



Hinckley Academy

Noise Impact Assessment

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Client: Reds 10 (UK) Ltd

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TABLE OF CONTENTS

TABLE OF CONTENTS	2
REVISION HISTORY	2
1 INTRODUCTION	3
2 BASIS OF NOISE ASSESSMENT	4
LOCAL AUTHORITY REQUIREMENTS	4
BUILDING BULLETIN 93	5
BS 4142:2014 – METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND.....	6
3 THE SITE, SITE SETTING AND PROPOSED DEVELOPMENT	7
SITE DESCRIPTION.....	7
NEARBY NOISE SENSITIVE RECEPTORS (NSRs)	7
PROPOSED DEVELOPMENT	7
4 NOISE CLIMATE	8
NOISE SURVEY	8
5 NOISE MODEL	9
6 BUILDING ENVELOPE SOUND INSULATION	12
INDOOR AMBIENT NOISE CRITERIA	12
OVERHEATING	12
BUILDING FAÇADE ASSESSMENT	13
NOISE FROM MECHANICAL VENTILATION UNITS.....	15
7 BUILDING SERVICES NOISE EMISSIONS	16
8 EXTERNAL PLAY AREAS – SCHOOL USE DURING BREAK-TIMES	17
ASSESSMENT STANDARDS AND GUIDANCE.....	17
NOISE MODEL –OUTDOOR PLAY AREA.....	18
PREDICTED NOISE IMPACT.....	19
9 SUMMARY AND CONCLUSION	20
APPENDIX A – GLOSSARY OF ACOUSTIC TERMINOLOGY	21
APPENDIX B – NOISE SURVEY DATA- TETRA TECH REPORT	23

REVISION HISTORY

Revision	Date	Revision Details	Author	Checked
R02	03/02/2023	Original Issue	Joseph Tony BTech MIOA	Susan Witterick BSc MIOA
R02A	22/03/2023	Updated to include external playarea noise assessment	 Joseph Tony (Mar 22, 2023 17:37 GMT) Joseph Tony BTech MIOA	 Ben Tomlin BSc MIOA

1 INTRODUCTION

- 1.1 It is proposed to demolish an existing school block at the Hinckley Academy and John Cleveland Sixth Form College, Hinckley, LE10 1LE and replace with a new three-storey STEM block. The Local Authority is Hinckley and Bosworth Borough Council (HBBC).
- 1.2 dBx Acoustics Ltd has been appointed by Reds10 (UK) Ltd. to undertake a noise impact assessment for the proposed new building.
- 1.3 Reference has been made to noise survey undertaken at the site by Tetra Tech (included within Appendix B), when assessing noise impact to the surroundings and environmental noise affecting the development.
- 1.4 A glossary of acoustic terminology has been supplied in Appendix A in order to assist the reader.

2 BASIS OF NOISE ASSESSMENT

- 2.1 Information regarding existing noise levels has been taken from the Noise Constraints Assessment Report issued by Tetra Tech on 23rd July 2021.
- 2.2 A noise survey was carried out by Tetra Tech between 7th and 12th July 2021. The monitoring locations and measurement results extracted from this report are presented in Appendix B. dBx Acoustics Ltd cannot accept responsibility for the accuracy of the information contained therein.
- 2.3 This report considers the Site's suitability for the nature of proposed uses through assessment of existing noise levels affecting the site, which have been used to carry out the following works:
- To determine prevailing environmental noise levels affecting the site of the proposed school buildings due to nearby noise sources (e.g. road traffic);
 - Assessment of potential noise intrusion to school spaces and development of preliminary sound reduction requirements for the building façades with consideration of the proposed ventilation strategy;
 - The setting of appropriate noise emission limits for new fixed building services plant associated with the development.
- 2.4 The noise impact assessment is based on the following:
- Department for Education (2015) 'BB93 Acoustic Design of Schools'. (BB93)
 - BS4142:2014 'Methods for Rating and Assessing Commercial Sound'

Local Authority Requirements

- 2.5 Hinckley and Bosworth Borough Council (HBBC) has published a number of guidance documents however, there is no published quantitative guidance on acoustic criteria for noise emissions from building services plant items.
- 2.6 dBx Acoustics has consulted with the Environmental Health Department of HBBC concerning the plant noise standard adopted by the Council in controlling the impact of noise from external plant and equipment.
- 2.7 Further to liaison with the Giles Rawdon, Environmental Health Officer (Pollution), it is understood that HBBC has no formally adopted criteria for the control of building services noise emissions, but would expect the BS4142:2014 rating level $L_{A,T,r}$ to be no higher than the existing background noise level, and ideally 5dB lower than this.

Building Bulletin 93

- 2.8 Requirement E4 from Part E of Schedule 1 to The Building Regulations 2000 (as amended) states that:

"Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use."

- 2.9 These regulations came into force in July 2003.

- 2.10 Part E of the Building Regulations includes schools within its scope, and gives the following guidance:

"In the Secretary of State's view, the normal way of satisfying Requirement E4 will be to meet the values for sound insulation, reverberation time and internal ambient noise which are given in Section 1 of Building Bulletin 93 'The Acoustic Design of Schools', produced by DfES."

