

MAY 8, 2024



BS8233 & BS6472 ASSESSMENT OF BRYN YR EOS CHAPEL, WHITEHURST, CHIRK, WREXHAM

JAMES FLITTON

E2 HOUSE,
41 Business Park,
S Park Way,
Wakefield
WF2 0XJ

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1.0 Introduction

- 1.01 E2 Consultants have been commissioned to undertake a noise and vibration impact survey and assessment for Bryn yr Eos Chapel, Whitehurst, Chirk, Wrexham
- 1.02 The methodology used for this assessment will be BS8233 as this is a new development within the designated area, and BS6472-2 for the vibration aspect of the assessment.
- 1.03 The report will also issue recommendations of acoustic performance of glazing and, if required, ventilation proposals in order for the future dwelling to meet all necessary criteria.

2.0 Development Description

- 2.0.1 The proposed dwelling is located on the existing plot at Bryn yr Eos Chapel, Whitehurst, Chirk, Wrexham. The proposed dwelling is the conversion of the existing Chapel into 2 units with driveway and parking.
- 2.0.2 The development is situated close to the main rail line heading out of Wrexham south towards Shrewsbury.
- 2.0.3 The main noise sources likely to disrupt the proposed building are from the rail line to the West of the site. The road noise in the area is deemed to be too far away to have any significant adverse impact on the proposed development. The rail line is also seen as a possible source of vibration that may need to be addressed.
- 2.0.4 With the above sources in mind the monitoring took place close to the rail line on the West boundary of the site for the noise and then on the West boundary of the existing Chapel building for the vibration measurements.

2.1 Locations of Monitors

- 2.1.1 A Type 1 sound level meter and triaxial vibration meter were installed in the area that is likely to be the garden for the proposed development and Western Boundary facing the rail line. This allowed calculations to be made from likely screening objects from the proposed development itself to the other facades, and the noise impact for outdoor spaces in accordance with BS8233.
- 2.1.2 Figure 1 & 2 shows the area where the monitor was installed
- 2.1.3 All locations are displayed on site map in figure 3

