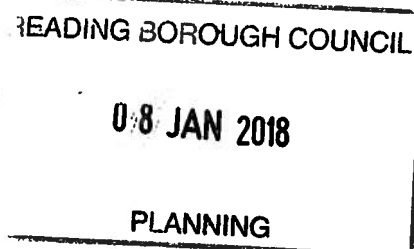


for
Taylor Wimpey UK Ltd
Stratfield House
Station Road
Hook
Hampshire
RG27 9PQ

Dated: 16 June 2015

ENVIRONMENTAL NOISE MEASUREMENTS
WITH MITIGATION ASSESSMENT
FOR A PROPOSED DEVELOPMENT
ON LAND AT BATH ROAD
AND SOUTHCOTE LANE,
READING, BERKSHIRE



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1. INTRODUCTION

AIRO is retained by Taylor Wimpey UK Ltd to provide independent specialist advice and measurement services in respect of a proposed residential development of land at Bath Road and Southcote Lane, Reading, Berkshire.

This report presents the results of noise measurements made on the site on 1 to 3 November 2011, and an environmental noise assessment based on the survey. Reference is made to national planning policy guidance set out in the National Planning Policy Framework (NPPF) (ref 1).

Outline façade mitigation advice is given where appropriate to satisfy the internal noise levels given in British Standard BS 8233 (ref 2).

The layout assessed for the outline mitigation advice is that shown on the Broadway Malyan drawing no 30717-A-02-001 Rev P10 that has been provided by Armstrong Rigg Planning on behalf of Taylor Wimpey UK Ltd.

2. DESCRIPTION OF THE SITE AND DEVELOPMENT PROPOSAL

The site for which development is proposed is broadly rectangular in shape and at the time of the survey was occupied by vacant buildings and gardens of the former Elvian School. The site is located between Bath Road to the north and Southcote Lane to the south. The roads are diverging as they travel west past the site with the distance between the two roads forming an approximate 200 metre long eastern boundary and 280 metre long western boundary of the proposed development site.

The northern boundary with Bath Road is approximately 225 metres long and the southern boundary with Southcote Lane is approximately 210 metres long.

The western portion of the site, currently the former school playing field, is at the same approximate ground height as Bath Road on the northern boundary but is on a slight embankment approximately 1.5 metres to 2 metres above Southcote Lane at the southern boundary. The eastern portion of the site is landscaped at its northern boundary with Bath Road such that the existing ornamental gardens are sunk approximately 1.5 metres below the level of Bath Road.

The eastern part of the site, from the ornamental gardens to Southcote Lane, is at the same ground height as the playing fields to the west, but slopes more gently to a boundary with Southcote Lane at about 1 metre above road level.

Road traffic on Bath Road is the most significant noise source at the northern part of the site and across the entire site in general whilst road traffic on Southcote Lane, due to a much lower flow rate by comparison, is only significant during each wave of traffic passbys. Other sources of noise are highflying aircraft but these are considerably less significant noise events than passing road traffic.

The proposed residential development is understood to consist of about 118 dwellings on the Southcote Lane side of the site. The balance of the site towards Bath Road is to be developed as a school and is outwith the scope of this report.

3. MEASUREMENT UNITS

3.1 A-Weighted Equivalent Continuous Sound Level - $L_{Aeq,T}$

Noise levels quoted in the report are, in the main, A-weighted Equivalent Continuous Sound Levels or $L_{Aeq,T}$ in dB.

As its name suggests, the $L_{Aeq,T}$ is a measure of the acoustic energy of a fluctuating noise climate over a given period T expressed as the single continuous noise level having the same energy as the time varying signal.

The 'A' within the descriptor means A-weighted, an internationally agreed frequency response generally similar to that of the human ear so that A-weighted sound levels in dB correspond reasonably well with what is heard.

For assessment purposes, the day is typically divided into a 16-hour daytime period (07:00 to 23:00) and an 8-hour night-time period (23:00 to 07:00). The period values may be derived from the logarithmic average of the relevant hourly values.

