Assessment of the Existing Noise Climate in the Vicinity of the Proposed New Residential Accommodation at 57 - 59 Leicester Road, Wigston

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1.0 Summary

Planning permission is being sought to permit the conversion of the first floor space, above the vacant ground floor retail premises at 57 - 59 Leicester Road in Wigston, to form two new residential flats. In support of the application for planning permission, Druk Limited was commissioned to undertake an assessment of the existing noise climate in the immediate vicinity of 57 - 59 Leicester Road to assess what effect it may have on the proposed residential flats within the existing building.

The existing noise climate in the vicinity of 57 - 59 Leicester Road in Wigston was characteristic of an urban environment, subject to noise contributions primarily from road traffic, although some occasional noise contributions were made by the surrounding commercial enterprises including very infrequent contributions from the patrons of the William Wygston public house standing outside to smoke. Despite being an urban environment, the existing noise climate was not regarded as being particularly noisy.

Applying the assumptions stated within this report, relating to the sound insulation of the façade elements, calculations have been undertaken to assess the likely internal noise levels within the proposed residential flats. The calculations have demonstrated that the sound insulation of the proposed building elements would ensure that the calculated break-in sound levels within the proposed first floor flats would not exceed the adopted design guide values assuming the windows closed and ventilation openings open, scenario.

Despite this it is recognised that opening the windows for ventilation purposes, purge ventilation excepted, would result in the internal noise levels exceeding the design guide levels. As a result it is suggested that alternative means of ventilation, to permit the internal spaces to be ventilated without requiring the windows to be opened, should be considered. In this case a system 3 or 4, as detailed within Approved Document F, would be appropriate. As with any ventilation installation it is essential that the emission of sound from the ventilation system is adequately controlled to ensure that this element does not detrimentally affect the internal noise climate. In addition it is essential that the occupants must also be provided with the option to open windows as they choose.

As a consequence of the foregoing, it is suggested the sound insulation of the proposed façade elements and proposed alternative ventilation provision, would be sufficient to limit the ingress of external noise to the proposed first floor flats in compliance with the adopted design guidance. As such, it is suggested that the proposed flats could be integrated into the existing environment without the potential for "unreasonable restrictions" to be placed upon already established businesses in the vicinity. Consequently, it is suggested that the existing noise climate should not be regarded as an impediment to the granting of planning permission.

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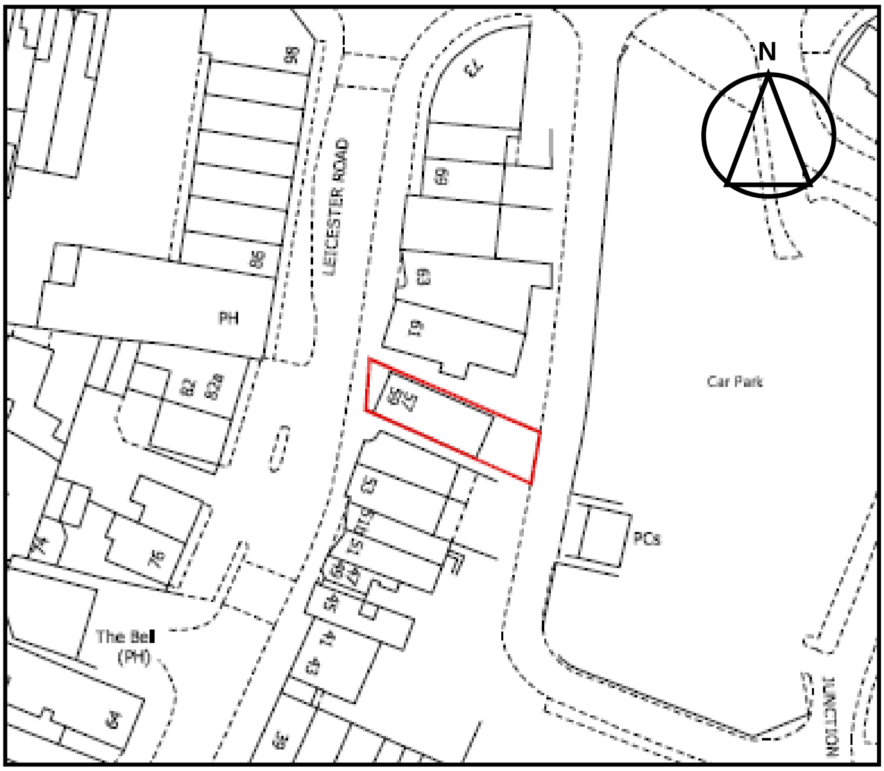
2.0 <u>Introduction</u>

Planning permission is being sought to permit the conversion of the first floor space, above the vacant ground floor retail premises at 57 - 59 Leicester Road in Wigston, to form two residential flats. In support of the application for planning permission, Druk Limited was commissioned to undertake an assessment of the existing noise climate in the immediate vicinity of 57 - 59 Leicester Road to assess what effect it may have on the proposed residential flats within the existing building.

3.0 <u>Site Description</u>

The proposed residential flats will be formed from a conversion of the first floor space above the vacant ground floor retail space at 57 - 59 Leicester Road in Wigston (figure 1 below and photograph 1 overleaf), to form two new residential flats. To the North of the application site are the existing mainly commercial premises on Leicester Road (photograph 2 overleaf) including: Lloyds Bank, an appliance and fireplace showroom, a turf accountants etc. (photograph 2 overleaf). To the South of the application site are more existing commercial premises on Leicester Road including a cafe, an Indian restaurant, beauty shop etc. (photograph 3 overleaf). To the East of the application site is the rear access road with the car park and residential dwellings beyond (photograph 4 overleaf). To the West of the development site is Leicester Road itself with further commercial properties, including the William Wygston public house (photograph 5 overleaf).

Figure 1. Site of the proposed residential flats (edged in red), 57 - 59 Leicester Road, Wigston



Photograph 1. Existing premises at 57 - 59 Leicester Road in Wigston

Photograph 2. Commercial premises on Leicester Road to the North of the application site

Photograph 3. Commercial premises on Leicester Road to the South of the application site

Photograph 4. Car park and residential dwellings to the East of the application site

Photograph 5. Leicester Road and the existing commercial premises to the West of the application site

4.0 Assessment Criteria

As a new planning application has been made, no planning conditions currently exist. Consequently, the aims of this assessment are to evaluate the existing noise climate in the vicinity of the proposed residential flats at 57 - 59 Leicester Road in Wigston and to quantify what effect it may have on the proposed development. With reference to these aims, the proposed development will be assessed with reference to the guidance contained within: the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG), British Standard (BS) 8233:2014 “Guidance on sound insulation and noise reduction for buildings” and the Planning and Noise: Professional Guidance on Planning and Noise (ProPG), May 2017, document, the guidance contained within the Acoustics, Ventilation and Overheating - Residential Design Guide.

4.1 National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG)

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE), originally released in 2010, and the National Planning Practice Guidance (NPPG) do not provide quantitative criteria for assessment purposes. Instead the documents detail general policy aims, statements as well as providing some guidance on how certain situations can be interpreted.

The main statement on noise contained within the revised NPPF, issued in December 2023, is to be found in paragraph 185:

185. 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 impacts 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.

In addition, paragraph 187 of the NPPF is also relevant and states:

187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

The NPPF also refers to the NPSE and as such details the following aims:

1. The avoidance of significant adverse impacts on health and quality of life;

2. Mitigate and minimise adverse impacts on health and quality of life; and

3. Where possible, contribute to the improvement of health and quality of life.

In order to reflect these objectives the NPSE referenced concepts utilised by the World Health Organisation, which in turn employed concepts from toxicology and applied them to noise impacts. These concepts are:

- NOEL – No Observed Effect Level. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

SOAEL is clearly something the policy seeks to avoid in aim 1. Aim 2 represents situations between SOAEL and LOAEL, and seeks to minimise and mitigate the possible effects.

The NPPG section on noise adds some further detail, much of it reproducing the NPPF and NPSE, but some useful qualitative guidance is provided in the noise exposure hierarchy table and this is reproduced in table 1 below and overleaf.

The NPPG also highlights that the subjective nature of noise means that there is not a simple relationship between noise levels and the possible impact on those affected. It recognises that any effects will depend on how various factors combine in any particular situation, including absolute noise levels and how they may compare with the underlying background noise, the impulsiveness or intermittence pattern of the noise, its spectral content, and the time of day. It discusses in very general terms the issues to consider when introducing noise sources to existing noise sensitive area, new residential development in areas affected by existing noise sources (most of which have their own specific guidance, such as BS 4142, BS 8233, etc.) and the potential impact on wildlife.

Table 1. Noise exposure hierarchy table

Perception	Examples of Outcomes	Increasing effect level	Action
Not noticeable	No effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	

Table 1, continued. Noise exposure hierarchy table

Perception	Examples of Outcomes	Increasing effect level	Action
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

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

BS 8233:2014 draws together research and best practice relating to building design, providing guidance to facilitate the development of buildings that have internal noise environments that are consistent with and appropriate for their intended use. The Standard states that the guidance it contains is applicable to the design of new buildings, or refurbished buildings undergoing a change of use and as such it is deemed applicable to this proposal.

The British Standard highlights methods for the control of noise from a number of sources including external noise and building services etc., as well as evaluating the effect that noise from these sources may have on the acoustics of the internal spaces. With reference to the design guidance relating to the internal noise climate of dwelling houses flats and rooms in residential use, it is suggested that the guidance is applicable to 'anonymous' noise without a '*specific'* character, and this is typically the situation where road traffic type noise is the dominant or principal contributor to the existing noise climate. This being the case BS 8233:2014 indicates that it would be desirable for the internal noise levels, resulting from the break-in of external noise, not to exceed the guide values detailed within table 4 of section 7.7.2. The main elements of the guidance contained within table 4 of section 7.7.2 of BS 8233:2014 are reproduced in table 2 below.