Figure 1 - Noise



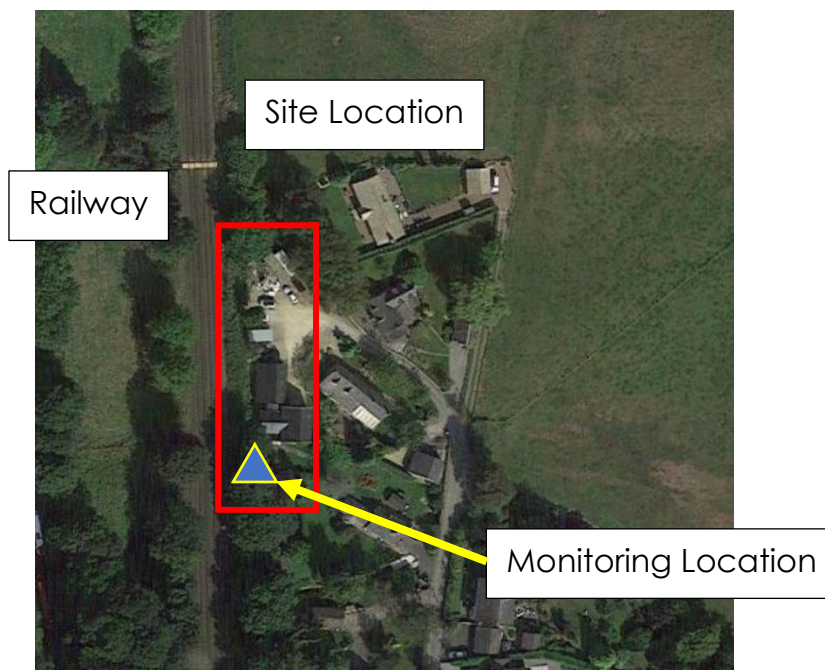
Figure 2 - Vibration



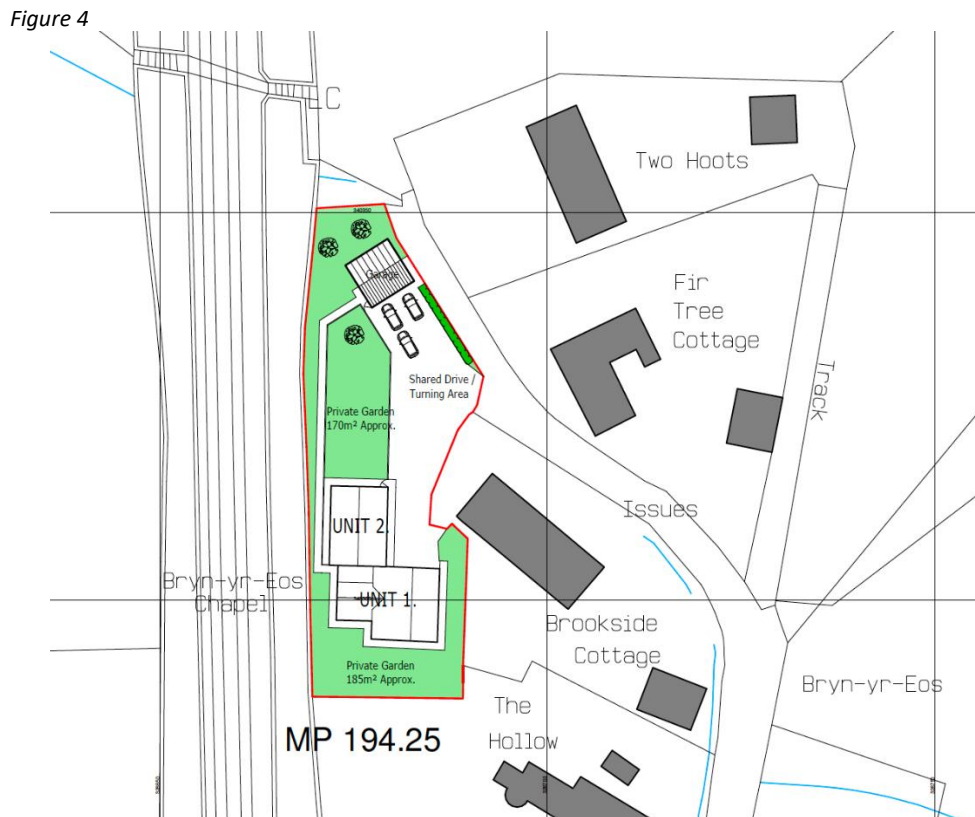
- 2.1.4 Noise measurements were made in 15 minute periods, on 1 second averaging, to allow for the removal of anomalies and increased accuracy. The data was averaged into $L_{Aeq16hr}$ daytime and L_{Aeq8hr} night-time with data also recorded for L_{AMax} in both day and night periods for the BS8233 assessment.
- 2.1.5 The monitoring was conducted using 1 x Type 1 NTI XL2 sound level meter, outdoor case with batteries and outdoor microphone protection, and 1 x Sigicom C22 PPV & VDV triaxial vibration monitor.
- 2.2.6 The measurements were taken by a fully qualified engineer with AMIOA status with the institute of Acoustics.
- 2.2.7 All measurements were taken after a field calibration was undertaken to ensure accuracy and repeatability of measurements. Calibration checks were performed post measurement as well to ensure accuracy of data.
- 2.2.8 Further data such as wind speed, wind direction, rainfall intensity, temperature and cloud cover were all recorded at the beginning and end of the assessment at the monitoring location.
- 2.2.9 Any anomalies (such as noise by the engineer during setup and collection of the kit) were removed from the survey for a true reflection of the ambient levels in the vicinity. This was done by recording audio throughout the survey at each location and listening back through the files during the analysis process to confirm what was recorded manually during the survey.
- 2.2.10 Care was taken to inform any residents in the area that audio recording was taking place.

2.2 Plan Views of Site with Designated Work Areas

Figure 3



2.3 Proposed Layout



3.0 Noise Assessment Criteria

- 3.0.1 The Planning Policy Wales sets out the Government's economic, environmental and social planning policies. Section 3.22 states;

"Planning authorities should develop and maintain places that support healthy, active lifestyles across all age and socio-economic groups, recognising that investment in walking and cycling infrastructure can be an effective preventative measure which reduces financial pressures on public services in the longer term. The way a development is laid out and arranged can influence people's behaviours and decisions and can provide effective mitigation against air and noise pollution."

- 3.0.2 The guidance also sees traffic consideration and management as key when it comes to noise impact assessments. Section 4.1.45 states

"Local authorities must adopt an integrated approach to traffic management. They should consider how different measures can complement one another and contribute to the achievement of wider planning and transport objectives, implementing the Active Travel Act and reducing exposure to air and noise"

pollution, taking into account the needs of the disabled and less mobile sections of the community.”

