

Appendix K Transport and Land Use Capacity

SGS Economics and Planning
2016

Preface

From the perspective of Transport and Land Use Capacity, this study builds on the projections of the 1971 City of Sydney Strategic Plan and brings them forward to 2036.

With an increase in working population travelling to the CBD since the seventies, current rail and bus infrastructure accounts for over two thirds of that population, with the balance accounted for almost equally by car and active travel.

Assuming current trends in working population growth, present public transport provision would reach capacity by 2026. The additional capacity of pipeline initiatives - CBD and South East Light Rail, Sydney Metro – could account for the projected growth in working population to 2036.

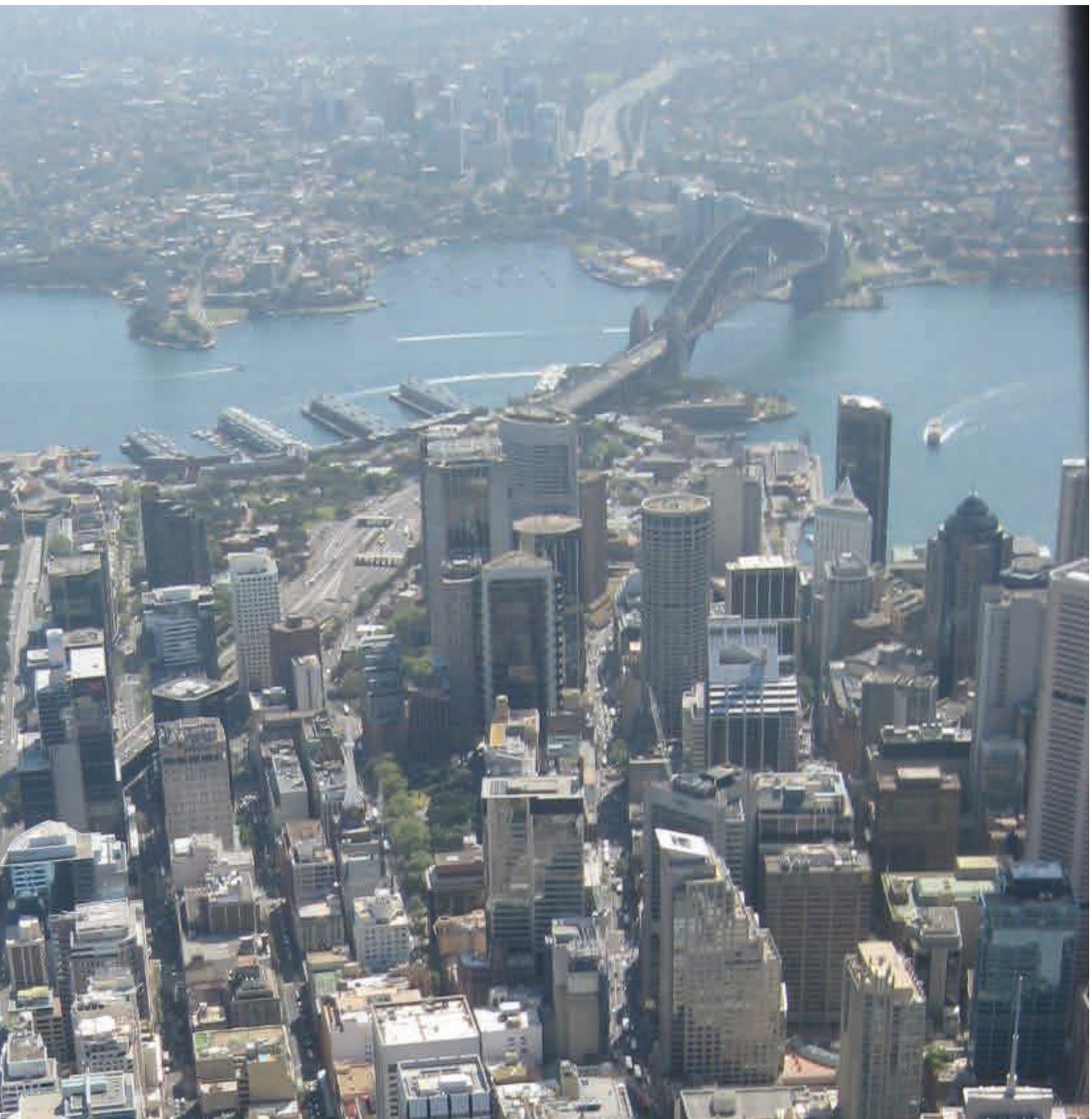
Supporting employment growth beyond 2036 implies further significant transformational steps, such as new metro networks serving Green Square and the south east, and West Metro (Westmead/Parramatta to Central).

The significant question arising from this study is the additional pressure on existing pedestrian networks in Central Sydney. Constrained station exits and the pathway networks connecting them could easily reach capacity. The study highlights this as a critical issue requiring further study and resolution.

Central Sydney Planning Review – Transport and Land Use Capacity

Final Report

City of Sydney
July 2015





This report has been prepared for City of Sydney. SGS Economics and Planning has taken all due care in the preparation of this report. However, SGS and its associated consultants are not liable to any person or entity for any damage or loss that has occurred, or may occur, in relation to that person or entity taking or not taking action in respect of any representation, statement, opinion or advice referred to herein.

SGS Economics and Planning Pty Ltd
ACN 007 437 729
www.sgsep.com.au
Offices in Canberra, Hobart, Melbourne and Sydney

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1 INTRODUCTION	3
1.1 Project background	3
1.2 Overview of the 1971 City of Sydney Strategic Plan	4
1971 Strategic Plan Findings	5
2 CITY OF SYDNEY TRANSPORT	8
2.1 Travelling to the City of Sydney	8
2.2 City of Sydney Gateways	14
3 TRANSPORT CAPACITY ASSESSMENT	18
3.1 Employment capacity outcomes	21
3.2 Where are the people coming from?	24
3.3 What does this mean for employment?	25
3.4 What does this mean for gateway demand?	27
4 CONCLUDING REMARKS	30
REFERENCES	32
APPENDIX A	33

TABLES

TABLE 1. ESTIMATED DISTRIBUTION OF WORKFORCE	6
TABLE 2. MODE SPLIT IN PEAK HOUR COMMUTE	6
TABLE 3. TRAVEL BY MODE 2002-2012, WEEKDAY AM PEAK HOUR	9
TABLE 4. MODE SHARE STUDY COMPARISON	12
TABLE 5. SYDNEY CBD STATION EXITS (AM PEAK 3.5 HOURS)	16
TABLE 6. ESTIMATED TRANSPORT CAPACITY BY MODE TWO HOUR PEAK	19
TABLE 7. A2 AND B2 NO GROWTH IN CAR PARKING, CURRENT PUBLIC TRANSPORT COMMITMENTS	21
TABLE 8. A3 AND B1 CURRENT SYDNEY METRO WITH NO GROWTH IN CAR PARKING	22
TABLE 9. 2031 SCENARIOS – EMPLOYMENT CAPACITY	23
TABLE 10. 2051 SCENARIOS – EMPLOYMENT CAPACITY	23
TABLE 11. ESTIMATED VERSUS OBSERVED WORKFORCE 1966 – 2011	24
TABLE 12. ESTIMATED DISTRIBUTION OF WORKFORCE 2011 – 2051	25
TABLE 13. TRANSPORT CAPACITY GROWTH SINCE 2011	25
TABLE 14. CBD PRECINCT GROWTH 2011 - 2051	26
TABLE 15. EMPLOYMENT IN CORE AREA SUMMARY BY CENSUS YEAR	26
TABLE 16. TRIPS TO THE CBD	27
TABLE 17. REVIEW OF POTENTIAL IMPACT ON CBD CAPACITY	34

FIGURES

FIGURE 1. CITY OF SYDNEY - BOUNDARY DEFINITIONS	5
FIGURE 2. TRENDS IN TRAVEL TO THE SYDNEY CITY CENTRE – AM PEAK 1 HOUR	8
FIGURE 3. CAR PARKING PROVIDED POST 2000	9
FIGURE 4. TOTAL WORK TRIPS TO CENTRAL SYDNEY BY SLA 2006	10
FIGURE 5. TOTAL WORK TRIPS TO CENTRAL SYDNEY BY SLA 2011	10
FIGURE 6. INNER RING MODE SHARE, 2011 WORK TRIPS	11
FIGURE 7. MIDDLE RING MODE SHARE, 2011 WORK TRIPS	11
FIGURE 8. OUTER RING MODE SHARE, 2011 WORK TRIPS	12
FIGURE 9. MELBOURNE CBD 8AM	13
FIGURE 10. MELBOURNE CBD 12PM	13
FIGURE 11. PASSENGERS ENTERING THE CITY CENTRE - KEY GATEWAYS 8AM – 9AM	14
FIGURE 12. SYDNEY CBD STATION ENTRIES AND EXITS 2004 - 2013	15
FIGURE 13. SYDNEY CBD STATION ENTRIES AND EXITS BY TIME OF DAY AND DAY TYPE	15
FIGURE 14. CITY OF SYDNEY PRECINCTS	18
FIGURE 15. PREVIOUS METRO NETWORK STRATEGY	20
FIGURE 16. ESTIMATED GATEWAY DEMAND, 2026 UNDER SCENARIO A2-B2	28
FIGURE 17. ESTIMATED GATEWAY DEMAND, 2036 UNDER SCENARIO A2-B2	29
FIGURE 18. SYDNEY'S RAIL FUTURE	33

EXECUTIVE SUMMARY

The 1971 City of Sydney Strategic Plan was developed during a period of rapid growth for the City of Sydney. It aimed to guide the development of the City of Sydney to ensure sustainable and productive outcomes. The Strategic Plan set out the policies which helped to effectively manage growth for the next 30 years.

The 1971 Strategic Plan undertook projections of future travel demand to understand how the transport system would interact with employment growth. The key principle was that the City's maximum employment capacity was assumed to be strongly linked with the transport capacity of the morning peak period for workers traveling to the CBD.

This study has reviewed the projections made in the 1971 Strategic Plan and has produced a new set of long term projections to help inform the Central City Planning Review.

The analysis of the available data revealed a number of findings:

- In 2011 around two thirds of the CBD's 285,000 workers were drawn from the Northern (19.5 percent), Eastern (17.2 percent), South Western Inner (16.6 percent) and Western Inner (13.1 percent) sub-regions. This is compared to around 70 percent in 1966.
- Around 75 percent of work trips are made inside the peak period. Despite increasing congestion during peak periods this figure hasn't change significantly over the past ten years.
- City workers are faced with competition from other travellers during the morning peak. These include people travelling to elsewhere in Sydney via the CBD (through trips) and people travelling for other purposes (education, recreation, business trips).
- Over the past decade car travel has grown at 0.8 percent per annum, public transport trips have increase 3.3 percent per annum and active travel has increased by 8.2 percent per annum (although from a very low base).
- Of the total capacity of 300,000 workers, the rail network accounts for almost half (140,000), followed by bus (70,000). Active travel (30,000) provides almost as much capacity as car (50,000).

The current level of public transport provision would struggle to accommodate a workforce of more than 340,000. On current trends (annual growth of 2.1 percent) that level employment would be reached within the next ten years (to 2026).

The introduction of CBD and South East Light Rail, the Sydney Metro, continued growth in active travel and a range of other transport initiatives (managed growth of bus, ferry and light rail corridors) could accommodate another decade's worth (to 2036) of employment growth (around 430,000 jobs).

Supporting employment growth beyond 2036 would require another transformational step in providing access to Central Sydney, such as the construction of the next stage of the Sydney Metro rail network. There are a number of possible options including the West Metro line (Westmead to Central), developing a metro line that services the Green Square renewal area, UNSW, Maroubra and other urban renewal opportunities in the south east. Such a metro line could be accompanied by an extension of the light rail network into the inner suburbs that ring Central Sydney, providing increased capacity and reliability on what would be highly congested bus corridors.

This scenario could support around half a million jobs in Central Sydney. To fully assess the capacity for future employment of this scale, a site by site capacity assessment for employment (including accounting for sites which will become residential) would be required to better understand the land use

capacity for employment. This would include factoring in trends of more intensive use of office space, extended opening hours for retail and food services, and other changes in workplace practices.

The main issue which this study identified, but could not quantify, was the significant volume of pedestrian flows that a workforce of half a million people in Central Sydney would generate. The issue of pedestrian capacity is an important one, as future rail usage increases the flow of pedestrians in and out of constrained station exits, as well as on narrow footpaths, and could lead to a scenario in which pedestrian capacity is reached. Understanding the current and future pedestrian demand and ensuring that capacity is provided for increased pedestrian flows within Central Sydney is a critical action identified in this review.

1 INTRODUCTION

Sydney is the economic powerhouse of the nation and a gateway to the global economy. It generates almost a quarter of Australia's GDP, is home to much of the nation's key economic infrastructure, critical to the prosperity of industries and sectors across New South Wales and Australia. Given Sydney's paramount economic and social importance, the structure and functioning of the city has ramifications across all spheres of government and supporting businesses, whether in relation to issues of productivity, social stability, environmental sustainability or, ultimately, government taxation revenues.

The City of Sydney sits at the centre of the broader metropolitan economy. Ensuring that the City of Sydney is effectively planned requires careful transport and land use planning. The 1971 City of Sydney Strategic Plan was developed to help to guide the development of the CBD to ensure sustainable and productive outcomes. A key principle in the Strategic Plan was that the maximum employment capacity was assumed to be strongly linked with the capacity of the morning peak period for workers traveling to the CBD.

