Land South of 295 Main Street, Stanton under Bardon, Leicestershire

Noise Impact Assessment

12754.1001

27th June 2025

Revision A

ANC ACOUSTICS & NOISE CONSULTANTS

Institute of Acoustics sponsoring organisation

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Prepared for

Allison Homes

7 Boundary Court, Willow Farm Business Park, Castle Donington, DE74 2UD

Prepared by

Alun Williams MIOA

Checked by

Tom Lucas MIOA

Apex Acoustics Limited Reg. in England no. 05656507
Design Works, William Street, Gateshead, NE10 0JP

T 0191 620 0750
E info@apexacoustics.co.uk
W www.apexacoustics.co.uk

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1 Summary

1.1 This report has been prepared for a planning application for a proposed residential development located south and east of 295 Main Street, Stanton under Bardon, Leicestershire.

1.2 Sound levels at the site have been measured during the day and night. Sound levels are relatively modest and are controlled by distant road traffic, vegetation movement due to the wind and occasionally aircraft passing overhead.

1.3 Standard thermal double-glazed units with a nominal acoustic rating are suitable to control noise break-in to achieve indoor ambient noise levels.

1.4 Standard, non-acoustic, trickle vents may be used and will control noise break-in to achieve indoor ambient noise levels.

1.5 Compliance with Part O requirement O1 can be demonstrated with use of the simplified method.

1.6 Based on the details outlined in this report, the noise risks identified are suitably mitigated and controlled to meet typically referenced planning policy and noise control guidance.

2 Introduction

2.1 Apex Acoustics has been contracted by Allison Homes to carry out a noise survey and noise impact assessment for a planning application for the next phase of a proposed residential development involving the construction of 27 new houses on an area of land east of 295 Main Street in Stanton under Bardon, Markfield, Leicestershire, LE67 9TQ.

2.2 A residential development involving the construction of 50 new houses on an area of land south of 295 Main Street is currently under construction. This report is concerned with the next phase of the development on adjoining land to the north, and east of 295 Main Street.

2.3 The development site is currently a grass field used for equestrian and/or agricultural purposes.

2.4 The development site location is indicated in Figure 1. The development currently under construction is also indicted.

2.5 A preliminary site plan is included in Appendix A.

2.6 The scope of our instruction includes:

- Measurement of the noise impact over a minimum 24-hour period at representative positions;
- Set out a noise insulation scheme to control the ingress of external noise into houses to meet good acoustic practice and planning requirements.

Figure 1: Development site boundary indicated with red outline

3 Acoustic Requirements

3.1 National Planning Policy Framework (NPPF)

3.2 The National Planning Policy Framework (NPPF), Reference 1, sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. In respect of noise, Paragraph 187, 198 and 200 of the NPPF state the following:

3.3 Paragraph 187:

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

3.4 Paragraph 198:

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

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life[72 [See Explanatory Note to the Noise Policy Statement for England];

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

3.5 Paragraph 200:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

3.6 Noise Policy Statement for England (NPSE)

3.7 The Noise Policy Statement for England, Reference 2, states three policy aims as follows:

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

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

3.8 The NPSE defines adverse noise impact as follows:

- No Observed Effect Level (NOEL)
  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.
- Lowest Observed Adverse Effect Level (LOAEL)
  This is the level above which adverse effects on health and quality of life can be detected.
- Significant Observed Adverse Effect Level (SOAEL)
  This is the level above which significant adverse effects on health and quality of life occur

3.9 The first two aims of the NPSE require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

3.10 Professional Practice Guidance on Planning & Noise

3.11 Professional Practice Guidance on Planning & Noise: New Residential Development (ProPG), Reference 3, is a guidance document on the management of noise within the planning system in England for new build housing developments.

3.12 The document draws together guideline limits for internal noise levels from external transport sources from other sources of guidance, including BS 8233, Reference 4, and the World Health Organisation (WHO) Guidelines for Community Noise, Reference 5; these are set out in Table 1.

