ACOUSTIC CONSULTANTS LTD

Noise Impact Assessment

Proposed Artificial Grass Pitch
Ryburn Valley High School, Sowery Bridge

Reference: 10490/LN

Client:
Surfacing Standards Limited SPORTS PITCH CONSULTANTS

Document Control

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The report has been prepared in good faith, with all reasonable skill and care, based on information provided or available at the time of its preparation and within the scope of work agreement with the Client. We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above. The report is provided for the sole use of the named Client and is confidential to them and their professional advisors. No responsibility is accepted to other parties.

The report limits itself to addressing solely on the noise, acoustic, and vibration aspects as included in this report. We provide advice only in relation to noise, vibration and acoustics. It is recommended that appropriate expert advice is sought on all the ramifications (e.g. CDM, structural, condensation, fire, legal, etc.) associated with any proposals in this report or as advised and concerning the appointment. It should be noted that noise predictions are based on the current information as we understand it and, on the performances noted in this report. Any modification to these parameters can alter the predicted level. All predictions are in any event subject to a degree of tolerance of normally plus or minus three decibels. If this tolerance is not acceptable, then it would be necessary to consider further measures.

Table of Contents

1.	Introduction	4
2.	The Site	5
3.	Planning and Noise	6
4.	Relevant Noise Guidance for AGP Assessment	10
5.	Site Noise Monitoring	14
6.	Noise Levels of AGP Use	17
7.	Noise Modelling Methodology	25
8.	AGP Noise Emission Prediction	27
9.	AGP Predicted Noise Levels	28
10.	Noise Management Plan	35
11.	Summary and Conclusions	36
12.	Appendix 1 – Glossary of Acoustic Terminology	38

1. Introduction

Surfacing Standards Limited appointed Acoustic Consultants Limited to undertake an environmental noise assessment for the proposed new artificial grass pitch (AGP) located at Ryburn Valley High School, Sowery Bridge. The assessment considered the impact of environmental noise on the nearby noise-sensitive residential properties.

The assessment includes the prediction of noise emission from the AGP at the nearby noise-sensitive properties, based on noise level data from activities measured at existing AGPs.

A site noise survey has been completed to determine the existing residual noise climate during the proposed hours of use.

The author of this report is an Associate Member of the Institute of Acoustics and is considered suitably qualified to undertake this noise impact assessment. This report has been checked by a Member of the Institute of Acoustics (MIOA) and Director of the company with over 16 years' experience in the industry.

2. The Site

The site is to be located within grounds associated with Ryburn Valley High School, Sowery Bridge. The nearest noise sensitive residential receivers in respect to the proposed AGP are understood to be approximately 30 metres to the south.

The proposed hours of use are 08:00-22:00 Monday to Friday and 08:00-18:00 Saturday and Sunday.

The proposed AGP location is provided on the figure below.

Figure 1: Proposed AGP location

3. Planning and Noise

3.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 and revised in September 2023. Section 15 entitled 'Conserving and enhancing the natural environment' addresses noise as a requirement of planning. Paragraph 174 states:

"174. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability…"

Paragraph 185 states:

"185. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

The document does not prescribe any assessment methodology or criteria to assess the adverse effect of noise.

3.2. Noise Policy Statement for England

The NPPF refers to the Noise Policy Statement for England (NPSE). This was published in March 2010 and aims to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner, in a timely fashion, and applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise.

The NPSE sets out the long-term vision of Government noise policy. This long-term vision is supported by three noise policy aims as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

avoid significant adverse impacts on health and quality of life;
mitigate and minimise adverse impacts on health and quality of life; and
where possible, contribute to the improvement of health and quality of life."

The NPSE introduces the concept of "Significant adverse" and "Adverse" impacts of noise which relate to the noise policy aims. These are applied as follows:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. With regard to where there is potential for noise impact it states the following in relation to the second noise policy aim:

"The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur."

The NPSE does not provide any assessment criteria for the noted effect levels and each case must be considered on its merits. The NPSE does, however, emphasise that in dealing with noise Local Planning Authorities are required to take a balanced approach in considering the benefits of development against any adverse effects which arise. Paragraph 2.18 of the NPSE is particularly relevant in this respect and states:

"There is a need to integrate consideration of the economic and social benefits of the activity or policy under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focusing solely on the noise impact without taking into account other related factors."

The planning need is outside the scope of noise and acoustics and will need to be addressed by others.

3.3. National Planning Practice Guidance, Noise (NPPG)

The National Planning Practice Guidance (NPPG) on noise referred to here is based on the current version (July 2019) as provided on the Planning Guidance Website.

It states that "Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment."

It provides generic guidance on how to determine the noise impact and what factors could be a concern. It includes the option types to mitigate any adverse effects of noise stating that there are four broad types of mitigation. These are engineering, layout, using planning conditions or obligations and noise insulation.

Paragraph 5 of the NPPG provides a table identifying the effect level and examples of effect relating to the impact effect levels provided in the NPSE. The table is duplicated below:

Table 1: NPPG Noise – Perception of Effect Levels

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable but not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

The table does not provide any objective assessment that equates to the noted effect levels.

The NPPG identifies that where noise is audible it is not necessarily intrusive. The effect and impact on people is based primarily on the level of noise.

The Noise Policy Statement for England (NPSE) states that noise levels above the Lowest Observed Adverse Effect Level are acceptable in planning when reduced to a minimum and when taken into account against all other planning considerations.

Section 4 of this report identifies guidance which is considered to provide noise criteria equivalent to effect levels below the Lowest Observed Adverse Effect Level. This is where the perception of noise is "not noticeable" or "noticeable but not intrusive" as indicated in table above.

4. Relevant Noise Guidance for AGP Assessment

The following sections outline what we consider to be relevant guidance and suitable noise criteria within the context of the national planning policy.

This includes advice contained within the Sport England Design Guidance Note 'Artificial Grass Pitch (AGP) Acoustics – Planning Implications' which refers to the following documents.

4.1. World Health Organisation 'Guidelines for Community Noise'

The World Health Organisation 'Guidelines for Community Noise' published in 1999 gives the following description of community noise.

"Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood. Typical neighbourhood noise comes from premises and installations related to the catering trade (restaurant, cafeterias, discotheques, etc.); from live or recorded music; sport events including motor sports; playgrounds; car parks; and domestic animals such as barking dogs."

This includes "sport events" and, as such, the use of AGP sites.

For noise levels internally and externally to dwellings it states:

"In Dwellings. The effect of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 LAeq for continuous noise and 45 LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the noise source. At night-time, outside sound levels about 1 metre from façades of living spaces should not exceed 45 dB LAeq, so that people may sleep with bedrooms open. This value was obtained by assuming the noise reduction from outside to inside with the window open is 15 dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB LAeq. The maximum sound pressure level should be measured with the sound pressure meter set at "fast"."

Based on the same methodology used to determine the night time noise level (with a 15 dB(A) for an open window) outside a residential property, the daytime noise level about 1 metre from façades of living spaces should not exceed 50 dB LAeq.