Table 2. Indoor ambient noise levels for dwellings (reproduced from table 4 of BS8233:2014)

Activity	Location	0700 to 2300	2300 to 0700
Resting	Living room	35dB $L_{Aeq,\ 16\ hour}$	-
Dining	Dining room/area	40dB $L_{Aeq,\ 16\ hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,\ 16\ hour}$	30dB $L_{Aeq,\ 8\ hour}$

It should also be noted that BS8233:2014 applies the frequently quoted 'rule of thumb' that where a window is partially open for ventilation purposes etc., the sound levels just outside the window will be around 15dB higher than the levels just inside the window. Despite this, a number other documents indicate that the sound insulation provided by a partially open window would be in the region of 9 - 13dB.

In addition to the internal noise design guidance detailed above, supplementary notes 4, 5 and 7 to table 4 of section 7.7.2 are deemed appropriate to this assessment and state the following:

***Note 4**. Regular individual noise events (for example scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or LAmax,F, depending on the character and number of events per night. Sporadic noise events could require separate values.*

***Note 5**. 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 sound level*.

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

With reference to note 4, the design guidance detailed within the previous 1999 version of BS 8233 relating to individual noise events, expressed as L_{Amax} levels, will be adopted for this assessment. This guidance stated: "*for a reasonable standard for bedrooms at night, individual noise events (measured with the fast time-weighting) should not normally exceed 45 dB L_{Amax}*", and this guidance complies with the provisions contained within the WHO document.

It must however be stated that many regard the 45dB L_{Amax} criterion as stringent. Additionally, it must be remembered that all of the above criteria are design guidance, they do not represent a set of rigid criteria, below which a development 'passes' and above which a development 'fails'.

4.3 Planning and Noise: Professional Guidance on Planning and Noise (ProPG)

This document was published in May 2017 and was produced jointly by representatives of the Chartered Institute of Environmental Health (CIEH), the Institute of Acoustics (IoA) and the Association of Noise Consultants (ANC). The ProPG document seeks to provide guidance on and complement the wider aims contained within the Noise Policy Statement for England (NPSE) and the additional guidance contained within the National Planning Policy Framework(NPPF). In addition the ProPG document acknowledges the contribution made by existing guidance contained within both the World Heath Organisations (WHO) "Guidelines for Community Noise" and (BS) 8233:2014 “Guidance on sound insulation and noise reduction for buildings”.

The ProPG document guidance is restricted to the consideration of new residential developments and the potential implications for these developments arising from predominantly airborne noise that typical emanates from transportation noise sources. The document utilises a risk assessment based two stage approach to: Stage 1 -

undertake an "initial noise risk assessment of the proposed development site" and Stage 2 - undertake a "systematic consideration of four key elements". With reference to the four key elements, these are defined as:

- Element 1 - demonstrating a "Good Acoustic Design Process".
- Element 2 - observing internal "Noise Level Guidelines".
- Element 3 - undertaking an "External Amenity Area Noise Assessment, and.
- Element 4 - consideration of "Other Relevant Issues".

With reference to Stage 1, the requirement to undertake a noise risk assessment of the proposed development site, the site 'risk' category boundaries are described with reference to the external free field noise levels that would affect a proposed development and these are contained within figure 1 of Section 2 of the document. Whilst the ProPG document does not attribute specific noise levels to the 'risk' categories, an interpretation of the noise levels presented within figure 1 of the ProPG document is contained in table 3 below. Again, the guidance relates primarily to 'anonymous' type noise.

Table 3. Level 1 assessment 'risk' boundary noise levels (derived from figure 1 of the ProPG document)

Indicative noise levels		
Daytime (07:00 - 23:00) $L_{Aeq, 16 hour}$	**Night time (23:00 - 07:00) $L_{Aeq, 8 hour}$**	**Noise 'risk' assessment**
≤ 50dB	≤ 40dB	Negligible
> 50 and ≤ 63dB	> 40 and ≤ 53dB	Low
> 63 and ≤ 68dB	> 53 and ≤ 58dB	Medium
> 68dB	> 58dB	High

The guiding principle of the ProPG document with reference to the existing noise climate is that once the potential impact on a development has been quantified, good acoustic design should be implemented to mitigate the potential effects that the existing noise climate may have on the proposed resident of any new residential development. In this case the good design principle relates to both the internal acoustic environment within dwellings and any external amenity areas serving those dwellings. With reference to good acoustic design ProPG does recognise that this does not mean "*overdesign or gold plating*", but it does mean delivering "*the optimum acoustic outcome for a particular site*".

With respect to the internal noise level guidelines, ProPG makes reference to the guidance contained within table 4 of section 7.7.2BS 8233:2014, reproduced in section 4.2 above. Whilst recognising that it is preferable to achieve the internal noise guidelines ProPG does, at paragraph 2.30, recognise that national planning and noise policy does not always require that these levels are achieved. This is particularly the case where to do so would "*disproportionately increase the cost of the development*".

Remaining with the issue of internal noise level guidance and the proposed levels for individual noise events, expressed as an L_{max}, the guidance contained within Appendix A of the ProPG is instructive. The Appendix contains a short summary of research into the effects of individual noise events and the effect that these can have on sleep. In the light of this summary the document, at paragraph A.20, states the following, "...*therefore, it is considered that if, in bedrooms at night, the* $L_{Amax,F}$ *from individual noise events (from all sources) would not normally exceed 45dB more than 10 times a night, then this represents a reasonable threshold below which the events on sleep can be regarded as negligible*".

The potential impact of ventilation on the acoustic integrity of the façade of a dwelling is also addressed by the ProPG document. The document suggests that good acoustic design should be used to achieve the internal design targets in noise sensitive rooms with windows partially open for ventilation purposes. Despite this the ProPG document also recognises the limitations of acoustic design an highlights that internal noise levels may only be achievable with window closed in certain environments such as urban areas or sites adjacent to transportation noise sources. In these situations it is suggested that internal noise levels are assessed with windows closed but with any façade openings used for ventilation purposes in their open position. Finally and with reference to ventilation ProPG at paragraph 2.35 states that "*internal noise level guidance are generally not applicable under purge ventilation conditions*".

4.4 Acoustics, Ventilation and Overheating - Residential Design Guide

There is an increasing recognition that in addition to securing an acceptable internal noise climate, there needs to be a degree of integration between acoustic design and the requirement to address both the ventilation and thermal comfort of a dwelling. Typically, achieving a good internal acoustic environment has been achieved by requiring dwelling windows to remain closed, but most ventilation and overheating assessments look to the ability to open windows to permit both adequate ventilation and the management of the internal thermal environment. In many locations, particularly urban environments, it is recognised that opening windows will typically have negative impacts on the internal acoustic environment within a dwelling.

In an attempt to provide additional guidance on the interplay between suitable ventilation to address potential overheating within a noisy environment, The "Acoustics Ventilation and Overheating Residential Design Guidance", hereafter referred to as the AVO Guide, has been formulated by the Association of Noise Consultants (ANC). This comprehensive document seeks to strike a balance between the often competing requirements relating to both good acoustic conditions within a residential dwelling and the provision of ventilation to mitigate potential overheating.

In its simplest form the AVO Guide provides for a two stage assessment procedure. The first stage, level 1, may be considered as a 'site risk' assessment and is based on the external noise levels to which a residential dwelling may be exposed. A level 2 assessment seeks to assess the potential adverse effects that may result and would be based on a combination of the internal ambient noise levels the duration, times and the frequency when open windows would be required etc. It should however be remembered that this report will restrict itself to a level 1, 'site risk', assessment. A level 2 assessment is considered to be beyond the remit of this report.

A level 1 assessment is predicated on the adoption of partially open windows as the primary method of internal temperature control. The various site 'risk' categories have been described according to the external free field noise levels that are likely to affect a proposed development and these are detailed in table 3.2 of the Guide. Although the AVO Guide does not attribute specific noise levels to the various 'risk' categories, an interpretation of the noise levels presented within table 3.2 of the AVO Guide and the likely 'risk' categories to which they correspond, is produced in table 4 overleaf. As with the guidance contained within BS 8233:2014 and the ProPG document, the guidance relates primarily to 'anonymous' type noise.

Table 4. Level 1 assessment 'risk' boundary noise levels (derived from table 3.2 of the AVO Guide)

External free - field noise level at façade		
Daytime (07:00 - 23:00) $L_{Aeq, 16 hour}$	**Night time (23:00 - 07:00) $L_{Aeq, 8 hour}$**	**Level 1 'risk' category**
≤ 52dB	≤ 47dB	Negligible
> 52 and ≤ 57dB	> 47 and ≤ 52dB	Low
> 57 and ≤ 62dB	> 52 and ≤ 55dB	Medium
> 62dB	> 55dB	High

Note 4. Where 78dB L_{AFmax} is normally exceed during the night time period a level 2 assessment is recommended.

The guidance also recognises that there may be instances where occupants may 'trade' the internal acoustic environment by accepting higher noise levels for a period of time in order to maintain control over the thermal environment.

The document relates primarily to residential developments that are subject to airborne noise from transportation noise sources. Despite its focus on new residential dwellings, predominantly flats and houses, the AVO Guide does suggest that it may also be applicable to other forms of residential dwellings such as care homes and residential institutions.

The potential implications of opening windows on the internal acoustic environment and the possible outcomes for the occupants of the ventilated spaces are summarised in table 5 overleaf, which combines the guidance contained within table 3.3 and figures B-2 and B-3 from the AVO Guide.

