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410A Wilbraham Road, Manchester, M21
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Assessment of noise climate at 410A
Wilbraham Road, Manchester for
residential development.

Prepared for :-

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1.0 SUMMARY

The existing development comprises a terraced house, on the ground floor of which is a take away restaurant, with the upper floors proposed to undergo conversion into 3 no. apartments.

The day time existing noise climate incident upon the front elevation overlooking Wilbraham Road was dominated by road traffic during both the day time and night time periods. During lulls in traffic, pedestrians talking, and activity from local shops could occasionally be heard.

On the rear elevation, during the opening hours of the ground floor takeaway, the dominant noise source was noise from externally-situated extract fans, serving the kitchen extraction system. Once the extraction system was turned off (at midnight), the noise climate was influenced by infrequent passing cars along Wilbraham Road, local external plant not related to this development, and more distant road and air traffic.

'Desirable' conditions (ref: BS8233:2014) should be achievable internally through the correct implementation of our recommendations of upgraded glazing and ventilation solutions - including confirmation of appropriately robust roof and dormer constructions at third floor level, specifically.

Please see Section 5 for full details regarding BS8233 assessments and the assumptions that the predicted levels are based upon.

With regards to noise from the extraction system, based on a series of assumptions, and the implementation of our noise control recommendations¹, the predicted rating level falls 5 dB below the measured background sound level at the assessment location.



A P Frisby MIOA BSc PgDip

¹ Please refer to Section 6.2 of this report for details.

2.0 INTRODUCTION

Acoustic Tests were asked to carry out an independent assessment of the above site with regards to its suitability for residential development from a noise perspective.

This report begins by summarising assessment standards and, where appropriate, discusses alternative interpretations.

After a brief statement of survey details we discuss basic results and the resulting assessment, along with any mitigation which might be implied. We sum-up and conclude at the end, along with brief recommendations.

3.0 ASSESSMENT STANDARDS

3.1 NPPF, NPSE and NPPG

The National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE) and the National Planning Practice Guidance (NPPG) provide nothing in the way of quantitative criteria but instead provide general policy aims and statements and some guidance on how certain situations can be interpreted.

The NPPF's main statement on noise is to be found in paragraph 191:-

191. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:
- 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 life⁶⁹;

Paragraph 193 is also relevant:-

193. 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 refers to the NPSE which sets out the following aims:-

1. *avoid 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.*

It also introduces the concepts of:

- *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 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 Noise Exposure Hierarchy, as follows:-

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

It also makes the point that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation, including the level of the noise in absolute terms and how it might 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.

3.2 BS8233

Table 4 of BS8233 gives the desirable criteria for indoor ambient noise levels for dwellings as follows:-

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

Note that the standard accepts the widely used rule of thumb that, for a partly open window, the levels just outside will be 15dB higher than those just inside. This brings us to an external equivalent of the above table, as follows:-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	50 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	55 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	50 dB $L_{Aeq,16hour}$	45 dB $L_{Aeq,16hour}$

It goes on to state that, where necessary, the criteria can be relaxed by up to 5 dB and still achieve reasonable conditions. Note that the new version no longer states criteria for bedroom noise in terms of dB L_{Amax} .

Garden area criteria are unchanged with 50 dB L_{Aeq} and 55 dB L_{Aeq} being considered desirable and reasonable respectively.

3.3 BS4142:2014+A1

BS 4142 was updated in November 2014. The standard is very complicated but, basically, it describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- sound from industrial and manufacturing processes
- sound from fixed installations which comprise mechanical and electrical plant and equipment
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

Characteristics and Context

Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, we need to add a character correction to the specific sound level to obtain the rating level.

These features can include tonality, impulsivity and intermittency with corrections typically ranging potentially from 0 dB to 9 dB. Corrections at the higher end would represent characteristics which are highly perceptible in the context of the ambient noise as a whole. Corrections at the lower end would represent characteristics which are just perceptible in the presence of the ambient noise as a whole,

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Assessment

We obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level and considering the following.

- a) Typically, the greater this difference, the greater the magnitude of the impact.
- b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. *Where the rating level does not exceed the*

background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Where the initial estimate of the impact needs to be modified due to the context, pertinent factors need to be taken into consideration, including the following.

1) The absolute level of sound.

For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound.

We need to consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

3.4 Local Authority

The following planning conditions have been stipulated by the local authority:

“6) a) Before the development commences a scheme for acoustically insulating the proposed residential accommodation against noise from Wilbraham 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 commercial units/takeaways on Wilbraham Road.

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

b) Prior to first occupation of the residential units, a verification report shall be required to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic consultant's report. The report shall also undertake post completion testing to confirm that the internal noise criteria have been met. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the internal noise criteria.

Reason: To secure a reduction in noise from traffic or other sources in order to protect future residents from noise disturbance and to reduce the potential for overheating, pursuant to policies SP1 and DM1 of the Core Strategy for the City of Manchester."

"7) a) Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location. Prior to commencement of the use hereby approved the scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the

site. The scheme shall be implemented in full before the use commences or as otherwise agreed in writing by the City Council as local planning authority.

b) Prior to the operation of the scheme a verification report shall be submitted to and approved in writing by the City Council as local planning authority to validate that the work undertaken throughout the development conforms to the recommendations and requirements in the approved acoustic report. The report shall also undertake post completion testing to confirm that the noise criteria have been met. Any instances of non-conformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria.

Reason - To minimise the impact of the development and to prevent a general increase in pre-existing background noise levels around the site, pursuant to Policy DM1 in the Manchester Core Strategy and saved UDP Policy DC26."

4.0 SURVEY DETAILS

4.1 Site Times and Personnel

The measurements were carried out by Andrew Frisby MIOA BSc PgDip of Acoustic Tests.

