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Noise Impact Report

Project Details	
Client	W. Milligan & Sons
Client Address	6 Market Street Millom LA18 4AH
Site Address	6 Market Street Millom LA18 4AH
Reference	22271E

Quality Assurance	
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Revision History

Version	Date	Editor	Notes
V1	10/12/2024	Phil Lodge	First issue

Contents

1 Executive Summary

A noise assessment has been conducted for a proposed conversion of an existing car showroom into a gymnasium at 6 Market Street, Millom LA18 4AH.

The assessment is to be submitted as part of a planning application for the development site to Cumberland Council in response to a condition.

The assessment considers the impact on potentially noise sensitive neighbouring residential premises in comparison with BS 4142: 2014, BS 8233: 2014 and Cumberland Council Policy.

Assessment of noise levels due to typical internal activity and vehicle movement indicates no adverse impact on the amenity of the local community according to BS 4142: 2014 and Cumberland Council noise criteria, provided the recommended mitigation measures are implemented.

2 Introduction

W. Milligan & Sons has instructed Spratt and Hamer Limited to undertake an environmental noise survey in order to assess the impact of the proposed gym, which may have an impact on future residents of the proposed development.

The proposed development site is an existing car showroom. It is proposed to convert the showroom into a gymnasium with a focus on the use of free weights and cardio activities.

Documentation provided at the time of writing shows that the proposal is to have 33 no. exercise areas including: rowing machines, treadmills and weight resistance machines. Low level ambient music will be played during the operation of the gym with the client encouraging personal earphone / headphone use. We are informed that there is no proposal to hold gym classes. We have also been informed that there are no plans for any external mechanical plant to be installed.

The proposed operating hours are 04:00 to 23:00 from Monday to Sunday. A car park is not proposed as part of the development, however,

This report is prepared solely for W. Milligan & Sons. Spratt and Hamer Limited accepts no responsibility for its use by any third party.

This document has been prepared using the various documents listed within the appendices of this report, together with drawings, technical information and additional verbal representations made by third parties. We have not audited nor independently verified the content or accuracy of any of the documents and information provided to us in the preparation of this report.

If additional information comes to light subsequent to the production of this report, we reserve the right to revise our opinions and the conclusions reached within this report.

2.1 Noise Impact Assessment

Spratt and Hamer Limited has undertaken an environmental noise impact assessment at the above site with noise levels measured externally over a 24-hour period, consisting of a 16-hour day (07:00–23:00) and an eight-hour night (23:00–07:00). The measurements were carried out during a weekday (Thursday to Friday).

This report will state the measured noise levels and will refer to guidance relevant to the nature of this survey whilst considering Local Planning Authority guidance and conditions.

3 Assumptions, Limitations & Uncertainty

a. All suggested specifications require a good level of workmanship and for materials to be installed as the manufacture intends. Any poor workmanship may lead to weaknesses in the sound attenuation provided by the building elements.
b. It is assumed that the sound pressure levels measured on site during the environmental noise survey are typical of the site.
c. It is assumed that a minimum typical single glazing 4mm glass with R_w 29dB is currently installed.
d. The development is only proposed. As such, no measurements of noise emissions have been undertaken. It is assumed that the expected noise emissions used in the report are representative of the proposed development.
e. It is assumed that drawings and all information supplied by W. Milligan & Sons are up to date and correct.
f. It is assumed that the manufacturers technical data is up to date and correct.
g. A transport statement is not available at the time of writing; therefore, estimations of vehicle movement will be made.

4 Planning Policies, Guidance and Criteria

The planning policies and criteria listed below are taken from associated relevant guidance documents, all of which should be considered for the internal and external noise levels.

4.1 National Planning Policy

The National Planning Policy Framework (NPPF) December 2023 set out the Government's planning policies for England and how they are expected to be applied. It provides a framework within which the Local Authorities are to prepare local plans and use their planning powers to minimise the adverse impact of noise. It should contain the following in relation to noise impacts.

180. Planning policies and decisions should contribute to and enhance the natural and local environment by:

'preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.'

191. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

'*mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life*'

NPPF previously characterised noise by grading and recommending actions and different effect levels as reproduced in Table 1.

Perception	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Table 1: Noise exposure hierarchy based on likely average response.

4.2 Criteria

4.2.1 Local Planning Authority Criteria

A planning application has been submitted to the Local Authority under reference: 4/24/2304/0F1 and the Environmental Health Officer has produced the following condition to support the application:

'No development shall take place until an assessment on the potential for noise from the development affecting residential or commercial properties in the area has been submitted to and approved in writing by the Local Planning Authority. The assessment shall include noise from amplified music and speech in the premises, any plant equipment on the premises, and impact noise from gym equipment, that may breakout and break through from the premises via airborne and structural means.

Any noise mitigation measures shall be designed so that the following noise ratings are not exceeded at the centre of any residential room:

- *Daytime (07.00 – 23.00) NR15 L_{Max} for 31.5 Hz, 63 Hz and 125 Hz NR20 L_{Max} for 250 Hz – 8 kHz*
- *Night (23.00 – 07.00) NR10 L_{Max} for 31.5 Hz, 63 Hz and 125 Hz NR15 L_{Max} for 250 Hz – 8 kHz*
- *Background noise levels of the area are not exceeded by more than 5 dB.*

The noise assessment shall be carried out by a suitably qualified acoustic consultant / engineer and shall take in to account the provisions of BS 8233: 2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' and BS 4142: 2014 + A1: 2019 'Methods for Rating and Assessing Industrial and Commercial Sound'.

(...)

4.2.2 BS 4142+A1:2019 Method for rating and assessing industrial and commercial sound.

BS 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound is routinely used by local authorities in assessing noise associated with industrial and/or commercial activity.

In brief, BS 4142 provides a means of assessment whereby noise from industrial and commercial sources (the "specific sound level", $L_{Aeq,t}$) is compared with background noise ("background sound level", L_{AF90}).

The specific sound level may be corrected by a numerical penalty if it includes acoustic features that are considered to be distinctive. The corrected specific sound level is termed a "rating level" ($L_{Aeq,t}$) and is designed to reflect people's subjective reaction to noise characteristics that may be considered annoying.

The rating level is then compared to the background sound level to assess its impact. BS 4142 describes an indication of the impact according to the numerical difference between the rating level and the background sound level. This is shown below in Table 2.

Rating Level – Background Sound Level	Indication of Impact
+ 10dB	Significant Adverse Impact
+ 5dB	Adverse Impact
≤ 0dB	Low Impact

Table 2: BS 4142 Rating Level Impact

4.2.3 BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

The British Standard BS 8233:2014, Guidance on Sound Insulation and noise reduction for buildings, provides appropriate internal levels of noise within dwellings, flats and rooms in residential use when unoccupied.

Section 7.2.2 'Internal ambient noise levels in dwellings' of BS 8233: 2014 states that 'In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4'.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Table 3: Table 4 of BS 8233:2014 Indoor ambient levels for dwellings

Note 7 of section 7.7.2 states 'Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed up to 5 dB and reasonable internal conditions still achieved'.

4.3 Criteria Summary

In order to meet the requirements of Cumberland Council, the assessment and recommendations will be made in accordance with BS 8233:2014 and BS 4142+A1:2019. A summary of the conditions is set out as follows:

The following noise ratings shall not be exceeded at the centre of any residential room:

- Daytime (07:00 – 23:00) NR15 L_{AFMax} for single octave frequencies 31.5 Hz – 125 Hz and NR20 L_{AFMax} for 250 Hz – 8 KHz.
- Nighttime (07:00 – 23:00) NR10 L_{AFMax} for single octave frequencies 31.5 Hz – 125 Hz and NR15 L_{AFMax} for 250 Hz – 8 KHz.
- Background Noise levels of the area are not exceeded by more than 5 dB.

5 Site Description

The proposed development is an existing single storey building situated in Millom, a small town in Cumbria and is approximately 150m east of Millom railway station. The area is of a mixed commercial and residential environment with moderate traffic and regular pedestrian and patron activity.

To the west of the proposed development runs Lancashire Road, a 20mph two-way road which provides moderate levels of traffic flow. The front façade is situated directly adjacent to the pavement of Lancashire Road. On the opposite side of Lancashire Road is where most of the commercial activity takes place, including a Tesco Superstore, JT Atkinson Builders Merchant and Millom Recreation Centre (including gym facilities).

