Report prepared for:

[redacted]

Acoustic Impact Assessment

Land off High Street, Hauxton, Cambridgeshire. CB22 5HW

14.10.19

Report Reference: 152/Hauxton

Contents

1 Introduction

A site off High Street Hauxton has been identified by the client as potential development land for inclusion in the Strategic Housing Land Availability Assessment (SHLAA) for the South Cambridgeshire District Council (SCDC) Local Plan.

As part of the justification for the inclusion, the site constraints for development have identified the potential impacts of noise from the adjacent M11 motorway, and the adjacent railway.

This report has been prepared as a screening assessment identifying the acoustic impacts on the site and provides recommendations that will support the proposed inclusion of the site within the SHLAA.

The screening assessment is based on sound levels measured on site using methodology consistent with the Calculation for Road Traffic Noise, supplemented by the Calculation for Rail Noise. The results are then compared to British Standards and World Health Organisation Guideline values.

1.1 Statement of qualifications

Tony Higgins has over 25 years of regulatory and consultancy experience dealing with noise and nuisance issues and holds a Post Graduate Diploma in Acoustics and Noise Control. He is a Member of the Institute of Acoustics and also an elected member of the IOA Measurement & Instrumentation Group. He has spoken at (and organised) many IOA training events considering the implementation of BS4142:2014 and the use of noise measurements in both planning and licensing appeals. Tony managed the Public Protection service at Telford and Wrekin Council, including the Licensing Service, noise and statutory nuisance service and the consultation responses to the planning service.

Tony has also prepared and delivered training materials on noise and planning for the EMAQ training package used by over 250 local authorities and advises local authorities on the implementation of noise and planning matters. Tony has significant experience carrying out and evaluating data in determination of acoustic impact for complaints, licensing and planning work, and in formal and informal hearings as well as court.

1.2 Site Description

The proposed site is situated to the east of the village of Hauxton in Cambridgeshire.

The site is currently farmland and is located to the south of Hauxton High Street, to the east of Hauxton village and to the west of the M11 motorway. The southern boundary of the site is noted to be a rail line.

The site is relatively flat with little variation in height, though there is a gentle slope down to the motorway. The motorway is on an elevated embankment approximately 10m above the site, and it is screened from the proposal site with well-established trees. Bridges under the motorway serving the main road and the rail line flank the north and south of the proposed site.

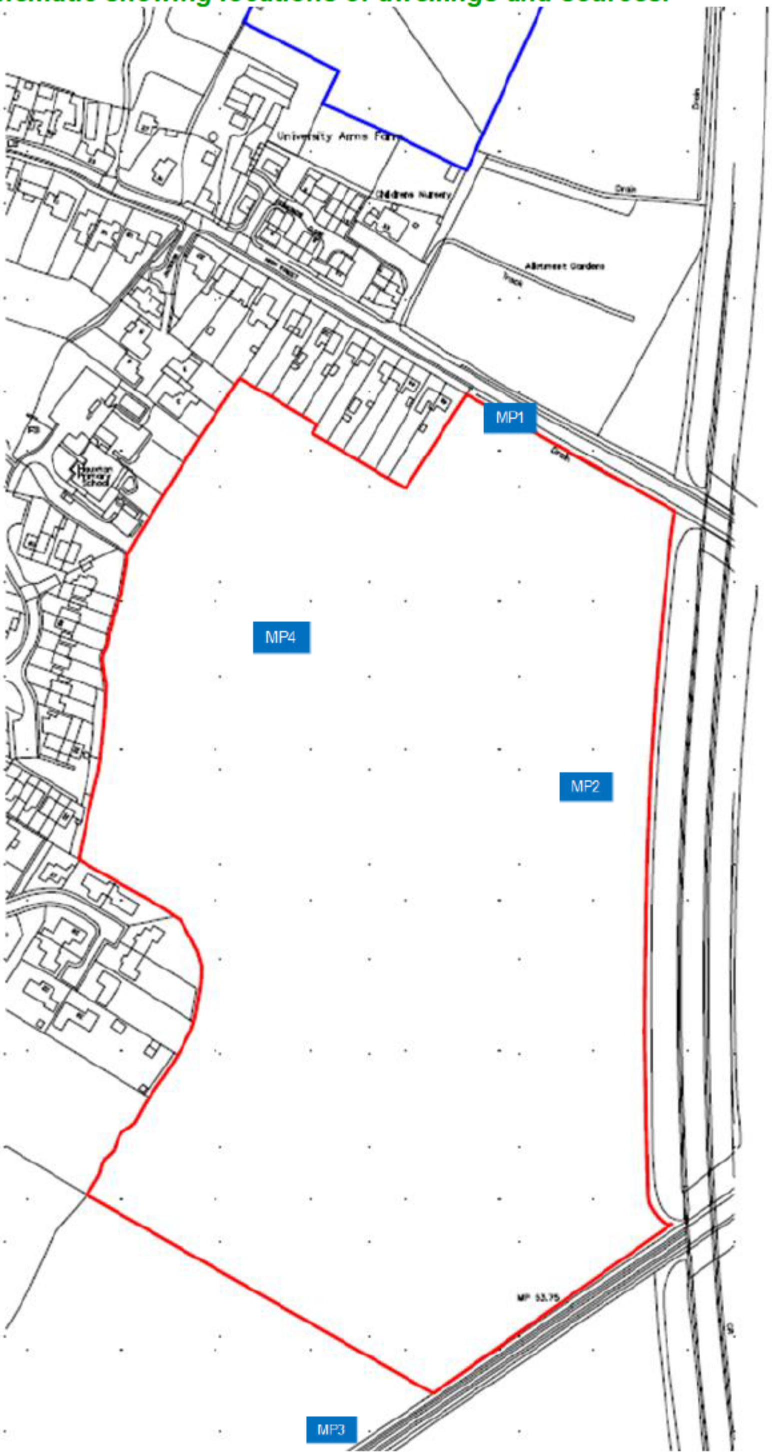
The dominant sounds noted on the proposal site are:

- Continuous road noise from the motorway
- Periodic Road noise from the High Street Hauxton
- Birdsong

The proposals for the site are for residential led development.

Fig.1 below shows the extent of the site and identifies the sound level monitoring positions adopted on site.

Fig.1. Schematic showing locations of dwellings and sources.



Site
Measurement positions

2 Legislation and Guidance

2.1 Guidance

2.1.1 National Planning Policy Framework (NPPF)

The National Planning Policy Framework sets out Governmental planning policies for England and how these are expected to be applied. It provides a framework within which local people can influence planning policy using distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities. The NPPF requires that Local Planning Authorities develop their own specific planning policies, however, all local plans are required to have regard to the principle enshrined in the NPPF and in particular sustainable development.

Paragraph 170 outlines general requirements in terms of noise:

170. Planning policies and decisions should contribute to and enhance the natural and local environment by: ….

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and…"

Paragraph 180 provides additional detail:

180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[60];
b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

60. See Explanatory Note to the Noise Policy Statement for England (Department for Environment, Food & Rural Affairs, 2010).

The NPPF 2019 replaces previous national planning policy and guidance issued in 2012 and removes the old specific policy paragraph 123 which is referenced in the South Cambridgeshire Local Plan, but is very similar to the paragraph 123 requirements.

The NPPF makes specific reference to the Noise Policy Statement for England (*NPSE*). The NPSE vision is to 'Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development' and this is normally achieved mainly through application of good strategic planning policy.

The NPSE refers to the World Health Organisation (WHO) guidance and deals with noise in the context of health. Health is defined as 'physical and mental well-being' and is quoted in terms of standards with 'observed' health impacts. Additionally, quality of life is also mentioned which is a subjective measure and can be considered to promote of amenity standards and in all cases, equate to prevention of nuisance. The NPSE makes reference is made to two concepts documented by the WHO, namely:

- No Observed Effect Level (*NOEL*): the level below which no effect can be detected
- Lowest Observed Adverse Effect Level (*LOAEL*): the level above which adverse effects on health and quality of life can be detected.

And (by extrapolation from WHO criteria), a further level;

- Significant Observed Adverse Effect Level (*SOAEL*): the level above which significant adverse effects on health and quality of life occur.

There is no specific definition of how these levels are to be calculated, however it is noted that methodologies comparing measured or predicted results for existing ambient levels to WHO derived standards is considered an appropriate material impact.

The determination as to how these impacts are to be demonstrated will depend on the nature of the noise, acoustic properties of the noise, and the site-specific circumstance of design and construction of development locations in which the noise is present. In most cases the local council within whose area the application site exists will provide additional guidance on what is required to determine impact in accordance with local policy that will, by definition, have regard to local conditions and circumstances.

2.1.2 Local Planning Policy

The South Cambridgeshire Local Plan 2018 has adopted a general policy (reproduced below).

