

Acoustic Associates Sussex Ltd

Planning Application Noise Assessment

Site: Land at Shrublands Nursery, Roundstone Lane, Angmering
Client: Sigma Homes

Report by: Simon Barrett BSc(Hons) MSc MIOA
Checked by: Peter Attwood BSc MSc MCIOB MIOA

Date: 20th July 2021
Project: J3058

Sound Insulation Testing - Acoustic Design of Buildings - BS4142 - PPB24 - Schools Acoustics BS683 -

Vibration - Expert Witness Testimony - Noise at Work - Air Tightness Testing - Auditorium Acoustics

PART OF THE ACOUSTIC ASSOCIATES GROUP OF CONSULTANTS:

DEVON HUMBERSIDE LEICESTERSHIRE NOTTINGHAMSHIRE PETERBOROUGH SUSSEX WESSEX WORCESTERSHIRE

Acoustic Associates Sussex Ltd., 8 Highdown House, Shoreham Airport, Shoreham-by-Sea, West Sussex BN43 5PB

www.aasussex.co.uk

Contents

1	Introduction	4
2	Context, Noise Criteria and Assessment Methodology	5
2.1	Context	5
2.2	National Planning Policy Framework	5
2.3	BS8233: 2014 Noise Criteria	5
2.4	Pro PG Planning and Noise Guidance - 2017	6
3	Noise Survey	7
3.1	General	7
3.2	Survey Results	8
4	Computer Noise Model	9
4.1	Immi Noise Model Output	10
5	Noise Assessment	11
5.1	Noise Criteria	11
5.2	Required Sound Reduction of Building Envelope	12
5.3	Outdoor Amenity Areas	13
5.4	Maximum Noise Levels	13
6	BS8233 Calculations	14
7	Conclusion	16
	Appendix A – Immi Noise Contour Models	17
	Appendix B – BS8233 Rigorous Calculations	21

Tables and Figures:

Table 1: BS8233:2014 Target Criteria	5
Table 2: Survey Results – Survey Location 1	8
Table 3: Survey Results - Survey Location 2	8
Table 4: Survey Results - Survey Location 3	8
Table 5: Immi Output	10
Table 6: Computer Noise Model Predictions and Required SRI to satisfy BS8233 and ProPG	12
Table 7: Initial BS8233 Calculations	14
Figure 1: ProPG Criteria	6
Figure 2: Un-Manned Long Term Survey Locations	7
Figure 3: Computer Prediction Noise Contours – Ground Floor, Daytime	9

Report by: Simon Barrett BSc(Hons) MSc MIOA
Checked by: Peter Attwood BSc (Hons) MSc MCIOB MIOA

Issue No.	Date	Comments
Issue 1	20/07/2021	Initial Issue

This report has been prepared for the private and confidential use of Sigma Homes Ltd. This report has been prepared by Acoustic Associates Sussex Limited with all reasonable skill, care and diligence and presents information included within the scope agreed with the client. If any third party whatsoever comes into possession of this report, they rely on it at their own risk and Acoustic Associates Sussex Ltd accepts no duty or responsibility (Including in negligence) to any such third party

1 Introduction

Acoustic Associates Sussex Ltd have been appointed to provide a sound insulation scheme in order to satisfy a planning application in respect of the proposed development on the land of Shrublands Nursery, Roundstone Lane, Angmering, West Sussex.

This report is required to assess the following:

- Noise levels affecting the proposed development at the different facades.
- The specification of suitable glazing and ventilation systems for the detailed design stage.

Measurements of sound levels have been carried out over a period of 7 days at three (3) locations around the proposed site, where it has been identified that noise generating premises exist as well as being adjacent to a road.

The measured noise levels have been input to a computer noise modelling program (IMMI) to show how the noise levels vary across the proposed site at ground and first floor levels.

The resultant noise levels at the proposed facades will be assessed against the criteria set out by:

- BS8233:2014 Sound insulation and noise reduction for buildings
- ProPG Planning and Noise Guidance: 2017

This report will conclude that no special mitigation measures are required for internal sound pressure levels during the daytime or the night-time and for within the garden areas during the daytime. As a result, it is recommended that planning consent is not withheld due to noise.

2 Context, Noise Criteria and Assessment Methodology

2.1 Context

It is proposed that the (former) Shrublands Nursery will be re-developed into a site with 40 residential dwellings comprising houses and flats.

The site is bounded to the North by Farrowfields Estate – a storage location which also incorporates a vehicle Paint and Repair works.

The site is bounded to the East by Roundstone Lane – a road which runs North – South in both directions.

The site is bounded to the South by Roundstone Boarding Kennels and Cattery and a Canine Hydrotherapy facility. Also, to the south, but to the west of the kennels, it was noted that a residential development is well underway to being constructed.

2.2 National Planning Policy Framework

Previously, planning policy guidance notes set out the Government's policies on different aspects of planning. Until recently, it was the case that Local Authorities must take their content into account in preparing their development plans. They may be material to decisions on individual planning applications and appeals. PPG24 (relating to noise) has recently been withdrawn, following the introduction of the National Planning Policy Framework 2012 document (recently updated to the 2018 version), (which is not meant to be a replacement for PPG24). This later document places the onus on Local Authorities to implement their own local criteria.

It is recommended in this case that appropriate criteria are provided by:

- BS8233 (Sound Insulation and Noise Reduction for Buildings) 2014
- ProPG Planning and Noise Guidance: 2017

2.3 BS8233: 2014 Noise Criteria

The target internal levels within residential properties are based upon BS8233 guidelines, as follows: (Expressed as $L_{Aeq,T}$ dB):

Activity	Location	Time period of day	
		07:00-23:00	23:00-07:00
Resting	Living Rooms	35dB $L_{Aeq,16hour}$	-
Dining	Dining Room/Area	40dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35dB $L_{Aeq,16hour}$	30dB $L_{Aeq,8hour}$

Table 1: BS8233:2014 Target Criteria

It is important to note that Annex G of BS8233:2014 states that partially open windows provide an attenuation of sound levels directly outside of a building by 15 dB.

The values in Table 1, above relate to anonymous noise sources such as road traffic. Where sources have more character, it is often necessary and wise to enhance the requirements by 5dB.

In the case of this site, there is a dog boarding facility at the south boundary of the site and a 5dB enhanced criteria will therefore be relevant.

2.4 Pro PG Planning and Noise Guidance - 2017

The following has been copied from the Association of Noise Consultants' (ANC) website:

Over recent years, we have seen the introduction of the Noise Policy Statement for England, as well as substantial changes in national planning policy. But these developments have not been accompanied by detailed technical acoustic advice.

The lack of detailed guidance can lead to inconsistent application of policy, that may in turn result in unsatisfactory development and affect quality of life.

To fill that gap and facilitate efficient and consistent decision-making in the development control process, the Institute of Acoustics, the Association of Noise Consultants and the CIEH have joined to produce a Professional Practice Guidance (ProPG) focussing on noise sensitive development.

