INFINITY ACOUSTICS

# Noise Assessment

130 Withington Road,
Manchester,
M16 8FB



INFINITY ACOUSTICS

**Project Description:**

Residential Noise Assessment

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## 1. Introduction

1.1 Infinity Acoustics Ltd has been appointed to undertake a noise assessment of the proposed residential development located at 130 Withington Road, Manchester, M16 8FB.

1.2 As part of the development process, the client has submitted a full planning application to Manchester City Council. The application reference number and title are: *139297/FO/2024 Proposal: Erection of single storey rear extension following demolition of existing outbuilding, installation of dormers to rear elevation including conversion of upper floors into self-contained flat*

1.3 The application was subsequently conditionally approved by the local planning authority. Condition 6 on the planning decision notice relates to the potential noise impact on the proposed residential flat on the upper floors. Section 6A of condition 6 is outlined below:

1.4 *a) Prior to above ground works commencing, a scheme for acoustically insulating the proposed residential accommodation against noise Withington Road shall be submitted to and approved in writing by the City Council as local planning authority. There may be other actual or potential sources of noise which require consideration on or near the site, including any local commercial/industrial premises such as the ground floor commercial premises.*

*The potential for overheating shall also be assessed and the noise insulation scheme shall take this into account. The approved noise insulation and ventilation scheme shall be completed before any of the dwelling units are occupied. Noise survey data shall include measurements taken during a rush-hour period and night time to determine the appropriate sound insulation measures necessary. The following noise criteria shall be required to be achieved when providing adequate ventilation as defined by Approved Document F of the Building Regulations (whole dwelling ventilation):*

- *Bedrooms (night time - 23.00 - 07.00) 30 dB LAeq (individual noise events shall not exceed 45 dB LAmax,F by more than 15 times)*
- *Living Rooms (daytime - 07.00 - 23.00) 35 dB LAeq*
- *Gardens and terraces (daytime) 55 dB LAeq*

*Higher internal noise levels than those specified above may be allowed when higher rates of ventilation are required in relation to the overheating condition.*

1.5 The aim of the noise survey and assessment below is to provide the relative information to assist the client and the local planning authority in discharging the noise condition. However, it should be noted that part b of Condition 6 requires a post-completion verification survey before the full condition can be discharged. The noise levels at the site will be measured and assessed according to the relative standards and local planning policy, a sound insulation scheme will be provided where necessary to ensure the amenity of any future residents can be protected from surrounding noise sources and that relative criteria can be achieved.

1.6 The following noise assessment report will be undertaken in line with the National Planning Policy Framework 2023 and Noise Policy Statement for England 2010 as well as the following legislation policy and guidance.

### 1.7 *BS8233:2014 – Guidance on Sound Insulation and Noise Reduction In Buildings*

The general noise criteria used in the assessment will be obtained from BS8233: 2014 'Guidance on sound insulation and noise reduction for buildings' The criteria in BS8233 are largely based on the World Health Organisation Guidelines on Community Noise. The BS8233 criteria are outlined below:

- Living Room/Bedroom - 35 dB $L_{Aeq,16hour}$ (Day)
- Dining Room – 40 dB $L_{Aeq,16hour}$ (Day)
- Bedroom – 30 dB $L_{Aeq,8hour}$ (Night)

$L_{Afmax}$ levels will also be assessed based on the criteria defined by the World Health Organisation. The WHO state within the 'Guidelines on Community Noise' that in order to avoid sleep disturbance within bedrooms during the night, the internal sound pressure level should not exceed 45 dB $L_{Afmax.}$ The frequency of $L_{Afmax}$ events should also be considered it is understood that for an $L_{Afmax}$ noise event to adversely impact sleep the criteria would need to be exceeded more than ten times during a night time period.

It should be noted that the above criteria are desirable however BS8233 states the following: *'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.'* Given the site has conditional planning permission it is assumed the development is desirable. Therefore, it is assumed that when considering an open window condition reasonable internal conditions can be achieved with a 5 dB relaxation in criteria.

The above criteria outlined in BS8233:2014 and the World Health Organization Guidelines on Community Noise fall in line with the criteria outlined in Condition 6 of the planning decision notice. Given this provided the BS8233 criteria can be achieved the internal noise criteria outlined in the planning condition will also be achieved.

## 2. Site & Surroundings

2.1 The development site is situated to the west of Alexandra Park and the surrounding area is comprised of a mixture of commercial units, cafes and residential dwellings. In general, the surrounding area could be considered urban.

2.2 To the east of the site is Withington Road which facilitates moderate levels of road traffic flow. During the site visit the road noise was considered to be the primary noise source in the area.

2.3 Further east of the site is Co-Op Foods which operates between 07:00 – 22:00. During the site visit noise from this location was not audible. The car park and loading areas associated with the Co-Op were located to the rear of the site fully shielded from the proposed development by the Co=op Building itself.

2.4 There are also a number of commercial units located in the same row of buildings as the development. These include Mediterranean Café which operates between 07:00 – 16:00, The Whalley Range Dental Practice which operates between 09:00 – 17:30 and Whalley Range Off-License which operates between 09:00 – 23:00.

2.5 Along the front façade of the development noise from these commercial units was not generally audible. The front area is used by the surrounding business for patron parking however generally parking activities were no louder than that of the vehicle pass-bys on Withington Road.

2.6 The nearby Mediterranean Café has a patron area to the front of the proposed development site however again patron conversation and noise from this location as not generally audible above the road noise in the area. It was also noted that this café has a kitchen extraction system however this was not audible at the development site. It is fully shielded from the line of sight when considering both the front and rear facades of the development.

2.7 To the rear of the site, the noise levels were significantly lower due to the shielding from the road. Intermittent noise from the adjacent dentist practice was faintly audible at the rear façade of the development however this was very low in level.

