THE SYDNEY CBD SOUTH EAST LIGHT RAIL (CSELR): RESPONSE TO ENVIRONMENTAL IMPACT STATEMENT

BY TONY PRESCOTT

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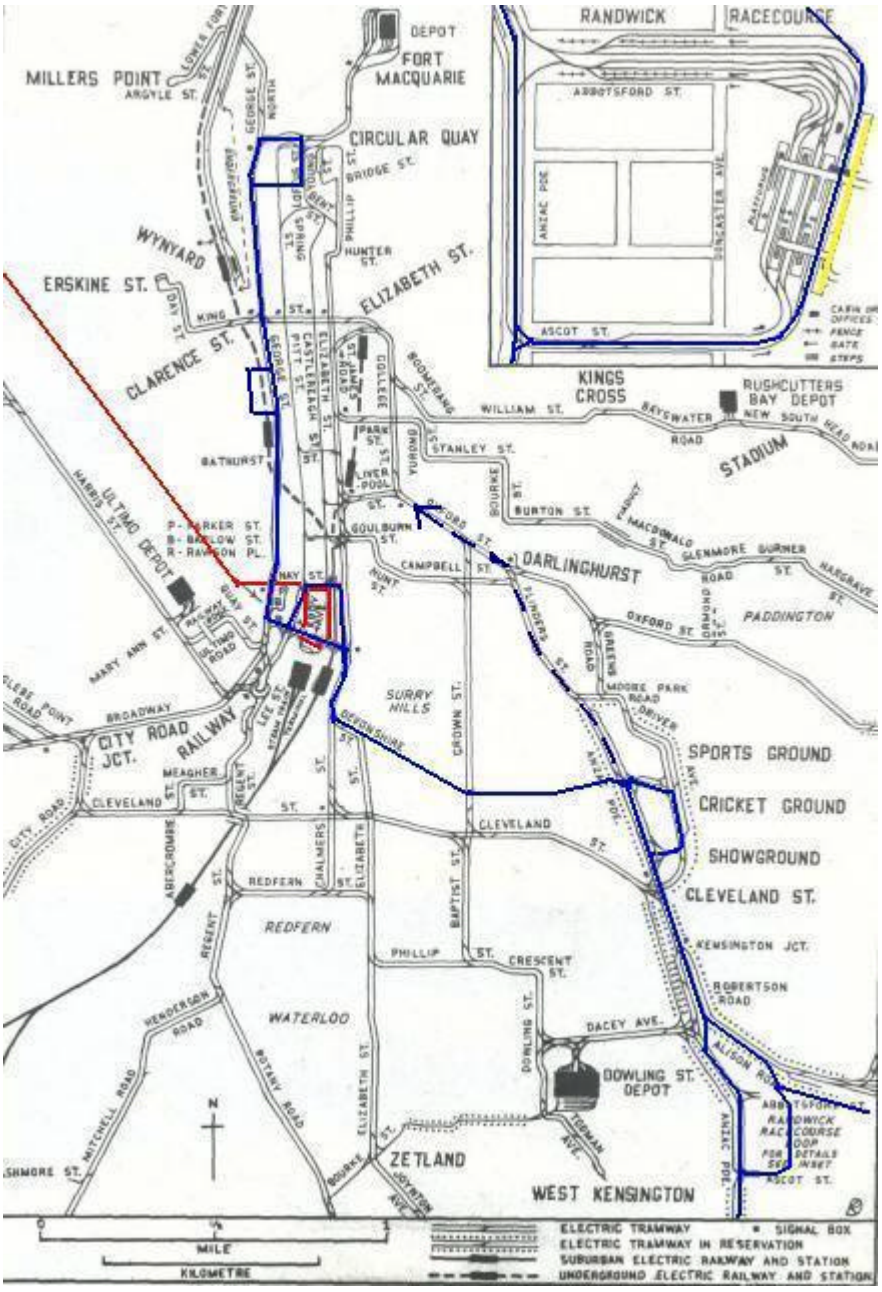

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DEFINITIONS

'Tram' - a passenger-carrying, electrically-powered public transport vehicle using steel wheels and guided by steel rails.

'Light rail vehicle (LRV)’ - a passenger-carrying, electrically-powered public transport vehicle using steel wheels and guided by steel rails.

(Note that 'tram' and 'LRV' are different names for the same vehicle, the usage depending on the conditions in which they operate.)

‘Tramway’ - a route for trams/LRVs that is largely on street and without grade-separation.

‘Light rail’ - a route for trams/LRVs that is grade-separated like a railway.

(Note that a route may be both tramway and light rail, where part is on street and part is grade-separated. The term ‘light rail’ is often erroneously applied to tramways.)

‘Reserved track’ - a section of route where the trams/LRVs operate completely free from interference by other vehicles.

‘Kassel kerb’ - a moulded facing on the operating side of a tram or bus stop platform that assists buses to stop close and parallel to the platform without scrubbing their tyres and ensuring that bus doors are the correct distance from the edge of the platform.

‘Vienna stop’ - a tram stop platform where the traffic lane adjacent to the tram track is ramped up and over the platform so that the traffic lane is the correct height for level, accessible boarding of the trams from the footpath. When there is no tram at the stop, the Vienna stop platform is used as

normal by road vehicles. When there is a tram at the stop, in accordance with Australian Road Rules, traffic must halt to allow free passage of pedestrians to and from the tram.

COVER ILLUSTRATION

The CSELR with proposed amendments superimposed on David Keenan's track map of the former Sydney tram system in 1947. CSELR is shown in blue, IWLR (SLR) is shown in red. Solid lines represent work recommended to be completed during initial construction (i.e. prior to commissioning). Broken lines indicate work for which planning should be initiated for early construction after commissioning of the initial system.

The writer has studied light rail and tramway systems for several years, including visits to systems and manufacturers in Europe. He has previously published several articles in Transit Australia on the subject and has provided advice to the Sydney City Council team preparing the original schemes and to the Transport Minister.

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1 INTRODUCTION

1.1 Background to this submission

This submission on the Sydney CBD South East Light Rail (CSELR) EIS addresses problems raised by the design of the CSELR as presently proposed and operational and user issues resulting therefrom. In doing so, it covers fundamental issues such as the capacity of the line, identifies aspects of the proposed system that are not operationally robust and makes recommendations for improvement of system design and operation, leading to an improved environmental result.

1.2 The issues

There are three major issues affecting the capacity and effectiveness of the line:

- System design
- Capacity to carry present and future traffic
- Stop design and location

Although the general proposal is accepted, due to its design the CSELR as a whole will be close to its capacity from day one and will not be able to provide much increased capacity for future catchment growth along the line or extensions of the branch lines, let alone accommodate the traffic of additional future lines feeding into it. It also has a rigid ceiling (18,000 people per hour) on the extent to which it can contribute to the objective of reducing car-use at special events that might attract up to 50,000 people. In general, it is barely capable of meeting current objectives and it is not future-proofed.

Thus, it will be essential that:

- construction be done in a way that facilitates expansion (track extension AND enhancement of capacity on current track in the future) to enable cost effective expansion as passenger demand increases in the future.
- bottlenecks are not built into the current infrastructure that precludes efficient and effective operation and expansion, as necessary, of the total system.
- design/construction activities do not introduce operational cost penalties that will increase annual operational and maintenance costs without any real benefit to government.

This submission suggests solutions that will increase the capacity and effectiveness of the operation.

Comments are also made on some other aspects of the proposal and EIS.

1.3 Summary of key recommendations

- The CSELR be redesigned as a looped system, with the initial exception that the branch-line termini at Kingsford and Randwick may remain as stubs for the time-being, with provision to convert to loops in the future (section 4.1 refers).

- All stops be designed to conventional tramway standard, that is, with side platforms, whether facing islands, staggered islands, Vienna stops or stops with platforms incorporated in the footpath (section 2.3 refers).

- Interchange with the Inner West Line be improved by relocation to the south of the Chinatown stop, if possible (section 3.1 refers).

- The Queen Victoria stop be relocated north of Market Street, more centrally to its catchment and the major retail precinct (section 3.2 refers).

- Platform faces be Kassel kerbs (or similar design) to assist the operation of buses through the platforms when desired (section 3.3 refers).

- The government commissioning agency should fully inform itself of the range of vehicle design issues and solutions and use that knowledge to set standards that tenderers are required to meet (section 3.4 refers).

- Turning-traffic lanes should not be located on, nor motor vehicles allowed on tram lanes under any circumstances (section 3.5 refers).

- A flyover be built on the Kingsford branch at the Anzac Parade/Alison Road intersection and an underpass at Kingsford roundabout (section 3.6 refers).

- Planning should commence immediately for an alternative relief CBD access for the south-east line from Moore Park, via Flinders Street (kerbside tracks on the eastern side) and Oxford Street (section 3.7 refers).

- Review should be undertaken of the possibilities for diversion of cross-city traffic and doubling the length of CBD stops and the wireless power supply proposal should be abandoned (section 3.7 refers).

- The Circular Quay terminus should be redesigned as a loop via George, Alfred, Loftus and Bridge Streets, with a holding siding in Loftus Street (section 4.2.1.1 refers).