- 2.11 The School Premises Regulations contain similar statements and apply to both new and existing school buildings.
- 2.12 Building Bulletin 93 (BB93) was updated in 2014 and is the current design standard applicable to compliance with the Building Regulations and the School Premises Regulations. This document includes design standards for indoor ambient noise levels, reverberation time, and sound insulation between critical spaces.
- 2.13 Building Bulletin 93 specifies upper limits for indoor ambient noise level for room types classified in terms of intended use.
- 2.14 The objective is to provide suitable indoor ambient noise levels (a) for clear communication of speech between teacher and student (b) clear communication between students and (c) learning and study activities. The indoor ambient noise level includes noise contributions from:
- External sources outside the school premises (including, but not limited to, noise from road, rail and air traffic, industrial and commercial premises);
 - Building services (e.g. ventilation system, plant, etc); and
 - Actuator and damper noise.
- 2.15 Where rooms are mechanically ventilated, the plant should be assumed to be running at its maximum operating duty.

Table 1: BB93 Indoor Ambient Noise Level Criteria

Room Type	Upper Limit for Indoor Ambient Noise Level
	dB L _{Aeq,30 min}
Secondary Classrooms, Small Group rooms	35
DT, Art, Food, CAD/CAM, Science Laboratories	40
Staff Work Room and Offices	40
Corridor, WC	50

- 2.16 Additionally, in order to protect students from regular discrete noise events, ambient noise levels should not exceed $60\text{dB}_{\text{LA1,30mins}}$.
- 2.17 The indoor ambient noise level excludes noise contributions from teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground. Noise transmitted from adjacent spaces is addressed by the airborne and impact sound insulation requirements, which will be determined as the building design progresses.

BS 4142:2014 – Methods for Rating and Assessing Industrial and Commercial Sound

- 2.18 BS 4142:2014 sets out a procedure for assessing noise impact whereby a Noise Rating is determined and compared with the existing local Background Sound Level.
- 2.19 The Rating Level ($\text{dBL}_{\text{Ar,Tr}}$) is evaluated from the Specific Noise Level by including several, cumulative corrections to account for factors such as distinguishable tone, impulse, intermittency or other readily distinguishable sound characteristics.
- 2.20 BS 4142:2014 seeks to determine a “representative” Background Sound Level, stating that “...the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods”.
- 2.21 The assessment of the impact depends upon the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level. An initial estimate of the impact of the specific sound is made by subtracting the Background Sound Level from the Rating Level, while considering the following points:
- a) Typically, the greater this difference, the greater the magnitude of the impact.
 - b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
 - c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
 - d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

3 THE SITE, SITE SETTING AND PROPOSED DEVELOPMENT

Site Description

- 3.1 The proposed new building is at the northern end of the existing Hinckley Academy and John Cleveland Sixth Form College campus.
- 3.2 The site is located off Butt Lane, with existing campus buildings immediately to the west and south. To the north are residential receptors (Bradgate Gardens). Hinckley Golf Course is located to the east.
- 3.3 Figure 1 below illustrates the location of the site boundary and the nearby noise sensitive receptors.

Figure 1: Site Boundary and Nearby Noise Sensitive Properties



Nearby Noise Sensitive Receptors (NSRs)

- 3.4 The proposed development site is located adjacent to the existing Hinckley Academy and John Cleveland Sixth Form College. The nearest residential receptors are at approximately 25m to the north of the site at Bradgate Gardens/Olympic Gate, as illustrated on Figure 1 above.

Proposed Development

- 3.5 The proposed development comprises a new three storey STEM building. It includes general, science, art, ICT, photography DT, and food classrooms, and administration and ancillary spaces.

4 NOISE CLIMATE

Noise Survey

- 4.1 Information regarding existing noise levels has been taken from the Noise Constraints Assessment Report issued by Tetra Tech on 23rd July 2021.
- 4.2 A noise survey was carried out by Tetra Tech between 7th and 12th July 2021. The monitoring locations and measurement results extracted from this report are presented in Appendix B. dBx Acoustics Ltd cannot accept responsibility for the accuracy of the information contained therein.
- 4.3 It is understood from the noise survey that the dominant noise source affecting site is road traffic on Butt Lane and Woodland Road.
- 4.4 The monitoring locations are presented in Figure 2.

Figure 2: Noise Monitoring Locations



- 4.5 The ambient noise levels from the noise survey results (Appendix B) has used to calibrate the noise model and the lowest measured background noise levels measured at Location ST3 have been used to set the noise emission limits for building services plant.

