S. & D. Garritt Ltd.

Acoustic Design
Testing & Consultancy

Vicarage Cottage, High Street, Wadworth, Doncaster DN11 9BG. Tel: 01302 854303 contact@sdgarritt.co.uk

ACOUSTIC REPORT

for

PROPOSED RESIDENTIAL DEVELOPMENT

at

HAICHS BUILDINGS, FIRTH STREET AND B6432, HUDDERSFIELD

Date of visits:	22nd & 23rd November, 1st December 2023
Date of report:	5th December 2023
Prepared for:	Acumen Designers & Architects, Shound Property Ltd
Prepared by	David Garritt, BEng, MIOA

Members of the Association of Noise Consultants (ANC) & Institute of Acoustics (IOA)
Originally established in 1981. Company number 4688174.

CONTENTS

1.0 Introduction

The existing Haichs Buildings located at the junction of Firth Street and the B6432 / Kings Bridge Road are currently used as a House of Multiple Occupation (HMO), consisting of ground and first floor accommodation.

A planning application is being submitted to remodel the existing ground and first floors, also constructing new second and third floors to provide an extended and improved house of multiple occupation offering, predominantly for the student market.

1.1 Summary Conclusions

A survey was undertaken of the existing sound climate at the site. The existing building is constructed immediately at the edge of the pavements of Firth Street and the B6432 and so the site is unsuitable for leaving equipment unattended for long periods of time. The existing sound climate was quantified using a series of attended measurements around the site

The dominant sound source at all times was road traffic. The adjacent development of student accommodation features a small convenience store 'Dorm Express' that includes two condensers/chillers located in the rear courtyard. A hot food takeaway 'Top Taste' is located to the south of the proposed development site, which includes two condenser/chiller items of fixed plant and two extract chimneys. A small commercial unit to the south of the site is occupied by a catering company.

Sound from all of these premises received at the proposed development is assessed and found to be significantly below the environmental background sound level at all times. The BS 4142 assessment concludes that there is no adverse impact from these commercial operations.

Sound levels from road traffic affecting the Firth Street and B6432 elevations are typically 70 – 72 dB $LA_{eq,15mins}$ during the daytime and 67 – 72 dB $LA_{eq,15mins}$ during the first or last hours of night.

Short duration peaks are generally 82 – 83 dB $LA_{max,f}$ at night in each of the 15 minute measurement logging periods.

An acoustic specification is given for the building elevations that targets compliance with the normal British Standards and guidance documents for internal sound level. There are two alternative specifications for the ground and first floor elevations where the existing building already features residential accommodation. The lower of the specifications is commercially and practicably more feasible, but results in some small exceedances above the normal requirements for short duration peak sound levels. Some

decision is needed by the Local Planning Authority on the acceptability of these exceedances and therefore which of the acoustic specifications should apply. Full commentary and discussion is given in the main body of the report.

It is concluded that the building can be constructed in a manner to offer a satisfactory internal acoustic environment.

2.0 Standards and Guidance Documents

The standards and guidance documents relevant to this site are listed below and summarised in this section of the report:

- Central Government policy, which sets the overarching objectives for all development
- BS 8233 : 2014 'Guidance on sound insulation and noise reduction for buildings' for indoor sound levels caused by outdoor environmental and general sources
- Additional guidance issued by the World Health Organisation on acceptable sound levels within dwellings.
- BS 4142 : 2014 'Methods for rating and assessing industrial and commercial sound' for noise impact arising from existing commercial sources.
- The Acoustics, Ventilation and Overheating (AVO) guide

2.1 Central Government Policies

The government's planning policies are described in the National Planning Policy Framework (NPPF) which includes consideration of potential adverse impacts of noise caused by new development. The NPPF makes reference to the Noise Policy Statement for England (NPSE) which includes an Explanatory Note describing three incremental categories of noise impact:

- No Observed Effect Level (NOEL) being the situation below which no effect caused by noise can be detected,
- Lowest Observable Adverse Effect Level (LOAEL) being the situation above which adverse effects caused by noise can be detected,
- Significant Observed Adverse Effect Level (SOAEL) being the level above which significant adverse effects caused by noise occur.

Stated objectives of the NPSE are:

1. Avoid significant adverse impacts, usually interpreted as calling for sound levels above SOAEL to be avoided.

2. Mitigate and minimise adverse impacts, usually interpreted as calling for noise mitigation to be used within the bounds of practicality for situations between LOAEL and SOAEL.

3. Where possible contribute to the improvement of health and quality of life, usually interpreted as calling for noise reductions to be made where possible for situations between NOEL and LOAEL.

Although introducing these subjective concepts for the assessment of impact, the NPPF and NPSE documents do not provide quantitative values against which the suitability of a site for development can be assessed in terms of sound levels.

2.2 **BS 8233: 2014**

BS 8233 provides guidance on interior sound levels inside various building interiors caused by external sources of an anonymous nature, for example flowing road traffic and mixed environmental sound. It is recommended that the internal ambient sound levels in dwellings do not exceed:

Living rooms	35 dB LA_{eq}	from 07.00-23.00
Dining rooms	40 dB LA_{eq}	from 07.00-23.00
Bedrooms	35 dB LA_{eq}	from 07.00-23.00
	30 dB LA_{eq}	from 23.00-07.00
Gardens	50 dB LA_{eq}	is the desirable limit
	55 dB LA_{eq}	is the upper guideline value.

The above sound limits are described in BS 8233 as applying to “steady external noise sources”. A note in paragraph 7.7.1 of the same document states that “Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.”

BS 8233 describes a ‘More Rigorous’ calculation procedure for the prediction of internal sound levels and this guidance is adopted for this report.

2.3 **World Health Organisation: 2000**

Guidance from the WHO gives additional guidance to BS 8233 on the interior sound levels in bedrooms at which sleep disturbance can be expected to occur:

Bedrooms	30 dB LA_{eq} }	to avoid sleep
	45 dB LA_{max}}	disturbance

The guidance on LA_{max} is usually intended to apply to sound from regular and typical events only. The definition of 'regular and typical' is open to some interpretation and depends on the context and sources being considered.

2.4 **BS 4142: 2014**

The noise rating method of BS 4142 is to measure or predict the outdoor sound levels at noise-sensitive premises during the emission of noise from the industrial or commercial premises under investigation and measure the background sound level typical of that location in the absence of the industrial or commercial noise. A correction factor is applied if appropriate to the measured levels for some acoustic features that affect acceptability, described as tonal, impulsive or other characteristic features which are distinctive against the residual acoustic environment. The corrected measured level, the rating level, is compared with the background.

- If the rating level exceeds the background by around +10 dB or more then this is an indication of a significant adverse impact, depending on the context.

- A difference of around +5 dB is an indication of an adverse impact, depending on the context.

- The lower the rating level is relative to the background, the less likely it is that the industrial / commercial source will have an adverse impact.

- Where the rating level does not exceed the background, this is an indication of the industrial / commercial source having a low impact, depending on the context.

Situations where a noise impact assessment may need to be modified due to the context include those where:

- The residual sound levels in the absence of the industrial / commercial source are particularly high or low.

- The character of the residual sound has acoustic features comparable to those of the industrial / commercial sound.

- The sensitivity of the receptor is significant, and whether residential properties incorporate design measures that secure good internal or outdoor acoustic conditions.

2.5 Acoustics, Ventilation and Overheating

The Acoustics, Ventilation and Overheating (AVO) guide seeks to provide guidance on the interaction between these three factors. It is an in depth document that covers many types of ventilation systems.

The document suggests that the control of overheating should be considered. The conventional way of controlling overheating is to open window casements, but this leads to an increase in indoor sound levels. It may be accepted that slightly elevated sound levels are acceptable during the control of overheating, and a relatively low chance of adverse impact exists if internal conditions remain reasonable.

High levels of outdoor sound may result in unacceptable acoustic conditions inside dwellings with open windows, forcing a decision from the resident to have either acoustic or thermal comfort. Depending how often these conditions occur, significant adverse effect may be caused to living amenity.

If the various recommendations in the AVO guide are followed, the table below gives the level of risk to acoustic comfort during overheating conditions, if a partially open window casement is used (typical attenuation 13 dBA).

