



157 Milton Road, Gravesend

Noise Assessment for Planning

31st January 2024

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1. INTRODUCTION

1.1. Overview

inacoustic has been commissioned to assess the impact of noise at 157 Milton Road, Gravesend DA12 2RG in respect of the site's suitability for residential development.

The assessment is based upon environmental noise measurements undertaken at the site and a predictive exercise.

Consideration has also been taken to assess the effects of noise arising from adjoining commercial uses on the proposed residential properties through any party separating floors.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.2. Scope and Objectives

The scope of the noise assessment can be summarised as follows:

- A sound monitoring survey was undertaken at discrete locations around the Site;
- A detailed assessment of the suitability of the Site, in accordance with relevant standards in respect of sound from the existing sources
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the National Planning Practice Guidance in England: Noise¹ and BS8233:2014²; and
- An assessment of the sound insulation performance of the separating floor between the existing ground floor and proposed residential dwellings.

¹ Department for Communities and Local Government (DCLG), 2014. National Planning Practice Guidance for England: Noise. DCLG.

² British Standard Institution. BS 8233:2014 Guidance on sound insulation and noise reduction for buildings.

2. LEGISLATION AND POLICY FRAMEWORK

The development proposals for the Site are guided by the following policy directives and guidance:

2.1. National Policy

2.1.1. National Planning Policy Framework, 2023

The *National Planning Policy Framework* (NPPF)³ sets out the Government's planning policies for England. Planning policy requires that applications for planning permission must be determined in accordance with the development plan, unless material considerations indicate otherwise.

The NPPF is also a material consideration in planning decisions. It sets out the Government's requirements for the planning system and how these are expected to be addressed.

Under Section 15; *Conserving and Enhancing the Natural Environment*, in Paragraph 174, the following is stated:

"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 of the document goes on to state:

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

- a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- 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"*

Paragraph 185 refers to the Noise Policy Statement for England, which is considered overleaf.

³ Department for Levelling Up, Housing & Communities (DLUHC), September 2023. National Planning Policy Framework. HMSO. London.

2.1.2. Noise Policy Statement for England, 2010

The underlying principles and aims of existing noise policy documents, legislation and guidance are clarified in *DEFRA: 2010: Noise Policy Statement for England* (NPSE)⁴. The NPSE sets out the “*Long Term Vision*” of Government noise policy as follows:

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

The NPSE outlines three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- *“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”.*

The guidance states that it is not possible to have a single objective noise-based measure that defines “*Significant Observed Adverse Effect Level (SOAEL)*” that is applicable to all sources of noise in all situations and that not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

2.1.3. National Planning Practice Guidance in England: Noise, 2019

Further guidance in relation to the NPPF and the NPSE has been published in the *National Planning Practice Guidance in England: Noise* (NPPG Noise)⁵, which summarises the noise exposure hierarchy, based on the likely average response. The following three observed effect levels are identified below:

- **Significant Observed Adverse Effect Level:** This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- **Lowest Observed Adverse Effect Level:** This is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- **No Observed Adverse Effect Level:** This is the level of noise exposure below which no effect at all on health or quality of life can be detected.

⁴ Department for Environment, Food and Rural Affairs (DEFRA), 2010. Noise Policy Statement for England. DEFRA.

⁵ Department for Communities and Local Government (DCLG), 2019. National Planning Practice Guidance for England: Noise. DCLG.

Criteria related to each of these levels are reproduced in Table 1.

TABLE 1: SIGNIFICANCE CRITERIA FROM NPPG IN ENGLAND: NOISE

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not Noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and Not Intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and Disruptive	The noise causes a material change in behaviour and/or attitude, 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
Noticeable and Very Disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.2. British Standards

2.2.1. BS8233:2014

BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* draws on the results of research and experience to provide information on achieving internal acoustic environments appropriate to their functions. The guideline values provided are in terms of an average (L_{Aeq}) level.

The standard advises that, for steady external noise sources, it is desirable for internal ambient noise levels to not exceed the guidance values, as detailed below in Table 2.

TABLE 2: BS8233:2014 AMBIENT NOISE LEVELS

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room	40 dB $L_{Aeq,16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS8233:2014 goes on to suggest that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions will still be achieved.

With regard to maximum noise levels, the standard identifies that regular individual noise events (such as passing trains or scheduled aircraft etc) can cause sleep disturbance. The standard does not provide a guideline design target, but simply goes on to suggest that a guideline value may be set in terms of SEL or $L_{Amax,F}$, depending upon the character and number of events per night. It goes on to suggest that more sporadic noise events could require separate values.

In respect of external noise levels, the guidance in BS8233:2014 suggests that *“it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments”*.

BS8233:2014 provides a much more detailed narrative on noise levels in external amenity areas and acknowledges that it may not always be necessary or feasible to ensure that noise levels remain within these guideline values.

In respect of gardens and patios, BS8233:2014 states;

“...it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable.”

BS8233: 2014 goes on to state, for areas adjoining the strategic transport network:

“...a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited”.

In respect of balconies, roof gardens and terraces, BS8233:2014 states; *“Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal*

external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses; however, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space”.

It is clear from the narrative of BS8233:2014, that proposed development within noisy environments should be designed to ensure that the recommended internal design standards are achieved, and that noise levels in external amenity areas are designed to effectively control and reduce noise levels, although it acknowledges that in certain circumstance meeting the external design recommendations may not be feasible, or necessary, especially where the provision of such spaces is desirable for other technical, planning or policy reasons.

2.2.2. BS4142+A1:2019

BS4142+A1:2019 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142+A1:2019 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ ‘specific sound level’, immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ ‘rating sound level’. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

BS4142+A1:2019 states: *“The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs”*. An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- *“Typically, the greater this difference, the greater the magnitude of the impact.”*
- *“A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.”*
- *“A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.”*
- *“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.”*

During the daytime, the assessment is carried out over a reference time period of 1-hour and 15 minutes during the night. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

2.2.3. Local Authority Requirements

A prior approval application has been refused on the 5th December 2023. Noise is referenced within the decision notice and expanded upon within the delegated officer report;

"In order to address the concerns regarding both external and internal noise, a noise assessment needs to be undertaken by a suitably qualified person and submitted with any planning application. The assessment must address the impact of the following on the residential amenity of any future residents of the proposed flats and be undertaken in accordance with the relevant standards and guidance such as BS 8233:2014 and BS4142:2014:

- *Traffic noise*
- *Noise from fixed building services/mechanical plant/equipment etc noise associated with the nearby commercial uses (including the use on the ground floor)*
- *People noise associated with the use of the late-night town centre uses at night (including the use on the ground floor).*
- *Early morning delivery noise to commercial uses*
- *Internal noise/sound insulation*
- *Noise from any mechanical ventilation systems if required as a mitigation measure for air quality (see below)*

The quality and the standard of the sound insulation properties of the building should be assessed to ensure that future residents are not impacted by internal noise eg noise from the commercial premises on the ground floor and noise from flat to flat. To address this, the noise assessment should include details of the assessment methodology and any enhanced sound insulation performance of the construction that separates the residential and ground floor commercial use and internal partitions between flats. This should resist the transmission of airborne sound such that the weighted standardised difference ($D_{nT,W} + C_{tr}$) is not less than 53 decibels (i.e. an enhancement of the minimum levels stated in the Building Regulations of 10dB).

