Acoustic Associates Sussex Ltd

Noise Survey & Assessment

Site: **127 South Street, Lancing**
Client: **Nicolas Chow**

Report by: Martyn Chambers BA (Hons) MSc PGDip: Acoustics AMIOA

Date: 10/08/21
Project: J3233

Acoustic Associates Sussex Ltd.

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Sound Insulation Testing - Acoustic Design of Buildings - BS4142 - PPG24 - Schools Acoustics BB93 - Vibration - Expert Witness Testimony - Noise at Work - Air Tightness Testing - Auditorium Acoustics

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Issue 1	10/08/2021

Acoustic Associates Sussex Ltd.

1 Introduction & Executive Summary

Acoustic Associates Sussex have been appointed to undertake a noise assessment in support of a change of use from a commercial space to a three-story residential dwelling at 127 South Street, Lancing, BN15 8AA.

The purpose of this assessment is to assess the following:

- Road Traffic noise levels affecting the planned development.
- The impact of commercial noise levels from neighbouring take-away restaurants.
- Provide mitigation measures (if necessary)

Sound has been measured on the existing site. The noise levels for the day and the night-time periods have been assessed in terms of and following the guidelines of the documents listed below:

- World Health Organisation (WHO) - Guidelines for Community Noise 1999
- ISO9613 (Attenuation of sound during propagation outdoors) 1996
- BS8233 (Sound insulation and noise reduction for buildings) 2014
- Pro-PG (Planning and Noise guidance) 2017
- Noise Policy Statement for England (NPSE) 2010
- National Planning Policy Framework NPPF 2019
- BS4142:2014+A1:2019 - Methods for rating and assessing industrial and commercial sound

The ProPG Stage 1 Assessment of the location shows that sound pressure levels at the site are at the medium risk level.

In order to demonstrate that the noise criteria can be achieved, BS8233:2014 Rigorous calculations have been completed to show what mitigation measures will be required:

Lounge windows

- Frame/Glazing to achieve $R_{traffic} \geq 34dB$
- $D_{n,e,w} \geq 42dB$ vents (trickle vents of this value used in calculation)

Bedroom 1 windows

- Frame/Glazing to achieve $R_{traffic} \geq 34dB$
- $D_{n,e,w} \geq 40dB$ trickle vents (trickle vents of this value used in calculation)

Bedroom 2 windows

- Frame/Glazing to achieve $R_{traffic} \geq 29dB$
- $D_{n,e,w} \geq 40dB$ vents (trickle vents of this value used in calculation)

In tandem with these mitigation measures it would be recommended that all additional glazing not covered in the above bullet points on the west and north facing facades should have a minimum $R_{traffic}$ of 34dB. On the east side this would need to be a minimum $R_{traffic}$ of 29dB.

The sound pressure levels in the external amenity space provided by the proposed balcony would likely exceed the 50 – 55 dB $L_{Aeq,16hr}$ guideline. It is noted that ProPG:2017 states the $L_{Aeq'T}$ target levels may be relaxed by up to 5dB where a project is considered 'necessary or desirable'. Furthermore, "Headborough Gardens" is adjacent to the site and Lancing beach is within a 5-minute walk of the property. These locations provide the future residents an alterative external amenity spaces for relaxation, allowing the site to meet the requirements of ProPG:2017

If these mitigation methods are implemented by the developer, it is considered that from the perspective of acoustics, there is no reason for the planning consent to be withheld.

2 Context, Noise Criteria & Noise Assessment Methodology

2.1 Site Description

The application site is based to the east of South Street (A2025). North of the site is a small public garden (Headborough Gardens). To the south of the site there are 2 take away restaurants, 'Lancing Burger Bar' and "Mr Chips".

Lancing Burger Bar operates 12:00-14-00 and 17:00 – 22:30 six days a week. It is closed Tuesdays. It has an extract flue that is approximately 2m from the east facing 2nd floor window and flat roof area of the application site.

Mr Chips operates 12:00-14-00 and 17:00-21:00 six days a week. It is closed Sundays. Mr Chips has no visible flue from the application site. However, upon investigation it is believed to be located in the small rear alley between Lancing Burger Bar and Mr Chips. It is believed there are residential properties above both Lancing Burger Bar and Mr Chips.

On Acoustic Associates Sussex's visits to site, road noise from South Street was by far the most dominant noise source.

