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For **Roetel Ltd**
Park House
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The Roebuck, Oxford Road, Reading
Noise & Vibration
Assessment Report

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WBM

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Contents

The Authors.....	2
WBM.....	2
1 Introduction.....	4
2 Site Description	4
2.1 Proposed Floor Plan Layouts.....	5
2.2 Existing Constructions	5
3 Noise & Vibration Surveys	6
3.1 Previous Assessment	6
3.2 Measurement Description	6
3.3 Results – Road Noise	7
3.4 Results – Railway Noise	7
3.5 Summary of External Noise Levels	9
3.6 Results – Railway Vibration	10
4 Noise Assessment.....	11
4.1 Noise Guideline Values	11
4.2 Required Façade Sound Insulation.....	13
4.3 Internal Noise – Current Situation, Windows Closed.....	14
4.4 Internal Noise – Windows Open	15
4.5 Upgraded Constructions	16
5 Summary and Conclusion	21
Appendix A – Glossary of Acoustic Terms	23
Appendix B – Guidance Documents	25
Appendix C – Plans	40
Appendix D – Noise Survey Details and Results	43
Appendix E – Vibration Survey Details and Results.....	47
Appendix F – Road Traffic Noise Analysis	48
Appendix G – Train Movement Data from RealTime Trains	50

1 Introduction

WBM has been instructed by Roetel Ltd to prepare a noise assessment in support of a planning application for the conversion to apartments of The Roebuck on Oxford Road, Reading.

Oxford Road is at the front of the site and there are railway lines at the rear. The building is exposed to significant levels of transportation noise on all sides.

WBM has undertaken noise surveys to determine the impact of road and rail traffic noise on the property and the proposed apartments. A vibration survey has also been undertaken to determine if there is any impact on vibration from train movements at the rear of the site.

The survey details, results and assessment are set out in this report. To aid comprehension, a glossary of acoustic terms is presented in Appendix A. Summaries of the guidance documents used in this report are set out in Appendix B.

This document is an updated version of the previous report dated May 2025. This version of the report incorporates mitigation measures to the constructions including reference to the use of ventilation units on the site. Other edits to the report have been incorporated to improve clarity.

2 Site Description

The Roebuck is located on Oxford Road, Tilehurst Reading, in a mainly residential area. The location of the building is provided in Plan C.1 in Appendix C, with elevations provided in Plans C.2. The building has a long-established noise-sensitive use, previously as a hotel and currently as a House in Multiple Occupation (HMO).

Oxford Road (A329) is immediately to the south-west of the building and road traffic is a significant noise source affecting the site.

To the rear (north) of the building lies railway lines between Didcot and Reading, with the Thames Path and River Thames beyond. The railway lines are in a cutting. The rear (northern) side of the building is exposed to frequent rail noise from passenger and freight traffic. An example of the number of trains past the site is set out in Appendix G, which gives the number of passing trains (passenger and freight) over a typical weekday in February 2025.

The site is exposed to transportation noise on all sides, including road traffic at the front and railway noise at the rear.

Part of the building is grade II listed, and the rest of the building is also listed by association. The grade II listing places constraints on any modifications that can be made to the building.

The building is currently used as an HMO. Planning permission is being sought to convert the building into 8 apartments.

2.1 Proposed Floor Plan Layouts

The proposed layouts of the apartments are shown in Plan C.3 in Appendix C.

Apartments 1, 2 and 3 are at ground floor. Apartment 4 is at first and second floors. Apartments 5 and 6 are at first floor. Apartments 7 and 8 are at second floor.

There are no proposed changes to the external building envelope.

2.2 Existing Constructions

It is understood that the existing windows are all single glazed. It is assumed that the single glazing comprises 4mm glass and single glazed windows have a sound reduction performance of around 31 dB R_w and 28 dB R_w+C_{tr} (R_{tr}).

There are no ventilation grilles or other vents in the building envelope to habitable rooms. The windows need to be opened in order to allow ventilation and mitigation against overheating to the habitable rooms.

The external wall is assumed to be a cavity masonry construction with a sound reduction performance of around 51 dB R_w and 47 dB R_w+C_{tr} .

Some of the rooms have ceilings / walls formed by the pitched roof. WBM has been advised by the applicants that the roof construction is likely to be roof tiles on timber battens, underdrawn with lathe and plaster, with no insulation in the cavity. The likely sound reduction performance of this type of roof construction is around 30 dB R_w+C_{tr} .

3 Noise & Vibration Surveys

3.1 Previous Assessment

A previous noise & vibration assessment was prepared for the site in 2006 by Enviro Consulting, which found noise & vibration levels affecting the property of:

- Road traffic noise of 70 dB $L_{Aeq,T}$ during the day and 57 dB $L_{Aeq,T}$ at night (freefield)
- Rail traffic noise of 66 dB $L_{Aeq,T}$ during the day and 59-60 dB $L_{Aeq,T}$ at night (freefield)
- Maximum levels up to 81 dB $L_{Amax,f}$ at the front (road traffic) and 80 dB $L_{Amax,f}$ at the rear (rail traffic)
- Vibration levels of up to 0.26 m/s^{1.75} during the day and 0.16 m/s^{1.75}, corresponding to a low probability of adverse comment

3.2 Measurement Description

Noise and vibration measurements were undertaken by WBM around the site during the daytime of 06 February 2025 and the night-time (early morning) of 07 February 2025.

The details and results of the noise measurements are set out in Appendix D, and the vibration measurements in Appendix E.

During the surveys there was regular road traffic on Oxford Road and road traffic was a significant noise source at the front of the building.

There was also regular rail traffic on the railway lines at the rear of the site; rail traffic was a significant noise source at the rear of the site. From inspection of the railway traffic data from the 'Real Time Trains' website for a typical weekday in February 2025, there are over 350 train movements on the lines adjacent to the site during the day, and over 40 movements at night. The train movements include both passenger and freight traffic. The data reported on 'Real Time Trains' agrees with the train movement observations noted by WBM.

During the day, there are typically around 30 freight train movements, and over 320 passenger train movements (i.e. typically 20 per hour) between 7am and 11pm – see Appendix G. The busiest times for the railway lines are between 7am and 9pm.

At night, there are over 30 passenger train movements and over 10 freight train movements between 11pm and 7am. The busiest hours at night are those that start 6am and 11pm, however it appears that there are train movements throughout the night period.

The train movements include both passenger and freight traffic. The data reported on 'Real Time Trains' broadly agrees with the train movement observations noted by WBM.

3.3 Results – Road Noise

The results of the road traffic noise measurements at Locations 1 and 2 at the front of The Roebuck are provided in Appendix D. Location 1 was approximately 1m from the façade of The Roebuck and Location 2 was a free-field location at least 3.5m from the nearest façade of The Roebuck. The difference between the free-field and façade locations was approximately 2 dB.

Analysis of the levels measured at Location 1 have been used to determine daytime and night-time levels and are provided in Appendix F. The calculated freefield 16 hour daytime level is 71 dB $L_{Aeq,16h}$. The freefield night-time level, determined from sample measurements between 5am and 7am, is calculated to be 64 dB $L_{Aeq,8h}$.

Maximum noise levels at Location 1 from passing road traffic during the day and night were up to 96 dB $L_{Amax,f}$ (façade) although the majority of maxima were at or below 88 dB $L_{Amax,f}$ (façade), which is the equivalent of around 86 dB $L_{Amax,f}$ (freefield).

3.4 Results – Railway Noise

During the daytime there was regular rail traffic noise at the rear of the site, due to passenger and freight traffic.

The railway lines are in a cutting at the rear of the site. Rail traffic noise measurements were undertaken at both 1.5m and 4m heights above local ground to check the potential effects of screening from the edge of the railway cutting at 1.5m. However, the screening effects were found to be negligible, as the results at 4m were generally lower than those at 1.5m. The fluctuations in noise level were due to variations in local activities.

The average daytime noise level measured at the rear of the building from all samples at Locations 3 and 4 was 71 dB $L_{Aeq,T}$ (façade). This is the equivalent of 68 dB $L_{Aeq,T}$ freefield.

During the night-time (early morning survey) there were no trains for the majority of one of the 15 minute samples, during which the measured levels were noticeably lower. External noise levels with train movements, which occurred more regularly from around 5:45 onwards, were around 71 dB $L_{Aeq,T}$ (façade), i.e. similar to daytime levels.

Maximum noise levels at Locations 3 and 4 from passing road traffic during the day and night were up to 93 dB $L_{Amax,f}$ (façade) although the majority of maxima were at or below 87 dB $L_{Amax,f}$ (façade), which is the equivalent of around 85 dB $L_{Amax,f}$ (freefield).

The façade level single event levels (L_{AE}) of individual train movements noted during the survey have also been determined from the measured levels. These are summarised below:

Table 3.1: Single event levels from measured train noise levels	
Range (average) dB L_{AE} (façade levels)	
Passenger	Freight
79-93 (87)	93-103 (99)

The average single event levels, corrected to freefield values are:

- 84 dB L_{AE} for passenger trains; and
- 97 dB L_{AE} for freight trains.

These freefield values have been used to calculate the noise exposure due to railway traffic for worst case hours during the daytime and night, and also the overall daytime and night-time levels.

Table 3.2: Calculated Train Noise Levels			
	Passenger	Freight	Overall
Freefield L_{AE} dB	84	97	-
Worst case hour (daytime)			
No. movements	23	3	26
Calculated dB $L_{Aeq,1h}$	63	66	68
Worst case hour (night-time)			
No. movements	8	4	26
Calculated dB $L_{Aeq,1h}$	58	67	68

Table 3.2: Calculated Train Noise Levels			
	Passenger	Freight	Overall
Overall daytime (16 hours)			
No. movements	326	30	356
Calculated dB $L_{Aeq,16h}$	62	64	66
Overall night-time (8 hours)			
No. movements	32	11	43
Calculated dB $L_{Aeq,8h}$	55	63	63

The calculated train noise levels show that the worst case hours (during the day and night) gave calculated noise levels of 68 dB $L_{Aeq,1h}$ (freefield). This is in agreement with the survey results from the rear of the property, which had measured levels of 68 dB $L_{Aeq,T}$ (freefield).

