NRE 4.2

Proof of Evidence – Noise (Mr Simon Taylor)

Inquiries Procedure (England & Wales) Rules 2004

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CSIE
NRE4.2 PROOF OF EVIDENCE FOR NOISE

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LIST OF ABBREVIATIONS USED

AMB	Anne McLaren Building
AZ	AstraZeneca
BPM	Best Practicable Means
CBC	Cambridge Biomedical Campus
CoCP A and CoCP B	Code of Construction Practice
CCiC	Cambridge City Council
CFA	Continuous Flight Auger
CPFF	Cambridge, Past Present and Future
CLP	Cambridge Local Plan
CRN	Calculation of Rail Noise
CRTN	Calculation of Road Traffic Noise
DMRB	Design Manual for Roads and Bridges
GSMR	Global System for Mobile Communication – Railway
HoT	Heads of Terms
LMB	Laboratory of Molecular Biology
NPPF	National Planning Policy Framework
MHCLG	Ministry of Housing, Communities & Local Government
MRC	Medical Research Council
OLE	Overhead line equipment
PAVA	Platform announcement system.
SCDC	South Cambridgeshire District Council
SCLP	South Cambridgeshire Local Plan
SPD	Supplementary Planning Guidance
WAML	West Anglia Main Line
WHO	World Health Organisation
UoC	University of Cambridge

1. Author

1.1 I am Simon Taylor. I am a Director of Acoustics at Ramboll UK Limited, where I have worked since 2016. I have 15 years of acoustic consultancy experience in buildings and environmental acoustics, and noise control.

1.2 During this time I have been involved in the design of a number of rail schemes and projects where construction noise had the potential to impact extremely noise sensitive receptors and also in the design of a number of developments on the Cambridge Biomedical Campus ("**CBC**"). This includes the contractor side acoustic design of Royal Papworth Hospital at CBC, managing the noise and vibration surveys for the Astra Zeneca development at CBC, 5 years for Crossrail Contract C305 (rail tunnelling through London) and acoustic advice to a number of sensitive laboratory / research buildings including University College London Institute of Neurology / Dementia Research Institute, UCL Ear Institute, University of Cambridge ("**UoC**") Cavendish III, UoC Whittle and University of Manchester Sir Henry Royce Institute.

1.3 I have a Bachelor of Science degree (BSc (Hons)) in Computer Science and Audio Technology from Anglia Ruskin University. I am a corporate member of the Institute of Acoustics.

2. Role in the Project

2.1 My role on the proposed Cambridge South Infrastructure Enhancements (CSIE) project ("the **CSIE Project**") started in September 2021, providing acoustic advice to Network Rail and preparation of this Proof of Evidence (**NRE4.1**).

1.1 I have visited site regularly over the past 10 years in my capacity as an acoustic consultant involved in the acoustic design of a number of major projects within the CBC, and also occasionally providing acoustic consultancy for Addenbrooke's Estates Department and other departments / facilities on the Addenbrooke's Hospital site.

3. Scope and Purpose of this Proof of Evidence

3.1 The proof of evidence is structured as set out below:

a) Section 4 provides an overview of the CSIE Project and the key aspects for noise
b) Section 5 sets out the legislative and policy context
c) Section 6 gives a background to the stakeholder engagement undertaken through the Environmental Statement (ES) (**NR16**) and since submission of the proposed Order under the Transport and Works Act 1992 ("the **TWAO application**"; "the **proposed TWAO**") (**NR1**)
d) Section 7 provides a Summary of the ES noise assessment
e) Section 8 sets out the noise assessment methodology from the ES
f) Section 9 sets out the findings of the ES for the receptors with a predicted significant adverse impact
g) Section 10 summarises the objections raised relating to the proposals from a noise perspective and provides a response to the specific aspects raised in the Objectors' statements of case
h) Section 11 sets out the Conclusions and contains my Declarations
i) **Appendix A** within the Appendices for this Proof (**NRE4.3**) is a glossary of acoustic terms
j) **Appendix B** sets out my methodology for assessing significant noise effects upon animal receptors (explained further below)
k) **Appendix C** sets out a methodology for comparing External façade noise levels to internal noise limit criteria (also explained further below)`

3.2 **Appendix A** sets out a glossary of acoustic terms and provides an explanation of some of the terminology used in the evidence.

3.3 **Appendix B** of my proof sets out my proposed acceptable internal noise criteria for areas of the Medical Research Council Laboratory of Molecular Biology (respectively, "**MRC**" and "**MRC LMB**") and the University of Cambridge Anne McLaren Building (respectively "**UoC**" and "**UoC AMB"**) that house animals (rodents and fish) based on the guidance within the Home Office *Code of Practice for the Housing and Care of Animals Bred, Supplied or Used for Scientific Purposes* (December 2014) (**D49**). These are proposed in absence of any specific criteria from the AMB and LMB, and I believe them to be an accurate basis to assess noise effects upon such animals.

3.4 These criteria are then used within Appendix B to assess the significance of effects upon the animals housed in the MRC LMB and UoC AMB based upon the construction noise levels predicted in the ES Chapter 5.

3.5 Appendix C of my proof sets out an easy to understand methodology for considering whether the external construction noise levels, in terms of the 'maximum' noise levels (L_{AFmax}), are likely to result in significant effects due to noise within any noise sensitive research areas of the MRC LMB and UoC AMB.

3.6 The opinions expressed are my own unless I state otherwise. I have been assisted by colleagues from within the project team in the various tasks that are reported in this document. Colleagues are also presenting evidence within their specialist expertise.

3.7 It is not my intention to reproduce large sections of text from the ES, but simply to cross refer to, or highlight key procedural and technical matters that are pertinent to the assessment of the published Scheme. Consequently, I will refer in this Proof of Evidence to supporting material contained within the ES and the ES Supplements where relevant.

4. CSIE Project Overview

4.1 The CSIE Project will deliver a new passenger railway station and associated infrastructure required to maintain capacity and train performance. Key elements of this comprise:

a) A new railway station with four platform faces including forecourts, pedestrian and cycle access paths, new interchange for taxi and pick up/drop off points, cycle parking spaces, and limited parking for staff/contractors and blue badge holders, together with associated works. The new station will be located between the CBC and Hobson's Park and bordered to the north by the Cambridge Guided Busway;
b) introduction of 2 additional loop lines on West Anglia Main Line ("**WAML**") for the purpose of enabling trains to access the eastern and western platforms in the area of the new station and associated Overhead Line Equipment and signalling;
c) track replacement/modification/additional loop line to the WAML;
d) new Overhead Line Equipment and improvement works at Shepreth Junction and replacement of the Global System for Mobile Communication – Railway ("**GSMR**");
e) new permanent rail systems compound and associated works to the south-west of Addenbrooke's Road (Nine Wells Bridge);
f) attenuation ponds and drainage works;
g) closure of Dukes No.2 Level Crossing and Webster's Level Crossing over the WAML at Shelford and extinguishment of the existing private access rights over the crossings together with provision of alternative access measures; and
h) replacement open space provision.

Further details of the CSIE Project are provided in the proof of Mr Andrew Barnes (**NRE1.2**)

Key aspects for the CSIE Project relevant to noise

4.2 Railways and associated infrastructure can be sources of noise. The existing railway line has been present for well over 100 years and is already a source of noise and nearby development has needed to account for the effects of the noise in its design.

4.3 The CSIE Project will create modifications to the existing railway lines and construct new station infrastructure. The key noise aspects are therefore:

a) What new or elevated sources of noise are created as a result of the project?
b) What are the noise sensitivities of the receivers?
c) Are any of these of sufficient magnitude to have a significant adverse effect on the receivers nearby?

4.4 The noise sensitive receptors near to the CSIE Project can be grouped as follows:
a) Scientific research institutions (including MRC LMB, UoC AMB and AstraZeneca ("**AZ**")) on the CBC;
b) Hospital facilities on the CBC;
c) Residences near to Shepreth Branch Junction;
d) Residences (Belvedere) and commercial office (AstraZeneca, Academy House) near to Hills Road junction;
e) Residences (Trumpington Meadows), near to the area of the station development - these are much further away than the more sensitive CBC receivers.

4.5 Following a desktop study and a site visit in February 2019, eleven noise monitoring locations were selected to establish the baseline sound environment. They were chosen as being representative of either residential or non-residential sensitive receptors in the general vicinity of each monitoring location. The noise monitoring locations, as agreed with the local Environmental Health Officers, are provided in Appendix 5.1 of the ES and reproduced in Figures 4-1 to 4-3 of this proof.

4.6 The areas each location represents is described as follows:

a) NML1L – Residential property, Granham's Road
b) NML2S – Long Road Sixth Form College
c) NML3L – MRC Laboratory of Molecular Biology, trackside (east)
d) NML4L – AstraZeneca, BioMed Site
e) NML5L – Trumpington Meadows residential area immediately west of Hobson's Brook
f) NML6L – Anne McLaren Building (research facility)
g) NML7L - Note: Reference NML7 not used following revisions to survey
h) NML8S – Trumpington Meadows (South) close to Addenbrooke's Road
i) NML9L – Individual residential properties, Graham's Road, Great Shelford
j) NML10L – Residential area, Davey Crescent, Great Shelford
k) NML11L – Residential properties. Graham's Road

4.7 Construction / operational noise has been predicted to the noise monitoring locations, as well as the following additional locations (incident façade noise levels).

a) A: AstraZeneca, Academy House, Hill's Road (construction noise assessment only)
b) B: The Belvedere – Residential properties, Hill's Road (construction noise assessment only)
c) C: MRC Laboratory of Molecular Biology
d) D: AstraZeneca BioMed Campus Site
e) E: Anne McLaren Building
f) F: ABCAM
g) G: Properties on Abberley Wood Road
h) H: 25 Davey Close

4.8 These locations are presented in Figure 4.1, Figure 4.2 and Figure 4.3 (below). The baseline ambient noise levels have been established through modelling with commercially available noise modelling software CadnaA® by calibrating with the noise data obtained from the survey.