The following extract has been taken (Figure 2, Page 13) from the May 2017 ProPG document:

Activity	Location	Daytime – 07:00-19:00 hrs	Nighttime – 19:00-07:00 hrs
Resting	Living room	35 dB $L_{Aeq,10hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,10hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,10hr}$	30 dB $L_{Aeq,8hr}$ for 45 dB $L_{Amax,10min}$ (Noise A)

NOTE 1 The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table.

NOTE 3 These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 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 $L_{Amax,10min}$, depending on the character and number of events per night. Sporadic noise events could require separate values. 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 45dB $L_{Amax,10min}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any facade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. 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". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. 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. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form (see Section 3.2).

Figure 1: ProPG Criteria

3 Noise Survey

3.1 General

An un-attended noise survey was carried out from Wednesday 7th July 2021 to Wednesday 14th July 2021 in order to measure the noise levels incident to the proposed development from road traffic and from the adjacent sites to the north and south.

Three separate sound level meters were located around the site measuring the sound pressure levels over consecutive 15-minute and 5-minute periods.

The locations of the sound level meters can be seen in Figure 2, below.



Figure 2: Un-Manned Long Term Survey Locations

3.2 Survey Results

The results of the noise survey at the measurement positions are shown in the tables below:

Day	Daytime $L_{Aeq,16hr}$ (07:00 – 23:00) (dB)	Night Time $L_{Aeq,8hr}$ (23:00 – 07:00) (dB)
Wednesday*	65*	56.17
Thursday	63.29	56.29
Friday	63.22	54.86
Saturday	64.48	53.52
Sunday	61.94	58.08
Monday	63.47	54.58
Tuesday	63.1	54.36
Wednesday*	63.9*	-
Average	64	55

Table 2: Survey Results – Survey Location 1

Day	Daytime $L_{Aeq,16hr}$ (07:00 – 23:00) (dB)	Night Time $L_{Aeq,8hr}$ (23:00 – 07:00) (dB)
Wednesday*	49.1*	42.03
Thursday	50.57	42.37
Friday	50.06	39.63
Saturday	52.8	41.87
Sunday	56.09	42.54
Monday	48.85	43.49
Tuesday	49.88	41.97
Wednesday*	49.72*	-
Average	51	42

Table 3: Survey Results - Survey Location 2

Day	Daytime $L_{Aeq,16hr}$ (07:00 – 23:00) (dB)	Night Time $L_{Aeq,8hr}$ (23:00 – 07:00) (dB)
Wednesday*	51.62*	48.8
Thursday	49.91	48.15
Friday	49.7	45.12
Saturday	46.81	43.31
Sunday	46.55	41.59
Monday	47.83	41.07
Tuesday	46.71	41.66
Wednesday*	47.31	0
Average	48*	44

Table 4: Survey Results - Survey Location 3

Asterisked Days and their corresponding asterisked values are incomplete periods.

Graphical representation of the results can be found in the appendices.

4 Computer Noise Model

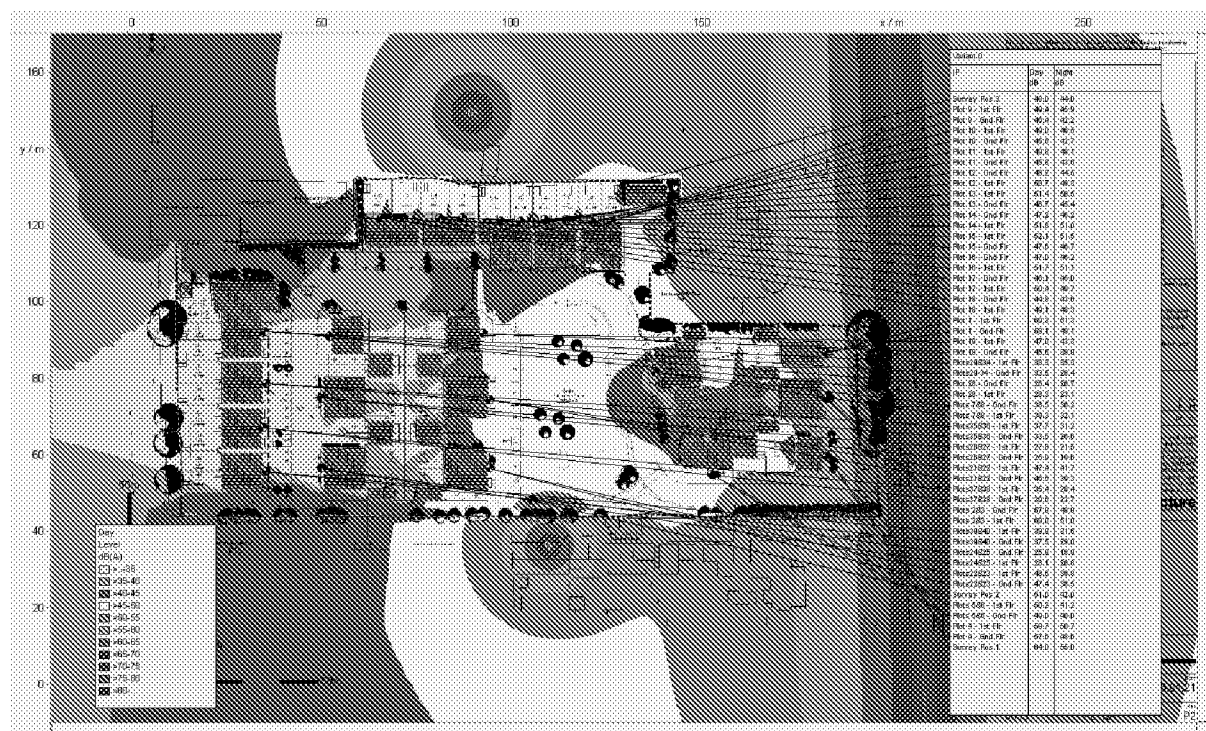
A computer noise model was completed using the computer package IMMI (Wolfel). The survey data from Tables 2 – 4, above and drawings of the proposed development were used to complete the noise models. IMMI faithfully implements the propagation method of ISO-9613:1996; Acoustics – Attenuation of sound during propagation outdoors.

Reception Points were placed into the model to represent the survey locations.

The computer model was calibrated so that the sound pressure levels at the reception points matched the average sound pressure levels from the three measurement locations, as detailed in tables 2-4 above.

Reception Points representing each of the plots were then placed into the computer model at ground floor and first floor levels and the model was run to show the sound levels at these reception points.