2.8 Situated on the ground floor of the development site is an existing takeaway that does not currently operate. However, the client has indicated that the ground floor of the development will be converted into office space. Along the rear façade of the development was an associated takeaway kitchen extraction system. During the site visits attempts to operate the extraction system were made in order to measure the noise produced by the unit however it would not operate. The fan unit was identified as Flackwoods 500mm diameter fan and the ductwork had no visible noise attenuators. The duct work terminated approximately 2m from the exterior rear façade windows. The client has indicated the extraction system will be removed as part of the development of the ground floor takeaway into office space given this it will not be included in the subsequent assessment.

2.9 During the site visit, it was established that the constriction of the building was typical masonry facades with a tile roof. The existing glazing was assumed to be standard double glazing 4mm glass/16mm cavity/4mm glass. The floor between the ground floor and the flat above was assumed to be timber floor boards 200mm timber joists and a 15mm plasterboard ceiling.

## 3. Survey

3.1 A noise survey of the site was undertaken between the 14th of May to the 17th of May 2024.

3.2 The following equipment was used to undertake the noise survey. Calibration certificates for the equipment can be provided upon request.

- SVAN 971A Class 1 Sound Level Meter – SN – 113352
- SVAN 971A Class 1 Sound Level Meter – SN – 139441
- SVAN SV33B Class 1 Calibrator – SN – 122241

Field calibration was undertaken before and after the survey and the meters were found to have less than 0.2 dB drfit which falls within acceptable levels.

3.3 The long-term noise meter and associated microphone at Measurement Location 1 (ML1) were located along the front façade. The meter was located approximately 3.5m from the ground attached to the shop sign associated with the ground floor takeaway.

The long-term noise meter and associated microphone at Measurement Location 2 (ML2) were located along the rear façade. The meter was positioned appreciate 3.5m from the ground attached to a drainpipe.

Due to the flat being occupied the upper floor windows could not be utilised to install the equipment. Due to the proximity of the microphone to the façade of the development appropriate façade corrections be applied to establish free field noise levels as required in BS8233.

3.4 The weather during the setup of the equipment on the 14th is outlined below:

- 15.7 degrees Celsius
- W wind direction with speeds less than 1m/s
- Full cloud cover and light precipitation

3.5 The weather during the collection of the equipment on the 16th and 17th is outlined below:

16th of May

- 19.4 degrees Celsius
- NNE wind direction with speeds of 1.5m/s
- Low cloud cover no precipitation

17th of May

- 13.7 degrees Celsius
- E wind direction with speeds less than 1m/s
- Low cloud cover no precipitation

3.6 Generally, the weather across the majority of the survey complied with the requirements of BS 7445-2. A full weather summary for the duration of the survey is outlined in the table below.

| Weather Data – Chorlton 14/05/2-24 – 17/05/2024 | |
|---|---|
| **Description** | **Data** |
| Temp (C) | 10.7 – 23.0 |
| Rain Fall (mm) | 0.0 – 4.8 |
| Wind Speed (m/s) | 0.0 – 2.1 |
| Prevailing Wind | ESE |
| Relative Humidity (%) | 46.0 – 96.0 |

*Table 1.0 – Weather Data*

**Heavy rain occurred before the survey commenced*

3.7 The results of the ambient noise survey at ML1 the front façade are presented in the tables below and will be used in the subsequent Noise Assessment.

| 16 & 8 Hour Results ML1 | | | |
|---|---|---|---|
| **Date** | **Time Period** | **$L_{Aeq\ (dB)}$** | **$L_{Afmax\ (dB)}$** |
| Day – 16/05/2024 | 10:45 – 23:00 | 62.0 | 97.0 |
| Night – 16/05/2024 | 23:00 – 07:00 | 55.0 | 79.0 |
| Day – 17/05/2024 | 07:00 – 07:15 | 60.0 | 85.0 |
| **ML1 $L_{Afmax}$ Analysis** | | | |
| **Time Period** | | **$10^{th}$ Highest $L_{Afmax,1min}$** | |
| Night 1 | | 74.0 | |

*Table 2.0 – Noise Survey Global Data ML1*

| 1/1 Octave Band Leq – Measurement Location 1 (Hz) (dB) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Description** | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** |
| Highest $L_{Zeq,16hour}$ | 65.0 | 58.0 | 55.0 | 56.0 | 58.0 | 55.0 | 49.0 |
| Highest $L_{Zeq,8hour}$ | 58.0 | 51.0 | 48.0 | 49.0 | 52.0 | 48.0 | 42.0 |