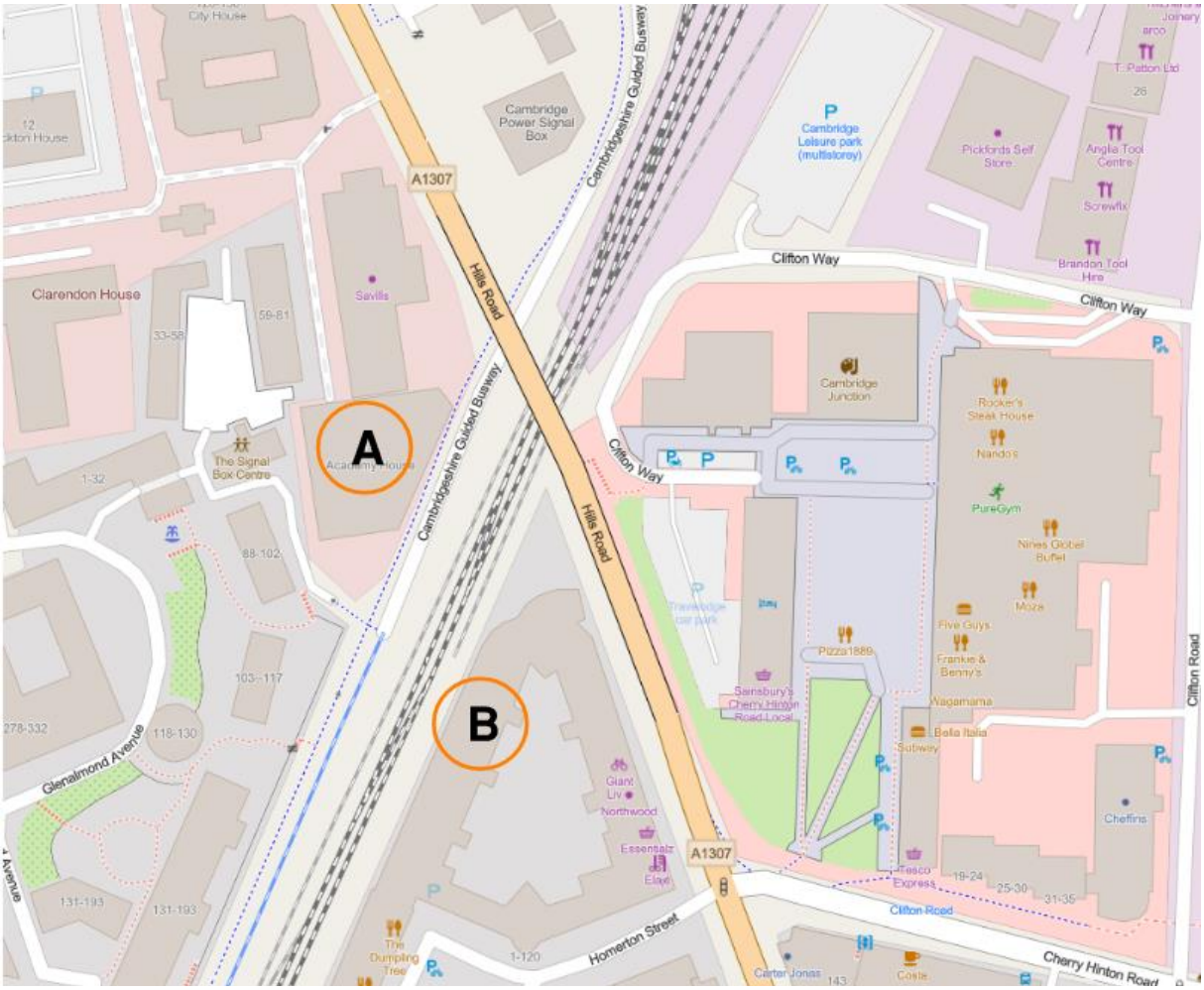

Figure 4.1 Assessment Locations – Hills road

Figure 4.2 Assessment Locations – Cambridge Biomedical Campus

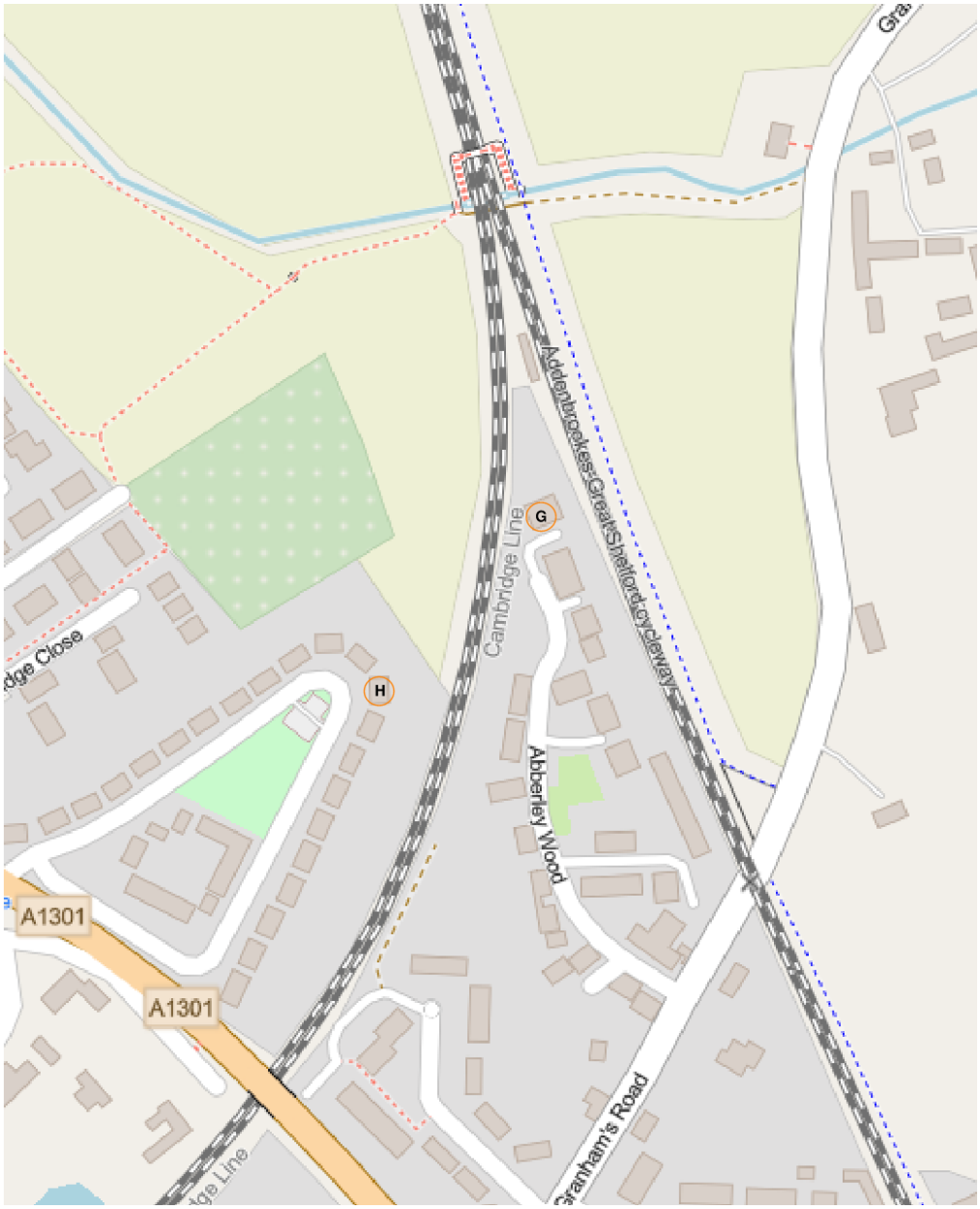

Figure 4.3 Assessment Locations – Shepreth Branch Junction

4.9 The Department of Transport also requested external amenity be considered for the assessment of operational rail noise. The following receptors, shown in Figures 4.2 and 4.3 (above), were identified:

I: Trumpington skate park
J: Hobson Bird Reserve
G: Gardens of properties on Abberley Wood Road
H: Garden of 25 Davey Close
K: Nine Wells Local Nature Reserve

5. Legislative and Policy context

Legislation

5.1 The noise impact assessment has been undertaken in accordance with current national legislation and guidance as well as local plans and policies relating to noise in the context of the proposed development. A summary of the relevant legislation and policies, the requirements of these policies and the project response is provided below.

5.2 The following legislation and regulations are relevant to the assessment of noise effects and has been used to inform the assessments:

a) The Transport and Works (Applications and Objections procedure) (England and Wales) Rules 2006 as amended (**B3**)
b) The Control of Pollution Act 1974 (**B26**)
c) The Environmental Protection Act 1990 (**B27**)
d) The Noise Insulation Regulations 1975 (**B28**)
e) The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 (**B29**)

5.3 The following policy has been considered in the assessment of noise:

a) Noise Policy Statement for England (NPSE) 2010 (**D35**)
b) Cambridge City Council ("**CCiC**") Cambridge Local Plan (October 2018) Policy 35: Protection of human health and quality of life from noise and vibration (**D6**) ("**CLP**")
c) South Cambridgeshire District Council ("**SCDC**") District Design Guide Supplementary Planning Guidance ("**SPD**") 2010 Appendix 6: Noise: Supplementary Design Guide (**D36**)
d) South Cambridgeshire Local Plan (September 2018) Policy HQ/1: Design Principles (**D8**)

Guidance

5.4 The following National Standards and Guidance have been considered in the assessment of noise associated with the proposed Development:

a) BS4142 2014 + A1:2019 Method for Rating and Assessing Industrial and Commercial Sound (**D37**)
b) BS 5228:2009 +A1:2014: Code of practice for noise and vibration control on construction and open sites; Part 1 Noise (**D38**)
c) BS7445-1:2003 & 2:1991 Description and measurement of environmental noise. (**D39**)
d) BS8233:2014: Guidance on sound insulation and noise reduction for buildings. (**D40**)
e) Calculation of Rail Noise ("**CRN**") Technical Memorandum 1995. (**D41**)
f) Calculation of Road Traffic Noise ("**CRTN**") 1988. (**D42**)
g) Design Manual for Roads and Bridges ("**DMRB**") LA111 Noise and Vibration 2020. (**D33**)
h) Design and Installation Requirements for Public Announcement, Voice Alarm and Long Line Public Announcement Systems (NR-L2-TEL-30134-PAVA). (**D44**)
i) Network Rail document NR/L2/ENV/121 ISSUE 1 Managing Environmental and Social Impact of Noise and Vibration 2019. (**D45**)
j) World Health Organisation (WHO): Guidelines for Community Noise 1999. (**D46**)
k) WHO: Night Noise Guidelines for Europe 2009. (**D47**)
l) WHO: Environmental Noise Guidelines for the European Region 2018. (**D48**)

m) Ministry of Housing, Communities & Local Government ("**MHCLG**"): Planning Practice Guidance Noise 2019. (**D4**)

5.5 The legislation, and national and local planning policy set out specific requirements for the assessment of noise. However, the guidance focusses on human perception and there is very little reference to noise sensitive research facilities in policy documents.

5.6 The ES chapter sets out the detail of the approach taken to establish the impact on sensitive buildings and other receptors including the British and International standards used.

5.7 In the absence of specific legislation or policy in relation to very noise sensitive facilities the principles of Agent of Change are applied:

> "[187] Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed." (National Planning Policy Framework, July 2021) ("**NPPF**") (**D1**)

5.8 This principle has been used as the basis for the assessment of the onset of significant adverse impact on research within sensitive facilities which are different than would be required for human occupation.

5.9 I set out the approach taken to establish impact on noise sensitive research being undertaken within the research facilities in Section 10 and **Appendices B and C** of this Proof of evidence. The approach firstly compares the predicted construction noise level ($L_{Aeq,10hours}$) against the proposed internal noise limits and determines the minimum sound insulation requirement for the Façade to meet the internal noise limit. I then compare the requirement against specifications for example constructions and demonstrate that any façade will comfortably achieve the required level of sound insulation. Secondly, I compare the existing 'maximum' external noise levels (L_{AFmax}) measured during the baseline survey, with the 'maximum' (L_{AFmax}) noise levels predicted from construction. Where maximum predicted construction noise levels do not significantly exceed existing 'maximum' noise levels, i.e. by no more than 3dB, it is my considered opinion that no significant effect is likely to occur.

6. Engagement with Stakeholders

Pre-application Engagement.

6.1 Arcadis produced the ES, including the scoping and noise chapter, under the instruction of Network Rail. Due to limited capacity within the Arcadis noise team, the work to prepare the final noise chapter was sub-contracted to a third party, Ramboll UK Limited, to complete.

6.2 Table 6.1 shows a summary of consultation for noise that I understand was undertaken by Arcadis to inform the ES Scoping, and the issues raised.

Table 6.1 Consultation undertaken by Arcadis related to noise before the TWAO submission

Consultee	Contact / Date	Summary of Issues Raised/Agreed
Cambridge City Council (CCiC)	EHO 18.06.19	EHO confirmed he was happy with the baseline noise survey as proposed.
South Cambridgeshire District Council (SCDC)	EHO 19.09.19	EHO confirmed he was happy with the baseline noise survey as proposed.
Greater Cambridge Shared Planning & Cambridge City Council	19.06.20	Following changes to the scheme design a presentation was made setting out the approach to the noise assessment to form part of an environmental impact assessment. Broadly positive verbal feedback provided to the proposals presented.
CCiC, EHO, Environmental Planning	16.10.20 21.10.20	Details and plans provided of revised scheme design setting out noise monitoring locations and survey methodology based upon the most recent project design information that had changed from that previously consulted on, information provided includes area over which CCC has jurisdiction. Confirmation received confirming there are no particular issues with scope in terms of monitoring locations within the Cambridge City boundary. It was noted by the EHO that there are no proposed baseline monitoring locations at / near the closest residences at Trumpington Meadows. It is acknowledged that these are quite some distance from the proposed activities. However, as they are the nearest residential premises with unobstructed line of site to the proposed location of the south station, the EHO indicated that they would expect them to be included as sensitive receptor locations when carrying out the detailed assessments. Confirmation provided that sensitive receptors at Trumpington Meadows would be assessed.
SCDC, EHO, Environmental Planning	16.10.20 19.10.20	Details and plans provided of revised scheme design setting out noise monitoring locations and survey methodology based upon the most recent project design information, including areas over which SCDC has jurisdiction. With regard to the noise monitoring proposals, the EHO at SCDC confirmed their agreement with the locations and duration of the baseline measurements proposed.

