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2nd May 2012

Carpenter Projects

Assessment of noise issues associated with the outline planning application for a mixed use refurbishment of the Trade Union Building, Hardman Street, Liverpool.

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1.0 SUMMARY

In terms of the impact of the existing noise on the future occupants of the proposed serviced apartments, most facades will have adequate sound insulation if they are naturally ventilated with opening windows. One exception is the facade closest to and facing towards Hardman St of the serviced apartments' western arm. This will need windows to remain shut in order to meet appropriate criteria.

However, depending on where deliveries, congregation and smoking areas are to be located, the existing noise climates may be added to, such that greater sound insulation will be required.

Noise from Bars and Restaurants can easily be conditioned regarding their internal noise generation affecting existing and proposed residential accommodation, with a combination of internal noise limits and/or sound insulation. Noise from external congregation of customers (such as smokers) is unlikely to have any impact on existing residential on surrounding streets. If necessary, the impact of such sources on inward facing serviced apartment facades can be controlled by conditions relating to the sound insulation of the rooms.

Deliveries would have to be at an unrealistically high level to cause any problems on Hardman and Hope Streets. Deliveries will not use Back Hope Place. Noise from Deliveries using the inner courtyards can be controlled by way of sound insulation conditions to the serviced apartment facades.

Mechanical Services will need controls but details are not available at this outline planning stage. It should be perfectly feasible to operate under the local authority's standard requirements, controlled by conditions.

-------------------------------------- A R Raymond

-------------------------------------- P J Durell

2.0 INTRODUCTION

ADC was asked to carry out an independent assessment of site referred to as The Trade Union Building, Hardman Street, Liverpool, with regards to its suitability from a noise perspective for development into mixed use, including serviced apartments, offices, bars and restaurants.

3.0 ASSESSMENT STANDARDS

All standards come with their own jargon. Please refer to Appendix 1 for definitions of Acoustic Terms

3.1 NPPF

The National Planning Policy Framework is of almost no value here. We will proceed with a discussion of standards previously used in planning applications for similar projects in the same area.

3.2 BS8233

BS8233 is a wide-ranging document which covers many aspects of noise in buildings but includes recommended “Reasonable” and “Good” noise climates in its Table 5. Of most significance to this project are the levels given for living rooms and bedrooms.

The significant aspects are summarised below:

Environment Experiencing the Noise	Criterion	Implied Limits		
		L_{Aeq} (0700-2300)	L_{Aeq} (2300-0700)	L_{Amax} (2300-0700)
Living Rooms	Good Conditions	30dB	n/a	n/a
	Reasonable Conditions	40dB	n/a	n/a
Bedrooms	Good Conditions	n/a	30dB	45dB
	Reasonable Conditions	n/a	35dB	45dB

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:-

Environment Experiencing the Noise	Criterion	Implied Limits		
		L_{Aeq} (0700-2300)	L_{Aeq} (2300-0700)	L_{Amax} (2300-0700)
Living Rooms	Good Conditions	45dB	n/a	n/a
	Reasonable Conditions	55dB	n/a	n/a
Bedrooms	Good Conditions	n/a	45dB	60dB
	Reasonable Conditions	n/a	50dB	60dB

Note also that the standard is aimed at general anonymous noise and not necessarily specific and identifiable sources. In a rural situation this might be distant traffic interspersed with infrequent local traffic. In a suburban situation this might be local and middle distance traffic. In a city centre, this might be crowds of people and busy traffic, and perhaps some faint music.

These criteria are used to assess the impact of the existing noise on the future occupants of the serviced apartments.

3.3 Perceived Change

Quoting from the Guidelines for Noise Impact Assessment (draft 10/04/02) by the Institute of Environmental Management and Assessment and the Institute of Acoustics, the following table shows the effects of changes in noise:-

Change in Level (no other changes of character)	Subjective Effect	Likely Impact
0 dB	No change	None
Up to 3 dB	Imperceptible	Slight
3 to 5 dB	Perceptible	Moderate
5 to 10 dB	Up to a doubling	Substantial
10dB or more	At least doubling	Severe

Note, however, that such subjective effects and impact assume that the nature of the noise is unchanged. So, for instance, increases in the noise from people and traffic will often be of a similar character, whereas the introduction of a new source such a such as amplified music will be different and may need a for sensitive assessment.

We have used these criteria to assess the impact of deliveries.

3.4 Music Noise

There are no adopted standards for assessing music noise. In a quiet suburb, one might go for an inaudibility (or barely audible) standard. In a town centre, however, a more relaxed approach is typical, such as audible but not intrusive.

Music noise would usually be more or less inaudible if its L_{eq} values were below the background L_{90} values in octave bands across the frequency range (See Definition of Acoustic Terms below). Alternatively, the music noise L_{max} value up to 5 dB above background L_{90} level, again in octave bands across the frequency range, would also give more or less inaudible music. See Appendix 1 for definitions of Acoustic Terms.

