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Project:

62-68 Silver Street

Title:

Façade Sound Insulation Assessment



Report Title	62-68 Silver Street Façade Sound Insulation Assessment		
Reference	MO/EC15019-002		
Version	0		
Issue Date	6 December 2016		
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Revision	Date	Author	Checked
0			

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1 INTRODUCTION

- 1.01 Environmental Equipment Corporation Limited has been commissioned by Mr Richard Turner to undertake a noise assessment to support a planning application for developing residential accommodation within an existing building at 62-68 Silver Street, Reading, RG1 2QH.
- 1.02 This assessment is concerned with the site's suitability for residential development in terms of external noise ingress into the proposed residential dwellings. The assessment is undertaken in accordance with the requirements of the National Planning Policy Framework (NPPF) and Noise Policy Statement for England (NPSE), and is based on the results of a noise survey carried out on site over a representative period.
- 1.03 This report is prepared solely for Mr Richard Turner. Environmental Equipment Corporation Limited accepts no responsibility for its use by any third party.
- 1.04 Whilst every effort has been made to ensure that this report is easy to understand, it is necessarily technical in nature. To assist the reader, an explanation of the terminology used in this report is contained in Appendix A.

2 SITE

- 2.01 62-68 Silver Street is a two-storey building formerly of light industrial use, located in a mixed commercial/residential area of Reading. The building has not been occupied in excess of 15 years and is currently in a poor condition.
- 2.02 The property is bound by the following:
 - North – a former HSS Hire shop (one-storey with parking at front);
 - South – a three-storey residential building of Hieatt Close (Mount Pleasant);
 - East – Silver Street roadway, with Windsor Square business park beyond consisting of up to three-storey buildings and a car park.
 - West – a row of two storey residential terraced houses (Hawk Cottages) with an open amenity area.

The property is shown on the site plan in Appendix B.

- 2.03 The proposed building consists of 8 No. residential flats: two on the ground floor, three on the first floor, and three on the second floor (an additional storey and new roof which is to be added to the existing two storey building). There will be habitable rooms located on all of the building's external elevations.
- 2.04 The noise climate on site is dominated by local road traffic along Silver Street.

3 GUIDANCE

In order to assess the site's suitability for residential development, the external noise ingress into the building from sources such as the surrounding roads must be evaluated. The noise must be below thresholds stipulated in the relevant standards to ensure reasonable living conditions. It is proposed that the recommendations of BS8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' are used as a basis for setting the limits for the external noise transmission into the building. The recommendations for the maximum ambient noise levels inside the dwellings are included in Table 4 in Section 7.7.2 of the Standard, shown below:

Table 4 Indoor ambient noise levels for dwellings

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 $L_{Aeq,8hour}$

Achieving the above noise levels (as a minimum) is considered consistent with the requirements of the NPPF and NPSE. The relevant sections of these documents are included in Appendix C.

NOTE 4 below the above table in BS8233 states:

“Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.”

The previous version of BS8233 (1999) recommends that the L_{AFmax} noise levels should ‘not normally exceeded 45dB L_{AFmax} ’. This statement is widely assumed to originate from World Health Organisation guidance which states:

“For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10-15 times per night.”

Therefore, the maximum noise levels stated in the following assessment have been based on the highest levels that were exceeded more than 15 times by the measured maximum noise levels during the night-time period.

4 MEASUREMENTS

4.01 Environmental noise measurements were carried out over a weekday period, between approximately 1215 hours on Monday 28th November 2016 and concluded approximately 1500 hours the following day, to establish the existing noise levels at the site. The survey methodology and results are set out below.

4.02 Extended period noise measurements have been carried out at the following positions, as shown in Appendix B and described as:

- Position 1: located outside a first-floor window on the rear façade of the building. The measurement was located within 1 metre of the façade, but more than 3.5 metres of any other significant reflecting surface.
- Position 2: located outside a first-floor window on the recessed portion of the front façade of the building. The measurement was located within 1 metre of the façade, but more than 3.5 metres of any other significant reflecting surface.

An auxiliary short-term measurement was taken concurrently with the measurement at Position 2 at the following location:

- Position 3: located at a height of approximately 1.5 metres approximately 3 metres to the north from the building's boundary and at the same distance from the road as the front façade. The position was located more than 3.5 metres from any significant reflecting surface other than the ground.

4.03 The above positions are considered to be representative of the noise climate outside the following facades, as indicated on the site plan in Appendix B:

- Position 1 – Façade A (rear elevation);
- Position 2 – Façades B (side and recessed front elevations);
- Position 3 – Façades C (side and front elevations).

4.04 The weather was dry with little wind for the whole duration of the survey.

4.05 The predominant source of noise at all measurement positions was road traffic on Silver Street, with the noise levels being the highest at Façades A, decreasing at Façades B due to larger distance to the road and partial acoustic screening by the intervening building structures, and being the lowest outside Façades C due to further distance losses and significant acoustic screening provided by the building.

5 EQUIPMENT

5.01 The equipment used for the survey was as follows:

Positions 1, 2, and 3

- 01dB Metravib Black Solo Integrating Sound Level Meter conforming to Class 1 BS EN 61672, Type 1 BS EN 60804 & BS EN 60651: 1994;
- 01dB Metravib MCE 212 Condenser Microphone, PRE21 S Pre-amp and Connecting Leads;
- 01dB Outdoor Microphone Kit and a
- Tripod.