Policy SC/10: Noise Pollution

1. *Planning permission will not be granted for development which:*
    a. *Has an unacceptable adverse impact on the indoor and outdoor acoustic environment of existing or planned development;*
    b. *Has an unacceptable adverse impact on countryside areas of tranquillity which are important for wildlife and countryside recreation;*
    c. *Would be subject to unacceptable noise levels from existing noise sources, both ambient levels and having regard to noise characteristics such as impulses whether irregular or tonal.*
2. *Conditions may be attached to any planning permission to ensure adequate attenuation of noise emissions or to control the noise at source. Consideration will be given to the increase in road traffic that may arise due to development and conditions or Section 106 agreements may be used to minimise such noise.*
3. *Where a planning application for residential development is near an existing noise source, the applicant will be required to demonstrate that the proposal would not be subject to an unacceptable noise levels both internally and externally.*
4. *The Council will seek to ensure that noise from proposed commercial, industrial, recreational or transport use does not cause any significant increase in the background noise level at nearby existing noise sensitive premises which includes dwellings, hospitals, residential institutions, nursing homes, hotels, guesthouses, and schools and other educational establishments. [author's emphasis]*

The above policy provides useful clarification and advice on the level of impact considered acceptable by SCDC. In simple terms the policy advises that development can be approved where it is not subject to unacceptable noise impacts (see table 2.2 noise impacts below). Adverse noise impacts affecting residential development should be mitigated or controlled so that the impact is reduced both internally and externally, other adverse or significant adverse impacts should be reduced to a minimum. Advice on assessment of noise impact is provided in the online Planning Policy Guidance (see 2.2 below)

2.2 Noise Impact

The standards required to be met depend on the nature of the sound and the acoustic environment within which the sound is perceived. The Planning Policy Guidance (online) recommends an approach on determining the impact of sounds as follows:

*"**How to determine the noise impact?***

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation. As noise is a complex technical issue, it may be appropriate to seek experienced specialist assistance when applying this policy."

The NPPG also stipulates the appropriate actions in accordance with the likely response to noise exposure:

Table 2.2 – Noise impacts

Perception	Examples of Outcomes	Increasing effect level	Action
Not Noticeable	No effect	No observed Effect	No specific measures
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No observed Adverse effect	No specific measures
		Lowest Observed Adverse Effect Level	
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Source: http://planningguidance.planningportal.gov.uk/blog/guidance/noise/noise-guidance/

Noise impact and the level of effect is normally determined by compliance with appropriate standards.

2.2.1 Professional Practice Guidance (ProPG)

Professional Practice Guidance on Planning & Noise (ProPG) was issued in 2017 by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH). It seeks to secure good acoustic design for new residential development within England's planning system, and helps provide both a screening assessment for determining the impact of noise and sites, and a methodology for achieving good acoustic performance for new sites. It does not constitute official government guidance but seeks to assist Local Planning Authorities with a methodology for securing good acoustic design and performance for new residential development.

The scope of the guidance is restricted to sites that are exposed predominantly to noise from transportation sources. Where industrial or commercial noise is present on the application site that is *not dominant*, this incidental contribution may be included in the ProPG assessed noise level used to establish the degree of risk. More significant industrial or commercial noise should not use the ProPG the risk assessment and should instead utilise the methodology and guidance in BS4142:2014.

ProPG requires that the preparation of an Acoustic Design Statement (ADS), which is expected to be more detailed than for a site assessed as high risk than for one identified as low risk.

The level of risk is dependent on the projected long term LAEQ average levels for a site as identified in the adjacent inset panel.

ProPG advises that a 2-stage approach should be undertaken with an initial screening assessment (Stage 1) identifying potential concerns and a more detailed (Stage 2) assessment which is a systematic consideration of four key elements. These are:

1. Demonstrating a *Good Acoustic Design Process*;
2. Observing internal *Noise Level Guidelines*
3. Undertaking an *External Amenity Area Noise Assessment*; and
4. Consideration of “Other Relevant Issues”.

This should then mitigate noise impact.

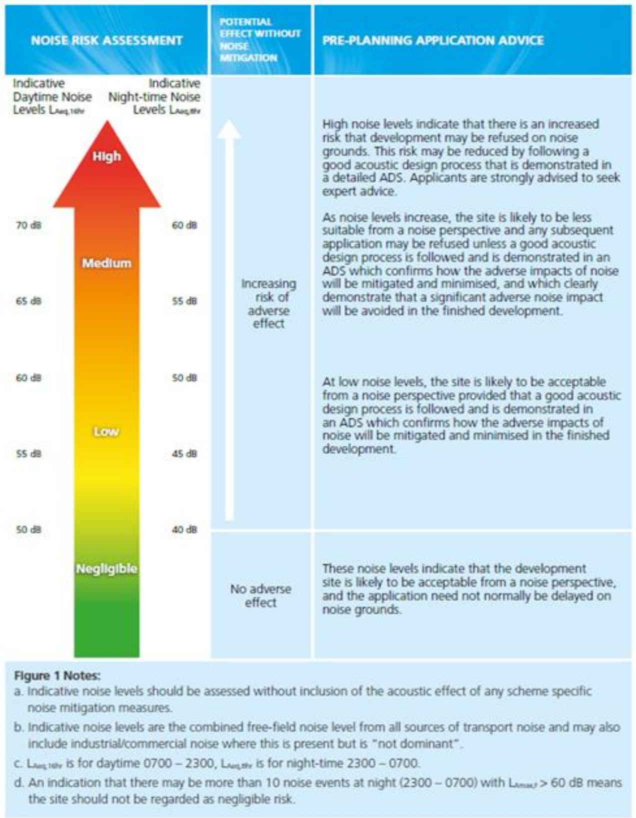


Figure 1. Stage 1– Initial Site Noise Risk Assessment

This document is a suitable stage 1 screening assessment and refers to several appropriate standards to be used in determining impacts.

2.3 Standards

Standards for determination of impact are normally based on absolute fixed levels or derived values based on comparisons. They are normally divided into standards set externally to sensitive developments or internally for particular rooms/activities.

The particular standard(s) to be applied depends on the character of the noise to be assessed, the sensitives of the receptors and the intended use/design of the development.

2.3.1 External Standards

In order to determine the appropriate level of impact, the most appropriate metric for determination of that impact is required.

BS8233:2014 Guidance on sound insulation and noise reduction for buildings, also provides guidance on external noise levels, in particular for amenity areas such as gardens. External noise levels for most development in rural areas are suggested to not exceed 50dB LAeq,T, and noisier urban environments should not exceed the guideline value of 55 dB LAeq,T.

The **World Health Organisation (WHO)** Guidelines on Community Noise is a document which specifies a number of absolute sound levels which seek to prevent health impacts, including the avoidance of noise and disturbance. The key external noise level standards quoted in the document are:

Specific environment	Critical health effect(s)	LAeq [dB]	Time base [hours]	LAmax, fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

2.3.2 The Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996

The existing properties within are England and Wales legislation that applies to works on new, altered or additional railway systems. The regulations set the daytime criterion for noise insulation of residential buildings at: greater than or equal to the relevant noise level.

Regulation 9 requires that the 'relevant noise level' be calculated in accordance the Calculation of Railway Noise (1995) (CRN 1995). CRN 1995 provides a method for estimating long term LAEQ levels associated with train noise over 18hours for daytime and 6hours for night time.

In this case, train noise has been measured over a 3-hour period and the maximum recorded 1hour LAEQ used as an estimate of the relevant noise level. The measured levels for train noise are shown in Appendix 1 Monitoring Point 4. The maximum measured level was noted to 66.2dB LAEQ. This maximum measured level has been used as a screening level for train noise.

2.3.3 Internal Standards

In addition to the above values, BS8233:2014 gives guidance for noise levels *inside* habitable rooms based on their sensitivity. Table 1 Indoor ambient noise levels for dwellings lists the acceptable sound levels inside properties:

Activity	Location	07:00 to 23:00 hours	23:00 to 07:00
Resting	Living Room	35 dBA $L_{Aeq,16hour}$	
Dining Room	Dining Room/Area	40 dBA $L_{Aeq,16hour}$	
Sleeping (daytime resting)	Bedroom	35 dBA $L_{Aeq,16hour}$	30 dBA LAeq,8hour

BS8233:2014 offers additional guidance in the form of notes appended to the above table. In particular:

> *NOTE 5: If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.*
> *NOTE 7: Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.*

The standard for long term LAEQ is consistent with the WHO guidelines on Community Noise standards However, WHO also recommends an LAMax standard to account for impulsive noise as shown below:

Specific environment	Critical health effect(s)	LAeq [dB]	Time base [hours]	LAmax, fast [dB]
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	45
Inside bedrooms	Sleep disturbance, night-time	30	8	

These external and internal standards are directly relevant to the proposed site.

3 Assessment Strategy

3.1 Methodology

Attended surveys have been undertaken at locations identified in paragraph 1.2 above. These locations are determined to be suitable for use in acoustic assessments and provide spatial coverage of the site, as well as background data for likely locations of sensitive receptors. No indicative plan has been provided.

Measurements taken characterise typical background and residual sound levels that are subsequently used as a baseline for determination of impacts.

Impact assessments are based on either measurements taken of specific sound sources or levels calculated based on source data obtained using road traffic noise CRTN methodology (shortened method).

Calculations are then used based on the TRL document to convert this data to $LAFEQ_{,16hour}$, and $LAFEQ_{,8hour}$ respectively (see Appendix 1 for more details). This data is then compared to the ProPG criteria and to other standards as necessary.

