ACOUSTIC CONSULTANTS LTD

Proposed Artificial Grass Pitch
Fleet Primary School, Camden

Noise Impact Assessment

Reference: 7116/DO
April 2018

Proposed Artificial Grass Pitch
Fleet Primary School, Camden

Noise Impact Assessment

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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 Fleet Primary School in Camden. The assessment considered the impact of environmental noise on the nearby noise-sensitive residential properties.

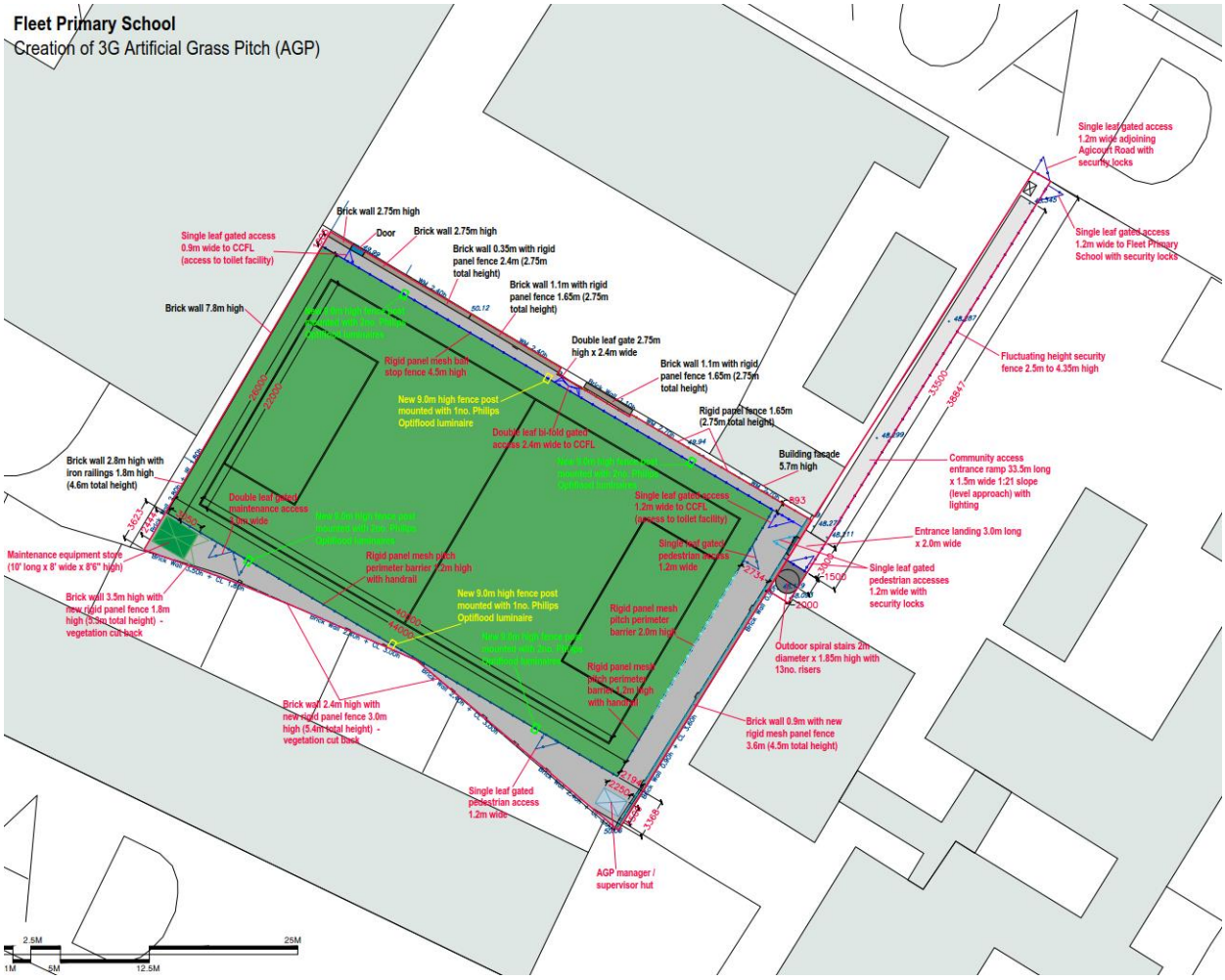
The assessment includes the prediction of noise emission from the AGP at the nearby noise-sensitive properties, based on noise level data from activities measured at existing AGPs. The predicted noise level is compared to current relevant noise guidance.

This report includes the findings of a site noise survey and assesses the impact of noise based on a number of methodologies and measurement parameters considered appropriate for this type of noise and activity.

2. The Site

The proposal is to resurface the existing playground to form a new floodlit on the school site. The nearest noise sensitive receivers to the proposed AGP are the residential dwellings to the South on Fleet Road, these are approximately 10 metres from the pitch with gardens bordering the site boundary. The proposed hours of use are until 21:00 hours Monday to Friday and until 16:00 hours on weekends and bank holidays. The proposed site is shown on Figure 1 below:

Figure 1: Proposed site plan



3. Planning and Noise

3.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) was published in March 2012 and replaces the withdrawn Planning Policy Guidance Document 24 entitled 'Planning and Noise'. Section 11 entitled 'Conserving and enhancing the natural environment' addresses noise as a requirement of planning.