To the east, the rear of the building directly adjoins a residential property (number 8 Market Street). To the North and south are Market Street and an unnamed road, respectively, both of which are overlooked by neighbouring residential properties.

The noise profile of the area is dominated by traffic and other noise sources secondary in nature, such as pedestrian activity.

5.1 Subjective Observations

During site attendance, subjectively the main source of noise was vehicular traffic, mixed with plant noise (from car showroom), pedestrian and occasional HGV noise and grinding activity emanating from the builders' merchant.

5.2 Weather

14-15/11/2024	Thursday	Friday
Temperature (°C)	6.1 – 12.5	7.2 – 11.5
Wind Speed (m/s)	0.0 – 1.8	0.0 – 3.5
Wind Direction	SSE	W
Precipitation (mm/h)	0.0	0.0 – 2.4 (mean 0.1)
Damp road/ wet ground	No	Damp
Fog/snow/ice	None	None

Table 4: Measuring Weather Conditions

All weather data taken from wow.metoffice.gov.uk from the Old Kiln weather station, located at approximately 6.9km ENE of the proposed development.

6 Noise Measurement Procedure

6.1 Survey Date(s)

14/11/2024 - 15/11/2024.

6.2 Personnel Present

Dave Roberts BSc (Hons).

6.3 Survey Equipment Used

Manufacturer	Model	Serial No.	Description
Rion	NL-52	01054205	Integrating Sound Level Meter and Real Time Analyser
Pulsar	Model 105	59964	Acoustic Calibrator

Table 5: Survey Equipment Used

6.4 Calibration

The sound level meters were calibrated with the field calibrator to a level of 94.0 dB @ 1 kHz prior to and on completion of the survey. No significant drift in calibration was observed. The meters used during the survey are precision grade Class 1.

Calibration certificates are available on request.

6.5 External Ambient Sound Measurements

The measurement locations chosen during the survey were deemed suitable for the determination of the ambient and background sound levels of the area.

The sound level meters were set to measure broadband and A-weighted 1:1 octave centre frequency bands $L_{Aeq,}$ and L_{A90} in 5-minute periods.

6.5.1 Monitoring Position 1

A microphone was placed protruding from the edge of the roof, at least 1.5m from the front façade and 4.5m from ground level overlooking Lancashire Road. The sound level meter was set to record WAV file audio recordings for all maximum sound level events above 68 dBA. The meter was set to measure the complete 24-hour period.

6.6 Location Plan of Measurement Positions

The location plan below shows the proposed development, positions of the monitoring equipment and location of the noise sensitive receptors.

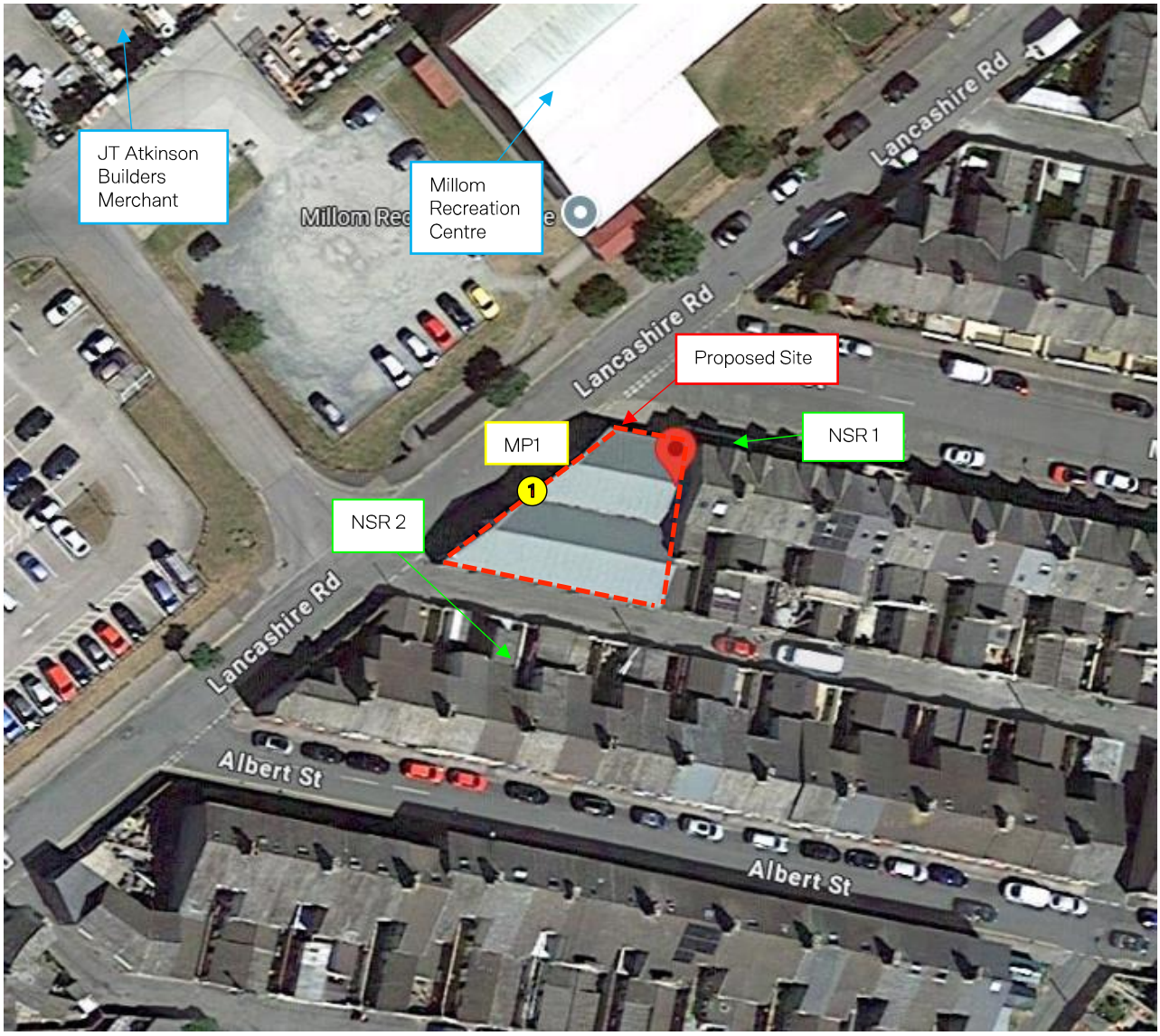


Figure 1: Indicative Site Map. Image taken from www.google.com/maps.

7 Results and Analysis

7.1 Background Noise Level Measurement Analysis

The following table presents the measured results from the monitoring position during the operational time of the proposed development (04:00 – 23:00 Monday to Sunday). The table shows daytime and nighttime $L_{Aeq,t}$ values in 1-hour interval for the daytime and 5-min interval for the nighttime period, thus providing a robust approach.

A façade correction of 2dB applied in order to adjust the result so that it is comparable to a free-field sound pressure level.

Monitoring position	Time Period *t*	$L_{Aeq,t}$ (dB)	Min $L_{A90,t}$ (dB)	Max $L_{A90,t}$ (dB)	Modal $L_{A90,t}$ (dB)
1	Daytime 07:00 – 23:00	60.0	26.6	47.4	45.0
	Nighttime 23:00 – 07:00	55.6	28.0	43.8	39.0

Table 6: Measurement Results

Data charts and tables can be found in the appendix.

The following histograms outline the measured $L_{A90,t}$ background results at the monitoring positions during the proposed operational time of the gym. All values are rounded to integers such that 0.5 is rounded up.

