NoiseAssess

Acoustics, Noise and Vibration Consultants

Project:	**Proposed Co-Op Food Store** **Former Bush Inn, Keresforth Hill Road, Barnsley**
Planning Reference:	**2016/1060**
Scope of Report	**Assessment of noise from the proposed mechanical services and deliveries**
Client:	Quest Property
Report Reference:	12183.01.v1 April 2017
Prepared by:	Matthew Gascoigne BSc (Hons) CEng MICE MIOA
Checked by:	Richard Housley BSc (Hons) MIOA

NoiseAssess Ltd

9 Rochester Road, Sheffield S10 4JP
Tel: 0114 230 2181, Email: matthew@noiseassess.co.uk

Also at: 33 Main Street, Stanton by Dale, Ilkeston DE7 4QH

Website: noiseassess.co.uk

Registered in England No. 07352339
Registered office 8 Church St, Nottingham NG5 8FB

CONTENTS

		PAGE
1.0	INTRODUCTION	3
2.0	CRITERIA	5
3.0	NOISE SURVEY	8
4.0	NOISE IMPACT ASSESSMENT AND RECOMMENDATIONS	9
5.0	CONCLUSIONS	16
6.0	REFERENCES	17
FIGURE 1. SITE LOCATION		18
FIGURE 2. PROPOSED SITE LAYOUT		19
FIGURE 3. NOISE MONITORING AND ASSESSMENT LOCATIONS		20
APPENDIX A1: ACOUSTIC TERMINOLOGY		21
APPENDIX A2: EXISTING NOISE LEVELS – SURVEY RESULTS		23

1.0 INTRODUCTION

1.1 This noise assessment has been commissioned by Quest Property in support of a planning application for the proposed conversion of the former Bush Inn at Keresforth Hill Road in Barnsley to a Co-Op mini supermarket.

1.2 This noise assessment has been requested by James Gardham, Pollution Prevention & Control Officer at Barnsley MBC Regulatory Services who has been consulted on the application by James Hyde, Planning Officer at Barnsley MBC.

1.3 The application site is bounded by Keresforth Hill Road (A6133) to the north; Keresforth Hall Road to the east; a former church, which appears to have been converted to a residential property, to the south and residential properties to the west. There are also residential properties on the other side of Keresforth Hill Road to the north and Keresforth Hall Road to the east. The site location is shown on Figure 1.

1.4 The existing former public house building on the site is to be converted to a mini supermarket and there will be parking to the south and east of the building. There will a plant compound to the west of the building and a service yard to the southwest of the building. The proposed layout is shown on Figure 2.

1.5 Figures 1 and 2 are taken from plans provided by Axis Architecture.

1.6 The nearest residential properties are on Keresforth Hill Road to the west and Keresforth Hall Road to the south as denoted by references R1 and R2 on Figure 3.

1.7 The layout plan shows a proposed 2.2m high timber fence to the western boundary of the plant area and a proposed 2.5m high timber fence to the southern boundary and the southern part of the western boundary.

1.8 The proposed trading hours have not yet been decided but for the purposes of this assessment it has been assumed that the store could be open for any period between 07:00-23:00 hrs. Therefore a

distinction has been made between plant which may operate in daytime hours only (07:00-23:00 hrs) - i.e. when the store is open - and plant that may be required to operate overnight (e.g. refrigeration plant). The proposed delivery hours have not yet been decided and are to be informed by the outcome of this noise assessment.

1.9 This report relates to the potential impact of the operational noise arising from mechanical services plant and servicing. It has been assumed that no assessment is required of noise from customer cars because this issue has not been raised in the email response from James Gardham.

2.0 CRITERIA

BS4142

2.1 The noise impact of commercial/industrial noise sources on existing residential properties is normally assessed in accordance with BS4142[1].

2.2 The scope of BS4142 is given in the extract below.

"1.1 This standard describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) Sound from industrial and manufacturing processes;

b) Sound from fixed installations which comprise mechanical and electrical plant and equipment;

c) Sound from the loading and unloading of goods and materials at industrial and / or commercial premises; and

d) Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and / or commercial site.

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident."

2.3 The standard compares sound from industrial / commercial sources with the background sound level. The standard states in Clause 9.1 that "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". Such features are taken into account by adding a correction to the specific sound level depending on the extent to which the distinguishing acoustic characteristics will attract attention. The standard states the following in Clause 9.2:

"Tonality: For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone that is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible".

"Impulsivity: A correction of up to 9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."

"Other sound characteristics: Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied."

"Where tonal and impulsive characteristics are present in the specific sound within the same reference period then these two corrections can both be taken into account. If one feature is dominant then it may be appropriate to apply a single correction. Where both features are likely to affect perception of response, the correction ought normally to be applied in a linear fashion."

"Intermittency: 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. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied".

Note: Although not clear in the standard it appears from the examples given that the intermittency penalty is for use when the specific sound source is intermittent but not particularly impulsive. Therefore it has been assumed that impulsive and intermittency penalties would not generally be both applied in a linear fashion.

2.4 BS4142 provides guidance on the assessment of impacts in Clause 11.

"11 Assessment of the impacts

COMMENTARY ON CLAUSE 11.

The significance of sound of an industrial / commercial nature depends upon both the margin by which the rating of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs / will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level, and consider the following:

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context".

2.5 BS4142 recommends that the specific sound level during daytime periods 07:00 - 23:00 hrs should be determined over a reference time interval of 1 hour and during night-time periods 23:00 - 07:00 hrs over a reference time interval of 15 minutes.

Assessment in Context

2.6 BS4142 recommends that the industrial sound should also be assessed in context. Therefore, the sound levels have been assessed in the context of the character of the area; the existing ambient noise levels and the criteria given in BS8233[2].

2.7 The BS8233 recommendations for indoor ambient noise levels are given below.

Table 1: BS8233 recommendations for indoor ambient noise levels

Activity	Location	07:00 to 23:00 hrs	23:00 to 07:00 hrs
Resting	Living room	35 $dBL_{Aeq,16hour}$	-
Dining	Dining room/area	40 $dBL_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 $dBL_{Aeq,16hour}$	30 $dBL_{Aeq,8hour}$

2.8 Paragraph 7.7.3.2 of BS8233 recommends that for traditional external amenity areas such as gardens and patios, it is desirable that during the daytime the external noise level does not exceed 50 $dBL_{Aeq,T}$ with an upper guideline value of 55 $dBL_{Aeq,T}$ which would be acceptable in noisier environments. The time period is not stated but is assumed to be 16 hours (07:00 hours to 23:00 hrs) as in the previous version of BS8233.