5.02 The equipment holds current UKAS or equivalent accreditation and serial numbers as follows:

Positions 1 and 3	Sound Level Meter 01dB Black Solo	Serial No.	61719
		Calibration Date	5 th May 2016
		Cal Certificate No.	U21536
	½" MCE 212 Condenser Mic.	Serial No.	166397
		Calibration Date	5 th May 2016
		Cal Certificate No.	21535
	Calibrator CAL 21	Serial No.	34344442
		Calibration Date	5 th May 2016
		Cal. Certificate No.	U21534
Position 2	Sound Level Meter 01dB Black Solo	Serial No.	65736
		Calibration Date	29 th July 2015
		Cal Certificate No.	U19328
	½" MCE 212 Condenser Mic.	Serial No.	166397
		Calibration Date	29 th July 2015
		Cal Certificate No.	19326
	Calibrator CAL 21	Serial No.	34634297
		Calibration Date	24 th October 2016
		Cal. Certificate No.	U22947

N.B. Copies of calibration certificates are available upon request.

5.03 The equipment was calibrated both before and after the survey with no difference noted in the levels.

6 RESULTS

- 6.01 A list of the measured levels is included in Appendix D and represented graphically in Appendix E.
- 6.02 A summary of the measured time-averaged ambient, background and maximum noise levels is shown in Tables 6.1 and 6.2. Positions 1 and 2 include a -3 dB correction applied to the measured levels to compensate for reflections from the closest façades and to represent free field measurement conditions.
- 6.03 In Table 6.1, the minimum L_{A90} is the lowest five-minute measurement in the specified period. The stated L_{AFmax} levels are the highest levels that were exceeded more than 15 times during the night-time period (see Section 3).

Position	Period	$L_{Aeq,T} - \text{dB}$	Minimum $L_{A90, 5\text{min}} - \text{dB}$	$L_{AFmax} - \text{dB}$
1	Day time and evening (0700-2300 hrs)	49	38	-
	Night-time (2300-0700 hrs)	43	32	58
2	Day time and evening (0700-2300 hrs)	66	42	-
	Night-time (2300-0700 hrs)	60	36	78

Table 6.1: Free-field measured noise levels. Readings from Positions 1 and 2 are corrected to eliminate the influence of reflections from the closest façades and represent free field conditions (-3 dB with respect to the measured levels). The stated L_{AFmax} levels are the highest levels that were exceeded more than 15 times during the night-time period.

Position	Period	$L_{Aeq,15\text{min}} - \text{dB}$	$L_{A90, 15\text{min}} - \text{dB}$	$L_{AFmax} - \text{dB}$
2	1448-1503 hrs	66	51	78
3	1448-1503 hrs	70	55	83

Table 6.2: Free-field measured noise levels. Readings from Position 2 are corrected to eliminate the influence of reflections from the closest façades and represent free field conditions (-3 dB with respect to the measured levels).

7 SITE SUITABILITY FOR RESIDENTIAL DEVELOPMENT

- 7.01 Habitable rooms are proposed to be sited on all external elevations of the building, and so the impact of the existing noise sources on all external façades should be investigated.
- 7.02 The external building fabric of the dwellings should be specified to ensure that the external noise is reduced to the levels proposed in Section 3. To represent the worst case, the required sound insulation performance is based on the lowest proposed internal noise criteria for the associated period, i.e. 35 dB $L_{Aeq,16hours}$ (BS8233:2014 day-time criterion for a living room) and 30 dB $L_{Aeq,8hours}$ (BS8233:2014 night-time criterion for a bedroom). The BS8233:1999 sleep disturbance criterion of 45 dB L_{AFmax} is also considered.
- 7.03 The site survey established that the dominant source of noise at all the façades of the property is from traffic on Silver Street. The maximum noise levels, the L_{AFmax} , are therefore controlled by traffic using this route. As the road traffic is sporadic in nature overnight it consists of individual noise events which have the potential to cause sleep disturbance, as described in Section 3.
- 7.04 It is proposed that the minimum required sound reduction performance of the external façades is calculated based on the following measurements:
- Façade A: Position 1;
 - Façades B: Position 2;
 - Façades C: Position 2 with the levels corrected based on the comparison between the concurrent readings from Position 2 and Position 3. The short-term $L_{Aeq,15min}$ and $L_{A90,15min}$ readings from Position 2 were 4 dB lower than equivalent concurrent readings at Position 3. As the dominant source and the character of the ambient noise does not change throughout the day and night, it is considered appropriate to assume that this difference will be consistent at any time. It is therefore proposed that the extended period measurements from Position 2, included in Table 6.1, are increased by 4 dB and used to assess the noise ingress on Façades C.

The extent of the above types of façades is marked with orange, green, and purple colours respectively in the site plan in Appendix B.

- 7.05 The results of the calculations are shown in Table 7.1, where the controlling requirements have been highlighted bold.
- 7.06 The sound reduction performance requirements set out below apply to the whole external building fabric of the property. However, since windows are typically the weakest link in the external façades in terms of acoustic performance, the requirements apply to glazing in particular. In this case the existing building is formed of masonry which will offer a good level of sound insulation. It will therefore be essential that the additional storey be formed in a similar way or using constructions that offer similar levels of sound insulation to the existing masonry.
- 7.07 Windows do not reduce noise equally across the frequency spectrum, and so the overall sound reduction performance of a given window unit will be influenced by the frequency content of the sound. As road traffic is the dominant noise source at the site, glazing with the R_w+C_{tr} descriptor has been specified to account for the low frequency characteristics of road traffic noise. Table 7.1 below gives an indication of the R_w+C_{tr} values that the glazing elements should provide.
- 7.08 To achieve the most stringent internal noise requirement a window glazing, door and frame system achieving R_w+C_{tr} of at least 14 dB, 33 dB, and 37 dB is required for Façades A, B, and C

respectively. Table 7.2 below presents example of glazing recommendations for the site that could be incorporated into the façade design to provide the required sound insulation values.