In essence, the higher the external noise level the more likely it is that the internal noise levels would exceed the guide values detailed within BS 8233:2014 and summarised in table 2 above, with windows partially open for ventilation purposes. As a consequence, as the external noise levels increase it is more than likely that additional or alternative ventilation requirements will be required in order to ensure the internal areas can be effectively ventilated, in all but purge ventilation conditions, without prejudicing the façade sound insulation and so the internal noise climate. It must however be remembered that where alternative mechanical ventilation is specified, the emission of noise from such systems must not lead to an unnecessary increase in the internal noise climate.

Table 5. Guidelines for a level 2 assessment (derived from table 3.3 and figures B.2 and B.3 of the AVO Guide)

Internal ambient noise level (from road traffic noise)			
$L_{Aeq,T}$ during 07:00 - 23:00	**$L_{Aeq,T}$ during 23:00 - 07:00**	**Individual noise events, L_{AFmax}, during 23:00 - 07:00**	**Potential outcome**
≤ 35dB	≤ 30dB	45dB not normally exceeded more than 10 times a night	**LOAEL**: Noise can be heard but does not cause any change in behaviour
> 35 and ≤ 40dB	> 30 and ≤ 35dB	Increasing adverse effect	Increasing adverse effect
> 40 and ≤ 50dB	> 35 and ≤ 42dB		
> 50dB	> 42dB	Normally exceeds 65dB	**Exceeds SOAEL**: Noise causes a material change in behaviour, e.g. keeping windows closed

4.5 Ventilation - Approved Document F (ADF)

With reference to the relevant guidance relating to the ventilation of dwellings, this is contained within Approved Document F (ADF) guidance to the Building Regulations 2010, currently in the 2021 edition as it relates to dwellings.

In summary the ventilation strategies outlined in ADF relies on a combination of approaches, including: Extract ventilation to remove water vapour or pollutants; whole dwelling ventilation to provide fresh air to the building and to dilute, disperse and remove water vapour and pollutants not removed by extract ventilation and purge ventilation to remove high concentrations of pollutants and water vapour. With reference to extract ventilation this is typically achieved via intermittent extraction fans, whole house ventilation is often achieved through a combination of background (trickle) ventilators or continuous supply fans and purge ventilation is typically achieved through the opening of windows. ADF also states that "*Other ventilation systems may be acceptable if they can be shown to meet an equal level of performance*".

Additionally, ADF details four main types of ventilation systems that can be used to provide ventilation to dwellings and these are described as systems 1 to 4. A summary of these systems is provided within table 6 overleaf and this table also provides additional annotation that is expands upon the details provided within ADF.

Typically systems 1, 3 and 4 are most commonly found within the majority of dwellings. With reference to purge ventilation, this can and is often used to address the thermal comfort of occupants, although this element is not 'controlled' by the Building Regulations.

It should however be borne in mind that any reference to the various types of ventilation provision contained within this report relate to an assessment of the interaction of the ventilation provision with the internal noise levels and any adopted internal noise design targets. It is not intended as a detailed ventilation design statement and a full evaluation of any ventilation provision is beyond the remit of this report.

Table 6. Summary of the ADF ventilation systems 1 - 4

Ventilation system	Purge ventilation
System 1: background ventilation (trickle ventilators) and intermittent extraction fans	Typically provided by opening windows
System 2: passive stack (natural)	Typically provided by opening windows
System 3: Continuous mechanical extraction (MEV) (Trickle ventilators provide inlet air)	Typically provided by opening windows
System 4: Continuous mechanical supply and extract with heat recovery (MVHR)	Typically provided by opening windows

5.0 Survey Details

5.1 Survey Times and Personnel

The noise survey, to evaluate the existing noise climate in the vicinity of 57 - 59 Leicester Road in Wigston, was undertaken between 17:00 hours on the 26th February until 09:45 hours on the 27th February 2024. This time period was selected as it encompassed both the afternoon and morning peak periods, with respect to road traffic, as well as the full night time period.

As a consequence it is suggested that the adopted measurement period was representative of the existing noise climate and would include contributions from all the potential noise sources within the immediate vicinity. During the course of the existing noise climate survey the measurements were attended, between 17:00 - 01:00 hours and again between 08:00 - 09:45 hours. All measurements were conducted by Mr. R Smith of Druk Limited.

5.2 Weather

Throughout the existing noise climate survey the weather conditions were as follows:

26th – 27th February 2024

All surfaces were essentially dry throughout the survey period, cloud cover was around 50 - 70%, the temperature ranged between 8 - 4°C throughout the survey, the wind speed was approximately 0.5m/s, the barometric pressure ranged between approximately 1007 - 1003mb.

5.3 Equipment

All the noise surveys and measurements were conducted using the equipment detailed in the table 7 below. The sound level meters were field calibrated before, after and during the surveys as necessary, during which time no significant deviations in the calibrated levels were observed. For the duration of the surveys the sound level meter microphones were mounted with weather protection enclosures.

Table 7. Equipment used during the existing noise climate measurements

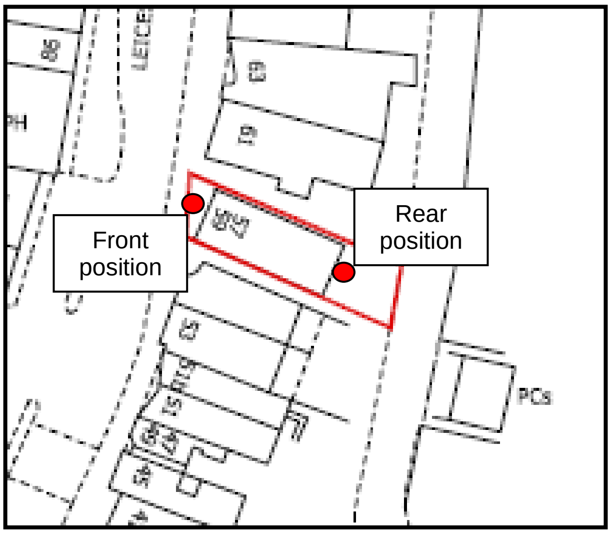
Equipment description	Manufacturer	Model number	Serial number
Sound level meter	NTI Audio	XL2-TA	A2A-10232-E
Microphone pre-amplifier	NTI Audio	MA220	5537
Microphone	NTI Audio	M2230	8636
Sound level meter	NTI Audio	XL2-TA	A2A-23832-E1
Microphone pre-amplifier	NTI Audio	MA220	141157
Microphone	NTI Audio	M2230	A26843
Acoustic calibrator	Norsonic AS	Nor 1251	31522
Microphone weather protection enclosures	NTI Audio	WP30 (x 2)	-

5.4 Measurement Procedure

The location of the proposed development suggested that the principal contributors to the existing noise climate would be road traffic from vehicles on Leicester Road and the service road and car park to the rear of the existing building. As a consequence measurements of the existing noise climate were obtained from positions on the front and rear elevations of the existing building at 57 - 59 Leicester Road.

In both positions the measurements were made continuously over the survey period. In both positions the microphones, in the weather protection enclosures, were extended on booms from first floor windows on the front and rear elevations. In these positions the microphones were approximately 1 metre from the existing façades and approximately 4.5 metres above ground level. The approximate location of the measurement positions is as detailed on figure 2 overleaf. Throughout the surveys all measurements were made with the ‘fast’ time weighting engaged, the measurement time interval was 5 minutes, all the measurements were made consecutively and the measurements were attended between 17:00 - 01:00 hours and between 08:00 - 09:45 hours.

Figure 2. Approximate location of the noise survey measurement positions



6.0 Noise Survey Results

The existing noise climate in the vicinity of 57 - 59 Leicester Road in Wigston was characteristic of an urban environment, subject to noise contributions primarily from road traffic, although some occasional noise contributions were made by the surrounding commercial enterprises including very infrequent contributions from the patrons of the William Wygston public house standing outside to smoke. Despite being an urban environment, the existing noise climate was not regarded as being particularly noisy.

During the course of the survey it was noted that many of the ground floor commercial premises on Leicester Road included residential accommodation on the first floors of the buildings. This 'living above the shop' arrangement appeared to be quite common in the immediate vicinity and suggested that the local noise climate should be regarded as being conducive to further residential development.

The following paragraphs contain brief subjective descriptions of the noise sources noted during the survey periods.

6.1 Qualitative Assessment: Front Elevation

During the survey the principal contributor to the existing noise climate was road traffic on Leicester Road, with the majority of the vehicles comprising private cars and taxis. Despite this a number of vans and light goods vehicles were also observed and relatively frequent buses were also observed. With reference to the buses these appeared to stop around 23:30 - 00:00 hours and did not commence again until the morning period.

The numbers of vehicles on Leicester Road remained relatively steady until around 22:00 hours after which a slow reduction in traffic volume was noted. The volume of traffic reduced gradually through the night time period reaching its lowest point around 02:30 - 03:00 hours. The general level of traffic noise began to increase again from around 05:00 hours after which it appeared to stabilise around 07:00 hours.

With reference to the additional noise sources, these included: contributions form pedestrians walking along Leicester Road whilst talking, some noise from the nearby commercial premises, occasional cars with loud music playing and some patrons of the William Wygston public house standing outside to smoke and talking with fellow smokers as they did. Remaining with the noise contribution from the William Wygston public house, although the patrons were occasionally audible during the relatively infrequent lulls in the road traffic, the contribution from this source did not appear to have a significant effect on the measured levels.

6.2 Qualitative Assessment: Rear Elevation

The noise climate on the rear elevation was similar in character to the front elevation except the overall noise climate was a little quieter. Again, the principal contributor to the noise climate was road traffic from Leicester Road itself but also from vehicles on the rear service road and the large car park. The overall noise climate displayed a similar pattern to the front elevation although the noise climate began to reduce at an earlier hour before increasing again at both a slightly slower rate and at a slightly later time that was the case on the front elevation.

