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90-102 Regent Street, Redfern - Train Tunnel Vibration Impact Assessment

1 INTRODUCTION

This report details the assessment of potential structure borne noise and vibration impacts to the future student accommodation development to be located at 90-102 Regent Street, Redfern. The site is near to both the existing T4 (Eastern Suburbs & Illawarra) tunnel (approximately 55m), whilst the new Sydney Metro City & Southwest tunnel is located directly below the site, with construction ongoing.

Attended measurements to determine potential structure borne noise and vibration impacts from the existing T4 rail line were undertaken on the 5th of July 2019. Given the Sydney Metro line is not yet operational, a review of the Environmental Impact Statement prepared by *SLR Consulting Australia* has been undertaken to assess any potential impacts from the site.

2 SITE DESCRIPTION & PROPOSAL

It is proposed to demolish existing residential and commercial buildings on the site to construct an 18 storey student accommodation building. The lower three levels (basement, lower ground and ground floor/level 1) consist of basement, back of house and common areas, whilst student accommodation bedrooms begin on level 2. Relative to the existing development on site, the proposed development will marginally lower the basement level, and extent it to encompass the full building footprint.

Given the proposed levels of the student accommodation are not substantially different to the existing residential development on the site, the predicted levels of structure borne noise and vibration detailed in the *SLR* report are relevant to the assessment.

The location of the existing Sydney Rail and future Sydney Metro tunnels relative to the site are detailed in the Figures 1, 2 & 3, in addition to the attended measurement locations.

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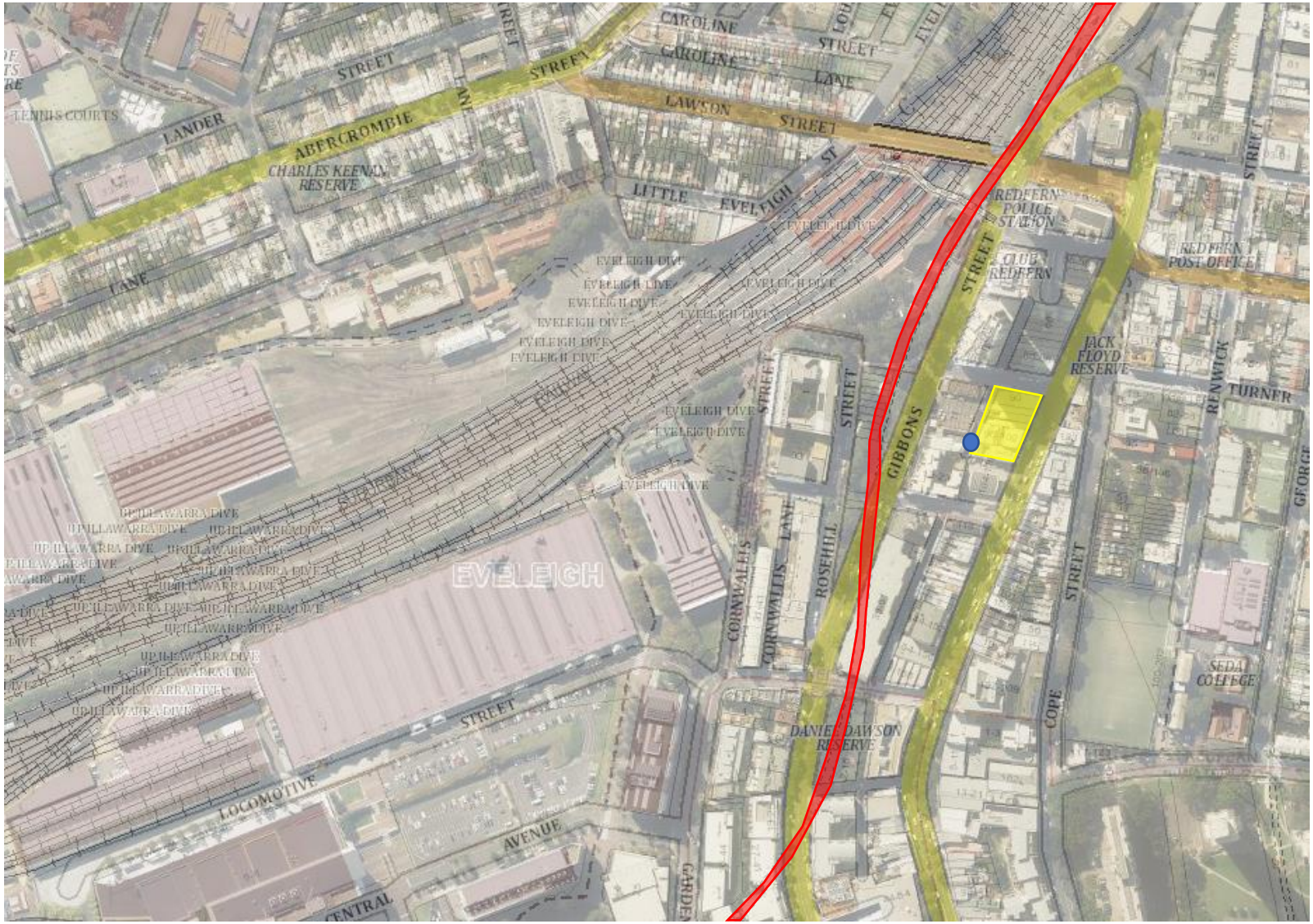