3.2 Maximum Noise Level - L_{AFmax} , L_{ASmax}

In some circumstances it is useful to quantify the maximum level of fluctuating noise and a commonly used descriptor is L_{Amax} . The L_{Amax} represents the maximum reading given by a sound level meter for a given event or period of time and is usually qualified by F for 'Fast' or S for 'Slow' according to the response time setting of the meter. For the purposes of this report the 'Fast' response is used.

3.3 A-weighted Percentile Levels - $L_{An,T}$

Percentile noise levels are a statistical representation of the time varying level. The value is the 'A-weighted' noise level, L_A , exceeded for n% of the time period T . In particular the A-weighted sound level exceeded for 90% of the time period, expressed as $L_{A90,T}$, is often used to describe the background noise level or mean minimum noise level.

4. MEASUREMENT SURVEY

Measurements of noise levels were made during the period from 12:00 hours on Monday 1 November to 11:00 hours on Wednesday 3 November 2011. Long-term noise measurements were made at two locations as follows:

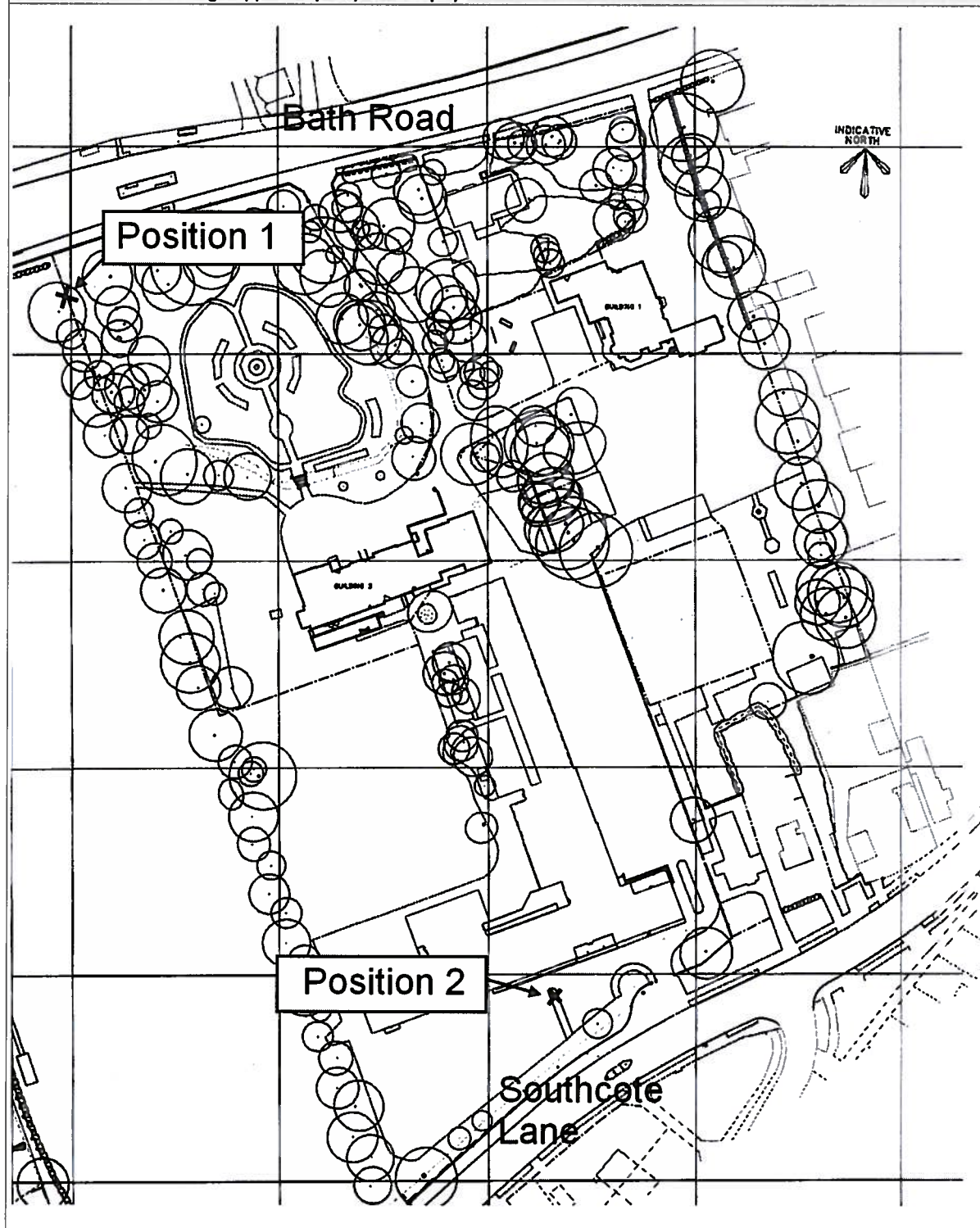
Position 1 was located 10 metres into the site from the northern boundary with Bath Road along a boundary fence line between the former Elvian school playing field and the ornamental gardens. This location is approximately 14 metres from the nearside kerb of Bath Road and 153 metres west of the eastern site boundary. The microphone was positioned at 1.5 metres above local ground level and in free-field conditions. The local ground level at this point is at grade with Bath Road.

