

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

21467-R02-C

23 November 2021

Our League Life National Hub

Planning noise assessment report

London, Manchester, Edinburgh, Birmingham, Belfast

Sandy Brown Ltd

Registered in England & Wales

No. 13227735

post@sandybrown.com

www.sandybrown.com

Registered Office: 55 Charterhouse Street, London EC1M 6HA

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

Version	Date	Comments	Author	Reviewer
A	9 Nov 21		Daniel Shaw	Mark Howarth
B	10 Nov 21	Revised following comments from project team	Daniel Shaw	Mark Howarth
C	23 Nov 21	Added construction noise limits	Daniel Shaw	Mark Howarth

Disclaimer

This report has been prepared for the sole benefit and use of our client based on their instructions and requirements. Sandy Brown Ltd extends no liability in respect of the information contained in the report to any third party.

Summary

Sandy Brown has been commissioned by The Rugby Football League to provide acoustic advice in relation to the proposed development of a Rugby League training centre, 'Our League Life' at Bell Crescent, Beswick, Manchester.

An environmental noise survey has been carried out to determine the existing sound levels in the area. The noise survey was carried out between 14:30 and 21:00 on Friday 15 October 2021.

Data from the survey has been used to inform the design of the development with respect to atmospheric noise emissions from training activity on the pitch and crowd noise during events. Minor increases in average noise levels at the nearest noise sensitive receptors are expected during training sessions, with slight increases during full usage of the stand, which is only proposed to occur a maximum of ten times annually. As such, the impact is reduced given the infrequency of events, and the short duration of training sessions.

The report details potential options for mitigation measures to further minimise any potential noise impact to neighbouring properties if required.

Limits for noise egress from items of plant associated with the development have been set in line with Manchester City Council guidance.

Construction noise egress limits for various levels of impact have been set based on the results of the noise survey.

Contents

1 Introduction.....5

2 Site description5

3 Noise survey method6

4 Noise survey results9

5 Noise egress.....13

6 Conclusion26

Appendix A27

 Survey details.....27

1 Introduction

Sandy Brown has been commissioned by The Rugby Football League to provide acoustic advice in relation to the proposed development of a Rugby League training centre, 'Our League Life', at Bell Crescent, Beswick, Manchester.

As part of this, an environmental noise survey is required, the purpose of which is to establish the existing sound levels on and around the site.

This report presents the survey method, results and potential impact of the proposed development. An assessment of noise egress from practices on the pitch and spectators in the stand has been carried out and plant noise egress limits set.

2 Site description

2.1 The site and its surrounding

The site is located in Beswick, East Manchester in a strategically important location within the wider Etihad Campus area. The site is located off Kirkstead Close, to the north of Bell Crescent. The East Manchester Academy and associated sports fields are located immediately to the north and north-west of the site. To the south-west of the site a line of trees forms a boundary line between the site and the rear gardens of the two-storey residential properties along Metcombe Way. Bell Crescent borders the site from the south to the east. The wider area is characterised by a mixture of residential properties and much larger buildings used for sports, leisure and education. The site location in relation to its surroundings is shown in Figure 1.

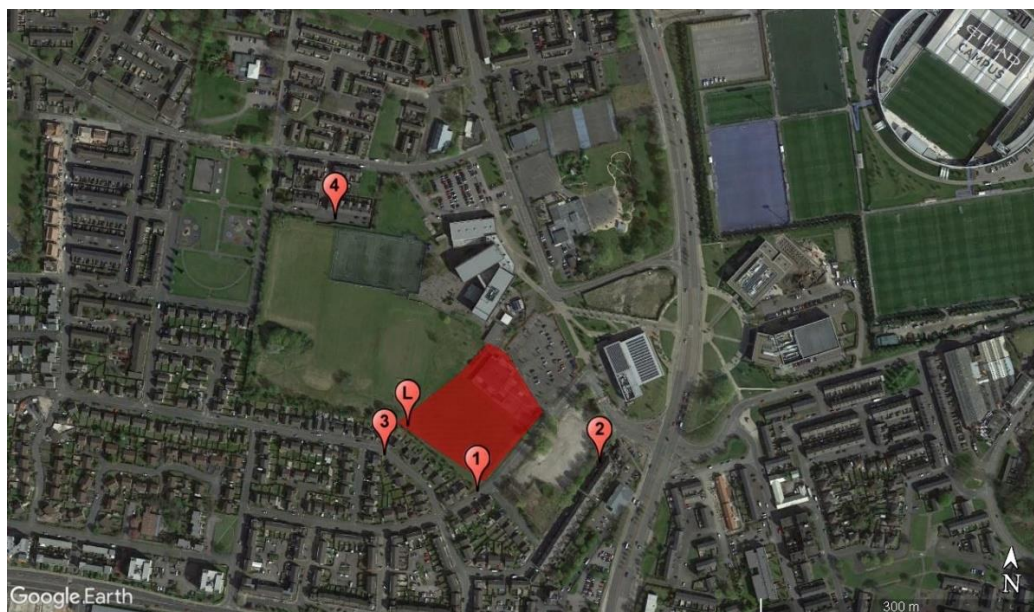


Figure 1 Aerial view of site (courtesy of Google Earth Pro)

2.2 Adjacent premises

The site is generally surrounded by residential premises to the west and south with other houses further to the east with a vacant site between, across Bell Crescent. The nearest houses are 18 m to the south of the pitch sidelines. The East Manchester Academy, St Brigid's Primary, and the East Manchester Leisure Centre are to the north.

