Office of the
Coordinator
General of Rail

Long-term Strategic Plan for Rail

Greater Sydney metropolitan region

Overview report

June 2001

Office of the
Coordinator
General of Rail

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The Hon Carl Scully
Minister for Transport
Minister for Roads
Level 34, Governor Macquarie Tower
1 Farrer Place
Sydney NSW 2000

Dear Minister,

Following a meeting of the Budget Committee of Cabinet on 30 November 2000, you asked me to develop a long-term strategic plan for rail, both for the operation of the rail network and the maintenance and development of the capital stock, incorporating independent analyses and a significant study of future land use and demand scenarios.

In accordance with your request, I am now pleased to present to you this high-level *Overview Report*, which summarises a detailed and integrated ***Long-Term Strategic Plan for Rail*** for Sydney, the Central Coast, Newcastle, the Illawarra, the South Coast and the Blue Mountains.

The *Overview Report* and the *Long-Term Strategic Plan for Rail* have been prepared with the active assistance of the State Rail Authority, Rail Infrastructure Corporation and the Department of Transport. Their valuable contributions are gratefully acknowledged.

A pragmatic and integrated plan

The *Long-Term Strategic Plan for Rail* is long overdue.

In contrast to the attention paid to road network development needs in recent years, there had not been a detailed and comprehensive examination of the needs of the greater metropolitan rail system since the former State Rail Authority was split up in 1996. As a result, planning was undertaken on an independent basis by Rail Access Corporation (now part of Rail Infrastructure Corporation) and the State Rail Authority, rather than in unison.

Further, it is generally acknowledged that by its very nature the Government's 1998 transport strategy *Action for Transport 2010* was not able to "drill down" to the level of detail required to fully analyse what was (and is) needed to achieve an efficient and effective metropolitan rail system.

The *Long-Term Strategic Plan for Rail* seeks to redress these deficiencies by setting out, with expressly acknowledged assumptions and clearly argued justifications, a comprehensive program of short-term, medium-term and long-term operational, infrastructure and rolling stock changes to the metropolitan rail system.

In doing so, it should be regarded not as "the final word" but rather as the *starting* point for ongoing strategic planning. For example, the timeframes for individual projects are based on the best advice on likely future patronage growth patterns available at present, but will need to be continually reassessed in the light of (for example) changes in land-use and employment patterns and changes in the economic climate.

The *Long-Term Strategic Plan for Rail* recognises the importance of State Rail's taking a more proactive role than in the past in indicating its requirements for the future—both as the sole operator of suburban and intercity passenger services in the metropolitan region and as the organisation now legally responsible for the timetabling and control of all

passenger and freight train movements on the metropolitan rail network. With State Rail providing the necessary guidance, initially through this *Long-Term Strategic Plan for Rail*, Rail Infrastructure Corporation will no longer be left to "second guess" what its future requirements are.

Similarly, the development of the *Long-Term Strategic Plan for Rail* provides **an opportunity for the Government to guide the private sector in more productive directions**, by making it clear what the overall requirements for the metropolitan rail system are. In this regard, valuable lessons have been learnt in the late 1990s concerning the importance of ensuring private sector projects deliver what is actually required for an efficient and effective rail system, rather than being developed almost in isolation from these requirements. If a summary of the rail system requirements and responses set out in the *Long-Term Strategic Plan for Rail* were publicly released, private sector organisations submitting ideas for new rail infrastructure etc would be much better placed to put forward proposals that are likely to prove acceptable and attractive to the Government and the rail agencies.

Some changes in priorities

As already indicated, the starting basis for the *Long-Term Strategic Plan for Rail* is *Action for Transport 2010*. The *Long-Term Strategic Plan for Rail* builds on this foundation by specifically addressing:

- The best ways of achieving the regional and corridor transport objectives established by *Action for Transport*, and
- Issues which were largely beyond the scope of *Action for Transport*, including, in particular, rail safety and reliability issues and the rail system's critical capacity constraints.

In some instances the new analyses, using a range of projections for the most likely growth in rail patronage on different rail corridors, now point to **a reordering of priorities, with a greater emphasis on reliability and capacity improvements before some (but not all) of the more ambitious projects proceed.**

For example, the original objectives of several *Action for Transport* projects will simply not be able to be achieved unless capacity-enhancement projects in other areas already subject to severe congestion, especially the inner city, are completed first.

A longer-term conceptual framework

At the same time, the new analyses have permitted the development of **a more coherent long-term view** of a possible "ultimate" form of a greater metropolitan rail system, serving the multiple social, economic, employment and educational access and other transport needs of a metropolis of (perhaps) six million people.

This provides an essential long-term but non-prescriptive context for all rail development proposals, in much the same way as long-term regional and corridor plans have guided road network development over the last 55 years.

Just as vital road corridors have been reserved in the past, there is now **an urgent need to take action to protect future rail corridors**, and especially the corridors identified in alignment studies for new rail lines required in the next 10–20 years, through planning controls, land acquisitions and other measures.

Choosing the most appropriate mode of public transport

The *Long-Term Strategic Plan for Rail* focuses heavily on the transport tasks most suited to heavy rail—for passenger transport, the movement of large numbers of people at comparatively high speeds.

In doing so, however, the *Long-Term Strategic Plan for Rail* expressly recognises that **in many situations other public transport modes, including road and "transitway"-based buses and light rail, are more suitable**, especially when relatively small numbers of people are involved.

For example, in the case of several of the possible new longer-term rail corridors in suburban Sydney the *Long-Term Strategic Plan for Rail* suggests that other modes should probably be used at the outset, with rail modes being adopted for a corridor only if and when the much higher speeds and capacities of heavy rail become important or when constraints such as road congestion prevent buses from fulfilling their transport tasks.

In short, transitways and other "feeder" bus services will serve a vital role *in combination with* heavy rail.

The *Long-Term Strategic Plan for Rail* also expressly recognises **the importance of easy inter-modal and rail–rail interchanging.** As the metropolis develops, the amount of interchanging required will inevitably increase, although rail operation studies suggest that even in the long term rail–rail interchanging should be able to be minimised for the most heavily trafficked routes.

Innovative approaches

A range of **"non-traditional" options for enhancing the capacity, performance and safety of the metropolitan rail system** have also been examined.

While the *Long-Term Strategic Plan for Rail* makes it clear that there are no "magic bullet" solutions, as has sometimes been claimed, a series of investigations and pilot installations are recommended, and several of the options, including communications-based signalling and new "metro"-style railway lines operating independently of the existing rail network, are identified as having potentially important benefits, especially in the medium to longer term.

The critical issue of capacity constraints

Probably the most important single aspect of the *Long-Term Strategic Plan for Rail*, however, is its clear identification of the seriousness of the looming problem of severe capacity constraints on the metropolitan rail network.

This problem reflects the fact that in the last 50 years there have been almost no track amplifications—the equivalent of road widenings to provide extra traffic lanes—on the metropolitan rail network.

This means all types of services—fast and slow, and to and from a wide variety of locations via a wide variety of routes—are forced to share the same overcrowded tracks, with few if any overtaking opportunities and with major congestion at the routes' numerous junctions.

The system is rapidly approaching gridlock. This is already manifest in the extreme day-to-day sensitivity of CityRail services to even the most minor of disruptive incidents.

The *Long-Term Strategic Plan for Rail* sets out a detailed program of changes in rail operating patterns and essential capacity-enhancing works for the next decade, with another prime objective being to restore the physical separation of different types of CityRail services in order to improve on-time running.

This program of works is essential *regardless* of whether a communications-based signalling system—sometimes presented as an "alternative"—is adopted.

But the *Long-Term Strategic Plan for Rail* also makes it clear that **by between about 2011 and about 2015 the relief provided by these corridor-based enhancements will be effectively exhausted and a new rail route through the**

inner city and the CBD, between Eveleigh and St Leonards, will be essential. Again, this conclusion applies *regardless* of whether a communications-based signalling system is adopted.

In essence the situation now is analogous to that before the Eastern Suburbs Railway was built in the 1970s. By providing a new route through the inner city and CBD, the Eastern Suburbs Railway provided vital relief for the City Circle and the North Shore line through the CBD, but this capacity relief will shortly be completely used up, even with all the capacity augmentations proposed for the next ten years, and another additional route through the CBD will once again be required.

Initial investigations into the new route are now underway. Once the route and staging options and their operational implications have been identified, a relatively early decision will need to be made by the Government, as a lead time of at least ten years is likely to be required before construction of even the first stage or stages could be completed.

Because of the complexity of almost all aspects of this project, it will be essential to start serious planning for this new line immediately.

Yours sincerely,

Ron Christie
Coordinator General of Rail

Office of the
Coordinator
General of Rail

Long-term Strategic Plan for Rail

Greater Sydney metropolitan region

Overview report

Contents

1. Introduction

This report provides a high-level overview of an integrated *Long-Term Strategic Plan for Rail* for Sydney, the Central Coast, Newcastle, the Illawarra, the South Coast and the Blue Mountains (*Figures 1.1 and 1.2*), developed by the Office of the Co-ordinator General of Rail with the assistance of the State Rail Authority, Rail Infrastructure Corporation and Department of Transport.

The *Long-Term Strategic Plan for Rail*, the preparation of which was agreed to by the Budget Committee of Cabinet on 30 November 2000, sets out:

- Plans for essential short-term (0–2 year) and medium-term (2–10 year) operational, capital and maintenance programs primarily addressing safety and CityRail and rail freight service reliability and quality issues. Many of these programs have been the subject of previous recommendations from the Office of the Co-ordinator General of Rail and have already been announced by the Government.
- Plans for essential medium-term operational, capital and maintenance programs primarily addressing the severe and rapidly worsening capacity constraints of the greater metropolitan rail system. Again, several of these programs have been the subject of previous recommendations from the Office of the Co-ordinator General of Rail and have already been announced by the Government.
- Over a 20-year timeframe, and much more indicatively over a 35–50 year timeframe, plans for the development of the greater metropolitan rail system, in close integration with other public transport modes, to serve the needs of a still-expanding but higher-density metropolis.

Rail planning inputs

The starting basis for the *Long-Term Strategic Plan for Rail* is the Government's 1998 transport strategy *Action for Transport 2010*, which in particular foreshadowed:

- Major mode shifts to public transport, in accordance with "vehicle kilometres travelled" targets set in the Government's 1998 metropolitan air quality strategy *Action for Air*, and
- The establishment of a number of new railway lines in the Sydney region and the upgrading of existing intercity rail corridors, to help achieve these *Action for Air* goals and provide better rail services for western Sydney, the Illawarra and the Central Coast.

The *Long-Term Strategic Plan for Rail* builds on this foundation by:

- Specifically addressing the best ways of achieving the regional and corridor transport objectives established by *Action for Transport*, including the use of bus-based public transport systems as precursors to the longer-term establishment of heavy rail corridors, in line with realistic population, employment and travel demand forecasts, and
- Specifically addressing issues which were largely outside the scope of *Action for Transport*, including rail safety and reliability issues and the rail system's critical capacity constraints.

In doing so, the *Long-Term Strategic Plan for Rail's* consideration of what is required for metropolitan passenger rail services is **driven by pragmatic analyses by State Rail of its own needs**, both as the sole operator of suburban and intercity passenger services in the metropolitan region—and thus the only client of this type of the rail infrastructure owner and maintainer, Rail Infrastructure Corporation, in the region—and as the organisation now legally responsible for all timetabling and the control of all passenger and freight train movements on the metropolitan rail network.

This approach can be contrasted with past proposals for rail infrastructure capital works and maintenance, which were driven more by (a) serious shortfalls in available funding and (b) the interests and analyses of Rail Infrastructure Corporation's predecessors, and thus had much less regard to State Rail needs. This often produced priorities (such as a downgrading of major periodic maintenance of rail infrastructure assets) which were different to State Rail's, and contributed to the degradation of CityRail service quality in the last few years.

Rail Infrastructure Corporation should continue to be the prime driver of metropolitan *freight* rail infrastructure planning, provided these plans reflect the real needs of rail freight operators, but again the resultant infrastructure plans should take full account of the needs of State Rail as the major rail operator in the region (for example, through the sharing of new lines where this maximises the overall benefits and/or

Figure 1.1. The rail network of the Greater Metropolitan Region.

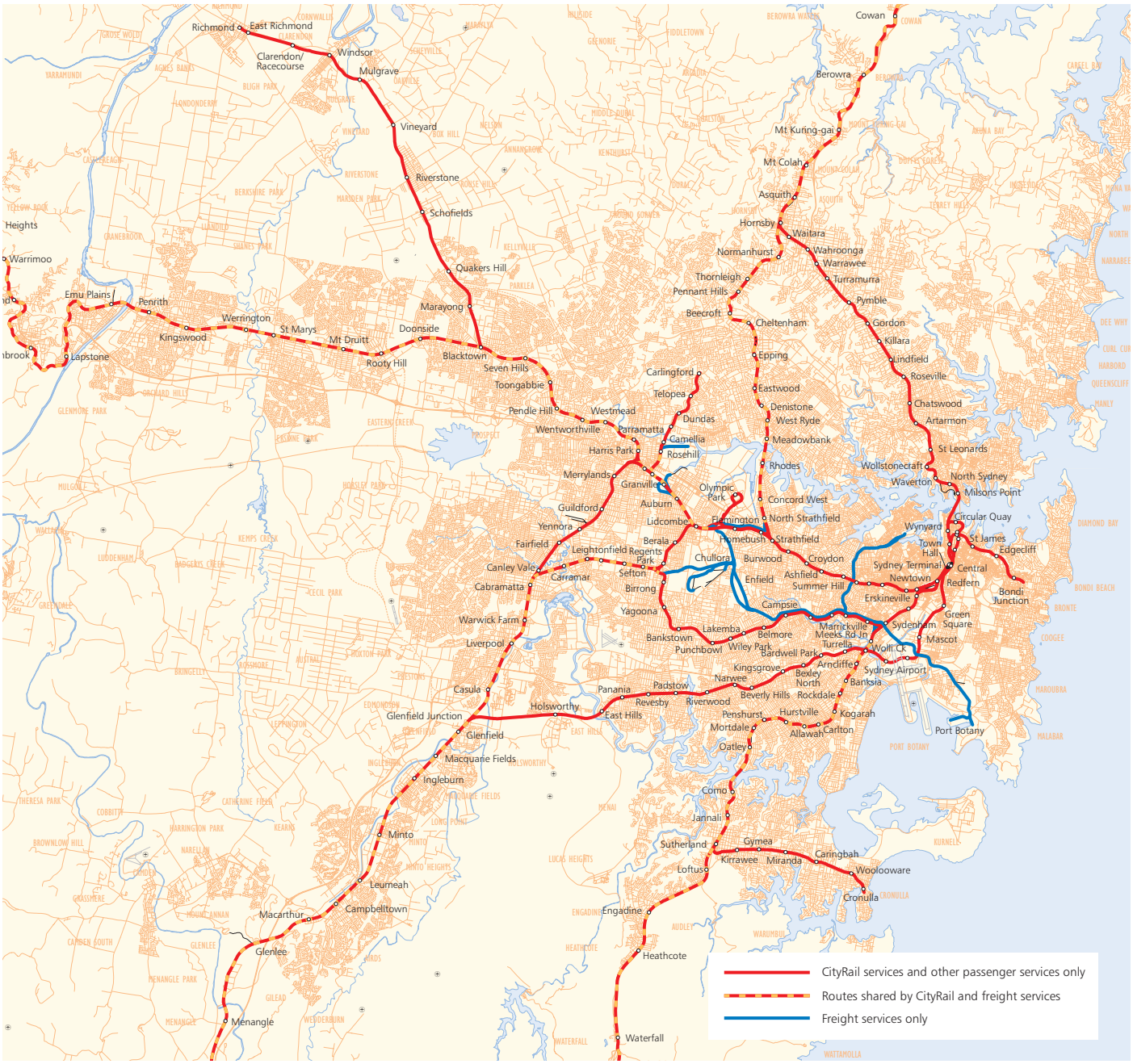


Figure 1.2. The rail network in Sydney.

there is insufficient space for separate freight and passenger tracks).

The change in emphasis to have the metropolitan passenger rail planning process and metropolitan train control planning process driven by State Rail's needs is both fundamental and essential.

The other fundamental change in the *Long-Term Strategic Plan for Rail*, compared with previous annually presented proposals by the rail agencies for metropolitan rail system capital works and maintenance only over the next year or two, is that it sets out quite detailed **five-year and ten-year plans, plus more indicative plans for the following decade and a long-term conceptual framework**, so that:

- Individual projects do not have to be launched from "standing starts" on a yearly basis as in the past, a "stop/go" process which has been inimical to good project planning, design, control and on-time delivery
- All the key projects necessitating long-term planning, concept development, land acquisitions and approval processes, over periods of up to ten years in some cases, are clearly identified well in advance, so that urgent actions such as option and route investigations and rail corridor protection measures can be launched in a timely fashion (in some cases, immediately)
- The assumptions behind the conclusions that the identified projects will be required by certain dates, including patronage growth and rail operational assumptions, are clearly identified, so that the plans can be progressively revised in the light of actual experience in the future, thus providing a "rolling" medium and long-term planning framework, and

- Other transport and urban planning agencies, including the Department of Urban Affairs and Planning, the Department of Transport and the Roads and Traffic Authority, have a clear picture of medium-term plans for the metropolitan rail system and longer-term principles and possibilities.

Changes in priorities

In some instances the analyses carried out since *Action for Transport 2010* was released now point to a reordering of priorities, with a greater emphasis on reliability and capacity improvements before some (but not all) of the more ambitious projects proceed.

In most of these cases, the analyses have essentially shown that *other* works, focussed more on reliability and capacity, are pre-requisites for the *Action for Transport* projects now suggested for short-term to medium-term deferral.

For example, the original objectives of several *Action for Transport* projects will simply not be able to be achieved unless capacity-enhancement projects in other areas already subject to severe congestion, especially the inner city, are completed first.

In other cases, the new analyses have suggested that demand in the relevant corridor(s) is unlikely to increase as rapidly as previously assumed, while demand growth in other corridors may well be—and often already is—much faster.

At the same time, the new analyses have permitted the development of a more coherent long-term view of a possible "ultimate" form of a greater metropolitan rail system, serving the multiple social, economic, employment and educational access and other transport needs of a metropolis of (perhaps) six million people.

This provides an essential long-term but non-prescriptive context for all rail development proposals, in much the same way as long-term regional and corridor plans have guided road network development over the last 55 years.

Among other things, it allows a greater understanding of the potential "ultimate" roles of rail infrastructure and services developed for short-term and medium-term purposes over the next 15–20 years, and should assist the Government in:

- Assessing the transport options available for these purposes, including multi-modal options and staged development options, and
- Ensuring, with local councils and communities, that all land-use developments maximise the public transport and/or rail freight opportunities presented by the proposed shape of the future rail system.

This overview report

Section 2 of this overview report very briefly summarises *current* passenger and freight rail transport operations and constraints in the greater metropolitan region, including the factors determining the safety, reliability, efficiency and overall quality of current CityRail services.

Section 3 provides a similarly brief overview of the factors directly affecting the shape of future rail transport in the region over the next 10–20 years, including future passenger and freight demand and the requirements imposed by the need for improved operational safety, reliability and efficiency.

Section 4 draws these threads together to set realistic short-term and medium-term objectives and service quality standards and then to analyse, on a corridor by corridor basis and on an "operational sector" basis,

- The passenger rail services that will be required to meet realistically expected increases in suburban and intercity passenger demand over the next 10–20 years, coupled with the progressive introduction of more robust operational patterns with greater "sectorisation" of services and thus greater CityRail service reliability, and
- The rail infrastructure, station, operational and maintenance changes required to accommodate these services in the next ten years (to 2011).

Section 4 also summarises, for the same timeframe,

- The types of rail freight network improvements likely to be required within the greater metropolitan region
- Proposals for the upgrading of key stations and bus–rail interchanges, and
- Strategies for greatly improved rail infrastructure maintenance to boost the inherent reliability of the rail system.

Section 5 presents a longer-term perspective, outlining a vision of the possible "ultimate" greater metropolitan rail network, serving a metropolis of (perhaps) 5–6 million people.

Section 6 summarises, for the whole of the greater metropolitan network, strategies and timeframes for the essential replacement, augmentation and upgrading of CityRail's ageing suburban and intercity train fleets in line with the requirements summarised in sections 4 and 5.

It is emphasised that this report is only a high-level summary of a much more detailed report. For further information on any of the issues presented in this report, readers should refer to the full *Long-Term Strategic Plan for Rail* report.

2. Current passenger and freight rail operations and constraints

2.1 CityRail operations

Passenger rail services in the greater metropolitan area are dominated by CityRail services operated by State Rail.

These services massively outnumber long-distance services to and from Sydney by State Rail (Countrylink) and other passenger rail operators. For this reason, and because there are currently no proposals for competitive services to be provided by other passenger rail operators in the greater metropolitan region, the *Long-Term Strategic Plan for Rail's* consideration of passenger service requirements in the region is essentially based on analyses of CityRail services and, where relevant, their interactions with freight rail services.

In 1999–2000 CityRail's total patronage was 279 million passenger trips, up by 12% from the 248 million carried in 1990 and up by 21% on the 230 million carried at the end of the most recent economic downturn in 1993. On an average weekday 940,000 trips are made on CityRail services, by about 550,000 individuals each day.

CityRail has 306 stations and a fleet of 1,456 double deck electric multiple unit carriages—1,138 "suburban" carriages, 80 "outer suburban" carriages and 238 "intercity" carriages—and 44 single-deck diesel multiple unit carriages.

It operates about 3,000 train services each weekday, comprising:

- Suburban train services in the area bounded by Waterfall to the south, Macarthur to the southwest, Emu Plains to the west and Berowra to the north, and also in the Wollongong area.
- "Intercity" train services (using "intercity" and "outer suburban" trains) in the wider electrified rail network area bounded by Dapto to the south, Lithgow to the west and Newcastle to the north, and

Apart from some sidings and yards and some privately owned freight tracks, all rail infrastructure (track, signals, etc) in the greater metropolitan region is owned and maintained by the **Rail Infrastructure Corporation (RIC)**, which sells access rights to rail operators.

The main passenger rail operator in the greater metropolitan region is the **State Rail Authority**, whose suburban and intercity services are marketed under the "CityRail" brand name and whose long-distance services are marketed under the "Countrylink" brand. Because they are widely known and understood, these descriptors are used in this report. State Rail also owns and operates the stations and is responsible for all timetabling and the control of all passenger and freight train movements on the metropolitan rail network.

RIC and State Rail objectives

Under the Transport Administration Act, RIC's "principal" objective is to ensure that the NSW rail network enables **safe and reliable** passenger and freight services to be provided in an efficient, effective and financially responsible manner". Similarly, State Rail's "principal" objective is to "deliver safe and reliable railway passenger services in New South Wales in an efficient, effective and financially responsible manner".

Other RIC and State Rail statutory objectives, equal in importance to each other but expressly of lesser importance than the principal "safety and reliability" objectives, are:

- For RIC, to promote and facilitate access by rail operators to the NSW rail network in accordance with an "open access" regime established under the Transport Administration Act
- For RIC, to maintain reasonable priority and certainty of access for railway passenger services
- For both, to be a successful business and, to that end, to operate at least as efficiently as any comparable businesses and to maximise the net worth of the State's investments in RIC and State Rail
- For both, to exhibit a sense of social responsibility by having regard to the interests of the community in which they operate
- For both, to operate in compliance with the principles of ecologically sustainable development, and
- For both, to exhibit a sense of responsibility towards regional development and decentralisation.

- Diesel train services to and from Bomaderry and the Southern Highlands and in the Hunter, especially between Maitland and Newcastle but also as far north as Scone and Dungog (*Figure 1.1*).

As part of the overall passenger transport mix in the greater metropolitan region, rail's primary role has traditionally been to carry people relatively long distances to major centres of activity.

In 1996, for example, CityRail accounted for only 5% of all the trips made by all transport modes in the region, but 10% of the kilometres travelled and 14.5% of all journeys to work.

For journeys to work at the major centres, rail is either the dominant mode of transport, with 49% of this market for the Sydney CBD in 1996 (down from 51% in 1981), or second only to private car travel, with a mode share of 40% at North Sydney (up from 30% in 1981), 28% at Chatswood (up from 14%), 23% at Parramatta (up from 14%) and 30% for the city's centres as a whole (31% in 1981).

Rail's second major passenger transport role in the region has been to provide transport for students travelling to and from schools, universities and colleges.

For both of these major roles there is a strong concentration of patronage in the morning peak and, to a lesser extent, the afternoon peak. The latter peak period has lengthened from 2½ to 3½ hours in the last decade.

With the growth in demand in recent years, almost all peak period trains are now operating at or near their full capacity, even though there have been significant increases in the capacity provided on CityRail trains over the last 20 years.

The constraints on CityRail's capacity

Peak patronage demand and hence the capacity provided by peak CityRail services are heavily concentrated on the main routes into the Sydney CBD on the Main West, Illawarra and North Shore lines, which combine the inputs of numerous intercity and suburban lines, as illustrated in *Figure 2.1*.

The factors affecting passenger rail system capacity on any particular section of the rail network, and hence CityRail's ability to meet rapidly increasing patronage demand, include:

- **The number of passengers able to be carried on each train.** For many years the growth in patronage was successfully handled by introducing double deck trains—the equivalent of cramming more people into each car on the road—but the temporary relief afforded by this measure has now been almost totally absorbed.
- **The number of CityRail trains available to carry passengers during the peaks.** With improvements in the proportion of CityRail's fleet available at these times, the major constraint is the total number of CityRail trains, which in recent years has failed to keep pace with the growth in patronage demand.
- **The number of tracks**. This is a severe constraint, as **in the last 50 years there have been almost no track amplifications—the equivalent of converting two-lane roads into multiple lane roads—on the metropolitan rail network.**
- The need for CityRail to accommodate three types of demand on the one network: relatively long-distance intercity and outer suburban demand, short-haul suburban demand and "inner city distribution" demand. This necessitates a **mix of station stopping patterns**, with "fast" ("express" and "limited stop") services sharing the tracks used by slower trains, some stopping at all stations. Because there are limited (if any) overtaking opportunities, this significantly reduces the capacity of many key lines, typically by 35% or more.
- **The long train "dwell" times required at several of the busiest stations**, including the main CBD underground stations, as passengers leave trains and others wait on overcrowded platforms to board.
- **The large number of "flat" (i.e. non grade-separated) junctions,** many of which necessitate complex "conflicting" train movements (i.e. trains cannot enter until other trains crossing or merging with their path have either passed through the junction or have been held back from entering the junction themselves). The congestion at these junctions substantially reduces the capacity of all lines feeding into the junctions. (Again, there have been almost no grade separations of rail junctions—the equivalent of road intersection grade separations—in the last 50 years.)
- **The inability of the signalling system to permit trains to travel closer together**, thereby providing greater service frequencies, even in those sections of the rail network where this would otherwise not be ruled out by the necessary mixing of service patterns, junction merging and crossing requirements and long station dwell times.
- **A wide range of other constraints**, discussed below.

The breaking down of 'sectorisation'

Since the 1980s State Rail has attempted to operate CityRail services in three discrete rail network "sectors", so as to minimise the impact of any service disruptions in any one sector on the rest of the metropolitan rail system (*Figure 2.2*):

- **Sector 1 (Illawarra)**, extending from the Bondi Junction terminus of the Eastern Suburbs Railway to Bomaderry.
- **Sector 2 (south)**, essentially covering the southwestern suburbs of Sydney, and
- **Sector 3 (northwest)**, essentially covering the western and northern suburbs of Sydney, the Blue Mountains, the Central Coast, Newcastle and the Hunter.

As illustrated in *Figure 2.2*, while Sector 1 is still largely discrete, the growth in patronage (and hence train services) in recent years has led to considerable interaction between Sector 2 and Sector 3 services along the Main West line corridor between Granville and the CBD, and even in the case of Sector 1 rapid growth in patronage on the Illawarra line has forced some diversions of Sector 1 train services onto the City Circle, which was previously reserved for Sector 2.

This problem reflects the fact that in the last 50 years there have been almost no track amplifications on the metropolitan rail network. This means all types of services—fast and slow, and to and from a wide variety of locations via a wide variety of routes—are forced to share the same overcrowded tracks, with few if any overtaking opportunities and with major congestion at the routes' various junctions.

The system is rapidly approaching gridlock, as there is a finite limit on how many trains can reliably and safely use each track and, even more significantly, on how closely they can follow each other through multiple congested junctions and/or wait their turn.

The forced breakdown of "sectorisation" as train numbers have increased beyond the capacities of any one sector has been one of the factors contributing to the increased sensitivity of CityRail peak services to disruptions in recent years.

The restoration and strengthening of "sectorisation" operational approaches is therefore one of the main emphases of the *Long-Term Strategic Plan for Rail*, both in the short and medium terms and in the longer run (see sections 3, 4 and 5). This will need to involve both increases in the inherent capacity of the rail infrastructure—the equivalent of road

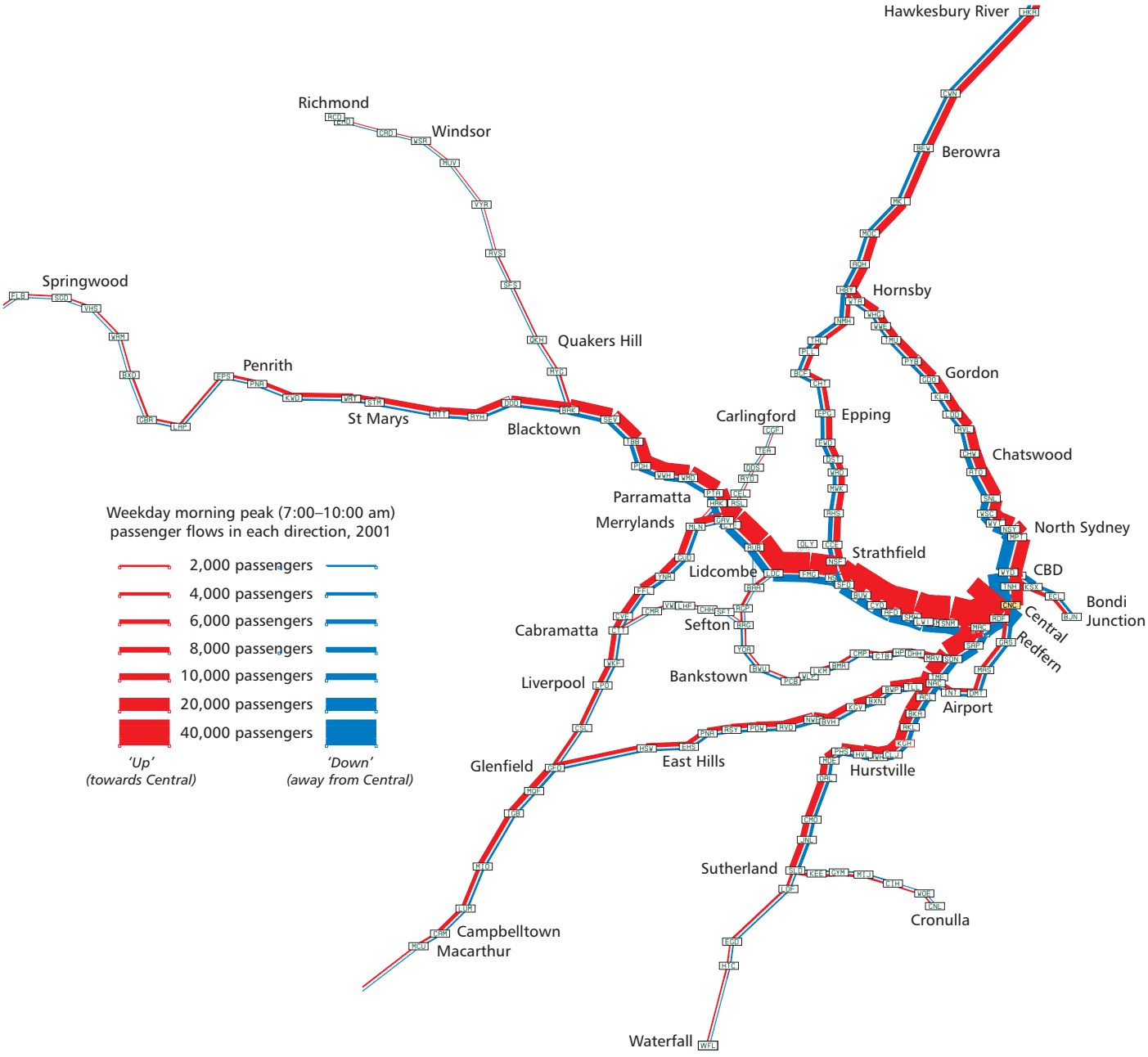


Figure 2.1. Current peak passenger demand is heavily concentrated on the Main West, Illawarra and North Shore lines into the Sydney CBD. In this computer modelling diagram the thickness of the lines is proportional to current morning peak passenger flows.

widening programs—and the physical separation of the tracks and routes used by trains operating on different existing and new operational sectors.

Mixtures of service patterns

As already indicated, within each of the current three main operational sectors there is a complex mix of "fast" ("express" and "limited stop") services—generally those travelling longer distances, including intercity services—and slower trains with a variety of station stopping patterns, including trains which stop at all stations on their routes.

This mixture of services reflects the need for CityRail to accommodate three types of demand on the one network: relatively long-distance intercity and outer suburban demand, short-haul suburban demand and "inner city distribution" demand.

It also reflects the strong desires of commuters, who often prefer to stand for long distances on crowded faster trains than have a seat on slower trains, even when the difference in total travel time is only a few minutes.

In some cases the different services are able to be segregated from each other on four or six track sections of the

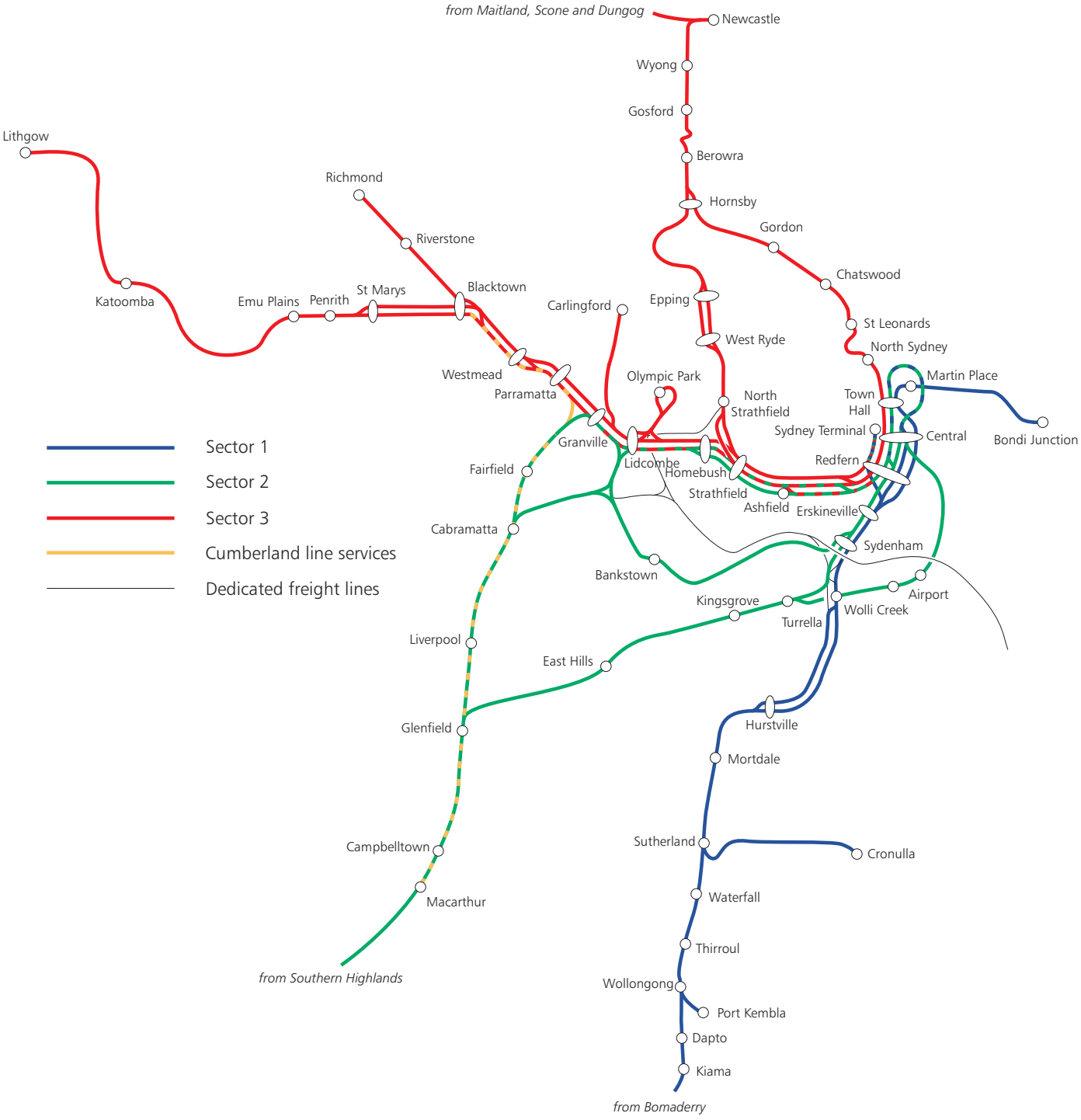


Figure 2.2. Current CityRail operational "sectors", showing the interactions between the theoretically isolated sectors forced by recent increases in patronage demand and the resultant need to increase train numbers beyond the capacity of lines within the sectors.

network, allowing the faster services to overtake. In most cases, however, the almost total absence of track amplifications and junction grade separations in the last 50 years means this option is not available, and complex and disruption-sensitive timetabling is required.

As the number of trains has increased, the operational robustness of timetables with complex mixes of types of services has declined.

Again, the segregation of services to overcome this difficulty is a major focus of the *Long-Term Strategic Plan for Rail* (see sections 3, 4 and 5).

Other operating constraints

The other principal constraints on current CityRail operations, described in detail in the *Long-Term Strategic Plan for Rail*, are (*Figure 2.3*):

- The fact that **key lines are already operating at or beyond their maximum "robust" train frequencies** (the theoretical limit is 18 to 20 trains per hour, but the real limit is much less on many lines, because of the capacity-limiting factors already described).

  For example, there are already 20 northbound trains per hour crossing the harbour bridge in the morning peak, so unless the inherent capacity of this line can be increased (see section 4.3) this route cannot be used to accommodate any further growth in the number of trains entering the CBD in the mornings.

  Again, this problem reflects the fact that in the last 50 years there have been almost no track amplifications on the metropolitan rail network. The temporary relief afforded to the network as a whole by the introduction of double deck trains and to the City Circle by the construction of the Eastern Suburbs Railway in the 1970s has now been almost totally absorbed.

- The related problem of **passenger overcrowding**, which not only exposes passengers to unacceptable travel conditions but can delay trains for long periods at the busiest stations as passengers leave trains and others wait to board.

- **The large number of "flat" junctions.**

  Because trains using the key junctions have to be very closely timetabled during peak periods, with complex merging and conflicting train movements, there can be acute service reliability problems, as even a slight delay in one train service can very quickly delay large numbers of trains. This effect may not be as visible as at a heavily congested road intersection, because the signalling system automatically holds the trains well back at safe separations, but its impacts are just as real.

  The problem is compounded when the conflicting or merging train services are operating on different "sectors", such as on the Main West corridor and in the inner city and CBD.

- **The low speed limits applying at almost all of these junctions**, because of the low-speed geometry of the points ("turnouts") and tracks, accentuating the problem just described.

- **The need at several locations to terminate and turn back trains on the main lines**, rather than on separate tracks specifically developed for this purpose ("turnbacks"). This obstructs the flow of other trains seeking to enter or pass through these locations, and substantially reduces the overall capacity of some key lines, including the Eastern Suburbs Railway and the Main West line.

- **Similar obstructions by trains entering and leaving train maintenance facilities** at Mortdale, Flemington and Hornsby.

- **The shortage of daytime train "stabling" (parking) facilities in the inner city**, which forces large numbers of empty trains to travel to the middle-distance train maintenance depots in the morning, after they have brought commuters to the city, and return empty again in the afternoon, cluttering up the system and increasing its vulnerability to disruptions.

- Similarly, **the lack of facilities at the main overnight train stabling yards, such as Penrith, Campbelltown, Blacktown and Waterfall, for trains to be washed and minor routine maintenance or repairs to be carried out.** This means CityRail trains needing cleaning or even the simplest routine maintenance or repairs have to be taken out of service during the next morning's peak and travel to the middle-distance train maintenance depots.

  In essence, the locations of facilities for minor routine train maintenance reflect the requirements of passenger rail operations some 50 to 70 years ago, when the train maintenance depots were at or near the extremities of suburban rail services, but not those of today's geographically extended operations.

- On some lines, **constraints imposed by long and slow-moving freight trains**, even in off-peak periods (as discussed below, freight trains are subject to "curfews" during peak periods).

- **The obsolescence of much of the signalling control technology** used in the greater metropolitan region, dating back in some areas to the early and mid-20th century, and **the lack of a modern train control centre.** These factors greatly handicap the ability of State Rail signallers and train controllers to efficiently manage train movements on the metropolitan network.

In summary, the metropolitan rail network is now so congested that peak CityRail operations are extremely finely

balanced, with minimal margins before delays occur and escalate.

The *Long-Term Strategic Plan for Rail* explicitly addresses all of the factors described above, along with other major factors in poor on-time running performance: rolling stock failures, the increased frequency and severity of rail infrastructure failures, and limitations on incident response and recovery capabilities.

Service reliability and on-time running performance

The principal measure used by State Rail to monitor the punctuality or "on time running" of CityRail services is the proportion of peak services arriving at their destination within 3 minutes of the timetabled time in the case of suburban services and within 5 minutes in the case of intercity services.

Figure 2.3. Overview of operating constraints in Sydney.

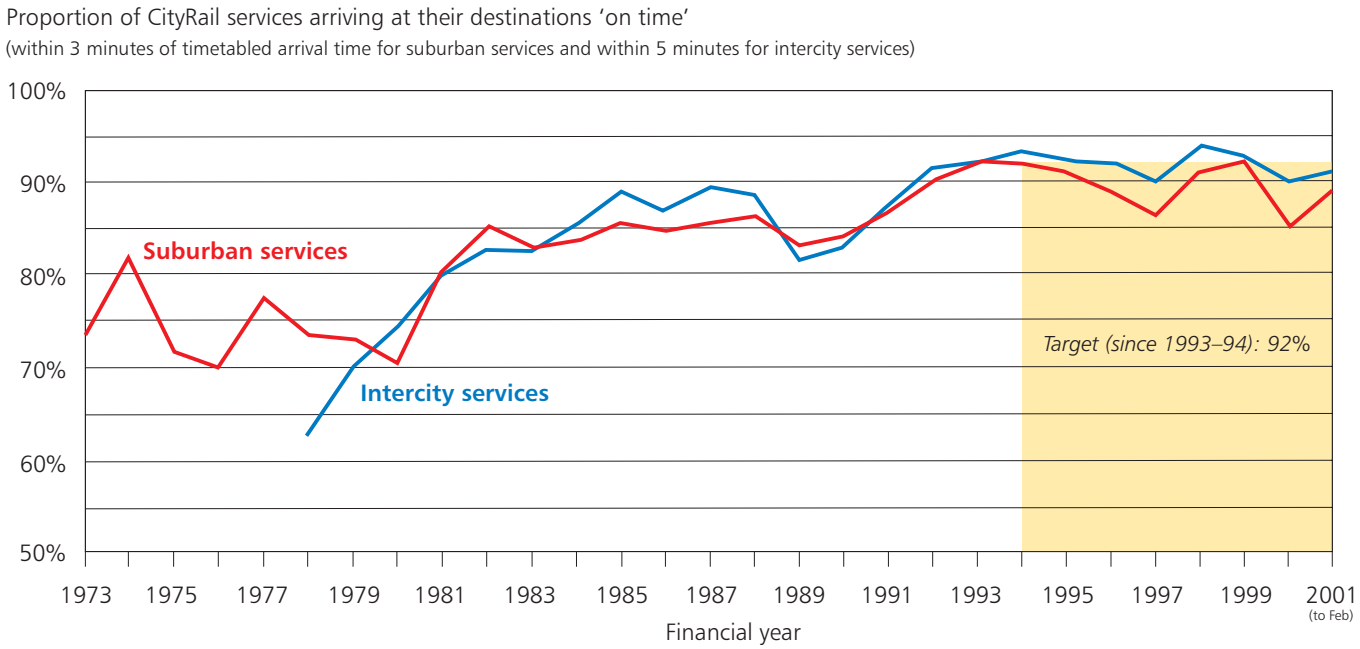


Figure 2.4. Long-term trends in morning and afternoon peak period CityRail on-time running performance.

