National Consultancy, Locally Delivered

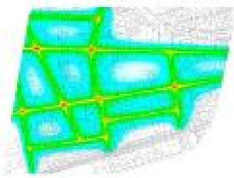
Noise Impact Assessment
Woolton Road, Liverpool

REC Reference: 90625r3

Report Prepared For: Redrow Homes Limited

11th April 2016





QUALITY ASSURANCE

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Date	29th July 2014	24th February 2016	11th April 2016
Prepared by	Lee Faulkner	Lee Faulkner	Lee Faulkner
Qualifications	BSc (Hons), AMIOA	BSc (Hons), AMIOA	BSc (Hons), AMIOA
Signature			
Checked by	John Goodwin	John Goodwin	John Goodwin
Qualifications	BSc (Hons), MIOA	BSc (Hons), MIOA	BSc (Hons), MIOA
Signature			
Authorised by	John Goodwin	John Goodwin	John Goodwin
Qualifications	BSc (Hons), MIOA	BSc (Hons), MIOA	BSc (Hons), MIOA
Signature			
Project number	90625r0	90625r2	90625r3

EXECUTIVE SUMMARY

Resource and Environmental Consultants Limited have been commissioned by Redrow Homes Limited to undertake a Noise Impact Assessment to support a planning application for a proposed residential development on land at Woolton Road in Liverpool.

This assessment has been completed with due regard to the requirements of Liverpool City Council.

Noise Impact Assessment

The Noise Impact Assessment has shown that, without mitigation, external noise levels will be exceeded in a number of garden areas and that internal noise levels, with windows open, will be exceeded for all habitable rooms with line of sight to Woolton Road.

No discernible noise from the residential care home to the east was audible on Site and as such has not been assessed.

Recommended Noise Mitigation

Accordingly, this assessment has recommended the installation of acoustic fences around some of the garden areas and alternative ventilation for any habitable rooms with line of sight to Woolton Road.

Given the favourable outcome of this assessment it is considered that noise should not be deemed a determining factor in granting planning permission for this development.

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APPENDICES

1.0 INTRODUCTION

1.1 Background

Resource and Environmental Consultants (REC) Limited have been commissioned by Redrow Homes Limited to undertake a Noise Impact Assessment for a proposed residential development on land at Woolton Road in Liverpool, to be referred to hereafter as 'the Site'.

The purpose of this assessment is to determine the existing noise impacts across the Site at the closest proposed noise sensitive receptors. The key source of noise impacting the Site is from road traffic using Woolton Road to the south of the Site.

This assessment has been completed with due regards to the requirements of the Environmental Health Department at Liverpool City Council (LCC).

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.2 Site Location & Proposed Development

The Site is located off Woolton Road approximately 676m to the east of the centre of Allerton. The Site currently exists as open fields and woodland. Allerton Priory borders the Site to the north east and Leonard Cheshire Disability border the Site to the south east. Allerton Road borders the Site to the west and Woolton Road runs along the southern boundary. Ye Priory Court borders the Site to the north.

Proposals include for the construction of up to 160 residential dwellings.

This Noise Impact Assessment has been completed with due regard to the following planning layout:

- Allerton Priory Masterplan (Drawing Number: SK007 Rev B) received from Redrow Homes on 8th April 2016.

The Masterplan is included within Figure I of Appendix III.

1.3 Limitations

The limitations of this report are presented in Appendix I.

1.4 Confidentiality

REC has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from REC; a charge may be levied against such approval.

2.0 ASSESSMENT CRITERIA

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) provides very brief guidance on planning and noise. The NPPF replaced the Planning Policy Guidance (PPG) Note 24. Paragraph 123 of the NPPF document states that 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 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*

This has been considered throughout the assessment where applicable.

No further guidance is given as to what a 'significant' impact would entail. It is therefore considered that meeting the criteria outlined in BS8233 and recommendations contained within the World Health Organisation guidelines, "significant adverse impacts" on health and quality of life associated with noise would be avoided.

2.2 Local Authority Guidance and Criteria – Liverpool City Council's Environmental Health Department

REC have contacted Ian Rushforth, Environmental Health Officer at LCC on Tuesday 22nd July 2014 in order to agree the methodology for the noise surveys and the appropriate noise criteria for this assessment which are as follows:

- The maximum permissible average noise level in garden areas shall not exceed 50dB $L_{Aeq,16hr}$ in accordance with BS8233: 2014;
- The maximum permissible average noise level in living rooms shall not exceed 35dB $L_{Aeq,16hr}$;
- The maximum permissible average noise level in bedrooms shall not exceed 30dB $L_{Aeq,8hr}$; and,
- The maximum permissible instantaneous noise level in bedrooms shall not exceed 45dB $L_{Amax,fast}$ criteria.