A real time comparison of incident sound levels caused by passing trains has been provided. This identifies the impact of train noise on the proposed site, the impact of trains has been assessed using a CRN methodology. The actual measured levels $LAFEQ_{,1hour}$ for daytime trains have been assumed to represent the worst case, and have been used as a screening comparison as the relevant level for train noise.

LAFMax has been assessed for all locations and provides an indication of compliance with WHO guideline levels.

3.2 Limitations & Uncertainty

The baseline noise level surveys used equipment and methods that generally would be expected to give results accurate to within ±1 dBA. The inherent uncertainty in measurement was minimised by ensuring measurements carried out complied with appropriate standards notable BS7445:2003.

The monitoring carried out was noted to reflect the residual and background levels and are considered typical for the area.

Other sources of potential uncertainty were minimised by ensuring:

- Weather conditions were recorded as dry with maximum wind speeds of approximately 3m/s during the monitoring period
- The ambient temperature during measurements was above 13ºC.
- Measurement locations were located 1.5m above ground level and more than 3.5m away from reflective surfaces (see Fig.1 above and photographs in Appendix 3)
- Survey periods were carried out in accordance with approved standards and sufficiently characterise the sounds assessed.

3.3 Measurement equipment and conditions

Noise measurements were taken with two Cirrus 171B Class 1 integrating sound level meters located at measurement point A, B and C as noted in 3.4 below):

- G079497
- G300930

The meters were field calibrated prior to measurements with Cirrus CR515 calibrators ref: 75350 and 89208 respectively. Meter compliance checked after measurements, no significant drift was noted.

Copies of calibration certificates can be seen in Appendix 2 of this report.

3.4 Measurement location and times

Measurements were made at two locations as indicated on Fig 1. Above, as follows:

- **Monitoring Position 1**: Located adjacent to the road sign entering Hauxton 10m from the road edge 1.5m above ground level.
- **Monitoring Position 2**: Located approximately 30m from the fence line (50m from the Motorway) and 120m from the High Street.
- **Monitoring Position 3**: Located approximately 290m from the M11 motorway and 10m from rail tracks and directly adjacent to two white signal boxes
- **Monitoring Position 4**: Located approximately 160m from the High Street, 210m from the M11 motorway and 120m from the rear façade of Hauxton Primary School.

Note: Measurement Position 3 was selected to be distant enough from the motorway so that rail noise was clearly dominant, but road noise did not affect those measurements. The LAEQ levels reported are heavily affected by short duration train noise as seen in the graph presented in Appendix 1 Monitoring position 3. Train noise represents less than 2% of the total noise measured within that period, as such the LAEQ is noted to be significantly elevated compared to the LA10. Derived LAEQ levels from the LA10 measurements better reflect the ambient noise level of the area for road traffic influences (which were observed to be audible, but much reduced at this location) than the actual LAEQ measured levels for road noise.

Measurements and observations were taken on:

Date	Conditions
8 October 2019 9am – 3pm	Cloudy 3/8 cloud cover, cool, dry, 14ºC, SW wind 1m/s then slight increase in wind to 3m/s and overcast until 1pm, then slight rain shower, followed by sunny periods and 6/8 cloud cover

4 Results

A summary of the results for monitoring points 1 – 4 are shown in the table below, the full data set and associated calculations are shown in Appendix 1. The presented data has been converted using the CRTN 1998 methodology as discussed above from measured LA10 levels to noise indicator suitable for comparison with WHO and BS8233:2014 standards. A short paragraph of observations at each location is also provided below.

Monitoring Point	Calculated daytime LAEQ	Calculated Night-time LAEQ
1	61.9 dB	59.1 dB
2	60.5 dB	57.9 dB
3	53.8 dB*	52.2 dB*
4	53.6 dB	51.7 dB

*denotes calculated values from offsite measurements.

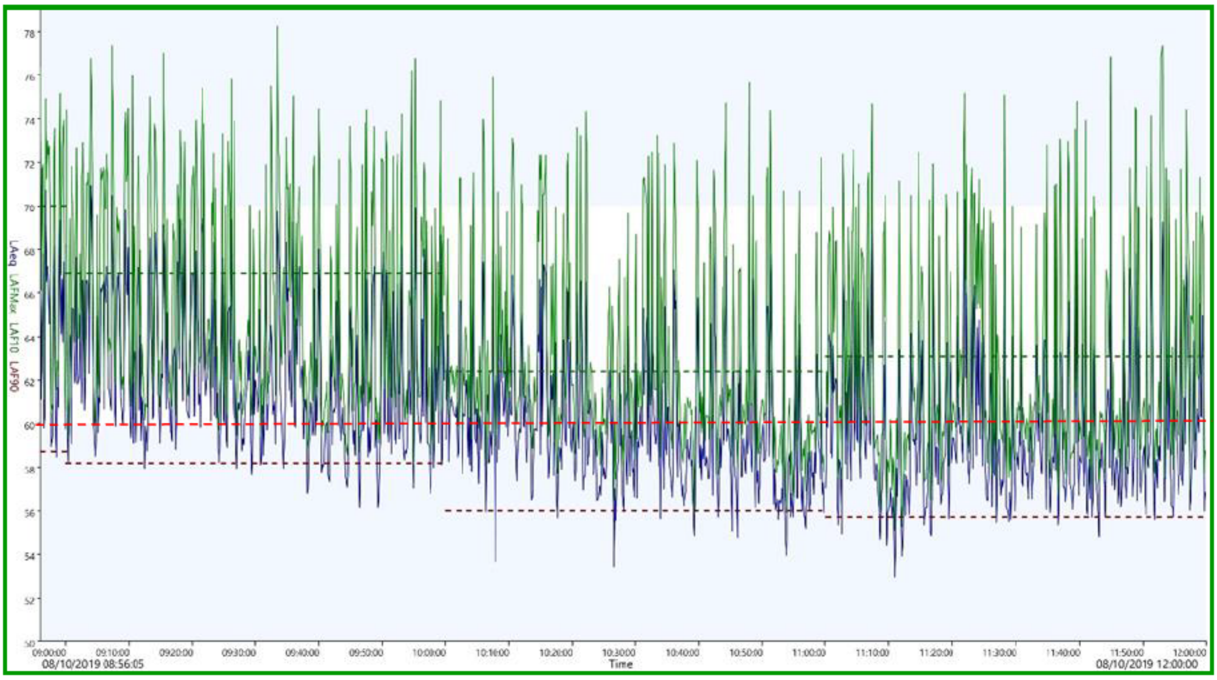
The 'Relevant level' for Rail Noise as defined in the Noise Insulation (Railways and Other Guided Transport Systems) Regulations 1996 is estimated to be 66.2dB (assuming a location 10m from the track edge)

Monitoring Point 1

Observations made from this location noted that road traffic from the motorway was the dominant source resulting in a constant drone punctuated by occasional clanks of HGV's and/or revving of high-power engines. Local road traffic passing the monitoring point was infrequent by resulted in high numbers of LAMax events.

The red dotted line on the graph below indicates the WHO LAMax guideline level. As noted below, local road traffic provides a significant contribution and may be absent after 11pm at night, but distant motorway noise also created significant LAMax events.

The graph below shows the principle measurement parameters and clearly shows the high levels of LAMax events noted most associated with vehicles passing along the High Street.



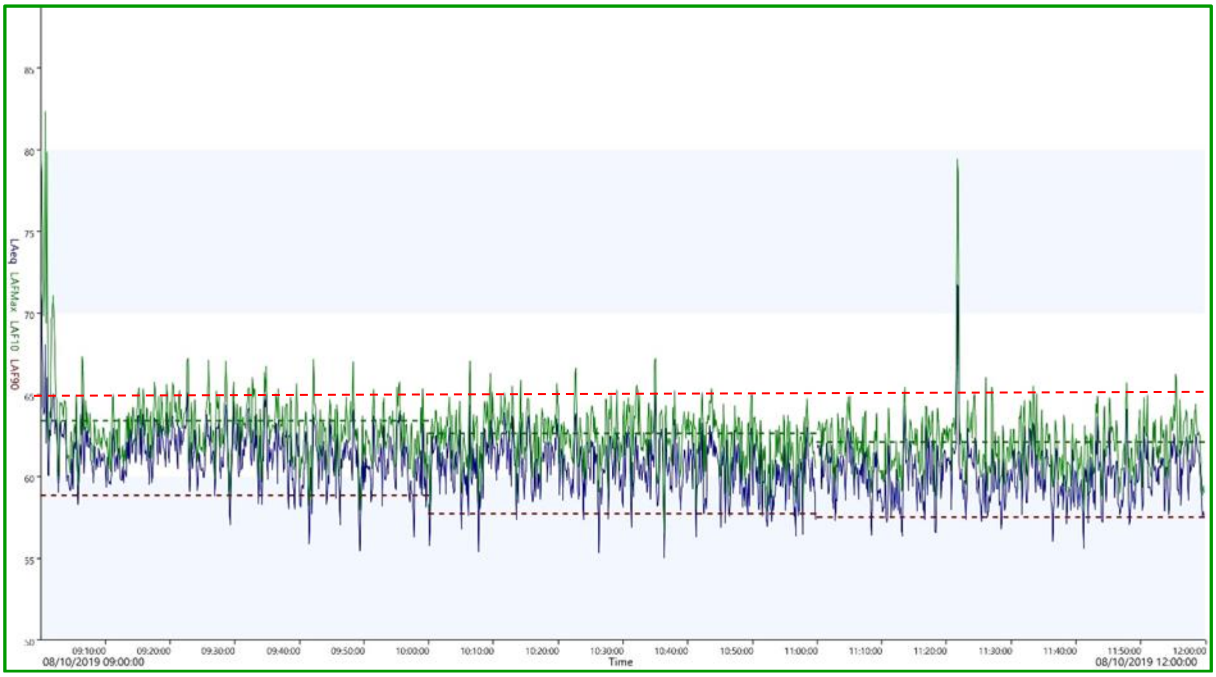
Monitoring Point 2

Observations made from this location noted that the constant drone of motorway noise was clearly evident but there was some masking effect due to the level differences between the motorway and the road which reduced or negated some of the LAMax events that were clearly audible at Monitoring point 1.