The full set of computer models are shown in the Appendices however, for reference, one model output can be seen below:



4.1 Immi Noise Model Output

The full tabulated output from the computer model showing noise levels directly outside the plots' façades is shown below:

Reception Point	Daytime Leq,16hr	Night time Leq,8hr	Daytime Leq,16hr	Night time Leq,8hr
	dBA	dBA	dBA (rounded)	dBA (rounded)
Survey Pos 1	64.018	55.018	64	55
Survey Pos 2	51.007	42.049	51	42
Survey Pos 3	48.023	43.972	48	44
Plot 1 - Gnd Flr	58.13	49.132	58	49
Plots 2&3 - Gnd Flr	57.89	48.891	58	49
Plot 4 - Gnd Flr	57.564	48.565	58	49
Plots 5&6 - Gnd Flr	48.979	39.99	49	40
Plots 7&8 - Gnd Flr	38.488	30.217	38	30
Plot 9 - Gnd Flr	46.445	42.227	46	42
Plot 10 - Gnd Flr	45.479	42.715	45	43
Plot 11 - Gnd Flr	45.766	43.565	46	44
Plot 12 - Gnd Flr	46.239	44.541	46	45
Plot 13 - Gnd Flr	46.737	45.405	47	45
Plot 14 - Gnd Flr	47.204	46.196	47	46
Plot 15 - Gnd Flr	47.63	46.689	48	47
Plot 16 - Gnd Flr	47.017	46.18	47	46
Plot 17 - Gnd Flr	46.089	45.022	46	45
Plot 18 - Gnd Flr	44.849	43.614	45	44
Plot 19 - Gnd Flr	45.572	39.903	46	40
Plots21&22 - Gnd Flr	46.504	39.292	47	39
Plots22&23 - Gnd Flr	47.426	38.481	47	38
Plots24&25 - Gnd Flr	25.88	18.925	26	19
Plots26&27 - Gnd Flr	25.941	19.618	26	20
Plot 28 - Gnd Flr	26.373	20.694	26	21
Plots29-34 - Gnd Flr	33.485	28.394	33	28
Plots35&36 - Gnd Flr	33.483	26.564	33	27
Plots37&38 - Gnd Flr	30.573	23.736	31	24
Plots39&40 - Gnd Flr	37.499	28.961	37	29
Plot 1 - 1st Flr	60.295	51.301	60	51
Plots 2&3 - 1st Flr	60.03	51.031	60	51
Plot 4 - 1st Flr	59.748	50.749	60	51
Plots 5&6 - 1st Flr	50.182	41.195	50	41
Plots 7&8 - 1st Flr	39.275	32.139	39	32
Plot 9 - 1st Flr	49.399	45.851	49	46
Plot 10 - 1st Flr	48.988	46.543	49	47
Plot 11 - 1st Flr	49.811	48.06	50	48
Plot 12 - 1st Flr	50.667	49.334	51	49
Plot 13 - 1st Flr	51.437	50.524	51	51
Plot 14 - 1st Flr	51.793	51.048	52	51
Plot 15 - 1st Flr	52.111	51.545	52	52
Plot 16 - 1st Flr	51.659	51.121	52	51
Plot 17 - 1st Flr	50.36	49.721	50	50
Plot 18 - 1st Flr	49.075	48.281	49	48
Plot 19 - 1st Flr	47.031	43.251	47	43
Plots21&22 - 1st Flr	47.429	41.683	47	42
Plots22&23 - 1st Flr	48.631	39.825	49	40
Plots24&25 - 1st Flr	28.147	20.848	28	21
Plots26&27 - 1st Flr	27.835	21.517	28	22
Plot 28 - 1st Flr	28.303	23.094	28	23
Plots29-34 - 1st Flr	38.305	35.34	38	35
Plots35&36 - 1st Flr	37.701	31.195	38	31
Plots37&38 - 1st Flr	35.435	28.431	35	28
Plots39&40 - 1st Flr	39.93	31.595	40	32

Table 5: Immi Output

5 Noise Assessment

5.1 Noise Criteria

As mentioned in Section 2.3 of this report, the values in Table 1, relate to anonymous noise sources such as road traffic. Where sources have more character, it is often necessary and wise to enhance the requirements by 5dB.

In the case of this site, there is a dog boarding facility at the south boundary of the site and a 5dB enhanced criteria will therefore be relevant for internal ambient noise levels.

A summary of the criteria can be found below:

- Lounges & Bedrooms: 30 dBA $L_{eq,16hour}$ during daytime hours
- Bedrooms: 25 dBA $L_{eq,8hour}$ during Night time hours
- Bedrooms: L_{Amax} to not exceed 45dBA (no more than 10 exceedances per night)
- Outdoor Amenity Areas: Should not exceed 55dBA $L_{eq,16hour}$ during daytime hours

5.2 Required Sound Reduction of Building Envelope

The noise levels at the different reception points can be seen in table 6, below, together with the required Sound Reduction (SRI), which will have to be achieved by the building envelope at different floor heights for all the plots for the proposed development. All values have been rounded to the nearest whole dB.

Reception Point	Daytime Leq,16hr dBA	Night time Leq,8hr dBA	Daytime Leq,16hr dBA (rounded)	Night time Leq,8hr dBA (rounded)	Daytime IANL Requirement (LAeq,16hr) dB	Night time IANL Requirement (LAeq,8hr) dB	Attenuation Required Daytime (dB)	Attenuation Required Night time (dB)
Survey Pos 1	64.018	55.018	64	55				
Survey Pos 2	51.007	42.049	51	42				
Survey Pos 3	48.023	43.972	48	44				
Plot 1 - Gnd Flr	58.13	49.132	58	49	35	30	23	19
Plots 2&3 - Gnd Flr	57.89	48.891	58	49	35	30	23	19
Plot 4 - Gnd Flr	57.564	48.565	58	49	35	30	23	19
Plots 5&6 - Gnd Flr	48.979	39.99	49	40	35	30	14	10
Plots 7&8 - Gnd Flr	38.488	30.217	38	30	35	30	3	0
Plot 9 - Gnd Flr	46.445	42.227	46	42	35	30	11	12
Plot 10 - Gnd Flr	45.479	42.715	45	43	35	30	10	13
Plot 11 - Gnd Flr	45.766	43.565	46	44	35	30	11	14
Plot 12 - Gnd Flr	46.239	44.541	46	45	35	30	11	15
Plot 13 - Gnd Flr	46.737	45.405	47	45	35	30	12	15
Plot 14 - Gnd Flr	47.204	46.196	47	46	35	30	12	16
Plot 15 - Gnd Flr	47.63	46.689	48	47	35	30	13	17
Plot 16 - Gnd Flr	47.017	46.18	47	46	35	30	12	16
Plot 17 - Gnd Flr	46.089	45.022	46	45	35	30	11	15
Plot 18 - Gnd Flr	44.849	43.614	45	44	35	30	10	14
Plot 19 - Gnd Flr	45.572	39.903	46	40	35	30	11	10
Plots 21&22 - Gnd Flr	46.504	39.292	47	39	35	30	12	9
Plots 22&23 - Gnd Flr	47.426	38.481	47	38	35	30	12	8
Plots 24&25 - Gnd Flr	25.88	18.925	26	19	35	30	-9	-11
Plots 26&27 - Gnd Flr	25.941	19.618	26	20	35	30	-9	-10
Plot 28 - Gnd Flr	26.373	20.694	26	21	35	30	-9	-9
Plots 29-34 - Gnd Flr	33.485	28.394	33	28	35	30	-2	-2
Plots 35&36 - Gnd Flr	33.483	26.564	33	27	35	30	-2	-3
Plots 37&38 - Gnd Flr	30.573	23.736	31	24	35	30	-4	-6
Plots 39&40 - Gnd Flr	37.499	28.961	37	29	35	30	2	-1
Plot 1 - 1st Flr	60.295	51.301	60	51	35	30	25	21
Plots 2&3 - 1st Flr	60.03	51.031	60	51	35	30	25	21
Plot 4 - 1st Flr	59.748	50.749	60	51	35	30	25	21
Plots 5&6 - 1st Flr	50.182	41.195	50	41	35	30	15	11
Plots 7&8 - 1st Flr	39.275	32.139	39	32	35	30	4	2
Plot 9 - 1st Flr	49.399	45.851	49	46	35	30	14	16
Plot 10 - 1st Flr	48.988	46.543	49	47	35	30	14	17
Plot 11 - 1st Flr	49.811	48.06	50	48	35	30	15	18
Plot 12 - 1st Flr	50.667	49.334	51	49	35	30	16	19
Plot 13 - 1st Flr	51.437	50.524	51	51	35	30	16	21
Plot 14 - 1st Flr	51.793	51.048	52	51	35	30	17	21
Plot 15 - 1st Flr	52.111	51.545	52	52	35	30	17	22
Plot 16 - 1st Flr	51.659	51.121	52	51	35	30	17	21
Plot 17 - 1st Flr	50.36	49.721	50	50	35	30	15	20
Plot 18 - 1st Flr	49.075	48.281	49	48	35	30	14	18
Plot 19 - 1st Flr	47.031	43.251	47	43	35	30	12	13
Plots 21&22 - 1st Flr	47.429	41.683	47	42	35	30	12	12
Plots 22&23 - 1st Flr	48.631	39.825	49	40	35	30	14	10
Plots 24&25 - 1st Flr	28.147	20.848	28	21	35	30	-7	-9
Plots 26&27 - 1st Flr	27.835	21.517	28	22	35	30	-7	-8
Plot 28 - 1st Flr	28.303	23.094	28	23	35	30	-7	-7
Plots 29-34 - 1st Flr	38.305	35.34	38	35	35	30	3	5
Plots 35&36 - 1st Flr	37.701	31.195	38	31	35	30	3	1
Plots 37&38 - 1st Flr	35.435	28.431	35	28	35	30	0	-2
Plots 39&40 - 1st Flr	39.93	31.595	40	32	35	30	5	2