Daytime measurements were carried out on 18th June 2024 between 16:00 and 18:30 to represent a busy day time rush period, and between 23:00 hours and 01:00 hours (on the 18th to 19th June 2024) representing what was likely to be a noisier time of night.

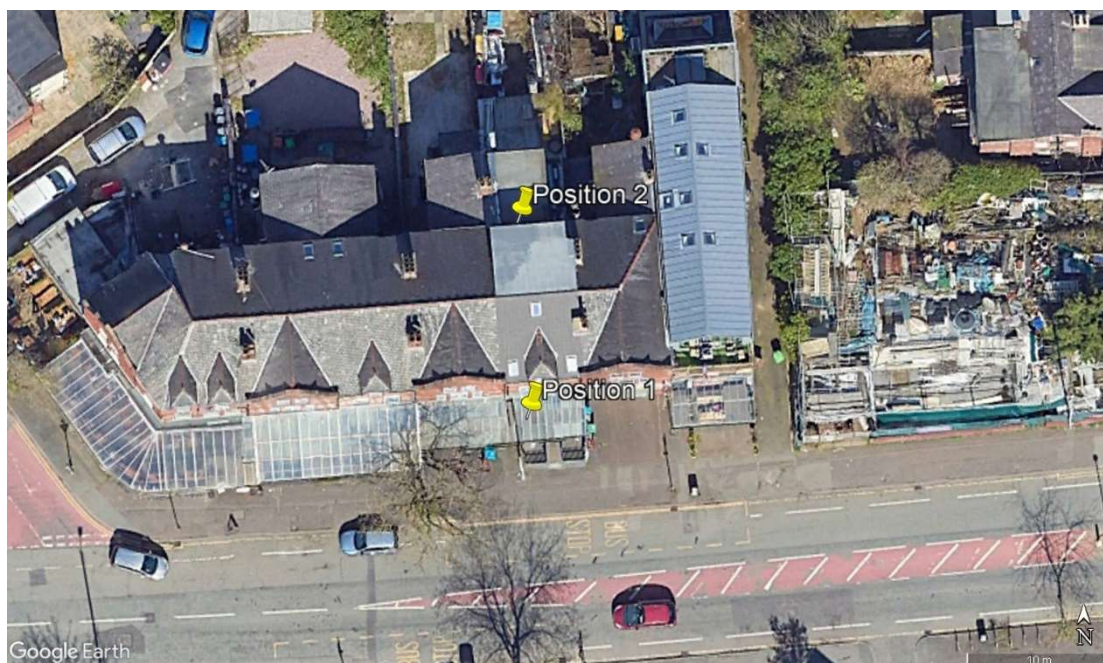
4.2 Instrumentation

The sound level meter was calibrated before the start and at the end of each period and no deviation was noted.

Equipment Description	Manufacturer	Type Number	Serial Number	Date of Calibration	Calibration Certification Number
Sound Level Meter	Norsonic	140	1402833	10/10/2023	U45597
Acoustic Calibrator	CEL	284/2	4/10327024	10/10/2023	U45595
Pre-Amplifier	Norsonic	1209	12440	10/10/2023	U45596
Microphone	Norsonic	1225	72882	10/10/2023	U45596

4.3 Measurement Positions & Assessment Location

For the main survey period, the microphone was extended 1m out of a first floor window on both the front and rear elevation, alternately. Approximate locations are shown in the below measurement plan:



'Position 1' represents the noise levels incident upon the front elevation. 'Position 2' represents the noise levels incident upon the rear elevations.

The assessment location for the BS4142:2014+A1 assessment is the proposed first floor living room window on the new rear elevation, closest to the new location of the flue, as shown below circled in green:



4.4 Survey Conditions

Weather conditions were as follows:-

Daytime 18th June 2024:

Weather: surfaces dry, cloud cover $\approx$ 75%, temperature $\approx$ 15C, wind speed < 8 mph (WNW).

Night time Survey 18th – 19th June 2024:

Weather: surfaces dry, cloud cover $\approx$ 75%, temperature $\approx$ 13 C, wind speed < 8 mph (NW).

The conditions encountered during our survey appeared to be representative of typical conditions.

5.0 RESULTS AND DISCUSSIONS

5.1 Basic Results & Observations

The day time existing noise climate incident upon the front elevation overlooking Wilbraham Road was dominated by road traffic during both the day time and night time periods. During lulls in traffic, pedestrians talking, and activity from local shops could occasionally be heard.

On the rear elevation, during the opening hours of the ground floor takeaway, the dominant noise source was noise from external mounted extract fans, serving the kitchen extraction system. Once the extraction system was turned off (at midnight), the noise climate was influenced by infrequent passing cars along Wilbraham Road, external plant serving other local establishments, and more distant road and air traffic.

Initial measurements were made during the daytime on both the front and rear elevations to determine whether ventilation can be provided by partially opening a window, whilst still complying with either reasonable or desirable conditions with reference to BS8233:2014.

These measurements exceeded 'reasonable' conditions in both locations and showed that windows will need to be closed to meet either reasonable (40 dB L_{Aeq}) or desirable (35 dB L_{Aeq}) conditions with reference to BS8233:2014², assuming noise levels were to remain at this level throughout the entire day and night periods respectively.

The microphone was then extended 1m from the façade of the development, via an open window, and measurements were made of the external noise climate, to determine by how much the external noise climate required attenuating at the front (position 1) and rear (position 2) elevations, respectively.

² Based on the rear elevation noise levels prior to the proposed changes to the extraction system.
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Full survey details are given in Appendix 2. A summary of these measurements is as follows³:-

Measurement Summary

Time	Position	Index	dB(A)
Overall Rush Hour	1	Leq	64
		Lmax	80
	2	Leq	58
		Lmax	69
Overall Early Night	1	Leq	61
		Lmax	78
	2	Leq*	46
		Lmax	58

* Overall Early Night Position 2 L_{Aeq} is an 8 hour model assuming 1 hour of the current extraction system running (i.e. between 23:00 – 00:00) and 7 hours of the noise level measured between 00:30 – 01:00.