Figure 4: Daytime Noise Map -Site and Surroundings

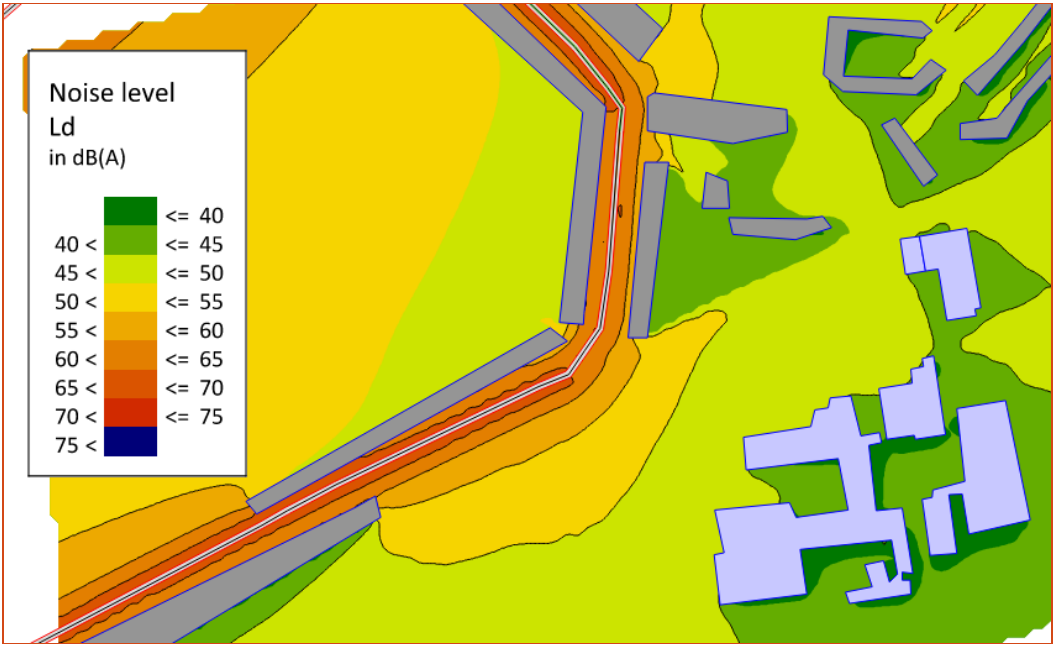


Figure 5: Daytime Noise Map – Site Only (1.5m above ground)



- 5.5 Based on the results of the noise model, Table 2 below presents a summary of the predicted typical daytime external noise levels at the facades of the proposed development.

Table 2: Predicted Typical Daytime Noise Levels at the Facades of the Proposed Development

Façade Direction	Receiver	Daytime Ambient dB $L_{Aeq,30minutes}$
North	General Classrooms, Science, DT Classrooms, Staff Rooms	51
West	Science, DT, Textile, Photography, ICT Classrooms	51
East	General Classrooms, Science, Food/DT, Textile Classrooms, Staff Rooms	49
South	General Classrooms, Science, Art, Classrooms	46

6 BUILDING ENVELOPE SOUND INSULATION

Indoor Ambient Noise Criteria

- 6.1 An external noise break-in assessment has been undertaken to assess the suitability of the site for the proposed development.
- 6.2 In accordance with BB93 guidance, for naturally ventilated teaching spaces, an internal noise level limit of 40 dBL_{Aeq,30mins} is considered appropriate for general classrooms and 45dBL_{Aeq,30mins} for DT/Art/Food/Science Laboratory/Photography/Textile classrooms. BB93 also states that where external ambient free field noise levels at the façade do not exceed the IANL figures given in Table 1 by more than 16 dB for single sided ventilated spaces and 20dB for cross ventilated or roof ventilated spaces, the criteria for natural ventilation can usually be achieved.
- 6.3 Based on the results of the noise survey and the predicted façade incident noise levels (Table 2), natural ventilation is therefore suitable for all teaching spaces within the proposed new school building.
- 6.4 It is understood that some of the teaching spaces will be ventilated via a hybrid system (Hybrid units) and rest of the teaching and admin spaces will be ventilated by mechanical means (MVHR).

Overheating

- 6.5 The BB93 indoor ambient noise level criterion during overheating conditions in general teaching space while controlled by natural or hybrid ventilation is 55dB L_{Aeq,30min}. Based on the predicted external noise levels, this criterion is achievable at this site with windows open to provide additional ventilation / cooling.
- 6.6 This IANL is permitted during the hottest 200 hours in peak summertime conditions. The ventilation must be under the local control of the teacher so that the noise level can be reduced to normal levels when needed.

Building Façade Assessment

- 6.7 Given that natural ventilation via open windows is acceptable, there are no specific requirements for the acoustic performance of the building façade or glazing for majority of areas. Any glazing unit achieving a sound insulation performance of 26 dB R_w or greater would be sufficient, which is not an onerous requirement.
- 6.8 Standard thermal glazing with 4/TC/4mm (glass/air/glass) configuration is expected to achieve a sound insulation performance of 31 dB R_w .