Location	Period	Measured External Noise Level, dB	Internal Noise Level Requirement, dB	Sound Reduction Performance Requirement, dB R_w+C_{tr}
Façade A	Daytime	49 L_{Aeq}	35 L_{Aeq}	14
	Night-time	43 L_{Aeq}	30 L_{Aeq}	13
		58 L_{AFmax}	45 L_{AFmax}	13
Façades B	Daytime	66 L_{Aeq}	35 L_{Aeq}	31
	Night-time	60 L_{Aeq}	30 L_{Aeq}	30
		78 L_{AFmax}	45 L_{AFmax}	33
Façades C	Daytime	70 L_{Aeq}	35 L_{Aeq}	35
	Night-time	64 L_{Aeq}	30 L_{Aeq}	34
		82 L_{AFmax}	45 L_{AFmax}	37

Table 7.1: Minimum required façade sound insulation performance.

Location	Pilkington's insulating glass units	Octave Band Sound Insulation Performance, dB							
		125	250	500	1k	2k	4k	R_w	R_w+C_{tr}
Façade A	4 mm / (6-16 mm) / 4 mm	21	17	25	35	37	31	29	25
Façades B	Optiphon™ 6 mm / 16 mm argon / 6.8 mm	22	27	35	42	41	48	38	33
Façades C	Optiphon™ 10 mm / 16 mm argon / 9.1 mm	29	33	44	46	49	57	45	40

Table 7.2: Pilkington glazing manufacturer's performance values. Typical examples.

- 7.09 It should be noted that Table 7.2 is only relevant for habitable rooms. For non-habitable spaces, for example in common stairwell/corridors, the sound insulation requirements will likely be readily met with glazing offering the minimum thermal insulation.
- 7.10 Glazing arrangements other than that suggested above may be suitable and it is the responsibility of the glazing manufacturer to recommend and provide appropriate systems that meet the minimum sound reduction index from Table 7.1.
- 7.11 The above outline analysis is provided to demonstrate that a design solution that meets the requirements of appropriate standards with respect to internal noise limits is feasible at the site.
- 7.12 The detailed design of the proposed property will have an influence on both the required sound reduction performance and the appropriate selection of glazing units. The aspects of the detailed design that are important are the room dimensions, room finishes, window dimensions and the sound reduction performance of non-glazing elements.
- 7.13 It is also important to note that the stated sound insulation requirements are for the glazing 'systems' and include the effects of frames, panels, spandrels and mullions.
- 7.14 Further to the glazing requirements, internal noise levels should be considered in the context of room ventilation requirements.
- 7.15 Approved Document F (ADF 2010) presents dwelling ventilation rates in terms of the number of bedrooms within each dwelling and describes whole building ventilation (for continuous occupation), intermittent extract ventilation from wet rooms and intermittent purge ventilation throughout the dwelling. Purge ventilation is that required to "to aid the removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water. Purge ventilation is intermittent, i.e. required only when such occasional activities occur."
- 7.16 The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of passive ventilation systems. IP4/99: *Ventilators: Ventilation and Acoustic Effectiveness* (October 1999) details a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different through-wall passive ventilators. The measured sound reduction performance, after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator, ranged from 14 to 46dB.
- 7.17 Passive vents to provide background ventilation are therefore available that meet or exceed the sound reduction required by the glazing elements. However, consultation with the mechanical services engineer will be required to establish the exact type of trickle ventilation product and equivalent free area requirement of each space to ensure that the correct acoustic performance of the product is selected.
- 7.18 With regard to rapid or purge ventilation rates, it is generally accepted that a partially open window provides a reduction in external noise levels of up to 15dB. In light of this and the sound reduction requirements outlined in Table 7.1 it can be seen that the internal noise levels will not be met with open windows on Façades B and C. In the event of purge ventilation being provided by open windows the internal noise levels will therefore be exceeded in the rooms located at these façades. However, it may be acceptable in these instances of purge ventilation that higher noise levels are tolerable and other prevailing requirements may take a precedent over the acoustic design.
- 7.19 Alternatively, a suitable mechanical ventilation system may be considered if internal noise levels are required to meet the design standards whilst achieving the required rapid ventilation rates

indicated in Approved Document F. An appropriate noise control scheme may be required to ensure any internal mechanical services system is designed to meet the internal ambient noise levels stated in BS8233. Additionally, the external noise emissions of any mechanical services plant will need to be considered to ensure that the noise has no adverse impact on the amenity of the neighbouring residential properties.

8 CONCLUSIONS

- 8.01 Environmental Equipment Corporation Limited has been commissioned by Mr Richard Turner to undertake a noise assessment to support a planning application for developing residential accommodation within an existing building at 62-68 Silver Street, Reading, RG1 2QH.
- 8.02 The purpose of the assessment was to establish whether the site is suitable for residential development with respect to external noise ingress into the proposed dwellings.
- 8.03 A noise survey has been undertaken to establish the existing noise on site. The results were used to specify the required façade sound insulation performance for the proposed residential dwellings based on the requirements of BS8233:2014 to ensure the desirable internal noise limits can be achieved.
- 8.04 Example glazing configurations have been proposed to demonstrate feasibility of the assessed buildings to meet the proposed internal noise limits. Assuming that the installed glazing meets the sound reduction performance values stated in this report and a suitable background ventilation scheme is developed, whether trickle vents or mechanical ventilation, it is considered that ambient noise ingress does not pose a material constraint to the proposed residential development.
- 8.05 The predicted internal noise levels exceed the design criteria with open windows on all façades except for the rear of the building. Open windows may be required for purge ventilation. However, during these infrequent periods it is considered likely that higher noise levels will be acceptable. If this is not the case, the possibility for implementing mechanical ventilation systems may be investigated.