We are not aware of any proposed outdoor living areas serving this development.

5.2 Assessments

In terms of BS8233, we are mainly concerned with the dB(A) L_{eq} values, or the dB L_{Aeq} levels. See definition of Acoustic terms in Appendix 1. BS8233 no longer has night time criteria in terms of dB(A) L_{max} values, or dB L_{Amax} values, but some local authorities still like to see them presented.

The above results and discussions give the following assessments:

Required Reductions for BS8233 Guidelines

Environment	Position	Required Reductions	
		Desirable	Reasonable
Living Rooms	1	29 dB	24 dB
	2	23 dB	18 dB
Bedrooms	1	31 dB	26 dB
	2	16 dB	11 dB

Note, of course, that these assertions are based upon the assumption that night-time noise levels are represented by measurements around midnight and that daytime noise levels are represented by measurements from the afternoon rush. In other words, they should represent a worst-case.

³ L_{max} values are the highest value recorded during the 'daytime' at positions 1 and 2. The highest during the night at position 2, and the joint-third highest during the night at position 1.

This implies bedrooms will only achieve BS8233 criteria for “reasonable” or “desirable” conditions during both the day time and night time period with closed windows.

This in turn implies that ventilation will be required such that occupants have the realistic option of keeping windows shut.

This can be achieved using active or passive ventilation which provides a suitable sound insulation. This could take the form of ventilation through acoustic or non-acoustic vents or a whole house-type system which does not require any wall or window vents.

Note that this assessment provides the specification for the *acoustic* performance of vents. Ventilation needs should be determined by others.

5.3 Mitigation & Predicted Summary

To begin with, we have used specific passive trickle ventilation in the calculations below, but any glazing or ventilation system with the same (or greater) R_w dB (for glazing) or $D_{n,e,w}$ dB performance (ventilation) should be sufficient.

A list of the assumed building fabric and proposed mitigation – using acoustic trickle ventilation as the primary means of ventilation - is as follows:

Mitigation Summary

Façade	Elevation / Location	Make-Up on Which Calculations are Based
Position 1	Front Façade / Wilbraham Road	Walls: Traditional Masonry Glazing: $R_w = 40$ dB (e.g. 6/50/4, or 10/12/6.4) Vents: $D_{n,e,w} = 40$ dB (e.g. Passivent Fresh AL-dB 450)
Position 1 & 2	Flat 3 Bedroom 3 (Roof Space)	Walls: Traditional Masonry Roof: Assumed $R_w = 46$ dB - see footnote in report Glazing: Basic thermal eg. 4+20+4 Vents: $D_{n,e,w} 33$ dB (e.g. Simon acoustic TTF slimline 3000, frame vent)
Position 2	Rear Elevations	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: $D_{n,e,w} 33$ dB (e.g. Simon acoustic TTF slimline 3000, frame vent)

The key points to be noted are as follows^{4,5}:

⁴ Our calculations assume 1 trickle vent per room.

⁵ We have assumed that the roof structures will have a sound insulative performance equal or greater than the following: Marley roof tiles with a 125mm overlap fixed to 25 x 50mm battens over a breathable membrane fixed to 50 x 150mm rafters with 100mm of rigid PIR insulation between the rafters. The rafters will be lined internally with Kingspan K18 thermal plasterboard. Test results for a similar construction suggest that a roof of this type should provide an overall sound insulation of around 46dB R_w . A less robust roof or dormer construction, or poor build quality on site may result in post-completion verification failures, prohibiting sign-off.

- Any existing standard double glazing units that are in as new / good condition on the **rear elevation** may be **retained**, as standard thermal double glazing is suitable.
- Slightly upgraded acoustic trickle ventilation with a performance of no less than **33 dB $D_{n,e,w}$** should be fitted to all habitable room windows on the **rear elevation** (e.g. Simon acoustic TTF slimline 3000, frame vent).
- Upgraded glazing will be required for all habitable rooms on **the front elevation** with a performance no less than **40 dB R_w** (e.g. 10/12/6.4)
- Upgraded trickle ventilation will be required for all habitable rooms on the **front elevation** with a performance no less than **40 dB $D_{n,e,w}$** .
- Roof and dormer specification must be checked in the detailed design to ensure good sound insulation properties.
- Any mechanical ventilation system employed should not exceed an operational noise level in each room of 20 dB L_{Aeq} .

This yields the following predicted internal noise levels with windows shut and trickle ventilation set to the 'open' position⁶:

Predicted Summary

Façade	Time	Index	dB(A)
Position 1 Flat 1 Bedroom	Rush	Leq	32
	Night	Leq	27
		Lmax	45
Position 1 & 2 Flat 3 Bedroom3 (Roof Space)	Rush	Leq	33
	Night	Leq	24
		Lmax	43
Position 2 Flat 2 - Living Room	Rush	Leq	35
	Night	Leq	23
		Lmax	36
Position 2 Flat 3 Bedroom 2	Rush	Leq	34
	Night	Leq	21
		Lmax	34

Full calculation details may be found in Appendix 2 of this report.

