

Report VA4946.231006.NIA

127a Loverock Road, Reading

Noise Impact Assessment

06 October 2023

**Hathaway Opportunity Fund GP Ltd
c/o Cube Real Estate
21A Kingly Street
London
W1B 5QA**

01962 461016
0203 8650332
mail@ventaacoustics.com

registered company no. 10139494

Contents

1. Introduction.....	1
2. Site Description.....	1
3. Design Criterion and Assessment Methodology	1
3.1 BS4142:2014+A1:2019	1
3.2 The National Planning Policy Framework (2023)	3
3.3 Noise Policy Statement for England (2010).....	3
3.4 Planning Practice Guidance	4
3.5 BS8233:2014	5
4. Environmental Noise Survey	5
4.1 Survey Procedure & Equipment	5
5. Results	6
5.1.1 Automated Noise Survey	6
6. BS4142 Noise Impact Assessment	6
6.1.1 Source Noise Levels	7
6.2 Acoustic Character Correction	7
6.3 Rating Noise Level and Assessment	7
6.4 Context	8
6.5 Uncertainty	9
7. Mitigation	9
8. Conclusion	10

Attachments

VA4946/SP1	Indicative Site Plan
VA4946/TH1-TH4	Environmental Noise Time Histories
Appendix A	Acoustic Terminology
Appendix B	Acoustic Calculations

Report Version	Author	Approved	Changes	Date
NIA	Steven Liddell	Jamie Duncan	-	6/10/23

The interpretations and conclusions summarised in this report represent Venta Acoustics' best technical interpretation of the data available to us at the time of assessment. Any information provided by third parties and referred to in this report has not been checked or verified by Venta Acoustics, unless otherwise expressly stated in the document. Venta Acoustics cannot accept any liability for the correctness or validity of the information provided. Due to a degree of uncertainty inherent in the prediction of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable for any loss, cost, damages or expenses incurred or sustained by anyone resulting from any interpretations, predictions of conclusions made by the company or employees. The findings and conclusions are relevant to the period of the site survey works, and should not be relied upon to represent site conditions at later dates. Where additional information becomes available which may affect the findings of our assessment, the author reserves the right to review the information, reassess the findings and modify the conclusions accordingly.

1. Introduction

An application is to be made for a temporary change of use of the existing industrial site at 127a Loverock Road, Reading to B8 Open Storage for a period of 5 years.

Venta Acoustics has been commissioned by Cube Real Estate to undertake an assessment of the potential noise impact of the proposed use on the surrounding residential dwellings as requested by Reading Borough Council.

An environmental noise survey was undertaken to determine the background noise levels at the nearest dwellings. Predictions of sound levels expected to be generated by the use were made and these levels were then used to undertake an assessment of the likely impact with reference to the methodology in BS4142:2014 *Methods for rating and assessing industrial and commercial sound*, BS8233: 2014 *Guidance on sound insulation and noise reduction for buildings*. This report also compares the measured levels with the aims and intents of the National Planning Policy Framework (2021), Noise Policy Statement for England (2010), Planning Policy Guidance and the World Health Organisation Guidelines for Community Noise (2023).

All staff at Venta Acoustics are fully qualified and members of the Institute of Acoustics, the recognised UK professional body for acoustics, noise and vibration professionals and are fully competent to undertake BS4142 assessments.

2. Site Description

As illustrated on attached site plan VA4946/SP1, the site is located within an established employment area consisting of commercial and light industrial warehouse buildings with agricultural fields beyond a raised railway line to the north and residential elements beyond Wigmore Lane to the south.

The nearest dwellings are located on Store Street some 130m to the south and are separated from the site by Wigmore Lane and the warehouse building directly adjacent to the site which provides good levels of screening.

Noise levels in the locality are determined by moderately heavy traffic on Wigmore Lane / Portman Road during the day although there are no major road networks in the locality that would have continuous traffic at night.

3. Design Criterion and Assessment Methodology

3.1 BS4142:2014+A1:2019

British Standard BS4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and;
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

The Standard is therefore suited to this assessment.

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the source under investigation in terms of a L_{Aeq} value over a one-hour period during daytime operation (07:00-23:00 hours) and a fifteen-minute period during night-time operation (23:00-07:00 hours).

