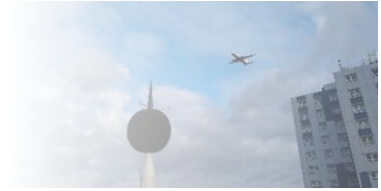


EV2442-01-B



Noise Impact Assessment

St Paul's Catholic College, Burgess Hill

Client

Thames Energy Ltd

Evolved Acoustics

info@evolvedacoustics.co.uk

Document Control and Revision History

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Project Consultant	T Hegan MIOA

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1. Introduction

1.1 Scope

Evolved Acoustics Limited was commissioned in September 2024 to undertake a Noise Impact Assessment (NIA) of an array of proposed Air Source Heat Pumps (ASHPs) at St Paul's Catholic College, Burgess Hill.

The assessment has been prepared to accompany a planning application for the installation of the ASHPs which is being undertaken to upgrade the school's current fossil-fuel based systems to more sustainable electrical systems.

A background sound survey has been undertaken at the site and an assessment of the sound impact of the ASHPs has been undertaken using the principles of BS 4142:2014+A1:2019 ¹.

The potential noise impact of the ASHPs upon the school itself has been assessed using guideline criteria of Building Bulletin 93 ².

1.2 Statement of Competency (BS 4142 Requirement)

The assessment has been undertaken by Tim Hegan. Tim is a full member of the Institute of Acoustics (MIOA) and has eight years' experience in acoustic consultancy. He has worked on numerous assessments where BS 4142 was applied, including undertaking sound measurements, producing calculations and authoring of acoustic reports.

¹ British Standards Institution (BSI). BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound. 2019.

² Department for Education. BB93. Acoustic design of schools: performance standards. 2015.



2. Noise Policy and Criteria

2.1 Planning Noise Advice Document: Sussex

The Planning Noise Advice Document: Sussex (PNADS) ³ is a guidance document prepared on behalf of various Local Authorities in the Sussex area. The latest revision of the document was published in November 2023.

The document aims to provide advice for developers and their consultants to assist in making a planning application in East and West Sussex having regard to noise.

The PNADS advises that planning applications which have the potential to introduce a new sound source of an industrial or commercial nature into a noise-sensitive area should be accompanied by a Noise Impact Assessment using BS 4142:2014.

2.2 BS 4142:2014+A1:2019

BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* describes how to assess industrial and commercial sound and is also the prescribed standard for the assessment of sound from heat pumps. The latest revision of the standard was published in June 2019.

The methods described in BS 4142 use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The basic mechanism of BS 4142 for determining an initial assessment of the impact of a specific sound source is to compare the “rating level” of the specific source against the background sound level.

The background sound level is the typical sound level at the assessment location in the absence of the specific source being assessed, expressed using $L_{A90,T}$ descriptor which is the A-Weighted residual noise that is exceeded for 90% of a given time interval.

BS 4142 allows certain corrections to be applied to the rating level to account for sound characteristics which could attract attention such as tonality, intermittency and impulsivity. Feature

³ Mid Sussex District Council. Planning Noise Advice Document: Sussex. November 2023.

corrections may be applied based on a subjective appraisal or, where appropriate, using objective methods prescribed in the standard.

Typically, the greater the excess of the rating level over the background sound level, the greater the magnitude of the impact. According to BS 4142:

- a difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- a difference of around +5 dB is likely to be an indication of an adverse impact, depending on context.
- the lower the rating level is relative to the measured background sound level, the less likely it is that the specific source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

Once an initial assessment of the impact has been carried out using the method above, BS 4142 advises that the context of the sound should be considered and, if necessary, the assessment of impact modified accordingly.



3. Site and Proposed ASHPs

3.1 Site Description

St Paul's Catholic College is situated within a mixed-use area on the outskirts of Burgess Hill, near to the roundabout connecting the A2300 and A273. The closest residential noise-sensitive receptors are the dwellings on The Rowans, approximately 170m south of the proposed location of the ASHPs.

A site location plan is shown on Figure A1 of Appendix A.

3.2 Proposed Plant Equipment

A summary of the proposed plant equipment is presented in Table 3.1. The sound levels have been taken from the manufacturer's product data sheet, an extract of which is provided on Figure A2 in Appendix A.

TABLE 3.1: DETAILS OF PLANT EQUIPMENT

Ref	Description	Make	Model	Quantity	Sound Power Level (dB L _{WA})	Sound Pressure Level @ 1m (dB L _{pA})
ASHP 1 - 4	Outdoor Air Source Heat Pump	Clivet	WiSAN-YEE1 50.4	4	85	67

The Sound Power Level (L_{WA}) is the more onerous figure and has been adopted in the sound impact calculations in this assessment. The Sound Pressure Level reading may not be reliable as this is based on a measurement distance which is relatively small in comparison to the overall size / volume of the sound source.

The ASHPs will be located within the south-western extent of the school grounds as shown on Figure A3 in Appendix A. The ASHP compound will be enclosed using a regular hit & miss fence.

3.3 Operating Hours and Mode of Operation

The purpose of the ASHPs will be to provide space heating from mid-October to mid-May.

The ASHPs will typically become active at between 04:00 and 05:00 hrs to heat the buffer vessel and will remain active until around 18:00 hrs, Monday to Friday.

