Noise Impact Assessment of Proposed School Facilities

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Site address:	*The Spinney* *Twyncyn* *Dinas Powys* *CF64 4AS*

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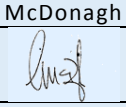
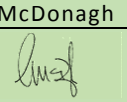
Signature					
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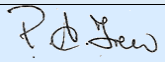
Signature					
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BRIEF FOR CONSULTANCY

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for Reading Agricultural Consultants, Gate House, Beechwood Court, Long Toll, Reading, RG8 0RR under the instruction of Sophie Berry.

Order No: n/a

OBJECTIVES

To carry out a noise impact assessment for a proposed school facility.

Where applicable recommend mitigation to meet impact criteria.

NON-TECHNICAL SUMMARY

It is proposed to utilise a detached building within the curtilage of The Spinney as a temporary teaching facility until a permanent site has been found and designed. The proposal will provide home schooling for up to 20 children within the age ranges of 10 – 12 years old. The proposed operating times are 10:00 – 16:30 hours.

In response to the planning application for the proposed development, ref: 2019/00690/FUL, the local council requested further information with regard to any potential noise impact from the children when assessed at neighbouring residential receptors.

This report assesses the potential noise impact from the proposed development based on criteria provided by Mr Andrew Nunn, Neighbourhood Services Officer with the Shared Regulatory Services of Bridgend, Cardiff and the Vale of Glamorgan. The criteria and methodology were provided and agreed for a similar project, at a nearby location (within 1km), with a similar potential noise impact from a small number of children (maximum of 24) at a proposed childcare facility.

It is reasonable to presume that, as the sound sources are identical, that the criteria and methodology agreed for the previous project would be equally applicable in this case. The criteria are summarised below (revised to reflect the proposed development):

"Measure and report the ambient sound levels in the vicinity of the development during periods when it is anticipated that the school be in use.

Model the development and the surrounding area using 3D CAD modelling techniques.

Use, as the noise source, the maximum number of children.

Include in the model, noise sources and extant buildings, including predictions with the development windows open and closed.

Use the model to predict noise levels on surrounding and adjacent dwellings.

Provide a noise map of the area to include the effects, if applicable, of any proposed mitigation.

Report the calculated noise levels and compare with the agreed criteria of 50 dB L_{Aeq1HR}.

Provide contextual commentary on the anticipated impact of the use of the play area."

The site is in a semi-rural area, bounded by residential properties to the north, south and east. The site is located at the boundary of the course at Dinas Powys Golf Club, 50m to the north. Subjectively, the acoustic climate at the site was characterised by distant road traffic with regular instances of golfers using the golf course including striking the ball and audible voices. During the survey, the use of machinery with a perceptible tone was also in use at the golf course for extended periods, possibly associated with the green keeping operation. Additional sources of noise were from intermittent birdsong, occasional local vehicle pass-bys, overhead aircraft, distant train horns, residential activity and dog barking.

To determine the potential impact from noise from the children during a typical school day, the following three scenarios were considered for this assessment:

- A maximum of 20 children located within the school building with the windows closed.
- A maximum of 20 children within the school building with the windows open.
- A maximum of 20 children outside within the external garden area at the northern extent of the site.

A 3D acoustic model was constructed to predict the noise emissions from the proposed facility and the results were assessed against the criteria detailed above. The modelling procedures adopted a worst-case approach to determine the maximum impact at the neighbouring properties. In the absence of any specific guidance, the noise emissions from children was

determined using a prediction model detailed in published research which is based on the number of children in an area, the number of children that are likely to be vocal in that area, the type of voice (i.e. casual, normal, loud etc.) and how long the children are vocally active during the assessment period. The research model, states that the number of children that are vocally active at any one time would typically be up to 35% of the total number of children.

The results of this assessment indicate that the noise emissions from the proposed development will be significantly below the required criterion of 50 dB $L_{Aeq,1hr}$ and result in a very low impact at all sensitive receptors surrounding the development.

The absolute noise levels will be significantly below the levels at which the World Health Organisation would expect the majority of people to start to be moderately annoyed. Even though the noise levels are significantly below the criteria level, the children would still be occasionally audible, but will be at levels that only the most sensitive receptors would possibly find disturbing. To place this in context, the absolute noise levels predicted at the sensitive receptors is at most 38 dB $L_{Aeq,1hr}$ and would be lower than those expected in a quiet office and approaching levels experienced within a library.

At the beginning and end of the school day, all attending children are collected and returned to a collection point located off site. Access to the site will be via the common site entrance driveway which passes the curtilage of the neighbouring property. It is anticipated that the entrance and exit activity will last no longer than 5 minutes in any one day and any noise impact will be minimal. Any noise emissions will be effectively controlled by the supervising staff during these times.

1.0 DESCRIPTION OF SITE

1.1 The site is located at The Spinney, Twyncyn, Dinas Powys, CF64 4AS and is currently a private residence.

1.2 The site is in a semi-rural area, bounded by residential properties to the north, south and east. The site is located at the boundary of the course at Dinas Powys Golf Club, 50m to the north.

2.0 DISCUSSION

2.1 It is proposed to utilise a detached building within the curtilage of the site as a temporary facility until a permanent site has been found and designed. The proposal will provide home schooling for up to 20 children within the age ranges of 10 – 12 years old.

2.2 The proposal will include internal modifications to the building to provide a single open plan teaching area on each of the two storeys (see Appendix 4). Each classroom will have the capacity for up to 10 children.

2.3 An external play area is to be provided within a demarcated area of the applicant's garden located at the northern extent of the site. The children will be restricted to this area during external activity.

2.4 The proposed opening times are 10:00 – 16:30 hours, Monday to Friday.

2.5 In response to the planning application for the proposed development, ref: 2019/00690/FUL, the local council requested further information with regard to any potential noise impact from the children when assessed at neighbouring residential receptors.

2.6 Acoustics and Noise Ltd were engaged to carry out an assessment with regard to the above proposal.

2.7 **Assessment Criteria**

2.7.1 This report assesses the potential noise impact from the proposed development based on criteria provided by Mr Andrew Nunn, Neighbourhood Services Officer with the Shared Regulatory Services of Bridgend, Cardiff and the Vale of Glamorgan.

2.7.2 The criteria and methodology were provided and agreed for a similar project, at a nearby location (within 1km), with a potential noise impact from a small number of children (maximum of 24) at a proposed childcare facility.

2.7.3 It is reasonable to presume that, as the sound sources are identical, that the criteria and methodology agreed for the previous project would be equally applicable in

this case. The criteria are summarised below (revised to reflect the proposed development):

- *Measure and report the ambient sound levels in the vicinity of the development during periods when it is anticipated that the facility is in use.*
- *Model the development and the surrounding area using 3D CAD modelling techniques.*
- *Use, as the noise source, the maximum number of children.*
- *Include in the model, noise sources and extant buildings, including predictions with the development windows open and closed.*
- *Use the model to predict noise levels on surrounding and adjacent dwellings.*
- *Provide a noise map of the area to include, if applicable, the effects of any mitigation.*
- *Report the calculated noise levels and compare with the agreed criteria of 50 dB $L_{Aeq,1hour}$.*
- *Provide contextual commentary on the anticipated impact of the use of the proposed facility.*

3.0 RELEVANT GUIDANCE

3.1 As a matter of best practice, this assessment has been undertaken based on the relevant guidance on noise. This includes but not necessarily exclusive to:

3.2 **Guidelines for Community Noise, W.H.O. [1]**

3.2.1 Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood.

3.2.2 The objective of the World Health Organization (WHO) is '*the attainment by all peoples of the highest possible level of health*'.

3.2.3 WHO defines 'health' as '*A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'*. This broad definition of health makes reference to the concept of well-being and thereby includes noise impacts such as annoyance, speech interference, and impaired task performance as 'health' issues.

3.2.4 The WHO guidelines [1] deal with all aspects of environmental noise impact and provide guideline values for community noise in specific environments. Most of the noise guidelines are given as period L_{Aeq} values. The relevant values for Dwellings are summarized in Table 1 below.

Table 1 – WHO Guideline Noise Levels for Dwellings

Residential Environment	Critical Health Effect(s)	$L_{Aeq,T}$ (dB)	Time Base, T
Outdoor Living Area	Serious Annoyance, daytime and evening	55	07:00 – 23:00 (16 hours)
	Moderate Annoyance, daytime and evening	50	07:00 – 23:00 (16 hours)

3.2.5 These guideline values consider specific environments and identified health effects on the majority of the population. Each value is set at the lowest levels that affect health such as annoyance and were derived from annoyance studies.

