Blue Acoustics NS357 (V2)

Rose Gardens Banqueting Suite, Parkfield Road, Wolverhampton WV4 6EE

Acoustic Impact Assessment

Planning Application : 17/00925/FUL

Prepared by :

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On behalf of :

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1 Executive Summary

Main Hall Sound Insulation Test
Music noise above 100Hz was not readily measurable at the surrounding receptors, indicating that the building envelope provides effective sound insulation for all but the lowest frequency bands.
There is no significant change in low frequency noise leakage through the lobby roof with the main hall doors open or closed.
There is no significant change in low frequency noise leakage through the lobby doors towards NSR 1, when all doors (lobby & hall) are open.
Main hall music noise is greatest at NSR 1 (flats opposite) than at the other two receptors. Subjectively setting main hall noise levels according to music audibility at NSR 1 may therefore be appropriate for all surrounding receptors. It is advised that limiter settings are made on a weekend evening between 22:00 - 23:00, the last hour of daily operation and potentially the most noise sensitive period.
Function Room Sound Insulation Test
Measurement data indicates that **function room** music noise is greatest at the pub (NSR 2), where it was only measurable in the 40Hz to 80Hz 1/3 octave bands.
Music noise breaks out of the function room through the roof and the west side wall, which is acoustically weak. This explains why music noise is greatest at NSR 2.
To minimise the possibility of an adverse noise impact at the nearby receptors from function room use, it is strongly recommended that a 1/3 octave band limiting device be mandatorily installed immediately before the amplifier input for each function. The limiter should be set with the amplifier set to maximum output, and adjusted according to its audibility at NSR 2 (the pub). The limiting device should be periodically checked to ensure it has not been by-passed by the DJ / sound system crew.

Table 1 : Test conclusions

The following table detailed the recommended (un-weighted) music noise limit settings in 1/3 octave frequency bands. The values have been calculated to match but not exceed background noise levels, measured before the covid 19 pandemic. Whilst it is understood that the limiter may be set by subjective means, these values provide a good reference point when monitoring internal noise.

Un-weighted	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
Main Hall Noise Limits	**82 dB**	**93 dB**	**91 dB**	**96 dB**	**100 dB**	**101 dB**	**101 dB**	**99 dB**
Function Room Noise Limits	**94 dB**	**97 dB**	**101 dB**	**103 dB**	**102 dB**	**116 dB**	**110 dB**	**102 dB**

Table 2 : 1/3 octave band noise limits for the main hall and the function room

2 Introduction

Blue Acoustics has been instructed to carry out an acoustic impact assessment for Rose gardens Banqueting Suite in Wolverhampton. The suite comprises a main hall and associated lobby area on the ground floor, and a smaller yet substantial function room on the 1st floor.

Figure 1 : Rose Gardens

The suite is to be used for a range of private hire functions, notably weddings which often feature live music and DJs, and are known to generate very high music noise levels with significant bass content. As such, the building has been designed to minimise noise breakout through the construction of high mass concrete block cavity wall and suspended ceiling systems.

Operational hours are restricted to 10.00am to 23:00 pm hrs Mondays to Sundays and on Bank and Public Holidays.

The site was visited on the morning of Friday 28th May 2021 between 00:00 - 02:00 during which a range of tests were carried out to establish the sound insulation of the building and the associated impact at the surrounding receptors. This time was chosen to minimise measurement error from residual noise generated by traffic. Weather conditions were ideal with wind speeds below 2mph.

High level music with significant bass content was played at high volume through each sound system and simultaneous noise measurements taken internally and at three nearby receptors. The data was used to calculate 1/3 octave band noise limiter settings according to background noise data, which was measured pre-covid pandemic.

There following table details the surrounding receptors and their position in relation to the suite :

Receptor	Description	Approx. Distance From Suite
1	Apartment block on opposite side of Parkfield Road	50m to the south
2	Dudley Road Buildings / Old Ash Tree Pub	100m to the west
3	Houses on Hailes Park Close	130m to the east

Table 3 : Noise Sensitive Receptors

After the first test, a number of potential improvements were identified which included :

1 Introducing rubber matting under the bass cabs in the main room to minimise sound transmission through the floor into the super structure.

2 Building lobby systems around the fire doors along the northern side of the main hall building

3 Sealing the east facing function room door

The site was then re-visited and re-tested on the morning of Sunday 27.06.21 between 05:00 - 07:00. This report features test data from the original test for the open door assessments, and updated data for the most recent noise impact tests at the surrounding receptors.

Maximum internal 1/3 octave band noise limits have been prescribed to ensure background noise levels are not exceeded at the nearby dwellings. However, it should be understood that these limits are related to background noise readings taken on a particular night and, whilst taken before lockdown, are not necessarily representative of every event night. As such the noise limits may be open to a degree of interpretation and may be ‘tweaked’ according to the on-going noise climate at the nearby receptors. This enables the venue to maximise music noise levels, whilst minimising the likelihood of complaint from residential neighbours.

It is therefore recommended that the duty managers follow the noise management strategy set out in the accompanying Noise Management Plan, composed specifically for this venue.

3 Guidance & References

This assessment has been carried out in response to the following conditions in the premises license:

1. Prior to the Rose Banqueting Hall opening an acoustic impact assessment shall be conducted in agreement with and to the satisfaction of the Licensing Authority which shall include*, inter alia:*

- An appraisal of the physical structure of the premises and building components in terms of its ability to mitigate internally generated sounds.

- Specifications for electronic/electrical systems and means to be used as permanent installations for the purposes of producing, reproducing and amplifying music and other sounds associated with the licensed use.

- Required means to mitigate and prevent adverse noise impact at noise-sensitive premises that includes measure to limit and control internally generated music and other sounds produced, reproduced or amplified by electronic/electrical systems associated with the licensed use.

- A Noise Management Plan that incorporates external noise sources arising through use of the licensed premises.

2. Ensure that when the Rose Garden banqueting Hall is in use the Noise Prevention and Event Dispersal Policy (Document Reference -RGBH/NPAEDP/01 Dated: 28th April 2020) which has been agreed with Environmental Health is adhered to at all times. This document is subject to annual review and should be updated and/or amended as deemed necessary by the City of Wolverhampton Councils Environmental Health Section.

Additional guidance has been provided by Emma Waites (WCC Senior Environmental Health Officer) :

“With reference undertaking an acoustic impact assessment It is critical to assess the potential impacts of low frequency (bass) components of amplified music and other sounds along with acoustic instrumentation (i.e drums) that may be associated with any function or event. To this end simplistic dB(A) versus dB (C) and dB (Z) can be used as an initial screening tool however it is also relevant to examine 1/3rd octave band components in the sub 200 Hz range since acoustic transmission through structures inclusive of windows is well known to be relatively efficient and difficult to mitigate.”