The assessment should look at any required mitigation measures to ensure that internal noise levels are appropriate. Overheating and ventilation must also be considered in the design of any mitigation."

Taking this into consideration, an assessment of the effects of noise on the proposed residential units has been carried out. The report considers the impact of noise from external sources, as well as internal noise associated with commercial activity on the ground floor.

3. SITE DESCRIPTION

3.1. Site and Surrounding Area

The Proposed Development is situated to the south of Milton Road (A226). On the ground floor of the existing building is Cake Box, handmade cake makers, and Kemoy's the barber's shop. To the rear is a car park, and adjacent is St John The Evangelist RC Church.

The Proposed Development area can be seen in Figure 1, below.

The ambient sound environment across the site was heavily influenced by moderate to high levels of road traffic noise arising from vehicles on Milton Road. To the south of the development, the ambient noise climate consisted of distant road traffic and some plant noise associated with the nearby church.

FIGURE 1: PROPOSED DEVELOPMENT SITE AND SURROUNDING AREA



3.2. Proposed Development Overview

Proposals are to convert the existing vacant restaurant into residential one-bedroom flats on the first and second floors extending to the mezzanine area above the 2nd floors, with habitable room facades located on the north (front), south (rear) and western elevations.

It is anticipated that the ventilation strategy for the facades with habitable rooms, will be of mechanical ventilation, with secondary glazing throughout.

No external amenity spaces are being proposed as a part of the Development.

FIGURE 2: PROPOSED DEVELOPMENT LAYOUT – FLOOR PLANS



4. MEASUREMENT METHODOLOGY

4.1. General

The prevailing noise conditions in the area have been determined by an environmental noise survey conducted during both daytime and night-time periods between Thursday 18th and Monday 22nd January 2024.

4.2. Measurement Details

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445⁶.

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672⁷. A full inventory of this equipment is shown in Table 3 below.

TABLE 3: INVENTORY OF SOUND MEASUREMENT EQUIPMENT

Measurement Position	Make, Model & Description	Serial Number
MP1	Rion NL-52 Sound Level Meter	00810638
	Rion NH-25 Preamplifier	11181
	Rion UC-59 Microphone	20046
MP2	NTI XL2 Sound Level Meter	A2A-14637-E0
	MA220 Preamplifier	7615
	MC230A Microphone	A15851
Both	Cirrus CR:515 Acoustic Calibrator	72886

The sound measurement equipment used during the survey was field calibrated at the start and end of the measurement period. A third party calibration laboratory has calibrated the field calibrator used within the twelve months preceding the measurements. A drift of less than 0.1 dB in the field calibration was found to have occurred on all sound level meters.

The weather conditions during the survey were conducive to environmental noise measurement; it being largely dry, with little or no discernible wind for most of the survey. During the final night-time period, heavy winds were recorded. This portion of the data has been removed.

The microphones were fitted with protective windshields for the measurements, which are described in Table 3, with an aerial photograph indicating their respective locations shown in Figure 3.

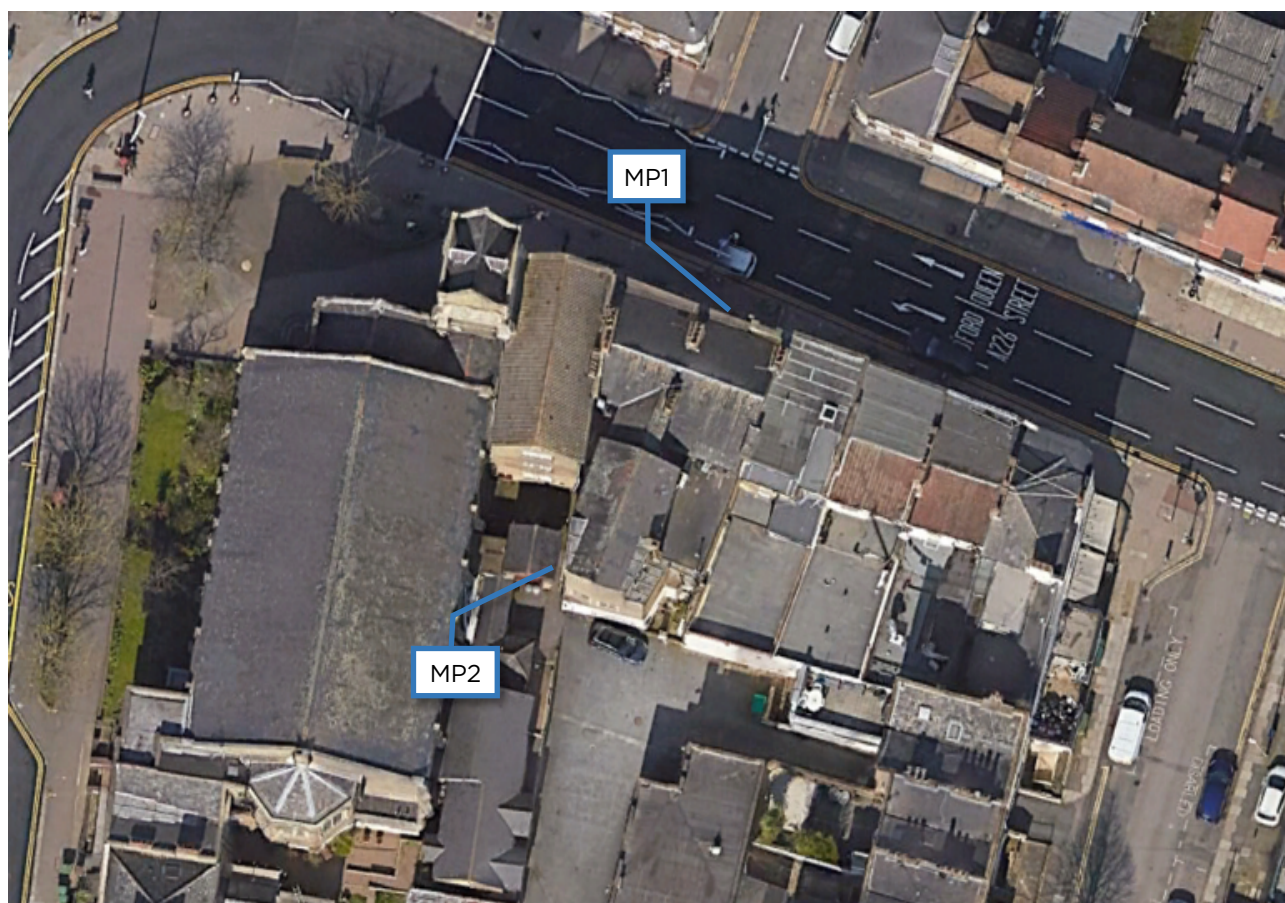
⁶ British Standard 7445: 2003: Description and measurement of environmental noise. BSI

