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Noise Survey of a Residential Development

Client: Alfa House Ltd.

Address: 1 Commercial Street,
Batley,
West Yorkshire,
WF17 5HN

Date: 26/11/2018



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Executive summary

An environmental noise survey and noise impact assessment has been undertaken at the proposed residential development at 1 Commercial Street, Batley, WF17 5HN, to assess the suitability of site. The measured ambient sound levels have allowed a BS8233:2014 noise assessment to be carried out.

Outline mitigation measures have been recommended in section 4.0, including glazing and ventilation. These recommendations should be sufficient to achieve the internal noise levels for the Proposed Development according to BS8233:2014 noise criteria.

A ProPG assessment has shown that the site falls into NRC 3 'High risk'. This is due to elevated night time noise levels, and if the assessment was based exclusively on day time levels, the development would be classified as NRC 2 'Medium Risk'. It is assumed however that provided good acoustic design is implemented throughout the project the amenity of all future residents can be fully protected.

Due to the close proximity of the Proposed Development to the Taproom, a detailed assessment has been made of the noise emissions during operational hours of the public house. In order to protect against extraneous noise, the necessary sound reduction of the north-eastern façade has been specified using the highest 1-hour octave band measurements taken during the operational periods of the Taproom. As the opening hours are stated to include day time and night time hours, both NR25 and NR20 curves have been used in the assessment.

The residential development is located above a commercial property, and as such the partition floor between the properties has been assessed. A floor design has been suggested in section 4.0 that is predicted to achieve the required sound reduction.

Written approval of the findings of this report is required from the Local Authority prior to works commencing.

A Brief overview of the Findings of This Report can be seen below:

- Bedrooms at the northern facade require a minimum sound reduction of **29.0 dB** R_w + c_{tr} and **36.0 dB** R_w . An minimum octave band glazing sound reduction has also been defined.
- Living rooms at the northern facade require a minimum sound reduction of **28.0 dB** R_w + c_{tr} . An minimum octave band glazing sound reduction has also been defined.
- Bedrooms and living rooms at the southern façade require a minimum sound reduction of **34.0 dB** R_w + c_{tr} and **39.0 dB** R_w .
- Glazing has been suggested that would satisfy the necessary criteria.
- Ventilation with a minimum $D_{n,e,w}$ of **39.0 dB** should be installed in all habitable rooms.

- A ProPG assessment has categorised the development as “High Risk”. Provided the glazing specification and octave band SRI are adhered to the amenity of the future occupants can be fully protected.

1. Introduction

1.1 Overview

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a residential development ('the Proposed Development') at 1 Commercial Street, Batley, WF17 5HN ('the Site').

The Applicant has submitted a prior approval application, no. 2018/CLASS O/93134/E ('the Application') to Kirklees Council.

Accordingly, the following technical noise assessment has been produced to accompany the Application to Kirklees Council.

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 & Objectives

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

- Ambient sound monitoring survey to evaluate the prevailing sound levels incident on the Site;
- Detailed sound modelling, acoustic calculation and analysis in accordance with ISO9613 – 1 prediction methodology to predict sound levels incident on the Site;
- A detailed assessment of the suitability of the Site, in accordance with relevant standards in respect of sound from the surrounding noise sources; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the National Planning Practice Guidance in England and Wales, BS8233:2014, World Health Organisation Guidelines and other relevant standards.

1.3 Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

- National Planning Policy Framework (2018)
- Noise Policy Statement for England
- ProPG: Planning & Noise
- BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'
- ISO 9613-2 Attenuation of sound during propagation outdoors
- BS EN 12354-4 Building Acoustics

1.4 Local Policy Guidance & Discussions with the Local Authority

Dion Gervin of Kirklees Council has made the following comments regarding the planning application.

"I am concerned that the proposed development may be subject to elevated levels of noise from road traffic, noise from the night time economy i.e. nearby bars/clubs and nearby daytime

commercial uses. Therefore, before determining the application, it is recommended that the applicant provides the Local Planning Authority (LPA) with an acoustic report by a suitably competent person (see note). The report shall:

(i) Determine the existing noise climate

(ii) Predict the noise climate in gardens (daytime), bedrooms (night-time) and other habitable rooms of the development

(iii) Detail the proposed attenuation/design necessary to protect the amenity of the occupants of the new residences (including ventilation if required). If levels predicted in the report are unacceptable, it may be necessary to refuse the application. Otherwise, it may be necessary to specify attenuation measures as conditions of consent."



2. Site Description & Background Information

2.1 Site & Surroundings

The Proposed Development is to convert 1st and 2nd floor offices (Class B1) into 13 residential dwellings (Class C3) at 1 Commercial Street, Batley. The site is located at the intersection of Commercial Street and Wellington Street just outside of Batley Town Centre. The area is predominantly commercial with a minority of residential properties. The surrounding acoustic environment is moderate to high in level. The dominant source of noise at the site is vehicle noise from Wellington Street which facilitates a medium to high level of traffic, there is also the Wellington Pub adjacent to the site. The Taproom Public House directly opposite the north-eastern façade of the Proposed Development is considered to present a potential noise risk, and as such, the assessment period was scheduled to include weekend day time and night time measurements. There are other commercial properties in the immediate area, which include a hair dresser, a local convenience shop, and a haberdashery retailer, however these shops are assumed to have minimal noise output and operate during standard daytime hours of 09:00 – 17:00. An overview of all information and plans provided indicates there are no external amenity spaces associated with the Proposed Development.