2.3 Calculation of Road Traffic Noise 1988

The Calculation of Road Traffic Noise (CRTN) memorandum, produced by the Department of Transport Welsh Office, describes the procedures for calculating noise from road traffic. This document is widely used within the UK when undertaking road traffic measurements and calculations. Section III of this memorandum details the shortened measurement procedure whereby measurements of the L_{10} parameter are made over any three consecutive hours between 10:00 and 17:00. From the arithmetic average of the three 1-hour values, the $L_{10,18hr}$ noise levels is derived before derivation of the $L_{Aeq,16hr}$ value.

2.4 Transport Research Laboratory – Converting the UK Traffic Noise Index $L_{A10,18hr}$ to EU Noise Indices for Noise Mapping

This document provides a method for converting the $L_{A10,18hr}$ level to the L_{night} level using the following formula, applicable to non-motorway roads;

$$L_{night} = 0.90 \times L_{A10,18hr} - 3.77dB$$

2.5 British Standard BS8233: 2014: Guidance on Sound Insulation and Noise Reduction for Buildings

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in Table 2.1:

Table 2.1: BS8233 Recommended Internal Noise Levels

Criterion	Typical Situation	Design $L_{Aeq,T}$ (dB)
Suitable resting / sleeping conditions	Living Room	35
	Bedroom	30
For a reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not normally exceed 45dB L_{Amax}		

BS8233 goes on to recommend noise levels for gardens. According to BS8233;

> *"It is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted".*

BS8233 goes on to say:

> *"In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited".*

2.6 World Health Organisation's (WHO) 'Guidelines for Community Noise'

The WHO 'Guidelines for Community Noise' offers advice with regard to setting noise criteria applicable to sleep disturbance. Section 4.2.3 specifies:

> *'If the noise is not continuous, L_{Amax} or SEL are used to indicate the probability of noise-*

> *induced awakenings. Effects have been observed at individual L_{Amax} exposures of 45 dB or less. Consequently, it is important to limit the number of noise events with a L_{Amax} exceeding 45 dB.'*

The guidelines go on to state:

> *'At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax}, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.'*

The sound insulation performance value of 15dB for a façade containing a partially open window accords with the guidance offered in BS8233:2014.

The guidelines reference a study by Vallet & Vernet, 1991, which concluded that:

> *'For a good sleep, it is believed than indoor sound pressure levels should not exceed approximately 45 dB $L_{AF,max}$ more than 10-15 times per night.'*

Accordingly this assessment has utilised the 10^{th} highest measured maximum noise level from the night-time period and allows for a an assessment of a typical maximum noise level in determining façade sound insulation performance.

3.0 NOISE SURVEY

3.1 Road Traffic Noise Survey – Woolton Road

REC has conducted a Road Traffic Noise Survey in accordance with the shortened procedure given in CRTN. The survey was carried out over the following periods:

- Thursday 24th July 2014 between 11:59 and 14:59.

The following noise measurement position was chosen for the Noise Survey:

- Noise Measurement Position 1 (NMP1): Located on the south eastern boundary of the Site with Woolton Road where a 3 hour road traffic noise measurement was undertaken. The microphone of the sound level meter was located at a distance of 6m from the centre of the closest carriageway of Woolton Road and at a height of 1.8m above ground level. Noise sources at this location consisted predominately of road traffic.

A summary of the measured sound pressure levels from the Road Traffic Noise Survey are presented in Table 3.1.

Table 3.1: Summary of Measured Noise Levels for NMP1

Measurement Position	Period	Measured Sound Pressure Level, free-field (dB)			
		$L_{Aeq,T}$	$L_{Amax,fast}$ [1]	$L_{A90,T}$	$L_{A10,T}$
NMP1	24/07/2014 11:59	69.0	85.6	49.1	73.9
	24/07/2014 12:59	68.4		49.6	73.1
	24/07/2014 13:59	68.8		51.9	73.4

[1] 10th highest $L_{Amax,fast}$ from three 1-hour periods

3.2 Source Noise Measurements of Residential Care Home

REC has conducted a Noise Survey in order to measure any noise associated with the residential care home to the east and Allerton Priory to the north. The survey was carried out over the following periods:

- Thursday 24th July 2014 between 12:05 and 15:00.