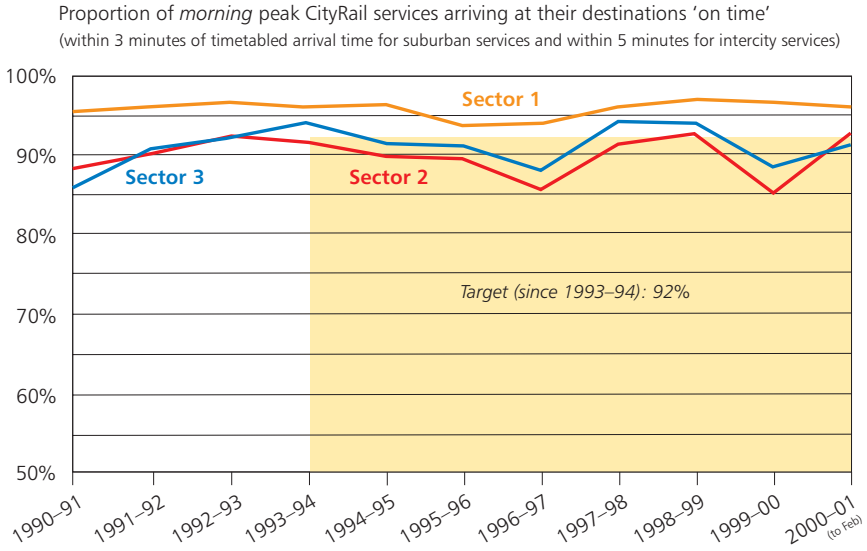


Figure 2.5. Morning peak CityRail on-time running performance over the last ten years, by operational "sector" (see Figure 2.2).

Since 1993–94 the target for this measure has been 92%.

Although on-time running has generally improved over the last 25 years (*Figure 2.4*), it declined in 1999–2000 to levels not experienced since the late 1980s, and despite a strong recovery during 2000–01 on-time running is still only about 90%, below State Rail and customer expectations.

On-time running performance is affected by:

- **The inherent and growing sensitivity of the near-capacity rail system to disruptions**, because of all the capacity and operational constraint factors discussed above.

  This is well illustrated by the fact that on-time running is poorer on the rail corridors in Sectors 2 and 3, which have the most complex and inter-woven operating patterns and the greatest number of flat junctions, than on Sector 1 lines, where service patterns are less complex and are still comparatively isolated from the other sectors (*Figures 2.5 and 2.6*).

- **Other inefficiencies in rail operations**, including:

  — Inefficiencies in incident responses as a result of the current inability of train controllers to know the precise locations of trains on most of the metropolitan network. (This deficiency should not be confused with the past inability of signallers in local signal boxes to know the locations of trains in adjacent track sections controlled by automatic signalling systems, a deficiency now being rectified after the Glenbrook accident of December 1999.)

  — Other past inefficiencies in incident management, now redressed through the establishment of a Railway Coordination Centre to ensure integrated responses are achieved.

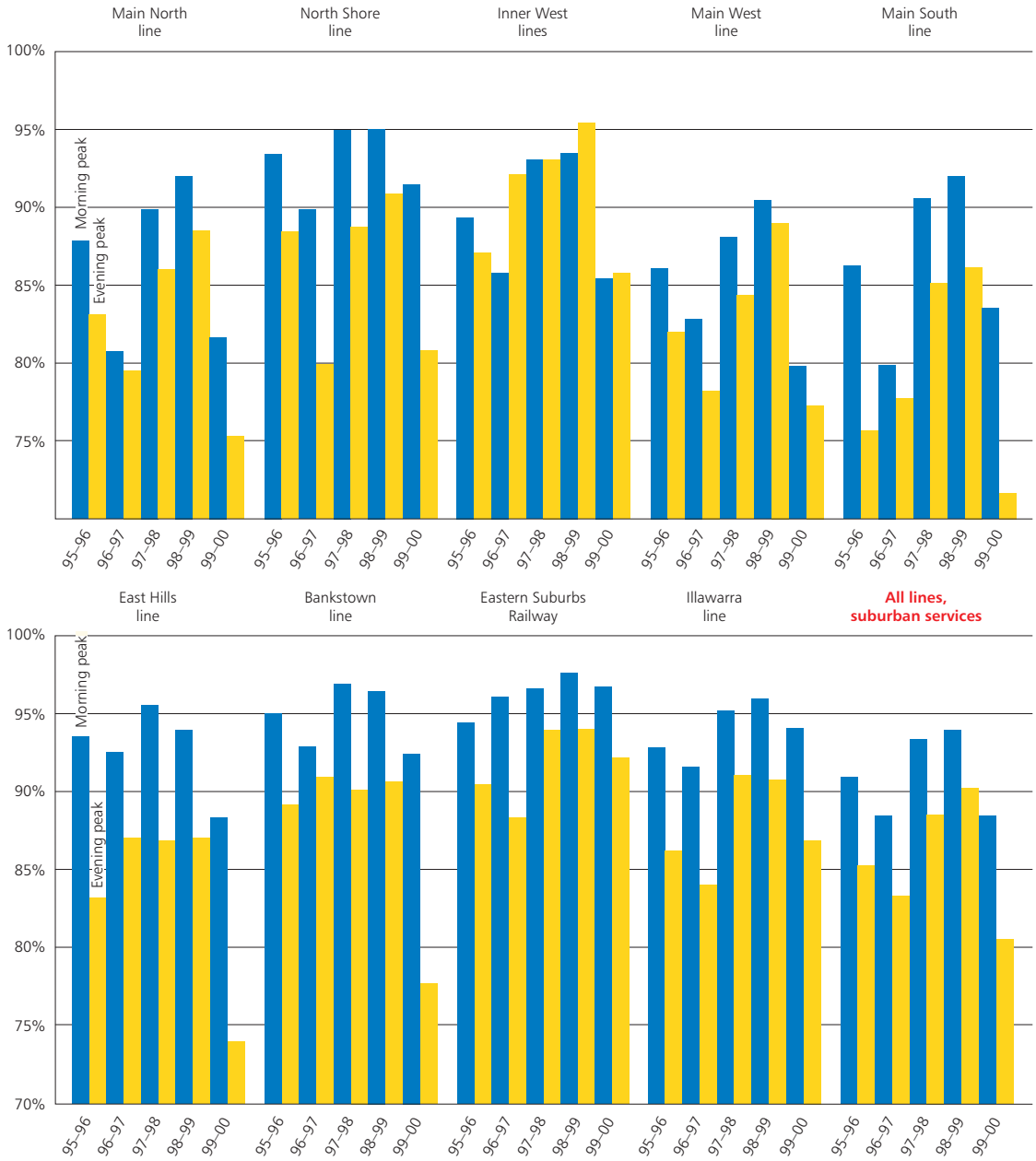


Figure 2.6. Peak CityRail on-time running performance for suburban services only over the last five years, by line. (On-time running in the afternoon peak period is generally well below that in the morning peak because service disruptions during the day can mean trains are not in their proper "starting positions" when the afternoon peak commences.)

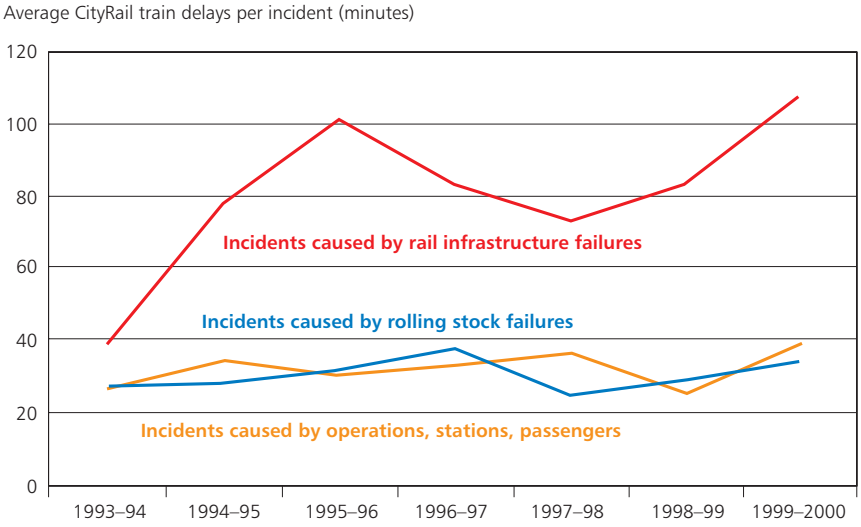


Figure 2.7. Infrastructure failures typically cause longer delays than other factors, even though they do not occur as frequently. In recent years the impact of these types of failures has been worsened both by an increase in the number of incidents (Figure 2.8) and by an increase in the average train-delaying impact of each incident (above).

- **Vandalism, trespassing** on the tracks and passenger falls and suicides.
- **Rolling stock failures.**

  The reliability of the CityRail fleet is hampered by the mix of different types of rolling stock, the age of a significant proportion of the fleet and inadequacies in train maintenance facilities, equipment and parts inventories. Until recently it was also hampered by deficiencies, now being redressed, in the maintenance and overhaul regimes for key components such as doors.

  The Government has recently made some important funding commitments to enable these issues to be addressed in the short term, as discussed in section 6.3.

- **Rail infrastructure failures**, including track, signalling, points, electrical and civil infrastructure failures.

  Although infrastructure failures account for only 15% of all the incidents delaying peak CityRail trains, they usually cause longer delays than the other factors (*Figure 2.7*), and in 1999–2000 they were responsible for almost 30% of CityRail train delays, with both the number of rail infrastructure failures and their impacts on CityRail services being well up on earlier years (*Figure 2.8*).

  About three-quarters of the rail infrastructure reliability problems delaying CityRail peak services are associated with track and signalling failures at junctions.

  The factors contributing to the increase in rail infrastructure reliability problems in recent years are discussed in section 2.3 below, and strategies to address these problems are summarised in section 4.10.

  Again, the Government has recently made some important funding commitments to improve rail infrastructure maintenance in the short term, as discussed in section 4.10.

2.2 Freight operations

Most of the railway lines used by freight trains in the greater metropolitan region are shared with passenger services, although there are dedicated freight lines between North Strathfield Junction, Flemington Goods Junctions, Chullora, Sefton Goods Junction, Enfield, Rozelle and Port Botany (*Figures 1.1 and 1.2*).

Rail freight services within and through the greater metropolitan region comprise:

- General interstate and intrastate freight services, including inter-modal container freight services, focussed primarily on the major freight terminals at Enfield and Chullora and the port facilities at Port Botany and Rozelle
- Cross-metropolitan freight transport linking Port Botany and Rozelle with Enfield, Chullora, Clyde and Leighton-

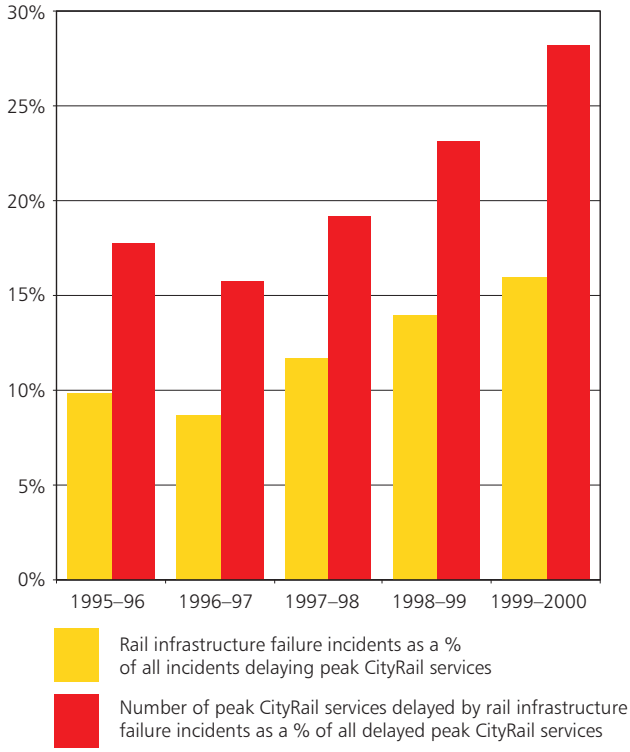


Figure 2.8. *Trends in rail infrastructure failures delaying peak CityRail services, 1995–96 to 1999–2000.*

field and increasingly also with smaller freight facilities such as new facilities at Minto, Ingleburn and St Marys

- Coal transport from the western coalfields to Port Kembla and, on occasions, the coal terminals at Newcastle
- Coal transport from the Newcastle, Hunter and Gloucester coalfields to the export coal terminals at Newcastle, and
- Movements of grain to the ports and to refining facilities near Nowra.

Rail freight operations in the greater metropolitan region are severely constrained by a long-standing **"curfew" on freight train movements during weekday commuter peak periods —6 to 9 am and 3 to 6 pm—on lines which are also used by CityRail trains in Sydney and as far north as Wyong.**

The effects of this curfew are most critical on the Main South line between Macarthur and Sefton Goods Junction, part of the main routes connecting Melbourne and Adelaide with the Sydney freight terminals and ports and Brisbane, because the busiest times for freight trains arriving from Melbourne coincide with the busiest times for CityRail commuter services from Campbelltown and Liverpool to the city.

On the Main North line to Newcastle (and on to Brisbane) the constraint is less significant, because there are fewer freight trains and operating patterns are different. For this corridor it is likely that a guarantee of two freight train "paths" per hour for 22 hours per day in the contra-peak direction—i.e. with a two-hour peak direction "curfew"—would suffice to meet anticipated freight demand, and even this is regarded by Rail Infrastructure Corporation as a long-

The recent construction of a grade-separated route for freight trains under the passenger lines at Flemington Junctions leading to Olympic Park is an example of the type of projects required to reduce conflicts between freight and passenger train movements in Sydney. These conflicts have long necessitated "curfews" on freight train movements during the commuter peaks, greatly handicapping the ability of rail to compete with road freight.

term target, rather than one to be achieved in the metropolitan area in the short to medium term, because there are other, more severe constraints on Sydney–Brisbane freight services further to the north, on the single-track North Coast line.

Investigations over the last four years have identified the most cost-effective ways of progressively reducing the curfews on the Main South and Main North corridors, including the construction of a new bidirectional track from Macarthur to the Sydney side of Cabramatta Junction for use primarily by freight services. These works, which are now the subject of detailed design and environmental studies but will proceed only if Commonwealth funding is provided, are discussed in sections 4.4 and 5 below.

Other constraints on rail freight services in the greater metropolitan region include:

- **Inadequate capacity on the Port Botany goods line from Marrickville to the port**, which is expected to have to cope with a doubling of freight demand over the next few years. Amplification and resignalling works are already underway, although the final stage of these works —duplication from Cooks River to Marrickville—may not be needed for at least five years.
- **Capacity constraints for freight services on the Main North line north of Wyong**, potentially necessitating extra passing loops, especially if a proposed new coal mine in the Wyong area proceeds, and **capacity constraints on the Hunter coal network**, including the junctions leading into the export coal terminals in the Newcastle area.

  The capacity constraints affecting Hunter coal freight services—and by implication CityRail and long-distance passenger services in that region—are potentially severe, but are being addressed in separate RIC capital works programs and studies and are beyond the scope of the *Long-Term Strategic Plan for Rail.*
- **The distance of the rail freight network from areas in western Sydney which are now being developed for industrial purposes.** A proposal for a new "Sydney West Industrial" line in the Erskine Park/Horsley Park region, to help redress this deficiency and actively encourage "rail friendly" industrial development in this region, is among the longer-term rail network development options outlined in section 5 below.
- **The complexity of rail operations and infrastructure required to service the increasing demand for larger numbers of relatively small rail–road intermodal freight terminals.** For example, the operation of rail freight services into and out of the new Minto and Ingleburn terminals—on opposite sides of a two-track Main South line which is likely to become a three-track line in the next few years and ultimately a four-track line—will inevitably be constrained by conflicts with passenger services and "through" freight services on this important corridor.

Rail Infrastructure Corporation has recently commenced the development of an over-arching *Metropolitan Rail Freight Strategy* to address these and other rail freight issues.

2.3 Rail infrastructure maintenance and reliability

As indicated in section 2.1, the reliability of metropolitan rail infrastructure has fallen in recent years, increasing both the absolute and proportional contribution of infrastructure failures to CityRail train delays.

One of the main factors in this degradation was the downgrading of many "major periodic" maintenance programs during the 1990s. Although reductions in major periodic maintenance expenditures (*Figure 2.9*) were intended at the time to be at least partly counterbalanced by efficiency gains, and funding levels were reduced in this expectation, in practice the anticipated gains were only partially realised, even on lines maintained by the private sector after competitive selection processes. Because of the reduced funding, and also because other projects were regarded as having a higher priority at the time, the scope of major maintenance programs was severely curtailed.

These programs—which can be traced back to upgrading works initiated around the time of the Granville disaster—included a track strengthening and concrete resleepering program, a signalling modernisation program, an overhead wiring modernisation program, a junction renewal and upgrading program and ballast cleaning, track tamping, rail grinding, timber resleepering and rerailing programs.

The downgrading of these major periodic maintenance programs has now resulted in a serious maintenance backlog,

degraded asset quality and reliability and increased day-to-day routine maintenance costs.

Even with increased funding, this backlog will be difficult to overcome, as Rail Infrastructure Corporation's major plant items are old and incapable of meeting production requirements (many of the items which will have to be used over the next couple of years have been taken out of "mothballs") .

The actions and expenditures required to redress this situation are discussed in section 4.10 of this report.

2.4 Safety

The December 1999 Glenbrook accident and a series of other derailments and "signals passed at danger" incidents in recent years have highlighted the importance of a more concentrated focus on rail safety issues.

The major deficiencies in metropolitan rail safety systems, *almost all of which have been or are now being addressed*, have been:

- Inadequacies in the management, training, mentoring, testing and supervision of train drivers, signallers and train controllers, especially in the case of less experienced drivers. (All of these inadequacies have been expressly addressed, in conjunction with relevant staff and unions.)
- Deficiencies and unnecessary complexities in the *Safeworking Rules* which govern all operations of the railway system and in the application of these rules. (Revised and much simpler safety rules are now being developed, in conjunction with relevant staff and unions. After a six-month period of staff training, new rules for work on the tracks will become effective in November 2001, new rules for train operations will take effect from March 2002 and new rules for signalling will take effect from June 2002.)
- Deficiencies in signalling and communications systems, including the inability of signallers in many local signal boxes to view the locations of trains in adjacent automatic signalling areas ("colloquially known as "dark territories"), poor sightlines to some trackside signals, the unreliability of some communications systems and incompatibilities between different communications systems. (The measures required to overcome these deficiencies are summarised in section 4.9 below.)
- Deficiencies in signal and train control systems, many of which are now extremely dated and maintenance-intensive and almost all of which offer very limited capabilities. For example, signallers and train controllers are not able to view the location of trains on most sections of the metropolitan network (*Figure 2.10*), even those sections controlled from local signal boxes other than their own, so they have to rely heavily on telephone-based communi-

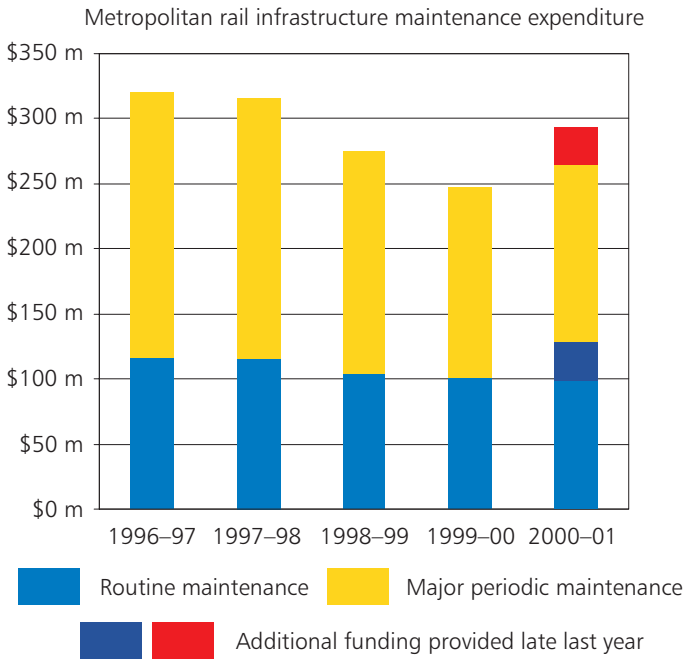


Figure 2.9. *Metropolitan rail infrastructure maintenance funding was significantly reduced in the 1990s. The increased funding commitments made by the Government in late 2000 to address infrastructure unreliability issues and assist in the replacement of life-expired rail infrastructure assets have now partly restored funding to earlier levels.*

Primarily in response to reduced funding, many key rail infrastructure major periodic maintenance programs, including major track strengthening programs (above), junction upgradings, signalling modernisation programs, overhead wiring modernisation programs, ballast cleaning and rail grinding (below), were downgraded during the 1990s. This contributed to a significant increase in rail infrastructure failures affecting CityRail services, and there is now a large backlog of essential major maintenance tasks. These types of programs need to be reinstated, but the backlog will take up to 20 years to clear, even if there is significantly increased funding and RIC is able to use more modern equipment, asset monitoring systems and preventative maintenance techniques.

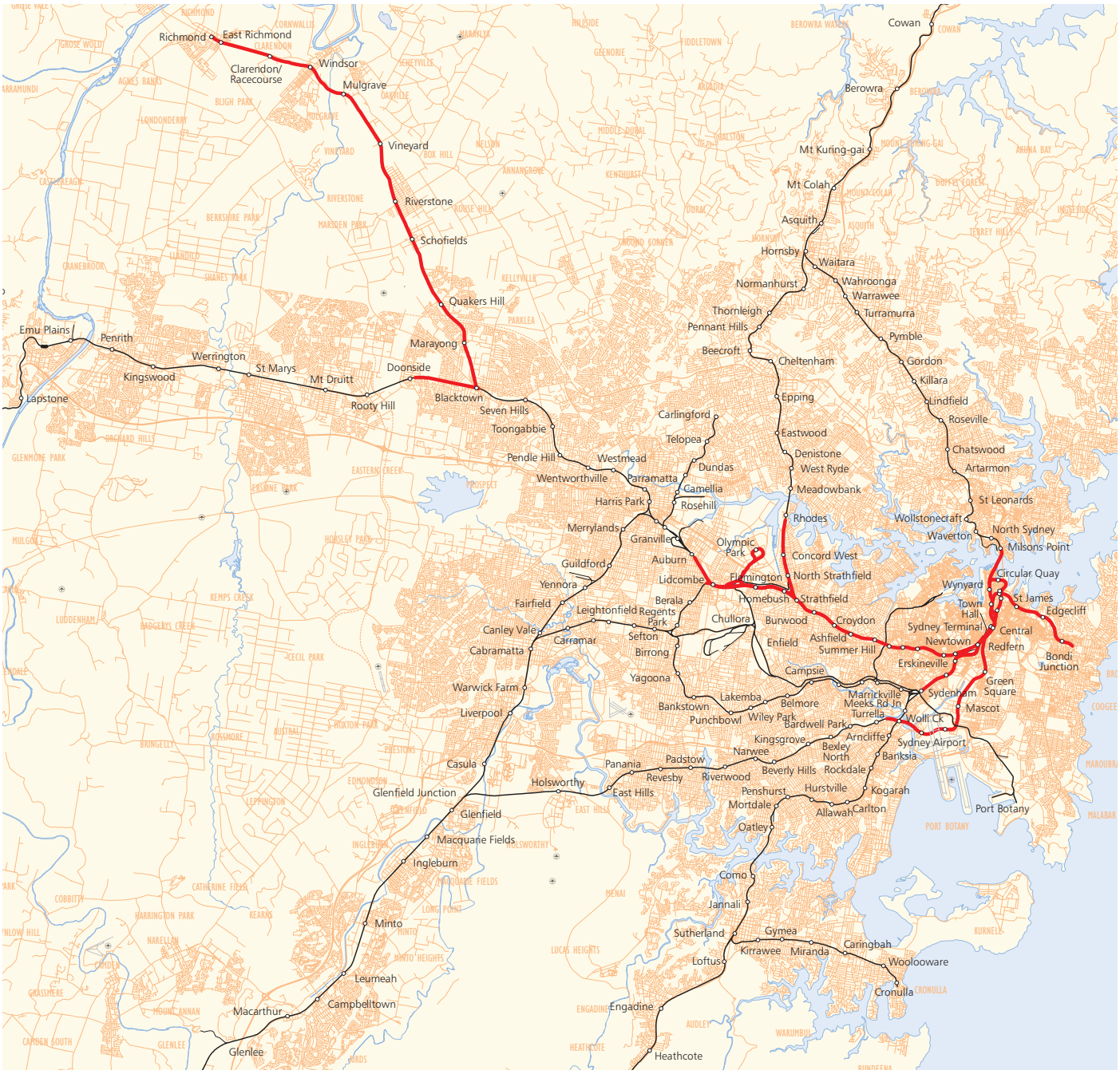


Figure 2.10. State Rail's central metropolitan train controllers are currently able to view the locations of trains only on the line sections shown in red. For the other areas they are forced to rely on phone and fax communication with signallers in local signal boxes, who only now are becoming able themselves to monitor the locations of trains on adjacent line sections controlled by automatic signalling systems. These inadequacies greatly hamper efficient routine management of train movements and fast recovery from incidents.

cations. (Again, the measures required to overcome these deficiencies are summarised in section 4.9 below.)

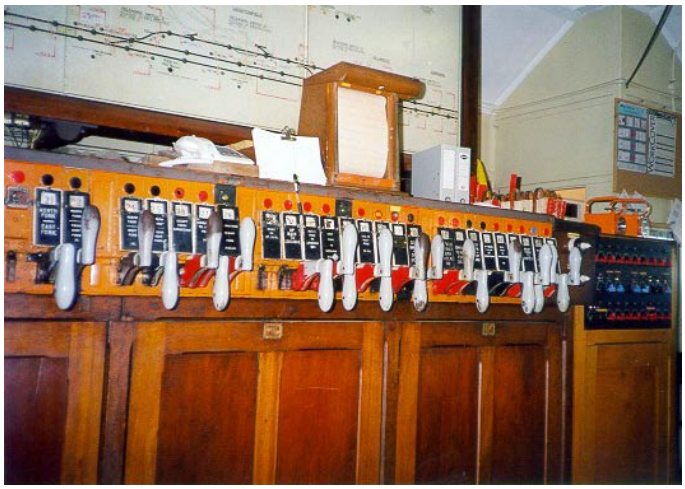
- The need to rely on "train stops"—a dated and maintenance-intensive system of trackside mechanical devices which automatically activate CityRail trains' brakes—to prevent train collisions if a train passes a (red) signal "at danger". These train stops are not able to stop freight trains, and Countrylink trains are only now being fitted with the necessary systems. (These limitations are inherent, and can only be overcome by adopting more modern systems. Automatic Train Protection (ATP) systems, which can offer much better protection for *all* types of trains, are to be piloted in Sydney in the next two years, as described in section 4.3 below.)

- The absence of even this "train stop" system on the intercity lines. (A program to fit train stops on these lines within the next two years is now underway.)

- The potential for a serious loss of life if there were a major fire on a train on the underground sections of the network or at an underground station, other than on the new Airport line, which incorporates modern fire and life safety measures. (The measures required to overcome these risks are discussed in section 4.7 below.)

- The need to relocate some "catchpoints"—points designed to deliberately derail any train passing a signal "at danger" on a siding before it can enter a main line, thereby reducing the risk of a collision with another train—so that a derailed train can safely come to a stop. (Corrective action at 13 locations identified as posing a "high" risk will be completed in 2002.)
- The ongoing need to protect and improve the safety and security of passengers on trains and at stations. (For details on station upgrades, see section 4.6 below.)
- The need to narrow the gaps between trains and platforms at many stations, to reduce the risks of passengers falling beneath the trains or otherwise injuring themselves. (Again, see section 4.6 below.)
- The need for improved security fencing along rail corridors, including fencing for the cycleways being established on some corridors and security screens on bridges over railway lines. (This need is being addressed by RIC.)

Much of the signalling control technology used in the greater metropolitan region is now extremely dated and offers few of the capabilities available with modern systems. (The mechanical and electric relay-based systems shown here, at Gosford (above), Sefton (below) and Strathfield (left), date back to the early 1900s, the 1920s and the 1970s.) The equipment and facilities stand in stark contrast to the modern equipment and high-quality facilities used for monitoring and controlling road traffic flows in Sydney, even though the road monitoring and control systems are not primarily concerned with safety.



3. The factors shaping future rail transport in the greater metropolitan region

The factors directly affecting the shape of future rail transport in the region over the next 10–20 years include:

- **Future passenger demand**, which will depend on (among other things):
  - **Overall population growth** in the region
  - **The distribution of this population growth**, and especially the proximity of residential growth to the rail network, both through urban consolidation and through the selection of new urban development areas (desirably with higher densities of development close to railway stations and good "feeder" bus services for more distant areas)
  - **The extent to which the rail network is able to expand to serve new and previously remote residential growth areas, especially in northwestern and southwestern Sydney** (this will depend very heavily on whether new rail corridors are protected in the immediate future)
  - **Employment growth and patterns**, and especially the proximity of employment growth to the rail network and major centres in the region, particularly the Sydney CBD and other inner city centres but also Parramatta and other centres targeted for employment growth
  - **The extent to which rail network and station capacity and the CityRail train fleet are able to expand to cater for new and emerging demand** (if they cannot, current and potential new passengers will switch to or remain with other modes of transport, even if road congestion worsens severely)
  - Increases or decreases in **trip rates** (the number of trips made per person)
  - The impacts of **changing technologies**, especially e-commerce and teleworking
  - **Changes in working hours**, "spreading" the peaks
  - **The extent to which "feeder" public transport services, and especially road-based and transitway bus services, are developed and improved**, especially in areas more distant from the rail network
  - **Improvements in transport mode interchanging speed, ease and facilities**, including improvements to bus–rail interchanges, "park and ride" commuter car parks, "kiss and ride" facilities, taxi ranks and additional *Easy Access* facilities
  - The introduction of **faster intercity services**, including, in the longer term, possible tilt train and magnetic levitation train technologies
  - Increases in **fuel prices**
  - Increasing **road congestion**
  - The **pricing of CityRail services**
  - The **quality, frequency, reliability and safety of CityRail's services**
  - **Customer and potential customer perceptions** of service quality and "value for money"
  - Community views on **environmental issues** and the extent to which these views translate to choices of a relatively "green" form of transport, and
  - The extent to which there are **additional interventions by the Government**—beyond the measures proposed in the *Long-Term Strategic Plan for Rail*, which are based on forecasts of *likely* future patronage growth—in order to achieve the more ambitious CityRail patronage growth needed **to satisfy the Government's *Action for Air* and *Action for Transport 2010* target of a halt to the growth of total vehicle kilometres travelled in the greater metropolitan region by 2021**.
- **Future freight demand**, which experience has shown is inherently more difficult to predict.

  Although overall rail freight growth has been running at about 4% pa for the past decade, demand for particular types of services can and does vary greatly and very rapidly, and freight demand forecasting often involves difficult "chicken and egg" judgments about the likely

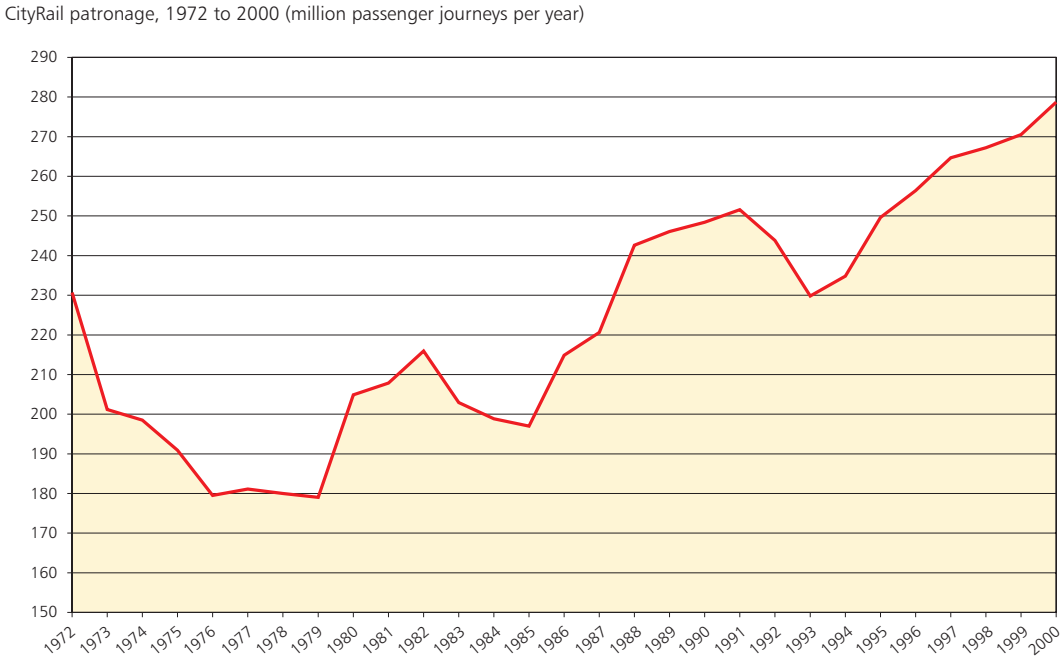


Figure 3.1. Annual total CityRail patronage, 1971–72 to 1999–2000.

market-generating impacts of improvements in rail freight services and capabilities.

- **The requirements imposed and new opportunities created by the need for improved rail operational safety, reliability and efficiency**, and in particular:
  - The ability to **restore the "sectorisation" of CityRail services** and enhance this approach by developing separate new "sectors" through the combination of new lines and extra tracks on existing lines, so that increasingly CityRail trains will operate on much simpler, much more segregated and much more robust "end to end" service patterns
  - The associated ability to **simplify the "mixing" of fast and slow CityRail services** on the major rail corridors
  - The ability to **create new "turnback" facilities**, thereby removing obstructions to through services and increasing line capacity
  - The potential of **new computerised signalling control systems** now being installed in parts of the metropolitan area (see section 4.9) to improve both operational efficiency (for example, through automatic route setting and the ability to precisely monitor all train movements) and infrastructure and train maintenance efficiency (through automatic logging and reporting of asset conditions and failures)
  - The ability of **emerging communications-based "in cab" signalling technologies** to improve both rail safety (through Automatic Train Protection systems which would prevent overspeeding and the passing of signals "at danger") and the capacity of the rail network (through "moving block" and similar systems which, subject to a number of other factors discussed in section 4.3, could permit trains to travel closer together with reduced "headways"), and
  - The introduction of **new technologies and facilities improving both the reliability and performance of the CityRail fleet and the cost-effectiveness of rail infrastructure and operations**, such as upgraded infrastructure and train maintenance capabilities and systems, alternating current electric traction and, in the longer term, more efficient types of wheel-on-rail rolling stock and possible magnetic levitation or similar technologies.

3.1 Future passenger demand

Over the last 20 years CityRail's patronage has increased by an average annual growth rate of 1.55%, outstripping the average annual population increase over the same period of 1.2%.

This growth has not been uniform. Downturns have been experienced during periods of reduced economic activity, followed by faster growth during and following economic recoveries (*Figure 3.1*), and the growth rate has been much higher on some lines—particularly those carrying the most passengers, but also on the Central Coast and South Coast lines—than on others.

In the five years to 1999–2000, for example, total patronage on the "inner west" lines between Macdonaldtown and Regents Park increased by 24%, patronage on the Main North and Illawarra lines increased by 20%, patronage on the lower North Shore line increased by 19% and patronage on the Bankstown line increased by 17%—but patronage on the

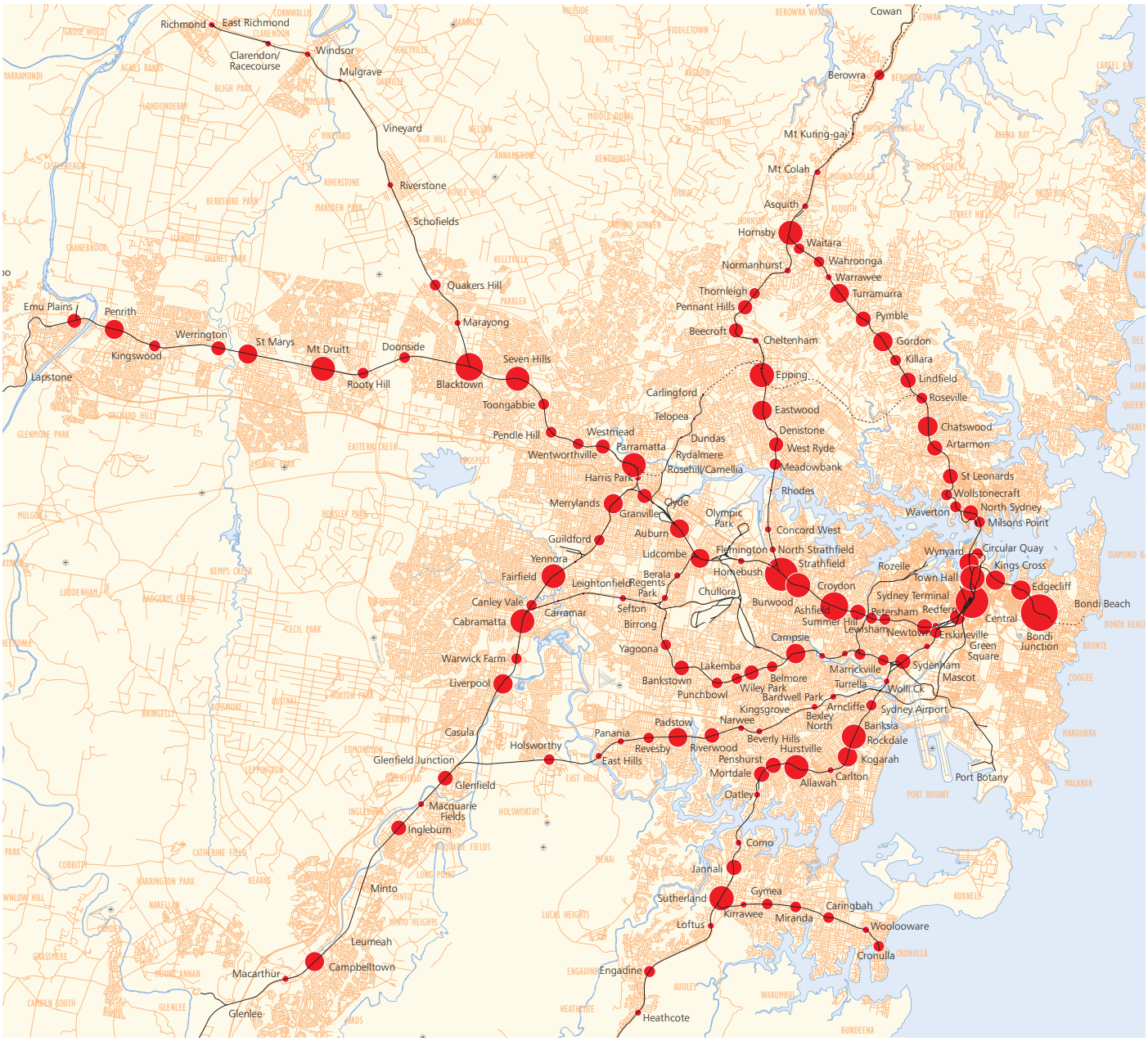


Figure 3.2. *Station entries, 6:00–9:30 am, weekdays in 2000 (the areas of the "bubbles" are proportional to the patronage flows).*

Main West line between Emu Plains and Doonside increased by only 0.2%.

Further, the growth rates experienced for *peak period* trips —mainly journeys to work—have been different to the *total patronage* patterns just discussed. For example, over the last four years morning peak hour patronage into the Sydney CBD has increased by 21%, but the increases have ranged between 30% for patronage from the North Shore line to only 5% for patronage from the Bankstown line.

Although journeys to work represent only 19% of all journeys in the region, as already indicated they constitute a large proportion of CityRail's peak loadings, especially in the most congested parts of the rail network, and are therefore critical in assessing the likely future peak demand for CityRail services and the consequential needs for increases in the rail system's capacity.

In 1996 about 54% of all rail journeys to work were to the Sydney CBD, 13% were to the lower North Shore, 8% were to Sydney's west, including Parramatta and Blacktown, and 8% were to the inner west, including Strathfield, Burwood and Ashfield.

This pattern is well illustrated by *Figures 3.2 and 3.3*, which summarise station entry and station exit data for weekday morning peak periods during 2000 (the areas of the "bubbles" are proportional to the patronage flows).

Employment has increased rapidly in the CBD and North Sydney over the last ten to 15 years, but is expected to increase at a slower rate in the future with a continuation of the trend to employment at more dispersed locations in the suburbs and especially in "outer ring" areas, including new business parks. On the other hand, the swing to employment in service industries in the finance, property and business

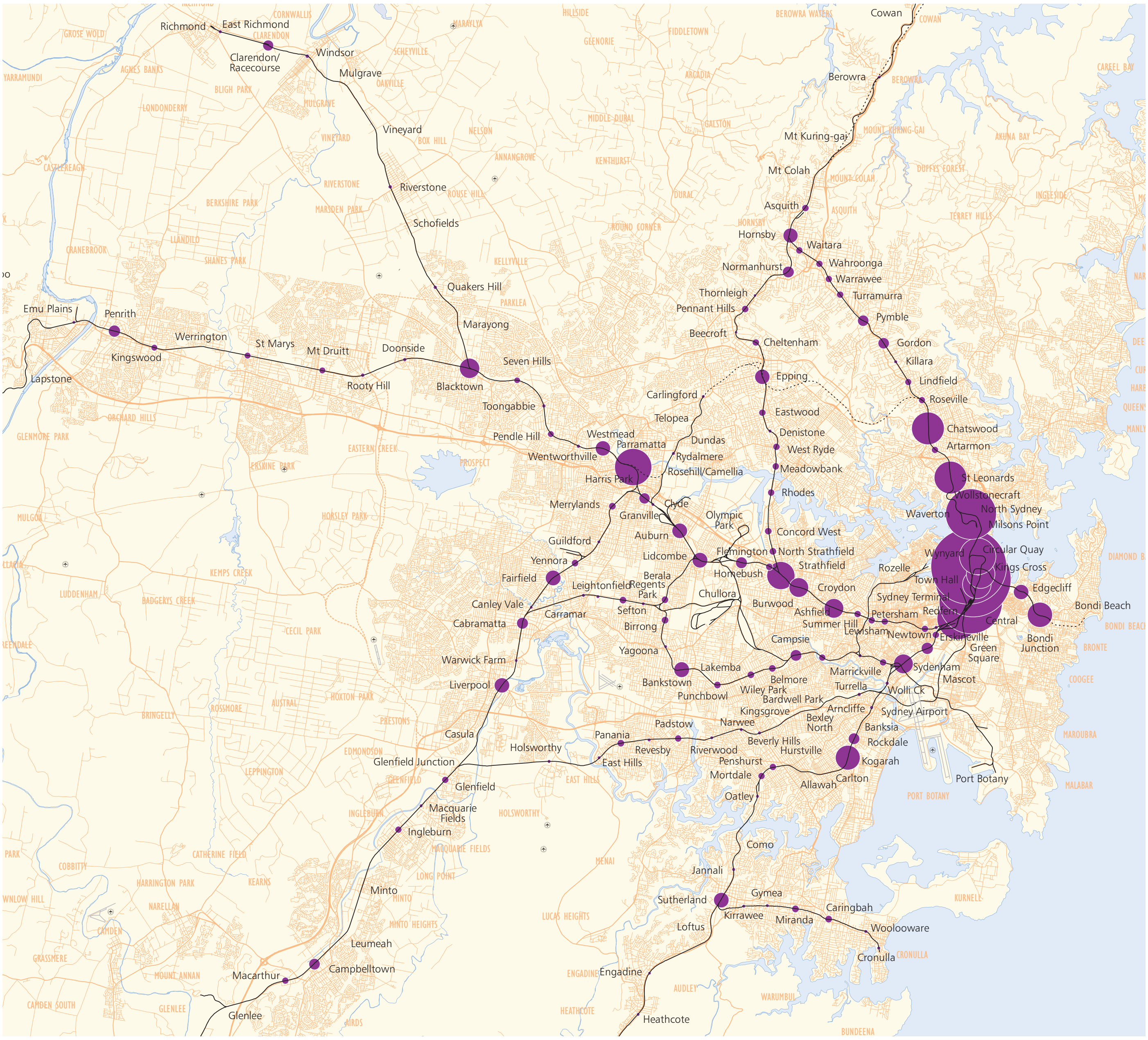


Figure 3.3. Station exits, 6:00–9:30 am, weekdays in 2000 (the areas of the "bubbles" are proportional to the patronage flows).

services sectors is expected to continue to concentrate employment in the major urban centres of the Sydney CBD, North Sydney, Chatswood and Parramatta, all of which are key rail markets.