A correction factor is added to this level to account for the acoustic character of the sound. This is determined as follows when using the subjective assessment methodology:

Tonality – For sound ranging from not tonal to prominently tonal, the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be allocated as a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.

Impulsivity – A correction of up to +9dB can be applied for sound that is highly impulsive considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be allocated as a penalty of 3 dB for impulsivity which is just perceptible at the receiver, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.

Other sound characteristics – Where the specific sound contains characteristics that are neither tonal nor impulsive, but are otherwise startling, disturbing or incongruous with the residual acoustic environment, a penalty of +3 dB can be applied.

Intermittency – When the specific sound has identifiable on/off conditions, if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.

An initial estimate of the impact of the source is then obtained by subtracting the typical background noise level, in terms of an L_{A90} value over the relevant period of operation, from the corrected Specific Sound Level.

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB could be an indication of an adverse impact, depending on the context.

- The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound having a low impact, depending on the context.

The initial estimate of the impact may then be modified by taking into consideration the context in which the sound occurs.

3.2 The National Planning Policy Framework (2023)

The revised *National Planning Policy Framework* (NPPF), published in September 2023, sets out the Government's planning policies for England, superseding all previous planning policy statements and guidance.

In respect of noise, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing developments from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

Hence, Paragraph 185 states that *planning policies and decisions should also ensure new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life*
- b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*

In regards to the term adverse impact, reference is made to the Noise Policy for England:

3.3 Noise Policy Statement for England (2010)

The Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy: to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

This vision is supported by the following aims:

- *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.*

The terms “significant adverse” and “adverse” are related to the following concepts:

No Observed Effect Level (NOEL) – *the level below which no effect on health and quality of life can be detected.*

Lowest Observed Adverse Effect Level (LOAEL) – *the level above which adverse effects on health and quality of life can be detected.*

Significant Observed Adverse Effect Level (SOAEL) – *the level above which significant adverse effects on health and quality of life occur.*

The guidance acknowledges that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations, but will be different for different noise sources, receptors and times.

In order to enable assessment of impacts in line with these requirements, reference should be made to other currently available guidance.

3.4 Planning Practice Guidance

This document advises on how planning can be used to manage potential noise impacts on communities.

The document has some overlap with the NPSE in its guidance although it does introduce new concepts regarding amenity.

Local planning authorities’ plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

The document includes a table, reproduced in Table 3.1, regarding the perception of noise in relation to the effect on residents, which is summarised below. This provides a qualitative description of noise and how it affects people and their behaviour.

Perception	Examples of outcomes	Increasing effect level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required

		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, eg turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, eg avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, eg regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, eg auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 3.1 – Noise exposure hierarchy

3.5 BS8233:2014

BS8233 *Guidance on sound insulation and noise reduction for buildings* provides guidance as to suitable internal noise levels for different areas within residential buildings.

The relevant section of the standard is shown below in Table 3.2.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB LAeq, 16 hour	-
Dining	Dining Room	40 dB LAeq, 16 hour	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq, 16 hour	30 dB LAeq, 8 hour

Table 3.2 – Excerpt from BS8233: 2014

[dB ref. 20µPa]

4. Environmental Noise Survey

4.1 Survey Procedure & Equipment

In order to establish the existing background noise levels at the site, a noise survey was carried out between Thursday 28th September and Monday 5th October 2023 at the location shown in site plan VA4946/SP1. This location was chosen to be representative of the background noise level at the most affected noise sensitive receivers.

Continuous 5-minute samples of the L_{Aeq} , L_{Amax} , L_{A10} and L_{A90} sound pressure levels were undertaken at the measurement location.

The weather during the survey period was generally dry with light winds with a period of rain on the morning of the 29th which has been excluded from the analysis. The background noise data is not considered to have been compromised by these conditions.

Measurements were made generally in accordance with ISO 1996 2:2017 *Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels*.

The following equipment was used in the course of the survey:

Manufacturer	Model Type	Serial No	Calibration	
			Certificate No.	Date
Nti Class 1 Integrating SLM	XL2	A2A-12202-E0	UCRT23/1146	1/23
Larson Davis calibrator	CAL200	19816	1506037-1	28/7/23

Table 4.1 – Equipment used for the survey

The calibration of the sound level meter was verified before and after use with no significant calibration drift observed.

5. Results

The measured sound levels are shown as time-history plots on the attached charts VA4946/TH1-4.

