Noise impact assessment to a proposed residential development

Unit 53, First Floor, Swanley Shopping Centre, Swanley BR8 7TQ

Client: Sheet Anchor Evolve (London) Limited

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0. SUMMARY

0.1. ACA Acoustics Limited has been commissioned to assess the impact of existing external noise sources to a proposed residential development at Unit 53, Swanley Shopping Centre, Swanley. The assessment is required to support a planning application for the development.

0.2. A sound level survey was carried out between Thursday 9th February and Friday 10th February 2023. Whilst on site, ACA Acoustics' consultant considered the soundscape at the front and side facades comprised primarily of a relatively even mix of local/distant road traffic noise, along with a high level of pedestrian activity within the ASDA Walk area especially during the daytime. Mechanical plant serving the various nearby retail units were dominant at the rear of the site which will be where Flat A Living Room will be located.

0.3. Measured sound levels incident on the rear façade of the development are $L_{Aeq\ 16\text{-hour}}$ 58dB during the daytime and $L_{Aeq\ 8\text{-hour}}$ 56dB overnight. Short-term individual noise events overnight do not regularly exceed a level of LAfmax 71dB. Short-term attended measurements at the front indicate that the levels are around 3dB higher.

0.4. A Stage 1: Initial Site Noise Risk Assessment, in accordance with ProPG Planning & Noise, identifies the site as being in an area with a low noise risk during the daytime and a medium noise risk at night. However, an assessment of noise from the various items of mechanical equipment and delivery activity in the vicinity of the site indicates that without mitigation, noise from these commercial sources is at a level where there is a likelihood of significant adverse impact to future occupants. An acoustic specification of façade elements, including mechanical ventilation, is proposed to mitigate this impact and by extension all other noise sources.

0.5. A Stage 2 detailed acoustic design process has been followed, in accordance with ProPG. Details of the Acoustic Design Statement are included in this report.

0.6. Resultant internal sound levels during the daytime will not exceed LAeq 35dB. Sound levels at night shall not exceed LAeq 30dB and LAfmax 45dB. However for the Flat A Living Room, the outline scheme for sound insulation of the building envelope has been developed such that internal sound levels during the daytime do not exceed LAeq 30dB. This level is at least 5dB more stringent than the guideline criteria in BS 8233:2014. This ensures that noise intrusion from industrial and commercial sources will be low and will not be detrimental to the amenity of future occupants. Incorporating mechanical ventilation to the living room of Flat A will allow residents to achieve appropriate ventilation rates and to mitigate overheating without having to open windows.

0.7. In conclusion, ACA Acoustics recommend that the site is suitable for residential development, subject to implementation of noise control measures as set out in this report, and that planning consent may be granted for the proposed development.

1. INTRODUCTION

The client is preparing an application to Sevenoaks Borough Council for the change of use from Class E Offices to Class C3 Dwelling houses at Unit 53, First Floor, Swanley Shopping Centre, Swanley.

ACA Acoustics Limited has been commissioned to carry out an assessment of external sound levels to the development, and, where necessary, to make recommendations for a suitable sound mitigation scheme.

The objective of the assessment is to determine the impact that existing sources would have on the proposed residential dwellings in accordance with ProPG: Planning & Noise, national planning policies, and other relevant British Standards and guidance documents.

This report presents results of the sound level surveys, along with ProPG Stage 1 and Stage 2 assessments.

2. ACOUSTIC CRITERIA

2.1 National Planning Policy Framework (NPPF) and Noise Policy Statement for England (NPSE)

The National Planning Policy Framework (referred to as NPPF) sets out the Government's planning policies for England and provides guidance on how these are expected to be applied, providing a framework within which Local Authorities can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

Paragraph 174 of the NPPF states that,

"*Planning policies and decisions should contribute to and enhance the natural and local environment by … e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability*".

Paragraph 185 also talks specifically about noise and advises,

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

a) *Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and quality of life.*
b) *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*."

The Government's long-term policy aims relating to noise are contained in the Noise Policy Statement for England (referred to as NPSE). Stated aims of the NPSE are:

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

Avoid significant adverse impacts on health and quality of life,
Mitigate and minimise adverse impacts on health and quality of life, and
Where possible, contribute to the improvement of health and quality of life."

Paragraphs 2.19 to 2.24 clarify the above aims, referring to established concepts from toxicology; NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level). It also introduces a new concept relating to "significant adverse" of SOAEL (Significant Observed Adverse Effect Level), however noting,

"It is not possible to have a single objective noise-based measure that describes SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times".

The first aim of NPPF Paragraph 185 and the second underlying aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development, as set out in the NPPF. As neither the NPPF nor NPSE includes any numerical criteria, it is necessary to consider guidance provided in other documents to determine suitable limits that would define the LOAEL on an individual basis.

Finally, it is also of benefit to consider Paragraph 2.7, which advises that,

"… the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications".

This provides clear guidance that noise must not be considered in isolation but as part of the overall scheme taking into account the overall sustainability and associated impacts of the proposed development; there is no benefit in reducing noise to an excessively low level if this creates or increases some other adverse impact. Similarly, it may be appropriate in some cases for noise to

have an adverse impact if this is outweighed by the reduction or removal of some other adverse impact that is of greater significance to the development.

2.2 Planning Practice Guidance – Noise (PPG-N)

Related to the NPSE and the NPPF, The Department for Communities and Local Government has published additional guidance and clarifications within the Planning Practice Guidance – Noise (PPG-N), available at https://www.gov.uk/guidance/noise--2.

Paragraph 003 of the PPG advises that:

"Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

- *Whether or not a significant adverse effect is occurring or likely to occur;*
- *Whether or not an adverse effect is occurring or likely to occur; and*
- *Whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure … is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation."

This guidance is like that set out in the NPPF and NPSE, however, Paragraph 005 of the PPG-N provides outline guidance of the definition of "*significant adverse*" and "*adverse*" effects. A copy of the table appended to Paragraph 005 is repeated below.

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Figure 1: Noise exposure hierarchy, taken from Planning Practice Guidance – Noise

Although this table provides descriptions of definitions for the NOEL, LOAEL and SOAEL, as with the NPPF and NPSE there are no numerical values provided.

Paragraph 011 of the PPG-N also provides examples where the noise impact may be offset, including through the use of local amenity areas, noting:

"Noise impacts may be partially offset if residents have access to one or more of:

- *a relatively quiet facade (containing windows to habitable rooms) as part of their dwelling;*

- *a relatively quiet external amenity space for their sole use, (e.g., a garden or balcony). Although the existence of a garden or balcony is generally desirable, the intended benefits will be reduced if this area is exposed to noise levels that result in significant adverse effects;*
- *a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings, and/or;*
- *a relatively quiet, protected, external publicly accessible 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 minute walking distance).*"

Swanley Recreation Ground is a short walk from the site, which may offset any residual concerns about noise, as defined in the PPG-N.

2.3 ProPG: Planning & Noise

ProPG: Planning & Noise is a collaborative document prepared by the Institute of Acoustics, Association of Noise Consultants, and the Chartered Institute of Environmental Health.

The document brings together guidance and recommendations in assessing the noise impact on new residential developments from various documents including the NPPF, NPSE, PPG-N, BS 8233:2014 and the World Health Organisation guidance. The aim is to regularise the assessment process and to encourage good acoustic design for new noise-sensitive developments.

The assessment process is split into two sequential stages:

- Stage 1 – An initial noise risk assessment of the proposed development site; and
- Stage 2 – A systematic consideration of four key elements:
  - Element 1 – Demonstrating a "Good Acoustic Design Process";
  - Element 2 – Observing internal "Noise Level Guidelines";
  - Element 3 – Undertaking an "External Amenity Area Noise Assessment"; and
  - Element 4 – Consideration of "Other Relevant Issues".

The Stage 1 risk assessment requires sound levels to be measured at the site over daytime and night-time periods and, if necessary, any anticipated significant changes to the climate to be predicted to determine a "'*typical worst case' 24-hour day either now or in the foreseeable future*".