4 Site Detail

4.1 General

The suite is located on Parkfield Road, a dual carriageway approximately 1.5km South of Wolverhampton City Centre in the suburb of Goldthorn Park. Parkfield Road is busy throughout the day with a constant flow of traffic both moving and queueing at the nearby junction with the Dudley Road (A459). Traffic flow remains relatively constant throughout the evening period, though at a significantly reduced rate.

Figure 2 : Map of site location

To the south is Parkfield Road and further from this are several apartment buildings at approx 50m. To the east of these are a row of houses stretching down Parkfield Road.

To the west is the site car park and further to this is a row of shops along Dudley Road ranging 70m to 100m. It is unknown whether or not these are occupied at 1st floor level and so all measurements have been made to the Old Ash Tree pub where it is known that 1st floor accommodation exists.

To the east is a medical centre and associated car park. Recreational sports facilities in Phoenix park are just to the north of the centre. Further west across the park are a number of dwellings in Haines Close, at approx. 130m from the site. To the north is Phoenix park.

Figure 3 : Aerial view of site in relation to receptors

4.2 Main Room Sound System Specifications

The following table details the main sound system components, installed in the main room. The amplifiers and signal processing are housed in the control room at the rear of the main hall.

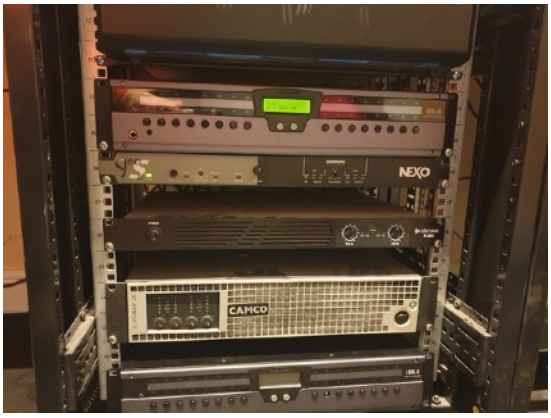
Component	Description	Image
Line Array	8 x Nexo GEO 12 Tops, 4 flown on each side	
Bass Bins	4 x twin 18” units positioned under the stage	
Amplification	Camco Q Power 10, Citronic PL2000	
Signal Processing	Allen & Heath IDR-8 Matrix Mixer and signal processor	

Table 4 : Main room sound system

5 Measurement Details

5.1 Personnel & Equipment

All testing, calculation & evaluation was conducted by Tim Sherlock-Brown M.I.O.A. of Blue Acoustics. He is a Member of the Institute of Acoustics and possesses an MSc in Applied Acoustics.

Meter s/n	Calibration Date	Calibration Certificate	Position
G079832	17.11.2020	149029	Internal : Main Hall & Function Room
G068016	13.01.2020	136387	Variable position
G066520	24.02.2021	153521	Flats Opposite

Table 5 : Measurement equipment table

Care was taken to eliminate external influence on the measurements by the application of a windshield, and with particular attention paid to wind speed when selecting measurement periods. Unless otherwise stated, meters were tripod mounted at a height of 1.2-1.5m at an angle of approximately 60 degrees. Calibration was performed before and after each measurement or set of measurements with no notable drift. A drift of up to 0.5dB with a Class 1 meter is considered reasonable and is generally caused by variations in temperature, humidity and battery power.

5.2 Weather Conditions

Dry; Temp 12c to 13c; Windspeed 0-4m/s northerly; unknown % cloud cover

5.3 Measurement Positions

Figure 4 : Aerial view of measurement positions

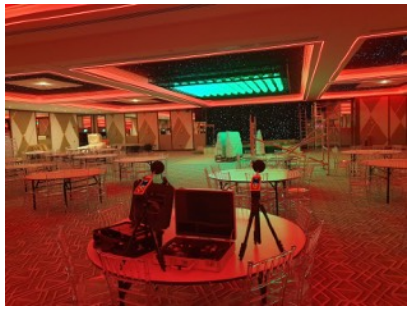
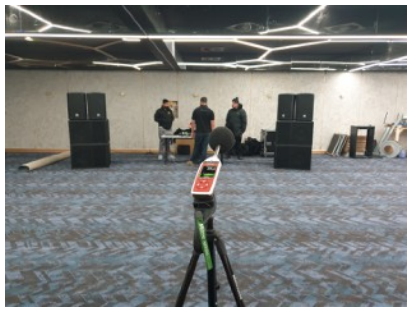
Position	Description	Image
Main Hall	Source room measurement taken by moving arc procedure at the centre of the room	
Function Room	Source room measurement taken by moving arc procedure at the centre of the room	
P1	Taken in line with the front facade of the flats opposite, 3.5m from the east end of the eastern most apartment building.	
P2	Taken 3.5m from the rear facade of the rear facade of the pub.	
P3	Taken in line with the nearby dwellings in the adjacent car park.	

Table 6 : Measurement position table

6 Sound Insulation Testing

Sound insulation testing is typically carried out using white or pink noise. Whilst this works well for residential purposes, the pink noise spectrum lacks 'low end punch' and is very difficult to measure in the presence of residual noise. As such, music noise has been employed for its ability to punch through the building envelope and be readily distinguishable, and therefore measurable, over the residual noise climate.

The following measurement strategy was designed to attain critical sound insulation data through measurement at the nearby receptors. The strategy also includes a series of measurements designed to evaluate the effect of open door states for the lobby and main hall.

Room Test	State	Measurement position(s)
Main Hall	All doors closed	NSR 1, NSR 2, NSR 3 + Lobby Roof
	Hall doors open (only)	NSR 1 + Lobby Roof
	Hall + Lobby doors open	NSR 1
Function Room	All doors closed	NSR 1, NSR 2, NSR 2

Table 7 : Measurement strategy table

Internal noise measurements were taken by the sweeping arc method which minimises error from standing waves by cutting through them in a continuous motion. The meter was waved around for a 1min period over an area of approximately 5m^2 in the centre of each space to attain 'reverberant' noise levels within the space. External measurements are not subjected to this phenomena and may therefore be fixed in position.

To maximise measurement accuracy, the chosen track was looped at a bass heavy section 8 seconds long, and looped many times to make a 7 minute track. The 8s section generated relatively steady state noise throughout the lower frequency range at a rate of 7 full loop cycles every minute.

To ensure music noise was easily recognisable from the measurement data, the track was edited to include a 5s period of silence after every 30s. This method generates visually distinguishable square shaped forms within the low frequency data graph, and allows for better recognition against the residual noise climate.

The following graphs demonstrate this principal. The influence of music noise is clearly visible in the 40Hz 1/3 octave band, with the 5s silences showing as periodic dips in noise level. However, it becomes less visible as frequency increases and is distinctly less apparent in the 80Hz band, becoming un-measurable in the adjacent 100Hz band as it is lost in the residual noise.

