



CSP Acoustics

NOISE IMPACT ASSESSMENT

Proposed Leisure Development,
Seaton Park, Arbroath

Prepared for:


Voigt Partnership Limited

Per:

Mr. Jonathon Reeve

Ref: 1073 003 PR V1

Date: 7th March 2017



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1.00 Introduction

- 1.01 This Report has been prepared by CSP Acoustics on behalf of Voight Partnership Limited to support Planning application Ref No. 16/00074/FULL.
- 1.02 It considers the impact of noise from a Leisure Development on the nearest residential properties. The Leisure Development is to be built at Seaton Park, Arbroath.
- 1.03 Details of the development are shown on drawings prepared by Voight Partnership Limited and are shown in Appendix A in the end of this report and includes an All Weather Synthetic Football Pitch and Warm-Up area.
- 1.04 The predictions within the report are based on the results of an on-site survey, CSP historical noise measurements of sports matches on Synthetic Grass Pitches (SGP's). Analysis of noise impact from activities within the proposed football pitches on residential properties has been completed using a proprietary noise prediction software CadnaA[®] (computer Aided Noise Abatement) developed by Datakustik.



CSPAcoustics

1.05 All CSP Acoustics Consultants/Surveyors hold membership of the Institute of Acoustics.

CSP Acoustics:

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2.00 Summary

- 2.01 CSP Acoustics has completed a noise impact assessment for a proposed development to be constructed on Site 6, Waterfront, Dundee. The development will include two residential buildings, a hotel, offices and commercial/retail accommodation.
- 2.02 This Report has been prepared by CSP Acoustics on behalf of Voight Partnership Limited to support Planning application Ref No. 16/00074/FULL.
- 2.03 It is proposed to build a new Leisure Development at the existing Seaton Park, Arbroath. This will consist of synthetic football pitches and warm up area. The assessment has determined the impact of the proposed development on nearby residential buildings.
- 2.04 The impact of sports noise from the proposed development on the nearest residential properties, has been assessed using the proprietary noise prediction software CadnaA[®] and the general methods of calculation set out in ISO 9613.
- 2.05 Quantitative and qualitative assessments suggests that noise from the Sport Pitch Development is likely to result in acceptable levels of noise impact at dwellings to the north and west. Sport Pitch noise at dwellings to the south and east are likely to result in unacceptable levels of impact and mitigation measures will be required in the development design to reduce this.
- 2.06 It is recommended that predicted sports pitch noise levels should be reduced by the introduction of a noise control barrier located at the south and east boundary of the proposed development site, as indicated in figure 2 of this report.
- 2.07 With the barrier in place, sports pitch noise levels will be reduced at dwellings. The magnitude and significance of impact for this scenario is set out in Table 1 and 2 below. The results of the assessment is shown in more details in the Appendix D and Appendix E of this report:

| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
|---|-----------------|-----------------|----------------|----------------|
| Sport pitch Noise Level $L_{Aeq,1hr}$ (dB) | 50.7 | 41 | 43.3 | 49.8 |
| Impulsivity correction (dB) | +6 | +6 | +6 | +6 |
| Rating level (dB) | 56.7 | 47.0 | 49.3 | 55.8 |
| Background Noise $L_{A90,1hr}$ (dB) | 42.5 | 39.4 | 39.4 | 42.5 |
| Level above or below background (dB) | +14.2 | +7.6 | +9.9 | +13.3 |

2.08 In accordance with TAN, the sensitivity of the nearest dwellings is medium to high. Magnitude and significance assessments have been prepared in accordance with the TAN to PAN 1/2011 by determining the likely increase in the ambient noise level, L_{Aeq} , due to Sport Pitches operating at the proposed Leisure development and the recommended barrier in place as follows:

| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
|---|-----------------|-----------------|-----------------|----------------|
| Existing ambient noise level at t dwellings L_{Aeq} | 57 | 42 | 42 | 57 |
| sports pitch noise level at dwelling façade L_{Aeq} | 50.7 | 41 | 43.3 | 49.8 |
| sports pitch Noise level at dwelling + existing ambient L_{Aeq} | 57.9 | 44.5 | 45.7 | 57.8 |
| Change in Noise Level | +0.9 | +2.5 | +3.7 | +0.8 |
| Sensitivity of receptor | High | Medium | Medium | High |
| Magnitude of impact | Negligible | Minor | Moderate | Negligible |
| Significance of Impact | Slight | Slight | Moderate | Slight |

2.09 The assessment indicates that where noise barriers are introduced to the proposed development site then the significance of impact of noise from the development is reduced to Slight / Moderate at all properties. TAN notes that where a "Slight/ moderate" significance of impact occurs then:

"Slight: These effects may be raised but are unlikely to be of importance in the decision making process"

"Moderate: These effects, if adverse, while important, are not likely to be key decision making issues."

2.10 Additional calculations have been completed to determine the potential impact of players on pitches moving further away from barriers in terms of noise reduction. The calculations suggests that the variability of noise source (player) location and distance with respect to the noise barriers proposed for sports pitch results in either no change or a marginal change in the Significance of Impacts determined above.

2.11 Calculations indicated that noise levels arising in gardens, from the operation of the Workshop and Yard, are no more than the WHO guidance limit of 55 dB $L_{Aeq,16hr}$. It should be noted that existing noise levels at site exceed this limit.

2.12 TAN descriptions set out above indicate that noise should not be a key issue in determining the grant of planning permission.

3.00 Impact Assessment Criteria

3.01 The Scottish Office Development Department issued SODD Circular 10/1999 and the associated Planning Advice Note - PAN 56 - "Planning and Noise" in April 1999. In March 2011 the Scottish Government issued PAN1/2011 "Planning and Noise" and an associated Technical Advice Note which replaces PAN 56.

3.02 **PAN 1/2011:** The Planning Advice Note recommends the use of Quantitative and Qualitative assessments of road traffic noise together with assessments of the level of its significance to help planning authorities determine applications for residential development on sites subject to noise from roads, rail, air and mixed transportation noise. The PAN and its accompanying Technical Advice Note do not however offer significant guidance with respect to the standards to be applied in assessments of noise impact.

The Technical Advice Note that accompanies the PAN in Chapter 3, para 3.8 states that: "The choice of appropriate criteria noise levels and relevant time periods are the responsibility of the local authority. Although this may lead to inconsistencies between different Local Authorities and, indeed, across areas within a given Local Authority, it does provide flexibility, allowing particular circumstances to be taken into account and the use of the latest guideline values to be included where appropriate."

3.03 The PAN also notes, in Appendix 1, a range of Technical Standards and Codes of Practice that may be relevant to assessments including BS4142 which can be used for assessing the impact (in terms of likelihood of complaint) of industrial development, BS 8233 which provides general guidance on acceptable levels within buildings and WHO "Guidelines for Community Noise, 1999" et alia.

The Technical Advice Note, for illustrative purposes, cites WHO guidelines for quantitative assessment of daytime and night-time noise with external free-field façade levels as noted below:

| | | |
|-----------------------|-------------|--------------------|
| Road Traffic | 0700 – 2300 | 55dB $L_{Aeq,16h}$ |
| Noise in $L_{Aeq}(t)$ | 2300 – 0700 | 45dB, $L_{Aeq,8h}$ |

These levels can be used to assess the need for amelioration of road traffic noise.

3.04 BS 8233: 2014: "Guidance on sound insulation and noise reduction for buildings"

This document establishes basic criteria for dwellings as follows:

| | | | |
|-------------------------|--------------|-----------------------|------------|
| Criteria for Dwellings: | Living Rooms | 35dB, $L_{Aeq,16hrs}$ | Daytime |
| | Dining Rooms | 40dB, $L_{Aeq,16hrs}$ | Daytime |
| | Bedrooms | 35dB, $L_{Aeq,16hrs}$ | Daytime |
| | Bedrooms | 30dB, $L_{Aeq,8hrs}$ | Night-time |

- 3.05** World Health Organisation (WHO): From research commissioned to examine community noise the WHO recommends criteria to prevent sleep disturbance of less than 30dB $L_{Aeq,8hr}$ within an affected property subject to a maximum level of 45dB(A) [L_{Amax}] for a limited number of noise events. By assuming a reduction across a slightly open window of 15dB the WHO concluded that external levels should generally not exceed 45dB(A), $L_{Aeq,8hr}$ at 3.5metres from the facade of a dwelling and that occasional external event levels should not exceed 60dB(A) L_{Amax} . (It should be noted that these are free-field values and façade reflection effects will give levels some 3dB(A) higher at 1metre in front of receiving facades).

WHO guidance for daytime levels are for maximum exposure levels of 35dB $L_{Aeq,16hr}$ for indoor living areas (no L_{Amax} limit specified) and maximum exposure levels of 55dB $L_{Aeq,16hr}$ for outdoor living areas (no L_{Amax} limit specified). By assuming a reduction across a window open for ventilation of 15dB the WHO concluded that external levels in relation to indoor use should not exceed 50dB(A), L_{Aeq} at 3.5metres from the facade of a dwelling. (It should be noted that these are free-field values and façade reflection effects will give levels some 3dB(A) higher at 1metre in front of receiving facades).

- 3.06** It is generally taken that the insulation of a partially open window is of the order of 10 to 15dB(A) (Source PPG 24, Planning & Noise and others). With windows shut, or higher specifications of window and ventilation systems, lower internal levels will obtain.

- 3.07** **Angus Council:** Previous discussions with Angus Council established that the WHO and BS8233:2014 limits are typically used for sport pitch noise impact assessments; however, these are more applicable to steady continuous noise. Noise from sports matches is likely to contain ball impacts and shouting, these characteristics are more likely to cause annoyance than steady continuous noise. Accordingly criteria that takes into account the characteristics of the noise should be used.