Activity	Room	Guideline upper limit, dB		
		$L_{Aeq,daytime}$	$L_{Aeq,night-time}$	L_{AFmax}
Resting	Living room	35	-	-
Dining	Dining room	40	-	-
Sleeping (daytime resting)	Bedroom	35	30	45

Table 1: Internal noise level requirements

3.13 The daytime period is defined as the 16 hours between 07:00 to 23:00 and the night-time period is defined as the 8 hours between 23:00 to 07:00.

3.14 With regard to the night-time L_{AFmax} criterion, ProPG states:

"In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax,F}$ more than 10 times a night."

3.15 It is considered that the adopted internal ambient noise level targets align with the LOAEL following the terminology of the NPSE, such that meeting these targets adequately achieves the aims of the NPPF and the NPSE.

3.16 **AD-O**

3.17 All new residential buildings which have building notice, full planning application, or initial notice submitted after 15th June 2022, or have site works starting after 15th June 2023, are required to comply with Part O of Schedule 1 to the Building Regulations 2010, Reference 6 (AD-O). Requirement O1 is shown in Figure 2.

Requirement

Requirement	*Limits on application*
O1 Overheating mitigation	
(1) Reasonable provision must be made in respect of a dwelling, institution or any other building containing one or more rooms for residential purposes, other than a room in a hotel ("residences") to—	
(a) limit unwanted solar gains in summer;	
(b) provide an adequate means to remove heat from the indoor environment.	
(2) In meeting the obligations in paragraph (1)—	
(a) account must be taken of the safety of any occupant, and their reasonable enjoyment of the residence; and	
(b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.	

Figure 2: AD-O, Requirement O1 Overheating mitigation

3.18 The aim of AD-O is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

3.19 With respect to noise, AD-O states:

"Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:

a. 40 dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

b. 55 dB L_{AFmax}, more than 10 times a night (between 11pm and 7am)"

3.20 As described by the Approved Document, in the Secretary of State's view, compliance with requirement O1 can be demonstrated by using one of the following methods.

3.21 The simplified method for limiting solar gains and providing a means of removing excess heat, as set out in Section 1 of AD-O.

3.22 The dynamic thermal modelling method, as set out in Section 2 of AD-O.

3.23 The dynamic thermal modelling method may be required where the requirements of the simplified method are not achieved, or where other factors such as noise restrict the use of the simplified method.

4 Noise Survey

4.1 The existing acoustic environment was measured over a 5-day and 4-night period from around midday on Friday 20th June to around 10:45 on Tuesday 24th June 2025.

4.2 The measurement positions, 'P1' and 'P2', located adjacent to the western and eastern corners of the development site, are indicated in Figure 3.

4.3 The microphones were fixed to a pole and fencepost or a tripod around 1.5 metres above ground level, and away from reflective surfaces such that measurements are considered to be 'free-field'.

4.4 Data was recorded in third-octave band frequencies at one-second intervals throughout the measurement period. The meter was equipped with audio recording to facilitate identification of noise sources.

4.5 Based on published weather data, it was sunny and settled on Friday and Saturday but was somewhat unsettled with increased wind speeds for periods from Sunday to Tuesday.

4.6 Wind speeds were low (< 5 ms^{-1}) on Friday and Saturday, but were up to 10 ms^{-1} for periods from Sunday to Tuesday. It was predominantly dry throughout the survey except for some periods of rain over Sunday night into Monday morning. Temperatures ranged from 12-29 °C.

4.7 The equipment used is listed in Table 2.

4.8 Both meters and calibrators have current calibration certificates traceable to national standards. The sound level meters have been calibrated within the last two years and calibrators have been calibrated within the last year; calibration certificates are available on request.

4.9 The equipment was field-calibrated before and after the measurements with no significant drift in sensitivity noted.

Equipment	Model	Serial no.
Sound Level Meter	NTi XL3	A3A-01135-F0
Calibrator	Larson Davis CAL 200	22086
Sound Level Meter	NTi XL3	A3A-01140-F0
Calibrator	Larson Davis CAL 200	21846

Table 2: Equipment used

4.10 **Noise sources and results**

4.11 Noise levels at the site are relatively modest.

4.12 The dominant noise source affecting the development site is distant road traffic (Cliffe Hill Road is thought to be the most significant), wind noise and vegetation movement, birdsong and occasional aircraft passing overhead.