Noise Ingress via External Wall and Glazing

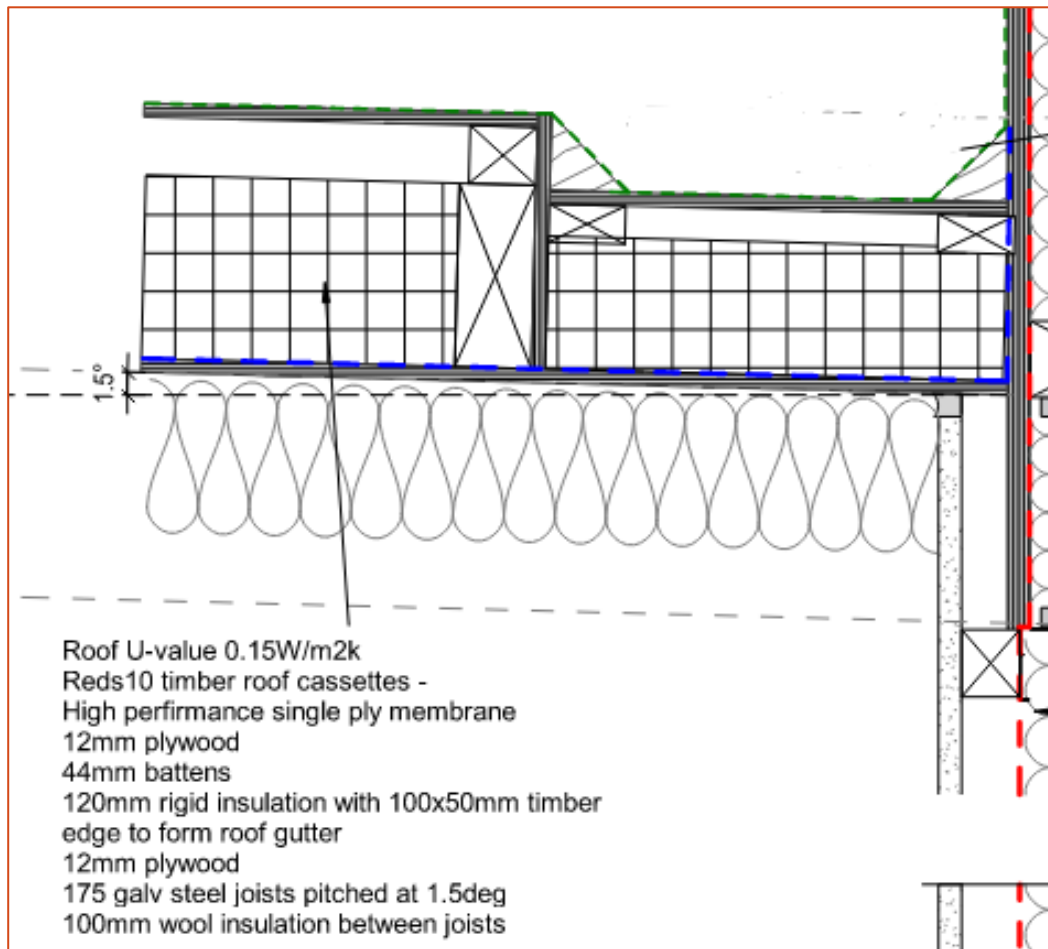
- 6.9 The proposed windows are understood to comprise of triple glazed construction, which would easily meet the required sound insulation performance.
- 6.10 The non-glazed element is expected to comprise of;
- Drylining + VCL (1x 15mm Plasterboard);
 - 38 x 44mm timber battens with 100mm mineral fibre insulation (min 150mm cavity);
 - Fibre cement cladding (minimum 8mm);
- 6.11 The above wall construction has a predicted sound insulation performance of at least 45 dB R_w and hence would easily meet the required sound insulation performance.
- 6.12 In order not to compromise the sound insulation performance of the external cladding, the passive operation mode of the hybrid units (louvre) would need to have an element-normalized sound level difference of $\geq 26 \text{ dB } D_{n,e,w} + 10 \log N$, where N is the number of elements per room. This will be reviewed once details are available.

Roof and Rain Noise

- 6.13 Consideration will need to be given to the control of rain noise impact for roofs. According to BB93, noise levels during heavy rain should not be more than 25 dB above the appropriate indoor ambient noise levels given in Table 1. Heavy rain noise excitation is defined in BS EN ISO 140-18¹.
- 6.14 BB93 requires that lightweight roofs are designed to provide suitable control of the reverberant sound pressure level within a space during heavy rainfall. It is intended that calculation should be provided; however, this is only possible where a manufacturer can provide laboratory test data for their roof. Where data is not available, the roof design should include specific measures designed to reduce rain noise impact.
- 6.15 The proposed roof build-up will comprise a multi-layer construction, with no available laboratory test data, as indicated in Figure 6, below.

¹ British Standards Institution (BSI) (2006): 'BS EN ISO 140-18:2006 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 18: Laboratory measurement of sound generated by rainfall on building elements'. BSI.

