port of Genoa-Savona is constant and updates.

This is a mixed line (freight and passenger), so its use depends on the operating model.

Rightly speak of goods and a Northwest regions political pact that aims at gradual strengthening of traffic.

But the use should be maximized, for this can also serve as a high speed for passengers, obviously being careful not to create disadvantages to the existing lines.

The basic strategy is, however, to better connect Italy, facilitate access to metropolitan cities,

Appendix 8 - PUBLIC DEBATE AND GREAT WORKS: A CHANGE OF CULTURE – 8 Feb 2018

(English translation of original Italian)

Over 250 people took part in the day of ***discussion*** on the topic "***The public debate on shared works"*** organized by LAPO, the Policy Laboratory of the Department of Cultures, Politics and Society of the University of Turin - in collaboration with the Government Commissioner of the Terzo Valico hsr rail project Iolanda Romano **on Wednesday 7 February 2018 in Turin**, on the occasion of the imminent approval of **the implementing decree** that will introduce the instrument of public debate in Italy.

The event - included in the Open Administration Week 2018 and Connecting Italy - has attracted administrators, professionals, operators, companies and scholars and has offered a program divided between plenary and parallel sessions with more than **35 interventions qualified**.

At the opening, the introduction and remembrance dedicated to the role of Luigi Bobbio in the development of deliberative democracy in Italy in the words of **Gustavo Zagrebelsky**, Professor emeritus at the University of Turin and President of Biennale Democrazia, and **Stefania Ravazzi**, Professor of Analysis of public policies and Deputy Director of LaPo, University of Turin.

Then came the merit of the decree implementing the public debate with the intervention of **Ennio Cascetta**, sole director of Ram-Logistics Infrastructures and Transport and President of Anas, who framed the context of application of this tool in the context of *Connecting 'Italy*, the new season of planning and programming of public works, useful, streamlined and shared. Exceeded the time of lists of unjustified works, the **infrastructural priorities for the country to 2030** foresee **108 works and programs** for a total of **126.3 billion Euros**, of which **94.2 bn euro** already financed.

Jean-Michel Fourniau, president of the GIS Democratie et Participation, in his speech on the French experience of *Débat public*, provided some interesting points for reflection and presented some statistical data on the projects that were the subject of public debate between 2003 and 2011:
--- half were carried out without major changes,
--- in more than a third of the cases the most significant changes were made by the same proponent, and in 1 case out of 12, on the basis of an option that emerged during the debate,
--- only in 6% of cases the project has been suspended or abandoned.

Connected by videoconference, the Minister of Infrastructure and Transport stressed the importance of public debate as "*cultural rather than technical element, which goes in the direction of decisions that are also imperfect but shared*. *The simplifications do not help us, it helps us the effort to reconstruct the most distant positions, to reintroduce the concept of 'common good', to listen to the intelligences of the territories. The effective participation of citizens is the real cultural revolution in the approach to great works".*

Afterwards,
--- **Alberto Selleri**, Head of the Autostrade Works for Italy Construction Department, presented the pilot cases of public debate made at the time for the **Genoa Gronda,** and recently for the **Bologna bypass**, while
--- **Aldo Isi**, Director of the Investment Department Rete Ferroviaria Italiana, illustrated the results of the **concertation** applied during the design phase - with reference to the experience on the Verona / Padua HS / HC rail line - and during construction, in the case of the Terzo Valico dei Giovi.

In the afternoon, the participants were distributed in the **three parallel sessions** to analyze the views of **actors**, **scholars** and **professionals** on the opportunities and risks of implementing the law on public debate.

Thanks to the use of a **dedicated software**, that of the **Town Meeting**, and to the operators present in the three rooms, the results of the discussions were sent in real time to a central *Theme Team*, which summarized them in a comprehensive summary, divided into *Risks and Opportunities for the implementation of the public debate*.

The synthesis was entrusted - in plenary - to the considerations of **Mauro Bonaretti**, head of cabinet of the Ministry of Infrastructures and Transport.

Here are some of the results of the day:
--- the public debate will represent, first of all, an **opportunity** for **cultural change:**

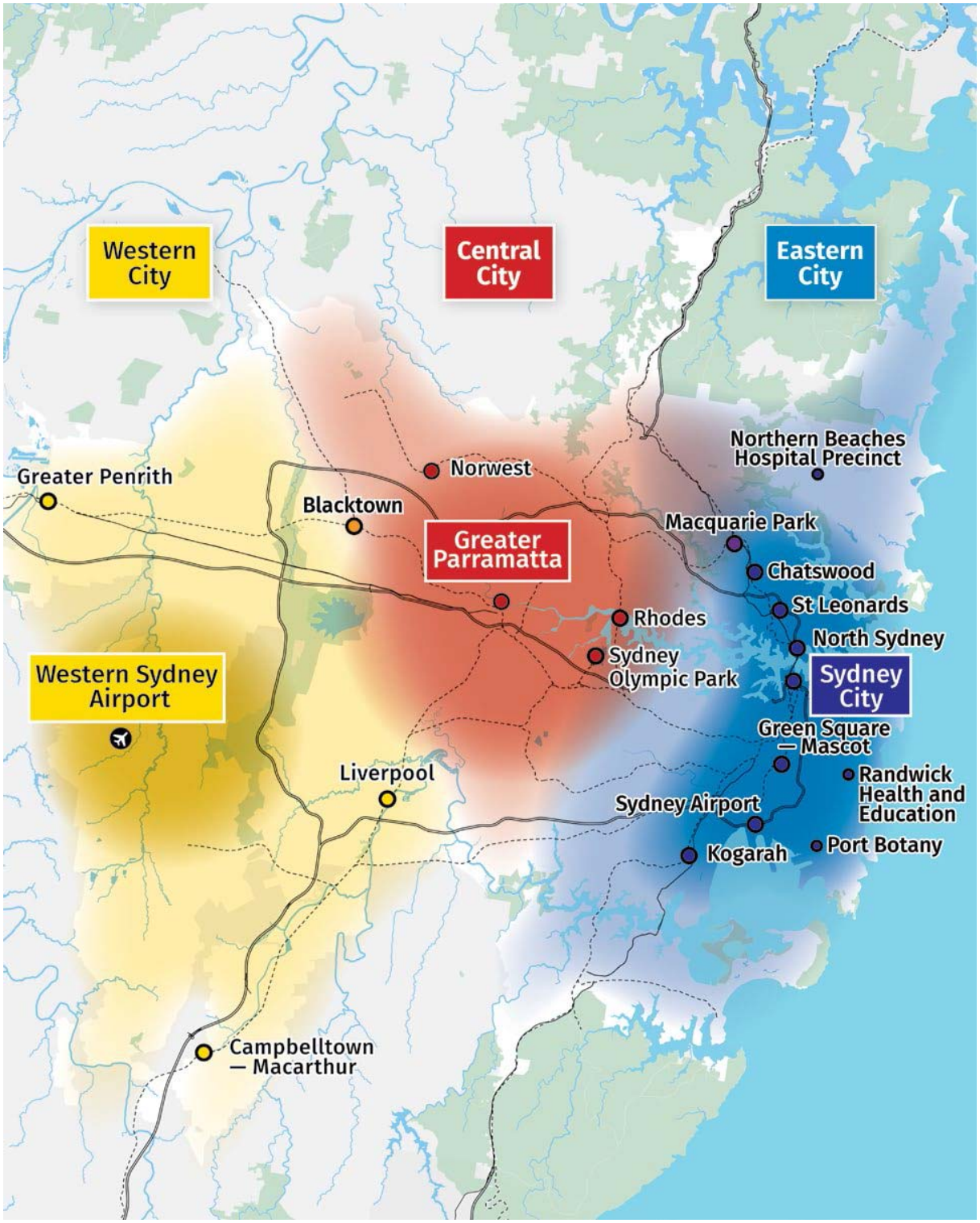
- --- for **political actors**, giving way to develop a culture of confrontation(??) and shared responsibility focused on long-term commitments;
- --- for **designers** who will cease to be the sole bearers of truth;
- --- for **citizens**, in breaking the wall of distrust of institutions and politics;
- --- for **technicians and officials**, because they will interact directly with public debates and will have to adapt to their timing, dynamics and solicitations.