Table 4.1 of the document provides guidelines for community noise in specific environments, suggesting noise levels at which adverse health and annoyance effects are likely. The relevant noise criteria are as follows:

Table 2: WHO Noise Criteria

Specific Environment	Critical Health Effect	$L_{eq(T)}$ dB(A)
Outdoor living area	Serious annoyance, daytime and evening	55
	Moderate annoyance, daytime and evening	50
Dwelling indoors	Speech intelligibility & moderate annoyance, daytime & evening	35

According to the WHO guidance, moderate annoyance is caused by noise levels exceeding 50 $L_{Aeq(T)}$ dB externally and 35 $L_{Aeq(T)}$ dB internally. With relation to the adverse effect level, we would consider this the threshold of the Lowest Observed Adverse Effect Level.

Therefore, where noise levels from the proposed development do not exceed 50 $L_{Aeq(T)}$ dB externally and 35 $L_{Aeq(T)}$ dB internally, the effect is below the Lowest Observed Adverse Effect Level and will have no adverse effect. The noise level of the AGP may be noticeable but not intrusive and is considered acceptable in planning terms.

The equivalent noise level is determined over a specific time period. The World Health Organisation guidelines for residential developments are typically equivalent noise levels calculated over a 16-hour daytime period.

In our opinion, an AGP 16-hour assessment period may not truly reflect the noise impact as it takes into account times of use and non-use. We would propose an alternative, more stringent but appropriate assessment time period of one hour, $L_{Aeq\ (1\ hour)}$, as this is the typical time period for a community sports session on an AGP. Therefore, we would suggest the more stringent target noise level of 50 dB $L_{Aeq\ (1\ hour)}$ is more suitable for the more sensitive evening time.

The WHO criteria were reviewed in a report by the National Physical Laboratory (reference CMAM16) which states:

"Exceedance of the WHO guideline values does not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher levels of noise exposure are reached."

Therefore, it is not necessarily the case that where these levels are exceeded the noise will adversely affect nearby residential properties.

4.2. Comparative Assessment

The criteria set out in section 4.1 is an absolute level in a dwelling or external amenity area. As such, it does not consider existing noise levels on or around the site. However, for certain applications it may be more suitable to consider a comparative assessment as part of the overall impact assessment.

For example, this would be a site where the existing noise levels already exceed the WHO guideline values. This existing noise for example, could be due to transportation noise or other sporting facilities.

In terms of noise level changes, withdrawn Planning Policy Guidance 24 states in the Glossary under dB (A) the following:

"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)."

The Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment, Version 1.2 published in November 2014 categorises the significance of a change in noise level, this is summarised as follows and taken from Table 7-14 of the guidance.

Table 3: IEMA Impact from the Change in Sound Levels (Table 7-14)

Sound Level Change LpT	Long-term impact classification	Short-term impact classification
$\geq$ 0 dB and < 1 dB	Negligible	Negligible
$\geq$ 1 dB and < 3 dB		Minor
$\geq$ 3 dB and < 5 dB	Minor	Moderate
$\geq$ 5 dB and < 10 dB	Moderate	Major
$\geq$ 10 dB	Major	

Where noise from the proposed development does not exceed the existing noise climate, the increase in noise will be no more than 3 decibels. It is expected there will be no observed effect on nearby residential properties. This would be applicable where noise levels currently exceed the WHO guidelines which would be used as a lower limit. The noise levels are both measured in the $L_{Aeq(T)}$ parameter over the same time period, T.

Where noise levels do not exceed the WHO guidelines, a higher change could be considered acceptable without having an observed adverse effect as the noise levels are suitably low.

4.3. Transient Sounds

To assess noise from short term sources, we have considered separately the noise from shouts, whistles and the impact of balls on the perimeter fence. There is no specific guidance for the maximum noise level of environmental noise during the daytime and, as such, we have taken a pragmatic approach in considering the most appropriate available guidance.

By assessing both the equivalent noise level for continuous use of the AGP and the maximum noise level of discrete events, we consider that this addresses the character of the noise.

4.4. Proposed Assessment Methodology

The aim of the assessment is to determine whether noise from the proposed pitch can be controlled to acceptable levels during the proposed hours of use.

It is proposed to assess the development against the WHO guidelines and the existing noise climate. Where the predicted noise level of the AGP is below the WHO guidelines threshold for the onset of 'moderate annoyance' in terms of the NPPG, the development will have 'no observed adverse effect'.

Where noise from the AGP exceeds the WHO guidelines but does not exceed the existing noise climate, the increase in the ambient noise climate will be no more than 3 decibels and have a negligible impact.

The above impact is expected to have no observed effect on nearby residential properties. The NPPG states that the perception of 'No Observed Adverse Effect' is 'noticeable and not intrusive' and gives an example outcome as follows:

"Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

The 'No Observed Adverse Effect' level falls below the Lowest Observed Adverse Effect Level of the NPPG.

It is also considered necessary to consider the maximum noise levels generated by the use. However, there is no directly appropriate criteria for daytime maximum noise levels and as such we provide this information and assessment for consideration by the Local Planning Authority.

5. Site Noise Monitoring

A partially attended site noise survey was undertaken on the 10th October 2023. The purpose of the noise survey was to determine the existing ambient noise climate at a location representative of the nearest noise sensitive residential property during the proposed AGP hours of use.

5.1. Monitoring Equipment

Sound Pressure Levels were measured using Class 1 sound level meters with a half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2017 "General requirements for the competence of testing and calibration laboratories"; in accordance with British Standard EN 10012:2003 "Measurement management systems. Requirements for measurement processes and measuring equipment"; and traceable to the National Standards. This equipment was checked and calibrated as noted below and the certificates are available for inspection.

Table 4: Equipment and Calibration Status

Equipment Description / Manufacturer / Type	Serial Number	Date of Calibration	Calibration Certification Number
SLM, NTI, XL2	A2A-17200-E0	10/05/2022	UK-22-029
Pre-Amp, NTI, MA220	8848	10/05/2022	UK-22-029
Microphone, NTI, MC230A	A22973	10/05/2022	UK-22-029
Calibrator, B&K, 4231	2665006	25/11/2022	42612

The measurement equipment was checked before and after use with the noted calibrators and no significant drift was detected.

