LIGHT HORSE BUSINESS HUB

SSD-9667 MOD 1
Operational Noise Impact Assessment

Prepared for:

Charter Hall
Level 20
1 Martin Place
Sydney NSW 2000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Charter Hall (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18514-R03-v1.0	16 June 2022	Joshua Ridgway	Mark Irish	Mark Irish

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Charter Hall to assess the potential operational noise impacts of the Light Horse Business Hub (LHBH), located adjacent to the M4 and M7 Motorways Light Horse Interchange in Eastern Creek.

The Concept Proposal for the LHBH obtained Development Consent under SSD-9667 on 31 August 2020 from the Department of Planning and Environment (DPE) (then Department of Planning, Industry and Environment). A Noise Impact Assessment (SSD-9667 NIA) was prepared as part of the SSD-9667 application (SLR Report *610.18514-R02-v1.0*, dated March 2019). A noise impact assessment for Lot 7 of the LHBH (Lot 7 NIA) was also prepared for SSD-34991713 (SLR Report *610.30765-R03-v1.0-20220602*, dated June 2022). It is noted that the detailed SSD-34991713 for Lot 7 is to be lodged concurrently with MOD 1 and relies on the modification being approved.

The design of the development has been updated as part of a modification (MOD 1) to Development Consent SSD-9667. This report presents a review of the potential operational noise impacts for MOD 1 and compares the predicted noise levels to the noise limits for the site, as specified in Development Consent SSD-9667.

2 MOD 1 Design Changes

The proposal seeks to modify the Subdivision layout including:

- Changes to the building envelopes, road layout, services and stormwater.
- Changes to the road location to be shorter and further to the west of the approved alignment.
- Re-organisation of the master plan layout, including the deletion of one building to reduce the total number of buildings to six overall, resulting in a net increase of 11,810 m^2 of total warehouse gross floor area and a decrease of 80 m^2 of total office gross floor area.
- Adjustment to total parking provisions across the site to accord with the revised adjusted GFA.
- Modification to the stormwater layout, including the deletion of the M7 upstream flow pipes and diversion of the upstream catchment via a swale drain on the northwest arc of the site.
- Inclusion of boundary retaining walls within the scope of works in Stage 1.

The approved Masterplan design is shown in **Figure 1**. The proposed MOD 1 Masterplan design is shown in **Figure 2**.

Figure 1 Approved Masterplan Design

Note 1: Sourced from Appendix 1 of the SSD-9667 Development Consent.

Figure 2 Proposed MOD 1 Masterplan Design

Note 1: Figure provided by Charter Hall, dated 18 May 2022.

3 Operational Noise Limits and Sensitive Receivers

3.1 Operational Noise Limits

The operational noise limits for the LHBH are detailed in Condition B12 of the SSD-9667 Development Consent. The noise limits are shown in **Table 1**.

Table 1 Operational Noise Limits

Receiver Type/ Location	Day ($L_{Aeq(15minute)}$)	Evening ($L_{Aeq(15minute)}$)	Night ($L_{Aeq(15minute)}$)	When in Use ($L_{Aeq(15minute)}$)
Residential (NCA01)	46	46	43	-
Residential (NCA02)[2]	52	48	43	-
Childcare	-	-	-	48
Educational	-	-	-	43
Place of Worship	-	-	-	48
Hotel	63	53	48	-
Passive Recreation	-	-	-	48
Commercial	-	-	-	63

Note 1: Noise is to be measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW *Noise Policy for Industry*.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