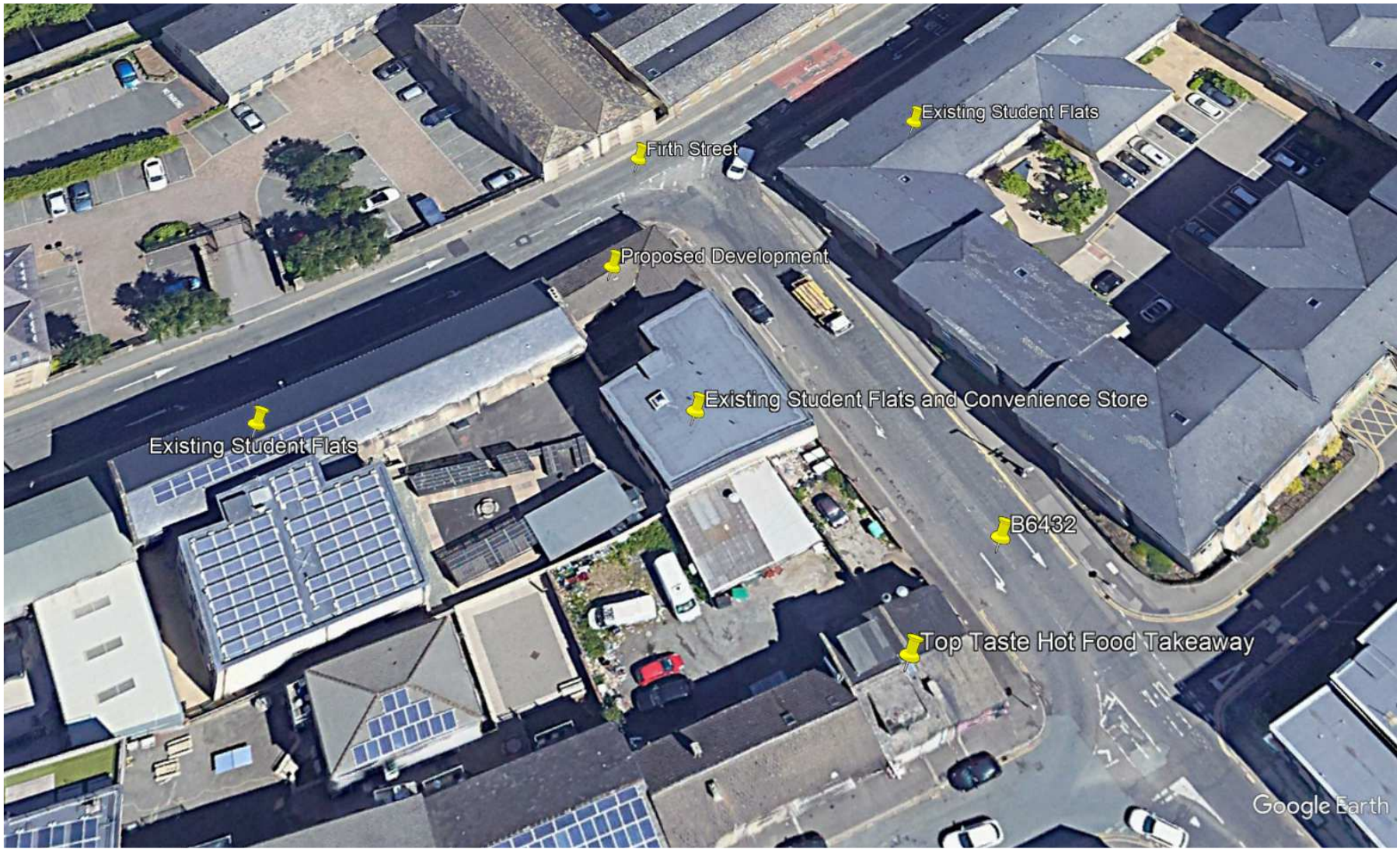
These are not fixed thresholds and use the full day and night time averaging periods of 16 and 8 hours, but give an indication as to the suitability of open windows to be the sole method of controlling overheating.

Likely suitability of using windows to control overheating

Risk Level	**Daytime $LA_{eq,16\ hour}$**	**Night $LA_{eq,8\ hour}$**	**Night Maxima $LA_{max,f}$**	**Overheating Control**
High	Above 63 dB	Above 55 dB	Regularly exceeds 78 dB	Overheating Control with open windows unlikely to be possible without adverse impact.
Medium	53 - 63 dB	48 - 55 dB		Risk of adverse impact with open windows, suitability depends on overheating regularity.
Low	48 - 53 dB	43 - 48 dB		Reasonable conditions with open windows
Negligible	Under 48 dB	Under 43 dB	Does not regularly exceed 58 dB	Open windows with no adverse impact

3.0 **Site Details**

Location Plan



Floorplans

Lower Ground Floor

First Floor

Ground Floor

Second Floor

Third Floor

3D Model, Rear

3D Model, Front

Existing Front

Existing Rear

3.1 Plan of Suggested Acoustic Specification, All Floors

.

All Bedrooms:

Double plasterboard ceilings on top floor bedrooms. If they follow the pitch of the roof, the plasterboard should be mounted on acoustic resilient bars such as British Gypsum RB1 (all top floor rooms).

Note this is separate to Part E of The Building Regulations, which may require all ceilings to be constructed using two layers of plasterboard. We can provide guidance on compliance with this document if required.

B6432, Kings Bridge Road and Firth Street

Ground & First Floor Alternative 1 (see report for full explanation of which alternative will apply)
Glazing: 10mm float, 20mm gap, 8.8mm acoustic (eg 10-20-8.8). The gap being at least 20mm is important
External doors to bedroom: Acoustic door with sound insulation at least R_w = 44 dB, including fit and seal. Alternatively, no external door to bedroom, windows only or lobbied door.

Ground & First Floor Alternative 2:
Glazing: 10mm float, 20mm gap, 16.8mm acoustic (eg 10-20-16.8) The gap must be at least 20mm. External doors should not lead directly into a bedroom, instead being subject to a lobby with solid external door and acoustic internal door, or windows only. If an external door was to lead directly to a bedroom it would require sound insulation in excess of R_w = 50 dB including fit and seal.

Third and Fourth Floors:
Glazing: 10mm float, 20mm gap, 8.8mm acoustic (eg 10-20-8.8). The gap being at least 20mm is important

Window frames must be capable of preserving the overall sound insulation of the glazing specification through fit, seal and the attenuation offered by the frames themselves.

Ventilation:
No trickle ventilators, alternative form of ventilation eg. mechanical system

Rear

Glazing: 4mm float and 6mm float glass with a 12-20mm gap between them (eg 6-16-4)

Ventilators: $D_{n,e,w}$ = 38 dB or greater such as Greenwood 5000 EAW.AC1 or Titon SFX V50 if trickle ventilators are required at the rear

4.0 **Site Survey**

A survey was undertaken of the existing sound climate at the site. The existing building is constructed immediately at the edge of the pavements of Firth Street and the B6432 and so the site is unsuitable for leaving equipment unattended for long periods of time.

The possibility was considered of fixing a microphone to existing parts of the building elevation (eg. TV aerial installations), but this was deemed lacking in ultimate accuracy due to reflections and elevation above ground level.

For these reasons, the existing sound climate was quantified using a series of mainly attended measurements around the site, on some occasions using two sound level meters so simultaneous measurements could be undertaken. Sound levels were measured during different periods of daytime and nighttime, including periods of peak traffic.

. Type I sound level meters were used with valid calibration certificates, full details of which are given later in this report. Sound levels were logged every 15 minutes.

The dominant sound source at all times was road traffic. The adjacent development of student accommodation features a small convenience store 'Dorm Express' that includes two condensers/chillers located in the rear courtyard.

A hot food takeaway 'Top Taste' is located to the south of the proposed development site, which includes two condenser/chiller items of fixed plant and two extract chimneys.

Sound measurements were taken of these items of fixed plant, full details of which are given later in the report. It can be summarised that sound from all of these items of fixed plant remains significantly below the measured environmental background sound level at all times.

There is also a small commercial building to the south of the site within the yard occupied by 'Top Taste.' This small unit has signage indicating that it is occupied by a catering company 'Lola.' There is a condenser on the side of this building and what appears to be a boiler extract flue at roof level. These premises were closed and unoccupied during our visits to the site, but assessment of likely sound from the condenser has been undertaken using measurements of identical units obtained by us as part of previous surveys. Again, full details are given later in this report, but the predictions remain below the environmental background sound level at all times.

The adjacent student accommodation has a self-closing gate to the rear yard, the 'bang' noise from this has been separately measured and quantified later in the report.

4.1 Overall Sound Climate Measurements

The survey of existing sound levels on site yields a large number of data points. A summary of measured sound levels are given in this section. The tables below show mean / average results for the different quantities measured across the various relevant 15 minute periods. Graphical summaries are given overleaf.

Firth Street

Period Description	Start Time	End Time	Ambient (Mean)	Background (Mean)	Maximum (Mean)
			dB $LA_{eq,15min}$	*dB $LA_{90,15min}$*	*dB $LA_{max,f}$*
Typical Daytime			71.6	60.3	84.3
Peak Traffic pm	16:45	17:45	72.4	62.9	84.3
Early Night	23:00	00:00	68.5	55.4	82.5
Early Morning	05:55	06:55	72.1	57.4	83.3

