

RM2/OBJ/9

**SUMMARY PROOF OF EVIDENCE of RICHARD MUIR (MSc BSc CEng MIOA
MIMechE)
of SANDY BROWN LIMITED on behalf of the Medical Research Council**

Noise and Vibration

January 2022

1 QUALIFICATIONS AND EXPERIENCE

- 1.1 My full name is Richard Muir. I am a director of the independent acoustic consultancy practice, Sandy Brown. Prior to joining Sandy Brown 18 years ago, I spent 11 years working for Sound Research Laboratories Limited advising on environmental noise and vibration matters. I was responsible for providing noise and vibration design advice as part of the design team that delivered the Medical Research Council Laboratory for Molecular Biology (LMB) building completed in 2013.

2 SCOPE OF EVIDENCE

- 2.1 I have been engaged by the MRC Laboratory of Molecular Biology (LMB) to advise on noise and vibration matters associated with The Network Rail (Cambridge South Infrastructure Enhancements) Order (CSIE). My evidence is a review of the Environmental Statement (ES) and supporting information pertaining to noise and vibration prepared by Ramboll on behalf of Network Rail. My evidence will cover noise and vibration from the operation once completed and also temporary noise and vibration during construction.
- 2.2 I firstly described the current noise and vibration climate at the LMB and the sensitivity of the building to noise and vibration. My evidence will review the impact of operational vibration as reported in the ES which is a key area of concern. I also review the anticipated construction noise and vibration impacts from track works close to the site.

3 LMB BUILDING

- 3.1 The LMB contains equipment that is particularly sensitive to vibration, specifically the electron cryo-microscopy unit (Cryo-EM) as well as other electron microscopes.
- 3.2 Vibration from the railway currently meets appropriate vibration criteria for electron microscopes and the LMB have advised that no increase in vibration would be acceptable.
- 3.3 The site is relatively quiet, and the main source of noise and vibration is the existing railway line adjacent to the site. The LMB building is located approximately 24 m west of the existing railway line and about 75 m north of the proposed station location.
- 3.4 LMB has indicated that no increase in vibration is desirable because this would potentially result in a loss of image resolution which in turn may impact on the performance of the Cryo EM.
- 3.5 The main operational impact is anticipated to be increased vibration because of the proposed switches and crossings to be installed close to the LMB. There are also temporary construction noise and vibration impacts.

4 EXISTING NOISE AND VIBRATION CLIMATE

- 4.1 I conducted unattended baseline noise and vibration measurements in the LMB Building between 14 November 2021 and 19 November 2021. Vibration levels in the ground floor laboratory space were recorded close to the west of the building, and external noise levels at the roof terrace close the roof terrace outside the 5th floor restaurant continuously for 6 days. Attended vibration measurements were also conducted in the building between 1200 hours and 1600 hours.
- 4.2 I found that, in summary, the LMB site is quiet, and the building facade is sealed and protects against existing noise sources. While the vibration is with the required criterion, the highest train events recorded are only just lower than VC-D at the Cryo EM. This means that there is no margin for any increase in vibration at the Cryo EM. In the other areas, vibration levels are within VC-C whereas the criterion is VC-B.

5 OPERATIONAL VIBRATION ASSESSMENT

Environmental Statement

- 5.1 The LMB is identified in the ES as being a high sensitivity receptor due to the low vibration requirements of the Cryo EM laboratory.
- 5.2 The bespoke assessment methodology has been adopted to assess vibration changes due to the switches and crossings and has been done by comparative measurements at the Shepreth Branch Junction which is 2km south of the proposed station.
- 5.3 The assessment compares the vibration levels taken close to the switch and crossing with a straight length of track and correcting these results for distance. This type of assessment relies on similarity between the Shepreth Branch Junction in terms of switch and crossing design, track geometry, train speed and ground conditions.
- 5.4 In the ES, any increase in vibration is considered a minor impact and a change in vibration band is classed as a major impact. For high sensitivity receptors a minor, moderate, or major impact is classed as having a significant adverse impact.
- 5.5 The main vibration impact at the LMB will be due to the introduction of switches and crossings on the eastern track which is closest to the LMB.
- 5.6 The ES suggests provision of mitigation measures at the receptor in the form of active vibration isolation systems for the electron microscopes and other sensitive equipment. This involves provision of specialist tables that have either air springs or active vibration isolation systems which act like shock absorbers in a car. It is not clear that such mitigation would be appropriate and the LMB team have reservations about the effectiveness of such systems.
- 5.7 In summary, the ES has identified a significant increase in vibration caused by the introduction of switches and crossings close to the LMB. No specific mitigation measures are identified in the ES and while a significant adverse impact is predicted, and mitigation is being explored, this is unclear and unspecified. The ES concludes that the residual effect is no longer significant.