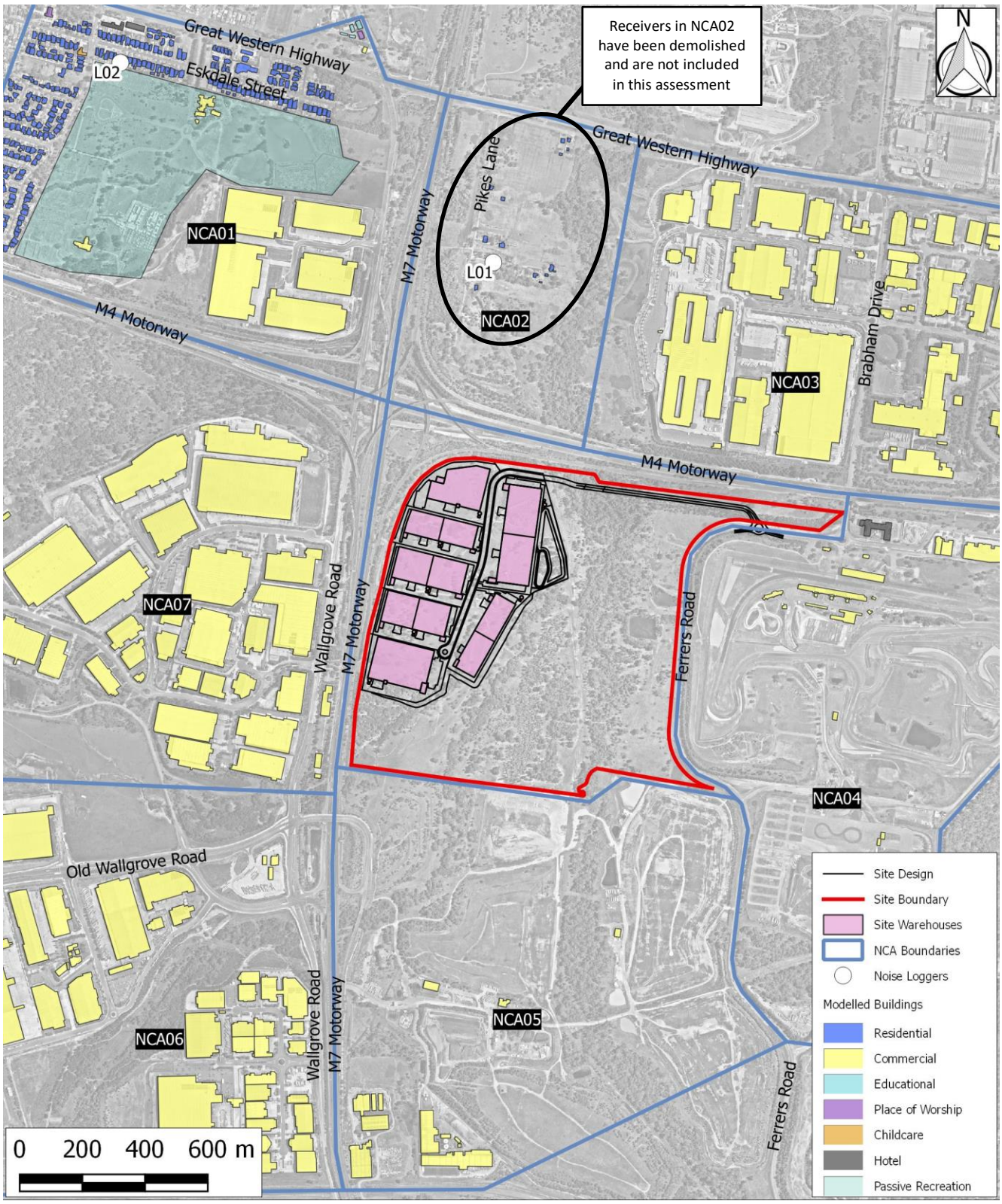
3.2 Receiver Locations

The locations of noise sensitive receivers in the vicinity of the LHBH are shown in **Figure 3**, extracted from Appendix 4 of the SSD-9667 Development Consent.

Sensitive receivers include residences, passive recreation, educational premises, a place of worship and a childcare centre in NCA01, and hotels in NCA01 and NCA04. Commercial premises are located in all NCAs except NCA02.

The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

Figure 3 NCAs and Sensitive Receiver Locations



Note 1: Sourced from Appendix 4 of the SSD-9667 Development Consent.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

4 Operational Noise Assessment

4.1 Operational Noise Modelling

The SoundPLAN noise model prepared for the SSD-9667 NIA and updated for the Lot 7 NIA has been updated for the MOD 1 design and operations.

