



Noise & Vibration Impact Assessment

Site Address: 91 Buckingham Road, Manchester, M21 0QT

Client Name: Mr Dwayne Campbell

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Delivering sustainable development by promoting good health and well-being through effective management of noise.

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1. Introduction

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a new build residential development ('the proposed development') at 91 Buckingham Road, Manchester, M21 0QT ('the site'). The proposed development for the erection of a two-storey dwelling.

The applicant has received conditional approval for planning application No. 130857/FH/2021 ('the Application') from Manchester City Council. This report has been prepared to discharge Condition 11 imposed by the Local Planning Authority ('LPA').

A noise survey has been undertaken to establish the prevailing sound levels at the proposed development. The findings have been subsequently used to assess the suitability of the site for residential use. Measures required to mitigate noise impacts for the proposed development have been assessed in accordance with the relevant performance standards, legislation, policy, and guidance.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.1 Standards, Legislation, Policy & Guidance

The following performance standards, legislation, policy, and guidance have been considered to ensure good acoustic design in the assessment:

- The LPA's conditional approval; specifically, 'Condition 11'.
- Manchester City Council's policy document; Planning and Noise Technical Guidance (PNTG)
- National Planning Policy Framework (2023).
- Noise Policy Statement for England (2010).
- British Standard BS8233:2014 – 'Guidance on sound insulation and noise reduction for buildings'.
- Approved Document O: Overheating (2021).
- Acoustics Ventilation Overheating: Residential Design Guide 2020' (AVO Guide).

Further information on the legislation can be found in Appendix B.

1.2 Proposal Brief

The proposal is for the erection of a single storey dwelling (referred to as Annex), a garden office, and a two-storey extension to 91 Buckingham Road. There will also be a garden amenity area located in the centre of the site. The figure below shows the proposed development.



Drawing Ref No. Dwayne Campbell O1 R05-Model

Figure 1 – Proposed Development

1.3 Local Planning Authority & Background

The following condition of the approved planning application No. 11 requires discharging:

“11) Works to the outbuilding shall not take place until a scheme for acoustically insulating the proposed development against noise and vibration from the adjacent Metrolink line has been submitted to and approved in writing by Manchester City Council as local planning authority. The approved noise insulation scheme shall be completed before the use of the development commences.

Reason - To secure a reduction in noise from Metrolink to protect future residents from noise nuisance, pursuant to policies DM1 and SP1 of the Core Strategy Development Plan Document.”

Manchester City Council review noise and vibration impact assessments in line with their PNTG document. This requires a noise impact assessment to be carried in line with the requirements of BS 8233 and the other guidance documents and legislation listed in Section 1.1.

2. Environmental Survey

2.1 Measurement Methodology

A noise survey was carried out at the site to determine the existing noise climate affecting the proposed development. Unattended monitoring was undertaken in a location that was representative of the façade most affected by tram noise to the west. During the measurements, a 130mm diameter windshield was fitted to the microphone. The sound level meter was calibrated at the start and end of the survey; negligible drift was noted.

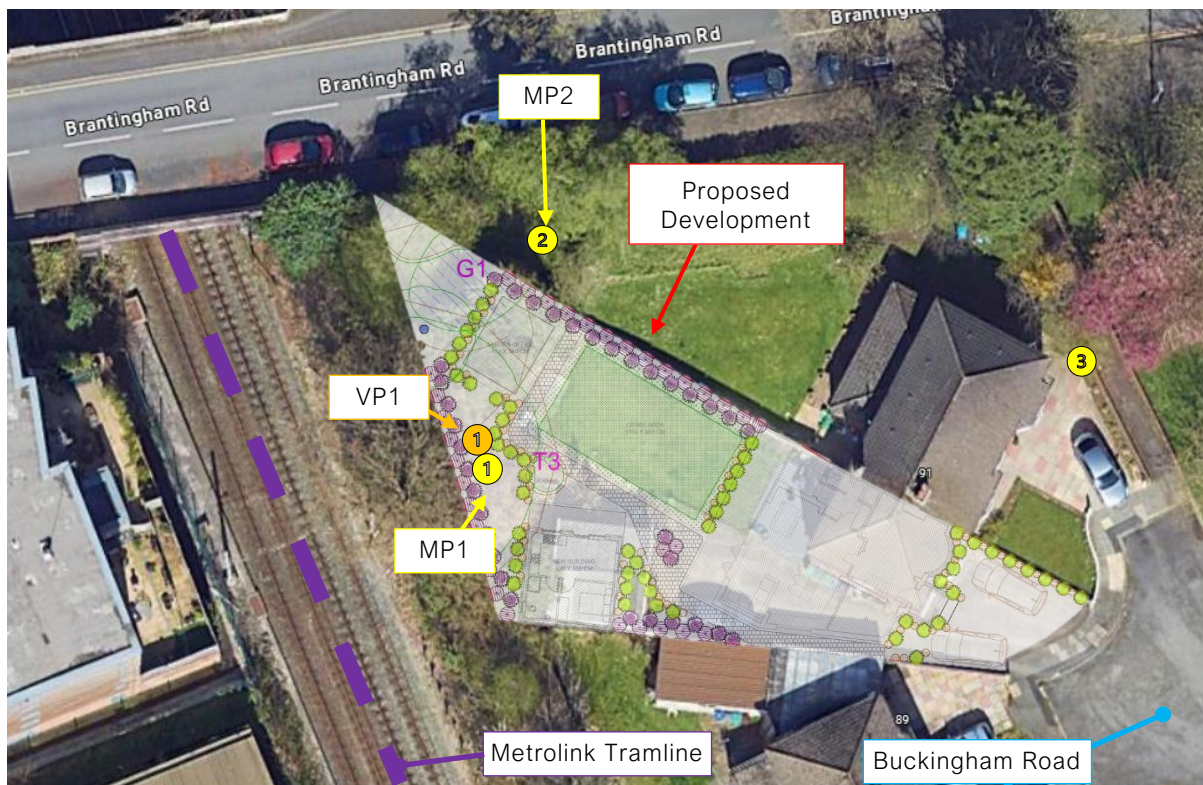
Vibration monitoring was also undertaken in this same location that was deemed most affected at the proposed development by potential vibration transmission.