Additional sources of noise in this position included shoppers returning tot heir vehicles on the car park and talking as they walked, pedestrians walking down the alley ways either side of 57 - 59 and talking as they walked and the occasional sound of car alarms from cars on the car park. One event that was particular to the rear elevation was a large vehicle making deliveries to Dominos Pizza, which occurred around 23:30 hours.

6.3 Basic Results and Discussion

By virtue of the significant amounts of measured noise data collected from the front and rear measurement positions during the noise survey, tables 8 and 9 overleaf and graphs 1 and 2 overleaf contain summaries of the noise data from the afternoon and night time measurement surveys. With reference to the measured noise levels from the from both the front and rear positions, as these were obtained from position approximately 1 metre from the existing building façade, a 3dB façade correction has been applied in order to establish representative free field noise levels. A summary of the measured noise data are presented in Appendix 1.

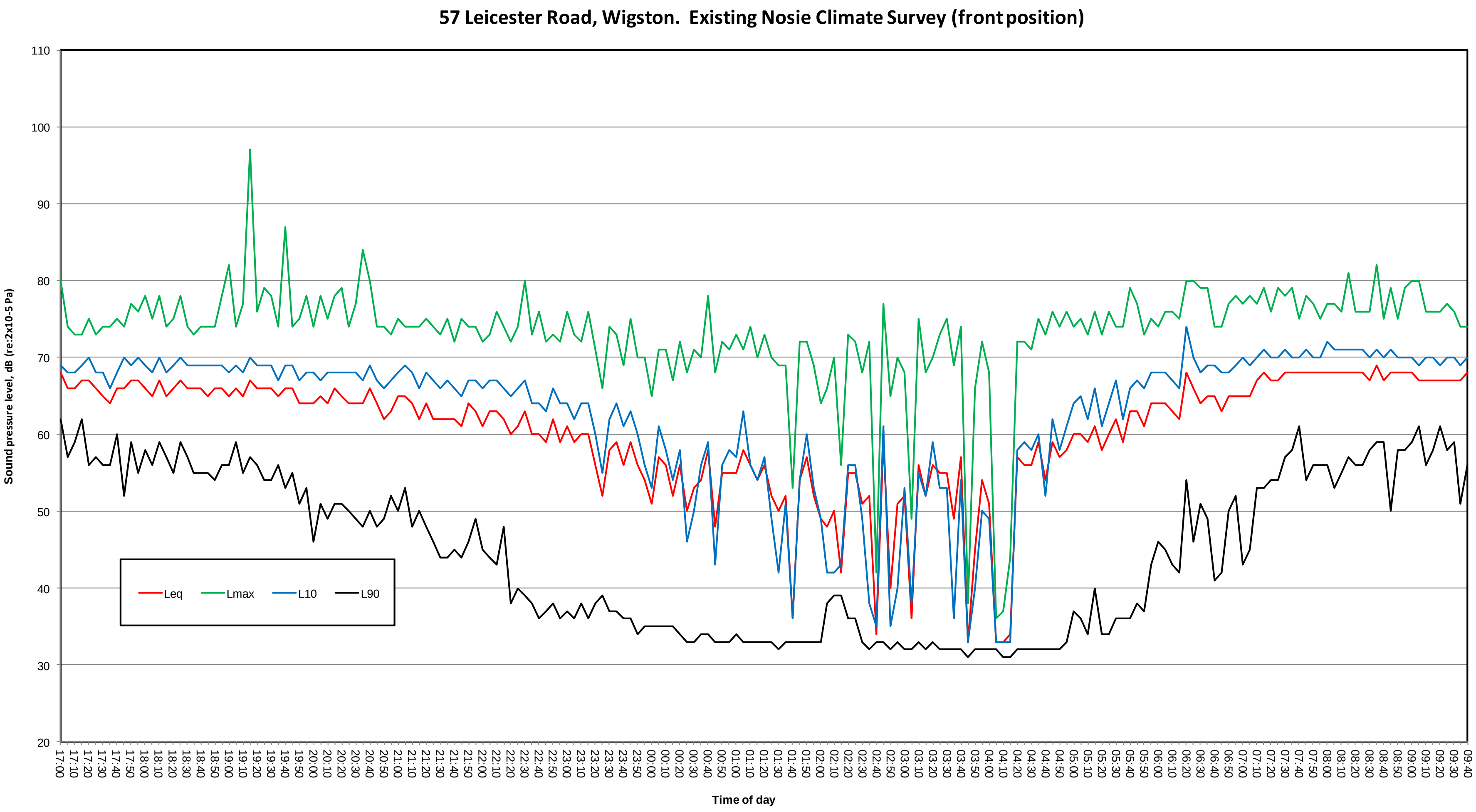
Table 8. Measured sound level summary, front elevation, 53 - 59 Leicester Road

	$L_{Aeq,T}$	$L_{Amax,T}$	$L_{A10,T}$	$L_{A90,T}$
Standard deviation, daytime period	2.43	3.39	1.81	6.32
Standard deviation, night time period	7.78	8.77	10.26	4.98
Mean (log), daytime period	66	80	69	55
Mean (log), night time period	59	73	63	41
Modal value, daytime period	66	74	70	56
Modal value, night time period	56	73	64	33
Maximum value daytime period	72	97	72	62
Minimum value daytime period	59	72	63	36
Maximum value night time period	68	80	74	54
Minimum value night time period	33	36	33	31

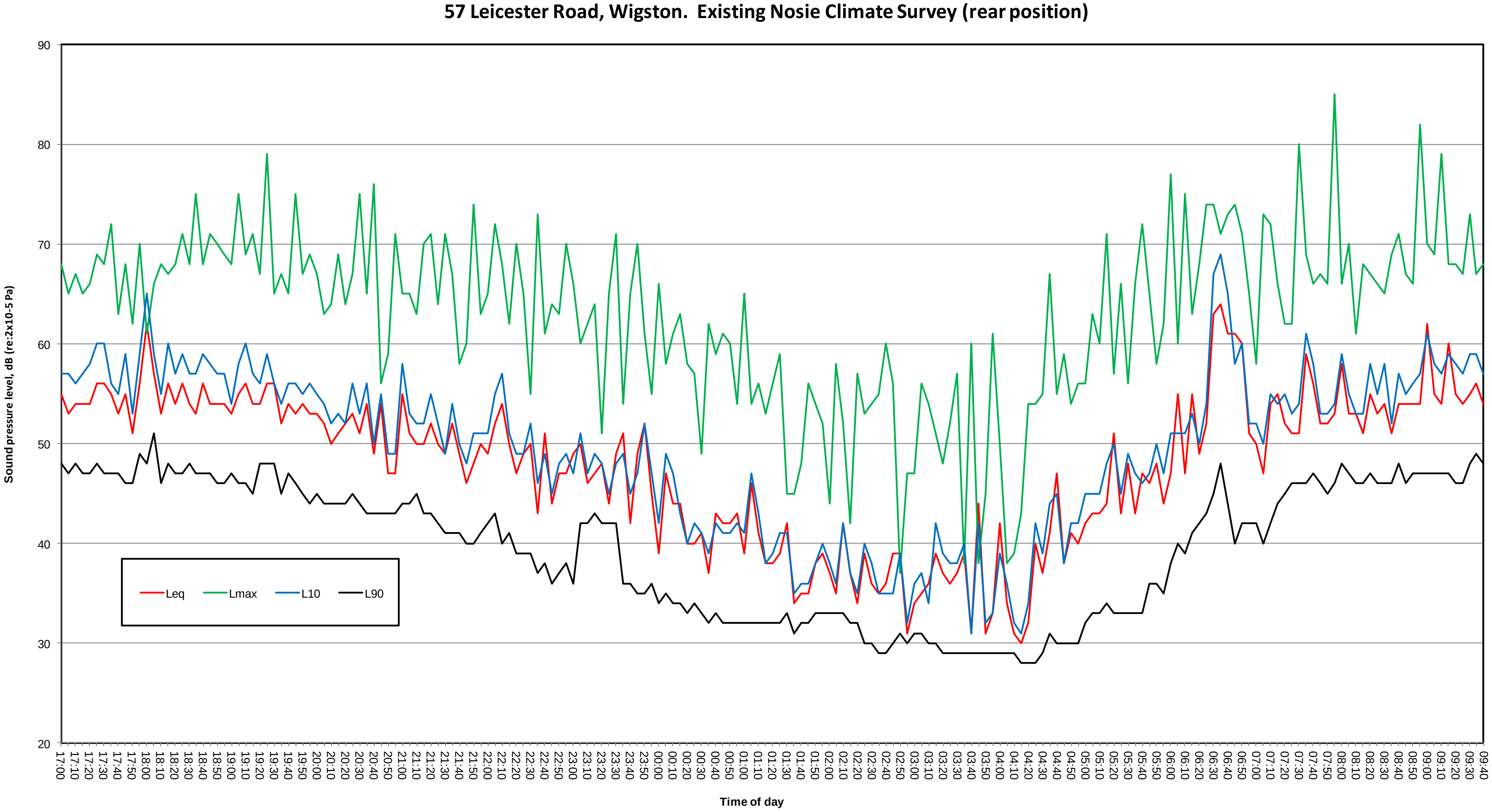
Table 9. Measured sound level summary, rear elevation, 53 - 59 Leicester Road

	$L_{Aeq,T}$	$L_{Amax,T}$	$L_{A10,T}$	$L_{A90,T}$
Standard deviation, daytime period	3.27	5.05	3.63	3.04
Standard deviation, night time period	7.33	9.06	7.48	4.60
Mean (log), daytime period	54	72	56	46
Mean (log), night time period	51	65	53	37
Modal value, daytime period	54	68	57	47
Modal value, night time period	39	54	42	33
Maximum value daytime period	62	85	65	51
Minimum value daytime period	43	55	45	36
Maximum value night time period	64	77	69	48
Minimum value night time period	30	37	31	28

Graph1. Measured sound level summary, front elevation, 57 - 59 Leicester Road



Graph 2. Measured sound level summary, rear elevation, 57 - 59 Leicester Road



As can be seen from tables 8 and 9 the noise climate on the front elevation was a little steadier during the daytime period, but the noise climate during the night time period was a little steadier on the rear elevation. Reference to Graphs 1 and 2 reveal a similar reducing trend in the measured noise levels from the late evening, through the earlier to middle part of the night before increasing again from around 05:00 hours on the front elevation and around 05:30 hours on the rear elevation.

