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John Southworth

Assessment of noise at Land on the corner of Old Market Street
and Domett Street, M9 8DX, for proposed residential development

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1.0 **SUMMARY**

Traffic on Old Market Street was the dominant noise source throughout the survey periods. During the rush hour period, mechanical ventilation units at the rear of nearby shops were just audible, but barely noticeable without seeking them out. There was also a delivery to one of the shops including unloading activities.

During the early night time, road traffic noise continued to dominate. Voices of pedestrian leaving the public house and passing the site was significant. Apart from its customers passing the site, the public house had no impact at all on the measurement positions. As we were preparing to depart, the area became significantly quieter.

To the rear façade, apart from the first floor bedroom closest to Old Market St, external noise break-in to all room can be expected to meet BS 8233 criteria for at least *reasonable* conditions with partly open windows. The first floor bedroom closest to Old Market St will only meet criteria with windows closed. The front façade is a lot noisier and criteria will only be met if windows are closed. Note that most habitable rooms run through front to back and could presumably rely on rear windows for natural ventilation if necessary.

Some upgrading to the glazing is required to the front façade, along with moderate-to-high performance acoustic vents (if used).



A R Raymond



P J Durell

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 15 is relevant to this assessment.

15) Before above ground development commences, a scheme for acoustically insulating the residential accommodation against noise from Old Market Street and neighbouring public house shall be submitted to and approved in writing by the City Council as Local Planning Authority.

The approved noise insulation scheme shall be completed before any of the residential units are occupied.

Upon completion of the development and prior to first occupation of the apartments hereby approved, a verification report shall be submitted to and approved in writing by the City Council as Local Planning Authority in order to validate the works undertaken conform to the recommendations and requirements contained within the report. The report should contain details of post completion testing to confirm that the internal noise criteria has been met. Any instances of non conformity with the recommendations contained within the report shall be detailed, along with any measures required to ensure compliance with the internal noise criteria.

Reason - To safeguard the amenities 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, H1 and DM1 of the Core Strategy.

The condition reasonable, but it is not clear why the public house has been emphasised. We note that the condition wording is identical to a condition on the development across Domett Street and it may have simply been carried across. The development across Domett St of course now provides very substantial screening between this site and the public house. We note later that the pub had no impact at all.

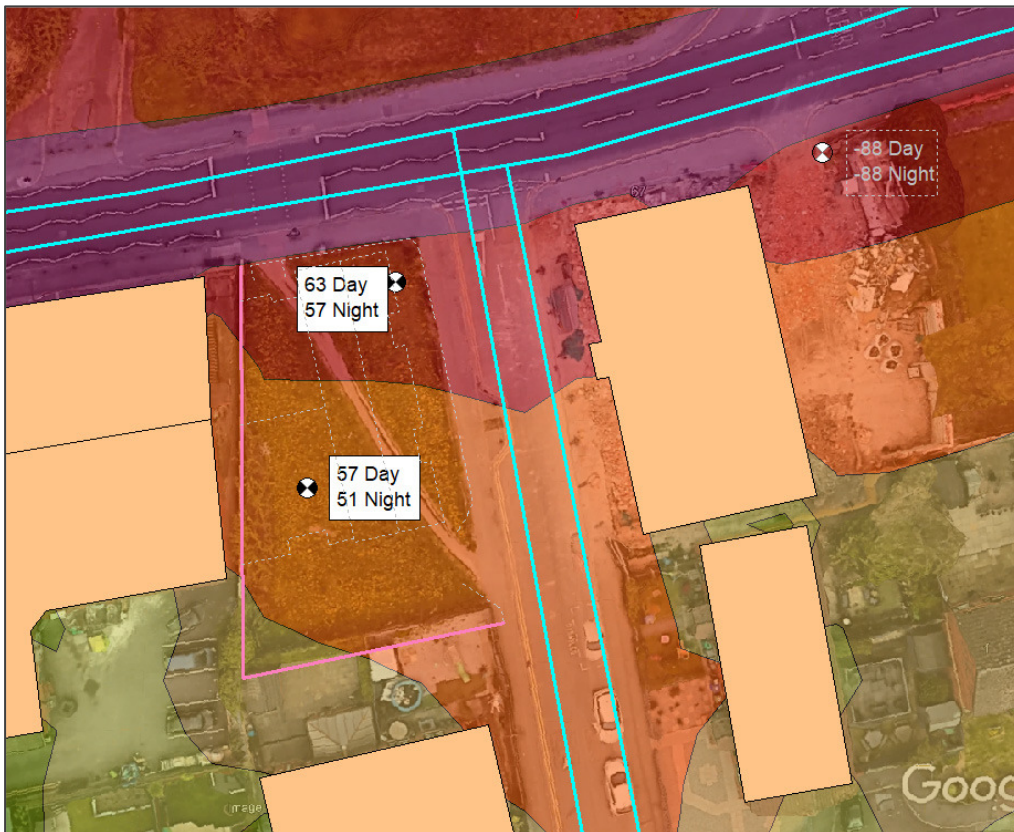
4.0 GUIDE TO MODELLING

4.1 Noise Levels Around the Site

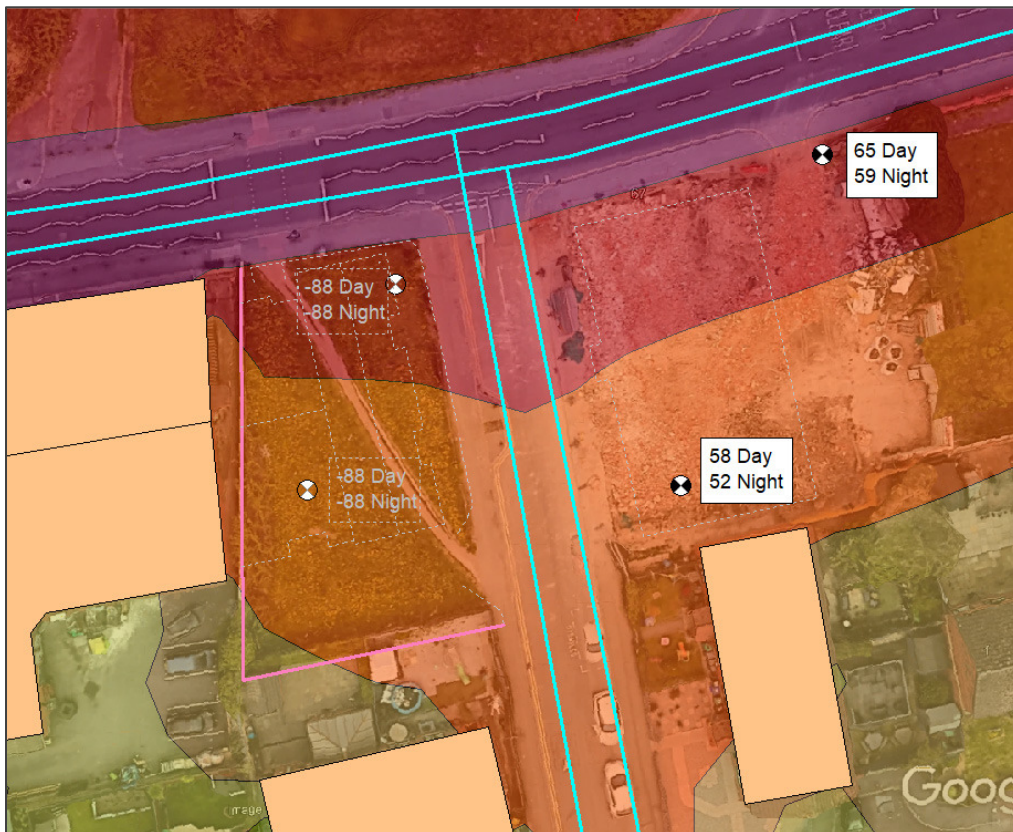
As the site is currently undeveloped, and the main sources very local to the closest facades, some modelling is useful to derive the noise affecting proposed facades, some of which will be heavily screened from the main sources (the surrounding roads). The following image shows the result of a modelling exercise using the well-established CadnaA software. Note that it is not intended to be full-blown traffic noise modelling process - its purpose is simply to show how the noise can be expected to vary between the current and proposed site layouts.