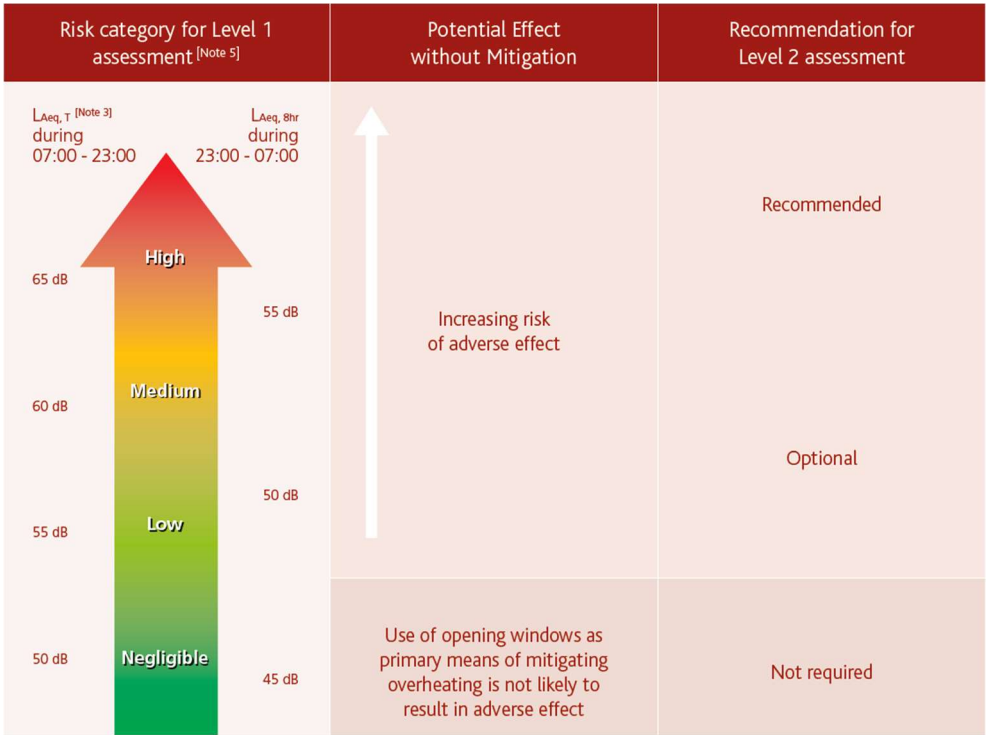
Of course, these assessments are very robust as they use what are likely to be the noisier times of day and night instead of the average of the entire 16 hour day, and 8 hour night periods.

⁶ We assume that the proposed development is subject to no significant structural noise transfer from nearby roads or adjoined buildings, and that no significant airborne noise travels through the walls or floors (from neighbouring areas adjacent, or above / below – with particular reference to activity in the ground floor takeaway and the proposed relocation of the extract fans internally within the building at ground floor level) into the proposed residential apartments. We also assume that the building fabric (main walls, roof, entrance doors, windows etc) are in good condition, with no significant defects, holes, gaps, etc.

5.4 Overheating

The Acoustics, Ventilation and Overheating Guide (AVOG) provides noise assessment guidance for new residential development at the Planning stage, with the aim of appraising future effects on users taking into consideration the interdependent nature of acoustics, ventilation, and overheating.

The guide sets out a two-level noise assessment procedure to identify where there is a risk and estimate potential impacts where open windows are relied upon to mitigate overheating. A ‘risk based’ approach is taken in the AVOG; a Level 1 site risk assessment and, where required, followed by a Level 2 adverse effect assessment based on duration and the overheating condition. AVOG Level 1 risk guidance is shown in Figure 4 below.



Having closed windows at certain locations to achieve satisfactory acoustic conditions can impact other design aspects. The interconnection between acoustics, ventilation, and overheating means that windows may need to be opened to reduce overheating, temporarily resulting in excessive noise. This necessitates an integrated approach during the detailed design stage of the project.

The figures measured during the day time indicate that front elevation of the development, overlooking Wilbraham Road falls within the 'medium - high risk' category for excessive noise during overheating conditions. The front elevation falls into the 'high risk' category for the night time period.

However, these measurements are based upon measurements around 'rush hour' during the day time, and around 'midnight' during the night time, as such it is anticipated that the risk category for the entire 16 hour day time period, and 8

hour night time period, would approach 'medium risk' when considering the overall averages of each period.

However, for the rear façade facing away from the road the risk level during the daytime is 'medium risk' and 'low – negligible risk' during the night time.

It is crucial to note that these risk categorisations do not confirm noise will be an issue on the front elevation during overheating but assigns a risk category to inform future detailed design and specification.

Whether noise during overheating has a significant adverse effect depends on the duration and frequency of overheating, which can be assessed through a detailed overheating evaluation, such as a AVO Level 2 risk assessment, or a full CIBSE TM59 assessment, both of which are beyond the scope of this report.

Considering the noise levels expected on the front elevation (with particular reference to Flat 1 Bedroom overlooking Wilbraham Road) and the (existing) noise levels on the rear elevation of the proposed site, noise conditions are likely to impact compliance with the requirements of Approved Document O of the Building Regulations.

Therefore, it is recommended to refer further to Part O of the Building Regulations and, if necessary, the Acoustics Ventilation and Overheating – Residential Design Guide document, as part of the scheme's detailed design process.

If, as a consequence of these assessments - or if selected by design choice alone – mechanical ventilation is selected as a means of provided ventilation and/or controlling overheating, the operational noise levels of the system within each room should not exceed 20 dB L_{Aeq} .

6.0 RESULTS AND DISCUSSIONS

6.1 Basic Results & Observations

The existing extraction system breaks out of the ground floor kitchen some distance from the flue, and travels along the top of the flat roof in this area, as shown in the below picture:



Two extract fans are positioned within the ducting, with one of these fans shown above.

The model of these fans is currently not known, but the breakout noise from these fans (not the fan outlet or inlet noise) was the dominant noise source in this area whenever the extraction system was operational (in terms of both L_{Aeq} and L_{A90}), and the fans themselves are currently in close proximity to proposed habitable room windows.

No plans or further details exist of the proposed changes to the extraction system beyond the location, diameter and height of the new flue and a verbal indication that the main run of ducting, along with the extract fans, are going to be brought inside the building at height at ground floor level, and exit by the proposed location of the flue.