The application site previously operated as Text Book Printing Service, with a shop front based on the ground floor, and office space on the 1st and 2nd floor. The planned conversation will see the ground floor converted into a lounge and kitchen area. At first floor there will be two bedrooms, one at the front of the property and a second at the rear. At 2nd floor level there will be a study, a store room and the flat roof will be converted into a balcony.

The location can be seen below in figure 1. The proposed floor plans can be seen in figures 2-4.

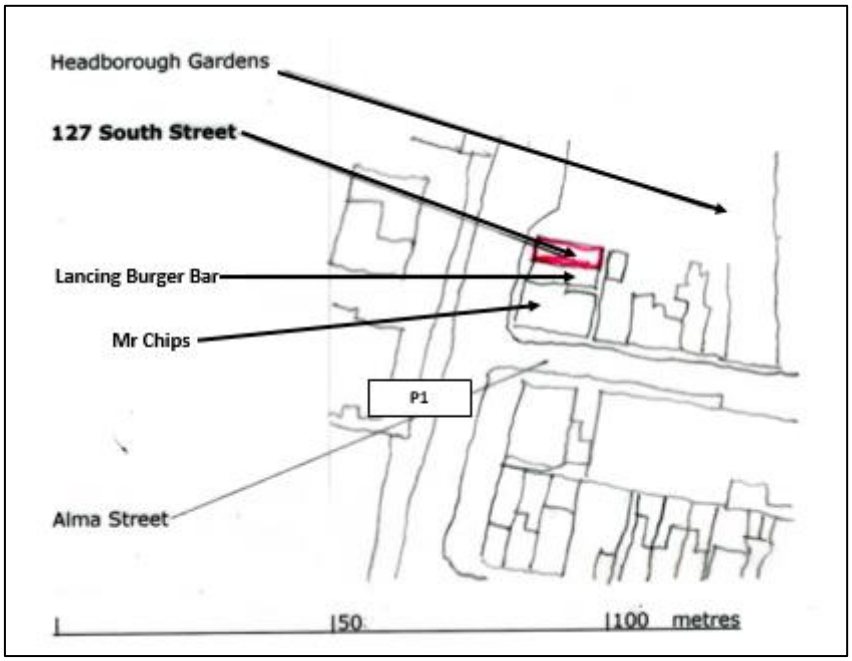

Figure 1: Site location plan

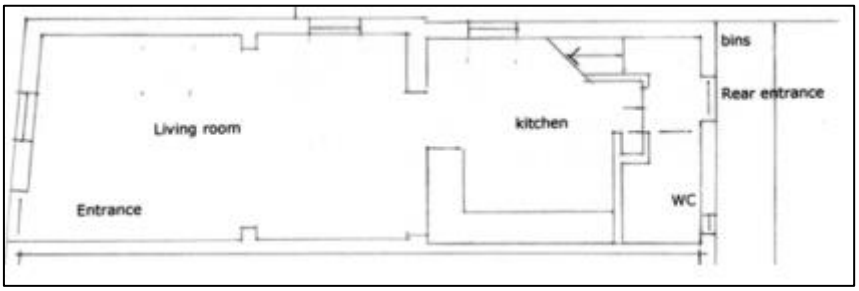

Figure 2: Proposed Ground Floor Plan

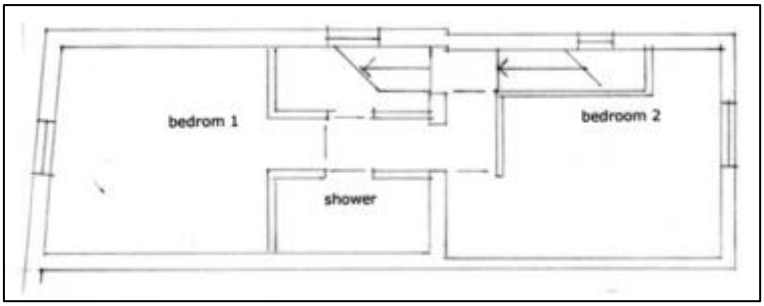

Figure 3: Proposed 1st Floor Plan

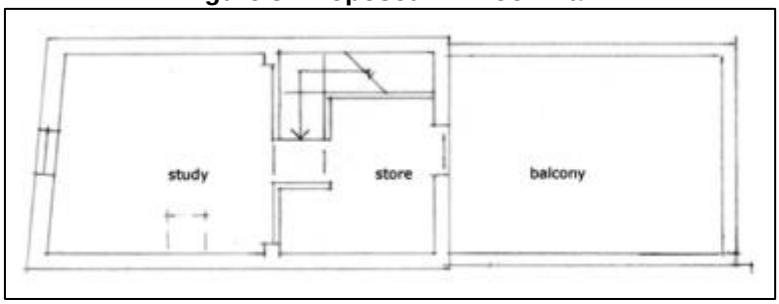

Figure 4: Proposed 2nd Floor Plan

3 Standards and Guidance

3.1 BS8233: Sound insulation and noise reduction for buildings (2014) Noise Criteria

Table 4 of BS8233 provides the following guideline values: for maximum noise levels within habitable spaces

