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27th November 2016 Rev A

Carpenter Investments

Assessment of noise impact at the proposed Phase 1 Student Accommodation at on the Hardman House Site, L1 9AS

Prepared for :-

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1.0 SUMMARY

Daytime and night time noise was completely dominated by traffic on Hardman Street. Pedestrians' voices are also quite frequent but have far less impact than traffic. Between local sources, the general distant noise of the city was audible as well as very faint mechanical noise which was just audible at times.

Levels on the proposed Hardman St façade are fairly high and will require mitigation in the form of upgraded glazing to achieve reasonable internal conditions. More basic glazing will be adequate on other facades and on the 6th and 7th floors of the Hardman St façade which is significantly set back.

The commercial units are not part of the scope of this report but can easily be controlled by conditions.

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 redevelopment as student accommodation from a noise perspective. It is the first of two assessments, this one covering the main block of accommodation referred to as Phase 1.

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

The National Planning Policy Framework provides nothing in the way of quantitative criteria. The main statement on noise is to be found in paragraph 123:-

123. Planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

The NPPF refers to the Noise Policy Statement for England (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.

3.2 BS8233

BS8233 was updated in March 2014. Quantitatively, however, the design criteria are little changed – just expressed differently to reduce ambiguity in certain situations.

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

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

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

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

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

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

Note that the new version of BS8233 more explicitly specifies the assessment periods as 16 hour and 8 hour for daytime and night time respectively.

3.3 Local Authority

As far as we are aware no planning conditions have been proposed.

4.0 SURVEY DETAILS

4.1 Site Times and Personnel

The measurements were carried out by Andrew Raymond of ADC Acoustics.

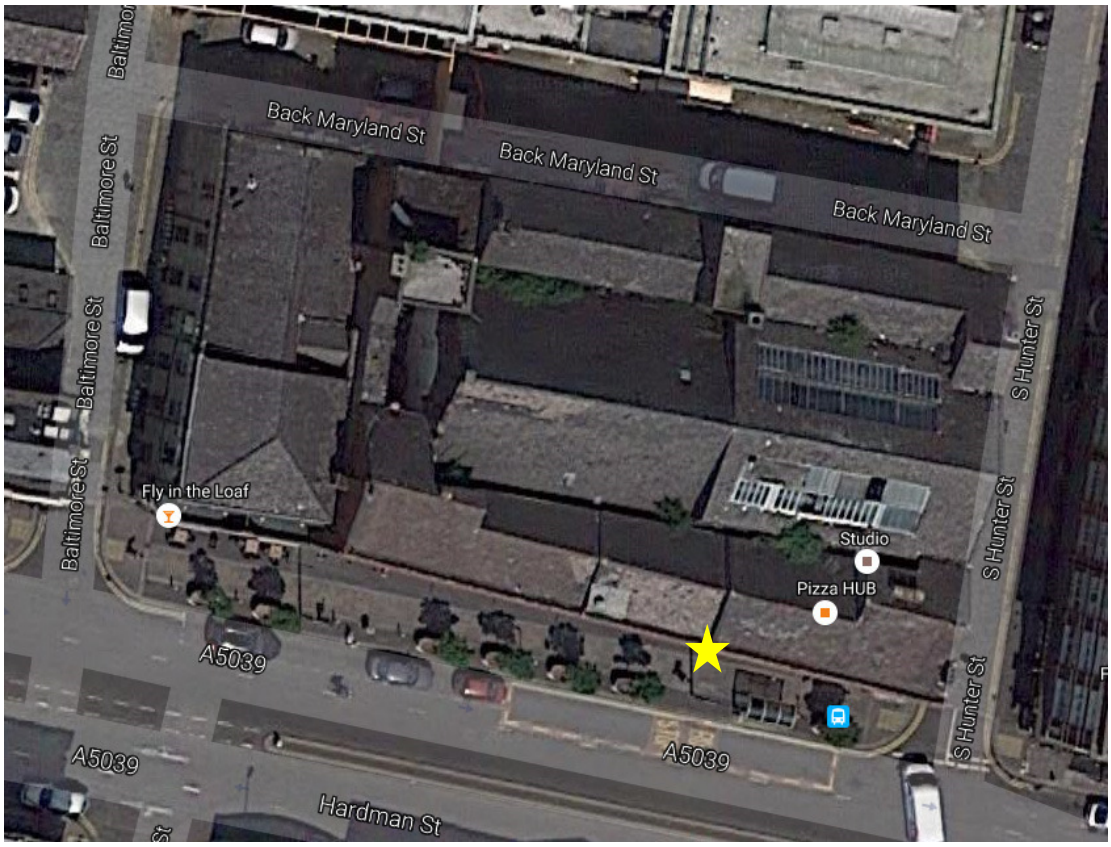
Daytime measurements were carried out from around 16:00 of Friday 11th November through to 09:00 on Saturday 12th February 2016. These times covered a rush hour period and a Friday night which should represent a worst case. Rush hour, early night time, and morning periods were attended, the rest being unattended monitoring.

