Recent developments in rail passenger travel demand and transit oriented development in Sydney

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1 Introduction

The history of rail network with urban development in Sydney over the past 153 years since 1855 has generally seen a mutually supporting pattern of development of new urban areas in combination with the development of the heavy rail and the former tramway (now government bus) networks.

From time to time, this historic pattern of "Transit Oriented" urban development was interrupted through periods of little or no expansion of the rail network and more recently in the newer outer suburban areas, where "Car Dependant" land use patterns have developed with infrequent bus services and no close access to rail services.

The changing demographics of the Sydney Region and it's workforce through increasing globalisation of commercial activity and rapidly growing commercial office and retailing based workforces with corresponding declines in traditional manufacturing employment, is now leading to an increasing concentration of the workforce. Strong employment growth is now occurring mainly in the Sydney CBD and other rail access based commercial centres and "growth corridors" throughout the city", e.g. Parramatta, North Ryde and St Leonards.

Elsewhere in Sydney, several major "business park" employment centres have also developed in some middle and outer suburban areas and the two largest examples of these centres are now either about to be (Macquarie Park) or proposed to be (Norwest) also connected to the rail network by new underground rail links.

Commuter rail transport (either conventional heavy rail or metro lines) despite its high capital cost, is rapidly becoming the transport mode of choice for the workforce and city planners for access to major employment centres, primarily because of its speed, comparable to cars, in moving commuters from outer suburban areas and its inherent high capacity to move large numbers of employees and visitors to and from city centres during the peak periods, with little or no adverse effects on the surface travel patterns or amenity and safety of pedestrians within the central city areas.

However, the most recent growth in rail commuter travel demand in the Sydney Region has not been without its problems. Since 2006, increased rates of growth of peak hour rail passenger travel, driven by increasing road congestion, greater environmental awareness and most recently, spiralling fuel prices, have exacerbated existing peak hour rail network capacity limitations. Many peak hour train routes and CBD stations are now operating at reasonable capacity limits for the traditional heavy rail network and type of trains. The ability of the existing heavy rail network to meet increased peak hour travel demand and still provide acceptable travelling conditions is now compromised in many locations.

This is an additional constraint which is now beginning to limit actual growth in rail passenger travel demand in the Sydney region, in addition to the poor access to the rail network in many newer outer suburban areas. In recognition of this, both the State Government and the Sydney City Council Planning Authority have now endorsed in principle a new "metro" network for Sydney, which extends the reach of the commuter rail network into many

previously unserved suburban areas of Sydney. This will provide additional underground rail transport access capacity to the CBD with new underground platforms at CBD rail stations.

In addition to the proposed surface heavy rail network extension in South West Sydney, the new metro lines will provide a strong additional focus for "Transit Oriented" development in existing urban areas of Sydney. The future transport corridor land use planning for these metro routes is still in its preliminary stages, but the opportunity for "Transit Oriented" development to occur and "land value benefit capture" principles to be applied to help fund the construction of new metro lines should not be ignored.

2 New urban development and growth in journey to work travel

The 2006 Census Journey to work travel data (trips sorted by residential origin) from the CDATA outputs from the ABS Census has been examined for both the 2001 and 2006 Census periods. The data shows for each local government area (LGA) the areas of the "Greater Metropolitan Region" (GMR) where most population growth has been occurring, in particular growth in the "active population" of employed persons who travel to and from work.

The overall year 2001-2006 total growth of 105,099 journey to work trips by all travel modes (car, bus, rail, walk, cycle and other) represent a total trip growth of 5.8 per cent (1.2% annually) in journey to work travel throughout the region. The regional distribution of this "active" population growth is illustrated by Figure 1. The three major components of the 5 year total regional growth in journey to work travel are as follows:

- 62.9% (66,157 trips) Sydney Metropolitan Region including Blue Mountains
- 27.5% (28,933 trips) Lower Hunter and Central Coast Regions
- 9.5% (10,009 trips) Illawarra - Shoalhaven - Wingecarribee Region

In this analysis, because the City of Sydney Council area has recently expanded to include the Former City of South Sydney (FSS) and a large area of Leichhardt LGA, these three areas have been grouped together as a single larger area, which is now the third largest concentration of "active" population growth in the GMR. The six largest areas of this growth are, in order of magnitude:

- Baulkham Hills 8,404 *increase* in journey-to-work trips, 2001-2006
- Blacktown 8,391
- Sydney +FSS+Leich 7,287
- Newcastle 6,078
- Lake Macquarie 5,771
- Wyong 5,694

These high growth areas (except for the City of Sydney) are all outer suburbs or adjoining regions with historically low level of rail transport usage.

The six areas with the lowest levels of "active" population growth (having negative growth) are primarily affluent coastal areas with stable resident populations but significant numbers of residents who are now leaving the workforce and continuing to live in these areas, namely:

- Waverley 1,010 *decrease* in journey-to-work trips, 2001-2006
- Woollahra 894
- Mosman 380
- Pittwater 342
- Lane Cove 294
- Manly 152

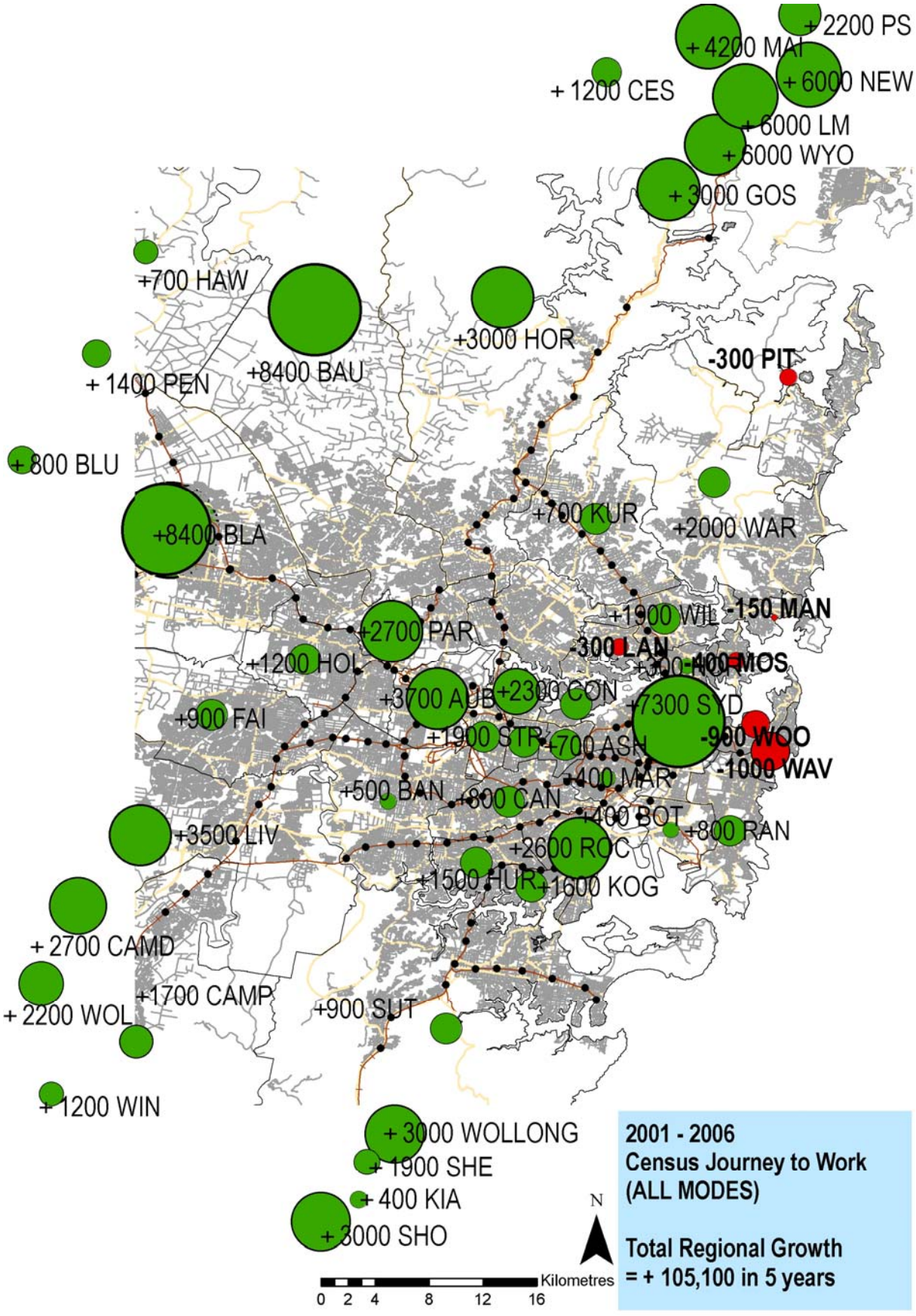


Figure 1 – Five year growth in Census journey to work travel (by residential LGA)

3 Growth in Sydney region rail travel demand

3.1 Growth in overall rail travel demand (CityRail data)

The 2001-06 growth trends in total annual rail travel in the Sydney Region is illustrated by Table 1, based on published statistics (CityRail, 2006, 2008).