- 3.0.3 Section 6 of the document also tackles the likely social and well-being impacts of the preservation of ‘distinctive and natural places’. Section 6.7.1 refers to the need to protect the soundscape of areas;

“Clean air and an appropriate soundscape, contribute to a positive experience of place as well as being necessary for public health, amenity and well-being. They are indicators of local environmental quality and integral qualities of place which should be protected through preventative or proactive action through the planning system. Conversely, air, noise and light pollution can have negative effects on people, biodiversity and the resilience of ecosystems and should be reduced as far as possible.”

This is then continued in reference to noise in section 6.7.4;

“The planning system should maximise its contribution to achieving the well-being goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution alongside action to tackle high pollution hotspots. In doing so, it should consider the long-term effects of current and predicted levels of air and noise pollution on individuals, society and the environment and identify and pursue any opportunities to reduce, or at least, minimise population exposure to air and noise pollution, and improve soundscapes, where it is practical and feasible to do so.”

- 3.0.4. It is possible to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:
- The effect may be determined by reference to guideline noise values. British Standard (BS) 8233:2014 and World Health Organisation (WHO) “Guidelines for Community Noise” contain such guidelines.
 - Another method is to compare the resultant noise level against the background noise level (L_{A90}) of the area. This is the method employed by BS 4142:2014 to determine the likelihood of complaint from noise of an industrial nature. It is best suited to the assessment of steady or pseudo-steady noise.
- 3.0.5 British Standard 8233:2014 is principally intended to assist in the design of new dwellings; however, the Standard does state that it may be used in the assessment of noise from new sources being brought to existing dwellings.
- 3.0.6 The WHO guideline values are appropriate to what are termed “critical health effects”. This means that the limits are at the lowest noise level that would result in any psychological or physiological effect.

The WHO/BS 8233 guideline noise values are summarised in the following table:

Table 1

Guidance Document	L _{AeqT}	L _{AMax}	Outcome
World Health Organisation "Community Noise 2000"	55dB		Serious annoyance, daytime and evening. (Continuous noise, outdoor living areas)
	50dB		Moderate annoyance, daytime and evening. (Continuous noise, outdoor living areas).
	35dB		Moderate annoyance, daytime and evening. (Continuous noise, dwellings, indoors)
	30dB		Sleep disturbance, night-time (indoors)
		60dB	Sleep disturbance, windows open at night. (Noise peaks outside bedrooms, external level).
		45dB	Sleep disturbance at night (Noise peaks inside bedrooms, internal level)
BS 8233:2014 "Sound Insulation and noise reduction for buildings"	55dB		Upper limit for external steady noise. (gardens and patios).
	50dB		Desirable limit for external steady noise. (gardens and patios).
	L _{Aeq} 16 hours = 35 dB		Resting, living room day. (Internal – steady noise)
	L _{Aeq} 16 hours = 40 dB		Dining, dining room day. (Internal – steady noise)
	L _{Aeq} 16 hour = 35 dB		Sleeping, bedroom day (Internal – steady noise)
	L _{Aeq} 8 hours = 30 dB		Sleeping, bedroom day (Internal – steady noise)

3.0.7 For L_{AeqT} criteria the time base (T) given in the documents is 16 hours for daytime limits and 8 hours for night time limits. All surveys are conducted on 1 hour daytime and 15 minute night values – based on 1 second readings on a Type 1 sound level meter. The readings are taken every 5 mins for noise to allow the elimination of erroneous data if required.

- 3.0.8 The WHO guidelines are also concerned with the $L_{A\text{Max}}$ for night-time sleep disturbance. The guideline states:

“For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB $L_{A\text{Fmax}}$ more than 10-15 times per night”

- 3.0.9 On this basis, for the purpose of assessing night-time $L_{A\text{Fmax}}$ noise events, it is considered appropriate to adopt the 10th highest $L_{A\text{Fmax}}$ noise event occurring in a typical night-time (23:00 – 07:00) period.
- 3.0.10 Audio recordings are taken throughout the measurements to allow for further assessments on high levels. Listening to the audio and performing tonal analysis will allow anomalies to be removed from the data, if required.

