Additional Information provided to Department of Planning and Environment to support the assessment of the CBD and South East Light Rail Project

This information was submitted in response to requests for further information requested by the Department of Planning and Environment since lodgement of the CSELR Submissions Report in March 2014.

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1. Traffic assessment

Strategic network wide management

There are a wide range of strategic management measures signposted in the EIS which will need to be undertaken both prior to, during and post- construction. These are set out in the EIS.

Where feasible, mitigation has been integrated into the design. A broader network management plan is proposed to further develop operational responses to critical incidents, demand management and network optimisation not only resulting from the CSELR but together with the cumulative effects of other initiatives, major projects, events and private development in the Sydney CBD.

Implementation of the CSELR project will require whole of government collaboration to minimise impacts and maximise benefits.

For example, references to strategic planning documents, such as the Sydney City Centre Access Strategy (SCCAS), relate to the role of other areas of the Transport Cluster in determining and resolving broader Sydney CBD access issues outside of the scope of the project.

References to other government agencies, such as Roads and Maritime Service (RMS), or stakeholders, such as councils, point to the authorities who will need to be actively engaged in the ongoing delivery of the project where it has the potential to impact on issues outside of the immediate project scope.

The EIS outlines the expected impacts of TfNSW's reference scheme. The PPP model places responsibility for detailed design with Opco therefore there is a need for ongoing dialogue with respect to traffic management.

Transport network performance is the responsibility of TfNSW. TfNSW will continue to assess the likely future conditions during construction and operation based on more detailed design, construction planning and interface with other projects.

Since the EIS, TfNSW has developed a comprehensive governance structure to plan, assess and manage impacts arising not only as a result of the CSELR but the cumulative effects of other initiatives, major projects, events and private development in the Sydney CBD.

The traffic and transport governance structure is further explained in Section 8.

Future traffic network performance predictions

The network performance statistics in the EIS present a fair comparison of the network performance impact of the project at opening year vis a vis the network performance in that year without the project. It is not realistic to compare future year do-something case with current year base, since the broader network impacts of traffic growth, land development etc will not otherwise be captured in the base case.

Light rail operations

Review of road rules

The road environment will be designed in accordance to the NSW road rules. Regulations with respect to light rail operations within the road environment are currently being reviewed.

All signage and traffic control devices will draw from the Australian Road Rules and Austroads standards.

Traffic signal priority

Operational modelling has been prepared for the light rail which incorporates signal delays. This information was discussed and agreed with RMS and the Transport Management Centre (TMC).

The modelling is considered conservative in terms of the level of priority that the service would receive. Optimisation of light rail / traffic coordination is ongoing.

Stop spacing on High Street

Stop spacing on High Street is consistent with the stop spacing throughout suburban sections of CSELR and comparable to the Inner West extension. A 600m spacing would mean even at the furthest point from a stop no-one would have to walk further than 3-4 minutes to a stop.

The Prince of Wales Hospital main entrance is located approximately 200m from the Randwick stop, a short walking distance.

An additional stop in High Street was considered but not taken forward due to the wider significant operational impacts on both general traffic and buses. Furthermore there are engineering constraints (gradient and width) to introducing a stop in High Street.

As outlined in the submissions report, the UNSW upper campus stop has been relocated into High Street (from Wansey Road) reducing the distance to the terminus by approximately 100m.

Stop patronage assumptions

UNSW stops

The UNSW campus will be served by both branches of the CSELR. Therefore will receive 20 services per hour, per direction, **at opening**.

This provides a capacity **at opening** of 6,000 passengers per hour per direction, i.e. total 12,000 passengers. The existing level of peak hour demand from Central Station is approximately 2000 passengers.

The project is easily scalable for peaks in demand with the potential to increase service frequency to both lines.

It is worth noting that the UNSW demand profile is less concentrated than for the typical weekday peak period travel. Also that the direction of the demand for the UNSW is largely contra peak.

Central station stop

The patronage table for the Central Station stop indicates loadings / unloading less than that for the UNSW stop. The reasons for this are that passengers travelling to UNSW are expected to access the CSELR from a number of stops in the CBD, not just Central Station (which has the highest level of outbound boardings).

Central Business District stops

Figure 9.7 of Volume 1A indicates no rail transfers to light rail at any of the CityRail stations in the CBD area. This figure is incorrect and has been corrected in the Submissions Report.

Significant interchange is forecast from heavy rail to light rail at Town Hall and Central Station Stops.

Patronage forecasting undertaken for the project was developed by TfNSW's Bureau of Transport Statistics using the Public Transport Project Model. The PTPM has been calibrated to existing demands using existing extensive surveys and future growth consistent with Department of Planning and Infrastructure projections.

Traffic operations

Local area impacts

There has been extensive consultation with local government over local area impacts. The forecast change in conditions is shown within the meso-scopic model. Councils have not raised any significant concerns regarding local traffic impacts.

TfNSW will continue to work with Councils in managing congestion in local traffic networks. Local roads that have significantly degraded performance as a result of the project will be mitigated as appropriate. Local government partners will address residual amenity impacts as part of their ongoing local area traffic management programs.

Traffic analysis has covered the whole project corridor while reporting has focussed on areas of major impacts, which includes the CBD, arterial roads in the south east and other local roads along the light rail alignment.

Configuration of Wansey Road

The configuration of Wansey Road has been modified in the Submissions Report in response to community feedback. Wansey Road is proposed to be one way between Alison Road and Arthur Street with a parking lane. The section of Wansey Road between High Street and Arthur Street (adjacent to the station) is retained as 2-way operation without parking.

Management of shared zone in George Street

The reference design is well advanced, and details for pavement type and delineation are included in the urban design. This will be subject to further design development by OpCo in association with the relevant approval authorities including the Centre for Road Safety and City of Sydney.

OpCo are required to undertake safety audits at each design stage and have these approved by the relevant authorities.

Local access will only be permitted in the George Street pedestrianised zone on the southbound track only and only for one block. This includes deliveries and access off street only with only limited space for vehicles to pull over to stop. Stopping on the light rail tracks is prohibited and speed for general traffic in shared spaces is up to 20km/h. In this context TfNSW and CoS believes that it will be very unattractive for motorists to "rat run" along George Street and unattractive for Taxis to trawl for a fare.

City of Sydney and the operator will monitor the situation and consider what, if any measures for enforcement, is required.

Intersection operations

Intersection capacity of all known changes and assumptions were assessed in the strategic and meso-scopic traffic modelling undertaken and reported in the EIS. Impacted intersections within the corridor have been mitigated to the extent possible through design and operational improvements.

Ongoing assessment of the operational performance of the road network is being undertaken by TfNSW and RMS through the Network Management Plan to iteratively support detailed design and construction planning following contract award.

Subsequent to the EIS, further detailed analysis of key intersections such as Kingsford Nineways, Alison/Anzac and South Dowling St has been undertaken with RMS. Results of this detailed microsimulation analysis is available to DPI on request.

RMS and the TMC are further refining the CSELR Aimsun traffic model as a platform to refine their signal design and coordination.

The Network Management Plan will also take account of other SCCAS projects that will affect the network, which is outside of the control of the CSELR project.

Anzac Parade/Alison Road intersection

Detailed microsimulation of the 2-stage transition for the light rail from running along the eastern side of Anzac Parade across the Alison Road intersection to a central alignment has informed the reference scheme; TfNSW and RMS are satisfied with the performance of this intersection and detailed results can be provided to DPI on request.

The microsimulation showed an improvement in intersection performance in the preferred design than the existing situation.

Nineways intersection, Kingsford

The 9-ways signalisation has been developed in partnership with RMS and Randwick City Council (RCC). This has been further refined in the reference design and Submissions Report. No right turn restrictions are proposed

- Gardeners Rd to Anzac Pde South
- Anzac Pde to Rainbow St East

Detailed microsimulation modelling of this arrangement together with the surrounding road network was undertaken and RMS and TfNSW are satisfied with the performance in the intersection and detailed results can be provided to DPI on request.

This scheme will be refined through detailed design following the appointment of the successful tenderer.

Management of diversions

Devonshire Street

Devonshire Street is a local distributor for Surry hills. While some trips may divert to Cleveland Street, the majority of trips will find alternative routes through Surry Hills.

Alternative westbound routes for local access in Surry Hills include Foveaux Street, Lansdowne / Belvoir Street and Kippax Street.

Gardeners Road to Anzac Parade.

The proposed alternate route as a result of the right-turn restriction from Gardeners Road to Anzac Parade (southbound) at Kingsford will be via Sturt Street, south of the interchange facility. This has been included in the microsimulation modelling of the 9-ways intersection.

Impacts on turning movements

Where encroachment occurs at intersections, traffic and light rail would be separated by separate phases of traffic signals. Measures developed through the detailed design phase together with enforcement will be applied to deter motorists travelling along the LRT tracks.

Rationalisation of right hand turns

The rationalisation of right turns has been developed in close consultation with RMS and RCC.

This has been modelled within the Aimsun network model and SIDRA intersection models, and has not shown any areas of significant concern.

RMS and the councils will continue to review potential wider network impacts as a result of the implementation of the CSELR and develop appropriate solutions through the NMP.

The right turn movement from Devonshire St to Bourke St remains under the proposed scheme.

Wilmot Street

The CSELR project does not propose closing Wilmot Street at George Street.

The City of Sydney is looking to undertake this work separately and this is likely to occur prior to the construction of CSELR.

Wilmot Street and Central Street will reverse direction of operation.

Swept path analysis

Turning manoeuvres proposed in the EIS have been assessed and meet relevant design standards.

Traffic demand predictions

The project will remove 3,500 trips from the road network during the morning peak period and 4,000 trips during the afternoon peak period.

Traffic model predictions

Key model assumptions in Section 5.5.2.1 of Transport Operations Report relate specifically to the South Dowling Street at grade crossing. Further modelling and assessment has since been undertaken by TfNSW as part of the Aimsun network model reported in the EIS.

Usage of single lane during traffic incidents

The NMP would deal with contingency measures for incident management.

The final track design is yet to be determined, however the design principle is that the design will allow motor vehicles to mount and travel along the track if required but discourage general use of the tracks.

Emergency vehicles may use the light rail tracks under lights and sirens at any time.

Impacts on car share locations

Typical on-street car share bays locations are indicated in the EIS. TfNSW is working with Councils with respect to kerbside access and management.

Management of construction road closures

Alison Road and Anzac Parade

TMC have stated that their preference is to reduce the impacts on works along Alison Road and Anzac Parade during concurrent works. This however does not mean that works cannot occur concurrently. TMC has outlined a framework of when and how works can occur at the same time. The TMC requirement is that no long-term reduction in capacity is to occur on Anzac Parade from intersection of Todman Avenue north (towards Alison Road) if works are being undertaken on Alison Road at the same time.

Lang Road

During the closure of Lang Road at Anzac Parade, Driver Avenue and Lang Road East are the proposed alternative routes.

In preliminary discussions, TMC has agreed to night closures only of Lang Road. Details agreed with TMC are as follows:

- Full closures of Lang Road can be undertaken during night works.
- Close Lang Road from Anzac Parade to Driver Avenue.
- Divert westbound traffic on Lang Road via Driver Avenue and Moore Park Road.
- Divert eastbound traffic on Cleveland Street via Anzac Parade, Moore Park Road and Driver Avenue.
- No construction works at intersection to be undertaken that may affect Class 1 Events or Class 2 Events at Moore Park precinct.

Spoil haulage truck movements

During construction, the number of haul movements identified in the EIS is the best estimate based on the information presented in Project Definition Design.

The actual percentage split of spoil exported and re-used will be determined by the OpCo during the detailed design phase (this will include further Geotechnical assessments). These volumes and number of trucks would be identified in the Construction Traffic Management Plan(s).

Cumulative vehicle movements for construction compounds

Construction compounds will operate simultaneously during works. The number of compounds along the route is spread across the project and cumulative impacts on particular routes are unlikely to be significant in the context of total traffic volumes.

Property access during construction

OpCo is to provide access to properties at all times during construction (through the worksite) along Devonshire St, unless otherwise agreed by the property owner. In the section between Riley and Crown, OpCo must provide access to Marlborough Lane (north) as there is no alternative access. The details of this access could be through the worksite or via a dedicated lane. These details are to be resolved by OpCo.

Construction worker parking in CBD

Providing employee parking in long-term leased parking spaces is one option to provide employee parking in the CBD where workers need to bring equipment. It is not intended to provide special dispensation in terms of site parking in the CBD.

Bus operations

The 180-220 reduction includes other bus network enhancements identified in the SCCAS as a result of the CSELR such as through routing across the CBD and nearside termination at Central Station.

The demand shift from bus to light rail was forecast by the TfNSW Bureau of Transport Statistics using the Public Transport Project Model. Detailed demand and operational modelling has confirmed that the capacity of the CSELR is appropriate.

Impacts to buses in the CBD

The implementation of the CBD Bus Plan prior to construction commencing on the CSELR is proposed to mitigate the impacts for bus operations in the CBD during construction.

Further detailed planning of the CBD Bus Plan is underway to optimise travel times. This will be supported by a Network Management Plan as previously described.

Parking impacts

There is generally sufficient parking capacity in streets surrounding the light rail alignment to cater for observed demand. In some areas, parking management measures may be required to meet community expectations with respect to parking availability and proximity.

Councils are responsible for managing kerbside access. TfNSW is working with local councils to progress strategies for parking management in the corridor, with a particular focus on high priority uses such as loading zones, disability parking and bus/taxi zones.

Additionally, further surveys were undertaken as part of the submission report to better understand the usage of these spaces.

The UNSW and RCC are supportive of parking measures to support public transport mode shift to the UNSW campus.

Kiss'n'ride at Randwick stop

Light rail is proposed as a walk up service, with appropriate provision for high quality interchange between other access modes such as bus, rail and ferry. Key stops including termini will also include Bike n' Ride facilities.

Kiss and ride provision is currently under consideration as a part of the kerb access planning being developed by RCC with TfNSW input.

Pedestrian impacts

Pedestrian crossings in CBD

The principles for pedestrian crossings in the CBD are as set out below:

- Mid-block pedestrian crossings would no longer be required within the pedestrianised zone
- Outside of the pedestrianised zone mid block crossings would remain
- Pedestrian movements will still controlled by signals at the end of blocks in the CBD
- Further design refinement will be undertaken by OpCo in conjunction with the relevant approval authorities (RMS, Council) requiring typical safety review and approvals processes.

Bicycle impacts

Shared path along Chalmers Street

A key change to the CSELR proposal in the Submissions Report is the removal of through traffic from Chalmers Street between Randall Street and Elizabeth Street. This will allow the establishment of a shared space for cyclists, pedestrians and vehicles accessing properties.

The footpath to the south of Devonshire Street is proposed to be widened to accommodate a shared path from Prince Alfred Park through to Devonshire Street where cyclists would cross to the east side of the Central Station Stop. Cyclists would travel through the shared space to a dedicated cycle path at the Elizabeth Street intersection leading around to a dedicated cycle crossing in Eddy Avenue.

Shared path along Wansey Street

A shared path will be provided along the length of Wansey Road to replace the existing facility.

2. Design issues

Surry Hills

Access to St Peters Church

TfNSW have been meeting with the church to discuss options to ensure access can be provided. TfNSW are in the process of preparing a concept design to adjust the courtyard of the church into a parking and turning bay.

The church are currently supportive of the concept that has been proposed to date.

Access to South Dowling Street from Parkham Lane

There is a significant grade difference between the light rail and Parkham Place in the order of 1.0 – 1.5m. The light rail height is determined by the clearance over the eastern distributor which in itself may result in a slight lift to the pavement for South Dowling Street. To achieve a through movement for Parkham place regrading of Parkham lane, Parkham Place and Nobbs Lane will be required.

There appears to be only 30m between Parkham Place and South Dowling Street (measured from the reference scheme) this would be insufficient to store a 45m LRV.

The implication of “coordinating” the signals for Parkham Place and the crossing of South Dowling Street will effectively extend the length of the intersection that the LRT will need to cross. Currently the LRT requires approx 16sec to cross South Dowling street which even with full priority was acceptable to RMS. We are adding effectively another 45-50m to the length of a 55m crossing potentially doubling the phase time to say 30seconds. This would be a significant impact on the performance and will reduce the amount of priority LRT will receive. Given the proposed length of the intersection in this scenario the likelihood of inbound and outbound light rail services crossing in this location increased, meaning either traffic on South Dowling street will need to be held longer on an extended phase for LRT or we will lose priority for light rail in the off peak direction.

Randwick Precinct

Provision of taxi rank for Prince of Wales Hospital

<u>Current Situation</u>

Taxis wait kerbside on High Street. Customers can access a taxi on the rank or call for one to pick them up in the Porte-Cochere

<u>Proposed</u>

Taxis will wait kerbside in Clara Street. Customers can access a taxi at the rank. To improve accessibility a TAXI light would be provided out the front of the hospital – hotel style. A customer would summon a taxi by pushing a taxi call button.