3.0 NOISE SURVEY

3.1 An unattended noise survey has been carried out from 12:00 hours on Friday 31/03/2017 to 11:00 hours on Monday 03/04/2017. The survey was carried out at the noise monitoring location marked as M on Figure 3. The location was to the rear of the existing building at first floor level. The microphone was extended on a pole 1m from the rear façade.

3.2 The noise survey was carried out using a Rion NL-31 Class 1 sound level meter (s/n 00583274). The sound level meter was calibrated using a portable Norsonic 1251 calibrator (s/n 32860) at the start and finish of the survey with no variation in the calibration level.

3.3 The weather conditions during the periods of attendance on site were dry with light winds (<5m/s). Weather forecasts / reports indicated that the weather conditions were similar for the majority of the unattended noise survey period.

3.4 The results of the noise survey are summarised below and are presented in full in Appendix A2. The L_{Aeq} values given are log averages of the 5-minute values and the L_{A90} values have been arithmetically averaged. The results in the tables below have been corrected to free-field by the subtraction of 3 dB(A).

Table 2. Summary of existing daytime noise levels, 31/03/17-03/03/17

Day	Start time	End time	Average dBL_{Aeq}	Average dBL_{A90}	Modal dBL_{A90}
Friday	12:00	00:00	53.7	46.9	49
Saturday	07:00	23:00	51.7	45.5	47
Sunday	07:00	23:00	50.4	41.9	45
Monday	07:00	11:00	54.0	49.5	-

Table 3. Summary of existing night-time noise levels, 31/03/17-03/03/17

Night	Start time	End time	Average dBL_{Aeq}	Average dBL_{A90}	Modal dBL_{A90}
Friday-Saturday	23:00	07:00	46.1	36.9	38
Saturday-Sunday	23:00	07:00	49.7	35.7	33
Sunday-Monday	23:00	07:00	47.8	39.8	36

4.0 NOISE IMPACT ASSESSMENT AND RECOMMENDATIONS

Criteria and Methodology

4.1 The potential noise impact of new mechanical services plant and deliveries has been assessed in accordance with BS4142[1]. An explanation of BS4142 can be found in Section 2 above.

Closest noise sensitive properties

4.2 The closest receptor locations used in this assessment are as detailed below and are shown on Figure 3.

R1: The closest residential properties on Keresforth Hill Road.

R2: The closest residential property on Keresforth Hall Road.

4.3 The existing noise levels measured at the monitoring location marked M on Figure 3 have been taken as representative of the existing noise levels at R1 and R2.

Mechanical Services Noise Design Targets

4.4 No information is available at this stage about the mechanical services plant. Therefore, noise design targets have been calculated as shown below. The design targets are based on the criterion that the BS4142 Rating Level should not exceed the Background Noise Level. BS4142 suggests that this level of plant noise would result in a low impact. Separate targets are given for plant which will run in daytime hours only and for plant which may run overnight. The targets are based on the lowest Modal dBL_{A90} levels (1-hour daytime and 15-mins at night). The required penalties are not know at this stage but a 2 dB tonal penalty and a 3 dB impulsive/intermittency penalty have been included as a precaution. This is in line with penalties normally required for mechanical services plant at other supermarket sites.

Table 4. Calculation of plant noise design targets at R1 & R2

Running period of plant	07:00-23:00hrs	24hrs
Measured Background Noise Level, dBL_{A90}	45	36
Allowable difference (Rating-Background), dB	0	0
Highest Permissible Rating Level, dB	45	36
Total of acoustic feature penalties, dB	5	5
Highest Permissible Specific Noise Level, dBL_{Aeq}	40	31

4.5 The above design targets relate to the total noise from all new plant. The design target for individual plant items should be reduced by 10xLog(n) where n is the number of sources likely to affect the same receiver. The distance and screening attenuation can be added to the above figures to give the noise limits at 1m.

Mechanical Services Noise in Context

4.6 BS4142 recommends that the noise also be judged in context. It is worthwhile comparing the recommended plant noise levels with the current ambient noise levels. The lowest ambient noise levels measured during the noise survey were 50 $dBL_{Aeq(16\text{-}hour)}$/46 $dBL_{Aeq(1\text{-}hour)}$ in the daytime and 46 $dBL_{Aeq(8\text{-}hour)}$/38 $dBL_{Aeq(15\text{-}min)}$ at night. The recommended plant noise levels at R1 are 40 dBL_{Aeq} in the daytime and 31 dBL_{Aeq} at night. Therefore, the plant noise level will be at least 6 dB(A) below lowest current daytime 1-hour ambient noise level and at least 7 dB(A) below the lowest current night-time 15-minute ambient noise level. Therefore the plant noise will not result in any significant increase in the ambient noise levels.

4.7 The noise levels can also be compared with absolute criteria given in BS8233[7]. The recommended plant noise levels at R1 are 40 dBL_{Aeq} in the daytime and 31 dBL_{Aeq} at night. The recommended daytime plant noise level is well below the lowest guideline level of 50 dBL_{Aeq} for outdoor amenity areas. The internal noise level produced by the plant within residential properties if their windows are open can be estimated using an attenuation of 10-15 dB(A) for an open window. This would be less than or equal to 30 dBL_{Aeq} during the daytime and 21 dBL_{Aeq} at night. These are low noise levels when compared with the recommended internal noise levels of 35 dBL_{Aeq} in the day and 30 dBL_{Aeq} at night. It is recognised that these criteria are for anonymous noise sources but the comparison is included here to give further assessment of the noise levels in context.

4.8 The assessment of the noise levels in context demonstrates that the recommended plant noise levels will be acceptable.