3.2.6 The time period, T, should be chosen to reflect the normal operation of the noise source.

3.2.7 The guidelines, whilst not having any legal force in the UK, are commonly used by local authorities when setting environmental noise criteria for proposed developments.

3.3 Carrying out noise assessments for proposed childcare facilities [2]

3.3.1 The sound produced from children at play varies significantly at different times. This paper [2] was presented at the ACOUSTICS Conference 2006 and provides details of an acoustic model developed for the calculation of sound levels from children at play.

3.3.2 The model is based on sound pressure level data for one child at 1 metre as given by Kryter [3] and presented in Table 2 below. The noise levels when the children are quiet are not considered in the model. Annoyance, leading to complaints, are only likely to occur when the sound level from children at play is raised. The model considers the number of children in an area, the number of children that are likely to be vocal in that area, the type of voice (i.e. casual, normal, loud etc.) and the times and distances between source and receiver.

Table 2 – Sound Pressure Levels for 1 Child at 1 metre (dBA)

Type of Voice (1 child, aged 2 – 5 years)	Sound Pressure Level at 1 metre (dBA)
Casual	53
Normal	58
Raised	65
Loud	74
Shout	82

3.3.3 The estimated time each type of voice is used to predict a 15-minute average for one child and an adjustment is made for the number of children vocal at any one

time. This is typically 20% to 35 % of the total number of children at play. Hence, for example, out of a group of 24 children, a maximum of 9 children could be expected to be vocal at any one time.

3.3.4 The model used in this report is based on the realistic worst-case (or at least an upper percentile) noise level which is then used to assess the impact on neighbouring premises.

3.4 **ISO 9613 [4]**

3.4.1 Part 1 of this standard specifies an analytical method of calculating the attenuation of sound as a result of atmospheric absorption for a variety of meteorological conditions

3.4.2 Part 2 describes a method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in ISO 1996) under meteorological conditions.

4.0 ASSESSMENT DETAILS

4.1 Extant Ambient Sound Levels

4.1.1 The proposed school is in a residential area. Sound emissions from children could potentially impact of the amenity at the front or rear of neighbouring properties.

4.1.2 The primary noise source at the site location is distant road traffic and activity noise associated with the neighbouring golf course.

4.1.3 To determine the extant ambient sound levels within the neighbourhood, a survey was conducted within the site at the boundary with the neighbouring property (see Appendix 2.

4.1.4 Subjectively, the ambient sound at the site was characterised by distant road traffic with regular instances of golfers using the golf course including striking the ball and audible voices. During the survey, the use of machinery with a perceptible tone was also in use at the golf course for extended periods, possibly associated with the green keeping operation. Additional sources of noise were from intermittent birdsong, occasional local vehicle pass-bys, overhead aircraft, train horns, residential activity and dog barking.

4.1.5 Any audible noise from the children occurred over very short periods and did not materially affect the resultant ambient sound levels determined over the 2-hour period.

4.1.6 The results of the ambient sound surveys are presented in Appendix 3 and summarised in Table 3 below.

Table 3 – Summary of Measured Ambient Sound Levels

Description	$L_{Aeq,t}$ (dB)	$L_{A90,t}$ (dB)	L_{AFmax} (dB)
Total Survey, t = 2hrs	43	34	69
Minimum Value, t = 5 mins	37	32	47
Maximum Value, t = 5 mins	48	38	69
Representative (Median) Value, t = 5 mins	40	35	59

4.2 Sound Emission Levels from Child Activity

4.2.1.1 The following three scenarios were considered for this assessment:

- A maximum of 20 children located within the school building with the windows closed.
- A maximum of 20 children within the school building with the windows open.
- A maximum of 20 children outside within the external garden area at the northern extent of the site.

4.2.1.2 Using the calculation model proposed by Scannell and Harwood [2], the predicted sound pressure level at a distance of 1m, was calculated for the maximum occupancy total of 20 children. A further calculation was completed to represent the sound pressure level within a single classroom (10 children).

4.2.1.3 The model includes a correction for the number of children that are vocal at any one time. This is typically 20% to 35% of the total number of children in an area. To represent worst case, this assessment determines the noise emissions from the learning area by assuming that 35% of the total number of children are vocally active during the assessment period of 1 hour.

4.2.1.4 The calculated sound pressure level was further corrected to determine the sound power level using the relationship $L_{wA} = L_{pA} + 8$ dB. The frequency spectrum of the children playing is described using the spectrum adaptation term C as defined in BS EN ISO 717-1 [5].

4.2.1.5 The calculations are presented in Appendix 5 and summarised in Table 4 below.

Table 4 – Summary of Sound Emission Level for Children Activity

		63	125	250	500	1000	2000	4000	Total
Sound Pressure Level 20 Children	$L_{Aeq,15\ mins}$ (dB)	44	54	61	67	70	71	71	76
Sound Power Level 20 Children	L_{wA} (dB)	52	62	69	75	78	79	79	84
Sound Pressure Level 10 Children (Single Classroom)	$L_{Aeq,15\ mins}$ (dB)	42	52	59	65	68	69	69	74

4.2.1.6 It is assumed that the calculated sound levels over a 15-minute period, detailed in Table 4, is representative of the sound emissions from the children over a 1-hour assessment period where the activities are consistent throughout the hour.

4.3 **Prediction of Noise Levels Across Proposed Development Site**

4.3.1 As the assessment area is relatively large and comprises multiple receptors, a 3D acoustic CAD model of the area, including the proposed development, was constructed to aid in the identification of potential locations that may not meet the stated criteria. This process minimises unnecessary schemes of mitigation.

4.3.2 EMS B&K Predictor V2019 Software was utilised to model the sound emission levels across the whole of area. This prediction software allows for the investigation of sound emissions in complex or large outdoor environments. The software can be used to analyse sound sources and propagation to the latest European and U.K. Standards.

4.3.3 A major advantage of using this method is the ability to remodel changes and alterations to the site and/or sources.

4.3.4 Results are displayed in easily understood sound propagation contours overlaid onto an OS drawing of the area.

4.3.5 **CAD Model Construction**

4.3.5.1 Topographical information for the site was obtained from 'Stanfords Planning Portal' in the form of Digital Terrain height data (5m resolution). This data was imported into the CAD software and used to construct the 3D terrain for the site and surrounding area.

4.3.5.2 A site centred OS drawing for the area was also downloaded from Stanfords Planning Portal and used to accurately position the existing buildings onto the terrain.

4.3.5.3 The sound emissions from the building were modelled as a series of emitting façades. The sound insulation of a building façade is typically determined by the weakest acoustic element which in this case will be the windows. To represent

worst case, this assessment represents the sound insulation performance of the façade as being equivalent to the sound insulation performance of the windows.

4.3.5.4 With reference to the proposed development drawings presented in Appendix 4, the rear elevation only has windows on the ground floor and the side elevation to the south only has windows on the first floor. These elevations are modelled as single storey emitting façades each with an internal sound level representing a single classroom of 10 children. The remaining façades have windows at both storeys and are modelled as full height emitting facades with an internal sound level of 20 children to represent the sound emissions from both classrooms at these elevations.

4.3.5.5 For each of the emitting facades the sound reduction of the façade is represented by the sound reduction of the windows, which in this case are proposed to be 4/16/4 glazing units.

4.3.5.6 With the windows closed the sound reduction performance for the glazing units was obtained from BS EN 12758 [6].

4.3.5.7 When using open windows to provide ventilation, the sound reduction of the façade is reduced to 10 – 15 dB. To represent worst case, the sound reduction performance of a façade containing an open window is modelled as 10 dB across all frequencies.

4.3.5.8 An '*area source*' was located at the position of the proposed external learning/play area, located north of the building, to represent the sound emissions from the maximum number of 20 children using the area.

4.3.5.9 The modelling software defines an 'area source' as '*an item for modelling noise sources with a specific sound power level per m^2. An area source is divided into a grid of point sources with equal distances in x and y direction'.*

4.3.6 **CAD Model Prediction**

4.3.6.1 The calculated sound power level from 20 children, detailed in Table 4 above, is used as the emission level for the external area source included in the model. The emission level is the total sound power level for the 1-hour period. The modelling

software calculates the sound power level per square metre based on the dimensions of the area source. The height of the source is modelled at 1m, to represent the height of a typical 10 – 12 year old child.

4.3.6.2 The sound emissions from each of the modelled emitting facades was determined as an indoor to outdoor calculation, assuming a 'acoustically live' internal space. The calculations are completed by the modelling software using an internal sound pressure level for the relevant number of children and corrected for the sound reduction of the façade for each of the open and closed window scenarios described above.