The red dotted line on the graph below indicates the WHO LAMax guideline level. This location is affected by short duration events at night as the level of impact during the day shows exceedances of the 60dB standard, however, the results are very constant and the prominence of the events is not significant.

The graph below shows the principle measurement parameters and that levels of ambient noise and LAMax events are very similar, indicating that LAMax events were not prominent at this location. This lack of prominence matches observations made.

It is unlikely that any significant mitigation measures would be required at this location other than appropriate design and glazing options.

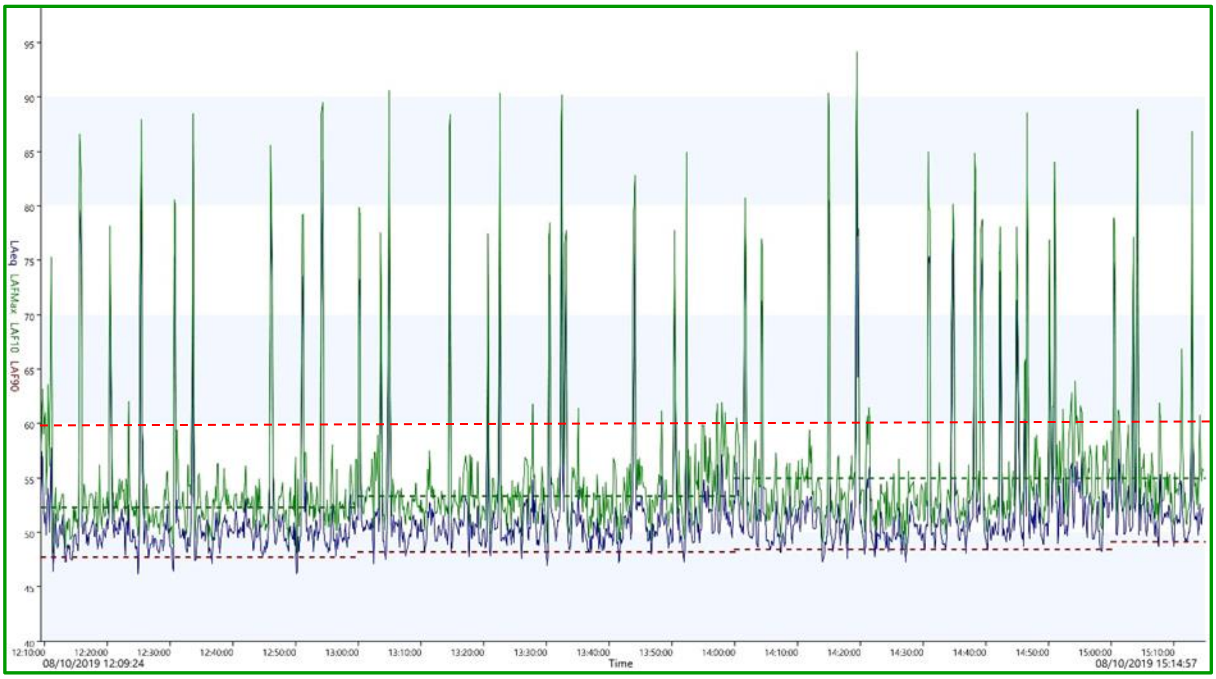


Monitoring Point 3

Observations made from this location were made noting that the drone of motorway road traffic was significantly reduced. This enabled measurement of rail noise to be taken without materially affecting those results. The noise from road traffic was a muted hum at this location. Train noise, when it occurred was dominant throughout the period of the train passing. Train noise generated a number of high LAMax events that were clearly audible at Monitoring point 3 and at other points around the site and consists of clanks, rattles, metal on metal impacts, and the use of a train horn on one occasion.

The red dotted line on the graph below indicates the WHO LAMax guideline level. The most significant feature is the passing rail traffic which provides a significant contribution 34 rail events were noted within the 3-hour measurement window. Review of the rail schedules indicates in excess of 170 trains throughout the day.

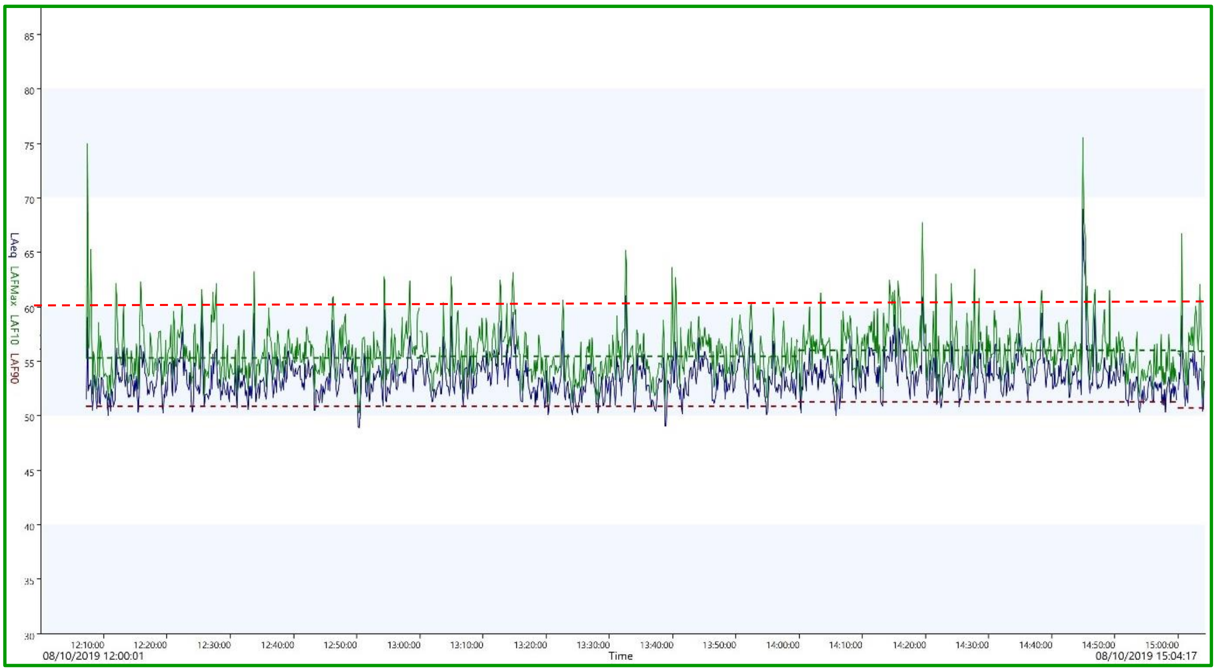
The graph below shows the principle measurement parameters and that levels of ambient noise and LAMax events, each LAMax event is a train passing. Trains at night 0.00hrs to 06.00hrs are clearly capable of producing very significant LAMax events and some form of mitigation would be required.



Monitoring Point 4

Observations made from this location noted a significantly lower perceived noise level of motorway road traffic. Individual road traffic events from the motorway and the High Street were not significant during the day but might become more prominent at night, equally, whilst train noise was not noticeable at this location during the day, this may also be more prominent at night. Whilst no noise was noted from the adjacent Hauxton Primary School during monitoring, it is likely that sensitive premises located on the school boundary may notice noise from the school, however, this is unlikely to be any more significant than that already experienced by residents of Jacksons Close or Jopling Way.

The graph below shows the principle measurement parameters and that levels of ambient noise and LAMax events are substantively below WHO Guideline levels. It is unlikely that any mitigation measures would be required for development at this location.



5 Conclusions

Based on the monitoring carried out and analysis against the screening assessment criteria outlined in ProPG, the following conclusions can be drawn.

1. The proposed site is capable of being developed for housing but is subject to constraints due to the impact of noise from the M11 motorway, the High Street Hauxton and the Rail line to the south of the site.
2. The eastern part of the site is subject to the adverse influence of a section of the M11 motorway (the principal source of noise impact). The motorway is elevated compared to the proposed site.
3. The rail line and rail noise directly affects only a small part of the proposed site, but may be more significant at night
4. Noise generated by local traffic on the High Street is significant during the day but would be expected to be negligible at night.

