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Assessment of noise at Land at Kenyon Lane,
M5 5FH for proposed residential development

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1.0 **SUMMARY**

Distant traffic, presumably the M60 was the dominant noise source throughout the morning period along with frequently passing trains on the nearby railway line. Very few vehicles passed down Kenyon Lane.

During the first hour of the night time, a faint humming noise could be heard from the direction of the train depot. Otherwise, the main source of night time noise was distant traffic and occasional trains.

All BS 8233 criteria for gardens should be easily met, along with break-in to habitable rooms based on partly open windows. The WHO-type criterion for "peak" levels at night are also likely to be met with partly open windows, perhaps marginally exceeded, depending on the standard used for open windows. With windows closed and vents open, all criteria are easily met.

The only external mechanical equipment is the ASHPs. These are quiet domestic units and are likely to have negligible impact. They are substantially below daytime background levels under worst case conditions and 2 dB below night time background levels under worst case conditions. Such conditions are very unlikely to occur at night, but are presented for completeness.



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2.0 INTRODUCTION

ADC was 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 198:-

198. 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 life⁷²;
 - 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.

Paragraph 200 is also relevant:-

200. 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 and WHO

BS 8233 was updated in March 2014. Its guidance is primarily intended for new buildings, but the criteria are routinely referred to for putting general noise climates into context.

The criteria in Table 4 of BS 8233 are based on WHO guidance and give the desirable criteria for indoor ambient noise levels for dwellings as follows:-

<i>Activity</i>	<i>Location</i>	<i>07:00 to 23:00</i>	<i>23:00 to 07:00</i>
Resting	Living Room	35 dB L _{Aeq} , 16 hour	-
Dining	Dining Room	40 dB L _{Aeq} , 16 hour	-
Sleeping (daytime resting)	Bedroom	35 dB L _{Aeq} , 16 hour	30 dB L _{Aeq} , 8 hour

The standard does not explicitly state criteria for bedroom noise in terms of dB L_{Amax} but the WHO Guidelines for Community Noise (or similar) are widely used with a recommendation that the noise inside bedrooms should not typically exceed 45 dB L_{Amax}, for instance no more than 10 to 15 times a night.

BS 8233 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 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. Other more recent research suggests a difference of 13 dB. The latter brings us to an external equivalent of the above table, as follows:-

<i>Activity</i>	<i>Location</i>	<i>07:00 to 23:00</i>	<i>23:00 to 07:00</i>
Resting	Living Room	48 dB L _{Aeq} , 16 hour	-
Dining	Dining Room	53 dB L _{Aeq} , 16 hour	-
Sleeping (daytime resting)	Bedroom	48 dB L _{Aeq} , 16 hour	43 dB L _{Aeq} , 8 hour

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

3.3 Local Authority

Planning condition 20 is relevant to this assessment.

20) Any 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. 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 approved scheme shall be completed before the apartments are occupied.

Upon completion of the development a verification report will be required 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 has been met. Any instances of nonconformity with the recommendations in the report shall be detailed along with any measures required to ensure compliance with the agreed noise criteria.

Reason - To safeguard the amenity of existing and future occupiers of nearby residential accommodation, pursuant to saved policy DC26 of the Unitary Development Plan for the City of Manchester and policies SP1 and DM1 of the Manchester Core Strategy.

It is not entirely clear if this wording was intended for this site. It refers to “apartments” and has wording more typically associated with much more substantial external equipment. It also refers to “rating level” which is a BS 4142 term which is for commercial applications only. Further, the criterion is significantly more onerous than BS 4142 and does not allow for consideration in context, which is crucial but frequently misunderstood aspect of the standard. Note that the only external mechanical equipment is the ASHPs which are quiet domestic units and are likely to have negligible impact. This is discussed in the assessment below.

We note that there are no conditions related to external noise break-in. We have carried out an assessment anyway as the site is close to a railway track, but this should not form part of the discharging of Condition 20.

3.4 MCS-020

The Microgeneration Installation Standard MC-020 is a document published by the Microgeneration Certification Scheme. It is a simplified method of calculation, erring very heavily on the side of caution, for instance with respect to the effect of barriers and the assumption that surfaces reflect 100% of the sound.

It defines the assessment position as the centre of the nearest door or window of a habitable room of a neighbouring property – a neighbouring bedroom window for instance, or a neighbouring window or door onto a living room.

It provides a simplified calculation method for the propagation of the sound. The result is then added to a notional background level of 40 dB(A) to give an overall predicted level. If this less than or equal to 42 dB(A) then the proposal meets the criterion for permitted development.

Note that the standard is intended for permitted development situations but the simplified methods are no less appropriate in any application.

4.0 GUIDE TO MODELLING

4.1 Noise Break-In to Habitable Rooms

Full details of calculations are given in Appendix 2. The basic approach is as follows.

1. The external noise break-in is based on the level of external noise just outside the façade(s), the area of the façade(s), the sound insulation properties of the façade(s) and the internal absorption of the room.
2. The first input to the calculation process is the area of the exposed façade. Where more than one façade is exposed, then they can all be entered. The room depth is also entered so as to derive the room volume. Where the room is not a straight forward rectangular shape, an “effective depth” is sometimes entered so as to derive the approximate room volume. Judgement may occasionally be used if the room is not simple, such as a very unusual shape or a multi-use room such as a through-kitchen/dining room/living room, or studio-style area.
3. The reverberation time (RT) is entered. Usually this is a standardised 0.5 seconds and represents the absorption properties of the room.
4. Two corrections result from the above inputs. Firstly, we have the Area Correction. Put simply, the greater the exposed area, the more noise will break in. The correction is $10 \times \log(\text{Effective Area})$ and is usually a positive number. Note that the “Effective Area” takes account of the method of modelling vents – see later. The Room Correction takes account of the room absorption (more absorption reduces the noise) and the room volume (a larger volume disperses, and so reduces, the noise). The correction is $10 \times \log(\text{RT}/0.163/\text{Volume})$ and is usually a negative number.
5. These corrections, together with the sound insulation properties of the façade(s) give us the basic outside-to-inside level difference. The sound insulation properties of the façade(s), known as the Sound Reduction Index (SRI or just R) are effectively the sound insulation of 1m^2 of material (apart from vents – see later). Of course, a façade is usually made up of more than one element – windows and walls for instance. The overall SRI or R is referred to as the Composite SRI or composite R and is related to the SRI or R of the individual elements and their respective areas. SRI or R figures are usually based on laboratory tests and therefore somewhat idealised.
6. An additional complication is that performance data for vents is generally standardised to 10m^2 . The area of a vent is therefore usually entered as 10m^2 , even though its actual area will usually be nowhere near that much.