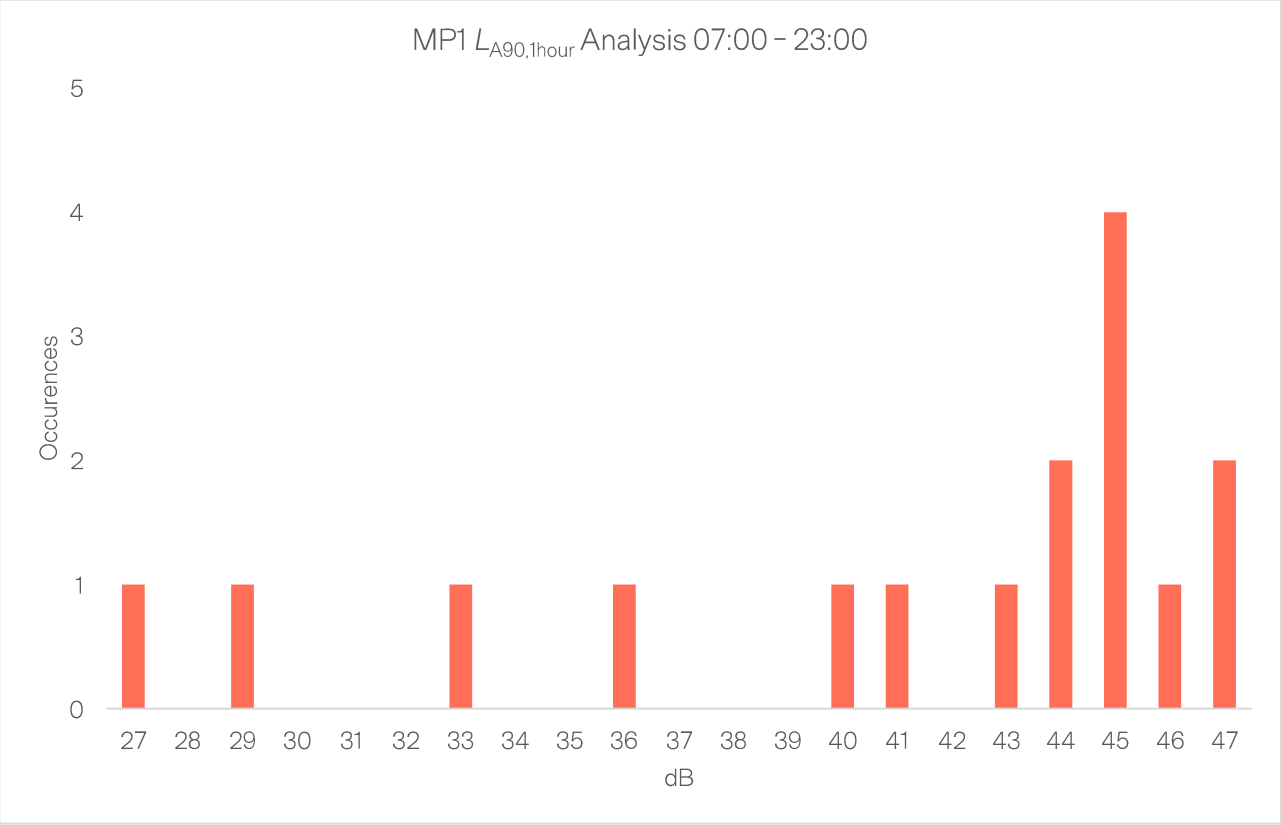


Figure 2: Daytime Background Noise Analysis

As can be seen, the highest modal $L_{A90,t}$ is 45 dB, which sits in the higher end of the range value. The second highest modal values are 44 dB and 47 dB $L_{A90,t}$.In order to provide a robust approach, the lowest modal $L_{A90,t}$ value of 44 dB will be used in the assessment as it is considered to be representative of the background noise level of the area.

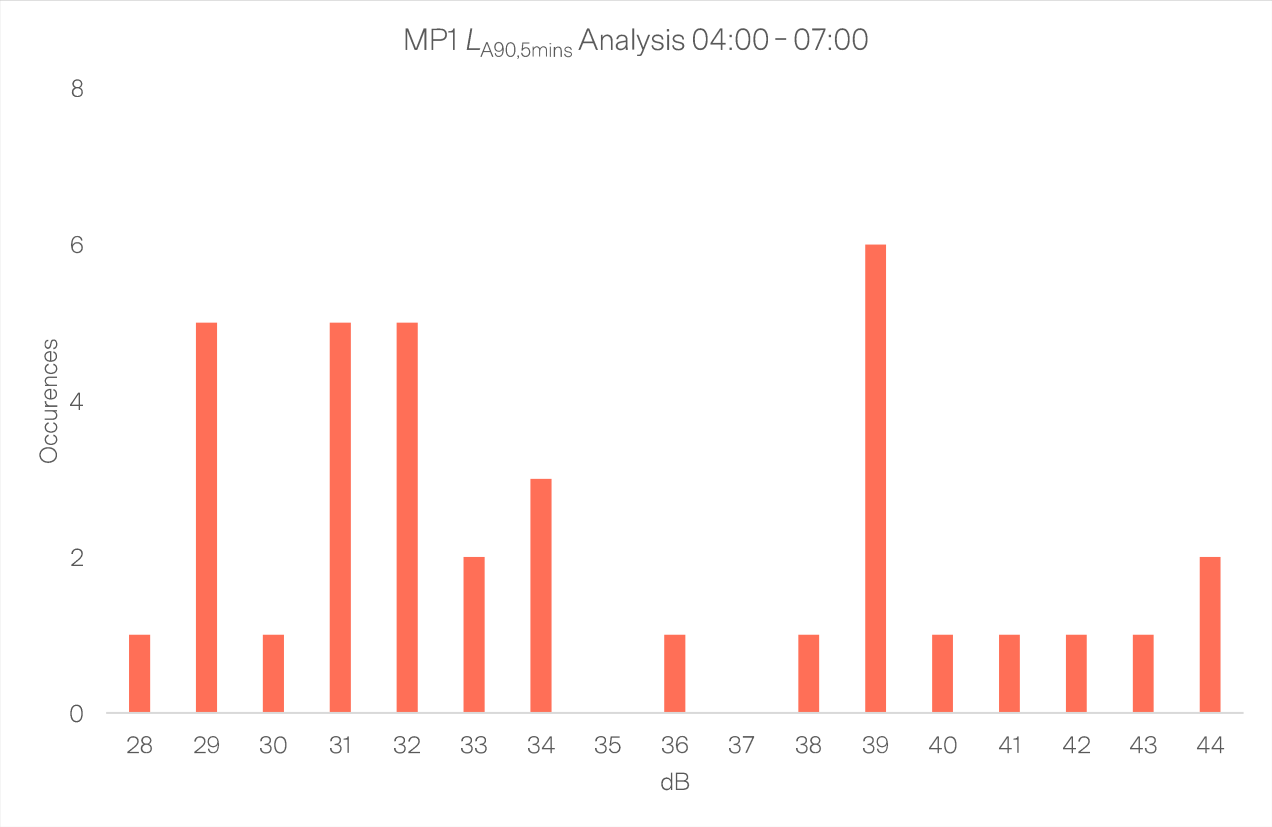


Figure 3: Nighttime Background Noise Analysis

As can be seen, the highest modal $L_{A90,t}$ is 39 dB, which sits in the mid to higher end of the range value. The second highest modal values range from 29 dB to 32 dB $L_{A90,t}$. As such, in order to provide a robust approach, the $L_{A90,t}$ value of 29 dB will be used in the assessment.

8 Noise Impact Assessment

The proposed gym will comprise of light free weights and cardio activities, it has been advised by the client that music will be played in the background only and not readily distinctive from a normal conversation level. As such, it is therefore considered negligible and will not be considered in the assessment. It is considered that noise from activities will be the cause of most disturbance onto the nearest receptors.

The gym is only proposed and, as such, no measurements of the noise emissions have been undertaken. Therefore, Spratt and Hamer historical data for the operation of a similar gym will be used in the assessment.

8.1 Gymnasium Noise Emissions

The L_{AFMax} noise emissions taken from the Spratt and Hamer historical data for the gym are outlined in the table below and include the use of treadmills, rowing machines, static bikes, skiergs and body exercise mats.

Description	Un-weighted Octave Band Centre Frequency Hz (dB)									Overall (dBA)
	31.5	63	125	250	500	1K	2K	4k	8K	
Gym noise emissions L_{Amax}	83.1	83.1	81.5	79.2	83.4	82.9	78.8	77.6	75.1	87.1

Table 7: Gymnasium Noise Emissions

The L_{FMax} values shown in the table above are the highest at each octave band from all of the activities combined. As such, it is considered to represent a worst-case scenario.

8.2 Noise Breakthrough Analysis

The proposed gym will be located directly adjoining an existing residential dwelling, as such the noise breaking through the wall partition will be assessed in this section.

It is expected that the noise emissions within the proposed gym are typical, with normal voice conversation levels and light background music.

8.2.1 Existing Separating Element Test & Analysis

The wall performance has been measured and the results are presented in the table below. The sound test was carried out in accordance with ISO-140 and Approved Document E. The test certificate can be found in the Appendix.