- During special events affecting the George Street line in the CBD, trams should be terminated at Central Station stop if they cannot be run through to Circular Quay, due to the difficulties of reversing trams at close headways without an intermediate loop along the line (e.g. at Queen Victoria Building) (section 4.2.1.1 refers).

- A special-event turning and holding loop should be built at Central Station, around the streets surrounding the perimeter of Belmore Park (section 4.2.2.1 refers).

- A special-event loop, with platform adjacent to Driver Avenue and a holding siding, should be built at Moore Park (section 4.2.2.2 refers).

- Randwick Racecourse special-event stop should be relocated to the west side of the racecourse on a loop around the depot – the site of the former racecourse tram station (section 4.2.2.3 refers).

- The proposed racecourse stop in Alison Road should not be a special event stop and should be relocated to the east to be more centred on its catchment (section 4.3.5 refers).

- There should be an additional stop with Vienna platforms in High Street, between Clara and Avoca Streets, as the proposed terminus stop in High Cross Park does not satisfactorily serve the hospitals and shopping centre (section 4.3.7 refers).

- The Todman Avenue stop should be relocated (as a side platform stop) south of Todman Avenue to be more centred on its catchment (section 4.3.9 refers).

2 SYSTEM DESIGN

2.1 Background

The design of the line – a stubbed system with reversing turnbacks and (several) centre-island platforms – is that of a system for a much smaller task, typical of cities with a population of under one million people, or operating only in less busy outskirts of larger cities (such as the outer suburban lines in London and Paris). The CSELR is neither robust, nor does it provide for major growth.

It is important to recognise that the CSELR will probably be the busiest new light rail line in the world, operating, as it will, into the CBD of a major world city with a population in millions. This sets it apart from any other new light rail project around the world built in the last 20 or 30 years.

The operating headways, the closest practicable for a single stubbed line, will mean that the line will be virtually at capacity from day one. A future improvement capability in peak headways from 3 to only 2.5 minutes is identified in the EIS.

This is an operationally failure-prone situation for such a vital facility and places it at risk in peak situations where there will be little or no redundancy. Also, if the operation is stopped due to some blockage or failure, or requires additional vehicle capacity, bustitution buses will not be able to operate along the tram lanes, due to the random interspersed centre-island platforms, and will be thrown into mixed traffic, with consequent delays and loss of ability to move the volume of traffic carried by the tramway. This is a lesson that should have been learned during the recent closure of the Inner West Line.

On top of this, the line has to carry special event traffic to and from Moore Park and Randwick and the provisions for that are completely inadequate, relying on the time-consuming and cumbersome process of reversing trams in dedicated stubs and without the ability to hold more than one or two trams in reserve to meet peak demands. In one case (Randwick Racecourse), the reversing stubs also force the tram stop a greater distance away from its principal daily (residential and educational) catchment. The system's limited capacity ceiling for special events will mean that it cannot contribute fully to reducing the environmental impact of other transport modes, namely cars and buses.

In addition, the line is proposed to support increased development and population density (via Urban Activation Precincts) along its corridors, leading to the desirability of extensions to Maroubra Junction and Little Bay and to Coogee.

In short, the system design is neither robust, nor has capacity for handling a future increase in traffic. In other words, it will be virtually at capacity from day one, yet its catchment has official predictions and planning strategies for significant future growth – not to mention extensions to the lines.

The underlying answer to this capacity question is to be found both in virtually all large world cities with major tramway/light rail operations, as well as in the former Sydney tram system in its busiest areas (including the CBD) – the looped system, supported by traffic light priority.

Looped systems provide almost unlimited capacity, like a conveyor-belt, as well as removing the impediment of trams reversing in the face of each other. Looped operation is the universally accepted and long-established method for high capacity tramways and the majority of the world's tram/light rail systems are looped. (The majority of them also operate unidirectional trams which have significantly higher seating capacity without losing standing capacity, are more mechanically reliable, with less downtime, and cost less to purchase and maintain, something that Sydney should consider as the system is extended.)

The more-recent popularity of stubbed systems in new tramways/light rail is often a result of these systems being designed by people with a heavy rail background, who tend to dismiss the need to draw on the vast knowledge and experience of older, large operations. Alternatively, some systems (e.g. Melbourne) have branches at both ends of a line (e.g. Swanston Street) that can disperse trams and spread the headways so that trams can be reversed in an achievable time. Stubbed design has so far worked for most new light rail systems only because they are mostly smaller systems with a lower demand. If their demand grew to the levels of major tram cities, they would face capacity problems. CSELR will not be one of these lower-intensity small systems and does not branch at one end of the line.

The stubbed system-design is a major constraint on the CSELR. Some background is given in section 2.2 and specific solutions are suggested in Section 4.

2.2 Performance and capacity issues for modern "light rail"

Broadly speaking, there are two types of street-tram operation in the world. The vast majority – and biggest carriers – are the so-called legacy systems that have been long-established, often for over 100 years, and have decades of institutional knowledge and experience to draw upon. These are concentrated mainly in Central and Eastern Europe (roughly from Germany to Russia).

The other type is the new tram systems – often erroneously referred to as "light rail" (which is actually an operation that is usually over longer distances at higher speeds in railway-type reservations). In many cases, an operation mixes the two types, partly on-street and partly on grade-separated reservation, such as Calgary, Manchester, Croydon, Prague, Karlsruhe, Vienna and the Sydney (Inner West) Light Rail.

The new systems are often designed and operated without reference to the experience of the legacy systems and so fall short in performance. Often, the consultants involved have only a heavy rail background. As a result, the tramway design and operational

arrangements can be strongly influenced by heavy-rail practice, resulting in them being over-engineered and with cumbersome and unnecessary operational practices, such as railway signalling. Many of these new systems are quite slow, in spite of having dedicated tram lanes/rights-of-way and modern vehicles with good performance capabilities. With rare exceptions, the new systems should not be used as operational models.

Sometimes this poor planning can lead to major problems, like the Adelaide system that was overwhelmed by demand, far beyond that predicted, from inception and subsequently experienced 10% per annum patronage growth. There was much negative press about the overcrowding and additional trams had to be ordered, which took a long time until delivery. This is a common situation for new light rail systems and must be anticipated on CSELR.

The major looped systems are capable of outstanding performance and capacity potential, as trams can move at very close headways, limited only by stop dwells and traffic light cycles. Headways of 30 seconds or less are possible on such systems (indeed practised on a daily basis in some cities), giving the operation the opportunity to respond to surges in demand. A well-known recent example is the Prague tramway system, which had to take over the function of metro lines closed by two flood events during the last decade. The system normally moves over 350 million passengers per year, but on those two occasions it is estimated that its patronage roughly doubled on a pro rata basis.

Another example is closer to home where the former Sydney tramway system (which, at its height, moved 400 million passengers per year) moved massive special event crowds between Moore Park sporting and entertainment complex, Randwick Racecourse and Central Station and the CBD, again by means of looped lines. Record daily tram movements were 175,000 people for Moore Park and 110,000 people for Randwick Racecourse. The racecourse stop could load 1,000 persons per minute, while at the racecourse and Moore Park storage sidings could hold 280 and 200 trams respectively to feed into the loop when required. Simultaneous events at both venues would result in the movement of over 250,000 people in one day, in addition to regular route services along the same line. A record load of 56,000 people from a match at Sydney Cricket Ground was lifted in 25 minutes.

It is noted that the CSELR proposal includes an objective to replace substantial car, bus and pedestrian movements to these venues and, subsequently, there is a current proposal for an annual music concert at Randwick Racecourse that is expected to attract up to 50,000 patrons per day. Yet, the system will have a rigid capacity ceiling for special events (18,000 people per hour), thus will not meet the above objective and will lack the flexibility to respond to big spikes in demand that the former Sydney system and traditional European systems like Prague are capable of.

Both of these examples demonstrate the extraordinary lifting ability of trams/light rail, if not subject to artificial constraints like reversing stubs on single lines. Such achievements are only possible when loops are provided at termini, so that cars can run in continuous conveyor-belt fashion, unless the core line is split into branches at its outer ends. The CSELR is split only at one end and the other end is a CBD terminus.

Figure 1: Trams in Prague substituting for a closed metro line during floods in 2012. This is not a tram jam, the trams are moving like a conveyor belt, something only possible with a looped line or a line split into several branch lines at both ends with each branch line in turn having reversing stubs of sufficient capacity. In events like this, traffic light priority is also given to the trams.

Another constraint will be the wireless power section in the CBD that will enforce – through need to recharge – stop dwells of probably about 40 seconds, twice as long as the maximum desirable stop dwell for a tram, and a longer enforced dwell at Circular Quay, preventing quick turnaround. This is in addition to the environmental disbenefits associated with batteries, lack of ability to regenerate energy and higher whole-of-life costs.

It is systems like Prague and the former Sydney tramway that the CSELR should be modelled on, not new light rail systems carrying a fraction of the potential patronage that Sydney will need to cater for. The figure of 30 million passengers per year cited in the EIS should only be a starting point for a catchment like that of the CSELR, given the future development proposed along the corridors. Yet the proposed system design will ensure that, when built, it will be not far short of a rigid capacity ceiling and that alternative transport systems, such as a metro line, will have to be considered in the future. This does not encourage a good business or environmental case for the CSELR; indeed suggests that it is being designed to fail.