A surface car park is located to the north-east of the site.

2.3 Proposed development

Currently, the site is an existing grass rugby pitch, typically used during the day, and the vacant former Beswick Local Shops. The proposed development includes an upgraded grass pitch with floodlights and associated 900-seat stand incorporating associated offices, seminar spaces and training rooms.

Additional training use is to be up to 3 times per week during the evening until 21:00 at the latest. Tournaments are to be held on weekends during the day up to 10 times per year.

3 Noise survey method

Attended sample measurements were taken by Daniel Shaw at 5 locations around the site. These are indicated in Figure 1 as positions L and 1 to 4. The measurements were carried out on 15 October 2021 over 5 minute periods.

At each position the microphone was mounted approximately 1.2 m above the ground level and at least 3 m from any other reflective surface. Details of the equipment used and the noise indices measured are provided in Appendix A.

Dominant noise sources occurring during the measurements were noted.



Figure 2 Photograph showing measurement position L



Figure 3 Photograph showing measurement position 1

SANDY BROWN

Consultants in Acoustics, Noise & Vibration



Figure 4 Photograph showing measurement position 2



Figure 5 Photograph showing measurement position 3



Figure 6 Photograph of measurement position 4

During the attended noise measurements, the weather was generally clear and dry and no rain occurred. Wind speeds were measured at each position and varied between 3 m/s and 5 m/s. These weather conditions are considered suitable for obtaining representative measurements.

4 Noise survey results

4.1 Observations

The dominant noise sources observed at the site during the survey were from traffic on the nearby trunk road and individual cars passing by. Less significant noise sources included pedestrians and planes.

4.2 Noise measurement results

Noise levels and key sources recorded during the attended measurements are summarised in Table 1. All measurements were carried out in the free field.

Table 1 Summary of measurement results at position L

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
L	15:05	47	66	43	Noise sources at position L included students playing basketball and bleep training until about 16:30, but was dominated by distant road traffic.
L	15:10	47	63	43	
L	15:15	47	57	45	
L	15:20	47	57	44	
L	15:25	47	57	45	
L	15:30	47	61	44	
L	15:35	45	61	43	
L	15:40	46	64	43	
L	15:45	46	59	42	
L	15:50	46	56	43	
L	15:55	46	61	43	
L	16:00	52	70	45	
L	16:05	45	51	43	
L	16:10	45	52	43	
L	16:15	44	50	42	
L	16:20	44	53	42	
L	16:25	45	51	43	
L	16:30	46	65	44	
L	16:35	47	58	44	
L	16:40	49	64	44	
L	16:45	45	50	44	
L	16:50	46	54	44	
L	16:55	47	54	45	
L	17:00	49	68	44	
L	17:05	46	52	44	
L	17:10	47	57	45	

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
L	17:15	50	65	45	
L	17:20	51	66	46	
L	17:25	45	56	43	
L	17:30	47	52	45	
L	17:35	46	54	44	
L	17:40	47	61	44	
L	17:45	48	62	45	
L	17:50	50	67	46	
L	17:55	47	59	46	
L	18:00	47	56	46	
L	18:05	49	64	46	
L	18:10	48	63	45	
L	18:15	50	62	47	
L	18:20	47	52	46	
L	18:25	48	60	46	
L	18:30	50	68	47	

Table 2 Summary of measurements at positions 1-4

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
1	14:30	58	79	43	Distant road traffic from Ashton Old Road and Alan Turing Way, schoolchildren talking, infrequent traffic on adjacent road (1 per minute)
1	14:35	59	83	45	
1	14:40	57	74	44	
2	15:15	56	74	47	Mostly distant traffic noise, infrequent traffic on Bosworth
2	15:20	59	78	49	

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
2	15:25	58	74	49	Rd, some leaf rustle with low wind. Distant pupils, dogs, music from corner shop, regular sirens
3	15:35	56	80	39	Power tools from a house, children playing basketball, pedestrians nearby,
3	15:40	56	73	40	infrequent car traffic on adjacent road, background is distant road traffic on inner ring road.
3	15:46	52	67	39	Very infrequent distant rail noise heard during quiet periods.
4	16:00	51	68	43	Mostly distant road traffic for background. Geese, plenty of.
4	16:05	51	72	42	Infrequent rail noise. Lots of playing on nearby park, full of kids.
4	16:10	53	70	46	
2	16:25	56	72	47	Similar sources, slightly increased road traffic.
2	16:31	56	72	47	
2	16:36	58	73	48	
1	16:45	59	74	44	Similar sources but with reduced pedestrian activity
1	16:50	57	71	44	
1	16:55	61	76	45	
3	17:05	52	69	41	Similar background sources, no longer noise from the school
3	17:10	50	66	42	
3	17:15	56	73	43	
4	17:29	52	66	46	Similar sources, some infrequent activity within school MUGA
4	17:35	55	81	45	
<i>Evening measurements</i>					
2	19:00	53	70	48	