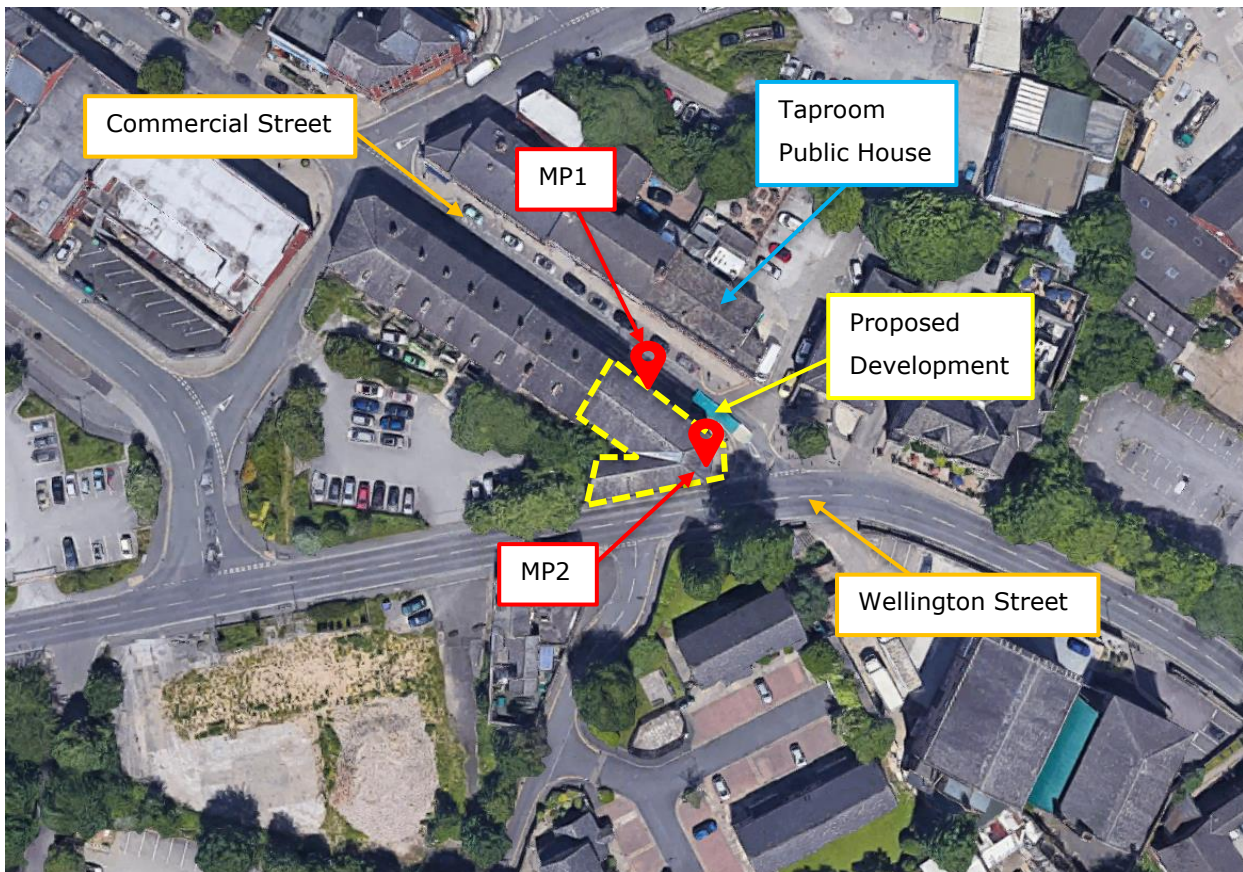


Figure 1.0 – Site and Surroundings

2.2 Background

The client has applied for prior approval. Kirklees Council has listed noise as one of the main concerns for the development, and as such, a noise survey has been requested to ensure the amenity of

future occupants can be protected. In order to mitigate against possible extraneous noise from the Taproom Public House, an octave band frequency analysis has been completed at the north-eastern façade of the property (MP1) and the loudest hour measurement has been used for assessment. As the opening hours for this establishment are 12:00 – 00:00 on weekends and 14:00 – 00:00 on Fridays. During the day time recorded measurements have been compared to an NR25 curve and during the night time measurements have been compared with an NR20 curve. Location and site plans are included in appendices C and D respectively.



3. Environmental Noise Survey

In order to characterise the sound profile of the area of the proposed development, a 71-hour environmental survey was carried out from the 26th October 2018 to 28th October 2018 at two locations.

3.1 Measurement Methodology

For the long-term sound monitoring, the sound level meters were placed at 1st floor level, protruding from windows at northern and southern facades of the proposed site. The microphones were positioned approximately 1m away from the building's façades and the monitoring positions were chosen in order to collect representative sound levels of the area during the week and weekend day time and night time periods. The measurement positions can be found in Figure 1.0.

3.2 Measurement Equipment

Piece of Equipment	Serial No	Calibration Deviation
SVAN 977 Class 1 Sound Level Meter	34826	≤0.5
SVAN Class 1 Calibrator SV31	32569	
CESVA SC310 Class 1 Sound level meter	T246452	≤0.5
CESVA CB006 Class 1 Calibrator	901997	

Table 1.0 – Measurement Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with negligible deviation of ≤0.5 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective wind shield for the entire measurements period. Calibration certificates can be provided upon request.

3.3 Weather Summary

As the environmental noise surveys were carried out over long un-manned periods no records of weather conditions were taken. However, during the set up and collection of the monitoring equipment the weather was calm with wind speeds of less than 5m/s and no precipitation. All measurements have been compared with met office weather data of the area and periods of elevated weather conditions have been excluded from the subsequent calculations. The weather conditions were suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise.

3.4 Results

3.4.1 Summary Results

The following table shows a summary of the sound survey results; L_{Aeq} , L_{Amax} , L_{A90} and the L_{A10} for the measurement period.