--- At the same time, this new tool will be an opportunity for **improve and deepen the knowledge** of the various project alternatives and their impact on the territory.
--- Another aspect to be considered concerns the **new training windows** that will open for the figure of **mediator of the public debate and for the project manager of the projects**.
--- Professional associations can contribute as training places where to prepare expert technicians to work alongside the coordinator and translators of the technical languages so that they can be used by everyone.
--- The **risks** identified in the discussions seem to be linked to how the public debate will actually take place. Possible problems may concern:
--- the **exclusion of private works** not subject to the Code of Contracts;
--- **delays on medium-small works** when they are also subject to public debate;
--- the wide margin of **discretion enjoyed by the coordinator** of the debate and the doubts on its effective autonomy being a figure linked to the proponent;
--- an **unbalanced participation** in negative stakeholders;
--- the **timing of the public debate** that could prove too tight;
--- the problem - once the comparison is over - of **how to fulfil the commitments** made during the project and monitor their implementation.

The public debate, therefore, **should not be understood as a mere fulfillment**, but as an **activator of relations between citizens and decision makers** capable of generating a mutual virtuous circle, made of greater trust and better performances.

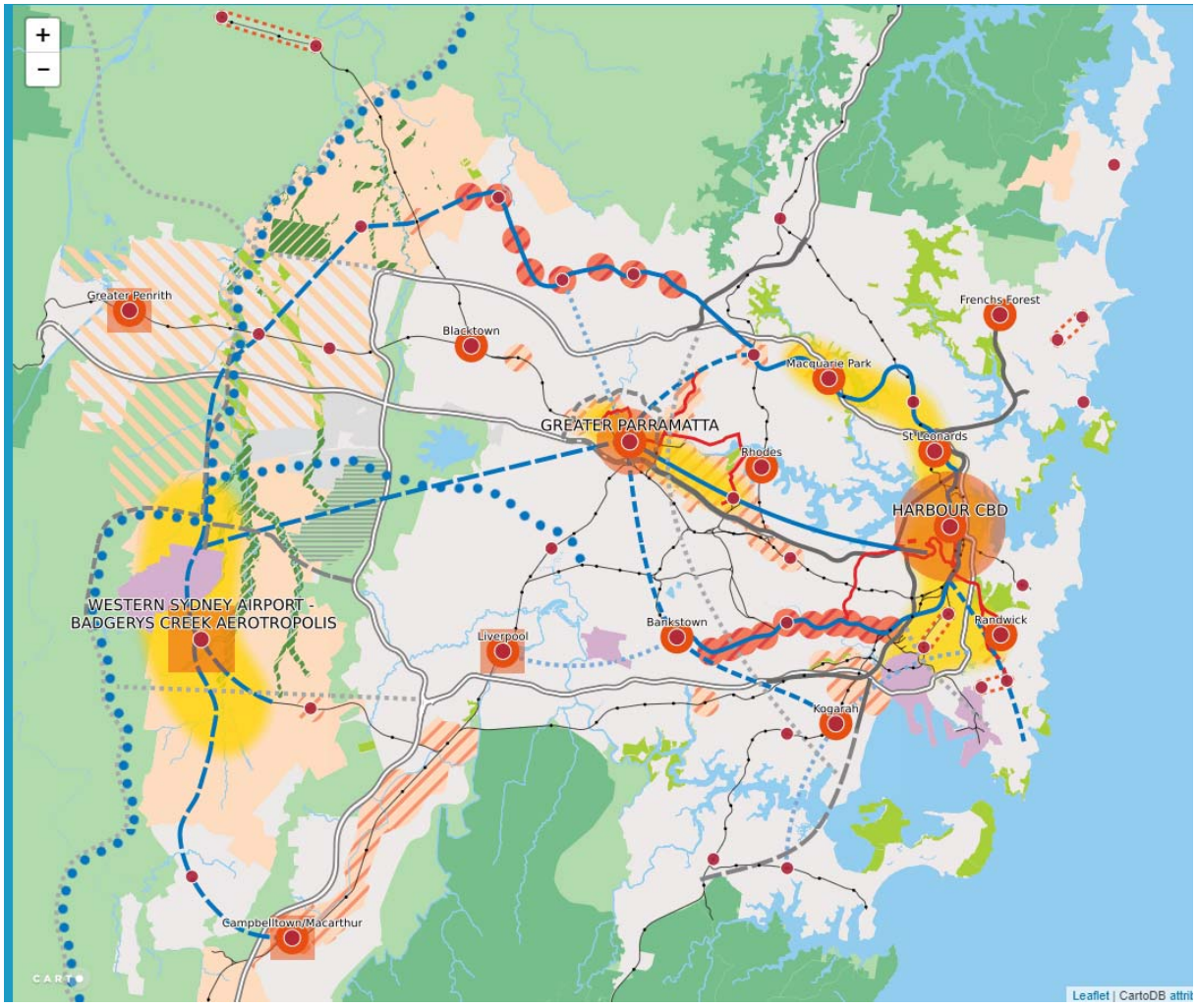
Appendix 8 – Metropolitan Planning

Sydney metropolitan planning



'Three cities' is a good concept for consumer access to goods and services as it reduces travel demand, but it does not reduce need for metropolitan and state-wide rail and road corridors for jobs and B2B services.