1. The main surrounding roads are set up as line sources 0.5 m above the ground. This is completely dominated by Old Market Street, but Domett Street is included as well.
2. The immediately surrounding buildings are entered which act as both screens and reflectors. All buildings and walls are assumed to be mainly reflective (0.5 dB loss of reflection).
3. The intervening ground is mainly reflective, with an overall absorption coefficient of 0.2.
4. There are two orders of reflection in the modelling.

5. The model was then set up to represent the *current* measurement conditions, ie. no development at this stage. We then setup the sound power generated by the roads so as to reproduce the levels measured at the measurement positions. The following image shows the results. Note that the image is cropped and the roads continue some distance each way in the actual model. The line sources for the roads are shown by pale blue lines and the buildings are the beige blocks. The harlequined circles are the measurement positions at 1.3 m above the ground.



6. This result is a “calibrated” model from which we go on to enter the actual site plan.
7. Note that we also set up the same system for the site before the development across Domett Street was built. This was useful to add confidence to the modelling set up. The daytime levels matched up almost exactly although the night time measurements in our survey were higher.



8. The proposed buildings are then entered with the same reflective properties assumed.
9. The proposed facades are then analysed with predicted levels distributed across. These figures are fed into the external noise break-in modelling described in 4.2 below.

4.2 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 $10 \times \log(RT/0.163/\text{Volume})$ 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.

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 11th December 2024 between approximately 07:00 hours and 09:00 hours to represent rush hour and between 2300 hours and 0100 hours, representing what was likely to be a noisier time of night.

5.2 Instrumentation

Instrumentation used were Rion NL-52 Class I sound level meters which both hold a current calibration certificate and which were field-calibrated as necessary with no drift noted. The meters were 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 positions were as shown on the following plan.



Position 1 was the early night time position, chosen as the most exposed bedrooms are mainly influenced by the front façade. Position 2 was the rush hour position, chosen as the living rooms are mainly influenced by the rear façade (only small kitchen windows to the front) and of course the gardens are to the rear.

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	:	100%
Temperature	:	6 Celsius (same both day and night)
Wind	:	negligible

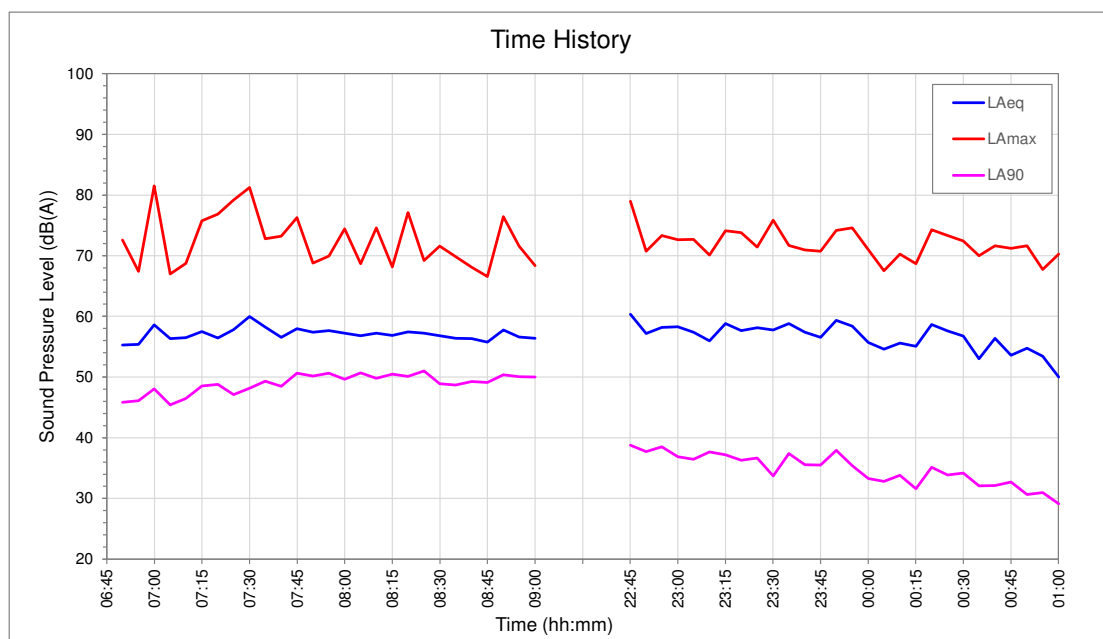
6.0 **RESULTS AND DISCUSSIONS**

Traffic on Old Market Street was the dominant noise source throughout the survey periods. During the rush hour period, mechanical ventilation units at the rear of nearby shops were just audible, but barely noticeable without seeking them out. There was also a delivery to one of the shops including unloading activities.

During the early night time, road traffic noise continued to dominate. Voices of pedestrian leaving the public house and passing the site was significant. Apart from its customers passing the site, the public house had no impact at all on the measurement positions. As we were preparing to depart, the area became significantly quieter.

