The Hillingdon Hospital NHS Foundation Trust

Project Furze, Hillingdon Hospital

201056

Noise Impact Assessment

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Contents

Executive Summary

Couch Perry Wilkes Acoustics were appointed by The Hillingdon Hospitals NHS Trust to provide an acoustic report in support of a planning application for the refurbishment of the Furze building at Hillingdon Hospital.

The refurbishment comprises the overhaul of internal areas and new items of external fixed plant. Given the surrounding area is largely residential, an outline assessment of the plant's noise impact has been undertaken so that any potential adverse impact can be mitigated.

A comprehensive background noise survey was undertaken 19th – 20th August 2021 to establish the existing noise climate at the Site and at nearby noise sensitive receptors. Noise monitoring results confirmed that during the daytime the dominant source of noise within the area is road traffic noise, notably from Colham Green Road and Pield Heath Road. During the night-time period road traffic movements on the wider road network within and around Hillingdon Hospital formed the background noise environment. Typical lowest daytime and night-time background noise levels of 45 dB and 38 dB L_{A90} were measured respectively.

We have discussed the plant noise emission requirements with Hillingdon Borough Council. They confirmed that plant noise emission should be assessed in accordance with BS 4142 and the Rating Level (as defined in BS 4142) for new items of fixed plant should not exceed a level equal to the measured typical lowest Background Sound Level.

An indicative assessment of the plant noise emission has been undertaken that comprises 1 no. air handling unit. Attenuation will be included on the atmospheric side of the air intake and exhaust ducts. The assessment indicates that HBC's noise requirements are achievable with the proposed plant equipment using typical noise control measures.

1.0 Introduction

Couch Perry Wilkes have been commissioned by The Hillingdon Hospital NHS Foundation Trust to undertake a noise assessment in support of their application for the refurbishment of the Furze building. The proposals comprise the refurbishment of the existing building and the introduction of some new items of external plant.

The Furze Building is located on the eastern side of the Hillingdon Hospital site adjacent to Colham Green Road, residential properties are located on the eastern side of Colham Green Road. This report presents an assessment of noise impact and as part of this assessment, the following works have been carried out.

- Consultation with Hillingdon Borough Council (HBC) to establish their requirements for noise;
- A baseline environmental noise survey to quantify the existing noise climate affecting the Site and nearby noise sensitive properties;
- Specification of noise emission limits for new fixed building services plant to adhere; and
- Recommendations for the control of noise and vibration, where necessary.

A glossary of common acoustic terms is included within Appendix A of this document.

2.0 Criteria

Consideration has been given to relevant planning policy and regulations concerning the redevelopment and the Site. The National Planning Policy Framework (NPPF)[1], the Noise Policy Statement for England (NPSE)[2] and Noise Planning Practice Guidance[3] provide a framework for how noise should be considered within planning system. Generally, noise policy and guidance gives Local Authorities flexibility to develop specific requirements appropriate to their area and the Site in question.

The core aim of these documents is to avoid and reduce significant adverse impacts and other adverse impacts on health and quality of life a more detailed overview of these documents is included within Appendix B of this document.

2.1 Local Planning Authority

HBC were asked to provide their requirements for noise from fixed items of plant. It is common practice that the below will form the basis for an appropriately worded planning condition.

- New (or relocated) items of building services should be rated and assessed in accordance with British Standard 4142[4] *Methods for rating and assessing industrial and commercial sound*.
- A Rating Level as defined in BS 4142 that does not exceed the typical lowest Background Sound Level for new or relocated items of plant should be targeted.
- A Specific Sound Level as defined in BS 4142 that does not exceed 10 dB below the typical minimum Background Sound Level should be targeted.

BS 4142 provides a method to assess the likelihood of adverse comment due to noise from new industrial or commercial sources. A relevant summary of BS 4142 is included within Appendix B of this document.