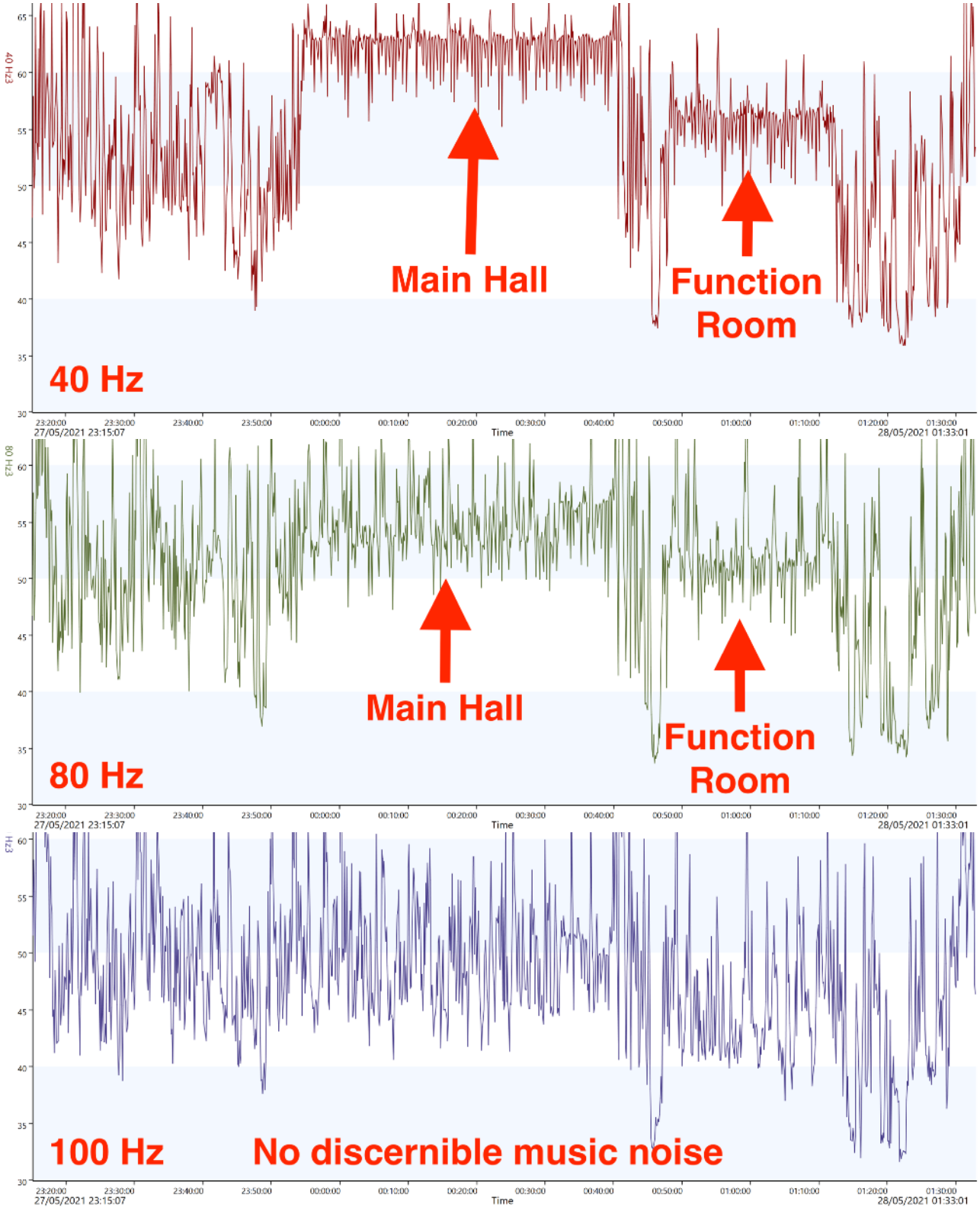


Figure 5 : 40Hz, 80Hz & 100Hz 1/3 Octave band measurements at NSR 1

6.1 Main Hall

Figure 6 : Main hall

The following tables detail the test result data for the main hall. The measurement data is presented in 1/3 octave un-weighted format between 31.5Hz - 160Hz.

The first test establishes the effect of opening the doors between the main hall and the lobby, on the lobby roof breakout noise level - considered to be the weakest component of the whole building. Measurements were taken at the centre of the lobby roof with the doors closed, and then opened.

The test results indicate that there is no significant difference in low frequency noise leakage through the lobby roof with the main hall doors open or closed, except for a +4dB rise in the 40hz band. This is assumed to be a result of the fact that the noise is already reverberating through the structure, with internal door states having little effect on structure borne sound transmission.

	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	LAeq
Source Noise Level	91.4	104.8	111.1	109.1	108.4	105.6	101.3	99.3	99 dB
Lobby Roof (Doors Closed)	69.0	77.3	85.4	77.4	72.0	64.6	56.2	49.9	58 dB
Lobby Roof (Doors Open)	68.1	80.9	86.0	78.6	73.3	65.1	56.3	49.5	58 dB
Discernible difference	-0.9	**+4 dB**	0.6	1.2	1.3	0.5	0.1	-0.4	

Table 8 : Hall to lobby assessment table

The second test establishes the effect of opening the main room doors, and the lobby doors, at the flats opposite (NSR 1).

The lack of any significant change in level at NSR1 when opening all doors is a clear indication that open door states do not affect the lower frequencies at the nearby receptors. Subjectively, the higher frequency bands were not discernible at NSR 1 with the doors open, further minimising the likelihood of significant noise impact at the flats opposite.

	Door State	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	LAeq
Source Noise Level		91.4	104.8	111.1	109.1	108.4	105.6	101.3	99.3	99 dB
P1 (Flats opposite)	All Closed	54.4	62.9	73.0	60.6	56.7	52.3	55.6	55.7	62 dB
	Hall open	55.2	62.9	73.2	60.1	56.2	53.4	49.7	48.3	59 dB
	All Open	53.3	62.4	73.1	58.5	58.8	53.1	49.0	46.8	57 dB
Open door level change		-1.1	-0.5	0.1	-2.1	2.1	0.8	-6.6	-8.9	

Table 9 : Assessment of closed / open door states at flats opposite

The following table details the low frequency level difference between the main hall and the nearby residential receptors. Values highlighted in bold represent frequency bands where the measured music noise level is easily and visually identifiable, and exceeds the residual noise level by a measurable margin. Measurement data indicates that music noise is significantly louder at the flats opposite than at the other two receptors.

	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	LAeq
Source Noise Level	88.1	106.6	112.6	110.2	108.2	100.5	99.4	98.2	96 dB
P1 (Flats opposite)	**53.8**	**62.6**	**72.8**	**58.8**	**54.4**	49.0	47.3	46.9	
Attenuation	-34	-44	-40	-51	-54	NA	NA	NA	
P2 (Ash Tree Pub)	49.9	**58.6**	**63.2**	**58.4**	**52.2**	45.9	42.7	39.6	
Attenuation	NA	-48	-49	-52	-56	NA	NA	NA	
P3 (Haines Close)	**48.2**	**56.5**	**66.6**	**59.9**	**48.0**	46.1	44.8	41.9	
Attenuation	-40	-50	-46	-50	-60	NA	NA	NA	

Table 10 : Main Hall to residential / music noise attenuation values

6.2 Function Room

Figure 7 : Function room

The function room roof is the weakest component of the building. It is relatively low, with a floor to roof distance of approx. 5m.