During the survey, no discernible noise was audible from either of the premises and as such will not be assessed in the report.

The weather conditions during the Noise Surveys were conducive towards the measurement of environmental noise, being fine and dry with wind speeds of less than 5.0m/s.

The following equipment was used for the Noise Surveys.

Table 3.2: Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
NMP1	Sound Level Meter	01dB-Metravib Black Solo	65629	19th November 2014
	Pre-amplifier	01dB-Metravib PRE 21 S	166569	
	Microphone	01dB Metravib MCE212	16255	
	Calibrator	01dB-Metravib CAL-21	34924066	25th November 2014

Calibration dates correspond to those at the time of the Survey. The sound level meter was field-calibrated on Site prior to and after noise measurements were taken. No significant drift was witnessed. Calibration certificates are available upon request.

4.0 NOISE IMPACT ASSESSMENT

4.1 Road Traffic Noise

For the purposes of this assessment, the daytime and night-time average ($L_{eq,T}$) noise levels have been calculated based on the shortened measurement procedure detailed in CRTN. The respective daytime and night-time noise levels have been derived using the following calculations:

1. Calculation of the $L_{A10,18hr}$ noise level by using the following formula:

$$L_{10,18hr} = L_{10,3hr} – 1dB$$

2. Calculation of the $L_{Aeq,16hr}$ noise level by using the following formula:

$$L_{eq,16hr} = L_{10,18hr} – 2dB$$

3. Calculation of the night-time $L_{Aeq,8hr}$ noise level by using the following formula:

$$L_{night}\ (L_{eq,8hr}) = 0.90 \times L_{10,18hr} – 3.77dB$$

Table 4.1 displays the calculated daytime average and night-time average and maximum noise levels.

Table 4.1: Calculation of Daytime and Night-time Road Traffic Noise Levels

Measurement Position	Period	Calculated L_{Aeq} (dB)	10th Highest Measured $L_{Amax,fast}$ (dB)	Measurement Distance from Centre of Woolton Road (m)
NMP1	Daytime (07:00 – 23:00)	70.5	N/A	6.0*
	Night-time (23:00 – 07:00)	61.5	85.6[1]	

[1] 10th highest $L_{Amax,fast}$ from three 1-hour periods
* 6m has been used as the measurement distance as the westbound carriageway is shielded by a 1m high brick wall and as such it is assumed that the closest carriageway was the main source of noise.

In determining the level of noise impact at the various dwellings, the following equation has been used to determine the resulting noise level from the daytime and night-time 'average' noise levels:

$$L_{Aeq,2} = L_{Aeq,1} – (10 \times \log (D_2/D_1)$$

Where
$L_{Aeq,2}$ = noise level under investigation
$L_{Aeq,1}$ = measured noise level
D_2 = distance under investigation
D_1 = measurement distance

The following equation has been used to determine the resulting noise level from the night-time measured maximum noise level:

$$L_{Amax,fast,2} = L_{Amax,fast,1} – (20 \times \log (D_2/D_1)$$

Where
$L_{Amax,fast,2}$ = noise level under investigation
$L_{Amax,fast,1}$ = measured noise level
D_2 = distance under investigation
D_1 = measurement distance

Finally, Line of Sight Removal has been applied to garden areas that have partial of sight removal from Woolton Road in the form of 5dB attenuation. Where a proposed dwelling blocks line of sight, the attenuation the building provides, as an acting barrier, has been applied.

4.1.1 External Amenity Areas

Table 4.2 details the calculated daytime noise levels for the nearest external amenity areas to Woolton Road using a noise measurement distance of 6m from the centre of Woolton Road. Dwellings immediately behind those assessed will benefit from lower noise levels and thus any mitigation measures required for the closest gardens will also provide attenuation for these garden areas. The Master Plan does not detail plot numbers, therefore, assigned numbers have been used. These are shown in Figure 1 of Appendix III.

Table 4.2: Calculation of Daytime Outdoor Garden Noise Levels

Dwelling	Calculated Daytime $L_{Aeq,16hr}$ (dB)	Distance to Garden (m)	Line of Sight Removal/ Barrier Attenuation (dB)	Calculated Noise Level in Garden (dB)	Noise Criteria Level (dB)	Difference +/- (dB)
1	70.5	70.6	-17.9	42	50	-8
2	70.5	70.6	-17.9	42	50	-8
3	70.5	70.6	-5	55	50	**+5**
8	70.5	83.5	-10	49	50	-1
9	70.5	78.9	-10	49	50	-1
10	70.5	63.0	-10	50	50	0
11	70.5	65.0	-5	55	50	**+5**
12	70.5	70.6	-10	50	50	0

Table 4.2 indicates that the daytime noise level from road traffic in the majority of the closest garden areas exceed the outdoor noise criteria level. Accordingly the following Section will consider appropriate mitigation in order to reduce these exceedences.

