



NOISE IMPACT ASSESSMENT

REEDS FARM, HICKSTEAD

WORK BY HERE LTD

MARCH 2025

NOISE IMPACT ASSESSMENT REEDS FARM, HICKSTEAD

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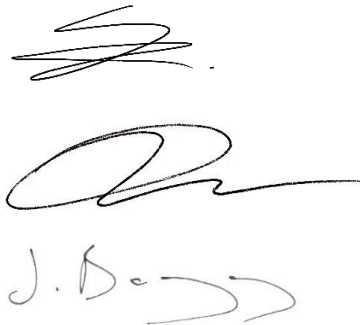
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1-0	First draft for team comment	26/11/21	RNM	CW
2-0	Updated bund positions	10/09/24	JE	JB
3-0	Updated bund design	27/02/25	JN	JB

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1 INTRODUCTION

Anderson Acoustics Ltd was commissioned by Work By Here Ltd in February 2025 to update a previous noise assessment (appended to end of this document) for the construction of an earth bund on the land at Reeds Farm, Hickstead. This assessment has been undertaken to determine the resultant change in noise level across the development site with an earth bund in place along the western boundary.

This report presents the results of an environmental noise survey undertaken at the site, which was used to develop a noise model using the software CadnaA (2024 edition). The model has been used to calculate the typical daytime and night-time sound levels across the site in order to determine the requirement for noise mitigation in light of the relevant external and internal noise criteria.

This report is technical in nature, and as such, a glossary of relevant technical terminology can be found [here](#).

2 SITE DEVELOPMENT DETAILS

2.1 Existing Site

The site is located to the east of the A23 and is surrounded to the north, east and south by farmland. The existing residential building is in a dilapidated state and has been demolished and replaced with a new dwelling. There are a number of commercial units on the opposite side of the A23 on the A2300. An aerial view of the site location and surrounding area is shown in Figure 2.1 below.

Figure 2.1: Site location and measurement positions ©2024 Google



2.2 Noise Sources

As to be expected, it was noted during site visits that the noise environment was dominated by road traffic movements from the A23. Bird song was audible during the breaks in traffic. No noise was witnessed from the commercial uses on the other side of the A23.

Gatwick Airport is located approximately 20 km to the north of the site. No noise from aircraft movements were audible during the installation and collection of the sound level monitors.

In terms of the assessment, therefore, it is considered sufficient to assume that all sound levels measured originate from the A23.

2.3 Proposed Development

An earth bund running parallel to the A23 is proposed, in part, to reduce noise levels at the new premises. The extent of the proposed bund is shown by the red contour in Figure 2.2 (each contour represents 1m increments). A 2.5m solid fence/gate is also proposed at the break in the bund for access and extends southwards running along the top of the first part of the southern bund.

Figure 2.2: Site plan of proposed development (preliminary) (Source: Fluid Planning)



3 BASELINE NOISE CONDITIONS

3.1 Introduction

The prevailing noise conditions across the development have been determined by detailed unattended environmental noise survey. This was undertaken over an eight-day period between Wednesday 6th and Thursday 14th October 2021, and managed by a consultant certified as competent in environmental noise monitoring.

The continuous unattended noise measurements were undertaken to the north of the site as shown in Figure 2.1 earlier. The two locations were chosen to characterise the day and night noise emissions from the main source impacting the site, i.e. the A23.

Monitor position 1 (MP1) was located 30m east of the A23 at a height of 1.5m and monitor position 1 (MP2) was located 60m east of the A23 at a height of 2.5m. Both monitors were under free-field conditions. The fact that two positions were adopted was to provide better coverage for calibrating the noise model, as described in Section 5.

3.2 Instrumentation

A full inventory of the monitoring equipment is shown in Table 3.1 below. Calibration certificates are available on request. The sound levels meters used conform to Class 1 specification of BS 61672-1:2013.

Table 3.1: Inventory of Measurement Equipment

Location	Item	Make and Model	Serial Number	Calibration	
				Certificate number	Expiry Date
MP1	Sound Level Meter	Rion NL-52	00732147	UCRT20/2260	18/12/2022
	Preamplifier	Rion NH-25	32175		
	Microphone	Rion UC-59	05339		
	Calibrator	Rion NC-74	34304643	1500367-1	24/5/2022
MP2	Sound Level Meter	Rion NL-32	00872234	UCRT20/1914	23/09/2022
	Preamplifier	Rion NH-25	24096		
	Microphone	Rion UC-59	319496		
	Calibrator	Rion NC-74	34304643	1500367-1	24/5/2022

Each measurement was calibrated at the start of the survey, and the level checked at the end. No significant drift in calibration level was found to have occurred.

3.3 Weather Conditions

Weather conditions were dry with light to moderate winds during both the installation and decommissioning of the sound level monitoring equipment. This is understood to have predominantly remained the case for the duration of the survey, whereby the conditions are considered conducive to the reliable measurements of typical noise conditions.

Since, however, the A23 is both close to the site and dominant, we would expect little influence due to changes in meteorological conditions in any case. As shown below, the results day to day are very consistent.

3.4 Noise Survey Results

The 15-minute results are presented in chart form in Appendix A, with the period $L_{Aeq,T}$ levels and the night-time L_{AFmax} levels, as most relevant to the assessment, presented overleaf for MP1 and MP2 in Tables 3.2 and 3.3. Strictly, the L_{AFmax} levels should be determined on an “event” basis. Since, as is often the case for long term data, levels are available on a period basis only – 15-minutes in this case – the 90th percentile levels have been determined.

Table 3.2: Summary Results of the Unattended Noise Survey (Free-Field Levels) – Position 1

Date	Daytime (0700-2300)	Night-time (2300-0700)	
	$L_{Aeq,16h}^1$	$L_{Aeq,8h}^1$	90 th Percentile L_{Amax}^2
Wednesday 21/10/06	70 ³	63	76
Thursday 21/10/07	70	63	76
Friday 21/10/08	70	63	74
Saturday 21/10/09	69	63	80
Sunday 21/10/10	69	64	75
Monday 21/10/11	70	63	75
Tuesday 21/10/12	69	63	75
Wednesday 21/10/13	70	-	-
Average (Highest)	70 (70)	63 (64)	76 (80)

¹ Based on the logarithmic average of the $L_{Aeq,5min}$ levels.

² Used on the 5-minute levels as an alternative to the 10th highest “event” level.

³ Part data from after the equipment was installed (strictly $L_{Aeq,11h}$).

Table 3.3: Summary Results of the Unattended Noise Survey (Free-Field Levels) – Position 2

Date	Daytime (0700-2300)	Night-time (2300-0700)	
	$L_{Aeq,16h}^1$	$L_{Aeq,8h}^1$	90 th Percentile L_{Amax}^2
Wednesday 21/10/06	67 ³	58	69
Thursday 21/10/07	64	58	70
Friday 21/10/08	64	59	69
Saturday 21/10/09	65	58	74
Sunday 21/10/10	65	61	73
Monday 21/10/11	66	59	70
Tuesday 21/10/12	66	60	70
Wednesday 21/10/13	66	-	-
Average (Highest)	65 (67)	59 (61)	71 (74)

¹ Based on the logarithmic average of the $L_{Aeq,5min}$ levels.

² Used on the 5-minute levels as an alternative to the 10th highest “event” level.

³ Part data from after the equipment was installed (strictly $L_{Aeq,11h}$).

The following are observed from the above data:

- All levels are very consistent, with only 1 dB between the average and highest levels. This indicates consistent conditions across the survey and a robust dataset.
- The difference between the daytime and night-time $L_{Aeq,T}$ levels is 7 dB on average, this is to be expected in such a location. This means that relative to the criteria, which are 5 dB apart between the daytime (living room/bedroom) and night-time (bedroom) periods (see Table 3.1), the daytime conditions are relatively higher than the night-time conditions.

- The difference between the night-time $L_{Aeq,8h}$ and L_{AFmax} levels is 10 dB on average. Since the difference between the criteria for these metrics is 15 dB (see Table 3.1), meeting the $L_{Aeq,8h}$ criterion will be the driving factor at night. This is to be expected for such a location.
- The maximum noise levels taken from the 90th percentile are shown as 76 and 71 dB for positions 1 and 2 respectively. A value of 74 dB L_{AFmax} has been used in the following assessment. It is considered to be a reasonable approach to use these maximum noise levels for the assessment given the data and nature of the source/noise.

Overall, the data is entirely as expected, and considered further below.

4 NOISE MODELLING

In order to calculate the sound levels across the site as a whole, i.e. beyond the monitoring location, and account for the effect of boundary screening and the location of the building, a 3D noise model has been built using the proprietary noise modelling software CadnaA. The calculations have been carried out in accordance with ISO 9613, therefore, which allows consideration of the effects of the ground and atmospheric absorption, and acoustic reflections and screening.

Existing site and surrounds topography information has been acquired from the Department for Environment Food & Rural Affairs (Defra) and has been imported into CadnaA.