The proposal is for the porte-cochere to be accessed via a 4-way intersection with Clara Street which permits this movement.

Pedestrianisation of High Street between Wansey and Botany Roads

Whilst TfNSW can understand the benefits of providing a pedestrianised zone along High Street, this is not something that is required for the project. The design of the High Street stop (with an island platform) in the preferred infrastructure report provides a safe and operationally efficient design to provide for the forecast customer

demand from UNSW and the future UAP at this stop. The island platform design does not preclude future pedestrianisation of the adjacent general traffic lanes.

Pedestrianising High Street would create flow on impacts additional to those of the CSELR proposal that would need to be resolved such as enabling access to properties that currently use High Street, access to surrounding streets as well as additional traffic flows in surrounding streets and the subsequent impacts to intersections.

Additionally, a number of bus routes use High Street to access the hospitals, these buses would need to be diverted to Arthur Street, which potentially limits their ability to provide direct access to the Hospitals on High Street.

TfNSW is currently considering the option to provide two side platforms for the High Street stop (rather than an island platform), which would be compatible with future pedestrianisation of High Street. This design will be further considered during the detailed design phase in consultation with the relevant stakeholders in the area, including Randwick City Council, UNSW and Health Infrastructure.

Preservation of grade along Wansey Road at Arthur Street.

The definition design shows the light rail alignment in approximately 2.1m lower than Wansey Road at the Arthur Street intersection. This requires a retaining wall between the light rail and pedestrian shared path and the Wansey Road. This option allows the light rail to be lower than Wansey Road for a length of 220m leading, up a significant hill, into the Arthur Street intersection from the north. The crest of the hill is at the Arthur Street/Wansey Road intersection. This has the advantage of mitigating some noise and visual impacts of the light rail on residential dwellings on the eastern side of Wansey Road.

If the light rail were to be at-grade with Wansey Road at the Arthur Street intersection the vertical alignment leading from the north into the intersection would require significant modifications. Using the desired maximum grade of 5% the light rail would now be higher than Wansey Road for a length of 320m. This would require a retaining wall for this entire length that, in the worst instance, would be 3.5m high. This would have an adverse visual impact on the residential dwellings along Wansey Road.

It is therefore recommended that the light rail vertical alignment not to be at grade with Wansey Road at the Arthur Street intersection and the alignment is optimised to reduce grades and provide some noise and visual mitigation where possible.

Timing arrangements for construction compounds

Without a construction contractor on board it is difficult to understand the exact timing and scheduling of works and the required durations for use of construction compounds. Availability of space for construction compounds along the route is very constrained, therefore it is likely that the compounds at High Cross Park and Ward Park would be the first areas setup and the last to demobilise.

Further clarification of requirements for these parks and the timing and durations required would be confirmed once more detailed construction planning has been undertaken, and identified through the construction environmental management plan.

As requested Figure 1 below provides a larger scale indicative outline for the construction compound at High Cross Park.

Figure 1: High Cross Park, Randwick – indicative construction compound footprint

Randwick stabling yard

The following indicative perspectives are provided to outline the currently anticipated design of the stabling yard. These images are indicative only and will be refined during detailed design.

NSW GOVERNMENT | Transport for NSW

Randwick Stabling

View from Randwick Racecourse Grandstand

WORK IN PROGRESS - INDICATIVE ONLY

APRIL 2014

NSW GOVERNMENT | Transport for NSW

Randwick Stabling

View from Doncaster Avenue property

WORK IN PROGRESS - INDICATIVE ONLY

APRIL 2014

Transport for NSW

Randwick Stabling

View from Doncaster Avenue property

WORK IN PROGRESS - INDICATIVE ONLY

APRIL 2014

Transport for NSW

Randwick Stabling

Aerial view

WORK IN PROGRESS - INDICATIVE ONLY

APRIL 2014

3. UNSW demand forecast

UNSW commissioned the Traffix Group to prepare estimates of future (2020) light rail demand, provided to TfNSW on 20 January 2014. These estimates were used to determine the potential Level of Service (LOS) on light rail platforms.

The process employed by the Traffix Group to prepare the estimates was in summary:

1. Take existing (2013) UNSW gate entry and exit data (7am-9pm).
2. Factor down existing demand to reflect an assumed future public transport mode split of 80%, of which 80% would use light rail (64% of total).
3. Grow existing demand based on UNSW estimates of future campus activity, for example by 160% for exits to Anzac Parade and 185% for exits to Wansey Road. This equates to an average growth of 12% p.a.
4. Report future light rail boardings and alightings for each stop in 15 minute increments.

Observations of the above process and estimates are:

- The analysis is based on detailed data showing observed entries and exits to the campus.
- The mode split to light rail is assumed, and is greater than the existing reported public transport mode share of 59% of all trips.
- The projected growth to 2020 has been assumed by the University to be an average of 12% p.a. Growth in enrolments in the last 5 years has been an average of 3.1% p.a. No estimates of growth beyond 2020 are included.
- The existing pattern of arrivals and departures may be influenced to a degree by express bus routes, which operate along High Street towards the university (routes 890/891) but predominantly along Anzac Parade towards the CBD (891/895).
- The estimate does not include demand to and from the surrounding area (ie. relates to the university only).

Proposed 2036 Design Forecast

The 2036 PM peak 15-minute design forecasts for UNSW stops are based on:

a) AM peak forecasts used in the CSELR business case; and

b) Appropriate assumptions to convert to the PM peak 15-minute period.

Step 1 - 2036 AM peak 1-hour forecasts at UNSW Anzac Pde & High St stops, by origin/destination

	UNSW Anzac Pde		UNSW High St		Total	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
To/from UNSW	66	1,327	115	1,310	181	2,637
To/from other areas	642	346	727	1,493	1,369	1,839
Total	708	1,673	842	2,803	1,550	4,476

Source: CSELR PTPM

Step 2 - Invert to PM peak 1-hour

	UNSW Anzac Pde		UNSW High St		Total	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
To/from UNSW	1,141	57	1,127	99	2,268	156
To/from other areas	298	552	1,284	625	1,582	1,177
Total	1,439	609	2,411	724	3,849	1,333

Source: CSELR PTPM

PM peak as a proportion of AM peak	86%

Source: UNSW

Step 3 - Adjust the Anzac Pde / High St split for UNSW demand

	UNSW Anzac Pde		UNSW High St		Total	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
To/from UNSW	1,519	104	748	51	2,268	156
To/from other areas	298	552	1,284	625	1,582	1,177
Total	1,817	656	2,032	677	3,849	1,333

Source: CSELR PTPM

PM peak as a proportion of AM peak	67%

Source: UNSW

Step 4 - Convert to PM peak 15-minute peak

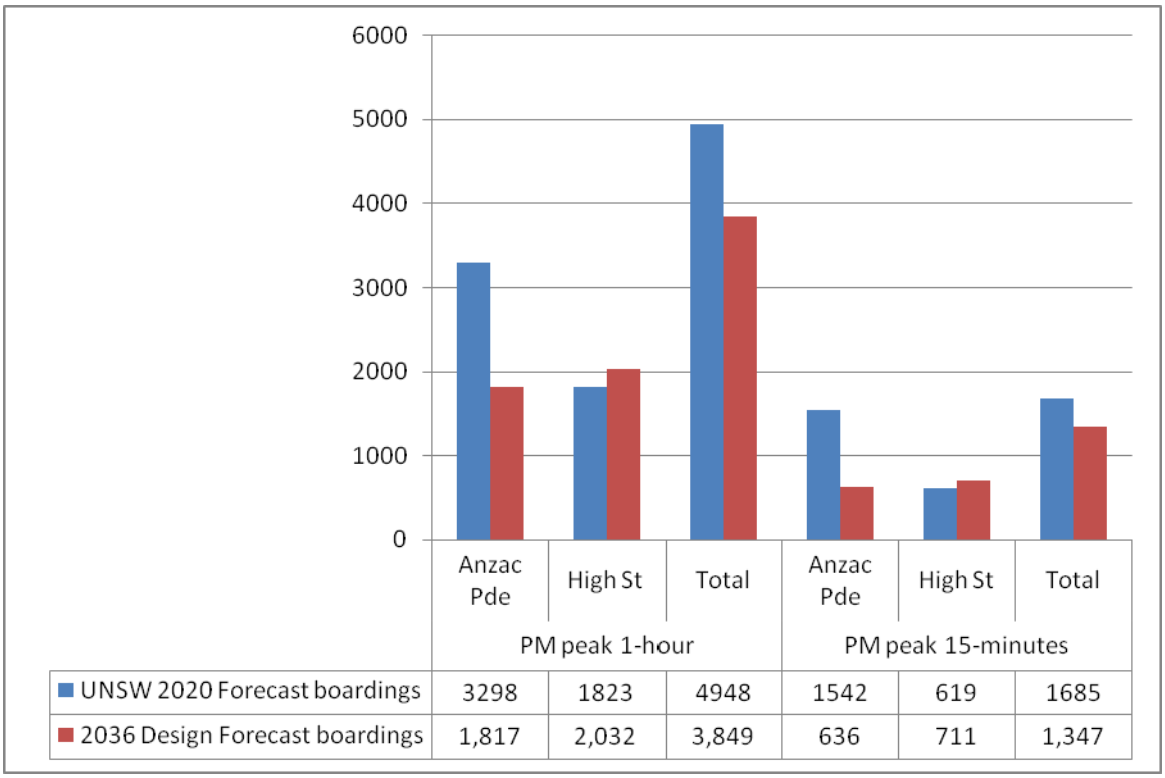
	UNSW Anzac Pde		UNSW High St		Total	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
To/from UNSW	532	37	262	18	794	54
To/from other areas	104	193	449	219	554	412
Total	636	230	711	237	1,347	467

Source: CSELR PTPM

Peak 15-minute demand	35%

Source: UNSW

Comparison with UNSW forecasts



	PM peak 1-hour			PM peak 15-minutes		
UNSW 2020 Forecast boardings	3298	1823	4948	1542	619	1685
2036 Design Forecast boardings	1,817	2,032	3,849	636	711	1,347

Note: UNSW 2020 total forecast is not the sum of Anzac Pde and High St stops.

Conclusion

The PM peak design forecasts were informed by CSELR PTPM demand forecasts and information provided by UNSW.

The results of this analysis suggest that the existing stop design requirements are appropriate to meet forecast demand in 2036 at each stop. Notwithstanding, it is always best to err on the side of caution with respect to design forecasts to ensure safety is not compromised. The design forecasts presented in this memo should therefore be reviewed in this context.

The design forecast does not include allowances for additional demand which may be generated by the NSW Government's proposed Urban Activation Precinct at Randwick. Analysis of this scenario is underway by BTS.

4. Platform capacity

Victorian rail standard

Section 8.4 of Victorian Rail Industry Operators Group Standards (VRIOGS) 002.1, Railway Station Design Standard and Guidelines. Revision A, 29/03/2011 says:

"The general requirements for all circulation elements are to include:

i. Passenger circulation concourses including platforms should be designed to Level of Service C for Walkways (as defined by Fruin – see Appendix A)."

This is consistent with Traffix assumptions in UNSW's letter. However VRIOGS continues on to say that:

"However, for short periods (up to 3 minutes within arrival of a train), up to Level of Service E is acceptable on platforms only;"

This equates to queuing LoS of C-D (using the TfL or Network rail guidelines) on the platform around the arrival/departure time of a tram. The consequence of using LoS C walkways for design would result in platforms needing to be >9m wide to accommodate a tram load of people.

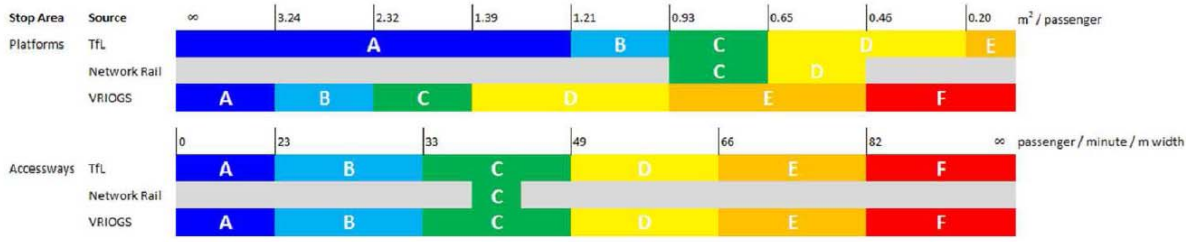


Figure 1 – Comparison of Level of Service from relevant guidelines
Source: Traffix Group

5. Bus Servicing

Priority for Light Rail

Current planning for the CSELR is based on low to medium priority for light rail. Work between the Transport Management Centre (TfNSW), RMS and the project team (TfNSW) into the provision of increased priority for CSELR is ongoing. Detailed design and frequency by the preferred tenderer is a key input to this analysis.

Note that the CSELR traverses the Anzac Parade, Alison Road intersection where opportunities for priority for light rail may be limited.

Run express buses in the morning peak along Alison Road and Botany Street onto High Street

This has been previously discussed with UNSW. Reversing the direction of UNSW services will not improve reliability or running times. This requires the introduction of three right turns which will increase delay to the service.

Operationally this will increase the cost to the operator as the services are mostly provided using buses that would have otherwise returned empty to pick up an additional peak run to the East and South East of Sydney. The proposed change of direction will impact the efficiency of this operation and ability for these buses to continue through to pick up the additional inbound peak service. These buses are supplemented with buses from north of the harbour which need to return to the city to undertake other duties. Reversing the direction will impact the reliability of these buses returning to the city due to the additional right turns and the inability to access the Moore Park busway.

Provide shelter at Eddy Avenue;

TfNSW are undertaking bus planning for the construction stage of the CSELR and for the City Centre Access Strategy.

Currently UNSW buses pick up students from Belmore Park in Eddy Avenue. This will not change during construction for the CSELR.

While there are shelters currently provided at each bus stand, it is recognised that shelter is not provided in Belmore Park where UNSW students are marshalled. The CSELR does not propose any changes to the current UNSW bus operation in the AM peak. TfNSW does not propose erecting shelters in Belmore Park for students.

Investigate loading express buses on Chalmers street south of Devonshire Street per the major events;

Currently UNSW buses pick up students from Belmore Park in Eddy Avenue. This will not change during construction for the CSELR.

Relocating the UNSW bus operations will reduce convenient interchange to other bus services for students and impact traffic and bus operation of Chalmers Street in the AM peak. Special Event services operate mostly in the afternoon or the weekends.

Afternoon UNSW services are proposed to set down at Belmore Park – likely to be at the stop where they pick up from.

Guarantee Sydney buses staff are on site to load buses from rear doors and ensure ticket machines are operational;

This is an issue for UNSW to take up with Sydney Buses as it is an operational issue. UNSW have a direct relationship with Sydney Buses with respect to the UNSW operations.

Allow the larger articulated buses to continue to provide express bus services;

Current fleet allocation is as a result of availability of buses coming off other routes to the Sydney CBD. The majority of articulated buses on the UNSW route originate from north of the harbour.

The fleet mix for UNSW operations is at the discretion of Sydney buses.

Dispense with tickets for the duration of construction;

TfNSW have completed rolling out Opal Card on ferrys and trains. It is anticipated that Opal will be live on all buses in Sydney end of 2014/Early 2015.

Provide supplementary services from Green Square, Redfern and/or Bondi Junction;

Currently the 400 and 410 provide a high frequency service from Bondi Junction and the 348, 370 from Green Square.

TfNSW regularly reviews demand for services and adjusts frequencies accordingly.

Provide alternate depot locations for peak service buses to the southern side of the harbour (eg Green Square) to improve service reliability.

Current fleet allocation is as a result of availability of buses coming off other routes to the Sydney CBD. It is recognised that buses on the UNSW route that originate from north of the harbour may impact on some bus availability in the event of an incident on the Harbour Bridge, however the fleet mix for UNSW operations is at the discretion of Sydney buses.

The CBD bus plan is likely to change allocation of buses to the UNSW services.

The Central Station East-West link is required to provide an integrated solution and seamless transfer between heavy rail and light rail for University staff and students as well as people attending special events.

Noted. Timing for the new East West Concourse is yet to be determined.

6. Proposed Project Governance Structure

The Sydney Light Rail Program governance structure includes a Business Reference Group and a Community Reference Group. These groups are two of five reference groups, including the Delivery Phase Roundtable, to be established to support delivery of the CSELR.

Business Reference Group

The Sydney Light Rail Business Reference Group is being established as a consultative group to make recommendations on initiatives that would support businesses along the alignment through the construction period. It is intended that the SLR Business Reference Group will run until the completion of construction of the CBD and South East Light Rail.