Measurement Position MP1				
Measurement Time Period ('t')	L _{Aeq,t}	L _{Amax,t}	L _{A90,t}	L _{A10,t}
Day 1 - 26/10/18 - 15:10 – 23:00	62.6	97.5	55.7	65.7
Night 1 - 26/10/18 - 23:00 – 07:00	57.1	83.2	40.3	60.5
Day 2 - 27/10/18 - 07:00 – 23:00	62.9	96.2	54.7	66.2
Night 2 - 27/10/18 - 23:00 – 07:00	58.1	85.9	41.3	62.0
Day 3 - 28/10/18 - 07:00 – 23:00	61.6	90.6	47.7	65.8
Night 3 - 28/10/18 - 23:00 – 07:00	56.7	87.8	37.0	59.3
Day 4 - 29/10/18 - 07:00 – 14:50	62.2	86.2	53.4	66.2

Table 2.0 – Sound Survey Results Summary

Measurement Position MP2				
Measurement Time Period ('t')	L _{Aeq,t}	L _{Amax,t}	L _{A90,t}	L _{A10,t}
Day 1 - 26/10/18 - 15:10 – 23:00	68.2	104.1	59.1	69.7
Night 1 - 26/10/18 - 23:00 – 07:00	62.2	101.4	40.2	66.5
Day 2 - 27/10/18 - 07:00 – 23:00	67.3	101.5	56.4	69.9
Night 2 - 27/10/18 - 23:00 – 07:00	62.6	89.5	40.1	67.1
Day 3 - 28/10/18 - 07:00 – 23:00	64.9	96.1	49.9	69.0

Table 3.0 – Sound Survey Results Summary

The following table shows a summary of the highest octave band sound levels measured at MP1 during the operational periods of the Taproom Pub. The operational hours are 16:00 - 23:00 during the day time, and 23:00 – 00:00 during the night time.

Measurement Position MP1							
Frequency Analysis	Z-weighted Octave Band Sound Power Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest L _{eq,1hour} During Operational Periods – Day Time	71.6	66.1	61.3	59.7	62.2	60.2	52.5
Highest L _{eq,1hour} During Operational Periods – Night Time	67.1	63.5	57.4	56.6	58.4	54.4	45.9

Table 4.0 – Highest Octave Band L_{eq,1hour} During Operation Hours

The following table shows a summary of the maximum sound level results during the highest measured night time period at measurements positions 1 and 2.

Measurement Position MP1			
Measurement Period ('t')	L _{AFMax,15min}	Statistically most Repeated L _{AFMax,15min}	No. of exceedances of 81 dB L _{AFMax,15min}
Night 1 - 26/10/18 - 23:00 – 07:00	83.2	75.0	3
Night 2 - 27/10/18 - 23:00 – 07:00	85.9	76.0	4
Night 3 - 28/10/18 - 23:00 – 07:00	87.8	76.0	4

Table 5.0 – Maximum Sound Level Summary Results

Discussion

According to the statistical analysis the highest most repeated L_{AMAX,15min} value is 76.0 dB L_{Amax} during Nights 2 and 3. However, this L_{Amax,t} value has been exceeded more than 10 times over night and according to the ProPG document such an exceedance may generate “unacceptable adverse effect on health and quality of life”. Thus, a more suitable value is represented by 81.0 dB L_{Amax} which is only exceeded 4 times during Night 2 and 3. Therefore, the value of 81.0 dB L_{Amax} is deemed to be a ‘typical’ value. This value will be used in the following assessment.

Measurement Position MP2			
Measurement Period ('t')	L _{AFMax,15min}	Statistically most Repeated L _{AFMax,15min}	No. of exceedances of 84 dB L _{AFMax,15min}
Night 1 - 26/10/18 - 23:00 – 07:00	101.4	80.0	4
Night 2 - 27/10/18 - 23:00 – 07:00	89.5	77.0	4

Table 6.0 – Maximum Sound Level Summary Results

Discussion

According to the statistical analysis the highest most repeated L_{AMAX,15min} value is 80.0 dB L_{Amax} during Nights 1 and 2. However, this L_{Amax,t} value has been exceeded more than 10 times over night and according to the ProPG document such an exceedance may generate “unacceptable adverse effect on health and quality of life”. Thus, a more suitable value is represented by 84.0 dB L_{Amax} which is only exceeded 4 times during Night 1 and 2. Therefore, the value of 84.0 dB L_{Amax} is deemed to be a ‘typical’ value. This value will be used in the following assessment.

3.5 Subjective impression & Context

Whilst on site it was found that the acoustic environment of the area was moderate to high. The dominant source of noise was traffic both on Wellington Street and Commercial Street. During the site visit the Taproom public house was open, however, the noise from the pub was not dominant at the façade of the Proposed Development.

4 Noise Assessment

4.1 ProPG Stage 1 Initial Noise Risk Assessment

Considering the noise levels measured across the entire measurement period, the development site falls into Noise Risk Category (NRC) 3. As shown in the following table.

Noise Risk Category	Potential Effect if unmitigated	Pre-Planning Application Guidance
3 - High $L_{Aeq, 16hour} > 70dB$ $L_{Aeq, 8hour} > 60dB$	Unacceptable adverse effect on health and quality of life	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. The risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice.

Table 7.0 – Noise Risk Category for Site

Discussion:

As can be seen in the assessment above the site falls in to NRC 3 'High risk'. This is due to elevated night time noise levels. If the assessment was based exclusively on day time levels, the development would be classified as NRC 2. It is assumed however that provided good acoustic design is implemented throughout the project the amenity of all future residents can be fully protected.

4.2 BS8233:2014 Noise Assessment

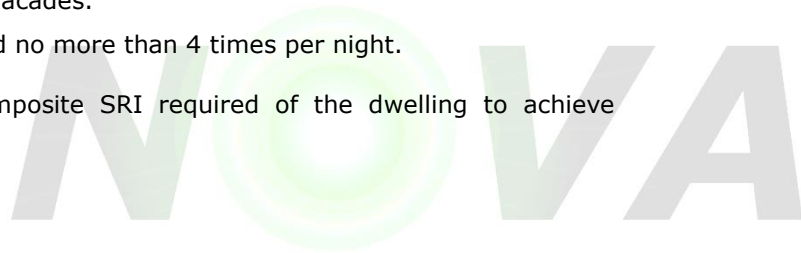
4.2.1 Internal Noise Level Assessment

The following section analyses the ambient sound levels incident on the development compared with the internal noise level criteria presented within BS8233:2014.