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

Table 1: BS8233 criteria

3.2 WHO Internal Noise Criteria (Guidelines for Community Noise 1999)

The target internal levels are based on guidelines laid out by the World Health Organisation (WHO) and are as follows:

Room Type	**Target Maximum Internal Level - L_{Aeq} dB (A)**
Living rooms	35 (Daytime only)
Bedrooms	30 (Night)
Room Type	**Maximum Internal Level – L_{Amax} dB(A)**
Bedrooms	45 (not more than 10-15 times per Night)

The target maximum internal noise level for a bedroom during the night time corresponds to the threshold of sleep disturbance. WHO state that the noise level outside a bedroom window would be less than 45dB(A) this assumes that an open window provides 15dB attenuation.

3.3 WHO External Noise Criteria (Guidelines for Community Noise 1999)

With regard to outdoor amenity areas WHO states the following:

To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB(A) on balconies, terraces and in outdoor living areas.

To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 50dB(A) on balconies, terraces and in outdoor living areas.

3.4 Noise Policy Statement for England (NPSE)

The document "Noise Policy Statement for England" sets out the following vision for on-going noise policy:

"Promote good health and quality of life through the effective management of noise within the context of Government policy on sustainable development."

This vision should be achieved through the following Noise Policy Aims:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development: avoid significant adverse impacts on health and quality of life; mitigate and minimize adverse impacts on health and quality of life; and where possible, contribute to the improvement of health and quality of life".

3.5 NPSE Noise "Effect Levels"

To achieve these objectives the Noise Policy Statement sets out three noise levels to be defined by the assessor:

- NOEL - No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level there is no detectable effect on health and quality of life due to the noise.

- LOAEL - Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

- SOAEL - Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

The Noise Policy Statement considers that noise levels above the SOAEL would be seen to have, by definition, significant adverse effects and would be considered unacceptable.

Where the assessed noise levels fall between the LOAEL and the SOAEL noise levels, the Policy Statement requires that:

"All reasonable steps should be taken to mitigate and minimize adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development... .. This does not mean that such adverse effects cannot occur."

Where noise levels are below the LOAEL it is considered there will be no adverse effect. Once noise levels are below the NOEL there will be no observable change.

3.6 ProPG –Planning and Noise: new residential development

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

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

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

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

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

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

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

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

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

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any 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, subject to the further advice in Note 7.

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

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form **(see Section 3.D)**.

Figure 5: ProPG criteria

3.7 National Planning Policy Framework NPPF 2019

The following has been copied from point 182 of NPPF 2019:

"Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

3.8 BS4142:2014+A1:2019 - Methods for rating and assessing industrial and commercial sound

The below is a note from is an extract of section 8.5 of BS4142:2014+A1:2019.

> *NOTE Where a new noise-sensitive receptor is introduced and there is extant industrial and/or commercial sound, it should be recognized that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation.*

Figure 6: Note of section 8.5 of BS4142:2014+A1:2019

3.9 Methodology and Approach

Two sound surveys were set up at the site.

1. To measure the road traffic noise from South Street
2. To measure the impact of the commercial noise sources associated with the adjacent take away restaurants.

The first survey location will be used to determine the required sound reduction index (SRI) required for the west facade facing on to South Street.

The second survey location will be used to determine the required SRI required for the east façade. When introducing a new commercial noise source into an environment where there are noise sensitive receptors, a BS4142 assessment is required. However, when the scenario is reversed and noise sensitive receptors are introduced into a soundscape with existing commercial noise, then alternative standards would need to be referenced (see section 8.5 of BS4142). The 'Agent of Change' principle within the policy of the National Planning Policy Framework NPPF 2019, displayed in section 3.7, must also be taken into account to ensure noise from existing commercial activities have been suitably mitigated against when a new development is proposed.

The measured sound pressure levels from both sound survey locations will be compared to the noise criteria within BS8233(2014) Noise Criteria, WHO and ProPG.