In terms of noise sources, it is only necessary and practicable to include the A23. Daytime and night-time flows for this road have been determined based on the average $L_{Aeq,16h}$ and $L_{Aeq,8h}$ levels (as presented in Tables 4.2 and 4.3) measured at both locations (as presented in Table 3.1). Good correlation was found between the levels at both locations, confirming that the A23 was dominant and indicating that the model should be fit for purpose.

Accordingly, the (calibrated) model has been used to calculate the day and night-time sound levels across the site with the introduction of the earth bund. The location of the building is as per the current scheme drawings.

The results are summarised in the following figures and tables. The first set of images in Figure 5.2 presents the existing situation, with sound level contour bands representing the daytime $L_{Aeq,16h}$ levels at 4.5 m above ground level (AGL) (equivalent to upper floor window level) as worst case. The second set of images in Figure 5.3 presents the same for the night-time $L_{Aeq,8h}$ period.

Table 5.1 presents the daytime $L_{Aeq,16h}$ results at ground floor level (1.5 m AGL) and at the upper height (i.e. 4.5 m AGL), where bedrooms would be located. Table 5.2 presents the night-time $L_{Aeq,8h}$ levels at the upper height (i.e. 4.5 m AGL), where bedrooms would be located.

The results are presented and discussed in Section 4.2

4.1 Results

Graphical noise model results are displayed below in Figures 4.1 to 4.3 for 1.5m AGL and 4.5m AGL, respectively.

Figure 4.1: Calculated Sound Levels Across the Site at 1.5 m AGL

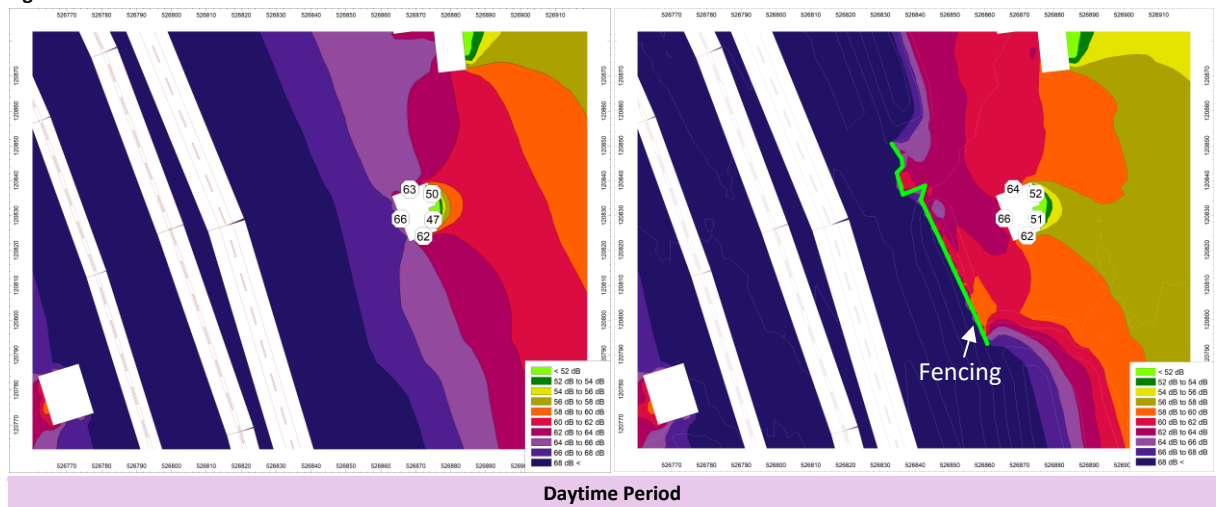


Figure 4.2: Calculated Daytime Sound Levels Across the Site at 4.5 m AGL

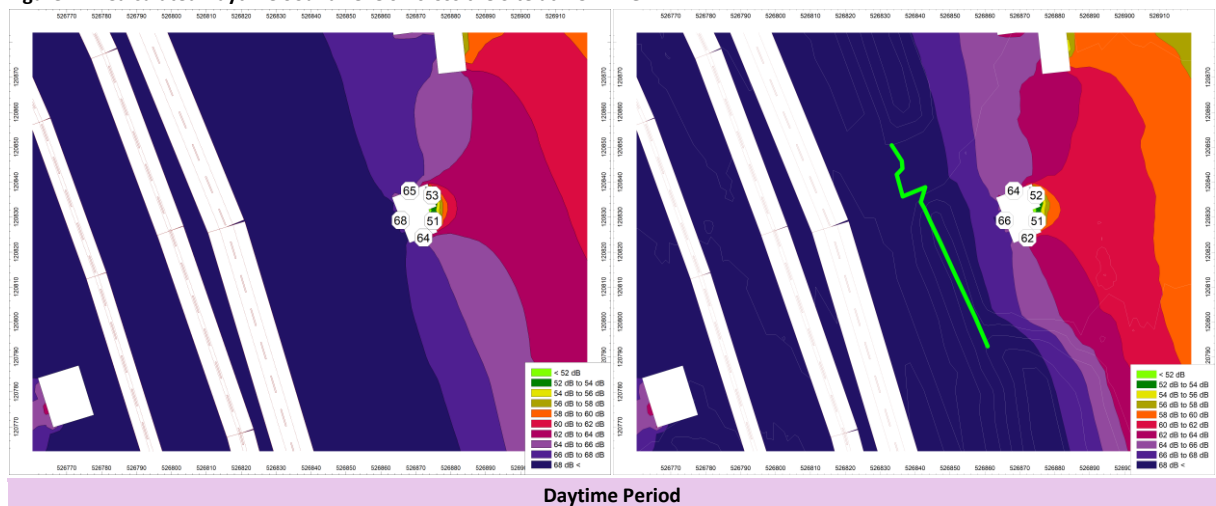
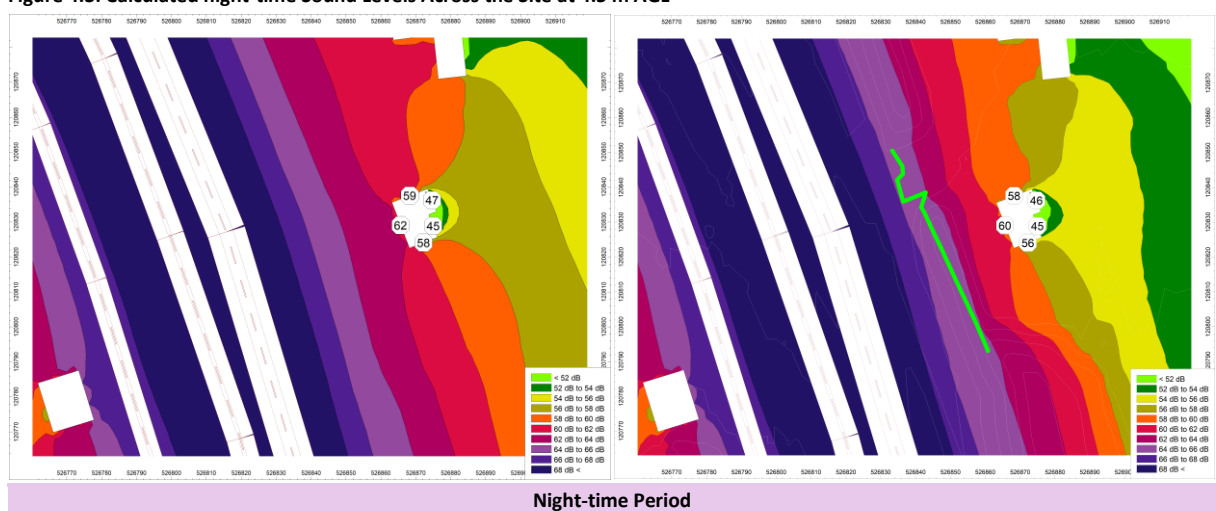


Figure 4.3: Calculated night-time Sound Levels Across the Site at 4.5 m AGL



The tabulated noise model results are displayed below in Tables 4.1.

Table 4.1: Calculated Sound Levels for Mitigation Options Compared to Existing

Floor	Façade	Scenario	
		Existing	Earth bund and fencing
Daytime Period, dB L _{Aeq,16h}			
Ground Floor (1.5 m AGL)	West façade	66	62 (-4)
	North façade	63	60 (-3)
	East façade	50	48 (-2)
	South façade	62	57 (-5)
First Floor (4.5 m AGL)	West façade	68	66 (-2)
	North façade	65	64 (-1)
	East façade	53	52 (-1)
	South façade	64	62 (-2)
Night-time Period, dB L _{Aeq,8h}			
First Floor (4.5 m AGL)	West façade	62	60 (-2)
	North façade	59	58 (-1)
	East façade	47	46 (-1)
	South façade	58	56 (-2)

4.2 Discussion

The above results demonstrate that external sound levels at the façade of the premises can be reduced with the construction of an earth bund and fencing. Maximum benefits due to the presence of the bund are up to 5 decibels. For context, a difference of around 10dB is considered a doubling/halving of subjective loudness. Maximum reductions in noise level would be experienced at ground floor level where the effective barrier height is greatest.