In an environment where higher noise levels of this nature can reasonably be expected, such as in a vibrant town centre area, these standards are often relaxed by up to 5 dB in each octave band. The existing houses backing on Back Hope Place are not currently exposed to music noise, so the criteria of the previous paragraph should apply.

3.5 Mechanical Services

The local authority's preferred criterion for new mechanical plant rear residential property is based upon BS4142. Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.

The noise from mechanical plant, assessed at the nearest residential property in terms of dB L_{Aeq}, and suitably adjusted for its feature as per BS4142 (+5 dB for a tonal, impulsive or intermittent character), shall not exceed the pre-existing background noise measured in terms of dB L_{A90}. See Definitions of Acoustic Terms in Appendix 1.

4.0 SURVEY DETAILS

4.1 Site Times and Personnel

Rush hour measurements were carried out between 17:30 hours and 18:30 hours and late evening/night measurements between 22:30 hours and 00:00 hours. These represent what are likely to be the noisier times of day and night. Measurements in Back Hope Place at around midnight were dominated by faint mechanical noise and so would not be expected to drop after this time, so there was no need to continue measurements at this location into the small hours.

4.2 Instrumentation

In all cases, instrumentation used was a Larson Davis 824. This is a precision grade sound level meter which holds a current calibration certificates and which were field-calibrated as necessary. It was set up to measure 5 to 15 minute samples in terms of dB L_{eq}, L_{max} and L_{90} in overall A-weighted terms, and in octave bands across the frequency range. See Definition of Acoustic Terms in the attached Appendix 1.

4.3 Survey Conditions

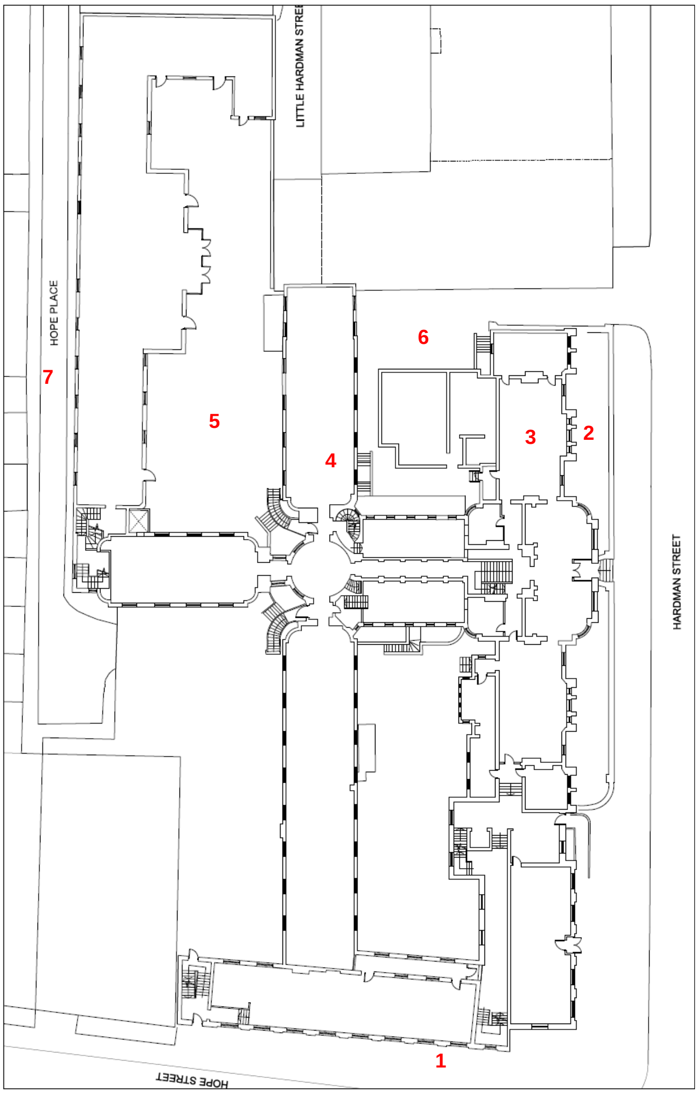
We have no reason to believe that conditions were other than normal and representative. Some criteria and recommendations depend on the pre existing noise and we have assumed that the noise climate we have measured is representative.

Weather conditions were as follows :-

Rain	:	none, dry roads
Cloud	:	0 to 20%
Temperature	:	16 to 20 Celsius
Wind	:	negligible

4.4 Measurements Positions

The measurement positions are shown in the following plan.



The microphone was 1.5 m above ground and, where possible, well away from other reflecting surfaces.

Note that internal positions 3 and 4 turned out to be of limited value as the rooms were generally so large and stripped bare, and because windows were in relatively poor condition.

5.0 IMPACT OF THE SURROUNDING AREA ON THE DEVELOPMENT

5.1 Assessment

Over the general background noise of the Liverpool city centre, most noise came from pedestrians and vehicles along Hardman Street and Hope Street. At all measurement positions the noise was only slightly quieter at night. In Back Hope Place, nearby mechanical noise dominated the steady noise.

