



BARRATT DAVID WILSON HOMES

LAND SOUTH OF WATER LANE, ANGMERING

**DISCHARGE OF CONDITION 9
ARUN DISTRICT COUNCIL PLANNING
PERMISSION REF. A/99/17/OUT**

SOUND INSULATION ASSESSMENT

APRIL 2021



BARRATT DAVID WILSON HOMES

LAND SOUTH OF WATER LANE, ANGMERING

**DISCHARGE OF CONDITION 9
ARUN DISTRICT COUNCIL PLANNING
PERMISSION REF. A/99/17/OUT**

SOUND INSULATION ASSESSMENT

APRIL 2021

Project Code:	24612
Prepared by:	David Denham MIOA MCIEH MEnvSc
Approved by:	Paul Gray BSc(Hons) MIOA
Issue Date:	April 2021
Status:	Ver 1.4

Land South of Water Lane, Angmering
Discharge of Condition 9 of
Arun District Council Planning Ref. A/99/17/OUT
Sound Insulation Assessment

List of Contents

Sections

1	Introduction	1
2	Site Description	3
3	Proposed Development.....	5
4	Design Criteria and Assessment Methodology	7
5	Existing Noise Environment.....	7
6	Computational Noise Modelling	26
7	Sound Insulation Scheme	28
8	Performance Verification	33
9	External Amenity	35
10	Conclusions	38

Figures

Figure 2.1: Site in Relation to the Local Highway Network.....	3
Figure 3.1: Proposed General Arrangement of Site	6
Figure 4.1: ProPG Internal Noise Level Design Guidance	9
Figure 5.1: Automated Measurement Locations	12
Figure 5.2: A1 Noise Monitoring Results	15
Figure 5.3: A2 Noise Monitoring Results	15
Figure 5.4: A3 Noise Monitoring Results	16
Figure 5.5: A4 Noise Monitoring Results	16
Figure 5.6: Attended Measurement Locations	17
Figure 6.1: Daytime Noise Model LAeq,16hour	26
Figure 6.2: Night-time Noise Model LAeq,8hour	27
Figure 7.1: Acoustic Performance Recommendations	31
Figure 8.1: Plots Selected for Performance Verification.....	33
Figure 9.1: Proposed Location of 3m Acoustic Barrier	35
Figure 9.2: Noise Levels in External Amenity Areas	36

Figure 9.3: Noise Levels in Communal Amenity Space Serving Block A	37
--	----

Tables

Table 4.1: BS 8233 Indoor Ambient Noise Level Design Guidance	7
Table 5.1: Noise Monitoring Locations.....	13
Table 5.2: Instrumentation Details	13
Table 5.3: Weather.....	14
Table 5.4: Attended Noise Monitoring Locations	18
Table 5.5: Instrumentation Details	18
Table 5.6: Manual Measured Sound Levels	19
Table 5.6: A1 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels	20
Table 5.7: A2 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels	21
Table 5.8: A3 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels	21
Table 5.9: A4 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels	22
Table 5.10: Comparison of Historic and Contemporary Noise Data.....	23
Table 5.11: Calculated Daytime and Night-time $L_{Aeq,T}$ values.....	24
Table 7.1: Estimated Apparent SRI for Solid External Walls Elements	29
Table 7.2: Corrections for Multiple Ventilators	32

Sound Insulation Assessment

1 Introduction

1.1 Mayer Brown Limited has been commissioned by Barratt David Wilson Homes, to provide acoustic consultancy advice to assist with the detailed design of sound insulation provisions for a new residential development on land South of Water Lane, Angmering.

1.2 Outline planning consent for the development was granted by Arun District Council on 26/06/2017 (ref. A/99/17/OUT). Condition 9 of the Outline Planning Permission granted requires:

“Prior to the commencement of development a noise mitigation scheme shall be submitted for approval to the Local Planning Authority. The noise mitigation scheme shall include details relating to acoustic barriers and the façade treatment of all houses facing onto the A280 and Water Lane. The approved noise mitigation shall be implemented in accordance with the details submitted. All facades of all houses facing onto the A280 and Water Lane should be provided with acoustically treated mechanical ventilation to all habitable rooms.”

1.3 This report seeks to provide relevant information regarding the sound insulation of properties and protection of outdoor amenity spaces to discharge the above condition. This report is structured as follows:

- **Section 2** describes the location of the site in relation to the existing transport infrastructure and neighbouring land uses;
- **Section 3** outlines the proposed development;
- **Section 4** sets out the technical design requirements it is proposed to adopt;
- **Section 5** presents the results of environmental noise monitoring undertaken at the site;
- **Section 6** presents the results of computational noise modelling to assist in understanding the variation of noise levels around the site;
- **Section 7** outlines the proposed sound insulation scheme;
- **Section 8** provides a summary of calculated internal noise levels for the scheme, based on detailed sound insulation calculations in accordance with BS EN ISO 12354: 2017: *“Building Acoustics - Estimation of Acoustic Performance of Buildings from the Performance of Elements - Part 3: Airborne Sound Insulation Against Outdoor Sound”*, which are also appended to this assessment;
- **Section 9** provides a summary of calculated noise levels in external amenity areas of the site

Sound Insulation Assessment

- Conclusions are presented in **Section 10**.

1.4 A glossary of the acoustic terminology used in this report is attached at **Appendix A**.

2 Site Description

- 2.1 The location of the proposed development in relation to the local highway network and infrastructure is shown below in **Figure 2.1**.

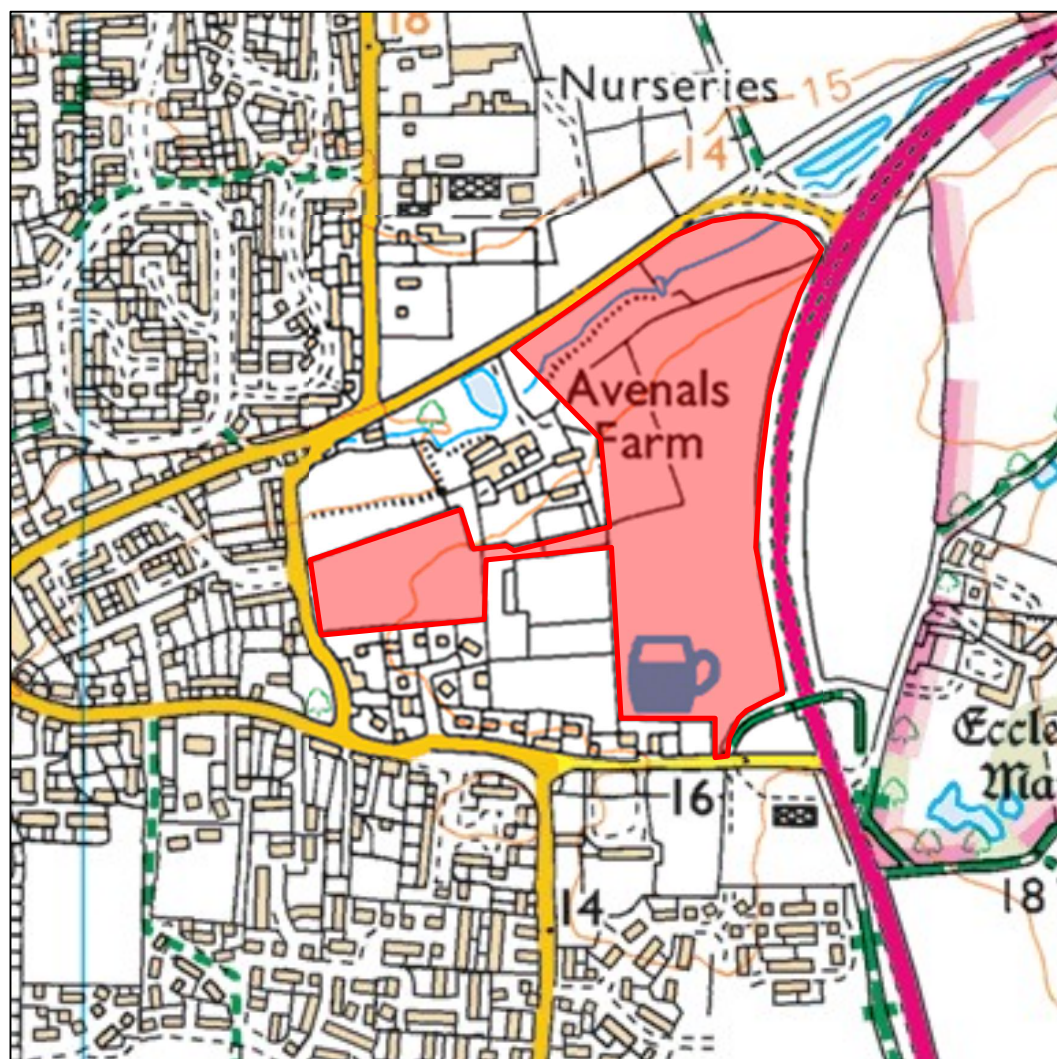


Figure 2.1: Site in Relation to the Local Highway Network

- 2.2 The site is located to the east of Angmering town centre, and to the west of the A280.
- 2.3 The site currently consists of open fields marked with hedgerows. The site includes a western parcel of land connected by a corridor. The site comprises of approximately 7.5 hectares of agricultural land.
- 2.4 To the north the site is bounded by Water Lane, a single carriageway leading off the A280 and onto Station Road. Further North of Water Lane are areas of open grassland.
- 2.5 To the east the site is bounded by the A280.

Sound Insulation Assessment

- 2.6 To southern boundary of the site is formed with a commercial unit currently occupied by a restaurant/public house (The Spotted Cow), further south are residential properties.
- 2.7 To the West of the site are two large residential dwellings, surrounding the residential properties are vast areas of open fields. Further west of the fields are residential properties.

Sound Insulation Assessment

3 Proposed Development

- 3.1 Outline planning consent for the development was granted by Arun District Council (ADC) on 26/06/2017 (ref. A/99/17/OUT).
- 3.2 The outline planning permission (ref. A/99/17/OUT) permits the development of:
- Up to 175 dwellings, including affordable homes;
 - A local play area
 - Public open space;
 - Strategic landscaping;
 - All associated and ancillary infrastructure and development.
- 3.3 The proposed general arrangement of the site proposed in the reserved matters application is shown in **Figure 3.1** overleaf:



Sound Insulation Assessment

4 Design Criteria and Assessment Methodology

- 4.1 Whilst the reason for Condition 9 is clear (i.e. *“For the protection of health and residential amenity”*), the condition does not make any specific reference to noise intrusion design targets or recommendations for external amenity areas.
- 4.2 The design recommendations presented in this report have therefore been informed by the guidance set out in:
- BS 8233: 2014: *“Guidance on Sound Insulation and Noise Reduction for Buildings”*; and
 - *“ProPG: Planning & Noise – Professional Practice Guidance on Planning & Noise - New Residential Development”* published by the Association of Noise Consultants, Institute of Acoustics and Chartered Institute of Environmental Health, May 2017.
- 4.3 Both documents are referenced in paragraph 015, Reference ID: 30-015-20190722 of the Government’s Planning Practice Guidance¹.
- [BS 8233: 2014 Sound Insulation and Noise Reduction for Buildings](#)
- 4.4 BS 8233: 2014 *Sound Insulation and Noise Reduction for Buildings* offers the following design guidance for indoor ambient noise levels within dwellings:

Activity	Location	07.00 to 23.00 hours	23.00 to 07.00 hours
Resting	Living Room	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 4.1: BS 8233 Indoor Ambient Noise Level Design Guidance

- 4.5 A note accompanying the above table states:

“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.”

¹ <https://www.gov.uk/guidance/noise--2>

Sound Insulation Assessment

- 4.6 The planning condition also makes reference to noise levels in external amenity spaces. Section 7.7.3.2 of BS 8233: 2014 states:

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might 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.

ProPG: Professional Practice Guidance on Planning and Noise

- 4.7 ProPG: Planning & Noise was published in May 2017. The guidance was authored by the Chartered Institute of Environmental Health (CIEH), Institute of Acoustics (IOA) and Association of Noise Consultants (ANC) and seeks to consolidate and standardise existing industry best practice in order to expedite the planning process with regard to the consideration of noise.
- 4.8 The guidance essentially promotes a two-stage assessment process to determine the suitability of a site for residential development and an appropriate noise mitigation strategy for addressing potential noise constraints.
- 4.9 A “Stage 1” assessment considers the initial noise “risk” of the site. An assessment in accordance with this guidance was presented in the “Noise and Vibration Assessment” prepared by Mayer Brown Limited which accompanied the outline planning application. This concluded that subject to adherence to a good acoustic design process, the site would be suitable for residential development.
- 4.10 This Noise Survey and Mitigation Scheme report therefore focusses on the more detailed requirements of Stage 2 of the ProPG guidance. In essence, this requires consideration of four key elements:
- **Element 1** – Good Acoustic Design Process
 - **Element 2** – Internal Noise Level Guidelines
 - **Element 3** – External Amenity Area Noise Assessment
 - **Element 4** – Assessment of Other Relevant Issues

Sound Insulation Assessment

4.11 Element 1 (Good Acoustic Design Process) encourages the development of sites with due regard to the following hierarchy of mitigation strategies:

- Reducing noise “at source”;
- Providing “buffer” zones to limit noise exposure;
- Reducing noise propagation across site (e.g. through the use of barriers);
- Developing the layout of the site to optimise acoustic protection (e.g. through the use of “barrier” blocks to help further limit noise propagation and the use of courtyard style development to protect external amenity areas);
- The orientation/general internal arrangement of buildings (e.g. by locating non-habitable rooms on ‘noisier’ facades and more sensitive uses on acoustically screened facades); and
- Providing buildings with appropriate sound insulation through the specification of appropriate external fabric constructions (in particular windows) and providing appropriate alternative means of ventilation if acceptable internal noise levels cannot be achieved if windows are open.

4.12 In relation to Element 2 (Internal Noise Design Targets), Figure 2 of ProPG makes the following design recommendations:

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16\text{ hr}}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16\text{ hr}}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16\text{ hr}}$	30 dB $L_{Aeq,8\text{ hr}}$ 45 dB $L_{Amax,F}$ (Note 4)

Figure 4.1: ProPG Internal Noise Level Design Guidance

4.13 The above recommendations are accompanied by a number of notes. Of particular relevance are:

- **Note 4** – which clarifies that the recommended $L_{Amax,fast}$ value should not normally be exceeded 10 times per night; and
- **Note 5** – which states “Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade 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....”.

4.14 It should be noted that the above design guidance is primarily intended for sites characterised by noise from transportation sources. Where existing noise levels are

Sound Insulation Assessment

dominated by industrial or commercial noise, ProPG recommends that reference is made to the assessment methodology of BS 4142: 2014².

4.15 For sites where industrial or commercial noise may be present but not “dominant”, ProPG suggests that the industrial noise component may be included and combined with the transportation noise component and professional judgement used to determine appropriate mitigation. ProPG clarifies that noise can be considered “*dominant*” where the impact would be rated as “*adverse or greater, subject to context*”. This implies a plant rating level that is at least 5dB above the typical background level, when rated in accordance with BS 4142.

4.16 In relation to Element 3 (External Amenity Area Noise Assessment), the following guidance is given:

“The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB L_{Aeq,16hr}.”

These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.”

4.17 Element 4 (Assessment of Other Relevant Issues) does not set out any quantitative technical guidance, but requires consideration of “*issues that should be considered about the noise aspects of a particular planning proposal for new residential development*”.

Local Authority Liaison

4.18 The scope of this report and relevant assessment criteria have been discussed with Arun District Council’s Environmental Health Team (Carol Reynolds, Senior Environmental Health Officer) where it was suggested that the in addition to achieving industry standard internal noise criteria i.e BS8233/WHO/ProPG values, the external amenity noise levels should be within WHO guideline value of 55dB to avoid significant annoyance and more preferably 50dB. A detailed analysis of the 1min L_{Amax, fast} values was also requested in order to assess the impact on future sensitive receptors.

4.19 Reference was also made to the historical monitoring data which accompanied the outline application³ for the site and a request was made to review the more contemporary

² This standard has now been replaced by BS 4142: 2014 + A1: 2019.

³ Phlorum: Noise Assessment – Land South of Water Lane, Angmering, West Sussex (November 2016)

Sound Insulation Assessment

data undertaken by Mayer Brown Limited as it was felt it did not align with the historical data, particularly in light of the latter data being obtained during the Covid-19 pandemic.

4.20 The email correspondence with the EHO is attached as **Appendix D**.

Sound Insulation Assessment

5 Existing Noise Environment

General

- 5.1 Existing baseline noise conditions at the site have been established using a combination of automated and manned noise surveys.

Automated Noise Monitoring

- 5.2 The automated survey was undertaken over a notional seven day period between approximately 13.00 hours on 29 July 2020 to 13:00 hours on 05 August 2020.
- 5.3 Noise levels were monitored at four locations as indicated in **Figure 5.1** below and described in **Table 5.1** overleaf



Figure 5.1: Automated Measurement Locations

Sound Insulation Assessment

Position	Description
A1	On the south-eastern boundary of the site, attached to the boundary fence. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.
A2	At the north-eastern corner of the site, approximately 10m from the A280 The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
A3	On the northern boundary of the site, attached to the boundary fence adjacent to the entrance to Avenals Farm. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.
A4	On the northern boundary of the western parcel of the site, attached to the boundary fence. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.

Table 5.1: Noise Monitoring Locations

5.4 The following instrumentation was used:

Location	Description	Manufacturer	Model	Serial No.	Calibration Date
A1	Sound Level Meter	Svantek	SVAN 71	55551	16/06/2020
	Microphone		7052E	63681	
	Preamplifier		SV18	57254	
	Outdoor Mic. Kit		SA271U	n/a	n/a
A2	Sound Level Meter	Svantek	SVAN 71	55550	16/06/2020
	Microphone		7052E	63684	
	Preamplifier		SV18	57249	
	Outdoor Mic. Kit		SA271U	n/a	n/a
A3	Sound Level Meter	Svantek	SVAN 71	72535	13/07/2020
	Microphone		7052E	72235	
	Preamplifier		SV18	68261	
	Outdoor Mic. Kit		SA271U	n/a	n/a
A4	Sound Level Meter	Convergence Instruments	NSRT_MK 3	CnvcrdU4UXU Vjngx+jxlD	13/05/2019
All	Calibrator	Rion	NC-74	34651766	13/07/2020

Table 5.2: Instrumentation Details

5.5 The sound level analysers were calibrated before the survey and checked upon completion. No drift in calibration was observed.

Sound Insulation Assessment

Survey Procedure

- 5.6 The sound level analysers were configured to record the L_{A90} , L_{Aeq} , $L_{Amax,fast}$ and $L_{Amax,slow}$ sound levels over consecutive 15 minute periods. The meters were also programmed to log noise levels at higher (1 second resolution) and to make audio recordings to assist with post analysis discrimination of noise events/sources.

Weather

- 5.7 Whilst weather conditions during the automated survey were not actively measured, observations at the time of site attendances and publicly available historic online data indicates that weather conditions were typically characterised as set out in **Table 5.3** below:

2020	Temp. (°C)	Humidity (%)	Wind Speed (km/h)	Wind Direction	Pressure (hPa)		Rainfall(mm)
July/Aug	Avg.	Avg.	Avg.	Avg.	Max	Min	total
29	15	74	1	WSW	1021	1019	0.00
30	20	65	1	S	1019	1014	0.00
31	23	65	1	SSE	1014	1009	0.00
1	19	65	2	W	1016	1013	0.00
2	17	84	2	W	1017	1015	0.00
3	18	64	3	NW	1016	1014	0.00
4	16	74	3	WSW	1017	1014	0.00
5	19	81	1	WSW	1015	1013	0.00

Table 5.3: Weather

Sound Insulation Assessment

Measurement Results

- 5.8 The results of the automated noise monitoring are presented in **Figures 5.2 to 5.5** below. Higher resolution copies of these time history graphs are also attached at **Appendix B**.