7. So, the composite SRI or R, combined with the areas and room corrections gives us the basic level difference to be expected under perfect (laboratory) conditions. However, actual site conditions are affected by workmanship, which can never be guaranteed to be perfect, and flanking paths (noise paths other than straight through the façade(s)). We add a 3 dB allowance for this.
8. Finally we have to enter any differences between the measurement position and the façade being modelled. If the measurements were made in free field conditions, then a façade effect of up to +3 dB is necessary.
9. The process is repeated in octave bands across the frequency range to derive the predicted internal levels.

4.2 Mechanical Equipment

The simplified methods of MCS-020 are used to provide a reasonable estimate of the noise levels at neighbouring windows and doors on to habitable rooms. However, as well as the method requires an assumed level of background noise, we also use the result at Step 6 to compare with the actual background levels so as to assess the results against Planning Condition 20. These two approaches give very different outcomes and so both are presented and discussed.

5.0 SURVEY DETAILS

5.1 Site Times and Personnel

The measurements were carried out by Mark Pimlett of ADC Acoustics.

Measurements were carried out on 10th December 2024 from 06:50 hours to shortly after 09:00 hours to represent the end of the night time and rush hour, and from approximately 23:00 hours to shortly before 06:50 hours to represent night time.

5.2 Instrumentation

Instrumentation used was a Rion NL-52 Class I sound level meter which holds a current calibration certificate, and which was field-calibrated as necessary with no drift noted. The meter was set up to measure continuous 5 minute samples in terms of dB L_{eq} , dB L_{max} and dB L_{90} in overall A-weighted terms, and in octave bands across the frequency range. See Definition of Acoustic Terms in Appendix 1.

5.3 Measurement Positions

The main measurement position was as shown on the following plan.



Position 1 was chosen to present the nearest residential locations to the railway line. In terms of underlying background levels it was representative of the whole site.

The microphone was 1.3 m above ground and well away from other reflecting surfaces.

5.4 Survey Conditions

We have no reason to believe that the conditions we found on the survey were anything other than representative of normal conditions.

Weather conditions were as follows :-

Rain	:	none, dry roads
Cloud	:	70 to 100%
Temperature	:	6 Celsius (same both day and night)
Wind	:	<0.6m/s from the north east direction

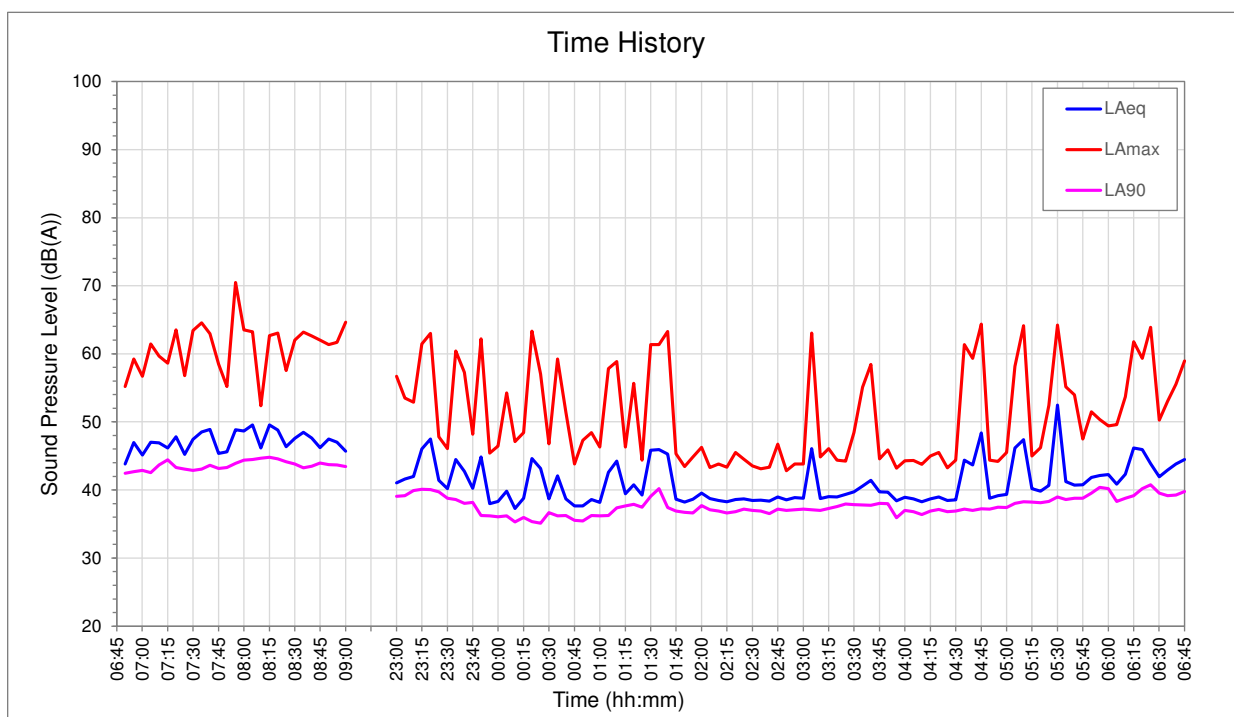
6.0 RESULTS AND DISCUSSIONS

Distant traffic, presumably the M60 was the dominant noise source throughout the morning period along with frequently passing trains on the nearby railway line. Very few vehicles passed down Kenyon Lane.

During the first hour of the night time, a faint humming noise could be heard from the direction of the train depot. Otherwise, the main source of night time noise was distant traffic and occasional trains.

6.1 Basic Results

Full details are given in Appendix 2. They can be viewed graphically overtime as follows:-



A summary of overall levels for external noise break-in is as follows:-

Time Period	Index	dB(A)
Overall Rush Hour	Leq	48
	Lmax	63
	L90	44
Overall Night Time	Leq	42
	Lmax	56
	Lmax*	60
	L90	38

* Level exceeded 15 times in the night, otherwise logarithmic mean values

The lowest 15 minute period (in terms of the LA90 index) is shown below for use in the assessment for the ASHPs in relation to Planning Condition 20.

