1 Gordon Avenue is close to the track and will suffer excessive vibration as well as noise. We strongly disagree with the assessment that the effect will not be adverse!

From the measurement results taken within the Sydney Metro project area it is evident that the vibration levels at locations V1 and V2 are typically consistent with that predicted by the FTA base curve with some measurements higher on average and others lower on average. The variation in measured vibration levels from the FTA base curve is likely to be due to the local ground conditions at the measurement locations and the propagation path from the tracks into the ground.

Section B2.3 of the DECC vibration guideline indicates that the threshold of perception for most people is approximately 103 dB RMS (0.14 mm/s). From the measurement results presented in **Figure 35**, it is anticipated that for some train passbys, vibration levels may be perceptible at times where buildings are located within approximately 20 m from the nearest track. It is noted that the observed average train speeds for Sydney Trains operations on the T1 North Shore Line in the vicinity of the Chatswood dive are approximately 20 km/h lower than the 80 km/h line speeds for this region. Therefore the average vibration impacts are likely to be approximately 2.5 dB lower than the FTA base curve displayed in **Figure 35**.

Some residential buildings located immediately adjacent the surface rail track in the vicinity of the Chatswood dive may experience an increase in train passby vibration levels. Residential receivers located on the eastern side of the surface rail corridor in between Mowbray Road and Gordon Avenue, Chatswood are located approximately 11 m (horizontally) from the nearest existing rail track (T1 North Shore Line Up track). As a result of the track realignment associated with the project, the nearest track would be located approximately 8 m (horizontally) from the nearest residential receiver. According to the FTA base curve displayed in **Figure 35**, this change in track to receiver distance equates to a change in vibration level of approximately 2 dB. This level of change in vibration level is expected to be barely perceptible to most people.

Train passby vibration levels may exceed the night-time 103 dB_V vibration criteria at residential receivers located within 10 m of the design alignment. This includes four residential receivers located on the Up side of the surface rail corridor between Mowbray Road and Gordon Avenue, Chatswood.

However, the maximum predicted VDV value is 0.1 $m/s^{1.75}$ during the day and 0.07 $m/s^{1.75}$ during the night, which is well below the VDV criterion of 0.2 $m/s^{1.75}$ during the day and 0.1 $m/s^{1.75}$ during the night in accordance with BS 6472.

When taking into account the above levels and the duration and frequency of train passbys adjacent to the realigned T1 North Shore Line Up track, no adverse vibration impacts are anticipated adjacent to the project surface rail sections.

4.1.7 Summary of Ground-borne Vibration Assessment

As discussed in **Section 4.1.2**, the human comfort (perception) objectives for ground-borne vibration are more stringent than other possible design limits relating to building damage risk or the potential effects on building contents.

On the basis of the input data and modelling assumptions described in the previous sections, compliance with the ground-borne vibration objectives (the human comfort vibration criteria from *Assessing Vibration: A Technical Guideline*) is predicted for all residential receivers and other sensitive receiver locations above or near to the proposed project alignments.

There are no anticipated vibration impacts adjacent to project related surface rail tracks.

Table 11-10 Ground-borne vibration predictions for receivers containing highly sensitive equipment

Receiver	Location	Maximum 1/3 Octave Band Vibration Level (dB ref 1 nm/s)	
		Design objective	Predicted
Royal North Shore Hospital	Near the tunnel alignment between Artarmon substation and Crows Nest Station	82	74
Health Care Imaging Services	Near the tunnel alignment between Pitt Street Station and Central Station	82	75

The human comfort objectives for ground-borne vibration are more stringent than other possible design limits related to building damage risk or the potential effects on building contents.

Compliance with the ground-borne vibration design objectives (and the human comfort vibration criteria from *Assessing Vibration: a technical guideline* – DEC, 2006) is predicted for all receivers located above or near to the proposed tunnel alignment.

Surface track ground-borne vibration

Some residential buildings located immediately adjacent to the surface rail track between Chatswood Station and Chatswood dive may experience an increase in train passby vibration levels. Residential receivers located on the western side of the rail corridor between Mowbray Road and Gordon Avenue, Chatswood are currently around 11 metres from the closest rail track. As a result of the realignment of the T1 North Shore Line, the surface track would be located around eight metres from these receivers (three metres closer). Based on previous investigations of vibration propagation from rail lines undertaken by the US Federal Transit Administration (2006), this change would equate to a potential increase in vibration level of around 2 dB. This increase is expected to be barely noticeable to the receivers.