Figure 6: Roof Construction within the Development



- 6.16 In the absence of laboratory test data for this roof construction, the rain noise impact level has been predicted in Insul, and used to calculate rain noise levels in a typical classroom.
- 6.17 The assessment indicates that the proposed roof construction is capable of controlling rainfall noise to meet the requirements of BB93. It should also be noted that this roof build up has been installed in previous Red's 10 school projects, with no complaints from end users.
- 6.18 Where roof lights are proposed, these should be double glazed and not polycarbonate.
- 6.19 In terms of noise break-in, the above roof has a predicted airborne sound insulation performance of at least 45 dB R_w , and hence would be acceptable.

Noise from Mechanical Ventilation units

- 6.20 It is understood that classrooms will be ventilated via a hybrid system, with the remainder of the spaces ventilated by mechanical means (MVHR).
- 6.21 It should be noted that the noise contribution from the mechanical system of hybrid units and MVHR units should not exceed the IANL criteria as presented in Table 1 above.
- 6.22 The cumulative noise contribution from hybrid units together with noise ingress through the building façade should not exceed the IANL criteria as presented in Table 1 above by more than 5dB for hybrid ventilation. The cumulative noise within each space due to building services should be therefore designed to a noise level no greater than the limits presented in Table 1.

7 BUILDING SERVICES NOISE EMISSIONS

- 7.1 Any externally mounted or discharging building services should be designed to avoid any adverse impact on the NSRs (Figure 1) when assessed in accordance with the guidance in BS 4142:2014 'Methods for Rating and Assessing Industrial and Commercial Sound'.
- 7.2 Further to communication with Giles Rawdon, Environmental Health Officer (Pollution), it is understood that HBBC has no formally adopted criteria for the control of building services noise emissions but would expect the plant noise rating level to be no higher than the existing background noise level, and ideally 5dB lower than this.
- 7.3 Based on the noise survey data, the lowest background noise level measured during the daytime period (07:00-19:00h) at location ST3 was 35 dB $L_{A90, T}$ and the lowest background noise level measured during the night period (07:00-23:00h) was 31 dB $L_{A90, T}$.
- 7.4 Due to low measured background noise levels at night-time, it is proposed that the plant noise rating level from building services affecting the surrounding noise sensitive receptors should be controlled to achieve a BS4142:2014 rating level $L_{Ar, Tr}$ of no greater than the existing background noise level.
- 7.5 The design should seek to avoid acoustically distinctive features where reasonably practical.
- 7.6 The nearest noise sensitive building for this scheme is identified as the existing Hinckley Academy and John Cleveland Sixth Form College to the west of the proposed development (Figure 1), which is around 20m from the proposed roof plant area. This receptor would only be considered a noise sensitive receptor during the daytime period.
- 7.7 The residential receptors to the north of the proposed development (Figure 1) are around 35m from the roof plant area and should be considered during both the day and night time periods.
- 7.8 ***On this basis, plant noise emissions should be controlled such as the rating level when assessed at the nearest noise sensitive receptor (Figure 1) is no higher than 35 dB $L_{Ar, Tr}$ during daytime (07:00h-23:00h) and 31 dB $L_{Ar, Tr}$ during night time (23:00h-07:00h).***
- 7.9 The noise limits are to be met at 1m from the window of the identified NSRs (Figure1).
- 7.10 At this stage in the design of the Development, the details of plant to be installed are yet to be developed. A detailed BS4142 noise impact assessment will be undertaken in later design stages to assess the noise impact from the externally mounted units, and appropriate mitigation measures will be proposed where necessary.

8 EXTERNAL PLAY AREAS – SCHOOL USE DURING BREAK-TIMES

- 8.1 Based on the comments received from EHO, the noise model has been updated to include an assessment of noise impact from the external play areas on nearby sensitive receptors.
- 8.2 The nearest residential receptors are at approximately 25m to the north of the external play area at Bradgate Gardens/Olympic Gate, as illustrated on Figure 1 above.
- 8.3 On warm summer dry days, the school estimates around 200-300 of the pupils may go outside during break-times. The following calculation considers the potential noise impact from the normal and raised voices of pupils at the external play area pitch area during school break-times.
- 8.4 It should be noted that, for the majority of the time, during cooler Autumn/Spring time, it is estimated that only around 120 pupils would access the outdoor areas, and the potential noise impact will therefore be reduced. This calculation is therefore a worst-case assessment.

Assessment Standards and Guidance

- 8.5 There is no specific guidance for assessing the noise from school playground use. The predicted noise levels from outdoor play area has therefore been compared to noise limits in and around residential properties as defined in the World Health Organisation's "Guidelines for Community Noise."

World Health Organisation (WHO) Guidelines for Community Noise / BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

- 8.6 Table 1 of the WHO document 'Guidelines for Community Noise' recommends the following upper limits when assessing outdoor areas:
- 50-55 dB $L_{Aeq,T}$ in outdoor living environments (including balconies and terraces) during day and evening periods; and
 - 35 dB $L_{Aeq,T}$ inside living rooms over 16 hour daytime period (7am-11pm)
- 8.7 The 2019 WHO document '*Environmental Noise Guidelines for the European Region*' notes that these levels remain valid.
- 8.8 These limits are the same as that recommended within BS8233:2014 '*Guidance on Sound Insulation and Noise Reduction for Buildings*'.