The following table outlines the measurement dates and particulars.

Location	Survey Dates	Measurement Particulars
MP1 (Unattended)	11/11/2024 – 13/11/2024	Equipment mounted on a tripod 1.5m above ground in a location level with the westernmost façade of the proposed development.
VP1	11/11/2024 – 13/11/2024	Accelerometer mounted to rigid concrete slab.

Table 1 – Measurement Methodology

The figure below outlines the site surroundings and measurement locations:



Imagery ©2024 Airbus, Map Data ©2024

Figure 2 – Measurement Locations and Site Surroundings

2.2 Context & Subjective Impression

The proposed development site is in the rear garden of 91 Buckingham Road, Manchester. The area surrounding the site consists primarily of residential dwellings to the north, east and south. The site is bound to the west by the Firwood – Chorlton Metrolink tramline.

The acoustic environment is deemed to be low to moderate in level and the noise profile is dominated by road traffic noise emissions from the surrounding roads and tram pass-bys. Occasional birdsong also affected the measurements.

2.3 Environmental Noise Survey Results

The following section outlines a summary of the measured free-field sound levels during the survey. The ambient sound levels throughout the daytime and night-time periods are presented, alongside the 10th highest maximum noise level measured during the night-time over a 1-minute sampling period. The time history results can be found in Appendix D.

Location	Measurement Period ('T')	Octave Frequency Band (Hz, L _{eq,T} , dB)							L _{Aeq,T} (dB)	'Typical' L _{AFmax,1min} (dB)
		63	125	250	500	1k	2k	4k		
MP1	L _{eq,16hr} (Day)	59	53	50	54	49	46	43	55	--
	L _{eq,8hr} (Night)	52	46	43	40	39	36	34	44	65

Table 2 – Sound Level Results Summary

It should be noted that along the western boundary of the site was a partial timber fence. It is understood that this will be removed as part of the works. While the measurements did have line of sight to any passing trams, a conservative allowance will be made to the above noise levels to account for any slight screening that may have affected the measurements.

3. Noise Break-in Assessment and Sound Insulation Scheme

3.1 Internal Noise Level Criteria

The following table outlines the internal acoustic design criteria used in the following assessment.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
Resting	Living Room	35 dB $L_{Aeq,16hr}$	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hr}$	--
Sleeping (Daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB L_{AFmax}^*

**Note 1: The maximum criteria have been taken from the World Health Organisation (WHO) Guidelines for Community Noise.*

**Note 2: ProPG:2017 which is relevant to 'New Residential' states; "In most circumstances in noise sensitive rooms at night (e.g., bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax, F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability, and regularity of noise events".*

Note 3: BS8233:2014 states: "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved".

Note 4: BS8233:2014 states: "The levels shown in Table 4 (criteria shown above) are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g., 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

Note 5: BS8233:2014 states: "If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.

Table 3 – Internal Acoustic Design Criteria

The measured sound levels at the proposed development are assessed against the relevant criteria and a sound insulation scheme is provided to achieve a good internal acoustic environment.

