

SHARPS REDMORE

ACOUSTIC CONSULTANTS



Report

Nanny Marr Road, Darfield

Noise assessment of a proposed residential development

Prepared by

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Project No. 1414627



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1.0 Introduction

1.1 Sharps Redmore (SR) have been instructed to undertake an environmental noise assessment of a proposed residential development at the former Foulstone School site at Nanny Marr Road, Darfield. Outline planning permission has been granted by Barnsley Metropolitan Borough Council (application 2014/1232) subject to a number of planning conditions. The client now wishes to apply for full planning permission.

1.2 Planning condition 21 of Outline consent 2014/1232 states:

“In accordance with sections 4.1 to 4.10 of the Sharps Redmore Noise assessment report a noise assessment shall accompany the reserved matters submission detailing the proposed noise mitigation measures that will be applied to the residential development to ensure that noise levels are no greater than those specified in BS8233:2014 (30dBA in bedrooms and 35dBA during the day in living rooms).”

1.3 This report is submitted in order to remove the need for a similarly worded condition.

1.4 This assessment is based on the following Nicol Thomas Architects drawings:

- Site layout drawing drawing M3864 (PL)01 D;
- House Type A – 2 bedroom bungalow drawing M3864 (PL)02;
- House Type B – 2 bedroom house drawing M3864 (PL)03;
- House Type C – 3 bedroom house drawing M3864 (PL)04;
- Street elevation drawing M3864 (PL)05.

1.5 Section 2 of this report contains details of the environmental noise survey undertaken at the site.

1.6 The assessment of appropriate mitigation measures is presented in Section 3. The assessment conclusions are contained in section 4.

1.7 A guide to the acoustic terminology used in this report is shown in Appendix C.

2.0 Noise survey details

- 2.1 A noise survey was undertaken between Wednesday 23rd July and Thursday 24th July 2014 at a single measurement location representative of the noise climate at the properties in Nanny Marr Road (location A).
- 2.2 Noise measurements were taken using a Norsonic 118 sound level meter fitted with an environmental microphone kit. The sound level meter was calibrated at the start and end of the measurements and no variation in levels noted.
- 2.3 Weather conditions during the survey were dry, partly cloudy (50% cover) and warm (25°C) with light and variable winds (<5 m/s).
- 2.4 Noise measurements were made every 5 minutes during the survey. The sound level meter microphone was located in free field conditions at a height of approximately 2 metres above ground level.
- 2.5 The purpose of the noise survey was to establish the noise climate to which the proposed houses would be exposed.
- 2.6 The noise levels measured during the survey were dominated by local road traffic sources.
- 2.7 The results of the noise survey are summarised below and presented in full in Appendix B.

TABLE 1: Summary of measured noise levels

Location	Measured noise levels dB				
	Daytime (0700 – 2300)		Night time (2300 – 0700)		
	L _{A90}	L _{AeqT}	L _{A90}	L _{AeqT}	L _{Amax}
A	33.6-54.6	47.8-65.1	28.9-47.2	32.2-63.0	40.5-86.2

- 2.8 The following octave band levels, associated with the levels above will be used to assess the glazing requirements.

TABLE 2: Octave band spectra

Location	Parameter	dBA	Octave Band Centre Frequency Hz						
			63	125	250	500	1k	2k	4k
A	Daytime L _{eq}	63	67	62	58	57	60	56	47
	Night L _{eq}	60	63	57	54	53	56	54	44
	Typical L _{Amax}	73	81	73	71	71	72	66	62

3.0 Noise mitigation for proposed residential development

- 3.1 It is recognised that the only realistic means of providing a suitable internal noise climate within the proposed residential units will be to have windows closed and an alternative means of providing ventilation.
- 3.2 It is proposed that the building envelope and glazing should be specified such that the internal noise levels within the new residential units meet the criteria presented in BS 8233:2014.