The following table details the low frequency level difference between the function room and the nearby receptors. Values highlighted in bold represent frequency bands where the measured music noise level is easily and visually identifiable, and exceeds the residual noise level by a measurable margin.

The data indicates that the function room breakout noise registers greatest at NSR 2 (The pub). This is assumed to be caused by sound easily penetrating the western wall, which is significantly lower in mass than the main hall walls.

	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	LAeq
Source Noise Level	93.6	111.9	121.4	117.6	112.9	115.7	110.2	101.7	102 dB
P1 (Flats opposite)	52.2	**61.5**	**66.8**	**59.7**	**53.6**	52.5	48.8	48.5	
Attenuation	NA	-50	-55	-58	-59	NA	NA	NA	
P2 (Ash Tree Pub)	50.8	**59.8**	**67.0**	**61.4**	**53.2**	45.6	41.0	37.6	
Attenuation	NA	-52	-54	-56	-60	NA	NA	NA	
P3 (Haines Close)	49.5	**60.0**	**68.1**	**61.1**	**48.6**	45.1	43.7	42.6	
Attenuation	NA	-52	-53	-57	-64	NA	NA	NA	

Table 11 : Function Room to residential / music noise attenuation values

7 Noise Limitation

To establish workable noise limits for the lower 1/3 octave bands, measured music noise has been assessed against background noise levels at all three receptors. Calculations have been made to determine how much the music noise exceeds the background noise levels in each band, which is then applied to the internal noise levels to provide 1/3 octave band settings for a signal path limiter. The greatest attenuation requirement for each band at each receptor has been used to simultaneously minimise the noise impact at all three NSRs / receptors.

It is understood that the chosen limiting device in the main room is lockable. This ensures that it cannot be driven harder by the DJs.

7.1 Background Noise Levels

The following table details background noise data measured at the nearby receptors for the initial report in 2018.

	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
NSR 1 (Flats Opposite)	9	14	22	22	24	14	26	28
NSR 2 (Pub)	4	10	19	21	22	24	23	25
NSR 3 (Haines Close)	4	11	18	20	20	21	22	25

Table 12 : 1/3 octave band background noise levels at each receptor

7.2 Main Hall Assessment

Flats Opposite	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
Source Noise Level	88.1	106.6	112.6	110.2	108.2	100.5	99.4	98.2
LA90 22:00 - 23:00	9	14	22	22	24	24	26	28
P1 (Flats opposite)	**53.8**	**62.6**	**72.8**	**58.8**	**54.4**	49.0	47.3	46.9
A-Weighting	-39.4	-34.6	-30.2	-26.2	-22.5	NA	NA	NA
Music noise (A-weighted)	14	28	43	33	32	NA	NA	NA
Required Attenuation to match LA90 level	5 dB	14 dB	21 dB	11 dB	8 dB	NA	NA	NA
Pub	**31.5Hz**	**40Hz**	**50Hz**	**63Hz**	**80Hz**	**100Hz**	**125Hz**	**160Hz**
LA90 22:00 - 23:00	4	10	19	21	22	24	23	25
P2 (Ash Tree Pub)	49.9	**58.6**	**63.2**	**58.4**	**52.2**	45.9	42.7	39.6
A-Weighting	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	NA	NA
Music noise (A-weighted)	11	24	33	32	30	27	NA	NA
Required Attenuation to match LA90 level	6 dB	14 dB	14 dB	11 dB	8 dB	3 dB	NA	NA
Hailes Park Close	**31.5Hz**	**40Hz**	**50Hz**	**63Hz**	**80Hz**	**100Hz**	**125Hz**	**160Hz**
LA90 22:00 - 23:00	4	11	18	20	20	21	22	25
P3 (Haines Close)	**48.2**	**56.5**	**66.6**	**59.9**	**48.0**	46.1	44.8	41.9
A-Weighting	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1	NA	NA
Music noise (A-weighted)	9	22	36	34	26	29	NA	NA
Required Attenuation to match LA90 level	5 dB	11 dB	18 dB	14 dB	6 dB	NA	NA	NA
Highest attenuation requirements per band	**6 dB**	**14 dB**	**21 dB**	**14 dB**	**8 dB**			
Un-weighted Main room noise limits	**82 dB**	**93 dB**	**91 dB**	**96 dB**	**100 dB**	**101 dB**	**101 dB**	**99 dB**

Table 13 : Calculation of main hall working noise limits (31.5Hz to 160Hz)

7.3 Function Room Assessment

Flats Opposite	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
Source Noise Level	93.6	111.9	121.4	117.6	112.9	115.7	110.2	101.7
LA90 22:00 - 23:00	6	12	18	20	20	24		
P1 (Flats opposite)	52.2	**61.5**	**66.8**	**59.7**	**53.6**	52.5	48.8	48.5
A-Weighting	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1		
Function Room (A-weighted)	13	27	37	34	31	33		
Required Attenuation to match LA90		15 dB	19 dB	14 dB	11 dB			
Pub	**31.5Hz**	**40Hz**	**50Hz**	**63Hz**	**80Hz**	**100Hz**	**125Hz**	**160Hz**
LA90 22:00 - 23:00	6	12	18	20	20	24		
P2 (Ash Tree Pub)	50.8	**59.8**	**67.0**	**61.4**	**53.2**	45.6	41.0	37.6
A-Weighting	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1		
Function Room (A-weighted)	11	25	37	35	31	27	41.0	37.6
Required Attenuation to match LA90		13 dB	19 dB	15 dB	11 dB			
Hailes Park Close	**31.5Hz**	**40Hz**	**50Hz**	**63Hz**	**80Hz**	**100Hz**	**125Hz**	**160Hz**
LA90 22:00 - 23:00	6	12	18	20	20	24		
P3 (Haines Close)	49.5	**60.0**	**68.1**	**61.1**	**48.6**	45.1	43.7	42.6
A-Weighting	-39.4	-34.6	-30.2	-26.2	-22.5	-19.1		
Function Room (A-weighted)		25	38	35	26			
Required Attenuation to match LA90		13 dB	20 dB	15 dB	6 dB			
Highest attenuation requirements per band		**15 dB**	**20 dB**	**15 dB**	**11 dB**			
Un-weighted Function room noise limits	**94 dB**	**97 dB**	**101 dB**	**103 dB**	**102 dB**	**116 dB**	**110 dB**	**102 dB**

Table 14 : Calculation of function room noise limits (31.5Hz to 100Hz)

8 Conclusions

At the test level, music noise was not measurable over 100Hz at any of the three receptors. It may be assumed that music noise above 100Hz will be inaudible at all 3 receptors.

