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20241259.6/1405A/R0/PF

14/05/2025

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Attn: Poonam Chauhan

391-423 Pacific Highway, Crows Nest - Sydney Metro Operational Impact Assessment

This letter has been prepared in response to the following Department of Planning's Request for Additional Information:

> *Ensure the Modification Report includes the following: noise and vibration implications from Sydney Metro Corridor as a result of deleting 2 basement levels (with supporting statement from your acoustic consultant).*

Acoustic Logic (AL) note that a detailed metro tunnel ground borne noise prediction was conducted in Section 6.2.2 of the original DA Acoustic Assessment (Ref: *20230371.1/3107A/R4/PF*, dated 31/07/2024). This section has now been updated by incorporating the proposed changes of reducing basement levels from 7 to 5.

AL note that the calculation procedures presented in this section follow the steps presented in the EIS report prepared by SLR *Sydney Metro Chatswood to Sydenham Technical Paper 2: Noise and Vibration* (Report Number *610.14718R1*, V1.0, dated 28th April 2016).

1 SOURCE VIBRATION LEVELS CALCULATION

The first step for vibration level prediction is to select the reference source vibration levels. According to the *EIS report*, standard attenuation will be used for the tunnel track below the project site, hence the following relevant reference source vibration will be used. The noise levels are measured on tunnel wall at 80 km/h reference speed.

Table 1 – Reference Sound Vibration Levels – Standard Attenuation Track

Vibration Levels	1/3 Octave Bands (Hz) – $L_{max, slow\ 95\%}$															
dB$_v$ re 1nm/s	10	12	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315
	77	78	78	77	80	86	86	86	85	84	84	89	86	82	79	78

Then, the source vibration levels are aligned based on the track radii at the project location. No correction has been applied for track radii given the EIS report does not specify any tight radius curves around the project site between Victoria Cross station and Crows Nest station.

A speed adjustment has been applied to the vibration levels based on the following equation and the speed profile of the metro shown in Figure 1. Given the project site is located approximately 0.5km south of Crows Nest Station, an averaged value of 90 km/h is hence adopted as indicated in the speed profile. Hence, a 1 dB adjustment is applied based on the equation:

$$V(speed\ adjusted) = V(reference) + 20\log_{10}(\frac{speed}{80})$$

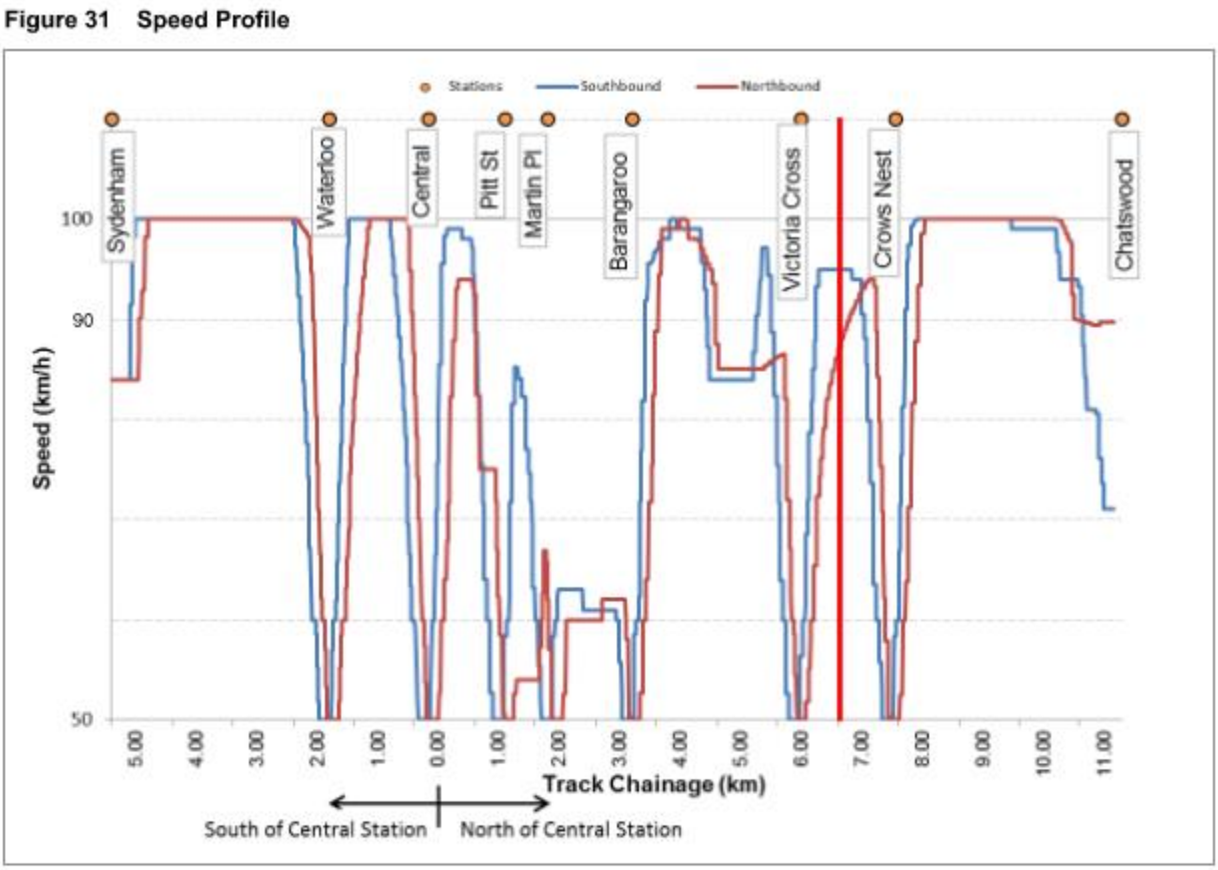


Figure 1 – Speed Profile (Sourced from SLR EIS report)

Furthermore, a 5dB safety factor has been applied to the predictions to accommodate any specific site factors (e.g abnormal building construction methods or fairly close distance between tunnel and development). The resulting vibration levels for metro tunnel at the building footing of the project site is hence presented below. The prediction presented in the following sections will be performed in octave bands between 31.5Hz – 250Hz.

Table 2 – Source Vibration Levels at Project Site

Vibration Levels	**1/3 Octave Bands (Hz) – $L_{max, slow\ 95\%}$**															
dB_v re 1nm/s	**10**	**12**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**
	83	84	84	83	86	92	92	92	91	90	90	95	92	88	85	84
Vibration Levels	**Octave Bands (Hz) – $L_{max, slow\ 95\%}$**															
dB_v re 1nm/s	-	**31.5**	**63**	**125**	**250**											
	-	96	96	98	91											

2 VIBRATION ATTENUATION DURING PROPAGATION

This section details the vibration attenuation predictions for the transmission of vibration from tunnel to the proposed new development at 391-423 Pacific Highway, Crows Nest.

First of all, the vibration attenuation due to geometric spreading is considered. Prediction will be conducted considering the tunnel vibration transmission through the closeted building façade at southeastern conner at basement level. Hence, vibration propagated to the subject wall at the building base is calculated based on the following formula:

$$V(spreading) = 10\log_{10}(\frac{2}{distance})$$

in which $V(spreading)$ is the change in vibration levels (dB). 2 is the distance between the central of rail track and tunnel wall (source vibration measurement location). $distance$ is the distance between point source and the receiver location, which is approximately 20 m as indicted in the below drawing. Therefore, a 10 dB reduction is applied for each frequency band.