Objectives

The objectives of the SLR Business Reference Group are to provide a forum through which:

- The needs of all businesses along the alignment are represented in the development of the project.
- Recommendations can be made to the SLR Project Director regarding potential initiatives to support businesses through the construction of the CSELR.
- Dialogue between Transport for NSW, its contractors and businesses is encouraged and supported.

Membership

- The SLR Business Reference Group will draw members from business associations, industry groups and two nominated members from each local business forum.
- All members will be asked to be a conduit of project information for their association businesses or group.

Meetings

- The SLR Business Reference Group will meet quarterly per year, or as otherwise required by the Chair.

Local Business Forums

Approximately three area-specific local Business Forums are being established to report to the BRG and support its work. The Business Forums will meet at least quarterly. The Forums will each nominate two representatives to be members of the BRG.

The project team visited and emailed a large number of businesses along the alignment, and placed advertisements in local newspapers requesting attendance at the Forums. Information nights about the local Business Forum meetings were held in March 2014, at local venues in the CBD, Surry Hills, Randwick and Kensington/Kingsford. An information night about the Business Forum for Moore Park stakeholders occurred in April 2014.

Community Reference Group (CRG)

Similar to the BRG, a Community Reference Group (CRG) will also be established. The CRG would provide a forum through which:

- Information on the project can be made available to community stakeholders, including residents, interest groups and associations
- The community can inform the development of the plans by providing local and specialist knowledge and insights
- Dialogue between communities along the route and the project team is encouraged and supported
- Community understanding of project objectives, outcomes, impacts and mitigation is enhanced
- Community representatives can provide input to a community engagement strategy to be implemented during construction of the project.

To support the CRG, TfNSW will establish four area-specific local Community Forums: one each for the CBD, Surry Hills and Moore Park, Randwick, and a combined Forum for Kensington and Kingsford, once planning approval is received; which then report into the CRG. The CRG will be chaired by an SLR Advisory Board Member, and it will meet at least quarterly throughout the life of the project.

Traffic and transport governance framework

Purpose

The purpose of the CBD transport, traffic and access governance-operations management framework is to:

(i) enable coordinated multi-modal decision making within the transport cluster for all transport-traffic-access related activities in the Sydney CBD, and to link this effectively with NSW government approval mechanisms and external stakeholders

(ii) provide a single point of reference for transport-traffic incident response and change management, and coordinating transport operations within the Sydney CBD.

Objectives

The objectives of the CBD transport, traffic and access governance-operations management framework are to:

(i) ensure the government's expectations for the outcomes of the Sydney City Centre Access Strategy are delivered
(ii) enable integration of planning, delivery and operation of transport projects and initiatives in the Sydney CBD
(iii) promote effective delivery of Sydney CBD projects and initiatives by streamlining multi-modal decision making and removing roadblocks
(iv) enable coordinated decision making to assist the CBD Transport Taskforce in undertaking its role.

Mechanisms

The current governance arrangements are both extensive and complex. However, these arrangements are necessary to address the various levels of detail and timeframes associated with major transport systems managed by two levels of government.

The following briefly explains the role and function of the key groups:

- Transport for NSW is the agency responsible for advising Government on transport policy, the implementation of the Government's transport agenda and undertaking various statutory responsibilities.
- Roads and Maritime Services (not shown on the diagram) is an agency within the Transport for NSW cluster responsible for the implementation of road-based initiatives including road works on state roads and the operation of the Sydney Coordinated Adaptive Traffic System (SCATS). RMS is represented on all the various committees, taskforces and working groups shown in Attachment A.
- City of Sydney Council, as the local government authority, is responsible for the majority of roads within the CBD area and for the provision of parking (itself a key element in the transport network).
- Transport Management Centre (TMC) is a real time management centre for the state's road network and a coordination centre for overall transport network across the state.
- Central Sydney Traffic and Transport Committee (CSTTC) is a joint NSW Government and City of Sydney committee established by legislation to ensure the coordination of transport activities across these two levels of

government. CSTTC approval is required before any changes can be made to the CBD road network.

SLR Specific Planning

SLR, as for any other project, is responsible for transport and traffic planning associated with the project's scope of work. The SLR is a road-based system extending over 12kms and passing through numerous intersections with numerous other interactions with pedestrians, cyclists, property owners, service providers and utilities. Extensive planning has been completed in order to develop the reference design as it now stands. This work has been reported in the EIS and reviewed by the project's key stakeholders.

Discussion of this planning usefully divides in to:

1. End-state. This is the configuration of transport network at the conclusion of the CSLER following the implementation of all the permanent works and associated service changes.
2. Construction-state. This is the transition period between the today's transport and the end-state arrangement. It comprises the necessary stages and configurations required to construct the SLR along its entire alignment.

1. End-state

The current reference design represents a version of the end-state that has been the basis of extensive consultations within the Transport cluster and the general community most notably through the EIS process. The end-state improves the overall operation of the transport network through the use of high capacity LRVs reducing bus volumes and attracting a share of car drivers.

2. Construction-state

The construction-state will be continually changing as the project progresses. It is expected that the project will be delivered on multiple work fronts each with their own set of transport and traffic management requirements.

Local area impacts are managed through the preparation and implementation of Transport Management Plans (governed by a common set of overarching requirements and principles) for each location and at each stage. These Transport Management Plans (TMPs) will address the specific issues associated with construction including:

- traffic and public transport diversions;
- pedestrian and cyclist management;
- property access; and
- emergency services.

To ensure the needs of all affected parties are considered in the TMP, a SLR Traffic and Transport Liaison Group will be established including various representative groups. Given the geographical extent of the SLR special arrangements will be required to ensure the TTLG operates effectively.

Appendix 1 Noise assessment

MEMORANDUM

610.12515 Response to Planning 20140325.docx

[redacted] [redacted]

Transport for NSW

DATE: 25 March 2014
NO OF PAGES: 23
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CBD and South East Light Rail Project
Independent Review of Noise/Vibration Assessment
Response to Issues Raised

Wilkinson Murray Pty Ltd has reviewed the CBD and South East Light Rail Project Environmental Impact Assessment, in particular the Noise and Vibration Technical Paper, at the request of the NSW Government Planning and Infrastructure Agency (Planning & Infrastructure). Their letter Ref 14055Ltr140214JW dated 21 February 2014 raises a number of issues and requests for clarification. The issues and responses are summarised below.

1 Operational Noise

> ***Query/* Recommendation:** An exceedance of the noise trigger levels by 2 dB or less at locations where traffic noise dominates may be intuitively appropriate; however the consultant should provide additional technical justification. The information should include, but not be limited to, actual background noise (L_{A90}) measurements in the areas affected (eg Kensington and Randwick), show the emergence of the LRV over the background level (L_{A90}) rather than a comparison of L_{Aeq} levels, the frequency of LRV events, the frequency of traffic passby events (particularly buses), consideration that the LRV is a new noise source, dose response relationships, cumulative noise levels, etc.

This response focuses on the night-time noise impacts, in recognition that the light rail noise goals for the night-time period control the noise mitigation requirements.

Additional night-time attended measurements and road traffic observations have been undertaken throughout the proposal area at representative locations in each Precinct. These measurements were undertaken mid-week, during the period from 10:00 pm to 12:00 am, and repeated in the early morning period from 5:00 am to 7:00 am. Measurements were undertaken on the public footpath at each location with the distance to the centre of the nearest traffic lane and to the nearest facade shown in in **Table 1**. In the discussion that follows, it is assumed that the footpath levels are approximately equivalent to facade levels.

The aim of these measurements and observations was to characterise the existing road traffic during the expected times of night-time operation of the CSELR. The measured L_{Amax} noise levels for different road vehicles are summarised in **Table 1** along with the number of each type of vehicle observed in a 15 minute period, and the background and ambient noise levels (L_{A90} and L_{Aeq}).

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During these times, the anticipated service frequency under normal operations (excluding special events) is one LRV every 10 minutes (each way) in the CBD, Surry Hills and Moore Park Precincts, and one LRV each way every 20 minutes in the Kensington/Kingsford and Randwick Precincts.

Table 1 15 Minute Attended Measurements – Existing Traffic Noise

Location	Date	Start Time	Overall Noise Levels (dBA)		Events		Noise Levels (dBA)
			L_{Aeq}	L_{A90}	Type	No.	L_{Amax}
485 George St, Sydney 2 m from centre of nearest traffic lane 3 m from nearest facade	11/03/2014	21:59	74	65	Buses	10	75, 75, 75, 85, 79, 84, 84, 87, 79, 81
					Cars	139	$L_{Amax,50\%}$ 75, $L_{Amax,95\%}$ 81
					Trucks	1	81
					Motorbikes	2	81, 75
	12/03/2014	04:50	73	60	Buses	6	74, 84, 90, 84, 88, 89
					Cars	30	$L_{Amax,50\%}$ 74, $L_{Amax,95\%}$ 82
					Trucks	14	75, 83, 72, 76, 89, 86, 82, 78, 83, 77
					Motorbikes	2	77, 77
129 Devonshire St, Surry Hills 3 m from centre of nearest traffic lane 2 m from nearest facade	11/03/2014	23:56	61	46	Buses	0	n/a
					Cars	24	$L_{Amax,50\%}$ 71, $L_{Amax,95\%}$ 75
					Trucks	1	82
					Motorbikes	0	n/a
	12/03/2014	06:30	70	50	Buses	0	n/a
					Cars	37	$L_{Amax,50\%}$ 73, $L_{Amax,95\%}$ 77
					Trucks	4	80, 88, 69, 93
					Motorbikes	1	89
256 Devonshire St, Surry Hills 3 m from centre of nearest traffic lane 2 m from nearest facade	11/03/2014	23:34	66	48	Buses	0	n/a
					Cars	40	$L_{Amax,50\%}$ 72, $L_{Amax,95\%}$ 77
					Trucks	0	n/a
					Motorbikes	1	85
	12/03/2014	06:06	65	47	Buses	0	n/a
					Cars	26	$L_{Amax,50\%}$ 72, $L_{Amax,95\%}$ 77
					Trucks	4	80, 79, 78, 79, 78
					Motorbikes	1	78
Corner Devonshire St and Edgley St, Surry Hills 5 m from centre of nearest traffic lane 5.5 m from nearest facade	11/03/2014	23:08	55	43	Buses	0	n/a
					Cars	17	$L_{Amax,50\%}$ 65, $L_{Amax,95\%}$ 69
					Trucks	0	n/a
					Motorbikes	0	n/a
	12/03/2014	05:45	58	44	Buses	1	70
					Cars	7	$L_{Amax,50\%}$ 69, $L_{Amax,95\%}$ 75
					Trucks	1	76
					Motorbikes	1	75

Location	Date	Start Time	Overall Noise Levels (dBA)		Events		Noise Levels (dBA)
			L_{Aeq}	L_{A90}	Type	No.	L_{Amax}
625 South Dowling St, Surry Hills 4 m from centre of nearest traffic lane 5 m from nearest facade	11/03/2014	22:43	70	56	Buses	0	n/a
					Cars	239	$L_{Amax,50\%}$ 73, $L_{Amax,95\%}$ 79
					Trucks	3	85, 84, 76
					Motorbikes	0	n/a
	12/03/2014	05:22	71	60	Buses	0	n/a
					Cars	168	$L_{Amax,50\%}$ 78, $L_{Amax,95\%}$ 81
					Trucks	5	74, 78, 70, 87, 85
					Motorbikes	5	75, 82, 80, 85, 85
58 Martin Rd, Centennial Park 21 m from centre of nearest bus lane 3 m from nearest facade	11/03/2014	22:20	56	50	Buses	12	54, 66, 61, 65, 54, 58, 59, 63, 60, 56, 58, 58
					Cars	18	$L_{Amax,50\%}$ 57, $L_{Amax,95\%}$ 60
					Trucks	2	58, 60
					Motorbikes	3	68, 62, 59
	12/03/2014	05:00	54	47	Buses	4	64, 54
					Cars	40	$L_{Amax,50\%}$ 53, $L_{Amax,95\%}$ 62
					Trucks	17	53, 63, 58, 56, 58, 52, 50
					Motorbikes	0	n/a
19 Wansey Rd, Randwick 3 m from centre of nearest traffic lane 3 m from nearest facade	11/03/2014	23:58	49	40	Buses	1	42 (distant road)
					Cars	2	$L_{Amax,50\%}$ 72, $L_{Amax,95\%}$ 73
					Trucks	1	53, 51 (distant road)
					Motorbikes	3	57, 50, 54 (distant road)
	12/03/2014	06:32	63	47	Buses	0	n/a
					Cars	39	$L_{Amax,50\%}$ 71, $L_{Amax,95\%}$ 75
					Trucks	1	73
					Motorbikes	1	76
56 High St, Randwick 2 m from centre of nearest traffic lane 4 m from nearest facade	12/03/2014	22:10	59	42	Buses	1	60
					Cars	33	$L_{Amax,50\%}$ 65, $L_{Amax,95\%}$ 73
					Trucks	1	79
					Motorbikes	2	75, 74
	12/03/2014	06:59	66	50	Buses	7	69, 83, 69, 72, 73, 78, 74
					Cars	26	$L_{Amax,50\%}$ 68, $L_{Amax,95\%}$ 72
					Trucks	4	68, 75, 80, 76
					Motorbikes	0	n/a
6 Anzac Parade, Kensington 2 m from centre of nearest traffic lane 4 m from nearest facade	11/03/2014	22:47	66	51	Buses	6	71, 85, 78, 65, 82, 82
					Cars	60	$L_{Amax,50\%}$ 70, $L_{Amax,95\%}$ 75
					Trucks	1	66
					Motorbikes	2	78, 73
	12/03/2014	05:23	63	49	Buses	3	65, 68, 83
					Cars	56	$L_{Amax,50\%}$ 67, $L_{Amax,95\%}$ 73
					Trucks	3	72, 68, 72
					Motorbikes	1	77

Location	Date	Start Time	Overall Noise Levels (dBA)		Events		Noise Levels (dBA)
			L_{Aeq}	L_{A90}	Type	No.	L_{Amax}
244 Anzac Pde, Kensington 5 m from centre of nearest traffic lane 5 m from nearest facade	11/03/2014	23:09	68	52	Buses	2	76, 91
					Cars	55	$L_{Amax,50\%}$ 69, $L_{Amax,95\%}$ 75
					Trucks	2	79, 75
					Motorbikes	2	69, 62
	12/03/2014	05:44	70	54	Buses	7	82, 84, 78, 78, 89, 69, 70
					Cars	56	$L_{Amax,50\%}$ 73, $L_{Amax,95\%}$ 79
					Trucks	7	78, 71, 71, 84, 78, 79
					Motorbikes	3	80, 85, 78
301-303 Anzac Pde, Kingsford 4 m from centre of nearest traffic lane 7 m from nearest facade	11/03/2014	23:33	64	52	Buses	5	72, 78, 75, 67
					Cars	43	$L_{Amax,50\%}$ 67, $L_{Amax,95\%}$ 73
					Trucks	2	77, 69
					Motorbikes	1	71
	12/03/2014	06:06	70	58	Buses	8	80, 68, 85, 80, 76, 77, 81, 70
					Cars	70	$L_{Amax,50\%}$ 71, $L_{Amax,95\%}$ 76
					Trucks	6	76, 72, 75, 73, 78, 68
					Motorbikes	5	71, 78, 72, 81

The impact of introducing light rail in each area is discussed in **Table 2**.

Table 2 Light Rail Impacts vs the Observed Existing Traffic Environment (Night-time)

Precinct	Proposed Light Rail Night-time Passbys per Hour[1]	Existing Hourly Number of Events L_{Amax} > 80dBA[2]	Discussion
City Centre	12 (10 minutes each way)	34 (excluding cars)	The number of observed traffic events above the light rail $L_{Amax,95\%}$ goal of 80 dBA is almost three times greater than the proposed number of light rail events. The $L_{Amax,95\%}$ level due to cars was also above 80 dBA at the measurement location. The existing background noise level is 10-15 dB above the light rail L_{Aeq} noise goal. Existing L_{Aeq} noise levels up to 24 dB above the light rail noise goals were observed during the night-time period. For this reason, mitigation of light rail noise impacts would have minimal impact on the overall noise environment. Acceptance of light rail noise impacts above the RING trigger levels for L_{Amax} or L_{Aeq} in the CBD Precinct would be considered reasonable in light of the existing high road traffic noise impacts.
Surry Hills	12 (10 minutes each way)	0-8 (Devonshire Street) 14 (South Dowling Street)	The introduction of the light rail to Devonshire Street will introduce a new noise source to an area that experiences low existing road traffic noise. Existing background noise levels are also generally below the light rail L_{Aeq} noise goals. Locations fronting South Dowling Street experience more existing traffic noise than other residential areas in the Surry Hills Precinct. Consideration of reasonable and feasible mitigation of light rail noise is required at all locations where the RING trigger levels are exceeded.