During the survey period the mean (log) and modal values for the L_{eq} parameter on the front elevation were 66 and 59dB respectively during the daytime and night time periods, with the mean (log) values on the rear elevation being 54 and 51dB respectively for the day and night time periods on the rear elevation. It should be remembered that although the full night time 8 hour period was surveyed, it will be assumed that the daytime measured levels were representative of the wider 16 hour L_{eq} daytime period.

With reference to the ProPG document, again, assuming the obtained noise levels would be representative of the mean 16 hour L_{eq} values, the mean (log) levels on the front elevation would fall within the 'medium' and 'high' noise risk categories for the day and night time periods. With reference to the situation on the rear elevation the mean (log) levels would again fall within the 'low' category for the day and night time periods.

Consequently and as suggested, it is likely that suitable measures would need to be employed to mitigate and minimise the potential ingress of external noise levels to the rooms within the proposed development, particularly during the night time period. With reference to these suitable measures, the guidance contained within the ProPG document, at paragraph 2.34, suggests:

"*Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources... In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole building ventilation" in accordance with Building Regulations Approved Document F (e.g. trickle ventilation) in the open position*".

With reference to the AVO Guide, again using the initial assessment procedure to provide context to the assessment, again assuming the obtained levels would be representative of levels measured over a full 16 hour daytime period, the mean (log) and modal values for the L_{eq} parameter on the front elevation would fall into the 'high' risk category for the day and night time periods. With reference to the noise climate on the rear elevation, this would fall within the 'low' risk category for the day and night time periods. With reference to the measured L_{Amax} values from the night time period, the 78dB level was exceeded in only five of the measurement periods during the night on the front elevation only.

The measured noise levels would have implications for the potential ventilation proposals for the proposed dwelling. Applying the 9 - 15dB 'rule of thumb' for the sound attenuation offered by a partially open window, it is suggested that where a window was partially open for ventilation purposes the internal noise levels detailed in table 2 above would very probably be exceeded on both the front and rear elevations. As a result it is likely that an alternative means of ventilating the proposed flats, to permit the internal spaces to be ventilated without recourse to opening windows and so increasing the internal noise levels, should be considered.

7.0 Noise Transmission Calculations

Using the measured noise levels from the existing noise climate survey, calculations have been performed to assess the likely internal noise levels within the proposed flats. As the existing noise climate was dominated by noise that predominantly lacked specific character and so was regarded as being 'anonymous' in nature, the assessment of the likely internal noise levels within the proposed residential development will be undertaken with reference to the design guide values detailed within BS8233:2014 and reproduced in table 2 above.

The subsequent assessment of the potential internal noise levels within the proposed flats have been undertaken using the highest measured levels from the noise surveys and these levels are detailed in tables 11 and 12 below. By applying the highest measured noise levels from the surveys, it is suggested that the following calculations may be regarded as worst case assessments using noise levels that are unlikely to persist for all but very short periods of time.

Table 11. Highest measured sound levels, front elevation

OBCF, Hz*	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Overall, dB(A)**
Daytime, L_{Aeq}, (17:00 - 17:05 hours)	47	48	57	60	65	62	52	43	**68**
Night time, $L_{Aeq.}$ (06:25 - 06:30 hours)	41	49	55	60	63	60	53	43	**66**
Night time, $L_{Amax,}$ (06:25 - 06:30 hours)	60	70	70	76	76	74	70	59	**80**

Table 12. Highest measured sound levels, rear elevation

OBCF, Hz*	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Overall, dB(A)**
Daytime, L_{Aeq}, (09:00 - 19:05 hours)	41	46	50	53	58	57	51	48	**62**
Night time, $L_{Aeq,}$ (06:35 - 06:40 hours)	35	42	55	59	59	58	55	42	**64**
Night time, $L_{Amax.}$ (06:00 - 06:05 hours)	55	55	60	68	72	72	67	59	**77**

The sound insulation provided by a building envelope is calculated from the sound insulation provided by the various façade elements, such as the glazing, external walls etc., and the areas they cover. In the majority of cases it is the glazing and ventilation provision that can be considered as the ‘weak’ links acoustically, therefore increasing the sound insulation of these elements will improve the overall sound insulation of the façade. The result of the calculation is a composite sound insulation value for the whole façade.

The following assessments of the likely internal noise levels within the proposed residential flat have been undertaken according to the room and façade dimensions detailed on the drawings issued by Architecture 365 of Lynmouth Road, Leicester. To facilitate the calculations to be made the following assumptions have been employed:

- The reverberation times within the flats will be 0.5 seconds.
- The floor to ceiling height will be approximately 2.4 metres.
- The calculations have been produced assuming the windows would be closed but the ventilation openings would be open.
- The highest measured noise levels detailed in tables 11 and 12 above would be equally incident upon the front and rear elevations of the proposed development.

7.1 Construction Specification

The external walls of the proposed development is likely to be of cavity masonry construction around 300 mm thick and the following general composition has been assumed: an external brick leaf, a 75 - 100mm cavity and a 100mm thick aggregate block inner leaf lined with one layer of 12.5mm plasterboard on adhesive dabs. Test results for a similar construction suggest that external walls of this type should provide an overall sound insulation of around 52dB R_w, with the octave band sound insulation values being as detailed in table 13 below.

Table 13. Masonry Cavity Wall Construction**,** Octave Band Sound Insulation Values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, R_w dB(A)**
Sound Insulation, dB	38	42	51	59	63	63	**52**

* Octave Band Centre Frequency

Glazing

The suggested glazing for the proposed residential development would be of the sealed unit type and would be of the following nominal specification: 4mm pane, 16/20mm cavity, 4mm pane and this is equivalent to the existing glazing at first floor level. Laboratory test data obtained from Pilkington Glass indicate that this configuration should provide a sound insulation value of 29dB R_w. The octave band sound insulation values are as detailed in table 14 below.

Alternative glazing configurations would be acceptable providing the sound insulation performances are at least equivalent to the specifications detailed in table 14 below.

Table 14. Glazing, octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, R_w (C_{tr}) dB**
4mm, 16/20mm, 4mm	24	20	25	35	38	35	**29 (-4)**

* Octave Band Centre Frequency

Ventilation

The initial assessments will be undertaken assuming the provision of input air via window frame mounted 'background' (trickle) ventilators. In this case the selected window frame mounted background ventilators of the Greenwood 4000EAV and Titan V75/C50 and V75/C50 types have been selected. The Titan ventilators may be regarded as an 'acoustic' type ventilators, but units offering equivalent sound insulation performance to those selected would be acceptable.

Laboratory test data indicates that the Green wood window frame mounted ventilator should provide a sound insulation value of 33dB $D_{n,e,w}$ in its open position, whereas the two Titan acoustic ventilators would provide sound insulation values of 42 and 44dB $D_{n,e,w}$ in their open positions. The octave band sound insulation values for the selected window frame mounted ventilators are detailed in table 15 overleaf. Alternative ventilator configurations would be acceptable providing the sound insulation performance of the units is at least equivalent to the specification detailed in table 15 below.

Table 15. Background ventilation**,** octave band sound insulation values

OBCF, Hz*	**125**	**250**	**500**	**1k**	**2k**	**4k**	**Overall, $D_{n,e,w}$ dB**
Greenwood 40000EAV	36	37	34	30	33	38**	**33**
Titan V75/C50	40	37	34	43	50	53	**42**
Titan V75/C75	37	37	36	47	49	55	**44**

* Octave Band Centre Frequency.

7.2 Calculation Results and Discussion

For the purposes of the calculations the highest measured noise levels detailed in tables 11 and 12 above were used. Calculations have been performed for the proposed two flats on the first floor of the existing building at 57 - 59 Leicester Road. For the purposes of the calculations it has been assumed that the windows would remain closed but the background ventilation would be in its open position.

The results of the break-in noise calculations, including the assumptions relating to the proposed façade elements detailed above, are presented with reference to the design guidance contained within section 4.0 above, in tables 16 and 17 overleaf. With respect to the presentation of the results of the calculations, with respect to the night time L_{Aeq} and L_{Amax} results these are presented in the same columns with the L_{Amax} results being contained within brackets. Full data are available in Appendix 2.

Table 16. Calculated noise levels, proposed flat 1, first floor

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq}	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Living room/kitchen*	35	**33**	-	**-**
Bedroom**	35	**31**	30 (45)	**30 (45)**

*Titan V75/C50 ventilator ** Titan V75/C75 ventilator

Table 17. Calculated noise levels, proposed flat 2, first floor

Location	Design target, daytime, dB L_{Aeq}	Calculated level, daytime, dB L_{Aeq}	Design target, night time, dB L_{Aeq}	Calculated levels, night time, dB L_{Aeq} and (L_{Amax})
Living room/kitchen***	35	**32**	-	**-**
Bedroom*	35	**25**	30 (45)	**29 (40)**

*** Greenwood 4000EAV ventilator * Titan V75/C50 ventilator

As can be seen from tables 16 and 17 above, based on the stated assumptions relating to the sound insulation of the proposed façade elements and under the windows closed but ventilation openings open scenario, the calculated internal noise levels within the proposed residential flats resulting from external noise break-in would not exceed the design guidance contained within BS 8233:2014. It should however be remembered that the results presented in tables 16 and 17 above must be considered as a worst case using the highest measured noise levels. With this in mind it is suggested that the internal levels within the proposed accommodation would, for the majority of the time, be below the levels presented within tables 16 and 17.