4.1.2 Internal Amenity Areas

In addition to noise levels in garden areas, it is necessary to consider internal noise levels within habitable rooms. Table 4.4 details the calculated noise levels for the facades of the dwellings that have line of sight to Woolton Road using the measurement distance of 6.0m.

An angle of view correction has been applied using the following formula:

$$\text{Angle of View Correction} = 10 \times \text{Log}(\theta / 180)$$

Table 4.3: Calculation of Noise Levels at the Facade

Dwelling	Period	Measured Noise Level (dB)	Distance to Façade (m)	Angle of View (θ)	Angle of View Correction (dB)	Calculated External Noise Level at Façade (dB)
1 to 3	Daytime	70.5 $L_{Aeq,16hr}$	53.5	165	-0.4	60.6
	Night-time	61.5 $L_{Aeq,8hr}$				51.6
		85.6 $L_{Amax,fast}$				66.2
5	Daytime	70.5 $L_{Aeq,16hr}$	81.3	68	-4.2	54.9
	Night-time	61.5 $L_{Aeq,8hr}$				45.9
		85.6 $L_{Amax,fast}$				58.7
8	Daytime	70.5 $L_{Aeq,16hr}$	87.7	66	-4.4	54.5
	Night-time	61.5 $L_{Aeq,8hr}$				45.4
		85.6 $L_{Amax,fast}$				57.9
9	Daytime	70.5 $L_{Aeq,16hr}$	85.6	74	-3.9	55.1
	Night-time	61.5 $L_{Aeq,8hr}$				46.0
		85.6 $L_{Amax,fast}$				58.7
10 to 12	Daytime	70.5 $L_{Aeq,16hr}$	55.6	168	-0.3	60.5
	Night-time	61.5 $L_{Aeq,8hr}$				51.5
		85.6 $L_{Amax,fast}$				66.0

The now revoked PPG24 suggests that the sound reduction index afforded by such glazing set in a standard brick block wall will reduce road traffic external to internal noise levels by approximately 33dB. Table 4.4 calculates the internal noise level using standard thermal double glazing. Any exceedences are highlighted in bold.

Table 4.4: Calculation of Internal Noise Levels with Standard Thermal Double Glazing

Dwelling	Period	Calculated External Noise Level at Façade (dB)	Attenuation Afforded by Standard Thermal Double Glazing (dB)	Calculated Internal Noise Level (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
1 to 3	Daytime	60.6	33	27.6	35	-7.4
	Night-time	51.6	33	18.6	30	-11.4
		66.2	33	33.2	45	-11.8

5	Daytime	54.9	33	21.9	35	-13.1
	Night-time	45.9	33	12.9	30	-17.1
		58.7	33	25.7	45	-19.3
8	Daytime	54.5	33	21.5	35	-13.5
	Night-time	45.4	33	12.4	30	-17.6
		57.9	33	24.9	45	-20.1
9	Daytime	55.1	33	22.1	35	-12.9
	Night-time	46.0	33	13.0	30	-17.0
		58.7	33	25.7	45	-19.3
10 to 12	Daytime	60.5	33	27.5	35	-7.5
	Night-time	51.5	33	18.5	30	-11.5
		66.0	33	33.0	45	-12.0

Table 4.4 indicates that standard thermal double glazing will be sufficient for habitable rooms for all dwellings across the Site. Therefore, no mitigation measures are required.

During summer months it may be necessary to open windows in order to provide a supply of fresh air to cool the habitable room. Table 4.5 determines the internal noise levels for proposed dwellings along the southern boundary. BS8233:2014 states that the sound reduction index of a partially open window will attenuate noise by approximately 15dB. Exceedences are highlighted in bold.

