Allegro Acoustics Limited,
C1 South City Business Park,
Tallaght, Dublin 24
Tel: +353 (0) 1 4140485
www.allegroacoustics.ie

Lime Quarry Theatre

Commons North, Lanesborough, Co. Longford

Planning Stage Noise Assessment

21 December 2022

DE BLACAM AND MEAGHER ARCHITECTS

Report Author: Stephen Kearney

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Report Author:	Stephen Kearney BE MIEI MIOA

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3				

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Executive Summary

Allegro Acoustics was commissioned by De Blacam and Meagher Architects to complete a baseline noise survey and noise impact assessment as part of a planning submission for a new outdoor theatre located at Commons North in Lanesborough, Co. Longford. The proposed outdoor theatre will include the following elements:

- Performance Stage with Canopy.
- Terraced seating with capacity for a 500-person audience.
- Provision of backstage, sanitary and welfare facilities.
- Access routes.
- Vehicle parking.

The existing noise sources at this location were noted during the baseline noise survey to be road traffic along the L-1169 (Rathcline Road), pedestrians and birdsong.

Noise emissions limits and good practice noise control measures have been proposed for the construction phase of this development. It is proposed that these limits will be enforced using continuous noise monitoring.

In order to control any potential noise emissions from the operational phase of the proposed theatre, it is proposed to apply a 55dB L_{Aeq} noise limit to this development. This noise limit is considered applicable at the façade of the noise sensitive locations closest to the proposed theatre. A comprehensive noise modelling exercise has been carried out to quantify the likely noise impact from the proposed theatre. The noise model predicts that the 55dB L_{Aeq} noise criteria will be met at each of the closest noise sensitive locations to the proposed theatre once an appropriately specified directional speaker system is used.

It is therefore, concluded that the noise emissions from the proposed Lime Quarry Theatre will be appropriately controlled during the construction and operational phases of this development.

1 Introduction

Allegro Acoustics was commissioned by De Blacam and Meagher Architects to complete a noise impact assessment as part of a planning submission for a new outdoor theatre located at Commons North in Lanesborough, Co. Longford. The site is located adjacent to a natural woodland along the Rathcline Road on the outskirts of Lanesborough. This location for the proposed theatre is shown in Figure 1 below.

Figure 1: Satellite image showing the location of the proposed Lime Quarry Theatre in red.

The proposed outdoor theatre is part of the European 'Just Transition' process to bring opportunities and tourism to the town of Lanesborough. The proposed outdoor theatre will include the following elements:

- Performance Stage with Canopy.
- Terraced seating with capacity for a 500-person audience.
- Provision of backstage, sanitary and welfare facilities.
- Access routes.
- Vehicle parking.

It is understood that this theatre will provide an opportunity for the local community to put on productions, but it will also play host to larger music events and concerts, attracting people to the area, generating revenue for the site as well as encouraging visitors to spend money locally and creating demand for hospitality services.

In order to determine the potential noise impact due to the development, a 3D environmental noise model was developed in SoundPLAN V7.3. This model represents the various noise sources associated with the proposed theatre. This noise model was used to predict the noise levels attributable to the theatre at the closest noise sensitive locations to the development.

This report details the noise modelling process and discusses the potential noise impact associated with the proposed development.

2 Baseline Noise Levels

In order to establish the existing noise environment in the vicinity of the proposed theatre, Allegro Acoustics carried out a manned noise survey at four locations at the site of the proposed development on the 8th and 9th of April 2021. Noise measurements were carried out during day and evening times. Night time measurements were not undertaken as the theatre will not be operational during night time hours. Noise monitoring was carried out according to the methodologies outlined in the following standards:

- International Standards Organization, *ISO 1996 Acoustics – Description and Measurement of Environmental Noise* [1].
- Environmental Protection Agency, *Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* [2].

Four noise monitoring locations were chosen for this noise survey. These monitoring locations represent the closest noise sensitive locations to the proposed theatre. The noise monitoring locations, denoted as NSL1, NSL2, NSL3 and NSL4 are detailed in Table 1 below.

Noise Monitoring Locations	
Monitoring Point	Receptor Type
NSL1	Amenity Area
NSL2	Residential
NSL3	Residential
NSL4	Residential

Table 1: Description of the noise monitoring locations.

Figure 2: Baseline Noise Survey Monitoring Locations.

The duration and number of measurements at each monitoring location is presented in Table 2 below. As per the guidance provided by the Environmental Protection Agency in *Guidance Note for Noise (NG4)* [2], day and evening time periods are defined as follows:

- Day: 07:00 - 19:00
- Evening: 19:00 - 23:00

Noise Monitoring Duration		
Monitoring Point	Day Time (07:00 – 19:00)	Evening Time (19:00 – 23:00)
NSL1	1 x 30 Minutes	1 x 30 Minutes
NSL2	1 x 30 Minutes	1 x 30 Minutes
NSL3	1 x 30 Minutes	1 x 30 Minutes
NSL4	1 x 30 Minutes	1 x 30 Minutes

Table 2: Noise monitoring duration.

Weather conditions were observed to be conducive to noise monitoring throughout the noise survey (wind <5m/s, rain <1mm per hour [2]). The characteristics of the noise environment are described in Table 3 below.