APPENDIX A
GLOSSARY OF TECHNICAL TERMS

TECHNICAL TERMS AND UNITS

Decibel (dB) - This is the unit used to measure sound. The human ear has an approximately logarithmic response to sound over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). We therefore use a logarithmic scale to describe sound pressure levels, intensities and power levels. The logarithms used are to base 10; hence, an increase of 10 dB in sound pressure level corresponds to a doubling in perceived loudness of the sound.

Sound Power Level (SWL) - This is a function of the noise source alone and is independent of its surroundings. It is a measure of the amount of sound power output measured in decibels.

Sound Pressure Level (SPL) - This is a function of the source and its surroundings and is a measure of the sound pressure at a point in space. For example, a sound pressure level measured at 1 metre from a sound source of certain sound power in reverberant room will not be the same as the sound pressure level 1 metre from the sound source measured in open space.

Octave and One-Third Octave Bands - The human ear is sensitive to sound over a range of approximately 20 Hz to 20 KHz and is generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum is divided into frequency bands and the sound pressure level is measured in each band. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For finer analysis, each octave band may be split into one-third octave bands.

"A" Weighting - A number of frequency weightings have been developed to imitate the ear's varying sensitivity to sound of different frequencies. The most commonly used weighting is the "A" weighting. The "A" weighted SPL can be measured directly or derived from octave or one-third octave band SPLs. The result is a single figure index which gives some idea of the subjective loudness of the sound, but which contains no information as to its frequency content.

Noise Rating (NR) Curves - The "A" weighted sound pressure level cannot be used to define a spectrum or to compare sounds of different frequencies. NR curves convey frequency information in a single-figure index. This is done by defining the maximum permissible sound pressure level at each frequency for each curve. To measure the noise rating of a given environment, the SPL is measured in octave or one-third octave bands and the noise rating is then the highest NR curve touched by the measured levels.

Intermittency and Time-Weighting - The degree of annoyance caused by a noise also depends on its duration and intermittency of a noise. Intermittent, impulsive or repetitive noises tend to be more annoying than continuous noises. Various time-weightings have been derived to measure sounds of differing intermittences and these can be measured directly on modern equipment. The most common time-weightings in use are as follows:-

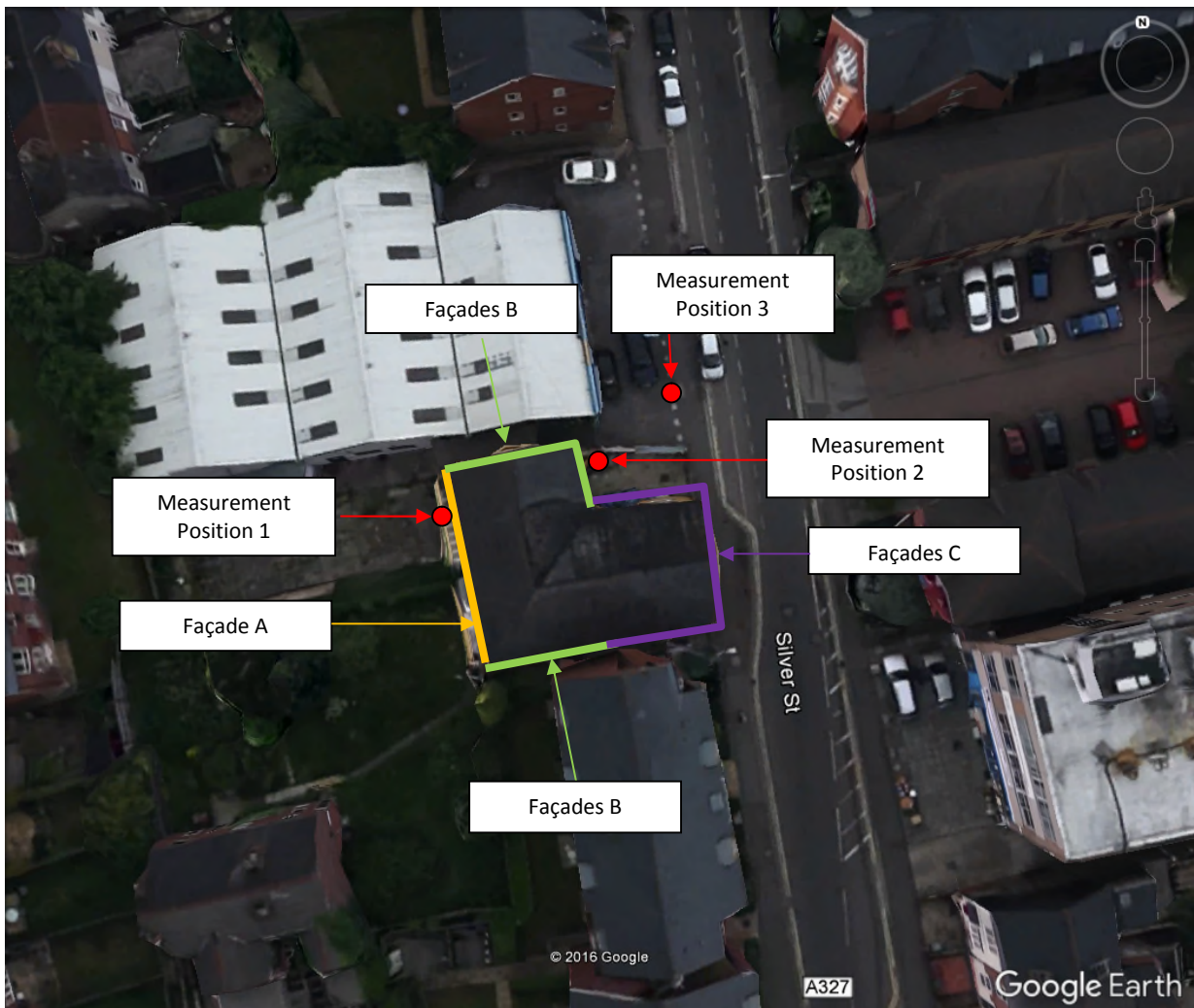
L_{90} This is the sound pressure level exceeded for 90% of the measurement period. It is widely used to measure background noise levels.