3.4 Noise Sensitive Receptors (NSRs)

Details of the closest residential receptor to the site are provided in Table 3.2.

TABLE 3.2: NOISE SENSITIVE RECEPTOR

Receptor I.D.	Address	Direction	Distance to Sound Source (m)	Type
NSR 1	11 The Rowans	South	170	Residential

The NSR is also displayed on Figure A3 of Appendix A.

4. Background Sound Survey

4.1 Continuous Unattended Background Sound Survey

Background sound monitoring was undertaken at position U-P1 over a 9-day period in September 2024. A summary of the main details of the sound survey is provided in Table 4.1.

TABLE 4.1: SUMMARY OF SOUND SURVEY DETAILS

Position	Start Date & Time	End Date & Time	Description of Measurement Position
U-P1	Tues 10/09/24 10:30 hrs	Weds 18/09/24 10:00 hrs	Microphone 1.4m above ground level within school grounds. As shown on Figure A3 (Appendix A)

The sound level meter (SLM) was configured to measure ambient ($L_{Aeq,15min}$), background ($L_{A90,15min}$) and maximum (L_{AFmax}) sound levels.

4.2 Attended Background Sound Survey

Attended sound measurements were carried out over a 1-hour period from 04:00 to 05:00 on Wednesday, 18th September 2024. The purpose was to observe the primary sources influencing the background sound climate at the nearest residential receptors during the most sensitive time period, and to compare sound levels at the attended position with those at the fixed background sound monitoring location.

The attended monitoring position A-P1 is marked on Figure A3 of Appendix A.

The clock on the sound meter used for the attended survey was synchronised with the clock on the unattended sound meter.

4.3 Equipment

All sound measurements were undertaken using equipment conforming to Class 1 as described in BS EN 61672-1:2013. A summary of the equipment details is provided in Table 4.2.

**TABLE 4.2: DETAILS OF SOUND MEASUREMENT EQUIPMENT**

Type	Make	Model	Serial No.	Date of Last Laboratory Calibration
Class 1 Integrating SLM	Rion	NL-31	00410242	08/08/24
Class 1 Integrating SLM	Rion	NL-32	00513572	05/12/23

Copies of the calibration certificates for the sound monitoring equipment can be provided upon request.

The unattended SLM was housed in a weather-proof casing with a windscreen fitted to the microphone. The microphone was attached to an extension pole and positioned approximately 1.4m above local ground and away from vertical reflective surfaces.

The attended SLM was placed on a tripod approximately 1.4m from ground level with a windscreen protecting the microphone.

4.4 Field Calibration

Calibration checks were performed on the sound monitoring equipment before and after the surveys using a Castle dBCal GA611 acoustic calibrator. The calibration checks indicated that no significant drift occurred throughout the measurements.

4.5 Weather Conditions

The weather conditions during the attended sound survey on 18th September 2024 were dry and calm with no precipitation. Wind speeds were measured at below 2 m·s⁻¹ using a handheld anemometer.

A record of the weather conditions during the unattended background sound survey has been obtained from a nearby meteorological monitoring position and is shown in Appendix B. Average temperatures ranged between 9 °C and 18 °C and average wind speeds remained below 5 m·s⁻¹.

Sound data corresponding to periods of moderate rainfall during the evenings of 10th and 11th September have been excluded from the analysis. Very light rainfall also occurred on 12th and 13th September however analysis of the measured sound levels indicated that this did not have any adverse effect on the reliability of the survey results.



5. Sound Survey Results

5.1 Continuous Unattended Sound Survey Results

The results of the background sound survey are summarised in Table 5.1 with a time history graph provided in Appendix C.

The average ambient ($L_{Aeq,T}$), background ($L_{A90,T}$) and maximum (L_{Amax}) values are shown in Table 5.1 for each daytime and night-time period, with the range of $L_{Amax,F}$ levels shown in parentheses. Average $L_{Aeq,T}$ sound levels have been calculated logarithmically whilst average background and maximum sound levels have been calculated arithmetically.

TABLE 5.1: SOUND LEVELS AT POSITION U-P1

Date	Measured Noise Levels, dB [A]					
	DAYTIME (07:00 – 23:00 hrs)			NIGHT-TIME (23:00 – 07:00 hrs)		
	$L_{Aeq,15min}$	$L_{A90,15min}$	$L_{Amax,F}$	$L_{Aeq,15min}$	$L_{A90,15min}$	$L_{Amax,F}$
Tue 10/09	60	55	71 (85 / 60)	54	42	65 (79 / 61)
Wed 11/09	60	56	71 (85 / 62)	54	43	65 (76 / 61)
Thu 12/09	60	55	71 (85 / 63)	53	40	65 (75 / 60)
Fri 13/09	59	55	72 (93 / 62)	50	38	64 (74 / 59)
Sat 14/09	59	54	70 (87 / 61)	50	39	65 (76 / 56)
Sun 15/09	59	53	70 (92 / 61)	51	38	63 (75 / 57)
Mon 16/09	57	52	69 (81 / 61)	51	37	63 (72 / 58)
Tue 17/09	57	52	69 (80 / 59)	51	36	62 (77 / 57)
Wed 18/09	58	56	68 (76 / 65)	-	-	-
Average (Excluding Adverse Weather)	59	55	70 (85 / 62)	52	39	64 (76 / 59)

Notes:

[A] free-field sound levels dB re 2×10^{-5} Pa

The daytime background sound levels at position U-P1 between the hrs of around 07:00 and 19:30 hrs were governed predominantly by sound from the existing boiler system. During the evening following the boiler switching off the background levels ($L_{A90,15min}$) dropped steadily from around 58 dBA to around 40 dBA by 23:00 hrs as can be seen in the time history graph in Appendix C.