The lowest measured background sound level ($L_{A90(15 \text{ minutes})}$) on the rear elevation shortly after the latest operating hours⁷ of the existing extraction system is shown below:

Time	Index	dBA
00:30 - 00:45	Leq	46
	L90	32

⁷ We have been informed the extraction runs until 23:00 during the week, and 00:00 on the weekends.
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6.2 Sources / Assumptions

In the absence of detailed information regarding the proposed extraction system, its ducting route, and mitigation, we make the following assumptions based on a mixture of what may be considered typical, and what we have been verbally informed of by the client:

- 300mm diameter ducting. 3 runs of 14.5m, 4.4m and 3.6m metres joined with radius bends.
- Ducting and fans rehoused internally within commercial kitchen area such that direct noise breakout from fan casings, and ducting itself is negligible externally⁸.
- 2 no. (Woods) 50Max Fan Compac extract fans, housed within the ducting. Each with a maximum outlet in-duct sound power level of 96 dB.
- Any old fans⁹ to be re-used in the new extraction system to be appropriately balanced and serviced such that their outlet noise level does not exceed an in-duct sound power level of 96 dB.
- Mitigation: An 1800 Splitter Attenuator fitted in the appropriate location, to attenuate the noise breakout via the flue.
- No external condensers / air handling units / other external units have been assessed, as we have been informed that there will not be any in operation.

It should be noted that these assumptions are made only to facilitate a BS4142:2014+A1 assessment in the absence of detailed information, and in no way should be relied upon with regards to ventilation or extraction requirements, and as such, these should be checked / confirmed by an appropriately qualified person.

6.3 Assessment

Using the assumptions outlined in 6.2 above (including the fitting of the 1800 Splitter Attenuator):

⁸ Appropriate sound insulation measures may need to be considered in the detailed design stage to ensure no significant internal transfer into residential units occurs. Additional consideration may be required for noise within the commercial kitchen in relation to 'The Control of Noise at Work Regulations 2005' document, dependent on the noise levels employees are subject to.

⁹ The 2 no. 50Max Fan Compac fans are used as a substitute for these existing older fans for assessment purposes, and so if the client decides to reuse these older fans, they must not exceed these Compac fans outlet noise level.

BS4142:2014 'Night-time' Assessment	Index	dBA
Predicted Specific Sound Level @ Assessment Location	Leq	27
L90 @ Assess Loc between 00:30 - 00:45	L90	32
Feature Corrections? No: Assumed run time of 100%, and impulsivity or tonality should not be audible at the assessment location.	dB	0
Rating Level	L _{Ar}	27
Rating Level Vs. Background Sound Level (L90)	dB	-5

BS4142:2014 states “Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a **low impact**, depending on the context”.

Please see section 6.4 for a discussion of the context of this assessment, and Appendix 2 for calculation details.

6.4 Context

The proposed changes to the extraction system serving the ground floor takeaway restaurant involves the re-routing and re-locating of the ducting and flue serving the kitchen extract fans. It is not known if new fans are to be installed, or if the existing fans are to be retained.

A takeaway has been in existence at this location for a number of years, with the existing extraction system also having been in place for a number of years, so future residents of the assessment location should be aware of the presence of the takeaway, and its extraction system. Contextually, this is more favourable than if the takeaway opened after residents were present at the assessment location.

In addition to this, the current noise climate at the assessment location is dominated by noise breakout from the fans within the external ducting. The relocating of this duct run internally within the building will significantly reduce the noise level by attenuating large amounts of the fan noise break out to the external areas.

Other takeaway restaurants are present at ground floor level in the row of terraced buildings in question, including Casa Burritos (immediately next door) and further along a delicatessen, and a bar and restaurant. Therefore, it is expected that other mechanical services plant / extraction systems will make up a significant amount of the underlying background sound level, post-relocation, and as such, the character of the noise from the extraction system will not be incongruent with the residual climate, further supporting a low impact conclusion.

6.5 Uncertainty

There is a great deal of uncertainty in the BS4142:2014+A1 assessment presented within this report due to a lack of information available regarding the current extraction system, and the proposed changes – beyond the new location of the flue.

Due to this, a number of assumptions have had to be made including duct length, number of bends, type of bends, duct diameter, negligible breakout from fan / fan casing to external environment, number of fans, fan make and model, and silencers / mitigation.

Were even one of these assumptions to be inaccurate, this would impact the predicted rating level, and consequently, could cause issues with the post-completion verification testing for sign-off requested by the LPA.

If it is discovered that any of the assumptions in this report are underestimated¹⁰, or detailed plans and information becomes available, we will need to be contacted prior to any works commencing on site to revise our predicted rating level / proposed mitigation, for which we will need to submit an additional proposal fee.

With regards to assessment times, we have used the background sound level from a midweek day, at least 30 minutes later (00:30 – 00:45) than we have been informed that the proposed extraction system is to run (i.e. up to 00:00). This errs towards the side of caution by using what is likely to be one of the lowest background sound levels as the basis for assessment, and this helps reduce the uncertainty within this assessment.

Weather conditions can affect measurement conditions but as the weather was good, there should be no additional uncertainty due to the weather.

¹⁰ Where possible we have tried to err on the side of caution but by 'underestimate' we mean for example, 'the fans have a higher outlet sound power level than 96 dB, the duct lengths are shorter than assumed, there is no silencer / a lesser specification of silencer in the ducting, etc'. Please call for further details.

7.0 CONCLUSIONS/RECOMMENDATIONS

'Desirable' conditions (ref: BS8233:2014) should be achievable internally by following the recommendations within this report with regards to upgraded glazing and ventilation solutions, including ensuring adequate roof and dormer constructions, all installed correctly to achieve their maximum possible performance level from a sound insulative perspective.

Please see Section 5 for full details regarding BS8233 assessments and the assumed building fabric make up that the predicted levels are based upon.