The overall calculated 16-hour daytime and 8-hour night-time train noise levels at the rear of the property are 66 dB $L_{Aeq,16h}$ and 63 dB $L_{Aeq,8h}$ respectively.

3.5 Summary of External Noise Levels

A summary of the overall and maximum noise levels affecting the property during the day and night from the different sources (road and rail) is provided below.

Table 3.3: Summary of freefield noise levels at front and rear of building			
	Day	Night	Maximum*
Front of property (road traffic)	71 dB $L_{Aeq,16h}$	64 dB $L_{Aeq,8h}$	≤86 (94) dB $L_{Amax,f}$
Rear of property (rail traffic)	66 dB $L_{Aeq,16h}$	63 dB $L_{Aeq,8h}$	≤85 (91) dB $L_{Amax,f}$
* The typical highest equivalent freefield maxima values are presented in the table, with the absolute maximum freefield value in brackets.			

The above results represent the worst case external noise levels affecting the property. The values at various windows on the façade may be lower due to limited angle of view / local screening. However, there will also be some apartments where the external noise levels are as tabulated above.

The magnitude of external noise levels at the sides of the building will be between the front and rear values tabulated above.

The daytime $L_{Aeq,T}$ results measured by WBM are within 1 dB of the previous noise survey results undertaken by Enviros Consulting in 2006. However the night-time levels measured by WBM are higher than those determined previously, by 3-4 dB $L_{Aeq,8h}$ for rail traffic at the rear ($L_{Aeq,8h}$), 7 dB for road traffic at the front ($L_{Aeq,8h}$). The maximum levels ($L_{Amax,f}$) measured by WBM are also greater at the front and rear of the site by at least 5 dB.

3.6 Results – Railway Vibration

The results from the vibration measurements are set out in Appendix E. The vibration meter reported the hourly VDV values during the daytime and night (early morning) surveys.

During the daytime, there were regular trains on the adjacent railway lines. The highest VDV was measured in the vertical (Z) axis with an hourly level of up to $0.022 \text{ m/s}^{1.75}$ VDV. Assuming similar train activity for the remainder of the day, the estimated daily total would be up to $0.044 \text{ m/s}^{1.75}$ VDV, which is well below the range of values indicating low probability of adverse comment (see guidance in BS 6472 as summarised in Appendix B).

During the night, although train activity still occurred, it was less frequent. As for the daytime, the highest VDV was measured in the vertical (Z) axes with an hourly level of up to $0.016 \text{ m/s}^{1.75}$ VDV. Assuming similar train activity for the remainder of the night, the estimated night-time total would be up to $0.028 \text{ m/s}^{1.75}$ VDV, which is also well below the range of values indicating low probability of adverse comment (see guidance in BS 6472 as summarised in Appendix B).

In summary, the vibration levels due to train activity were found to be below the values indicating low probability of adverse comment, and are therefore considered to be not significant.

4 Noise Assessment

4.1 Noise Guideline Values

ProPG

Professional Practice Guidance on Planning and Noise (ProPG) provides guidance on noise for new dwellings, including those that are newly converted. The magnitude of noise experienced at the site indicates that the converted building would be within the medium to high risk for noise. ProPG advises that the risk could be reduced following good acoustic design. Good acoustic design would involve providing suitable internal noise levels such as the target $L_{Aeq,T}$ values provided in BS 8223 along with appropriate maximum levels in bedrooms at night. Note that as these are apartments without gardens or balconies, there are no external amenity areas to consider in terms of noise.

WHO

The internal noise level requirements of the 1999 World Health Organisation (WHO) “Guidelines for Community Noise” are valid. Within this document it is recommended that the levels inside dwellings do not exceed 35 dB $L_{Aeq,16h}$ during the day, and levels inside bedrooms do not exceed 30 dB $L_{Aeq,8h}$ at night. It is also recommended that indoor maximum levels in bedrooms at night should not exceed 45 dB $L_{Amax,f}$ more than 10-15 times per night.

BS 8233

BS 8233 “Guidance on sound insulation and noise reduction for buildings” suggests indoor ambient noise levels for dwellings from noise sources without a specific character (“anonymous noise”).

For dwellings, the main considerations are the acoustic effects on sleep in bedrooms, and resting, listening and communicating in other rooms. The guideline indoor values are similar to those set out in the WHO guidelines, comprising:

- 35 dB $L_{Aeq,16h}$ in living rooms and bedrooms during the day
- 40 dB $L_{Aeq,16h}$ in dining rooms during the day
- 30 dB $L_{Aeq,8h}$ in bedrooms at night

BS 8233 also advises that:

- If relying on closed windows to meet the guideline values, there needs to be an appropriate, alternative means of ventilation that does not compromise the façade insulation or the resulting internal noise level.
- Where development is considered necessary or desirable, the internal levels set out in BS 8233 may be relaxed by up to 5 dB and reasonable internal conditions still be achieved.

AVO Guide

The Acoustics Ventilation and Overheating (AVO) Residential Design Guide provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed. Many buildings require closed windows to provide good internal acoustic conditions whereas opening a window is the normal way to keep a building cool.

The AVO Guide provides an indication of the amount of outside to inside level difference that might be obtained from a partially open window of 13 dB(A) – assuming a simple façade opening of around 2% of the floor area.

The magnitude of external noise at this site indicates that the building is a high risk in terms of noise exposure.

The AVO Guide suggests that the internal noise levels set out in BS 8233 should be achieved in dwellings for the situation with adequate whole dwelling ventilation. However, it is considered reasonable to allow higher internal noise levels when higher rates of ventilation are required in relation to the overheating condition, as this occurs for only part of the time and occupants may accept a trade-off between acoustic and thermal conditions.

The guide also suggests that BS 8233 internal levels relaxed by up to 5 dB are considered reasonable.

Approved Document O (ADO) and ANC ADO Noise Guide

Note that Approved Document O 'Overheating' (ADO) is not applicable to this site as the guidance in ADO applies to new residential building only, and does not apply to buildings undergoing a change of use. The document is included in Appendix B for information.

ADO sets out internal noise limits for bedrooms at night of 40 dB $L_{Aeq,8h}$ and 55 dB $L_{Amax,f}$, with the implication that bedroom windows would need to remain closed if these limits are exceeded if windows were opened. The Association of Noise Consultants (ANC) document “Approved Document O, Noise Guide” provides advice on the noise requirements of ADO. AND Guide also provides indications of outside to inside level differences for different window openings.

- outside to inside level difference of 10 dB(A) – assuming an opening of 4% of the floor area; and
- outside to inside level difference of 5 dB(A) – assuming an opening of 13% of the floor area.

4.2 Required Façade Sound Insulation

Based on the guidance values set out above, the required outside to inside level differences of the façade to achieve the various internal noise levels set out in Section 4.1 above are as follows:

Table 4.1: Sound insulation requirements for the front / rear of the building			
	Day	Night	Maximum
External noise levels (front / rear)	71 / 66 dB $L_{Aeq,16h}$	64 / 63 dB $L_{Aeq,8h}$	86 / 85 dB $L_{Amax,f}$
WHO Guidelines / BS 8233 ⁽¹⁾	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$	45 dB $L_{Amax,f}$
Required sound level difference (front / rear)	36 / 31 dB(A)	34 / 33 dB(A)	41 / 40 dB(A)
‘Reasonable’ [BS 8233+5 dB]	40 dB $L_{Aeq,16h}$	35 dB $L_{Aeq,8h}$	-
Required sound level difference (front / rear)	31 / 26 dB(A)	29 / 28 dB(A)	-
ADO requirement ⁽²⁾	-	40 dB $L_{Aeq,8h}$	55 dB $L_{Amax,f}$
Required sound level difference (front / rear)	-	24 / 23 dB(A)	31 / 30 dB(A)
⁽¹⁾ Under adequate whole building ventilation rates ⁽²⁾ Applies to new constructions only; does not apply to conversions (provided for information) and applies under higher ventilation rates to control overheating			

4.3 Internal Noise – Current Situation, Windows Closed

Living Room Level Difference Requirements

As shown in Table 4.1 above, outside to inside level difference requirements of up to 36 dB(A) at the front and 31 dB(A) at the rear would be required in order to achieve the recommended BS 8233 internal noise levels in living rooms during the day, assuming no relaxation to the criteria. Reduced level difference requirements of up to 31 dB(A) at the front and 26 dB(A) at the rear would be required in order to achieve reasonable internal levels in living rooms during the day (i.e. the BS 8233 guideline values relaxed by 5 dB).

Bedroom Level Difference Requirements

Outside to inside level difference requirements of up to 36 dB(A) at the front and 33 dB(A) at the rear would be required in order to achieve the recommended BS 8233 internal noise $L_{Aeq,T}$ values in bedrooms during the day and night. Reduced level difference requirements of up to 31 dB(A) at the front and 28 dB(A) at the rear would be required in order to achieve reasonable internal $L_{Aeq,T}$ values in bedrooms during the day and night.

For bedrooms the WHO Guidelines for Community Noise also provide requirements for maximum levels at night. The requirements for outside to inside level differences to achieve the WHO maximum guideline values is 41 dB(A) at the front and 40 dB(A) at the rear.

To achieve the ADO requirements for internal maxima would require outside to inside level differences of 31 dB(A) at the front and 30 dB(A) at the rear.