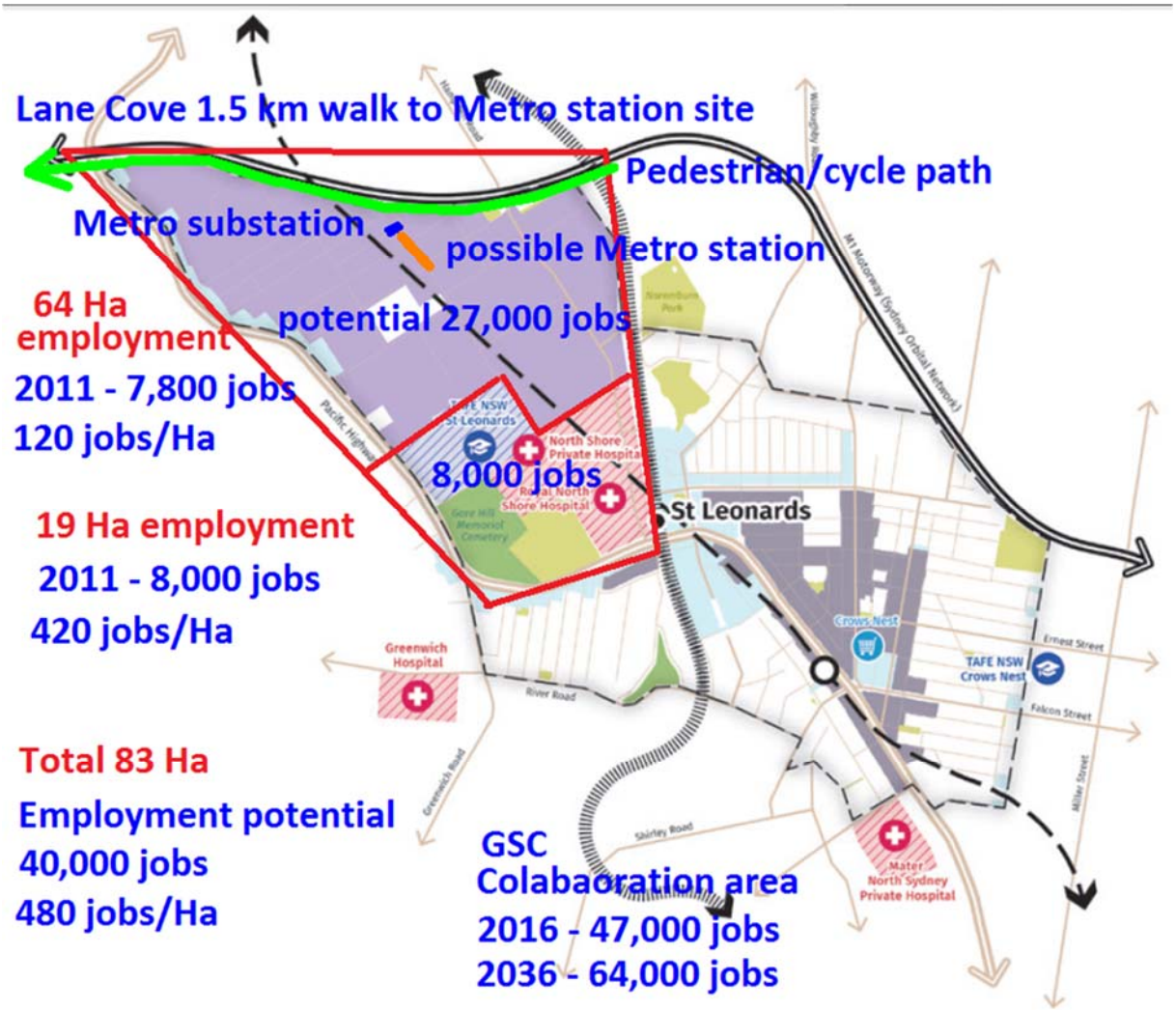
Three cities concept



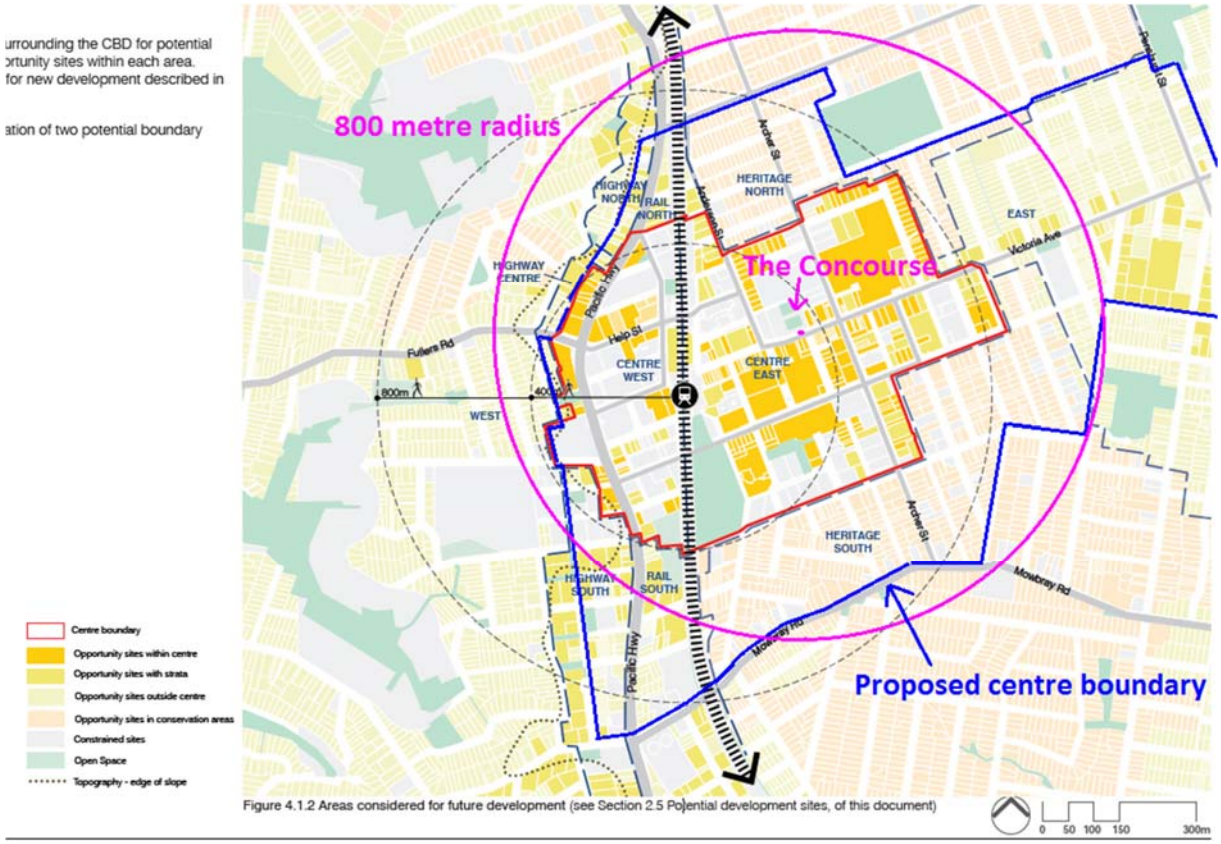
'Three cities' is a good concept for consumer access to goods and services as it reduces travel demand, but it does not reduce need for metropolitan and state wide rail and road grids for jobs and B2B services.

Government 2056 rail plan

Appendix 9 - Local and regional centre planning



St Leonards Priority Precinct – Transfer to GSC



urrounding the CBD for potential
ortunity sites within each area.
for new development described in

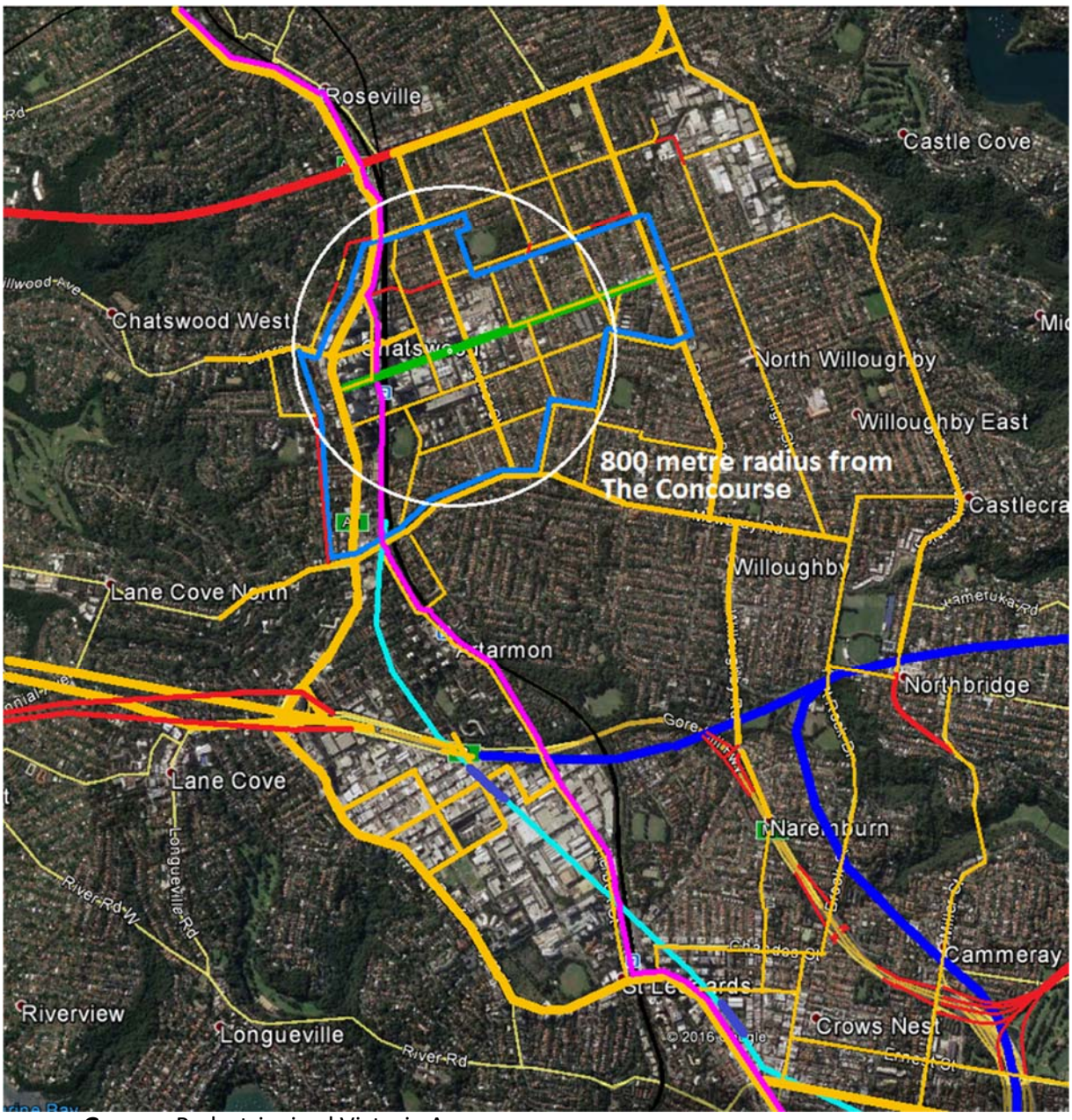
ation of two potential boundary

Figure 4.1.2 Areas considered for future development (see Section 2.5 Potential development sites, of this document)

Chatswood CBD 800 metre radius boundary centred on The Concourse <u>not</u> the rail station due to terrain