Precinct	Proposed Light Rail Night-time Passbys per Hour[1]	Existing Hourly Number of Events L_{Amax} > 80dBA[2]	Discussion
Moore Park	12 (10 minutes each way)	0	While a high number of heavy vehicles were observed on Anzac Parade, the set back to the residences in this area means the existing maximum noise levels due to road traffic are well below 80 dBA. Existing background noise levels are generally below the light rail L_{Aeq} noise goals, while existing L_{Aeq} levels are around 5 dB above the light rail L_{Aeq} trigger level. Consideration of reasonable and feasible mitigation of light rail noise is required at all locations where the RING trigger levels are exceeded.
Randwick	6 (20 minutes each way)	0 (Wansey Road) 2 (High Street)	The number of heavy vehicles observed on High Street was 26 per hour across the measurement periods. One bus was observed to generate noise above the light rail $L_{Amax,95\%}$ goal with a level of 83 dBA. The bus timetable indicates that 3-4 buses per hour are scheduled along High Street during the period 10:00 pm to midnight, and around 12 buses per hour are scheduled between 5:00 am and 7:00 am (both directions combined). Some of these bus services (but probably not all) would be replaced by light rail services. The maximum noise levels from buses on High Street are expected to be similar to maximum noise levels from light rail. The number of light rail services relative to existing bus numbers is unlikely to result in an increase in the number of high noise night-time events along High Street. While the background noise level on High Street was observed to be as low as 42 dBA, the existing L_{Aeq} noise levels are around 9 dB higher than the light rail L_{Aeq} noise goals. Acceptance of light rail noise impacts 2 dB to 3 dB above the RING trigger levels for L_{Amax} or L_{Aeq} along High Street in Randwick is considered reasonable in light of the existing road traffic L_{Aeq} and L_{Amax} noise impacts. Along Wansey Road, there is a low incidence of existing road traffic and consideration of reasonable and feasible mitigation of light rail noise is required at all locations where the RING trigger levels are exceeded.
Kensington / Kingsford	6 (20 minutes each way)	6-12	The number of observed traffic events above the light rail $L_{Amax,95\%}$ goal is up to two times greater than the proposed number of light rail events. The number of bus passbys observed was 18-26 per hour. Maximum noise levels up to 91 dBA due to buses were observed at 244 Anzac Parade, which is one of the closest locations to the both the road and the light rail alignment (identified with a marginal exceedance of the light rail noise goals in the EIS). At this location, existing L_{Aeq} noise levels up to 20 dB above the light rail noise goals were observed during the night-time period. Acceptance of light rail noise impacts above the RING trigger levels for L_{Amax} or L_{Aeq} along Anzac Parade in Kensington and Kingsford is considered reasonable in light of the existing high road traffic noise impacts.

Note 1: Based on EIS night-time service frequency, including both directions.

Note 2: The number of road traffic passby events observed in the two 15 minute measurements with maximum levels above the Light Rail 95th percentile LAmax goal, scaled to estimate the hourly number of events.

The following points summarise the conclusions from the additional night-time attended noise measurements in each precinct:

- In the City Centre, the existing road traffic noise environment gives rise to many more high noise events during the night-time than would be introduced by the light rail. Acceptance of light rail noise impacts above the RING trigger levels for L_{Amax} or L_{Aeq} in the CBD Precinct would be considered reasonable in light of the existing high L_{Amax} and L_{Aeq} road traffic noise impacts, as mitigating light rail noise would not reduce the overall future road traffic noise levels.
- In Surry Hills, Devonshire Street has low numbers of heavy vehicles during the night-time. Consideration of reasonable and feasible mitigation of light rail noise is required at all locations where the RING trigger levels are exceeded.
- In Moore Park, the nearest residences are set back from the bus lanes and Anzac Parade, and existing maximum noise levels due to traffic are below the RING noise goals. Consideration of reasonable and feasible mitigation of light rail noise would be required at any locations where the RING trigger levels are exceeded, noting that no exceedances are anticipated at this location.
- In Randwick, the maximum noise levels from buses on High Street are expected to be similar to maximum noise levels from light rail. While the existing background noise level on High Street is low, the existing L_{Aeq} noise levels are around 9 dB higher than the light rail L_{Aeq} noise goals. The number of light rail services relative to existing bus numbers is unlikely to result in an increase in the number of higher night-time noise events along High Street. Acceptance of the predicted light rail noise impacts of 2 dB to 3 dB above the RING trigger levels along High Street in Randwick is considered reasonable in light of the existing road traffic noise impacts.

  Along Wansey Road, there is a low incidence of existing road traffic noise and consideration of mitigation of light rail noise would be required at any locations where the RING trigger levels are exceeded, noting that no exceedances are anticipated at this location.
- In Kensington and Kingsford acceptance of light rail noise impacts above the RING trigger levels along Anzac Parade is considered reasonable in light of the existing high road traffic noise impacts, as mitigating light rail noise would not reduce the overall future road traffic noise levels.

2 Treatment of Residual Operational Noise Impacts

It is noted that the detailed design of the project will need to balance airborne noise impacts with ground-borne noise and vibration impacts. In general, track designs that minimise ground-borne noise and vibration result in higher airborne noise levels, while track designs that minimise airborne noise levels can give rise to higher vibration and ground-borne noise levels. The RING specifies external noise goals, as well as internal ground-borne noise goals. The internal ground-borne noise goals are relevant only where they are higher than the airborne noise. This means that ground-borne noise levels above the RING goals are considered acceptable if the airborne noise masks the ground-borne noise.

At locations where the route is in close proximity to residential facades, balancing the ground-borne and airborne noise impacts may require acceptance of external noise levels above the RING goals and above the EIS airborne noise predictions in order to facilitate the minimisation of internal ground-borne noise.

Where the light rail trigger levels are exceeded, RING requires an assessment of feasible and reasonable mitigation measures that would be required to reduce noise levels down to the trigger levels. If it is reasonable to achieve these levels, the proponents should do so. In this case, mitigation options include optimisation of the route alignment, specification of low noise LRVs, absorptive track treatments, speed limits in residential streets, etc. Barriers are not feasible in most areas.

Where the trigger levels can't be met using feasible and reasonable mitigation measures (as is the case in some areas of the project), then the noise assessment should provide justification as to why they cannot be met and project-specific noise levels should be identified. An assessment of the acceptability of residual impacts should also be provided in the event of noise impacts above the RING trigger levels after source mitigation.

At the meeting between TfNSW, SLR Consulting, Wilkinson Murray and Planning & Infrastructure on 5 March 2014 the possibility of defining a Condition of Approval to clarifying the approach to be taken to residual impacts was discussed. The objective of this Condition would be to protect residential amenity in existing quiet areas. The following points are made with regard to the acceptability of residual impacts.

2.1 Acceptability of Residual Impacts

It is noted that the RING night-time L_{Aeq} noise trigger levels are relatively stringent. According the RING (Appendix 5 Figure 2), an external $L_{Aeq(9hour)}$ level of 50 dBA would correspond to less than 5% of people being highly annoyed, while a level of 55 dBA would correspond to less than 10% of people being highly annoyed.

The impact would also depend on the existing noise environment. An increase in overall road traffic noise of 2 dB is described in the NSW Road Noise Policy as being an appropriate limit on the increase in total traffic noise due to a development. This provides some justification for applying a 2 dB increase limit to overall traffic noise (road plus light rail).

Further justification for an approach including both a light rail overall noise level of 55 dBA and an increase in total noise exposure can be found in the US Federal Transit Administration guideline *Transit Noise and Vibration Impact Assessment* (FTA-WA-90-1003-06, May 2006). The FTA guideline provides information on transit noise impacts in relation to existing noise exposure. It discusses impacts in terms of the L_{DN} parameter – in the following discussion, this is replaced with the equivalent night-time $L_{Aeq(9hour)}$ value, being the L_{DN} minus 10 dB.

It is noted that the FTA existing noise exposure includes both noise from roads and transit sources, and also ambient noise (for example due to population density). In the FTA Guideline, the following points are made:

- A change in noise level from an existing external night-time ambient $L_{Aeq(9hour)}$ of 40 dBA to 45 dBA is a minimal impact. It takes a 5 dB increase in noise to cause a 2% increase in highly annoyed people if the existing noise level is 40 dBA.
- A change in noise level from an existing external night-time ambient $L_{Aeq(9hour)}$ of 50 dBA to a cumulative level of 55 dBA with a project represents a change from an acceptable noise environment to the threshold of an unacceptable noise environment.
- A moderate impact on residences is considered to occur when the transit noise level in isolation equals or exceeds 55 dBA $L_{Aeq(9hour)}$. A severe impact is considered to occur whenever the transit noise level equals or exceeds 65 dBA $L_{Aeq(9hour)}$.

At the RING trigger levels, the CSELR would have a low to moderate impact in existing quiet locations, but minimal impact in areas with existing higher ambient noise levels. At 5 dB above the RING trigger levels, the impact in existing quiet areas (for example Devonshire Street or Wansey Road) would be on the threshold of an unacceptable residual impact. In areas with some existing traffic noise such as High Street, a light rail noise level of 55 dBA $L_{Aeq(9hour)}$ would represent a moderate impact. The impact of this level in high noise areas such as the CBD and Anzac Parade would remain low.

Figure 1 has been reproduced from the FTA Guideline, with the indicative impacts at key locations along the CSELR alignment. It indicates that in existing quiet areas such as Devonshire Street or Wansey Road, an increase in overall ambient noise levels of 2 dB to 3 dB would be acceptable. A 2 dB increase would also be acceptable in High Street, Randwick. In existing high-noise areas, the acceptable increase due to a transit project is almost zero. However, it is noted that in these areas the light rail noise would not be expected to contribute significantly to the overall $L_{Aeq(9hour)}$ noise levels.

Table 3 demonstrates which situations would result in residual impacts above an acceptable level in the event that light rail night-time noise levels exceed 55 dBA and the increase in total road traffic noise is 2 dB or more. In the event that source control measures cannot reduce the noise impact, residual impacts above this unacceptable level would require consideration of property treatments.

Figure 1 FTA Guideline Allowable Increase in Cumulative Noise Levels

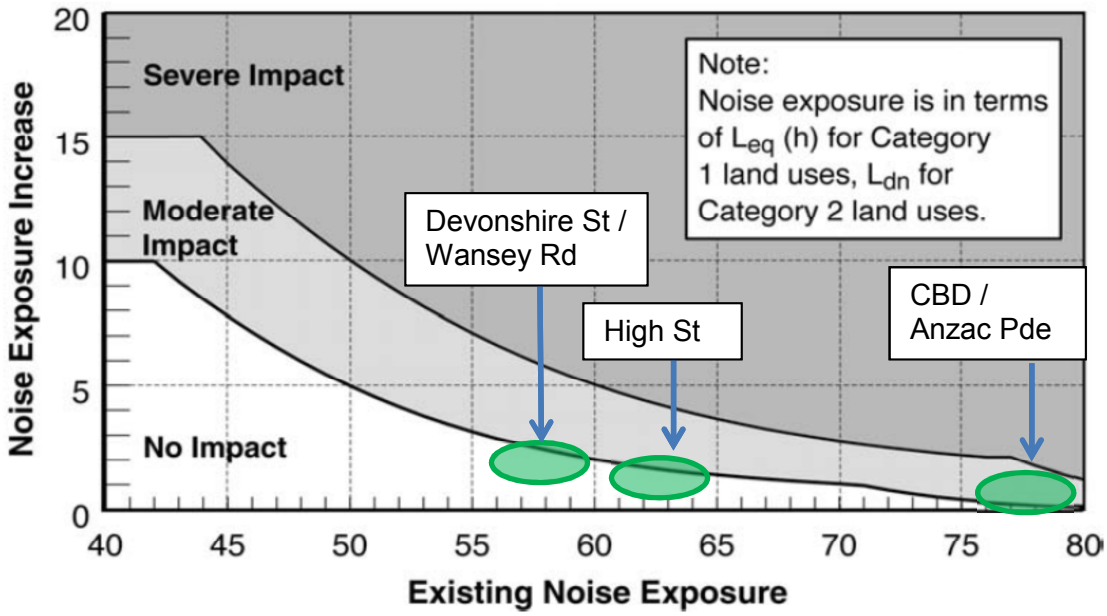


Figure 3-2. Increase in Cumulative Noise Levels Allowed by Criteria (Land Use Cat. 1 &2)

Note: FTA Guideline Figure 3-2 uses the L_{DN} parameter to describe existing noise exposure. This is approximately equivalent to LAeq(9hour) plus 10 dB.

Table 3 Example of When Property Treatments Would be Considered

Existing Road Traffic Noise LAeq(9hour) (dBA)	Light Rail Noise Level LAeq(9hour) (dBA)	Combined Overall LAeq(9hour) (dBA)	Increase in Total Road Traffic Noise (dB)
<45	**>55**	**56**	**>10.9**
45	**>55**	**56**	**10.9**
50	**>55**	**57**	**6.6**
55	**>55**	**58**	**3.3**
56	**>55**	**59**	**2.8**
57	**>55**	**59**	**2.3**
58	>55	60	1.9
59	>55	61	1.6
60	>55	61	1.3
>60	>55	62	<1.3

Note: Shaded bold values indicate situations that would require consideration of property treatments, with light rail LAeq(9hour) noise levels above 55 dBA and an increase in total road traffic noise of 2 dB or more

3 Noise Model Validation

***Query/* Recommendation:** A number of models are available for predicting airborne noise levels at receptors as a result of railway operations. They include the Nordic Rail Prediction Method, Schall 03 (German), OAL30 (Austrian) and Calculation of Railway Traffic Noise (CoRN – United Kingdom). All models can calculate the L_{Aeq} level. The Nordic model calculates L_{Amax} in addition to L_{Aeq} and may be advantageous to use for this project. However, as this is a unique use of the Nordic model to predict light rail noise in an urban environment it is recommended that the model is validated for this project. This could be done, for example, by modelling some parts of the existing Sydney light rail network in an urban environment and comparing the results with measured noise levels.

In response to this query, SLR Consulting have undertaken attended passby measurements of the existing Sydney Light Rail near Paddy's Markets, for the purpose of comparison of the results with modelled noise levels at the measurement location using the Nordic algorithm. Measurements were undertaken on 12 March 2014 in the early morning period to minimise noise from other sources.

A total of 13 passbys were captured. Audible track defects were observed throughout the embedded track section on both the Up and Down tracks between Darling Drive and Central. The influence of these defects on both tracks affected the measured noise levels and resulted in a clunking characteristic as the LRVs progressed along the tracks. The defects take the form of shallow depressions around 50 mm across. They appear to be remnants left after grinding (undertaken recently to remove more serious defects).

All measurements were taken in the free field at a distance of 7.5 m from the relevant track centre (different measurement locations were used for passbys on each track). Speeds were determined from the known 29 m length of the vehicle and the passby time. The measurement results are summarised in **Table 4.**

Table 4 Measured Noise Levels – Existing Light Rail at 7.5 m near Paddy's Market

Ref	Direction	Measurement Duration (s)	Passby Time (s)	Speed (km/h)	L_{AE} (dBA)	L_{Amax} (dBA)
0004.S3B	Dn	17	5.4	19	81	75
0006.S3B	Dn	18	5.2	19	81	75
0008.S3B	Dn	20	5.9	17	79	73
0011.S3B	Dn	13	5.4	19	80	76
0012.S3B	Dn	26	6.0	17	79	71
0015.S3B	Dn	14	5.6	18	80	74
0002.S3B	Up	10	-	-	79	76
0005.S3B	Up	16	6.2	16	78	71
0007.S3B	Up	14	4.8	21	79	75
0009.S3B	Up	14	5.2	19	81	77
0010.S3B	Up	23	5.1	20	80	77
0013.S3B	Up	16	5.9	17	77	73
0014.S3B	Up	13	5.8	17	79	76
					Average speed: 18 km/h	
					Logarithmic Average L_{AE}: 80 dBA	
					95th Percentile L_{Amax}: 77 dBA	

The presence of audible track defects means the measured noise levels cannot be directly compared with the EIS noise predictions. Notwithstanding, the measured situation has been replicated in SoundPLAN using the Nordic algorithm with input source levels adjusted to account for the measured noise levels. The comparison between modelled and measured levels is summarised in **Table 5**.

Table 5 Modelled vs Measured Noise Levels – Existing Light Rail at 7.5m near Paddy's Market

	LAeq(24hour) Assuming 100 passbys	**LAmax (dBA)**
Measurements at 7.5m	50 dBA	77
Modelled	52 dBA	76
Difference	+1.8 dB	-1.0 dB

The agreement between the measured and modelled levels is within +/- 2.0 dB for both L_{Aeq} and L_{Amax}. This variation is considered to be the usual range of modelling accuracy and is considered acceptable.

In the detailed design stage, the ONVR would be required (by the tender specifications) to provide evidence that the noise and vibration prediction model has been validated via measurement and prediction on other rail systems.