The sound levels influenced by the existing boiler system have been excluded from the analysis in determining the background sound assessment levels for the NIA.

5.2 Attended Noise Survey Results

The results of the attended noise survey undertaken on 18th September 2024 are shown in Table 5.2.

TABLE 5.2: ATTENDED NOISE SURVEY RESULTS

Date	Position	Start Time	Duration T (mins)	Measured Sound Levels, dB [A]		
				Ambient L _{Aeq,T}	Background L _{A90,T}	Maximum L _{Amax,F}
18/09/24	A-P1	04:00	15	47	35	69
		04:15	15	47	36	66
		04:30	15	45	36	62
		04:45	15	46	35	68
		Total:		46	36	69
Notes: [A] free-field sound levels dB re 2x10 ⁻⁵ Pa						

The ambient sound climate at the monitoring location was governed mainly by road traffic on the A2300, A273 and surrounding roads. A large proportion of the vehicles during the early morning were HGVs, however the road traffic also included cars / taxis and vans.

The synchronised sound data at the attended position A-P1 and the fixed monitoring position U-P1 have been compared for the corresponding time periods. The comparison showed that there was an insignificant difference (± 2 dB) in the average ambient ($L_{Aeq,T}$) and background ($L_{A90,T}$) sound levels between the two positions, with the levels at the attended position being slightly higher on average.

5.3 Analysis of Background Sound Levels

A statistical analysis has been carried out to determine the most commonly occurring daytime background sound level based on an example method given in BS 4142:2014+A1:2019, excluding any periods when the existing boiler system was operational. The background sound assessment level derived using this method provides a reasonably worse-case level due to a weighting toward the quieter evening periods.

The results of the statistical analysis are shown in Appendix D. Based on this analysis the statistically most-repeated daytime background sound level was 42 dB $L_{A90,15min}$.

The background sound assessment level for the night-time period has been derived based on the average $L_{A90,15min}$ sound levels between the hours of 04:00 – 05:00 hrs each day, representing the most sensitive night-time hours during which the ASHPs would begin to operate. The average background sound level based on this analysis was 36 dB $L_{A90,15min}$.



6. Calculation Method

6.1 Sound Model

Sound levels of the ASHPs have been calculated using a spreadsheet-based sound model considering the sound level of each item of plant, the distance from the source to the receptor, the reflections from the surfaces upon which the plant is mounted and screening effects of intervening barriers.

$$L_p = L_w + 10 \log \left(\frac{Q}{4\pi r^2} \right) - A_{\text{barrier}}$$

Where:

- L_p is the calculated sound pressure level at the receptor (dBA).
- L_w is the Sound Power Level of each item of plant (dBA).
- Q is a surface-reflection factor, (1, 2, 4 or 8) depending on the number of flat, reflective planes the sound source is mounted against.
- A_{barrier} is a correction for screening effects of existing buildings or other barriers between the source and the receptor.

Further details of the sound model are listed below:

- Free-field sound levels have been calculated at 1m from the façade of each noise-sensitive receptor.
- Sound levels have been calculated individually in each octave band between 63 Hz and 8 kHz and summed logarithmically to provide the overall A-Weighted level.
- The calculations assume continuous, cumulative operation of all ASHPs.
- Atmospheric absorption of sound has been calculated in accordance with ISO 9613-1:1993.
- No attenuation has been included for any foliage, fences or other structures between the sound source and the receptor.
- The sound calculations do not include any mitigation, for example acoustic fencing.



7. BS 4142 Sound Assessment

7.1 Background Sound Assessment Levels

The background sound assessment levels ($L_{A90,T}$) have been established using the method described in Section 5 and are as follows:

- 42 dB $L_{A90,15min}$ (daytime, 07:00 – 23:00 hrs).
- 36 dB $L_{A90,15min}$ (night-time, 23:00 – 07:00 hrs).

7.2 Specific Sound Level

In accordance with BS 4142, specific sound levels have been calculated over a reference time interval of 1-hour for the daytime (07:00 – 23:00 hrs) and 15-minutes during the night (23:00 – 07:00 hrs). Table 7.1 shows the calculated specific sound levels.

TABLE 7.1: CALCULATED SPECIFIC SOUND LEVELS

Rec I.D.	Address	DAYTIME Specific Sound Level, dB $L_{Aeq,1hr}$	NIGHT-TIME Specific Sound Level, dB $L_{Aeq,15min}$
NSR 1	11 The Rowans, Burgess Hill	36	36

7.3 Rating Level

Sound from Air Source Heat Pumps can include tonal components from compressors and fans. However, the specific sound levels are low relative to the ambient ($L_{Aeq,15min}$) sound levels, with survey observations indicating the presence of road traffic noise throughout the plant's operating period, which is likely to provide considerable masking of any sound characteristics.