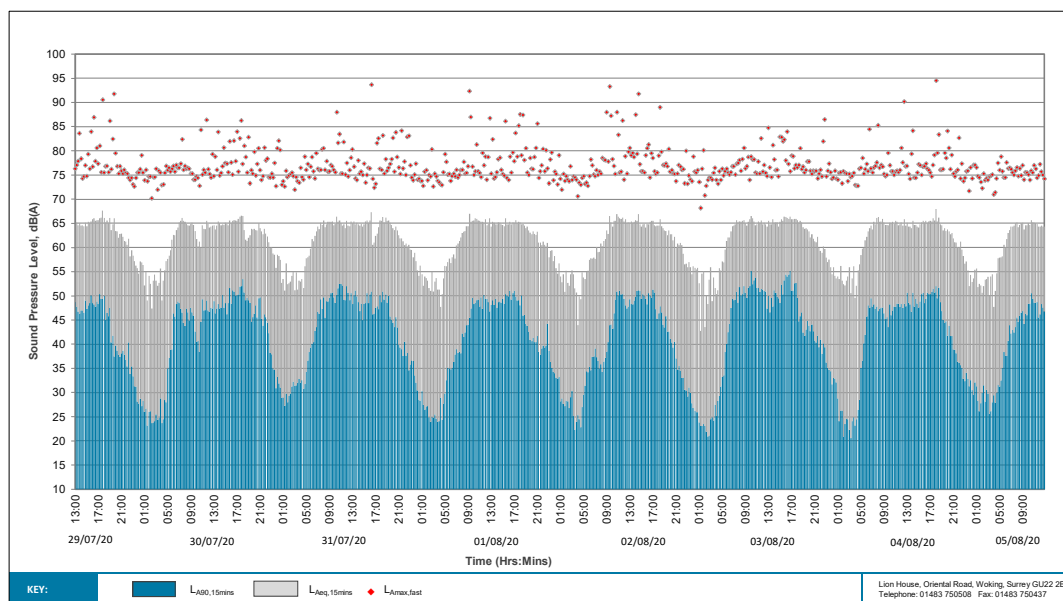


Figure 5.2: A1 Noise Monitoring Results

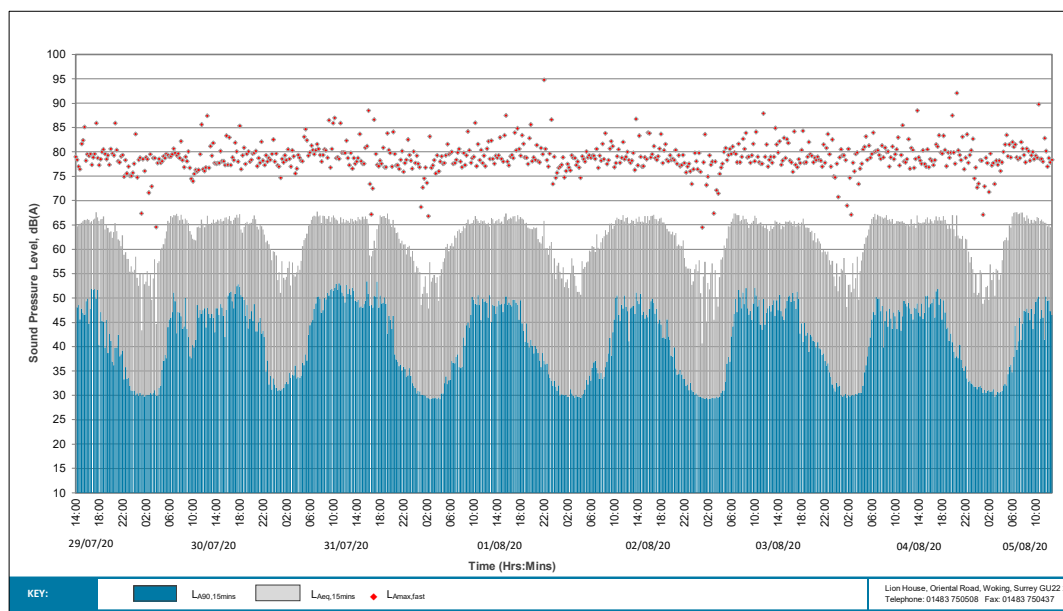


Figure 5.3: A2 Noise Monitoring Results

Sound Insulation Assessment

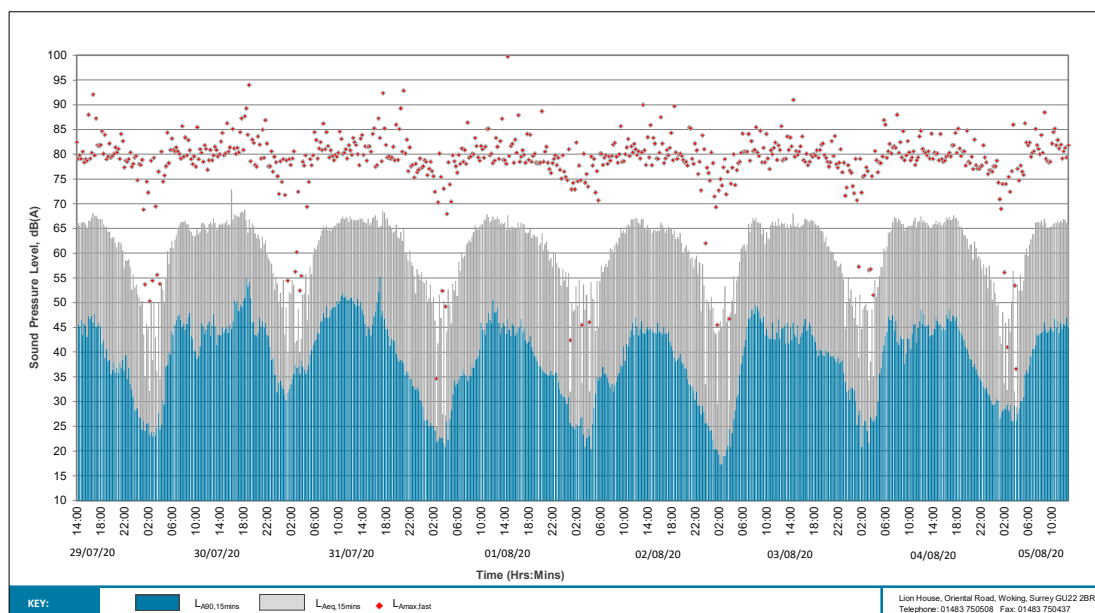


Figure 5.4: A3 Noise Monitoring Results

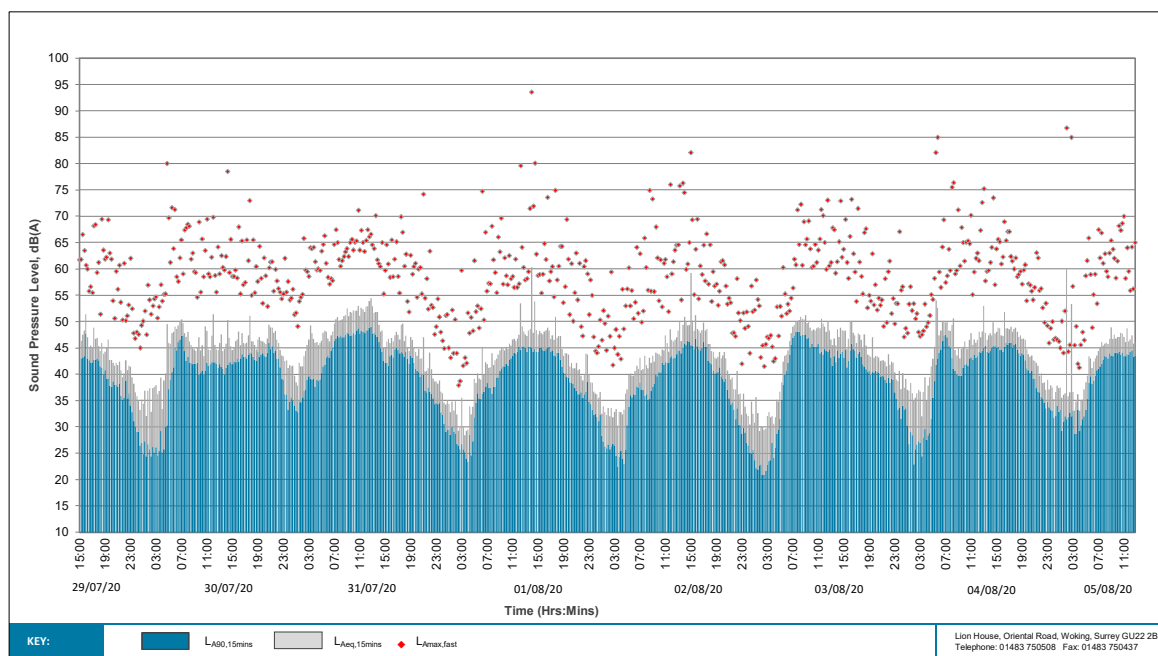


Figure 5.5: A4 Noise Monitoring Results

Observations

- 5.9 During site attendances, it was observed that noise levels characterising the site were dominated by road traffic noise.
- 5.10 The prevailing wind direction during the survey was variable and included periods of both downwind and upwind propagation from adjoining dominant road traffic sources.

Sound Insulation Assessment

Attended Monitoring

- 5.11 In order to supplement the automated noise monitoring, additional attended noise measurements were undertaken during our site attendances on 29th July 2020 and 5th August 2020.
- 5.12 Noise measurements were made at six locations shown in **Figure 5.6** below and described in **Figure 5.4** overleaf.



Figure 5.6: Attended Measurement Locations

Sound Insulation Assessment

Position	Description
M1	At the north-eastern corner of the site, approximately 10 meters from the curb of the A280. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M2	On the eastern boundary of the site, approximately 15 meters from the curb of the A280. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M3	At the south-eastern corner of the site, approximately 15 meters from the curb of the A280. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M4	At the northern corner of the site, approximately 4m from the curb of Water Lane. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.
M5	On the northern boundary of the site, adjacent to the entrance of Avenals Farm. The position is approximately 4m from the curb of Water Lane. The measurement microphone was positioned approximately 2.5 metres above ground level in free field conditions.
M6	To the west of the site, along Water Lane. The position is approximately 2m from the curb of Water Lane. The measurement microphone was positioned approximately 1.5 metres above ground level in free field conditions.

Table 5.4: Attended Noise Monitoring Locations

5.13 The following instrumentation was used

Location	Description	Manufacturer	Model	Serial No.	Calibration Date
M1-6	Sound Level Meter	NTI	XL2-TA	A2A-13108-E0	12/07/2019
	Microphone		M2230A	A14228	
	Preamplifier		MC230A	6832	
	Outdoor Microphone Kit		-	-	n/a
All	Calibrator	Rion	NC-74	34651766	13/07/2020

Table 5.5: Instrumentation Details

5.14 The weather during the survey on 29th July 2020 (M4-M6) was dry and cloudy with a temperature of around 15°C, little/no wind and with around 5 oktas of cloud cover. Weather during the additional survey on 5th August 2020 (M1-M3) was dry and cloudy with a temperature of around 20°C, little/no wind and with around 3 oktas of cloud cover.

Sound Insulation Assessment

Survey Procedure

- 5.15 At each location, attended noise measurements were undertaken over a three-hour period, in general accordance with the ‘*shortened measurement procedure*’ of the ‘*Calculation of Road Traffic Noise*’⁴.
- 5.16 The sound level analyser was configured to measure the L_{A90} , L_{A10} , L_{Aeq} and $L_{Amax,fast}$ noise indices over a notional 15 minute time period. The measured value is taken to be representative of the hour in which the measurement was taken.

Attended Survey Results

- 5.17 The measurement results are presented in **Table 5.6** overleaf:

Location	Time	$L_{A90,15mins}$	$L_{Aeq,15mins}$	$L_{A10,15mins}$	$L_{Amax,fast}$
M1	13.00 – 14.00	52	65	70	78
	14.00 – 15.00	53	64	68	77
	15.00 – 16.00	51	64	68	84
M2	13.00 – 14.00	52	62	66	73
	14.00 – 15.00	53	62	62	74
	15.00 – 16.00	54	63	66	73
M3	13.00 – 14.00	48	62	67	73
	14.00 – 15.00	46	63	67	79
	15.00 – 16.00	49	63	67	79
M4	13.00 – 14.00	48	71	76	84
	14.00 – 15.00	47	70	75	85
	15.00 – 16.00	49	70	75	85
M5	13.00 – 14.00	47	69	74	82
	14.00 – 15.00	48	69	73	83
	15.00 – 16.00	46	68	73	85
M6	13.00 – 14.00	48	69	73	83
	14.00 – 15.00	42	67	72	81
	15.00 – 16.00	42	67	72	82

Table 5.6: Manual Measured Sound Levels

⁴ Department of Transport. (1998) Calculation of Road Traffic Noise (CRTN). HMSO. London.

Sound Insulation Assessment

Observations and Discussion

- 5.18 The noise measurements were dominated by road traffic noise from the A280 and Water Lane.

Analysis of Data

Automated Noise Data

- 5.19 The measurement data has been post-processed using SvanPC++ data analysis software provide an indication of likely daytime ($L_{Aeq,16hr}$) and night-time ($L_{Aeq,8hr}$) values. These are summarised in **Table 5.6** to **Table 5.9** below:

A1	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	65	58
30/07/20	64	58
31/07/20	65	56
01/08/20	64	56
02/08/20	64	57
03/08/20	65	58
04/08/20	65	57
05/08/20	65	-

Table 5.6: A1 Estimated Daytime $L_{Aeq,16hr}$ and Night-time $L_{Aeq,8hr}$ Noise Levels

Sound Insulation Assessment

A2	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	65	61
30/07/20	65	61
31/07/20	65	58
01/08/20	65	57
02/08/20	65	60
03/08/20	65	61
04/08/20	65	61
05/08/20	66	-

Table 5.7: A2 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels

A3	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	65	56
30/07/20	66	55
31/07/20	66	53
01/08/20	65	53
02/08/20	64	55
03/08/20	65	56
04/08/20	65	56
05/08/20	66	-

Table 5.8: A3 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels

Sound Insulation Assessment

A4	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
29/07/20	45	44
30/07/20	47	45
31/07/20	50	37
01/08/20	48	37
02/08/20	47	39
03/08/20	48	45
04/08/20	47	46
05/08/20	47	-

Table 5.9: A4 Estimated Daytime $L_{Aeq,16hour}$ and Night-time $L_{Aeq,8hour}$ Noise Levels

Night-Time $L_{Amax,fast}$ Values

5.20 With respect to night-time $L_{Amax,fast}$ values, the WHO Guidelines for Community Noise advises;

‘For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10–15 times per night’

5.21 Further guidance on dealing with night-time noise and sleep awakening is provided in the ProPG⁵. The guidance advises that based on various studies linking individual noise events to behavioural awakenings;

“....it can be concluded that at night (2300 - 0700 hrs) a significant effect on sleep disturbance e.g. behavioural awakening, is likely to occur where the maximum sound level at the façade of a building with partially open windows is above:

- 85 dB $L_{Amax,F}$ (where the number of events exceeding this value is ≤ 20);
or
- 80 dB $L_{Amax,F}$ (where the number of events exceeding this value is > 20)”

.....

A site should not be regarded as negligible risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 60 dB more than 10 times a night. A site should be regarded as high risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 80 dB more than 20 times a night”

⁵ ProPG Planning and Noise: Professional Practice Guidance on Planning and Noise – Appendix A. Dealing with Noise Events (May 2017) Available at <https://www.ioa.org.uk/sites/default/files/14720%20ProPG%20Main%20Document.pdf>

Sound Insulation Assessment

5.22 Analysis of the 1 minute $L_{Amax,fast}$ values for positions A1 and A2 (those closest to the A280, the dominant noise source across the development site) for the complete night-time monitoring period has been undertaken and the 10th highest individual event value has been established as 76dB $L_{Amax,fast}$ and 79dB $L_{Amax,fast}$ respectively. It should also be noted that the reported values were measured at 16m (A1) and 10m (A2) from the A280 and have not been corrected for distance to the closest dwellings (approximately 22m). Once corrected to the nearest dwelling the values reported above will be -3dB (A1) and -7dB (A2) lower than the measured values resulting in typical free-field values of 73dB $L_{Amax,fast}$ and 72dB $L_{Amax,fast}$ and therefore in light of the above ProPG advice above it can be concluded that significant effects on sleep as a result of individual noise events are avoided.

Comparison with Historical Monitoring Data

5.23 As detailed in **Section 4**, a request has been made by Arun District Council's Environmental Health Team to review the automated monitoring data because in the EHO's opinion it does not appear to align with historical monitoring data and was obtained during the Covid-19 pandemic.

5.24 A comparison has therefore been made with the Phlorum monitoring data and in particular the measurement location denoted as Site 1 in the Phlorum report, stated as being positioned 12m from the A280 in the south-east corner of the site. As shown in **Figure 5.1** above, the Mayer Brown Limited measurement position A1 was also located in the south-east corner, at 16m from the A280. It would therefore be expected that the Phlorum measured data would be higher due to the measurement position being closer to the A280. **Table 5.10** below compares the resultant $L_{Aeq, 16hr}$ and $L_{Aeq, 8hr}$ data;

Monitoring Location	Day-time $L_{Aeq,16hr}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8hr}$ (23:00 – 07:00)
Phlorum – Site 1	68	61
Mayer Brown Ltd – A1 ⁶	66	59

Table 5.10: Comparison of Historic and Contemporary Noise Data

5.25 As shown above, the measured datasets are closely aligned with a -2dB difference for both the daytime period night-time period. It should also be noted that the Phlorum data was obtained during a relatively short-term 24-hour survey whereas, as shown above

⁶ Data includes a +1dB correction to account for reduced traffic flow due to the Covid-19 pandemic (See paragraph 5.27 – 5.29)

Sound Insulation Assessment

the Mayer Brown Limited survey comprised a 7-day survey period and is therefore considered a more robust dataset.

- 5.26 In light of the above analysis, it is concluded that there is a good consistency between the historical and contemporary data.

Attended Noise Measurements

- 5.27 Daytime and night-time sound levels for the attended noise measurement locations have been estimated in accordance with the shortened measurement procedure of CRTN⁷. This analysis yields a predicted $L_{A10,18\text{hour}}$ value from which the $L_{Aeq,16\text{hour}}$ and $L_{Aeq,8\text{hour}}$ values have been estimated using the procedures developed by TRL/Casella Stanger for DEFRA⁸.

- 5.28 Calculated values are summarised in **Table 5.11** below.

Location	Day-time $L_{Aeq,16\text{hr}}$ (07:00 – 23:00)	Night-Time $L_{Aeq,8\text{hr}}$ (23:00 – 07:00)
M1	65	57
M2	62	54
M3	64	55
M4	72	63
M5	70	61
M6	69	60

Table 5.11: Calculated Daytime and Night-time $L_{Aeq,T}$ values

Covid-19

- 5.29 It should be noted that the noise survey work was undertaken during the Covid-19 “lockdown” and thus on-site noise levels may not be fully representative of (may underestimate) “normal” (pre-pandemic) noise levels.

⁷ Department of Transport. (1988) “*Calculation of Road Traffic Noise*”. HMSO, London.

⁸ TRL/Casella Stanger (2006) for DEFRA. Method for Converting the UK Road Traffic Noise Index $L_{A10,18h}$ to the EU Noise Indices for Road Noise Mapping.

Sound Insulation Assessment

- 5.30 The Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA) has published guidance⁹ on the reliability of baseline noise surveys and noise impact assessments which states that;

“...it is still important to minimize uncertainties in surveying and to select appropriate baseline conditions, in a clear and transparent way. Furthermore, by good communication between those preparing the reports and those that will be reviewing them, the planning process (and other relevant processes) will be able to continue as smoothly as possible.....

