NRE 4.3

Proof of Evidence Appendices – Noise (Mr Simon Taylor)

Inquiries Procedure (England & Wales) Rules 2004

January 2022

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APPENDIX 1
GLOSSARY OF ACOUSTIC TERMS

Term	Definition
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa ($20x10^{-6}$ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by 20 log10 (s_1/s_2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the time period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$ or Background Noise Level	A noise level index defined as the noise level exceeded for 90% of the time over the time period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
NR or Noise Rating	A method for rating the acceptability of indoor environments for the purposes of hearing preservation, speech communication and annoyance, based on curves developed by Kosten and van Os (1962). The NR level is the highest noise rating curve touched by the measured octave band spectrum.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS5969.
NSR	A Noise Sensitive Receiver is any receiver that is classed as being sensitive to noise sources, (residential properties, churches, music studios etc).
R_w	Weighted Sound Reduction index (R_w) representing the sound insulation capability of a material as measured in an acoustic laboratory.
R_w+C_{tr}	Weighted Sound Reduction index (R_w) representing the sound insulation capability of a material as measured in an acoustic laboratory, with an adjustment applied to account for low frequency content ($+C_{tr}$).

APPENDIX 2
ASSESSMENT OF NOISE IMPACT UPON ANIMAL WELFARE

1. The objections from both the LMB and AMB are concerned with the impact upon the animals used for research.

2. No evidence is provided as to the noise level at which animals become impacted other than a single study included by the UoC where mice were subjected to noise levels of 100dBA at their cages which is understood to have affected their sperm count. My proposed noise limit for construction noise in areas used for animals of 45 dBA, is several orders of magnitude lower than the noise level used in this evidence..

3. The MRC has suggested in their response on the 2 November 2021 that a noise limit of 55dB L_{AFmax} internally is acceptable, based upon their minimum acoustic design specification for the façade during the build. In practice the façade is understood to mitigate noise significantly better than the minimum acoustic design specifications, for non-acoustic reasons, such as thermal, security and health and safety. No acoustic criteria or noise limits are proposed by the UoC as to what noise level would be acceptable for them at the time of this proof.

4. I set out below my reasoning as to why I consider 45 dBA to be an appropriate internal noise level from construction noise in areas used to house animals.

Proposed Noise limits for areas housing animals

5. The Home Office *Code of Practice for the Housing and Care of Animals Bred, Supplied or Used for Scientific Purposes (December 2014),* referred to within this document as CoPanimal (2014), provides guidance on the impact of noise upon animals within Home Office licensed facilities.

6. Section 2 Chapter 2, 2.3 states, *"Noise levels, including ultrasound, shall not adversely affect animal welfare. Establishments shall have alarm systems that sound outside the sensitive hearing range of the animals, where this does not conflict with their audibility to human beings. Holding rooms shall, where appropriate, be provided with noise insulation and absorption materials."*

7. Section 3, Chapter 2, 1.1.5 states, *"As rodents are very sensitive to ultrasound, and use it for communication, it is important that this extraneous noise is minimised…. It is advisable to check the acoustic environment over a broad range of frequencies and over extended time periods. Sudden irregular noises create more disturbance in breeding rodents than continuous or predictable sounds. The rodent neonate uses ultrasound production to communicate distress – it is important that extraneous noise is minimised during late pregnancy and early lactation to reduce the risk of mismothering or cannibalism."*

8. Section 3, Chapter 2, 2.1.5 states, "*Mice have very acute hearing and are sensitive to ultrasound."*

9. Section 2, Chapter 10, 3 states, *"Noise levels shall be kept to a minimum and, where possible, equipment causing noise or vibration, such as power generators or filtration systems, shall be separate from the fish-holding tanks."*

10. The 2014 version of the CoPanimal guidance provides no specific noise limits for rodents or fish.

11. A previous version of the CoPanimal guidance, withdrawn in 2016 but considered to be the best available advice, stated*, "it has been found empirically that if the general background sound level in an empty animal room can be kept below about 50dB (A); below a noise rating curve of 45; and free from distinct tonal content, then it is unlikely that there will be damage to animals or personnel when the room is in use."*

12. It is my considered opinion that a noise limit of "*general background sound level in an empty animal room can be kept below about 50dB (A); below a noise rating curve of 45; and free from distinct tonal content,"* is appropriate for these areas.