To ensure a robust analysis the following considerations have been taken:

- The highest $L_{Aeq, 16hour}$ and $L_{Aeq, 8hour}$
- The highest $L_{eq, 1hour}$ octave band frequencies during the operational periods of the local public house at the north-eastern and eastern facades.
- The $L_{AFmax, 15min}$ during the night exceeded no more than 4 times per night.

The following table analyses the required composite SRI required of the dwelling to achieve appropriate internal noise levels.



Façade	Location	Time Period	Façade Noise Level	BS8233 Criteria	Min. SRI Required (dB)
North-Eastern	Bedroom / Living Room	Day time	62.9	35 dB $L_{Aeq,16hour}$	28.0 $R_w + C_{tr}$
	Bedroom	Night time	58.1	30 dB $L_{Aeq,8hour}$	29.0 $R_w + C_{tr}$
	Bedroom	Night time	81.0	45 dB $L_{Amax,8hour}$	36.0 R_w^{**}
Southern and Eastern	Bedroom / Living Room	Day time	68.2	35 dB $L_{Aeq,16hour}$	34.0 $R_w + C_{tr}$
	Bedroom	Night time	62.6	30 dB $L_{Aeq,8hour}$	33.0 $R_w + C_{tr}$
	Bedroom	Night time	84.0	45 dB $L_{Amax,8hour}$	39.0 R_w^{**}

Table 8.0 – BS8233 Internal Noise Level Analysis

The following tables analyse the composite octave band SRI required of the dwelling to achieve appropriate internal noise levels. As the Taproom pub is operational during the day time and night time, the day time noise levels will be assessed against an NR25 curve, and the night time noise levels will be assessed against an NR20 curve.

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest $L_{eq,1hour}$ During Operational Hours of the Local Public House	71.6	66.1	61.3	59.7	62.2	60.2	52.5
NR25 Curve (dB)	55.2	43.7	35.2	29.2	25.0	21.9	19.5
Required Octave Band SRI (R_w)	16.5	22.4	26.1	30.5	37.2	38.3	33.0

Table 9.0 – Octave Band Internal Noise Level Analysis – Day Time

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)						
	63	125	250	500	1K	2K	4K
Highest $L_{eq,1hour}$ During Operational Hours of the Local Public House	67.1	63.5	57.4	56.6	58.4	54.4	45.9
NR20 Curve (dB)	51.3	39.4	30.6	24.3	20.0	16.8	14.4
Required Octave Band SRI (R_w)	15.8	24.1	26.8	32.3	38.4	37.6	31.5

Table 10.0 – Octave Band Internal Noise Level Analysis – Night Time

4.2.2 Recommendations & Mitigation

Building Envelope

The noise levels within the proposed dwellings will be dictated by the configuration, materials and elements of the façade. The non-glazed elements of the facade will contribute significantly to the reduction of ambient noise levels in combination with a superior quality appropriate acoustic glazing specification.

a) Facades

The prediction of the performance of the facade is based upon a construction of 200mm brick and is calculated within INSUL software, the expected performance is shown in the following table.

Frequency (Hz)	63	125	250	500	1K	2K	4K	R _w
Façade SRI	41	44	42	47	55	63	68	53

Table 11.0 – Façade SRI

Any other configuration of external walls that would achieve at least these insulation figures will be suitable for the development.

b) Roofs

If the dwelling has rooms within the roof space the roof system will require additional sound insulation to achieve appropriate internal noise levels. If the roof, is being utilized as a voided loft space with thermal insulation the following detailing is not required.

The ceilings in the roof space should consist of 100mm 45kg/m² fitted tightly between the 200mm roof joists and 2no. 15mm SoundBloc plasterboard fixed to resilient bars to achieve a uniform sound reduction. The expected performance as predicted within INSUL software is shown in the following table.

Frequency (Hz)	63	125	250	500	1K	2K	4K	R _w
Roof SRI	33	45	52	57	60	57	61	58

Table 12.0 – Roof SRI

Any other configuration of roof that would achieve at least these insulation figures will be suitable for the development.

c) Glazing

Windows can be considered the weakest point of a façade in terms of noise reduction from external noise. To provide a robust assessment the composite SRI required for the entire building envelope will be used to provide the glazing specification.

Glazed elements installed in all the living rooms and bedrooms require a minimum sound reduction index value as shown in Table 8.0, 9.0 and 10.0. The glazing units shown in the following table would provide a suitable sound reduction, any other window capable of providing this attenuation

will be suitable. The performance is specified for the whole window unit, including frame and other design features.

Façade	Location	Glazing Configuration	Attenuation (dB)
North-Eastern	Living Rooms	<i>Double Glazing</i> 6 mm Glass / 16 mm argon Cavity / 8.8 mm Pilkington Optiphon™ Glass	35 $R_w + C_{tr}$ 41 R_w^{**}
	Bedrooms	<i>Double Glazing</i> 6 mm Glass / 16 mm argon Cavity / 8.8 mm Pilkington Optiphon™ Glass	35 $R_w + C_{tr}$ 41 R_w^{**}
Southern and Eastern	Living Rooms	<i>Double Glazing</i> 6 mm Glass / (6 - 16 mm Air Cavity) / 6 mm Laminated Glass	33 $R_w + C_{tr}$ 38 R_w^{**}
	Bedrooms	<i>Double Glazing</i> 6 mm Glass / 16 mm argon Cavity/ 6.8 mm Pilkington Optiphon™ Glass	34 $R_w + C_{tr}$ 40 R_w^{**}

Table 13.0 – Glazing SRI

The octave band performance all specified glazing for the façade opposite the Taproom can be found in appendix F. The glazing system above will protect the amenity of the occupants of the dwellings against extraneous noise. The glazing specifications have been taken from the BS6262 – 2 and Pilkington’s Optiphon range however any glazing providing the same attenuation can be used.

d) *Ventilation*

BS8233 States;

"If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

and

"The Building Regulations’ supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant’s choice. Alternatively, acoustic ventilation units are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

It is recommended that an alternative ventilation system is installed to fully protect the amenity of future inhabitants. As stated in BS8233:2014 section 5.4.4, having complete enclosure of the noise source or receiver is the most effective barrier of sound. An alternative ventilation strategy allows for maximum sound insulation from the noise source whilst still maintaining a sufficient level of ventilation. It is recommended that the alternative ventilation should provide the same resistance to sound as the glazed elements. The following table provides ventilation systems that meets the above recommendations.