Characteristics of the Noise Environment		
Location	Period	Observations
NSL1	Day	The primary noise sources at NSL1 during the day time measurement was observed to be cars moving in the adjacent car park and pedestrians. Additional noise sources included birdsong.
	Eve	The primary noise sources at NSL1 during the evening time measurement was observed to be pedestrians and cars infrequently moving in the adjacent car park. Additional noise sources included birdsong, and water on the lake shore.
NSL2	Day	The primary noise source during the day time measurement at NSL2 was observed to be traffic on the adjacent Rathcline Road. Additional noise sources included pedestrians and birdsong.
	Eve	The primary noise source during the evening time measurement at NSL2 was observed to be traffic on the adjacent Rathcline Road. Additional noise sources included pedestrians and birdsong.
NSL3	Day	The primary noise source during the day time measurement at NSL3 was observed to be traffic on the adjacent Rathcline Road. Additional noise sources included pedestrians and birdsong.
	Eve	The primary noise source during the evening time measurement at NSL3 was observed to be traffic on the adjacent Rathcline Road. Additional noise sources included pedestrians and birdsong.
NSL4	Day	The primary noise source during the day time measurement at NSL4 was observed to be traffic on the Rathcline Road. Additional noise sources included pedestrians and birdsong.
	Eve	The primary noise source during the evening time measurement at NSL4 was observed to be traffic on the adjacent Rathcline Road. Additional noise sources included pedestrians and birdsong.

Table 3: Characteristics of the noise environment as observed during the noise survey.

The results of the noise survey are presented in Table 4 and Figure 3 below. A detailed table of results is also included Appendix A.

Notes:

1) The background noise level is typically depicted using the dB L_{A90} statistical indicator [3].
2) The noise survey for this project was carried out during Covid-19. As such, the baseline noise levels in the area may have increased since Covid-19 related travel restrictions have been removed.

Measured Noise Levels									
Location	Meas No.	Start Time	Period	Duration	dB L_{Aeq}	dB L_{A90}	dB L_{A10}	dB L_{Amax}	dB L_{Amin}
NSL1	18	09/04/2021 12:21	Day	00:30:00	45.1	38.8	46.9	72.9	35.5
	10	08/04/2021 19:17	Eve	00:30:00	48.6	45.8	50.6	61.9	39.2
NSL2	19	09/04/2021 13:05	Day	00:30:00	63.5	31.6	62.7	85.3	27
	11	08/04/2021 19:51	Eve	00:30:00	63.4	39.5	60.5	88.5	19.6
NSL3	21	09/04/2021 14:00	Day	00:30:00	65.6	42.7	64.7	87.5	35.3
	12	08/04/2021 20:23	Eve	00:30:00	60.9	37.9	58.6	86	34.7
NSL4	22	09/04/2021 14:33	Day	00:30:00	63.4	37.6	61.5	90.2	32.8
	13	08/04/2021 20:57	Eve	00:30:00	62.3	33.4	60	87.3	29.8

Table 4: Measured noise levels at the site of the proposed development.

The 1/3rd Octave frequency breakdown for each measurement has been assessed for tonality using the 1/3rd Octave method outlined by the Environmental Protection Agency in *Guidance Note for Noise (NG4)* [2]. Using this methodology, the following conclusions were made:

- The background noise environment at the site of the proposed development was not observed to have any significant tonal or impulsive characteristics.

The measured 1/3rd octave dB L_{eq} and dB L_{90} values for each measurement are shown in Appendix A.