Angus Council EHO Ms. Wendy ball has advised that Sports Pitch noise impact should be assessed using BS4142: 2014, PAN 1/2011 and accompanying TAN. As the development is expected to be operating into the evening the assessment should cover this period. Achievement of internal limits should be considered with windows open for ventilation.

Angus Council EHO Ms. Wendy ball also advised the following: “The assessment should include noise from balls hitting any physical barriers used around the pitch and used to separate the main pitch into smaller pitches. Consideration should also be given to patron noise”.

4.00 Survey

4.01 According to Voight Partnership Ltd. the development operational hours will be as follows:

- Monday-Friday, 10:00am – 9:00pm;
- Weekends, 9:00am – 7:00am.

4.02 Discussion with Angus Council indicated the lowest occurring ambient noise level at the site of the proposed development is likely to occur at the nearest noise sensitive receptor in the evening period between 8:30pm and 9:30pm and therefore this is the period used for the assessment.

4.03 A noise survey was carried out on the 5th May 2016, between 20:30 and 21:30, using a Norsonic Type 140 Sound Level Meter with associated microphone and calibrator. The equipment was set up and used in accordance with British Standard and ISO procedures.

4.04 The sound level meter was positioned 1.2 metres above ground level and there were no vertical reflecting surfaces within 1 metre of the survey station. Three different measurement locations were used and are shown on figure 1 below. These locations are considered to be representative of the noise climate at the nearest dwellings in relation to the proposed development.

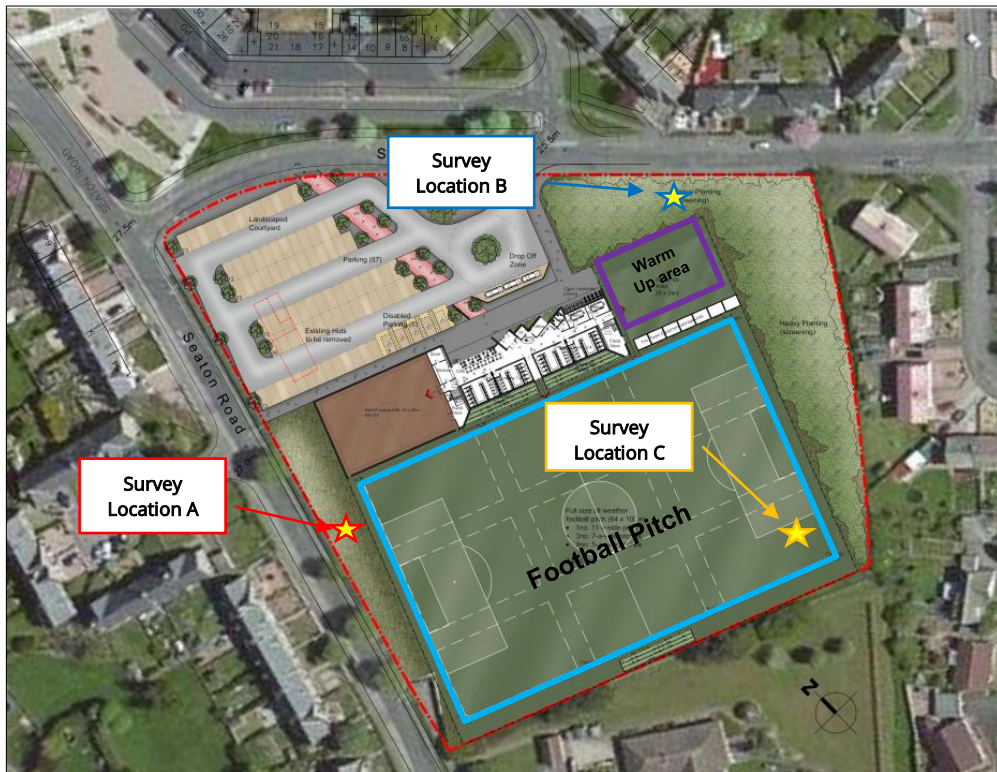


Figure 1 – Site layout and measurement locations

- 4.05 Weather conditions at the time of the survey were noted as follows: wind speed of less than 5m/sec an air temperature of 7 degrees Celsius and no rain with dry roads.
- 4.06 Measured levels were influenced by road traffic noise; Seaton Road and St Ninian’s Road were considered to be the dominant source of noise in the area. Data obtained from the survey is tabulated below:

| Table 3 – Noise measurements near the nearest existent dwelling | | | | |
|---|---------------|-----------------------|-----------------------|-----------------------|
| Location | Time (15 min) | L _{eq} dB(A) | L ₁₀ dB(A) | L ₉₀ dB(A) |
| A | 20:49 | 57.4 | 62.4 | 42.5 |
| B | 21:06 | 56.5 | 59.5 | 42.5 |
| C | 21:22 | 42.8 | 44.4 | 40.1 |
| | 21:37 | 41.3 | 43 | 38.7 |
| Mean (A and B) | - | 57.0 | 60.9 | 42.5 |
| Mean (C) | - | 42.1 | 43.7 | 39.4 |

- 4.07** Survey location A and B were considered to be very similar in terms of noise climate and will be used to assess the residential dwellings located to the west and north side of the proposed development. Survey location C will be used to assess the residential dwellings located to the south and east side of the proposed development.

5.00 Synthetic Grass Pitch Noise: Quantitative Assessment

5.01 Noise issues can arise from use of Sports Fields mainly due to calling / shouting between players and from balls hitting screens / netting etc. CSP Acoustics has completed a series of surveys of matches, intensive training sessions, casual matches and casual training sessions in the East of Scotland covering the most typical Synthetic Grass Pitch (SGP) based sports, including football, rugby and hockey. These measurements also include the noise of balls hitting pitch fences, shouting from players and small crowds watching games/training sessions. Measurements were carried out at a standardised distance of 10 metres from the edge of the pitches, on the centre-line of the length and width of the pitches and remote from reflecting surfaces (other than the ground). Where training exercises took place within one half or one quarter of the pitch, then measurements were taken at 10 metres from the edge of that section. Measurements were conducted when where other sources of noise were low and therefore unlikely to influence measured noise levels of the sports activities.

5.02 The table below summarises detailed survey results for football match noise, and related activities, from Synthetic Grass Pitches (SGP).

| Table 4 –Survey Results of Football Match Noise from Synthetic Pitches | | | | |
|--|---|-------------------------------|----------------------------|-----------------------------|
| General Description | What was surveyed | Sample duration | Mean L _{Aeq} (dB) | Mean L _{Amax} (dB) |
| Football Training (adults): Generally limited to half a pitch (sometimes a third) with a series of drills and game scenarios. High-intensity drills may involve peaks in volume and will be concentrated into a small area. There is some noise from coaches with instruction and whistling. Before and after training, a group sometimes shoots for goal and more often than not miss which creates some volume of noise from fence impact. | Short sample measurements: Drills and game scenarios concentrated in small spaces: High intense exercises, passing the ball, dribbling the ball, passing the ball warm up exercises. Loudest noise is from players shouting. | 1:05 min; 3:52 min | 67 | 84 |
| | Short sample measurements: Shoot for goal: missing the shoot / hitting the fence shooting average every 10 seconds | 6:54 min | 65 | 89.9 |
| | Continuous measurements: Typical Training noise levels (including all sources above) | 45 min (3x15min) | 63 | 83 |
| Football Training (Youths): Clubs book a full pitch if they have the numbers and can have high volumes of children, coaches, and parents. Younger children are involved in multiple games, youths are involved in some skills training and multiple games. All of this will be taking place at the one time with coaches shouting instructions. | Short sample measurements: Drills and game scenarios concentrated in small spaces; different football attacks and defence exercises made in half football pitch; shooting drill exercise; main noise source to be from coach talking/ encouraging players | 3:14 min; 5:24 min | 54 | 78 |
| | Continuous measurements: Typical Training noise levels | 45 min (3x15min) | 55 | 80 |

| Table 4 –Survey Results of Football Match Noise from Synthetic Pitches | | | | |
|--|--|--|-------------------------------|--------------------------------|
| General Description | What was surveyed | Sample duration | Mean L _{Aeq} (dB) | Mean L _{Amax} (dB) |
| Parents can occasionally be heard over this. There is some noise from coaches with instruction and whistling. Before and after training, a group sometimes shoots for goal and more often than not miss which creates some volume of noise from fence impact. | including warm up exercises, groups spread in multiple areas within the pitch; | | | |
| Football Training (Youths) more than 300 Kids & parents (weekend survey): Same as Football training (youths) | Continuous measurements: Typical Training noise levels including more than 300 kids playing football in multiple small game fields; parents assisting and talking with each other, high intense use | 45 min (3x15min) | 63 | 80 |
| 7 aside football match (group of friends renting a football pitch for one hour): 14 players or more per pitch with 3-4 pitches depending on the setup. The play is not controlled by a referee and this can lead to minor disputes, there is more risk of bad language in this type of use. This use, in particular, will have shooting practice before and after the match. | Continuous measurements: Football pitch used by approx. 14 to 21 amateurs players; a group of people rent half of the pitch during 1 hours to play football; includes occasional shooting against the fence, swearing, minor disputes; this match, in particular, was not considered to be extremely noisy | 6:06 min | 55 | 75 |
| 11 aside adult football match: Typical 11 a side football match with 2 amateurs/ semi-pro team; small crowd assisting the match | Continuous measurements: Typical match noise levels including first and second half time match and warm up shooting goal exercise; shouting was considered to form the predominant source of noise together with minor disputes | 1:11 min (Warm up exercise); 38:42min (1st half); 36.49min (2nd Half) | 59 | 81 |

5.03 Survey measurement data sets out above, is summarized in Table 5 with the range and typical mean of levels given in Table 6:

| Sport | Total Mean L_{Aeq} (dB) | Total Mean L_{Amax} (dB) |
|--|---------------------------|----------------------------|
| Football Training (adult) – Single Events | 66 | 88 |
| Football Training (adult) – Continuous Measurement | 63 | 83 |
| Football Training (Youths) – Singles Events | 54 | 78 |
| Football Training (Youths) more than 300 Kids - Continuous Measurement | 61 | 80 |
| 7 aside football match - Continuous Measurement | 55 | 75 |
| 11 aside football match - Continuous Measurement | 59 | 81 |

| Sport | Total Mean L_{Aeq} (dB) range | Total Mean L_{Amax} (dB) range |
|-------------|---------------------------------|----------------------------------|
| Football | 55 -66 | 75-88 |
| Mean | 61 | 82 |

5.04 From the above carried out survey, it was established that a level of 61dB $L_{Aeq,5min}$ at 10 metres is typically representative of football activity on a SGP. This level will be used in this report to assess the noise from the proposed development. Sport England gives guidance on typical on football match levels in *Artificial Grass Pitches (AGP) Acoustics – Planning Implications New Guidance for 2015*. The document indicates that a free-field noise level of 58 dB $L_{Aeq,1hour}$ at 10 metres from the halfway marker on the side line is typical for sports matches. Consequently this suggests that the mean of 61 dBA at 10 metres determined from CSPA measurements is representative of typical football match noise.