Model	Attenuation (dB)
Titon Sonair F+	55dB $D_{n,e,w}$
Titon V75 + C75	44dB $D_{n,e,w}$

Table 14.0 – Ventilation Specification

If the above ventilation systems are not deemed suitable for the development, then a mechanical heat-recovery ventilation (MHRV) system should be employed. It should be noted that if a MHRV system is used, the self-generating noise from the system will need to conform to the internal noise levels outlined in BS8233:2014.

e) Partition Floor

The Proposed Development is located on the 1st and 2nd floors of the building, and a commercial unit is located on the ground floor. For this reason, there is potential that noise breaking through the partition could adversely impact on future residents of the development. Consequently, the floor must be assessed to ensure the sound in the residential units above will comply with BS8233:2014. The building regulations part E states that an adjoining party floor between a commercial unit and a dwelling formed by material change of use requires a minimum sound reduction of 43 dB $D_{nt,w + Ctr}$, however, to ensure the amenity of future residents is protected we would suggest that it would need to provide a minimum sound reduction of 53 dB $D_{nt,w + Ctr}$, 10dB above the level stated in the building regulations. It is assumed that the existing floor is a minimum of 150mm concrete. This is predicted to provide a sound reduction of 50 dB $D_{nt,w + Ctr}$. Consequently, we would advise installing the following upgrades to ensure sufficient sound reduction.

- Suspended metal frame ceiling
- Min. 1 x 12.5mm SoundBloc plaster board.

This build-up would be predicted to score a $D_{nt,w + Ctr}$ of approximately 58 dB, which would provide the necessary sound reduction to achieve appropriate internal noise levels.

Appendix A – Acoustic Terminology

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 s ₁ and s ₂ is given by 20 log ₁₀ (s ₁ / s ₂). 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.

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, BS4142:2014 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125ms.



Appendix B – Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

National Planning Policy Framework (2018)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2018. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 170e, it states:

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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

Paragraph 180 states:

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; and*
- c) Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

Noise Policy Statement for England

Paragraph 123 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

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

To achieve this vision the Statement identifies the following three aims:

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

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

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and 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. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

ProPG: Planning & Noise

The Professional Practice Guidance on Planning and Noise (ProPG) has been produced to provide practitioners with guidance on the management of noise within the planning system in England.

Noise can have a significant effect on the environment and on the quality of life enjoyed by individuals and communities. For these reasons, noise is a material consideration in the planning process and a key aspect of sustainable development. Noise must therefore be considered and given serious attention when new developments might create additional noise and when new developments would be sensitive to the prevailing acoustic conditions.

It aims to:

- Advocate full consideration of the acoustic environment from the earliest possible stage of the development control process;
- Encourage the process of good acoustic design in and around new residential developments;

- Outline what should be taken into account in deciding planning applications for new noise-sensitive developments.
- Promote appropriate noise exposure standards; and
- Assist the delivery of sustainable development.

This document describes an acoustic design process which is multi-faceted and that seeks to deliver the best acoustic outcome for a particular site. The advice and procedures contained in the ProPG are restricted to the consideration of new residential development that will be exposed predominantly to airborne noise from existing transport sources. New housing is the most common type of new residential development, however the ProPG can also be applied to other types of residential developments such as residential institutions, care homes etc.

The document a Stage 1 Initial Site Risk Assessment, as follows:

Noise Risk Category	Potential Effect if unmitigated	Pre-Planning Application Guidance
0 – Negligible $L_{Aeq, 16hour} < 50dB$ $L_{Aeq, 8hour} < 40dB$	No adverse effect	These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.
1 - Low $L_{Aeq, 16hour} < 50 - 60dB$ $L_{Aeq, 8hour} < 40 - 50dB$	Adverse effect on health and quality of life	At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and the minimized in the finished development.
2 - Medium $L_{Aeq, 16hour} < 60 - 70dB$ $L_{Aeq, 8hour} < 50 - 60dB$	Significant adverse effect on health and quality of life	As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimize, and which clearly demonstrated that a significant adverse noise impact will be avoided in the finished development.
3 - High $L_{Aeq, 16hour} > 70dB$ $L_{Aeq, 8hour} > 60dB$	Unacceptable adverse effect on health and quality of life	High noise levels indicate that there is an increased risk that development may be refused on noise grounds. The risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice.

Table 15.0 – ProPG Stage 1 Initial Risk Assessment Criteria



BS8233:2014 `Guidance on sound insulation and noise reduction for buildings`

The British Standard BS 8233: 2014, Guidance on Sound insulation and noise reduction for buildings provides additional guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, WHO Guidelines on Community Noise, 1999. The criteria desirable levels of steady state, “anonymous” noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below:

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

Table 16.0 - BS8233 criteria for internal noise levels in dwellings

It is noted, however that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

The standard also recommends that for traditional external amenity areas, such as gardens, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, and that 55 dB $L_{Aeq,T}$ would be acceptable in noisier environments. However, it is recognised that these values may not be achievable in all areas where development is desirable and in such locations, development should be designed to achieve the lowest practicable levels.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the LOAEL as defined in the NPSE above.

