Environmental Noise Assessement

Ysgol Plas Brondyffryn

Ystrad Road, Denbigh

Stroma Built Environment Ltd.

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II. Executive Summary

Stroma Built Environment (SBE) has been appointed to provide acoustic consultancy for the proposed Ysgol Plas Brondyffryn Special Educational Needs School development in Denbigh. The scheme involves the construction of a new two storey building on a site currently occupied by playing fields owned by the neighbouring Denbigh High School.

The purpose of this report is to provide a review of the proposed acoustic design with regard to satisfying the *Acoustic design of schools: performance standards Building Bulletin 93* (BB93) design requirements.

SBE has carried out a noise survey at the development site to assess noise levels incident on the new building façade, and to establish prevailing background noise levels. The noise climate at the site is relatively quiet, controlled by distant road traffic noise, surrounding resident and pedestrian activity, noise from activity on the artificial grass pitch, and bird song.

There are various indoor ambient noise level (IANL) criteria defined in BB93 for different spaces. Measured noise levels have been used to inform the building envelope requirements with respect to control of external noise intrusion. Minimum façade element performances are given and typical building envelope design will be suitable for the scheme with no requirement for acoustic upgrades.

The roof construction must provide adequate sound insulation to prevent both external noise break in and provide suitable control of rain noise. A lightweight roof build-up may need to incorporate a resilient acoustic layer to meet the rain noise requirements.

If applicable, double glazed roof lights will meet acoustic requirements. Conversely, polycarbonate roof lights are unlikely to be viable in teaching and learning spaces or the halls.

The proposed hybrid ventilation strategy predominantly uses hybrid ventilation units ducted to the façade to provide ventilation without the need to open windows, thereby maintaining the sound insulation of the building envelope. Occupants are given the choice to open windows if desired without having to do so to provide normal ventilation.

A requirement for the project is to be ‘Net Zero Carbon’. In order to achieve this, natural ventilation must be employed. The proposed hybrid ventilation strategy to classrooms uses a combination of natural ventilation via open windows and hybrid ventilation units (HVUs) to boost ventilations rates as and when required. Based on measured site noise levels and assessment of noise propagation across the site, noise levels incident on new building façades are relatively low and, therefore, a natural ventilation strategy using open windows is viable for all spaces throughout the building and will result in IANLs compliant with BB93 requirements.

When the existing artificial grass pitch to the north of the site is in use it generates elevated noise events and, given the sensitive nature of students, there is a risk of these noise events intruding into classrooms on the most northerly building elevation unmitigated. However, the hybrid ventilation strategy means that occupants can close windows while the pitch is in use. With closed windows, break-in noise levels are predicted to be low.

Based on measured site noise levels, partially open windows and/or open vents may be employed to all spaces to enhance ventilation to control summertime overheating during the hottest 200 hours of the year, or provide intermittent boost ventilation (e.g. to expel fumes during practical activities), throughout the building. However, in SEN teaching and learning spaces (i.e. Classrooms, Group Rooms & Therapy Rooms) noise from mechanical building services must not exceed the IANL (≤ 30 dB $L_{Aeq,30min}$). In all other spaces, noise from mechanical building services may exceed the IANL by up to 5 dB when providing enhanced ventilation to control summertime overheating during the hottest 200 hours of the year or providing intermittent boost ventilation.

Based on measured site noise levels, external areas across the site are exposed to noise levels of 55 dB $L_{Aeq,30min}$ or less thereby meeting recommendations.

The new site car park and drop-off points are accessed by Ystrad Road. The proposed parking arrangement will feature staff and visitor car park spaces as well as bus drop off / pick up points. It is anticipated that the majority of staff will travel to the site by car and the majority of students will arrive by bus or minibus. Calculations indicate that this will result in higher peak use noise levels of limited duration at the start and end of the school day, however, noise levels averaged over the daytime are no higher than prevailing noise levels.

A pair of new MUGA courts is proposed to the north-west of the site. The MUGA has been moved to the east and a 3 m high closeboard timber acoustic fence has been added along the north and west sides of the MUGA to mitigate the risk of noise impact to nearby dwellings to the west. With consideration to the site context, prevailing noise climate and a predicted cumulative noise increase of up to +2 dB at the nearest dwellings, noise due to the new MUGA is considered to have a minor impact and no further mitigation measures are considered to be necessary.

Representative background noise levels measured at the nearest dwellings have been used to inform noise limits proposed for any new sources of building services noise introduced by the scheme, in line with guidance in BS 4142:2014 *Methods for rating and assessing industrial and commercial sound*.

III. Contents

1. Introduction

1.1 Stroma Built Environment (SBE) has been appointed by Wates Construction to provide acoustic consultancy for the proposed Ysgol Plas Brondyffryn Special Educational Needs (SEN) School development off Ystrad Road in Denbigh, Denbighshire, north Wales.

1.2 The development involves erection of a new Ysgol Plas Brondyffryn Special Educational Needs (SEN) School for ages 3-19, including formation of Multi Use Games Areas (2no.), external plant / services area, new 118 space car parking area (including 14 electric charging bays), minibus parking (4no.), cycle parking (60no.), designated drop off area, new vehicular access off Ystrad Road, extension / improvements to existing active travel route, community café, landscaping works and all other associated works. The illustrative site masterplan is included in Appendix II.

1.3 The purpose of this assessment is to consider the existing noise climate around the proposed development site in relation to the acoustic influence on the development, and assess the noise impact due to the scheme with consideration to existing background sound levels at nearby noise sensitive premises.

1.4 SBE has carried out a baseline noise survey to assess the noise climate at the development site, with consideration to the acoustic influence on the development with regard to satisfying the *Acoustic design of schools: performance standards Building Bulletin 93* (BB93) design requirements. Provisional noise limits for items of plant associated with the development are provided.

1.5 Recommendations are provided to inform the acoustic design of the scheme; these may change as the scheme develops and, therefore, may need to be updated accordingly. Information is up to date at the time of issue.

1.6 This document has been prepared for the sole use, benefit and information of Wates Construction for the purposes set out in the document or instructions commissioning the works. The liability of SBE in respect of the information contained herein will not extend to any third party.

1.7 This report is limited to addressing the specific acoustic issues contained herein and is based on information and drawings provided by the client.

1.8 Whilst every effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix III.

2. Relevant Acoustic Standards

Building Bulletin 93 *'Acoustic design of schools: performance standards'*

2.1 Section 8 of Approved Document E states that the normal way of satisfying Requirement E4 of Part E to Schedule 1 of the Building Regulations 2010 for new school buildings is to meet the performance standards set out in Building Bulletin 93 *'Acoustic design of schools: performance standards'* (BB93).

2.2 Section 1.1 of BB93 presents indoor ambient noise level (IANL) upper limit criteria for various types of teaching, study, and ancillary spaces. Teaching spaces are required to achieve an IANL ≤ 35 dB $L_{Aeq,30min}$. Teaching spaces intended specifically for students with special hearing and communication needs are to achieve an IANL of ≤ 30 dB $L_{Aeq,30min}$. In addition, BB93 states that the indoor ambient noise level should not regularly exceed 60 dB $L_{A1,30min}$.

2.3 BB93 IANL criteria include contributions from external sources outside the school premises and building services noise but exclude contributions from teaching activity/equipment, staff, and students within the school premises.