Similarly, distinct on/off cycles are not likely to be distinguishable at the receptor location and the equipment should not generate any impulsive sounds. Accordingly, no character corrections are relevant under BS 4142:2014+A1:2019.

The calculated rating levels and an initial assessment of the sound impact using BS 4142 are presented in Table 7.2 and 7.3 for the daytime and night-time respectively.



TABLE 7.2: BS 4142 SOUND ASSESSMENT – DAYTIME (07:00 – 23:00 HRS)

Assessment Time Period and Location			Background Sound	BS 4142 Initial Assessment of Daytime Impact				
Time Period	Rec I.D.	Address	Background Sound Level, dB L _{A90,1hr}	Specific Sound Level, dB L _{Aeq,1hr}	Rating Corrections Applied (dB)	Rating Level, dB L _{Ar}	Rating Level Minus Background	Initial Outcome Indicated by Rating Level vs Background Comparison
Daytime	NSR 1	11 The Rowans, Burgess Hill	42	36	0	36	-6	Low Impact

TABLE 7.3: BS 4142 SOUND ASSESSMENT – NIGHT-TIME (23:00 – 07:00 HRS)

Assessment Time Period and Location			Background Sound	BS 4142 Initial Assessment of Night-time Impact				
Time Period	Rec I.D.	Address	Background Sound Level, dB L _{A90,15min}	Specific Sound Level, dB L _{Aeq,15min}	Rating Corrections Applied (dB)	Rating Level, dB L _{Ar}	Rating Level Minus Background	Initial Outcome Indicated by Rating Level vs Background Comparison
Night	NSR 1	11 The Rowans, Burgess Hill	36	36	0	36	0	Low Impact



7.4 BS 4142 Initial Assessment Outcomes

The assessment presented in Table 7.2 shows that the daytime rating level of the ASHPs falls below the background sound level ($L_{A90,T}$) by 6 dB.

Table 7.3 shows that the night-time rating level is predicted to be no higher than the corresponding background sound level.

BS 4142 indicates that where the rating level does not exceed the background sound level ($L_{A90,T}$) this indicates that the source will have a low impact, depending on the context.

7.5 Context

BS 4142 states that the context of the sound should be considered and, if necessary, the assessment of impact modified accordingly.

One contextual factor is the relationship between ambient temperatures, the potential sound output of the ASHPs and the sensitivity of receptors.

The sensitivity of receptors is likely to be most elevated when ambient temperatures are higher as this typically leads to increased reliance on open windows for ventilation and more frequent use of external amenity areas. During these warmer temperature conditions, the demand on the ASHPs is likely to be much lower, in turn leading to a lower likelihood of any adverse impact.

Based on the predicted external sound levels, the contribution of ASHP sound to the overall internal sound levels inside the receptor dwelling is likely to be insignificant.

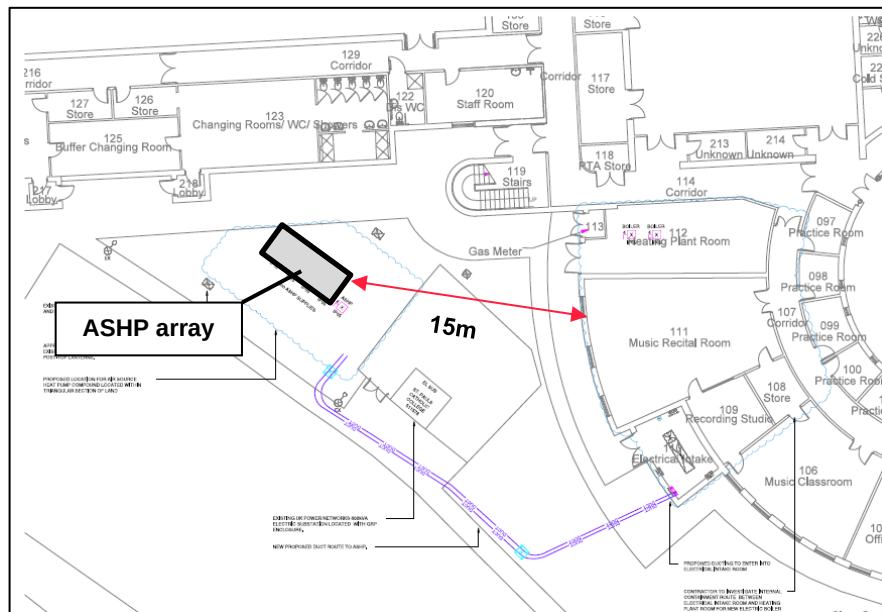
Considering the context, there is a very low expected likelihood of any adverse impact arising from the ASHP sound upon residential noise-sensitive receptors.

8. Assessment of Sound Impact Upon School

8.1 Noise-Sensitive Rooms

Figure 8.1 below shows the floor plan of the school within the zone of influence of the ASHP sound. The closest noise-sensitive room is the Music Recital Room approximately 15m to the east of the ASHP array.

Figure 8.1: School Floor Plan



8.2 Internal Noise Levels

Using the calculation method described in Section 6, the predicted free-field sound level of the ASHPs at 1m from the Music Room window is c. 60 dBA.