Control of Mechanical Services Noise

4.9 The mechanical services plant can be designed to meet the above noise targets at the detailed design stage. The following mitigation measures can be considered if necessary:

- Making the timber fencing proposed on the boundary as acoustic fencing. Acoustic fencing should have a minimum mass of 10kgm^2 and may be constructed from weather treated timber of minimum thickness 20mm with cover strips over the gaps between panels and gravel boards to seal the gap at the base.
- Extending the acoustic fencing further along the boundary to reduce the spillage of noise around the ends. Alternatively, returning it up to the building to completely surround the plant area.
- To reduce the reflection of noise from hard finishes it is recommended that an acoustically absorbent lining is added to the inside face of the acoustic fencing and to the wall of the building facing the plant area. The absorbent lining could be formed with mineral wool covered with perforated metal sheeting with a minimum 30% open area. Alternatively, proprietary panels could be used such as 'Tilon' noise absorptive panels (http://www.tiloncomposites.com/page22.html) or 'Prosonic' external acoustic panels (http://www.customaudiodesigns.co.uk/prosonic-external-acoustic-panels.htm).
- Selection of plant with a low noise rating, particularly for plant which will run at night.
- Measures can be applied to individual plant items such as enclosures; acoustic lagging; anti-vibration mounts and flexible connectors; damping sheets; attenuators; reducing velocity and turbulence in ductwork to reduce air-flow noise etc.

4.10 The above measures are indicative examples only and required measures can only be determined once plant noise levels are known. This report relates to acoustic matters only and any mitigation measures selected should be checked by specialists in other disciplines as required. The safety implications of

the installation of all products / material should be checked by the Client before use and appropriate systems of work put in place.

Servicing Noise

Delivery operations data

4.11 Deliveries to the new store will be carried out by reversing the vehicle into the car park on the south side of the store to the position shown on Figure 2. A tail lift will then be used to remove cages and they will be wheeled into the building via the service entrance.

4.12 The assessment of noise due to deliveries has been based on noise levels measured during deliveries at another Co-Op store in Sheffield. The noise readings were taken at 7m from the tail lift position when the vehicle was parked. The noise readings included arrival of the vehicle, off-loading of cages, loading empty cages and departure. The noise level generated was 62 dBL_{Aeq}. This was the log-average of a number of 5-minute measurements taken over a period of around 1-hour during a delivery.

Control of delivery noise

4.13 It is recommended that the boundary fencing proposed for the southern and western boundaries be constructed as acoustic fencing. Acoustic fencing should have a minimum mass of $10kgm^2$ and may be constructed from weather treated timber of minimum thickness 20mm with cover strips over the gaps between panels and gravel boards to seal the gap at the base. It has been assumed that the top of the fencing will be 2.5m above the yard level as shown on the drawings. Where the fencing is attached to the existing brick wall it should be sealed to the brickwork at the base.

Calculation of noise from deliveries

4.14 The closest residential windows to the proposed deliveries are at R2 (see Figure 3) and are around 12m from the proposed tail lift position when the vehicle is parked. These are gable end windows of the former church and it is not known whether they are to noise-sensitive areas. For the purposes of this

assessment a gable end window at ground level at R2 has been used as the nearest receptor. The windows of the properties at R1 will be further from the delivery position. The correction for distance required between the 7m source measurement positon and the 12m receptor positon is 5 dB(A) The 2.5m high boundary acoustic barrier proposed is expected to provide attenuation of 8 dB(A). Therefore the worst case delivery noise generated at the R2 properties gable end is expected to be 49 dBL_{Aeq}. Based on the measurements at the other store it is expected that this level of noise can be taken as applicable to the 1-hour reference period for daytime deliveries (07:00-23:00 hours). If night-time deliveries are required to be assessed over a 15-minute reference period it is expected that the level could be around 4 dB(A) higher due to the shorter time base. However, if assessment is required to upper floors at night they would not be screened by the boundary fencing and therefore the receptor noise level would be a further 8 dB(A) higher giving a night time worst case noise level of 61 dBL_{Aeq}.

BS4142 assessment of delivery noise

4.15 The BS4142 assessment of delivery noise to the nearest residential receivers is shown below. A 2 dB tonal penalty and a 3 dB impulsive/intermittency penalty have been added.

Table 5. BS4142 assessment of delivery noise at R2

Time	Day	Night
Specific noise level, $dBL_{A\,eq}$	49	61
Tonal Penalty, dB	2	2
Impulsive/Intermittency penalty, dB	3	3
Rating, dB	54	66
Background noise level, $dBL_{A\,90}$	45	36
Rating - background, dB	**9**	**30**

4.16 The results of indicate that night-time deliveries are unlikely to be acceptable at this site. The results also indicate that there could be an adverse impact from daytime deliveries. However, this is based on the modal background noise level for the Sunday and BS4142 also recommends that the noise levels must be judged in context. Daytime delivery noise is considered further below.

Daytime delivery noise considered in context

4.17 BS4142 recommends that the noise also be judged in context.

i) The lowest daytime (07:00-23:00 hours) ambient noise level measured during the noise survey was 46 $dBL_{Aeq(1\text{-}hr)}$. The calculated daytime delivery noise level is 49 $dBL_{Aeq(1\text{-}hr)}$. Therefore the delivery noise would result in a significant increase in the ambient noise level if the delivery occurred in the quietest daytime hour.

ii) The lowest daytime ambient noise level occurred on a Sunday in the 21:00-22:00 hours' period and it is unlikely that a delivery would occur at that time.

iii) It is normally considered that an increase of 3dB(A) is borderline acceptable based on the fact that 3dB(A) is the minimum change of noise level normally perceptible. It is recognised that this normally applies to continuous noise where there the character of the noise remains the same. However, this site is near to a busy main road and the premises were previously sued as a public house which could have resulted in higher noise impact. Therefore the above 3 dB(A) guideline has been used to give an indication of the daytime hours delivery restriction that could be applied in this case.

iv) Based on the criterion that deliveries should be permitted at times when the predicted delivery noise would be no higher than the current ambient noise level it may be advisable to restrict delivery hours at the weekends to 07:00-21:00 hours on Saturdays and 09:00-18:00 hours on Sundays. On the weekdays during the survey the measured ambient noise levels were above 49 $dBL_{Aeq,1\text{-}hr}$ free-field (52 $dBL_{Aeq,1\text{-}hr}$ façade) throughout the 07:00-23:00 hours period.