Time Period	Index	dB(A)
Lowest Daytime	Leq	45
	Lmax	57
	L90	43
Lowest Night Time	Leq	39
	Lmax	51
	L90	36

6.2 Noise Break-in to Habitable Rooms

The above results give the following assessments.

In terms of BS 8233/WHO, 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. The current version of 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 and assessed to WHO guidelines or similar.

In order to meet criteria, the measured levels appear to suggest that sound insulation will need to be designed to control external noise break-in as follows:

<i>Position</i>	<i>Environment</i>	<i>Reductions for BS8233 desirable* criteria</i>	<i>Reductions for WHO-Type Criteria</i>
Main	Living Rooms	13 dB L_{Aeq}	-
	Bedrooms	12 dB L_{Aeq}	15 dB L_{Amax}
	Outdoor Living Areas	0 dB L_{Aeq}	-

* BS 8233 considers a 5 dB relaxation would still provide *reasonable* conditions

For outdoor living areas no mitigation is required, although garden fencing will inevitably reduce the noise.

Moving on to break-in to habitable rooms, a partly open window can be expected to provide 13 to 15 dB reduction. This will be sufficient to achieve BS 8233 criteria for *desirable* conditions for all rooms, and right on the WHO-type criterion, potentially marginally above, depending on the standard used for open windows.

A summary of mitigation (or building elements assumed in our calculations) is as follows:-

<i>Façade</i>	<i>Room Type</i>	<i>Make-Up on Which Calculations are Based</i>
Rear	Larger Living Room	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300
	Largest Bedroom	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300
	Smaller Living Room	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300
	Smallest Bedroom	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300

Full calculation details are shown in Appendix 2 and a summary of predicted internal noise levels (closed windows, open vents) is as follows:-

<i>Façade</i>	<i>Room Type</i>	<i>Time</i>	<i>Index</i>	<i>dB(A)</i>
Rear	Larger Living Room	Rush	Leq	28
	Largest Bedroom	Night	Leq	25
			Lmax	42
	Smaller Living Room	Rush	Leq	28
	Smallest Bedroom	Night	Leq	27
			Lmax	44

Of course, these assessments are very robust as they use what are likely to be the noisier times of day, assume all facades have a unrestricted lines of sight to the main sources and that the development itself (buildings and garden fencing) will not provide any screening to its own properties.

6.3 Mechanical Equipment

See Our discussion of Planning Condition 20 in 4.4 above, and the approach to calculation in 4.2 above.

The only external mechanical equipment is the ASHPs. We are advised that the proposed units are Vaillant aroTHERM Plus 3.5 kW units. These are designed for domestic installations. Information from the datasheet is as follows:-

Technical data	Unit	3.5kW	5kW	7kW	10kW	12kW
Noise emissions, heating mode						
Sound power, EN 12102, EN 14511 LWA, A7/W35	dB(A)	51		53		58
Sound power, EN 12102, EN 14511 LWA, A7/W45	dB(A)		53			58
Sound power, EN 12102, EN 14511 LWA, A7/W55	dB(A)	54		55		60

We have assumed that the highest figure of 54 dB L_{Aw} for the 3.5 kW and 5 kW units applies constantly, 24 hours a day. This of course is very unlikely to occur especially at night and especially in warmer seasons when windows are more likely to be open. It should therefore be very robust and err significantly on the side of caution.

The daytime calculation for MCS-020 is as follows:-

MCS-020 Calculation - ground floor daytime

Step	Quantity/Process	Result
1	Sound Power Level	54 dB(A)
2	No. of reflective surfaces within 1m Q Value	2 4
3	Heat Pump to Assessment Position Horizontal Distance Vertical Distance Overall distance (rounded down to 0.5 m)	5.0 m 0.0 m 5.0 m
4	Overall Reduction	-19 dB
5	Barrier Effect Ass't pos visible from any part of unit Ass't pos visible only if move 25 cm Ass't pos <u>not</u> visible, even if move 25 cm	Y 0 dB
6	Step 1 + Step 4 + Step 5	35 dB(A)
7	Notional Background Noise Level	40 dB(A)
8	Step 7 - Step 6	5 dB(A)
9	Adjustment figure Final Result (rounded up)	1.2 dB 42 dB(A)
10	Equal to or lower than the permitted level of	42 dB(A) Yes

Note that we have assumed that the nearest habitable room window or door to be 5 m away and in full view (ie. no boundary fencing). Adding a partial barrier effect for a fence reduces the level by a further 5 dB. However, as it is, the predicted levels of 35 dB L_{Aeq} (at Step 6) is 8 dB below the lowest 15 minute background level of 43 dB L_{A90} for daytime. It therefore easily meets the requirement of Planning Condition 20. It also falls within the normal requirement of MCS-020.

The night time calculation for MCS-020 is as follows:-

MCS-020 Calculation - first floor night time

Step	Quantity/Process	Result
1	Sound Power Level	54 dB(A)
2	No. of reflective surfaces within 1m Q Value	2 4
3	Heat Pump to Assessment Position Horizontal Distance Vertical Distance Overall distance (rounded down to 0.5 m)	5.0 m 4.0 m 6.0 m
4	Overall Reduction	-20 dB
5	Barrier Effect Ass't pos visible from any part of unit Ass't pos visible only if move 25 cm Ass't pos <u>not</u> visible, even if move 25 cm	Y 0 dB
6	Step 1 + Step 4 + Step 5	34 dB(A)
7	Notional Background Noise Level	40 dB(A)
8	Step 7 - Step 6	6 dB(A)
9	Adjustment figure Final Result (rounded up)	1.0 dB 41 dB(A)
10	Equal to or lower than the permitted level of	42 dB(A) Yes

Note that we have assumed that the nearest habitable room window to be 5 m away horizontally, and 4 m vertically (ie. first floor level) and in full view (ie. no boundary fencing). The predicted levels of 34 dB L_{Aeq} (at Step 6) is 2 dB below the lowest 15 minute background level of 36 dB L_{A90} for night time. It therefore falls a little short of the requirement of Planning Condition 20, but falls within the normal requirement of MCS-020.