4 Noise Source Level Assumptions

Query/ Recommendation: Please provide reference material, namely:

- *http://www.silence&ip.org/site/index.php?id=197; and*
- Compliance measurements of the existing Sydney light rail system between 2004 and 2013

Additionally provide all assumptions which were used in the calculation of the L_{AE} and L_{Amax} 95% levels from the reference levels, for example LRV passby duration, etc.

The link to the SILENCE website should include a dash "-" in place of the ampersand "&":

http://www.silence-ip.org/site/index.php?id=197

See also http://www.silence-ip.org/site/index.php?id=201 for information specific to low noise rolling stock including links to recommendations for exterior noise limits (*VDV 154:2011 Noise from Mass Transit Rail Vehicles Acc. To Bostrab* (published by Verband Deutscher Verkehrsunternehmen, the association of German Transport Companies). These limits are reproduced in **Figure 2**.

Figure 2 Recommendations for Exterior Noise Limit Values

Recommendations for exterior noise limit values issued by VDV	
Standstill (1.2 m/ 3.5 m mic height)	60/63 dB
Passby (60 km/h)	79 dB
Starting	75 dB
Exterior microphone distance 7.5m; L_{pAeq} for all cases except "starting" (L_{pAmax})	

The recommendations shown in **Figure 2** do not specify maximum noise levels, but it is anticipated that on a well maintained system they would typically be only 1 dB to 2 dB above the L_{pAeq} noise level, and therefore assuming an L_{Amax} 95th percentile of 82 dBA (3 dB above the L_{Aeq}) is appropriate.

For a 45 m LRV, a passby L_{pAeq} noise limit of 79 dBA is equivalent to an L_{AE} of 83 dBA considering only the passby time itself. It is acknowledged that the time either side of the passby itself should also be included, but this was omitted in the EIS. The effect of the rise and fall on the L_{AE} depends on the track form (track decay rate) and would vary with different track forms and at different speeds. It is estimated that this could increase the source levels and hence noise predictions by 1 dB to 2 dB above the EIS predictions, depending on the speed and trackform. Further discussion of the sensitivity of the model predictions to this change in source level follows in **Section 5**.

Compliance measurements on the existing light rail have been taken at six locations between 2003 and 2013. The locations for compliance measurements include locations with crossovers, and locations near stops with passbys at relatively low speeds (with residential receivers in close proximity). One location, in Federal Park, has been measured with typical speeds near the reference speed of 60 km/h. Measurements were undertaken at a distance of 7.5 m from one track, with the results from the other track corrected for distance to correspond to the reference distance. The measured levels at this location are summarised in **Table 6**. It is noted that the maximum noise level observed in Federal Park often includes flanging noise due to the curve.

Table 6 Federal Park Compliance Measurements Corrected to 7.5 m and 60 km/h

Year	Number of Passbys	Logarithmic Average L_{AE} (dBA)	Average L_{Amax} (dBA)	Maximum L_{Amax} (dBA)
2003	11	82	76	83
2004	10	81	77	81
2005	10	78	76	79
2006	9	82	78	82
2007	9	82	79	85
2009	10	81	75	84
2010	10	81	78	83
2012	11	80	79	82
Overall	**80**	**81**	**83 (95th Percentile)**	

Note: Measurements from 2011 have been excluded due to high squeal levels (attributed to a lubrication system failure). Corrections for distance are based on a 20 log relationship for LAmax and a 10 log relationship for LAE. Corrections for speed are based on a 30 log relationship for LAmax and a 20 log relationship for LAE.

The above measurements on the existing system give a logarithmic average of 81 dBA for L_{AE} (with an LRV length of 29 m) and a 95th percentile L_{Amax} of 83 dBA (including flanging events). Extending the LRV length to 45 m would increase the L_{AE} to 83 dBA, which is the source level assumed in the EIS assessment.

5 Operational Noise Uncertainty Factor

Query/ Recommendation: The Operational Vibration assessment in section 6.3 has included a 5 dB safety factor for the purpose of determining frequency-dependent vibration impacts, to account for potential differences in the spectrum measured on the existing Sydney Light Rail and the CSELR (with different trackform and rolling stock). Should a safety factor be included in the operational noise predictions to ensure that noise predictions are not exceeded or are the current noise predictions essentially conservative?

It is recognised that there is uncertainty in the noise predictions in the absence of details of the track form and rolling stock, and the necessary assumptions around operating speeds. The current predictions are not considered to be conservative, unless LRV's travel at lower speeds than assumed. The predictions are considered to be representative of the noise emissions of a modern, well maintained system, with track form selected to minimise airborne operational noise levels.

The impact of operational source noise levels 2 dB and 5 dB above the assumed source levels has been tested in terms of the number of locations triggered for consideration of noise mitigation. The results are summarised in **Table 7** in terms of the Noise Catchment Areas (NCA's) defined in the EIS.

Table 7 RING Trigger Locations – Sensitivity to Increased Source Levels

Precinct	NCA	Residential Buildings Above RING Trigger Levels		
		EIS Source Levels	EIS +2 dBA	EIS +5 dBA
City Centre	NCA01.1	0	0	0
	NCA01.2	0	0	Two apartment buildings on George Street
	NCA01.3	One apartment building facing Chalmers Street	As in EIS	As in EIS
Surry Hills	NCA02.1	All residential buildings between Elizabeth Street and Crown Street	As in EIS, plus two additional residences: at the corner of Nickson Road and Devonshire Street, and on Bourke Street (north of Wimbo Park)	Effectively all residential properties immediately adjacent to the tracks, including properties with facades on Devonshire Street, houses on Nobbs Street and Parkham Street, and houses on Bourke Street either side of Wimbo Park
Moore Park	NCA03.1	0	0	0
Kensington / Kingsford	NCA04.1	One apartment building facing Anzac Parade, on corner of Abbotford Street	As in EIS, plus three additional apartment buildings fronting Anzac Parade	19 buildings fronting Anzac Parade, being a mix of apartment buildings and houses
	NCA04.2	Apartments above shops on Anzac Parade between Darling Street and Doncaster Avenue	As in EIS, plus four additional apartment buildings fronting Anzac Parade	23 buildings fronting Anzac Parade, being a mix of apartment buildings and houses
	NCA04.3	0	0	3 buildings fronting Anzac Parade
Randwick	NCA05.1	0	0	One building fronting Alison Road
	NCA05.2	0	0	0
	NCA05.3	0	Five buildings on Wansey Road	29 Buildings on Alison Road, Wansey Road and High Street
	NCA05.4	Two apartment buildings and one house on High Street.	19 buildings on High Street	23 buildings on High Street

As exceedances of the RING noise goals are controlled by the night-time L_{Aeq} levels, the increased impacts with increased source levels should be viewed in light of the existing night-time road traffic noise environment.

- In the City Centre, increasing the light rail source levels by up to 5 dB would not increase the impacts above the existing road traffic levels. No additional mitigation would be expected to be required.

- In Surry Hills, the close proximity of the residences on Devonshire Street means these properties are already triggered for consideration of mitigation. Addition of 2 dB to the source levels would trigger only two additional buildings. Addition of 5 dB to the source levels would extend the requirement to consider mitigation throughout the Surry Hills Precinct.
- In Moore Park, no properties would be triggered for consideration of mitigation even with a factor added to the noise source levels.
- In Kensington and Kingsford, while more properties would be triggered the light rail levels would remain well below the existing road traffic L_{Aeq} levels. No additional mitigation would be expected to be required.
- In Randwick, the addition of 2 dB to the source levels would trigger consideration of mitigation at 5 buildings on Wansey Road. However, it is noted that design changes in this area mean the light rail tracks are now proposed to be dropped to below road height, with a retaining wall having potential to shield the affected receivers. These changes have not been assessed in detail as they are expected to reduce the noise impacts. At this location, source and path control measures may be effective if required. Increasing the L_{Aeq} source levels along High Street would trigger a large number of properties for consideration of mitigation, however the light rail L_{Aeq} levels would remain below the existing traffic L_{Aeq} levels. Recognising that the number of high noise events is not likely to increase, with a reduction in bus services to be replaced by LRVs, mitigation of noise on High Street may not be considered reasonable.

6 Rolling Stock Noise Emissions

Query/ Recommendation: Having the lowest possible Light Rail Vehicle specification would be sensible to mitigate any possible noise impacts from the operation of the Light Rail. Please provide any consultation with rolling stock providers on possible low noise specifications.

The draft specifications for the light rail system include a requirement for the LRV noise emissions as follows:

> *"For an LRV running at speeds up to 60 km/h under all operating conditions, with all systems operating and the doors closed, the $L_{pAeq,Tp}$ noise level during a passby measured at a point 7.5m from the centreline of track and 1.2m above rail level must be no greater than 78 dBA."*

This target noise level is to be maintained throughout the life of the system. The target is considered to be representative of best practice noise emissions. Consultation with rolling stock providers will take place throughout the tender process.

7 LRV Service Frequency and Special Events

Query/ Recommendation: Table 10 of the report is inconsistent with Table 5.5 of the EIS main body (Volume 1A). Are the minimum intervals for the LRV in 2036 2.7 or 2.5 minutes? Does this have any consequence with the noise predictions?

A service interval of 2 minutes would allow an increase in frequency of LRVs. Will the network ever work at the design capacity? Should noise predictions be conducted under this design capacity scenario?

The service frequencies in Table 10 of the Noise Technical Paper are consistent with the hourly maximum number of services shown in Table 5.6 of the EIS Volume 1A. The 2.5 minute service frequency is considered in the Noise Technical Paper Section 5.5.6 for special events. Operating the special event frequency during the daytime gives rise to a relatively small increase in the noise predictions, but operating the special event frequency at night for one hour with 90 m LRVs increases the night-time L_{Aeq} predictions by 3 dB.

While it is noted that special events are expected to occur around once a week, special events requiring 90 m LRVs to clear crowds during the night-time period would be less frequent. Of the total special events, around one in ten would have crowds >30,000 and may require 90 m LRVs. Around one in four events would have crowds in the 20,000 to 30,000 range with the remainder of events having crowds less than 20,000. It is estimated that 90 m special event services would be required for approximately 20 events per year. RING suggests that the assessment should reflect the reasonable maximum use, or the 'worst-case' typical day rather than average use. At this stage in the project, it is not known how many of these events would require special event services after 10:00 pm. Final operating service frequencies and hours of operation would be confirmed during detailed design once the PPP contractor is engaged.

In the event that the frequency of regular services is increased in future, the predicted exceedances of the L_{Aeq} noise goals would increase. The increase would depend on the time of day of the increased service frequency. In the event that the number of services in the CBD, Surry Hills and Moore Park would increase by 50% up to predicted capacity the resulting increase in night-time L_{Aeq} noise levels would be 1.8 dB.

8 PA Systems and Warning Bells

Query/ Recommendation: PA systems and warning bells are a constant source of community complaint. Please confirm that warning bells would not be routinely used upon entry to stops by drivers, unless of course there is an emergency situation?

Overseas experience would suggest that light rail systems typically do not have PA systems on road stops and rely on information display systems. Please justify the use of PA systems for the proposed project?

With regard to warning bells, while these would not be required on approach to a stop, at locations with high pedestrian activity, bells would be used to alert pedestrians of the presence of an LRV. There are a number of different bell sounds that might be used.

With regard to PA systems, the EIS identifies the potential for annoyance due to PA systems at stops in residential areas. It is agreed that regular PA announcements at all stops are not necessary. The existing Sydney Light Rail stops are fitted with PA systems, but these are not used on a regular basis.

9 Road Traffic Noise Impacts

Query/ Recommendation: It is understood that potential traffic noise impacts as part of the project are difficult to manage and potentially there is little opportunity to mitigate the traffic noise levels. Based on review of the reported changes in road traffic noise levels, road traffic noise impacts appear to be quite significant, however they are in streets predominately commercial.

To understand the potential traffic noise impacts more closely, it is recommended that the existing noise levels in the road sections where increases in traffic noise have been identified to be greater than 2 dB be estimated and a survey of residential dwellings in those streets be conducted.

The estimate of increase in traffic noise is conservative in that it assumes that an increase in traffic numbers corresponds directly to an increase in noise. While this would be the case in free flowing traffic, in congested city traffic the change in noise would be less (where engine noise dominates over wheel/road noise).

This comment is considered particularly applicable to road traffic noise impacts on Randle Street following diversion of existing traffic from Chalmers Street. Additional night-time attended measurements have been taken on Chalmers Street, Randle Street and Elizabeth Street to characterise the existing night-time noise environment as described in **Table 8**.

Table 8 Attended Noise Monitoring Results – Randle Street, Surry Hills

Location	Date	Time	Noise Levels (dBA)					Description and Typical L_{Amax} Levels (dBA)
			L_{Amax}	L_{A1}	L_{A10}	L_{Aeq}	L_{A90}	
372 Elizabeth St, Surry Hills 5 m from centre of nearest traffic lane 3 m from nearest facade	12/03/2014	00:16	89	78	73	69	54	Buses 81-87 Cars 68-80 Trucks 68-89
30 Chalmers St, Surry Hills 4.5 m from centre of nearest traffic lane 4 m from nearest facade	12/03/2014	00:37	79	75	68	64	51	Cars 64-78 Pedestrians 60
15 Randle St, Surry Hills 4 m from centre of nearest traffic lane 2.5 m from nearest facade	12/03/2014	00:55	83	71	59	60	50	Cars 69-70 Trucks 65-83 Pedestrians 54 Waste truck 58
1-5 Randle St, Surry Hills 6 m from centre of nearest traffic lane 4 m from nearest facade	12/03/2014	01:12	83	72	68	64	52	Cars 61-75 Trucks 68-83

Table 8 confirms that existing night-time road traffic noise impacts on the arterial routes of Chalmers Street and Elizabeth Street are relatively high. At residential apartments on Randle Street, the noise impacts vary with distance from the existing arterial routes. 1-5 Randle Street is located on the corner of Elizabeth Street, with existing night-time L_{Aeq} levels around 64 dBA. At the rear of apartments with a façade on Randle Lane, near 15 Randle Street, existing night-time L_{Aeq} noise levels are around 60 dBA.

With these existing noise levels on Randle Street, it is clear that the night-time external noise goals for local roads defined in the NSW Road Noise Policy are not appropriate. Appropriate internal noise goals would be developed for these receivers in the detailed design stage with reference to AS2107, and following measurement of the existing internal noise levels and the attenuation provided across the facade.

Mitigation of road traffic noise impacts due to the diversion and additional traffic on Elizabeth Street (and other affected arterial roads in the CBD) is not considered reasonable in light of the existing road traffic noise environment.

10 Stabling and Maintenance Facilities

Query/ Recommendation: The report confirms that noise is a significant concern with this site and raised the issue of barriers / partial roofs or a complete shed, without including any plans or elevations showing the extent of these building areas. With the extent of the impacts and non-compliance of the night time noise criteria presented in the report it is recommended that the noise assessment be revised in detail to show how noise will be mitigated/managed and achieve INP criteria. The assessment needs to address the issues highlighted above, present plans, cross sections and elevations showing the extent of mitigation, show noise contour or façade plots to indicate where the noise impacts are for each scenario, exact source locations for each scenario, etc.

The modelling of noise impacts for the Randwick Stabling facility refers to measurements and observations of the existing Light Rail Depot at Pyrmont. TfNSW have advised that there may be scope to change pre-start practices to minimise noise impacts. Furthermore, the layout of the facility may change as tenderer's propose alternatives. It may also be possible to enclose only some areas of the site.

At this stage it is difficult to confirm details of mitigation measures. The approach taken has been to identify whether it is possible for a stabling facility at the Randwick location to be designed to comply with the INP goals. The assessment indicates it is possible for the facility to comply with the noise goals at all locations in all time periods, with the exception of 5 receiver points located in two buildings adjacent to the site exit road. The source of the exceedance at this location is staff cars (light vehicles) leaving the site, for example drivers leaving at the end of a shift.

Following discussion with Wilkinson Murray and Planning & Infrastructure, it is noted that the concerns with the Randwick Stabling area also relate to concerns around residential amenity in general.

The applicability of the noise logger position BG07 at 24 Doncaster Avenue to the site extremities was also discussed in the meeting with Wilkinson Murray and Planning & Infrastructure. Additional night-time attended measurements at the northern and southern ends have been undertaken and are shown in **Table 9**.

Table 9 Attended Noise Monitoring Results – Randwick Stabling Extremities

Location	Date	Time	Noise Levels (dBA)					Description and Typical L_{Amax} Levels (dBA)
			L_{Amax}	L_{A1}	L_{A10}	L_{Aeq}	L_{A90}	
7 Doncaster Ave, Randwick (Northern end of proposed stabling facility)	12/03/2014	00:32	77	67	61	58	43	Buses 56-67 Cars 48-67 Trucks 61-77 Motorbike 62
66 Doncaster Ave, Randwick (Southern end of proposed stabling facility)	12/03/2014	00:58	56	47	45	42	39	Buses 42-43 Cars 43-46 Motorbike 46-56

The BG07 logger recorded a night-time background noise level of 38 dBA, and a night-time L_{Aeq} noise level of 46 dBA. The additional attended measurements confirm that the ambient and background levels are higher near Alison Road (at 7 Doncaster Avenue) than at the southern end of the site. However, the assessment of noise impacts at this site is controlled by the background level. The attended night-time measurements of the background level confirm that the logger is representative of the receivers with the lowest existing background noise levels.