The assessment should include all relevant sources of transport noise that affect the site (road, railway, aircraft). It may also include industrial and commercial noise, where this is present but not dominant.

The measured/calculated daytime $L_{Aeq,\ 16\text{-hour}}$ and night-time $L_{Aeq,\ 8\text{-hour}}$ sound levels are then compared with Figure 1 of ProPG to complete the site's initial noise risk assessment. Copy of Figure 1 from ProPG is included in Figure 2 below.

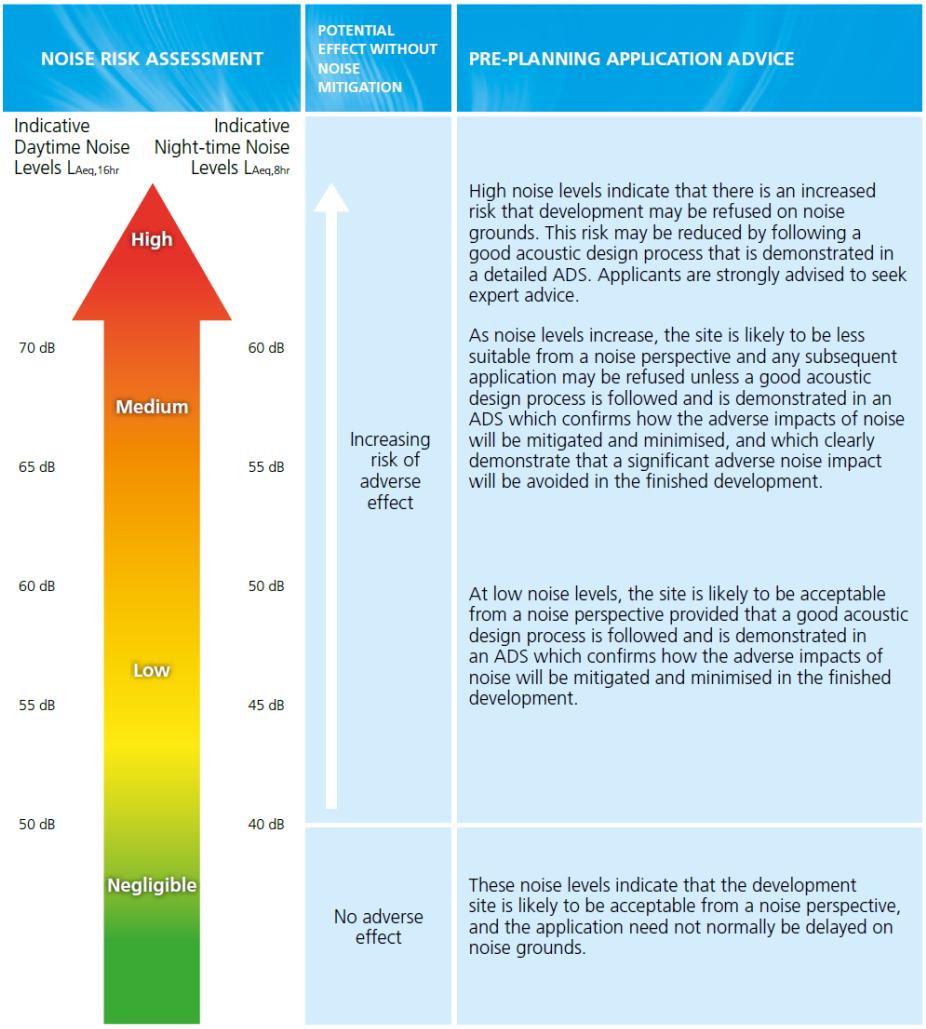


Figure 2: Noise Risk Assessment, taken from Figure 1 of ProPG Planning & Noise

The outcome of the Stage 1 initial risk assessment determines the next step and whether an Acoustic Design Statement is necessary. It is of benefit to note guidance in Paragraph 2.10 of ProPG:

> *"The indicative noise levels are intended to provide a sense of the noise challenge at a potential residential development site and should be interpreted flexibly having regard to the locality, the project and the wider context."*

A site being placed in the High-Risk category is not necessarily an indication that the development should be refused, but rather should be viewed considering the context of the development and highlights the importance of following a good acoustic design process from an early stage.

Element 2 of the Stage 2 assessment provides recommended internal sound levels to the residential dwellings. Criteria are taken from BS 8233:2014 with an additional criterion for individual short-term sound levels at night (LAfmax) and various clarifications and notes. These include an expansion on advice relating to the potential relaxation of the internal sound levels which is often overlooked when considering BS 8233:2014.

Paragraphs 2.33 to 2.36 discuss the impact of ventilation and opening windows. It is clearly stated that:

> "*Most residents value the ability to open windows at will, for a variety of reasons, and LPAs should therefore normally request that designers principally aim, through the use of good acoustic design, to achieve the internal noise level guidelines in noise-sensitive rooms with windows open*".

However, Paragraph 2.33 confirms that an open window typically reduces the sound insulation performance of the façade to 10 to 15dBA. This means that any site with a noise risk assessment above "*Negligible*" would fail to achieve the internal sound level criteria with windows open. Paragraph 2.34 acknowledges this, confirming that internal sound levels for sites in urban areas and adjacent to transportation noise sources may only be practically achieved with windows closed.

> "*In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole dwelling ventilation" in accordance with Building Regulations Approved Document F (e.g., trickle ventilators) in the open position. Furthermore, in this scenario the internal LAeq target noise levels should not generally be exceeded.*"

Copy of Figure 2 of ProPG is included in Figure 3 below.

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 $L_{Amax,F}$** (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 3: Internal sound level guidelines, taken from Figure 2 of ProPG: Planning & Noise

Sound levels in external amenity areas are considered in Element 3 of the Stage 2 assessment. This requires that, where practical, sound levels in amenity areas that are an intrinsic part of the overall design, should ideally not be above the range $LAeq_{,\ 16\text{-hour}}$ 50 to 55dB. It does however quote BS 8233:2014, that:

> "*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 amenity spaces but should not be prohibited.*"

As discussed in Section 2.2, the PPG-N acknowledges that any adverse impact may be partially offset through access to a relatively quiet façade, or alternative private or public amenity space in the vicinity.

2.4 The Building Regulations Approved Document O

The Building Regulations Approved Document O is applicable to all new residential development. Requirement O1 of Schedule 1 to The Building Regulations 2010 requires that the following is met.

Requirement

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

Figure 4: Requirement O1 of The Building Regulations 2010

The aim of Requirement O1 is to protect the health and welfare of the occupants of residential buildings, by reducing the occurrence of high indoor temperatures.

Where practical, this should be achieved through limiting solar gains through the design of the building and façade elements. Excess heat should then be removed through opening windows, ventilation louvres in external walls, a mechanical ventilation system, or a mechanical cooling system. Paragraph 2.11 of Approved Document O confirms that "*The building should be constructed to meet requirement O1 using passive means as far as reasonably practicable*".

However, requirement O1(2)(a) requires that any successful overheating mitigation strategy must also consider other potential adverse impacts, including sound levels inside bedrooms at night.

Paragraphs 3.2 and 3.3 consider the impact of noise on the overheating strategy. These have been included below.

"*3.2 In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).*

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

a. 40dB LAeq, T averaged over 8 hours (between 11pm and 7am).
b. 55dB LAfmax more than 10 times a night (between 11pm and 7am)."

Joint guidance issued by the Institute of Acoustics and Association of Noise Consultants advises that a window open to the degree required to mitigate overheating will achieve a sound reduction of around 9dBA. On this basis, where sound levels incident on a bedroom window do not exceed $L_{Aeq,\ 8\text{-hour}}$ 49dB and LAfmax 64dB more than 10 times per night, then the criteria in paragraph 3.3 of Approved Document O should be achieved and an overheating mitigation strategy allowing for open windows is appropriate. When external sound levels exceed these levels then it is likely windows will be closed by occupants overnight and an alternative strategy is required.