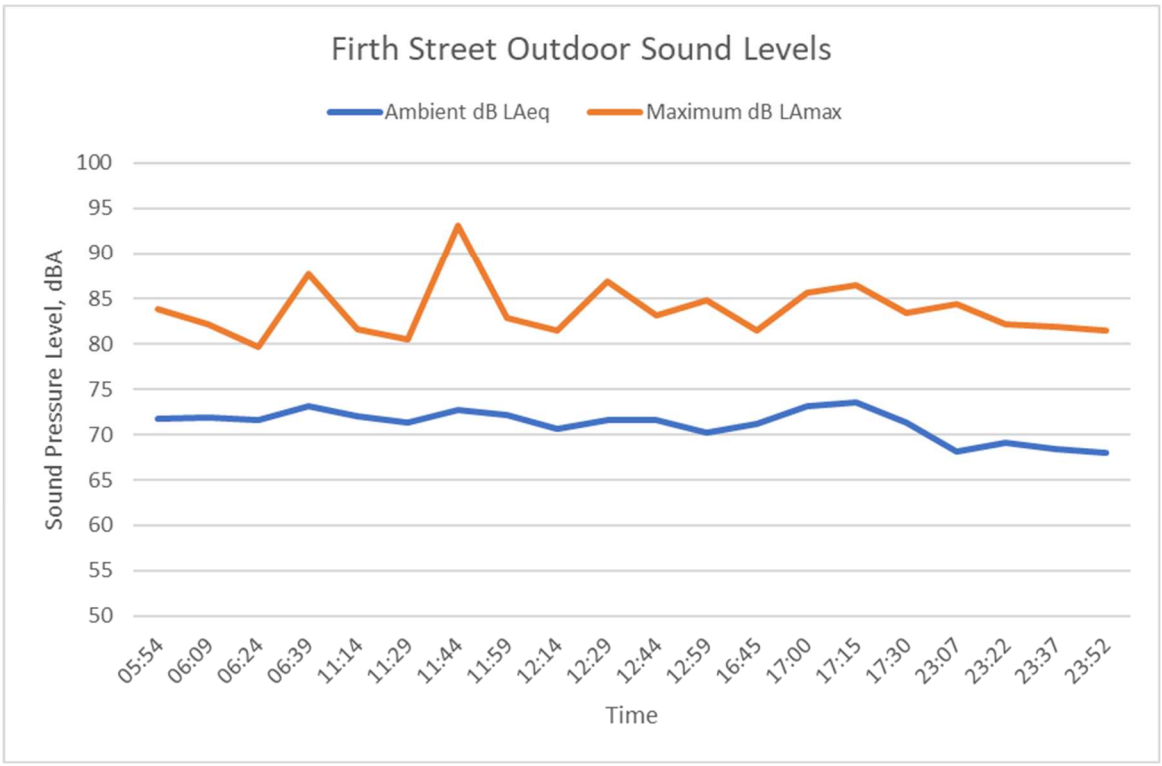
B6432 Elevation

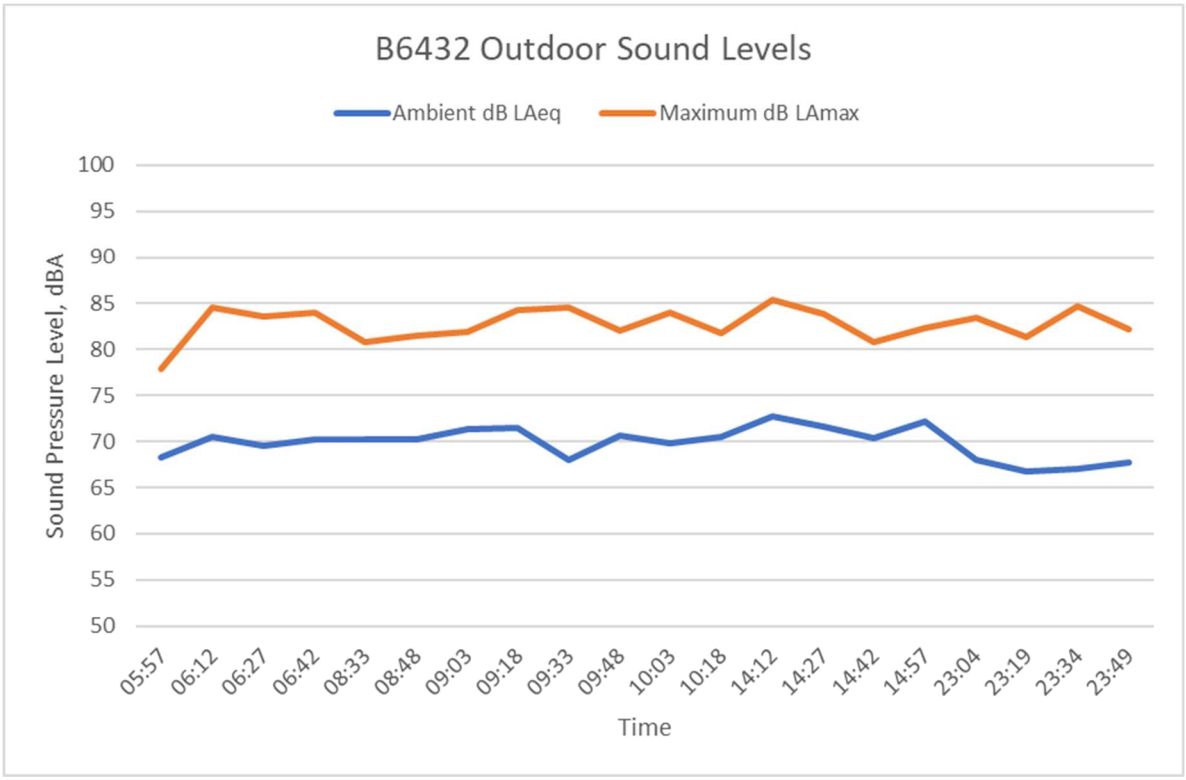
Period Description	Start Time	End Time	Ambient (Mean)	Background (Mean)	Maximum (Mean)
			dB $LA_{eq,15min}$	*dB $LA_{90,15min}$*	*dB $LA_{max,f}$*
Peak Traffic am	08:30	09:30	70.9	61.4	82.1
Typical Daytime			71.2	60.7	83.0
Early Night	23:00	00:00	67.4	57.6	82.9
Early Morning	06:00	07:00	69.7	56.6	82.5

Rear Elevation

At the rear, daytime sound levels were 58 – 60 dB $LA_{eq,15mins}$ with peaks of 68 – 74 dB LA_{max} and background sound levels of 53 – 55 dB $LA_{90,15mins}$. At night, the ambient sound levels were 56 – 57 dB $LA_{eq,15mins}$ with peaks of 66 – 70 dB LA_{max} and background sound levels of 50 – 53 dB $LA_{90,15mins}$.

Peaks from closing of the entrance gate were measured as being up to 68.9 dB $LA_{max,f}$.


Firth Street Outdoor Sound Levels
Ambient dB LAeq
Maximum dB LAmax
Sound Pressure Level, dBA
100
95
90
85
80
75
70
65
60
55
50
05:54
06:09
06:24
06:39
11:14
11:29
11:44
11:59
12:14
12:29
12:44
12:59
16:45
17:00
17:15
17:30
23:07
23:22
23:37
23:52
Time


B6432 Outdoor Sound Levels
Ambient dB LAeq
Maximum dB LAmax
Sound Pressure Level, dBA
100
95
90
85
80
75
70
65
60
55
50
05:57
06:12
06:27
06:42
08:33
08:48
09:03
09:18
09:33
09:48
10:03
10:18
14:12
14:27
14:42
14:57
23:04
23:19
23:34
23:49
Time

4.2 Summary of Sound from Commercial Premises

Full details of a BS4142 assessment are contained in a separate section later in this report. A summary of specific sound levels from the various commercial premises fixed plant reaching the proposed development site is shown below .

Specific Sound Levels at Proposed Flats, dB $LA_{eq,1hour}$

Source	Specific Sound
Top Taste	34.6
Lola	24.9
Dorm Express	31.0
Cumulative Total	36.5

The background sound levels at the rear of the development where the building provides some shielding of road noise are lower than at the front and used in the BS4142 assessment to provide a reasonable worst-case scenario. The background sound levels are:

- 53 – 56 dB $LA_{90,15mins}$ during the daytime
- 50 – 53 dB $LA_{90,15mins}$ during evening periods of Ripon Farm Services operation.

The comparisons between the BS 4142 Rating Levels and typical background measurements are:

- Daytime, Rating Levels 16 dB below background
- Night, Rating Levels 13 dB below background

At the elevations of the building facing the main roads, the Rating Levels are 23 dB below the typical daytime background and 20 dB below the background at night.

It can be concluded that the existing commercial sources will have no adverse impact on residential amenity at the proposed development site.

5.0 Internal Sound Levels

5.1 Acoustic Specification

The suggested acoustic specification has been designed so that the predicted sound levels fall within the requirements outlined in section 2 of this report. The ‘More Rigorous’ method of BS 8233 has been used.

At second and third floor where the new build elements are located, overall compliance is predicted for typical sources, with only the noisiest irregular events causing exceedances above the short duration criteria of 45 dB $LA_{max,f}$. This is the correct way to implement the guidance, which is intended to apply to regular or typical sources only.

At ground and first floor level where there is existing residential building, there is a degree of option with regard to acoustic specification versus regularity of compliance, for which some discussion may be beneficial with the Local Planning Authority and decision from them is needed on overall acceptability.

It is possible to provide an acoustic specification for ground and first floors that results in internal predictions being within the normal guidance criteria for all regular sources, but this specification is extremely onerous. If it is judged that a small amount of relaxation in guidance for short duration peaks can be applied due to the nature of the proposed use and that this accommodation is existing, then the specification becomes more practical and commercially feasible.

All Plots:

Double plasterboard ceilings on top floor bedrooms. Where they follow the pitch of the roof, the plasterboard should be mounted on acoustic resilient bars such as British Gypsum RB1 for all top floor rooms. Note this is separate to Part E of The Building Regulations, which may require all ceilings to be constructed using two layers of plasterboard. We can provide guidance on compliance with this document if required.

In all instances, the sound insulation of window frames including fit and seal must be capable of meeting the sound insulation properties of the glazing specification. For windows facing Firth Street or the B6432, this may require the use of specialist frames with a high degree of sound insulation. We are happy to liaise with window manufacturers as the project progresses if desired.

Rear of Building Facing Courtyard

Glazing:
One leaf of 4mm float glass and one leaf of 6mm float glass with a 12-20mm gap between. (eg 4-16-6).

Ventilators:
If trickle ventilators are required as part of the ventilation strategy for habitable room windows facing the rear courtyard, they should be acoustic models with $D_{n,e,w}$ = 38 dB or greater, eg. Greenwood 5000 EAW.AC1 or Titon SFX V50.

Second and Third Floor Facing Firth Street and B6432 / Kings Bridge Road

Glazing: 10mm float, 20mm gap, 8.8mm acoustic (eg 10-20-8.8). The depth of the cavity is important and should be at least 20mm.