4.2 Instrumentation

Instrumentation used was a Rion NL52. This is a precision grade sound level meter which holds a current calibration certificate and which was field-calibrated as necessary. The meter was set up to measure continuous 15 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.

4.3 Measurement Positions

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



The microphone was on a boom outside a first floor window and clearly represents the general noise on Hardman Street. Brief measurements were also made on S Hunter St and Baltimore St, simply to verify calculated levels in these side streets.

4.4 Survey Conditions

We have no reason to believe that the conditions we found on the survey were anything other than representative of normal conditions. A Friday night was chosen to represent a probable worst case.

Weather conditions were as follows :-

Rain	:	None, dry roads
Cloud	:	50 to 100%
Temperature	:	2 to 5 Celsius
Wind	:	negligible

5.0 RESULTS AND DISCUSSIONS

Daytime and night time noise was completely dominated by traffic on Hardman Street. Pedestrians' voices are also quite frequent but have far less impact than traffic. Between local sources, the general distant noise of the city was audible as well as very faint mechanical noise which was just audible at times. There was almost no traffic noise from the surrounding side streets.

5.1 Basic Results

Full details are given in Appendix 2. A summary is as follows:-

Summary	Index	**dB(A)**
Friday Rush Hour	Leq	**66**
	Lmax	**77**
	L90	**56**
Friday Evening	Leq	**66**
	Lmax	**82**
	L90	**57**
Friday Night	Leq	**67**
	Lmax	**79**
	L90	**55**

5.2 Assessments

The above results give the following assessments.

In terms of BS8233, we are mainly concerned with the dB(A) L_{eq} values, or the dB L_{Aeq} levels. See definition of Acoustic Terms in Appendix 1. The new 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.

The measured levels appear to suggest that sound insulation will need to be designed to control external noise break-in as follows:

Environment	Position	Required Reductions	
		Desirable	Reasonable
Living Rooms	Main	31 dB	26 dB
Bedrooms	Main	32 dB	27 dB

Note that these required reductions are for floors 1 to 5 of the Hardman St façade only. Calculated levels (verified by brief measurement) in the side streets of S Hunter St and Baltimore St are *at least* 6 dB lower as

would be the proposed 6th and 7th floors of the Hardman St facades which are significantly set back.

They are also based on a Friday afternoon and night so should represent a worst case.

5.3 Mitigation

A partly open window can be expected to provide about 15 dB reduction. This will not be sufficient to achieve BS8233 criteria of "reasonable" conditions for Hardman St or the side streets. However a whole-house-type scheme of ventilation is proposed, making closed windows a reasonable choice for occupants.

So, based on closed windows, a summary of mitigation (or building elements assumed in our calculations) is as follows:-

Façade	Room Type	Make-Up on Which Calculations are Based
Hardman St Levels 1-5	Living Room	Walls: Traditional Masonry Glazing: 35 dB Rw, eg. 10+14+6 Vents: None - Whole House System
	Bedroom	Walls: Traditional Masonry Glazing: 35 dB Rw, eg. 10+14+6 Vents: None - Whole House System
Baltimore/S Hunter St/Hardman St Levels 6-7	Living Room	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: None - Whole House System
	Bedroom	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: None - Whole House System

In summary, all habitable rooms to level 5 of the Hardman St façade will require fairly high spec glazing (35 dB R_w). All other facades, and the set-back Hardman St facades of floors 6 to 7 should be fine with basic thermal double glazing. Ventilation is provided by a whole-house-type mechanical system.

