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## **GOALS MANCHESTER**

**Noise Impact Assessment – Rev 01**

**4<sup>th</sup> November 2021**

**Report no. 7294-00-01**

## GOALS MANCHESTER

### Noise Impact Assessment – Rev 01

#### 1 INTRODUCTION

This report is written on behalf of Ink Design Architects and presents details of a noise impact assessment for the proposed 3-pitch extension at Goals Manchester, 4 Irish Town Way, Manchester, M8 0AE.

The Goals development which was granted planning permission in 2011, has three remaining pitches to be installed at the west end of the site. A variation to the original planning layout, has been approved, to rotate and alter dimensions with a larger pitch to the south corner (Variation of condition 2 (specified plans) of planning permission referenced 098223/MO/2011/N1 to allow alterations to the playing pitch configuration). However, details of the “acoustic fence” to be installed to the west corner of the site have been requested by the Local Authority Planners in Condition 11 of the Planning Permission.

Condition 11 states,

*“Notwithstanding the details shown on drawing numbered 20-8111-PL 02/A, received by the City Council as Local Planning Authority on 5 February 2021, full details of the proposed acoustic fence shall be submitted to and approved in writing by the City Council as Local Planning Authority. The new playing pitches hereby approved shall only become operational, once the acoustic fence has been erected in accordance with the agreed details.”*

This report assesses noise from the final three pitches (granted permission 2020) plus a review of the requirements for the acoustic fence.

The assessment is undertaken applying relevant national and regional policy and guidance following liaison with Manchester City Council environmental protection department and using measured source noise levels from a similar Goals Soccer Centre site in Glasgow (measured pre-lockdown on 3<sup>rd</sup> March 2020).

Guidance on the assessment of noise during the Covid-19 pandemic is taken from the joint IoA / ANC, “Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments” Version 6, January 2021. As uncertainty in measured background and residual noise levels remains elevated due to many activities and traffic flows being untypical because of Covid-19 related restrictions, alternative methods of establishing typical noise levels may be required.

All noise levels in this report are free field unless otherwise specified.

This report is written by Anne Budd, MIOA, BEng Electroacoustics (2000). Measurements of noise from the Goals Glasgow site were made by Callum Forsyth, AMIOA, BSc Audio Engineering (2018), DipIoA (2021).

## 2 BACKGROUND

The Manchester Goals site is located on former industrial ground at 4 Irish Town Way in the Cheetham Hill area of Manchester. The site is bounded to the south and west by industrial and commercial neighbours, to the east by further sporting facilities and to the north by a wooded hill beyond which are residential terraced houses.

The existing site and neighbours can be seen on the satellite image in Figure 1.



Figure 1 – Goals and surrounding land uses (c) Getmapping plc

The original site plan granted permission in 2011 showed an additional 3no. 5-a-side sized pitches which were never built. The 2020 plans alter this to 2no. 5-a-side (pitch 4 and pitch 8) and 1no. 7-a-side (pitch 9) as shown on Ink Design drawing no. 20-811-PL-02 Rev A. The original layout is shown in Appendix 1 and the current layout for the pitches is shown Appendix 2 of this report.

The nearest noise sensitive neighbours to the 3no. new pitches is located at no. 19 Holborn Drive.

There is an “acoustic fence” indicated on drawing no. 20-8111-PL 02 Rev A located between 19 Holborn Drive and the new pitches. The location and extent of the this can be seen on drawing no. 20-811-PL-02 Rev A, as this fence is positioned directly in front of an existing hill its effectiveness as a noise barrier is questionable.

The pitches will operate through till 2200 hours.

### 3 RELEVANT NOISE POLICY

The relevant English noise policy for the development is described here.

#### 3.1 NPPF

The National Planning Policy Framework (NPPF) was published in March 2012 and revised in 2018, 2019 and 2021. It sets out the government's planning policies for England and how these are expected to be applied.

The document outlines the policy framework in which noise should be treated in planning but does not dictate an assessment method to be used or criteria to be applied in the assessment of noise impact.

#### 3.2 NPSE

The NPPF refers to the Noise Policy Statement for England (NPSE). The NPSE was published in 2010, section 1.3 states that, *"The aim of this document is 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."*

The NPSE sets out long term vision for government policy and then provides three aims to support this vision as follows:

- 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.

In order to allow people to assess noise against these aims the document set out the definition of "significant adverse" and "adverse". It does this by introducing effects levels 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.

The NPSE does not provide any assessment criteria for these effect levels as each case is individual, however, it does state that a balanced approach should be taken by Planning Authorities when considering benefits of development.

### 3.3 NPPG

The National Planning Policy Guidance (NPPG) on Noise advises on how planning can manage potential noise impacts in new development. It was published in 2014 and last updated in 2019.

The NPPG provides generic guidance on determining noise impact and provides types of mitigation that could be used to mitigate any adverse effects of noise.

It also provides a table titled the “noise exposure hierarchy” which sets out actions to be taken at each effect level but does not define noise levels associated with each level. As reproduced in Table 3.

| Response                                  | Examples of outcomes                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Increasing effect level             | Action                           |
|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------|
| No Observed Effect Level                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |                                  |
| Not present                               | No Effect                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | No Observed Effect                  | No specific measures required    |
| No Observed Adverse Effect Level          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |                                  |
| Present and not intrusive                 | Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.                                                                                                                                                                                                                                                                   | No Observed Adverse Effect          | No specific measures required    |
| Lowest Observed Adverse Effect Level      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |                                  |
| Present and intrusive                     | Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.                                          | Observed Adverse Effect             | Mitigate and reduce to a minimum |
| Significant Observed Adverse Effect Level |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                     |                                  |
| Present and disruptive                    | The noise causes a material change in behaviour, attitude or other physiological response, 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                            |
| Present and very disruptive               | Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.                                                                                                                                                                                       | Unacceptable Adverse Effect         | Prevent                          |

Table 3 – NPPG Noise Exposure Hierarchy

## 4 STANDARDS & GUIDES

Relevant guidance on noise from sports artificial grass pitches such as the proposed pitches at Goals Manchester is found in the Sports England Guide. It is considered this guidance can be used to establish the “no observed adverse effect level” as referenced in the government policy as set out in Section 3. The Sports England guidance refers to the World Health Organisation Community Guidelines from 1999 which are now superseded, however, BS 8233: 2014 contains the same outdoor performance targets and is referenced here.

### 4.1 Sports England AGP Acoustics

In 2015, Sport England conducted a study of noise from AGP facilities, resulting in the production of a design guidance note, *“Artificial Grass Pitches (AGP) Acoustics – Planning Implications”*.

The guidance contains representative noise levels from AGP use, noting that the worst case noise level is adjacent to the halfway line position. It notes that,

*“The most significant noise levels were found to be generally derived from the voices of players, with the exception of hockey where impact noises of balls hitting perimeter strike boards and goal back boards were more noticeable. Such impact noises can be mitigated by incorporating shock absorbing noise reduction measures. Assuming such mitigation measures, the most significant noise source from typical AGP sports sessions is therefore voice and as such, a typical noise level can be determined”*.