HBC also asked for the assessment to consider any other new items of plant to be installed elsewhere across the Hillingdon Hospital site. We are not aware of any new notable items of plant that will be installed near to the Furze Building and would impact upon the same exposed noise sensitive receptors. It is assumed that the captured Background Sound Levels incorporated contributions from existing plant associated with Hillingdon Hospital and by designing to a Specific Sound Level of 10 dB below existing Background Sound Levels, the new plant associated with the redevelopment of the Furze building will not lead to an ever-increasing background noise environment.

[1] Department for Communities and Local Government (DCLG) (2012); 'The National Planning Policy Framework', TSO.
[2] Department for Environment, Food and Rural Affairs (DEFRA) (2010); 'Noise Policy Statement for England', DEFRA.
[3] DCLG (2014); 'Planning Practice Guidance website', DCLG. (http://planningguidance.planningportal.gov.uk/)
[4] British Standards Institution (BSI) (2014); BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound', BSI.

3.0 The Site and Nearby Noise Sensitive Receptors

The Hillingdon Hospital Site comprises numerous buildings, the Furze building comprises a listed property with several extensions from different eras. A new plant compound is proposed on the southern side of the building adjacent to Colham Green Road.

Colham Green Road separates the Furze building from the nearest residential buildings. The following satellite image (Google Maps) shows the Furze building bounded in red and the nearest residential properties outlined in Blue.

Figure 3.1: Location of Site

The existing background noise level at the NSRs is dominated by traffic noise from Colham Green Road and Pield Heath Road. These were dominant in the daytime with sporadic traffic movements during the night-time. Occasional ambulance siren events were also present during the daytime due to the proximity of the A&E hospital entrance, off Pield Heath Road. The night-time period was dominated by road traffic movements on the wider road network within and around Hillingdon including the more distant M25, M40 and M4 motorways.

4.0 Baseline Noise Survey

4.1 Method

A site visit was undertaken 19th – 20th August 2021 to measure the existing prevailing ambient noise levels (dB $L_{Aeq,T}$) and background noise levels (dB $L_{A90,T}$) at a location representative of the nearby NSRs.

Environmental noise monitoring was undertaken in general accordance with BS 7445-1:2003 *Description and measurement of environmental noise – Part 1: Guide to quantities and procedures.*

Details of the survey equipment are provided in *Table 4.1* serial numbers can be provided upon request.

Equipment
NTi XL2 sound level meter
Nor 1251 calibrator
NTi MA220 pre amplifier
NTi MC230 microphone
Accuracy: Sound level meters were field-checked and calibrated at the start and end of the survey periods. No significant drift in calibration was observed.
Sound calibrator: The accuracy of the sound calibrator used can be traced to National Physical Laboratory Standards.

Table 4.1: Survey Equipment Details

4.2 Noise Monitoring Locations

The noise monitoring locations are illustrated in *Figure 4.1.*

This location was chosen to be representative of the levels at the location of the nearest NSRs located on Colham Green Road. The measurement location was a similar distance from the road when compared to the NSRs and therefore the measured background levels are considered representative.

Figure 4.1: Noise monitoring location

4.3 Weather Conditions

Weather conditions at the time of the noise survey were appropriate for noise monitoring. Weather conditions were monitored remotely throughout the survey period.

Conditions from 19th – 20th August 2021 were dry with temperature ranging between 15 and 21ºC and no more wind than a gentle breeze.

4.4 Results

A summary of noise monitoring data is presented in *Table 4.2.* Our full measurement data can be provided upon request.

Location	Date	Time Period	dB $L_{Aeq,15min}$	dB $L_{A90,\ 15min}$
L1	19 – 20/08/2021	Daytime (07.00 – 23.00)	62	45[1]
		Night-time (23.00 – 7.00)	57	38[1]

Notes: [1] The 10th percentile value is given for each survey period, this is considered representative of the typical lowest background sound levels experienced.

Table 4.2: Survey results summary

5.0 Assessment

5.1 Proposals

It is understood that the main item of new external plant will be a new air handling unit servicing the Haematology department within the Furze building. This is to be located within an external plant enclosure at ground floor level. The location of the plant enclosure is bounded by yellow in *Figure 5.1*.