6.1 **Basic Results**

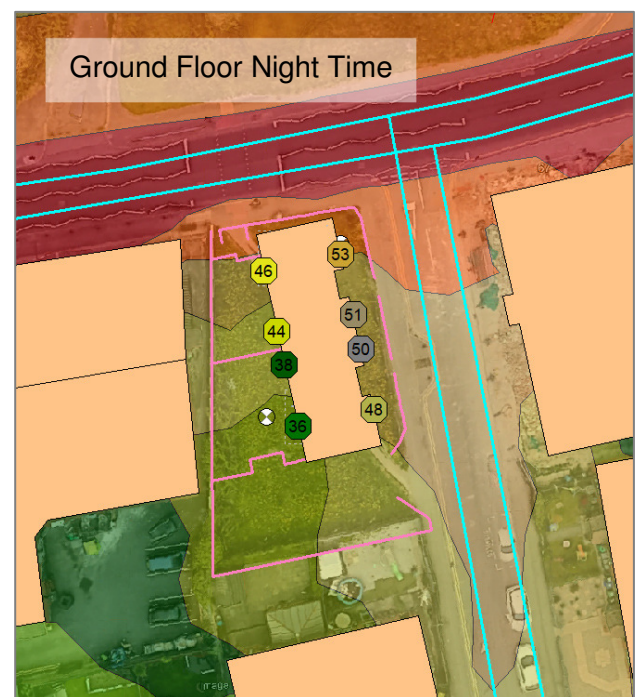
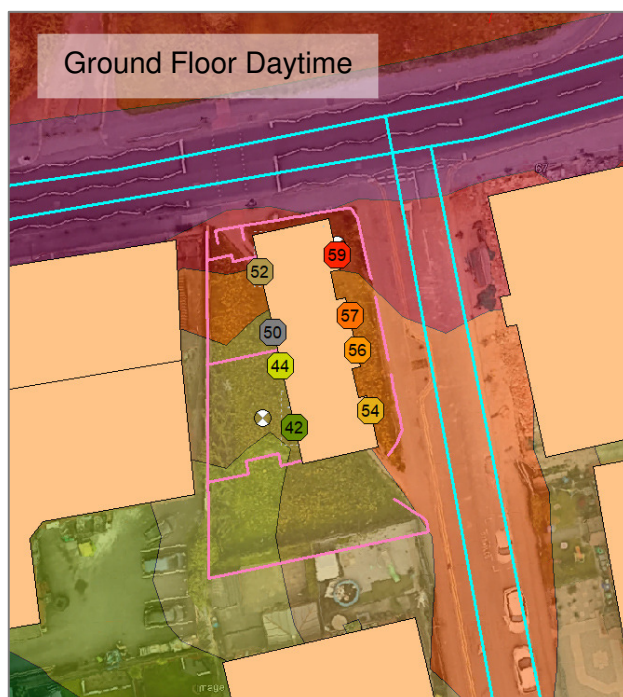
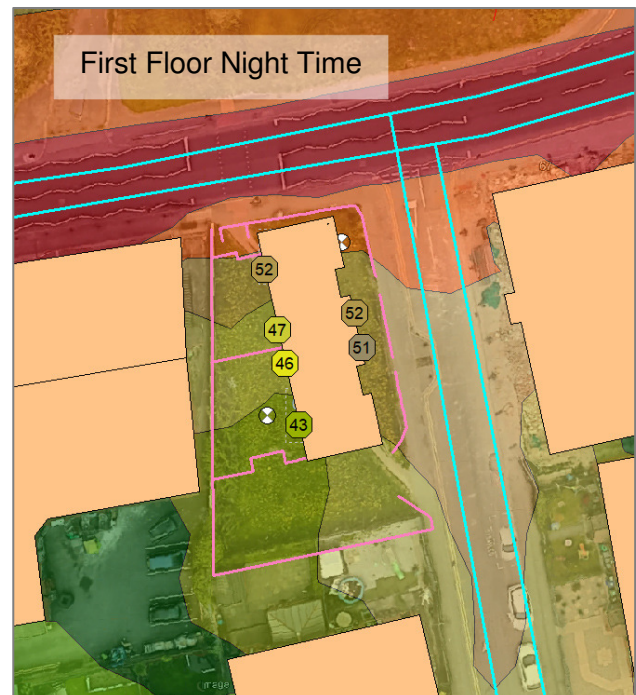
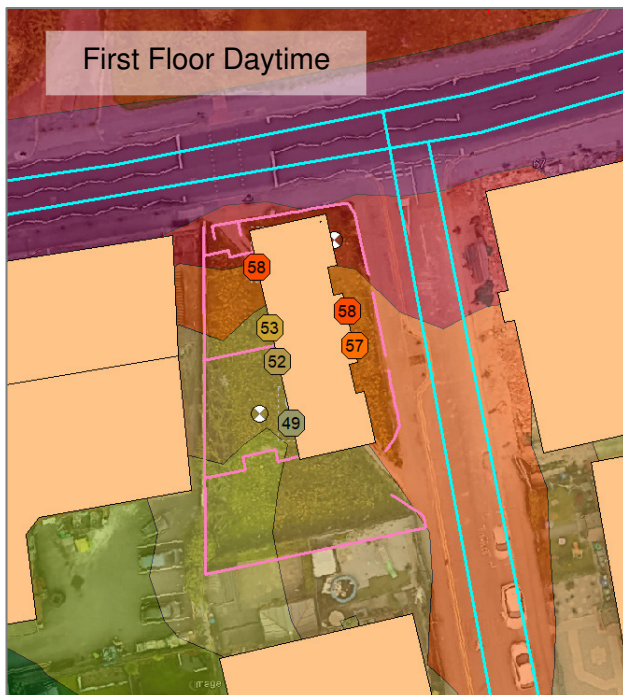
Full details are given in Appendix 2. They can be viewed graphically overtime as follows:-



Note that the rush hour period was at Position 1 and the early night time period was at Position 2. See 5.3 above. We can see that the LAeq and LAmax levels appear to be consistent for both rush hour and early night time. However, position 2 was much closer to Old Market Street and so much closer to the main sources of noise. The LA90 index lower at night time because the this underlying level generally comprises more distant sources and will reflect the expected general reducing of the noise levels.

<i>Time Period</i>	<i>Index</i>	<i>dB(A)</i>
Position 1 Overall Rush Hour	Leq	57
	Lmax	75
	L90	49
Position 2 Overall Early Night Time	Leq	57
	Lmax	72
	L90	35

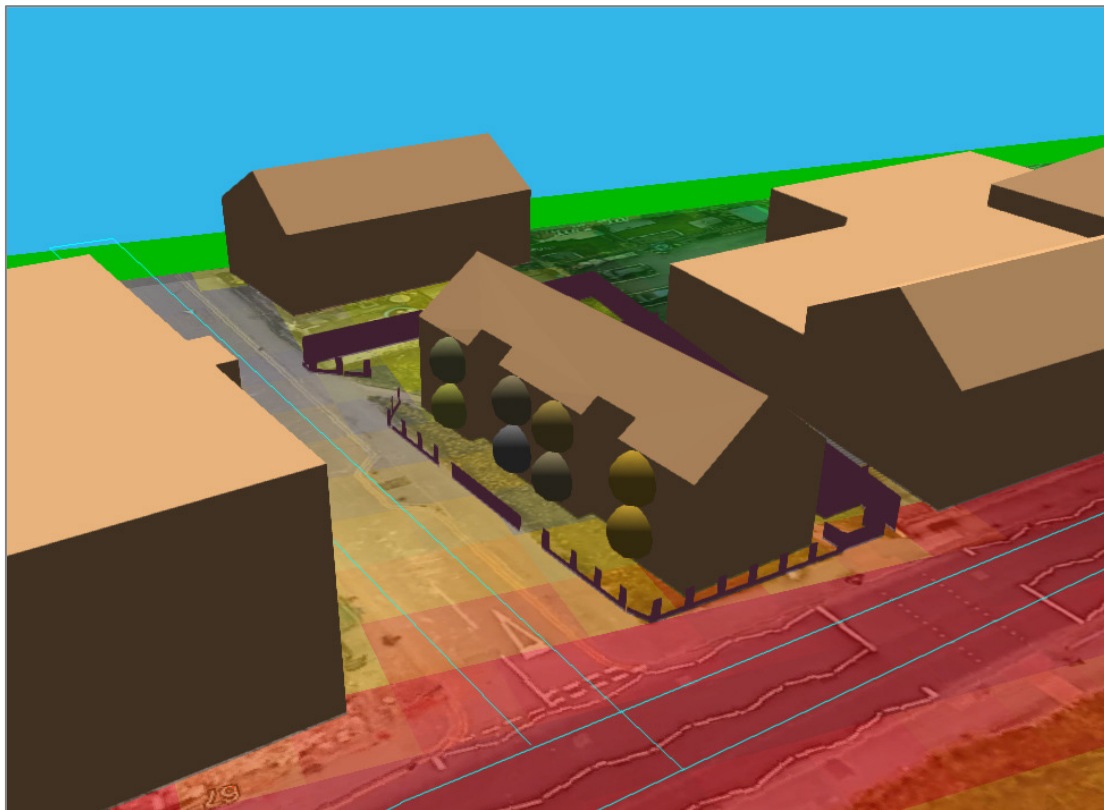
These overall measurements and the extensive measurements carried out for the site across Domett St, were used to calibrate the CadnaA model (see 4.1 above) and derive levels at the different facades on the site. The dB L_{Aeq} levels are shown in the images below for daytime and night time, at ground floor and first floor levels.