Full results are given in Appendix 2 but a summary is as follows:-

Position	Time	Index	Meas't
1 Hope St	Rush	L_{Aeq}	67
		L_{Amax}	73
	Night	L_{Aeq}	63
		L_{Amax}	73
2 Ouside Main Entrance on Hardman St	Rush	L_{Aeq}	66
		L_{Amax}	74
	Night	L_{Aeq}	64
		L_{Amax}	76
5 Outside The Flying Picket	Rush	L_{Aeq}	49
		L_{Amax}	70
	Night	L_{Aeq}	44
		L_{Amax}	60
6 Rear of Harman St Arm	Rush	L_{Aeq}	55
		L_{Amax}	70
	Night	L_{Aeq}	53
		L_{Amax}	62
7 Back Hope Place	Rush	L_{Aeq}	47
		L_{Amax}	64
	Night	L_{Aeq}	46
		L_{Amax}	68

In terms of planning, we would suggest that criteria for reasonable conditions would be adequate for apartments in a location such as this. Individual operators of course may have their own more stringent criteria. Measured levels at positions 5 and 6 best represent the noise climates at proposed serviced apartment facades. Essentially facades facing away from Hardman Street or overlooking enclosed courtyards can have naturally ventilated rooms and still meet criteria. The facade represented by position 6 will need to have closed windows. With non-acoustic trickle vents and basic thermal double glazing, the noise within the rooms on this facade will be adequately controlled, but the most likely upgrade to the existing single glazing will be a secondary pane. With a 4 or 6mm secondary pane and 50mm cavity, as well as non-acoustic trickle vents, the following internal levels are predicted. Full details are given in Appendix 2.

Predicted Levels Summary at Position 6	*Meas't*	*Index*	***dB(A)***
Predicted Internal Levels	Rush	Leq	**36**
	Mid-night	Leq	**33**
		Lmax	**42**

Levels are within BS8233 Reasonable criteria. With acoustic vents, the levels will be within BS8233 Good criteria.

5.2 <u>Noise Generated by the Development</u>

The above calculations and assessments assume that the existing noise climate will be present when the serviced apartments are in use. The likelihood is, however, that the development will itself create some noise that could affect them.

When we consider later the noise from deliveries and patrons of the bars and restaurants, we will refer back to this section. In essence we have applied the noise levels at positions 1 and 2 to the apartment facades. This will allow for somewhat extreme cases of delivery noise and noise from patrons. In such circumstances, windows are assumed shut, glazing will be a secondary upgrade as described above, and vents will be acoustic type (Passivent TVAL dB 800 used in our calculations). The predicted internal levels are as follows, with full details given in Appendix 2:-

Predicted Levels Summary at Position 1	*Meas't*	*Index*	***dB(A)***
Predicted Internal Levels	Rush	Leq	**37**
	Mid-night	Leq	**32**
		Lmax	**43**

This is well within BS8233 Reasonable criteria. Remember that this is based on a somewhat extreme assumption of late evening deliveries and/or noise from patrons giving levels similar to those on Hardman and Hope streets.

6.0 IMPACT OF THE DEVELOPMENT ON RESIDENTIAL

6.1 Existing Noise Climate

In Section 5.0 we presented a summary of noise measurements at the various positions. The serviced apartments are represented by positions 5 and 6 and the houses backing onto Back Hope Place are represented by Position 7. Note that the background noise was dominated at night by mechanical noise which therefore represents the lowest levels likely to be reached.

The serviced apartments are dealt with in the following subsections by considering worst case scenarios which can all be controlled by sound insulation, ie. by conditions. The houses backing onto Back Hope Place cannot be protected that way.

6.2 Deliveries

It clearly cannot be defined exactly what vehicles will serve what areas at what times. We are advised, however, that deliveries are unlikely to be required outside of 0700 to 2300 and that conditions imposing such restrictions can be considered. So let us assume the worst case of deliveries around 23:00 on a weeknight. Our approach here is to identify how many deliveries can take place before suitable criteria are breached.

In the case of the serviced apartments we have modelled deliveries of a frequency that brings the noise levels in the inner courtyards up to the levels of Hardman and Hope Street – clearly a somewhat extreme worst case.

We have therefore carried out what is effectively a feasibility study, based on 7m to 9m rigid delivery trucks (the largest size one can drive on a normal driving license) and smaller delivery vans with refrigeration units (these routinely deliver to quiet residential areas and are themselves very quiet). To assist in visualising the types of vehicle being referred to, examples of similar vehicles are illustrated below.

We have not modelled large articulated vehicles as they are unlikely to be acceptable.