Calculated Level Difference Based on Existing Constructions

WBM has assessed the outside to inside level differences provided for a selection of rooms across the development based on the existing constructions as set out in Section 2.2. Note that the level difference performance varies between rooms due to the area of the windows and the size of the rooms.

At ground and first floors, the calculated level differences are at least 26 dB(A) for living rooms and 28 dB(A) for bedrooms. For habitable rooms on the second floor, where external façades of the rooms are largely composed of roof construction, the level differences are at least 24 dB(A).

These calculated level differences fall short of the requirements in order to achieve appropriate internal noise levels.

The acoustically weakest parts of the building envelope at present are the single glazed windows and (at second floor) the roof. It is recommended that these constructions be upgraded to improve the acoustic performance – see Section 4.5.

Note that the level differences above apply when the windows and glazed doors are fully closed. If these are opened, e.g. for ventilation purposes, the level differences would be lower. See Section 4.4 below with regard to ventilation, which also needs to be considered.

4.4 Internal Noise – Windows Open

The previous section addressed internal noise for the current situation with windows closed; however, the internal noise levels when windows are open also needs to be considered.

There does not appear to be any ventilation grilles in the existing windows or in the majority of façades. It is assumed that ventilation and mitigation against overheating can only be achieved in habitable rooms via open windows.

The different internal noise levels that could occur for different amounts of window opening are set out below.

Table 4.2: Internal noise with windows open (front / rear of the building)			
	Day	Night	Maximum
External noise levels (front / rear)	71 / 66 dB $L_{Aeq,16h}$	64 / 63 dB $L_{Aeq,8h}$	86 / 85 dB $L_{Amax,f}$
Window ajar 2% of floor area			
Indicative outside to inside level different	13 dB(A)		
Internal level (front / rear)	58 / 53 dB $L_{Aeq,16h}$	51 / 50 dB $L_{Aeq,8h}$	73 / 72 dB $L_{Amax,f}$
Window open 4% of floor area			
Indicative outside to inside level different	10 dB(A)		
Internal level (front / rear)	61 / 56 dB $L_{Aeq,16h}$	54 / 53 dB $L_{Aeq,8h}$	76 / 75 dB $L_{Amax,f}$
Window open 13% of floor area			
Indicative outside to inside level different	5 dB(A)		
Internal level (front / rear)	66 / 61 dB $L_{Aeq,16h}$	59 / 58 dB $L_{Aeq,8h}$	81 / 80 dB $L_{Amax,f}$

As shown above, the internal noise levels when windows are open are in excess of the recommended values (BS 8233, WHO Guidelines, ADO) for all scenarios. There is a risk that future occupants would find these magnitudes of internal noise levels unacceptable, especially when they have no other option other than to open windows for ventilation and/or mitigation against overheating.

It is recommended that alternative forms of ventilation are considered so that windows could remain closed at all times if so desired by future occupants.

4.5 Upgraded Constructions

The Roebuck has a long-established noise-sensitive use, previously as a hotel and currently as a House in Multiple Occupation (HMO). Considering also that the building is Grade II listed, any mitigation measures for the constructions will need to be reasonable and not too onerous, taking into account the constraints that apply to the building.

With windows closed, some of the internal noise levels will exceed the recommended internal noise guidelines due to excessive transmission via the windows and, in some cases the roof (for the top floor rooms). The following sections consider upgrades to these constructions to reduce external noise ingress into the building.

Alternative forms of ventilation are also recommended so that windows can remain closed.

Upgraded Windows

As set out above, the sound reduction performance from the current single glazed windows would be around 31 dB R_w .

In order to improve external noise ingress without materially affecting the external façade, it is recommended that secondary glazing is installed, i.e. an additional internal pane of glass on a large cavity. It is anticipated that secondary glazing, with all windows closed, should be able to provide an improvement in sound reduction to the glazing of at least 10 dB R_w , possibly more depending on the configuration of the secondary glazing (cavity depth and glass thickness). The larger the cavity depth and/or second glass thickness, the better the improvement in external noise ingress.

WBM has considered the improvement (reduction) in internal levels with a basic secondary glazing (e.g. additional internal layer of 4mm glass on at least 200mm cavity, or additional internal layer of 6mm glass on at least 100mm cavity). The expected performance of the upgraded secondary glazing should be at least 42 dB R_w and 37 dB R_w+C_{tr} (R_{tr}).

Any installation of secondary glazing would need to be undertaken taking the Grade II listing into account, along with any other constraints. The installation of secondary glazing could be undertaken without making permanent changes to the structure and so would preserve the character of the listed building.

Upgraded Roof

For the rooms on the top floor, the internal noise levels are also affected by excessive ingress via the roof. As set out above, roof construction is likely to be tiles on timber battens, underdrawn with lathe and plaster, with no insulation in the cavity. The likely sound reduction performance of this type of roof construction is around 31 dB R_w+C_{tr} . This could be improved by the introduction of mineral wool insulation in the roof cavity and also the introduction of additional plasterboard layers to the underside of the roof construction.

The improvement in acoustic performance would depend on the treatment provided. Any improvements to the roof construction would need to be undertaken taking the Grade II listing into account, along with any constraints.

WBM has considered the improvement (reduction) in internal levels at second floor with an upgraded roof construction above habitable rooms including at least 50mm mineral wool insulation in the roof cavity and the ceiling upgraded with an additional layer of 12.5mm heavy (minimum 10 kg/m²) plasterboard or the ceiling replaced with minimum 2 x 12.5mm heavy plasterboard. The expected performance of the upgraded roof construction is expected to be at least 46 dB R_w and 35 dB R_w+C_{tr} .

Upgraded Vents

It is recommended that alternative forms of ventilation are considered so that windows could remain closed at all times if so desired by future occupants.

WBM has been requested to consider the acoustic implications of the introduction of passive vents such as the Ryton 9x6 Cowled Acoustic AirLiner Set. The performance of the vent when open is 42 dB $D_{ne,w}$ and 39 dB $D_{ne,w}+C_{tr}$.

The installation of any vent would require a grille opening in the building façade, which would need to be considered with regard to the Grade II listing. WBM understands that the Ryton ventilation grille features a low-profile cowled external grille in a discreet finish, which is sympathetic to the listed building façade.

External Doors

Some of the ground floor flats have external doors to living rooms (Flats 1 and 2 at ground floor). It is recommended that, where external doors are fully or part glazed, that the glazing of the external doors is also upgraded to secondary glazing (similar to that required for the windows).

In addition, high acoustic performance door seals should also be fitted around the door perimeter (including at the threshold) to prevent leakage.

Internal Noise Levels with Upgraded Constructions

With the proposed mitigation measures to improve acoustic performance (secondary glazing, upgraded roof and the installation of vents), internal $L_{Aeq,T}$ noise levels would meet the daytime and night-time requirements of BS 8233 in all habitable rooms at ground and first floor with 1 open vent per room. At second floor, the internal $L_{Aeq,T}$ levels in habitable rooms either meet the BS 8233 requirements or are within 2 dB of these guideline values (i.e. well within the 'reasonable' threshold of BS 8233).

In addition to the $L_{Aeq,T}$ guideline values set out in BS 8233, the WHO 1999 Guidelines for Community Noise also recommends that maximum noise levels do not exceed 45 dB $L_{Amax,f}$ in bedrooms more than 10-15 times per night. Approved Document O 'Overheating' (ADO) also provides some maximum noise levels for bedrooms. Note that ADO is not applicable to this site as this guidance applies to new residential building only (it does not apply to buildings undergoing a change of use). For information, the internal noise levels that are required for bedrooms at night in ADO are 40 dB $L_{Aeq,8h}$ and 55 dB $L_{Amax,f}$.

As set out in the survey results from WBM, maxima at this site were generally at or below 86 dB $L_{Amax,f}$, although occasionally higher maximum levels do occur. With these external maxima and with the upgraded constructions, internal maxima in bedrooms with windows closed should be at or below 50 dB $L_{Amax,f}$ at ground and first floors and at or below 54 dB $L_{Amax,f}$ at second floor. These internal levels are above the recommended values set out in the WHO Guidelines, but meet the values set out in ADO.

Note that it would be extremely challenging to meet the WHO Guidelines values for maximum levels without substantial changes to the building envelope and the inclusion of a full mechanical building services system; such changes would be difficult to achieve given the Grade II listed status of the building and the resulting constraints to any construction alterations.

Number of vents

It may be possible for some habitable rooms to have more than 1 vent and still comply with the BS 8233 / ADO requirements. The internal noise levels with up to 4 open vents per room have been considered by WBM. The allowable numbers of open vents per room are tabulated below, to achieve:

- BS 8233 internal $L_{Aeq,T}$ noise guidelines
- BS 8233 internal $L_{Aeq,T}$ noise guidelines relaxed by 3 dB $L_{Aeq,T}$ (i.e. within the 'reasonable' threshold)
- ADO internal maxima values of 55 dB $L_{Amax,f}$ (assuming external maxima of 86 dB $L_{Amax,f}$)

Table 4.3: Number of vents for habitable rooms				
Flat	Room	Number of vents to meet:		
		BS 8233 L _{Aeq,T} Guidelines	BS 8233 L _{Aeq,T} Guidelines + 3 dB	ADO L _{Amax,f}
Ground floor				
Flat 1	Living/Dining	2	4	n/a
	Bedroom 1	4	4	4
	Bedroom 2	2	4	4
Flat 2	Living/Dining	3	4	n/a
	Bedroom	3	4	4

Table 4.3: Number of vents for habitable rooms				
Flat	Room	Number of vents to meet:		
		BS 8233 $L_{Aeq,T}$ Guidelines	BS 8233 $L_{Aeq,T}$ Guidelines + 3 dB	ADO $L_{Amax,f}$
Flat 3	Living/Dining	1	4	n/a
	Bedroom 1	4	4	4
	Bedroom 2	1	4	4
First Floor				
Flat 4	Living	4	4	n/a
	Dining	4	4	n/a
	Bedroom 1	2	4	4
Flat 5	Living	4	4	n/a
	Dining	4	4	n/a
	Bedroom	2	4	4
Flat 6	Living/Dining	2	4	n/a
	Bedroom	1	3	4
Second floor				
Flat 4	Bedroom 2	*	3	2
	Bedroom 3	*	2	2
Flat 7	Living/Dining	4	4	n/a
	Bedroom	*	3	3
Flat 8	Living/Dining	*	3	n/a
	Bedroom 1	*	3	3
	Bedroom 2	2	3	2
* Exceeds BS 8233 guideline $L_{Aeq,T}$ values by up to 2 dB with 1 vent				

It is recommended that, where possible, the number of vents used per habitable room complies with the lowest value per scenario, for example Bedroom 1 in Flat 4 should ideally have no more than 2 vents. However, where the ventilation / mitigation against overheating requirements necessitate additional vents, the number used should not exceed the maximum values per room set out in Table 4.3.