*Table 3.0 – Noise Survey Octave Band Data ML1*

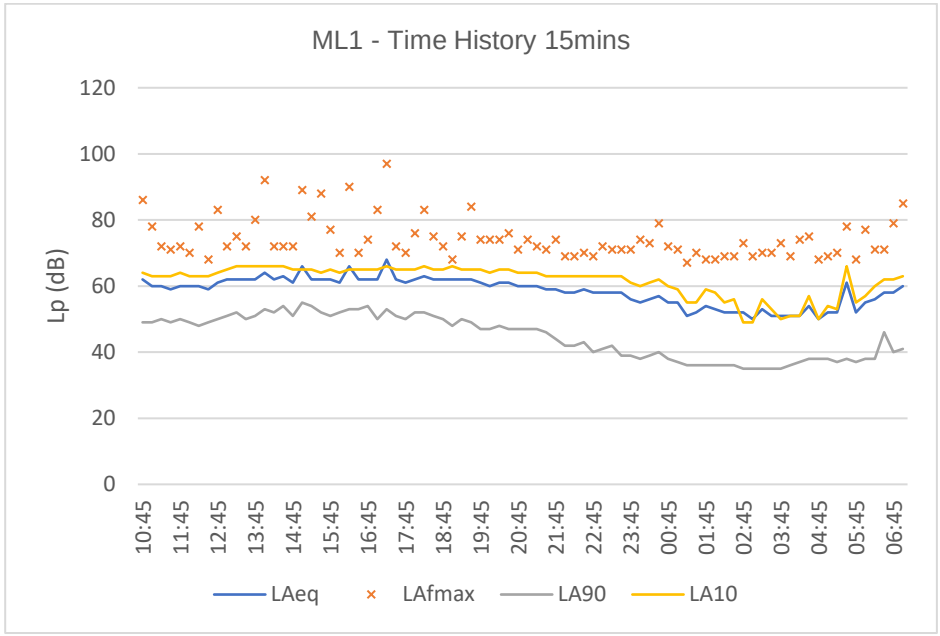



*Figure 1.0 – Time History ML1*

3.8 The time history indicated in Figure 1.0 indicates that the noise incident on the façade of the development is relatively steady state and continuous with little variance and no significant increases. The noise measured at the front façade follows typical diurnal patterns with a significant drop in noise levels during the night time period. This is indicative of road noise being the dominant noise source in the area which lines up with the subjective impressions gained on site.

3.9 The results of the ambient noise survey at ML1 the front façade are presented in the tables below and will be used in the subsequent Noise Assessment.

| 16 & 8 Hour Results ML2 | | | |
|---|---|---|---|
| **Date** | **Time Period** | **$L_{Aeq\ (dB)}$** | **$L_{Afmax\ (dB)}$** |
| Day – 14/05/2024 | 11:00 – 23:00 | 47.0 | 85.0 |
| Night – 14/05/2024 | 23:00 – 07:00 | 42.0 | 67.0 |
| Day – 15/05/2024 | 07:00 – 23:00 | 49.0 | 76.0 |
| Night – 15/05/2024 | 23:00 – 07:00 | 41.0 | 69.0 |
| Day – 16/05/2024 | 07:00 – 10:30 | 47.0 | 77.0 |
| **ML2 $L_{Afmax}$ Analysis** | | | |
| **Time Period** | | **10th Highest $L_{Afmax,1min}$** | |
| Night 1 | | 60.0 | |
| Night 2 | | 58.0 | |

*Table 4.0 – Noise Survey Global Data ML2*

| 1/1 Octave Band Leq – Measurement Location 1 (Hz) (dB) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Description** | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** |
| Highest $L_{Zeq,16hour}$ | 62.0 | 59.0 | 52.0 | 50.0 | 47.0 | 46.0 | 43.0 |
| Highest $L_{Zeq,8hour}$ | 47.0 | 45.0 | 41.0 | 37.0 | 33.0 | 32.0 | 37.0 |

*Table 5.0 – Noise Survey Octave Band Data ML2*

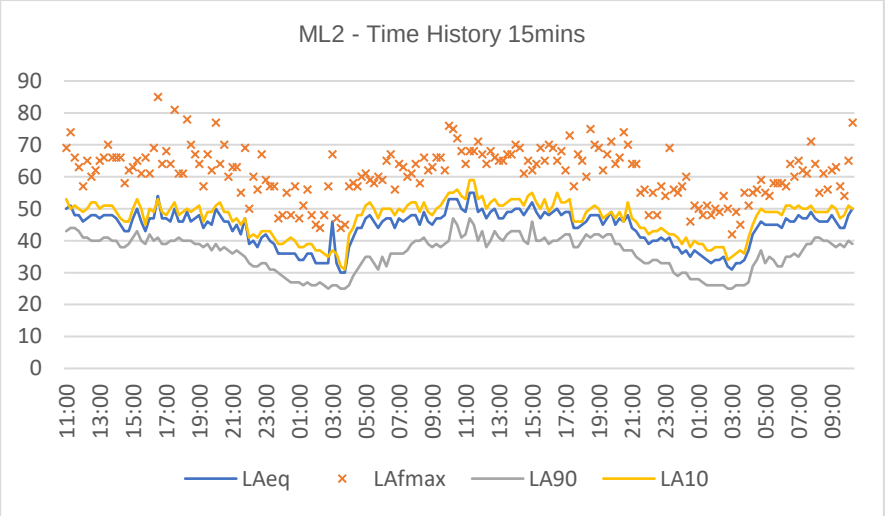



*Figure 2.0 – Time History ML2*

3.10 The noise levels measured at the rear of the site were lower than those measured at the front facade. As can be seen in Table 3.0 considering the average daytime and night time noise levels open windows could be used as primary means of ventilation whilst still achieving appropriate internal noise criteria. This is a positive indication that the site is suitable for future development.

## 4. Sound Insulation Scheme and Recommendations

4.1 The following section of the report details the sound insulation scheme required to ensure internal noise criteria can be achieved and that future residents are protected from noise ingress from the external environment. Prior approval of the sound insulation scheme should be sought from the local authority before any of the works outlined below are implemented.

4.2 Facades & Roof

The façade build-up obtained during the site visit is assumed to be a minimum of 210mm masonry brick. When modelled in INSUL 10.0 typical wall constructions such as this are found to provide a minimum of 50 dB $R_w$ and therefore is deemed sufficient.

The roof space is to be developed and dormers will be installed. Therefore the sound insulation of the roof and dormer constructions needs to be considered. The detail has been modelled in INSUL 10.0 and deemed to provide a minimum 50 dB $R_w$ and is therefore sufficient.