Noise Model –Outdoor Play Area

- 8.9 An assessment has been undertaken to predict the noise impact from the proposed external play area to existing residential dwellings.
- 8.10 Figure 7 below presents the site layout showing the play area.

Figure 7- Site layout with External Play Area and NSRs.

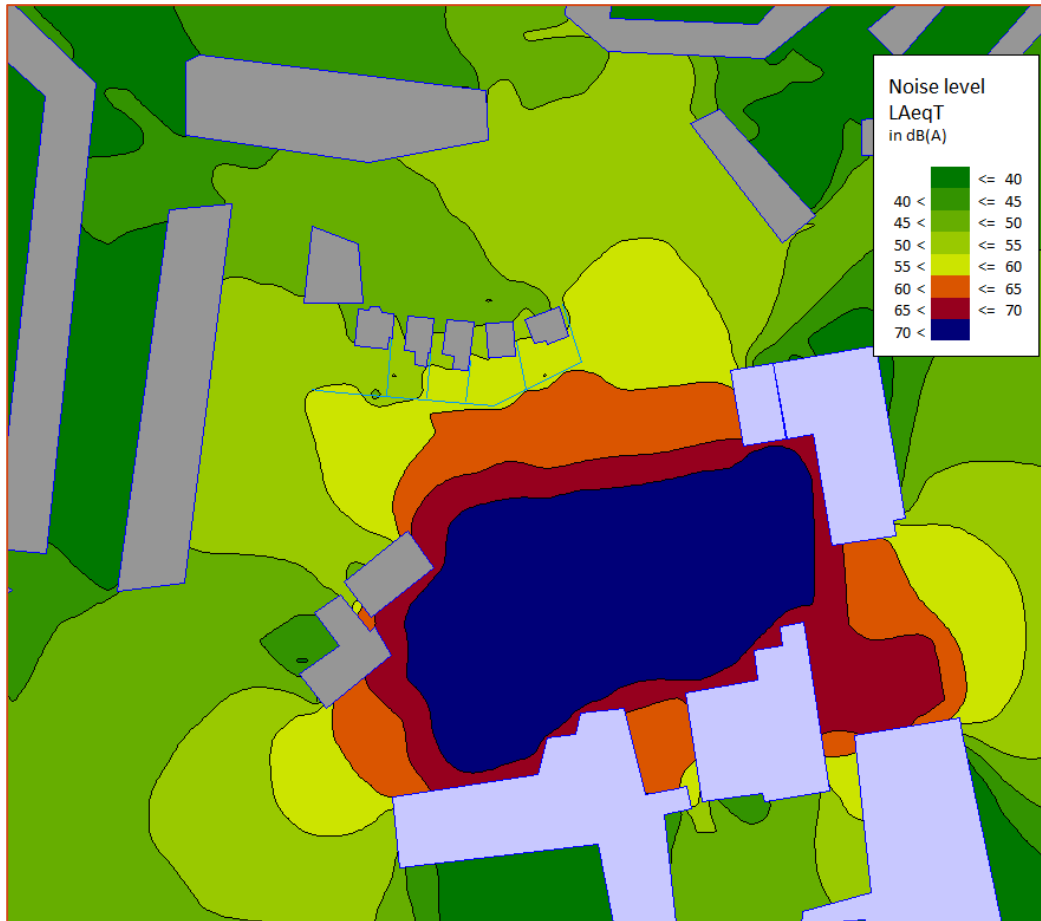


- 8.11 Based on ANSI 3.5, the sound power level of a 'normal' human voice is 68dBL_{WA}, 'raised' human voice is 76dBL_{WA} and 'shouted human' voice is 91dBL_{WA}.
- 8.12 For the purpose of this assessment, the following assumptions have been made;
- Around 100 pupils could use the external hard informal and other play areas simultaneously with a normal voice;
 - Around 30 pupils could use the external hard informal and other play areas simultaneously with a raised voice;
 - Around 30 pupils could use the external hard informal and other play areas simultaneously with a shouted voice;
 - The nearby residential receptors will have a 1.8m high garden fence.
- 8.13 Due to the size of the external play area, this has been modelled as an area source using Soundplan 8.2 to distribute this sound power evenly across the hard informal and other play areas.

Predicted Noise Impact

- 8.14 The predicted noise levels arising at the nearest noise sensitive receptors at Bradgate Gardens/Olympic Gate is in the order of 49-55 dB $L_{Aeq,T}$.
- 8.15 The results are presented as a noise map at ground floor level (1.5m above ground) in Figure 8 below.

Figure 8: Noise Map – Outdoor Play Area to NSRs



- 8.16 Based on the results of the noise modelling exercise undertaken, the noise levels from external play area will achieve the WHO outdoor amenity noise criterion.
- 8.17 The above assessment can be considered as a worst-case assessment of noise impact i.e., most intensive potential use of the outdoor play area during the summer months.