There are considerable (and inconsistent) differences in the forecasts of "CBD and inner city" employment growth made by different forecasters.

The Department of Urban Affairs and Planning (DUAP), the Department of Transport's Transport Data Centre (TDC) and a report prepared for Rail Access Corporation by Richard Kirwan in September 2000 all forecast only slow to modest growth in central area employment.

TDC also expects that the increasing residential population of the CBD will absorb many of the new jobs in this area.

As a result, TDC has forecast a total increase in CityRail patronage between 2001 and 2021, *assuming no new rail lines are built during this period*, of around 16%, or roughly the rate of population increase.

In essence, this is a conservative projection catering for the possibility that future rail patronage will no longer outstrip population growth, even though it has consistently done so, on average, in the past. (TDC's projections for 1996–2001 have already proved to be well below the 4.5% pa CBD patronage growth actually experienced.)

At the other end of the spectrum, BIS Shrapnel and a report prepared for Rail Infrastructure Corporation by CB Richard Ellis in January 2001 have forecast faster growth in *white collar* employment in the CBD, albeit not as fast as in the past (see *Figure 3.4*, which also illustrates the similarity of past patterns in CBD white collar employment and CityRail patronage).

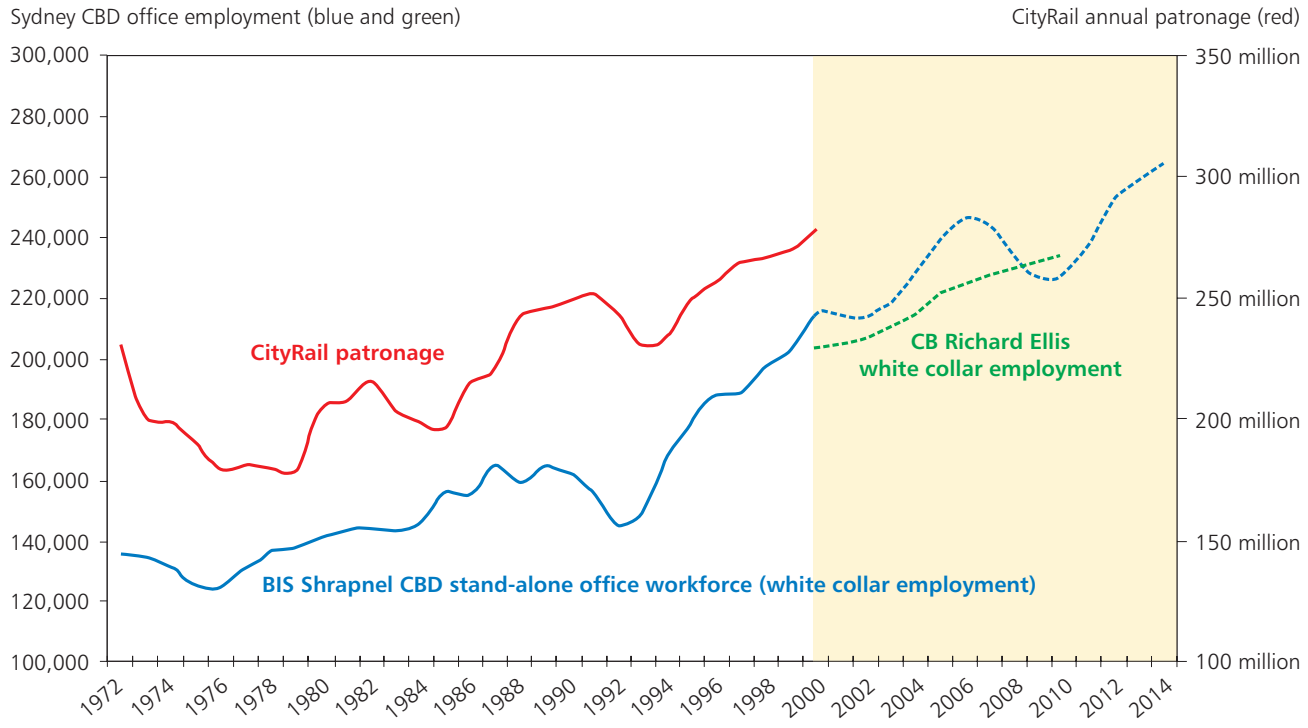


Figure 3.4. BIS Shrapnel and CB Richard Ellis forecasts of white collar employment in the CBD, with a comparison of past patterns in CBD white collar employment and total CityRail patronage.

Accordingly, **for the purposes of the corridor growth analyses summarised in section 4.4 below, four patronage growth scenarios have been tested:**

- A **"low growth" scenario**, based on the TDC forecasts, with the growth in *total* rail demand being 0.8% pa, in line with DUAP's population growth forecasts (as with all the scenarios, there are significant variations in growth rates between the different rail corridors).
- A **"medium growth" scenario**, with a total growth rate of 4.5% pa from July 2000 to June 2001 (continuing the trend of the previous four years, and ignoring the extra growth generated by the Olympics) and 1.55% pa from July 2001 to 2021 (the trend growth rate over the last 20 years), or a slightly higher growth rate of 1.7% pa when the likely effects of the opening of new lines are taken into account.
- A **"high growth" scenario**, with a total growth rate of 4.5% pa from July 2000 to June 2001 and 2.0% pa from July 2001 to 2021.
- A **"recession followed by medium growth" scenario**, replicating the patronage downturns of previous recessions by assuming a 10% reduction in total patronage between 2001 and 2004 and then applying a 1.55% pa growth rate from 2004 to 2021, again with slightly higher growth rates of 1.7% pa in 2011 and 2016 to take account of the opening of new lines.

Figure 3.5 shows the forecast total morning peak passenger flows into the CBD under these four scenarios, and *Figure 3.6* shows forecast total annual CityRail patronage under the four scenarios.

In *Action for Air* and *Action for Transport 2010* the Government set an ambitious target of a halt to the growth of total vehicle kilometres travelled in the greater metropolitan region by 2021, as a necessary part of moves to prevent an unacceptable degradation of air quality in the region.

Action for Air predicted that to achieve this target public transport's mode share would need to increase by almost 50% from 1996 to 2021. Later RIC and SRA studies suggest that even if bus and ferry patronage increases as fast as rail patronage, a rail mode share increase closer to 60% will be required.

In order to achieve the *Action for Air/Action for Transport 2010* target, it is now estimated, after allowing for population growth as forecast by the Department of Urban Affairs and Planning, that:

- Average weekday morning peak CityRail passenger flows into the Sydney CBD (bound for the CBD and other destinations) will need to increase to about 305,000 passengers by 2021, and
- Total CityRail patronage will need to increase to about 480 million passenger trips per year by 2021

even if the total number of trips made per person, by all transport modes, does not continue to increase.

As illustrated in *Figures 3.5 and 3.6*, **all four of the patronage growth scenarios modelled, reflecting the range of different predictions of *likely* patronage growth, fall well short of the patronage growth required for the Government's *Action for Air/Action for Transport 2010* target to be achieved.**

Despite this shortfall, the scenarios reflect the best advice currently available to the Office of the Coordinator General of Rail on realistically likely patronage growth. **The plans and projects identified in sections 4, 5 and 6 as necessary for the accommodation of the forecast *likely* growth would need to be significantly accelerated if the rail system had to be developed to cope with the growth rate targeted in *Action for Air* and *Action for Transport 2010*.**

Because the growth rate assumptions behind the plans and projects identified as necessary in section 4, 5 and 6 are

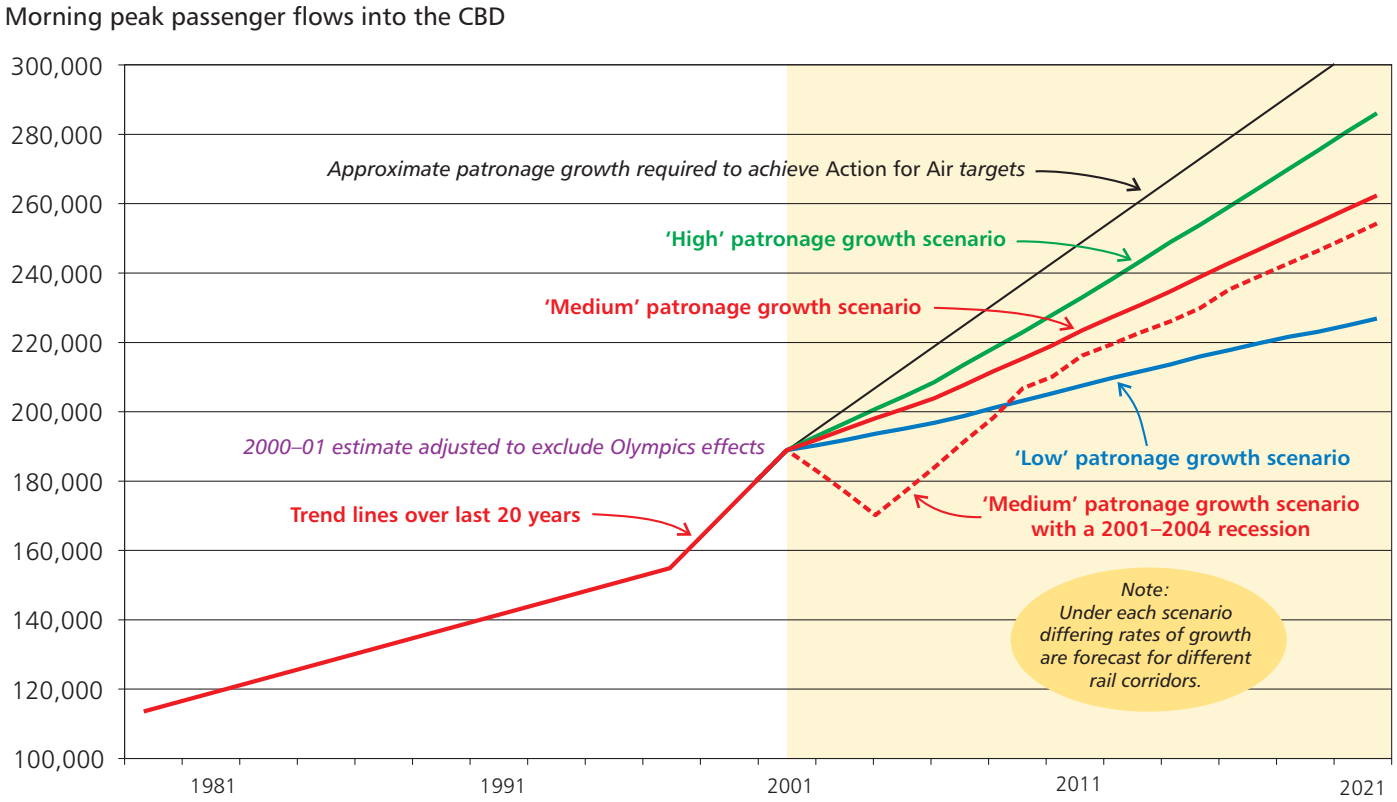


Figure 3.5. Forecast total morning peak passenger flows into the CBD under the four growth scenarios modelled in section 4.

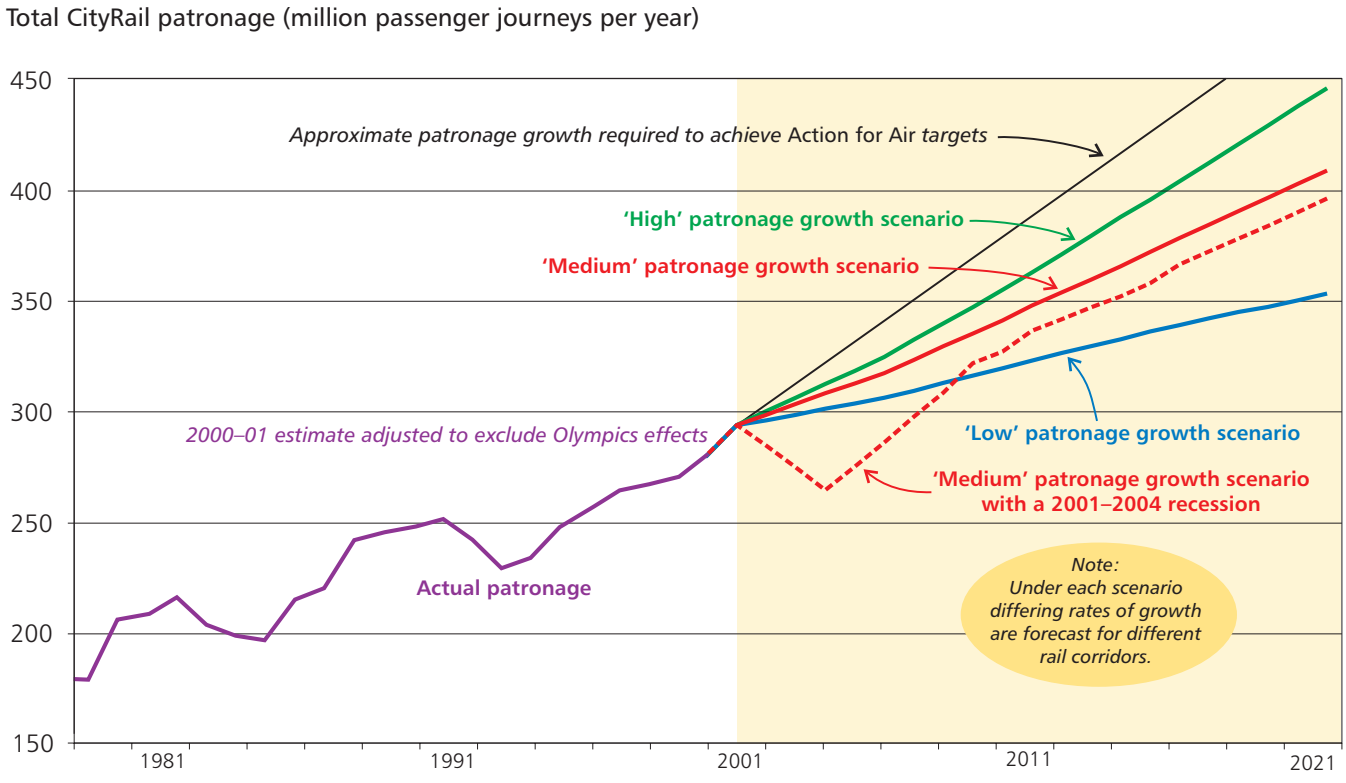


Figure 3.6. Forecast total annual CityRail patronage under the four growth scenarios modelled in section 4.

clearly identified, the timings and priorities of the various projects will be able to be adjusted in the light of the growth rates actually experienced in the future.

Growth along the rail corridors

As already indicated, the growth rates under the four "likely growth" scenarios have not been applied uniformly to all rail corridors in modelling possible future corridor patronage.

Instead, slightly over half of the growth rate assumed under each scenario has been distributed between the various lines in accordance with a 1996 SRA forecasting model based on distributions of population and employment in these corridors, broadly using growth distributions predicted by TDC (*Figures 3.7 and 3.8*) but with higher overall growth rate assumptions, and the balance has been distributed between the various lines—but only until 2006—in accordance with higher-than-forecast growth patterns in recent years, reflecting factors such as road congestion, CBD car parking shortages, rapid population growth near particular stations and local initiatives to increase rail patronage. After 2006 this component has been assumed to be equal for all lines (*Table 3.1*).

To illustrate the effects of these adjustments, under the "medium growth" scenario, with an assumed *total* increase in morning peak passenger flows into the CBD of 36% between 2000 and 2016, the increases for various lines over the same period have varied between 24% and 48%, with the fastest rates of increase being on the intercity lines (albeit from a much smaller patronage base than the suburban lines) and on the East Hills and North Shore lines and with the lowest rate of increase being on the Bankstown line (*Table 3.1*).

The factors likely to affect patronage growth in each of the corridors over the next 5–10 years are described below. The results of the corridor patronage analyses using the four scenarios for patronage growth are presented in section 4.4.

Illawarra line

The recent rapid growth of patronage on this line has arisen mainly from significant urban consolidation along the Illawarra and Cronulla lines, especially around Hurstville, Sutherland and Rockdale stations, which are served by "fast" and "semi-fast" CityRail trains, but also at other centres such as Kogarah.

This urban consolidation has provoked considerable local community debate, and it is expected that the overall pace of

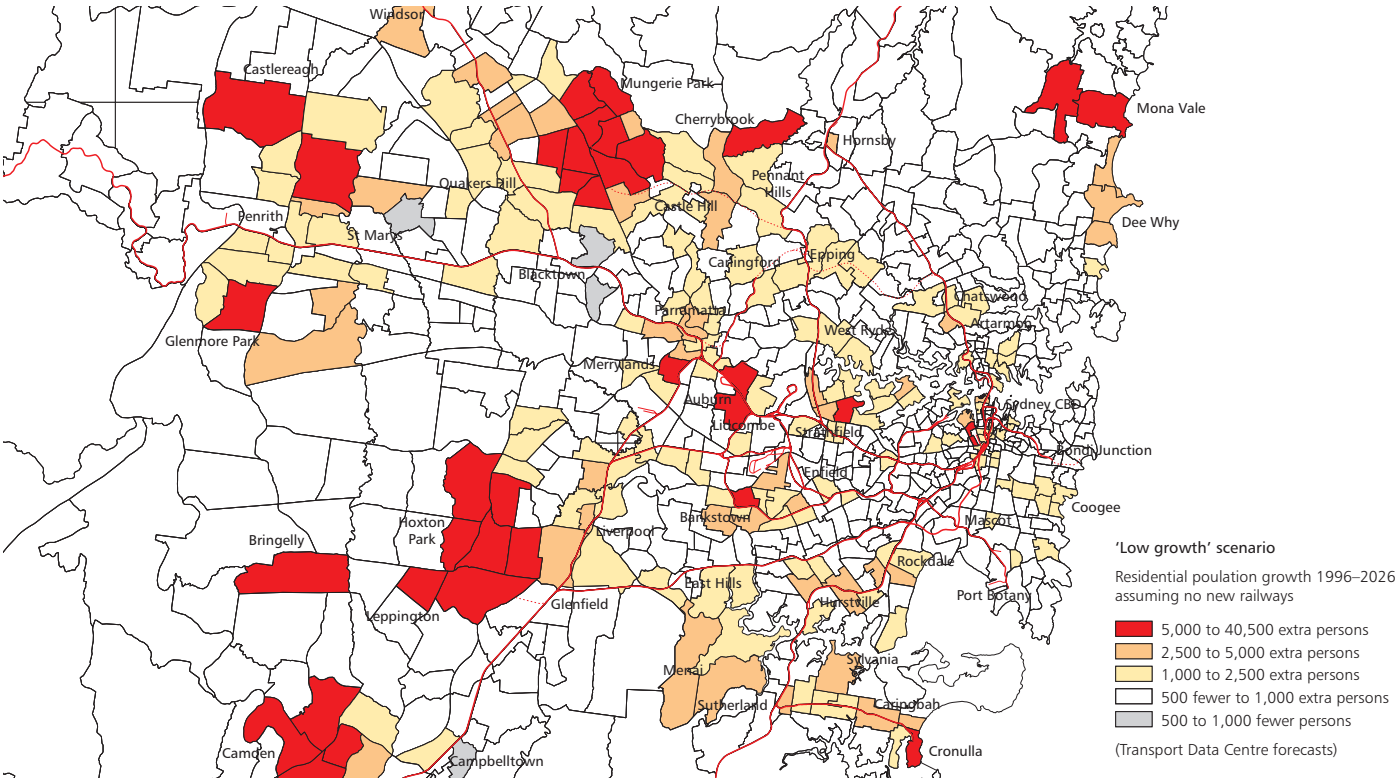


Figure 3.7. *Transport Data Centre "low growth" forecasts of the distribution of residential population growth between 1996 and 2026, assuming no new railway lines are constructed during this 30-year period. Broadly similar distributions, but with higher growth rates, have been assumed for slightly over half the growth rates assumed in each of the four patronage growth scenarios, with the balance of the distributions being assigned, between 2001 and 2006, on the basis of the differences between actual and forecast patronage growth in particular rail corridors between 1996 and 2001 (see Table 3.1).*

The major "greenfield" population growth areas, reflecting plans by the Department of Urban Affairs and Planning, are expected to be in the North West sector, in the Hoxton Park/Leppington/Bringelly area, in the Campbelltown–Camden corridor, in the Mona Vale area and, in the longer term, in the St Marys and Castlereagh areas. Significant urban consolidation population growth is expected along several existing rail lines.

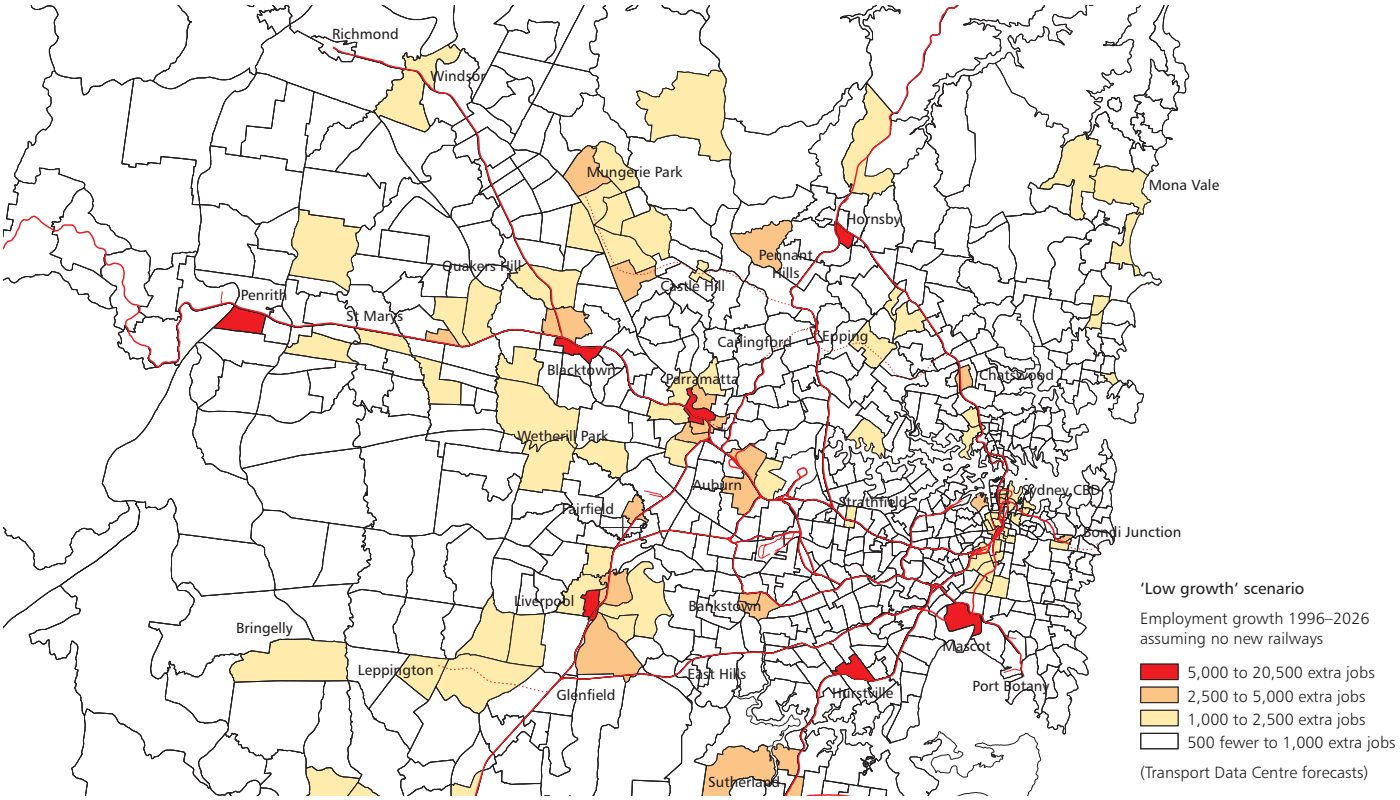


Figure 3.8. Transport Data Centre "low growth" forecasts of the distribution of employment growth between 1996 and 2026, again assuming no new railway lines are constructed during this 30-year period. The centres likely to experience the greatest employment growth are clearly shown, but the total employment growth in these centres will be less than the total growth at dispersed locations. Again, broadly similar distributions, but with higher growth rates, have been assumed for slightly over half the growth rates assumed in each of the four patronage growth scenarios, with the balance of the distributions being assigned, between 2001 and 2006, on the basis of the differences between actual and forecast patronage growth in particular rail corridors between 1996 and 2001.

***Table 3.1.* Morning peak period corridor patronage growth assumptions under the "medium growth" scenario**
(at the "CBD cordon" locations described in section 4.4)

Corridor	Morning peak patronage (7:00 am to 10:00 am)	Current annual growth rate	Growth from 2001 to 2006		Growth from 2006 to 2011		Growth from 2011 to 2016		Total growth from 2000 to 2016
			Component based on SRA 1996 land-use based forecasts	Other growth component *(based on 1996–2001 growth not forecast in 1996)*	Component based on SRA 1996 land-use based forecasts	Other growth component *(assumed uniform)*	Component based on SRA 1996 land-use based forecasts	Other growth component *(assumed uniform)*	
Illawarra	28,990	4.7%	2.8%	13.1%	2.9%	3.8%	2.8%	3.8%	38%
Eastern Suburbs	15,552	3.7%	1.0%	13.6%	0.9%	3.8%	1.2%	3.8%	28%
South Coast	3,750	8.7%	3.6%	21.7%	1.7%	3.8%	3.4%	3.8%	48%
East Hills	20,510	3.5%	6.3%	5.1%	4.2%	3.8%	3.4%	3.8%	42%
Bankstown	12,190	0.9%	1.8%	4.3%	1.7%	3.8%	2.1%	3.8%	24%
South/Inner West	23,050	4.8%	2.3%	11.0%	3.1%	3.8%	2.2%	3.8%	35%
West	24,840	1.2%	4.5%	8.3%	2.1%	3.8%	2.4%	3.8%	30%
Blue Mountains	3,970	7.4%	5.2%	17.6%	3.3%	3.8%	3.2%	3.8%	48%
Main North	11,450	2.3%	3.5%	7.7%	3.0%	3.8%	2.0%	3.8%	31%
Central Coast	9,202	5.9%	6.0%	18.2%	3.2%	3.8%	3.1%	3.8%	47%
North Shore	24,900	2.3%	2.3%	4.6%	2.1%	3.8%	2.1%	3.8%	39%
Total	**178,405**	**5.6%**	**8.0%**		**9.4%**		**8.9%**		**36%**

development will slow over the next few years. The market is well tuned to this type of development, however, and the areas close to the city and with good train services are likely to see increased growth as competition with other parts of Sydney becomes less intense.

Major developments are planned for around Wolli Creek station. Development applications for at least 2,500 dwelling units and major employment and commercial activities are currently before Rockdale Council. (These developments are not taken into account in the "low growth" TDC modelling shown in *Figures 3.7 and 3.8*.)

The proposed Cooks Cove development could also increase demand on the line, as could a number of the station and interchange improvements planned for locations where existing interchange facilities such as commuter car parks and bus services are already unable to cope with demand (see sections 4.4 and 4.6).

South Coast line

The population of the South Coast south of Thirroul is growing rapidly, with the Wollongong, Shellharbour and Kiama local government areas all experiencing considerable urban growth, as the area provides an affordable "overflow" housing area for Sydney.

While there is some urban consolidation, most of the growth is from major "greenfield" developments, mainly by Landcom.

There is likely to be significant continued growth in demand on the South Coast line for commuting to Sydney, assisted by the commencement of the major West Dapto development within the next five years, the electrification of the Dapto–Kiama line, the proposed new Oak Flats interchange and station, the proposed Flinders station (adjacent to 3,500 dwellings) and the inability of the RTA to upgrade Mount Ousley Road because of land slip problems.

East Hills line

With the exception of the development proposals for Wolli Creek mentioned above, there has been relatively little urban consolidation pressure on the inner sections of the East Hills line, largely because of the predominance of single residences erected in the 1940s and 1950s along this line.

This situation is unlikely to persist, however. The sale of Department of Defence holdings in Padstow and the availability of significant numbers of large residential blocks along the line are likely to entice developers over the next five years (the Department of Defence developments are not factored into the TDC predictions in *Figure 3.7*).

Improved bus services from outlying areas such as Menai to Padstow are also likely to develop as the East Hills line is amplified, increasing patronage on this line while taking some pressure off the Illawarra line.

Further to the west, the Department of Defence is proposing the development of 800 new dwellings within walking distance of Holsworthy station plus a major new development in about five years—ultimately with more than 12,000 residents and more than 30,000 jobs—near Moorebank Avenue, to be served by a new Georges River station (again, these developments, not being part of DUAP plans, are not factored into the TDC predictions in *Figures 3.7 and 3.8*). An expansion of the Holsworthy station car parking facilities, which are already unable to cope with demand, is also planned, and this could trigger a further growth in demand.

Greenfield development sites are now scarce in existing urban areas in the Glenfield to Macarthur (Main South line) corridor. There are already increasing pockets of urban consolidation, and infill development is being encouraged by DUAP in preference to further development south of Macarthur. The impacts of this policy are expected to be gradually felt over the next five years.

The proposed new Glenfield–Leppington line (see section 5) will serve new urban release areas planned by DUAP and other residential developments on Department of Defence and other land in the Bardia area not shown in *Figure 3.7*. This line will affect both patronage and train operations on the entire corridor from Glenfield to the CBD.

Pressure is mounting for improved public services to and from the urban growth areas around Camden. This demand is initially likely to be met by express bus services, potentially increasing CityRail patronage demand to and from Campbelltown. The topography of the area and the extensive development that has already occurred between Camden and Campbelltown mean Camden would be very difficult to serve adequately with a new heavy rail line, but light rail services might provide increased capacity for the "feeder" services in the longer term.

Bankstown line

The eastern part of the Bankstown line is starting to see pockets of urban consolidation, and there are opportunities for major urban consolidation around the site of the former railway carriage sheds in Punchbowl.

Bankstown is rapidly developing as a major employment centre, and this trend is expected to continue, increasing the importance of Bankstown as a destination.

A Department of Defence development near Regents Park station, creating about 350 new dwellings, is not expected to have a major impact on Bankstown line patronage.

South and Inner West lines

In recent years there has been some substantial urban consolidation along the Old South line between Liverpool and Granville. Although the prime sites have been developed, there are still opportunities for further development along this line.

Some increase in rail demand is expected to result from the new Parramatta–Liverpool transitway, which is now expected to be completed in 2003. The Liverpool station and interchange redevelopment has already increased demand.

There are few opportunities for residential or employment development between Sefton and Cabramatta in the short term, as the area is largely industrial and there are superior land development opportunities elsewhere. More significant redevelopment can be expected in this corridor in the longer term.

Some 400 dwelling units are now under construction around Homebush, and more are planned within two years. Strathfield and Burwood are also experiencing significant urban consolidation, and again more is expected in the next few years.

The proposed new Pippita station (see section 4.6) could place some minor additional demands on the Inner West line in the short term, but more significant pressure, especially on interchanging at Strathfield, is likely to come from the rejuvenation of old industrial areas near the Olympic precinct, the proposed Parramatta–Strathfield bus transitway and proposed new bus services from Granville to Strathfield along Parramatta Road.

Burwood will continue to grow as a sub-regional commercial, retail and employment area, and State Transit intends to increase its bus services to Burwood by 50% over the next few years. The current station and interchange are ill equipped for these tasks, but if they are redeveloped (as proposed) Burwood could become a major station, affecting other stations in the Inner West.

A DUAP Urban Improvement Policy is being developed for the Homebush–Strathfield–Burwood area, with a major focus on increasing the mode share of public transport.

Further to the east, more than 400 new dwellings are being built within 400 m of Croydon and Ashfield stations, and more are being planned.

Further east again, there is considerable "gentrification" along the Inner West to Macdonaldtown station, and this is producing considerable increases in patronage at all these stations, with the highest rate of increase being at Newtown, because of the high density of existing dwellings and increasing urban consolidation in this area.

Major redevelopments are planned for Redfern over the next few years. If current negotiations for major global high-technology companies to establish their southeast Asian headquarters at the Australian Technology Park are successful, up to 12,000 people could be employed on this site, and this would have a major impact on Redfern station. The station's capacity may also come under stress from proposed new bus services between the station and the University of New South Wales, assisted by planned improvements to bus stops south of the station.

West line

Urban consolidation between Parramatta and Toongabbie is driving up rail demand, and this trend is expected to continue with the reinforcement of Parramatta as a major regional centre.

Further west, however, there is little urban consolidation on the Main West line west of Blacktown, and most new developments are more than 5 km from a station. As a result, patronage growth in this corridor is patchy, at best, and St Marys, with declining retail and industrial areas adjacent to the station, is experiencing some patronage decline.

There are, however, opportunities for increases in demand on the Main West. 2,000 new unit dwellings are being developed by the Department of Defence on a site next to Penrith station, and 350 or more new dwellings are planned by the Department of Defence for a new residential and commercial precinct next to the site of the proposed University of Western Sydney station between Werrington and Kingswood.

The largest planned development, however, is on the ADI site north of St Marys, with approximately 8,000 dwellings. If it proceeds, this development will be linked by a bus transitway to both Penrith and St Marys stations.

In addition, there are numerous other former industrial and commercial sites along the Main West line which could be redeveloped for residential purposes within the next ten years if the local councils adopted favourable planning policies.

Negotiations are underway for a 20-storey residential, retail and commercial tower on the northern side of Blacktown station, with direct pedestrian links to the station.

The Richmond line is experiencing considerable patronage growth, and more is likely in the near future, especially from the rapidly developing North West sector. This line will bear the brunt of rail demand growth from the Rouse Hill area until the proposed Epping–Castle Hill–Mungerie Park line is built at some time in the next ten to 20 years (see section 5).

Blacktown Council is about to exhibit rezoning plans for 1,100 hectares north of the Richmond line between Schofields and Riverstone. When this area is fully developed it will house some 30,000 people. As discussed in section 5, it will be important to ensure that a corridor for a future Mungerie

Park–Vineyard rail link is reserved as part of the rezoning of this area within the next 12 months.

The Department of Defence is proposing to redevelop the former HMAS Nirimba site between Quakers Hill and Schofields for up to 1,400 dwellings. This will necessitate the construction of a new Nirimba station to serve this "landlocked" site.

Blue Mountains line

There are limited opportunities for further patronage growth on the Blue Mountains line. Although there are some pockets of urban consolidation in the lower mountains, opportunities for greenfield developments are severely constrained by topographic, environmental and bushfire safety limitations.

Main North line

Patronage on this line is growing rapidly. There are large pockets of urban consolidation at major centres along the line, and with the advent of the Epping–Chatswood line in 2008 there are likely to be further strong increases in demand.

Patronage growth remains strong in the Hornsby area, and urban consolidation is starting to filter towards West Pennant Hills. However, the two strongest urban consolidation areas are between Epping and Meadowbank and between Rhodes and North Strathfield. Demand in these areas is expected to grow dramatically in the next five years, and the Epping–North Strathfield corridor is expected to be one of the largest growth segments for CityRail over the next decade. (This expectation is not mirrored in the modelled "extra growth" distributions shown in *Table 3.1*, which are conservatively based only on growth which has actually occurred in the last five years.)

Some 2,000 to 3,000 new dwellings are expected to be built along the line north of Parramatta River, 3,000 are expected around Rhodes station, which will be redeveloped at the developers' cost (see section 4.6), large numbers of new dwellings are expected around Concord West, the former Arnotts' biscuit factory site may be redeveloped and 1,000 new dwellings are expected to be developed on a site north of North Strathfield station. There are also numerous other sites for smaller scale redevelopments.

This corridor is also a growing area for employment in high-technology industries and financial services.

Central Coast

Patronage on the Central Coast line has grown rapidly in the last decade.

While most of the opportunities for greenfield growth are now moving north into the northern part of Wyong Shire, there are still limited opportunities close to the railway in the Gosford Council area.

At the same time there are significant opportunities arising from urban consolidation around Gosford and Wyong, much of it close to the major stations, as these areas mature.

Up to 40,000 new residents are likely to move into the northern part of Wyong Shire in the next ten years. The area is regarded as one of the last with affordable housing, and large tracts of land have been acquired by Landcom. A major new urban centre is to be developed around Warnervale, necessitating the construction of a new bus–rail interchange station some 1.5 km north of the existing station.

North Shore line

The lower North Shore has been subject to major urban consolidation for a long time, but this is expected to continue with renewed vigour in the next decade with increasing numbers of high-rise apartments. The advent of the Epping–Chatswood line is expected to accelerate this process.

Chatswood and St Leonards are expected to further consolidate with multi-function retail, commercial, employment and residential developments close to and dependent on the railway. They will continue to grow as regional centres, and because parking is already constrained their future growth will increasingly depend on good bus and rail public transport links.

North Sydney will also continue to grow in size and complexity. North Sydney Council is anxious to increase floor space ratios in the North Sydney business district to attract the overflow from the Sydney CBD, but the viability of this will depend on a substantial increase in the capacity of North Sydney station.

The most pressing demand issue on the North Shore line, however, is the development of close links between the North Shore, the Sydney CBD, the Eastern Suburbs and the Airport. Once the Epping–Chatswood line is operational this nexus will become particularly important for the high-technology employment zone around North Ryde, as it will provide a vital link to other parts of the Sydney region essential to these industries' operations.

4. The next ten years

4.1 Service levels and objectives

In the light of the operational issues and constraints discussed in section 2, the overall increases in patronage discussed in section 3, the immediate priorities listed at the start of section 4.2 below and the viability of the alternatives discussed in section 4.3, it is proposed that:

- The greater metropolitan passenger rail system should continue to provide mixes of service types, service frequencies, service qualities and station and interchange facilities designed to maximise CityRail's patronage and accommodate patronage demand to the fullest extent possible, subject to the over-riding statutory requirement to provide safe and reliable services and the practical limitations imposed by available resources and the operational constraints of a complex railway system.
- Planning of the future development of the greater metropolitan rail system should continue to be based on sound assessments of actual rail patronage and the *most likely* changes in rail patronage—even though State Rail should continue to aim to achieve the more ambitious *Action for Air/Action for Transport 2010* patronage growth targets—and actual and "most likely" changes in rail freight demand.
- The target for CityRail on-time running (i.e. arriving within three minutes of the timetabled time for suburban services and within five minutes for intercity services) should continue to be at least 92% of all peak services. (This target is at least as high as those set for major urban railways overseas. Most comparable rail systems have adopted lower standards.)
- CityRail should aim to deliver peak service frequencies of at least one train every 15 minutes for any station used by more than 1,000 passengers per hour in the peak.
- The target for the proportion of scheduled CityRail peak services which actually run should continue to be at least 99%.
- In future years CityRail train loadings should be planned not to exceed 135% of seated capacity, and where possible passengers should continue not to have to stand on any train for more than 20 minutes, other than by choice. (In practice, for planning purposes—including the calculation of future train requirements—this means the *average* suburban train capacity should be assumed to be about 1,000 passengers, to cater for fluctuations in demand.)
- The target for the proportion of CityRail rolling stock to be available to run services during peak periods (i.e. not undergoing maintenance or requiring repairs) should continue to be at least 90%.
- There should be comprehensive and accurate real-time passenger information systems at stations and on trains.
- The comfort, convenience, safety and security of passengers and the accessibility of CityRail services should continue to be improved through the upgrading of train designs and fitout (when new trains are ordered to cater for patronage growth and when existing trains are replaced and refurbished), through targeted station and interchange upgrading programs, through high-quality staff services, through improved train and station maintenance and cleaning and through convenient multi-modal ticketing systems, including smartcard ticketing.
- The exteriors of all CityRail trains should be cleaned at intervals of no more than 14 days, and more frequently if possible.
- The interiors of all CityRail trains should be cleaned at least daily, with major cleanings at intervals of no more than 30 days.
- Graffiti should be removed from CityRail trains as soon as possible, and in any event within 24 hours.
- Operational segregation and sectorisation of CityRail services should be re-established and considerably strengthened to reduce the probability of service disruptions and minimise their effects, through the measures discussed in sections 4.4 and 5 below.
- The metropolitan passenger rail system should be protected against the threat of operational paralysis within the next 10–15 years by implementing the prioritised program of capacity-enhancement projects discussed in sections 4.4, 4.5 and 5.
- Subject to the availability of Commonwealth funding, the metropolitan freight rail network should be upgraded over the next 10–15 years to cater for demand growth and progressively reduce the peak-period "curfew" on

freight train movements, especially on the Main South corridor, by implementing the prioritised program of projects discussed in sections 4.4 and 5.

- Rail infrastructure failures, CityRail rolling stock failures and whole-of-life asset costs should be reduced to targeted and systematically monitored and reported levels through the maintenance improvements discussed in section 4.10 and 6.3.

4.2 Strategies

As described in more detail in sections 4.4 to 4.10 below, the principal strategies for CityRail services for the next decade, in the face of the operational difficulties outlined in section 2 and forecast patronage growth, are to:

In the next year:

As already recommended and approved:

- Continue with the immediate **safety-related improvements** already underway for driver, signaller and train controller training, improvements to train monitoring and communications systems, new and simpler safe-working rules, additional train stops, etc, arising from the issues listed in section 2.4.
- Continue to improve infrastructure reliability by **increasing rail infrastructure maintenance funding and re-establishing vital major periodic track, signalling and electrical infrastructure maintenance programs**, including a program to expand the capacity of the electrical power system to cope with future increases in traffic and the power requirements of CityRail trains.
- Continue to **improve rolling stock reliability and presentation** by increasing maintenance funding and improving both routine maintenance and major overhauls.
- Continue to **eliminate automatic signalling "dark territories"** through the installation of systems permitting train movements on these sections of the network to be monitored from adjacent signal boxes and other control locations.

In other measures:

- Amend timetables to **simplify the mixes of service patterns**, thereby improving the separation of trains on individual corridors and increasing service reliability.

  A new timetable for CityRail services would be able to change the stopping patterns for several services, making them simpler and more repetitive.
- Amend timetables to provide slightly increased but **more realistic train running times**, thereby again improving service reliability, as demonstrated by the timetabling approaches adopted during the Olympics.