Consistent with the SSD-9667 NIA and Lot 7 NIA, the noise model includes standard weather conditions during the daytime and evening periods, with noise-enhancing weather conditions during the night-time period, using an F-class temperature inversion with a 2 m/s source to receiver drainage flow.

It is noted that standard noise model inputs required by DPE (such as loading dock sources and heavy vehicle sound power levels) have been updated since the approval of the LHBH. As such, the sound power levels for noise model inputs for MOD 1 are typically higher than those modelled in the SSD-9667 NIA. This is consistent with the Lot 7 NIA.

4.1.1 Operational Noise Sources

The MOD 1 development is in the early design stages and certain future tenants are currently unknown. Several assumptions have been made by Charter Hall regarding the likely future tenants, uses and sources of noise, based on the likely tenants. These assumptions are generally consistent with the approved development, unless stated otherwise. The main sources of operational noise at the development include:

- On-site light and heavy vehicle movements
- Loading dock activities in hardstands
- Mechanical plant.

A summary of the expected worst-case noise sources associated with the operation of the development is provided below. All noise sources associated with Lot 7 are consistent with the Lot 7 NIA.

On-Site Traffic

Vehicle volumes for MOD 1 were provided by Charter Hall, sourced from the Proposed Concept Plan Modification Traffic Impact Assessment (MOD 1 TIA) prepared by Transport and Traffic Planning Associates (*Ref 21077 (D) Rev C*, dated June 2022).

The following peak-1hour volumes have been used, based on the above information:

- 354 vehicle movements in the AM peak (daytime), comprising 255 light vehicles and 99 heavy vehicles.
- 354 vehicle movements in the PM peak (evening), comprising 255 light vehicles and 99 heavy vehicles.
- 106 vehicle movements in the night-time peak, comprising 76 light vehicles and 30 heavy vehicles.

The peak 1-hour vehicle volumes above have been assumed to be spread evenly across the 1-hour period, and have been divided by four to model worst-case 15-minute volumes during the daytime, evening and night-time periods.

Vehicle volumes have been divided amongst the warehouses based on their GFA, ie larger warehouses have more vehicles assigned to them than smaller warehouses. Vehicles for Lot 7 are consistent with the Lot 7 NIA.

The relevant sound power levels (SWLs) and modelling assumptions are detailed in **Table 2**.

Table 2 Vehicle Noise Sources

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)
Large Trucks	Estate roads	108[1]	20
	On-lot truck access and hardstands		5
Light Vehicles	Estate roads	96[2]	40
	Car parks and light-vehicle access		20

Note 1: Sound power level for large trucks based on 106 dBA for trucks at slow speed for 80% of the time and 111 dBA for trucks accelerating for 20% of the time. Sound power levels taken from the Federal Highway Administration's Traffic Noise Model.

Note 2: Taken from *Road Traffic Noise Prediction Model "ASJ RTN-Model 2013" Proposed by the Acoustical Society of Japan – Part 2: Study on Sound Emission of Road Vehicles*, OKADA et al, Internoise 2014, and accounts for vehicles accelerating.

Loading Docks

The modelled loading dock noise sources for MOD 1 are detailed in **Table 3**. Consistent with the SSD-9667 NIA and Lot 7 NIA, external forklift movements (ie outside of the warehouses) have been modelled in the at-grade dock areas of the hardstands, operating continuously during any one 15-minute period.

Table 3 Loading Dock Noise Sources

Noise Source	Sound Power Level (dBA)	Typical Duration of Use in Worst-case 15-minute Period	Source Height (m)
Truck reversing alarm[1]	107[2]	30 seconds	1.0
Forklift reversing alarm[1]	102[2]	90 seconds	0.5
Truck air brakes	118	1 second	1.0
Gas forklift	93	900 seconds	1.0

Note 1: The operation of this equipment is typically intermittent and a +5 dB modifying correction factor has been added to the night-time noise level in accordance with the NPfI.