5.2. Weather Conditions

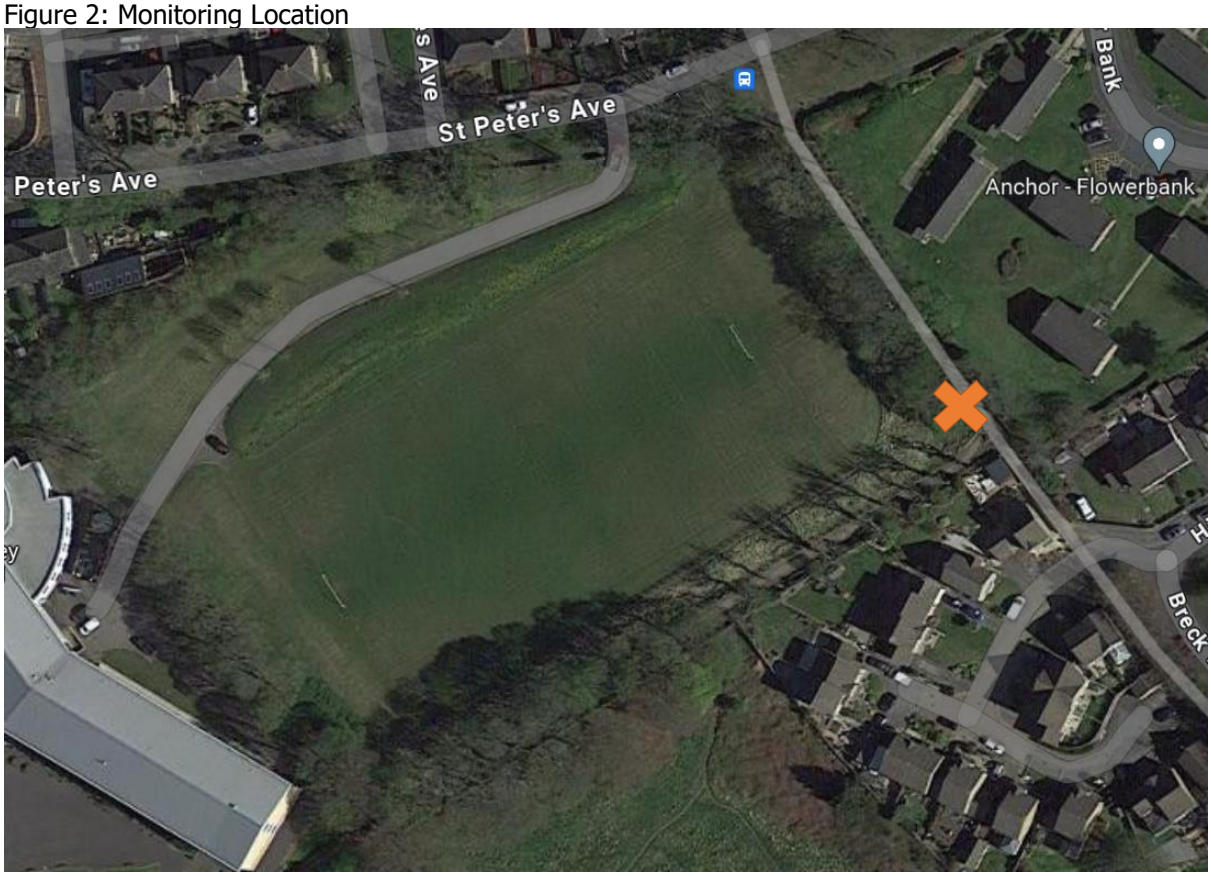
During the measurement, the weather was dry with no rain after 18:30 after light drizzle and the temperature average 15 degrees centigrade. Wind speeds during the noise monitoring exercise were between 3 and 5 metres per second. The weather conditions are not expected to have adversely affected the measured noise data.

5.3. Monitoring Procedure

Noise monitoring was undertaken in one location representative of the nearest noise sensitive receivers to the proposed AGP. Noise measurements were undertaken between 18:00-22:00 hours.

During the measurements the noise climate was primarily determined by distant road traffic to the north. The microphone was in a free-field position, approximately 1.5 metres above ground on a tripod. The monitoring location is shown on the figure below:

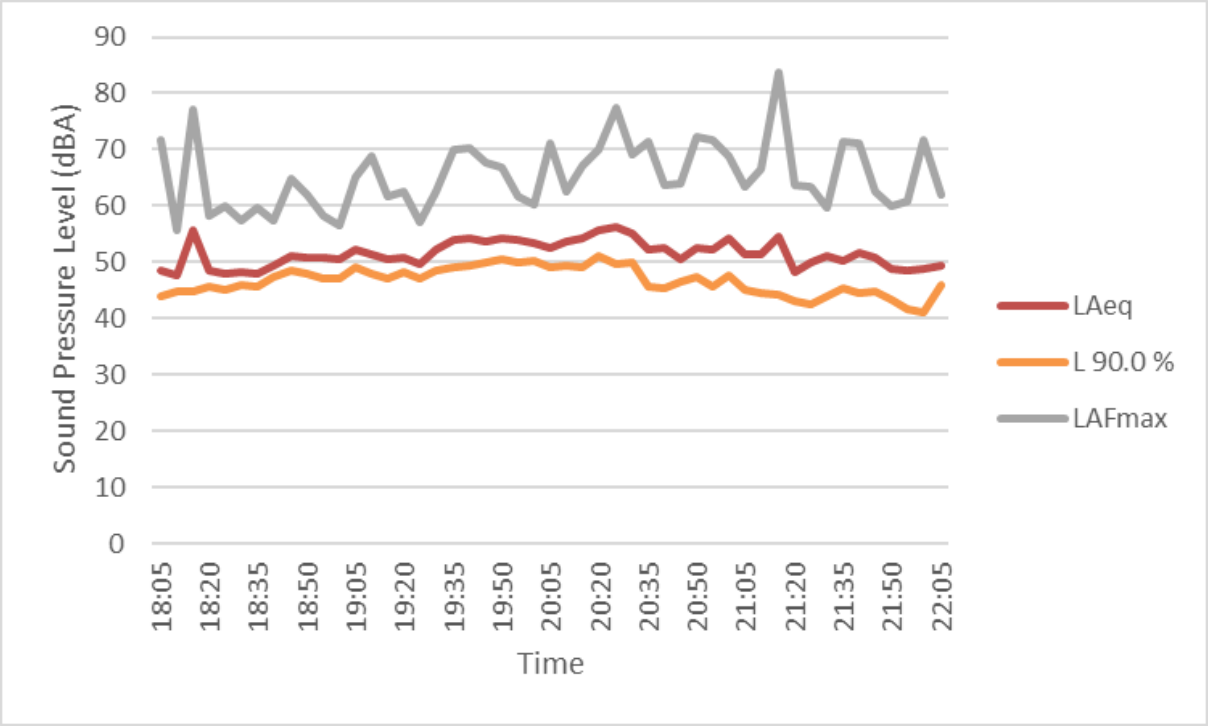
Figure 2: Monitoring Location



5.4. Measured Noise Levels

The following chart provides the measured noise levels for the duration of the measurement period:

Chart 1: Measured noise levels



The following table provides the equivalent noise level over each hour of the evening period.

Table 5: Measured noise levels

Time	$L_{Aeq,1\ hour}$ (dB)
18:00	51
19:00	53
20:00	54
21:00	51

6. Noise Levels of AGP Use

Noise levels were measured at nine sports sessions on three separate AGPs. The measurements included football, hockey and rugby, with men, women and children participating in different sessions. The purpose of the measurements was to determine a 'typical' noise level for an AGP sports session.

Measurements were undertaken behind the goal line and to the side-line at the halfway line. It was found that noise levels at the halfway line were generally higher than behind the goal.

Noise levels from sporting activity were generally determined by person's voices. This is except for hockey where the balls hitting the backboard of the goal and perimeter boards of the pitch are the main noise sources. The pitch surface is primarily for football and can be used for rugby. It is not suitable for hockey and is not expected to be used for hockey.