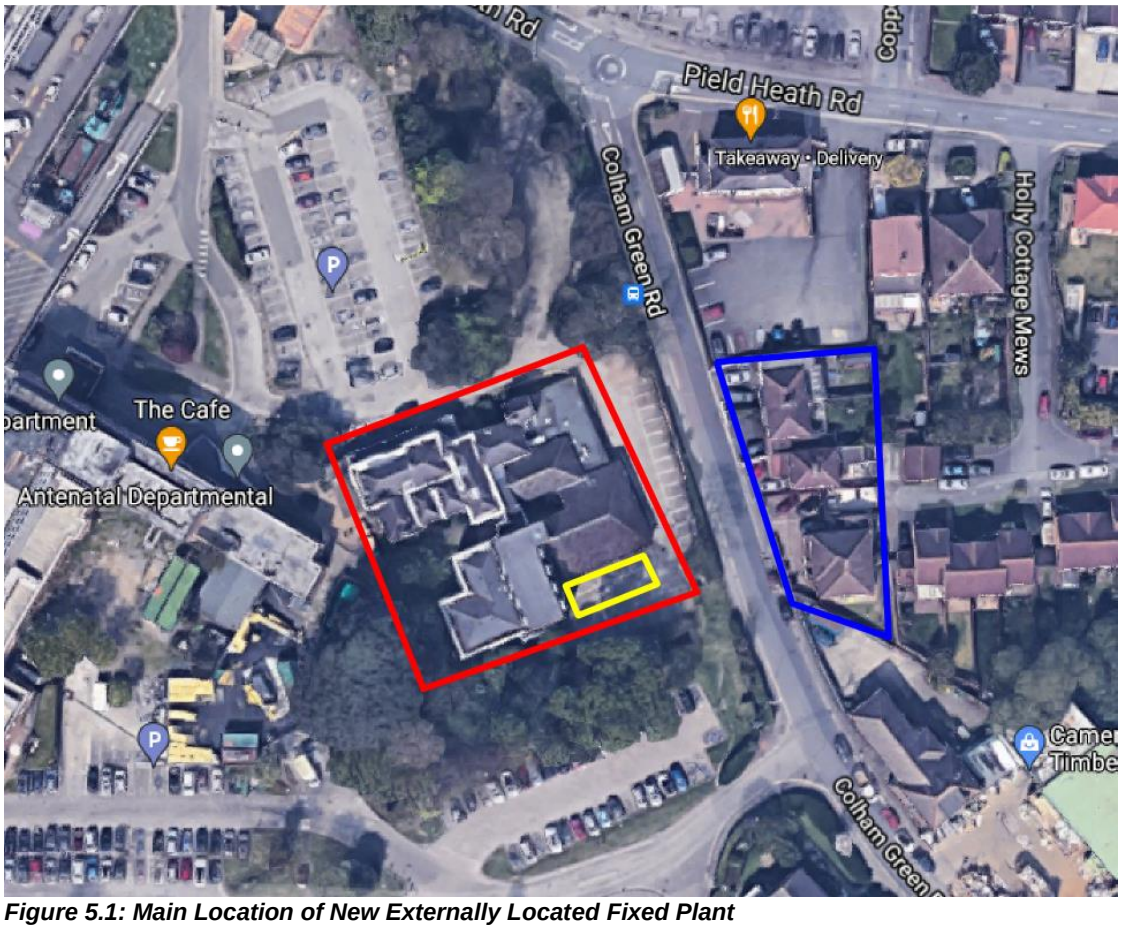

Figure 5.1: Main Location of New Externally Located Fixed Plant

It is understood that the plant enclosure will house 1 no. air handling unit (AHU). Currently, only indicative equipment selections have been made. The final acoustic performance of the enclosure and any noise control equipment will depend upon the final equipment selections. It is anticipated that in-duct attenuators will be required on the atmospheric side (intake & exhaust) of the air moving plant. Sufficient space should be allowed for within the enclosure to accommodate such attenuation.

5.2 Operating Plant Noise Limits

Based upon HBC's requirements for noise from new items of fixed plant and the measured Background Sound Levels reported in Section 4.4, plant noise limits have been derived and are shown in *Table 5.1* below.