With regards to mechanical extraction noise, using a variety of assumptions, including assumed mitigation required, we have predicted a rating level that meets the LPA criteria of 5 dB below the background sound level.

Our assumptions for this predicted rating level require careful consideration, as a noisier-than-assumed set of fans, and lesser-performing silencers may result in the predicted rating level not being met (amongst other potential underestimations). Where possible however, we have attempted to err on the side of caution in these assumptions.

Full details of our assumptions may be found in Section 6.2 for review.

Should detailed plans / duct layouts and fan and silencer specifications become available in the detailed design phase, this assessment should be redone to ensure that the appropriate predicted rating level is achieved.

A similar process (recalculation / reassessment) should be followed with regards to any deviations in the assumed building fabric performance with regards to internal ambient noise levels / BS8233:2014.

Both the internal ambient noise levels of the development, and the 'rating level' from the operation of the extraction system will need post-completion testing to verify that the requested LPA targets have been met at the end of the development.

Appendix 1

Definition of Acoustic Terms

The Decibel

The decibel is the basic unit of noise measurement and is denoted dB. Technically, it is a means of expressing the difference in noise level between the measured noise and a standard level of noise. Most often the threshold of human hearing is used as the standard reference but it really should be stated. The threshold of human hearing is a sound pressure of $20\mu\text{Pa}$ or a sound power of 1pW .

A sound pressure level or SPL should be expressed in dB(re. $20\mu\text{Pa}$). A sound power level or SWL should be expressed in dB(re. 1pW). If the reference levels are omitted, it will often (but not always) be safe to assume that they are referenced to the threshold of human hearing.

A-Weighting and dB(A)

The human hearing system responds differently to different frequencies. The A-weighting system takes account of this by emphasising mid and high frequencies more than low frequencies to give an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted level are discussed below.

Other weighting systems, such as C-Weighting, denoted dB(C), reflect the human hearing system's response at higher noise levels.

Equivalent Continuous Sound Level, L_{eq}

This is a kind of mean noise level.

The unit is dB L_{eq} . For A-weighted levels the unit is dB(A) L_{eq} or, in more modern units, dB L_{Aeq} . The Noise at Work Regulations use $L_{eq(s)}$ which refers to a sample level.

Maximum Level, L_{max}

This is the maximum level reached (usually for a fraction of a second) in the measurement period.

The unit is dB L_{max} . For A-weighted levels the unit is dB(A) L_{max} or, in more modern units, dB L_{Amax} .

Statistical (Percentile) Levels, L_n

During a measurement of fluctuating noise, it is often useful to establish the levels exceed for a percentage of the time. L_n is the index representing the level exceeded for $n\%$ of the measurement period.

The unit is dB L_n . For A-weighted levels, the unit is dB(A) L_n or, in more modern units, dB L_{A_n} .

Common examples are as follows :-

dB L_{A90} is the A-weighted level exceeded for 90% of the time and is often used to describe the underlying background noise.

dB L_{A50} is the A-weighted level exceeded for 50% of the time. Mathematically, it is the median, another kind of average.

dB L_{A10} is the A-weighted level exceeded for 10% of the time and has traditionally been used to describe the intermittent highs in the noise climate such as passing cars or aircraft.

Frequency Analysis

Here the audible frequency range is divided up into bands and the noise level is expressed in each frequency band from low pitches to high pitches.

Octave Band analysis is where the frequency range is divided into 8 bands from 63 Hz to 8kHz, or sometimes into 10 bands from 31.5 Hz to 16kHz.

1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

Narrow Band analysis takes this further with the possibility of many thousands of bands, possibly only 1Hz wide, or even less.

In all types of frequency analysis, the level in each band can be expressed in terms of L_{eq} , L_{max} , L_n , etc. as defined above.

Appendix 2

Measurement and Calculation Details

Raw survey data is available upon request.

Measurement Summary

Time	Position	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Overall Rush Hour	1	Leq	64	71	65	59	60	61	57	49	43
		Lmax	80	87	79	78	76	74	71	69	70
	2	Leq	58	59	71	57	54	49	42	35	28
		Lmax	69	71	73	65	63	66	61	51	42
Overall Early Night	1	Leq	61	66	59	55	55	58	54	45	40
		Lmax	78	85	81	71	67	72	69	69	74
	2	Leq*	46	49	51	49	46	37	31	21	20
		Lmax	58	62	65	65	50	47	44	39	31

* Overall Early Night Position 2 L_{Aeq} is an 8 hour model assuming 1 hour of the current extraction system running (i.e. between 23:00 – 00:00) and 7 hours of the noise level measured between 00:30 – 01:00.

Selection of Break-in-Calculations

Position 1			dB(A)	63	125	250	500	1k	2k	4k	8k
<i>Flat 1 Bedroom</i>											
Width of Exposed Façade 1	5.50 m		-	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m		-	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		-	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		-	-	-	-	-	-	-	-	-
Total Exposed Façade Width	5.50 m		-	-	-	-	-	-	-	-	-
Element Height	2.50 m		-	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	0.00 m		-	-	-	-	-	-	-	-	-
Element Area	13.75 m ²		-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	23.75 m ²		-	-	-	-	-	-	-	-	-
Room Volume	41.25 m ³		-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		-	-	-	-	-	-	-	-	-
Element Area Correction			-	14	14	14	14	14	14	14	14
Room Correction 10 x Log (RT/0.163V)			-	-11	-11	-11	-11	-11	-11	-11	-11
Walls: Traditional Masonry	9.35 m ²		-	23	32	41	47	49	53	58	55
Glazing: $R_w = 40$ dB (e.g. 6/50/4, or 10/12/6.4)	4.40 m ²		-	17	26	30	35	42	46	54	51
Vents: $D_{n,e,w} = 40$ dB (e.g. Passivent Fresh AL-dB 450)	10.00 m ²		-	34	45	44	36	40	42	55	55
Composite SRI	23.75 m ²		-	22	31	36	38	42	45	56	54
Level Difference (Reverberant only)			-	-20	-29	-34	-35	-40	-42	-53	-51
Allowance for flanking/workmanship			-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	32	54	39	28	28	24	17	-1	-5
		Lmax	27	49	33	24	23	21	14	-5	-8
	Night	Lmax	45	69	55	40	35	35	29	19	26