This study has reviewed the projections made in the 1971 Strategic Plan and has produced a new set of long term projections to help inform the Central City Planning Review. There have been a range of challenges which have been confronted during this study including:

- Comparing the 1971 projections in the face of changes in geographic boundaries by which data is collected and published.
- Working with different datasets which provide only a partial insight into travel patterns.
- Estimating the impact of future transport projects on transport capacity to the CBD. Reasonable assumptions have been made using published information about increased capacity. It has also been assumed that fine tuning improvements will be made to the transport network over coming years as demand increases.
- The uncertainty in projecting employment and population growth, travel behaviour and the interaction between land use and transport accessibility over long periods of time.
- Capacity is not a fixed number and can be altered by people's behaviour (switching modes, travelling at different times of the day, increased tolerance to crush capacities) and incremental improvements to the provision of transport services.

The remainder of this report is structured as follows:

- Section 1 provides further background to the project and reviews the 1971 Strategic Plan
- Section 2 outlines current CBD transport patterns
- Section 3 describes the future transport capacity under a range of scenarios
- Section 4 presents concluding remarks
- Appendix 1 presents additional detailed material

1.1 Project background

The City of Sydney Council is undertaking a review of planning controls for the Central Sydney area (the CBD). The CBD is able to support and attract many large office buildings not simply because zoning has allowed such development, but because the CBD is the most accessible location within the entire city. Served by an abundance of transport and other infrastructure, Sydney's CBD is accessible to a large and wide pool of potential workers, customers and suppliers. This advantage is referred to as the benefits resulting from agglomeration economies.

As CBD employment grows, so does the demand for transport as commuters are required to access their jobs. Adding to the theoretical understanding of agglomeration benefits, a recent survey¹ identified that being close to public transport is the most important factor in attracting and retaining staff when tenants choose an office location. Businesses place a price premium on this accessibility as it underpins their viability and, as a result, they are willing to pay higher rents. This willingness to pay higher prices per square metre of office space, in turn incentivises denser development.

However, if transport capacity is constrained then it may result in reduced development occurring within the City of Sydney. The overall objective is to present a range of transport demand and capacity data to illustrate potential considerations in the development of land use planning and related controls for Central Sydney.

This will update the analysis presented in the 1971 Central Sydney Plan (Transport Annexure), presenting a timeline of how transport capacity and demand has changed over the last 45 years, and how it is expected to continue to change into the future (over at least the next 20 to 30 years).

1.2 Overview of the 1971 City of Sydney Strategic Plan

The 1971 City of Sydney Strategic Plan was developed to help guide the development of the central city in a coordinated manner. It outlined the management of the various City of Sydney precincts via the integration of the transport network and other assets such as open space.

There were some key assumptions about future development made by the 1971 Strategic Plan. These include:

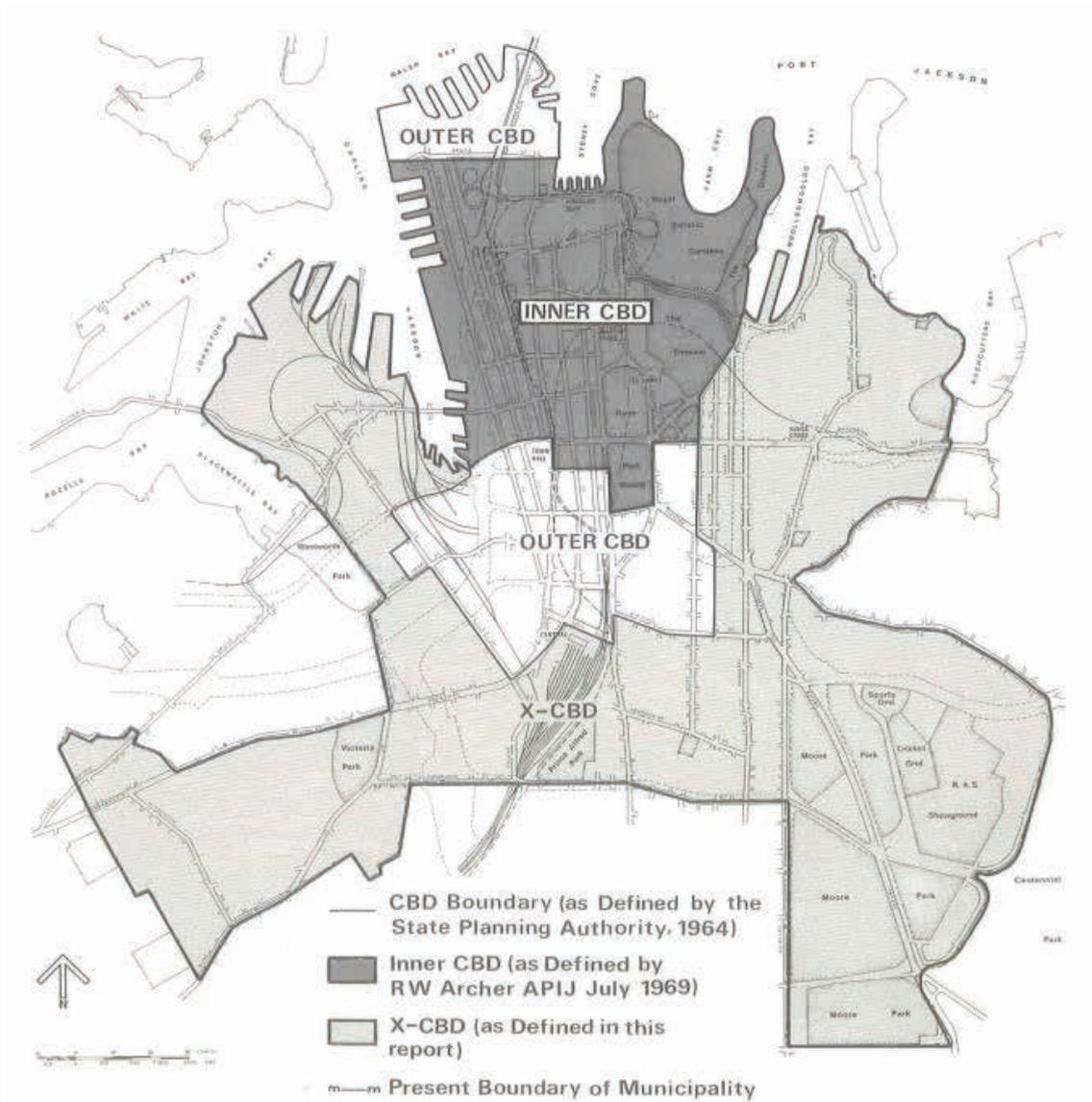
- The City of Sydney will remain the dominant metropolitan centre, though its relative contribution to total metropolitan growth will continue to decline. This proved to be largely correct.
- The City's decline in residential population can be arrested by conservation of much of the existing housing, by requirements and incentives for new residential development, and by creating new areas in the City for housing. This proved to be correct.
- The workforce in the Central Business District could increase from its present estimated level of about 240,000 at a rate which would result in employment there of 360,000 to 400,000 people by the end 2000. In 2001 employment was around 300,000. However, by 2011 employment was around 440,000.

The 1971 Strategic Plan used the following process to understand the range of future transport demand:

- Assessment of 1966 journey to work to the CBD data by each mode.
- Assignment estimates were constructed for each mode, route approaches and city stations.
- Estimates were then applied to traffic flows consistent with two CBD workforce levels – 360,000 and 400,000 at the year 2000. This incorporated known or expected changes in the various networks.
- Operation assignments were produced for traffic on rail system and route approaches for 1980, 1990, and 2000, which were contrast to station and route capacities, as well as road capacities. Shortcomings were identified.
- Results were tested against changes in overall mode share – one with a shift towards rail, the other with a shift towards the use of bus and private car.

¹ (Colliers International 2012 Office Tenant Survey)

FIGURE 1. CITY OF SYDNEY - BOUNDARY DEFINITIONS



Source: City of Sydney Strategic Plan 1971

1971 Strategic Plan Findings

A workforce of 360,000 in the CBD by the year 2000 will require transport facilities capable of handling a peak hour movement of 230,000 persons compared with an estimated 148,500 in 1966. A workforce of 400,000 requires a transport system able to handle a peak hour movement of 260,000 persons.

In summary the main deficiencies identified were:

- (i) Lack of track **capacity on the western rail approach;**
- (ii) Lack of **station capacity at Wynyard and Town Hall;**
- (iii) Lack of **north-south road capacity crossing the Harbour and by-passing the City;**
- (iv) Lack of **capacity within the City street system** to absorb the projected commuter and visitor car traffic.

Major problems of capacity were expected in the short to medium future on the western rail track approach and at Wynyard and Town Hall stations. Measures to relieve the problems associated with track capacity include providing links between the railway lines on the southern approach to the City on the Illawarra line and the Main Southern line (Liverpool and Campbelltown line) and increasing the capacity of other links leading to the southern approach to the city.

Operational measures to improve the overall transport problem expected included the diversion of CBD orientated bus traffic to bus-rail interchanges on the rail approaches in which spare capacity existed or could be made available reasonably easily. Such measures included improved fare structuring, collection methods and administrative changes, rationalisation of bus-rail operations with a possible shift to bus operation on the approaches where spare rail capacity did not exist or was not likely to be available in the foreseeable future.

Improvements in station and platform capacity at Wynyard and Town Hall were expected. The existing urgent need for additional road capacity to handle north-south traffic skirting the City would be greatly intensified over the coming decades. From this, the need for an additional Harbour crossing capacity should be studied. The City's street system is near capacity and early studies are required for traffic management and other operational measures designed to relieve the pressure.

A shift in the preference of commuters to the use of road transport would intensify all of the present problems without providing any significant relief to rail capacity problems. Further, a shift in the preference of commuters to the use of rail transport would intensify the problems on the western rail approach thus making the proposed rail improvements on the southern approach even more attractive and necessary.

An increase of the City of Sydney workforce to 400,000 will intensify the highlighted problems, in particular, the capacity problems on the western rail approach.

TABLE 1. ESTIMATED DISTRIBUTION OF WORKFORCE

Sector	1966			1980			1990			2000		
	Population	Workforce		Population	Workforce		Population	Workforce		Population	Workforce	
		Number	Percent									
Eastern	322,000	42,000	13.0	335,000	50,000	15.0	340,000	52,000	15.3	350,000	54,000	15.4
Northern	381,000	49,000	12.9	490,000	58,000	11.8	560,000	66,000	11.8	610,000	70,000	11.5
North-western	202,000	18,000	8.9	250,000	22,000	8.8	270,000	23,000	8.5	290,000	25,000	8.5
South & South-western (inner)	453,000	46,000	9.9	470,000	46,000	9.8	490,000	46,000	9.4	500,000	47,000	9.4
South & South-western (outer)	299,000	21,000	7.1	380,000	27,000	7.1	400,000	29,000	7.3	420,000	31,000	7.4
Western (inner)	245,000	25,000	10.2	250,000	28,000	11.2	240,000	29,000	12.1	240,000	29,000	12.1
Western (intermediate)	392,000	19,000	4.9	520,000	26,000	5.0	590,000	29,000	5.0	670,000	34,000	5.0
Western (outer)	243,000	9,000	3.7	420,000	16,000	3.8	700,000	27,000	3.8	1,050,000	40,000	3.8
Campbelltown	34,000	1,000	2.9	150,000	6,000	4.0	300,000	10,000	3.3	500,000	16,000	3.2
Central Coast	43,000	1,000	2.4	130,000	4,000	3.1	210,000	7,000	3.3	350,000	12,000	3.4
Total	2,600,000	231,000	8.9	3,400,000	283,000	8.3	4,100,000	320,000	7.8	5,000,000	358,000	7.2
Peak Hour Commuter Load		148,500			183,000			206,000			230,000	

Source: 1971 City of Sydney Strategic Plan

TABLE 2. MODE SPLIT IN PEAK HOUR COMMUTE

YEAR 1966

Sector	Rail	Bus	Ferry	Car	Total
Eastern *	—	22,000 (18)	—	5,000 (19)	27,000
Northern	13,500 (42)	7,000 (22)	6,000 (19)	5,500 (17)	32,000
North-western	7,000 (61)	2,000 (17)	—	2,500 (22)	11,500
South-southwest (inner) *	20,000 (70)	6,000 (21)	—	2,500 (9)	28,500
South-southwest (outer)	13,500 (90)	—	—	1,500 (10)	15,000
Western (inner) *	7,000 (48)	5,000 (35)	—	2,500 (17)	14,500
Western (intermediate)	12,000 (96)	—	—	500 (4)	12,500
Western (outer)	5,500 (100)	—	—	—	5,500
Campbelltown	1,000 (100)	—	—	—	1,000
Central Coast	1,000 (100)	—	—	—	1,000
Total	80,500 (55)	42,000 (28)	6,000 (4)	20,000 (13)	148,500

Source: 1971 City of Sydney Strategic Plan

Mode share shift scenarios were considered by the 1971 Strategic Plan. For example:

- **Shift to road:** a 20 to 25 percent increase in the number of cars approaching the CBD while there would be a reduction of only some 20,000 people being carried by the rail system, mainly on the eastern and northern sectors, without major reduction in the traffic on the critical western approach. It would seem therefore that this pattern would very substantially worsen the problems of vehicle congestion while doing little to reduce the problem of capacity in the rail system.
- **Shift to rail.** In 1966 about 55 percent of the peak hour commuters travelled to the CBD by rail. Had the Eastern Suburbs Railway been in operation this proportion is expected to have been 62 percent.