3.2 Determined External Noise Levels

As previously stated, an existing fence (albeit in poor condition) may have partially screened the measurements and the subsequent results in Table 2. Therefore, to form a robust assessment, it is determined that the noise levels incident on the facades of the development will be determined as **60 dB $L_{Aeq,16h}$** during the daytime and **50 dB $L_{Aeq,8h}$** and **70 dB L_{AFmax}** , at night. Were there to be 90 degrees of screening, this would result in approximately 3 dB of screening to be allowed for. Given that the fence screens less than this, yet a 5 dB increase on the noise levels in Table 2 has been applied, the above represents a worst-case scenario.

3.3 Glazing and Background Ventilation Specification

The following section provides a glazing and background ventilation specification that achieves the relevant internal noise criteria. The calculations considering the following sound insulation scheme can be found in Appendix E.

The noise levels impacting the annex building, as detailed in Section 3.2, have been used to inform the below assessment. Due to the extension at 91 Buckingham Road being further away and benefiting from additional screening attenuation, the noise levels on its facades will be lower than those outlined in Section 3.2. Consequently, the following glazing and ventilation strategy is also appropriate for the extension.

Furthermore, the below strategy would also ensure that internal noise levels within the office would not exceed the criteria stated in BS 8233 for an 'executive office' (35 – 40 dB L_{Aeq}).

Description	Octave Frequency Band (Hz, dB)							Overall (dB)
	63	125	250	500	1k	2k	4k	
8mm Glass / 16mm Air Cavity / 6mm Glass	20	20	21	33	40	36	48	35 R_w (-6; C_{tr})
Titon V25 + C25 (2 No. Trickle)	25	39	38	34	32	42	49	36 $D_{ne,w}$ (-2; C_{tr})

Table 4 – Glazing & Background Ventilation Specification

Any other window or ventilation specification capable of providing this attenuation will be suitable provided the glazing suppliers can provide an acoustic test report in accordance with BS EN ISO 10140-2:2010 or an evidence-based calculation.

To not downgrade the performance of the façade, the other elements within the external envelope (roof, walls etc.) must have a sound insulation performance that is at least 10 dB greater than the glazing presented above (45 R'_w).

This would be readily achievable with a cavity masonry wall construction. Where the roof is lined, this would require an acoustic design review during the design stages of the development.

The above performance relating to the ventilators must be achieved in the 'open' position.

4. Overheating Screening Assessment

In order to avoid excessively high temperatures and provide adequate levels of thermal comfort within dwellings, an overheating mitigation strategy must be developed. In low noise areas, this strategy can often rely upon opening windows as the primary source of ventilation, however, in areas with higher levels of noise, this would present a risk of adverse effects on health and quality of life.

4.1 Overheating Criteria

The threshold levels at which adverse effects may occur are defined in Approved Document O ('ADO') and the 'Acoustics Ventilation and Overheating Design Guide' ('AVO'). Considering that a partially open window provides approximately 9 dB of attenuation in areas of moderate risk (as stated in the ADO supporting documentation), the proposed internal and external noise criteria are summarised as follows:

Period	Proposed Criteria (dB)		External Level (dB)	
	Internal	External	Measured	Exceedance
Daytime ($L_{Aeq,16hr}$)	50 [1]	59	60	+1
Night-time ($L_{Aeq,8hr}$)	40 [2]	49	50	+1
Night-time ($L_{AFmax,T}$) [3]	55 [2]	64	70	+6

Notes:

[1] Criterion taken from the AVO guide. Above this level, it is stated: "Noise causes a material change in behaviour, e.g., having to keep windows closed most of the time."

[2] Criteria taken from Approved Document O. Above this level, it is stated: "Windows are likely to be closed during sleeping hours."

[3] L_{AFmax} exceeded fewer than 10 times per night.

Table 5 – External Noise Level Limits for Overheating Criteria

4.2 Overheating Assessment

The noise levels measured on site exceed the external noise criteria shown in the table above. However, as there is only a 1 dB exceedance during the daytime and the external noise levels incident on the facades of the development are deemed a worst case (see section 3.2), this should be deemed acceptable. Given this, it is thought that opening windows can be used as the primary means of mitigating overheating during the daytime.

At night, however, there is an exceedance of +6 dB and, therefore, an assessment of whether the development is at risk of overheating would need to be undertaken by a suitably qualified person. Should the outcome indicate the site is at low risk of overheating, then a secondary ventilation strategy may not be required. If the outcome is that the site is at moderate to high risk, then it is recommended that openable windows are not used as the primary source of ventilation.

Alternative forms of ventilation include passive systems (such as acoustic louvres) and mechanical systems (such as 'centralised mechanical extract ventilation' and 'mechanical ventilation with heat recovery'). The installation of passive systems is generally preferable; however, the precise requirements

must be confirmed with a ventilation specialist. Further to this, it must also be ensured that all ventilation strategies are compliant with the requirements of Approved Document F.

It should be noted that this assessment relates exclusively to overheating mitigation, and as such, open windows may be used for purge ventilation without acoustic constraint.