Consultee	Contact / Date	Summary of Issues Raised/Agreed
	21.10.20	Clarification was also sought on whether predictions would be made using noise mapping software. It was confirmed by email that noise predictions would be made using noise mapping software.

Post Submission Engagement

6.3 Following the submission of the TWAO application engagement sessions with stakeholders about noise have been held as follows:

6.3.1 MRC Engagement

a) Friday 24 September 2021 9am. I met with MRC to discuss the objection and Statement of Case (SoC) (E4) and to agree next steps.
Informed discussions were undertaken with the MRC regarding the sensitivity of the research and the proposed methodology for assessing the impact of noise upon their research. I explained my proposed methodologies for assessing risk of noise impact upon research activities within the building. I also proposed an internal noise limit from construction noise to be met within areas used to house animals (see **Appendix B**) This noise limit is based upon best available guidance and includes an additional 5dB penalty to allow for the fact that the intermittent nature of construction noise has the potential to make it a more intrusive noise source than a simple steady sound. This same criterion has been agreed as a criterion on a similar type of project, with the potential to impact very similar research activities. The MRC responded positively to the proposed noise limits and assessment methodology proposed by Ramboll and expressed confidence that the proposed approach is appropriate and robust. It was agreed during the meeting that Ramboll's proposed methodology would be formalised in a technical note for review and agreement by the MRC.

b) I provided a response to the MRC, dated 14/10/2021 (XX), regarding the objections in their SoC. This response also included clarification of the Ramboll proposed noise limits and methodology for assessing the risk of noise impact upon research activities.

c) Sandy Brown, MRC's noise consultants, replied on 2nd November 2021 (XX) with the following comments on behalf of the MRC:
   i. It is agreed within section 8 of the Sandy Brown reply that the CSIE operational noise levels, as predicted and assessed within Chapter 5 of the ES, are considered not significant.
   ii. It is agreed that construction traffic is deemed to be '*unlikely to be problematic in terms of noise'* in section 7.2 of the Sandy Brown reply;
   iii. No comment was made regarding proposed internal noise limits within areas used to house animals. It is therefore assumed that a background noise limit of 45 dBA is considered acceptable within these areas.

d) Thursday 11 November 2021 4pm. I met with MRC and their representative for noise, Richard Muir of Sandy Brown to discuss the potential issues and their comments on my responses to the MRC SoC. Points 6.3.1 c)i, c)ii and c)iii, as set out above, were agreed. It was agreed that I would update calculations to compare worst case noise levels from construction activities, as identified in the latest construction information (from Murphys/NR on 11/11/2021), in terms of $L_{Afmax,}$ at

the façade of the MRC LMB, against pre-existing measured noise levels; and use this for the basis of an assessment of noise impact upon research activities.

e) Tuesday 23 November 3pm. I met with Richard Muir of Sandy Brown (acting as the representative of the MRC) to further discuss the potential noise issues. I specifically discussed my proposed methodology for assessing noise impact upon research activities and the detailed construction activities proposed close to the LMB.

f) Thursday 2 December 2021. A further noise response was issued to MRC LMB (XX) and their representative for noise Richard Muir of Sandy Brown. At the time of this proof no further response has been issued by the MRC to the above.

g) It is my understanding that my proposals for noise limits are broadly acceptable to the MRC and that Heads of Terms (HoTs) are under discussion. I will provide an update at the Inquiry.

6.4 UoC Engagement

a) Friday 24 September 2021 11am. I met with UoC representatives to discuss the objection and SoC (**E3**) and to agree next steps. The same methodology for assessing the impact of noise upon research was proposed for the UoC as for the MRC. The UoC representatives at the meeting were not technical experts in the specific area of noise and were therefore unable to comment on the suitability of the proposed assessment methodology. It was agreed that the UoC representatives would take away a number of questions for comment on by their technical experts. The two specific questions were:

    1. Does the UoC AMB have any internal noise limits to be met in noise sensitive areas. If not do they accept our proposed internal noise limits, as derived from the Home Office CoP animals guidance, as appropriate to allow research to continue without any undue effect to animal behaviour from noise?

    2. Does the UoC agree that their research can be successfully completed without impact from the pre-existing noise levels measured around the site?

b) Ramboll Provided a response to the UoC SoC, dated 13/10/2021 (CSIE- RUK noise response to UoC v2) This response included clarification of the Ramboll proposed noise limits and methodology for assessing the risk of noise upon research activities. UoC responded to this on 22 October 2021 with comments which prompted a meeting on 4 November 2021 between the relevant parties.

c) Thursday 04 November 2021 11am. I met with UoC AMB representatives including Karl Williams (UoC) and UoC's noise expert Rupert Thornley-Taylor (Rupert Taylor Limited), to discuss UoC's comments on my response to the UoC SoC.

d) Wednesday 1 December 2021 NR submitted a Draft Heads of Terms (HoT) for use as the basis of a legal agreement between NR and UoC. The Draft HoT includes proposed internal noise limits for areas housing animals for research within the AMB. These HoTs are currently under discussion and I will provide an update at the inquiry.

7. Summary of the ES Noise Assessment

7.1 This part of my evidence provides an overview of the noise assessment set out in Chapter 5 of the ES. The Scheme provides a new train station at the CBC with alterations to the track and associated buildings and infrastructure. A detailed description of the Scheme is provided in Chapter 2 of the ES and the Proof of Evidence of Mr Barnes (**NRE1.2**).

7.2 Short term noise and effects will arise as a result of the construction of the new station.

7.3 The ES assesses the likely significance of these effects as a result of the construction and operation of the proposed scheme in terms of noise in the immediate community. The assessment makes reference to legislation, local and national policy and relevant guidance.

7.4 The impact of noise from construction activities and its significance are assessed at each sensitive receptor based on the predicted noise level. The operational noise impact, and significance, are assessed at each sensitive receptor based on the change in anticipated noise level. Finally, mitigation for construction effects is discussed.

7.5 The outcome of the construction noise assessment in Chapter 5 of the ES is that following the mitigation, in the form of Best Practicable Means ("**BPM**"), construction noise is considered to have a Moderate impact during the day and significant adverse effects on the AstraZeneca Academy House, The Belvedere, Long Road, MRC, AZ, and UoC receptors. These are considered in greater detail in Section 9.

7.6 The outcome of the operational noise impact assessment in Chapter 5 of the ES is that the Scheme will not result in significant adverse impacts at any receptors.

8. Assessment Methodology

ES Assessment Methodology

8.1 Noise impact arising from the construction and operation of the Scheme has been assessed in Chapter 5 of the ES. This assessment follows industry best practice to predict noise levels and prescribed methodology to assess the significance of these impacts to nearby sensitive receptors.

8.2 Assessment of impact is broken down into two phases, which are the short-term construction phase and the operational noise impact of the Scheme for the opening year (short term). Reference is made to the appropriate British and International standards, Codes of Practice and industry guidance for each phase using the latest 3D noise modelling software to undertake noise predictions.

Methodology - Short Term Impact from Construction

8.3 Construction noise predictions have been carried out in CadnaA® based on an assumed worst-case per construction area (Station Area, Shepreth Branch Junction and Hills Road), i.e. highest number of concurrent construction stages, plant on times set to 100%. The construction information provided detailed plant to be used for each separate construction activity. Construction noise predictions were carried out based on a worst-case assumed list of plant to be operating in each construction area at once. The spectrum for the dominant plant item was applied in the CadnaA® noise model.

8.4 Assessment of construction noise impact has been undertaken in accordance with the BS 5228-1:2009+A1:20142 using 'ABC' method (given in Annex E.3.2 of BS 5228-1:2009+A1:2014) to set significance thresholds for impact. This is the appropriate standard for use in assessment of the short-term impact of construction activities associated with infrastructure projects such as the CSIE Project. Construction noise limits are determined based on the pre-existing ambient noise levels at receptors established as part of the baseline and are therefore relative to current conditions. Predicted construction noise levels are compared to the BS5228 derived noise threshold levels to determine magnitude of impact. Magnitude of impact is compared to the 'sensitivity' of the receptor to determine whether significant effects are likely. This methodology is explained fully within Section 5 of the ES.

8.5 Noise generated by construction traffic using the public Highway was assessed in accordance with the methodology of the Calculation of Road Traffic Noise (CRTN), and an assessment made drawing upon pertinent aspects of the methodology provided within the Design Manual for Roads and Bridges (DMRB) LA111.

Methodology - Operational Noise Impact

8.6 Consideration of the potential effects resulting from new and altered rail lines, and a possible increase in rail traffic and any changes in rail traffic speed was determined using CadnaA® version 2021 noise modelling software.

8.7 Rail noise modelling was undertaken by implementing the airborne noise calculation methodology of Calculation of Rail Noise (CRN) which is applicable for the assessment of new and altered rail lines. The method to predict airborne sound attributable to rail operations was used to model sound propagation taking account of the following effects: topography, track design, track points, reflections, shielding by barriers and buildings and where appropriate any physical mitigation measures proposed using noise modelling techniques.

8.8 Predictions were made for an 18-hour daytime period $L_{Aeq,18\ hours}$ between 0600 and 2400 hours and a 6-hour night-time period $L_{Aeq,\ 6\ hours}$ between 0000 and 0600 hours.

8.9 An assessment to determine the indirect effects of any changes in road traffic as a result of the proposed development was based upon the methodology and significance criteria set out in the DMRB LA111 Noise and Vibration document. Consideration was also given to the potential effects associated with the new station drop-off facility for road vehicles.

8.10 Changes in traffic as a result of the proposed development on the local network were calculated in accordance with the methodology of the CRTN, and an assessment made under DMRB LA111. The DMRB is intended for the assessment of new or altered road schemes, which is not the situation for the proposed development, it does however provide some relevant guidance that can be adopted for the assessment of noise in the short term, resulting from changes in traffic flows. As such, aspects of the DMRB methodology were implemented as a way to consider the impacts of traffic flow changes on the local road network attributable to the proposed development once operational.

9. Findings of the Environmental Statement

9.1 The Environmental Statement Chapter 5 and associated appendices set out the detail of the assessments undertaken for all the identified receptors. Many of the receptors were not found to be significantly impacted as a result of the construction or operational phases. On this basis and since there have been no objections relating to those receptors, this proof of evidence does not provide further detail on them.

9.2 Noise impact assessments at all receptor locations are based upon setting construction noise thresholds using the BS5228 5228-1:2009+A1:2014 (BS5228) 'ABC' method. Predicted construction noise levels are compared to the BS5228 derived noise threshold levels to determine magnitude of impact. Magnitude of impact is compared to the 'sensitivity' of the receptor to determine whether significant effects are likely. This methodology is explained fully within Section 5 of the ES.

9.3 Construction noise has been modelled in Chapter 5 of the ES 'worst-case' scenario. This is typical when assessing construction noise for planning, as the precise construction information is not available. This includes using high percentage on-times (100%) for plant in the calculations, and also an onerous assumption for cumulative noise levels from concurrent work stages. For example, it has been assumed that all work stages overlap and results presented are the highest predicted cumulative levels.

Unmitigated Results.

Tables 9.1 and 9.2 below show the receptors considered likely to experience significant effects prior to mitigation.