With much of the future increase in commuters to the CBD likely to come from the rail oriented outer western and south-western suburbs, the overall proportion of peak hour commuters travelling by rail is estimated to increase to 65 percent of the total by 1990. If a rail oriented program were to be adopted about 20,000 commuters might be transferred from bus to rail at suburban interchange stations. This is subject to the rail system being capable of absorbing this additional load as well as the natural growth already projected. All approaches except for the Western approach have the capacity to absorb the additional passengers but would require other improvements.

Under a scenario of 400,000 CBD workers, the higher level of growth can be expected to intensify and accelerate the problems discussed under the 360,000 workforce.

1971 Strategic Plan: Other items of interest

Below are other items of interest that were identified in the 1971 Strategic Plan:

- Many of the streets within the CBD were operating under saturation conditions with comparatively low traffic volumes.
- Any serious attempt at reducing the overall proportion of private cars into the CBD would need to be aimed at the more affluent areas and also at those areas not well served by rail transport. Offsetting this was identified as a likely small switch to private car transport from the outer suburbs as the outer metropolitan expressway system takes shape.
- Concurrent with this continued growth at Wynyard would be a rapid increase at Town Hall, which would be the only underground station to serve all train lines on the underground system. As a consequence, the number of commuters changing trains at the Town Hall station for other destinations within the CBD would be very high, unless a flexible approach to routing trains through the CBD was feasible.
- Eastern Suburbs Railway was expected to replace around two-thirds of buses serving the Eastern suburbs (reducing bus commuters to the CBD by 20 percent).
- The analysis of car travel estimates that the number of peak hour commuters would rise from 20,000 in 1966 to about 32,000 in 2000 if the 1966 modal split were maintained. This implied an increase of about 8,000 cars entering the approaches to the CBD in the peak hour period.
- The inner networks handled a maximum flow of about 21,000 vehicles per hour in approach to the CBD and (for practical purposes) they were considered operating at capacity under the traffic management conditions at the time. This was estimated to be composed of about 12,500 commuter cars with destination in the CBD and 8,500 cars in transit through the CBD. Estimates of capacity indicated that a maximum flow of about 24,000 per hour could be handled when the Stage 1 of the Western Distributor and the Northwestern Expressway were completed in the period to 1975, and about 28,000 to 30,000 when the whole of the Western Distributor was completed.
- Continued growth of the North Sydney, St. Leonards and Chatswood business centres may place such a demand on Sydney Harbour Bridge that the present peak hour tidal flow arrangements may have to be revised within ten years and possibly discontinued within fifteen years from the report.

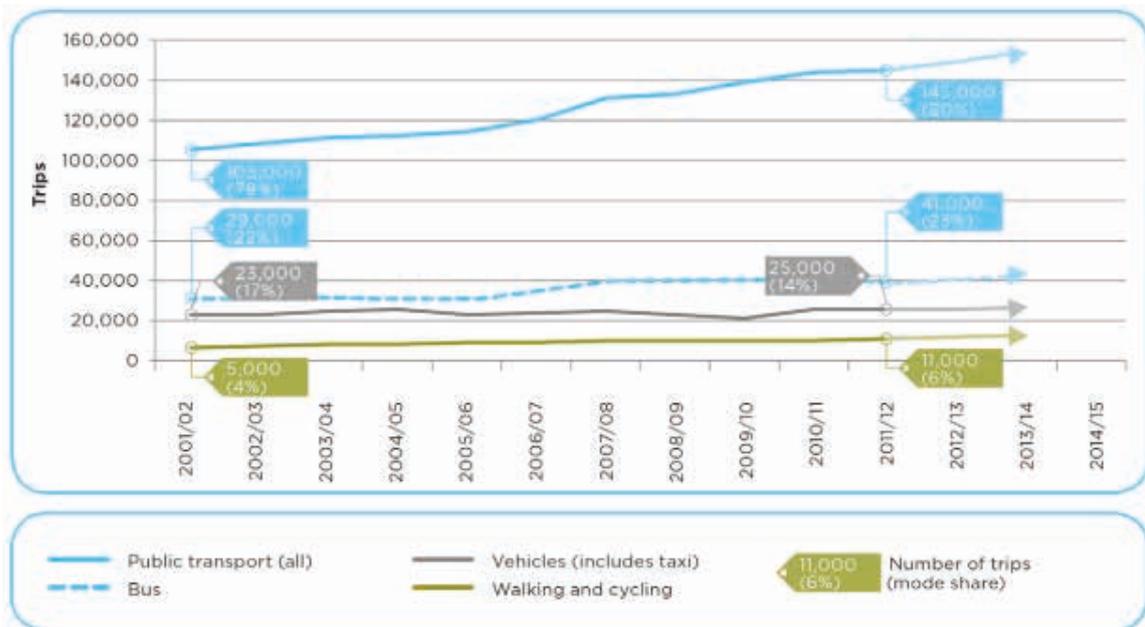
2 CITY OF SYDNEY TRANSPORT

This section briefly outlines the travel patterns of people travelling to and through the City of Sydney. The Sydney City Centre Access Strategy, Australian Bureau of Statistics Journey to Work data and the Household Travel Survey have all been used to build a profile of the travel patterns. One area where there is little to no data is on pedestrian flows from the main transport gateways. This issue is important as any growth in future rail usage, increases the flow of pedestrians in and out of constrained station exits or narrow footpaths. This could lead to a scenario in which pedestrian capacity is reached.

2.1 Travelling to the City of Sydney

The City of Sydney has experienced an increase in public transport usage over the past decade. During 2012 to 2013, more than 80 percent of people travelling to or from the CBD during the morning peak did so via public transit². This is compared with 14 percent of trips to the city centre being made by car.

FIGURE 2. TRENDS IN TRAVEL TO THE SYDNEY CITY CENTRE – AM PEAK 1 HOUR



Source: NSW Government Sydney City Centre Access Strategy

Figure 2 illustrates that over the last 10 years, the number of people driving to the CBD in the morning peak hour has plateaued at around 25,000 trips, while the number of people arriving by public transport has increased from 105,000 to 145,000 trips. The relationship between public transport capacity and pedestrian capacity is an important and often overlooked one, particularly given current trends of increases in public transport usage. An improved understanding of pedestrian flows across the CBD, and in particular the flows of pedestrian in and out of stations is much needed. From a low base, walking and cycling trips to the CBD in the morning peak hour has more than doubled in just 10 years from 5,000 to 11,000 trips.

² (Heavy rail, bus, light rail and ferry)

TABLE 3. TRAVEL BY MODE 2002-2012, WEEKDAY AM PEAK HOUR

Mode	2001-02-	2011-12	Annual Growth Rate
Car	23,000	25,000	0.8%
Bus	29,000	41,000	3.5%
Walk & Cycle	5,000	11,000	8.2%
All Public Transport	105,000	145,000	3.3%

Source: Sydney City Centre Access Strategy and SGS Economics and Planning 2015

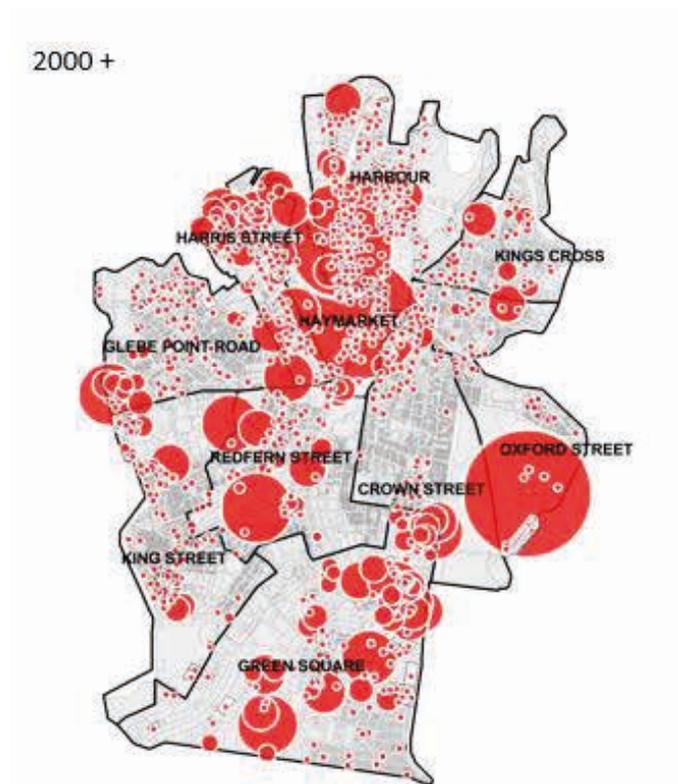
The number of trips made by car to the CBD during morning peak hour shows almost flat growth at 0.8 percent per annum from 23,000 trips to 25,000 trips. However, looking at developments post the year 2000 (Figure 3) there has been a significant increase in car parking provision (650,000 square metres), although these have been more associated with retail and residential development

Bus trips have increased over the last ten years from 29,000 to 41,000 trips, highlighting that the growth per annum is higher than public transport overall.

The figures on the following pages identify the origin of people working in Central Sydney. In Figure 4, the total trips made to the CBD in 2006 were predominately from the Eastern Suburbs and the North Shore. The multi-modal Harbour Bridge Corridor and the Eastern Suburbs corridors carry significant volumes of these trips to the city.

Figure 5 illustrates an increase in total trips to Central Sydney from the North Shore and Eastern Suburbs in 2011. Other areas such as the Southern Western Inner region experienced an increase in the total number of trips.

FIGURE 3. CAR PARKING PROVIDED POST 2000



Source: City of Sydney, 2011 Floorspace and Employment Study

FIGURE 4. TOTAL WORK TRIPS TO CENTRAL SYDNEY BY SLA 2006

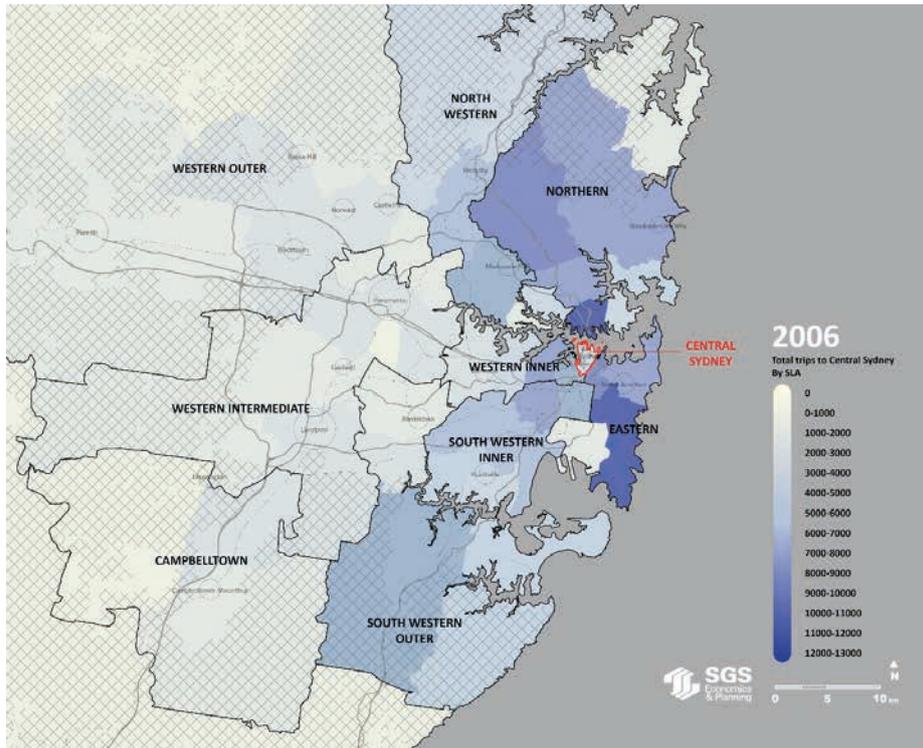


FIGURE 5. TOTAL WORK TRIPS TO CENTRAL SYDNEY BY SLA 2011

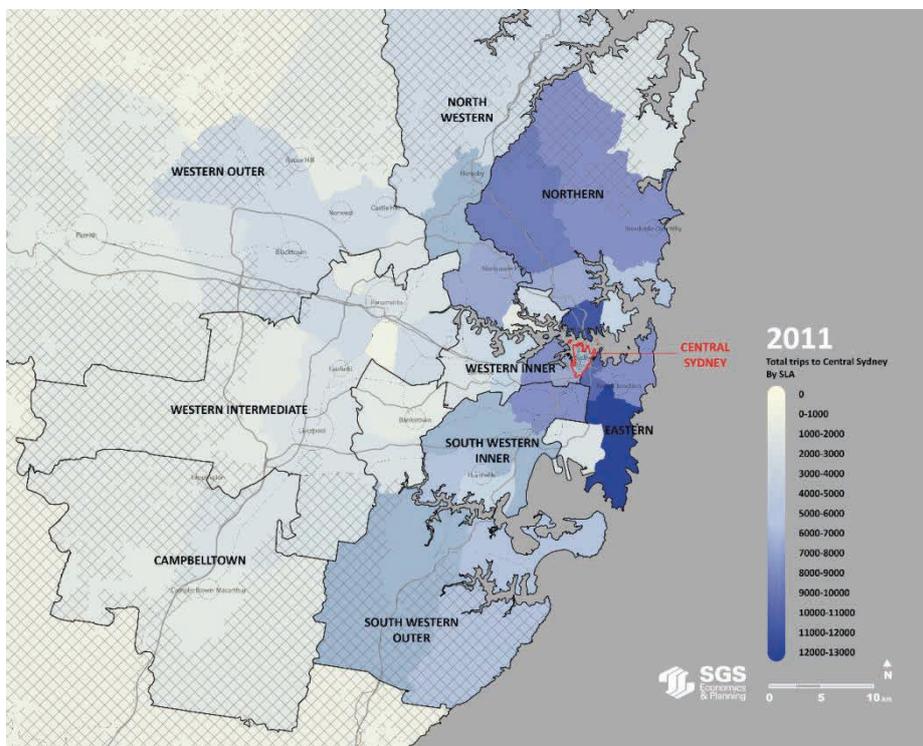


Figure 6 shows a high variation in the use of modes from suburbs within Sydney's inner ring. Using rail as a mode of transport to work varies from 3 percent to 73 percent with an average of 25 percent. The origins of Ashfield and Marrickville have the highest percentages of train mode at 73 and 60 percent.