The guidance suggests the use of a fixed noise level at residential receptors to avoid moderate annoyance during daytime and evening periods of 50dB  $L_{Aeq,1hr}$ , based on the figure from the WHO CNG 1999 for avoidance of “moderate annoyance”, however, the Sports England guidance recommends a shortened assessment period, equivalent to the length of a typical sports “let” i.e. 1 hour, rather than the normal 16 hour daytime period.

The Sports England guidance is primarily for use where planning permission is being sought for a new pitch development adjacent to existing receptors.

### 4.2 BS 8233: 2014

BS8233:2014 *“Guidance on Sound Insulation and Noise Reduction in Buildings”* provides design criteria for external noise in outdoor amenity areas in Section 7.7.3.2, where it states that,

*“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB  $L_{Aeq,T}$ , with an upper guideline value of 55 dB  $L_{Aeq,T}$  which would be acceptable in noisier environments. ”*

These figures correspond to the values found in the now superseded WHO CNG 1999.

Reference to limiting of "maximum" noise levels in the BS 8233 guidance on dwellings is restricted to the night time periods e.g. between 2300-0700 hours, as it is specially used to prevent sleep disturbance.

#### 4.3 WHO NNG for Europe

Although the WHO Community Guidelines 1999 are in the most part superseded the WHO Night time Noise Guidelines for Europe 2009 still remain valid. Although the Manchester pitches will not be used at night time these guidelines do provide a "no observable adverse effect level" (NOAEL) for maximum noise events beneath which no observable effect occurs (sleep awakenings). This is stated as an internal noise level of 42dB  $L_{Amax}$ .

### 5 LOCAL AUTHORITY LIAISON

Manchester City Council published a Technical Note on Planning & Noise in 2015. This document does not provide guidance on the assessment of artificial grass pitches but does recommend in section 3.6.1.6 that pre-application advice is sought from Environmental Protection for MUGAs and Sport Stadia.

It also states on page 14 that BS 4142: 2014 *"is not designed to assess noise which is not of an industrial nature such as noise from sports facilities or noise from bars, pubs or clubs, public address systems or construction and demolition"*.

In June 2021 a request was made to MCC Environmental Health officer Graeme Souter for further information on the requirements of a noise assessment for the alternative arrangement of the sports pitch. The following comments were provided via email as reproduced in italics below.

**Subject:** *Noise from 5 a side pitches*

*Hi Anne*

*I am in receipt of your query regarding the variation to the Goals football pitches in Cheetham Hill, Manchester. Is this application just to allow the change to the orientation of pitch number 9 and also increase the capacity from 5 a side to 7 a side? I understand the current planning application is just for the re-orientation of the pitch rather than increase the capacity?*

*The assessment ideally needs to demonstrate the noise level at the noise sensitive properties against the LA90 (background noise level) I am aware that the neighbourhood team are currently investigating some*

*complaints regarding noise from activity at the site so we will also need to see an assessment of the  $L_{Amax}$  levels caused by noise from footballs banging against the boundary fence and raised voices etc the nearby properties. It is likely that an acoustic fence will be required*

*I hope this helps*

*Kind regards*

Following receipt of the above email further requests for discussion relating to the assessment were made but unfortunately, we did not receive any further correspondence from MCC. In the absence of further correspondence there are three matters in the original email to be addressed.

The first being that comparison of noise levels from the 3no. pitches to the background  $L_{A90}$  (as per BS 4142) is not an appropriate method of assessment. MCC 2015 Technical Note states that BS 4142 is not designed to assess this type of noise and BS 4142:2014+A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* scope excludes its own use for the assessment of recreational activities, this is because the sound character of noise from the pitches is not commercial or industrial in nature. Whilst a simple comparison of pitch noise with background could be undertake there is no way of determining the impact of the noise from this.

The second matter being complaints relating to the existing site. These are not relevant to the current application. Following discussion with Goals we understand that complaints primarily related to management of pitch use and hours of operation and that the protocols for management of these matters have been tightened. In addition, the 3 additional pitches are located at the far end of the site significantly further from the complainants than the existing facilities.

The third matter being the proposed assessment of  $L_{Amax}$  noise levels from the pitch. As the pitch does not operate beyond 2200 hours it is not appropriate to apply a criteria which is normally only applied during night time hours to reduce the risk of sleep disturbance.

## 6 SOURCE NOISE

Noise measurements were taken on the evening of the 3<sup>rd</sup> of March 2020 at a similar football complex to the development - Goals Glasgow South, 5-a-side Football Complex at 941 Pollokshaws Road, Glasgow. The Manchester Goals is similar pitch layout, dimensions and surrounding boards to the pitches at Goals Glasgow South.

The measurements were made using a Bruel & Kjaer Type 2250 sound level meter which was fitted with the standard foam windshield Type UA 1650 and was calibrated before and after the measurements using a Type 4231 sound level meter calibrator.

The meter was tripod mounted at a height of 1.5m from the ground and was located approximately 4m back from the edge of the relevant pitch fence at the halfway line. The measurements were made for a total of 15 minutes (in 1-minute logging periods) in third octave bands across the normal range of parameters, including  $L_{Aeq,T}$ <sup>1</sup> and  $L_{Amax}$ <sup>2</sup> and were attended throughout. All measurements were fast weighted. The measurement position and a photograph of the set-up are shown in Appendix 3.

Weather conditions during measurements were dry and partly cloudy with a SSW wind direction at speeds up to  $4.1ms^{-1}$  and a temperature of  $5^{\circ}C$ .

The noise environment during measurements consisted of noise from participants communicating and noise from the ball striking the surrounding wooden strike boards. It should be noted that whilst noise from other surrounding pitches was audible, the noise from the relevant pitch under test was dominant throughout, and other pitches are considered to have had a minimal contribution to the overall measured level, which was  $L_{Aeq,15mins}$  62dB, with a maximum noise level of  $L_{Amax(fast)}$  80dB. Logged 1-minute measurement data is presented in Appendix 4.

These noise levels are similar to measurements undertaken by New Acoustics at other 5-a-side sites where for example during a 5-a-side practice match the average noise level was 61dBA and the maximum noise level was 75dBA. The match was "low key" without a referee and therefore with no whistle. Most of the noise was from the impact of the foot on the ball and calls between the players. Other 5-a-side matches with adults playing proper games that New Acoustics have measured averaged 59.0 to 62.0dBA

Extensive measurements by New Acoustics of after school use of larger 3G pitches for football (training and matches under 15s, under 12s and under 9s) returned noise levels averaged between 57-61dBA, with maximum noise levels relating to the ball being kicked at the fence of between 70-80dBA (all at 4m).

The measured level of  $L_{Aeq,T}$  62dB @ 4m will be applied as the source noise in the assessment of new pitches at Goals Manchester and is in keeping with New Acoustics library data for measurements of similar sports activities and is also in line with the 2015 Sport England Design Guidance Note on AGP Noise (when modelled as a large area source) which states that the activity noise level for 1 hour is  $L_{Aeq,T}$  58dB @ 10m (based on a survey of nine sports sessions). This noise data is considered robust for use inline with the IoA / ANC, *"Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments."*

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<sup>1</sup>  $L_{Aeq,T}$  is the logarithmic average noise level over time period T

<sup>2</sup>  $L_{Amax}$  is used to represent the highest noise level occurring during each time period

## 7 NOISE MODEL

In order to assess the noise level at the nearest neighbours, an ISO 9613 Cadna-A environmental noise model has been created based on Ink Design drawing no. 20-811-PL02-RevA-ProposedSitePlan-500-A2 and using topographical information from NextMap\_2m\_Contours and mapping data for local area from OS\_VectorMap\_Local.