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

Façade	Time	Index	**dB(A)**
Hardman St Levels 1-5	Rush	Leq	**35**
	Night	Leq	**35**
		Lmax	**48**
Baltimore/S Hunter St/Hardman St Levels 6-7	Rush	Leq	**34**
	Night	Leq	**32**
		Lmax	**45**

5.4 Other Issues

Although it is not part of the scope for this assessment, we feel it is important to discuss briefly the commercial units. Clearly it is impossible carry out a detailed assessment as the exact uses are not yet known and may in any case change over time.

You will be obliged to comply with the sound insulation criteria of the Building Regulations Part E, and this will be enforced by Building Control not Planning. We also recommend that you put the onus on future

tenants and occupiers of the commercial units to ensure that their activities do not exceed appropriate criteria, such as BS8233 for general activities, inaudibility for music, etc. Planners may seek to impose a condition requiring you to submit for approval a tenants' requirements document.

The commercial units may well wish to fit mechanical equipment such as external refrigeration equipment. Exact details cannot be known at this stage but a condition requiring proposals to be submitted for approval would be a straight forwards solution.

6.0 CONCLUSIONS/RECOMMENDATIONS

Daytime and night time noise was completely dominated by traffic on Hardman Street. Pedestrians' voices are also quite frequent but have far less impact than traffic. Between local sources, the general distant noise of the city was audible as well as very faint mechanical noise which was just audible at times.

Levels on the proposed Hardman St façade are fairly high and will require mitigation in the form of upgraded glazing to achieve reasonable internal conditions. More basic glazing will be adequate on other facades and on the 6th and 7th floors of the Hardman St façade which is significantly set back.

Inward facing facades should be fine with no particular mitigation measures.

The commercial units are not part of the scope of this report but can easily be controlled by conditions. A short statement should be adequate.

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 is really should be stated. The threshold of human hearing is a sound pressure of 20μPa or a sound power of 1pW.

A sound pressure level or SPL should be expressed in dB(re. 20μPa). 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 given an overall level. An A-Weighted noise level, therefore, reflects the way normal, healthy hearing would perceive the overall level of the noise. The basic unit is dB(A), although other systems of expressing an A-weighted level are discussed below.

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

Equivalent Continuous Sound Level, L_{eq}

This is a kind of mean noise level.

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

Maximum Level, L_{max}

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

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

Statistical (Percentile) Levels, L_n

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

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

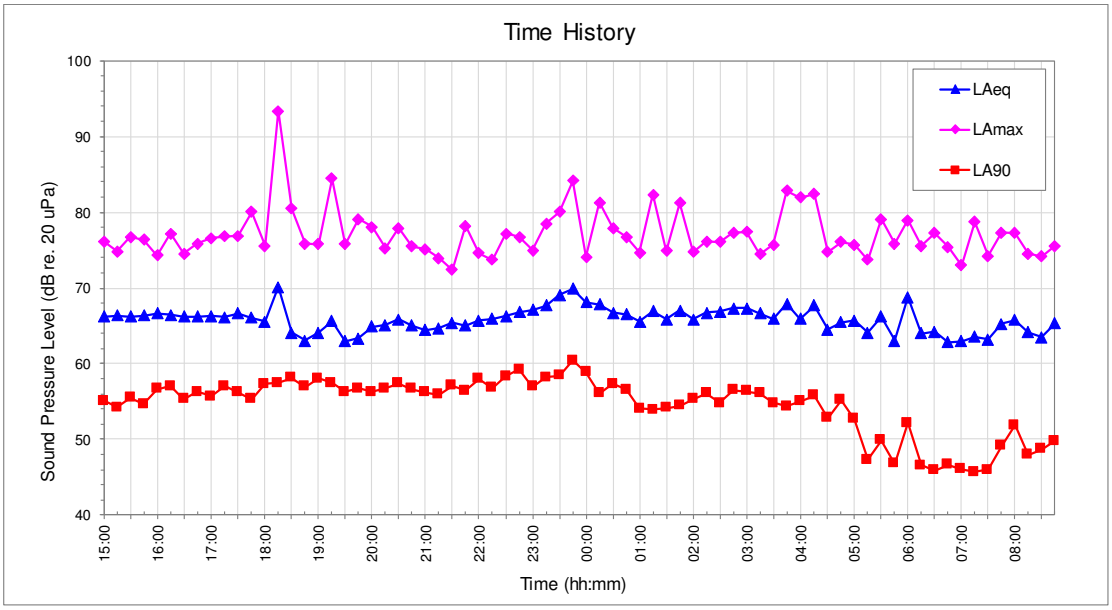
1/3 Octave Band analysis provides more detailed subdivision into 24 bands from 50 Hz to 10kHz, or sometimes into 30 bands from 20Hz to 20kHz.