It should be noted that in order to achieve the results presented in Table 5.1, the 2.5m gate and fencing should be made of a solid material with a minimum surface mass of 12kg/m².

APPENDIX A

NOISE SURVEY TIME HISTORY GRAPHS



Figure A-1: Noise survey's time history – Monitoring Position 1

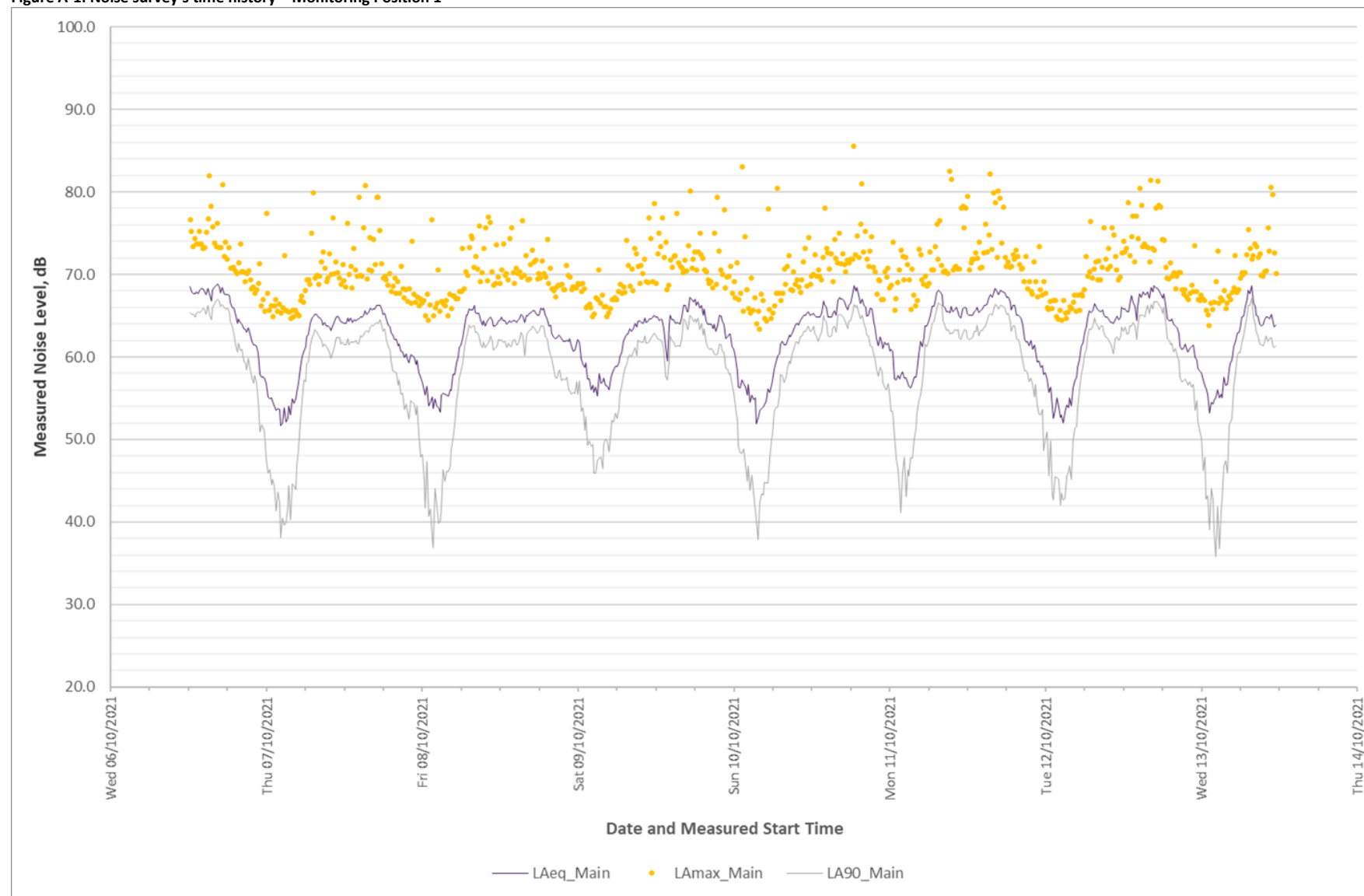
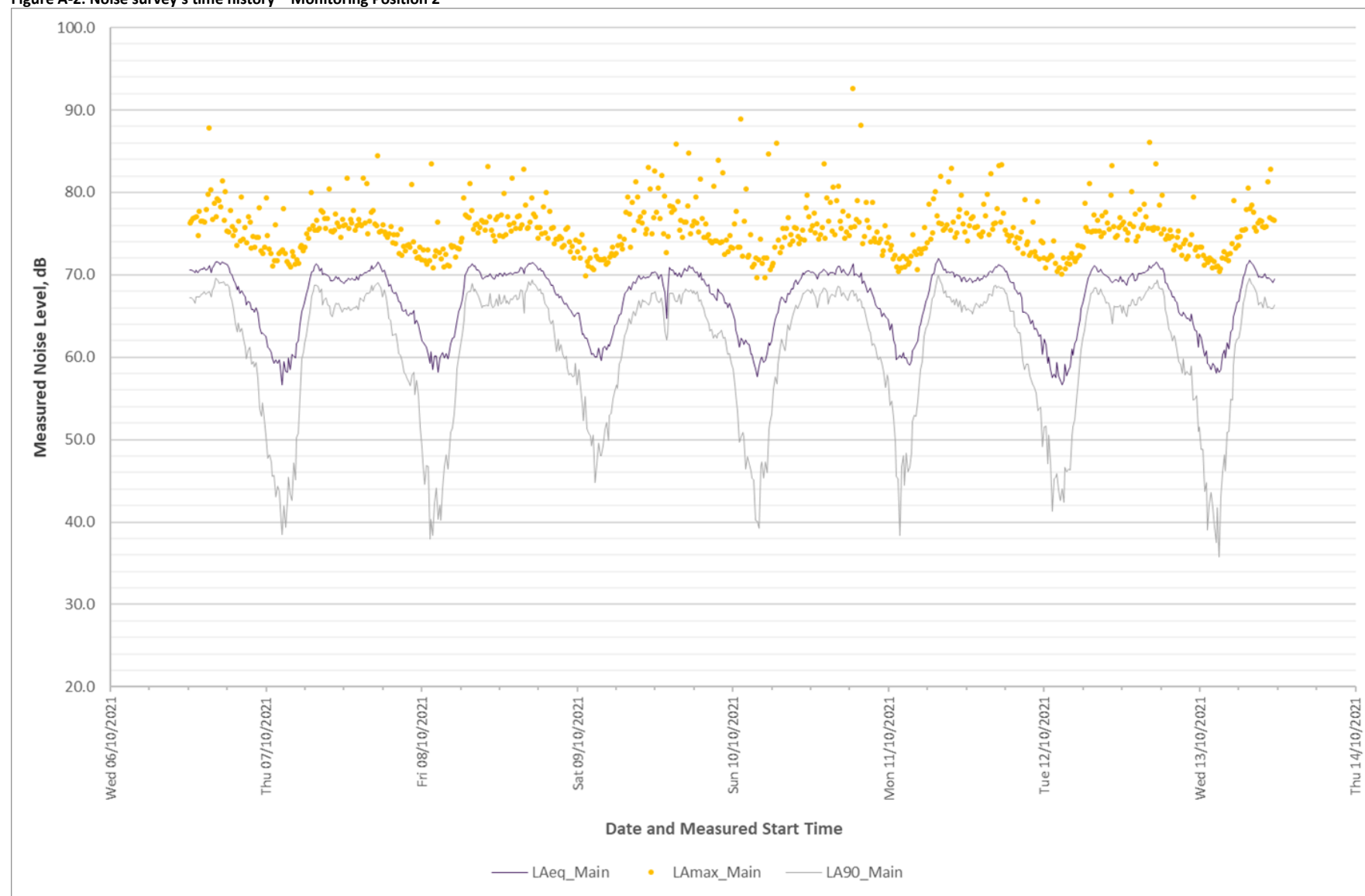


Figure A-2: Noise survey's time history – Monitoring Position 2



APPENDIX B

2021 OPTIONS APPRAISAL (5549_001R_1-0_RNM_E)



NOISE ASSESSMENT

REEDS FARM, HICKSTEAD

FLUID PLANNING

NOVEMBER 2021

NOISE ASSESSMENT
REEDS FARM, HICKSTEAD
Our Ref: 5549_001R_1-0_RNM



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0-5	First draft for team comment	26/11/21	RNM	CW

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1 INTRODUCTION

Anderson Acoustics Ltd was commissioned in October 2021 by Fluid Planning to carry out a noise assessment for the development of a new detached property on the land at Reeds Farm, Hickstead. This assessment is aimed at determining and assessing the noise from the A23 at the site in relation to residential accommodation and, where required, assist with the outline design of a bund.