The “average” pitch noise is modelled as per the Sports England Guidance as a single area source. This source is positioned at a height of 1.5m above the pitch surface to represent the mouth height of typical user (adult height).

Receivers have been located at the façade line of the noise sensitive receptors at 19 Holborn Drive, 14 and 11 Fairfield Drive. Receiver heights are set at 1.5m and 4m above ground level to represent ground and first floor receptors respectively. The model layout is shown in Appendix 5.

Ground absorption in the model has been set to  $G=0.5$  (mixed hard and soft ground) and the air temperature set to 10°C with 70% relative humidity to provide typical scenario for air absorption. Buildings are reflecting with structured facades and 2no. reflections included in the model.

The frequency spectrum for the pitch noise has been applied to the single figure noise level and converted to an area source with sound power level as shown in Table 7. These sound power levels have been shifted to provide  $L_{Aeq,T}$  62dB @ 4m in the noise model.

| <b>Table 7 - Sound Power Level of Pitches used in Cadna-A model</b> |      |      |      |      |      |      |      |      |      |
|---------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|
| Frequency (Hz)                                                      | 63   | 125  | 250  | 500  | 1k   | 2k   | 4k   | 8k   | dBA  |
| 5-a-side (dB)                                                       | 86.8 | 78.8 | 76.9 | 83.8 | 89.5 | 90.1 | 81.6 | 69.4 | 94.1 |
| 7-a-side (dB)                                                       | 87.8 | 79.8 | 77.9 | 84.8 | 90.5 | 91.1 | 82.6 | 70.4 | 95.1 |

The predicted noise levels are set out for each receptor in the model in Appendix 5 with no fence and with fence heights of 1.8m, 3m and 4m. All predicted noise levels are freefield and external. Corresponding noise contour plots are provided for the “no fence” and “4m fence” scenarios.

In addition to the average noise level predictions, ball impact noise as an  $L_{Amax}$  has also been modelled with the source noise located at three locations in line with the northern fence of each of the three new pitches (pitch 4, pitch 8 and pitch 9). The point source is located at a height of 1.5m above the ground and is calibrated to give an  $L_{Amax}$  noise level at 4m distance of 80dBA as measured in Glasgow. The predicted maximum noise levels (freefield) are set out for each receptor in the model (for each pitch) in Appendix 5 with no acoustic fence. Corresponding noise contour plots are provided for the “no fence” scenario for the maximum noise level from each pitch.

## 8 ASSESSMENT

The Sport England guidance is set at 50dBA externally to protect the majority of people from being *moderately* annoyed.

With no mitigation (no fence) all the receptors are predicted to have pitch noise levels from the three new pitches of well below the 50dB  $L_{Aeq,1hr}$  external noise level for “no observed adverse effect level” (NOAEL) as referenced in the government policy as set out in Section 3.

The highest predicted 1 hour average noise level (with no acoustic fence) being 37dBA (external freefield) at 1<sup>st</sup> floor height, some 13dB below the 50dBA target and therefore considered to be “no observed effect level” (NOEL). All predicted noise levels can be seen in Appendix 5.

The addition of a 4m acoustic fence reduces noise levels at the closest receptor at 19 Holborn Drive by 3dB but does little for the other receptors which are less shielded by the natural topography. As predicted noise levels are already so far below the 50dB target noise level it is not considered that the introduction of the acoustic fence is providing significant improvement to justify its inclusion in the design.

The highest maximum noise level at the most exposed receptor from ball hits on the perimeter fence is predicted to be 41dB  $L_{Amax}$  externally at first floor window height. This is more than 10dB below the recommended night time noise levels for preventing sleep disturbance set out in relevant World Health Organisation guidelines<sup>3</sup> and is therefore considered to be “no observed effect level” (NOEL).

## 9 CONCLUSION

An assessment of the noise levels from the three proposed pitches (pitch 4, 8 and 9) at Goals Manchester has been undertaken.

Source noise data used in the assessment is robust having been recorded pre-lockdown at Goals Glasgow.

The assessment is undertaken in line with relevant government policy and applies the “no observed adverse effect level” as the test of impact based on Sports England Guidance and relevant WHO guidance.

Both average and maximum predicted noise levels are shown to be NOEL without an acoustic fence as mitigation. It is therefore not considered that the fence as shown on drawing no. 20-8111-PL 02 Rev A is providing significant improvement in noise level and it is not recommended that the fence is included in the design.

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<sup>3</sup> WHO Night Noise Guidelines for Europe (2009), which recommends an internal  $L_{Amax}$  of 42dB as the NOEL (threshold level for conscious awakenings) for transportation noise sources.





### APPENDIX 3: MEASUREMENT POSITION & EQUIPMENT

The measurement position is indicated in Figure A3.1 with a photograph of the set-up displayed in Figure A3.2.

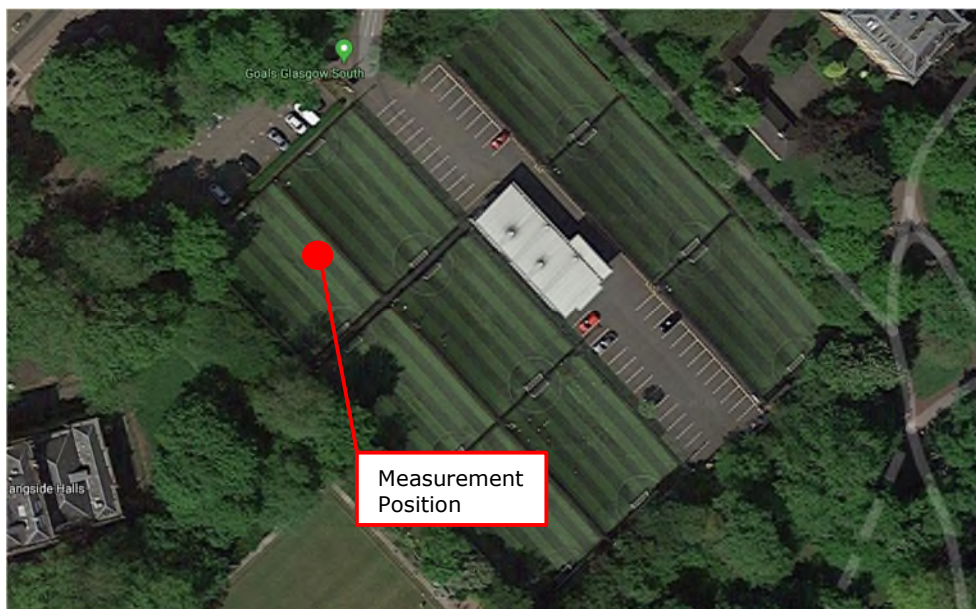


Figure A3.1 – Source Measurement Position



Figure A3.2 – Measurement Equipment in Situ (03/03/20)