Note that:-

- The beige shapes are surrounding buildings and the application site building in its proposed form.
- The magenta lines are fences and walls.
- The blue lines are the line sources of the vehicle routes.
- The coloured numbers are the noise levels at the residential facades.
- Note that the noise contours are shown for guidance only as to how the noise propagates. The contours are at a height of 4 m (including the ground floor models)

The following 3D view should help to visualise the model.



6.2 Assessments

The above results give the following assessments.

Façade levels of 48 to 50 dB L_{Aeq} or less for daytime and 43 to 45 dB L_{Aeq} or less for night time should provide internal levels within BS 8233 criteria for *desirable* conditions based on partly open windows. Also night time levels of 58 to 60 dB L_{Amax} or less should meet WHO criteria or similar, again based on party open windows. Note that the night time L_{Amax} levels are consistently around 15 dB above the night time L_{Aeq} levels, ie. the same difference as the criteria, and so they are basically equivalent.

Façade levels up to 5 dB above these values can still be considered to provide BS 8233 *reasonable* conditions with partly open windows.

Above these levels, criteria will only be met if windows are closed.

Note, of course, that above 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 around rush hour. In other words, they should represent a worst-case.

6.3 Mitigation

Acoustic barriers are shown above by the magenta lines. They are based on the architect's drawings. Some are existing walls and some are proposed new fences. Note that the fences are only relied upon to reduce noise by up to 6 dB, so they do not need to be particularly high-spec. Theoretically, a barrier which is required to provide a 10 dB reduction only needs a density of 3 kg/m² which would be equivalent to around 6 mm thick timber. Of course the fence would be far thicker than this for structural purposes. The important point is that there are no gaps, including allowance for shrinkage and warping. An overlapping 12 to 15 mm fence would be a typical example of a simple acoustic fence.

Where façade levels are above the values discussed in 6.2 above, criteria will only be met with closed windows. This implies that ventilation may be required such that occupants have the realistic option of keeping windows shut. It is important to note that we are not saying the windows must be closed – just that noise criteria may not be met if they are open. We are also not providing ventilation advice, other to the specify the acoustic performance of vents. Ventilation needs should be determined by others.

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>
North End Front and Rear	FF Living Room	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
North End Rear Only	FF Bedroom	Rear Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Rear Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB
South End Front and Rear	FF Living Room	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
South End Rear Only	FF Bedroom	Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
North End Front and Rear	GF Living Room	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
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NB. R_w should come with a negative C_{tr} term, usually around -5 dB, eg. 35 dB R_w and -5 dB C_{tr} is 30 dB R_w+C_{tr}

Note that the table provides the acoustic specifications (such as R_w for windows and $D_{n,e,w}$ for vents) to meet appropriate criteria. The glazing build-ups and vent models which are also shown are examples and many other options achieving the same acoustic performance are available.

Full calculation details are shown in Appendix 2 and a summary of predicted internal noise levels is as follows:-

<i>Façade</i>	<i>Room Type</i>	<i>Time</i>	<i>Index</i>	<i>dB(A)</i>
North End Front and Rear	FF Living Room	Rush	Leq	34
	FF Bedroom	Night	Leq	26
			Lmax	43
South End Front and Rear	FF Living Room	Rush	Leq	33
	FF Bedroom	Night	Leq	24
			Lmax	40
North End Front and Rear	GF Living Room	Rush	Leq	31
	GF Bedroom	Night	Leq	28
			Lmax	44
South End Front and Rear	GF Living Room	Rush	Leq	32
	GF Bedroom	Night	Leq	25
			Lmax	41

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

To assist with visualising the above table the following shows where each should be applied (NB. habitable rooms only).



Note that the dotted red line indicates that the red category of sound insulation is required, but only if the windows are to the bedrooms. If they are to a hallway as shown on some drawings, then they can be basic glazing and vents.

7.0 CONCLUSIONS/RECOMMENDATIONS

To the rear façade, apart from the first floor bedroom closest to Old Market St, external noise break-in to all room can be expected to meet BS 8233 criteria for at least *reasonable* conditions with partly open windows. The first floor bedroom closest to Old Market St will only meet criteria with windows closed. The front façade is a lot noisier and criteria will only be met if windows are closed. Note that most habitable rooms run through front to back and could presumably rely on rear windows for natural ventilation if necessary.

Some upgrading to the glazing is required to the front façade, along with moderate-to-high performance acoustic vents (if used).

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_{An} .