Position 2 was located at 16 metres from the southern boundary, 19 metres from the nearside kerb of Southcote Lane and 45 metres west of the boundary with number 70 Southcote Lane, which is currently unoccupied and is understood to be part of the proposed development site. The microphone was positioned approximately 1.2 metres above local ground level in free-field conditions. Local ground level at this position is approximately 1 metre above the Southcote Lane road level.

The measurement positions are shown on a drawing of the site layout at the time of the survey in Figure 1 overleaf. Figure 2 shows the proposed development layout.

Figure 1 - Existing site layout and noise measurement positions

(drawing supplied by Taylor Wimpey)



BroadwayMalay™
Architectural Consultants Division

Site map: 10 map sheet
Scale: 1/8" = 1'-0"
Project No.: 10-0000
Date: 10/10/10

Owner:
Taylor Wapley
Elean School S&S
Site Layout

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5. RESULTS

The results of the noise measurements at Positions 1 and 2 are shown in Tables 1 and 2 respectively. The tables show hourly values of L_{Aeq} , L_{AFmax} and L_{A90} as well as the calculated daytime and night-time period values, $L_{Aeq,16h}$ and $L_{Aeq,8h}$ and the 'period' noise level ranges of the L_{A90} and L_{AFmax} indices.

A summary of the calculated daytime and night-time period values $L_{Aeq,16h}$ and $L_{Aeq,8h}$ and the ranges of L_{AFmax} and L_{A90} noise levels are shown in Table 3.

Table 1 - Position 1, hourly data - long term noise level measurement			
Period Commencing	Free-Field Noise Levels, dB		
	L_{Aeq}	L_{A90}	L_{AFmax}
<u>1/11/11</u>			
13:00	62	56	78
14:00	63	55	88
15:00	61	55	83
16:00	62	55	82
17:00	62	55	82
18:00	62	55	91
19:00	61	53	77
20:00	60	52	76
21:00	58	49	74
22:00	57	46	71
23:00	56	43	73
<u>2/11/11</u>			
00:00	53	38	73
01:00	52	37	74
02:00	50	37	71
03:00	49	37	69
04:00	52	38	70
05:00	57	44	74
06:00	60	51	73
07:00	66	56	94
08:00	60	55	75
09:00	65	55	95
10:00	63	54	90
11:00	61	54	84
12:00	66	53	93
Daytime (07:00 - 23:00)	63	46 - 56	71 - 95
Night-time (23:00 - 07:00)	55	37 - 51	69 - 74