The receivers and source locations considered in the assessment are shown in **Figure 3**.

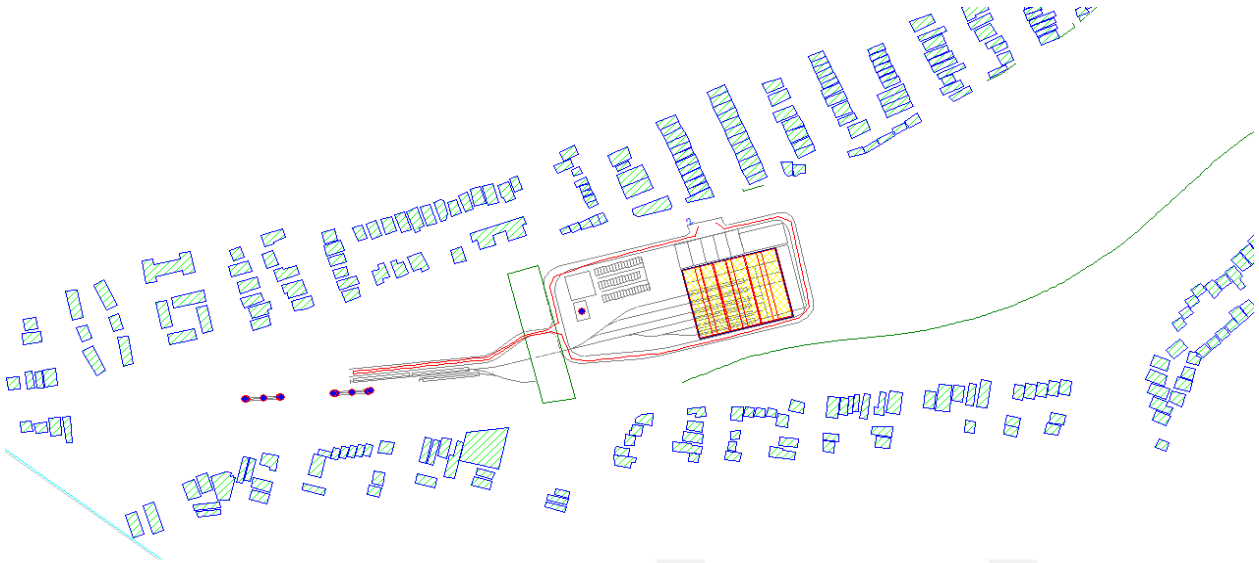
> ***Query/ Recommendation:*** Please review Table 36 in the Report which presents predicted noise levels from the Rozelle Maintenance Facility. Given the location of the noise sources, it is surprising that the highest noise levels are on the ground floor. It is unclear where the receiver locations are. The assessment needs to present noise contour or façade plots or a plan showing receiver locations to indicate where the noise impacts are for each noise scenario.

The maximum levels impacting on different building stories reported in Table 36 are not necessarily incident on the same building (some buildings have only one storey).

The receivers and source locations considered in the assessment are shown in **Figure 4**.

Figure 3 Randwick Stabling Model and Receivers

Figure 4 Rozelle Maintenance Facility Model and Receivers

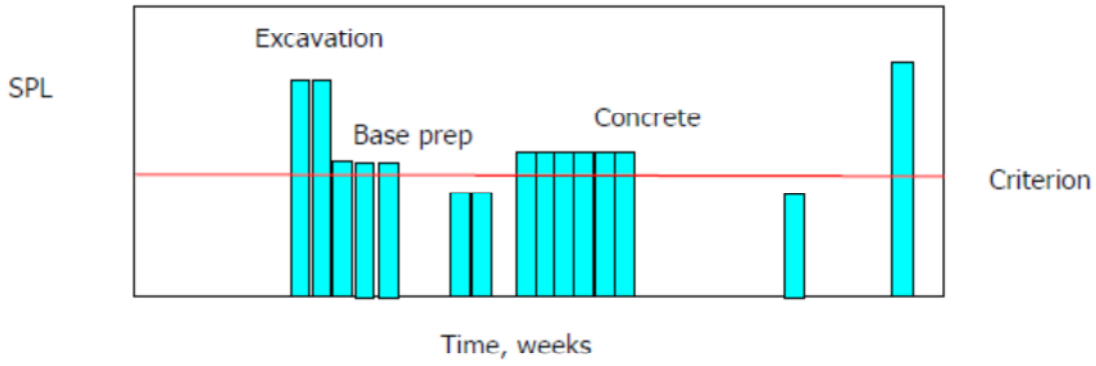


11 Construction Noise

Query/ Recommendation: It is unclear the level and duration of the noise impact at locations along the construction of the light rail system. To understand the construction noise impacts along the construction of the track it is requested that a noise profile be constructed for a typical (worst) receiver (day, evening and night) and show in graphical terms the duration of construction in each of the areas, namely:

- City Centre Precinct ;
- Surry Hills Precinct;
- Moore Park Precinct;
- Kensington / Kingsford Precinct;
- Randwick Precinct;
- Randwick stabling yard; and
- Rozelle maintenance facility.

The profile should be similar to: eg xx Devonshire Street (Day) (typically x metres from the Receiver)



At this stage, details of the schedule for the works are not available. There are a number of different approaches that could be taken to construction that would give an entirely different noise profile (for example, whether Appitrack or Slipforming machines are used).

An indicative graph of the mainline track construction work stages is shown for the most affected residential location in each Precinct in the following figures. The schedule is based on a number of assumptions as follows:

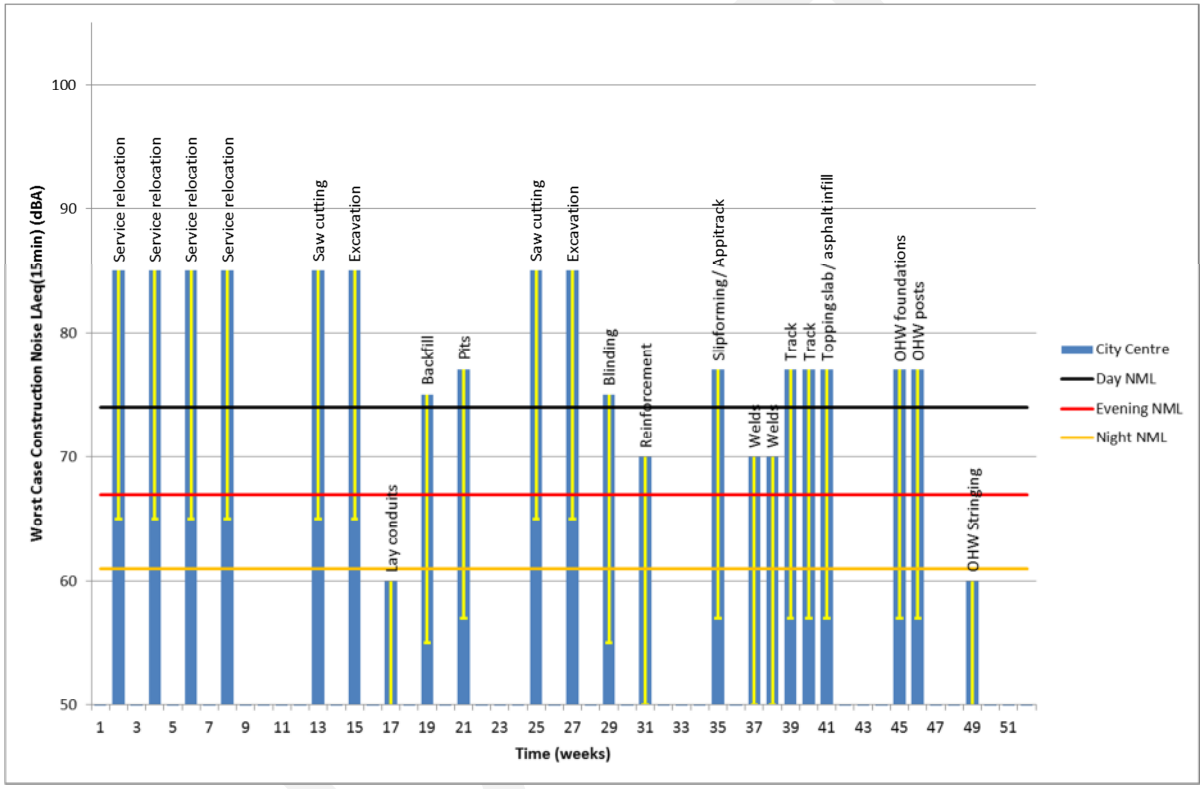
- Works shown are occurring mid-block – works at intersections would occur during road closures and the schedule would be different.
- The overall duration of mid-block works is anticipated to be approximately 12 months.
- Around two months of this would be required for service relocations.

The majority of other activities would occur in “waves” along the alignment. For a 200 m long section of track mid-block, most individual activities would be completed in 3-8 shifts, that is, over approximately three to eight days. Each week of activity is assumed to be followed by a week with minimal activities (at each individual receiver location), while work is taking place further along the alignment and before the next “wave” comes through.

Even with works in the same block, the noise impacts on any single receiver would be less for the proportion of that time that works are not occurring immediately adjacent. As the source moves away from the receiver, the noise level would reduce. An indicative reduction would be around 20 dB where the source is around 100m further along the alignment than the nearest point, for a receiver around 10m from the track. The noise levels corresponding to this reduction from the worst case situation is shown in the following figures in the form of a 20 dB range (shown as a yellow bar) below the predicted worst case level.

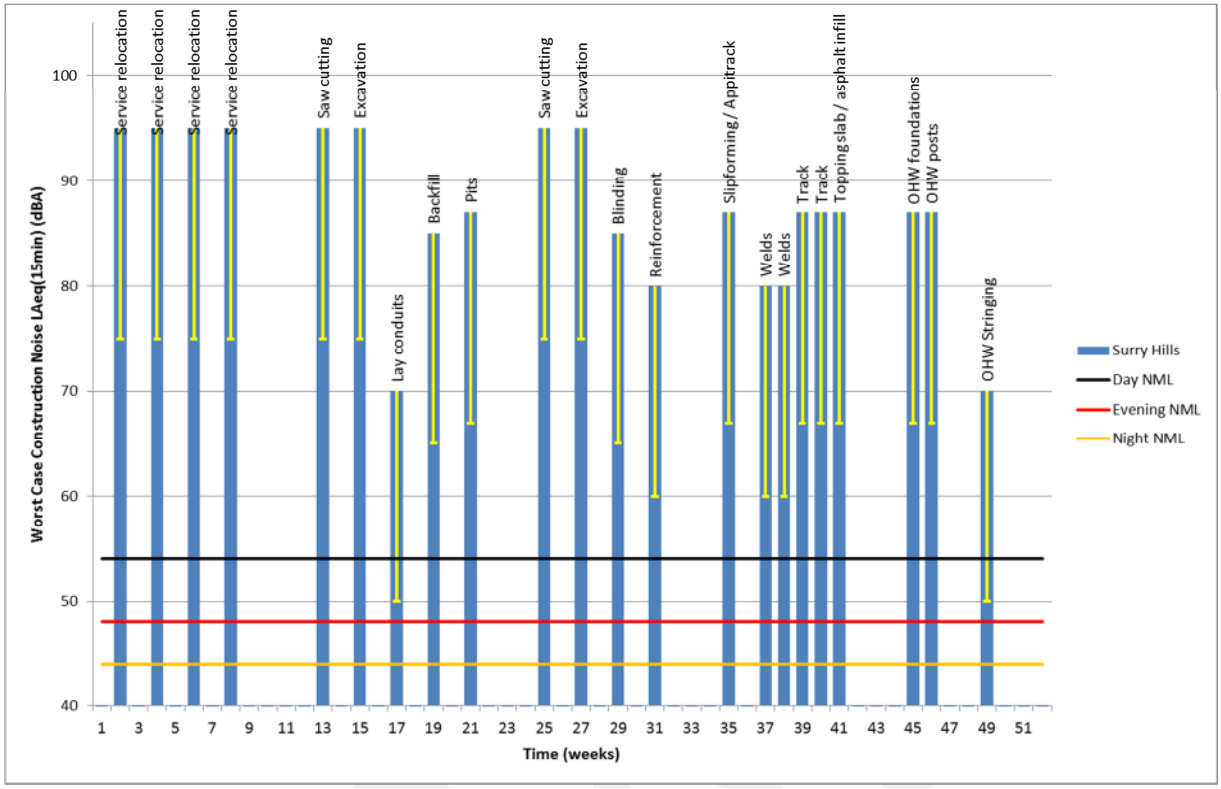
It is noted that the Roads and Maritime Traffic Management Centre (TMC) require work outside of standard hours for intersections as well as for some mid-block works. For example, mid-block works along Anzac Parade will be required during the night-time, as these works will require closure of the traffic lanes adjacent to the works (which would not be permitted during the daytime). The following figures show the relevant Noise Management Levels (NMLs) in each time period.

Figure 5 Indicative Construction Impacts on Residential Receivers – City Centre



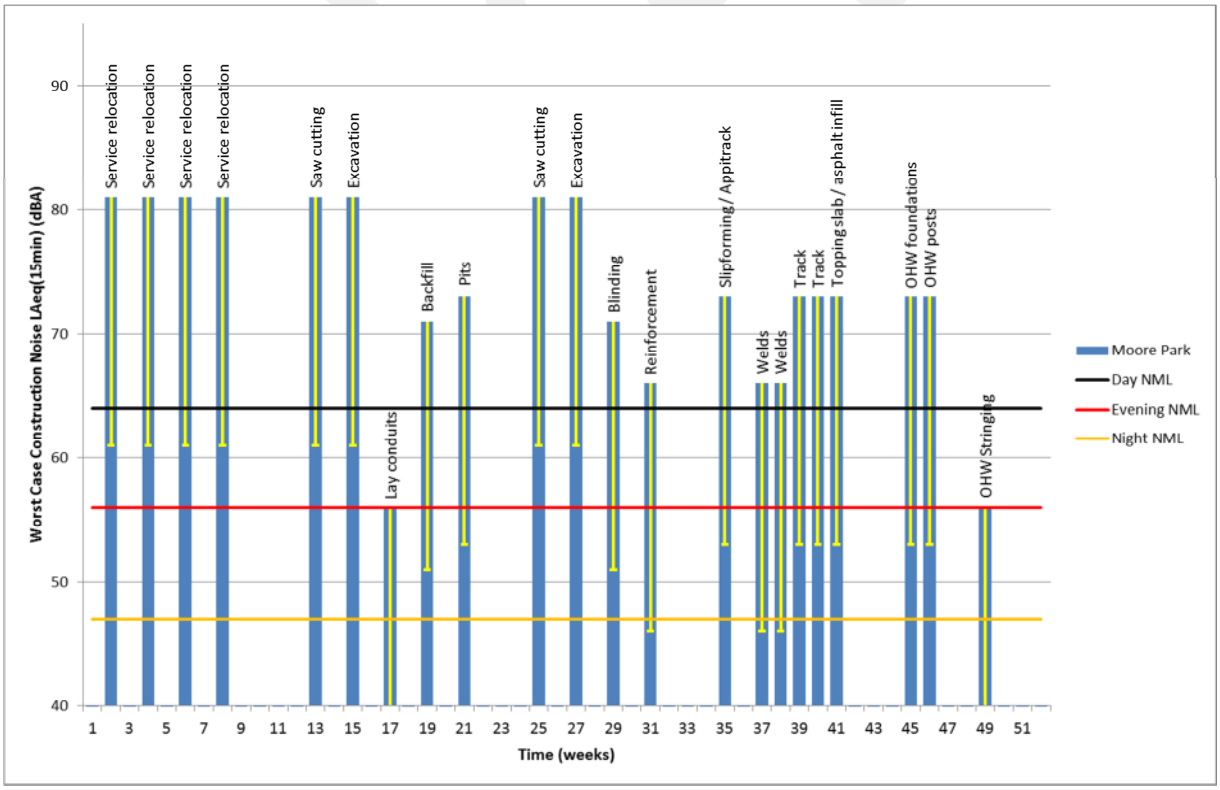
Note: Yellow bars indicate 20 dB range for approximate noise levels where the source is within 100 m of an individual receiver.