Methodology

For transport schemes, there will have to be a reliance on predicted sound levels to describe the baseline conditions, with a corresponding need to source flow/activity data. There are now many sources of transport data available and these should be used, where possible, along with previously made direct site measurements to describe baseline conditions”

- 5.31 As noted earlier, noise levels at the site are dominated by road traffic noise. Data published by the government during the survey period¹⁰ indicate that the public usage of the road network is estimated to have reduced to around 13% of “normal” activity for all motor vehicles. It follows that measured noise levels may be around 1dB lower than “pre-Covid” noise levels. In order to account for this, a correction of 1dB will be applied to the measurement data to provide a more robust indications of existing noise levels. With this correction applied, measured noise levels also show consistency with environmental noise survey work historically undertaken at the site to inform the original outline application.

⁹ Association of Noise Consultants [ANC] and the Institute of Acoustics [IOA] *Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments* (April 2020)

¹⁰ <https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>

Sound Insulation Assessment

6 Computational Noise Modelling

- 6.1 In order to obtain a detailed understanding of the propagation of noise across the development site, a computational noise model has been developed using Datakustic CadnaA® noise modelling software. This software implements the “*Calculation of Road Traffic Noise*”¹¹ (CRTN).
- 6.2 The noise model was constructed using OS topographical data and AAP Architecture Drawing No. Site Layout Plan (Drawing Ref: PLN-1-1101).

Daytime Noise Model

- 6.3 **Figure 6.1** below presents modelled daytime ($L_{Aeq,16\text{hour}}$) noise levels (calculated at 1.5m above local ground level).



Figure 6.1: Daytime Noise Model $L_{Aeq,16\text{hour}}$

¹¹ Department of Transport. (1988). “*Calculation of Road Traffic Noise*”. HMSO, London.

Sound Insulation Assessment

Night-time Noise Model

6.4 **Figure 6.2** below presents modelled night-time ($L_{Aeq,8hour}$) noise levels (calculated at 4m above local ground level).



Figure 6.2: Night-time Noise Model $L_{Aeq,8hour}$

7 Sound Insulation Scheme

General

- 7.1 The level of sound insulation required of a building façade will be determined by:
- **The noise levels incident on a particular area of façade.** In the case of this development, it is clear that higher levels of sound insulation will be required for facades looking “towards” neighbouring roads, than for units facing away from such sources.
 - **The sound insulation capabilities of the constituent building elements.** For windows set within masonry external walls, noise intrusion will generally be determined by the acoustic performance of the windows.
 - **The relative proportion of building elements.** The sound insulation required will increase as the façade area to a room increases. The sound insulation required of weaker performing elements (e.g. windows) will also increase when the proportional area of these is increased.
 - **The acoustic conditions of the receiving room.** Noise intrusion into acoustically hard (reverberant) rooms, will increase sound insulation requirements.
- 7.2 In order to assess sound insulation, detailed noise intrusion calculations have been undertaken in accordance with BS EN 12354-3:2017 *“Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound”*.
- 7.3 The baseline data and assumptions used in these calculations are outlined in the following sections.

Incident Noise Levels

- 7.4 Incident noise levels have been evaluated based on the noise levels determined from the computational noise models outlined in Section 6. Incident octave band sound levels have been determined by applying the normalised spectrum corrections to the modelled $L_{Aeq,T}$ sound level.

Sound Insulation Assessment

Architectural Design Information

- 7.5 All calculations are based on relevant drawings for each house/block of flats prepared by AAP Architecture.

External Wall Construction

- 7.6 Noise intrusion into buildings is normally determined by the acoustic performance of the windows, since these represent the “weakest” element acoustically. For preliminary calculation purposes, it is assumed that “solid” external wall construction will maintain the following minimum apparent sound reduction indices.

Apparent Sound Reduction Index, dB					
125 Hz	250 Hz	500 Hz	1kHz	2kHz	4kHz
41	43	48	50	55	55

Table 7.1: Estimated Apparent SRI for Solid External Walls Elements

The above performance values should also be achievable with a masonry faced steel or timber framed construction system and therefore provides a robust assessment basis for reviewing the likely acoustic performance requirements of windows and feasibility of maintaining an appropriate level of sound insulation.

Room Acoustic Conditions

- 7.7 As noted earlier, noise intrusion into flats/houses will also be partially determined by the internal room finishes, which will determine the reverberation times within the building. For the purpose of this assessment, a reverberation time of 0.5 seconds has been assumed for all rooms, in line with the standardised reverberation time implemented in Approved Document E of the Building Regulations 2010.

Ventilation Strategy

- 7.8 It is understood that the whole building and extract ventilation requirements of Approved Document E are to be achieved through the use of continuous mechanical extract system, in line with System 1 of Approved Document F of the Building Regulations 2010 (as amended), i.e. passive ventilators (e.g. trickle vent) and intermittent extract.

Glazing & Ventilator Sound Reduction Performance Requirements

- 7.9 Calculations have been undertaken in accordance with the methodology of BS EN ISO 12354-3: 2017: *“Building acoustics. Estimation of acoustic performance in buildings from the performance of elements. Airborne sound insulation against outdoor sound”* to

Sound Insulation Assessment

determine typical sound reduction performance requirements for windows and ventilators.

- 7.10 The calculations indicate that noise intrusion into the majority of properties on the site should be readily controlled in line with the guidance of BS 8233: 2014 guidance with the use of “standard” thermal double glazing (e.g. windows glazed with 4mm glass / 16mm cavity / 4mm glass, which would typically offer a performance of around R_w 29dB) and standard trickle vents (e.g. vents offering a notional performance of $D_{ne,w}$ 32 dB).
- 7.11 For those properties fronting the A280 exposed to higher levels of noise in order that windows can remain closed, alternative ventilation through the use of enhanced performance acoustically rated trickle ventilators (offering of performance up to $D_{ne,w}$ 38dB) is also recommended.
- 7.12 The proposed sound insulation scheme is summarised in **Figure 7.1** below.

Sound Insulation Assessment



Figure 7.1: Acoustic Performance Recommendations

Sound Insulation Assessment

- 7.13 The acoustic performance values are expressed in terms of octave band “Sound Reduction Indices” (R) and “Normalised Sound Level Differences” (D_{ne}) as determined in accordance with BS EN ISO 10140-2:2010: *“Acoustics. Laboratory Measurement of Sound Insulation of Building Elements. Measurement of Airborne Sound Insulation.”* and BS EN ISO 10140-4:2010: *‘Acoustics. Laboratory measurement of sound insulation of building elements. Measurement procedures and requirements’*.
- 7.14 The sound insulation offered by a window system is not solely dependent upon the thickness of glass and separating airspace. The framing details, sealing arrangements etc. will all affect how the system will perform in practice. In view of this, it is not normally appropriate to recommend specific glazing configurations to meet the specified performance requirements and compliance should be verified by reference to acoustic data from proposed manufacturer’s/suppliers.
- 7.15 It should be noted that the trickle ventilator performance indicated assume a single trickle vent per habitable room. If more than one ventilators needs to be installed, the acoustic performance value for **each** ventilator will need to be increased in line with the corrections set out in the following table:

No of Ventilators	Correction to be Applied to Specified D_{ne} Performance Value
1	0
2	+3
3	+5

Table 7.2: Corrections for Multiple Ventilators

- 7.16 It is recommended that the acoustic performance requirements set out above form part of the tender documentation and that suppliers are requested to submit appropriate evidence to demonstrate compliance with the specified values.

Sound Insulation Assessment

8 Performance Verification

8.1 In order to verify the adequacy of the sound insulation recommendations above, detailed calculations have been undertaken for a representative sample of rooms on each elevation of the building, implementing the same performance data and assumptions set out in Section 7 above. Selected plots are shown in **Figure 8.1** below:



Figure 8.1: Plots Selected for Performance Verification

Sound Insulation Assessment

- 8.2 Calculation sheets for the above plots are attached at **Appendix C**.
- 8.3 The calculations sheets confirm that implementation of the acoustic design strategy outlined in **Section 7** above is fully compatible with controlling noise intrusion levels into the development in accordance with the guidance of BS 8233: 2014 and as such provide an adequate scheme of insulation as required by Condition 9 of the outline planning permission.

Sound Insulation Assessment

9 External Amenity

- 9.1 The guidance of BS 8233 and the WHO's "Guidelines for Community Noise" both recommend that noise levels in external amenity spaces are below 55dB $L_{Aeq,T}$, where it is practicable for this to be achieved.
- 9.2 The layout of the development is such that the majority of external amenity space is located to the rear of dwellings to benefit from the mass that the building provides, however in order to further reduce external noise levels, to as low as reasonably practicable, acoustic screening is recommended in the form of a 3m high acoustic barrier in the location shown in **Figure 9.1** below;



Figure 9.1: Proposed Location of 3m Acoustic Barrier

- 9.3 **Figure 9.2** below shows the resultant noise levels in the external areas of the site with the acoustic barrier in place. Noise levels below $L_{Aeq,16hour}$ 55 dB are shown in "GREEN". Noise levels which exceed $L_{Aeq,16hour}$ 55dB are shown in "PINK".

Sound Insulation Assessment

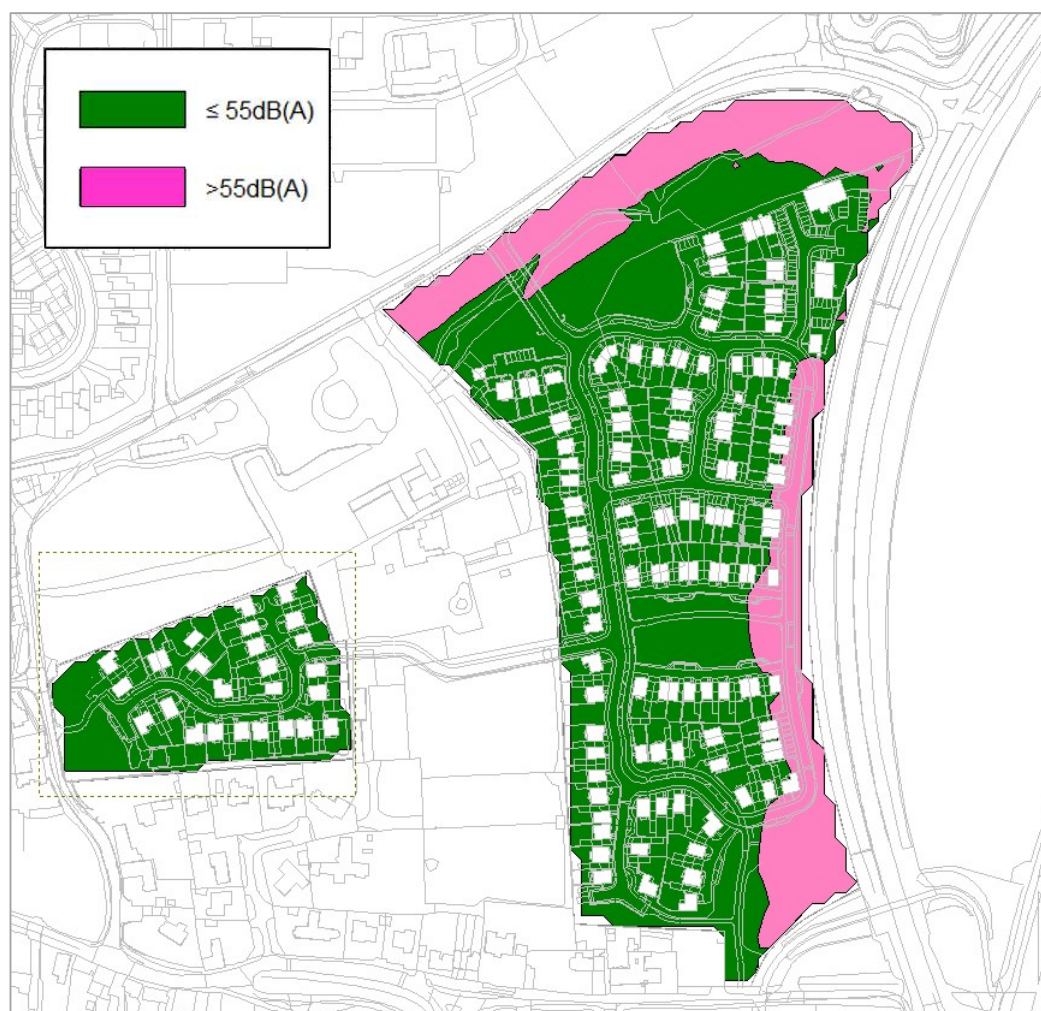


Figure 9.2: Noise Levels in External Amenity Areas

- 9.4 As shown in **Figure 9.2** the general massing of buildings and orientation of the dwellings in addition to the erection of a 3m high acoustic barrier, coupled with boundary screening that will be provided as a matter of course, will help minimise the propagation of noise from the A280 and shows that noise levels in amenity spaces should generally be compliant with the aspirational noise levels indicated in both WHO and BS 8233 guidance.
- 9.5 It will be noted however that some of the communal external amenity space serving Block A (Plots 160-167), located in the north-east corner of the site, is highlighted as being above the aspirational 55dB $L_{Aeq, T}$, however it should be noted that the amenity space provided represents an overprovision of the standard required and it is this overprescribed area where noise levels marginally exceed 55dB $L_{Aeq, T}$.

Sound Insulation Assessment

9.6 **Figure 9.3** below presents the noise levels as values on the model grid to show the extent of exceedance;



Figure 9.3: Noise Levels in Communal Amenity Space Serving Block A

9.7 As shown in **Figure 9.3** the extent of exceedance of the 55dB L_{Aeq, T} value is considered to be acoustically negligible and as such residents will have access to amenity space generally compliant with the aspirational WHO and BS8233 guideline value.

10 Conclusions

Existing Noise Environment

- 10.1 The results of noise monitoring providing information to inform detailed design analyses are presented.

Computational Noise Modelling

- 10.2 Computational noise modelling of the site has been developed to assist with developing noise mitigation strategies.

Noise Intrusion

- 10.3 Performance requirements for glazing and ventilators, compatible with delivering the technical requirements of BS 8233: 2014, are presented.
- 10.4 Detailed calculations in accordance with BS EN ISO 12354-3: 2017 are presented to verify the acceptability of these design recommendations.

External Amenity

- 10.5 Noise levels in private and external amenity spaces have been assessed as being generally compliant with aspirational levels. The erection of a 3m high acoustic barrier is recommend along a section of the A280 in order to reduce noise levels to the lowest practicable.
- 10.6 Residents will also have access to the available public amenity space across the development.

Conclusion

- 10.7 It is concluded that proposed noise mitigation adequately protects the future occupiers of the site from traffic noise, as required by Condition 9 of the outline planning permission granted for the development.

APPENDIX A: Glossary of Acoustic Terminology

General

A vibrating surface or turbulent fluid flow will cause pressure fluctuations in the surrounding air. These pressure fluctuations are perceived by the human ear as “sound”.

Measurement Units

The human ear can detect sound pressures as low as about 20 µPa, and can tolerate (for short periods) sound pressures as high as 200 Pa, an amplitude range of 10 million times. To take account of this huge amplitude range, sound pressure levels (often written in “acoustic shorthand” as SPL or Lp) are quantified using a logarithmic scale, the decibel (dB) scale. This is based on a reference pressure of 20µPa, thus a sound pressure of 20µPa would equate to 0dB and a pressure of 200Pa would equate to 140dB.

Frequency (Pitch) Characteristics

The sound received at any particular location is not solely influenced by the sound pressure level, the frequency characteristics (pitch) of the noise is also an important factor. Noise audible to a human (with “normal” hearing), typically covers the frequency range 20 Hertz to 20,000 Hertz. Hertz (Hz) are defined as the number of times the sound pressure fluctuates in one second. “Low” pitched sounds fluctuate less times per second than “high” pitched sounds. Whilst humans are capable of detecting a wide range of frequencies, the ear is not equally sensitive to all frequencies – the ear is most sensitive at frequencies towards the middle of the audible range and less sensitive to the lower and higher frequencies.

To take account of this frequency response, sound pressure fluctuations are normally quantified by applying a frequency-weighting network or filter which simulates the frequency response of the ear. In essence, this means that more significance is given to the frequencies at which the ear is most sensitive and less significance to those at which the ear is less sensitive. Noise measurements relating to human reaction are generally made using an “A-weighting” network. These measurements are reported as A-weighted decibels or dB(A). The A-weighted sound pressure level is written in “acoustic shorthand” as LA.

Variation of Sound with Time

It will be appreciated that the sound pressure level of most noise sources will fluctuate with time. In order to take account of the way in which the human ear perceives noise, it is normal for the sound pressure level to be quantified using a time weighting network, to mimic the speed of response of the human ear. The standardised setting for most types of noise is a “Fast” time weighting.

The manner in which sound fluctuates with time can also influence the subjective manner in which noise is perceived. Noise can be continuous (showing no significant variation with time as in the case of a fan), intermittent (i.e. the noise is transient in it’s nature, such as a train pass-by) or impulsive (i.e. there is a sudden build up of noise - this can range from “clanking” types sounds as might be experienced next to railway goods yard or a high energy discharge such as an explosion)

Measurement of Sound

Sound pressure levels are measured using equipment comprising a pressure-sensitive microphone, associated amplifier, frequency weighting network, time weighted network and output indicator. In its simplest form this is a small hand-held instrument called a sound level meter. More sophisticated instrumentation (a sound level analyser) is also available which allows the real-time output of the frequency characteristics of the sound to be quantified.

Comparison of Sound Levels

To put the significance of noise measurement into context, the following Table presents the A-weighted sound pressure level of some typical sources:

Sound Pressure Level, dB(A)	Typical Noise Source . Activity
160	Saturn Rocket Taking Off
140	Military Jet Taking Off at 30m
100	Nightclub
90	Heavy goods vehicle driving past at 7m
80	Busy urban road
70	Domestic vacuum cleaner at 3m
60	Busy office environment
55	Normal speech at 1m
40	Whispered conversation at 2m
30	Bedroom at night (BS 8233: 1999)
20	Remote country location
0	Threshold of hearing – a very eery silence

Addition of Sound Levels

It is important to note that the use of a logarithmic scale to describe noise does not allow normal arithmetic addition. This means that two noise sources each generating a level of, say, 60dB(A) will not generate a combined sound level of 120dB(A). The values must be added logarithmically, which would actually yield a combined sound level of 63dB(A) in this example.

Subjective Perception of Sound Levels Changes

With regard to the human perception of sound level changes, the human ear:

- Cannot generally perceive a sound level difference of less than 3dB(A)
- Will perceive a sound level difference of 4-5dB(A) as “noticeable”
- Will perceive a sound level difference of 10dB(A) as a doubling (or halving) of loudness.

Acoustic Terminology

As stated previously, most sources of noise will fluctuate with time. In order to characterize such noise, it is therefore normal to represent the noise climate using a variety of noise parameters and statistical indices. The most commonly adopted noise parameters are described below:

$L_{Aeq,T}$	This is the equivalent continuous A-weighted sound level measured over a specified time period “T”. This is the notional continuous sound level which, over the time T, contains the same amount of energy as the actual fluctuating sound being measured. This parameter is widely accepted as being the most appropriate noise descriptor for most environmental noise and the effects of noise on humans.
$L_{Amax,fast}$	This is maximum A-weighted sound pressure measured with a fast frequency response recorded during the stated measurement period. It is typically used to characterise the highest sound level caused during a noise event.
$L_{A90,T}$	This is the A-weighted sound pressure level exceeded for 90% of the specified time period “T”. It is normally used to describe the underlying background noise level of an environment since it inherently excludes the effects of transient noise sources.

Noise Rating (NR) Level

When describing noise from building services installations, it is common to express noise levels in terms of a Noise Rating (NR) Level. The NR level is determined by plotting the measured frequency spectrum of a noise against a series of reference curves, which roughly approximate to equal loudness values. This method permits higher sound levels at low frequencies corresponding to the sensitivity of the human ear. The NR level is defined as the value of the highest curve “touched” by the plotted frequency spectrum. For typical sources of building services noise, the overall A-weighted sound level is numerically around 5-6dB higher than the NR level of the noise.