This report presents the results of an environmental noise survey undertaken at the site, which was used to develop a noise model using the software CadnaA (2021 edition). The model has been used to calculate the typical daytime and night-time sound levels across the site, and at different heights, in order to determine the requirement for noise mitigation in light of the relevant external and internal noise criteria.

Due to the proximity of the site to the A23, significant noise control will be required (regardless of the location on site), hence this has been explored in terms of the use of screening on the site boundary, the location of the property and its external building fabric. Whilst, due to the location of the access to the site from the A23 resulting in the need for a break in the boundary screening, in practice a combination of all three forms of control may be required.

A brief description of the site is given in Section **Error! Reference source not found.**

Guidance relevant to the assessment has been presented and briefly discussed in Section **Error! Reference source not found.**

The methodology and results of the environmental noise survey are given in Section 4.

Section 5 provides details of the noise modelling used to calculate the sound levels across the site and account for the effect of the boundary screening options.

Section 6 provides an initial assessment of the external sound levels based on the assumed boundary screening, and discussion on the additional measures required to meet relevant internal noise targets during both background ventilation and overheating/cooling conditions.

A summary is presented as Section 7.

2 SITE AND DEVELOPMENT DETAILS

2.1 Existing Site

The site is located to the east of the A23 and is surrounded to the north, east and south by farmland. The existing residential building is in a dilapidated state and is to be demolished to make way for the new development. There are a number of commercial units on the opposite side of the A23 on the A2300. An aerial view of the site location and surrounding area is shown in **Figure 2.1** below.

Figure 2.1: Site location (highlighted in blue) and measurement position (red). ©2021 Google



2.2 Noise Sources

As to be expected, it was noted during site visits that the noise environment was dominated by road traffic movements from the A23. Bird song was audible during the breaks in traffic. No noise was witnessed from the commercial uses on the other side of the A23.

Gatwick Airport is located approximately 20km to the north of the site. No noise from aircraft movements were audible during the installation and collection of the sound level monitors.

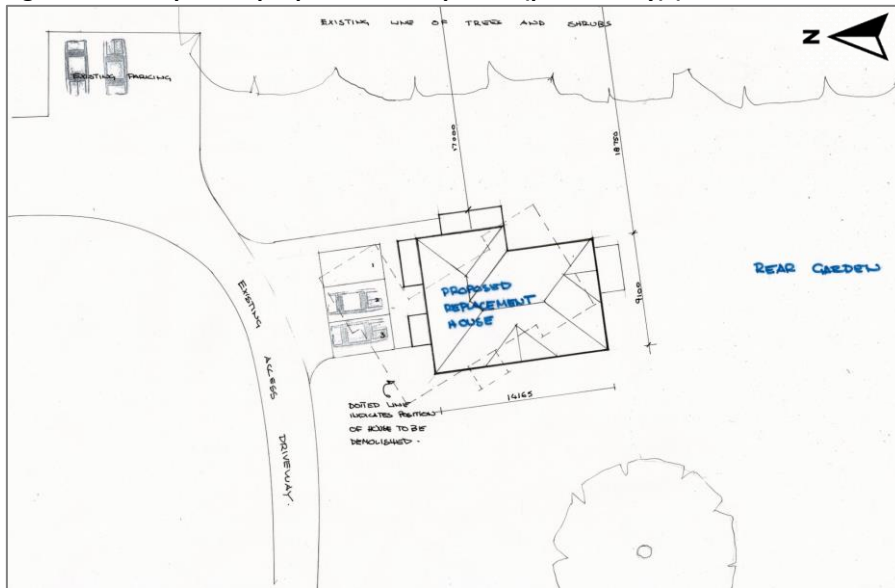
In terms of the assessment, therefore, it is considered sufficient to assume that all sound levels measured originate from the A23.

2.3 Proposed Development

Planning permission is sought for a single detached dwellings with associated landscaping and parking. A site plan of the proposed development is provided in **Figure 2.2** below. The footprint of the existing building can just be seen as a dashed line. The plans are preliminary, with alternative locations having been explored as part of the noise assessment to maximise the benefit of boundary screening. The access and parking area shown are as per the current arrangements.

At this stage the ventilation strategy is not known and so on this basis, windows have been assumed to be openable for the purposes of purge ventilation during which noise criteria do not apply.

Figure 2.2: Site plan of proposed development (preliminary) (Source: Fluid Planning)



3 NOISE CRITERIA

3.1 External Noise Criteria

BS 8233 recommends that:

...for traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external 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. However, it is also recognised that these guideline values are not achievable in all circumstances where development might also be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Accordingly, levels in the main outdoor amenity space(s) of no more than 50 dB $L_{Aeq,T}$ should be the aim, but where levels of up to 55 dB should also be acceptable. The time period, T, applicable to these thresholds is not given in the Standard; however, in keeping with the equivalent daytime internal noise criteria, and other guidance (such as the **WHO Guidelines**¹ and the **ProPG**²), the 16 hour period between 07:00 and 23:00 hours is considered applicable. In other words, the limit is 55 dB $L_{Aeq,16h}$ due to the nature of the site.

3.2 Internal Noise Criteria

The criteria recommended in **BS 8233**³ for residential spaces are summarised in **Table 3.1**.

Table 3.1: Indoor ambient noise levels for dwellings (as per Table 4 of BS 8233)

Activity	Location	07-23 (Daytime)	23-07 (Night-time)
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

Further to which, the Standard states that:

Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.

In keeping with the previous version of the Standard, and also the guidance in the aforementioned **WHO Guidelines** and the **ProPG**, a limit of 45 dB $L_{Amax,F}$ (also written L_{AFmax}) is typically adopted, which is not to be exceeded more than 10 times per night. In other words, higher levels can be permitted if not occurring regularly.

¹ World Health Organization (WHO) Guidelines for Community Noise (2000)

² Professional Practice Guidance on Planning & Noise (ProPG: Planning & Noise, 2017) for New Residential Development

³ BS8233:2014 - Guidance on sound insulation and noise reduction for buildings

As a minimum, the above criteria are to be met whilst whole dwelling ventilation (also known as background ventilation) is being achieved. In modern buildings, this is where trickle ventilation units (usually within the window frames) come in to play, with assessments of external noise ingress needing to account for these being open, but where windows can be assumed to be closed.

Further to the whole dwelling ventilation scenario, it is appropriate to consider the situation of windows being opened, either for additional whole dwelling ventilation or as a means of providing cooling. Since this isn't typically required as often as the trickle vents being open, the expectation is that higher noise conditions will be tolerated during such periods, assuming such periods are not atypically prolonged or frequent. **BS 8233** doesn't provide any guidance directly on this; however, it states that:

Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

Since the **BS 8233** internal criteria are in line with the **WHO Guidelines**, this indicates that the values presented in **Table 3.1** can be relaxed by up to 5 dB and "reasonable internal conditions still achieved." The **ProPG** expands upon this very point, stating:

The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable" ... Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally.

In other words, assuming the risk or occurrence of overheating is low, whereby cooling by opening windows is only required occasional, levels of at least up to 5 dB above those on **Table 3.1** are likely to be considered reasonable, with levels up to 10 dB still being acceptable.

4 BASELINE NOISE CONDITIONS

4.1 Introduction

The prevailing noise conditions across the development have been determined by detailed unattended environmental noise survey. This was undertaken over an eight-day period between Wednesday 6th and Thursday 14th October 2021, and managed by a consultant certified as competent in environmental noise monitoring.

The continuous unattended noise measurements were undertaken to the north of the site as shown in **Figure 2.1** earlier. The two locations were chosen to characterise the day and night noise emissions from the main source impacting the site, i.e. the A23. Monitor position 1 (MP1) was located 30m east of the A23 at a height of 1.5m and monitor position 2 (MP2) was located 60m east of the A23 at a height of 2.5m. Both monitors were under free-field conditions. The fact that two positions were adopted was to provide better coverage for calibrating the noise model, as described in **Section 5**.

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1 Based on the logarithmic average of the $L_{Aeq,5min}$ levels.

2 Used on the 5-minute levels as an alternative to the 10th highest “event” level.

3 Part data from after the equipment was installed (strictly $L_{Aeq,11h}$).

Table 4.3: Summary Results of the Unattended Noise Survey (Free-Field Levels) – Position 2

Date	Measured Sound Level, dB		
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Tuesday 21-10-12	66	60	70
Wednesday 21-10-13	66	-	-
Average (Highest)	65 (67)	59 (61)	71 (74)

1 Based on the logarithmic average of the $L_{Aeq,5min}$ levels.

2 Used on the 5-minute levels as an alternative to the 10th highest “event” level.

3 Part data from after the equipment was installed (strictly $L_{Aeq,11h}$).

The following are observed from the above data:

- All levels are very consistent, with only 1 dB between the average and highest levels. This indicates consistent conditions across the survey and a robust dataset.
- The difference between the daytime and night-time $L_{Aeq,T}$ levels is 7 dB on average, this is to be expected in such a location. This means that relative to the criteria, which are 5 dB apart between the daytime (living room/bedroom) and night-time (bedroom) periods (see **Table 3.1**), the daytime conditions are relatively higher than the night-time conditions.
- The difference between the night-time $L_{Aeq,8h}$ and L_{AFmax} levels is 10 dB on average. Since the difference between the criteria for these metrics is 15 dB (see **Table 3.1**), meeting the $L_{Aeq,8h}$ criterion will be the driving factor at night. This is to be expected for such a location.
- The maximum noise levels taken from the 90th percentile are shown as 76 and 71 dB for positions 1 and 2 respectively. A value of 74 dB L_{AFmax} has been used in the following assessment. We feel this is a reasonable approach to use these maximum noise levels for the assessment given the data and nature of the source/noise.