From our data base of vehicle movements (reversing, unloading, pulling away) we have modelled four basic scenarios for a 1 hour period. These are any one of the following:-

a) 45 x delivery vans per hour
   0 x larger rigids per hour

b) 31 x delivery vans per hour
   1 x larger rigids per hour

c) 18 x delivery vans per hour
   2 x larger rigids per hour

d) 4 x delivery vans per hour
   3 x larger rigids per hour

Each of these scenarios give noise levels the same as those measured at Positions 1 and 2 at night. The above section shows how noise breaking into the apartments can be at least adequately controlled at these positions so, by applying the same controls to the apartment facades then even these extreme scenarios can be acceptable.

Deliveries will not use Back Hope Place.

6.3 <u>Bars and Restaurants</u>

There are no plans to have noisy bars but some music noise is likely to be desired. The Back Hope Place houses are realistically only going to be affected by what is currently the Flying Picket. However, only a series of small windows in the Flying Picket back wall overlook Back Hope Place and these can easily be specified to contain music noise as necessary. There are no entrance doors or fire doors. Control by conditions would be easy enough.

There is little evidence of residential accommodation nearby on Hardman Street or Hope Street but some may be possible. Even though there was some feint music beat audible on Hardman Street, music noise can easily be controlled by conditions on the internal music levels and/or the sound insulation properties.

Music noise potentially affecting the can be controlled the same way, but with the added control possible of sound insulation to the bedrooms.

6.4 Mechanical Plant

No details are available for mechanical plant noise but it is clear enough that the noise can be controlled by suitable conditions.

6.5 Smoking Areas

We have modelled the noise likely to be produced for two types of conditions – conversational speech and significantly raised (drunken) speech.

We have started with basic noise data for speech for one person at 1m. We have then assumed the rule of thumb that doubling the number of people increases the speech by 5 dB L_{Aeq} and 2 dB L_{Amax}.[1]

Then we correct for distance to the nearest bedroom windows.

In order to no more than equal existing noise levels at positions 1 and 2 (for which we have already established suitable sound insulation to bedrooms in the above sections) we have found that 91 people involved in conversational speech or 24 people involved in significantly raised speech can use outdoor smoking areas. Such levels of usage are likely to be a somewhat extreme worst case.

These calculations show the feasibility of allowing smoking areas outside of and within the development.

7.0 CONCLUSIONS/RECOMMENDATIONS

In terms of the impact of the existing noise on the future occupants of the proposed , most facades will have adequate sound insulation if they are naturally ventilated with opening windows. One exception is the facade closest to and facing towards Hardman St of the ’s western arm. This will need windows to remain shut in order to meet appropriate criteria.

However, depending on where deliveries, congregation and smoking areas are to be located, the existing noise climates may be added to, such that greater sound insulation will be required.

[1] The reason for these increases is due to the fact that a doubling of energy gives a 3 dB increase so double the number of people will create 3 dB more “average” noise, assuming each person makes the same amount of noise. For this reason the peaks would be more or less unchanged. However, people tend to speak louder when they are in noisier environments, by about 2dB per doubling in numbers. So this gives us a 5 dB increase in dB L_{Aeq} levels and a 2 dB increase in db L_{Amax} levels as a reasonably reliable rule of thumb. One problem with this rule of thumb is that, as number increase the L_{eq} (“average”) levels begin to rise above the L_{max}(peak) levels which clearly does not make sense. So, we have set the L_{max} levels to be at least 5 dB above the L_{max} levels in each frequency band for conversational speech and at least 8 dB above for raised speech.

The sound insulation of the rooms can easily be controlled by a condition requiring the submission of a scheme of sound insulation and ventilation.

Noise from Bars and Restaurants can easily be conditioned regarding their internal noise generation affecting existing and proposed residential accommodation, with a combination of internal noise limits and/or sound insulation. A conditions requiring the submission of a scheme would be perfectly appropriate.

Noise from external congregation of customers (such as smokers) is unlikely to have any impact on existing residential on surrounding streets. If necessary, the impact of such sources on inward facing facades can be controlled by conditions relating to the sound insulation of the rooms as stated above, which would allow relatively high numbers of people to congregate.

Deliveries would have to be at an unrealistically high level to cause any problems on Hardman and Hope Streets. Deliveries using Back Hope Place may need to be restricted to certain times. Noise from Deliveries using the inner courtyards can be controlled by way of sound insulation conditions to the facades as stated above, which would allow the same very high levels of deliveries as would be acceptable on the main streets.

Mechanical Services will need controls but details are not available at this outline planning stage. It should be perfectly feasible to operate under the local authority's standard requirements, controlled by conditions as necessary.

As this is an outline planning application, conditions should be as broad as possible along the lines of *...a scheme to be submitted and approved...*

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.

Exposure Level and $L_{EP,d}$

This is a development of L_{eq} and is called the Daily Personal Exposure Level. It refers to an average noise levels to which an operator is exposed in his or her working day. It is vital to note that, while L_{eq}, is associated with a machine, process, position, etc, $L_{EP,d}$ is associated with a person. So, if a person moves around, or does a variety of jobs in a working day, their overall exposure level will be based upon exposures from a number of machines, processes, positions, etc, all with different noise levels and durations.

The unit is dB(A) $L_{EP,d}$ or sometimes dB $L_{AEP,d}$.