3.1 Standards and Guidelines (Vibration)

- 3.1.1 BS6472-part 1 2008 is the Guide to evaluation of human exposure to vibration in buildings. This is an effective assessment procedure for the likelihood of annoyance from vibration. The standard says:

“Whether at home or at work, the vibration tolerance of people varies over a wide range. As well as a large range of individual vibration sensitivity over the population, specific values depend on social and cultural factors, psychological attitudes and the expected degree of intrusion.

Building vibrations as they affect people can be classified usefully according to a combination of descriptions. The time history of the vibration input to the subject can be:

- *continuous;*
- *intermittent; or*
- *occasional”*

- 3.1.2 Impulsive vibration levels are seen as the most likely to cause issues and annoyance to property dwellers through ‘startling’. For this reason the standard employs the vibration dose summation procedure. The standard explains this procedure as;

“allows comparison of all types of vibration exposure on a common basis, i.e. the severity of impulsive and/or intermittent vibration is evaluated on a basis applicable equally to continuous vibration.”

- 3.1.3 Train pass-by measurements are typically done using this Vibration Dose Value measurement technique (VDV) as there is a build-up of energy to a peak.
- 3.1.4 Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings.

Table 2

Place and Time	Low probability of adverse comment m.s.p1.75 1)	Adverse comment possible m.s.p1.75	Adverse comment probable m.s.p1.75 2)
Residential buildings 16 h day	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential buildings 8 h night	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

- 3.1.5 In circumstances where there is an expected level of vibration that will result in Adverse comment it is important to determine the true impact levels on human occupiers of the structures. BS6472-1:2008 provides the following recommendations for vibration measurement:

“Vibration should normally be measured on the floor of the room implicated (where any complaint originates, or where the greatest adverse comment is predicted.) at or near the point of greatest weighted acceleration.”

“For external excitation (e.g. ground-borne vibration), it is likely that the response of a floor will be dominated by rigid body motion or by its lowest “dish-shaped” mode of vibration. In this case, one or two measurement points in a suitable available area, preferably in the central part within one-third and two-thirds of the width/length, are sufficient to determine the vibration response of the floor to this form of excitation.”

- 3.1.6 Where vibration measurement is not an option within the building (i.e. access issues or due to the fact the structure does not exist) measurements are required at the most reasonable locations and the impact on the proposed structure calculated based on the materials to be used in construction

3.2 TAN 11: October 1997

- 3.2.1 The Technical Advise Note (Wales) 11, Noise – October 1997 provides some further criteria in relation to noise criteria categories for Noise-sensitive developments. These categories have been derived to assist local planning authorities in their consideration of planning applications. These categories are part of Annex A of the guidance document and are displayed in the tables below.

3.2.2 “Local planning authorities should consider whether proposals for new noise-sensitive development would be incompatible with existing activities, taking into account the likely level of noise exposure at the time of the application and any increase that may reasonably be expected in the foreseeable future. Such development should not normally be permitted in areas which are, or are expected to become, subject to unacceptably high levels of noise and should not normally be permitted where high levels of noise will continue throughout the night.”

Table 2: RECOMMENDED NOISE EXPOSURE CATEGORIES FOR NEW DWELLINGS NEAR EXISTING NOISE SOURCES					
Noise Levels ⁽¹⁾ corresponding to the Noise Exposure Categories for New Dwellings L _{Aeq,T} dB					
Noise Source		Noise Exposure Category			
		A	B	C	D
road traffic	0700-2300	<55	55-63	63-72	>72
	2300-0700 ⁽²⁾	<45	45-57	57-66	>66
rail traffic	0700-2300	<55	55-66	66-74	>74
	2300-0700 ⁽²⁾	<45	45-59	59-66	>66

TABLE 1: NOISE EXPOSURE CATEGORIES	
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.
B	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection.
C	Planning permission should not normally be granted. Where it is considered that permission should be given, for example, because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

3.3 Chosen Criteria

3.3.1 Based on the proposed development for a new dwelling, BS8233 was selected for this assessment. BS6472 will also be looked at due to the close proximity of the rail line to the rear of the proposed development. The final process will include the TAN assessment.