Further advice can be provided by NOVA Acoustics if required.

5. Ground-Borne Vibration Screening Assessment

Due to the proximity of the adjacent tramlines, it is possible that the site may be affected by ground borne vibration and re-radiated noise. For this reason, vibration measurements have been undertaken in line with the façade deemed to be most affected.

5.1 Ground-Borne Vibration Criteria

BS6472-1:2008 provides criteria for assessing ground-borne vibration in the form of the “likelihood of adverse comment” that might result from given Vibration Dose Values (‘VDV’) within buildings. The following table outlines the criteria presented within BS6472-1:2008.

Description	VDV $\text{m.s}^{-1.75}$		
	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential 16-hour Day	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential 8-hour Night	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Table 6 – BS6472-1:2008 Ground-Borne Vibration Criteria Inside Dwellings

The guidance above relates to vibration measured at a point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper-storey floor, rather than the point of entry into the building, a foundation element for example.

Where the vibration is measured at another location, BS6472-1:2008 states that a transfer function should be applied; however, no further guidance is provided in BS6472-1:2008. It does however reference other publications that contain transfer functions. It is necessary to estimate the effect that any building will have on the magnitude of vibration at the point of entry to the human body.

Two key aspects in terms of building structure effect the measured vibration levels:

- Generally, a reduction occurs as the vibration passes into the foundations of a building.
- Typically, amplification occurs as the vibration propagates up the building to the upper storeys and across the potentially suspended floors.

In this instance, the vibration levels were measured at ground level at the façade of the development building. It is generally accepted that a multiplication factor must be applied where there are upper floors within a development that require assessment. Considering that the measurement was taken on a concrete slab, no multiplication factor will be applied to the vibration at ground level, however, vibration at the 1st floor levels of the extension will be multiplied by a factors of 2.

5.2 Ground-Borne Vibration Measured Results

VDV measurements were undertaken using a Vibrock V9000 vibration monitor. As previously stated, to provide a representative assessment of exposure for future residents, the accelerometer was set up in line with where the future development will be located.

The table below presents the measured VDV levels during each daytime and night-time period within the survey. The maximum values across each co-ordinate are subsequently presented and will be used within the assessment.

Date	Measurement Period	VDV 16-hour $m.s^{-1.75}$		
		X Axis (W_d)	Y Axis (W_d)	Z Axis (W_b)
11/11/2024	07:00 – 23:00	0.004	0.005	0.005
12/11/2024	23:00 – 07:00	0.005	0.005	0.005
	07:00 – 23:00	0.003	0.004	0.004
13/11/2024	23:00 – 07:00	0.003	0.005	0.004
	07:00 – 23:00	0.002	0.002	0.002

Table 7 – Summary of Measured VDV Levels

The calculated day and night-time vibration dose values incident on the ground and first floors are detailed in the table below. The calculation method is taken from Formula 2 in Appendix B of BS6472-1:2008.

Description	Calculated VDV $m.s^{-1.75}$		
	X Axis (W_d)	Y Axis (W_d)	Z Axis (W_b)
16-hour Day – Ground Floor	0.004	0.005	0.005
8-hour Night – Ground Floor	0.005	0.005	0.005
16-hour Day – 1 st Floor	0.008	0.010	0.010
8-hour Night – 1 st Floor	0.010	0.010	0.010

Table 8 – Summary of Calculated VDV Levels

As shown above, the calculated vibration dose values across daytime and night-time are significantly below the 'low probability of adverse impact' criteria provided in Table 6. As such, vibration is not thought to be of concern based on the measurements at ground level.

However, additional consideration of potential vibration effects at foundation level may be required given the separation distance from the tramline.

Typically, this would require the following additional surveys:

- In locations where shallow raft foundations are proposed, vibration monitoring at the proposed foundation depth should be undertaken once excavated.
- For areas where deep piles are proposed, a test pile should be installed and vibration monitoring undertaken directly on top of the pile.

Due to the nature of the above surveys, and associated costs, it is anticipated that these would only be undertaken after conditional approval for the site is granted by the Local Authority.

If necessary, mitigation would likely comprise of isolation at the building base to mitigate vibration and re-radiated noise throughout the build. This would be designed to limited both vibration effects and re-radiated noise through the structure.

6. External Noise Level Assessment

6.1 External Noise Level Assessment

As per BS 8233, noise levels within external amenity areas should not exceed 55 dB LAeq,16hr as an upper guideline value.

The following table analyses the determined ambient noise levels expected within the external amenity and compares it against this noise level limit.

The below determined noise level has accounted for screening attenuation ($-4 \text{ dB} = 10 \cdot \log(70/180)$) and distance attenuation ($-3 \text{ dB} = 10 \cdot \log(9/18)$) to the proposed amenity area.