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

Measured Levels

Rush Hour

Position	*Measurement*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1 Hope St	1	Leq	**66**	75	69	64	61	63	59	51	42
		Lmax	**73**	80	65	68	72	69	64	55	42
		L90	**55**	61	59	56	52	50	47	39	30
	2	Leq	**68**	74	69	66	63	65	61	53	48
		Lmax	**73**	74	70	69	67	72	63	54	45
		L90	**55**	60	57	55	51	51	48	39	29
	Overall	Leq	**67**	75	69	65	62	64	60	52	46
		Lmax	**73**	78	68	69	70	71	63	55	44
		L90	**55**	61	58	55	52	51	47	39	29
2 Ouside Main Entrance on Hardman St	1	Leq	**65**	72	68	63	60	62	58	49	42
		Lmax	**75**	78	68	70	67	74	65	52	42
		L90	**52**	58	58	53	48	47	43	36	27
	2	Leq	**66**	73	66	62	61	63	59	51	40
		Lmax	**72**	77	74	67	68	69	63	54	43
		L90	**57**	62	59	55	53	54	50	41	29
	Overall	Leq	**66**	72	67	62	60	63	58	50	41
		Lmax	**74**	78	72	69	67	72	64	53	43
		L90	**55**	60	58	54	51	52	48	39	28
3 Inside Hardman St Facade	Overall	Leq	**45**	62	58	43	38	36	32	27	24
		Lmax	**57**	80	68	49	43	51	40	33	25
		L90	**34**	45	45	32	28	26	23	23	23
4 Inside overlooking inner courtyard	Overall	Leq	**33**	38	41	33	28	26	23	24	24
		Lmax	**39**	45	48	42	38	30	26	25	24
		L90	**30**	29	31	29	23	22	20	23	23
5 Outside The Flying Picket	1	Leq	**44**	59	49	45	41	39	33	27	26
		Lmax	**53**	66	52	48	42	49	46	44	43
		L90	**40**	49	45	41	37	34	28	24	23
	2	Leq	**51**	62	52	48	47	48	43	38	32
		Lmax	**73**	69	58	56	56	71	65	60	51
		L90	**40**	50	46	42	38	35	29	24	23
	Overall	Leq	**49**	61	50	46	45	45	40	35	30
		Lmax	**70**	68	56	54	53	68	62	57	49
		L90	**40**	50	45	41	38	34	29	24	23
6 Rear of Harman St Arm	1	Leq	**55**	65	60	53	51	51	46	41	34
		Lmax	**65**	68	61	52	51	56	60	60	56
		L90	**46**	53	49	45	43	41	37	29	24
	2	Leq	**55**	66	59	53	52	51	47	41	35
		Lmax	**72**	71	61	57	56	70	65	62	57
		L90	**46**	54	50	46	43	41	36	29	26
	Overall	Leq	**55**	66	59	53	51	51	47	41	34
		Lmax	**70**	69	61	55	54	67	63	61	56
		L90	**46**	53	50	46	43	41	36	29	25
7 Back Hope Place	1	Leq	**48**	63	54	52	44	41	37	32	30
		Lmax	**66**	69	71	65	65	62	55	44	40
		L90	**44**	53	49	48	40	37	32	25	23
	2	Leq	**46**	57	53	51	42	38	33	28	24
		Lmax	**54**	61	63	60	49	41	35	32	25
		L90	**44**	53	50	49	39	37	32	25	23
	Overall	Leq	**47**	61	54	51	43	40	36	31	28
		Lmax	**64**	66	69	63	62	59	52	41	37
		L90	**44**	53	50	48	40	37	32	25	23