Ventilators: An alternative method of ventilation that does not rely on trickle ventilators or open windows, for example mechanical systems.

First and Second Floor Facing Firth Street and B6432 / Kings Bridge Road

This is where there is some option in acoustic specification, depending on the view of the Local Planning Authority with regards to overall compliance with the normal requirements.

Alternative 1

If it is judged that some slight relaxation can be applied to short duration peaks, then the glazing specification remains the same as for upper floors, being 10mm float, 20mm gap, 8.8mm acoustic glass (eg 10-20-8.8). Overall compliance is still predicted for time averaged LA_{eq} sound levels.

It is likely that the exceedance of typical short duration peaks above the requirements listed in section 2 would be in the order of 1 – 3 dBA. Clearly the precise internal sound level peaks depend on the sound levels emitted by individual vehicles and the behaviour of their drivers as they negotiate the Firth Street / B6432 junction, but the predictions indicate that typical events would generally not exceed 47 – 48 dB $LA_{max,f}$.

The predictions – as do all in these acoustic survey reports, depend on the quality of fit and seal for windows, doors and construction integrity of the building. It can also be noted that the measurements of outdoor sound include some reflections from the existing building elevation. The vehicles that cause the highest short duration peak sound levels pass close to the measurement position, so the contribution to the measured sound levels of these reflections is likely to be fairly small, but this still provides a reasonable worst case scenario and may be taken into account when reaching a conclusion on which specification should be implemented.

There are currently residential rooms at ground and first floor level, which are likely to exhibit significantly lower standards of sound insulation than given here and so this specification would provide a significant improvement on the current situation experienced by residents.

It may be worthy of note that the predictions using this specification would entirely comply with previous guidance adopted by the Local Planning Authority in the document ‘Kirklees MC Noise Design Advice,’ which we believe is no longer in use, but provides further information on context.

There are some external doors that lead directly from Firth Street or the B6432 to bedrooms: These would need to be high performing acoustic doors with sound insulation at least R_w = 44 dB, including fit and seal. Alternatively, external doors to bedrooms could be omitted, being replaced with windows only or a lobbied door arrangement with solid external door and conventional acoustic internal door.

Alternative 2

If the Local Planning Authority dictate that all but the most irregular events must comply with an indoor requirement to not exceed 45 dB $LA_{max,f}$ then it will be necessary to provide an extremely high standard of glazing.

The glazing specification would be 10mm float glass, 20mm gap, 16.8mm acoustic glass (eg 10-20-16.8).

External doors should not lead directly into a bedroom, instead being subject to a lobby with solid external door and acoustic internal door, or being replaced with windows only. If an external door was to lead directly to a bedroom it would require sound insulation in excess of R_w = 50 dB, including fit and seal, which is unlikely to be practicable.

5.2 Predicted Internal Sound Levels

The predicted sound levels from typical events received at the second and third floors of elevations facing Firth Street or the B6432 are in compliance with the requirements outlined in section 2. The predictions are broadly similar in each room and all are given in the appendices. A summary is shown below for the top floor of rooms facing Firth Street, showing the highest, lowest, mean and selected intervening predictions:

Quantity / Rank	Bedroom, Day LA_{eq}	Bedroom, Night LA_{eq}	Bedroom, Night LA_{max}
Mean	24.1	23.4	40.9
Maximum	27.6	25.8	45.8
2	27.4	24.1	43.2
4	26.5	23.2	42.6
6	23.5	22.8	39.2
Min	21.4	22.6	36.2

As can be seen, the only exceedance is from the single noisiest peak event during our attended night time monitoring, which would not be considered a typical event. Even then, the exceedance is around 1 dBA.

Ground and First Floors

The table below shows predictions for bedroom / studio interiors for the ground floor facing Firth Street, with the more practicable glazing specification of 10mm glass, 20mm gap, 8.8mm acoustic glass, referred to as 'Alternative 1' in this report.

Quantity / Rank	**Bedroom, Day LA_{eq}**	**Bedroom, Night LA_{eq}**	**Bedroom, Night LA_{max}**
Mean	27.5	26.8	44.3
Maximum	31.0	29.2	49.3
2	30.8	27.5	46.6
4	29.9	26.6	46.0
6	26.9	26.2	42.6
Min	24.8	26.0	39.6

As can be seen, out of eight night time 15-minute monitoring periods, all of the ambient sound levels comply with the normal criteria. The predicted exceedances are all short duration peaks, with most exceedances being 1 – 2 dBA.

The same predictions with the enhanced specification including 16.8mm acoustic glass referred to as 'Alternative 2' is shown below:

Quantity / Rank	**Bedroom, Day LA_{eq}**	**Bedroom, Night LA_{eq}**	**Bedroom, Night LA_{max}**
Mean	24.3	23.5	40.7
Maximum	27.6	25.9	45.6
2	27.5	24.3	42.9
4	26.3	23.2	42.5
6	23.9	22.8	39.3
Min	21.7	22.5	36.2

The difference in predictions can be seen by comparing the two tables. All but the single highest, non-typical peak complies with the requirements outlined in section 2 with the increased specification 'Alternative 2.'

The regularity of compliance with the short duration peak criteria if the lower 'Alternative 1', will clearly depend on the peaks from traffic passages in any individual time period at night.

As mentioned earlier in this report, the ground and first floors are already in use as existing residential rooms and this specification would clearly constitute an improvement compared to the existing situation. There is likely to be a significant difference in cost and practical difficulty of implementation between the two alternative specifications.

Ultimately, the acceptability of some exceedances being above the short duration peak criteria lies with the Local Planning Authority. This is an unusual situation where the development includes remodelling of existing accommodation and numerical adherence to peak sound level criteria within the spaces has a significant implication on cost and potentially feasibility.

Further context is that the development is intended for use by the student market and so occupation is not by permanently residing families. We are of course happy to take part in discussions with the Local Planning Authority if it would be helpful.

Rear of Building

The predicted sound levels at the rear of the building are all in compliance with the requirements outlined in section 2. They are typically 28 – 30 dB $LA_{eq,15mins}$ during the daytime and 27 – 28 dB $LA_{eq,15mins}$ at night. Short duration peaks at night are up to 42 dB $LA_{max,f}$ from the noisiest typical sources. There are no private rear gardens at the development.

6.0 **Acoustics, Ventilation and Overheating**

When increased ventilation rates are needed, for example when cooling is required, the default method is to open windows, leading to increased internal sound levels.

The measured day and night time sound levels are used for comparison to the recommendations of the AVO guide. This document is not regulatory, but provides guidance and commentary on this topic.

The measured results suggest that the Firth Street and B6432 elevations fall into the **high risk** category, so concludes that reasonable conditions are unlikely to be achieved with windows open for ventilation.

At this site, the external sound levels facing the main roads are relatively high. The acoustic specification designed to achieve compliance with the normal indoor criteria assume no trickle ventilators being fitted to windows on these elevations. When glazing specifications are high, it is usually the case that trickle ventilators reduce the overall sound insulation of a building envelope. It is likely that ventilation at this site will need to be achieved using an acoustically treated alternative means such as mechanical ventilation.

The newly introduced Part O of the Building Regulations provides further guidance, which will be regulatory for all new developments and is briefly outlined in a separate letter to you.

7.0 BS 4142: Commercial Sources

The most common standard for the outdoor assessment of industrial or commercial sound is BS 4142. The initial conclusions are reached based on quantitative data and predictions, then consideration of context is required to reach final conclusions.

Section 12 of BS 4142 lists the information that should be reported in an assessment. For ease of reference and completeness of information, this section of the report follows the same order as BS 4142 section 12.

(a) Qualifications and Experience

S & D Garritt Ltd are members of the Association of Noise Consultants (ANC). All work related to this report was undertaken by David Garritt.

David Garritt has been a member of the Institute of Acoustics since 2005 and holds an honours degree in Electronic and Computer Systems Engineering.

David teaches acoustics at post graduate level on a part time basis for the Institute of Acoustics and sits on the ANC Communications and PR Committee. David has extensive experience in the preparation of surveys involving industrial sound sources directly comparable to the subject of this report.

(b) Sources Being Assessed

The sources being assessed are:

- Chillers / condensers at the rear of the site within the student accommodation courtyard at the rear of “Dorm Express” convenience store

- Fixed plant at the rear of the hot food takeaway ‘Top Taste’ consisting of two condenser/chiller units and two extract chimney flues.

- Fixed plant associated with a small commercial unit occupied by ‘Lola’ caterers.

Sound levels from each site are:

- Top Taste, all items in operation, 60.9 dB $LA_{eq,T}$ at 5m distance
- “Dorm Express” condensers, 62.9 dB $LA_{eq,T}$ at 1m distance

The premises occupied by ‘Lola’ caterers was unoccupied and closed during all of our site visits. In order to quantify sound levels from fixed plant, we have used data previously obtained by us at a previous site where identical condensers manufactured by ‘JE Hall’ were in use. Measured sound levels were:

Item	**dB LA_{eq}**
JEHS-0400-M-3, 1m	59.5
JEHS-0250-M-3, 0.5m	61.5
JEHS-0350-M-3, 0.5m	63.7
JEHS-0350-M-3, 1m	60.6

Typically levels from this range of plant items are around 60 dBA at 1m.

2. Hours of operation of the premises are:

    - 'Top Taste' 12.00 – 02.15 Sunday – Thursday, 12.00 – 02.45 Friday and Saturday
    - 'Dorm Express' 09.00 – 23.00 Monday – Friday, 12.00 – 23.00 Saturday and Sunday
    - 'Lola' unable to contact, likely to be normal daytimes but assumed to use condenser at night for reasonable worst case assessment.