LAeq,16hr Noise Level (dB)	BS8233:2014 Criteria (dB)	Exceedance (dB)
52	50 – 55 LAeq,16hr	-3

Table 9 – BS8233:2014 External Amenity Area Noise Level Assessment

Based on the above, the requirements would be met, and no mitigation measures are required.

7. Conclusion and Action Plan

The proposed development has been assessed against the acoustic design criteria and a sound insulation scheme has been provided to ensure the criteria has been achieved.

The following 'Action Plan' is outlined to ensure the design considerations and specifications from this report are duly implemented:

- The proposed glazing and background ventilation system, or a suitable alternative, should be installed as shown in section 3.3.
- To assist in the design of the alternative ventilation strategy an overheating assessment should be undertaken to ascertain how frequently open windows will be required to mitigate overheating during the night-time.
- A vibration impact assessment was carried out and this is detailed in Section 5. In summary, the calculated vibration dose values across daytime and night-time are significantly below the 'low probability of adverse impact' criteria. As such, vibration is not thought to be of concern based on the measurements at ground level. However, additional consideration of potential vibration effects at foundation level may be required given the separation distance from the tramline. Further information is provided in Section 5.2.
- Noise levels within the external amenity area would not exceed BS 8233 criteria. Therefore, no mitigation measures are required.

The findings of this report will require written approval from the Local Authority prior to work commencing.

Appendix A – Acoustic Terminology

A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure given by the following formula in decibels (dBA). $L_{pA} = 10 \log_{10} (pA/p_0)^2$. Where: pA is the A-weighted sound pressure in pascals (Pa) and p_0 is the reference sound pressure (20 μ Pa)
Background Sound	Underlying level of sound over a period, T , which might in part be an indication of relative quietness at a given location
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T , has the same mean-squared sound pressure as the sound under consideration that varies with time
Facade level	Sound pressure level 1 m in front of the facade
Free-field level	Sound pressure level away from reflecting surfaces
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants
Noise Criteria	Numerical indices used to define design goals in a given space
Noise Rating (NR)	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves
Octave Band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit
Percentile Level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting “F”, which is exceeded for $N\%$ of a specified time interval
Rating Level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise
Reverberation time, T	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped
Sound Pressure, p	root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound
Sound Pressure Level, L_p	Quantity of sound pressure, in decibels (dB), given by the formula: $L_p = 10 \log_{10} (p/p_0)^2$. Where: p is the root-mean-square sound pressure in pascals (Pa) and p_0 is the reference sound pressure (20 μ Pa)
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies

Appendix B – Standards, Legislation, Policy, and Guidance

This report is to be primarily based on the following standards, legislation, policy, and guidance.

B.1 – National Planning Policy Framework (2023)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2023. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 180, it states:

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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.

Paragraph 191 states:

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:

- a) 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;*
- b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- c) Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes, and nature conservation.*

B.2 – Noise Policy Statement for England (2010)

Paragraph 191 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- Avoid significant adverse impacts on health and quality of life:
- Mitigate and minimise adverse impacts on health and quality of life:
- Where possible, contribute to the improvement of health and quality of life.

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that “significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development”.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: “all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.”

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: “where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.”

This is further expanded using the updated “Noise Exposure Hierarchy Table” which includes an additional level of impact referred to as the ‘No Observed Adverse Effect Level’ (‘NOAEL’). It is stated that at this level: *“noise can be heard, but does not cause any change in behaviour, attitude or other physiological response”*. In addition, noise at this level *“can slightly affect the acoustic character of the area but not such that there is a change in the quality of life”*.

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

B.3 – BS8233:2014 ‘Guidance on Sound insulation and noise reduction for buildings’

BS8233 provides guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, ‘WHO Guidelines on Community Noise, 1999’. The Guidelines on Community Noise (1999) document defines community noise to include noise from “industries” and “construction”. The desirable criteria levels of steady state, “anonymous” noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below.

Activity	Location	Daytime (07:00 – 23:00)	Night-time (23:00 – 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 $L_{Aeq,8hour}$ 45 dB L_{AFmax}^*

Table 10 – BS8233:2014 Internal Ambient Noise Level Criteria

**ProPG:2017 states that's good acoustic design can be used so that individual noise events do not normally exceed 45 dB L_{AFmax} more than 10 time a night within noise sensitive rooms such as bedrooms. However, where it is not reasonably practicable to achieve the guideline then the judgment of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number distribution, predictability, and regularity of noise events.*

It is noted, however, that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the ‘LOAEL’ as defined in the NPSE in Appendix B.

B.4 – Approved Document O: Overheating (2021)

Approved Document O states the following in relation to noise:

1. 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).
2. 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. 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.