5 Summary and Conclusion

WBM has been instructed by Roetel Ltd to prepare a noise assessment in support of a planning application for the conversion to apartments of The Roebuck on Oxford Road, Reading. WBM has undertaken noise surveys to determine the impact of road and rail traffic noise on the property and the proposed apartments. In addition to a vibration survey to determine if there is any impact on vibration from train movements at the rear of the site.

As stated in BS 8233, recommended internal noise levels are 35 dB $L_{Aeq,16h}$ in living rooms and bedrooms during the day, 40 dB $L_{Aeq,16h}$ in dining rooms during the day and, 30 dB $L_{Aeq,8h}$ in bedrooms during at night. It was determined that the outside to inside sound level difference of the building was insufficient to achieve these recommended levels when windows are closed. In addition, there are no means to ventilate / cool rooms other than open windows.

WBM's recommendations to Roetel Ltd are as follows:

- Secondary glazing is installed to all habitable rooms (living rooms, dining rooms, bedrooms) with a sound reduction performance of at least 42 dB R_w and 37 dB R_w+C_{tr} (R_{tr}) and comprising at least:
 - 4mm glass on 200mm cavity; or
 - 6mm glass on 100mm cavity.
- Where the ceiling above habitable rooms is formed by the pitched roof, the construction must be upgraded to at least 46 dB R_w and 35 dB R_w+C_{tr} and comprising:
 - at least 50mm mineral wool insulation in the roof cavity
 - ceiling upgraded with an additional layer of minimum 12.5mm plasterboard (at least 10 kg/m²) or replaced with at least 2x12.5 mm plasterboard (at least 10 kg/m²).
- Vents must be installed to habitable rooms to provide ventilation without the need to open the windows. WBM has assessed the acoustic implications of the Ryton 9x6 Cowlled Acoustic AirLiner Set and have confirmed the number of vents that could be used in habitable rooms in order to meet various noise values (see Table 4.3).

- Where external doors to habitable rooms are fully or part glazed, the glazing of the external doors is also upgraded to secondary glazing (similar to that required for the windows). In addition, high acoustic performance door seals should also be fitted around the door perimeter (including at the threshold) to prevent leakage.

With the above mitigation measures, it should be possible to achieve good or reasonable internal $L_{Aeq,T}$ values in habitable rooms (following BS 8233) and also maximum levels in line with the requirements of Approved Document O, with windows closed and ventilation provided via the installed vents.

Any mitigation treatment would need to be undertaken taking the Grade II listing into account, along with any constraints that would impose.

Results from the vibration survey show that vibration levels due to train activity were below the values indicating low probability of adverse comment, and therefore are considered to be not significant.

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Appendix A – Glossary of Acoustic Terms

General Noise and Acoustics

The following section describes some of the parameters that are used to quantify noise.

Decibels dB

Noise levels are measured in decibels. The decibel is the logarithmic ratio of the sound pressure to a reference pressure (2×10^{-5} Pascals). The decibel scale gives a reasonable approximation to the human perception of relative loudness. In terms of human hearing, audible sounds range from the threshold of hearing (0 dB) to the threshold of pain (140 dB).

A-weighted Decibels dB(A)

The 'A'-weighting filter emulates human hearing response for low levels of sound. The filter network is incorporated electronically into sound level meters. Sound pressure levels measured using an 'A'-weighting filter have units of dB(A) which is a single figure value to represent the overall noise level for the entire frequency range.

A change of 3 dB(A) is the smallest change in noise level that is perceptible under normal listening conditions. A change of 10 dB(A) corresponds to a doubling or halving of loudness of the sound. The background noise level in a quiet bedroom may be around 20 –30 dB(A); normal speech conversation around 60 dB(A) at 1 m; noise from a very busy road around 70-80 dB(A) at 10m; the level near a pneumatic drill around 100 dB(A).

Façade Noise Level

Façade noise measurements are those undertaken near to reflective surfaces such as walls, usually at a distance of 1m from the surface. Façade noise levels at 1m from a reflective surface are normally around 2-3 dB greater than those obtained under freefield conditions.

Freefield Noise Level

Freefield noise measurements are those undertaken away from any reflective surfaces other than the ground.

Frequency Hz

The frequency of a noise is the number of pressure variations per second, and relates to the "pitch" of the sound. Hertz (Hz) is the unit of frequency and is the same as cycles per second. Normal, healthy human hearing can detect sounds from around 20 Hz to 20 kHz.

Octave and Third-Octave Bands

Two frequencies are said to be an octave apart if the frequency of one is twice the frequency of the other. The octave bandwidth increases as the centre frequency increases. Each bandwidth is 70% of the band centre frequency.

Two frequencies are said to be a third-octave apart if the frequency of one is 1.26 times the other. The third octave bandwidth is 23% of the band centre frequency.

There are recognised octave band and third octave band centre frequencies. The octave or third-octave band sound pressure level is determined from the energy of the sound which falls within the boundaries of that particular octave or third octave band.

Appendix A (continued)

Equivalent Continuous Sound Pressure Level $L_{Aeq,T}$

The 'A'-weighted equivalent continuous sound pressure level $L_{Aeq,T}$, is a notional steady level which has the same acoustic energy as the actual fluctuating noise over the same time period T . The $L_{Aeq,T}$ unit is dominated by higher noise levels, for example, the $L_{Aeq,T}$ average of two equal time periods at, for example, 70 dB(A) and 50 dB(A) is not 60 dB(A) but 67 dB(A).

The $L_{Aeq,T}$ is the chosen unit of BS 7445-1:2003 "Description and Measurement of Environmental noise".

Maximum Sound Pressure Level L_{Amax}

The L_{Amax} value describes the overall maximum 'A'-weighted sound pressure level over the measurement interval. Maximum levels are measured with either a fast or slow time weighted, denoted as $L_{Amax,f}$ or $L_{Amax,s}$ respectively.

Sound Exposure Level L_{AE} or SEL

The sound exposure level is a notional level which contains the same acoustic energy in 1 second as a varying 'A'-weighted noise level over a given period of time. It is normally used to quantify short duration noise events such as aircraft flyover or train passes.

Statistical Parameters L_N

In order to cover the time variability aspects, noise can be analysed into various statistical parameters, i.e. the sound level which is exceeded for $N\%$ of the time. The most commonly used are the $L_{A01,T}$, $L_{A10,T}$ and the $L_{A90,T}$.

$L_{A01,T}$ is the 'A'-weighted level exceeded for 1% of the time interval T and is often used to give an indication of the upper maximum level of a fluctuating noise signal.

$L_{A10,T}$ is the 'A'-weighted level exceeded for 10% of the time interval T and is often used to describe road traffic noise. It gives an indication of the upper level of a fluctuating noise signal. For high volumes of continuous traffic, the $L_{A10,T}$ unit is typically 2–3 dB(A) above the $L_{Aeq,T}$ value over the same period.

$L_{A90,T}$ is the 'A'-weighted level exceeded for 90% of the time interval T , and is often used to describe the underlying background noise level.

Appendix B – Guidance Documents

Summaries of guidance documents are set out in this Appendix. The documents include:

- Professional Practice Guidance on Planning and Noise (ProPG) 2017
- World Health Organisation - Environmental Noise Guidelines for the European Region 2018, Night Noise Guidelines for Europe 2009 and Guidelines for Community Noise 1999
- BS 8233: 2014 “*Guidance on sound insulation and noise reduction for buildings*”
- Acoustics Ventilation and Overheating Guide 2020
- The Building Regulations 2010 – Approved Document O: Overheating, and ANC Approved Document O Noise Guide 2024
- BS 6472

Appendix B (continued)

Professional Practice Guidance on Planning and Noise

Professional Practice Guidance on Planning and Noise (ProPG) dated May 2017 was released in June 2017. The document was produced to provide acoustic practitioners with guidance on a recommended approach to the management of noise within the planning system in England. The scope of ProPG is restricted to the consideration of new residential development that will be exposed to predominantly airborne noise from transportation sources. Though not specifically stated, it is assumed that ProPG is applicable to new converted residential as well as new build residential.

ProPG advocates a systematic, proportionate, risk based, 2-stage approach that encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging.