  The new 2001 timetable will allow realistic dwell times at stations, reflecting station patronage, and will allow extra time at junction interchange stations. Timetabled running times will increase by between two and five minutes during the peaks.
- Improve the new **coordinated approach to incident management** through the Rail Coordination Centre

  Work is continuing with the relevant staff and unions to identify the ways in which the coordination centre can enhance its role as the coordination point for all the actions that need to be managed during a major service disruption.
- Commence work on the establishment of **a modern new network control centre and enhancements to the geographic coverage of the *Train Location System* used by State Rail train controllers and managers**, so that train controllers are able to view train locations on all portions of the metropolitan rail network south of Wyong and north of Bomaderry by December 2002.
- **Commence detailed concept development and design studies for a new inner city rail link between Eveleigh and St Leonards via the Sydney CBD and North Sydney** (as discussed in sections 4.4 and 4.5, this new rail link will be critically important by between 2011 and 2015).
- **Commence land acquisitions, planning controls and other measures to protect the routes of proposed new railway lines,** as discussed in section 5, thereby significantly reducing the ultimate cost of these projects by minimising the need for underground alignments.
- **Commence project definition studies for the piloting and possible future wider introduction of communications-based in-cab signalling systems**, with Automatic Train Protection systems to prevent train overspeeding and the passing of signals "at danger" and possibly also with other functions that could increase the effective capacity of the rail network, as discussed in section 4.3.
- Commence the introduction of a modern **computerised signalling control system** already trialled during the Olympics, thereby improving operational efficiency, reliability, safety and incident recovery, providing essential data for more systematic maintenance programs, providing accurate "real time" information to passengers and reducing signalling and train control costs.

  This work is now focussed on the installation of the new control system in the Sydenham signal control complex.

Progressively over the rest of the decade:

- **Continue the re-established major periodic maintenance programs for metropolitan rail infrastructure** to

overcome the existing backlog, improve infrastructure reliability and minimise infrastructure life cycle costs.

- **Continue *Easy Access* upgrades of a further 44 stations** throughout the metropolitan area, targeted to the stations with the greatest passenger flows.
- **Complete fire and life safety improvements** to the underground rail network and underground stations.
- **Provide additional, prioritised infrastructure to improve the segregation and "sectorisation" of services and the capacity of capacity-constrained lines subject to rapid patronage growth**, including, in particular,
  - The early provision of additional tracks on sections of the East Hills, Cronulla and Richmond corridors, followed by additional tracks on sections of the North Shore and Illawarra corridors, to increase capacity, permit overtaking and reduce the interdependence of different types of services
  - The early grade separation of the network's most capacity-overloaded junction at Glenfield
  - The early construction of "turnbacks" clear of the main lines at Central, Lidcombe, Homebush, Panania and Bondi, followed by new turnbacks at Glenfield, Macarthur, Sutherland and Hornsby, and
  - The construction, in the second half of the decade, of flyovers to permit trains to "change lanes" without obstructing oncoming trains on multiple-track sections of the Main West and Illawarra lines.
- **Investigate and conduct pilot installations to assess the potential for further capacity relief through the targeted introduction on key lines of in-cab train signalling systems**, consistent with agreed international standards, and commence wider implementation if clear benefits and system robustness are demonstrated.
- Construct and open the new Epping–Chatswood line, thereby permitting more trains to enter the CBD by using the only remaining route with significant spare capacity, the southbound track across the Harbour Bridge.
- **Continue detailed design, planning and operational investigations and preparations for the new inner city rail link** between Eveleigh and St Leonards via the Sydney CBD and North Sydney.
- **Continue land acquisitions, planning controls and other actions to protect future rail corridors.**
- **Increase the CityRail fleet to cater for patronage growth** (the initial increases required have already been approved by the Government).
- Over the rest of the decade, **replace life-expired electric and diesel carriages and commence a major and ongoing program of progressive replacement of other ageing electric rolling stock**, thereby improving the quality of CityRail services and reducing maintenance costs.
- Depending on the success of initial installations at Sydenham, expand and possibly complete the **introduction of the new computerised signalling control system.**
- Upgrade the capacity, safety and comfort of stations, with the highest priority for capacity upgrading being Town Hall station.
- **Construct several new stations** to cater for new residential developments and improve access to education and employment facilities.
- **Upgrade targeted bus–rail interchange facilities** to cater for and encourage increased use of public transport by residents in areas which are not close to the rail network.
- **Upgrade targeted rail commuter car parks, "kiss and ride" facilities and taxi facilities.**
- **Modernise train maintenance and cleaning facilities and equipment**, with facilities for minor routine maintenance and repairs and train cleaning being established at the major train stabling areas to improve train cleanliness and maintenance efficiency and rapid response capabilities.
- **Establish new train stabling facilities** to reduce unnecessary movements of empty trains after the morning peak and before the afternoon peak.
- **Investigate the introduction of 25 kV AC (alternating current) traction** on intercity routes to help reduce travel times and electrical infrastructure requirements and costs, with dual-voltage trains also able to travel on lines retaining the existing 1,500 V DC (direct current) electrical system.

4.3 Alternatives

Despite claims made from time to time by the advocates of particular "solutions", **there are no "magic bullets"** that can provide a complete answer to the difficulties faced by a complex, capacity-constrained and ageing metropolitan rail system such as Sydney's, faced as it is with the prospect of considerable further patronage growth in the short, medium and long terms and the continued need for a mix of long-distance, suburban and "inner city distribution" types of services.

Nonetheless, a number of the "alternatives" merit serious consideration, and elements of them are quite likely to find a place in the more comprehensive and realistic strategies advanced in the *Long-Term Strategic Plan for Rail*.

Diversions to other modes?

The options for managing rail patronage growth, in addition to the measures outlined in section 4.2 above, include diversions to other transport modes such as private cars and buses, a process actively encouraged in many parts of the world in the second half of the 20th century.

This option is now neither feasible nor desirable, given increasing road congestion, degrading air quality and the severe peak period overloading already experienced by the Sydney bus fleet.

Indeed, the approach now preferred—not only by rail and public transport agencies but also by road network planners and developers, including the Roads and Traffic Authority—is to actively manage and reduce the growth in road network demand, by reducing the need for people to rely on private car travel and encouraging the use of more efficient modes of transport, including rail-based public transport.

The Government's target for a halt to the growth of total vehicle kilometres travelled in the greater metropolitan region by 2021, as spelt out in *Action for Air* and *Action for Transport 2010*, depends very heavily on boosting rather than cutting rail patronage (see section 3.1).

More specifically, in developing the transport strategies set out in *Action for Transport 2010* the Government consciously reinforced this approach by choosing to make major investments in the rail system and bus transitways in preference to major freeway/motorway projects.

As discussed in section 5, the *Long-Term Strategic Plan for Rail* proposes a number of longer-term rail development options, for possible implementation after 2021, which would utilise corridors previously reserved for now-abandoned freeways such as the F6, or permit the scaling back or long-term deferral of otherwise essential major road projects.

More passengers per train?

Another option would be to reduce CityRail service standards, with trains routinely having to carry more passengers than the current maximum of 135% of seated capacity—equivalent to about 1,200 passengers on suburban trains—and/or with passengers being forced to stand for longer than the current maximum of 20 minutes.

(The current requirement, barely able to be met on the most congested lines, is that passengers should stand for no more than 20 minutes *unless they choose to do so*, as many do when they board crowded "fast" services in preference to slower services stopping at more stations.)

This option of carrying more people on each carriage is not practical for double deck rolling stock with only two doors on each side of the carriage. Once the number of passengers reaches about 150% of seated capacity there is a significant reduction in the ability of these trains to maintain schedules and maintain high service frequencies, as it takes a long time for passengers to move out of and into the trains, especially at busy locations like the major city underground stations.

In many overseas cities higher train loads are achieved in inner city areas by using **single-deck "metro" style trains with very limited seating**, large numbers of standing passengers and up to six doors on each side of the carriage.

If such an approach were adopted in Sydney very large and expensive interchanges between the existing suburban and intercity trains and the new metro trains would need to be constructed, and passengers would experience significant inconvenience, especially in the case of the large numbers of commuters passing through the CBD on their way to other major destinations such as Parramatta and Chatswood.

For these reasons, major European cities faced with similar problems—even those with established metro systems—are now choosing to extend their *suburban* railways in new tunnels through the CBD, rather than continuing to rely on interchanges to metros.

A variant on the metro approach would be to introduce metro services, each carrying up to 2,000 passengers, right out into the suburbs. This would force large numbers of passengers to regularly stand for 40 minutes or more, because even with more than 30 trains per hour the seated capacity would be less than half that of the current suburban services. Nonetheless, such services might ultimately become necessary in the long term, if available line capacity for trains carrying fewer people becomes completely exhausted.

Another variant, which may well be more attractive in the medium to long term, would be to use **fast and powerful single deck "metro" style trains, with more seats than traditional metros, on entirely new suburban lines, with totally new and separate operational "sectors", passing through the inner city or Parramatta** (see section 5).

In combination with the reduced train separations made possible by the new types of signalling systems likely to be adopted for such lines, this might offer the benefits of relatively high service frequencies and high passenger loads on trains able to use much smaller tunnels and climb steeper gradients, thereby significantly reducing the costs of constructing the new lines and permitting their routes to be more closely tailored to land use requirements and opportunities.

No such dedicated "suburban metro" lines are needed or contemplated for at least the next 20 years, however, as most of the inner areas they would serve have good bus services and are therefore not the highest priority for new rail services. In the longer term, however, continued increases in the density of these areas and consequential local and cross-regional patronage demand and road congestion can be

expected to shift the balance in favour of the greater capacities and faster travel able to be provided by rail.

Another method of increasing train loads would be to **increase the length of the existing style of suburban trains,** with a corresponding lengthening of station platforms. This idea is superficially attractive, but there would be massive costs in the platform extensions and associated station reconfigurations, especially on underground lines, and complicated trackwork at the ends of stations would preclude the option in several instances. The option might, however, be an attractive way of increasing capacity on any new railway lines built as entirely separate operational "sectors" in the longer term, such as those discussed in section 5 of this report.

Communications-based signalling?

Communications-based signalling systems with in-cab signals, originally developed mainly for high-speed trains, are now under serious investigation and development for metropolitan rail systems overseas.

It seems likely that international standards to ensure the "interoperability" of equipment from different suppliers will become reasonably firmly established in the next few years, thereby reducing the costs of implementing such a system on part or all of the Sydney metropolitan network and helping to ensure the compatibility of any such system with any similar systems introduced elsewhere in Australia.

Communications-based signalling systems are usually classified in terms of three "levels" of functionality, all of which provide Automatic Train Protection (ATP) to prevent trains from overspeeding or passing signals set at "danger". This ATP function could replace the old and very maintenance-intensive technology of mechanical "train stops", which stop CityRail (and soon Countrylink) trains only after they have passed red signals and which do not provide any protection for other long-distance passenger services or freight trains.

With the highest ("moving block") level 3 of functionality, expensive and maintenance-intensive conventional trackside signals and track circuits can be removed and the headways between trains can often be significantly reduced, thereby increasing the capacity of each track. Similar but lesser capacity increases can be achieved with some "level 2" systems, which retain conventional track circuits.

The *theoretical* capacity benefits of the higher "levels" of communications-based signalling are unlikely to be fully realised in Sydney, however, because of the complex mixes of fast and slow services, the complexity of merging and crossing services with minimal time to spare at numerous flat junctions and the extended dwell times at the busiest stations (up to 90 seconds at Town Hall).

Nonetheless, the gains in line capacity may still be a cost-effective way of handling patronage growth on at least some existing lines, at least in the short to medium term, and there could be clear and more substantial capacity benefits for any future (longer term) new suburban lines forming totally separate operational sectors (see section 5).

The other benefits of such systems, including Automatic Train Protection and enhanced abilities to recover from disruptive incidents, are also attractive, although the signalling *control* capabilities typically introduced in conjunction with such a system, such as automatic train "route" setting and defect logging, will already be provided by the new computerised signalling control system introduced for the Olympic loop and the Airport line and now being installed at the Sydenham control centre as the first stage of a possible wider rollout in the greater metropolitan region (see section 4.9).

It is therefore proposed that **the merits, costs, design and programming of an introduction of communications-based signalling will be seriously investigated over the next few years, while other works which will be required *regardless* of the signalling system are carried out and additional trains able to utilise any newly created capacity are acquired.** All new trains will also incorporate provisions for the later easy installation of in-cab signalling.

It is stressed that **the proposals for amplifications and other upgradings of the rail network and stations set out in sections 4.4 to 4.10 below are entirely consistent with a communications-based signalling system and will still be required if such a system were introduced.**

In other words, communications-based signalling is a possible complement to, and *not* a substitute for, the works recommended in this report.

Further, any rail system capacity increases flowing from a communications-based signalling system will *not* significantly affect the timing of the projects identified as essential in the next 10–15 years, including the new inner city route which is likely to be required by between 2011 and 2015 (see sections 4.4 and 4.5). It is only in the longer term that project-deferral benefits might become significant and a factor to be weighed against the potentially substantial costs and risks of introducing the new signalling system.

Within the next year Rail Infrastructure Corporation is planning to commence a detailed investigation of the options for communications-based signalling in the greater metropolitan region, in partnership with private sector experts selected on the basis of a call for expressions of interest.

This will be followed by the installation of a pilot "level 1" or "level 2" system on a selected part of the network, to "prove up" the viability, benefits and robustness of the system prior to its possible wider introduction.

It is highly likely that in the longer timeframes considered in section 5 of this report, if not earlier, some internationally and nationally standardised form of communications-based in-cab signalling will be introduced in the greater metropolitan region.

Pricing demand management?

By international standards CityRail's fares are low, but they are comparable with those in other Australian cities and are controlled by the Independent Pricing and Regulatory Tribunal, so substantial changes in fares in order to manage demand are very unlikely.

Further, estimates of price elasticities during peak periods suggest that only a *substantial* increase in fares would have a noticeable impact on patronage levels, even if this were desired.

Changes in land uses?

In theory rail patronage growth could be reduced by changing the patterns of residential and employment growth in a way that would consciously reduce the role of rail in urban transport.

Any such move would undermine the Government's urban consolidation, air quality and transport objectives.

As discussed in section 3.1, it is unlikely that there will be a reversal of the land-use trends favouring continued rail patronage growth on the main corridors to large employment centres, even though the ongoing spread of urban areas and dispersal of employment locations—slowed but not halted by urban consolidation—may continue to reduce rail's overall transport mode share.

4.4 Corridor patronage growth forecasts and service and infrastructure responses

The cost estimates reported below are indicative costings only, in 2000/2001 A$ with no escalation. Unless otherwise indicated, they are regarded as being accurate only to within –10% to +30% (in other words, the cost of each project could be up to 30% higher than the figure shown, even if the scope of works is unchanged). Accordingly, **at this stage all the cost estimates should be treated with caution.**

Illawarra line and Eastern Suburbs Railway

Figure 4.1 shows forecast morning peak suburban (i.e. non-intercity) patronage growth on the Illawarra line at Sydenham under the four growth scenarios discussed in section 3.1, the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario, and the timing of the infrastructure works identified as essential to permit these increases in train services.

In *Figure 4.1* (and the equivalent graphs for other corridors discussed below) the left-hand scale and the coloured lines show the number of passengers entering the "CBD cordon" location (in this case Sydenham) on CityRail services arriving at Central between 7:30 and 8:30 am, while the right-hand scale and the yellow bars indicate the number of trains currently arriving between these times and the numbers likely to be required in the future under the "medium growth" scenario.

Figure 4.2 shows forecast morning peak CBD-bound patronage growth under the four growth scenarios on the Eastern Suburbs Railway.

The Illawarra line has two tracks from the southern terminus of suburban services at Waterfall to Hurstville and four tracks from Hurstville to the city (two "Illawarra main" tracks and two "Illawarra local" tracks, with no crossovers between these tracks north of Sydenham). The Cronulla branch line is a single track, with a long passing loop between Gymea and Caringbah. The Eastern Suburbs Railway, from Erskineville Junction to Bondi Junction, has two tracks.

At present there are 13 suburban trains to the city on the Illawarra line during the peak hour, 12 of which travel onto the Eastern Suburbs Railway (together with two services from the South Coast) and one of which travels onto the City Circle. (The maximum number of trains able to be accommodated on the Eastern Suburbs Railway, because of "turnback" constraints at Bondi Junction, discussed below, is 14 per hour.)

An extra suburban train is already required on the Illawarra line to relieve overcrowding, and the number of trains required is expected to grow to 17 per hour by 2007 and 18 by 2011.

By this stage, even with the infrastructure works and operational changes shown in *Figure 4.3 and 4.4* and listed below, there will be no more spare capacity on the Eastern Suburbs Railway for trains from the Illawarra line and **an alternative route through the CBD will be essential if further growth is to be accommodated.** (As will become apparent below, the same limitation will also apply, within a broadly similar timeframe, for *all* other routes into the CBD.)

The essential infrastructure works on this corridor in the next ten years to accommodate the forecast growth are:

- *By 2003:*
  - **An urgent increase in turnback capacity at Bondi Junction**, in order to increase the capacity of the Eastern Suburbs Railway from 14 to 18 trains per hour in each direction. *Estimated net present value of construction cost $72 million (± 18%) and estimated net present value of whole-of-life cost $86.4 million.*

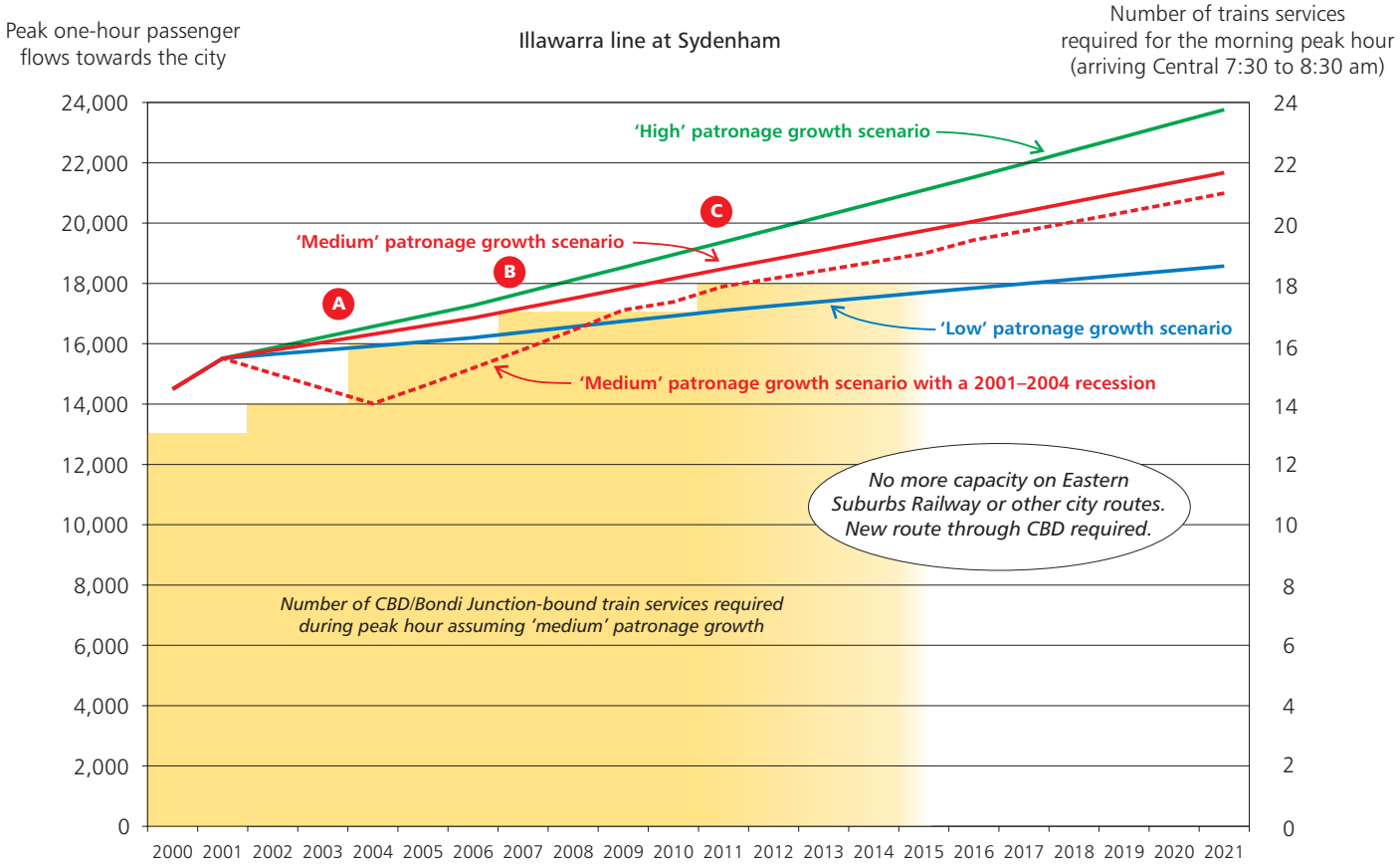


Figure 4.1. Forecast morning peak suburban patronage growth and train service requirements on the Illawarra line at Sydenham. The infrastructure works needed to accommodate the extra trains and help segregate service patterns for greater reliability are: (A) Bondi Junction turnback and initial Cronulla line duplication and signalling works, (B) the upgrading of Erskineville Junction, a flyover south of Wolli Creek Junction and track amplification from Hurstville to Mortdale Yard, and (C) two extra tracks from Sydenham to Erskineville, track amplification from Mortdale to Oatley and the completion of the duplication of the Cronulla line.

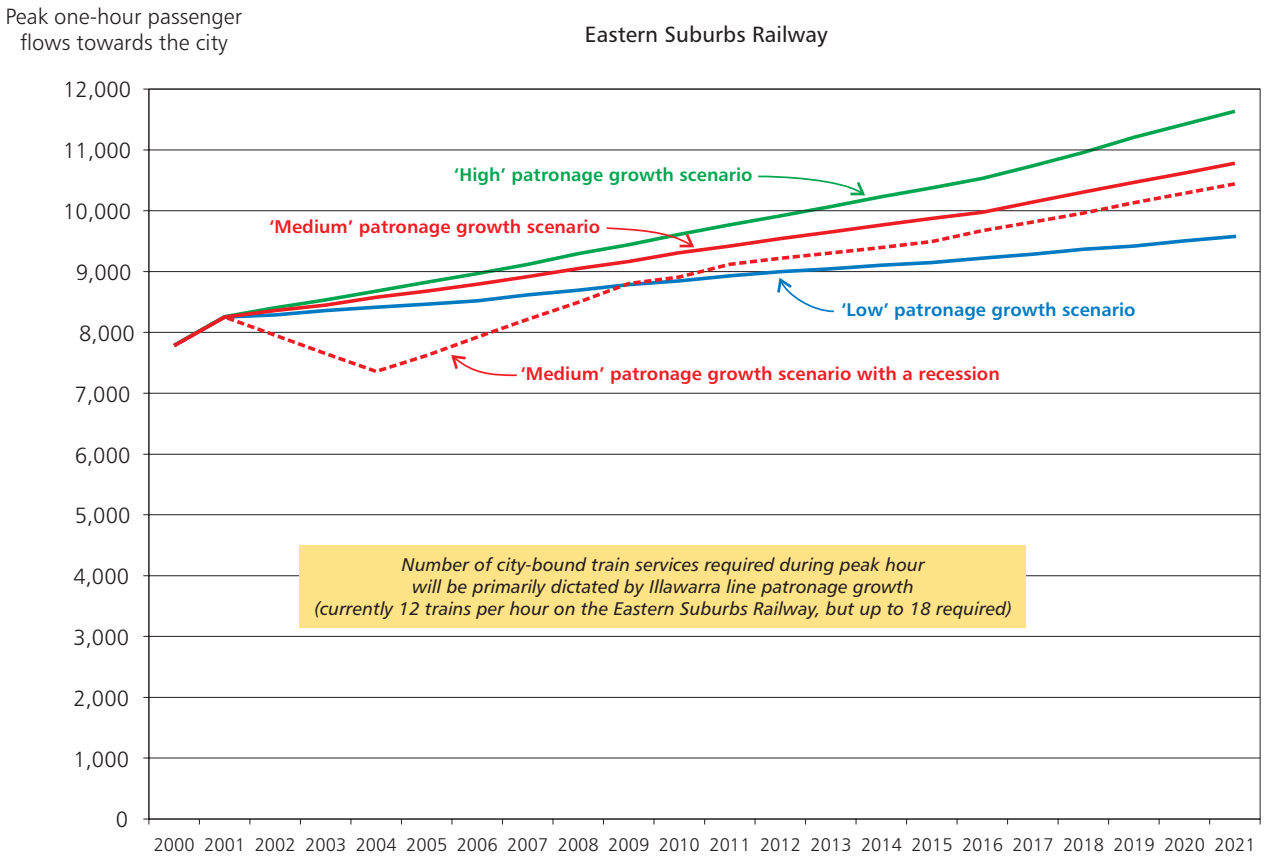


Figure 4.2. Forecast morning peak patronage growth on the Eastern Suburbs Railway.

— The first (Kirrawee–Gymea) stage of the **progressive duplication of the Cronulla line** and upgrading of that line's signalling (in addition to $28 million of signalling modernisation works on the Illawarra line between Oatley and Sutherland and on the Cronulla line between Sutherland and Cronulla in the near future), to improve reliability and provide sufficient capacity on the Cronulla branch line. *Indicative cost for the entire duplication project: $40 million.*

This line is experiencing rapid patronage growth and is currently very sensitive to any service disruptions, with the impact of these disruptions often spreading to the entire Illawarra/Eastern Suburbs Railway corridor.

— **Upgrading of the capacity of Town Hall station** to increase its ability to handle large numbers of passengers, through a northward extension of its concourse level under George Street (in conjunction with the proposed fire and life safety works discussed in section 4.7 below) and the construction of new fast, high-capacity passenger escalators and stairs between this new concourse area and the northern ends of the platforms below. *Indicative cost $30 million.*

- *By 2005:*

— **The diversion of fast Illawarra and intercity trains from the Illawarra line's main tracks**, which by then will need to be devoted to the increased number of suburban services, to the existing Illawarra local tracks, with **Erskineville Junction being upgraded** to allow the diverted intercity trains to access the "Illawarra Dive" tracks, which pass under the Main West line east of this junction, so they can enter Sydney Terminal station. *Indicative cost: $29 million.*

— **A new flyover on the Illawarra line south of Wolli Creek Junction**, to permit a better split of fast and slow trains travelling away from the city on the southbound "main" and "local" tracks (there is a northbound track between these two southbound tracks). This flyover is essential if more than 16 trains per hour are to be able to operate on the Eastern Suburbs Railway. *Indicative cost: $30 million.*

- *By 2006:*

— **Capacity-enhancing upgrading of Sydenham station**, whose narrow overhead concourse severely restricts access to and from the platforms during peak periods. *Indicative cost $15 million.*

- *By 2007:*

— **Triplication or quadruplication of the Illawarra line between Mortdale Yard Junction and Hurstville**, a pre-requisite for operating more than 14 trains per hour north of Mortdale Yard.

This will need to be followed by an extension of the extra track or tracks to Oatley by around 2011, so that additional fast trains from the South Coast and Cronulla can overtake "all stops" services from Sutherland.

If quadruplication is preferred or required (it would provide much simpler and more robust operational patterns), options such as tunnelling between Penshurst and Mortdale will need to be investigated, to minimise impacts on suburban centres and simplify access to and from the Mortdale Yard. *Indicative total cost for Hurstville–Oatley triplication: $100 million.*

- *By 2008–2010:*

— **Two extra tracks on the Illawarra line between Sydenham and Erskineville**, so that Bankstown line services—including proposed new fast services from Liverpool—can be kept separate from Campbelltown/East Hills services and the South Coast intercity trains. *Indicative cost: $100 million.*

- *By 2011:*

— **The completion of full duplication of the Cronulla line** to permit at least six peak services per hour (this work may need to be completed earlier if urban consolidation along this line has not slowed as expected). *Indicative cost for the entire duplication project: $40 million.*

— In an associated project, **capacity-enhancing upgrading of Sutherland station**, with a new turnback and platform on the western side of the station to remove conflicts with "through" services. This project will need to be designed in conjunction with the improvements to Sutherland Junction carried out as part of the Cronulla line duplication project. *Indicative cost $10 million.*

— **Amplification of the Illawarra line from Mortdale Yard to Oatley**, as discussed above. *Indicative total cost for Hurstville–Oatley triplication: $100 million.*

— **Capacity-enhancing upgrading of Redfern station**, primarily to cater for increased rail–rail interchanging demand but potentially also to cater for significant increases in local employment demand and university student bus–rail demand (as discussed in section 3.1), as well as the need to modernise ageing facilities. *Indicative cost $30 million.*

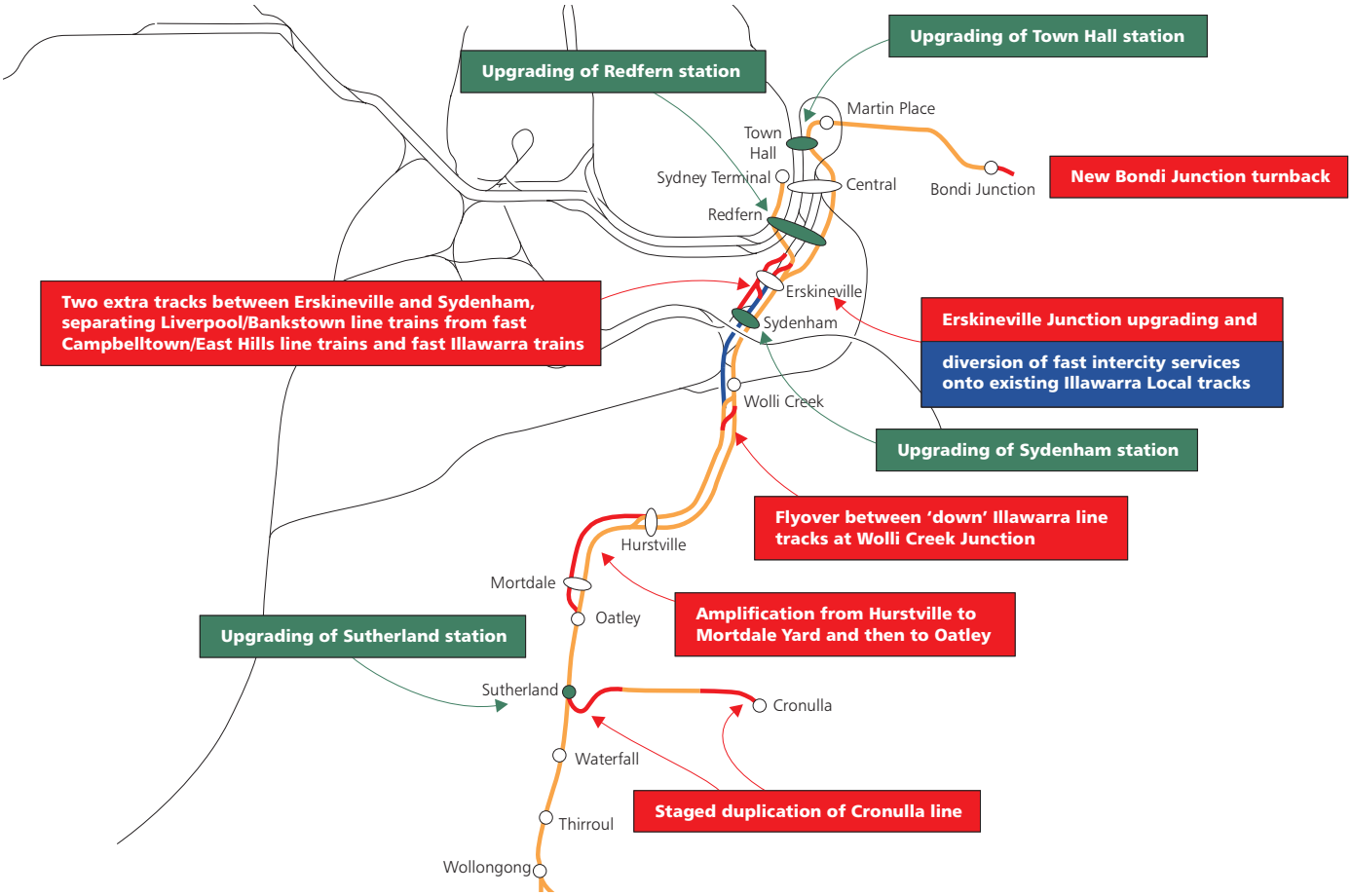


Figure 4.3. Essential "Sector 1" (Illawarra line and Eastern Suburbs Railway) infrastructure works over the next ten years.

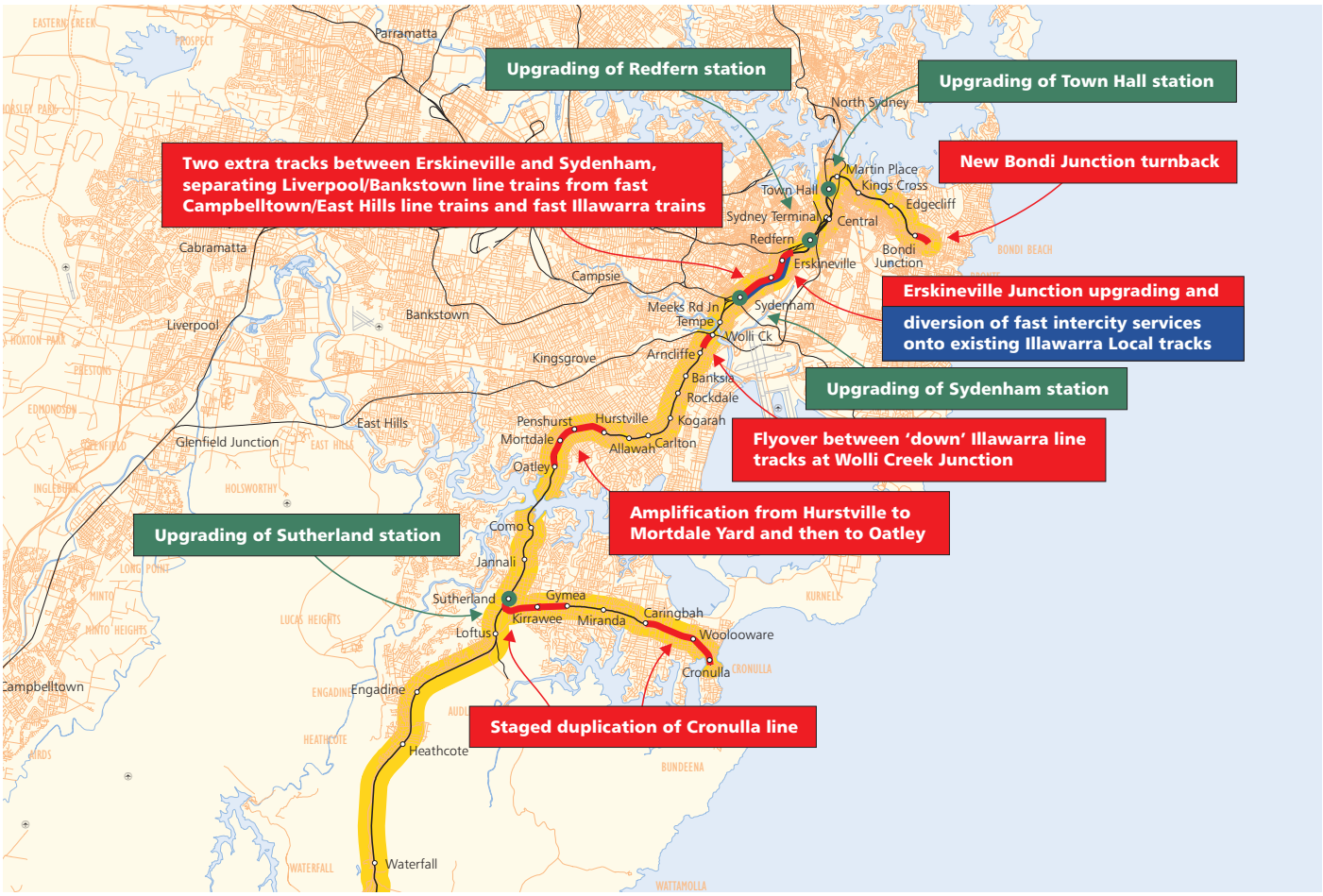


Figure 4.4. Essential "Sector 1" (Illawarra line and Eastern Suburbs Railway) infrastructure works over the next ten years.

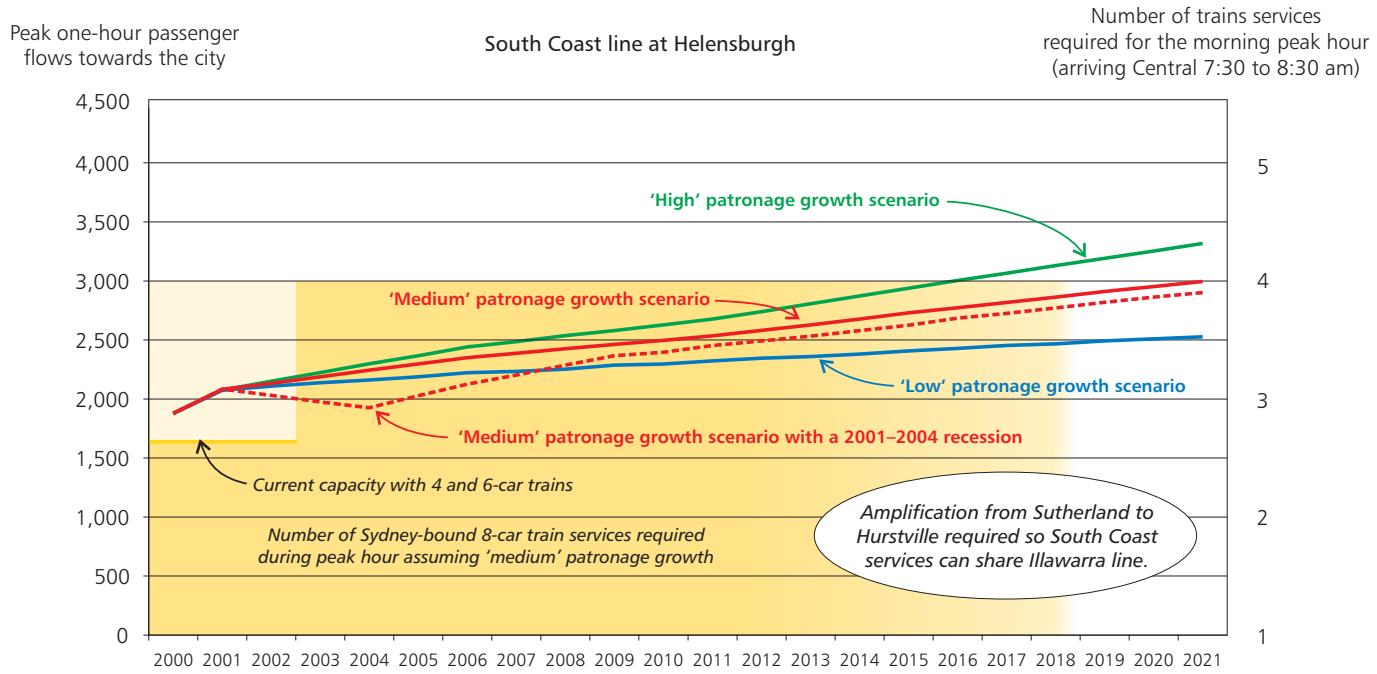


Figure 4.5. *Forecast morning peak intercity patronage growth and train service requirements on the South Coast line at Helensburgh.*

In addition to these works, several bus–rail interchanges and rail commuter car parks will need to be upgraded to cater for the increased demand, as discussed in section 4.6, significant fire and life safety works will be required on the Eastern Suburbs Railway, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

South Coast line

Figure 4.5 shows forecast patronage growth on the South Coast line at Helensburgh under the four growth scenarios summarised in section 3.1 and the capacity of existing intercity train services with the current four and six carriage trains and with the same number of eight carriage trains.

An *immediate* increase in rolling stock is required to service this route by providing longer trains. This increase has already been approved.

Provided all peak trains are boosted to eight carriages, no additional rail infrastructure is expected to be required on the South Coast line to meet the forecast growth in demand in the next ten years, although latent demand is difficult to estimate. As already indicated, amplifications will be required further north, between Oatley and Hurstville, so the intercity trains can pass the increasing number of local suburban services.

To achieve the benefits of the proposed new high-speed passenger line from south of Waterfall to north of Thirroul, it will be necessary to complete a number of other projects to remove capacity constraints on the South Coast–Illawarra corridor north of this project and in the CBD.

Land slips and other geotechnical problems have long caused difficulties on the South Coast line, necessitating expensive remedial works on a number of occasions. The Stanwell Park viaduct, which is already subject to speed restrictions for these reasons, may need to be replaced during the next ten years, but the timing of the these works is difficult to predict.

As discussed in section 4.6, the Wollongong bus–rail interchange is planned for upgrading by 2003 and the Dapto bus–rail interchange and rail commuter car park are planned for upgrading to cater for rapidly increasing demand in this area by 2005.

East Hills line

As discussed in earlier submissions by the Office of the Coordinator General of Rail, the East Hills line corridor from Sydenham/Wolli Creek to Campbelltown/Macarthur has the worst CityRail on-time running and service reliability record of the suburban network, and its poor performance adversely affects the entire system.

Figure 4.6 shows forecast suburban patronage growth on the East Hills line at Sydenham/Wolli Creek under the four growth scenarios summarised in section 3.1, the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario, and the timing of the infrastructure works identified as essential to permit these increases in train services, which are shown in *Figures 4.7 and 4.8*.

By around 2011, 14 trains per hour will be required and there will be no more spare capacity on the City Circle, so **an alternative route through the CBD will be essential if further growth is to be accommodated.**

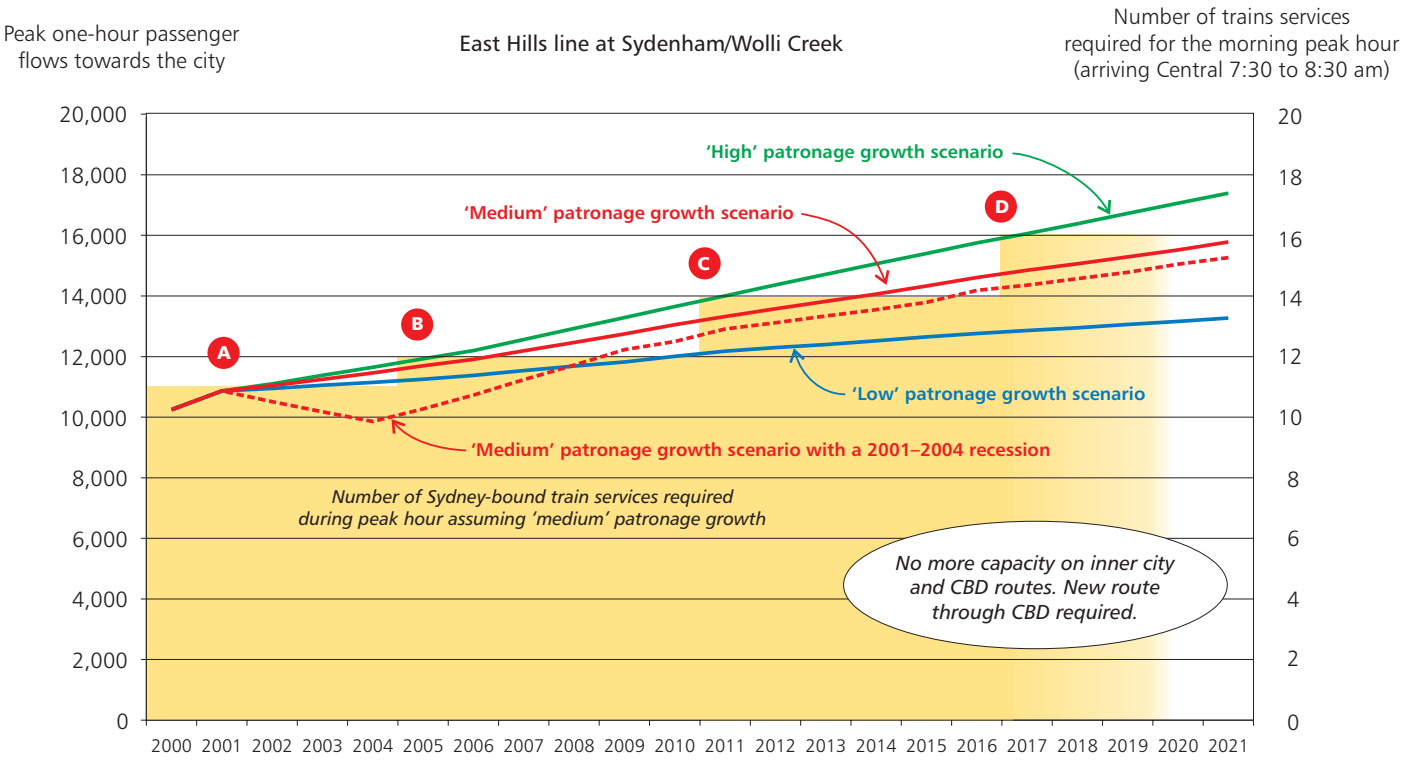


Figure 4.6. Forecast morning peak suburban patronage growth and train service requirements on the East Hills line at Sydenham/Wolli Creek. The infrastructure works needed to accommodate the extra trains and help segregate service patterns for greater reliability are: (A) Airport line turnback at Central, Kingsgrove turnback (now under construction) and Panania/Revesby turnback, (B) Macdonaldtown stabling, Glenfield Junction grade separation, Kingsgrove–Riverwood quadruplication, Glenfield–Campbelltown signalling improvements, Campbelltown Yard upgrading and Macarthur turnback, (C) more Macdonaldtown stabling, and (D) Glenfield–Macarthur track amplification.