The background noise level is determined by traffic on the surrounding roads. Background noise levels during the normal working day are seen to be consistently around L_{A90} 50dB during the week and weekends. Night time levels on Friday evening were generally around L_{A90} 40dB. However, over the weekend the background sound level dropped to around L_{A90} 30dB during the early hours.

Ambient noise levels due to traffic on Wigmore Lane were around L_{Aeq} 55dB during the day and above L_{Aeq} 40dB at night.

The typical background noise levels measured were:

Monitoring Period	Typical ¹ $L_{A90,5min}$
07:00 – 23:00 hours	42 dB
23:00 – 07:00 hours	28 dB

Table 5.1 – Typical background noise levels

[dB ref. 20 μ Pa]

¹ The typical L_{A90} value is taken as the 10th percentile of all L_{A90} values measured during the relevant period.

6. BS4142 Noise Impact Assessment

As an open storage site, the primary noise expected is from deliveries via HGV lorries off Loverock Road and forklifts arranging the products on the floor or open storage racking.

6.1 Source Noise Levels

Noise sources have been included in the assessment including the use of forklifts and HGV deliveries which are based upon library data measured at other, similar sites. These are summarised in Table 6.1.

Noise Source	Measurement Distance	L _{Aeq}	Notes
Lorry Reversing with Tonal Alarm	10m	74 dB	
Forklift	5m	74 dB	Petrol forklift manoeuvring, removing items from lorry – placing on racking

Table 6.1 – Library data noise sources used for assessment

6.2 Acoustic Character Correction

The subjective method of allocating corrections to the sound source has been used following the methodology provided in BS4142:2014 and summarised in section 3.1.

Noise Source	Subjective Description	Allocated Corrections
Lorry Manoeuvring	Intermittent deliveries, diesel engine broadband, tonal alarm and not impulsive	Tonality: +4 dB Impulsivity: 0 dB Intermittency: +3 dB
Lorry unloading/loading by forklift	Impulsive noise from occasional bangs, clatters, from loading. Intermittent nature of deliveries.	Tonality: 0 dB Impulsivity: +3 dB Intermittency: +3 dB

Table 6.2 – Acoustic character corrections

These penalties are applied to the specific noise level in section 6.3 to obtain the rating noise level.

6.3 Rating Noise Level and Assessment

The rating noise levels at the assessment locations are compared against the relevant background noise levels to assess the notional significance of the noise impact as follows. Operations are adjusted to the appropriate on times.

The following shows the assessments for the proposed operations on the most affected façade of the nearest residents.

Results	Daytime	Nighttime	Relevant Clause	Commentary
Specific Sound Level	L _{Aeq} 74 dB	L _{Aeq} 74 dB		Lorry manoeuvring. Measured at 10m
Assumed noise on time	-12 dB	-12 dB	7.2	4 lorry movements during the day and 1 movement per 15 minutes at night. 1 minute per movement.
Distance Loss to 130m	-22 dB	-22 dB		
Screening	-10 dB	-10 dB		Provided by intermediate building
Acoustic feature correction	+7 dB	+7 dB	9.2	+4 dB for tonality, +3dB for intermittency
Rating level	L _{Ar} 37 dB	L _{Ar} 37 dB	9.2	
Background sound level	L _{A90} 42 dB	L _{A90} 28 dB	8	
Excess of rating over background sound level	-5 dB	9 dB	11	
Assessment indicates	Low impact	Adverse impact	11	Depending on context

Table 6.3 – BS4142 Assessment – HGV Manoeuvring

Results	Daytime	Nighttime	Relevant Clause	Commentary
Specific Sound Level	L _{Aeq} 56 dB	L _{Aeq} 56dB		Used to unload lorry / move products. Measured at 5m
Assumed noise on time	-3 dB	-0dB	7.2	Forklift assumed to operate for 30minutes per hour during the day. May operate continuously during a 15 minute period at night.
Distance Loss to 130m	-28 dB	-28dB		
Screening	-10 dB	-10		Provided by intermediate building
Acoustic feature correction	+6 dB	+6 dB	9.2	+3 dB for impulsivity, +3dB for intermittency
Rating level	L _{Ar} 21 dB	L _{Ar} 24 dB	9.2	
Background sound level	L _{A90} 42 dB	L _{A90} 28 dB	8	
Excess of rating over background sound level	-21 dB	-4 dB	11	
Assessment indicates	Low impact	Low impact	11	Depending on context

Table 6.4 – BS4142 Assessment – Forklift Use (loading / unloading)

6.4 Context

BS4142 is primarily a context-based assessment methodology and the Standard is clear that initial estimates of sound impact can be modified by the specific context of the site and proposed operation of the new development.