Table 1 – Growth in Sydney region overall rail travel demand since 2001

Year	*Annual journeys*	*Growth from previous year*	*% Annual growth*
2000/01	285,700,000		
2001/02	276,400,000	-9,300,000	-3.3%
2002/03	273,400,000	-3,000,000	-1.1%
2003/04	273,300,000	-100,000	-0.04%
2004/05	270,300,000	-3,000,000	-1.1%
2005/06	273,100,000	+2,800,000	+1.0%
2006/07	281,500,000	+8,400,000	+3.1%
2007/08	296,100,000*	+14,700,000	+5.2%
Total	**Seven Year Period**	**+10,400,000**	**+0.5% per annum**

The overall growth trend of the CityRail patronage data shows a gradual decline during the period 2001/02 to 2004/05, with the turnaround to positive growth only occurring after 2004/05. There was a significant earlier peak of 285.7 million rail passenger trips annually in the Sydney Region which occurred during the year 2000/01. This is the adjusted figure excluding any Olympic Games related travel during the year. The actual figure for 2000/01 including Olympic Games travel was over 300 million trips.

The overall 5 year growth increment in the data in Table 1, from the year 2001/02 to the year 2006/07, shows an increase of 5.1 million annual rail passenger journeys over the period. During this period the growth in rail travel demand was suppressed by a number of factors, including the opening of new road projects (the M5 East and the M7 motorways), poor reliability of peak hour on-time running of trains, driver shortages, timetable adjustments including a significant slowing of many trains, reduced weekday and weekend off peak train service frequencies and two high profile rail accidents involving multiple fatalities.

3.2 Growth in journey to work rail travel demand (Census data)

A similar “residential LGA” based analysis of the 5 year growth in journey work travel by rail has been undertaken for the GMR region as illustrated graphically by Figure 2. In this case the distribution of growth areas is markedly different to Figure 1, with the rail travel growth being much more concentrated from the inner and middle ring suburbs and with the exception of the Blacktown and Campbelltown LGAs, very little growth is occurring from the outer suburbs and the Central Coast, Newcastle, Illawarra and Shoalhaven areas.

The overall 2001-2006 growth in journey to work rail travel in the region is 24,918 trips which represent overall growth of 10 per cent (2% annually) over the period. Including return journeys each day, this growth is equivalent to 14.7 million additional rail passenger trips annually which is significantly higher than the actual total growth of 5.1 million CityRail passenger journeys for the corresponding period which is shown in Table 1.

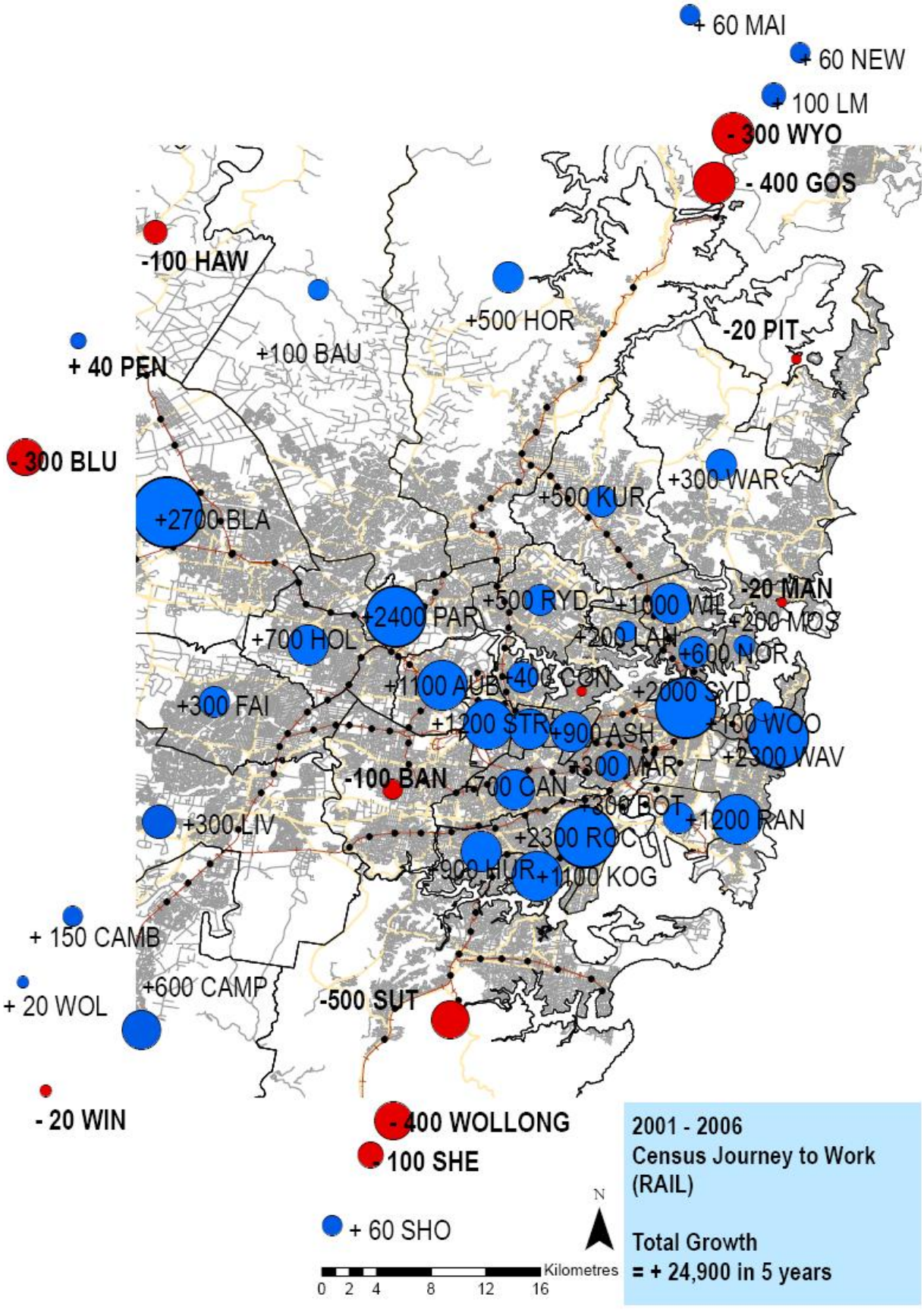


Figure 2 – Five year growth in Census journey to work rail travel (by residential LGA)

The comparison of the Census data 2001-06 growth in journey to work rail travel and the CityRail annual trips data between 2001 and 2006 indicates that, in conjunction with the recent growth in journey to work rail travel, there must actually have been a decline in other types of rail travel, for example off peak period and recreational travel.