Ground-borne noise predictions

Predictions of ground-borne noise levels are provided in Figure 11-3 for residential receivers and Figure 11-4 for commercial and other sensitive receivers. The predictions are based on a 'best estimate' plus a 5 dB safety factor. On average, the predicted ground-borne noise levels (for the highest 1 in 20 trains) at the nearest receivers would be around 30 dB which is well below the ground-borne noise design objectives. At most locations the noise levels would be much lower.

The proposed ground-borne noise levels are predicted to comply with the ground-borne noise objectives at all residential, commercial and other sensitive receiver locations.

THIS SEVERELY AFFECTS 1-3 GORDON AVENUE. A "BARELY NOTICEABLE" INCREASE ON AN ALREADY UNACCEPTABLE LEVEL IS NOT ACCEPTABLE

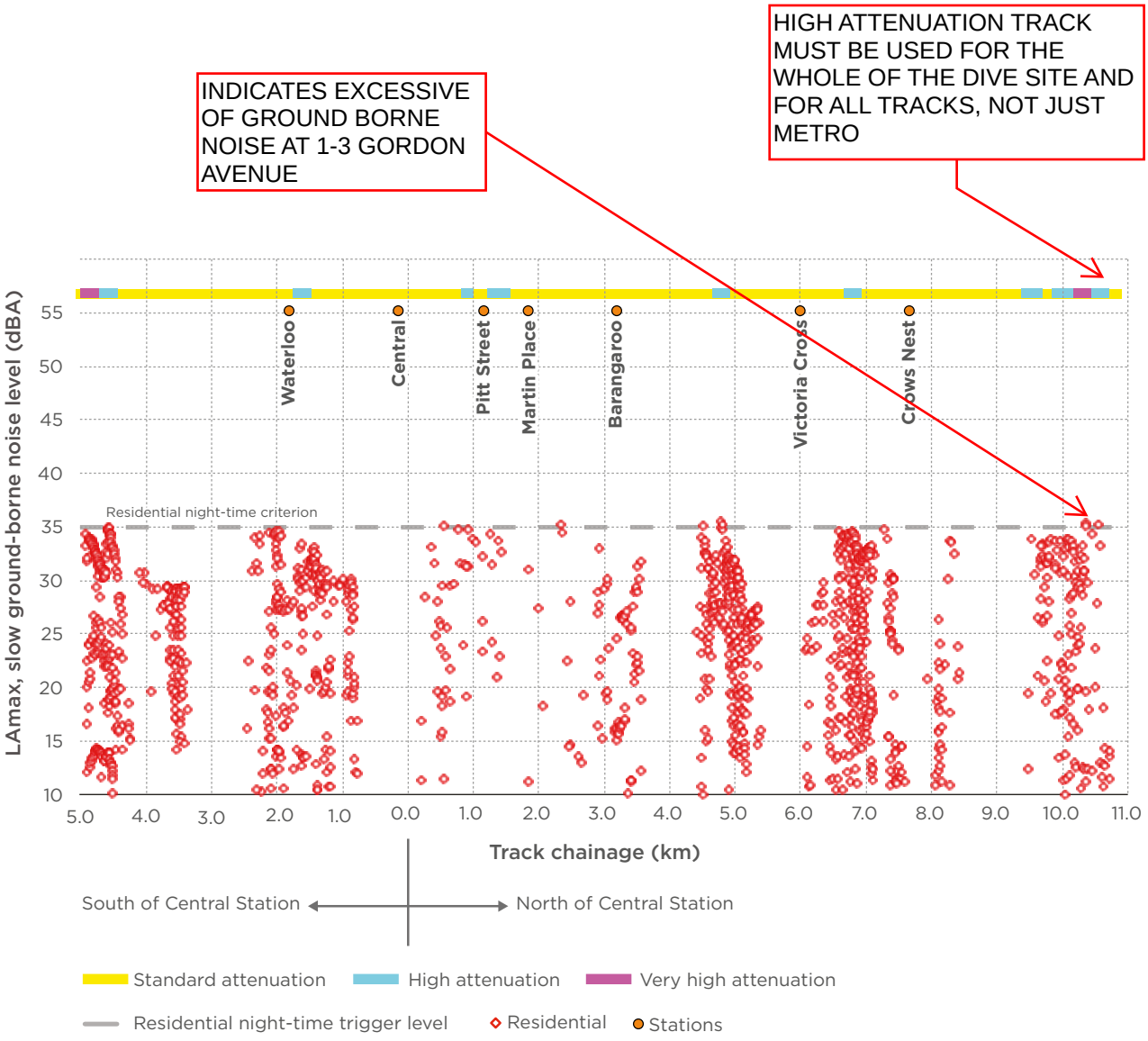

Figure 11-3 Predicted ground-borne noise levels – residential receivers

THIS INCREASE OPPOSITE 1 GORDON ACTUALLY WILL CREATE GREATER REFLECTED NOISE TO THE UPPER FLOOR OF OUR BUILDING.

THIS HIGHER WALL DOES NOT INCLUDE 1-3 GORDON AVENUE AS STATED ELSEWHERE BE-CAUSE IT WONT HELP

THIS TREATMENT MUST INCLUDE THE HEAVY RAIL SYSTEM AND NORTH BOUND OVER BRIDGE AS WELL AS THE METRO, AND EX-TEND TO THE FULL LENGTH OF THE DIVE SITE AS IT HAS GREATER IMPACT ON 1-3 GOR-DON AVENUE

Northern surface works

In order to mitigate potential airborne noise impacts at the northern end of the project, the design has incorporated the following measures:

- An increase in the height (to four metres) of the noise barrier between Chapman Avenue and Nelson Street on the eastern side of the rail line
- An increase in the height (to four metres) of the noise barrier between the Frank Channon Walk pedestrian underpass and Albert Avenue on the western side the rail line
- An increase in the height (to four metres) of the noise barrier between Nelson Street and Gordon Avenue on the western side the rail line
- A two metre high noise barrier to the south of the Mowbray Road on the western side of the rail line
