

APPENDIX 11.1
NOISE AND VIBRATION

LAND AT OAKLEY FARM, CHELTENHAM

ROBERT HITCHINS LTD

OCTOBER 2019

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APPENDIX 11.1 NOISE AND VIBRATION

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Status	Prepared By	Date
1.0	L Jephson BEng (Hons) MIOA	21/10/19

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CONTENTS

1.	Introduction	1
2.	Noise Units	2
3.	Baseline Noise Assessment	3
4.	Road Traffic Noise Modelling	6

Figures

Annexes

1. Introduction

This Appendix provides additional details of the noise and vibration assessment which has been carried out for the Proposed Development. It provides further information on the measurement exercises carried out to ascertain the existing noise environment within the development and the road traffic noise calculations which have been prepared to identify potential impacts associated with development traffic. Proposed mitigation measures are described within the main ES and have not been considered further in this appendix.

2. Noise Units

Decibels (dB)

Noise can be defined as unwanted sound. Sound in air can be considered as the propagation of energy through the air in the form of oscillatory changes in pressure. The size of the pressure changes in acoustic waves is quantified on a logarithmic decibel (dB) scale firstly because the range of audible sound pressures is very great, and secondly because the loudness function of the human auditory system is approximately logarithmic.

The dynamic range of the auditory system is generally taken to be 0 dB to 140 dB. Generally, the addition of noise from two sources producing the same sound pressure level, will lead to an increase in sound pressure level of 3 dB. A 3 dB noise change is generally considered to be just noticeable, a 5 dB change is generally considered to be clearly discernible and a 10 dB change is generally accepted as leading to the subjective impression of a doubling or halving of loudness.

A-Weighting

The bandwidth of the frequency response of the ear is usually taken to be from about 18 Hz to 18,000 Hz. The auditory system is not equally sensitive throughout this frequency range. This is taken into account when making acoustic measurements by the use of A-weighting, a filter circuit which has a frequency response similar to the human auditory system. All the measurement results referred to in this report are A-weighted.

Units Used to Describe Time-Varying Noise Sources (L_{Aeq} , L_{A10} , L_{A90} and L_{Amax})

Instantaneous A-weighted sound pressure level is not generally considered as an adequate indicator of subjective response to noise because levels of noise usually vary with time.

For many types of noise, the Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$) is used as the basis of determining community response. The $L_{Aeq,T}$ is defined as the A-weighted sound pressure level of the steady sound which contains the same acoustic energy as the noise being assessed over a specific time period, T.

The L_{A10} is the noise level exceeded for 10% of the measurement period. It has been used in the UK for the assessment of road traffic noise.

The L_{A90} is the noise level exceeded for 90% of the measurement period. It is generally used to quantify the background noise level, the underlying level of noise which is present even during the quieter parts of the measurement period.

The L_{Amax} is the maximum value that the A-weighted sound pressure level reaches during a measurement period. $L_{Amax F}$, or Fast, is averaged over 0.125 of a second and $L_{Amax S}$, or Slow, is averaged over 1 second.

3. Baseline Noise Assessment

3.1. Preamble

In order to determine the baseline noise climate within the Proposed Development and at surrounding noise sensitive properties to enable the development of the site design and layout, a noise monitoring exercise was carried out on the site, which comprised unattended noise surveys, supplemented with attended noise measurements at a number of positions around the site.

3.2. Unattended Noise Surveys

In order to ascertain the existing noise levels within the Proposed Development, unattended noise surveys were carried at two locations within the Application Site, one located within the north western corner and a second along the proposed southern residential boundary.

The two locations were selected, as they were considered representative of the locations of the proposed dwellings.

The measurements were carried out over a period of seven days between Thursday 3 to Thursday 10 October 2019 using two Rion NL-52 Class 1 Sound Level Meters, fitted with Rion WS-15 outdoor microphone protection. The instruments were calibrated before and after the exercise using a Rion NC-74 Class 1 Acoustic Calibrator, with no drift recorded.

One instrument was positioned within the north western corner of the site, close to the existing residential properties located along Wessex Drive and Pillowell Close, with the second instrument located adjacent to the existing wooded area along the proposed southern residential boundary. The monitoring locations are indicated on Figure 1.

At each position, the microphone was set free-field (i.e. at least 3.5 metres from any property facades or other reflecting surfaces) at a height of 1.3 metres above the ground.

The weather conditions during the survey were generally fine and dry, with light winds, which were considered suitable for undertaking environmental noise monitoring. There was a period of rain observed during Saturday night, which clearly influenced the noise measurements and care has been taken when considering the noise levels obtained during this period.

Measurements were taken over 5 minute periods during the survey, which enabled particular events to be identified and to allow a comparison with the attended noise measurements. In addition, the instruments were installed with an audio recording card, which was used to capture audio samples throughout the survey and to enable the identification of any particular events.

The survey results (summarised into hourly periods) are presented graphically on Figures 2 and 3, with tabulated results, summarised in Annexes A and B.

The results have been subsequently analysed to determine the period day and night-time noise levels at each location, as follows.

