Teddington Direct River Abstraction

Preliminary Environmental Information Report
Appendix 14.1 – Acoustic Terminology

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Appendix 14.1 – Acoustic Terminology

A.1 Introduction

A.1.1 This appendix provides an explanation of the terminology used in Chapter 14: Noise and Vibration of the Preliminary Environmental Information (PEI) Report.

A.2 Human perception

A.2.1 Noise is commonly defined as unwanted sound and is therefore subjective. The human perception of noise is influenced by physical, physiological and psychological factors. Physical factors include the sound pressure level at the position of the listener, physiological factors include the acuity of hearing, and psychological factors include acclimatisation to steady sound and the activity that an individual is undertaking while the sound is present.

A.2.2 Sound consists of vibrations transmitted to the ear as rapid variations in air pressure which can be measured accurately. The more rapid the variations in air pressure, the higher the frequency of the sound. Frequency is defined as the number of pressure fluctuations per second and is expressed in Hz.

A.2.3 The ear can detect both loudness and frequency of sound. However, the sensitivity of the human ear varies with frequency, and therefore noise is commonly measured using the A-weighted filter network which mimics the frequency response characteristics of the human ear. The ‘A’ notation is used to indicate when noise levels have been filtered using the A-weighting network. Noise levels are usually presented using the decibel (dB) scale.

A.2.4 Noise levels range from the threshold of hearing at 0dB(A) to levels of over 130dB(A) at which point the noise becomes painful. Noise levels over 80dB(A) are considered potentially damaging to hearing. Table A.1 presents a guide to the A-weighted sound pressure levels in common areas and activities.

Table A.1 Common noise levels

Source	Sound pressure level, dB(A)
Threshold of hearing – silent	0
Quiet bedroom	25–35
Quiet rural area	45–50
Suburban areas away from main traffic routes	50–60
Conversational speech at 1m distance	60–70
Busy urban street corner	70–80
Passenger car at 60km/h and 10m distance	70

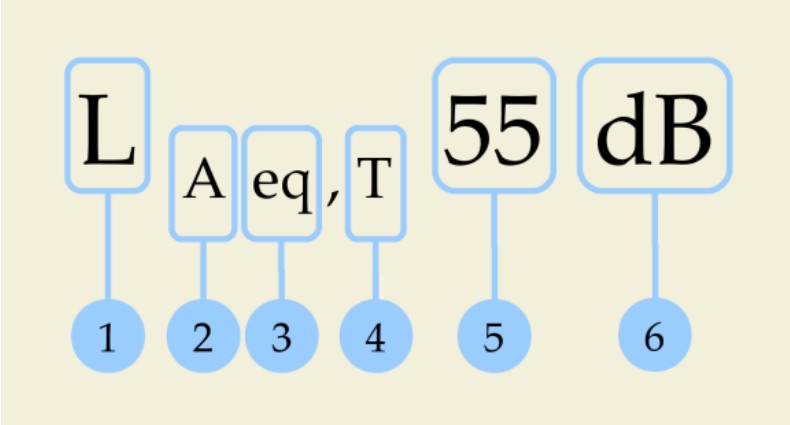
Source	Sound pressure level, dB(A)
Health and Safety 'lower exposure action value' to prevent damage to hearing	80
Heavy lorry at 40km/h and 10m distance	80
Pneumatic drill (un-silenced) at 7m distance	95
Threshold of pain	130

A.3 Acoustic descriptors

A.3.1 Outdoor noise levels may fluctuate rapidly over time, and therefore to describe the acoustic environment it is necessary to collect statistical data on the distribution of noise levels during the period of interest.

A.3.2 The nomenclature used to represent acoustic quantities can appear complicated; however, once understood it becomes a logical and efficient way of qualifying noise levels. As an example, the upper guideline level recommended by BS 8233:2014 (British Standards Institution, 2014a) for noise levels in gardens is $L_{Aeq,T}$ 55dB, as shown in Plate A.1.