From the measurement data, a typical free-field noise level of 58 dB $L_{Aeq\ (1\ hour)}$ at a distance of 10 metres from the side-line at the halfway line has been determined as representative for noise from an AGP. The following table summarises the measurement data undertaken.

Table 6: Summary of Measured Noise Levels

Monitoring Session	**AGP Activity**	**Measured Noise Level, $L_{Aeq\ (1\ hour)}$ dB**
1	Rugby training on one half of the pitch with approximately 20 players and football training on the other half with approximately 20 players.	60
1	8 a-side training match on one half of the pitch only with the other half unused.	56
1	Football training for a single club of approximately 22 players. The start of the session involved heading drills before the full pitch was used to play an 11 a-side game.	56
1	Ladies Hockey Club training involving stick drills, passing etc., with multiple balls per team and therefore a lot of impact noise from stick on ball. Approximately 30 players on the pitch.	56
1	Ladies Hockey Club undertaking defence/attack drills on different halves of the pitch. Single ball used per team with less stick on ball impacts than previous training. Approximately 30 players on the pitch.	58
1	Men's 6 a-side social football match using half the pitch and hockey goals (12 players).	51
2	Under sixteen football training with the pitch divided into four quarters and a total of approximately fifty players.	58
2	Two adult football games using half the pitch each with a total of 28 players.	56
2	Two 8 a-side adult football games using half the pitch each with a total of 32 players.	56

The following sections provide information on the measurements undertaken to determine the typical AGP noise levels stated above.

6.1. Noise monitoring session 1 – 18th February 2014

Measurements were undertaken at two AGP pitches at Coombe Dingle Sports Complex in Bristol. The Complex is owned and operated by the University of Bristol. The complex has one sand dressed pitch and a newer synthetic pitch.

Noise measurements were undertaken using CEL and B&K sound level meters. The equipment information and calibration status is as follows:

Table 7: Measurement Equipment – session 1

Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
Real Time Analyser, B & K Type 2250-A	3000994	12/03/13	K017112
Pre-Amplifier, B & K, Type ZC0032	14611	12/03/13	K017112
Microphone, B & K, Type 4189	2638388	12/03/13	K017112
Calibrator, B&K Type 4231	1934013	12/03/13	K017111
Real Time Analyser, CEL, Type 593	100972	17/06/2013	K031407
Pre-Amplifier, CEL, Type 527	3/0232063	17/06/2013	K031407
Microphone, GRAS 40AE	34509	17/06/2013	K031407
Calibrator, CEL, Type 284/2	5819051	17/06/2013	K031408

During the noise monitoring the conditions were calm, dry and overcast with an air temperature of 7 degrees centigrade. The conditions were considered suitable for noise monitoring.

Measurements of the synthetic pitch were undertaken at monitoring location 'A' 10 metres from the edge of the pitch on a slightly raised bund. The monitoring location had a full view of the pitch.

Measurements of the sand based pitch were undertaken at monitoring location 'B' 10 metres from the edge of the pitch on a slightly raised bund. The monitoring location had a full view of the pitch.

After the monitoring session, when there was no use of the pitch a five minute ambient noise measurement was undertaken, this was due to distant road traffic on the M5 to the South West.

The monitoring locations and pitches are shown below. The monitoring locations were selected to reduce, as far as feasible, noise contributions from the other pitch.

Figure 3: Monitoring Location Site Plan – session 1

The activities that took place during the monitoring session on each pitch are as follows:

Synthetic AGP

19:00 hours to 20:00 hours

Clifton Hockey Club Ladies First Team. For the first 30 minutes: exercise and running drills without sticks or balls. The most significant noise was from player's voices but some extraneous noise from the other pitch (rugby and football training) was observed. Approximately 15 players on the pitch.

The second 30 minutes of the session involved the first team on one half and the third team on the other. The activities involved stick drills, passing etc, with multiple balls per team and therefore a lot of impact noise from stick on ball. Approximately 30 players on the pitch.

20:00 hours to 21:00 hours

Clifton Hockey Club Ladies first and third teams (approximately 30 players) undertaking defence/attack drills on different halves of the pitch. Single ball used per team so less stick on ball impacts than previous training.

21:00 hours to 22:00 hours

Men's 6-a-side social football match using half the pitch and hockey goals. It was observed that noise from the other pitch during this session was significant at the monitoring location.

Sand-Dressed Pitch

19:00 hours to 20:00 hours

Rugby training on one half of the pitch with approximately 20 players and football training on the other half with approximately 20 players.

20:00 hours to 21:00 hours

8-a-side training match on one half of the pitch only with the other half unused.

21:00 hours to 22:00 hours

Football training for a single club of approximately 22 players. The start of the session involved heading drills before the full pitch was used to play an 11-a-side game.

Measured Noise Levels

Noise measurements were undertaken at monitoring locations 'A' and 'B'; the measured noise levels have been corrected for ambient noise determined from the noise measurements undertaken after the pitches were in use.

The pitch noise levels are as follows:

Table 8: Measured Noise Levels

Session Period	Synthetic pitch Monitoring location 'B'		Sand dressed pitch Monitoring location 'A'	
	$L_{Aeq\ (1\ hour)}$	$L_{Amax\ (fast)}$	$L_{Aeq\ (1\ hour)}$	$L_{Amax\ (fast)}$
19:00 to 20:00 hours	56	83	60	78
20:00 to 21:00 hours	58	86	56	82
21:00 hours to 22:00 hours	51	78	56	78

6.2. Noise monitoring session 2 – 5th March 2014

Measurements were undertaken at a 3G AGP pitch at Clifton College Sports Ground on the outskirts of Bristol. The complex has a number of artificial pitches, the newest one being the 3G pitch on which monitoring took place.

Noise measurements were undertaken using Svantek and B&K sound level meters. The equipment information and calibration status is as follows:

Table 9: Measurement Equipment – session 2

Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
Real Time Analyser, B & K Type 2250-A	3000994	12/03/13	K017112
Pre-Amplifier, B & K , Type ZC0032	14611	12/03/13	K017112
Microphone, B & K, Type 4189	2638388	12/03/13	K017112
Calibrator, B&K Type 4231	1934013	12/03/13	K017111
Sound Level Meter, Svantek 959	14784	08/04/13	K0200009
Calibrator, CEL, Type 110	045169	08/04/13	K020983
Microphone, GRAS 40AE	98073	08/04/13	K0200009

During the noise monitoring the conditions were calm, dry and overcast with an air temperature of 8 degrees centigrade. The conditions were considered suitable for noise monitoring.

Measurements of the pitch were undertaken at monitoring location 'A' 10 metres behind the goal line of the pitch and monitoring location 'B' 10 metres from the halfway line of the pitch. The monitoring locations had a full view of the pitch.

The monitoring locations are shown below.

Figure 4: Monitoring Location Site Plan – session 2

The activities that took place during the monitoring session are as follows:

18:00 hours to 19:00 hours

Under sixteen football training with the pitch divided into four quarters and a total of approximately fifty players.

19:00 hours to 20:00 hours

Two adult football games using half the pitch each with a total of 28 players.

20:00 hours to 21:00 hours

Two 8 a-side adult football games using half the pitch each with a total of 32 players.