4.0 Results

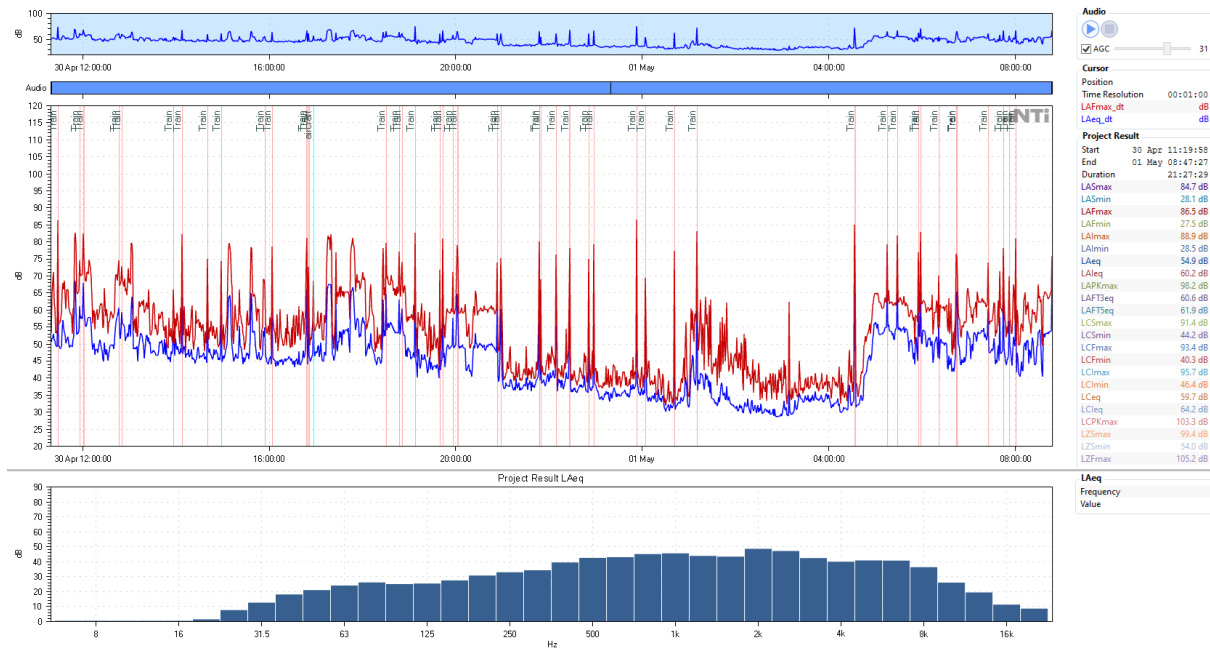
4.1 Noise Assessment 11.19am 30/04/24 – 08.47am 01/05/24

Table 3

Location	L _{Aeq} _16hr	L _{Aeq} _8hr	L _{Amax} (10th highest)
Day	54.5dBA		
Night		42.6dBA	69.3dBA

4.1.1 Comments: Mainly train pass-by noise. Other peaks from regular birdsong.

Figure 4



Day/Time	Cloud Cover	Temperature (Celcius)	Presence of fog/snow/ice	Wind Speed (m/s)	Wind Direction
Installation	3	11	No	0.2	NW
Collection	1	15	No	1.4	W

4.2 Comparison of Results to BS8233

Table 4

Location	L _{AeqT} (16hr Day & 8hr Night)	L _{AMax}	BS8233 & WHO Internal noise	BS8233 & WHO External Noise	Difference to L _{Aeq} (internal/external) limit	Difference to Max (internal/external)
Day (0700-2300)	55dBA		35dBA	55dBA	(+20dBA/ +0dBA)	-
Night (2300-0700)	43dBA	69dBA (10 th Highest)	30dBA (45dBA L _{AMax})	(60dBA L _{AMax})	(+13dBA)	(+24dBA)

5.0 Observations and Further Discussions

- 5.0.1 The measured L_{Aeq} values for both the day and the night periods are shown in table 4. The day period is 20dBA above the limit for indoor noise levels and at the limit for outdoor levels. With the addition of a standard screen or fence along the rail line this would mean that the outdoor levels meet the BS8233:2014 criteria.
- 5.0.2 The night value is 13dBA above the recommended value for internal noise to prevent sleep disturbance. BS8233 assumes that a standard double-glazed window will provide up to 15dB reduction when open. This would mean that any modern double-glazed window in the building can be left open with a low chance of sleep disturbance being had by the inhabitants of the proposed dwellings during the night period.
- 5.0.3 The L_{AMax} value to prevent the likelihood of sleep disturbance is set at 60dBA external and 45dBA internal. Based on the highest value from the tenth-highest daily value measured during the week the reading for L_{AMax} night was 69dBA. This value is 24dBA above the limit for internal L_{AMax} values which changes the recommendation regarding opening windows for ventilation in the point above. There should be acoustic vents fitted to the property, both to the front and rear, as the main noise source during the night period is occasional trains. The infrequent nature of the noise source would mean that the use of acoustic vents would be preferable as opposed to relying on the opening of windows to control ventilation in accordance with Document O.
- 5.0.5 The guide figures from table 4 can be used in the BS8233:2014 Annex G calculation methodology to ascertain the correct glazing and ventilation specification to be used in the property.