#### APPENDIX 4: SOURCE NOISE LOGGED MEASUREMENT DATA

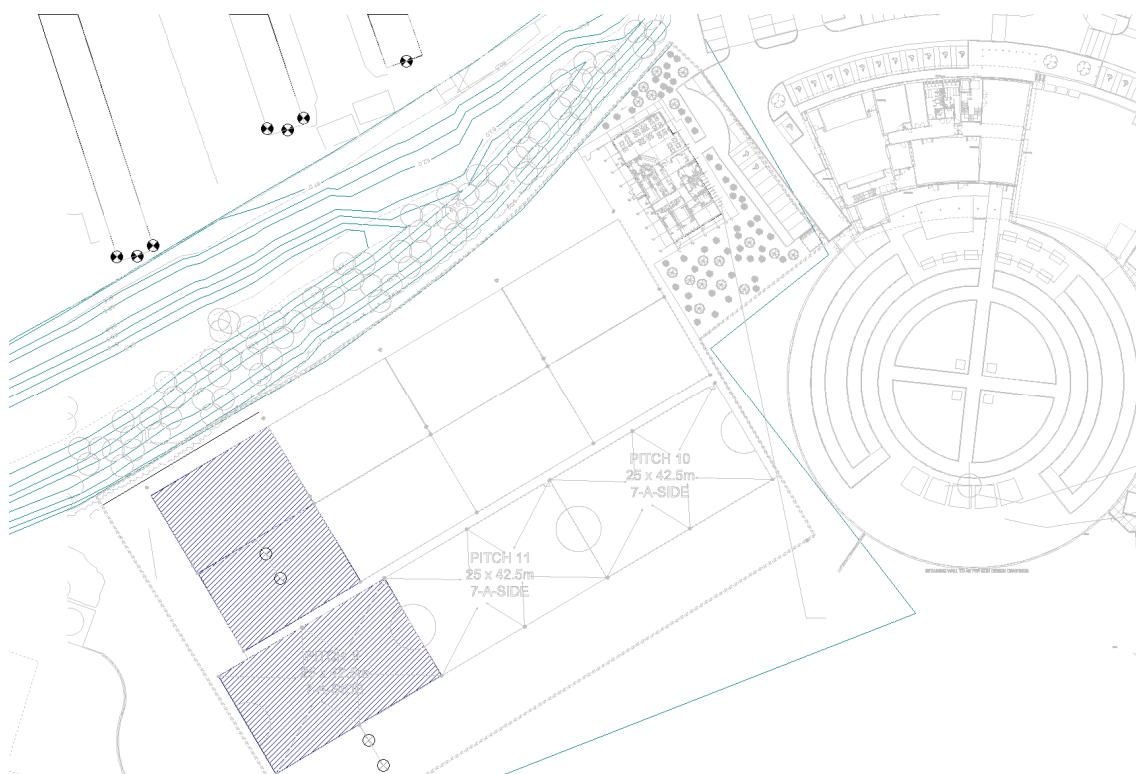
The logged measurement data for the source measurements described in Section 7 is displayed in Table A4.1.

| <b>Table A4.1 – Source Noise Logged Measurement Data</b> |                   |                     |                          |                          |                          |
|----------------------------------------------------------|-------------------|---------------------|--------------------------|--------------------------|--------------------------|
| <b>Date</b>                                              | <b>Start time</b> | <b>Elapsed time</b> | <b>L<sub>AFmax</sub></b> | <b>L<sub>Aeq,T</sub></b> | <b>L<sub>A90,T</sub></b> |
| 03/03/2020                                               | 19:42:04          | 00:01:00            | 82*                      | 64*                      | 54                       |
| 03/03/2020                                               | 19:43:04          | 00:01:00            | 75                       | 62                       | 54                       |
| 03/03/2020                                               | 19:44:04          | 00:01:00            | 79                       | 61                       | 53                       |
| 03/03/2020                                               | 19:45:04          | 00:01:00            | 71                       | 58                       | 53                       |
| 03/03/2020                                               | 19:46:04          | 00:01:00            | 79                       | 62                       | 52                       |
| 03/03/2020                                               | 19:47:04          | 00:01:00            | 80                       | 64                       | 54                       |
| 03/03/2020                                               | 19:48:04          | 00:01:00            | 82*                      | 65*                      | 53                       |
| 03/03/2020                                               | 19:49:04          | 00:01:00            | 80                       | 63                       | 54                       |
| 03/03/2020                                               | 19:50:04          | 00:01:00            | 79                       | 64                       | 54                       |
| 03/03/2020                                               | 19:51:04          | 00:01:00            | 76                       | 62                       | 55                       |
| 03/03/2020                                               | 19:52:04          | 00:01:00            | 79                       | 64                       | 53                       |
| 03/03/2020                                               | 19:53:04          | 00:01:00            | 74                       | 61                       | 55                       |
| 03/03/2020                                               | 19:54:04          | 00:01:00            | 78                       | 63                       | 54                       |
| 03/03/2020                                               | 19:55:04          | 00:01:00            | 72                       | 61                       | 56                       |
| 03/03/2020                                               | 19:56:04          | 00:01:00            | 72                       | 61                       | 55                       |
| <b>AVERAGE:</b>                                          |                   |                     |                          | <b>62</b>                |                          |

\* Removed from average calculation due to extraneous noise event.

## APPENDIX 5: MODEL LAYOUT & PREDICTED NOISE LEVELS

The Cadna-A environmental noise model layout showing 3no. new pitches (no. 4, 8 and 9), receivers positioned on the façade line of the receptors, the barrier location and topography of the hill is shown in Figure A5.1