Measured Noise Levels

Noise measurements were undertaken at monitoring locations 'A' and 'B'; the pitch noise levels are as follows:

Table 10: Measured Noise Levels

Session Period	Monitoring location 'A' Behind Goal Line		Monitoring location 'B' On Halfway Line	
	$L_{Aeq(1\ hour)}$	$L_{Amax(fast)}$	$L_{Aeq(1\ hour)}$	$L_{Amax(fast)}$
18:00 to 19:00 hours	42 dB	71 dB	58 dB	82 dB
19:00 to 20:00 hours	39 dB	71 dB	56 dB	76 dB
20:00 to 21:00 hours	39 dB	65 dB	56 dB	85 dB

7. Noise Modelling Methodology

The measured AGP noise emission data has been used to generate a noise map of the site, in order to predict the noise level at the nearby noise-sensitive residential properties.

The modelling has been undertaken using noise mapping software CadnaA by DataKustik. This uses the calculation method of ISO 9613 to predict noise levels.

The assessment is based on the noise modelling methodology using an area source covering the playing surface as the noise source. The area source is at a height of 1.5 metres representative of head height.

To validate the modelling methodology we have created a noise map of one of the sites where AGP noise was measured (Coombe Dingle in Bristol). The noise map in Figure 5 shows the noise propagation of an area source created from thirty moving point sources. The second noise map (Figure 6) shows the noise propagation of thirty individual point sources spread across the playing surface.

Figure 5: Noise model using an area source

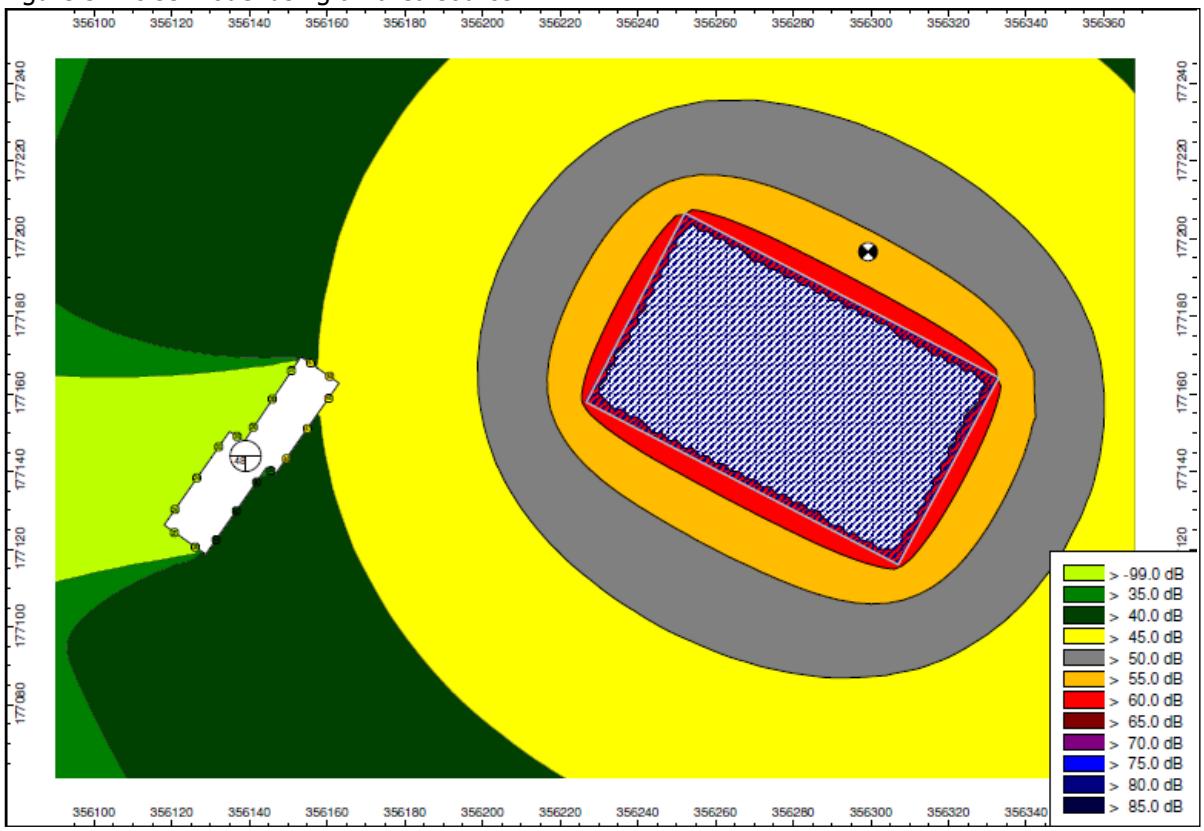
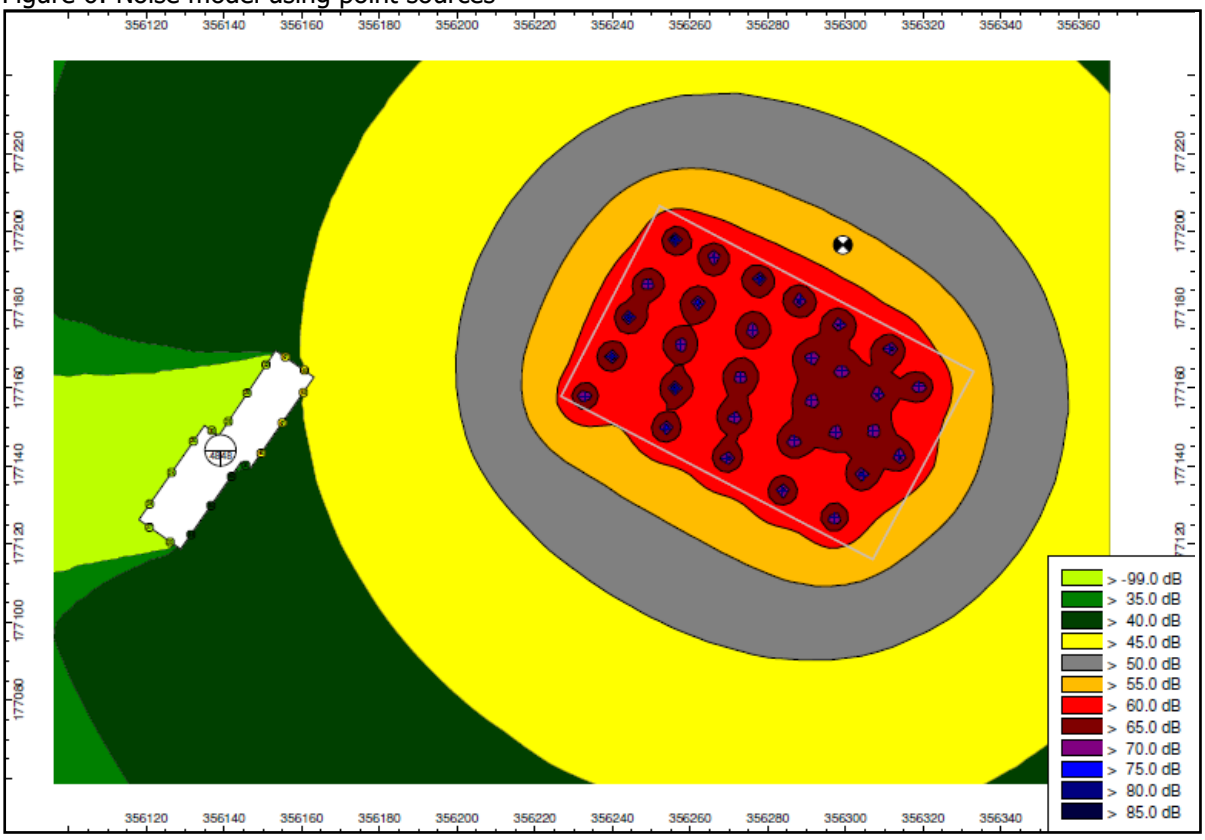


Figure 6: Noise model using point sources



As can be seen from the two maps, there is no significant difference in the noise propagation and as such, it is our opinion that an area source is suitable for noise modelling of AGPs.