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

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
06:50	Leq	55	59	54	52	50	52	49	41	29
	Lmax	73	75	74	67	67	69	66	61	52
	L90	46	50	46	41	42	44	35	25	16
06:55	Leq	55	59	55	51	50	52	50	40	27
	Lmax	67	73	70	66	65	61	61	52	38
	L90	46	51	48	42	41	44	37	25	15
07:00	Leq	59	62	57	55	53	54	53	45	32
	Lmax	81	75	72	71	77	76	77	70	53
	L90	48	54	50	45	42	45	40	30	17
07:05	Leq	56	63	57	55	50	52	50	41	29
	Lmax	67	77	70	70	61	61	59	53	42
	L90	45	53	49	43	41	43	33	25	15
07:10	Leq	56	60	55	53	50	53	51	41	28
	Lmax	69	74	71	65	64	63	64	53	42
	L90	46	52	48	42	41	44	38	26	15
07:15	Leq	58	62	58	57	52	53	51	44	33
	Lmax	76	78	74	74	69	71	71	64	49
	L90	49	54	49	45	42	46	41	31	19
07:20	Leq	56	64	57	54	51	52	51	43	32
	Lmax	77	84	72	67	72	71	73	66	52
	L90	49	55	51	46	42	46	42	31	20
07:25	Leq	58	64	67	56	51	53	51	42	31
	Lmax	79	85	92	78	67	69	72	65	50
	L90	47	54	50	44	41	44	40	29	17
07:30	Leq	60	65	59	59	56	55	54	46	33
	Lmax	81	83	73	78	76	76	76	71	56
	L90	48	54	50	45	42	45	41	29	16
07:35	Leq	58	63	58	58	54	54	52	43	31
	Lmax	73	77	71	77	71	66	63	58	47
	L90	49	56	50	46	43	46	43	31	18
07:40	Leq	57	62	61	55	53	52	50	40	30
	Lmax	73	75	82	71	74	60	59	56	49
	L90	48	55	51	46	43	45	41	31	20
07:45	Leq	58	65	60	58	54	53	52	44	31
	Lmax	76	84	77	71	74	68	71	65	47
	L90	51	59	54	50	45	46	44	35	23
07:50	Leq	57	64	60	56	52	53	51	43	32
	Lmax	69	79	73	70	65	64	59	54	45
	L90	50	57	52	48	44	46	44	35	21
07:55	Leq	58	67	60	57	52	52	52	45	35
	Lmax	70	82	72	73	64	64	62	58	52
	L90	51	60	54	50	45	46	43	36	24
08:00	Leq	57	65	59	56	51	52	50	42	49
	Lmax	74	77	70	72	65	61	61	55	74
	L90	50	56	51	48	44	46	43	33	21
08:05	Leq	57	65	58	55	51	53	50	42	40
	Lmax	69	86	71	64	63	62	61	55	62
	L90	51	57	52	48	44	47	44	35	21
08:10	Leq	57	66	60	56	52	52	51	44	42
	Lmax	75	80	75	68	67	64	66	61	73
	L90	50	58	53	48	44	46	43	35	24
08:15	Leq	57	66	61	58	52	52	50	43	33
	Lmax	68	78	74	71	65	60	59	55	53
	L90	50	60	54	49	45	46	43	36	25
08:20	Leq	57	68	64	56	53	52	51	42	32
	Lmax	77	87	83	71	71	70	73	60	57
	L90	50	59	53	50	45	46	43	36	24
08:25	Leq	57	65	60	57	52	53	51	42	33
	Lmax	69	79	74	71	65	63	60	56	56
	L90	51	58	52	49	45	47	44	34	20
08:30	Leq	57	65	63	56	51	52	50	44	32
	Lmax	72	79	82	70	65	62	58	66	51
	L90	49	56	52	47	43	46	41	33	19
08:35	Leq	56	65	57	54	51	52	50	42	30
	Lmax	70	81	71	66	61	66	65	54	42
	L90	49	56	51	46	43	46	41	31	19
08:40	Leq	56	63	57	54	50	52	50	43	31
	Lmax	68	77	69	63	58	62	63	61	46
	L90	49	56	51	47	43	46	43	34	22
08:45	Leq	56	64	58	55	50	51	49	42	30
	Lmax	67	75	70	66	61	61	61	53	44
	L90	49	58	51	47	44	45	42	33	22
08:50	Leq	58	67	61	57	52	52	51	47	39
	Lmax	76	80	73	73	66	70	71	70	63
	L90	50	59	53	49	45	47	43	36	24
08:55	Leq	57	66	61	58	52	51	49	42	32
	Lmax	72	79	76	73	68	66	64	56	49
	L90	50	59	54	48	45	46	43	36	23
09:00	Leq	56	65	60	55	51	51	50	45	38
	Lmax	68	78	74	63	59	61	60	63	58
	L90	50	57	53	48	45	46	43	37	26

Time Period	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
22:45	Leq	60	61	64	56	57	56	54	44	32
	Lmax	79	75	83	77	81	67	65	57	49
	L90	39	48	42	37	33	36	31	20	14
22:50	Leq	57	60	52	51	50	54	52	41	29
	Lmax	71	76	70	68	62	67	64	62	47
	L90	38	46	40	34	31	35	30	17	13
22:55	Leq	58	57	51	51	50	55	53	43	33
	Lmax	73	72	64	66	64	70	68	60	56
	L90	39	46	40	35	33	36	29	17	13
23:00	Leq	58	61	52	51	51	55	53	42	31
	Lmax	73	78	67	66	67	69	67	56	46
	L90	37	49	40	34	32	35	26	14	13
23:05	Leq	57	59	50	51	50	54	52	42	32
	Lmax	73	77	65	68	65	69	67	57	57
	L90	36	48	40	36	32	33	26	15	13
23:10	Leq	56	57	50	50	49	52	51	40	33
	Lmax	70	74	68	66	62	66	64	58	60
	L90	38	46	41	35	32	35	29	16	13
23:15	Leq	59	57	52	51	51	56	54	43	30
	Lmax	74	74	69	66	65	69	70	63	53
	L90	37	48	42	35	32	35	27	15	13
23:20	Leq	58	60	53	51	51	54	52	42	30
	Lmax	74	80	68	65	66	70	69	58	47
	L90	36	46	40	34	31	34	25	14	13
23:25	Leq	58	57	56	52	50	55	53	42	29
	Lmax	71	74	73	64	63	68	66	56	44
	L90	37	46	40	34	31	34	28	16	13
23:30	Leq	58	63	65	55	51	53	52	42	31
	Lmax	76	84	86	73	68	69	70	56	47
	L90	34	46	40	33	29	30	23	13	13
23:35	Leq	59	60	56	52	51	56	53	43	31
	Lmax	72	78	71	65	64	69	66	55	45
	L90	37	47	41	34	31	35	30	18	13
23:40	Leq	57	59	51	50	50	54	52	42	30
	Lmax	71	75	68	63	62	68	66	54	46
	L90	36	46	39	33	31	33	25	14	13
23:45	Leq	57	57	49	50	49	53	51	40	28
	Lmax	71	75	70	65	63	67	65	54	45
	L90	35	45	39	33	30	33	26	15	13
23:50	Leq	59	63	55	55	55	56	53	43	32
	Lmax	74	82	75	74	71	70	65	58	49
	L90	38	46	41	35	32	35	30	18	13
23:55	Leq	58	59	53	53	51	55	53	43	31
	Lmax	75	76	70	71	68	70	70	58	47
	L90	35	45	40	33	30	33	26	15	13
00:00	Leq	56	54	48	48	48	52	51	40	27
	Lmax	71	71	64	64	63	67	66	56	44
	L90	33	45	39	32	29	30	22	13	13
00:05	Leq	55	55	46	48	47	51	50	39	26
	Lmax	68	72	59	63	59	63	63	54	41
	L90	33	44	38	31	28	30	22	14	13
00:10	Leq	56	63	51	50	48	52	50	40	28
	Lmax	70	84	68	64	62	66	65	56	46
	L90	34	45	38	32	29	31	25	14	13
00:15	Leq	55	55	50	49	47	52	49	40	28
	Lmax	69	72	69	62	62	66	62	52	42
	L90	32	44	38	31	27	28	20	13	13
00:20	Leq	59	60	53	52	52	55	53	42	31
	Lmax	74	77	74	67	72	69	68	57	46
	L90	35	45	39	32	29	32	27	14	13
00:25	Leq	58	61	54	50	50	54	52	42	29
	Lmax	73	79	73	65	67	70	68	57	44
	L90	34	44	40	32	29	31	23	13	13
00:30	Leq	57	59	54	50	49	53	52	41	28
	Lmax	72	74	73	65	63	69	68	58	43
	L90	34	44	39	31	29	31	25	13	13
00:35	Leq	53	56	50	49	46	49	48	37	27
	Lmax	70	74	72	71	62	65	64	56	50
	L90	32	44	38	30	27	29	21	12	13
00:40	Leq	56	57	51	51	49	53	51	41	31
	Lmax	72	76	69	68	65	68	66	58	49
	L90	32	43	38	31	28	29	22	12	13
00:45	Leq	54	54	47	46	46	50	48	40	30
	Lmax	71	73	66	63	64	68	66	57	49
	L90	33	42	37	31	28	30	23	13	13
00:50	Leq	55	53	48	46	47	52	50	39	25
	Lmax	72	73	67	64	63	68	67	56	42
	L90	31	42	37	29	28	27	18	12	13
00:55	Leq	53	49	46	47	46	50	48	38	26
	Lmax	68	64	61	61	60	64	63	52	41
	L90	31	42	37	30	27	28	20	13	13
01:00	Leq	50	47	42	43	42	47	45	35	23
	Lmax	70	64	62	64	63	67	65	54	40
	L90	29	41	36	29	25	25	18	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>
Position 1 Overall Rush Hour	Leq	57	65	60	56	52	53	51	43	38
	Lmax	75	81	80	72	70	68	69	64	63
	L90	49	57	52	47	44	46	42	33	21
Position 2 Overall Early Night Time	Leq	57	59	54	51	50	54	51	41	30
	Lmax	72	78	74	67	66	68	67	57	50
	L90	35	45	39	33	30	32	26	14	13