Table 1 (cont'd) - Position 1, hourly data - long term noise level measurement			
Period Commencing	Free-Field Noise Levels, dB		
	L_{Aeq}	L_{A90}	L_{AFmax}
<u>2/11/11</u>			
13:00	62	53	90
14:00	63	53	91
15:00	60	54	77
16:00	64	54	93
17:00	62	53	87
18:00	65	54	93
19:00	60	53	72
20:00	59	51	76
21:00	58	49	70
22:00	58	47	73
23:00	55	42	68
<u>3/11/11</u>			
00:00	53	39	70
01:00	53	40	78
02:00	55	38	78
03:00	49	34	67
04:00	52	36	69
05:00	57	42	77
06:00	60	50	73
07:00	66	56	90
08:00	61	55	79
09:00	69	55	97
10:00	61	54	79
Daytime (07:00 - 23:00)	63	47 - 56	70 - 97
Night-time (23:00 - 07:00)	56	34 - 50	67 - 78

Table 2 - Position 2, hourly data - long term noise level measurement			
Period Commencing	Free-Field Noise Levels, dB		
	L_{Aeq}	L_{A90}	L_{AFmax}
<u>1/11/11</u>			
12:10	58	49	75
13:00	58	46	74
14:00	61	47	80
15:00	59	49	73
16:00	61	50	83
17:00	60	51	87
18:00	59	51	83
19:00	58	48	73
20:00	57	49	76
21:00	55	46	73
22:00	54	46	69
23:00	51	44	66
<u>2/11/11</u>			
00:00	49	41	66
01:00	47	41	66
02:00	47	41	65
03:00	47	41	72
04:00	50	42	74
05:00	53	46	66
06:00	58	51	70
07:00	61	56	75
08:00	61	56	79
09:00	59	51	72
10:00	58	50	71
11:00	58	49	77
Daytime (07:00 - 23:00)	59	46 - 56	71 - 87
Night-time (23:00 - 07:00)	52	41 - 51	65 - 74

Table 2 (cont'd) - Position 2, hourly data - long term noise level measurement			
Period Commencing	Free-Field Noise Levels, dB		
	L_{Aeq}	L_{A90}	L_{AFmax}
<u>2/11/11</u>			
12:00	59	49	70
13:00	58	48	71
14:00	59	49	69
15:00	59	51	72
16:00	60	52	71
17:00	60	52	68
18:00	60	51	72
19:00	59	50	73
20:00	57	48	72
21:00	57	46	72
22:00	55	45	76
23:00	51	42	75
<u>3/11/11</u>			
00:00	49	40	68
01:00	48	40	69
02:00	51	37	68
03:00	46	36	68
04:00	49	38	76
05:00	52	43	66
06:00	56	48	70
07:00	59	52	70
08:00	60	52	73
09:00	58	50	77
10:00	57	48	76
11:00	60	48	88
Daytime (07:00 - 23:00)	59	45 - 52	68 - 88
Night-time (23:00 - 07:00)	51	36 - 48	66 - 76

Table 3 - Summary of period noise levels at measurement positions

Position and Period Commencing	Free-Field Period Noise Levels*, dB					
	$L_{Aeq,16h}$	$L_{Aeq,8h}$	L_{A90} Daytime	L_{A90} Night-time	L_{AFmax} Daytime	L_{AFmax} Night-time
<u>Position 1</u>						
1 to 2 Nov	63	55	46 - 56	37 - 51	71 - 95	69 - 74
2 to 3 Nov	63	56	47 - 56	34 - 50	70 - 97	67 - 78
<u>Position 2</u>						
1 to 2 Nov	59	52	46 - 56	41 - 51	71 - 87	65 - 74
2 to 3 Nov	59	51	45 - 52	36 - 48	68 - 88	66 - 76

* or range of noise levels where appropriate.

Figures 3 and 4 below show examples of the long-term noise level time-histories at Positions 1 and 2.