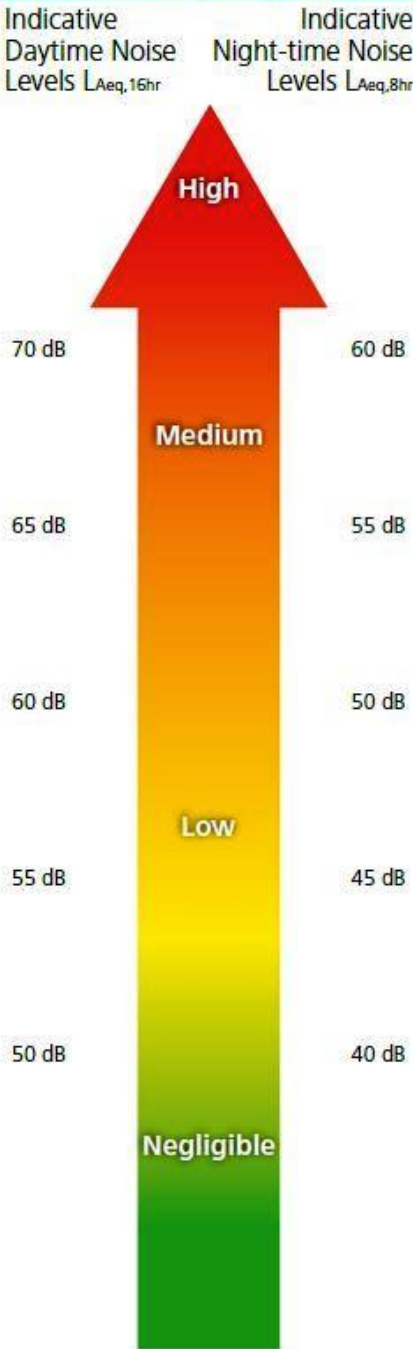
Stage 1 is an initial noise risk assessment that should provide an indication of the likely risk of adverse effects from noise, excluding the effects of subsequent mitigation. There are no specific noise risk levels presented within ProPG but the following figure is provided as guidance.

With regard to the noise levels presented in the figure overleaf:

- Indicative noise levels should be assessed without inclusion of the acoustic effect of any scheme specific noise mitigation measures.
- Indicative noise levels are the combined free-field noise level from all sources of transport noise and may also include industrial/commercial noise where this is present but is “not dominant”.
- $L_{Aeq,16hr}$ is for daytime 0700 – 2300, $L_{Aeq,8hr}$ is for night-time 2300 – 0700.
- An indication that there may be more than 10 noise events at night (2300 – 0700) above 60 dB $L_{Amax,f}$ means the site should not be regarded as negligible risk.

Appendix B (continued)

ProPG Stage 1 Initial Site Noise Risk Assessment

NOISE RISK ASSESSMENT		POTENTIAL EFFECT WITHOUT NOISE MITIGATION	PRE-PLANNING APPLICATION ADVICE
Indicative Daytime Noise Levels $L_{Aeq,16hr}$ Indicative Night-time Noise Levels $L_{Aeq,8hr}$  High 70 dB 65 dB 60 dB 55 dB 50 dB Medium Low Negligible 60 dB 55 dB 50 dB 45 dB 40 dB Increasing risk of adverse effect		High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice. As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development. At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.	
		No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.

Appendix B (continued)

Stage 2 is a systematic consideration of four key elements:

- 1) demonstrating a “Good Acoustic Design Process” – this should be considered at an early stage of the development control process and takes an integrated approach to internal and external acoustic conditions.
- 2) observing internal “Noise Level Guidelines” – it is considered that suitable internal LAeq target levels for internal noise levels can be found in BS 8233: 2014 for steady external noise sources without a specific acoustic character. Additional guidance is provided that maximum levels should not normally exceed 45 dB $L_{Amax,f}$ more than 10 times a night where practical.
- 3) undertaking an “External Amenity Area Noise Assessment” - if external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended. The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 - 55 dB $L_{Aeq,16hr}$.
- 4) consideration of “Other Relevant Issues” including compliance with relevant national and local policy, magnitude and extent of compliance with ProPG, likely occupants of the development, acoustic design versus unintended adverse consequences and acoustic design versus wider planning objectives.

Appendix B (continued)

World Health Organisation

Environmental Noise Guidelines for the European Region 2018

The main purpose of the World Health Organisation (WHO) “Environmental Noise Guidelines for the European Region” 2018 is to provide recommendations for external noise levels for protecting human health from exposure to environmental noise originating from various sources. These noise sources include: transportation (road traffic, railway and aircraft), wind turbine and leisure activities.

The 2018 guidelines supersede the outdoor noise recommendations from “Guidelines for Community Noise” (1999) although the 1999 guidelines for internal noise remain valid.

Several guiding principles (reduce, promote, coordinate and involve) were also developed and apply to the implementation of all of the specific recommendations:

- Reduce exposure to noise, while conserving quiet areas.
- Promote interventions to reduce exposure to noise and improve health.
- Coordinate approaches to control noise sources and other environmental health risks.
- Inform and involve communities potentially affected by a change in noise exposure.

Guidelines for Community Noise

The WHO “Guidelines for Community Noise” 1999 have in part been superseded by the 2018 document, however the guidelines on internal noise remain valid.

The 1999 guidelines provide advice on community noise based on knowledge of the health impacts of community noise and also provides guidance on the protection of people from the harmful effects of noise in non-industrial environments. Some of the relevant internal noise guideline values according to specific environments and critical health effects are tabulated below.

Summary of WHO 1999 Guidance for Noise Levels inside Dwellings

Specific environment	Critical health effect	L_{Aeq} (dB)	Time base (hours)	$L_{Amax,fast}$ (dB)
Dwellings, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45

According to the WHO guidelines, the time base for $L_{Aeq,T}$ values is 16 hours for daytime (including evening) and 8 hours for night-time.

The effects of noise in dwellings are usually sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. The WHO indoor guideline values for bedrooms are 30 dB $L_{Aeq,T}$ for continuous noise. If the noise is not continuous, maximum noise levels should be used to indicate the probability of noise-induced awakenings with 45 dB $L_{Amax,f}$ as the relevant criterion. The WHO guidelines state that *“For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night...”*

Appendix B (continued)

BS 8233

British Standard (BS) 8233: 2014 “*Guidance on sound insulation and noise reduction for buildings*” gives recommendations for the control of noise in and around buildings, and suggests indoor ambient noise levels for dwellings from noise sources without a specific character (“*anonymous noise*”).

For dwellings, the main considerations are the acoustic effects on sleep in bedrooms, and resting, listening and communicating in other rooms.

The suggested levels in dwellings due to steady external noise, such as road traffic, mechanical services or continuously running plant, are presented below (based on Table 4 of BS 8233: 2014).

Summary of BS 8233: 2014 Guidance for Noise Levels in Dwellings

Activity	Location	Indoor ambient noise levels	
		Daytime 07:00 to 23:00 hours	Night-time 23:00 to 07:00 hours
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Daytime resting / night-time sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS 8233: 2014 notes the following:

- The suggested levels are based on existing guidelines issued by the World Health Organisation and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, an appropriate alternative time period, e.g. 1 hour, may be used but the level should be selected to ensure consistency with the recommended values tabulated above.
- Regular individual events, e.g. aircraft or trains, can cause sleep disturbance. Guideline values may be required in terms of a single event level (SEL) or maximum value ($L_{Amax,f}$) depending on the character and number of events per night.
- If relying on closed windows to meet the guideline values, there needs to be an appropriate, alternative means of ventilation that does not compromise the façade insulation or the resulting internal noise level.
- Where development is considered necessary or desirable, the internal levels tabulated above may be relaxed by up to 5 dB and reasonable internal conditions still be achieved.

Only external noise without character is considered in Table 4 of BS 8233. BS 8233 goes on to note that noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.

However, BS8233 also notes in paragraph 6.5.2 “*Assessment of industrial noise*” that where industrial noise affects residential or mixed residential areas, the methods for rating noise in BS 4142 should be applied.

Appendix B (continued)

As well as indoor ambient noise limits, BS 8233 also provides design criteria for noise outside dwellings. For traditional external areas that are used as amenity spaces (e.g. gardens) it is desirable that external noise does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$, which would be acceptable in noisier environments.

However, in higher noise areas, such as city centres or adjacent to the strategic transport network, a compromise between elevated noise levels and other factors might be warranted. BS 8233: 2014 advises that in such situations, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

For residential building where normal external amenity space might be limited or not available, the specification of noise limits in areas such as small balconies (for example used for drying washing or growing pot plants) is not necessarily appropriate. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which are intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. BS 8233: 2014 states *“Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.”*

Appendix B (continued)

Acoustics Ventilation and Overheating Guide

The Acoustics Ventilation and Overheating (AVO) Residential Design Guide was prepared by the Association of Noise Consultants in January 2020 for the consideration of new residential development exposed to mainly transport noise and also to noise from mechanical services within the dwelling. The document provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed. Many buildings require closed windows to provide good internal acoustic conditions whereas opening a window is the normal way to keep a building cool.

The AVO Guide recommends an approach to acoustic assessments for new residential development that take due regard of the interdependence of provisions for acoustics, ventilation and overheating. Application of the AVO Guide is intended to demonstrate good acoustic design as described in ProPG when considering internal noise level guidelines.

The aim of the AVO Guide is to assist designers to adopt an integrated approach to the acoustic design within the context of the ventilation and thermal comfort requirements. Information is provided within the document about ventilation requirements and the overheating assessment methodology, along with guidance relating to different ventilation and overheating conditions for environmental noise ingress and building services noise.

With regard to environmental noise ingress, a two-level assessment procedure is described for the overheating condition. A Level 1 site risk assessment is based on external noise levels and the assumption that opening windows are the primary means of mitigating overheating. A Level 2 assessment considers the potential for adverse effect on occupiers based on the internal ambient noise level.

The AVO Guide indicates that the role of the acoustician is to assist the design team in developing options to suitably control external noise ingress in conjunction with adequate ventilation and mitigation of overheating. There is a need to address how the strategies for ventilation and mitigating overheating impacts on the acoustic conditions and if a more detailed overheating assessment is required to inform this.