Overall, the data is entirely as expected, and considered further below.

5 NOISE MODELLING

5.1 Noise Modelling

In order to calculate the sound levels across the site as a whole, i.e. beyond the monitoring location, and account for the effect of boundary screening and the location of the building, a 3D noise model has been built using the proprietary noise modelling software CadnaA. The calculations have been carried out in accordance with ISO 9613⁴, therefore, which allows consideration of the effects of the ground and atmospheric absorption, and acoustic reflections and screening.

Existing site and surrounds topography information has been acquired from the Department for Environment Food & Rural Affairs (Defra) and has been imported into CadnaA.

In terms of noise sources, it is only necessary and practicable to add in the A23. Daytime and night-time flows for this road have been determined based on the average $L_{Aeq,16h}$ and $L_{Aeq,8h}$ levels (as presented in **Tables 4.2** and **4.3**) measured at both locations (as presented in **Table 3.1**). Good correlation was found between the levels at both locations, confirming that the A23 was dominant and indicating that the model should be fit for purpose.

Accordingly, the (calibrated) model has been used to calculate the day and night-time sound levels across the site with the introduction of boundary screening being considered in the form of acoustic fencing at 2.5 m tall and, separately, earth bunds with heights of 3, 4, 5 and 6 metres, either side of the access road. The location of the building is as per the current scheme drawings.

The security gate onto the site has not been modelled as to present a worst-case situation. In reality the gate may be left open at times and the results should reflect how this might affect the noise levels across the site.

The results are summarised in the following figures and tables. The first set of images in **Figure 5.2** presents the existing situation, with sound level contour bands representing the daytime $L_{Aeq,16h}$ levels at 4.5 m above ground level (AGL) (equivalent to upper floor window level) as worst case. The subsequent figures present sound level contours for the daytime period (at 4.5 m AGL) for the fence and bund height options, thus showing how the fencing and bunds do (or do not) effect the sound levels on site. The second set of images in **Figure 5.3** presents the same for the night-time $L_{Aeq,8h}$ period.

Table 5.1 presents the daytime $L_{Aeq,16h}$ results at ground floor level (1.5 m AGL) and at the upper height (i.e. 4.5 m AGL), where bedrooms would be located.

Table 5.2 presents the night-time $L_{Aeq,8h}$ levels at the upper height (i.e. 4.5 m AGL), where bedrooms would be located.

The results are presented and discussed in **Section 5.3**

⁴ ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors

5.2 Proposed Bund

The plans for the bund are not fixed at this stage; however, it is understood that it is likely to be between three and six metres in height to run along the boundary of the A23 and the site, as indicated in the drawing presented as **Figure 5.1** below.

Figure 5.1: Indicative Bund Arrangement ©2021 Google



5.3 Results

Graphical noise model results are displayed below in **Figures 5.2** and **5.3** for the daytime and night-time periods, respectively. These show the difference in sound level around the proposed dwelling between the different options.

Figure 5.2: Calculated Daytime Sound Levels Across the Site at 4.5 m AGL

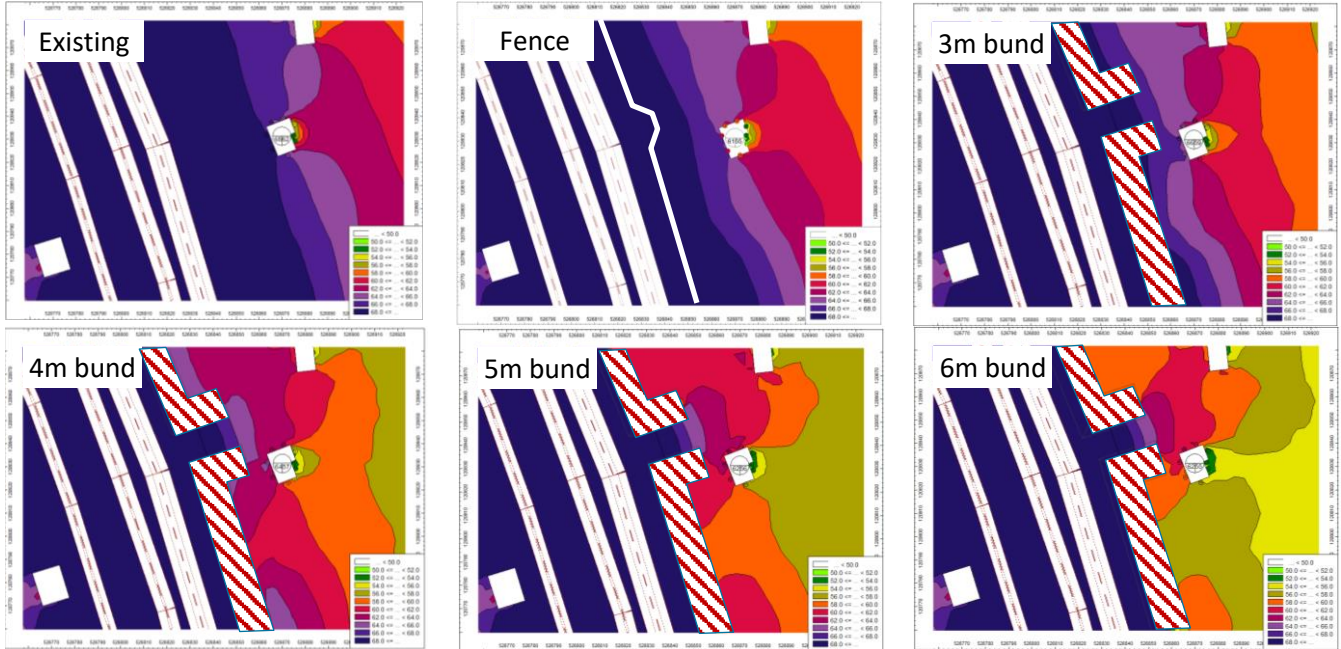
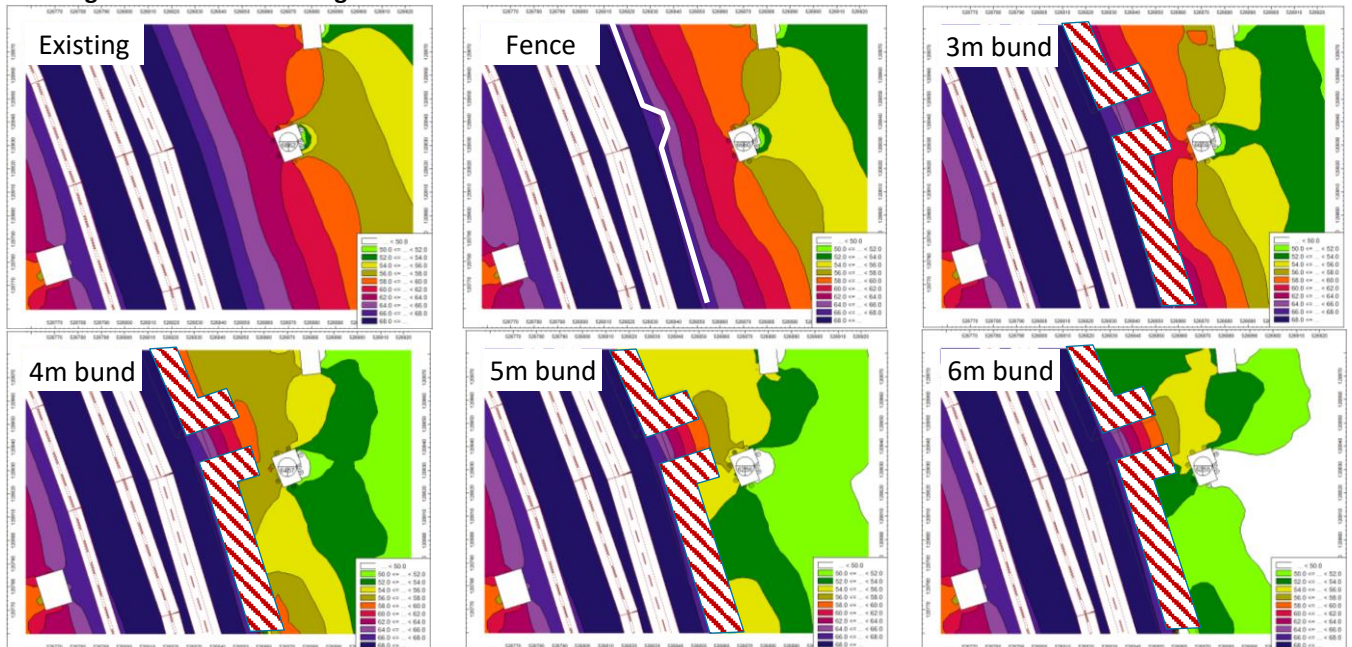


Figure 5.3: Calculated Night-time Sound Levels Across the Site at 4.5 m AGL



The tabulated noise model results are displayed below in **Tables 5.1** and **5.2** for the daytime and night-time periods, respectively. Values are colour coded according to their difference to the set criteria for outdoor spaces on the ground floor only. The colours are coded to **less than or equal to 55dB**, **between 51 and 55 dB** and **greater than 55 dB**.