In the case of the proposed development, commercial activity, including delivery vehicle movements and loading/unloading activity, is already an established feature of the sound climate from the existing commercial units surrounding the development site.

The introduction of the proposed use is therefore not expected to result in a readily perceptible change in the character of the sound climate at the surrounding dwellings.

The assessment indicates that a low impact is generally expected with the exception of HGV movements in the early hours of the morning during the weekend. In practice, there would be a limited number of deliveries during these times and when these do occur, they would be infrequent and over a short period of time. The predicted sound levels are lower than the nighttime ambient sound level existing due to traffic in the area and this indicates that the impact would be significantly reduced from the initial estimate.

Reviewing the Planning Practice Guidance in Table 3.1 above, sound from the site is expected to be at or below the No Observed Adverse Effect Level.

On balance, a generally low impact is expected from the use and it is not considered that there would be a significant noise impact on the identified properties along Stone Street.

6.5 Uncertainty

This section considers the variable in the assessment that may cause variations within the final results and describes how these have been addressed.

- Use of a Class 1 sound level meter is considered to reduce instrument error to insignificant levels as compared with environmental variations. The calibration of the instrumentation was confirmed before and after the noise surveys.
- The background measurements were undertaken under suitable weather conditions over a period designed to include reasonable temporal variations in background noise levels, including a weekend period. The monitoring location was selected to be representative of the background noise levels expected to be experienced by the existing dwellings without being unduly influenced by extraneous noise sources.
- Where library data has been used, propagation calculations have been used to correct noise levels to the relevant distance at the receiver.

Overall, the uncertainty is considered to have been minimised to a suitable range so as not to risk significant variations in the impact assessment of typical operations.

7. Mitigation

Although a low impact is predicted, the risk of a noise impact can be further reduced by appropriate management of the site:

- It is recommended that lorries are loaded and unloaded in the area behind the adjacent warehouse to gain maximum benefit from screening. The layout of the site suggests that this is likely to be the default case as storage is usually located around the perimeter of the site with unloading taking place in the centre of the site;

- A loudspeaker public announcement system will not be used to direct lorries. If required, electronic signage or an operator's booth at the gate will be used;
- Forklifts and similar that are associated with the site will be fitted with broadband reversing alarms. If these are to be used outdoors at night, the alarms should be disabled and visual warning lights used;
- Where possible, the majority of deliveries will be prioritised for during the day, with nighttime and weekends scheduled only when operational requirements do not allow these to be avoided;
- Excessive or unnecessary revving of engines will be avoided on site and when arriving and leaving (to be noted on signage);
- Engines will be turned off promptly once parked and only turned on when necessary to leave the site;
- Refrigerated vehicles are not anticipated to be used on this site;
- Where possible, lorries with broadband reversing alarms will be preferred. Spoken warning systems are to be discouraged and should be deactivated on site where possible;
- Loud radios may not be played in cabs or outside;
- Sounding of horns is not permitted at the gate and only in emergency situations within the yard (to be noted on signage);
- No shouting is allowed onsite;
- No maintenance of vehicles that involves banging or electric tools will be allowed in the yard.

8. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the background noise climate in the locality of 127a Loverock Road, Reading.

The measured noise levels have been assessed against BS4142:2014 *Methods for rating and assessing industrial and commercial sound* to assess potential noise impacts on the surrounding dwellings.

The site is located in an existing industrial/commercial area with the nearest dwellings at a significant distance and well screened by intermediate buildings. Noise levels in the area are generally determined by traffic on the surrounding road which already includes a proportion of HGV traffic. The exception is the early morning during the weekends when deliveries are less likely to occur.

When assessed using BS4142, noise from most activities on site have been shown to have a low impact.

The low expected impact notwithstanding, management policies that can be adopted to further reduce the risk.

Overall, the proposals are not expected to create a significant noise impact on the identified properties along Stone Street.