ISO 9613-2 Attenuation of sound during propagation outdoors

The ISO 1996 series of standards specifies methods for the description of noise outdoors in community environments. Part 2 of ISO 9613 is intended to enable noise levels in the community to be predicted from sources of known sound emission. The method is general in the sense that it may be applied to a wide variety of noise sources, and cover most of the major mechanisms of attenuation.

This standard provides guidance on the outdoor propagation of sound. It is widely used to establish the different attenuations that occur during the transmission of the sound from the sources to the receivers. The total attenuation is the sum of the following: geometrical divergence, atmospheric absorption, ground effect, barriers, and miscellaneous other effects.

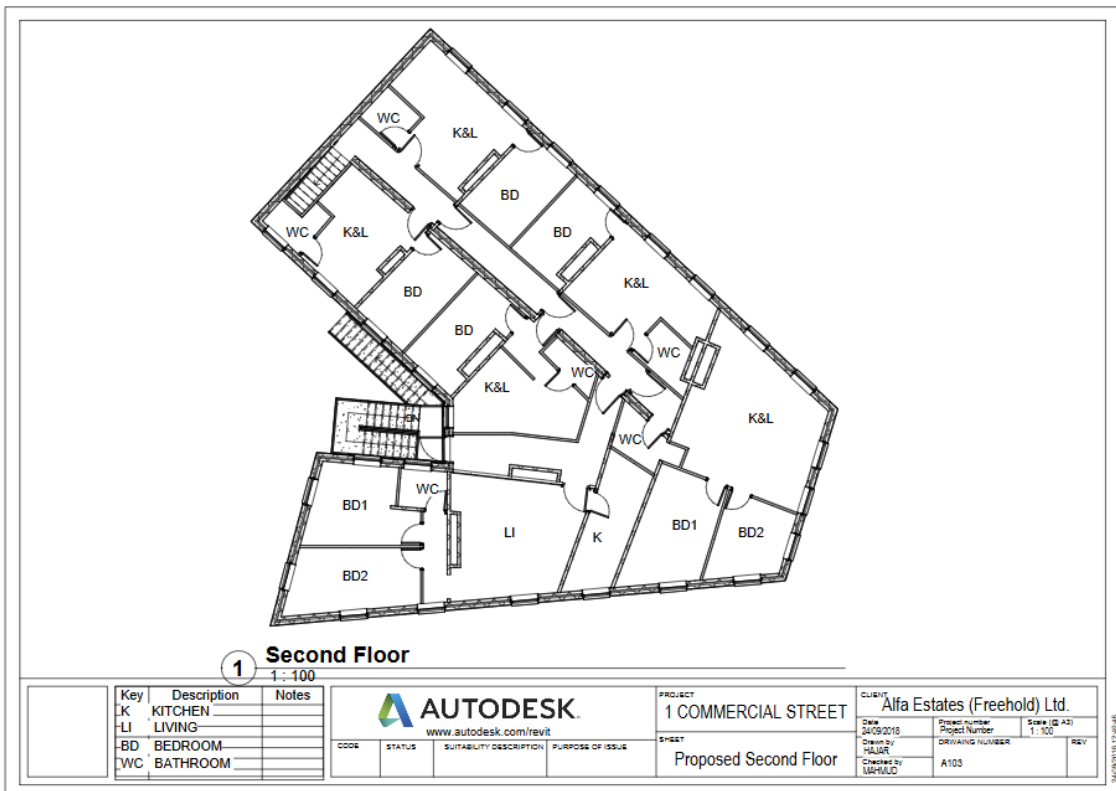
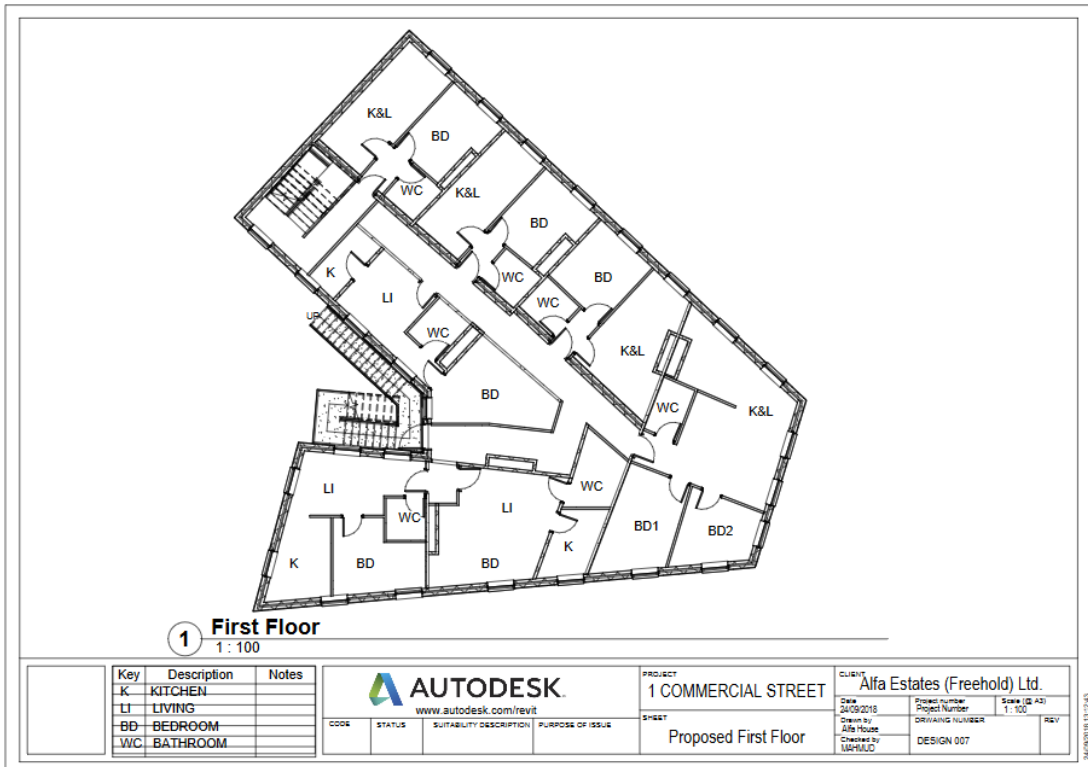
BS EN 12354-4 Building Acoustics