Figure 1 - Site Context & Existing Rail Tunnel Location

Project Site

Approximate Location of T4 Rail Tunnel

Attended Vibration Measurements

Figure 2 – Sydney Metro Tunnel Location Overlay

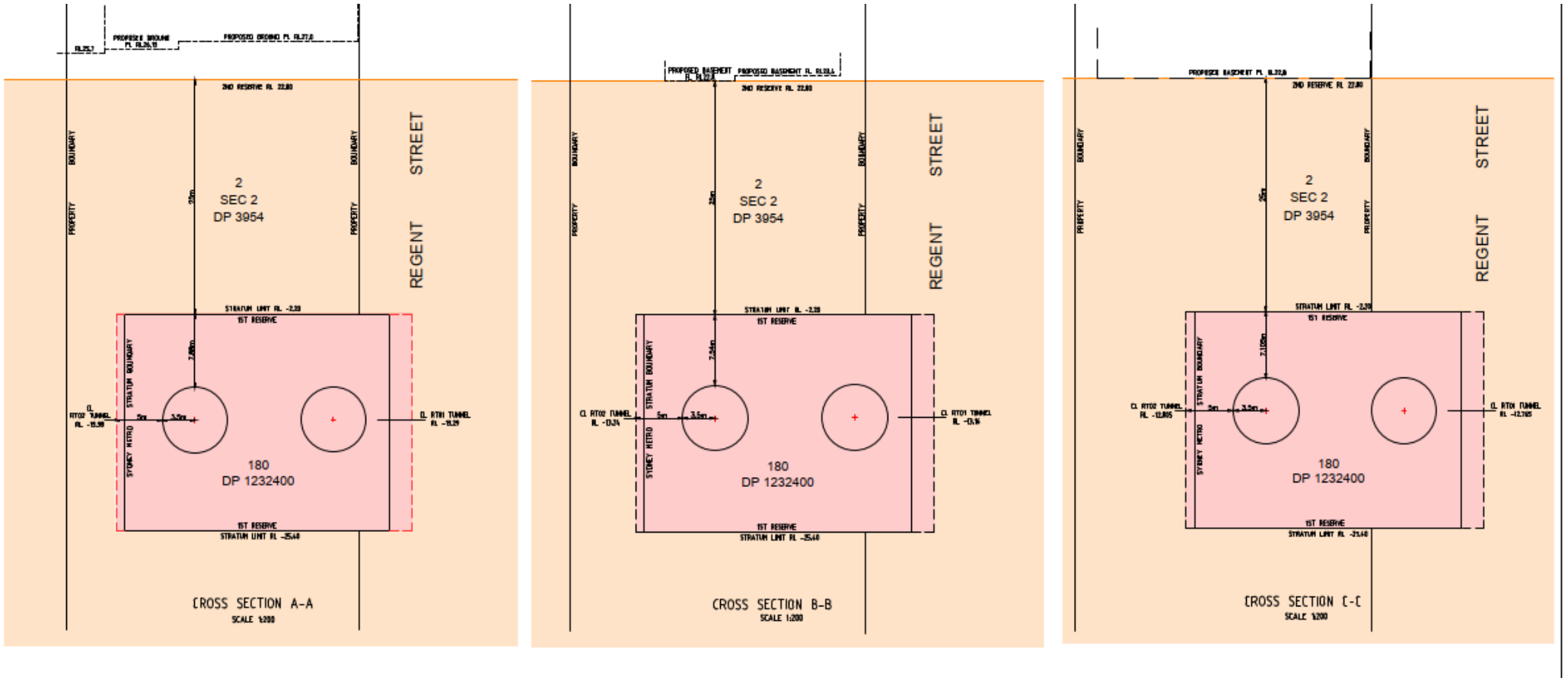

Figure 3 – Sydney Metro Tunnel Sections, Including Proposed Basement Level

3 ACOUSTIC CRITERIA

Trains induce ground borne vibration that is transmitted through the subsoil. This vibration can be perceptible close to railways.