- Typical Roofing Tile or Waterproof membrane and 22mm OSB
- 25mm Batten
- 100mm roof truss
- 100mm insulation minimum density 22kg/$m^2$
- 30mm Resilient Bar System
- No.2 layers of 12.5mm Sound Block Plasterboard

  Expected Performance: <50 dB $R_w$

4.3 Glazing

To ensure the amenity of the future residents can be protected the minimum sound reduction defined in the section below should be achieved by all glazing. The following glazing units are sufficient to achieve said performance and could be installed along each facade zone for both bedrooms and living rooms.

**Front Facade**

- 6mm Glass / 16 mm Air Cavity / 4mm Glass (32 dB $R_w$ / 28 dB $R_{w+Ctr}$)

**Rear Façade**

- 4mm Glass / 16 mm Air Cavity / 4mm Glass (29 dB $R_w$ / 25 dB $R_{w+Ctr}$)

The glazing in the table above has been taken from the Pilkington database however any other glazing capable of achieving the minimum required sound reduction is outlined above would be sufficient and thus could be installed.

4.4 Ventilation

An open window assessment and AVO Guide Assessment have been undertaken and can be found in Appendix D2. The results indicate that:

- The windows along the rear of the site can be used for ventilation whilst still achieving appropriate internal noise levels and there is a low risk of overheating due to keeping windows closed as a result of elevated noise.
- Along the front façade of the site, appropriate criteria cannot be achieved with an open window and there is a medium risk of overheating due to windows remaining closed to reduce noise levels internally.

Given this, an alternative ventilation system should be employed across the site and this will be outlined for each façade, the ventilation system will be specified to ensure noise ingress can be reduced whilst vents are open and operating and the internal noise criteria achieved.

The AVO Guide is typically used to assess the risk of overheating due to elevated noise. The AVO Guide can also be used to specify an appropriate ventilation system with regard to its acoustic properties and sound reduction capabilities. Based on the noise levels incident on each façade and Table B-3 of the AVO Guide, System 3 outlined in the Building Regulations Approved Document F should be sufficient for the development. System 3 is a whole dwelling ventilation system which outlines the use of trickle or through-wall ventilation and continuous mechanical extract, as indicated in the figure below. It is assumed however that the residents can still use open windows for purge ventilation and rapid dispersion of moisture and odour.




*Figure 3.0 – Proposed Ventilation System*

The following trickle vents are deemed appropriate with regard to their sound reduction. The following trickle vent also provided the minimum Equivalent Area of 4000m$^2$ for each trickle vent required when utilising a continuous mechanical extract system. The system should also be designed to provide the minimum rates of ventilation for whole dwelling ventilation outlined in Approved Document F of the building regulations. The following trickle vents should be installed on all facades and in all rooms both bedrooms and living rooms.

***All Facades***

- Greenwoods 5000EAW.AC1 - Vent 5000EA + 1 Acoustic Set (39 dB $D_{n,e,w}$ / 37 $D_{n,e,w+ctr}$

Internal mechanical ventilation such as extract systems produce self-generated noise which needs to be fully considered. The following criteria should be archived by any mechanical ventilation systems employed at the site. The criteria below have been defined by the ANC in consultation on the Future Home Standards 2019 and the AVO Guide 2020.

Whole-dwelling ventilation system noise should not exceed:

- 26 dB $L_{Aeq,t}$ in Bedrooms
- 30 dB $L_{Aeq,t}$ in Living rooms

This would apply to Mechanical Extract Ventilation (MEV) and Mechanical Ventilation with Heat Recovery (MVHR) systems.

Extract ventilation system noise should not exceed:

- 26 dB $L_{Aeq,t}$ in Bedrooms
- 35 dB $L_{Aeq,t}$ in Living rooms
- 45 dB $L_{Aeq,t}$ in Kitchens and Bathrooms

This would apply to intermittent fans used with natural ventilation as well as MEV and MVHR.

4.5 Separating Floor Construction

The floor separating the ground floor commercial unit and the proposed self-contained dwelling above requires upgrades to ensure that noise transference is sufficiently suppressed. The following details should be installed.

- Existing floorboards sealed to an airtight condition
- Existing 200mm timber joists with 150mm insulation minimum density 45kg/$m^2$.
- The existing plasterboard ceiling is assumed 15mm plasterboard.
- Independent timber frame ceiling minimum drop 125mm.
- Minimum 50mm insulation within ceiling void minimum density 45kg/$m^3$
- No.2 layer of 12.5mm sound bloc plasterboard.

Expected Performance: 65 dB Rw / 50 dB $D_{nt,w+ctr}$

4.6 Separating Wall Construction

The wall separating the ground floor commercial unit and the proposed self-contained dwelling entrance hall requires upgrades to ensure that noise transference is sufficiently suppressed. The following details should be installed.

- No.2 layers of 12.5mm sound bloc plasterboard
- 100mm timber stud with 100mm Insulation density 45kg/$m^2$
- Minimum 50mm cavity
- 100mm timber stud with 100mm Insulation density 45kg/$m^2$
- No.2 layers of 12.5mm sound bloc plasterboard

Expected Performance: 63 dB $R_w$ / 53 dB $D_{nt,w+ctr}$

## 5. Noise Break-In Assessment

5.1 The following section of the report presents the calculated internal noise levels within the development considering the sound insulation scheme above has been implemented.

5.2 In order to calculate the internal noise levels within the development rigorous noise break-in calculations have been undertaken using the Apex Method which is based on the complex methodology in BS8233 and BS12354 - 3. Full break in calculations can be seen in Appendix D.