4.3.6.3 A noise contour grid covering the whole area is then constructed to display the external free field noise levels. Each grid represents the free field noise levels throughout the area and is actually a collection of receivers set 1m apart at a height of 1.5m.

4.3.6.4 Individual receivers were also placed in the model to quantify the free field sound levels within the amenity areas of sensitive locations surrounding the site. The following locations were identified:

- Longdrive, north and south of the property
- Witchwood, rear garden
- Longmead, rear garden
- 71 Highwalls Avenue, rear garden
- Measurement survey position at site boundary

4.3.6.5 Using EMS B&K Predictor V2019 software, calculations were made for the grid and receivers for each of the scenarios discussed above.

4.3.6.6 To minimise the level of uncertainty, the calculations represent the worst case, the acoustic attenuation from trees and hedges surrounding the site and any garden fences at neighbouring properties are assumed to be minimal and are not included in the calculations. The ground cover for the fields between the properties has been modelled as '80% soft' with the remaining ground cover modelled as '100% hard'. No meteorological corrections were applied.

4.3.6.7 Calculations are made for a 1-hour period.

4.3.6.8 The results of the ambient survey indicated that the noise levels measured at the survey location were 43 dB $L_{Aeq,2hrs}$. This represents the scenarios where the children were inside with the windows open and when the children were outside. If we compare the measured levels with the modelled results at the measurement location for these scenarios, the results of the model are 43 dB $L_{Aeq,1hr}$ when the children are indoors with the windows open and 42 dB $L_{Aeq,1hr}$ when the children are outdoors. The results of the modelling indicate good correlation with the measured results and are a good indication of the robustness of the modelling procedures.

4.3.6.9 The results of the assessment are presented in the form of easily understood sound propagation contour maps and are shown in Appendix 6.

4.3.6.10 These contour maps indicate the free field sound levels across the whole of the area surrounding the development with the contour colour boundary assigned to the assessment criteria level, so that areas that comply with the criteria can be easily identified.

4.3.7 **Analysis of Noise Contour Maps**

4.3.7.1 Colour coded noise contour maps are generated by the acoustic model to aid identification of the following:

- *Children inside, school windows closed: External free-field noise levels across the area surrounding the proposed development at a height of 1.5m. Areas where the assessment criteria are satisfied are indicated in green for ease of identification.*
- *Children inside, school windows open: External free-field noise levels across the area surrounding the proposed development at a height of 1.5m. Areas where the assessment criteria are satisfied are indicated in green for ease of identification.*
- *Children outside: External free-field noise levels across the area surrounding the proposed development at a height of 1.5m. Areas where the assessment criteria are satisfied are indicated in green for ease of identification.*

4.3.7.2 The contour maps presented in Appendix 6, details the predicted noise emissions from the proposed development into the surrounding area. The areas located within the green band are exposed to noise levels that are below the required criteria of 50 dB $L_{Aeq,1hr}$.

4.3.7.3 The contour map clearly indicates that the predicted noise levels are below 50 dB $L_{Aeq,1hr}$ at all of the neighbouring properties for all scenarios and satisfy the criteria.

4.3.7.4 The calculated noise levels at the receptors identified above are presented in Table 5 below for each of the modelled scenarios and indicate that the noise levels are significantly below the criteria of 50 dB $L_{Aeq,1hr}$ at all receptors.

Table 5 – Summary of Model Results

Receptor	Receptor Height (m)	Children Indoors, Classroom Windows Open Calculated $L_{Aeq,1hr}$ at Receptor (dB)	Children Indoors, Classroom Windows Closed Calculated $L_{Aeq,1hr}$ at Receptor (dB)	Children Outdoors Calculated $L_{Aeq,1hr}$ at Receptor (dB)
71 Highwalls Avenue	1.5	37	17	38
Longdrive North	1.5	36	18	36
Longdrive South	1.5	16	1	14
Longmead Garden	1.5	17	3	31
Witchwood	1.5	27	8	14
Measurement Position	1.5	43	25	42

4.3.8 **Consideration of the Context of Impact**

4.3.8.1 The extant ambient noise levels were measured during a typical two-hour period during a normal school day. There were 17 children in attendance. For most of the time, the children were located indoors, and the windows were open for ventilation. It is anticipated that the children will spend no longer than 1 hour outside during a normal school day.

4.3.8.2 Subjectively, any audible noise from the children was mostly at a similar or lower level than the levels observed from the golf course which included regular instances of golfers striking the ball and audible voices. During the survey, the use of

machinery with a perceptible tone was also in use at the golf course for extended periods, possibly associated with the green keeping operation. The only times the noise from the children became dominant was during the short periods when they moved from the building to the outdoor learning area.

4.3.8.3 The short-term measured ambient noise levels at the site were within the range 37 – 48 dB $L_{Aeq,5mins}$ with a typical value of 40 dB $L_{Aeq,5mins}$. For most of the time the noise from the children was inaudible at the measurement position. The noise from the children was only audible during the periods when the children were located outside within the external learning area at the northern extent of the site.

4.3.8.4 The World Health Organisation would expect a majority of people to be moderately annoyed if exposed to noise levels exceeding 50 dB $L_{Aeq,t}$.

4.3.8.5 The results from the modelling indicate that the predicted noise levels from the children will be significantly below this level at all times which was confirmed by the survey results.

4.3.8.6 Even though the noise levels are significantly below the criteria level, the children would still be occasionally audible, but will be at levels that only the most sensitive receptors would possibly find disturbing. To place this in context, the absolute noise levels predicted at the sensitive receptors is at most 38 dB $L_{Aeq,1hr}$ and would be lower than those expected in a quiet office and approaching levels experienced within a library (see Appendix 7).

4.3.8.7 At the beginning and end of the school day, all attending children are collected and returned to a collection point located off site. Access to the site will be via the common site entrance driveway which passes the curtilage of the neighbouring property. It is anticipated that the entrance and exit activity will last no longer than 5 minutes in any one day and any noise impact will be minimal. Any noise emissions will be effectively controlled by the supervising staff during these times.

5.0 CONCLUSIONS

5.1 The results of this assessment indicate that the noise emissions from the proposed development will be significantly below the required criterion of 50 dB $L_{Aeq,1hr}$ at all times and result in a very low impact at all sensitive receptors surrounding the development.

5.2 The absolute noise levels will be significantly below the levels at which the World Health Organisation would expect a majority of people to start to be moderately annoyed.

5.3 Even though the noise levels are significantly below the criteria level, the children would still be occasionally audible, but will be at levels that only the most sensitive receptors would possibly find disturbing. To place this in context, the absolute noise levels predicted at the sensitive receptors is at most 38 dB $L_{Aeq,1hr}$ and would be lower than those expected in a quiet office and approaching levels experienced within a library.

5.4 At the beginning and end of the school day, all attending children are collected and returned to a collection point located off site. Access to the site will be via the common site entrance driveway which passes the curtilage of the neighbouring property. It is anticipated that the entrance and exit activity will last no longer than 5 minutes in any one day and any noise impact will be minimal. Any noise emissions will be effectively controlled by the supervising staff during these times.

P.A.T. 08/10/19
M.Sc., I.Eng., M.I.O.A., M.Inst.SCE., M.A.E.S.

Appendix 1
Baseline Noise Survey Details

A1.0 BASELINE NOISE SURVEY DETAILS

A1.1 **Programme of Measurements:**

A1.1.1 The meter was calibrated at the start of the measurement procedure.

A1.1.2 The calibration was checked at the end of the procedure and no significant errors recorded.

A1.1.3 Measurements were carried out on 18th September 2019, commencing at 10:25 hours.

A1.1.4 Weather conditions: 20% Cloud, dry, 15°C, slight intermittent breeze (<3ms^{-1}).

A1.2 **Measurement Procedure:**

A1.2.1 The B&K 2250 was set up on a tripod so that the measuring height was 1.2m and located at the perimeter of the site to determine the acoustic characteristics in the area surrounding the proposed development (see Figure 1, Appendix 2).

A1.2.2 The meter was adjusted to measure L_{Aeq}, L_{A90}, L_{AFmax} in 5-minute sample periods for a total measurement period of 2 hours.

A1.3 **Acoustic Climate**

A1.3.1 The acoustic climate at the site is characterised by distant road traffic, occasional distant trains with audible train horn. Additional sources of noise were observed from intermittent birdsong and dog barking, occasional residential activity and overhead aircraft. There was also frequent audible activity associated with the neighbouring golf club which included noise from golfers talking and striking the ball and the use of machinery with a perceptible tonal component.