Position	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
2	19:06	53	73	48	Dominated by ring road traffic, similar regular sirens.
2	19:11	51	65	47	
1	19:18	58	76	46	Similar to late afternoon, reduced local traffic and pedestrians
1	19:24	56	75	45	
1	19:29	57	79	46	
3	19:36	48	65	44	Similar to late afternoon but with further reduced pedestrian activity
3	19:41	50	66	43	
3	19:47	50	68	44	
2	19:56	52	72	45	As before, regular sirens
2	20:01	52	62	46	
2	20:06	51	64	46	
1	20:15	56	73	46	As before
1	20:21	54	75	46	
1	20:26	59	77	46	
3	20:33	55	71	44	Similar to before, planes audible, some music from nearby houses
3	20:38	52	67	45	
3	20:43	51	64	45	Includes some talking from occupants of the house, idling cars etc

The lowest background noise level measured during the survey was L_{A90} 39 dB.

5 Noise egress

5.1 Basis for noise levels

5.1.1 Pitch noise

Guidance on noise from sports pitches is provided in documents from Sport England and Sport Scotland. However, Sport England provide only levels for Football, stating an expected

L_{Aeq} 58 dB at 10 m from the sideline. Data for noise from Rugby pitches has therefore been taken from Sport Scotland guidance on Synthetic Grass Pitches, which is in line with data also provided by Sport England. In the document *Siting of Synthetic Grass Pitches – Guidance on Noise and Floodlighting*, Sport Scotland present a range of noise levels measured at 10 m from the pitch perimeter line. This table is reproduced in Table 3 below.

Table 3 Sport Scotland synthetic pitch noise levels

Sport	Mean, L_{Aeq}
Football	61dB(A)
Rugby	58dB(A)
Hockey	66dB(A)

Standardised Noise levels 10m from pitch perimeter line

Sandy Brown have previously carried out several surveys of pitch noise in situ. These suggest that:

- Noise is predominantly from shouting rather than ball rolling or footfall noise, and as such the type of surface has little impact on the expected noise level
- Noise is reasonably evenly distributed across a pitch such that similar levels are measured behind goals and at the half-way line

As such, the Sport Scotland Rugby data is considered suitable for assessing noise egress from the grass pitch during training and events.

5.1.2 Stand crowd noise

In *Prediction of Noise from Small to Medium Sized Crowds* by M. Hayne et al in Proceedings of Acoustics 2011, formulae are presented for predicting sound power levels of crowds based on empirical measurements of crowds up to 100. For un-oriented, random crowd behaviour, the average sound power level across the area covered by the crowd is given as:

$$L_{wAeq} = 15 \log(N) + 64 \text{ dB(A)}$$

Where N is the number of people within the crowd. For the upper range of occupancy against which the formula has been verified (N = 100 people), the sound power level would be L_{wAeq} 94 dB, suggesting that each tenth of the proposed stand produces this average noise level.

Assuming these sources act independently and not synchronized, then a standard correction of $10 \log(M)$ for incoherent sources could be applied, where M is the number of 100-person units forming a full stand (ie 9). This gives a sound power level of L_{wAeq} 104 dB. This assumes that there is no further Lombard effect for crowds watching a game, as the Lombard effect is

dependent on people raising their voices to be understood, whereas this is not necessarily the case for cheering at a match.

For the proposed coverage area, orientation and angle of stand seating, calculations within our computer model of the stand gives a typical worst case sound pressure level at standing height within the centre of the stand of L_{Aeq} 71 dB.

To verify the assumptions for sports crowd sizes above 100 people and therefore beyond the scope of M. Hayne et al, comparison has been made against previous measurements carried out by Sandy Brown at other stadia within the crowds. Both of these sets of measurements include sound from the PA, music and announcements. Measurements were made at Anfield on 10 November 2019. Measurements were also made at the Etihad stadium on 31 August 2013, before the south stand development, when all roof soffits had sound absorbent finishes.

Table 4 Summary of measurements made at nearby stadia

Stadium	Average sound pressure level, L_{Aeq} (dB)	Absolute/typical maximum sound pressure level, L_{Amax} (dB)	Comments on construction and capacity
Anfield	95	116/105	53,000 capacity, hard reflective soffit
Etihad	86	110/ 103-107	48,000 people, sound absorbent soffit ie close to free-field conditions

With its sound-absorbent soffit, Etihad Stadium is most applicable to the proposed single stand, as with the single stand, noise is not enclosed within a full structure and also approximates free-field conditions to a similar extent.

A similar standard correction of $10 \log(N / M)$ could be applied to the Etihad average noise levels to approximate the contribution from just a block of 900 fans, where M is the capacity of the Etihad, assuming sources are largely incoherent with other areas for at least average noise levels. This gives a correction of -17 dBA, or L_{Aeq} 69 dB, suggesting that assumptions for extending the Hayne et al formula generally hold up, within a degree of certainty.

As such, the calculated sound power level of L_{wAeq} 104 dB across the stand has been used for modelling noise egress.