5.05 Noise source location: Consideration has been given to the propagation of noise from sports pitches. In terms of theoretical acoustic sources a sport match on a pitch represents a series of point sources moving within a defined area. The worst case for propagation from a source on the sports pitch to a receiver is considered to be from the nearest pitch boundary, as this will be closest. In addition, where spectators are present then pitch boundaries are typically where they gather. On this basis; pitch boundaries will be used as the source location for sports pitch noise and considered to propagate as a point source.

- 5.06** Calculated Sport Pitches Noise Levels at Nearest Dwellings: The impact of sports noise from the proposed development on the nearest residential properties has been assessed using the proprietary noise prediction software CadnaA and the general methods of calculation set out in ISO 9613.
- 5.07** Receiving point heights representative of the highest floor level of each individual house were used and are understood to be between 1.5 metres and 4.5 metres height above ground. Terrain level height used in the model was considered to be horizontal.
- 5.08** The results of the assessment are summarised below; more detailed information is shown in Appendix D of this report:

| Dwellings Location | Noise Level $L_{Aeq,1hr}$ (dB) | Height above ground (m) |
|--------------------|--------------------------------|-------------------------|
| North | 50.7 | 4.5 |
| South | 53.5 | 1.5 |
| East | 51.4 | 4.5 |
| West | 49.8 | 4.5 |

- 5.09** BS4142: PAN 1/2011 TAN Magnitude and Significance Assessments: The impact of noise levels at the nearest dwellings due to SGP pitch noise activities has been assessed in accordance with BS4142: PAN 1/2011 as follows:

| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
|---|-----------------|-----------------|----------------|----------------|
| Sport Pitch Noise Level $L_{Aeq,1hr}$ (dB) | 50.7 | 53.5 | 51.4 | 49.8 |
| Impulsivity correction (dB) | +6 | +6 | +6 | +6 |
| Rating level (dB) | 56.7 | 59.5 | 57.4 | 55.8 |
| Background Noise $L_{A90,1hr}$ (dB) | 42.5 | 39.4 | 39.4 | 42.5 |
| Level above or below background (dB) | +14.2 | +20.1 | +18 | +13.3 |

5.10 In accordance with TAN, the sensitivity of the nearest dwellings is high. Magnitude and significance assessments have been prepared in accordance with the TAN to PAN 1/2011 by determining the likely increase in the ambient noise level, L_{Aeq} , due to Sport Pitches operating at the proposed Leisure development as follows:

| Table 9: PAN & TAN 1/2011 Assessment | | | | |
|--|-----------------|--------------------|--------------------|----------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Existing ambient noise level at dwellings L_{Aeq} | 57 | 42 | 42 | 57 |
| Sport Pitch noise level at dwelling façade L_{Aeq} | 50.7 | 53.5 | 51.4 | 49.8 |
| Sport Pitch Noise level at dwelling + existing ambient L_{Aeq} | 57.9 | 53.8 | 51.9 | 57.8 |
| Change in Noise Level | +0.9 | +11.8 | +9.9 | +0.8 |
| Sensitivity of receptor | High | High | High | High |
| Magnitude of impact | Negligible | Major | Major | Negligible |
| Significance of Impact | Slight | Large / Very Large | Large / Very Large | Slight |

5.11 **Conclusion 1:** The assessment indicates that where sport activities occur at the proposed development, then an increase of up to 0.9 dB results at dwellings to the north and west resulting in a 'Slight' significant of impact. An increase of up to 11.8dB at dwellings to the south and east are likely and a 'Large/ Very Large' significance of impact results. TAN notes the following with respect to these significances of impact.

"Slight: These effects may be raised but are unlikely to be of importance in the decision making process".

"Large: These effects are likely to be important considerations but where mitigation may be effectively employed such resultant adverse effects are likely to have a Moderate or Slight Significance."

"Very Large: These effects represent key factor in the decision – making process. They are generally, but not exclusively associated with impacts where mitigation is not practical or would be ineffective".

- 5.12 The descriptions given above indicate that noise from the Sport Pitch Development is likely to result in acceptable levels of noise impact at dwellings to the north and west. Sport Pitch noise at dwellings to the south and east are likely to result in unacceptable levels of impact and mitigation measures will be required in the development design to reduce this.

6.00 Synthetic Grass Pitch Noise: Qualitative Assessment

6.01 To take account of the qualitative impact of the proposed sports pitches at Seaton Park the following has been considered.

- Sport match noise includes shouting, calling, ball impact noise etc. are considered impulsive sources of noise occurring intermittently throughout the period of the activity. The influences of these sources of noise are most likely to be captured by maximum noise measurements (L_{Amax}), and noise data of this type will be used to complete this assessment.
- Proposed sports pitches will operate until into the evening, the qualitative assessment considers the impact of the noise sources described into this period.
- Seaton Park is already subject to sports activities; hence it is considered that residents of dwellings surrounding the area are likely to expect to hear sports/leisure noise. Hence the proposal to include all weather pitches to the site represents an intensification of an existing noise source rather than a new noise source.

6.02 CSP Acoustics has completed measurements of sports pitch noise in relation to other projects. This includes noise measurements of an 11 a side football match held at the Dundee International Sports Centre (DISC), measurements were taken at 10 m from the side of the pitch. Measurements were taken throughout the duration of the match. Table 10 below summarises the highest L_{Amax} level occurring in each measurement period of the match

| Table 10: 11 aside Football Match L_{Amax} Noise Data | | |
|---|-------------------------------------|------------------------|
| Match Half | Measurement Sample/Time | L_{Amax} Level in dB |
| 1 st Half | 1 st – 15 minutes | 78 |
| | 2 nd – 15 minute | 82 |
| | 3 rd – 8 mins 40 seconds | 82 |
| 2 nd Half | 1 st – 15 minutes | 81 |
| | 2 nd – 15 minute | 77 |
| | 3 rd – 6 mins 51 seconds | 77 |

6.03 With reference to the table above it can be seen that the highest occurring maximum noise levels within the samples taken range from 77 to 82 dB L_{Amax} . This suggests that absolute maximum noise levels were relatively consistent throughout the match. Further information on the distribution of L_{Amax} levels is taken from 1 second data completed for each sample above. The results of these are show in bar charts below:

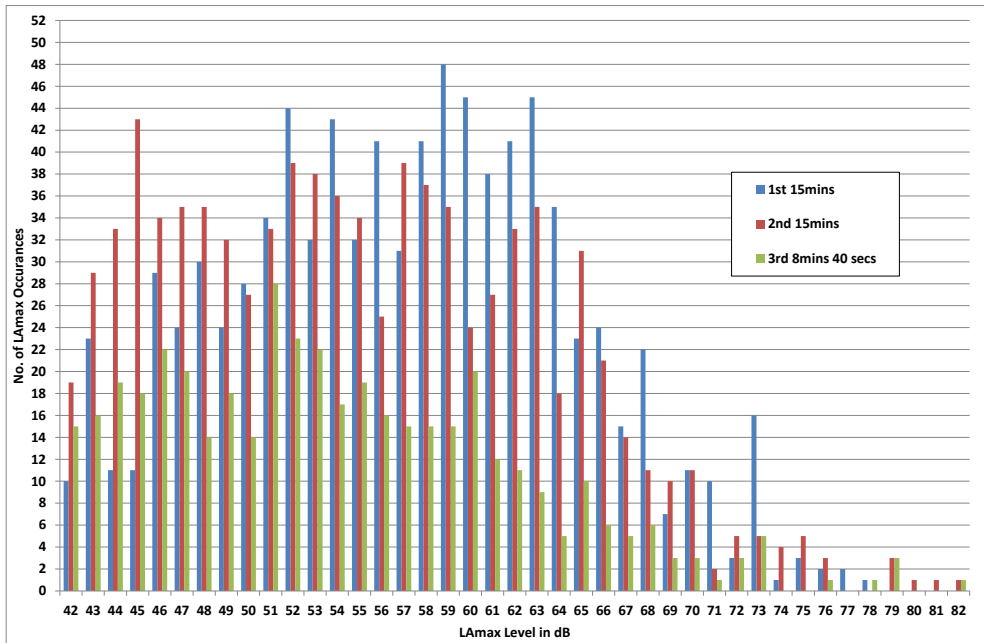


Figure 2: Football Match 1st Half: Distribution of L_{Amax} levels

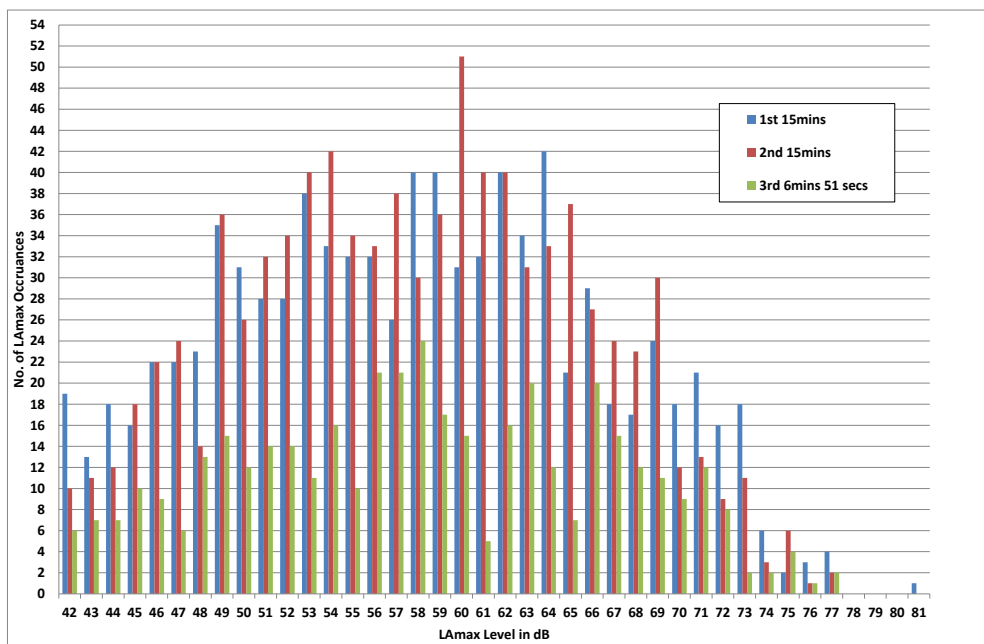


Figure 3: Football Match 2nd Half: Distribution of L_{Amax} levels

- 6.04** With reference to figures 2 and 3, it can be seen that for both 1st and 2nd half samples the distribution of L_{Amax} levels is relatively similar. The 3rd sample completed for both 1st and 2nd halves gives a different distribution due to the shorter measurement period. On this basis L_{Amax} data from 15 minute samples taken during the 1st and 2nd halves of the match are considered representative of the levels occurring throughout the match. Data from shorter samples will not be used for the qualitative assessment. For information, the first 15 minute sample measured during the 1st half will be used for comparison against existing noise levels completed at the Seaton Park site.
- 6.05** The Football Match L_{Amax} level data has been corrected for distance from assessment locations used to the north, east, south and west of the proposed pitch, as noted in section 5.0 of this, report to the nearest dwellings in those directions.
- 6.06** The football match L_{Amax} data has then been compared against existing L_{Amax} noise data recorded at measurement locations at the site. These noise levels were recorded during the evening between 20.50 and 21.50 and are assumed to be representative of existing impulsive noise levels at residential properties.
- 6.07** Data for comparison has been organised in terms of ranges of L_{Amax} levels occurring with the number of occurrences at each level over the assessment period time of 15 minutes. The lower limit of the L_{Amax} ranges for both existing levels and football pitch noise levels has the same numerical value as the 15 minute period average existing noise level measured at the survey location. The assessment is carried out on the basis that levels lower than this are likely to be perceived as part of average noise climate. For example, at location A, considered to be representative of dwellings to the west of the site, survey measurements indicated a level of 57 dB $L_{Aeq,15min}$. Hence 57 dB L_{Amax} has been taken as the lower limit of the range of consideration. The comparison of football match and existing L_{Amax} noise levels are set out in Appendix C.

6.08 The results of the comparisons set out in Appendix C are summarised in Table 11 below.

| Table 11: Noise Impact of proposed Sports Pitch Based on 11 a side use | | | | |
|--|-------------------------------|---|---|--|
| Residential Dwellings direction with respect to Sports Pitch | Existing $L_{Aeq,15min}$ (dB) | Existing Range of L_{Amax} above $L_{Aeq,15min}$ (dB) | Range of L_{Amax} events from Football Pitch above $L_{Aeq,15min}$ (dB) | Comment |
| North | 57 | 57 - 74 | 58 - 72 | Intensification of impulsive noise events within existing range of site levels/potential reduction of intermittency |
| East | 42 | 42 - 59 | 43 - 71 | Intensification of impulsive noise events within and beyond range of existing site levels/potential reduction of intermittency |
| South | 42 | 42 - 59 | 43 - 77 | |
| West | 56.5 | 57- 73 | 58 - 70 | Intensification of impulsive noise events within existing range of site levels/potential reduction of intermittency |

6.09 The results summarised in table 11 indicate that houses to the north and west are likely to be subject to an intensification of impulsive noise levels within the existing range of levels that are present at site due to the use of the proposed sports pitches. A potential reduction of intermittency may occur due to increase of impulsive events. At houses to the east and south intensification of impulsive noise levels is likely to occur within and beyond current site levels, again, a potential reduction of intermittency may occur with increased impulsive events. With reference to table 2.5 of the Technical Advice Note to PAN 1/2011, it is consider that the qualitative effects of impulsive noise impacts are likely to be as follows:

| Dwellings Located to: | Perception | Criteria of Descriptor for residential dwellings | Descriptor for qualitative impact |
|-----------------------|-------------------------------|---|-----------------------------------|
| East and South | Noticeable (Disruptive) | Causes an important change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion. 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 character of the area. | Moderate |
| North and West | Noticeable (Mildly intrusive) | Noise can be heard and may cause small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; closing windows more often. Potential for non-awakening sleep disturbance. Can slightly affect the character of the area but not such that there is a perceived change in the quality of life. | Minor |

6.10 A summary of the findings for the impact of sports pitch average noise levels on dwellings were given in table 6. A shortened version of this is given below:

| Dwellings located to | North | East | South | West |
|------------------------|-----------------|------------------|------------------|-----------------|
| Magnitude of Impact | Minor | Major | Major | Minor |
| Significance of Impact | Slight/Moderate | Large/Very Large | Large/Very Large | Slight/Moderate |

6.11 With reference to table 13, the descriptors of qualitative impact established are similar to levels of impact established through the quantitative impact. On this basis the qualitative assessment does not imply that the findings established through the quantitative assessment should be varied.

7.00 Mitigation Measures

- 7.01 It is recommended that predicted Sport Pitch noise levels be controlled by the introduction of a noise control barrier at the eastern and southern boundaries of the proposed development site, as indicated in figure 4 below.

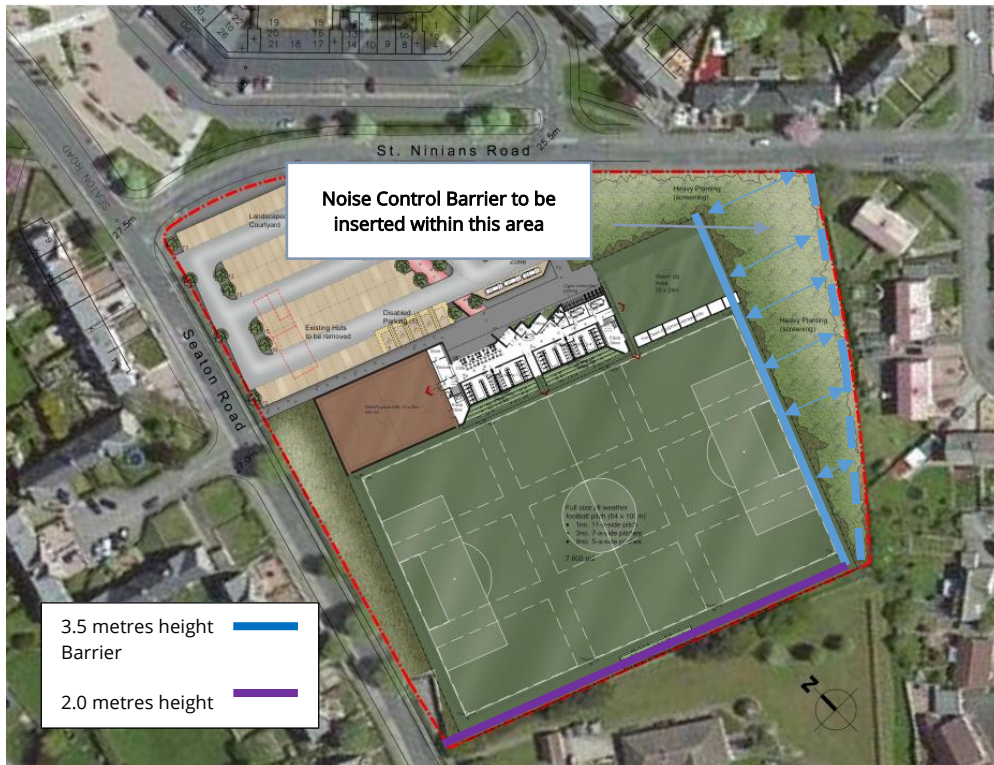


Figure 4 – Recommended noise control barrier locations

- 7.02 The southern and eastern barriers should be 2 and 3.5 metres in height respectively as indicated in figure 2 above. The barriers should be constructed with a minimum superficial mass of at least 10kg /m². The barriers can be formed from earth bunds, brick walls, timber fences or a combination of these. Where fencing is used to form the barrier then timber used should meet the weight requirement specified excluding the weight of supports and rails. In addition a timber fence is only likely to provide an effective barrier where boarding is lapped, or double sheeted. The barrier should be continuous from ground level to the full specified height and be imperforate.
- 7.03 With the barrier in place, Sport Pitch noise levels will be reduced at dwellings to the south and east. Revised magnitude and significance of impact for this scenario is set out in tables below. The results of the assessment is shown in more details in the Appendix D and Appendix E of this report:

| Table 14 – Sports Pitch BS4142:2014 Noise Assessment at nearest dwellings with the introduction of a noise control barrier | | | | |
|--|-----------------|-----------------|----------------|----------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Sports Pitch Noise Level $L_{Aeq,1hr}$ (dB) | 50.7 | 41 | 43.3 | 49.8 |
| Impulsivity correction (dB) | +6 | +6 | +6 | +6 |
| Rating level (dB) | 56.7 | 47.0 | 49.3 | 55.8 |
| Background Noise $L_{A90,1hr}$ (dB) | 42.5 | 39.4 | 39.4 | 42.5 |
| Level above or below background (dB) | +14.2 | +7.6 | +9.9 | +13.3 |