4 Noise Survey Baseline Conditions and Results

A noise survey was carried out from the 4th to the 9th of August 2021 in order to assess the soundscape of the site. Unfortunately, due to adverse weather conditions, including high winds and heavy rain, measurements from the 8th and 9th had to be removed from the data set.

As previously discussed, 2 survey locations were chosen to measure the impact of both the road traffic noise from South Street and commercial sounds from the adjacent takeaway restaurants.

- **SP1:** Was located out of a 1st floor window facing onto South Street. The microphone position was approximately 4m from ground level and 0.5m from façade of the property.

- **SP2:** Located on the 2nd floor flat roof of the property. It was 0.3m from façade of the property and 1.2m from the flat roof. Additionally, the survey location was 2m from the Lancing Burger Bar extract flue.

At survey locations, the results would be considered as facade level measurements. Therefore, for ease and consistency in the reporting process 3dB(A) have been removed from the results to make the measurements freefield. All data therefore displayed in the current report will be freefield results.

Photos of the survey locations can be seen below in figures 7 & 8.



Figure 7: SP1



Figure 8: SP2

It should be noted that on Acoustic Associates Sussex's vits to site, while SP2 was designed to measure the impact of commercial sound sources, road traffic noise form South Street was still clearly audible on the east facing facade.

4.1 Baseline Conditions

- Survey carried out by:
- Martyn Chambers: BA (Hons) MSc PGDip: Acoustics AMIOA

- Equipment used:
  - 01dB Solo (SP1)
  - Castle Mirus (SP2)

The Meters were calibrated before and after commencing the noise measurements (@94dB no drift).

4.2 Noise Survey Results

The survey data has been used to calculate the 16hr daytime and the 8hr night-time period sound levels. As previous mentioned adverse weather affected the survey and the data from the 8th and 9th unfortunately needed to be removed. Data from Table 2 below shows the entire day and night-time period noise levels that were measured at the unmanned survey position (SP1).

Date (2021) August	Time Period	Freefield Level $L_{Aeq,16hr/8hr}$ – dB(A)	
		SP1	SP2
4th	07:00-23:00hrs	67.0	58.2
5th	07:00-23:00hrs	67.3	58.2
6th	07:00-23:00hrs	67.4	57.9
Arithmetic Average	**07:00-23:00hrs**	**67.2**	**58.1**
4th/5th	23:00-07:00hrs	61.2	51
5th/6th	23:00-07:00hrs	61.0	55.2
6th/7th	23:00-07:00hrs	59.6	51.4
Arithmetic Average	**23:00-07:00hrs**	**60.2**	**52.5**

Table 2: Survey noise levels

5 ProPG Stage 1 Assessment

The ProPG stage one risk assessment does not include a specific location or height which the indicative $L_{Aeq,16hr}$ and $L_{Aeq,8hr}$ should be assessed. The document does, however, state that a "typical worse case 24 hours" should be assessed. The highest measured sound levels at SP1 have therefore been used for the ProPG Stage 1 Assessment. Figure 8, below, shows that the levels at the site are in the medium risk category.

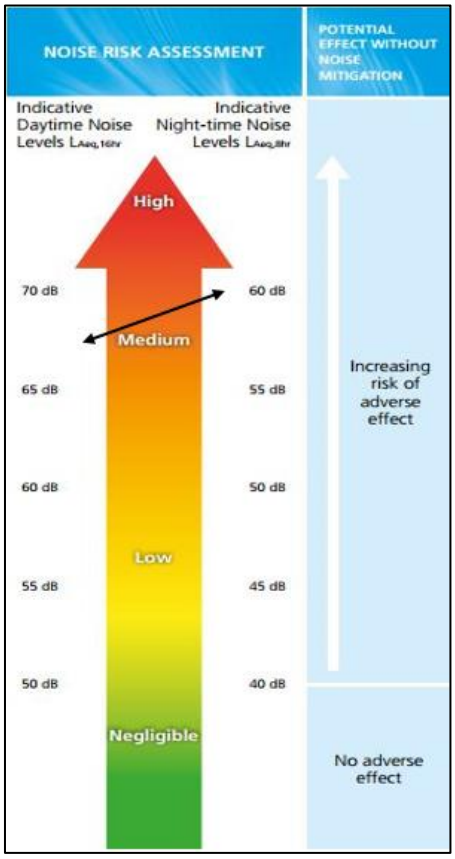

Figure 9: ProPG Stage 1 Assessment

6 Noise Mitigation Measures

As discussed in the methodology section detailed in 3.9, the data SP1 gathered will be used to calculate the required mitigation methods for rooms on the west facade. The results from SP2 will be used to calculate the required mitigation methods for rooms on the east façade. While the results from SP2 have been used to calculate the required mitigation methods for rooms on the east façade, it is possible that the rooms on the lower floors of the east facing facade will have lower external sound pressures than those measured at SP2. Using this data set, however, represented a worst-case scenario allowing for robust mitigation methods to be provided to protect the future residents. Additionally, to ensure a robust assessment, the highest measured day and night-time period measured during the survey will be used for the assessment. These were:

- **SP1:** 67.4dB(A) Day $L_{Aeq,16\ hour}$ and 61.2dB(A) Night $L_{Aeq,\ 8\ Hour}$
- **SP2:** 58.2dB(A) Day $L_{Aeq,16\ hour}$ and 55.2dB(A) Night $L_{Aeq,\ 8\ Hour}$

For ease of reporting, the rooms that BS8233:2014 provides the strictest criterion will be considered in the to be discussed calculation, as it stands to reason that if the mitigation methods suggested for these rooms meet the criterion, then the rooms with a less strict criterion would also meet the requirements of the standards and guidance.

The rooms considered will be:

- Ground floor west facing lounge
- Bedroom 1 (first floor west facing).
- Bedroom 2 (first floor east facing).

6.1 Noise Criteria

6.1.1 Continuous Noise Levels

The BS8233:2014 and WHO noise criteria will be used to specify the noise mitigation measures for all habitable rooms. The maximum internal noise level for each area is as follows:

- Bedrooms 35/30dB(A) Day/Night $L_{Aeq,\ 16\ hour/8\ Hour}$
- Lounges 35dB(A) Day $L_{Aeq,\ 16\ hour}$

6.1.2 Road Noise Maximum Noise Levels

For L_{Amax} events the ProPG noise L_{Amax} criterion will be used to specify the noise mitigation measures for bedrooms only:

For a reasonable standard in noise sensitive rooms at night (e.g. bedrooms) individual noise events should not normally exceed 45dB LAFmax more than 10 times a night.

The above is similar to guidance in the WHO Guidelines for Community Noise 1999 document. However, the ProPG criteria suggests limiting the number of LAmax events (over 45dB(A) to less than 10 times a night as opposed to less than 10-15 times a night as stipulated by the WHO.

6.2 Required Sound Reduction of Building Envelope – Continuous Noise levels

The Sound Reduction Index (SRI) has initially been calculated so that the continuous noise level criteria can be achieved (L_{Amax} discussed in next sub section).

Table 5 below shows the required SRI which will have to be achieved by the building envelope.

Location	External Free Field Day: $L_{Aeq,16Hr}$	Criterion $L_{Aeq,16Hr}$	ReqSRI	External Free Field Night $L_{Aeq,8Hr}$	Criterion $L_{Aeq,8Hr}$	ReqSRI
Lounge	67.3	35	32.3	61.2	N/A	
Bedroom 1	67.3	35	32.3	61.2	30	31.2
Bedroom 2	58.2	35	23.2	55.2	30	25.2

Table 3: Required SRI

6.3 Required Sound Reduction of Building Envelope – L_{Amax}

Table 5 in the above section shows the required SRI for continuous noise levels. However, for this level of sound reduction to be acceptable there is also a requirement to meet the ProPG 2017: This suggests limiting the number of L_{Amax} events (over 45dBA) within a bedroom to no more than 10 occurrences per night-time period (23:00-07:00hrs).

The suggested SRI for each bedroom shown in table 5 were used to calculate how many $L_{Amax,}$ above 45dBA there would be inside the bedroom over a night-time period (between 23:00 and 07:00).

As with the calculations shown in Table 5, the external sound pressure for Bedroom 1 was calculated using the data gathered at SP1 and the external sound pressure for Bedroom 1 was calculated using the data gathered at SP2. The results are shown below in Table 6.

RP	Trial SRI	Night 1	Night 2	Night 3	Average
Bedroom 1	31.2	35	36	21	30.7
Bedroom 2	25.3	9	24	7	13.4

Table 4: $L_{Amax,\ 5min}$ events with SRI ascertained from the continuous noise level

Unfortunately, neither of the bedrooms would have satisfied the L_{Amax} criterion if the SRI was based on a specification necessary to attenuate for continuous noise levels. Therefore, for both bedrooms the trial SRI was adjusted until it brought the number of L_{Amax} events over 45dBA to below 10 on all nights of the survey at each survey location.