Measurements suggest that maximum noise levels are 10-20 dB greater than the average levels. However, the prediction of maximum levels relies even more heavily on assumptions of the extent to which sources are synchronised, gender balances of the crowd and many other factors.

5.2 Modelling of egress

Noise egress from the proposed activity at the site has been assessed using the acoustic computer modelling program CadnaA from Datakustik. This takes into account reflections, screening and attenuation with distance.

5.2.1 Existing baseline levels

The model of the existing baseline levels has been calibrated to the measurements carried out during the survey. Screenshots of the existing facade levels at the nearby residential receptors are shown in Figure 7, with daytime levels shown as the first value, and evening levels as the second value. A screenshot of the 3D model is also provided in Figure 8. Education and leisure uses to the north are not considered sensitive during the evenings or weekends.

Noise levels at the existing facades facing onto the rugby pitch are in the region of L_{Aeq} 55 dB to 61 dB depending on their exposure to local access roads.

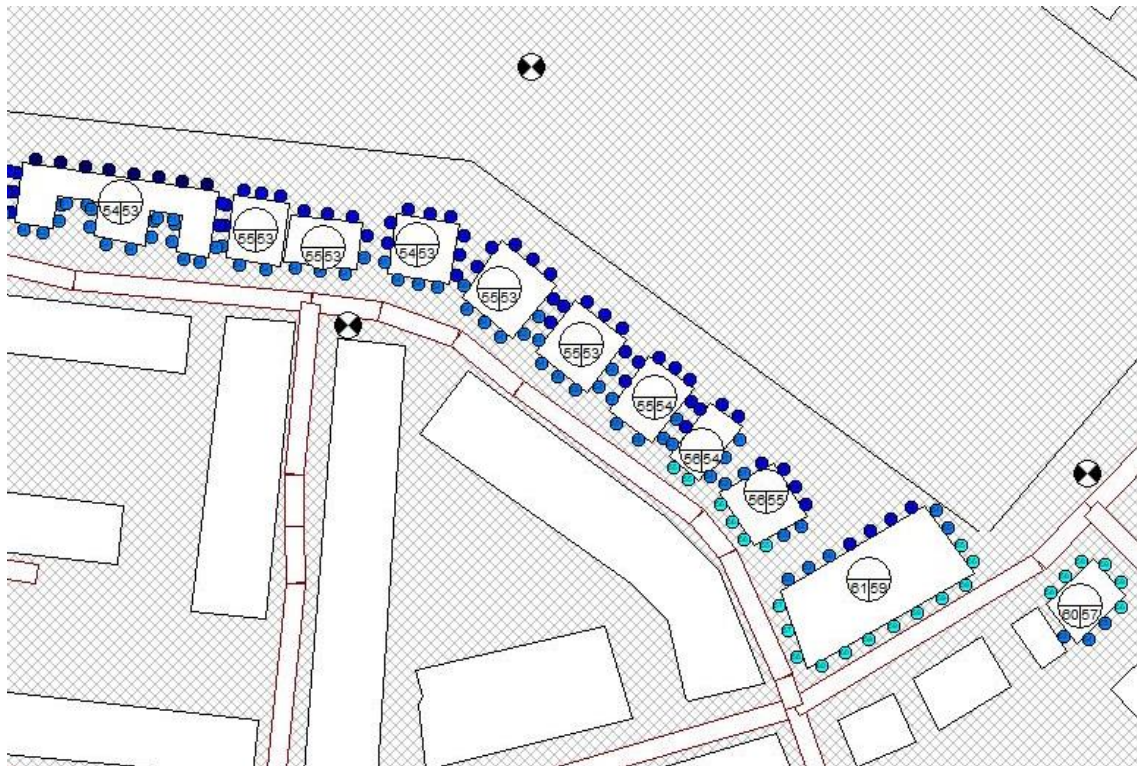


Figure 7 Screenshot of existing noise levels at nearby noise sensitive receivers to the south of the site