5.3 The table below indicates the internal noise levels within the bedrooms and living rooms on each façade considering the sound insulation scheme outlined in Section 4.0 has been implemented.

| Noise Break-In Assessment Results – Front Facade | | | | |
|---|---|---|---|---|
| **Location** | **Description** | **Calculated Internal Noise Level (dBA)** | **Internal Criteria (dBA)** | **Criteria Achieved** |
| Front Façade | Living Room Day Time | 32.0 | 35 dB $L_{Aeq,16hour}$ | Yes |
| Front Façade | Bedroom Day Time | 30.6 | 35 dB $L_{Aeq,16hour}$ | Yes |
| Front Façade | Bedroom Night | 23.7 | 30 dB $L_{Aeq,8hour}$ | Yes |
| Front Façade | Bedroom Night | 41.0 | 45 dB $L_{Afmax,t}$ | Yes |

*Table 6.0 – Noise Break-In Assessment Results – Front Façade*

| Noise Break-In Assessment Results – Rear Facade | | | | |
|---|---|---|---|---|
| **Location** | **Description** | **Calculated Internal Noise Level (dBA)** | **Internal Criteria (dBA)** | **Criteria Achieved** |
| Rear Façade | Kitchen Day Time | 29.0 | 35 dB $L_{Aeq,16hour}$ | Yes |
| Rear Façade | Bedroom Day Time | 27.0 | 35 dB $L_{Aeq,1hour}$ | Yes |
| Rear Façade | Bedroom Night | 15.1 | 30 dB $L_{Aeq,1hour}$ | Yes |
| Rear Façade | Bedroom Night | 29.0 | 45 dB $L_{Afmax,t}$ | Yes |

*Table 7.0 – Noise Break-In Assessment Results – Rear Façade*

5.4 The results of the assessment outlined in the tables above indicate that provided the sound insulation scheme and specified ventilation system are installed appropriate internal noise levels outlined in the relevant planning Condition 6a can be achieved.

## 6. Noise Breakthrough Assessment

6.1 The following section of the report undertakes a noise breakthrough assessment. To assess the potential impact of sound transference into the dwelling via the separating floor and walls between the commercial ground floor unit and dwellings above.

6.2 In order to assess compliance an internal noise level within the ground floor of 80 dB has been assumed this falls in line with the Noise at Work Regulations 2005. As the noise breakthrough is considered non-anonymous the internal noise criterion used in the assessment has been lowered from 35 dB daytime to 30 dB daytime. This approach is deemed robust and will ensure that future residents can be fully protected from commercial noise.

| Noise Breakthrough Assessment | | | | |
|---|---|---|---|---|
| **Separating Element** | **Internal Noise Level (dBA)** | **Sound Reduction of Element (Rw)** | **Internal Noise Level in Flat (dBA)** | **30 dBA Criteria Achieved** |
| Wall | 80.0 | 63.0 | 17.0 | Yes |
| Floor | 80.0 | 65.0 | 15.0 | Yes |

*Table 8.0 – Noise Breakthrough Assessment*

## 7. Conclusion

7.1 In conclusion, a noise survey has been undertaken at 130 Withington Road, Manchester, M16 8FB. The noise levels obtained during the survey have allowed a noise assessment to be undertaken in order to calculate the requirements for a sound insulation scheme to ensure the amenity of future residents can be protected.

7.2 As a result of the noise assessment, a sound insulation scheme and further mitigation measures have been defined in Section 4.0 to ensure all the criteria outlined in BS8233:2014 and Condition 6a of the planning decision notice can be achieved. The effectiveness of the sound insulation scheme has been assessed in Sections 5.0 and 6.0. Provided the sound insulation scheme and recommendations are installed and retained thereafter the amenity of future residents can be fully protected and all criteria should be achieved. Prior to the commencement of any works or implementation of the sound insulation works the above assessment should be fully approved by the local authority.

**APPENDIX A – List of Terms and Glossary**

The following section of the report outlines a glossary of terms used in the assessment to assist the reader in understanding the assessment above which is by necessity technical in nature.

**Decibel DB** - The decibel often denoted as dB is the logarithmic unit used to describe the magnitude of sound or noise levels. The typical range of sound pressure levels is from 0 dB, defined as the threshold of hearing to 120dB defined as the threshold of pain.

**Frequency Hz –** As well as the decibel sound and noise is also measured and defined in frequency. Frequency or Hertz (Hz) is an expression of the number of cycles a sound wave will complete per second. Lager frequencies may be expressed in Kilo Hertz (kHz). The typical range of human hearing is from 20 Hz to 20,000Hz however with age the audible frequency range decreases in most humans.

**A - Weighting –** The A-weighting is the most commonly used weighting curve taken IEC 61672:2003 and is applied to sound pressure level measurements. The A-weighting is applied to measured sound levels to account for the loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.

**LAeq** - The A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over any given time period. $L_{Aeq}$ is the level of a continuous noise that has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. The A-weighting represents a curve that is applied to the measured noise levels to represent the way the human auditory system perceives sound.

**LAfmax** - The maximum A-weighted noise level that was recorded during the monitoring period using a fast time weighting. This acoustic parameter represents more transient sound levels within the acoustic environment which may only occur for a few seconds or minutes.

**LA10** - This is the A-weighted noise level exceeded for 10% of a given time period. This parameter is typically used to measure and predict road traffic noise.

**LA90** - This is the A-weighted noise level exceeded for 90% of any given time period. Generally, this acoustic parameter represents the underlying background sound level in a given area and doesn't generally include transient or short-term noise events that may occur within the surroundings.

**Sound Pressure –** Sound pressure is the difference between the instantaneous pressure at a point in the presence of a sound wave and the static pressure of the medium. Sound pressure fluctuates due to refractions and compressions of air molecules.

**Sound Reduction Index –** The sound reduction index denoted by the parameter 'R' is the laboratory-measured sound reduction given material or construction. R is measured in 1/3 octave band frequencies. The $R_w$ sound insulation parameter stands for the weighted standardised sound reduction index and is a single-figure global rating of the sound insulation of a given material or construction.