Paragraph 109 states:

"109. The planning system should contribute to and enhance the natural and local environment by:

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

Paragraph 123 states:

"123. Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

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 and 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 as 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 (January 2015) 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
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and 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 which 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 where reduced to a minimum 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 1 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 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 L_{Aeq}.

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 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 development 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. British Standard 8233:2014 Guidance on sound insulation and noise reduction for buildings

British Standard 8233:2014 entitled 'Guidance on sound insulation and noise reduction for buildings' came into effect on 28th February 2014 and supersedes British Standard 8233:1999.

Table 4 of the British Standard provides internal ambient noise levels for dwellings from noise sources 'without a specific character' and are based on existing guidelines issued by the World Health Organisation in 1999. The British Standard provides no definition of noise 'without a specific character'.

No reference of guidance on sporting uses is given in the British Standard, unlike the WHO Guidelines. As such we propose that the definition of community noise is applicable to the proposed noise limits. The British Standard 8233:2014 provides the same guidance levels as the World Health Organisation document.

4.3. British Standard 4142:2014

The British Standard 4142:2014 entitled 'Method for rating and assessing industrial and commercial sound' was published on the 31st October 2014 and replaced British Standard 4142:1997. British Standard 4142:2014 describes methods for rating and assessing sound of an industrial and/or commercial nature by comparing the Rating level of the noise under assessment against the Background Noise Level.

Within section 1 'Scope', paragraph 1.3 states:

"The standard is not intended to be applied to the rating and assessment of sound from:

a) recreational activities, including all forms of motorsport."

Whilst a comparison with Background Noise Levels could be undertaken, there is no way of determining the impact on noise-sensitive properties or the likelihood of complaints from this noise type. It is therefore not considered appropriate to use the British Standard for the assessment of this type of activity and clearly should not be used.

4.4. Comparative Assessment

The criterion 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 & Assessment (IEMA) new Guidelines on Environmental Noise Impact Assessment set out key principles and advice on how to effectively integrate noise impacts and effects into the consenting process of all types of development. The significant of changes in noise levels from the IEMA guidelines is summarised below:

Table 3: IEMA Noise Level Changes

Noise Change (dB)	Category
0	No Change
0 – 2.9	Neglible
3.0 –5.9	Minor
6.0 –9.9	Moderate
10.0 and more	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 is the LAeq(T) parameter over the same time period, T.

4.5. Proposed Assessment Methodology

It is proposed to assess the development against the WHO guidelines. 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'.

It is considered that where the proposal exceeds the WHO guidelines but does not increase the existing evening noise climate by more than 3 decibels there will be no adverse impact on the nearby noise sensitive residential properties and by more than 3-6 decibels there will be no significant adverse impact on the nearby noise sensitive residential properties. It is our opinion that this would also fall within the Lowest Observed Adverse Effect Level of the NPPG.

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.

5. Noise Levels of AGP Use

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.

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. Whilst the dimensions of the pitch are different from a full size AGP we consider this is still a reasonable representative of the noise generated.

The following table summarises the measurement data undertaken.

Table 4: 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 *

* During these measurements, noise levels were measured 10 metres from the halfway line (stated noise level) and 10 metres behind the goal line. The measured noise levels behind the goal line were at least 15 decibels lower than those measured at the half way line.

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

5.1. 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 5: 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 2: 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 first 30 minutes exercise and running drills without sticks or balls. The most significant noised 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 6: 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

5.2. 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 7: 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 3: 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 8: 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

6. Site Noise Monitoring

A 24 hour site noise survey was undertaken at a monitoring location representative of the noise sensitive properties commencing at 12:01 hours on the 25th April 2017. The purpose of the site survey was to determine the existing noise climate at locations close to the nearby residential properties during the evening hours of proposed operation.

The measurements were undertaken generally in accordance with British Standard 7445. The main source of noise at this time was road traffic along Fleet Road and other more distant road traffic, during school hours noise was determined by pupils using the payground.

Sound pressure levels were measured using a Class 1 sound level meter, 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 17025:2005, and in accordance with British Standard EN 10012:2003, and traceable to the National Standards.

This equipment was checked and calibrated as noted below and the certificates are available for inspection. Table 5 provides the equipment and calibration status.