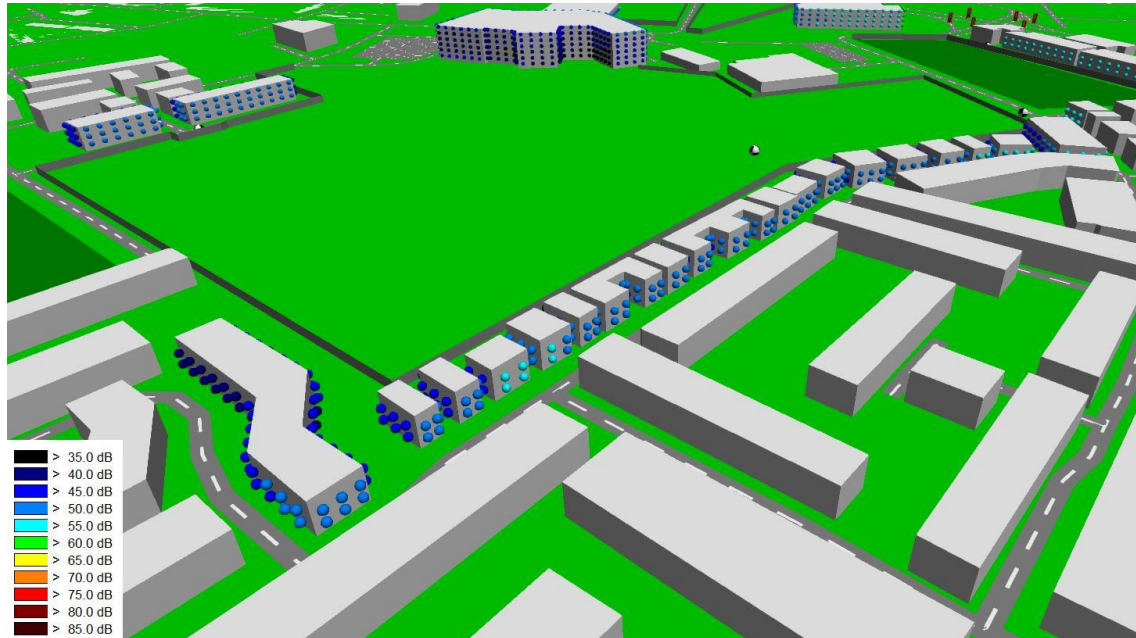
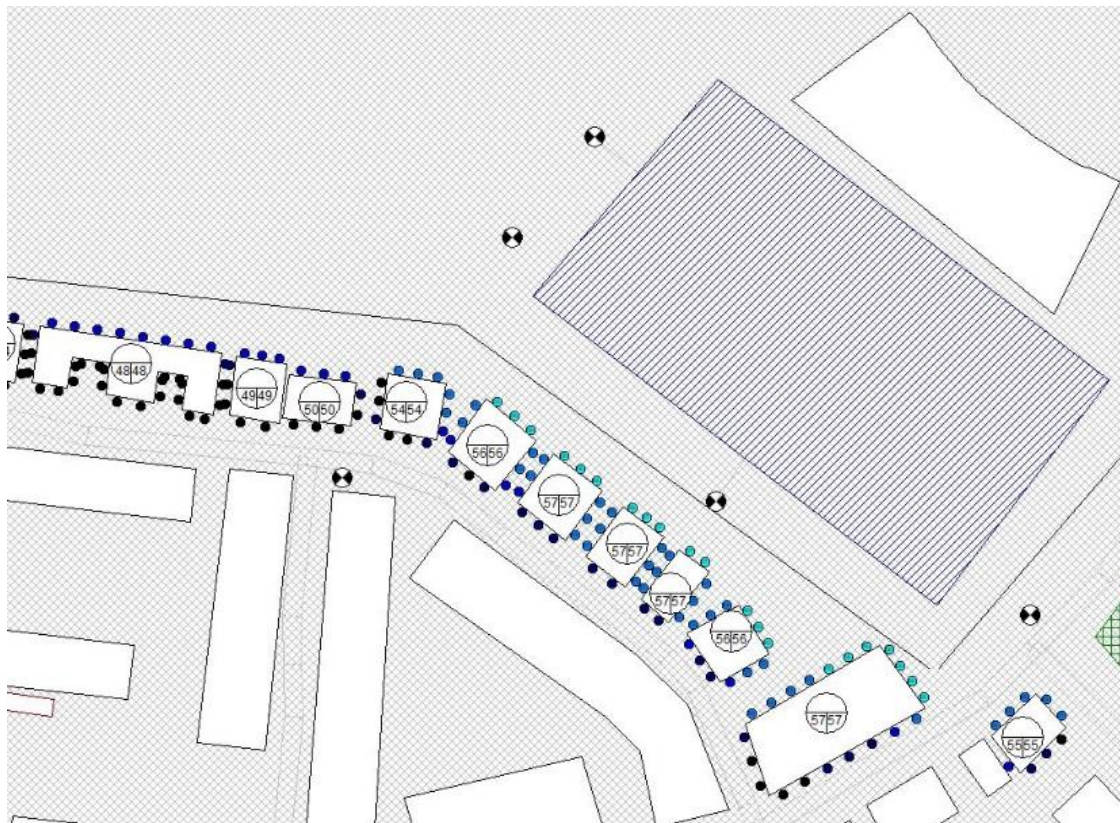


Figure 8 Screenshot of existing daytime noise levels at the site

5.2.2 Pitch noise

Modelling of pitch noise has been carried out using a single area source for the full pitch, calibrated to meet the Sport Scotland guideline values at 10 m. Screenshots of predicted noise from the pitch alone, and in combination with the existing noise climate, are provided in Figure 9 and Figure 10 respectively. Noise levels at the receptors to the north were not significant.