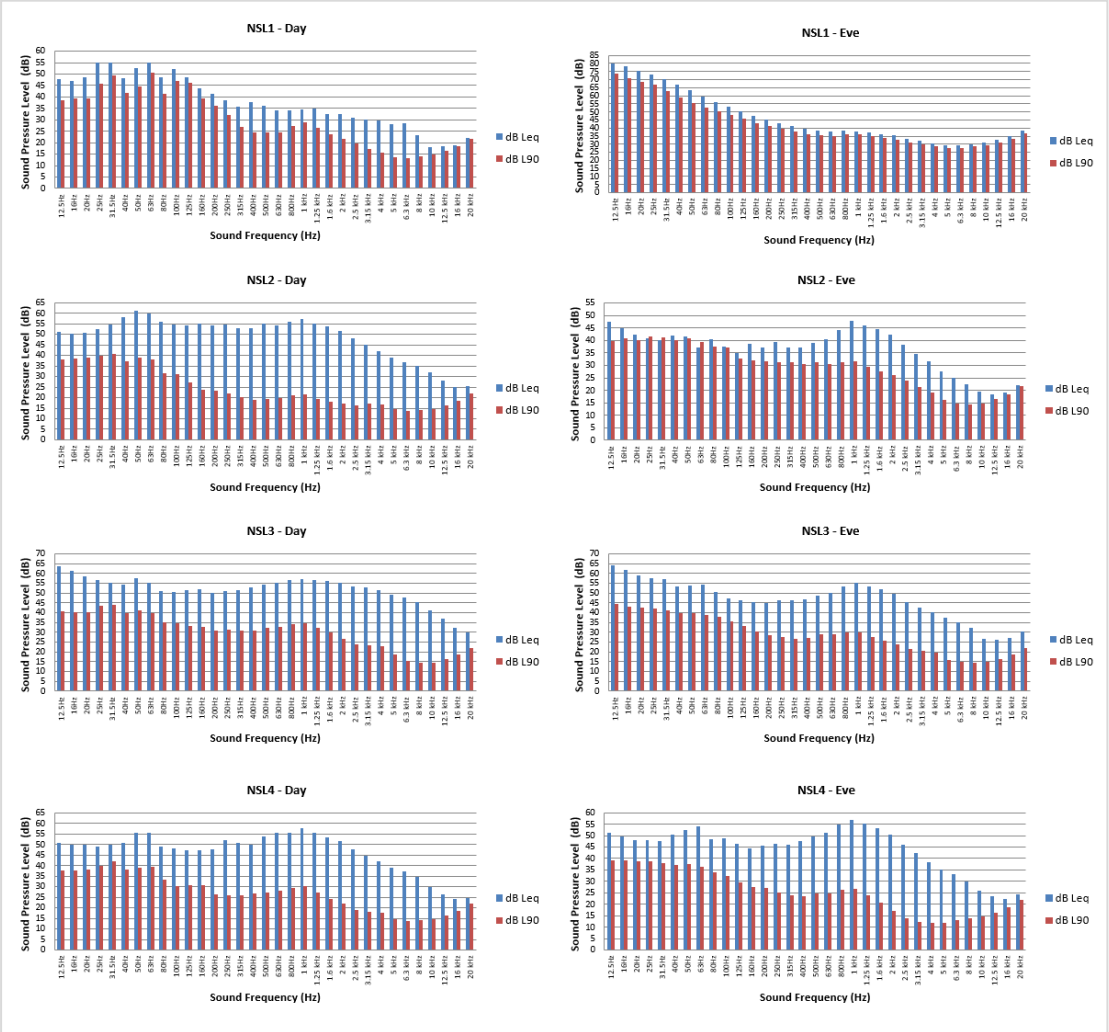


Figure 3: Graphical representation of the measured 1/3rd octave dB L_{eq} and dB L_{90} values for each measurement. This data is included in tabular format in Appendix A.

3 Construction Phase Noise Assessment

Allegro Acoustics proposes that the construction noise limits outlined by The National Roads Authority in *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* [4] are appropriate to apply to this development. While these limits relate to road schemes, in the absence of any statutory guidelines in the Republic of Ireland relating to noise limits for outdoor theatre developments, these noise limits are considered to be the most appropriate construction noise limits for this development. These construction noise limits are outlined in Table 5 below.

Proposed Construction Noise Limits		
Day & Times	dB $L_{Aeq\ (1hr)}$	dB L_{Amax}
Monday – Friday (07:00 to 19:00)	70	80
Monday – Friday (19:00 to 22:00)	60	65
Saturday (08:00 to 16:30)	65	75
Sundays and Bank Holidays (08:00 to 16:30)	60	65

Table 5: Proposed construction noise limits for this development.

These noise limits will be enforced using continuous noise monitoring during the construction phase of this project. The noise monitoring station used will be equipped with real time text / email alerts to notify the site team as soon as an exceedance takes place. This will allow the contractor to investigate the cause of the exceedance and take action immediately to reduce the noise levels to below the levels outlined in Table 5 above.

The good practice measures outlined in *BS 5228-1 + A1 Code of practice for noise and vibration control on construction and open sites* [5] will be implemented at this site as appropriate to control and minimise the impact of construction noise on the surrounding noise environment. These measures are summarised as follows:

- A site representative responsible for matters relating to noise will be appointed at the start of the construction phase of the project.
- Channels of communication between the contractor and the nearby noise sensitive locations will be established. This will allow for the maintenance of good relations and clear channels of communication between the contractor and the occupants of the nearby noise sensitive buildings.
- Plant equipment with low inherent potential for generation of noise will be selected where practical.
- Where earth movers dump material into dumper trucks, the material fall height will be minimised as much as practical so that noise generation is minimised.
- Mufflers and silencers will be fitted to constant noise sources such as vehicular machinery and generators where required.
- Machinery will be switched off when it is not in use instead of leaving it on idle.
- As far as reasonably practical, sources of significant noise will be enclosed. Acoustic screens will be used close to noisy operations where required.
- Temporary hoarding will be erected around items such as generators or high duty compressors where required.
- Noisy plant will be located as far away from noise sensitive facades as practical and as permitted by site constraints.
- Diesel engines will be substituted with electric motors where practical.

4 Operational Phase Noise Assessment

4.1 Project Description

It is proposed that the outdoor theatre will consist of the following elements:

- Performance Stage with Canopy.
- Terraced seating for a 500-person capacity audience.
- Provision of backstage, sanitary and welfare facilities.
- Access routes.
- Vehicle parking.
- Amplified performances (theatre performance, spoken word, live music etc) to be held on a semi regular period (average of 1 – 2 performances per week).

Note: All performances are to be held during day and evening time hours (i.e. between 09:00 and 23:00).

Figure 4: Example of a similar outdoor theatre at Ballykeefe Quarry in Co. Kilkenny.

4.2 Proposed Noise Criteria

It is proposed that the daytime noise limit outlined by the World Health Organisation in the document *Guidelines for Community Noise* [6] is appropriate to apply to this theatre.