Description	D_{nT} Octave Band Centre Frequency Hz (dB)							$D_{nT,w}$ (dB)
	63	125	250	500	1K	2K	4k	
Separating Wall	41.9	45.1	47.0	52.8	62.4	68.9	69.7	58

Table 8: Sound Test Result

The following table assesses the current wall performance against Cumberland Council criteria.

Description (dB)	Un-weighted Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4K	8K
Gym Noise emissions L_{Amax}	83.1	83.1	81.5	79.2	83.4	82.9	78.8	77.6	75.1
Existing Wall SRI	-35.9	-41.9	-45.1	-47.0	-52.8	-62.4	-68.9	-69.7	-69.7
Sound Level in NSR 1	47.2	41.2	36.4	32.2	30.6	20.5	9.9	7.9	5.4
NR10 (Nighttime criteria)	62.0	43.3	30.7	-	-	-	-	-	-
NR15 (Nighttime criteria)	-	-	-	26.0	18.9	15.0	11.7	9.3	7.0
Exceedance (nighttime)	-14.8	-2.1	+5.7	+6.2	+11.7	+5.5	-1.8	-1.4	-1.6
NR15 (Daytime criteria)	65.6	47.3	35.1	-	-	-	-	-	-
NR20 (Daytime criteria)	-	-	-	30.6	23.8	20.0	16.8	14.4	12.6
Exceedance (daytime	-18.4	-6.1	+1.3	+1.6	+6.8	+0.5	-6.9	-6.5	-7.2

Table 9: Initial Breakthrough Assessment

As can be seen from the table above the current wall does not meet the criteria at the low to mid frequencies (125 Hz – 1KHz). Consequently, upgrade treatments will be required.

8.2.2 Wall Upgrade Recommendations

An upgrade of the partition element dividing the proposed gym from the residential unit is outlined in the following table. It should be noted that modifications to the resident side of the wall is not a consideration for the assessment.

Upgrade	Recommendation/s
225mm Solid Masonry with Independent Wall Lining	1. Create an independent wall lining using a 70mm steel stud with min. 15mm air gap. The stud must be completely independent to the masonry wall without any connections or bracings. 2. Partially fill the cavity between frames with 50mm mineral wool insulation of 10kg/m^3 e.g. Isover APR1200, tightly fitted and without gaps. 3. Close with 2 no. 15mm sound/fire rated plasterboard.

Table 10: Party Wall Recommendations

The table below outlines the sound reduction $D_{nT,w}$ of the wall. The performance has been predicted using INSUL 9.0 prediction software. Note that the resulting sound insulation levels have not taken into consideration factors such as flanking paths, geometry, size or reverberation of the rooms involved, therefore uncertainty can be expected. Consequently, a minimum 3 dB uncertainty correction has been applied.

Description (dB)	R_w Octave Band Centre Frequency Hz (dB)									$D_{nT,w}$
	31.5	63	125	250	500	1K	2K	4k	8k	
Predicted Wall Performance	35*	41	53	69	81	90	96	97	97**	79

Table 11: Predicted Upgraded Wall Performance

*INSUL limitation. Hence 31.5Hz value = 63Hz - 6dB has been applied.

** INSUL limitation. Hence 8kHz value = 4 kHz value has been applied.

Analysis has shown a predicted increase in sound insulation performance of 21 dB. The following section will assess the suitability of the proposed wall upgrade.

8.2.3 NR Curve Target Assessment with Upgrade

NR Curve analysis is used to gain a greater understanding of the frequency content of a sound. The criteria set by Cumberland Council outlines that the airborne sound transfer from the gym must achieve NR10 and NR15 curve targets for the nighttime at the NSR. The nighttime criteria will be used as a worst-case scenario.

The table below determines the NR curve of the upgraded wall construction and is compared to the nighttime criteria.

Description	Un-weighted Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4K	8K
Gym Noise emissions L_{Amax}	83.1	83.1	81.5	79.2	83.4	82.9	78.8	77.6	75.1
Upgraded Wall SRI	-34.9	-40.9	-53.1	-69.0	-80.8	-90.4	-95.9	-96.7	-96.7
Sound Level in NSR 1	48.2	42.2	28.4	10.2	2.6	-7.5	-17.1	-19.1	-21.6
NR10 criteria	62.0	43.3	30.7	-	-	-	-	-	-
NR15 criteria	-	-	-	26.0	18.9	15.0	11.7	9.3	7.0
Exceedance	-13.8	-1.1	-2.3	-15.8	-16.3	-22.5	-28.8	-28.4	-28.6

Table 12: Upgraded Wall Breakthrough Assessment

As can be seen from the table above, the noise emissions within the receptor falls in line with the criteria at all frequencies providing the proposed upgrades are implemented.

8.3 Breakout Noise Assessment

In accordance with the documentation provided and observations taken on site, it is shown that the current building construction is predominantly comprised of large, glazed windows (assumed to be a minimum of 4mm single glazing) and a composite metal plank on steel frame roof structure (assumed to be filled with thermal 'PIR' insulation and mineral wool insulation), boarded internally with a lightweight galvanised steel or PVC liner.

8.3.1 Initial Assessment

Gym noise emissions will be assessed against the NR curve target with the current building construction. The following considerations and/or assumptions have been taken into account.

- Gym noise emissions of L_{Amax} 87.1 dB and octave band values of all internal activities combined.
- NSR 2 is considered to be the most exposed receptor, situated in direct line of sight, hence representing a worst-case scenario.
- Expected SRI R_W of 32 for current roof. Value taken from the Kingspan Acoustic Performance Guide.
- Daytime and Nighttime background noise level of 29 dB and 44 dB $L_{A90,T}$, respectively.
- The distance attenuation has been calculated taking into account an area source using $10\log(r_2/r_1)$.
- The distance between the noise source and the NSR window has been determined using the centre of the façade / roof of the noise source, this being 11m to NSR2.
- 15 dB attenuation of a partially open window. Data taken from a study carried out by Napier University - NANR116: 'Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows.

Description	Un-weighted Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4K	8K
Noise emissions L_{Amax}	83.1	83.1	81.5	79.2	83.4	82.9	78.8	77.6	75.1
Roof sound reduction (R_w)	-12.0	-18.0	-19.0	-22.0	-29.0	-31.0	-40.0	-58.0	-49.0
Distance attenuation (11m)	-10.4	-10.4	-10.4	-10.4	-10.4	-10.4	-10.4	-10.4	-10.4
Open window attenuation	-14.0	-20.0	-14.0	-14.0	-16.0	-14.0	-17.0	-19.0	-19.0
Sound level inside NSR 2	46.7	34.7	38.1	32.8	28.0	27.5	11.4	-9.8	-3.3
NR10 (Nighttime criteria)	62.2	43.3	30.7	-	-	-	-	-	-
NR15 (Nighttime criteria)	-	-	-	26.0	18.9	15.0	11.7	9.3	7.5
Exceedance (nighttime)	-15.5	-8.6	+7.4	+6.8	+9.1	+12.5	-0.3	-19.1	-10.8
NR15 (Daytime criteria)	65.6	47.3	35.1	-	-	-	-	-	-
NR20 (Daytime criteria)	-	-	-	30.6	23.8	20.0	16.8	14.4	12.6
Exceedance (daytime)	-18.9	-12.6	+3.0	+2.2	+4.2	+7.5	-5.4	-24.2	-15.9

Table 13: Initial Roof Breakout Assessment

As can be seen, the current roof will not provide the required sound reduction at the low to mid frequencies (125 Hz – 1KHz). As such, mitigation measures will require to be implemented.

8.4 Roof Upgrade Recommendations

The proposal is to operate until 23:00, as requested by the client, this section will set out two upgrade options for the roof, one for operation from 04:00 and one for operation from 07:00.

Upgrades to the building element are outlined in the following table for each option. It should be noted that modifications to the resident side of the wall is not a consideration for the assessment.

Upgrade	Recommendation/s
Option 1: Operating from 04:00 Suspended MF Ceiling (520mm cavity)	- Existing roof - MF ceiling on acoustic hangers creating a min, 520mm cavity. Cavity filled with 60mm mineral wool insulation of 10kg/m^3, tightly fitted and without gaps. - 1 no. layer of 12.5mm standard plasterboard
Option 2: Operating from 07:00 Suspended MF Ceiling (180mm cavity)	- Existing roof - MF ceiling on acoustic hangers creating a min, 180mm cavity. Cavity filled with 60mm mineral wool insulation of 10kg/m^3, tightly fitted and without gaps. - 1 no. layer of 12.5mm standard plasterboard

Table 14: Roof Upgrade Recommendations

The table below outlines the sound reduction D_{nTw} of each element. The performance has been predicted using INSUL 9.0 prediction software. Note that the resulting sound insulation levels have not taken into consideration factors such as flanking paths, geometry, size or reverberation of the rooms involved, therefore uncertainty can be expected. Consequently, a minimum 3 dB uncertainty correction has been applied.