Daytime

Table 9.1 – Receptors with significant effects – Daytime

Receptors	Construction area	Measured ambient noise level dBA	Construction noise threshold value dBA	Predicted construction noise façade levels dBA	Magnitude of Impact
(NML 2) – Long Road 6th Form	Station Area	61	65	65	Major
C (NML 3) - LMB	Station Area	59	65	67	Major
D (NML 4) – AZ BioMed	Station Area	62	65	67	Major
E (NML 6) - AMB	Station Area	59	65	67	Major
NML 8 (Resi)	Station Area	61	65	68	Moderate
A - AstraZeneca Academy House	Hills Road	61	65	67	Major
B - The Belvedere	Hills Road	61	65	67	Major
D – AstraZeneca Biomed Campus	Station Area	62	65	68	Moderate

Hills Road Area

9.3.1 Major impacts are predicted at receptors AstraZeneca Academy House and the Belvedere. These receptors are considered to have high sensitivity, therefore a Large to Very Large Adverse and significant effects are predicted. The significant effects are based on a 'worst-case' and are expected to be temporary in nature. The significant effects are expected to occur over several months as the overall construction for Hills Road area is programmed to extend over 6 months.

Station Area

9.3.2 Major impacts are predicted at receptors NML 2, NML 3, NML 4 and NML 6. These receptors are considered to have a high sensitivity, therefore a Large to Very Large Adverse and significant effects are predicted.

9.3.3 Moderate impacts are predicted at NML 8 and AstraZeneca BioMed Campus site, which are considered high sensitivity. Therefore Moderate Adverse and significant effects are predicted.

9.3.4 These effects are based on a 'worst-case' and are expected to be temporary in nature. It is expected these effects are programmed to span 5-6 months.

Shepreth Branch Junction

9.3.5 No significant noise effects are predicted as a result of construction work in the vicinity of the Shepreth Branch Junction.

Night time

Table 9.2 – Receptors with significant effects – Night time

Receptors	Construction area	Measured ambient noise level dBA	Construction noise threshold value dBA	Predicted construction noise façade levels dBA	Magnitude of Impact
D (NML 4) – AZ BioMed	Station Area	58	58	58	Moderate
E (NML 6) - AMB	Station Area	54	55	68	Major
NML 9	Shepreth Branch Junction	46	55	56	Moderate
NML 10	Shepreth Branch Junction	50	55	56	Moderate
AstraZeneca Academy House	Hills Road	58	58	68	Major
The Belvedere	Hills Road	58	55	73	Major

Receptors	Construction area	Measured ambient noise level dBA	Construction noise threshold value dBA	Predicted construction noise façade levels dBA	Magnitude of Impact
AstraZeneca BioMed Campus site	Station Area	58	58	73	Major
Properties on Abberley Wood Road	Shepreth Branch Junction	50	55	58	Moderate
25 Davey Close	Shepreth Branch Junction	50	55	56	Moderate

Hills Road Area

9.3.6 Major impacts are predicted at receptors AstraZeneca Academy House and the Belvedere. These receptors are considered to have a high sensitivity, therefore a Large to Very Large Adverse and significant effects are predicted. Night-time works at Hills Road are scheduled to take 2-3 days at a time. Therefore, the significant effects are based on a 'worst-case' and are short-term and temporary in nature.

Station Area

9.3.7 Major impacts are predicted at NML 6 and AstraZeneca BioMed Campus site. The receptors are considered to have a high sensitivity, therefore Large to Very Large Adverse and significant effects are predicted. Regardless, night-time works are scheduled to take place for no more than 8 days at a time and therefore the effects are anticipated to be short-term and temporary in nature.

9.3.8 Moderate impacts are predicted at NML 4, which is a high sensitivity receptor. Moderate or Large Adverse and significant effects are predicted. As previously stated, night-time works are scheduled for no more than 8 days at a time and therefore the effects are anticipated to be short-term and temporary in nature.

Shepreth Branch Junction

9.4 Moderate impacts are predicted at properties on NML 9, NML 10, Abberley Wood Road and 25 Davey Close, which are high sensitivity receptors. Therefore, Moderate or Large Adverse and significant effects are predicted. It should be noted the effects are anticipated to be short-term and temporary in nature as night-time works at Shepreth Branch Junction are scheduled to take place for no more than 1-2 days at a time.

9.5 Following mitigation in the form of BPM, construction noise is considered to have a Moderate impact during the day and significant adverse effects on the AstraZeneca Academy House, The Belvedere, Long Road, MRC LMB, Astra Zeneca Biomed, and UoC AMB receptors.

9.6 The results of the assessment for each of the receptors where significant residual effects are predicted are provided in Table 9.3 for day time and Table 9.4 for night time.

Table 9.3 – Receptors with significant residual effects – Daytime

Receptors	Construction area	Measured ambient noise level dBA	Construction noise threshold value dBA	Predicted construction noise façade levels dBA	Magnitude of Impact
(NML 2) – Long Road 6th Form	Station Area	61	65	65	Moderate
C (NML 3) - LMB	Station Area	59	65	67	Moderate
D (NML 4) – AZ BioMed	Station Area	62	65	67	Moderate
E (NML 6) - AMB	Station Area	59	65	67	Moderate
A - AstraZeneca Academy House	Hills Road	61	65	67	Moderate
B - The Belvedere	Hills Road	61	65	67	Moderate

9.7 Construction noise is considered to have a Major impact during the night time and significant adverse effects upon the AstraZeneca Academy House, The Belvedere, Astra Zeneca Biomed and UoC AMB.

Table 9.4 – Receptors with significant residual effects – Night time

Receptors	Construction area	Measured ambient noise level dBA	Construction noise threshold value dBA	Predicted construction noise façade levels dBA	Magnitude of Impact
E (NML 6) - AMB	Station Area	54	55	63	Major
AstraZeneca Academy House	Hills Road	58	58	68	Major
The Belvedere	Hills Road	58	55	68	Major
AstraZeneca BioMed campus	Station Area	58	58	63	Major

9.8 In the following sub-sections the findings of the assessment for each of the receptors where significant residual impacts are predicted are set out in more detail.

9.9 The methodology within Chapter 5 of the ES does not determine whether there is the potential for impacts on noise sensitive research being undertaken inside the building, only upon people within the building. This will be specifically addressed in the following chapter.

Long Road Sixth Form. Education facility – Non Research

9.10 Temporary direct significant adverse effects are predicted at the Long Road receptor for short periods of time during the day time when breaking of concrete is required within 40m of the receptor. This would include breaking out of any existing concrete and breaking out of pile caps.

9.11 These activities are scheduled for no more than a few hours at a time, during each stage of construction at this location. Therefore noise levels will be significantly lower than this for >98% of the construction period.

Station Area (MRC LMB, Astra Zeneca Biomed, UoC AMB) - Research

9.12 Temporary significant noise effects will arise as a result of the construction of the new station at both the facades of the MRC LMB, UoC AMB and AstraZeneca Biomed site. These noise effects are related to human comfort and not upon animals housed within the buildings (which was not dealt with in the ES but which is addressed in this Proof).

9.13 *Daytime* – Temporary Moderate impacts and Moderate or Large Adverse and Significant effects are predicted at MRC LMB, UoC AMB and AstraZeneca Biomed site.

9.14 The noise levels predicted in the construction noise assessment in Chapter 5 of the ES are worst case construction noise predictions. The individual buildings would only ever by subject to these worst case noise levels during works to break concrete during the construction of the station building and the closest OLE gantries. High noise levels would be expected for no longer than 1 day per pile. The greatest impact would be from the 2 to 4 closest piles to the facades. Noise levels will be significantly lower than this for the vast majority of the time, >98% of the construction period.

9.15 *Night-Time* - Major impacts and Large to Very Large Adverse and Significant effects are predicted at the UoC AMB and AstraZeneca Biomed site. Night-time works in the Station Area are scheduled for no more than 8 days at a time. Predictions are worst case scenarios and would only occur for short periods during any night, 1 to 2 hours. Therefore, the effects are based on a 'worst-case' and are short-term and temporary in nature happening. Noise levels will be significantly lower than this for the vast majority of the time, >98% of the construction period. Noise levels will be significantly lower than this for the vast majority of the time, >98% of the construction period.

Hills Road Receptors – Non-research

9.16 *Daytime* - Moderate impacts, and a Moderate or Large Adverse and Significant effects are predicted at the Hills Road area receptors (AstraZeneca Academy House and The Belvedere). The significant effects are based on a 'worst-case' and are short-term and temporary in nature. Noise levels will be significantly lower than this for the vast majority of the time, >98% of the construction period.

9.17 *Night-time* - Major impacts, and Large to Very Large Adverse and Significant effects are predicted at receptors AstraZeneca Academy House and the Belvedere. Night-time works at Hills Road are scheduled for 2-3 days at a time. Therefore, the significant effects are based on a 'worst-case' and are short-term and temporary in nature. Noise levels will be significantly lower than this for the vast majority of the time, >98% of the construction period.

10. Objections and Comments Raised and Responses to the same

10.1 Objections have been received on the grounds of noise, and in particular noise during the construction period, from MRC (**E4**, **OBJ9**) and the UoC (**E2**, **OBJ3**). A high-level noise concern has been raised by the Cambridge Past, Present and Future ("**CPFF**") as part of their objection to the scheme (**OBJ14**). Objections have also been received from SCDC and CCiC and these include reference to noise.

10.1.1 **MRC Objection (OBJ/09, E4)**

10.1.1.1 The MRC submitted a SoC dated 15th September 2021 which provides some further information on the key points of objection. For noise this refers to the construction phase noise impact.

10.1.1.2 The MRC has objected to the scheme on the grounds that significant noise impacts are predicted to their LMB building. They are primarily concerned as to whether noise sensitive research undertaken at the LMB will be impacted by the construction noise. The two key concerns raised by the MRC are:

1) Paragraph 5.11 MRC SoC - Risks of effects upon the behaviour of their animals, in particular mice (dealt with in paragraphs 10.2.1 to 10.2.42, below).
2) Paragraph 5.12 MRC SoC - Concern that Chapter 5 of the ES predicts significant adverse effect at the facade of the LMB (dealt with in paragraphs 10.2.43 to 10.2.48, below).

10.1.2 **UoC Objection (OBJ/08, E3)**

10.1.2.1 A SoC (**E3**) was submitted by Mills and Reeve on behalf of UoC (dated 14th September 2021). This document and its appendices provide a more detailed background to the importance of the AMB to the University and how elevated noise levels could impact on research being undertaken.

10.1.2.2 The SoC sets out the UoC's specific concerns relating to the construction phase and the operational phase. Additional information is requested in relation to the assessment that has been undertaken to allow the University to assess the potential impacts further.

10.1.2.3 The UoC has objected to the CSIE Project on the grounds that significant noise impacts are predicted to their AMB building. They are primarily concerned as to whether noise sensitive research undertaken at the AMB will be impacted by the construction noise**.** The six key points raised by the UoC are:

1) Paragraph 4.3.1 UoC SoC - Risk of effects upon their sensitive imaging equipment (dealt with in paragraphs 10.3.5 to 10.3.29)
2) Paragraph 4.3.2 UoC SoC - Risks of effects upon the behaviour of their animals (dealt with in paragraphs 10.3.5 to 10.3.29)
3) Paragraph 6.6 UoC SoC - Lack of consideration of mitigation beyond Best Practicable Means (BPM) (dealt with in paragraphs 10.3.1 to 10.3.2);
4) Paragraph 6.6 - a Blanket inclusion of 5dB for BPM (dealt with in paragraphs 10.3.3 to 10.3.4)
5) Paragraph 6.7 - UoC SoC - Concern that predicted construction noise levels could be 77dBA at the façade rather than 72dBA (dealt with in paragraphs 10.3.30, 10.3.31).
6) Paragraph 6.9 UoC SoC - Risk of internal criteria being exceeded due to construction noise (dealt with in paragraphs 10.3.5 to 10.3.29).

10.1.3 **CPFF Objection (OBJ/14, E7)**

10.1.3.1 A SoC (E7) was submitted by Cam PFF dated 15 September 2021. CPFF care for certain green spaces around Cambridge and are concerned that noise from the station development may impact amenity on the land referred to as Hobson's Park. The single reference to noise is contained in section 7 of Cam PFF's statement of case.

10.1.3.2 The CPFF objection is speculative in terms of noise and does not include any specifics as to how noise may impact Hobsons' Park. However they appear to be concerned only about the operational phase of the CSIE Project given they refer to cumulative impacts of "the station".