A1.3.2 For the majority of the survey, the noise from the children was inaudible. There were 17 children being taught at the time of the survey and the windows and ground floor door was open throughout.

A1.3.3 Noise from the children was audible during break periods when they were located towards the northern extent of the outdoor learning area (see Figure 1, Appendix 2).

A1.3.4 Subjectively, the noise from the children was mostly at a similar or lower level than the level observed from the golf course. The only times the noise from the children became dominant was during the short periods when they moved from the building to the outdoor learning area.

A1.4 **Equipment Used:**

Table 6 – Equipment Used

ITEM	Serial No	UKAS calibration Certificate Date (if applicable)
(ANL-M4) B&K 2250 Handheld Analyser	2567736	Certificate: 15417 Date: 16/05/18
(ANL-C4) B&K 4231 Calibrator	2567363	Certificate: 15416 Date: 15/05/18

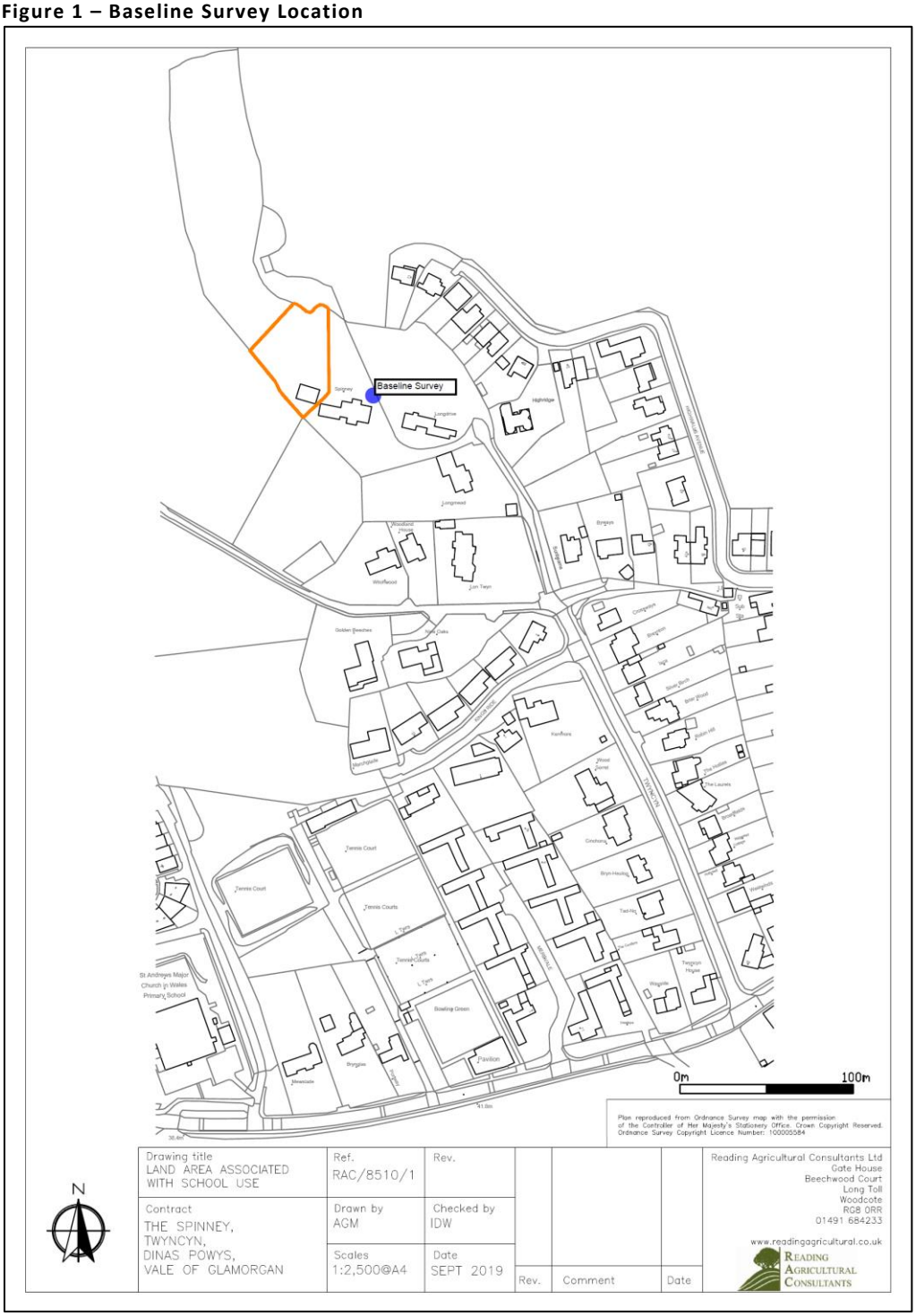
Table 7 – Meter Details

Instrument:		2250
Application:		BZ7224 Version 4.7.5
Start Time:		09/18/2019 10:21:44
End Time:		09/18/2019 12:41:11
Elapsed Time:		02:10:00
Bandwidth:		Broadband
Max Input Level:		141.14
	Time	Frequency
Broadband (excl. Peak):	FSI	AZ
Broadband Peak:		A
Instrument Serial Number:		2567736
Microphone Serial Number:		2560565
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field
Calibration Time:		09/18/2019 10:09:36
Calibration Type:		External reference
Sensitivity:		48.88 mV/Pa

Appendix 2
View of Baseline Survey Location

A2.0 VIEW OF BASELINE SURVEY LOCATION

Figure 1 – Baseline Survey Location



Appendix 3
Baseline Survey Results

A3.0 BASELINE SURVEY RESULTS

Table 8 – Summary of Survey Results (Free-Field Noise Levels, $L_{Aeq,1\ hour}$ dB)

Name	Period (hh:mm:ss)	Duration, t (mm:ss)	$L_{Aeq,t}$ (dB)	$L_{AF90,t}$ (dB)	L_{AFmax} (dB)
Hour 1	10:35	60:00	43.5	34.7	69.2
Hour 2	11:35	60:00	41.6	34.1	68.6

Table 9 – Free-Field Noise Levels, $L_{Aeq,5mins}$ dB

Start date	Start time	$L_{Aeq,5mins}$ (dB)	$L_{AF90,5mins}$ (dB)	L_{AFmax} (dB)	Comment
18/09/2019	10:21:44	41.2	36.8	58.2	Children arrive
18/09/2019	10:24:17	Paused			Visitor
18/09/2019	10:27:28	46.8	35.5	60.3	Children awaiting start of lessons
18/09/2019	10:29:28	Paused			
18/09/2019	10:31:07	38.8	34.9	54.1	Lessons started. Children inaudible.
18/09/2019	10:33:35	Paused			Visitor
18/09/2019	10:35:00	40.4	35.7	59.8	
18/09/2019	10:40:00	38.3	34.4	52.7	
18/09/2019	10:45:00	36.9	34.3	54.2	
18/09/2019	10:50:00	42.8	35.4	59.9	
18/09/2019	10:55:00	41.1	37.0	58.5	
18/09/2019	11:00:00	41.8	34.9	57.5	
18/09/2019	11:05:00	45.8	34.4	62.4	Overhead aircraft dominates
18/09/2019	11:10:00	51.2	34.0	69.2	Overhead aircraft dominates
18/09/2019	11:13:56	Paused			Delivery Van
18/09/2019	11:15:00	39.7	34.4	49.9	
18/09/2019	11:20:00	42.4	35.6	64.6	
18/09/2019	11:25:00	42.6	35.6	65.8	
18/09/2019	11:29:06	Pause			
18/09/2019	11:30:00	38.4	34.5	57.6	Break, Children move to outdoor learning area
18/09/2019	11:35:00	36.6	33.8	51.4	
18/09/2019	11:40:00	42.6	33.8	68.6	Single scream from child near school
18/09/2019	11:45:00	39.8	35.6	59.4	
18/09/2019	11:50:00	41.2	34.6	68.1	Several children outside
18/09/2019	11:55:00	41.0	35.2	58.9	
18/09/2019	12:00:00	40.1	33.5	63.9	Classes resume. Several children