Leichhardt and Randwick have the lowest percentage of train mode share at 3 and 4 percent and the highest mode share of buses at 56 percent and 67 percent respectively.

FIGURE 6. INNER RING MODE SHARE, 2011 WORK TRIPS

Origin Local Government Area / Ring / Region	Train	Bus	Ferry/ Tram	Private motor vehicle	Walked only	Other
Ashfield (A)	73%	10%	0%	14%	1%	2%
Botany Bay (C)	22%	50%	0%	25%	0%	3%
Lane Cove (A)	22%	44%	5%	24%	1%	4%
Leichhardt (A)	3%	56%	10%	22%	3%	6%
Marrickville (A)	60%	20%	0%	13%	2%	5%
Mosman (A)	5%	48%	15%	27%	1%	3%
North Sydney (A)	30%	41%	7%	14%	4%	4%
Randwick (C)	4%	67%	0%	23%	1%	4%
Sydney (C)	17%	24%	0%	10%	43%	6%
Waverley (A)	51%	14%	4%	25%	2%	4%
Woollahra (A)	30%	22%	9%	28%	8%	4%
Inner Ring Total	25%	34%	3%	17%	15%	5%

Source: Train Statistics, 2014, BTS

Bus mode is between 14 percent and 67 percent and the average is significantly higher than rail at 34 percent. Within the inner ring, walking and other (cycling) modes are high, accounting for 20 percent of all trips.

Turning to middle ring suburb origins, Figure 7 illustrates that the majority of travel from the middle ring is by rail, although there are some key bus and ferry corridors including Victoria Road and Manly. Rail is higher in the west. Overall rail share ranges between two and 87 percent in the middle ring with a mode average of 63 percent.

FIGURE 7. MIDDLE RING MODE SHARE, 2011 WORK TRIPS

Origin Local Government Area / Ring / Region	Train	Bus	Ferry/ Tram	Private motor vehicle	Walked only	Other
Auburn (C)	87%	1%	1%	11%	0%	0%
Bankstown (C)	84%	1%	0%	14%	0%	0%
Burwood (A)	82%	4%	0%	11%	0%	2%
Canada Bay (A)	32%	33%	9%	23%	0%	2%
Canterbury (C)	79%	4%	0%	16%	0%	1%
Hunters Hill (A)	2%	51%	17%	25%	1%	3%
Hurstville (C)	88%	0%	0%	11%	1%	1%
Kogarah (C)	83%	1%	0%	16%	1%	0%
Ku-ring-gai (A)	66%	5%	0%	26%	1%	2%
Manly (A)	8%	30%	40%	18%	1%	3%
Parramatta (C)	78%	8%	1%	12%	0%	0%
Rockdale (C)	82%	2%	0%	16%	1%	1%
Ryde (C)	39%	40%	2%	18%	1%	1%
Strathfield (A)	87%	1%	0%	11%	0%	1%
Willoughby (C)	42%	33%	0%	22%	1%	3%
Middle Ring Total	63%	14%	4%	17%	1%	1%

Source: Train Statistics, 2014, BTS

The Victoria Road corridor incorporates the middle ring origins of Canada Bay, Hunters Hill, Parramatta and Ryde. These origins have the highest percentages of bus mode with 51 percent for Hunters Hill and 33 percent for Canada Bay. Private motor vehicle is also higher in these origins compared to the Auburn, Hurstville and Rockdale areas, potentially due to lack of access to rail.

In Ku-ring-gai, private motor vehicle share is 26 and rail share is 66 percent. This car share is relatively high compared to other origins that also have access to rail services such as Burwood where rail is 82

percent and private motor vehicle is 11 percent. The ferry mode average in the middle ring is 4 percent which is higher than the inner and outer rings. Manly predominately relies on ferry services, accounting for 40 percent of work trips to the City of Sydney.

In the outer ring (Figure 8) most of the local government areas rely on rail with the average rail share higher than the inner and middle rings at 65 percent. Rail share is at 92 percent from Campbelltown, 88 percent from Holroyd and 87 percent from Penrith.

Across the rings, the outer ring has the lowest percentage of private motor vehicle mode share for trips to Central Sydney (15 percent).

Bus share is between 0 and 62 percent in the outer ring, with an average of 18 percent. Origins on the Northern Beaches and The Hills only have regional bus corridors and, therefore, have the highest bus mode percentage in the outer ring. The origins of Pittwater and Warringah on the Northern Beaches account for 52 and 62 percent of bus mode, whereas bus mode is 58 percent in the Hills Shire. The Hills bus network will largely cease once the full Sydney Metro railway system opens.

FIGURE 8. OUTER RING MODE SHARE, 2011 WORK TRIPS

Origin Local Government Area / Ring / Region	Train	Bus	Ferry/ Tram	Private motor vehicle	Walked only	Other
Blacktown (C)	78%	11%	0%	10%	0%	0%
Blue Mountains (C)	82%	2%	0%	14%	1%	0%
Camden (A)	86%	0%	0%	12%	1%	0%
Campbelltown (C)	92%	1%	0%	7%	0%	0%
Fairfield (C)	86%	1%	0%	13%	0%	0%
Gosford (C)	84%	1%	0%	14%	2%	0%
Hawkesbury (C)	72%	6%	0%	21%	0%	1%
Holroyd (C)	88%	1%	0%	10%	0%	0%
Hornsby (A)	70%	15%	0%	13%	0%	1%
Liverpool (C)	85%	1%	0%	13%	0%	1%
Penrith (C)	87%	0%	0%	11%	1%	1%
Pittwater (A)	5%	52%	4%	37%	0%	1%
Sutherland Shire (A)	81%	0%	0%	18%	1%	1%
The Hills Shire (A)	23%	58%	0%	18%	0%	1%
Warringah (A)	6%	62%	5%	25%	0%	2%
Wollondilly (A)	77%	2%	0%	20%	1%	0%
Wyong (A)	73%	1%	1%	24%	2%	0%
Outer Ring Total	65%	18%	1%	15%	0%	1%

Source: Train Statistics, 2014, BTS

The main difference in mode share between the 1971 study and this study is that the 1971 study forecast an increased use of rail to 65 percent by 2000. With reference to Table 4, it is evident that this forecast did not occur as the 2011 actual mode share for rail was 53 percent. The 1971 study forecast a net decrease in bus trips from 42,000 in 1966 to 34,000 in 2000. In reality, bus mode has only marginally reduced as a proportion of total mode share, presenting one of the biggest challenges for the growth of Central Sydney.

TABLE 4. MODE SHARE STUDY COMPARISON

Mode	1971 Study – 1966 mode share	1971 Study – Forecast 2000 mode	2011 JTW – actual mode share
Rail	55 %	65 %	53 %
Bus	28 %	16 %	25 %
Ferry	4 %	5 %	3 %
Car	13 %	14 %	18 %

Source: 2011 JTW shares are from 2014 train stats, Table 8 to CBD, mechanised modes
1971 Study data Annex D, Table 2

One issue which wasn't examined in great detail by the 1971 study was pedestrian flows. SGS recently completed a study of pedestrian flows in Melbourne, and a number of the patterns observed are likely to also occur in Sydney. These provided a detailed insight into the variation in pedestrian flows throughout the day across the CBD³.

Figure 9 illustrates the pedestrian flows occurring during the morning peak period (from 8:00 am). The largest flows are directly linked with Melbourne CBD stations during this period. Heavier flows occur at Flinders St station in the South, Southern Cross station in the west, Parliament station in the east and Melbourne Central station in the north. Major pedestrian flows emerge from stations and then taper out as the pedestrian network branches into streets and laneways.

Figure 10 illustrates the pedestrian flows that occur during the lunchtime peak. The flows are substantially more distributed across the pedestrian network during this period. Significant flows occur along retail streets such as Swanston St, Elizabeth St, Latrobe and Bourke Streets, and are linked to people leaving their CBD workplaces on their lunchbreaks.

Understanding the volume and variation in pedestrian flows throughout the day is crucial in understanding pedestrian capacity within Sydney's CBD. Greater insight into the pedestrian flows across Sydney's CBD would be useful in planning for anticipated increased employment density in the area.

FIGURE 9. MELBOURNE CBD 8AM

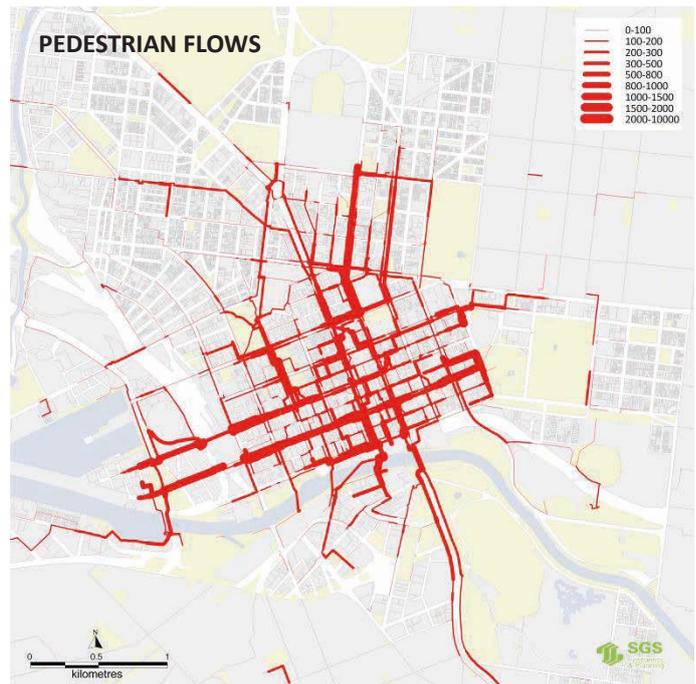
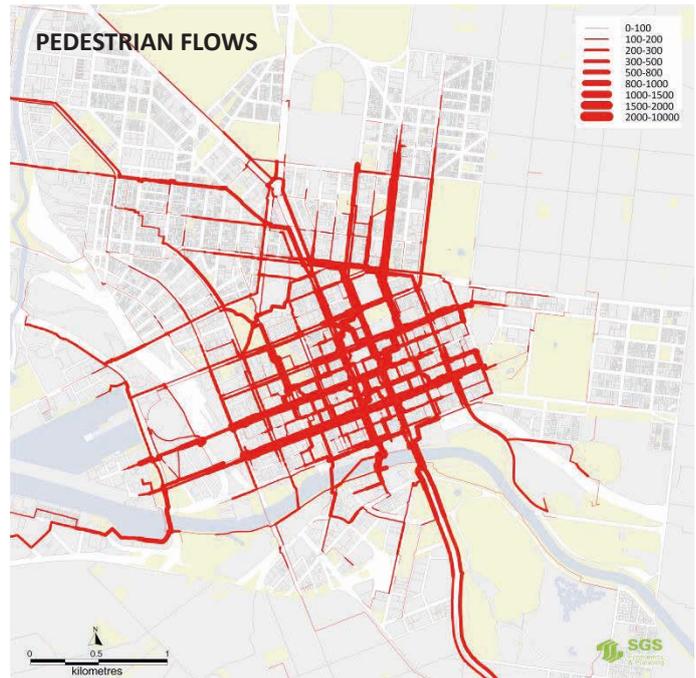