**APPENDIX B – Surroundings and Location**




*Figure 4.0 – Site and Measurement Location*

**APPENDIX C – Site Plans**

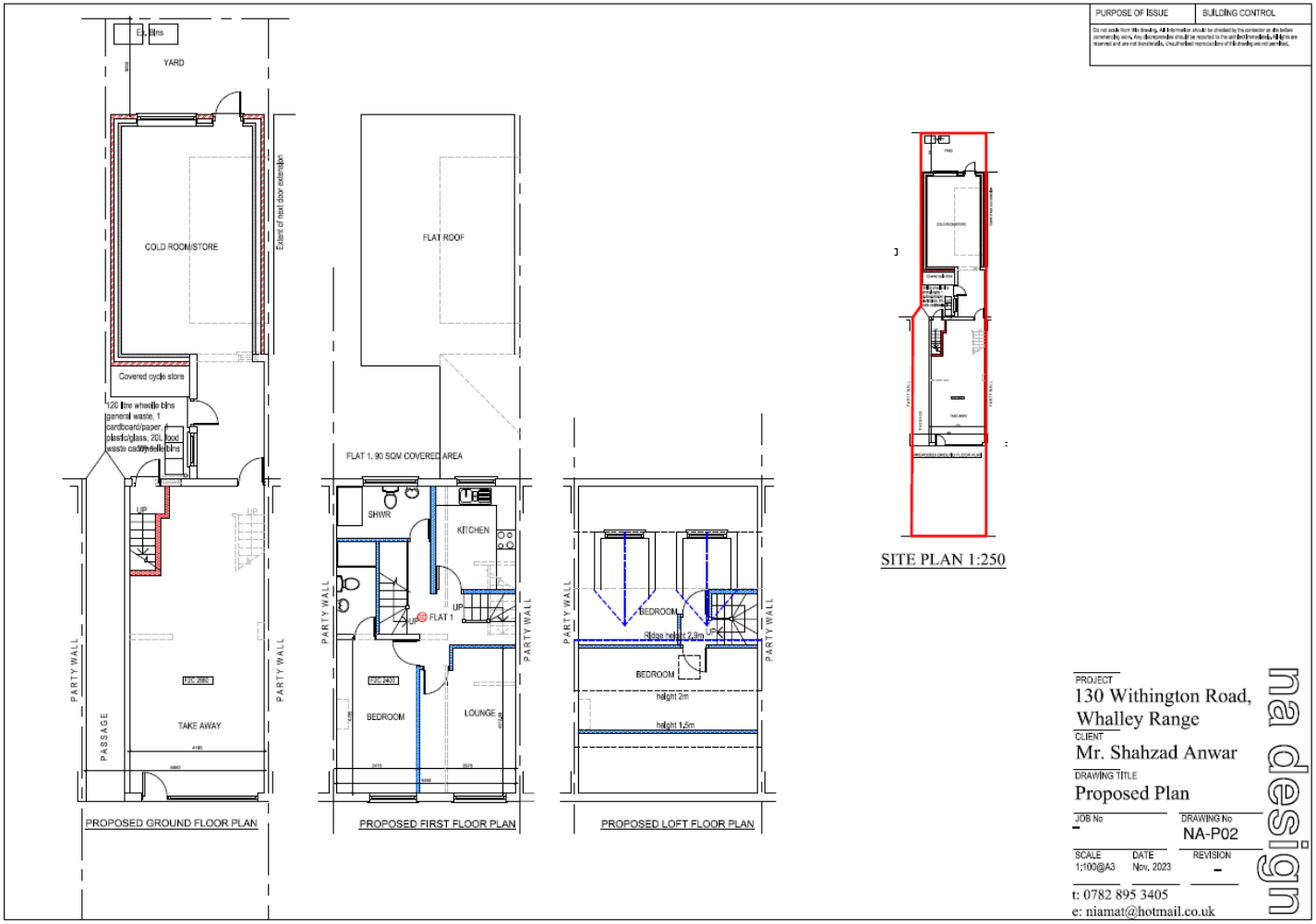



*Figure 5.0 – Site Plan*

## APPENDIX D – Calculations

### D.1 – BS8233 Noise Break-In Assessment

The tables below calculate the expected internal noise levels at each of the defined facade zones and compare this to the criteria outlined in BS8233:2014 in order to assess compliance.

Front Facade

**Complex Noise Break In Calculations**

| Calculation Specifics | |
|---|---|
| Room Name | Bedroom |
| Room Volume (m3) | 33.6 |
| Window Area (m2) | 2.55 |
| Reverb Time (Secs) | 0.5 |
| Number of Trickle Vents | 1 |

| LAeq,16hours (dB) Day Time | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz |
|---|---|---|---|---|---|---|---|
| External Free Field Noise (dBZ) | 65.0 | 58.0 | 55.0 | 56.0 | 58.0 | 55.0 | 49.0 |
| 6mm/16mm Air/4mm | 19.0 | 21.0 | 20.0 | 26.0 | 38.0 | 37.0 | 39.0 |
| Noise Through Glazing L2 | 42.8 | 33.8 | 31.8 | 26.8 | 16.8 | 14.8 | 6.8 |
| Greenwoods 5000EAW.AC1 | 32.0 | 39.0 | 38.0 | 30.0 | 43.0 | 43.0 | 40.0 |
| Noise Through Vent L2 | 35.7 | 21.7 | 19.7 | 28.7 | 17.7 | 14.7 | 11.7 |
| Total Noise Break in (dBZ) | 44.0 | 34.0 | 32.0 | 31.0 | 20.0 | 18.0 | 13.0 |
| A Weighting Curve | -26.2 | -16.2 | -8.7 | -3.2 | 0.0 | 1.2 | 1.0 |
| Total Noise Break in (dBA) | 17.8 | 17.8 | 23.3 | 27.8 | 20.0 | 19.2 | 14.0 |
| Total Global Noise Break in (dBA) | 30.6 | | | | | | |
| Complies with 35 dB Criteria? | Yes | | | | | | |