8. AGP Noise Emission Prediction

A noise model has been generated of the development site. The AGP location and surrounding area has been determined from the provided drawings.

The surrounding area has been determined from Google Maps imagery.

All buildings in the vicinity of the playing fields have been built within the model. The height of these buildings has been determined via Google Maps imagery.

The noise from an AGP is primarily from voice. The noise source is at a height of 1.5 metres above the ground (approximately head height).

Third-order reflections are calculated.

The variation in topography is determined by LIDAR data from 2022.

A noise bund has been included to the north of the site being 2.4m high to the west and 1.6m high to the east.

The sound reduction provided by the boundary fences around the gardens is not considered in the modelling as it cannot be demonstrated that the construction complies with the requirements of ISO 9613.

The noise map in Figure 6 below shows noise emission from the AGPs predicted at ground floor level (1.5 metres above the ground), which is typical of a 'daytime' habitable room in a house and external amenity areas.

Noise Barriers

Noise mitigation barriers are required in order to reduce noise levels to within the criteria. The noise barrier must be 1.8m high to the north of the site and 2m to the south. This is to be outside and not in contact with the weldmesh fencing, with no gaps and a surface density of at least 10 kilograms per metre squared.

The barrier to the south must also be on the same surface level as the pitch and must not follow the topography of the ground outside of the levelled pitch surface.

9. AGP Predicted Noise Levels

The following figure shows the predicted noise emission from the proposed AGP. The location of the barrier is indicated in red.

Figure 7: Predicted AGP Noise Emission (1.5 metres above the ground).

The highest predicted noise level from the proposed AGP is 47 dB $L_{Aeq\ (1\ hour)}$ at the nearest noise sensitive receivers to the north, 40 dB $L_{Aeq\ (1\ hour)}$ at the nearest noise sensitive receivers to the east and 45 dB $L_{Aeq\ (1\ hour)}$ at the nearest noise sensitive receivers to the south.

The predicted noise level is below the criterion of 50 dB $L_{Aeq\ (1\ hour)}$ derived from WHO 1999 as being the threshold for the onset of moderate community annoyance.

The World Health Organisation provides a sound reduction through an open window of 15 dB(A) which results in a predicted internal equivalent noise level of 32 dB $L_{Aeq\ (1\ hour)}$ at the NSRs.

The highest predicted noise level in the gardens is 49 dB $L_{Aeq\ (1\ hour)}$, which is within the proposed criterion of 50 dB $L_{Aeq\ (1\ hour)}$.

The following table gives overall change in noise level and IEMA classification at the most noise sensitive location based on the existing ambient noise level and predicted AGP noise levels above.

Table 11: Change in noise levels at the NSRs to the south east

Time	Existing Equivalent Noise Level, $L_{Aeq,1hr}$	Predicted Equivalent Noise Level, $L_{Aeq,1hr}$	Change	Long Term Impact
18:00	51	45	+1 dB	Negligible
19:00	53		+0.6 dB	
20:00	54		+0.5 dB	
21:00	51		+1 dB	

As can be seen in the table above the pitch has a 'negligible' impact on the existing noise climate.

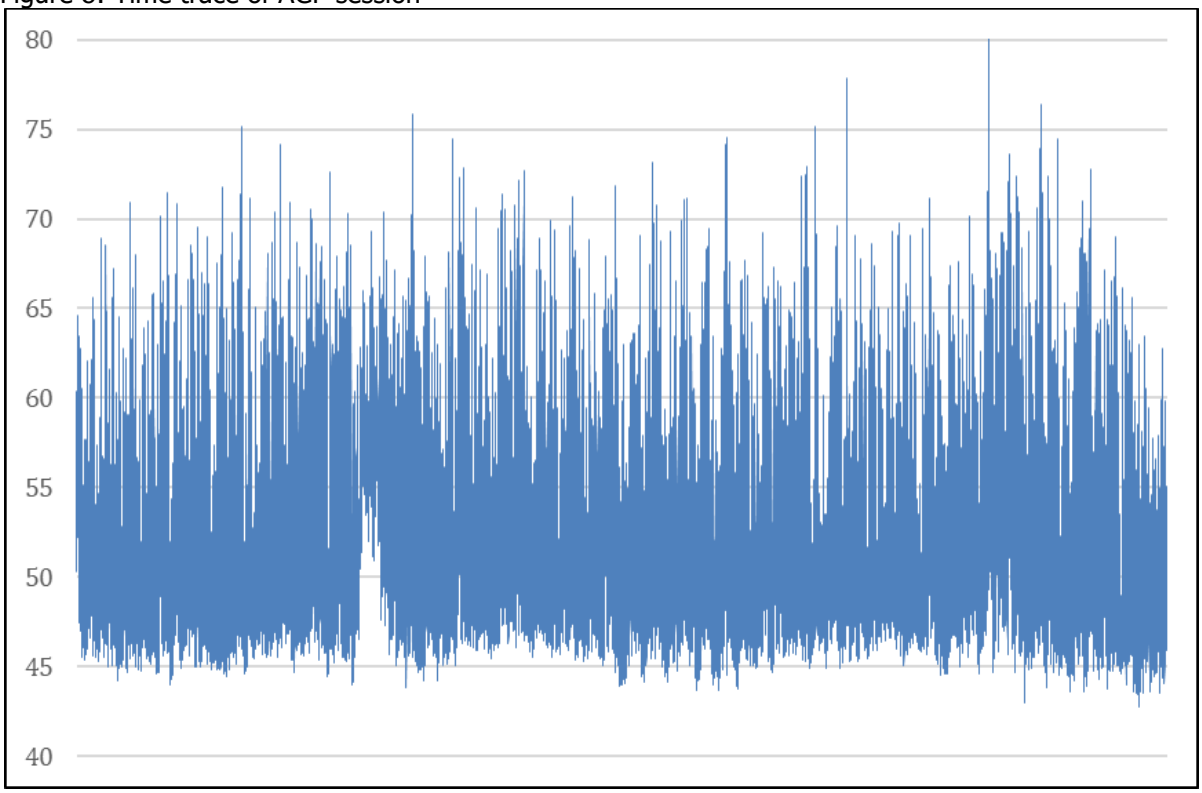
9.1. Assessment of Transient Noise Levels

The following section addresses the maximum noise levels generated by AGP activity. This would include whistles, voice and ball impact.