Acoustics of Schools: a design guide

2.4 The Acoustics of Schools: a design guide, published jointly by the Institute of Acoustics (IOA) and Acoustics & Noise Consultants (ANC) in November 2015, is the accompanying guidance document to BB93.

Planning Guidance

National Planning Policy Framework

2.5 The current planning guidance for the assessment of the potential environmental noise impact is outlined in the National Planning Policy Framework (NPPF). Whilst the NPPF does not set criteria that must be achieved, the NPPF states the following in relation to the appropriate control of potential noise impacts (paragraph 170):

> *"The planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability…"*

2.6 Therefore, the policy requires that new developments are not affected to an unacceptable degree by environmental noise.

Planning Policy for Wales

2.7 The Planning Policy for Wales, Edition 11, February 2011 provides further guidance on the Welsh Government's policy with regard to the delivery of sustainable development and improving the social,

economic, environmental and cultural well-being of Wales. 'Air quality and Soundscape' are considered together and the policy states:

"Clean air and an appropriate soundscape contribute to a positive experience of place as well as being necessary for public health, amenity and well-being. They are indicators of local environmental quality and integral qualities of place which should be protected through preventative or proactive action through the planning system. Conversely, air, noise and light pollution can have negative effects on people, biodiversity and the resilience of ecosystems and should be reduced as far as possible." (6.7.1)

WHO *'Guidelines for Community Noise'*

2.8 The World Health Organisation (WHO) has published guidelines that relate to acceptable levels of noise from a health perspective detailed in the WHO 'Guidelines for Community Noise', 1999. The document sets out the following criteria that should be achieved on residential balconies, terraces and in outdoor living areas to protect the majority of people from being annoyed during the daytime, outlined in Table 1.

Table 1: Guideline values for community noise in specific environments (WHO)

Specific Environment	Guidance	Criteria Limit $L_{Aeq,16hr}$ (dB)
Outdoor living area	'Few seriously annoyed' in outdoor living areas	≤ 55
	'Few moderately annoyed' in outdoor living areas	≤ 50

IEMA *'Guidelines for Environmental Noise Impact Assessment'*

2.9 The document '*Guidelines for Environmental Noise Impact Assessment'* published by the Institute of Environmental Management and Assessment (2014) provides further guidance and suggests that the daytime threshold of Lowest Observed Adverse Effect Level is typically 50 dB $L_{Aeq,16hours}$ for residential dwellings.

2.10 Table 7-14 from the document provides guidance on assessing the impact due to a change in environmental noise level (originally from the HS2 Phase I Environmental Statement) and is reproduced in Table 2.

Table 2: Typical interpretation of impact from a change in sound level

Long-term Impact Classification	Short-term Impact Classification	Sound level change dB $L_{Aeq,T}$ (positive or negative) T = either 16hr day or 8hr night
Negligible	Negligible	≥ 0 dB and < 1 dB
	Minor	≥ 1 dB and < 3 dB
Minor	Moderate	≥ 3 dB and < 5 dB
Moderate	Major	≥ 5 dB and < 10 dB
Major		≥ 10 dB

2.11 While withdrawn, Planning Policy Guidance 24: Planning and Noise (1994) still contains relevant guidance, and the glossary states: *"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."*

Control of External Noise Impact from Building Services

2.12 It is recommended that the cumulative noise level of all operational plant does not exceed the representative background noise level at the nearest residential properties, and that this be assessed in accordance with the relevant method as set out in BS 4142:2014 *'Methods for rating industrial and commercial sound'*.

BS 4142:2014 *'Methods for rating and assessing industrial and commercial sound'*

2.13 BS 4142 describes a method for assessing the likelihood of complaints from noise sources that are of an industrial nature (e.g. fans, pumps, chillers, air handling units etc.). The assessment methodology is based upon determining a 'rating level' for the equipment being assessed, which is the level of noise from the item or items of plant being assessed (measured as an L_{Aeq}). The rating level is then compared with the underlying background noise level (measured as a L_{A90}) in the absence of noise from the item or items of plant being assessed.

2.14 BS 4142 states that a penalty should be added for any plant which gives rise to noise features that may increase disturbance such as tonal, impulsive or intermittent characteristics. Generally, a rating penalty for a sound should be based on a subjective assessment of its characteristics.

Operational Noise Impact

2.15 Consideration should be given to the potential for an adverse impact on the noise climate due to the operation of the new school. Similarly, to a plant noise impact assessment in terms of noise, the impact of a development is considered relative to the existing noise climate and with particular reference to noise sensitive receptors.

Sport England Guidance

2.16 The Sport England document *'Artificial Grass Pitch (AGP) Acoustics - Planning Implications'*, 2015, provides guidance on noise levels for artificial pitches and Multi Use Games Areas (MUGAs), including provision of typical noise levels, stating:

"a typical free-field noise level of 58 dB LAeq(1 hour) at a distance of 10 metres (m) from the side-line halfway marking has been determined as representative for noise from an AGP."

3. Baseline Noise Survey

Site Description

3.1 The development site is situated on existing Denbigh High School premises, currently used as playing fields. The site shall be accessed via Ystrad Road, off Ruthin Road. The site is currently owned by the neighbouring Denbigh High School (Ysgol Uwchrad Dinbych), however, it is separated from the bulk of the High School site by Clwyd Avenue.

3.2 The site is bound by Denbigh Leisure Centre and a floodlit artificial grass pitch (AGP) to the north, by Ystrad Road and residential premises to the east, by agricultural fields to the south, and by Clwyd Avenue and residential premises to the west with 'Middle Parc', Denbigh Town FC playing fields beyond. Plas Brondyffryn School and Denbigh High School are also located beyond Clwyd Avenue to the north-west. There is a pedestrian and cycle path that currently runs along the southern and eastern site boundary.

3.3 The floodlit AGP to the north is owned by Denbigh Leisure Centre, but it is understood that Denbigh High School regularly use the pitch.

3.4 The closest identified noise sensitive receptors (NSR) to the development are residential premises on Ystrad Road to the east (NSR A) and on Clwyd Avenue to the west (NSR B), indicated in Figure 1 below.

Noise Survey

3.5 A baseline noise survey has been undertaken at the site in order to assess noise levels incident on the new building façade and to establish prevailing background noise levels at noise sensitive premises. Long term noise measurements were obtained between Friday 21st and Tuesday 25th January 2022.

3.6 Measurements were obtained at position LT1 in the north-eastern corner of the site, and at position LT2 at the south-western boundary. Measured noise levels at these positions are considered to be representative of background noise levels at surrounding residential premises.

3.7 An aerial image of the site with the noise survey positions are indicated in Figure 1 below. Table 3 presents a summary of measured noise levels, with plots of measurements in Appendix I.

3.8 The microphone at position LT1 was mounted on a bracket fixed to a fence post on the south-eastern corner of the AGP around 2.0 m above the ground. The microphone at position LT2 was mounted on a tripod approximately 1.5 m above the ground. All measurements were obtained using calibrated NTI XL2-TA Class 1 sound level meters. Microphones were fitted with weather protection throughout. The sound level meters are equipped with audio recording to facilitate identification of noise sources.

3.9 As the microphone at position LT2 was within 1 m of the corner of a standalone garage building, a conservative 1.5 dB façade correction has been applied to reflect free field noise levels.