L_{10} This is the sound pressure level exceeded for 10% of the measurement period. It is widely used to measure traffic noise. For a given measurement period, the L_{10} level is by definition greater than or equal to the L_{90} level.

L_{eq} The equivalent continuous noise level is often used to measure intermittent noise. It is defined as the notional steady noise level that would contain the same acoustic energy as the varying noise. Because the averaging process used is logarithmic, the L_{eq} level tends to be dominated by the higher noise levels measured.

APPENDIX B

**SITE PLAN
&
MEASUREMENT LOCATION**



APPENDIX C

**PLANNING POLICY
AND GUIDANCE**

quietly moving forward

PLANNING POLICY AND GUIDANCE

National Planning Policy Framework and the Noise Policy Statement for England

The Department for Communities and Local Government published the National Planning Policy Framework (NPPF) on 27th March 2012 and upon its publication, the majority of planning policy statements and guidance notes were withdrawn, including Planning Policy Guidance 24 Planning and Noise, which previously presented the government's overarching planning policy on noise.

The NPPF contains four aims, which are set out at paragraph 123 in Section 11 of the document, titled *Conserving and enhancing the natural environment*:

"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 Department for Environment Food and Rural Affairs published the Noise Policy Statement for England (NPSE) in March 2010. The explanatory note of NPSE defines the following terms used in the NPPF:

"NOEL – No Observed Effect Level

This is the level below which no effect can be detected. 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.

2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur."

The NPSE does not define any of the above effect levels numerically.

The NPSE presents the Noise Policy Aims as:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy and sustainable development:

avoid significant adverse impacts on health and quality of life;

mitigate and minimise adverse impacts on health and quality of life; and

where possible, contribute to the improvement of health and quality of life."

It can be seen that the first two bullet points are similar to Section 11 of the NPPF, with a third aim that seeks to improve health and quality of life. The NPSE later expands on the Noise Policy Aims, stating:

2.23 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also taking into account the guiding principles of sustainable development (paragraph 1.8).

2.24 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.

2.25 This aim (the third aim), seeks where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development (paragraph 1.8), recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

It is clear that noise described in the NPSE as SOAEL that would lead to significant adverse effects should be avoided, although there is no definition as to what constitutes a significant adverse effect. Similarly, noise should be mitigated where it is high enough to lead to adverse effects, termed the LOAEL, but not so high that it leads to significant adverse effects.

APPENDIX D

SURVEY RESULTS
(TABULAR)

EC 15019 - 62 Silver Street, Reading

Richard Turner

Tabulated Noise Data - Position 1

Sheet 1 of 4

Time	L _{Aeq}	L _{AMax}	L _{A90}
12:15	50	59	43
12:20	50	57	43
12:25	50	60	43
12:30	51	62	43
12:35	52	62	45
12:40	51	60	45
12:45	51	62	43
12:50	52	62	46
12:55	50	63	43
13:00	52	62	45
13:05	54	68	46
13:10	52	63	45
13:15	50	56	45
13:20	51	59	44
13:25	52	63	44
13:30	53	63	46
13:35	50	57	43
13:40	50	59	44
13:45	51	57	45
13:50	51	62	46
13:55	51	60	46
14:00	51	63	46
14:05	53	64	45
14:10	52	63	45
14:15	51	58	45
14:20	51	55	45
14:25	51	59	45
14:30	51	57	44
14:35	50	56	45
14:40	52	62	45
14:45	51	58	46
14:50	51	64	46
14:55	51	59	45
15:00	50	59	44
15:05	51	58	46
15:10	51	61	46
15:15	51	61	45
15:20	53	61	47
15:25	51	60	47
15:30	51	57	46
15:35	50	58	45
15:40	52	64	47
15:45	59	79	47
15:50	51	72	44
15:55	51	58	47
16:00	52	59	46
16:05	53	69	47
16:10	50	58	45

Time	L _{Aeq}	L _{AMax}	L _{A90}
16:15	53	64	44
16:20	52	64	46
16:25	52	62	47
16:30	54	74	47
16:35	51	64	45
16:40	52	60	43
16:45	51	60	44
16:50	51	58	45
16:55	50	61	44
17:00	50	58	44
17:05	51	58	46
17:10	51	56	44
17:15	51	58	45
17:20	50	58	45
17:25	53	64	46
17:30	52	71	46
17:35	52	59	47
17:40	52	58	47
17:45	51	58	46
17:50	53	70	45
17:55	50	57	46
18:00	52	61	48
18:05	51	58	46
18:10	51	59	46
18:15	52	66	46
18:20	52	65	47
18:25	51	59	46
18:30	52	61	46
18:35	51	58	45
18:40	53	66	46
18:45	53	68	47
18:50	51	60	46
18:55	50	58	45
19:00	52	64	46
19:05	52	63	46
19:10	51	63	46
19:15	52	61	46
19:20	51	59	45
19:25	51	58	45
19:30	52	60	46
19:35	53	64	47
19:40	53	67	47
19:45	50	59	44
19:50	50	60	45
19:55	50	59	45
20:00	50	56	44
20:05	53	67	46
20:10	52	63	45

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Tabulated Noise Data - Position 1