NSR (See Figure 3.1)	External Plant Noise Rating Level Limit During Plant Operating Period, $L_{Ar,Tr}$ (dB)	
	Daytime (07.00 – 23.00)	Night-time (23.00 – 7.00)
All NSRs	45	38

Table 5.1: Cumulative Plant Noise Limits at the Location of the Most exposed NSRs

The above plant noise limits are cumulative limits to be met by all new sources of plant associated with the refurbishment. In addition, HBC also require Specific Sound Level limits of 10 dB below the levels in 5.1. The above Rating Level limits include corrections to the Specific Sound Level for the presence of any acoustic characteristics.

5.2.1 Indicative Assessment

At this stage, the only confirmed plant selection is for the air handling unit (AHU) and therefore only this item has been assessed. If any other external plant is to be included it is anticipated that the AHU will produce the highest level of noise emission.

A high-level indicative assessment of noise emission from the AHU has been undertaken. Consideration has also been given to typical noise control measures that could be employed to achieve the plant noise limits seen in Table 5.1. The assessment was undertaken using Cadna-A which adopts the propagation methodology of ISO 9613[5]. The following table presents the manufacturer's noise data for the currently selected AHU in the absence of any additional in-duct attenuation.

Description	Location	Data Type	Octave Band Centre Frequency (Hz)								dBA
			63	125	250	500	1k	2k	4k	8k	
AHU Case Radiated	Inside Plant Enclosure	dB L_w	61	57	49	41	37	36	32	30	47
AHU Exhaust	Ducted through Enclosure	dB L_w	71	74	74	72	72	69	65	64	76

[5] International Organisation for Standardisation (ISO) (1996); ISO 9613 'Attenuation of sound during propagation outdoors', ISO.

AHU Intake	Ducted through Enclosure	dB L_w	59	65	61	61	56	54	48	45	62

5.2: Manufacturer's sound power level data

It is understood that the AHU plant will be enclosed by a plant screen, through which the fresh air intake and the exhaust will penetrate. An indicative height of 2 m has been included within the model, this will be refined as the design develops. Currently, it is not anticipated that the enclosure will need to have any acoustic performance characteristics and only a basic structure has been assumed at this stage. It is proposed that the AHU air intake and the exhaust will have atmosphere side attenuation. For assessment purposes attenuators of 900mm in length have been used to reduce the exhaust and intake noise levels reported in Table 5.2. The following table gives the software predictions for Specific Sound Level AHU at the established NSRs.

Predicted Highest Façade Incident Specific Sound Level, dB $L_{Aeq,Tr}$
26

5.3: Predicted Specific Sound Level at nearest NSRs

The following figure presents the predicted noise levels resulting from the AHU at each of the receptors.