3.10 Weather conditions during the attended survey period were settled with a high pressure system present throughout the survey period. On Friday 21st January the weather was noted as being calm, dry and mild (7°C) but overcast, wind speeds less than 5 ms^{-1}. On Wednesday 26th January the weather was observed as being calm, dry, sunny and mild with little to no cloud cover and negligible wind. Weather conditions are considered to be suitable for the noise survey.

3.11 Prevailing noise levels across the site were found to be controlled by distant road traffic noise, surrounding resident and pedestrian activity, noise from activity on the AGP (particularly at position LT1), and bird song. Construction activity was in progress in Denbigh Leisure Centre car park which influenced measured noise levels during working hours on weekdays at position LT1. It is noted that the AGP did not appear to be in use until 18:30 on Friday 21st and 15:30 on Monday 24th.

3.12 At one point on Sunday afternoon it sounded like a helicopter landed nearby and took off shortly afterwards; the noise levels were so great that it had a significant influence on measured noise levels. This is taken to be an atypical occurrence and results are presented with the event excluded.

Figure 1: Aerial image of the site with noise survey positions

Table 3: Noise measurement summary

Position	Date	Period	Measured sound pressure level, dB			
			$L_{Aeq,T}$	$L_{A90,T}$	$L_{A10,T}$	$L_{A1,T}$
LT1	21/1/22	Daytime: 11:30-23:00	51	38	54	60
	21/1/22 - 22/1/22	Night time: 23:00-07:00	43	26	36	46
	22/1/22	Daytime: 07:00-23:00	52	35	52	61
	22/1/22 - 23/1/22	Night time: 23:00-07:00	35	25	34	49
	23/1/22	Daytime: 07:00-23:00	64 / 56[2]	30 / 30[2]	50 / 49[2]	63 / 56[2]
	23/1/22 - 24/1/22	Night time: 23:00-07:00	37	24	36	50
	24/1/22	Daytime: 07:00-23:00	55	38	58	64
	24/1/22 - 25/1/22	Night time: 23:00-07:00	38	23	36	51
	25/1/22	Daytime: 07:00-07:20	45	37	48	56
LT2[1]	21/1/22	Daytime: 11:45-23:00	42	31	46	50
	21/1/22 - 22/1/22	Night time: 23:00-07:00	37	20	29	36
	22/1/22	Daytime: 07:00-23:00	41	28	41	50
	22/1/22 - 23/1/22	Night time: 23:00-07:00	29	20	27	38
	23/1/22	Daytime: 07:00-23:00	51 / 38[2]	24 / 24[2]	40 / 40[2]	57 / 48[2]
	23/1/22 - 24/1/22	Night time: 23:00-07:00	29	21	32	40
	24/1/22	Daytime: 07:00-23:00	44	32	47	52
	24/1/22 - 25/1/22	Night time: 23:00-07:00	27	19	30	37
	25/1/22	Daytime: 07:00-12:55	42	34	43	52

Notes to Table 3:

[1] 1.5 dB façade correction applied to reflect free field noise levels

[2] Excluding the helicopter landing and take-off

4. Building Envelope Sound Insulation

4.1 A site noise survey has been undertaken by SBE and detailed in Section 3. Measured noise levels have been used to inform the building envelope requirements with respect to control of external noise intrusion.

4.2 The northern building elevation faces the AGP which is the most significant regular noise source that affects the development site. Therefore, the northern building elevation is the most noise affected.

4.3 Concerns have also been raised about the risk of noise intrusion from the new school car park and drop off areas immediately outside the eastern building elevation to the east of the site. On this basis, the eastern building elevation is also considered to be more noise exposed in operation.

4.4 Break-in calculations used to inform specification of the building envelope sound insulation have given particular consideration to noise from the AGP based on elevated noise levels measured during periods of the survey when it appeared to be used for hockey and football.

IANL Requirements

4.5 There are various indoor ambient noise level (IANL) criteria defined in BB93 for different spaces. For new build classrooms specifically intended for use by children with special educational needs IANL should not exceed 30 dB $L_{Aeq,30min}$. Practical teaching spaces have less onerous IANL requirements. A selection of BB93 room types and IANL requirements applicable to the development are set out in Table 4. Note that IANL criteria apply with the ventilation scheme operating under normal conditions.

Table 4: Selection of BB93 IANL requirements

Type of Room	Upper limit for the IANL dB $L_{Aeq,30mins}$
Teaching Space intended specifically for students with special hearing and communication needs, i.e. Classrooms, Group Rooms & Therapy Rooms	30
SEN calming room, Sensory, Inclusion	35
Multi-purpose hall (drama, PE, audio/visual presentations, assembly, occasional music), Music rooms	35
Practical teaching spaces: Food, Art, Graphics, Design Technology, ICT rooms, Science Laboratories	40
Libraries, Open plan resource/breakout areas	40
Dining room	45

4.6 Furthermore, in order to protect students from regular discrete noise events (the examples given in BB93 are aircraft or trains passing) indoor BB93 states that the internal noise level should not regularly exceed 60 dB $L_{A1,30min}$.

Building Envelope Sound Insulation

4.7 The building envelope must be specified to provide adequate sound reduction of external noise levels to achieve IANL. The following minimum façade element performances outlined in Table 5 are calculated to provide BB93 compliant IANL with windows closed.

Table 5: Minimum building façade sound insulation requirements

Building Element	Minimum Airborne Sound Insulation Performance	
	Enhanced treatment to teaching spaces on the most noise exposed façades (i.e. north & east facing)	All other elevations
Walls	45 dB R_w	
Façade glazing	35 dB R_w	30 dB R_w
Roof	32 dB R_w	
Rooflights	27 dB R_w	

4.8 Based on the above façade sound insulation requirements, the overall sound insulation performance of the external building envelope is likely to be dictated by the glazing as this is typically the weakest acoustic element. It is noted that thermal double glazing typically employed for thermal purposes are likely to be rated 35 dB R_w or higher.

4.9 Façade constructions are to be based on a Structural Insulated Panels (SIPS) with an internal plasterboard lining on SFS and external brickwork or rain screen panels. This system will be capable of meeting the sound insulation requirements in Table 5. Proposals will be reviewed at the technical design stage to confirm compliance.

4.10 Typical building envelope design will be suitable for the scheme with no requirement for acoustic upgrades.

4.11 Break-in calculations also consider the sound insertion loss through HVUs based on acoustic laboratory testing of typically used units.

Roof Construction

4.12 The roof construction must provide adequate airborne sound insulation to prevent external noise break in. Areas of roof comprising of concrete planks will be capable of meeting the sound insulation requirement outlined in Table 5. A lightweight construction, such as a single ply membrane, rigid insulation panels and metal profile roof liner sheet is viable and should also be capable of meeting the sound insulation requirement outlined in Table 5.

4.13 Although rain noise is excluded from the definition of indoor ambient noise in Section 1 of BB93, the guidance states submissions should demonstrate that lightweight roofs (<150 kg/m^2) and roof glazing (if applicable) have been designed to provide suitable control of rain noise reverberant sound pressure level in a space. Levels during heavy rain should not be more than 25 dB above the relevant IANL in Table 4.