Sheet 2 of 4

Time	L _{Aeq}	L _{AMax}	L _{A90}
20:15	50	57	45
20:20	51	60	45
20:25	51	59	45
20:30	50	59	44
20:35	53	63	44
20:40	49	66	43
20:45	49	57	43
20:50	50	58	43
20:55	50	60	44
21:00	49	61	44
21:05	53	72	45
21:10	52	63	44
21:15	53	65	44
21:20	52	65	43
21:25	51	61	43
21:30	53	66	44
21:35	50	60	44
21:40	50	61	44
21:45	50	59	43
21:50	50	59	43
21:55	48	57	43
22:00	50	61	43
22:05	49	59	43
22:10	50	60	43
22:15	49	59	44
22:20	49	61	41
22:25	47	57	42
22:30	50	64	42
22:35	48	62	42
22:40	48	58	41
22:45	47	58	41
22:50	48	57	41
22:55	47	58	41
23:00	46	58	41
23:05	48	57	42
23:10	48	57	42
23:15	50	66	42
23:20	48	60	41
23:25	44	57	40
23:30	50	68	40
23:35	44	56	40
23:40	46	58	40
23:45	47	58	40
23:50	46	59	39
23:55	44	56	38
00:00	44	58	39
00:05	45	58	40
00:10	46	56	40

Time	L _{Aeq}	L _{AMax}	L _{A90}
00:15	45	57	40
00:20	47	59	41
00:25	47	59	39
00:30	46	60	41
00:35	45	58	39
00:40	46	62	39
00:45	42	55	38
00:50	43	54	39
00:55	44	57	38
01:00	43	59	38
01:05	45	57	38
01:10	43	55	39
01:15	44	59	38
01:20	44	58	39
01:25	42	59	38
01:30	43	55	38
01:35	43	55	38
01:40	44	59	39
01:45	40	49	38
01:50	44	59	38
01:55	41	57	38
02:00	43	54	39
02:05	42	56	38
02:10	45	56	38
02:15	42	56	37
02:20	41	54	37
02:25	43	59	38
02:30	42	56	38
02:35	43	56	38
02:40	52	76	38
02:45	44	61	37
02:50	45	61	38
02:55	41	56	36
03:00	40	54	36
03:05	43	59	36
03:10	43	57	36
03:15	42	56	37
03:20	41	52	37
03:25	42	57	36
03:30	37	45	35
03:35	43	58	37
03:40	42	57	37
03:45	41	54	37
03:50	39	54	35
03:55	42	58	37
04:00	38	42	36
04:05	43	57	36
04:10	43	58	36

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Tabulated Noise Data - Position 1

Sheet 3 of 4

Time	L _{Aeq}	L _{AMax}	L _{A90}
04:15	40	54	37
04:20	42	56	38
04:25	44	57	38
04:30	44	59	39
04:35	44	59	39
04:40	44	57	39
04:45	44	60	38
04:50	44	59	39
04:55	45	58	38
05:00	41	54	39
05:05	42	57	39
05:10	41	55	39
05:15	47	61	40
05:20	45	58	40
05:25	46	57	41
05:30	47	61	40
05:35	47	61	40
05:40	48	61	42
05:45	46	57	42
05:50	48	58	43
05:55	50	59	43
06:00	48	58	43
06:05	48	59	43
06:10	50	60	45
06:15	48	61	43
06:20	49	62	43
06:25	48	58	44
06:30	49	61	44
06:35	50	60	44
06:40	50	61	45
06:45	52	60	45
06:50	53	67	46
06:55	52	61	46
07:00	50	59	45
07:05	51	61	45
07:10	53	69	47
07:15	53	61	47
07:20	51	59	46
07:25	53	71	47
07:30	52	61	45
07:35	52	62	47
07:40	52	59	47
07:45	52	60	46
07:50	53	62	47
07:55	53	71	48
08:00	52	59	47
08:05	52	57	48
08:10	52	59	49

Time	L _{Aeq}	L _{AMax}	L _{A90}
08:15	51	58	47
08:20	52	60	47
08:25	52	59	48
08:30	52	61	47
08:35	52	69	47
08:40	52	58	47
08:45	52	62	48
08:50	52	62	48
08:55	52	64	48
09:00	52	60	47
09:05	58	73	48
09:10	52	58	47
09:15	53	66	49
09:20	52	66	47
09:25	52	61	47
09:30	52	58	47
09:35	53	62	47
09:40	52	60	47
09:45	50	59	46
09:50	52	62	45
09:55	50	60	45
10:00	51	61	46
10:05	50	58	45
10:10	50	64	46
10:15	52	60	45
10:20	51	58	44
10:25	50	64	44
10:30	50	60	44
10:35	51	60	44
10:40	49	57	44
10:45	51	60	44
10:50	50	57	45
10:55	51	60	44
11:00	51	58	45
11:05	50	60	43
11:10	51	62	44
11:15	55	73	46
11:20	50	60	44
11:25	49	58	44
11:30	51	59	43
11:35	50	59	43
11:40	50	57	43
11:45	51	59	43
11:50	50	62	46
11:55	50	58	43
12:00	50	59	44
12:05	51	61	46
12:10	50	59	43

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Tabulated Noise Data - Position 2