Table 9: Equipment and Calibration Status

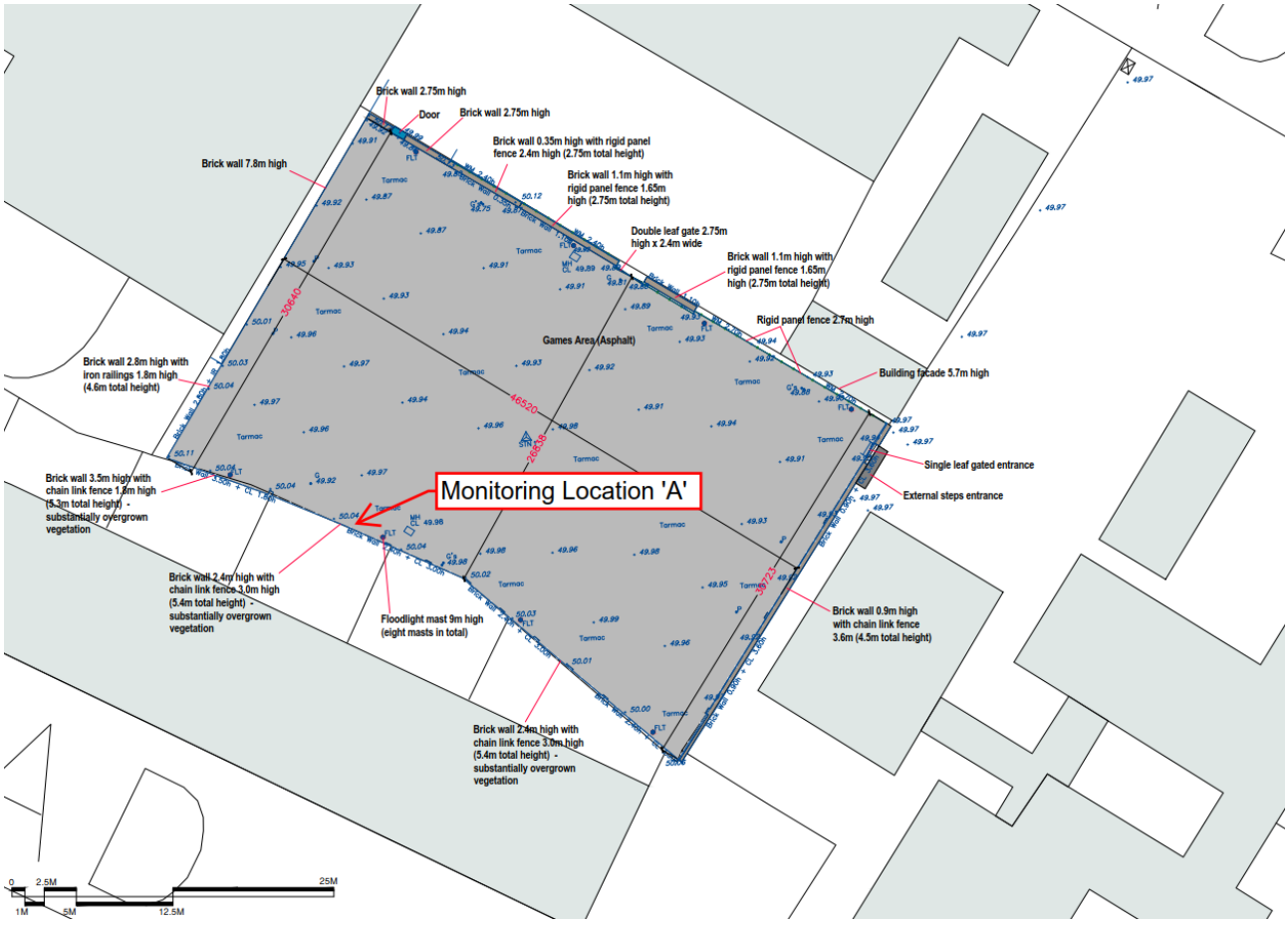
Equipment Description / Manufacturer / Type	Serial number	Date of calibration	Calibration Certification Number
NTI XL2 Sound Level Meter	A2A-09705-E0	04/09/2017	15284
NTI MA220 Pre-Amp	5332	04/09/2017	15284
NTI Microphone Capsule	A14374	04/09/2017	15284
Calibrator, CEL, Type 284/2	3/02716829	04/09/2017	15283

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

The weather conditions throughout the survey were dry, with an air temperature of 12-14 degrees Celsius, full cloud cover and an easterly wind of 3-5 metres per second.

At monitoring location A, the equipment was set up in a free-field position on top of the existing brick wall, at an approximate height of 3 metres. The monitoring location is shown below on Figure 4.

Figure 4: Monitoring Location – site monitoring



The following graph and table provides the measured noise levels.