The results presented within tables 16 and 17 highlight that the adopted guidance relating to the internal noise levels within the proposed first flats can be achieved with closed windows and background ventilation openings in their open positions. It is however recognised that opening the windows for ventilation purposes, purge ventilation purposes excepted, would result in the internal noise levels exceeding the design guide levels detailed in BS 8233:2014. Assuming a level difference in the outside to inside sound levels of between 9 - 15dB proposed in the AVO guide and other documents, it can be seen from both the measured noise levels obtained during the existing noise climate survey and the results presented within tables 16 and 17 above, that partially opening the windows for ventilation purposes would result in the internal noise levels exceeding the design guide levels. As a result it is suggested that alternative means of ventilation, to permit the internal spaces to be ventilated without requiring the windows to be opened should be considered.

Two ventilation options that would be capable of meeting the above brief would fall under the description of what are termed systems 3 and 4 as defined within Approved Document F, guidance to the Building Regulations. System 3 relates to a continuous mechanical extraction (MEV) system which operates to remove air from the building with the 'make-up' air being drawn in via background ventilators. System 4 refers to a fully mechanical system incorporating heat recovery and is typically used in noisy environments etc. In both cases the requirement to ventilate to internal spaces would need to be carefully considered as the benefit to the occupants should be balanced with the possible disincentives to use, such as the perceived complexity of the installation and running costs.

In this case and with reference to the ventilation options presented within table 6 above, bearing in mind the existing noise climate was not regarded as being particularly noisy, the alternative ventilation strategy could take the form of a system 3 provision. With reference to the alternative ventilation, as with any ventilation installation it is essential that the emission of sound from the ventilation system is adequately controlled to ensure that this element does not detrimentally affect the internal noise climate. In addition it is essential that the occupants must also be provided with the option to open windows as they choose.

Consequently, the existing noise climate should not be regarded as an impediment to the granting of planning permission providing the suggested sound insulation measures, or alternative no less effective measures, are applied to the proposed flats. In addition, the foregoing has indicated that the proposed flats could be integrated into the existing environment without the potential for "unreasonable restrictions" to be placed upon already established businesses in the vicinity.

8.0 Conclusion

The existing noise climate in the vicinity of 57 - 59 Leicester Road in Wigston was characteristic of an urban environment, subject to noise contributions primarily from road traffic, although some occasional noise contributions were made by the surrounding commercial enterprises including very infrequent contributions from the patrons of the William Wygston public house standing outside to smoke. Despite being an urban environment, the existing noise climate was not regarded as being particularly noisy.

Applying the assumptions stated above, relating to the sound insulation of the façade elements, calculations have been undertaken to assess the likely internal noise levels within the proposed residential flats. The calculations have demonstrated that the sound insulation of the proposed building elements would ensure that the calculated break-in sound levels within the proposed first floor flats would not exceed the adopted design guide values assuming the windows closed and ventilation openings open, scenario.

Despite this it is recognised that opening the windows for ventilation purposes, purge ventilation excepted, would result in the internal noise levels exceeding the design guide levels. As a result it is suggested that alternative means of ventilation, to permit the internal spaces to be ventilated without requiring the windows to be opened, should be considered. In this case a system 3 or 4, as detailed within Approved Document F, should be considered. As with any ventilation installation it is essential that the emission of sound from the ventilation system is adequately controlled to ensure that this element does not detrimentally affect the internal noise climate. In addition it is essential that the occupants must also be provided with the option to open windows as they choose.

As a consequence of the foregoing, it is suggested the sound insulation of the proposed façade elements and proposed alternative ventilation provision, would be sufficient to limit the ingress of external noise to the proposed first floor flats in compliance with the adopted design guidance. As such, it is suggested that the proposed flats could be integrated into the existing environment without the potential for "unreasonable restrictions" to be placed upon already established businesses in the vicinity. Consequently, it is suggested that the existing noise climate should not be regarded as an impediment to the granting of planning permission.

Appendix 1: Existing Noise Climate Survey, Measured Sound Levels

Front elevation, 57 - 59 Leicester Road, Wigston, 26th – 27th February 2024

Front measurement position, measured sound levels

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
17:00	68	80	69	62
17:05	66	74	68	57
17:10	66	73	68	59
17:15	67	73	69	62
17:20	67	75	70	56
17:25	66	73	68	57
17:30	65	74	68	56
17:35	64	74	66	56
17:40	66	75	68	60
17:45	66	74	70	52
17:50	67	77	69	59
17:55	67	76	70	55
18:00	66	78	69	58
18:05	65	75	68	56
18:10	67	78	70	59
18:15	65	74	68	57
18:20	66	75	69	55
18:25	67	78	70	59
18:30	66	74	69	57
18:35	66	73	69	55
18:40	66	74	69	55
18:45	65	74	69	55
18:50	66	74	69	54
18:55	66	78	69	56

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
19:00	65	82	68	56
19:05	66	74	69	59
19:10	65	77	68	55
19:15	67	97	70	57
19:20	66	76	69	56
19:25	66	79	69	54
19:30	66	78	69	54
19:35	65	74	67	56
19:40	66	87	69	53
19:45	66	74	69	55
19:50	64	75	67	51
19:55	64	78	68	53
20:00	64	74	68	46
20:05	65	78	67	51
20:10	64	75	68	49
20:15	66	78	68	51
20:20	65	79	68	51
20:25	64	74	68	50
20:30	64	77	68	49
20:35	64	84	67	48
20:40	66	80	69	50
20:45	64	74	67	48
20:50	62	74	66	49
20:55	63	73	67	52

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
21:00	65	75	68	50
21:05	65	74	69	53
21:10	64	74	68	48
21:15	62	74	66	50
21:20	64	75	68	48
21:25	62	74	67	46
21:30	62	73	66	44
21:35	62	75	67	44
21:40	62	72	66	45
21:45	61	75	65	44
21:50	64	74	67	46
21:55	63	74	67	49
22:00	61	72	66	45
22:05	63	73	67	44
22:10	63	76	67	43
22:15	62	74	66	48
22:20	60	72	65	38
22:25	61	74	66	40
22:30	63	80	67	39
22:35	60	73	64	38
22:40	60	76	64	36
22:45	59	72	63	37
22:50	62	73	66	38
22:55	59	72	64	36

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
23:00	61	76	64	37
23:05	59	73	62	36
23:10	60	72	64	38
23:15	60	76	64	36
23:20	56	71	60	38
23:25	52	66	55	39
23:30	58	74	62	37
23:35	59	73	64	37
23:40	56	69	61	36
23:45	59	75	63	36
23:50	56	70	60	34
23:55	54	70	56	35
00:00	51	65	53	35
00:05	57	71	61	35
00:10	56	71	58	35
00:15	52	67	54	35
00:20	56	72	58	34
00:25	50	68	46	33
00:30	53	71	50	33
00:35	54	70	56	34
00:40	58	78	59	34
00:45	48	68	43	33
00:50	55	72	56	33
00:55	55	71	58	33

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
01:00	55	73	57	34
01:05	58	71	63	33
01:10	56	74	56	33
01:15	54	70	54	33
01:20	56	73	57	33
01:25	52	70	49	33
01:30	50	69	42	32
01:35	52	69	51	33
01:40	36	53	36	33
01:45	54	72	54	33
01:50	57	72	60	33
01:55	52	69	53	33
02:00	49	64	49	33
02:05	48	66	42	38
02:10	50	70	42	39
02:15	42	56	43	39
02:20	55	73	56	36
02:25	55	72	56	36
02:30	51	68	49	33
02:35	52	72	38	32
02:40	34	42	35	33
02:45	59	77	61	33
02:50	40	65	35	32
02:55	51	70	40	33

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
03:00	52	68	53	32
03:05	36	49	38	32
03:10	56	75	55	33
03:15	52	68	52	32
03:20	56	70	59	33
03:25	55	73	53	32
03:30	55	75	53	32
03:35	49	69	36	32
03:40	57	74	54	32
03:45	33	38	33	31
03:50	45	66	40	32
03:55	54	72	50	32
04:00	51	68	49	32
04:05	33	36	33	32
04:10	33	37	33	31
04:15	34	44	33	31
04:20	57	72	58	32
04:25	56	72	59	32
04:30	56	71	58	32
04:35	59	75	60	32
04:40	54	73	52	32
04:45	59	76	62	32
04:50	57	74	58	32
04:55	58	76	61	33

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
05:00	60	74	64	37
05:05	60	75	65	36
05:10	59	73	62	34
05:15	61	76	66	40
05:20	58	73	61	34
05:25	60	76	64	34
05:30	62	74	67	36
05:35	59	74	62	36
05:40	63	79	66	36
05:45	63	77	67	38
05:50	61	73	66	37
05:55	64	75	68	43
06:00	64	74	68	46
06:05	64	76	68	45
06:10	63	76	67	43
06:15	62	75	66	42
06:20	68	80	74	54
06:25	66	80	70	46
06:30	64	79	68	51
06:35	65	79	69	49
06:40	65	74	69	41
06:45	63	74	68	42
06:50	65	77	68	50
06:55	65	78	69	52