Start date	Start time	$L_{Aeq,5mins}$ (dB)	$L_{AF90,5mins}$ (dB)	L_{AFmax} (dB)	Comment
					remain in outdoor learning area.
18/09/2019	12:05:00	39.9	34.8	59.5	
18/09/2019	12:08:46	Pause			Visitor leaves
18/09/2019	12:10:00	48.0	37.8	60.7	
18/09/2019	12:15:00	41.9	34.4	58.9	
18/09/2019	12:20:00	36.7	33.9	46.8	
18/09/2019	12:25:00	37.8	34.2	50.5	
18/09/2019	12:30:00	37.0	32.3	54.3	Children audible in distance
18/09/2019	12:35:00	37.3	32.8	53.9	
18/09/2019	12:40:00	42.5	34.4	55.6	

** Measurement paused during extraneous events on site e.g. visitors, car movements etc*

Appendix 4
Proposed Development Plans

A4.0 PROPOSED DEVELOPMENT PLANS

Figure 2 – Proposed Development Elevations

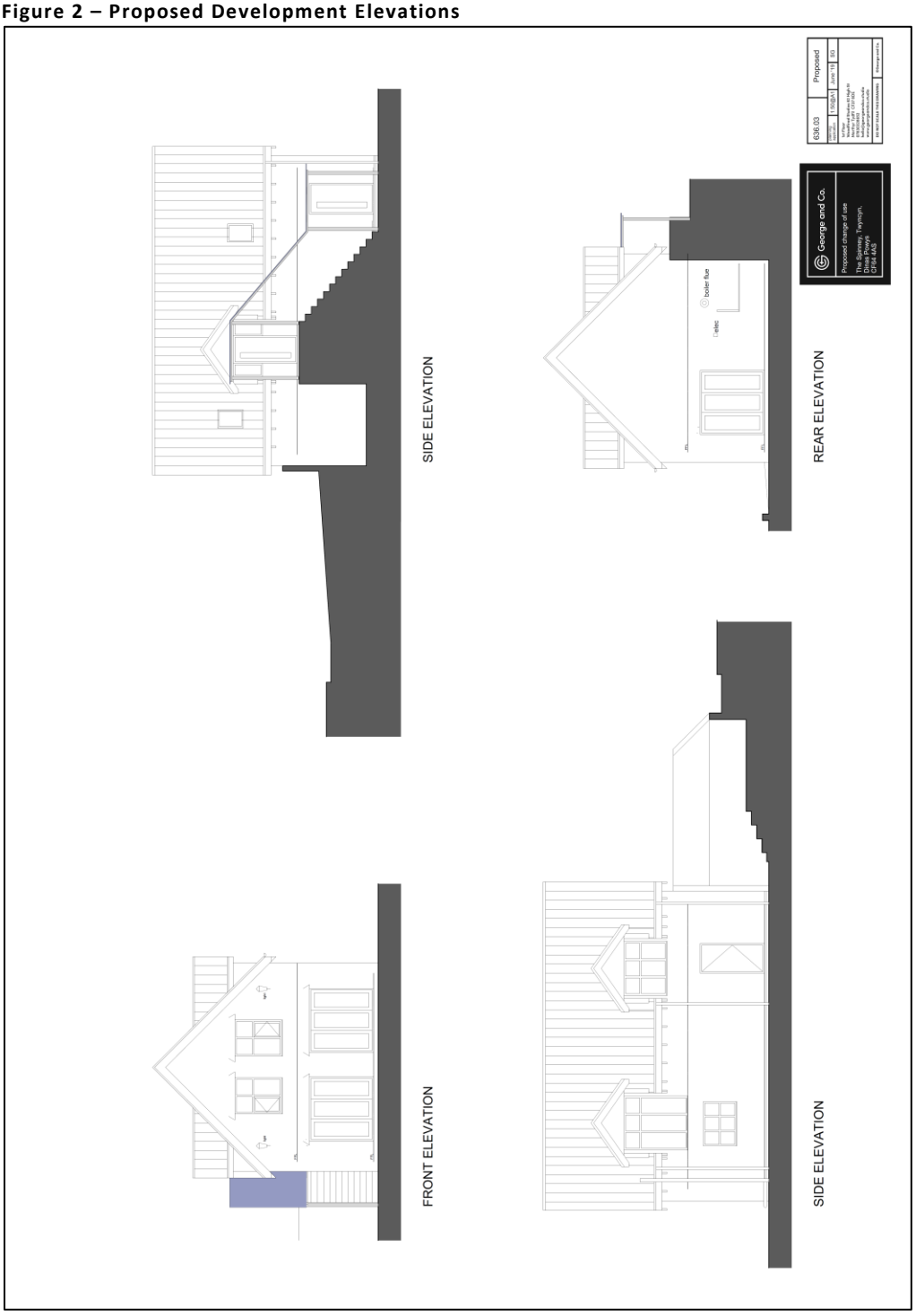


Figure 3 – Location Plan

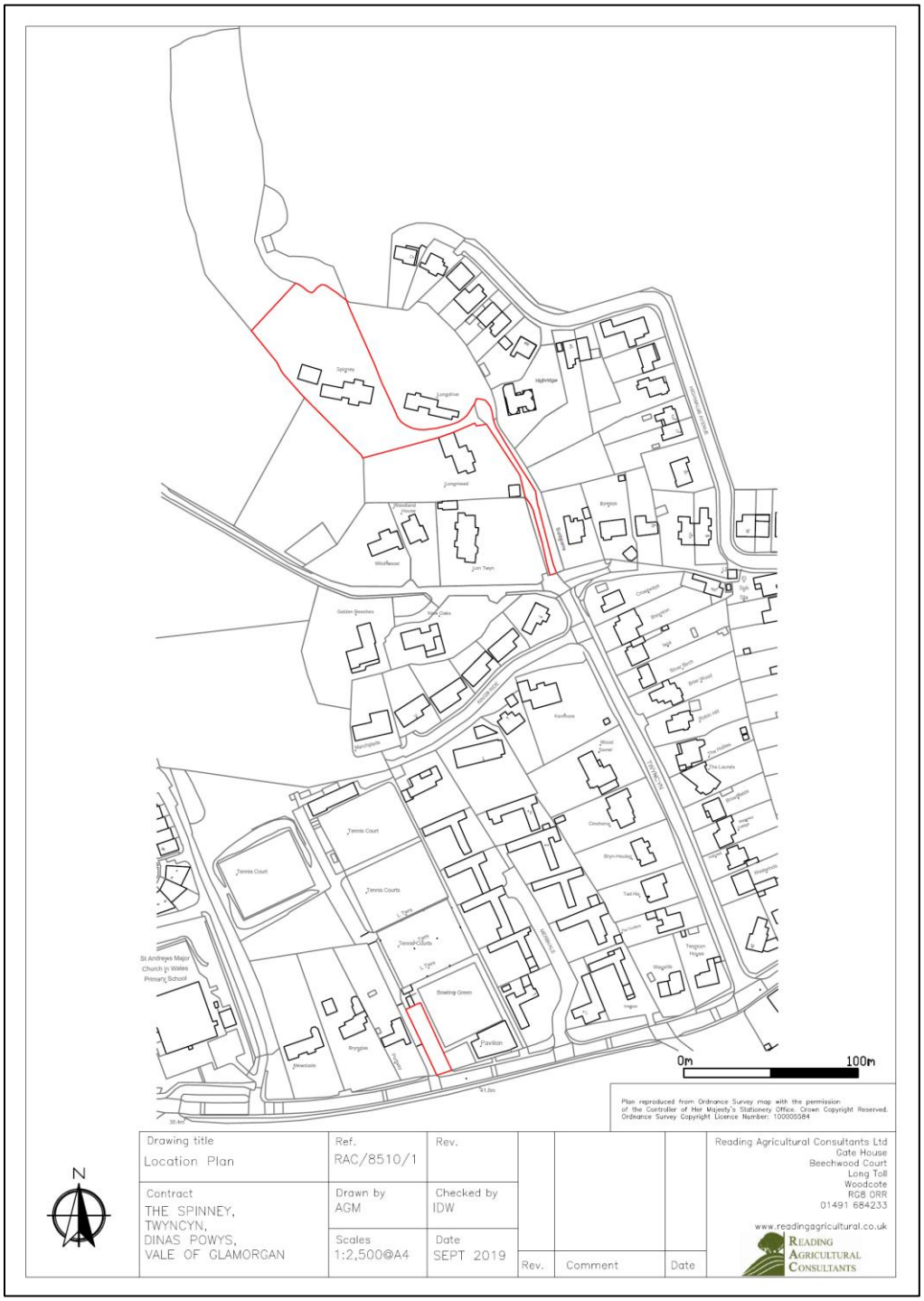
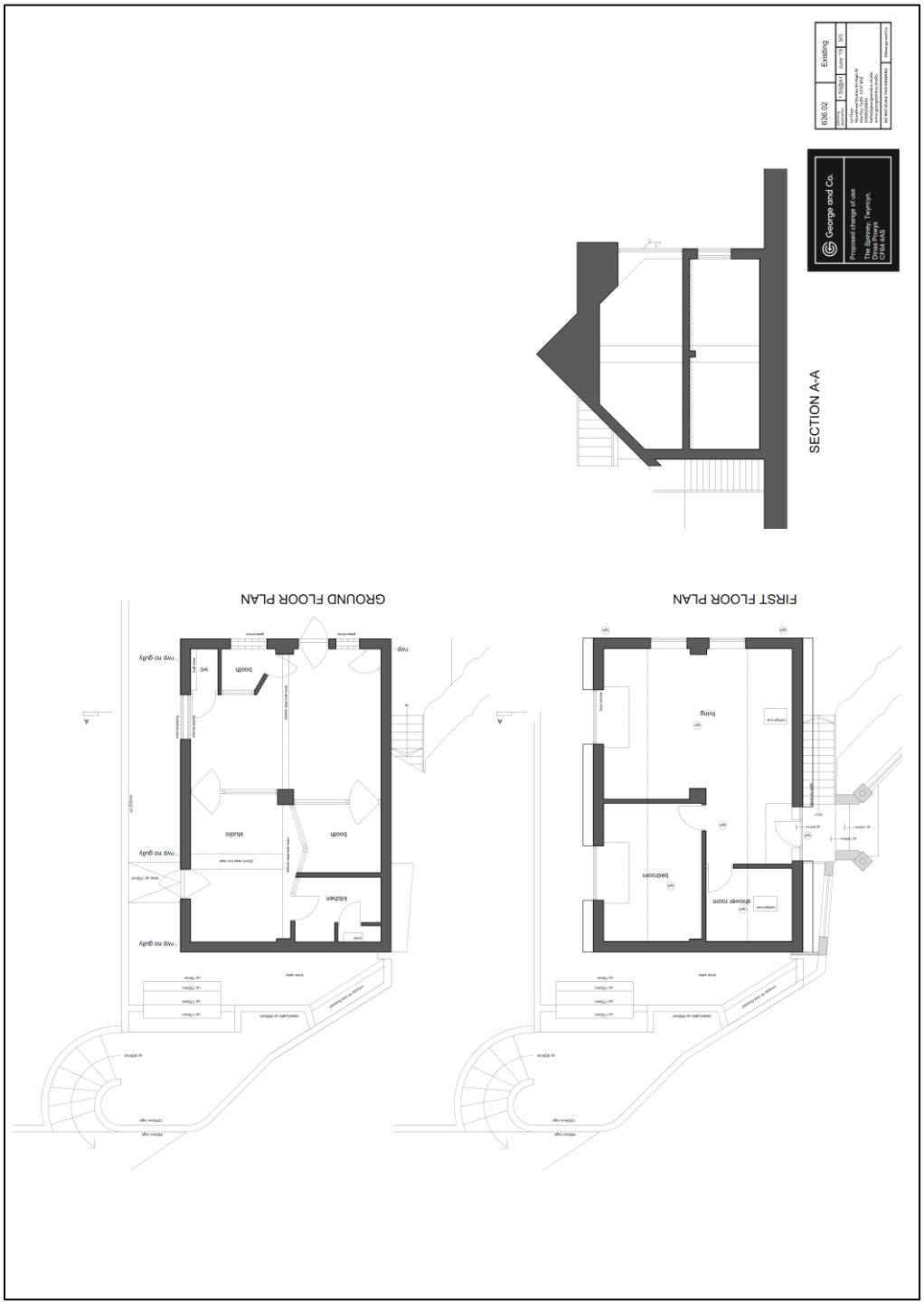