Also, the new growth in the rail passenger journey to work travel is effectively now all occurring from the Central City, Inner Western and Central Western residential sub regions of Sydney. The six highest areas of rail passenger journey to work travel demand growth, which account for over half the total growth over the 5 year period, are as follows:

- Blacktown 2,657 *increase* in journey-to-work rail trips, 2001-2006
- Parramatta 2,447
- Waverley 2,327
- Rockdale 2,283
- Sydney +FSS+Leich 2,092
- Strathfield 1,245

The six highest journey to work rail travel growth areas are primarily LGAs located on the Main Western rail line corridor directly to the west of the Sydney CBD. Only Rockdale and Waverley LGAs are located on other lines. The six lowest (negative growth) areas of rail passenger journey to work travel demand over the 5 year period are as follows:

- Sutherland 494 *decrease* in journey-to-work rail trips, 2001-2006
- Wollongong 448
- Gosford 414
- Wyong 314
- Blue Mountains 270
- Bankstown 125

The six lowest (negative growth) journey to work rail travel areas are all Outer Suburban Sydney or Central Coast and Illawarra Region LGAs, with only Bankstown being close to the "middle ring" suburban area. There are many possible reasons why journey to work rail travel has been declining from these outer areas, ranging from positive community factors such as greater local availability of jobs now in the outer metropolitan areas reducing the need for longer distance rail commuter travel and the lack of highway tolls on the Central Coast, Hunter and Illawarra Region road networks making road travel less expensive in these areas, to negative factors for the rail network such as longer journey times for longer distance rail travel, high levels of passenger crowding of peak hour trains and temporary reductions in passenger confidence in rail safety as a consequence of rail accidents.

4 Distance and other factors in rail commuter travel

The declines in longer distance journey to work rail travel in the Sydney region during 2001-6 indicate there is a distance factor affecting the attractiveness and potential for growth in journey to work rail travel. This is also illustrated by the changes in the ranking of all 53 LGAs of the GMR by resident's percentage journey to work rail travel as shown in Table 2, Figure 3 and Figure 4.

The changes in the percentage levels and ranking of the 53 LGAs in Table 2, over the past 5 years, is an indication of many factors including the quality and attractiveness of the rail services. The Inner Western Sydney LGAs of Ashfield, Burwood, Marrickville and Strathfield all show up as having consistently high levels of rail travel percentage for the journey to work by LGA residents. The rail travel percentages for the journey to work from these LGAs have now increased typically from the "low to mid" thirties to the "mid to high" thirties.

Table 2 – Change in total and rail journey to work by residential LGA of origin (past 5 years)

	2001				*2006*		
LGA Name	*Total JTW*	*Rail JTW*	*% Rail*	*LGA Name*	*Total JTW*	*Rail JTW*	*% Rail*
Ashfield	15,862	5,352	34%	Burwood	11,724	4,501	38%
Burwood	10,808	3,543	33%	Ashfield	16,523	6,244	38%
Marrickville	32,023	9,561	30%	Waverley	25,546	8,957	35%
Auburn	16,812	4,956	29%	Strathfield	12,013	4,008	33%
Hurstville	27,255	7,568	28%	Marrickville	32,400	9,827	30%
Strathfield	10,155	2,763	27%	Auburn	20,473	6,091	30%
Kogarah	19,718	5,129	26%	Hurstville	28,771	8,430	29%
Kuring-gai	36,575	9,157	25%	Kogarah	21,292	6,207	29%
Waverley	26,556	6,630	25%	Rockdale	35,886	10,337	29%
Rockdale	33,278	8,054	24%	Kuring-gai	37,300	9,609	26%
Canterbury	43,168	10,380	24%	Canterbury	43,981	11,038	25%
Hornsby	59,552	14,054	24%	Hornsby	62,571	14,596	23%
Concord - Canada Bay	11,244	2,338	21%	Parramatta	55,694	12,398	22%
Campbelltown	52,748	10,557	20%	Willoughby	26,683	5,675	21%
Parramatta	52,961	9,951	19%	Campbelltown	54,403	11,171	21%
Willoughby	24,827	4,634	19%	Concord - Canada Bay	13,529	2,774	21%
Holroyd	32,204	5,991	19%	Holroyd	33,431	6,670	20%
North Sydney	29,947	5,274	18%	North Sydney	30,286	5,848	19%
Bankstown	56,188	9,837	18%	Blacktown	102,526	19,050	19%
Blacktown	94,135	16,393	17%	Woollahra	20,703	3,836	19%
Sutherland	88,133	15,319	17%	Bankstown	56,642	9,712	17%
Woollahra	21,597	3,702	17%	Sutherland	89,073	14,825	17%
Gosford	50,563	7,983	16%	Sydney + FSS+ Leich.	90,763	14,217	16%
Blue Mountains	27,010	4,105	15%	Fairfield	57,621	8,367	15%
Sydney + FSS+ Leich.	83,476	12,125	15%	Gosford	53,703	7,569	14%
Fairfield	56,709	8,103	14%	Blue Mountains	27,731	3,835	14%
Liverpool	55,419	7,403	13%	Liverpool	58,927	7,653	13%
Penrith	68,411	8,688	13%	Penrith	69,785	8,727	13%
Ryde	39,808	4,377	11%	Ryde	39,809	4,900	12%
Lane Cove	13,567	1,233	9%	Lane Cove	13,273	1,386	10%
Wollongong	60,491	4,617	8%	Randwick	50,417	3,764	7%
Camden	17,953	1,327	7%	Camden	20,652	1,483	7%
Wyong	38,062	2,709	7%	Wollongong	63,630	4,169	7%
Baulkham Hills	61,381	4,274	7%	Baulkham Hills	69,785	4,372	6%
Hawkesbury	23,888	1,360	6%	Botany Bay	14,463	879	6%
Wollondilly	13,865	744	5%	Wyong	43,756	2,395	5%
Randwick	49,647	2,549	5%	Mosman	10,797	573	5%
Manly	15,442	629	4%	Hawkesbury	24,546	1,275	5%
Botany Bay	14,088	557	4%	Wollondilly	15,896	766	5%
Mosman	11,177	409	4%	Manly	15,290	614	4%
Drummoyne Canada B	14,727	490	3%	Drummoyne Canada B	15,514	469	3%
Maitland	17,874	521	3%	Hunter's Hill	4,590	130	3%
Shellharbour	18,859	491	3%	Warringah	57,770	1,579	3%
Wingecarribee	12,968	330	3%	Maitland	22,098	583	3%
Kiama	6,153	152	2%	Kiama	6,649	151	2%
Hunter's Hill	4,518	110	2%	Wingecarribee	14,131	319	2%
Warringah	55,748	1,243	2%	Shellharbour	20,848	391	2%
Lake Macquarie	56,786	955	2%	Lake Macquarie	62,557	1,066	2%
Newcastle	45,017	640	1%	Newcastle	51,095	710	1%
Pittwater	21,847	213	1%	Pittwater	21,505	188	1%
Shoalhaven	21,461	102	0%	Shoalhaven	24,683	157	1%
Cessnock	12,619	53	0%	Cessnock	14,233	57	0%
Port Stephens	16,594	53	0%	Port Stephens	19,006	58	0%
Total	**1,801,874**	**249,688**	**13.9%**	**Total**	**1,906,973**	**274,606**	**14.4%**