NOTE: Guidance on reducing the passage of external noise into buildings can be found in the National Model Design Code: Part 2 – Guidance Notes (MHCLG, 2021) and the Association of Noise Consultants' Acoustics, Ventilation and Overheating: Residential Design Guide (2020).B.6 - Acoustics Ventilation and Overheating – Residential Design Guide 2020

B.5 – Acoustics Ventilation and Overheating – Residential Design Guide 2020

It is suggested that the desirable internal noise criteria within BS8233:2014 should be achieved considering adequate ventilation as defined by Building Regulations 'Approved Document F' ('ADF') whole dwelling ventilation. However, for a whole dwelling ventilation system such as MVHR it is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition.

The 'Institute of Acoustics' ('IOA') and the 'Association of Noise Consultant's' ('ANC') have published 'The AVO Guide: 2020' document 2020. It provides guidance for those acousticians involved in the design of buildings to prevent noise ingress to and achieve reasonable internal levels. This provides valuable guidance on ventilation and overheating in support of the "Good Acoustic Design" principle advocated by ProPG. Along with guidance showing an acoustic assessment during the overheating condition, the AVO Guide (2020) provides a framework that has a two-level assessment procedure to estimate the potential impact on occupants:

Level 1 Risk Assessment

AVO 'Level 1' risk assessment criteria guide based on external free field ambient noise levels for dwellings relying on purge ventilation (e.g., opening windows) to prevent summertime overheating. AVO Guide Table 3-2 detailed in the figure below. To assess the possibility of overheating it is reasonable to relax the BS 8233:2014 internal ambient noise levels from opening a window by 5 decibels (5 dB). Also, it is assumed that a partially open window will provide a sound reduction of 13 dB. Therefore, to achieve internal noise levels in line with BS 8233:2014 the façade external noise levels should fall inside the levels shown in Table 3-2.

Risk category for Level 1 assessment ^[Note 5]	Potential Effect without Mitigation	Recommendation for Level 2 assessment
LAeq,T ^[Note 3] during 07:00 - 23:00 LAeq,8hr during 23:00 - 07:00 High 65 dB 55 dB Medium 60 dB 50 dB Low 55 dB 50 dB Negligible 50 dB 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

Table 3-2 of AVO Guide (2020)

Figure 3 – AVO Guide Level 1 Risk Category

The AVO Guide (2020) seeks to determine the level of risk associated with overheating in a new residential development based on the existing noise climate. The AVO risk categories are detailed in the table below with clearer categorisation.

AVO Guide (2020) Level 1 Risk Assessment			
Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	Risk Category	Mitigation
≥ 63 dB $L_{Aeq,16hour}$	≥ 55 dB $L_{Aeq,8hour}$	High Risk	Level 2 assessment recommended. Windows which are unopenable on grounds of noise will inevitably create issues for the overheating strategy.
57 – 62 dB $L_{Aeq,16hour}$	52 – 54 dB $L_{Aeq,8hour}$	Medium Risk	Level 2 assessment optional to give more confidence regarding the suitability of internal noise conditions.
54 – 56 dB $L_{Aeq,16hour}$	49 – 51 dB $L_{Aeq,8hour}$	Low Risk	
≤ 53 dB $L_{Aeq,16hour}$	≤ 48 dB $L_{Aeq,8hour}$	Negligible Risk	None required – openable windows suitable for ventilation

Table 11 – AVO Guide (2020) Level 1 Risk Assessment

Level 2 Risk Assessment:

A 'Level 2' assessment of noise is recommended where a dwelling using purge ventilation (e.g., open windows) reaches Level 1 'High Risk' or 'Medium Risk'. The Level 2 assessment guidance comments that where internal ambient noise levels are >50 dB $L_{Aeq,16hr}$ (day) or >42 dB $L_{Aeq,8hr}$ (night) then the outcome might be that the noise causes a material change in behaviour, e.g., having to keep windows closed for the majority of the time, or there is the potential for sleep disturbance.

To conduct a Level 2 assessment, the following minimum information is required:

- Statement of the overheating criteria being applied.
- Description of the provisions for meeting the stated overheating criteria. This should include, where relevant, the area of façade 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 events.
- Assessment of the adverse effect on occupants.

The figure below outlines the AVO Guide (2020) guidance for a Level 2 assessment of noise from transport sources relating to the Overheating Condition.