**Figure A5.1 – Noise Model Layout**

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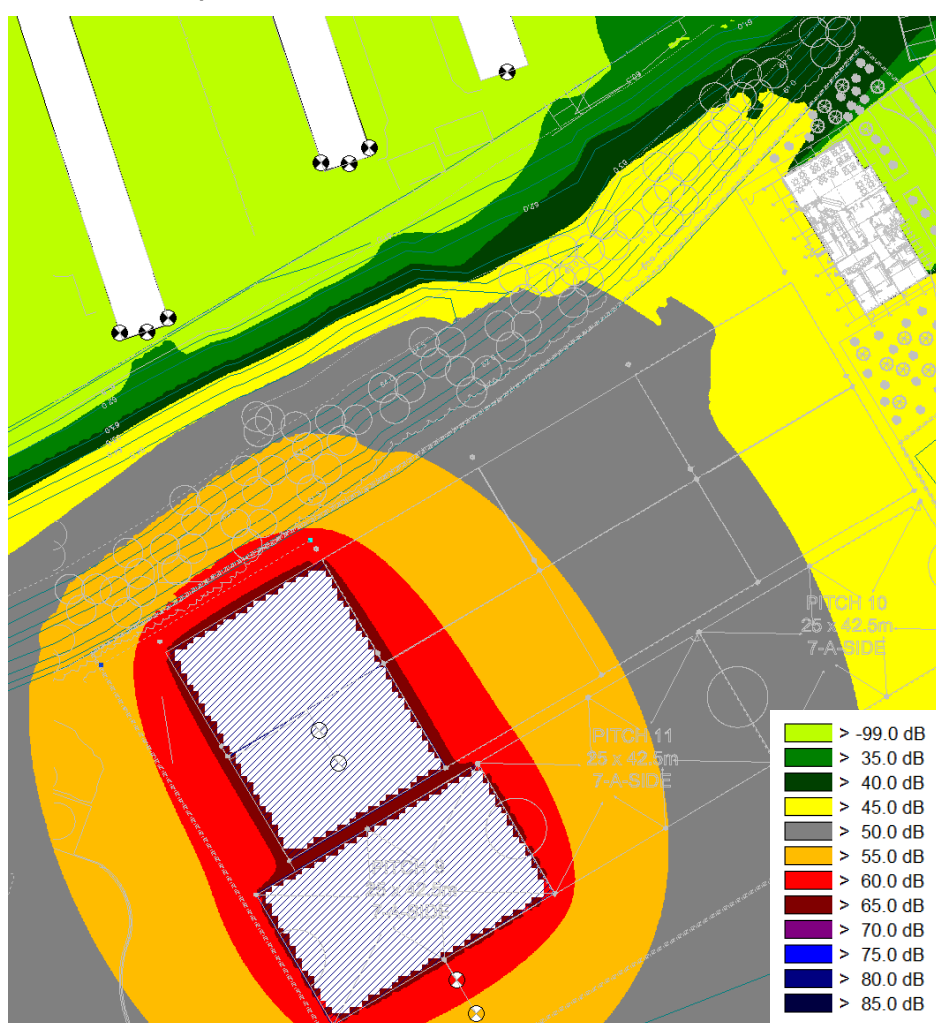
Predicted External Average Noise Levels with no acoustic fence:-

| Receptor                         | Predicted External Noise Level $L_{Aeq,1hr}$ (dB) | Height of Receiver (m) |
|----------------------------------|---------------------------------------------------|------------------------|
| 19HolbornDrive_FrontWindow_Grd   | 30.2                                              | 1.5                    |
| 19HolbornDrive_FrontWindow_1st   | 35.8                                              | 4                      |
| 19HolbornDrive_GableWindow_Grd   | 30.6                                              | 1.5                    |
| 19HolbornDrive_GableWindow_1st   | 37.0                                              | 4                      |
| 19HolbornDrive_RearWindow_Grd    | 30.5                                              | 1.5                    |
| 19HolbornDrive_RearWindow_1st    | 36.7                                              | 4                      |
| 14FairfieldDrive_RearWindow_Grd  | 30.3                                              | 1.5                    |
| 14FairfieldDrive_RearWindow_1st  | 35.5                                              | 4                      |
| 14FairfieldDrive_GableWindow_Grd | 30.2                                              | 1.5                    |
| 14FairfieldDrive_GableWindow_1st | 35.7                                              | 4                      |

|                                  |      |     |
|----------------------------------|------|-----|
| 14FairfieldDrive_FrontWindow_Grd | 29.1 | 1.5 |
| 14FairfieldDrive_FrontWindow_1st | 33.8 | 4   |
| 11FairfieldDrive_GableWindow_Grd | 31.1 | 1.5 |
| 11FairfieldDrive_GableWindow_1st | 37.0 | 4   |

The corresponding noise contour plots showing predicted external noise levels with no acoustic barrier fence at 1.5m and 4m grid heights are shown in figures A5.2 and A5.3

1.5m grid height noise contour plot ( $L_{Aeq,1hr}$  in dB) is shown below (no acoustic fence):



