



Improving Customer Experience

Opportunities for improving Sydney's suburban rail service

Discusson Paper

A paper prepared for NSW Business Chamber

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FOREWORD

Every day the businesses of NSW rely on our public transport system to move over two million people to their workplace. On the rail network, over 900,000 people catch a train every working day.

Right from the first moment a potential employee meets an employer for an interview, questions about transportation become a factor in determining if an employee takes the job. In some areas of Sydney the absence or unreliability of public transport has seen many businesses find it difficult to attract or indeed keep staff.

Public transport not only impacts on the decision of potential staff about where they will work, it also impacts business every day through the costs of congestion.

Public transport is a business issue – and a critical one.

I believe that our public transport system in NSW could be so much better.

In the NSW Business Chamber's 10 Big ideas to Grow NSW released in 2010 we argued that the first step in improving decision making in transport was to integrate the work of the fifteen different and autonomous transport authorities in NSW. The creation of Transport for NSW by the O'Farrell Government ensures we can make better decisions in transport and improving the customer experience on public transport is central to that mission.

We believe the sector has to become more innovative and customer focused. Those that run our trains, buses and ferries should have the same passion for improving customer experience as the great transport brands of the world do.

This excellent paper, prepared by the Tipping Point Institute for NSW Business Chamber, is meant to be a debate starter about how we can improve the customer experience for those who travel the rail network, how we can orientate decision making towards customer focus metrics and how we can improve existing capacity in our public transport network.

Our hope is that this paper will contribute to decisions that make our rail network faster, more reliable and more enjoyable. If it does, commuters, businesses and indeed, the wider community will all benefit.

Yours sincerely



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Improving Customer Experience

Dear Stephen

I am pleased to attach our discussion paper exploring the opportunities for Sydney's rail network from the perspective of the customer's experience. The paper identifies significant service improvements that can be initiated immediately, including more and faster services from Sydney's west to the CBD. The discussion also considers the current methods for measuring the performance of services as a key barrier to achieving short term and lasting improvement.

We hope this paper fosters discussion on the provision of new services without the need for multi-billion dollar projects, and that it promotes, via tools such as Network Seat Wait Time, rigour in the debate for investment in rail infrastructure.

Regards

Kym Lennox
Australian Practice Lead
The Tipping Point Institute

30 August 2011

Executive Summary

In targeting customer experience as the key performance measure for Sydney's transport network, the NSW Government has both understood the needs of the commuting public and entered into uncharted territory. This new target represents a significant shift from a past where the focus has been on measuring the operator's ability to run services – an outcome that is management focused rather than customer focused.

To deliver on this customer experience promise the Government will need to manage some key issues. The suburban rail network is the backbone of Sydney's public transport system. The near decade of stagnation in network capacity enhancement means that today, it is under servicing demand, is progressively less reliable, and does not reach areas of Sydney that were planned around rail transport availability. Solving these problems will involve the delivery of multi-year, multi-billion dollar infrastructure projects. Yet, conversely, other options exist today because the network is not yet being utilised at full capacity.

Focusing on improving the customer experience now, several “no new infrastructure” options are available that collectively:

- increase peak services by almost 10%, including four new express services from Western Sydney;
- lower congestion on the services most susceptible to causing unreliability across the network;
- lower congestion on Central and Town Hall Stations' platforms and concourses; and

- improve journey times for customers whose journeys include an interchange between train services.

Key to implementing these options now, and planning the right options for the future is measurement. The current metrics guiding the delivery of public transport are not yet customer focused. In order to address the expectations of the travelling public the governing metrics will need to directly target customer experience while also informing Transport for NSW on operational and planning targets.

A review of international best practice within and outside of public transport provides a set of seven metrics; the first five target network operations and the last two, target policy and planning:

1. Overall Passenger Journey Time
2. Passenger Journey Time Reliability
3. Seating Availability
4. Service Frequency
5. Perceived Passenger Security
6. Ratio of population within 800m of a rail system station
7. Network-wide seat availability wait time

The refocusing of public transport services on customer experience is an important first step. Implementing the available “no new infrastructure options” today, and achieving the desired improvements tomorrow, is dependant on the careful framing of relevant performance metrics.

Preamble

The Federal Government has recently published its *Our Cities, Our Future* national urban policy. This policy strongly focuses on transport infrastructure as a core enabler of a prosperous Australia, and viewed across the priorities of productivity, sustainability and liveability. The policy indicates that for public transport a chasm exists between the current state of affairs and the necessary future.

The National and State themes of a growing and ageing population, the end of 'cheap' energy and the pricing of carbon all point towards increased demand for public transport. In fact, these factors point to society fundamentally shifting its choices regarding land and transport use.

In considering Sydney's rail network over the past forty years, it is an important reflection that while Sydney's population has doubled, the capacity of the train services on the rail network has only increased by 37%. Almost all of this increase came from the introduction of the Eastern Suburbs line in 1979 and the corresponding increases in train services on the Illawarra, East Hills, and ultimately, Campbelltown lines. This comparative under-development of the rail network has only been viable due to the shift away from rail to private cars that occurred in the 1960s and 1970s.

In a growing Sydney, the bias for private cars is unsustainable. This observation points to the possibility of returning to the network use of the 1950s if the network adequately served the metropolitan area - a shift that equates to a near 50% increase in demand over and above the reference growth rates.

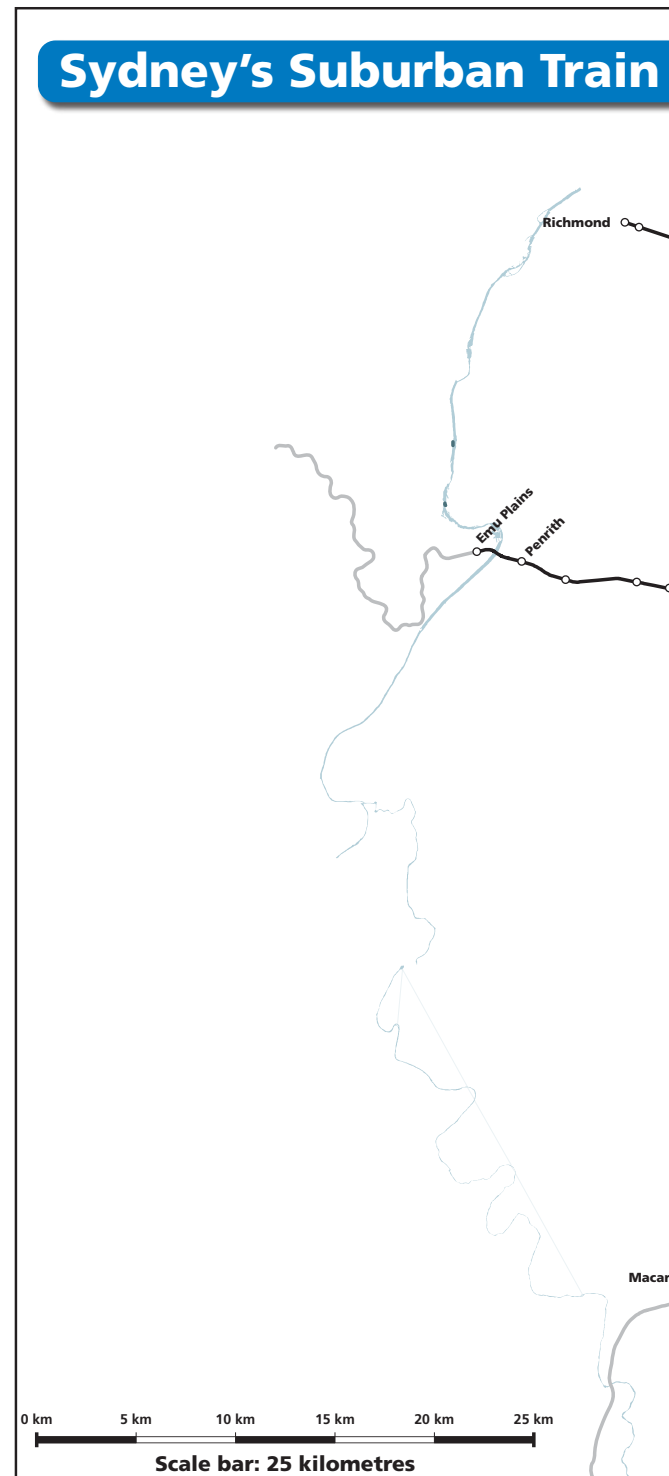
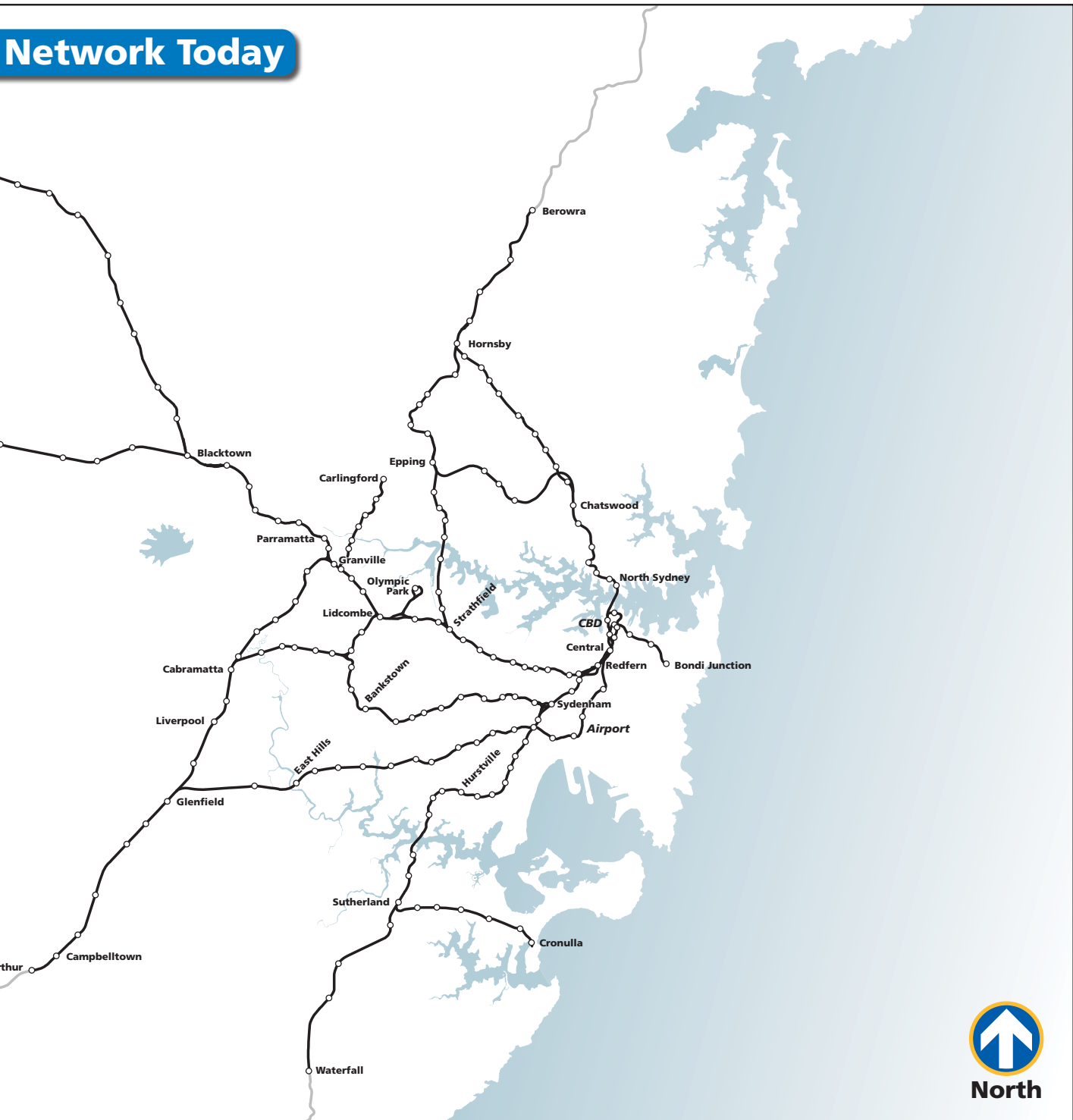


Figure 1: Existing Sydney Suburban Train Network

Network Today



Introduction

Customer centric design is the current focus of business. In Australia, the large service based corporations are rebuilding their processes around the customer experience – so too is Transport for NSW. Since 19 April 2011, the department has been re-structuring around Customer Experience – including establishing a Deputy Director General to lead a team targeted to “define what the NSW transport system has to deliver from a customer perspective in order to increase customer satisfaction and usage of the system”.

The rebuilding in the private sector has started from a base where business had already been customer focused. In the public sector it is far less clear if the customer has been the prime stakeholder. Actions such as the 2004 slowing down of the timetable to improve its performance suggests that RailCorp, as an organisation, has not had a customer focus. There is clearly a significant journey in shifting to a target of improving customer experience.

This paper aims to inform debate on the planning and operation of public transport in Sydney in the context of this journey. Focusing on rail as the core element, options to improve the customer experience today and initiatives to drive long term improvement are proposed.

Sydney's rail network is now congested to a point where it is impeding the State's economy. The common approach to addressing this 'problem' has been one or more multi-year, multi-billion dollar infrastructure projects. This solution need not

necessarily be the only option. The Government's focus on customer experience provides a genuine opportunity for improving the services provided by public transport operators through shifting the approach to the 'problem'. Doing so requires, at the very least, measurement of customer experience at a granular level – granular enough to optimally guide decisions on present infrastructure and the evaluation of future options.

Once measured, and preferably constantly measured in a 'big data' fashion, it is possible to re-target to a set of new metrics. The power of metrics should not be under-estimated. An overly strong bias on metrics such as journey time can drive counter-intuitive planning such as the timetabling of services that stop at too few stations – not actually fill with passengers before reaching the CBD. Paradoxically, today's singular focus on “on-time” running can drive service compromising responses such as adding the insult of skipping timetabled stations to the inconvenience of late running, so as to return the service to on-time operation. This outcome is no accident. Every part of the customer experience is realised from the service provider's focus on the metrics that govern their performance.

Crucially, sub-optimal customer experience can emerge from each component of the service – from demand analysis through project definition, operational planning, service modelling, operation and finally legacy management. A better set of metrics, that differ from those which guided

planning in the past, will generate fundamentally better operational approaches and service outcomes.

New South Wales is now gearing up to undertake a level of investment in transport infrastructure not seen in almost a century. This focus is a great opportunity to shift Sydney's transport onto a sustainable path where it once again enables rather impedes the State's economy. However, utilising this opportunity means dramatic action and the ill-fated Sydney CBD Metro is a public example of the downside risks. The real cost of that project – in the misdirection of the limited pool of skilled resources and the industry's lost confidence in public sector procurement – unfortunately far exceeds the \$500+ million cost to Treasury.

The long lead times, financial scale and mutually-exclusive nature of transport infrastructure alternatives, mandates the need for a very clear strategic target and for clarity about how performance is then measured against that target. A clear set of measures for performance at appropriate settings for each part of the service can then enable an improved customer experience.



Sydney's Rail Network Today

Customer experience for the Sydney CityRail service, operated by RailCorp, is primarily measured by on-time-running and seating capacity. They are defined as:

- A service is not on time when less than 92% of services arriving in the peak direction at Central are within 5 minutes and 59 seconds of their timetabled arrival time; and
- There isn't sufficient seating capacity once the train is 135% loaded, meaning that the number of standing passengers is equal to 35% of a fully-seated load.

The question is what do these two metrics, by definition, really tell us about the service that customers are actually experiencing? Just as importantly, is there clear guidance as to how to improve that experience based on the metric and how was it calculated?

The disconnection between the goals of RailCorp and customer experience results in a service that contains a number of unintentional inefficiencies. The complexity of operating the network means that these inefficiencies have crept in over time and are now a daily source of customer frustration.

Take the AM peak cross platform interchange from Inner-West Services to North Shore services that occur at Central from platforms 17 to 16 as an example. There are currently a considerable number of passengers who need to change between these services to get from the Inner-West Line to the North Shore.

The Inner-West services arrive at Central platform 17 approximately every 15 minutes and trains crossing the bridge operate almost every 3 minutes. The problem is that the first North Shore train arriving on Platform 16 that Inner-West passengers could change onto is usually only proceeding to North Sydney.

The next train that will proceed through to St Leonards and Chatswood is then usually so full that nobody can change onto it – resulting in service delays due to a long dwell time in the platform. The next train is then an opportunity to squeeze on and continue to Chatswood, but not before another long dwell time at Central, which is again repeated at Town Hall when that same service arrives there and more passengers must swap past each other to alight and board. The overall delay for a passenger at Central can be as much as 9 or 10 minutes before the interchange has been achieved. Services proceeding to the North Shore are often delayed by as many as 6 additional minutes due to extended dwell times at both stations.

This problem could be partially remedied by reconfiguring the arrival times of the Inner-West Trains (on Sector 2) to ensure that they arrive at Central just before the more lightly loaded “Slow West” services which should themselves be extended to operate through to Gordon (not terminate at North Sydney). This would alleviate most of the passenger delay and reduce the platform dwell time of the previously affected services.

Notably, this is a minor change not greatly impacting the operations or the costs of service delivery and the fact that it hasn't been implemented is not due to a failure in planning. Simply, the inconvenience it addresses is not measured and 'you cannot count on what you do not measure'.

This is only one interchange point of one service combination on the network. Given the right metric, similar analysis would be conducted at a number of service delay points around the network to determine if such timetabling adjustments would improve service efficiencies and enhance the customer experience.

This is only the tip of the iceberg. The lack of relevant metrics means that many potential service enhancements are not being implemented. Measures such as refining stopping patterns and speeding up run times to reduce crowding on overloaded services, or adding additional services, could both be introduced to supplement capacity. The overall result of the timetable analysis would be less crowded services and an increase in the number of fast services during peaks.

Customer experience is not only constrained because it is not the focus of improvements, but also because retaining it when real-time operational disruptions occur is also overlooked. Take a late running train, to improve the results for on time running RailCorp makes real time operational adjustments such as skipping stops and not running the service to the

end of line. These actions, in the name of meeting performance targets, actually lower the customer experience. Most of the on-time running the action creates applies to empty trains heading against the direction of demand – and perceivably have little impact. However, this is not the case as perceived by the individual passengers affected.

It is material that RailCorp does not have the capacity to measure actual passenger loading on each service. This means the metric is fundamentally qualitative and opaque. The nature of a suburban rail service means the loading of any given train at a station is volatile, with detail hidden by diluting them into averages. That is, by mixing the loading figures of popular but overcrowded trains with the figures for lightly used services that stop at less popular stations on the same line – the real and observed over-crowding can vanish in the current metric. This uneven congestion is evident on Sydney's network in what is known as "poor load balance" – a situation where overcrowded services are immediately followed by half empty ones.

In Sydney, despite the potential validity of seating capacity or over-crowding metrics, the current methodology results in poor outcomes. Potentially, even the same metric, developed so as to not obscure the network behaviour, would instead support achieving a better load balance between all services on all lines and provide an improvement in service quality for many customers.

Improving Customer Experience Today

Sydney's rail network is not operating at capacity. At the same time – it is congested to a level that forces customers to use alternative means of transport. The network does not serve large parts of Sydney and becomes highly unreliable across much of the network from single – apparently minor – events. There would appear a broad range of potential for improving the network's performance.

In fact there have been too many proposals to improve the service outcomes for customers, each with their benefits, costs and negative impacts.

Recent Proposed Enhancements

- Speeding up the timetable to provide services that achieve similar run-times to those some 8 years ago [That is, back to before services were slowed to achieve better “on-time-running”];
- Introduction of additional fast services that are dependent on new infrastructure [A dependence meaning the cost started now with the benefit not present for many years in the future];
- Re-signalling significant proportions of the network to safely permit increasing the frequency of services [This being proposed each time without the analysis of the impact on journey times];
- Duplicating the rail crossing of the Harbour [A proposal that does not consider the operational interface so as to improve customer experience].

This paper recommends that a more pragmatic approach to customer service improvements should be fully investigated. An approach that examines the network's full potential to deliver service enhancements using the infrastructure already available today. This is not to say that network expansion is not required to facilitate forecast growth. Rather, it is suggested that the network should be optimised before the additional trains from the proposed new lines can be accommodated.

Any investigation should start with assessing spare capacity. There is currently some spare line capacity in the city circle and at Central's terminating platforms. Unfortunately, the source of the network's current congestion problems is not on the services that can access this capacity. The key to utilising this spare capacity is to leverage the complexity of the network to its own advantage. The network has multiple paths that a train can take to get from one origin to a destination and at many stations on the network a customer has more than one train service that serves their destination. That is, the suburban rail network is flexible and can respond to demand in more than one way.

An examination of the options to utilise this spare capacity provides three opportunities that could allow up to an additional 10 trains per hour – all without investment in additional track infrastructure:

1. Four additional express trains on the Western Line
2. Four additional semi-fast trains from Liverpool/Cabramatta via the Bankstown Line
3. Two additional fast services from Campbelltown/Macarthur via the East Hills Line and Sydenham.