4.18 The noise levels can also be compared with absolute criteria given in BS8233[2]. The calculated daytime delivery noise level at the closest residential property is 49 dBL_{Aeq}. This level is below the lowest guideline level of 50 dBL_{Aeq} for outdoor amenity areas. The internal noise level produced by deliveries within residential properties if their windows are open can be estimated using an attenuation of 10-15 dB(A) for an open window. This would be around 34-39 dBL_{Aeq} which is around or just above the recommended daytime internal noise level of 35 dBL_{Aeq}. However, existing road traffic noise levels would be likely to be above this criterion if windows were open.

Summary of delivery noise assessment

4.19 The results of the BS4142 assessment and consideration in context indicate that deliveries should be allowed during the following times:

- 07:00-23:00 hours on weekdays
- 07:00-21:00 hours on Saturdays
- 09:00-18:00 hours on Sundays

4.20 Background noise levels have not been measured over a public holiday but for this kind of location it is considered likely that ambient noise levels on public holidays would be similar to those measured on the Saturday. Therefore on that basis public holiday delivery hours could be made the same as the Saturday delivery hours given above.

4.21 The assessment indicates that deliveries should be restricted to daytime hours and not take place at night (23:00-07:00 hours).

4.22 The above hours are a suggestion based on the noise survey results and they would need to be agreed with the Planning Officer and Environmental Health Officer at Barnsley MBC.

5.0 CONCLUSIONS

5.1 Noise design targets have been provided which can be used for the design of the mechanical services plant at the detailed design stage. Separate targets have been provided for plant which will run in the daytime only and for plant which may be required to run overnight.

5.2 Examples have been provided of noise mitigation measures which could be used to control the plant noise if necessary. The measures could include the upgrading of the proposed boundary fencing to an acoustic type of fencing and returning the fencing to the building at the sides of the plant area.

5.3 A 2.5 high acoustic fence is proposed on the southern boundary and part of the western boundary as shown on the proposed layout plan (Figure 2). It is recommended that this be upgraded to an acoustic type of fencing to provide some attenuation of delivery noise.

5.4 Based on indicative delivery noise calculations it has been recommended that delivery times be restricted to 07:00-23:00 hours on Monday to Friday; 07:00-21:00 hours on Saturdays and Public Holidays and 09:00-18:00 hours on Sundays. The results of the assessment indicate that deliveries should not be permitted during night-time hours (23:00-07:00 hours). These suggested hours would need to be checked and agreed with the Local Planning Authority.