Note that this does not mean that windows should be sealed closed as most residents would desire the choice of whether to open windows or not. For example, a resident may choose to open windows to a bedroom to help mitigate overheating to the property whilst the bedroom is not in use during the daytime, then close the windows when sleeping in the bedroom overnight.

In accordance with The Building Regulations Approved Document F, it is recommended that where continuous mechanical ventilation is used, sound levels in bedrooms overnight should not exceed a level of LAeq 30dB when the system is operating at its minimum low rate. Although, evidence reference in The Association of Noise Consultants' *Acoustics Ventilation and Overheating: Residential Design Guide*, notes that "*a more prudent limit for mechanical services noise around 24-26dBA is likely to be required to prevent an adverse reaction from most occupants while falling asleep*".

2.5 British Standard 8233:2014

Approved Document O provides appropriate criteria to assess acoustic impacts whilst mitigating overheating such as when windows are open, but lower sound level criteria would be appropriate at other times. The introduction to BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* confirms that,

"This guide suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria."

Guidance limits for internal sound levels within living rooms and bedrooms, taken from Table 4 of BS 8233:2014, are shown in Table 1 below and would be appropriate to ensure a good standard of amenity to future occupants at times when windows are closed and whole dwelling ventilation rates of Approved Document F are being achieved.

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35dB LAeq, 16hr	-
Dining	Dining Room/Area	40dB LAeq, 16hr	-
Sleeping (daytime resting)	Bedroom	35dB LAeq, 16hr	30dB LAeq, 8hr

Table 1: BS 8233:2014 indoor ambient sound levels for dwellings

These values are identical to criteria in ProPG and are appropriate to protect the amenity of future residents.

2.6 British Standard 4142:2014+A1:2019

The scope of BS 4142:2014+A1:2019 advises that "*this British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature … to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*". BS 4142:2014+A1:2019 is commonly used to assess the potential for loss of amenity due to noise from mechanical services equipment and is considered appropriate for this application.

The assessment method of BS 4142:2014+A1:2019 corrects the specific sound level from the source under investigation to account for characteristics that could make the sound more obtrusive to obtain a rating level. This rating level is compared against the prevailing background noise outside the noise-sensitive property. Section 11 provides a commentary of the assessment result and advises that:

a) *Typically the greater this difference* [between the rating level and background sound level]*, the greater the magnitude of the impact;*
b) *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
c) *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context;*
d) *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

It is important to note that BS 4142 requires the context of the assessment to be considered which can materially alter the outcome of the initial numerical assessment.

2.7 Local Authority

The above guidance also forms the basis of policy EN7 of the Sevenoaks Allocations and Development Management Plan.

3. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

The development site is located at Unit 53, First Floor, Swanley Shopping Centre, Swanley.

The proposal entails converting the existing office space into 2 x 1-bedroom residential units. The soundscape at the north façade comprises of a relatively even mix of local & distant road traffic noise, along with a high level of pedestrian activity on Asda Walk, especially during the daytime. The south façade is dominated by mechanical plant noise (particularly the equipment serving the KFC unit). There are also quite frequent deliveries including at unsocial hours.

MP1 was selected to measure the sound level of the commercial noise sources such as the 'KFC/Kebab Shop' plant and associated delivery activity. Subjective monitoring was also undertaken at the front of the site. During the survey, the soundscape at this position was dominated by pedestrian activity, local road traffic and car park activity. Due to site access issues, it was not possible to setup a similar long-term monitoring position at the front of the site. However short-term attended measurements were conducted at the front façade during ACA Acoustics' visit to site.

The site is located within 1.5km of both the A20 and M25 arterial roads. The vehicle traffic noise from these roads also is a significant contributor at the monitoring positions, especially during the night-time periods.

Aerial photograph of the site is shown in Figure 3 below, with the development site and sound level measurement positions highlighted.

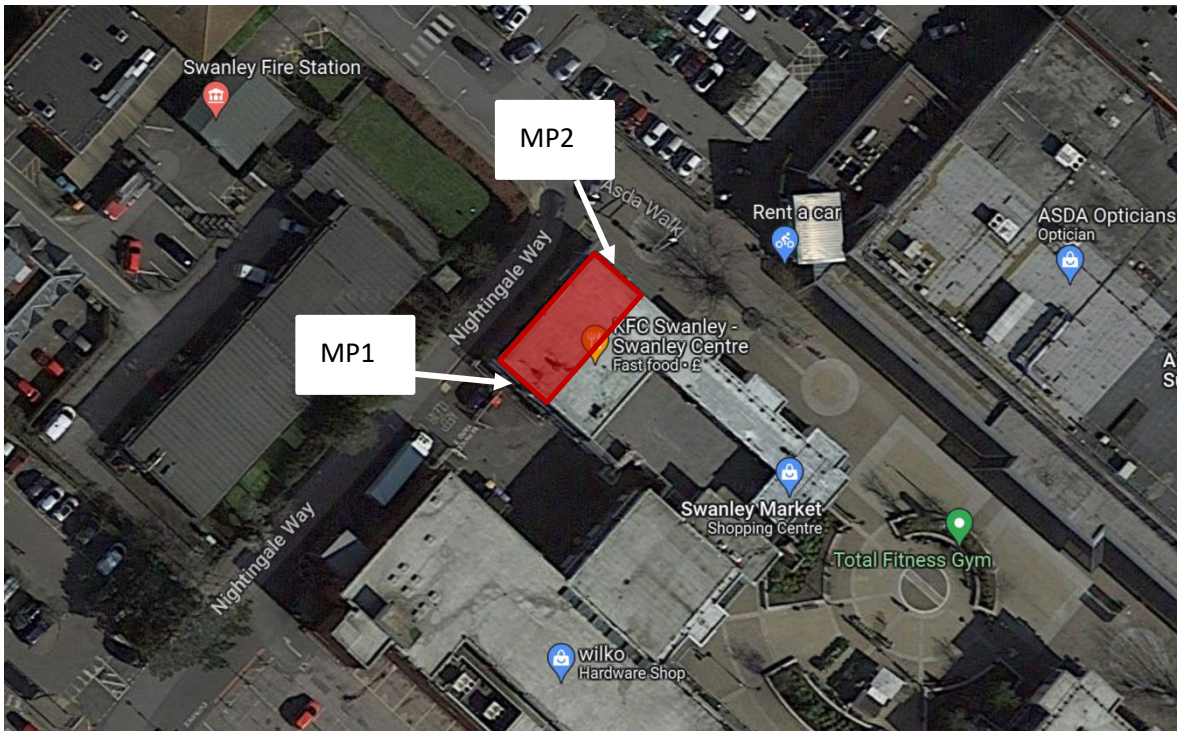


Figure 5: Aerial photograph of the development site (Available at www.google.com/maps)

Figure 6 below shows the internal layout of the apartment.

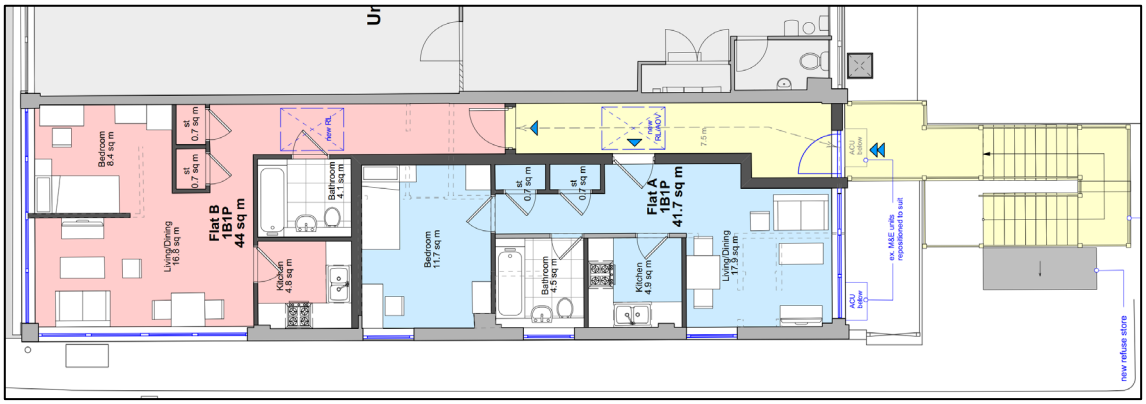


Figure 6: Internal layout of apartment

4. SOUND LEVEL SURVEY

To assess the impact of existing noise sources, a sound level survey has been conducted at the measurement positions indicated in Figure 5 above. Details of the survey carried out by ACA Acoustics are provided below.