- Proposed Noise Limit (09:00 – 23:00): 55dB $L_{Aeq,30\ mins}$.

This noise criterion is considered applicable at the façade of the closest noise sensitive locations to the proposed theatre.

4.3 Noise Modelling

In order to quantify the impact that the proposed development will have on the surrounding noise environment, Allegro Acoustics developed a 3D Environmental Noise Model of the proposed Lime Quarry Theatre and of the surrounding area using SoundPLAN Version 7.3 environmental noise modelling software. This software implements the calculation and prediction methodologies outlined in *ISO 9613 Acoustics - Attenuation of sound during propagation outdoors* [7] [8].

The Lime Quarry Theatre was represented in this model using drawings provided by the project architect. These drawings were supplemented with a site visit by Allegro Acoustics personnel and additional information freely available from Google™ Earth regarding the study area. Using this information, a comprehensive and detailed environmental noise model was developed for the site. This model includes all objects which form barriers for noise, including buildings, foliage, and perimeter walls. A graphic from this model is shown in Figure 5 below.

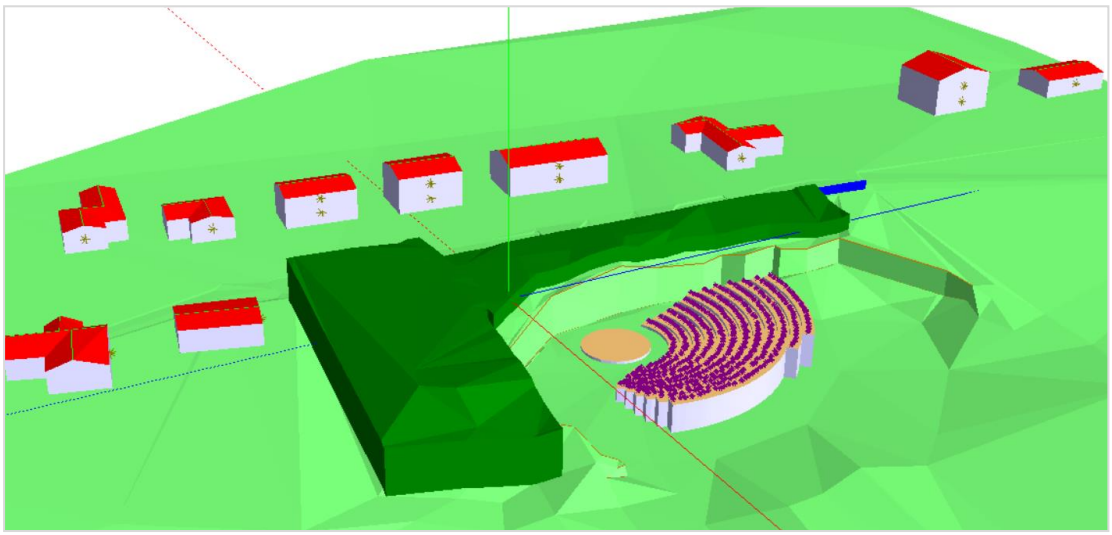


Figure 5: 3D graphic from the SoundPLAN noise model showing the theatre and surrounding residences.

4.3.1 Noise Sensitive Receivers

Noise sensitive locations (NSLs) in the vicinity of the Lime Quarry Theatre are included as receivers in the noise model. This includes nearby residential facilities, childcare facilities, educational facilities, and places of worship.

Modelled Receivers			
Reference	Description	Reference	Description
R01	Residential	R10	Residential
R02	Residential	R11	Residential
R03	Residential	R12	Residential
R04	Residential	R13	Recreational
R05	Residential	R14	Recreational
R06	Residential	R15	Recreational
R07	Residential	R16	Representing Residential Locations West of the lake.
R09	Residential		

Table 6: Modelled receivers.

Figure 6: Graphic showing the receiver locations.

4.3.2 Noise Source Representation

To accurately represent the theatre, the following two scenarios were modelled:

- Scenario 1 consists of a 15minute period with 2.5 minutes of clapping and 12.5 minutes of talking for 500 occupants.
- Scenario 2 consists of a representative 30-minute period with a loudspeaker setup providing 77-80dBA throughout the entirety of the audience area.

The noise sources used to represent these two scenarios are detailed in subsections 4.3.2.1 and 4.3.2.2 below.

4.3.2.1 Scenario 1: Clapping and Talking

The noise levels for the clapping and talking scenario are sourced from the *SoundPLAN V7.3 Emissions Library* [9] and the document *Handclap for Acoustic Measurements: Optimal*

Application and Limitations [10]. These noise sources were time weighted to get a 15-minute average with 2.5 minutes of clapping and 12.5 minutes of talking. The resulting noise sources was applied to model 500 times to represent the full audience talking / clapping.

4.3.2.2 Scenario 2: Amplified Performance

A loudspeaker setup was modelled to represent the theatre during an amplified performance. As the final speaker setup has not been designed at this stage in the project, an indicative setup was used to obtain an appropriate music / speech level in the theatre (77-80dBA).

The indicative setup included two loudspeaker arrays located at the stage and four loudspeakers located over the audience area. The speakers have been modelled using the directivity pattern of a D&B Y7P loudspeaker which were oriented towards the tiered seating.