6.0 REFERENCES

1. BS4142: British Standard 4142:2014, Methods for rating and assessing industrial and commercial sound.

2. BS8233: British Standard 8233, Guidance on sound insulation and noise reduction for buildings, BSI 2014.

FIGURE 1. SITE LOCATION

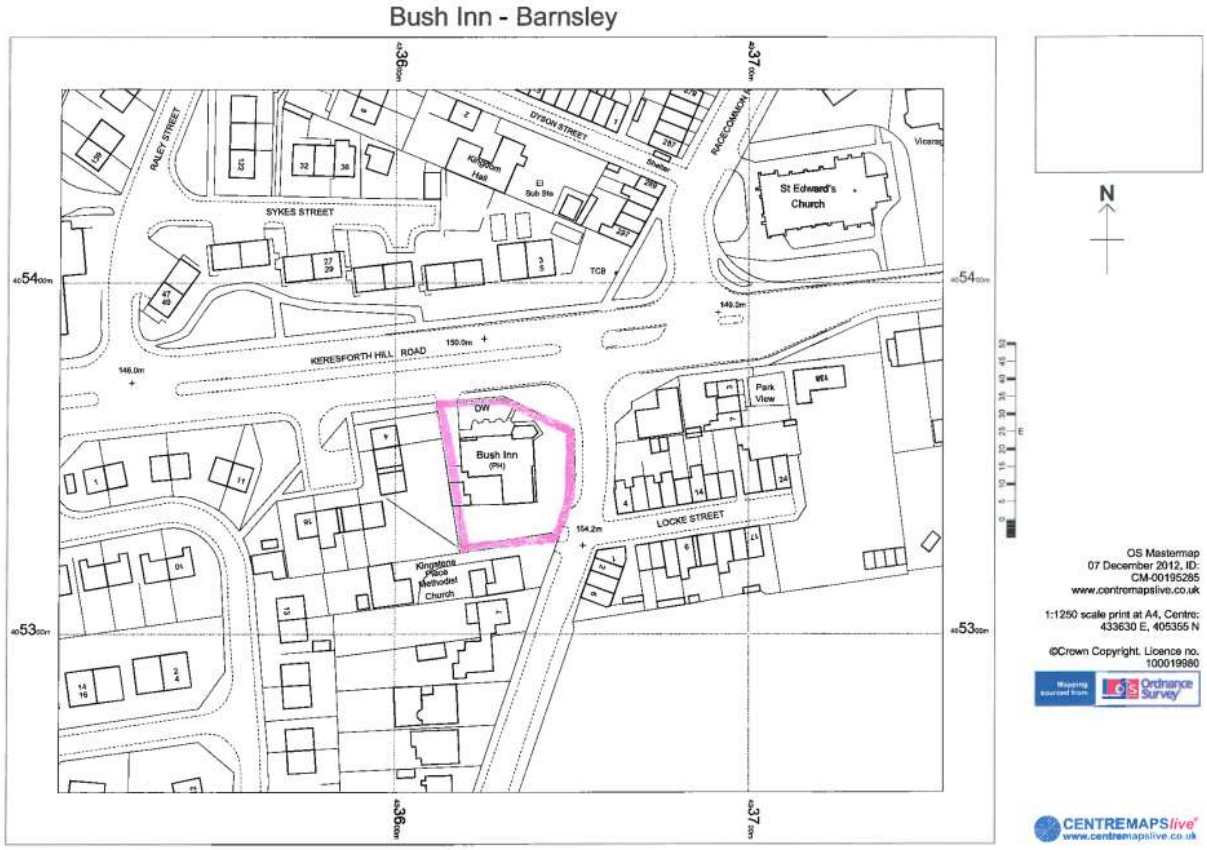


FIGURE 2. PROPOSED SITE LAYOUT

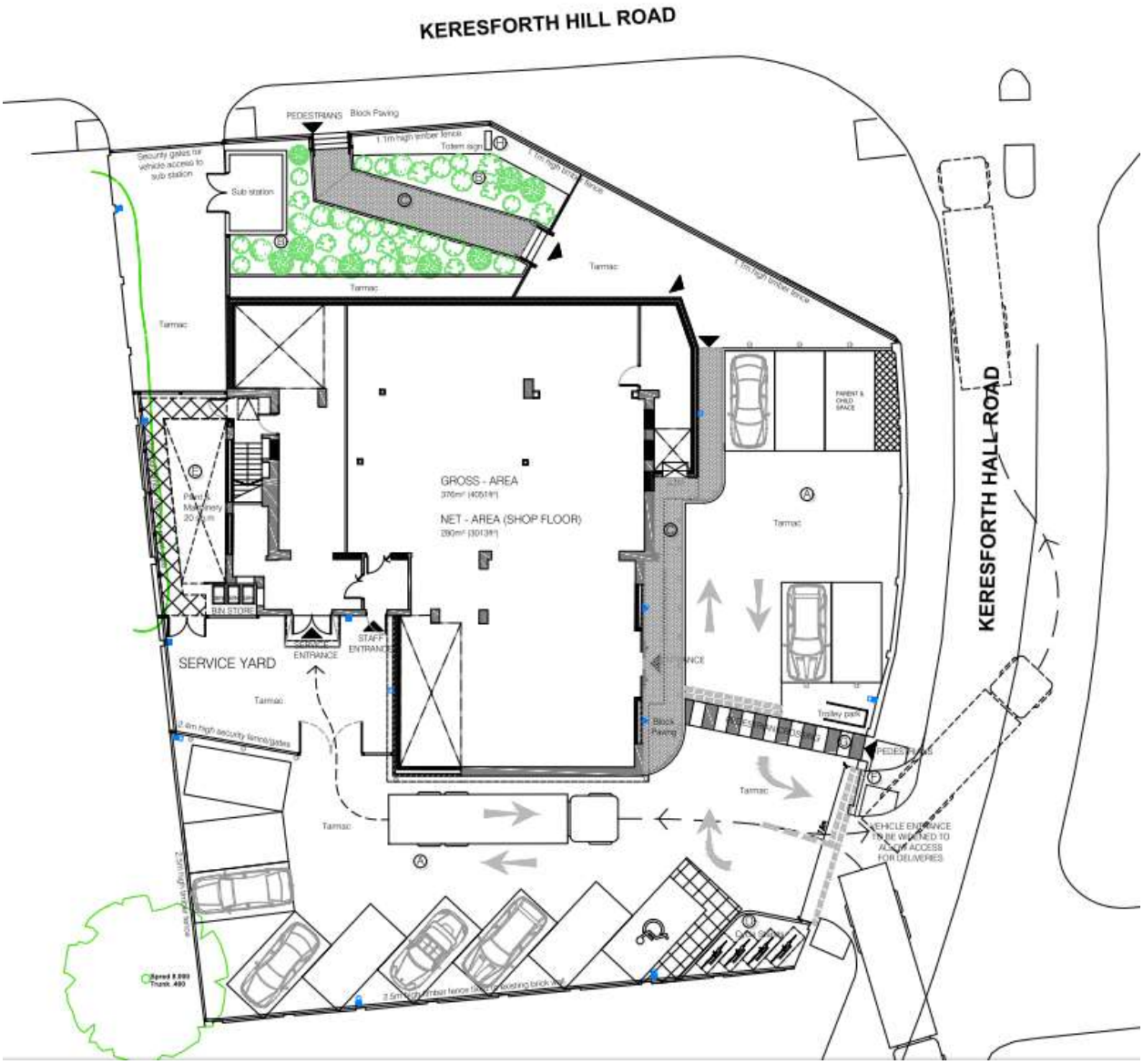
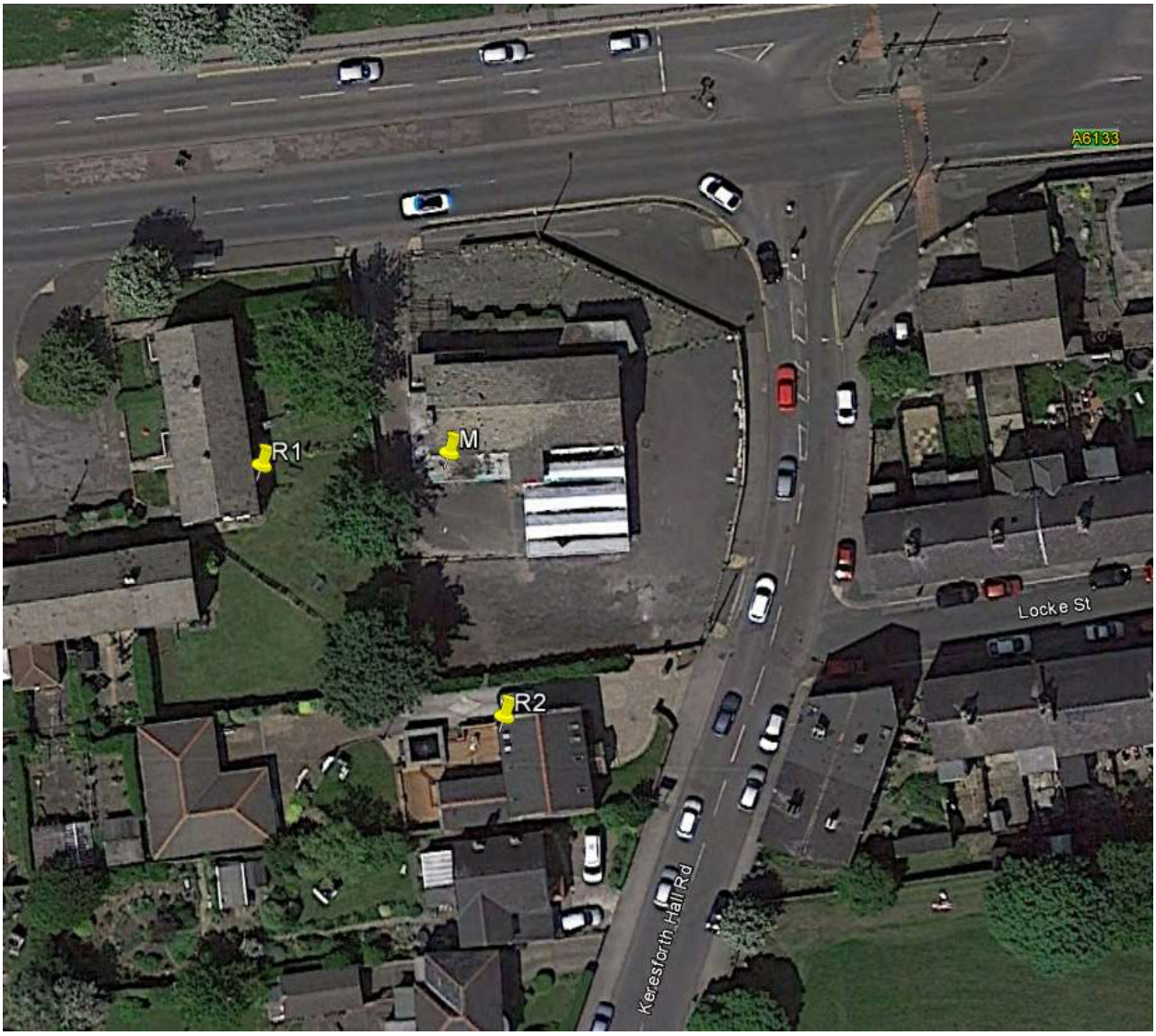