Ramboll Technical Update Note 5

- 5.8 The technical update considers the RIVAS 2013 research paper¹ which provides supporting research that indicates that amplification factor measured at Shepreth Junction and used in the ES is pessimistic.
- 5.9 The revised assessment detailed in the technical update predicts that the introduction of switches and crossing will still exceed the required criterion. There is a high degree of uncertainty with the assessment and prediction noting there is no margin for any increase in vibration. Therefore, the conclusion remains that the switches and crossing represent a significant (major) impact based on the change from VC-D to VC-C and the risk to the LMB that vibration levels may increase remains.
- 5.10 Following on from the technical update, Ramboll presented the results from an additional vibration survey of switches and crossings on the 11 November 2021 to myself and the LMB team.
- 5.11 This assessment concentrates on comparing southbound trains without switches and crossings, with northbound trains with switches and crossings, and has limited the assessment to two pairs of trains at similar speeds and lengths.
- 5.12 The measurements further away from the track demonstrate that the amplification effect is much reduced with distance and the measurements at 160 m from the track indicate that passenger trains are within VC-D and freight trains are marginally above VC-D.
- 5.13 I consider the revised updated assessment to be more robust than the original ES assessment which now indicates that the required criteria will be met.
- 5.14 In conclusion, the measurement updates indicate that the switches and crossings are now predicted to be within VC-D and that existing sources of vibration are also within VC-D. However, there remains a high degree of uncertainty in relation to the amplification factor and therefore the predicted levels based on the difference between the switches used for the measurement and those proposed which represents a residual risk to LMB.

6 CONSTRUCTION VIBRATION

6.1 The track works comprise three main activities:

- a) Construction of a haul road to the west of the track;
- a) Track works preparing the track; and
- b) Overhead line works which involves creation of the overhead gantry.

6.2 There is also a proposal in the ES to provide a site access road along the south boundary of the LMB and a haul road along both the east and west side of the track. The site access road and east haul road are close to the LMB and are potential sources of noise and vibration.

6.3 The station works take place further away but involve similar vibration producing activities to the track works and for a longer period of time.

6.4 The ES advises that the anticipated vibration producing construction activities are as follows:

- a) Vibratory compaction by means of vibratory roller
- b) Large bulldozer excavation and/or transport of material
- c) Loaded trucks with loading and unloading operations
- d) 360-degree excavators
- e) Vibratory piling (see below)
- f) Rotary bored piling.

¹ Railway Induced Vibration Abatement Solutions Collaborative Project-SCP0-GA-2010-265754 Description of the vibration generation mechanism of turnouts and the development of cost-effective mitigation measures 29/3/2013.

- 6.5 In this case, it is then important that mitigation measures are taken, which may include:
- a) Informing the occupants of the building of the schedule of works with particular attention to activities of extended duration that are close to the sensitive receptors;
 - b) Appropriately prepare the surface of the site access and site haul roads in order to minimise the induced vibration from loaded trucks and vehicles going past;
 - c) Vibratory methods (e.g., vibration compaction and vibratory piling) to be avoided except in specific time windows where notice has been given to nearby receptors; and
 - d) Agree a time schedule with the building occupants for the access of large vehicles in areas particularly close to buildings (i.e., site haul road at west of the MRC LMB building).
- 6.6 Moderate impacts are predicted at the LMB building which results in a significant effect in accordance with the Significance Matrix. The ES concludes a significant impact of construction vibration. The ES states for the LMB, the closest works are the creation and use of the haul roads. Construction of these haul roads will be of short-term duration. A well-maintained road surface will be provided to mitigate against any increase in vibration impacts due to potholes and other significant vibration causing defects.
- 6.7 Construction vibration monitoring is proposed to alert the contractor to any exceedances of defined criteria, allowing the contractor to take steps to mitigate the exceedances.
- 6.8 In conclusion, the ES predicts significant impact from vibration due to construction activities which cannot be fully mitigated although the precise construction methodology and duration of the various impacts is not clear in the ES.

Ramboll Technical Update Note 5

- 6.9 As previously mentioned, Ramboll provided an update to the ES dated 14 October 2021 which provides further detail on the assessment and proposed mitigation of construction vibration to the LMB.

- 6.10 This note states that from the stakeholder engagement meeting, if the proposed mitigation measures are implemented, the main concern for the LMB in relation to construction vibration impact is indirect. This indirect effect is that their vehicular deliveries may be prevented from passing to the west of the building and instead would need to pass to the east and immediately adjacent to their most vibration sensitive areas of the building.
- 6.11 Network Rail have confirmed that access to the west of the building would be maintained for the LMB to use and that they would not need to change their vehicular routes. A traffic management plan would be in place to control this.