Artarmon – 200 metre radius of station entrance development uplift

Appendix 10 – traffic reduction measures

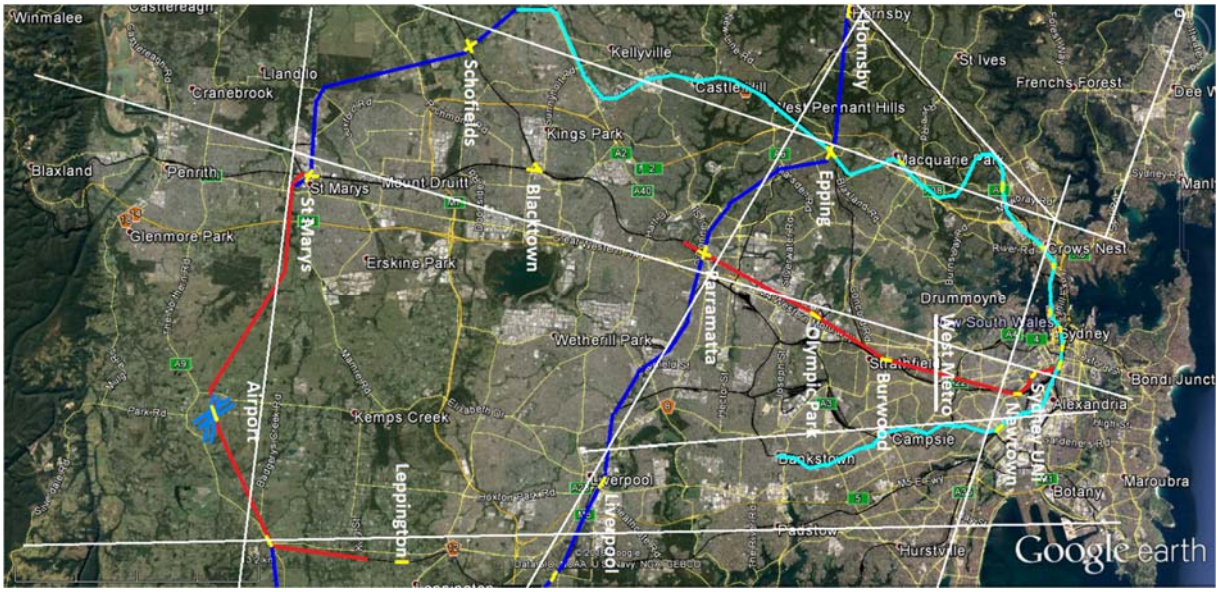


Green – Pedestrianised Victoria Ave
Pink – Pedestrian-cycle path
Medium blue – Proposed Chatswood CBD boundary.
Acqua/Light Blue – Sydney Metro (A station is needed in the Artarmon Industrial Area due to industry change to higher density activities and reduce traffic
Dark Blue – Government Beaches Link plan
Red – new or upgraded roads incl. tunnels. However, since the release of the Willoughby Council Local Centres plan: A) **Motorway access between North Shore Line and Miller St should be concentrated at Brook St** to minimise impact on local centres; **B) Motorway access to and from the north at Miller St** should be restricted outside peak hours to reduce traffic impact on Cammeray and Northbridge until the Northbridge tunnel can be built.

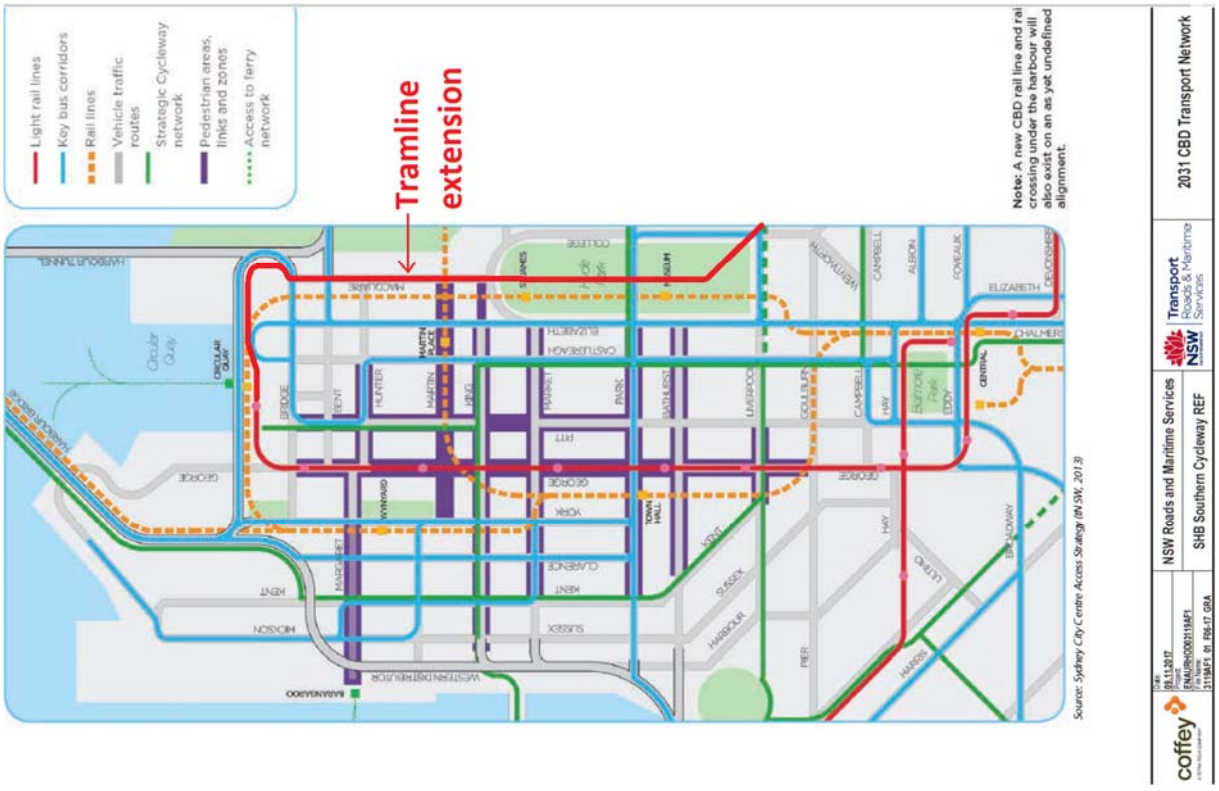
Local and regional centre traffic reduction measures
Road upgrades to support a Chatswood CBD centred on The Concourse

Appendix 11 – Metropolitan public transport grid

A rail grid, supported by local and regional bus services allows people to access jobs across the metropolitan area within a reasonable travel time reducing private vehicle peak hour travel demand.



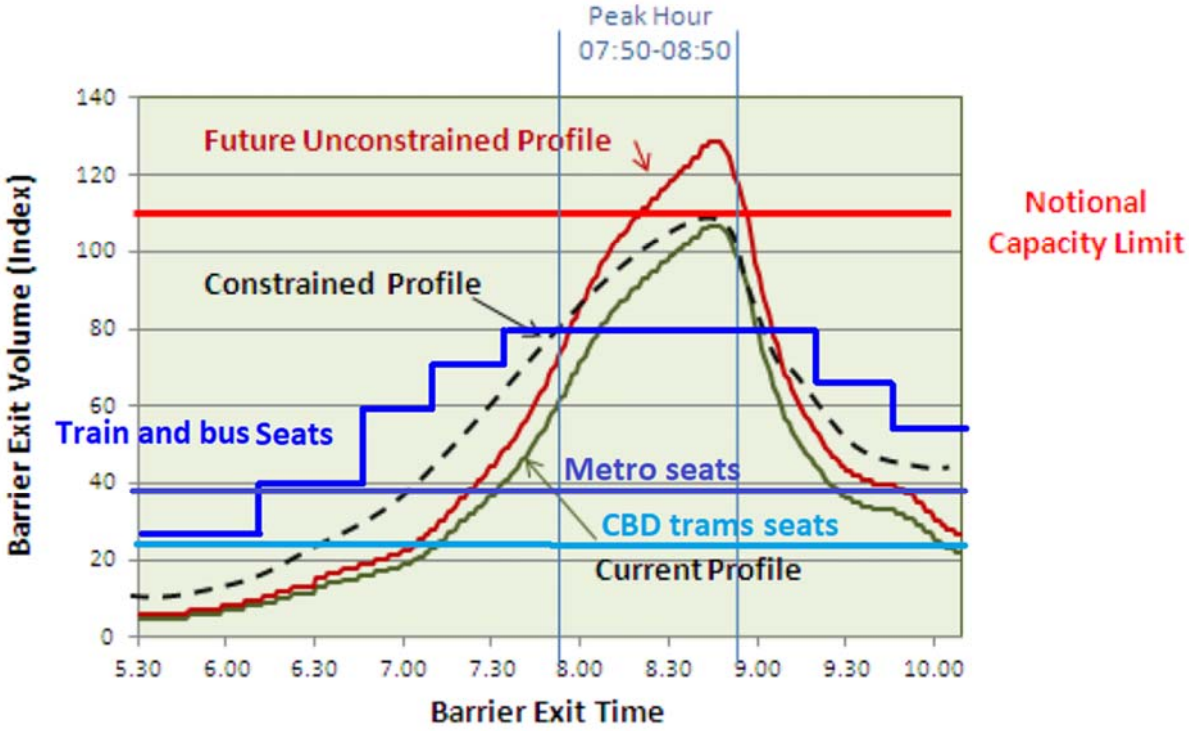
Sydney Metropolitan public transport trunk grid – Rail and B-line