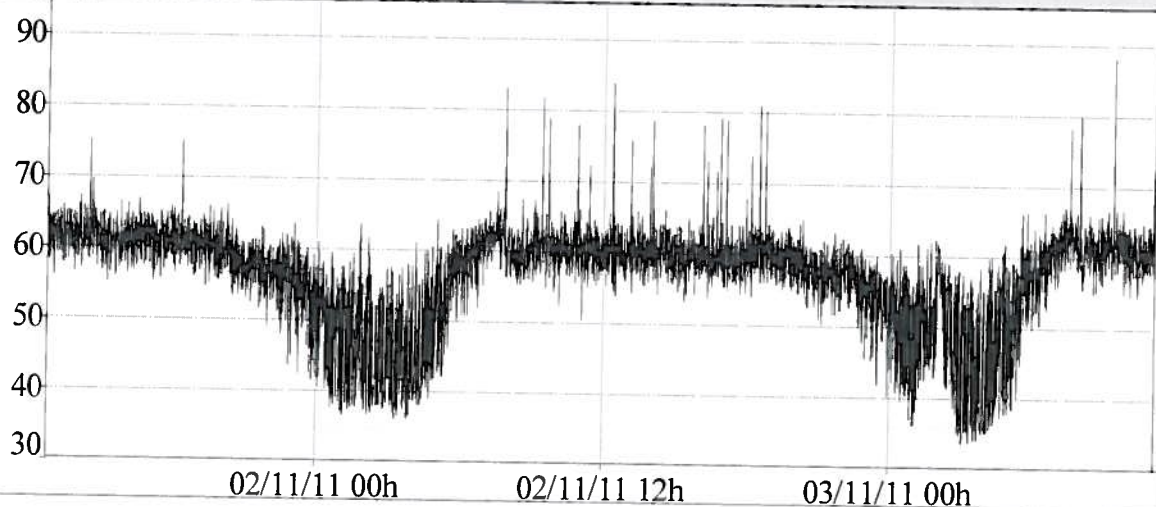
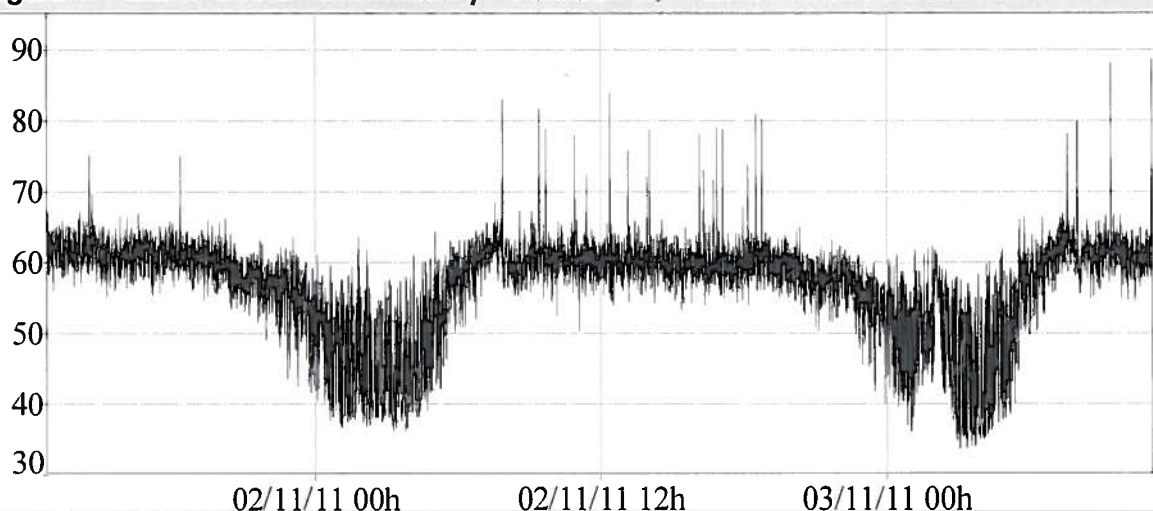
Figure 3 - Noise Level Time History - Position 1, 1 to 3 November 2011


Figure 4 - Noise Level Time History - Position 2, 1 to 3 November 2011

6. PLANNING REQUIREMENTS

Since its publication on 27 March 2012 the National Planning Policy Framework (NPPF) (ref 1) provides the current national planning policies for England, including those related to noise.