Estimation of acoustic performance of buildings from the performance of elements – Transmission of indoor sound to the outside

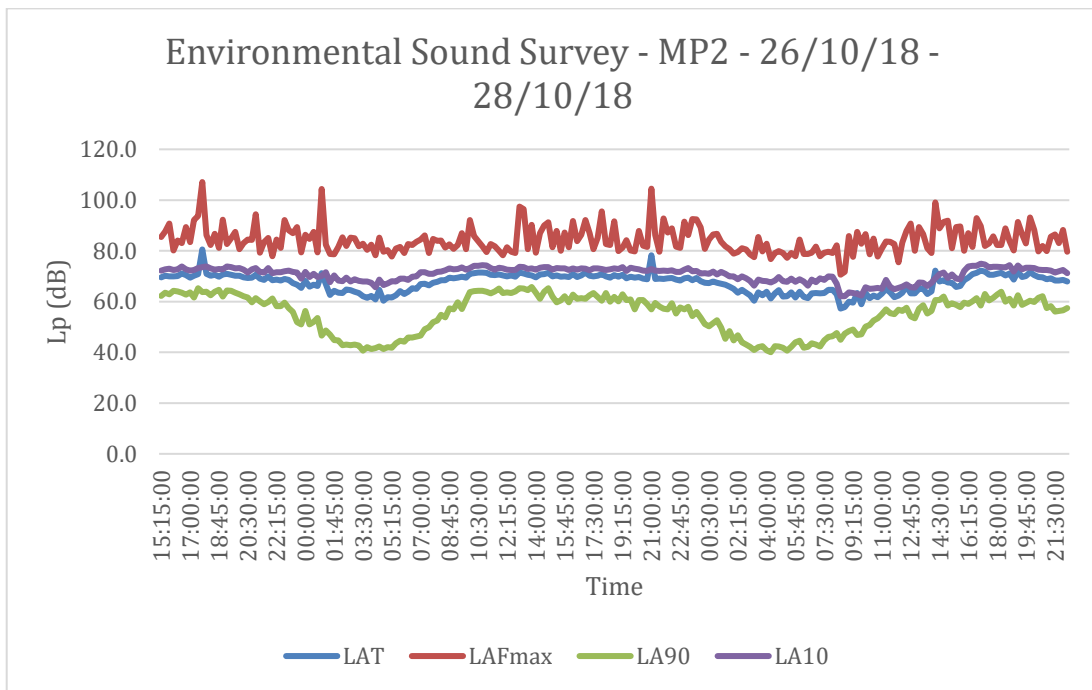
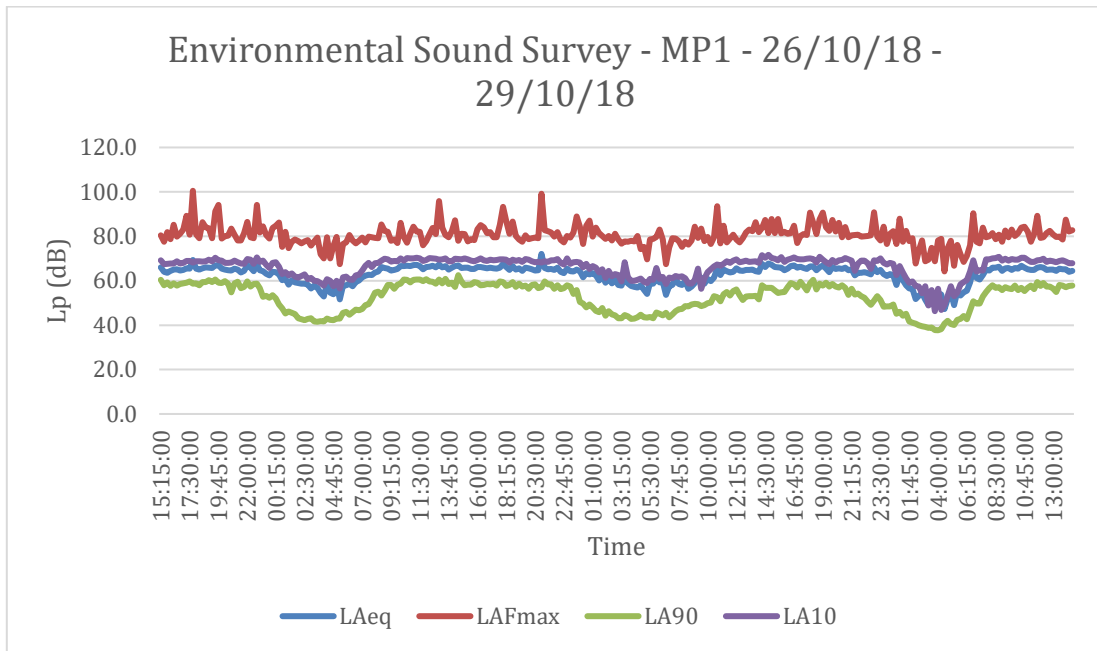
This European Standard describes a calculation model for the sound power level radiated by the envelope of a building due to airborne sound inside that building, primarily by means of measured sound pressure levels inside the building and measured data which characterize the sound transmission by the relevant elements and openings in the building envelope. These sound power levels, together with those of other sound sources in or in front of the building envelope, form the basis for the calculation of the sound pressure level at a chosen distance from a building as a measure for the acoustic performance of buildings.