There is no significant change in low frequency noise leakage through the lobby roof with the **main hall** doors open or closed.

The lack of any significant change in level at NSR1 when opening all **main hall** and lobby doors is a clear indication that open door states do not affect the lower frequencies at the nearby receptors.

Measurement data indicates that **main hall** music noise is significantly louder at the flats opposite (NSR 1) than at the other two receptors. Subjectively setting main hall noise levels according to NSR 1 may therefore be appropriate for all surrounding receptors.

Measurement data indicates that **function room** music noise is greatest at the pub (NSR 2), where it was only measurable in the 40Hz to 80Hz 1/3 octave bands. Subjectively setting function room noise levels according to NSR 2 may therefore be appropriate for all surrounding receptors.

It is understood that the chosen limiting device for the **main hall** is lockable. This ensures the installed system cannot be driven harder by the DJs, and thus limit the noise impact at the nearby receptors.

To minimise the possibility of an adverse noise impact at the nearby receptors from function room use, it is strongly recommended that a 1/3 octave band limiting device be mandatorily installed immediately before the amplifier input for each function. The limiter should be set with the amplifier set to maximum output, and adjusted according to its audibility at NSR 2 (the pub). The limiting device should be periodically checked to ensure it has not been by-passed by the DJ / sound system crew.

9 Disclaimer

Blue Acoustics takes no responsibility for any physical implementation & strongly suggests the client seek structural advice before carrying out the proposed work. Recommendations in this report are for acoustics purposes only, and it is the responsibility of the Project Manager or Architect to ensure that all other requirements are met including (but not limited to) structure, fire and Building Controls.

The calculations within this report are based upon sourced and or calculated data. It should be understood that complex flanking transmission paths through the structure can lead to excess vibration transmission and that mitigation measures within the rooms may have to be 'tweaked' after construction. Also, build quality can greatly affect partition performance and Blue Acoustics takes no responsibility for the integrity of any physical work carried out.

The opinions and interpretations presented in this report represent our best technical interpretation of the data made available to us. However, due to uncertainty inherent in the estimation of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, cost, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. The findings and opinions expressed are relevant to the dates of the site works and should not be relied upon to represent conditions at substantially later dates. If additional information becomes available which may affect our comments, conclusions or recommendations, the author reserves the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

Except for the provision of professional services on a fee basis, Blue Acoustics does not have a commercial arrangement with any person or company involved in the interests that are the subject of this report. Blue Acoustics cannot accept any liability for the correctness, applicability or validity for the information they have provided, or indeed for any consequential costs or losses in this regard. Our efforts have been made on a "best endeavours" basis and no responsibility or liability is warranted or accepted by Blue Acoustics.

Appendix 1 – Glossary of Terms

'A' weighting (dB(A)): A frequency dependent correction which weights sound to correlate with the sensitivity of the human ear to sounds of different frequencies.

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 people'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 halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Ambient Noise: A measure of the typical noise (excluding any unusual events) present at a site. This is usually described in terms of $L_{Aeq,T}$.

Anonymous noise: Noise that cannot be attributed to a single (specific source). For example noise from cars on a road would be considered anonymous whereas a noisy ventilation unit would not.

Attenuation: A reduction in the intensity of a sound signal.

Audible: Sound that can be heard or is perceptible by the human ear.

Background Noise: A measure of the underlying noise (excluding any unusual events) which is present at a site before a new noise source is introduced. This is usually described in terms of the L_{A90} level: the sound pressure level exceeded for 90% of the time.

C_{tr} Spectrum adaptation term: A correction added to a sound insulation quantity (such as R_W) to take account of a specific (traffic noise) spectra. See BS EN ISO 717-1:1997. For example the difference between internal and external traffic noise levels in dB(A) is calculated using $R_W + C_{tr}$ (equivalent to $R_{traffic}$)

Clearly audible: There is no acoustic definition for clearly audible and as such a noise source may be deemed to be clearly audible if it is both easily identifiable and deemed likely to adversely affect the amenity of residents of any (proposed) development.

$D_{ne,W}$ Weighted element normalized level difference: A single-number quantity which characterizes the airborne sound insulation of a small building element. See BS EN ISO 717-1: 1997

$D_{nT,W}$ Standardised level difference: A single-number quantity which characterizes the airborne sound insulation between rooms. See BS EN ISO 717-1: 1997

Decibel (dB): A unit used for many acoustic quantities to indicate the level of sound with respect to a reference level.

EPU: Environmental Protection Unit, a service within the Environmental Health section of the Regulatory Services Department of Birmingham City Council.

Façade measurement: Noise measurements made outside an external wall of a structure (usually 1 metre from the wall).

Free Field: 1. A free sound field is a field in a homogeneous, isotropic medium free from boundaries. In practice it is a field in which the effects of the boundaries are negligible over the region of interest. The actual pressure impinging on an object (e.g., a microphone) placed in an otherwise free sound field will differ from the pressure which would exist at the point with the object removed, unless the acoustic impedance of the object matches the acoustic impedance of the medium.
2. An environment in which there are no reflective surfaces within the frequency region of interest.
3. A region in which no significant reflections of sound occur.
4. [BS4142] suggests that free-field environmental noise measurements need to be made at least 3.5m from any reflecting structure.

Habitable room: A room used for sleeping or recreation / relaxation.

Hertz (Hz): unit of frequency, equal to one cycle per second. Frequency is related to the pitch of a sound.

Inaudible: Sound that cannot be heard or is imperceptible to the human ear.

Industrial-type noise sources: Noise sources that are industrial in character. For example noise from plant and machinery, materials handling operations, or manoeuvring of heavy vehicles.

Institute of Acoustics: A professional body representing persons at all levels working in the field of acoustics. http://www.ioa.org.uk/

$L_{A90,T}$: Sound pressure level exceeded for 90% of the measurement period "T" or 'background level'.

$L_{Aeq,T}$: Equivalent continuous sound pressure level measured over the time period "T"

L_{Amax}: The maximum RMS A weighted sound pressure level

Mixed Use: Premises or development which will include both residential and non-residential uses

Noise: Unwanted sound.

Noise with a specific character: Noise has a specific character if it contains features such as a distinguishable, descrete and continuous tone, is irregular enough to attract attention, or has strong low frequency content .

Noise Nuisance: A legal term used to describe noise at a level that is disturbing as perceived by a reasonable person. The meaning of nuisance is defined by precedent in common law.

Outdoor Amenity Area: An outdoor area adjacent to a residential building which is designed and intended primarily for the leisure and recreation of the occupants of the dwelling. This will include gardens, landscaped areas, balconies.

R, Sound reduction index: A quantity which characterizes the airborne sound insulation of a material or building element in a stated frequency band. See BS EN ISO 140-3:1995

R_W, Weighted sound reduction index: A single-number quantity which characterizes the airborne sound insulation of a material or building element measured in the laboratory. See BS EN ISO 717-1: 1997

Rating Level: The noise level of an industrial noise source which includes an adjustment for the character of the noise. Used in BS4142.