10.1.4 **CCiC Objection (OBJ/23, E11)**

10.1.4.1 **Noise is dealt with at paragraphs 68 – 74 of CCiC's statement of case dated 15 September 2021** (**E11**). A number of these paragraphs confirm CCiC's agreement with the approach adopted by Network Rail and the results of the assessment carried out – see in particular paragraphs 68, 70, 73 and 74.

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10.1.4.2 CCiC has identified four residual concerns, as follows**:**

1) Paragraph 69 where they recommend an operational plant noise condition for operational plant "It is required that the rating level (in accordance with BS4142:2014) from all plant, equipment and vents etc (collectively) associated with this application should be less than or equal to the existing background sound level (LA90) at the boundary"

2) Paragraph 70 where they acknowledge that PAVA (platform announcement system, "**PAVA**") design is not yet known and that "details of the PAVA can be required through an additional condition".

3) Paragraph 71 where they set out requirements for mitigation measures discussed in the ES to be included in the CoCP B;

4) Paragraph 72 where they seek clarification that impact piling will not be used.

10.1.4.3 Whilst these noise points are included within the CCiC objection it should be noted that they are standard CCiC conditions for a development such as this. My view is that these are not 'objections' on the basis of noise, but standard acoustic issues to be resolved in the typical way as they would be on any site in Cambridge City.

10.1.5 **SCDC Objection (OBJ/24, E10)**

10.1.5.1 Noise is dealt with at paragraph 23 of SCDC's statement of case dated 15 December 2021 (**E10**)

10.1.5.2 SCDC acknowledge that due to health and safety reasons and access constraints work will have to be carried out during daytime and night time that will result in moderate to major noise impacts. Areas where they have however identified residual concern is as follows:

1) Paragraph 23 SCDC require that where works have the potential to adversely impact residents site specific mitigation and attenuation measures will need to be employed, and these measures must be included in the CoCP B.

10.1.5.3 Whilst this point is included in the SCDC letter of objection, this is not considered an objection on the grounds of noise but of the standard process for agreeing this type of works.

10.2 **Response to the MRC LMB objection**

OBJ/09 – 1) Risk of effects upon the behaviour of their animals

10.2.1 I set out below my reasoning as to why the construction of the CSIE Project does not risk causing effects upon the behaviour of the animals at the CSIE Project. I do this by first comparing the construction noise level predicted within the ES ($L_{Aeq,10hours}$) against the acoustic specification of a typical façade and demonstrate that ambient noise levels within the MRC will be significantly below a level where animal behaviour would be subject to effects. I then compare the pre-existing measured maximum noise levels (L_{AFmax}) against the predicted maximum construction noise levels and demonstrate that the maximum construction noise levels will be at a lower level and less frequent than the pre-existing maximum noise levels, understood to be from the passing trains.

Assessment of construction noise levels at the AMB façade

10.2.2 Noise levels from construction activities associated with the CSIE Project are predicted within the CSIE ES chapter 5 to be up to 67 dB $L_{Aeq,10hours}$ at the façade of the MRC LMB.

10.2.3 I have reviewed the construction noise model used for the ES and am confident it provides a reasonable worst case daytime $L_{Aeq,10h}$ construction noise level.

10.2.4 The ES construction noise modelling is based on plant running with 100% on-times, and with concurrent construction stages. This is a typical assumption for an assessment done at early project stages, when limited information is available, but it is unlikely to reflect noise levels in practice as it gives an overestimation of noise. Therefore I consider that construction noise levels will be lower than 67 dB $L_{Aeq,10hours}$ for the vast majority of the construction period (>95%).

10.2.5 It is noted following discussions with Sandy Brown on 23/11/2021, that the original acoustic design specification for the sound insulation performance of the MRC LMB facade was a minimum of R_w+C_{tr} 25. R_w+C_{tr} is a measure of how much an element is capable of attenuating noise levels, full explanation is in the Acoustic Glossary (**Appendix A**). This is a very low acoustic performance that could be comfortably achieved with standard thermal double glazing and any basic sealed façade containing at least one layer of dense board.

10.2.6 In practice, the MRC LMB is a high-performance building with strictly controlled environmental and security requirements. Having visually inspected the building I believe that it can be conservatively assumed that the existing façade provides at least R_w+C_{tr} 35 of sound insulation, due to the non-acoustic reasons (i.e. H&S, security, thermal, etc).

10.2.7 Predicted external construction noise levels, as predicted in Chapter 5 of the ES, of 67 dB $L_{Aeq,10hours}$ are anticipated to reduce to below 35 $dBL_{Aeq,10hours}$ inside the worst affected spaces of LMB . Noise levels are anticipated to be significantly lower than this in the majority of the building (>98%).

10.2.8 I provide additional calculations in the next section, based upon the latest construction information available to me, to check the predicted noise levels of the noisiest construction activity at the closest locations to the MRC LMB. This represents the very worst case scenario.

10.2.9 It is my opinion that if the noise level from the noisiest construction activity in terms of maximum noise level (L_{AFmax}), is not significantly higher than the pre-existing measured maximum noise levels, then no risk of effects upon the behaviour of animals at the MRC is considered to occur. This is because the animals are currently are currently subject to those pre-existing noise levels.

Assessment of noisy works close to the AMB façade and a comparison with pre-existing measured noise levels.

Existing noise levels

10.2.10 It is confirmed by the MRC LMB's acoustic consultant Richard Muir of Sandy Brown that regular 'maximum' noise levels up to $85dBL_{AFmax}$ were measured at a location equivalent to the LMB façade during their noise survey in October 2021. It is understood that these 'maximum' noise level events were typically from the regular passing trains.

10.2.11 During the survey undertaken by Arcadis for the purposes of the ES in March 2021 similar regular noise levels were measured. It should be noted that the highest maximum level measured during the Arcadis survey was 98 dBL_{AFmax}.

10.2.12 It is understood that the LMB operates currently without external noise impacting the research carried out within the building, ie without effects upon the mice.

Construction noise

10.2.13 The highest construction noise levels are typically from percussive activities such as concrete breakers. The site is soft ground. Therefore concrete breaking will be limited to the breaking out of the pile caps. This activity must take place for the construction of the station building and is likely to take place for the construction of the Overhead Line Equipment gantries close to the MRC dependent upon the choice of final gantry construction methodology.

Station Works

10.2.14 The location of the proposed station building and its location in relation to the MRC LMB is shown in figure 10.1 and 10.2. (below).

10.2.15 A sound power level of 120 L_{wA} has been used for the concrete breaker. This is taken from the list of plant in Appendix 5.1 of the ES.

10.2.16 Percussive activities such as concrete breaking create high 'maximum' (L_{AFmax}) noise levels. As the frequency of the impacts increases, the difference between the L_{AFmax} levels and the L_{Aeq} levels tends towards zero.

10.2.17 For the purposes of a very worst case assessment, we have added on 10dB to the L_{Aeq} to approximate the L_{AFmax} level from the concrete breaker.

10.2.18 The calculation assumes a 2.4m high solid hoarding around the site boundary (see Figure 10.1.3), including along the edge of the guided busway. This should be proposed as part of the COCP B.