The screening assessment based on worst case is summarised below:

Receptor Location	Level (LAeq,T) Day/night	ProPG	BS8233:2014 / WHO levels (55dB LAeq,16hour)	WHO levels (50dB LAeq,16hour)	WHO levels (internal 30dB LAeq, 8hour)*	BS8233 levels (internal 40dB LAeq, 16hour*
Northern part of the site (MP1)	62 / 59	Medium/High	+7	+12	+14	+7
Eastern part of the site (MP2)	61 / 58	Medium/High	+6	+11	+13	+6
Southern part of the site (MP3)	54 / 52	Low/Low	✓	+4	+7	✓
Western part of the site (MP4)	54 / 52	Low/Low	✓	+4	+7	✓

*assumes 15dB reduction due to open window

For the parts of the site with a medium or high risk of noise impact, mitigation measures would need to be considered to enable development. For the parts of the site considered to be low risk no significant mitigation should be necessary except where internal night time sound levels need to be achieved. The table above provides an indication of the level of mitigation/reduction needed to ensure compliance with the standards noted. The following general noise mitigation measures should be considered:

- Careful design of the site to ensure noise sensitive facades are not exposed to the principal noise sources.
- Screening sensitive areas such as amenity space using the development buildings should be included as part of the design, likewise orientation of buildings should minimise the exposure of sensitive rooms to noise sources.
- Specification for acoustic glazing for noise sensitive rooms should include passive ventilation systems to ensure thermal comfort can be maintained
- Consideration of the height and location of acoustic barriers for the motorway source, and the rail line. The elevated section of motorway may not be capable of being screened using barriers so design and layout of the site will need to be carefully considered. Additionally, any smaller local barriers protecting amenity spaces should be considered at the design stages.
- Maximise separation distances between roads and sensitive receptors.

Based on measurements carried out, and observations made on the site, it is clear that, whilst challenging, the site could be developed subject to appropriate design and installation of appropriate noise mitigation measures. The nature and extent of those measures will depend on the final design, but it should be easily possible to use barriers or site design to reduce sound levels from road traffic by 15dB and/or design the development to provide appropriate screening, gable end walls or other noise protection.

The impact of train noise can be reduced by installing local barriers along the site boundary. The height and length of the barriers would need to be determined by the final design and layout. Again, the sound level reduce should be approximately 15dB.

LAMax event noise from both road and rail is significant only at night. It is likely that most of Hauxton village is already exposed to these LAMax events at night, either trains passing or significant vehicular events. Any development on the site would expect to have modern acoustic glazing fitted to noise sensitive rooms along with passive ventilation systems to ensure thermal comfort.

5.1 Summary conclusion

In my opinion, whilst there may be some challenges to develop the site for residential land use, the results would not preclude development subject to appropriate design and mitigation measures.

The final design would need to be assessed, preferably using a noise model to aid the design process and ensure optimum protection for proposed dwellings.

Subject to the above, there is no acoustic reason why the site cannot make a valuable contribution to South Cambridgeshire's housing provision.

Prepared by:

Tony Higgins MSc BSc(Hons) PGDip MIOA CMCIEH

Glossary of terms

Sound – an acoustic effect perceived by an individual. Sound is perceived differently by individuals and is highly subjective. Acoustically for sound to be perceived it has to be above the threshold of hearing (typically taken to be 0dB) but this threshold varies between individuals.

Noise – noise is defined as unwanted sound. The level at which noise is present will indicate the potential impact. In order for a sound to become noise, it has to be perceivable by the individual. Technically noise can be described in terms of its acoustic profile, typically though noise at or below the ambient levels is rarely loud enough to be considered significant.

Acoustic environment sound from all sound sources as modified by the environment [BS ISO 12913-1:2013]

'A' Weighting – This function modifies the linear frequency response of the meter sound profile to attempts to simulate the characteristics of human hearing. Hence a dB(A) reading is a subjective evaluation of what we actually hear whereas dB(LIN) (now written dBZ), is an objective reading of what is actually present. A weightings are normally used in environmental and occupational measurements

Ambient – This is the general level of sound in an area. It is usually composed of sound from many sources near and far, that together make the 'average' noise for an area. Ambient noise is normally described using a long term average sound level (typically LAEQ).

Ambient sound – totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. *NOTE The ambient sound comprises the residual sound and the specific sound when present.*

ambient sound level, LAeq,T – equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, *T*. *NOTE The ambient sound level is a measure of the residual sound and the specific sound when present.*

Attenuation – The loss in energy level of the sound usually used in relation to the loss due to sound passing through a structure or enclosure.

Background Noise Level – The underlying level of sound in the absence of the source is normally measured as an LA90, the level which is exceeded by 90% of sound present. This measurement effectively screens out transient noises. Occasionally LA99 is used which is the level which is exceeded by 99% of the sound present.

Background sound level, LA90,T – A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using time weighting F and quoted to the nearest whole number of decibels

Decibel (dB) – a unit or level, derived from the logarithm of the ratio between the sound pressure measured and a reference value. For sound pressure level the reference quantity is 20µPa, the threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only barely perceptible whilst a change of 10dB is considered significant. Sound pressure levels are noted as SPL, sound power can also be measured as a ratio of energy values, and is normally noted as SWL.

dB(A) (See A weighting above) – decibels measured on a sound level meter weighted by a scale which is designed to reflect the perception by the human ear. A noise meter incorporates a frequency weighting device to create this differentiation. Measurements in dB(A) broadly agree with people's assessment of loudness for broadband noise. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; a busy factory may have a level around 85dB(A); the level near a pneumatic drill about 100 dB(A).

Equivalent continuous A-weighted sound pressure level, LAeq,T – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, *T* = *t*2 – *t*1, has the same mean-squared sound pressure as a sound that varies with time. *NOTE The equivalent continuous A-weighted sound pressure level is normally quoted to the nearest whole number of decibels.*

Frequency – This is the number wavelengths passing a given point per second. The unit is the hertz (Hz). Frequency is the normal variation in pitch that most sounds have over time. Sound is normally made up of many different frequencies, and they behave differently within the environment. For example, moderate and high frequencies are damped out easily by barriers, screens or enclosures while low frequencies are more difficult to attenuate, which explains why loud music from a neighbour perceived through a wall often only sounds like a dull base thumping noise.

Impulse Noise – Single or repeated sound of short duration such as a bang or crash.

LA90 – The A weighted noise level exceeded for 90% of the specified measurement period. It is a statistical measurement. Used in BS 4142:2014 as the baseline for impact assessment and more generally it is used to define background noise level. Example, if a sound measurement carried out each second over 100 seconds the LA90 result would be the level representing the quietest 10% of the readings i.e. 10seconds.

LAeq – The equivalent continuous sound level - the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. LAeq is used to describe many types of noise and can be measured directly with an integrating sound level meter. It is obtained by continuously integrating ('adding up the energy of') a fluctuating sound signal and dividing by the elapsed time, to give the true mathematical average of any time varying signal. An Leq reading must always be related to a time period, it should not be read as an instantaneous value of sound pressure.

LAmax – The highest A weighted noise level recorded during a noise event. The time weighting used (F or S) should be stated. Almost all environmental measurements are 'Fast' weighted.

Logarithmic – A scale where the exponent indicating the power to which a fixed number, the base, must be raised to produce a given number. The base used in acoustics is 10. Thus, the logarithm of 10 = 1, the logarithm of 100 = 2 and the logarithm of 1000 = 3. Logarithms are used to convert very spans of pressure or energy measurements into usable scales.

Loudness – An observer's auditory impression of the strength of a sound. It is a subjective effect which is a function of the way we hear, and psychoacoustic response as well as the amplitude and frequency of the sound.

Masking – The process by which the threshold of hearing of one sound is reduced due to the presence of another which 'masks' the first.

Measurement Periods (T) – is the period over which the measurement is taken, normally varies between 5mins to an hour. More commonly 'real time' analysis and new data storage capabilities has allowed measurement times to be reduced to 1 second

Measurement time interval, Tm – total time over which measurements are taken. *NOTE This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.*

Meter response and time weightings – Sound Level Meters are provided with a sampling reference time weightings dependent on the sounds to be assessed. The variable time response control with settings are:- 'S' Slow; 'F' Fast; 'I' Impulse; 'P' Peak.

'S' Slow – meter response is over damped with a time constant of approximately 1000ms. The setting tends to average out variations in sound levels in the readings.

'F' Fast – meter responses sample over a response of 125ms. i.e. the measurement for variable sound will respond each 1/8th of a second showing a value.

'I' Impulse – uses a special electrical circuit with a time constant of about 35ms (of the same order as the response time of the human ear) to permit a very rapid response for investigating very sudden, short duration - impulsive - sounds. This setting incorporates a detector which in effect stores the signal for sufficient time to allow it to be displayed. Also a slow decay rate is incorporated with time response of approx. 1500ms to allow more easy reading of the maximum value as the indicator moves back relatively slowly.

Peak – Sound Level Meters often incorporate this setting which enables the **absolute peak** (as opposed to the rms) value of an impulsive waveform to be measured. A time constant of the order of 20 - 50 micro seconds is now involved to permit the following of very sharp impulsive events. Evidently electrical signal storage is also required to permit the meter to register the peak of such very fast events.