FIGURE 3. NOISE MONITORING AND ASSESSMENT LOCATIONS



APPENDIX A1: ACOUSTIC TERMINOLOGY

Ambient noise	The sound pressure level at a given location (i.e. sound from all sources) usually measured using the L_{Aeq} parameter.
A-weighting	A weighting applied to the frequencies which make up a sound pressure level to mimic the response of the human ear which is less responsive to low frequency sounds as it is to high frequency sounds. The resultant level after application of the weighting is called the 'A-weighted sound pressure level' and is denoted by dB(A) or by using a subscript A (e.g. dBL_{Aeq}).
Background noise	The noise measured in the absence of the noise under investigation usually using the statistical parameter L_{90} which represents the quietest parts of the measurement period.
Broadband sound	Sound which contains all the frequencies.
Decibel (dB)	A logarithmic measurement scale used for sound pressure levels. This scale is used because the simple use of sound pressures would be unwieldy as the range of pressures to which the human ear responds is very large. The normal threshold of hearing at 1kHz is 0dB. A level of $120dBL_{Aeq}$ is very loud (L signifies level and the A and eq are explained under A-weighting and L_{eq}). Some night club dance floors can have sound levels of around 110 dBL_{Aeq}. In the workplace the wearing of hearing protection is compulsory for staff who experience a noise level of over $85dBL_{Aeq}$ averaged over an 8-hour day and is normally used when the levels are over $80dBL_{Aeq}$ averaged over the 8-hour day. Noise intrusion levels into bedrooms (e.g. from traffic noise) are often controlled to below $30dBL_{Aeq}$ in the design of new properties (standards sometimes vary between authorities). Noise levels of below $20dBL_{Aeq}$ are very quiet and would normally only be achieved in a well designed recording studio. Although noise calculations are normally carried out using figures to 1 decimal place the results are often presented to the nearest dB as changes of a fraction of a dB are not normally perceptible even in controlled conditions.
Facade noise level	Noise level including a contribution from the reflection from a building facade, usually measured at 1m from the facade.
Free field	Noise levels with no contribution from reflections from nearby structures.
Hertz	The units used for frequency denoted by Hz, i.e. the number of cycles of pressure fluctuation per second. K used in front of Hz represents 1000 (1kHz = 1000Hz). High frequency sounds (e.g. 8kHz) are high pitched and low frequency sounds (e.g. 63Hz) are the bass notes.

L_{eq}	A parameter used to denote the 'equivalent continuous sound pressure level'. This is the sound pressure level of a continuous sound that would contain the same energy as the varying sound being measured or investigated. L_{Aeq} is the parameter used to denote the 'A-weighted equivalent continuous sound pressure level' (see A-weighting).
L_{10}	A statistical parameter often used for the measurement of road traffic noise. It is the level exceeded for 10% of the time period being considered. If A-weighted a subscript A is included and the time period can also be included in subscript, e.g. $L_{A10,\ 1hour}$.
L_{90}	A statistical parameter often used for the measurement of background noise levels. It is the level exceeded for 90% of the time period being considered. If A-weighted a subscript A is included and the time period can also be included in subscript, e.g. $L_{A90,\ 5min}$.
L_{max}	The maximum noise level which occurred during the monitoring period. $L_{Amax,f}$ denotes the maximum A-weighted sound pressure level using the fast time constant of 125ms.
Loudness	Although a 3dB increase is equivalent to a doubling of the sound power level of a sound source this increase is the minimum perceptible under normal conditions. It takes a 10dB change in noise level for it to sound roughly twice (or half) as loud subjectively.
Rating Level	A term used in BS4142. The 'Specific Noise Level' plus a 5dB weighting if the noise has certain characteristic features which may make it more disturbing.
Residual noise	The ambient noise remaining when the specific noise source being investigating is not contributing to the noise level at that location (normally measured using the L_{Aeq} parameter).
Specific Noise Level	A term used in BS4142. The L_{Aeq} noise level produced at the assessment position by the noise source being investigated over the reference time period (1-hour in the day and 5-mins at night).
SEL	Single Event Level. The total sound energy of a noise event (e.g. a train pass-by) compressed into 1 second. i.e. . the 1 second L_{Aeq} which has the same total A-weighted energy as the entire event.