7.04 In accordance with TAN, the sensitivities of the nearest dwellings range from medium to high. Magnitude and significance assessments have been prepared in accordance with the TAN to PAN 1/2011 by determining the likely increase in the ambient noise level, L_{Aeq} , due to Sport Pitches operating at the proposed Leisure development and the recommended barrier in place as follows:

| Table 15: PAN & TAN 1/2011 Assessment with the introduction of a noise control barrier | | | | |
|--|-----------------|-----------------|-----------------|----------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Existing ambient noise level at dwellings L_{Aeq} | 57 | 42 | 42 | 57 |
| Sport Pitch noise level at dwelling façade L_{Aeq} | 50.7 | 41 | 43.3 | 49.8 |
| Sport Pitch Noise level at dwelling + existing ambient L_{Aeq} | 57.9 | 44.5 | 45.7 | 57.8 |
| Change in Noise Level | +0.9 | +2.5 | +3.7 | +0.8 |
| Sensitivity of receptor | High | Medium | Medium | High |
| Magnitude of impact | Negligible | Minor | Moderate | Negligible |
| Significance of Impact | Slight | Slight | Moderate | Slight |

7.05 Conclusion 2: The assessment indicates that where noise barriers are introduced to the proposed development site then the significance of impact of noise from the development is reduced to Slight / Moderate at all properties. TAN notes that where a “Slight/ Moderate” significance of impact occurs then:

“Slight: These effects may be raised but are unlikely to be of importance in the decision making process”

“Moderate: These effects, if adverse, while important, are not likely to be key decision making issues.”

7.06 Qualitative Impact With Noise Barriers: The impact Football Match L_{Amax} Levels has been assessed with noise barriers in place as described in 6.7. Comparison tables of results are set out in Appendix C, the results for residential dwellings protected by barriers to the east and south are summarised in the following table:

| Residential Dwellings direction with respect to Sports Pitch | Existing $L_{Aeq,15min}$ (dB) | Existing Range of L_{Amax} above $L_{Aeq,15min}$ (dB) | Range of L_{Amax} events from Football Pitch above $L_{Aeq,15min}$ (dB) | Comment |
|--|-------------------------------|---|---|---|
| East | 42 | 42 - 59 | 43 - 63 | Intensification of impulsive noise events within existing site levels/potential reduction of intermittency. Small Increase in maximum range of levels but with relatively few events within this extended range |
| South | 42 | 42 - 59 | 43 - 64 | |

7.07 Conclusion 3: With respect to table 16, it is considered that the qualitative impact of the sports pitch is likely to be minor, see table 12, with noise barriers in place. Impacts determined from the quantitative assessment indicated significance of impacts of ‘moderate’ and ‘minor’ for east and south dwellings respectively with noise barriers in place. On this basis it is considered that qualitative assessment does not imply a greater significance of impact than established through the quantitative assessment.

7.08 Effects of Noise Source Position with Respect to Noise Control Barrier location: Generally the closer a noise source is with respect to a noise control barrier then greater screening attenuation will result at a receiver location protected by the barrier and vice-versa. However, as a source moves further away from a noise barrier then attenuation will also naturally increased due to increased distance. Given the size of sports pitches and movement of players within it, these two effects require consideration for fixed barrier locations. To model these effects three different source location scenarios were considered, see figure 5 below.

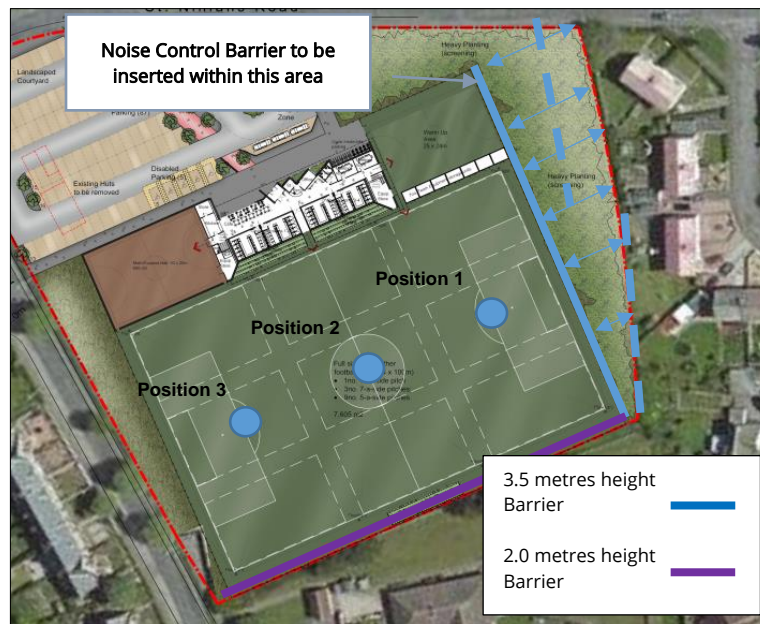


Figure 5 – Further noise source location assessment scenarios

7.09 The impact of noise at dwellings from these three locations has been assessed with noise barriers in place has been assessed. The results are summarized in the tables below:

- Position 1

| Table 17 – Sports Pitch BS4142:2014 Noise Assessment at nearest dwellings with the introduction of a noise control barrier and source in Position 1 | | | | |
|---|-----------------|-----------------|----------------|----------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Sports Pitch Noise Level $L_{Aeq,1hr}$ (dB) | 42 | 36 | 40 | 39 |
| Impulsivity correction (dB) | +6 | +6 | +6 | +6 |
| Rating level (dB) | 48 | 42 | 46 | 45 |
| Background Noise $L_{A90,1hr}$ (dB) | 42.5 | 39.4 | 39.4 | 42.5 |
| Level above or below background (dB) | +6 | +2.6 | +6.6 | +2.5 |

| Table 18: PAN & TAN 1/2011 Assessment with noise source located in position 1 | | | | |
|---|------------------|------------------|----------------|------------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Existing ambient noise level at dwellings L_{Aeq} | 57 dB | 42 dB | 42 dB | 57 dB |
| Sport Pitch noise level at dwelling façade L_{Aeq} | 42 dB | 36 dB | 40 dB | 39 dB |
| Sport Pitch Noise level at dwelling + existing ambient L_{Aeq} | 57.1 dB | 42.9 dB | 44.1 dB | 57.1 dB |
| Change in Noise Level | +0.1 | +0.9 | +2.1 | +0.1 |
| Sensitivity of receptor | Medium | Low | Medium | Low |
| Magnitude of impact | Negligible | Negligible | Minor | Negligible |
| Significance of Impact | Neutral / Slight | Neutral / Slight | Slight | Neutral / Slight |

- Position 2

| Table 19 – Sports Pitch BS4142:2014 Noise Assessment at nearest dwellings with the introduction of a noise control barrier and source in Position 2 | | | | |
|---|-----------------|-----------------|----------------|----------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Sports Pitch Noise Level $L_{Aeq,1hr}$ (dB) | 36 | 37 | 36 | 42 |
| Impulsivity correction (dB) | +6 | +6 | +6 | +6 |
| Rating level (dB) | 42 | 43 | 42 | 48 |
| Background Noise $L_{A90,1hr}$ (dB) | 42.5 | 39.4 | 39.4 | 42.5 |
| Level above or below background (dB) | -0.5 | +4 | +3 | +5 |

| Table 20: PAN & TAN 1/2011 Assessment with noise source located in position 2 | | | | |
|---|-----------------|------------------|------------------|------------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Existing ambient noise level at dwellings L_{Aeq} | 57 dB | 42 dB | 42 dB | 57 dB |
| Sport Pitch noise level at dwelling façade L_{Aeq} | 36 dB | 37 dB | 36 dB | 42 dB |
| Sport Pitch Noise level at dwelling + existing ambient L_{Aeq} | 57 dB | 43.2 dB | 42.9 dB | 57.1 dB |
| Change in Noise Level | 0 dB | +0.2 dB | +0.9 dB | +0.1 dB |
| Sensitivity of receptor | Low | Low | Low | Low |
| Magnitude of impact | No Change | Negligible | Negligible | Negligible |
| Significance of Impact | Neutral | Neutral / Slight | Neutral / Slight | Neutral / Slight |

- Position 3

| Table 21 – Sports Pitch BS4142:2014 Noise Assessment at nearest dwellings with the introduction of a noise control barrier and source in Position 3 | | | | |
|---|-----------------|-----------------|----------------|----------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Sports Pitch Noise Level $L_{Aeq,1hr}$ (dB) | 30 | 37 | 33 | 46 |
| Impulsivity correction (dB) | +6 | +6 | +6 | +6 |
| Rating level (dB) | 36 | 43 | 39 | 52 |
| Background Noise $L_{A90,1hr}$ (dB) | 42.5 | 39.4 | 39.4 | 42.5 |
| Level above or below background (dB) | -6.5 | +3.6 | -0.4 | +9.5 |

| Table 22: PAN & TAN 1/2011 Assessment with noise source located in position 3 | | | | |
|---|-----------------|-------------------------|-------------------------|-------------------------|
| Calculation Notes | North dwellings | South dwellings | East dwellings | West dwellings |
| Existing ambient noise level at dwellings L_{Aeq} | 57 dB | 42 dB | 42 dB | 57 dB |
| Sport Pitch noise level at dwelling façade L_{Aeq} | 30 dB | 37 dB | 33 dB | 46 dB |
| Sport Pitch Noise level at dwelling + existing ambient L_{Aeq} | 57 dB | 43.2 | 42.5 | 57.3 |
| Change in Noise Level | 0 | +1.2 | +0.5 | +0.3 |
| Sensitivity of receptor | Low | Low | Low | Medium |
| Magnitude of impact | No change | Minor | Negligible | Negligible |
| Significance of Impact | Neutral | Neutral / Slight | Neutral / Slight | Neutral / Slight |

| Table 23: Summary of Significance of Impacts for Position 1 to 3 | | | | |
|--|------------------|------------------|------------------|------------------|
| Assessment Position | North dwellings | South dwellings | East dwellings | West dwellings |
| 1 | Neutral / Slight | Neutral / Slight | Slight | Neutral / Slight |
| 2 | Neutral | Neutral / Slight | Neutral / Slight | Neutral / Slight |
| 3 | Neutral | Neutral / Slight | Neutral / Slight | Neutral / Slight |