TABLE 3: BS 8233 internal noise levels

Room/conditions	Noise level dB
Resting, living room day. (Internal – steady noise)	$L_{Aeq\ 16\ hours} = 35\ dB$
Dining, dining room day. (Internal – steady noise)	$L_{Aeq\ 16\ hours} = 40\ dB$
Sleeping, bedroom day (Internal – steady noise)	$L_{Aeq\ 16\ hour} = 35\ dB$
Sleeping, bedroom night (Internal – steady noise)	$L_{Aeq\ 8\ hours} = 30\ dB$

- 3.3 The calculations presented below are based on the reasonable assumption that the external wall construction provides a sound reduction index at least 10 dB higher than the most onerous glazing performance.
- 3.4 The acoustic performance of the elements will be expressed in terms of Sound Reduction Index (R) in octave bands. Suitable products will have been tested to ISO 140/3 to determine compliance with the specified values.
- 3.5 The calculations are based on the room dimensions and glazing areas taken from the Nicol Thomas architects house type floor plan and elevation drawings.
- 3.6 The required sound insulation performance for glazing will be based on calculations performed using the typical external noise levels measured during the relevant periods (as indicated in Table 2).
- 3.7 In L_{eq} terms this will be the spectrum relating to the log average values; L_{Aeq} 63 dB daytime and 60 dB night time.
- 3.8 In L_{fmax} terms the spectrum will relate to a typical L_{Afmax} value during the relevant time period discounting exceptional levels that are high but occur occasionally. This relates to peak noise levels of L_{Afmax} 73 dB at night time.

3.9 In order to achieve the BS 8233:2014 internal noise levels from external noise intrusion the following glazing specifications are required in the indicated locations (as indicated at Figure 1 on the next page).

- 3.10 The specified glazing systems in Figure 1 will be required to meet the following minimum sound reduction index.

TABLE 4: Glazing performance specification and typical glass build-up

Type	Sound Reduction Index dB - Octave band centre frequency Hz						Typical R_w	Typical system glass-air gap-glass mm
	125	250	500	1k	2k	4k		
1	20	18	25	36	36	30	29	4-12-4, standard double glazed unit
2	20	19	29	38	38	38	33	6-12-6

- 3.11 This above sound insulation requirement is the overall performance for the window system (including frame, seal and glass). It can be seen in Figure 1 that those properties directly fronting onto Nanny Marr Road require the higher specification glazing, with standard double glazed units used across the remainder of the site.
- 3.12 In order to meet the BS 8233 internal noise level requirement it is necessary that windows will be closed to provide the stated level of sound reduction. With the windows closed it is necessary to provide an alternative means of background ventilation. This applies to habitable rooms on all elevations.
- 3.13 The sound reduction performance requirements of the ventilators will vary by locations but the following minimum performance, based on one ventilator per room, will be required:

TABLE 5: Ventilator specification

Window type	Vent performance $D_{n,e,w}$ dB when open
1	Standard trickle vents
2	43

- 3.14 The specification of the vents selected should be confirmed with SR; similarly if additional numbers of vents are required then this too should be reconsidered.

4.0 Assessment conclusions

- 4.1 The glazing specification calculations undertaken within Section 3 of this assessment demonstrate that internal noise levels within the proposed residential units would comply with the requirements of BS 8233:2014.