In our opinion, considering the maximum noise level parameter as well as the equivalent noise level would address the character of the noise. Maximum noise levels would include sounds that make up the general noise from an AGP and would also determine the equivalent noise level. Examples of this would be the voices of players and coaches and impacts of balls on the fences.

The following figure shows the time trace (100ms) of noise from one of the measured AGP sessions stated in the noise impact assessment previously provided during the one hour measurement period. During this measurement exercise there was football training for a single club of approximately 22 players. The start of the session involved heading drills before the full pitch was used to play an 11 a-side game. During the monitoring exercise maximum noise levels were generated by occasional shouts, whistles and balls hitting the fence.

Figure 8: Time trace of AGP session



The maximum noise levels are typically in the range of 70-75 dB(A).

It is not possible to accurately undertake a prediction for a maximum noise level in the same way as an equivalent noise level. This is because the maximum noise level by its nature takes place at a finite location whereas the equivalent noise level over a time period takes place over many locations across the pitch.
The following considers three noise sources, that from voice, whistle and that from the impact of ball on fence.

9.2. Noise from Voice

If we consider the maximum noise level from voice, a typical level of shouting is in the order of 90dB(A) at 1 metre.

Noise modelling has been undertaken using noise mapping software Cadna:A by Datakustik. This uses the calculation method of ISO 9613 to predict noise levels. Predictions have been undertaken to determine the maximum noise levels from an individual point source at multiple locations around the pitch.

With barriers described above, the highest predicted maximum noise levels from the highest individual source location at the window of the façade of the NSRs is 48 dB(A).

9.3. Noise from Whistle

Measurements have been previously undertaken to determine the noise level from an Acme Thunderer referees whistle. The measured maximum noise level was 85dB $L_{Amax(fast)}$ at a distance of 10 metres.

Noise modelling has been undertaken using noise mapping software Cadna:A by Datakustik. This uses the calculation method of ISO 9613 to predict noise levels. Predictions have been undertaken to determine the maximum noise levels from an individual point source at multiple locations around the pitch.

With barriers described above, the highest predicted maximum noise levels from the highest individual source location at the window of the façade of the NSRs is 64 dB(A).

9.4. Noise from Ball Impact

Noise is generated when a ball hitting the fence panel causes it to rattle against the supporting post and adjoining and overlapping adjacent fence panel. To minimise this noise, it is recommended that neoprene isolators are located between the panels and the posts.

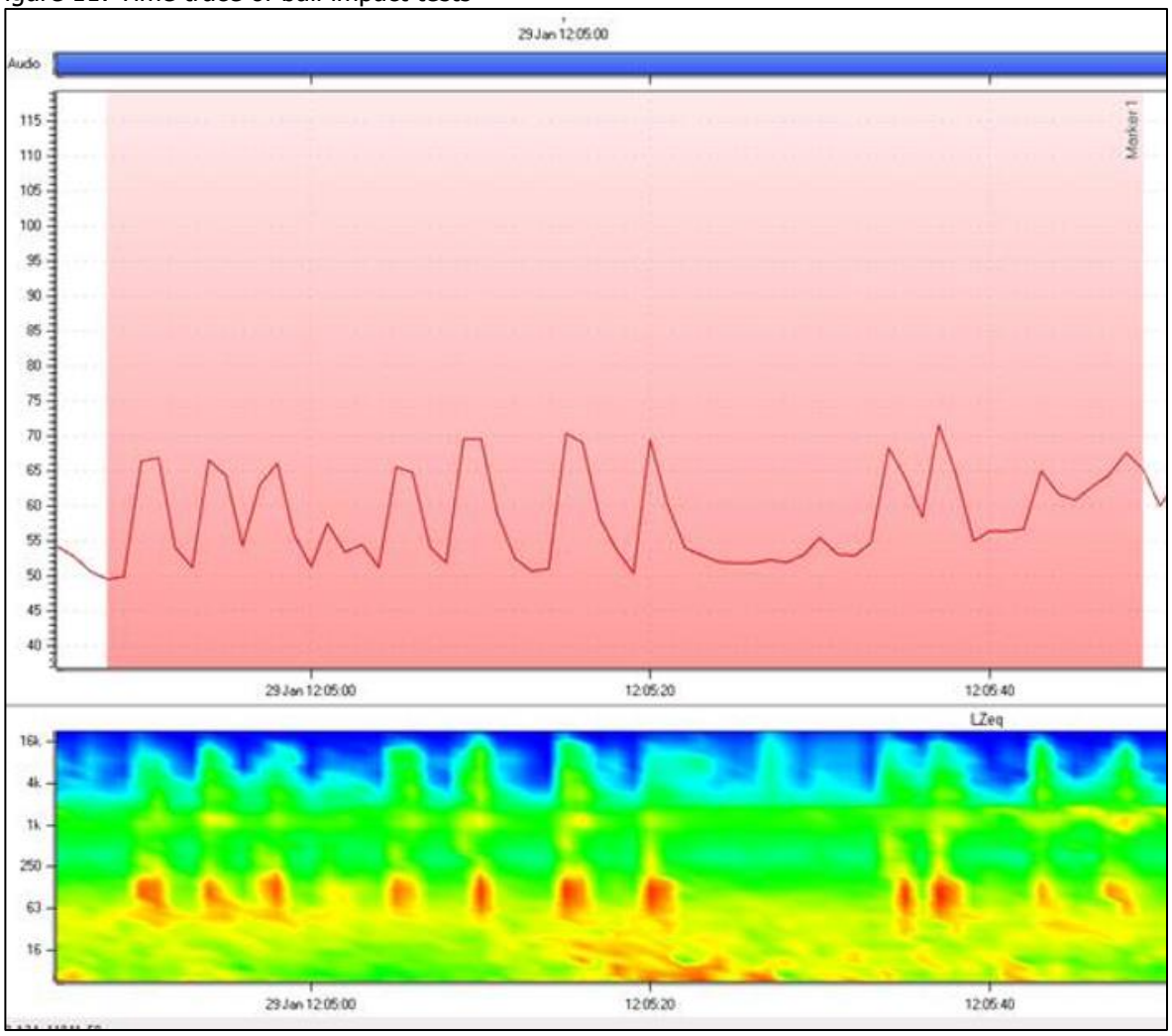
Measurements of ball impacts upon a fence were undertaken at a recently completed AGP in Swindon, Wiltshire. The fence under tests was 4.5 metres tall with neoprene isolators between the panels and posts as proposed for this project. The neoprene isolators, fence and monitoring set up is shown in the figures below.

Figure 9: Image showing neoprene isolators

Figure 10: Fence and tests setup

The figure below shows the time trace and spectral content of the fence impact tests.

Figure 11: Time trace of ball impact tests



The typical level of a loud ball impact is around 66-70 dB $L_{Amax(fast)}$ at 20 metres.

To determine the possible reduction of an acoustic fence, noise modelling has been undertaken using noise mapping software Cadna:A by DataKustik. This uses the calculation method of ISO 9613 to predict noise levels.