2.3 Centre-island stops and their alternatives

Apart from the stubbed design, the use of centre-island platforms is another serious impediment for the CSELR, as presently designed. The issues with centre-island platforms are outlined below.

Centre-island platforms have no history of use on tramways, which traditionally have their access oriented towards the footpath (nearside) where pedestrian/passenger activity is located. They are heavy rail practice, used exclusively to save costs of access stairs, lifts, buildings etc. Heavy rail systems have more lateral space available to create larger holding areas on island platforms than tramways, which are constrained by roadways on either side.

The recent upsurge in use of centre-island platforms on new light rail systems is a result of design by heavy rail expertise with no understanding of tramway operation, a desire to save construction cost and pressure by road authorities to minimise lateral space encroachment on road lanes. However, there is an alternative that addresses the lateral space issue – the split stop, which has two side platforms longitudinally offset from each other with the tracks slewed around the stops. These can occupy less lateral space than a centre-island platform because a single side platform doesn't need to be as wide as a centre-island platform because it is catering to half the demand.

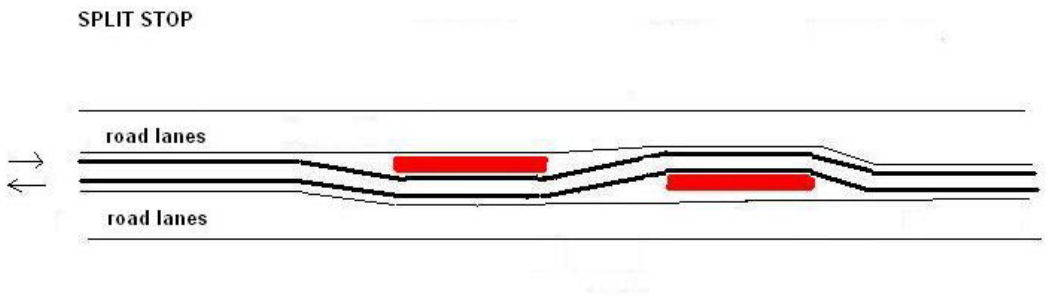

Figure 2: Stop with split (offset) side platforms

That smaller total platform footprint of a centre-island (compared to two side platforms) means less space on the platform for a crowd of passengers and having conflicting flows clashing, rather than being separated. The centre island has to handle twice as many people as a side platform, without the advantage of twice as much width, because it is used to reduce lateral width. If a tram in one direction is loading or discharging a particularly large load, a tram in the opposing direction may have to stand off the platform until the crowd clears (observation from Adelaide). This undermines on-time running.

There are significant safety issues associated with centre-island platforms. There is no fence to act as a backstopper to prevent people being pushed off the platform by a crowd. Trams on centre-island platformed systems (like Adelaide and Dublin) have recorded incidents of wrong-side door openings, meaning there is a safety hazard of passengers (particularly young children) unwittingly stepping out into road traffic. As failsafes, fencing would be needed between the tramlines and the traffic lanes and trams would need to be fitted with software that remembers the route and ensures that the doors are opened on the correct side – an additional upfront and ongoing cost.

Buses cannot access centre-island platforms and therefore cannot run along the tram lanes should that be required for easy interchange, supplementing fleet shortages or for bustitution when the trams are not operating. This is a growing practice on European tramways as it maximises convenience for passengers, frees buses from the constraints

of mixed traffic and avoids the need for construction of expensive and space-consuming interchanges. Side platforms are necessary for buses in tram lanes.

When the platforms are alternated on different sides of the tram along a line, as proposed on CSELR, the latent standing (and pram etc) capacity of the tram is limited because vestibules on both sides must be kept clear. Many passengers tend not to realise what side the door is going to open next, so sometimes the door can open to reveal a plug of passengers/prams blocking it, impacting on dwell times. Passengers are deprived of a consistent (undisturbed) standing/pram refuge on the offside of the double-ended tram, a feature now common in buses and unidirectional trams.

Centre-island platforms preclude any opportunity for a future administration to introduce unidirectional trams, which have significantly more seating (over 30% more in the case of the design proposed for CSELR, important as routes are extended out into the suburbs) and are cheaper, lighter and more reliable (half as many components prone to failure), thus reducing operating costs and downtime.

Side platforms will handle large crowds without conflicting movements. A side platform is dealing with the crowd travelling in one direction only, not two – half as many people as a centre-island platform has to handle, yet the centre-island is typically little wider than a single side platform.

The other alternative to centre-island platforms in narrower (4 lane) streets is the “Vienna” (drive-over) side platform, which also has the advantage of being directly connected to the footpath which has a larger holding capacity than an island platform. Vienna platforms are increasingly used in Europe and are now being built in Melbourne. Road traffic drives over the platform but has to obey the relevant Road Rules in respect of giving way to trams and passengers (this can be reinforced by a tram-activated traffic light at the tail end of the platform if desired). Another advantage of Vienna platforms is that they enable driveway access to properties fronting the stop to be maintained.

There are at least a couple of places on the CSELR where the Vienna platform can be used – Devonshire Street (on one side, thus avoiding encroachment into Ward Park) and High Street (enabling a stop to directly serve the Prince of Wales Hospital Complex).

Figure 3: “Vienna” platform in Prague

Figure 4: “Vienna” stop in Melbourne CBD

Figure 5: “Vienna” platform in Melbourne showing retained driveway access to adjacent property

Key recommendation: All stops be designed to conventional tramway standard, that is, with side platforms, whether facing islands, staggered islands, Vienna stops or stops with platforms incorporated in the footpath.

3 OTHER ISSUES

3.1 Poor interchange with Inner West Line

A lot of users of the Inner West Line have had the expectation of riding up the CBD to Circular Quay that they were promised for years. As there is presently no official intention to introduce an unbroken journey, it seems obvious that they should be offered a quick and convenient interchange – ideally through the same stop, or at least virtually adjacent and without having to cross traffic.

The Chinatown stop is 100 metres and a light-controlled crossing away, the Rawson Place stop a set of stairs and a similar crossing and the Central stop a set of stairs and a walk. Three opportunities - yet none provide a convenient interchange. An effort should be made at least to bring the Chinatown stop closer.

It is noted, on the other hand, that there is scope for routing some Inner West Line trams via Central Station stop to the South-east line. This could be for special events or to provide a connection to UNSW from the inner west, for example. Although the long CSELR trams will not be able to service the Inner West Line, there is no obstacle (subject to mechanical compatibility and sufficient doors) to running Inner West Line trams through to the South-east lines. Indeed, if the Circular Quay terminus of the CSELR was looped, it would be possible to also run trams from the inner west to Circular Quay, as more line capacity would be opened up (subject to traffic light cycles).

In order to avoid the sharp turn from Hay Street into George Street and the busy George Street line, this submission proposes a through-routing connection for the Inner West Line via Hay and Elizabeth Streets. This connection can also be used by CSELR vehicles proceeding to and from the Rozelle workshops. Details are shown in section 4.2.2.1 below.

Key recommendation: Interchange with the Inner West Line be improved by relocation to the south of the Chinatown stop, if possible.

3.2 Queen Victoria stop too far south

It is considered that the Queen Victoria stop is off-centre to its catchment and separated from the major retail precinct north of Market Street. It is too far from the Wynyard stop and should be relocated north of Market Street.

Key recommendation: The Queen Victoria stop be relocated north of Market Street, more centrally to its catchment and the major retail precinct.

3.3 Buses sharing tram lanes UNSW to Kingsford

The notion of buses sharing tram lanes is a sensible one and is becoming increasingly common in Europe. It provides passengers with a direct interchange - and therefore increases service attractiveness – and it removes buses from delays caused by running in mixed traffic. It can also reduce the need for separate bus lanes.

However, it requires some essential prerequisites:

- The use of tram lanes by buses must be constrained to the extent that it does not impact on tram operation.

- To this end, buses must be prepay with all-door entry (i.e. no front door-only loading) in order to match tram dwell times and therefore not hold up trams, particularly where the latter have close headways as on the CSELR. Buses have slower acceleration than trams; therefore short dwell time will be critical to minimise the risk of buses holding up trams. This will require operational reform by Sydney Buses prior to the opening of the CSELR.

- Side platforms are required at stops. Buses cannot stop at centre-island platforms. The section from UNSW to Kingsford nominated in the present proposal for shared running has a stop with a centre-island platform that the buses cannot use - which raises the question of why the buses need to use these lanes at all, if they have to leave the lanes and move over to the kerb to access their kerbside stops.

The use of tram lanes generally by buses can also arise in instances of bustitution, or supplementation of trams with buses if there is a shortage of vehicles. This is common practice in Europe and has the advantage of removing buses from delay in mixed traffic and gives them a chance to move at least something like the number of people that the trams for which they are substituting move.

The closure of the Inner West Line for three weeks in October 2013 should have been a wake-up call for light rail system designers. The bustitution on the CBD section of the line would not have been possible, at least in proximity, if the line had centre-island platforms. The other disadvantages of centre-island platforms are outlined in section 2.3, but this is a significant one of them.