Table 5.1: Calculated Daytime Sound Levels for Mitigation Options Compared to Existing

Floor	Facade	Daytime, dB L _{Aeq,16h} (Change from Existing, dB)					
		Existing	Fence	3m bund	4m bund	5m bund	6m bund
Ground	West façade	66	58(-8)	56(-10)	55(-11)	54(-12)	52(-14)
	North façade	64	56(-8)	55(-9)	54(-10)	54(-10)	53(-11)
	East façade	50	48(-2)	48(-2)	47(-3)	47(-3)	46(-4)
	South façade	62	56(-6)	54(-8)	52(-10)	51(-11)	50(-12)
1st	West façade	68	61(-7)	60(-8)	58(-10)	57(-11)	56(-12)
	North façade	66	60(-6)	59(-7)	57(-9)	58(-8)	56(-10)
	East façade	55	54(-1)	53(-2)	52(-3)	52(-3)	50(-5)
	South façade	65	59(-6)	57(-8)	55(-10)	54(-11)	52(-13)

Table 5.2: Calculated Night-time Sound Levels for Mitigation Options Compared to Existing

Floor	Facade	Night-time, dB L _{Aeq,8h} (Change from Existing, dB)					
		Existing	Fence	3m bund	4m bund	5m bund	6m bund
1st	West façade	62	55(-7)	54(-8)	52(-10)	51(-11)	49(-13)
	North façade	60	53(-7)	52(-8)	51(-9)	51(-9)	50(-10)
	East façade	49	46(-3)	46(-3)	45(-4)	45(-4)	44(-5)
	South façade	59	53(-6)	51(-8)	48(-11)	48(-11)	46(-13)

5.4 Discussion

As to be expected, the differences – the benefit of the screening – increase with increasing height, up to the point that reductions of up to 14 dB at ground floor and 13 dB at first floor are calculated at the key façades when compared to the existing situation.

With reductions of between 3 and 7 dB, the fence option could be said to be providing worthwhile screening, but where, of course, the taller bund options perform better.

In terms of the external spaces, the relevant **BS 8233** upper target of 55 dB would be met for all ground floor spaces around the building with a 4 m bund or greater in place. The eastern façade space is predicted to meet the lower criteria of 50 dB with all mitigation options due to the shielding offered by the building.

With all scenarios, there is an inherent weakness due to the need for access. With the dwelling in the current modelled location, the northern façade is likely to have some line of sight of the A23. Whilst this can be accounted for in the selection of the glazing and/or means of ventilation/cooling, as necessary (see **Section 6**), the feasibility of repositioning the property further to the south could be explored.

6 NOISE CONTROL SCHEME

6.1 External Noise Conditions

As quoted earlier, **BS 8233** states that “...for traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external 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.” Accordingly, an upper target of 55 dB $L_{Aeq,16h}$ is considered appropriate in this instance.

The fence and bund scenarios above show that the areas to the east and south of the dwelling are predicted to experience daytime sound levels (at 1.5m AGL) between 48 and 54 dB for the differing screening heights. Therefore, with the dwelling modelled in the proposed location, there are external areas around the property that demonstrate conformity with **BS 8233**.

6.2 Internal Noise Conditions

Similarly, the internal sound levels should conform to the standard(s) identified by **BS 8233**. These are presented in **Table 3.1**, where a level of 35 dB $L_{Aeq,16h}$ applies to living rooms and bedrooms during the day, and a level of 30 dB $L_{Aeq,8h}$ applies to bedrooms at night. In addition to which, though not given in **BS 8233**, a level of 45 dB L_{AFmax} would also typically apply to bedrooms at night.

It should be borne in mind that, as stated in **BS 8233**, these levels are based on annual average data and do not have to be achieved in all circumstances.

The difference between the external and internal conditions will be dictated by the widows and means of ventilation. The first place to start is to consider the sound insulation performance of an open window, such as for ventilation or cooling purposes. As per the value given in **BS 8233**, a performance of 15 dB is usually adopted for the purpose of a partially open window.

We have assumed, at least, the following glazing units will used with a single slot vent required per bedroom.

Table 6.1: Acoustic performance of the windows and ventilation units

Element	Description	SRIs (dB) at Octave Band Frequencies (Hz)						Equivalent $R_w(C_{tr})/D_{n,e,w}(C_{tr})$
		125	250	500	1k	2k	4k	
Glazing	6/12/6 mm double glazing	20	19	29	38	34	45	31(-4)
Vent	Standard acoustic trickle vent	30	33	38	37	36	36	38(-2)

For the non-glazed façade elements, the following are applicable.

Table 6.2: Acoustic performance of the walls and roof

Element	Description	SRIs (dB) at Octave Band Frequencies (Hz)						Equivalent $R_w(C_{tr})/D_{n,e,w}(C_{tr})$
		125	250	500	1k	2k	4k	
Wall (applicable to the 1 st floor)	Brick-block cavity wall	41	45	45	54	58	58	52(-4)
Roof (applicable to the 1 st floor)	Tiled roof, 12 mm plasterboard ceiling, sound absorbing layer	24	34	40	45	49	49	43(-6)

6.2.1 Partially open window

Based on the above, and room and element dimensions estimated for a dwelling of this size, the calculated internal sound levels are as follows for **partially open windows** in **Tables 6.3 to 6.5**.

Values are colour coded according to their difference to the set criteria for that metric. As mentioned in **Section 3**, assuming the risk or occurrence of overheating is low, whereby cooling by opening windows is only required occasionally, levels of at least up to 10 dB above those in **Table 3.1** are likely to be considered acceptable. This assumption is considered reasonable since the development is for a detached, multi-aspect property, surrounding by green infrastructure. The colours are coded to **less than or equal to +5 dB**, **between +6 and +10 dB** and **greater than +10 dB**.

Table 6.3: Calculated Internal Daytime Sound Levels within Ground Floor Rooms (with a Partially Open Window)

Option	Daytime dB $L_{Aeq,16h}$ (Comparison with default BS 8233 Criterion, dB)			
	West façade	North façade	East façade	South façade
None	48 (+13)	46 (+11)	33 (-2)	44 (+9)
2.5 m Fencing	45 (+10)	43 (+8)	33 (-2)	42 (+7)
3 m Bunds	43 (+8)	42 (+7)	32 (-3)	40 (+5)
4 m Bunds	41 (+6)	41 (+6)	32 (-3)	38 (+3)
5 m Bunds	40 (+5)	40 (+5)	31 (-4)	36 (+1)
6 m Bunds	38 (+3)	40 (+5)	31 (-4)	35 (+0)

Table 6.4: Calculated Internal Night-time Sound Levels within 1st Floor Bedrooms (with a Partially Open Window)

Option	Night-time dB $L_{Aeq,8h}$ (Comparison with default BS 8233 Criterion, dB)			
	West façade	North façade	East façade	South façade
None	44 (+14)	42 (+12)	31 (+1)	41 (+11)
2.5 m Fencing	42 (+12)	40 (+10)	31 (+1)	39 (+9)
3 m Bunds	41 (+11)	40 (+10)	30 (0)	37 (+7)
4 m Bunds	39 (+9)	39 (+9)	30 (0)	34 (+4)
5 m Bunds	37 (+7)	38 (+8)	29 (-1)	33 (+3)
6 m Bunds	35 (+5)	37 (+7)	28 (-2)	31 (+1)

Table 6.5: Calculated Internal Maximum Night-time Event Levels within 1st Floor Bedrooms (with a Partially Open Window)

Screening	Night-time dB L_{AFmax} (Comparison with default Criterion, dB)			
	West façade	North façade	East façade	South façade
None	56 (+11)	54 (+9)	43 (-2)	53 (+8)
2.5 m Fencing	54 (+9)	52 (+7)	43 (-2)	51 (+6)
3 m Bunds	53 (+8)	52 (+7)	42 (-3)	49 (+4)
4 m Bunds	51 (+6)	51 (+6)	42 (-3)	46 (+1)
5 m Bunds	49 (+4)	50 (+5)	41 (-4)	45 (0)
6 m Bunds	47 (+2)	49 (+4)	40 (-5)	43 (-2)

It can be seen that, based on the assumption of low risk of overheating, sound levels are likely to remain acceptable with a window partially open in all instances (as represented by the green and amber colours) with the use of the 4 m bunds. More instances of green colouring are shown with the 5 and 6 m bunds, but where, even with the 6 m bunds, amber colouring is shown for the north façade.