**Figure A5.2 – 1.5m grid height noise contour plot with no acoustic fence,  $L_{Aeq,1hr}$  (dB)**

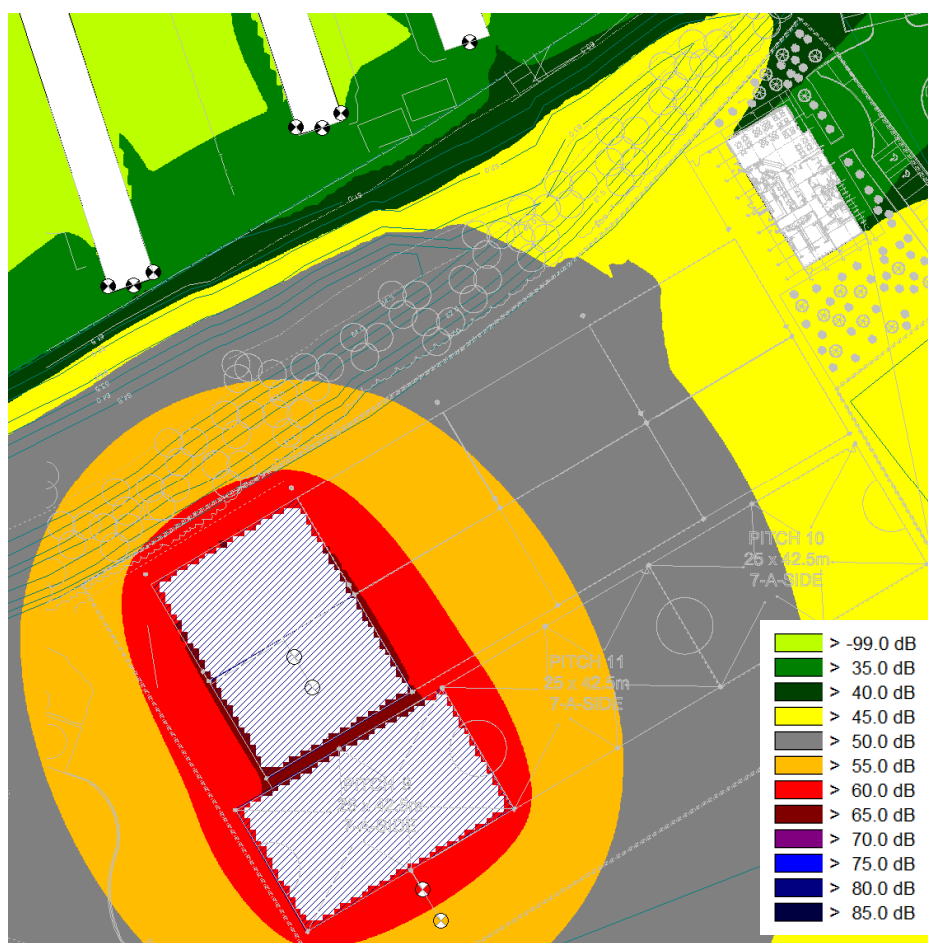


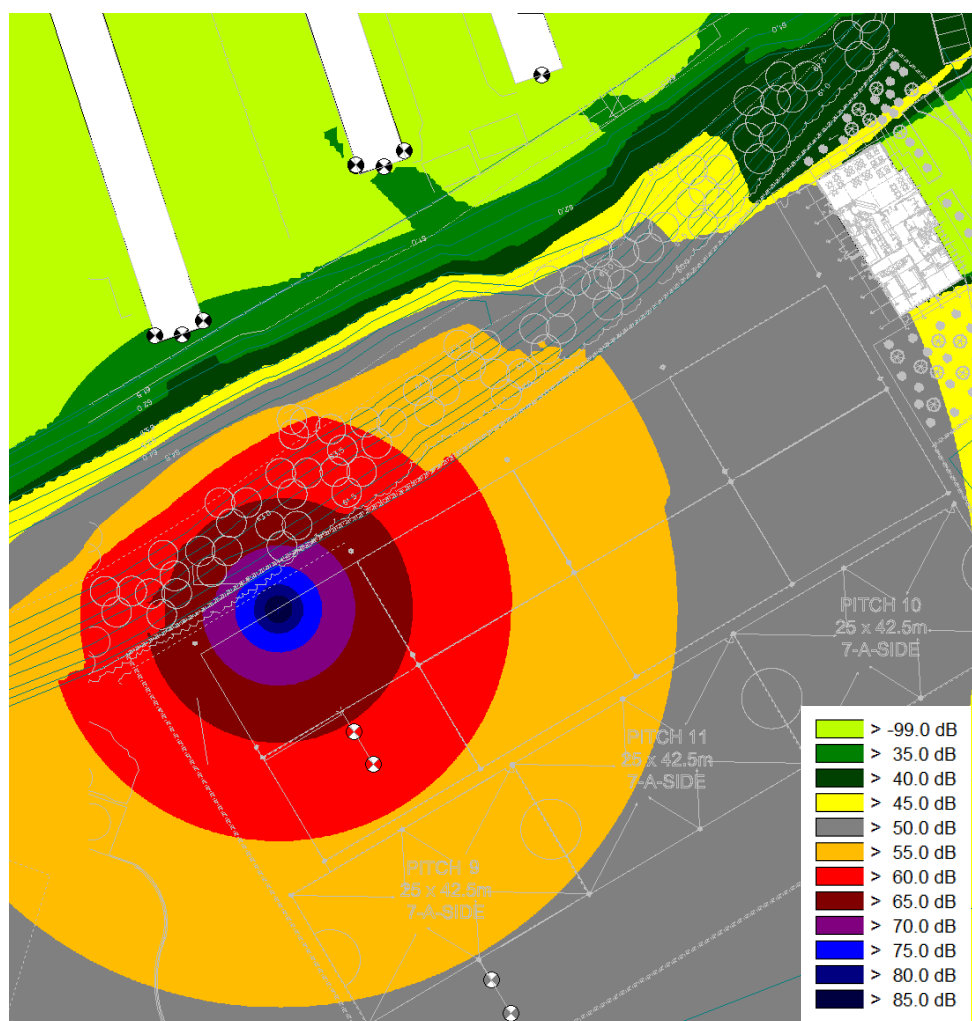
Figure A5.3 – 4m grid height noise contour plot with no acoustic fence,  $L_{Aeq,1hr}$  (dB)

Predicted External Maximum Noise Levels with no acoustic fence:-

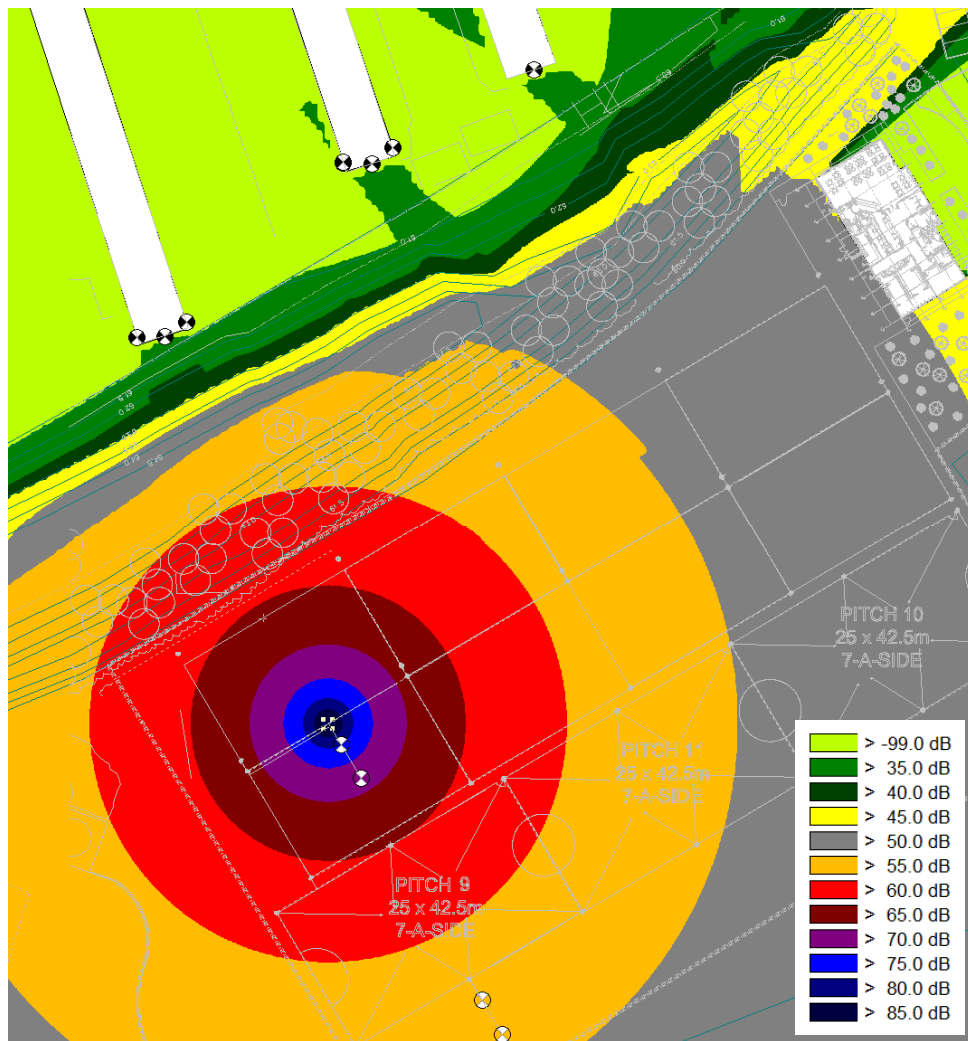
| Receptor                         | Predicted External Maximum Noise Level $L_{Amax,1hr}$ (dB) – with no fence |         |         | Receiver Height (m) |
|----------------------------------|----------------------------------------------------------------------------|---------|---------|---------------------|
|                                  | Pitch 4                                                                    | Pitch 8 | Pitch 9 |                     |
| 19HolbornDrive_FrontWindow_Grd   | 35.0                                                                       | 33.4    | 31.7    | 1.5                 |
| 19HolbornDrive_FrontWindow_1st   | 38.2                                                                       | 38.6    | 38.0    | 4                   |
| 19HolbornDrive_GableWindow_Grd   | 35.4                                                                       | 33.9    | 32.2    | 1.5                 |
| 19HolbornDrive_GableWindow_1st   | 39.0                                                                       | 39.7    | 39.6    | 4                   |
| 19HolbornDrive_RearWindow_Grd    | 35.1                                                                       | 33.9    | 32.3    | 1.5                 |
| 19HolbornDrive_RearWindow_1st    | 38.7                                                                       | 39.7    | 39.6    | 4                   |
| 14FairfieldDrive_RearWindow_Grd  | 33.5                                                                       | 33.3    | 32.5    | 1.5                 |
| 14FairfieldDrive_RearWindow_1st  | 36.4                                                                       | 37.9    | 38.4    | 4                   |
| 14FairfieldDrive_GableWindow_Grd | 33.6                                                                       | 33.2    | 32.4    | 1.5                 |
| 14FairfieldDrive_GableWindow_1st | 36.6                                                                       | 38.1    | 38.6    | 4                   |

|                                  |      |      |      |     |
|----------------------------------|------|------|------|-----|
| 14FairfieldDrive_FrontWindow_Grd | 32.8 | 32.2 | 31.1 | 1.5 |
| 14FairfieldDrive_FrontWindow_1st | 35.5 | 36.5 | 36.5 | 4   |
| 11FairfieldDrive_GableWindow_Grd | 32.6 | 33.0 | 33.6 | 1.5 |
| 11FairfieldDrive_GableWindow_1st | 35.8 | 38.0 | 41.1 | 4   |