Rating Level – The specific noise level of a source when measured at receiver location (usually averaged over a time interval) plus any adjustment (penalty or weighting) for the characteristic features of the noise. It is used in BS4142 to rate the likelihood of complaints.

Reference time interval, Tr – specified interval over which the specific sound level is determined. *NOTE This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.*

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

Residual sound level, Lr = LAeq,T – equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, *T*

Specific sound level, Ls = LAeq,Tr – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *T*r

Specific sound source – sound source being assessed

WHO – World Health Organisation

References

1. BS 7445-1:2003: Description and measurement of environmental noise. Guide to quantities and procedures
2. BS 4142:2014 Method for rating and assessing industrial and commercial sound
3. BS 8233:2014
4. WHO Guidelines on Community Noise 1999
   http://www.who.int/docstore/peh/noise/guidelines2.html
5. WHO Noise Guidelines for Europe 2009
   http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf
6. CONVERTING THE UK TRAFFIC NOISE INDEX LA10,18h TO EU NOISE INDICES FOR NOISE MAPPING 2002 (TRL)
   https://pdfs.semanticscholar.org/32b4/09d29b0d811f0c36afe4e01529beea802caa.pdf

Appendix 1 Data and calculations

Calculations for Ambient Noise level assessment

The measurements carried out provide 3 x 1 hour results. The measured levels of LA10 are recorded and then used to produce a predicted level for L_{day} and L_{night} respectively in accordance with the method below:

The Calculation for Road Traffic Noise (CRTN) provides for a shortened method of determination of $LA10_{18hours}$. This can then be used to establish $LAeq_{16hour}$ and $LAeq_{8hour}$ to align measured levels with WHO standards as follows:

LA10(18hour) = LA10(3hour) – 1dB (1)

The L10(3hour) is calculation by *arithmetically* averaging the L10(1hour) results. (ref: CRTN para 43).

The conversion of 18-hour LA10 to LAeq as described in the TRL document CONVERTING THE UK TRAFFIC NOISE INDEX LA10,18h TO EU NOISE INDICES FOR NOISE MAPPING 2002 (Method 3 pg.29)

For motorways: -

$L_{day} = 0.98\times LA10{,}18h + 0.09$ dB (2)
$L_{evening} = 0.89\times L10{,}18h + 5.08$ dB (3)
$L_{night} = 0.87\times LA10{,}18h + 4.24$ dB (4)
$L_{den} = 0.90\times LA10{,}18h + 9.69$ dB (5)

The calculations (1), (2) and (4) converting the measured data are presented for each monitoring point below.

Monitoring Point 1

The following data was obtained from monitoring point 1:

Time	Duration	LAeq (dB)	LAFMax (dB)	LA10) (dB)	LA90) (dB)
08/10/2019 09:00	01:00:00	63.6	78.2	66.9	58.2
08/10/2019 10:00	01:00:00	60.9	75.9	62.4	56
08/10/2019 11:00	01:00:00	61.1	77.3	63.1	55.7

$LA10_{1hour}$ measurements are (66.9 + 62.4 + 63.1)/3 = 64.1 – 1 = 63.1dB

For MP1

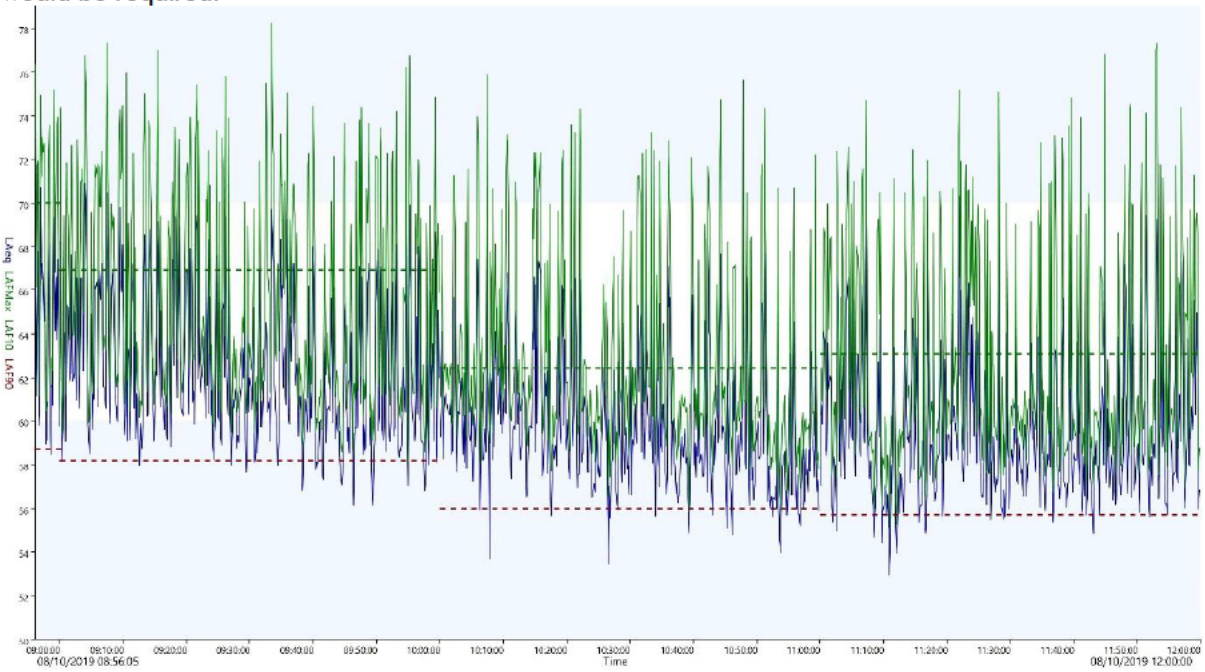
Lday = (0.98 x 63.1) + 0.09 dB
Lday = 61.9dB

Lnight = (0.87× 63.1) + 4.24 dB
Lnight = 59.1dB

Comparing this to the ProPG schematic in Paragraph 2.2 above, indicates that the site of high risk at night and medium risk during the day from motorway noise. The screening assessment indicates:

> *"High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice."*

Careful acoustic design and site orientation can address this risk, a detailed noise impact assessment would be required.



The graph above shows indicative LAMax events noted from road traffic. Most of the LAMax events were noted to be HGV's using the motorway. It is likely that any typical LAMax events at night would be less frequent, but the magnitude would be similar to that for observed during the daytime. Noise sensitive rooms would need to be protected to ensure they meet the internal LAMax standard required by WHO Guidelines.

Monitoring Point 2

The following data was obtained from monitoring point 2

Time	Duration	LAeq (dB)	LAFMax (dB)	LA10) (dB)	LA90) (dB)
08/10/2019 09:00	01:00:00	61.7	82.3	63.4	58.8
08/10/2019 10:00	01:00:00	60.7	67.2	62.6	57.7
08/10/2019 11:00	01:00:00	60.5	79.4	62.1	57.5

$LA10_{1hour}$ measurements are (63.4 + 62.6 + 62.1)/3 = 62.7 – 1 = 61.7dB

For MP2

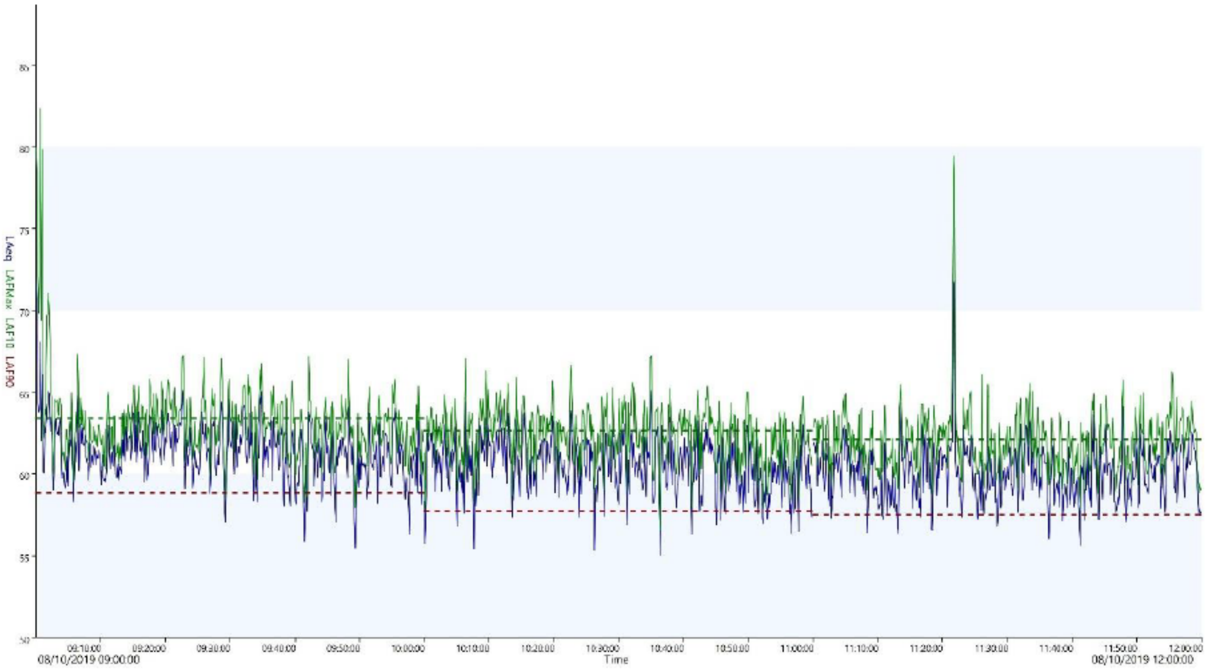
Lday = (0.98 x 61.7) + 0.09 dB
Lday = 60.5dB

Lnight = (0.87× 61.7) + 4.24 dB
Lnight = 57.9dB

Comparing this to the ProPG schematic in Paragraph 2.2 above, indicates that the site of high risk at night and medium risk during the day from motorway noise. The screening assessment indicates:

> *"High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice."*

Careful acoustic design and site orientation can address this risk, a detailed noise impact assessment would be required.