Accordingly, the use of bunds of at least 4 m in height, therefore, are considered to result in acceptable internal noise conditions should windows be opened for ventilation or overheating mitigation.

6.2.2 Windows closed

The next step is to consider the performance of the window(s) closed, with the trickle vent(s) open (assuming these are the choice for whole dwelling ventilation), which has been done following the 'more rigorous calculation' method set out in **BS 8233**⁵.

Tables 6.6 to 6.8 give the predicted internal levels with **windows closed and the trickle vent slot open**.

Table 6.6: Calculated Sound Levels within Ground Floor Rooms (with Window(s) Closed and Slot Vent Open)

Screening	Daytime dB L _{Aeq,16h} (Comparison with default BS 8233 Criterion, dB)			
	West façade	North façade	East façade	South façade
None	33 (-2)	31 (-4)	17 (-18)	29 (-6)
2.5 m Fencing	30 (-5)	28 (-7)	18 (-17)	27 (-8)
3 m Bunds	28 (-7)	27 (-8)	17 (-18)	25 (-10)
4 m Bunds	26 (-9)	26 (-9)	17 (-18)	23 (-12)
5 m Bunds	25 (-10)	25 (-10)	16 (-19)	21 (-14)
6 m Bunds	23 (-12)	25 (-10)	16 (-19)	20 (-15)

Table 6.7: Calculated Sound Levels within 1st Floor Bedrooms (with Window(s) Closed and Slot Vent Open)

Screening	Night-time dB L _{Aeq,8h} (Comparison with default BS 8233 Criterion, dB)			
	West façade	North façade	East façade	South façade
None	29 (-1)	27 (-3)	16 (-14)	26 (-4)
2.5 m Fencing	27 (-3)	25 (-5)	16 (-14)	24 (-6)
3 m Bunds	26 (-4)	25 (-5)	15 (-15)	22 (-8)
4 m Bunds	24 (-6)	24 (-6)	15 (-15)	19 (-11)
5 m Bunds	22 (-8)	23 (-7)	24 (-6)	18 (-12)
6 m Bunds	20 (-10)	22 (-8)	13 (-17)	16 (-14)

Table 6.8: Calculated sound levels within 1st floor bedrooms (with window(s) closed and slot vent open)

Screening	Night-time dB L _{AFmax} (Comparison with default Criterion, dB)			
	West façade	North façade	East façade	South façade
None	41 (-4)	39 (-6)	28 (-17)	38 (-7)
2.5 m Fencing	39 (-6)	37 (-8)	28 (-17)	36 (-9)
3 m Bunds	38 (-7)	37 (-8)	27 (-18)	34 (-11)
4 m Bunds	36 (-9)	36 (-9)	27 (-18)	31 (-14)
5 m Bunds	34 (-11)	35 (-10)	36 (-9)	30 (-15)
6 m Bunds	32 (-13)	34 (-11)	25 (-20)	28 (-17)

It can be seen that, when windows are closed (and vents open), the criteria are met in all instances. The situation of windows being used for ventilation or cooling purposes is further considered below.

⁵ The method is based on that in BS EN 12354-3:2000, which our calculation spreadsheet is based upon.

6.3 Discussion

The above results essentially leave two main options for the control of internal sound levels in the habitable rooms as per the current layout. These are:

- 1 Construct a pair of at least a 4 m high bunds, which could allow windows to be opened whilst maintaining “reasonable” or at least “acceptable” internal sound levels (i.e. level no more than 10 dB above the default **BS 8233** criteria), thus avoiding the potential for acoustic conditions to be unacceptable during the use of windows to mitigate overheating, regardless of the frequency of occurrence; or
- 2 Construct lower height screening, which provides suitable external levels within the outdoor amenity space, and install a mechanical system or systems to provide ventilation and/or cooling, as required. It is anticipated that a “whole house” MVHR (mechanical ventilation with heat recovery) unit (as per System 4 of **Approved Document F** of the **Building Regulations**), providing background/whole dwelling ventilation, with summer bypass and boost settings, will be sufficient to give occupants the choice whether to open windows or not based on their preference. There are also room-specific units that could be used instead of a whole house system, if preferred.

7 SUMMARY

Anderson Acoustics has undertaken an assessment to determine the effect of mitigation options proposed along the western boundary of the Reeds Farm site, Hickstead in relation to traffic noise from the A23.

An unattended survey was carried out to understand the current sound climate at various locations across the site, with the results having been used to calibrate a 3D noise model of the site and surrounds.

Mitigation options for acoustic fencing and bunds were added into the model, allowing heights for the fencing of 2.5m and 3, 4, 5 and 6m for the bunds.

In terms of the external spaces, the relevant **BS 8233** upper target of 55 dB would be met for all ground floor spaces around the building with a 4 m bund or greater in place. The eastern façade space is predicted to meet the lower criteria of 50 dB with all mitigation options due to the shielding offered by the building.

In terms of the internal spaces, the assessment has shown that for sound levels to remain “acceptable” with windows partially open for ventilation or cooling purposes, at least 4 m high bunds would be required. With windows closed (and trickle vents, where present, open), the default **BS 8233** (and L_{AFmax}) noise criteria would be met in all instances regardless of screening.

Should lower height screening be sought, there is a risk that internal sound levels could be unacceptable where windows are relied upon for cooling during periods of overheating, regardless of frequency of occurrence. To mitigate this, an option could be to install a mechanical system or systems to provide ventilation and/or cooling, as required. It is anticipated that a “whole house” MVHR (mechanical ventilation with heat recovery) unit (as per System 4 of **Approved Document F** of the **Building Regulations**), providing background/whole dwelling ventilation, with summer bypass and boost settings, will be sufficient to give occupants the choice whether to open windows or not based on their preference.

It has been shown, therefore, that despite the high sound levels from the A23, options are available to achieve suitable noise conditions within both the external and internal noise-sensitive areas. It is considered, therefore, planning permission could be granted from the proposed development subject to suitable noise-related planning conditions. It is anticipated that a condition will be required to confirm the noise control strategy based on the final designs for the development, including any boundary screening.

APPENDIX A

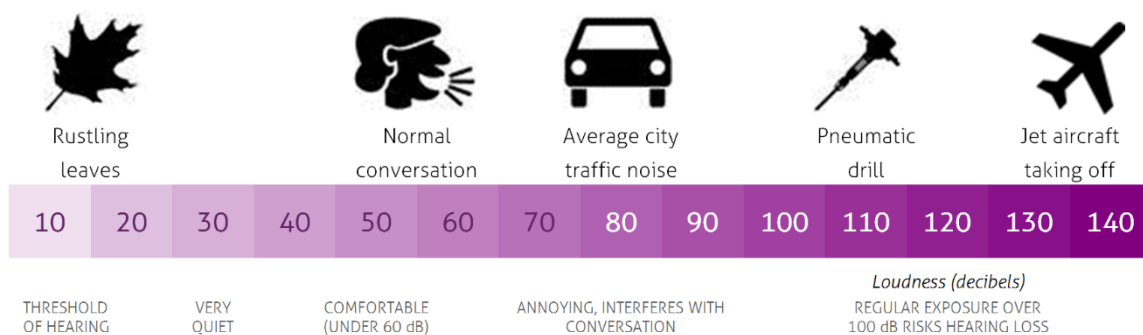
GLOSSARY OF TERMINOLOGY

There is a ten million to one ratio between the threshold of hearing and the highest tolerable sound pressure. Sound is therefore measured using a logarithmic scale, to account for this wide range, called the decibel (dB) scale. Noise is defined as unwanted sound and the range of audible sound varies from around 0 dB to 140 dB.

The human ear is capable of detecting sound over a range of frequencies from around 20 Hz to 20 kHz; however, its response varies depending on the frequency and is most sensitive to sounds in the mid frequency range of 1 kHz to 5 kHz. Instrumentation used to measure sound is therefore weighted across the frequency bands to represent the sensitivity of the ear. This is called 'A weighting' and is represented as dB(A), dBA or L_{Aeq} for example (see also below).

It is generally accepted that under normal conditions humans are capable of detecting changes in steady sound levels of 3 dB, whilst a change of 10 dB is perceived as a doubling or halving of the sound level. An indication of the range of sound levels commonly found in the environment is given below.

Figure A1: Typical sound levels



A number of different indices are used to describe the fluctuations in sound level over certain time periods. The main indices include:

- $L_{A90,T}$** This is the sound level exceeded for 90% of the measurement period and provides a measurement of relatively continuous sounds that make up quieter 'lull' periods in between sound events. It is often referred to as the background sound level, and usually measured using the 'fast' time response (hence sometimes written $L_{AF90,T}$).
- $L_{Aeq,T}$** This is the "equivalent continuous A weighted sound pressure level" and is the level of a notional steady sound which has the same acoustic energy as the fluctuating sound over a specified time period. It is often used for measuring all sources of sound in the environment, which can be referred to as the ambient sound.
- $L_{Amax,F}$** This is the maximum sound pressure level measured in a given time period with the sound level meter set to 'fast' response. Also written $L_{Amax,fast}$ OR L_{AFmax} .