It is recommended that the platforms at all CSELR side-platform stops be fitted with Kassel kerbs to facilitate the use of tram stops by buses, even if it is only occasional or rare use (the emergency use of bustitution can never be predicted).

Key recommendation: Platform faces be Kassel kerbs (or similar design) to assist the operation of buses through the platforms when desired.

3.4 Vehicle design and operational noise

It is noted that a fairly detailed tram specification is provided in the EIS. This is evidently quite specifically for a double-ended (bidirectional), multi-articulated, 40-45 metre, 7 section vehicle with 6 double and 2 single doors, such as has been selected for the Gold Coast system.

While this format is appropriate for the predicted intense use of the CSELR, it should be noted that this is not the only mechanical platform available from manufacturers and some other designs may be more effective for the job. For example, the other common mechanical platforms available are 4 or 5 section, 40-45 metre articulated trams with either bogies under each section or Jacobs bogies. These designs can be better performers on curves, for example, and can provide 8 double doors in the same length (the equivalent of one extra double door), yet similar seating/standing/total capacity. The doors are more evenly-spaced in these designs and thus enhance passenger flow and distribution. It is important that the specification be kept open to all the design alternatives available on the market.

It is also important to appreciate that the type of bidirectional tram specified will offer more limited seating capacity than the buses it replaces. The Gold Coast tram, for example, has 80 seats (not 100 as suggested in the EIS) and 220 standees – a total of 300 passengers - in its 45 metre length. In a bidirectional tram it is not possible to provide more seats without reducing the number of doors and to do so would be a fatal mistake on an operation as intense as the CSELR. In the future, as lines are extended further into the suburbs, for which more seating would be desirable, the introduction of unidirectional trams should be considered as these offer about 30% more seating capacity without reduction of standing capacity.

Tenderers should also be advised of the prevailing gradient and horizontal and vertical curvatures on the operating lines and within the depot/s.

Wireless/battery power is not recommended because it will be a significant operational impediment (via recharge time) on such a busy line, carries additional costs and risk of reduced reliability and is environmentally unsound.

In terms of operational noise, tram manufacturers tend to be quite secretive about the noise output of their vehicles (for competitive marketing reasons) and the EIS may be ambitious in seeking to reach firm predictions about noise. Yet it is a critical factor, particularly in Surry Hills, through which a high volume of trams will pass.

Wheel/rail interface noise is a reasonably known factor, but traction noise is a little more variable. Noise from motors has generally improved over the years, but trams with asynchronous motors (the majority on the market) still have gearboxes and these are a variable factor as many gearboxes can become noisier over time as they wear and loosen up. So the tram may become noisier after a few years' operation than when it was new, something that would only be deduced by going to Europe and observing the vehicles in operation.

One tram model (Skoda 15T, operating in Prague and Riga) has synchronous permanent magnet motors without gearboxes and is well-known (confirmed by this writer's direct observation) for being almost silent, bar the rolling noise of the wheels – probably the quietest tram on the market, something the government might consider when looking at tender proposals.

The other significant tram-noise factor on new systems (assuming otherwise good track-condition) is wheel-squeal on curves. Fortunately, there is little significant curvature on the CSELR and squeal will depend on variables like whether the bogies are fixed or swivelling or on the geometry of the vehicle design. This varies between manufacturers.

An open mind should be kept on vehicle-design solutions for noise abatement and tendering consortiums that are tied with one vehicle manufacturer should ensure that the selected vehicle meets noise objectives. Not all trams are the same.

Key recommendation: The government's commissioning agency should fully inform itself of the range of vehicle design issues and solutions and use that knowledge to set standards that tenderers are required to meet.

3.5 Turning traffic in High Street at Botany Street

It is noted that it is suggested that motor vehicles will be allowed on the tram tracks to turn right from High Street to Botany Street, Randwick. This is an unfortunate precedent and contrary to modern tramway practice. Vehicles should wait in the lane to the left of the tram lane to turn, regardless of whether other traffic has to wait behind them. This can be readily resolved by clearing traffic ahead of the arrival of a tram by a green light, then holding right-turning traffic on red so that the tram can pass on full priority. It is essential that tram lanes be separated from general traffic lanes by berms so that general traffic is kept off the tramlines, while emergency vehicles can cross the berms if necessary.

Key recommendation: ***Turning-traffic lanes should not be located on, nor motor vehicles allowed on tram lanes under any circumstances.***

3.6 Traffic light priority and grade separation

The proposed end-to-end journey time of 30-34 minutes is somewhat slow for a tram line of this length and number of stops, compared to European equivalents, but is better than the original prediction and hopefully can be shortened further. It is not so much maximum speed that assists tram performance, but the contribution to raising average speed of the exceptional acceleration/deceleration capabilities of the vehicles and the short dwell times – if enough doors are provided. Stop dwells should typically be in the order of 10-20 seconds. However, traffic light cycles also have a bearing on journey time and if trams cannot receive the desirable full light priority, then, depending on the degree of delay incurred, consideration needs to be given to grade separation at intersections.

It is noted that the predicted journey times take into account traffic light cycles, but the writer has some doubt that the lights at the Anzac Parade/Alison Road intersection would work well for trams as the intersection must already be near capacity. Similarly, the Kingsford roundabout has potential to cause delay. Full light priority for trams (particularly important for special-event trams) may be difficult to achieve in some cases.

It is strongly recommended that a flyover be constructed on the Kingsford branch at the Anzac Parade/Alison Road intersection and an underpass at Kingsford roundabout.

Key recommendation: That a flyover be built on the Kingsford branch at the Anzac Parade/Alison Road intersection and an underpass at Kingsford roundabout.

3.7 Capacity of the George Street line (Circular Quay-Central Station)

Looping of the system will considerably augment the potential capacity of the George Street section of the line. However, it is obvious that other measures will be necessary to maximise its efficiency and enable future system extensions to be linked to it:

- Planning should commence immediately for an alternative relief CBD access for the south-east line from Moore Park, via Flinders Street (kerbside tracks on the eastern side) and Oxford Street, where it would merge with a future Bondi line. Initially, about 10 trams per hour could be diverted along this route and the tram lanes can be shared by buses until the Bondi line is built.
- Provision for cross-city vehicular traffic should be reviewed with view to directing as much as possible into the Cahill Expressway and cross-city tunnel in order that full traffic light priority can be achieved.
- There should be no wireless/battery operation of trams as this will impinge on the efficiency and reliability of the line, among its other detrimental factors.
- The design of all George Street stops should be reviewed to establish whether they can be doubled in length (to 90 metres) in order to hold two trams at a time.

Key recommendation: Planning should commence immediately for an alternative relief CBD access for the south-east line from Moore Park, via Flinders Street (kerbside tracks on the eastern side) and Oxford Street.

Key recommendation: Review should be undertaken of the possibilities for diversion of cross-city traffic and doubling the length of CBD stops and the wireless power supply proposal should be abandoned.

4 CHANGES NECESSARY TO ADDRESS ISSUES

4.1 Line looping

Without looping or branching, the CSELR will have a fatal capacity constraint. The line will be virtually at capacity from day one with little scope for patronage growth, new extensions or achieving high levels of public transport use at special events. This work needs to be done as part of the original construction because it is highly disruptive, costly and environmentally unsound to rebuild parts of the system after a few years, as traffic increases.

The only exception in the short-term is the stub ends of the two branches at Kingsford and Randwick, which - each having half the traffic of the main trunk - will be initially adequate and future conversion to loops will not involve significant infrastructure reconstruction. If the lines are extended, these would themselves become intermediate loops.

In the case of special event operations, as it stands - with cumbersome and time-consuming reversing stubs (also requiring relay drivers) and almost no facility for holding reserve vehicles for spikes in demand - special events operations have a good chance of failing in their task in extreme situations. As much as the rest of the system, the special-event operation requires the conveyor-belt effect of the loop.

Other issues with the special event provisions are:

- At Moore Park there is a long walk to the venues and the necessity to cross tram tracks, apparently requiring an elaborate overhead pedestrian bridge structure with lifts at the Moore Park stop. This is heavy-rail thinking at its worst and has no place in tramway design which is, in principle, light and accessible.

- At Randwick Racecourse, the long reversing stub forces the stop some 100 metres further west, away from its regular daily catchment - the residential and educational precinct east of Darley Road. As a result, this precinct, almost in its entirety, will be beyond the 400 metre catchment. Yet it is a daily passenger market, unlike the racecourse, which is used only two or three days a month. A case of the tail wagging the dog. In addition, like Moore Park, passengers are expected to cross tracks from one platform.

Also, at the racecourse stop, there is another example of totally inappropriate heavy-rail thinking – a platform face on each side of one tramline. Like the identical proposed stop at UNSW, this is completely unnecessary as there will not be simultaneous crowds entering and exiting the trams. A pair of side platforms is all that is required here (and at UNSW).

Key recommendation: The CSELR be redesigned as a looped system, with the initial exception that the branch-line termini at Kingsford and Randwick may remain as stubs for the time-being, with provision to convert to loops in the future.