⁷ British Standard 61672: 2013: Electroacoustics. Sound level meters. Part 1 Specifications. BSI.

TABLE 3: MEASUREMENT POSITION DESCRIPTIONS

Measurement Position	Description
MP1	A largely unattended measurement of ambient sound taken from the first floor of the north façade. The measurement was undertaken under facade-field conditions, with the microphone protruding from the window of the application building. The sound environment was dominated by road traffic using Milton Road.
MP2	A largely unattended measurement of ambient sound at a location along the southern facade of the property. The measurement was undertaken under facade-field conditions, with the microphone from the window of the application building. The microphone was positioned to measure sound levels to the rear of the property. The sound environment included vehicle movement within the rear car park and distant road traffic from the surrounding roads and some contribution from plant noise associated with the church.

FIGURE 3: MEASUREMENT POSITIONS



The summarised results of the environmental noise measurements are presented in the Table below;

TABLE 4: SUMMARY OF NOISE MEASUREMENT RESULTS – UNCORRECTED FAÇADE LEVELS

Measurement Position	Period	Noise Level, dB			
		L _{Aeq,T}	L _{A90}	L _{A10}	L _{AMax}
MP1	Day	67	56	68	86
	Night	61	41	62	80
MP2	Day	58	47	50	73
	Night	43	31	43	61

*L_{A90} values calculated using statistical analysis

The summarised spectral results of the environmental noise measurements are presented in Table 5, The sound levels presented below have been calculated including a façade correction due to the proximity of the microphone to the wall.

TABLE 5: SPECTRAL MEASUREMENT RESULTS – CORRECTED FAÇADE LEVEL

Period	dB(A)	Z-weighted Octave Band (Hz) Sound Level (dB)							
		63	125	250	500	1000	2000	4000	8000
MP1									
L _{eq,T}									
Day	64	68.1	68.4	62.8	56.0	57.0	58.4	55.0	50.2
Night	58	60.2	67.6	55.2	49.9	50.3	51.7	48.6	43.4
L _{FMax}									
Night	77	77.4	76.2	71.0	72.3	72.2	69.6	67.3	67.7
MP2									
L _{eq,T}									
Day	55	32.6	37.0	40.3	51.3	53.4	44.1	35.1	28.8
Night	40	27.3	37.1	32.8	35.7	37.2	32.1	25.3	20.8
L _{FMax}									
Night	58	51.9	53.1	52.5	52.5	52.8	51.3	48.3	44.3

4.2.1. Summary Results - Commercial Sources

A plant noise assessment in accordance with BS4142 has been undertaken. It was not possible to control the ON/OFF operation of the third-party commercial plant in order to determine the ambient, residual and background sound levels. A pragmatic approach has been taken, however, to assess periods when the plant was operational and when the plant was non-operational, that can be observed in the measured time histories presented under Appendix B. The summarised results of the periods used to assess static plant noise in accordance with BS 4142 are presented in Table 6. These measurements have derived the ambient and residual sound levels at this development.

TABLE 6: SUMMARY OF COMMERCIAL NOISE MEASUREMENT RESULTS – CORRECTED FAÇADE LEVELS

Position	Period	Time	Noise Level, dB	
			$L_{Aeq,T}$	L_{A90}
MP2	Plant 'On' (Ambient)	17:00 to 18:00 18/01/2024	46	43
	Plant 'Off' (Residual)	18:00 to 19:00 18/01/2024	44	39

Typically, the specific sound level at the measurement location would be derived by means of subtracting the residual sound level from the ambient sound level. Due to a difference of less than 3 dB between these two values, the L_{A90} has been used, as it provides a more accurate reading, unaffected by extraneous noise sources and is an accurate way of measuring continuous plant noise

During the attended portion of the survey, it was noted that the plant noise arose from the adjacent church, therefore, assessing during a one-hour daytime period is considered representative of typical operational periods of the church.

The resultant specific sound level associated with the static plant at the rear of the development is 43 $L_{Aeq,1hour}$ dB at MP2.

The background levels were derived using the L_{A90} of the data measured during the residual 'OFF' period at MP2. The background level to be used in this assessment is therefore 39 L_{A90} dB for the daytime.

5. NOISE ASSESSMENT

5.1. Introduction

Given the layout of the Proposed Development, the assessment has focused on the facades with habitable rooms; being the northern façade overlooking Milton Road (A226) and the southern and western facades overlooking the rear of the building.

5.2. Context and Commercial Noise Assessment

BS4142 has been historically intended for the assessment of impact of industrial noise on people already living in the vicinity, so has not been entirely appropriate for use in assessing the impact of industrial noise on the future occupants of a housing development. Post-2014 versions of BS4142 have removed this distinction, so an assessment of noise levels in the context of BS4142 is set out here.

BS4142:2014+A1:2019 does assert the importance of the context in which the sound occurs; the important factors of which, in this instance are considered to be.

- The receptors are new and occupiers will not have a pre-existing expectation upon the noise climate;
- The sound levels incident upon the affected area of the Proposed Development are typically constant for the majority of the time, although characterised by sound of a commercial nature; and
- The Proposed Development has responded to the environmental conditions prevailing at the site.

This element of the assessment is therefore considered to be complementary to the core part of the assessment; being the BS8233 requirements. This part of the assessment is therefore presented in order to identify the acoustic contributions of the adjacent commercial activities in the context of the overall noise levels.

For further context; the area is mixed, residential/commercial in nature, with an anticipated expectation of the future occupiers of typical sound sources associated with such an area.