Greater Metropolitan Train Network

with Western Express

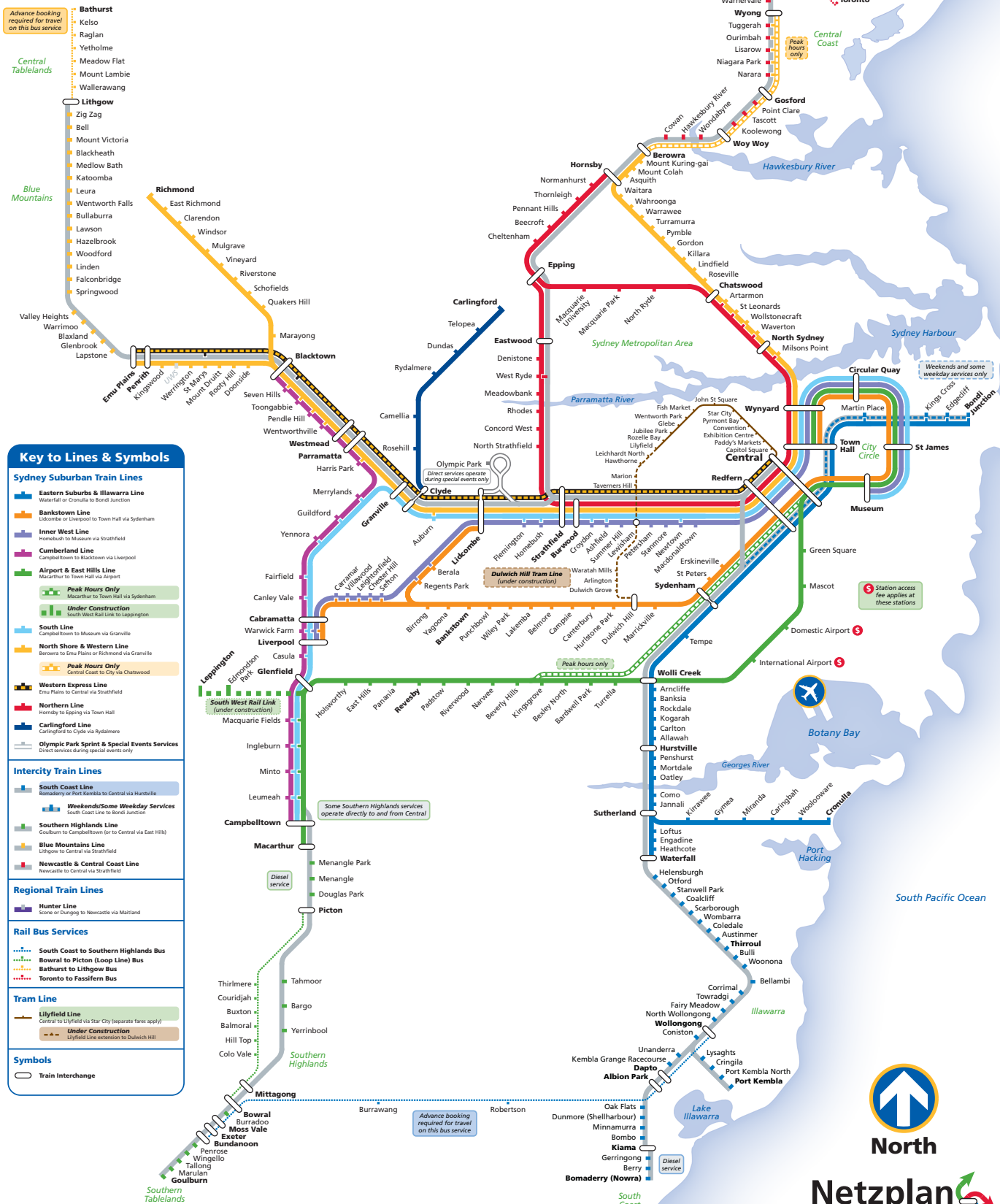


Figure 2: Greater Metropolitan Train Network including Western Express

The improved customer service of this set of services is not limited to the added capacity and faster service they provide to the parts of the network they directly serve. In fact the greatest benefit is provided by customers switching from their current service to these new preferred services. The switch away from the current service reduces congestion for that service. The current services of these switching customers are overcrowded and this overcrowding is to a point that is causing extended dwell times at stations as customers jostle passed each other alighting and boarding a full train. Extended dwell times are the main cause of unreliability of the CityRail service.

The benefits of these new services are network wide:

- Extra capacity on the through services heading to the North Shore from The West;
- Improved reliability of services sensitive to the extended dwell times currently experienced;
- Spare capacity on the South services running through Fairfield, Merrylands, Granville, Auburn and Lidcombe;
- Additional capacity on the Bankstown Line in the form of new express services from Liverpool via Sydenham; and
- Spare capacity on the Airport Line as more Campbelltown passengers are diverted onto the faster route via Sydenham.

This type of service and passenger flow redistribution is a standard solution to network overcrowding on the Suburban Rail Systems of Europe. It represents the simplest and cheapest way to provide immediate capacity relief whilst also offering additional faster services. It is recommended that these options to optimise the network's operating efficiency are investigated prior to considering the value of proposed infrastructure upgrades for improving customer experience.

Rolling stock may not be the Constraint

RailCorp is constrained in optimally utilising the network due to a lack of rolling stock given the current operational plan, timetable implementation and controlling metrics. The shift to the new target of customer experience changes the plan, timetable and metrics – and as a result changes the rolling stock dynamics.

A common approach in operating suburban rail networks is to retain some rolling stock stabled across the network, to provide replacement services when the scheduled rolling stock cannot run the required services. Calculations of the optimal amount of retained rolling stock respond to the performance measure placed on RailCorp. The issue is compounded when services require specific rolling stock such as the services via the Epping Chatswood Rail Link and the outer-suburban services. Nevertheless, given a different performance measure, more or less rolling stock would be retained.

There is a lack of survey data regarding the preferences of Sydney's commuting public. It is therefore not currently possible to evaluate if running services at a higher rolling stock utilisation rate to help alleviate congestion – but at the cost of slightly increased service cancellations – would deliver a better customer experience or not. It is recommended that studies be made to provide guidance to such key service planning considerations.

In any case, the only barrier to delivering this alternative is the performance measure that the operator is targeted to achieve.

Notwithstanding all the efforts to improve rolling stock utilisation and availability, for the next few years at least, rolling stock constraints will prevent expansion of service before infrastructure constraints do. In this circumstance, the key to delivering improved customer experience is the consideration of the metrics at a granular service and line segment level.

The performance of the service is not equal across the network. A transport network's higher order goal to support economic vitality suggests that certain levels of congestion are to be avoided at the cost of increasing congestion elsewhere. This is particularly the case where the congestion begins to impact safety. A fine grain monitoring of metrics provides the capacity to robustly inform policy formation on optimising train services for Sydney.

Operating the Additional Services

Accessing the capacity with “no new infrastructure”

Analysis of the current Standard Working Timetable of the Sydney CityRail Network has revealed that a number of opportunities exist to introduce additional faster services on some lines running to some city destinations. If these services are implemented they will represent a significant service improvement for passengers who choose to use them instead of the existing overcrowded services that will continue to service the current destinations. By diverting these passengers onto the additional services, space will be freed-up to relieve overcrowding and accommodate some additional patronage growth.

“No new infrastructure” West Express Services

Four additional fast services for the West

A redistribution of Fast West Suburban and West Intercity services on the Main West Line will facilitate the operation of up to 4 additional Express Suburban services from Penrith via Blacktown, Westmead, Parramatta, Strathfield and into Central Terminal. These new Express Suburban services will be up to 3 minutes faster into Central, offering an attractive alternative for passengers heading there when compared to the existing overcrowded services running through the CBD to the North Shore.

In the morning peak, more than 5,000 passengers disembark services from the West at Redfern and Central. The new faster services heading to those two destinations provide a preferred service for these customers. The switch made by these customers to the new services frees-up capacity on the existing services from their stations of origin in western Sydney right through the CBD and over the Harbour Bridge to the North Shore. Notably, this represents a similar passenger service outcome as that expected from the multi-billion dollar “Western CBD Relief Line” proposed by the previous NSW Government without the cost of, or the wait for, the new infrastructure.

200% increase in fast services for Liverpool

Four additional fast services for Liverpool via Bankstown

Analysis of the service patterns on the Bankstown Line has also indicated that an improvement in the stopping patterns on this line will facilitate the speeding up of all services on the line and will also allow up to 4 additional fast services from Liverpool to be slotted in-between the local services. The net result will be 4 additional faster services to the City from Liverpool/Cabramatta, faster services all along the Bankstown Line and the corresponding relief of overcrowding on the existing South Line services running via Fairfield, Granville and Auburn.

50% increase in fast services for Macarthur

Two additional fast services for Macarthur via Sydenham

A redistribution of services on the East Hills line after the completion of the Kingsgrove to Revesby clearways project will allow the operation of two additional fast services an hour from Macarthur/Campbelltown to the City via Sydenham. This will also allow either 2 additional local services via the Airport line to be commenced at Revesby, or, existing services from Campbelltown via the Airport to be relieved of overcrowding as passengers move over to the additional faster services via Sydenham.

The net outcome will be two additional faster trains for the Campbelltown line plus approximately two train loads worth of spare capacity on the Airport line during the peak periods. This is an improvement on the current situation where Airport passengers with baggage struggle to board overloaded city-bound trains originating out of Campbelltown.

The adjoining diagram demonstrates how these additional services would “fit” into the timetable blueprint, known as a train plan. Further details regarding these service redistributions and capacity enhancements on the existing network are contained in Appendix A.

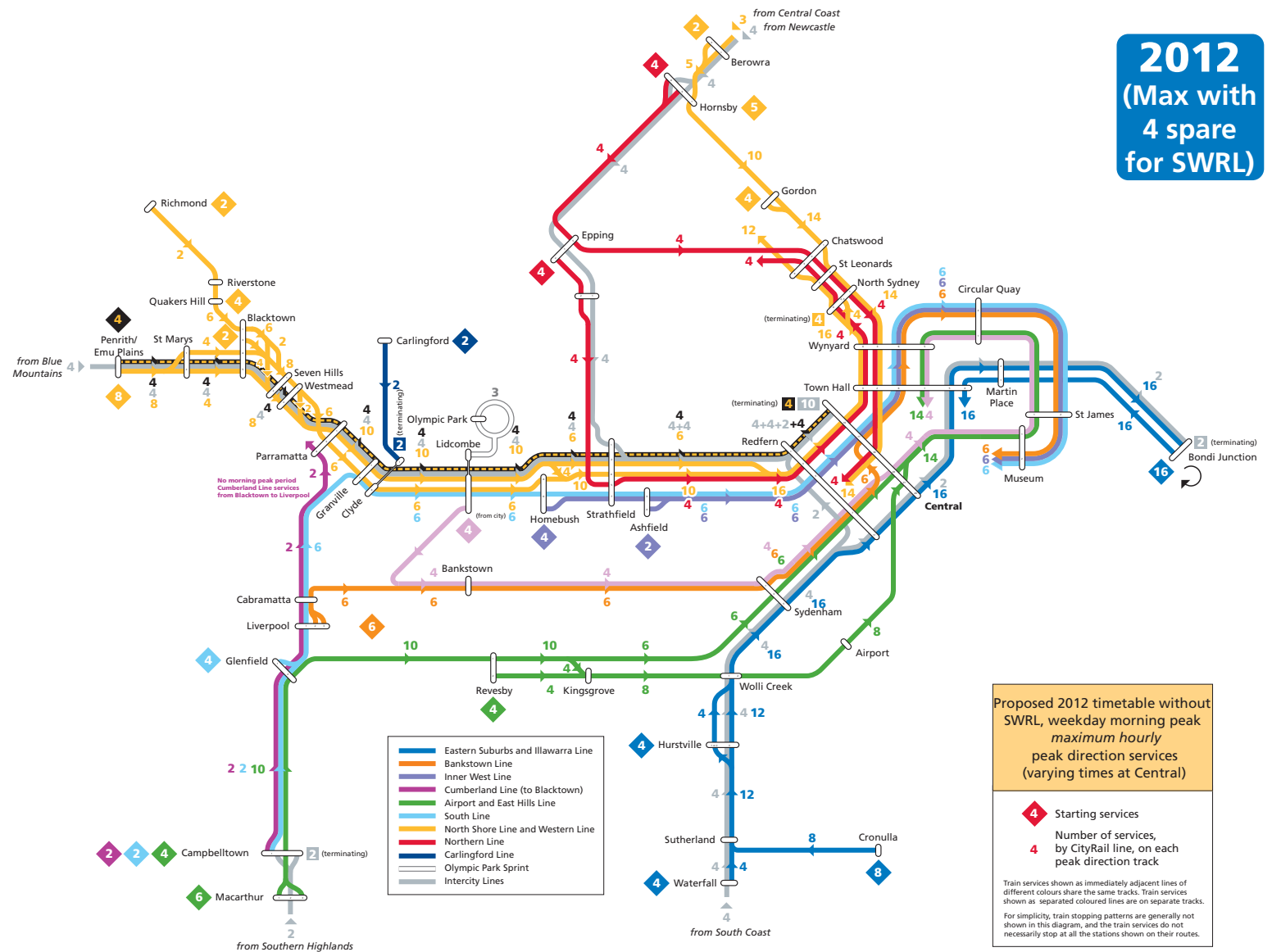


Figure 3: 2012 AM Peak One-Hour Train Plan (Inbound Only) for the Sydney Suburban Train Network including 4 Western Express Services, 2 Additional Fast Services from Macarthur via Sydenham, and 4 Additional Fast Services from Liverpool via Bankstown.

New Metrics

The Key to Improving Customer Experience

Metrics are powerful tools. Since the beginning of Industrialisation, measurement of performance has defined the customer experience. In Sydney, the suburban rail network is measured first by safety and then by “on-time-running”. Safety as a metric has limited utility as safety systems are only truly measured on failure. In contrast, “on-time-running” is a metric that can be dynamically measured and is within the control of the stakeholders. Measuring “on-time-running” is relatively simple, and setting such a target is relatively easy to do and to communicate. The question is: “Does better “on-time-running” really provide what customers want?”

Most passengers do not care if the train they catch is late so long as it does not affect their own journey time. If the same train runs every ten minutes, does it matter if it runs ten minutes late? Not to the passenger – but it does if the service is only measured by an “on-time-running” metric.

If, to remedy that problem the operator chooses to skip stops to get the train back on time then this will have a more significant impact on the passengers left behind than allowing the trains to continue running ten minutes late. It may be missing the point to measure on-time running where the customer’s experience is all about their journey time.

The risk involved in ill-conceived metrics is that the service provider can appear to be achieving good performance yet fail to deliver a good customer experience or improve passenger focused outcomes. In Sydney, this risk became a reality because “improving” the performance of the rail network was achieved by slowing journey times and removing services to achieve better ‘on-time-running’.

Therefore, linking the policy goal of improving customer experience to the planning and governance of the service is dependant on choosing the right performance to measure and the metric that it represents. The metric must be carefully defined to ensure that it is systematically measurable, that it is correlated to how well the service is meeting its intended outcomes, and that it is relevant to the customers it was intended to serve.

In exploring which performance metrics are able to measure different outcomes, it is helpful to categorise those outcomes. One approach is to categorise them into three core groups:

1. Customer Experience outcomes;
2. Economic outcomes; and
3. Management Proficiency outcomes.

This approach seeks to address the issue that a single metric may be viewed in more than one way. “On-time-running”, for example, can be viewed either as a metric for passenger experience or alternatively, for management proficiency. To date, in Sydney’s rail network, this metric has only been viewed in terms of Management Proficiency, implemented as a metric of train movements against a timetable. In contrast, on time running could be implemented as a metric concerning the on time arrival of passengers and therefore be viewed in terms of Customer Experience.

These approaches may appear to provide clear guidance to policy and governance in transport, but consider the metric “route kilometres travelled out of service” (or “dead running”). On the one hand it is a guide to efficiency and lends itself to both economic and management proficiency outcomes. Yet as it is a result of the interaction of the train plan with the constraint of stabling at the start and end of services, improving it unilaterally will typically result in fewer services. However, to improve customer experience, without impacting proficiency, involves investment in infrastructure that impacts economic outcomes. Hence, the metric is not providing clear guidance.

Each metric informs each stakeholder differently. It is important to take each one in context and acknowledge how each is interpreted. The selection of the metrics, and more particularly the target values for each metric, is a matter for policy and a strategic choice for Government. Take, for example, the metric for the ratio of trips that include public transport. If the policy and strategy is to demonstrate good performance and improve the morale of public transport’s frontline staff, then the target will be set as a value close to today’s observed value. In contrast, if the target is part of a policy to address the economic costs of congestion, then it might be set at twice the current observed value.

The announcement that the new Integrated Transport Authority in NSW is focusing on customer experience indicates a fresh approach. Turning this new approach into a new reality for transport services will need new metrics.

Operational Metrics

An International Review

In reviewing the reporting by rail network operators serving more than twenty metropolitan cities across the globe, it is clear that service performance is not proactively reported by operators or governments. This is not to say that metrics are not reported in annual reports or that private sector operators do not have contractual performance metrics. The gap is that the metric is not targeted to inform the customer of their likely experience, reflect the experience they can personally recall, or be evaluated frequently enough to have relevance.

The review suggests cultural bias for the importance of reporting by public transport operators and a negative correlation between transport as a socio-political topic and the reporting. That is, the more that public transport was seen as performing, the less prevalent the reporting of metrics. Surprisingly, the review indicates that there are metrics that can be directly applied to Sydney's rail network that will drive change to improve the customer experience.

One potential was the 'Lost minutes' metric used by Transport for London (TfL). On first glance, it would appear a useful metric. However, the method for its calculation is not transparent and incorporates qualitative judgements, for example, references to 'normal congestion'. As a time series the metric is useful in informing the customer of improvement trends, but what exactly does having a service with "4 lost minutes" mean? Does this mean customers can expect to consistently have a trip 4 minutes longer than it should be? Or that if they use the network over the reporting cycle period they will be delayed 4 minutes and how often?

The conclusion is that rather than providing direct guidance as to what to measure Sydney's transport

network by, the international experience informs us what the metric needs to integrate together in order for it to be widely adopted and make a difference to customer experience.

In considering the 'Lost minutes' metric, the complexity in its formulation is such that it can't inform planning by the operator or by policymakers as to what actions will improve it. Thus, the review of this metric provides two key lessons. Firstly, metrics need to mean something to the target audience without education and more importantly, a metric will only be effective if the methodology of how it is calculated is able to provide guidance for actions to improve it.

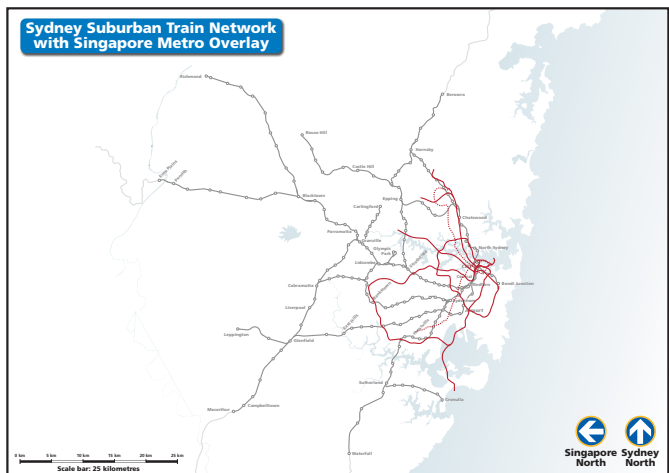
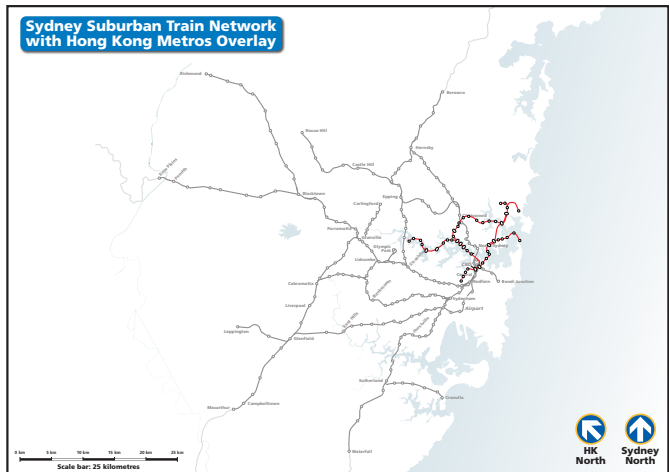
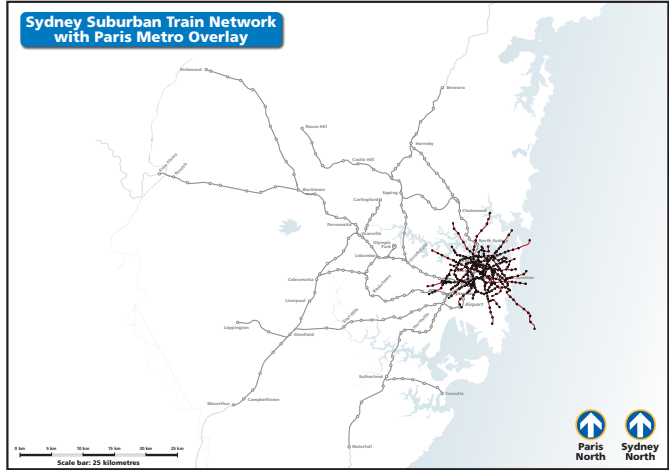
Seeking to foster discussion, a set of metrics is proposed. In some form or other, the international railways that are recognised for their customer service quality including the London Underground, the Paris RER, the Zurich S-Bahn and the Long Island Rail Road (NY) collectively have metrics that align into the following:

1. Overall Passenger Journey Time (where shorter is better)
2. Passenger Journey Time Reliability (where predictability is better). This is not the on-time running of trains
3. Seating Availability (where utilisation rates are targeted towards 110% to assist reliability)
4. Service Frequency (where more is better until 8 trains or more per hour are offered)
5. Perceived Passenger Security (where on-board staff improve the perceived safety of the service)

Line length, station spacing and service frequency all contribute to service journey time. Journey time influences the need for seating availability. Understanding the geographic differences between “Metro” and “Suburban” railway networks is the key to unlocking how to plan the

best operational response, select the best rolling stock, and define the right metrics to govern the service. It is no coincidence that the networks with larger geographic spread have branched lines, mixed stopping patterns and double-deck trains.