Night Time

Position	*Measurement*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
1 Hope St	1	Leq	**61**	71	62	60	56	56	54	47	37
		Lmax	**70**	85	66	70	66	66	63	56	42
		L90	**54**	59	54	53	50	49	46	38	28
	2	Leq	**65**	68	60	63	60	62	57	49	37
		Lmax	**74**	75	66	73	68	72	63	57	46
		L90	**52**	57	53	52	49	46	45	38	28
	Overall	Leq	**63**	70	61	61	59	60	55	48	37
		Lmax	**73**	82	66	71	67	70	63	56	45
		L90	**53**	58	53	53	49	48	46	38	28
2 Ouside Main Entrance on Hardman St	1	Leq	**64**	74	65	62	59	60	56	48	37
		Lmax	**76**	69	63	68	77	69	66	59	44
		L90	**52**	58	56	53	49	47	43	35	25
	2	Leq	**65**	72	69	64	60	61	59	51	49
		Lmax	**76**	75	71	70	69	75	66	56	48
		L90	**52**	59	56	53	49	47	43	35	26
	Overall	Leq	**64**	73	68	63	59	60	58	50	47
		Lmax	**76**	73	68	69	75	73	66	57	47
		L90	**52**	59	56	53	49	47	43	35	26
4 Inside overlooking inner courtyard	Overall	Leq	**30**	44	40	29	24	23	20	21	21
		Lmax	**41**	62	50	39	35	33	23	22	21
		L90	**27**	27	28	26	20	19	17	20	20
5 Outside The Flying Picket	1	Leq	**45**	61	51	43	39	38	38	33	31
		Lmax	**62**	69	54	44	48	51	60	49	27
		L90	**38**	50	47	40	34	33	27	23	23
	2	Leq	**42**	57	50	42	37	36	31	33	28
		Lmax	**55**	59	51	44	40	39	35	53	40
		L90	**38**	48	47	40	34	32	27	23	23
	Overall	Leq	**44**	59	51	43	38	37	35	33	30
		Lmax	**60**	66	53	44	46	49	57	52	37
		L90	**38**	49	47	40	34	32	27	23	23
6 Rear of Harman St Arm	1	Leq	**53**	67	60	55	47	47	44	40	35
		Lmax	**65**	68	60	56	55	56	57	61	53
		L90	**42**	53	51	43	38	36	32	26	23
	2	Leq	**53**	61	61	50	50	47	43	35	30
		Lmax	**58**	67	67	53	55	52	49	37	32
		L90	**42**	49	49	42	40	36	31	26	23
	Overall	Leq	**53**	65	61	53	49	47	43	38	33
		Lmax	**62**	68	65	55	55	55	54	58	50
		L90	**42**	52	50	42	40	36	32	26	23
7 Back Hope Place	1	Leq	**48**	63	54	50	44	43	36	31	26
		Lmax	**71**	84	75	68	66	68	60	50	33
		L90	**42**	53	51	43	38	36	32	26	23
	2	Leq	**43**	63	50	47	38	35	30	27	25
		Lmax	**51**	62	52	49	40	36	43	48	41
		L90	**42**	49	49	42	40	36	31	26	23
	Overall	Leq	**46**	63	52	49	42	40	34	30	25
		Lmax	**68**	81	72	65	63	65	57	49	38
		L90	**42**	52	50	42	40	36	32	26	23

Break In to Rooms

Position 1

Measured Levels Summary at Position 1	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Daytime		Leq	**67**	75	69	65	62	64	60	52	46
	Overall	Lmax	**73**	78	68	69	70	71	63	55	44
		L90	**55**	61	58	55	52	51	47	39	29
Night Time		Leq	**63**	70	61	61	59	60	55	48	37
	Overall	Lmax	**73**	82	66	71	67	70	63	56	45
		L90	**53**	58	53	53	49	48	46	38	28

Break-in Calculation		dB(A)	63	125	250	500	1k	2k	4k	8k
Element Width	3.00 m	-	-	-	-	-	-	-	-	-
Element Height (or Length if roof)	2.50 m	-	-	-	-	-	-	-	-	-
Room Depth	4.00 m	-	-	-	-	-	-	-	-	-
Element Area	7.50 m2	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	17.50 m2	-	-	-	-	-	-	-	-	-
Room Volume	30.00 m3	-	-	-	-	-	-	-	-	-
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)		-	-10	-10	-10	-10	-10	-10	-10	-10
Main Walls	4.89 m2	-	23	32	41	47	49	53	58	55
6+50+6 Secondary Glazing	2.61 m2	-	16	25	29	34	41	45	53	50
Passivent TVALdB 800 Window frame vent	10.00 m2	-	34	46	44	38	43	43	50	50
Composite SRI	17.50 m2	-	23	32	36	38	44	45	51	51
Level Differnece (Reverberant only)		-	-20	-29	-34	-36	-41	-42	-49	-48
Allowance for flanking/workmanship	5 dB	-	5	5	5	5	5	5	5	5

Predicted Levels Summary at Position 1	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Predicted Internal Levels	Rush	Leq	**37**	60	45	36	32	28	23	8	3
	Mid-	Leq	**32**	54	37	33	28	24	18	4	-6
	night	Lmax	**43**	67	42	43	36	34	25	12	2

Position 2

Measured Levels Summary at Position 2	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Daytime		Leq	**66**	72	67	62	60	63	58	50	41
	Overall	Lmax	**74**	78	72	69	67	72	64	53	43
		L90	**55**	60	58	54	51	52	48	39	28
Night Time		Leq	**64**	73	68	63	59	60	58	50	47
	Overall	Lmax	**76**	73	68	69	75	73	66	57	47
		L90	**52**	59	56	53	49	47	43	35	26