Internal ambient noise level ^[Note 2]			Examples of Outcomes ^[Note 5]	
$L_{Aeq,T}$ ^[Note 3] during 07:00 – 23:00 ^[Note 6]	$L_{Aeq,8h}$ during 23:00 – 07:00	Individual noise events during 23:00 – 07:00 ^[Note 4]		
> 50 dB	> 42 dB	Normally exceeds 65 dB $L_{A,max}$	Noise causes a material change in behaviour e.g. having to keep windows closed most of the time	Avoiding certain activities during periods of intrusion. 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.
 Increasing noise level			Increasing likelihood of impact on reliable speech communication during the day or sleep disturbance at night	At higher noise levels, more significant behavioural change is expected and may only be considered suitable if occurring for limited periods. As noise levels increase, small behaviour changes are expected e.g. turning up the volume on the television; speaking a little more loudly; having to close windows for certain activities, for example ones which require a high level of concentration. Potential for some reported sleep disturbance. Affects the acoustic environment inside the dwelling such that there is a perceived change in quality of life. At lower noise levels, limited behavioural change is expected unless conditions are prevalent for most of the time. ^[Note 8]
≤ 35 dB	≤ 30 dB	Do not normally exceed $L_{A,max}$ 45 dB more than 10 times a night	Noise can be heard, but does not cause any change in behaviour	Noise can be heard, but does not cause any change in behaviour, attitude, or other physiological response ^[Note 9] . Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.

Note 1 The noise levels suggested in Tables 3-2 and 3-3 assume a steady road traffic noise source but may be adapted for other types of transport.

Table 3-3 of AVO Guide (2020)

Figure 4 – AVO Guide Level 2 Internal Ambient Noise Levels

Appendix C – Location Plans



Figure 5 – Location Plans

Appendix D – Environmental Survey

D.1 – Time History Noise Data

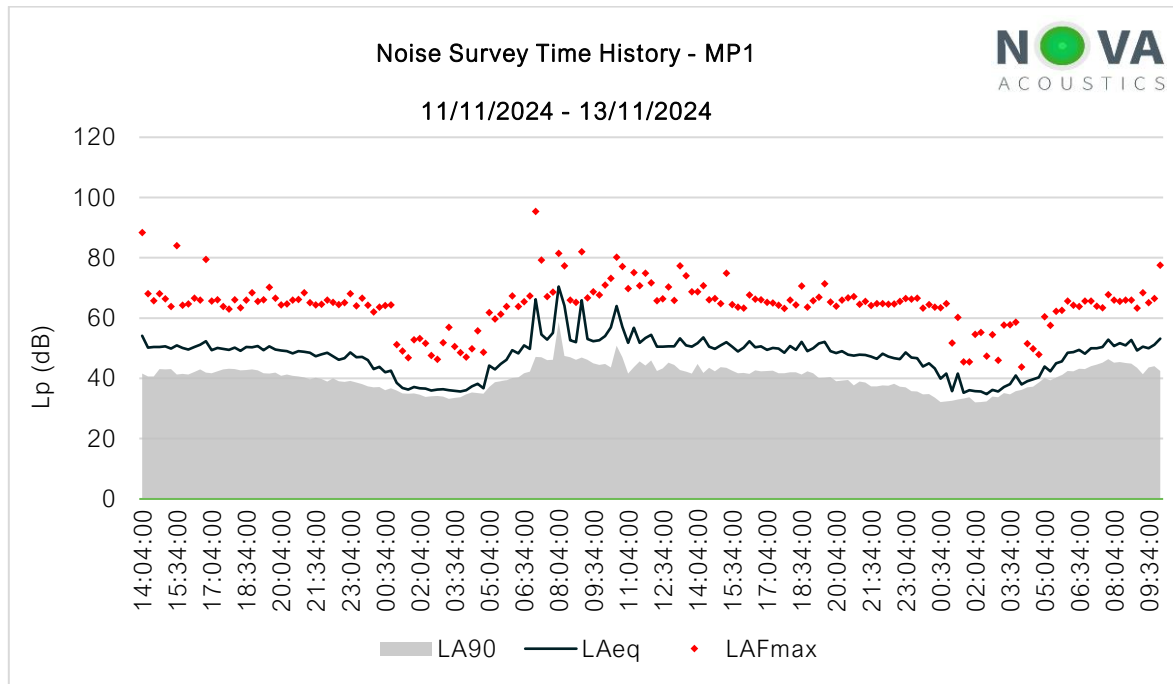


Figure 6 – MP1 Noise Survey Time History

D.2 – Surveying Equipment

Piece of Equipment	Serial No.	Calibration Deviation
Svantek SV971 Class 1 Sound Level Meter	44018	≤0.2
Svantek SV36 Class 1 Calibrator	106876	

Table 12 – Surveying Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

D.3 – Meteorological Conditions

As the environmental noise survey was carried out over a long un-manned period no localised records of weather conditions were taken. However, all measurements have been compared with met office weather data of the area, specifically the closest weather station, and the data from the weather station is outlined in the table below. When reviewing the time history of the noise measurements, any scenarios that were considered potentially to be affected by the local weather conditions have been omitted. The analysis of the noise data includes statistical and percentile analysis and review of minimum and maximum values, which aids in the preclusion of any periods of undesirable weather conditions. The weather conditions

were deemed suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise. The table below presents the average temperature, wind speed and rainfall range for each 24-hour period during the entire measurement.