5.2.1. Specific Sound Level Summary

The derived specific sound levels for the observed peak levels of commercial activity at the attended measurement positions are set out in Table 7

TABLE 7: SPECIFIC SOUND LEVEL SUMMARY

Position / Period	Specific Sound Level (dB)
MP2 / 17:00 to 18:00 (18/01/2024)	43

5.2.2. Rating Penalty Principle

Section 9 of BS4142:2014+A1:2019 describes how the rating sound level should be derived from the specific sound level, by determining a rating penalty.

BS4142:2014+A1:2019 states:

“Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:

- a) subjective method;*
- b) objective method for tonality;*
- c) reference method.”*

Given that the noise sources identified were operational, the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014+A1:2019, which states:

“Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.

Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources.”

BS4142:2014+A1:2019 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

Tonality

A rating penalty of +2 dB is applicable for a tone which is *“just perceptible”*, +4 dB where a tone is *“clearly perceptible”*, and +6 dB where a tone is *“highly perceptible”*.

Impulsivity

A rating penalty of +3 dB is applicable for impulsivity which is *“just perceptible”*, +6 dB where it is *“clearly perceptible”*, and +9 dB where it is *“highly perceptible”*.

Intermittency

BS4142:2014+A1:2019 states that when the *“specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time ... if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.”*

Other Sound Characteristics

BS4142:2014+A1:2019 states that where *“the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinct against the residual acoustic environment, a penalty of +3 dB can be applied.”*

5.2.3. Rating Penalty Assessment

Considering the above, an assessment of the off-site commercial noise sources influencing the Proposed Development, in terms of whether any rating penalties are applicable, has been detailed in Table 8.

TABLE 8: RATING PENALTY ASSESSMENT

Source	Tonality	Impulsivity	Intermittency	Other Sound Characteristics	Discussion
Existing Static Plant	0 dB	0 dB	+3 dB	0 dB	The plant was observed to be on for longer than 100% of the BS4142 reference time interval (1 hour during the day). As clarified by the Association of Noise Consultants (ANC) Technical Note on BS 4142:2014+A1:2019, dated March 2020, if a source is considered to be ON for 100% of the reference time interval, an Intermittency correction should not, therefore, be applied, however, it has been applied in this instance for robustness and to demonstrate worst-case. The plant associated with the church, was not observed to be Tonal.

In summary, a rating penalty of +3 dB has been included in the assessment for the identified off-site source of commercial sound.

5.2.4. Uncertainty

BS4142:2014+A1:2019 requires that the level of uncertainty in the measured data and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of uncertainty.

Measurement Uncertainty

BS4142:2014+A1:2019 states that measurement uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

- “
- ...
 - b) *the complexity and level of variability of the residual acoustic environment;*
 - ...
 - d) *the location(s) selected for taking the measurements;*
 - ...
 - g) *the measurement time intervals;*
 - h) *the range of times when the measurements have been taken;*
 - i) *the range of suitable weather conditions during which measurements have been taken;*
 - ...
 - k) *the level of rounding of each measurement recorded; and*
 - l) *the instrumentation used.”*

Each of the measurement uncertainty factors outlined above have been considered and discussed in Table 9.

TABLE 9: MEASUREMENT UNCERTAINTY FACTORS

Measurement Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Residual acoustic environment is relatively constant, hence no correction for a complex residual acoustic environment.
d)	0 dB	The measurements were undertaken at the closest point of the site to the off-site sources of commercial sound.
g)	0 dB	Measurement time intervals were set in accordance with BS4142:2014+A1:2019, hence no further correction needs to be made.
h)	0 dB	Measurements were taken over two, one-hour periods, during the late afternoon when the plant was operating latest in the daytime period. Demonstrating a worst-case example.
i)	0 dB	No periods of significant wind or precipitation were noted during the attended portion of the survey. During the final night-time period, high winds speeds were recorded, this data was omitted from calculations.
k)	0 dB	Measured values were rounded to 0.1 dB, therefore rounding would not have had a significant impact on the overall typical background sound levels.
l)	0 dB	The acoustic measurement equipment accorded with Type 1 specification of British Standard 61672, and were deployed with appropriate wind shields.

In summary, no correction has been included to account for measurement uncertainty.

5.2.5. BS4142:2014+A1:2019 Assessment

The rating sound level, as calculated from the measured specific sound level, has been assessed in accordance with BS4142:2014+A1:2019.

The BS4142:2014+A1:2019 assessment can be seen in Table 10.

TABLE 10: BS4142:2014+A1:2019 ASSESSMENT OF COMMERCIAL NOISE (DAYTIME)

Results	Sound Level (dB)	Notes
Specific Sound Level	43	As shown in Table 7.
Rating Penalty	+3	As discussed in Table 8.
Rating Sound Level	46	-
Daytime Background Sound Level	39	See Section 4.2.1
Excess of Rating over Daytime Background Sound Level	+7	Assessment indicates a potentially "Adverse Impact" dependent upon context.

5.3. Discussion on Context

The assessment reveals that the site is mainly influenced by daytime road traffic, particularly at the front facade, and is also audible at the rear of the building. Additionally, plant noise affects the rear of the building.

The BS4142 assessment indicates a potential 'Adverse Impact' at dwellings overlooking the rear of the building. However, this impact is likely limited to noise sensitive spaces facing west, where the existing plant is located. It's important to note that the potential 'Adverse Impact' is a result of the robust feature correction applied for intermittency. Without this correction, the noise impact would range from 'Low Impact' to 'Adverse Impact.'

As observed in the dataset (Appendix B), the noise from the static plant is mostly continuous when operational and is limited to days when the church is in use, which only 2-3 days a week. Given this, the most effective way to mitigate potential noise issues for future occupants is through the facade. Specifically, addressing glazing and ventilation specifications, as detailed in the following section.

5.4. Façade Requirements

In order to achieve appropriate noise levels within internal living spaces, in those areas where such levels will not be achieved with open windows, the dwellings themselves need to be considered with regard to the level of façade mitigation required in order to achieve internal noise levels of $L_{Aeq,16-hour} < 35$ dB in habitable rooms during the day; $L_{Aeq,8-hour} < 30$ dB and typical L_{AFMax} levels of < 45 dB during the night.

The glazing and ventilation elements are typically the weakest acoustic link in the construction of a building facade. Therefore, in order to assess the acoustic performance of the proposed dwellings, it is appropriate in the first instance to explore the level of protection that will be afforded by the performance of the glazing and ventilation elements.

Windows do not reduce noise equally across the entire frequency spectrum, so the frequency content of the sound will influence the overall sound reduction performance of a given window and by extension, the resulting noise levels within the receiving room.