4.2 Details of a looped design

4.2.1 Termini

This section describes the basic looping requirements for the CSELR.

4.2.1.1 Circular Quay

Construction of the line at Circular Quay as a loop is a simple matter, based on the precedent of the former tramway system, the lines of which were all looped at the Quay. North of Bridge Street, the George Street line would become a single track to Alfred Street, into which it would turn to a single long-platform terminus (for at least two trams) at the northern kerb of Alfred Street, alongside the railway station.

This would return more of the Alfred Street space to pedestrian plaza and remove the "railway marshalling yard" appearance created by the present terminus design. Except as described in the next paragraph, there would be no layover at Circular Quay and the trams would loop continuously in and out. The layover (including driver rest breaks) would be at the outer termini.

In the long term, if there are new suburban branches (e.g. to inner west and South Sydney) feeding into the line, a second nearside platform could be built adjacent to the first, with each platform being dedicated to a particular route or set of routes. Passengers appreciate such consistency, compared with the present proposed arrangement in which a Randwick or Kingsford tram could depart from any of the three platforms.

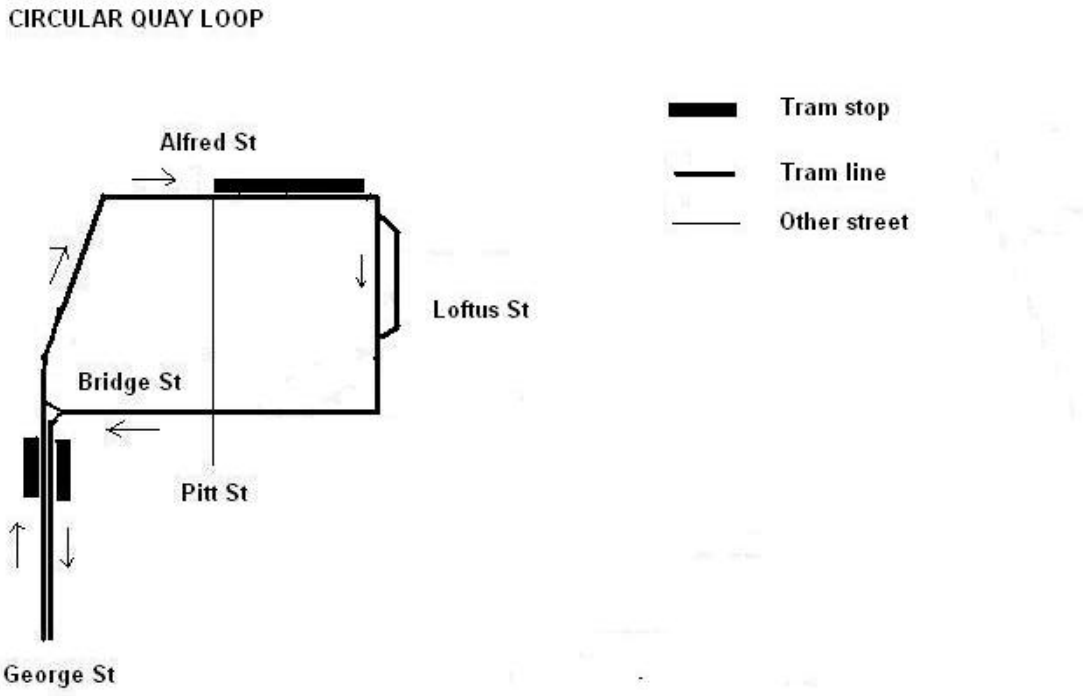

Figure 6: Circular Quay loop

After leaving the platform, trams would turn into Loftus Street, then Bridge, then back into George. (A shortcut is possible via Macquarie Place if desired.) A siding loop/layover can be provided in Loftus Street to enable any out-of order trams to pass each other, or to hold trams on standby to meet additional needs (e.g. during special events). These trams can return to the Quay on the loop via Bridge and George Streets, back to Alfred Street. In the longer term, a return on the loop can be built via Pitt Street. This would enable more trams to be held in reserve for special events and fed in more quickly.

The George Street line to Circular Quay is also affected by special event issues, described in the EIS. These involve various degrees of shortworking, with services cut back, for example, to Town Hall stop. It is considered that, in view of the close headways on the line, any attempt to short-work trams by reversing them on crossovers is fraught with risk of disruption. With such close headways, the loop is the best method of turning trams around and, along George Street, Queen Victoria Building (the site of a loop on the former system) is the most feasible location for a loop. This would be via York Street and would run anti-clockwise. It can have a dedicated terminus platform for these short-workings incorporated into the kerb on the east side of York Street.

Another option, that bypasses Alfred Street plaza, is to reopen the former Millers Point line via George Street North and Lower Fort Street to the still-extant terminus loop in Argyle Place, or follow Hickson Road to Barangaroo. This still provides a service to Circular Quay without entering Alfred Street.

The proposed special events workings in the CBD need more analysis by the proponent, in consultation with Sydney City Council, to ensure that the line is closed as little as possible. After all, of all occasions, special events are when operation of the light rail is most needed. The more people there are to move, the more public transport is required.

It is recommended that there not be an attempt to reverse trams along the route. If there is no intermediate loop inserted along George Street, then a decision needs to be made to either run trams the full way to Circular Quay or terminate them at the Central Station stop (using the Central loop) and transfer passengers to the City Circle heavy rail.

Key recommendation: The Circular Quay terminus should be redesigned as a loop via George, Alfred, Loftus and Bridge Streets, with a holding siding in Loftus Street.

Key recommendation: During special events affecting the George Street line in the CBD, trams should be terminated at Central Station stop if they cannot be run through to Circular Quay, due to the difficulties of reversing trams at close headways without an intermediate loop along the line (e.g. at Queen Victoria Building)

4.2.1.2 Kingsford

At Kingsford, there is presently plenty of room for layover sidings (and a drivers' amenity building) in the Anzac Parade central reserve south of the stop. This will cater comfortably for initial headways, even if additional peak university services from Central are inserted.

In the future, in the event of a long-distance extension served by unidirectional trams with more seating, in order to short-work UNSW services without reversing, trams can loop via

Sturt and Botany Streets, back to the central reserve between Botany and Sturt Streets. At present, however, this loop would be a low priority.

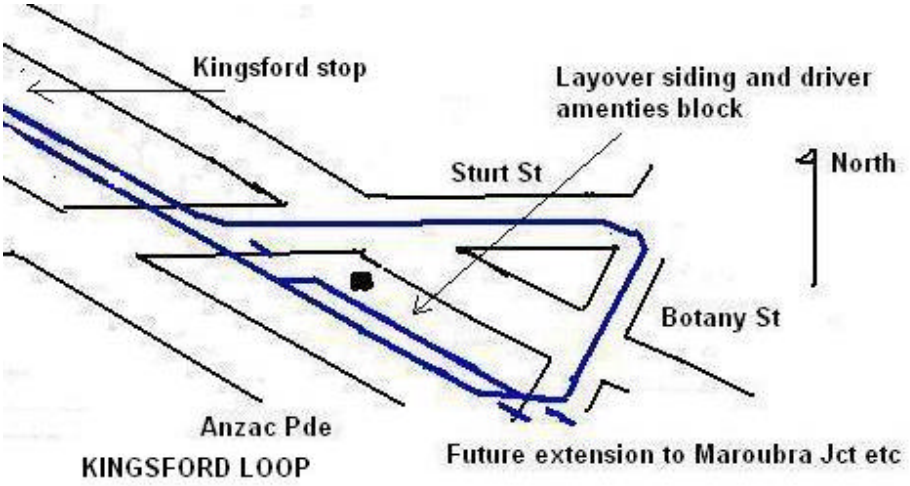

Figure 7: Kingsford loop

4.2.1.3 Randwick

High Cross Park is an ideal site for a loop and layover (with drivers' amenity building), which could be set in grass lawn and not destroy the park, as the present proposal does. It is not the place for a stop – which should be in High Street to directly serve the hospitals and shops – but it is recognised that the initial intention is to provide a bus interchange. However, if the line is extended to Coogee, the need for this interchange should significantly diminish, but the loop can remain as a turning-point, for example for UNSW peak services.

Figure 8: Stromovka Royal Park in Prague: an example of a tram layover loop blending comfortably into parkland. Tramlines and loops set into parks are widespread in Europe. This is the way a tramway should address parkland, not destroy it.