With particular reference to noise, the NPPF refers to the Noise Policy Statement for England (NPSE), published in March 2010. The NPSE provides the long-term vision of Government noise policy:

"Noise Policy Vision

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

The NPSE says that the long-term vision is supported by the following aims:

"Noise Policy Aims

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

- *avoid significant adverse impact on health and quality of life;*
- *mitigate and minimise adverse impact on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

The Explanatory Note to the NPSE discusses the terms "*Significant adverse*" and "*adverse*" linking concepts from toxicology that are being applied to noise impacts (for example, by the World Health Organization). The concepts are "NOEL" and "LOAEL" which are the "No Observed Effect Level" and "Lowest Observed Adverse Effect Level" respectively. The Note extends these concepts to introduce a "SOAEL" (Significant Observed Adverse Effect Level) but recognises that objective noise measures or limits are not developed for SOAEL.

It is important to note that the NPSE says it makes a "*distinction between 'quality of life' which is a subjective measure that refers to people's emotional, social and physical well-being and 'health' which refers to physical and mental well-being*". The Noise Policy Aims include reference to both of these aspects.

Guidelines for Community Noise (GCN) published in 1999 by WHO is often cited in relation to noise level limits.

Since its publication another WHO document, Night Noise Guidelines for Europe (NNG) published in 2009, has been released that also provides guidance in this area.

WHO defines health in the NNG as "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity and recognizes the enjoyment of the highest attainable standard of health as one of the fundamental rights of every human being*". This definition of 'health' clearly aligns with the joint definitions of 'quality of life' and 'well-being' presented in the NPSE.

It is reasonable therefore to suggest that the guideline limits presented by WHO can be drawn on in relation to the requirements of the NPPF.

Guidelines for Community Noise provides guideline noise level limits which it says are "*essentially values for the onset of health effects from noise exposure*" and includes consideration of various aspects including Sleep Disturbance, Mental Illness, Performance and Social and Behavioural Effects of Noise.

Night Noise Guidelines for Europe provides updated guidance with, as the title suggests, particular regard to night-time noise. Consideration and threshold noise level limits are given for Biological Effects, Sleep Quality, Well-being and Medical Conditions.

The indoor noise level limits presented where sufficient evidence is available align reasonably well with the night-time limits given in the earlier GCN. Indeed NNG says that it "*complements the 1999 guidelines*" and also that "*the recommendations on government policy framework on noise management*

elaborated in the 1999 Guidelines should be considered valid and relevant for the Member States to achieve the guideline values of this document".

AIRO interprets this to mean that the internal noise level limits given in Guidelines for Community Noise are current and the relevant limits to be used in relation to providing a reasonable noise environment inside newly built dwellings.

The noise level limits in dwellings that are provided in the latest version of BS 8233 are based on the WHO guidance.

7. NOISE MITIGATION

7.1 BS 8233

BS 8233 suggests indoor ambient noise level limits to be achieved inside dwellings. The standard requires that indoor ambient noise levels in living rooms and bedrooms during the daytime be no higher than 35 dB $L_{Aeq,16-hour}$ and in bedrooms at night be no higher than 30 dB $L_{Aeq,8-hour}$.

The ambient noise limits suggested are based on noise levels within the room during normal hours of occupation but in absence of noise from the occupants and their activities.

The arithmetic difference between the daytime or night-time period free-field external A-weighted noise levels at the relevant room façade location and the corresponding A-weighted internal noise level limit gives the minimum level of mitigation to be provided by the room façade.

7.2 Façade Sound Insulation

In respect of the selection of the appropriate glazing and ventilation for any specific project, AIRO recommends that manufacturers be asked to supply suitable test evidence of the acoustic performance, preferably from tests carried out in a UKAS accredited laboratory. UKAS is the United Kingdom Accreditation Service.

Manufacturers' acoustic data should be in the form of an ' $R_w + C_{tr}$ ' in dB where R_w is the Weighted Sound Reduction Index in dB and C_{tr} is the Spectrum Adaptation term in dB. In this instance a single figure ' $R_w + C_{tr}$ ' value can be considered equivalent to an A-weighted sound level difference, thus a window having 35 dB $R_w + C_{tr}$ sound insulation would be expected to give 35 dB(A) sound attenuation against a typical road traffic noise spectrum.