The survey was undertaken over nominally a 1-day period between the 9th and 10th February 2023. The survey was set up by Sam Thorpe of ACA Acoustics Limited.

Sound levels were recorded in consecutive 15-minute samples of overall LAeq, LAfmax, and LA90 values along with other statistical indices and octave band spectra. During visits to site to set up and collect the monitoring equipment, ACA Acoustics' consultant spent time on site undertaking subjective observations of the acoustic climate and audible sources and undertaking short-term measurements to the front façade.

Weather conditions at the time of setting up the survey consisted of a temperature of 6°C, 100% cloud, a moderate south-westerly breeze, and dry ground conditions. Weather conditions have been reviewed at www.worldweatheronline.com, using the closest available commercial weather station. The extended nature of the survey ensures that a reasonable sample of results have been recorded with appropriate weather conditions.

The measurement positions are marked on the aerial photograph in Figure 5 and are described below.

Position Reference	Description
MP1	At a height of nominally 6m to the rear of unit 53 overlooking a delivery area with several items of mechanical plant equipment in close proximity. Façade Position.
MP2	At a height of nominally 1.6m to the front of unit 53. Freefield Position.

Table 2: Sound level survey measurement positions

The following equipment was used during the survey; the sound level meters were calibrated before the survey and checked after with no deviation noted.

Equipment	Serial Number
Rion Class 1 sound level meter type NL-52 complete with weatherproof and lockable outdoor environmental kit	00564867
Svantek calibrator type SV33B. Compliant to IEC 60942-1:2003	83826

Table 3: Equipment used for the sound level surveys – MP1 & MP2

Results of the measurement survey at MP1 are shown in graphical form below.

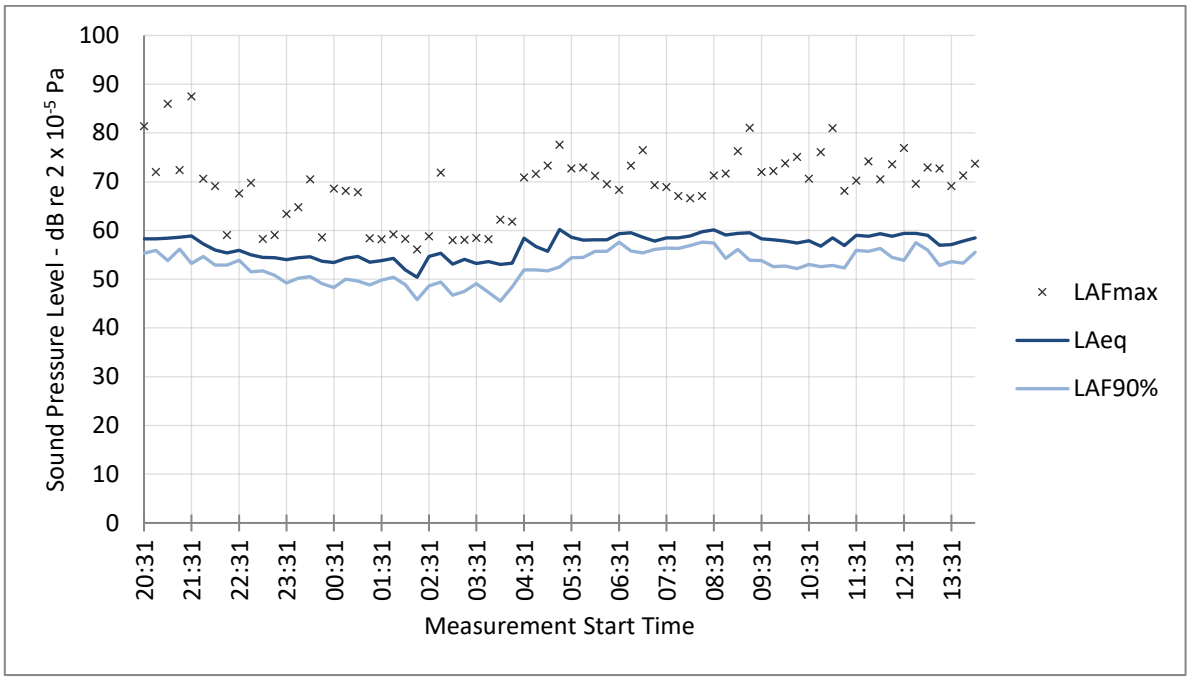


Figure 7: Sound level survey results 9th-10th February 2023 – MP1

Note that the results in graphical form are the measured raw data. A 3dB façade correction is applicable to determine the sound level incident on the façade.

Summary sound level survey results are shown in tabular form below, incorporating the façade correction.

Position	Daytime (07:00 – 23:00) LAeq	Minimum Daytime (07:00 – 23:00) LA90	Night-Time (23:00 – 07:00) LAeq	Minimum Night-Time (23:00 – 07:00) LA90	Night-Time Typical LAfmax[1] (23:00 - 07:00)
MP1	58dB	52dB	56dB	46dB	71dB
MP2	61dB	53dB	-	-	-

Table 4: Summary sound level survey results

[1]: The 10th highest measured LAfmax values over the period between 23:00 and 07:00 have been reported as being representative of a typical 'high' LAfmax value.

5. ProPG STAGE 1 INITIAL NOISE RISK ASSESSMENT

Results of the sound level survey have been plotted on the image in Figure 2 to determine the relevant noise risk category.

Results of the initial risk assessment are included in Figure 8 below.

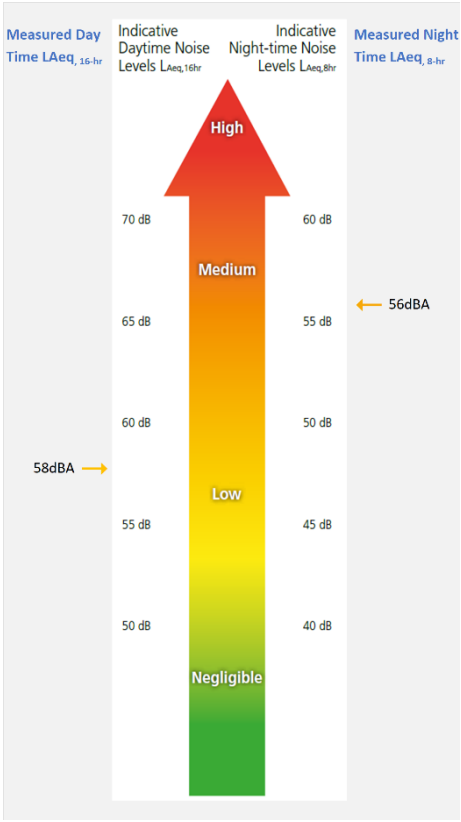


Figure 8: ProPG initial noise risk assessment (MP1)

It is appropriate to consider that this is the raw data and does not include any proposed mitigation. Paragraph 2.12 confirms that:

> *"It is important that the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker. The recommended approach is intended to give the developer, the noise practitioner, and the decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of the acoustic issues that would be faced."*

The initial site risk assessment indicates that site is in an area where there is a low noise risk during the daytime and a medium noise risk at night. At these noise levels the site is likely to be acceptable from a noise perspective, as long as an acoustic design is implemented.

6. ProPG STAGE 2 ACOUSTIC DESIGN STATEMENT

As discussed in Section 2.3, Stage 2 of ProPG is separated into four elements: an overview ensuring a good acoustic design process, assessment of internal sound levels, consideration of sound levels in external amenity areas, and finally an assessment of any other relevant issues.
The four elements are considered in more detail within this Section.