Source: Census Data, CDATA for 2001 and 2006

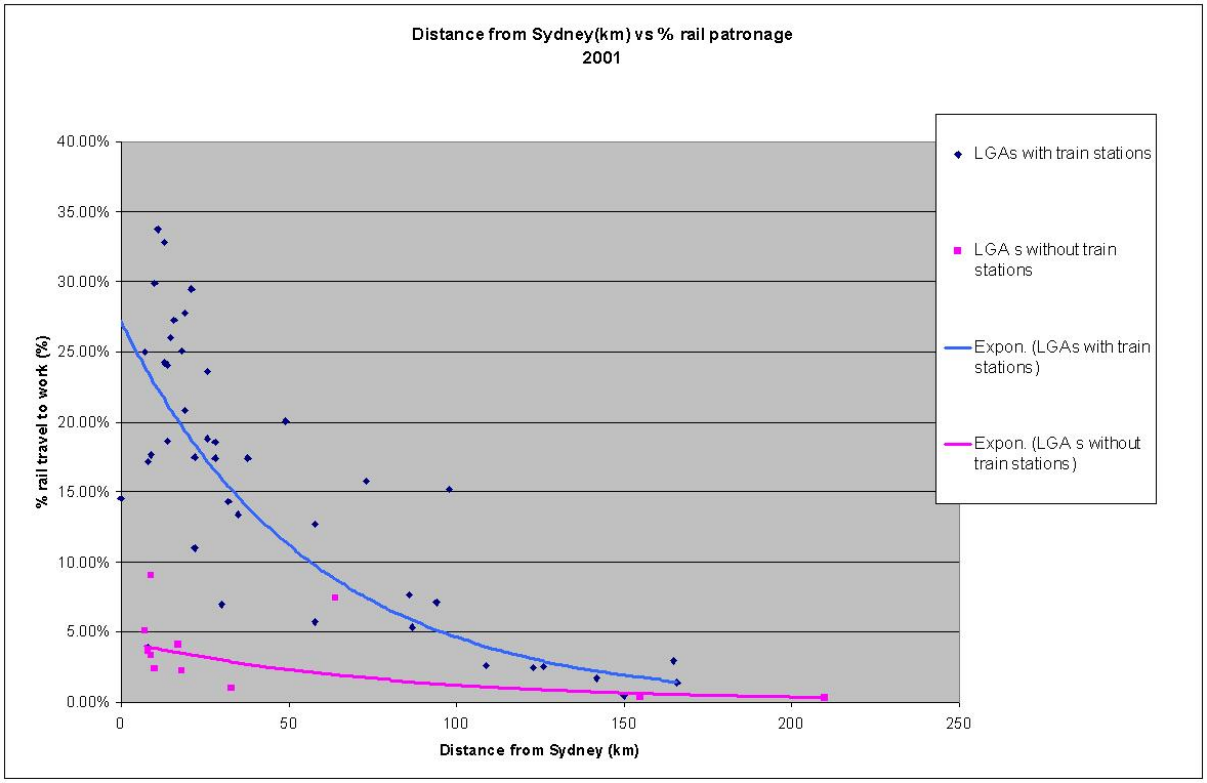


Figure 3 – Journey to work % travel by rail vs distance from the Sydney CBD (2001)

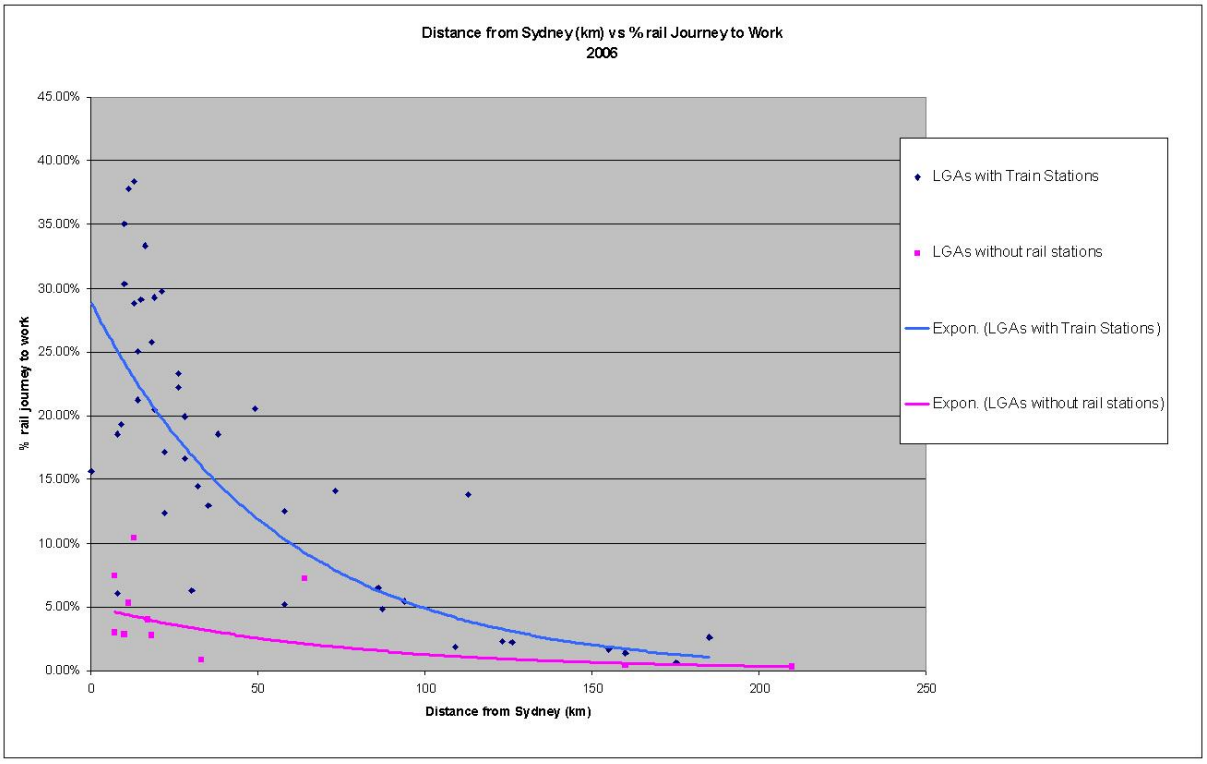


Figure 4 – Journey to work % travel by rail vs distance from the Sydney CBD (2006)

The data in Figure 3 and Figure 4 shows that the attractiveness of rail travel for the journey to work now effectively peaks within a 10 kilometre radius of the Sydney CBD and progressively declines at increasing distances from the Sydney CBD beyond this range. In this grouping, Baulkham Hills is included in the group of LGAs that have rail stations although its single rail station (Carlingford) is located at the extreme South East corner of the LGA and the peak hour rail service from this station is relatively infrequent and indirect.

The changes in Figure 2 for the % journey to work rail travel in the census between 2001 and 2006 are clearly showing a decline in longer distance journey to work rail travel occurring from the outer areas of the GMR Region during this period, despite the generous subsidy, on a per kilometre travel cost basis, which is offered to longer distance rail commuters in comparison to shorter distance rail travel.

On most lines leading into the Sydney CBD, the high level of crowding of peak hour train services, which is now typically 100-150% seated capacity (CityRail, 2008), combined with the limited time for which passengers are prepared to stand while travelling on trains, means that effective growth in peak hour rail passenger travel is now only possible from areas within "standing commuter" travel distance from the Sydney CBD.

This "distance effect" is illustrated by the two plots in Figure 3 and Figure 4 which compare the 2001 and 2006 census data, showing the trend lines for the journey to work percentage travel by rail compared to distance from the Sydney CBD, for those areas that either have or do not have direct access to the rail network. For the inner suburban LGAs, where distance to the CBD is low, the y-axis intercept percentage has increased from 27% to 29%, which is a 2 per cent increase in rail travel journey to work for LGAs closest to the CBD.

5 The transit orientation of new urban development

During the period 2001-06, "Transit-Oriented" residential development has been occurring increasing rail patronage within the primary walking distance catchments of many railway stations in the Sydney Region. The extent to which new urban development and population growth in any part of the Sydney Region can be considered "Transit Oriented Development" is defined here primarily with reference to the rail network as this is the major focus of the "Transit Oriented" urban development" which has been occurring in the Sydney Region.

The other major public transport corridors in Sydney such as the south eastern bus corridor through Randwick (Anzac Parade) and the northern beaches bus corridor via Military Road, Spit Road and Pittwater Road are also potential major "Transit Oriented Development" corridors and have attracted significant clusters of higher density residential developments in recent years. These major bus corridors in Sydney, including the Parramatta Road and Victoria Road bus corridors to the west, are now identified by the NSW Government and the City of Sydney Council planning as potential new "Metro Rail" Corridors.