Figure 6 Indicative Construction Impacts on Residential Receivers – Surry Hills



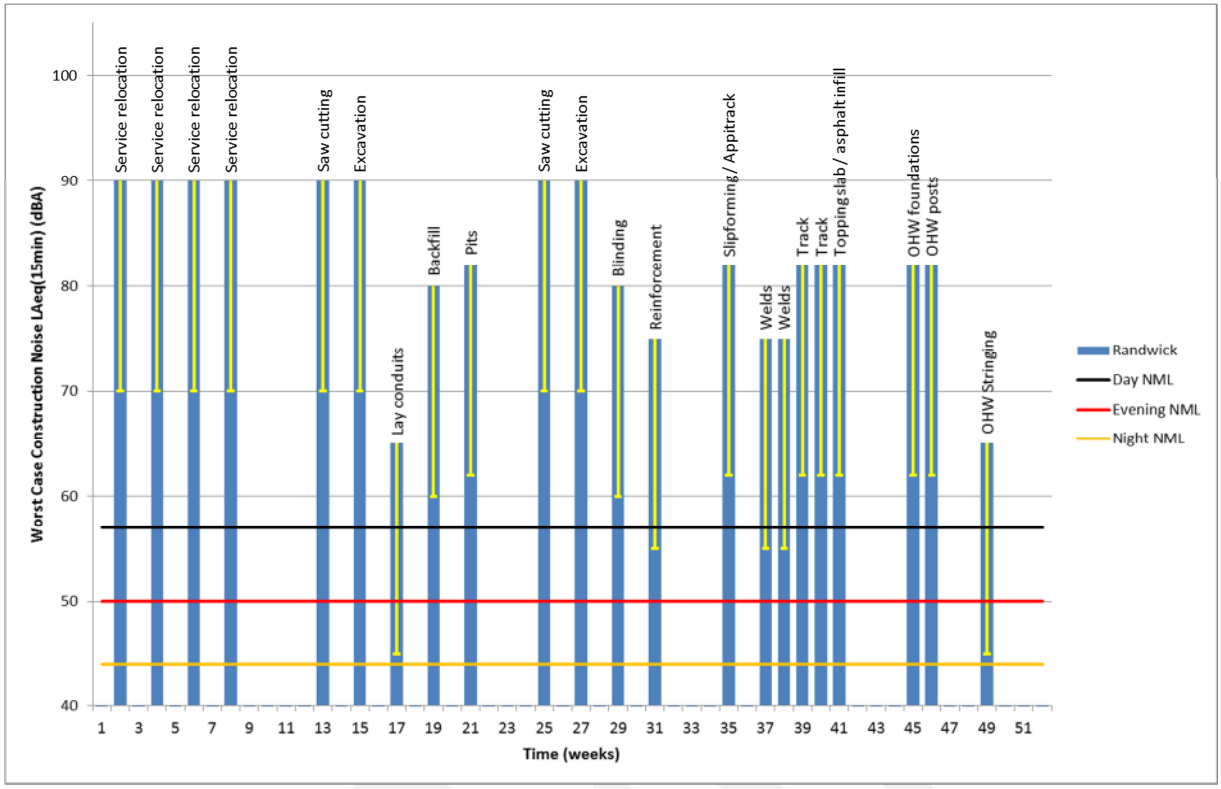
Note: Yellow bars indicate 20 dB range for approximate noise levels where the source is within 100 m of an individual receiver.

Figure 7 Indicative Construction Impacts on Residential Receivers – Moore Park



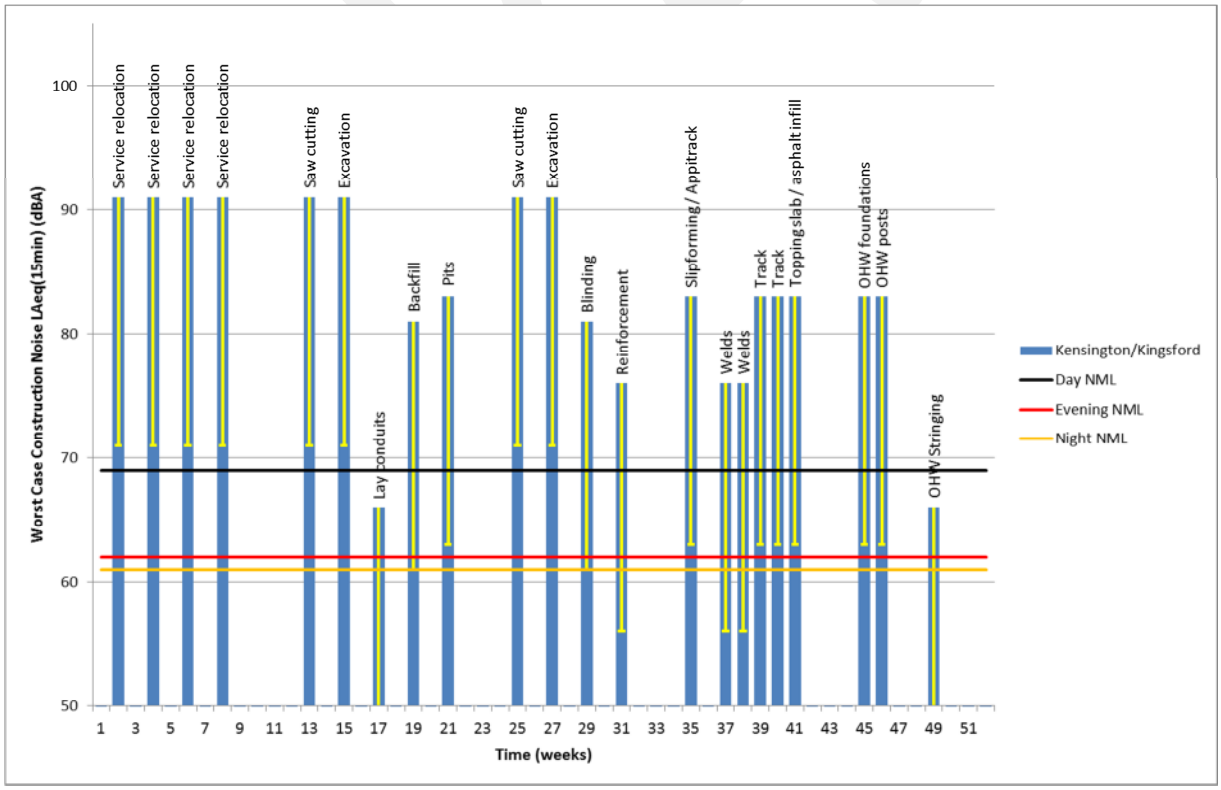
Note: Yellow bars indicate 20 dB range for approximate noise levels where the source is within 100 m of an individual receiver.

Figure 8 Indicative Construction Impacts on Residential Receivers – Randwick



Note: Yellow bars indicate 20 dB range for approximate noise levels where the source is within 100 m of an individual receiver.

Figure 9 Indicative Construction Impacts on Residential Receivers – Kensington / Kingsford



Note: Yellow bars indicate 20 dB range for approximate noise levels where the source is within 100 m of an individual receiver.

12 Concluding comment

Please contact the undersigned to discuss in the event further clarification is required.

Yours sincerely

BRIONY CROFT
Principal - Noise and Vibration

Appendix 2 Flood Assessment – Randwick Stabling

Transport for NSW
Level 17 338 Pitt St
Sydney NSW 2000

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29 April 2014

[redacted]

Re: Light Rail Stabling Depot Preliminary Flood Assessment

Further to your email of 1st April 2014 WMAwater has undertaken a preliminary flood assessment of the proposed light rail stabling yard development adjacent to the Royal Randwick Racecourse. The proposed development is situated on the undeveloped lot to the rear of the residential properties along Doncaster Avenue between Alison Road and Ascot Street.

Development Requirements

The operational requirement of the stabling yard is that it remains dry during major flood events, which in practical terms means that water is not more than 50 mm above rail level throughout the yard in the 1% AEP (1 in 100 year) flood event. To ensure the development does not adversely impact neighbouring properties from a flood perspective, it is proposed that the entire yard be built on an elevated deck supported on piles so that existing flow paths can be maintained below the deck.

Methodology

As part of the assessment herein, the TUFLOW hydraulic model developed as part of the 2013 Kensington – Centennial Park Flood Study (WMAwater, 2013) was modified and used to simulate the 1% AEP design flood event. Similar to the Flood Study, a 1 hour embedded in a 12 hour storm was adopted as the critical design storm in the hydraulic modelling. Two scenarios were modelled: (1) existing conditions (base case); and (2) post-development conditions whereby changes were made to the hydraulic model to remove existing building footprints and introducing elements of flow constriction that account for the 750 mm diameter RC piles placed on a 4 m by 6 m spacing across the stabling yard footprint. No excavation of the ground to form additional temporary floodplain storage was assumed.

Modelling Results

Referring to Figure **1** which shows existing flood behaviour, floodwaters enter the development site from Alison Road (north) before discharging through residential properties to Doncaster Avenue (south-west). The existing peak flood level for the site is 29.2 mAHD in the 1% AEP flood event (sampled along the northern edge of the development). The 1% AEP flood extent does not encroach to higher ground at the southern end (Figure **2**) hence development on this part of the land does not have to be on piles.

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In post-development conditions with the removal of existing buildings within the development site and introduction of the RC piles, the peak flood level upstream decreases to 29.16 mAHD in the 1% AEP flood event (refer Figure **2**) which is expected as floodwaters are no longer impeded by existing buildings that serve as obstructions to flow. However, this results in a slight increase in peak flood levels downstream along the western boundary of the development site at the rear end of the residential properties on Doncaster Avenue. Figure **3** shows the 1% AEP flood impact of the development and it can be seen that a maximum localised impact up to 30 mm can be expected on the peak flood levels. Post-development flood velocities remains relatively unchanged from existing conditions and are generally <1 m/s.

From the concept drawings provided pertaining to the design of the stabling yard platform and RC piles (attached), the platform with a surface elevation of 30 mAHD and soffit at 29.25m AHD would remain dry throughout the 1% AEP flood event. Thus the operational requirement would be met. This assumes that there is no blockage caused by the piers.

The modelling results reported herein were also validated using the 1 dimensional HEC-RAS hydraulic model and similar results were obtained in terms of afflux (in the order of 10 mm) as a result of the proposed development.

Summary and Recommendations

In conclusion, a flood impact assessment of the proposed development shows that minor changes to the 1% AEP peak flood levels can be expected in the immediate surrounds of the development site.

A decrease in the flood levels was found upstream whilst a slight increase of up to a maximum of 30 mm was found along the western boundary of the site.

Preliminary indications suggest that minor changes to the local landform, by excavation to reduce ground levels for example or construction of blockages to replicate the existing building layouts should be able to address the adverse impacts. A detailed assessment of these possible mitigation strategies has not been undertaken at this stage.