Despite not quite meeting the requirement of Condition 20, we have to emphasise that the criterion is far more onerous than any relevant standard, and takes no consideration of the context. Here the units are unlikely to run at all during the night and, realistically, only in cold weather when windows are unlikely to be open. Also crucial to the context is the that absolute levels are very low. This is an aspect of context specifically cited in BS 4142. Although the standard no longer defines low noise, previous versions of the standard suggested that a rating level of 35 dB L_A would be very low noise. Even with an open window, the internal noise is likely to be around 20 dB L_{Aeq} and completely inaudible¹.

We would suggest the impact in all conditions is likely to be negligible.

¹ The units are extremely unlikely to be tonal or impulsive. They will be intermittent to a degree at source but, at the receiver position, the intermittency is extremely unlikely to be "readily distinctive against the residual acoustic environment", as BS 4142 describes it. Also, the units are assumed to run continuously, and on on-time correction is included which would reduce the predicted level. In any case, as the noise is likely to be inaudible at the receiver positions, then clearly no character corrections apply.

7.0 CONCLUSIONS/RECOMMENDATIONS

All BS 8233 criteria for gardens should be easily met, along with break-in to habitable rooms based on partly open windows. The WHO-type criterion for “peak” levels at night are also likely to be met with partly open windows, perhaps marginally exceeded, depending on the standard used for open windows. With windows closed and vents open, all criteria are easily met. It would seem somewhat excessive to require ventilation to be provided so that windows can be assumed shut and we would suggest the internal environment should be at least reasonable.

The only external mechanical equipment is the ASHPs. These are quiet domestic units and are likely to have negligible impact. They are substantially below daytime background levels under worst case conditions and 2 dB below night time background levels under worst case conditions. Such conditions are very unlikely to occur at night, but are presented for completeness.

We recommend that you issue this report to Planners and we would encourage Officers to contact us directly with any queries.

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 exceeded 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

<i>Time Period</i>	<i>Index</i>	<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
06:50	Leq	44	54	44	39	42	41	30	22	19
	Lmax	55	68	62	53	46	46	50	46	42
	L90	42	51	42	37	40	40	27	15	13
06:55	Leq	47	58	52	42	43	44	36	26	15
	Lmax	59	76	66	57	54	55	50	40	28
	L90	43	51	43	37	41	40	29	16	13
07:00	Leq	45	54	48	41	43	43	32	21	15
	Lmax	57	64	67	54	50	53	46	36	33
	L90	43	51	42	38	41	41	28	16	13
07:05	Leq	47	57	50	41	43	45	36	24	14
	Lmax	61	73	67	57	56	59	51	39	21
	L90	43	51	43	37	41	40	28	15	13
07:10	Leq	47	58	50	43	44	44	35	24	16
	Lmax	60	72	67	59	54	56	49	40	29
	L90	44	53	44	38	41	41	29	16	13
07:15	Leq	46	57	47	43	44	44	32	19	22
	Lmax	59	64	54	54	52	57	47	34	41
	L90	44	55	45	39	42	42	29	16	13
07:20	Leq	48	58	54	44	44	45	37	26	17
	Lmax	63	70	72	67	56	59	50	39	40
	L90	43	53	45	38	41	41	29	17	13
07:25	Leq	45	58	47	40	42	42	34	25	19
	Lmax	57	75	63	54	52	52	47	42	37
	L90	43	51	43	37	41	41	29	18	14
07:30	Leq	47	56	52	43	43	45	38	30	24
	Lmax	63	72	72	63	54	60	53	47	48
	L90	43	51	44	37	41	40	30	18	14
07:35	Leq	49	68	51	45	43	45	39	30	22
	Lmax	65	87	68	62	56	58	53	48	42
	L90	43	52	43	38	41	41	30	18	14
07:40	Leq	49	62	52	45	45	46	39	30	20
	Lmax	63	80	72	60	58	59	52	43	39
	L90	44	52	44	39	41	41	31	19	14
07:45	Leq	45	56	48	43	43	42	34	27	19
	Lmax	58	78	66	57	50	46	52	48	39
	L90	43	51	44	38	41	41	31	19	14
07:50	Leq	46	54	46	40	43	43	35	25	17
	Lmax	55	63	60	49	52	51	48	41	31
	L90	43	51	43	38	41	41	31	18	14
07:55	Leq	49	57	51	43	44	45	43	32	28
	Lmax	70	74	70	64	55	63	68	55	55
	L90	44	52	44	39	41	41	32	20	14
08:00	Leq	49	61	55	45	45	45	39	30	22
	Lmax	64	77	73	58	56	55	58	52	40
	L90	44	52	44	39	42	42	32	20	14
08:05	Leq	50	63	51	42	45	47	39	32	19
	Lmax	63	82	72	58	56	59	53	49	38
	L90	44	53	44	39	42	42	33	20	14
08:10	Leq	46	56	47	41	43	44	35	23	17
	Lmax	52	70	57	49	49	48	42	33	35
	L90	45	53	45	40	42	42	33	20	14
08:15	Leq	50	58	51	42	45	47	40	34	32
	Lmax	63	72	70	54	56	60	52	47	47
	L90	45	52	45	39	42	42	34	20	14
08:20	Leq	49	57	53	50	47	44	36	31	28
	Lmax	63	66	71	66	62	54	47	43	43
	L90	45	53	44	39	42	42	33	20	14
08:25	Leq	46	56	48	41	43	44	36	27	21
	Lmax	58	69	64	54	53	53	50	44	34
	L90	44	53	45	39	42	42	32	18	14
08:30	Leq	48	58	51	45	44	44	38	31	27
	Lmax	62	71	71	60	56	57	54	50	45
	L90	44	53	44	38	41	41	31	17	13
08:35	Leq	48	67	50	43	44	45	37	30	22
	Lmax	63	83	67	58	55	60	52	46	43
	L90	43	53	44	38	41	41	31	19	14
08:40	Leq	48	57	50	41	43	45	39	29	25
	Lmax	63	71	71	54	54	58	56	48	46
	L90	43	52	44	38	41	41	30	18	14
08:45	Leq	46	55	47	40	43	43	38	24	23
	Lmax	62	64	58	46	48	57	59	43	43
	L90	44	53	44	38	41	42	31	18	14
08:50	Leq	47	62	50	41	44	45	35	26	18
	Lmax	61	80	68	56	55	58	49	43	38
	L90	44	53	45	38	41	41	30	16	13
08:55	Leq	47	59	53	42	44	44	36	28	19
	Lmax	62	76	71	57	56	55	53	52	44
	L90	44	52	44	38	41	41	30	16	13
09:00	Leq	46	55	47	41	43	42	35	34	30
	Lmax	65	71	61	57	55	52	58	60	57
	L90	43	52	44	39	41	41	30	18	14