4.13 Construction is ongoing on the development to the south. Periods affected by construction noise have been excluded from the results.

4.14 The dawn chorus commenced around 3:30 am each night and was the dominant source of sound for the remainder of the night. These periods have been excluded from the results.

4.15 At position P2, a release of water was audible at around 9:30 pm each night. Water flow was audible for a period and slowly reduced as time went on into the night. This may be attributed to an irrigation system, or similar, in the vicinity of measurement position P2. These events influenced measured levels at position P2 and, therefore, measured levels at this position and time period should be treated with caution. It is likely that water flow noise will be less, likely inaudible, where houses are located.

4.16 There is an industrial site approximately 200 metres east of the development; based on audio recordings, noise from the site does not appear to have any influence on the noise climate at the site.

4.17 The daytime and night-time noise levels are shown in Table 3. Time histories of the measured noise levels are shown in Appendix B.

Figure 3: Development site boundary (red), new houses (blue) and noise survey measurement positions (orange)

Position	Parameter	Start Date	Duration hh:mm	dB(A)	Octave band centre frequency, Hz A-weighted sound pressure level, dB							
					63	125	250	500	1k	2k	4k	8k
P1	Daytime, $L_{Aeq,T}$	20/06/25	06:00	45	22	29	35	38	39	39	39	34
	Night-time, $L_{Aeq,T}$	20/06/25	04:30	42	22	28	34	38	38	29	26	23
	Daytime, $L_{Aeq,T}$	21/06/25	16:00	48	24	32	36	38	40	44	41	40
	Night-time, $L_{Aeq,T}$	21/06/25	04:30	40	21	26	30	32	35	32	32	29
	Daytime, $L_{Aeq,T}$	22/06/25	16:00	53	33	37	40	44	46	47	46	44
	Night-time, $L_{Aeq,T}$	22/06/25	04:30	43	25	30	32	34	36	36	37	34
	Daytime, $L_{Aeq,T}$	23/06/25	07:00	51	32	36	39	42	44	45	45	42
	Night-time, $L_{Aeq,T}$	23/06/25	04:30	38	21	26	30	31	31	30	31	28
	Daytime, $L_{Aeq,T}$	24/06/25	01:00	54	35	38	41	46	48	48	45	42
	Night-time, L_{AFmax}	20/06/25	00:02	52	28	36	49	45	44	33	32	29
P2	Daytime, $L_{Aeq,T}$	20/06/25	06:00	49	20	29	35	39	42	43	42	42
	Night-time, $L_{Aeq,T}$	20/06/25	04:30	48	21	27	34	40	44	44	39	33
	Daytime, $L_{Aeq,T}$	21/06/25	16:00	46	22	31	35	38	39	39	39	39
	Night-time, $L_{Aeq,T}$	21/06/25	04:30	38	19	25	30	32	34	28	27	26
	Daytime, $L_{Aeq,T}$	22/06/25	16:00	50	31	35	39	42	43	43	42	41
	Night-time, $L_{Aeq,T}$	22/06/25	04:30	41	22	27	31	32	34	35	34	32
	Daytime, $L_{Aeq,T}$	23/06/25	07:00	50	29	33	37	41	45	46	42	39
	Night-time, $L_{Aeq,T}$	23/06/25	04:30	46	19	25	30	35	41	42	38	32
	Daytime, $L_{Aeq,T}$	24/06/25	01:00	51	30	34	38	42	43	43	45	46
	Night-time, L_{AFmax}	20/06/25	00:02	55	25	33	40	49	52	55	48	41

Table 3: Measured noise levels ('free-field')

4.18 The highest maximum night-time noise levels are set out in Table 4. The highest maximum night-time noise levels during the nights, excluding wind and rain noise and birdsong, are generally attributable to aircraft.