The essential infrastructure works on the Campbelltown–East Hills corridor in the next ten years to accommodate the forecast growth are:

- *By 2001–02:*
  - **A new turnback off the Airport line into Platform 23 at Central station**, so Airport line services can continue to operate if there are problems or maintenance works on the City Circle. *Indicative cost: $10 million.*
  - **A new Panania or Revesby turnback** (previously suggested for Padstow) to remove conflicts on the East Hills line between terminating local services and "through" service to Glenfield, Campbelltown and Macarthur. (The existing single turnback at East Hills station is insufficient for this busy line.) *Indicative cost: $15 million.*
- *By 2003:*
  - The first stage of **new train "stabling" (parking) facilities at Macdonaldtown**, primarily for the daytime storage of empty trains returning from the City Circle in the mornings but also for limited overnight storage (and associated washing and minor maintenance) of "early starter" trains. *Indicative cost for the full project: $25 million.*
  - **Capacity-enhancing upgrading of Town Hall station**, as described above. *Indicative cost $30 million.*
- *By 2005:*
  - **The grade separation of Glenfield Junction** (this very busy junction is already a major cause of train delays, because three major routes converge at this point and even a slight delay by one train often causes major delays for many) and **the construction of a new turnback at Glenfield station**, so that Main South and East Hills line trains can arrive at this station simultaneously and trains can turn back onto the East Hills line without obstructing the Main South line, while still providing a connection for Main South line passengers. *Indicative cost: $50 million.*
  - **Quadruplication from Kingsgrove to Riverwood** to increase capacity and permit fast services to overtake slower trains (quadruplication of the East Hills line from Turrella to west of Kingsgrove and the construction of a new Kingsgrove turnback are already underway). *Indicative cost: $83 million.*
  - **Signalling improvements between Glenfield Junction and Campbelltown**, to permit an increase in the number of trains able to use this section of the Main South line from 12 to 20 per hour in each direction. *Indicative cost: $6–7 million.*

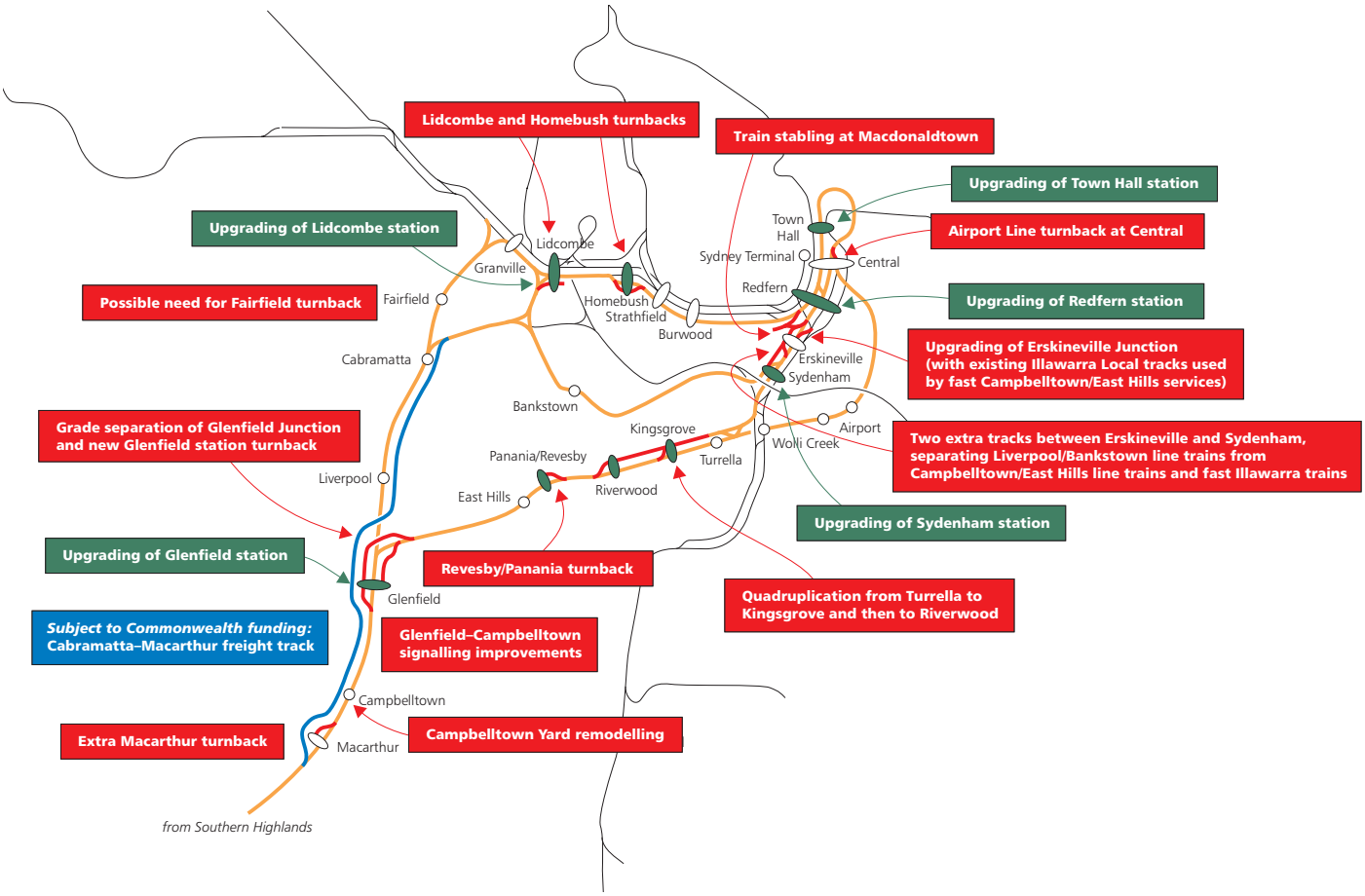


Figure 4.7. Essential "Sector 2" infrastructure works over the next ten years.

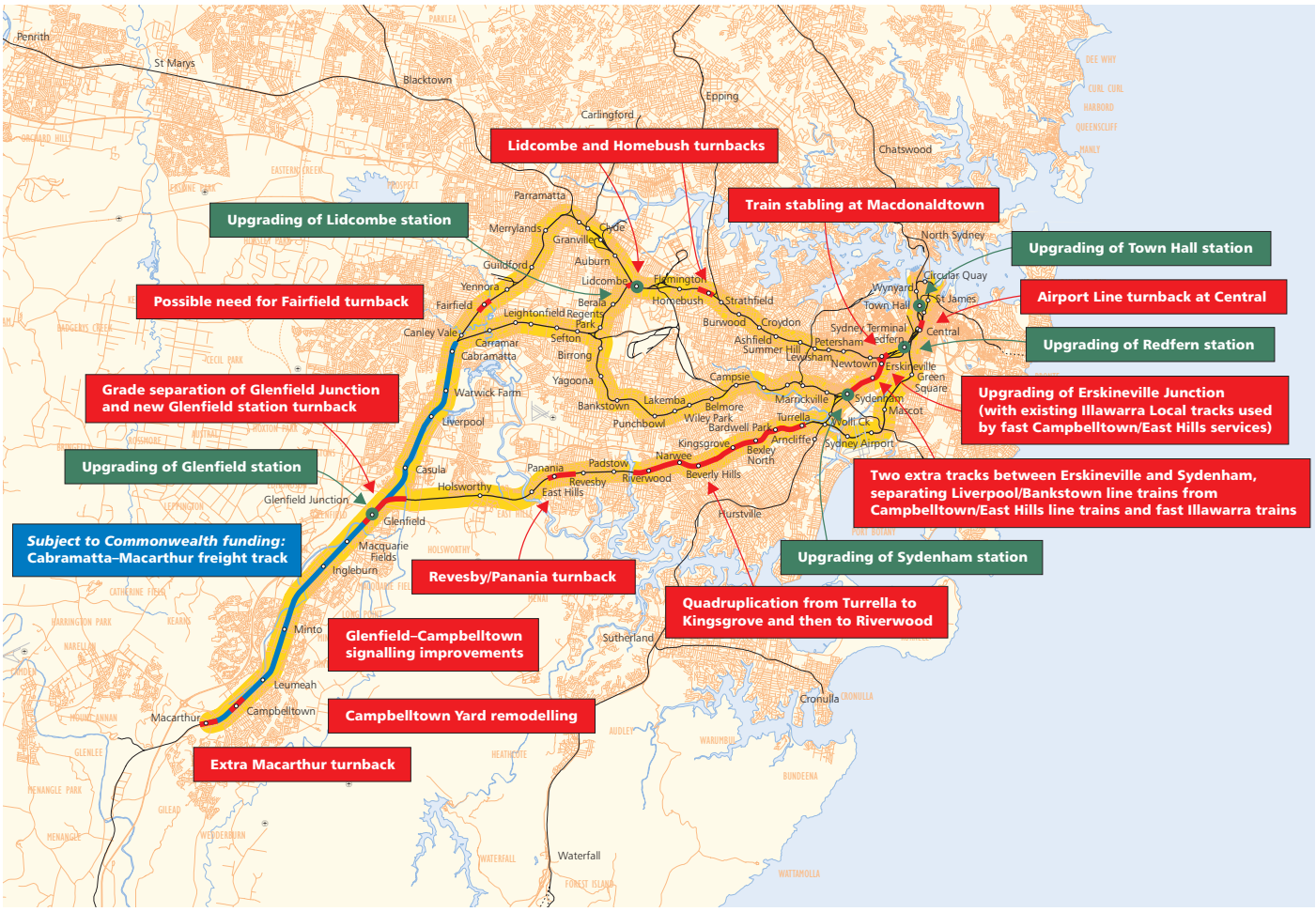


Figure 4.8. Essential "Sector 2" infrastructure works over the next ten years.

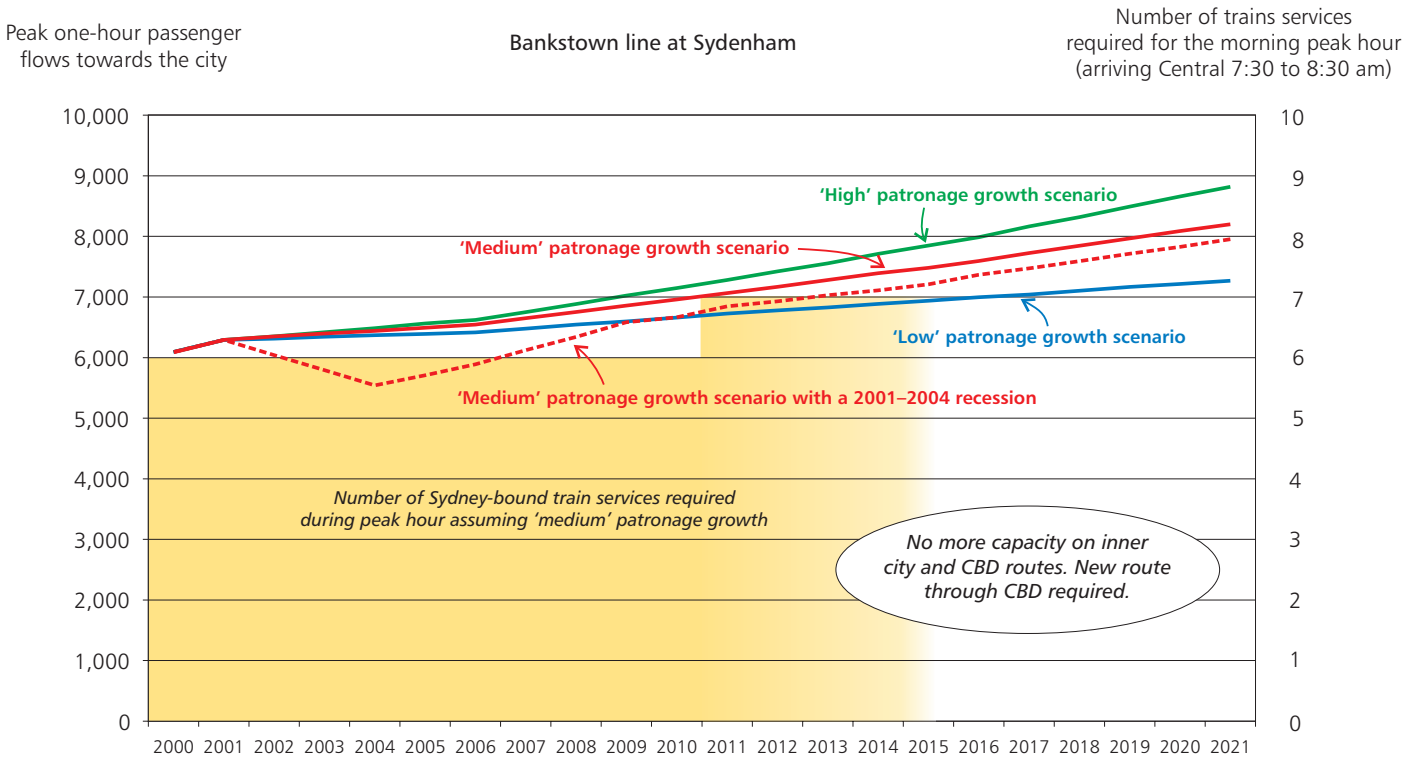


Figure 4.9. Forecast morning peak suburban patronage growth and train service requirements on the Bankstown line at Sydenham.

- — **The remodelling of Campbelltown Yard** to improve operating efficiency and provide extra train stabling facilities (as described in section 6.3, facilities for train cleaning and minor maintenance and repairs will also be provided). *Indicative cost: $30 million.*
- — **An additional turnback facility at Macarthur station**, the terminus for many CityRail suburban services. *Indicative cost: $23 million.*

- *By 2006:*
  - — **Capacity-enhancing upgrading of Sydenham station**, as described above. *Indicative cost $15 million.*
- *By 2011:*
  - — The second stage of **new train "stabling" facilities at Macdonaldtown.** *Indicative cost for the full project: $25 million.*
  - — **Capacity-enhancing upgrading of Redfern station,** as described above. *Indicative cost $30 million.*
- *In the longer term, but possibly by as early as 2017:*
  - — **Quadruplication of the Main South line between Glenfield Junction and Macarthur.** *Indicative cost: $120 million.*

    (Subject to the availability of Commonwealth funding, the construction of **a single extra track from Macarthur to Cabramatta, primarily for use by freight services**, is a much more urgent priority, preferably commencing in 2002. The estimated cost of this project is about $146 million.)

In addition to these works, several bus–rail interchanges and rail commuter car parks will need to be upgraded to cater for the increased demand, as discussed in section 4.6, significant fire and life safety works will be required on the City Circle, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

Bankstown line

Figure 4.9 shows forecast patronage growth on the Bankstown line at Sydenham under the four growth scenarios summarised in section 3.1 and the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario.

There are currently six peak trains per hour on this twin track line, operating via the City Circle, which could accommodate up to three more trains, two of which could be new "fast" services from Liverpool to the city (the alternative of extra Liverpool services via the Main West line will not be possible, because of increasing congestion on that line).

Once the total number of Campbelltown/East Hills and Bankstown trains exceeds 24 per hour in the peak **an alternative route through the CBD will be essential**, as the available City Circle capacity will be exhausted.

The essential infrastructure works on the Bankstown line corridor in the next ten years to accommodate the forecast growth are (*Figures 4.7 and 4.8*):

- *By 2003:*
  - — **Capacity-enhancing upgrading of Town Hall station,** as described above. *Indicative cost $30 million.*

- *By 2005:*
  - **The upgrading of Erskineville Junction**, as already discussed for the Illawarra line. New tracks through the unfinished platforms at Erskineville station, as part of this project, would enhance operational efficiency on both the Bankstown and East Hills lines by permitting Bankstown line trains to "queue" before reaching the junction and be overtaken by faster Illawarra and East Hills line services. *Indicative cost: $29 million.*
- *By 2006:*
  - **Capacity-enhancing upgrading of Sydenham station**, as described above. *Indicative cost $15 million.*
- *By 2008–2010:*
  - **Two extra tracks to segregate Bankstown line services from Illawarra and East Hills line services between Sydenham and Erskineville**, as already discussed for the Illawarra line. *Indicative cost: $100 million.*
  - **Capacity-enhancing upgrading of Redfern station**, as described above. I*ndicative cost $30 million.*

Again, in addition to these works, the Bankstown bus–rail interchange and rail commuter car park will need to be upgraded, as discussed in section 4.6, significant fire and life safety works will be required on the City Circle, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

South and Inner West lines

Figure 4.10 shows forecast patronage growth on the South and Inner West lines at Redfern under the four growth scenarios summarised in section 3.1, the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario, and the timing of the infrastructure works identified as essential to permit these increases in train services, which are shown in *Figures 4.7 and 4.8*.

At present there is a complex and inter-weaving mix of peak services on the lines along the Main West corridor into Redfern which are used by services from the south (e.g. from Liverpool via Granville or Regents Park). The other trains using these lines include "Sector 3" services from the west, from Carlingford and from Epping.

To improve reliability as demand continues to increase, it is proposed to restore "sectorisation" and the segregation of services as much as possible in this area by:

- Terminating the Carlingford line trains at Clyde
- Diverting the Epping service from the City Circle onto the North Shore line, and
- Providing a greatly simplified operating pattern for South services using the Main West line's "local" tracks and the City Circle, rather than the complex mix of tracks used at present.

In addition, it is proposed to reduce the complexity of local South services, and reduce conflicts between South services and slow West line services at Lidcombe and Homebush junctions, by constructing new turnbacks at these locations, so that trains terminating and reversing direction at these stations do not obstruct "through" services. These new turnbacks will permit "stand alone" local services to operate on both the Bankstown and Inner West lines.

By 2011 an additional two South trains per hour are expected to be required. Because the Main West line routes will be at full capacity by this time, these services are likely to be diverted, as "semi fast" services from Liverpool, onto the Bankstown line corridor, with associated amplification implications for that route as described above.

The essential infrastructure works on the South and Inner West corridor in the next ten years to accommodate the forecast growth are (*Figures 4.7 and 4.8*):

- *By 2003:*
  - **The construction of new turnbacks** (with new platforms and associated facilities for interchanging passengers) **at Lidcombe and Homebush stations**. This will include significant works on a difficult site to upgrade Lidcombe station to accommodate a platform for the new turnback and connections to the other platforms. The Homebush station works will be much simpler. *Indicative cost: $35 million.*
  - The first stage of **new train "stabling" (parking) facilities at Macdonaldtown**, as already discussed for the East Hills corridor. *Indicative cost for the full project: $25 million.*
  - **Capacity-enhancing upgrading of Town Hall station**, as described above. *Indicative cost $30 million.*
- *By 2011:*
  - The second stage of **new train "stabling" facilities at Macdonaldtown.** *Indicative cost for the full project: $25 million.*
  - **Capacity-enhancing upgrading of Redfern station**, as described above (*indicative cost $30 million*), **and some other Inner West stations such as Burwood and Newtown.**

An additional turnback on the Old South line at Fairfield may also be required .

Again, after 2011 **an alternative route through the CBD** will be essential.

Further, several bus–rail interchanges and rail commuter car parks will need to be upgraded to cater for the increased

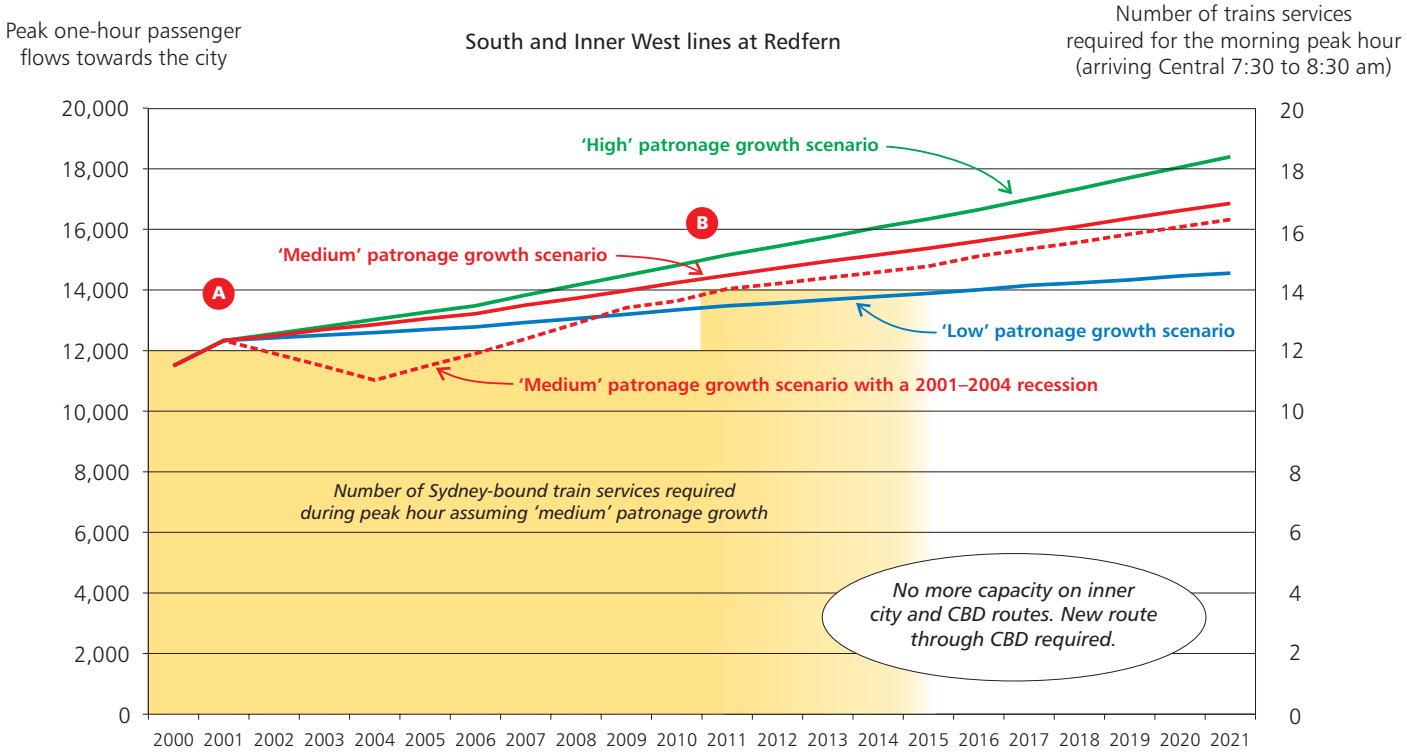


Figure 4.10. *Forecast morning peak patronage growth and train service requirements on the South and Inner West lines at Redfern. The infrastructure works needed to accommodate the extra trains and help segregate service patterns for greater reliability are: (A) the Lidcombe and Homebush turnbacks and Macdonaldtown stabling, and (B) the amplification works required for the Bankstown line, because any additional South services (e.g. from Liverpool or Cabramatta) will need to be diverted onto that line.*

demand, as discussed in section 4.6, significant fire and life safety works will be required on the City Circle, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

West lines

Figure 4.11 shows forecast suburban patronage growth on the "Sector 3" lines from western Sydney (Emu Plains/Penrith and Richmond) at Redfern under the four growth scenarios summarised in section 3.1, the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario, and the timing of the infrastructure works identified as essential to permit these increases in train services, which are shown in *Figures 4.12 and 4.13*.

The Main West line has two tracks from Emu Plains to St Marys, four tracks from St Marys to Homebush (two of them "main" tracks and two of them "suburban" tracks) and six tracks from Strathfield to the city (two "main" tracks, two "suburban" tracks" and two "local" tracks"), with numerous "flat" junctions between these tracks and with other lines. As already indicated, there are complex interactions between West, South and North services along this corridor from Granville to the city, and the simplification of operational patterns and the restoration of "sectorisation" are essential if additional services are to be viable. Most of the Richmond line north of Marayong is a single track.

The essential infrastructure works for the West corridor in the next ten years to accommodate the forecast growth are:

- *By 2003:*
  - **The duplication of the Richmond line from Marayong to Quakers Hill**, as addressed in previous submissions and now underway, to improve service reliability and allow extra peak trains to operate on this line. *Indicative cost: $25 million.*
  - **The construction of new turnbacks at Lidcombe and Homebush stations**, as already described. *Indicative cost: $35 million.*
  - **Capacity-enhancing upgrading of Town Hall station.** *Indicative cost $30 million*.
- *By 2008:*
  - **The construction of the new Epping to Chatswood line**, allowing four peak services per hour to be diverted from their current Main North and Main West line route into the city via Strathfield onto a new North Shore line route into the city, thereby freeing up essential extra capacity along the Main West line for additional West services.

    This project is likely to include **new flyovers between the "main", "suburban" and "local" tracks on the Main West line at Homebush Junction**, so that services from the west can be diverted onto their desired routes into the CBD with minimal

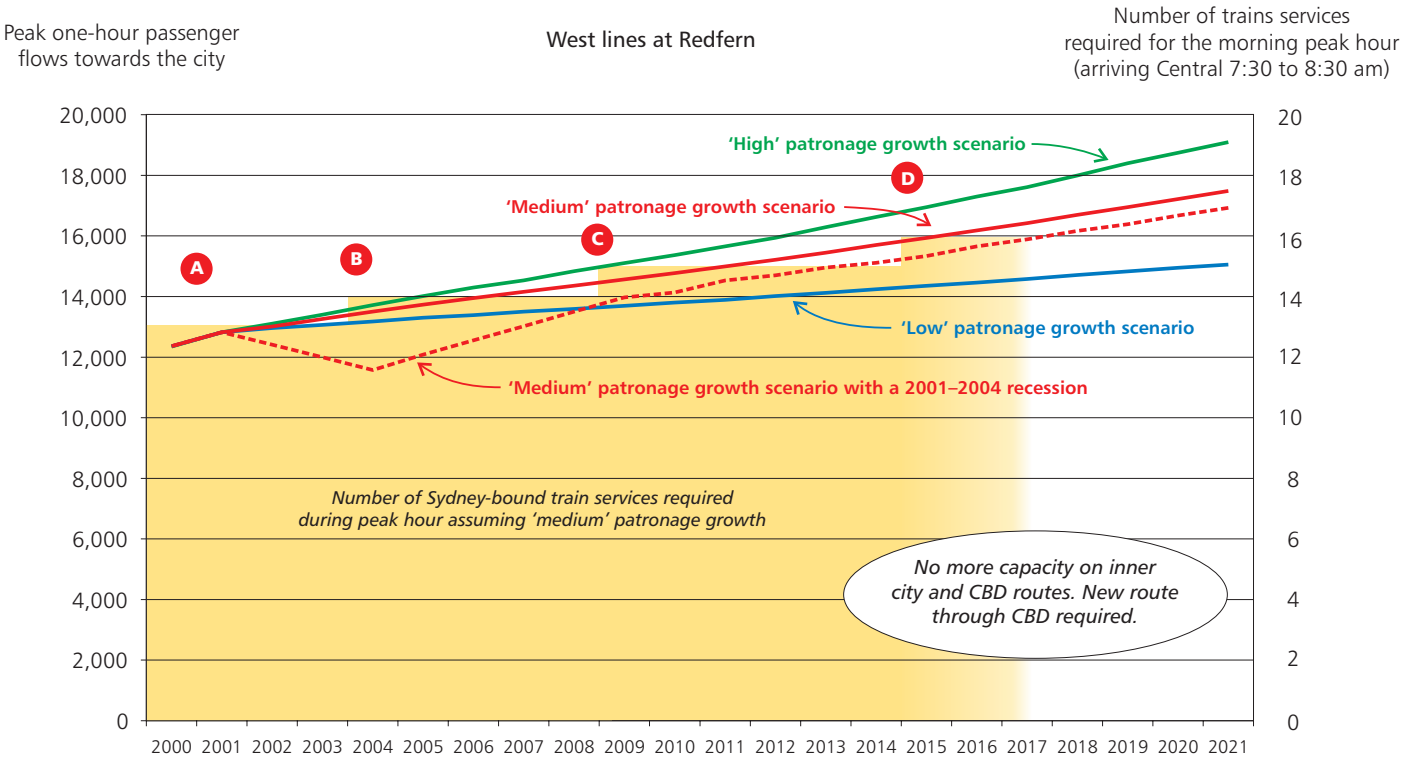


Figure 4.11. Forecast morning peak suburban patronage growth and train service requirements on the West lines at Redfern. The infrastructure works needed to accommodate the extra trains and help segregate service patterns for greater reliability are: (A) duplication of the Richmond line from Marayong to Quakers Hill, (B) the Lidcombe and Homebush turnbacks, (C) the new Epping to Chatswood line, which will relieve pressure from the north on the western corridor from Strathfield to the city, new flyovers on the Main West line at Homebush Junction and duplication of the Richmond line from Quakers Hill to Riverstone, and (D), in the longer term, the new Parramatta–Epping line (primarily for community social, economic and educational access reasons rather than rail operational reasons).

conflicts with other services, including services from the north joining the Main West corridor at Strathfield, and can then travel all the way to the city without having to swap between the tracks again as they often have to at present.

Total cost (including an indicative $140 million for the Homebush Junction works plus other associated projects at Epping and Hornsby, described later): $1,445 million.

— **Duplication of the Richmond line from Quakers Hill to Riverstone and a new passing loop at Mulgrave**, primarily to cater for patronage growth. *Indicative cost: $40 million.*

- *By 2011:*

— **Capacity-enhancing upgrading of Redfern station.** *Indicative cost $30 million.*

In the longer term, by around 2015, the construction of a **new Parramatta–Epping line** would provide some further capacity relief by allowing Parramatta and Carlingford line passengers bound for the North Shore to divert off the Main West corridor.

This line is, however, justifiable primarily for community social, economic and educational access reasons rather than rail operational reasons, because the combination of the proposed Lidcombe and Homebush turnbacks, the proposed grade separation flyovers at Homebush Junction and the capacity relief from Strathfield to the city provided by the Epping–Chatswood line will allow the Parramatta–Epping line to be deferred for many years. (As indicated in section 5, these projects will also permit the long-term deferral, for at least 20 years, of very expensive and disruptive track amplifications, requiring large-scale land acquisitions, on the Main West line between Granville and Strathfield.)

If the Parramatta–Epping line is constructed, it is likely that the preference will be for a terminating underground station at Parramatta rather than the earlier proposal for trains from the west to divert off the Main West line onto the new line at Westmead. This would provide much simpler, more robust and more readily "sectorised" operating patterns, and the capacity relief intended to be provided by the Westmead diversions is more readily and flexibly achieved by the means indicated above.

Further, even if the *full* Parramatta–Epping–Chatswood relief line were constructed, the combined capacity of the West, North and North Shore corridors into the city is still expected to be exhausted by around 2015 (compared with around 2011 for other corridors into the city), **necessitating a new route through the CBD if rail is to be able to cater for future growth in the west.**

In addition, as for the other corridors, several bus–rail interchanges and rail commuter car parks will need to be

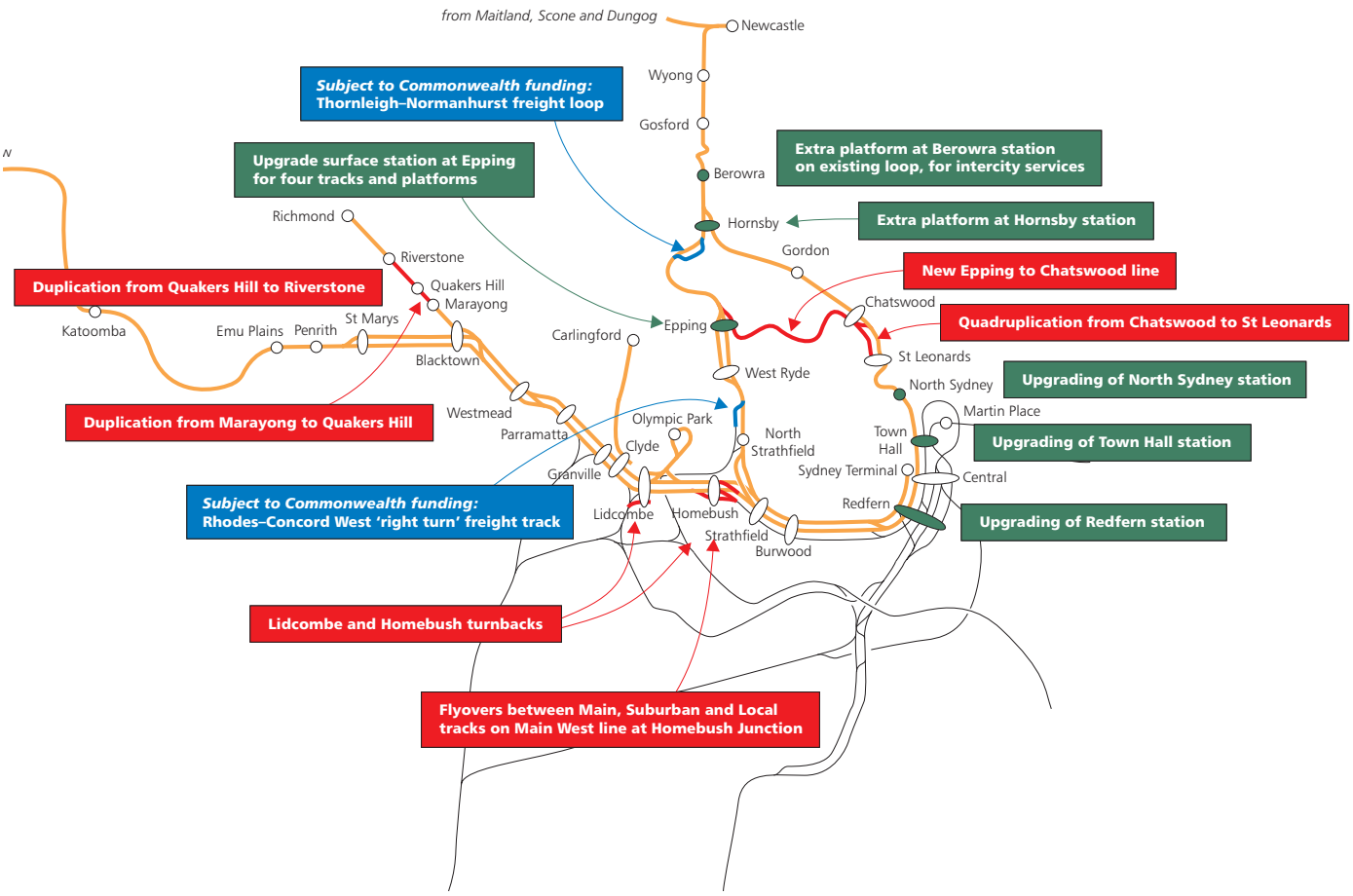


Figure 4.12. Essential "Sector 3" infrastructure works over the next ten years.

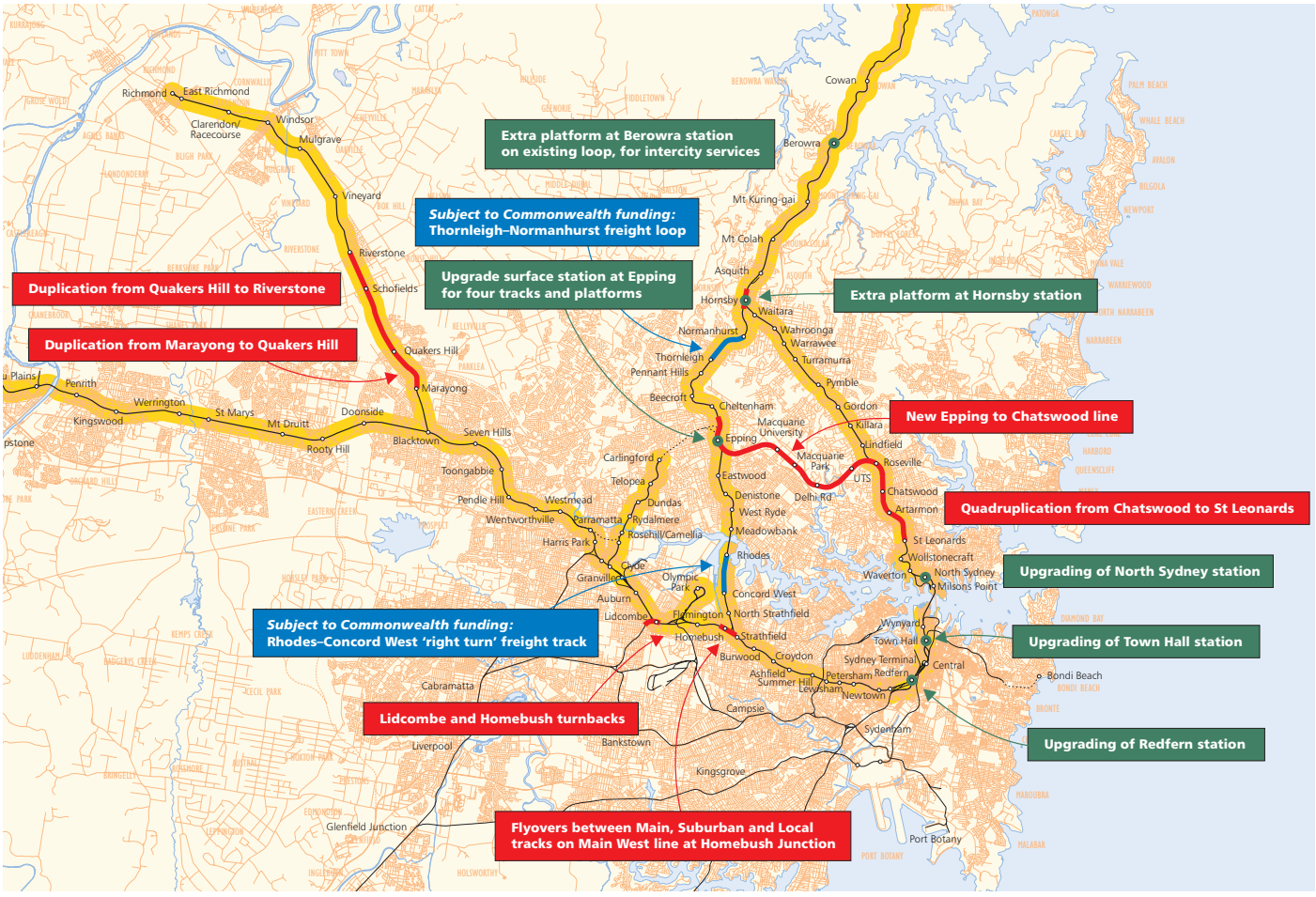


Figure 4.13. Essential "Sector 3" infrastructure works over the next ten years.

upgraded to cater for the increased demand, as discussed in section 4.6, significant fire and life safety works will be required on the underground lines and stations in the CBD, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

Blue Mountains

Figure 4.14 shows forecast patronage growth on the Main West line over the Blue Mountains at Glenbrook under the four growth scenarios summarised in section 3.1.

With the boosting of some six-carriage trains to eight-carriage trains there is expected to be sufficient capacity on the Blue Mountains line to cater for growth over the next 20 years, and no capacity-enhancing infrastructure developments are proposed in this timeframe.

The key difficulties faced by these services are those associated with the highly congested West entry into the city, discussed above.

Main North and Central Coast lines

Figure 4.15 shows forecast patronage growth on *suburban* CityRail services on the "Sector 3" lines from the north (via the Main North line through Epping) at Redfern under the four growth scenarios summarised in section 3.1, the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario. *Figure 4.16* does likewise for *intercity* CityRail services on the Main North line at Woy Woy.

Most of the Main North line has two tracks, but there are some sections with three tracks—mostly where there are passing loops or "refuges" or a dedicated freight track, such as the section between Rhodes and North Strathfield, but also including a short three-track section through Epping station —and there are four tracks between West Ryde and Epping and on a short section between Pennant Hills and Thornleigh.

Existing Central Coast *intercity* services are running at capacity, but the necessary additional capacity can be provided by boosting some six-carriage trains to eight-carriage trains and by utilising a train "path" currently used for a low-patronage two–carriage service to Parramatta.