Plate A.1 Common layout of acoustic quantities



Source: Jacobs

A.3.3 The descriptor in Plate A.1 is comprised as follows:

a. The first grouping ('L') indicates that the quantity is a sound pressure level. Other common quantities are sound intensity level (L_I) and sound power level (L_W).

b. The second grouping ('A') denotes that the sound pressure level is evaluated using the A-weighted filter network.

c. The third grouping of characters identify the statistical index. In this example, the letters indicate that the quantity is in terms of the equivalent continuous noise level (eq), which has some similarities with the concept of an average noise level. Numerical values can also be used, and these indicate the level exceeded for n per cent of the measurement (e.g. a value

of $L_{A90,T}$ 45dB indicates that the A-weighted sound pressure level exceeds 45dB for 90% of the period analysed).

d. The quantity ('T') shown after the statistical descriptor is the duration over which the quantity is evaluated. This is typically represented in minutes or hours, e.g. 15min, 16h.

e. The fifth term identifies its numeric value. This value is usually given as a whole number or to one decimal place.

f. The sixth and final group of characters indicate that the units of the sound pressure level are decibels.

A.3.4 A variety of statistical indices are used to quantify noise in different situations. The most common are described in the Section A.4.

A.4 Common acoustic parameters

Ambient noise level

A.4.1 General environmental noise from transport, commercial, construction, industrial or unidentified sources is often expressed in terms of the equivalent continuous sound pressure level over the time period of interest ($L_{Aeq,T}$). This is the notional continuous constant noise that contains the same sound energy over the period of interest as the actual fluctuating noise. This is not an 'average' sound level over a period, but the concept has some similarities and provides a single figure quantity that can be used to compare noise levels which fluctuate with time.

Background noise level

A.4.2 The $L_{A90,T}$ index identifies the noise level exceeded for 90% of the period of interest and provides a good indication of the background noise level that remains in a location in the absence of any easily identifiable sources.

Maximum sound level

A.4.3 The maximum sound level (L_{Amax}) is the highest time-weighted sound level measured during a period. The time constant of the measure may either be Fast (125ms), Slow (1s) or Impulsive (35ms), and it is usual to identify the time constant in the notation, e.g. L_{AFmax} indicates that the maximum sound level was measured with the fast time-weighting. The longer the time constant over which the measurement is integrated, the greater the smoothing effect of the time-weighting, which may result in a lower numeric value of the measurement. If it is not clear which time weighting has been used for a measurement, then it is generally assumed to be the fast time weighting as this is most common.

A.5 Vibration

A.5.1 Groundborne vibration is typically measured in terms of velocity (mm/s, millimetres per second). Where sources of vibration are impulsive/intermittent it is the peak velocity or acceleration which is measured (and this will be the maximum value recorded during a specific event).

A.5.2 Acceptable levels for human exposure to vibration and for the evaluation of building vibration with respect to annoyance and comfort are provided in various standards and guidance documents. Based on guidance given in BS 5228-2:2009 +A1:2014 (British Standards Institution, 2014b), Table A.2 summarises the effects of vibration levels on buildings and humans.

Table A.2 Guidance on the effects of vibration levels

Vibration level, peak particle velocity[1]	Effect
0.14mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3mm/s	Vibration might be just perceptible in residential environments.
1mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
6mm/s	Possible cosmetic damage to a building structure may occur from continuous works.
10mm/s	Vibration is likely to be intolerable to humans for any more than a very brief exposure to this level.
15mm/s	Damage to an unreinforced or light building structure can occur from transient works (value to be halved for continuous works).
50mm/s	Damage to a reinforced or heavy building structure can occur from transient works (value to be halved for continuous works).

1 Peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. It is specified in mm/s. It should be noted that the PPV refers to the movement within the ground of molecular particles and not surface movement.

A.6 Groundborne noise

A.6.1 Groundborne noise is an audible noise caused by vibration, when the propagation path of the vibration from the source is partially or wholly through the ground, e.g. from tunnel boring or underground railways. It can be heard as a rumbling sound and can have an adverse impact on quality of life.

A.7 References

Documents and legislation referenced in the Appendix 14.1 are shown in the tables below.

Documents

Title	Document date
British Standards Institution. BS 8233:2014 Guidance on sound insulation and noise reduction for buildings, London: BSI	2014a
British Standards Institution. BS 5228-2:2009 +A1:2014 Code of practice for noise and vibration control on construction and open sites - Part 2: Vibration, London: BSI.	2014b