Date	Period Noise Levels [dB]			
	Daytime $L_{Aeq, 16 \text{ hour}}$	Night-time $L_{Aeq, 8 \text{ hour}}$	Average Daytime L_{A90}	Average Night-time L_{A90}
Thursday 3/10/19	49.6	37.1	43.2	32.9
Friday 4/10/19	49.9	35.5	41.8	23.9
Saturday 5/10/19	47.3	44.4	39.9	34.7
Sunday 6/10/19	47.5	40.5	40.6	29.9
Monday 7/10/19	48.3	37.1	42.3	31.3
Tuesday 8/10/19	49.7	39.1	43.3	32.5
Wednesday 9/10/19	49.0	37.0	43.0	33.3
Typical Weekday	49	37	43	31

Table 3.1 – Summary Results Obtained from Unattended Noise Monitoring at North Western Boundary (Position U1)

Date	Period Noise Levels [dB]			
	Daytime $L_{Aeq, 16 \text{ hour}}$	Night-time $L_{Aeq, 8 \text{ hour}}$	Average Daytime L_{A90}	Average Night-time L_{A90}
Thursday 3/10/19	51.2	39.3	43.9	33.2
Friday 4/10/19	49.2	44.3	40.9	23.5
Saturday 5/10/19	45.5	43.1	36.7	34.1
Sunday 6/10/19	49.4	38.4	41.3	29.1
Monday 7/10/19	48.9	39.6	41.8	31.1
Tuesday 8/10/19	50.0	38.3	42.9	32.7
Wednesday 9/10/19	48.7	38.1	42.5	33.1
Typical Weekday	50	42	40	31

Table 3.2 – Summary Results Obtained from Unattended Noise Monitoring at Southern Residential Boundary (Position U2)

Noise levels monitored were observed to be principally attributable to road traffic on the road surrounding the Proposed Development during the day and night-time periods. During daytime periods, light aircraft operating out of Gloucester Airport were also clearly audible as they flew overhead, generally influencing ambient (L_{Aeq}) and maximum (L_{Amax}) noise levels.

3.3. Attended Noise Monitoring

To supplement the unattended noise survey, attended noise measurements were made at a further 4 positions within the site during Thursday 3 October 2019.

The measurements were made using a combination of a Rion NA-28 and Rion NL-52 Class 1 Sound Analyser, which were calibrated using a Rion NC-74 Class 1 Acoustic Calibrator. The measurements were taken freefield and at a height of 1.2 metres.

A series of measurements over 15 minute durations were made over a period of 1 hour at each position, concurrent with the unattended noise surveys. The data has been subsequently compared with the unattended measurement results to enable the day and night-time period noise levels to be determined at each location.

The results of the attended noise measurements are presented in Annex C, with the period noise levels at each position summarised in Table 3.3.

Monitoring Location		Period Free-field $L_{Aeq,T}$ Noise Levels [dB]		Principal Noise Sources
		Daytime	Night-time	
S1	North eastern site boundary	47	37	Distant road traffic, aircraft movements into Gloucester airport during daytime periods.
S2	Eastern site boundary	46	36	
S3	10m from kerb of Harp Hill (southern site boundary)	54	45	
S4	Western site boundary	47	38	

Table 3.3 – Period Noise Levels Evaluated at Sample Monitoring Positions

4. Road Traffic Noise Modelling

The operation of the Proposed Development would give rise to changes in road traffic flows on the surrounding road network.

Roads where changes in road traffic flows of more than 10% have been considered within the assessment. Generally, a change of more than 20% would represent a 1 dB(A) change in noise levels and thus have the potential to give rise to potential impacts. On the basis of an analysis of the traffic data, only Harp Hill would be subject to changes of more than 10% in road traffic with the Proposed Development operational and considering other committed developments within the surrounding area.

To assess the potential impacts, changes in road traffic noise levels have been calculated using the methodology contained in A Calculation of Road Traffic Noise at a distance of 10 metres from the kerb of the road, taking account of road speeds and %HGV. Conversions from L_{A10} to L_{Aeq} noise levels have been made on the basis of utilising the DEFRA methodology.

24 hour weekday daytime road traffic flows based upon the data provided in the Transport Assessment have been used as the basis of the assessment. To provide a worst case assessment, it has been assumed that the 24 hour flows would be equivalent to the daytime 18 hour flows upon which this assessment has been based.

Calculations have been made for the following scenarios, for the road links surrounding the Proposed Development, which would be subject to the greatest changes in traffic:

- 2019 Base;
- 2024 Forecast Year; and
- 2024 Forecast Year + Proposed Development.

The details of the calculations are provided in Annex D, with the noise level changes summarised in Table 4.1.

Road Link	Change in Basic Noise Level [dB $L_{Aeq, 16 \text{ hour}}$]		
	2024 Forecast Year - 2019 Base	2024 Forecast Year + Proposed Development - 2019 Base	2024 Forecast Year + Proposed Development - 2024 Forecast Year
Harp Hill West of Proposed Development Access	+0.2	+1.3	+1.1
Harp Hill West of Stanley Road	+0.2	+1.2	+1.0

Table 4.1 Change in Road Traffic Noise Levels on Roads Surrounding the Proposed Development