9 SUMMARY AND CONCLUSION

- 9.1 It is proposed to demolish an existing school block at the Hinckley Academy and John Cleveland Sixth Form College, Hinckley, LE10 1LE and replace with a new three-storey block. The Local Authority is Hinckley and Bosworth Borough Council (HBBC).
- 9.2 dBx Acoustics Ltd has been appointed by Reds10 (UK) Ltd. to undertake a noise impact assessment for the proposed School.
- 9.3 A noise survey was undertaken at the site by Tetra Tech to determine noise levels affecting the proposed development. Based on these measured noise levels, a noise model of the site has been created to undertake an assessment of the required building envelope sound insulation in order to meet indoor ambient noise levels set out in Building Bulletin 93.
- 9.4 Using the predicted incident noise levels, it has been determined that natural ventilation by means of openable windows will be appropriate for this site, and it is understood that hybrid/mechanical ventilation is proposed.
- 9.5 Based on the lowest background noise levels measured by Tetra Tech, noise emission limits for building services plant have been set such that no adverse impact would be expected.
- 9.6 An indicative assessment has been undertaken to assess the activity noise from the sports pitches to nearby noise sensitive receptors. The noise emissions from the activities within the outdoor play areas will meet the WHO targeted outdoor amenity noise criterion.
- 9.7 Taking the above into account, noise should not be a limiting factor in any planning application.

APPENDIX A – GLOSSARY OF ACOUSTIC TERMINOLOGY

Decibel, dB	A unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level (L_p) the reference quantity is 2×10^{-5} N/m ² . The sound pressure level existing when microphone measured pressure is 2×10^{-5} N/m ² is 0 dB, the threshold of hearing.
L	Instantaneous value of Sound Pressure Level (L_p) or Sound Power Level (L_w).
Frequency	Number of cycles per second, measured in hertz (Hz), related to sound pitch.
A-weighting	Arithmetic corrections applied to values of L_p according to frequency. When logarithmically summed for all frequencies, the resulting single "A weighted value" becomes comparable with other such values from which a comparative loudness judgement can be made, then, without knowledge of frequency content of the source.
$L_{eq,T}$	Equivalent continuous level of sound pressure which, if it actually existed for the integration time period T of the measurement, would possess the same energy as the constantly varying values of L_p actually measured.
$L_{Aeq,T}$	Equivalent continuous level of A weighted sound pressure which, if it actually existed for the integration time period, T, of the measurement would possess the same energy as the constantly varying values of L_p actually measured.
$L_{n,T}$	L_p which was exceeded for n% of time, T.
$L_{An,T}$	Level in dBA which was exceeded for n% of time, T.
L_{Fmax}	The instantaneous maximum sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
L_{AFmax}	The instantaneous maximum A weighted sound pressure level which occurred during the measurement. F indicates that the fast time-weighting is used.
$L_{Ar,Tr}$	The rating level: the equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise.
Reverberation Time, T	The time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped. The descriptor T, often includes other nomenclature to describe the type of reverberation time measurement or if the reverberation time is an average taken for specific frequencies. For example, a T_{mf} is the mid-frequency reverberation time.
Absorption Coefficient, α	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Class, A - E	Classification of sound absorbers into Sound Absorption Classes A-E, according to BS EN ISO 11654, including frequencies 200-5000 Hz
NRC	A single-number rating system used to compare the sound-absorbing characteristics of building materials. A measurement of the acoustical absorption performance of a material, calculated by averaging its Sound Absorption Coefficients at 250, 500, 1000 and 2000 Hz
STI	Speech Transmission Index , Metric ranging between 0 and 1 representing the transmission quality of speech with respect to intelligibility by a speech transmission channel
R	Sound Reduction Index , the laboratory measured sound insulation properties of a material or building element in octave or third octave bands.
R_w	Weighted Sound Reduction Index , a single number which represents the sound reduction of a material. It is derived by plotting the sound reduction index against a set of reference curves. The curves are shifted until a best-fit is established and the curve which best fits the sound reduction spectrum is used to represent the single figure value.
D_w	Weighted Level Difference , the weighted level difference between a pair of rooms, stated as a single figure.