Table 6: Computer Noise Model Predictions and Required SRI to satisfy BS8233 and ProPG

N.B. In Table 6 above, the worst-case daytime and night-time levels are at the front façade Plots 1 – 4 at first floor height followed by the same units at ground floor height.

5.3 Outdoor Amenity Areas

From the computer noise model, it has been found that all gardens satisfy the requirement of being less than 50dBA in order to mitigate against moderate annoyance assuming that the fencing around all gardens on the proposed plan is standard 1.8m high fencing (which has already been added to the computer model).

5.4 Maximum Noise Levels

Night Time (23:00hrs – 07:00hrs) L_{Amax} levels were also measured during the long-term noise survey. The distances from the survey positions to the reception points of the proposed plots have been calculated based upon the Leq computer noise model output values shown in Table 5.

It is worthy to note that at Survey Position 3, which was measuring sound from the industrial estate beyond the northern site boundary, the sound sources in said industrial estate are irrelevant to the Night Time L_{max} assessment as none operate beyond 21:00hrs. However, the Road (Roundstone Lane) to the East and the Dog Kennels to the South are relevant and will be considered for this assessment.

With regard to the front 8 plots (which are closest to the road), the worst-case affected plots are plots 1 – 4, with up to 33 occurrences of L_{Amax} exceeding 45dB in bedrooms during the night time hours assuming an open window and allowing for 4dB distance attenuation in comparison to the survey position (survey position 1).

With regard to the southern-most plots, closest to the Dog Kennels the most affected plots are Plots 20 & 21, with up to 22 occurrences of L_{Amax} exceeding 45dB in bedrooms during the night time hours assuming an open window and allowing for 0dB distance attenuation in comparison to the relevant survey position (survey position 2).

In these cases, it is clear that mitigation measures are required. It has been calculated that the level of attenuation required for satisfying the Daytime and Night time Leq sound levels for the worst case affected plots also satisfies the requirements for the L_{max} criterion.

6 BS8233 Calculations

Annex G of BS8233:2014 states that a partially open window can achieve attenuation of 15dB (against a façade-level measured sound pressure level – or 12dB against a free-field measured sound pressure level).

As can be seen by the last two columns of table 6 in section 5.2 of this report, the worst-case required sound reduction index for a building envelope is 25dB during daytime and 21dB during night time.

BS8233 “Rigorous Calculations” have been used to predict the sound insulation provided by the building envelope (Calculations detailed in BS8233 (Annex G.2) and full details of the calculations can be found in the appendices of this report.

The normalised frequency profile of passing traffic has been taken from BS EN 1793-3 for the purpose of calculations, matched to the Immi computer noise model output SPL for the worst-case plots.

The calculation predicts the total building envelope (glazing and masonry) sound reduction index (SRI).

The calculations have initially been completed for the worst-case properties on the East and South boundaries – those closest to the night-time sound creating sources – to check on the composite performance of the SRI of the building envelope AND background ventilation arrangement. It will follow that if standard arrangements meet the requirements for the worst-case properties, then the remainder of the properties’ requirements will also be met.

A summary of the initial calculations can be found in the table 7:

Location	SRI required (standard)	SRI achieved	Glazing	R_{tr}	Ventilation $D_{tr, w+ C_{tr}}$
Plots 1 – 4, 1 st Floor (Day)	25	29	4_12_4	25	Standard Trickle
Plots 1 – 4, 1 st Floor (Night)	21	29	4_12_4	25	Standard Trickle
Plots 22 – 23, 1 st Floor (Day)	14	30	4_12_4	25	Standard Trickle
Plots 22 – 23, 1 st Floor (Night)	10	30	4_12_4	25	Standard Trickle

Table 7: Initial BS8233 Calculations

Other glazing configurations are possible, providing equivalent sound attenuation performance, and these should also be considered. It is for the supplier to confirm that the required performance can be achieved with the system proposed. Laboratory test reports are often the best way to do this.

N.B. In the table above, glazing is stated as 4_12_4:

4_12_4 is translated as 4mm glass, 12mm air gap, 4mm glass.

As can be seen in the table above, these worst-case positions comfortably satisfy the requirements of BS8233 for internal ambient noise levels during the daytime and the night-time using standard thermal double glazing with standard slot trickle ventilators in the windows.

It follows that all other plots (which are less exposed to the noise sources) will also allow the use of standard thermal double glazing and standard trickle vents.

Therefore, for ALL plots, no enhanced acoustic requirements will be needed.

It should also be re-iterated that as previously mentioned in Section 5.4, the Lmax criterion for bedrooms during night-time hours needs no additional attenuation to be satisfied and as a result, the glazing and background ventilation arrangements in Table 7 will also satisfy the Lmax criterion for this development.