The results of this calculation are provided in the table below.

RP	Required SRI	Night 1	Night 2	Night 3	Average
Bedroom 1	35	5	7	2	4.7
Bedroom 2	28	7	8	7	7.2

Table 5: $L_{Amax,\ 5min}$ with Suggested minimum RP SRI

The required SRIs shown in the above table 7 will therefore be the minimum sound reduction indices required in order for the two bedrooms of the development to meet the ProPG 2017: suggested limit of L_{Amax} events (over 45dBA).

6.4 Glazing and Trickle Vents

The BS8233 “Rigorous Calculation” has been used to predict the sound insulation provided by the building envelope (Calculation detailed in BS8233 (Annex G.2)) and full details of the calculations can be found in the appendix of the report. The calculations have been conducted on the rooms shown in table 5 to show how the required SRI could be met.

RP	ReqSRI	Frame + Glazing Performance	Ventilator Performance	Predicted Building Envelope SRI
Lounge	33	$R_{traffic}$* ≥ 34	$D_{n,e,w}$ ≥ 42	35
Bedroom 1	35	$R_{traffic}$* ≥ 34	$D_{n,e,w}$ ≥ 40	36
Bedroom 2	28	$R_{traffic}$* ≥ 29	$D_{n,e,w}$ ≥ 40	30

Table 6: Glazing/Ventilation Specification

** This is the required $R_{traffic}$ of the frame and glazing together. If the glazing supplier has test results for the glazing on its own an $R_{traffic}$ value 2-3dB higher would be required (glazing tested on its own will outperform glazing that is tested within a window frame). It should also be noted that $R_{traffic}$ on some manufactures data is displayed as R_w+$C_{tr.}$*

6.5 Ventilation

Due to the level of road traffic noise from the nearby South Street combined with the elements of commercial noise in the vicinity of the development, an alternative ventilation method to opening windows would be required is some rooms of the proposed development. As section 6.4 shows, if trickle vents or through wall ventilators were installed, they would be able to meet the required SRI even in the worst-case rooms.

It should be noted that if two trickle vents are needed in any one room to meet the required air changes needed, then this may increase the required $D_{n,e,w}$ value, however this would still easily be achievable with off the shelf acoustic trickle vents and through the wall vents.

Ventilation and glazing are inextricably linked, as whilst glazing may provide protection against sound levels incident on the façade, any ventilation strategy must not inadvertently compromise the protection and performance provided by the glazing.

Ventilation requirements are dictated by the Building Regulations and currently Approved Document F. It is therefore appropriate that a ventilation engineer or M+E consultant check the requirements and proposals of this particular report to ensure that the requirements of Approved Document F are met in respect of the rooms and in particular to ensure adequate background ventilation.

6.6 Outdoor Amenity Spaces.

The external amenity space proposed by the development is converting the flat roof at the second-floor level to a balcony.

The criterion laid out in section 3.2 of this report for external amenity spaces states that outdoor living spaces should not exceed 55 dB(A) $L_{Aeq,16hour}$. The data collected SP2 shows that sound pressure level on the proposed balcony would likely exceed this by on average 3.1dB(A).

It should be noted that in note 7 of figure 2 of ProPG:2017 (also shown in figure 5 of the current document) it states L_{Aeq} target levels may be relaxed by up to 5dB where a project is considered 'necessary or desirable'.

Additionally, in the 'External Amenity Area Noise Assessment" of ProPG:2017 it states that planning permission maybe granted if the residents have access to *"a relatively quiet, protected, publicly accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance)."* As previously mentioned adjacent to the site is the public garden "Headborough Gardens". Also, the Lancing beach is within a 5-minute walk of the property. Therefore, this criterion would be deemed to have been met.

Finally In section 2.46 of the document, it states that exceedances of the 50 – 55 dB $L_{Aeq,16hr}$ guidance should not prohibit a development.

7 Uncertainty

The main uncertainty within the current report was the weather during the noise survey. All care has been taken to remove the data affected by adverse weather. However, it is possible that an element of severe weather conditions may have artificially raised the data collected during the report. This however ensures the calculations made during the report are based on worst-case sound pressure levels. As the report has demonstrated, even under these conditions it is possible to meet the relevant criterion.

The results from SP2 have been used to calculate the required mitigation methods for rooms on the east façade. It is possible that the rooms on the lower floors of the east facing facade will have lower external sound pressures that those measured at SP2, using this data set however represented a worst-case scenario allowing for robust mitigation methods to be provided to protect the future residents.