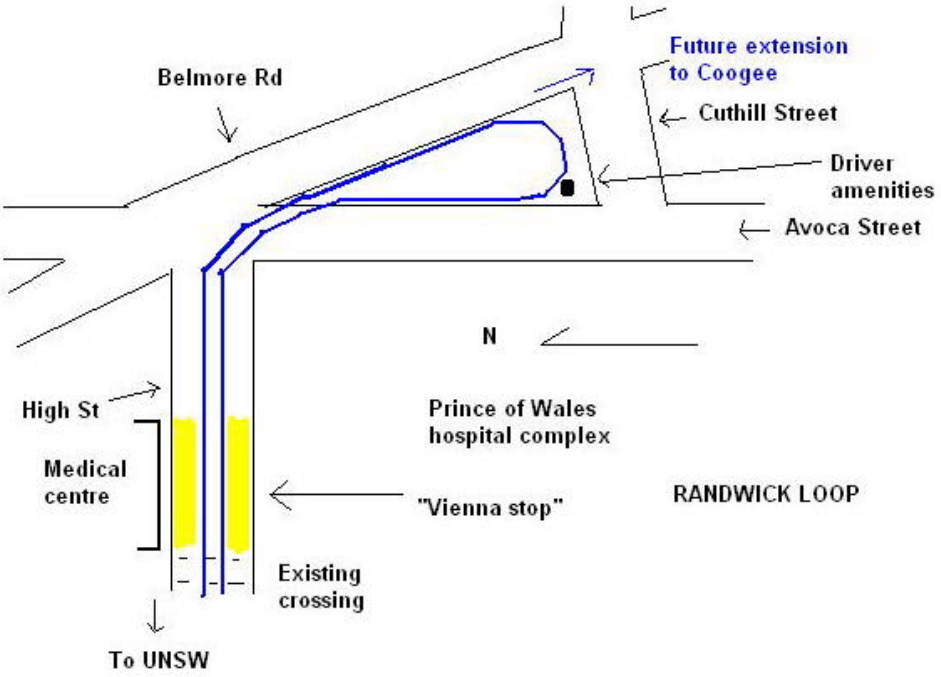

Figure 9: Randwick loop

Section 4.3.7 in this submission deals with the need for a stop in High Street which can service residual bus interchange should the line be extended to Coogee.

4.2.2 Intermediate loops

Well-designed looped systems also have intermediate loops to enable short-working, if required. These would be at Central, Moore Park and Randwick Racecourse. If it is decided to short-work trams in the CBD, a loop can be provided around the Queen Victoria Building (via York Street).

In terms of special events, the most critical need is providing for a smooth flow of trams, at extremely close headways if necessary, with a comfortable reserve available. Three loops are recommended – at Central Station, Moore Park and Randwick Racecourse. The last of these is on a relocated site, around the proposed depot – the location of the former racecourse tram station prior to 1961.

It should be noted that, in the designs proposed here for Moore Park and the racecourse - and unlike the designs in the EIS - event crowds will not have to cross tramlines (yet all movements will be on level ground and no overhead grade-separated structures will be required). This is very important as trams will not be delayed by having to move through large crowds and there will be no safety issue from pedestrian/tram interface.

4.2.2.1 Central Station

This one-way loop is proposed from Eddy Avenue, north into Pitt Street, east into Hay Street (kerbside on the north side of the street, adjacent to the Inner West Line), south

into Elizabeth Street (kerbside on the west side of the street) and across Eddy Avenue to rejoin the line at Chalmers Street.

The additional siding in Eddy Avenue can be retained to hold reserve trams on standby or can be dispensed with, but it will no longer be required for reversing. To maximise the flexibility of the loop it would have turnouts facing east and west, so that it can also be used if there is a need to terminate trams from Circular Quay at Rawson Place.

Loops can hold a number of trams on standby that can be fed into the stop as required. Being separated from the service line, trams can be stored around this Central loop (as well as in the Eddy Avenue siding if it is retained). Thus, there is no need for the additional platform face in Chalmers Street (and it can thus be permanently used as a bus stop), as trams can be fed into the stop from the loop immediately, as needed.

As there would be two reserved tram tracks in Hay Street, it is proposed that there be only one traffic lane, westbound on the southern side. There is also scope for connections via this loop to and from the Inner West Light Rail should any through-routing to the south-east be required, as outlined in section 3.1 above. A platform can be incorporated in the footpath on the northern side of Hay Street to serve the loop should it be required in any special circumstances.

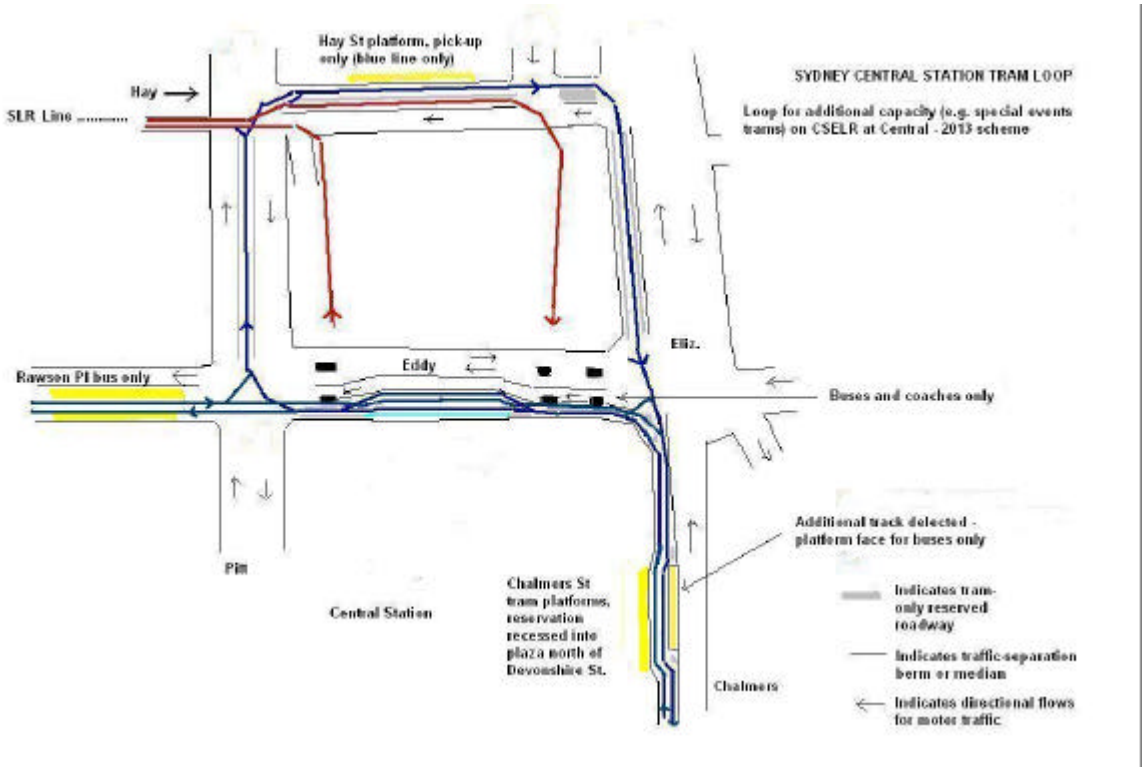

Figure 10: Central Station loop

Key recommendation: A special-event turning and holding loop should be built at Central Station, around the streets surrounding the perimeter of Belmore Park.

4.2.2.2 Moore Park

This proposed one-way loop follows the former tram loop (later used by special event buses) between Gregory and Macarthur Avenues. It would be accessed from a turnout from the Down track just before the tunnel exit (and thus grade-separated from the Up line of a future extension to Oxford Street) and would return to the service line south of the Moore Park tram stop. At this point it would also have a southward turnout so that trams can be returned to the depot or run to Randwick or Kingsford. A siding within the loop is also proposed so that a number of trams can be held on standby to feed in as required.

The tram loop tracks (like all of the track through Moore Park) can be set into grass lawn to blend with the park and, as there will be no trams on the loop outside of special events, can thus be comfortably traversed by daily workers and visitors from the regular Moore Park stop to access the entertainment quarter.

There would be a long (90+ metres) nearside platform on the eastern side of the loop, adjacent to Driver Avenue – merging into the pedestrian plaza and bringing patrons up close to the venues and without having to cross any tram tracks.

The Moore Park regular stop would remain as a stop for the route services only and would serve normal daily needs of the high schools and the entertainment quarter. An overhead pedestrian bridge at the stop would not be needed. That said, an integrated pedestrian/cycle plan for Moore Park generally – including grade-separated crossing of Anzac Parade, logically a subway beside and built in conjunction with the CSELR tunnel – seems necessary in conjunction with the project.