For Background Ventilation, System 1 is all that is needed to satisfy the internal ambient noise levels and provided that it is well designed, will meet the requirements for background ventilation within Approved Document F. Opening windows is not classed as a type of background ventilation.

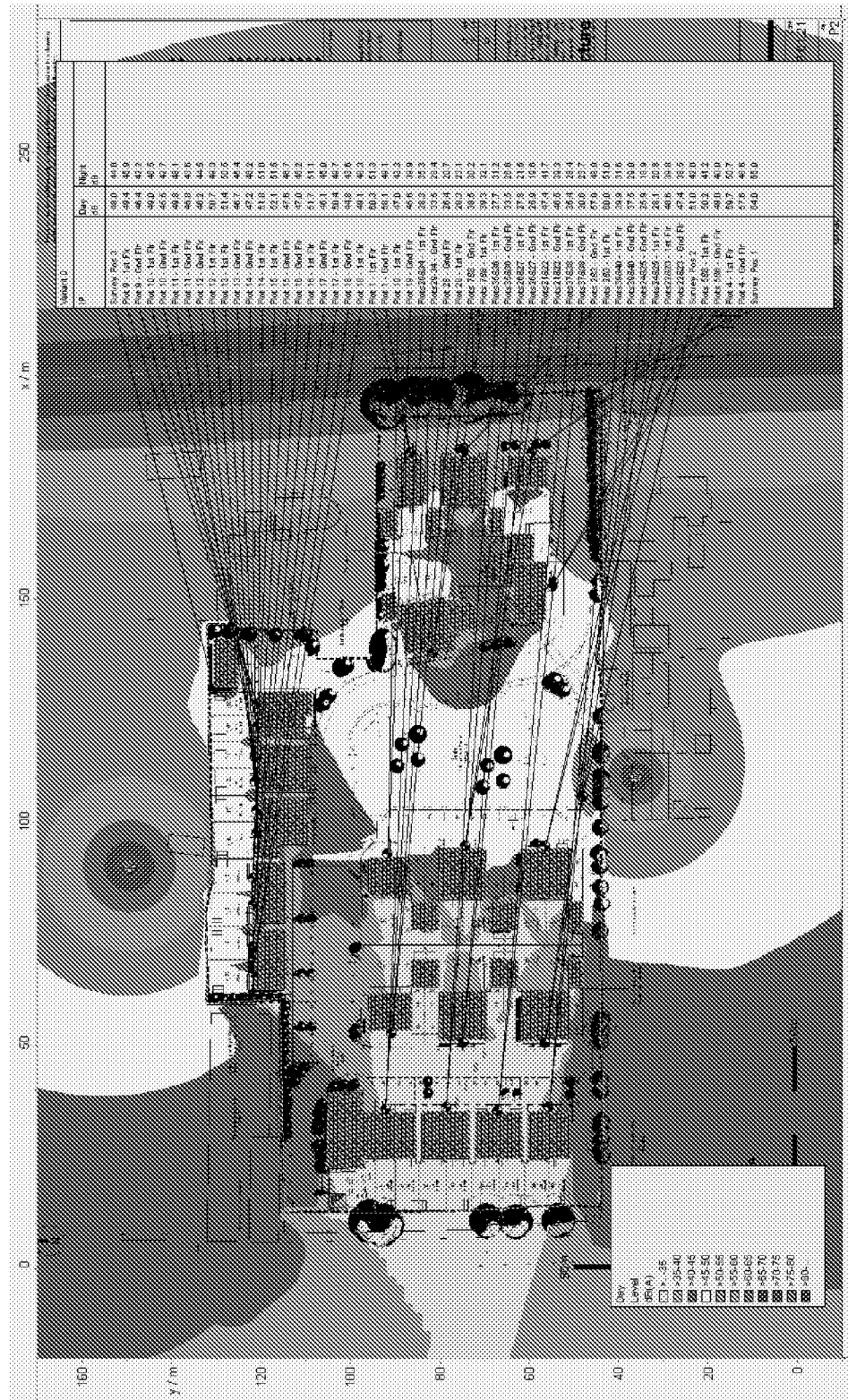
In terms of PURGE ventilation, as this is customer choice, opening windows is the typical method and there are no regulations relating to noise levels as purge ventilation as this is generally short periods of time only, to rapidly dilute indoor pollutants.

7 Conclusion

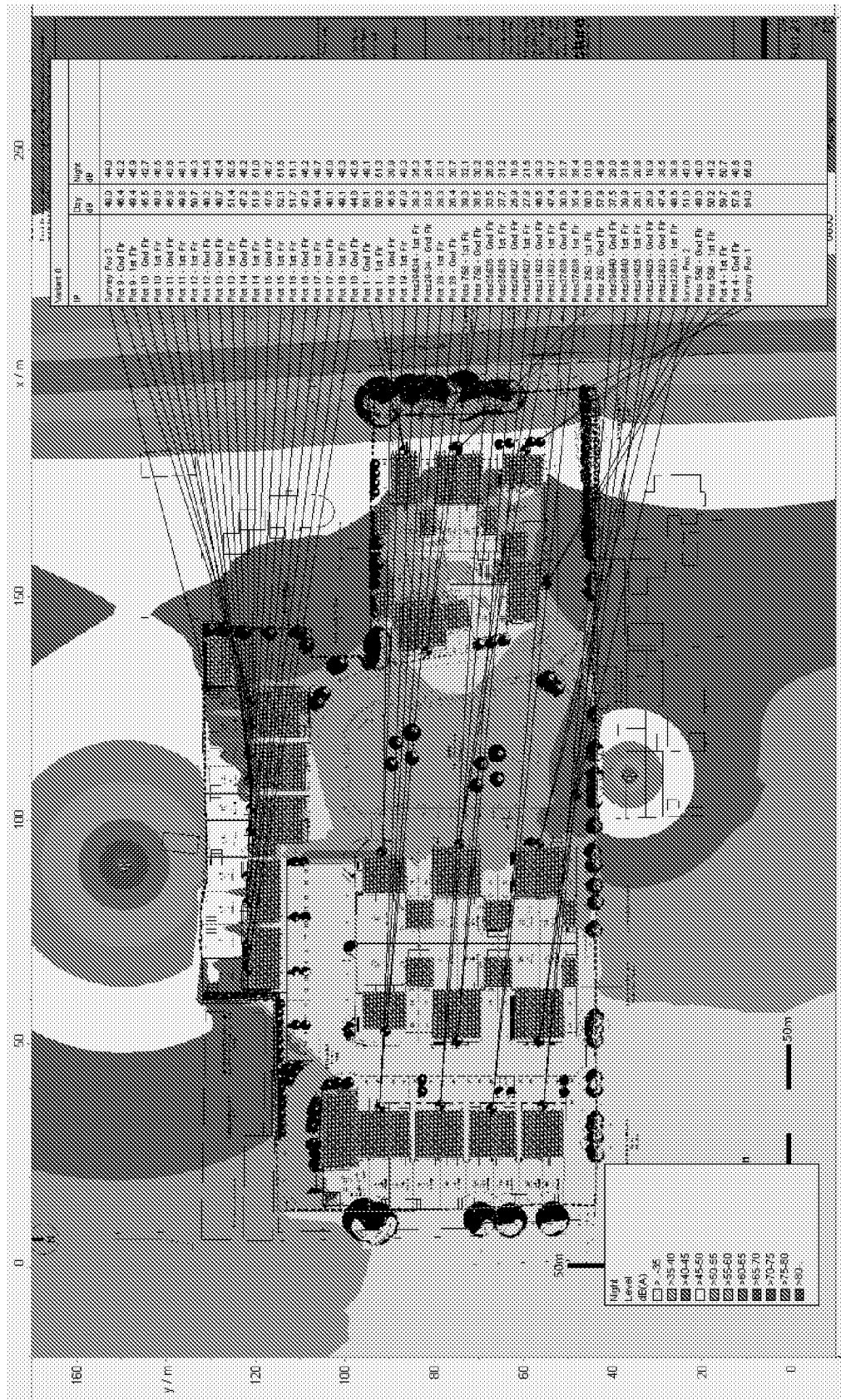
- In order to see how noise varies at the different positions for the proposed development a computer noise model has been completed using the computer package IMMI. Acoustic Associates road **noise long-term measurements** and architects' floor plans and elevations of the proposed development have been used to complete the noise model.
- The assessment was carried out in accordance with BS8233:2014 and ProPG Planning and Noise 2017 guidelines in order to be able to establish an appropriate Sound Insulation Scheme to support the planning application for this development.
- In order to demonstrate that the BS8233:2014 and ProPG:2017 internal levels criteria can be achieved, BS8233 Rigorous calculations have been completed for the worst-case units' bedrooms which are located on the first floor.
- It has been found that the criteria for all units' internal ambient noise levels during daytime and night-time hours, plus the Lmax sound level within bedrooms during night-time hours is satisfied simply by using standard thermal double glazing for windows and standard slot-based trickle vents for background ventilation.
- It has also been found that in terms of the plots affected by dogs barking from the southern sound source of Dog Boarding Kennels, even with enhancing the criteria by 5dB for internal ambient noise levels during daytime and night-time periods, the criteria are still satisfied.
- By good acoustic design, all plots' gardens automatically meet the requirements for sound pressure levels within outdoor amenity spaces of not exceeding Leq,16hr 50dBA during the daytime in order to prevent moderate annoyance.
- In summary, no special mitigation measures are required for internal sound pressure levels during the daytime or the night-time and also for within the garden areas during the daytime. As a result, it is recommended that planning consent is not withheld on the basis of noise.