Single-Deck – Metro Networks (in Red)



Double-Deck – Suburban Networks (in Red)

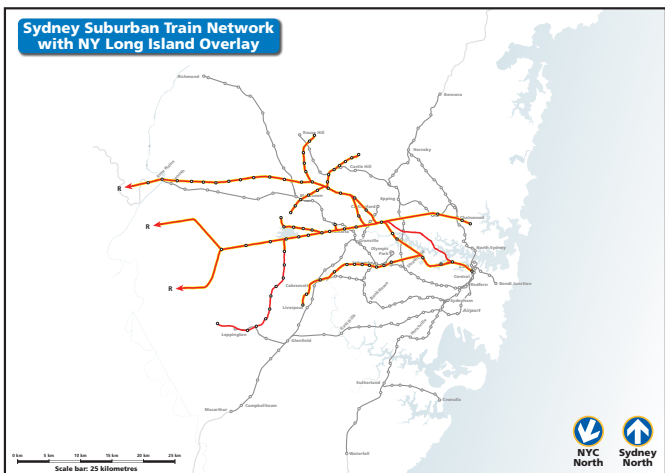
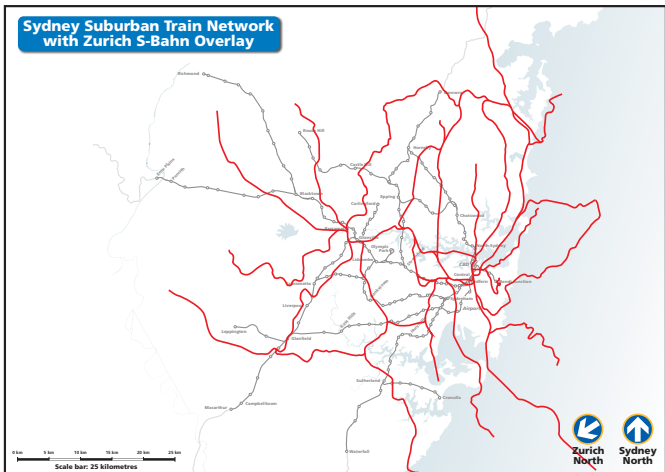
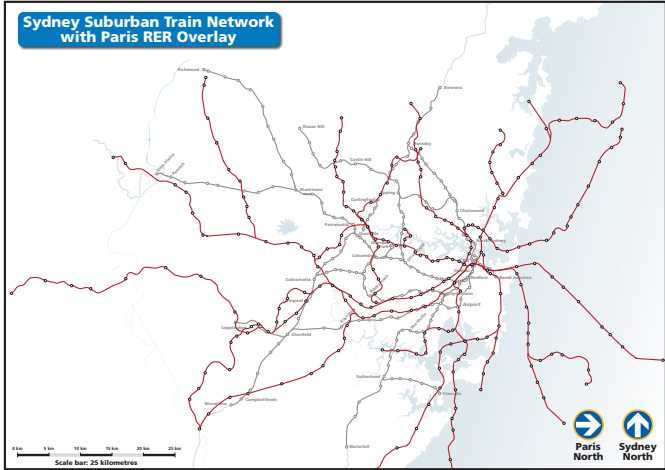


Figure 4: Geographic Network Overlays, Sydney with various Metros and Suburban Networks. Please refer to Appendix B for more detailed analysis.

Realising Long-Term Improvement

Making Metrics Drive Improved Customer Experience

It is clear from this initial investigation that selecting high-level metrics is key to the success of the new customer experience focus. Improving the performance of the service against these metrics is dependant on how each metric is utilised across the service delivery lifecycle and should include:

- developing transparent and empirical methodologies to enumerate the metrics;
- designing the process of the metric to clearly inform the Integrated Transport Authority of approaches for improvement;
- embedding the measurement process into operational procedures; and
- setting targets for the metrics at levels representing genuine improvement for the customer experience.

Notably, the metrics considered earlier are operational metrics. There are limits on how well modelling and forecasting of policy and planning choices can provide comparative performance on such a set of metrics. The challenge is that a proposed infrastructure project or alternative train plan will have a mix of influences on the operational metrics, an outcome that shifts the analysis to be overly qualitative. Selecting the 'better' option can then become a battle of perception and open to influences not targeted on the best outcome for customers.

This suggests there is considerable value for improving the customer experience in metrics that target policy and planning. These metrics still need to be measureable on the existing infrastructure and current network operations. The metrics also need to reflect the impact that new and/or improved infrastructure provides to the service. Two additional metrics meet these criteria:

6. Ratio of population within 800m of a rail system station

7. Network-wide seat availability wait time

The first is relatively straight forward with improvements available from land use changes that increase urban density in the proximity of stations or new transport infrastructure that adds service to locations not currently served by rail. The second is less straight forward but far more useful.

The customer experience metric – Network-Wide Seat Availability Wait Time

Seat wait time is the period from arriving at the station to the availability of a seat on the service. This metric combines the congestion on the service and its frequency. Importantly, the metric differentiates between a lack of seats on short trips from services that are so congested that customers must stand for long periods or are unable to board and must wait for the next service. Further, the metric does not reward frequency without a corresponding demand for the increased seat availability the frequency provides – that is, running empty trains on-time does not offset poor peak performance.

Considering the discussion earlier, it is clear that the metric can be understood without education and that improvements are easily noticed by customers. Importantly, improving seat wait time can stem from all parts of service delivery life-cycle. Starting from policy providing added capacity, to network operational planning balancing demand across service patterns, and even to customer information systems shifting usage patterns, each part of the service's delivery participates in the network's seat wait time.

Understanding how metrics affect the operational outcomes on difficult railway networks is sometimes best demonstrated graphically. The following graph shows how “Metro” Railways occupy a very difficult geographical and market niche as compared to “Suburban” Railways. The graph clearly shows that Metro Railways have shorter line lengths and closer station spacing – well-suited to dense inner-city

areas, whereas Suburban Railway lines are much longer with more widely spaced stations – better suited to longer and faster journeys from the lower density suburbs. Double-deck rolling stock then plays an important role in ensuring seating availability on these longer journeys.

Urban Rail Metrics: Metro and Suburban Zones

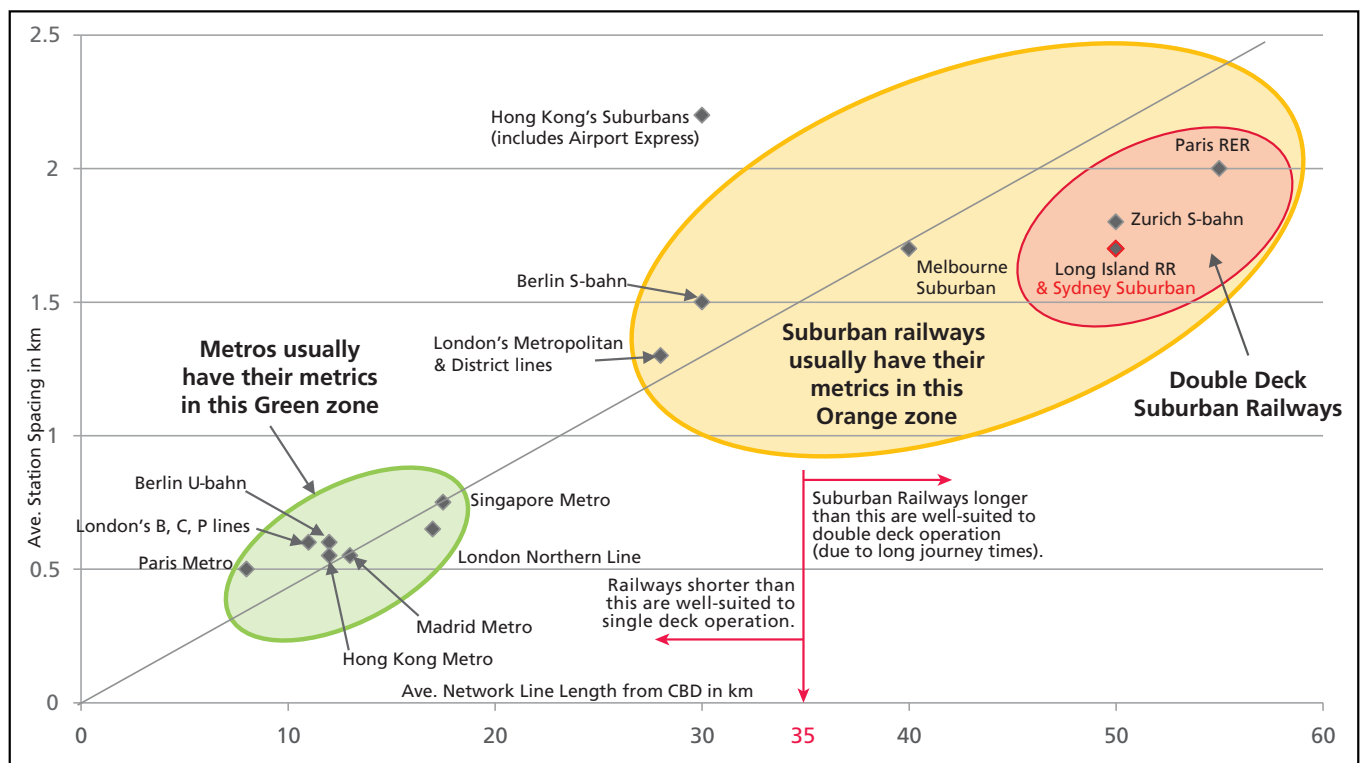


Figure 5: A Graph Comparing the Core Metrics of Metro Networks and Suburban Rail Networks – Demonstrating the Delineation Boundaries as “Zones” on the graph. It becomes clear that metro railways occupy a very different zone to that of suburban railways, and this fact can be used to better plan the services provided on both network types. Please refer to Appendix B for more detailed analysis.

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Appendix A: New Service Enhancements

Sydney's Suburban Rail Service:
Operational Details of Service Enhancement Opportunities

Operational Analysis supporting three zero-infrastructure service enhancements:

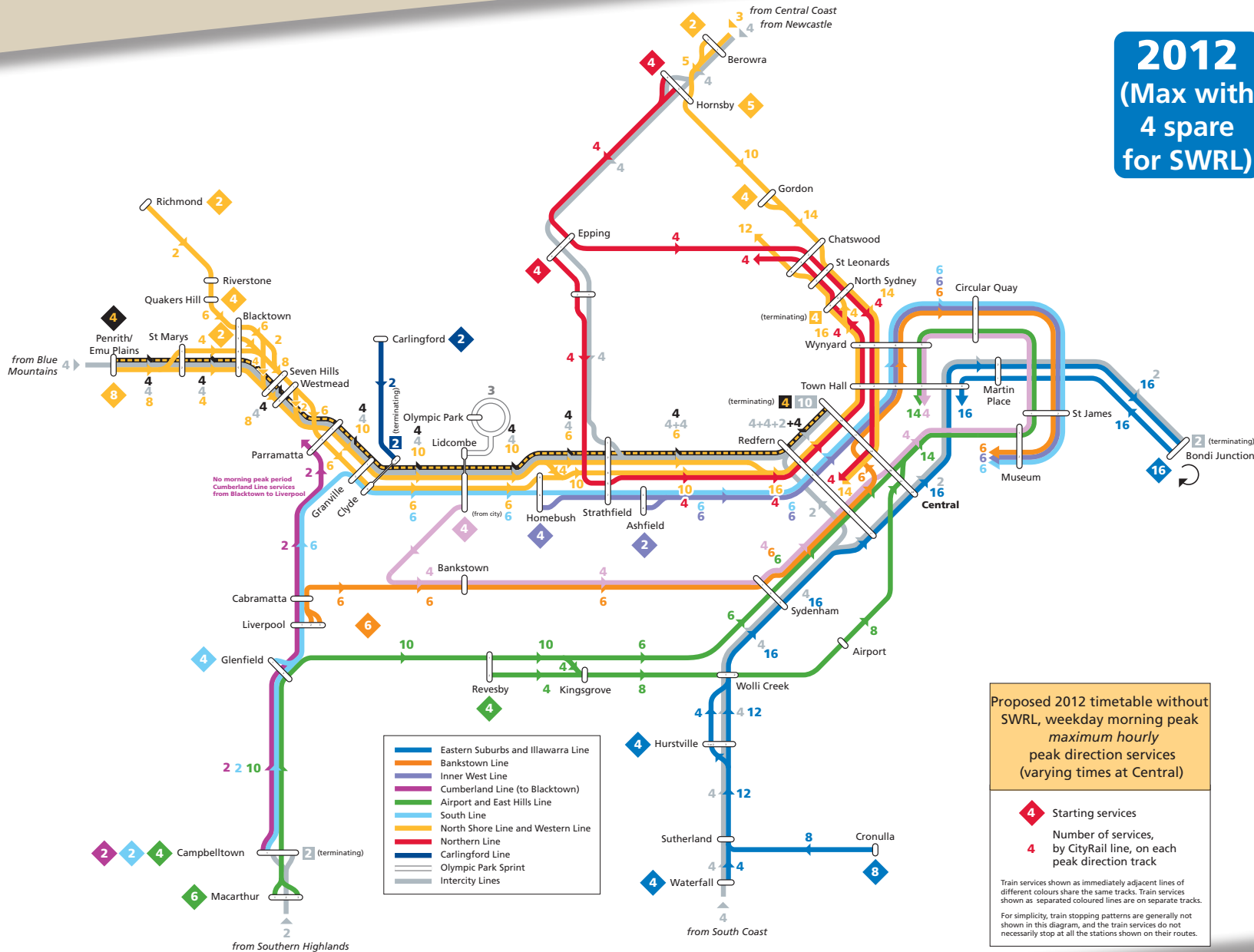
1. No-New-Infrastructure West Express;
2. Fast Liverpool via Bankstown Services;
3. Fast Macarthur Services via Sydenham.

Operational Analysis of Line Capacity and Demand on the Western Line, Liverpool via Bankstown Line, and Macarthur via Sydenham Line

The following diagrams demonstrate the existing line capacity and service enhancement potential on the Western Line, Liverpool via Bankstown Line and Macarthur via Sydenham Line.

- The first two diagrams are “Network Train Plans” and they show how these extra fast services would fit into the network on the existing lines.
- The next two diagrams are CBD “Track Utilisation Diagrams” which show how these extra services would fit on the available track in the CBD.
- The final three graphs show how demand on each line is matched by the proposed service supply. These are projected out to 2031 to demonstrate how this strategy can be expanded (with subsequent additional infrastructure post 2014) to accommodate the increasing forecast demand from each line.

Although these diagrams do not represent new timetables they demonstrate how the network has the capacity to accommodate these extra services. New timetables would need to be developed to show where these extra services would “fit” between the existing services on each line.



Existing Sydney Network in 2012

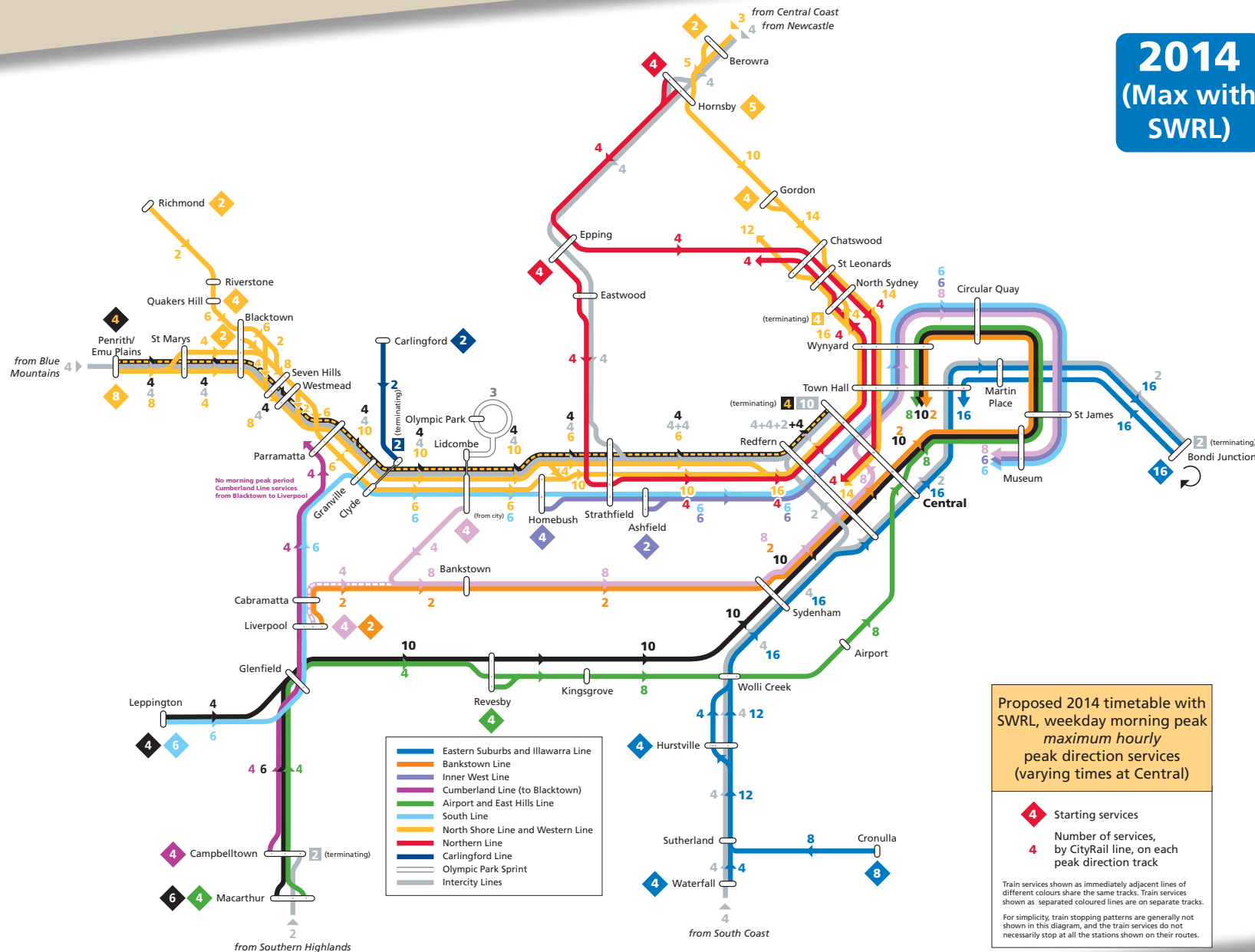
The existing Sydney Railway network has some spare capacity, if used carefully, that can allow some additional fast rail services to operate during peak times to selected destinations.

Spare capacity on the Main West tracks into Central Terminal will allow up to 4 extra Fast West (or West Express) services per hour to operate to Central.

Spare capacity in the City Circle via Sydenham will allow extra fast services via both the Bankstown and East Hills Lines to operate from Liverpool and/or Macarthur.

Spare space is preserved for SWRL services once they are needed.

This network train plan shows Sydney's existing rail network in 2012. It includes 4 new "West Express" services, 2 new "Fast Liverpool" via Bankstown services and 2 new "Fast Macarthur" via Sydenham services.



Sydney Network + SWRL in 2014

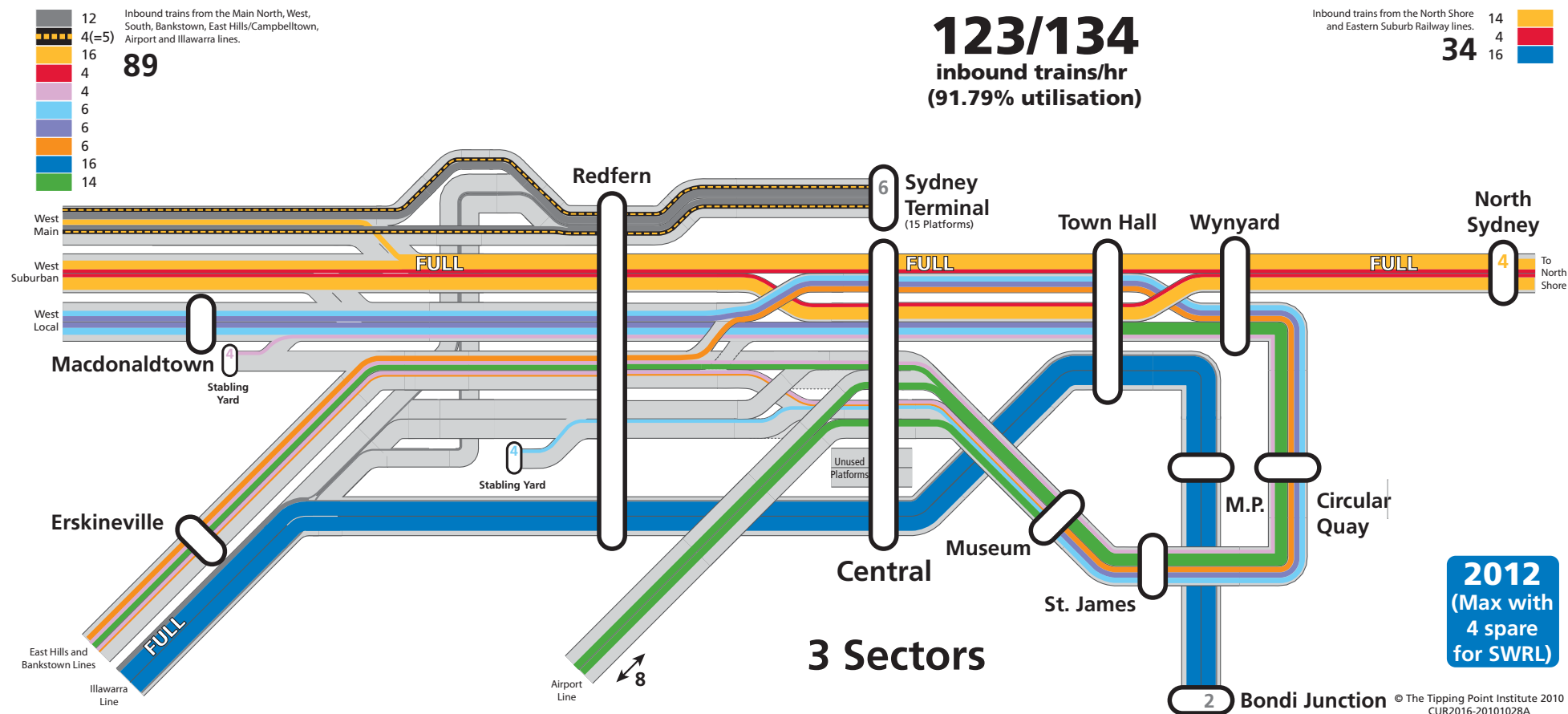
The existing Sydney Railway network has more spare capacity, if used carefully, that can allow some additional fast rail services during the peaks as well as SWRL services to operate.