APPENDIX A

SITE LOCATION PLAN

Appendix A: Site location plan showing noise measurement location



APPENDIX B

NOISE SURVEY RESULTS

Measurement location A - Adjacent to 50 Nanny Marr Road

Date	Sample start time	Noise Parameter - dB				
		L _{A10}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{AFmin}
23.7.14	13:50:00	65.5	48.4	61.0	69.9	44.0
	13:55:00	67.2	48.0	62.6	74.5	43.4
	14:00:00	65.5	48.8	61.0	72.8	45.9
	14:05:00	66.8	49.1	62.3	74.6	46.1
	14:10:00	66.8	51.4	62.6	73.2	46.5
	14:15:00	65.3	48.6	61.4	73.5	45.1
	14:20:00	67.6	51.8	64.0	76.1	46.7
	14:25:00	65.2	47.7	60.5	74.0	46.3
	14:30:00	66.5	50.3	62.2	75.6	46.0
	14:35:00	66.8	50.0	62.5	74.0	45.7
	14:40:00	65.9	48.1	61.0	70.6	45.5
	14:45:00	67.0	47.2	62.2	71.9	44.4
	14:50:00	66.8	50.0	62.9	76.4	46.1
	14:55:00	65.6	49.6	61.4	71.6	45.9
	15:00:00	66.2	50.0	62.5	76.2	47.5
	15:05:00	67.0	48.9	63.4	77.3	46.0
	15:10:00	66.5	48.4	61.9	71.1	44.3
	15:15:00	66.8	48.4	63.4	78.8	44.7
	15:20:00	66.8	48.5	62.5	71.2	46.1
	15:25:00	66.6	49.1	61.8	73.4	46.5
	15:30:00	67.0	51.7	63.3	75.1	47.9
	15:35:00	66.8	49.2	63.1	75.6	45.6
	15:40:00	66.5	48.1	63.8	79.7	45.7
	15:45:00	65.7	48.6	61.1	71.1	45.5
	15:50:00	66.4	49.6	62.3	76.4	46.2
	15:55:00	66.5	49.7	62.1	74.1	46.3
	16:00:00	65.5	49.6	61.4	75.1	44.1
	16:05:00	66.9	51.2	63.1	75.0	43.7
	16:10:00	65.0	49.2	60.6	69.6	46.4
	16:15:00	66.7	49.5	62.0	73.3	46.9
16:20:00	66.7	51.1	63.1	76.6	48.5	
16:25:00	67.5	49.6	63.3	75.8	47.3	
16:30:00	65.7	51.8	61.7	73.7	48.2	
16:35:00	67.5	48.7	63.5	73.6	46.2	
16:40:00	66.6	51.0	62.6	74.1	48.3	
16:45:00	67.8	51.1	63.7	75.5	48.1	
16:50:00	66.6	50.5	62.5	71.2	45.5	
16:55:00	66.7	48.3	62.7	73.1	45.3	
17:00:00	67.5	49.0	62.8	70.9	45.1	
17:05:00	66.7	51.3	62.8	71.8	48.6	
17:10:00	67.3	48.5	62.8	71.9	45.6	
17:15:00	67.4	51.7	63.4	74.8	47.2	
17:20:00	67.5	50.3	63.4	72.1	45.1	
17:25:00	67.5	51.4	64.2	85.4	44.8	
17:30:00	67.9	49.6	63.8	76.2	44.7	
17:35:00	67.5	52.0	63.3	71.3	46.4	
17:40:00	65.7	47.8	62.1	77.8	44.7	
17:45:00	66.8	49.2	63.7	79.0	45.7	