Residual Noise : The ambient noise remaining at a given position in a given situation when the specific noise level is suppressed to a degree such that it does not contribute to the ambient noise.

Sound insulation: A quantity which is used to characterize the reduction in sound pressure level across an element or partition. (See R, R_W, $D_{nT,W}$, $D_{ne,W}$, C_{tr})

Specific noise source : The noise source under investigation for assessing the likelihood of complaints.

Steady State Noise: Noise that gives fluctuations over a range of not more than 5 dB on a sound level meter set to frequency weighting A and time weighting S. [BS 4142:2014]

Structure borne noise: Noise that propagates through a structure, for example through a building.

Appendix 2 Measurement Data Sheets
Main Hall Source Level

01/07/2021

Cirrus Research plc

Measurement Summary Report

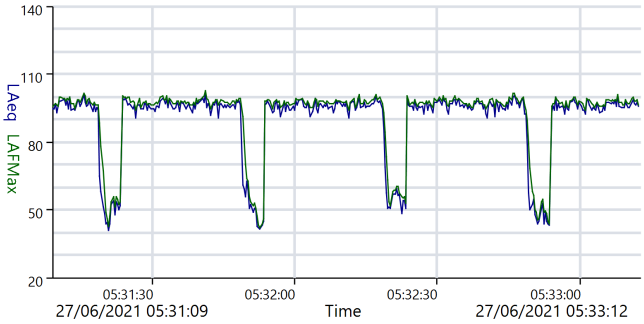
Name	Main Hall Internal Source Level			
Time	27/06/2021 05:31:09	**Person**	**Place**	**Project**
Duration	00:02:03			Rose Gardens
Instrument	G068016, CR:171B			

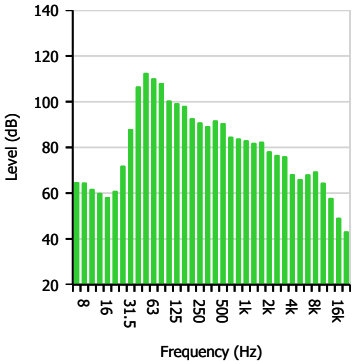
Calibration

Before	27/06/2021 04:12	Offset	0.57 dB	**After**	28/06/2021 15:53	Offset	0.15 dB

Basic Values	
LAeq	95.7 dB
LAE	116.6 dB
LAFMax	102.4 dB

Statistical Levels (Ln)	
LAF1	100.1 dB
LAF5	98.7 dB
LAF10	98.3 dB
LAF50	95.6 dB
LAF90	54.3 dB
LAF95	48.4 dB
LAF99	42.7 dB





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Main Hall - NSR 1

01/07/2021

Cirrus Research plc

Measurement Time History Report

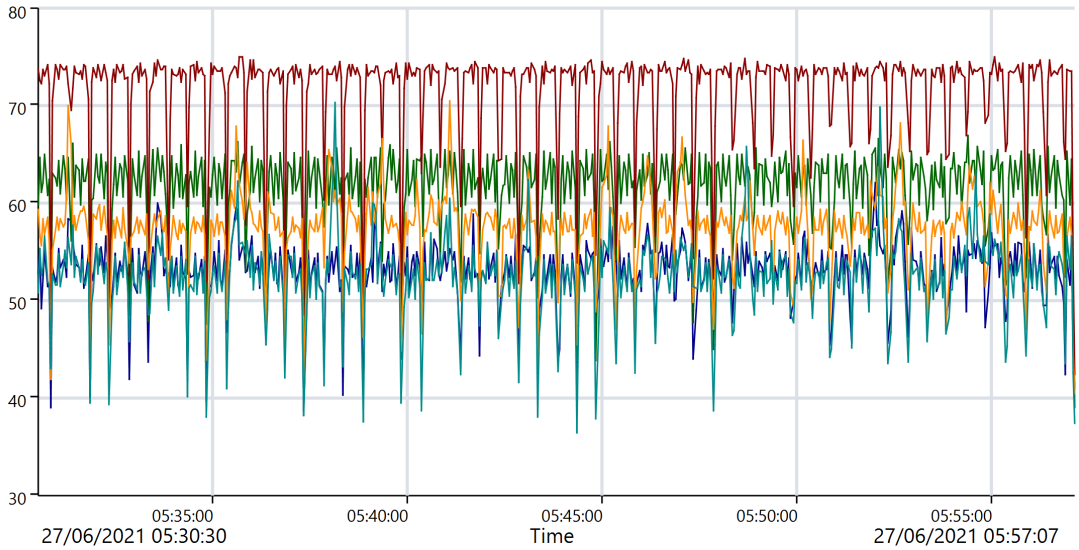
Name	Main Hall Noise @ NSR 1				
Time	27/06/2021 05:00:01	**Person**		**Place**	**Project**
Duration	01:00:00				Rose Gardens
Instrument	G066520, CR:171B				

Calibration

Before	27/06/2021 04:12	Offset	0.39 dB	**After**	27/06/2021 07:50	Offset	0.12 dB

Period 27/06/2021 05:30:30 - 27/06/2021 05:57:07

Legend	31.5 Hz3	40 Hz3	50 Hz3	63 Hz3	80 Hz3
Value	53.8 dB	62.6 dB	72.8 dB	58.8 dB	54.4 dB



These values have been recalculated due to the large number of samples displayed.

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Main Hall - NSR 2

01/07/2021

Cirrus Research plc

Measurement Summary Report

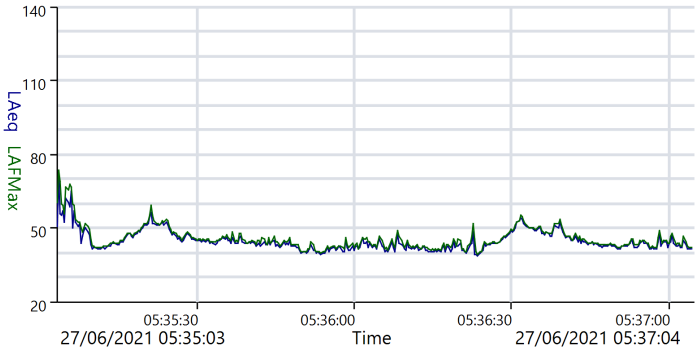
Name	Main Room (Pub)			
Time	27/06/2021 05:35:03	**Person**	**Place**	**Project**
Duration	00:02:01			Rose Gardens
Instrument	G068016, CR:171B			