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



Measurement Summary

Summary	Index	**dB(A)**	63	125	250	500	1k	2k	4k	8k
Friday Rush Hour	Leq	**66**	70	66	62	62	63	58	51	45
	Lmax	**77**	84	81	77	70	72	68	67	62
	L90	**56**	60	56	53	55	51	46	39	31
Friday Evening	Leq	**66**	70	65	61	62	62	57	51	46
	Lmax	**82**	85	80	75	76	80	70	69	67
	L90	**57**	61	57	53	57	52	48	41	33
Friday Night	Leq	**67**	70	64	60	62	63	60	55	50
	Lmax	**79**	82	79	73	74	75	71	66	63
	L90	**55**	63	57	51	52	51	48	42	34

Required Reductions fro BS8233 Guidelines

Environment	Position	Required Reductions	
		Desirable	Reasonable
Living Rooms	Main	31 dB	26 dB
Bedrooms	Main	32 dB	27 dB

Mitigation Summary

Façade	Room Type	Make-Up on Which Calculations are Based
Hardman St Levels 1-5	Living Room	Walls: Traditional Masonry Glazing: 35 dB Rw, eg. 10+14+6 Vents: None - Whole House System
	Bedroom	Walls: Traditional Masonry Glazing: 35 dB Rw, eg. 10+14+6 Vents: None - Whole House System
Baltimore/S Hunter St/Hardman St Levels 6-7	Living Room	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: None - Whole House System
	Bedroom	Walls: Traditional Masonry Glazing: Basic thermal eg. 4+20+4 Vents: None - Whole House System

Predicted Summary

Façade	Time	Index	**dB(A)**	63	125	250	500	1k	2k	4k	8k
Hardman St Levels 1-5	Rush	Leq	**35**	55	44	36	30	27	22	8	2
	Night	Leq	**35**	55	43	35	31	27	24	13	8
		Lmax	**48**	66	58	47	44	40	36	23	21
Baltimore/S Hunter St/Hardman St Levels 6-7	Rush	Leq	**34**	49	39	39	31	22	15	14	8
	Night	Leq	**32**	50	38	36	30	22	17	17	12
		Lmax	**45**	62	53	49	42	34	28	28	25

Break-in

Hardman St Levels 1-5 *Living Room*			***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	4.50 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	5.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		**-**	-	-	-	-	-	-	-	-
Total Exposed Façade Width	9.50 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	5.00 m										
Element Area	23.75 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	23.75 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	56.25 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)			**-**	-13	-13	-13	-13	-13	-13	-13	-13
Walls: Traditional Masonry	20.18 m2		**-**	26	32	41	47	49	53	58	55
Glazing: 35 dB Rw, eg. 10+14+6	3.57 m2		**-**	18	24	27	32	37	37	44	44
Vents: None - Whole House System	0.00 m2		**-**	0	0	0	0	0	0	0	50
Composite SRI	23.75 m2		**-**	23	29	34	40	44	45	51	51
Level Difference (Reverberant only)			**-**	-22	-28	-33	-38	-43	-44	-50	-49
Allowance for flanking/workmanship	7 dB		**-**	7	7	7	7	7	7	7	7
Predicted Internal Levels	Rush	Leq	**35**	55	44	36	30	27	22	8	2
	Evening	Leq	**35**	55	44	35	30	26	21	8	3
	Night	Leq	**35**	55	43	34	30	27	24	12	7
		Lmax	**47**	66	58	46	43	39	35	23	21
				28	28	27	27	27	23	9	1