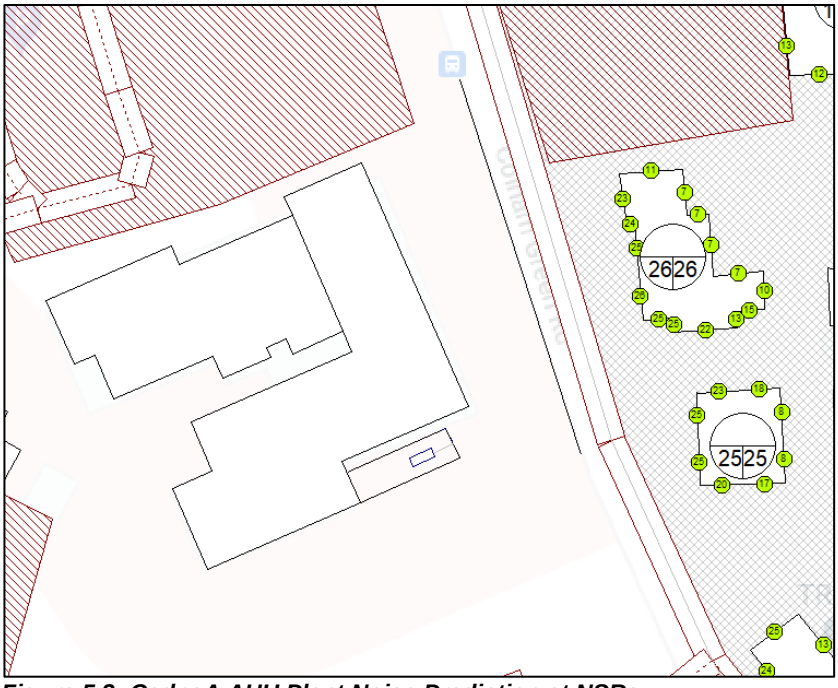

Figure 5.2: CadnaA AHU Plant Noise Prediction at NSRs

We understand that the external building services equipment will operate during normal daytime opening hours for the non-emergency/24hr care wards within Hillingdon Hospital and therefore we anticipate no night-time operation. As such, the Specific Sound Level of the plant should only be assessed against the daytime plant Rating Level limits.

No further mitigation was included within the assessment. In accordance with BS 4142 2014, corrections can be applied based upon the presence of any acoustic characteristics. Currently, we do not anticipate such equipment to have any acoustic characteristic features and therefore the predicted Rating Level of the equipment is anticipated to be the same as the above Specific Sound Level which achieves the limit contained within Table 5.1. Given that the predicted Specific Sound Level is 14 dB below the daytime Rating Level Limit the presence of some acoustic characteristics could be accommodated.

This assessment is indicative only, final to be installed equipment selections will be finalised at a later date. A range of further noise control options are available should the final equipment selections require them:

- Additional plant screening/relocation of duct terminations;
- Selection of alternative plant with lower noise emission levels; and
- Introduction of enhanced plant attenuation.

Appendix A - Glossary of Acoustic Terminology

This Appendix provides a non-specialists explanation of common acoustics terms that may occur in reports and technical notes. It is intended to give a brief overview of the term.

Term	Definition
Decibel, dB	Is a unit of measurement of sound and is expressed on a logarithmic (base 10) scale. The human ear has a large dynamic range in sound reception, the logarithmic scale is a convenient way of compressing a range of sound pressures into a smaller range of numbers.
Sound Pressure Level, *Lp*	$$L_p = 20log10\left(\frac{P_{rms}}{P_{ref}}\right)dB$$ This is the pressure deviation against a reference pressure caused by a passing sound wave. Where P_{rms} is the root mean square measured pressure and P_{ref} is the reference pressure, which is $2x10^{-5}$ pascals for air.
Sound Power Level, L_w	$$L_W = 10log10\left(\frac{P}{P_0}\right)dB$$ This is the total sound energy radiated from a given source. P_0 is the reference sound power level ($1x10^{-12}$) and the measured power.
Noise Rating Level, NR dB	Commonly used when describing noise from building services systems. This is a single figure value derived by plotting a noise spectrum against a set of curves. The lowest curve under which the level fits is the resulting NR level. The overall NR value is the highest of the individual NR values for each frequency band.
Frequency, Hz	$$f = \frac{1}{T} = \frac{v}{\lambda}$$ Where f is the frequency, T is the time to complete one cycle, v is the speed of sound and λ is the wavelength of a given sound pressure wave. Different frequencies are divided into octave and one third octave bands.
Frequency Weightings	Weightings are often applied to a spectrum of sound and act as a filter to account for different sensitivities and conditions. Weightings are often used to present a single figure value from a spectrum of sound.
A-weighted sound pressure level, L_{pA}	The sound pressure level with the A-weighting applied. The A-weighting is used for most environmental noise measurements and is used to weight a spectrum of sound to match the sensitivity of the human ear.
Measurement Time Weightings, Fast, Slow	Depending upon the measurement in question the time response of a sound level meter can be adjusted. For most measurements the Fast time weighting is selected (F) however, a slow time weighting (S) is often used to for the measurement train noise and vibration.
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	An energy average and defined as the level of sound which, through a given period of time (T) would equate to the same A-weighted sound energy as the actual measured fluctuating sound.
Octave Band	A frequency band where the upper frequency of the band is twice the frequency of the lower limit.