Spare capacity on the Main West tracks into Central Terminal will allow up to 4 extra Fast West (or West Express) services per hour to operate to Central.

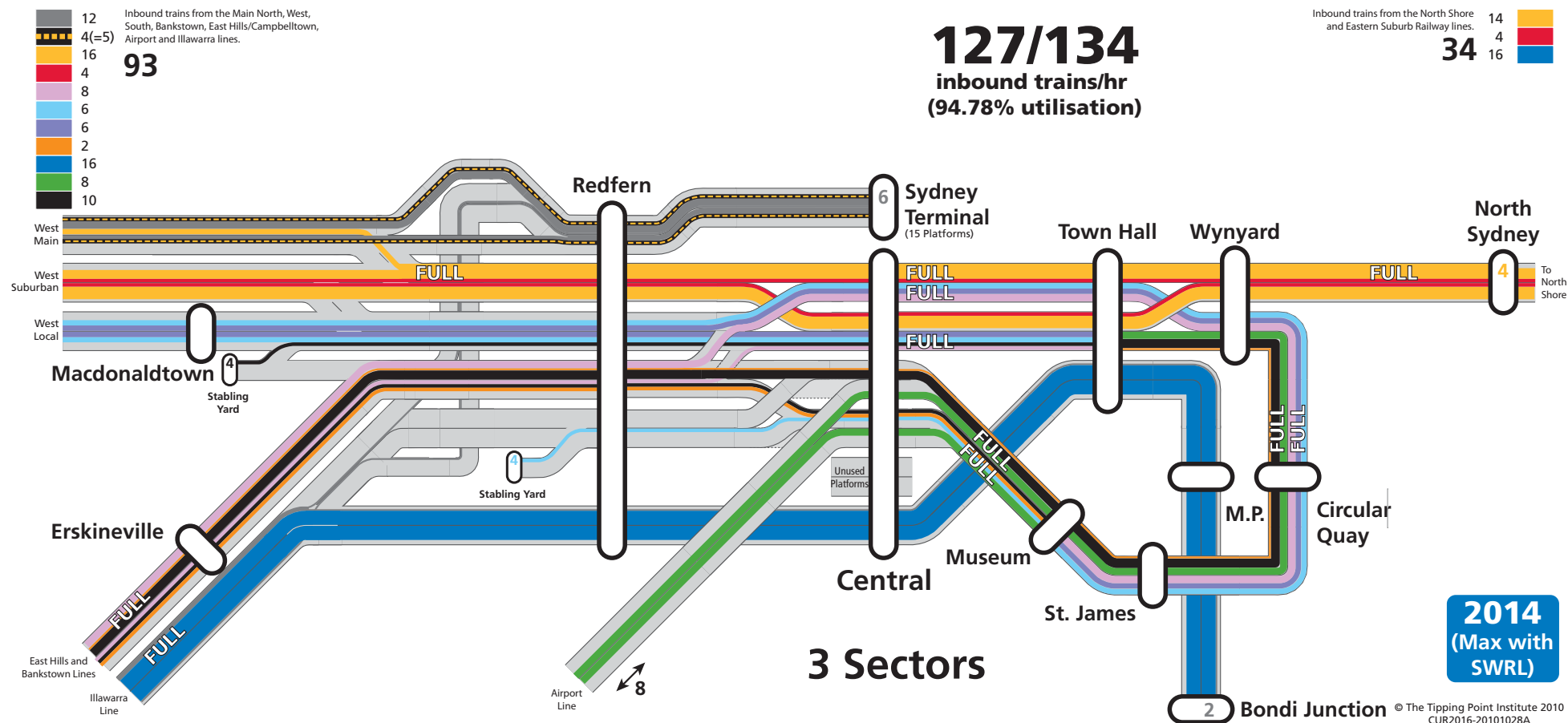
Spare capacity in the City Circle via Sydenham will allow extra fast services via both the Bankstown and East Hills Lines to operate from Liverpool and/or Macarthur.

Spare space previously preserved for SWRL services is now utilised by these services.

This network train plan shows Sydney's existing rail network in 2012. It includes 4 new "West Express" services, 2 new "Fast Liverpool" via Bankstown services, 2 new "Fast Macarthur" and 4 SWRL via Sydenham services.

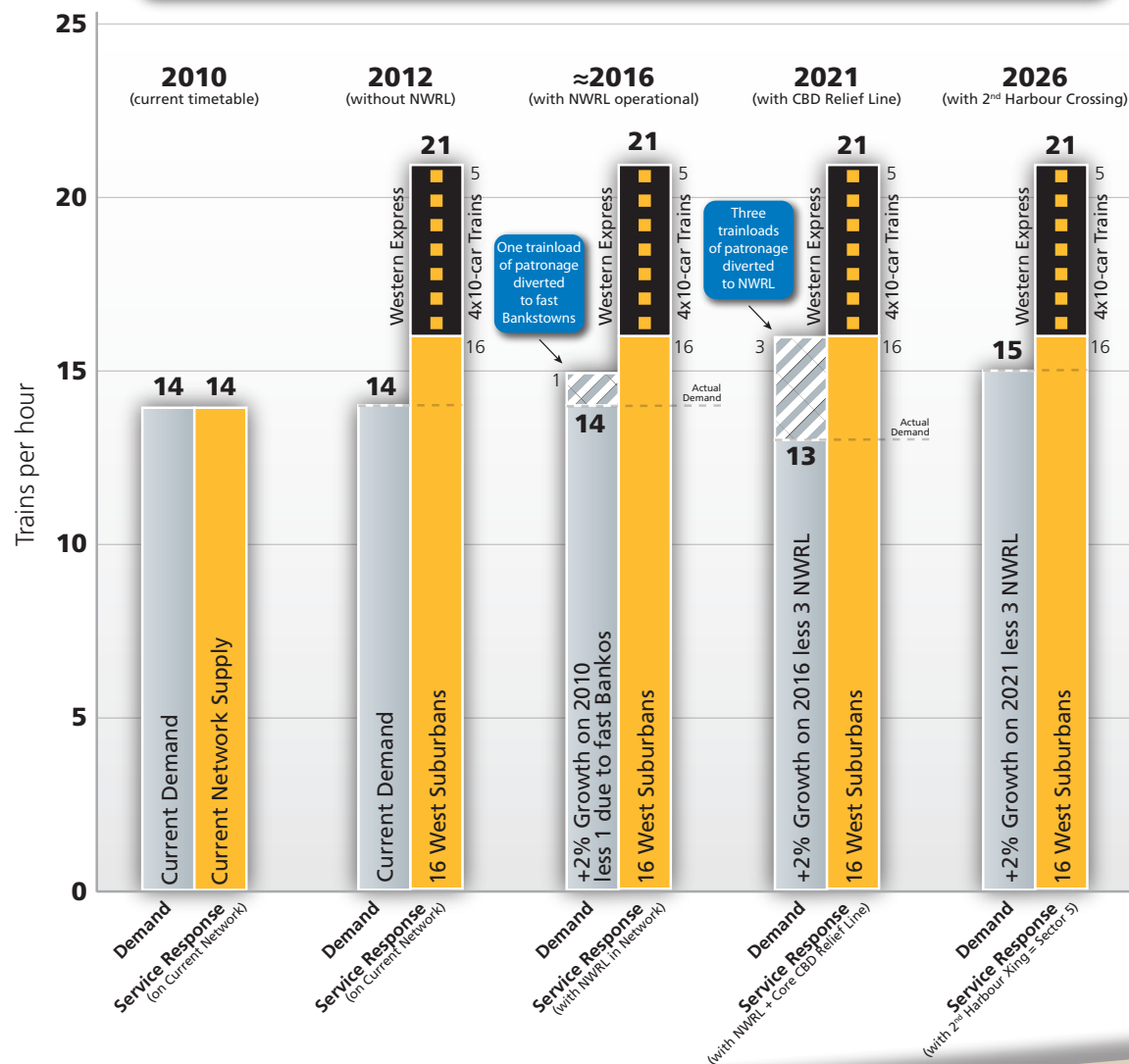


This CBD train plan shows Sydney's existing rail network in the CBD in 2012. It includes 4 new "West Express" services, 2 new "Fast Liverpool" via Bankstown services and 2 new "Fast Macarthur" via Sydenham services.



This CBD train plan shows Sydney's existing rail network in the CBD in 2014. It includes 4 new "West Express" services, 2 new "Fast Liverpool" via Bankstown services and 2 new "Fast Macarthur" and 4 SWRL via Sydenham services.

West Services (with Fast Bankstowns and with North West Rail Link)



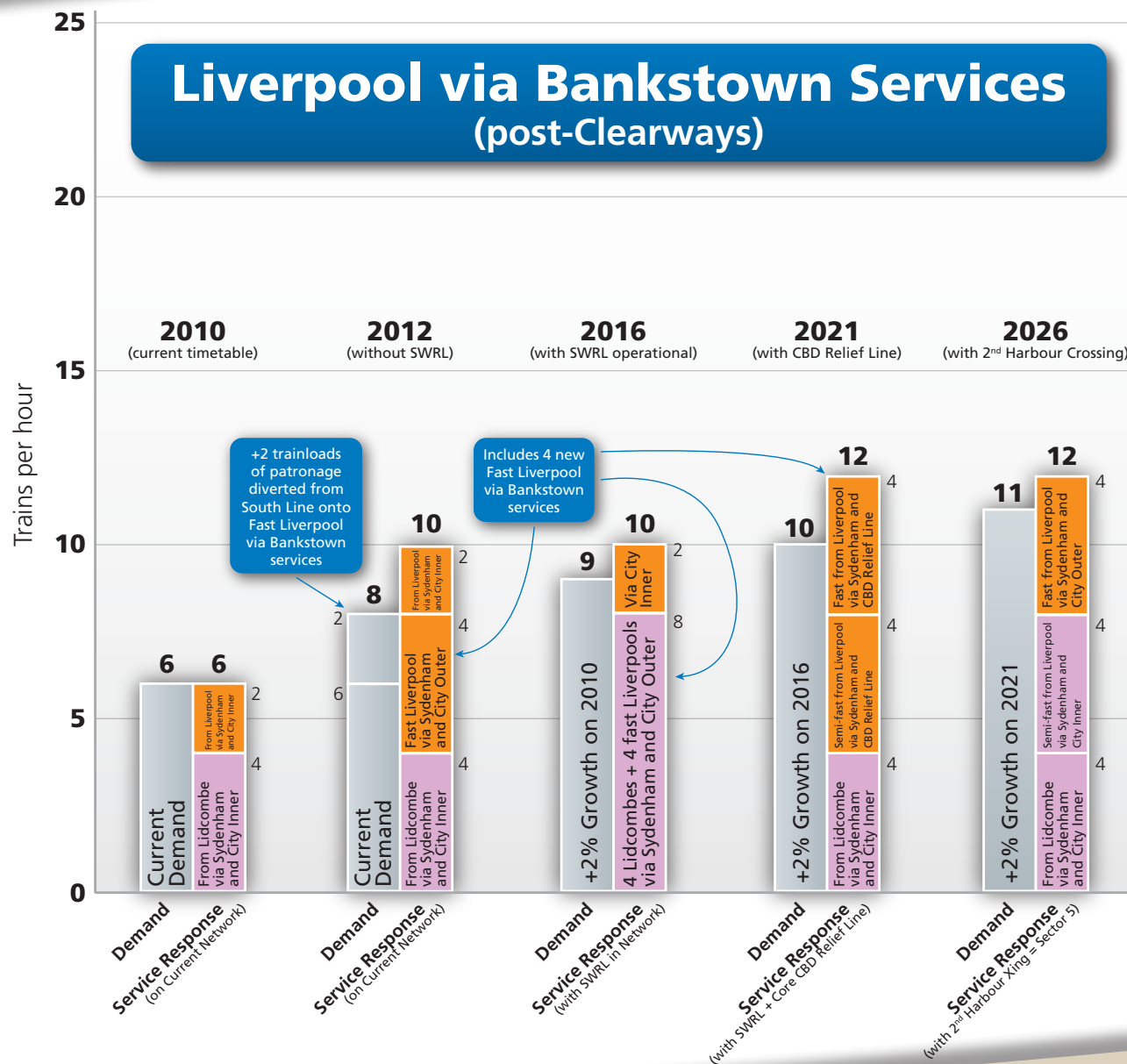
No New Infrastructure West Express Services

The Western Line currently has a service supply that just matches demand, however, 2% pa growth forecasts indicate that demand will out-strip the maximum possible supply of through CBD services (crossing the bridge to North Sydney) by 2021 at the latest.

Some of this current demand is “crowded off” the full South services at Granville, Auburn and Lidcombe stations (being served by both the West and South lines). The introduction of fast Bankstown services from Liverpool will free up some space on the South via Granville services – subsequently freeing up some space (about 1 train load) on the West services.

The opening of the North West Rail Link (NWRL) will also divert up to 3 train loads of passengers off the West services by 2021 because this will become the fastest way to get to Chatswood, St Leonards and North Sydney for those passengers heading from the North West. Together, these two new service introductions will redistribute up to 4 train loads worth of Western Line patronage onto other lines – significantly reducing the ongoing growth in demand on this line.

The introduction of 4 extra fast trains on the Main West Tracks (WEX services), that only run to and from Central, will provide a faster option for the 25% of West passengers who want Redfern and Central as a destination or to interchange to buses. These WEX services can run on the existing network either in front of or behind the Blue Mountains Intercity Services.



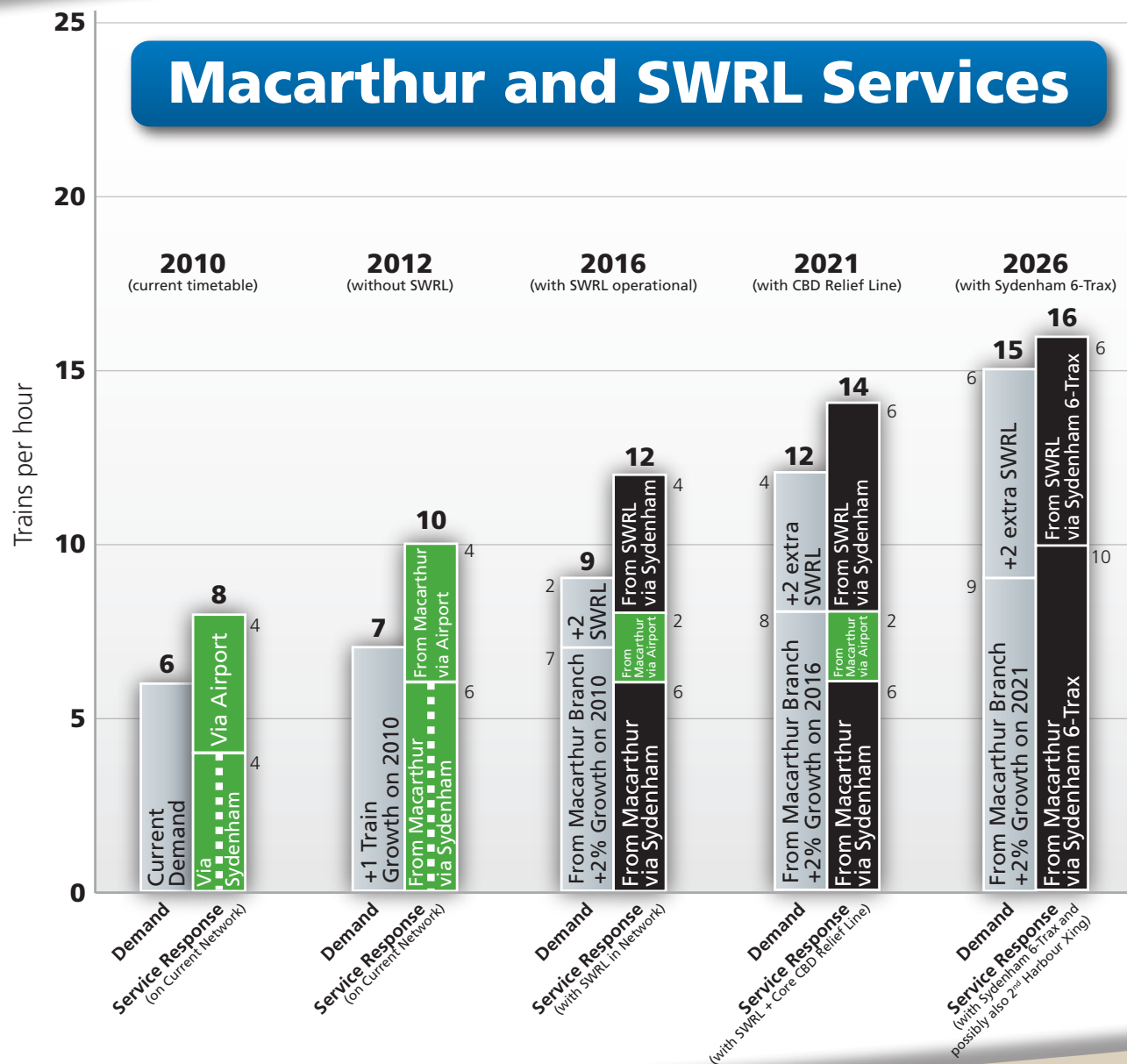
Fast Liverpool via Bankstown Services

The Bankstown Line is currently the most underutilised branch in the inner part of the Sydney rail network. This is partially because there is limited capacity through Sydenham and in the City Circle into which it feeds, but also because the large number of stations on the line makes the all stops journey along it relatively slow compared to other lines.

There is spare capacity through Sydenham and on the City Circle that could be utilised by additional Bankstown line services however the key to unlocking the spare capacity is to speed up the services on the line – making them faster than alternative routes – and attracting passengers away from those over-crowded alternatives (freeing up space on them also).

By introducing a third stopping pattern and converting the existing two patterns into skip-stops services, all services on the line will become faster. The new stopping patterns will not reduce the hourly service frequency at any station below their current minimum as there will be extra trains on the line to compensate.

The speeding up of the existing services will allow the new services to be slotted in on faster paths than is currently possible, making these the fastest services from Liverpool, Cabramatta and Bankstown to the City.



Macarthur (and SWRL) via Sydenham Line

The current demand from the Macarthur via Sydenham Line (including that part of the East Hills Line beyond East Hills) fills 6 trains with passengers heading to the CBD or beyond (some changing in the CBD). The current service pattern on the line splits the peak hour services so that some run via the Airport and some via Sydenham (the Airport route being up to 9 minutes slower). This advantages neither market as most Macarthur line passengers do not want the slower journey and Airport passengers must crowd onto already full trains.

With the introduction of SWRL services from about 2014 onwards there will be increased demand for fast services via Sydenham to the City. Additional services starting from Revesby (using the 2 now completed Revesby turnbacks) will supplement the Airport services with more lightly loaded trains. This in-turn allows more of the Macarthur services to operate fast via Sydenham. Two of these could operate today.

In the fullness of time, once the Sydenham 6-trax is completed and eventually a 2nd harbour crossing also, a new operational sector will have been created – one that allows express services from Macarthur and SWRL direct access into the CBD, North Sydney and Chatswood.

Conclusions

Analysis of the existing network capacity and operating patterns reveals that there are some limited opportunities to run additional express services on some lines.

Western Express Services

Up to four additional West Express Services (WEX) could operate* on the existing West Line into Central and terminate. These would be up to three minutes faster than the existing suburban services, making them attractive to passengers heading to Redfern and Central but not attractive enough to encourage interchange by customers with destinations beyond Central. The result is an optimised shift in loading across the trains that avoids any increase in both interchange burden and dwell-time delays on the West Suburbans at Central.

The key is that existing passengers on West Suburban trains heading beyond Central would continue using the through services because the time saving made by the new services is not sufficient enough to offset the interchange at Central. Importantly, up to 25% of the passengers on West Suburban services benefit sufficiently from the new services to free up their previously used seats on the existing “through CBD” Suburban services. These ‘freed up’ seats would then be available all the way from the point of origin to destinations in the CBD and over the Harbour Bridge without the need to, or increased demand for, interchange at Central, Town Hall or Wynyard. This achieves a better result than running WEX services into a new CBD Relief Line because the same amount of now spare capacity is made available – but it runs right through to destinations on the North Shore – and all without the need to build a CBD Relief Line!

Faster and additional services from Liverpool via Bankstown

Initially, up to two*, and ultimately up to four*, additional Fast Liverpool via Bankstown Line services could operate on the existing network. Accommodating these new services has the added advantage of speeding up all services on the Bankstown line.