3. It is assumed that the sources operate continuously for the daytime assessment period of one hour and for 15 minutes at night, ie. continual operation for reasonable worst case.

4. All items were being used to their normal automatic capacity during our source measurements.

5. All sources are outdoors. Existing buildings will break line of sight from all parts of all sources to all parts of the proposed development building. Sound barrier effect has been calculated using the theory of Maekawa with a conservative path difference of 0.1m

(c) **Subjective Impressions**

Source sound levels were taken at distances where the source under test was the dominant source at the distances used for measurements.

Subjective impressions of the existing sound climate at the proposed development site were entirely environmental during our visits to site, mainly consisting of road traffic. Fixed plant was inaudible at all positions around the development site during our survey.

(d) **Existing Context**

The proposed site is an existing house of multiple occupation at ground and first floor level and generally surrounded by other student accommodation developments, with the commercial sources mentioned in this section.

Many of the other student accommodation blocks appear to have been converted relatively recently and many are in closer proximity to the commercial sources than those that are subject of this application.

The site lies in a busy city centre area of Huddersfield and is intended for use as student accommodation.

Given this context, it is possible that the end residents may be less sensitive to sound from commercial sources than in some other scenarios. However, this is a relatively moot point because the predictions show that the BS4142 Rating Level remains significantly below the environmental background sound level at all times and at all positions.

(e) Measurement Locations

The receptors considered in this report are the proposed new dwellings.

Ground floor receptor heights are taken as 1.5m and first floor receptor heights are 4.5m. Second floor receptors are at 7.2m and third floor 9.9m. The assessment is undertaken for positions at the rear of the development facing the courtyard. For elevations facing Firth Street or the B6432, there is additional distance decay for sound sources and the background sound levels are higher, producing an even more favourable assessment.

The correct formula for distance decay from a point source over relatively hard ground is *Decay = 20 x log (Distance Ratio) dB.* The principle of Rathe dictates that this point source decay occurs at distances from sources that are greater than the major dimension of the source divided by pi (3.14), and this principle is adhered to in the calculation process.

Background Measurements

Background sound levels are described in section m) to follow the same order as section 12 of BS 4142: 2014. The background sound levels were measured at the proposed development site as attended measurements during different times of day.

(f) Instrumentation

Equipment Description	Type number	Manufacturer	Date of expiration of Calibration	Calibration Certificate Number
Sound Level Meter	XL2 TA s/n A2A-10019-E0	NTi Audio	14.08.2024	178637
Microphone	MK 224 s/n 213144A	Cirrus Research	14.08.2024	178634
Sound Level Meter	2260 s/n 2409281	Bruel & Kjaer	16.10.2024	181588
Preamplifier	ZC 0026	Bruel & Kjaer	16.10.2024	181588
Microphone	MK:224 s/nm216473B	Cirrus Research Plc	20.10.2024	181872
Calibrator	4231 s/n 2402706	Bruel & Kjaer	24.07.2024	196005

(g) **Operational Tests**

1. The reference level of the calibrator is 94 dB SPL at 1000 Hz.

2. The meter readings with the calibrator before and after measurements were also 94.0 dB SPL before and after the unattended monitoring and source measurements. No drift was apparent during any measurements.

(h) **Weather Conditions**

The weather conditions during our attended visits to the proposed development site were entirely suitable for the outdoor measurement of environmental sound. Temperatures were cold on the morning of 1st December, but there is no large expanse of soft ground between source and receiver where frozen ground would cause a material change in sound levels. The road surface was not frozen or icy and vehicles did not appear to be travelling artificially slowly as a result of the cold temperatures. The density of tall buildings in the area provide shelter from open ground wind speeds. A summary is shown in the table below:

	Temperature ^{O}C		Wind Speed (m/s)			Direction	Precipitation	Cloud Cover
Date	**Min**	**Max**	**Low**	**Typical**	**High**		**mm**	**%**
22/11/2023	5.3	10.8	1.3	3.1	6.8	W	0.4	75 - 100
23/11/2023 night	4.6	8.3	2.1	3.4	8.6	W	0.6	75 - 100
01/12/2023	-2.9	3.0	0.8	2.3	3.8	NW	0.0	25 - 50

(i) **Date and Time of Measurements**

Measurements at this site were taken between 14:00 and 18:00 on Wednesday 22nd November, 22:00 and 00:15 on Thursday 23rd November and 05:50 and 13:15 on Friday 1st December 2023.

(j) **Measurement Time Intervals**

Background sound levels were measured over continuous 15 minute intervals in accordance with BS 4142: 2014. Measurements of specific source machinery were taken over time periods that allowed the measured results to settle to a constant value.

(k) Reference Time Interval

The reference time interval is 1 hour during the daytime and 15 minutes at night in accordance with 3.8 of BS 4142.

(l) Specific Sound Levels

The specific sound levels from fixed plant at each premises are shown below:

Specific Sound Levels at Proposed Flats, dB $LA_{eq,1hour}$

Source	Specific Sound
Top Taste	34.6
Lola	24.9
Dorm Express	31.0

The cumulative sound level is 36.5 dB LA_{eq}.

The methods of determining the specific sound levels of the sources are in accordance with section F.2.1 of BS 5228-1 which describes methods of quantifying the sound levels of sources on a site. Three alternative means of obtaining the necessary data on source sound levels are described in BS 5228 as:

(a) Carry out sound measurements on similar plant items operating in the same mode as those proposed at the application site.

(b) Use data on typical sound levels of various plant items as provided in Annexes C and D of BS 5288-1.

(c) Use data on the maximum permitted sound levels of plant items under EC Directive 2000/14/EC[11].

Section F.2.1 advises that "The method given in item (a) is likely to provide the most accurate prediction" and that method has been employed, using direct measurements of similar sources at previously surveyed sites or measurements at this site.

(m) Background Sound Level

Background sound measurements were taken as part of the main survey of sound climate at site. Full results are given in the appendices of this report, with a summary shown in this section.

The background sound levels at the rear were lower than the front and are used initially in this assessment to provide a reasonable worst-case scenario.

- 53 – 56 dB $LA_{90,15mins}$ during the daytime
- 50 – 53 dB $LA_{90,15mins}$ at night.

Given the attended nature of the site survey at the rear, which yields fewer datapoints than a longer unattended survey, the lowest (most onerous) of the measured background sound levels is used in the assessment.

Background sound levels at the Firth Street and B6432 elevations were typically around 60 dB $LA_{90,15mins}$ during the daytime and 57 dB $LA_{90,15mins}$ at night.

(n) **Rating Levels**

The BS 4142 Rating Levels are shown in this section. BS 4142 dictates that correction factors or penalties are applied to Rating Levels to take account of the acoustic characteristics as received at the receptors. Generally the corrections are applied for whichever character is dominant, though more than one correction can be applied if deemed appropriate.

- Up to 6 dB for tonality as perceived at the receptor (eg, +2dB for just perceptible, up to +6 dB for highly perceptible),
- Up to 9 dB for impulsivity as perceived at the receptor (eg, +3dB for just perceptible, up to +9 dB for highly perceptible),
- 3 dB for intermittency, ie. if the source has easily identifiable repeated on/off conditions
- The option to add 3 dB if the source is neither tonal, impulsive or intermittent, but is of a character that is likely to cause annoyance

Objective third octave analysis of the measurements containing the appendices of the report show the absence of tones. It is assumed that the sources operate continuously to provide a reasonable worst-case assessment. The operation of the fixed plant items is not impulsive.

In any case each of the sources as received at the proposed development site are generally up to 15 dB below the background sound level, so it is highly unlikely that any acoustic character would be audible.

The BS 4142 Rating Levels are:

Source	Rating Level, dB
Top Taste	35
Lola	25
Dorm Express	31

The cumulative BS4142 Rating Level is 37 dB.

(o) Background Comparisons

The comparisons between BS 4142 Rating Levels and typical background measurements are:

- Daytime, Rating Levels 16 dB below background
- Night, Rating Levels 13 dB below background

At the elevations of the building facing the main roads, the Rating Levels are 23 dB below the typical daytime background and 20 dB below the background at night.

It can be concluded that the existing commercial sources will have no adverse impact on residential amenity at the proposed development site.

(p) BS 4142 Conclusions

the context of the site has not change the conclusion, being that the existing commercial sources will have no adverse impact on residential amenity at the proposed development site

(q) Uncertainty

It is a requirement of BS 4142: 2014 that the level of uncertainty in data and calculations should be considered. These uncertainties and how they have been minimised are considered in this section.

Sound data for the sources has been taken from measurements taken by us at sites surveyed as part of previous work or by direct measurement of sources at this site. All assumptions have been made on a reasonable worst-case basis.

The procedures used for the calculation of specific sound levels at the nearest noise-sensitive receptors are based on basic, fundamental principles of acoustics. Sound decay with distance from the sources has been calculated using the principles and methods recommended in BS 5228 and by the methods of Rathe. The addition and subtraction of sound levels was done logarithmically on an energy basis, which is the correct method for decibel calculations. It is anticipated that this method would be considered by other suitably qualified acousticians to be relevant, correct and appropriate for this survey and is a method examined by the Institute of Acoustics on their post graduate diploma course.

All sound level measurements were taken with a calibrated type 1 sound level meter, which represents the most accurate type of SLM available. Sound levels were measured to the nearest 0.1 dB, time periods were measured and recorded to the nearest second. No rounding was done in any calculations, the only rounding being done on final results, in compliance with BS 4142 : 2014. The sound level meter was calibrated before and after each survey period and no drift was apparent.