Many glazing manufacturers test their products under laboratory conditions using a typical road traffic noise frequency spectrum source. The resultant measured noise attenuation, in dB, gives a very useful guide to in-situ sound reduction performance of the window for situations where road traffic noise dominates. This performance index is known as the R_{TRA} , or $R_w + C_{tr}$.

The Building Regulations recommend on ventilation that habitable rooms in dwellings have background ventilation. Internal noise levels should be considered in the context of room ventilation requirements. In this instance, the target internal noise levels will only be achieved in the majority of dwellings when windows are closed. An alternative means of ventilation will therefore be required to comply with the requirements of the Building Regulations Approved Document F.

In order to achieve the target daytime and night-time internal noise levels, it is necessary to determine the minimum acoustic performance requirements of each façade component. It is typically assumed that the default choice of glazing for the habitable rooms of the proposed development will be thermal double glazing and the default choice for ventilation will be a mechanical ventilation system with secondary glazing.

As already stated; in order to provide a robust assessment and a high quality living environment for future residents, providing internal noise levels of < 35 dB $L_{Aeq,16-hour}$ by day and < 30 dB $L_{Aeq,8-hour}$ by night, as well as < 45 dB typical L_{AFMax} by night, as defined in BS 8233 has been adopted as the design target for the proposed development.

To determine the glazing and ventilation requirements in order to provide an adequate level of protection against external noise intrusion, $L_{Aeq,16hour}$ daytime, $L_{Aeq,8hour}$ and typical L_{AFMax} night-time noise levels have been determined at the building façade.

Accordingly, the required composite $R_w + C_{tr}$ sound reduction performance for the building facades of the development, to provide appropriate internal noise levels during both daytime and night-time periods, as described, are identified in Table 11.

TABLE 11: REQUIRED SOUND LEVEL DIFFERENCE OUTSIDE TO INSIDE, dB

Index	Predicted Free-field Noise Level, dB		Target Internal Noise Level - dB		Required Sound Level Difference, dB
	Day	Night	Day	Night	
Northern Facade (West Hill Road - A226)					
L _{Aeq,T}	64	58	35	30	29
L _{AFMax}	-	77	-	45	32
Southern and Western Facade					
L _{Aeq,T}	55	40	35	30	20
L _{AFMax}	-	58	-	45	13

Table 11 identifies that the sound reduction requirements for the north facade are driven by meeting the adopted target night-time L_{AFMax} internal noise limit of 45 dB, and the requirements for the south and west facade are driven by the adopted target daytime L_{Aeq} internal noise limit of 35 dB.

It should also be noted that the sound reduction detailed in Table 11 apply to habitable rooms such as living rooms, dining rooms and bedrooms only. For non-habitable rooms such as kitchens, bathrooms, stairways, halls, landings, lower performance standards would be permissible.

Based upon the latest layout proposals and robust assumptions of up to 40% of a room facade being glazed and a room volume of 30m³, calculations have been carried out to determine the likely required acoustic performances for the external facade elements, in order to provide appropriate internal noise levels in rooms during both the daytime and night-time periods.

The outline performance requirements are presented in Table 12.

TABLE 12: MINIMUM ACOUSTIC PERFORMANCES FOR GLAZING AND VENTILATION

Example Glazing	Octave Band (Hz) Sound Level (dB)							
	63	125	250	500	1000	2000	4000	R _w
	Sound Reduction Performance, R dB							
North Façade (Milton Road)								
6/100/4 Secondary Glazing	22	26	34	44	56	53	52	46
South/West Façade								
4/12/6 Double Glazing	19	23	22	27	38	40	41	33
Example Ventilation	Octave Band (Hz) Sound Level (dB)							
	63	125	250	500	1000	2000	4000	D _{new}
	Element Normalised Level Difference (D _{n,e}) dB							
All Facades								
MVHR	-	-	-	-	-	-	-	-
Example Walls	Octave Band (Hz) Sound Level (dB)							
	63	125	250	500	1000	2000	4000	R _w
	Sound Reduction Performance, R dB							
All Facades								
Façade Wall	36	41	41	45	54	58	58	52
*Brick/ Blockwork Cavity Wall (BS8233)								

The above mitigation measures demonstrate that appropriate internal noise levels are entirely achievable through the use of suitable façade treatments, resulting in No Observed Adverse Effect.

Other products may be suitable and it is the responsibility of the glazing manufacturer to recommend and provide appropriate systems. The above analysis is provided to demonstrate that a design solution is feasible at the site for the purposes of a planning application and not necessarily for the purposes of detailed design or glazing procurement.

The detailed design of the proposed properties may affect both the required sound reduction performance and the appropriate selection of glazing units. The aspects of the detailed design that are important are the room dimensions, room finishes, window dimensions and the sound reduction performance of non-glazing elements.

5.4.1. Predicted Indoor Noise Levels

Considering the ventilation, glazing and external wall specifications outlined in this section, the following indoor ambient and maximum noise level incident on the front and rear façade has been predicted in accordance with BS EN 12354-3:2000.

The predicted indoor ambient and maximum noise levels, are detailed in Table 13 below, against the requirements of BS8233:2014 and the WHO Guidance.

TABLE 13: INDOOR SOUND LEVEL ASSESSMENT (FAÇADE MITIGATION)

Period	Predicted Indoor Sound Levels (dB)		Indoor Sound Level Criterion (dB)		Exceedance (dB)	
	Ambient Sound Level, $L_{Aeq,T}$	Maximum Sound Level, L_{AFmax}	Ambient Sound Level, $L_{Aeq,T}$	Maximum Sound Level, L_{AFmax}	Ambient Sound Level, $L_{Aeq,T}$	Maximum Sound Level, L_{AFmax}
Northern Façade						
Day	26	-	35	-	-9	-
Night	24	35	30	45	-6	-10
Southern Façade						
Day	23	-	35	-	-12	-
Night	8	25	30	45	-22	-20

It can be seen that, incorporating the façade design outlined in this section, that the requirements of BS8233:2014 and the WHO Guidance can be achieved.

5.5. Additional Ventilation Requirements – Thermal Comfort

The level of noise exposure experienced on all facades may require an additional means of ventilation to openable windows and background trickle ventilation.

Consequently, a means of Mechanical Ventilation Cooling, providing higher rates of air turnover than would be provided by background trickle ventilation alone, is proposed; such that it will not be necessary to open the windows.

This is intended to be provided by the MVHR system. The system would be entirely user controlled and operated on-demand by the occupant, via a switch located within the dwelling. The system will provide a boost mode which can be chosen by the user to introduce increased amounts of cool air into the dwellings and reduce thermal gains during the summer months. As discussed in section 2.2 of the Acoustics, Ventilation and Overheating Residential Design Guide 2020¹, this method would provide Mechanically Ventilated Cooling which would aim to ensure the balance of thermal and acoustic comfort.