Noise Impact Assessment

Maximum noise Level, L_{AFmax}	With the meter set with a fast time response, F, this is the maximum instantaneous noise level measured during a given period of time.
Percentile level, $L_{AN,T}$ ($L_{A90,T}$, $L_{A10,T}$)	A sound pressure level which is exceeded for a given N% of a specified time period with an A-weighting and measured with a fast time response.
Background Sound/Noise Level, L_{A90}	Typically, these are amongst the lowest noise levels referenced over a given period and act to describe the noise level that is consistently exceeded 90% of the time. The background sound level excludes short term, intermittent noise sources and often acts to describe noise sources that operate consistently through a given period.
Ambient Noise Level	The most commonly used value to describe the ambient noise level the $L_{Aeq.\ lt}$ is the noise level in a given environment whilst it is subject to all of its normal sources of noise.
Rating Level, $L_{Ar,Tr}$	As defined in BS 4142. The equivalent continuous A-weighted sound pressure level that includes corrections for the presence of any acoustic characteristics such as tonality, impulsivity and intermittency.
Reverberation Time, T	The time needed for the sound pressure level to decrease by 60 dB after the sound source has stopped, often written RT60. *T* is often followed by descriptors to present type of reverberation time value. For example, a T_{mf} is the mid-frequency (500 Hz – 2 kHz) reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Absorption, A	$$A = \alpha S$$ This is a measure of how much sound energy is absorbed by a material rather than reflected. Acoustic absorption is derived from the multiplication of the absorption coefficient by the surface area, S m^2 of a given material.
Absorption Class, A - E	The process of classifying materials into discreet Classes A-E, with Class A having the highest level of absorption. Each class band has upper and lower reference curve for absorption coefficients between 200 Hz and 5 kHz. Materials should be tested in accordance with BS EN ISO 354 and classified according to BS EN ISO 11654.
NRC	A single-number value ranging from 0 (no absorption) – 1 (100% absorption) describing the absorption performance of a material. NRC of a material is calculated by averaging its Sound Absorption Coefficients between250 Hz – 2 kHz .
Sound Insulation	The capacity of building elements to reduce sound transmission between spaces across a range of frequencies.
Sound Reduction Index, R	$$R = L_1 - L_2 + 10log10\left(\frac{S}{A}\right) dB$$ A laboratory measure of the sound insulation performance of a material in a given frequency band or range. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room, S is the area of the tested element and A is the equivalent sound absorption area.
Weighted Sound Reduction Index, R_w	A single figure value derived from a range of frequencies that characterises the sound reduction of a material. A reference curve is compared to the measured sound reduction

	indices and is adjusted until the total of unfavourable deviations below the reference curve is as close to but does not exceed 32.
Weighted Level Difference, ***D_w***	$$D = L_1 - L_2$$ The difference in noise level between a source room and a receive room. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room. The difference is then weighted and stated as a single figure.
Standardized Weighted Level Difference, ***$D_{nT'w}$***	$$D_{nT} = D + 10log10\left(\frac{T}{T_0}\right) dB$$ Where D is the measured level difference standardised for the reference reverberation time, T_0 and then weighted.
Weighted, Normalised Flanking Level Difference, D_{nFw}	The level difference via a flanking element, such as a mullion or ceiling detail, which is normalised and weighted.
Weighted, Normalised Element Level Difference, D_{new}	The level difference through a small element such as a trickle ventilator, which is normalised and weighted.
C_{tr}	A spectrum adaption term applied to the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$). The C_{tr} adaption term acts to describe the performance of an element in the context of low frequency noise, such as that generated by traffic.
Impact Sound	Is the noise generated by an impact on a structure, such as walking or weight drops.
Weighted standardized impact sound pressure level, ***$L_{nT,w}$***	$$L_{nT} = L_i - 10log10\left(\frac{T}{T_0}\right) dB$$ Where L_i is the measured impact sound pressure level standardised for the reference reverberation time, T_0. It is used to describe the impact sound insulation performance of a floor. This is a measured noise level in a receive room generated by a standardised impact source in the room above.
Insertion Loss, **IL**	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence. A dynamic insertion loss, DIL, would include the impact of any regenerated noise.
Cross-talk	This references noise transmission via ventilation duct or similar air path between rooms.
Vibration	The vibratory motion of a surface can be described by the **displacement (m)**, **velocity (m/s)** or the **acceleration (m/s^2)** of its oscillation. Depending upon the circumstance it is often useful to quantify the magnitude of vibration in a range of ways, including **Peak to Peak**, **Peak, r.m.s.** and **dB**. A reference level of 10-6 m/s^2 r.m.s. is usually used for acceleration.
Ground borne noise	Where the noise propagation path from a source is transmitted through the ground into a structure and is radiated via the structure, such as noise experienced from an underground train within a building above ground.
Structure borne noise	Noise caused by vibrating of elements of a structure, the source of which is within a building or structure with common elements.