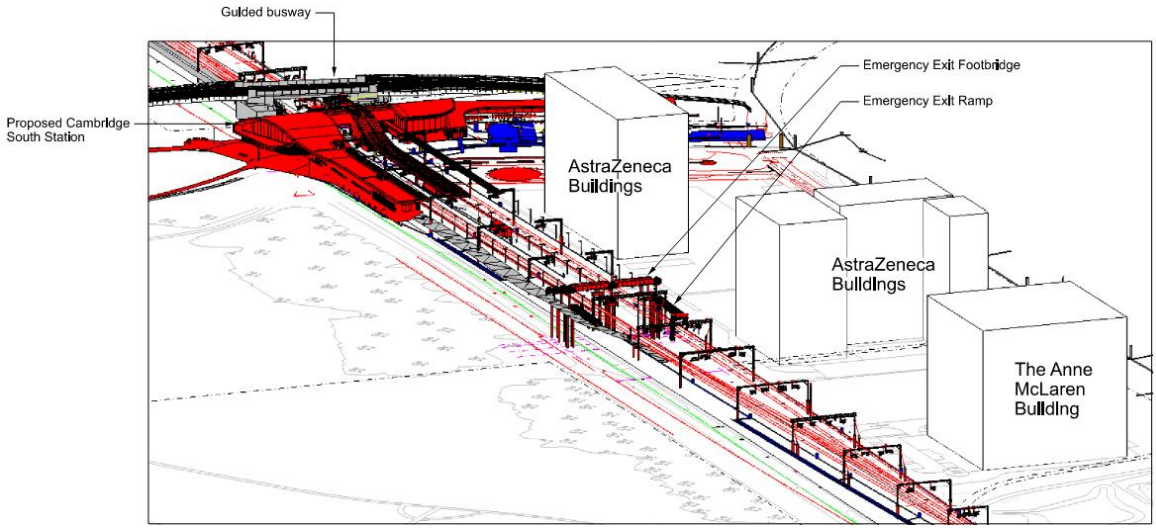


Figure 10.1 – Proposed station area works

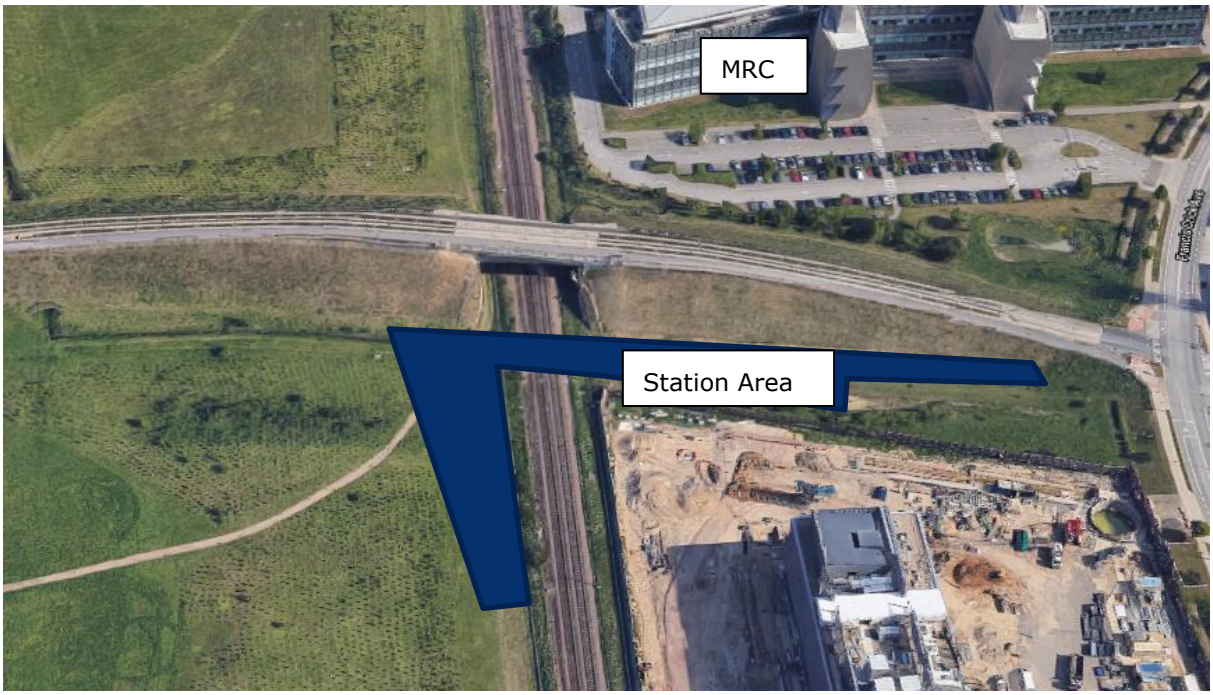


Figure 10.2 – Station area in relation to the MRC

Figure 10.3 – Indication of proposed site hoarding location

10.2.19 The closest concrete breaking for the station works is around 90m from the LMB as shown in Figure 10.4.

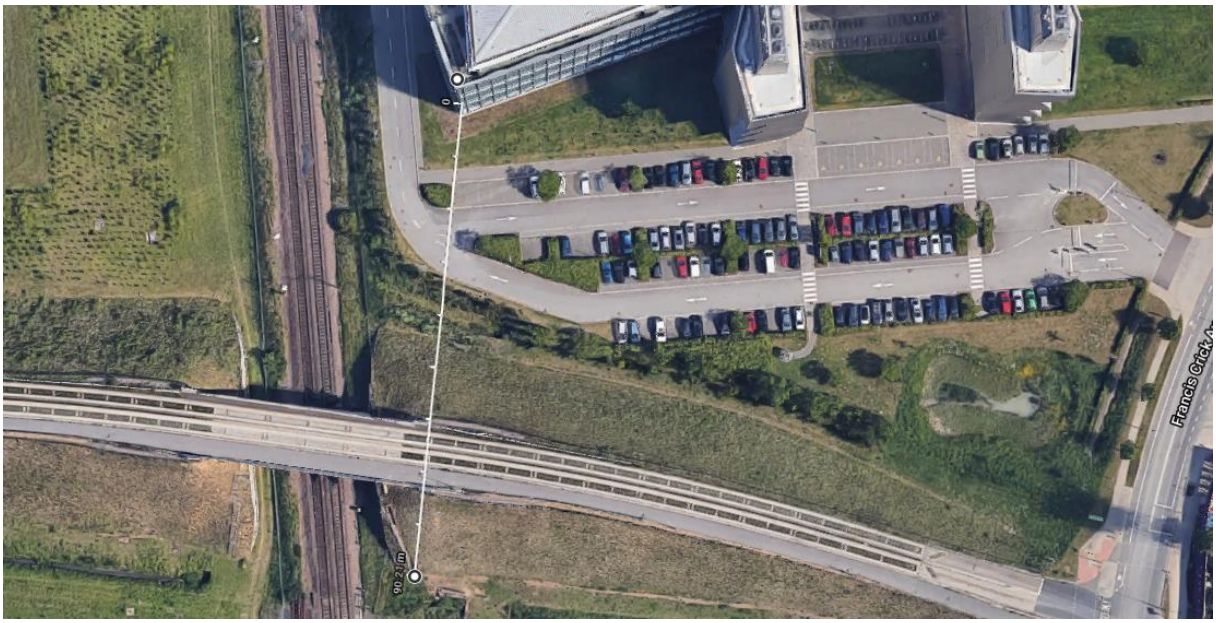


Figure 10.4 - Distance from MRC LMB to closest pile location for Station

10.2.20 Noise levels, both ambient ($L_{Aeq,T}$) and maximum (L_{AFmax}), are predicted for the concrete breaking activities associated with the station works at the closest part of the AMB façade in Tables 10.1 and 10.1b

a) Sound power levels for concrete breakers of 120 L_{wA} have been used from the calculations in Chapter 5 of the ES.

b) Sound power is converted to sound pressure at 10m by subtracting 28 dB

c) Maximum noise levels include a +10dB correction to covert from ambient noise levels. This is an approximation based on an assumed worst case for concrete breaking.

d) Calculations include a distance correction from a position 10m (10m) from the noise source to the façade of the AMB (90m), based on inverse square law for noise propagation 20Log(10/90).

e) For the ambient noise level, a 10dB reduction on the basis that the actual concrete breaking will only take place for 10% of the day.

Table 10.1 – Predicted noise levels at MRC façade from concrete breaking for Station

Table 10.1a - Predicted L_{AFmax} noise levels from concrete breaking for Station	
Concrete Breaker Sound Power level	120 L_{wA}
Convert to pressure at 10m	-28
Conversion to Maximum level	+10
Distance correction (20log(10/90m))	-19
Screening from site hoarding and Bridge	-10
Total (L_{AFmax})	73

Table 10.1b - Predicted $L_{Aeq,10hour}$ noise levels from concrete breaking for Station	
Concrete Breaker Sound Power level	120 L_{wA}
On time 10%	-10
Convert to pressure at 10m	-28
Distance correction (20log(10/90m))	-19
Screening from site hoarding and Bridge	-10
Total ($L_{Aeq,10hour}$)	53

Noise from other construction activities – OLE gantry foundations.

10.2.21 Some smaller construction works will occur closer to the façade of the LMB than the station works, for example the erection of the gantries for the Overhead Line Equipment ("**OLE**").

10.2.22 A number of possible options are being considered for the gantry foundations on the north side of the bridge, including screw piles and Continuous Flight Auger ("**CFA**")

10.2.23 The highest noise levels associated with CFA piling are from the breaking out of pile caps. Cleaning of the auger has the potential to create high noise levels, however this can be mitigated by using an auger cleaning attachment, rather than simply shaking the auger to clean it.

10.2.24 It is understood that no concrete breaking is required for the screw piles.

10.2.25 My assessment is based upon the closest distance from construction activity to the LMB façade of 20m. A source height for breaking concrete of 0.5m, a receiver height of 18m for the upper windows of the LMB and the use of localised hoarding, e.g. echo barrier or similar cutting line of sight to the windows of the LMB. A 2.4m high site hoarding is also assumed (Figure 10.5), though this only provides benefit to the ground floor of the MRC LMB.

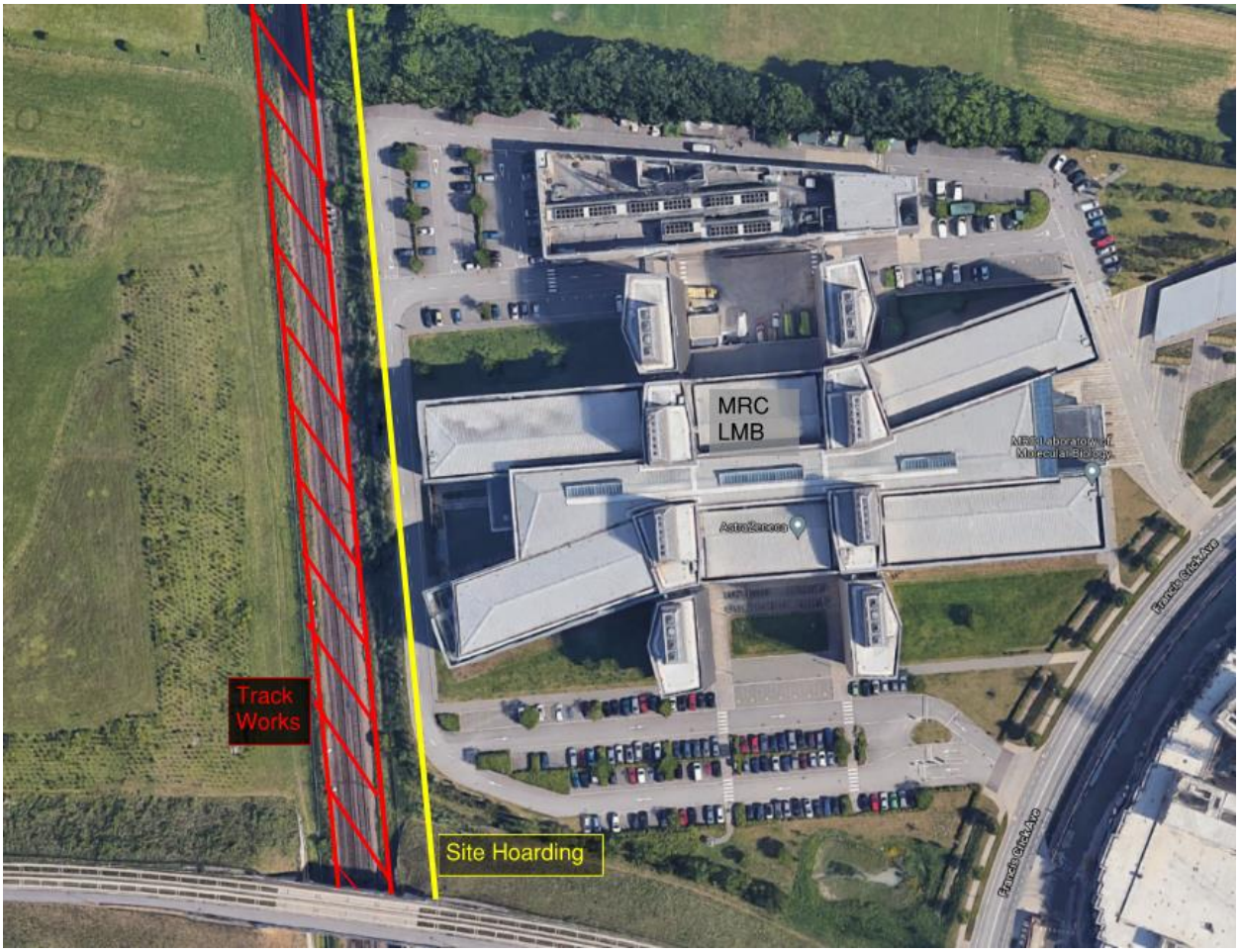


Figure 10.5 – Indication of track works location in respect to MRC

10.2.26 Defra provide a list of measured construction L_{AFmax} noise levels within "Update of Noise Database for Prediction of Noise on Construction and Open Sites.". This data is reproduced within Appendix C of BS 5228-1:2009+A1:2014.

10.2.27 The Defra/BS5228 L_{AFmax} data contains measured noise levels for a range of typical construction activities, such as dump trucks, dozers, tippers, skip wagons and rollers, but does not include noise levels of any percussive activities such as concrete breaking.

10.2.28 The construction activities listed within the Defra/BS5228 data are typically reported with measured noise levels of around 80 dBL_{AFmax} at 10m with the very highest reported at 92 dBL_{AFmax} at 10m.

10.2.29 The following calculation (Table 10.2a) is based on using the highest L_{AFmax} reported in the Defra/BS5228 construction noise data and represents non percussive works, e.g. screw piling. The sound power level ($120L_{WA}$) of concrete breaking noise level from Table 1 is used for the calculation in Table 10.2b.

10.2.30 A very worst works location of 20m from the façade has been used for the calculation.

10.2.31 Maximum noise levels (L_{AFmax}) are predicted for the non-percussive works and concrete breaking activities associated with the station works at the closest part of the AMB façade in Tables 10.2 and 10.2b.

10.2.32 Noise levels used for non-percussive construction activities are measured noise levels at a reference distance of 10m from the source.

10.2.33 Noise levels for concrete breaking are based on sound power levels converted to sound pressure levels at a reference distance of 10m with 10dB added on to approximate the maximum noise levels (L_{AFmax}) as agreed with Richard Muir of Sandy Brown. This gives a worst case assumption for the maximum noise levels based upon the sound power level of the concrete breaker.

10.2.34 The calculations include a distance correction from a reference position of 10m (10m) from the noise source, to the façade of the AMB (20m), based on inverse square law for noise propagation 20Log(10/20).

Table 10.2 – Predicted noise levels at MRC façade from close Gantry works options

Table 10.2a - Predicted L_{AFmax} noise levels from non-percussive construction activities – OLE (including screw piling)

Noise level at 10m (BS5288 C.6.13)	92 L_{AFmax}
Distance correction (20log(10/20m))	-6
Screening from site hoarding and localised barriers	-10
Total (L_{AFmax})	74

Table 10.2b - Predicted L_{AFmax} noise levels from breaking out CFA pile caps - OLE	
Concrete Breaker Sound Power level	120 L_{wA}
Convert to pressure at 10m	-28
conversion to Maximum level	+10
Distance correction (20log(10/20m))	-6
Screening from site / localised hoarding	-10
Total (L_{AFmax})	86

10.2.35 The high noise levels associated with CFA piling levels, as per table 10.2b, would only occur during the part of the process where the pile caps are broken out by the concrete breaker.

10.2.36 It is understood that each OLE gantry foundation would require 2 CFA piles. Each CFA pile would take 1 to 2 hours to drill and another 1 to 2 hours to break out. Therefore these worst case L_{AFmax} noise levels of 86dBA are only predicted for short periods of a time (up to 4 hours per foundation) for the two closest foundations at the worst affected windows facing directly on to the railway.

10.2.37 At all other times during the seven weeks of OLE works north of the guided busway bridge, and at all other times during the construction program, noise levels would be lower.