Figure 4 – Proposed Development Layout



Appendix 5
Detailed Calculations

A5.0 DETAILED CALCULATIONS

Table 10 – Calculated Sound Pressure Level for 20 Children (dBA)

Reference Time Period	15			
Type of Voice	**Sound Pressure Level at 1m (dBA)**	**Estimated time spent at each type of voice during reference time period**	**On-Time Correction (dB)**	**Resultant Sound Pressure Level during Reference Time Period (dBA)**
Casual	53	2.8	-7	46
Normal	58	5	-5	53
Raised	65	5	-5	60
Loud	74	2	-9	65
Shout	82	0.2	-19	63
15-minute average for 1 child at 1m, $L_{Aeq,15mins}$ (dB)				68
Number of Children in Play Area				20
% Children active at any one time				35
Number of Children Vocal at any one time				7
15-minute average for Play Area, $L_{Aeq,15mins}$ (dB)				76

Table 11 – Calculated Sound Power Level for Proposed External Learning Area (20 Children)

		63	125	250	500	1000	2000	4000	
Spectrum Adaptation 1	$C_{50\text{-}5000}$	-32	-22	-15	-9	-6	-5	-5	
External Learning Area Noise SPL at 1m (dBA)	76								
									Total
20 Children, $L_{Aeq,15mins}$ (dB)		44	54	61	67	70	71	71	76
Sound Power Level, L_{wA} (dB)									
									Total
20 Children, L_{wA} (dB)		52	62	69	75	78	79	79	84

Table 12 – Calculated Sound Pressure Level for 10 Children (dBA)

Reference Time Period	15			
Type of Voice	**Sound Pressure Level at 1m (dBA)**	**Estimated time spent at each type of voice during reference time period**	**On-Time Correction (dB)**	**Resultant Sound Pressure Level during Reference Time Period (dBA)**
Casual	53	2.8	-7	46
Normal	58	5	-5	53
Raised	65	5	-5	60
Loud	74	2	-9	65
Shout	82	0.2	-19	63
15-minute average for 1 child at 1m, $L_{Aeq,15mins}$ (dB)				68
Number of Children in Play Area				10
% Children active at any one time				35
Number of Children Vocal at any one time				4
15-minute average for Play Area, $L_{Aeq,15mins}$ (dB)				74

Appendix 6
Modelling Results

A6.0 MODELLED NOISE CONTOUR MAPS

Table 13 – Calculated Activity Sound Levels at Receptors

Receptor	Receptor Height (m)	Children Indoors, Classroom Windows Open Calculated $L_{Aeq,1hr}$ at Receptor (dB)	Children Indoors, Classroom Windows Closed Calculated $L_{Aeq,1hr}$ at Receptor (dB)	Children Outdoors Calculated $L_{Aeq,1hr}$ at Receptor (dB)
71 Highwalls Avenue	1.5	37.2	16.5	38.1
Longdrive North	1.5	35.7	17.6	36.0
Longdrive South	1.5	15.5	0.8	13.5
Longmead Garden	1.5	17.1	2.7	31.0
Witchwood	1.5	27.4	8.4	13.5
Measurement Position	1.5	43.2	24.9	42.0

Figure 5 – Noise Emissions from Proposed School Building (Windows Closed)