Appendix A – Immi Noise Contour Models

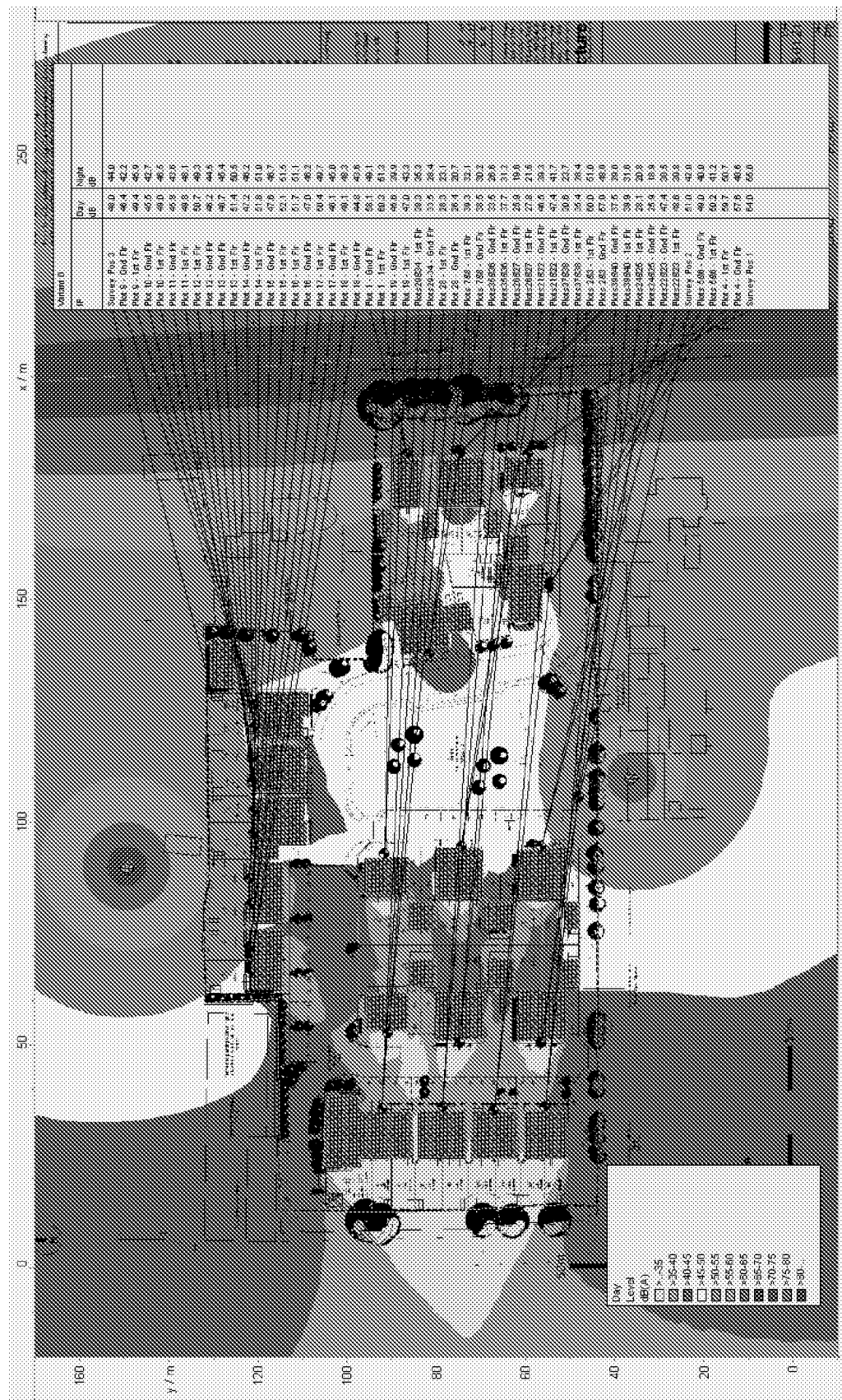
Daytime – Ground Floor



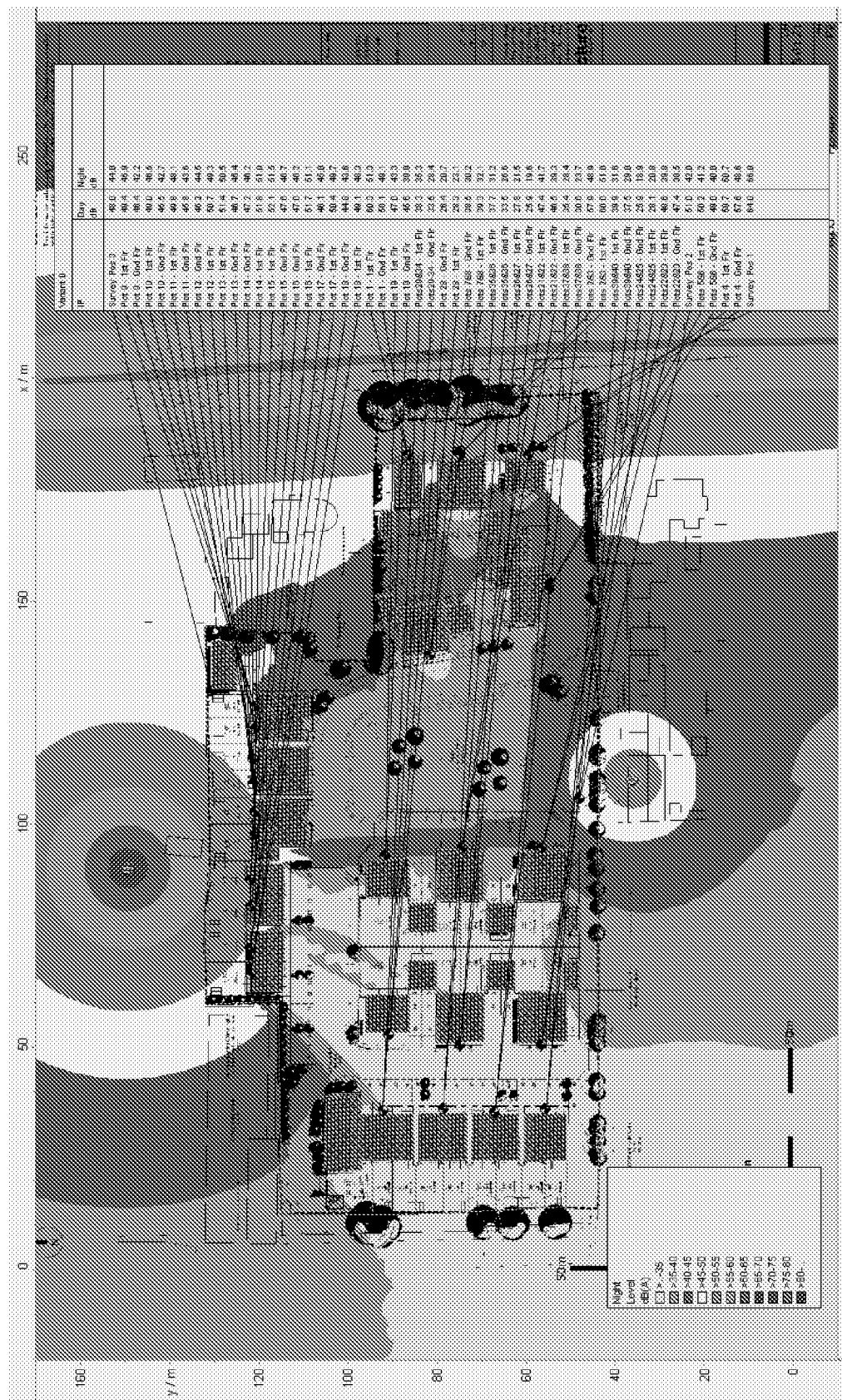
Night time – Ground Floor



Daytime – First Floor



Night-time – First Floor



Appendix B – BS8233 Rigorous Calculations

Plots 1 – 4: 1st Floor, Daytime

Non Frequency Dependent Variables			Key for Table Below	
Term	Derivation	Value	R_{wi}	Sound Reduction of Window (Octave)
A_0	Given in BS EN 20140-10 = 10 (m ²)	10	R_{ew}	Sound Reduction Index of External Wall (Octave)
S_f	Total Facade Area (m ²)	10.2	R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
S_{wi}	Window Area (m ²)	2.16	A	Equivalent Absorbent Area of Rx Room
S_{ew}	External Wall Area (m ²)	8.04	$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)
S_{rr}	Ceiling Area (m ²)	0.001		
S	Total Area sound enters the room (m ²)	15		

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	60.9	56.9	54.9	54.9	51.9	44.9
$D_{n,e}$	Typical Trickle Vent	34	34	34	34	34	34
R_{wi}	4_12_4	24	20	25	35	38	35
R_{ew}	HardiePlank Clad Timber Frame Wall	25	36	46	50	50	50
R_{rr}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorbent Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
Term From Equation Below	Octave Band Centre Frequency					
	125	250	500	1000	2000	4000
$L_{eq,ff}$	60.9	56.9	54.9	54.9	51.9	44.9
$A_0/S \cdot 10^{(-D_{n,e}/10)}$	0.0002654	0.000265	0.000265	0.000265405	0.000265405	0.000265405