Figures

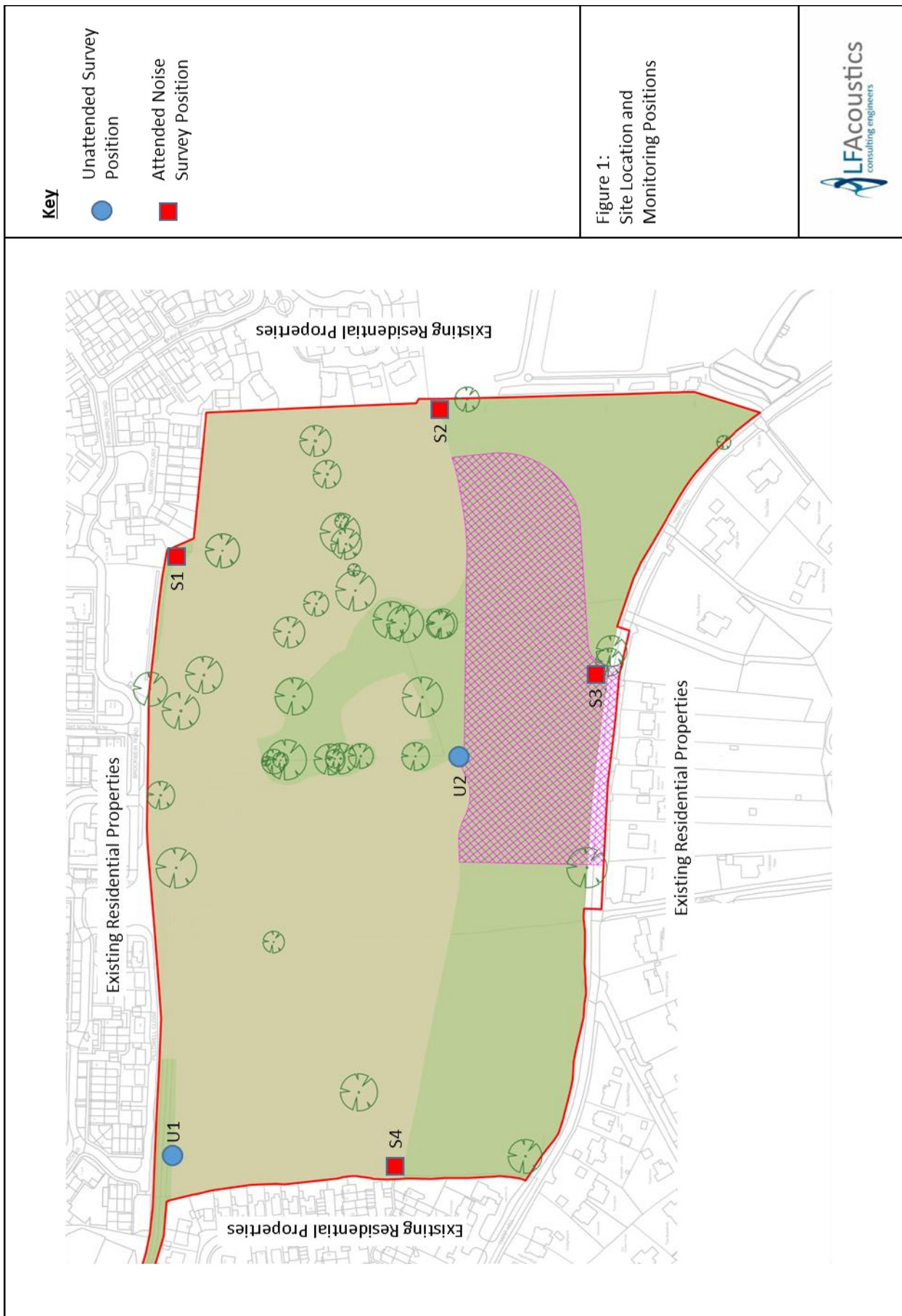


Figure 2:
 Unattended Noise Survey
 Results - Position U1

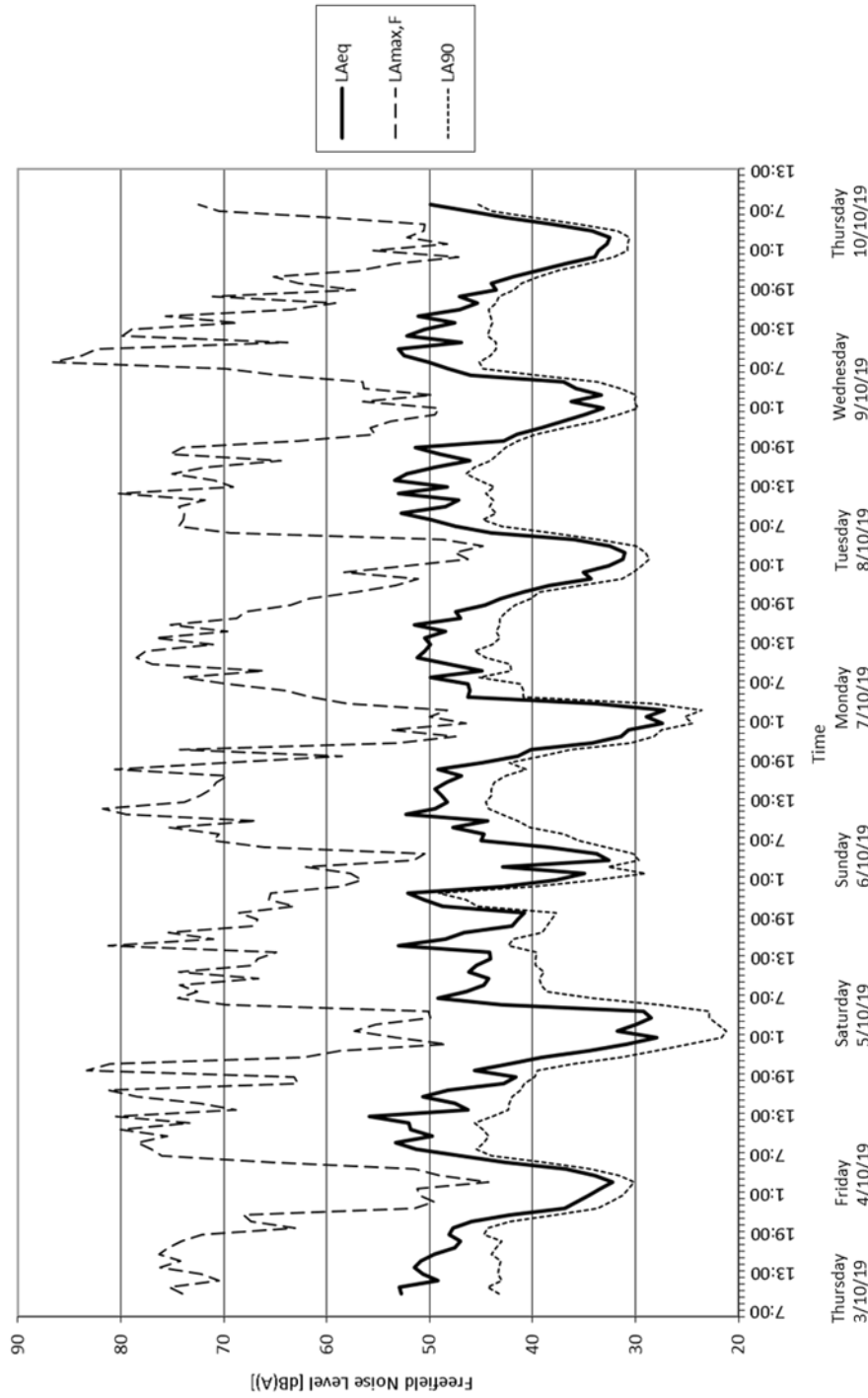
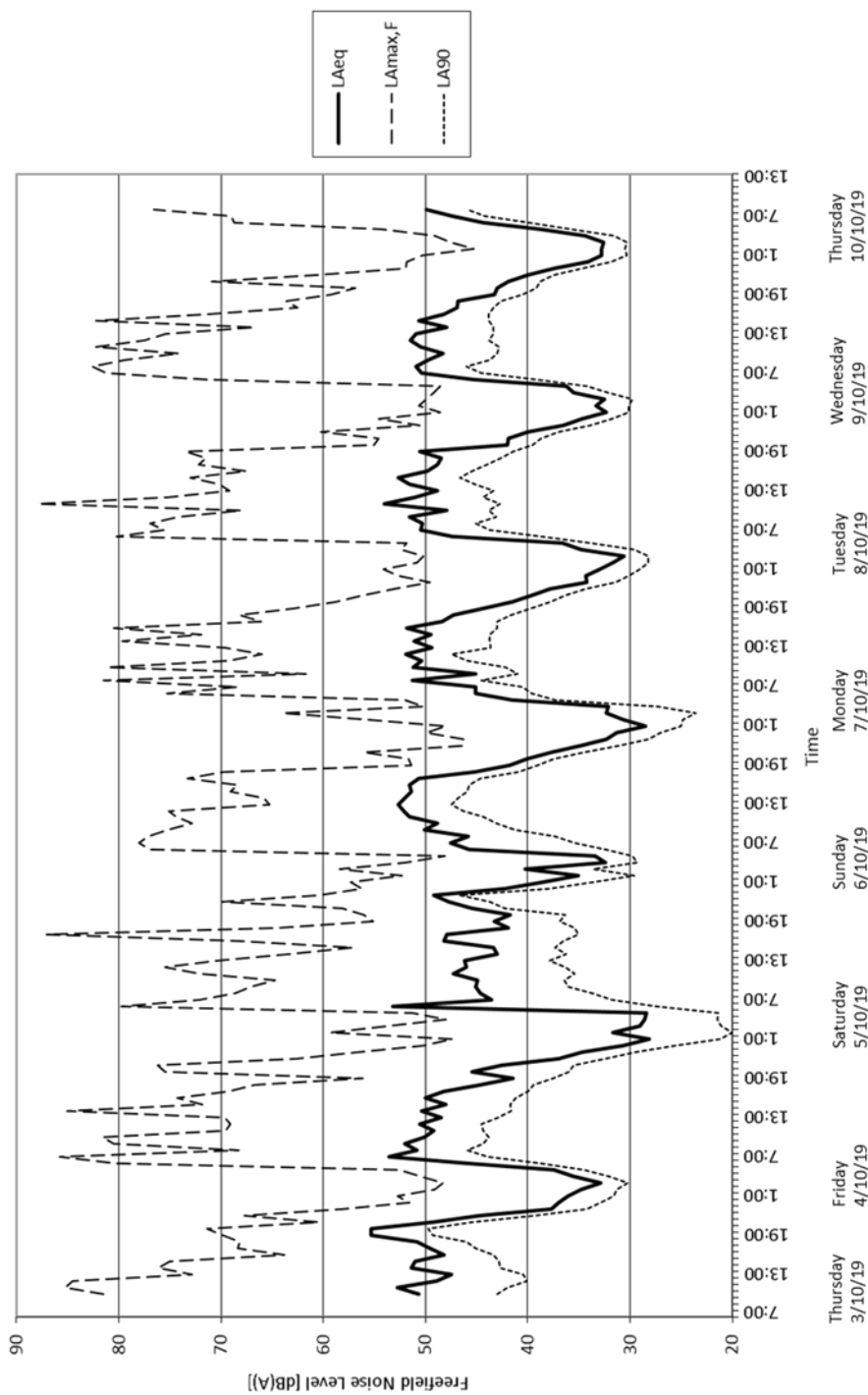


Figure 3:
Unattended Noise Survey
Results - Position U2



Annex A
Summary Results of Unattended Noise Survey
Position U1 – North Western Boundary

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231655)