6.1 Element 1 – Good Acoustic Design Process

The pre-planning application advice contained in ProPG confirms:

> "*As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS* [Acoustic Design Statement] *which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrates that a significant adverse noise impact will be avoided in the finished development.*"

ProPG and the supplementary documents provide guidance on the typical matters that should be considered in an Acoustic Design Statement. These matters are discussed in Table 5.

Principle/Topic	**Discussion**
Identify significant existing and potential noise sources and measure or estimate sound levels	Mechanical plant, traffic, and pedestrian activity has been identified as the dominant noise source across the site. Results and discussion of the sound level survey and analysis of the results are included in Sections 4.
Consider the feasibility of reducing sound levels or relocating noise sources	It is not feasible to relocate the noise source as part of this relatively minor application.
Consider the potential to mitigate sound through planning of the site and orientation of the buildings	The limited size of the development and use of existing buildings restricts these types of options.
Mitigating the sound through use of barriers or screens	Due to the proposed height of the development, it would not be practical to install acoustic screens or barriers.
Select construction types and methods to achieve the internal sound level criteria	The façade is to an existing building. Discussion of internal sound levels is included in Section 7.2.
Consider the acoustic impact of the proposed ventilation strategy	This is discussed in more detail in Section 7.2.1.
Assess sound levels to external amenity areas	This is discussed in more detail in Section 7.3.

Principle/Topic	Discussion
Assess the viability of alternative solutions	Where appropriate, alternative solutions have been considered during the design phase and the most appropriate scheme has been put forward.
Examine the effects of noise control measures on ventilation, fire regulation, H&S, costs, CDM, or other unintended consequence	Under the Construction (Design and Management) Regulations 2015, ACA Acoustics are acting as a Designer. This Acoustic Design Statement and the supporting evidence has considered best practice to reduce or control foreseeable risks. It is recommended that other relevant parties, including the Principal Designer, consider all non-acoustic aspects of the design.

Table 5: Acoustic Design Statement details

6.2 Element 2 – Internal Noise Level Guidelines

A scheme for sound insulation is necessary to ensure sound levels inside rooms of the new residential dwelling are reasonable and comply with the requirements of ProPG and BS 8233:2014.

For dwellings where there is potential adverse impact due to noise from mechanical services equipment (refer Section 6.4) ACA Acoustics recommend that internal levels to living room of Flat A are at least 5dBA better than those shown in ProPG, to ensure occupants are not disturbed by this mechanical plant. Other habitable rooms of the flats are on facades facing away and screened from mechanical plant and therefore the noise limit criteria of ProPG and BS8233:2014 are appropriate.

A computer model has been set up using the measured/calculated sound levels incident on the façade of the development along with anticipated façade elements. The computer model is based on the calculation procedures outlined in BS EN ISO 12354-3:2000 and BS 8233:2014.

Confirmation of the acoustic performance of the building envelope elements used in the calculation model is provided in Table 6 below.

Description	Location	Rw (dB)	Rw + C'tr (dB)	Typical Construction
Façade walls	Entire Development	55	51	Existing masonry or concrete construction
Windows & Glazed Doors	Flat A Living room	37	31	Upgraded laminated double-glazing configuration such as 6-16-6.8 or similar.

Description	Location	Rw (dB)	Rw + C'tr (dB)	Typical Construction
	Rest of Development	34	30	Thermal double-glazing with asymmetrical panes such as 4-16-6 or similar.
Roof	Entire Development	52	47	Existing concrete flat roof

Table 6: Acoustic performance specification for facade elements

Note that the performance provided is estimated for the existing building construction. Variations on the specification would be acceptable so long as the installed construction achieved the specified sound insulation performance. The specification for glazed elements is for the window/door as a complete unit, including frames and seals.

Copy of acoustic calculations for daytime and night-time noise intrusion into the habitable rooms is provided in Appendix A. Summary results are confirmed in Table 7 below and demonstrate that intrusive sound levels within the living room of Flat A, overlooking the mechanical plant, are at least 5dBA better than the guidance limits in ProPG and BS 8233:2014. Sound levels in the bedroom of Flat A and in Flat B achieve the limits of ProPG and BS 8233:2014. Unless otherwise stated, the calculations are based on the average daytime and night-time levels given in Table 4. These levels are slightly higher than the specific plant sound levels used in Section 6.

Plot / Room	Description	Calculated Internal Sound Level	Criteria
Flat A Living Room	Daytime LAeq	30dB	≤ 30dB*
	Night-Time LAeq	-	-
	Night-Time LAfmax	-	-
Flat A Bedroom	Daytime LAeq	29dB	≤ 35dB
	Night-Time LAeq	27dB	≤ 30dB
	Night-Time LAfmax	42dB	≤ 45dB
Flat B Living Room	Daytime LAeq	34dB	≤ 35dB
	Night-Time LAeq	-	-
	Night-Time LAfmax	-	-
Flat B Bedroom	Daytime LAeq	32dB	≤ 35dB
	Night-Time LAeq	30dB	≤ 30dB
	Night-Time LAfmax	45dB	≤ 45dB

Table 7: Summary internal sound levels within sample habitable rooms

*: The criteria for the Flat A living room is 5dBA more stringent than the guideline levels shown in BS 8233:2014 and ProPG to account for the noise sources including mechanical services plant.

6.2.1 Ventilation strategy

Section 2.3 confirms that any site with a noise risk assessment above '*Negligible*' would fail to achieve internal sound level criteria with windows open and in this instance ProPG and the supplementary guidance requires that internal sound level criteria are achieved whilst providing the '*whole dwelling ventilation*' rate as set out in The Building Regulations Approved Document F through the use of above-window or through-wall trickle ventilators.

To ensure noise from external sources is not detrimental to the amenity of future occupants, it will be necessary to incorporate an acoustic ventilation scheme into the design such that residents can achieve adequate ventilation without necessarily needing to open windows.

Values in Table 8 below show a specification schedule of ventilator sound insulation performance used in the computer model. Note that there are many different passive ventilators including through-wall type and those built into the window frame. If the Dn,e,w performance is not lower than that shown in Table 8 then any alternative ventilator may be used.

As discussed in Section 6.4, to protect the amenity of residents in Flat A from external mechanical services equipment serving nearby premises, it is recommended that a mechanical ventilation system is utilised to the living room of Flat A.

Description	**Dn,e,w (dB)**	**Typical Ventilator Type**
Flat A Living Room	N/A	MVHR
Vents to habitable rooms across the rest of the development	35	Hit and miss trickle vent.

Table 8: Specification for ventilator Element Normalized Level Difference - Dn,e,w (dB)

In accordance with Approved Document O of The Building Regulations, where sound levels to inside bedrooms exceed $L_{Aeq,\,8\text{-hour}}$ 40dB or LAfmax 55dB more than 10 times per night, then it may not be appropriate to rely on open windows to mitigate overheating. In this instance dynamic thermal modelling may be necessary to determine an appropriate overheating mitigation strategy.

Based on calculated levels to the facades of the site of LAeq 56dB and LAfmax 71dB, and allowing a reduction through open windows of 9dBA as recommended within the IOA/ANC guidance, internal sound levels within bedrooms to the front façade overlooking the road will be nominally LAeq 47dB and LAfmax 62dB with windows open. These sound levels exceed the requirements of Approved Document O and it may be appropriate to consider the overheating mitigation strategy further.

Should it be considered necessary to include mechanical ventilation systems such as MVHR or MEV throughout the whole development, it is important that any self-noise (i.e., noise from the fans) and external noise intrusion through the ducted system must not cause internal sound levels to

exceed the design requirements. To achieve these limits, it is recommended that the overall noise from any mechanical ventilation system will need to be no higher than LAeq 26dB to allow for accumulation of noise sources. Suitable MVHR systems must also incorporate summer bypass mode to minimise the potential for overheating during summer months.

6.3 Element 3 – External Amenity Area Noise Assessment

There are no external amenity areas associated with this development.