8 Conclusion

Noise has been measured on the existing site. The ProPG Stage 1 Assessment of the location shows that sound pressure levels at the site are at the upper end of the medium risk level.

In order to demonstrate that the noise criteria can be achieved BS8233:2014 Rigorous calculations have been completed to show what mitigation measures will be required:

Lounge windows

- Frame/Glazing to achieve $R_{traffic} \geq 34dB$
- $D_{n,e,w} \geq 42dB$ vents (trickle vents of this value used in calculation)

Bedroom 1 windows

- Frame/Glazing to achieve $R_{traffic} \geq 34dB$
- $D_{n,e,w} \geq 40dB$ trickle vents (trickle vents of this value used in calculation)

Bedroom 2 windows

- Frame/Glazing to achieve $R_{traffic} \geq 29dB$
- $D_{n,e,w} \geq 40dB$ vents (trickle vents of this value used in calculation)

In tandem with these mitigation measures it would be recommended that all additional glazing not covered in the above bullet points glazing on the west and north facing facades should have a minimum $R_{traffic}$ of 34dB. On the east side this would need to be a minimum $R_{traffic}$ of 29dB

The sound pressure levels of the external amenity space provided by the proposed balcony would likely exceed the 50 – 55 dB $L_{Aeq,16hr}$ guideline. It is noted that ProPG:2017 states the L_{Aeq} target levels may be relaxed by up to 5dB where a project is considered ‘necessary or desirable’. Furthermore “Headborough Gardens” is adjacent to the site and Lancing beach is within a 5-minute walk of the property. These locations provide the future residents as alterative external amenity spaces for relaxation. allowing the site to meet the requirements of ProPG:2017

If these mitigation methods are implemented by the developer, it is considered that from the perspective of acoustics, there is no reason for the planning consent to be withheld.

9 Appendix

9.1 BS8233 Calculations

Non Frequency Dependent Variables		
Term	Derivation	Value
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	27.5
S_{wi}	Window Area (m^2)	5
S_{ew}	External Wall Area (m^2)	22.5
S_{rr}	Ceiling Area (m^2)	0
S	Total Area sound enters the room (m^2)	27.5

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octave)
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	69.3	65.3	63.3	63.3	60.3	53.3
$D_{n,e}$	Vent 2500EA + 2 Acoustic Set	41.7	39.6	37.2	45.3	52.6	54.9
R_{wi}	10_12_6.4	27	29	36	41	42	52
R_{ew}	Sound reduction index (octave band value) of the external wall	40	44	45	51	56	56
R_{rr}	Sound reduction index (octave band values) of the roof/ceiling	28	34	40	45	49	49
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
$L_{eq,ff}$	69.3	65.3	63.3	63.3	60.3	53.3
Ao/S . 10^(-Dn,e/10)	2.458E-05	3.99E-05	6.93E-05	1.07317E-05	1.99833E-06	1.1767E-06
Swi/S . 10^(-Rwi/10)	0.0003628	0.000229	4.57E-05	1.44423E-05	1.1472E-05	1.1472E-06
Sew/S . 10^(-Rew/10)	8.182E-05	3.26E-05	2.59E-05	6.49905E-06	2.05518E-06	2.05518E-06
Srr/S . 10^(-Rrr/10)	0	0	0	0	0	0
10log10(S/A)+3	6.9794001	5.932047	5.352127	5.352127112	5.632414348	5.632414348
Leq,2	42.992776	36.02261	30.13918	23.65902606	17.84285967	5.346242333
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**26.892776**	**27.42261**	**26.93918**	**23.65902606**	**19.04285967**	**6.346242333**
Prediced Building Envelope SRI	35					

Lounge

BS8233 Calculation can be seen below:

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

Figure 10: BS8233 Calculation Lounge

Non Frequency Dependent Variables		
Term	Derivation	Value
A_o	Given in BS EN 20140-10 = 10 (m^2)	10
S_f	Total Facade Area (m^2)	19
S_{wi}	Window Area (m^2)	2
S_{ew}	External Wall Area (m^2)	17
S_{rr}	Ceiling Area (m^2)	0
S	Total Area sound enters the room (m^2)	19