Weather Conditions – Chorlton (Approx. 1km W of Site)				
Time Period	Air Temp (°C)	Rainfall (mm/h)	Prevailing Wind Direction	Wind Speed (m/s)
11/11/24 – 00:00 – 23:59	4.4 – 11.0	0.0	ESE	0.0 – 0.0
12/11/24 – 00:00 – 23:59	0.5 – 10.5	0.0	ENE	0.0 – 0.2
13/11/24 – 00:00 – 23:59	0.6 – 9.5	0.0	SSE	0.0 – 0.2

Table 13 – Weather Conditions

Appendix E – Noise Break-in Calculations

E.1 – Façades with Background Ventilation

The façade sound reduction and predicted internal noise levels are calculated assuming the following:

- The calculation method for façade sound reduction is in accordance with BS8233:2014 and BS EN 12354-3.
- The reverberation time has been set at 0.3 seconds and 0.5 seconds, for bedrooms and living rooms, respectively. This is deemed typical for furnished rooms in the UK.
- Based on the technical drawings provided to NOVA Acoustics, window percentage areas of approximately 20% and 50% have been used for bedrooms and living rooms, respectively. Where these figures increase as the design develops (because of increased window sizes and / or a reduction in room sizes), the below calculations will need to be revised.
- The acoustic performance of the façade elements are taken from the relevant manufacturers technical information or the sound reduction has been predicted using INSUL 9.0.
- For background trickle ventilation a total Equivalent Area of 5000mm² per habitable room has been used in the calculations, which equates to 2 No. trickle vents (2500mm² each).
- Please note that only the calculations for the annex are presented below. The noise levels incident on the rooms within the extension are subject to increase distance and screening attenuation and so the below represent the most affected facades within the development.

Living Room (Annex) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	60	64	57	55	58	54	51	48	52
Glazing Noise Ingress	23	38	31	28	19	8	9	-6	-2
Ventilation Noise Ingress	24	38	17	15	23	20	8	-2	1
Wall Noise Ingress	-3	16	4	0	-7	-12	-15	-18	-14
Roof Noise Ingress	21	39	29	22	20	12	7	-5	-1
Room Absorption Correction		5	5	4	4	4	3	2	1
Total Noise Ingress	34	51	41	36	33	28	19	6	8
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-1	-8	-7	-3	0	-2	-7	-18	-14

Bedroom (Annex) Day Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	60	64	57	55	58	54	51	48	52
Glazing Noise Ingress	18	33	26	23	14	3	4	-11	-7
Ventilation Noise Ingress	26	40	20	18	25	23	10	0	4
Wall Noise Ingress	-1	17	6	1	-5	-11	-14	-17	-13
Roof Noise Ingress	22	40	29	22	21	12	8	-4	-1
Room Absorption Correction		2	2	2	1	1	1	0	-2
Total Noise Ingress	32	49	36	31	31	28	17	4	7
NR30	35	59	48	39	33	30	26	24	22
Exceedance of Criteria	-3	-10	-12	-8	-2	-2	-9	-20	-15

Bedroom (Annex) Night Time Leq

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Leq,T Spectrum	50	58	51	49	46	45	42	40	35
Glazing Noise Ingress	11	27	20	17	2	-6	-5	-19	-24
Ventilation Noise Ingress	17	34	13	12	13	14	1	-8	-13
Wall Noise Ingress	-9	11	0	-5	-18	-20	-23	-25	-29
Roof Noise Ingress	14	33	23	16	8	4	-1	-13	-17
Room Absorption Correction		2	2	2	1	1	1	0	-2
Total Noise Ingress	24	42	30	25	19	19	7	-4	-10
NR25	30	55	43	35	28	25	21	19	17
Exceedance of Criteria	-6	-13	-13	-10	-9	-6	-14	-23	-27

Bedroom (Annex) Night Time Max

Item / Description	dB(A)	63	125	250	500	1k	2k	4k	8k
Corrected Lmax Spectrum	70	75	71	65	61	64	64	63	56
Glazing Noise Ingress	28	43	40	33	17	13	17	4	-3
Ventilation Noise Ingress	35	51	33	28	28	33	23	15	8
Wall Noise Ingress	9	28	19	11	-2	0	-1	-2	-8
Roof Noise Ingress	31	50	42	32	24	23	20	11	4
Room Absorption Correction		2	2	2	1	1	1	0	-2
Total Noise Ingress	42	59	50	41	34	38	29	19	11
NR40	45	67	56	49	43	40	37	34	33
Exceedance of Criteria	-3	-8	-6	-8	-9	-2	-8	-15	-22



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