- Rail dampers and deck absorption within the Chatswood dive structure.

The exact height and extent of the noise barriers in these locations would be further refined during detailed design.

A summary of the predicted worst-case noise levels for residential receivers for the 2034 (future year) scenario are presented in Table 11-11. The future year 2034 scenario has been presented as it results in the highest noise level predictions. Results for the at opening 2024 scenario are provided in *Technical paper 2 – Noise and vibration*.

Table 11-11 Predicted 2034 airborne noise levels – residential receivers Chatswood dive

NCA	Side	Worst-case predicted noise level (dBA)								
		Without project			With project			Increase		RING triggers
		$L_{Aeq(15h)}$	$L_{Aeq(9h)}$	L_{Amax}	$L_{Aeq(15h)}$	$L_{Aeq(9h)}$	L_{Amax}	L_{Aeq}	L_{Amax}	
01	Up	50	46	68	52	47	68	1.6	-0.1	0
	Down	61	58	80	63	58	81	1.2	0.5	0
02	Up	**68**	**64**	**86**	**70**	**65**	**86**	1.9	-0.3	0
	Down	64	60	84	**67**	**62**	**85**	0	1.3	1
03	Up	**69**	**65**	**88**	**68**	**64**	**87**	0.7	0.8	0
	Down	63	59	81	65	60	81	1.8	0.7	0
04	Up	**69**	**65**	**87**	**69**	**65**	**87**	0.3	0	0
	Down	**68**	**64**	**85**	**68**	**64**	**85**	0.1	0	0

1 *Red bold indicates an exceedance of criteria*

2 *For reference the trigger levels are:*
development increases existing $L_{Aeq(period)}$ rail noise levels by 2 dB or more, or existing L_{Amax} rail noise levels by 3 dB or more and predicted rail noise levels exceed: daytime: 65 $L_{Aeq(15hour)}$ or 85 L_{Amax}, night-time: 60 $L_{Aeq(9hour)}$ or 85 L_{Amax}.

OUR BUILDING IS SPECIFICALLY IDENTIFIED AS SUFFERING EXCESSIVE NOISE. THIS DOES NOT MENTION THE EXCESSIVE VIBRATION THAT IS ALSO ALMOST CERTAIN.

UNIT 9 IS OWNER OCCUPIED AND RUNS A PROFESSIONAL CONSULTING PRACTICE FROM A HOME OFFICE. THUS THEIR BUSINESS AND LIFE WILL BE SEVERELY AFFECTED BY THE WORKS ON A 24 HOUR BASIS, MAKING IT UNACCEPTABLE.

The results indicate that noise levels at residential receivers without the project are generally already close to, or exceeding, the overall noise criteria levels.