The essential infrastructure works to accommodate forecast growth on the *suburban* Main North corridor in the next ten years, from a passenger services perspective, are (*Figures 4.12 and 4.13*):

- *By 2003:*
  - **The construction of an additional platform at Berowra station**, on the existing track loop used by trains travelling to the north, so that intercity trains to Gosford can stop at this station when the centre track is occupied by a suburban train terminating at this station. *Indicative cost $3 million.*
  - **Capacity-enhancing upgrading of Town Hall station.** *Indicative cost $30 million.*
- *By 2008:*
  - **The construction of the new Epping to Chatswood line.**

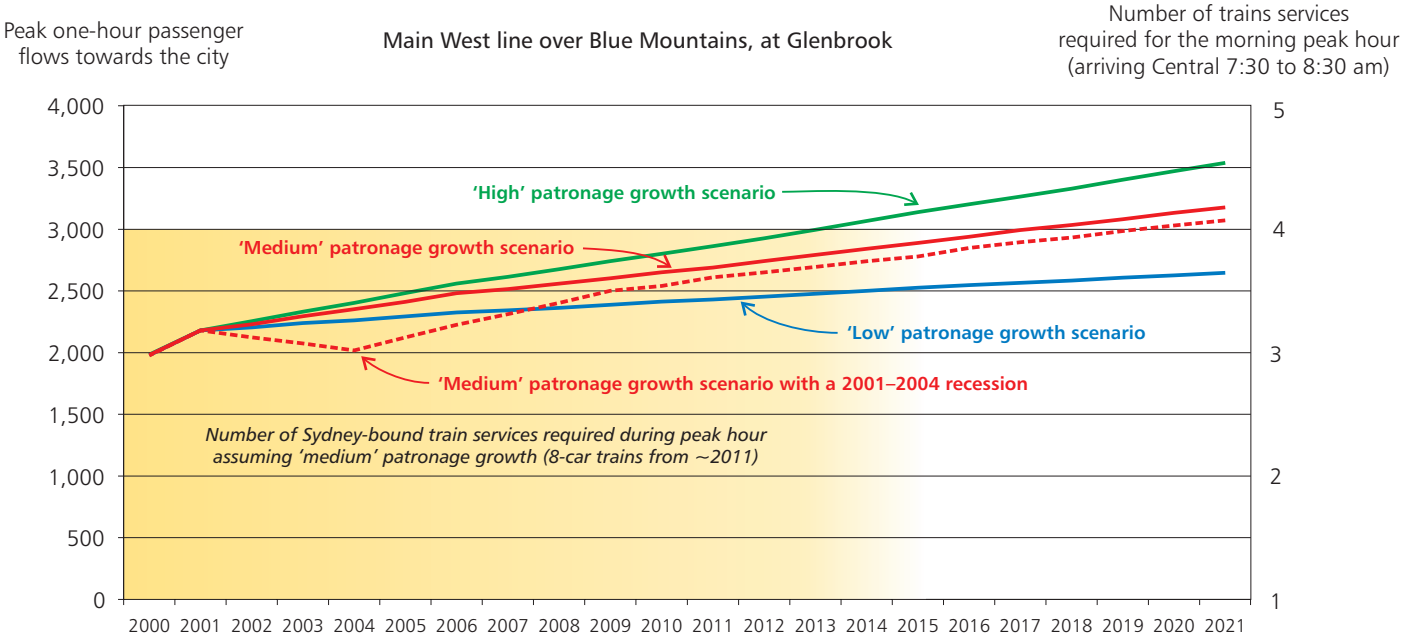


Figure 4.14. *Forecast morning peak patronage growth and train service requirements on the Main West line over the Blue Mountains at Glenbrook.*

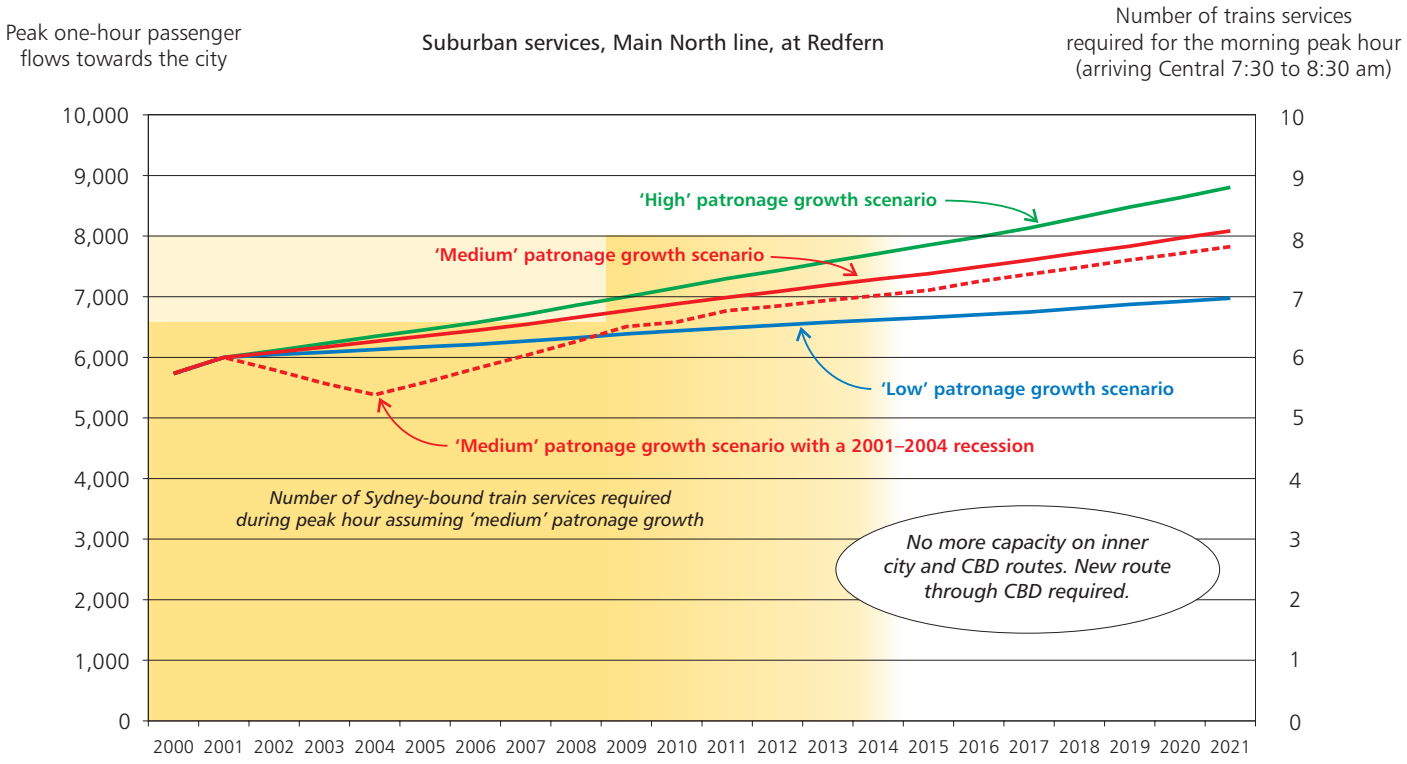


Figure 4.15. Forecast morning suburban CityRail service peak patronage growth and train service requirements on the Main North line (flows at the Redfern cordon).

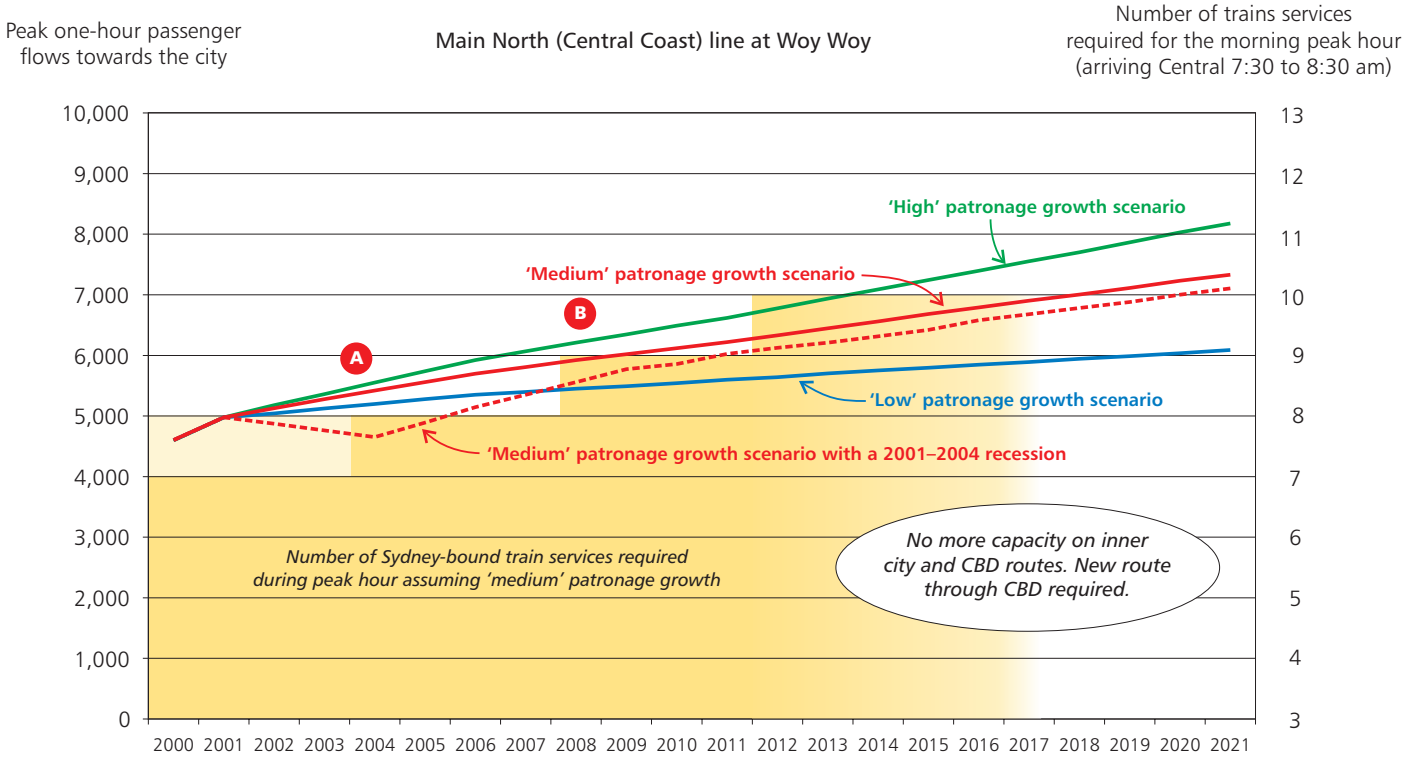


Figure 4.16. Forecast morning peak intercity CityRail patronage growth and train service requirements on the Main North line at Woy Woy. The infrastructure works needed to accommodate the extra trains and help segregate service patterns for greater reliability are: (A) the construction of an additional platform at Berowra station and (B) additional interchange platforms at Hornsby station and (in the longer term) track amplification between Hornsby and Berowra.

This project is also likely to include:

- **An additional platform or platforms at Hornsby station**, which will become essential to reduce conflicts between local services to and from this station (via both the Main North line and the North Shore line) and "through" services.

  These works will need to take account of plans for longer-term amplification of the Main North line through Hornsby, including quadruplication of the line from Epping to Hornsby and triplication or quadruplication from Hornsby to Berowra, as foreshadowed in section 5.

- **An upgrade of the surface section of Epping station**, extending the four-track West Ryde–Epping section of the line north through this station as the first stage of longer-term track amplifications to permit fast services to overtake slower trains on the steep grades between Epping and Hornsby.

Total cost (including an indicative $140 million for the Hornsby and Epping station works plus the other associated project at Homebush Junction, described above): $1,445 million.

- *By 2011:*
  - **Capacity-enhancing upgrading of Redfern station.** *Indicative cost $30 million.*
- *In the longer term:*
  - **Track amplification between Hornsby and Berowra**. *Indicative cost $83 million.*

Other enhancement works north of Hornsby considered necessary at the time *Action for Transport 2010* was being prepared are now considered, on the basis of the later patronage growth analyses conducted for the *Long-Term Strategic Plan for Rail*, as being highly unlikely to be required in the medium term. This is because the proposed increase in the size of existing trains and the scope for an additional service, as discussed above, will be able to provide up to 2,500 extra seats in the medium term.

To achieve the benefits of **the proposed new high-speed tunnelled passenger line from Hawkesbury River to Mt Ku-ring-gai**, it will be necessary to meet the following prerequisites:

- Completion of the Epping–Chatswood line, *and*
- The provision of substantial extra capacity south of Epping and Chatswood, through:
  - The amplification of the North Shore line from Chatswood to St Leonards, described below, *and*
  - The construction of a new alternative route through the CBD, linking Eveleigh and St Leonards via the CBD and North Sydney—a project that will also be urgently required, within the next 10–15 years, for all other corridors into the inner city.

As for the other corridors, several bus–rail interchanges and rail commuter car parks will need to be upgraded to cater for the increased demand, as discussed in section 4.6, significant fire and life safety works will be required on the underground lines and stations in the CBD, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

Subject to the availability of Commonwealth funding, **freight services** on the Main North corridor would benefit from the early construction, within five years, of:

- **An extension of the existing city-bound freight "refuge" track at Thornleigh north to Normanhurst.** This new track would be used by CityRail services to the city, and the central track would become a 2 km long bidirectional freight line, reducing conflicts between slow freight trains and faster passenger services on this steep section of the line.
- **An additional track between Rhodes and Concord West**, with the existing freight track then being able to be used as a "right turn lane" by freight trains destined to Flemington Junctions and Chullora, again reducing conflicts with passenger services.

Each of these projects has been indicatively costed at about $13 million.

North Shore line

Figure 4.17 shows forecast patronage growth on the North Shore line at Waverton under the four growth scenarios summarised in section 3.1, the timing of the extra train requirements associated with the most likely of these scenarios, the "medium growth" scenario.

With the addition of at least four peak trains per hour from the new Epping–Chatswood line the practical capacity of the two-track North Shore line will be exhausted by 2013 at the latest.

The only essential infrastructure capital project to cater for forecast growth on the North Shore corridor in the next ten years (*Figures 4.12 and 4.13*) are:

- *By 2006:*
  - **Capacity-enhancing upgrading of North Sydney station**, which is already nearing its full capacity during peak periods and still has no *Easy Access* facilities (*indicative cost covering all works not yet determined*).

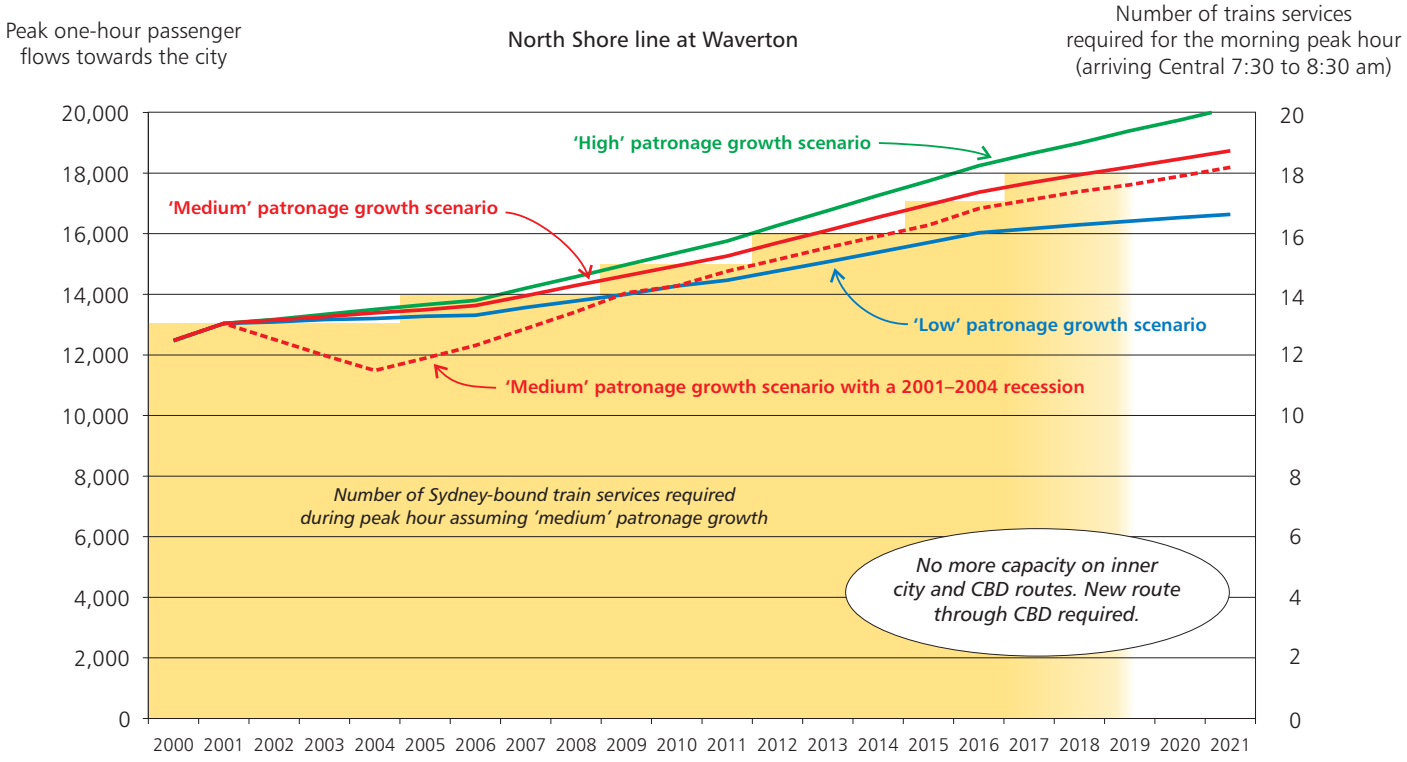


Figure 4.17. Forecast morning peak patronage growth and train service requirements on the North Shore line at Waverton.

- *By 2008:*

  — The **quadruplication of the line from Chatswood to St Leonards**, to assist immediately with the segregation of faster and slower services and to provide the first stage of an essential capacity increase after the opening of the new Epping–Chatswood line in 2008 (*indicative cost $80 million*).

Again, however, after 2011 the construction of a **new alternative route through the CBD**, linking Eveleigh and St Leonards via the CBD and North Sydney, will be essential, so that this route into the city can accommodate additional trains from the Epping–Chatswood line, including at least four extra services per hour from the new Epping–Castle Hill–Mungerie Park line announced in *Action for Transport 2010* (see section 5).

As for the other corridors, several bus–rail interchanges and rail commuter car parks will need to be upgraded to cater for the increased demand, as discussed in section 4.6, significant fire and life safety works will be required on the underground lines and stations at North Sydney and in the CBD, as discussed in section 4.7, and significant upgrading of the capacity of electrical systems will be required, as discussed in section 4.8.

In the longer term amplification of the North Shore line north of Chatswood, perhaps to Gordon, may become necessary if traffic moving onto the Epping–Chatswood line from the new Mungerie Park line reduces the number of Central Coast and Hornsby trains able to use the Main North and Epping–Chatswood route.

Separation of services

The changed CityRail service operational patterns and additional rail infrastructure identified in the corridor analyses above as necessary to enhance reliability and capacity and reduce junction and turnback conflicts will produce a significant improvement in the physical separation—and hence the operational robustness and on-time running—of different types of CityRail services, as summarised in *Figure 4.18*.

For example, the grade separations and turnbacks on the Main West line at Lidcombe and Homebush will permit all suburban CityRail services from the west to move onto the "suburban" tracks—thereby leaving a clear path for intercity services from the north to move onto the "main" tracks at Strathfield—without creating conflicts with trains coming from the city, Inner West trains on the "local" tracks or trains terminating at Lidcombe or Homebush. The need for trains from the west or north to change tracks again further towards the city will also be removed.

Major difficulties with the mixing of different types of services and the non-separation of service "sectors" will remain in some areas, however, including the "Cumberland line" from Macarthur to Blacktown. These difficulties will be especially acute on the highly congested approaches to, and lines within, the inner city and CBD, which will all be operating at their full capacity by 2011 to 2015

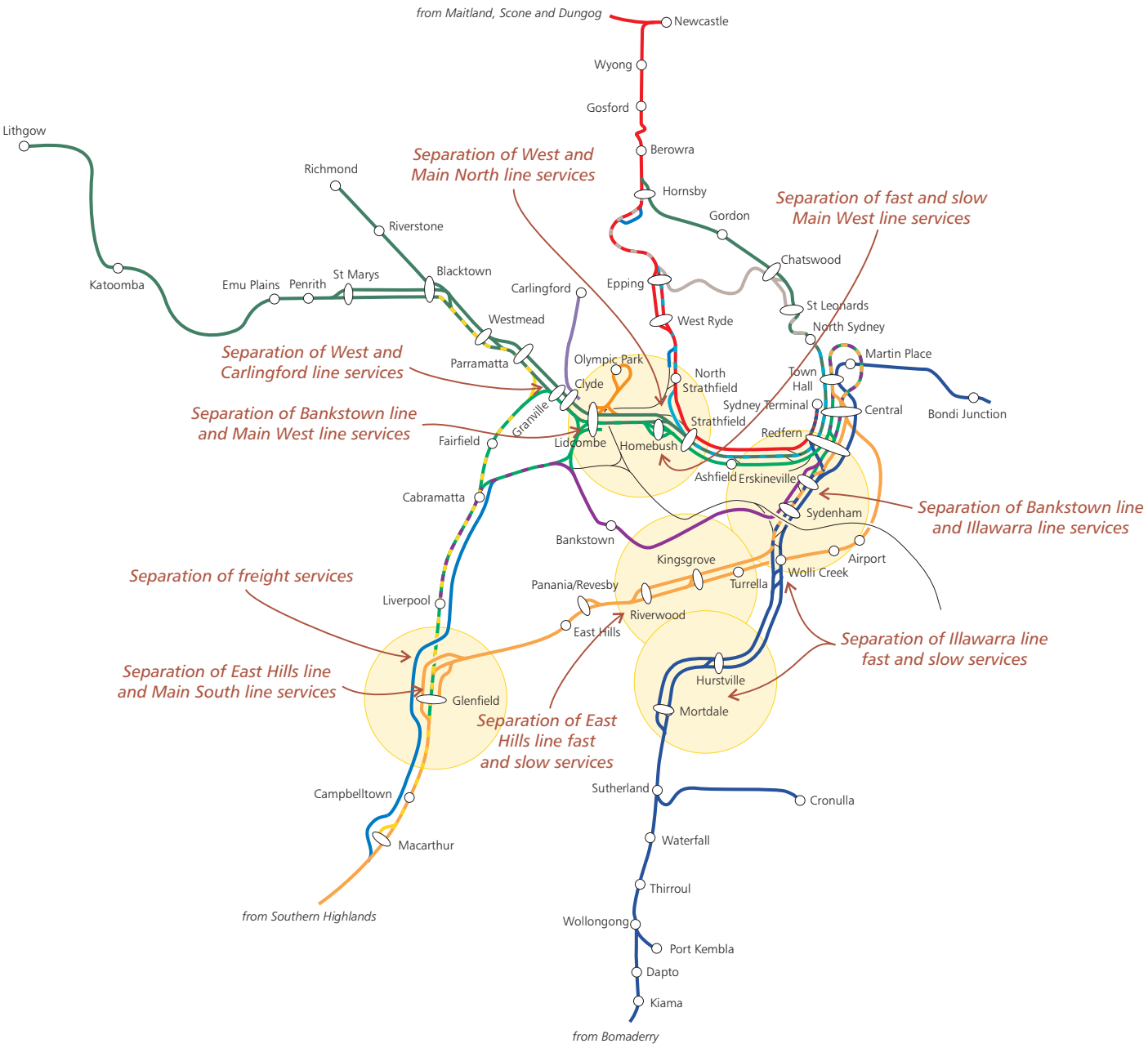


Figure 4.18. The CityRail operational changes and rail infrastructure projects identified as necessary in the next ten years in the corridor growth analyses in section 4.4 of this report will significantly assist in separating different types of services, as summarised above. Major "service and sector mixing" difficulties will remain in some areas, however, and especially on the highly congested approaches to and lines within the inner city and CBD, which will all be operating at their full capacity by 2011 to 2015 (see section 4.5).

4.5 The vital need to add new capacity through the CBD

As will be evident from the discussion above, despite all the operational refinements proposed on all the corridors into the city and all the infrastructure upgrades required to accommodate demand growth in the short to medium term, **the inner city lines will all be saturated within the next ten years or so** (*Figure 4.19*), **and there will be a need for a new, alternative route through the CBD, from Eveleigh to St Leonards, in the medium term, most likely by between 2011 and 2015.**

In essence the situation now is analogous to that before the Eastern Suburbs Railway was built in the 1970s. By providing a new route through the inner city and CBD, the Eastern Suburbs Railway provided vital relief for the City Circle and the North Shore line through the CBD, but this capacity relief will shortly be completely used up, even with all the capacity augmentations discussed in sections 4.3 and 4.4, and another additional route through the CBD will very soon be required.

This project is regarded as being of the highest priority. Without it, the metropolitan rail system will face strangulation and progressive operational collapse—and the

solutions if this occurs will all have very long lead times, of up to ten years or more.

Preliminary investigations into the options for such a new route are now nearing completion. It is regarded as essential that the route should:

- Use the unused platforms 26 and 27 at Central station, rather than more remote Haymarket locations suggested by some in the past, to facilitate easy interchanging with other CityRail services
- Have at least two stations within the CBD, one near Park Street, providing essential relief for Town Hall station, and another further to the north, preferably in the centre of the CBD "spine"
- Have stations at North Sydney and St Leonards, and desirably also at intermediate locations such as Crows Nest
- Be completed *before* any additional demand—beyond the substantial growth in demand forecast along the existing rail corridors—is created by the opening of any new rail lines such as the proposed Castle Hill–Mungerie Park line. (The need to provide capacity relief for the existing routes is urgent, and in any event the benefits of the new projects are unlikely to be able to be realised until the new inner city route is completed.)

Within these constraints, the CBD route options include routes using the reserved "Metro West" Sussex and Kent Street alignments and routes under Pitt Street, either as far north as Park Street (and then joining the Metro West route at Wynyard) or further north to Circular Quay (and then crossing to North Sydney via a tunnel). The ultimate decision on these options will need to take account not only of short and medium-term patronage demands and opportunities but also "sectorisation" requirements, the chosen route for a harbour crossing and the need to preserve longer-term options for additional routes through the CBD, such as those foreshadowed in a possible "ultimate" (35–50 year) form of the metropolitan rail network discussed in section 5.

The harbour crossing options include rail tunnel options—some routes might necessitate undesirably deep station(s) in North Sydney, but others might not—and the resumption of the two eastern lanes of the Harbour Bridge (restoring the form in which the bridge originally operated), with bus lane and/or general road traffic requirements being met by constructing a supplementary roadway within the latticework under the existing bridge deck or (much less desirably, and from the viewpoint of the Government's public transport objectives counter-productively) another road tunnel.

The options from North Sydney to St Leonards include quadruplication of the existing North Shore line or a new and more expensive underground route with a possible new station in Crows Nest.

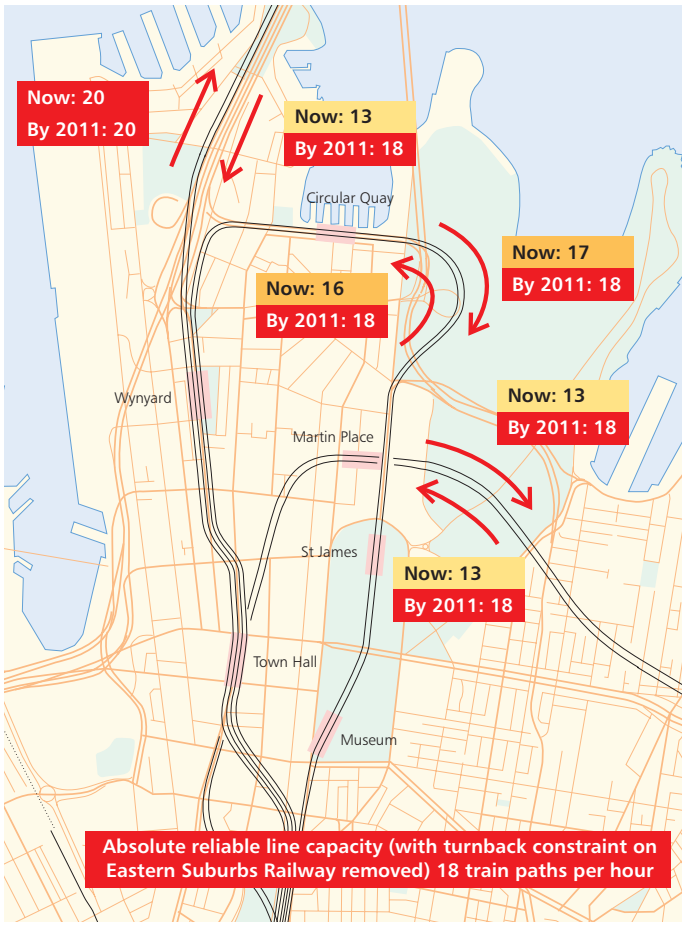


Figure 4.19. By 2011 all lines in the CBD will need to be operating at their full reliable capacity and the system will have reached saturation point. A new alternative route through the CBD will be essential, probably by between 2011 and 2015.

Options for the staging of the works and the operational implications of these options will need to be very carefully considered. For example, it might be desirable to quickly build and open an initial new CBD station accessed from the south, in order to provide some immediate capacity relief for the existing CBD lines and Town Hall station while construction of the new line northward through the CBD and across or under the harbour continues. Similarly, there could be advantages in constructing and opening the St Leonards–North Sydney section as an interim measure before the harbour crossing is established.

Once the initial investigations have more clearly identified the route and staging options and their operational implications a relatively early decision will need to be made by the Government, as a lead time of at least ten years is likely to be required before construction of even the first stage or stages could be completed.

In short, **if rail patronage grows as expected, and even if it grows much more slowly than expected, there is now no time to spare.**

Because of the complexity of almost all aspects of the project, it is essential to start serious planning for this new line immediately.

4.6 Station, bus–rail interchange and car park upgradings

As indicated in section 4.4, capacity-enhancing station upgrades will be required within the next ten years at Town Hall, Redfern, Sydenham, Glenfield, Sutherland, Parramatta, Homebush, Lidcombe, Burwood, Newtown, Epping, Berowra, Hornsby, Chatswood and North Sydney stations.

By far the most urgent of these projects is the upgrading of Town Hall station, which is already operating at saturation capacity during peak periods and is significantly affecting the reliability and capacity of the rail system, with station dwell times having to be as long as 90 seconds.

In other station and interchange projects over the next ten years,

- **Five new stations** are planned, at
  - **Oak Flats** on the South Coast line, as promised in *Action for Transport 2010* (*indicative cost $2 million, to be completed by 2002*)
  - **The University of Western Sydney** on the Main West line between Werrington and Kingswood, as promised in *Action for Transport 2010* (*indicative cost $7 million, to be completed by 2003*)
  - **Flinders** on the South Coast line (*indicative cost $2 million, to be completed by 2004*)
  - **Glendale** on the Central Coast line, as promised in *Action for Transport 2010* (*indicative cost, excluding associated trackwork costs, $12 million, to be completed by 2004*), and
  - A new **Warnervale** site on the Central Coast line, north of the existing station (*indicative cost $12 million, to be completed by 2007*).
- **Three more new stations** are under investigation:
  - **Nirimba** on the Richmond line (*indicative cost $11 million, with 90–95% of this cost to be met by the Department of Defence, and completion by 2005*)
  - **Georges River** on the East Hills line (*indicative cost $12 million, with 90–95% of this cost to be met by the Department of Defence, and completion by 2005*), and
  - **Pippita** on the Olympic line (*indicative cost $1 million, with all of this cost to be met by developers, and completion by 2004*).
- **Rhodes** station is expected to be rebuilt (*indicative cost $7 million, with 70–80% of this cost to be met by developers, and completion by 2004*).
- **Kingsgrove station** on the East Hills line is also expected to be rebuilt, as part of the *Easy Access* upgrading of this station (see below), with four platforms to the east of the existing station site, facilitating interchanges between Sydenham and Airport trains.
- **The upgrading of stations to provide *Easy Access* facilities** is planned to proceed, with another 44 stations planned for upgrading between 2001–02 and 2005–2006 (there are currently 47 *Easy Access* stations, and five more— Engadine, Katoomba, Allawah, Regents Park and Caringbah—are currently being upgraded).

  The stations planned for upgrading (*Figure 4.20*) are:
  - **2001–02:** Riverwood, Beresfield, Beverly Hills, Maitland, Thornton, Wollongong, Summer Hill, Rockdale, West Ryde, Campsie and Padstow
  - **2002–03:** Holsworthy, North Sydney, Cabramatta, Miranda and Granville
  - **Between 2003 and 2006:** 27–30 other stations, with priorities yet to be determined by the Government (estimated $85 million).

  By the time these projects are completed about one-third of all CityRail stations, serving approximately 80% of CityRail's passengers, will have full *Easy Access* facilities.

  Further upgradings may be required, in accordance with the final Transport Disabilities Standards, even though there will be rapidly diminishing returns from these investments. The last 60 stations, each with fewer than 100 passengers per day, serve only 0.2% of CityRail's customers.

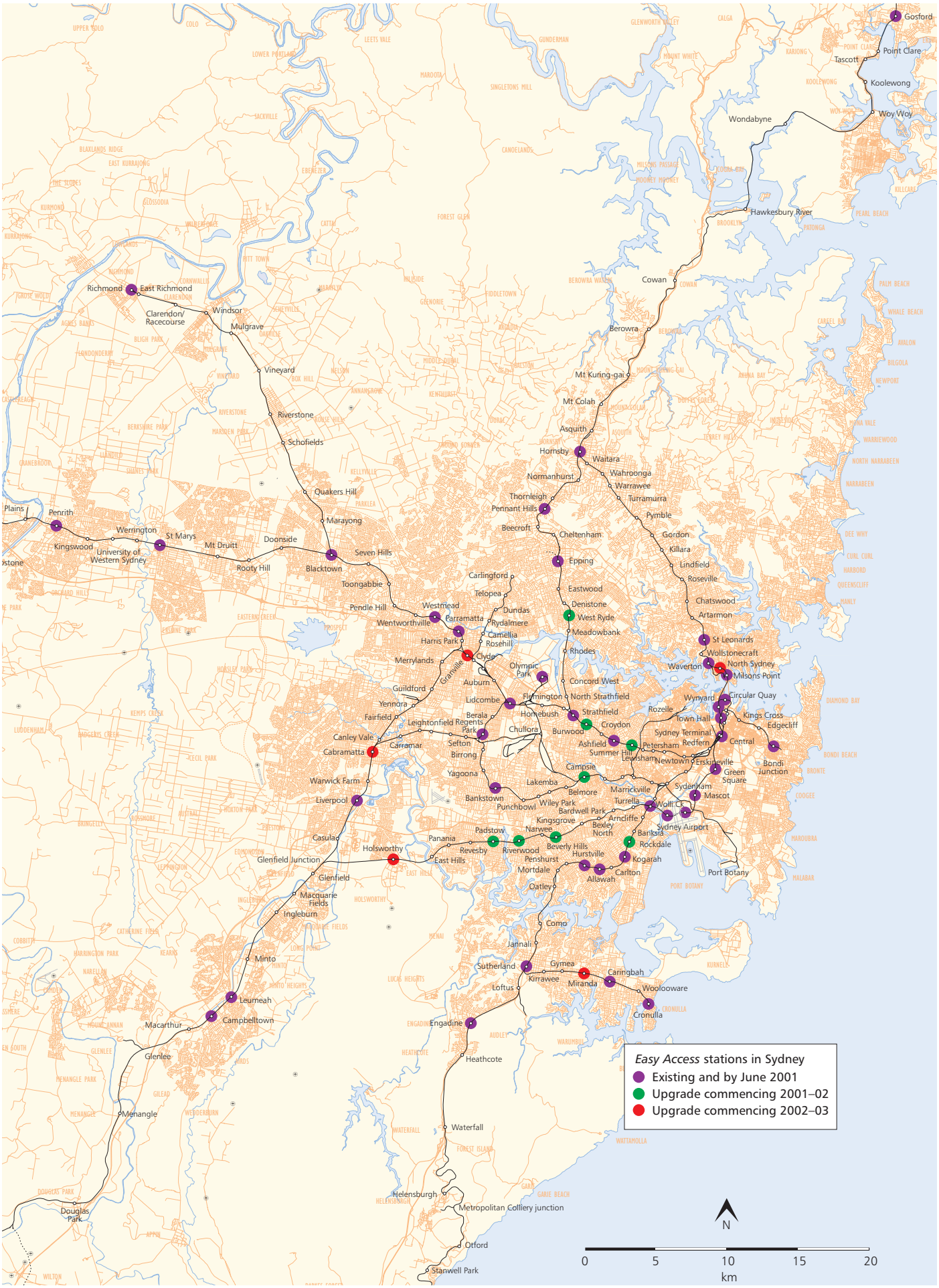
Reservation and protection of longer term rail corridors

There is an urgent need to commence the planning controls, land acquisitions and other actions required to protect the opportunity to build new surface and underground railway lines in the metropolitan area.

These actions need to commence immediately and continue throughout the next decade—at an estimated cost of around $15–20 million per year—but for convenience the routes involved are considered in the context of longer-term plans for the rail system, in section 5 of this report.

Rolling stock requirements

Rolling stock acquisition and replacement requirements and maintenance strategies, both within the next ten years and in the longer term, are separately discussed in section 6 of this report.


Gosford
Point Clare
Tascott
Koolewong
Woy Woy
Wondabyne
Hawkesbury River
Cowan
Berowra
Mt Kuring-gai
Mt Colah
Asquith
Hornsby
Waitara
Wahroonga
Warrawee
Turramurra
Pymble
Gordon
Killara
Lindfield
Roseville
Chatswood
Artarmon
St Leonards
Wollstonecraft
North Sydney
Milsons Point
Waverton
Circular Quay
Wynyard
Rozelle
Town Hall
Kings Cross
Edgecliff
Sydney Terminal
Central
Redfern
Petersham
Newtown
Erskineville
Green Square
Bondi Junction
Sydenham
Marrickville
Mascot
Wolli Ck
Sydney Airport
Banksia
Rockdale
Kogarah
Carlton
Allawah
Port Botany
Oatley
Mortdale
Penshurst
Hurstville
Beverly Hills
Riverwood
Narwee
Kingsgrove
Arncliffe
Bexley North
Bardwell Park
Wiley Park
Turrella
Belmore
Lakemba
Campsie
Punchbowl
Bankstown
Yagoona
Birrong
Sefton
Regents Park
Berala
Chullora
Burwood
Croydon
Strathfield
Homebush
Flemington
North Strathfield
Lidcombe
Concord West
Olympic Park
Auburn
Granville
Merrylands
Clyde
Rosehill
Camellia
Harris Park
Rydalmere
Dundas
Telopea
Carlingford
Eastwood
Denistone
West Ryde
Meadowbank
Rhodes
Epping
Pennant Hills
Thornleigh
Normanhurst
Beecroft
Cheltenham
Westmead
Parramatta
Wentworthville
Pendle Hill
Toongabbie
Seven Hills
Blacktown
Doonside
Rooty Hill
Mt Druitt
St Marys
University of Western Sydney
Kingswood
Werrington
Penrith
Plains
Marayong
Quakers Hill
Schofields
Riverstone
Vineyard
Mulgrave
Windsor
Clarendon/ Racecourse
Richmond
East Richmond
Guildford
Yennora
Fairfield
Leightonfield
Canley Vale
Carramar
Cabramatta
Warwick Farm
Liverpool
Casula
Glenfield Junction
Holsworthy
East Hills
Panania
Padstow
Revesby
Glenfield
Macquarie Fields
Ingleburn
Minto
Leumeah
Campbelltown
Macarthur
Glenlee
Menangle
Douglas Park
Como
Jannali
Sutherland
Gymea
Kirrawee
Miranda
Caringbah
Woolooware
Cronulla
Loftus
Engadine
Heathcote
Waterfall
Helensburgh
Metropolitan Colliery junction
Otford
Stanwell Park
Easy Access stations in Sydney
Existing and by June 2001
Upgrade commencing 2001–02
Upgrade commencing 2002–03
N
0
5
10
15
20
km

- **Bus–rail interchange facilities and rail commuter car parks will need to be upgraded** at key locations where patronage growth is outpacing the existing facilities.

  These facilities are important for CityRail's patronage growth, as approximately 23% of all journeys to work by rail also involve bus transport (the proportion is much higher at several larger suburban and intercity stations) and there has been a rapid increase in car–rail interchanging at many stations.

  Priorities for these projects are assessed by the Department of Transport on the basis of Government commitments such as those in *Action for Transport 2010*, intermodal patronage forecasts, associated proposals by State Rail for station upgrades, analyses of regional economic costs and benefits, Government decisions and local community representations. Most of the funds required come from parking space levies in the CBD and other major centres.

  Current Department of Transport plans, not yet approved by the Government, assume parking space levy revenue will total $40 million per year, not all of it for rail-related project, and therefore involve some significant delays in addressing existing problem areas. To take but one example, at Sutherland large numbers of rail commuters are already being forced to park in surrounding streets, and this is causing considerable local resentment, but rail commuter car parks in the area are not scheduled for upgrading for many years.

  Further, the impacts of a number of the Department of Transport's preliminary concepts for expanded car parks on CityRail and "feeder" bus patronage and operations still need to be examined. If the locations of major car parks are not carefully planned, these facilities have the potential to actively encourage greater car travel at the expense of bus services and the use of local railway stations, while producing little if any gain in total rail patronage. This result would undermine the Government's public transport objectives, and clearly needs to be avoided.

  The main rail-related interchange projects over the next ten years currently envisaged by the Department of Transport (with *highly* indicative costings) are:

  By 2002:

  — Upgrading of the bus–rail interchange at **Wyong** station (already underway). *Indicative cost: $2.5 million.*

  — A new bus–rail interchange at **Oaks Flat** station (already underway). *Indicative cost: $1.5 million.*

  — A new rail commuter car park at **Kogarah** station (already underway). *Indicative cost: $12.6 million.*

The existing Holsworthy rail commuter car park (above) and the new car park and bus stop facilities now being developed.

  — Upgrading of the rail commuter car park at **Holsworthy** station (already underway). *Indicative cost: $8 million.*

  — Upgrading of the rail commuter car park at **Gosford** station (already underway). *Indicative cost: $3.9 million.*

  — Upgrading of the rail commuter car parks at **Jannali** and **Loftus** stations (already underway). *Indicative cost: $0.7 million.*

  By 2003:

  — Upgrading of the bus–rail interchange and car park at **Rockdale** station (already underway). *Indicative cost: $8 million.*

  — Upgrading of the bus–rail interchange at **Wollongong** station. *Indicative cost: $1.5 million.*

  Between 2004 and 2011:

  — Upgrading of bus–rail interchange facilities and/or rail commuter car parks at **38–40 other stations**, with the program to be finalised when the Government determines the priorities for individual projects. *Indicative cost: $220 million.*

- **Station security upgrades** will continue, with an estimated expenditure of $58 million over the next ten years, $40 million of it over the next five years.
- Real-time **station passenger information systems** will continue to be installed, with an estimated expenditure of $100 million over the next ten years, $40 million of it over the next five years.
- **New station ticketing systems** will also be installed, with an estimated expenditure of $71 million over the next ten years, $51 million of it over the next five years.

4.7 Fire and life safety upgrades in the underground system

Investigations by State Rail and Rail Infrastructure Corporation and its predecessors in the years since the disastrous Kings Cross Station fire in London in 1987 have disclosed potentially serious shortcomings in fire and life safety systems for the underground portions of the rail network (other than the new Airport line, for which the most modern control measures have been implemented).

These investigations have included risk assessment studies for the SRA in 1995 and 1996, an emergency services test exercise ("Blue Rattler") in May 1997 and a further risk assessment study for Rail Access Corporation in 1998. The risk assessments have all concluded that the current risks are above acceptable limits.

The greatest hazard is a train fire in a tunnel, and especially the smoke and fumes from such a fire, which would cause major problems not only in the tunnel but also in the stations. While the probability of such an incident is very small, the consequences could be extremely serious.

As a result of these investigations, a suite of urgent safety initiatives has been developed, with priorities being determined on the basis of achieving the greatest possible reductions in risks.

The major components of these works are:

- The installation of smoke management systems and ventilation systems for the existing tunnel network and underground stations
- Government Radio Network coverage in the tunnels (now completed)
- An upgraded emergency phone system
- Smooth walking surfaces in the tunnels, and
- Emergency escape ladders (now completed).

Site emergency management plans are also to be updated, redundant equipment and flammable materials (including litter) have been and continue to be removed from the tunnels and stations, and new CityRail rolling stock, including the Millennium trains being introduced from 2002, will be constructed with less flammable internal materials (floors, seating, etc).

Although some of the works identified in the studies as essential and urgent have been carried out, and the preliminary design of smoke management systems has been completed, most of the major works have not yet commenced.

Because of the significant cost of the measures identified in past studies as necessary—$114 million for the tunnel smoke management systems, about $51 million for the underground stations and about $13 million for the remaining other works—additional risk evaluations are now being carried out, to re-check the justifications for the various works in the light of a new RIC Safety Risk Standard.

If the need for the currently proposed program of works is confirmed, expected to be divided into five segments, staged over the period from June 2002 to December 2006: Wynyard and Town Hall, Museum and St James, Redfern to Martin Place, Kings Cross to Bondi Junction and North Sydney.

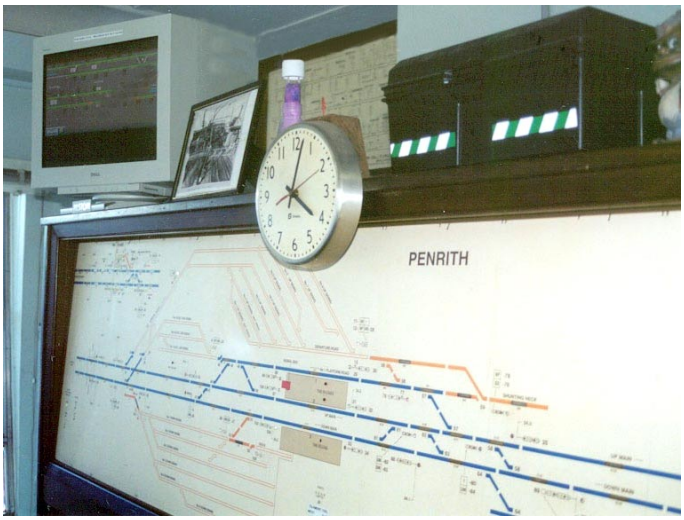
4.8 Electrical capacity upgrades

Electrical systems in the greater metropolitan region will need to be upgraded to cope with increased power requirements arising from:

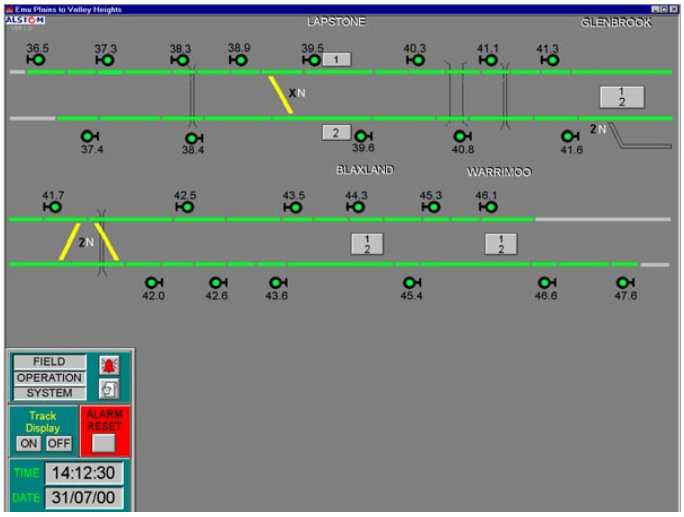
- The introduction of new CityRail trains, which will increase:
  - The total number of trains on the network
  - The air-conditioning loads imposed by each train (the oldest 40% of the existing fleet, all of which will have to be replaced over the next 17 years as discussed in section 6.2, is not air-conditioned), and
  - Other power requirements (for example, the new "outer suburban" carriages to be introduced from 2003 will have more powerful motors)
- The possible fitting of new motors for CityRail's existing "V set" intercity fleet
- The introduction of new lines and the amplification of existing lines, and
- Increased peak period loadings.