Windows will remain openable throughout the development to provide an optional method of purge ventilation or thermal cooling, should it be required.

5.6. Static Plant Limits

The exact details of any static plant to be installed as part of the Proposed Development are not currently known, therefore, for the purposes of this noise assessment, it is considered appropriate to set plant noise emission limits in accordance with British Standard requirements, which can be incorporated into an appropriately worded planning condition, to be discharged at a later date.

The limits are presented in Table 14 and are based on the cumulative Noise Rating Level arising from any new mechanical plant being 5 dB below the measured background sound levels, including a façade correction of 3dB.

TABLE 14: PLANT RATING LEVELS AT THE NEAREST RECEPTOR

Period	Proposed Plant “Rating Level - L_{Ar} ” at the Nearest Residential Receptor – dB(A)
Nearest Noise Sensitive Receptors	
Daytime (07:00 – 23:00)	39
Night time (07:00 – 23:00)	23

The above limits would apply to the total noise emission level from all plant within the Proposed Development. Individual plant items may need to be designed to a lower limit such that the overall total achieves the stated criteria above at the nearest noise sensitive receptors.

¹ Acoustics Ventilation and Overheating Residential Design Guide – ANC & Institute of Acoustics 2020

6. INTERNAL BUILDING FABRIC ASSESSMENT

6.1. Sound Insulation Design Criteria

A sound insulation assessment has been carried out to mitigate the impact of noise from the ground floor premises transmitting into the properties above. The following section outlines the different assessment criteria used to provide a robust assessment and aim to protect the amenity of the adjacent residents.

6.1.1. Subjective Assessment

Whilst on site, a subjective assessment of noise has been carried out to determine if any noise from the commercial premises on the ground floor was audible in the existing first floor space. It was noted that there was no audible noise within the first-floor space whilst the commercial areas were operating.

6.1.2. Building Regulations – Approved Document E

The Approved Document E (ADE) provides acoustic performance standards that must be achieved when refurbishing or developing a new residential building.

Table 15 below provides the sound insulation requirements of AD-E applicable to purpose built dwelling houses and flats.

TABLE 15: AD-E SOUND INSULATION PERFORMANCE REQUIREMENTS – DWELLING-HOUSES & FLATS (TABLE 1A)

Separating Element	Airborne Sound Insulation $D_{nT,w} + C_{tr}$ dB (Minimum Values)	Impact Sound Insulation $L'_{nT,w}$ dB (Maximum Values)
Dwelling-Houses and Flats Formed by a Change of Use - Walls	≥ 43	-
Dwelling-Houses and Flats Formed by a Change of Use - Floors and Stairs	≥ 43	≤ 64

With regard to the building regulations requirement for commercial to residential spaces, Section 0.8 of Approved Document E states the following:

'The performance standards set out in Tables 1a and 1b are appropriate for walls, floors and stairs that separate spaces used for normal domestic purposes. A higher standard of sound insulation may be required between spaces used for normal domestic purposes and communal or non-domestic purposes. In these situations the appropriate level of sound insulation will depend on the noise generated in the communal or non-domestic space. Specialist advice may be needed to establish if a higher standard of sound insulation is required and, if so, to determine the appropriate level.'

An improvement of +10 above the building regulations has been requested by the local authority and will provide suitable mitigation from noise within the ground floor upon the residents in the first-floor flats.

6.2. Separating Floor

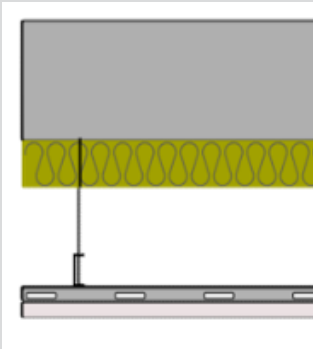
6.2.1. Existing Structure

The existing floor is understood to be constructed from a concrete plank, with a suspended ceiling hung underneath and no mineral wool in the ceiling void.

6.2.2. Proposed Floor Construction

The floor construction and the associated $R_w + C_{tr}$ below should meet the design criteria as set out in Section 6.1.2.

TABLE 16: PROPOSED SEPARATING FLOOR AND THE ESTIMATED SOUND REDUCTION PERFORMANCE

Separating Element	Floor Construction	Floor Build Up	$R_w + C_{tr}$ dB
Floor between commercial and residential		- Existing Solid Concrete Plank - Suspended Light Steel Grid 60mm Rockwool (Min 10kg/m^3) within the void - Existing ceiling tiles	62

It is understood that the perimeter walls are solid masonry or stone, which will provide sufficient resistance to flanking sound transmission. However, if the walls between the commercial and residential areas are found to have a mass per unit area of less than 375 kg/m^2 then a wall lining may be required to prevent flanking paths.

The wall lining should comprise at least a 50mm timber batten or metal C-stud and two layers of plasterboard, with a minimum mass per unit area of 25kg/m^2 . The plasterboard should be built up to the new ceiling and should **not** penetrate the ceiling itself.

All gaps should be sealed with non-hardening mastic and care should be taken to follow the manufacturers installation guidelines to ensure that the acoustic hangers and resilient bars are installed correctly and perform efficiently.

It should be also noted, that if the existing floor construction is found to be different from that which is discussed within this report, then inacoustic should be informed and alterations should be made to ensure that the design criteria is met which should later be confirmed by the Local Authority.

6.3. Sound insulation Assessment

The sound insulation performance has been assessed against the design criteria as set out in Section 6.1.2. The results of the assessment can be seen below in Table 17.

TABLE 17: ASSESSMENT AGAINST DESIGN CRITERIA

Design Criteria	Required $D_{nTw}+C_{tr}$	Likely in-Situ Performance $D_{nTw}+C_{tr}$	Achieved?
Approved Document E +10dB	$\geq 53\text{dB}$	58	Yes

The resulting on site sound insulation performance of the separating floor should therefore achieve $D_{nTw}+C_{tr}$ 58 dB, and is therefore a 15 dB improvement above the standard Building Regulations requirement.

For context, it should be noted that, if tested under the current Building Regulations, all partitions should comfortably pass the requirements of the Approved Document E.

7. CONCLUSION

inacoustic has been commissioned to assess the impact of noise at 157 Milton Road, Gravesend, DA12 2RG, in respect of the site's suitability for residential development.

The following technical noise assessment has been produced to provide supporting information to accompany a planning application to Gravesham Borough Council and is based upon environmental noise measurements undertaken at the site.