The manufacturers' data for ventilation attenuation is usually given in the form $D_{n,e,w} + C_{tr}$ in dB, which is the Weighted Element-Normalized Level Difference plus spectrum adaptation term.

Windows and ventilators usually represent the main transmission path for noise outside to inside dwellings. Conventional walls (i.e. with masonry leaf) and roof constructions generally offer significantly higher sound insulation than glazing and ventilation. Lightweight external wall systems such as masonry plus lightweight outer cladding or a completely lightweight framed wall offer significantly less sound insulation than a cavity masonry wall and in the worst cases could offer less sound insulation than good quality windows.

The sound insulation of a typical cavity masonry façade would be expected to be between 48 dB and 50 dB $R_w + C_{tr}$. An external masonry element with lightweight internal frame would be expected to achieve up to 48 dB $R_w + C_{tr}$ and a lightweight external wall, such as a lightweight internal frame with external rain screen cladding might be expected to achieve at best up to 45 dB $R_w + C_{tr}$ however in the worst cases, particularly those walls without an absorptive mineral or glass wool layer, might only achieve 40 dB $R_w + C_{tr}$ or even less.

The composite sound insulation of each room façade will be dependent on the ratios of the wall, window and ventilator areas and by the relative sound insulation performances of each element. The performance is also dependent on the ratio of the room volume to the room façade area and the reverberation times within the room.

7.3 Mitigation Requirements

The expected daytime and night-time period noise levels have been calculated for the most exposed facades in the proposed development. The daytime noise exposure controls the minimum sound insulation requirements for living rooms and bedrooms

The free-field A-weighted ground floor noise levels at the proposed façade locations are presented in Table 4 overleaf and where appropriate these have included a correction for a reduced angle of view of the road where restrictions are formed by adjacent new or existing buildings within the proposed development.

Also shown are the minimum composite façade sound insulation requirements expressed in dB(A) based on the room type and internal noise level limits suggested in BS 8233 (ref 2).

Minimum ventilation attenuation requirements should normally be numerically at least 10 dB higher than the glazing performance requirement in each room. Thus where a room requires a window sound insulation of 25 dB the ventilator performance in the same room must achieve at least 35 dB $D_{n,e,w} + C_{tr}$ providing only one vent is installed. If more than one ventilator is required, the acoustic performance of the ventilator will need to be increased.

The sound insulation figures expressed in Table 4 as dB(A) values against road traffic noise equate to the combined façade sound insulation performance expressed in terms of ' $R_w + C_{tr}$ ' in dB. The combined sound insulation values shown should not be taken as the performance for glazing, but as the nett sound insulation resulting from the relative areas and sound insulation performances of all the elements within the room façade.

Table 4 - Free-field noise level and minimum façade attenuation		
Road and Plot number/façade	Free-field noise levels, dB Daytime $L_{Aeq,16h}$	Minimum Ground Floor Level Façade Attenuation, dB Living Rooms and Bedrooms
Southcote Lane		
Block E (S)	61	26
Block E (W)	57	22
Block E (E)	59	24
7 and 8 (S)	60	25
7 (W)	56	21
8 (E)	58	23
5 and 6 (S)	59	24
35, 39, 43 (S)	61	26
34, 38, 42 (S)	60	25
33, 37, 41 (S)	59	24
26 to 32 (S)	59	24

NB The ventilation performance requirement in $D_{n,e,w} + C_{tr}$ terms must numerically be at least 10 dB higher than the attenuation requirements shown for the relevant room type.

Precise detailed mitigation calculations on a room for room basis are beyond the scope of this report however some example calculations follow in Table 5 which

have been made for a small bedroom and a small living room on the most exposed dwellings facing Southcote Lane. Only one ventilator at the specified performance is assumed within those calculations.

The sample calculations have been made for a 25 m³ living room and a 20 m³ bedroom each with façade areas of 10 m² for the most exposed dwelling on the Bath Road and Southcote Lane sides of the site. The façade walls are assumed to have a masonry wall with a performance achieving 48 dB $R_w + C_{tr}$. The area of glazing versus wall is assessed for two possible conditions, one with a 5 m² area for each and the other for 3 m² area of glass versus 7 m² area of wall.