The new fast services would be the fastest service to the City from Liverpool, Warwick Farm and Cabramatta. This replaces the South via Granville services as the fastest service for those passengers, a change that will shift up to three train loads of demand off the South via Granville services by 2016. This shift will be evident in the reduced loading of the South trains at stations between Granville and Lidcombe when overcrowding diverts customers onto the West services at these stations. The result is both increased service supply and speed – that lowers overflow demand onto the West services.

The benefits of running additional and fast Liverpool via Bankstown services cannot be overstated given the network wide value they provide.

* Subject to rolling stock availability.

Conclusions

Additional Fast Macarthur Services

Initially, up to two* additional fast Macarthur via Sydenham services could operate on the network immediately – while still accommodating up to four* services per hour from the South West Rail Link once it opens. All of these services operate via Sydenham providing up to nine minutes faster services than those operating via the Airport.

In response to demand, fast Macarthur services could be further increased from two to four* additional services per hour with the introduction of the Sydenham 6-tracks 'clearways' project.

* Subject to rolling stock availability.

Further development of detailed timetables would need to be undertaken to fully demonstrate the final functionality of these proposed service changes. The methodology used for this analysis is sufficient to conclude that network capacity is available, and that demand will be more than satisfied, by these proposed service changes. Although we are confident of their viability, we recommend that detailed timetable development and independent performance modelling (with RailSys) be undertaken as a priority to provide a more robust assessment of these proposed service enhancements.

Appendix B: Spatial Rail Network Metrics

Metro Rail Services and Suburban Rail Services: Determining Factors for Service Type Selection

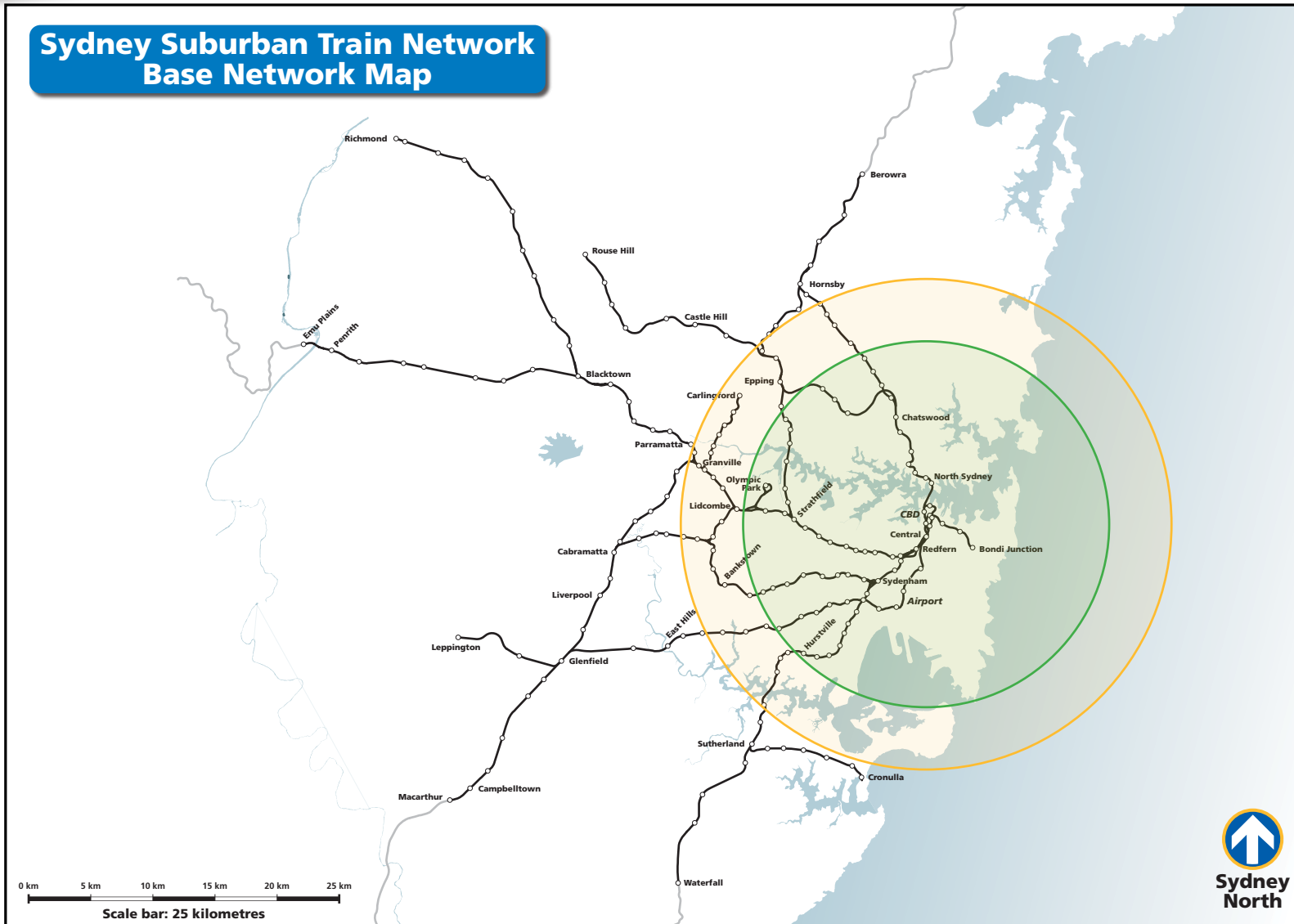
The past few years has seen proposals for both a “metro style” service for the North West of Sydney and possible conversion of some or all of Sydney’s Suburban Rail Lines to single deck “metro style” operation.

The following spatial and geographic analysis of the world’s best known – and most frequently referenced – Metro and Suburban rail networks clearly illustrates that “metro” style conversion of the current and planned Suburban Rail Network would negatively impact the customer experience.



Review of International Metro Networks Spatial Metrics

Sydney Suburban Train Network Base Network Map



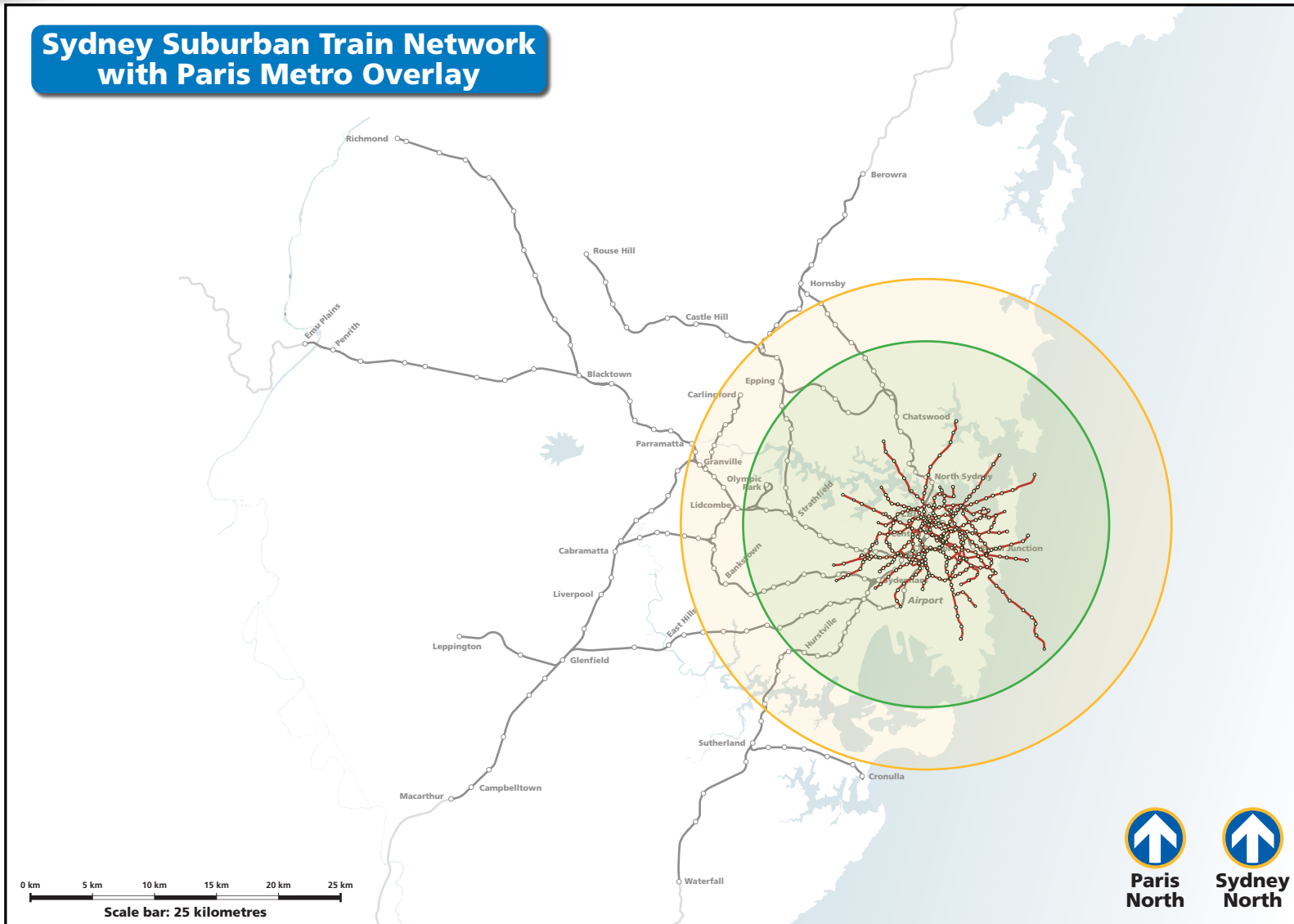
Sydney's Network

The Sydney Suburban Rail Network is typical of many suburban railways in that it grew out along the lines of the original main line railway. As suburbs formed around the core of the city more stations were opened and, in some corridors, new suburban rail lines were built to supplement the original main line network (e.g. the Bankstown Line).

Unlike most of the world's suburban railways – which operated to terminal stations until the 1960s and 70s – Sydney's network was through routed into the CBD in the 1920s, 30s and 50s.

This map shows the Sydney Suburban Rail Network with both NWRL and SWRL added. The green circle is 15km radius from Town Hall and the yellow circle is 20km radius. Penrith is 50km from the CBD.

Sydney Suburban Train Network with Paris Metro Overlay



Paris Metro

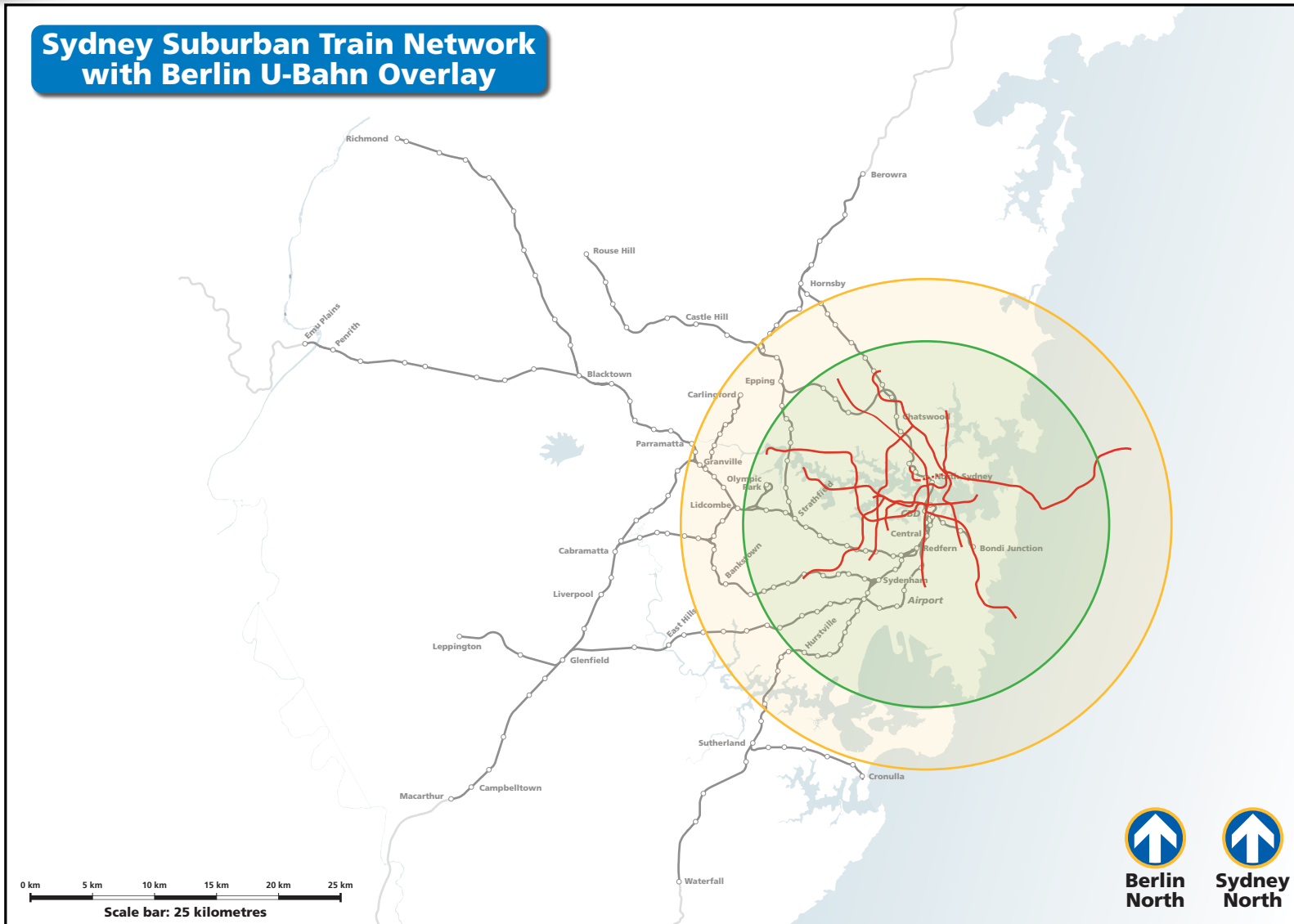
The Paris Metro is a very compact inner-city metro network. Most lines only radiate out to 8km from the City Centre and station spacing is as close as 400m apart.

It becomes clear looking at these two networks together that there is a significant difference between both line length and station spacing when comparing a metro network with a suburban railway.

Paris is also serviced by a separate comprehensive double deck suburban railway, similar to Sydney's, which is shown in subsequent comparisons.

This map shows the Sydney rail network with the Paris Metro overlaid at the same scale. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Berlin U-Bahn Overlay



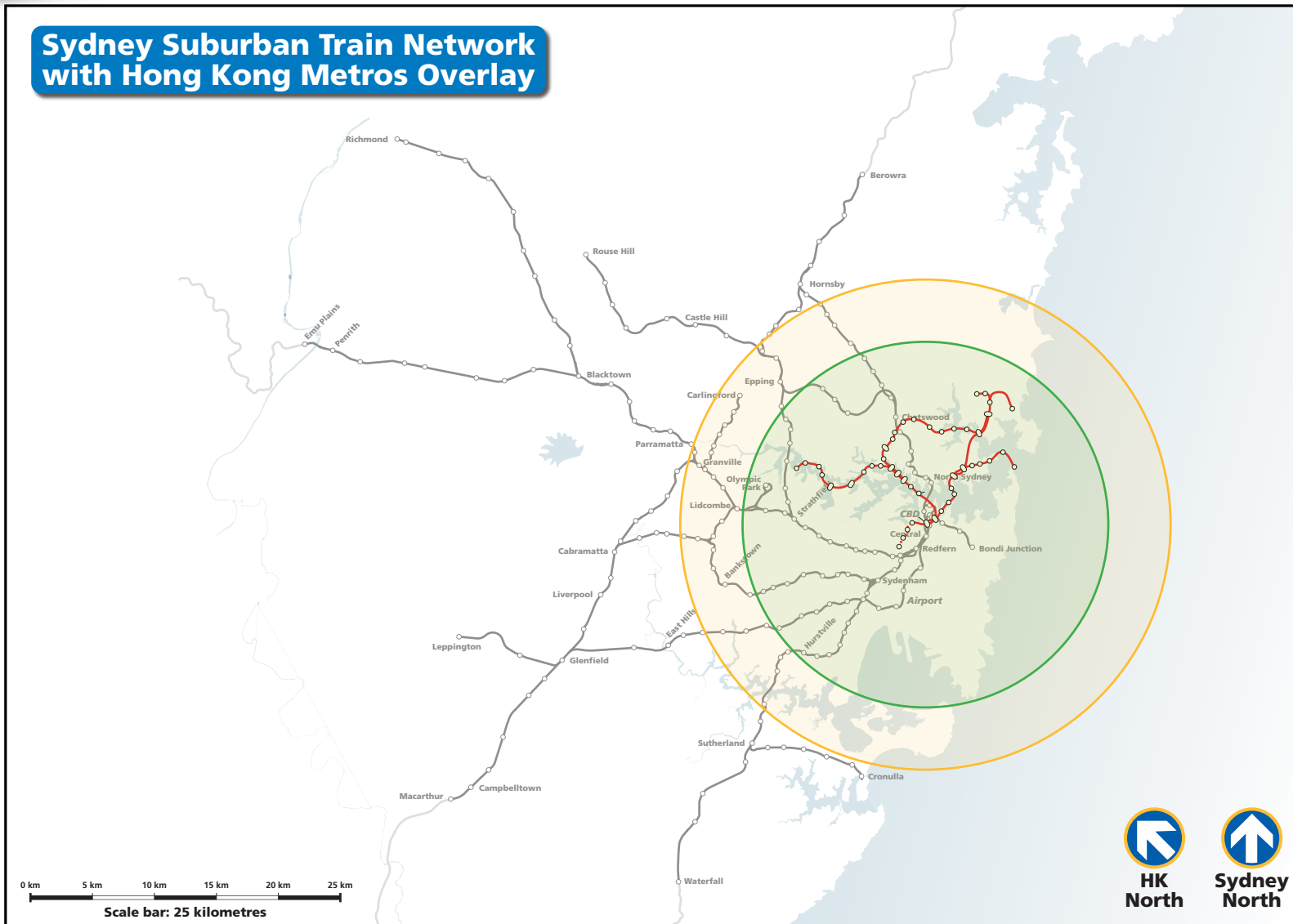
Berlin Metro

The Berlin U-Bahn is a compact inner-city metro network with an average line length of 12km from the city-centre and station spacing of around 600m. All lines fit within 15km of their city-centre start point. The line U5 has its start point at the old East Berlin city centre of Alexanderplatz – some 3km from the 1920s centre, and hence just crosses the usual 15km green limit for metros.

Berlin also has a comprehensive suburban rail network, similar to Sydney's, that is shown in subsequent comparisons.

This map shows the Sydney rail network with the Berlin Metro (U-Bahn) overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Hong Kong Metros Overlay



Hong Kong's True Metros

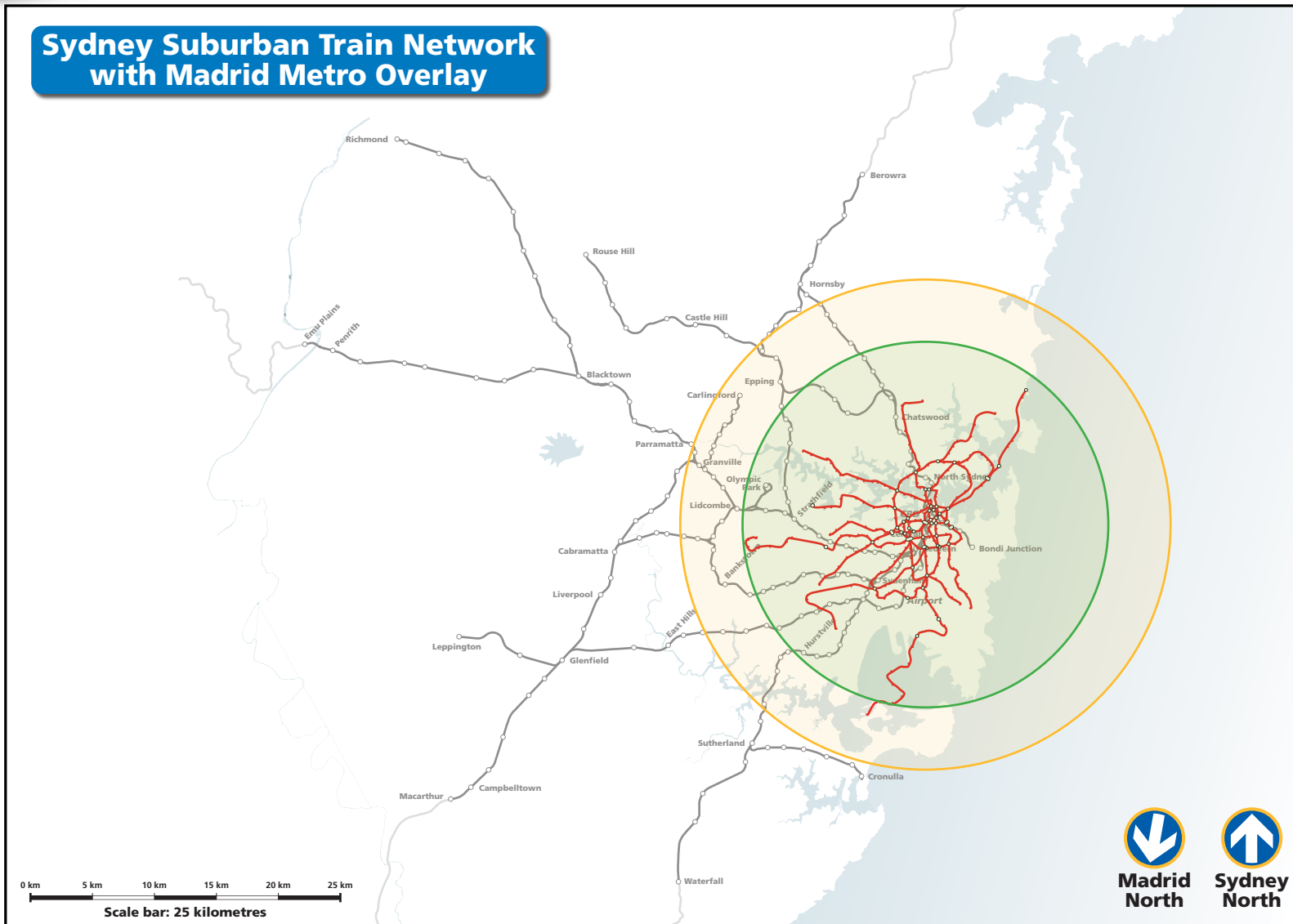
Hong Kong has a unique rail development history with Main Lines linking to China, Suburban Lines in the same corridors and some Metros built to service the inner-city.