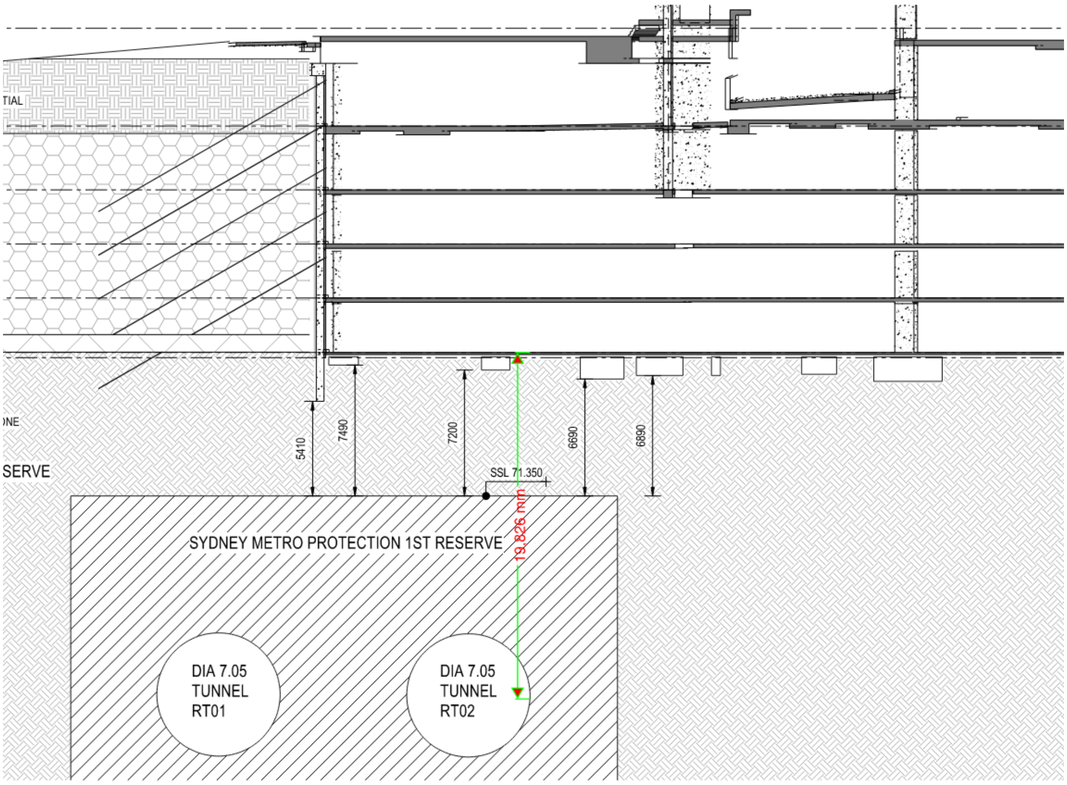


Figure 2 – Distance Between Metro Tunnel and the Building Foundations

Then vibration attenuation due to material damping is estimated. The excess attenuation curve for Sydney Hawkesbury sandstone is applied for the project site. The following attenuation values at octave bands are obtained from the below curve with a distance of 20 m.

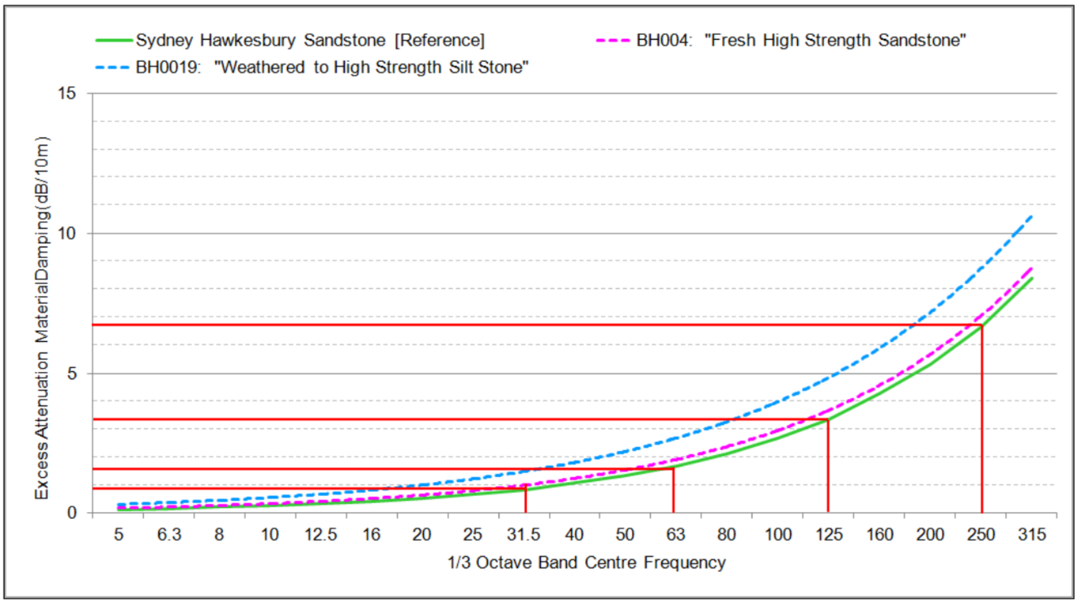


Figure 3 – Material Damping Induced Excess Attenuation

The excess attenuation damping values in 1/1 octave bands are extrapolated below:

Table 3 – Excess Attenuation Due to Material Damping at Project Site

Vibration attenuation	Octave Bands (Hz)			
	31.5	**63**	**125**	**250**
dB	1.8	3.6	6.4	13.4

3 PROPAGATION OF VIBRATION WITHIN BUILDINGS

This section discusses vibration levels travel from the footing of the building to the first residential floor at level 3.