6.4 Element 4 – Assessment of Other Relevant Issues

Although the initial site risk assessment indicates a medium risk level, the character of the noise sources necessitates further analysis and assessment.

Noise from mechanical services equipment serving the nearby various retail units are subjectively audible to the rear of the development and will affect the Flat A Living Room. As such it is necessary to consider the potential for adverse impact using methodology set out in BS 4142:2014+A1:2019.

An assessment of noise from the mechanical plant at MP1 is shown below.

Description	**Flat A, LR Receptor**	**Relevant Clause**	**Commentary**
Specific sound level of plant equipment	LAeq 56dB	7.3.2	Typical LAeq level, with identifiable periods of daytime plant operating.
Background sound level	LA90 50dB	8.1	Representative background sound level
Acoustic feature correction	+3dB	9.2	The equipment has a distinguishable characteristic. Therefore, in accordance with Section 9.2 a correction of +3dB is applied.
Rating level	LAr 59dB	9.2	
Excess of rating level over background sound level	**9dB**	**11**	**Assessment indicates likelihood of significant adverse impact**

Table 9: BS 4142:2014+A1:2019 assessment to MP1

The initial outcome of the BS 4142 assessment of operational noise emissions from the nearby commercial sources is that, without mitigation, there is a high likelihood of significant adverse impact, depending on the context.

The primary context of this assessment is the development of new residential properties to an area of existing commercial use. In the author's experience the likelihood of adverse impact is reduced in this context compared to the reverse situation of bringing a new noise-generating use to an existing residential dwelling; in situations where a new noise source is introduced, residents notice a change in the acoustic climate, potentially causing a reduction of amenity. However, in this instance residents moving into the new residential flats would not be conditioned to any pre-existing lower levels.

It is generally accepted that achieving a good acoustic design initially considers reducing sound levels at source, mitigating the transmission from source to receiver, and finally through use of façade sound insulation. However, it is not practical to reduce sound levels from the sources in this instance as they are operated by a third-party and any barrier would need to be impractically high and/or aesthetically detrimental to achieve any meaningful benefit.

Section 11 of BS 4142:2014 discusses potential aspects which may alter the initial assessment result and advises that:

> "*where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following … the sensitivity of the receptor and whether dwellings … will incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*
>
> *i) Façade insulation treatment;*
> *ii) Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation*", and;
> *iii) Acoustic screening.*

This confirms that designing the sound insulation performance of façade elements to achieve appropriate internal sound levels mitigates the adverse impact, particularly where the scheme includes mechanical ventilation such that residents can achieve both background and rapid ventilation rates without needing to open windows.

An appropriate scheme of façade sound insulation has been developed to ensure external noise intrusion to dwellings on the rear facade is low and levels are significantly below guideline criteria contained in the ProPG. This is discussed in Section 6.2.1.

7. CONCLUSION

An application is to be submitted to Sevenoaks Borough Council seeking consent for the conversion of existing offices to a new residential apartment at Unit 53, First Floor, Swanley Shopping Centre, Swanley.

ACA Acoustics have undertaken a sound level survey at the site. A ProPG Stage 1 initial noise risk assessment has indicated the site is in a medium risk area.
However, an assessment of noise from the various mechanical services equipment and commercial sources in the vicinity of the site has identified that, without appropriate mitigation, noise from the commercial sources would have a significant adverse impact on future residents. As such, an acoustic specification for façade insulation elements has been developed, including mechanical ventilation to the Flat A Living Room, to ensure internal sound levels within habitable rooms facing the plant will be at least 5dBA better than recommended criteria set out in ProPG and BS 8233:2014.

Through a good acoustic design process ACA Acoustics have developed an Acoustic Design Statement, included in this report.

It is the author's assessment that the Acoustic Design Statement has demonstrated that potential adverse or significant adverse impacts can be adequately mitigated to ensure noise is not detrimental to the amenity of future occupants.

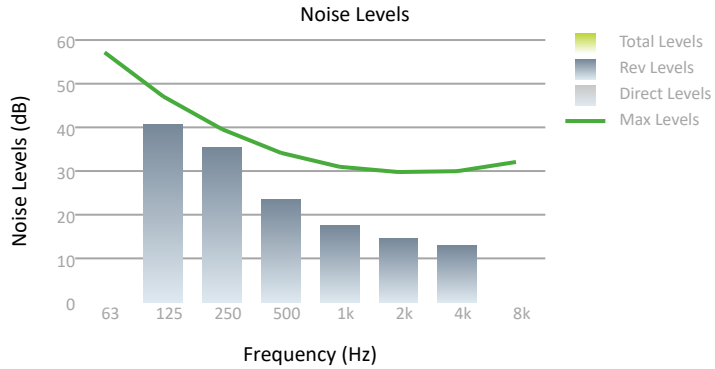
In accordance with guidance in ProPG it is recommended that planning consent may be granted for the proposed development.

Appendix A

External sound intrusion calculations

Unit 53, Swanley Shopping Centre

Reference	Flat A Living Room
Description	
Target Sound Level	35dB(A)
Max Sound Level	40dB(A)
Calculated Sound Level	29.9dB(A)
Calculated Tmf T60 (s)	0.5
Volume (m^3)	27.8



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Day)	1	-	40.7	35.3	23.4	17.4	14.7	12.9	-

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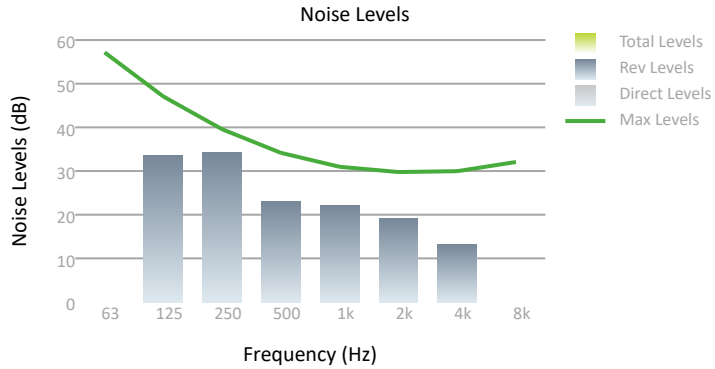
Unit 53, Swanley Shopping Centre

Reference	Flat A Bedroom Day
Description	
Target Sound Level	35dB(A)
Max Sound Level	40dB(A)
Calculated Sound Level	29.1dB(A)
Calculated Tmf T60 (s)	0.45
Volume (m^3)	28.9



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Day)	1	-	33.6	34.2	23.1	22.2	19.2	13.2	-

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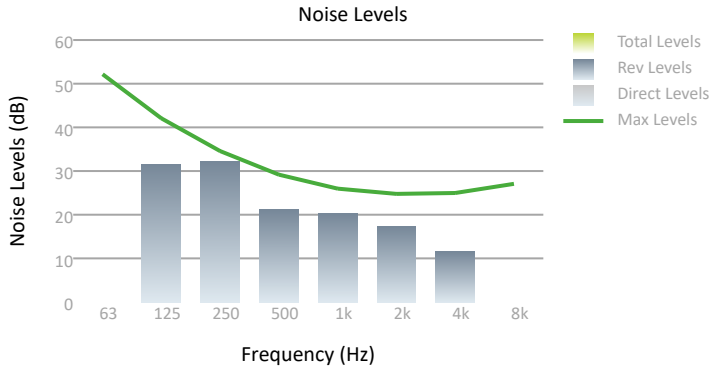
Unit 53, Swanley Shopping Centre

Reference	Flat A Bedroom Night
Description	
Target Sound Level	30dB(A)
Max Sound Level	35dB(A)
Calculated Sound Level	27.2dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	-



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Night)	1	-	31.6	32.2	21.1	20.2	17.3	11.6	-