With barriers described above, the highest predicted maximum noise levels from the highest individual source location at the window of the façade of the NSRs is 65 dB(A).

9.5. Assessment of Maximum Noise Levels

There are no specific noise criteria for maximum noise levels from this type of noise during the day. There is a night time maximum noise criterion of 45dB $L_{Amax(fast)}$ for bedrooms at night in BS8233:2014 and WHO1999. With sound reduction through an open window this would equate to 60dB $L_{Amax(fast)}$ outside a dwelling.

During the daytime, a higher maximum noise level is likely to be permissible but is not stated in any relevant guidance documents. The difference between the daytime and night time equivalent noise criteria in both WHO and BS8233:2014 is 5 decibels, it may therefore be that a 5 decibel increase to the maximum noise level is appropriate.

With the proposed acoustic barriers, the predicted maximum noise levels from voice, whistles and ball impacts are within the criteria of 65dB $L_{Amax(fast)}$ externally and thus, considered acceptable.

10. Noise Management Plan

The assessment undertaken in this report considers noise levels against relevant criteria to avoid an adverse effect on nearby residential properties.

In addition to the level of noise, it is also important to consider the content. From experience, we have found that where complaints have been made it is often due to anti-social behaviour such as swearing. Anti-social behaviour is not necessarily related to the noise level and is something that cannot effectively be 'engineered out'.

As such, it is proposed that a noise management plan is implemented as part of the development.

The noise management plan should include a method of informing the users that swearing and anti-social behaviour is unacceptable and that the centre reserves the right to dismiss users from the pitch and ban future use if this is the case.

It is advised that neighbours are given a facility to report excessive noise or anti-social behaviour directly to the operator. This will allow the complaint to be investigated and addressed quickly.

It is important that complaints are investigated swiftly, that action is taken where necessary and that the complainant is kept informed of progress, especially where it is not possible to address or resolve complaints straight away.

Staff at the site should have a written action plan to deal with complaints. This would include the ability to warn or ban user groups from the pitches. A log of complaints should also be kept.

It is also advised that all perimeter fencing is fixed to the support posts with a neoprene isolator installed to fully isolate the panels from the posts. This measure greatly reduces the 'rattling' associated with ball impacts on metal fencing.

11. Summary and Conclusions

Surfacing Standards Limited appointed Acoustic Consultants Limited to undertake an environmental noise assessment for the proposed new artificial grass pitch (AGP) located at Ryburn Valley High School, Sowery Bridge. The assessment considered the impact of environmental noise on the nearby noise-sensitive residential properties.

The proposed hours of use are 08:00-22:00 Monday to Friday and 08:00-18:00 Saturday and Sunday. The nearest noise sensitive residential receivers in respect to the proposed AGP are understood to be the dwellings to the east of the proposed AGP.

The assessment includes the prediction of noise emission from the proposed AGP at the nearby noise-sensitive properties, based on noise level data from activities measured at existing AGPs.

Noise levels were measured at nine sports sessions on four separate AGPs. The measurements included football, hockey and rugby, with men, women and children participating in different sessions. The purpose of the measurements was to determine a 'typical' noise level for an AGP sports session.

A noise model has been generated of the development site, utilising these previous measurements as its basis.

Noise mitigation barriers have been proposed to achieve noise levels within the criteria. The barriers should be 2m high to the south and 1.8m high to the north, be close boarded with no gaps, and have a minimum surface mass of 10kg/m^2.

With the barriers, the highest predicted noise level from the proposed AGP is 47 dB $L_{Aeq\ (1\ hour)}$ at the façade of the nearest noise sensitive receivers.

The predicted noise level is below proposed criterion of 50 dB $L_{Aeq\ (1\ hour)}$ derived from WHO 1999 as being the threshold for the onset of moderate community annoyance.

The World Health Organisation provides a sound reduction through an open window of 15 dB(A) which results in a predicted internal equivalent noise level of 32 dB $L_{Aeq\ (1\ hour)}$) at the NSRs.

The predicted noise level in the gardens is within the proposed criterion of 50 dB $L_{Aeq\ (1\ hour)}$.

The predicted maximum noise levels from voice, whistles and ball impacts are within the criteria and are thus considered acceptable.

When compared to the existing noise climate, the proposed artificial pitch would lead to a 'negligible' impact on the existing noise climate.

With regards to planning policy, we would expect that the development would potentially be noticeable but not intrusive and would result in 'no observed adverse effect'. This is defined in the NPPG as 'Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life'.

Based on the above, the proposals are considered acceptable in terms of noise.

12. Appendix 1 – Glossary of Acoustic Terminology

A-weighted sound pressure pA – value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network.

A-weighted sound pressure level, L_{pA} - quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$L_{pA} = 10 \log_{10} (p_A/p_0)^2$

where:

p_A is the A-weighted sound pressure in pascals (Pa);
p_0 is the reference sound pressure (20 µPa)

Background sound level, $L_{A90,T}$– A-weighted sound pressure level that is exceeded by the residual sound assessment location for 90% of a given time interval, T, measured using weighting F and quoted to the nearest whole number of decibels

Break-in - noise transmission into a structure from outside.

Decibel (dB) – The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t2 – t1, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{AeqT} = 10\lg_{10}\left\{(1/T)\int_{t_1}^{t_2}[p_A(t)^2/p_0^2]dt\right\} \quad (1)$$

where:

p_0 is the reference sound pressure (20 µPa); and
$p_A(t)$ is the instantaneous A-weighted sound pressure (Pa) at time t

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

Facade level – sound pressure level 1 m in front of the façade. Facade level measurements of L_{pA} are typically 1 dB to 3 dB higher than corresponding free-field measurements because of the reflection from the facade.

Free-field level – sound pressure level away from reflecting surfaces. Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source).

Octave and Third Octave Bands – The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example, third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

Sound pressure level – Sound pressure level is stated on many of the charts. It is the amplitude of the acoustic pressure fluctuations in a sound wave, fundamentally measured in Pascals (Pa), typically from 20 micro-Pascals to 100 Pascals, but commonly simplified onto the decibel scale.

Sound reduction index, R – laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

Specific sound level, $L_s = L_{Aeq,Tr}$ – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.

Structure-borne noise – audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements.

Rating level, $L_{Ar,Tr}$ – Specific sound level plus any adjustment for the characteristic features of the sound.

Reverberation Time, T – The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level once the noise source has stopped. It is measured in seconds. Often a 60 dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60 dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20 dB decay multiplied by three) and T30 (time taken for a 30 dB decay multiplied by two).

Vibration Dose Value, VDV – measure of the total vibration experienced over a specified period of time.

Estimated Vibration Dose Value, eVDV – estimation of the total vibration experienced over a specified period of time. This is usually based on the number of events and shortened measurement data.

Weighted sound reduction index, R_w – Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory (see BS EN ISO 717-1).

Head Office: 194 West Street, Bedminster, Bristol, BS3 3NB
T: 0117 986 2956

www.acoustic-ltd.co.uk

Registered Office: 194 West St, Bristol, BS3 3NB Registered No: 8544901