3.1 DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS – INTERIM GUIDELINE

3.1.1 Ground Borne Noise

Development located adjacent to railway lines must be assessed in accordance with Clause 87 of the SEPP (Infrastructure) 2007. It is noted that the requirements of this standard are achieved when assessed in accordance with the NSW Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline (2008)*. The section relevant to ground borne noise is as follows:

> *Where buildings are constructed over or adjacent to land over tunnels, ground borne noise may be present without the normal masking effect of airborne noise. In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground borne L_{Amax} noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.*

Table 1 - Internal Railway Noise Level Criteria for Ground Borne Noise

LOCATION	TIME OF DAY	Internal Ground Borne Noise Criteria dB(A)$L_{max\ (SLOW)}$
Living and sleeping areas	Day (7am-10pm)	40
	Night (10pm-7am)	35

Whilst we note that student accommodation would not strictly be classed as residential accommodation (and as such not specific referenced in clause 87), for the purposes of this assessment measured/predicted vibration levels will be compared to the above criteria.

3.1.2 Tactile Vibration

Human comfort is typically assessed with reference to the British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

The Interim Guideline references the NSW EPA *Assessing Vibration- A technical guideline* which recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

Human response to vibration has been shown to be biased at particular frequencies, which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represent the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

This standard assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (6am-10pm) and "Night time" (10pm-6am). The overall value is then compared to the levels in Table below. For this project the aim will be for a low probability of adverse comment.

Table 2 - Vibration Dose Values (m/s1.75) above which various degrees of adverse comment may be expected in residential buildings

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 16hr day (Daytime)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8hr night (Night time)	0.13	0.26	0.51

4 RAIL TUNNEL NOISE & VIBRATION IMPACT ASSESSMENT

Potential noise and vibration impacts on the future site will be assessed with reference to the above criteria. For the existing T4 line, attended measurement results will be used, whilst the Environmental Impact Assessment prepared by SLR Consulting Australia will be considered for impact from the future Sydney Metro line.

4.1 SYDNEY TRAINS TUNNEL – T4 EASTERN SUBURBS & ILLAWARRA LINE

4.1.1 Vibration Measurements

Rail vibration measurements were conducted externally within William Lane at the rear of the proposed site. Measurements were taken at what appeared to be the closest location of the site to the existing train tunnel, which represents the most impacted portion of the site.

Attended train vibration measurements were conducted on 5th of July between 10am and 12pm. A Svan 958 AE Vibration Analyser was used for the vibration measurements. The analyser was fitted with a Dytran triaxial accelerometer.

4.1.1.1 Tactile Vibration

The measured vibration levels, duration of train pass-by and the number of rail movements per hour were used to determine the overall vibration dose (VDV) at the proposed development for both daytime and night time periods. The results are presented the table below.

Table 3 - Vibration Dose Values

Time Period	Calculated VDV $m/s^{1.75}$	Criteria VDV $m/s^{1.75}$	Comments
Day (7am – 10pm)	0.05	0.2 to 0.4	Meets Project Requirements
Night (10pm -7am)	0.03	0.13	

The measured Vibration Dose Values were less than the "low probability of adverse comment" criteria (the most stringent criteria) for the subject site.

4.1.1.2 Structure Borne Noise

Internal noise levels within residential units as a result of structure borne noise have been calculated for a number of train pass-bys. Noise levels have been determined based on-site measurements of rail induced vibration. Refer to Figure 1 for measurement locations.

Table 4 – Predicted Structure Borne Vibration Levels

Location	Time Period	Predicted Internal Noise Level	Criteria	Comments
Level 2 Residential Apartments	Day (7am-10pm)	< 30 dB(A)$L_{max(slow)}$	40 dB(A)$L_{max(slow)}$	Meets Project Requirements
	Night (10pm-7am)	< 30 dB(A)$L_{max(slow)}$	35 dB(A)$L_{max(slow)}$	

The results above indicate that vibration isolation treatment is not required to comply with structure borne noise criteria.