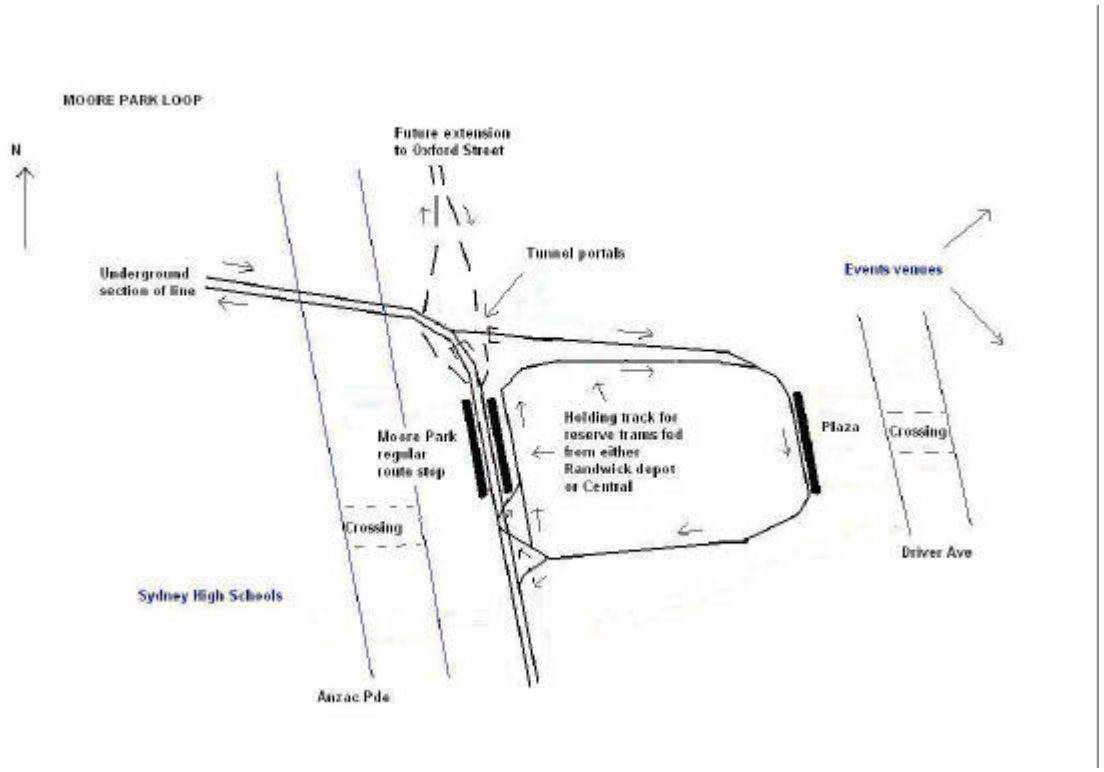

Figure 11: Moore Park special events loop and stop

Key recommendation: A special-event loop, with platform adjacent to Driver Avenue and a holding siding, should be built at Moore Park.

4.2.2.3 Randwick Racecourse

It is proposed that the Randwick Racecourse special events function be transferred from the Alison Road stop to a loop around the proposed tram depot, following the line of the former racecourse tram station around the eastern edge of the depot site. It would be a single track with a single, long 90-100 metre platform capable of holding two trams on the nearside (eastern side), facing the racecourse entrance so that patrons would not have to cross tramlines. The loop would start at the depot turnout of the Randwick line in Alison Road and has a couple of options for exiting:

- Using the loop track within the depot fan, return to Alison Road via the westernmost storage track in the depot yard; or
- Follow the former tramway alignment out the Ascot Street gate and along that street to join the Kingsford line in Anzac Parade, Kensington.

The second option is the preferred one as it also offers the advantage of providing direct access to the Kingsford line from the depot so that trams can be dispatched to and returned from Kingsford terminus. The junction of the Ascot Street track and the Anzac Parade tracks would have turnouts in both directions to facilitate this. Under the present arrangement, there is direct access from the depot to the Randwick terminus, but trams to Kingsford have to go along Alison Road to Robertson Road at Moore Park and then reverse down the Kingsford line, a very impractical and time-consuming arrangement.

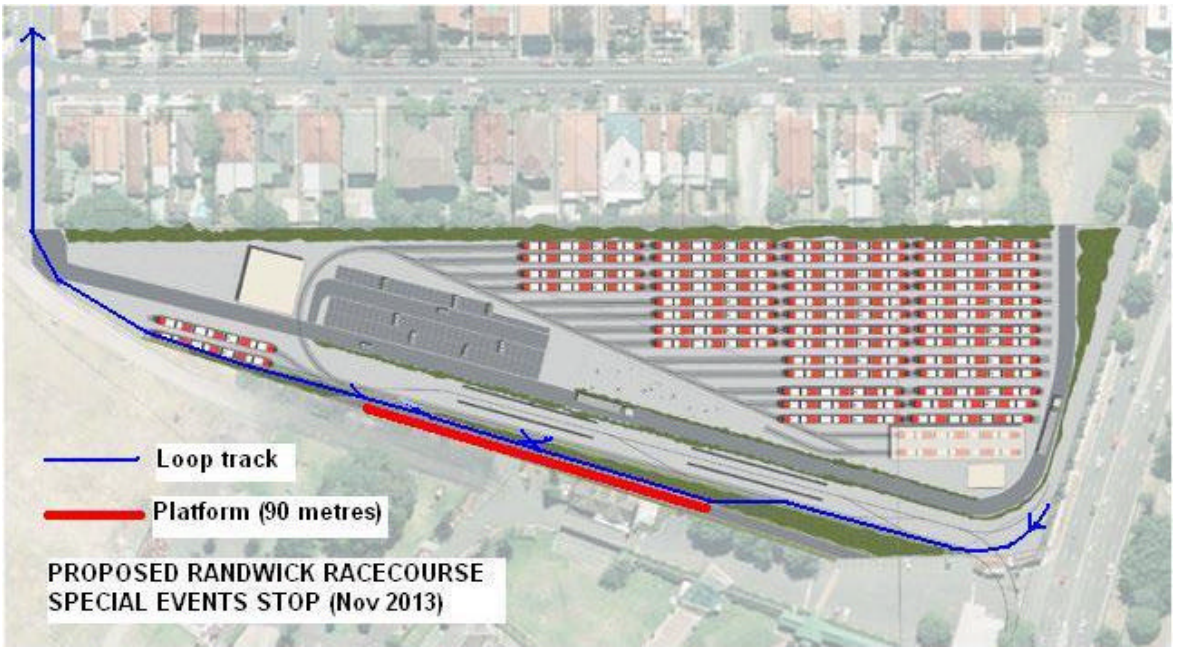

Figure 12: Randwick racecourse special events loop and stop

Minor adjustment would need to be made to the depot trackwork to accommodate this special event stop, but there is room for it and it offers advantages for normal daily dispatching and return of trams as well.

With a depot adjacent, there should be no need for additional storage tracks to hold trams in reserve at this location. If it becomes very busy in the future, trams could be looped out via Ascot Street, north into Anzac Parade and returned via Abbotsford Street where trams could be stored in sidings in the central reserve that was the location of sidings for the same purpose on the old system (see the map on the cover of this report). From there, they would be fed in via the northern depot gate (off Doncaster Avenue), as required.

The existing proposed racecourse stop would continue to provide normal daily access to the racecourse for workers and visitors but, with the elimination of the reversing siding from the plan, can be moved adjacent to the Darley Road intersection from where it can properly serve (i.e. extend the 400 metre catchment into) its regular daily market – the residential area and tertiary education campuses surrounding and between King and Cowper Streets.

This function it fails badly in its present location, where it is intended to serve an event that occurs only two or three times a month. The stop should be renamed Darley Road and redesigned with two side platforms only.

It is recognised that this Darley Road stop has potential to act as an additional special-event stop. This is not necessarily a bad thing as long as it does not inconvenience regular commuters by crowding-out the trams. If it becomes an issue, use of this racecourse entrance/exit can be restricted, depending on the size of the event crowd and whether special services are being provided.

Key recommendation: Randwick Racecourse special-event stop should be relocated to the west side of the racecourse on a loop around the depot – the site of the former racecourse tram station.

4.3 Stop design changes

Several stops have design issues that will inhibit successful operation, particularly those with centre-island platforms that need to be converted for bus access, among other reasons, as discussed previously. The relevant stops are:

4.3.1 World Square

The reasons described in the EIS for making this a centre-island stop are noted. However, it is fairly critical that it have side-platforms because of the level of activity in this section of George Street and the crowds that will come to the stop to use the tram (not to mention bustitution access). Centre-island platforms are neither safe nor efficient with large crowds. The obstacles outlined are not insurmountable and an effort should be made to overcome them.

In particular it is questioned why staggered platforms would take away footpath space when the width of the tramway should theoretically be less with staggered side platforms than with a centre-island. Also, temporary construction disruption is not a valid reason when constructing infrastructure designed to serve for generations. The time of original construction is the time to get it right – there is more disruption if it has to be rebuilt later when it is discovered that a centre island is inadequate and unsafe to handle the crowds using it.

4.3.2 Central Station (Chalmers Street)

As described previously, the easternmost platform face would not be required for holding special event trams if a loop was provided at Central to feed standby trams instantly into the stop. This platform face could then be used permanently as a bus stop.

4.3.3 Surry Hills (Devonshire Street)

The use of a centre-island platform at this location is an extravagant use of road space and causes an unnecessary excision of open space from Ward Park. A side platform on the south (kerb) side could be incorporated into the footpath (like, for example, Capitol Square stop) and, on the north side of the line, a Vienna (drive-over) platform could be built in the road lane. Vehicle access would still be available to the school over the platform or could be relocated around the corner in Riley Street. The stop would be moved slightly east to clear the Riley Street corner in this scenario.

4.3.4 Moore Park

With a loop with its own platform for special event trams, Moore Park stop can be built more simply with two side platforms and no overhead structure. The overhead bridge is unnecessary (heavy rail practice) and the reversing stub south of the stop would not be needed. This is a textbook example of over-designed light rail where a simple, cheaper and far more effective solution (a separate special-event stop closer to the venue, not requiring crowds to cross the tracks) is readily available.