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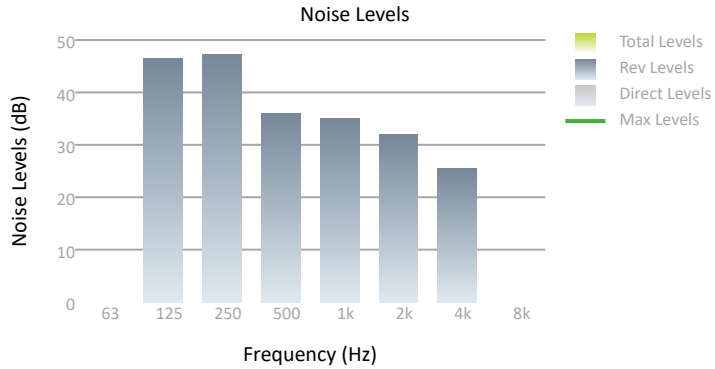
Unit 53, Swanley Shopping Centre

Reference	Flat A - Bedroom Max
Description	
Target Sound Level	45dB(A)
Max Sound Level	-
Calculated Sound Level	42dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	-



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Lmax, ff (Night)	1	-	46.6	47.2	36.0	35.1	32.0	25.5	-

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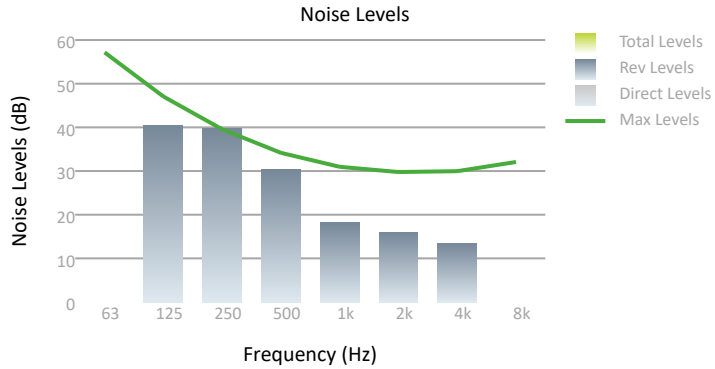
Unit 53, Swanley Shopping Centre

Reference	Flat B Living Room
Description	
Target Sound Level	35dB(A)
Max Sound Level	40dB(A)
Calculated Sound Level	33.5dB(A)
Calculated Tmf T60 (s)	0.5
Volume (m^3)	36.7



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Day)	1	-	40.4	39.8	30.4	18.2	16.0	13.4	-

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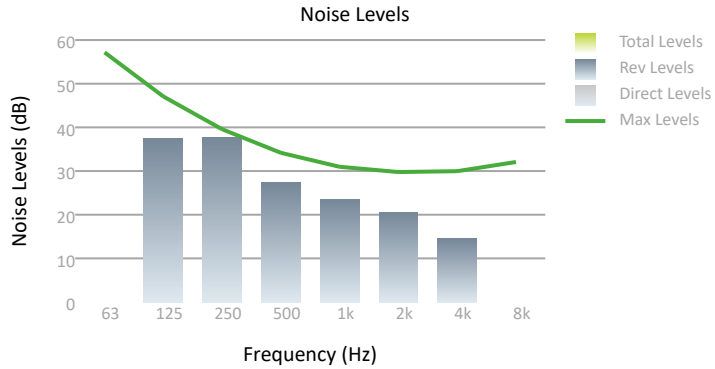
Unit 53, Swanley Shopping Centre

Reference	Flat B Bedroom Day
Description	
Target Sound Level	35dB(A)
Max Sound Level	40dB(A)
Calculated Sound Level	32.1dB(A)
Calculated Tmf T60 (s)	0.45
Volume (m^3)	22.3



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Day)	1	-	37.4	37.7	27.3	23.5	20.5	14.4	-

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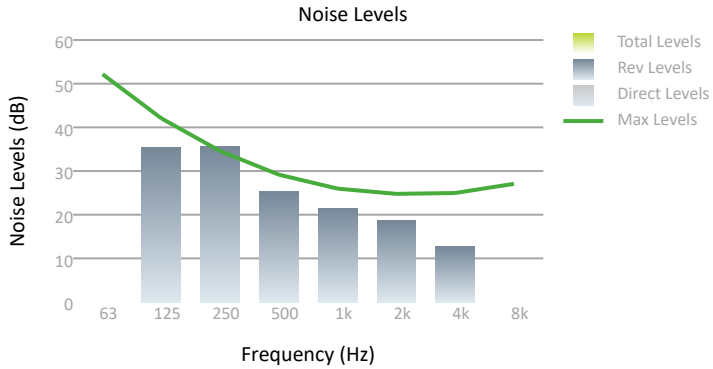
Unit 53, Swanley Shopping Centre

Reference	Flat B Bedroom Night
Description	
Target Sound Level	30dB(A)
Max Sound Level	35dB(A)
Calculated Sound Level	30.1dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	-



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Night)	1	-	35.4	35.7	25.3	21.5	18.6	12.8	-

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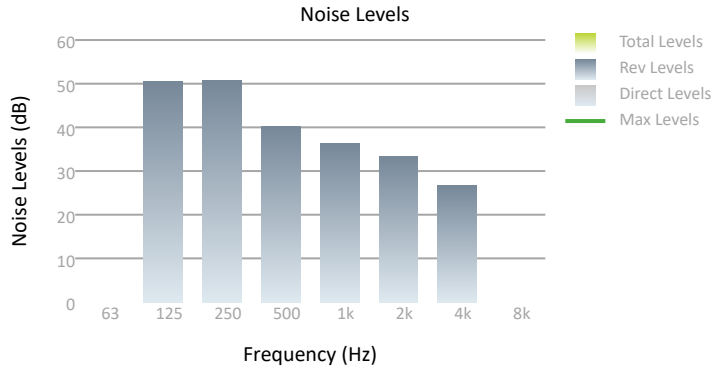
Unit 53, Swanley Shopping Centre

Reference	Flat B - Bedroom Max
Description	
Target Sound Level	45dB(A)
Max Sound Level	-
Calculated Sound Level	45dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	-



Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Lmax, ff (Night)	1	-	50.4	50.7	40.3	36.4	33.3	26.8	-

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Calculation Sheet

Flat A Living Room

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**58.0**									
Octave Band Frequencies										
Leq,ff		**62.0**	**60.0**	**56.0**	**54.0**	**54.0**	**50.0**	**45.0**	**39.0**	**Row A**
Facade Wall Element										
		-	*-48.5*	*-52.5*	*-56.5*	*-63.5*	*-66.5*	*-71.5*	-	
Facade Glazed Element										
		-	*-30.3*	*-31.3*	*-41.3*	*-49.3*	*-50.3*	*-59.3*	-	
Facade Roof Element										
		-38.3	*-41.3*	*-42.3*	*-51.3*	*-55.3*	*-59.3*	*-62.3*	-	
Cumulative Lp										
Result		**-**	**30.1**	**25.1**	**13.7**	**7.7**	**4.9**	**3.1**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*10.6*	*10.2*	*9.8*	*9.8*	*9.8*	*9.8*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat A Living Room **Reverberant Field, LPrev:**		**-**	**40.7**	**35.3**	**23.4**	**17.4**	**14.7**	**12.9**	**-**	

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Calculation Sheet

Flat A Bedroom Day

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Daytime Leq)										
Source dBA	**58.0**									
Octave Band Frequencies										
Leq,ff		**62.0**	**60.0**	**56.0**	**54.0**	**54.0**	**50.0**	**45.0**	**39.0**	**Row A**
Facade Wall Element										
		-	*-47.1*	*-51.1*	*-55.1*	*-62.1*	*-65.1*	*-70.1*	-	
Facade Glazed Element										
		-	*-37.1*	*-33.1*	*-40.1*	*-54.1*	*-53.1*	*-55.1*	-	
Facade Roof Element										
		-38.1	*-41.1*	*-42.1*	*-51.1*	*-55.1*	*-59.1*	*-62.1*	-	
Ventilators										
		-35.9	*-36.9*	*-29.9*	*-39.9*	*-37.9*	*-36.9*	*-37.9*	*-38.9*	
Cumulative Lp										
Result		**-**	**26.9**	**28.0**	**17.3**	**16.4**	**13.4**	**8.0**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*6.6*	*6.2*	*5.8*	*5.8*	*5.8*	*5.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat A Bedroom Day **Reverberant Field, LPrev:**		**-**	**33.6**	**34.2**	**23.1**	**22.2**	**19.2**	**13.2**	**-**	