Description (dB)	R_w Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4k	8k
Option 1 Predicted Performance	11*	17	31	45	48	53	54	56	56**
Option 2 Predicted Performance	5*	11	22	43	48	53	54	56	56**

Table 15: Predicted Performance

*INSUL limitation. Hence 31.5Hz value = 63Hz - 6dB has been applied.

** INSUL limitation. Hence 8kHz value = 4 kHz value has been applied.

Note that all suggested specifications require a good level of workmanship and for materials to be installed as the manufacture intends. Any poor workmanship may lead to weaknesses in the sound insulation provided by the building elements.

8.4.1 NR Curve Target Assessment with Mitigation

The table below outlines the resulting internal ambient noise levels and compares it with the relevant NR curve at NSR2 for each roof upgrade option. Previously defined considerations have been taken into account, including distance attenuation and sound reduction of a partially open window.

Option 1: Operating from 04:00	Un-weighted Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4k	8K
Sound Level in NSR2	47.7	35.7	26.1	9.8	9.0	5.5	-2.6	-7.8	-10.3
NR10 / NR15 Nighttime Criteria	62.2	43.3	30.7	26.0	18.9	15.0	11.7	9.3	7.5
Criteria Exceedance	-14.5	-7.6	-4.6	-16.2	-9.9	-9.5	-14.3	-17.1	-17.8
Option 2: Operating from 07:00	Un-weighted Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4k	8K
Sound Level in NSR2	53.7	41.7	35.1	11.8	9.0	5.5	-2.6	-7.8	-10.3
NR15 / NR20 Daytime Criteria	65.6	47.3	35.1	30.6	23.8	20.0	16.8	14.4	12.6
Criteria Exceedance	-11.9	-5.6	0.0	-18.8	-14.8	-14.5	-19.4	-22.2	-22.9

Table 16: NR Curve Assessment Results with Mitigation

As can be seen, the noise emissions at the receptor meets the criteria at all frequencies for options 1 and 2 providing the proposed upgrades are implemented.

8.5 Cumulative Noise Emissions Assessment at NSR1

The predicted cumulative noise level on the receptor NSR 1, including both noise emissions from external noise ingress and through the separating element, is presented in the following charts.

These have been compared with the Cumberland Council NR rating curve criteria once the proposed roof mitigation measures are implemented. Calculations can be found in the appendix

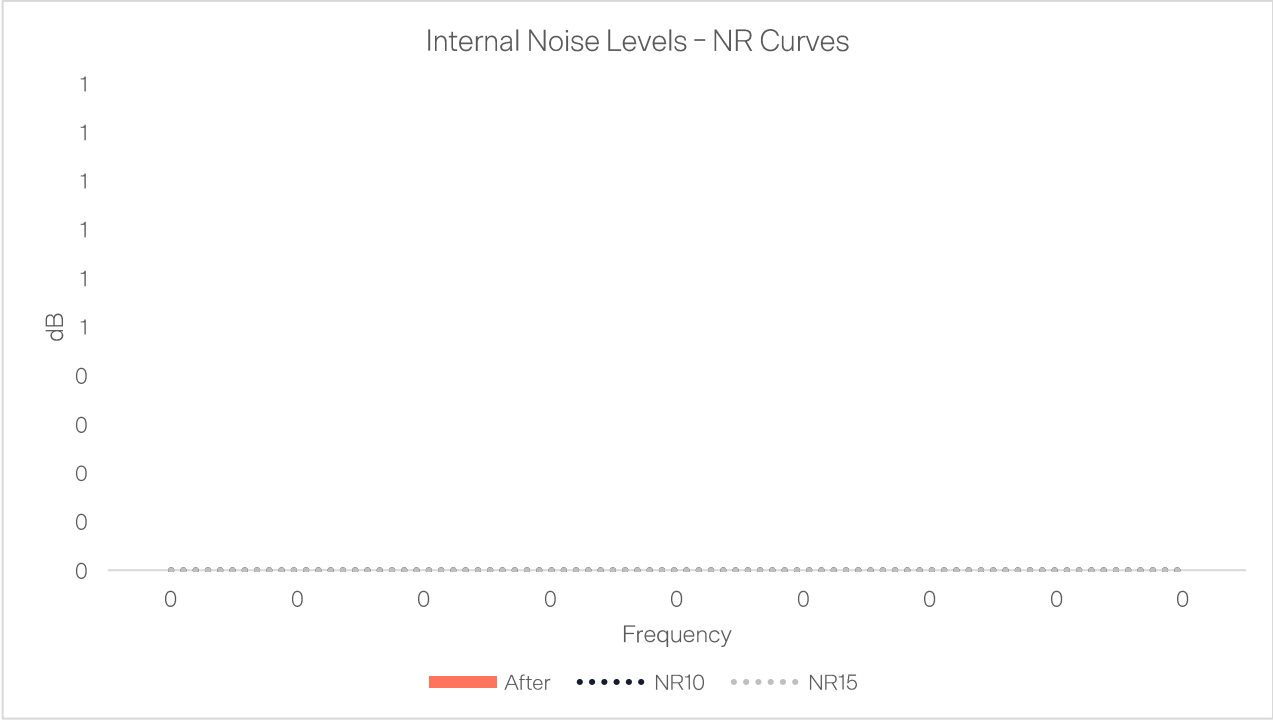


Figure 4: NR Curve Assessment – Operating from 04:00

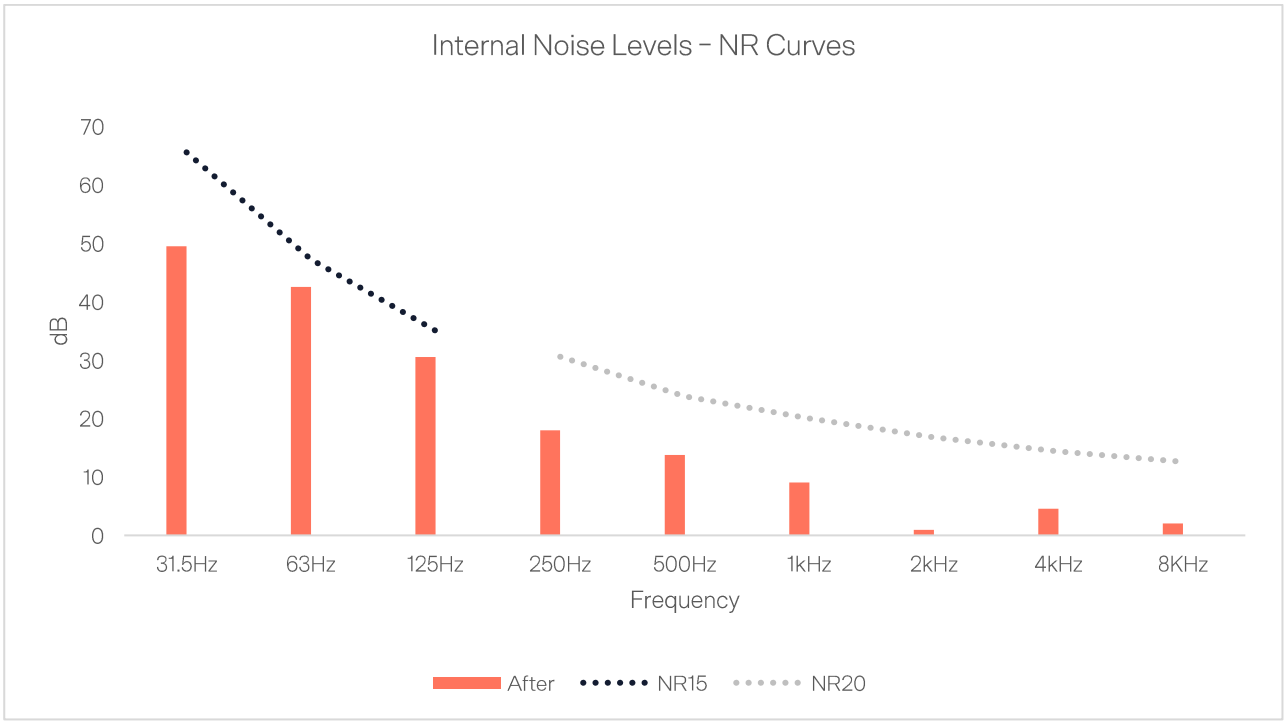


Figure 5: NR Curve Assessment – Operating from 07:00

8.6 Structure Borne Impact Assessment

Airborne and structural noise transmission may occur from the uncontrolled dropping of weights onto the gym floor or weight resistance machines. It has been advised by the client that heavy weights will not be used within the proposed gym. However, the dropping of lighter weights in an uncontrolled manner may occur sporadically and pose a potential impact at the adjoining receptor. Therefore, mitigation

measures in order to minimise airborne sound transfer emanating from free-weight impact must be considered.