This presentation of the public transport and active transport demonstrates how the road grid and underground space has been utilized to deliver transport services widely over the CBD

Sydney CBD – city centre access plan 2013 – with proposed tramline extension

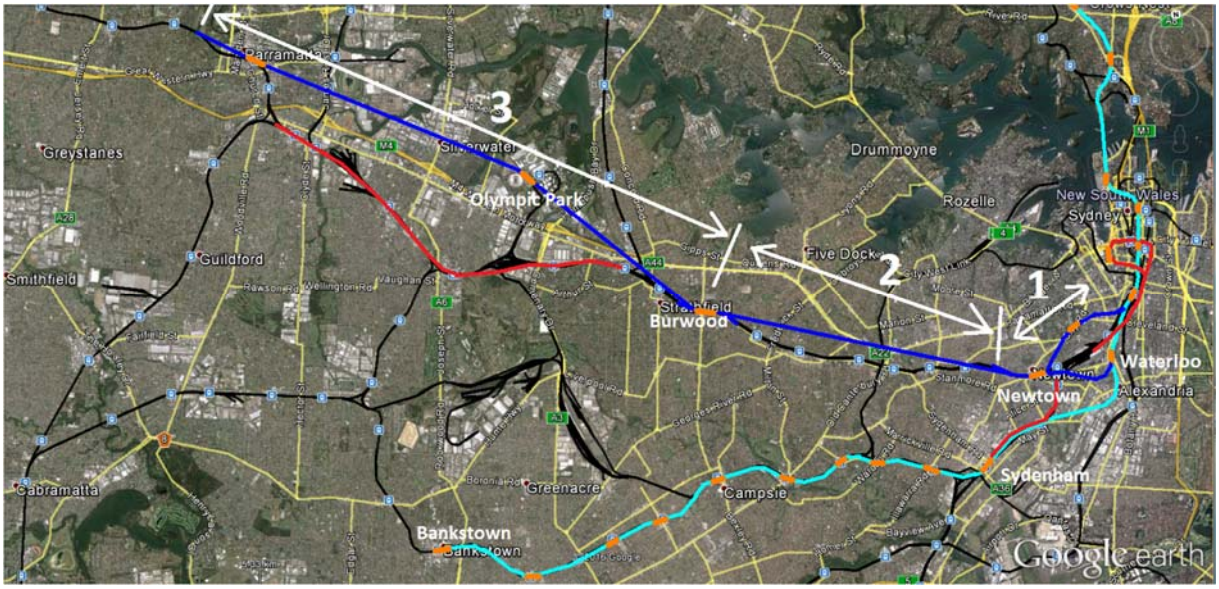
B-Line trunk bus service with high-density seating with small standing capacity



Standing capacity should only be used for the peak of the peak-hour due to passenger comfort and safety concerns

Public transport capacity by mode and demand

Appendix 12 – West Metro and other metropolitan rail service enhancements



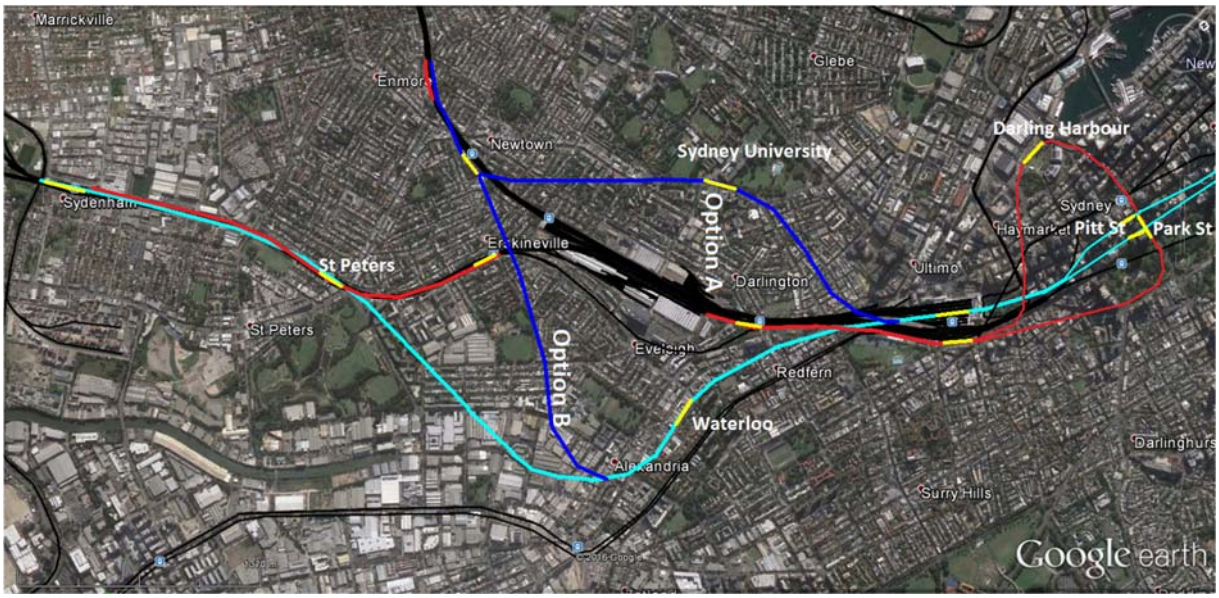
Government has rightly terminated its West Metro plan at Westmead. A key principle of 'Metro' vehicle design is carrying standing passengers. The government regards 20 minutes as the maximum a passenger should stand. Westmead-Sydney CBD will be a half-hour service with 8 to 10 stops.

Express services are better directed to the 6-track western line corridor where there are separate tracks for express and all-stops services.

West Metro Express option

New centres should connect with the largest CBD between Sydney and Parramatta – Burwood

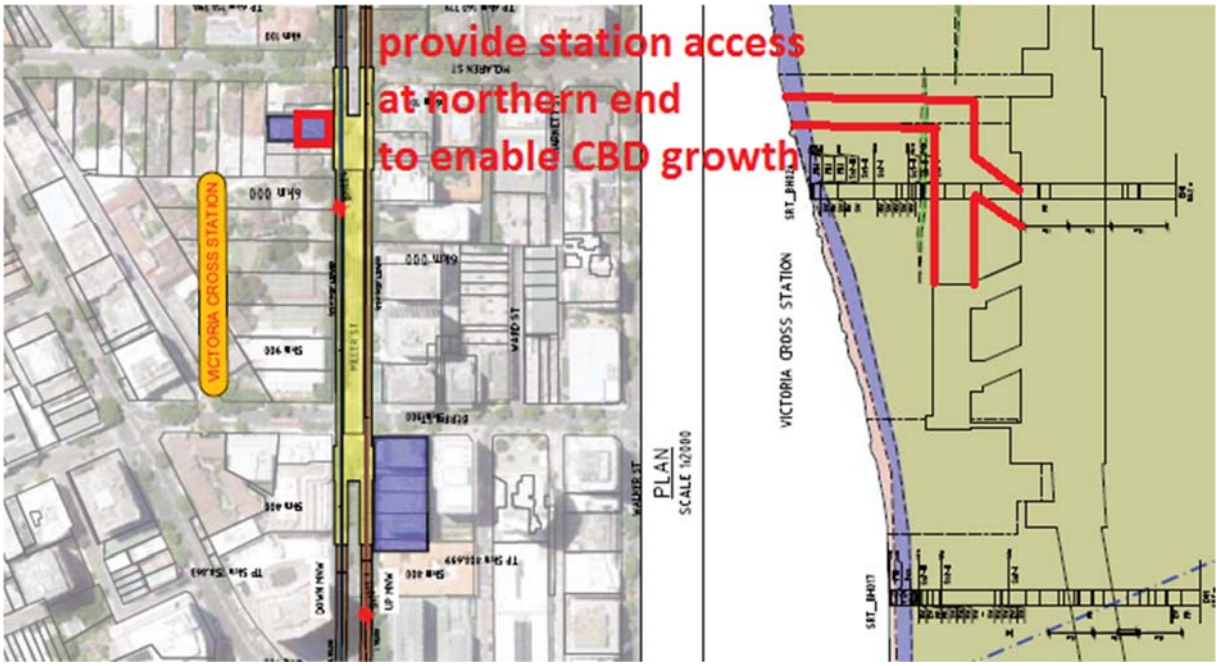
West Metro – early 4 station express plan modified to also serve Burwood regional centre