| LAeq,8hours (dB) Night Time | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz |
|---|---|---|---|---|---|---|---|
| External Free Field Noise (dBZ) | 58.0 | 51.0 | 48.0 | 49.0 | 52.0 | 48.0 | 42.0 |
| 6mm/16mm Air/4mm | 19.0 | 21.0 | 20.0 | 26.0 | 38.0 | 37.0 | 39.0 |
| Noise Through Glazing L2 | 35.8 | 26.8 | 24.8 | 19.8 | 10.8 | 7.8 | -0.2 |
| Greenwoods 5000EAW.AC1 | 32.0 | 39.0 | 38.0 | 30.0 | 43.0 | 43.0 | 40.0 |
| Noise Through Vent L2 | 28.7 | 14.7 | 12.7 | 21.7 | 11.7 | 7.7 | 4.7 |
| Total Noise Break in (dBZ) | 37.0 | 27.0 | 25.0 | 24.0 | 14.0 | 11.0 | 6.0 |
| A Weighting Curve | -26.2 | -16.2 | -8.7 | -3.2 | 0.0 | 1.2 | 1.0 |
| Total Noise Break in (dBA) | 10.8 | 10.8 | 16.3 | 20.8 | 14.0 | 12.2 | 7.0 |
| Total Global Noise Break in (dBA) | 23.7 | | | | | | |
| Complies with 30 dB Criteria? | Yes | | | | | | |

| LAfmax,t (dB) Night Time | (dBA) |
|---|---|
| External Free Field LAfmax L1,ff (dBA) | 74.0 |
| 6mm/16mm Air/4mm | 32.0 |
| Noise Through Glazing L2 | 38.8 |
| Greenwoods 5000EAW.AC1 | 39.0 |
| Noise Through Vent L2 | 37.7 |
| Total Noise Break in (dBA) | 41.0 |
| Complies with 45 dB Criteria? | Yes |

**Complex Noise Break In Calculations**

| Calculation Specifics | |
|---|---|
| Room Name | Living Room |
| Room Volume (m3) | 37.8 |
| Window Area (m2) | 2.89 |
| Reverb Time (Secs) | 0.5 |
| Number of Trickle Vents | 2 |

| LAeq,16hours (dB) Day Time | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz |
|---|---|---|---|---|---|---|---|
| External Free Field Noise (dBZ) | 65.0 | 58.0 | 55.0 | 56.0 | 58.0 | 55.0 | 49.0 |
| 6mm/16mm Air/4mm | 19.0 | 21.0 | 20.0 | 26.0 | 38.0 | 37.0 | 39.0 |
| Noise Through Glazing L2 | 42.8 | 33.8 | 31.8 | 26.8 | 16.8 | 14.8 | 6.8 |
| Greenwoods 5000EAW.AC1 | 32.0 | 39.0 | 38.0 | 30.0 | 43.0 | 43.0 | 40.0 |
| Noise Through Vent L2 | 38.2 | 24.2 | 22.2 | 31.2 | 20.2 | 17.2 | 14.2 |
| Total Noise Break in (dBZ) | 44.0 | 34.0 | 32.0 | 33.0 | 22.0 | 19.0 | 15.0 |
| A Weighting Curve | -26.2 | -16.2 | -8.7 | -3.2 | 0.0 | 1.2 | 1.0 |
| Total Noise Break in (dBA) | 17.8 | 17.8 | 23.3 | 29.8 | 22.0 | 20.2 | 16.0 |
| Total Global Noise Break in (dBA) | 32.0 | | | | | | |
| Complies with 35 dB Criteria? | Yes | | | | | | |

Rear Facade

**Complex Noise Break In Calculations**

| Calculation Specifics | |
|---|---|
| Room Name | Bedroom |
| Room Volume (m3) | 34.5 |
| Window Area (m2) | 2.4 |
| Reverb Time (Secs) | 0.5 |
| Number of Trickle Vents | 1 |

| LAeq,16hours (dB) Day Time | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz |
|---|---|---|---|---|---|---|---|
| External Free Field Noise (dBZ) | 62.0 | 59.0 | 52.0 | 50.0 | 47.0 | 46.0 | 43.0 |
| 4mm/16mm Air/4mm | 18.0 | 21.0 | 17.0 | 25.0 | 35.0 | 37.0 | 31.0 |
| Noise Through Glazing L2 | 40.4 | 34.4 | 31.4 | 21.4 | 8.4 | 5.4 | 8.4 |
| Greenwoods 5000EAW.AC1 | 32.0 | 39.0 | 38.0 | 30.0 | 43.0 | 43.0 | 40.0 |
| Noise Through Vent L2 | 32.6 | 22.6 | 16.6 | 22.6 | 6.6 | 5.6 | 5.6 |
| Total Noise Break in (dBZ) | 41.0 | 35.0 | 32.0 | 25.0 | 11.0 | 9.0 | 10.0 |
| A Weighting Curve | -26.2 | -16.2 | -8.7 | -3.2 | 0.0 | 1.2 | 1.0 |
| Total Noise Break in (dBA) | 14.8 | 18.8 | 23.3 | 21.8 | 11.0 | 10.2 | 11.0 |
| Total Global Noise Break in (dBA) | 27.0 | | | | | | |
| Complies with 35 dB Criteria? | Yes | | | | | | |