Comparing the 'with project' and 'without project' noise levels indicates that there is generally no change in noise levels from the project, primarily due to the measures incorporated into the design to minimise operational airborne noise impacts.

From the results it can be seen that there remains a predicted exceedance of the noise trigger levels at one residential receiver building (at address 1-3 Gordon Avenue, Chatswood) on the western side of the rail line. This residential receiver is a multi-storey apartment building and would consist of several dwellings. The upper floors of this receiver would have an unobstructed view of the rail tracks over the noise barrier, even with the proposed increase in barrier height. To break line of sight at the triggered receivers on the upper floor of this building would require a noise barrier in excess of six metres high. Noise barriers of this height are unlikely to be considered reasonable and may not be feasible, particularly since the barrier would need to be located in close proximity to the building facade. Based on the outcomes of noise modelling during detailed design, this property would be considered for at property treatment.

A summary of the predicted worst-case noise levels for other sensitive receivers for the 2034 (future year) scenario are presented in Table 11-12. The future year 2034 scenario has been presented as it results in the highest noise level predictions. Results for the at opening 2024 scenario are provided in *Technical paper 2 – Noise and vibration*.

Table 11-12 Predicted 2034 airborne noise levels – other sensitive receivers Chatswood dive

NCA	Side	Worst-case predicted noise level (dBA)					
		Without project		With project		Increase	RING triggers
		$L_{Aeq(1h)}$ Day	$L_{Aeq(1h)}$ Night	$L_{Aeq(1h)}$ Day	$L_{Aeq(1h)}$ Night	$L_{Aeq(1h)}$	
01	Up	59	55	61	56	2.2	0
	Down	61	58	62	58	1.2	0
02	Up	N/A	N/A	N/A	N/A	N/A	0
	Down	66	62	69	63	3.2	0
03	Up	N/A	N/A	N/A	N/A	N/A	0
	Down	63	59	64	60	1.8	0
04	Up	N/A	N/A	N/A	N/A	N/A	0
	Down	68	64	68	64	0.1	0

1 GORDON AVENUE WILL BE SEVERELY AFFECTED

Compliance with the ground-borne vibration design objectives (and the human comfort vibration criteria from *Assessing Vibration: a technical guideline* – DEC, 2006) is predicted for all receivers located above or near to the proposed tunnel alignment.

Surface track ground-borne vibration

Some residential buildings located immediately adjacent to the surface rail track between Chatswood Station and Chatswood dive may experience an increase in train passby vibration levels. Residential receivers located on the western side of the rail corridor between Mowbray Road and Gordon Avenue, Chatswood are currently around 11 metres from the closest rail track. As a result of the realignment of the T1 North Shore Line, the surface track would be located around eight metres from these receivers (three metres closer). Based on previous investigations of vibration propagation from rail lines undertaken by the US Federal Transit Administration (2006), this change would equate to a potential increase in vibration level of around 2 dB. This increase is expected to be barely noticeable to the receivers.

Ground-borne noise predictions

Predictions of ground-borne noise levels are provided in Figure 11-3 for residential receivers and Figure 11-4 for commercial and other sensitive receivers. The predictions are based on a 'best estimate' plus a 5 dB safety factor. On average, the predicted ground-borne noise levels (for the highest 1 in 20 trains) at the nearest receivers would be around 30 dB which is well below the ground-borne noise design objectives. At most locations the noise levels would be much lower.

The proposed ground-borne noise levels are predicted to comply with the ground-borne noise objectives at all residential, commercial and other sensitive receiver locations.