4.14 To meet this requirement lightweight roof build-ups such as the aforementioned single ply construction may need to incorporate a resilient acoustic mat (e.g. SIG D&T acoustic mat, Regupol or similar) to meet rain noise requirements. If the roof is of lightweight construction with greater mass, is a green roof, or is surfaced with ballast or paving slabs, then the inclusion of a resilient acoustic mat is not necessary.

4.15 Double glazed roof lights will meet rain noise requirements. Polycarbonate roof lights do not tend to mitigate rain noise drumming as well as double glazed roof lights and, therefore, are unlikely to be viable in teaching and learning spaces or the Halls.

5. Ventilation Strategy

Normal Ventilation

5.1 Section 1.1.3 of BB93 addresses natural and hybrid (natural/mechanical) ventilation in schools and states that a 5 dB relaxation of BB93 IANL is applicable to teaching spaces when the proposed ventilation systems are operating in their normal condition, which is also defined:

"The upper limit for the indoor ambient noise level may be increased by 5 dB when natural/hybrid ventilation limits the daily average carbon dioxide concentration to no more than 1,500 ppm with the maximum concentration not exceeding 2,000 ppm for more than 20 consecutive minutes on any day. This would normally equate to a minimum ventilation rate of approximately 5l/s per person."

5.2 A requirement for the project is to be 'Net Zero Carbon'. In order to achieve this, natural ventilation must be employed as extensively as possible.

5.3 The proposed hybrid ventilation strategy to classrooms uses a combination of natural ventilation via open windows and hybrid ventilation units (HVUs) located within rooms and ducted to the façade to boost ventilations rates as and when required. Occupants are given the choice to open windows if desired without having to do so to provide ventilation and be exposed to excessive external noise intrusion.

5.4 Based on measured site noise levels and assessment of noise propagation across the site, noise levels incident on new building façades are relatively low and, therefore, a natural ventilation strategy using open windows is viable for all spaces throughout the building and will result in IANLs compliant with BB93 requirements.

5.5 When the existing AGP is in use it generates elevated L_{AFmax} noise events, such as ball impacts on the sideboards and fences. Given the sensitive nature of students, there is a risk of these noise events intruding into SSP classrooms on the most northerly building elevation unmitigated. However, the hybrid ventilation strategy means that should this be the case, the option remains to close windows while the pitch is in use to maintain the sound insulation of the building façade. With closed windows, break-in noise levels are predicted to be low with L_{AFmax} noise events ≤ 30 dBA, which is lower than the IANL.

5.6 The proposed hybrid ventilation strategy for large multipurpose halls on the east facing building elevation comprises of closable louvred openings on the façade and slot windows at high level on the opposite side of the hall providing crossflow ventilation. Again, there is an option to close louvres if required to control the break-in of noise from activity in the school car park, however, as much of the activity in the car park occurs at the beginning and end of the school day this is not anticipated to be necessary.

Control of Summertime Overheating

5.7 BB93 permits elevated IANLs to certain spaces to mitigate summertime overheating allowable during the hottest 200 hours of the year (which includes the summer holiday period), however, this does not apply to spaces with an IANL requirement of 30 dB $L_{Aeq,30min}$, i.e. Classrooms, Group Rooms & Therapy Rooms.

5.8 Control of summertime overheating to Classrooms, Group Rooms & Therapy Rooms may be achieved with partially open windows and/or open vents. However, noise specifically due to mechanical systems (e.g. AHU [air handling units], HRU [heat recovery units], HVU [hybrid ventilation units], or FCU [fan coil units], etc.) must not exceed the IANL criterion, i.e. ≤ 30 dB $L_{Aeq,30min}$.

5.9 For all other spaces with an IANL limit of 35 dB $L_{Aeq,30min}$ or higher (i.e. all spaces except for Classrooms, Group Rooms & Therapy Rooms) elevated IANLs are permitted to mitigate summertime overheating allowable during the hottest 200 hours of the year. The ventilation must be under the local control of the teacher so that the noise level can be reduced to normal levels when needed. Noise specifically due to mechanical systems must not exceed the specific BB93 room IANL by more than 5 dB.

Intermittent Boost Ventilation

5.10 BB93 permits elevated IANLs for short periods to provide intermittent boost ventilation, e.g. to expel fumes during practical activities. The ventilation must be under the local control of the teacher so that the noise level can be reduced to normal levels when needed. Open windows may be used to provide intermittent boost ventilation throughout the building.

Table 6: BB93 requirements for IANL tolerance

Ventilation condition	Noise limit	
	30 dB ($L_{Aeq,30mins}$), i.e. Classrooms, Group Rooms & Therapy Rooms	35 dB or higher ($L_{Aeq,30mins}$), i.e. all other spaces (see IANL limits Table 4)
Normal ventilation – vents / windows closed	30 dB	IANL
Normal ventilation – windows / vents open (where permissible)	30 + 5 dB	IANL + 5 dB
Summertime (allowable during hottest 200 hours of the year, including summer holidays)	as above	≤ 55 dB
Intermittent boost	n/a	≤ 55 dB

6. External Teaching Areas

6.1 Section 2.2 of the Acoustics of School: a design guide states that:

"Although Requirement E4 does not apply to external noise, the following recommendations are considered good practice for providing suitable acoustic conditions outside school buildings. […]

Noise levels in unoccupied playgrounds, playing fields and other outdoor areas should not exceed 55 dB $L_{Aeq,30min}$ and there should be at least one area suitable for outdoor teaching activities where noise levels are below 50 dB $L_{Aeq,30min}$."

6.2 Based on measured site noise levels, the majority of external areas across the site are exposed to noise levels of less than 55 dB $L_{Aeq,30min}$, and external areas towards the west of the site, and particularly areas between the wings of the building that extend westwards, will be exposed to noise levels of less than 50 dB $L_{Aeq,30min}$, thereby meeting recommendations.

7. Development Noise Impact Assessment

Operational Noise Impact

7.1 The new site car park and drop-off points are accessed by Ystrad Road. The proposed parking arrangement will feature 118 staff and visitor car park spaces as well as bus drop off / pick up points. The majority of staff will travel to the site by car, however, the majority of students will arrive by bus or minibus. Therefore, an assessment is required to gauge the potential noise impact on nearby NSRs.

7.2 It is anticipated that the majority of vehicle movements in the car park will arrive or leave at the start or end of the school day, with a reduced number of vehicle movements during the day. It is assumed that there will be up to 108 cars and up to 10 buses accessing the site per hour at the start and end of the day.

7.3 Calculations indicate that the highest noise level at nearby residential houses will be up to 60 dB $L_{Aeq,1hr}$ at the start and end of the day, however, averaged over the daytime this reduces to up to 51 dB $L_{Aeq,16hr}$, which is no higher than prevailing noise levels measured nearby at position LT1. Furthermore, the average daytime noise level is in line with WHO guidance set out in Table 1. Higher peak use noise levels will be of limited duration at the start and end of the school day.

7.4 Based on the above, it is not considered necessary to provide mitigation to reduce noise levels from the new car park.

Sport Facilities Noise Impact Assessment

7.5 A pair of new MUGA courts is proposed to the north-west of the site (see illustrative landscape masterplan in Appendix II). Following liaison with the design team, the MUGA has been moved to the east to increase the distance from houses on Clwyd Avenue, and a 3 m high closeboard timber acoustic fence has been added along the north and west sides of the MUGA.