APPENDIX A2: EXISTING NOISE LEVELS – SURVEY RESULTS

Daytime Noise Measurements

Table A2.1: Daytime Noise Survey Data
Friday 31 Mar 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
31/03/2017	12:00:02	01:00:00	57.1	88.4	52.4
31/03/2017	13:00:02	01:00:00	56.2	71.3	51.7
31/03/2017	14:00:02	01:00:00	55.2	69.9	51.9
31/03/2017	15:00:02	01:00:00	55.6	77.5	51.9
31/03/2017	16:00:02	01:00:00	57.6	87.2	52.1
31/03/2017	17:00:02	01:00:00	61.4	86.8	52.0
31/03/2017	18:00:02	01:00:00	56.7	80.0	50.7
31/03/2017	19:00:02	01:00:00	54.1	70.8	49.2
31/03/2017	20:00:02	01:00:00	53.2	74.7	47.4
31/03/2017	21:00:02	01:00:00	55.3	88.0	45.7
31/03/2017	22:00:02	01:00:00	54.6	85.5	44.4
AVERAGE			56.7	-	49.9
HIGHEST			61.4	88.4	52.4
LOWEST			53.2	69.9	44.4
MODE			-	-	52

Table A2.2: Daytime Noise Survey Data
Saturday 01 Apr 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
01/04/2017	07:00:02	01:00:00	52.1	78.0	44.2
01/04/2017	08:00:02	01:00:00	53.7	69.2	46.7
01/04/2017	09:00:02	01:00:00	54.1	77.7	47.3
01/04/2017	10:00:02	01:00:00	54.4	67.6	49.4
01/04/2017	11:00:02	01:00:00	55.6	89.1	50.0
01/04/2017	12:00:02	01:00:00	54.8	65.7	50.4
01/04/2017	13:00:02	01:00:00	57.4	88.7	50.8
01/04/2017	14:00:02	01:00:00	55.3	77.6	50.5
01/04/2017	15:00:02	01:00:00	56.1	79.5	51.8
01/04/2017	16:00:02	01:00:00	55.4	76.8	50.4
01/04/2017	17:00:02	01:00:00	55.4	78.3	50.1
01/04/2017	18:00:02	01:00:00	54.8	75.6	49.1
01/04/2017	19:00:02	01:00:00	56.5	85.8	48.5
01/04/2017	20:00:02	01:00:00	52.1	70.5	46.8
01/04/2017	21:00:02	01:00:00	51.4	78.7	45.2
01/04/2017	22:00:02	01:00:00	50.7	68.2	44.9
AVERAGE			54.7	-	48.5
HIGHEST			57.4	89.1	51.8
LOWEST			50.7	65.7	44.2
MODE			-	-	50

Table A2.3: Daytime Noise Survey Data
Sunday 02 Apr 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
02/04/2017	07:00:02	01:00:00	51.3	77.8	43.4
02/04/2017	08:00:02	01:00:00	51.3	68.5	44.8
02/04/2017	09:00:02	01:00:00	52.5	66.4	45.5
02/04/2017	10:00:02	01:00:00	53.3	70.7	47.3
02/04/2017	11:00:02	01:00:00	53.7	69.2	47.6
02/04/2017	12:00:02	01:00:00	56.7	87.6	47.6
02/04/2017	13:00:02	01:00:00	55.1	80.0	47.9
02/04/2017	14:00:02	01:00:00	56.1	84.6	47.8
02/04/2017	15:00:02	01:00:00	52.7	77.8	46.4
02/04/2017	16:00:02	01:00:00	53.0	74.3	46.5
02/04/2017	17:00:02	01:00:00	53.1	74.7	46.6
02/04/2017	18:00:02	01:00:00	55.2	79.4	46.3
02/04/2017	19:00:02	01:00:00	52.3	76.4	44.7
02/04/2017	20:00:02	01:00:00	51.1	74.5	42.8
02/04/2017	21:00:02	01:00:00	48.8	72.6	38.6
02/04/2017	22:00:02	01:00:00	49.6	75.8	34.5
AVERAGE			53.4	-	44.9
HIGHEST			56.7	87.6	47.9
LOWEST			48.8	66.4	34.5
MODE			-	-	48

Table A2.4: Daytime Noise Survey Data
Monday 03 Apr 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
03/04/2017	07:00:02	01:00:00	57.3	67.5	54.8
03/04/2017	08:00:02	01:00:00	55.7	69.2	51.8
03/04/2017	09:00:02	01:00:00	57.4	80.5	52.5
03/04/2017	10:00:02	01:00:00	57.5	85.8	50.7
AVERAGE			57.0	-	52.5
HIGHEST			57.5	85.8	54.8
LOWEST			55.7	67.5	50.7
MODE			-	-	None

Night-time Noise Measurements

Table A2.5: Night time Noise Survey Data
Friday 31 Mar 2017 to Saturday 01 Apr 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
31/03/2017	23:00:02	00:15:00	52.4	82.6	42.9
31/03/2017	23:15:02	00:15:00	55.1	75.7	42.4
31/03/2017	23:30:02	00:15:00	47.7	65.4	41.0
31/03/2017	23:45:02	00:15:00	48.4	63.2	41.3
01/04/2017	00:00:02	00:15:00	47.4	59.8	41.1
01/04/2017	00:15:02	00:15:00	48.0	62.6	41.0
01/04/2017	00:30:02	00:15:00	46.4	59.4	40.4
01/04/2017	00:45:02	00:15:00	46.9	58.7	41.1
01/04/2017	01:00:02	00:15:00	46.6	62.5	40.6
01/04/2017	01:15:02	00:15:00	46.3	61.2	39.4
01/04/2017	01:30:02	00:15:00	45.0	58.8	39.1
01/04/2017	01:45:02	00:15:00	44.8	59.0	39.0
01/04/2017	02:00:02	00:15:00	42.3	57.5	36.5
01/04/2017	02:15:02	00:15:00	52.4	82.0	38.9
01/04/2017	02:30:02	00:15:00	44.3	61.5	37.9
01/04/2017	02:45:02	00:15:00	44.1	56.8	38.3
01/04/2017	03:00:02	00:15:00	45.7	64.8	39.3
01/04/2017	03:15:02	00:15:00	44.0	62.1	36.5
01/04/2017	03:30:02	00:15:00	45.2	59.5	38.7
01/04/2017	03:45:02	00:15:00	44.4	63.7	37.6
01/04/2017	04:00:02	00:15:00	44.8	59.1	35.7
01/04/2017	04:15:02	00:15:00	42.2	59.1	36.8
01/04/2017	04:30:02	00:15:00	41.6	61.1	35.5
01/04/2017	04:45:02	00:15:00	43.1	58.2	37.7
01/04/2017	05:00:02	00:15:00	44.9	58.1	38.7
01/04/2017	05:15:02	00:15:00	46.7	59.1	39.8
01/04/2017	05:30:02	00:15:00	48.3	63.9	42.8
01/04/2017	05:45:02	00:15:00	55.0	75.1	42.2
01/04/2017	06:00:02	00:15:00	55.4	72.8	41.4
01/04/2017	06:15:02	00:15:00	50.3	62.2	44.2
01/04/2017	06:30:02	00:15:00	50.6	61.6	44.9
01/04/2017	06:45:02	00:15:00	51.0	64.0	45.0
AVERAGE			49.1	-	39.9
HIGHEST			55.4	82.6	45.0
LOWEST			41.6	56.8	35.5
MODE			-	-	41