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Calculation Sheet

Flat A Bedroom Night

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Nighttime Leq)										
Source dBA	**56.0**									
Octave Band Frequencies										
Leq,ff		**60.0**	**58.0**	**54.0**	**52.0**	**52.0**	**48.0**	**43.0**	**37.0**	**Row A**
Facade Wall Element										
		-	*-47.1*	*-51.1*	*-55.1*	*-62.1*	*-65.1*	*-70.1*	-	
Facade Glazed Element										
		-	*-37.1*	*-33.1*	*-40.1*	*-54.1*	*-53.1*	*-55.1*	-	
Facade Roof Element										
		-38.1	*-41.1*	*-42.1*	*-51.1*	*-55.1*	*-59.1*	*-62.1*	-	
Ventilators										
		-35.9	*-36.9*	*-29.9*	*-39.9*	*-37.9*	*-36.9*	*-37.9*	*-38.9*	
Cumulative Lp										
Result		**-**	**25.0**	**26.0**	**15.4**	**14.5**	**11.5**	**6.3**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*6.6*	*6.2*	*5.8*	*5.8*	*5.8*	*5.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat A Bedroom Night **Reverberant Field, LPrev:**		**-**	**31.6**	**32.2**	**21.1**	**20.2**	**17.3**	**11.6**	**-**	

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Calculation Sheet

Flat A - Bedroom Max

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Nighttime Lmax)										
Source dBA	**71.0**									
Octave Band Frequencies										
Leq,ff		**75.0**	**73.0**	**69.0**	**67.0**	**67.0**	**63.0**	**58.0**	**52.0**	**Row A**
Facade Wall Element										
		-	*-47.1*	*-51.1*	*-55.1*	*-62.1*	*-65.1*	*-70.1*	-	
Facade Glazed Element										
		-	*-37.1*	*-33.1*	*-40.1*	*-54.1*	*-53.1*	*-55.1*	-	
Facade Roof Element										
		-38.1	*-41.1*	*-42.1*	*-51.1*	*-55.1*	*-59.1*	*-62.1*	-	
Ventilators										
		-35.9	*-36.9*	*-29.9*	*-39.9*	*-37.9*	*-36.9*	*-37.9*	*-38.9*	
Cumulative Lp										
Result		**-**	**39.9**	**41.0**	**30.2**	**29.3**	**26.2**	**20.2**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*6.6*	*6.2*	*5.8*	*5.8*	*5.8*	*5.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat A - Bedroom Max										
Reverberant Field, LPrev:		**-**	**46.6**	**47.2**	**36.0**	**35.1**	**32.0**	**25.5**	**-**	

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Calculation Sheet

Flat B Living Room

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**58.0**									
Octave Band Frequencies										
Leq,ff		**62.0**	**60.0**	**56.0**	**54.0**	**54.0**	**50.0**	**45.0**	**39.0**	**Row A**
Facade Wall Element										
		-	*-50.5*	*-54.5*	*-58.5*	*-65.5*	*-68.5*	*-73.5*	-	
Facade Glazed Element										
		-	*-30.2*	*-26.2*	*-33.2*	*-47.2*	*-46.2*	*-48.2*	-	
Facade Roof Element										
		-39.2	*-42.2*	*-43.2*	*-52.2*	*-56.2*	*-60.2*	*-63.2*	-	
Cumulative Lp										
Result		**-**	**30.1**	**29.9**	**20.9**	**8.7**	**6.5**	**4.0**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*10.3*	*9.9*	*9.5*	*9.5*	*9.5*	*9.5*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat B Living Room **Reverberant Field, LPrev:**		**-**	**40.4**	**39.8**	**30.4**	**18.2**	**16.0**	**13.4**	**-**	

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Calculation Sheet

Flat B Bedroom Day

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Daytime Leq)										
Source dBA	**58.0**									
Octave Band Frequencies										
Leq,ff		**62.0**	**60.0**	**56.0**	**54.0**	**54.0**	**50.0**	**45.0**	**39.0**	**Row A**
Facade Wall Element										
		-	*-52.8*	*-56.8*	*-60.8*	*-67.8*	*-70.8*	*-75.8*	-	
Facade Glazed Element										
		-	*-31.7*	*-27.7*	*-34.7*	*-48.7*	*-47.7*	*-49.7*	-	
Facade Roof Element										
		-37.9	*-40.9*	*-41.9*	*-50.9*	*-54.9*	*-58.9*	*-61.9*	-	
Ventilators										
		-35.7	*-36.7*	*-29.7*	*-39.7*	*-37.7*	*-36.7*	*-37.7*	*-38.7*	
Cumulative Lp										
Result		**-**	**29.9**	**30.5**	**20.6**	**16.8**	**13.9**	**8.3**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*7.5*	*7.1*	*6.7*	*6.7*	*6.7*	*6.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat B Bedroom Day **Reverberant Field, LPrev:**		**-**	**37.4**	**37.7**	**27.3**	**23.5**	**20.5**	**14.4**	**-**	

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Calculation Sheet

Flat B Bedroom Night

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Nighttime Leq)										
Source dBA	**56.0**									
Octave Band Frequencies										
Leq,ff		**60.0**	**58.0**	**54.0**	**52.0**	**52.0**	**48.0**	**43.0**	**37.0**	**Row A**
Facade Wall Element										
		-	*-52.8*	*-56.8*	*-60.8*	*-67.8*	*-70.8*	*-75.8*	-	
Facade Glazed Element										
		-	*-31.7*	*-27.7*	*-34.7*	*-48.7*	*-47.7*	*-49.7*	-	
Facade Roof Element										
		-37.9	*-40.9*	*-41.9*	*-50.9*	*-54.9*	*-58.9*	*-61.9*	-	
Ventilators										
		-35.7	*-36.7*	*-29.7*	*-39.7*	*-37.7*	*-36.7*	*-37.7*	*-38.7*	
Cumulative Lp										
Result		**-**	**27.9**	**28.5**	**18.6**	**14.9**	**12.0**	**6.7**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*7.5*	*7.1*	*6.7*	*6.7*	*6.7*	*6.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat B Bedroom Night **Reverberant Field, LPrev:**		**-**	**35.4**	**35.7**	**25.3**	**21.5**	**18.6**	**12.8**	**-**	

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Calculation Sheet

Flat B - Bedroom Max

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Nighttime Lmax)										
Source dBA	**71.0**									
Octave Band Frequencies										
Leq,ff		**75.0**	**73.0**	**69.0**	**67.0**	**67.0**	**63.0**	**58.0**	**52.0**	**Row A**
Facade Wall Element										
		-	*-52.8*	*-56.8*	*-60.8*	*-67.8*	*-70.8*	*-75.8*	-	
Facade Glazed Element										
		-	*-31.7*	*-27.7*	*-34.7*	*-48.7*	*-47.7*	*-49.7*	-	
Facade Roof Element										
		-37.9	*-40.9*	*-41.9*	*-50.9*	*-54.9*	*-58.9*	*-61.9*	-	
Ventilators										
		-35.7	*-36.7*	*-29.7*	*-39.7*	*-37.7*	*-36.7*	*-37.7*	*-38.7*	
Cumulative Lp										
Result		**-**	**42.9**	**43.5**	**33.6**	**29.7**	**26.7**	**20.6**	**-**	
ISO 12354-3 Lfs Correction										
		-	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		-	*7.5*	*7.1*	*6.7*	*6.7*	*6.7*	*6.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Flat B - Bedroom Max										
Reverberant Field, LPrev:		**-**	**50.4**	**50.7**	**40.3**	**36.4**	**33.3**	**26.8**	**-**	

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