| LAeq,8hours (dB) Night Time | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz |
|---|---|---|---|---|---|---|---|
| External Free Field Noise (dBZ) | 47.0 | 45.0 | 41.0 | 37.0 | 33.0 | 32.0 | 37.0 |
| 4mm/16mm Air/4mm | 18.0 | 21.0 | 17.0 | 25.0 | 35.0 | 37.0 | 31.0 |
| Noise Through Glazing L2 | 25.4 | 20.4 | 20.4 | 8.4 | -5.6 | -8.6 | 2.4 |
| Greenwoods 5000EAW.AC1 | 32.0 | 39.0 | 38.0 | 30.0 | 43.0 | 43.0 | 40.0 |
| Noise Through Vent L2 | 17.6 | 8.6 | 5.6 | 9.6 | -7.4 | -8.4 | -0.4 |
| Total Noise Break in (dBZ) | 26.0 | 21.0 | 21.0 | 12.0 | -3.0 | -5.0 | 4.0 |
| A Weighting Curve | -26.2 | -16.2 | -8.7 | -3.2 | 0.0 | 1.2 | 1.0 |
| Total Noise Break in (dBA) | -0.2 | 4.8 | 12.3 | 8.8 | -3.0 | -3.8 | 5.0 |
| Total Global Noise Break in (dBA) | 15.1 | | | | | | |
| Complies with 30 dB Criteria? | Yes | | | | | | |

| LAfmax,t (dB) Night Time | (dBA) |
|---|---|
| External Free Field LAfmax L1,ff (dBA) | 60.0 |
| 4mm/16mm Air/4mm | 29 |
| Noise Through Glazing L2 | 27.4 |
| Greenwoods 5000EAW.AC1 | 39.0 |
| Noise Through Vent L2 | 23.6 |
| Total Noise Break in (dBA) | 29.0 |
| Complies with 45 dB Criteria? | Yes |

**Complex Noise Break In Calculations**

| Calculation Specifics | |
|---|---|
| Room Name | Kitchen |
| Room Volume (m3) | 21.5 |
| Window Area (m2) | 2.6 |
| Reverb Time (Secs) | 0.5 |
| Number of Trickle Vents | 1 |

| LAeq,16hours (dB) Day Time | 63Hz | 125Hz | 250Hz | 500Hz | 1kHz | 2kHz | 4kHz |
|---|---|---|---|---|---|---|---|
| External Free Field Noise (dBZ) | 62.0 | 59.0 | 52.0 | 50.0 | 47.0 | 46.0 | 43.0 |
| 4mm/16mm Air/4mm | 18.0 | 21.0 | 17.0 | 25.0 | 35.0 | 37.0 | 31.0 |
| Noise Through Glazing L2 | 42.7 | 36.7 | 33.7 | 23.7 | 10.7 | 7.7 | 10.7 |
| Greenwoods 5000EAW.AC1 | 32.0 | 39.0 | 38.0 | 30.0 | 43.0 | 43.0 | 40.0 |
| Noise Through Vent L2 | 34.7 | 24.7 | 18.7 | 24.7 | 8.7 | 7.7 | 7.7 |
| Total Noise Break in (dBZ) | 43.0 | 37.0 | 34.0 | 27.0 | 13.0 | 11.0 | 12.0 |
| A Weighting Curve | -26.2 | -16.2 | -8.7 | -3.2 | 0.0 | 1.2 | 1.0 |
| Total Noise Break in (dBA) | 16.8 | 20.8 | 25.3 | 23.8 | 13.0 | 12.2 | 13.0 |
| Total Global Noise Break in (dBA) | 29.0 | | | | | | |
| Complies with 35 dB Criteria? | Yes | | | | | | |

### D.2 – Open Window & AVO Guide Assessment

The assessment below has been undertaken assuming a 13 dB attenuation from an open window to establish the internal noise levels. BS8233 states that where development is desirable noise criteria can be relaxed by 5 dB. The AVO Guide indicates at levels approximately 5 dB above the criteria there would be a low risk of overheating. Document O of the Building Regulations also stipulates internal levels of 40 dB $L_{Aeq,8hours}$ or below and $L_{Amax}$ levels not regularly exceeding 55 dB are sufficient when using open windows for ventilation and prevention of overheating. Given this, it is reasonable to expect a 5 dB relaxation in the BS8233 criteria and still achieve acceptable internal noise levels when considering the open window condition.

| Open Window and Overheating Assessment | | | | | | |
|---|---|---|---|---|---|---|
| **Location / Time Period** | **Façade Zone** | **External Level (dBA)** | **Internal Noise Level (dBA)** | **BS8233 Criteria (dBA)** | **Exceedance (dBA)** | **AVO Guide Assessment** |
| Bedroom / Living Room Day | Front Red Facade | 62.0 | 49.0 | 40 dB $L_{Aeq,16hour}$ | +9.0 | Medium |
| Bedroom Night | | 55.0 | 42.0 | 35 dB $L_{Aeq,8hour}$ | +7.0 | Medium |
| Bedroom Night | | 74.0 | 61.0 | 50 dB $L_{Afmax,8hour}$ | +11.0 | Medium |
| Bedroom / Living Room Day | Green Rear Façade | 49.0 | 36.0 | 40 dB $L_{Aeq,16hour}$ | -4.0 | Low |
| Bedroom Night | | 42.0 | 29.0 | 35 dB $L_{Aeq,8hour}$ | -6.0 | Negligible |
| Bedroom Night | | 60.0 | 47.0 | 50 dB $L_{Afmax,8hour}$ | -3.0 | Low |

*Table 9.0 – Open Window Assessment*

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1) Infinity Acoustics Ltd has undertaken the above assessment and provided the above interpretations based on the information available at the time of the assessment, and details provided by the client, it has been undertaken given our 'best endeavours'.
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