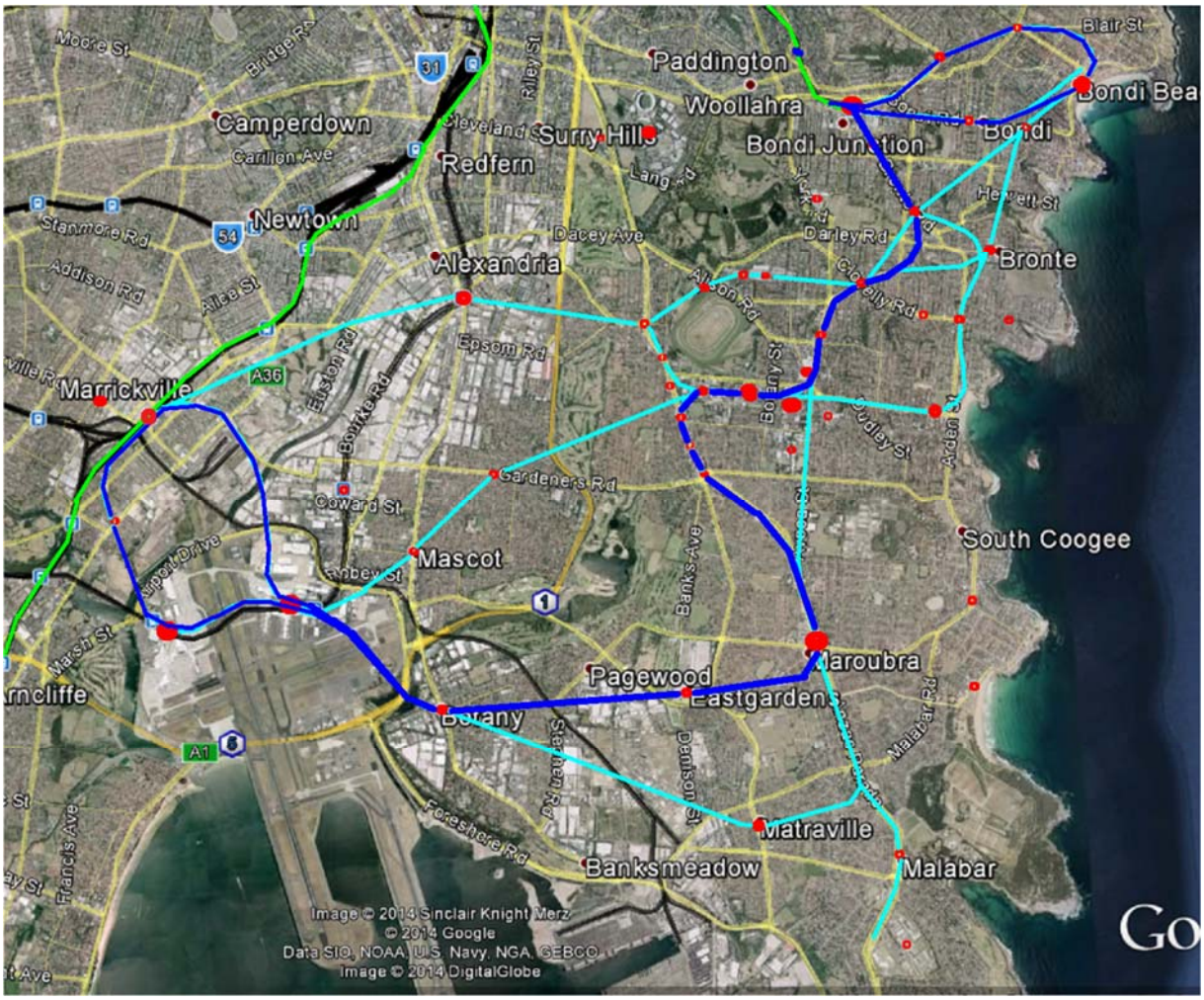
Some West Metro and Second City Circle options

Improving the utility of Metro stations described in the EIS and network integration

The Metro project needs to plan for long term growth of CBDs and for integration with the current network as it is upgraded to 30 driverless double-deck trains per hour.

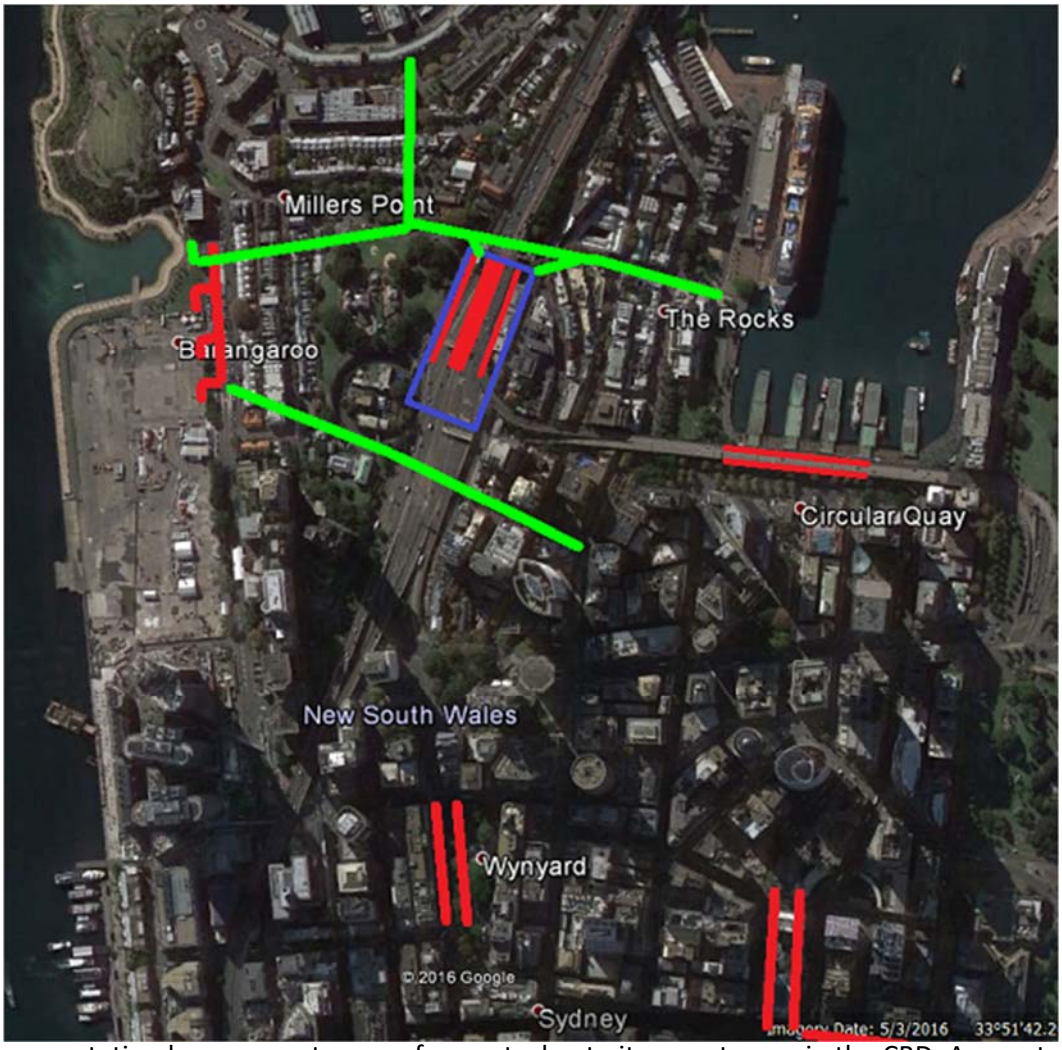


North Sydney station needs an entrance at its northern end to support future growth of the CBD – project modified to achieve this outcome, but with the second entrance further north