Baltimore/S Hunter St/Hardman St Levels 6-7 *Living Room*			***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	3.00 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	3.00 m		**-**	-	-	-	-	-	-	-	-
Element Height	3.00 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	5.00 m										
Element Area	9.00 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	9.00 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	45.00 m3		**-**	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		**-**	-	-	-	-	-	-	-	-
Element Area Correction			**-**	10	10	10	10	10	10	10	10
Room Correction 10 x Log (RT/0.163/V)			**-**	-12	-12	-12	-12	-12	-12	-12	-12
Walls: Traditional Masonry	6.24 m2		**-**	26	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	2.76 m2		**-**	15	21	17	25	35	37	31	31
Vents: None - Whole House System	0.00 m2		**-**	0	0	0	0	0	0	0	50
Composite SRI	9.00 m2		**-**	19	25	22	30	40	42	36	36
Level Difference (Reverberant only)			**-**	-22	-28	-24	-32	-42	-44	-38	-38
Allowance for flanking/workmanship	7 dB		**-**	7	7	7	7	7	7	7	7
Predicted Internal Levels	Rush	Leq	**34**	49	39	39	31	22	15	14	8
	Evening	Leq	**33**	50	39	38	30	21	14	14	8
	Night	Leq	**33**	49	38	37	30	22	17	18	13
		Lmax	**45**	61	53	49	43	34	28	29	26

Hardman St Levels 1-5 *Bedroom*			**dB(A)**	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	2.80 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	2.80 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	3.50 m										
Element Area	7.00 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	7.00 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	24.50 m3		**-**	-	-	-	-	-	-	-	-
Assumed RT	0.50 s		**-**	-	-	-	-	-	-	-	-
Element Area Correction			**-**	8	8	8	8	8	8	8	8
Room Correction 10 x Log (RT/0.163/V)			**-**	-9	-9	-9	-9	-9	-9	-9	-9
Walls: Traditional Masonry	4.95 m2		**-**	26	32	41	47	49	53	58	55
Glazing: 35 dB Rw, eg. 10+14+6	2.05 m2		**-**	18	24	27	32	37	37	44	44
Vents: None - Whole House System	0.00 m2		**-**	0	0	0	0	0	0	0	50
Composite SRI	7.00 m2		**-**	22	28	32	37	42	42	49	49
Level Difference (Reverberant only)			**-**	-23	-29	-33	-38	-42	-43	-50	-49
Allowance for flanking/workmanship	7 dB		**-**	7	7	7	7	7	7	7	7
Predicted Internal Levels	Rush	Leq	**35**	54	44	37	31	28	23	9	3
	Evening	Leq	**35**	55	44	36	31	27	22	9	3
	Night	Leq	**35**	55	43	35	31	27	24	13	8
		Lmax	**48**	66	58	47	44	40	36	23	21
				40	42	39	40	40	37	24	20

Baltimore/S Hunter St/Hardman St Levels 6-7 *Bedroom*			**dB(A)**	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Width of Exposed Façade 1	4.50 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 2	5.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 3	0.00 m		**-**	-	-	-	-	-	-	-	-
Width of Exposed Façade 4	0.00 m		**-**	-	-	-	-	-	-	-	-
Total Exposed Façade Width	9.50 m		**-**	-	-	-	-	-	-	-	-
Element Height	2.50 m		**-**	-	-	-	-	-	-	-	-
Room Depth (re. Exposed façade 1)	5.00 m										
Element Area	23.75 m2		**-**	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	23.75 m2		**-**	-	-	-	-	-	-	-	-
Room Volume	56.25 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)			**-**	-13	-13	-13	-13	-13	-13	-13	-13
Walls: Traditional Masonry	20.99 m2		**-**	26	32	41	47	49	53	58	55
Glazing: Basic thermal eg. 4+20+4	2.76 m2		**-**	15	21	17	25	35	37	31	31
Vents: None - Whole House System	0.00 m2		**-**	0	0	0	0	0	0	0	50
Composite SRI	23.75 m2		**-**	22	28	26	34	43	46	40	40
Level Difference (Reverberant only)			**-**	-21	-27	-25	-33	-42	-44	-39	-39
Allowance for flanking/workmanship	7 dB		**-**	7	7	7	7	7	7	7	7
Predicted Internal Levels	Rush	Leq	**33**	50	39	38	30	22	15	13	7
	Evening	Leq	**32**	50	39	37	30	21	14	13	7
	Night	Leq	**32**	50	38	36	30	22	17	17	12
		Lmax	**45**	62	53	49	42	34	28	28	25