It is understood that the Music Room is air-conditioned and not reliant on open windows for ventilation. Accordingly, the assessment has been carried out based on a façade with a closed window offering a sound reduction of 33 dB Rw ⁴. The resulting internal noise level of the ASHP sound is 27 dBA, falling within the BB93 Guideline upper noise limit for music ensemble rooms and studios of 30 dB L_{Aeq,30min}. The ASHP sound should therefore not have any adverse effect on teaching and learning activities.

⁴ British Standards Institution (BSI). BS 8233:2014 Guidance on sound insulation and noise reduction for building. 2014.



9. Uncertainty

BS 4142:2014+A1:2019 requires that consideration is given to potential sources of uncertainty. Uncertainty in an assessment of this type can arise from factors such as: the reliability of the background sound survey data; the reliability of the manufacturer's sound data; and the accuracy of the sound model.

The unattended background sound survey has been undertaken over a sufficient duration to minimise uncertainty, with the results verified by means of an attended survey undertaken during the most sensitive night-time period. The worse-case data from the manufacturer's sound measurements of the ASHPs has been adopted in the calculations. Furthermore, the assessment is based on continuous, cumulative operational of all four ASHPs. As such It is expected that sound impact of the plant will be lower than indicated by the assessment for most of the time and the potential for uncertainty around the assessment's conclusions has been minimised.



10. Summary and Conclusions

A Noise Impact Assessment has been undertaken of the proposed Air Source Heat Pumps (ASHPs) at St Paul's Catholic College, Burgess Hill.

Sound levels of the ASHPs have been calculated using the manufacturer's acoustic data and an assessment has been carried out at the closest residential receptor using BS 4142:2014+A1:2019.

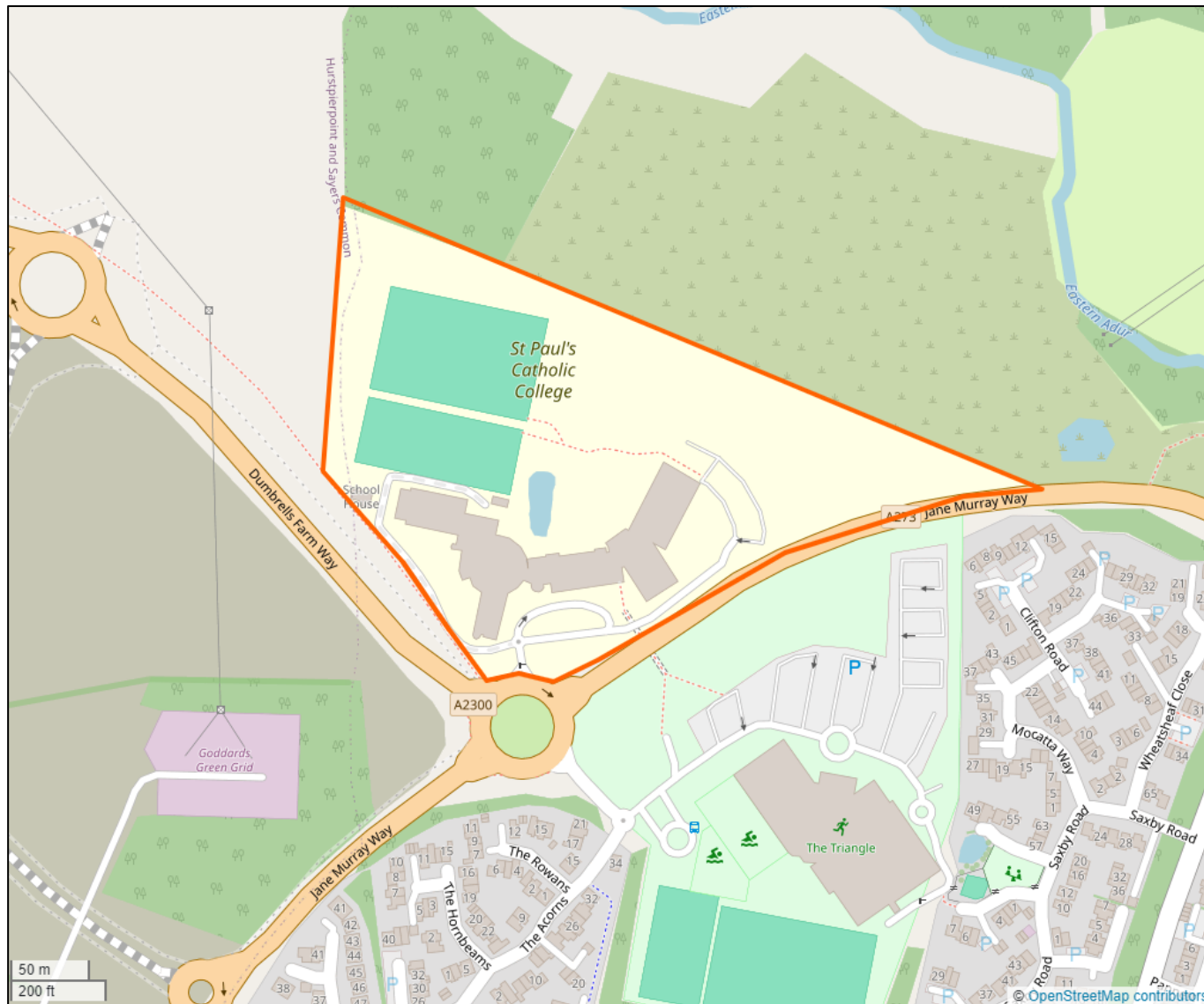
The BS 4142 assessment shows that the cumulative rating level of the ASHPs will be no higher than the background sound level ($L_{A90,T}$) during the most sensitive time period within the operational hours of the ASHPs. The assessment concluded that the ASHP sound is likely to have a very low impact at the closest residential noise-sensitive receptors.