4.19 52 dB(A) was not exceeded more than 10 times during the first night at position P1, and 55 dB(A) was not exceeded more than 10 times during the first night at position 2, and therefore these levels have been used as design cases.

4.20 It is noted that the 56 dB L_{AFmax} measured on the third night at position P1 has not been used as the design case because this is attributed to adverse weather conditions.

Position	Night	Measured 10 highest maximum noise events, L_{AFmax} (dB)									
P1	20/06/25-21/06/25	63	59	58	56	56	54	54	54	53	52
	21/06/25-22/06/25	64	61	59	59	57	56	56	55	54	54
	22/06/25-23/06/25	64	64	63	61	60	60	59	56	56	56
	23/06/25-24/06/25	60	59	56	55	54	54	53	53	52	52
P2	20/06/25-21/06/25	59	59	57	57	56	56	56	55	55	55
	21/06/25-22/06/25	64	58	57	52	52	52	51	51	51	50
	22/06/25-23/06/25	62	59	56	56	56	55	55	55	54	54
	23/06/25-24/06/25	56	54	54	53	52	52	52	52	51	51

Table 4: Measured L_{AFmax} events during the night-time periods

5 Noise impact assessment

5.1 To calculate noise levels incident on proposed new house façades, noise propagation has been modelled using proprietary software, CadnaA, Reference 7. This models noise propagation outdoors according to ISO 9613, Reference 8. Model details are set out in Appendix C.

5.2 Measured site noise levels at position P2 from the noise survey have been used to ascribe sound power levels to road traffic on Cliffe Hill Road.

5.3 Plan views with daytime and night-time road noise contours are shown in Figure 4 and Figure 5.

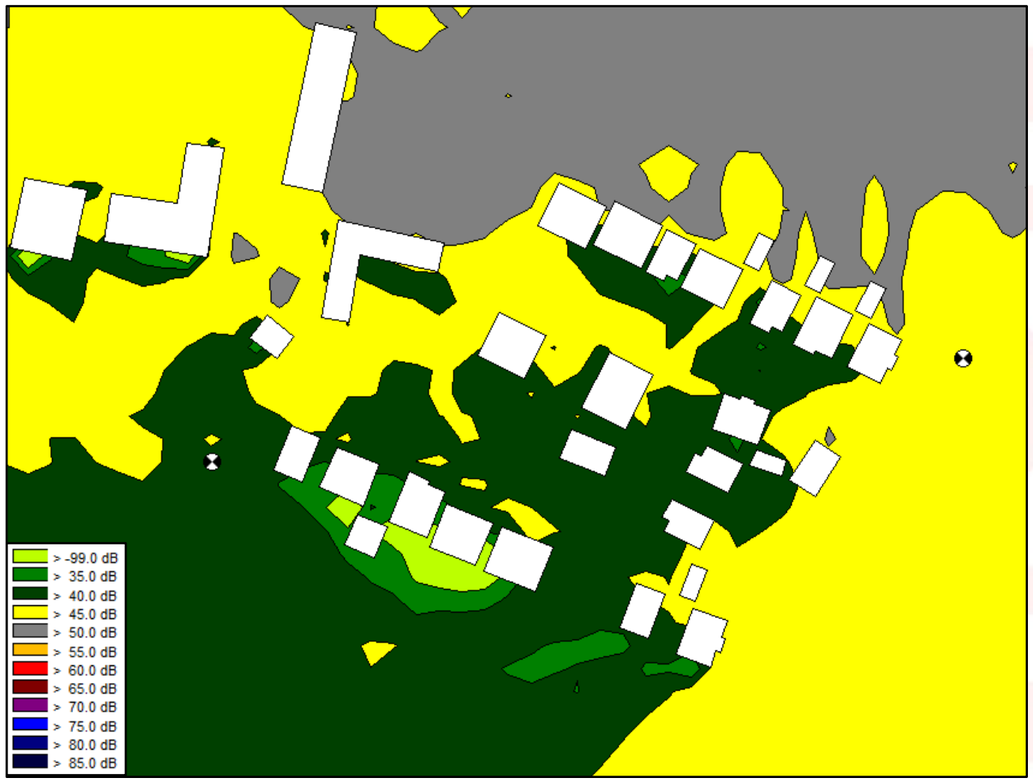

Figure 4: Plan view of the CadnaA model – Daytime $L_{Aeq,16hr}$ (dB) noise levels at 4.5 m