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
07:00	65	77	70	43
07:05	65	78	69	45
07:10	67	77	70	53
07:15	68	79	71	53
07:20	67	76	70	54
07:25	67	79	70	54
07:30	68	78	71	57
07:35	68	79	70	58
07:40	68	75	70	61
07:45	68	78	71	54
07:50	68	77	70	56
07:55	68	75	70	56
08:00	68	77	72	56
08:05	68	77	71	53
08:10	68	76	71	55
08:15	68	81	71	57
08:20	68	76	71	56
08:25	68	76	71	56
08:30	67	76	70	58
08:35	69	82	71	59
08:40	67	75	70	59
08:45	68	79	71	50
08:50	68	75	70	58
08:55	68	79	70	58

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
09:00	68	80	70	59
09:05	67	80	69	61
09:10	67	76	70	56
09:15	67	76	70	58
09:20	67	76	69	61
09:25	67	77	70	58
09:30	67	76	70	59
09:35	67	74	69	51
09:40	68	74	70	56

Rear measurement position, measured sound levels

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
17:00	55	68	57	48
17:05	53	65	57	47
17:10	54	67	56	48
17:15	54	65	57	47
17:20	54	66	58	47
17:25	56	69	60	48
17:30	56	68	60	47
17:35	55	72	56	47
17:40	53	63	55	47
17:45	55	68	59	46
17:50	51	62	53	46
17:55	56	70	59	49
18:00	62	61	65	48
18:05	57	66	59	51
18:10	53	68	55	46
18:15	56	67	60	48
18:20	54	68	57	47
18:25	56	71	59	47
18:30	54	68	57	48
18:35	53	75	57	47
18:40	56	68	59	47
18:45	54	71	58	47
18:50	54	70	57	46
18:55	54	69	57	46

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
19:00	53	68	54	47
19:05	55	75	58	46
19:10	56	69	60	46
19:15	54	71	57	45
19:20	54	67	56	48
19:25	56	79	59	48
19:30	56	65	56	48
19:35	52	67	54	45
19:40	54	65	56	47
19:45	53	75	56	46
19:50	54	67	55	45
19:55	53	69	56	44
20:00	53	67	55	45
20:05	52	63	54	44
20:10	50	64	52	44
20:15	51	69	53	44
20:20	52	64	52	44
20:25	53	67	56	45
20:30	51	75	53	44
20:35	54	65	56	43
20:40	49	76	50	43
20:45	54	56	55	43
20:50	47	59	49	43
20:55	47	71	49	43

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
21:00	55	65	58	44
21:05	51	65	53	44
21:10	50	63	52	45
21:15	50	70	52	43
21:20	52	71	55	43
21:25	50	64	52	42
21:30	49	71	49	41
21:35	52	67	54	41
21:40	49	58	50	41
21:45	46	60	48	40
21:50	48	74	51	40
21:55	50	63	51	41
22:00	49	65	51	42
22:05	52	72	55	43
22:10	54	68	57	40
22:15	50	62	51	41
22:20	47	70	49	39
22:25	49	65	49	39
22:30	50	55	52	39
22:35	43	73	46	37
22:40	51	61	49	38
22:45	44	64	45	36
22:50	47	63	48	37
22:55	47	70	49	38

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
23:00	49	66	47	36
23:05	50	60	51	42
23:10	46	62	47	42
23:15	47	64	49	43
23:20	48	51	48	42
23:25	44	65	45	42
23:30	49	71	48	42
23:35	51	54	49	36
23:40	42	65	45	36
23:45	49	70	47	35
23:50	52	61	52	35
23:55	45	55	47	36
00:00	39	66	42	34
00:05	47	58	49	35
00:10	44	61	47	34
00:15	44	63	43	34
00:20	40	58	40	33
00:25	40	57	42	34
00:30	41	49	41	33
00:35	37	62	39	32
00:40	43	59	42	33
00:45	42	61	41	32
00:50	42	60	41	32
00:55	43	54	42	32

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
01:00	39	65	41	32
01:05	46	54	47	32
01:10	41	56	43	32
01:15	38	53	38	32
01:20	38	56	39	32
01:25	39	59	41	32
01:30	42	45	41	33
01:35	34	45	35	31
01:40	35	48	36	32
01:45	35	56	36	32
01:50	38	54	38	33
01:55	39	52	40	33
02:00	37	44	38	33
02:05	35	58	36	33
02:10	42	52	42	33
02:15	37	42	37	32
02:20	34	57	35	32
02:25	39	53	40	30
02:30	36	54	38	30
02:35	35	55	35	29
02:40	36	60	35	29
02:45	39	56	35	30
02:50	39	37	39	31
02:55	31	47	32	30

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
03:00	34	47	36	31
03:05	35	56	37	31
03:10	36	54	34	30
03:15	39	51	42	30
03:20	37	48	39	29
03:25	36	52	38	29
03:30	37	57	38	29
03:35	39	38	40	29
03:40	31	60	31	29
03:45	44	38	42	29
03:50	31	45	32	29
03:55	33	61	33	29
04:00	42	50	39	29
04:05	34	38	36	29
04:10	31	39	32	29
04:15	30	43	31	28
04:20	32	54	34	28
04:25	40	54	42	28
04:30	37	55	39	29
04:35	41	67	44	31
04:40	47	55	45	30
04:45	38	59	38	30
04:50	41	54	42	30
04:55	40	56	42	30

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
05:00	42	56	45	32
05:05	43	63	45	33
05:10	43	60	45	33
05:15	44	71	48	34
05:20	51	57	50	33
05:25	43	66	45	33
05:30	48	56	49	33
05:35	43	66	47	33
05:40	47	72	46	33
05:45	46	65	47	36
05:50	48	58	50	36
05:55	44	62	47	35
06:00	47	77	51	38
06:05	55	60	51	40
06:10	47	75	51	39
06:15	55	63	53	41
06:20	49	68	50	42
06:25	52	74	54	43
06:30	63	74	67	45
06:35	64	71	69	48
06:40	61	73	65	44
06:45	61	74	58	40
06:50	60	71	60	42
06:55	51	65	52	42

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
07:00	50	58	52	42
07:05	47	73	50	40
07:10	54	72	55	42
07:15	55	66	54	44
07:20	52	62	55	45
07:25	51	62	53	46
07:30	51	80	54	46
07:35	59	69	61	46
07:40	56	66	58	47
07:45	52	67	53	46
07:50	52	66	53	45
07:55	53	85	54	46
08:00	58	66	59	48
08:05	53	70	55	47
08:10	53	61	53	46
08:15	51	68	53	46
08:20	55	67	58	47
08:25	53	66	55	46
08:30	54	65	58	46
08:35	51	69	52	46
08:40	54	71	57	48
08:45	54	67	55	46
08:50	54	66	56	47
08:55	54	82	57	47

Time	$L_{Aeq\ 5\ mins}$	$L_{Amax,\ 5\ mins}$	$L_{A10,\ 5\ mins}$	$L_{A90,\ 5\ mins}$
09:00	62	70	61	47
09:05	55	69	58	47
09:10	54	79	57	47
09:15	60	68	59	47
09:20	55	68	58	46
09:25	54	67	57	46
09:30	55	73	59	48
09:35	56	67	59	49
09:40	54	68	57	48

Appendix 2: Break-in Noise Calculations

Flat 1, first floor

L_{Aeq} Assessment, daytime

Flat 1, kitchen/living room - front elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		68	36	47	48	57	60	65	62	52	43	37
B	Exposed façade, m^2	9		9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
C	Volume of receiving room, m^3	57.7											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
F	Composite SRI			19.3	24.3	29.3	25.7	30.7	40.7	43.7	40.7	45.7	50.7
G	A + B + E - F		27	13.8	19.9	15.3	27.7	26.2	21.2	14.7	8.2	-5.9	-17.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		30	16.8	22.9	18.3	30.7	29.2	24.2	17.7	11.2	-2.9	-14.1
K	Number of ventilators	2											
L	Ventilator $D_{n,e}$				35	40	37	34	43	50	53	63	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				15.9	11.3	23.1	29.6	25.6	15.1	2.6	-16.5	
N	Internal room noise level, vent open		33		23.7	19.1	31.4	32.4	28.0	19.6	11.7	-2.7	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Titan V75/C50*

Flat 1, kitchen/living room - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		68	36	47	48	57	60	65	62	52	43	37
B	Exposed façade, m^2	15.6		11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9
C	Volume of receiving room, m^3	57.7											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7	-12.7
F	I bed existing			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		11	7.5	13.6	9.0	13.8	9.3	6.3	-1.2	-10.7	-24.8	-31.0
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		14	10.5	16.6	12.0	16.8	12.3	9.3	1.8	-7.7	-21.8	-28.0

Glazing: -

Ventilator type: -

Combined sound level, dB(A)	33

Flat 1, bedroom - front elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		68	36	47	48	57	60	65	62	52	43	37
B	Exposed façade, m^2	5.9		7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
C	Volume of receiving room, m^3	28.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
F	Composite SRI			20.3	25.3	30.3	26.8	31.9	41.8	44.8	41.9	46.9	51.8
G	A + B + E - F		27	14.1	20.2	15.6	27.9	26.3	21.4	14.8	8.3	-5.8	-16.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		30	17.1	23.2	18.6	30.9	29.3	24.4	17.8	11.3	-2.8	-13.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				32	37	37	36	47	49	55	61	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				17.7	13.1	21.9	26.4	20.4	14.9	-0.6	-15.7	
N	Internal room noise level, vent open		31		24.3	19.7	31.4	31.1	25.8	19.6	11.6	-2.6	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Titan V75/C75*