D_{nT}	Standardised Level Difference, a frequency-dependent measurement of airborne sound insulation, calculated using the following formula: $D_{nT} = L_1 - L_2 + 10\log(T/T_0)$ dB Where: L_1 is the energy-averaged sound pressure level due to the pink noise source measured in the source room using a sweep technique. L_2 is the energy-averaged sound pressure level measured in the receiving room using a sweep technique. T is the mean receiving room reverberation time (derived from T_{30} measured in seconds). T_0 is the reference reverberation time (= 0.5s for dwellings).
$D_{nT,w}$	Weighted Standardised Level Difference, a single-figure value of airborne sound insulation performance, derived according to procedures in BS EN ISO 717-1, based on the D_{nT} values at different frequencies (100-3150 Hz third octave bands).
$D_{n,F,w}$	Weighted, Normalised Flanking Level Difference, the normalised, weighted difference in sound level between a pair of rooms via a flanking element, such as mullion or ceiling detail. The level difference in octave bands is first normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
D_{ne}	Normalised Element Level Difference. The normalised difference in sound level between a pair of rooms via a small element such as a trickle ventilator. The level difference in octave bands is normalized to a reference amount of absorption.
$D_{n,e,w}$	Weighted, Normalised Element Level Difference. The normalised, weighted difference in sound level between a pair of rooms via a small element such as a trickle ventilator, stated as a single figure. The level difference in octave bands is normalized to a reference amount of absorption and then plotted against a set of reference curves to establish a single figure value.
C_{tr}	Spectrum Adaptation Term, a correction term applied to the sound insulation single-number values (R_w, D_{wT}, and $D_{nT,w}$) in accordance with BS EN ISO 717-1. Applying the C_{tr} penalises a construction's performance if its low frequency performance is poor in relation its performance at higher frequencies.
Impact Sound	The noise generated by an impact on a structure. This is normally used to describe the noise created by people walking or moving furniture on a floor structure.
L_{nT}	Standardised Impact Sound Pressure Level, a frequency dependent measurement of impact sound insulation, calculated using the following formula: $L_{nT} = L_1 + 10\log(T/T_0)$ dB Where: L_1 is the mean sound pressure level due to the tapping machine measured in the receiving room using a sweep technique. T is the mean receiving room reverberation time (derived from T_{30} measured in seconds). T_0 is the reference reverberation time (0.5s for dwellings)
$L'_{nT,w}$	Weighted Standardised Impact Sound Pressure Level, a single-figure value (@ 500 Hz) of impact sound insulation, performance, derived according to BS EN ISO 717-2, based on the L_{nT} values at different frequencies (100Hz- 3150 Hz third octave bands).
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence.
NR	The Noise Rating level. This is a single figure value derived by plotting a noise spectrum against a set of curves. The curve under which the spectrum fits is the resulting NR level.

APPENDIX B – NOISE SURVEY DATA- TETRA TECH REPORT

Table 2.1 Noise monitoring Locations

Ref	Description
LT1	Western part of the site, adjacent to site entrance road
ST1	Western part of the site, adjacent to the car park
ST2	West of the site, 68 Butt Lane
ST3	East of the site, between 98 and 108 Olympic Way
ST4	South-west of the site, 39 Woodland Road

Figure 2.1 Baseline Noise Monitoring Location Plan



Table 2.3 Results of Baseline Noise Monitoring Survey (Average Levels)

Period	Duration (T)	Monitoring Date and Times	Location	L _{Aeq,T} (dB)	L _{Amax,T} (dB)	L _{Amin,T} (dB)	L _{A16,T} (dB)	L _{A90,T} (dB)
Weekday Daytime 07:00 - 23:00	46 Hours	07/07/2021 – 12/07/2021 13:32 – 11:47	LT1	57.0	94.6	33.9	49.9	38
Weekday Night-time 23:00 – 07:00	24 hours	07/07/2021 – 12/07/2021 23:00 – 07:00		43.6	83.5	32.8	40.8	35
Weekend Daytime 07:00 - 23:00	32 Hours	10/07/2021 – 11/07/2021 07:00 – 23:00		46.9	90.9	34.5	45.9	40
Weekend Night-time 23:00 – 07:00	16 hours	10/07/2021 – 11/07/2021 23:00 – 07:00		42.2	84.8	33.5	41.0	36
Daytime 07:00 - 19:00	15 Mins	07/07/2021 13:39	ST1	47.8	64.1	39.9	50.1	42.3
	15 Mins	07/07/2021 15:02	ST2	63.4	93.8	38.3	65.0	43.1
	15 Mins	07/07/2021 14:41	ST3	42.3	57.3	32.6	45.9	34.7
	15 Mins	07/07/2021 15:20	ST4	59.7	74.2	33.2	64.8	38.0
	15 Mins	07/07/2021 13:54	ST1	50.4	72.8	40.4	49.6	43.0
	15 Mins	07/07/2021 16:01	ST2	60.9	85.8	39.8	60.2	43.2
	15 Mins	07/07/2021 15:42	ST3	45.2	67.4	35.9	47.4	39.0
	15 Mins	07/07/2021 16:17	ST4	60.3	77.4	35.8	64.1	40.3
Evening 19:00 - 23:00	15 Mins	07/07/2021 22:43	ST2	54.2	75.9	34.8	51.7	36.5
	15 Mins	07/07/2021 22:16	ST3	31.8	40.4	27.2	33.6	29.5
	15 Mins	07/07/2021 21:50	ST4	47.0	73.5	28.3	36.8	30.4
Night-time 23:00 - 07:00	15 Mins	07/07/2021 23:55	ST2	43.0	75.2	31.4	38.8	33.9
	15 Mins	07/07/2021 23:35	ST3	45.5	59.5	29.0	49.1	30.9
	15 Mins	07/07/2021 23:02	ST4	49.0	72.7	31.4	49.0	34.1

All values are sound pressure levels in dB re: 2x 10⁻⁵ Pa

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Final Audit Report

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