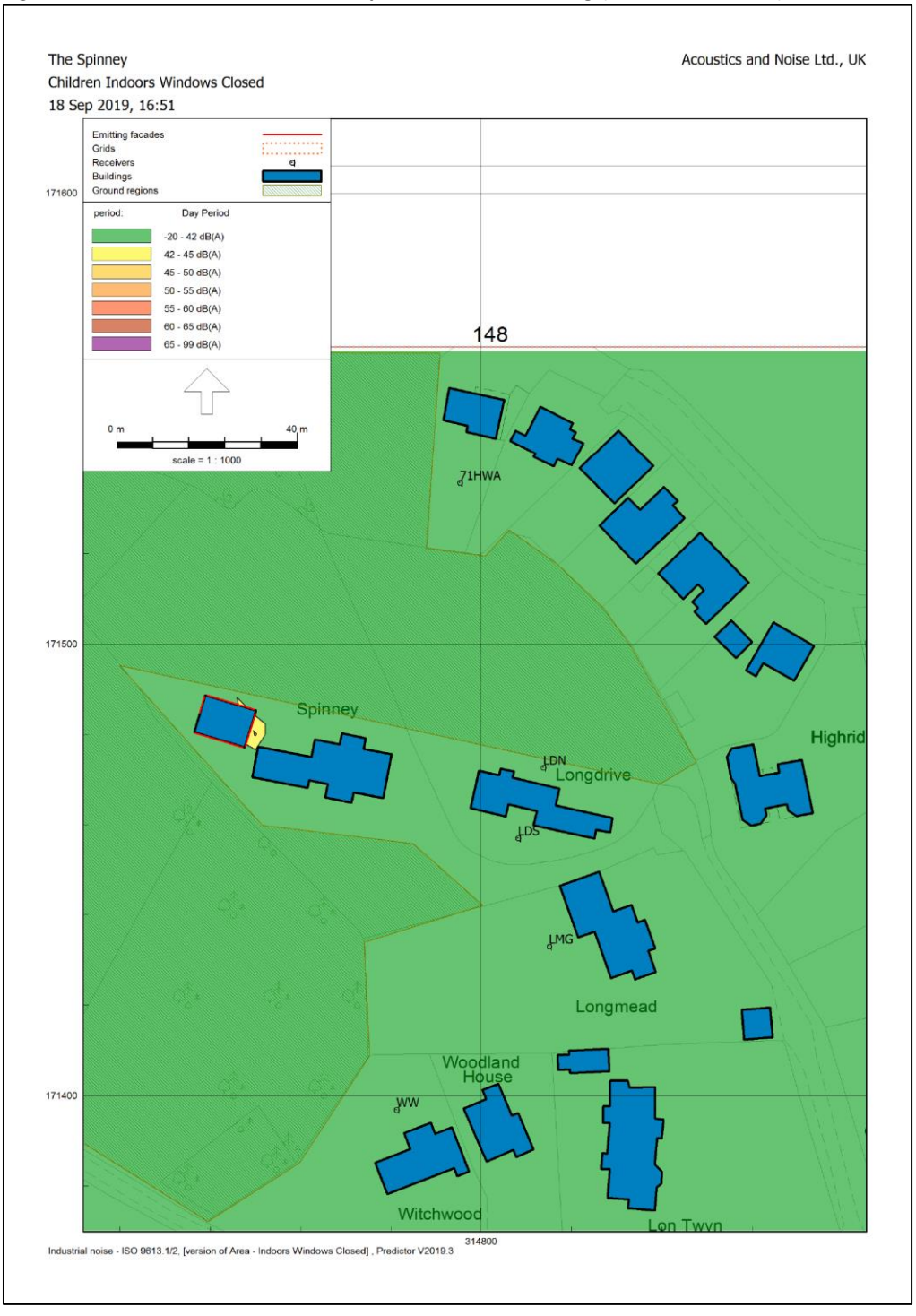


Figure 6 – Noise Emissions from Proposed School Building (Windows Open)

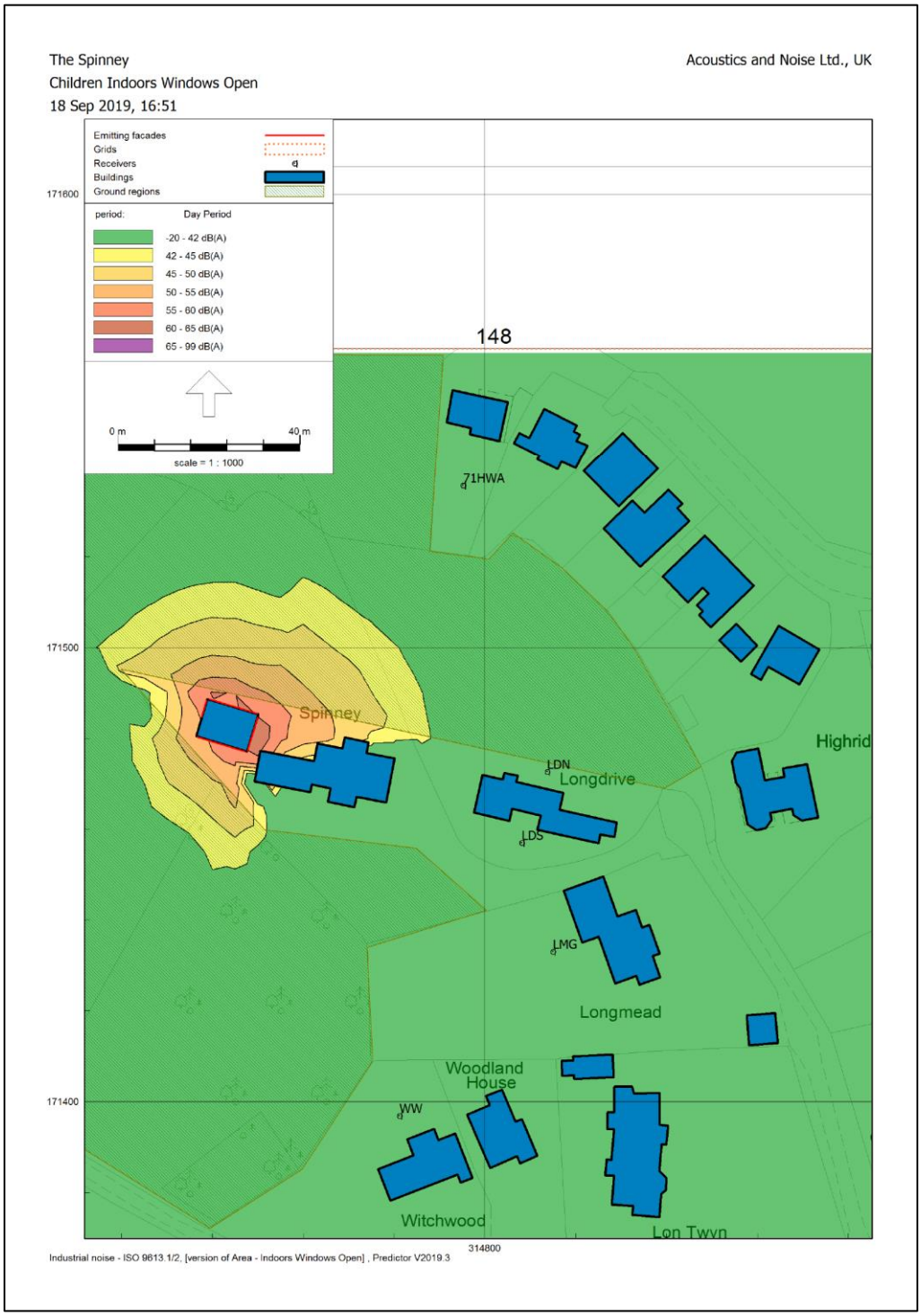
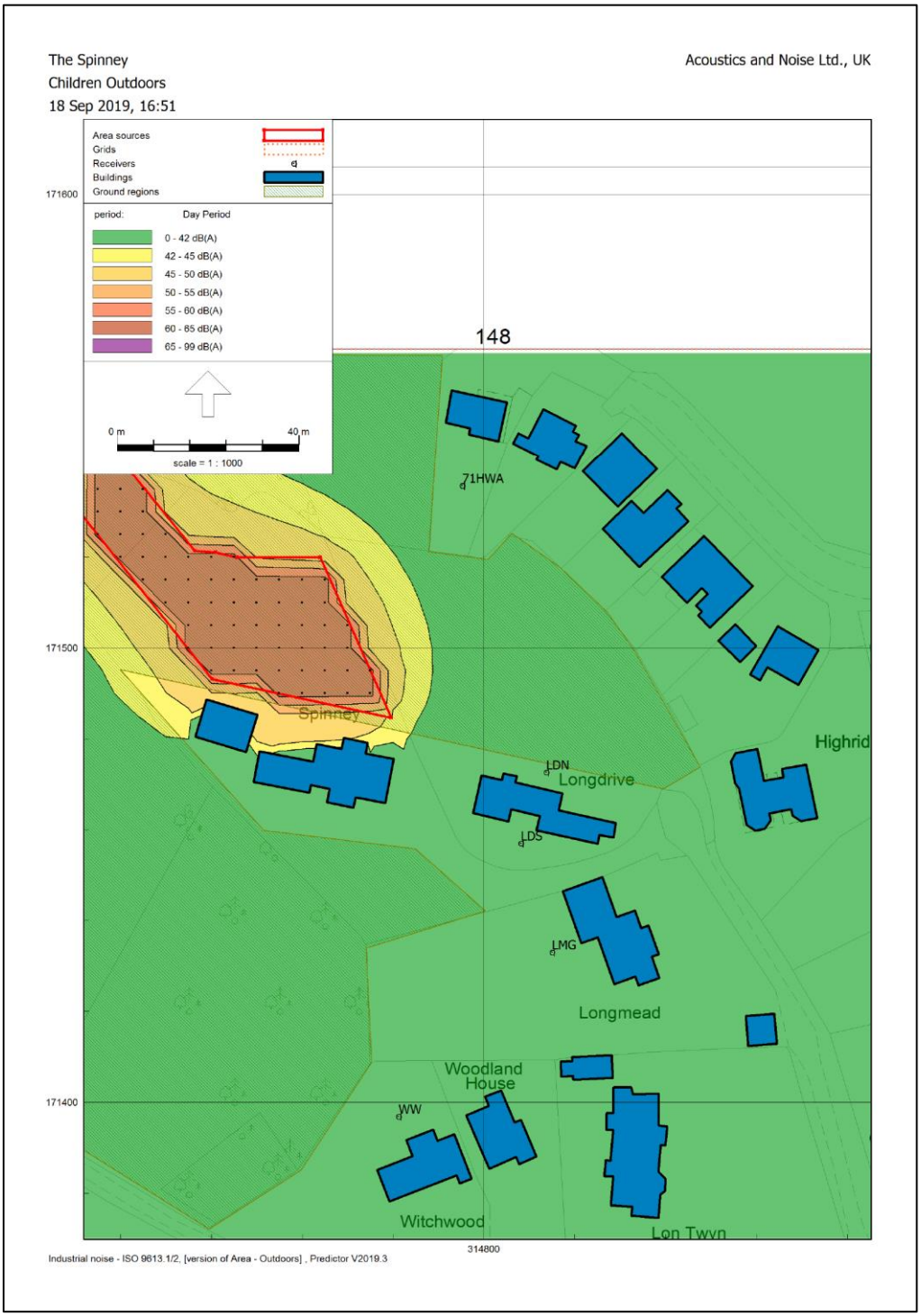