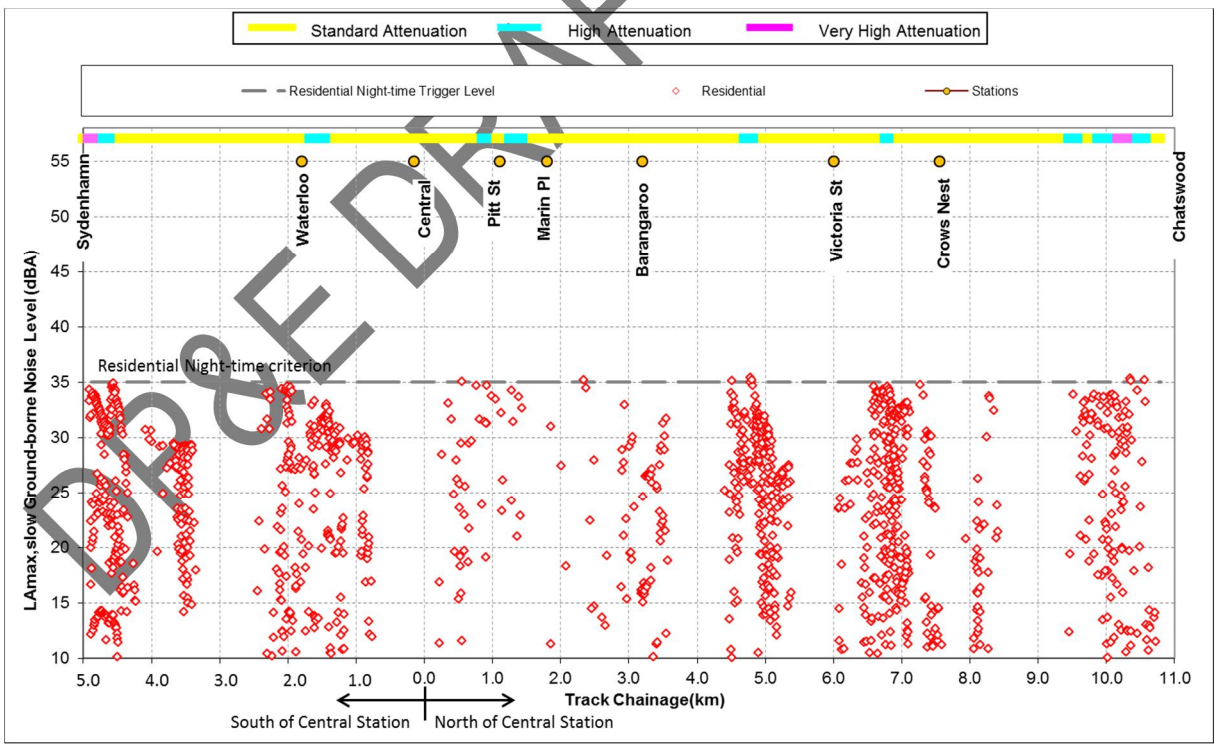

Figure 11-3 Predicted ground-borne noise levels – residential receivers

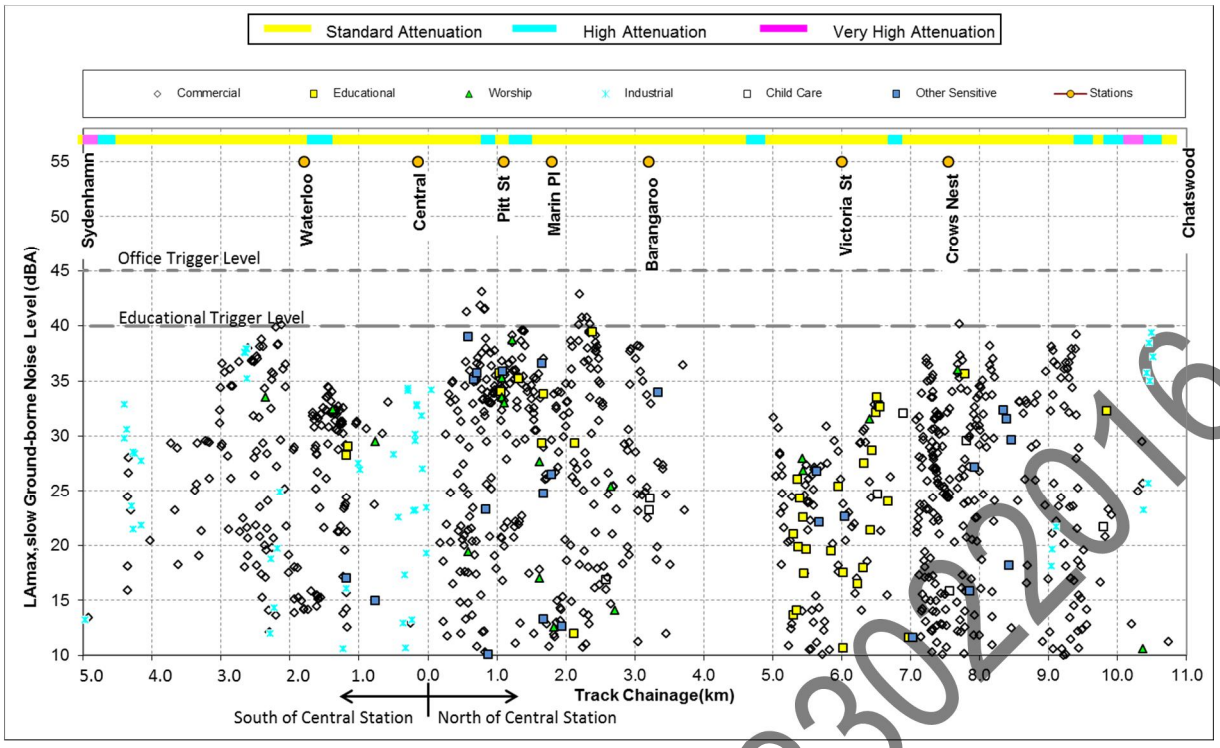

Figure 11-4 Predicted ground-borne noise levels – commercial and other sensitive receivers

11.4.2 Airborne noise

An operational airborne noise assessment has been carried out for the surface track sections at either end of the project, being:

- At the northern end of the project – metro trains operating between Chatswood Station and the Chatswood tunnel portal, and Sydney Trains trains operating on the realigned T1 North Shore Line between Chatswood Station and Brand Street, Artarmon
- At the southern end of the project – metro trains operating in the Marrickville dive structure.

For the purposes of assessment, receivers are broken into a number of noise catchment areas (NCAs). NCAs are determined to reflect the changing land uses and ambient noise environments adjacent to the project.

Northern surface works

In order to mitigate potential airborne noise impacts at the northern end of the project, the design has incorporated the following measures:

- An increase in the height (to four metres) of the noise barrier between Chapman Avenue and Nelson Street on the eastern side of the rail line
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- Rail dampers and deck absorption within the Chatswood dive structure.

The exact height and extent of the noise walls in these locations would be further refined during detailed design.

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Table 11-11 Predicted 2034 airborne noise levels – residential receivers Chatswood dive

NCA	Side	Worst-case predicted noise level (dBA)								
		Without project			With project			Increase		RING triggers
		$L_{Aeq(15h)}$	$L_{Aeq(9h)}$	L_{Amax}	$L_{Aeq(15h)}$	$L_{Aeq(9h)}$	L_{Amax}	L_{Aeq}	L_{Amax}	
01	Up	50	46	68	52	47	68	1.6	-0.1	0
	Down	61	58	80	63	58	81	1.2	0.5	0
02	Up	**68**	**64**	**86**	**70**	**65**	**86**	1.9	-0.3	0