It is notes that no coupling loss values is applied to the project site as the footing for the proposed development does not have any interface effect with the ground.

For vibration propagates inside the building, the following floor to floor loss values are adopted: The ground-borne noise and vibration levels attenuate by approximately 2 dB per floor for the first four floors and by approximately 1 dB per floor thereafter.

Table 4 – Vibration Loss Due to Transmission Between Floors

Vibration attenuation between floors	Vibration Loss (dB) in Octave Bands (Hz)			
	31.5	**63**	**125**	**250**
Each floor for the First 4 floors (dB)	2	2	3	3
Each floor for Further floors (dB)	1	1	1	1
Project building from basement 5 to level 3	13	13	17	17

Low frequency vibration can be amplified within buildings by resonances in floors and walls. Based on information discussed by Nelson (1987), the amplification spectra presented in Table 26 has been adopted. Nelson (1987) indicates that amplification values found in practice are typically within ±3 dB of these values. Slightly lower values are assumed for the ground-borne noise calculations as the use of the full floor amplification values can result in over estimation of the resultant noise levels.

Table 5 – Floor Resonance Amplification for Ground Borne Noise

Amplification between floors	Vibration Loss (dB) in Octave Bands (Hz)			
	31.5	**63**	**125**	**250**
dB	7	5.7	4.1	1.4

4 CONVERSION BETWEEN VELOCITY LEVELS AND GROUND – BORNE NOISE LEVELS

According to the book titled "*Measurement & Assessment of Ground borne Noise & Vibrvation*", authored by the Association of Noise Consultants (ANC 2001), the relationship between ground borne noise levels and vibration velocity levels is established as follows:

$L_p = L_v - 27$,

where: L_p is the L_{Amax} sound pressure level

L_v is the A weighted, L_{max} velocity level, in dB re 1 x 10^{-9} m/s

Note: In Section 4.1.2 of the latest version of the ANC Guideline (second edition 2012), the authors suggest that:

"… the conversion from the rms vibration velocity to the sound pressure level may overstate the sound pressure level by 5 dB and that the measured data supported a correction of -32 rather than -27 dB."

However, for this assessment, a conservative correction factor of -27 is used for this project instead of -32 which was used in EIS report.

5 PREDICTION OF VIBRATION LEVELS & GROUND – BORNE NOISE LEVELS

Based on the information and methodology discussed in the sections above, ground-borne noise levels have been predicted for the nearest residential areas located at ground floor level at the project site. The predicted levels are summarised in Table 6 and Table 7. The predicted ground-borne noise levels utilise the measured L_{Amax} vibration levels from the suburban train with the highest levels of vibration.

Table 6 – Summary of Predicted Vibration Velocity Level on Lower Ground

Location	Predicted L_{ASmax} Velocity Level (dB re 1×10^{-9} m/s) A Weighted Level (including floor amplification)				Overall dBv	Criteria dBv	Complies?
	31.5	63	125	250			
Ground Level	78	75	68	52	80	103	Yes

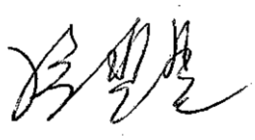
Table 7 – Summary of Predicted Ground Borne Noise Level on Lower Ground

Location	Predicted L_{ASmax} Velocity Level (dB re 1×10^{-6} m/s) A Weighted Level				Overall dB(A)	Criteria dB(A) $L_{max(slow)}$	Complies?
	31.5	63	125	250			
Ground Level	51	48	41	25	27	35	Yes

Based on the information presented in the above, predicted ground-borne noise levels are below the criteria for residential spaces. Vibration isolation treatment of the structure is therefore not required.

Please contact us should you have any further queries.

Yours faithfully,



Acoustic Logic Pty Ltd
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