FIGURE 10. MELBOURNE CBD 12PM

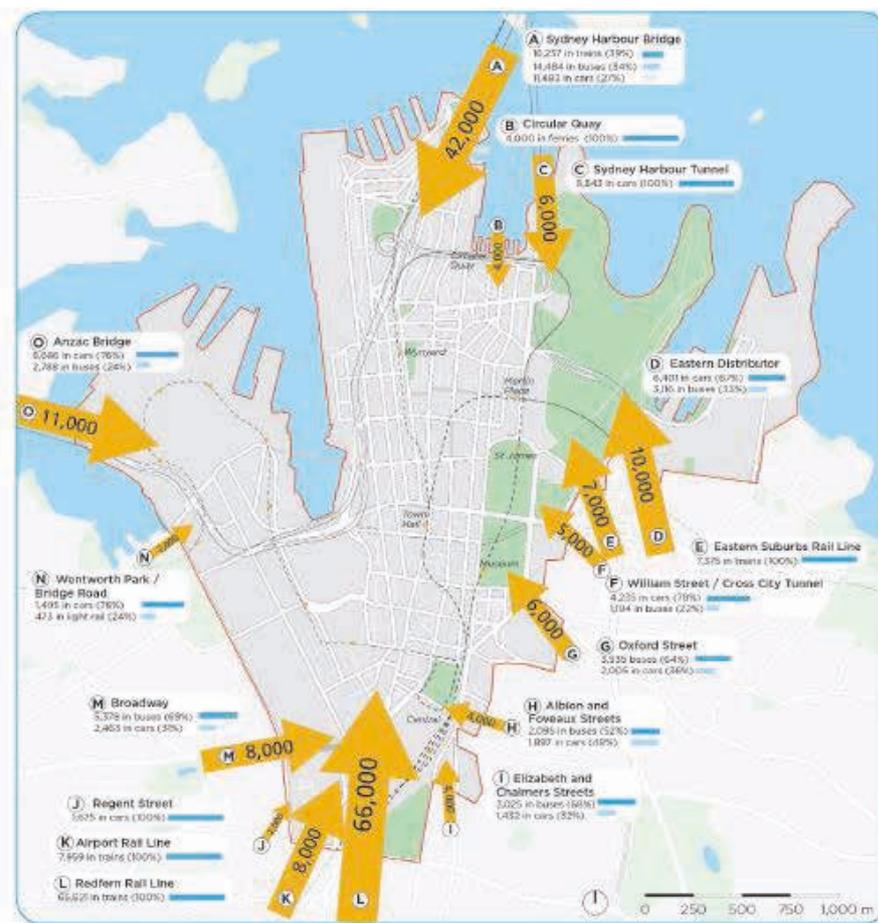


³ More information on this report can be found here: ['Walking to global competitiveness: A case study of Melbourne's CBD'](#)

2.2 City of Sydney Gateways

The Sydney City Centre Access Strategy (SCCAS) identified that over 115,000 of the 180,000 trips to the City Centre in the morning peak hour occur in two main corridors - the multi-modal Harbour Bridge corridor to the north with rail as the dominant mode, and the rail corridor through Central Station. In addition to key gateways identified in Figure 11, the SCCAS outlined that some corridors such as the Eastern and Western Distributor, Cahill Expressway and the Cross City Tunnel carry significant volumes of passengers through, under and around the city centre.

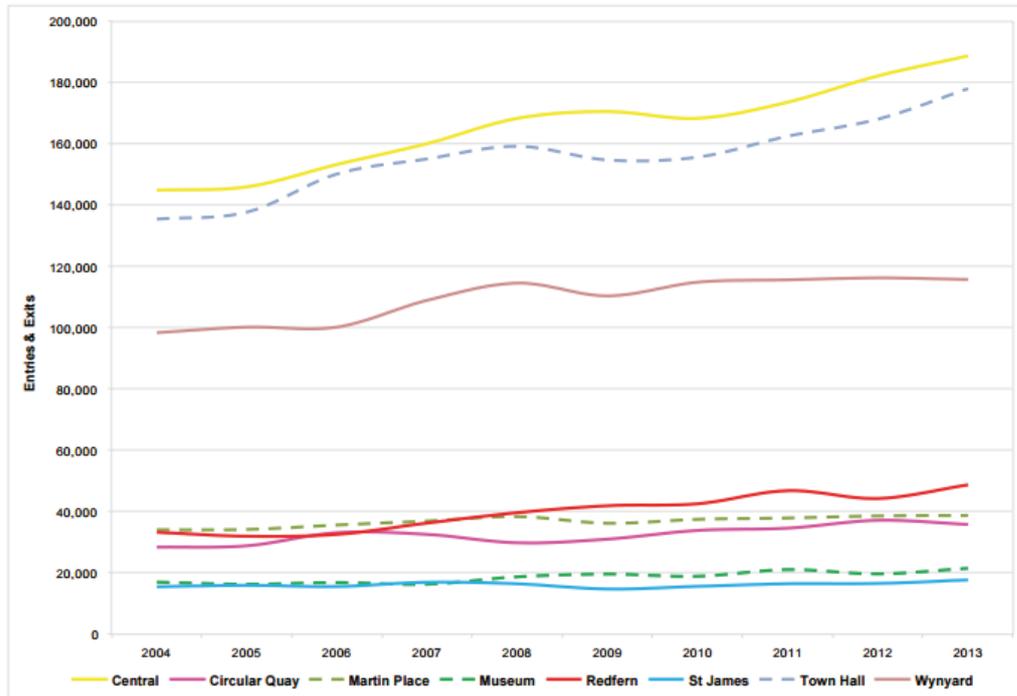
FIGURE 11. PASSENGERS ENTERING THE CITY CENTRE - KEY GATEWAYS 8AM – 9AM



Source: Sydney City Centre Access Strategy, Transport for NSW 2013

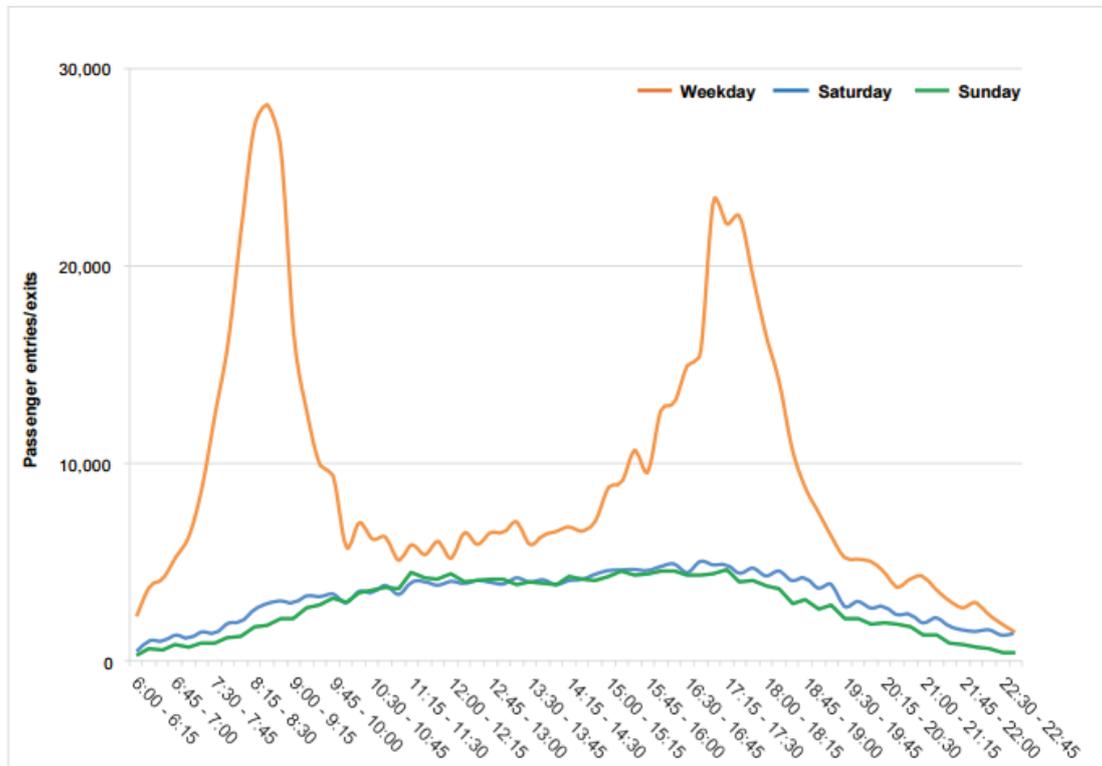
Figure 12 illustrates the CBD rail stations that experienced the strongest growth in passenger numbers over the past decade. Central and Town Hall are the most used stations reflecting higher activity in this part of Central Sydney including education trips and increased entries during the morning peak period. The 2008 / 2009 Global Financial Crisis had a major influence on the activity of the CBD stations.

FIGURE 12.SYDNEY CBD STATION ENTRIES AND EXITS 2004 - 2013



Source: Train Statistics, BTS 2014

FIGURE 13.SYDNEY CBD STATION ENTRIES AND EXITS BY TIME OF DAY AND DAY TYPE



Source: Train Statistics, BTS 2014

TABLE 5. SYDNEY CBD STATION EXITS (AM PEAK 3.5 HOURS)

Station	Station exits				
	6:00 to 7:00	7:00 to 8:00	8:00 to 9:00	9:00 to 9:30	6:00 to 9:30 Total
Town Hall	3,029	8,652	23,479	6,428	41,588
Central	3,538	8,777	21,222	6,742	40,279
Wynyard	2,402	8,687	22,389	5,074	38,552
Martin Place	889	3,049	7,989	1,784	13,711
Redfern	790	2,221	5,551	1,486	10,048
Circular Quay	746	1,581	4,334	1,520	8,181
Museum	370	1,334	3,145	979	5,828
St James	420	1,145	2,771	805	5,141
Total CBD	12,184	35,446	90,880	24,818	163,328

Source: Train Statistics, BTS 2014

With reference to Figure 13 and Table 5, movements at the CBD stations are still highly concentrated during the 8:00 am to 9:00 am period, with capacity for growth in the shoulder periods. This is in contrast to car travel which has more spread. The issue on public transport is that capacity, particularly on rail, drops off outside the peak hour. This issue reflects both the number of trains available and operational constraints.

Many of the initiatives in *Sydney's Rail Future* will increase the ability to provide higher frequencies and hence more capacity in the shoulder periods. Sydney Metro systems will be able to run peak frequency for as long as required as the Sydney Metro – North West will open with 15 trains per hour. On this route there is initially likely to be frequency well above demand. There does appear to be some capacity for growing total morning peak (3.5 hour) capacity through spreading the peak.

Wynyard, Town Hall, Martin Place and Central stations represent key interchanges between various modes of public transport and the volume of pedestrian flows from these stations is identified in Table 5. There is currently limited capacity within the pedestrian network around these stations which will require consideration if pedestrian flows from CBD stations increases during the morning peak. The proposed future integrated transport network in the Sydney City Centre Access Strategy involves creating new interchange precincts at these stations (as well as at Museum station) which may increase pedestrian capacity through 'decluttering footpaths'.

The recent commitment by the NSW Government to construct a new Sydney Metro station at Barangaroo will take considerable pressure off Wynyard station and reduce the intensity of pedestrian movements between Wynyard and Barangaroo.

The Walking Network

Increasing the number of pedestrian connections and ensuring new developments are permeable is a challenge for the future. With future increases in frequency and capacity within the Sydney Metro system, there is a critical need to consider the walking network that exists within Central Sydney. This issue is important as future rail usage will increase the flow of pedestrians in and out of constrained station exits or narrow footpaths and could lead to a scenario in which pedestrian capacity is reached.

A rich walking network with many routes, links, crossings and connections provides more walking choices, spreads the pedestrian load, stimulates more walking, reduces walking times, creates more economic activity by bringing people into new spaces and reduces walking distances.

New developments must be able to provide new connections whilst remaining viable both in their own right and in order to deliver a net community benefit through the viability of the development yield and the pedestrian network overall. Links may be footpaths, lanes, shared zones and formal or informal pedestrian crossings. They also include part-time links through arcades and other public connections through private property.

Sydney-wide, approximately 900,000 morning peak commuting trips are made during the 6:00am to 9:30 am peak period, and over 10 percent are into Sydney's centre (BTS, 2014). More than half of these trips into the CBD occur within the concentrated 8:00am to 9.00am period, and there would be benefits in spreading this peak.

Peak spreading of public transport trips would have a direct impact on the associated volumes of pedestrians entering the CBD. Given the current constrained capacity of the pedestrian network, there would be significant advantages in doing this.

Peak Spread

Spreading the peak is a means of adjusting to increased commuter volumes. Distributing increased volumes of commuters over a longer period of time leads to a flattening of commuter volumes across a longer time period. It is a means of reducing congestion and preventing the limited capacity of the network from being exceeded. Bolland and Ashmore(2002) identify two types of peak spreading; active and passive. Passive spreading is when the peak hour spreads due to excess demand and associated congestion and delays. Active spreads on the other hand occur when travellers actively choose to travel outside of the peak period (Bolland and Ashmore, 2002) in order to avoid congestion and to potentially enjoy a faster commute.

A number of policies exist locally and internationally that aim to foster peak spreading in both private vehicle and public transport commutes. These include temporal road pricing, flexi-time work options and time based public transport fare options (Holyoak, 2007).

3 TRANSPORT CAPACITY ASSESSMENT

Based on the Floorspace and Employment Survey, employment in the CBD (including the Haymarket and Harbour Precincts) was 285,000 in 2011. Examining the data provided in the Sydney City Centre Access Strategy suggests the morning peak (two hours) transport capacity into the CBD was around 300,000. Allowing for some work trips to be made outside the morning peak (and trips of other purposes within the morning peak), there is a broad match between CBD employment and morning peak period transport capacity.

When comparing employment with transport capacity there are a few items which should be noted:

- Approximately 25 percent of journey to work trips take place outside of the morning peak.
- People entering the CBD may not work within the CBD. A worker may arrive at Museum Station and then walk across Hyde Park to work in the Kings Cross Precinct.
- People are travelling to the CBD during peak for other reasons (business trips, education, shopping, recreation tourism etc.).
- Capacity is not a fixed number. For example, the number of people per car can increase or the number of people on a train can be over crush capacity. The network may have capacity to run more trains once more rolling stock is purchased.

Of the total capacity of 300,000 workers (Table 6), the rail network accounts for almost half of the resulting morning peak trips (140,000), followed by bus (70,000). Active travel (30,000) provides almost as much capacity as car (50,000).