The most visible "Transit Oriented Developments" in the Sydney Region are the high density "high rise" type developments which have been growing up in close proximity to major railway stations including at Bondi Junction, Strathfield, Parramatta, various locations in the Sydney CBD, North Sydney, St Leonards and Chatswood and also at Wolli Creek Junction and potentially at Green Square on the Airport Rail Link. These developments are all generally located within the prime 200-400 metre walking distance catchments of the railway stations. Other "Transit Oriented Development" more of a low rise nature, within the outer walking distance catchments, 400-800 metre radius of railway stations, can also contribute significantly to achieving regional or sub regional "Transit Oriented Development" growth outcomes, although in a less highly visible manner.

The Census data definition of rail based journey to work travel includes all types of bus and car feeder travel to rail stations in addition to journeys where persons walk to the railway station and from the railway station to their destination at the other end of the journey. The census data does not however distinguish whether these other travel modes are used at the beginning or the end of the rail journey, so cannot precisely determine station access modes.

However in the five largest rail commuter growth residential LGAs of the Sydney Region (Blacktown, Parramatta, Rockdale, Waverley and the City of Sydney) approximately 33% of the recent growth in rail based Journey to Work Travel is "rail only" travel with walking access to and from the rail station at both ends of the journey. This proportion of the overall growth in rail based journey to work travel must clearly be "Transit Oriented Development", i.e. development which generates travel walking distance of railway stations at both the origin and destination points of the journey.

In this analysis, the practical measure of the effectiveness of new urban development as "Transit Oriented Development" in the various regions of Sydney is effectively the percentage of the overall growth in journey to work travel which occurs with rail based travel as the primary travel mode. This analysis is shown in Table 3 and Figure 5.

Table 3 – Rail travel capture % of growth in journey to work travel demand since 2001

Sub region	*Name*	*Overall growth in journey-to-work travel*	*Growth in rail-based journey-to-work travel*	*% rail factor in growth*
1	East	-759	3,998	Over 100%
2	Inner North	1,594	2,475	Over 100%
3	South	7,828	4,653	59.4%
4	Inner West	6,507	3,510	53.9%
5	West Central	8,987	4,400	49.0%
6	Central (City of Sydney)	7,287	2,092	28.7%
7	North	3,744	994	26.5%
8	North East	1,528	296	19.4%
9	North West	19,548	2,439	12.5%
10	South West	9,893	1,042	10.5%
11	Central Coast and Lower Hunter	28,933	-476	Less than 0%
12	Illawarra Shoalhaven and Wingecarribee	10,009	-505	Less than 0%
Total	**All areas**	**105,099**	**24,918**	**23.7%**

The results in Table 3 show that the overall rail factor in journey to work travel growth throughout the GMR region, during the period 2001 to 2006, is approximately 24% which is significantly higher than the base level of 14% journey to work travel which existed in 2001.

When the Sydney region component of the GMR region (excluding the Central Coast, Lower Hunter and Illawarra-Shoalhaven-Wingecarribee regions) is considered alone, the marginal rate of rail capture of the increase in journey to work travel is even higher at 39%, based on the overall increase of 66,157 journey to work trips from these LGAs compared to 25,899 additional journey to work trips by rail from these LGAs between the 2001 and 2006 Census.

6 Regional and sub regional planning strategies

The NSW Government's regional and sub-regional planning strategies for Sydney and other parts of the GMR have been progressively developed and released over the past two years commencing with the overall metropolitan strategy document "City of Cities" (NSW Department of Planning 2005). The strategy provided future dwellings growth targets for the period 2004-2031 for each of twelve sub regions of the GMR based on detailed analysis of the development potential of individual areas at a micro (Census Collector District) level.

The draft sub-regional strategy documents for the Central Coast and eight of the ten Sydney regions (NSW Department of Planning 2007) were progressively released during 2007. In many cases these strategies have revised upwards the future period 2004-2031 dwellings growth targets for each sub region and also formally distributed these dwellings growth target between the individual LGAs in each sub region.

The overall distribution of future dwellings growth targets in the Sydney region is illustrated by Figure 6. The balance between the targets for the new greenfield growth areas (the North West and South West Growth Centres) and the targets for the existing urban and urban fringe LGAs is approximately 70% : 30%.

The actual dwellings growth targets are plus 437,300 new dwellings for existing areas which are still under the control of local government and plus 181,000 new dwellings for the growth centres. These targets are now the formal responsibility of these agencies to plan for and manage the impacts of. However planning for new major transport infrastructure such as improvements to the rail network remains the responsibility of the State Government.

7 Future transit oriented development opportunities

Based on the recent past trends as illustrated by Figure 5, the best future opportunities for "Transit Oriented Development" should actually be found in the Eastern and Inner Northern sub regions of Sydney which are already achieving over 100% rail travel capture of all growth in journey to work trips. However, the major proportion of the future Sydney region dwellings growth targets (including the North West and South West Growth Centres) are all generally located in the western half of the region, as shown in Figure 6, where rail based journey to work travel has recently been capturing only relatively small proportions (typically 10-12%) of the overall growth in journey-to-work travel.

However, the NSW Government proposes significant rail network development projects to address this deficiency including two current projects now under construction (The Epping to Chatswood rail line and the Cronulla rail line duplication) and three projects for which the planning stage is now substantially under way (the South West rail link to Leppington, the Richmond rail Line duplication to Vineyard and the North West rail line to Rouse Hill – as either a heavy rail or a metro line).

The location of these new rail projects and their respective corridors are illustrated in Figure 7 and Figure 8. These five new rail projects are the key locations where additional capacity is being provided for the rail network and should therefore be the primary focus of future "Transit Oriented Development" in the Sydney Region from both a development perspective and a "sustainable transport outcomes" perspective. There are also numerous existing urban areas which present significant redevelopment opportunities for "Transit Oriented Developments" in conjunction with other public transport in the Sydney Region. These opportunities are also illustrated in Figure 7 and Figure 8.