The graph above shows indicative LAMax events noted from road traffic. The LAMax events were noted to be almost continuous with little variation. It is likely that any typical LAMax events at night would be less frequent and perhaps more pronounced, but the magnitude would be similar to that for observed during the daytime. Noise sensitive rooms would need to be protected to ensure they meet the internal LAMax standard required by WHO Guidelines.

Monitoring Point 3

The following data was obtained from monitoring point 3. Note: the location was selected to be distant enough from the motorway so that rail noise was dominant. The LAEQ levels reported are heavily affect by short duration train noise. Train noise represents less than 2% of the total noise measured within that period, as such the LAEQ is noted to be significantly elevated compared to the LA10. Derived LAEQ levels from the LA10 measurements reflect better the ambient noise level of the area for road traffic influences (which were observed to be audible, but much reduced at this location).

The Noise Insulation (Railway) Regulations (NIRR 1996) applies to works on new, altered or additional railway systems. The regulations set the daytime criterion for noise insulation of residential buildings at the building façade (i.e. a facade noise level). Whilst the levels are considered to apply to existing sensitive receptors they can be used as a guideline for new receptors located next to existing railways.

The measured $LAEQ_{1hour}$ levels noted in the table below represent typical train noise contribution to noise from rail activities affecting the site. As a screening measure the worst-case result is 66.2dB for one-hour exposure, if replicated over 18hours, this would set a standard for NIRR 1996 requirements that could be mitigated with simple barriers and acoustic glazing.

Time	Duration	LAeq (dB)	LAFMax (dB)	LA10) (dB)	LA90) (dB)
08/10/2019 12:00	01:00:00	65.5	89.4	52.3	47.7
08/10/2019 13:00	01:00:00	65.6	90.6	53.3	48.2
08/10/2019 14:00	01:00:00	66.2	94.1	55	48.4

$LA10_{1hour}$ measurements are (52.3 + 53.3 + 55)/3 = 53.5 – 1 = 52.5dB

For MP3

Lday = (0.98 x 52.5) + 0.09 dB
Lday = 51.5dB

Lnight = (0.87× 52.5) + 4.24 dB
Lnight = 49.9dB

The calculated levels for the influence of road traffic noise show that rail noise was dominant throughout the monitoring period.

To correct the measured road traffic levels to an onsite location, the results above require distance correction. As road noise is a line source, the appropriate correction can be derived from the following calculation:

$LAEQ_{site} = LAEQ_{offsite} - 10 \text{ Log } (r2/r1)$ where r1 is 290m and r2 is 170m

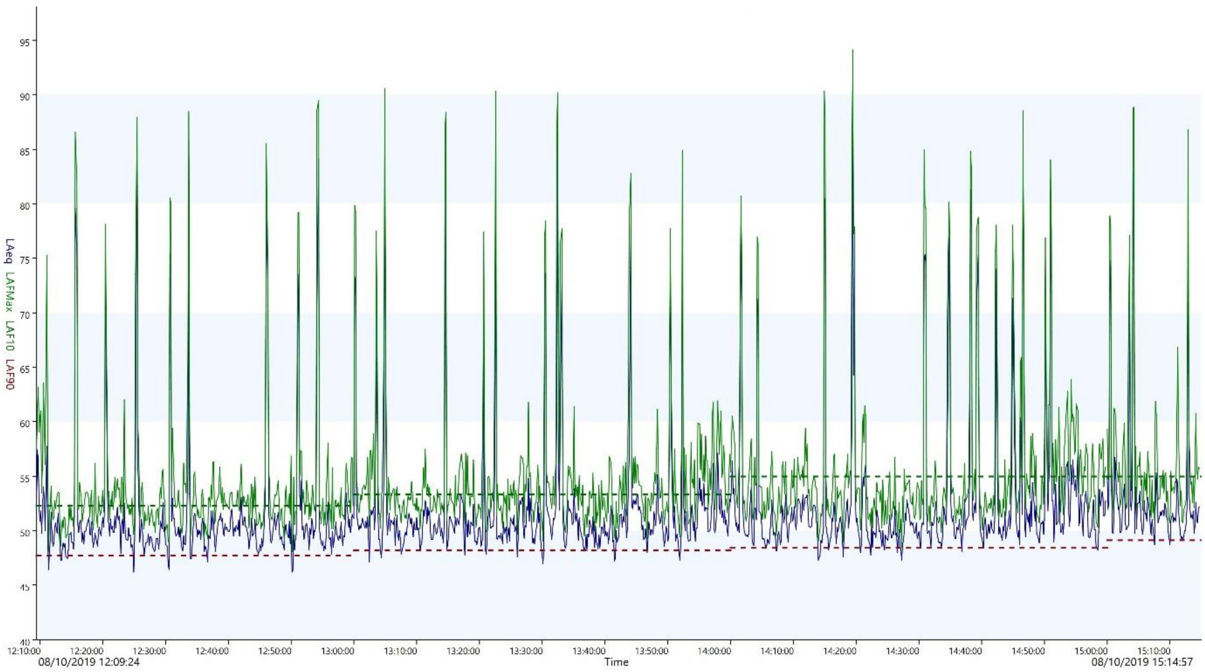
The table below provides those calculations:

Day Time levels	Night time levels
$LAEQ_{site} = LAEQ_{offsite} - 10 \text{ Log } (r2/r1)$ $LAEQ_{site} = 51.5 - 10 \text{ Log } (170/290)$ $LAEQ_{site} = 51.5 - 10 \text{ Log } (0.586)$ $LAEQ_{site} = 51.5 - 10 \times -0.2319$ **$LAEQ_{site}$ = 53.8dB**	$LAEQ_{site} = LAEQ_{offsite} - 10 \text{ Log } (r2/r1)$ $LAEQ_{site} = 49.9 - 10 \text{ Log } (170/290)$ $LAEQ_{site} = 49.9 - 10 \text{ Log } (0.586)$ $LAEQ_{site} = 49.9 - 10 \times -0.2319$ **$LAEQ_{site}$ = 52.2dB**

Comparing this to the ProPG schematic in Paragraph 2.2 above, indicates that the site of medium risk at night and Low risk during the day from motorway noise. The screening assessment indicates:

> *"As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.."*

Careful acoustic design and site orientation can help minimise the risk, a detailed noise impact assessment would be required.



The graph above shows indicative LAMax events noted from road traffic are relatively low, but the significant events are trains passing. Review of the train schedules for the lines, indicate in excess of 170 passenger trains per day and an unknown number of freight trains. It is likely that any typical LAMax events at night would be less frequent, but the magnitude would be similar to that for observed during the daytime. Noise sensitive rooms would need to be protected to ensure they meet the internal LAMax standard required by WHO Guidelines. A 'typical' LAMax as noted above is approximately 90dB at 10m. an acoustic barrier close to the rail line would reduce this by approximately 15dB which would mean an addition 15dB of mitigation would be required to meet WHO guideline levels at the building façade. The design and layout of the site would need to address protection of garden areas and exposed sensitive rooms to achieve these requirements.

Monitoring Point 4

The following data was obtained from monitoring point 4.