Figure 5: Plan view of the CadnaA model – Night-time $L_{Aeq,8hr}$ (dB) noise levels at 4.5 m

5.4 **Achieving internal noise levels**

5.5 Façade sound insulation calculations have been undertaken to determine the feasibility of achieving guideline internal noise level targets. An example calculation for a bedroom and living room in the most noise affected houses is included in Appendix E.

5.6 The calculation method for façade sound insulation is in accordance with BS 8233 and the principles of BS EN 12354-3, Reference 9.

5.7 From ISO 16283, Reference 10, the reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room. This value is used for both living rooms and bedrooms.

5.8 Details of the methodology used to calculate internal noise levels are provided on our website: https://www.apexacoustics.co.uk/calculation-facade-sound-insulation/.

5.9 Room dimensions and window areas are based on those of a typical house.

5.10 **Building envelope requirements**

5.11 Standard thermal double-glazed units with a nominal rating of 27 dB $R_w + C_{tr}$ are suitable to control noise break-in to achieve indoor ambient noise levels.

5.12 It is recommended that external wall build-ups achieve 40 dB R_w to control external noise break-in. Typical solid envelope constructions are normally suitable.

5.13 A traditional pitched tiled roof and ceiling comprising 1-layer of 12.5 mm standard plasterboard shall provide sufficient sound insulation.

5.14 **Noise and whole dwelling ventilation**

5.15 The proposed development will be required to meet Part F of the Building Regulations with regard to the whole dwelling ventilation condition, as described in the version of Approved Document F applicable to the scheme (AD-F), Reference 11.

5.16 Standard, non-acoustic, trickle vents may be used and will control noise break-in to achieve indoor ambient noise levels.

5.17 **Overheating**

5.18 Night-time sound levels ranged from 38-48 dB $L_{Aeq,T}$, with the higher levels being influenced by weather conditions and water flow (see paragraph 4.15).

5.19 55 dB L_{AFmax} was generally not exceeded more than 10 times a night.

5.20 On this basis, compliance with requirement O1 can be demonstrated with use of the simplified method.

5.21 **Purge Ventilation**

5.22 Purge ventilation conditions as described by AD-F is manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollutants and/or disperse water vapour. Purge ventilation may be provided by natural means (e.g. an openable window) or mechanical means (e.g. a fan).

5.23 For AD-F purge ventilation conditions, with regard to internal noise levels, ProPG states:

"It should also be noted that the internal level guidelines are generally not applicable under "purge ventilation" conditions as defined by Building Regulations Approved Document F, as this should only occur occasionally (e.g. to remove odour from painting and decorating or from burnt food)."

5.24 Considering this guidance, opening windows is considered acceptable for these occasional events without giving risk to potential adverse effect on occupants.

5.25 It should be emphasised that the above is not intended to constitute a ventilation strategy design, which is the responsibility of others.

6 Conclusion

6.1 This report details a noise survey, assessment and feasibility of achieving suitable noise levels within dwellings.

6.2 Sound levels at the site are relatively modest.

6.3 Standard thermal double-glazed units with a nominal acoustic rating of 27 dB $R_w + C_{tr}$ are suitable to control noise break-in to achieve indoor ambient noise levels.

6.4 Standard, non-acoustic, trickle vents may be used and will control noise break-in to achieve indoor ambient noise levels.

6.5 It is recommended that external wall build-ups achieve 40 dB R_w to control external noise break-in. Typical solid envelope constructions are normally suitable.

6.6 A traditional pitched tiled roof and ceiling comprising 1-layer of 12.5 mm standard plasterboard shall provide sufficient sound insulation.