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
23:00	Leq	41	53	44	39	36	38	29	25	21
	Lmax	57	59	52	48	46	47	52	51	46
	L90	39	50	43	37	35	37	25	14	13
23:05	Leq	42	53	46	40	37	39	29	18	13
	Lmax	53	62	58	52	45	51	43	31	21
	L90	39	49	43	37	35	37	25	14	13
23:10	Leq	42	53	48	40	37	40	28	16	13
	Lmax	53	62	65	54	43	47	39	29	17
	L90	40	50	43	38	35	38	26	14	13
23:15	Leq	46	57	51	43	40	44	36	24	15
	Lmax	61	70	70	59	56	58	52	38	26
	L90	40	52	44	38	36	38	27	15	13
23:20	Leq	47	58	50	43	42	45	37	24	16
	Lmax	63	76	68	58	56	61	53	40	25
	L90	40	52	44	38	36	38	27	16	13
23:25	Leq	41	53	45	40	37	39	28	17	14
	Lmax	48	61	51	46	46	44	35	26	21
	L90	40	50	43	38	36	37	26	15	13
23:30	Leq	40	53	45	39	36	38	26	15	13
	Lmax	46	61	50	45	40	44	33	24	22
	L90	39	51	43	37	34	36	25	14	13
23:35	Leq	44	58	53	43	38	41	34	21	13
	Lmax	60	74	73	60	51	53	48	35	17
	L90	39	50	42	36	34	36	25	14	13
23:40	Leq	43	53	48	40	37	41	30	21	13
	Lmax	57	69	67	56	48	54	44	37	15
	L90	38	50	42	36	34	36	23	13	13
23:45	Leq	40	53	44	38	35	38	25	14	13
	Lmax	48	66	53	44	41	46	29	20	18
	L90	38	50	42	36	34	36	24	13	13
23:50	Leq	45	58	49	41	37	43	35	26	16
	Lmax	62	80	71	61	52	58	51	50	40
	L90	36	48	40	35	31	34	23	13	13
23:55	Leq	38	53	42	37	33	35	25	14	13
	Lmax	45	63	48	44	37	42	36	26	22
	L90	36	49	40	36	32	34	23	13	13
00:00	Leq	38	55	42	38	33	35	24	14	13
	Lmax	46	66	48	46	41	42	33	27	16
	L90	36	50	40	35	32	33	23	13	13
00:05	Leq	40	53	47	38	34	37	27	17	13
	Lmax	54	64	68	53	44	47	41	30	20
	L90	36	49	39	36	32	34	23	13	13
00:10	Leq	37	51	41	36	31	35	24	15	13
	Lmax	47	61	51	45	40	44	39	30	24
	L90	35	48	39	35	30	33	23	13	13
00:15	Leq	39	51	42	39	33	37	25	15	13
	Lmax	48	59	48	51	39	47	30	24	19
	L90	36	49	40	36	31	33	24	13	13
00:20	Leq	45	58	55	43	37	41	33	21	13
	Lmax	63	76	76	63	54	57	51	39	20
	L90	35	49	40	35	30	33	23	13	13
00:25	Leq	43	59	47	41	36	40	34	23	14
	Lmax	57	74	63	56	47	53	49	37	20
	L90	35	48	40	35	30	32	22	14	13
00:30	Leq	39	56	43	38	33	35	26	16	13
	Lmax	47	69	53	45	37	41	34	26	23
	L90	37	52	41	36	31	34	24	14	13
00:35	Leq	42	58	45	40	34	36	36	33	22
	Lmax	59	74	58	52	44	57	49	47	45
	L90	36	52	40	36	31	33	24	14	13
00:40	Leq	39	56	44	39	33	35	26	18	14
	Lmax	51	64	62	54	44	41	42	40	32
	L90	36	53	41	36	31	33	24	14	13
00:45	Leq	38	56	42	37	32	34	24	15	13
	Lmax	44	65	49	41	37	40	28	25	22
	L90	36	53	40	35	30	32	23	13	13
00:50	Leq	38	56	41	37	31	34	25	14	13
	Lmax	47	61	47	48	40	44	38	29	20
	L90	35	53	40	35	30	32	23	13	13
00:55	Leq	39	57	43	38	33	35	26	18	15
	Lmax	48	68	54	43	37	46	37	27	23
	L90	36	53	41	36	31	33	24	14	13