Location: U1 - North Western Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Thursday 03/10/2019	10:00	52.8	74.0	53.2	43.3
	11:00	52.9	75.3	54.6	44.4
	12:00	49.2	70.5	50.3	43.0
	13:00	50.7	72.2	51.2	43.4
	14:00	51.5	76.2	50.9	43.3
	15:00	50.8	74.2	49.8	43.1
	16:00	49.6	76.3	50.0	44.0
	17:00	47.6	75.4	48.4	43.5
	18:00	47.0	74.1	48.5	43.0
	19:00	48.1	72.1	49.6	44.7
	20:00	47.7	63.1	49.9	44.4
	21:00	45.9	67.4	47.5	42.2
	22:00	42.2	68.1	43.5	37.8
Friday 04/10/2019	23:00	36.9	51.5	39.0	33.7
	0:00	35.7	49.6	37.5	32.4
	1:00	34.5	51.0	36.6	31.2
	2:00	33.4	51.2	35.1	30.7
	3:00	32.2	44.3	33.9	30.1
	4:00	34.0	49.0	35.7	31.6
	5:00	36.8	51.5	38.4	34.4
	6:00	42.6	65.3	43.4	38.9
	7:00	47.0	76.0	47.5	44.0
	8:00	51.3	77.0	49.8	45.5
	9:00	53.3	78.4	52.4	44.7
	10:00	49.7	75.5	48.3	44.3
	11:00	51.8	80.0	50.7	44.8
12:00	52.0	73.3	52.2	45.6	
13:00	55.9	80.5	51.0	43.9	
14:00	46.3	68.8	46.8	42.4	
15:00	47.6	72.4	47.4	42.3	
16:00	50.7	78.4	47.1	42.0	
17:00	48.2	81.2	46.6	41.2	
18:00	42.8	62.8	44.0	40.8	
19:00	41.6	63.2	42.8	39.8	
20:00	45.6	83.3	43.3	39.5	
21:00	42.3	81.0	40.5	36.1	
22:00	39.1	62.2	41.2	31.4	
23:00	34.5	58.7	35.8	28.0	

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231655)

Location: U1 - North Western Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Saturday 05/10/2019	0:00	30.9	48.4	32.8	24.8
	1:00	27.9	53.2	29.7	21.6
	2:00	31.8	57.3	30.2	21.2
	3:00	29.9	55.2	31.2	22.0
	4:00	28.5	49.9	30.7	22.8
	5:00	29.2	50.1	30.8	22.8
	6:00	43.0	69.7	39.3	27.7
	7:00	49.2	74.5	48.6	34.1
	8:00	46.5	72.6	46.9	38.6
	9:00	44.7	74.3	45.4	39.2
	10:00	44.3	66.6	45.6	39.3
	11:00	46.2	74.4	45.8	38.9
	12:00	45.5	67.2	47.1	39.7
	13:00	44.1	66.7	45.6	39.7
	14:00	44.2	64.9	45.4	39.6
	15:00	53.0	81.2	54.1	42.4
	16:00	48.5	71.0	49.1	41.9
	17:00	46.6	75.4	45.7	39.1
	18:00	42.0	67.1	43.2	38.6
	19:00	41.4	66.7	42.4	38.2
	20:00	40.8	68.5	41.5	37.7
	21:00	48.7	63.2	49.5	45.4
	22:00	50.6	65.6	51.0	46.5
23:00	52.1	65.4	53.2	49.1	
Sunday 06/10/2019	0:00	42.9	58.7	44.2	39.9
	1:00	37.7	56.6	38.8	33.9
	2:00	35.0	57.7	34.2	29.0
	3:00	42.9	62.1	39.5	32.7
	4:00	32.6	51.6	34.2	29.7
	5:00	33.8	50.5	35.6	30.2
	6:00	38.5	66.1	39.3	32.9
	7:00	45.0	71.0	44.4	35.5
	8:00	44.7	70.5	44.7	37.0
	9:00	47.7	75.3	47.2	40.3
	10:00	44.4	66.8	45.7	41.4
	11:00	52.3	79.5	48.7	43.0
	12:00	49.5	81.8	50.0	44.3
13:00	48.3	73.8	49.9	44.5	

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231655)

Location: U1 - North Western Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Sunday 06/10/2019	14:00	48.8	72.3	49.8	44.0
	15:00	49.5	71.2	50.8	44.0
	16:00	48.4	70.7	49.3	43.7
	17:00	46.9	69.6	47.6	42.6
	18:00	49.2	80.6	46.0	40.6
	19:00	44.9	69.9	45.7	42.3
	20:00	41.4	58.5	42.5	39.2
	21:00	40.2	74.3	40.3	36.3
	22:00	34.2	53.1	35.8	30.5
	23:00	31.4	47.5	33.5	28.2
Monday 07/10/2019	0:00	30.7	53.8	32.7	27.5
	1:00	27.4	46.5	28.7	24.5
	2:00	28.9	50.0	30.5	25.2
	3:00	27.2	48.3	28.3	23.6
	4:00	33.9	58.0	34.1	28.3
	5:00	46.3	61.5	46.0	40.9
	6:00	46.1	64.1	46.1	40.9
	7:00	46.3	69.6	46.7	41.2
	8:00	49.9	73.9	49.7	45.2
	9:00	44.9	66.1	46.1	42.1
	10:00	48.1	76.9	48.4	42.2
	11:00	51.2	78.5	51.5	44.5
	12:00	50.5	77.6	52.3	45.6
	13:00	49.9	71.0	51.7	43.9
14:00	50.5	76.7	49.7	43.2	
15:00	48.5	69.6	50.1	43.5	
16:00	51.5	75.2	51.3	43.2	
17:00	47.0	68.7	47.1	43.2	
18:00	47.5	67.9	47.9	42.5	
19:00	44.6	63.5	45.6	41.7	
20:00	43.1	61.7	44.0	40.2	
21:00	40.9	57.1	42.2	39.3	
22:00	38.3	53.3	39.5	35.3	
23:00	34.3	51.1	36.2	31.3	
Tuesday 08/10/2019	0:00	35.1	58.3	36.0	30.2
	1:00	32.6	52.1	34.0	29.4
	2:00	31.2	46.3	32.9	28.7
	3:00	31.0	47.6	32.6	29.0

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231655)