Measurement Summary

Position	Time	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
1	Overall Rush Hour	Leq	57	65	60	56	52	53	51	43	38
		Lmax	75	81	80	72	70	68	69	64	63
		L90	49	57	52	47	44	46	42	33	21
2	Overall Early Night	Leq	57	59	54	51	50	54	51	41	30
		Lmax	72	78	74	67	66	68	67	57	50
		L90	35	45	39	33	30	32	26	14	13

Required Reductions

Position	Environment	Reductions for BS8233 desirable* criteria	Reductions for WHO-Type Criteria
1	Living Rooms	22 dB L _{Aeq}	-
	Outdoor Living Areas	7 dB L _{Aeq}	-
2	Bedrooms	27 dB L _{Aeq}	27 dB L _{Amax}

Note that these figures do not include any façade effect which might be applicable

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

Mitigation Summary

Façade	Room Type	Make-Up on Which Calculations are Based
North End Front and Rear	FF Living Room	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
North End Rear Only	FF Bedroom	Rear Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Rear Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB
South End Front and Rear	FF Living Room	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
South End Rear Only	FF Bedroom	Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
North End Front and Rear	GF Living Room	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
North End Front and Rear	GF Bedroom	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
South End Front and Rear	GF Living Room	Rear Façade Glazing: Basic thermal eg. 4+20+4 Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300
South End Front and Rear	GF Bedroom	Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4 Front Façade Vents: Non-acoustic eg. Simon Airstrip 300 Rear Façade Glazing: Basic thermal eg. 4+20+4 Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300

NB. R_w should come with a negative C_{tr} term, usually around -5 dB, eg. 35 dB R_w and -5 dB C_{tr} is 30 dB R_w+C_{tr}

Predicted Summary

Façade	Room Type	Time	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
North End Front and Rear	FF Living Room	Rush	Leq	34	51	40	37	29	25	24	17	8
			Lmax	43	62	54	45	35	33	33	23	16
	FF Bedroom	Night	Leq	26	44	34	29	20	18	18	7	-5
South End Front and Rear	FF Living Room	Rush	Leq	33	50	39	36	28	24	23	16	7
			Lmax	40	55	45	42	36	34	32	23	12
	FF Bedroom	Night	Leq	24	36	25	25	20	19	17	7	-9
North End Front and Rear	GF Living Room	Rush	Leq	31	49	38	35	26	23	21	14	6
			Lmax	44	61	52	45	38	37	36	26	16
	GF Bedroom	Night	Leq	28	43	32	29	22	22	20	10	-4
South End Front and Rear	GF Living Room	Rush	Leq	32	48	37	36	27	22	21	15	7
			Lmax	41	58	49	42	36	34	33	23	13
	GF Bedroom	Night	Leq	25	39	29	26	20	19	18	8	-7

Living Room Break-in

North End Front and Rear FF Living Room		dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Front Façade	3.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Rear Façade	3.00 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth	6.30 m	-	-	-	-	-	-	-	-	-
Front Façade Area	7.50 m ²	-	-	-	-	-	-	-	-	-
Effective Front Façade Area (ie. with vents)	17.50 m ²	-	-	-	-	-	-	-	-	-
Rear Façade Area	7.50 m ²									
Effective Rear Façade Area (ie. with vents)	17.50 m ²									
Room Volume	47.25 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	1.00 s	-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)		-	-9	-9	-9	-9	-9	-9	-9	-9
Front Façade Area Correction		-	12	12	12	12	12	12	12	12
Front Façade Walls: Traditional Masonry	6.42 m ²	-	23	32	41	47	49	53	58	55
Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4	1.08 m ²	-	15	20	21	33	40	36	48	48
Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB	10.00 m ²	-	36	41	40	36	40	39	38	38
Front Façade Composite SRI	17.50 m ²	-	24	30	32	37	42	41	40	40
Front Façade relative to Measurement Position 1	1 dB	-	1	1	1	1	1	1	1	1
Front Façade Level Difference		-	-19	-26	-28	-33	-37	-36	-35	-35
Rear Façade Area Correction		-	12	12	12	12	12	12	12	12
Rear Façade Walls: Traditional Masonry	4.30 m ²	-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4	3.20 m ²	-	15	21	17	25	35	37	31	31
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m ²	-	23	28	26	26	29	29	29	36
Rear Façade Composite SRI	17.50 m ²	-	20	26	23	27	31	31	31	35
Rear Façade relative to Measurement Position 2	-4 dB	-	-4	-4	-4	-4	-4	-4	-4	-4
Rear Façade Level Difference		-	-20	-26	-23	-27	-32	-32	-31	-36
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	34	51	40	37	29	25	24	17
	Night	Leq	31	45	34	32	27	26	24	14
		Lmax	47	64	54	48	41	39	30	21