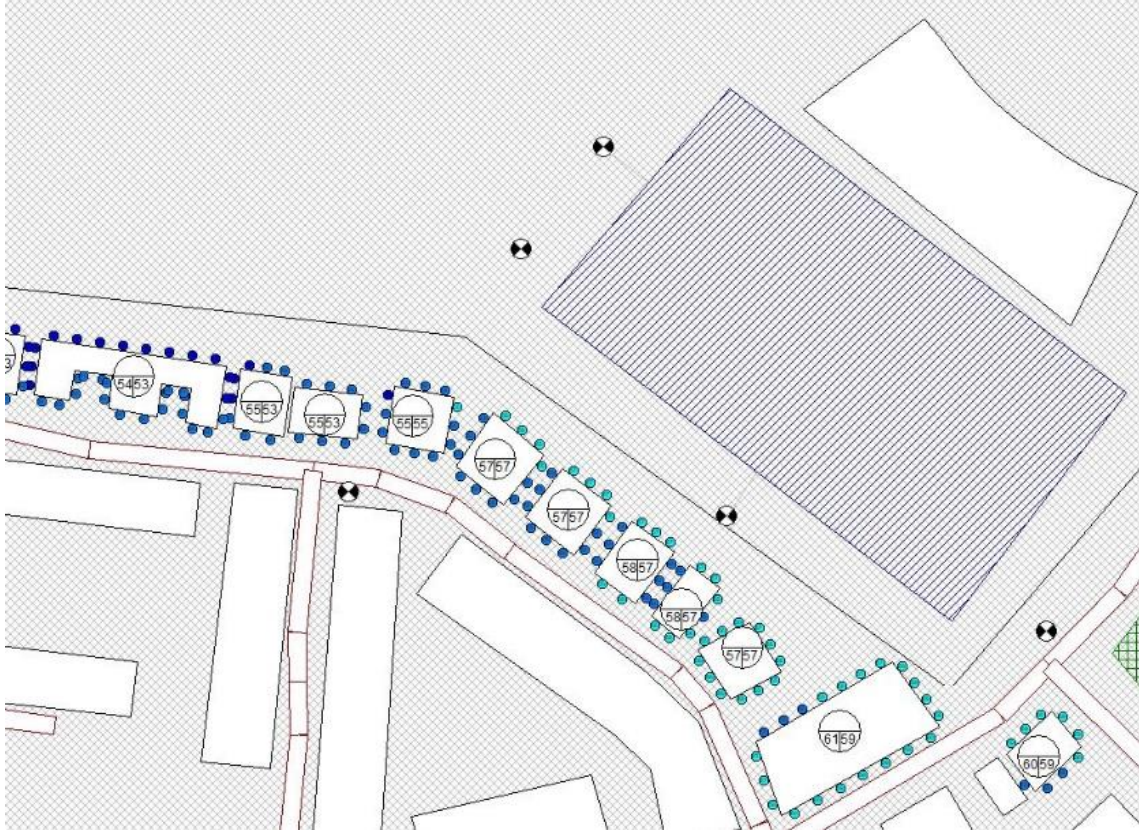


Figure 10 Screenshot of predicted average noise egress levels from pitch noise in combination with the existing noise climate

5.2.3 Pitch and stand noise

Screenshots of predicted average noise levels from the pitch and stand alone, and in combination with the existing noise climate, are provided in Figure 11 and Figure 12 respectively.



Figure 11 Screenshot of predicted average noise egress levels from pitch and stand noise alone

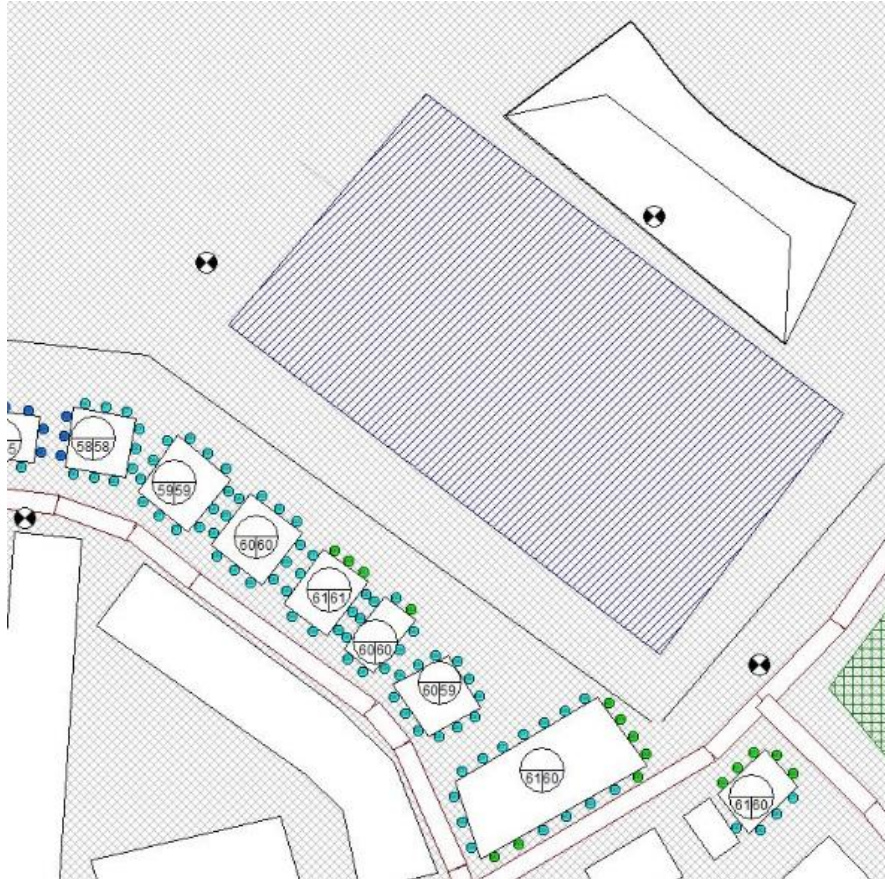


Figure 12 Screenshot of predicted average noise egress levels from pitch and stand noise in combination with the existing noise climate

5.3 Discussion of modelling results

5.3.1 Criteria

The Institute of Acoustics (IOA) and Institute of Environmental Management and Assessment (IEMA) provide 'Guidelines for Noise Impact Assessment', the criteria from which are reproduced below in Table 5.