The suitability of the site for residential development has been assessed, based on the development proposals and the measured noise levels.

Specific consideration has been given to the internal noise criteria for the proposed residential properties, as quoted as within BS8233:2014, with façade mitigation measures proposed to achieve the criteria stipulated therein.

Furthermore, subjective observations indicate that the commercial businesses on the ground floor are currently inaudible within the first floor rooms, however, to ensure the future development is robust, design advice has been recommended in Section 6.2, to minimise the likelihood of complaint from future residents, should the operational profile of the cake shop and barber's shop increase from its current level.

In light of the above, which demonstrates that the site is predicted to meet the requirements of the relevant British Standard and planning guidance, it is considered that noise does not present a constraint to the approval of the development.

8. APPENDICES

8.1. Appendix A – Definition of Terms

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10 ⁻⁶ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log ₁₀ (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

TABLE 18: TYPICAL SOUND LEVELS FOUND IN THE ENVIRONMENT

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10} , the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq} .

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1\text{hour}}$ dB and $L_{A90,15\text{mins}}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

8.2. Appendix B – Measurement Results

FIGURE 4: MEASURED TIME HISTORY MP1

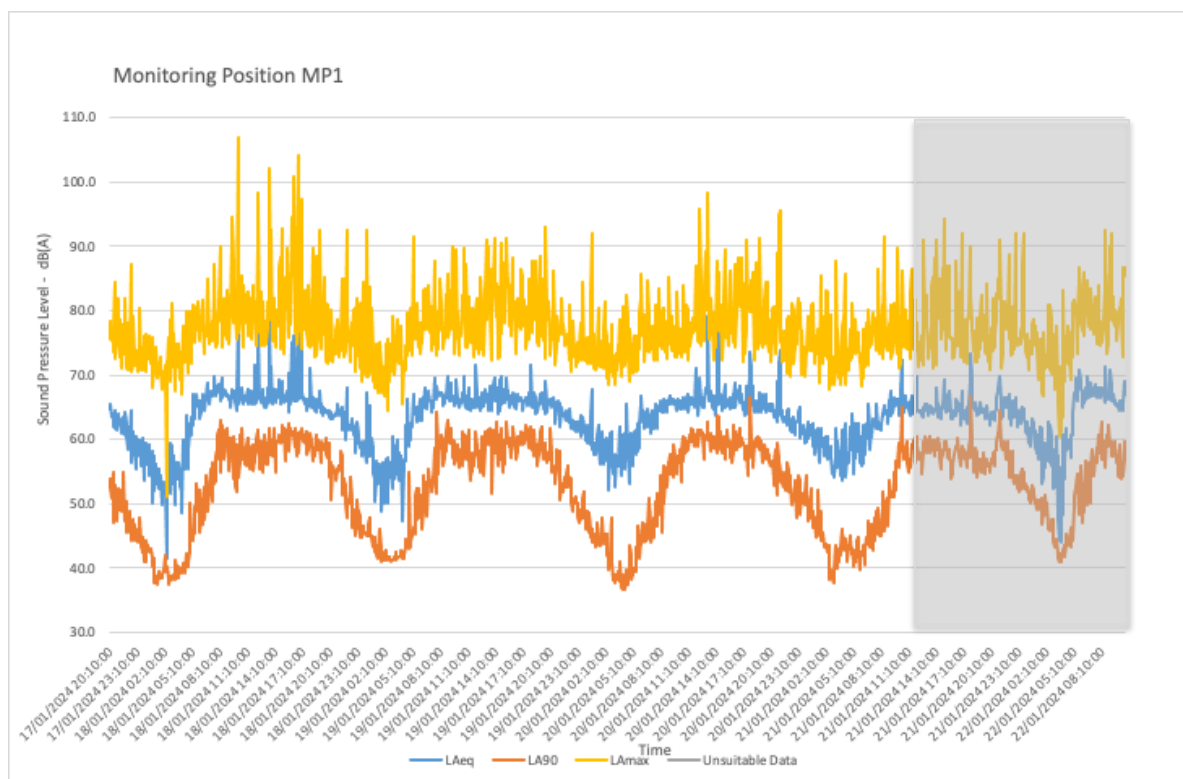
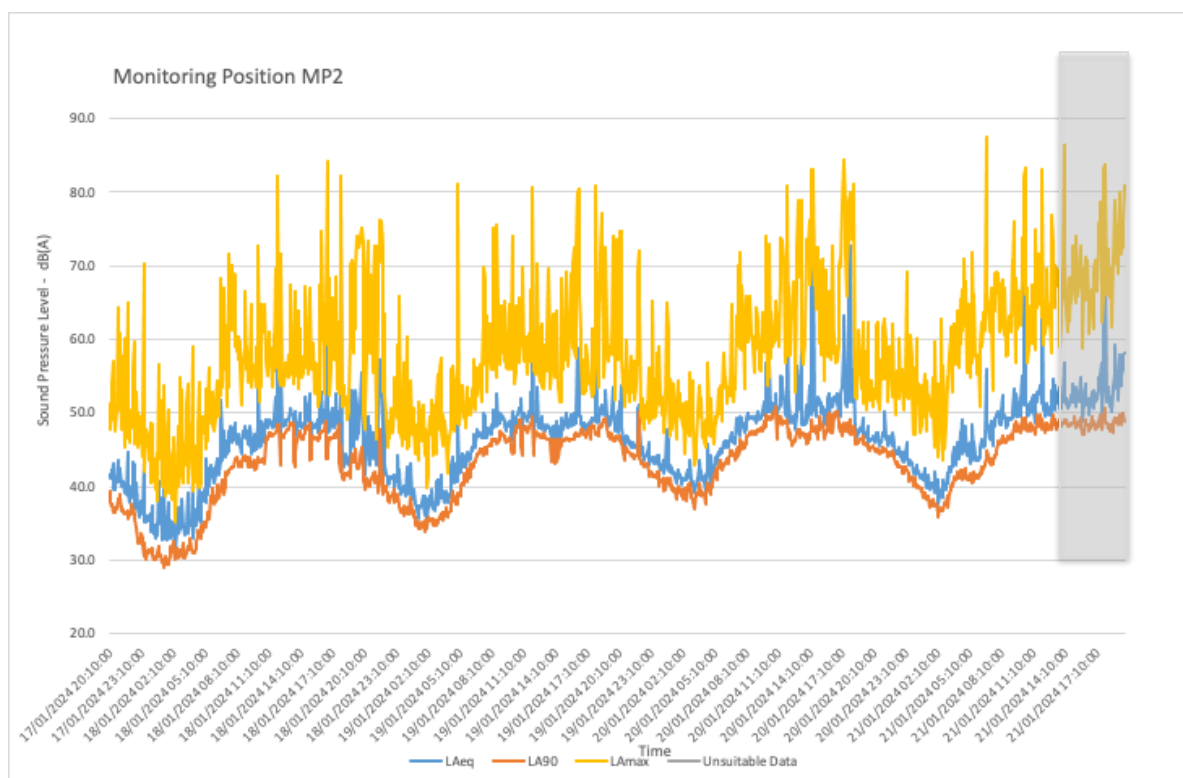