Ramboll Technical Update Note 10

- 6.12 Ramboll provided a further update in Technical Note 10 dated 3 December 2012 which revisits the assessment and provides further details of the assessment and supporting information with regard to the main vibration producing activities specifically vibratory compactors, piling, vibratory roller, bulldozer, loaded trucks and 360-degree excavation.
- 6.13 The revised predictions are significantly lower than those reported in the ES and are predicted to be generally within acceptable levels although some short-term exceedances are predicted from the vibratory roller and vibratory compaction. Vibration monitoring is proposed to enable management of vibration levels from track works close to the LMB.

7 OPERATIONAL NOISE ASSESSMENT

- 7.1 The ES defines the LMB as highly sensitive to noise and the main noise source at the site is railway noise.
- 7.2 The operational rail noise is predicted to reduce by 2.8 dBA at the LMB and Ramboll have confirmed that this is a consequence of the reduction in speed for a number of passenger trains combined with changes in the number of coaches.
- 7.3 There is a 6% increase in vehicles within the development which would result in a change in noise level of about 0.2 dB which is negligible.
- 7.4 The ES concludes that operational noise from rail, road and fixed plant are not significant. The assessment appears reasonable and there is no significant impact on the LMB building.

8 CONSTRUCTION NOISE ASSESSMENT

- 8.1 The sensitivity of the LMB is defined as very high in the ES.
- 8.2 In terms of construction noise, the ES defines a moderate impact when the relative threshold value is exceeded by up to < 5 dB. A major impact is predicted when the construction noise is ≥ 5 dB above the threshold value.
- 8.3 The measured daytime L_{Aeq} noise level at the LMB is 59 - 62 dB which places the site in Category A which has a threshold value of L_{Aeq} 65 dB. The predicted construction noise level from the ES is L_{Aeq} 72 dB which is 7 dB above the threshold. Therefore, construction noise is assessed as a major impact which is a very large effect and considered significant.
- 8.4 The predicted daytime construction noise impacts are estimated to be mitigated by 5 dB(A) when adopting Best Practicable Means (BPM) as defined in the Code of Construction Practice. However, the mitigation assumptions are very generalised and should be scrutinised to determine if they are, in fact, practicable.

Ramboll Technical Note 14 October and update note MRC-AC2 2 December 2012

- 8.5 As previously stated, Ramboll provided a technical response dated 14 October 2021 which provides some further detail on the construction activities but does not provide any further information of the proposed construction works at the station. The note does however provide an indication of the noisiest activities from the track works. The assessment assumes that the noisiest activity will be concrete breaking associate with dressing the piles.
- 8.6 The assessment has been updated on the 2 December 2021 and the general construction activities are predicted to be $L_{Aeq10hr}$ 67 dB which is classed in the ES as a moderate impact. Ramboll advise that the predicted level is a reasonable worst case.
- 8.7 The comparison with the worst case L_{AFmax} is also not accurate because this is the maximum level over a 10-hour period and therefore it does not occur regularly. My noise measurements show the $L_{AFmax,15min}$ levels is generally less than 85 dB.
- 8.8 Therefore, the assessment is not robust. Based on our experience of the LMB, the actual external facade performance is in the region of $R_w + C_{tr}$ 35 dB and a target internal noise level of $L_{Aeq5min}$ 45 dB from regularly occurring construction activities, this would suggest the external noise levels must not exceed 80 dB(A). To avoid confusion with train events a short term $L_{Aeq15min}$ of 75 dB is proposed as an operational noise limit.
- 8.9 In terms of construction traffic, it is unclear in the ES how the impact of these roads has been assessed. The ES suggests 50 vehicles per day which will be 8-wheel large 20T trucks. This information is still to be provided.
- 8.10 In summary, it is anticipated that the construction impacts from the station works will be reduced to acceptable limits by virtue of distance although the assessment in provided as part of the ES is overly simplified.

9 WITNESS DECLARATION AND STATEMENT OF TRUTH

I hereby declare as follows:

My proof of evidence includes all facts which I regard as being relevant to the opinions that I have expressed and that the inquiry's attention has been drawn to any matter which would affect the validity of that opinion.

I confirm that I am not instructed under any conditional or other success-based fee arrangement.

I confirm that I have no conflicts of interest.

I believe the facts that I have stated in my proof of evidence are true and that the opinions I have expressed are correct; and

I understand my duty to the inquiry to help it with matters within my expertise and I have complied with that duty which overrides any obligation to those instructing or paying me. I have prepared my report impartially and objectively, and that I will continue to comply with that duty throughout these proceedings.

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinions on the matters to which they refer.

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Richard Muir

Sandy Brown Limited

5 January 2022