Sheet 1 of 4

Time	L _{Aeq}	L _{AMax}	L _{A90}
12:50	68	82	52
12:55	68	81	49
13:00	70	81	54
13:05	69	77	53
13:10	67	78	51
13:15	68	76	53
13:20	68	81	49
13:25	68	82	51
13:30	69	77	52
13:35	66	77	48
13:40	66	76	49
13:45	69	79	52
13:50	67	78	51
13:55	68	79	53
14:00	68	79	50
14:05	69	88	50
14:10	71	89	51
14:15	69	80	50
14:20	69	77	53
14:25	68	79	51
14:30	69	79	48
14:35	67	77	49
14:40	69	79	50
14:45	69	78	51
14:50	67	79	51
14:55	69	80	52
15:00	69	81	49
15:05	69	78	50
15:10	69	79	52
15:15	69	80	53
15:20	69	82	54
15:25	69	83	55
15:30	69	79	55
15:35	68	78	51
15:40	69	82	56
15:45	81	104	51
15:50	67	80	51
15:55	69	77	55
16:00	67	77	52
16:05	68	82	53
16:10	67	78	51
16:15	70	85	50
16:20	69	78	52
16:25	68	78	54
16:30	70	80	54
16:35	67	85	52
16:40	69	81	49
16:45	68	77	50

Time	L _{Aeq}	L _{AMax}	L _{A90}
16:50	68	78	53
16:55	66	78	51
17:00	67	79	49
17:05	68	77	54
17:10	68	77	51
17:15	68	79	50
17:20	67	76	51
17:25	68	78	53
17:30	69	83	51
17:35	69	80	55
17:40	70	80	53
17:45	68	78	51
17:50	68	78	50
17:55	68	78	52
18:00	70	81	56
18:05	68	78	52
18:10	67	79	52
18:15	70	89	53
18:20	70	82	54
18:25	68	79	52
18:30	69	81	52
18:35	68	78	51
18:40	70	84	52
18:45	70	84	53
18:50	69	77	52
18:55	68	78	52
19:00	69	79	51
19:05	69	80	52
19:10	66	75	51
19:15	69	82	51
19:20	69	79	51
19:25	69	78	50
19:30	69	81	52
19:35	69	83	52
19:40	70	84	54
19:45	67	80	49
19:50	68	80	49
19:55	67	79	50
20:00	68	76	49
20:05	69	79	50
20:10	69	79	53
20:15	67	78	49
20:20	69	82	50
20:25	67	77	49
20:30	67	79	49
20:35	68	86	50
20:40	66	79	48
20:45	66	78	48

EC 15019 - 62 Silver Street, Reading

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Tabulated Noise Data - Position 2

Sheet 2 of 4

Time	L _{Aeq}	L _{AMax}	L _{A90}
20:50	68	78	48
20:55	68	79	49
21:00	66	77	50
21:05	69	87	51
21:10	68	80	49
21:15	68	80	49
21:20	66	78	49
21:25	68	83	50
21:30	69	84	48
21:35	68	81	50
21:40	67	82	49
21:45	67	79	48
21:50	68	80	49
21:55	65	78	48
22:00	69	81	48
22:05	66	80	49
22:10	69	80	49
22:15	67	79	50
22:20	66	81	47
22:25	64	77	46
22:30	68	85	47
22:35	66	83	48
22:40	66	79	45
22:45	65	78	46
22:50	66	78	46
22:55	65	78	45
23:00	64	78	45
23:05	66	77	47
23:10	65	77	46
23:15	68	85	47
23:20	66	81	47
23:25	59	78	44
23:30	67	88	45
23:35	60	76	44
23:40	64	79	44
23:45	65	78	44
23:50	62	79	43
23:55	61	77	42
00:00	61	79	43
00:05	60	76	44
00:10	63	77	44
00:15	62	76	44
00:20	64	80	45
00:25	65	79	43
00:30	63	81	46
00:35	63	79	42
00:40	64	83	44
00:45	59	75	42

Time	L _{Aeq}	L _{AMax}	L _{A90}
00:50	58	75	43
00:55	59	76	43
01:00	60	77	41
01:05	62	78	42
01:10	59	75	42
01:15	62	81	41
01:20	61	79	43
01:25	59	79	41
01:30	58	74	42
01:35	60	75	42
01:40	61	79	42
01:45	45	57	41
01:50	61	79	40
01:55	58	77	41
02:00	59	75	43
02:05	59	75	41
02:10	62	77	42
02:15	59	76	40
02:20	57	74	41
02:25	59	80	42
02:30	59	77	41
02:35	59	76	41
02:40	63	89	41
02:45	62	81	41
02:50	63	82	41
02:55	58	76	39
03:00	56	75	39
03:05	62	80	40
03:10	59	77	40
03:15	58	77	42
03:20	54	72	41
03:25	60	77	40
03:30	46	65	39
03:35	60	78	41
03:40	57	76	42
03:45	56	74	41
03:50	54	75	39
03:55	58	80	41
04:00	42	47	40
04:05	61	77	41
04:10	60	78	40
04:15	56	74	40
04:20	58	76	41
04:25	60	77	42
04:30	62	79	43
04:35	61	80	42
04:40	62	78	43
04:45	61	80	42

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Tabulated Noise Data - Position 2

