A1 Birtley to Coal House

Scheme Number: TR010031

6.3 Environmental Statement – Appendix 11.1 Noise and Vibration Glossary

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Environmental Statement - Appendix

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GLOSSARY OF ACOUSTIC AND VIBRATION TERMINOLOGY

1.1. NOISE

1.1.1. Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20Hz (deep bass) to 20,000Hz (high treble) and over the audible range of 0dB (the threshold of perception) to 140dB (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.

1.1.2. 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.

1.1.3. 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 LAeq, LA90 etc. according to the parameter being measured.

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

ACOUSTIC TERMINOLOGY

- **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 ($2x10^{-5}$ Pa).
- **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.
- **$L_{Aeq,T}$**: 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}:** The maximum A-weighted sound pressure level recorded over a particular period. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises

occur, which may have little effect on the overall $L_{Aeq,T}$ noise level, but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response, denoted L_{AFmax} or $L_{Amax,F}$.

- **L_{10} and 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 the L_{90} is the level exceeded for 90% of the time. Unless described otherwise, they are measured using the 'fast' sound level meter response, denoted LAF_{10} and LAF_{90}. When measuring noise levels in proximity to a road the use of the LA10 statistical parameter is preferred, as this generally captures the sound levels experienced as road traffic passes a location.
- **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 at least 3.5m away from buildings.
- **Façade Level:** A sound field determined at a distance of 1m in front of a large sound reflecting object such as a building façade.
- **Ambient Noise Level:** The all-encompassing noise level measured in $L_{Aeq,T}$. The Ambient Noise Level incorporates background sounds as well as the industrial source noise under consideration.

1.2. VIBRATION

1.2.1. Vibration is defined as a repetitive oscillatory motion. Vibration can be transmitted to the human body through the supporting surfaces; the feet of a standing person, the buttocks, back and feet of a seated person or the supporting area of a recumbent person. In most situations, entry into the human body will be through the supporting ground or through the supporting floors of a building.

1.2.2. Vibration is often complex, containing many frequencies, occurring in many directions and changing over time. There are many factors that influence human response to vibration. Physical factors include vibration magnitude, vibration frequency, vibration axis, duration, point of entry into the human body and posture of the human body. Other factors include the exposed persons experience, expectation, arousal and activity.

1.2.3. Experience shows that disturbance or annoyance from vibration in residential situations is likely to arise when the magnitude of vibration is only slightly in excess of the threshold of perception.

VIBRATION TERMINOLOGY

- **Displacement, Acceleration and Velocity:** Vibration is an oscillatory motion. The magnitude of vibration can be defined in terms of displacement (how far from the equilibrium position that something moves), velocity (how fast something moves), or acceleration (the rate of change of velocity).

- **Peak / Root Mean Square (RMS) / Root Mean Quad (RMQ) and Peak Particle Velocity (PPV):** When describing vibration, one must specify whether peak values are used (i.e. the maximum displacement or maximum velocity) or RMS / RMQ. values (effectively an average value) are used. Standards for the assessment of building damage are usually given in terms of peak velocity (usually referred to as Peak Particle Velocity, or PPV), whilst human response to vibration is often described in terms of RMS or RMQ acceleration.
- **RMS:** The RMS value of a set of numbers is the square root of the average of the squares of the numbers. For a sound or vibration waveform, the RMS value over a given time period is the square root of the average value of the square of the waveform over that time period.
- **RMQ:** The RMQ value of a set of numbers is the fourth root of the average of the fourth powers of the numbers. For a vibration waveform, the RMQ value over a given time period is the fourth root of the average value of the fourth power of the waveform over that time period.
- **Attenuation:** A general term used to indicate the reduction of noise or vibration, or the amount (in decibels) by which it is reduced.
- **Amplification:** A general term used to indicate the increase in noise or vibration, or the amount (in decibels) by which it is increased.

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