<i>Position 2</i> <i>Flat 2 - Living Room</i>		<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
Width of Exposed Façade 1	11.30 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m	-	-	-	-	-	-	-	-	-
Total Exposed Façade Width	11.30 m	-	-	-	-	-	-	-	-	-
Element Height	2.20 m	-	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	0.00 m	-	-	-	-	-	-	-	-	-
Element Area	24.86 m ²	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	34.86 m ²	-	-	-	-	-	-	-	-	-
Room Volume	28.00 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Element Area Correction		-	15	15	15	15	15	15	15	15
Room Correction 10 x Log (RT/0.163/V)		-	-10	-10	-10	-10	-10	-10	-10	-10
Walls: Traditional Masonry	23.36 m ²	-	23	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	1.50 m ²	-	15	24	20	25	35	38	35	32
Vents: Dn,e,w 33 dB (e.g. Simon acoustic TTF slimline 3000, frame vent)	10.00 m ²	-	32	38	35	35	31	32	35	40
Composite SRI	34.86 m ²	-	23	32	32	36	36	37	39	42
Level Difference (Reverberant only)		-	-17	-26	-27	-30	-30	-31	-34	-36
Allowance for flanking/workmanship	5 dB	-	5	5	5	5	5	5	5	5
Predicted Internal Levels	Rush	Leq	35	47	50	35	29	23	15	7
	Night	Leq	23	36	30	28	21	11	5	-7
		Lmax	36	50	44	44	25	21	18	10

<i>Position 2</i> <i>Flat 3 Bedroom 3 - Rear Wall Only</i>		<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
Width of Exposed Façade 1	3.50 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m	-	-	-	-	-	-	-	-	-
Total Exposed Façade Width	3.50 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	0.00 m	-	-	-	-	-	-	-	-	-
Element Area	8.75 m ²	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	18.75 m ²	-	-	-	-	-	-	-	-	-
Room Volume	30.00 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Element Area Correction		-	13	13	13	13	13	13	13	13
Room Correction 10 x Log (RT/0.163/V)		-	-10	-10	-10	-10	-10	-10	-10	-10
Walls: Traditional Masonry	7.54 m ²	-	23	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	1.21 m ²	-	15	24	20	25	35	38	35	32
Vents: Dn,e,w 33 dB (e.g. Simon acoustic TTF slimline 3000, frame vent)	10.00 m ²	-	32	38	35	35	31	32	35	40
Composite SRI	18.75 m ²	-	24	32	31	34	34	34	37	40
Level Difference (Reverberant only)		-	-21	-29	-28	-31	-31	-32	-34	-37
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	28	38	41	29	23	18	10	1
	Night	Leq	16	28	21	21	15	6	-1	-13
		Lmax	30	41	35	37	19	16	12	5

Position 1 Flat 3 Bedroom 3 - Front Roof (using position 1 data)			dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Façade 1	4.20 m		-	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	0.00 m		-	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		-	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		-	-	-	-	-	-	-	-	-
Total Exposed Façade Width	4.20 m		-	-	-	-	-	-	-	-	-
Element Height	3.00 m		-	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	0.00 m										
Element Area	12.60 m ²		-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	12.60 m ²		-	-	-	-	-	-	-	-	-
Room Volume	30.00 m ³		-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		-	-	-	-	-	-	-	-	-
Element Area Correction			-	11	11	11	11	11	11	11	11
Room Correction 10 x Log (RT/0.163/V)			-	-10	-10	-10	-10	-10	-10	-10	-10
Roof: Assumed Rw = 46 dB - see footnote in report	12.35 m ²		-	18	23	34	47	52	58	66	63
Glazing: Basic thermal eg. 4+20+4	0.25 m ²		-	15	24	20	25	35	38	35	32
Vents: Non-acoustic eg. Simon Airstrip 300	0.00 m ²		-	34	45	44	36	40	42	55	55
Composite SRI	12.60 m ²		-	18	23	32	41	49	53	52	49
Level Difference (Reverberant only)			-	-17	-22	-31	-40	-48	-52	-51	-48
Allowance for flanking/workmanship	0 dB		-	0	0	0	0	0	0	0	0
Predicted Internal Levels - Front Façade levels attenuated by 3 dB due to angle of incidence to roof.	Rush	Leq	28	51	40	25	17	10	1	-4	-7
	Night	Leq	23	46	34	21	13	7	-2	-8	-11
		Lmax	43	66	56	37	25	21	14	16	24