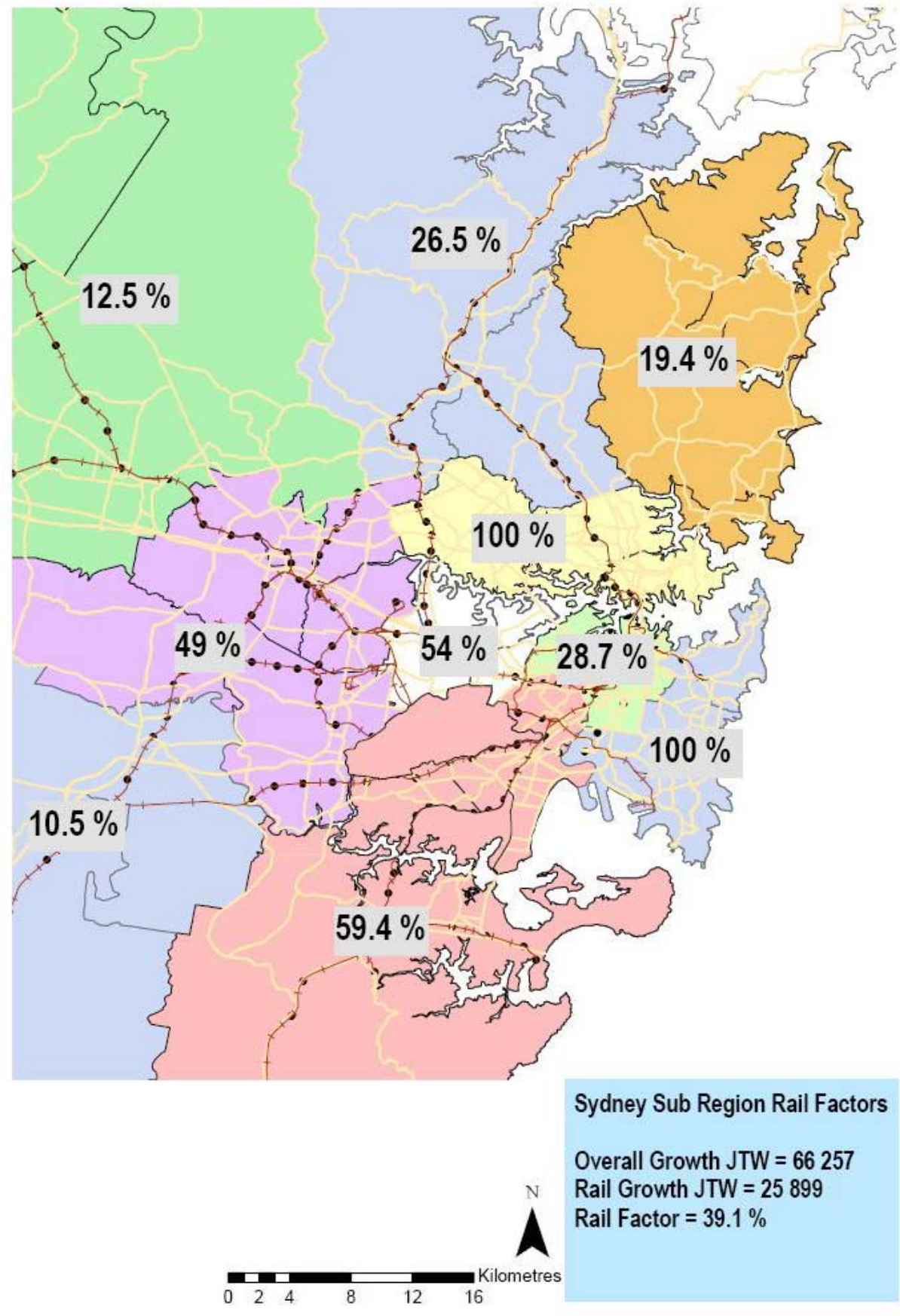
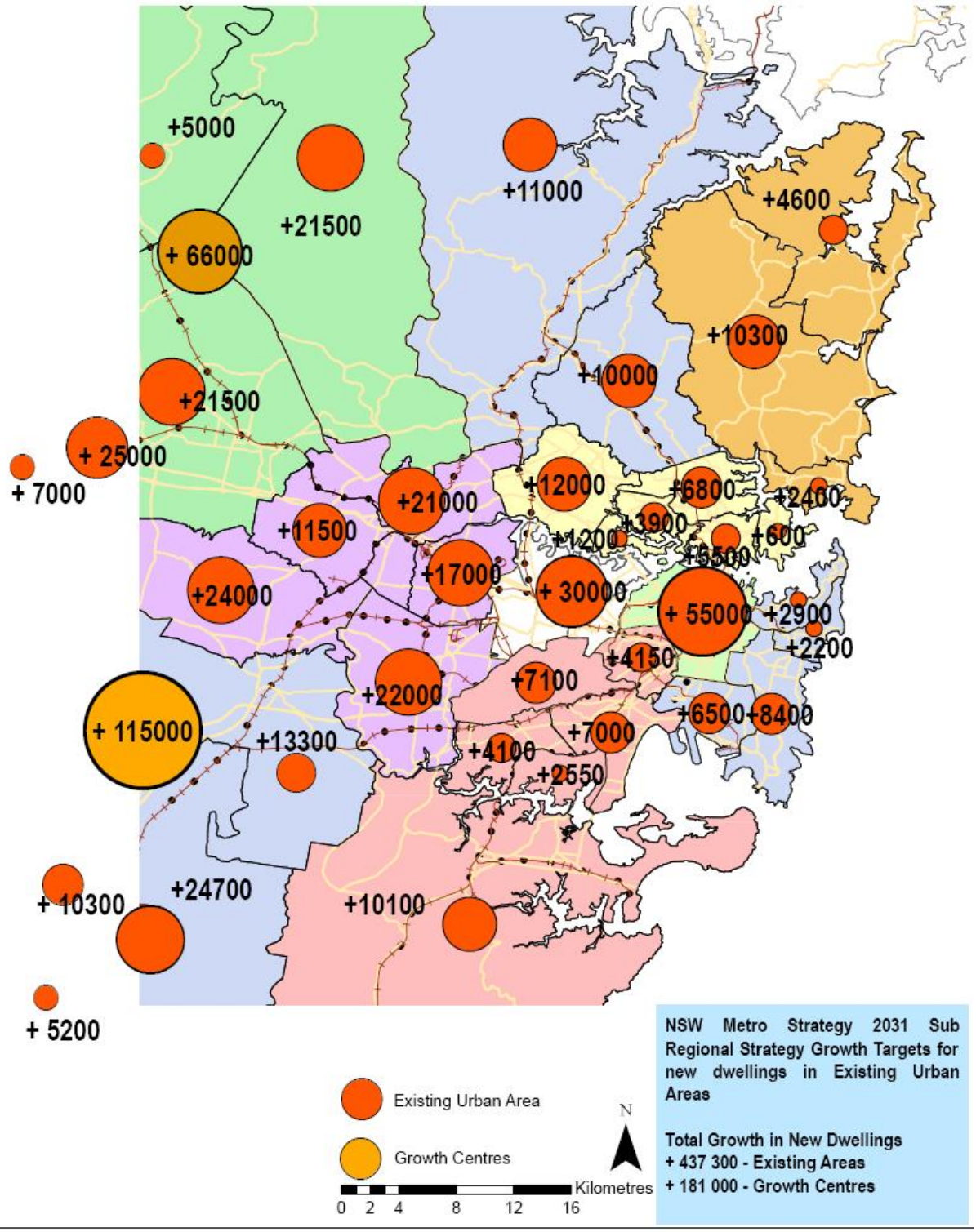


Figure 5 – Sydney sub-region rail factors in the 2001-06 journey-to-work travel growth



Note: The Inner West total of +30,000 is the total for the entire sub region

Figure 6 – 2031 Sydney sub regional growth strategy LGA targets for new dwellings