7.6 It is understood that the MUGA may be available for community use immediately after school hours and during the weekend, but during daytime only and not into the evening period, i.e. not after 18:00. Furthermore, flood lighting will not be provided to the MUGA.

7.7 To assess the potential acoustic impact of the sports facilities, proposed site layouts have been modelled using Cadna-A sound mapping software. Noise from the MUGA has been modelled both in isolation and when the existing AGP is in use to assess the cumulative noise level.

7.8 MUGA noise levels are based on guidance on noise levels for artificial pitches from the Sport England document *'Artificial Grass Pitch (AGP) Acoustics - Planning Implications'* – see paragraph 2.16.

7.9 Existing AGP noise levels are based on those measured at position LT1 during periods when the pitch was clearly in use.

7.10 Measured noise levels during the daytime periods only, i.e. 07:00-19:00, excluding the evening period, were 53 dB $L_{Aeq,8hr}$ at position LT1 and 44 dB $L_{Aeq,8hr}$ at position LT2. However, measured noise levels at position LT1 were influenced by construction activity in Denbigh Leisure Centre Car Park, therefore assessment is against the measured daytime noise level of 44 dB $L_{Aeq,8hr}$ at position LT2.

7.11 Assessment of MUGA noise has been considered at the rear of the nearest residential premises on Clwyd Avenue (NSR B), i.e. the nearest NSR to the MUGA.

7.12 An image of the CADNA-A sound map model with $L_{Aeq,T}$ noise contours due to MUGA use is included in Figure 2 on the following page. An image of the CADNA-A sound map model with $L_{Aeq,T}$ noise contours due to MUGA use, existing AGP use and both MUGA and existing AGP use is included in Figure 2, Figure 4 and Figure 4 below. The predicted noise levels and impact are summarised in Table 7 and Table 8.

Table 7: MUGA noise impact assessment

Representative daytime noise level, dB $L_{Aeq,8hr}$	Noise level due to MUGA use, dB $L_{Aeq,T}$	Change dB	Exceeds 50 dB $L_{Aeq,16hr}$?	Short term impact classification	Long-term impact classification
44	44	0	No	Negligible	Negligible

Table 8: MUGA noise impact assessment

Noise level due to existing AGP use, dB $L_{Aeq,T}$	Cumulative noise level due to existing AGP and new MUGA, dB $L_{Aeq,T}$	Change dB	Exceeds 50 dB $L_{Aeq,16hr}$?	Short term impact classification	Long-term impact classification
46	48	+2	No	Moderate	Minor