FIGURE 14. CITY OF SYDNEY PRECINCTS



Source: City of Sydney, Floorspace and Employment Study, 2011

TABLE 6. ESTIMATED TRANSPORT CAPACITY BY MODE TWO HOUR PEAK

Mode	Peak Period Central City Transport Capacity 2011
Car	50,000
Rail	140,000
Bus	70,000
Ferry/LR	10,000
Cycle/Walk from outside CBD*	25,000
Cycle/Walk from within CBD*	5,000
Total	300,000

Source: *Train Statistics*, BTS 2014 Note: *Based on number of trips rather than a service capacity.

Under all of the scenarios analysed there is an increasing number of trips via active transport as a mode. While relatively low it is has been a rapidly growing segment of the transport story for the City of Sydney.

As part of this study, a set of transport and parking scenarios were considered:

With regards to transport scenarios:

- Scenario B1 is assumed to include
 - introduction of CBD and SE light rail by 2018 including a new CBD bus network for Central Sydney
 - Stages 1 and 2 of *Sydney's Rail Future* including Western Rail Upgrade (refer to Appendix A for more details on *Sydney's Rail Future*)
 - introduction of elements of Northern Beaches Bus Rapid Transit
 - completion of Sydney Metro North West – Cudgegong Road to Chatswood
- Scenario B2 is assumed to include, in addition to B1:
 - Sydney Metro City and South West including second harbour rail crossing
- Scenario B3 is assumed to include further, unspecified investment in heavy and light rail with a particular focus on serving the middle and inner ring areas – this is discussed further below.

With regards to parking scenarios:

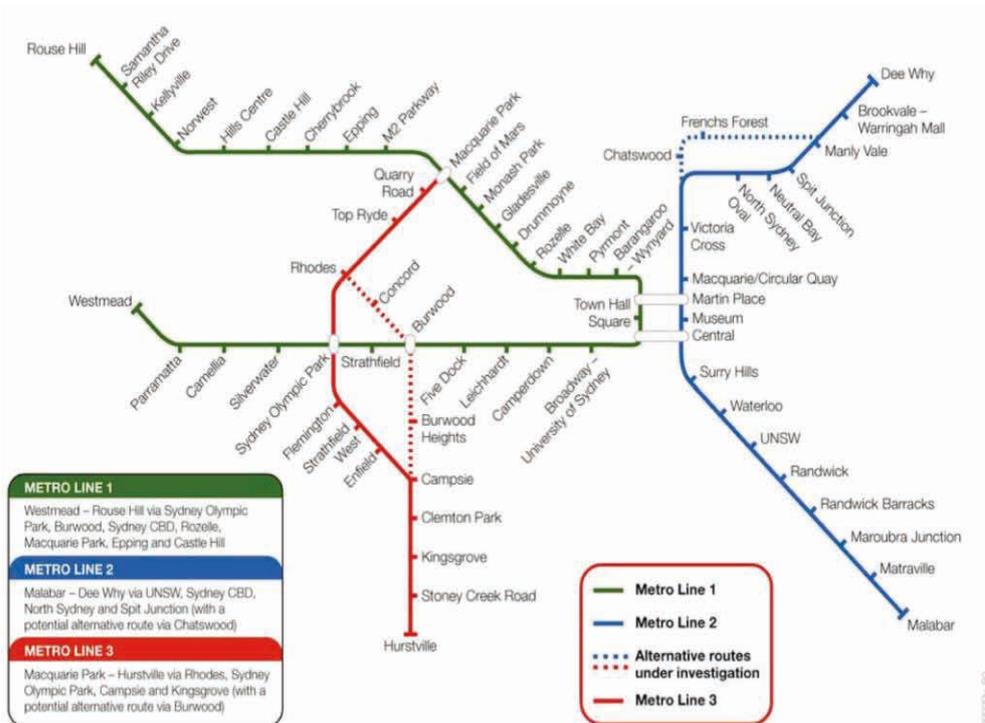
- Scenario A4 – Unconstrained parking growth
 - this scenario is assumed to correspond to the removal of maximum parking provision levels on all developments, and the possible increase in centralised parking supply
 - this scenario is considered infeasible as there are no plans to increase road capacity into Central Sydney to accommodate increased demand arising from higher parking supply
 - additionally, increasing traffic levels on the city streets would limit the ability to cater for surface public transport – buses and light rail; increased pedestrian demand from rail stations; and increased pedestrian activity from higher employment.
- Scenario A3 – Business as Usual
 - this scenario assumes that parking supply increases in line with employment
 - this scenario is not considered compatible with the 'high public transport' scenario (B3) described above
 - provision of good public transport will require more of the space currently allocated to private vehicles to become available for surface transit modes such as bus and light rail as well as pedestrians.
- Scenario A2 – no growth in parking supply
 - this scenario would lead to a decline in car mode share and generate a strong increase in demand for other modes including public transport
 - retaining current public transport capacity – scenario B1 above – would fail to meet this demand and provide little incentive for car drivers to switch to other modes.

- Scenario A1 – a real decline in parking
- this scenario would require substantial supporting measures including a high level of demand management and strong investment in public transport and active modes
- for these reasons, this scenario is considered inconsistent with public transport scenario B2 and infeasible altogether with scenario B1.

The assessment of future capacity in this report has been based on published information⁴ around the various projects (for example Light Rail and Sydney Metro service levels) rather than detailed transport modelling. For Transport Scenario B3, we have assumed another Sydney Metro line to the CBD. This line should target the middle and inner ring areas in contrast to much of the current Sydney's Rail Future which focuses on supporting growth from the outer ring.

The previous Metro Network Strategy outlined three lines shown in the figure below.

FIGURE 15. PREVIOUS METRO NETWORK STRATEGY



Source: Metro Network Strategy, NSW Government

The North West section of the green line is Sydney Metro North West to be completed by 2018. The proposed South East blue line is partly addressed by CBD and South East Light Rail but there is still strong potential for developing a metro line in this corridor that services the Green Square renewal area, UNSW, Maroubra and urban renewal opportunities in the South East area in a manner that the light rail line does not.

The proposed West Metro line (Westmead to Central) is a good example of a line that targets the middle and inner ring while also taking pressure off an existing rail line to improve its ability to service the outer ring.

Within Line 3 scenario, the addition of a new Metro line could be accompanied by an extension of the light rail network into the inner ring around Central Sydney. This would provide increased capacity and reliability on what would otherwise be a highly congested bus corridors.

Completion of the B3 transport scenario should complete the shift from bus to higher capacity rail and light rail, and provide the basis for sustained employment growth beyond the 2051 timeframe considered in this study.

3.1 Employment capacity outcomes

Using the public information on increases in train frequency (assuming a carrying capacity of 1,200 passengers per train) and carrying capacity of light rail systems, the transport capacity under each transport scenario has been estimated. For example, based on published information the Sydney Metro (second harbour crossing) should increase capacity by 60,000 passengers in the short term and 100,000 passengers in the longer term. Also the Western / Inner West Line will have an extra 14 trains per hour in operation by 2024 to 2025. This will bring around an extra 15,000 people into the CBD during the peak hour. Recent trends in active travel and population growth have been used to project forward people travelling to work by foot and bicycle.

Some analysis was done on the outcomes of combining different transport and parking scenarios. Examples are provided here for two combinations:

- Parking scenario A2 (no growth) with Transport scenario B2 (full Sydney Metro)
- Parking scenario A3 (business as usual parking) with Transport scenario B1 (Sydney Metro North West only)

The likely outcomes from combining parking scenario A2 (no growth) with transport scenario B2 (CSELR, Western Rail line improvements and Sydney Metro City and South West) are presented in the following table.

Assuming no growth in car parking leads to an assumption that car trips will remain at existing (2011) levels. Completion of Sydney Metro and CBD and South East Light Rail will result in a shift from bus to rail to the extent that it is expected. A decline in bus trips from existing levels in 2036 would follow, and then only moderate growth beyond that to 2051. In short, it is assumed that the City Centre has reached its capacity with respect to bus trips.

The completion of Sydney Metro, and associated Western Line improvements, would see a strong increase in rail trips under this scenario. A lot of this demand would be accommodated by new rail stations and/or platforms at Barangaroo, Martin Place, Pitt Street and Central. Additionally, it is expected that the existing City Circle stations will have an increased role.

Overall, this scenario is expected to provide capacity for up to 420,000 jobs in 2036 and 470,000 jobs in 2051.

TABLE 7. A2 AND B2 NO GROWTH IN CAR PARKING, CURRENT PUBLIC TRANSPORT COMMITMENTS

Mode	Peak period central city capacity		
	2011	2036	2051
Car	50,000	50,000	50,000
Rail	140,000	230,000	250,000
Bus	70,000	60,000	65,000
Ferry/LR	10,000	20,000	25,000
Active Outside CBD*	25,000	40,000	50,000
Active Within CBD*	5,000	20,000	30,000
Total	300,000	420,000	470,000

Source: SGS Economics and Planning 2015

Car capacity in this case is considered to be fixed at the 2011 figures for future years. Rail capacity has been identified primarily through the capacity brought online through the Sydney Metro rail project and other network improvements, a summary of which can be seen in Table 17 in Appendix A.

This scenario combination sees a drop in bus capacity in 2036 to simulate the introduction of the Light Rail which will absorb many of the trips from the east. Growth in the east after 2036 will then be met with bus servicing and therefore is seen to rise again in 2051. The introduction of the Light Rail to the transport capacity network also explains the increase in capacity for the Ferry/LR mode.

Other modes (Cycle/walk) sees an increase in line with population growth both within the CBD area for the 'within CBD' trips and to the CBD for trips originating 'outside CBD'.

The likely outcomes from combining parking scenario A3 (business as usual) with transport scenario B1 (partial Sydney Metro) are shown in the table below.

In this case, car demand would increase in line with employment growth. There would be the same reduction in bus demand as per the previous scenario but the ability for rail demand to grow will be limited without completion of the second harbour rail crossing and new rail stations in the CBD. For these reasons, this scenario is only expected to accommodate 365,000 jobs in 2036 and 430,000 jobs in 2051.

TABLE 8. A3 AND B1 CURRENT SYDNEY METRO WITH NO GROWTH IN CAR PARKING

Mode	Peak period central city capacity		
	2011	2036	2051
Car	50,000	60,000	75,000
Rail	140,000	160,000	185,000
Bus	70,000	70,000	70,000
Ferry/LR	10,000	15,000	20,000
Active Outside CBD*	25,000	40,000	50,000
Active Within CBD*	5,000	20,000	30,000
Total	300,000	365,000	430,000

Source: SGS Economics and Planning 2015

Car capacity in this case grows consistent to the observed trend line. Rail and Ferry/LR are considered to experience incremental improvements and hence see a small growth in capacity. Bus mode is seen not to increase.

Other modes (Cycle/walk) sees an increase in line with population growth both within the CBD area for the 'within CBD' trips and to the CBD for trips originating 'outside CBD'.

Table 9 and Table 10 provide the employment outcomes under the range of various scenarios considered feasible in 2036 and 2051.

The discussion at the start of Chapter 3 identified combinations that were considered either altogether infeasible or inconsistent with strategic planning principles, for example, allowing growth in parking supply while trying to increase public transport demand.

A key driver of the outcomes in Table 9 and Table 10 is the limited availability of surface street space within Central Sydney. The less constraints are placed on parking growth, the more pressure will arise from car traffic for road capacity and the less space is available for surface public transport and pedestrians.

TABLE 9. 2031 SCENARIOS – EMPLOYMENT CAPACITY

Parking scenario	Transport scenario		
	B1	B2	B3
A1	Infeasible	Inconsistent with strategic principles	420,000
A2	Inconsistent with strategic principles	420,000	440,000
A3	365,000	430,000	Inconsistent with strategic principles
A4	Infeasible	Infeasible	Infeasible

Source: SGS Economics and Planning 2015

With reference to Table 10, it is clear that stronger controls on parking will require investments in public transport. In saying that, public transport needs to be feasible and consistent with strategic principles, such as B2 and B3, in order to make A1 and A2 work. The provision of good public transport will require more space currently allocated to private vehicles to become available for surface transit modes such as bus, light rail and pedestrians.

TABLE 10. 2051 SCENARIOS – EMPLOYMENT CAPACITY

Parking scenario	Transport scenario		
	B1	B2	B3
A1	Infeasible	Inconsistent with strategic principles	500,000
A2	Inconsistent with strategic principles	470,000	520,000
A3	430,000	495,000	Inconsistent with strategic principles
A4	Infeasible	Infeasible	Infeasible

Source: SGS Economics and Planning 2015

3.2 Where are the people coming from?

In comparing the 1971 Strategic Plan projections with the observed actual outcome, it is clear that travel from outer areas including Campbelltown, Central Coast and Western Outer was forecast to grow strongly. However, this has not occurred and percentages illustrated in Table 11 identify decline since 1996.