4.2 SYDNEY METRO TUNNEL – CBD & SOUTHWEST LINE

Operational noise and vibration levels expected to be generated by the City & Southwest line are detailed in the SLR document Sydney Metro Chatswood to Sydenham Technical Paper 2: Noise & Vibration (Report Number 610.14718R1, dated 28 April 2016, Version Final). The report details the expected acoustic impacts on existing properties along the proposed rail line, including properties at 90-102 Regent Street, Redfern. Both tactile vibration and structure borne noise are considered as part of the technical paper.

90-102 Regent Street is located approximately 1km south of Central Station relative to the track chainage – Figure 4 indicates the location of the project site relative to the Metro rail tunnels and Central Station, whilst Figures 5 & 6 indicate the predicted ground borne vibration and noise respectively, both of which meet the project requirements.

We also note that the predictions detailed in the SLR report assume the noise/vibration level on the ground floor of each residence, however in this case there are three additional levels (basement, lower ground and ground/level 1) prior to the first level containing student accommodation. As vibration travels up the building, there will be additional attenuation, further reducing the impact of future occupants.

Figure 4 – Location of Project Site Relative to Chain Linkage from Central Station, Including Predicted Ground Borne Noise Levels (reproduced Appendix H1 from SLR Technical Paper)

Figure 34 Predicted Ground-borne Vibration Levels (Proposed Track Form)

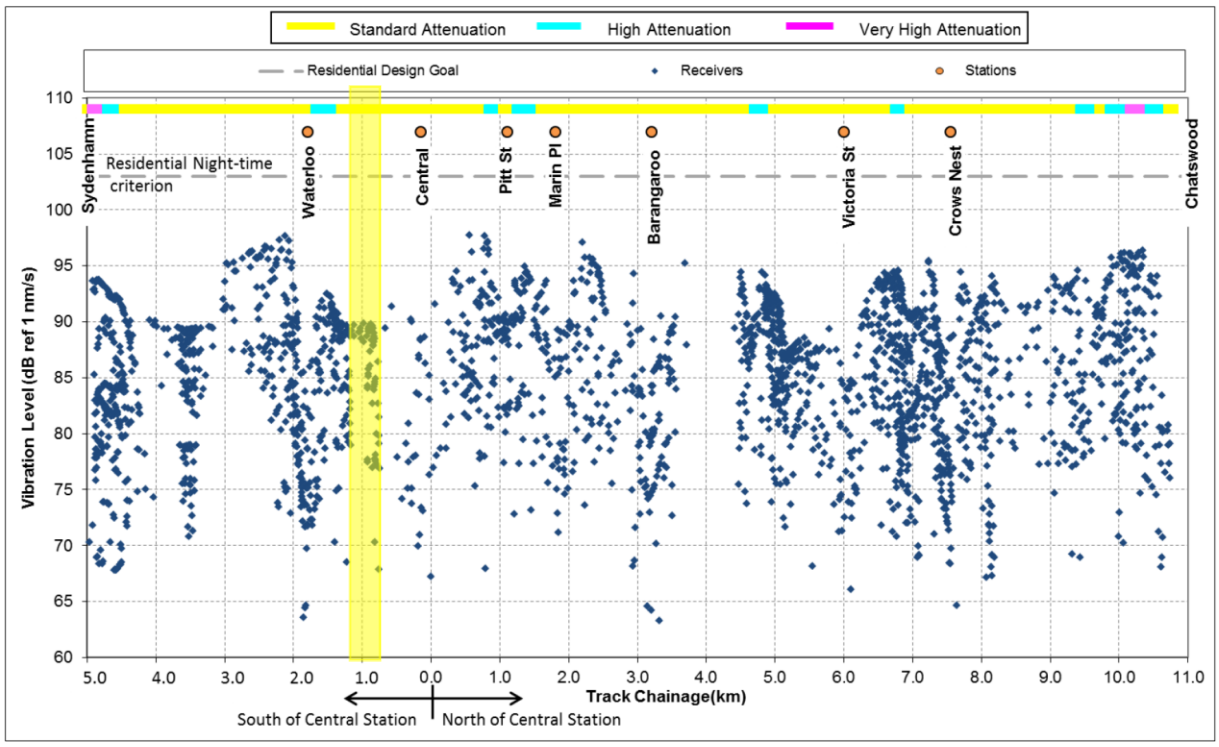

Figure 5 – Predicted Tactile Vibration Levels (Approximate Site Location Indicated in Yellow)