Table 5 Summary of IOA/IEMA guidance for noise impact assessment

Magnitude of Impact	Increase in Noise Level (dBA)	Description
Negligible	<1.0	Noise increase is unlikely to be discernible
Low	1.0-2.9	A slight increase in noise levels may be perceived in affected buildings and outdoor recreational areas

Magnitude of Impact	Increase in Noise Level (dBA)	Description
Medium	3.0-4.9	Increase in noise levels is likely to be noticeable in affected buildings and outdoor recreational areas
High	>5.0	Increase in noise levels is likely to be clearly perceptible and could have a significant effect on the continued use of a building

The WHO suggests that for moderate annoyance, external noise levels should ideally be lower than $L_{Aeq,16hr}$ 50 dB, with an upper range of $L_{Aeq,16hr}$ 55 dB in external spaces. Sports Scotland presents these values as design targets.

Sports England presents $L_{Aeq,1hr}$ 50 dB as a design target, shortening the range of consideration to only that over a single match rather than over a full day period.

5.3.2 Training sessions - pitch noise

Training sessions are expected to occur 3 times during each week, from around 18:00 until no later than 21:00, ie 3-hour sessions. The predicted noise levels from the pitch only suggest that during a 3 hour training session a worst-case noise level of $L_{Aeq,1hr}$ 57 dB is expected. This would exceed the Sport England criteria and would be an increase in the average noise level of 7-10 dB for the rear of the houses directly facing the pitch (or 2-3 dB compared to the average noise levels across all facades of the houses). The greatest change would occur during the evening (19:00-21:00) when the existing noise climate is quieter. Receptors further away have minimal increases in noise levels.

Correcting for the duration of the training sessions is based on the ratio of the event time divided by the full 16-hour daytime period, ie $10 \log (3 \text{ hours} / 16 \text{ hours})$, which results in a correction of -7 dB.

This gives a worst-case facade level of $L_{Aeq,16hrs}$ 50 dB. This meets the Sports Scotland and WHO criteria, and represents a 1-3 dB change which therefore corresponds to a 'Low' impact per the IOA/IEMA guidance.

The significance of the increase in noise levels is therefore heavily dependent on the period over which noise is assessed.

5.3.3 Events and tournaments – pitch and stand noise

The predicted noise levels for the pitch and stand operating at full capacity are around L_{Aeq} 61 dB as a worst-case. This suggests increases of around 11-14 dB for the rear of the houses directly facing the pitch, with reduced increases further away. As the tournaments are

over a longer period than the training sessions, time corrections are not to be applied, and as such this is a more significant increase to the noise levels, corresponding to a 'High' impact.

However, large events are only to take place a maximum of 10 times per year.

5.3.4 Noise mitigation measures

An option to reduce the noise level at the houses due to pitch noise could include additional screening in the form of an acoustic barrier. However, it would be difficult to fully screen all elements of the development, especially to upper floor windows of the houses, and tall screens would be obtrusive with a negative visual/ daylight impact to neighbouring residents. Any acoustic barrier would need to be 3-4 m tall to provide screening of around 5 dB to the upper floors of the houses.

Further measures which could be adopted to reduce noise levels during large events include adding a sound absorbent soffit or walls to the stand. Due to the orientation of the stand this would only be expected to make minor improvements to the noise levels.

Regardless of any other mitigation measures adopted, speakers for the PA system are to be directional, faced towards the crowd and away from the surrounding noise sensitive receptors.

5.4 Plant noise egress

5.4.1 Standard guidance

BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* (BS 4142) provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

5.4.2 Local Authority criteria

Manchester City Council (MCC) provides guidance in relation to plant noise emissions in *Planning and Noise Technical Guidance* document dated December 2015. It states the following in relation to plant noise egress:

‘Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.’

5.4.3 Plant noise egress limits

Based on the above criteria and the measurement results, the cumulative noise rating level from the operation of all new plant should not exceed L_{Aeq} 37 dB.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels. These have been corrected relative to the measured free-field background noise levels by the addition of 3 dB where necessary.

All building services plant will be designed to achieve the noise limits set out above, including any corrections for attention catching features.

6 Construction noise egress limits

6.1 Criteria

BS 5228-1:2009+A1:2014 provides practical information on construction noise and vibration reduction measures and promotes a ‘Best Practicable Means’ approach to control noise and vibration. The calculation method provided in BS 5228 is based on the number and types of equipment operating, their associated Sound Power Level (SWL), and the distance to receptors, together with the effects of any screening.