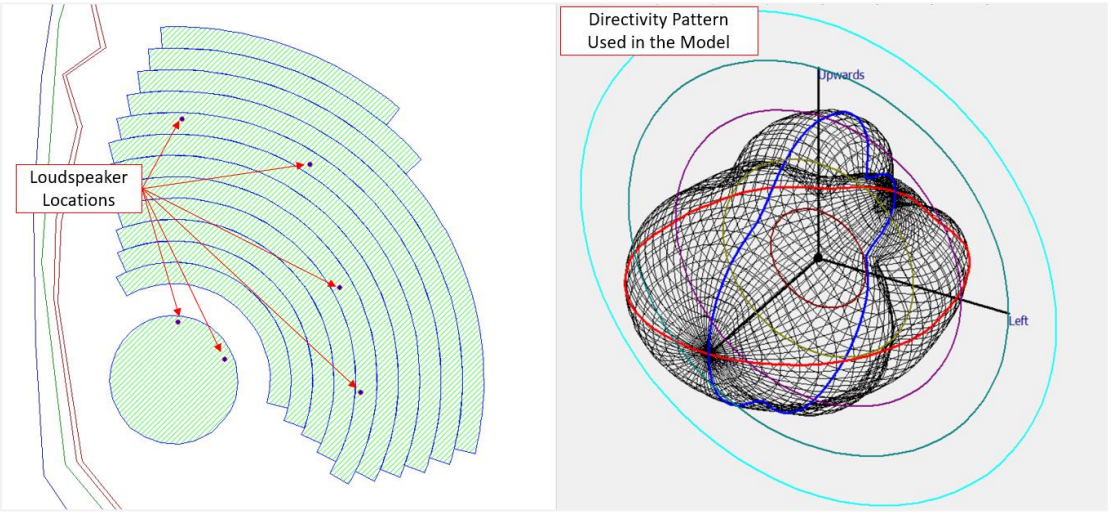


Figure 7: Left: Graphic showing the loudspeaker locations for the theatre. Right: Directivity pattern for the speakers used in the model.

4.3.3 Predicted Noise Levels

The modelled noise levels for the Lime Quarry Theatre are presented in Tables 7 and 8 below.

Modelled Noise Levels - Scenario 1: Talking and Clapping			
Model Receiver	Predicted Noise Levels (dB L_{Aeq})	Proposed Criteria (dB L_{Aeq})	Criteria Achieved
R01	42	≤55	Yes
R02	47	≤55	Yes
R03	47	≤55	Yes
R04	51	≤55	Yes
R05	52	≤55	Yes
R06	50	≤55	Yes
R07	44	≤55	Yes
R08	43	≤55	Yes
R09	51	≤55	Yes
R10	45	≤55	Yes
R11	33	≤55	Yes

Modelled Noise Levels - Scenario 1: Talking and Clapping			
Model Receiver	Predicted Noise Levels (dB L_{Aeq})	Proposed Criteria (dB L_{Aeq})	Criteria Achieved
R12	33	≤55	Yes
R13	37	≤55	Yes
R14	37	≤55	Yes
R15	41	≤55	Yes
R16	30	≤55	Yes

Table 7: Modelled noise levels for Scenario 1: Talking and Climbing relative to the noise criteria outlined in section 3.2 above.

Modelled Noise Levels - Scenario 2: Amplified Performance			
Model Receiver	Predicted Noise Levels (dB L_{Aeq})	Proposed Criteria (dB L_{Aeq})	Criteria Achieved
R01	49	≤55	Yes
R02	52	≤55	Yes
R03	52	≤55	Yes
R04	52	≤55	Yes
R05	53	≤55	Yes
R06	52	≤55	Yes
R07	48	≤55	Yes
R08	47	≤55	Yes
R09	52	≤55	Yes
R10	47	≤55	Yes
R11	37	≤55	Yes
R12	36	≤55	Yes
R13	40	≤55	Yes
R14	41	≤55	Yes
R15	44	≤55	Yes
R16	37	≤55	Yes

Table 8: Modelled noise levels for Scenario 2: Amplified Performance relative to the noise criteria outlined in section 3.2 above.

4.4 Discussion

The modelled noise levels presented in Table 7 and Table 8 above meet the noise criteria proposed for this development in Section 4.2 above. On this basis, it is concluded that once an appropriately specified directional speaker system is used, then the noise emissions at this theatre can be maintained at an appropriate level.

4.5 Predicted Noise Levels – Ecology

To assist an ecological survey additional receivers were added to the predictive model. These receivers are show in Figure 8 below.

Figure 8: Graphic showing the ecological receiver locations.

The predicted noise levels for the receivers shown in Figure 8 are presented in table below.

Scenario 1: Talking + Clapping		Scenario 2: Amplified Performance	
Model Receiver	Predicted Noise Levels (dB L_{Aeq})	Model Receiver	Predicted Noise Levels (dB L_{Aeq})
E01	43	E01	52
E02	41	E02	50
E03	44	E03	52
E04	39	E04	44
E05	38	E05	42
E06	36	E06	39
E07	35	E07	39
E08	34	E08	38

Table 9: Modelled noise levels for the ecological survey.