An assessment of noise from the ASHPs upon the school itself has been carried out using internal noise level criteria of BB93. With windows closed the internal noise level of the ASHP is predicted to be below 30 dB $L_{Aeq,30min}$, falling within the BB93 guideline Internal Ambient Noise Limits for music rooms.

Based on these outcomes, no specific mitigation measures are required to limit the noise impact of the ASHPs.

Appendix A – Figures

Figure A1: Site Location Plan

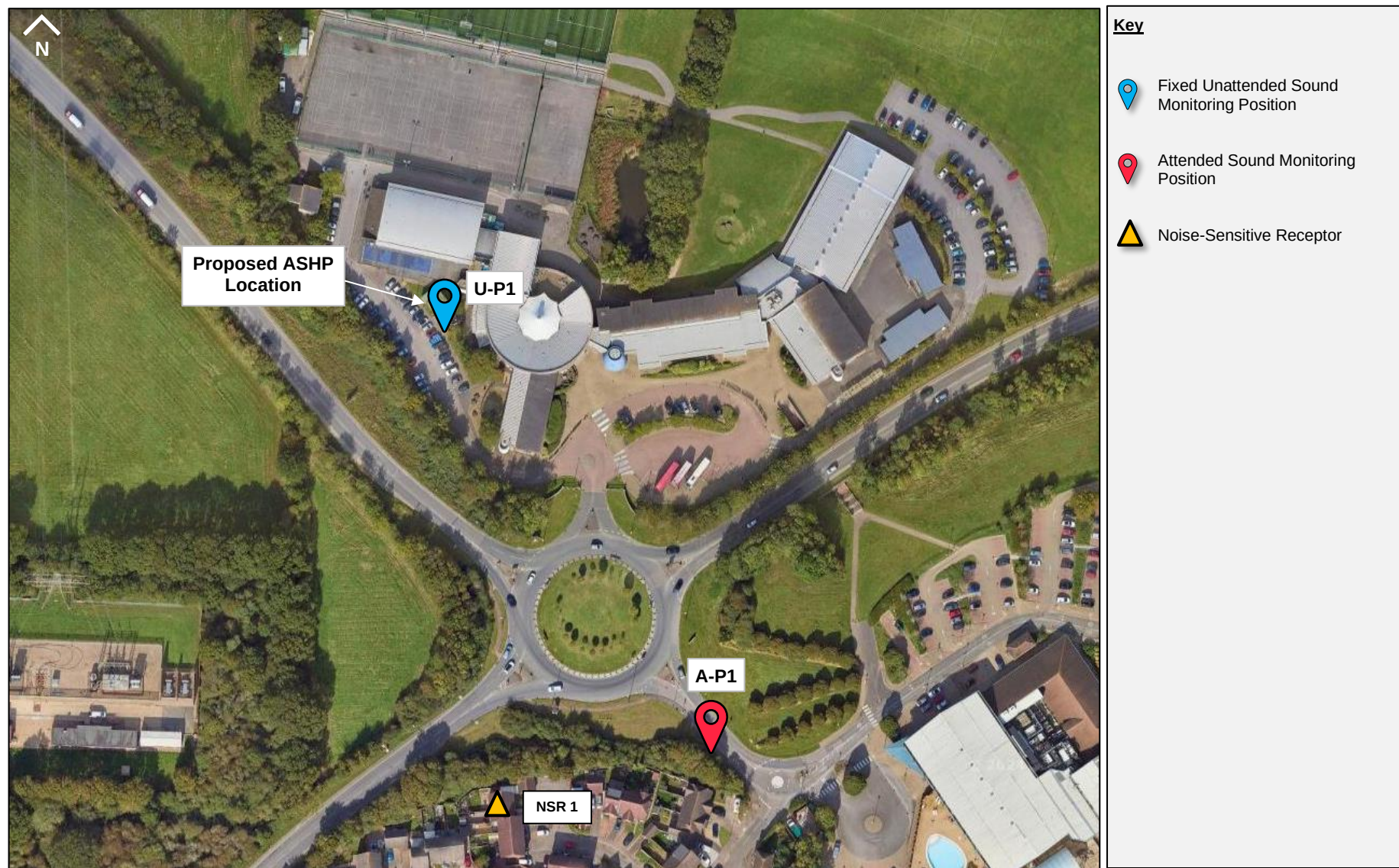


Sound power level: Hz								Sound pressure level	Sound power level
Octave band (Hz)									
63	125	250	500	1000	2000	4000	8000	dB(A)	dB(A)
68	71	77	78	81	81	70	66	67	85

Data refer to the following conditions: internal water exchanger = 12/7 °C; outdoor air temperature 35°C
the sound levels refer to the unit at full load, in the rated test conditions.?
The sound pressure level refers to a distance of 1m from the external surface of the units operating in an open field.
Measures are according to UNI EN ISO 9614-2 regulations, with respect to the EUROVENT 8/1 certification, which provides for a tolerance of 3 dB(A) on the sound power level, which is the only acoustic data to be considered binding.
Data refer to standard units.