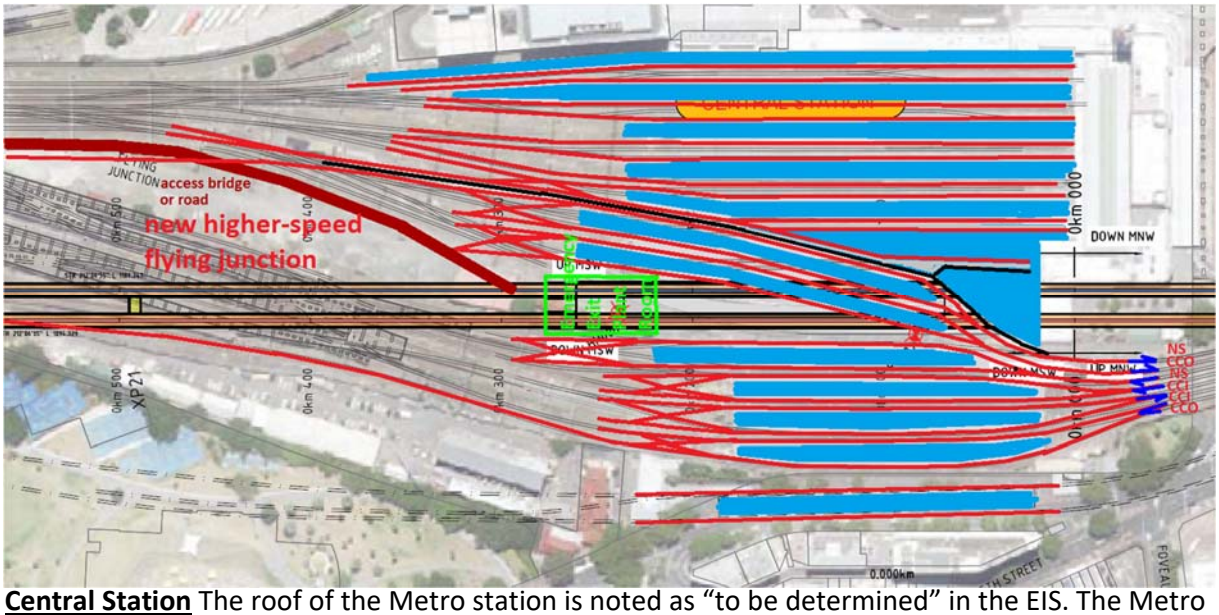
Some Eastern Suburbs Rail Line extension options

Appendix 13 – Enhancing rail capacity in the Sydney CBD

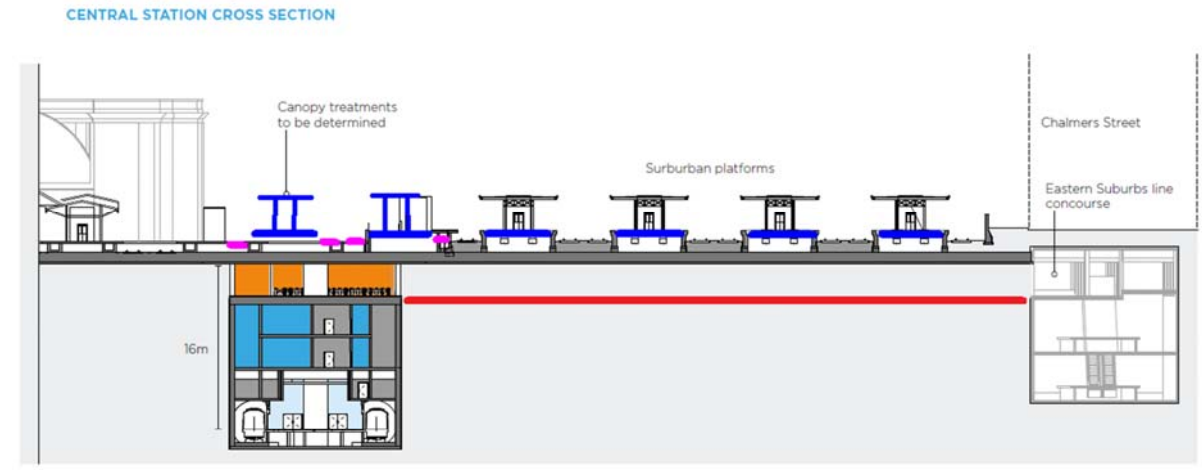


Barangaroo station has poor patronage forecasts due to its remoteness in the CBD. Access tunnels are needed to The Rocks, Walsh Bay, Essex St, Headland Park and a future North Shore line station under the Bradfield Hwy.

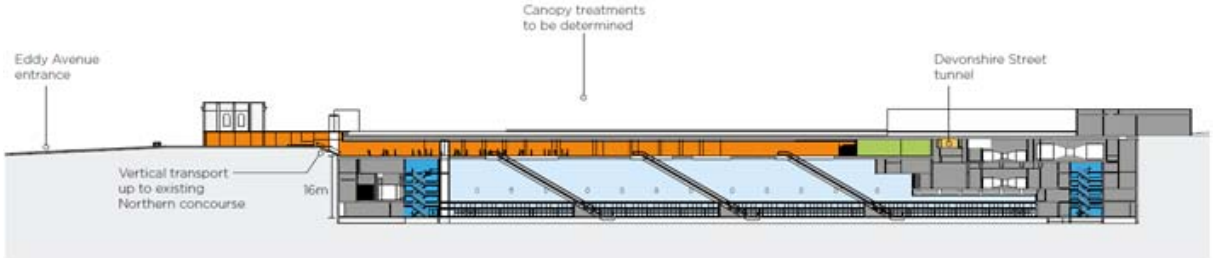
Observatory Hill station made possible, from construction perspective, by removal of toll gates



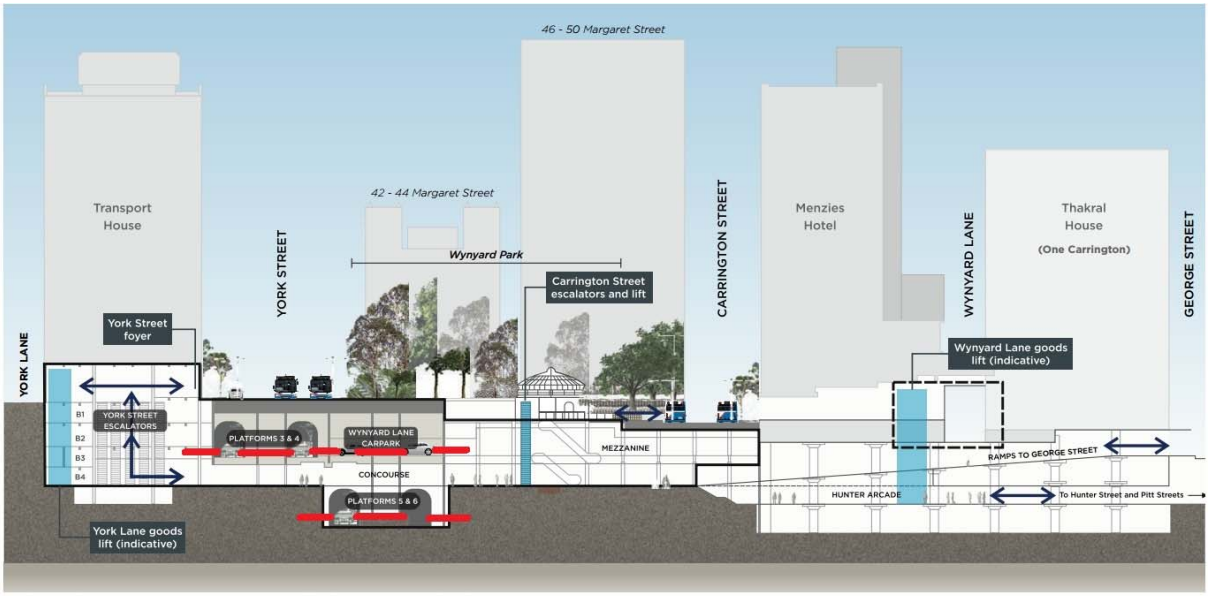
Central Station The roof of the Metro station is noted as "to be determined" in the EIS. The Metro plant room and emergency egress (green) is a significant intrusion into the Sydney railyard at surface level. Provision needs to be made for a rebuilding of the CBD Platforms to create a common concourse for Metro, Eastern Suburbs and aboveground platforms.
The CBD platforms and Flying Junction are 90 years old. They will be a century old by time of completion of this project. It's time to plan for a new CBD Platforms station with 6 island platforms to serve the 6 lines in to the CBD, and to build a new flying junction to reduce the time for trains to pass through it. We need to plan for the existing network to have 30 driverless trains per hour each way capability.