Background sound data was obtained using attended measurements by others with observations of subjective impressions and sound sources. The results have been analysed to ensure representative data is used in the assessment of noise impact.

It is concluded that the uncertainty in this survey has been minimised as far as possible and is below the level at which it would have an impact on the assessment conclusions contained in this report.

APPENDIX 1 – OUTDOOR SOUND LEVEL MEASUREMENTS

Firth Street

			Outdoor dBA						Outdoor Leq (Hz)									Outdoor Lmax (Hz)							
Date	Time		*dB LA_{eq}*	*dB LA_{max}*	*dB LA_{min}*	*dB LA_{10}*	*dB LA_{90}*		63	125	250	500	1000	2000	4000	8000		63	125	250	500	1000	2000	4000	8000
22/11/2023	16:45		71.2	81.5	57.6	74.7	62.7		76.8	71.0	68.3	66.7	68.2	63.9	54.6	45.8		93.8	87.7	84.6	78.4	78.3	73.8	69.3	56.8
22/11/2023	17:00		73.2	85.6	56.9	75.8	62.8		76.5	69.7	72.0	68.6	69.9	66.2	56.9	47.7		92.7	87.2	92.9	85.2	81.4	77.0	75.6	67.2
22/11/2023	17:15		73.6	86.5	58.3	75.5	63.8		77.7	70.2	70.2	68.4	70.5	66.7	57.2	48.0		91.3	85.2	84.4	85.6	82.6	78.9	70.9	62.9
22/11/2023	17:30		71.4	83.4	58.0	75.4	62.1		76.6	70.7	67.7	66.5	68.4	64.4	54.4	44.9		98.7	92.4	88.5	84.9	77.0	73.0	63.8	59.9
23/11/2023	23:07		68.2	84.4	52.6	71.7	55.6		72.2	66.3	66.1	63.6	64.6	61.4	51.6	42.4		92.5	86.1	87.1	80.7	79.2	75.0	70.1	61.5
23/11/2023	23:22		69.1	82.1	52.4	72.1	56.2		72.7	66.1	66.8	64.3	65.6	62.3	52.4	43.3		88.2	83.2	83.8	79.4	76.9	72.8	67.7	59.0
23/11/2023	23:37		68.4	81.9	51.0	70.5	55.8		72.9	66.0	64.6	63.1	65.3	61.6	51.4	42.1		94.6	87.5	84.1	79.1	76.9	72.1	63.9	57.1
23/11/2023	23:52		68.1	81.5	51.2	71.2	54.0		72.5	66.2	65.0	62.8	65.1	60.8	51.5	42.4		90.6	84.7	83.2	79.7	76.1	72.1	66.1	58.6
01/12/2023	05:54		71.8	83.8	51.8	74.2	56.8		70.3	71.3	69.5	66.1	68.6	65.0	56.9	47.1		85.9	93.5	87.9	81.9	82.0	74.6	75.5	63.1
01/12/2023	06:09		71.9	82.1	52.4	75.0	57.9		70.9	65.4	64.5	65.7	68.9	65.6	57.2	48.6		86.8	79.6	76.2	80.8	80.2	73.3	70.0	65.3
01/12/2023	06:24		71.7	79.7	53.7	75.0	58.2		70.5	65.9	66.4	65.6	68.5	65.2	57.8	48.5		85.5	79.6	79.4	77.3	77.8	75.9	69.7	61.3
01/12/2023	06:39		73.1	87.7	55.3	76.0	56.7		71.2	67.2	66.0	66.4	70.0	67.0	59.5	50.4		90.6	88.7	84.7	81.3	86.2	83.3	76.7	67.6
01/12/2023	11:14		72.0	81.6	57.4	75.4	61.4		70.2	62.0	64.4	65.4	69.0	65.9	57.3	47.2		89.5	74.8	75.2	76.6	79.6	76.1	68.5	60.8
01/12/2023	11:29		71.3	80.5	55.3	75.2	60.8		68.7	64.0	65.9	65.2	68.2	65.0	56.2	46.1		85.1	83.7	85.5	81.9	78.8	75.1	68.7	62.9
01/12/2023	11:44		72.7	93.1	55.3	74.8	58.9		69.3	62.9	63.6	67.1	68.5	67.1	60.8	52.4		88.1	82.8	83.2	90.2	87.3	88.1	83.4	75.4
01/12/2023	11:59		72.2	82.9	54.0	75.4	61.0		70.4	65.1	67.5	66.9	68.9	65.5	58.4	54.0		87.6	80.5	82.9	81.5	79.2	75.0	72.2	76.8
01/12/2023	12:14		70.7	81.5	53.9	74.6	58.8		67.4	63.7	64.3	64.5	67.7	64.3	56.0	47.2		82.8	83.6	83.0	77.7	80.9	76.5	70.8	64.5
01/12/2023	12:29		71.7	86.8	53.0	74.6	61.2		70.3	66.3	65.6	65.0	68.5	65.5	57.3	48.1		89.8	87.7	85.0	81.6	85.9	81.7	74.6	75.5
01/12/2023	12:44		71.6	83.1	53.5	75.0	61.0		73.1	66.0	65.9	66.9	68.1	64.8	58.6	50.8		91.8	82.0	80.6	85.4	79.8	75.9	73.8	68.1
01/12/2023	12:59		70.2	84.8	52.0	73.8	59.2		72.8	63.9	65.5	64.0	67.0	63.8	56.1	48.1		91.2	86.3	89.9	81.4	79.1	73.9	67.1	60.9

B6432 Elevation

			Outdoor dBA						Outdoor Leq (Hz)									Outdoor Lmax (Hz)							
Date	Time		*dB LA_{eq}*	*dB LA_{max}*	*dB LA_{min}*	*dB LA_{10}*	*dB LA_{90}*		63	125	250	500	1000	2000	4000	8000		63	125	250	500	1000	2000	4000	8000
22/11/2023	14:12		72.7	85.3	59.0	75.1	61.9		83.6	72.7	71.1	69.3	68.6	65.1	58.3	51.1		101.3	89.9	85.7	83.1	80.9	79.4	73.1	67.1
22/11/2023	14:27		71.6	83.8	58.0	73.8	61.2		79.2	75.9	70.0	67.5	67.4	64.3	56.2	59.1		96.6	95.2	84.6	82.0	80.9	78.1	71.6	83.6
22/11/2023	14:42		70.4	80.8	56.9	73.4	60.2		77.7	72.9	69.1	66.3	66.7	62.9	55.3	46.5		94.8	91.4	82.5	80.7	78.0	74.4	67.2	61.2
22/11/2023	14:57		72.2	82.3	57.5	75.4	61.9		75.6	70.1	68.1	67.1	69.4	65.0	54.8	45.8		92.8	85.4	82.2	80.6	80.0	75.4	64.1	58.9
23/11/2023	23:04		68.0	83.4	54.1	70.3	58.9		76.8	69.8	65.7	64.2	63.6	60.8	53.4	49.2		95.2	89.6	81.8	79.8	77.7	76.1	69.5	70.4
23/11/2023	23:19		66.8	81.3	54.6	69.3	58.3		74.4	70.4	65.2	62.6	63.1	58.8	51.6	46.7		91.8	89.3	79.5	77.4	76.3	72.4	65.5	68.3
23/11/2023	23:34		67.0	84.7	51.0	69.7	56.2		72.7	67.5	64.3	62.6	63.7	59.7	50.3	42.1		94.3	89.7	83.7	81.3	80.2	76.4	67.0	60.5
23/11/2023	23:49		67.7	82.1	52.5	70.0	56.9		74.2	69.0	65.6	63.3	64.1	60.2	51.9	45.2		93.8	87.7	80.9	78.4	77.1	74.5	66.0	63.8
01/12/2023	05:57		68.3	77.9	52.0	71.2	56.4		71.0	63.7	64.0	62.0	65.2	61.6	53.9	45.5		91.5	83.5	79.5	74.8	77.4	71.4	68.9	63.7
01/12/2023	06:12		70.5	84.5	51.9	72.2	57.2		74.2	66.4	66.8	65.5	66.9	63.7	57.3	49.9		90.5	82.8	81.7	80.8	81.8	78.2	73.2	66.3
01/12/2023	06:27		69.6	83.6	53.0	73.0	56.5		72.8	65.3	65.6	64.3	66.3	62.5	55.7	49.5		94.4	87.4	84.7	83.0	82.2	79.1	75.1	74.1
01/12/2023	06:42		70.2	83.9	52.8	72.8	56.2		73.6	68.4	69.5	65.5	66.7	62.8	55.1	47.1		91.0	88.5	90.9	83.8	74.4	70.8	66.6	62.7
01/12/2023	08:33		70.3	80.8	56.2	72.8	61.4		75.8	69.3	67.2	65.8	66.7	63.3	55.8	47.8		94.2	91.5	86.4	84.3	74.1	71.2	66.2	64.7
01/12/2023	08:48		70.3	81.4	57.0	72.8	61.6		73.0	65.5	66.1	64.6	66.7	63.3	59.4	52.5		91.6	83.0	78.1	75.3	76.1	73.3	80.4	73.7
01/12/2023	09:03		71.4	81.9	54.2	74.0	61.8		76.1	68.4	69.8	66.5	67.4	64.6	58.9	49.9		91.8	87.4	87.8	81.0	79.3	77.1	75.4	66.1
01/12/2023	09:18		71.5	84.3	56.8	74.0	60.6		76.3	73.7	70.8	68.3	67.1	63.7	57.9	49.5		90.1	92.7	88.7	85.7	78.6	74.3	71.0	62.9
01/12/2023	09:33		68.0	84.5	54.1	70.6	58.2		73.5	67.2	64.4	62.9	64.6	61.0	54.0	45.5		95.5	89.5	84.6	82.4	80.8	77.6	73.0	66.1
01/12/2023	09:48		70.6	82.0	56.0	72.8	62.0		79.6	69.1	67.6	65.1	67.1	63.6	56.6	47.5		101.7	92.0	87.7	79.3	76.2	77.7	75.5	69.7
01/12/2023	10:03		69.9	83.9	54.7	72.6	60.2		74.2	64.9	66.2	64.8	66.4	63.1	56.3	48.5		97.0	86.3	83.4	82.1	78.7	81.6	74.8	71.8
01/12/2023	10:18		70.5	81.7	54.2	73.6	59.0		74.6	66.9	67.7	65.4	67.2	63.5	56.5	49.4		93.2	81.6	82.0	79.3	79.1	76.6	70.3	66.5