Airborne Sound Insulation Measurement Parameters

The ability of a building element to reduce airborne noise can be described by a number of different parameters relevant to both laboratory and on-site performance evaluation. In general, the higher these values, the better the resistance of the construction to the transmission of airborne sound. The most commonly used parameters include:

R_w	The “ Weighted Sound Reduction Index ” (R_w) is a single value measure of the intrinsic sound reduction capabilities of a construction, as measured in an acoustic laboratory. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013.
R'_w	The “ Weighted Apparent Sound Reduction Index ” (R'_w) is a single value measure of the apparent sound reduction capabilities of a construction, when installed on-site (which will normally be some way lower than the laboratory value due to less favourable installation conditions, the quality of workmanship, etc.). Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-1: 2013. In practice, the R'_w of a construction can only be reliably determined if “direct” sound transfer through the partition can confidently be taken as the dominant noise transfer path (i.e. there is no “flanking” sound transmission).
D_w	The “ Weighted Sound Level Difference ” (D_w) is a single value measure of the on-site sound reduction between two rooms. This value inherently includes “direct” sound transmission through any separating construction and “flanking” transmission through other building elements.

Measurement values are determined in accordance with BS EN ISO 140-4: 1998 (for Building Regulations compliance purposes) or BS EN ISO 16283-1: 2014 and weighted in accordance with BS EN ISO 717-1: 2013.

$D_{n,fw}$	The “ Weighted Normalised Flanking Level Difference ” ($D_{n,fw}$) is a single figure measure of the sound reduction between two rooms solely due to sound transmission through a specified flanking path. This parameter is frequently used to provide an indication of the sound reduction capabilities of suspended ceiling and raised access floor constructions where there is common void between adjacent rooms or as a measure of sound that may be transmitted between rooms through external curtain walling. Measurements are undertaken in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-1: 2013.
------------	--

Impact Sound Insulation Measurement Parameters

Some building elements also have the potential to generate “impact” noise, for example due to human “footfall” on floor structures, or the impact of rainfall on lightweight roofing components. A variety of parameters are again available to define the amount of noise likely to be generated. In general, the lower these values, the less sound the construction will generate as a result of impacts. Typical measurements parameters include:

$L_{nT,w}$	The “ Standardised Impact Sound Pressure Level ” is a “single number” rating describing the intrinsic impact sound insulation capabilities of a construction (such as a floor system) as measured in an acoustics laboratory. Values are determined in a vertical sound transmission suite by locating a “tapping machine” in the upper room of the suite and measuring the amount of sound radiated by the floor in the room below. Measurement values are determined in accordance with the BS EN ISO 10140 series of standards and weighted in accordance with BS EN ISO 717-2: 2013.
$L_{nf,w}$	The “ Normalised Flanking Impact Sound Pressure Level ” is a “single number” rating describing the amount of flanking sound that would be transmitted to an adjoining space (separated by a partition) due to impacts on the test sample. It is, for example, used to indicate the amount of noise that may be generated due to footfall noise on a raised access floor system. Values are determined in a horizontal sound transmission suite by locating a “tapping machine” one side of a separating partition built off the test sample and measuring the amount of noise radiated by the floor in the adjoining space on the other side of the partition. Measurement values are determined in accordance with BS EN ISO 10848-2: 2017 and weighted in accordance with BS EN ISO 717-2: 2013.

Room Acoustic Measurements

T	The “ Reverberation Time ” (T) of a room is defined as the time taken for the sound energy produced by a source Time (RT)to decay by 60 dB after the source has been switched off. The reverberation time of a space can be calculated by considering the volume of the room and the areas and sound absorption qualities of room surface finishes. Small, “soft” rooms tend to give low reverberation times, whilst large, “hard” rooms tend to give long reverberation times.
α_p	The “ Practical Acoustic Absorption Coefficient ” (α_p) is a measure of how much sound energy is absorbed by a building element at a particular frequency, as measured in accordance with BS EN ISO 354: 2003.
α_w	The “ Weighted Absorption Coefficient ” (α_w) is a single figure measure of the overall sound absorption capabilities of a building element determined in accordance with BS EN ISO 11654: 1997.

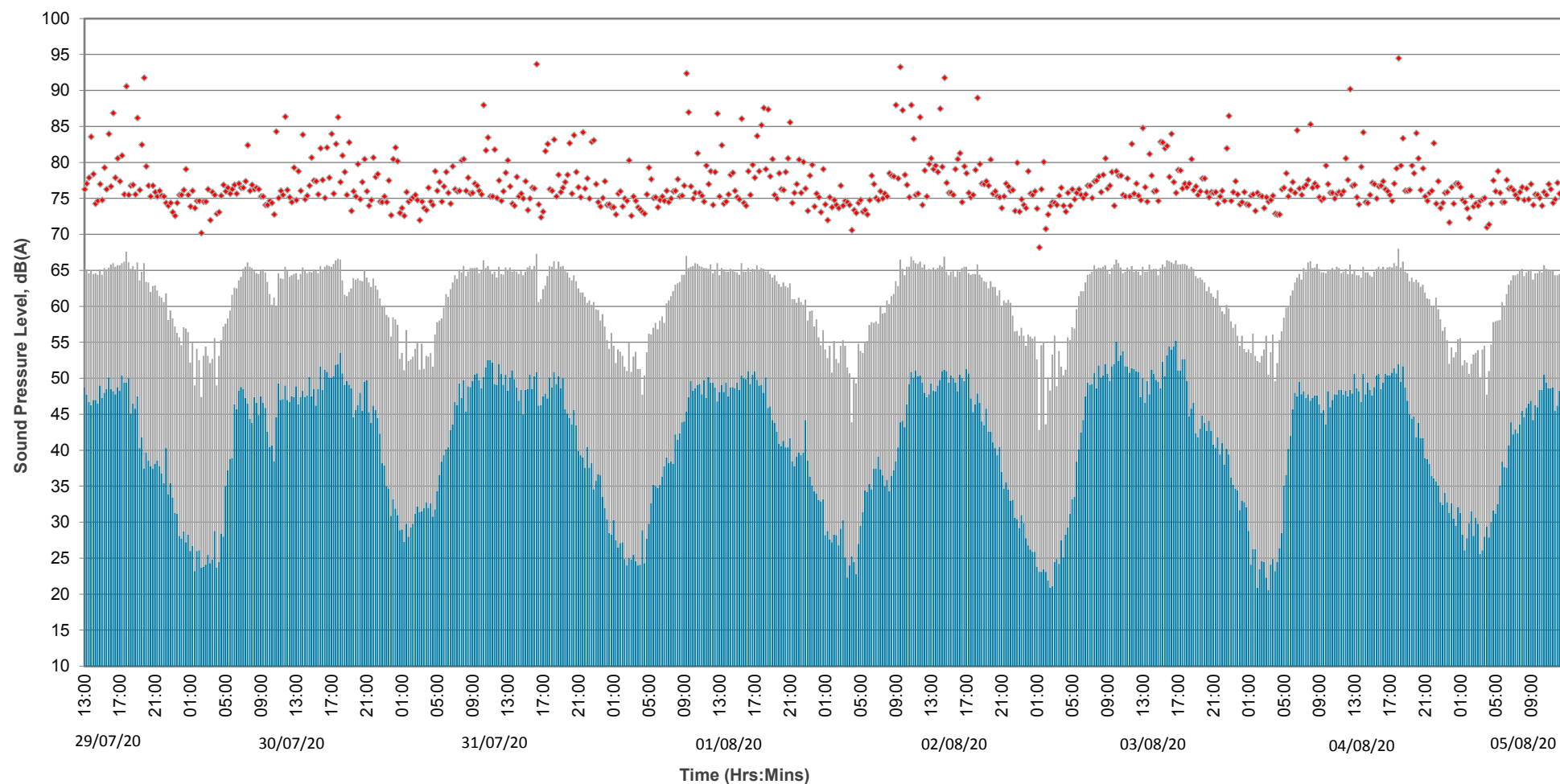
APPENDIX B: Noise Monitoring Time History Plots

Time History Graph A1

Project: Angmering

Measurement Location: A1

Survey Period: 29/07/20 - 05/08/20



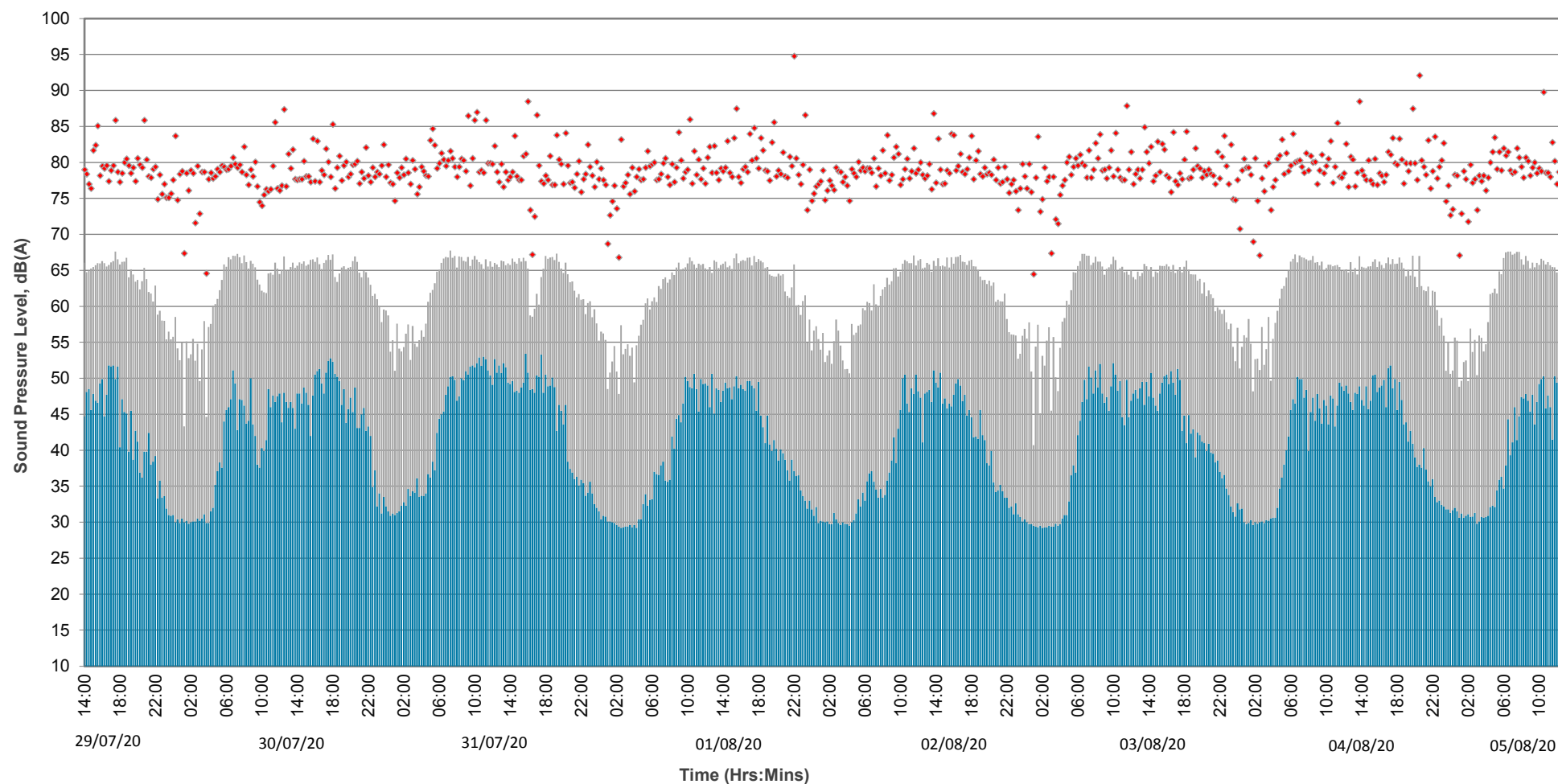
KEY:

L_{A90,15mins}L_{Aeq,15mins}♦ L_{Amax,fast}

Lion House, Oriental Road, Woking, Surrey GU22 2BR
 Telephone: 01483 750508 Fax: 01483 750437

Time History Graph A2

Project:	Angmering
Measurement Location:	A2
Survey Period:	29/07/20 - 05/08/20



KEY:

L_{A90,15mins}L_{Aeq,15mins}♦ L_{Amax,fast}

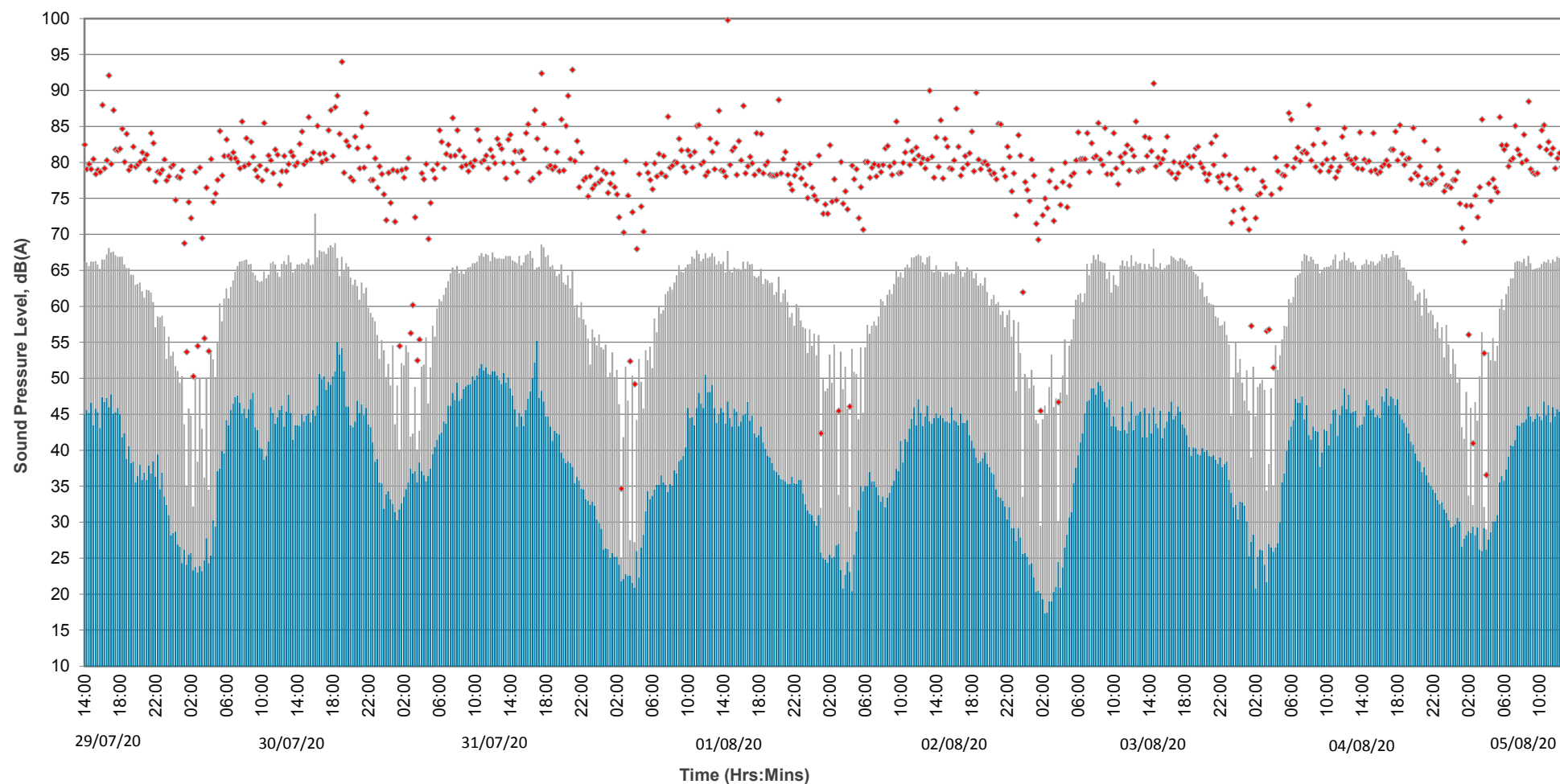
Lion House, Oriental Road, Woking, Surrey GU22 2BR
 Telephone: 01483 750508 Fax: 01483 750437

Time History Graph A3

Project: Angmering

Measurement Location: A3

Survey Period: 29/07/20 - 05/08/20



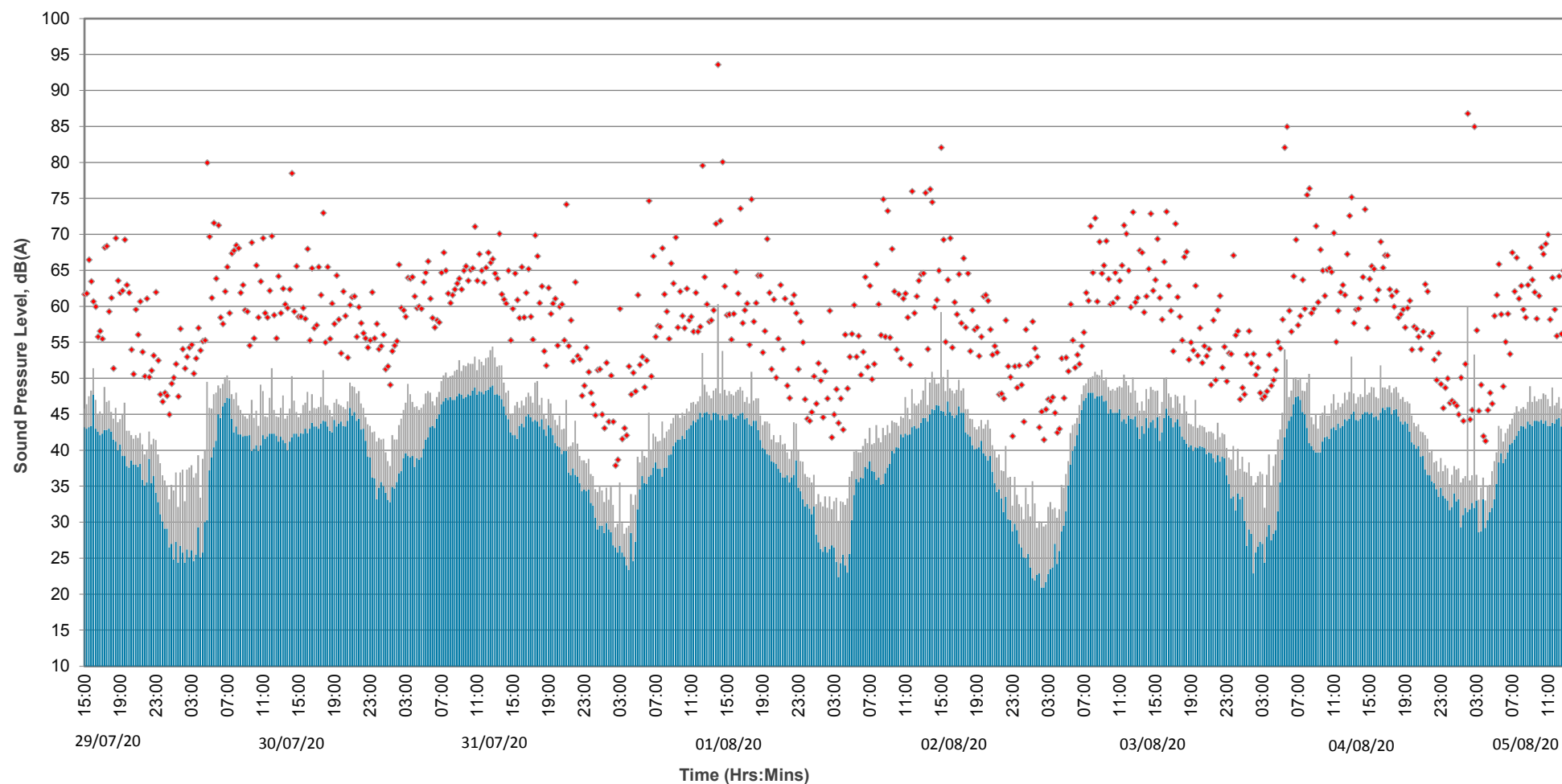
KEY:

L_{A90,15mins}L_{Aeq,15mins}♦ L_{Amax,fast}

Lion House, Oriental Road, Woking, Surrey GU22 2BR
 Telephone: 01483 750508 Fax: 01483 750437

Time History Graph A4

Project:	Angmering
Measurement Location:	A4
Survey Period:	29/07/20 - 05/08/20



KEY:

L_{A90,15mins}L_{Aeq,15mins}L_{Amax,fast}

Lion House, Oriental Road, Woking, Surrey GU22 2BR
 Telephone: 01483 750508 Fax: 01483 750437

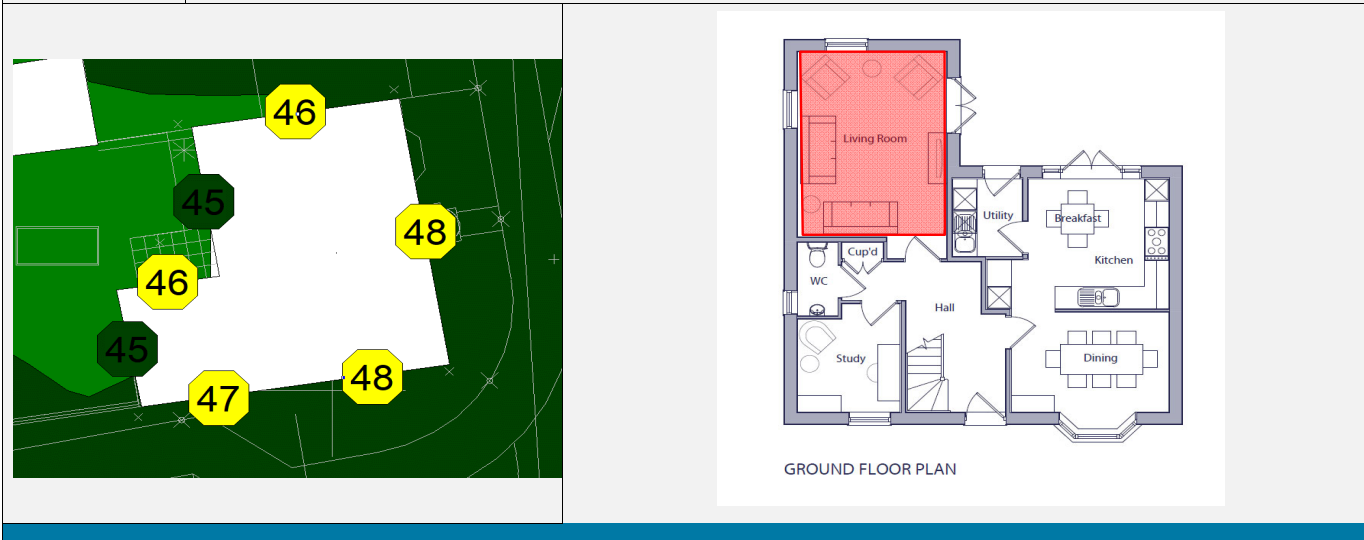
APPENDIX C: Sound Insulation Verification Calculations

Calculation Sheet	1	Receiver	Plot 16 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room	4.20	2.60	1.20	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	48	44	40	44	40	31	47	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{2m,n,T}	-27	-24	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	21	20	11	19	11	-1	20	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

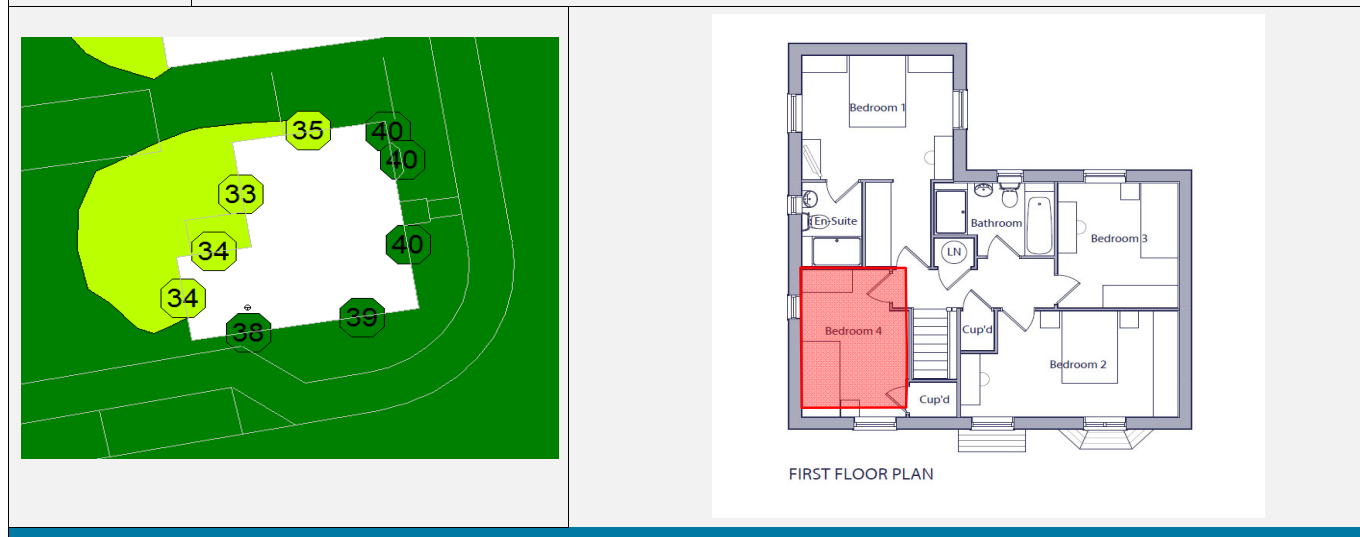


Calculation Sheet	2	Receiver	Plot 16 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Value
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	41	37	33	37	33	24	40	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{2m,nT}	-29	-26	-31	-27	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	17	16	7	14	6	-5	16	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

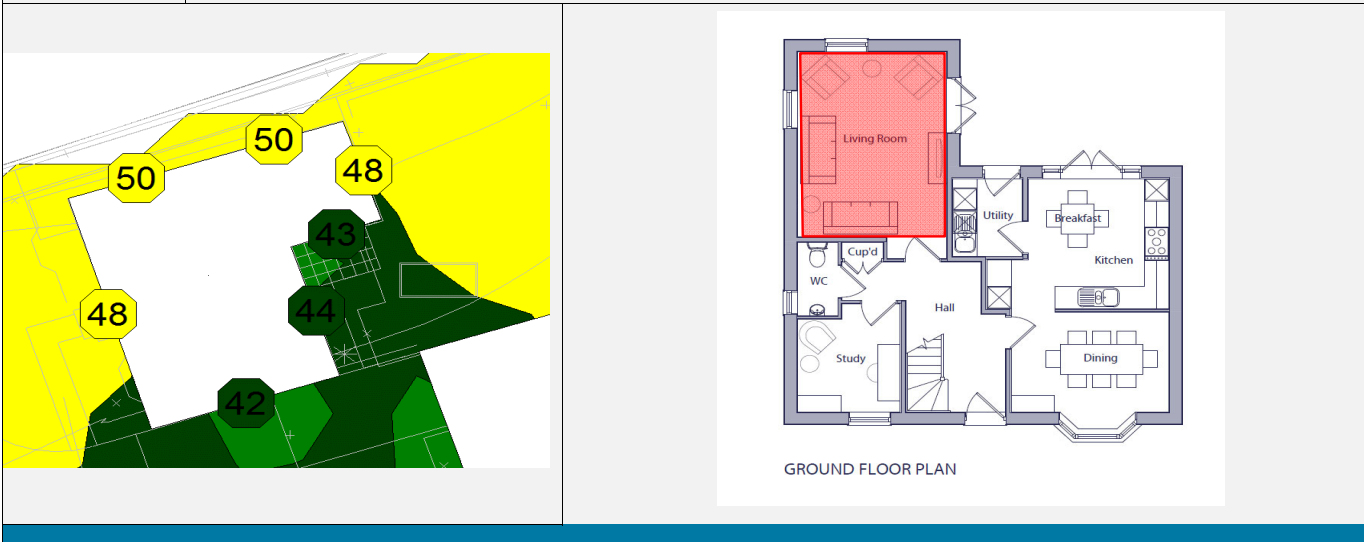


Calculation Sheet	3	Receiver	Plot 19 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room	4.20	2.60	1.20	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	51	47	43	47	43	34	50	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{2m,nT}	-27	-24	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	24	23	14	22	14	2	23	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

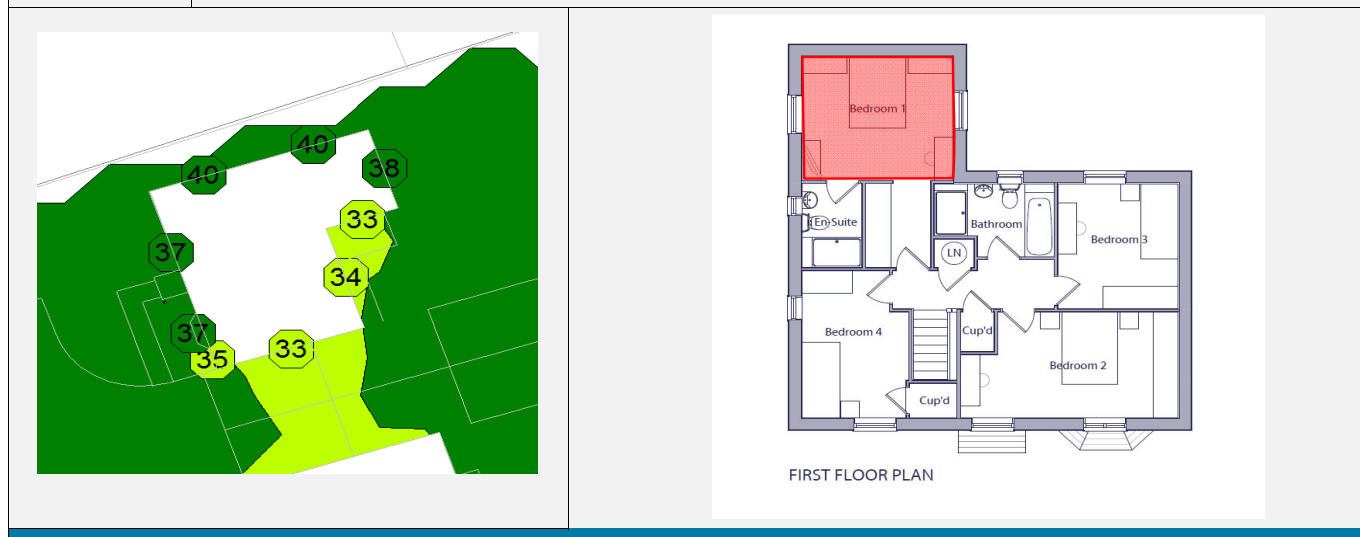


Calculation Sheet	4	Receiver	Plot 19 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Value
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	41	37	33	37	33	24	40	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{2m,nT}	-29	-26	-31	-27	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	17	16	7	14	6	-5	16	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

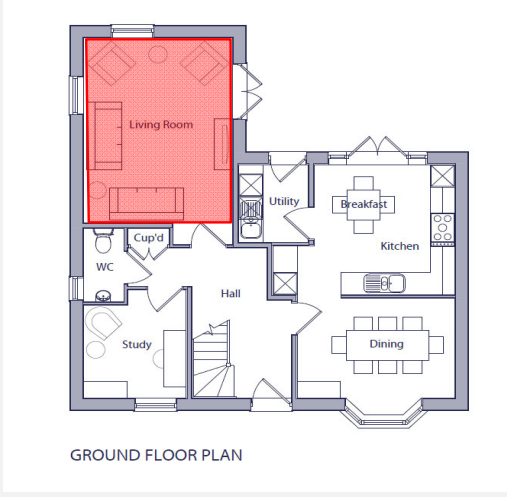
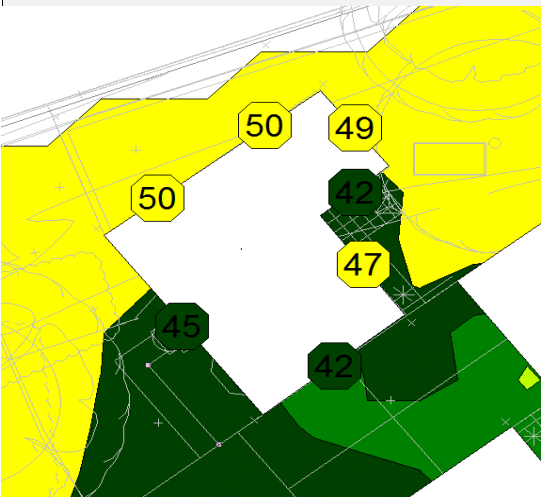


Calculation Sheet	5	Receiver	Plot 32 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room	4.20	2.60	1.20	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	51	47	43	47	43	34	50	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{2m,nT}	-27	-24	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	24	23	14	22	14	2	23	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

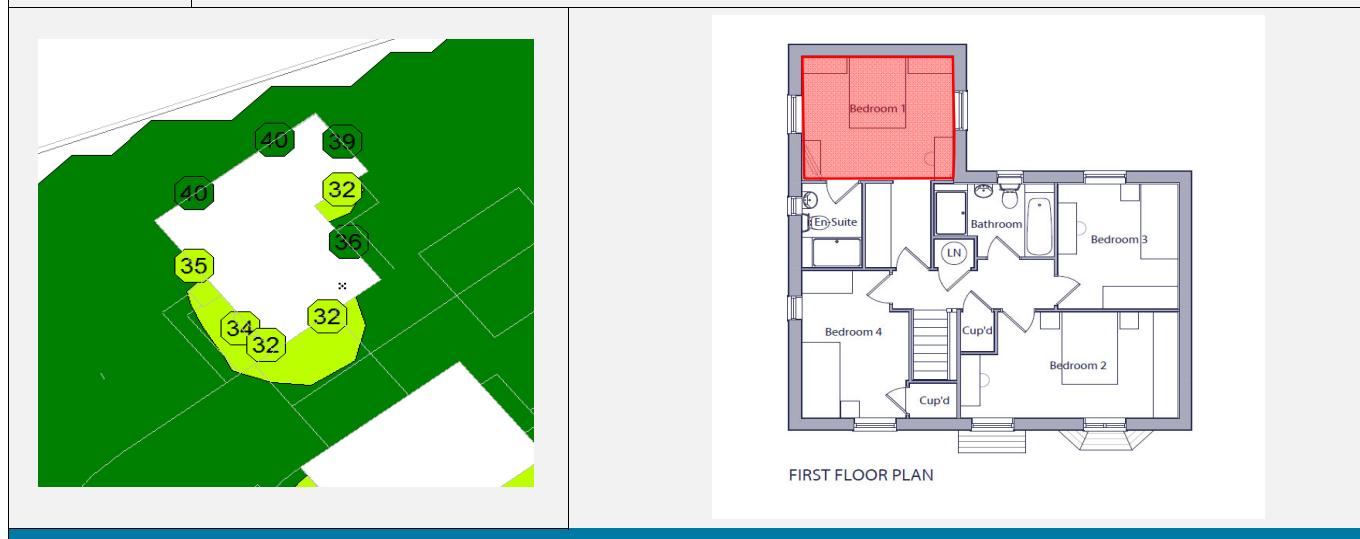


Calculation Sheet	6	Receiver	Plot 32 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.00	2.20	1.20	10.40	22.88

Term	Description	Units	Value
Sf	Total façade area	m ²	8.8
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.6
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	41	37	33	37	33	24	40	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{2m,nT}	-29	-26	-31	-27	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	17	16	7	14	6	-5	16	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

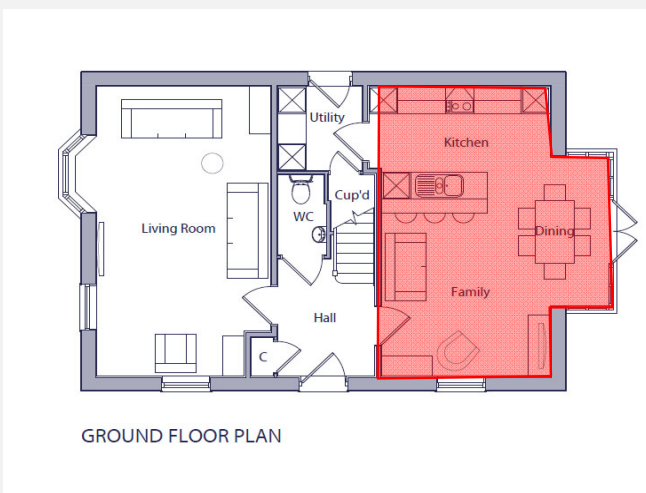
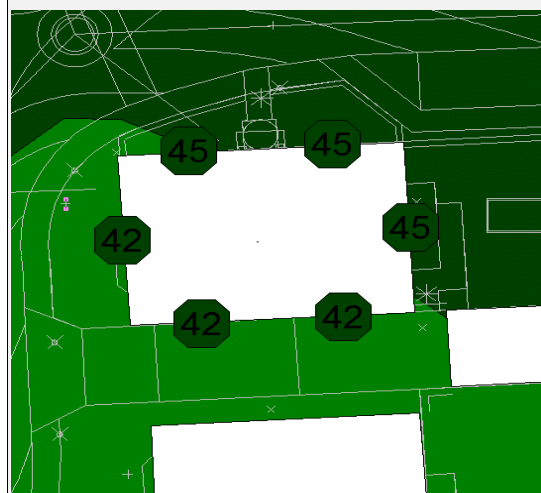


Calculation Sheet	7	Receiver	Plot 44 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room / Kitchen	7.00	2.70	10.00	20.4	55.1

Term	Description	Units	Value
Sf	Total façade area	m ²	18.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	10.0
Sew	External Wall Area	m ²	8.9
V	Volume of receiving room	m ³	55.1
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	17.7

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	45	41	37	41	37	28	44	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-24	-20	-27	-29	-33	-32	--	Total Apparent SRI
D _{2m,r,T}	-24	-20	-27	-29	-33	-32	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	25	25	13	15	7	-1	20	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