Measurement location A - Adjacent to 50 Nanny Marr Road

Date	Sample start time	Noise Parameter - dB				
		L _{A10}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{AFmin}
23.7.14	17:50:00	67.1	46.8	62.8	72.8	44.7
	17:55:00	66.7	48.9	62.0	72.1	45.3
	18:00:00	68.3	50.9	64.3	77.4	43.6
	18:05:00	66.8	49.3	63.1	82.1	45.2
	18:10:00	66.1	48.7	61.5	69.4	46.3
	18:15:00	66.5	47.1	61.9	73.2	43.2
	18:20:00	67.1	47.4	62.6	72.1	43.1
	18:25:00	66.4	47.2	61.9	72.2	43.2
	18:30:00	66.9	50.6	65.1	81.7	46.8
	18:35:00	65.9	46.0	61.3	71.7	43.4
	18:40:00	65.2	47.1	60.2	72.5	43.5
	18:45:00	65.9	46.7	61.3	72.5	43.9
	18:50:00	65.9	46.9	62.1	74.6	42.9
	18:55:00	66.4	46.7	62.3	76.0	43.4
	19:00:00	65.9	48.2	61.4	71.1	45.2
	19:05:00	67.0	45.8	62.4	81.2	41.7
	19:10:00	65.6	46.0	62.7	83.0	42.2
	19:15:00	66.4	48.6	62.3	73.6	45.1
	19:20:00	64.6	46.1	59.6	71.3	42.4
	19:25:00	64.9	45.3	60.3	73.2	42.0
	19:30:00	65.9	46.8	61.3	72.0	41.5
	19:35:00	65.1	44.4	60.0	71.2	40.5
	19:40:00	64.2	44.2	59.3	71.0	40.9
	19:45:00	64.5	45.1	60.2	73.8	42.8
	19:50:00	64.8	42.3	59.8	74.6	40.8
	19:55:00	64.3	45.7	60.3	75.9	41.5
	20:00:00	64.1	44.4	59.8	71.5	42.5
	20:05:00	64.4	43.3	59.5	69.7	40.1
	20:10:00	64.1	45.9	59.5	72.6	42.0
	20:15:00	63.8	43.3	59.5	75.3	39.9
	20:20:00	63.7	42.9	58.6	71.6	40.1
	20:25:00	65.7	44.7	61.3	77.0	41.4
	20:30:00	64.9	44.1	59.9	72.8	41.5
	20:35:00	65.9	41.4	61.4	75.2	39.0
	20:40:00	64.6	42.6	61.0	77.3	38.7
	20:45:00	64.4	43.5	60.3	76.5	39.5
	20:50:00	65.2	41.3	59.5	72.5	39.4
	20:55:00	65.1	43.7	59.9	71.7	41.1
	21:00:00	63.9	43.1	59.3	73.9	40.5
	21:05:00	65.0	45.4	61.3	77.2	41.9
21:10:00	65.7	49.0	61.2	75.9	47.8	
21:15:00	65.3	43.6	60.5	70.0	40.8	
21:20:00	63.4	41.5	59.5	77.9	39.9	
21:25:00	63.2	40.2	58.4	71.9	38.3	
21:30:00	62.7	40.4	57.3	69.4	38.2	
21:35:00	65.3	44.4	60.4	74.9	40.4	
21:40:00	64.9	41.6	61.1	75.7	38.7	
21:45:00	61.5	41.7	57.2	69.2	39.5	