Table A2.6: Night time Noise Survey Data
Saturday 01 Apr 2017 to Sunday 02 Apr 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
01/04/2017	23:00:02	00:15:00	55.4	73.2	44.7
01/04/2017	23:15:02	00:15:00	66.1	84.6	45.3
01/04/2017	23:30:02	00:15:00	50.5	64.8	45.1
01/04/2017	23:45:02	00:15:00	52.7	79.8	42.9
02/04/2017	00:00:02	00:15:00	48.3	62.6	41.2
02/04/2017	00:15:02	00:15:00	48.9	65.2	41.0
02/04/2017	00:30:02	00:15:00	47.2	61.6	39.7
02/04/2017	00:45:02	00:15:00	46.5	60.8	40.9
02/04/2017	01:00:02	00:15:00	47.6	63.5	39.7
02/04/2017	01:15:02	00:15:00	45.8	59.6	38.0
02/04/2017	01:30:02	00:15:00	46.8	60.9	37.5
02/04/2017	01:45:02	00:15:00	44.8	60.6	36.7
02/04/2017	02:00:02	00:15:00	44.8	58.8	36.9
02/04/2017	02:15:02	00:15:00	47.6	73.7	36.2
02/04/2017	02:30:02	00:15:00	44.6	63.5	35.2
02/04/2017	02:45:02	00:15:00	42.2	56.0	36.0
02/04/2017	03:00:02	00:15:00	43.5	62.3	34.4
02/04/2017	03:15:02	00:15:00	43.7	61.1	34.5
02/04/2017	03:30:02	00:15:00	46.7	69.0	34.4
02/04/2017	03:45:02	00:15:00	44.4	64.0	34.5
02/04/2017	04:00:02	00:15:00	43.5	65.4	33.3
02/04/2017	04:15:02	00:15:00	41.7	57.0	34.8
02/04/2017	04:30:02	00:15:00	43.5	61.8	34.0
02/04/2017	04:45:02	00:15:00	41.4	54.8	36.1
02/04/2017	05:00:02	00:15:00	43.3	58.6	36.3
02/04/2017	05:15:02	00:15:00	45.4	58.3	38.4
02/04/2017	05:30:02	00:15:00	46.3	58.1	39.8
02/04/2017	05:45:02	00:15:00	48.6	64.2	41.5
02/04/2017	06:00:02	00:15:00	50.5	69.6	42.3
02/04/2017	06:15:02	00:15:00	48.1	62.3	42.9
02/04/2017	06:30:02	00:15:00	48.7	64.9	42.2
02/04/2017	06:45:02	00:15:00	49.7	60.4	43.1
AVERAGE			52.7	-	38.7
HIGHEST			66.1	84.6	45.3
LOWEST			41.4	54.8	33.3
MODE			-	-	36

Table A2.7: Night time Noise Survey Data
Sunday 02 Apr 2017 to Monday 03 Apr 2017

Date	Start (h:m:s)	Period (h:m:s)	Façade noise levels (dB)		
			L_{Aeq}	$L_{Amax(f)}$	L_{A90}
02/04/2017	23:00:02	00:15:00	46.5	64.1	34.2
02/04/2017	23:15:02	00:15:00	45.6	61.4	34.5
02/04/2017	23:30:02	00:15:00	47.6	60.8	36.9
02/04/2017	23:45:02	00:15:00	47.0	64.2	39.6
03/04/2017	00:00:02	00:15:00	46.1	59.5	41.0
03/04/2017	00:15:02	00:15:00	45.7	64.4	37.9
03/04/2017	00:30:02	00:15:00	47.8	63.7	38.7
03/04/2017	00:45:02	00:15:00	45.8	59.9	38.5
03/04/2017	01:00:02	00:15:00	47.5	63.2	38.7
03/04/2017	01:15:02	00:15:00	46.5	59.3	40.3
03/04/2017	01:30:02	00:15:00	45.1	57.9	39.1
03/04/2017	01:45:02	00:15:00	45.2	57.7	37.7
03/04/2017	02:00:02	00:15:00	44.2	59.5	37.4
03/04/2017	02:15:02	00:15:00	46.5	58.1	40.8
03/04/2017	02:30:02	00:15:00	45.4	62.8	37.9
03/04/2017	02:45:02	00:15:00	45.3	58.4	38.8
03/04/2017	03:00:02	00:15:00	44.6	61.1	39.8
03/04/2017	03:15:02	00:15:00	46.6	65.5	40.4
03/04/2017	03:30:02	00:15:00	50.1	85.6	41.1
03/04/2017	03:45:02	00:15:00	44.9	53.9	41.5
03/04/2017	04:00:02	00:15:00	46.9	62.0	41.6
03/04/2017	04:15:02	00:15:00	49.3	62.3	45.1
03/04/2017	04:30:02	00:15:00	49.4	64.0	45.3
03/04/2017	04:45:02	00:15:00	50.0	60.9	46.7
03/04/2017	05:00:02	00:15:00	51.7	61.8	48.0
03/04/2017	05:15:02	00:15:00	53.1	63.3	50.2
03/04/2017	05:30:02	00:15:00	54.7	75.2	51.4
03/04/2017	05:45:02	00:15:00	54.6	64.5	51.2
03/04/2017	06:00:02	00:15:00	55.6	67.1	52.8
03/04/2017	06:15:02	00:15:00	56.1	64.8	53.7
03/04/2017	06:30:02	00:15:00	56.4	70.1	53.5
03/04/2017	06:45:02	00:15:00	56.9	65.6	54.2
AVERAGE			50.8	-	42.8
HIGHEST			56.9	85.6	54.2
LOWEST			44.2	53.9	34.2
MODE			-	-	39