Break-in Calculation		dB(A)	63	125	250	500	1k	2k	4k	8k
Element Width	3.00 m	-	-	-	-	-	-	-	-	-
Element Height (or Length if roof)	2.50 m	-	-	-	-	-	-	-	-	-
Room Depth	4.00 m	-	-	-	-	-	-	-	-	-
Element Area	7.50 m2	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	17.50 m2	-	-	-	-	-	-	-	-	-
Room Volume	30.00 m3	-	-	-	-	-	-	-	-	-
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)		-	-10	-10	-10	-10	-10	-10	-10	-10
Main Walls	4.89 m2	-	23	32	41	47	49	53	58	55
6+50+6 Secondary Glazing	2.61 m2	-	16	25	29	34	41	45	53	50
Passivent TVALdB 800 Window frame vent	10.00 m2	-	34	46	44	38	43	43	50	50
Composite SRI	17.50 m2	-	23	32	36	38	44	45	51	51
Level Differnece (Reverberant only)		-	-20	-29	-34	-36	-41	-42	-49	-48
Allowance for flanking/workmanship	5 dB	-	5	5	5	5	5	5	5	5

Predicted Levels Summary at Position 2	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Predicted Internal Levels	Rush	Leq	**35**	57	43	34	30	26	21	6	-2
	Mid-	Leq	**35**	58	43	34	29	24	20	6	4
	night	Lmax	**43**	58	44	40	44	37	29	14	3

Position 6

Measured Levels Summary at Position 6	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Daytime		Leq	**55**	66	59	53	51	51	47	41	34
	Overall	Lmax	**70**	69	61	55	54	67	63	61	56
		L90	**46**	53	50	46	43	41	36	29	25
Night Time		Leq	**53**	65	61	53	49	47	43	38	33
	Overall	Lmax	**62**	68	65	55	55	55	54	58	50
		L90	**42**	52	50	42	40	36	32	26	23

Break-in Calculation (non-acoustic vents)		dB(A)	63	125	250	500	1k	2k	4k	8k
Element Width	3.00 m	-	-	-	-	-	-	-	-	-
Element Height (or Length if roof)	2.50 m	-	-	-	-	-	-	-	-	-
Room Depth	4.00 m	-	-	-	-	-	-	-	-	-
Element Area	7.50 m2	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	17.50 m2	-	-	-	-	-	-	-	-	-
Room Volume	30.00 m3	-	-	-	-	-	-	-	-	-
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)		-	-10	-10	-10	-10	-10	-10	-10	-10
Main Walls	4.89 m2	-	23	32	41	47	49	53	58	55
6+50+6 Secondary Glazing	2.61 m2	-	16	25	29	34	41	45	53	50
Simon Airsrip 200 (Non Acoustic)	10.00 m2	-	23	28	25	25	25	24	28	34
Composite SRI	17.50 m2	-	21	28	27	27	27	26	30	36
Level Differnece (Reverberant only)		-	-18	-26	-24	-25	-25	-24	-28	-34
Allowance for flanking/workmanship	5 dB	-	5	5	5	5	5	5	5	5

Predicted Levels Summary at Position 6	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Predicted Internal Levels	Rush	Leq	**36**	52	39	34	32	31	28	18	5
	Mid-	Leq	**33**	52	40	33	29	27	24	15	4
	night	Lmax	**42**	54	44	35	35	35	36	35	21

Break-in Calculation (acoustic vents)		dB(A)	63	125	250	500	1k	2k	4k	8k
Element Width	3.00 m	-	-	-	-	-	-	-	-	-
Element Height (or Length if roof)	2.50 m	-	-	-	-	-	-	-	-	-
Room Depth	4.00 m	-	-	-	-	-	-	-	-	-
Element Area	7.50 m2	-	-	-	-	-	-	-	-	-
Effective Area (ie. with vents)	17.50 m2	-	-	-	-	-	-	-	-	-
Room Volume	30.00 m3	-	-	-	-	-	-	-	-	-
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)		-	-10	-10	-10	-10	-10	-10	-10	-10
Main Walls	4.89 m2	-	23	32	41	47	49	53	58	55
6+50+6 Secondary Glazing	2.61 m2	-	16	25	29	34	41	45	53	50
Simon Airsrip 200 (Non Acoustic)	10.00 m2	-	23	28	25	25	25	24	28	34
Composite SRI	17.50 m2	-	21	28	27	27	27	26	30	36
Level Differnece (Reverberant only)		-	-18	-26	-24	-25	-25	-24	-28	-34
Allowance for flanking/workmanship	5 dB	-	5	5	5	5	5	5	5	5

Predicted Levels Summary at Position 6	Meas't	Index	dB(A)	63	125	250	500	1k	2k	4k	8k
Predicted Internal Levels	Rush	Leq	**36**	52	39	34	32	31	28	18	5
	Mid-	Leq	**33**	52	40	33	29	27	24	15	4
	night	Lmax	**42**	54	44	35	35	35	36	35	21

Deliveries

Basic Data

Small Dilivery Van with Chiller, eg Asda Home Delivery	*Duration (s)*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Unloading @ 10m from centre of vehicle	300	Leq	**55**	56	62	57	55	43	39	32	25
		SEL	**79**	81	86	82	80	67	64	57	50
		Lmax	**68**	63	68	67	70	55	51	41	28
Reverse @ 10m from centre of vehicle	12	Leq	**59**	70	61	57	53	56	51	47	41
		SEL	**70**	81	72	68	63	66	62	57	51
		Lmax	**62**	73	64	60	55	59	53	49	42
Start up and Pull-away @ 10m from centre of vehicle	12	Leq	**62**	69	60	58	54	58	55	49	45
		SEL	**72**	80	71	69	65	69	66	60	56
		Lmax	**65**	70	62	60	57	61	58	55	48
All Activities	1	SEL	**81**	85	87	82	80	72	69	63	58
		Lmax	**66**	70	65	63	66	59	55	51	44