At the time of writing the report, it is proposed to install a resilient rubber floor system no specification of the proposed system has been yet provided. As such, it is important that a suitable floor system is incorporated in conjunction with mitigation measures to minimise sound transfer from the specific workout positions such as the pin-loaded weight resistance machines (impact washers, weight stack isolator), treadmills and rowing machines (treadmill isolation pads).

Further information on acoustic gym floor systems can be obtained directly from suppliers such as Regupol Sports (www.sports.regupol.com) and Pliteq (www.pliteq.com). Note that further testing and advice may be applicable in order to ascertain the suitability of the specific type of flooring system required.

8.7 BS 4142:2014+A1:2019 Assessment

The following table demonstrates the impact on the nearest noise sensitive dwelling during nighttime operation of the gym, as worst-case scenario. In order to provide a conservative scenario, a correction for 'Other Sound Characteristics' will be added in accordance with BS 4142:2014 for sound that features characteristics that may be readily distinctive against the residual environment.

The predicted sound levels have been calculated using 69 dB $L_{Aeq,t}$ average ambient noise levels, as previously measured by Spratt and Hamer in a similar size gym premises with all activities occurring simultaneously. Again, activities included the use of treadmills, rowing machines, static bikes, skiergs and body exercise mats.

Nighttime	Sound Level (dBA) NSR 1	Sound Level (dBA) NSR 2
L_{Aeq} internal	69	69
Building Fabric SRI	-36	-42
Distance attenuation (11m)	-10	-10
Shielding	-10	0
BS 4142:2014 Character Correction	+3	+3
Rating Sound Level at NSR	16	20
Nighttime background sound level + 5 dB	34	34
Exceedance	-18	-14

Table 17: BS 4142:2014 Assessment

The assessment indicates the noise impact due internal activity noise will be at least 14 dB below the Cumberland Council criteria, thus predicting a low Impact as per BS4142:2019 and No Observed Effect Level (NOEL) in accordance with NPPF.

8.8 Vehicle Movement Numerical Assessment

The client is proposing a cycle stand to encourage patrons to cycle to the is acknowledged that some patrons may travel by car. As such, this section assesses the potential impact in line with BS 4142:2014 at the most exposed NSRs during the daytime and nighttime.

The following considerations and assumptions have been taken into account, deemed to represent a conservative approach.

- It is assumed a maximum of 40 vehicle movements will occur per hour, both arriving at or leaving the gym, of which 50% will travel by car, equating to a total of 20 car movements.
- In the nighttime, 20 vehicle movements per hour are assumed, of which 50% will travel by car, equating to 2.5 (3 no. for the purpose of the assessment) car movements per 15 min interval.
- It is assumed that the patrons will park on Market Street, overlooked by NSR 1.
- The sound power level of 77dBA of a slow-moving vehicle will be used as a worst-case scenario. The value has been taken from a previous Spratt and Hamer's report.
- Expected low speed circa 10mph (16kmh). Hence the source will be considered as a point source.
- A background sound level $L_{A90,\ t}$ of 29 dB and 45dB for the night and daytime periods, respectively.

The following table outlines the time corrected sound power level of vehicles arriving at the gym.

Description	Value (Daytime)	Value (Nighttime)
Vehicle *Lw* (dBA)	77	
Total no. movements	20 / hour	3 / 15min
Speed (kph)	16	
Max. Distance (m)	100	
Total Time (min)	7.5	1.1
Time corrected *Lw* (dBA)	68	66
Expected *Lp* (dBA)	60	58

Table 18: Vehicle Movement Sound Level

The following table demonstrates the impact of the patron car movement on the most exposed noise sensitive dwellings.

Description	Daytime Sound Level (dB)	Nighttime Sound Level (dB)
Vehicle Time corrected sound level	60	58
Distance attenuation (9m)	-19	-19
Sound level at NSR1 Façade $L_{Aeq,t}$	41	39
Background sound level + 5 dB	49	34
Exceedance	-8	+5

Table 19: Vehicle Movement BS4142 Impact Assessment

The table above indicates that the noise impact due to vehicles arriving / leaving the gym exceeds Cumberland Council criteria at the façade during the nighttime, however during the daytime the noise level from vehicles is 8 dB below.

In consultant's opinion, further context needs to be considered in order to establish any potential impact from vehicle movement. The following section will assess the internal noise levels within the nearest receptor in accordance with the criteria of BS 8233:2014.

8.8.1 BS 8233:2014 Cumulative Open Window Assessment

The following table outlines the internal area noise levels on the nearest noise-sensitive receptor caused by a cumulative impact of vehicle movement events and gym operation. The assessment is carried out in accordance with the criteria of BS8233 during the daytime and nighttime time with a window open at the receptor.

Description	Daytime Internal Sound Level (dB)	Nighttime Internal Sound Level (dB)
Vehicle Movement $L_{Aeq,t}$ at NSR 1	41	39
Gym Sound Level $L_{Ar,Tr}$ at NSR 1	16	16
Cumulative $L_{Ar,Tr}$ at NSR 1	41	39
Sound reduction of an open window	-15	-15
Sound Level Internally $L_{Aeq,t}$	26	24
BS8233 criteria $L_{Aeq,t}$	35	30
BS8233 criteria Exceedance	-9	-6

Table 20: BS8233:2014 Assessment

As shown in the table above, the internal ambient noise level within the NSR would fall at least 9dB and 6dB below the required level in habitable rooms for the day and nighttime periods, respectively, equating to No Observed Adverse Effect Level (NOAEL) in accordance with NPPF.

8.9 Context

The proposed gym has been assessed using the measured nighttime background sound level of 29 dBA which is the lowest modal $L_{A90,t}$ value, as well as the second lowest background level measured throughout the monitoring period. As such, the difference between the noise emissions and the background noise level should be greater for most of the time, thus further minimising any impact.

In addition, the assessment considers the highest L_{Amax} sound levels for every frequency octave band considering all activities combined, occurring simultaneously. Consequently, it can be expected that the impact onto the near receptors is even lower for the majority of the time.

Vehicle assessment has been carried out assuming a worst case where 20 patrons will arrive and leave the site by car every hour during the day and three patrons every 15 minutes during the nighttime. It is expected that nighttime attendance is typically lower, therefore minimising the impact from vehicle movement.

9 Conclusion

The report concludes that, based on the gym internal activity and vehicle movement, noise from the proposed gym will have a low impact on the amenity of the residents of neighbouring dwellings providing the following mitigation measures and conditions are achieved:

- The wall separating the proposed gym from the adjoining residential property must be upgraded by implementing an independent wall lining.
- The roof must be upgraded, the extent to which is dependent on the chosen operation times.
- Music should only be played for background purposes.
- Specialist advice from a gym floor specialist must be sought. Further assessment and/or test may be applicable.
- A NMP (Noise Management Plan) should be implemented to ensure that noise emanating from the proposed development is minimised. This can include, but not limited to:
    - Raised voices (shouting) to be discouraged inside the premises.
    - Patrons must be encouraged to make use of personal earphones / headphones so the playing of ambient music can be kept to a minimum.
    - Staff should be trained on how to minimise noise and engage with the surrounding community, particularly during noise-sensitive periods such as early mornings and late evenings.

10 References

National Planning Policy Framework (NPPF).

BS 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound.

BS 7445-1:2003 Description and measurement of environmental noise – Part 1: Guide to quantities and procedures.

BS 8233:2014 Guidance on sound insulation and noise reduction for buildings.