5 Summary and Conclusion

Allegro Acoustics carried out a Baseline Noise Survey and a Noise Impact Assessment as part of a planning submission for a new outdoor theatre located at Commons North in Lanesborough, Co. Longford. The existing noise sources at this location were noted during the baseline noise survey to be road traffic along the L-1169 (Rathcline Road), pedestrians and birdsong.

Noise emission limits and good practice noise control measures have been proposed for the construction phase of this development. It is proposed that these limits will be enforced using continuous noise monitoring during the construction phase of this development.

In order to control any potential noise emissions from the operational phase of the proposed theatre, it is proposed to apply a 55dB L_{Aeq} noise limit to this development. This noise limit is considered applicable at the façade of the closest noise sensitive locations to the proposed theatre. A comprehensive noise modelling exercise has been carried out to quantify the likely noise impact from the proposed theatre. The noise model predicts that the 55dB L_{Aeq} noise criteria will be met at each of the closest noise sensitive locations to the proposed theatre once an appropriately specified directional speaker system is used.

It is therefore, concluded that the noise emissions from the proposed Lime Quarry Theatre will be appropriately controlled during the construction and operational phases of this development.

6 References

[1] International Standards Organisation, “ISO 1996-1 Acoustics - Description and measurent of environmental noise - Part 1: Basic quantities and assessment procedures,” 2016.

[2] Environmental Protection Agency, “Guidance Note for Noise: License Applications, Surveys and Assessments in Relation to Scheduled Activities,” 2016.

[3] British Standards Institution, “BS 4142 Method for rating and assessing industrial and commercial sound,” 2014.

[4] National Roads Authority, “Guidelines for the Treatment of Noise and Vibration in National Road Schemes,” 2004.

[5] British Standards Institution, “BS 5228-1 + A1 Code of practice for noise and vibration control on construction and open sites. Noise,” 2014.

[6] World Health Organization, Guidelines for Community Noise, 1999.

[7] International Standards Organisation, “ISO 9613-1 Acoustics - Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere,” 1993.

[8] International Standards Organisation, “ISO 9613-2 Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation,” 1996.

[9] SoundPLAN V7.3, Noise Emissions Library.

[10] N. M. P. a. G. E. Stavroulakis, Handclap for Acoustic Measurements: Optimal Application and Limitations, 2020.

Appendix A

Baseline Noise Levels

ALLEGRO
acoustics

Testing Agency:	Allegro Acoustics
Testing Operator:	Kevin Lynch BE
SLM:	Cirrus CR171B
SLM Serial Number:	G300367
SLM Factory Calibration Date:	02/05/2019
Sound Field Correction:	Free Field
Bandwidth:	1/3rd Octave - Fully Integrating
Time Weighting:	Fast

dB Leq Measurement Data

Location	Period	Measurement	Start Time	Elapsed	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq	LZeq
				Time	12.5Hz	16Hz	20Hz	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	16 kHz	20 kHz
NSL1	Day	18	09/04/2021 12:21	00:30:00	47.7	47.1	48.5	54.9	55.2	48	52.4	54.9	48.7	52	48.7	43.6	41.4	38.5	35.9	37.7	36.1	34.3	34.3	34.6	34.9	32.4	32.5	30.9	30.3	29.7	28	28.6	23.2	18	18.4	18.7	21.9
NSL1	Eve	10	08/04/2021 19:17	00:30:00	80.2	78.1	75.5	73.3	70.3	67	63.4	59.6	56	53.1	50.4	47.6	45.2	43.2	41.1	39.6	38.6	38	38.2	38.1	37.1	36.3	35.7	33.5	31.9	30.5	29.2	29.2	30	31	32.9	34.9	38.5
NSL2	Day	19	09/04/2021 13:05	00:30:00	51	50.2	50.5	52.4	54.8	58.1	61.1	59.8	56	54.7	54.2	54.9	54.3	54.7	52.7	52.8	55	54.2	55.9	57	55.2	53.7	51.5	48.2	45.1	42	38.9	36.9	35	31.8	28.1	25.1	25.3
NSL2	Eve	11	08/04/2021 19:51	00:30:00	47.3	44.9	42.4	40.9	40.2	42.1	41.5	37.1	40.3	37.7	35	38.7	37.3	39.4	37	37	39.1	40.5	44.3	47.8	46.1	44.6	42.5	38.1	34.5	31.5	27.7	25.1	22.5	19.4	18.3	19	22
NSL3	Day	21	09/04/2021 14:00	00:30:00	63.5	61.3	58.6	56.7	55.2	54.4	57.7	55.1	51	50.6	51.3	52.2	50	50.9	51.7	53.1	54.2	55.1	56.8	57.3	56.6	56.1	55.3	53.6	52.9	51.5	49.4	47.8	45.3	41.3	36.9	32.4	30.1
NSL3	Eve	12	08/04/2021 20:23	00:30:00	64.3	61.8	59.1	57.5	57	53.3	54	54.4	50.7	47.4	46.4	45.4	45	46.2	46.2	46.8	48.7	50	53.2	55.1	53.4	52.1	49.5	45.6	42.5	40.3	37.4	35.2	32.2	26.7	26.1	27	30.2
NSL4	Day	22	09/04/2021 14:33	00:30:00	50.9	50	49.8	48.9	49.7	50.7	55.6	55.3	48.9	48.1	47.4	47.2	47.8	52.2	50.5	50	53.9	55.3	55.3	57.5	55.4	53.5	51.5	47.8	44.8	42	39	37	34.5	29.9	26.5	24	24.8
NSL4	Eve	13	08/04/2021 20:57	00:30:00	51.3	49.7	48.2	48.1	47.8	50.4	52.6	53.9	48.5	48.8	46.6	44.3	45.7	46.3	45.9	47.5	49.6	51.1	54.9	56.9	55.2	53.4	50.5	46.1	42.3	38.4	35.1	33.3	30.1	26	23.7	22.3	24.2