$S_{wi}/S \cdot 10^{(-R_{wi}/10)}$	0.0005733	0.00144	0.000455	4.55368E-05	2.28225E-05	4.55368E-05
$S_{ew}/S \cdot 10^{(-R_{ew}/10)}$	0.001695	0.000135	1.35E-05	0.00000536	0.00000536	0.00000536
$S_{rr}/S \cdot 10^{(-R_{rr}/10)}$	5.296E-10	5.3E-10	5.3E-10	5.29552E-10	5.29552E-10	5.29552E-10
$10 \log_{10}(S/A) + 3$	4.3469857	3.299632	2.719713	2.719712764	3	3
$L_{eq,2}$	39.28447	32.84791	26.27808	22.62073363	19.57737963	12.90102087
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	23.18447	24.24791	23.07808	22.62073363	20.77737963	13.90102087

A-Weighted Level Outside	59
BS8233 Predicted Internal A-Weighted Level	30
Predicted Building Envelope SRI	29

BS8233 Calculation can be seen below:	
$L_{eq,2} \approx L_{eq,ff} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$	

Plots 1 – 4: 1st Floor, Night-time

Non Frequency Dependent Variables			Key for Table Below	
Term	Derivation	Value	R_{wi}	Sound Reduction of Window (Octave)
A_0	Given in BS EN 20140-10 = 10 (m ²)	10	R_{ew}	Sound Reduction Index of External Wall (Octave)
S_f	Total Facade Area (m ²)	10.2	R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
S_{wi}	Window Area (m ²)	2.16	A	Equivalent Absorbion Area of Rx Room
S_{ew}	External Wall Area (m ²)	8.04	$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)
S_{rr}	Ceiling Area (m ²)	0.001		
S	Total Area sound enters the room (m ²)	15		