Conclusion

10.2.38 On the basis that the MRC LMB operate without effects to the behaviour of their animals, with regular external maximum noise levels up to 85dB$L_{\mathbf{AFmax}}$ and occasional maximum noise levels up to 98 dB$L_{\mathbf{AFmax}}$, I conclude that there is no reason to believe that construction noise levels of 67 dB$L_{\mathbf{Aeq}}$, as predicted in Chapter 5 of the ES, and 86 dB$L_{\mathbf{AFmax}}$ would result in effects to the behaviour of their animals.

10.2.39 In Section 7.1 of the Sandy Brown response they state *"Based on our experience of the LMB, the specified external facade performance of R_w+C_{tr} 25 dB and a target internal noise level of LAFmax 55 dB from regularly occurring construction activities, this would suggest the external LAFmax must not exceed 80 dB(A)."*

10.2.40 Whilst I am unsure of the basis of the stated internal noise level requirement of 55dB$L_{AFmax,}$ or the stated façade performance, the suggested limit of 80 dBL_{Afmax} would be met for all activities other than a few hours of concrete breaking for the very closest OLE gantry foundations.

10.2.41 It should be noted that the 80dBL_{AFmax} noise limit is regularly significantly exceeded throughout the day by the noise from trains. This suggests that the acoustic performance of the façade is higher than the minimum acoustic design specification. This is typical of buildings with high specification thermal, security and environmental control requirements.

10.2.42 Therefore on the basis that research is currently undertaken without noise impact from the existing noise climate around the LMB, I conclude that there is no reason to believe that construction noise levels associated with the CSIE Project would impact research activities (including effects upon the behaviour of animals) at the LMB.

OBJ09 - 2) Concern that Chapter 5 of the ES predicts significant adverse effect at the façade of the LMB

10.2.43 The MRC SoC states a concern that the ES reports a large to very large adverse and significant effect at the LMB.

10.2.44 The assessment methodology within the ES compares the predicted construction noise level at the façade of the LMB to the pre-existing measured external ambient noise level. This methodology does not assess impact within the LMB, the research within the LMB or effects upon the animals within the LMB. Having reviewed the assessment, in my opinion any significant effects predicted within the ES would be limited to the external area between the LMB façade and the railway.

10.2.45 The likely significant effects may include people within this area (defined in 10.2.44) having to raise their voice to speak to a colleague.

10.2.46 It should be noted that noise levels of 67 dB$L_{Aeq,10hours}$ are significantly below the "lower exposure action value" within the Noise at Work Regulations 2005, of 80 dBA. The 80dBA relates to the noise level 'dose' at which hearing damage starts to occur and we can compare this to the predicted construction noise level. Therefore whilst noise levels in this external area are elevated compared to pre-existing noise levels, they are significantly below the level where hearing damage starts to occur.

Conclusion

10.2.47 It is my conclusion that the significant effects reported in the ES are related to limited external areas of the LMB and that any effects would be limited to the comfort and wellbeing of those present in this area.

10.2.48 All construction effects are temporary and whilst significant noise effects are predicted within Chapter 5 of the ES, based on the evidence provided in this proof, it is my opinion that they will not lead to adverse effects upon the operation of the MRC, the behaviour of the animals housed within the MRC, or the function of sensitive equipment within the MRC.

10.3 **Response to the UoC AMB objection**

OBJ/08 – 3) Lack of consideration of mitigation beyond Best Practicable Means

10.3.1 BPM is defined in the Control of Pollution Act 1974 and agreeing to implement it on the scheme becomes a legal obligation to use the best practicable means available to limit noise. An extensive list of proposed mitigation measures is provided in Chapter 5 of the ES and these are a significant commitment for the project. These should be included in the CoCP B.

10.3.2 It is my firm opinion that appropriate BPM mitigation is proposed to limit construction noise at the façade of the AMB, so that effects to research activities (including effects upon behaviour of animals) are prevented. Therefore there is no reason to consider further mitigation. This is demonstrated in paragraphs 10.3.5 to 10.3.29.

OBJ/08 – 4) blanket inclusion of 5dB for BPM

10.3.3 A list of BPM measures is listed in the ES and this is in addition to the provision of a 2.4m solid site hoarding and localised screening around noisy activities. A final list of BPM measures will be agreed for the final design and these will become project obligations within the Code of Construction Practice Part B ("**CoCP B**"), which is secured by condition.

10.3.4 The proposal to provide localised screening around the noisiest activities, in combination with the proposed site hoarding will itself result in a reduction of 5dB to construction noise levels at the AMB façade. In practice the hoarding, localised screening and BPM measures listed in Chapter 5 of the ES are likely to provide at least 5dB reduction at all times and significantly more than a 5dB reduction to construction noise levels at the AMB façade for the vast majority of the time. As such, I am satisfied that the inclusion of a 5dB reduction for BPM is appropriate, and I have not seen anything from UoC to suggest otherwise.

OBJ/08 – 1) Risk of Effects upon sensitive imaging equipment
OBJ/08 – 2) Risk of effects upon behaviour of their animals
OBJ/08 – 6) Risk of internal criteria being exceeded due to construction noise

10.3.5 No internal noise criteria were provided in the UoC SoC. However it is assumed that these criteria relate to threshold levels where effects upon either imaging equipment or animals start to occur. These three objections are therefore effectively the same, i.e. will the internal noise level criteria for where effects upon the operation of the MRC research start to occur, be exceeded?

10.3.6 I set out below my reasoning as to why the construction of the CSIE Project does not risk causing effects upon the behaviour of the animals nor risk effects upon sensitive imaging equipment at the AMB. I do this by first comparing the construction noise level predicted within the ES ($L_{Aeq,10hours}$) against the acoustic specification of a typical façade and demonstrate that ambient noise levels within the MRC will be below a level where animals would be affected. I then compare the pre-existing measured maximum noise levels (L_{AFmax}) against the predicted maximum construction noise levels and demonstrate that the maximum construction noise levels will be at a lower level and less frequent than the pre-existing maximum noise levels, understood to be from the passing trains.

10.3.7 Where I refer to research activities in this proof, this includes the function of sensitive equipment and the behaviour of animals.

Comparison of ES noise level prediction against sound insulation performance of standard façade construction

10.3.8 The UoC AMB is a sealed building with strictly controlled environmental conditions and strict security requirements. Even a very basic sealed facade construction provides reasonable levels of sound insulation. it is my opinion based upon visual inspection of the AMB façade that it provides at least R_w+C_{tr} 35 dB of sound insulation.

10.3.9 The predicted external construction noise levels from Chapter 5 of the ES of 67 dB $L_{Aeq,10hour}$ are anticipated to reduce to below 35 $dBL_{Aeq,10hour}$ inside the worst affected spaces of the AMB . Noise levels are anticipated to be significantly lower than this in the majority of the building (>98%). These noise levels are significantly below the noise limit of 45 dBA proposed in Appendix 2 to this Proof of Evidence and as such would not be likely to cause effects to the behaviour of animals at the AMB.

10.3.10 I provide additional calculations in the next section, based upon the latest construction information available to me, to check the predicted noise levels of the noisiest construction activities at the closest location to the AMB. This presents a very worst case assessment. I consider that where maximum noise levels (L_{Afmax}) from construction activities do not significantly exceed and are not significantly more frequent than the pre-existing maximum noise levels, understood to be from passing trains, then no significant effects upon research activities are likely to occur. This is because the research activities already take place with these pre-existing noise levels, without adverse effects.

Assessment of maximum noise levels from noisiest construction activities at the AMB façade against pre-existing measured noise levels

Pre-existing measured noise levels

10.3.11 It is reported in the ES that 'maximum' noise levels of 83 dBL_{AFmax} were measured at a location equivalent to the AMB façade with highest levels measured at 88 dBL_{AFmax}.

10.3.12 It is understood that the AMB operates currently without these external noise levels impacting the research carried out within the building. This includes the sensitive imaging equipment and the behaviour of animals housed on the premises.

Predicted Construction noise levels

10.3.13 The highest construction noise levels are typically from percussive activities such as concrete breakers. The site is soft ground. Therefore concrete breaking will be limited to the breaking out of the pile caps. This activity must happen for the construction of the station building and may happen for the construction of the OLE gantries close to the AMB dependent upon the choice of final gantry construction methodology.

10.3.14 The location of the proposed station building and its location in relation to the AMB is shown in Figure 10.1 above. The distance to the closest pile for the station works is shown in Figure 10.7

10.3.15 Calculation inputs for sound power level of 120 L_{wA} has been used for the concrete breaker.

10.3.16 Percussive activities such as concrete breaking create high 'maximum' (L_{AFmax}) noise levels. As the regularity of the impacts increases the difference between the L_{AFmax} levels and the L_{Aeq} levels tends towards zero.

10.3.17 For the purposes of a very worst case assessment, we have added on 10dB to the L_{Aeq} to approximate the L_{AFmax} level from the concrete breaker.

10.3.18 The calc assumes a 2.4m high solid hoarding around the site boundary, and localised screening around noisy activities such as breakers.

10.3.19 For the purpose of clarity, localised screening refers to composite mass barrier acoustic screens, such as Echo Barrier (Figure 10.6), on Heras type fencing close to the noise source, positioned between the noise source and the AMB. This is in addition to the 2.4m high solid site hoarding. It is recognised that the 2.4m solid site hoarding would only provide mitigation to the lower floors of the AMB.

Figure 10.6 – Example of localised screening

Station Works

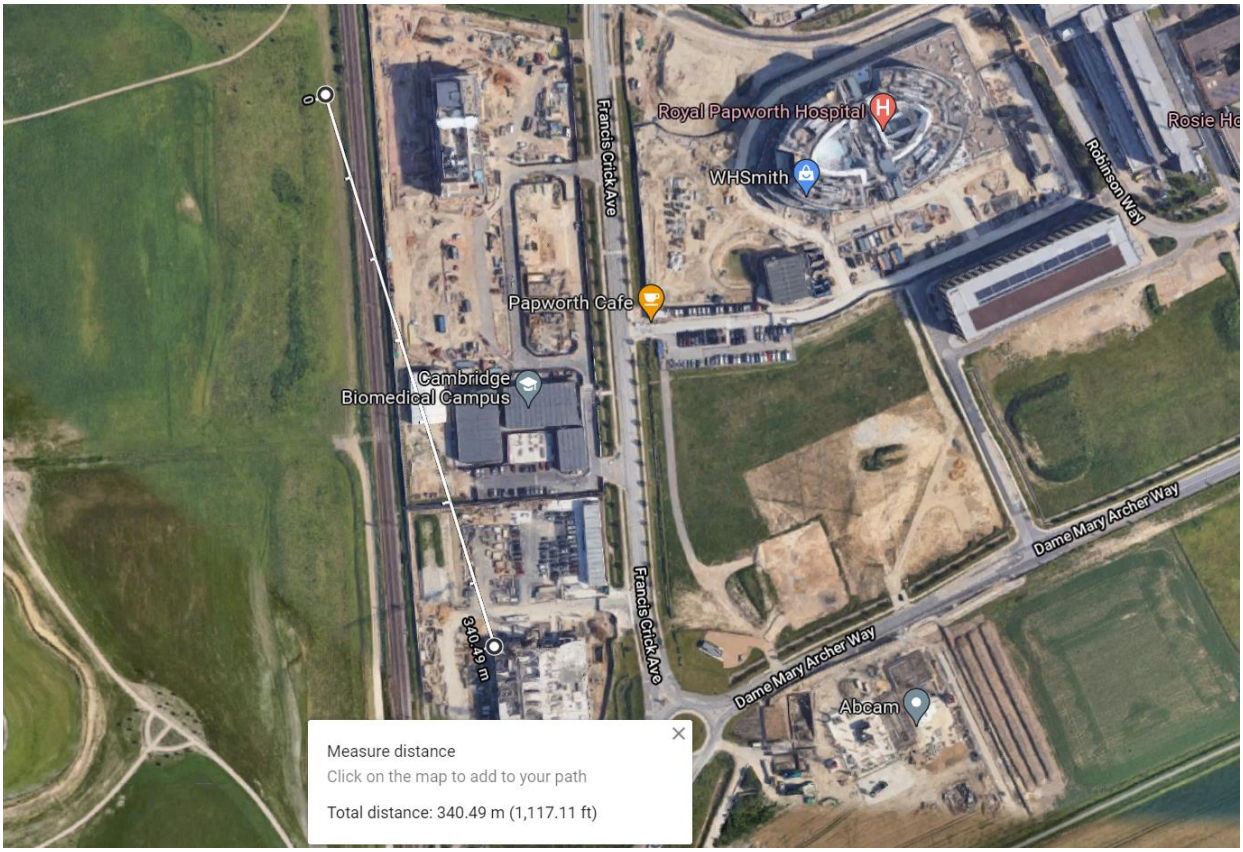


Figure 10.7 – Station area in relation to the AMB – Closest pile ~340m

Table 10.3 – Predicted noise levels at AMB façade from Concrete breaking for Station works

Table 10.3a - Predicted L_{AFmax} noise levels from Concrete breaking for Station	
Concrete Breaker Sound Power level	120 L_{wA}
Convert to pressure at 10m	-28
Approximate Maximum level	+10
Distance correction (20log(10/90m))	-31
Screening from site hoarding / localised screening	-10
Total (L_{AFmax})	61

Table 10.3b - Predicted $L_{Aeq,10hour}$ noise levels from Concrete breaking for Station	
Concrete Breaker Sound Power level	120 L_{wA}
On time 10%	-10
Convert to pressure at 10m	-28
Distance correction (20log(10/90m))	-19
Screening from site hoarding / localised screening	-10
Total ($L_{Aeq,10hour}$)	53

Noise from other construction activities – OLE gantry foundations.