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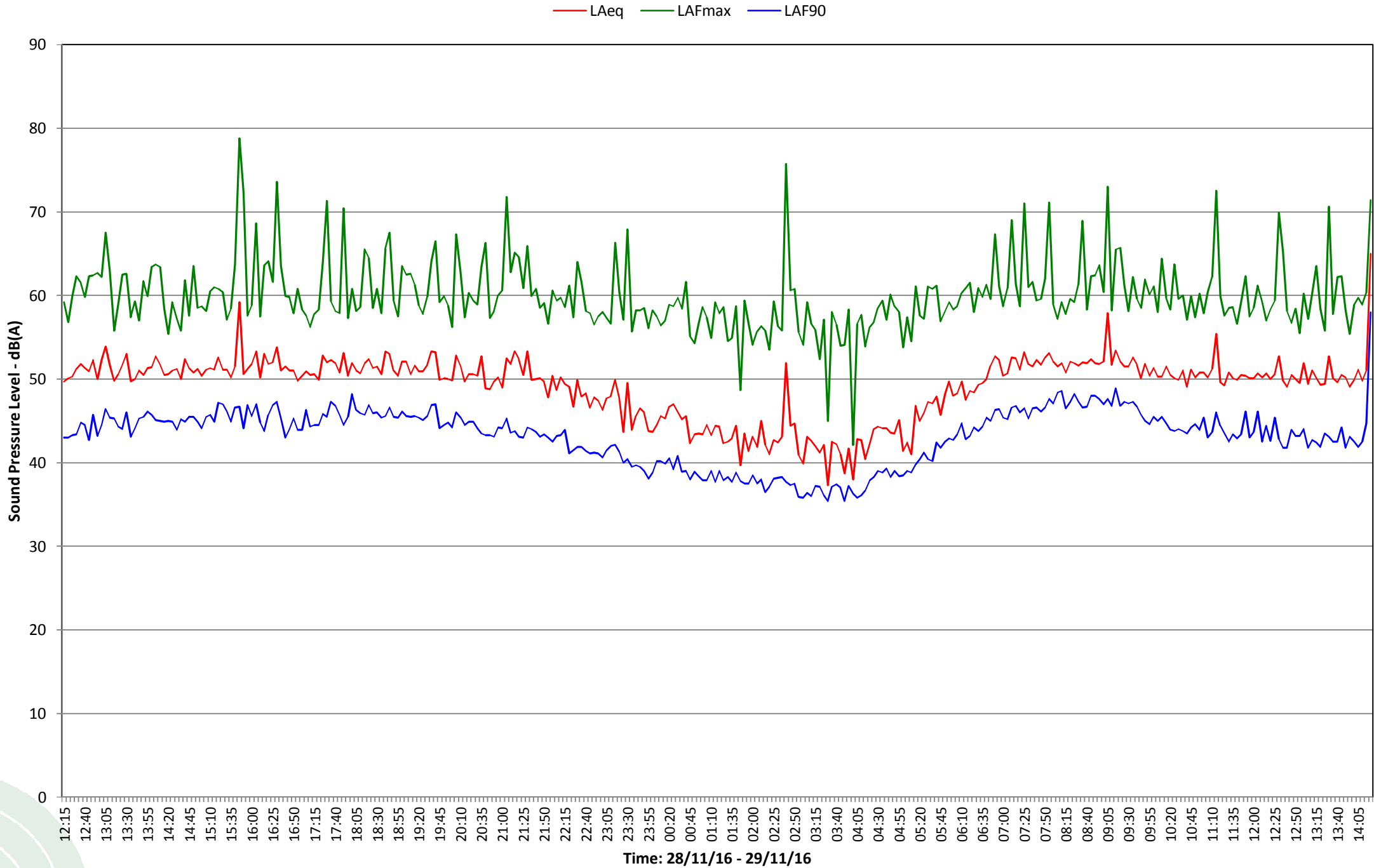
Time	L _{Aeq}	L _{AMax}	L _{A90}
04:50	61	80	42
04:55	61	79	42
05:00	55	74	43
05:05	58	77	42
05:10	54	75	42
05:15	65	81	44
05:20	61	78	45
05:25	62	78	46
05:30	65	82	44
05:35	65	81	44
05:40	65	82	47
05:45	62	78	46
05:50	65	77	47
05:55	63	80	47
06:00	64	78	47
06:05	64	78	48
06:10	66	80	50
06:15	65	80	48
06:20	66	81	48
06:25	66	78	49
06:30	66	80	48
06:35	66	80	49
06:40	67	82	50
06:45	69	80	50
06:50	69	82	52
06:55	70	81	53
07:00	68	78	51
07:05	68	81	50
07:10	70	80	52
07:15	70	82	51
07:20	68	79	51
07:25	70	78	52
07:30	69	81	50
07:35	69	81	52
07:40	70	79	52
07:45	69	79	51
07:50	70	80	51
07:55	70	80	52
08:00	70	81	55
08:05	69	79	54
08:10	70	81	56
08:15	68	78	52
08:20	70	82	53
08:25	69	78	56
08:30	69	83	54
08:35	68	81	52
08:40	69	79	53
08:45	69	78	56

Time	L _{Aeq}	L _{AMax}	L _{A90}
08:50	69	79	54
08:55	69	88	53
09:00	69	80	52
09:05	69	82	53
09:10	69	79	52
09:15	68	81	55
09:20	68	80	51
09:25	68	82	53
09:30	68	79	52
09:35	71	82	54
09:40	68	76	52
09:45	67	79	49
09:50	68	80	49
09:55	68	81	50
10:00	69	82	51
10:05	67	80	50
10:10	67	79	50
10:15	68	80	49
10:20	69	81	48
10:25	67	81	48
10:30	67	79	47
10:35	68	78	47
10:40	67	78	48
10:45	68	80	51
10:50	68	80	51
10:55	69	80	49
11:00	67	76	51
11:05	67	82	49
11:10	69	83	48
11:15	75	96	55
11:20	67	80	49
11:25	67	77	51
11:30	69	79	47
11:35	69	80	51
11:40	68	79	47
11:45	69	80	51
11:50	68	78	53
11:55	68	80	47
12:00	68	81	53
12:05	69	77	54
12:10	68	78	51
12:15	69	80	52
12:20	68	79	48
12:25	68	78	54
12:30	69	81	51
12:35	67	78	48
12:40	68	77	46
12:45	69	79	51

APPENDIX E
SURVEY RESULTS
(GRAPHICAL)

Noise Level Time History at 62 Silver Street, Reading

Position 1



Noise Level Time History at 62 Silver Street, Reading Position 2