Note 2: SWL includes a -3 dB reduction due to alarms being discrete events.

Mechanical Plant

Consistent with the SSD-9667 NIA and Lot 7 NIA, external mechanical plant for MOD 1 has been conservatively modelled on the warehouse rooftops (approximately 26 units) with an assumed SWL of 90 dBA per unit.

4.2 Predicted Operational Noise Levels

The predicted operational noise levels at the most-affected receivers in each NCA are summarised in **Table 4**. The predicted levels are the cumulative total of all lots in the LHBH Masterplan operating simultaneously.

The MOD 1 Masterplan noise level predictions and comparison to the noise limits are shown in the table. The SSD-9667 NIA noise levels (for the approved Masterplan Development) and predicted change from the SSD-9667 NIA noise levels are also shown for comparison.

Table 4 Predicted Operational Noise Levels MOD 1 – Most-affected Receiver –Masterplan Development

NCA	Receiver Type	Period (weather)	LAeq(15 minutes) Noise Level (dBA)					Compliance
			Noise Limit	MOD 1 Predicted	Exceedance	SSD-9667 NIA Predicted	Change	
NCA01	Residential	Daytime (standard)	46	36	-	32	+4	Yes
		Evening (standard)	46	36	-	32	+4	Yes
		Night-time (standard)	43	32	-	30	+2	Yes
		Night-time (noise-enhancing)	43	39	-	33	+6	Yes
	Childcare	When in use (all)	48	<30	-	<30	+2	Yes
	Educational	When in use (all)	43	<30	-	<30	+2	Yes
	Place of Worship	When in use (all)	48	<30	-	<30	+2	Yes
	Hotel	Daytime (standard)	63	<30	-	<30	+2	Yes
		Evening (standard)	53	<30	-	<30	+2	Yes
		Night-time (standard)	48	<30	-	<30	+1	Yes
		Night-time (noise-enhancing)	48	<30	-	<30	+3	Yes
	Passive Recreation	When in use (all)	48	36	-	30	+6	Yes
	Commercial	When in use (all)	63	42	-	37	+5	Yes
NCA02	Residential[2]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
NCA03	Commercial	When in use (all)	63	52	-	46	+6	Yes
NCA04	Hotel	Daytime (standard)	63	48	-	42	+6	Yes
		Evening (standard)	53	47	-	41	+6	Yes
		Night-time (standard)	48	43	-	37	+6	Yes
		Night-time (noise-enhancing)	48	48	-	42	+6	Yes
	Commercial	When in use (all)	63	49	-	41	+8	Yes
NCA05	Commercial	When in use (all)	63	37	-	31	+6	Yes
NCA06	Commercial	When in use (all)	63	37	-	34	+3	Yes
NCA07	Commercial	When in use (all)	63	46	-	47	-1	Yes

Note 1: **Bold red** text indicates an exceedance of the project noise trigger level.

Note 2: The residences in NCA02 have been demolished since the approval of the development. There are now no sensitive receivers in NCA02.

The above shows that cumulative operational noise levels of the MOD 1 Masterplan development are predicted to be compliant with the relevant noise limits at all receivers during all periods and weather conditions.

The MOD 1 development updates, along with the revised source sound power levels, result in changes in noise levels of -1 dB to +8 dB compared to the SSD-9667 NIA.

The largest increases are predicted to the north and east of the development, with minor increases to the south, and a slight reduction to the west. The rearrangement of the site layout generally relocates the hardstand areas of Lots 1, 2 and 3 to face more towards the north, while the larger Lot 4 hardstand is relocated to the eastern side of the warehouse.

These changes to the layout result in minor changes to the predicted noise levels compared to the approved development. The majority of the increase in noise levels is due to the revised model inputs, including additional noise sources associated with the hardstands (such as reverse alarms and airbrakes), and increased sound power levels across the dominant sources (such as truck movements and unloading activities).