6.7 Compliance with Part O requirement O1 can be demonstrated with use of the simplified method.

6.8 Based on the details outlined in this report, the noise risks identified are suitably mitigated and controlled to meet typically referenced planning policy and noise control guidance.

7 References

1 National Planning Policy Framework, Ministry for Levelling Up, Housing, Communities, December 2024

2 Noise Policy Statement for England, Department for Environment, Food and Rural Affairs, March 2010

3 Association of Noise Consultants (ANC), Institute of Acoustics (IOA) and Chartered Institute of Environmental Health (CIEH), ProPG: Planning & Noise - New Residential Development May 2017

4 BS 8233:2014, Guidance on sound insulation and noise reduction for buildings

5 Guidelines for Community Noise, Edited by Birgitta Bergland, Thomas Lindvall, Dietrich H Schwela, World Health Organisation, 1999

6 The Building Regulations 2010 (2021 edition): Approved Document O – Overheating

7 CadnaA environmental noise modelling software, version 2024, Datakustik GmbH

8 ISO 9613: Acoustics - Attenuation of sound during propagation outdoors

9 BS EN 12354-3:2000, Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 3: Airborne sound insulation against outdoor sound

10 BS EN ISO 16283-1:2014 Acoustics - Field measurement of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation

11 Approved Document F 2021 Edition, The Building Regulations 2010

Appendix A Site Plan

Appendix B Noise Survey Time History

B.1 Time history of measured noise levels

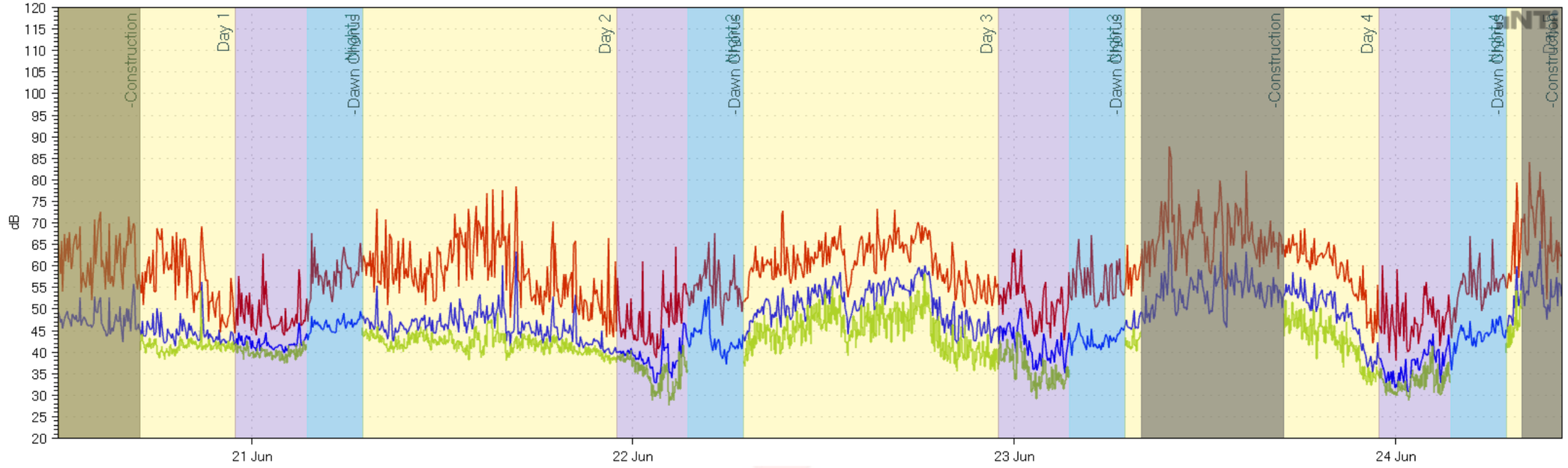

Figure 6: Time history of measured site noise levels showing $L_{Aeq,5min}$ (blue), L_{AFmax} (red) and $L_{A90,5min}$ (green) at position P1