Measurement location A - Adjacent to 50 Nanny Marr Road

Date	Sample start time	Noise Parameter - dB				
		L _{A10}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{AFmin}
23.7.14	21:50:00	63.9	40.4	58.7	70.2	38.4
	21:55:00	62.2	40.7	57.6	70.1	37.9
	22:00:00	63.7	40.6	58.0	68.6	38.6
	22:05:00	65.3	42.4	60.5	71.4	40.4
	22:10:00	62.8	39.2	56.7	68.4	37.1
	22:15:00	60.6	39.1	58.7	75.6	37.4
	22:20:00	62.2	39.2	57.3	72.4	36.7
	22:25:00	62.7	38.9	57.9	70.8	36.1
	22:30:00	62.3	38.6	57.8	71.1	35.6
	22:35:00	62.4	39.0	57.9	72.3	36.1
	22:40:00	56.3	38.7	56.2	75.4	35.0
	22:45:00	62.7	35.7	58.1	73.8	33.5
	22:50:00	44.4	33.6	47.8	65.2	31.9
	22:55:00	60.9	35.3	56.8	72.6	32.9
	23:00:00	61.1	35.7	57.0	71.2	31.8
	23:05:00	61.3	37.7	56.7	69.6	35.9
	23:10:00	55.5	38.8	54.2	69.7	36.4
	23:15:00	63.5	37.8	58.6	74.1	35.2
	23:20:00	47.2	36.9	51.6	68.6	35.6
	23:25:00	45.1	34.9	54.9	74.0	32.5
	23:30:00	54.9	34.9	52.6	67.6	32.0
	23:35:00	41.1	31.8	50.8	71.6	30.3
	23:40:00	50.4	34.2	50.2	67.0	30.9
	23:45:00	45.7	33.9	51.0	69.9	31.6
23:50:00	55.2	36.0	53.7	69.5	33.2	
23:55:00	52.3	34.1	51.4	67.2	31.3	
24.7.14	00:00:00	57.3	32.4	52.7	68.1	30.7
	00:05:00	53.5	35.9	53.6	68.2	32.7
	00:10:00	50.8	33.3	53.1	71.3	30.5
	00:15:00	40.5	34.0	40.8	54.6	31.5
	00:20:00	39.7	33.3	37.8	54.1	30.2
	00:25:00	49.5	32.0	48.7	63.9	30.2
	00:30:00	34.4	28.9	32.2	45.5	27.3
	00:35:00	46.3	32.1	48.9	67.3	30.0
	00:40:00	47.2	31.1	48.9	66.2	29.4
	00:45:00	38.9	32.3	36.4	45.8	29.9
	00:50:00	39.2	31.5	45.5	65.0	29.4
	00:55:00	38.2	30.5	34.9	47.0	28.5
	01:00:00	35.5	30.3	33.7	46.0	28.5
	01:05:00	38.8	30.6	35.8	48.3	29.2
	01:10:00	42.2	32.2	46.5	63.4	30.4
	01:15:00	51.5	31.2	50.3	66.9	29.7
	01:20:00	37.7	29.6	51.1	72.2	27.9
	01:25:00	38.3	30.5	48.2	67.1	28.7
01:30:00	37.3	30.8	34.3	52.3	29.3	
01:35:00	35.6	30.8	33.5	40.7	29.2	
01:40:00	38.3	31.7	36.3	51.4	29.5	
01:45:00	35.5	30.1	48.6	69.1	27.8	

Measurement location A - Adjacent to 50 Nanny Marr Road

Date	Sample start time	Noise Parameter - dB				
		L _{A10}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{AFmin}
24.7.14	01:50:00	48.2	35.9	49.6	68.0	35.4
	01:55:00	51.4	36.2	51.9	69.4	35.4
	02:00:00	42.9	35.8	46.0	66.6	35.3
	02:05:00	46.6	36.0	47.6	64.8	35.6
	02:10:00	43.6	36.0	49.5	67.6	35.3
	02:15:00	36.9	35.8	44.5	65.8	35.1
	02:20:00	50.6	36.2	51.9	70.7	35.5
	02:25:00	42.2	36.2	40.0	43.5	35.6
	02:30:00	45.1	35.8	46.6	62.1	35.1
	02:35:00	45.8	35.9	41.8	54.8	35.4
	02:40:00	49.9	36.0	53.2	70.7	35.4
	02:45:00	37.6	35.8	38.8	53.9	35.4
	02:50:00	44.0	35.8	47.3	64.7	35.2
	02:55:00	43.4	36.0	54.2	76.1	35.5
	03:00:00	49.7	36.1	49.8	67.6	35.5
	03:05:00	36.5	35.8	36.1	40.5	35.3
	03:10:00	42.8	36.0	47.0	65.8	35.4
	03:15:00	46.6	36.5	54.3	75.9	35.7
	03:20:00	44.8	37.0	47.0	66.3	36.0
	03:25:00	46.9	39.5	45.5	60.5	36.2
	03:30:00	51.0	37.8	48.2	63.7	35.9
	03:35:00	49.0	38.5	49.3	66.2	35.8
	03:40:00	53.1	40.0	50.2	65.4	36.1
	03:45:00	56.3	39.3	54.6	73.8	36.1
	03:50:00	46.7	39.1	46.7	62.1	37.8
	03:55:00	48.5	38.1	50.7	68.5	36.6
	04:00:00	43.6	37.4	45.9	62.9	36.0
	04:05:00	50.3	38.6	50.3	67.6	36.6
	04:10:00	50.6	40.4	49.8	67.6	37.4
	04:15:00	51.1	40.8	49.9	65.1	37.2
	04:20:00	54.4	42.8	52.2	67.9	37.5
	04:25:00	44.4	39.0	42.4	53.8	37.2
	04:30:00	50.3	39.0	49.4	64.9	36.9
	04:35:00	46.6	39.2	47.5	64.2	36.8
	04:40:00	55.5	39.5	52.0	67.0	37.4
	04:45:00	58.0	40.0	53.9	70.2	37.3
	04:50:00	58.8	42.4	54.3	67.2	37.7
	04:55:00	56.9	40.0	52.8	66.1	36.6
	05:00:00	62.3	39.1	57.3	71.4	37.0
	05:05:00	62.4	39.3	57.7	71.6	37.3
05:10:00	61.4	40.0	56.3	69.1	37.1	
05:15:00	61.4	41.8	56.4	70.0	36.6	
05:20:00	60.7	42.6	56.0	72.0	37.3	
05:25:00	61.6	42.1	56.4	69.2	37.8	
05:30:00	61.7	41.8	56.5	70.4	38.3	
05:35:00	56.4	39.3	52.3	67.7	36.8	
05:40:00	62.0	40.5	56.6	69.1	37.7	
05:45:00	61.5	42.7	57.2	72.9	38.7	