Rear Elevation

			Outdoor dBA						Outdoor Leq (Hz)									Outdoor Lmax (Hz)							
Date	Time		*dB LA_{eq}*	*dB LA_{max}*	*dB LA_{min}*	*dB LA_{10}*	*dB LA_{90}*		63	125	250	500	1000	2000	4000	8000		63	125	250	500	1000	2000	4000	8000
22/11/2023	15:21		57.8	67.7	51.5	60.1	53.6		64.6	56.9	55.9	53.3	54.2	50.9	42.8	34.0		83.5	68.6	66.2	64.9	64.5	63.2	59.1	52.6
22/11/2023	15:36		57.7	70.8	53.5	61.1	55.7		60.3	58.7	56.8	53.1	53.8	50.8	42.6	33.9		76.3	72.7	70.5	67.3	66.4	66.4	61.8	56.2
22/11/2023	15:51		58.2	74.1	51.0	60.6	53.0		62.6	57.5	57.1	52.6	54.4	50.9	46.1	40.8		77.3	67.8	66.0	62.4	69.8	66.5	71.4	67.2
22/11/2023	16:06		59.5	69.3	51.3	62.6	52.9		62.8	58.9	58.1	55.6	55.9	52.3	44.2	34.6		74.8	72.4	67.4	64.3	66.6	63.8	62.0	54.2
23/11/2023	21:57		56.8	67.6	49.8	59.0	50.4		68.8	56.8	53.5	52.2	53.1	50.0	41.4	31.8		83.6	70.0	62.0	64.3	64.5	62.1	54.6	46.5
23/11/2023	22:12		56.8	65.7	49.0	60.6	51.1		69.2	59.1	54.3	52.2	53.4	49.3	40.3	31.3		86.6	70.4	64.6	63.9	63.3	60.3	56.2	53.2
23/11/2023	22:27		57.2	69.5	49.9	59.7	52.5		66.5	61.3	54.3	52.4	53.9	49.7	40.6	36.2		84.3	74.0	67.5	64.4	68.1	61.1	53.0	59.7
23/11/2023	22:42		55.8	63.0	51.8	58.4	52.3		67.0	60.7	54.8	52.5	51.6	47.8	40.6	32.9		78.4	67.6	63.1	62.5	60.4	56.6	52.0	51.7
Gate			59.6	68.9	55.1	61.6	56.6		69.8	62.1	57.5	55.9	55.6	52.1	45.4	37.2		79.4	69.4	64.3	61.9	64.5	64.3	60.4	54.0

APPENDIX 2

INTERIOR SOUND CALCULATIONS

MORE RIGOROUS CALCULATION METHOD OF BS 8233: 2014

The method in BS 8233:2014 requires certain building parameters to be known or assumed as part of the calculation procedure. The interior layout and room dimensions have been taken from typical details for dwellings such as those proposed at this site.

The sound reduction indices of the recommended building specifications are:

Sound reduction indices. dB

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Outer Walls	34	41	45	50	56	65	69	72
4-16-6 glazing	19	21	20	26	38	37	39	43
10-20-8.8 acoustic	24	28	36	43	47	49	58	62
10 acoustic - 20- 16.8 acoustic	31	33	39	46	51	53	62	65
5000EAW.AC1 ventilator	33	39	38	31	44	43	46	49
Single Board Ceiling & Roof	29	34	40	45	49	46	48	50
Double Board Ceiling & Roof	35	40	46	51	55	52	54	56

Calculations and parameters are given below for the Firth Street Elevation. The process is repeated for the B6432 and rear elevations.

Firth Street, Ground Floor

Building Element	Value (m^2)
Reference absorption A_0	10
Total façade area S_f	10.66
Window area S_{wi}	3.6
External Wall area S_{ew}	7.06
Ceiling area S_{rr}	10.25
Total area $S = S_f + S_{rr}$	20.91

Firth Street, Second Floor

Building Element	Value (m^2)
Reference absorption A_0	10
Total façade area S_f	10.66
Window area S_{wi}	3
External Wall area S_{ew}	7.66
Ceiling area S_{rr}	10.25
Total area $S = S_f + S_{rr}$	20.91

Firth Street, Top Floor

Building Element	Value (m^2)
Reference absorption A_0	10
Total façade area S_f	10.66
Window area S_{wi}	3.8
External Wall area S_{ew}	6.86
Ceiling area S_{rr}	10.25
Total area $S = S_f + S_{rr}$	20.91

The overall outdoor-to-indoor sound level difference represented by the building elements is calculated using the method in BS 8233:2014 as:

Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Ground Floor, Alternative 1	25	29	38	45	49	52	61	65
Ground Floor, Alternative 2	30	34	40	47	52	56	64	67
Second Floor	26	30	38	45	50	53	61	66
Top Floor	24	29	37	44	49	51	58	62

The calculations involved in obtaining the ‘Overall Loss’ are lengthy, so the workings are omitted from this report for conciseness and readability. The overall loss predictions of the building envelope are applied to the measured frequency spectra in each 15 minute measurement period.

Internal Sound Level Predictions ae shown overleaf as overall dBA values.

The attenuation from ground floor to upper floors is obtained by calculating the distance decay according to Rathe from vehicle sources to elevation receptors, assuming line source behaviour to provide a reasonable worst-case. 3 dB is then subtracted from this distance decay to allow for reflections from the road surface. The attenuations are therefore 2.6 dBA to second floor and 4 dBA to the fourth floor.

Internal Sound Level Predictions

Firth Street, Alternative 1

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	16:45	30.1		
22/11/2023	17:00	30.8		
22/11/2023	17:15	31.0		
22/11/2023	17:30	29.9		
23/11/2023	23:07		26.2	46.0
23/11/2023	23:22		26.6	42.6
23/11/2023	23:37		26.1	46.6
23/11/2023	23:52		26.0	43.7
01/12/2023	05:54		29.2	49.3
01/12/2023	06:09		26.3	40.2
01/12/2023	06:24		26.6	39.6
01/12/2023	06:39		27.5	46.5
01/12/2023	11:14	25.6		
01/12/2023	11:29	25.6		
01/12/2023	11:44	25.7		
01/12/2023	11:59	26.9		
01/12/2023	12:14	24.8		
01/12/2023	12:29	26.5		
01/12/2023	12:44	27.3		
01/12/2023	12:59	26.1		

Firth Street, Alternative 2 (Enhanced Glazing)

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	16:45	26.5		
22/11/2023	17:00	27.6		
22/11/2023	17:15	27.5		
22/11/2023	17:30	26.3		
23/11/2023	23:07		22.8	42.5
23/11/2023	23:22		23.2	39.3
23/11/2023	23:37		22.5	42.6
23/11/2023	23:52		22.5	40.1
01/12/2023	05:54		25.9	45.6
01/12/2023	06:09		23.1	36.7
01/12/2023	06:24		23.4	36.2
01/12/2023	06:39		24.3	42.9
01/12/2023	11:14	22.5		
01/12/2023	11:29	22.6		
01/12/2023	11:44	22.7		
01/12/2023	11:59	23.9		
01/12/2023	12:14	21.7		
01/12/2023	12:29	23.2		
01/12/2023	12:44	23.9		
01/12/2023	12:59	22.8		

Firth Street, Second Floor

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	16:45	26.9		
22/11/2023	17:00	27.7		
22/11/2023	17:15	27.8		
22/11/2023	17:30	26.7		
23/11/2023	23:07		23.0	42.8
23/11/2023	23:22		23.4	39.4
23/11/2023	23:37		22.9	43.4
23/11/2023	23:52		22.8	40.5
01/12/2023	05:54		26.0	46.0
01/12/2023	06:09		23.2	37.0
01/12/2023	06:24		23.4	36.4
01/12/2023	06:39		24.3	43.3
01/12/2023	11:14	22.4		
01/12/2023	11:29	22.4		
01/12/2023	11:44	22.6		
01/12/2023	11:59	23.8		
01/12/2023	12:14	21.6		
01/12/2023	12:29	23.3		
01/12/2023	12:44	24.1		
01/12/2023	12:59	23.0		

Firth Street, Third Floor

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	16:45	26.8		
22/11/2023	17:00	27.4		
22/11/2023	17:15	27.6		
22/11/2023	17:30	26.5		
23/11/2023	23:07		22.8	42.6
23/11/2023	23:22		23.2	39.2
23/11/2023	23:37		22.7	43.2
23/11/2023	23:52		22.6	40.3
01/12/2023	05:54		25.8	45.8
01/12/2023	06:09		22.9	36.8
01/12/2023	06:24		23.2	36.2
01/12/2023	06:39		24.1	43.1
01/12/2023	11:14	22.2		
01/12/2023	11:29	22.2		
01/12/2023	11:44	22.3		
01/12/2023	11:59	23.5		
01/12/2023	12:14	21.4		
01/12/2023	12:29	23.1		
01/12/2023	12:44	23.9		
01/12/2023	12:59	22.8		