These original metros were built as “true” metros in the sense that they are no longer than 12km from the city-centre and have very close station spacing of 500 to 600m on average.

These metros are part of the MTR and have been bundled together with the former KCRC suburban lines and long express services to the new airport to form a combined “metro” and “suburban” MTR entity. This singular branding obscures the modal definitions.

This map shows the Sydney network with Hong Kong's original metro lines overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Madrid Metro Overlay



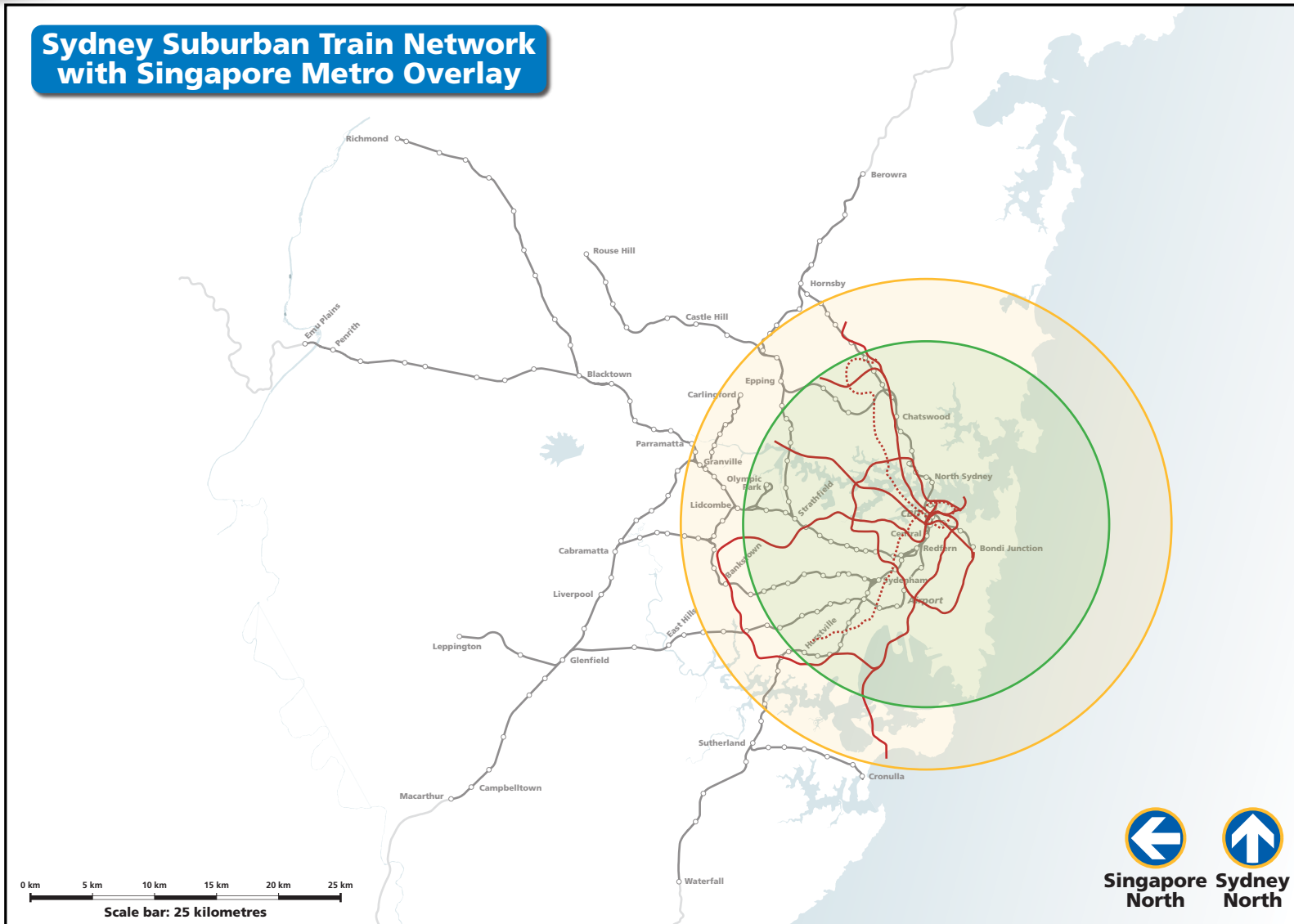
Madrid's Metros

Madrid's Metro System has a development history similar to many capital cities in Europe but has experienced rapid network expansion in recent decades. Average line length from the core is about 13km, (originally much less) and station spacing is about 500m to 600m. Only the very recent additions to the network have extended beyond the 15km ideal metro limit. Extending these lines was the only option as no other suburban lines were near these developments.

Madrid also has a suburban rail network, with double deck operation, for the suburbs beyond 15km.

This map shows the Sydney rail network with Madrid's metros overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Singapore Metro Overlay



Singapore's Metros

Singapore has never had a suburban railway but needed to link its entire island city-state with one rail network. The natural response to this problem was to build a network from scratch that was like no other at the time. The original lines were long by metro standards, stretching out to 20km from the core but they needed to stake their claim where no other option was possible. Station spacing is about 750m.

The newer metro lines fit perfectly within the more traditional 15km limit for metros – an indication that the long journey times on the original lines should not be replicated.

This map shows the Sydney rail network with Singapore's metros overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Metro Spatial Metrics Review

This completes the review of Metro Network spatial metrics.


What can be concluded from the sample of frequently referenced metro networks is the following:

- Metro networks consist of individual lines, usually with no branching
- Lines are usually no longer than 12 to 15km from the core of the city
- Station spacing ranges from 400 to 750m and averages about 600m

What can not be seen from the spatial analysis but is also common to metro rail services are:

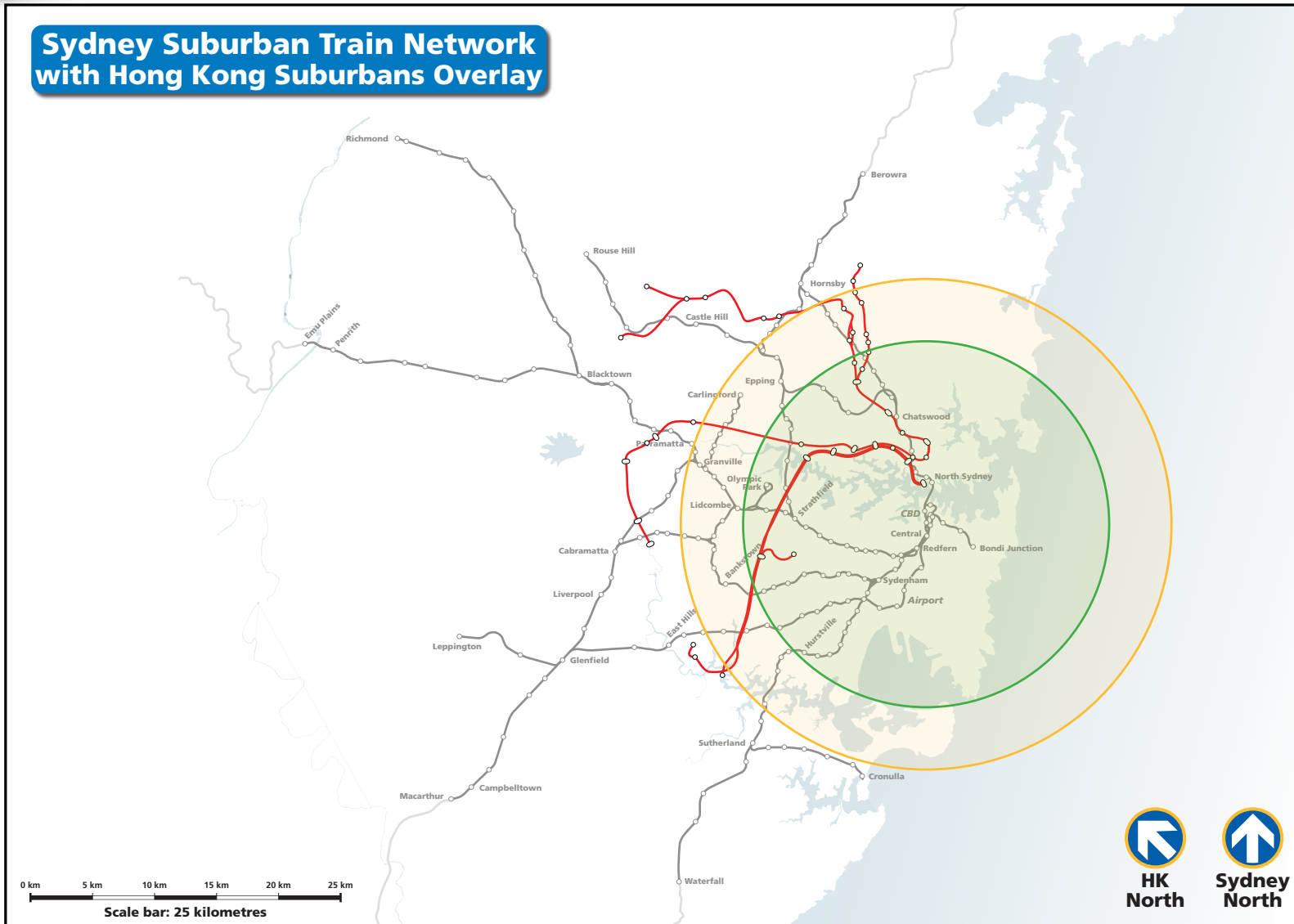
- An average line speed (including stopping) of about 25km/h
- All trains stop all stations (ie: no express services)

It is these two factors together that make metro style services unsuitable for the longer lines servicing suburbs beyond 15km because the journey times would be too long compared to alternative operational solutions.



Review of International Suburban Networks Spatial Metrics

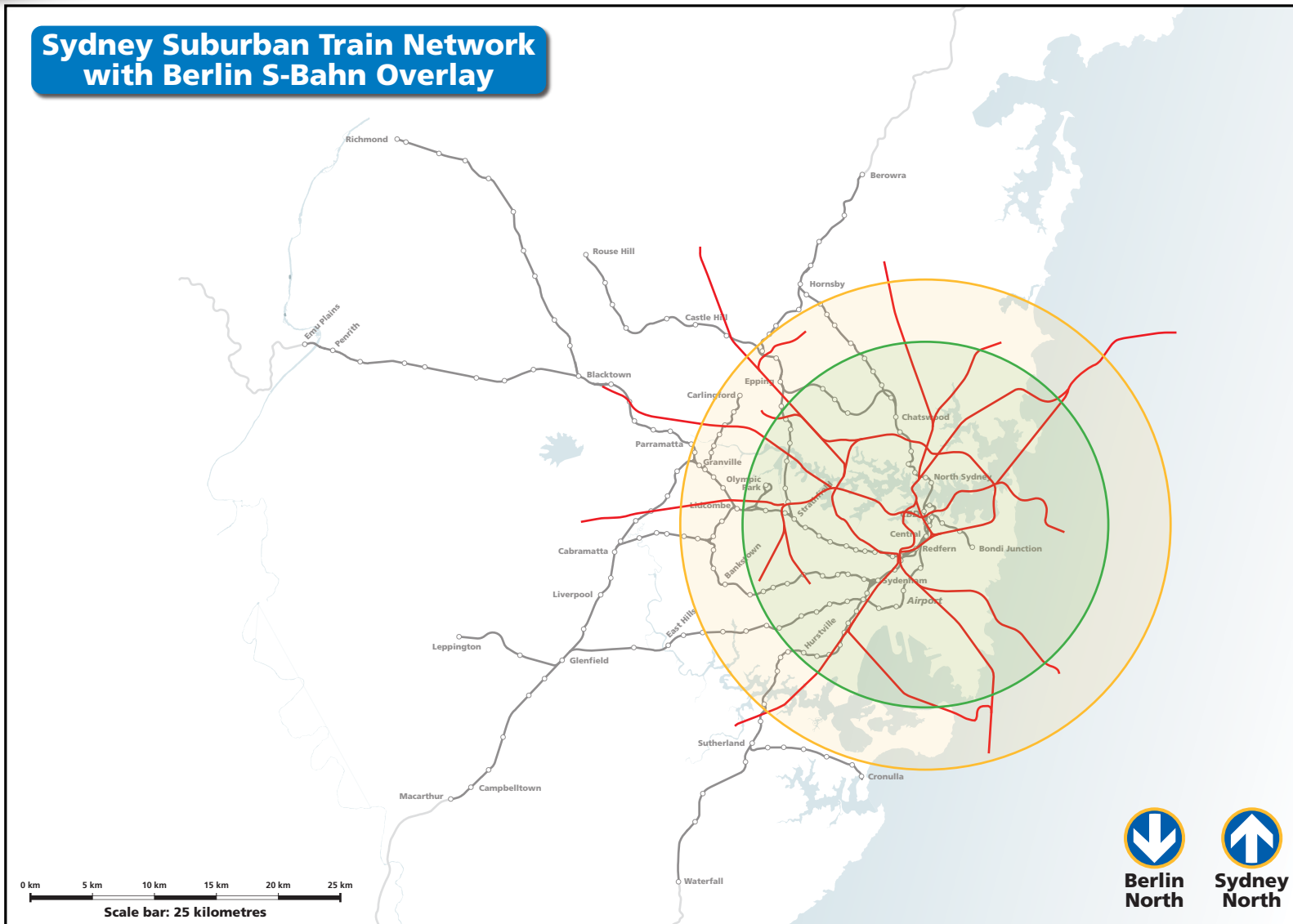
Sydney Suburban Train Network with Hong Kong Suburbans Overlay



Hong Kong's Suburban

The former Hong Kong suburban lines of the KCRC (East and West) have now been rebranded with the metros and express airport line to form the expanded MTR operated network. This combined branding, along with a complete rebuild in the 1990's of the operating infrastructure from the track-bed up – designed to deliver higher service frequencies – has generated some confusion as to what a Metro or Suburban Railway is. It is clear from the line length and station spacing (averaging over 2km) that these lines are not configured as metros. Their operation is typically suburban – but high density – with signaling allowing up to 28 t/hr. It should also be noted that multiple platforms at the CBD stations – all fed from the same track – allow for long dwell times with very high line service frequencies. This outcome could not be achieved in Sydney without effectively building a new line through the CBD. The line lengths – and hence journey times – on these lines, are shorter than the international average – hence a higher level of passenger standing is tolerated. This map shows the Sydney rail network with Hong Kong's old and new suburban lines. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Berlin S-Bahn Overlay



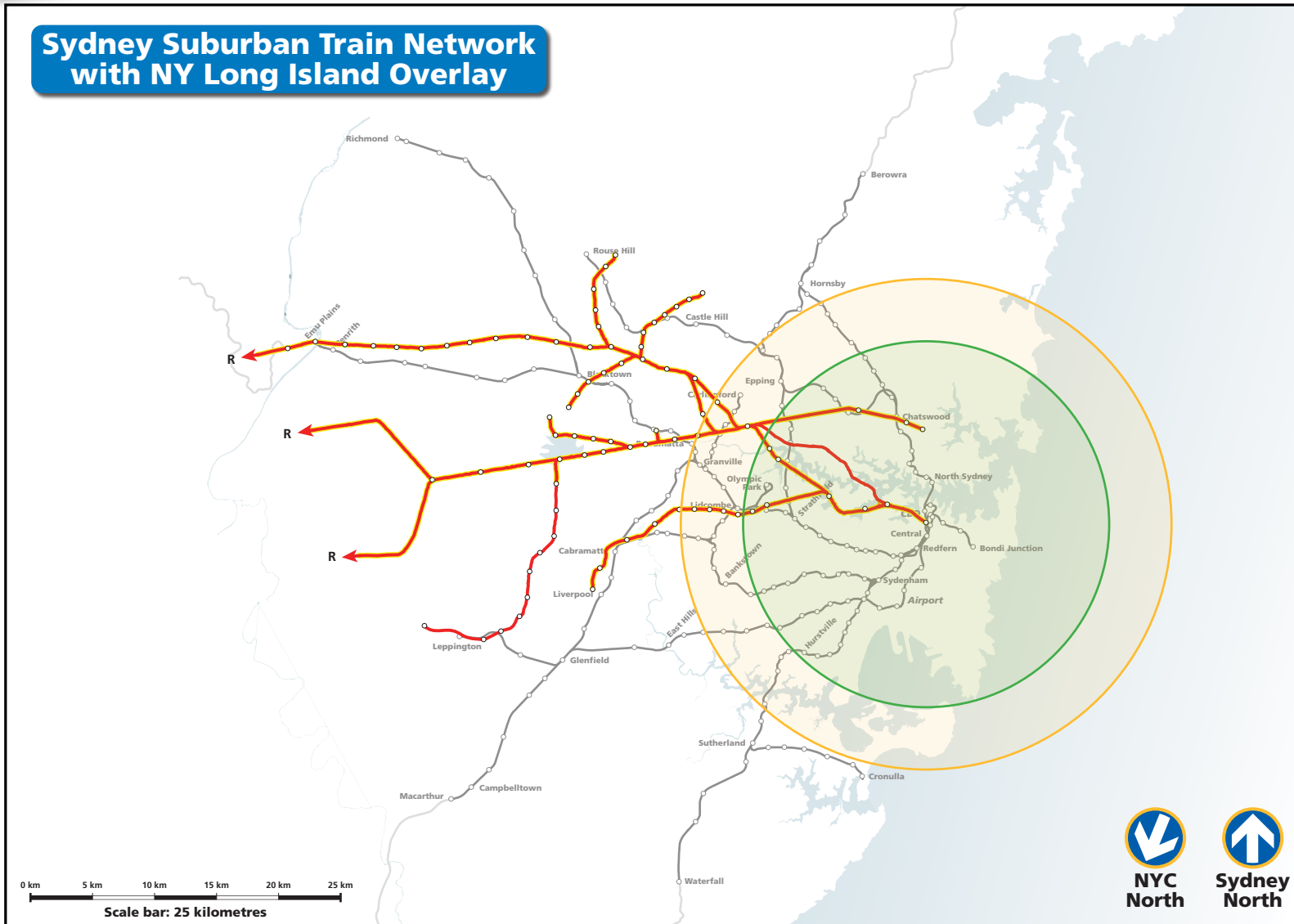
Berlin's S-Bahn

Berlin's S-Bahn suburban rail network has a number of operational sectors but some services are also interlined across sectors. Line lengths average about 25km from the core with some branched lines running out as far as 30km. Services consist of a mix of fast-express and slow-all-stops inner services sharing the same tracks in the core of each sector. Station spacing averages about 1500m.

The railway is single deck due to vertical clearance constraints in some tunnels but the regional commuter services, running out to 80km on the main line network, were converted to double-deck operation in the 1990's.

This map shows the Sydney rail network with Berlin's suburban (S-Bahn) lines overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with NY Long Island Overlay



Long Island RR Suburban

The LIRR is one of three suburban commuter rail networks serving New York City (note that the NY subway is not one of these networks as it is configured more like a metro).