Reference is often made to acoustic measurements being undertaken in 'free-field' or 'façade' locations. Free-field measurements represent a location away from vertical reflecting surfaces, normally by at least 3.5 m. A façade measurement is taken or calculated to a position 1 m from an external façade and a correction of up to 3 dB can be applied to account for the sound reflected from the façade. This latter position is often used when assessing the impact of external noise affecting residents inside properties.

In terms of the use of "sound" and "noise", strictly "sound" can be measured by a sound level meter or other measuring system, whilst "noise" is related to a human response, and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive. Care has been taken in this document to use the most relevant of these terms; however, in most reference documents, and, indeed, generally, these terms are used interchangeably, with noise being used, in correctly, more often than sound, and so a mix is presented in this document. Consequently, just because the term noise is used, doesn't necessarily mean a negative effect exists or will occur, and the context of the accompanying text should be taken into account.

Further definitions relating to this report are given overleaf.

DEFINITIONS

- Airborne Sound: Sound that reaches the point of interest by propagation through air.
- Ambient Sound: Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far.
- A-weighting, dB(A): The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
- Background sound: Underlying level of sound over a period, T, which might in part be an indication of relative quietness at a given location.
- Calibration: The measurement system/ chain should be periodically calibrated, within a laboratory, against traceable calibration instrumentation, to either National Standards or as UKAS-Accredited, as required. The calibration of the system should also be checked in the field using a portable calibrator before and after each short term measurements, and periodically for longer term monitoring.
- C_{tr} : Correction/adaption term applied against the sound insulation single-number values (R_w , D_w , and $D_{nT,w}$) to provide a weighting for low frequency performance. The reference values used within the C_{tr} calculation are based on urban traffic sound.
- Decibel (dB): A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds (s_1 and s_2) is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20 \mu\text{Pa}$.
- Dwelling: A building used for living purposes. A mobile home used for permanent living should be included in an assessment. If calculations are being conducted for compensation purposes, then some mobile homes are dealt with under the Highways Noise Payments and Moveable Homes Regulations.
- Façade/ Façade Level: At a distance of 1 m in front of a large sound reflecting object such as a building façade. According to BS 8233:2014, "Façade level measurements of L_{pA} are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the façade." The Calculation of Road Traffic Noise (1988) uses 2.5 dB, whilst BS 5228-1:2009+A1:2014 recommends 3 dB. Owing to the latter examples, together with other historical documents, it is more usual to apply 3 dB.
- Fast time-weighting (F): Averaging time used in sound level meters. Defined in BS EN 61672-2:2013 *Electroacoustics. Sound level meters. Pattern evaluation tests*.
- Free-field/ Free-field Level: Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 m away.
- Hertz (Hz): The unit of Frequency or Pitch of a sound. One hertz equals one cycle per second. 1 kHz = 1000 Hz, 2 kHz = 2000 Hz, etc.
- IOA: The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society (a daughter society of the Institution of Mechanical Engineers). It is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels. Our consultants/engineers are individual Members.
- $L_{AF10,T}$: The A-weighted sound pressure level exceeded for 10% of the time over the period, T, measured using fast time-weighting (F), see below. It can be considered to be the "average maximum" sound level, and is generally used to describe road traffic noise.

- $L_{AF90,T}$: The A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time fast time-weighting (F). Generally used to describe the 'background' sound conditions.
- L_{AFmax} : The maximum A-weighted sound pressure level during a given time period. L_{max} is sometimes used for the assessment of occasional loud sounds, which may have little effect on the overall L_{eq} noise level, but could still affect the sound environment. Unless described otherwise, it is measured using the fast time-weighting (F).
- $L_{eq,T}$: A sound level index called the equivalent continuous sound level over the time period, T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded. Where the value is A-weighted, it will be presented ' $L_{Aeq,T}$ ' or ' $dBA L_{eq,T}$ ', otherwise it should be an un-weighted (or linear) value.
- L_p : See Sound Pressure Level.
- Octave/ octave band: Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit. For example, the 1000 Hz (1 kHz) octave band contains noise energy at all frequencies from 707 to 1414 Hz.
- Percentile Level: The sound pressure level exceeded for N% of a specified time interval, see $L_{AF90,T}$ etc.
- R: See Sound Reduction Index.
- R_w : See Weighted Sound Reduction Index.
- Sound Level Metrics, Indices or Parameters: Sound levels usually fluctuate over time, so it is often necessary to consider an average or statistical sound level. This can be done in several ways, so a number of different metrics have been defined, according to how the averaging or statistics are carried out.
- Sound Pressure Level (Sound Level), L_p : The sound level is the sound pressure relative to a standard reference pressure of 20 μPa (20×10^{-6} Pascals) on a decibel scale.
- Sound Pressure: Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
- Sound reduction index (SRI), R: Laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.
- Weighted sound reduction index (SRI), R_w : Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies as measured in a laboratory.

APPENDIX B

NOISE SURVEY RESULTS

Figure B-1: Noise survey's time history – Monitoring Position 1

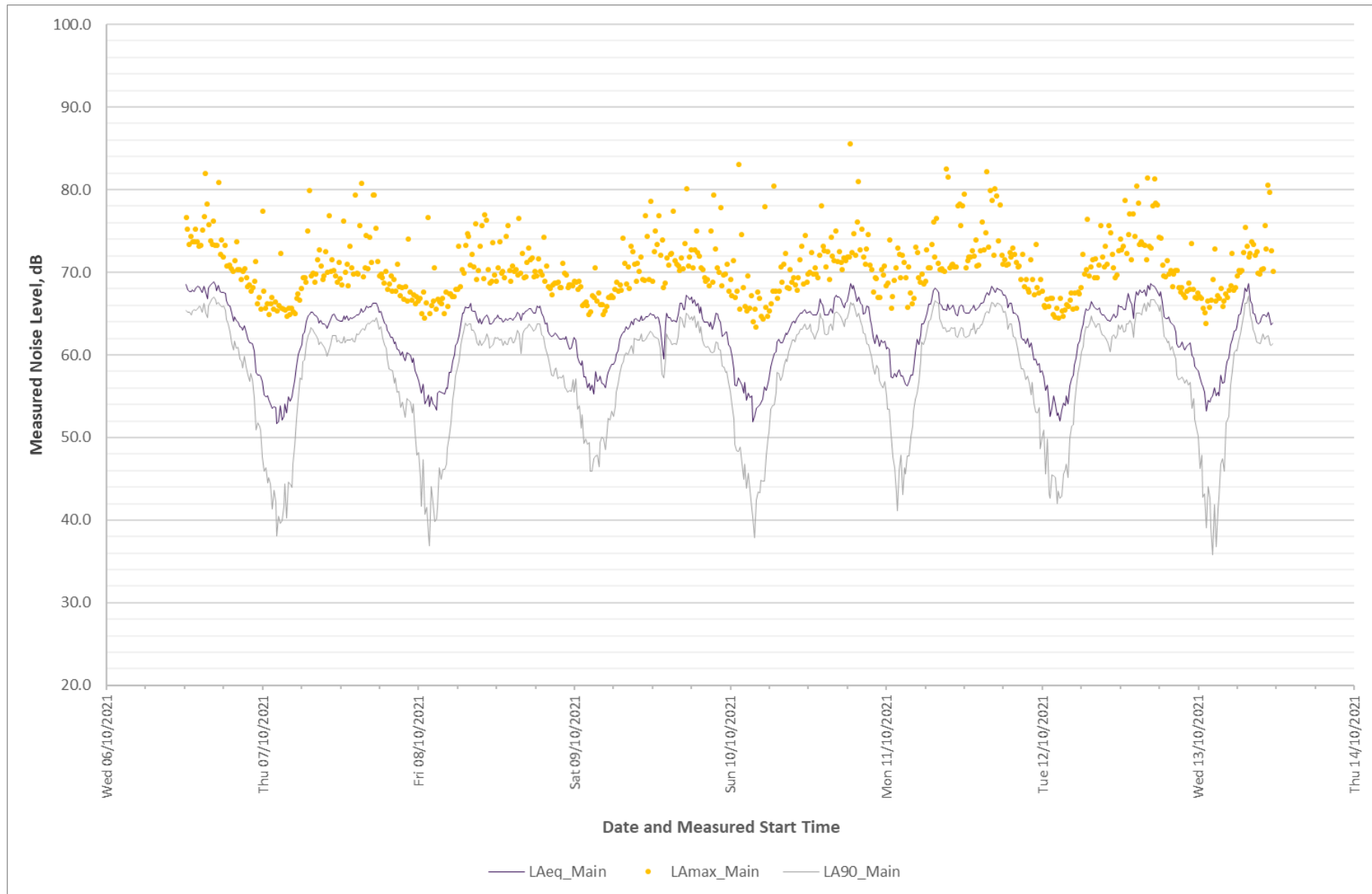


Figure B-2: Noise survey's time history – Monitoring Position 2