B6432, Alternative 1

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	14:12	34.4		
22/11/2023	14:27	33.2		
22/11/2023	14:42	31.2		
22/11/2023	14:57	29.5		
23/11/2023	23:04		29.0	47.5
23/11/2023	23:19		28.1	45.9
23/11/2023	23:34		26.2	47.4
23/11/2023	23:49		27.6	45.9
01/12/2023	05:57		24.6	43.0
01/12/2023	06:12		27.4	43.2
01/12/2023	06:27		26.3	46.9
01/12/2023	06:42		28.4	47.8
01/12/2023	08:33	28.8		
01/12/2023	08:48	26.6		
01/12/2023	09:03	29.4		
01/12/2023	09:18	31.5		
01/12/2023	09:33	26.5		
01/12/2023	09:48	30.7		
01/12/2023	10:03	26.9		
01/12/2023	10:18	27.9		

B6432, Alternative 2 (Enhanced Glazing)

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	14:12	30.4		
22/11/2023	14:27	29.3		
22/11/2023	14:42	27.3		
22/11/2023	14:57	26.0		
23/11/2023	23:04		25.0	43.3
23/11/2023	23:19		24.2	41.8
23/11/2023	23:34		22.5	43.4
23/11/2023	23:49		23.8	41.8
01/12/2023	05:57		21.1	38.9
01/12/2023	06:12		23.9	39.6
01/12/2023	06:27		22.8	43.0
01/12/2023	06:42		25.0	44.7
01/12/2023	08:33	25.2		
01/12/2023	08:48	23.1		
01/12/2023	09:03	25.9		
01/12/2023	09:18	27.9		
01/12/2023	09:33	22.8		
01/12/2023	09:48	26.6		
01/12/2023	10:03	23.4		
01/12/2023	10:18	24.4		

B6432, Second Floor

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	14:12	31.0		
22/11/2023	14:27	29.8		
22/11/2023	14:42	27.7		
22/11/2023	14:57	26.1		
23/11/2023	23:04		25.6	44.1
23/11/2023	23:19		24.7	42.4
23/11/2023	23:34		22.8	44.0
23/11/2023	23:49		24.2	42.5
01/12/2023	05:57		21.2	39.6
01/12/2023	06:12		24.1	39.8
01/12/2023	06:27		22.9	43.4
01/12/2023	06:42		25.0	44.4
01/12/2023	08:33	25.4		
01/12/2023	08:48	23.2		
01/12/2023	09:03	26.0		
01/12/2023	09:18	28.1		
01/12/2023	09:33	23.1		
01/12/2023	09:48	27.2		
01/12/2023	10:03	23.5		
01/12/2023	10:18	24.5		

B6432, Third Floor

		Bedroom		
Date	Time	Day L_{eq}	Night L_{eq}	Night L_{max}
22/11/2023	14:12	31.5		
22/11/2023	14:27	30.3		
22/11/2023	14:42	28.2		
22/11/2023	14:57	26.6		
23/11/2023	23:04		26.0	44.6
23/11/2023	23:19		25.1	42.9
23/11/2023	23:34		23.2	44.5
23/11/2023	23:49		24.6	43.0
01/12/2023	05:57		21.6	40.1
01/12/2023	06:12		24.5	40.3
01/12/2023	06:27		23.3	43.9
01/12/2023	06:42		25.4	44.8
01/12/2023	08:33	25.9		
01/12/2023	08:48	23.6		
01/12/2023	09:03	26.4		
01/12/2023	09:18	28.5		
01/12/2023	09:33	23.6		
01/12/2023	09:48	27.7		
01/12/2023	10:03	23.9		
01/12/2023	10:18	24.9		

APPENDIX 3 – SOUND LEVELS FROM COMMERCIAL SOURCES

Top Taste

	dBA		25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250
Source, 5m	60.9		59	65.4	63.8	61.7	59.5	59.6	68.4	59.8	55.9	58	56.4	53.4	53.1	54	53.9	53.7	51.7	49.3
Distance	36																			
Distance Decay			17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15
Assumed Path Difference	0.1																			
Barrier Effect			5.27	5.34	5.43	5.53	5.66	5.82	6.01	6.24	6.55	6.88	7.27	7.74	8.30	8.90	9.59	10.37	11.16	12.00
SPL at Flats			36.58	42.91	41.22	39.02	36.69	36.63	45.24	36.41	32.20	33.97	31.98	28.51	27.65	27.95	27.16	26.18	23.39	20.15
A weighted at Flats	**34.6**		-8.12	3.51	6.62	8.82	10.49	14.13	26.14	20.31	18.80	23.07	23.38	21.91	22.85	24.75	25.26	25.38	23.39	20.75

Tone Calculations

	40	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
Source Level	41.22	39.02	36.69	36.63	45.24	36.41	32.20	33.97	31.98	28.51	27.65	27.95	27.16	26.18	23.39	20.15	17.88	15.16	10.83	7.04	1.92	-2.15	-5.15	-11.09	-15.15
Diff to band lower		2.2	2.3	0.1	8.6	8.8	4.2	1.8	2.0	3.5	0.9	0.3	0.8	1.0	2.8	3.2	2.3	2.7	4.3	3.8	5.1	4.1	3.0	5.9	
Diff to band higher		2.3	0.1	8.6	8.8	4.2	1.8	2.0	3.5	0.9	0.3	0.8	1.0	2.8	3.2	2.3	2.7	4.3	3.8	5.1	4.1	3.0	5.9	4.1	
Tone?		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	

Dorm Express

	dBA		25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250
Source, 1m	62.9		60.6	60.5	59.9	60.5	61.2	62.6	70	64.5	64.2	58	56.9	54.9	55.8	56.9	56.4	54.6	53.5	51.4
Distance	20																			
Distance Decay			23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01
Assumed Path Difference	0.1																			
Barrier Effect			5.27	5.34	5.43	5.53	5.66	5.82	6.01	6.24	6.55	6.88	7.27	7.74	8.30	8.90	9.59	10.37	11.16	12.00
SPL at Flats			32.32	32.15	31.46	31.96	32.53	33.77	40.98	35.25	34.64	28.11	26.62	24.15	24.49	24.99	23.80	21.22	19.33	16.39
A weighted at Flats	**31.0**		-12.38	-7.25	-3.14	1.76	6.33	11.27	21.88	19.15	21.24	17.21	18.02	17.55	19.69	21.79	21.90	20.42	19.33	16.99

Tone Calculations

	40	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
Source Level	31.46	31.96	32.53	33.77	40.98	35.25	34.64	28.11	26.62	24.15	24.49	24.99	23.80	21.22	19.33	16.39	13.22	10.60	6.77	2.88	-2.54	-5.81	-11.71	-16.15	-21.41
Diff to band lower		0.5	0.6	1.2	7.2	5.7	0.6	6.5	1.5	2.5	0.3	0.5	1.2	2.6	1.9	2.9	3.2	2.6	3.8	3.9	5.4	3.3	5.9	4.4	
Diff to band higher		0.6	1.2	7.2	5.7	0.6	6.5	1.5	2.5	0.3	0.5	1.2	2.6	1.9	2.9	3.2	2.6	3.8	3.9	5.4	3.3	5.9	4.4	5.3	
Tone?		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	

Lola

	dBA		25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	
Source, 1m	60		57.5	55.1	49	58.2	48.9	48.7	61.5	49.6	57.7	61.1	60.7	49.1	50.5	55.5	50.2	49.1	49.9	48.2	
Distance	28																				
Distance Decay			25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	25.93	
Assumed Path Difference	0.1																				
Barrier Effect			5.27	5.34	5.43	5.53	5.66	5.82	6.01	6.24	6.55	6.88	7.27	7.74	8.30	8.90	9.59	10.37	11.16	12.00	
SPL at Flats			26.30	23.83	17.64	26.74	17.31	16.95	29.56	17.43	25.22	28.29	27.50	15.43	16.27	20.67	14.68	12.80	12.81	10.27	
A weighted at Flats	**24.9**		-18.40	-15.57	-16.96	-3.46	-8.89	-5.55	10.46	1.33	11.82	17.39	18.90	8.83	11.47	17.47	12.78	12.00	12.81	10.87	

Tone Calculations

	40	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**	**2000**	**2500**	**3150**	**4000**	**5**
Source Level	17.64	26.74	17.31	16.95	29.56	17.43	25.22	28.29	27.50	15.43	16.27	20.67	14.68	12.80	12.81	10.27	2.30	-0.42	2.55	-4.84	-4.46	-5
Diff to band lower		9.1	9.4	0.4	12.6	12.1	7.8	3.1	0.8	12.1	0.8	4.4	6.0	1.9	0.0	2.5	8.0	2.7	3.0	7.4	0.4	
Diff to band higher		9.4	0.4	12.6	12.1	7.8	3.1	0.8	12.1	0.8	4.4	6.0	1.9	0.0	2.5	8.0	2.7	3.0	7.4	0.4	0.9	
Tone?		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No

Overall Sound Levels

Source	**Specific Sound**
Top Taste	34.6
Lola	24.9
Dorm Express	31.0
	36.5

Source	**Rating Level**
Top Taste	35
Lola	25
Dorm Express	31
	37