TABLE 11. ESTIMATED VERSUS OBSERVED WORKFORCE 1966 – 2011

Sector	1971 Study forecast				JTW data			
	1966	1980	1990	2000	1996	2001	2006	2011
Campbelltown	0.4%	2.1%	3.1%	4.5%	2.7%	2.6%	2.4%	2.2%
Central Coast	0.4%	1.4%	2.2%	3.4%	2.0%	1.8%	1.6%	1.4%
Eastern	18.2%	17.7%	16.4%	15.1%	13.5%	13.1%	16.0%	17.2%
North Western	7.8%	7.8%	7.2%	7.0%	9.2%	9.1%	8.6%	8.2%
Northern	21.2%	20.5%	20.8%	19.6%	21.0%	20.9%	19.5%	19.5%
South Western Inner	19.9%	16.3%	14.5%	13.1%	17.0%	17.7%	15.4%	16.6%
South Western Outer	9.1%	9.5%	9.1%	8.7%	8.3%	7.6%	7.1%	6.9%
Western Inner	10.8%	9.9%	9.1%	8.1%	9.1%	10.3%	12.6%	13.1%
Western Intermediate	8.2%	9.2%	9.1%	9.5%	8.1%	8.4%	8.3%	9.3%
Western Outer	3.9%	5.7%	8.5%	11.2%	9.1%	8.6%	8.4%	5.6%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%

Source: SGS Economics and Planning 2015

The inner areas including the Western Inner, South Western Inner and Eastern were forecast to decline, however these areas have experienced growth. This reflects the gentrification and increased population densities which the planners of the 1970s did not fully anticipate.

This divergence from the 1971 plan forecast shows that the amenity found in the leafy north suburbs and the beaches of the eastern suburbs and northern beaches has been a stronger driver for the CBD's workforce as opposed to purely travel time. Based on this, transport improvements to the west and south west will not change the desire to live in more gentrified and higher amenity areas of the city's coastline. However, we may be in the same position whereby future trends emerge shifting or contradicting today's forecasts and model assumptions.

Looking into the future (seen in Table 12), given current and proposed transport infrastructure and travel patterns, the CBD is likely to continue to draw the bulk (approximately 75 percent) of its labour from the Eastern, Northern, South West Inner, Western Inner and Western Intermediate sub-regions.

TABLE 12. ESTIMATED DISTRIBUTION OF WORKFORCE 2011 – 2051

Sector	JTW data		Forecast growth, BTS	
	2006	2011	2036	2051
Campbelltown	2.4%	2.2%	2.4%	2.5%
Central Coast	1.6%	1.4%	1.3%	1.3%
Eastern	16.0%	17.2%	16.3%	15.9%
North Western	8.6%	8.2%	8.3%	8.4%
Northern	19.5%	19.5%	18.6%	18.0%
South Western Inner	15.4%	16.6%	16.0%	15.8%
South Western Outer	7.1%	6.9%	6.5%	6.4%
Western Inner	12.6%	13.1%	13.1%	12.8%
Western Intermediate	8.3%	9.3%	11.0%	11.9%
Western Outer	8.4%	5.6%	6.4%	6.9%
TOTAL	100%	100%	100%	100%

Source: SGS Economics and Planning 2015

3.3 What does this mean for employment?

The brief describes employment growth scenarios of 10 percent, 25 percent, 50 percent and 100 percent. Assuming 75 percent of work trips are made during peak and 50,000 other trips are made during peak, the transport capacity is shown below.

Under most scenarios the 50 percent growth rate can be accommodated within the planned transport improvements. The 100 percent increase could be met with the current transport infrastructure and increased population living in the CBD (although it would be challenging) by 2051. To meet this scenario an additional major transport project (along the lines of the Sydney Metro) would be required.

In particular, it is clear that CBD employment capacity will be constrained by the capacity for travel from the inner ring. The majority of currently committed transport projects (scenarios B1 and B2) target increased capacity at the middle and outer rings. Analysis in this report has shown that demand from the inner ring will remain strong and initiatives identified in transport scenario B3 need to target constraints on particular inner ring corridors including Victoria Road bus corridor, Green Square renewal area, Inner West rail line and the Illawarra Line between Central and Sydenham.

TABLE 13. TRANSPORT CAPACITY GROWTH SINCE 2011

Growth from 2011	CBD Employment	Peak transport capacity required	Which scenario can achieve this
10%	315,000	285,000	B1
25%	355,000	315,000	B2
50%	430,000	375,000	B2
100%	570,000	480,000	B3 in 2051

Source: SGS Economics and Planning 2015

To understand the likelihood for these various employment growth scenarios, the BTS data has been referenced. Sydney – Haymarket – The Rocks is a Statistical Area 2 which aligns broadly with the CBD (refer to Table 14Table 14. CBD Precinct growth 2011 - 2051). This area has growth of 1.1 percent per year out to 2051 and results in 470,000 workers located in the CBD.

TABLE 14. CBD PRECINCT GROWTH 2011 - 2051

	2011	2036	2051
Sydney - Haymarket - The Rocks	305,000	375,000	470,000
Growth from 2011		23%	54%
Average annual growth rates		1.4%	1.1%

Source: BTS

However, this growth rate is very low when compared to historical growth rates. Between 1996 and 2011 growth in the CBD was 3.1 percent although, this was a period of rapid development. Looking back further, the growth rate between 1986 and 2011 was 2.1 percent. This would suggest that growth over the longer term would result in higher employment than the BTS would be suggesting.

TABLE 15. EMPLOYMENT IN CORE AREA SUMMARY BY CENSUS YEAR

Year	Employment	5 Year growth	Grow rate since 1986
1986	170,000		
1991	160000	-1.2%	-1.2%
1996	179,000	2.3%	0.5%
2001	200,000	2.2%	1.1%
2006	230,000	2.8%	1.5%
2011	285,000	4.4%	2.1%

Source: City of Sydney Floor Space and Employment Survey (1986, 1991, 1996, 2001, 2006)

To fully assess the capacity for future employment a site by site capacity assessment for employment (including accounting for sites which will become residential) would be required to better understand the land use capacity for employment. This would include factoring in trends of more intensive use of office space, extended opening hours for retail and food services, and other changes in work practices.

Through Trips

Not all trips entering the CBD are destined to end in the CBD. These 'through trips' are a fact of life given the current transport network but do present some challenges. If through trips have to interchange between rail lines within the CBD, this slows journey times for CBD workers and impacts on capacity. The table below presents the size of through trips by mode and gateway direction for a one hour peak period.

TABLE 16. TRIPS TO THE CBD

Mode	Trips through City by direction					
	Entering CBD	North	East	South	West	TOTAL
Car	47,500	8,000	9,000	2,000	6,000	24,500
Bus	35,500	3,000	2,000	4,000	2,000	10,500
Rail	100,500	12,000	6,000	9,000	4,000	30,500
Total*	187,500	23,000	17,000	16,000	11,000	67,000
Car	100%	15.9%	19.5%	3.3%	12.5%	51.3%
Bus	100%	8.6%	5.2%	10.4%	4.9%	29.2%
Rail	100%	11.9%	5.8%	9.0%	3.7%	30.4%
Total*	100%	12.1%	9.2%	8.4%	6.1%	35.8%

Source: SGS Economics and Planning 2015

* including Ferry & Light Rail

3.4 What does this mean for gateway demand?

An estimate has been made here of how demand through the different gateways shown earlier in Figure 11 might change under currently planned transport infrastructure – transport scenario B2. Figures are provided for 2026 and 2036 in the Figure 16 and Figure 17.

Some key assumptions made in this analysis include:

- no increase in car trips entering the City either with a CBD destination or travelling through
- moderate growth in bus and ferry corridors where no shift to rail is expected - in line with CBD employment growth.

Overall, most gateways will experience an increase in trips in line with forecast employment growth but with some important changes in the share carried by different modes. In particular, there will be a shift from bus to rail in response to improved rail services, construction of light rail and the limited ability to increase bus capacity.

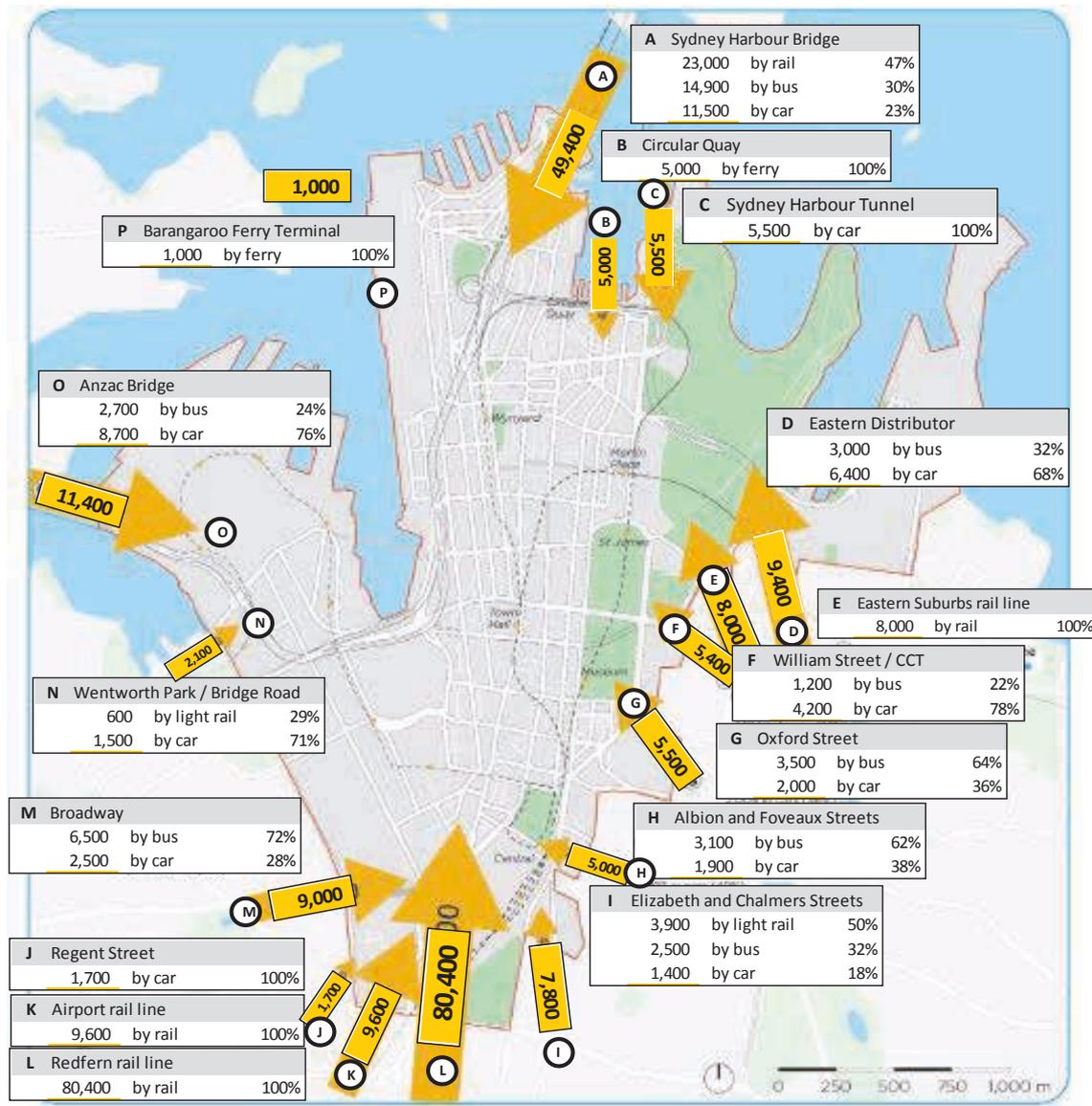
Gateways of particular note include:

- A: Sydney Harbour Bridge – a shift from bus to rail will occur as a result of completion of Sydney Metro North West in the 2026 scenario and Sydney Metro City by 2036; bus demand is expected to remain close to existing levels due to growth in demand from Northern Beaches
- H and I: Albion / Foveaux and Elizabeth / Chalmers Street – a shift from bus to light rail will occur after completion of SE light rail but this will be offset by a sharp increase in bus demand from the Green Square renewal area; the net result will be continued strong bus demand through these two corridors.

The Northern Beaches and Anzac Bridge bus corridors are expected to have continued growth in demand and contribute to increased pressures on Gateways A (Sydney Harbour Bridge) and O (Anzac Bridge). Population growth from the Northern region is expected to be below the Sydney average reflecting, to an extent, the transport constraint. Growth from the North Western region, feeding into the Anzac Bridge gateway, is expected to be at about the Sydney average.