Table 10: Measured Noise Levels

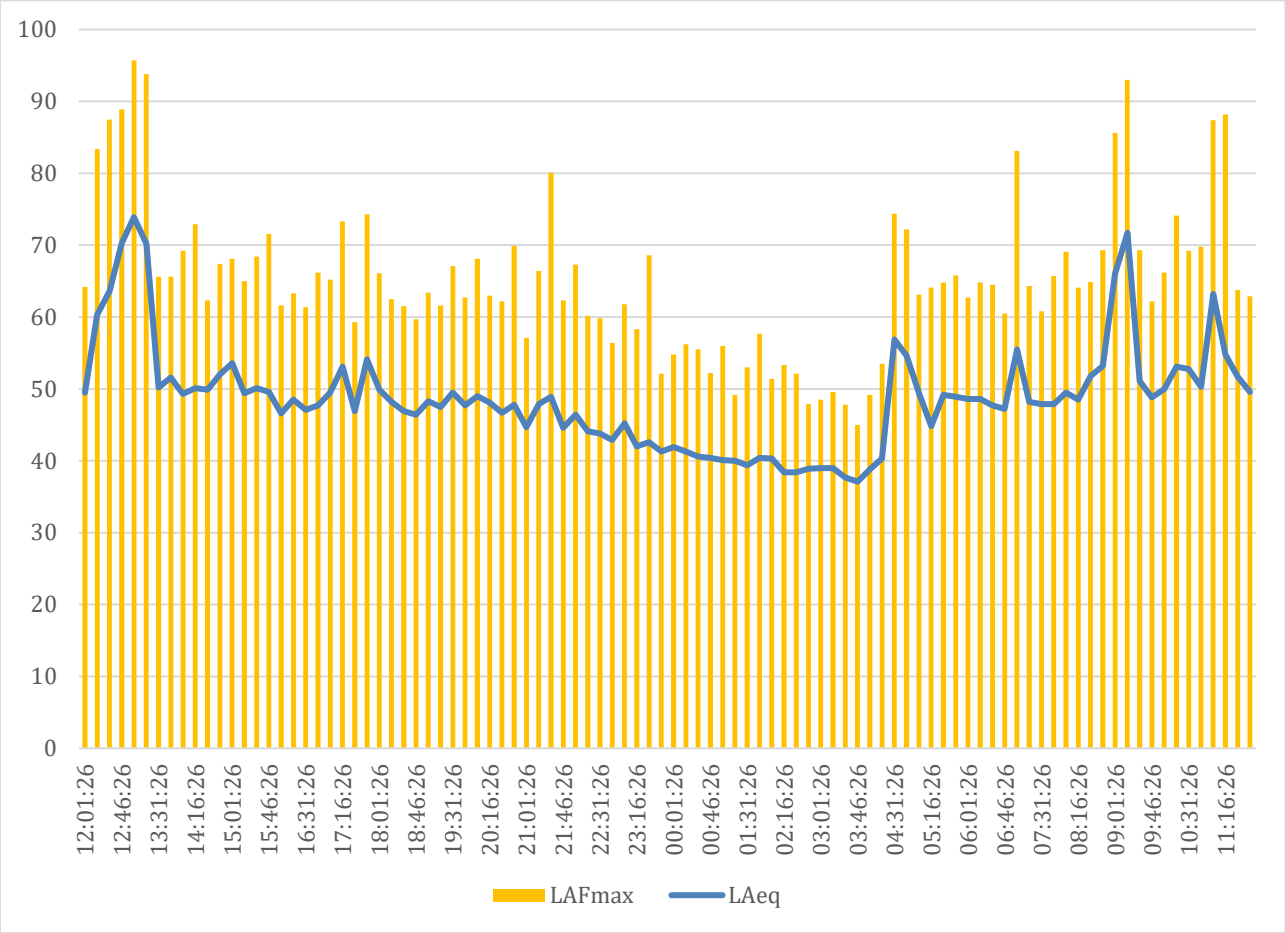


Table 11: Hourly evening measured noise levels

Start Time	$L_{Aeq,1\ hour}$ dB	$L_{Amax,fast}$ dB
16.00	48	66
17.00	52	74
18.00	48	66
19.00	48	67
20.00	48	70

Based on the measured data a typical noise level for the area during the proposed evening hours of operation is 48dB $L_{Aeq,1\ hour}$.

7. Noise Modelling Methodology

The measured AGP noise emission data have 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 4 shows the noise propagation of an area source created from thirty moving point sources. The second noise map (Figure 5) shows the noise propagation of thirty individual point sources spread across the playing surface.

Figure 5: Noise model using an area source

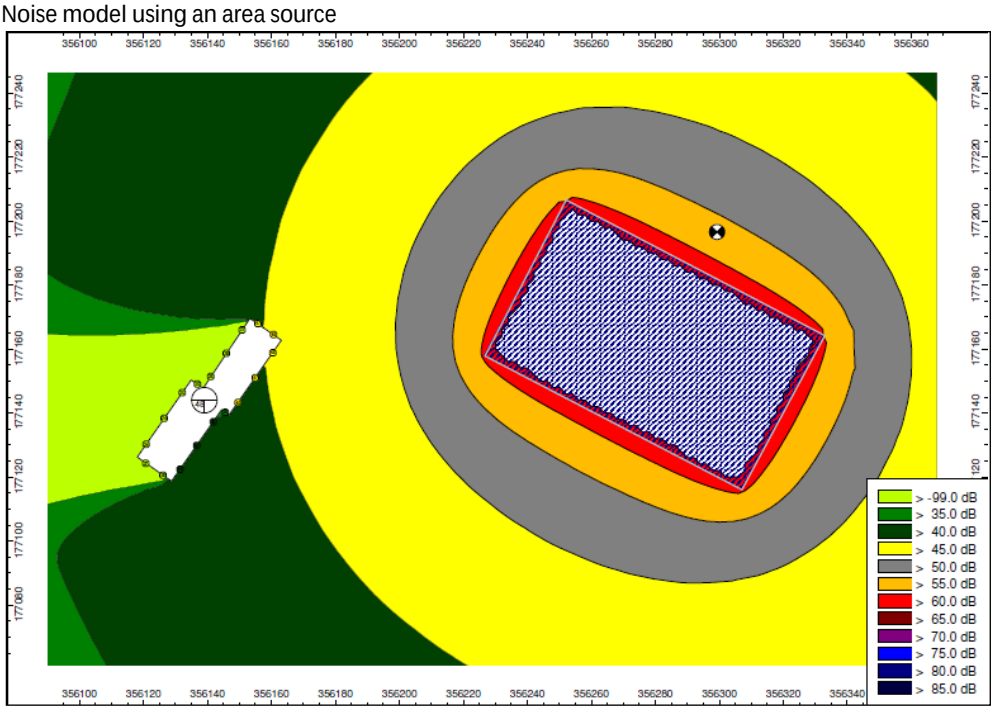
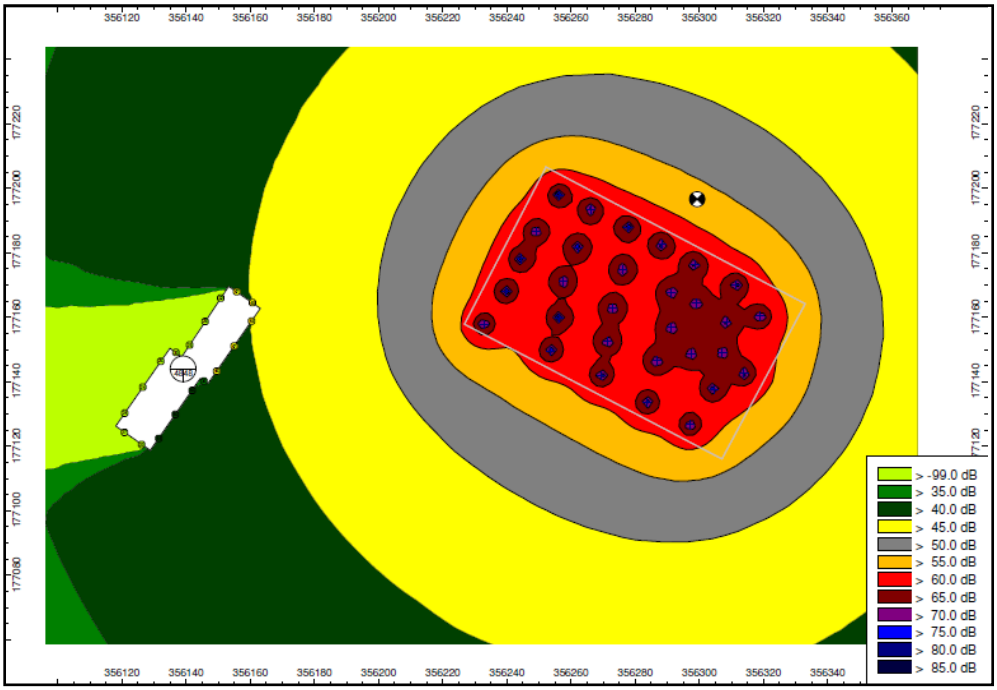