Yours Sincerely,
WMAwater

Richard Dewar
Director

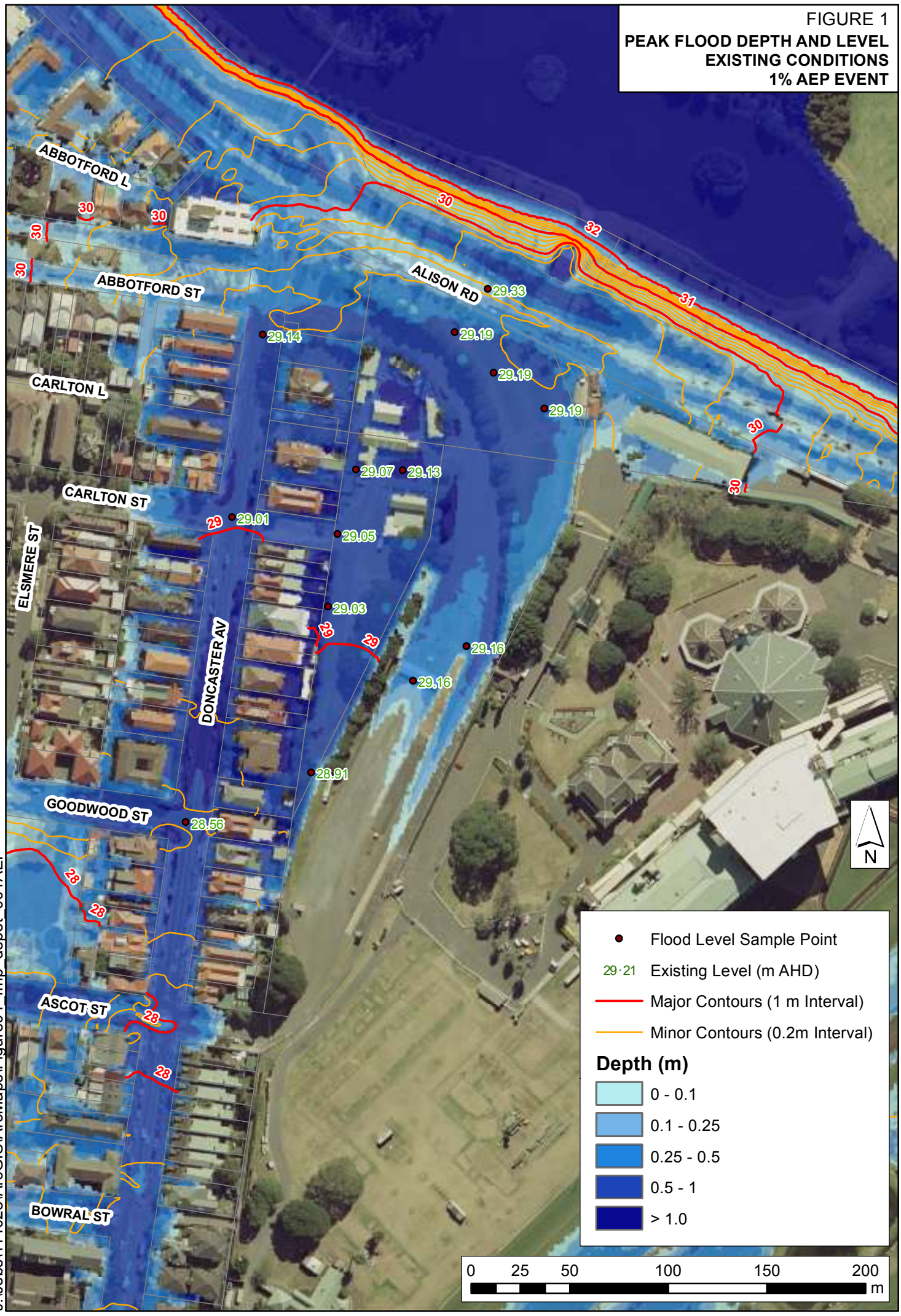
FIGURE 1
PEAK FLOOD DEPTH AND LEVEL
EXISTING CONDITIONS
1% AEP EVENT
ABBOTFORD L
ABBOTFORD ST
ALISON RD
CARLTON L
CARLTON ST
ELSMERE ST
DONCASTER AV
GOODWOOD ST
ASCOT ST
BOWRAL ST
29.33
29.14
29.19
29.19
29.19
29.07
29.13
29.01
29.05
29.03
29.16
29.16
28.91
28.56
N
Flood Level Sample Point
29·21 Existing Level (m AHD)
Major Contours (1 m Interval)
Minor Contours (0.2m Interval)
Depth (m)
0 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1
> 1.0
0 25 50 100 150 200
m
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FIGURE 2
PEAK FLOOD DEPTH AND LEVEL
POST DEVELOPMENT CONDITIONS
1% AEP EVENT
ABBOTFORD L
ABBOTFORD ST
ALISON RD
CARLTON L
CARLTON ST
ELSMERE ST
DONCASTER AV
GOODWOOD ST
ASCOT ST
BOWRAL ST
29.33
29.12
29.14
29.15
29.14
29.08
29.11
29.01
29.06
29.04
29.12
29.12
28.91
28.56
N
Flood Level Sample Point
29·33 Proposed Level (m AHD)
Major Contours (1 m Interval)
Minor Contours (0.2m Interval)
Light Rail Depot
Depth (m)
0 - 0.1
0.1 - 0.25
0.25 - 0.5
0.5 - 1
> 1.0
0 25 50 100 150 200
m
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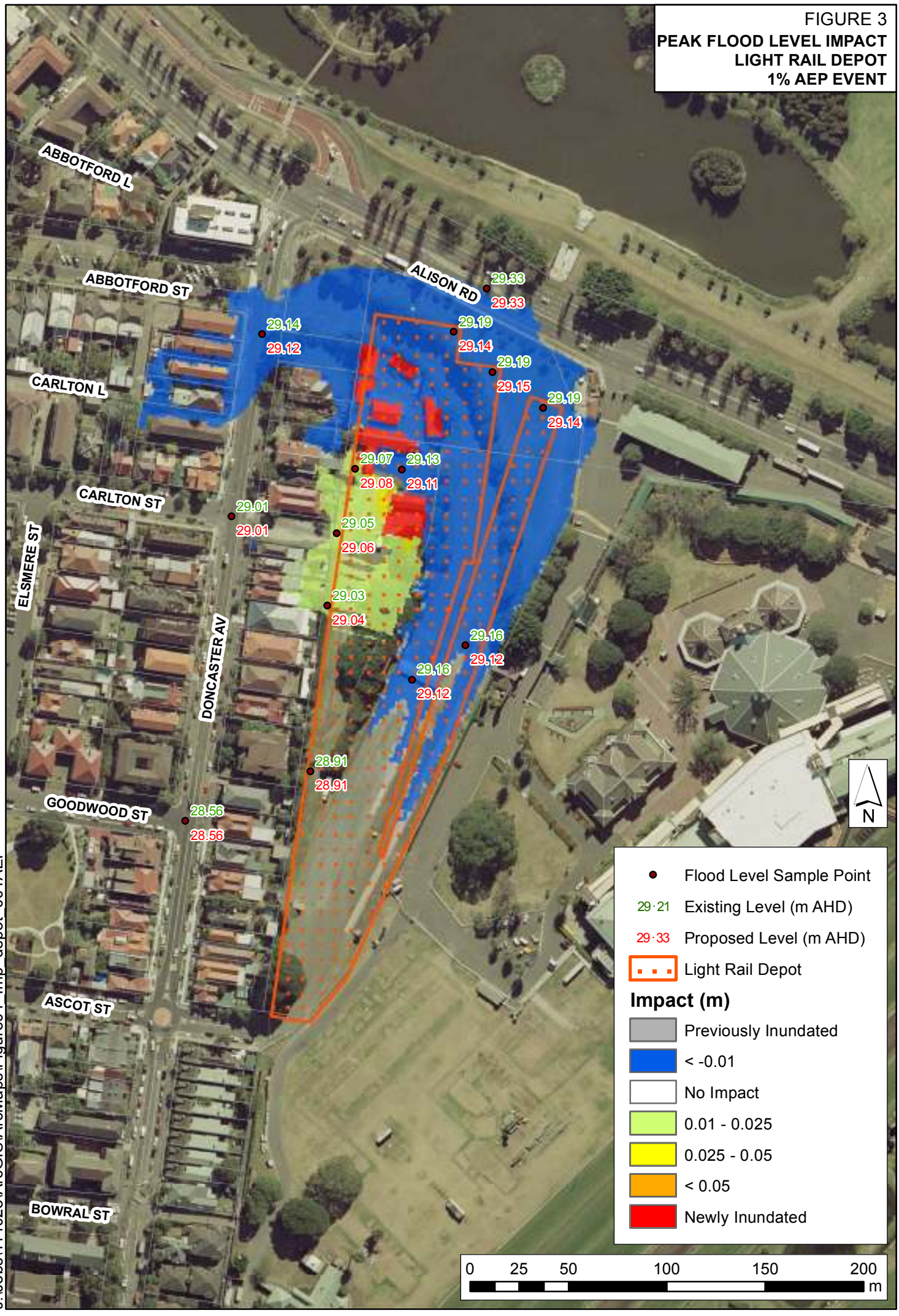
FIGURE 3
PEAK FLOOD LEVEL IMPACT
LIGHT RAIL DEPOT
1% AEP EVENT
ABBOTFORD L
ABBOTFORD ST
ALISON RD
CARLTON L
CARLTON ST
ELSMERE ST
DONCASTER AV
GOODWOOD ST
ASCOT ST
BOWRAL ST
29.33
29.33
29.14
29.12
29.19
29.14
29.19
29.15
29.19
29.14
29.07
29.13
29.08
29.11
29.01
29.01
29.05
29.06
29.03
29.04
29.16
29.12
29.16
29.12
28.91
28.91
28.56
28.56
N
Flood Level Sample Point
29·21 Existing Level (m AHD)
29·33 Proposed Level (m AHD)
Light Rail Depot
Impact (m)
Previously Inundated
< -0.01
No Impact
0.01 - 0.025
0.025 - 0.05
< 0.05
Newly Inundated
0 25 50 100 150 200
m
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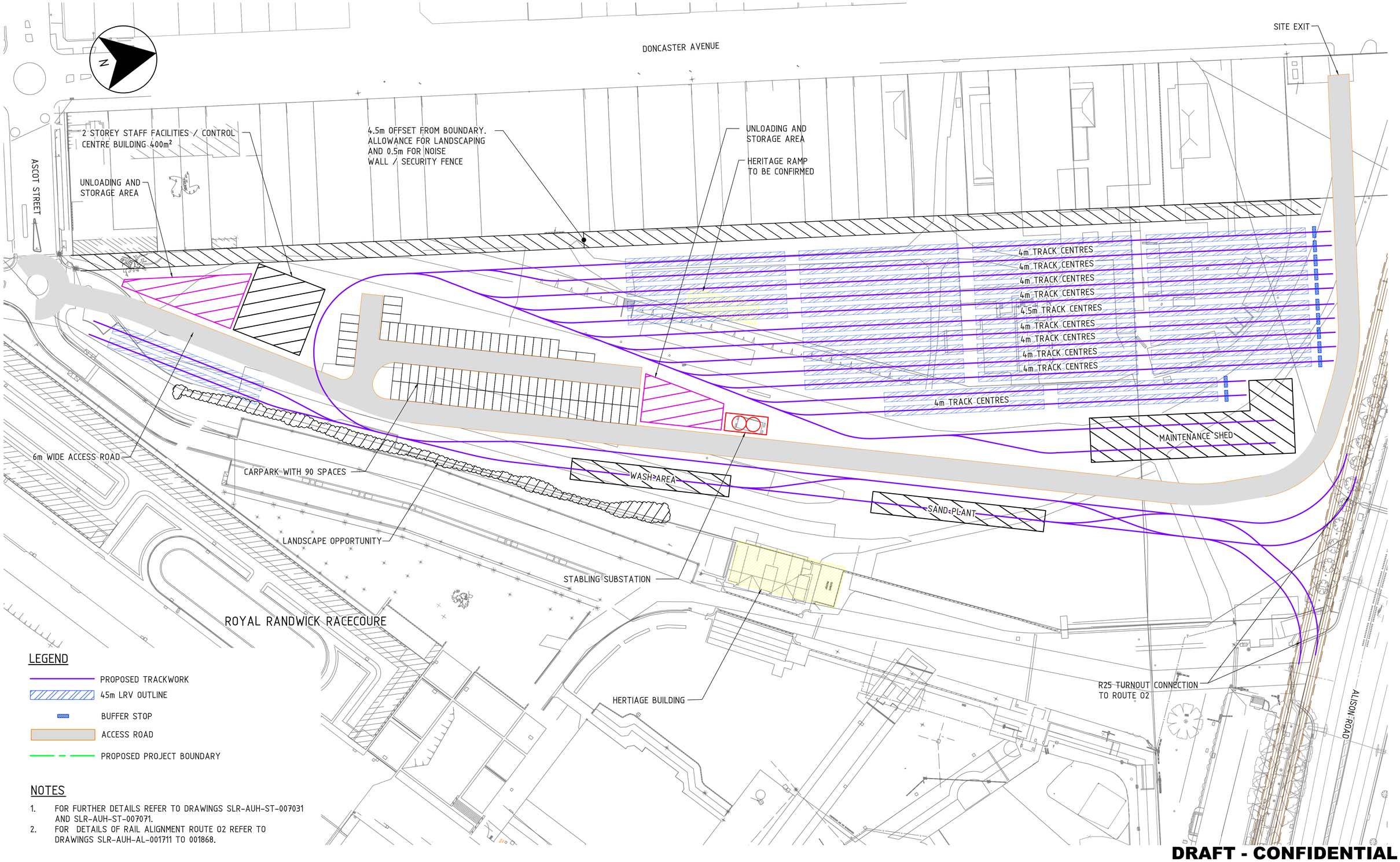

LEGEND

- PROPOSED TRACKWORK
- 45m LRV OUTLINE
- BUFFER STOP
- ACCESS ROAD
- PROPOSED PROJECT BOUNDARY

NOTES

1. FOR FURTHER DETAILS REFER TO DRAWINGS SLR-AUH-ST-007031 AND SLR-AUH-ST-007071.
2. FOR DETAILS OF RAIL ALIGNMENT ROUTE 02 REFER TO DRAWINGS SLR-AUH-AL-001711 TO 001868.

DRAFT - CONFIDENTIAL

REV	BY	DATE	DESCRIPTION	APPD.
A	NB	28/01/14	DRAFT ISSUED FOR TENDER	CD

A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: 1:250m

5 0 10 20m
1:500(A1)/1:1000(A3)

NOTES:

1. THESE DRAFT DRAWINGS ARE FOR INFORMATION ONLY AND REFLECT INFORMATION KNOWN AT THE DATE OF PREPARATION.
2. THEY ARE TO BE READ IN CONJUNCTION WITH THE SCOPE AND PERFORMANCE REQUIREMENTS (SPR) DOCUMENTATION AND DOC NO SLRP-00WP-GN-G-0004 "SCHEDULE OF AREAS REQUIRING DESIGN DEVELOPMENT".
3. THESE DRAFT DRAWINGS HAVE NOT BEEN FULLY CO-ORDINATED AND THEREFORE CONTAIN AREAS THAT MAY NOT FULLY REFLECT THE CONTENT OR INTENT OF THE SPRS.

CLIENT

NSW GOVERNMENT Transport for NSW

ARUP HASSELL

AH REFERENCE: -----

DRAWN	NIGEL BAREFOOT	28/01/14
DESIGNED	NIGEL BAREFOOT	28/01/14
DRG CHECK	JAMES BRYANT	28/01/14
DESIGN CHECK	CHRIS DOWNS	28/01/14
APPROVED	ANNA SQUIRE	28/01/14

SYDNEY LIGHT RAIL
RANDWICK
RANDWICK DEPOT
GENERAL ARRANGEMENT

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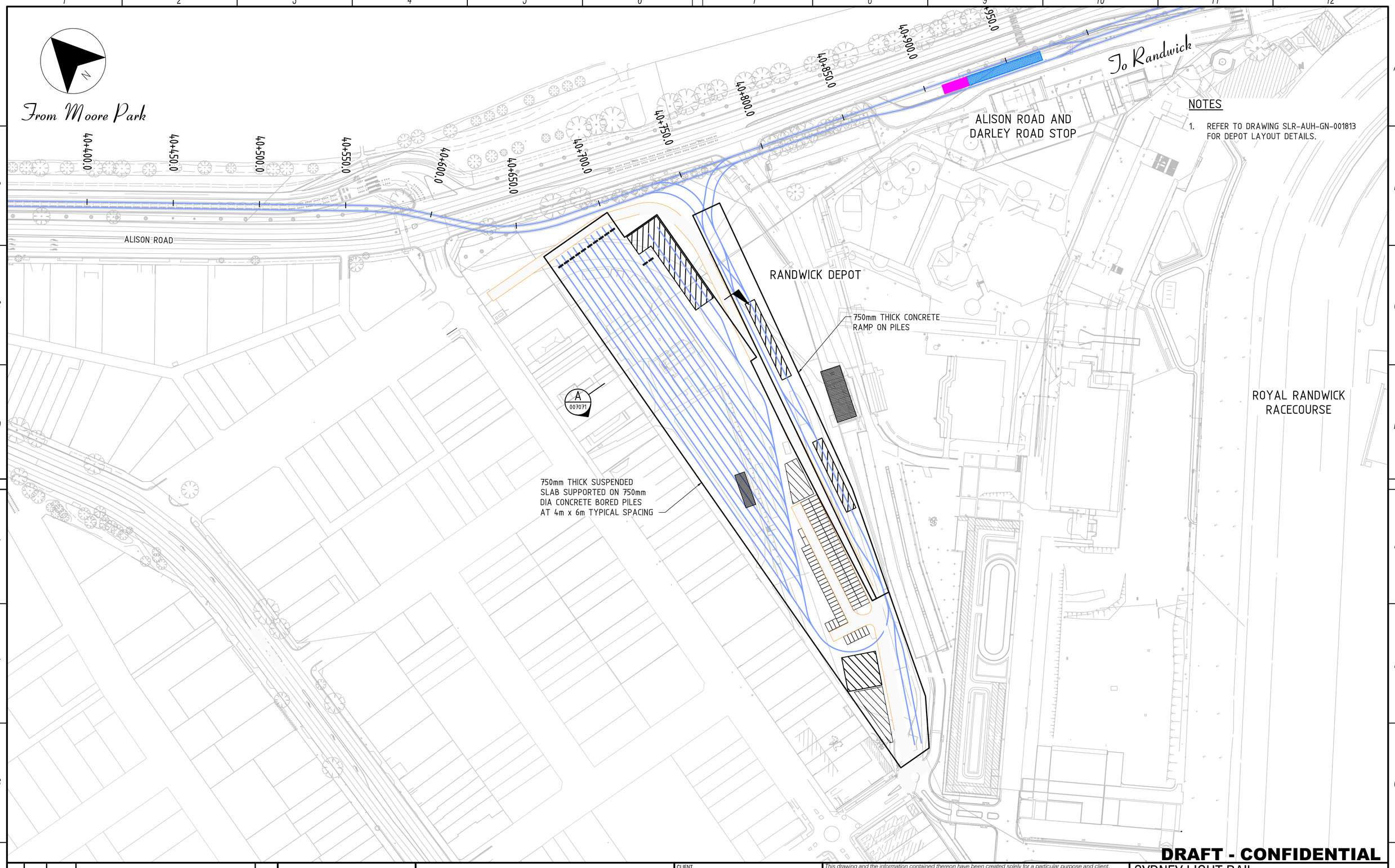
DRG No. SLR-AUH-GN-001831	A	EDMS No.



NOTES

1. REFER TO DRAWING SLR-AUH-GN-001813 FOR DEPOT LAYOUT DETAILS.

DRAFT - CONFIDENTIAL

REV	BY	DATE	DESCRIPTION	APPD.
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A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: 1:1000

10 0 10 20 30 40 50m
1:1000(A1)/1:2000(A3)

NOTES:

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CLIENT

NSW GOVERNMENT Transport for NSW

ARUP HASSELL

AH REFERENCE: -----

DRAWN	PETER MISIOREK	24/01/14
DESIGNED	NICOLE FERGUSON	24/01/14
DRG CHECK	JAMES BRYANT	24/01/14
DESIGN CHECK	VICTOR ANDRADE	24/01/14
APPROVED	ANNA SQUIRE	28/01/14

SYDNEY LIGHT RAIL
RANDWICK
STRUCTURES - ROUTE 02
RANDWICK DEPOT
PLAN

FILE No. SLR-AUH-ST-007031	1 OF 1	A1
STATUS: DRAFT FOR TENDER		©
DRG No. SLR-AUH-ST-007031	A	EDMS No. A

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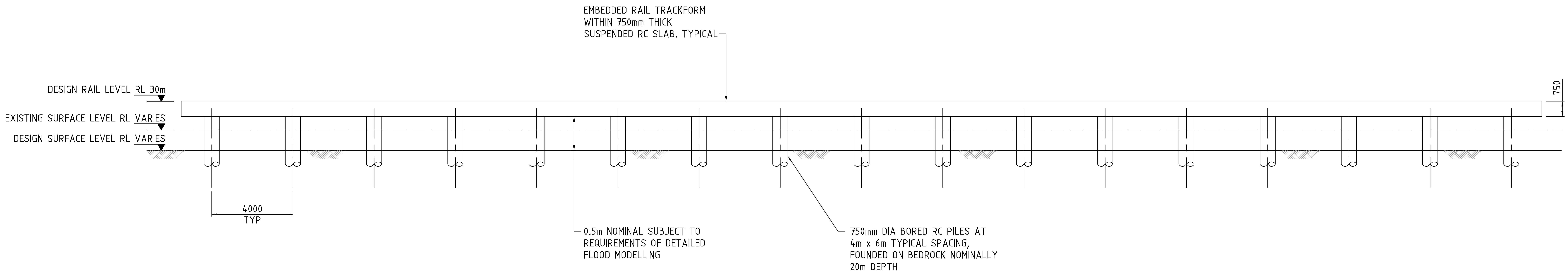

SECTION A
N.T.S. 007031

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A1 Original | Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D. | Scale: N.T.S.

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CLIENT

NSW GOVERNMENT | Transport for NSW

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AH REFERENCE: -----

DRAWN	PETER MISIOREK	24/01/14
DESIGNED	NICOLE FERGUSON	24/01/14
DRG CHECK	JAMES BRYANT	24/01/14
DESIGN CHECK	VICTOR ANDRADE	24/01/14
APPROVED	ANNA SQUIRE	28/01/14

SYDNEY LIGHT RAIL
RANDWICK
STRUCTURES - ROUTE 02
RANDWICK DEPOT
SECTION 'A'

FILE No. SLR-AUH-ST-007071 | 1 OF 1 | A1

STATUS: DRAFT FOR TENDER ©

DRG No. SLR-AUH-ST-007071 | A | EDMS No. | A