5.1 BS8233 Calculations

5.1.1

Time Period	Overall dBA	Octave Band Frequency (Hz)					
		125	250	500	1000	2000	4000
LaMax Night	69.3	57	62	65	63	59	57

Room Details	(m)	Bedroom 1, Unit 1
Height	2.2	
Width	3	
Length	4	
Sample Room Volume	26.4	
Sample Room Surface Area	30.8	

Element	Area/No.of	Element Specification
External Wall	6.6	Traditional solid 9" brick
Windows	1.5	4 mm / (6 - 16 mm) / 4 mm Pilkington
Ceiling	12	
Ventilation	1	Standard non-acoustic trickle ventilator typically $\geq D_{n,e,w}$ 30dB

Element SRI

Element	Area/No.of	Octave Band Frequency (Hz)						Single Figure Rating
		125	250	500	1000	2000	4000	
Walls	4	39	44	51	58	63	68	50
Windows	1	21	17	25	35	37	31	29
Ceiling	1	28	34	40	45	49	52	
Ventilation ($D_{n,e}$)	1	30	30	30	30	30	28	30

Overall Sound Reduction

Calculated Internal SPL	Overall	Octave Band Frequency (Hz)					
		125	250	500	1000	2000	4000
Leq,2	41.0	21.5	33.8	36.7	34.3	30.9	31.3
Limit	45						
Value under limit	4.0						

6.0 Glazing, Structural and Ventilation Recommendations

6.1 External Walls

6.1.1 External walls of the proposed building are understood to be traditional 9" brick:

Table 5

Description	Octave Band Centre Frequency (Hz)					
	Sound Reduction Index R dB					
	125	250	500	1k	2k	4k
Traditional solid 9" brick	39	44	51	58	63	68

6.2 Glazing

6.2.1 Suitable sound insulation performance of all windows and patio doors of the development may be achieved with the specification shown in table 6 below.

Table 6

Description	Octave Band Centre Frequency (Hz) Sound Reduction Index R dB						R_w (C; Ctr)
	125	250	500	1k	2k	4k	
4 mm (6-16) mm/ 4mm Pilkington	21	17	25	35	37	31	29 (-1,-4)

6.3 Ventilation

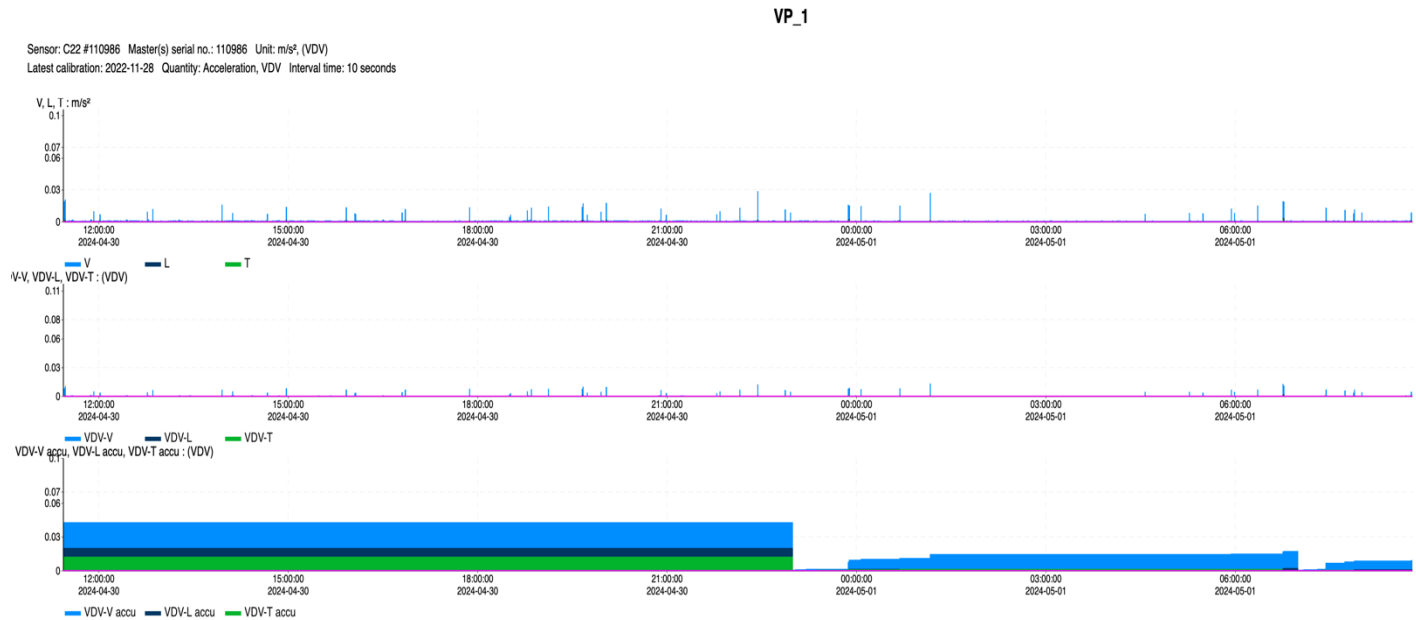
6.3.1 It is anticipated that a ventilation system will be needed to be incorporated into the scheme design, such that residents of the properties are able to have background ventilation without necessarily needing to open windows. Table 7 shows the specification for an example suitable product.