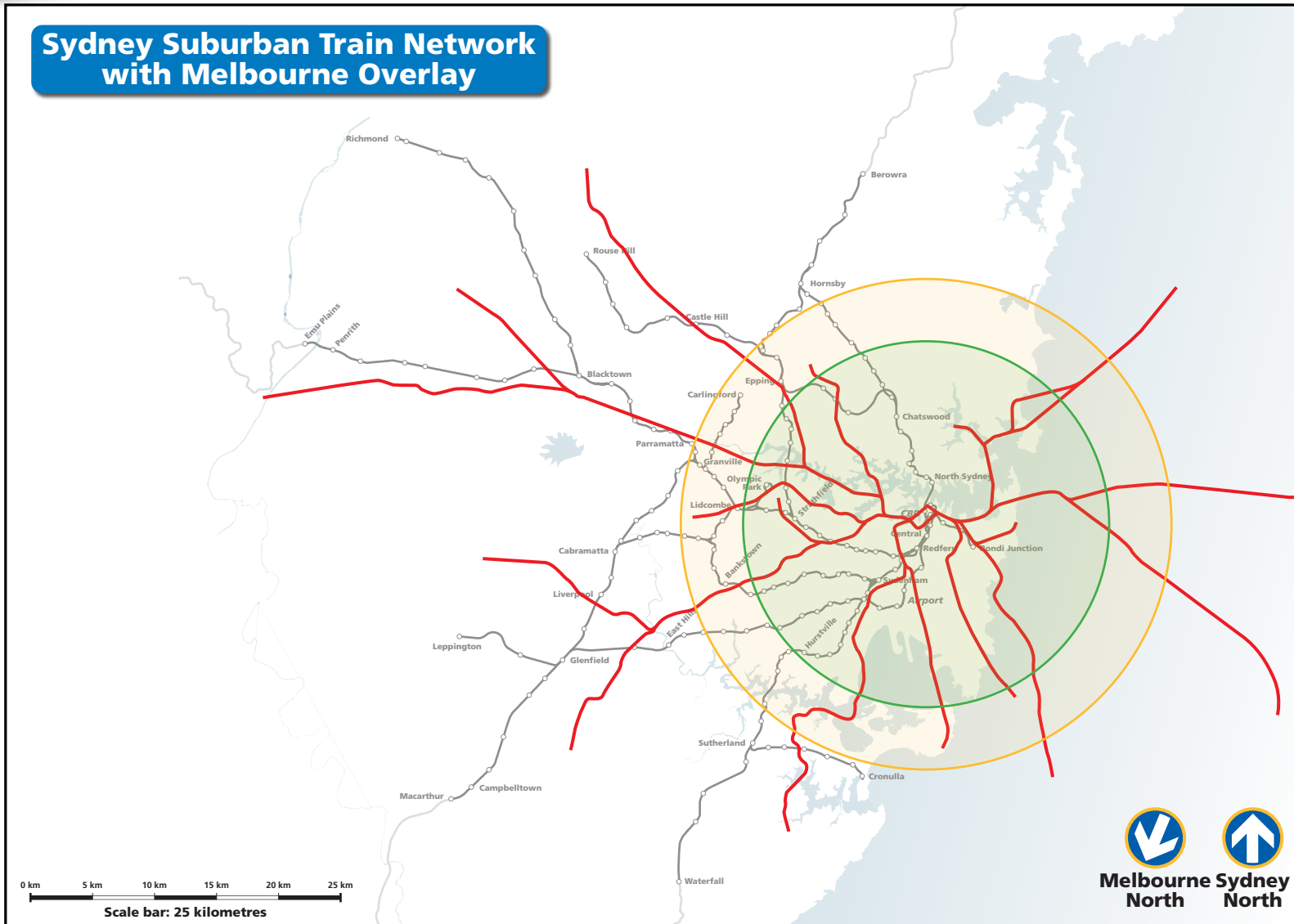
Line length and station spacing of the Suburban services are similar to Sydney's Suburban rail network – being about 50km long and 1.7km apart. The LIRR was one of the first in the world to trial double-deck carriages in the 1930s.

Most of their suburban services are now double deck.

Regional commuter lines extend beyond the suburban limits and run on the same tracks –similar to Sydney's.

This map shows the Sydney network with the Long Island Railroad suburbs overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Melbourne Overlay



Melbourne's Suburban

Melbourne's Suburban Rail Network has recently been rebranded as a "Metro" by its new contracted operator. However, it is clear when looking at the graphic to the left that this is not the case.

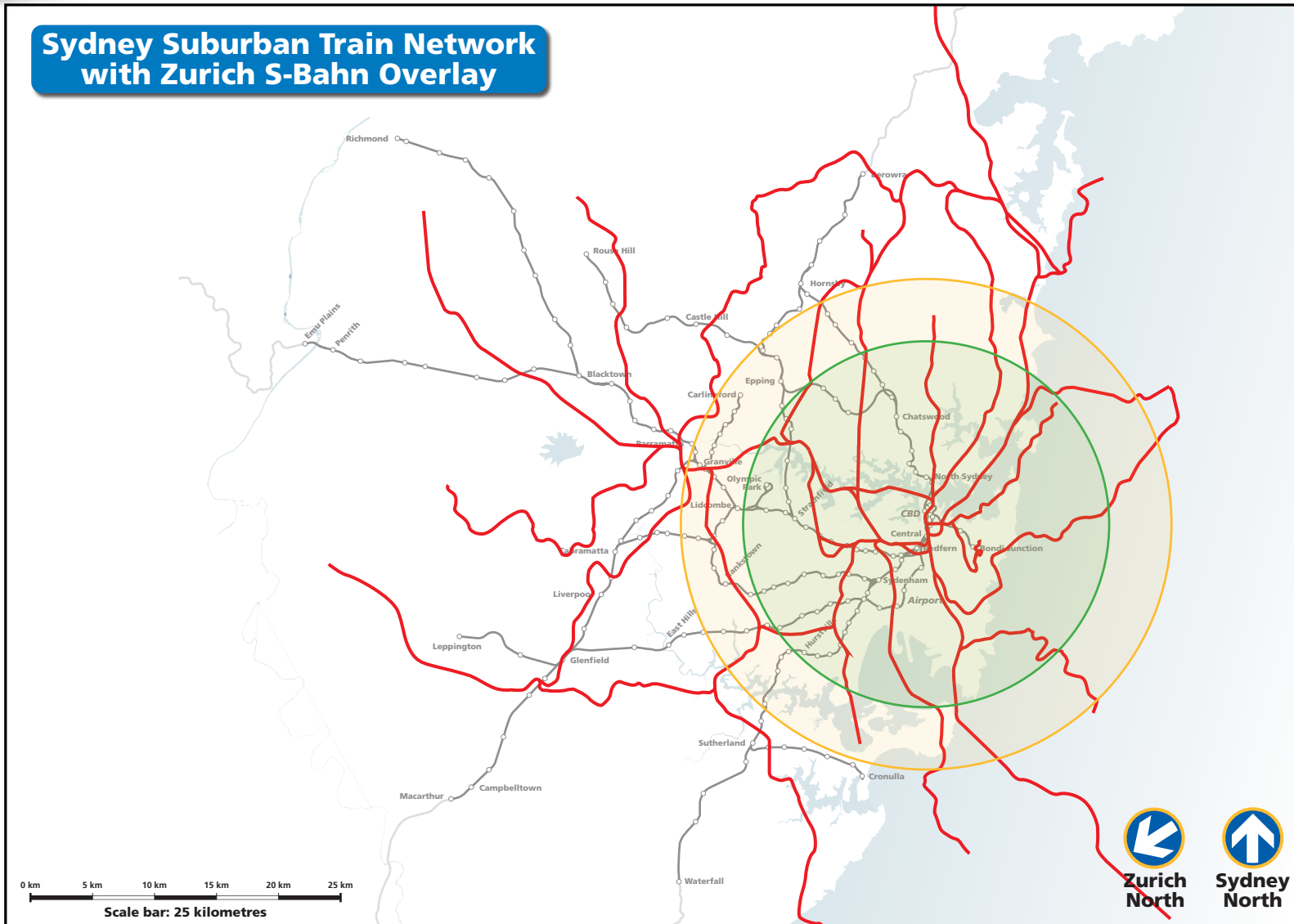
Melbourne shares similar metrics to most suburban rail networks – having multiple branch lines, a mix of fast and slow services, lines averaging 40km plus in length and average station spacing of about 1.7km.

The network is similar to Sydney's spatially, with a little more coverage due to geography (ie: there is no ocean on one side).

Double deck Tangara operation was trialed in the 1990's but was suspended after the influence of out of context "metro style" advice that used London as a reference example.

This map shows the Sydney rail network with the Melbourne suburban network overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Zurich S-Bahn Overlay



Zurich's S-Bahn

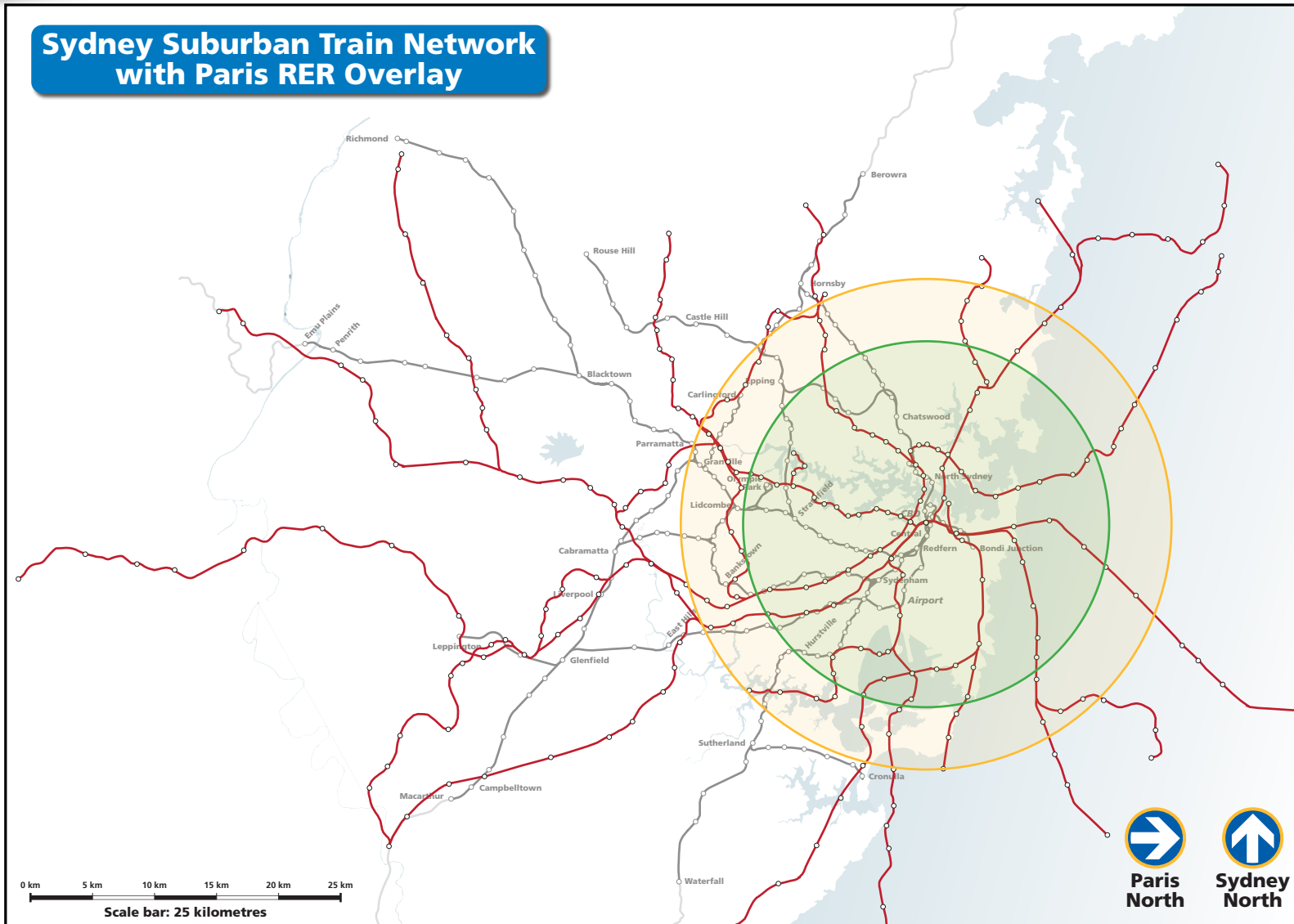
Zurich's S-Bahn Suburban Rail Network operates a minimum peak frequency of 4 trains per hour. This increases up to 26t/h on some double platformed sections of line in the core (where one track feeds two platforms). The lines are branched and average about 50km in length and the stations are spaced on average at 1.8km intervals.

A mix of fast and slow services operate on all sectors and full double-deck conversion is almost complete. Some regional services also share the same tracks – similar to Sydney's.

The Zurich S-Bahn is a good comparator to measure Sydney's Rail Service Performance against.

This map shows the Sydney network with the Zurich suburban (S-Bahn) lines overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with Paris RER Overlay



Paris' RER

Internationally recognised by rail operations experts as perhaps the most “service optimised” Suburban Rail Network anywhere in the world – the Paris RER complements the inner-area Metro – by servicing the suburbs with a high capacity network.

The lines are a little longer than Sydney's, with similar branching and station spacing. A mix of fast and slow services, all through routed through the centre of Paris, makes this network the envy of any city in the world.

Double-deck operation commenced many years ago on the lines where vertical height clearances allowed.

The RER is the Suburban Railway benchmark for international comparisons.

This map shows the Sydney rail network with Paris' RER suburban network overlaid. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Suburban Spatial Metrics Review

This completes the review of Suburban Rail Network spatial metrics.


What can be concluded from the sample of frequently referenced suburban rail networks is the following:

- Suburban networks consist of branched lines, preferably bundled into operational sectors
- Lines are usually at least 15km long out to 60km from the CBD
- Station spacing ranges from 1500m to 2km and averages about 1700m

What can not be seen from the spatial analysis but is also common to suburban rail services are:

- An average line speed (including stopping) of about 40km/h (almost double that of Metros and essential for covering the longer distances quickly)
- A mix of fast and slow services operating on the same tracks (this increases the average speed of services)
- Most networks have converted to double-deck where height clearances permit (providing more seating essential for longer journies)
- Reliable track capacity is usually set to about 20 trains per hour, divided into stopping pattern groups of 4 trains per hour each (this makes for easier “memory” timetables).

It is the high seating volume and faster services that together make Suburban Rail operation more suitable for the longer lines servicing suburbs beyond 15km.



Review of The London Underground's Spatial Metrics

The London Underground – Blurring the Boundaries

An examination of the London Underground provides some insight as to the cause of the common confusion regarding service and infrastructure delineation between Metro Railways and Suburban Railways. Prior to the London Underground becoming a single entity in 1933 there were a number of separate, privately built, railway companies competing for market share. The lack of centralised planning resulted in some “predatory” behaviour. One result of this behaviour was line lengths on some lines far exceeding the operational reliability of the Metro Style service originally adopted.

At that time, Central London’s rail lines had three distinct operating styles:

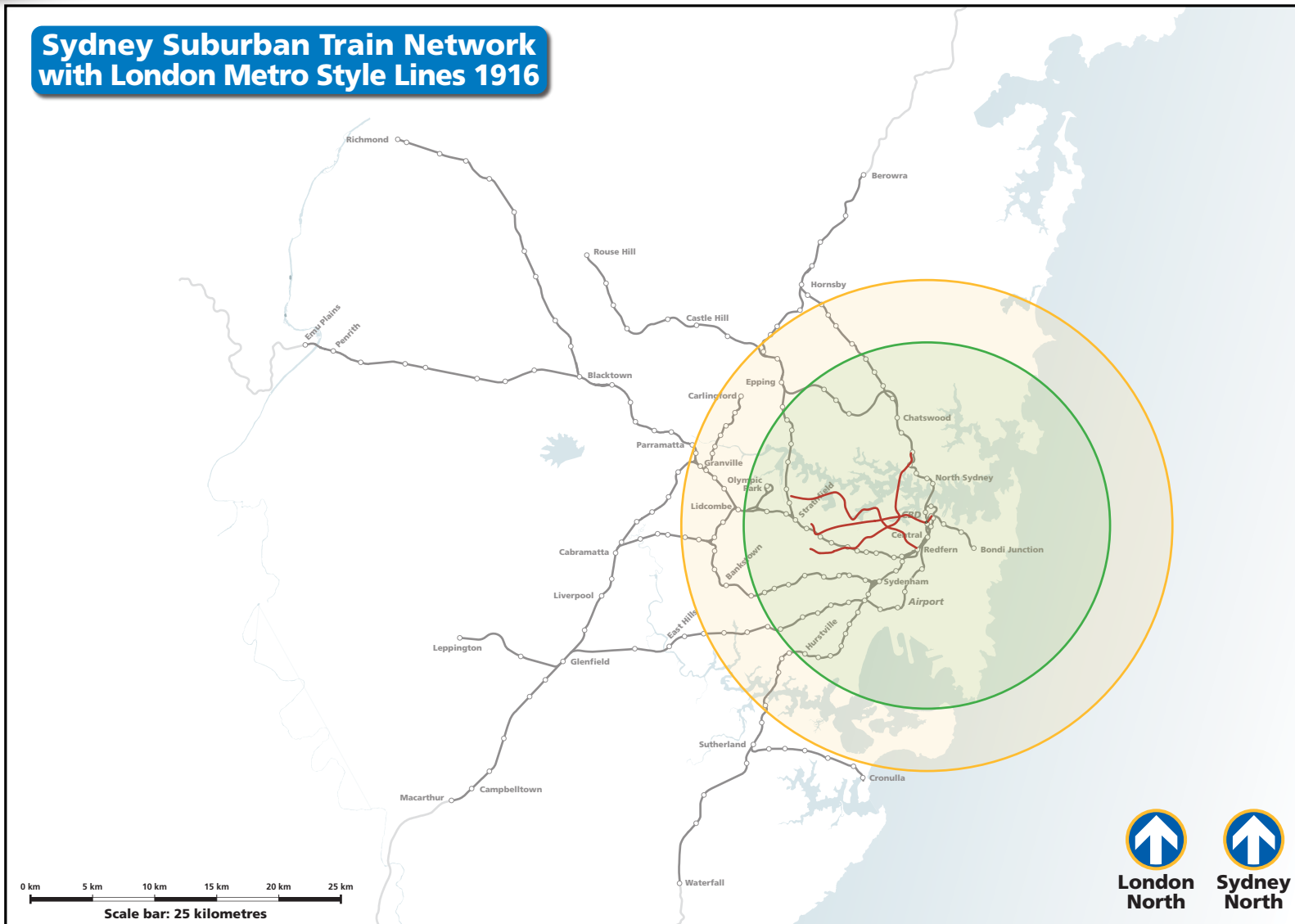
1. the true “metro style” lines (3 tubes – Bakerloo, Central and Piccadilly – pre 1916);
2. the Northern line with its metro scale infrastructure but complex service patterns; and
3. the Metropolitan/District group with its typically suburban line lengths, branch lines and mix of fast and slow services.

The period post-unification (co-branding) in 1933 has seen centrally planned additional lines and some branches exchanged between suburban style and metro style lines – further blending the previously more distinct service type boundaries. Branded as a single service provider, the combination of these three distinctly different railway operating styles and infrastructure scales – blurs the service delineation boundaries traditionally used to better identify customer focused service factors.

Subsequently, this has lead to a blurring of the role provided by the separate service styles and the misconception that “Metro Style” operations are well suited to operate on Suburban length lines. More detailed examination of the London Underground – line by line – reveals that the different service styles still function somewhat seperately – especially on the longer Suburban lines where Suburban style operations continue today. Without close examination these now subtle service deliniations are not apparent.

London's Early Metros in 1916

Sydney Suburban Train Network with London Metro Style Lines 1916

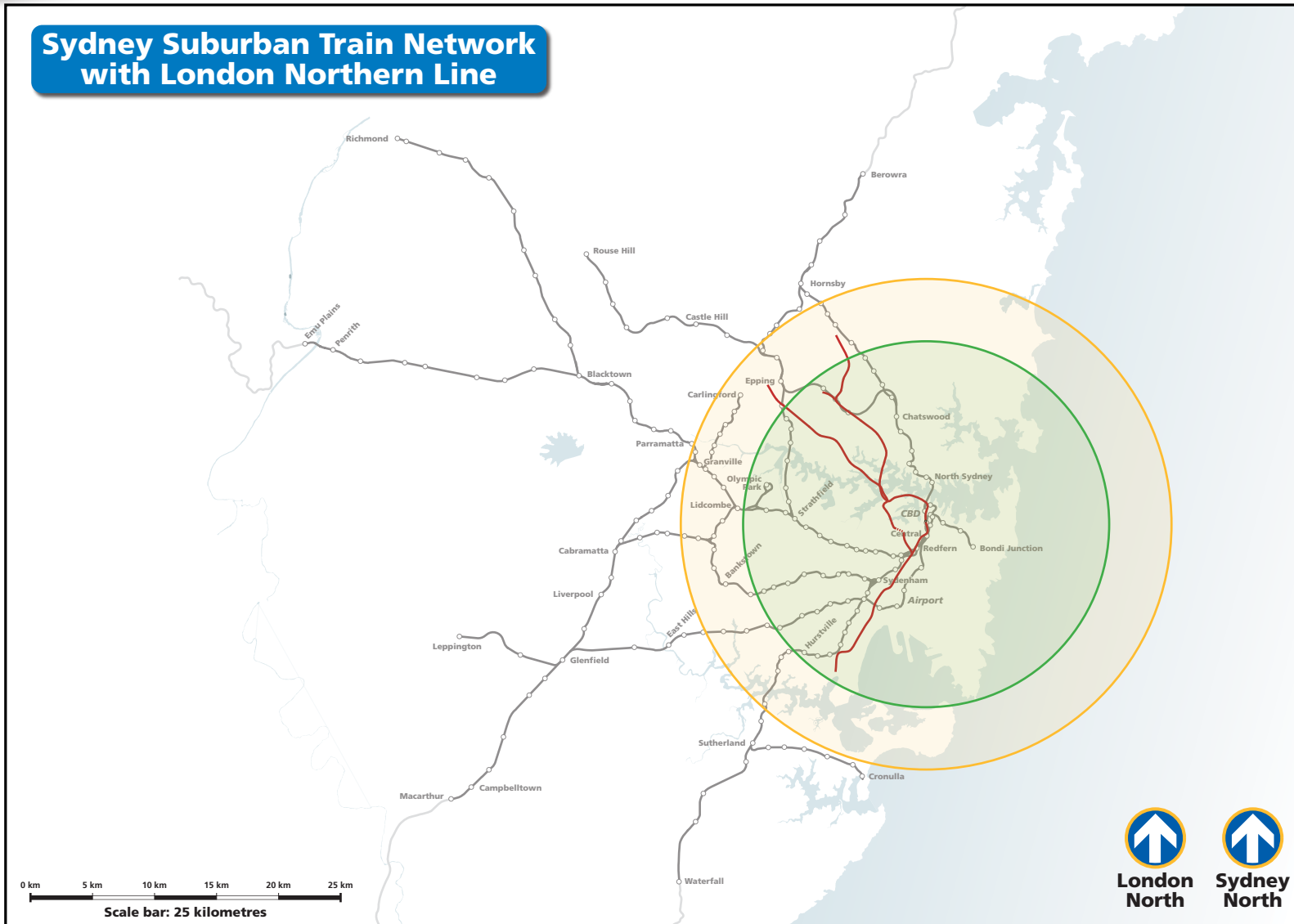


Three of the original privately built Tube lines were the Bakerloo, Central and Piccadilly Lines. Until 1916 they were configured in the typical Metro fashion, being short inner-city lines (less than 12km from the core), with close station spacing (about 600m). After the WWI they were extended to compete for patronage with the suburban style operations of the Metropolitan line and in 1933 they were fully taken over by London Underground.