Noise Impact Assessment

Vibration Dose Value, VDV	$$VDV = (\int_0^T a^4\,(t)dt)^{\frac{1}{4}}$$ Where a(t) is the frequency weighted acceleration (m/s^2), T is the total measurement period in seconds, VDV is the Vibration Dose Value (m/s$^{1.75}$) and is the dose a person is expected to be exposed to over the course of the day or night.
Estimated Vibration Dose Value, eVDV	$$eVDV = k.a_{rms}.t^{0.25}$$ Where k is a constant for crest factors (typically 1.41), a_{rms} is the weighted rms acceleration and t is the cumulative time of the period Typically used on short duration measurements of transients with known durations and occurrences

Appendix B – Summary of Relevant Planning Policy and Guidance

National Planning Policy Framework, 2021

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other developments can be produced.

One of the stated aims of the NPPF is to conserve and enhance the natural environment, as part of this new and existing developments should be prevented from contributing to or being put at risk from, or being adversely affected by unacceptable levels of noise pollution. Planning policies and decisions should aim to mitigate and reduce to a minimum potential adverse impacts resulting from noise or as a result of noise from a new development.

The NPPF makes reference to the Noise Policy Statement for England.

Noise Policy Statement for England, 2010

The aim of the NPSE is to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.

The following are the general national noise policy 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.

In order to define and quantify noise impacts the NPSE presents the following measures:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

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. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

Planning Practice Guidance, Noise 2019

The Planning Practice Guidance provides an online resource appraising when noise is relevant to the planning process, it's relationship with other planning concerns and how noise impacts can be determined. The resource references the NPSE and its approach for determining whether significant adverse effects are likely to occur.

The document presents a noise exposure hierarchy which is a useful framework for assessing the likely responses elicited by noise and whether action should be taken to mitigate.

The guidance document seeks to explain the subjective nature of noise and the factors that apply when determining the level of impact experienced.

The document also outlines how planning and design can address the adverse effects of noise.

British Standard 4142 2014 – Methods for rating and assessing industrial and commercial sound

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) sound from industrial and manufacturing processes;

b) sound from fixed installations which comprise mechanical and electrical plant and equipment;

c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and

d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

BS 4142 is applicable to the determination of the following levels at outdoor locations:

a) rating levels for sources of sound of an industrial and/or commercial nature; and

b) ambient, background and residual sound levels, for the purposes of:

1) investigating complaints;

2) assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and

3) assessing sound at proposed new dwellings or premises used for residential purposes.

BS 4142 defines the following terms:

Rating Level, $L_{Ar,Tr}$

Is the specific sound level plus any adjustment for the characteristic features of the sound. Characteristic features include tonality (up to +6 dB correction), impulsivity (up to + 9 dB correction) and intermittency (up to + 3 dB correction). For corrections of + 3 dB can be applied should any other characteristics be present that are distinctive against the residual acoustic environment.

Residual Sound, L_r

Is the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Specific Sound Level, Ls = $L_{Aeq,Tr}$

Is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.

BS 4142 presents a range of methods and examples on how ratings and assessments can be carried out.