<i>Time Period</i>	<i>Index</i>	<i>dB(A)</i>	<i>63</i>	<i>125</i>	<i>250</i>	<i>500</i>	<i>1k</i>	<i>2k</i>	<i>4k</i>	<i>8k</i>
01:00	Leq	38	57	43	39	32	34	26	14	13
	Lmax	46	68	49	43	38	42	37	25	21
	L90	36	54	41	37	30	33	24	13	13
01:05	Leq	43	64	49	41	34	37	29	17	13
	Lmax	58	82	63	56	47	50	42	27	15
	L90	36	55	42	36	30	32	24	14	13
01:10	Leq	44	68	50	41	36	37	28	16	13
	Lmax	59	84	64	54	43	46	38	28	16
	L90	37	55	42	37	32	34	25	14	13
01:15	Leq	39	58	44	38	35	36	26	17	15
	Lmax	46	69	53	42	38	40	31	27	29
	L90	38	54	43	36	34	34	25	14	13
01:20	Leq	41	57	45	39	38	37	25	15	13
	Lmax	56	62	54	52	56	52	32	24	19
	L90	38	54	44	36	34	34	24	14	13
01:25	Leq	39	57	45	37	35	36	25	15	13
	Lmax	44	63	51	43	38	41	28	21	20
	L90	37	54	43	35	33	34	24	13	13
01:30	Leq	46	62	56	44	40	41	32	22	14
	Lmax	61	78	73	59	58	55	47	37	28
	L90	39	56	44	37	35	36	24	14	13
01:35	Leq	46	58	46	42	46	42	31	23	16
	Lmax	61	64	50	55	63	55	48	41	30
	L90	40	55	44	38	37	37	26	15	13
01:40	Leq	45	62	52	43	42	41	32	22	15
	Lmax	63	81	71	59	62	57	51	45	39
	L90	37	55	43	36	33	34	24	14	13
01:45	Leq	39	57	44	37	34	35	24	14	13
	Lmax	45	63	50	41	43	42	28	17	16
	L90	37	54	42	35	33	34	23	13	13
01:50	Leq	38	58	43	36	33	35	23	15	13
	Lmax	43	64	50	39	37	40	30	23	20
	L90	37	55	42	34	32	34	22	13	13
01:55	Leq	39	57	44	37	34	35	25	15	13
	Lmax	45	63	52	43	39	41	32	23	18
	L90	37	55	42	35	33	33	23	14	13
02:00	Leq	40	59	44	38	35	36	26	16	14
	Lmax	46	66	56	44	41	41	29	23	20
	L90	38	56	42	35	34	34	25	14	13
02:05	Leq	39	58	43	38	34	35	24	13	13
	Lmax	43	63	48	43	38	39	27	18	21
	L90	37	56	42	36	33	33	23	13	13
02:10	Leq	38	58	43	37	33	35	24	13	13
	Lmax	44	63	48	41	38	41	29	21	17
	L90	37	56	42	35	32	33	23	13	13
02:15	Leq	38	58	43	36	33	35	23	14	13
	Lmax	43	63	47	41	37	40	28	19	17
	L90	37	56	41	34	32	33	22	13	13
02:20	Leq	39	58	43	37	34	35	25	15	14
	Lmax	46	63	48	43	38	41	39	29	28
	L90	37	56	41	35	32	33	23	13	13
02:25	Leq	39	58	43	37	34	35	24	13	13
	Lmax	45	63	50	45	37	41	30	21	19
	L90	37	56	41	35	33	34	23	13	13
02:30	Leq	38	58	43	37	34	35	23	14	13
	Lmax	44	63	47	42	37	41	28	21	18
	L90	37	56	41	35	33	34	22	13	13
02:35	Leq	39	58	43	37	34	35	24	14	13
	Lmax	43	63	51	42	37	39	29	19	22
	L90	37	56	42	34	33	33	23	13	13
02:40	Leq	38	58	43	36	34	35	24	15	13
	Lmax	43	63	49	43	38	39	30	22	18
	L90	37	55	41	34	32	33	22	13	13
02:45	Leq	39	58	44	38	34	35	25	15	14
	Lmax	47	69	54	46	39	40	30	26	21
	L90	37	56	42	35	33	34	23	14	13
02:50	Leq	39	58	44	37	34	35	25	15	13
	Lmax	43	63	49	42	37	38	28	21	21
	L90	37	56	42	35	33	33	24	13	13
02:55	Leq	39	59	44	37	34	35	25	15	13
	Lmax	44	64	48	43	38	39	30	29	18
	L90	37	56	42	35	33	33	24	13	13

<i>Time Period</i>	<i>Index</i>	<i>dB(A)</i>	<i>63</i>	<i>125</i>	<i>250</i>	<i>500</i>	<i>1k</i>	<i>2k</i>	<i>4k</i>	<i>8k</i>
03:00	Leq	39	58	44	38	34	35	24	16	13
	Lmax	44	63	51	44	39	39	28	27	21
	L90	37	56	42	35	33	34	23	13	13
03:05	Leq	46	62	55	43	39	43	35	22	14
	Lmax	63	78	74	59	55	59	52	38	22
	L90	37	55	42	35	33	34	24	14	13
03:10	Leq	39	58	44	37	34	35	25	16	14
	Lmax	45	64	51	43	41	41	29	25	19
	L90	37	56	42	35	32	33	24	14	13
03:15	Leq	39	58	44	38	34	35	25	16	13
	Lmax	46	67	53	44	38	41	30	29	19
	L90	37	56	42	36	33	34	24	13	13
03:20	Leq	39	59	43	37	34	35	25	14	13
	Lmax	44	64	47	41	38	41	30	22	17
	L90	38	56	42	36	33	34	24	13	13
03:25	Leq	39	59	44	38	35	35	25	15	13
	Lmax	44	64	48	42	38	41	29	23	20
	L90	38	56	43	36	34	34	24	13	13
03:30	Leq	40	58	46	39	35	36	27	18	14
	Lmax	48	66	54	49	42	42	42	31	23
	L90	38	55	44	37	33	34	25	14	13
03:35	Leq	41	60	45	38	35	37	28	16	13
	Lmax	55	76	59	53	47	51	45	33	20
	L90	38	56	43	36	33	34	24	13	13
03:40	Leq	41	60	50	40	35	37	28	17	13
	Lmax	58	75	71	58	48	51	45	33	16
	L90	38	57	43	35	33	34	24	13	13
03:45	Leq	40	58	45	39	35	36	27	17	14
	Lmax	45	64	50	45	39	40	31	23	20
	L90	38	55	44	37	34	34	25	14	13
03:50	Leq	40	58	45	39	35	36	25	14	13
	Lmax	46	63	49	46	42	43	29	25	20
	L90	38	55	44	37	34	34	24	13	13
03:55	Leq	38	58	44	36	33	35	24	14	13
	Lmax	43	63	50	40	37	39	27	21	17
	L90	36	54	41	34	30	33	23	13	13
04:00	Leq	39	58	44	38	34	35	24	16	13
	Lmax	44	64	50	43	39	40	29	26	20
	L90	37	55	42	36	33	33	23	14	13
04:05	Leq	39	58	43	38	34	35	24	16	13
	Lmax	44	63	48	44	39	41	28	25	19
	L90	37	54	41	35	33	34	22	13	13
04:10	Leq	38	57	43	37	34	34	24	16	14
	Lmax	44	64	49	42	38	40	30	25	19
	L90	36	54	41	35	33	33	22	13	13
04:15	Leq	39	58	43	38	35	35	25	16	13
	Lmax	45	67	49	44	39	39	33	26	17
	L90	37	54	41	36	33	33	24	14	13
04:20	Leq	39	58	44	38	34	35	25	16	13
	Lmax	46	65	53	43	39	41	33	26	22
	L90	37	54	42	36	33	34	23	13	13
04:25	Leq	38	58	43	37	34	35	24	15	13
	Lmax	43	63	48	42	37	39	31	29	16
	L90	37	54	41	35	33	33	22	13	13
04:30	Leq	39	57	43	36	34	35	23	14	13
	Lmax	44	63	47	40	43	40	30	25	21
	L90	37	54	41	35	33	34	21	13	13
04:35	Leq	44	65	52	42	37	40	31	20	13
	Lmax	61	84	69	57	52	54	48	36	19
	L90	37	54	42	36	33	34	23	13	13
04:40	Leq	44	64	49	41	37	40	32	19	13
	Lmax	59	81	66	56	51	54	48	34	18
	L90	37	55	42	35	33	34	22	12	13
04:45	Leq	48	63	58	46	41	45	37	25	13
	Lmax	64	80	77	62	56	59	52	40	21
	L90	37	55	42	35	33	34	22	12	13
04:50	Leq	39	58	44	37	34	35	23	15	13
	Lmax	44	63	48	42	37	40	36	30	18
	L90	37	55	42	35	33	34	22	13	13
04:55	Leq	39	58	44	37	34	36	23	13	13
	Lmax	44	63	52	43	37	41	30	25	21
	L90	37	55	42	35	33	34	22	12	13