Figure 6: Noise model using point sources



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 Surfacing Standards Limited Proposed AGP Plan drawing (SS2123 05 Revision 01).

The ground is considered to be 'hard' surfaces, where a ground absorption of zero has been assumed.

Residential and non-residential buildings in the vicinity of the playing fields have been built within the model as have the existing brick walls around the pitch. The height of these has been determined from the dimensions stated on the drawings.

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 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.

Noise maps show noise emission from the AGP 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.

9. AGP Predicted Noise Levels

The following figure shows the predicted noise emission from the proposed AGP. Residential noise sensitive receivers are marked in orange. The 4.5 metre high barrier is marked in red.

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

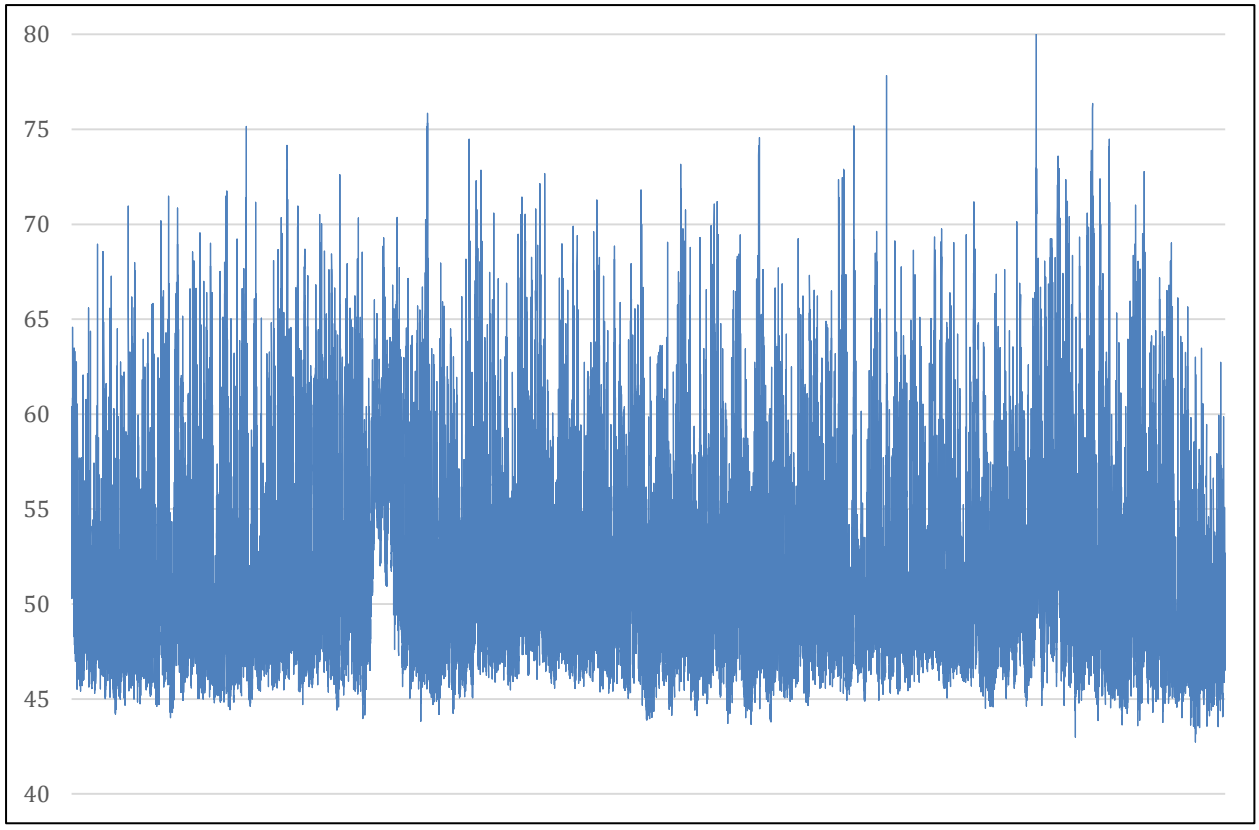
The highest predicted noise level at the ground floor façade and in the garden of a residential properties is 54 dB $L_{Aeq\ (1\ hour)}$.