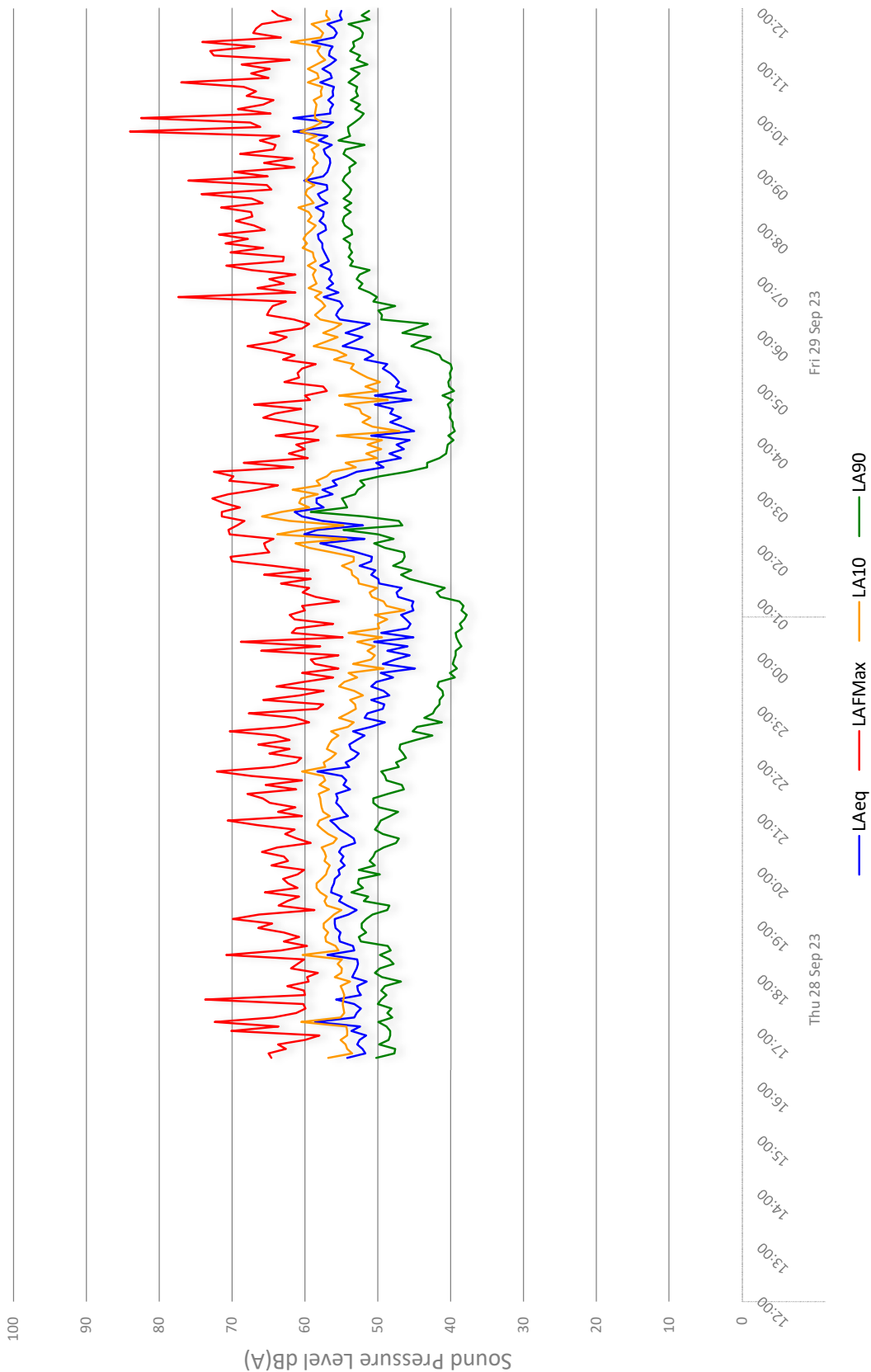
Steven Liddell MIOA



127a Loverock Road, Reading
Environmental Noise Time History: 1



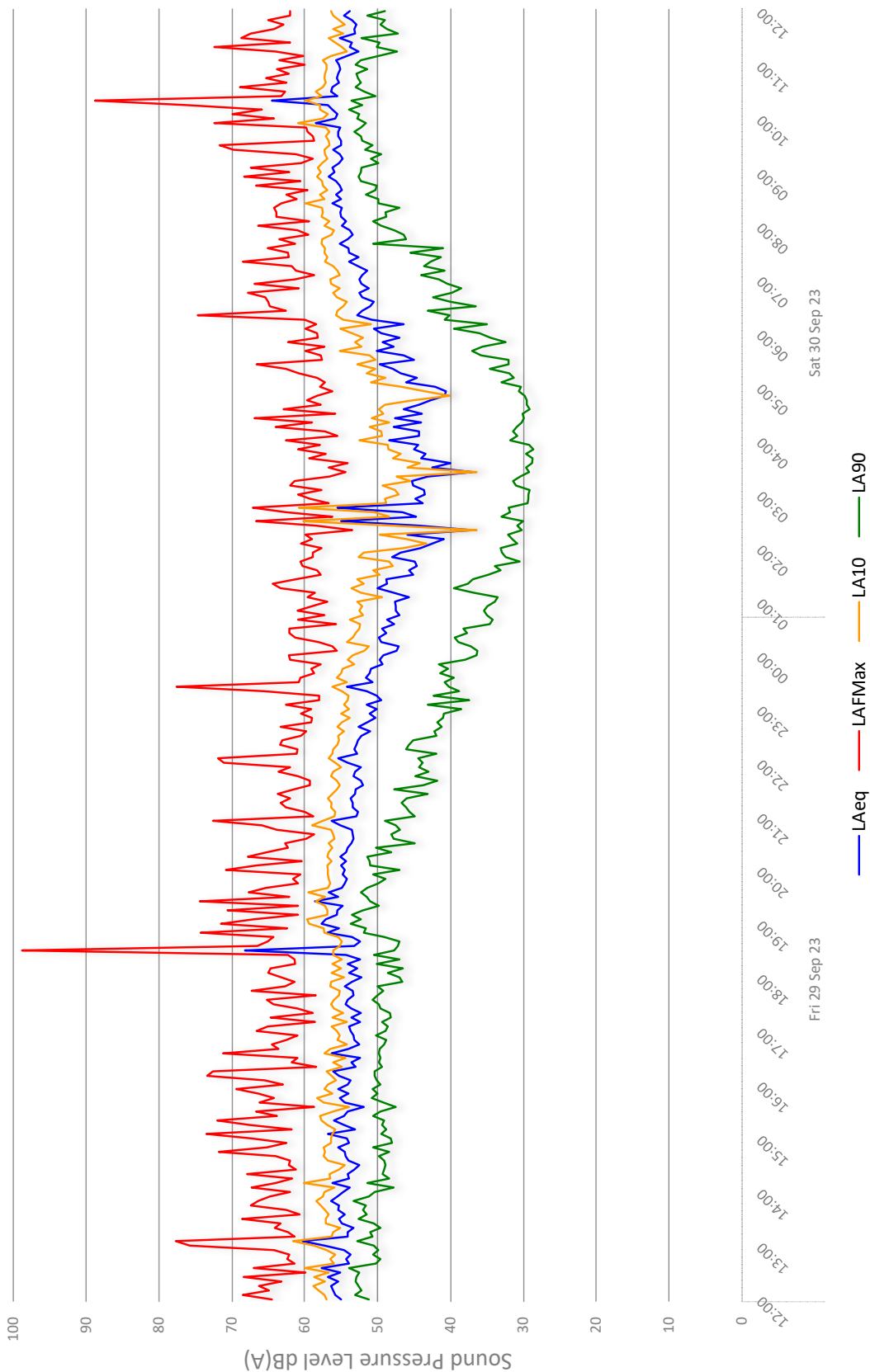
Figure VA4946/TH1



127a Loverock Road, Reading
Environmental Noise Time History: 2



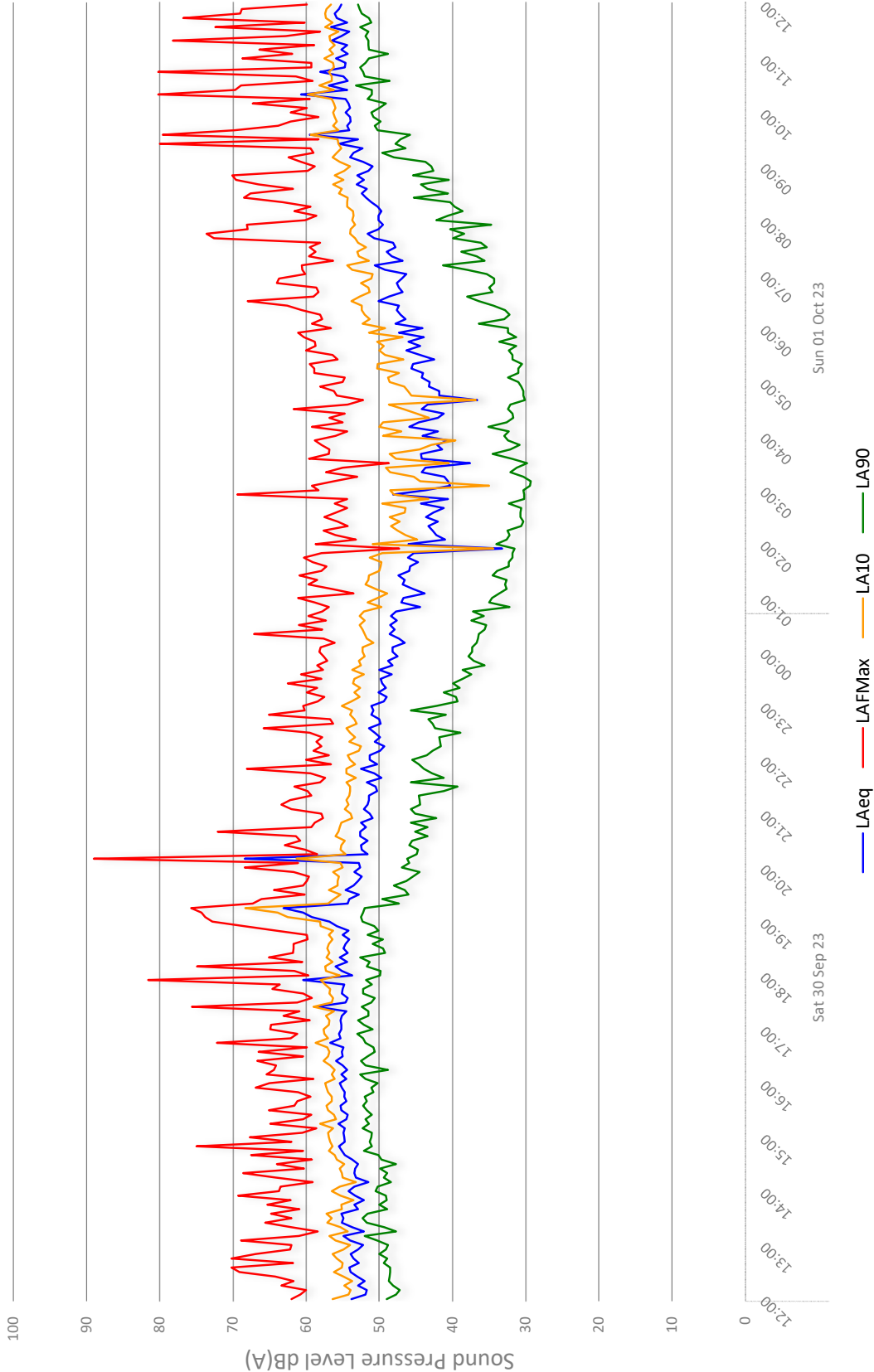
Figure VA4946/TH2



127a Loverock Road, Reading
Environmental Noise Time History: 3



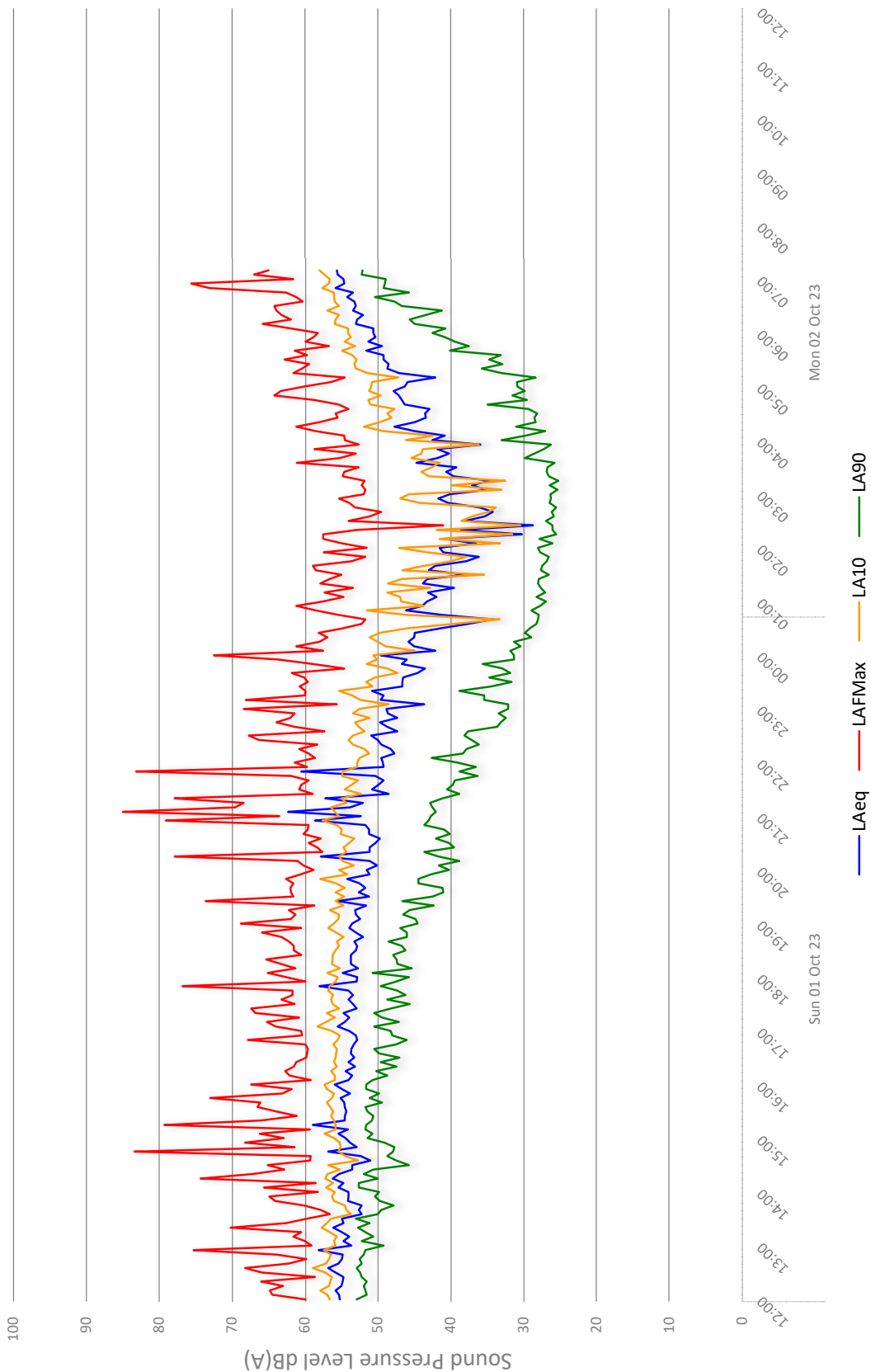
Figure VA4946/TH3



127a Loverock Road, Reading
Environmental Noise Time History: 4



Figure VA4946/TH4



APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A . A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc).
L_{eq} :	The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. 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 a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz		63		125		250		500		1000		2000		4000		8000
---------------------------------	--	----	--	-----	--	-----	--	-----	--	------	--	------	--	------	--	------

APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial

1.4 Earth Bunds and Barriers - Effective Screen Height

When considering the reduction in sound level of a source provided by a barrier, it is necessary to establish the "effective screen height". For example if a tall barrier exists between a sound source and a listener, with the barrier close to the listener, the listener will perceive the sound as being louder if he climbs up a ladder (and is closer to the top of the barrier) than if he were standing at ground level. Equally if he sat on the ground the sound would seem quieter than if he were standing. This is explained by the fact that the "effective screen height" is changing with the three cases above. In general, the greater the effective screen height, the greater the perceived reduction in sound level.

Similarly, the attenuation provided by a barrier will be greater where it is aligned close to either the source or the listener than where the barrier is midway between the two.