Table 7

Description	Octave Band Centre Frequency (Hz) Sound Reduction Index $D_{n,e}$ dB					
	125	250	500	1k	2k	4k
Standard non-acoustic trickle ventilator typically $\geq D_{n,e,w}$ 30dB	30	30	30	30	30	28

7.0 Vibration Data

Figure 7



Location	Date/Time	VDV Value (m/s ^{1.75})	Peak Event (m/s ^{1.75})
Railway Boundary	11.26am 30/04/24 – 08.47am 01/05/24	0.0123	0.0130

7.1 Vibration prediction values

- 7.1.1 The VDV values measured during the assessment are well below those, described in table 2, from BS6472-1:2008 as having 'low probability of adverse comment' so therefore full models based on the proposed structure construction are not considered necessary.
- 7.1.2 As a check the following procedure for the train pass-by in isolated events was performed: This is where the vibration conditions are constant or repeated regularly, only one representative sample, of duration τ seconds, needs to be measured. If the vibration dose value determined is $VDV_{b/d,\tau}$ then the total vibration dose value for the day, $VDV_{b/d,day}$ will be given by;

$$VDV_{b/d,day} = \left(\frac{t_{day}}{t_{\tau}} \right)^{0.25} \times VDV_{b/d,\tau}$$

Based on the assessment there are an average of 2 trains per hour, resulting in maximum 32 trains over a 16hr day period (28 in the assessment for just under 24hrs) and $VDV_b = 0.0075$

Therefore:

$$VDV_{b/d,day} = 32^{0.12} \times 0.0130$$

$$VDV_{b/d,day} = 0.0197 \text{ (m/s}^{1.75}\text{)}$$

- 7.1.3 According to Table 2 there is likely to be low probability of adverse comment from the rail route adjacent to the proposed development. There were 13 events through the night period, with none from 01:15am – 04:30am. None of these caused any significant vibration levels during the pass-by of both passenger and goods trains.

8.0 Categorisation to TAN 11: Oct 1997

- 8.0.1 The daytime levels measured at the location of the potential development produced L_{Aeq} values of 54.5dBA. This would mean that, in accordance with the Noise Exposure Categories (NEC) provided by the TAN guidelines, the development would be placed into category A for exposure to both road & rail noise. This means that noise should be considered a defining factor for the planning permission to be granted/refused. The addition of the proposed fencing along the boundary with the railway line will reduce this figure further below the threshold for Category A.
- 8.0.2 The glazing and ventilation strategy proposed in section 6 would provide more than sufficient mitigation measures to be considered acceptable under the Tan guidelines. This has been created by the specified glazing, the trickle vents and would also be further attenuated by the erection of a garden fence to reduce levels to the rear of the building. The creation of the property and fencing itself will also further screen the garden/outdoor space area to the rear and bring this area well within the guideline values of 55dBA as an enclosed space. The gardens to the front of the property are not expected to be used as outdoor leisure spaces although they will also meet the criteria for noise in outdoor areas.
- 8.0.3 The night values for the external façade of the proposed dwelling were measured as L_{Aeq} 42.6dBA. This would also put the proposed development into the Category a NEC with the same comments as the daytime measured values. Existing and proposed mitigation for the glazing and ventilation strategy and fencing to the rear and sides would again be considered sufficient measures to reduce levels further below the Category A criteria.