10. Maximum Noise Levels

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 history of maximum noise levels



The maximum noise levels are typically in the range of 70-75 dB(A). This does not include any sound reduction that would be afforded by the acoustic barrier proposed.

It is not possible to accurately undertake a prediction for a maximum noise level in the same was 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 from the impact of ball on fence.

10.1. Noise from Voice

If we consider the maximum noise level from voice, a typical level of shouting is in the order of 85dB(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. The predicted maximum noise level is on the order of 60dB $L_{Amax(fast)}$ at the nearby noise sensitive residential properties.

10.2. 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 LAmax(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. The predicted highest maximum noise level from the highest individual source location 78 dB LAmax(fast) at the nearby noise sensitive residential properties.

10.3. 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 isloatros are located between the panels and the posts.

A noise monitoring exercise was undertaken on the 29th October 2014 at the headquarters of Gloucestershire Football Association in Thornbury near Bristol. The purpose of the noise survey was to measure the maximum noise level generated as footballs impact upon the perimeter fencing.

The sound level meter was placed on a tripod 1.5 metres above the ground in a free field position 5 metres behind the fencing on hard ground. A football was repeatedly kicked against the fence at distances ranging from 3 metres to 15 metres with a combination of striking and passing the ball against the fence. The image below shows the measurement set up.

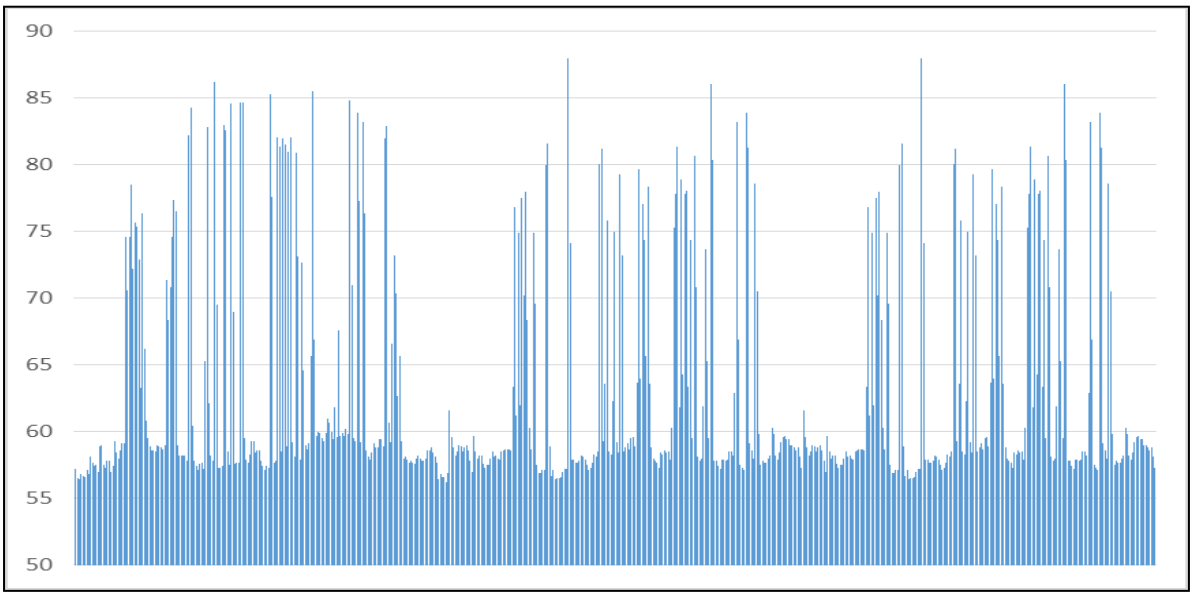
Figure 9: Impact noise measurement arrangement

The most significant impact noise is generated by the vibrating panel rattling against the post when the panel is struck by the ball. The fence comprises welded mesh panels fixed between metal uprights. A neoprene washer is located between the panel and the post to reduce this rattling. The image below shows the fixing between panel and post with the washer in place. It is proposed that the same fixing method, including the washer is used at the proposed site.