Magnitude of impact for construction plant noise are based on the guidance set out in BS 5228 and are presented in Table 6. These levels are external noise levels measured at the facade of the building and apply over the full period, ie, 07:00 to 19:00 for daytime and 19:00 to 23:00 for evening. Works are not proposed during the evening or night, but evening limits have been presented if needed.

Table 6 Construction works noise magnitude of impact

Magnitude of impact	Daytime noise level	Evening noise level
Negligible	Less than L_{Aeq} 65 dB	Less than L_{Aeq} 55 dB
Low	Between L_{Aeq} 66-70 dB	Between L_{Aeq} 56-60 dB

Magnitude of impact	Daytime noise level	Evening noise level
Medium	Between L_{Aeq} 71-75 dB	Between L_{Aeq} 61-65 dB
High	Greater than L_{Aeq} 75 dB	Greater than L_{Aeq} 65 dB

Noise levels at the existing facades facing onto the site are in the region of L_{Aeq} 55 dB to 61 dB depending on their exposure to local access roads.

During the daytime, residential and education receptors have a high sensitivity to noise, while external amenity, commercial and retail buildings have a low sensitivity to noise. Only residential receptors in the area are considered sensitive during the evening or night.

6.2 Proposed limits

Descriptions of the various effect significances are summarised in Table 7.

Table 7 Summary of effect significances

Scale and Nature of Effect	Description of Effect	Exceeds Significant Observed Adverse Effect Level?	Exceeds Lowest Observed Adverse Effect Level?
Major (Adverse)	Disruptive, causes a material change in behaviour and/or attitude. Potential for sleep disturbance. Quality of life diminished due to change in character of the area.	Yes	Yes
Moderate (Adverse)	Intrusive, noise can be heard and causes small changes in behaviour and/or attitude. Potential for non-awakening sleep disturbance. Affects the character of an area such that there is a perceived change in the quality of life.	No	Yes
Minor (Adverse)	Non-intrusive, can be heard but does not cause any change in behaviour or attitude. Can slightly affect the character of an area but not such that there is a perceived change in the quality of life.	No	No
Negligible	No discernible effect on the receptor	No	No

The proposed limits corresponding to each level of effect significance are outlined in Table 8 to allow consideration of effect significance against the duration of effects.

Table 8 Proposed construction noise egress limits for various effect significances

Effect significance	Daytime limits, $L_{Aeq,12hr}$ (dB)		Evening limits, $L_{Aeq,4hr}$ (dB)
	Residential receptors/ East Manchester Academy/ St Brigid's	East Manchester Leisure Centre	Residential receptors
Major	>75	-	>65
Moderate	75	-	65
Minor	70	>75	60
Negligible	65	75	55

An assessment of predicted construction noise has not yet been carried out and as such the results of that assessment may inform some of the duration of works.

7 Conclusion

A noise survey has been carried out at the site. Key noise sources at the site were noted as traffic on Ashton Old Road and Alan Turing Way, with local traffic on access roads also contributing at individual locations.

Measured ambient noise levels were in the range $L_{Aeq,5min}$ 43 to 61 dB during the day, and $L_{Aeq,5min}$ 48 to 59 during the evening. The lowest background sound level measured during the survey was $L_{A90,5min}$ 39 dB in free-field conditions. Plant noise egress limits have been set based on MCC standard guidance.

Noise egress from the proposed training pitch and associated stand has been assessed. Increases to average noise levels are expected during training session, though the impact is reduced when considering the impact over a full 16-hour period due to the short duration.

Higher noise levels are expected when the stand is fully occupied. However, large events at the proposed development are to take place a maximum of ten times a year and are therefore the potential impact is significantly reduced by the infrequency of these events.

Consideration has also been given to potential further mitigation measures, with the benefits and drawbacks covered in Section 5.3.4.

Overall, the impact of the Proposed Development is considered to be noticeable during activities, but infrequent or of short enough duration that the additional noise is of lower significance when considering full daytime or monthly periods.

Construction noise limits have been set at various levels of impact, based on the results of the noise survey.

Appendix A

Survey details

Equipment

The noise measurements were taken using Rion NI-52 and B&K 2250 sound level meters.

Calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	2250/3011964	Brüel & Kjær	8 Sep 23	UCRT21/2089, UCRT21/2090
Microphone	4189/3100176	Brüel & Kjær	8 Sep 23	UCRT21/2089, UCRT21/2090
Pre-amp	ZC0032/26376	Brüel & Kjær	8 Sep 23	UCRT21/2089, UCRT21/2090
Calibrator	4231/3019123	Brüel & Kjær	8 Sep 23	UCRT21/2086
Sound level meter	NL-52/01143564	Rion	15 Dec 22	TCRT20/1738
Microphone	UC-59/10153	Rion	15 Dec 22	TCRT20/1738
Pre-amp	NH-25/43581	Rion	15 Dec 22	TCRT20/1738
Calibrator	NC-74/34257023	Rion	14 Dec 22	TCRT20/1736

Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meters used in this survey are available upon request.

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures*.