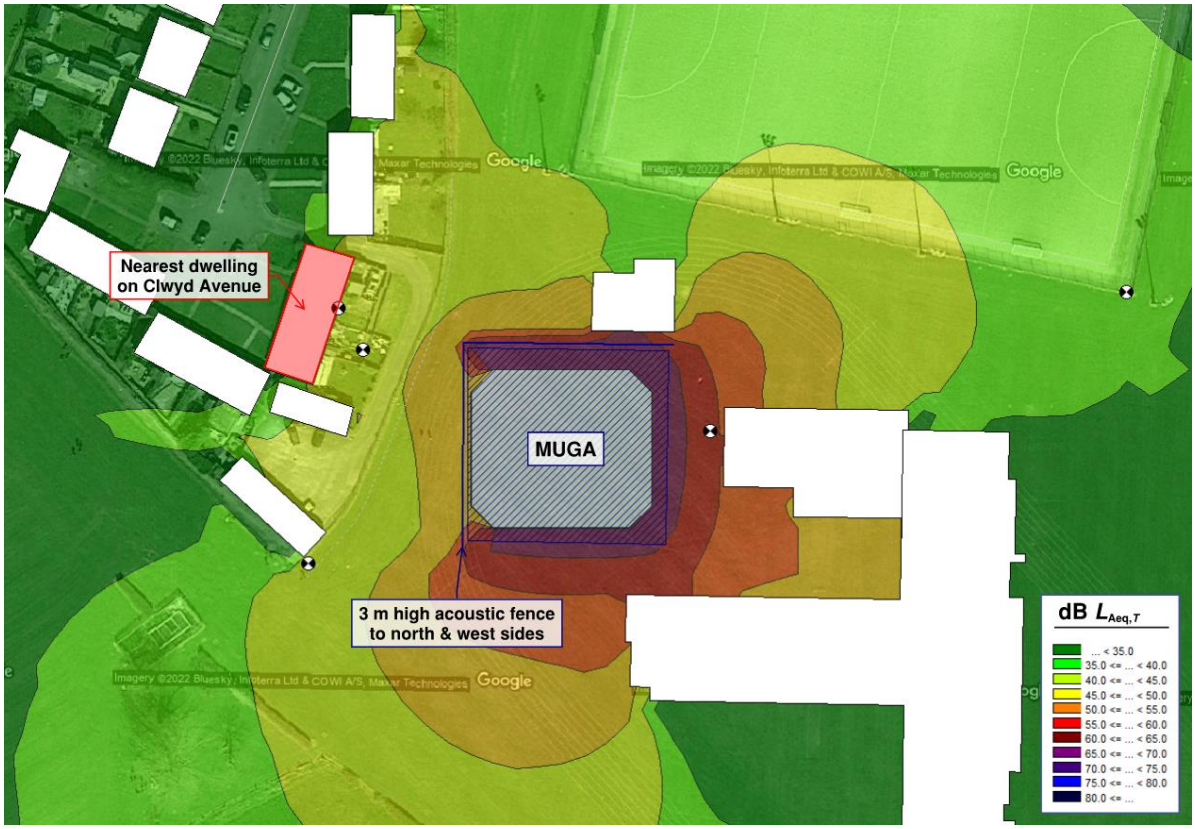

Figure 2: $L_{Aeq,T}$ noise contours due to MUGA use

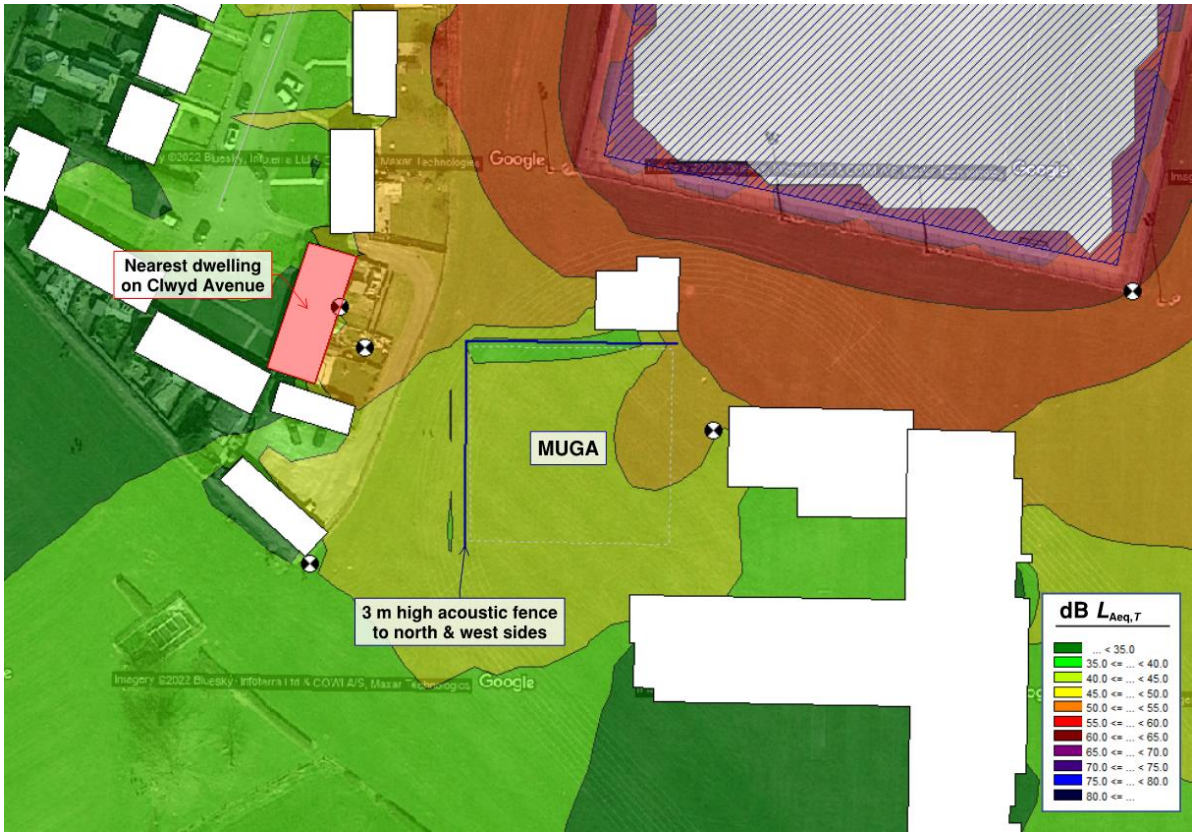

Figure 3: $L_{Aeq,T}$ noise contours due to existing AGP use

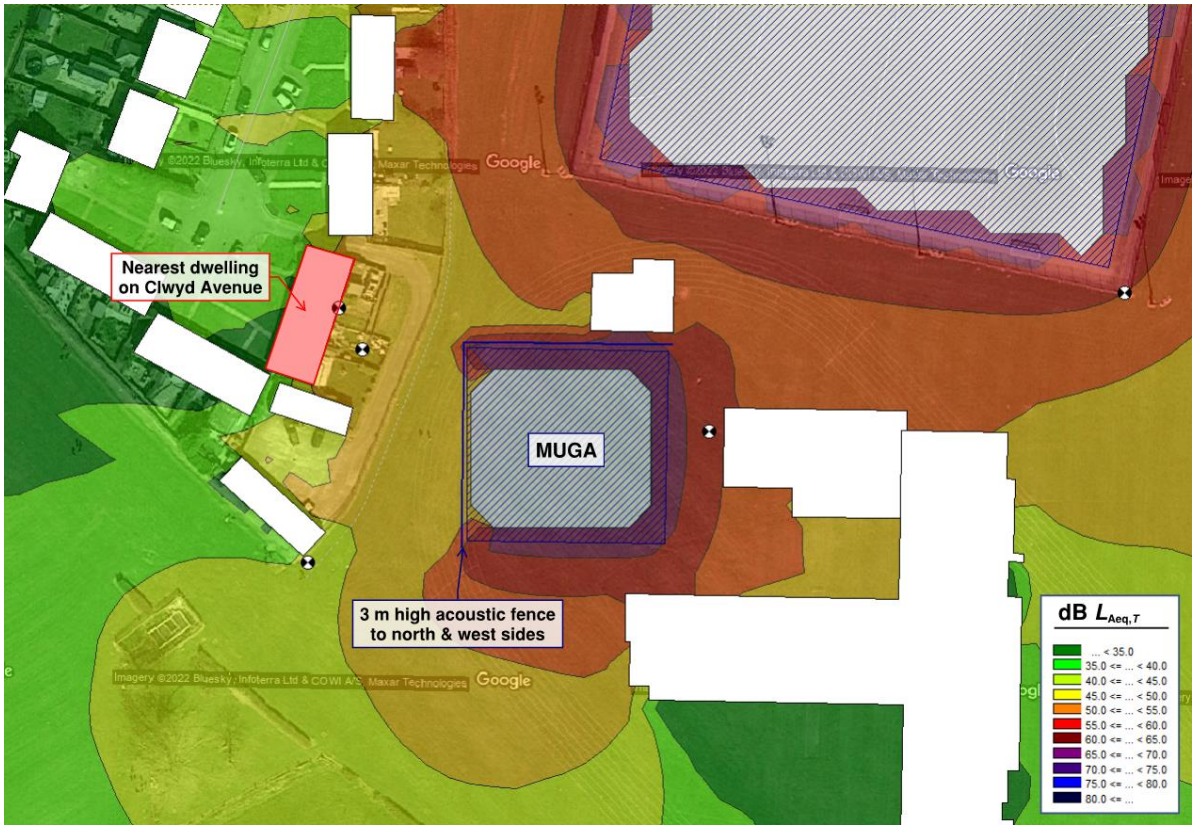

Figure 4: $L_{Aeq,T}$ noise contours due to existing AGP and MUGA use

7.13 The potential noise impact of the new MUGA must be considered within context of the site:

- The field is an existing school sports field and the existing AGP is used regularly. Clwyd Avenue is surrounded by Denbigh High School, Plas Brondyffryn School, Denbigh Town FC, Middle Parc, the existing school playing fields and Denbigh Leisure. The nature of noise from the new MUGA will not differ significantly from existing and surrounding site uses. Nearby residents will be accustomed to the noise climate and are unlikely to perceive an adverse impact.
- Based on our noise survey, the existing AGP is used later in the day and on weekends. As the proposed use for the new MUGA is predominantly during the daytime before 18:00, therefore, there will be limited periods when both the existing AGP and the new MUGA will be in use.
- It is understood that residents in dwellings on Ystrad Road to the east of the site have previously expressed concerns about noise; the new MUGAs are located to the west of the new building which will screen MUGA noise so that it does not impact dwellings on Ystrad Road.

7.14 Based on the assessment, with consideration to the site context, prevailing noise climate and a predicted cumulative noise increase of up to +2 dB at the nearest dwellings, noise due to the new MUGA is considered to have a minor impact. On this basis, no further mitigation measures are considered to be necessary.

7.15 The 3 m high closeboard timber acoustic fence along the north and west sides of the new MUGA must have no holes or weaknesses in the structure with a mass not less than 10 kg/m^2. There must be no gaps between the fence and the ground.

8. Mechanical Services Noise

Internal Mechanical Services Noise

8.1 BB93 internal ambient noise limits include the total noise from all building services, as well as noise from external sources. Therefore, noise emissions from building services must be designed to be sufficiently below the BB93 internal ambient noise limit so that cumulative noise levels remain within the relevant criterion.

8.2 Where Classrooms, Group Rooms & Therapy Rooms mechanical systems are operating to control summertime overheating, BB93 states that the noise level due to building services must not exceed the IANL criterion, i.e. ≤ 30 dB $L_{Aeq,30min}$.

8.3 Where all other teaching and learning spaces mechanical systems are operating to control summertime overheating, BB93 states that the noise level due to building services may exceed the IANL criterion by a maximum of 5 dB, allowable during the hottest 200 hours of the year.