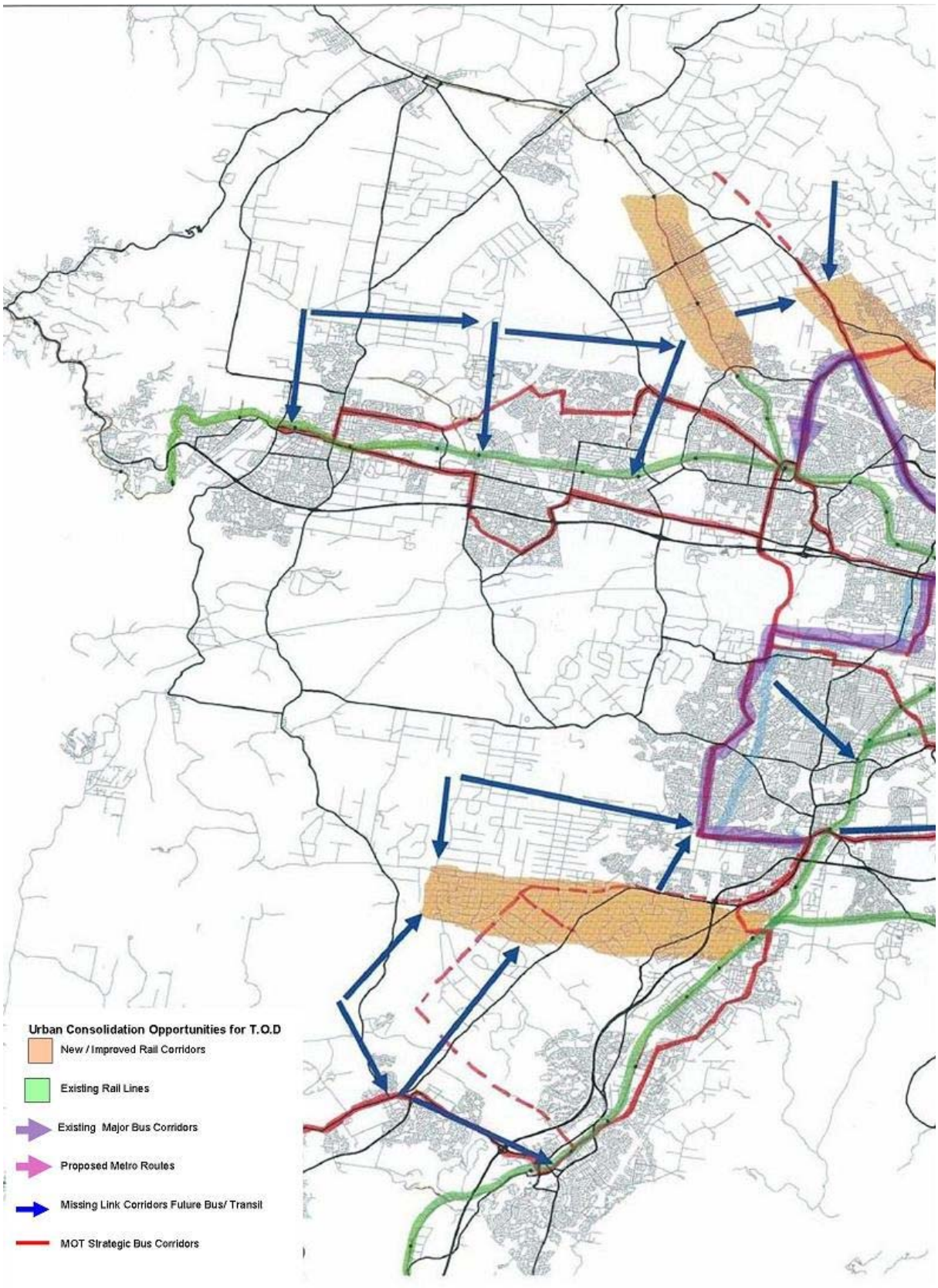


Figure 7 – Urban consolidation opportunities for TOD in Sydney - West

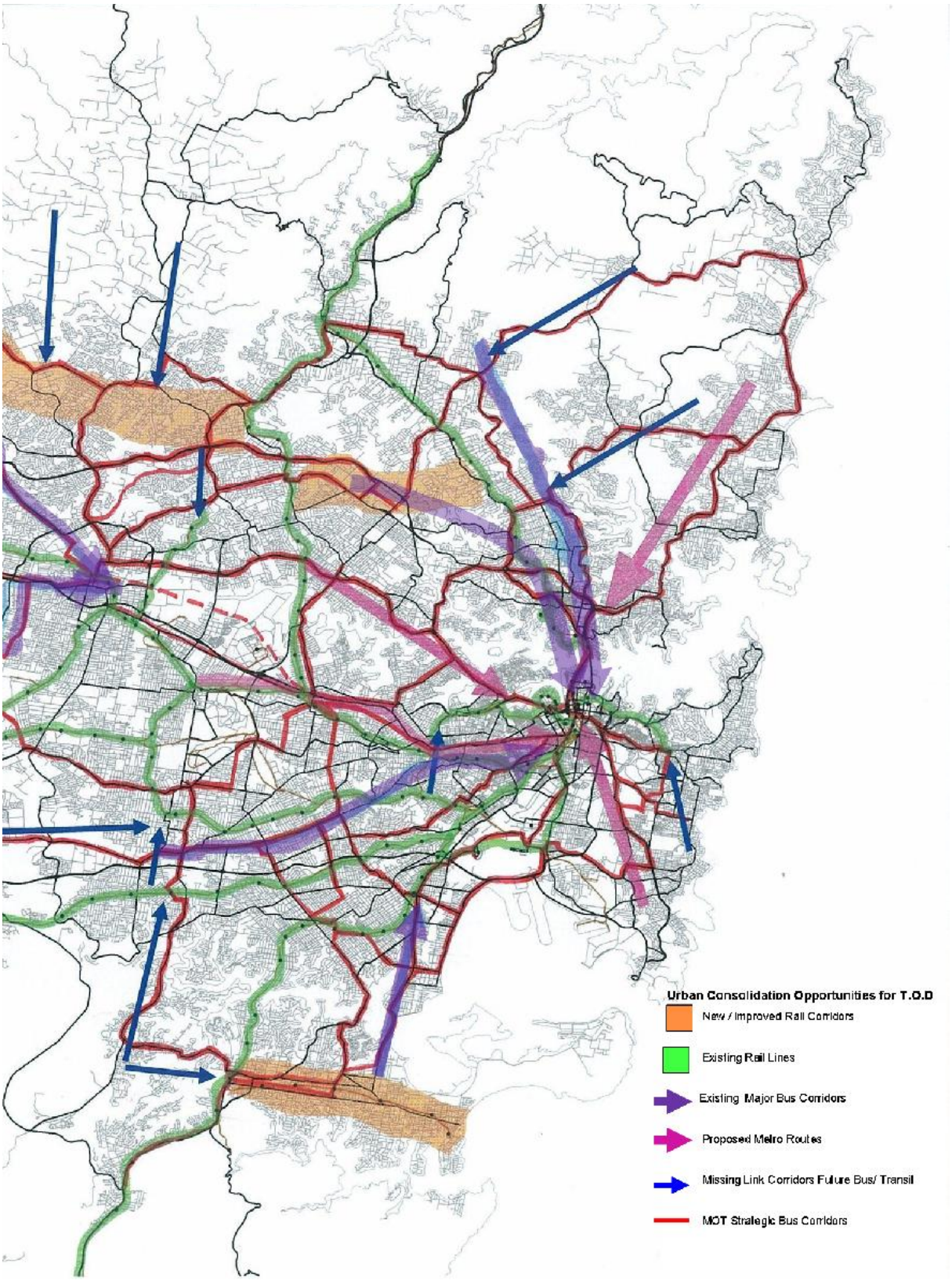


Figure 8 – Urban consolidation opportunities for TOD in Sydney - East

In the Sydney region, the full range of opportunities for future "Transit Oriented Development" is represented by the following transport modes and networks.

- Major rail stations on the existing heavy rail network
- Local rail stations on the existing heavy rail network
- Proposed metro routes (which generally follow major bus corridors)
- The MOT-identified network of 43 strategic bus corridors
- Other "missing link" bus-light rail corridors

For typical major railway stations on the existing heavy rail network, such as Blacktown and Rockdale, the full range of types of "Transit Oriented Development" which can occur within the primary and secondary walking distance catchments, are illustrated by the two maps in Figure 9. These two centres are good examples in Sydney of well developed "major railway station" centres where urban consolidation has occurred uniformly in all directions, although there could potentially be more future "mixed-use" town centre development at Blacktown.

For the major railway stations, the primary walking distance catchments (generally up to a 400 metre radius from the railway station) represent the core retail and commercial areas of these centres where higher density residential flats, including "medium rise and high rise" residential development, would be appropriate, subject to the necessary review of Council zoning and development controls. At most major railway stations, this type of development is appropriate but at local railway stations a lower height limit e.g. three stories, should generally be maintained.

For the secondary walking distance catchments of most major and the local railway stations (e.g. the areas between the 400 metre radius and the 800 metre radius rings), the type of "Transit Oriented Development" which would be most appropriate, subject to the appropriate changes to council zoning and development controls, would be two to three storey type townhouse type development, potentially similar in many respects to European-style inner city terrace housing.

This paper has not specifically investigated the future potential types and most appropriate locations for "Transit Oriented Development" in the adjoining Central Coast - Lower Hunter and Illawarra – Shoalhaven - Wingecarribee regions but there are significant over riding constraints to passenger rail access and efficient rail services which need to be addressed over time to promote more effectively future "Transit Oriented Development" based residential development strategies for these regions

In the Newcastle area, there are many potential urban renewal- urban consolidation sites available close to the railway line and rail stations, but the attractiveness of living close to the railway lines is compromised by the freight rail usage of the network where coal and other freight trains are using the network throughout the day and night time. A future freight rail bypass route of the Newcastle Urban Area (from Fassifern to Hexham) has been identified by the rail freight planning authorities for a number of years, primarily for reasons of freight rail capacity and efficiency but would also have potentially significant benefits in encouraging future residential development to be located in closer to the railway stations in the region.

In the Illawarra region, the current alignment of the railway line between Waterfall and Bulli, including a single track section at the Coal Cliff Tunnel, is a major constraint to improving the rail capacity and travel times for commuting to and from Sydney. This constraint can be addressed by a new rail bypass corridor route, either running along the coastal corridor in a tunnel generally parallel to the existing line, or inland potentially utilising a future high speed rail route into Sydney via the East Hills Line, through South West Sydney to Douglas Park, then utilising the partly constructed Maldon to Dombarton railway to reach the Wollongong urban area at Dapto.