Location: U1 - North Western Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]				
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}	
Tuesday 08/10/2019	4:00	32.5	44.8	34.1	29.9	
	5:00	36.0	48.7	37.5	33.7	
	6:00	44.0	69.4	44.0	38.2	
	7:00	47.5	74.4	47.7	43.0	
	8:00	49.8	73.9	49.8	44.8	
	9:00	52.8	73.8	52.6	43.5	
	10:00	48.5	74.4	49.3	44.2	
	11:00	47.2	71.8	49.0	43.8	
	12:00	53.0	80.2	52.6	44.5	
	13:00	48.3	69.1	49.4	43.7	
	14:00	53.4	70.9	52.6	45.2	
	15:00	52.2	75.0	52.7	46.5	
	16:00	49.5	71.7	50.8	45.6	
	17:00	46.1	64.4	47.5	44.1	
	18:00	49.0	75.2	48.4	43.4	
	19:00	51.4	74.0	48.9	42.6	
	20:00	42.8	62.8	43.8	41.4	
	21:00	41.5	55.3	42.7	39.7	
	22:00	39.2	55.8	40.9	36.9	
	23:00	37.1	53.8	39.0	33.9	
	Wednesday 09/10/2019	0:00	35.0	49.5	37.0	31.7
		1:00	33.1	49.1	34.9	29.8
		2:00	36.2	56.5	38.5	30.1
3:00		33.3	49.7	35.6	29.9	
4:00		35.8	56.4	37.7	31.5	
5:00		37.0	56.5	38.4	33.7	
6:00		46.0	64.6	44.6	39.5	
7:00		48.2	69.8	49.7	44.8	
8:00		50.1	86.6	48.3	45.2	
9:00		52.5	83.8	53.0	44.1	
10:00		53.0	82.3	52.3	43.5	
11:00		46.9	63.8	48.6	43.5	
12:00		52.2	79.9	52.4	44.4	
13:00		50.5	78.9	50.1	44.2	
14:00		47.6	68.6	48.7	43.9	
15:00		51.1	75.7	50.9	44.1	
16:00		47.1	63.5	48.7	44.3	
17:00	45.4	59.1	46.7	43.5		

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231655)

Location: U1 - North Western Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Wednesday 09/10/2019	18:00	47.1	71.1	47.3	43.3
	19:00	43.5	57.2	44.7	41.8
	20:00	44.0	62.7	45.2	41.1
	21:00	41.9	65.2	43.0	39.4
	22:00	39.3	56.7	40.7	37.4
	23:00	36.8	53.3	38.3	34.6
	Thursday 10/10/2019	0:00	34.0	47.2	35.4
1:00	33.6	55.5	35.1	30.8	
2:00	32.8	48.3	34.3	30.8	
3:00	32.5	52.2	33.8	30.6	
4:00	34.2	50.6	35.9	31.8	
5:00	38.1	50.5	39.7	35.5	
6:00	42.5	59.5	43.8	39.8	
7:00	46.2	70.5	47.2	44.0	
8:00	49.9	72.5	49.8	45.3	

Annex B
Summary Results of Unattended Noise Survey
Position U2 – Southern Residential Boundary

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231656)

Location: U2 - Southern Residential Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Thursday 03/10/2019	10:00	50.7	81.5	51.1	43.0
	11:00	52.8	85.2	51.8	42.0
	12:00	48.9	84.5	47.2	40.1
	13:00	47.5	72.8	48.7	40.4
	14:00	51.4	76.1	51.6	42.7
	15:00	51.0	75.0	51.6	42.8
	16:00	48.2	63.8	50.6	43.4
	17:00	49.6	68.4	51.8	45.1
	18:00	50.8	68.2	53.3	46.0
	19:00	55.3	69.8	57.7	49.3
	20:00	55.3	71.4	58.0	49.7
	21:00	49.3	60.4	51.5	45.5
	22:00	44.7	67.7	45.8	39.3
	23:00	37.7	58.1	39.5	34.2
Friday 04/10/2019	0:00	37.0	51.6	39.5	32.9
	1:00	36.1	52.8	38.2	31.6
	2:00	34.8	49.1	36.5	31.3
	3:00	32.9	48.3	34.8	30.2
	4:00	35.5	50.5	37.3	32.0
	5:00	37.4	52.6	39.1	34.5
	6:00	45.9	80.3	45.0	38.8
	7:00	53.6	85.8	51.1	43.9
	8:00	50.8	68.3	52.9	45.9
	9:00	52.0	80.5	52.4	44.4
	10:00	50.1	81.6	50.3	43.8
	11:00	49.2	69.5	51.5	44.4
	12:00	50.6	69.1	52.5	44.5
	13:00	48.5	69.6	50.6	42.9
14:00	50.4	85.1	50.3	41.6	
15:00	48.0	71.8	49.2	41.7	
16:00	50.0	74.3	50.1	41.2	
17:00	48.2	69.3	48.5	40.0	
18:00	44.6	66.7	46.3	39.4	
19:00	41.4	56.1	44.2	37.5	
20:00	45.5	75.5	44.3	36.0	
21:00	42.5	76.2	41.7	35.5	
22:00	37.0	62.6	38.4	32.4	
23:00	34.7	56.6	35.8	29.5	

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231656)