Table 4.5: Calculation of Internal Noise Levels with a Partially Open Window

Dwelling	Period	Calculated External Noise Level at Façade (dB)	Attenuation Afforded by a Partially Open Window (dB)	Calculated Internal Noise Level (dB)	Criteria Noise Level (dB)	Difference +/- (dB)
1 to 3	Daytime	60.6	15	45.6	35	**+10.6**
	Night-time	51.6	15	36.6	30	**+6.6**
		66.2	15	51.2	45	**+6.2**
5	Daytime	54.9	15	39.9	35	**+4.9**
	Night-time	45.9	15	30.9	30	**+0.9**
		58.7	15	43.7	45	-1.3
8	Daytime	54.5	15	39.5	35	**+4.5**
	Night-time	45.4	15	30.4	30	**+0.4**

		57.9	15	42.9	45	-2.1
9	Daytime	60.9	15	45.9	35	**+10.9**
	Night-time	51.9	15	36.9	30	**+6.9**
		66.7	15	51.7	45	**+6.7**
10 to 12	Daytime	60.5	15	45.5	35	**+10.5**
	Night-time	51.5	15	36.5	30	**+6.5**
		66.0	15	51.0	45	**+6.0**

Table 4.5 indicates that the internal target noise levels will be exceeded for all habitable rooms in proposed dwellings that have line of sight to Woolton Road if windows are opened and so the following section considers alternative ventilation to opening windows.

5.0 MITIGATION

5.1 Road Traffic

5.1.1 External Amenity Areas

The previous section has indicated that the noise level in certain garden areas exceeds the criteria level and the most appropriate method for controlling noise in garden areas is by use of an acoustic-grade fence. Table 5.1 details the required height of the acoustic fence for those dwellings in exceedence. In calculating the height of the acoustic fences, the following have been accounted for:

- Source height has been taken as 0.5m above local ground level; and,
- Receiver height has been taken as being 1.8m above local ground level accounting for a 1.8m high person stood in the centre of the garden area.

Table 5.1: Calculation of Acoustic Fence Heights

Garden Area	Exceedence of Criteria without Acoustic Fence +/- (dB)	Corresponding Path Difference (m)	Required Fence Height to Meet Criteria (m)
3	+5	0.00	1.8
11	+5	0.00	1.8

As the exact boundaries of the garden areas are unknown at this stage, the fence locations and heights are indicative only. The remaining dwellings will benefit from attenuation afforded by the proposed garden fences. The precise location of these fences cannot be determined at this stage and will be subject to an updated Noise Impact Assessment when the masterplan is fixed. The fences proposed for the Site should be close boarded construction, have a minimum mass of 16kg/m^2 and be free from holes.

5.1.2 Internal Habitable Rooms

The previous Section has identified that standard thermal double glazing will be sufficient in controlling external noise levels however if windows are opened, then the criteria noise levels will be exceeded for any habitable rooms that have line of sight to Woolton Road.

Accordingly, It is recommended that a through-frame window mounted trickle ventilator is incorporated into the glazing unit of the Habitable rooms that have line of sight to Woolton Road so that fresh air can enter the room without having to open windows. The minimum performance of the trickle ventilator, in the open position, must be higher than the exceedence predicted in Table 4.5.

The trickle ventilator should be combined with a Mechanical Extract Ventilation (MEV), a Mechanical Ventilation Heat Recovery (MVHR) or a Passive Extract Ventilation (PEV) system which extracts air from the habitable rooms.

Wherever possible habitable rooms should be located away from the noise source with less noise-sensitive rooms facing the noise source.

6.0 CONCLUSION

REC Limited have been commissioned by Redrow Homes Limited to undertake a Noise Impact Assessment for a proposed residential development on land at Woolton Road in Liverpool.

The purpose of this assessment is to determine the existing noise impacts across the Site at the closest proposed noise sensitive receptors. The key source of noise impacting the Site is from road traffic using Woolton Road to the south of the Site.

This assessment has been completed with due regards to the requirements of the Environmental Health Department at Liverpool City Council.

The Noise Impact Assessment has shown that, without mitigation, external noise levels will be exceeded in a number of garden areas and that internal noise levels, with windows open, will be exceeded for all habitable rooms with line of sight to Woolton Road.

Accordingly, this assessment has recommended the installation of acoustic fences around some of the garden areas and alternative ventilation for any habitable rooms with line of sight to Woolton Road.

Given the favourable outcome of this assessment it is considered that noise should not be deemed a determining factor in granting planning permission for this development.

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between REC Limited and the Client as indicated in Section 1.2.

2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

3. REC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by REC is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by REC in this connection without their explicit written agreement there to by REC.

APPENDIX II GLOSSARY OF ACOUSTICAL TERMINOLOGY

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1: Typical Sound Pressure Levels

Sound Pressure Level dB(A)	Location
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Acoustic Terminology

Table A2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq, T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L_{10} & L_{90}	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III FIGURES

Figure 1

Proposed Site Layout, Noise Measurement Position and Assigned Plot Numbers