SOUND LEVELS									
Sound power level: Hz								Sound pressure level	Sound power level
Octave band (Hz)									
63	125	250	500	1000	2000	4000	8000	dB(A)	dB(A)
68	71	77	78	81	81	70	66	67	85

Figure A3: Site and Background Sound Monitoring Positions



Appendix B – Weather Record

Day	Date	Temperature, (°C) Avg (Range)	Wind Speed (ms ⁻¹) Avg (Range)	Humidity	Precipitation (Total)
Tues	10-Sep-24	13.9 (18.9 / 8.8)	1.5 (6.9 / 0)	89 %	3.81 mm
Weds	11-Sep-24	10.6 (16.4 / 6.6)	1.1 (6.7 / 0)	83 %	1.78 mm
Thurs	12-Sep-24	9.1 (16.0 / 4.6)	0.8 (5.6 / 0)	85 %	0.76 mm
Fri	13-Sep-24	9.8 (18.1 / 2.6)	0.5 (3.6 / 0)	77 %	0.25 mm
Sat	14-Sep-24	11.0 (18.1 / 3.3)	0.5 (5.3 / 0)	79 %	0.00 mm
Sun	15-Sep-24	12.9 (19.9 / 6.0)	0.6 (4.9 / 0)	84 %	0.00 mm
Mon	16-Sep-24	15.9 (22.6 / 11.2)	0.6 (4.7 / 0)	80 %	0.00 mm
Tues	17-Sep-24	14.9 (21.4 / 7.7)	0.9 (5.7 / 0)	81 %	0.00 mm
Weds	18-Sep-24	18.0 (22.8 / 14.0)	1.2 (5.8 / 0)	83 %	0.00 mm