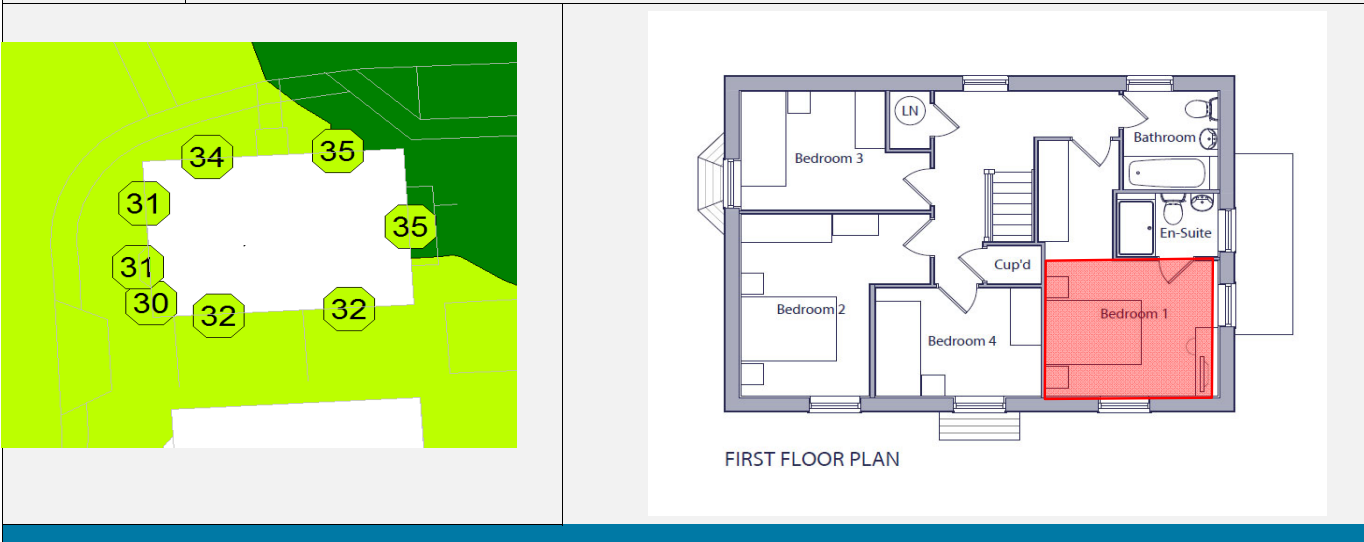


Calculation Sheet	8	Receiver	Plot 44 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.20	2.50	1.20	18.50	46.25

Term	Description	Units	Value
Sf	Total façade area	m ²	8.0
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	6.8
V	Volume of receiving room	m ³	46.3
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.9

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	36	32	28	32	28	19	35	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{2m,nT}	-25	-22	-27	-23	-27	-29	--	Total Standardized Difference
Room Correction	-3	-3	-3	-3	-3	-3	--	Room Absorption Correction
Sound Level	9	8	-1	6	-2	-13	8	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

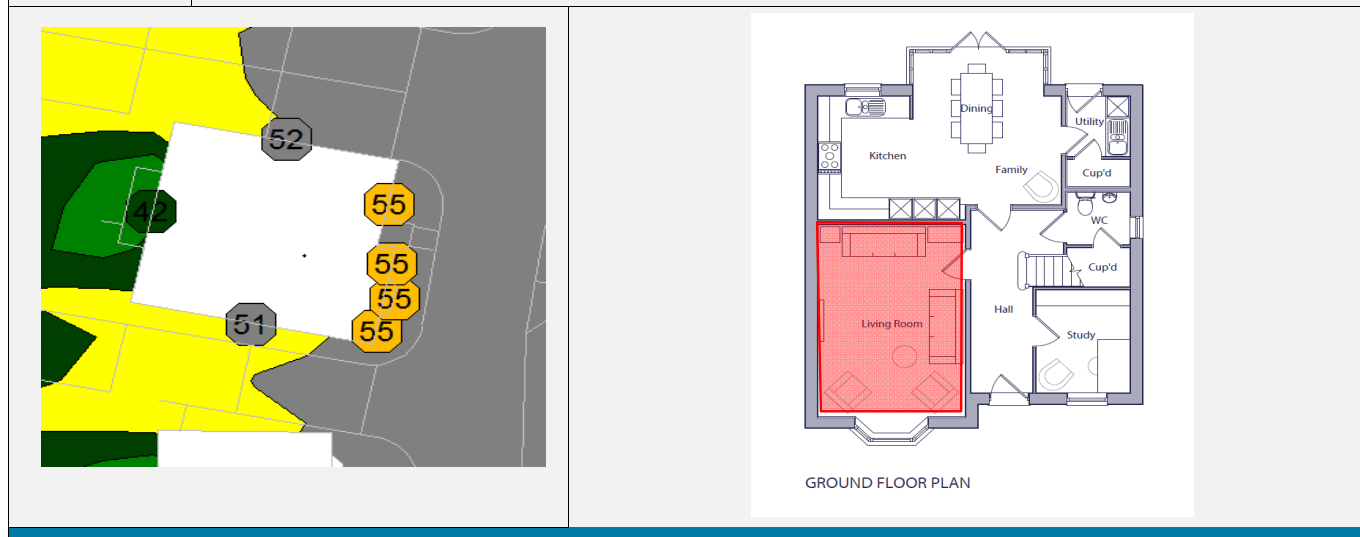


Calculation Sheet	9	Receiver	Plot 62 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living	4.20	2.60	4.00	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	4.0
Sew	External Wall Area	m ²	6.9
V	Volume of receiving room	m ³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	56	52	48	52	48	39	55	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-25	-21	-28	-27	-31	-32	--	Total Apparent SRI
D _{2m,nT}	-24	-20	-27	-26	-30	-31	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	33	33	22	27	19	9	30	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

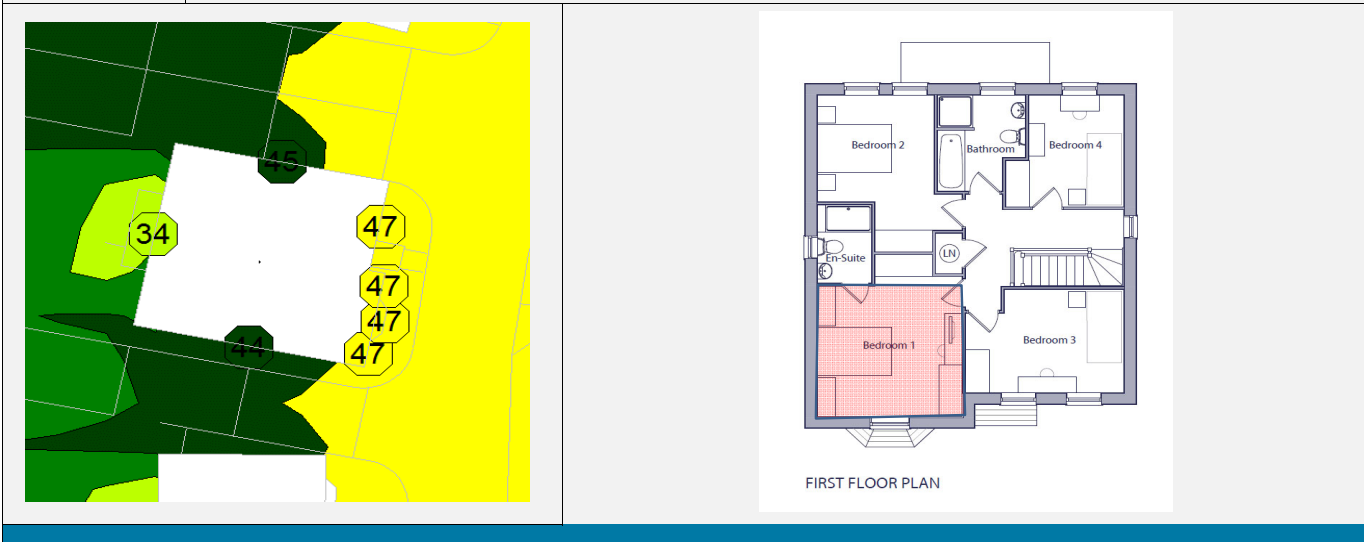


Calculation Sheet	10	Receiver	Plot 62 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.20	2.60	1.20	9.90	25.74

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.7
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	48	44	40	44	40	31	47	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{2m,nT}	-30	-27	-32	-28	-32	-34	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	23	22	13	21	13	2	23	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

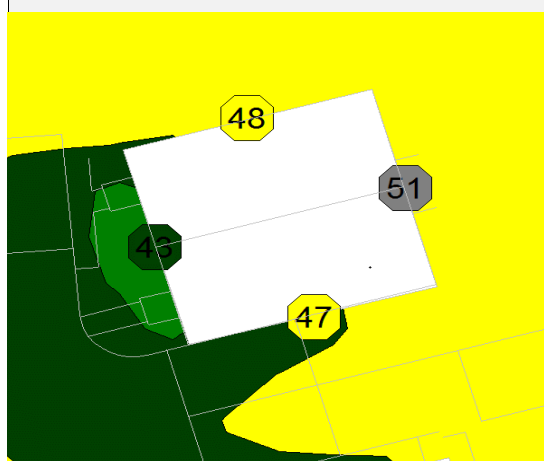


Calculation Sheet	11	Receiver	Plot 67 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room	4.20	2.60	4.40	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	4.4
Sew	External Wall Area	m ²	6.5
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	52	48	44	48	44	35	51	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-24	-21	-28	-27	-31	-32	--	Total Apparent SRI
D _{2m,nT}	-23	-19	-26	-26	-30	-30	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	29	29	18	23	15	5	26	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

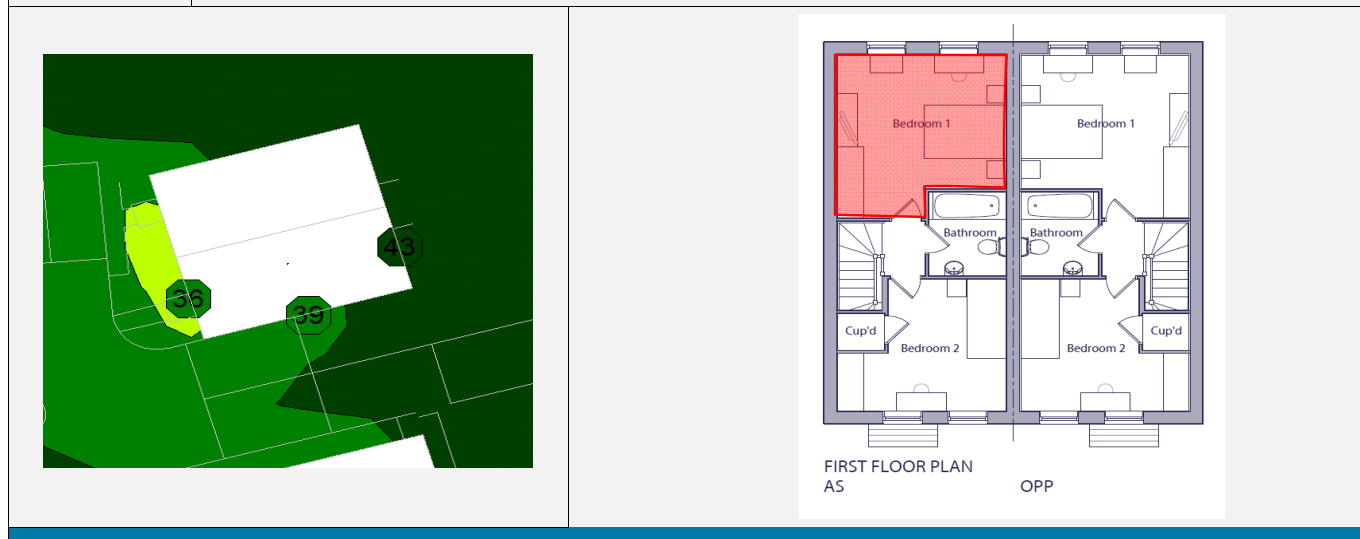


Calculation Sheet	12	Receiver	Plot 67 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.30	2.20	2.20	10.40	22.88

Term	Description	Units	Value
Sf	Total façade area	m ²	9.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	2.2
Sew	External Wall Area	m ²	7.3
V	Volume of receiving room	m ³	22.9
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	7.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	44	40	36	40	36	27	43	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-26	-23	-29	-27	-31	-32	--	Total Apparent SRI
D _{2m,nT}	-27	-24	-30	-28	-31	-33	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	22	21	11	17	10	-1	20	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

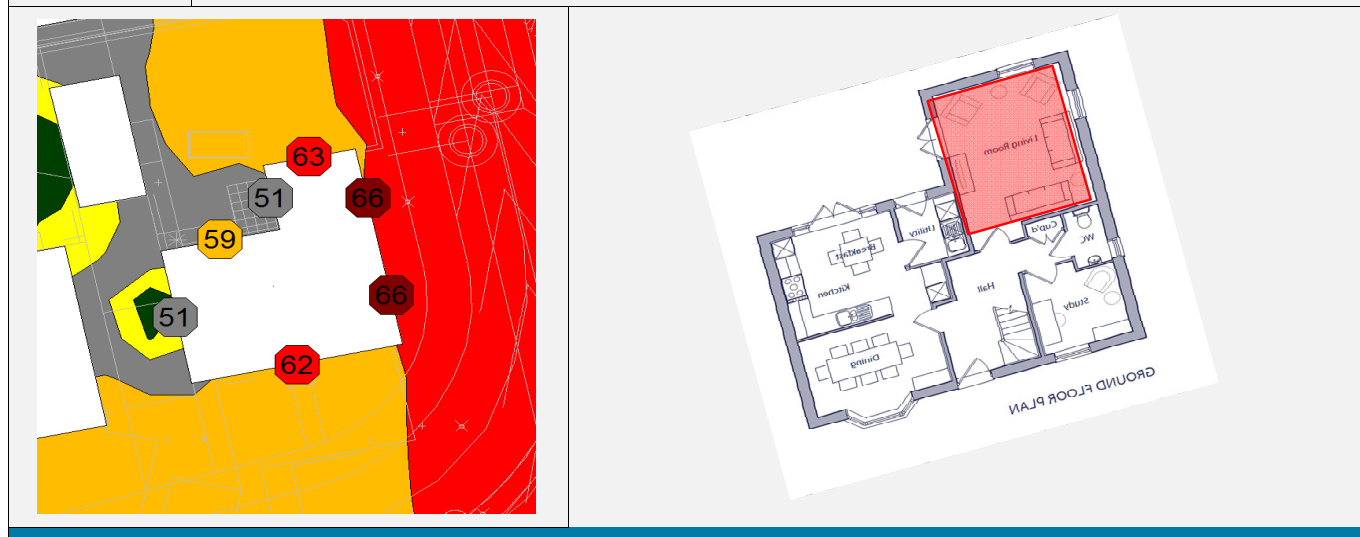


Calculation Sheet	13	Receiver	Plot 72 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room	4.00	2.60	2.30	17.2	44.7

Term	Description	Units	Value
Sf	Total façade area	m ²	10.4
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	2.3
Sew	External Wall Area	m ²	8.1
V	Volume of receiving room	m ³	44.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	67	63	59	63	59	50	66	L _{Aeq,16hour} value
Ventilator, Dne	40	38	32	47	54	48	41	High Performance Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-23	-29	-40	-43	-37	--	Total Apparent SRI
D _{2m,r,T}	-26	-22	-27	-39	-41	-36	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	41	41	32	24	18	14	35	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadha building evaluation for ground floor and Architect's general arrangement drawing.



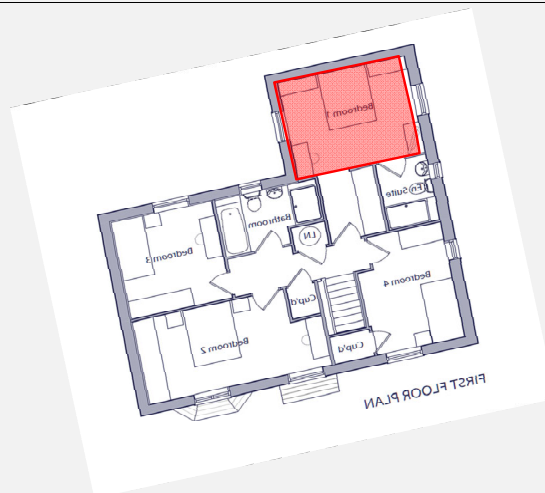
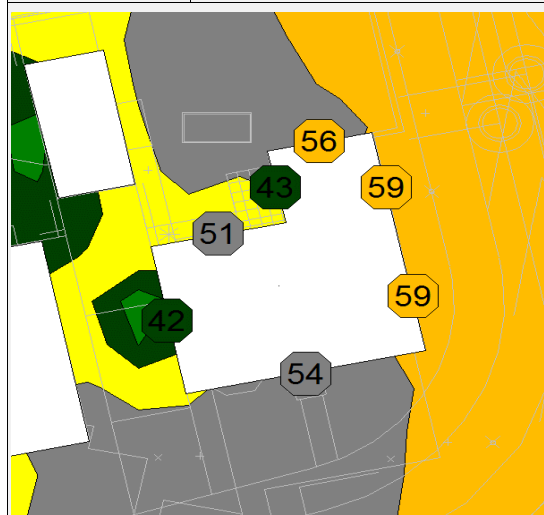
Calculation Sheet		14	Receiver	Plot 72 - 1st Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.00	2.50	1.20	10.40	26.00



Term	Description	Units	Value
Sf	Total façade area	m ²	10.0
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	8.8
V	Volume of receiving room	m ³	26.0
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	60	56	52	56	52	43	59	L _{Aeq,8hour} value
Ventilator, Dne	38	38	33	36	47	49	38	Enhanced Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-30	-35	-43	-40	--	Total Apparent SRI
D _{2m,r,T}	-30	-26	-31	-36	-44	-40	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	34	34	25	25	12	7	29	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

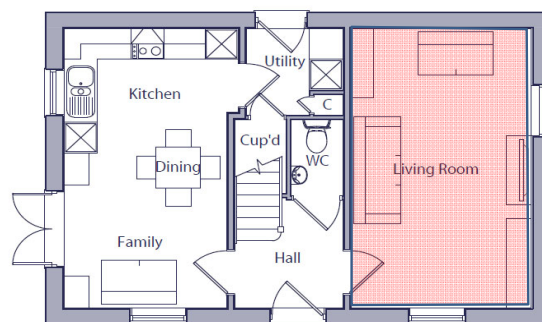
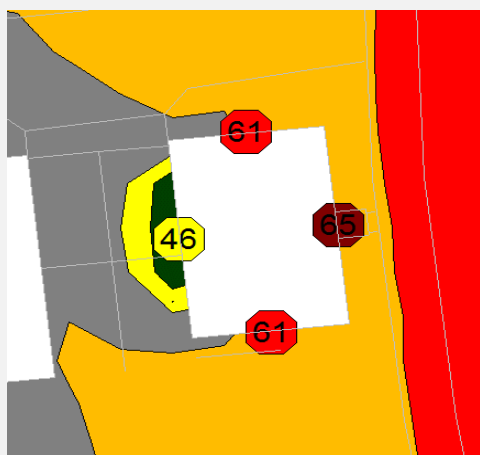


Calculation Sheet	15	Receiver	Plot 77 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living	3.70	2.60	1.40	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.4
Sew	External Wall Area	m ²	8.2
V	Volume of receiving room	m ³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	62	58	54	58	54	45	61	L _{Aeq,16hour} value
Ventilator, Dne	36	38	36	32	27	39	35	Standard Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-31	-31	-27	-36	--	Total Apparent SRI
D _{2m,nT}	-27	-23	-30	-30	-25	-34	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	35	34	24	28	29	10	33	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



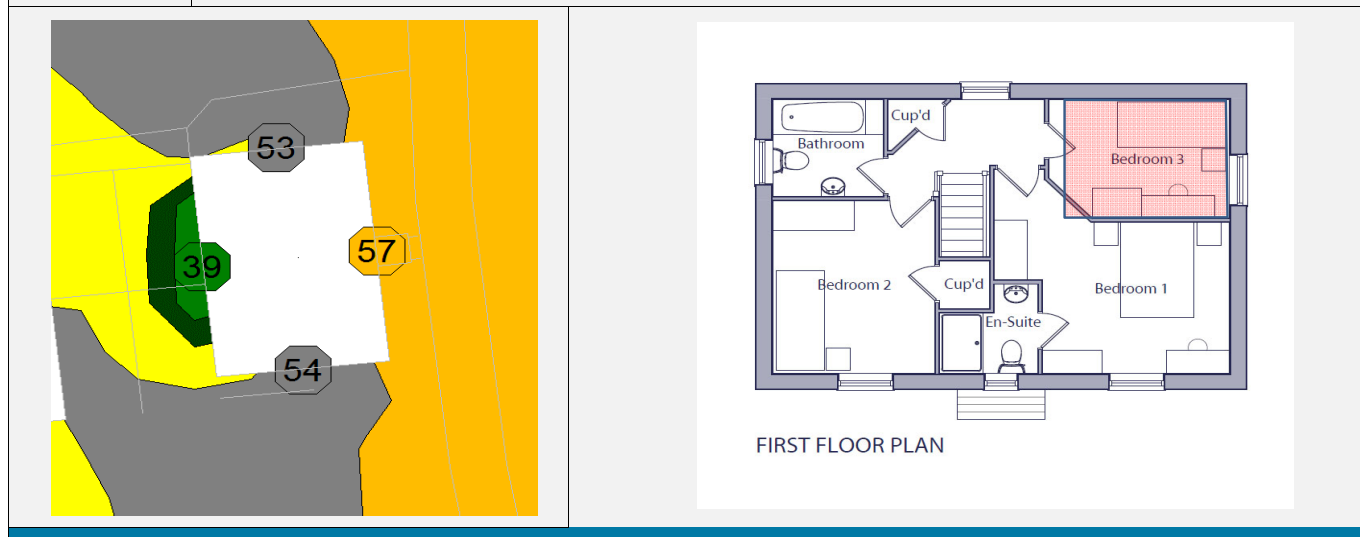
GROUND FLOOR PLAN

Calculation Sheet	16	Receiver	Plot 77 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.70	2.60	1.20	9.90	25.74