Measurement location A - Adjacent to 50 Nanny Marr Road

Date	Sample start time	Noise Parameter - dB				
		L _{A10}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{AFmin}
24.7.14	05:50:00	61.8	38.8	58.0	71.9	36.6
	05:55:00	60.7	38.6	57.9	73.1	35.6
	06:00:00	61.5	40.6	57.2	73.3	37.8
	06:05:00	65.0	40.7	60.4	75.6	38.7
	06:10:00	63.4	40.3	58.2	71.7	36.6
	06:15:00	62.6	42.4	58.1	73.6	39.3
	06:20:00	66.8	42.7	61.3	73.4	40.0
	06:25:00	64.2	41.6	58.5	70.7	39.3
	06:30:00	64.3	43.7	58.9	70.1	39.9
	06:35:00	65.3	47.2	60.6	70.6	42.6
	06:40:00	66.6	44.6	63.0	86.2	41.6
	06:45:00	64.0	41.4	58.6	71.0	39.5
	06:50:00	63.2	41.2	57.8	71.7	38.6
	06:55:00	63.9	42.0	59.0	70.8	38.1
	07:00:00	65.7	42.6	60.9	74.7	40.1
	07:05:00	63.7	41.0	58.2	70.3	39.5
	07:10:00	66.4	43.7	61.6	74.2	40.0
	07:15:00	66.8	44.1	61.5	73.1	40.8
	07:20:00	64.6	43.2	61.6	82.3	40.8
	07:25:00	66.1	43.6	61.7	75.8	39.0
	07:30:00	66.6	40.3	61.0	72.8	37.4
	07:35:00	66.2	43.7	62.8	78.5	41.0
	07:40:00	66.3	41.8	61.2	73.7	39.0
	07:45:00	65.9	44.8	61.0	72.7	41.2
	07:50:00	66.6	45.1	62.0	73.7	41.0
	07:55:00	67.4	44.0	61.9	70.9	40.3
	08:00:00	67.3	44.1	62.4	72.4	42.0
	08:05:00	65.8	43.9	61.1	72.7	38.5
	08:10:00	66.6	47.0	61.3	73.7	44.1
	08:15:00	67.2	45.0	62.8	77.9	42.8
	08:20:00	66.3	47.2	61.8	74.2	42.8
	08:25:00	65.7	43.9	61.4	72.7	40.1
	08:30:00	66.5	54.1	63.4	75.3	48.3
	08:35:00	66.6	50.9	61.9	72.7	48.4
	08:40:00	65.0	48.1	60.6	72.2	45.1
	08:45:00	65.7	46.1	62.1	76.7	41.7
	08:50:00	65.5	46.5	61.2	79.0	43.7
	08:55:00	67.9	44.3	63.9	77.8	40.8
	09:00:00	66.2	44.5	61.4	73.1	38.6
	09:05:00	65.5	43.7	60.4	72.2	40.8
09:10:00	65.2	43.8	60.5	71.3	39.0	
09:15:00	64.7	45.5	59.9	68.7	40.5	
09:20:00	66.0	46.3	62.0	72.6	41.5	
09:25:00	67.2	50.6	63.5	77.7	42.3	
09:30:00	64.4	40.7	59.5	71.0	38.4	
09:35:00	66.0	43.5	61.3	73.2	39.5	
09:40:00	65.3	47.8	60.7	72.6	40.2	
09:45:00	64.7	46.2	59.7	69.7	43.8	