Figure 40 Predicted Ground-borne Noise Levels - Residential Receivers

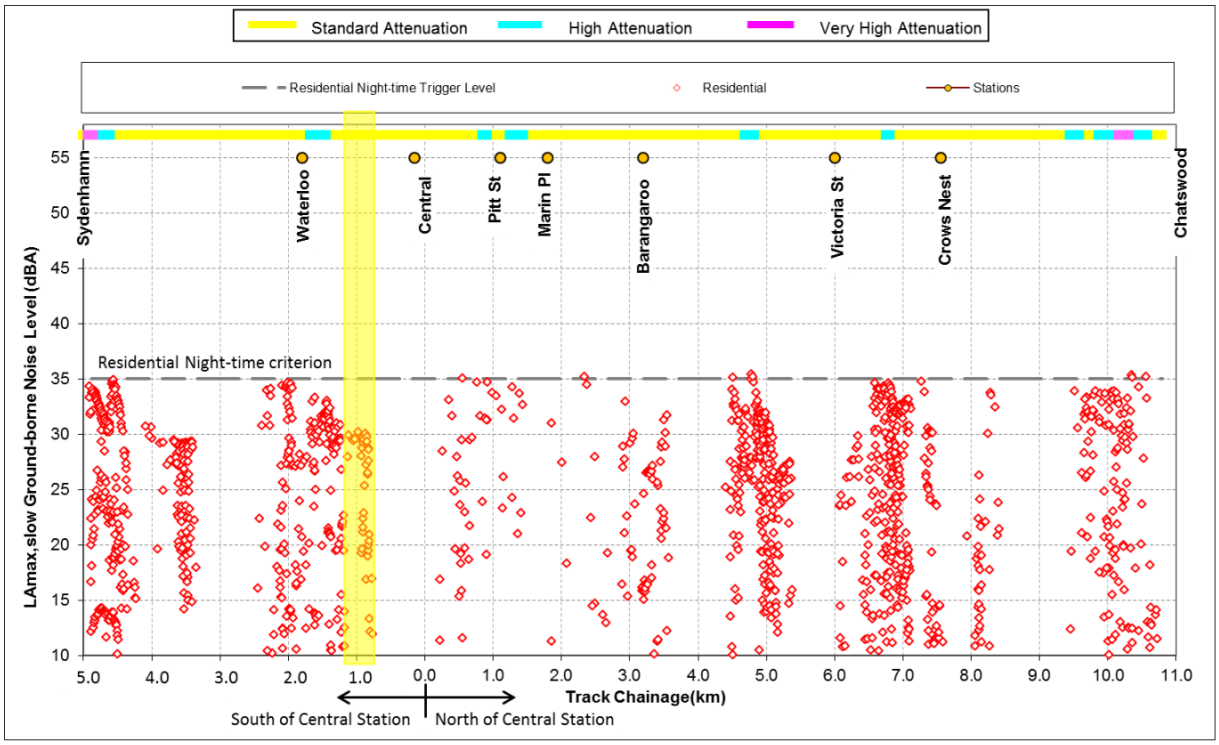

Figure 6 – Predicted Ground Borne Noise Levels (Approximate Site Location Indicated in Yellow)

5 SUMMARY OF RESULTS

Site measurements of the existing rail T4 rail tunnels nearby to site and review of the predicted impacts of the Metro tunnel below the site indicate that structure borne noise and tactile vibration impacts will meet the requirements of Clause 87 of SEPP (Infrastructure).

6 CONCLUSION

This report details the assessment of potential structure borne noise and vibration impacts to the future student accommodation development to be located at 90-102 Regent Street, Redfern. The site is near to both the existing T4 (Eastern Suburbs & Illawarra) tunnel (approximately 55m), whilst the new Sydney Metro City & Southwest tunnel is located directly below the site, with construction ongoing.

Based on the measured results from the existing Sydney Trains T4 tunnel and the predicted levels from the Sydney Metro Chatswood to Sydenham Environmental Impact Statement, noise and vibration impacts to the future development at 90-102 Regent Street are expected to meet the requirements detailed in State Environment Planning Policy (Infrastructure)

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Alex Washer