Term	Description	Units	Value
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	8.4
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	55	51	47	51	47	38	54	L _{Aeq,8hour} value
Ventilator, Dne	36	38	36	32	27	39	35	Standard Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-32	-32	-27	-36	--	Total Apparent SRI
D _{2m,r,T}	-29	-26	-32	-32	-27	-37	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	30	29	19	23	24	5	28	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

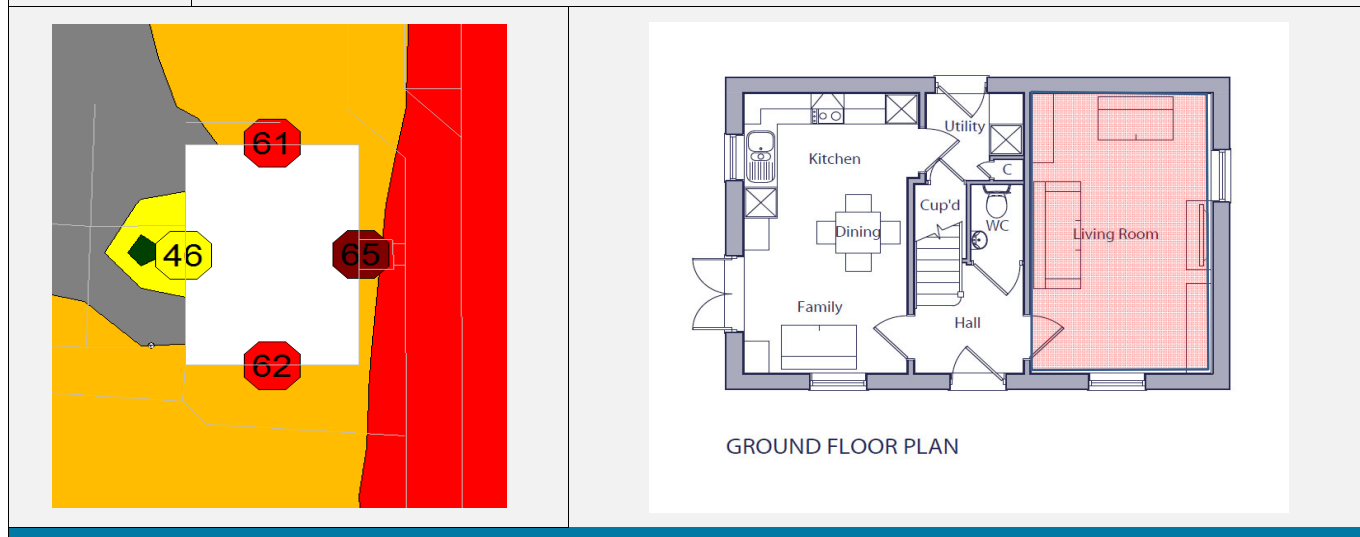


Calculation Sheet	17	Receiver	Plot 95 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living	3.70	2.60	1.40	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.4
Sew	External Wall Area	m ²	8.2
V	Volume of receiving room	m ³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	63	59	55	59	55	46	62	L _{Aeq,16hour} value
Ventilator, Dne	36	38	36	32	27	39	35	Standard Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-31	-31	-27	-36	--	Total Apparent SRI
D _{2m,rT}	-27	-23	-30	-30	-25	-34	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	36	35	25	29	30	11	34	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

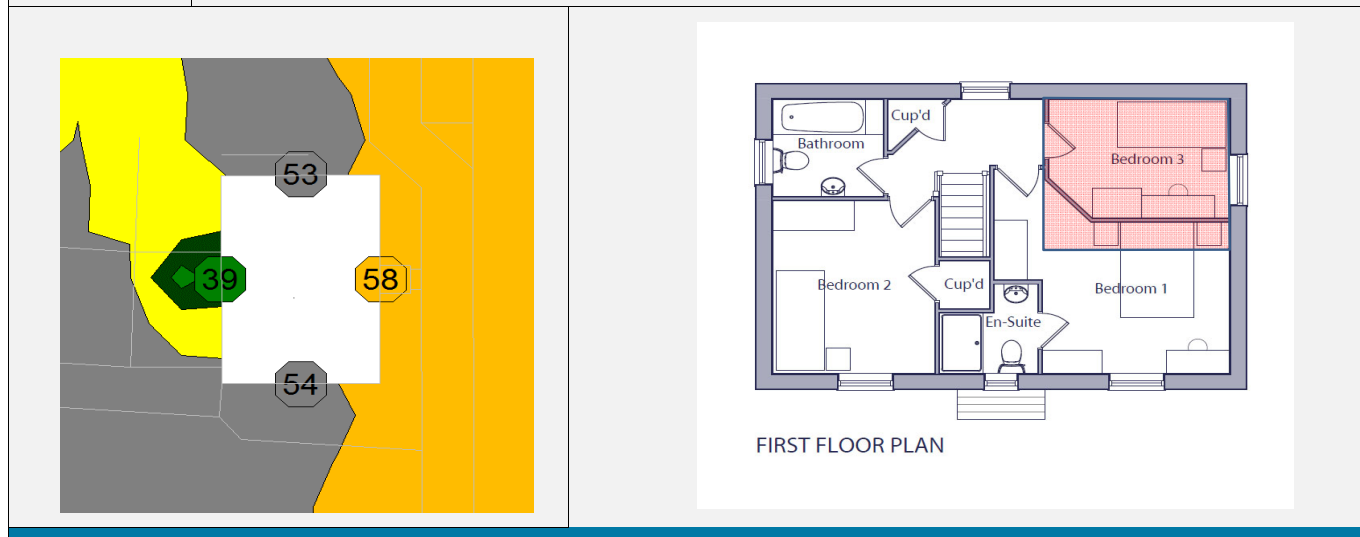


Calculation Sheet	18	Receiver	Plot 95 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.70	2.60	1.20	9.90	25.74

Term	Description	Units	Value
Sf	Total façade area	m ²	9.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	8.4
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	56	52	48	52	48	39	55	L _{Aeq,8hour} value
Ventilator, Dne	36	38	36	32	27	39	35	Standard Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-32	-32	-27	-36	--	Total Apparent SRI
D _{2m,nT}	-29	-26	-32	-32	-27	-37	--	Total Standardized Difference
Room Correction	1	1	1	1	1	1	--	Room Absorption Correction
Sound Level	31	30	20	24	25	6	29	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

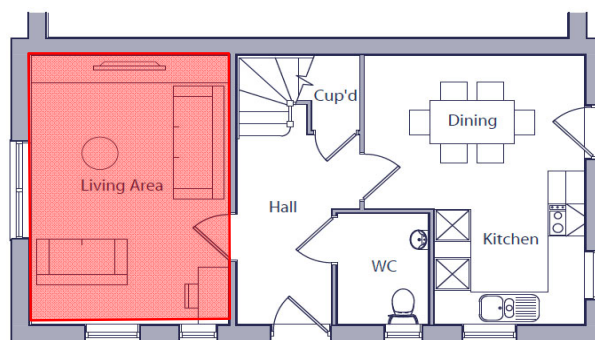
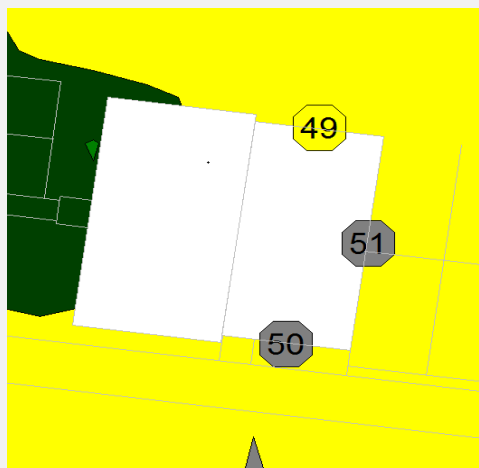


Calculation Sheet	19	Receiver	Plot 115 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room	3.00	2.50	3.00	17.2	43.0

Term	Description	Units	Value
Sf	Total façade area	m ²	7.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	3.0
Sew	External Wall Area	m ²	4.5
V	Volume of receiving room	m ³	43.0
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	13.8

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	52	48	44	48	44	35	51	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-24	-21	-27	-26	-29	-31	--	Total Apparent SRI
D _{2m,nT}	-21	-18	-24	-23	-27	-28	--	Total Standardized Difference
Room Correction	-3	-3	-3	-3	-3	-3	--	Room Absorption Correction
Sound Level	28	28	17	23	15	5	25	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



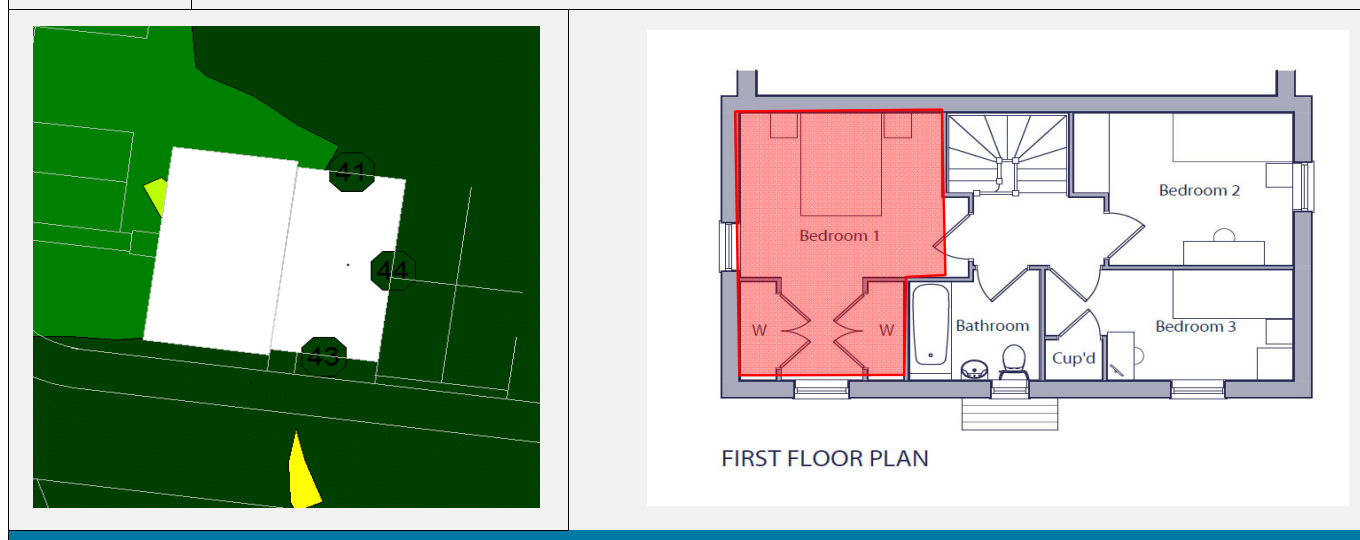
GROUND FLOOR PLAN

Calculation Sheet	20	Receiver	Plot 115 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.00	2.30	1.20	13.40	30.82

Term	Description	Units	Value
Sf	Total façade area	m ²	6.9
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	5.7
V	Volume of receiving room	m ³	30.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	9.9

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	45	41	37	41	37	28	44	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-24	-29	-25	-29	-31	--	Total Apparent SRI
D _{2m,nT}	-25	-22	-27	-24	-28	-30	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	19	19	10	17	9	-2	19	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

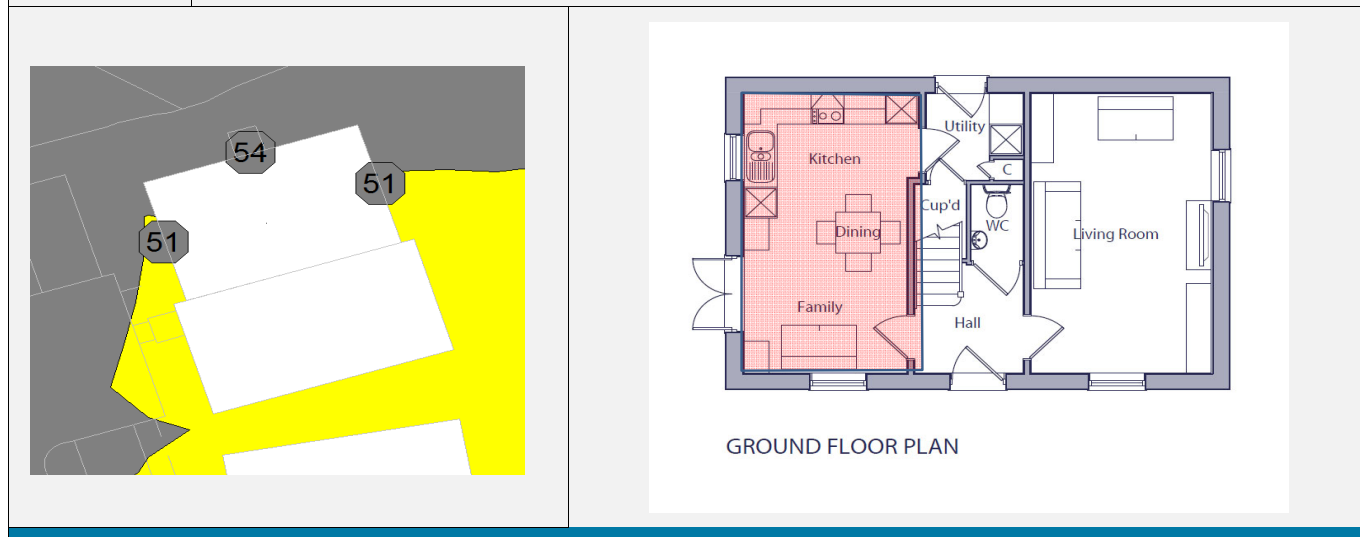


Calculation Sheet	21	Receiver	Plot 143 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living	6.00	2.60	5.00	16.7	43.4

Term	Description	Units	Value
Sf	Total façade area	m ²	15.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	5.0
Sew	External Wall Area	m ²	10.6
V	Volume of receiving room	m ³	43.4
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	14.0

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	55	51	47	51	47	38	54	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-25	-22	-29	-29	-32	-33	--	Total Apparent SRI
D _{2m,nT}	-26	-22	-29	-29	-33	-33	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	33	33	22	26	18	9	29	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



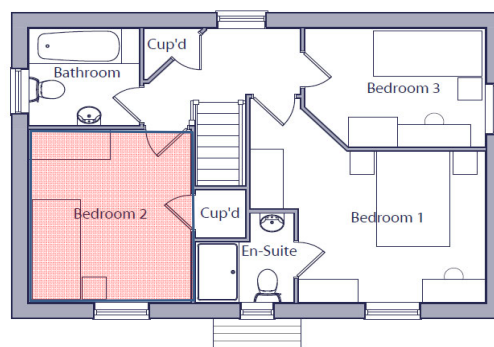
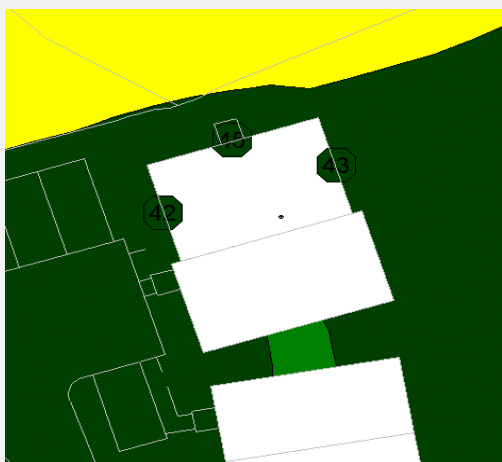
Calculation Sheet		22	Receiver	Plot 143 - 1st Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.30	2.60	1.20	9.90	25.74



Term	Description	Units	Value
Sf	Total façade area	m ²	8.6
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.4
V	Volume of receiving room	m ³	25.7
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	8.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	46	42	38	42	38	29	45	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{2m,nT}	-28	-25	-30	-26	-30	-32	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	21	20	11	19	11	0	21	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.