After the co-branding in 1933 some branches of the Metropolitan and District Lines were taken over for suburban length running by these 3 metro style lines – this started to blur the previously clear service style delineation boundaries.

This map shows Sydney overlaid with the Bakerloo, Central and Piccadilly lines at 1916. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with London Northern Line



London's Northern Line

The Northern Line has always been an operational oddity. This is because its lines were built using typically Metro scale infrastructure, but they were extended early into the middle distance suburbs (17km out) to capture market share in a rapidly growing pre WWI London.

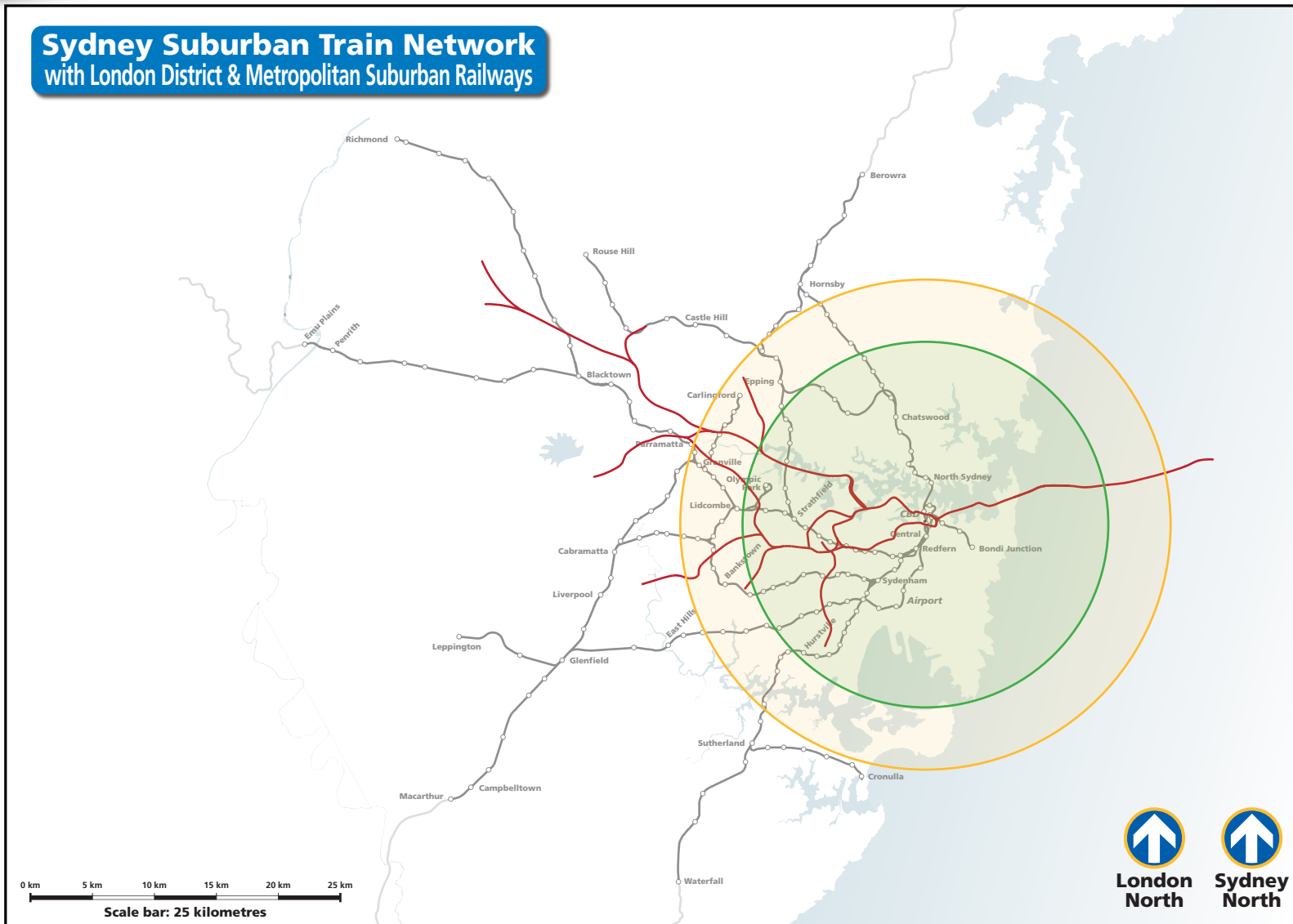
The resultant branching, both in the city and in the northern suburbs, leads to the need for a complex "X" shaped operating pattern – a response more typical of suburban railway operation. These complex operating patterns result in this group of services being some of the least reliable in the London Underground network.

Stations are about 600m to 700m apart – being typically metro.

This complex configuration is the result of independent competition, and is not likely to have resulted from rational integrated service planning.

This map shows Sydney with the London Northern Line "Metro Style" infrastructure. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Sydney Suburban Train Network with London District & Metropolitan Suburban Railways



Metropolitan and District

The Metropolitan and District lines were never configured to operate like Metro Lines, and hence they don't. The companies that built them had aspirations to become main line railways.

The lines are long, averaging over 25km in length from the CBD (some almost 40km), and station spacing outside of the shared "London Circle" line is about 1.3 km apart. The multiple branching and mix of fast and slow services on some lines are also typical of Suburban railway operation.

Their co-branding into the London Underground in 1933 resulted in a new Operator with a wide variety of operating styles under the one banner. For some observers this may have further obscured the service delineation boundaries.

This map shows Sydney with the London Metropolitan and District "Suburban" Lines. The green circle is 15km radius from Town Hall and the yellow is 20km radius.

Some Examples of Networks that Blur the Boundaries and Why

Every network has its achievements in customer experience – and its failures and constraints from poor planning – that cause unreliability and systemic poor service. In this, each network can inform the other, but also misdirect.

Singapore – as an island City-State – lacks the main line railway system from which it could have grown a suburban rail network, and has “inner-city” densities in areas almost 20km from the core. This unique problem is addressed by a “Metro” network with an exceptionally wide geographic coverage. This is an effective solution given Singapore’s needs but does not represent ideal practice for another city – one that already has a pre-existing Suburban Rail or a compact Metro network – and that is considering adding the other. Where the role of the existing service is already clearly defined then the role for the other should be also. In this regard Singapore does not represent a sound example as it is trying to be both.

This is not to say that they did not chose the right option in Singapore, however, only in a city with geographic constraints and developmental circumstances similar to Singapore’s would such a hybrid solution have worked.

Further to the confusion generated by the co-branding of operating styles in London, the New York Subway has itself endured a similar blurring of the roles of Metro and Suburban railway services.

The New York Subway is an excellent example of how poor foresight can ultimately lead to compromised outcomes many years into the future. Had the original creators of the independent subway companies not been competing with each other (to keep costs down and patronage up) they might have foreseen the ultimate scale of the railways that their efforts would achieve – and chosen the scale of their infrastructure differently.

The need to expand outwards into the growing suburbs to the north and south east beyond Manhattan Island necessitated the extension and branching of the Metro Style Subway lines well outside of their reliable service limits for such slow all stops services. To alleviate the overcrowding, and increasingly longer journey times, some sections of track were “quaded” from two to four track lines, creating fast and slow tracks. This allowed express trains to operate around stopping ones. From this point onwards the network was operating more like a Suburban Railway – with long lines out to 30km, multiple branch lines, and fast and slow tracks with mixed stopping patterns on the same line. The NY Subway’s operations are arguably more complicated now than many of the world’s Suburban Railways.

It is important to remember that you can only extend what you have already got. It is unlikely that the original builders of the NY Subway would have chosen such a constrained scale of infrastructure and rolling stock had they foreseen the eventual extent of their network. However, at that time, Suburban Railways as a concept were in their infancy.

Avoiding the Blurred Delineation Boundaries

The London Underground's hybrid service style functions well for London, but it is not the ideal network or service outcome for the markets it serves – that is, it is not the ideal outcome that a central, whole of network planning process, would have delivered. London Underground is a success as a whole, but this is due in part to its co-existence with parallel Suburban and Regional rail services and 100+ years of rail planning and social demographic responses to its limitations.

Many networks have – for their own geographic reasons – needed to blur their service outcomes. However, the use of London – or any other network – as a reference “out of context” will result in servicing concepts that produce lower customer experience – often with both higher construction and ongoing operating costs than the better alternatives.

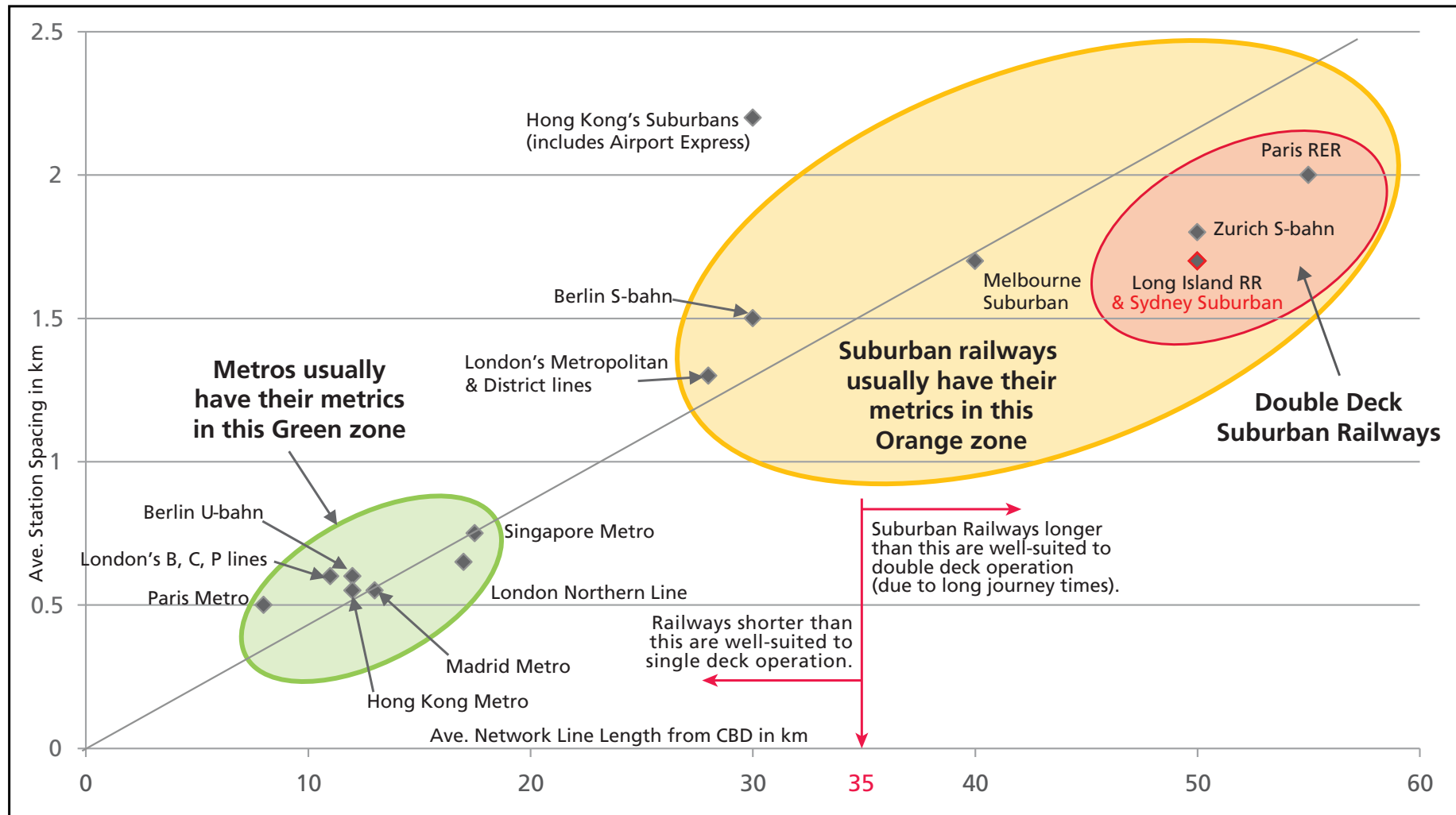
The casual observation of reference networks such as London, New York, Hong Kong and Singapore – against reviews of Sydney's network – without the due diligence for their history, performance, constraints and role in meeting overall transport demand – can offer little merit in guiding short and long term planning for Sydney's Rail Network.

Infrastructure is designed to meet specific operational parameters against the context of a strategic transport need. The blurred delineation between ideal infrastructure and service operations evident in some of the more frequently referenced rail networks is a result of shifting strategic needs, commercial and legacy infrastructure constraints, and service planning – that, in hindsight, was often less than ideal.

Sydney should learn from these examples by choosing not to emulate their mistakes. Decisions regarding Sydney's rail service outcomes need to be considered in the context of the legacy network already existing and the needs of the Customers using the service. Decisions should not be based on references to service patterns on networks that only work well in their specific context – and which would not work well in the context of Sydney's existing network and specific suburban spread. References to Zurich's S-Bahn* and Paris's RER* – with regards to network and service planning – represent a “better fit” with Sydney for comparative purposes.

* Unfortunately – it has been our experience that – many industry advisors are unfamiliar with the network configurations and operations of the Zurich S-Bahn and Paris RER networks – presumably due to the language barrier.

Urban Rail Metrics: Metro and Suburban Zones



- Notes: 1) London's B, C, P lines are Bakerloo, Central and Piccadilly – in 1916 before they were co-branded into the London Underground.
 2) The Hong Kong Suburbans include the Airport Express Line which has only 3 stations on its 30km length, raising the average.
 3) All the railways in the Green Zone display metro style operating patterns, all the railways in the Orange Zone display suburban railway operating patterns.

Comparison of Physical Metrics and Operating Patterns

The Graph on the previous page demonstrates that there are consistently and distinctively different geographic metrics for Metro railways and Suburban railways.

This aligns with their distinct operating patterns:

- The Metros are compact – they have short line lengths from the CBD with frequent stations, hence – all trains stop at all stations, train speeds are slow due to frequent stopping but journey lengths are short so a high tolerance for standing by passengers is accepted. With no line branching there is only one stopping pattern on each line and services are frequent to satisfy higher all day inner-city demand. This style of service is only well suited to high-density inner-city areas out to a maximum of 15km from the city centre.
- The Suburban Lines service the suburbs out to 50 or 60km from the CBD – the longer line lengths require much wider station spacing to help maintain higher train operating speeds over the distance. Even though line speeds are higher – journey times are much longer than for Metros – and a tolerance for standing is not accepted – hence, most western european Suburban rail networks have converted to double deck operation where physically possible to do so. The branched nature of Suburban rail networks necessitates a variety of stopping and servicing patterns with a mix of express and all stops services. This helps achieve better loading balance and faster journey times for all passengers. The frequencies of individual service patterns are therefore lower but this is a trade-off in exchange for faster and less crowded services to most CBD destinations. This style of service is very well suited to suburbs beyond 15km from the core but can also service inner areas with a limited number of all stops services. Sydney is currently one of the best international examples of how to implement this style of service pattern, perhaps only out-shone by the Zurich S-Bahn and Paris RER.

Conclusions

It becomes clear from an analysis of the physical characteristics of the Metro vs. Suburban railways that the operating patterns that have evolved on each are specific to the physical configurations and geographic spread of the networks. These operating patterns are focused on achieving the best outcomes for the majority of the Customers on each network's configuration.

Substituting Suburban Railway operating patterns on a Metro Network would simply not be possible without significantly lowering the network capacity with relatively little improvement in line speed due to the short line distances.

Substituting a Metro Style operating pattern on a Suburban railway might marginally improve line capacity (although this is also not possible if either: conversion to double deck has already occurred, or, if the tracks are shared by other service types ie: freight, regional or long distances services). However, the benefit of this slight increase in line capacity is more than lost by the significantly slower train speeds and longer journey times that a singular stopping pattern with closely spaced trains would produce for almost all customers. The outcome would be slow and crowded trains – with few seats – traveling long distances much slower than was the case with the previous Suburban Style operating plan. The extra capacity is only the result of most passengers needing to stand on what has now been converted into a longer journey.

Suburban operating patterns have evolved specifically to deliver better outcomes for passengers in terms of faster journey times and higher seating availability for the customers who need these most – those traveling the longest distances. Most passengers would agree that these benefits cannot be overstated.

About The Tipping Point Institute

The Tipping Point Institute (TTPI) is a specialist consultancy that focuses on developing and disseminating responses to the carbon constrained reality of the 21st century. TTPI is made up of a group of dedicated professionals who believe success is not found in the pursuit of personal gain, but rather in pursuing goals that benefit civil society and the international community. Based in Sydney, Australia, and with offices in Hong Kong and London, TTPI provides leadership, guidance and transformation in the following areas:

- Infrastructure;
- Tender procurement;
- Built environment; and
- Carbon economics.

TTPI believes that the right smallest adjustment can make significant change to an outcome. We provide stewardship to affect policy, planning and delivery of this transformation towards a sustainable future and see our role as leading these steps. TTPI works collaboratively in partnership with the corporate sector, institutions, governments and individuals.

TTPI is able to participate in the public policy cycle through independent analysis, drafting of reports and background papers, the coordination of issues, leadership of projects in all areas where TTPI has sectoral coverage. In supporting these processes, TTPI complements existing government structures and takes on issues management in the areas of economic analysis, government relations, stakeholder management and community consultation.

Transport planning

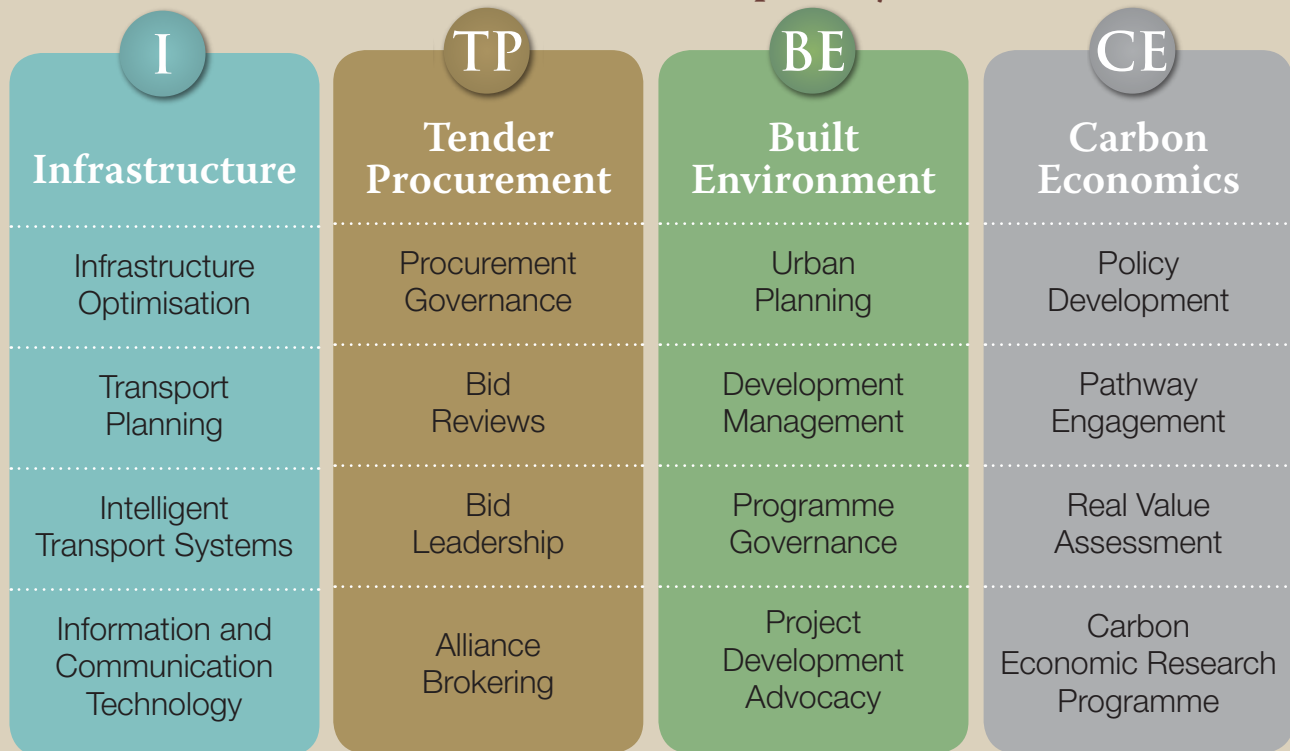
Personal transport and travel choices are one of the most significant influences on sustainability. These choices are constrained by the transport infrastructure, management and related urban planning of the cities in which we live and work.

The basis of our approach is to consider transport as a system in context of society and the city's urban plan.

The principles of a system approach are:

- Public transport as a customer focused service that considers the needs, values and expectations of the travelling public (regardless of preference, age, income or political affiliation)
- The acknowledgement that in urban areas, private modes on transport often have negative impacts on the urban form, carbon emissions and network efficiencies
- Inefficient network augmentation (often project driven) should be avoided—the focus instead should be on maximising the reliable utilisation rates of existing infrastructure
- Urban planning of residential density, employment land and nonresidential zoning as an integral consideration of transport options.

Four Pillars of Competency



Areas of Capability



Competency + Capability = Clarity

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