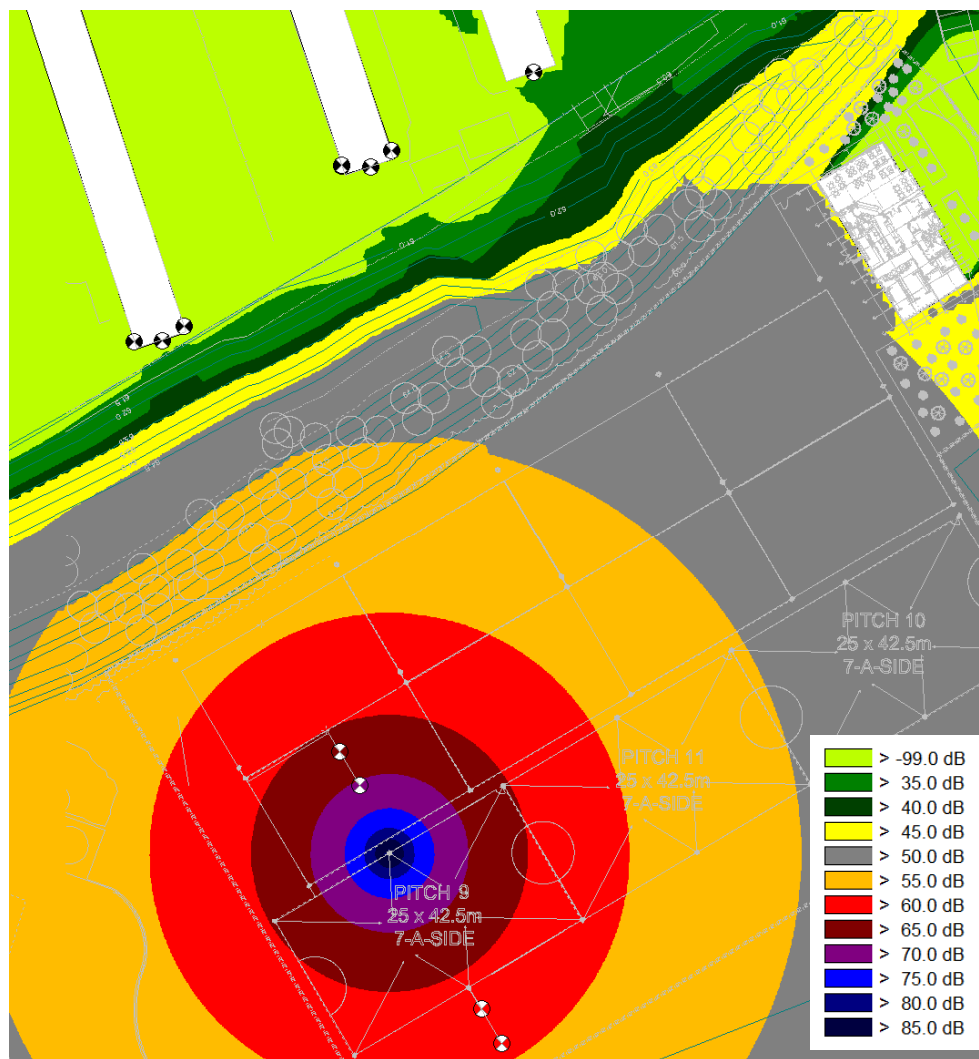
The corresponding noise contour plots ( $L_{Amax,fast}$  in dB) showing predicted noise levels with no acoustic fence at 4m grid heights are shown in figures A5.4, A5.5 and A5.6.



**Figure A5.4 – Maximum external noise level from pitch 4, 4m grid height noise contour plot with no acoustic fence,  $L_{Amax,T}$  (dB)**



**Figure A5.5 – Maximum external noise level from pitch 8, 4m grid height noise contour plot with no acoustic fence,  $L_{Amax,T}$  (dB)**



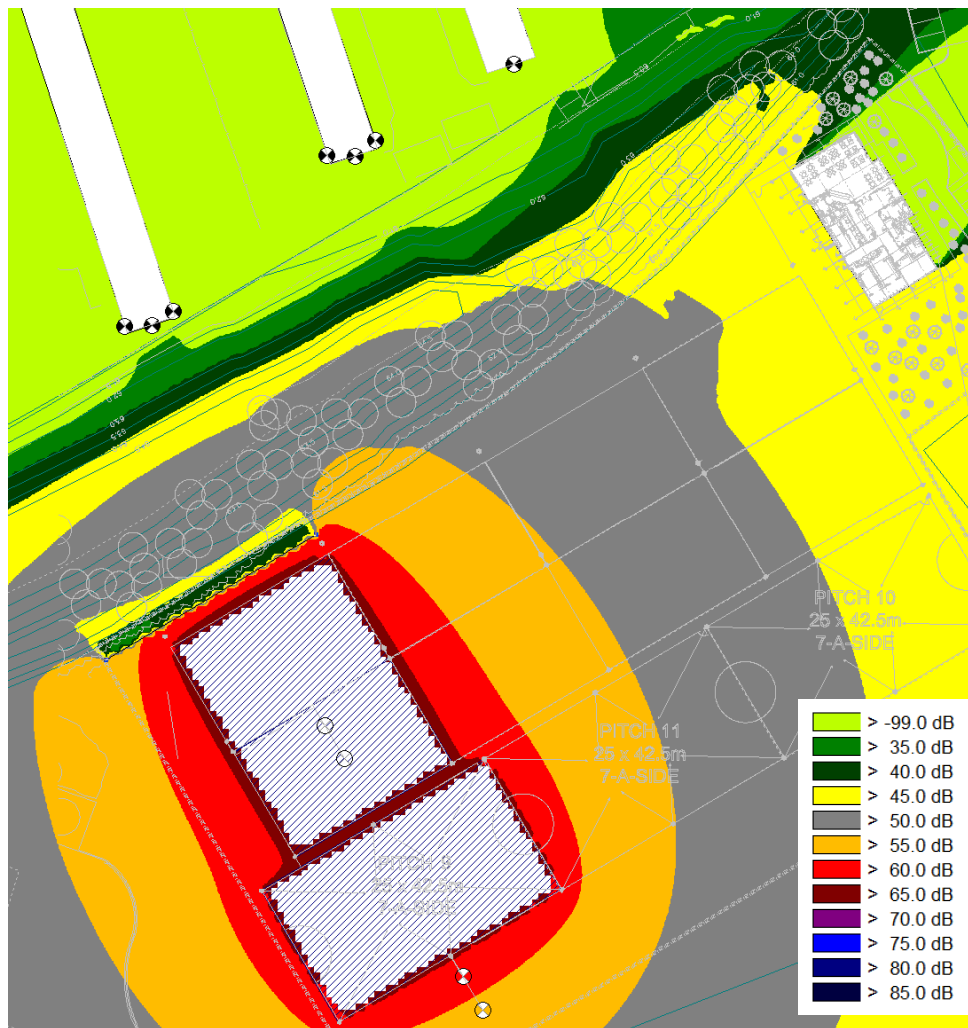
**Figure A5.6 – Maximum external noise level from pitch 9, 4m grid height noise contour plot with no acoustic fence,  $L_{Amax,T}$  (dB)**