Table 5 – Examples of glazing requirements for typical room sizes

Table 5 – Examples of glazing requirements for typical room sizes					
Room Type	Room Volume, m³	Wall Area, m²	Window Area, m²	Attenuation Requirements, dB	
				Ventilator, $D_{n,e,w} + C_{tr}$ (one vent only)	Glazing, $R_w + C_{tr}$
Block E, Southcote Lane – South Facade					
LR	25	5	5	≥ 38	≥ 28
Bed	20	5	5	≥ 38	≥ 29
LR	25	7	3	≥ 36	≥ 26
Bed	20	7	3	≥ 37	≥ 27

It should be noted that these examples may bear no resemblance to the actual room sizes or designs in the proposed development and are included for illustrative purposes only. AIRO recommends that detailed calculations are performed to ensure the appropriate glazing and ventilation specifications are provided within each dwelling. This work is normally carried out during a detailed design process.

AIRO would consider that a typical proprietary double-glazed window with 4 mm glass either side of a 6 to 16 mm sealed cavity in a conventional masonry façade is capable of providing up to 28 dB(A) attenuation against typical external noise sources such as road traffic. This assumes that any trickle vents are closed or omitted and that all units have effective seals, that is airtight when compressed and without there being distortion to any framing. With conventional trickle (non-acoustic) vents open the performance would be expected to drop to a maximum attenuation of around 25 dB(A).

Specifications of up to 37 dB(A) (e.g. 37 dB $R_w + C_{tr}$) may be achievable with good quality high performance proprietary double glazed or triple glazed systems such as those manufactured by Pilkingtons, Saint Gobain and others. From the range of mitigation requirements presented and based on the assumption that the façade walls are of masonry construction, it is apparent that sufficient sound insulation performance is likely to be readily achievable within a wide range of double glazed window systems with acoustically treated ventilators.

AIRO recommends that the manufacturers of glazing and ventilation be asked to provide sufficient evidence of performance, preferably from tests carried out in a UKAS accredited laboratory.

8. CONCLUSIONS

This report has presented the results of a survey at a proposed development site Bath Road and Southcote Lane, Reading. The noise exposure of the proposed dwellings has been based on the results of a noise survey carried out in November 2011 and the latest site layout drawings prepared in April 2015.

Outline façade mitigation advice is provided within the report which has determined that, with appropriate façade mitigation, noise levels within the dwellings can achieve the standard for internal noise levels given in the British Standard BS 8233 (ref 2).

Report Approved by:

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Principal Consultant

REFERENCES

1. National Planning Policy Framework
Department for Communities and Local Government
March 2012
2. British Standard BS 8233:2014
Guidance on Sound insulation and noise reduction for buildings
British Standards Institution

APPENDIX A

Table A1 - Schedule of Noise Measuring Instrumentation		
Use	Type	Serial No.
<u>Position 1</u>		
Measuring System	Cirrus CR 703B Unit Z	41517
Microphone	Cirrus MK 226	110733
Calibrator	Cirrus CR 511E	41882
<u>Position 2</u>		
Measuring System	Cirrus 703B Unit Y	43057
Microphone	Cirrus MK 226	110793
Calibrator	Cirrus CR 511E	43024

CALIBRATION

AIRO is accredited by the United Kingdom Accreditation Service as a UKAS testing laboratory No. 0483 and although the measurements carried out for this survey are not listed on our schedule of accreditation, all of AIRO's noise and vibration measurement equipment is routinely calibrated as part of the calibration regime in our Quality Manual and these calibrations are traceable to National Standards.

In addition, the calibration level of the measuring equipment was checked at the start and the end of each survey period and no significant drift was observed.

Table A2 - Record of Weather Conditions			
	1 November 2011	2 November 2011	3 November 2011
Temperature	14 °C	15 °C	17 °C
Wind Speed	< 1 m/s	3 to 6 m/s	2 to 4 m/s
Wind direction	From West	From Southeast	From South
Conditions	Dry	Occasional Rain	Dry