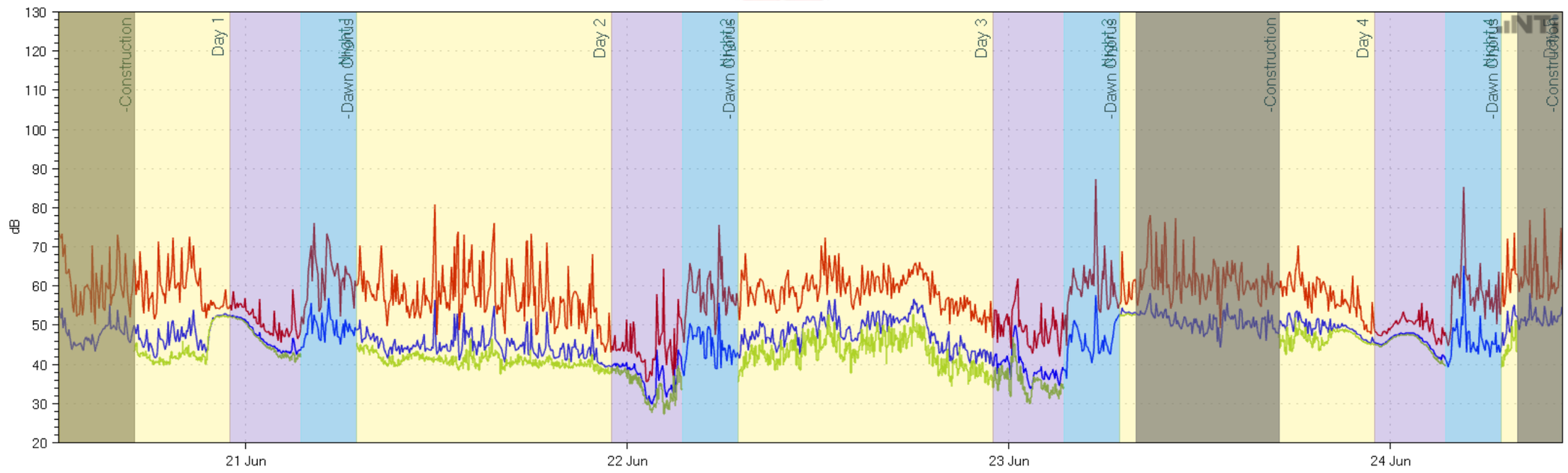

Figure 7: Time history of measured site noise levels showing $L_{Aeq,5min}$ (blue), L_{AFmax} (red) and $L_{A90,5min}$ (green) at position P2

Appendix C CadnaA model details

Parameter	Source	Details
Model dimensions	Google Earth	British Transverse Mercator coordinates
Site location and layout	Drawings	Site plan, see Appendix A
Topography	DEFRA	LIDAR height data
Building heights – proposed buildings	Apex	Assumed to be 8 m (3 m per storey + 2 m roof)
Building heights – outside of site	DEFRA	LIDAR height data
Receptor positions	Site observations and Google Street view	On the façade closest to the source at a height of 1.5 m and, 4.5 to represent ground and first floor window heights respectively
Building and barrier absorption coefficient	ISO 9613-2	0.21 to represent a reflection loss of 1 dB
G, Ground factor	ISO 9613-2	Generally, ground absorption set as G = 0.5, meaning semi-reflective to represent a mix of reflective (e.g. pavement) and absorptive (e.g. grassed/vegetated) surfaces.
Max. order of reflections	Apex Acoustics	Three