Appendix C – Graphs of Background Sound Levels

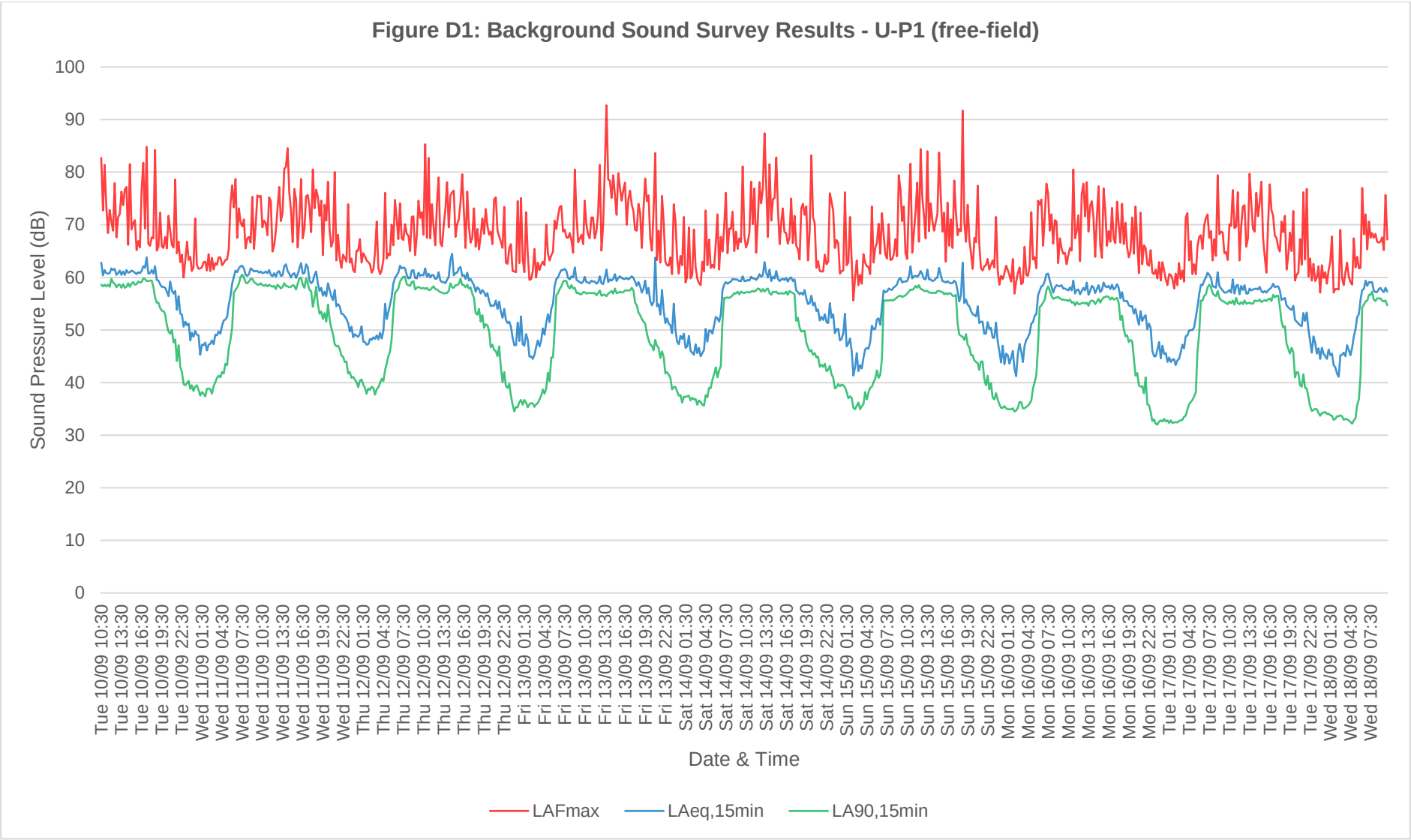
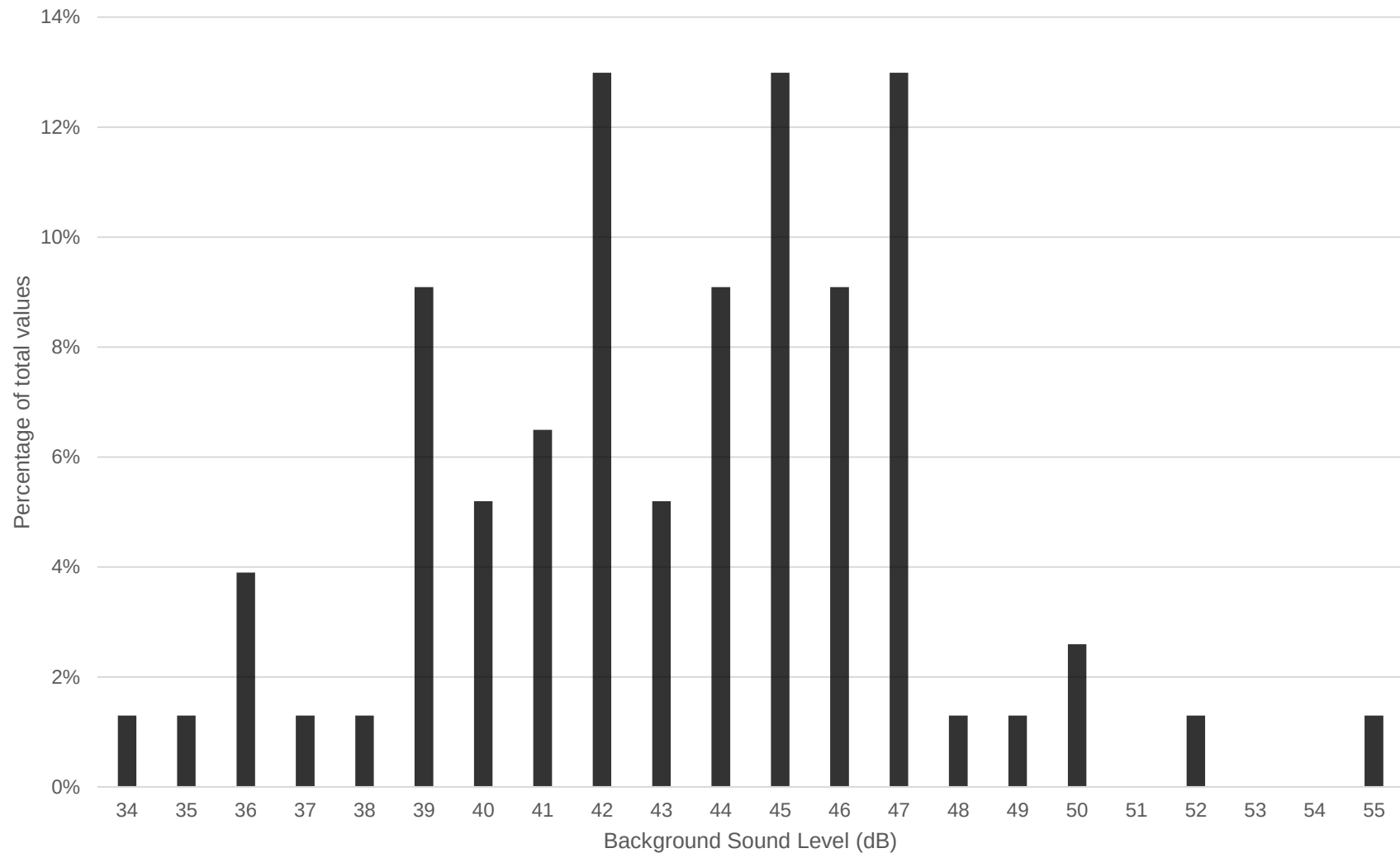


Figure D2: Statistical Analysis of Background Sound Levels (LA90,15min) - Daytime 07:00 - 23:00
hrs



Appendix D – Sound Calculations

NSR 1	Description	Unit	1/1 Octave Frequency Band (Hz)								Total
			63	125	250	500	1k	2k	4k	8k	
11 The Rowans	ASHP Sound Power Levels (4 no. Units)	LwA	74	77	83	84	87	87	76	72	91
	Distance	m	170	170	170	170	170	170	170	170	
	Q		1	1	1	1	1	1	1	1	
	A,barrier	dB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Propagation Loss (SWL > SPL Conversion)	dB	-55.6	-55.6	-55.6	-55.6	-55.6	-55.6	-55.6	-55.6	
	Atmospheric Absorption (ISO 9613-1)	dB	0.0	0.0	-0.2	-0.3	-0.7	-1.4	-4.4	-16.0	
	Sound Levels at Receiver	LpA	18.4	21.4	27.3	28.1	30.7	30.1	16.0	0.4	36