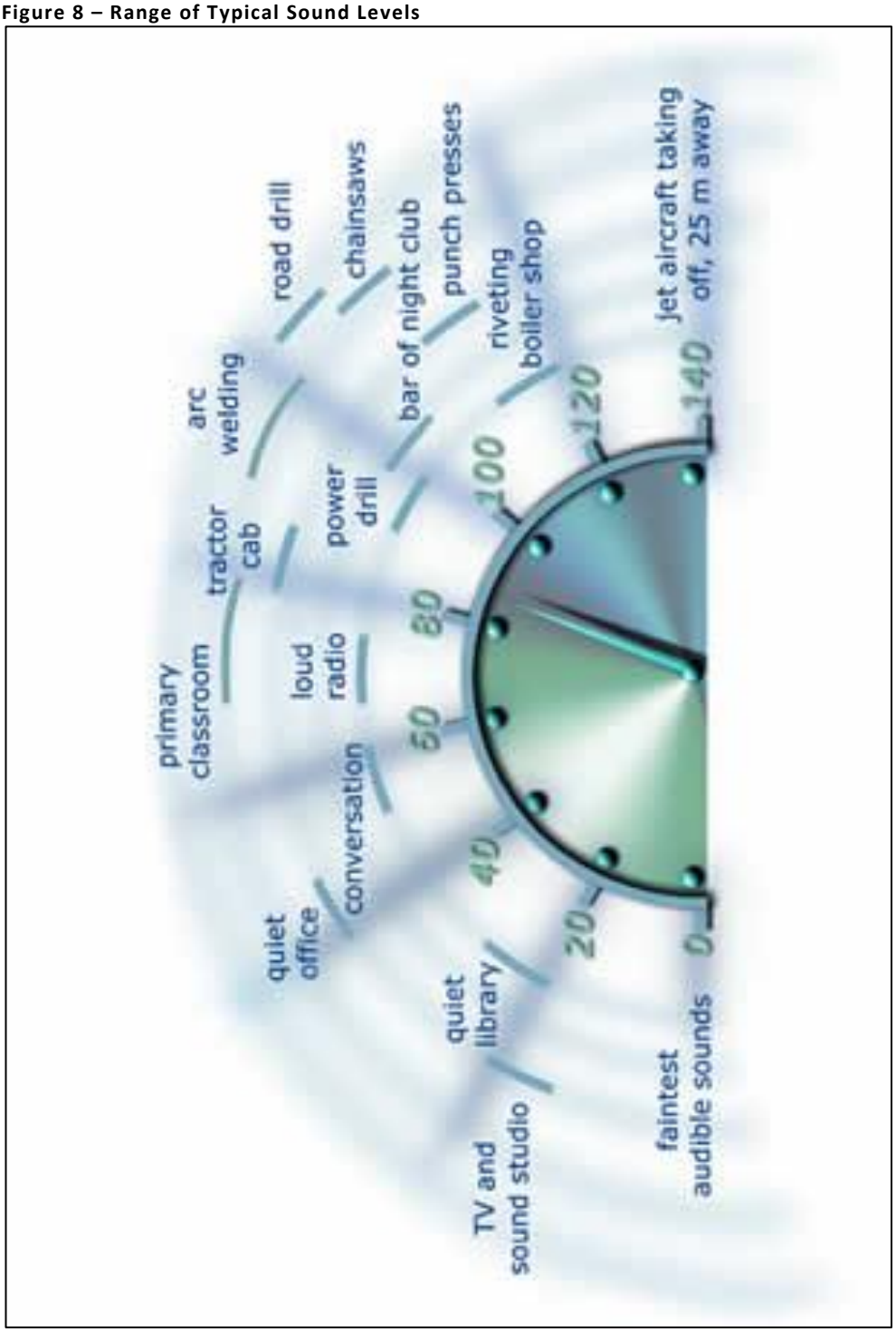
Figure 7 – Noise Emissions from Outdoor Learning Area



Appendix 7
Range of Typical Sound Levels

A7.0 RANGE OF TYPICAL SOUND LEVELS

Figure 8 – Range of Typical Sound Levels



Appendix 8
Glossary of Acoustic Terms

A8.0 GLOSSARY OF ACOUSTIC TERMS

A8.1 **Acoustic environment:**

Sound from all sound sources as modified by the e nvironment [BS ISO 12913-1:2013]

A8.2 **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.

A8.3 **Ambient sound level, $L_A = L_{Aeq,T}$:**

The 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.

A8.4 **Background sound level, $L_{A90,T}$:**

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

A8.5 **Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$:**

The 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 thesame mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq,T} = 10\lg\{(1/T)\int_{t1}^{t2}\left[\frac{pA(t)2}{po2}\right]dt\}$$

where:

p_0 is the reference sound pressure (20 µPa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure (Pa) at time *t*

NOTE The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number ofdecibels.

A8.6 **Measurement time interval, T_m:**

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.

A8.7 **Rating level, $L_{Ar,Tr}$:**

Specific sound level plus any adjustment for the characteristic features of the sound

A8.8 **Reference time interval, T_r:**

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 of15 min at night from 23:00 h to 07:00 h.

A8.9 **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

A8.10 **Residual sound level, $L_r = L_{Aeq,T}$:**

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, *T*

A8.11 **Specific sound level, $L_s = L_{Aeq,Tr}$:**

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

A8.12 **Specific sound source:**

Sound source being assessed

A8.13 **A-weighting:**

Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity is greatest between about 500 Hz and 5,000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to approximate this characteristic of human hearing.

A8.14 **Decibel (dB):**

The logarithmic measure of sound level. 0dB (A) is the threshold of normal hearing. 140 dB (A) is the level at which instantaneous damage to hearing is caused. A change of 1 dB is detectible only under laboratory conditions.

A8.15 **dB(A):**

Decibels measured on a sound level meter incorporating a frequency weighting (A-weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with an individual's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.

A8.16 **Free Field:**

A sound field in which no significant sound reflections occur.

A8.17 **L_{Amax}:**

The maximum 'A-weighted' level of sound recorded during a sound event. The time weighting used (fast or Slow) should be stated.

A8.18 **Tonality**:

The degree to which a sound contains audible pure tones. Broadband sound (across a wider range of frequencies) is generally less annoying than sound with identifiable tones.

A8.19 **Frequency:**

The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A8.20 **Hertz:**

Unit of frequency, equal to one cycle per second. Frequency determines the pitch of a sound.

Appendix 9
References

A9.0 REFERENCES

1 "Guidelines for Community Noise", Berglund, Lindvall, Schwela, World Health Organization, 1999

2 'Carrying out noise assessments for proposed childcare facilities', K. Scannell, M Harwood, Acoustics 2006

3 'The Effects of Noise on Man', Kryter, K.D., Second Edition, Academic Press Inc, Orlando, Florida, 1985

4 ISO 9613 Acoustics – Attenuation of sound propagation outdoors Parts 1 & 2

5 BS EN ISO 717-1:1997, 'Acoustics - Rating of sound insulation in buildings and of building elements, Part 1: Airborne sound insulation', British Standards

6 BS EN 12758, 'Glass in building – Glazing and airborne sound insulation – Product descriptions and determination of properties' British Standards Publication