Figure 10: Image showing neoprene isolators between fence panels and post

The maximum noise level (fast time weighting) was measured every second during the measurement period. Figure 10 shows the measured maximum noise levels in a free field position, 5 metres from the fence.

Figure 11: Measured maximum noise levels 5 metres from fence



From the measurement data a typical impact noise level is considered to be 85 dB $L_{Amax(fast)}$ and the highest measured level being 88 dB $L_{Amax(fast)}$. From the measurement data a typical impact noise level is considered to be 85 dB $L_{Amax(fast)}$.

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. The highest predicted maximum noise level with the current proposal is 80dB LAmax (fast).

11. AGP Noise Assessment

The predicted noise level within the gardens and at the façades of the nearest noise-sensitive property is 54dB $L_{Aeq\ (1\ hour)}$. This exceeds the proposed noise limiting criteria based on WHO by 4 decibels.

The lowest measured noise level typical of the existing noise climate at the nearby noise sensitive properties was also 48 dB $L_{Aeq(1\ hour)}$ during the proposed operation. The cumulative noise level due to noise from the proposed AGP and the existing noise climate is 55 dB $L_{Aeq(1\ hour)}$ resulting in an increase of 6 decibels. According to the IEMA guidelines this in a 'moderate' change.

We are not aware of any noise criteria for maximum noise levels during the day. There is night time maximum noise criteria of 45dB LAmax(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 65dB $L_{Amax(fast)}$ outside a dwelling window may be appropriate for daytime use.

The predicted noise levels from voice fall within this criteria although that from fence impact and whistle does exceed it.

On the basis of the above the proposals have potential to generate an Observed adverse effect or Significant Observed Adverse Effect and as such in accordance with national planning policy should be mitigated to a minimum.

The following sections provide advice on noise control measures through design and management to reduce the noise impact to a minimum and to avoid a significant adverse effect.

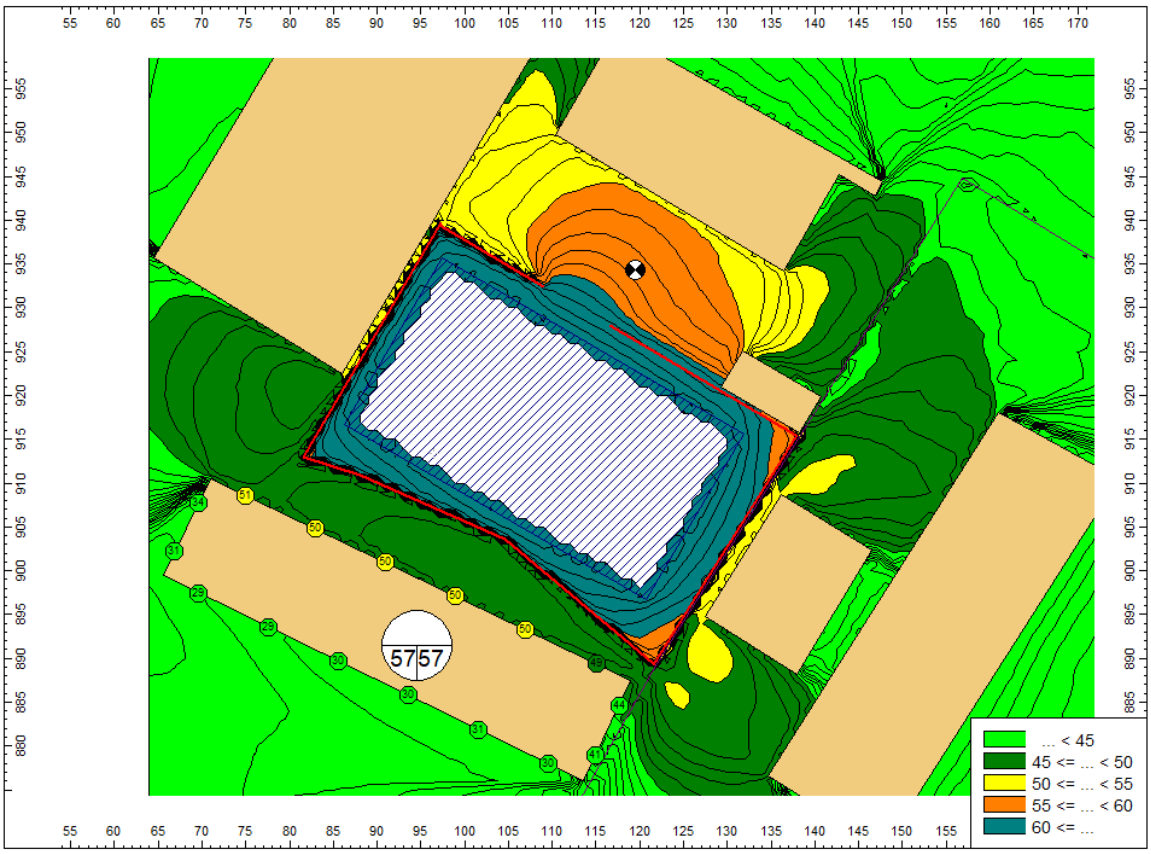
12. Noise Mitigation Measures

To reduce the equivalent noise level from the proposed AGP at the noise sensitive location it is advised that an acoustic barrier is installed along the southern boundary of the site, this could be along the line of the existing wall.