dB L90 Measurement Data

Location	Period	Measurement	Start Time	Elapsed	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90	LZ90
				Time	12.5Hz	16Hz	20Hz	25Hz	31.5Hz	40Hz	50Hz	63Hz	80Hz	100Hz	125Hz	160Hz	200Hz	250Hz	315Hz	400Hz	500Hz	630Hz	800Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	16 kHz	20 kHz
NSL1	Day	18	09/04/2021 12:21	00:30:00	38.5	39.4	39.4	45.8	49.5	41.7	44.5	50.7	41.4	47	46.2	39.2	36	32.3	26.8	24.6	24.3	24.5	27.3	29	26.4	23.5	21.8	19.5	17.4	15.7	13.8	13.4	13.9	14.7	16.4	18.5	21.8
NSL1	Eve	10	08/04/2021 19:17	00:30:00	73.6	71.1	68.4	66.8	62.9	58.8	55.6	52.8	50.5	48.2	45.8	43.2	41.5	39.6	37.8	36.3	35.4	35.2	36	36.2	35.1	34	32.8	31.2	29.8	28.5	27.5	27.7	28.5	29.4	31.3	33.3	36.9
NSL2	Day	19	09/04/2021 13:05	00:30:00	38.2	38.4	39	39.9	40.8	37	39	37.9	31.4	31.3	27.1	23.6	23.2	21.9	20.2	19	19.3	19.9	21.1	21.5	19.4	18.2	17.2	16.5	17	16.8	14.7	13.8	14	14.7	16.4	18.5	21.8
NSL2	Eve	11	08/04/2021 19:51	00:30:00	39.8	40.7	40	41.6	41.3	40	40.8	39.4	37.7	37.3	32.9	32.1	31.7	31.4	31.1	30.6	31.1	30.6	31.4	31.5	29.4	27.7	26.1	23.8	21.4	19.1	16.1	14.7	14.4	14.8	16.4	18.5	21.8
NSL3	Day	21	09/04/2021 14:00	00:30:00	40.6	40.2	40.5	43.5	44	39.9	41.2	39.9	35	34.5	33.2	32.9	30.9	31.6	30.8	31	32.1	33	34.3	34.8	32.2	29.9	26.9	23.8	23.6	22.9	18.8	15.3	14.3	14.7	16.3	18.5	21.8
NSL3	Eve	12	08/04/2021 20:23	00:30:00	44.5	43.3	42.4	42.1	41.2	40	39.7	39	37.7	35.7	33.2	30.6	28.5	27.4	26.7	27.1	28.9	28.8	29.8	30	27.5	25.7	24.1	21.4	20.6	19.8	15.8	14.9	14.4	14.8	16.4	18.5	21.8
NSL4	Day	22	09/04/2021 14:33	00:30:00	37.8	37.8	38.2	39.9	42	38.3	39.1	39.4	33.1	30.4	30.7	30.8	26.4	26.1	25.8	26.6	27.2	27.9	29.5	30.3	27	24.2	21.8	18.9	18.1	17.8	14.8	13.9	14	14.7	16.3	18.5	21.8
NSL4	Eve	13	08/04/2021 20:57	00:30:00	39.1	39.1	38.7	38.7	38.1	37.1	37.4	36.5	33.8	32.2	29.7	27.6	27.1	25	23.9	23.5	24.8	24.8	26.3	26.8	24	20.6	17.2	13.8	12.4	11.8	12	12.9	13.8	14.7	16.3	18.5	21.8

Appendix B

Calibration Cert

Certificate of Calibration

Cirrus Research plc
dedicated to noise measurement

Equipment Details

Instrument Manufacturer	Cirrus Research Plc
Instrument Type	CR:171B
Description	Sound Level Meter
Serial Number	G300367

Calibration Procedure

The instrument detailed above has been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	GRAS 40AP	Serial Number	173198	Calibration Ref.	0170
Calibrator Type	B&K 4231	Serial Number	2594796	Calibration Ref.	A1811