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
05:00	Leq	39	58	44	37	35	36	23	14	13
	Lmax	46	63	48	44	41	43	29	22	19
	L90	37	54	42	35	33	34	22	13	13
05:05	Leq	46	59	53	47	40	43	34	25	22
	Lmax	58	75	65	61	50	54	45	35	42
	L90	38	55	43	36	34	35	24	13	13
05:10	Leq	47	69	55	45	39	43	35	21	13
	Lmax	64	88	72	60	54	56	50	37	18
	L90	38	55	43	36	34	35	23	13	13
05:15	Leq	40	57	45	39	35	37	27	16	13
	Lmax	45	62	51	44	39	41	33	26	17
	L90	38	54	43	36	34	35	24	14	13
05:20	Leq	40	57	44	38	35	37	25	15	13
	Lmax	46	62	49	44	40	44	32	30	17
	L90	38	54	43	36	34	35	23	13	13
05:25	Leq	41	59	48	39	35	37	26	15	13
	Lmax	52	73	66	44	40	44	33	26	20
	L90	38	54	43	37	34	35	24	13	13
05:30	Leq	52	70	64	50	46	46	38	27	14
	Lmax	64	85	76	62	58	57	49	37	21
	L90	39	55	44	37	35	36	25	13	13
05:35	Leq	41	58	47	39	37	38	27	16	13
	Lmax	55	64	62	50	52	50	47	33	29
	L90	39	54	43	36	34	36	25	13	13
05:40	Leq	41	58	44	38	36	38	27	16	13
	Lmax	54	63	48	52	54	50	34	29	23
	L90	39	55	43	36	34	36	24	13	13
05:45	Leq	41	58	45	38	35	38	26	15	13
	Lmax	47	68	51	46	39	43	37	28	20
	L90	39	56	43	36	34	36	24	13	13
05:50	Leq	42	58	45	39	36	40	27	15	13
	Lmax	51	71	50	48	43	50	33	23	18
	L90	40	55	43	36	35	37	24	13	13
05:55	Leq	42	57	46	40	37	40	29	19	14
	Lmax	50	63	59	54	44	44	39	34	27
	L90	40	55	43	37	36	38	26	13	13
06:00	Leq	42	57	45	40	37	40	28	16	13
	Lmax	49	64	52	47	42	48	35	26	18
	L90	40	55	44	37	36	38	26	13	13
06:05	Leq	41	56	45	39	36	38	27	15	13
	Lmax	50	63	54	50	50	43	33	23	20
	L90	38	51	41	37	33	36	25	13	13
06:10	Leq	42	55	47	42	37	40	30	20	14
	Lmax	54	67	62	54	47	50	41	32	26
	L90	39	50	41	37	33	37	25	14	13
06:15	Leq	46	55	51	43	39	44	36	24	14
	Lmax	62	67	72	61	51	59	51	40	26
	L90	39	51	42	38	34	37	24	14	13
06:20	Leq	46	57	50	42	39	44	35	25	14
	Lmax	59	70	65	55	50	57	50	41	28
	L90	40	50	42	38	35	39	26	14	13
06:25	Leq	44	52	44	41	37	41	34	32	31
	Lmax	64	68	54	54	47	62	55	54	55
	L90	41	49	42	39	35	39	27	15	13
06:30	Leq	42	56	46	40	37	39	29	17	14
	Lmax	50	64	57	51	46	46	37	29	23
	L90	40	53	43	37	34	37	25	14	13
06:35	Leq	43	56	47	41	37	41	30	19	14
	Lmax	53	65	60	53	48	50	40	30	23
	L90	39	52	42	37	34	37	25	14	13
06:40	Leq	44	56	48	42	38	42	32	21	14
	Lmax	56	67	63	55	50	52	44	34	25
	L90	39	50	42	37	34	37	25	14	13
06:45	Leq	44	55	48	42	38	42	34	25	18
	Lmax	59	68	63	56	49	57	50	42	34
	L90	40	50	42	38	35	38	26	14	13

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Overall Rush Hour	Leq	48	60	51	43	44	45	37	29	24
	Lmax	63	78	69	60	55	58	56	47	44
	L90	44	52	44	38	41	41	31	18	14
Overall Night Time	Leq	42	59	50	40	37	39	30	21	16
	Lmax	56	74	66	54	50	52	45	39	37
	Lmax*	60	76	68	58	52	56	49	38	28
	L90	38	54	42	36	34	35	24	14	13

* Level exceeded 15 times in the night,
otherwise logarithmic mean values

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Lowest Daytime	Leq	45	56	49	41	43	43	33	23	16
	Lmax	57	72	65	55	51	53	49	43	38
	L90	43	51	42	37	41	40	28	16	13
Lowest Night Time	Leq	39	53	44	37	33	36	26	15	13
	Lmax	51	64	63	50	42	45	39	29	21
	L90	36	49	39	35	31	33	23	13	13