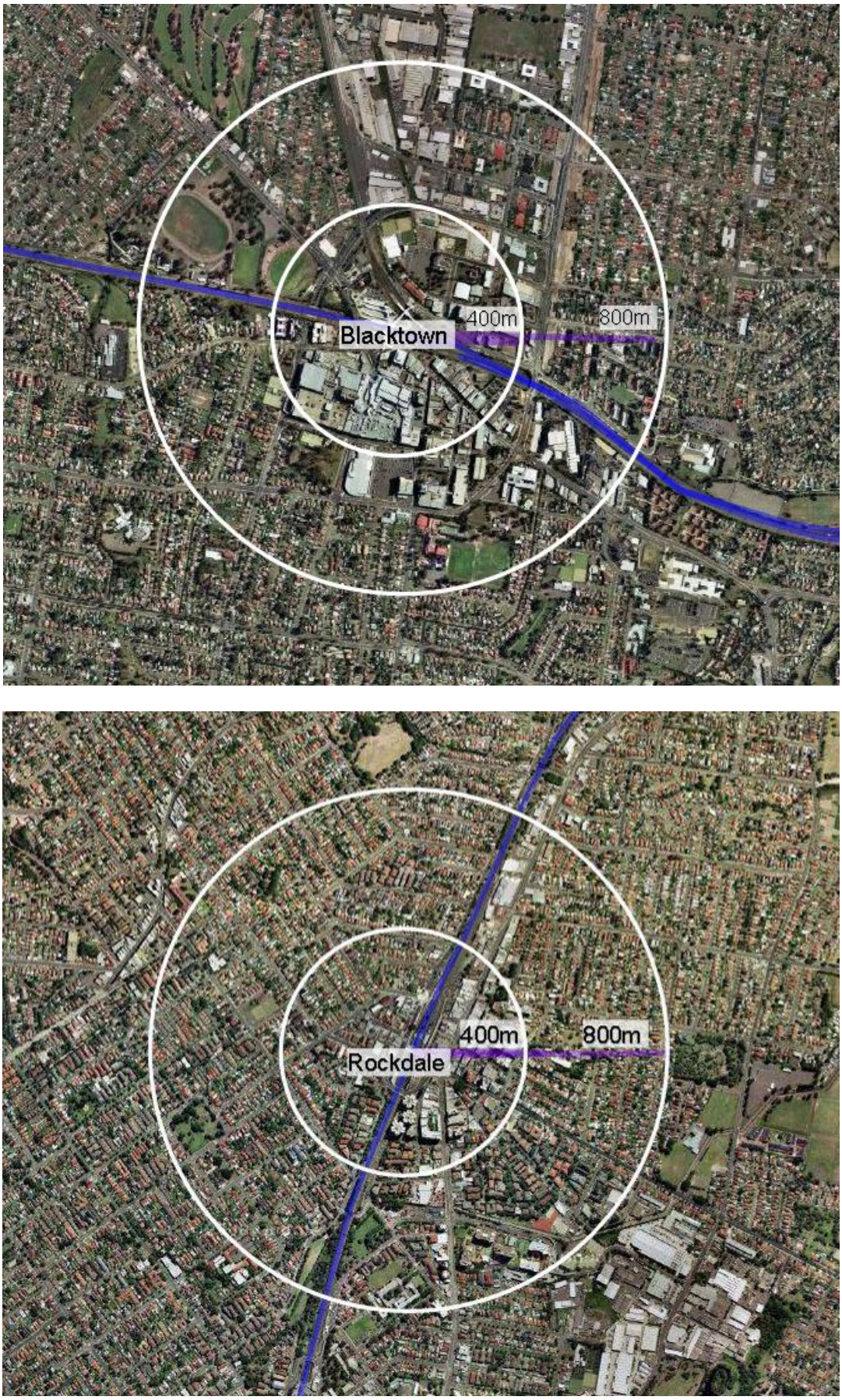


Figure 9 – Examples of major station urban consolidation in walking catchments at Blacktown (top) and Rockdale (bottom).

8 Conclusions

8.1 Urban consolidation strategy

The NSW Government's metropolitan planning strategy is substantially committed to urban consolidation principles for the Sydney Region now and as part of long term planning for the adjoining regions in the future. In Sydney, the future dwellings growth targets for each local government area and the North West and South West growth centres, now represent a future 70% : 30% balance between new dwellings in existing areas and the development of the "Growth Centres" as new urban communities.

Although this planning strategy proposes large numbers of new dwellings to be constructed in areas of North and South Western Sydney that do not currently have high levels of rail transport usage for the journey to work, there are corresponding transport strategies in place to address this deficiency.

In many existing urban areas, there are also significant targets for the construction of new dwellings (up to 25,000 additional dwellings for some individual LGAs) to meet the year 2031 sub regional planning strategy targets. A large proportion of these dwellings will need to be constructed in areas close to existing railway stations to achieve the overall "integrated land use and transport planning" development objectives of the various sub regional planning strategies (NSW Department of Planning, 2007)

8.2 The funding of new rail infrastructure and services

For the effective urban consolidation objectives and economic benefits of the new rail lines and systems in the Sydney region to be fully realised, future station area urban development masterplans must be prepared including revised planning controls permitting increased urban consolidation within each of the relevant station area catchments. This will require the detailed co-operation and co-ordination of land use and transport planning policies and activities between the relevant NSW State and Local Government Authorities.

In the Growth Centres Commission (GCC) controlled areas in North and South Western Sydney, the GCC has effectively assumed the development control powers of a Local Government Authority and is able to charge levies to facilitate the construction of new infrastructure for both road and rail transport services. Two of the current five new rail projects, the South West rail link to Leppington and the Richmond rail line duplication to Vineyard are now potentially able to be substantially funded by future local area development under the terms of the NSW Government's December 2006 Special Infrastructure Contribution Levy for the North West and South West Growth Centres.

There is also considerable future potential for extending the principles of the Growth Centres Special Infrastructure Contribution to apply to other "Transit Oriented Development" in the established urban areas of Sydney which will also benefit from either the existing rail network improvements or the proposed new metro lines, to help fund the not insignificant capital cost of identified projects to date and other future potential projects to augment the capacity of the Sydney Region rail network.

8.3 Implications for rail network development

The NSW Government's transport planning strategy for improvements to the heavy rail network has been evolving since the publication of the "Action for Transport 2010" document (NSW Government, 1998).

In spending terms, the strategy has generally been proceeding at or above the originally envisaged levels of capital investment. However, there have been numerous revisions and changes to priorities within the overall strategy. In particular, the adoption of the Rail Clearways Program in 2005 substantially changed the short term strategy, resulting in the addition of several new projects and the abandonment of other projects such as the Bondi Beach rail line and the western portion of the former Parramatta to Chatswood (now Epping to Chatswood) rail line.

With the most recent rail passenger growth in the Sydney Region since 2006 (CityRail, 2008) There are now significant capacity constraints on all existing peak hour rail services travelling into the Sydney CBD, such that the 8:00 – 9:00 a.m. morning peak hour average train passenger loadings are now in the range 100-150% for inbound trains, except for those on the Eastern Suburbs line. The current five major rail network improvement projects for the Sydney Region:

- Epping to Chatswood rail line (due to open 2009),
- Cronulla rail line duplication (due to open 2010/2),
- Richmond rail line duplication to Vineyard (due to open 2010/2),
- South West rail link to Edmonson Park/Leppington (due to open 2012) and
- North West metro line to Rouse Hill (due to open 2015)

are all still proceeding with the necessary government support. However, due to the current morning peak hour passenger capacity constraints on virtually all existing trains of the CityRail network approaching the Sydney CBD, any new capacity lines should, of necessity, form a major future component of the "Transit Oriented Development" residential planning strategy for the Sydney region, in the medium to long term development timeframe.

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