7.10 Conclusion 4: With reference to table 18, the results of the assessment indicate that the Significance of Impact for the three locations is either Neutral or Slight. This suggests that the variability of noise source location and distance with respect to the noise barriers proposed for sports pitch results in either no change or a marginal change in the Significance of Impact. TAN notes that where a “Neutral / Slight” significance of impact occurs then:

“Neutral: No effect, not significant, noise not be considered as a determining factor in the decision making process”

“Slight: These effects may be raised but are unlikely to be of importance in the decision making process”

7.11 Calculated Sport Pitches Noise Levels at Garden Areas: The impact of sports noise from the proposed development on the nearest garden areas of the nearest residential properties has been assessed at 1.5 metres height above ground.

7.12 The results of the garden assessment are summarised below:

| Dwellings Location | Noise Level $L_{Aeq,1hr}$ (dB) |
|--------------------|--------------------------------|
| North | 50.9 |
| South | 40.5 |
| East | 37.9 |
| West | 50.5 |

7.13 Conclusion 5: Calculations indicated that noise levels arising in gardens, from sports pitch noise, are no more than the WHO guidance limit of 55 dB $L_{Aeq,16hr}$. It should be noted that survey measurements indicate existing noise levels at dwellings to the north and west of the site already exceed this limit.

7.14 Subject to implementation of these recommendations we see no reason why noise issues should present any impediment to the grant of planning permission for this development.



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Appendix A: Acoustic Glossary

| Word | description |
|-----------------------------|--|
| Acoustic environment | Sound from all sound sources as modified by the environment |
| Ambient Noise | Totally encompassing sound at a given location, usually composed of sound from many sources near and far |
| Background Noise | The lowest noise level present in the absence of any identifiable noise sources. This is usually represented by the L_{A90} measurement index. |
| Break-in | Noise transmission into a structure from outside |
| Break-out | Noise transmission from inside a structure to the outside |
| Cross-talk | Noise transmission between one room and another room or space |
| Ctr | Correction term applied against the sound insulation single-number values (R_w , D_w and $D_{nT,w}$) to provide a weighting against low frequency performance |
| dB (decibel) | Defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2×10^{-5} Pa). |
| dB(A) | Level of sound across the audible spectrum with a frequency filter to compensate for the varying sensitivity of the human ear to sound at different frequencies at a lower SPL |
| Façade Level | A sound field determined at a distance of 1m in front of a building façade. |
| Free-field Level | A sound field measured at a point away from reflective surfaces other than the ground |
| Frequency (Hz) | Number of cycles of a wave in one second measured in Hertz. |
| Impact sound pressure level | Average sound pressure level in a specific frequency band in a room below a floor when it is excited by a standard tapping machine or equivalent |

| | |
|--|---|
| Indoor ambient noise | Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants |
| $L_{Aeq,T}$ | $L_{Aeq,T}$ is defined as the equivalent continuous "A"-weighted Sound Pressure Level in dB over a given period of time. |
| L_{Amax} | Maximum A - weighted sound pressure level recorded over the measurement period. Usually has a time constraint (L_{afmax} , L_{asmax}) |
| Measurement time interval, T_m | Total time over which measurements are taken |
| Noise | Unwanted sound. |
| Noise criteria | Numerical indices used to define design goals in a given space |
| Noise rating NR | Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves. This is usually used to control noise that has tonal characteristics that $L_{Aeq,t}$ wouldn't detect. |
| Noise-sensitive premises (NSPs) | Any occupied premises outside the assessment location used as a dwelling (including gardens), place of worship, educational establishment, hospital or similar institution, or any other property likely to be adversely affected by an increase in noise level |
| Normalized impact sound pressure level | Impact sound pressure level normalized for a standard absorption area in the receiving room |
| Octave band | Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit |
| Percentile level $L_{AN,T}$ | A-weighted sound pressure level obtained using time-weighting "F", which is exceeded for N% of a specified time period |
| Rating level, $L_{Ar,Tr}$ | Specific sound level plus any adjustment for the characteristic features of the sound |
| Reference time interval, T_r | Specified interval over which the specific sound level can be determined. |
| Residual sound | Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound |

| | |
|---|--|
| Residual sound level, $L_r = L_{Aeq,T}$ | Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T |
| Reverberation time T | Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped within a reverberant space |
| Sound level difference D | Difference between the sound pressure level in the source room and the sound pressure level in the receiving room |
| Sound power level, LWA | Ten times the logarithm to the base 10 of the ratio of the sound power radiated by a sound source to the reference sound power, determined by use of frequency-weighting network "A" |
| Sound pressure level | Is the Root Mean Squared value of the instantaneous sound level over a period of time expressed in decibels, usually measured with an appropriate frequency weighting |
| 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 |
| Specific sound source | The sound source which is being assessed |
| Third octave band | Octave bands sub-divided into three parts, equal to 23% of the centre frequency |
| Weighted level difference D_w | Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions |
| Weighted standardized level difference $D_{nT,w}$ | Single-number quantity that characterizes the airborne sound insulation between rooms |

Appendix B: Received Drawings / Documents / Files

- Design Statement Jan 2016.pdf
- LP-01 Location Plan 18 Jan 2016.pdf
- PD-01 Proposed Site Context Plan 18 Jan 2016.pdf
- PD-02 Proposed Site Plan 18 Jan 2016.pdf
- PD-03 Proposed Plans 18 Jan 2016.pdf
- PD-04 Proposed Sections 18 Jan 2016.pdf
- PD-05 Proposed Elevations 18 Jan 2016.pdf
- PD-10 Proposed 3D Views 1-2 18 Jan 2016.pdf
- PD-11 Proposed 3D Views 3-4 18 Jan 2016.pdf
- PD-12 Proposed 3D Views 5-6 18 Jan 2016.pdf
- PD-13 Proposed 3D Views 7-8 18 Jan 2016.pdf
- PD-14 Proposed 3D Views 9-10 18 Jan 2016.pdf
- PD-04-RE.pdf
- PD-01 MASTER PROPOSAL Nov 2015.dwg

Appendix C: Qualitative Assessment Tables of Football Noise L_{Amax} Level vs Occurrences at Residential Properties

| Football match L_{Amax} range of levels and No. of occurrences against existing at Northern Dwellings | | | | | | | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Football L_{Amax} range of levels | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | | |
| No. of L_{Amax} events at this level | 45 | 35 | 23 | 24 | 15 | 22 | 7 | 11 | 10 | 3 | 16 | 1 | 3 | 2 | 2 | 1 | | |
| Existing L_{Amax} range of Levels | | | | | | | | | | | | | | | | | | |
| Existing L_{Amax} range of Levels | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 |
| No. of L_{Amax} events at this level | 10 | 10 | 11 | 8 | 7 | 11 | 8 | 14 | 7 | 14 | 12 | 13 | 7 | 2 | 2 | 1 | 3 | 1 |

| Football match L_{Amax} range of levels and No. of occurrences against existing at Eastern Dwellings | | | | | | | | | | | | | | | | | | | |
|--|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|
| Football L_{Amax} range of levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | |
| No. of L_{Amax} events at this level | 24 | 28 | 34 | 44 | 32 | 43 | 32 | 41 | 31 | 41 | 48 | 45 | 38 | 41 | 45 | 35 | 23 | 24 | |
| Existing L_{Amax} range of Levels | | | | | | | | | | | | | | | | | | | |
| Existing L_{Amax} range of Levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | |
| No. of L_{Amax} events at this level | 139 | 184 | 172 | 134 | 79 | 51 | 33 | 14 | 2 | 5 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 2 | |
| Football L_{Amax} range of levels | | | | | | | | | | | | | | | | | | | |
| Football L_{Amax} range of levels | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | | | | | | | |
| No. of L_{Amax} events at this level | 15 | 22 | 7 | 11 | 10 | 3 | 16 | 1 | 3 | 2 | 2 | 1 | | | | | | | |
| Existing L_{Amax} range of Levels | | | | | | | | | | | | | | | | | | | |
| Existing L_{Amax} range of Levels | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | | | | | | | |
| No. of L_{Amax} events at this level | | | | | | | | | | | | | | | | | | | |

| Football match L_{Amax} range of levels and No. of occurrences against existing at Southern Dwellings | | | | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Football L_{Amax} range of levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| No. of L_{Amax} events at this level | 23 | 11 | 11 | 29 | 24 | 30 | 24 | 28 | 34 | 44 | 32 | 43 | 32 | 41 | 31 | 41 | 48 | 45 |
| Existing L_{Amax} Levels | | | | | | | | | | | | | | | | | | |
| Existing L_{Amax} Levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| No. of L_{Amax} events at this level | 139 | 184 | 172 | 134 | 79 | 51 | 33 | 14 | 2 | 5 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 2 |
| Football L_{Amax} range of levels | | | | | | | | | | | | | | | | | | |
| Football L_{Amax} range of levels | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 |
| No. of L_{Amax} events at this level | 38 | 41 | 45 | 35 | 23 | 24 | 15 | 22 | 7 | 11 | 10 | 3 | 16 | 1 | 3 | 2 | 2 | 1 |
| Existing L_{Amax} Levels | | | | | | | | | | | | | | | | | | |
| Existing L_{Amax} Levels | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 |
| No. of L_{Amax} events at this level | | | | | | | | | | | | | | | | | | |