Location: U2 - Southern Residential Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Saturday 05/10/2019	0:00	30.7	50.2	31.5	25.6
	1:00	28.1	47.4	29.0	21.2
	2:00	31.7	59.3	29.4	20.0
	3:00	29.0	53.7	30.5	21.1
	4:00	28.6	48.0	30.1	21.5
	5:00	28.4	51.3	29.4	21.4
	6:00	53.2	79.8	42.1	27.4
	7:00	43.5	72.1	43.3	31.8
	8:00	44.6	68.6	45.4	33.7
	9:00	45.1	67.1	47.7	36.1
	10:00	44.9	64.7	48.0	36.4
	11:00	47.3	72.1	47.2	35.4
	12:00	46.0	75.5	48.1	36.3
	13:00	46.2	70.4	48.5	37.9
	14:00	43.0	63.3	45.7	36.2
	15:00	43.4	57.1	46.0	37.3
	16:00	48.2	68.3	50.2	36.5
	17:00	47.9	87.1	46.4	35.1
	18:00	41.9	64.4	44.5	35.4
	19:00	43.3	55.1	45.8	36.9
	20:00	41.7	56.0	44.2	36.3
	21:00	45.5	58.1	47.1	42.3
	22:00	47.7	69.9	48.9	43.7
23:00	49.2	60.4	50.5	46.6	
Sunday 06/10/2019	0:00	42.3	56.2	44.4	37.9
	1:00	38.5	57.3	40.6	33.6
	2:00	35.1	52.3	35.5	29.6
	3:00	40.3	58.4	39.7	33.6
	4:00	32.4	51.9	34.2	29.3
	5:00	33.4	48.1	35.1	29.8
	6:00	45.7	76.9	39.7	32.4
	7:00	47.6	78.0	44.7	35.4
	8:00	45.8	77.1	44.6	37.3
	9:00	50.1	75.2	49.7	41.3
	10:00	48.8	72.8	50.1	43.1
	11:00	51.6	74.4	52.7	44.4
	12:00	52.1	75.1	54.6	46.3
13:00	52.7	65.3	55.4	47.5	

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231656)

Location: U2 - Southern Residential Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Sunday 06/10/2019	14:00	52.0	65.8	54.3	46.8
	15:00	51.4	69.1	53.9	45.9
	16:00	51.6	68.4	54.2	45.7
	17:00	50.7	73.3	52.2	44.6
	18:00	45.2	69.7	47.0	40.9
	19:00	41.8	51.4	43.5	39.1
	20:00	40.1	51.7	42.2	37.4
	21:00	37.7	56.0	39.5	34.5
	22:00	34.9	46.4	37.3	31.1
	23:00	32.3	46.3	34.5	28.2
Monday 07/10/2019	0:00	31.3	49.9	32.9	27.0
	1:00	28.5	48.0	29.6	25.0
	2:00	30.7	55.8	31.3	24.8
	3:00	32.3	64.0	30.2	23.6
	4:00	32.1	50.2	32.9	27.3
	5:00	41.5	52.0	41.2	37.3
	6:00	45.1	75.3	45.3	39.6
	7:00	45.1	68.4	46.9	40.5
	8:00	51.3	81.5	50.5	44.5
	9:00	45.1	61.7	47.5	41.0
	10:00	51.2	81.1	50.3	42.2
	11:00	50.4	69.3	52.8	45.9
	12:00	51.9	66.0	54.4	47.5
	13:00	49.4	69.6	52.2	43.6
	14:00	51.1	79.7	51.3	43.7
	15:00	49.5	71.9	51.8	43.7
	16:00	51.8	80.5	52.7	43.0
	17:00	48.4	66.1	50.3	43.0
	18:00	47.3	68.2	48.7	41.6
	19:00	44.4	62.9	46.6	39.7
	20:00	41.5	58.8	43.8	37.8
	21:00	39.6	56.1	41.7	36.3
	22:00	37.8	53.0	39.5	34.3
23:00	34.2	49.6	35.7	31.4	
Tuesday 08/10/2019	0:00	34.3	52.7	35.6	30.1
	1:00	33.0	54.1	34.3	29.0
	2:00	31.7	50.8	33.2	28.2
	3:00	30.6	50.2	32.1	28.2

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231656)

Location: U2 - Southern Residential Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Tuesday 08/10/2019	4:00	34.8	52.4	36.1	29.6
	5:00	36.6	51.8	38.0	33.9
	6:00	47.4	80.2	43.8	38.7
	7:00	50.5	75.6	50.8	43.7
	8:00	50.3	76.9	51.7	45.1
	9:00	51.6	74.2	52.7	43.1
	10:00	47.9	68.0	49.7	43.8
	11:00	54.0	87.9	49.2	42.7
	12:00	51.0	75.2	51.8	44.4
	13:00	48.8	69.2	50.8	43.4
	14:00	51.6	70.2	53.0	45.2
	15:00	52.7	73.0	54.1	46.6
	16:00	49.8	67.5	52.0	45.5
	17:00	48.8	72.2	51.1	44.0
	18:00	48.5	71.5	49.9	42.6
	19:00	50.6	73.5	49.2	41.4
	20:00	42.0	55.0	43.9	39.5
	21:00	41.9	54.6	44.1	38.7
	22:00	40.0	60.2	41.8	37.0
	23:00	36.5	50.6	38.0	33.9
Wednesday 09/10/2019	0:00	34.7	54.6	36.3	31.8
	1:00	32.3	48.6	33.7	30.1
	2:00	33.3	50.7	35.6	30.1
	3:00	32.5	49.9	34.4	29.8
	4:00	35.5	49.2	37.4	32.1
	5:00	36.2	48.6	37.2	34.2
	6:00	45.3	71.4	44.9	39.2
	7:00	50.4	81.2	51.8	44.5
	8:00	50.9	82.6	51.8	46.0
	9:00	49.7	79.4	50.2	43.7
	10:00	48.3	74.1	49.5	43.0
	11:00	50.5	82.2	50.9	42.8
	12:00	51.5	77.5	53.1	43.8
	13:00	50.9	75.4	51.1	43.4
	14:00	47.9	66.7	50.0	43.4
	15:00	50.7	82.2	52.1	43.8
	16:00	48.2	71.3	50.3	43.8
17:00	46.9	62.5	49.0	43.4	

Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out Between
3 - 10 October 2019

Equipment Used: Rion NL-52 Class 1 Sound Level Analyser (Serial No. 00231656)

Location: U2 - Southern Residential Boundary

All Levels; Fast, Freefield, Mic Height 1.3 metres.