Table 5: CadnaA model parameters and assumptions

Appendix D Glossary

Term	Meaning
A-weighting	The sensitivity of the human ear is frequency dependent. The weighting of a signal with the A-weighting network approximates the frequency response of the human ear at moderate noise levels. Although other networks, such as C-weighting, better approximate the response of the human ear at higher noise levels, in practice the A-weighting network is still used for convenience.
***C* & C_{tr}**	Spectral adaption terms – The single number rating method defined in BS EN ISO 717 uses a standard reference curve to determine the weighted value of airborne sound insulation. 'C' is the A-weighted pink noise spectrum. 'C_{tr}' is the A-weighted urban traffic noise spectrum. The relevant spectral adaption term is added to R_w or $D_{n,e,w}$ measurements to take into account low frequency noise.
Decibel, dB	A description of level, ten times the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure, L_p, the reference quantity is 2 x 10-6 N/m_2. The threshold of hearing is approximately 0 dB, and the threshold of pain around 120 dB. Hence the human perception of sound has a dynamic range of twelve orders of magnitude. Although sound pressure has units of N/m^2, the decibel has no dimensional units.
Frequency, Hz	The number of sound waves to pass a point in one second.
Hertz, Hz	The unit of frequency equivalent to one cycle per second.
L_{90}	A-weighted, sound level just exceeded for 90% of the measurement period and calculated by statistical analysis. Considered to represent the 'background noise level'.
$L_{Aeq,T}$	Continuous equivalent A-weighted sound pressure level – The value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that within a specified time interval, *T*, has the same mean squared sound pressure as the sound under consideration that varies with time.
L_{AFmax}	A-weighted, maximum, sound level measured with a fast time-constant.
Octave	Unit of logarithmic frequency interval: two sounds, the ratio of whose fundamental frequencies is 2, have a logarithmic frequency interval of 1 octave.
Octave bands	A convenient division of the frequency scale. Identified by their centre frequency, typically 63, 125, 250, 500, 1000, 2000, 4000, 8000 Hz.
R_w	Weight sound reduction index – A single-number quantity which characterizes the airborne sound insulation of a material or building element in the laboratory. See BS EN ISO 71 7-1:1997.
Sound level meter	An instrument for the measurement of sound level, with a standard frequency weighting and standard exponentially weighted time-averaging.
Third-octave bands	A small division of the frequency scale, three to each octave. Enables more accurate noise analysis.

Table 6: Acoustic Glossary

D.1 For a complete glossary of terms, see www.apexacoustics.co.uk

Appendix E Example façade sound insulation calculations

Bed in house in the north-east corner of the site (most noise affected)	
Volume, V / m^3	14
Window area, S / m^2	2
Reverberation Time, *T* / s	0.5
Number of vents feasible	1

Daytime $L_{Aeq,T}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	**49**	35	39	42	44	44
Glazing: 4/12/4 mm, *R*		24	20	25	32	37
Equation 1, L_2(a)	**21**	10	18	16	11	6
Vent: 8000 HD, $D_{n,e}$		33	32	29	28	30
Equation 2, L_2(b)	**26**	9	14	19	22	21
Total noise through all elements, L_2	**27**					

Night-time $L_{Aeq,T}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	**45**	27	32	37	41	41
Glazing: 4/12/4 mm, *R*		24	20	25	32	37
Equation 1, L_2(a)	**16**	2	11	11	8	3
Vent: 8000 HD, $D_{n,e}$		33	32	29	28	30
Equation 2, L_2(b)	**22**	1	7	14	19	18
Total noise through all elements, L_2	**23**					

Night-time L_{AFmax} (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	**55**	30	37	46	49	53
Glazing: 4/12/4 mm, *R*		24	20	25	32	37
Equation 1, L_2(a)	**24**	5	17	21	17	15
Vent: 8000 HD, $D_{n,e}$		33	32	29	28	30
Equation 2, L_2(b)	**32**	4	12	24	28	29
Total noise through all elements, L_2	**33**					

Living Room in house in the north-east corner of the site (most noise affected)	
Volume, V / m^3	29
Window area, S / m^2	2
Reverberation Time, *T* / s	0.5
Number of vents feasible	1

Daytime $L_{Aeq,T}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	**49**	35	39	42	44	44
Glazing: 4/12/4 mm, *R*		24	20	25	32	37
Equation 1, L_2(a)	**19**	7	16	14	9	4
Vent: 8000 HD, $D_{n,e}$		33	32	29	28	30
Equation 2, L_2(b)	**23**	5	10	16	19	17
Total noise through all elements, L_2	**24**					