Position 2 Bedroom - 3rd floor - Back Roof (using position 2 data weighted)			dB(A)	63	125	250	500	1k	2k	4k	8k	
Width of Exposed Façade 1			4.20 m	-	-	-	-	-	-	-	-	
Width of Exposed Façade 2			0.00 m	-	-	-	-	-	-	-	-	
Width of Exposed Façade 3			0.00 m	-	-	-	-	-	-	-	-	
Width of Exposed Façade 4			0.00 m	-	-	-	-	-	-	-	-	
Total Exposed Façade Width			4.20 m	-	-	-	-	-	-	-	-	
Element Height			3.00 m	-	-	-	-	-	-	-	-	
Room Depth (re. Exposed façade 1)			0.00 m									
Element Area			12.60 m2	-	-	-	-	-	-	-	-	
Effective Area (ie. with vents)			12.60 m2	-	-	-	-	-	-	-	-	
Room Volume			30.00 m3	-	-	-	-	-	-	-	-	
Assumed RT			0.50 s	-	-	-	-	-	-	-	-	
Element Area Correction				-	11	11	11	11	11	11	11	
Room Correction 10 x Log (RT/0.163/V)				-	-10	-10	-10	-10	-10	-10	-10	
Walls: Traditional Masonry			12.60 m2	-	18	23	34	47	52	58	66	63
Glazing: Basic thermal eg. 4+20+4			0.00 m2	-	15	24	20	25	35	38	35	32
Vents: Non-acoustic eg. Simon Airstrip 300			0.00 m2	-	23	28	26	26	29	29	29	36
Composite SRI			12.60 m2	-	18	23	34	47	52	58	66	63
Level Difference (Reverberant only)				-	-17	-22	-33	-46	-51	-57	-65	-62
Allowance for flanking/workmanship			0 dB	-	0	0	0	0	0	0	0	0
Predicted Internal Levels - Rear Façade levels attenuated by 3 dB due to angle of incidence to roof.	Rush	Leq	30	39	46	21	5	-5	-18	-33	-37	
	Night	Leq	12	29	26	13	-3	-17	-29	-47	-45	
		Lmax	26	42	40	29	2	-7	-16	-29	-34	
Cumulative Internal Noise Level - 3rd Floor Bedroom	Time	dB(A)	dB(A)	63	125	250	500	1k	2k	4k	8k	
	Rush	Leq	33	48.45	48.04	30.73	24.01	18.59	10.56	2.392	-5.19	
	Night	Leq	24	46.44	34.74	24.44	16.91	9.257	1.936	-7	-9.99	
		Lmax	43	65.62	56.22	40.29	25.7	21.8	16.04	15.99	23.55	

Predicted Summary

Façade	Time	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Position 1 Flat 1 Bedroom	Rush	Leq	32	54	39	28	28	24	17	-1	-5
	Night	Leq	27	49	33	24	23	21	14	-5	-8
		Lmax	45	69	55	40	35	29	19	19	26
Position 1 & 2 Flat 3 Bedroom3 (Roof Space)	Rush	Leq	33	48	48	31	24	19	11	2	-5
	Night	Leq	24	46	35	24	17	9	2	-7	-10
		Lmax	43	66	56	40	26	22	16	16	24
Position 2 Flat 2 - Living Room	Rush	Leq	35	47	50	35	29	23	15	7	-4
	Night	Leq	23	36	30	28	21	11	5	-7	-12
		Lmax	36	50	44	44	25	21	18	10	0
Position 2 Flat 3 Bedroom 2	Rush	Leq	34	45	48	33	27	23	15	6	-5
	Night	Leq	21	34	28	25	19	11	4	-8	-13
		Lmax	34	48	42	41	23	21	17	10	-2

Duct Break Out Calculations

Basic Source Levels

	63	125	250	500	1k	2k	4k	8k
Sound Power Level : 50Max Fan Compac (Outlet Lw = 96 dB max) x2 (2 fans)	84	85	94	89	90	90	88	84

Straight duct losses.

Length (m)	Duct Shape (Rect or Circ)	Duct Width (Rect) or Diameter (Circ) (mm)	Duct Height (Rect only) (mm)	63	125	250	500	1k	2k	4k	8k
14.5	C	300		-9	-9	-4	-4	-4	-4	-4	-4
4.4	C	300		-3	-3	-1	-1	-1	-1	-1	-1
3.6	C	300		-2	-2	-1	-1	-1	-1	-1	-1
0	C	0		0	0	0	0	0	0	0	0
Total				-14	-14	-7	-7	-7	-7	-7	-7

Number of Bends	Duct Shape (NB. can't be change)	Mitred or Radius Bend	Min Duct size (mm)	63	125	250	500	1k	2k	4k	8k
1	C	R	250	0	0	0	0	0	-1	-2	-2
0	C	R	0	0	0	0	0	0	0	0	0
0	C	R	0	0	0	0	0	0	0	0	0
0	C	R	0	0	0	0	0	0	0	0	0
Total				0	0	0	0	0	-1	-2	-2

Take offs.

Number of Take-Offs	Duct Shape (NB. can't be change)	Main Branch Duct Area (mm ²)	Take off Duct Area (mm ²)	63	125	250	500	1k	2k	4k	8k
0	C	0	0	0	0	0	0	0	0	0	0
0	C	0	0	0	0	0	0	0	0	0	0
0	C	0	0	0	0	0	0	0	0	0	0
0	C	0	0	0	0	0	0	0	0	0	0
Total				0	0	0	0	0	0	0	0

Other Attenuation

	9	17	29	47	50	50	49	36
Silencer Etc (Note. Use negative numbers)	63	125	250	500	1k	2k	4k	8k
1800 SA	-9	-17	-29	-47	-50	-50	-49	-36
X	0	0	0	0	0	0	0	0
X	0	0	0	0	0	0	0	0
X	0	0	0	0	0	0	0	0
Total	-9	-17	-29	-47	-50	-50	-49	-36

End reflection loss.

Duct Shape (Rect or Circ)	Duct Width (Rect) or Diameter (Circ) (mm)	Duct Height (Rect only) (mm)	Critical Dimension (mm)	63	125	250	500	1k	2k	4k	8k
C	300	0	300	-12	-8	-4	-1	0	0	0	0
Total				-12	-8	-4	-1	0	0	0	0

Sound Entering the Room

	63	125	250	500	1k	2k	4k	8k
Sound Power leaving the system :	50	47	54	34	33	32	30	39

Item / Process	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
SWL exiting Flue (1800 SA)	SWL	47	49.5	46.5	54.3	34.3	33.3	32.3	30.3	39.3
Attenuation	-	-	-20.5	-20.5	-20.5	-20.5	-20.5	-20.5	-20.5	-20.5
SPL at 3m (assessment location)	SPL	27	29.0	26.0	33.7	13.7	12.7	11.7	9.7	18.7