Date	Start Period	Measured Noise Levels [dB]			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}
Wednesday 09/10/2019	18:00	46.8	63.6	48.9	42.6
	19:00	43.3	59.2	45.5	40.5
	20:00	43.0	56.9	45.1	39.2
	21:00	41.9	70.9	43.8	38.8
	22:00	40.0	60.6	41.8	37.4
	23:00	37.4	51.9	39.0	34.7
Thursday 10/10/2019	0:00	34.1	51.8	35.5	31.9
	1:00	32.8	50.3	34.4	30.3
	2:00	32.8	45.3	34.3	30.5
	3:00	32.6	47.6	34.2	30.3
	4:00	34.4	49.1	36.3	31.6
	5:00	38.8	54.3	40.6	35.8
	6:00	44.4	68.7	45.5	39.9
	8:00	47.4	69.0	49.4	44.2
		49.9	76.6	51.4	45.9

Annex C
Results of Attended Noise Measurements

**Proposed Development on Land at Oakley Farm, Cheltenham
Results of Noise Measurements Carried Out on 3 October 2019**

Equipment Used: Rion NA-28 / NL-52 Class 1 Sound Level Analysers, Calibrated with Rion NC-74 Class 1 Acoustic Calibrator
All Levels: Fast, Freefield, Mic Height 1.2 metres.

Location	Time	FREEFIELD					Unattended Measurement Results Obtained from Position U2					Difference			
		L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}	L _{A90}	L _{Aeq}	L _{Amax,F}	L _{A10}	L _{A90}	L _{A90}	L _{Aeq}	L _{A90}		
S1 - North Eastern Boundary (NA-28)	09:50	43.8	59.1	45.7	39.8	43.6	47.3	62.4	49.0	43.6	-3.5	-3.8	Period Levels L _{Aeq} L _{A90}		
	10:05	42.2	61.5	44.6	37.9	42.3	48.7	81.5	47.8	42.3	-6.5	-4.4			
	10:20	51.3	70.5	50.6	38.9	43.2	50.7	69.4	51.5	43.2	0.6	-4.3			
	10:35	53.0	70.9	55.8	39.8	43.4	53.7	70.9	56.5	43.4	-0.7	-3.6			
Average Difference = -2.5 -4.0													Day	47.1	38.4
Average Difference = -2.2 -3.6													Night	37.4	26.7
S2 - Eastern Boundary (NA-28)	10:55	46.3	63.1	49.3	39.1	42.7	48.5	62.7	52.0	42.7	-2.2	-3.6	Period Levels L _{Aeq} L _{A90}		
	11:10	43.8	58.1	46.1	40.3	41.8	49.5	71.1	49.6	41.8	-5.7	-1.5			
	11:25	52.1	72.1	52.2	40.0	42.2	56.9	85.2	54.2	42.2	-4.8	-2.2			
	11:40	48.3	68.5	47.9	39.3	41.9	49.6	70.9	50.0	41.9	-1.3	-2.6			
Average Difference = -3.5 -2.5													Day	46.1	39.9
Average Difference = 8.6 -4.8													Night	36.4	28.2
S3 - 10m from Kerb of Harp Hill (NL-52)	09:55	54.1	68.5	58.9	37.1	42.4	45.5	64.0	47.3	42.4	8.6	-5.3	Period Levels L _{Aeq} L _{A90}		
	10:10	54.3	69.2	59.0	37.3	42.1	50.9	81.5	49.4	42.1	3.4	-4.8			
	10:25	56.2	68.3	61.1	39.4	43.6	52.9	69.3	54.4	43.6	3.3	-4.2			
	10:40	54.4	68.8	58.6	39.3	43.5	50.3	70.9	52.1	43.5	4.1	-4.2			
Average Difference = 4.9 -4.6													Day	54.4	37.8
Average Difference = 0.0 -2.5													Night	44.8	26.1
S4 - Western Boundary (NL-52)	11:05	46.6	62.9	49.1	41.3	42.4	50.1	71.1	51.1	42.4	-3.5	-1.1	Period Levels L _{Aeq} L _{A90}		
	11:20	52.3	73.7	51.1	39.3	41.8	52.3	73.9	52.0	41.8	0.0	-2.5			
	11:35	51.1	72.2	52.9	39.7	42.0	56.1	85.2	52.4	42.0	-5.0	-2.3			
	11:50	48.7	70.6	48.8	40.1	41.2	49.1	67.7	50.9	41.2	-0.4	-1.1			
Average Difference = -2.2 -1.8													Day	47.4	40.7
Average Difference = 3.7 29.0													Night	37.7	29.0

Annex D
Road Traffic Noise Calculations

Road Link	Calculated Noise Levels							Calculated Noise Levels						
	2019 Base							2024 Forecast Year						
	Daily Flow	Hourly Flow	%HGV	Speed	Low Flow	Hourly L _{A10}	L _{Aeq,16hr}	Daily Flow	Hourly Flow	%HGV	Speed	Low Flow	Hourly L _{A10}	L _{Aeq,16hr}
Harp Hill (West of Access)	3517	195	2	48	0.0	62.9	59.9	3711	206	2	48	0.0	63.1	60.1
Harp Hill (West of Stanley Road)	3822	212	2	48	0.0	63.3	60.3	4031	224	2	48	0.0	63.5	60.5

Road Link	Calculated Noise Levels						
	2024 Forecast Year + Proposed Development						
	Daily Flow	Hourly Flow	%HGV	Speed	Low Flow	Hourly L _{A10}	L _{Aeq,16hr}
Harp Hill (West of Access)	4833	269	2	48	0.0	64.3	61.2
Harp Hill (West of Stanley Road)	5152	286	2	48	0.0	64.6	61.5

Differences		
2024 Forecast Year - 2019 Base	2024 Forecast Year + Proposed Development - 2019 Base	2024 Forecast Year + Proposed Development - 2024 Forecast Year
0.2	1.3	1.1
0.2	1.2	1.0