Measurement Summary

Position	Time	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Main	Overall Rush Hour	Leq	48	60	51	43	44	45	37	29	24
		Lmax	63	78	69	60	55	58	56	47	44
		L90	44	52	44	38	41	41	31	18	14
	Overall Night Time	Leq	42	59	50	40	37	39	30	21	16
		Lmax	60	76	68	58	52	56	49	38	28
		L90	38	54	42	36	34	35	24	14	13

Required Reductions

Position	Environment	Reductions for BS8233 desirable* criteria	Reductions for WHO-Type Criteria
Main	Living Rooms	13 dB L _{Aeq}	-
	Bedrooms	12 dB L _{Aeq}	15 dB L _{Amax}
	Outdoor Living Areas	0 dB L _{Aeq}	-

* BS 8233 considers a 5 dB relaxation would still provide reasonable conditions

Mitigation Summary

Façade	Room Type	Make-Up on Which Calculations are Based
Rear	Larger Living Room	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300
	Largest Bedroom	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300
	Smaller Living Room	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300
	Smallest Bedroom	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: Non-acoustic eg. Simon Airstrip 300

Predicted Summary

Façade	Room Type	Time	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Rear	Larger Living Room	Rush	Leq	28	49	34	29	24	20	13	5	-3
			Lmax	42	64	50	43	33	32	26	15	1
	Largest Bedroom	Night	Leq	25	48	32	25	18	16	7	-2	-12
			Lmax	42	64	50	43	33	32	26	15	1
	Smaller Living Room	Rush	Leq	28	49	33	29	25	21	13	5	-4
			Lmax	44	67	53	46	36	35	29	18	4
	Smallest Bedroom	Night	Leq	27	50	34	28	21	19	10	1	-9
			Lmax	44	67	53	46	36	35	29	18	4

Living Room Break-in

<i>Rear</i>		<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
<i>Larger Living Room</i>										
Width of Exposed Façade 1	5.70 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	3.30 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m	-	-	-	-	-	-	-	-	-
Total Exposed Façade Width	9.00 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth (re. Exposed façade 1)	3.30 m	-	-	-	-	-	-	-	-	-
Element Area	22.50 m2	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	32.50 m2	-	-	-	-	-	-	-	-	-
Room Volume	47.03 m3	-	-	-	-	-	-	-	-	-
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)		-	-12	-12	-12	-12	-12	-12	-12	-12
Walls: Traditional Masonry	16.70 m2	-	23	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	5.80 m2	-	15	21	17	25	35	37	31	31
Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m2	-	23	28	26	26	29	29	29	36
Composite SRI	32.50 m2	-	20	26	24	29	33	34	33	37
Level Difference (Reverberant only)		-	-17	-23	-20	-25	-30	-30	-29	-33
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Façade relative to Measurement Position	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	28	49	34	29	24	20	13	-3
	Night	Leq	25	49	32	26	18	15	6	-11
		Lmax	42	65	51	43	33	32	25	14

<i>Rear</i>		<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
<i>Smaller Living Room</i>										
Width of Exposed Façade 1	5.00 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	5.00 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth (re. Exposed façade 1)	3.30 m	-	-	-	-	-	-	-	-	-
Element Area	12.50 m2	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	22.50 m2	-	-	-	-	-	-	-	-	-
Room Volume	41.25 m3	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Element Area Correction		-	14	14	14	14	14	14	14	14
Room Correction 10 x Log (RT/0.163/V)		-	-11	-11	-11	-11	-11	-11	-11	-11
Walls: Traditional Masonry	8.10 m2	-	23	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	4.40 m2	-	15	21	17	25	35	37	31	31
Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m2	-	23	28	26	26	29	29	29	36
Composite SRI	22.50 m2	-	20	26	23	28	32	32	31	36
Level Difference (Reverberant only)		-	-18	-24	-21	-25	-30	-30	-29	-33
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Façade relative to Measurement Position	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	28	49	33	29	25	21	13	-4
	Night	Leq	25	48	32	26	18	15	6	-11
		Lmax	42	64	50	43	33	32	25	15

Bedroom Break-in

<i>Rear</i> <i>Largest Bedroom</i>		<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
Width of Exposed Façade 1	5.00 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	5.00 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth (re. Exposed façade 1)	3.00 m	-	-	-	-	-	-	-	-	-
Element Area	12.50 m ²	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	22.50 m ²	-	-	-	-	-	-	-	-	-
Room Volume	37.50 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Element Area Correction		-	14	14	14	14	14	14	14	14
Room Correction 10 x Log (RT/0.163/V)		-	-11	-11	-11	-11	-11	-11	-11	-11
Walls: Traditional Masonry	8.90 m ²	-	23	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	3.60 m ²	-	15	21	17	25	35	37	31	31
Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m ²	-	23	28	26	26	29	29	29	36
Composite SRI	22.50 m ²	-	20	26	24	28	32	32	32	36
Level Difference (Reverberant only)		-	-18	-24	-21	-25	-29	-30	-29	-34
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Façade relative to Measurement Position	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	28	49	33	28	25	21	14	6
	Night	Leq	25	48	32	25	18	16	7	-2
		Lmax	42	64	50	43	33	32	26	15

<i>Rear</i> <i>Smallest Bedroom</i>		<i>dB(A)</i>	63	125	250	500	1k	2k	4k	8k
Width of Exposed Façade 1	2.20 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	2.20 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth (re. Exposed façade 1)	3.40 m	-	-	-	-	-	-	-	-	-
Element Area	5.50 m ²	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	15.50 m ²	-	-	-	-	-	-	-	-	-
Room Volume	18.70 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Element Area Correction		-	12	12	12	12	12	12	12	12
Room Correction 10 x Log (RT/0.163/V)		-	-8	-8	-8	-8	-8	-8	-8	-8
Walls: Traditional Masonry	1.90 m ²	-	23	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	3.60 m ²	-	15	21	17	25	35	37	31	31
Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m ²	-	23	28	26	26	29	29	29	36
Composite SRI	15.50 m ²	-	20	25	22	26	31	31	30	35
Level Difference (Reverberant only)		-	-15	-21	-18	-22	-26	-27	-26	-31
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Façade relative to Measurement Position	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	31	51	36	31	28	24	17	9
	Night	Leq	27	50	34	28	21	19	10	1
		Lmax	44	67	53	46	36	35	29	18