South End Front and Rear FF Living Room		dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Front Façade	3.00 m	-	-	-	-	-	-	-	-	-
Width of Exposed Rear Façade	3.00 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth	6.30 m	-	-	-	-	-	-	-	-	-
Front Façade Area	7.50 m ²	-	-	-	-	-	-	-	-	-
Effective Front Façade Area (ie. with vents)	17.50 m ²	-	-	-	-	-	-	-	-	-
Rear Façade Area	7.50 m ²									
Effective Rear Façade Area (ie. with vents)	17.50 m ²									
Room Volume	47.25 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	1.00 s	-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)		-	-9	-9	-9	-9	-9	-9	-9	-9
Front Façade Area Correction		-	12	12	12	12	12	12	12	12
Front Façade Walls: Traditional Masonry	6.42 m ²	-	23	32	41	47	49	53	58	55
Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4	1.08 m ²	-	15	20	21	33	40	36	48	48
Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB	10.00 m ²	-	36	41	40	36	40	39	38	38
Front Façade Composite SRI	17.50 m ²	-	24	30	32	37	42	41	40	40
Front Façade relative to Measurement Position 1	0 dB	-	0	0	0	0	0	0	0	0
Front Façade Level Difference		-	-20	-27	-29	-34	-38	-37	-36	-36
Rear Façade Area Correction		-	12	12	12	12	12	12	12	12
Rear Façade Walls: Traditional Masonry	4.30 m ²	-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4	3.20 m ²	-	15	21	17	25	35	37	31	31
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m ²	-	23	28	26	26	29	29	29	36
Rear Façade Composite SRI	17.50 m ²	-	20	26	23	27	31	31	31	35
Rear Façade relative to Measurement Position 2	-5 dB	-	-5	-5	-5	-5	-5	-5	-5	-5
Rear Façade Level Difference		-	-21	-27	-24	-28	-33	-33	-32	-37
Allowance for flanking/workmanship	3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	33	50	39	36	28	24	23	16
	Night	Leq	30	44	33	31	26	25	23	13
		Lmax	46	63	53	47	41	40	38	29

North End Front and Rear		dB(A)									
GF Living Room		63	125	250	500	1k	2k	4k	8k		
Width of Exposed Front Façade	3.00 m	-	-	-	-	-	-	-	-		
Width of Exposed Rear Façade	3.00 m	-	-	-	-	-	-	-	-		
Element Height	2.50 m	-	-	-	-	-	-	-	-		
Effective Room Depth	6.30 m	-	-	-	-	-	-	-	-		
Front Façade Area	7.50 m2	-	-	-	-	-	-	-	-		
Effective Front Façade Area (ie. with vents)	17.50 m2	-	-	-	-	-	-	-	-		
Rear Façade Area	7.50 m2										
Effective Rear Façade Area (ie. with vents)	17.50 m2										
Room Volume	47.25 m3	-	-	-	-	-	-	-	-		
Assumed RT	1.00 s	-	-	-	-	-	-	-	-		
Room Correction 10 x Log (RT/0.163/V)		-	-9	-9	-9	-9	-9	-9	-9		
Front Façade Area Correction		-	12	12	12	12	12	12	12		
Front Façade Walls: Traditional Masonry	6.42 m2	-	23	32	41	47	49	53	58	55	
Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4	1.08 m2	-	15	20	21	33	40	36	48	48	
Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB	10.00 m2	-	36	41	40	36	40	39	38	38	
Front Façade Composite SRI	17.50 m2	-	24	30	32	37	42	41	40	40	
Front Façade relative to Measurement Position 1	0 dB	-	0	0	0	0	0	0	0	0	
Front Façade Level Difference		-	-20	-27	-29	-34	-38	-37	-36	-36	
Rear Façade Area Correction		-	12	12	12	12	12	12	12	12	
Rear Façade Walls: Traditional Masonry	4.30 m2	-	23	32	41	47	49	53	58	55	
Rear Façade Glazing: Basic thermal eg. 4+20+4	3.20 m2	-	15	21	17	25	35	37	31	31	
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m2	-	23	28	26	26	29	29	29	36	
Rear Façade Composite SRI	17.50 m2	-	20	26	23	27	31	31	31	35	
Rear Façade relative to Measurement Position 2	-7 dB	-	-7	-7	-7	-7	-7	-7	-7	-7	
Rear Façade Level Difference		-	-23	-29	-26	-30	-35	-35	-34	-39	
Allowance for flanking/workmanship		-	3	3	3	3	3	3	3	3	
Predicted Internal Levels	Rush	Leq	31	49	38	35	26	23	21	14	6
	Night	Leq	29	43	32	30	24	24	22	12	-2
		Lmax	45	62	52	46	40	38	37	28	19

South End Front and Rear GF Living Room			dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Front Façade	3.00 m		-	-	-	-	-	-	-	-	-
Width of Exposed Rear Façade	3.00 m		-	-	-	-	-	-	-	-	-
Element Height	2.50 m		-	-	-	-	-	-	-	-	-
Effective Room Depth	6.30 m		-	-	-	-	-	-	-	-	-
Front Façade Area	7.50 m2		-	-	-	-	-	-	-	-	-
Effective Front Façade Area (ie. with vents)	17.50 m2		-	-	-	-	-	-	-	-	-
Rear Façade Area	7.50 m2										
Effective Rear Façade Area (ie. with vents)	17.50 m2										
Room Volume	47.25 m3		-	-	-	-	-	-	-	-	-
Assumed RT	1.00 s		-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)			-	-9	-9	-9	-9	-9	-9	-9	-9
Front Façade Area Correction			-	12	12	12	12	12	12	12	12
Front Façade Walls: Traditional Masonry	6.42 m2		-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4	1.08 m2		-	15	21	17	25	35	37	31	31
Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB	10.00 m2		-	36	41	40	36	40	39	38	38
Front Façade Composite SRI	17.50 m2		-	24	31	29	35	41	41	38	38
Front Façade relative to Measurement Position 1	-1 dB		-	-1	-1	-1	-1	-1	-1	-1	-1
Front Façade Level Difference			-	-21	-29	-26	-32	-38	-38	-36	-36
Rear Façade Area Correction			-	12	12	12	12	12	12	12	12
Rear Façade Walls: Traditional Masonry	4.30 m2		-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4	3.20 m2		-	15	21	17	25	35	37	31	31
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m2		-	23	28	26	26	29	29	29	36
Rear Façade Composite SRI	17.50 m2		-	20	26	23	27	31	31	31	35
Rear Façade relative to Measurement Position 2	-7 dB		-	-7	-7	-7	-7	-7	-7	-7	-7
Rear Façade Level Difference			-	-23	-29	-26	-30	-35	-35	-34	-39
Allowance for flanking/workmanship	3 dB		-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	32	48	37	36	27	22	21	15	7
	Night	Leq	29	43	31	31	25	24	21	12	-1
		Lmax	45	61	51	47	41	38	37	28	19

Bedroom Break-in

North End Rear Only FF Bedroom		dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Rear Façade	3.30 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth	4.40 m	-	-	-	-	-	-	-	-	-
Rear Façade Area	8.25 m ²	-	-	-	-	-	-	-	-	-
Effective Rear Façade Area (ie. with vents)	18.25 m ²	-	-	-	-	-	-	-	-	-
Room Volume	36.30 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)		-	-11	-11	-11	-11	-11	-11	-11	-11
Rear Façade Area Correction		-	13	13	13	13	13	13	13	13
Rear Façade Walls: Traditional Masonry	4.65 m ²	-	23	32	41	47	49	53	58	55
Rear Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4	3.60 m ²	-	15	20	21	33	40	36	48	48
Rear Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB	10.00 m ²	-	36	41	40	36	40	39	38	38
Rear Façade Composite SRI	18.25 m ²	-	21	27	28	36	41	39	40	40
Rear Façade relative to Measurement Position 2	1 dB	-	1	1	1	1	1	1	1	1
Rear Façade Level Difference		-	-18	-24	-25	-33	-38	-37	-37	-37
Allowance for flanking/workmanship		3 dB	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	30	49	40	34	22	17	9	4
	Night	Leq	26	44	34	29	20	18	7	-5
		Lmax	43	62	54	45	35	33	23	16