Flat 1, bedroom - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		68	36	47	48	57	60	65	62	52	43	37
B	Exposed façade, m^2	11.7		10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
C	Volume of receiving room, m^3	28.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		13	9.4	15.5	10.9	15.7	11.2	8.2	0.7	-8.8	-22.9	-29.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		16	12.4	18.5	13.9	18.7	14.2	11.2	3.7	-5.8	-19.9	-26.1

Glazing: -

Ventilator type: -

Combined sound level, dB(A)	31

L_{Aeq} Assessment, night time

Flat 1, bedroom - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		66	29	41	49	55	60	63	60	53	43	29
B	Exposed façade, m^2	5.9		7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
C	Volume of receiving room, m^3	28.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
F	Composite SRI			20.3	25.3	30.3	26.8	31.9	41.8	44.8	41.9	46.9	51.8
G	A + B + E - F		26	6.8	14.2	16.9	26.5	26.2	19.3	12.9	9.5	-5.6	-24.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		29	9.8	17.2	19.9	29.5	29.2	22.3	15.9	12.5	-2.6	-21.7
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				32	37	37	36	47	49	55	61	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				11.7	14.4	20.5	26.3	18.3	13.0	0.6	-15.5	
N	Internal room noise level, vent open		30		18.3	21.0	30.0	31.0	23.7	17.7	12.8	-2.4	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Titan V75/C75*

Flat 1, bedroom - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		66	29	41	49	55	60	63	60	53	43	29
B	Exposed façade, m^2	11.7		10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
C	Volume of receiving room, m^3	28.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		12	2.1	9.5	12.2	14.3	11.1	6.1	-1.2	-7.6	-22.7	-36.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		15	5.1	12.5	15.2	17.3	14.1	9.1	1.8	-4.6	-19.7	-33.9

Glazing: -

Ventilator type: -

Combined sound level, dB(A): 30

L_{Amax} Assessment, night time

Flat 1, bedroom - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		80	45	60	70	70	76	76	74	70	59	47
B	Exposed façade, m^2	5.9		7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
C	Volume of receiving room, m^3	28.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
F	Composite SRI			20.9	25.9	30.9	27.6	32.6	42.6	45.6	42.7	47.7	52.6
G	A + B + E - F		40	22.3	31.7	37.6	40.8	41.5	31.5	26.3	25.1	8.9	-7.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		43	25.3	34.7	40.6	43.8	44.5	34.5	29.3	28.1	11.9	-4.9
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				32	37	37	36	47	49	55	61	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				29.8	35.7	35.6	42.4	31.3	27.1	17.0	-0.2	
N	Internal room noise level, vent open		45		35.9	41.8	44.4	46.6	36.2	31.3	28.4	12.2	

Glazing: *4mm, 16/20mm, 4mm*

Ventilator type: *Titan V75/C75*

Flat 1, bedroom - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		80	45	60	70	70	76	76	74	70	59	47
B	Exposed façade, m^2	11.7		10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
C	Volume of receiving room, m^3	28.1											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6	-9.6
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		27	18.2	27.6	33.5	29.4	27.2	19.1	12.9	8.8	-7.4	-19.3
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		30	21.2	30.6	36.5	32.4	30.2	22.1	15.9	11.8	-4.4	-16.3

Glazing: -

Ventilator type: -

Combined sound level, dB(A): 45

Flat 2, first floor

L_{Aeq} Assessment, daytime

Flat 2, kitchen/living room - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		62	33	41	46	50	53	58	57	51	48	31
B	Exposed façade, m²	7.3		8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
C	Volume of receiving room, m³	35.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
F	Composite SRI			21.0	26.0	31.0	27.7	32.8	42.7	45.8	42.8	47.8	52.7
G	A + B + E - F		19	10.2	12.4	12.6	20.2	17.7	12.7	9.6	6.5	-1.4	-23.6
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		22	13.2	15.4	15.6	23.2	20.7	15.7	12.6	9.5	1.6	-20.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				31	36	37	34	30	33	38	43	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				10.9	11.1	14.4	19.9	28.9	25.8	14.7	6.8	
N	Internal room noise level, vent open		32		16.7	16.9	23.8	23.3	29.1	26.0	15.8	7.9	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Greenwood 4000EAV*												

Flat 2, kitchen/living room - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		62	33	41	46	50	53	58	57	51	48	31
B	Exposed façade, m²	12		10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
C	Volume of receiving room, m³	35.9											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7	-10.7
F	I bed existing			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		5	5.4	7.6	7.8	8.1	2.6	-0.4	-4.5	-10.6	-18.5	-35.7
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		8	8.4	10.6	10.8	11.1	5.6	2.6	-1.5	-7.6	-15.5	-32.7
Glazing:	-												
Ventilator type:	-												
	Combined sound level, dB(A)		32										

Flat 2, bedroom - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		62	33	41	46	50	53	58	57	51	48	31
B	Exposed façade, m²	7.6		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m³	28.7											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
F	Composite SRI			21.2	26.2	31.2	27.9	32.9	42.9	45.9	43.0	48.0	52.9
G	A + B + E - F		20	11.2	13.4	13.6	21.2	18.7	13.7	10.6	7.4	-0.5	-22.6
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		23	14.2	16.4	16.6	24.2	21.7	16.7	13.6	10.4	2.5	-19.6
K	Number of ventilators	1											
L	Ventilator $D_{n,e}$				35	40	37	34	43	50	53	63	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				6.7	6.9	14.2	19.7	15.7	8.6	-0.5	-13.4	
N	Internal room noise level, vent open		25		16.9	17.1	24.6	23.8	19.2	14.8	10.8	2.6	
Glazing:	*4mm, 16/20mm, 4mm*												
Ventilator type:	*Titan V75/C50*												

Flat 2, bedroom - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		62	33	41	46	50	53	58	57	51	48	31
B	Exposed façade, m²	9.3		9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
C	Volume of receiving room, m³	28.7											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		5	5.3	7.5	7.7	8.0	2.5	-0.5	-4.6	-10.7	-18.6	-35.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		8	8.3	10.5	10.7	11.0	5.5	2.5	-1.6	-7.7	-15.6	-32.8
Glazing:	-												
Ventilator type:	-												
	Combined sound level, dB(A)		25										

L_{Aeq} Assessment, night time

Flat 2, bedroom - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		**64**	31	35	42	55	59	59	58	55	42	34
B	Exposed façade, m^2	**7.6**		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m^3	**28.7**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
F	Composite SRI			21.2	26.2	31.2	27.9	32.9	42.9	45.9	43.0	48.0	52.9
G	A + B + E - F		**25**	8.8	7.6	10.2	26.4	25.3	15.2	11.6	11.1	-6.9	-19.8
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**28**	11.8	10.6	13.2	29.4	28.3	18.2	14.6	14.1	-3.9	-16.8
K	Number of ventilators	**1**											
L	Ventilator $D_{n,e}$				35	40	37	34	43	50	53	63	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				0.9	3.5	19.4	26.3	17.2	9.6	3.2	-19.8	
N	Internal room noise level, vent open		**29**		11.1	13.7	29.8	30.4	20.7	15.8	14.5	-3.8	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Titan V75/C50*

Flat 2, bedroom - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{eq}		**64**	31	35	42	55	59	59	58	55	42	34
B	Exposed façade, m^2	**9.3**		9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
C	Volume of receiving room, m^3	**28.7**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		**9**	2.9	1.7	4.3	13.2	9.1	1.0	-3.6	-7.0	-25.0	-33.0
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**12**	5.9	4.7	7.3	16.2	12.1	4.0	-0.6	-4.0	-22.0	-30.0

Glazing: -
Ventilator type: -

Combined sound level, dB(A)	**29**

L_{Amax} Assessment, night time

Flat 2, bedroom - rear elevation

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		**77**	52	55	55	60	68	72	72	67	59	43
B	Exposed façade, m^2	**7.6**		8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
C	Volume of receiving room, m^3	**28.7**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
F	Composite SRI			21.2	26.2	31.2	27.9	32.9	42.9	45.9	43.0	48.0	52.9
G	A + B + E - F		**35**	30.1	28.3	23.3	31.1	34.6	28.3	24.8	23.1	9.7	-10.9
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**38**	33.1	31.3	26.3	34.1	37.6	31.3	27.8	26.1	12.7	-7.9
K	Number of ventilators	**1**											
L	Ventilator $D_{n,e}$				35	40	37	34	43	50	53	63	
M	L_{Aeq} - $D_{n,e}$ + 10*log(10) - B				21.6	16.6	24.1	35.6	30.3	22.8	15.2	-3.2	
N	Internal room noise level, vent open		**39**		31.8	26.8	34.5	39.7	33.8	29.0	26.5	12.8	

Glazing: *4mm, 16/20mm, 4mm*
Ventilator type: *Titan V75/C50*

Flat 2, bedroom - gable

* Octave Band Centre Frequency, Hz			dB(A)	31.5*	63*	125*	250*	500*	1k*	2k*	4k*	8k*	16k*
A	Measured L_{max}		**77**	52	55	55	60	68	72	72	67	59	43
B	Exposed façade, m^2	**9.3**		9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
C	Volume of receiving room, m^3	**28.7**											
D	Reverb Time, seconds			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
E	10 x Log(RT60/(0.163 x V)			-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7	-9.7
F	Composite SRI			28.0	33.0	38.0	42.0	50.0	58.0	62.0	62.0	67.0	67.0
G	A + B + E - F		**19**	24.2	22.4	17.4	17.9	18.4	14.1	9.6	5.0	-8.4	-24.1
H	K = 3			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
I													
J	Calculated internal noise level		**22**	27.2	25.4	20.4	20.9	21.4	17.1	12.6	8.0	-5.4	-21.1

Glazing: -
Ventilator type: -

Combined sound level, dB(A)	**40**