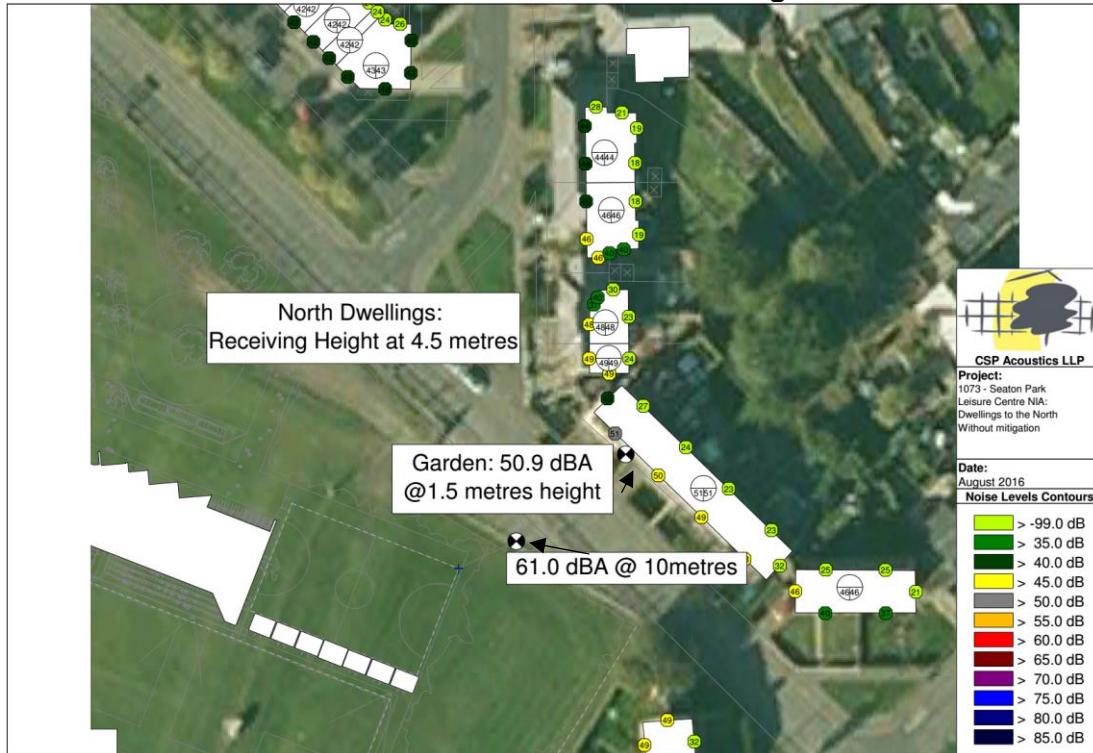
| Football match L_{Amax} range of levels and No. of occurrences against existing at Western Dwellings | | | | | | | | | | | | | | | | | |
|--|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Football L_{Amax} range of levels | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | | | |
| No. of L_{Amax} events at this level | 23 | 24 | 15 | 22 | 7 | 11 | 10 | 3 | 16 | 1 | 3 | 2 | 2 | 1 | | | |
| Existing L_{Amax} Levels | | | | | | | | | | | | | | | | | |
| Existing L_{Amax} Levels | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 |
| No. of L_{Amax} events at this level | 25 | 18 | 21 | 22 | 35 | 23 | 27 | 27 | 19 | 22 | 17 | 12 | 4 | 4 | 0 | 1 | 1 |

| Football match L_{Amax} range of levels and No. of occurrences against existing at Eastern Dwellings with Noise Barrier | | | | | | | | | | | | | | | | | | |
|---|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Football L_{Amax} range of levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| No. of L_{Amax} events at this level | 31 | 41 | 48 | 45 | 38 | 41 | 45 | 35 | 23 | 24 | 15 | 22 | 7 | 11 | 10 | 3 | 16 | 1 |
| Existing L_{Amax} Levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| No. of L_{Amax} events at this level | 139 | 184 | 172 | 134 | 79 | 51 | 33 | 14 | 2 | 5 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 2 |
| Football L_{Amax} range of levels | 60 | 61 | 62 | 63 | | | | | | | | | | | | | | |
| No. of L_{Amax} events at this level | 3 | 2 | 2 | 1 | | | | | | | | | | | | | | |
| Existing L_{Amax} Levels | 60 | 61 | 62 | 63 | | | | | | | | | | | | | | |
| No. of L_{Amax} events at this level | 0 | 0 | 0 | 0 | | | | | | | | | | | | | | |

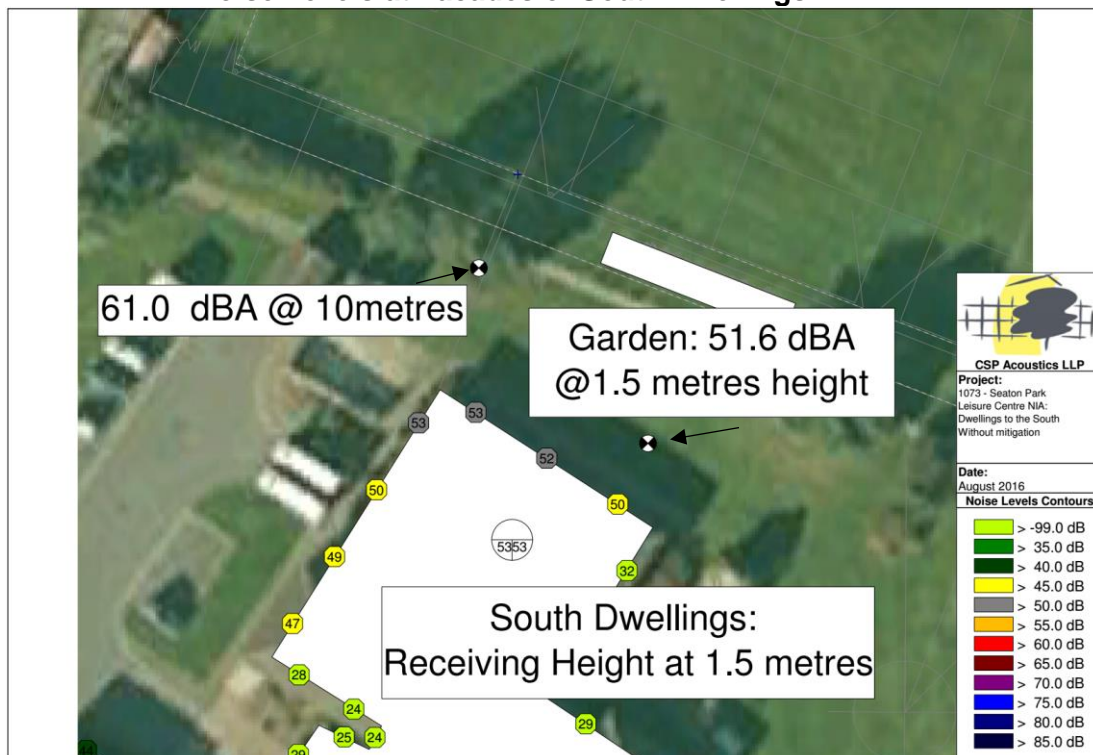
| Football match L_{Amax} range of levels and No. of occurrences against existing at Southern Dwellings with Noise Barrier | | | | | | | | | | | | | | | | | | |
|--|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Football L_{Amax} range of levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| No. of L_{Amax} events at this level | 41 | 31 | 41 | 48 | 45 | 38 | 41 | 45 | 35 | 23 | 24 | 15 | 22 | 7 | 11 | 10 | 3 | 16 |
| Existing L_{Amax} Levels | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| No. of L_{Amax} events at this level | 139 | 184 | 172 | 134 | 79 | 51 | 33 | 14 | 2 | 5 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 2 |
| Football L_{Amax} range of levels | 60 | 61 | 62 | 63 | 64 | | | | | | | | | | | | | |
| No. of L_{Amax} events at this level | 1 | 3 | 2 | 2 | 1 | | | | | | | | | | | | | |
| Existing L_{Amax} Levels | 60 | 61 | 62 | 63 | 64 | | | | | | | | | | | | | |
| No. of L_{Amax} events at this level | 0 | 0 | 0 | 0 | 0 | | | | | | | | | | | | | |