10.3.20 Some construction activities will occur closer to the façade of the AMB than the station works, for example the activities associated with the erection of the gantries for the overhead line equipment (OLE).

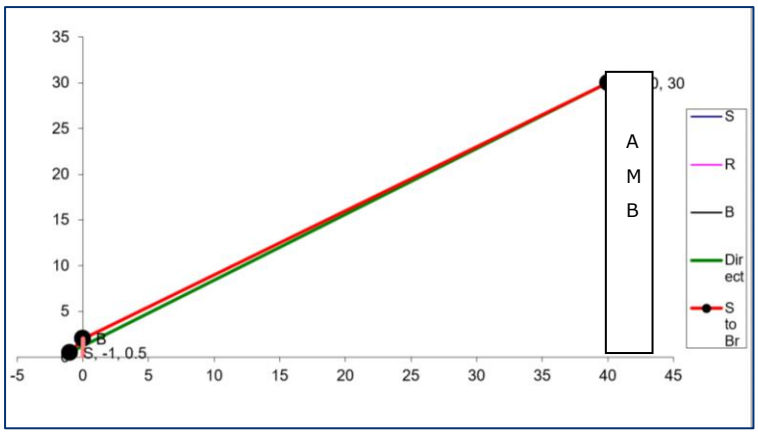
10.3.21 As noted previously, a number of possible options are being considered for the gantry foundations, including screw piles, CFA piles and concrete block foundations. Each of these proposed techniques produces different noise levels and results in different durations of work.

10.3.22 For the purpose of assessment a minimum distance from construction activity to AMB façade of 40m is assumed. A 2.4m site hoarding and localised screening is assumed to cut, or partially cut, line of sight to windows, dependent upon precise construction activity locations.

Figure 10.8 – Indication of track works location in respect to AMB

10.3.23 The following calculations (Table 10.4a / 10.4b) are based on using the highest L_{AFmax} reported in the Defra/BS5228 construction noise data (para. 10.2.36 to 10.2.38) and represents non percussive works, e.g. screw piling and / or concrete block foundations. A sound power level for concrete breakers of 120 L_{wA} have been used from the calculations in Chapter 5 of the ES.

10.3.24 The noisiest part of concrete breaking is the impact with the concrete itself. This typically happens at low level, i.e. 0.5m from ground level or lower.



Source height (breaking)	0.5m
Receiver Height (AMB upper floor)	30m
Distance source to barrier	1m
Distance barrier to receiver	40m
Barrier height	2m
Delta	0.119

Figure 10.9 – Geometry of screening to upper window of AMB from gantry foundations

10.3.25 A 2m high screen placed 1m from breaking activities taking place 0.5m from ground level will cut line of site to the upper windows (height 30m) of the AMB at a distance of 45m (Figure 10.9). This is demonstrated by putting the input parameters shown in Figure 10.9 into a Maekawa barrier calculation. The resultant 'positive' delta (δ) of 0.119 demonstrates the barrier 'cuts line of sight'. Therefore a 10dB reduction for screening is included for cutting line of sight, as per the BS5228 method.

Table 10.4 – Predicted noise levels at AMB façade from close Gantry works options

Table 10.4a - Predicted L_{AFmax} noise levels from non-percussive construction activities – OLE (including screw piling / concrete block foundations / rollers)

Noise level at 10m (BS5288 C.6.13)	92 L_{AFmax}
Distance correction (20log(10/40m))	-13
Screening from site hoarding and localised barriers	-10
Total (L_{AFmax})	69

Table 10.4b - Predicted L_{AFmax} noise levels from breaking out CFA pile caps – OLE - GF	
Concrete Breaker Sound Power level	120 L_{wA}
Convert to pressure at 10m	-28
Approximate Maximum level	+10
Distance correction (20log(10/40m))	-12
Screening from site / localised hoarding	-10
Total (L_{AFmax})	80

10.3.26 The highest noise levels associated with CFA piling are from the breaking out of pile caps. Cleaning of the auger also has the potential to create high noise levels, however this can be mitigated by using an auger cleaning attachment, rather than simply shaking the auger to clean it.

10.3.27 It is understood that each OLE gantry foundation would require 2 CFA piles. Each CFA pile would take 1 to 2 hours to drill and another 1 to 2 hours to break out. Therefore these worst case noise levels of 80dBL_{AFmax} are only predicted for short periods of a time (up to 4 hours per foundation) for the two closest foundations at the worst affected windows facing directly towards the railway.

10.3.28 At all other times during the construction program, that is >99% of the construction period, noise levels would be lower than 80dBL_{AFmax}.

Conclusion UoC AMB objection

10.3.29 On the basis that the UoC AMB can conduct research activities with regular external maximum noise levels up to 83dBL_{AFmax} and occasional maximum noise levels up to 88 dBL_{AFmax}, I conclude that there is no reason to believe that construction noise levels of 67 dBL_{Aeq} and occasionally up to 80 dBL_{AFmax} from the construction of the CSIE Project would impact research activities within the AMB.

OBJ/08 – 5) Concern that construction level may be 77dBA at the façade

10.3.30 Paragraph 6.7 of the UoC SoC states a concern that noise levels at upper floors of the AMB may be up to 77 dB rather than 72dB as they would not benefit from a 5dB reduction due to screening from the site hoarding. This is a misunderstanding of the prediction methodology.

10.3.31 Noise levels from construction activities associated with the CSIE Project are predicted within the CSIE ES chapter 5 to be up to 72 dB with no mitigation at all. This is predicted to reduce to 67 dB $L_{Aeq,10hours}$ at the façade of the AMB following Best Practicable Means (BPM), plus the inclusion of solid 2.4m site hoarding and localised screening of particularly noisy activities such as cutting, breaking of concrete and piling rigs.

10.4 **Response to Cam PFF**

10.4.1 **As noted previously,** the Cam PFF objection is speculative in terms of noise and does not include any specifics as to how noise may impact Hobsons Park.

10.4.2 The existing railway line has been present for well over 100 years and is already a source of noise at Hobson's Park.

10.4.3 Operational Noise levels at Hobsons Park are predicted within Chapter 5, Table 5-18, of the ES to increase by just 0.4 dB due to the operation of the proposed Station. This is a neutral effect and not significant.

10.5 **Response to Cambridge City Council (CCiC)**

10.5.1 CCiC confirm that the methodologies used for the operational noise assessments within Chapter 5 of the ES are acceptable. CCiC confirm that they concur with the findings.

10.5.2 CCiC SoC para 69 proposes the CCiC standard plant noise egress planning condition, *"the application requires assessment to ensure local amenity is protected. It is required that the rating level (in accordance with BS4142:2014) from all plant, equipment and vents etc (collectively) associated with this application should be less than or equal to the existing background sound level (LA90) at the boundary of the premises subject to this application and having regard to noise sensitive premises."* CCiC also propose the following condition, *"No operational plant, machinery or equipment both internal and external shall be installed until a noise assessment and any noise insulation / mitigation scheme as required to mitigate and reduce to a minimum potential adverse impacts has been submitted to and approved in writing by the local planning authority. The scheme shall be carried out as approved and retained a such".* I consider this proposed planning condition as reasonable and acceptable and it is accepted by Network Rail.

10.5.3 CCiC also propose a planning condition related to the PAVA, *"No station and platform public address / announcement sound system shall be installed until a detailed design / setup of and a scheme for the mitigation of noise to reduce to a minimum any adverse noise impacts from the said systems has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include details regarding hours of operation, design to include number, location and sound power of loudspeakers and permissible noise levels with consideration of noise mitigation / limiting measures as appropriate and a programme of maintenance. Any public address / announcement or voice alarm sound system associated with the approved development / use shall only be used for operational, health and safety, security and emergency announcements. The scheme shall be carried out as approved and retained a such."* I consider this planning condition to be reasonable and acceptable and it is accepted by Network Rail.

10.5.4 CCiC SoC para 71 states regarding construction noise, *"Site specific mitigation and attenuation measures will need to be employed at locations where works will occur that have the potential to (or are predicted to) adversely impact residential premises i.e. residential properties in the Hills Road. We will expect these measures to be included in the CoCP."* I consider this to be reasonable and acceptable and it is accepted by Network Rail.

10.5.5 It is confirmed that no impact piling is proposed for the construction of the CSIE Project (CCiC SoC para 72).

10.5.6 CCiC confirm the methodologies used to predict construction traffic noise within Chapter 5 of the ES as acceptable.

10.5.7 CCiC state, *"Part A of the CoCP has been submitted with the application. It contains details of embedded noise and vibration mitigation measures (including Best Practicable Means (BPM)) that will be utilised generally to reduce noise from the construction activities. Part B will be provided prior to commencement (in accordance with the draft CoCP condition) and will provide additional mitigation measures to reduce noise and vibration at surrounding sensitive receptors. The embedded measures are included in Section 5.5 of the ES."* I consider this to be reasonable and acceptable and it is accepted by Network Rail.

10.6 **Response to South Cambridgeshire District Council (SCDC)**

10.6.1 SCDC SoC para 23 acknowledges that moderate to major significant impacts during works at Shepreth Branch Junction are expected due to the specific health and safety reasons associated with the work. SCDC require, "…*site specific mitigation and attenuation measures will need to be employed at locations where works will occur that have the potential to adversely impact residential areas of Great Shelford. These measures must be included in the Code of Construction Practice."* I consider this to be reasonable and acceptable.

10.6.2 SCDC state in para 31.5 *"Site-specific noise mitigation and attenuation measures must be included in the Code of Construction Practice for locations where works will occur that have the potential to adversely impact residential areas of Great Shelford, in accordance with Local Plan 2018 policies HQ/1 and SC/10."* I consider this to be reasonable and acceptable.

11. Conclusion and Declaration

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

11.2 As Acoustic expert, I believe the acoustic design work undertaken for the proposed scheme has been undertaken in liaison with the engineering and other environmental specialists in the team, to minimise impacts of the Scheme and to optimise the effectiveness of proposed mitigation.

11.3 In my opinion the Noise Assessment has been carried out and published in accordance with legislation and professional guidance.

11.4 In my opinion there will be no impacts on animals used for research in the MRC LMB or UoC AMB, nor to sensitive imaging equipment, from noise associated with the construction of the CSIE Project and construction of the Project can proceed without having an adverse effect on research operations within the MEC LMB and UoC AMB through noise impact

11.5 I believe the facts I have stated in this proof of evidence are true and that the opinions expressed are correct.

11.6 I understand my duty to the Inquiry to assist it with matters within my expertise and believe that I have complied with that duty.