13. The guidance above states that rodents and fish are particularly sensitive to sudden irregular noise, such as the banging, drilling and sawing noise produced by demolition and construction activities.

14. Therefore, as construction can be a "sudden irregular" noise source, I consider it appropriate to apply a 5dB penalty to the limits adopted for the areas housing animals to account for these characteristics.

15. The application of this recommended penalty upon the noise limits from the CoPanimal guidance results in a noise limit of 45 dBA and Noise Rating (NR) 40 within the areas housing animals.

16. I consider that 45 dBA and NR 40 are acceptable as the limits for significant adverse effect from construction noise.

17. For context, it should be noted that noise levels experienced in the areas housing animals at the LMB and AMB, in the absence of any construction activities, are likely to regularly exceed the proposed limits of 45 dBA/NR40, due to the activity of the staff and the animals. For example, when staff speak noise levels will be in the region of 60dBA. Heating Ventilation Air conditioning (HVAC) systems in areas housing animals are typically limited to NR35. This means that the noise level will never drop below NR35, which is broadly equivalent to 40 dBA, at any time. This means that construction noise levels of 45 dBA/NR40 would be just audible above the background noise level of the HVAC systems, but significantly below the noise of animal or human activity within the rooms.

18. ASSESSMENT

19. Construction noise is predicted to be up to 67 dBA at the facade of the MRC LMB and up to 67dB at the UoC AMB. This means that the façade is required to attenuate the noise level by 22 dB to meet a noise level of 45 dBA within rooms located on the façade facing the proposed construction activities.

20. A sheet of 12.5mm thick standard plasterboard provides 27 dB (R_w) of sound reduction. Standard thermal double glazing provides at least 29dB of sound reduction. Therefore, any standard facade construction, including at least 1 layer of plasterboard or cement board, and any thermal double glazing will comfortably attenuate noise by more than 22 dB from outside to inside.

21. In addition to that, rooms within the MRC LMB and UoC AMB that do not directly overlook the construction activities, will benefit from significantly more sound insulation than rooms which are situated on the facades facing the works.

22. The CoPanimal guidance states that mice are particularly susceptible to ultrasound. Ultrasound is high frequency sound, above 20kHz, with short wave lengths and low energy. Construction materials such as glass, plasterboard and masonry attenuate noise levels far more effectively at high frequencies than at low frequencies. This means that any ultrasound created by construction activities will be effectively attenuated by the façade structure to a lower noise level than the noise within the human hearing range, i.e. 20Hz to 20kHz.

23. I therefore conclude that construction noise levels will be controlled within areas housing animals to comfortably below 45 dBA and NR 40 at all times and therefore no significant effects are predicted to the animals (rodents and fish) within the MRC LMB and UoC AMB.

24. It should be noted that this is a ‘similar’ noise level in real terms to the 55dBL_{AFmax} internal design noise level of the MRC, as confirmed by Sandy Brown in their reply on 2 November 2021. I believe that an internal noise limit of L_{AFmax} 55dB is also acceptable and achievable.

APPENDIX 3
EASY TO UNDERSTAND METHOD FOR ASSESSING POTENTIAL IMPACT ON NOISE SENSITIVE RESEARCH

1. Some research in both the MRC LMB and UoC AMB is understood to be sensitive to noise levels, even for just short term periods of time. Construction activities such as hammering and breaking can result in short term peaks of noise. The noise level of these events can be quantified in terms of a 'maximum' noise level (L_{AFmax}), which measures impulsive noise over 125ms intervals.

2. It is understood that the mitigation provided by the façades, structures and fit-outs of both the MRC LMB and UoC AMB, provide enough sound reduction to sufficiently reduce existing maximum external façade noise levels (L_{AFmax}) to allow research areas to operate within their required noise limits.

3. Pre-existing maximum noise levels were regularly measured up to 83 dBL_{AFmax} at the location of the UoC AMB and up to 85 dBL_{AFmax} at the location of the MRC LMB. The highest noise levels were measured up to 94dBL_{AFmax} at the MRC LMB and up to 88 dBL_{AFmax} at the UoC AMB.

4. It is my considered opinion that that when predicted construction noise levels (L_{AFmax}) do not significantly exceed, i.e. by no more than 3dB, the existing typical maximum noise levels (L_{AFmax}) at the facades of the MRC LMB and UoC AMB no significant adverse effect is predicted.