Table 9: BB93 requirements for control of internal mechanical services noise

Ventilation condition	Mechanical services noise limit	
	30 dB ($L_{Aeq,30mins}$), i.e. Classrooms, Group Rooms & Therapy Rooms	35 dB or higher ($L_{Aeq,30mins}$), i.e. all other spaces (see IANL limits Table 4)
Normal ventilation – vents / windows closed	30 dB	IANL
Normal ventilation – windows / vents open (where permissible)	30 dB	IANL
Summertime (allowable during hottest 200 hrs of the year, including summer holidays)	30 dB	IANL + 5
Intermittent boost	30 + 5 dB	IANL + 5

8.4 Mechanical systems, such as classroom HRUs, are to be designed such that the noise level outside any openable windows / ventilation openings does not exceed 45 dB $L_{Aeq,T}$.

External Mechanical Services Noise

8.5 It is common for Local Authority planning requirements to require a noise impact assessment. At the time of writing SBE are not aware of any specific noise impact assessment requirements for planning, however, it is good practice to control noise from mechanical services to ensure minimal impact on nearby noise sensitive premises. It is therefore recommended that noise from new building services plant does not exceed the representative background noise level when assessed at the nearest noise sensitive premises in line with BS 4142. This represents a BS 4142 assessment of 'low impact'.

8.6 Based on measured background noise survey data and statistical assessment in accordance with BS 4142, total emission levels for plant noise, including acoustic feature corrections where applicable, should not exceed the representative background sound levels set out in Table 10. Building services engineers should be made aware of the proposed plant noise limits in order to inform plant unit specification and selection.

Table 10: BS 4142:2014 Recommended maximum plant noise limits

Location	Period	Representative background noise level (dB $L_{A90,T}$)	Rating noise level (dB $L_{Ar,Tr}$)
1m from the façade of NSR	Daytime: 07:00-23:00	38	≤ 38
	Night time: 23:00-07:00	*22*	*≤ 27**

** Due to low background noise levels at the development site, the night time rating noise level limit not exceeding background would be overly onerous, a noise level approaching inaudibility in anything other than laboratory conditions. BS 4142 states that, "Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night". Therefore, the proposed rating noise level limit is based on the lowest measured night time $L_{Aeq,8hr}$.*

8.7 The rating level in Table 10 should be assessed in accordance with BS 4142, including appropriate consideration of any tonal or impulsive characteristics of the proposed building services plant. It is prudent to ensure that building services noise is designed to be sufficiently below the recommended plant noise limit criteria such that the cumulative noise level from all sources does not exceed the stated target level.

8.8 It is common for Local Authority planning requirements to require noise impact assessment and requirements can often be more onerous than the criteria proposed. Should there be specific noise impact requirements, SBE should be inform so the adjustments may be made to the plant noise limits.

Appendix I. Noise Survey Data

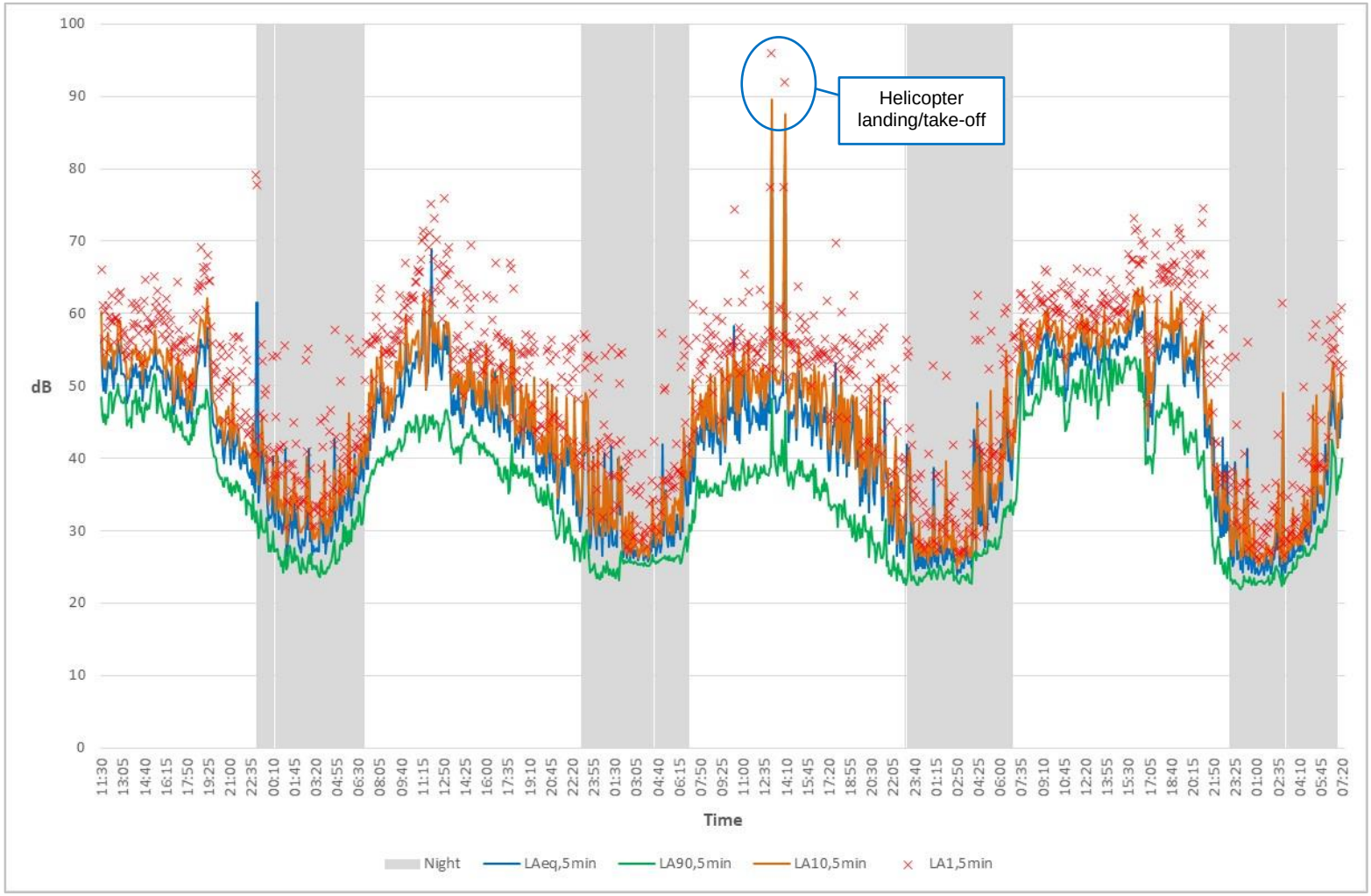

Figure I.1: Logged noise levels at position LT1 between 21st and 25th January 2022