A Level 1 site risk assessment is based on external freefield noise levels and the scenario where a partially open window is used to mitigate overheating, assuming an outside to inside level difference of 13 dB. This level difference is considered representative of typical domestic rooms with simple façade openings of around 2% of the floor area.

The outside to inside level difference for a partially open window is likely to differ from project to project and would require due consideration as part of a Level 2 assessment; a 13 dB difference should not be automatically taken as appropriate for all cases.

The following extract from Table 3.2 of the AVO Guide provides guidance of the Level 1 site risk assessment from transport noise sources, relating to overheating conditions.

Appendix B (continued)

Guidance for Level 1 site risk assessment

Risk category for Level 1 assessment ^[Note 5]	Potential Effect without Mitigation	Recommendation for Level 2 assessment
$L_{Aeq, T}$ ^[Note 3] during 07:00 - 23:00 $L_{Aeq, 8hr}$ during 23:00 - 07:00 65 dB High 60 dB Medium 55 dB Low 50 dB Negligible 45 dB	↑ Increasing risk of adverse effect	Recommended Optional
	Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect	Not required

Extracts from the notes following Table 3-2 are provided below:

"Note 1 The noise levels suggested assume a steady road traffic noise source but may be adapted for other types of transport. All levels are external free-field noise levels."

Note 2 The values presented in this table should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships.

Note 3 A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise source, the occupancy profile and times at which overheating might be likely to occur...

Note 4 ...Where 78dB LAFmax is normally exceeded during the night-time period (23:00-07:00), a Level 2 assessment is recommended.

Note 5 The risk of an adverse effect occurring will also depend on how frequently and for what duration the overheating condition occurs...

Note 6 To evaluate the risk category for a dwelling, all three aspects of external noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated. The highest risk category for any of the three aspects applies."

Appendix B (continued)

The AVO Guide suggests that the internal noise levels set out in BS 8233 should be achieved in dwellings for the situation with adequate whole dwelling ventilation. However it is considered reasonable to allow higher internal noise levels when higher rates of ventilation are required in relation to the overheating condition, as this occurs for only part of the time and occupants may accept a trade-off between acoustic and thermal conditions.

The guide also suggests that a Level 2 assessment is not required for situations where reasonable internal conditions, described in ProPG as BS 8233 internal levels relaxed by up to 5 dB, will be achieved for the overheating condition. This correspond to external noise levels within 'Negligible' risk where a Level 1 assessment is sufficient.

The upper category for internal noise during the day is considered to be 50 dB $L_{Aeq,T}$ as this is at the upper end of the range for reliable speech communication. Assuming a 13 dB difference for a partially open window would result in an external level of 63 dB $L_{Aeq,T}$. The upper category for the night is derived from the WHO Night Noise guidelines, which indicates that adverse health effects and sleep disturbance can occur when external levels are above 55 dB $L_{Aeq,T}$. External noise levels at or above these upper category values indicates 'High' risk, and a Level 2 assessment is recommended.

Where external levels are in the 'Low' or 'Medium' risk, a Level 2 assessment can optionally be undertaken to give more confidence regarding the suitability of internal noise conditions.

A Level 2 assessment should include:

- Statement of the overheating criteria being applied, e.g. the amount of time the temperature can exceed a given threshold.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant the area of facade opening.
- Details of the likely internal ambient noise levels whilst using provisions for mitigating overheating, and the method used to predict these.
- Estimation of how frequently and for what duration such provisions are required to mitigate overheating.
- Consideration of the effect of individual noise event
- Assessment of adverse effect on occupants.

A Level 2 assessment will require input from / consultation with the design team and other technical specialists such as building services engineers, in particular with regard to the assessment of overheating risk.

On smaller developments it may be disproportionate to carry out a formal overheating assessment. In this case, the risk factors for overheating may be noted along with the provisions for mitigating overheating and the associated noise levels anticipated. The level of risk to occupants may then be considered in a qualitative manner.

Appendix B (continued)

Recommendations for indoor ambient noise from mechanical services are provided in Figure 3-4 of the AVO Guide. These are summarised below:

Ventilation Condition	Possible system or design solution	Desirable internal ambient noise levels from mechanical services	
ADF – Whole Dwelling Ventilation	System 3: Continuous mechanical extract (MEV), minimum low ventilation rates System 4: Continuous mechanical supply and extract with heat recovery (MVHR), minimum low ventilation rates	Bedrooms	≤L _{Aeq} 26 or 30 dB [Note 1]
		Living Rooms	≤L _{Aeq} 30 dB
ADF – Extract Ventilation	System 1: Intermittent extract fans System 3: Continuous mechanical extract (MEV), minimum high ventilation rates System 4: Continuous mechanical supply and extract with heat recovery (MVHR), minimum high ventilation rates	Bedrooms	≤L _{Aeq} 26 or 30 dB
		Living / Dining Rooms	≤L _{Aeq} 35 dB
		Bathroom / WC / Kitchen	≤L _{Aeq} 45 dB
ADF – Purge Ventilation	Manually controlled fan exchanging a minimum 4 air changes per hour	No desirable noise levels are currently proposed based on the lack of evidence of acceptable noise levels when providing purge ventilation for the purpose of rapidly diluting indoor pollutants.	
Note 1 A lower level may be more appropriate; refer to paragraph 3.31 of the AVO Guide			
[Paragraph 3.31 states: Evidence indicates that “a more prudent limit for mechanical services noise around 24 – 26 dB(A) is likely to be required to prevent an adverse reaction from most occupants while falling asleep.”]			

Appendix B (continued)

The Building Regulations 2010 – Approved Document O: Overheating and ANC Approved Document O Noise Guide

Note that Approved Document O ‘Overheating’ (ADO) is not applicable to this site as the guidance in ADO applies to new residential building only, and does not apply to buildings undergoing a change of use. However information about ADO is provided for information.

The use of window openings to mitigate overheating is intrinsically linked to noise impact and this is acknowledged in Section 3 of AD-O “*Ensuring the overheating mitigation strategy is usable*” as reproduced below.

“Noise

- 3.2** *In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).*
- 3.3** *Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.*
- a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).*
 - b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am).*
- 3.4** *Where in-situ noise measurements are used as evidence that these limits are not exceeded, measurements should be taken in accordance with the Association of Noise Consultants’ Measurement of Sound Levels in Buildings with the overheating mitigation strategy in use...*

Requirements O1(2)(a) of the Building Regulations is a requirement to limit unwanted solar gains in summer, and in meeting this obligation, account must be taken of the reasonable enjoyment of the residence by the occupant. AD-O states:

“In the Secretary of State’s view, requirement O1(2)(a) is met in a new residential building if the building’s overheating mitigation strategy for use by occupants takes account of all of the following.

- a. Noise at night – paragraphs 3.2 to 3.4....”*

The Association of Noise Consultants (ANC) has published “Approved Document O, Noise Guide” (version 1.1 dated November 2024).

Within the guide, it is confirmed that external noise is considered to include sound generated from non-natural sources. Meteorological sounds (wind, rain), sounds from animals (except those associated with commercial premises such as kennels) and sound from water (flowing in watercourses or the sea) are outside the scope.

The scope includes transportation sources (road, rail and air traffic), sources from industrial / commercial premises (including kennels and agriculture) and sounds from entertainment premises. However, footnote 3 of the ANC guide notes: “*For effective noise management, it may be appropriate to use a lower threshold than those presented in paragraph 3.3 of AD-O for sources of an industrial or commercial nature, and sounds arising from entertainment venues, when determining whether opening windows can be used as the overheating mitigation strategy.*”

Appendix B (continued)

The ANC Guide also confirms that the noise limit in Paragraph 3.3 of ADO should also apply to external noise ingress into bedrooms at night associated with any other means of removing excess heat (e.g. louvres or trickle vents), as well as via an open window.

The document provides advice on external noise thresholds when using the Simplified Method to show compliance with ADO. This is based on calculation of the outside-to-inside level difference for window openings for 'high' risk locations and for 'medium' risk locations. The term 'risk' in this context refers to the risk of overheating. ADO defines 'high risk' locations as urban and suburban parts of London and some parts of central Manchester. 'Moderate risk' locations are considered to be all other areas in England excluding high risk parts of London and central Manchester.

The ANC Guide states that the resulting outside-to-inside level difference for windows openings are expected to be approximately 5 dB for 'high' risk locations and 10 dB for 'medium' risk locations.

An outside to inside level difference of 10 dB (for medium risk locations) assumes that the acoustic open area of the window is 4% of the room floor area. An outside to inside level difference of 5 dB (for high risk locations) assumes that the acoustic open area of the window is 13% of the room floor area.

Table 1 in the guide sets out the implied external free-field levels above which external noise precludes use of a Simplified Method for determining overheating and where thermal modelling should be used to demonstrate compliance with ADO.

Table 1 External Noise Levels Above Which the Simplified Method Cannot Be Used

Parameter	High Risk Location	Moderate Risk Location
$L_{Aeq,8h}$, averaged over 8 hours (between 11pm and 7am)	45 dB	50 dB
L_{AFmax} , more than 10 times a night (between 11pm and 7am)	60 dB	65 dB

Note: Several assumptions have been used to determine the outside-to-inside level difference. These are: 2.4m bedroom height, 0.5s bedroom RT, simple hole in the façade of area sufficient to provide the required Equivalent Area, no sound transmission other than via the opening. Calculation according to Equation G.1 of BS 8233:2014 [Ref. 7].

These values do not account for façade elements in front of the windows (e.g. balconies).

Where the Simplified Method cannot be used, or where the developer decides they want to use an alternative approach to the Simplified Method, dynamic thermal modelling is required.

Some variations in approach to removing excess heat may include: varying window open areas; opening windows to less than their full extent for the night-time period; and the use of façade openings that have better sound insulation than a traditional open window. The ANC Guide provides equations to determine the Equivalent Area of an open window, based on the required outside to inside level difference and room volume.