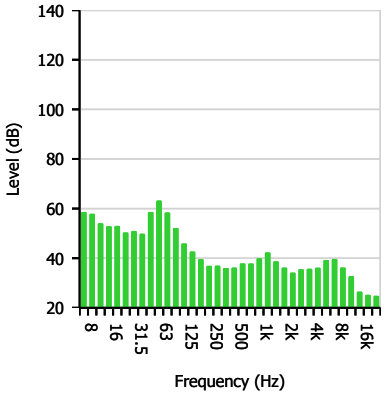
Calibration

Before	27/06/2021 04:12	Offset	0.57 dB	**After**	28/06/2021 15:53	Offset	0.15 dB

Basic Values	
LAeq	49.6 dB
LAE	70.4 dB
LAFMax	73.3 dB

Statistical Levels (Ln)	
LAF1	59.6 dB
LAF5	52.0 dB
LAF10	50.4 dB
LAF50	43.5 dB
LAF90	40.9 dB
LAF95	40.2 dB
LAF99	39.4 dB





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Main Hall - NSR 3

01/07/2021

Cirrus Research plc

Measurement Summary Report

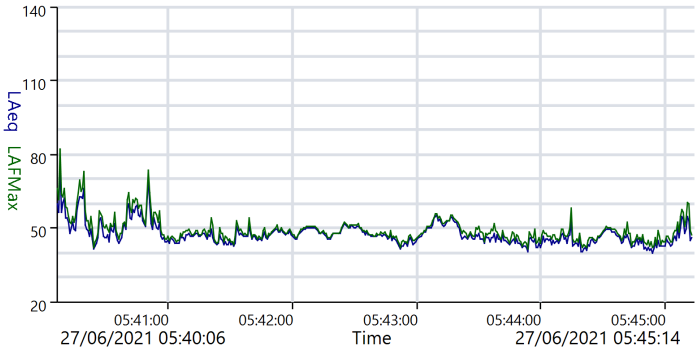
Name	Main Room (Haines Close)			
Time	27/06/2021 05:40:06	**Person**	**Place**	**Project**
Duration	00:05:08			Rose Gardens
Instrument	G068016, CR:171B			

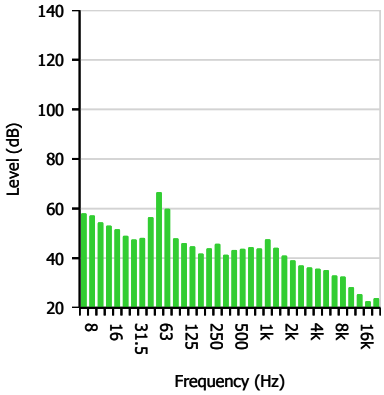
Calibration

Before	27/06/2021 04:12	Offset	0.57 dB	**After**	28/06/2021 15:53	Offset	0.15 dB

Basic Values	
LAeq	53.2 dB
LAE	78.1 dB
LAFMax	81.8 dB

Statistical Levels (Ln)	
LAF1	62.2 dB
LAF5	55.2 dB
LAF10	52.5 dB
LAF50	46.5 dB
LAF90	42.7 dB
LAF95	41.9 dB
LAF99	40.4 dB





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Function Room Source Level

01/07/2021

Cirrus Research plc

Measurement Summary Report

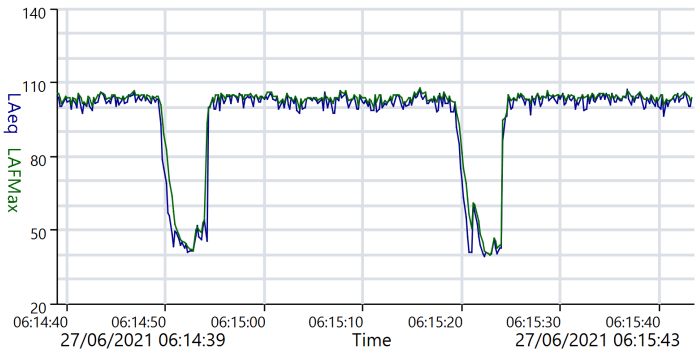
Name	Function Room Source Level			
Time	27/06/2021 06:14:39	**Person**	**Place**	**Project**
Duration	00:01:04			Rose Gardens
Instrument	G068016, CR:171B			

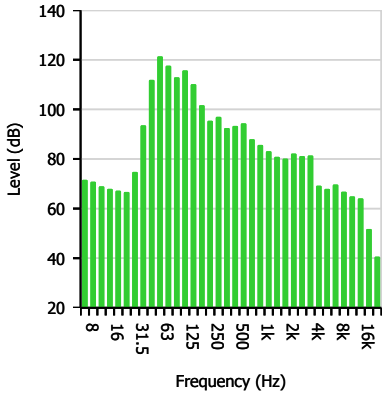
Calibration

Before	27/06/2021 04:12	Offset	0.57 dB	**After**	28/06/2021 15:53	Offset	0.15 dB

Basic Values	
LAeq	102.2 dB
LAE	120.3 dB
LAFMax	107.7 dB

Statistical Levels (Ln)	
LAF1	105.8 dB
LAF5	105.0 dB
LAF10	104.5 dB
LAF50	102.3 dB
LAF90	54.4 dB
LAF95	44.3 dB
LAF99	40.3 dB





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Function Room - NSR 1

01/07/2021

Cirrus Research plc

Measurement Time History Report

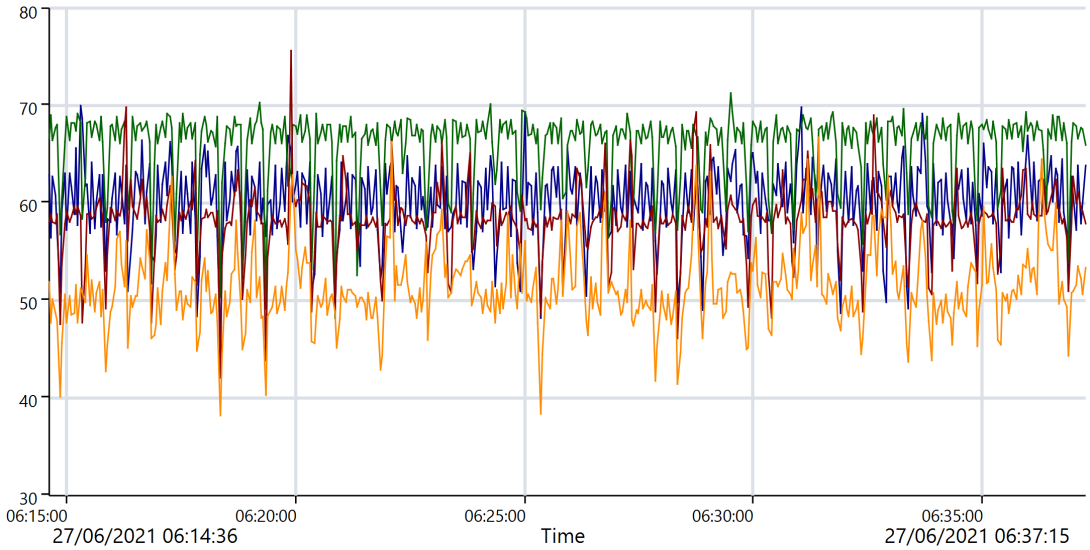
Name	Function Room Noise @ NSR 1				
Time	27/06/2021 06:00:02	**Person**		**Place**	**Project**
Duration	00:38:36				Rose Gardens
Instrument	G066520, CR:171B				