While there are relatively few overloading problems at present for the 1,500 V DC overhead wiring system, because much of it was rebuilt in the 1980s and early 1990s, within the next few years there will be many critically overloaded substations, all on the main corridors.

Further, although the high-voltage (33 kV and 66 kV) system supplying power to the substations was largely rebuilt during the 1960s, the spare capacity built into the system at that time has now been used up by load growth, and the high-voltage system is showing serious signs of impending overloading.



A new video display in the Penrith signal box (top left of photo above) showing train locations on the Emu Plains–Valley Heights automatic signalling section of the Main West line, previously "dark territory".



By 2006 the total load imposed by CityRail services is expected to be about 20% higher than at present, by 2011 it is expected to be 45% higher than at present and by 2021 it is expected to be about 70% higher than at present. **These increases will necessitate the upgrading of the capacity of substantial sections of the electrical supply system.**

Essential and urgent electrical supply capacity improvements in the five years to 2006 are expected to cost $30 million. Detailed cost estimates have not yet been prepared for the works required in the following years, although an initial identification has been made of the components of the electrical system most likely to require upgrading as electrical demand progressively increases, and substantial additional expenditure, of several tens of millions of dollars, is likely to be required.

In the longer term, the conversion of parts of the intercity network from 1,500 V DC power to 25 kV AC power, reducing electrical rail infrastructure requirements and permitting the use of more powerful trains, is likely to be an attractive proposition.

4.9 Modernisation of signalling and train control systems

Monitoring of 'dark territories'

Immediate safety-related improvements to the metropolitan signalling system's infrastructure in response to the Glenbrook accident of December 1999 have focussed on the provision in local signal boxes of screens showing the location of trains in adjacent track sections controlled by automatic signals, which were previously "dark territories".

These "Indication of Automatic Signalling Sections (IASS)" works are expected to be completed throughout the metropolitan network by the end of 2002.

Immediate network control improvements

In January 2001 State Rail reassumed statutory responsibility for all timetabling and the control of all passenger and freight train movements on the metropolitan rail network. The highest priorities for train control improvements are:

- **The establishment of a modern new train control centre for the entire metropolitan network**, replacing disparate antiquated and inadequate facilities, to permit better central management and control of all train movements in the region and faster and more effective coordinated incident responses.
- **The rapid expansion of the geographic coverage of State Rail's *Train Location System***, which provides a high-level diagrammatic screen overview—with much less detail than that required by signallers controlling the setting of individual signals and points etc—of the locations of all trains, but at present only covers about one-third of the Sydney suburban network (see *Figure 2.10*, which also shows areas currently able to be monitored by train controllers using other systems).

While the proposed new computerised metropolitan signal control system discussed below (or an equivalent) will ultimately provide all the necessary electronic inputs for expansion of the *Train Location System*'s coverage, the first stage of this new signal control system is only now being introduced, and its adoption for the rest of the network will need to be evaluated in the light of the success of Stage 1.

Accordingly, interim technological approaches—most of which will not be able to be used by the new metropolitan signal control system when it is later installed—will need to be adopted to achieve rapid expansion of the *Train Location System*'s coverage.

Stage 1 of a "Train Operations Management System (TOMS)" program to achieve this interim coverage would utilise data from the *Metronet* and *Countrynet* train radio systems, which have been subject to reliability problems and are increasingly

outmoded and difficult to service, plus inputs from existing signalling and electrical control systems and the new IASS "dark territory" monitoring systems, to provide coverage from Como to Waterfall, from Epping to Rhodes and from Lapstone to Katoomba, at an estimated cost of $4 million.

Stage 2 would provide complete coverage in the area bounded by Wyong to the north, Lithgow to the west, Macarthur to the southwest and Bomaderry to the south, at a an additional cost of $8 million, by 2003.

Modernisation of signalling infrastructure

A significant component of the re-established major periodic maintenance programs discussed in section 4.10 below will need to be the continued modernisation of signal systems in several parts of the metropolitan network. These systems date back 70 years or more, use obsolete components, are unreliable and maintenance-intensive, have limited capabilities by today's standards, constrain the rail network's capacity in several areas and are not able to be remotely controlled.

The most immediate priorities are resignalling to reduce train headways on the Main South line between Glenfield and Campbelltown (see section 4.4), signalling modernisation on the Illawarra and Cronulla lines from Oatley to Cronulla and in the area controlled by the Sefton signal box.

The costs of these and other resignalling projects are incorporated into the major periodic maintenance costings summarised in section 4.10.

The proposed program to pilot a communications-based signalling system, which could ultimately replace the existing conventional signalling technologies in at least some sections of the network, has already been discussed in section 4.3.

Modernisation of signal control systems

At present there are some 44 signal control locations in the portion of the metropolitan rail network south of Wyong, including 35 signal boxes. They control 78 different signal "interlockings"— discrete areas of control—using a mixture of mechanical, electrical relay and (in a few cases) computer-based technologies.

The signal control locations are based on the capabilities of the equipment being used early in the 20th century, and in most cases do not reflect the needs or capabilities of modern signal control and rail network management systems or practices.

Interactions between the various control locations are not automated and are heavily reliant on labour-intensive telephone, telegraph and fax communications.

Most of the signal boxes are more than 40 years old, and most use thoroughly obsolete technologies at least 20 years old.

The "Advanced Train Running Information Control System" (ATRICS) developed by Rail Infrastructure Corporation is now used for the control of the new Airport line and the Olympic loop, and Stage 1 of its possible wider introduction, controlling a number of other areas from Sydenham, is underway.

Many of the systems now being relied upon for the safe operation of the rail network have already reached or are approaching the end of their effective working lives, and are becoming increasingly unsupportable. They are very maintenance-intensive, spare parts are dwindling (many parts are no longer manufactured) and modifications are both difficult and costly to implement.

Facilities for staff operating these systems are also extremely poor in many locations.

It is therefore proposed that over the next decade—subject to the success of Stage 1 installations now commencing at the Sydenham signal control centre—a new computerised "Metropolitan Signal Control System" should be progressively introduced throughout the metropolitan rail system, with the current scattered and outmoded signal control locations being replaced by seven modern control locations (Sydenham, Sydney, Strathfield, Blacktown, Hornsby, Broadmeadow and Wollongong) (see *Figure 4.21*).

This system, already introduced for the Olympic rail loop and the Airport line, will be able to control both relay-based

and computer-based signalling technologies, with automatic logging of all signal system input and output data transfers, and will display the status of and data from all the metropolitan network's signalling systems, including all automatic signalling areas.

It will:

- Accept electronic inputs of timetables
- Communicate train plans to signallers and train controllers throughout the NSW rail network and interstate
- Control all the safety-critical elements of the metropolitan signalling systems
- Accept electronic inputs of actual train locations from the track circuits used to detect the presence of trains, via these signalling systems
- Improve train management efficiency by providing Automatic Route Setting capabilities
- Give signallers a clear indication of all signal settings, track circuits and train locations

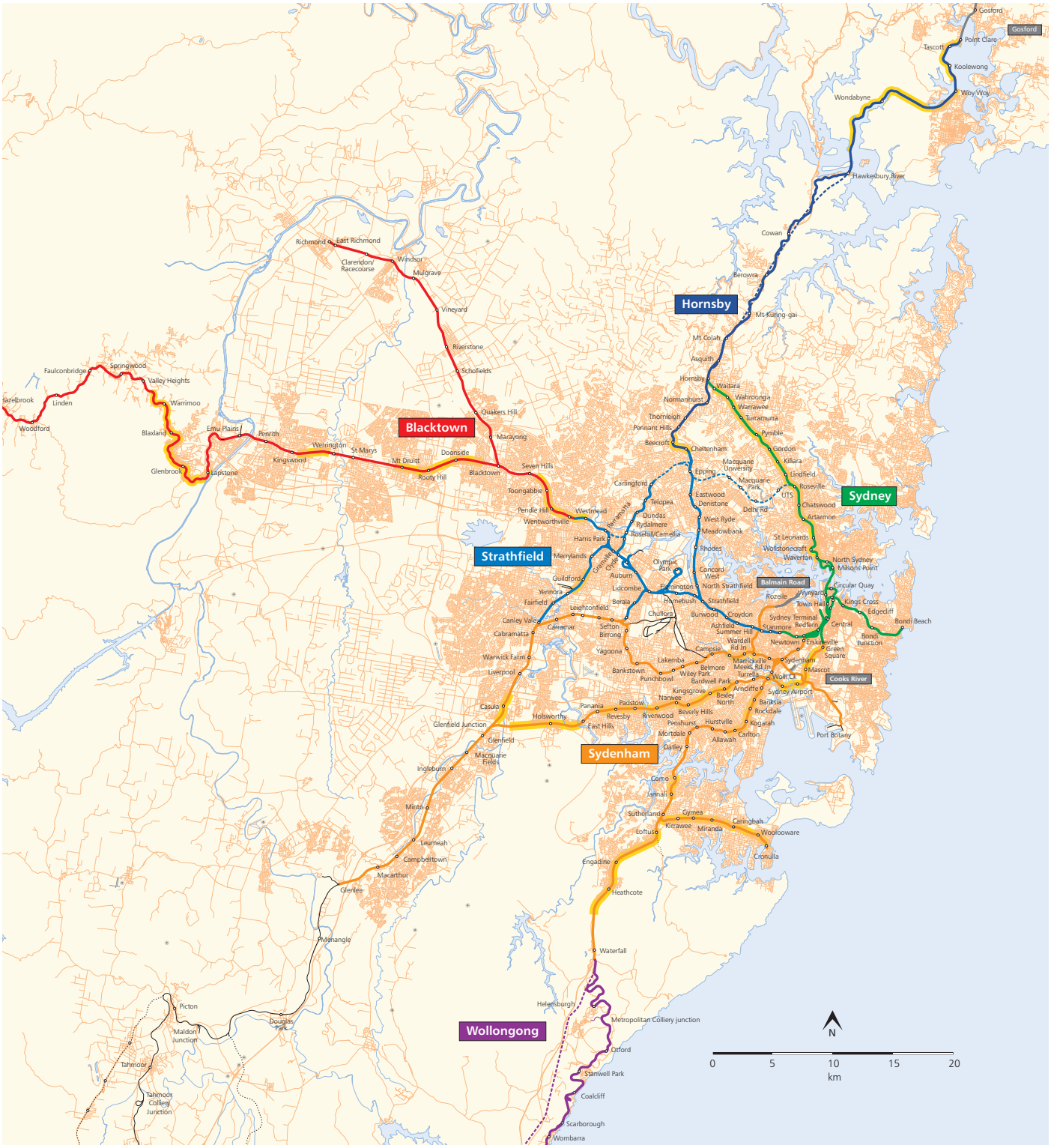


Figure 4.21. Possible amalgamated signal control areas in Sydney. The initial development of the new control system will be focussed on the lines controlled from Sydenham, and possible wider introduction of the new system will depend on the success of this Stage 1.

- Automatically provide alarms to draw signallers' attention to any unsafe train operations, including "signal passed at danger" (SPAD) incidents
- Allow signallers to initiate corrective action whenever variances in train running are detected
- Automatically provide the data needed for State Rail's higher-level *Train Location System* and similar systems for freight operators (e.g. to assist the Ports Authority in scheduling train loading and unloading operations at the ports)
- Automatically provide actual train schedule information to station and train-based passenger information systems
- Automatically send alarms notifying rail infrastructure maintenance groups of infrastructure failures, eliminating the current need for multiple phone calls and speeding up responses
- Automatically generate reports for managers on the overall operational and fiscal performance of the rail network and all incidents, including rail infrastructure failures
- Facilitate improved training for signallers, including training and competency-based assessment using simulator workstations as well as "on the job" training
- Improve signallers' working environments, and
- Significantly reduce signalling control costs, mainly through reductions in staffing requirements, savings on signal box replacements and refurbishments and lower signalling system maintenance costs.

Each signal control centre will be able to monitor and control signalling systems not only in its own area of control but, as a back-up, in other selected areas normally controlled by other signal control centre(s). This ability to reassign control areas will improve incident recovery and permit a stronger focus on operational problems.

The automatic logging of information and easy generation of detailed reports will facilitate rapid examinations of incidents and equipment needing attention and assist in the development of more efficient "reliability-centred" preventative maintenance strategies, based on the actual operational performance of rail infrastructure.

The new system will necessitate modernisation of very old signal systems in a number of areas not currently able to be remotely controlled, in addition to the Oatley–Sutherland–Cronulla and Sefton projects already mentioned, including sections of the Main West line (between Auburn and Granville, at Clyde, between St Marys and Penrith and at Katoomba and Mt Victoria, and possibly later at Hartley Vale, Newnes Junction, Lithgow Yard and Lithgow), the Main South line (at Campbelltown) and the Main North line (at Gosford and a number of other locations).

The new Metropolitan Signal Control System will directly interface with passenger information systems, automatically providing accurate "real time" train arrival time information to passengers.

An indicative estimated total cost of the project is $130 million, including $22 million for the initial resignalling projects south of Gosford (other than Oatley–Sutherland–Cronulla and Sefton) but excluding any works at Gosford or north of Wyong. Stage 1, for the control of the Sydenham, Wolli Creek, Port Botany, Wardell Road, Campsie/Bankstown, and Hurstville areas from Sydenham, has been costed at approximately $25 million.

4.10 Other rail and station infrastructure maintenance strategies

As discussed in section 2.3, one of the main factors in the degradation of rail infrastructure reliability in the greater metropolitan region in recent years has been the downgrading of many "major periodic" maintenance programs during the 1990s.

These programs included a track strengthening and concrete resleepering program, a signalling modernisation program, an overhead wiring modernisation program, a junction renewal and upgrading program and ballast cleaning, track tamping, rail grinding, timber resleepering and rerailing programs.

The downgrading of these programs has now resulted in a serious major periodic maintenance backlog, degraded asset quality and reliability, a consequential reduction in CityRail on-time running and increased day-to-day routine inspection and maintenance costs. Even with increased funding, this backlog will be difficult to overcome, as Rail Infrastructure Corporation's major plant items are old (many items were mothballed) and incapable of meeting production requirements. Even if urgent orders are placed, critical high-efficiency equipment may not be available for some time.

The *Long-Term Strategic Plan for Rail* reports recent RIC analyses of the expenditures required for both routine and

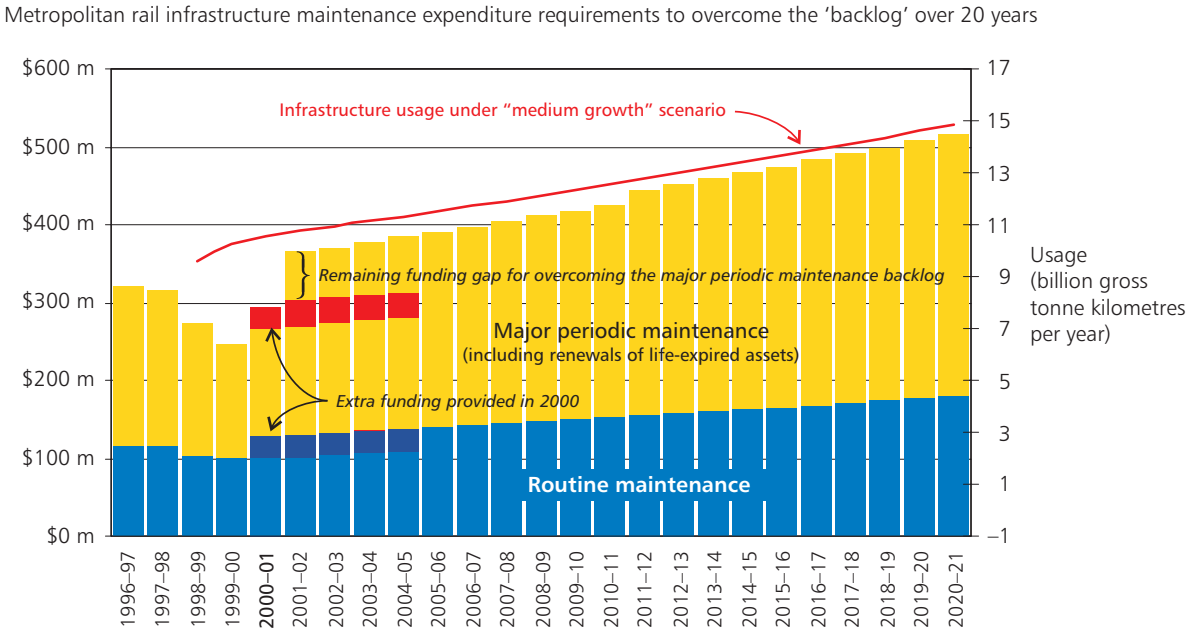


Figure 4.22. Metropolitan rail infrastructure maintenance expenditure requirements if the existing "backlog" in major periodic maintenance is to be overcome in the next 20 years, assuming the "medium growth" scenario.

major periodic maintenance of its various classes of infrastructure assets, both:

- In a "steady state", with expenditures being estimated on the basis of optimised maintenance regimes for each class of asset and the average lives of these assets, and
- During the extended period now required to overcome the substantial maintenance backlog, with the additional expenditures being based on a "baseline" backlog program of works—taking account of the deficiencies in the plant likely to be available in the initial years—for concrete resleepering, timber and steel sleeper resleepering, ballast cleaning, rerailing, rail grinding, production resurfacing, turnout resurfacing, signalling system renewals, electrical supply system renewals and the renewal of life-expired, low-speed junctions.

These RIC studies suggest that:

- **"Steady state" major periodic maintenance expenditure** for the metropolitan network's *existing* rail infrastructure needs to be about $152 million per year, in order to ensure adequate safety and reliability and minimise life-cycle costs
- **Total major periodic maintenance expenditure on metropolitan rail infrastructure during the "backlog catchup" period needs to be much higher**, averaging around $235 million per year during the first ten years, when the main focus should be on those works directly affecting CityRail service reliability and on-time running, and around $245 million per year during the following ten years, by which stage significant sections of the new infrastructure installed in the 1980s and 1990s will be due for major cyclical maintenance or replacement (*Table 4.1*).
- **Routine maintenance expenditure on existing metropolitan rail infrastructure**—taking account of the efficiencies likely to be able to be achieved—needs to average about $120–130 million per year.

These estimates do not include any allowance for the costs (and in some cases the off-setting cost savings) associated with:

- Increased maintenance requirements as usage of the metropolitan rail network increases (in general, expenditures will need to increase in line with increases in gross tonne kilometres, which will broadly reflect the patronage increases discussed in section 4.4, as shown in *Figure 4.22*)
- Fire and life safety projects (see section 4.7)
- Electrical system capacity upgrades (see section 4.8)
- New signal control systems and the possible introduction of communications-based signalling systems
- The maintenance and upgrading of State Rail and other yards and stabling facilities
- The maintenance of any of the new rail infrastructure constructed during the next 20 years
- Interface works associated with the construction of the planned new infrastructure
- Any "acts of God".

The "steady state" major periodic maintenance and routine maintenance expenditure requirements identified by RIC are broadly in line with 2001 funding levels, which were boosted by the Government late last year (in the case of metropolitan rail infrastructure maintenance, by $40 million per year, and in the case of the renewal of life-expired metropolitan rail

***Table 4.1*. Indicative estimates of future metropolitan rail infrastructure major periodic maintenance requirements, including prioritised works to overcome the current "backlog" over the next 20 years**

Asset type	Program	Next 10 years (to 2011)		Following 10 years (to 2021)	
		% renewal	Expenditure (2001 A$))	% renewal	Expenditure (2001 A$)
Track	Resleepering (concrete replacing timber)	60%	$201.9 m	40%	$134.7 m
	Resleepering (concrete replacing concrete)	0%	–	2%	$0.6 m
	Resurfacing	75%	$11.2 m	50%	$7.4 m
	Rerailing	35%	$130.2 m	35%	$130.2 m
	Reballasting	20%	$223.2 m	20%	$223.2 m
	Rail grinding	1,000%	$74.4 m	1,000%	$74.4 m
	Ballast cleaning	20%	$94.5 m	20%	$94.5 m
	Turnouts renewal	40%	$365.1 m	40%	$365.1 m
	Turnouts upgrading	40%	$51.6 m	40%	$51.6 m
	Track drainage systems	50%	$52.5 m	30%	$31.5 m
	Junction renewals (six)	100%	$180.0 m	–	–
	Track slabs	10%	$8.2 m	10%	$8.2 m
	Miscellaneous	100%	$46.5 m	100%	$46.5 m
	Total		**$1,439.3 m**		**$1,167.8 m**
Electrical	Transmission lines	20%	$1.7 m	20%	$1.7 m
	Substations, section huts, HV switching	20%	$73.4 m	20%	$73.4 m
	Overhead wiring and OHW structures	10%	$122.4 m	20%	$244.8 m
	Miscellaneous	100%	$18.6 m	100%	$18.6 m
	Total		**$216.1 m**		**$338.5 m**
Signalling	Lineside signalling	35%	$70.6 m	35%	$70.6 m
	Trunk cabling systems	25%	$300.5 m	25%	$300.5 m
	Interlockings	25%	$12.6 m	25%	$12.6 m
	Signal control points	35%	$2.8 m	35%	$2.8 m
	Remote control systems	50%	$2.3 m	50%	$2.3 m
	Signals	50%	$16.1 m	50%	$16.1 m
	Worked points/point ends	20%	$11.1 m	40%	$22.2m
	Train stops	20%	$9.6 m	40%	$19.3 m
	Miscellaneous	100%	$37.2 m	100%	$37.2 m
	Total		**$462.7 m**		**$483.5 m**
Communications	General systems	50%	$75.0 m	50%	$75.0 m
	Train radio	25%	$20.0 m	25%	$20.0 m
	Total		**$95.0 m**		**$95.0 m**
Bridges	Overhead parapets	20%	$4.6 m	20%	$4.6 m
	Overbridges	5%	$35.8 m	10%	$71.5 m
	Underbridges/flyovers/viaducts/transoms	10%	$21.4 m	10%	$21.4 m
	Culverts/subways	10%	$3.7 m	10%	$3.7 m
	Footbridges/service bridges	10%	$5.2 m	10%	$5.2 m
	Total		**$70.6 m**		**$106.3 m**
Land and buildings	Access roads	50%	$2.3 m	50%	$2.3 m
	Fences	10%	$5.5 m	10%	$5.5 m
	Cuttings and embankments	10%	$0.8 m	15%	$1.28 m
	Existing noise barriers	0%	–	5%	$0.4 m
	Removal of disused structures	20%	$2.5 m	20%	$2.5 m
	Level crossings	75%	$14.3 m	25%	$4.8 m
	Weighbridges	33%	$1.0 m	67%	$2.0 m
	Retaining walls	10%	$13.0 m	167%	$217.1 m
	Total		**$39.3 m**		**$235.7 m**
Tunnels	Tunnels and rock shelters renewal	20%	$24.0 m	10%	$12.0 m
Total			$2,347 m		$2,439 m

infrastructure assets, by $20 million in 2000–01 and by $30 million per year thereafter).

However, the *total* major periodic maintenance expenditures needed in the years ahead, so the current backlog can also be addressed, even over a very extended period of some 20 years, are:

- About $70 million per year higher than the current (2000–01) major periodic maintenance funding level of approximately $165 million per year (which includes the extra funding already provided), and
- About $60 million per year higher than the major periodic maintenance funding level previously planned for 2001–02, taking account of the further additional funding already agreed by the Government (*Figure 4.22*).

The additional funding for rail infrastructure maintenance agreed to by the Government late in 2000 was in response to a submission by the Office of the Coordinator General of Rail requesting:

- An additional $30 million in 2000–01 and $43 million per year thereafter for rail infrastructure maintenance (routine maintenance and some major periodic maintenance), and
- An additional $30 million in 2000–01 and $60 million per year thereafter for the renewal of life-expired infrastructure assets.

The additional $60 million per year now identified as necessary (from 2001–02) to permit the backlog of essential major periodic maintenance to be overcome over the next 20 years covers:

- The renewal of life-expired assets covered by the submission in 2000 (there being a $30 million per year gap between what was identified as necessary for these works and what was funded)
- Cyclical maintenance *during* the life of the assets, prior to their renewal (many of the items listed in *Table 4.1*), and
- The maintenance and renewal of types of assets not covered at all by the submission in 2000, such as electrical systems, communications systems (e.g. the *Metronet* analogue train radio system, now a decade old, is increasingly maintenance-intensive and many components and spares are no longer available), bridges, level crossings, retaining walls, tunnels and fencing.

Major periodic maintenance requirements for State Rail's metropolitan **stations** are expected to increase from $8.3 million per year at present to around $12 million per year by 2011 and $16 million per year by 2021. When the various station upgrading programs described above are also taken into account, about $100 million per year will be required to maintain and replace existing station assets.

5. *Beyond 2010:* Overcoming the critical inner city constraint and implementing a longer term vision

The *Long-Term Strategic Plan for Rail's* patronage growth and service and infrastructure response analyses summarised in section 4 of this report point very clearly to **one critically important project for the decade starting in 2011: a new alternative route through the CBD, linking Eveleigh and St Leonards via the CBD and North Sydney** (see sections 4.3 and 4.4).

A series of **other projects to further amplify the capacity of key rail corridors** as growth continues will also be essential.

The other projects likely to be required between 2011 and 2021 will, however, be much more a matter of choice. They will be driven by a wide range of considerations, extending well beyond (but still including) "rail system viability" considerations and including new urban development locations and patterns, the densities of development in new and existing urban areas, the longer-term development of bus transitways and the potential of different rail projects to reduce road demand growth. There will need to be close liaison between the rail agencies, the Department of Transport, the Department of Urban Affairs and Planning, the Roads and Traffic Authority and all other stakeholders in the planning and prioritisation of these projects.

Extending the rail system's 'reach'

In particular, **it will be highly desirable to extend the "reach" of the metropolitan rail system by building new lines into existing and new urban areas that are distant from the existing network, especially in northwestern and southwestern Sydney.**

This approach was expressly recognised in *Action for Transport 2010*, which included announcements of the new Epping–Castle Hill–Mungerie Park line and longer-term Warringah and Bondi Junction–Maroubra lines.

Unless the "reach" of the rail system is extended in this way, Sydney will be doomed to a future under which more than half the urbanised metropolitan area, and especially those areas at more distant locations, will not be served by the rail system, creating and reinforcing significant inequalities in access to employment, education and other community facilities.

The construction of new "greenfield" railways has important implications for the operation and capacity of the existing rail system, and highlights the importance of the principles of "sectorisation" and service segregation which have already been a key focus of proposals for the decade to 2011 (see section 4.4.)

Indeed, as already explained in the context of proposals for further upgrades to and from the Illawarra and the Central Coast, the *Long-Term Strategic Plan for Rail* envisages the deferral of a number of important "reach"-extending projects until the capacity and operational robustness necessary to accommodate the new services can be provided. Unless this is done, the "reach" extending projects would simply feed more trains into a strangulated and highly unreliable network.

The factors influencing the types, locations and timings of future new railways have been listed in section 3 of this report, and are considered in detail in the *Long-Term Strategic Plan for Rail*.

Although there are obviously some significant uncertainties about the future shape and nature of the greater Sydney metropolis, it seems clear that the two "reach"-extending projects warranting the highest priority will be:

- The proposed **Castle Hill–Mungerie Park line**, serving the extensive and rapidly developing northwestern urban development areas and providing some capacity relief for the existing western lines, and
- **A new line towards Leppington and ultimately Bringelly**, the next areas scheduled for "greenfield" urban development by the Department of Urban Affairs and Planning.

A staged approach in choosing the best public transport mode

The general approach adopted by the *Long-Term Strategic Plan for Rail* in considering possible future cross-regional and "greenfield" railways is that **in many cases alternative inter-**

mediate public transport modes should be used at the outset, especially road and "transitway"-based bus services, with rail modes being adopted for a corridor only when its demand is expected to reach (say) 5,000 people per hour during peak flows and when the much higher speeds and capacities of heavy rail become important or when constraints such as road congestion prevent buses from fulfilling their transport tasks.

This is consistent with the strong emphasis in *Action for Transport 2010* on the rapid development of a bus transitway network, not just for both cross-regional links and "greenfield" corridors, with rail being a longer term option.

The application of this principle of choosing the most appropriate mode of public transport for the demand means, however, that some previously envisaged medium-term cross-regional rail links, including the Hurstville–Strathfield railway announced in *Action for Transport 2010*, are unlikely to need to be provided as heavy rail links until the long term, if at all. The Hurstville–Strathfield link would instead be developed first through the provision of high-quality cross-regional bus services, potentially with dedicated bus lanes as demand develops, and then through a transitway-style bus corridor, moving to rail modes only if and when higher speeds and capacities are required.

A long-term framework

A large number of possible new rail links and augmentations of the existing network are considered in the *Long-Term Strategic Plan for Rail*, in corridors focussing on both the Sydney CBD and Parramatta.

Initial selections have been made of the projects believed to have the greatest merit at this stage.

While there will obviously be changes in projects and priorities as the future unfolds in unanticipated ways, new ideas are presented and detailed investigations are carried out, the longer-term vision for the rail network presented through these selections—ultimately for a metropolis of some five or six million people—provides an important planning context for all future transport developments in the region, essentially in the same way as DMR/RTA plans of a similar nature in the 1940s and 1950s have provided a context for most major road network planning in the last 50 years.

This is not a new philosophy for rail. The architect of much of the current metropolitan rail network, Dr Bradfield, adopted a similar approach, very successfully, in the 1920s and 1930s. The "unusual" nature of presenting a longer term rail vision is simply an artefact of the dominance of road planning in the last 50 years.

***Figures 5.1, 5.2, 5.3, 5.4 and 5.5* present increasingly indicative concepts of the rail network developments that will *need* to have occurred during the five-year periods to 2006, 2011 and 2016—as discussed in sections 4.4 and 4.5—and the developments that are *expected* to have occurred during the subsequent periods to 2021 and (say) 2051.**

With the exception of the vitally important new route through the CBD, the timing of projects during the five year periods to 2016 and 2021 is reasonably flexible. For example, if funding were available, some of the projects shown for 2016–2021 (*Figure 5.5*) could be carried out earlier, provided this does not jeopardise the completion of the new route through the CBD.

***Figures 5.6, 5.7 and 5.8* assemble the projects shown in *Figures 5.1 to 5.5* into "snapshots" of the existing rail network, the rail network in 20 years and the rail network in about 40–50 years, serving a metropolis of approximately 5–6 million people.**

The vision presented in these longer-term concepts is not intended to be prescriptive. Rather, it is intended to:

- **Highlight the medium-term corridors which warrant urgent protective action** (through planning controls, land acquisitions and other measures) as soon as possible.

  Alignment studies for the new Castle Hill/Mungerie Park line are now nearing completion, and similar studies were carried out for the Glenfield–Leppington–Bringelly line in the mid-1990s, so it should be feasible to start the essential process of protecting these two corridors in the near future, along with the "Metro West" corridor, the Mungerie Park–Vineyard corridor and other possible future rail corridors through the CBD and other inner city areas.
- **Highlight the importance of expansion of the passenger rail system into the northwest and southwest growth areas**, tapping into new markets which have been poorly served by public transport in the past and assisting "sectorised" operation of the existing network (e.g. a Mungerie Park to Campbelltown via North Sydney and the CBD end-to-end service "sector").
- **Assist DUAP and Councils in the development of land-use planning policies and plans to actively encourage and facilitate "public transport friendly" styles of residential, retail and employment-related development in the new corridors**.

  These styles of development, rather than lower density urban sprawl, will be vital if the potential benefits of the new corridors are to be fully realised.
- **Assist the Department of Transport and bus operators in planning both "feeder" and cross-regional bus services.**
- **Assist transport and urban planners to evaluate options for medium-term projects such as the new rail route through the CBD in the light of longer-term possibilities**, such as the possible new end-to-end service sectors

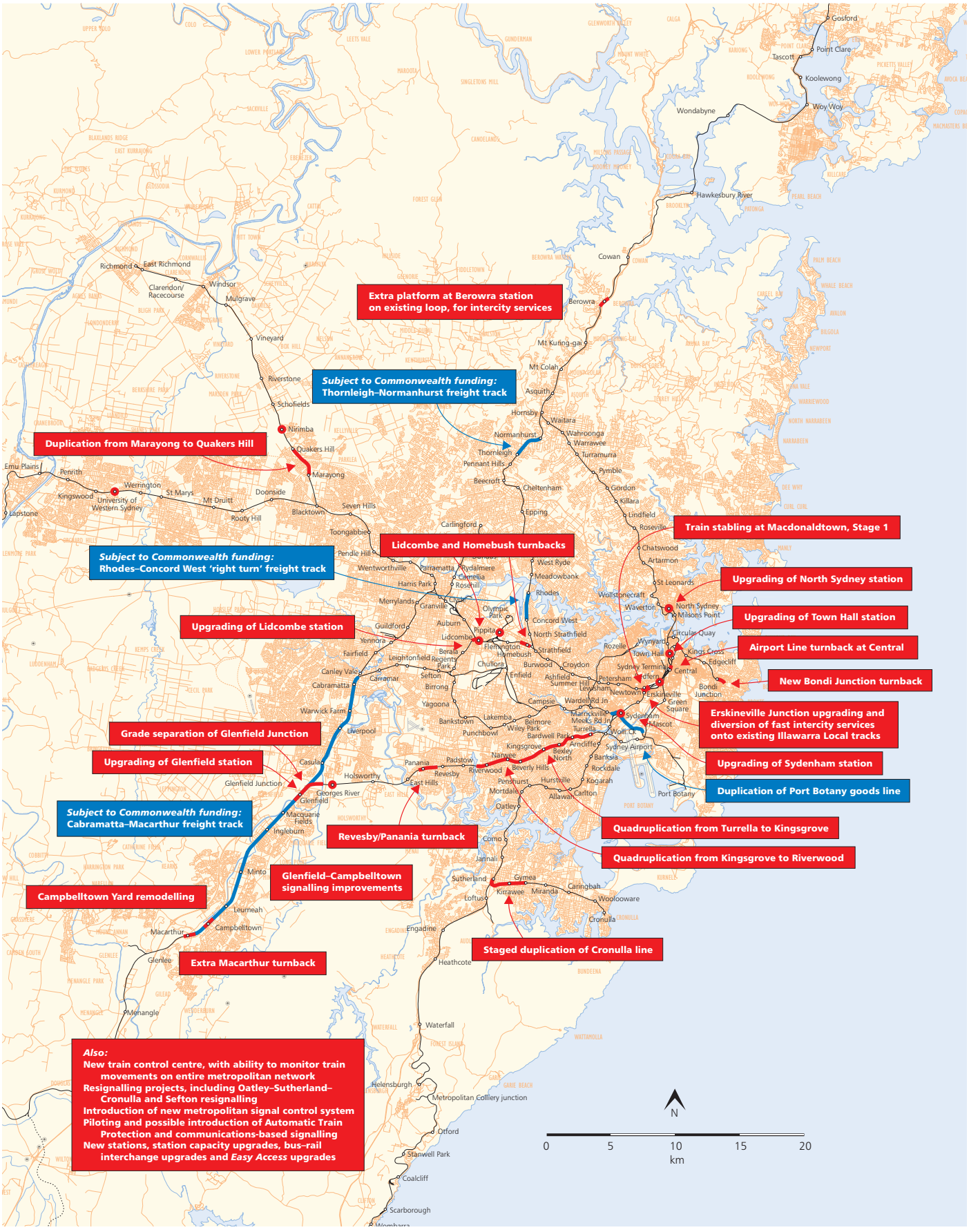


Figure 5.1. Rail network developments between 2001 and 2006 (for details, see section 4.4).

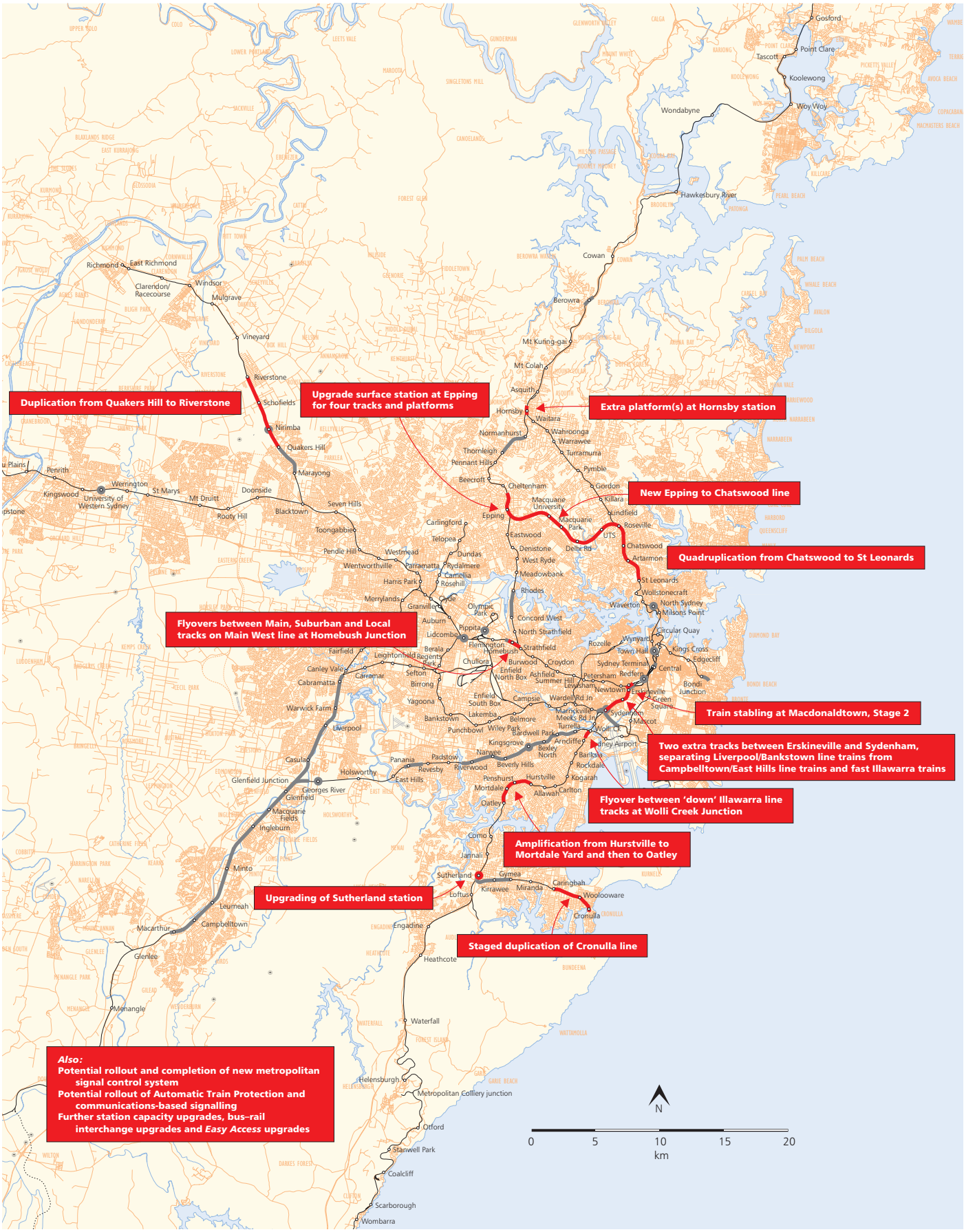
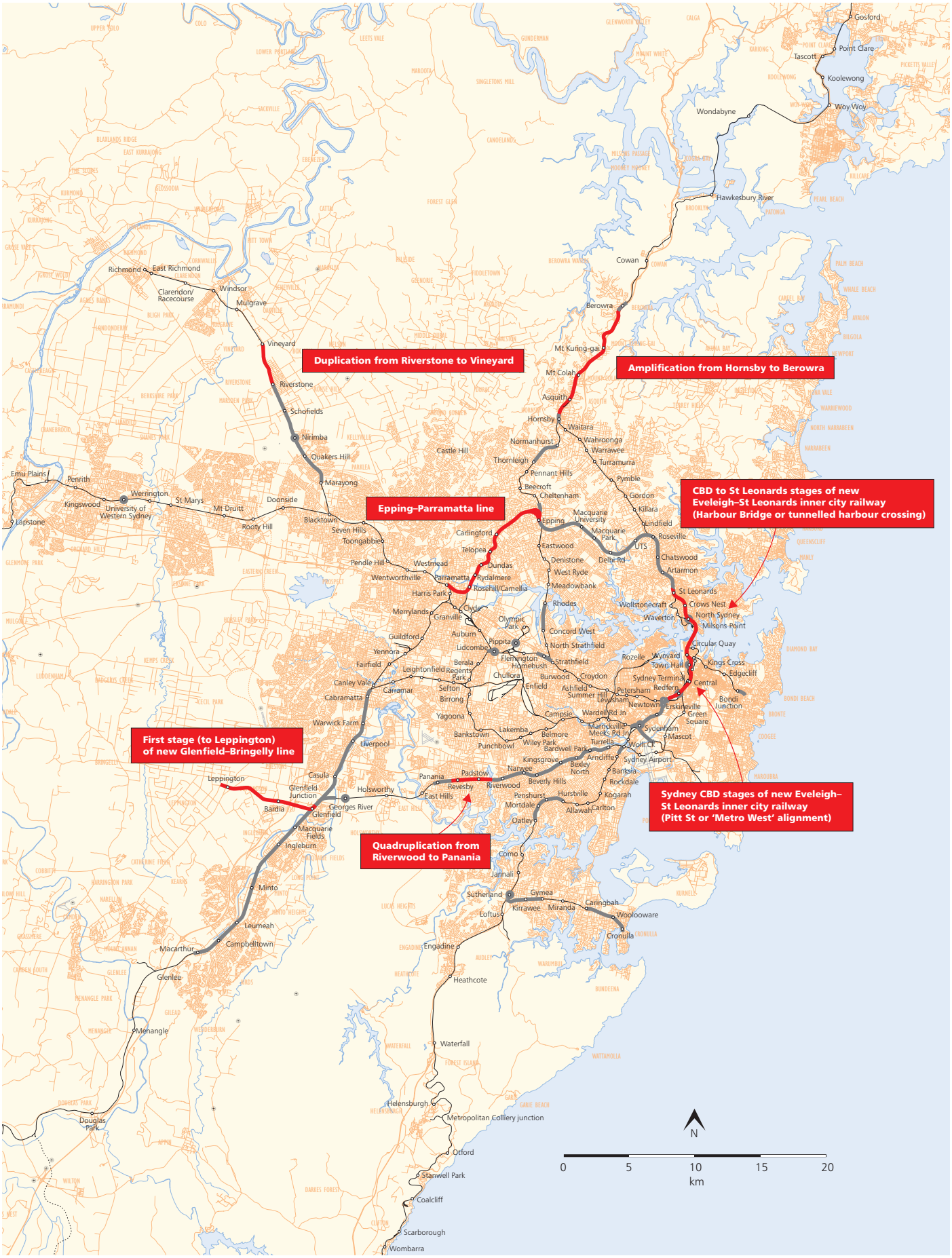


Figure 5.2. Rail network developments between 2006 and 2011 (for details, see section 4.4).



0 5 10 15 20 km

Figure 5.3. Rail network developments between 2011 and 2016. For details on the vital new route through the CBD, see sections 4.4 and 4.5. The timing of the other projects shown here and in Figure 5.4 (indicatively for 2016–2021) is more flexible.