Appendix D: Sports Pitch Noise without Mitigations

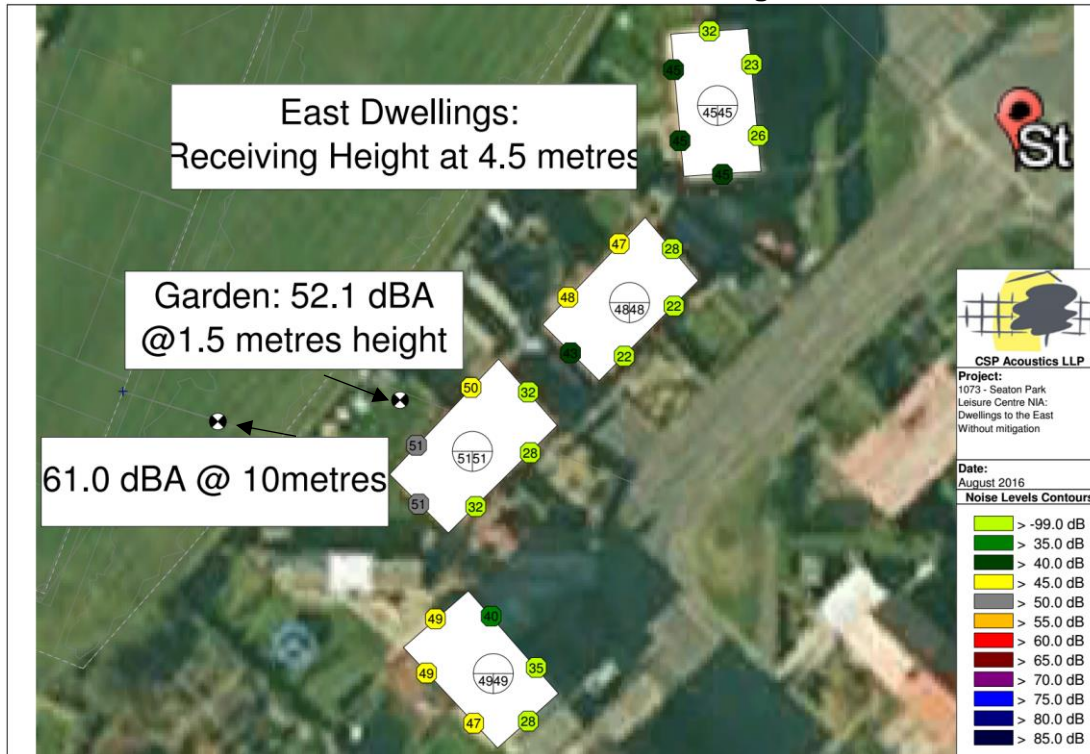
- **Noise Levels at Facades of North Dwellings**



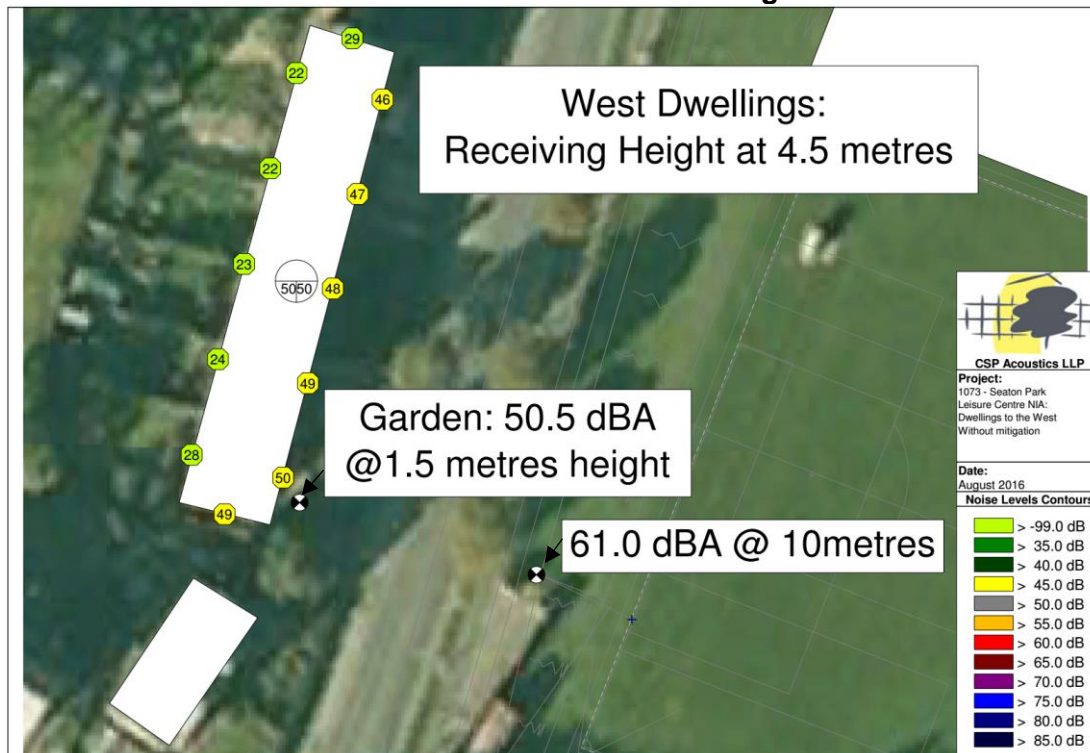
- **Noise Levels at Facades of South Dwellings**



• Noise Levels at Facades of East Dwellings

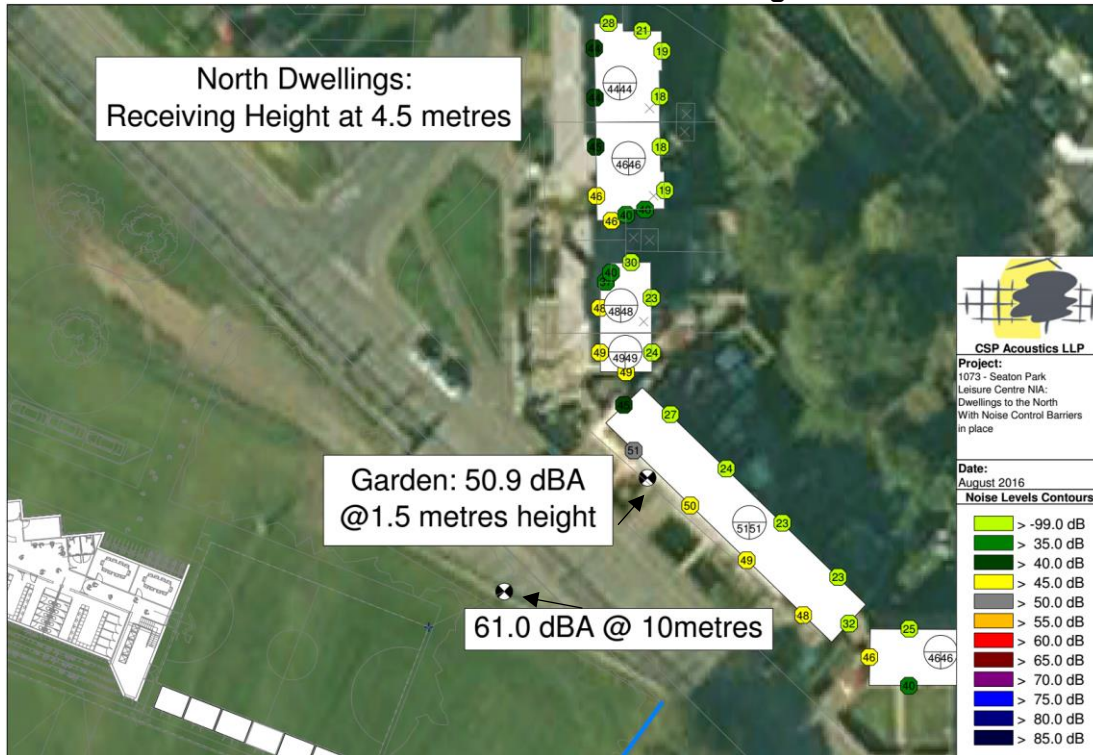


• Noise Levels at Facades of West Dwellings



Appendix E – Sports Pitch Noise Levels with Barriers in Place

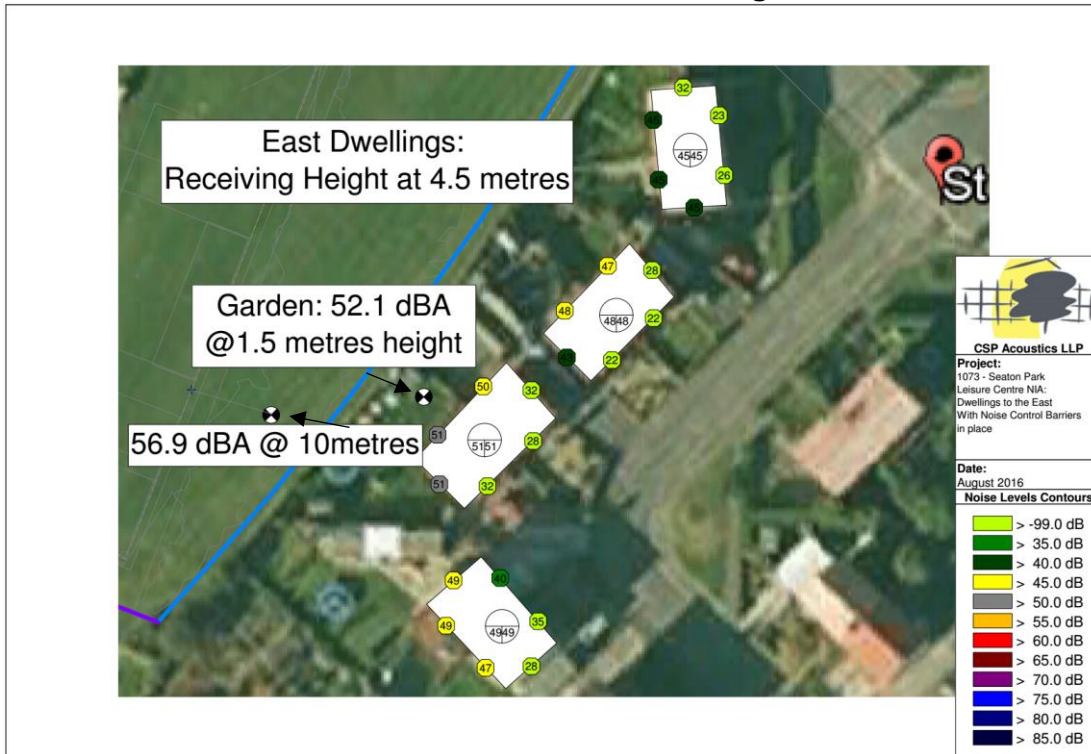
- Noise Levels at Facades of North Dwellings**



- Noise Levels at Facades of South Dwellings**




- **Noise Levels at Facades of East Dwellings**





- **Noise Levels at Facades of West Dwellings**



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