INSUL Version 9.0.24 – Sound Insulation Prediction Software

BS EN 12758:2011 Glass in building – Glazing and airborne sound insulation

NANR116: 'Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows

www.google.co.uk/maps.

wow.metoffice.gov.uk.

10.1 Drawing References

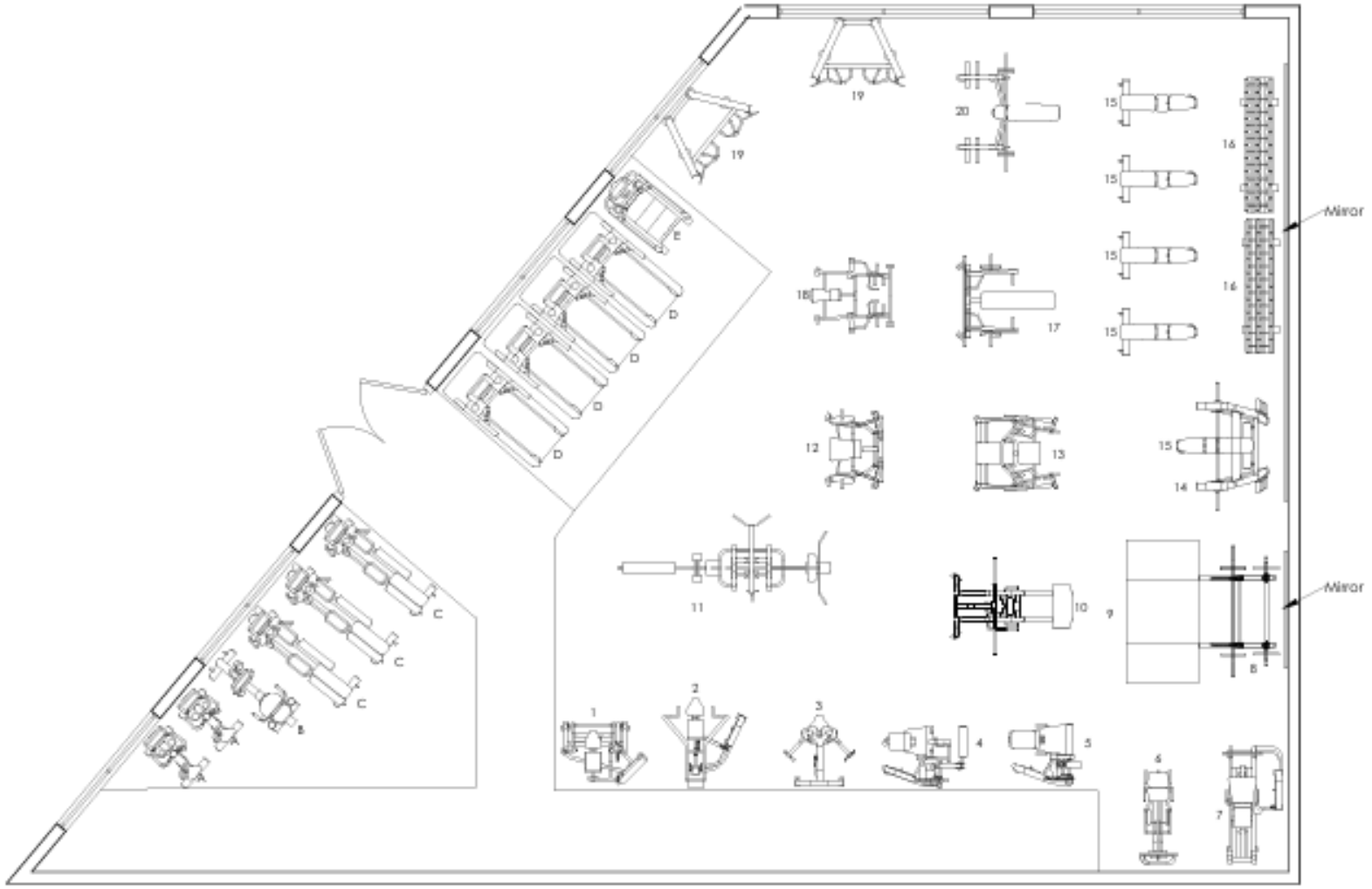
Drg. No. MSM.P.001 - Existing Floor Plan and Site Location Plan

Drg. No. MSM.P.002 - Proposed Floor Plan

Appendix

Photograph showing Monitoring Position 1

Site Plan



Cardiovascular Equipment

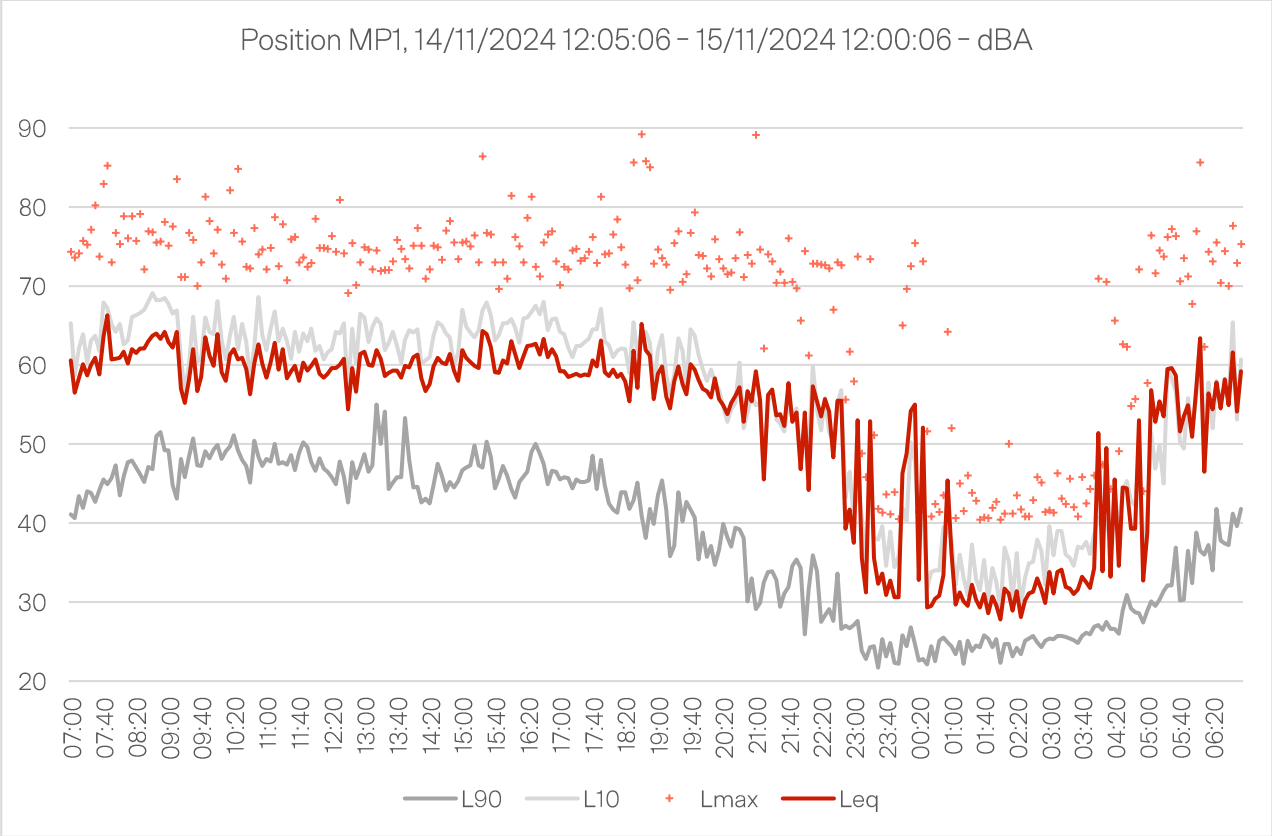
A Upright Bike - Aspire SE4 16" x 2
B Recumbent Bike - Aspire SE4 16"
C Cross-Trainer - Aspire SE4 16" x 3
D Treadmill - Aspire SE4 24" x 4
E Powermill Climber - SL