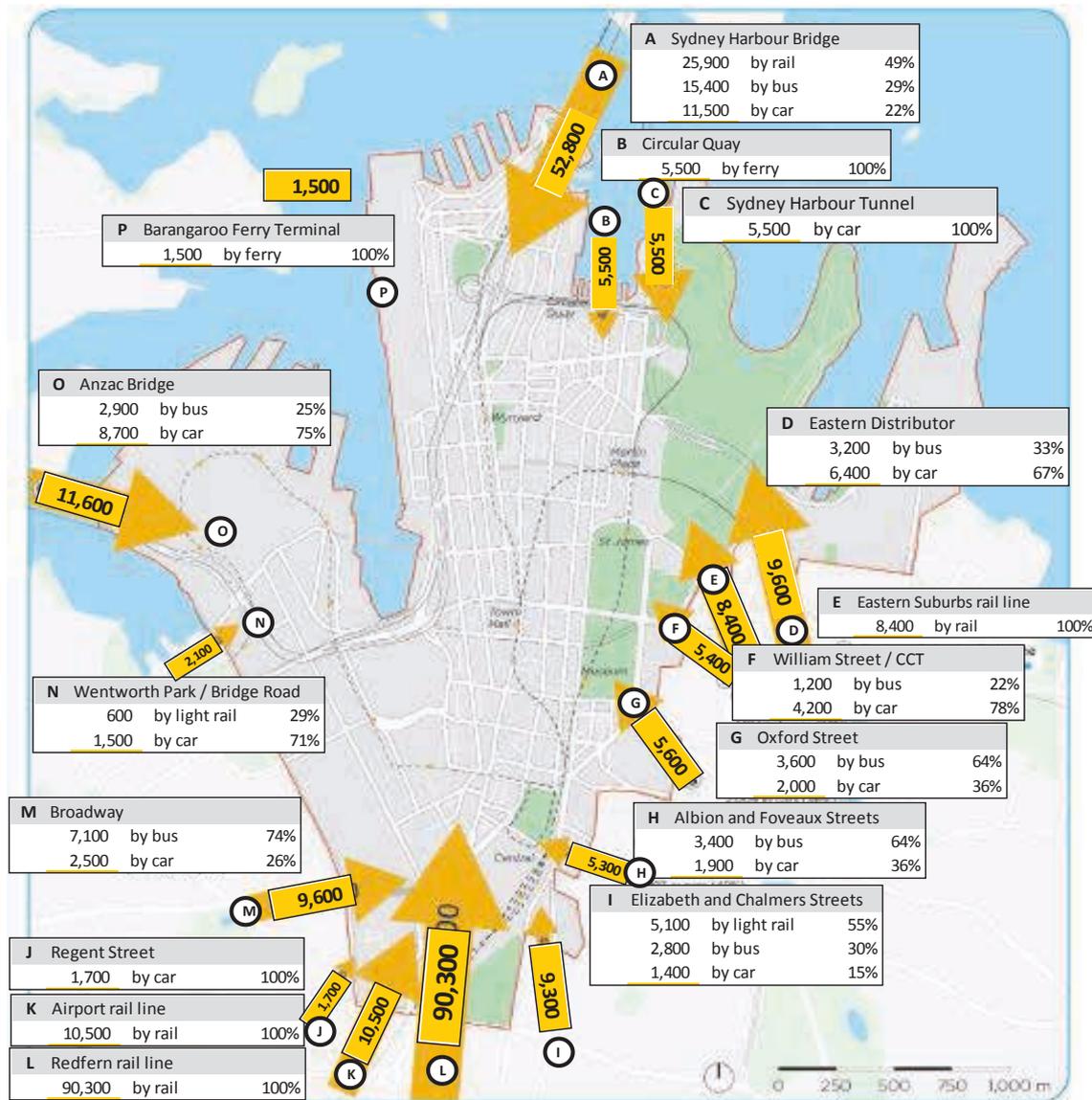
In summary, this analysis shows that while current plans for public transport provision address growth in demand from many of the Sydney regions there is a need to consider whether growth in the Ryde region is appropriate, and what solutions are available to accommodate increased bus demand from the Northern and North Western regions.

FIGURE 16. ESTIMATED GATEWAY DEMAND, 2026 UNDER SCENARIO A2-B2



Source: SGS Economics & Planning

FIGURE 17. ESTIMATED GATEWAY DEMAND, 2036 UNDER SCENARIO A2-B2



Source: SGS Economics & Planning

4 CONCLUDING REMARKS

The City of Sydney sits at the centre of the broader metropolitan economy. Ensuring that the City of Sydney is effectively planned requires careful transport and land use planning. The 1971 Strategic Plan was developed to help guide the development of the CBD to ensure sustainable and productive outcomes. A key principle in the Strategic Plan was that the maximum employment capacity of the City was assumed to be strongly linked with the capacity of the morning peak period for workers traveling to the CBD.

This study has reviewed the projections made in the 1971 Strategic Plan and produced a new set of long term projections to help inform the Central City Planning Review. The analysis of the available data revealed a number of findings:

- In 2011 around two thirds of the CBD 285,000 workers was drawn from the Northern (19.5 percent), Eastern (17.2 percent), South Western Inner sectors (16.6 percent) and Western Inner (13.1 percent) sectors. This compared to 70 percent in 1966.
- Around 75 percent of work trips are made during the peak period. Despite increasing congestion during peak periods this figure hasn't changed significantly over the past ten years.
- City workers are faced with competition from other travellers during the morning peak. These include people travel to elsewhere in Sydney via the CBD (through trips) and people travelling for other purposes (education, recreation, business trips).
- Over the past decade car travel have grown at 0.8 percent per annum, public transport trips have increased at 3.3 percent and active travel have increased by 8.2 percent (although from a very low base).

The current public transport provision would struggle to accommodate a workforce of more than 340,000. On current trends (annual growth of 2.1 percent) that level employment would be reached within the next ten years (to 2026).

The introduction of CBD and South East Light Rail, the Sydney Metro, continued growth in active travel and a range of other transport initiatives (managed growth of bus, ferry and light rail corridors) could accommodate another decade (to 2036) worth of employment growth (around 430,000 jobs).

Supporting employment growth beyond 2036 would require another transformational step in providing access to Central Sydney, including construction of the next stage of the Sydney Metro rail network. There are a number of possible options including the West Metro line or developing a metro line that services the south east. Such a South East Metro line could be accompanied by an extension of the light rail network into the inner ring around the City of Sydney providing increased capacity and reliability on highly congested bus corridors.

This transport scenario could support around half a million jobs in Central Sydney. To fully assess the capacity for future employment of this scale, a site by site capacity assessment for employment (including accounting for sites which will become residential) would be required to better understand the land use capacity for employment. This would include factoring in trends of more intensive use of office space, extended opening hours for retail and food services and other changes in work practices.

The main issue which this study identified, but could not quantify, was the pedestrian flows that a workforce of half a million people in Central Sydney would generate. The issue of pedestrian capacity is an important one, as future rail usage increases the flow of pedestrians in and out of constrained station exits, as well as on narrow footpaths, and could lead to a scenario in which pedestrian capacity is reached. Understanding the volume and variation in pedestrian flows throughout the day is crucial in understanding pedestrian capacity within Sydney's CBD. Greater insight into the pedestrian flows across Sydney's CBD would be useful in planning for anticipated increased public transport usage and employment density in the area.

While of a very different structure to the Sydney CBD, available analysis of the Melbourne CBD shows that the lunch time pedestrian peak is just as busy as the morning pedestrian peak. Key parts of the Melbourne CBD deal with a quarter of a million pedestrians each day. It is likely that the Sydney CBD would be experiencing similar or even greater traffic levels.

REFERENCES

Bolland, J. and Ashmore, D. (2002). Traffic peak spreading in congested urban environments, 25th Australasian Transport Research Forum, 2-4 October: Canberra.

Bureau of Transport Statistics (2014) 'Household Travel Survey Report: Sydney 2012/2013', Department of Transport, NSW

Holyoak, N. M. (2007). Modelling the trip departure timing decision and peak spreading policies, 2007 European Transport Conference, Netherlands.

State of NSW (2013): 'Sydney City Centre Access Strategy: December 2013', Department of Transport, NSW

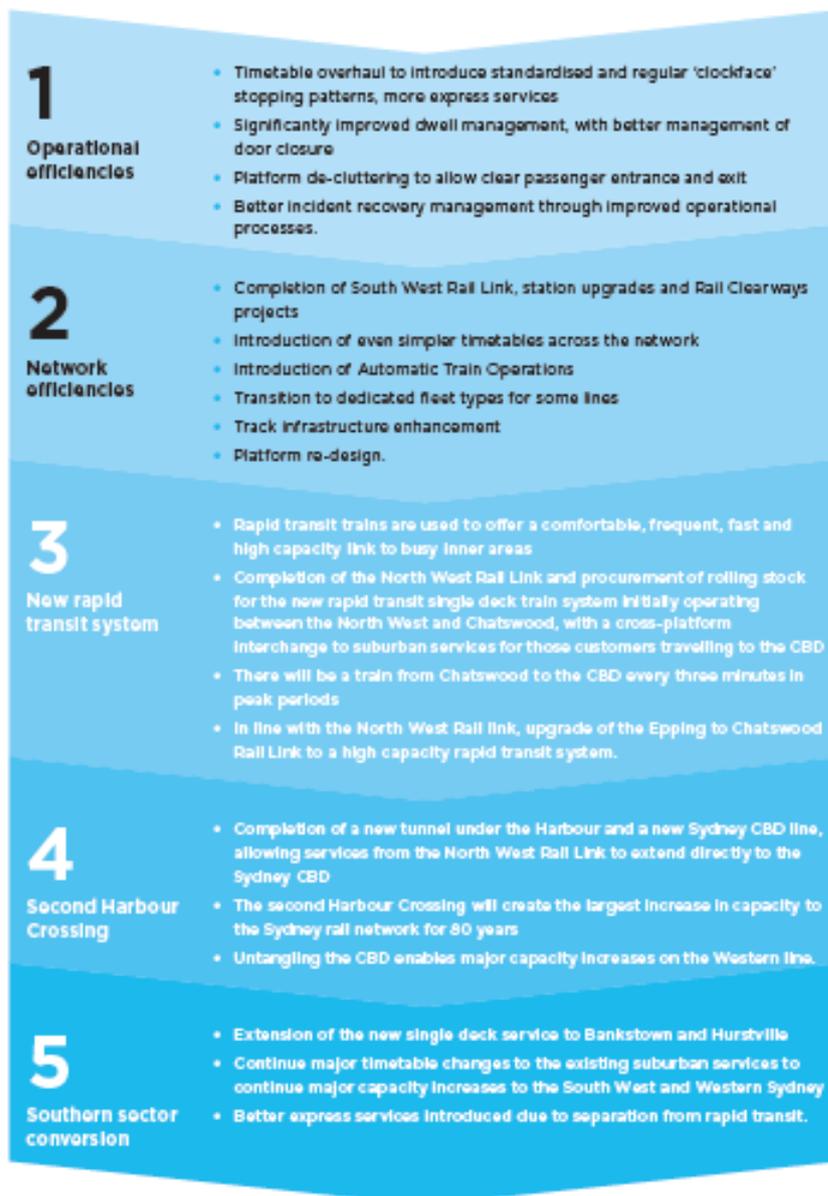
APPENDIX A

Current Government rail commitments

The State Government's *Sydney's Rail Future* document outlines five stages of improvements to the rail network (Figure 18).

FIGURE 18. SYDNEY'S RAIL FUTURE

THE FIVE STAGES OF SYDNEY'S RAIL FUTURE



Source: *Sydney's Rail Future*, Transport for NSW, 2012

An assessment of the potential impact of these stages on capacity for rail travel to the CBD is outlined in Table 17 below. Most improvements outlined in the table are targeted at travel from the outer ring of Sydney where population growth is forecast to be strong. Some parts of the middle and inner rings will not receive rail improvements.

The parts of the middle and inner rings that will receive rail improvements include:

- Inner West Line
- North Shore Line
- Bankstown Line.
-

The parts of the middle and inner rings without planned improvements include:

- The Western Line between Parramatta and Strathfield – there is an increased emphasis on express trains that may result in less stops at some minor stations such as Lidcombe, Homebush and Flemington
- The Illawarra Line between Hurstville and the CBD – the 2013 timetable ‘rationalised’ services on this line with less stops at key stations such as Kogarah; in the long term Stage 5b will increase capacity through here
- The Northern Line between Epping and Strathfield
- The Sydney Metro second harbour crossing, as currently planned, only adds two non-CBD stations in the middle and inner rings and, in this respect, operates more like a regional commuter rail line than a true ‘metro’ system

TABLE 17. REVIEW OF POTENTIAL IMPACT ON CBD CAPACITY

Line	Short Term 2013	SM North West 2019	SM City and SW 2024/25	Beyond
	Stages 1 and 2	Stage 3	Stages 4 and 5a	Stage 5b
North Shore	No significant change	Increase from 18 to 20 tph but also increased demand from SM NW interchange at Chatswood	Full SM can provide up to 30 extra tph through Central Sydney	
Bankstown	Additional services	No significant change	Conversion to single deck; 20 tph x 6-car trains; (assumed) up to 20 tph x 8-car trains.	
Illawarra Line	Rationalisation of services to spread demand more evenly	Increased from 18 to 20 tph in line with ESRL increase.	None?	Single-deck conversion to Hurstville will add 10 single-deck tph.
Western Line	Additional services to reach capacity of 20 tph	Western Sydney Rail Upgrade; more services; longer trains. SM NW takes some demand off but not much initially.	Extra 14 tph, or 35 % increase. More demand shift to SM NW	
Inner West	Homebush turn back – more services	No significant change.	Some of extra 14 tph on Western Line above may be on Inner West line.	
Northern Line	Two extra services		Increased services in line with demand	
East Hills and Airport Lines	Kingsgrove to Revesby quad - Increased services. Airport Line increased to 10 tph.		Increase of services from 10 to 16 per hour then up to 20 tph on Airport Line	
Eastern Suburbs (ESRL)	Increased from 18 to 20 tph.		No further change	

Source: SGS Economics and Planning 2015
tph = trains per hour in Up direction (towards CBD)

Contact us

CANBERRA

Level 6, 39 London Circuit
Canberra ACT 2601
+61 2 6263 5940
sgsact@sgsep.com.au

HOBART

Unit 2, 5 King Street
Bellerive TAS 7018
+61 (0)439 941 934
sgstas@sgsep.com.au

MELBOURNE

Level 5, 171 La Trobe Street
Melbourne VIC 3000
+61 3 8616 0331
sgsvic@sgsep.com.au

SYDNEY

Suite 12, 50 Reservoir Street
Surry Hills NSW 2010
+61 2 8307 0121