As noted in **Section 4.1**, the update to the noise model inputs is required to bring the MOD 1 assessment in line with recent expectations on standard noise sources by DPE, which have changed since assessment of the approved development. As such, this level of increase is unlikely to be prevalent in future modification assessments as changes to the noise levels resulting from changes to the layout are likely to be less substantial.

The MOD 1 development is compliant with all relevant operational noise limits detailed in SSD-9667, and as such, no operational noise mitigation measures are required to be implemented.

5 Conclusion

An operational noise impact assessment was undertaken for the MOD 1 Masterplan design of the LHBH in accordance with the SSD-9667 Development Consent.

Summary of Operational Noise Impacts

Cumulative operational noise levels of the MOD 1 Masterplan development are predicted to be compliant with the relevant noise limits at all receivers during all periods and weather conditions.

The MOD 1 development updates, along with the revised source sound power levels, result in changes in noise levels of -1 dB to +8 dB compared to the SSD-9667 NIA. As detailed above, the majority of the increase in noise levels is due to the revised model inputs to bring the MOD 1 assessment in line with recent expectations on standard noise sources by DPE, and changes to the noise levels resulting from future modifications are likely to be less substantial.

The MOD 1 development is compliant with all relevant operational noise limits detailed in SSD-9667, and as such, no operational noise mitigation measures are required to be implemented.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

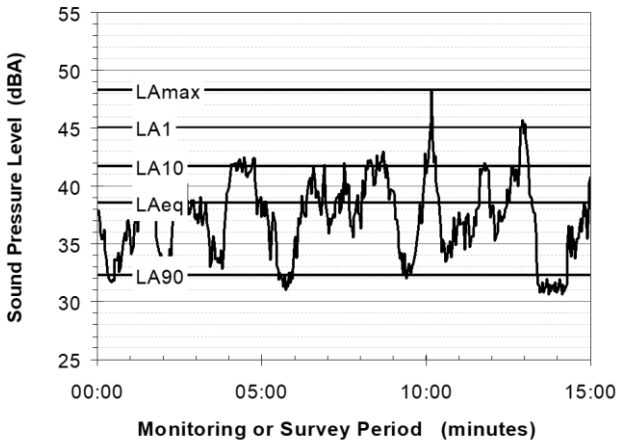
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

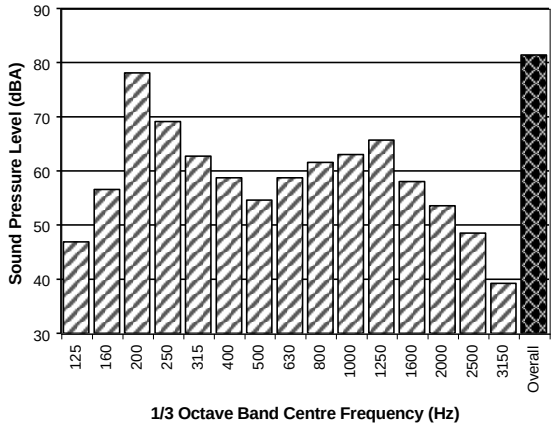
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

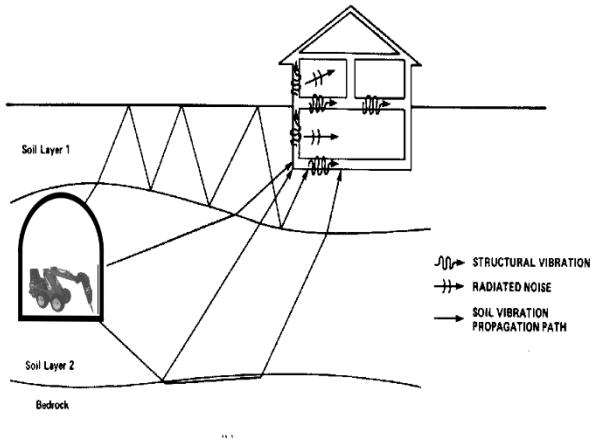
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

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