Cross-section of proposed new concourse for CBD platforms, Metro and Eastern Suburbs lines



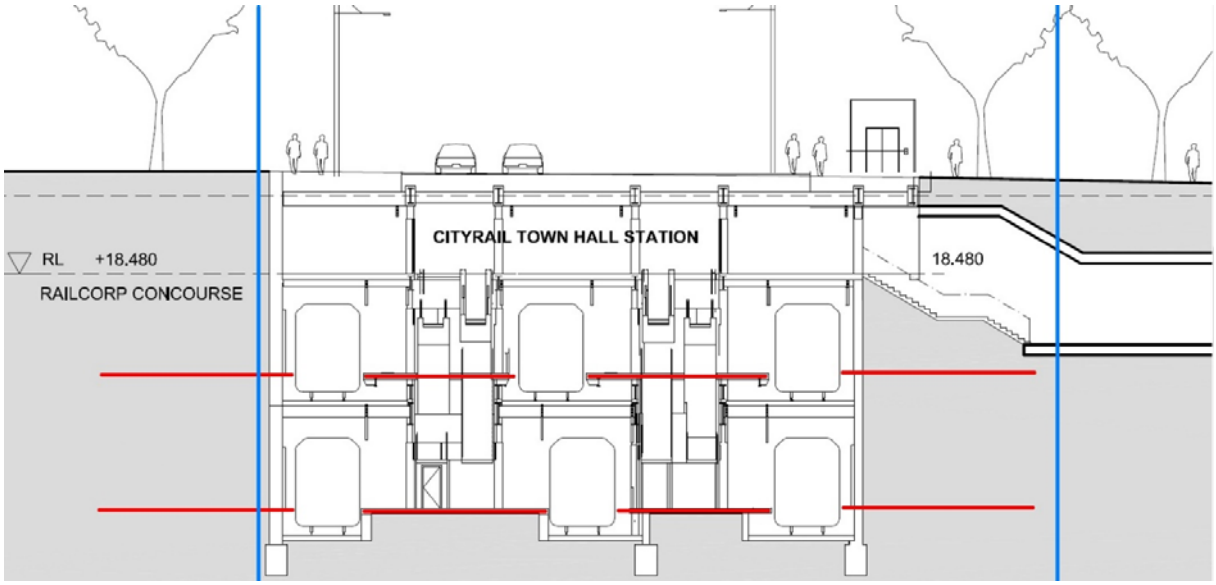
Long-section Sydney Metro Central



Indicative cross section of Wynyard Station

Peak hour board and alight from different platforms like Olympic Park

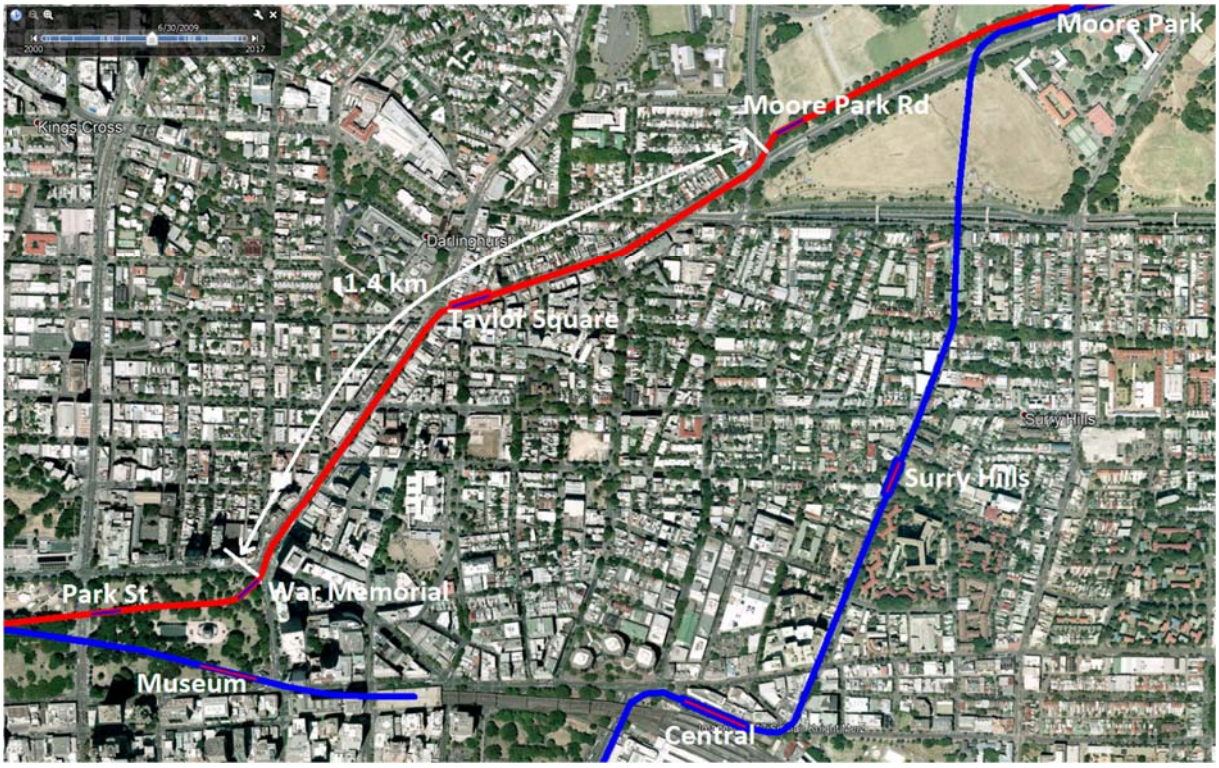
Network integration - additional platforms at <u>Wynyard</u> to support 30 trains per hour



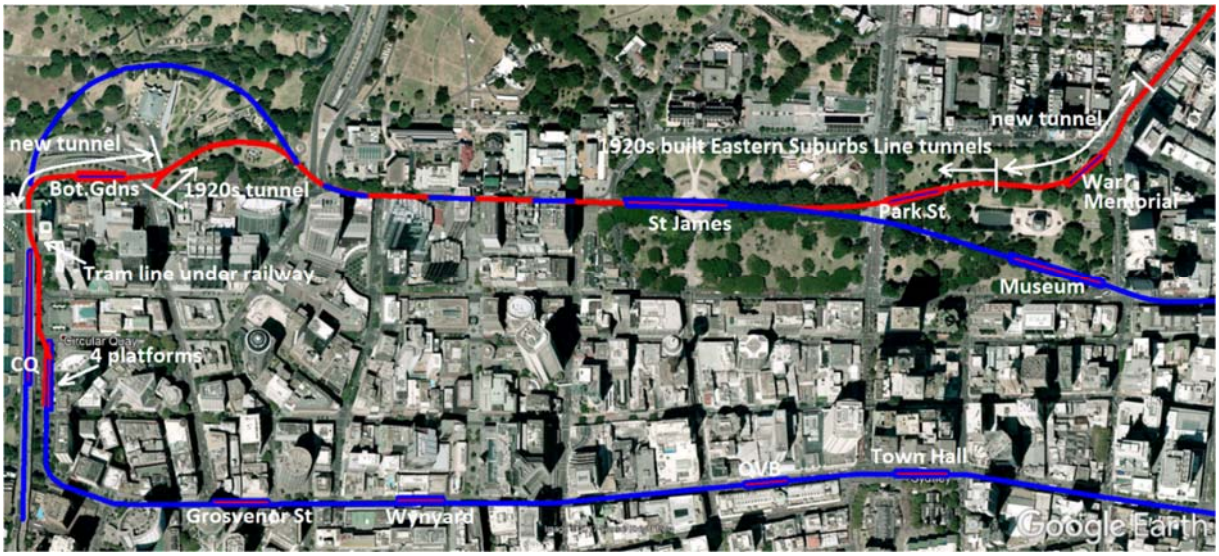
Peak hour board and alight from different platforms like Olympic Park

Network integration - additional platforms at <u>Town Hall</u> to support 30 trains per hour

Appendix 14 – Quadrupling Light Rail capacity in the Sydney CBD



CBD Light rail branch – Moore Park to Hyde Park



CBD Light Rail branch - Circular Quay to Hyde Park

Appendix 15 – National Stadium @ Central

The government plan for the rail yards at Central Station is shown below. However, the operating railway makes the site uneconomic for office buildings relative to other CBD locations.

As the rail yard is only suitable CBD site for a major rectangular field stadium, the extra cost of construction is not a deal breaker relative to non-CBD sites.

See over page- the stadium can go anywhere within the orange line – The remainder of the site would be converted to park facilities with the railyard fully covered.

Government plan for Central Station rail yards

National Stadium @ Central

Proposed national rectangular field stadium above rail yard.

The stadium can go anywhere with the orange line. Heritage and other buildings shown excluded from the site.

Blue and acqua lines are the Eastern Suburbs Line, Sydney Metro alignment, and the proposed second city circle line.

Parallel rail tracks allow piers supporting the stadium to be spaced at regular intervals.