Key for Table Below	
R_{wi}	Sound Reduction of Window (Octave)
R_{ew}	Sound Reduction Index of External Wall (Octave)
R_{rr}	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
$D_{n,e}$	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
$L_{eq,ff}$	Free-Field External Noise Level	69.3	65.3	63.3	63.3	60.3	53.3
$D_{n,e}$	Vent 2500EA + 1 Acoustic Set	40.7	38.8	35.8	42.7	43.9	45.1
R_{wi}	10_12_6.4	27	29	36	41	42	52
R_{ew}	Sound reduction index (octave band value) of the external wall	40	44	45	51	56	56
R_{rr}	Sound reduction index (octave band values) of the roof/ceiling	28	34	40	45	49	49
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
$L_{eq,ff}$	69.3	65.3	63.3	63.3	60.3	53.3
Ao/S . 10^(-Dn,e/10)	4.48E-05	6.94E-05	0.000138	2.82648E-05	2.14411E-05	1.62647E-05
Swi/S . 10^(-Rwi/10)	0.00021	0.000133	2.64E-05	8.36135E-06	6.64166E-06	6.64166E-07
Sew/S . 10^(-Rew/10)	8.947E-05	3.56E-05	2.83E-05	7.10715E-06	2.24748E-06	2.24748E-06
Srr/S . 10^(-Rrr/10)	0	0	0	0	0	0
10log10(S/A)+3	5.3736092	4.326256	3.746336	3.746336183	4.026623419	4.026623419
Leq,2	40.042955	33.38327	29.90574	23.45446152	19.14537628	10.1542842
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**23.942955**	**24.78327**	**26.70574**	**23.45446152**	**20.34537628**	**11.1542842**
Prediced Building Envelope SRI	**36**					

Bedroom 1

BS8233 Calculation can be seen below:

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

Figure 11: BS8233 Calculation Bedroom 1

Non Frequency Dependent Variables		
Term	Derivation	Value
Ao	Given in BS EN 20140-10 = 10 (m^2)	10
Sf	Total Facade Area (m^2)	14
Swi	Window Area (m^2)	2
Sew	External Wall Area (m^2)	12
Srr	Ceiling Area (m^2)	12
S	Total Area sound enters the room (m^2)	26

Key for Table Below	
Rwi	Sound Reduction of Window (Octave)
Rew	Sound Reduction Index of External Wall (Octave)
Rrr	Sound Reduction Index of Roof/Ceiling (Octave)
A	Equivalent Absorbtion Area of Rx Room
Dn,e	Insulation of Trickle Vent (BS EN 20140-10)

Frequency Dependent Variables							
		Octave Band Centre Frequency					
Term	Description	125	250	500	1000	2000	4000
Leq,ff	Free-Field External Noise Level	60.2	56.2	54.2	54.2	51.2	44.2
Dn,e	Vent 2500EA + 1 Acoustic Set	40.7	38.8	35.8	42.7	43.9	45.1
Rwi	10_12_4	26	29	33	28	24	24
Rew	Sound reduction index (octave band value) of the external wall	40	44	45	51	56	56
Rrr	Sound reduction index (octave band values) of the roof/ceiling	28	34	40	45	49	49
A	Equivalent Absorbtion Area of Room (Copied from BS8233)	11.00	14.00	16.00	16.00	15.00	15.00

BS8233 Calculation Details						
	Octave Band Centre Frequency					
Term From Equation Below	125	250	500	1000	2000	4000
Leq,ff	60.2	56.2	54.2	54.2	51.2	44.2
Ao/S . 10^(-Dn,e/10)	3.274E-05	5.07E-05	0.000101	2.06551E-05	1.56685E-05	1.18858E-05
Swi/S . 10^(-Rwi/10)	0.0001932	9.68E-05	3.86E-05	0.000121915	0.000306236	0.000306236
Sew/S . 10^(-Rew/10)	4.615E-05	1.84E-05	1.46E-05	3.66613E-06	1.15933E-06	1.15933E-06
Srr/S . 10^(-Rrr/10)	0.0007315	0.000184	4.62E-05	1.45951E-05	5.81042E-06	5.81042E-06
10log10(S/A)+3	6.7358066	5.688453	5.108534	5.108533653	5.388820889	5.388820889
Leq,2	36.951418	27.32489	22.32894	21.37223635	21.75912309	14.70888096
A-Weighting	-16.1	-8.6	-3.2	0	1.2	1
A-Weighted Leq	**20.851418**	**18.72489**	**19.12894**	**21.37223635**	**22.95912309**	**15.70888096**
Prediced Building Envelope SRI	**30**			Bedroom 2		

BS8233 Calculation can be seen below:

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

Figure 12: BS8233 Calculation Bedroom 2