4.3.5 Randwick Racecourse (Alison Road)

As described above, this stop should revert to being a normal stop with side platforms, located at Darley Road to serve its major catchment. The special event function is proposed for relocation to another site, also close to the venue but where the stop will not require crowds to cross the tracks. The reversing stub would be removed to enable relocation of the stop to the east. Like Moore Park, there is a far better solution here than hijacking a stop serving a significant urban precinct for a special event that only occurs two or three times a month.

Key recommendation: The proposed racecourse stop in Alison Road should not be a special event stop and should be relocated to the east to be more centred on its catchment.

4.3.6 Wansey Road

This stop has sufficient lateral space to be readily changed to side platforms.

4.3.7 High Street at POW hospital complex

It is a serious shortcoming of the scheme that a stop is not provided in the eastern part of High Street to enable easy access to the hospitals and shopping centre. The High Cross Park island is not a convenient location, but its justification as a bus interchange is acknowledged. As described in section 4.2.2.3 above, it should ultimately be converted to a turning loop and the park restored, but even beforehand, a stop can be placed in High Street as well to provide the convenience that the park stop does not.

The arguments for and against a High Street stop are noted, but it can be said that these arguments fail to acknowledge the solution of the "Vienna Stop", a pair of drive-over side platforms that still enable two-way traffic in the street. This can be located on the level section in front of the Medical Centre, east of the pedestrian crossing. The Vienna Platforms still enable access to property driveways fronted by the stop, the only compromise being that the access is approached one-way. This stop location is also set back from the Avoca Street corner and therefore does not have the issues described for this option in the EIS. It can be noted that buses can also use "Vienna" platforms as a stop, using the tram lanes rather than the road lanes and Kassel kerbs should be fitted.

It is strongly recommended that a stop be built at this location using Vienna platforms, notwithstanding the terminus and bus interchange around the corner. This terminus stop still has justification as an interchange and driver layover. However, it does not serve the hospital and shops effectively. This is considered a major issue.

Key recommendation: There should be an additional stop with Vienna platforms in High Street, between Clara and Avoca Streets, as the proposed terminus stop in High Cross Park does not satisfactorily serve the hospitals and shopping centre.

4.3.8 Carlton Street

This should be changed to a stop with staggered side platforms, which would still fit the lateral space.

4.3.9 Todman Avenue

This stop can readily have side platforms if located in the wider central reserve south of Todman Avenue which is, in any case, a location more central to its potential catchment. As it stands, the stop is too close to the Carlton Street stop and too far from the southern end of the catchment past Doncaster Avenue.

The traffic reasons for the present location are understood – and presumably this is the reason for not wanting a pedestrian crossing on the southern side of the Anzac/Todman intersection. However, a crossing can be installed at the southern end of the stop. This would also be more centred on the catchment and would give traffic turning from Todman Avenue south into Anzac Parade some stacking room if held by the crossing lights.

Key recommendation: The Todman Avenue stop should be relocated (as a side platform stop) south of Todman Avenue to be more centred on its catchment.

4.3.10 UNSW stop

This stop has a centre-island platform and an "Olympic Park"-style additional platform on the near side of Down trams. This is a total nonsense as there is not an Olympic Park scenario here – that is, large crowds entering and exiting the tram at the same time.

At the time when large numbers of students will be exiting, notably in the morning peak, there will be hardly any people boarding to travel the last couple of stops south to Kingsford terminus. This is another case of a fanciful and inappropriate heavy rail "solution". All that is required here is a pair of side platform stops. The Up stop can have a

wider platform to hold students exiting the university while the busiest Down platform would simply merge into the pedestrian plaza at the university entrance.

4.3.11 Strachan Street

Again, this is a stop requiring staggered side platforms. It is ridiculous that buses are proposed to run along the tram lanes here, yet they cannot use the stop because the platform is on the wrong side.

4.3.12 Kingsford

If the line is extended south and Kingsford ceases to be a terminus and bus interchange, the platforms should be converted to side platforms.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Comment

The CSELR will be an intense operation from day one, yet is later intended to expand to serve extensions and urban growth objectives set by the Government along its corridor. It will have little spare capacity to meet such growth – nor meet objectives for special events transport - and needs redesign as a looped operation, the standard European approach for busy tram operations.

The recent admission by the TfNSW Light Rail Project Director that the CBD section of the line (as presently designed) provides little scope for additional capacity - and that future service expansion will have to be diverted to ex-CBD locations such as Sydney University - is effectively a statement of failure. It is an admission that the system will be inadequate for its purpose in the long term and would need to be supplemented by further tramlines through the CBD or a metro system.

However, as this submission points out, there is a solution that can provide the proposed single line with much more potential capacity – looped design. Combined with addressing the inevitable need to confront the issue of diverting cross-city traffic onto the motorways and thus giving trams full traffic light priority, the George Street line is capable of much closer headways – certainly under one minute and even closer if not inhibited by wireless power recharges and the short single-vehicle platforms. This would at least double the capacity of the line.

There are also other capacity-increase solutions that relieve pressure on the George Street line, such as diverting some services up an extension from Moore Park, along Flinders Street to Oxford Street (joining a future Bondi Line) and then into the eastern part of the CBD. This would divert some services from the George Street line, enabling it to carry future additional services from the south-east (Coogee and Little Bay corridors), the inner west and South Sydney.

Ultimately, the inevitable necessity to use further CBD north-south streets - as did the former Sydney tram system - will have to be faced. (There is an off-street option from Oxford Street – diving into the section of unused railway tunnel from the south-east corner of Hyde Park, to a terminus in the unused centre platforms at St James Station. It is not

the most satisfactory solution from a tramway perspective but it does offer a short-term solution.)

Overall, the proposed system is under-designed and it is evident that the design process has paid little regard to the actual transport and planning objectives of the scheme and absolutely no regard to the knowledge and experience of long-established and successful major tramway systems, including the former Sydney system itself. It is effectively a heavy-rail line with low platforms, designed to a rigid formula with no attempt at subservience to the operational, capacity, future expansion and urban planning objectives it has to achieve. It represents an alarming, indeed appalling attitude of designing a piece of infrastructure with severe inherent limits and then handing to an operator who is expected to make the best of it, rather than being designed for its purpose.

As it stands, it is basically designed to fail and is fundamentally flawed as a transport system. It falls short of its potential as an environmentally enhancing project that seeks to replace car and bus use with a quiet, electric-powered transit system.

5.2 Key recommendations

It is recommended that:

- The CSELR be redesigned as a looped system, with the initial exception that the branch-line termini at Kingsford and Randwick may remain as stubs for the time-being, with provision to convert to loops in the future (section 4.1 refers).

- All stops be designed to conventional tramway standard, that is, with side platforms, whether facing islands, staggered islands, Vienna stops or stops with platforms incorporated in the footpath (section 2.3 refers).

- Interchange with the Inner West Line be improved by relocation to the south of the Chinatown stop, if possible (section 3.1 refers).

- The Queen Victoria stop be relocated north of Market Street, more centrally to its catchment and the major retail precinct (section 3.2 refers).

- Platform faces be Kassel kerbs (or similar design) to assist the operation of buses through the platforms when desired (section 3.3 refers).

- The government commissioning agency should fully inform itself of the range of vehicle design issues and solutions and use that knowledge to set standards that tenderers are required to meet. (section 3.4 refers).

- Turning-traffic lanes should not be located on, nor motor vehicles allowed on tram lanes under any circumstances (section 3.5 refers).

- A flyover be built on the Kingsford branch at the Anzac Parade/Alison Road intersection and an underpass at Kingsford roundabout (section 3.6 refers).

- Planning should commence immediately for an alternative relief CBD access for the south-east line from Moore Park, via Flinders Street (kerbside tracks on the eastern side) and Oxford Street (section 3.7 refers).

- Review should be undertaken of the possibilities for diversion of cross-city traffic and doubling the length of CBD stops and the wireless power supply proposal should be abandoned (section 3.7 refers).

- The Circular Quay terminus should be redesigned as a loop via George, Alfred, Loftus and Bridge Streets, with a holding siding in Loftus Street (section 4.2.1.1 refers).

- During special events affecting the George Street line in the CBD, trams should be terminated at Central Station stop if they cannot be run through to Circular Quay, due to the difficulties of reversing trams at close headways without an intermediate loop along the line (e.g. at Queen Victoria Building) (section 4.2.1.1 refers).

- A special-event turning and holding loop should be built at Central Station, around the streets surrounding the perimeter of Belmore Park (section 4.2.2.1 refers).

- A special-event loop, with platform adjacent to Driver Avenue and a holding siding, should be built at Moore Park (section 4.2.2.2 refers).

- Randwick Racecourse special-event stop should be relocated to the west side of the racecourse on a loop around the depot – the site of the former racecourse tram station (section 4.2.2.3 refers).

- The proposed racecourse stop in Alison Road should not be a special event stop and should be relocated to the east to be more centred on its catchment (section 4.3.5 refers).

- There should be an additional stop with Vienna platforms in High Street, between Clara and Avoca Streets, as the proposed terminus stop in High Cross Park does not satisfactorily serve the hospitals and shopping centre (section 4.3.7 refers).

- The Todman Avenue stop should be relocated (as a side platform stop) south of Todman Avenue to be more centred on its catchment (section 4.3.9 refers).