Resistance Equipment

1 Chest Press - HS
2 Shoulder Press - HS
3 Pec Fly / Rear Deltiod - HS
4 Seated Leg Curl - HS
5 Leg Extension - HS
6 Hip Abductor - HS
7 Seated Leg Press - HS
8 Half Rack - HD Athletic NX
9 4' X 8' Platform - HDE
10 Linear Hack Press - HPL
11 Multi-Jungle SM-40
12 Iso-Lateral Incline Press - HPL
13 Iso-Lateral Decline Press - HPL
14 Smith Machine - Sig
15 Multi-Adjustable Bench - Sig x 5
16 Dumbbell Rack Double - Sig x 2
17 Iso-Lateral Horizontal Press - HPL
18 Iso-Lateral Rowing - HPL
19 Dual Adjustable Pulley - CM x 2
20 Olympic Flat Bench with Weight Storage - Sig

Measurement Results

Monitoring Position 1



Monitoring position	Day	Time Period	Time Base T (hours)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	L_{A90} (dB)	L_{A10} (dB)
1	Thursday	Daytime	10hr, 55mins	61.3	-	33.6	63.8
		Nighttime	8hr	53.7	42.4 - 87.6	24.8	58.4
	Friday	Daytime	5hr, 5mins	63.2	-	45.5	65.5

Table 21: Measured Results

Cumulative Sound Level at NSR1 Calculation

Option 1: Operating from 04:00	Un-weighted Octave Band Centre Frequency Hz (dB)								
	31.5	63	125	250	500	1K	2K	4k	8K
Noise emissions L_{Amax}	83	83	82	79	83	83	79	78	75
Composite sound reduction (R_w)	-9	-15	-24	-28	-34	-40	-41	-34	-34
Full shielding attenuation	-10	-10	-10	-10	-10	-10	-10	-10	-10
Distance attenuation (11m)	-10	-10	-10	-10	-10	-10	-10	-10	-10
Open window attenuation	-14	-20	-14	-14	-16	-14	-17	-19	-19
Internal L_{AFMax} (Breakout)	39	27	23	17	13	9	1	5	2
Internal L_{AFMax} (Breakthrough)	48	42	28	10	3	-8	-17	-19	-22
Cumulative L_{AFMax}	49	42	30	18	14	9	1	5	2
Nighttime NR10 / NR15	62	43	31	26	19	15	12	9	8
Criteria Excess	-13	-1	-1	-8	-5	-6	-11	-5	-5
Option 2: Operating from 07:00	**Un-weighted Octave Band Centre Frequency Hz (dB)**								
	31.5	63	125	250	500	1K	2K	4k	8K
Noise emissions L_{Amax}	83	83	82	79	83	83	79	78	75
Composite sound reduction (R_w)	-5	-11	-21	-28	-34	-40	-41	-34	-34
Full shielding attenuation	-10	-10	-10	-10	-10	-10	-10	-10	-10
Distance attenuation (11m)	-10	-10	-10	-10	-10	-10	-10	-10	-10
Open window attenuation	-14	-20	-14	-14	-16	-14	-17	-19	-19
Internal L_{AFMax} (Breakout)	44	32	26	17	13	9	1	5	2
Internal L_{AFMax} (Breakthrough)	48	42	28	10	3	-8	-17	-19	-22
Cumulative L_{AFMax}	50	43	31	18	14	9	1	5	2
Daytime NR15 / NR20	66	47	35	31	24	20	17	14	13
Criteria Excess	-16	-5	-5	-13	-10	-11	-16	-10	-11

Table 22: Cumulative Sound at NSR1 Calculation

Sound Insulation Test

Airborne Sound Insulation Wall Test

Field measurements of airborne sound insulation between rooms

Client Name	W.Milligan & Sons
Site Address	6 Market Street, Millom, LA18 4AH
Date of Test	14/11/2024
Name of Technician	David Roberts BSc (Hons)
Source Room	Car Showroom, Ground Floor
Source Room Volume	1,274.1m³
Receiver Room	No. 8, First Floor, Bedroom
Receiver Room Volume	40.7m³
Area of Test Element	7.6m²
Construction Type	Wall Type 1
Construction Detail	Existing 9" Masonry Wall, Plasterboard On Dot And Dab

Rating according to ISO 717-1

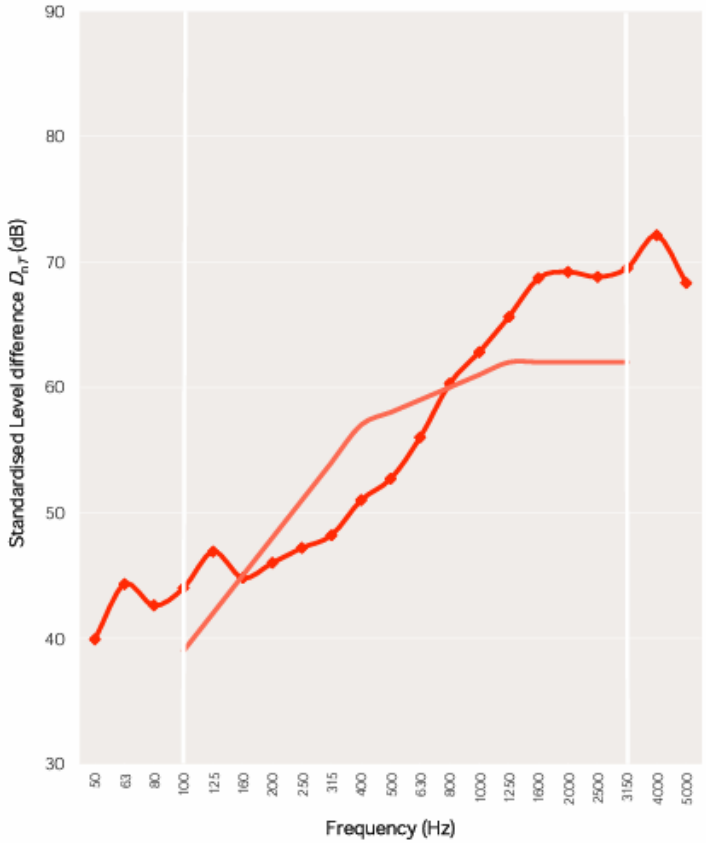
(Higher $D_{nT,w}$ + C_{tr} figures denote better sound insulation performance)

$D_{nT,w}$ = 58 dB

C_{tr} = -4 dB

58 dB $D_{nT,w}$

Evaluation based on field measurement results obtained by an engineering method
Frequency range according to the curve of reference values (ISO 717-1)



Standardised Level Difference according to BS EN ISO 140-4:1998 and Approved Document E 2003

Frequency (Hz)	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
DnT (dB)	≥39.9	44.3	42.6	44.0	46.9	44.8	46.0	47.2	48.2	51.0	52.7	56.0	60.3	62.8	65.6	68.7	≥69.2	≥68.8	≥69.5	≥72.1	≥68.3

' ≥' shows the limit of measurement due to background noise

Test Reference: 22271S-1 V1

Glossary of Acoustical Terms

A-weighting

Noise levels are corrected to represent human response to sound.

L_{Aeq}

This is a continuous equivalent of time varying noise, or effectively the average measured (A weighted) noise level over a defined period of time.

$L_{Aeq,16hour}$

A 16 hour long measurement of the L_{Aeq} over the period between 07:00 and 23:00, also known as a daytime measurement.

$L_{Aeq,8hour}$

An 8 hour long measurement of the L_{Aeq} over the period between 23:00 and 07:00, also known as a night time measurement.

L_{AFmax}

The highest, or maximum A-weighted sound pressure level measured over a specified time period. The 'F' defines a time weighting in Fast.

L_{A90}

The A-weighted noise level or average level which is exceeded for 90 percent of the measured time period. Also known as a background level.

L_{A10}

The A-weighted noise level or average level which is exceeded for 10 percent of the measured time period.

1:1 & 1:3 octave spectrum analysis

A single measurement that is separated into frequency bands to allow for a more detailed analysis of the noise source in question.

R_w

The weighted sound reduction index of a partition or facade. A single number value based on the performance of a partition between two rooms across the frequency range 100Hz to 3150Hz. The level is adjusted for the effects of reverberation and background noise.

$D_{n,e,w}$

The weighted level difference of a partition or façade which takes into account a small element such as a grill or vent.

SEL (sound exposure level)

A measure of A-weighted sound energy used to describe a particular event, such as a train pass. It is the sound energy, which, if occurring over one second would contain the same energy as the event.

Free field sound pressure

Is where the radiation or spread of sound is completely unaffected by the presence of any reflecting surfaces or boundaries.

Low Frequency Noise

A term generally used for sound below a frequency of 100 to 150Hz.

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