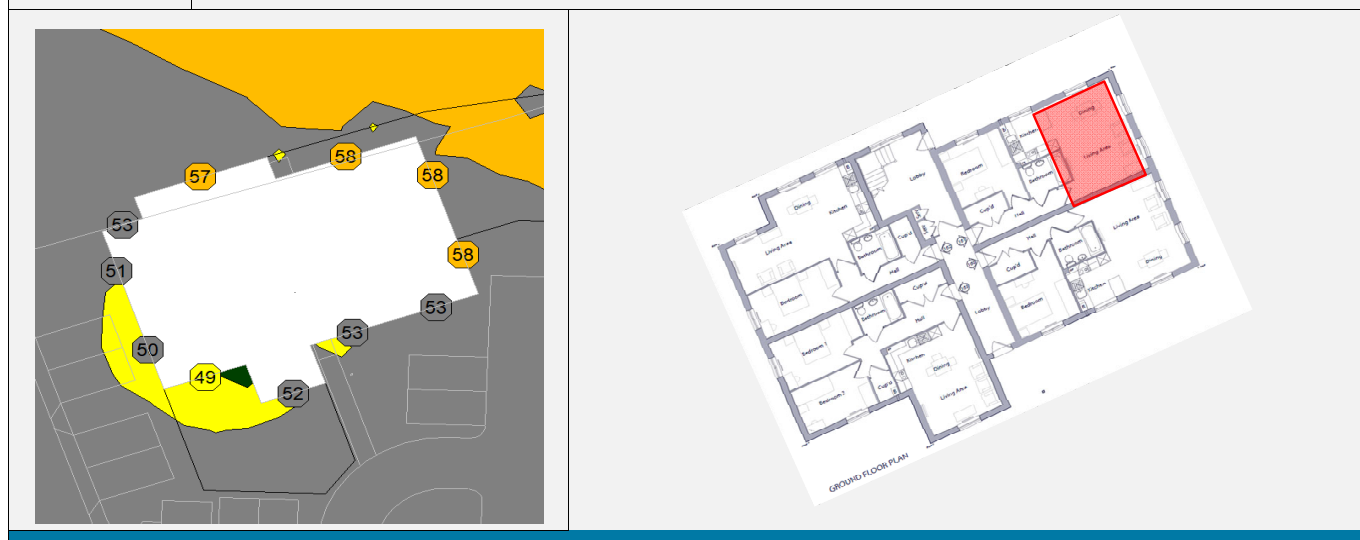
FIRST FLOOR PLAN

Calculation Sheet	23	Receiver	Plot 160-167 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living Room / Kitchen	6.00	2.50	3.00	19.5	48.8

Term	Description	Units	Value
Sf	Total façade area	m ²	15.0
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	3.0
Sew	External Wall Area	m ²	12.0
V	Volume of receiving room	m ³	48.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	15.7

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	59	55	51	55	51	42	58	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-24	-30	-29	-32	-34	--	Total Apparent SRI
D _{2m,r,T}	-27	-23	-30	-28	-32	-33	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	35	34	24	29	21	11	32	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



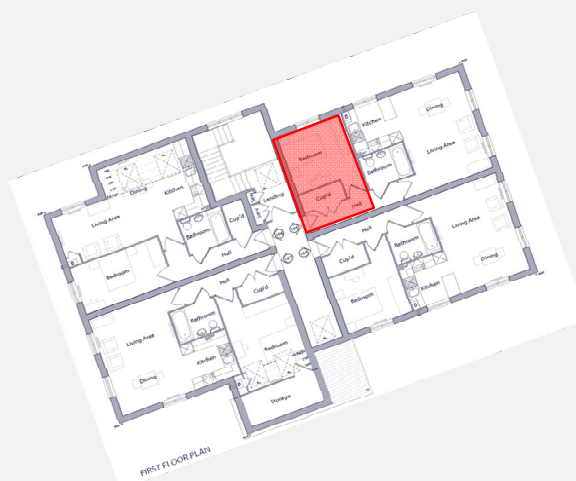
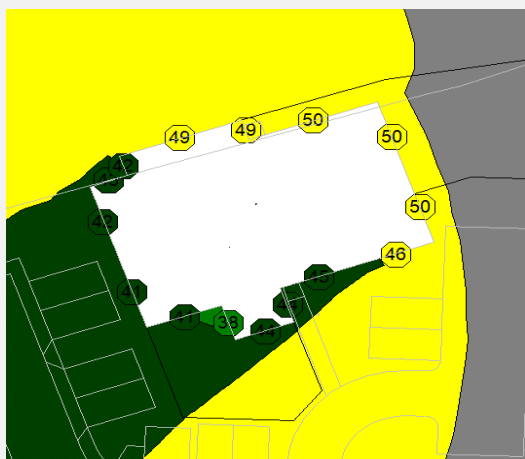
Calculation Sheet		24	Receiver	Plot 160-167 - 1st Floor	
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.30	2.50	1.50	14.30	35.75



Term	Description	Units	Value
Sf	Total façade area	m ²	8.3
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.5
Sew	External Wall Area	m ²	6.8
V	Volume of receiving room	m ³	35.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	11.5

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	51	47	43	47	43	34	50	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-24	-29	-26	-30	-32	--	Total Apparent SRI
D _{2m,nT}	-25	-22	-28	-24	-28	-30	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	26	25	15	23	15	4	24	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

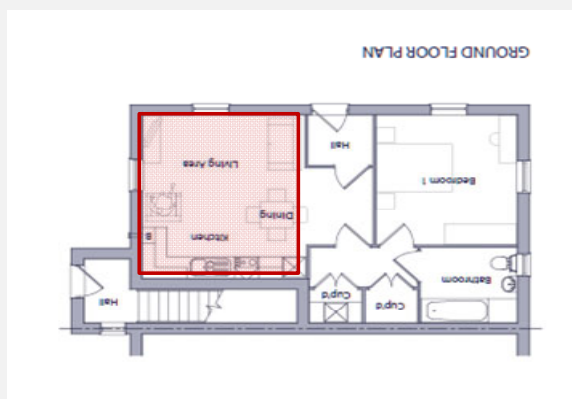
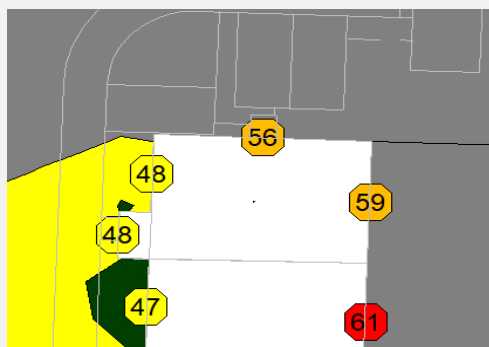


Calculation Sheet	25	Receiver	Plot 168 - 169 Living Room		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living	4.50	2.50	1.50	19.3	48.3

Term	Description	Units	Value
Sf	Total façade area	m ²	11.3
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.5
Sew	External Wall Area	m ²	9.8
V	Volume of receiving room	m ³	48.3
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	15.5

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	47	45	46	50	46	37	56	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-31	-27	-31	-33	--	Total Apparent SRI
D _{2m,r,T}	-27	-24	-29	-26	-30	-32	--	Total Standardized Difference
Room Correction	-1	-1	-1	-1	-1	-1	--	Room Absorption Correction
Sound Level	21	22	17	24	16	6	26	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2000 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadha building evaluation for ground floor and Architect's general arrangement drawing.

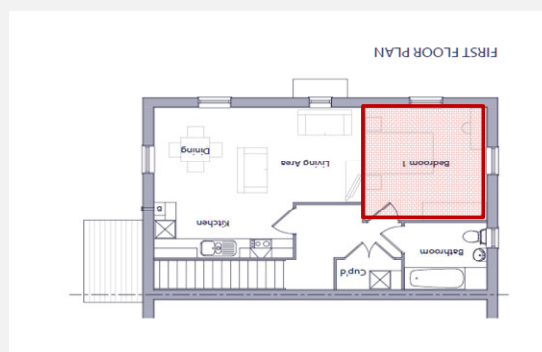
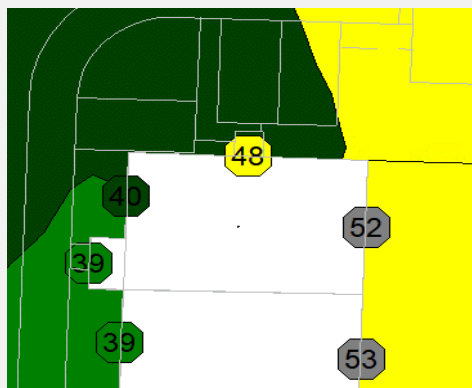


Calculation Sheet	26	Receiver	Plots 168 - 169		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.10	2.50	1.50	13.60	34.00

Term	Description	Units	Value
Sf	Total façade area	m ²	10.3
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.5
Sew	External Wall Area	m ²	8.8
V	Volume of receiving room	m ³	34.0
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	10.9

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	54	50	48	48	45	39	52	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-27	-31	-33	--	Total Apparent SRI
D _{2m,nT}	-27	-24	-30	-27	-30	-33	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	29	28	21	24	17	9	27	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadha building evaluation for first floor and Architect's general arrangement drawing.

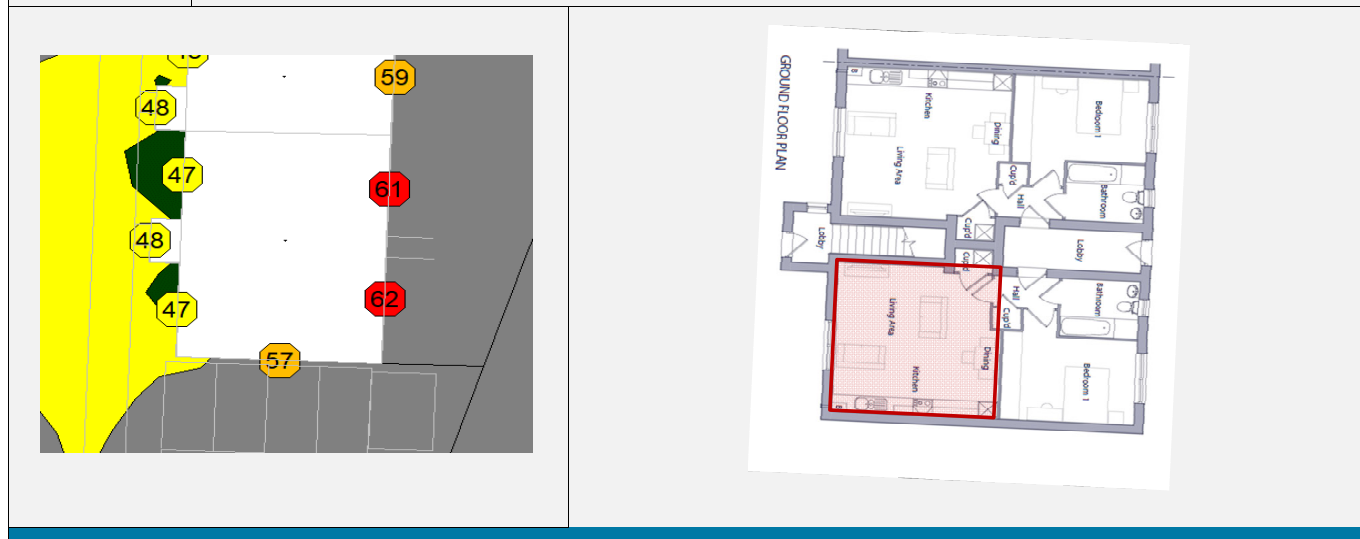


Calculation Sheet	27	Receiver	Plot 170 - 173 - Living Room		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Living	5.30	2.50	3.00	26.7	66.8

Term	Description	Units	Value
Sf	Total façade area	m ²	13.3
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	3.0
Sew	External Wall Area	m ²	10.3
V	Volume of receiving room	m ³	66.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	21.5

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	47	45	46	50	46	37	47	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-23	-30	-28	-32	-33	--	Total Apparent SRI
D _{2m,r,T}	-24	-21	-27	-26	-30	-31	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	22	23	18	23	15	5	25	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2000 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.



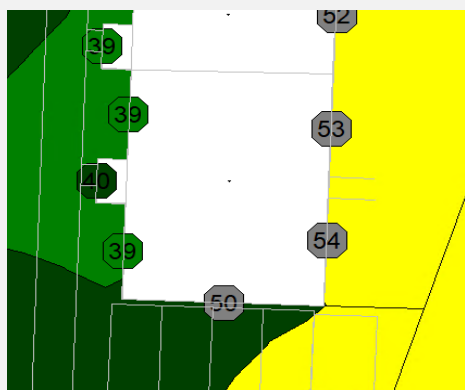
Calculation Sheet	28	Receiver	Plot 170 -173 - Bedroom		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	4.20	2.50	2.20	14.20	35.50



Term	Description	Units	Value
Sf	Total façade area	m ²	10.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	2.2
Sew	External Wall Area	m ²	8.3
V	Volume of receiving room	m ³	35.5
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	11.4

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	56	52	50	50	47	41	54	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-27	-23	-29	-27	-31	-33	--	Total Apparent SRI
D _{2m,rT}	-26	-23	-29	-27	-30	-32	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	32	31	23	26	19	11	29	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.

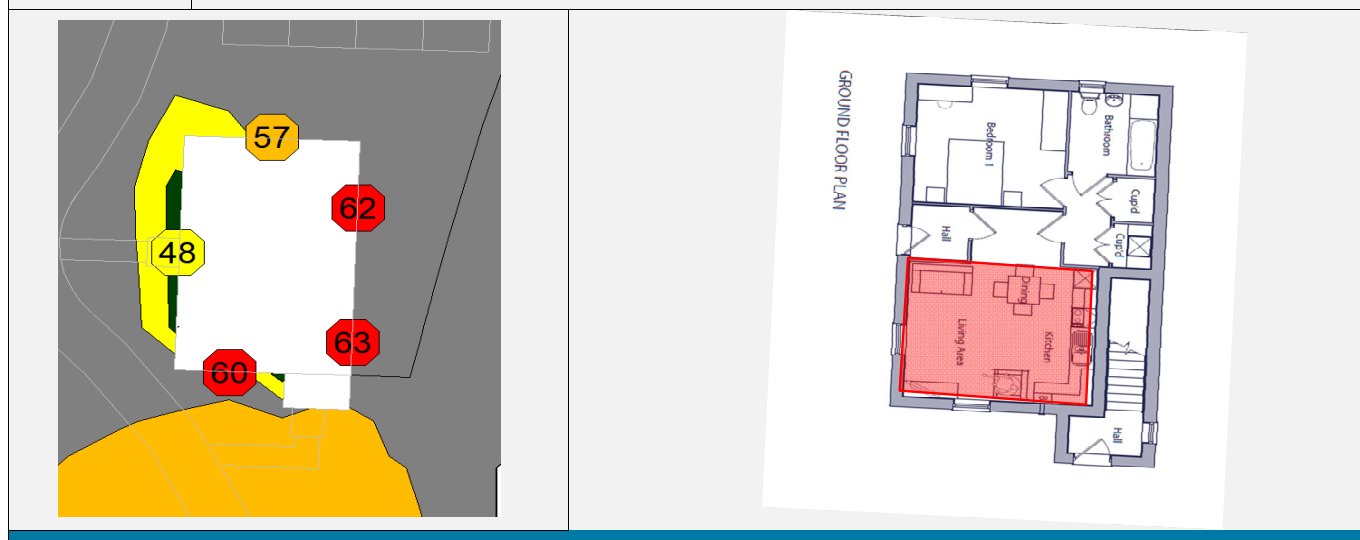


Calculation Sheet	29	Receiver	Plot 174 - Gnd Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Kitchen/Dining	4.00	2.60	1.20	18.7	48.6

Term	Description	Units	Value
Sf	Total façade area	m ²	10.4
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	9.2
V	Volume of receiving room	m ³	48.6
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	15.7

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Daytime	61	57	53	57	53	44	60	L _{Aeq,16hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-29	-26	-31	-27	-31	-33	--	Total Apparent SRI
D _{2m,nT}	-27	-24	-29	-25	-29	-31	--	Total Standardized Difference
Room Correction	-2	-2	-2	-2	-2	-2	--	Room Absorption Correction
Sound Level	34	33	24	31	23	12	33	Daytime L _{Aeq,16 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for ground floor and Architect's general arrangement drawing.

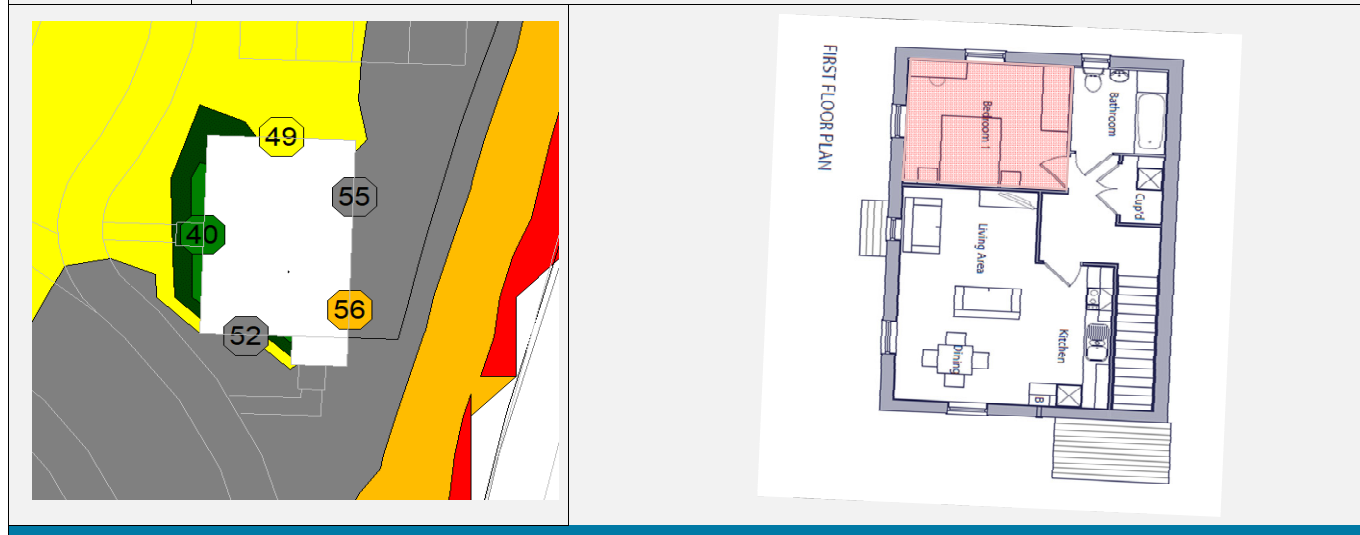


Calculation Sheet	30	Receiver	Plot 174 - 1st Floor		
Room Type	Façade Dimensions		Window Dimensions	Room Area	Volume
	W (m)	H (m)	Areas (m ²)	m ²	m ³
Bedroom	3.40	2.50	1.20	11.50	28.75

Term	Description	Units	Value
Sf	Total façade area	m ²	8.5
Svents	Vents Equivalent Open Area	m ²	0.005
Swi	Window Area	m ²	1.2
Sew	External Wall Area	m ²	7.3
V	Volume of receiving room	m ³	28.8
T	Rev. Time of Receiving room (residential room ISO 140)	sec.	0.5
A ₀	Reference Abs Area	m ²	10
A	Equivalent Abs Area (receiving room)	m ²	9.3

Term	Octave Band Values						Overall Level dB(A) / R _w / D _{new}	Description
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Leq,ff, Night-time	50	46	42	46	42	33	49	L _{Aeq,8hour} value
Ventilator, Dne	34	34	33	27	31	34	32	Standard Non-Acoustic Trickle Vent
Window SRI, Rwi	21	17	25	35	37	31	29	Standard Thermal Double Glazing
Solid Wall SRI, Rew	41	43	48	50	55	55	50	Brick Block Cavity Wall
Composite R'w	-28	-25	-30	-26	-30	-32	--	Total Apparent SRI
D _{2m,r,T}	-27	-24	-29	-26	-30	-32	--	Total Standardized Difference
Room Correction	0	0	0	0	0	0	--	Room Absorption Correction
Sound Level	25	24	15	22	14	3	24	Night-time L _{Aeq,8 hour} Value

Notes	
1	Evaluation based on calculation methodology of BS EN 12354-3:2017 "Estimation of acoustic performance of buildings from the performance of elements- Part 3: Airborne Sound Insulation Against Outdoor Sound"
2	Cadna building evaluation for first floor and Architect's general arrangement drawing.



APPENDIX D: EHO Correspondence

From: [Carol Reynolds](#)
To: [David Denham](#)
Cc: [Michael Eastham](#); [Paul Gray](#)
Subject: RE: Planning Consultation on PAA/4/20/ and previous A/99/17/OUT Land south of Water Lane [Filed 26 Feb 2021 10:55]
Date: 19 February 2021 18:29:03
Attachments: [image009.png](#)
[image015.png](#)

Dear David,

Your colleague Paul Gray very kindly phoned me back today. To answer your query, with only distant access to any area of open space, then my advice is that a suitable acoustic barrier should be provided north and east to surround the amenity space to flats at the far north-east of this site. This is in order to bring noise from adjacent roads to within the 55db (significant annoyance) and much more preferably 50db (moderate annoyance) criteria for outdoor amenity areas, as guided by BS8233.

Please would you also provide better description in your new report, of night-time LA_{max,f} as this will impact sensitive receptors, (see the ProPG and BS8233); and ensure 1 minute sampling periods for this. I also note that night-time noise exposure as calculated by Phlorum, Acoustic Report November 2016 would appear to be lower than in your September 2020 report, which is despite traffic reduction due to COVID. I would be most obliged if you would check this detail and make suitable adjustments as necessary.

I shall be away from the office next week, but back on the 2nd March should you wish to discuss any matter. I otherwise look forward to receiving your report.

Kind regards

Carol

Carol Reynolds
Senior Environmental Health Officer
Environmental Health Department

T: 01903 737678

E: carol.reynolds@arun.gov.uk

Please note my normal working days are Tuesday to Friday

Arun District Council, Civic Centre, Maltravers Rd, Littlehampton, West Sussex, BN17 5LF

www.arun.gov.uk

Sign up to our newsletter [here](#)

Business Support during Coronavirus click [here](#)

From: David Denham <ddenham@mayerbrown.co.uk>

Sent: 19 February 2021 14:57

To: Carol Reynolds <Carol.Reynolds@arun.gov.uk>

Subject: Automatic reply: Planning Consultation on PAA/4/20/ and previous A/99/17/OUT Land south of Water Lane