Time	Duration	LAeq (dB)	LAFMax (dB)	LA10) (dB)	LA90) (dB)
08/10/2019 12:00	01:00:00	53.6	74.9	55.3	50.9
08/10/2019 13:00	01:00:00	53.7	65.2	55.5	50.9
08/10/2019 14:00	01:00:00	54.5	75.5	56	51.3

$LA10_{1hour}$ measurements are (55.3 + 55.5 + 56)/3 = 55.6 – 1 = 54.6dB

For MP4

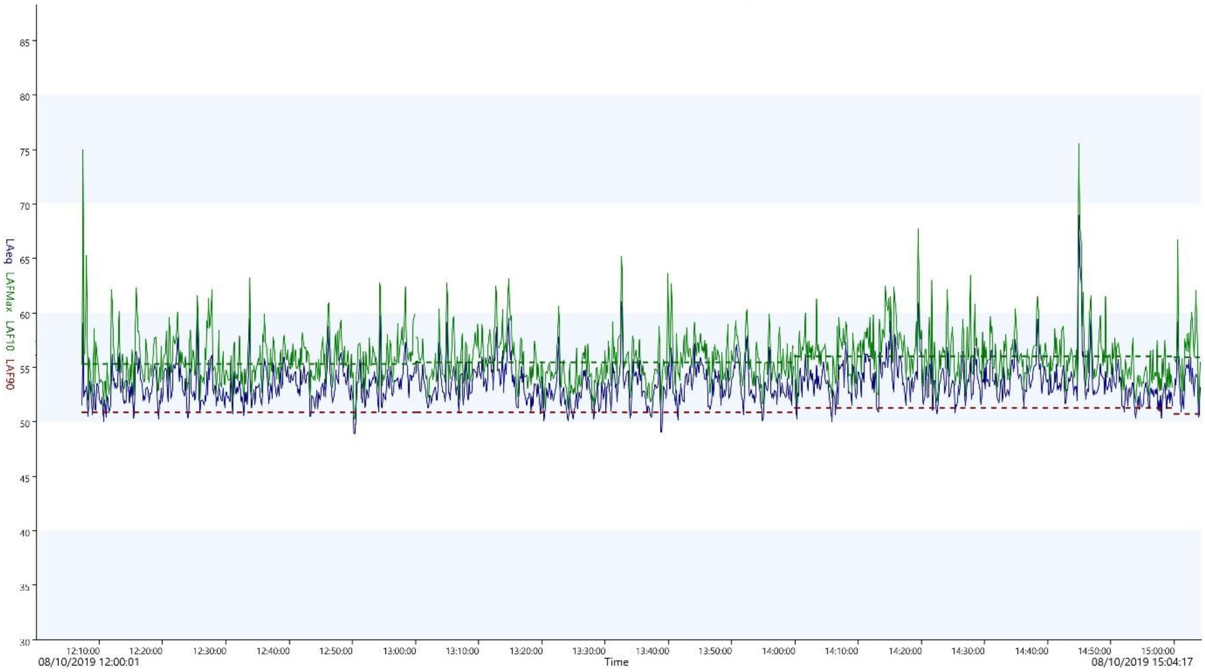
Lday = (0.98 x 54.6) + 0.09 dB
Lday = 53.6dB

Lnight = (0.87× 54.6) + 4.24 dB
Lnight = 51.7dB

Comparing this to the ProPG schematic in Paragraph 2.2 above, indicates that the site of Low-Medium risk at night and Low risk during the day from motorway noise. The screening assessment indicates:

> *"As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.."*

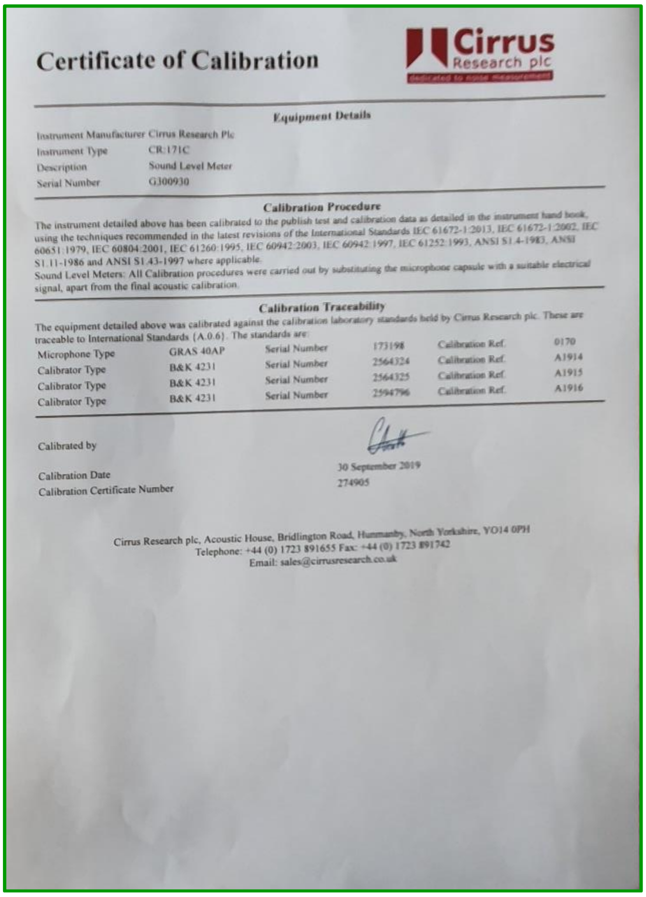
Careful acoustic design and site orientation can help minimise the risk, a detailed noise impact assessment would be required.



The graph above shows indicative LAMax events noted from road traffic. The LAMax events were noted to be almost continuous with little variation and mostly below the threshold for intervention measures. It is likely that any typical LAMax events at night would be less frequent, but the magnitude would be like that for observed during the daytime. Noise sensitive rooms may need to be protected to ensure they meet the internal LAMax standard required by WHO Guidelines, but design and orientation may prevent a need for significant treatment.

Appendix 2 Calibration Certificates

G300930 Cirrus 171C



Certificate of Calibration

Cirrus Research plc

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171C
Description	Sound Level Meter
Serial Number	G300930

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

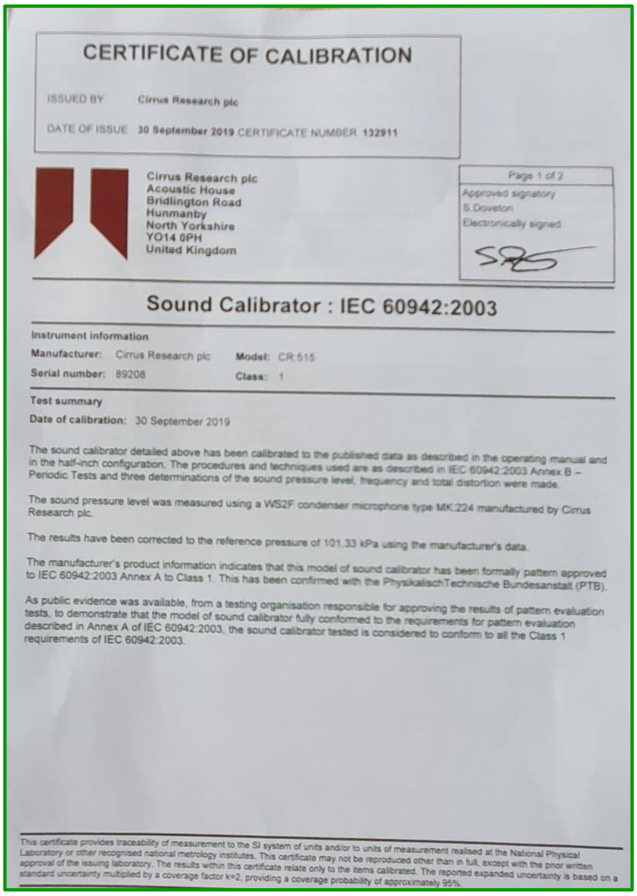
The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards (A.0.6). The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref.	0170
Calibrator Type	B&K 4231	Serial Number	2564324	Calibration Ref.	A1914
Calibrator Type	B&K 4231	Serial Number	2564325	Calibration Ref.	A1915
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref.	A1916

Calibrated by

Calibration Date: 30 September 2019
Calibration Certificate Number: 274905

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk



CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 30 September 2019 CERTIFICATE NUMBER 132911

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2
Approved signatory
S.Doveton
Electronically signed

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc **Model:** CR:515
Serial number: 89208 **Class:** 1

Test summary

Date of calibration: 30 September 2019

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC 60942:2003 Annex A to Class 1. This has been confirmed with the PhysikalischTechnische Bundesanstalt (PTB).

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

GO79497 Cirrus 171B

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171B
Description	Sound Level Meter
Serial Number	G079497

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref.	0170
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref.	A1811

Calibrated by

Calibration Date	06 December 2018
Calibration Certificate Number	266047

This Calibration Certificate is valid for 24 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration

Certificate Number: **124354**
Date of Issue: **06 December 2018**

Instrument

Manufacturer: **Cirrus Research plc** Serial Number: **79811**
Model Number: **CR:515**

Calibration Procedure

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC 60942:2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer s data.

Date of Calibration: **05 December 2018**

Initial Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	93.86	1000.3	0.61
2	93.86	1000.3	0.60
3	93.87	1000.3	0.61
Average	**93.86**	**1000.3**	**0.60**
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level.

Adjusted Calibration Results

Measurement	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
1	94.00	1000.3	0.60
2	94.00	1000.3	0.60
3	94.01	1000.3	0.60
Average	**94.00**	**1000.3**	**0.60**
Uncertainty	± 0.13	± 0.1	± 0.10

The reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level.

Cirrus Research plc, Acoustic House, Bridlington Road
Hunmanby, North Yorkshire, YO14 0PH, United Kingdom
Telephone: 0845 230 2434 **Int**: +44 1723 891655
Email: sales@cirrusresearch.co.uk
Web: www.cirrusresearch.co.uk
UK Registration No. 987160

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ISO 9001:2015 Quality Management — FM 531001
ISO 14001 Environmental Management — EMS 552104

Appendix 3 Site Photographs

Site photos

General Site view

Monitoring Point 1

Monitoring Point 2

Monitoring Point 3

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Monitoring Point 4