Measurement location A - Adjacent to 50 Nanny Marr Road

Date	Sample start time	Noise Parameter - dB				
		L _{A10}	L _{A90}	L _{Aeq}	L _{AFmax}	L _{AFmin}
24.7.14	09:50:00	66.9	49.0	62.3	71.7	40.8
	09:55:00	65.6	46.2	60.6	70.9	43.6
	10:00:00	64.7	43.1	59.6	71.1	41.0
	10:05:00	63.6	42.8	58.7	71.7	40.9
	10:10:00	65.0	44.2	60.1	69.7	40.0
	10:15:00	65.1	42.3	60.3	72.1	39.7
	10:20:00	65.7	45.0	60.4	70.3	41.8
	10:25:00	65.8	46.1	62.2	78.0	42.7
	10:30:00	64.8	43.5	60.9	76.2	41.3
	10:35:00	64.6	43.6	60.0	72.1	41.4
	10:40:00	65.1	47.7	60.6	72.5	42.7
	10:45:00	66.1	43.3	60.9	71.9	41.3
	10:50:00	65.3	43.6	62.5	80.5	40.5
	10:55:00	64.9	41.0	59.9	69.8	38.6
	11:00:00	65.1	45.3	60.5	69.6	41.7
	11:05:00	64.9	43.1	60.0	73.5	40.2
	11:10:00	65.6	45.5	61.3	71.5	41.7
	11:15:00	65.2	44.6	61.1	73.5	41.9
	11:20:00	65.4	45.5	61.0	71.2	41.6
	11:25:00	64.9	44.1	60.0	70.7	41.2
11:30:00	63.8	54.6	61.3	66.8	52.7	

APPENDIX C

ACOUSTIC TERMINOLOGY

Acoustic Terminology

- C1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. $50 \text{ dB} + 50 \text{ dB} = 53 \text{ dB}$. Increases in continuous sound are perceived in the following manner:
- 1 dB increase - barely perceptible.
 - 3 dB increase - just noticeable.
 - 10 dB increase - perceived as twice as loud.
- C2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.
- C3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).
- C4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p . Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p .
- C5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.
- C6 The main noise indices in use in the UK are:
- L_{A90} : The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.
 - L_{Aeq} : The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10} : The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used over many years to measure and assess road traffic noise.

L_{AMAX} : The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

- C7 The sound energy of a transient event may be described by a term SEL - Sound Exposure Level. This is the L_{Aeq} level normalised to one second. That is the constant level in dBA which lasting for one second has the same amount of acoustic energy as a given A weighted noise event lasting for a period of time. The use of this unit allows the prediction of the L_{Aeq} level over any period and for any number of events using the equation;

$$L_{AeqT} = SEL + 10 \log n - 10 \log T \text{ dB.}$$

Where

n = Number of events in time period T.

T = Total sample period in seconds.

- C8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = $20 \log$ (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \log \frac{160}{10} = 60 - 24 = 36 \text{ dB.}$$