Appendix B (continued)

AD-O requires that building should be constructed to mitigate against overheating using passive means as far as reasonably practicable (which includes openable windows and / or mechanical ventilation fans, but not mechanical cooling / air conditioning).

Where windows are required to be closed at night and an extract fan is used to remove excess heat, fresh air is typically provided by façade openings. Any associated façade openings needed for ventilation should be designed to uphold the sound insulation necessary to achieve the noise standards of AD-O.

Noise from any mechanical system should be effectively controlled, so that it does not discourage occupants from using that system. The suggested noise level for mechanical services is set out below (see also the AVO Guide).

Table 2: Recommended Noise Level for Mechanical Ventilation or Mechanical Cooling Systems

Parameter	Bedrooms
Mechanical ventilation or mechanical cooling system noise	$L_{Aeq,T} 30 (\pm 5) \text{ dB}$

The ANC Guide notes that higher noise levels than those in Table 2 (by up to 10 dB), may be appropriate in some operating scenarios, where rapid changes to the cooling or ventilation rates quickly improve the thermal comfort of the occupant. Equally, lower noise levels may be appropriate for some types of residential development.

The following process is recommended for the acoustic consultant to determine if an open window can be used for removing excess heat:

- (1) Establish the night-time noise exposure at all bedroom windows;
- (2) Determine the outside to inside sound insulation for each bedroom window required to meet the noise threshold;
- (3) Determine the Equivalent Area to achieve the required outside to inside sound insulation as determined in (2) above; and
- (4) Communicate the required total maximum night-time Equivalent Area via an open window for the dynamic thermal modeller to use.

See also the guidance from AVO regarding recommended indoor ambient noise from mechanical services.

Appendix B (continued)

BS 6472

BS 6472-1:2008 “Guide to evaluation of human exposure to vibration in building” (Part 1: Vibration sources other than blasting) provide guidance on predicting human response to vibration in buildings in terms of vibration dose values (VDV) in $\text{m/s}^{1.75}$.

A summary of the VDV ranges and the resulting probabilities of adverse comments is provided below:

Extract from Table 1 from BS 6472			
	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings, 16h day	0.2 to 0.4 $\text{m/s}^{1.75}$	0.4 to 0.5 $\text{m/s}^{1.75}$	0.8 to 1.6 $\text{m/s}^{1.75}$
Residential buildings, 8h night	0.1 to 0.2 $\text{m/s}^{1.75}$	0.2 to 0.4 $\text{m/s}^{1.75}$	0.4 to 0.8 $\text{m/s}^{1.75}$

Note that the vibration levels are to be determined in three orthogonal axes, X, Y and Z. For this assessment at The Robuck, the Z axis is vertical, and the X and Y axes are horizontal.

Note with BS 6472 advises that where vibration conditions are constant or repeated regularly, only one representative sample needs to be measured. The total vibration dose value for the period (day or night) is determined using the following equation:

$$\text{VDV}_{\text{period}} = [t_{\text{period}} / t_{\text{sample}}]^{0.25} \times \text{VDV}_{\text{sample}}$$

Appendix C – Plans

Plan C.1: Site Location



Appendix C (continued)

Plan C.2: External Elevations

Front

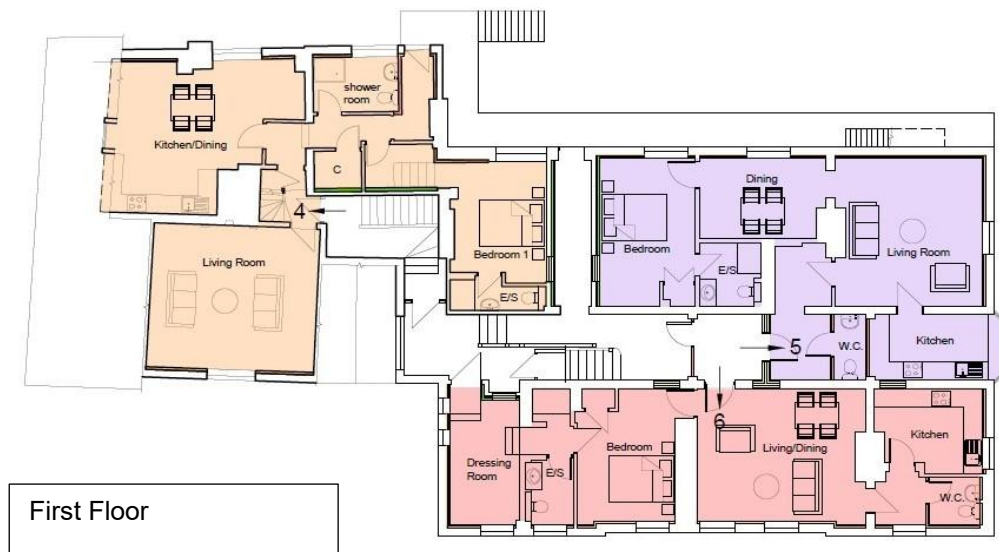


Rear



Appendix C (continued)

Plan C.3: Proposed Floor Plans



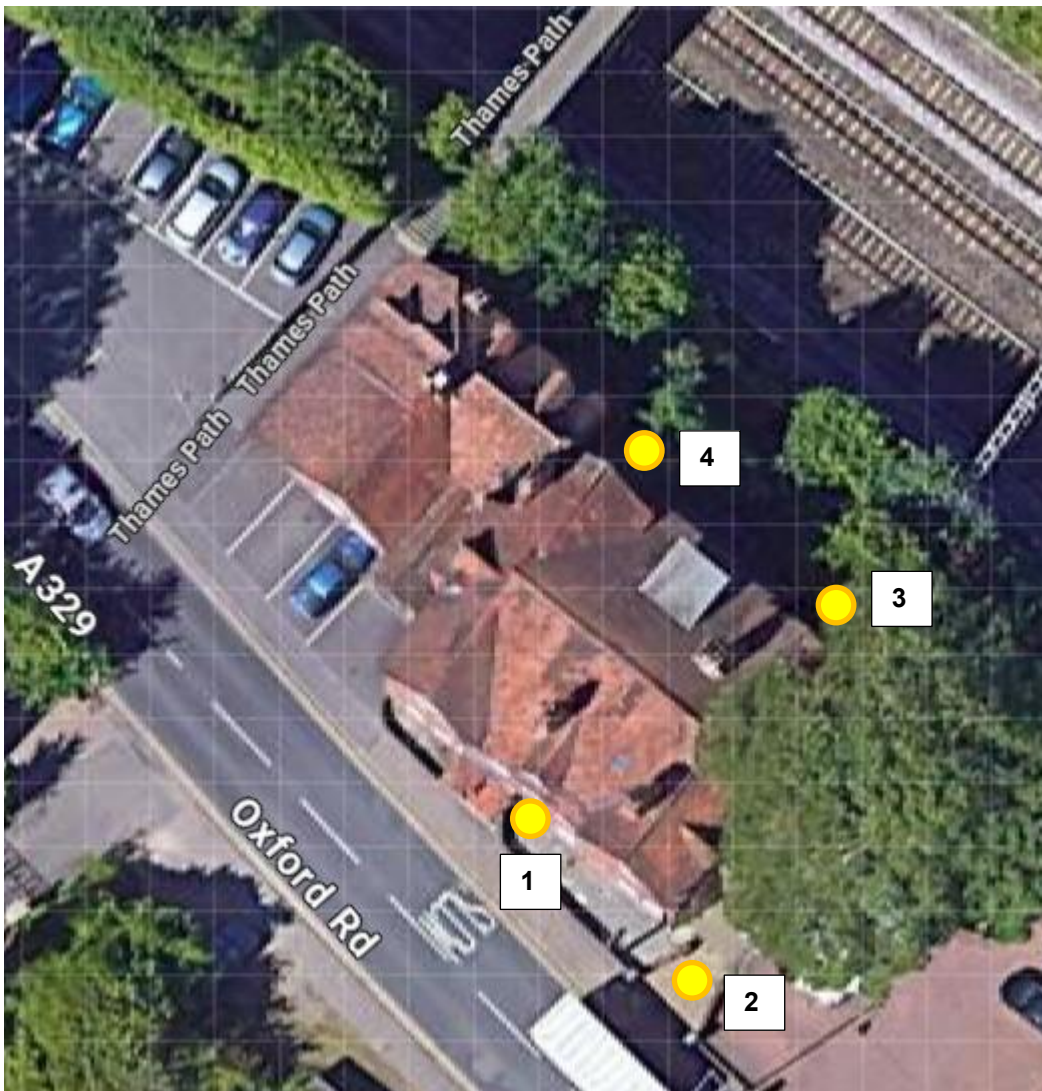
Appendix D – Noise Survey Details and Results

Dates of Surveys

Daytime: 06 February 2025, 12:00 to 14:30

Night-time: 07 February 2025, 05:00 to 07:00

Locations of Surveys



Location	Description
1	1m from front of property (façade) – 1.5m height
2	Front of property (freefield) – 1.5m height
3	Rear/side of property (façade) – 1.5m & 4m height
4	Rear/centre of property (façade) – 1.5m & 4m height

Appendix D (continued)

Survey carried out by

Jayan Mistry

Weather Conditions

Day 06 Feb 25, 12:00 to 14:30	Sunny, damp, clear skies, 2 Oktas, 0-2 m/s northeasterly wind, 8°C
Night 07 Feb 25, 05:00 to 07:00	Cloudy, gusty, 7 Oktas, 3-5 m/s northeasterly wind, 3°C

Instrumentation and Calibration

The instrumentation used (including serial number in brackets) is tabulated below. The sensitivities of the meters were verified on site immediately before and after the survey using the field calibrators. The measured calibration levels were as follows:

Instrumentation	Start Cal	End Cal
Daytime 06 February 2025		
Norsonic 140 Sound Level Meter (1404819)	113.7 dB(A)	113.7 dB(A)
Norsonic 1251 Calibrator (33321)		
Night-time (early morning) 07 February 2025		
Norsonic 140 Sound Level Meter (1404819)	113.8 dB(A)	113.9 dB(A)
Norsonic 1251 Calibrator (33321)		

The meters and calibrators are tested monthly against Norsonic Calibrators, type 1253 (serial number 22906) and type 1256 (serial number 125626100) both with UKAS approved laboratory certificates of calibration. In addition, the meters and calibrators undergo traceable calibration at an external laboratory every two years.