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03	Up	**69**	**65**	**88**	**68**	**64**	**87**	0.7	0.8	0
	Down	63	59	81	65	60	81	1.8	0.7	0
04	Up	**69**	**65**	**87**	**69**	**65**	**87**	0.3	0	0
	Down	**68**	**64**	**85**	**68**	**64**	**85**	0.1	0	0

Note 1: Red bold indicates an exceedance of criteria

Note 2: For reference the trigger levels are:
development increases existing $L_{Aeq(period)}$ rail noise levels by 2 dB or more, or existing L_{Amax} rail noise levels by 3 dB or more and
predicted rail noise levels exceed: daytime: 65 $L_{Aeq(15hour)}$ or 85 L_{Amax}, night-time: 60 $L_{Aeq(9hour)}$ or 85 L_{Amax}.

The results indicate that noise levels at residential receivers without the project are generally already close to, or exceeding, the overall noise criteria levels.

1-3 GORDON AVENUE WILL BE PENALISED

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From the results it can be seen that there remains a predicted exceedance of the noise trigger levels at one residential receiver building (at address 1-3 Gordon Avenue, Chatswood) on the western side of the rail line. This residential receiver is a multi-storey apartment building and would consist of several dwellings. The upper floors of this receiver would have an unobstructed view of the rail tracks over the noise barrier, even with the proposed increase in barrier height. To break line of sight at the triggered receivers on the upper floor of this building would require a noise barrier in excess of six metres high. Noise barriers of this height are unlikely to be considered reasonable and may not be feasible, particularly since the barrier would need to be located in close proximity to the building facade. Based on the outcomes of noise modelling during detailed design, this property would be considered for at property treatment.

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THE REPORT ACKNOWLEDGES THAT THEY CANT PROVIDE ADEQUATE SOUND BARRIERS FOR 1-3 GORDON AVENUE.