South End Rear Only FF Bedroom		dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Rear Façade	3.30 m	-	-	-	-	-	-	-	-	-
Element Height	2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth	4.40 m	-	-	-	-	-	-	-	-	-
Rear Façade Area	8.25 m ²	-	-	-	-	-	-	-	-	-
Effective Rear Façade Area (ie. with vents)	18.25 m ²	-	-	-	-	-	-	-	-	-
Room Volume	36.30 m ³	-	-	-	-	-	-	-	-	-
Assumed RT	0.50 s	-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)		-	-11	-11	-11	-11	-11	-11	-11	-11
Rear Façade Area Correction		-	13	13	13	13	13	13	13	13
Rear Façade Walls: Traditional Masonry	4.65 m ²	-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4	3.60 m ²	-	15	21	17	25	35	37	31	31
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300	10.00 m ²	-	23	28	26	26	29	29	29	36
Rear Façade Composite SRI	18.25 m ²	-	20	26	23	27	31	31	31	35
Rear Façade relative to Measurement Position 2	-8 dB	-	-8	-8	-8	-8	-8	-8	-8	-8
Rear Façade Level Difference		-	-26	-32	-29	-33	-37	-37	-37	-41
Allowance for flanking/workmanship		3 dB	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	26	42	32	30	22	18	16	10
	Night	Leq	24	36	25	25	20	19	17	7
		Lmax	40	55	45	42	36	34	32	23

North End Front and Rear GF Bedroom			dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Front Façade		3.30 m	-	-	-	-	-	-	-	-	-
Width of Exposed Rear Façade		3.30 m	-	-	-	-	-	-	-	-	-
Element Height		2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth		6.30 m	-	-	-	-	-	-	-	-	-
Front Façade Area		8.25 m2	-	-	-	-	-	-	-	-	-
Effective Front Façade Area (ie. with vents)		18.25 m2	-	-	-	-	-	-	-	-	-
Rear Façade Area		8.25 m2									
Effective Rear Façade Area (ie. with vents)		18.25 m2									
Room Volume		51.98 m3	-	-	-	-	-	-	-	-	-
Assumed RT		0.50 s	-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)			-	-12	-12	-12	-12	-12	-12	-12	-12
Front Façade Area Correction			-	13	13	13	13	13	13	13	13
Front Façade Walls: Traditional Masonry		5.25 m2	-	23	32	41	47	49	53	58	55
Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4		3.00 m2	-	15	20	21	33	40	36	48	48
Front Façade Vents: 39 dB Dn,e,w eg. Glidevale TVES4dB		10.00 m2	-	36	41	40	36	40	39	38	38
Front Façade Composite SRI		18.25 m2	-	22	27	29	36	41	40	40	40
Front Façade relative to Measurement Position 1		1 dB	-	1	1	1	1	1	1	1	1
Front Façade Level Difference			-	-20	-26	-27	-35	-40	-38	-39	-39
Rear Façade Area Correction			-	13	13	13	13	13	13	13	13
Rear Façade Walls: Traditional Masonry		6.45 m2	-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4		1.80 m2	-	15	21	17	25	35	37	31	31
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300		10.00 m2	-	23	28	26	26	29	29	29	36
Rear Façade Composite SRI		18.25 m2	-	21	27	25	28	31	31	31	37
Rear Façade relative to Measurement Position 2		-5 dB	-	-5	-5	-5	-5	-5	-5	-5	-5
Rear Façade Level Difference			-	-26	-32	-29	-32	-36	-36	-36	-41
Allowance for flanking/workmanship		3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	30	48	38	34	25	21	20	12	4
	Night	Leq	28	43	32	29	22	22	20	10	-4
		Lmax	44	61	52	45	38	37	36	26	16

South End Front and Rear GF Bedroom			dB(A)	63	125	250	500	1k	2k	4k	8k
Width of Exposed Front Façade		3.30 m	-	-	-	-	-	-	-	-	-
Width of Exposed Rear Façade		3.30 m	-	-	-	-	-	-	-	-	-
Element Height		2.50 m	-	-	-	-	-	-	-	-	-
Effective Room Depth		6.30 m	-	-	-	-	-	-	-	-	-
Front Façade Area		8.25 m2	-	-	-	-	-	-	-	-	-
Effective Front Façade Area (ie. with vents)		18.25 m2	-	-	-	-	-	-	-	-	-
Rear Façade Area		8.25 m2									
Effective Rear Façade Area (ie. with vents)		18.25 m2									
Room Volume		51.98 m3	-	-	-	-	-	-	-	-	-
Assumed RT		0.50 s	-	-	-	-	-	-	-	-	-
Room Correction 10 x Log (RT/0.163/V)			-	-12	-12	-12	-12	-12	-12	-12	-12
Front Façade Area Correction			-	13	13	13	13	13	13	13	13
Front Façade Walls: Traditional Masonry		5.25 m2	-	23	32	41	47	49	53	58	55
Front Façade Glazing: 30 dB Rw+Ctr eg. 8+16+4		3.00 m2	-	15	20	21	33	40	36	48	48
Front Façade Vents: Non-acoustic eg. Simon Airstrip 300		10.00 m2	-	36	41	40	36	40	39	38	38
Front Façade Composite SRI		18.25 m2	-	22	27	29	36	41	40	40	40
Front Façade relative to Measurement Position 1		-3 dB	-	-3	-3	-3	-3	-3	-3	-3	-3
Front Façade Level Difference			-	-24	-30	-31	-39	-44	-42	-43	-43
Rear Façade Area Correction			-	13	13	13	13	13	13	13	13
Rear Façade Walls: Traditional Masonry		6.45 m2	-	23	32	41	47	49	53	58	55
Rear Façade Glazing: Basic thermal eg. 4+20+4		1.80 m2	-	15	21	17	25	35	37	31	31
Rear Façade Vents: Non-acoustic eg. Simon Airstrip 300		10.00 m2	-	23	28	26	26	29	29	29	36
Rear Façade Composite SRI		18.25 m2	-	21	27	25	28	31	31	31	37
Rear Façade relative to Measurement Position 2		-7 dB	-	-7	-7	-7	-7	-7	-7	-7	-7
Rear Façade Level Difference			-	-28	-34	-31	-34	-38	-38	-38	-43
Allowance for flanking/workmanship		3 dB	-	3	3	3	3	3	3	3	3
Predicted Internal Levels	Rush	Leq	27	45	35	31	22	18	17	10	1
	Night	Leq	25	39	29	26	20	19	18	8	-7
		Lmax	41	58	49	42	36	34	33	23	13