The following table shows the comparison of predicted average ( $L_{Aeq,1hr}$ ) external noise levels with different height fences:

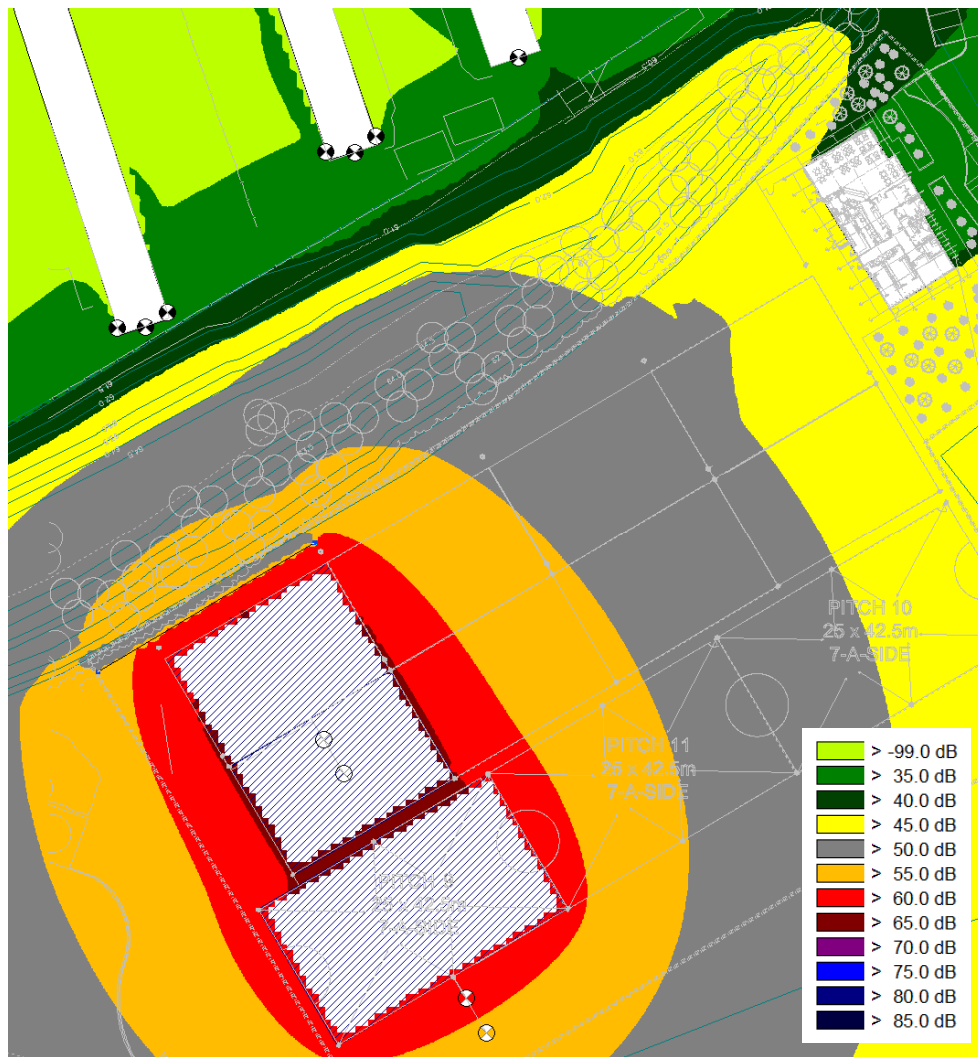
| Receptor                         | Predicted External Noise Level $L_{Aeq,1hr}$<br>(dB) |            |          |          |
|----------------------------------|------------------------------------------------------|------------|----------|----------|
|                                  | No fence                                             | 1.8m fence | 3m fence | 4m fence |
| 19HolbornDrive_FrontWindow_Grd   | 30.2                                                 | 29.4       | 27.4     | 27.3     |
| 19HolbornDrive_FrontWindow_1st   | 35.8                                                 | 35.8       | 35.0     | 33.5     |
| 19HolbornDrive_GableWindow_Grd   | 30.6                                                 | 30.6       | 30.6     | 30.5     |
| 19HolbornDrive_GableWindow_1st   | 37.0                                                 | 37.0       | 36.9     | 36.7     |
| 19HolbornDrive_RearWindow_Grd    | 30.5                                                 | 30.3       | 29.9     | 29.8     |
| 19HolbornDrive_RearWindow_1st    | 36.7                                                 | 36.7       | 36.5     | 36.2     |
| 14FairfieldDrive_RearWindow_Grd  | 30.3                                                 | 30.2       | 30.2     | 30.2     |
| 14FairfieldDrive_RearWindow_1st  | 35.5                                                 | 35.5       | 35.4     | 35.4     |
| 14FairfieldDrive_GableWindow_Grd | 30.2                                                 | 30.2       | 30.2     | 30.1     |
| 14FairfieldDrive_GableWindow_1st | 35.7                                                 | 35.7       | 35.7     | 35.6     |
| 14FairfieldDrive_FrontWindow_Grd | 29.1                                                 | 28.7       | 28.7     | 28.7     |
| 14FairfieldDrive_FrontWindow_1st | 33.8                                                 | 33.8       | 33.2     | 33.2     |
| 11FairfieldDrive_GableWindow_Grd | 31.1                                                 | 31.1       | 31.1     | 31.0     |
| 11FairfieldDrive_GableWindow_1st | 37.0                                                 | 37.0       | 36.9     | 36.9     |

The corresponding noise contour plots showing predicted noise levels with a 4m acoustic barrier fence at 1.5m and 4m grid heights are shown in Figures A5.7 and A5.8.

Shielding from the pitch noise can be seen directly to the rear of the 4m acoustic fence line, however due to the size and distance of the noise sources (the pitches) from the receptors and the location of the intervening earth bund (wooded hill) the 4m high acoustic fence is not providing significant additional shielding to the residential properties beyond.



**Figure A5.7 – 1.5m grid height noise contour plot with 4m high acoustic fence,  $L_{Aeq,1hr}$  (dB)**



**Figure A5.8 – 4m grid height noise contour plot with 4m high acoustic fence,  $L_{Aeq,1hr}$  (dB)**