- 8.0.4 The additional criteria for night-time noise classification is the $L_{A_{Max}}$ should not 'regularly exceed 82dB $L_{A_{Max}}$ several times in any hour'. There were 4 spikes through the entire night period (11pm – 7am), that exceeded the 82dB $L_{A_{Max}}$ limit. This was spread evenly through the night with the trains hitting these levels at 23.53pm, 01.11am, 04.34am and 05.59am. This has therefore been considered to not be enough to meet this criteria.

9.0 Conclusion

- 9.0.1 If the recommendations of this report are followed the proposed dwelling should produce a residence that does not produce adverse comment on the surrounding noise sources. The report has suggested more extreme mitigation measures than would have been accepted by just following the standards, but the nature and frequency of the noise sources (particularly during the daytime period) meant that they are required to produce a good quality of life for any future inhabitants.
- 9.0.2 The outdoor living spaces will not meet the criteria set in BS8233:2014 for outdoor living spaces due to the aircraft noise. Adding a solid acoustic fence will reduce the noise impact from the trainline and at least improve the outdoor living area. This is seen as the least desirable noise source in the area.
- 9.0.3 The resulting L_{Aeq} daytime and night-time levels do not fall into the council's limits of between 66 and 72 L_{Aeq} or night-time levels between 60 and 66 L_{Aeq} and therefore planning should not be refused on this basis.

Appendix A – Acoustic Terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10}(s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A-weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. Generally used to describe background noise level.

Appendix B - Noise Survey Instrumentation

Type	Manufacturer	Model	Serial Number	Last Cal	Cal Due
SLM	NTi	XL2-TA	A2A-18475-E0	19/10/2022	18/10/2024
Pre-amp	NTi	MA220	9378	19/10/2022	18/10/2024
Microphone	NTi	MC230A	A19093	19/10/2022	18/10/2024
Calibrator	NTi	CAL200	19829	20/11/2023	19/11/2024

Appendix C – Weather Conditions Chart Used

(Blank Version)

Weather Conditions				
Measurement Location	Date/Time	Description	Beginning of Survey	End of Survey
		Temperature:		
Cloud Cover Symbol Scale in oktas (eighths) 0 Sky completely clear 1 2 3 4 Sky half cloudy 5 6 7 8 Sky completely cloudy (9) Sky obstructed from view		Precipitation:		
		Cloud cover (oktas - see guide)		
		Presence of fog/snow/ice		
		Presence of damp roads/wet ground		
		Wind Speed (m/s)		
		Wind Direction		
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)		

Appendix D – BS8233:Annex G Calcs

		Octave Band Frequency (Hz)					
		125	250	500	1000	2000	4000
Leq,ff	A	57	62	65	63	59	57
Dn,e		30	30	30	30	30	28
$\frac{A_o}{S} 10^{\frac{-Dn,e}{10}}$	B	0.00054	0.00054	0.00054	0.00054	0.00054	0.00085
Rwi		21	17	25	35	37	31
$\frac{S_{wi}}{Sf} 10^{\frac{-Rwi}{10}}$	C	0.00181	0.00453	0.00072	0.00007	0.00005	0.00018
Rew		39	44	51	58	63	68
$\frac{S_{ew}}{Sf} 10^{\frac{-Rew}{10}}$	D	0.00010	0.00003	0.00001	0.00000	0.00000	0.00000
Rrr		28	34	40	45	49	52
$\frac{S_{rr}}{Sf} 10^{\frac{-Rrr}{10}}$	E	0.00288	0.00072	0.00018	0.00006	0.00002	0.00001
10log10(B+C+D+E)	F	-22.7	-22.3	-28.4	-31.8	-32.2	-29.8
A (furnished)		11	14	16	16	15	14
$\text{Log}10 \frac{S}{A}$		0.2	0.1	0.1	0.1	0.1	0.1
Leq,2	A+F+G+3	37.5	42.8	39.7	34.3	29.9	30.3
A-weighting		-16	-9	-3	0	1	1
LAeq,2		21.5	33.8	36.7	34.3	30.9	31.3
Total	41.0						