Appendix D (continued)

Survey Details

For both the daytime and night-time (early morning) surveys, a sound level meter was used at the front of the building to monitor road traffic noise at Location 1, with the microphone at a height of around 1.5m above local ground. Sample measurements were also obtained at the rear to monitor rail traffic noise at the remaining locations with the microphone at heights of 1.5m and 4m above local ground. Sample measurements were generally 15 minutes in duration. Suitable windshields were used throughout.

Results and Observations

Table D.1: Daytime noise measurements 06 February 2025

Location	Height	Start Time	Results dB (T = 15 minutes)				Comments / Observations
			L _{Aeq,T}	L _{Amax,f}	L _{A10,T}	L _{A90,T}	
1 (façade)	1.5m	12:00	73	84	78	57	Frequent local road traffic noise. Train movement in lulls of road traffic. Wind in trees. Overhead aircraft movements. In lulls of road traffic, tonal hiss from substation across road. Occasional pedestrian / cyclist walking by.
		12:15	74	85	78	59	
		12:30	73	87	78	56	
		12:45	74	85	78	55	
		13:00	73	85	78	57	
		13:15	74	85	78	57	
		13:30	73	86	78	55	
		13:45	74	96	78	56	
		14:00	73	87	78	57	
		14:15	73	87	78	56	
		Average	73	-	-	-	This is a façade level, the equivalent freefield level is 71 dB L_{Aeq,T}
2 (freefield)	1.5m	12:26	71	82	76	58	Frequent local road traffic noise. Train movement in lulls of road traffic. Wind in trees. Overhead aircraft movements. In lulls of road traffic, tonal hiss from substation across road.
3 (façade)	1.5m	12:48	69	86	59	44	Frequent rail traffic noise. Wind in trees. Overhead aircraft movements. Frequent duck / goose calls.
4 (façade)	1.5m	13:06	74	93	60	44	Wind in trees. Birdsong. Frequent rail traffic noise. Some residential noises, maintenance worker drilling.
3 (façade)	4m	13:35	68	87	57	46	Frequent rail traffic noise. Overhead aircraft movements. Birdsong.
4 (façade)	4m	13:58	70	87	61	46	Frequent rail traffic noise. Overhead aircraft movements. Birdsong.

Appendix D (continued)

Table D.2: Night-time (early morning) noise measurements 07 February 2025

Location	Height	Start Time	Results dB (T = 15 minutes)				Comments / Observations
			L _{Aeq,T}	L _{Amax,f}	L _{A10,T}	L _{A90,T}	
1 (façade)	1.5m	05:00	65	88	63	43	Wind in trees. Tonal hiss from substation. Occasional local road traffic noise.
		05:15	68	87	68	46	
		05:30	67	85	70	48	
		05:45	71	90	74	49	
		06:00	69	85	73	51	
		06:15	71	88	76	52	
		06:30	72	88	77	54	
		06:45	72	87	77	55	
		05:00-07:00	70	-	-	-	2 hour façade level
2 (freefield)	1.5m	05:04	62	87	59	45	Wind in trees. Tonal hiss from substation. Occasional local road traffic noise.
3 (façade)	1.5m	05:21	54	72	54	46	Wind in trees. Overhead Aircraft. No train passes.
4 (façade)	1.5m	05:44	73	91	56	44	Wind in trees. Overhead Aircraft. 3 train passes 05:59
4 (façade)	4m	06:11	69	87	61	48	Frequent road traffic noise. Overhead Aircraft. Wind in trees (gusty). Passenger train east 06:17.

Appendix E – Vibration Survey Details and Results

Dates of Surveys

Daytime: 06 February 2025, 12:10 to 14:30

Night-time: 07 February 2025, 05:00 to 06:52

Locations of Survey

Vibration measurements were undertaken at the rear of the property to determine the magnitude of vibration from train movements. The vibration meter was located adjacent to the rear of the building at Location 4 (see the plan in Appendix D).

Survey carried out by

Jayan Mistry

Vibration Instrumentation

Vibrocock 9000 Seismograph (S/N 002088)

Note that the Vibrock seismograph was hired from Vibrock for this survey.

Results

Table E.1: Vibration measurements 06 and 07 February 2025

	VDV m/s ^{1.75}		
	X	Y	Z
Daytime			
12:11-13:00	0.004	0.007	0.021
13:00-14:00	0.004	0.005	0.022
14:00-14:29	0.003	0.005	0.020
Night-time			
05:00-06:00	0.004	0.005	0.016
06:00-06:52	0.005	0.004	0.016

Train movements were frequent throughout the survey, including freight train and passenger trains, both easterly and westerly directions. There was a period between approximately 5am and 5:30am on 7th February 2025 where no train movements occurred.

Appendix F – Road Traffic Noise Analysis

Daytime Road Traffic Noise

Road traffic noise measurements at Location 1 were taken generally in accordance with the shortened measurement procedure detailed in “Calculation of Road Traffic Noise” (CRTN) Department of Transport 1988. From CRTN: $L_{A10,18h} = L_{A10,3h} - 1 \text{ dB}$ where $L_{A10,3h}$ is the arithmetic mean of values measured in three consecutive hours.

Table F1: Daytime Traffic Noise (Location 1)

Start time	dB $L_{A10,15min}$
12:00	78
13:00	78
14:00	78
$L_{A10,3h}$	78
$L_{A10,18h}$ (façade)	77

Note that the levels measured at Location 1 are façade levels. The equivalent freefield level is **74 dB $L_{A10,18h}$** .

Road traffic noise can be presented in terms of $L_{Aeq,16h}$ using approximations based on equations set out in the Defra document “Method for Converting the UK Road Traffic Noise Index $L_{A10,18h}$ to the EU Noise Indices for Road Noise Mapping” dated January 2006.

The calculated daytime level is **71 dB $L_{Aeq,16h}$** .

Night-time Road Traffic Noise (Bird & Fillery)

From Bird & Fillery (“Investigation into the Relationship between Long and Short Measurements for the Assessment of Road Traffic Noise”, S Bird & M Fillery, Institute of Acoustics 2002 Autumn Conference) it is possible to estimate the 8-hour night-time noise level from a shortened 2-hour measurement. The relationship is: $L_{Aeq,8h}$ (23:00 – 07:00 hours) = $L_{Aeq,2h}$ (05:00 - 07:00 hours) – 3.5 dB ($\pm 2 \text{ dB}$ for 95% confidence limit)

The results from the early morning survey were as follows:

Table F2: Night-time Traffic Noise (Location 1)

Measured dB $L_{Aeq,2h}$	Calculated dB $L_{Aeq,8h}$	Estimated Night-time Traffic Noise Level*	
		façade	freefield
69.8	$69.8 - 3.5 = 66.3$	66 dB $L_{Aeq,8h}$	64 dB $L_{Aeq,8h}$
* $\pm 2 \text{ dB}$ for 95% confidence limit			

Appendix F (continued)

Night-time Road Traffic Noise (Bird & Fillery)

From Bird & Fillery ("Investigation into the Relationship between Long and Short Measurements for the Assessment of Road Traffic Noise", S Bird & M Fillery, Institute of Acoustics 2002 Autumn Conference) it is possible to estimate the 8-hour night-time noise level from a shortened 2-hour measurement. The relationship is: $L_{Aeq,8h} (23:00 - 07:00 \text{ hours}) = L_{Aeq,2h} (05:00 - 07:00 \text{ hours}) - 3.5 \text{ dB}$ ($\pm 2 \text{ dB}$ for 95% confidence limit)

The results from the early morning survey on 21 August 2024 were as follows:

Table F3: Night-time Traffic Noise (Location 4)

Measured dB $L_{Aeq,2h}$	Calculated dB $L_{Aeq,8h}$	Estimated Night-time Traffic Noise Level
54.3	$54.3 - 3.5 = 50.8$	51 dB $L_{Aeq,8h}$

Location 4 was around 36m to the centre of Towcester Road. Allowing for corrections due to distance and screening attenuation from the boundary fence, the estimated noise levels at the new dwelling (Locations 1 and 2) would be:

Location 1: 59 dB $L_{Aeq,8h}$ (approximately 2.5m from boundary nearest Towcester Road)

Location 2: 56 dB $L_{Aeq,8h}$ (approximately 5m from boundary nearest Towcester Road)

Appendix G – Train Movement Data from RealTime Trains

Table G1: Typical weekday on Monday 3rd February 2025

Hour Starting	Number of Passing Train Movements		
	Passenger	Freight	Total
0	4	1	5
1	0	1	1
2	0	1	1
3	2	0	2
4	2	1	3
5	6	1	7
6	10	2	12
7	22	1	23
8	20	1	21
9	23	1	24
10	23	3	26
11	21	3	24
12	21	2	23
13	19	1	20
14	21	3	24
15	25	2	27
16	20	3	23
17	20	1	21
18	21	1	22
19	21	4	25
20	19	2	21
21	16	1	17
22	14	1	15
23	8	4	12
Total Day	326	30	356
Total Night	32	11	43