FIGURE 5: MEASURED TIME HISTORY MP2



8.3. Appendix C – Statistical Analysis

FIGURE 6: STATISTICAL ANALYSIS DAYTIME MP2

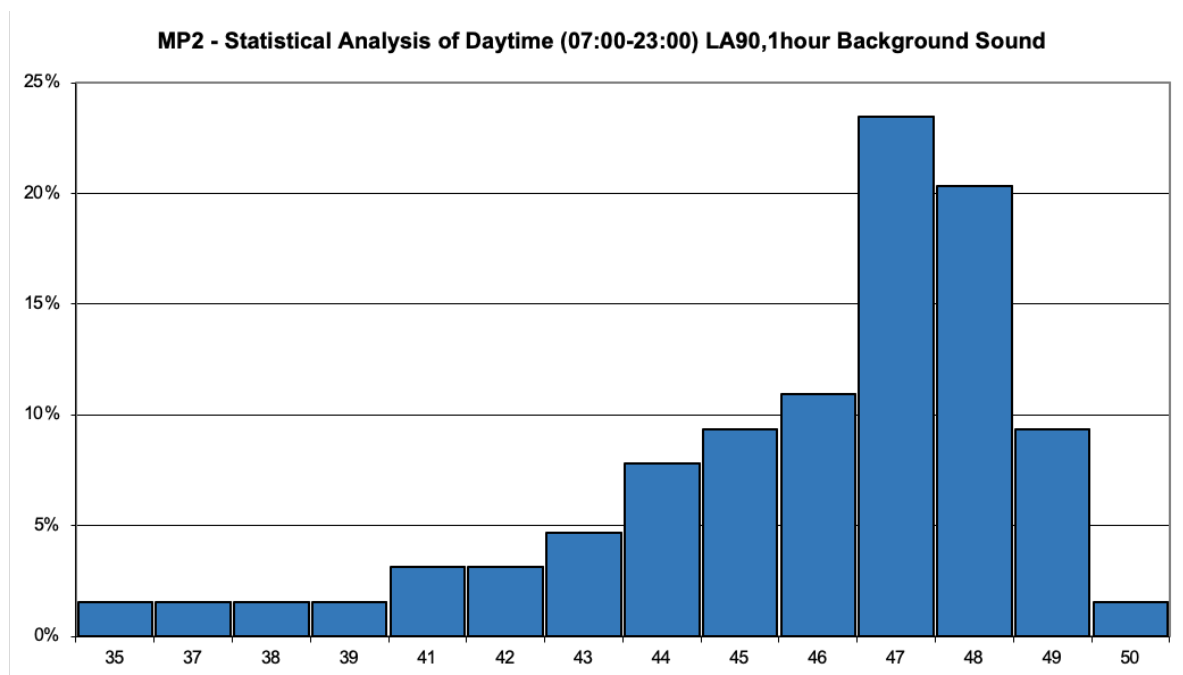
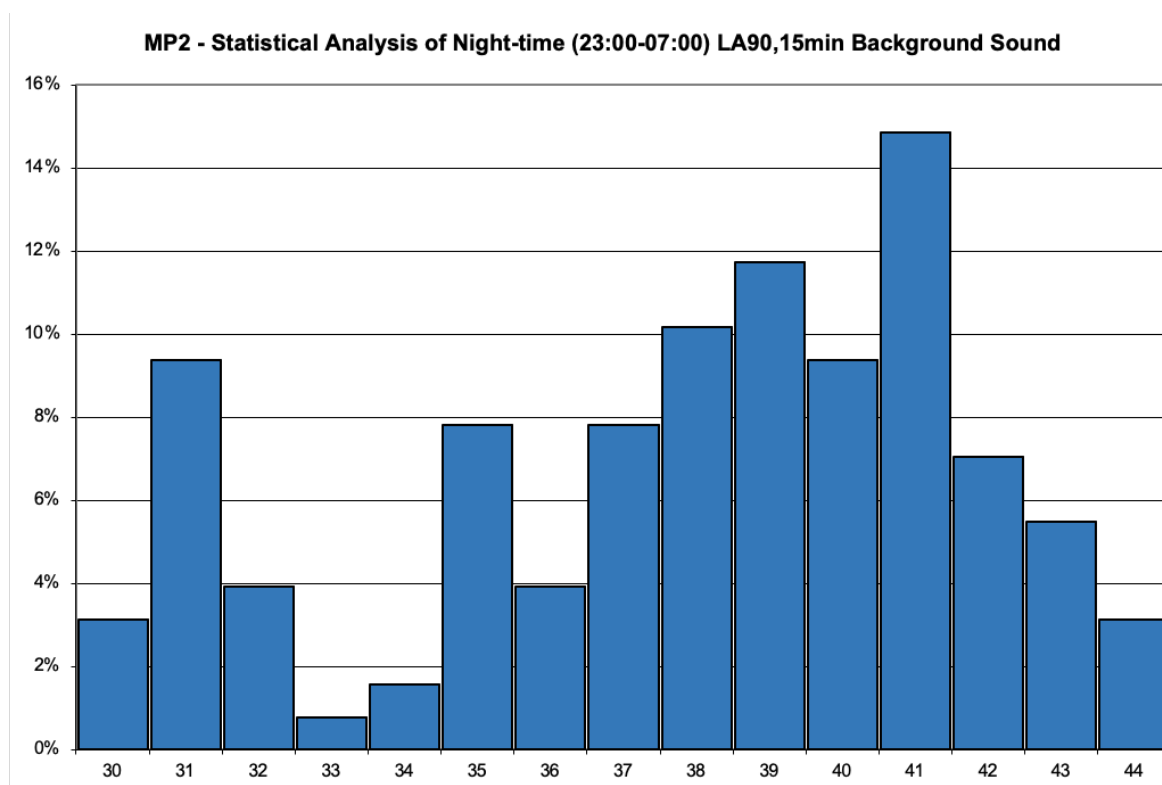


FIGURE 7: STATISTICAL ANALYSIS NIGHT-TIME MP2



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