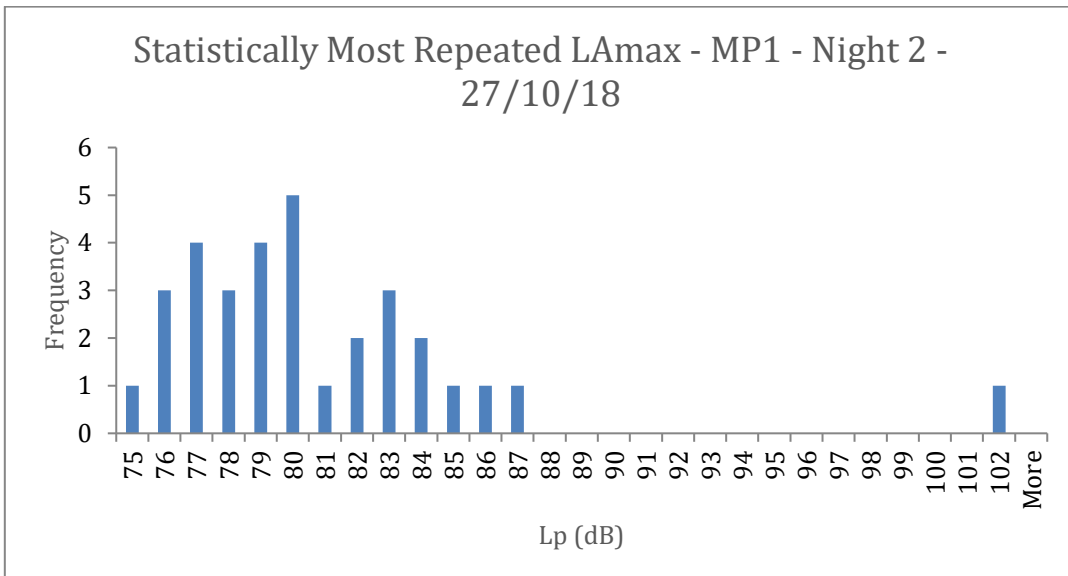
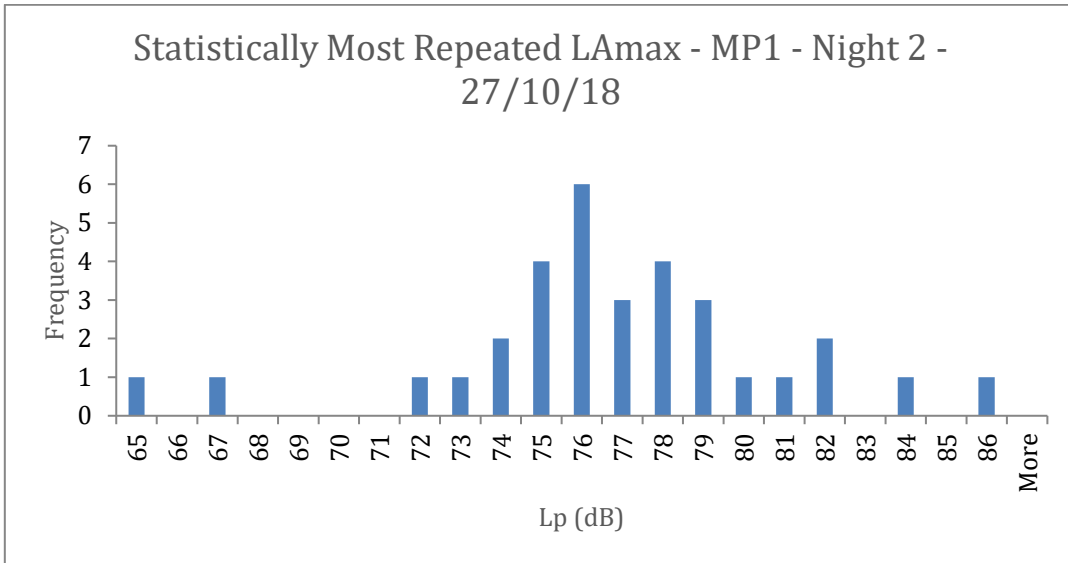


Appendix D – Site Plans



Appendix E – Environmental Sound Survey





Appendix F – Octave Band Glazing Spec

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R _w (C; C _v)	R _w	R _w +C	R _w +C _v
	125	250	500	1000	2000	4000				
Single glazing										
6.8 mm Pilkington Optiphon™	22	26	31	37	40	40	36 (-1; -4)	36	35	32
8.8 mm Pilkington Optiphon™	27	29	34	38	40	43	37 (0; -2)	37	37	35
10.8 mm Pilkington Optiphon™	26	30	35	39	40	46	38 (-1; -3)	38	37	35
12.8 mm Pilkington Optiphon™	29	32	36	41	42	51	40 (-1; -3)	40	39	37
16.8 mm Pilkington Optiphon™	31	33	38	41	43	54	41 (-1; -3)	41	40	38
Insulating glass units										
6 mm / 16 mm argon / 6.8 mm Pilkington Optiphon™	21	28	37	48	48	54	40 (-2; -6)	40	38	34
6 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™	25	27	38	48	47	55	41 (-2; -6)	41	39	35
8 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™	21	30	39	47	50	55	42 (-3; -8)	42	39	34
10 mm / 16 mm argon / 8.8 mm Pilkington Optiphon™	28	31	42	45	50	58	44 (-2; -6)	44	42	38
10 mm / 20 mm argon / 8.8 mm Pilkington Optiphon™	28	36	43	47	49	58	46 (-2; -6)	46	44	40
8.8 mm Pilkington Optiphon™ / 16 mm argon / 12.8 mm Pilkington Optiphon™	28	36	45	53	56	64	48 (-2; -7)	48	46	41
10.8 mm Pilkington Optiphon™ / 24 mm argon / 16.8 mm Pilkington Optiphon™	35	41	48	53	55	65	52 (-2; -6)	52	50	46
12.8 mm Pilkington Optiphon™ / 20 mm argon / 16.8 mm Pilkington Optiphon™	35	45	49	50	54	65	51 (-1; -4)	51	50	47