Calibration

Before	27/06/2021 04:12	Offset	0.39 dB	**After**	27/06/2021 07:50	Offset	0.12 dB

Period 27/06/2021 06:14:36 - 27/06/2021 06:37:15

Legend	40 Hz3	50 Hz3	63 Hz3	80 Hz3
Value	61.5 dB	66.8 dB	59.7 dB	53.6 dB



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Function Room - NSR 2

01/07/2021

Cirrus Research plc

Measurement Summary Report

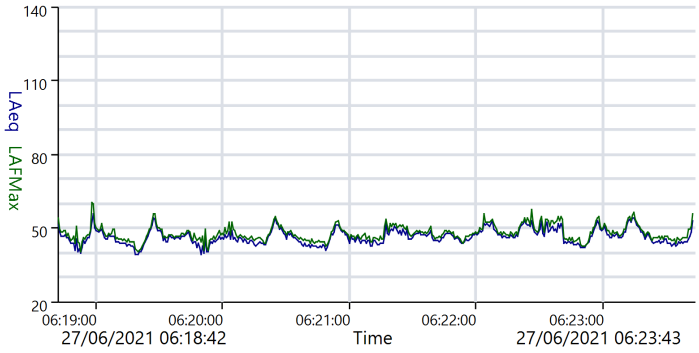
Name	Function Room (Pub)			
Time	27/06/2021 06:18:42	**Person**	**Place**	**Project**
Duration	00:05:01			Rose Gardens
Instrument	G068016, CR:171B			

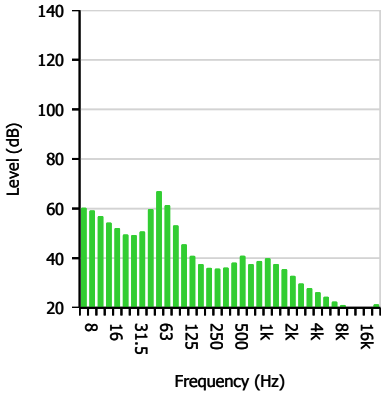
Calibration

Before	27/06/2021 04:12	Offset	0.57 dB	**After**	28/06/2021 15:53	Offset	0.15 dB

Basic Values	
LAeq	47.4 dB
LAE	72.2 dB
LAFMax	60.1 dB

Statistical Levels (Ln)	
LAF1	53.8 dB
LAF5	51.9 dB
LAF10	50.4 dB
LAF50	45.9 dB
LAF90	42.6 dB
LAF95	41.7 dB
LAF99	39.8 dB





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Function Room - NSR 3

01/07/2021

Cirrus Research plc

Measurement Summary Report

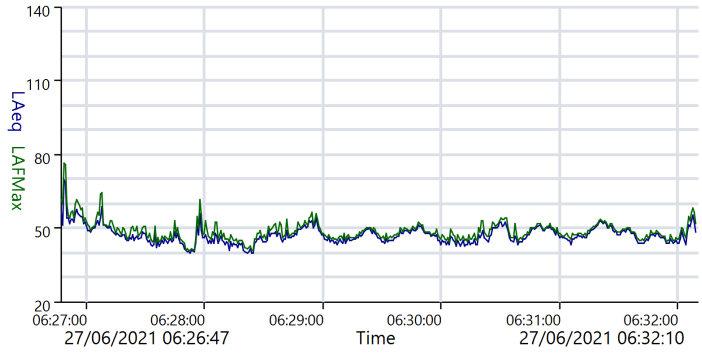
Name	Function Room (Haines Close)			
Time	27/06/2021 06:26:47	**Person**	**Place**	**Project**
Duration	00:05:23			Rose Gardens
Instrument	G068016, CR:171B			

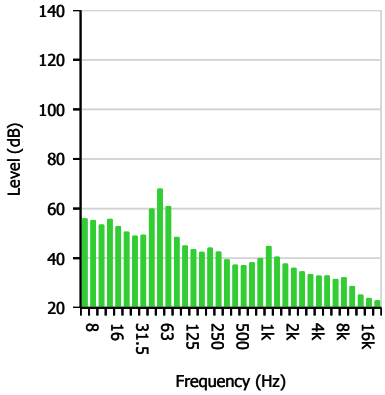
Calibration

Before	27/06/2021 04:12	Offset	0.57 dB	**After**	28/06/2021 15:53	Offset	0.15 dB

Basic Values	
LAeq	50.2 dB
LAE	75.3 dB
LAFMax	76.4 dB

Statistical Levels (Ln)	
LAF1	56.9 dB
LAF5	52.7 dB
LAF10	51.2 dB
LAF50	46.4 dB
LAF90	43.1 dB
LAF95	42.2 dB
LAF99	39.8 dB





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Appendix 3 Mitigation Results (Improvement Analysis Between 1st & 2nd tests)

The following table details the improvements achieved for the main hall sound systems through the additional works carried out between the first and second tests. It can be seen that the 40Hz, 80Hz and 100Hz bands have been significantly improved, potentially permitting more low frequency content within the hall space. Wind direction and speed changed significantly between the test days, from low speed southerly (1st test) to higher speed northerly (2nd test). This may have affected measurements at the flats opposite which are exposed to the greatest noise levels, and masked the difference somewhat. The improvement may therefore be even greater than the values detailed in the table below.

TEST		31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
1	Un-weighted Main room noise limits	85 dB	90 dB	90 dB	95 dB	96 dB	98 dB	101 dB	99 dB
2	Un-weighted Main room noise limits	82 dB	93 dB	91 dB	96 dB	100 dB	101 dB	101 dB	99 dB
Improvement		-	+3 dB	+1 dB	+1 dB	+4 dB	+3 dB	-	-

Table ? : Main hall sound level improvements after mitigation works

The following table details the improvements achieved for the function room sound system through the additional works carried out between the first and second tests. Whilst the data shows a significant improvement in all octave bands, it should be understood that the exact position of the speaker stacks was not faithfully repeated and so caution should be taken when setting sound levels / limits in this room. To minimise the possibility of an adverse noise impact at the nearby receptors, it is strongly recommended that a 1/3 octave band limiting device be mandatorily installed immediately before the amplifier input. The limiter should be set with the amplifier set to maximum output, and adjusted according to the sound power of the sound system. The limiting device should be periodically checked to ensure it has not been by-passed by the DJ / sound system crew.

TEST		31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz
1	Un-weighted Function room noise limits	90 dB	93 dB	97 dB	98 dB	97 dB	104 dB	105 dB	103 dB
2	Un-weighted Function room noise limits	94 dB	97 dB	101 dB	103 dB	102 dB	116 dB	110 dB	102 dB
		+4 dB	+4 dB	+4 dB	+5 dB	+5 dB	+8 dB	+5 dB	-

Table ? : Function room sound level improvements after mitigation works