

National Grid Cable Tunnel Replacement Project

Environmental Statement Volume VI

Appendix 11.1 Human Hearing and Acoustic Terminology

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Quality information

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1 Human Hearing and Acoustic Terminology

- 1.1.1 Sound is the sensation caused in the ear by tiny variations in air pressure. The rate of these variations is expressed as the frequency of the sound and is measured in Hertz, abbreviated to Hz. A frequency of 1Hz is equivalent to one variation in air pressure per second. Human hearing has a frequency range from 16Hz to 16,000Hz.
- 1.1.2 The pressure range detected by the human ear as sound covers an extremely large range. In practice the decibel (dB) unit is used to condense this range into a manageable scale by taking the logarithm of the ratio of the sound pressure to a reference sound pressure. The resulting quantity is termed the Sound Pressure Level (SPL) and is given the symbol L_p . Generally sound units measured in decibels are given the symbol L with a subscript used to identify the specific quantity. Expressed as SPL, the threshold of hearing would be an L_p of 0dB and the threshold of pain is taken to be an L_p of 140dB.
- 1.1.3 Human hearing sensitivity varies with the frequency of the sound; it is at its greatest between 2,000Hz and 5,000Hz. When measuring sound an 'A' weighting is often applied to the dB value. This weighting is a bias built into the frequency response of the sound level meter that aims to match the frequency sensitivity of the meter to that of the human ear. An SPL that has been 'A' weighted is indicated by the symbol L_{Ap} .
- 1.1.4 When two sound sources at the same level are combined the resulting level will be 3 dB higher than the single source. A 3 dB change in noise is usually considered just discernible; a 5 dB change in noise is usually considered as 'clearly discernible'. When two sounds differ by 10 dB the higher will generally be perceived as being twice as loud as the lower.
- 1.1.5 A summary of acoustic terminology used in the assessment are presented in Table 1.

Table 1: Acoustic Terminology

Term	Definition
Decibel (dB)	The range of audible sound pressures is approximately 2×10^{-5} Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0dB to 140dB. Mathematically Sound Pressure level = $20 \log \{p(t)/p_0\}$ Where $P_0 = 2 \times 10^{-5}$ Pa.
"A" Weighting (dB(A))	The human ear does not respond uniformly to different frequencies. "A" weighting is commonly used to simulate the frequency response of the ear.
'Fast' time weighting	A sound level meter setting with a 125-millisecond response time. Provides a better resolution for very short noise events that may be missed by a 'slow' response time.
Frequency (Hz)	The number of cycles per second, for sound this is subjectively perceived as pitch.
Frequency Spectrum	Analysis of the relative contributions of different frequencies that make up a sound.
Ambient Sound	Totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far. The

Term	Definition
	ambient sound comprises the residual sound and the specific sound when present.
Background Sound Level $L_{A90,T}$	A-weighted sound pressure level that is exceeded at the assessment location for 90% of a given time interval, T, measured using time weighting F.
$L_{A10,T}$	A-weighted sound pressure level that is exceeded at the assessment location for 10% of a given time interval, T, measured using time weighting F.
L_{AFmax}	The maximum sound pressure level using 'fast' sound level meter response time of 125-milliseconds and is used in the acoustic design of new residential developments
Equivalent Continuous A-weighted Sound Pressure Level $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation: $L_{Aeq,T} = 10 \times \log \left\{ \left(\frac{1}{T} \right) \int_{t_1}^{t_2} \left(\frac{P_A^2(t)}{P_0^2} \right) dt \right\}$ Where p_0 is the reference sound pressure (20μPA); and $P_A(t)$ is the instantaneous A-weighted sound pressure level at time t
Peak Particle Velocity	The peak speed of particle movement in the ground due to vibration and used to assess impacts from construction activity induced vibration. The Peak Particle Velocity is defined as millimetres per second (mm/s)