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
$L_{eq, \#}$	Free-Field External Noise Level	52.9	48.9	46.9	46.9	43.9	36.9
$D_{n,e}$	Typical Trickle Vent	34	34	34	34	34	34
R_{wi}	4 12 4	24	20	25	35	38	35
R_{ew}	HardiePlank Clad Timber Frame Wall	25	36	46	50	50	50
R_{rr}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorbion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
Term From Equation Below	Octave Band Centre Frequency					
	125	250	500	1000	2000	4000
$L_{eq, \#}$	52.9	48.9	46.9	46.9	43.9	36.9
$A_0/S \cdot 10^{(-D_{n,e}/10)}$	0.0002654	0.000265	0.000265	0.000265405	0.000265405	0.000265405
$S_{wi}/S \cdot 10^{(-R_{wi}/10)}$	0.0005733	0.00144	0.000455	4.55368E-05	2.28225E-05	4.55368E-05
$S_{ew}/S \cdot 10^{(-R_{ew}/10)}$	0.001695	0.000135	1.35E-05	0.00000536	0.00000536	0.00000536
$S_{rr}/S \cdot 10^{(-R_{rr}/10)}$	5.296E-10	5.3E-10	5.3E-10	5.29552E-10	5.29552E-10	5.29552E-10
$10 \log_{10}(S/A) + 3$	4.3469857	3.299632	2.719713	2.719712764	3	3
$L_{eq,2}$	31.28447	24.84791	18.27808	14.62073363	11.57737963	4.901020866
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted L_{eq}	15.18447	16.24791	15.07808	14.62073363	12.77737963	5.901020866

A-Weighted Level Outside	51
BS8233 Predicted Internal A-Weighted Level	22
Predicted Building Envelope SRI	29

BS8233 Calculation can be seen below:	
$L_{eq,2} \approx L_{eq, \#} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$	

Plots 22 – 23: 1st Floor, Daytime

Non Frequency Dependent Variables			Key for Table Below	
Term	Derivation	Value	R_{wi}	Sound Reduction of Window (Octave)
A_0	Given in BS EN 20140-10 = 10 (m ²)	10	R_{ew}	Sound Reduction Index of External Wall (Octave)
S_T	Total Facade Area (m ²)	6.6	R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
S_{wi}	Window Area (m ²)	1.56	A	Equivalent Absorption Area of Rx Room
S_{ew}	External Wall Area (m ²)	5.04	$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)
S_{rr}	Ceiling Area (m ²)	0.001		
S	Total Area sound enters the room (m ²)	15		

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
$L_{eq, \#}$	Free-Field External Noise Level	50.9	46.9	44.9	44.9	41.9	34.9
$D_{n,e}$	Typical Trickle Vent	34	34	34	34	34	34
R_{wi}	4 12 4	24	20	25	35	38	35
R_{ew}	HardiePlank Clad Timber Frame Wall	25	36	46	50	50	50
R_{rr}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
Term From Equation Below	Octave Band Centre Frequency					
	125	250	500	1000	2000	4000
$L_{eq, \#}$	50.9	46.9	44.9	44.9	41.9	34.9
$A_0/S \cdot 10^{(-D_{n,e}/10)}$	0.0002654	0.000265	0.000265	0.000265405	0.000265405	0.000265405
$S_{wi}/S \cdot 10^{(-R_{wi}/10)}$	0.000414	0.00104	0.000329	3.28877E-05	1.64829E-05	3.28877E-05
$S_{ew}/S \cdot 10^{(-R_{ew}/10)}$	0.0010625	8.44E-05	8.44E-06	0.00000336	0.00000336	0.00000336
$S_{rr}/S \cdot 10^{(-R_{rr}/10)}$	5.296E-10	5.3E-10	5.3E-10	5.29552E-10	5.29552E-10	5.29552E-10
$10 \log_{10}(S/A) + 3$	4.3469857	3.299632	2.719713	2.719712764	3	3
$L_{eq,2}$	27.657373	21.62917	15.42088	12.41478922	9.452229112	2.695076453
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted L_{eq}	11.557373	13.02917	12.22088	12.41478922	10.65222911	3.695076453

A-Weighted Level Outside	49
BS8233 Predicted Internal A-Weighted Level	19
Predicted Building Envelope SRI	30

BS8233 Calculation can be seen below:	
$L_{eq,2} \approx L_{eq, \#} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$	

Plots 22 – 23: 1st Floor, Night-time

Non Frequency Dependent Variables			Key for Table Below	
Term	Derivation	Value	R_{wi}	Sound Reduction of Window (Octave)
A_0	Given in BS EN 20140-10 = 10 (m ²)	10	R_{ew}	Sound Reduction Index of External Wall (Octave)
S_T	Total Facade Area (m ²)	6.6	R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
S_{wi}	Window Area (m ²)	1.56	A	Equivalent Absorption Area of Rx Room
S_{ew}	External Wall Area (m ²)	5.04	$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)
S_{rr}	Ceiling Area (m ²)	0.001		
S	Total Area sound enters the room (m ²)	15		

Frequency Dependent Variables							
Term	Description	Octave Band Centre Frequency					
		125	250	500	1000	2000	4000
$L_{eq, \#}$	Free-Field External Noise Level	41.9	37.9	35.9	35.9	32.9	25.9
$D_{n,e}$	Typical Trickle Vent	34	34	34	34	34	34
R_{wi}	4 12 4	24	20	25	35	38	35
R_{ew}	HardiePlank Clad Timber Frame Wall	25	36	46	50	50	50
R_{rr}	Tiles on felt, pitched roof, 100mm mineral wool on lath and plaster ceiling	51	51	51	51	51	51
A	Equivalent Absorption Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
Term From Equation Below	Octave Band Centre Frequency					
	125	250	500	1000	2000	4000
$L_{eq, \#}$	41.9	37.9	35.9	35.9	32.9	25.9
$A_0/S \cdot 10^{(-D_{n,e}/10)}$	0.0002654	0.000265	0.000265	0.000265405	0.000265405	0.000265405
$S_{wi}/S \cdot 10^{(-R_{wi}/10)}$	0.000414	0.00104	0.000329	3.28877E-05	1.64829E-05	3.28877E-05
$S_{ew}/S \cdot 10^{(-R_{ew}/10)}$	0.0010625	8.44E-05	8.44E-06	0.00000336	0.00000336	0.00000336
$S_{rr}/S \cdot 10^{(-R_{rr}/10)}$	5.296E-10	5.3E-10	5.3E-10	5.29552E-10	5.29552E-10	5.29552E-10
$10 \log_{10}(S/A) + 3$	4.3469857	3.299632	2.719713	2.719712764	3	3
$L_{eq,2}$	18.657373	12.62917	6.420884	3.414789217	0.452229112	-6.30492355
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted L_{eq}	2.5573727	4.02917	3.220884	3.414789217	1.652229112	-5.30492355

A-Weighted Level Outside	40
BS8233 Predicted Internal A-Weighted Level	10
Predicted Building Envelope SRI	30

BS8233 Calculation can be seen below:	
$L_{eq,2} \approx L_{eq, \#} + 10 \log_{10} \left(\frac{A_0}{S} 10^{\frac{-D_{n,e}}{10}} + \frac{S_{wi}}{S} 10^{\frac{-R_{wi}}{10}} + \frac{S_{ew}}{S} 10^{\frac{-R_{ew}}{10}} + \frac{S_{rr}}{S} 10^{\frac{-R_{rr}}{10}} \right) + 10 \log_{10} \left(\frac{S}{A} \right) + 3$	