Figure 5.4. Rail network developments between 2016 and 2021. Some of these projects might be completed earlier, provided this does not jeopardise the completion of the vital new route through the CBD shown in Figure 5.3 and discussed in sections 4.4 and 4.5.

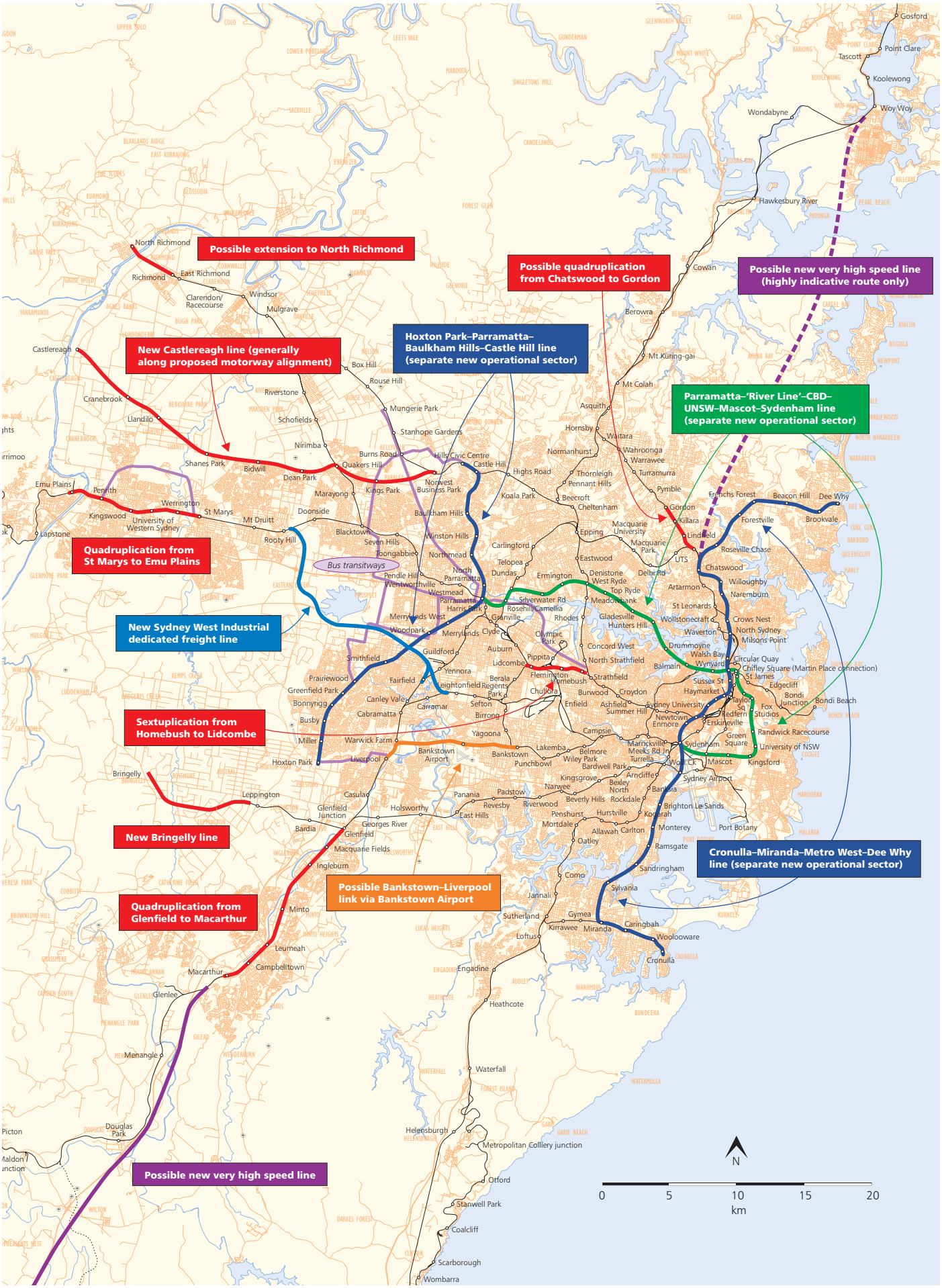


Figure 5.5. Rail network developments between 2021 and (say) 2051.

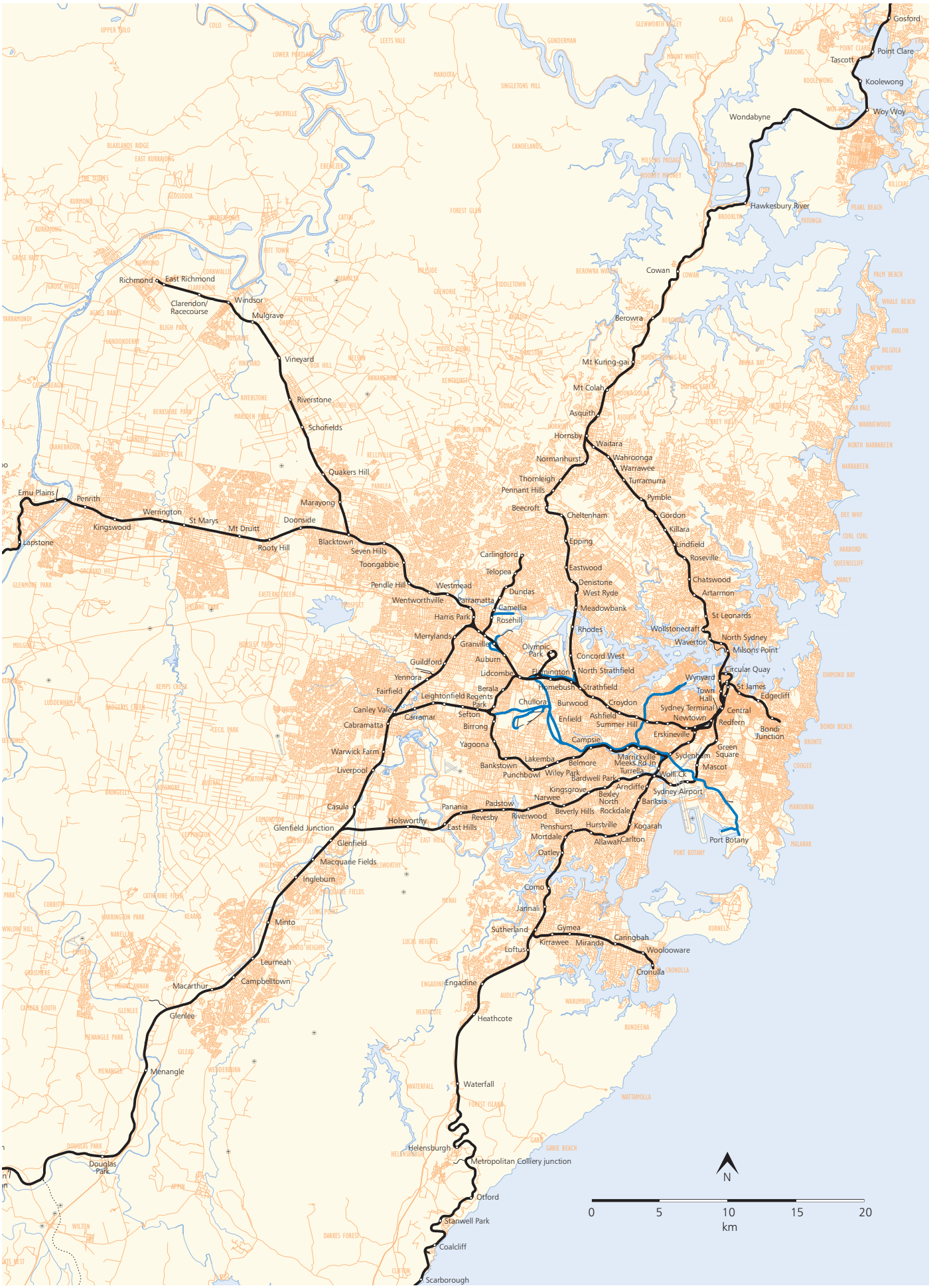


Figure 5.6. The Sydney rail network today.

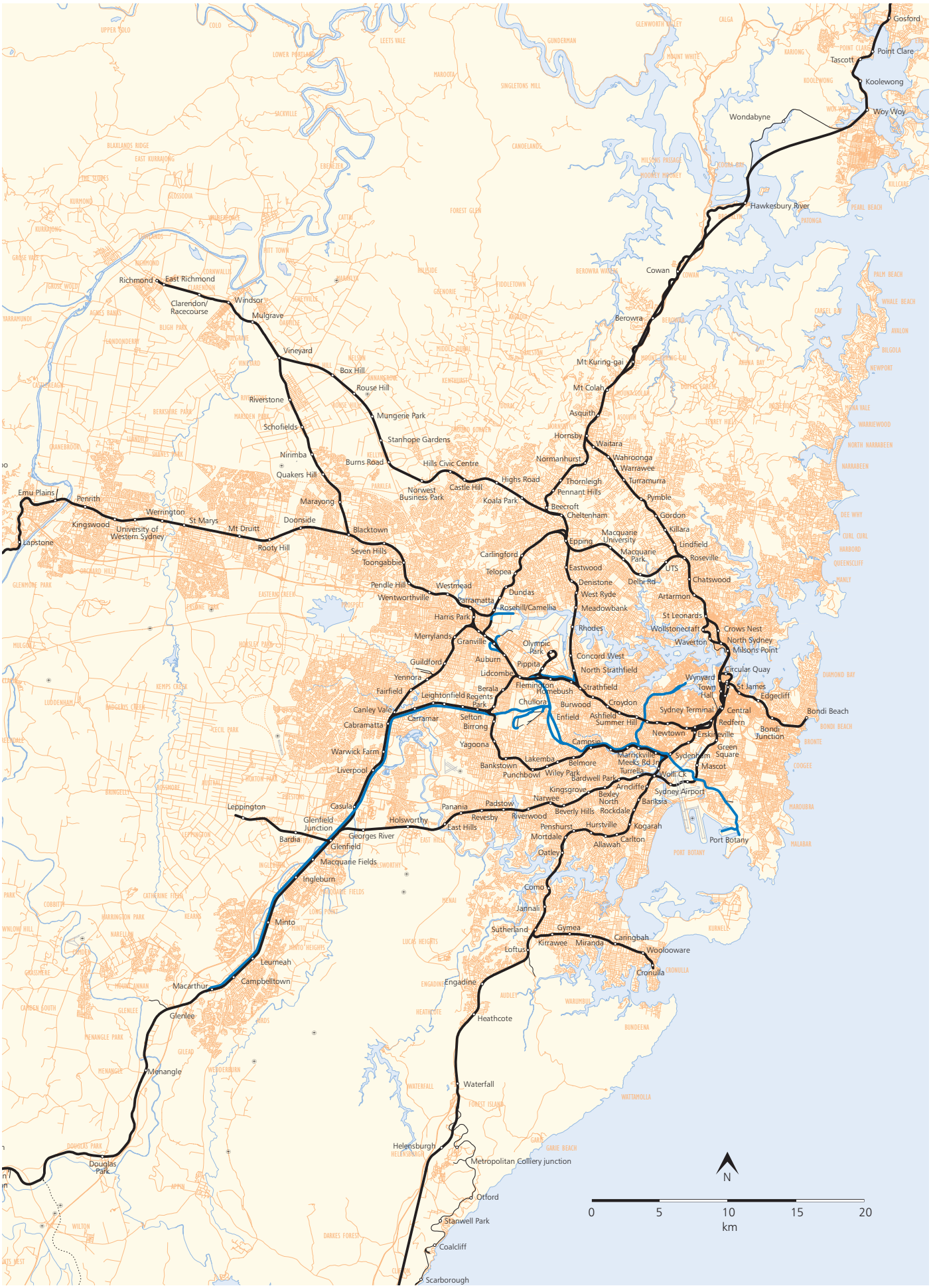


Figure 5.7. The Sydney rail network in 20 years.

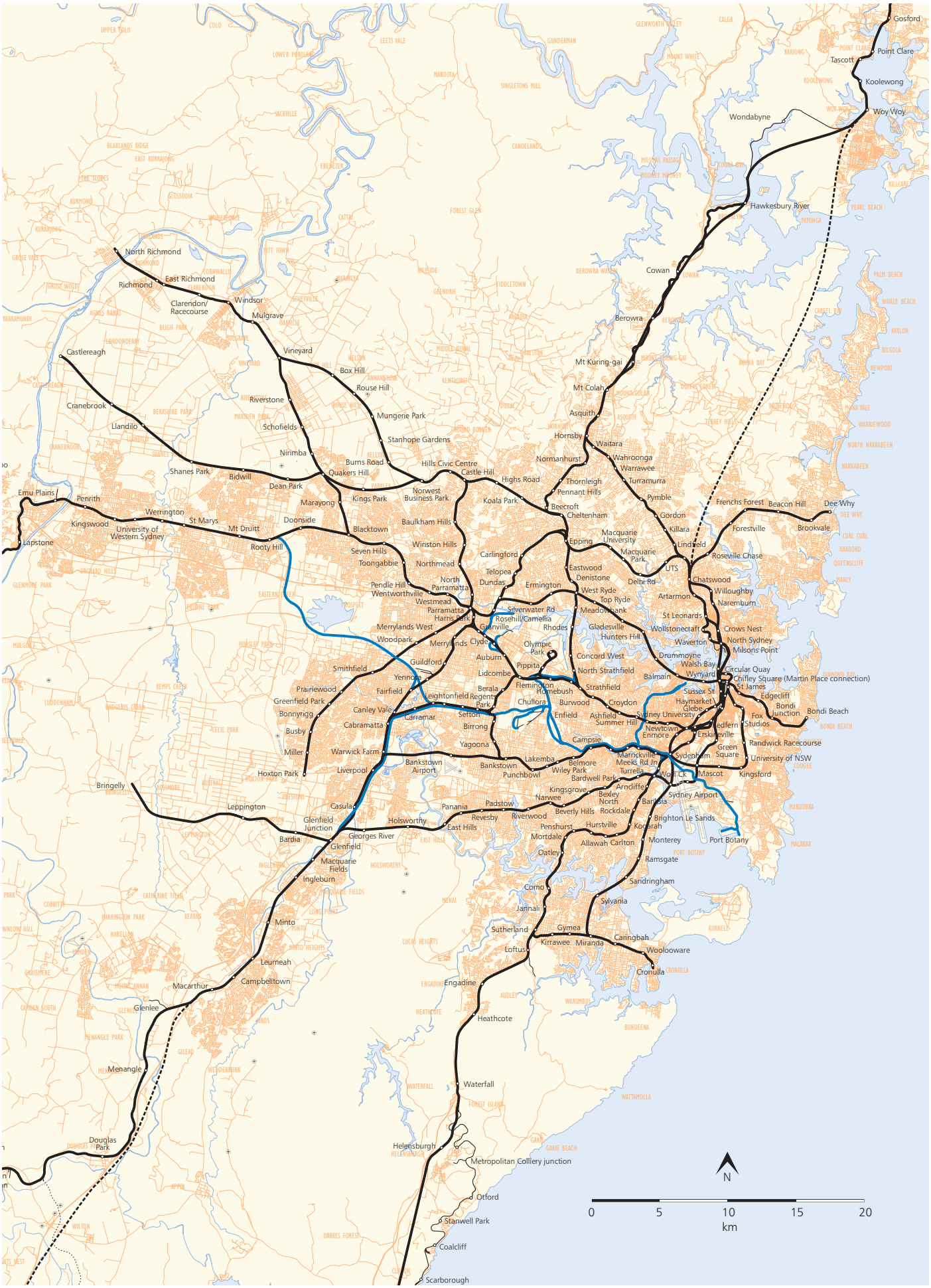


Figure 5.8. The Sydney rail network in (say) 40 to 50 years.

suggested in *Figure 5.5* for the Miranda–CBD–Dee Why, and Parramatta–CBD–UNSW–Sydenham and Hoxton Park–Parramatta–Castle Hill corridors, so that desirable options are not cut off by short-term decision-making.

Principles for viable operation of the longer-term rail system

Figure 5.5 and 5.8, showing possible long-term projects beyond the next 20 years, include **three entirely new railway routes, each operating independently of the existing rail network and each creating an entirely new operational "sector":**

- A Cronulla–Miranda–Sydney Airport–Inner West–CBD–North Sydney–Naremburn–Chatswood–Frenchs Forest–Dee Why line, which might extend further north.

  The first stage of this line might be the section along the F6 corridor to the airport's international terminal, initially with light rail operation and later with heavy rail. The Miranda–airport–city corridor will provide essential capacity relief for the Illawarra line, which by then is likely to be severely capacity-constrained.
- A new "River line" from Parramatta to Top Ryde or Olympic Park and then on to the CBD via Drummoyne, potentially extending from the CBD to the University of NSW and Sydenham.
- A Hoxton Park–Parramatta–Castle Hill line, complementing the Liverpool–Parramatta transitway and other transitways.

The physical separation of these (or similar) new lines from the existing rail network (and from its augmentations and extensions over the next two decades) is an important principle and vital to the long-term future of rail.

It is likely that by around 2020 (*Figure 5.7*), even with all the augmentations and extensions discussed in this report, including new signalling systems etc, the existing rail system will simply be unable to absorb any additional traffic created by the connection of any more new lines. Even if the capacity were theoretically available, the separation and "sectorisation" of different types of rail services would once again be placed under severe strain, jeopardising service quality, efficiency and reliability.

The solution of physically separating the new lines as much as possible, as illustrated in *Figures 5.5 and 5.8*, is already widely practised in large cities overseas which have been faced with analogous situations.

As indicated in section 4.3, it is possible that new, separated routes such as these, involving long lengths of tunnels, utilising the new high-capacity signalling systems which by then will be firmly established and passing through what will by then be relatively high-density urban and employment areas, might best be served by fast, high-frequency, high-powered, single-deck "metro"-style trains, albeit with more seating than traditional metros.

The additional benefits of this approach would include greater flexibility in choosing the alignments to maximise patronage and the railway's accessibility and land-use benefits and greatly reduced construction costs.

The precise routes of any such lines are obviously still to be determined, but the general principle is that they would be built in stages, reflecting the growth in patronage demand (both within the existing urban areas as higher density development continues and in greenfield areas) and the capacity constraints of the existing network (for example, the "River line" component of the Parramatta–Sydenham line, from Parramatta to the CBD, would help relieve long-term overcrowding of the Main West line, which will ultimately return as a major problem even with the track amplifications shown in *Figure 5.5*).

These types of proposals are not casually drawn "lines on maps". Like road developments, they are based on analyses of future patronage demand, land uses, etc. But unlike road developments, they are also heavily based on practically oriented *operational* studies, to ensure train services will be able to be provided to CityRail's customers using operational patterns which reflect not only their own travel needs and desires but the practical limitations of a complex rail system (trains, unlike cars, not being able to simply go where they please).

For example, although *Figures 5.5 and 5.8* suggest it is worth investigating a heavy rail link between Bankstown and Liverpool via Bankstown Airport, if such a line were integrated into the rest of the network it might cause severe operational complexities, and alternative and cheaper public transport modes might well be desirable for this reason (and also, quite possibly, because of the future level of patronage demand).

Figure 5.9 shows some preliminary concepts for the rail services that might realistically be able to be provided, consistent with the emphasis on greater "sectorisation" to ensure service reliability, with the "ultimate" rail network shown in *Figure 5.8*.

Figure 5.9 suggests that **while there will inevitably be much more interchanging between different train services as the complexity and density of the network increases, it should still be possible, with a network designed on the basis of *operational* viability, to provide "end to end" services, without interchanging, that will meet the travel needs of most CityRail customers.**

The suburban services suggested in *Figure 5.9* are:

- The Eastern Suburbs and Illawarra lines, essentially as developed over the next ten years (see section 4.4) but with completely dedicated tracks other than between Cronulla and Miranda.

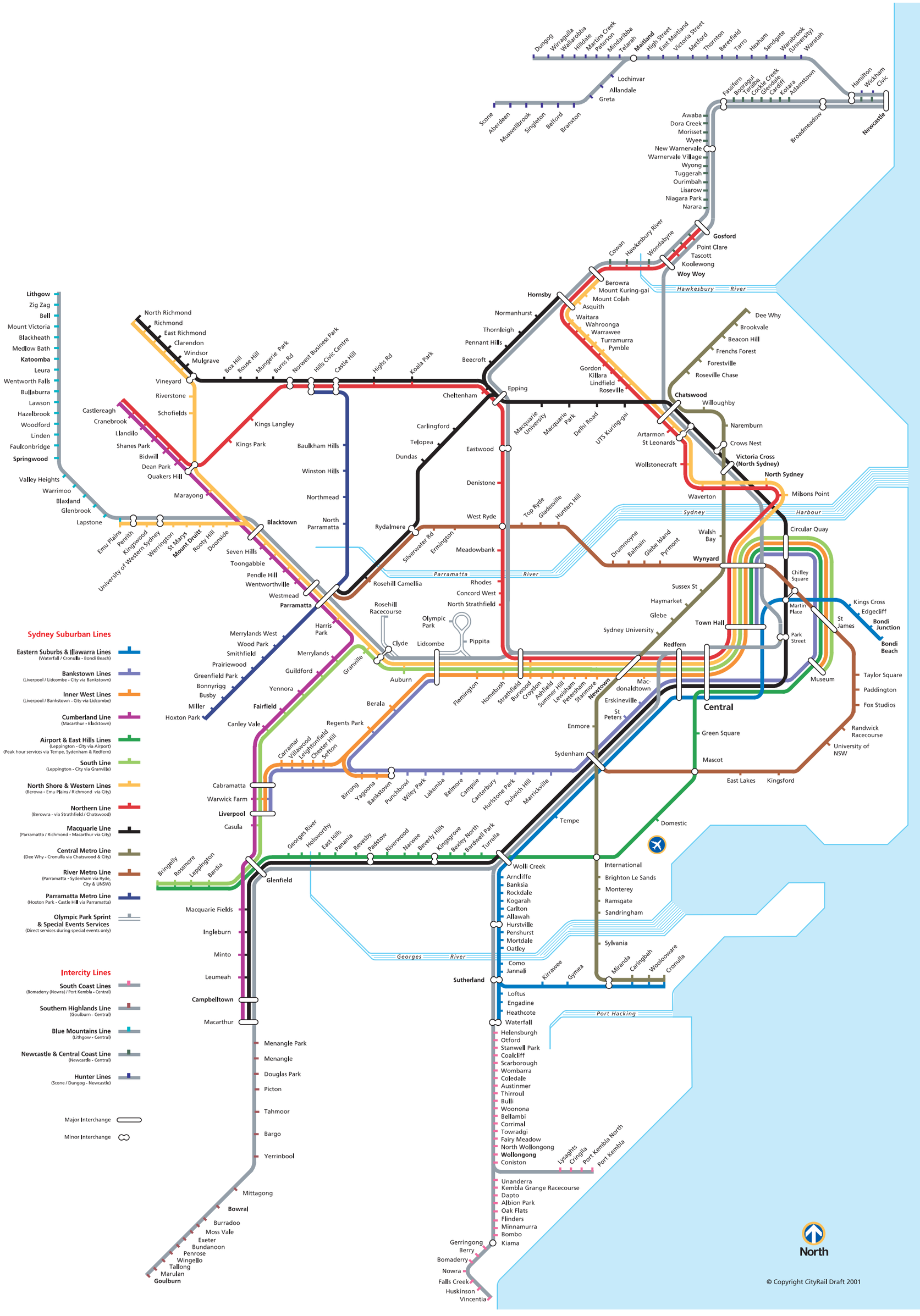


Figure 5.9. Indicative possible train operational patterns on the indicative "ultimate" rail network shown in Figure 5.8.

- The Bankstown lines, with services starting at Liverpool and the Lidcombe turnback and with separate tracks from Sydenham to the City Circle, essentially as developed over the next ten years but with additional track amplifications.
- The Inner West lines, again essentially as developed over the next ten years.
- The Cumberland line, again essentially as developed over the next ten years but possibly extending to Quakers Hill and Castlereagh. This line would be unusual in that it would probably need to share its tracks with a number of other lines.
- The Airport and East Hills lines, with services starting at Bringelly and with largely dedicated tracks to the City Circle.
- The South line from Liverpool to the city via Granville, with services starting at Bringelly but otherwise essentially as developed over the next ten years, with some additional track amplifications.
- The North Shore and Western lines between Berowra and Emu Plains/Richmond, essentially as developed over the next ten years but with some additional track amplifications.
- A new "Northern" line, from Gosford to Castlereagh via the North Shore line, the CBD, Strathfield, Epping, Castle Hill and Quakers Hill. This operating pattern would serve several different groupings of trip origins and destinations along the route.
- A "Macquarie" line, from Richmond (via Vineyard, Mungerie Park and Castle Hill), Parramatta (via Carlingford) and Hornsby (via the Main North line) to Epping and then to Chatswood, North Sydney and the CBD (via the new inner city/CBD route which will need to be built by around 2011–15), the Illawarra and East Hills lines (on fast tracks shared with intercity services) and the Main South line to Macarthur.

  This new line—forming a new operational "sector" in its own right—will be able to be commissioned in stages as the various components such as Parramatta–Epping, Epping–Castle Hill–Mungerie Park and Mungerie Park–Vineyard are progressively constructed.
- A "Central metro" line, the new line discussed above from Cronulla to Dee Why via another new route under the CBD. The only section of this line sharing tracks with another line would be between Cronulla and Miranda.

  Again, this line, along with the other new and potentially "metro" lines, would cater for several different groupings of trip origins and destinations along the route.
- A "River metro" line, the new line discussed above from Parramatta to the CBD and then on to Sydenham. The only section of this line sharing tracks with another line would be between Parramatta and Rydalmere.
- A "Parramatta metro" line, the entirely new line discussed above from Hoxton Park to Castle Hill and the Hills Civic Centre.
- The Lidcombe–Olympic Park line.
- Special event services from the city to Olympic Park and Rosehill racecourse.

The intercity lines shown in *Figure 5.9* are essentially along the same routes as at present, with the developments planned for the next ten years plus the higher-speed realignments proposed for the following decade, but would also have further track amplifications and substantial sections of dedicated tracks and might include a southward extension of the South Coast line.

6. CityRail rolling stock requirements

6.1 Extra rolling stock for patronage growth

Of the 140 suburban Millennium carriages now on order, 56 are to replace life-expired carriages (see section 6.2) and the balance are to provide additional capacity to cater for short-term patronage growth, mainly through the provision of eight-carriage trains on services currently provided by six-carriage trains.

Future additional *suburban* carriage requirements to cater for further patronage growth, assuming this growth is broadly consistent with the "medium growth" scenario discussed in section 3.1 and applied in section 4.4, are:

- A further 60 Millennium suburban carriages by 2006, and
- A further 80 to 100 suburban carriages by 2011.

These requirements could be met through the steady delivery of up to 30 new suburban carriages for patronage growth each year from 2003, at a cost of about $83 million per year.

Similarly, to cater for the forecast *intercity* patronage growth the intercity electric fleet will need to increase by 40 carriages by 2005 (16 for the South Coast and 20 for the Central Coast) and by up to a further 40 carriages by 2011 (12 for the South Coast, 16 for the Central Coast, eight to replace *suburban* Tangaras which currently have to be used for some services to Wyong and Springwood and four for use while other intercity carriages are being maintained).

These additional intercity "growth" requirements are planned to be met by two tranches of new carriages in 2003–05 and 2009–11, at a cost of $60 million per year. The first order, for 40 new "outer suburban"carriages, is expected to be placed in the near future, while the second, for a further 40 carriages to be developed from 2006, would be timed to fit in with the schedule for the replacement of old intercity rolling stock.

6.2 Replacement of the existing CityRail fleets

The 56 carriages that will be replaced by the initial delivery of 80 Millennium suburban carriages from 2002 are "Tulloch" carriages, originally used in combination with single-deck "red rattlers", dating back to the mid-1960s.

By 2006 a much more challenging suburban fleet replacement task will have arisen: the oldest carriages in the initial, non-airconditioned fleet of 500 double-deck stainless steel suburban carriages will be 35 years old, and all 498 will need

CityRail's existing fleet

Type	Number of carriages	Air conditioned?	Age
Suburban electric train carriages			
Tulloch "trailer" cars	56	No	35–37 years
 Double deck S and R cars	498	No	21–29 years
 Double deck K cars	160	Yes	16–20 years
 Double deck C cars	56	Yes	15 years
 Tangaras	368	Yes	7–12 years
Intercity electric train carriages			
 Intercity V cars	238	Yes	12–31 years
 Outer Suburban Tangaras	80	Yes	5–6 years
Diesel train carriages			
 620 Class	14	No	~40 years
 Endeavours	30	Yes	6 years

Table 6.1. Suburban and intercity fleet growth and replacement strategies.

(assuming 80 "outer suburban" Tangara carriages are switched to suburban services and an additional 120 outer suburban carriages —40 to cater for patronage growth and 80 for replacements—are purchased by 2007)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Suburban carriages											
New carriages to cater for patronage growth		30	30	30	30	30	30	30	30	30	30
New carriages to replace life-expired carriages	56					20	50	50	50	50	50
Cost	$154 m	$83 m	$83 m	$83 m	$83 m	$138 m	$220 m	$220 m	$220 m	$220 m	$220 m
Intercity carriages											
New carriages to cater for patronage growth			20	20					20	20	
New carriages to replace life-expired carriages					40	40					43
Cost			$60 m	$60 m	$120 m	$120 m	–	–	$60 m	$60 m	$129 m

to be replaced over the following ten years. (It would cost more than $1 million per carriage to refit these carriages to modern standards, and this would not address the problems posed by their ageing structures, which would still need to be replaced at a later date. State Rail studies have shown that replacement from 2006 is more financially attractive.)

One approach would be to commence a major suburban carriage replacement program in 2006, for 50 carriages per year until 2016, after which the later series of double deck suburban carriages will be life-expired and due for replacement at the same steady rate of 50 carriages per year, followed by the Tangaras.

An alternative approach has been adopted, however, under which:

- The 80 "outer suburban" Tangara carriages now used for intercity services will be switched to suburban services, deferring the need for the delivery of replacement suburban carriages until 2007.
- The gap in the intercity fleet will be filled by ordering 80 additional new "outer suburban" carriages for delivery in 2006 and 2007, to supplement the initial (2003–05) "growth" order of 40 outer suburban carriages (see section 6.1).
- 50 replacement suburban carriages will be delivered each year from 2007–08, at a cost of $138 million per year, with this steady rate of delivery being maintained (in effect) indefinitely, because by the time all the double deck fleet has been replaced the early Tangaras will be life-expired and due for replacement.

The advantage of this strategy is that it will result in a more homogeneous and higher-powered "outer suburban" fleet, improving maintenance efficiency and (with only minor modifications) providing the performance characteristics that will be needed to take advantage of any future high-speed rail alignments in the Central Coast and South Coast corridors (see section 5).

Replacement of the oldest "V set" intercity carriages will need to commence by 2012. By this time these carriages will be more than 40 years old.

Table 6.1 summarises the proposed suburban and intercity fleet growth and replacement strategies.

The diesel-powered CityRail fleet includes 14 "620 class" rail cars, now close to 40 years old, which are used in the Hunter Valley. After examining a range of options for the lower Hunter, including electrification and buses, a State Rail study has concluded that the best approach is to replace these life-expired trains with 14 new diesel-powered carriages, with an option for a further six carriages (bringing the total cost to about $70 million), and to relocate three Endeavour carriages from the Hunter to the Southern Highlands, where demand is increasing rapidly. This strategy has been approved by the Government.

Additional Endeavours for Southern Highlands services and/or for conversion to Xplorers for Countrylink will also become available with the electrification of the Dapto–Kiama line.

6.3 Rolling stock maintenance and cleaning

Maintenance expenditure requirements

Over the next five years **routine maintenance** costs for CityRail's electric fleet are expected to be about $51 million per year for the existing electric fleet, which is largely maintained

at the Flemington, Mortdale and Hornsby maintenance depots, and $4 million (2001–02) to $31 million (2005–06) for the new Millennium trains, which will be maintained by the rolling stock supplier at a new maintenance facility built by State Rail at Eveleigh (2000 A$).

Routine maintenance expenditure on CityRail's electric fleet will then need to increase as the number of carriages being serviced increases and the fleet continues to age, although as the new trains replace old rolling stock such as the "S" and "R" double deck suburban carriages over the next 15 years or so many maintenance requirements will decrease (for example, brakes will need to be checked and adjusted much less frequently).

Major periodic maintenance expenditure requirements for CityRail's electric fleet over the next five years—including expenditures of up to $15 million per year on the upgrading of the Maintrain maintenance facility at Clyde and additional expenditures of $23 million to $38 million per year, recently approved by the Government, to reduce the time between major component change-outs and refurbishments from six to four years—will vary between $104 million and $131 million per year.

These estimates do not include the cost of:

- Widening doors and retrofitting wheelchair-accessible toilets on the intercity "V car" fleet ($15–20 million), and
- Installing automatic wheel measuring technologies, an urgent requirement from both a safety perspective and a maintenance cost efficiency perspective ($17 million).

Routine maintenance costs for CityRail's diesel-powered fleet are expected to increase from about $16 million per year in 2001–02 to about $19 million per year in 2005–06, and major periodic maintenance costs are expected to be between $24 million and $27 million per year.

Location and upgrading of train maintenance facilities

As indicated in section 2.1, there are almost no facilities at the main overnight train stabling yards, such as Campbelltown, Penrith, Blacktown and Waterfall, for trains to be washed and minor routine maintenance or repairs to be carried out. This means CityRail trains needing cleaning or even the simplest routine maintenance or repairs have to be taken out of service during the next morning's peak and travel to the train maintenance depots at Flemington, Mortdale and Hornsby (and, in the future, Eveleigh).

In essence, the locations of facilities for minor routine train maintenance reflect the requirements of passenger rail operations some 50 to 70 years ago, when the train maintenance depots were at or near the extremities of suburban rail services, but not those of today's geographically extended operations.

The installation of external train washing plants, raised roads for undercar inspections and maintenance and other facilities for internal cleaning and minor maintenance at the Campbelltown, Penrith, Blacktown and Eveleigh stabling yards, along with a new maintenance road at Flemington adjacent to the lift shop and wash plants at other stabling yards such as Waterfall and Macdonaldtown, would significantly improve the cleanliness of trains and the efficiency of minor maintenance activities (brake maintenance, etc).

These new facilities would necessitate substantial rebuilding of some of the yards, including major resignalling at Campbelltown, in order to permit the necessary train movements. The Campbelltown Yard works alone, which are also highly desirable from the perspectives of improving train movements through the Campbelltown area on the Main South line and improving Campbelltown station, could cost of the order of $50 million.

There are also a number of other options to improve maintenance efficiency, including the possible rebuilding or replacement of the Hornsby facilities (even if major maintenance tasks are moved elsewhere, a wash plant, stabling and cleaning roads will still be required at Hornsby), a new purpose-built maintenance facility near the Maintrain site in Auburn and a new purpose-built facility next to the existing Flemington lift shop and wheel lathe.

In developing the optimum longer-term maintenance facility solution and deciding whether to proceed with new maintenance facilities at the stabling yards, the main considerations needing to be taken into account are:

- Whether new CityRail rolling stock will be delivered under "design, build and maintain" contracts, with the supplier then being responsible for train maintenance to CityRail standards, or whether State Rail will continue to carry out maintenance on its CityRail rolling stock.

  If "design, build and maintain" approaches are adopted, over time State Rail's own maintenance loads will be significantly reduced.
- The fact that whatever the delivery method adopted for new trains, State Rail's own intensive train maintenance requirements will be significantly reduced by the time all of the original "S" and "R" double deck trains have been replaced in about 15 years, because the later types of trains now in service require much less routine maintenance.

  In essence, this means that if there is to be a significant investment in minor maintenance facilities at stabling locations etc this investment needs to be made within the next five years, as after that there will be diminishing benefits.
- The types of "outer suburban" trains selected through a competitive tendering process. If these new train designs

are based on Tangaras, the most efficient maintenance locations might well be Hornsby and Mortdale, but if they are based on Millenniums the best location might be at Eveleigh.

- The balance that needs to be achieved between the number of major maintenance facility locations and the complexities of moving empty trains to and from these locations. It has been estimated, for example, that if there were only one major centre at least an extra 50 carriages would be required for the CityRail fleet, simply to cater for the inefficiencies inherent in the extra train movements. While the relatively maintenance-intensive "S" and "R" suburban carriages and "V" intercity carriages are still in operation, at least three major locations are likely to continue to be required.
- The interactions between train stabling (as distinct from maintenance) requirements at Flemington, Mortdale and Hornsby and the adequacy or otherwise of train stabling facilities at other locations. If new and expanded stabling facilities are provided elsewhere (e.g. at Macdonaldtown), the efficiency of operation of the existing maintenance facilities will be able to be significantly improved.

State Rail is about to commence a one-year project to refine and define the options and develop a clear strategy for train maintenance and washing facilities for the future. At this stage, it appears likely that an average of about $20 million per year will need to be invested in these facilities and associated yard reconfigurations, on top of the train maintenance expenditure requirements already listed, although a higher level of expenditure is likely to be required in the early years, for the reasons explained above.

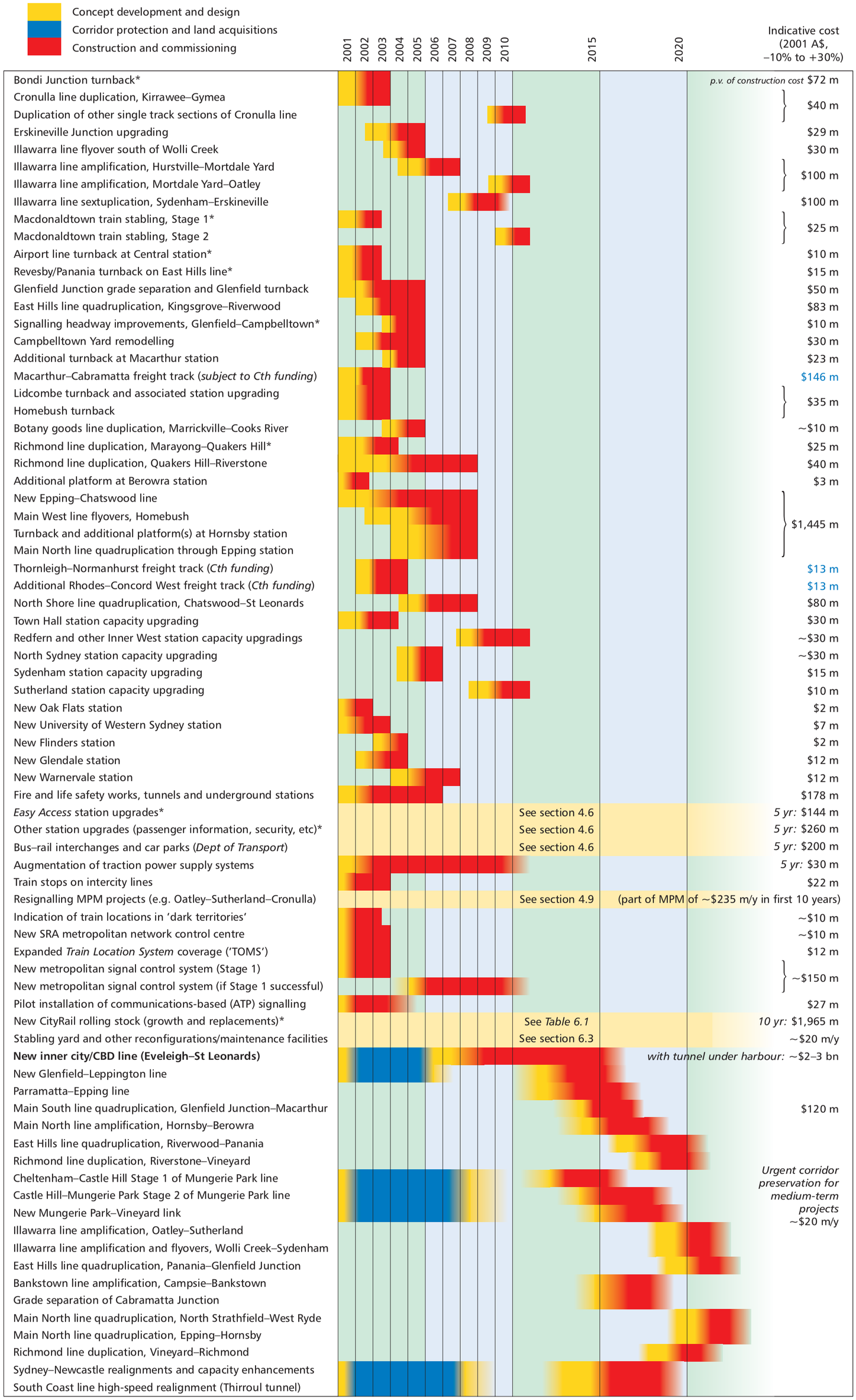
7. Overview of projects and timeframes

The timeframes and indicative costs of the short-term and medium-term projects highlighted in the *Long-Term Strategic Plan for Rail* and discussed in sections 4, 5 and 6 are summarised in *Figure 7.1* and *Table 7.1*.

As already indicated, the cost estimates are presented here as totals rather than in terms of additions to current budgets, and many of the items are already at least partly covered by current budgets.

Table 7.1. Indicative project and maintenance costs, 2001–2011 (2001 A$, generally –10% to +30%)

Rail infrastructure capital projects needed during the first ten years to cater for forecast patronage growth, as discussed in section 4.4, *excluding* those freight projects which are subject to Commonwealth funding	$2,285 million *plus* $500 million to complete priority works (by 2011) on the new inner city/CBD line, which could be essential by as early as 2011
Corridor protection (planning measures, land acquisitions, etc) for medium-term projects, as discussed in section 5	$20 million per year, probably throughout the first ten years
Capacity-enhancing station upgrades and new stations to cater for forecast patronage growth, as discussed in sections 4.4 and 4.6	$150 million
Fire and life safety works on underground lines and stations, as discussed in section 4.7	$180 million
Easy Access station upgrades, as discussed in section 4.6	$145 million in first five years, yet to be determined for the following five years (dependent on disability standards which are not yet finalised)
Bus–rail interchanges and rail commuter car parks (Department of Transport parking space levy funding), as discussed in section 4.6	$400 million (Department of Transport assumption of $40 million per year)
Other station upgrades (passenger information systems, station security, new ticketing systems, reduction of gaps between trains and platforms, etc)	$260 million in first five years, yet to be determined for the following five years but probably of the same order of magnitude
Traction power supply capacity upgrades for extra trains, air-conditioning, etc, as discussed in section 4.8	~$30 million in first five years, yet to be determined for the following five years (study about to commence)
Signalling and train control modernisation projects, as discussed in section 4.9 (including, for communications-based signalling, only the cost of the pilot installation, and *excluding* major conventional resignalling projects funded under RIC major periodic maintenance programs)	$230 million
New CityRail rolling stock, both to cater for forecast patronage growth and to replace life-expired existing rolling stock, as discussed in sections 6.1 and 6.2	$595 million in the first five years, $1,180 million in the next five years (and then a similar amount sustained indefinitely)
CityRail stabling yard and maintenance facility reconfigurations and provision of maintenance facilities and equipment for more efficient CityRail train maintenance and cleaning, as discussed in section 6.3	Average of $20 million per year over the first five years or so (study about to commence)
Rail infrastructure major periodic maintenance (including major junction and signalling renewals and extra maintenance required to cater for forecast "medium" growth in usage)	$235–273 million per year over the first ten years (see *Figure 4.22*; average $255 million per year)
Rail infrastructure routine maintenance (including extra maintenance required to cater for forecast growth in usage)	$130–152 million per year (see *Figure 4.22*; average $140 million per year)
CityRail stations major periodic maintenance	~$10 million per year
CityRail rolling stock major periodic maintenance, including additional component change-outs	During the next five years, ~$115–140 million per year
CityRail rolling stock routine maintenance	During the next five years, ~$67–100 million per year (increasing as fleet increases and continues to age)



* indicates partly or fully funded under current State Rail capital works program

Figure 7.1. Timeframes and indicative costs of the projects highlighted in the ***Long-Term Strategic Plan for Rail.***