Large Rigid with Chiller	*Duration (s)*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Unloading @ 10m from centre of vehicle	600	Leq	**64**	70	69	65	63	56	53	47	39
		SEL	**91**	97	97	93	91	84	81	74	67
		Lmax	**75**	78	77	75	76	67	64	56	46
Reverse @ 10m from centre of vehicle	12	Leq	**67**	76	69	65	62	62	59	54	47
		SEL	**77**	87	80	76	73	73	70	65	57
		Lmax	**73**	83	75	72	68	69	65	60	53
Start up and Pull-away @ 10m from centre of vehicle	12	Leq	**68**	76	69	65	63	64	61	55	49
		SEL	**79**	87	79	76	73	74	72	66	60
		Lmax	**74**	82	74	72	69	70	67	63	56
All Activities	1	SEL	**92**	98	97	93	91	84	82	75	68
		Lmax	**74**	82	76	73	72	69	65	60	53

Modelled Delivery Scenarios

No. of Small Deliveries per hour 45
No. of Larger Rigids per hour 0
Distance to Bedroom Windows (m) 8

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**63**	68	69	65	63	55	52	46	41
		Lmax	**68**	72	67	65	68	61	57	53	46
Larger Rigid	All	Leq	**0**	0	0	0	0	0	0	0	0
		Lmax	**0**	0	0	0	0	0	0	0	0
Overall 1 hour contribution	All	Leq	**63**	68	69	65	63	55	52	46	41
		Lmax	**68**	72	67	65	68	61	57	53	46

No. of Small Deliveries per hour 31
No. of Larger Rigids per hour 1
Distance to Bedroom Windows (m) 8

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**62**	67	68	64	61	54	50	44	39
		Lmax	**68**	72	67	65	68	61	57	53	46
Larger Rigid	All	Leq	**58**	65	64	59	57	51	48	42	34
		Lmax	**76**	84	78	75	74	70	67	62	55
Overall 1 hour contribution	All	Leq	**63**	69	69	65	63	56	52	46	40
		Lmax	**76**	84	78	75	74	70	67	62	55

No. of Small Deliveries per hour 18
No. of Larger Rigids per hour 2
Distance to Bedroom Windows (m) 8

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**60**	64	65	61	59	51	48	42	37
		Lmax	**68**	72	67	65	68	61	57	53	46
Larger Rigid	All	Leq	**61**	68	67	62	60	54	51	45	37
		Lmax	**76**	84	78	75	74	70	67	62	55
Overall 1 hour contribution	All	Leq	**63**	69	69	65	63	56	53	47	40
		Lmax	**76**	84	78	75	74	70	67	62	55

No. of Small Deliveries per hour 4
No. of Larger Rigids per hour 3
Distance to Bedroom Windows (m) 8

Type of Vehicle	*Activity*	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Small Delivery Van	All	Leq	**53**	58	59	55	52	45	41	35	30
		Lmax	**68**	72	67	65	68	61	57	53	46
Larger Rigid	All	Leq	**63**	69	68	64	62	56	53	47	39
		Lmax	**76**	84	78	75	74	70	67	62	55
Overall 1 hour contribution	All	Leq	**63**	70	69	65	63	56	53	47	40
		Lmax	**76**	84	78	75	74	70	67	62	55

Smoking Areas

Source Speech Levels	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Continuous conversatonal speech 1 person at 1m	Leq	**60**	41	60	61	59	54	50	49	42
	Lmax	**70**	51	66	67	69	64	61	60	54
Continuous significantly raised speech 1 person at 1m	Leq	**70**	40	64	66	71	61	62	55	52
	Lmax	**80**	50	72	76	80	72	73	65	65

Number of people on the terrace	91	
Percentage actually talkng continuously	25	%
Number Actualy talking continuously	22.8	
Distance from centre of terrace to Residential	10	m

Modelled Speech Levels	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Continuous conversatonal speech at Hotel Rooms	Leq	**63**	44	63	64	62	57	53	52	45
	Lmax	**68**	49	68	69	67	62	58	57	50

Number of people on the terrace	24	
Percentage actually talkng continuously	25	%
Number Actualy talking continuously	6.0	
Distance from centre of terrace to Residential	10	m

Modelled Speech Levels	*Index*	***dB(A)***	*63*	*125*	*250*	*500*	*1k*	*2k*	*4k*	*8k*
Continuous significantly raised speech at Hotel Rooms	Leq	**63**	33	57	59	64	54	55	49	45
	Lmax	**68**	38	62	64	69	59	60	54	51