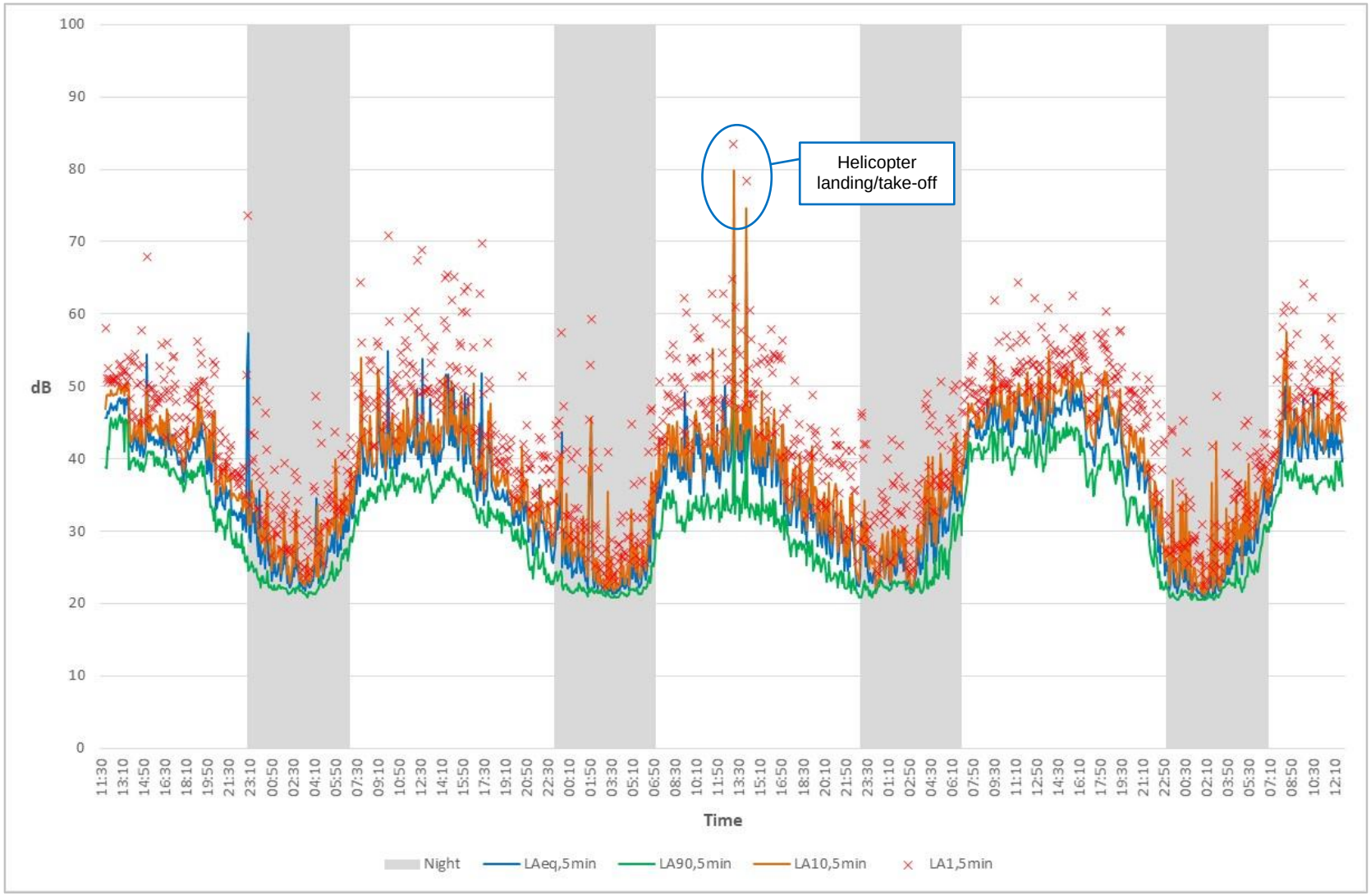

Figure I.2: Logged noise levels at position LT2 between 21st and 25th January 2022

Appendix II. Landscape Illustrative Masterplan

Appendix III. Acoustic Glossary

Sound pressure level and the decibel, dB

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. The decibel is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120 dB (threshold of pain).

Frequency and hertz, Hz

Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kilohertz (kHz), where 1 kHz = 1000 Hz. The human range of hearing is commonly accepted to be 20 Hz to 20,000 Hz. Additionally, an octave can be used to describe the interval between a frequency in Hz and either half or double that frequency.

Frequency weighting

Different weighting networks can be applied to a given sound level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The most commonly used weighting network is the 'A' weighting, and the letter 'A' will be included within a descriptor to indicate that the value has been 'A' weighted, e.g. $L_{Aeq,T}$ or L_{A90}. An 'A' weighted noise level may also be written as dB(A). Other weightings less commonly used are 'C' and 'D' weighting.

Noise indices

When a noise level varies with time, the measured 'A' weighted dB level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple 'A' weighted dB value. In order to describe noise where the level is continuously varying, a number of other indices, including statistical parameters, are used. The various indices used are described as below:

$\boldsymbol{L_{Aeq,T}}$	The 'A' weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period, *T*
$\boldsymbol{L_{Amax}}$	The maximum 'A' weighted noise level that was recorded during the monitoring period.
$\boldsymbol{L_{A10}}$	The 'A' weighted noise level that was recorded for at least 10% of the monitoring period.
$\boldsymbol{L_{A90}}$	The 'A' weighted noise level that was recorded for at least 90% of the monitoring period, usually taken as the underlying 'background' noise level.

Appendix IV. SBE Acoustic Credentials

SBE have specialised in providing the UK Construction Industry with a range of acoustics services since 2006. Specialising in Building Acoustics, all SBE acousticians are members of the Institute of Acoustics.

SBE has been accredited for on-site acoustic testing by United Kingdom Accreditation Service (UKAS) since 2006 (Testing Laboratory Number 2587).
SBE meet the relevant acoustic requirements typically required in the UK, including for sound insulation testing as defined in Approved Document E for the purposes of testing for Part E to the Building Regulations 2010.

This report has been prepared by Alun Williams, Acoustic Consultant who meets the BREEAM requirements for a suitably qualified acoustician (SQA) as follows:

1. Holds an MEng Civil Engineering (Hons) degree and an Institute of Acoustics (IoA) post graduate diploma in Acoustics and Noise Control.
2. Has been an Acoustic Consultant since December 2013, and previously worked within an industrial noise control company for 3 years and therefore has more than three year's relevant experience (within the last five years). This experience includes a practical understanding of factors affecting acoustics in relation to construction and the built environment; including, acting in an advisory capacity to provide recommendations for suitable acoustic performance levels and mitigation measures.
3. Holds Member of the Institute of Acoustics - MIOA membership.

This report has been read and reviewed and has been found to:

1. Represent sound industry practice.
2. Be appropriate given the building being assessed and scope of works proposed.
3. Avoid invalid, biased and exaggerated recommendations.

Appendix V. Report Conditions

This document has been prepared for the sole use, benefit and information of the Client. The liability of Stroma Built Environment Ltd. in respect of the information contained herein will not extend to any third party unless prior agreement is obtained in writing from Stroma Built Environment Ltd.

This report is limited to addressing the specific acoustic issues contained herein. Advice has been provided for acoustic reasons only and it is recommended that appropriate expert advice be sought on all the ramifications, e.g. safety, fire, structural, CDM etc., associated with any proposals contained herein.

The in-situ performance of acoustic measures is influenced to a large extent by the quality of workmanship and compliance with the specifications on-site during construction, as such, Stroma Built Environment Ltd. accepts no liability for issues with acoustic performance arising from such factors.

Acoustic survey and testing work carried out for the project is representative of the prevailing conditions at the time of the work. Conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

In particular, it should be noted that where calculations are carried out that are based on assumptions regarding certain aspects where information has not been supplied, these are provided for indicative purposes only and should be treated as such.