Calibrated by

Calibration Date	02 May 2019
Calibration Certificate Number	270493

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

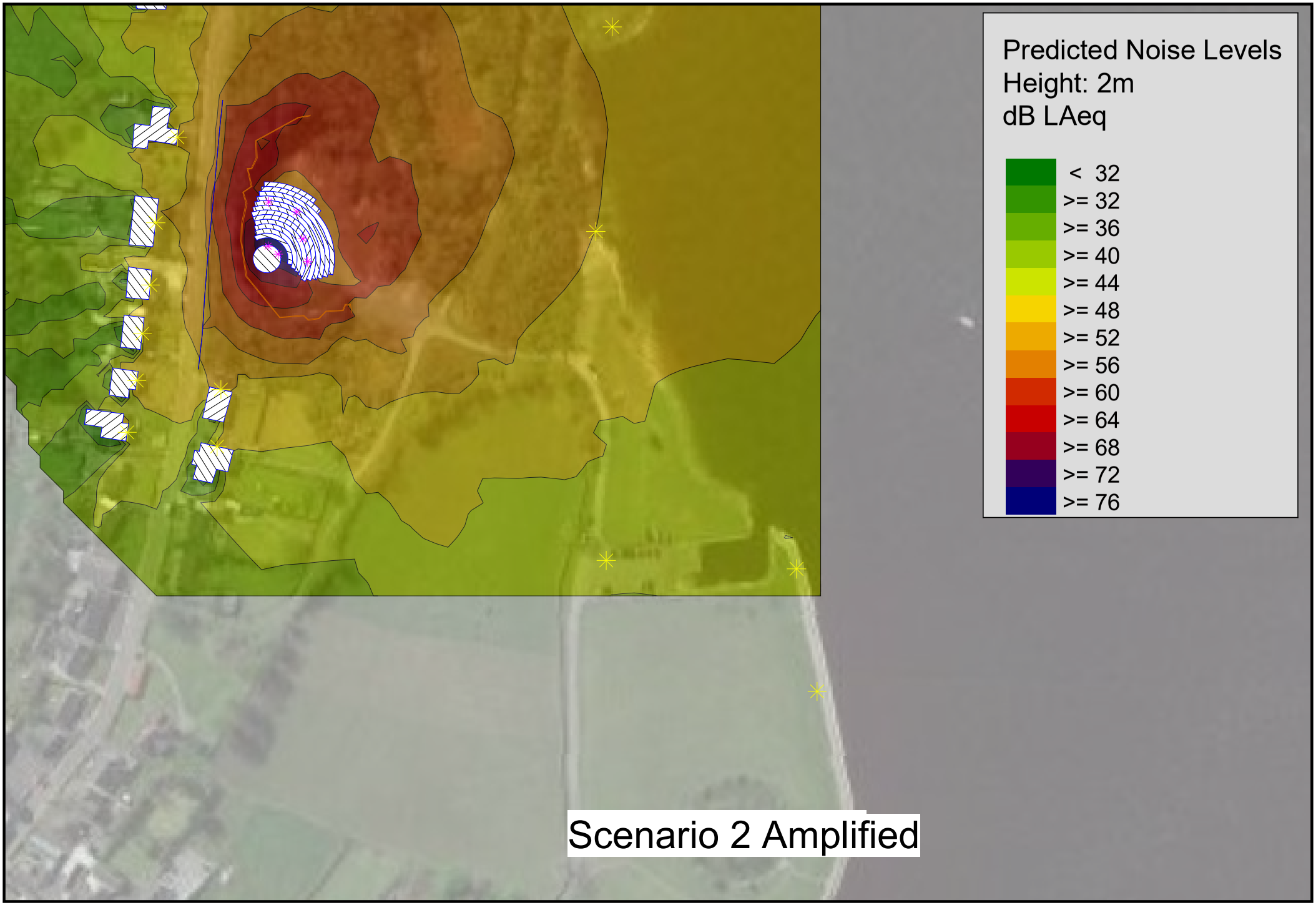
Appendix C

Predicted Noise Levels

Receiver	Floor	Clapping	Talking	Scenario 1: Talking and Clapping	Scenario 2: Amplified Performance
		L_{Aeq}	L_{Aeq}	L_{Aeq}	L_{Aeq}
E01	GF	48.7	40.0	43.2	51.9
E02	GF	45.8	37.9	40.6	50.1
E03	GF	49.9	40.7	44.2	51.5
E04	GF	44.0	36.0	38.8	43.9
E05	GF	42.8	35.0	37.6	41.9
E06	GF	41.4	33.8	36.3	38.9
E07	GF	40.5	32.1	35.1	39.0
E08	GF	39.3	31.0	33.9	37.8
R01	GF	47.3	39.1	42.0	48.6
R02	GF	49.9	40.7	44.2	49.3
R02	F1	53.2	42.6	47.0	51.8
R03	GF	52.1	44.7	47.1	51.6
R04	GF	50.4	43.3	45.6	49.8
R04	F1	57.0	46.9	50.9	52.2
R05	GF	51.2	42.3	45.6	50.3
R05	F1	58.1	46.1	51.5	52.5
R06	GF	50.9	41.2	45.0	49.6
R06	F1	56.5	44.5	49.9	51.7
R07	GF	50.1	40.3	44.1	48.4
R08	GF	49.3	39.5	43.3	47.0
R09	GF	56.9	46.0	50.6	52.0
R10	GF	51.0	40.8	44.9	46.7
R11	GF	37.9	30.1	32.7	36.6
R12	GF	38.1	30.1	32.9	36.3
R13	GF	42.5	33.6	36.9	39.5
R14	GF	42.6	33.7	37.0	40.5
R15	GF	46.7	38.6	41.4	44.3
R16	GF	34.1	28.8	30.3	37.3

Appendix D

Noise Maps


Predicted Noise Levels
Height: 2m
dB LAeq
< 32
>= 32
>= 36
>= 40
>= 44
>= 48
>= 52
>= 56
>= 60
>= 64
>= 68
>= 72
>= 76
Scenario 2 Amplified