The barrier should have a total height of 4 metres and extend along the entire southern boundary. The barrier should have a surface density of at least 10 kilograms per metre squared with no gaps.

The following figure shows that with the proposed barrier noise levels from the AGP within the gardens of the dwellings falls below the criteria of 50dB $L_{Aeq(1\ hour)}$ with the worst case ground floor façade experiencing a level of 51dB $L_{Aeq(1\ hour)}$ which could be reduced further if deemed necessary by returning the barrier along the western boundary towards the ambulance station.

Figure 12: Predicted equivalent noise levels with proposed acoustic barrier



Noise from whistles will also be reduced by the extended barrier to a level of approximately 70dB $L_{Amax(fast)}$. This is a significant reduction but there is potential for an adverse impact from this use. As such we recommend that a no whistle policy is applied to the site after an agreed time, for example 19:00 hours. This could be enforced via a planning condition, the planning condition could require a noise management plan to be agreed and enforced by the operator which would include the no whistle policy. The noise management plan would be a live document which could be altered by agreement to address noise complaints when the site is operating and thus gives a degree of control to the local authority which is potentially easier and more effective than noise abatement.

With the proposed barrier height the proposed weld mesh fencing will be higher and visible to the residential properties. To reduce noise from fence impacts the acoustic barrier could be extended in height so it is 0.5 metres higher that the weld mesh fencing. This would result in maximum noise levels of 64-66dB $L_{Amax(fast)}$ at the ground floor facades of the dwellings.

If a barrier of such a height was not feasible or permissible then the fence type could be changed from the standard 868 type panels. There are other fencing types which use different fixing methods to stop the panels rattling against each other and more rigid fence panels. These can result in lower noise levels from ball impacts.

A test report prepared for VICA S.L (no longer trading) assessed the difference in noise level between the standard 868 fencing and proprietary panel types by firing a football at the panels from a ball cannon. The results show that their Premier and Primary sports fencing gives a maximum noise level 8 decibels lower than the standard 868. Other manufacturers such as Lightmain Limited and Reech Sports provide similar products which are claimed to provide the same sound reduction.

On the basis of the test data, if the Primary or Premier fencing was used the predicted maximum noise level would be 73dB $L_{Amax(fast)}$.

13. Assessment of Noise Mitigation Measures

The proposed noise mitigation measures reduce noise from the proposed AGP and include an acoustic barrier, no whistle policy and potentially a different fence type.

With the proposed measures the predicted noise level within the gardens and at the ground floor façades of the nearest noise-sensitive property is 50dB $L_{Aeq\ (1\ hour)}$. The predicted noise level falls below the one hour equivalent noise level criteria based on WHO 1999 guidelines at which moderate community annoyance can start to occur.

The World Health Organisation provides a sound reduction through an open window of 15 dB(A) which results in an internal equivalent noise level of no more than 35 dB $L_{Aeq\ (1\ hour)}$.

The World Health Organisation guidance states *"To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB LAeq."* British Standard 8233:2014 provides the same noise criteria for a bedroom during the daytime period.

The lowest measured noise level typical of the existing noise climate at the nearby noise sensitive properties was also 48 dB $L_{Aeq(1\ hour)}$ during the proposed operation. The cumulative noise level due to noise from the proposed AGP and the existing noise climate is 52 dB $L_{Aeq(1\ hour)}$ resulting in an increase of 4 decibels. According to the IEMA guidelines this in a 'minor' change.

Maximum noise levels from voice are expected to be adequately controlled and with a no whistle policy after an agreed time noise from whistles will also be acceptably controlled.

Maximum noise levels from fence impact can be adequately controlled with a higher acoustic fence, if this is not possible then the noise impact can be mitigated to a minimum by changing the type of fence. We would also point out that the fence nearest the houses is along the side of the pitch and therefore is unlikely to be hit very often during games being played.

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"*.

The proposed noise mitigation measures also mitigate the noise to a minimum in accordance with national planning policy guidance.

The hours of use are into the early evening, we consider that the ground floor daytime habitable rooms are shielded from noise by the proposals, at higher points on the buildings the noise levels will be higher due to the reduced barrier correction.

On the above basis, with the noise mitigation measures proposed, the proposal is considered acceptable in environmental noise terms. Noise emission is adequately controlled at the nearby residential properties and the proposed noise mitigation measures mitigates the noise to a minimum in accordance with national planning policy guidance.

14. 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 past 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 sports centre. 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 school 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.

15. Limitations

The report limits itself to addressing solely on the environmental noise aspects as included herein. We provide advice only in relation to noise 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.

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.

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. If this tolerance is not acceptable, then it would be necessary to consider further measures.

16. 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 Fleet Primary School in Camden. 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. The predicted noise level is compared to current relevant noise guidance.

This report includes the findings of a site noise survey and assesses the impact of noise based on a number of methodologies and measurement parameters considered appropriate for this type of noise and activity.

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 to predict noise levels at nearby residential properties. The proposals have potential to generate an Observed adverse effect or Significant Observed Adverse Effect and as such in accordance with national planning policy should be mitigated to a minimum.

A number of noise mitigation measures have been proposed both in terms of design and management. With the noise mitigation measures proposed, the proposal is considered acceptable in environmental noise terms. Noise emission is controlled at the nearby residential properties and the proposed noise mitigation measures mitigates the noise to a minimum in accordance with national planning policy guidance.

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