



ACOUSTIC
CONSULTANTS LTD

Noise Impact Assessment

**Relocation of Extract Plant (Retrospective)
Thai Emerald Restaurant**

Reference: 10495/PR

Client:
Pearlbury Properties Limited

Document Control					
Version:	Revision Description:	Date:	Author:	Reviewed by:	Approved by:
1.0	1 st Issue	25/09/2023	Pedro Rodrigues, MIOA	Samuel Lawrence, MIOA	Blake Lucas, MIOA

The report has been prepared in good faith, with all reasonable skill and care, based on information provided or available at the time of its preparation and within the scope of work agreement with the Client. We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above. The report is provided for the sole use of the named Client and is confidential to them and their professional advisors. No responsibility is accepted to other parties.

The report limits itself to addressing solely on the noise, acoustic, and vibration aspects as included in this report. We provide advice only in relation to noise, vibration and acoustics. It is recommended that appropriate expert advice is sought on all the ramifications (e.g. CDM, structural, condensation, fire, legal, etc.) associated with any proposals in this report or as advised and concerning the appointment. It should be noted that noise predictions are based on the current information as we understand it and, on the performances noted in this report. Any modification to these parameters can alter the predicted level. All predictions are in any event subject to a degree of tolerance of normally plus or minus three decibels. If this tolerance is not acceptable, then it would be necessary to consider further measures.

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1. Introduction

Pearlbury Properties Limited appointed Acoustic Consultants Limited (ACL) to undertake a noise impact assessment in respect to the relocation of extraction equipment (retrospective) and proposed alterations to the extraction equipment at roof level associated with the Thai Emerald restaurant.

It is understood that around September 2022, Thai Emerald decided to replace the previously installed kitchen extract plant in an attempt to solve the plant noise related issues. The Environmental Department and our client were hopeful that these proposals would resolve the noise related issues that have been previously investigated by the EHO and ACL in July 2021 and confirmed in our report '9136 – 60 St Georges Place, Cheltenham, GL50 3 PN', dated 28th of July 2021 and site visit carried out on 6th of October 2021.

It was concluded from the noise assessment of the relocated plant carried out in September 2022 (9828 - Relocation of Extract Plant at Thai Emerald -1st Issue, dated 12th September 2022) that additional mitigation would be required to further reduce the plant noise impact at the receivers located to the east at Latherham House. However, it was also determined that receivers to the east (Latherham House) would now be subject to much lower plant noise impact when compared to that initially observed in 2021 resulting in an EHO investigation and abatement notice. It was also concluded that receivers previously exposed to the west along St George's Place, would now be exposed to acceptable plant noise levels when compared to the background noise levels and where context in accordance with BS4142 was considered.

Since the 2022 noise impact assessment carried out by ACL, the client applied some additional mitigation measures to the plant and has requested that we re-measure and reassess the plant noise impact on the receivers at Latherham House. The mitigation included lagging all the eastern ducting and plant items (apart from the main fan with exposed motor) and sealing all the joints found to be 'leaking' noise.

This report addresses Planning Condition 4 which requires measurements and assessment of the newly installed and recently mitigated plant upon the nearest noise sensitive receivers.

This report is also based on plant noise measurements of the installed kitchen extract system undertaken on site previously in September 2022 and more recently in 2023. The data measured, together with background sound levels obtained on site in July 2021, will be used to assess the impact of plant upon the nearest sensitive receivers in accordance with British Standard 4142:2014+A1:2019.

The author of this report is a full Member of the Institute of Acoustics with more than 13 years' experience within the field and as such, is considered suitably qualified to undertake a noise impact assessment.

2. The Site

The Thai Emerald restaurant is located at 60 St George Place, Cheltenham, GL50 3PN.

The newly installed kitchen extract plant is located at roof height above the restaurant. It replaces the kitchen extract plant previously assessed in 2021, which failed to demonstrate compliance with current standards such as BS4142:2014.

The older extract terminal has been replaced with a new upstand Jet Cowl located on the western side some 3.1 metres above the roof level. A new fan has also been installed, replacing the old axial fan. A total of 4 attenuators are currently fitted on site – 2No. attenuators on both the room and atmosphere sides. The filters and equipment located on the eastern side of the roof have been retained. All ducts and attenuators apart from the main fan have been lagged and joints sealed as recommended following the noise measurements carried out in 2022. It was determined that the noise on site is now mainly determined by the noise emission of the Extract Fan when in operation, which has an exposed motor.

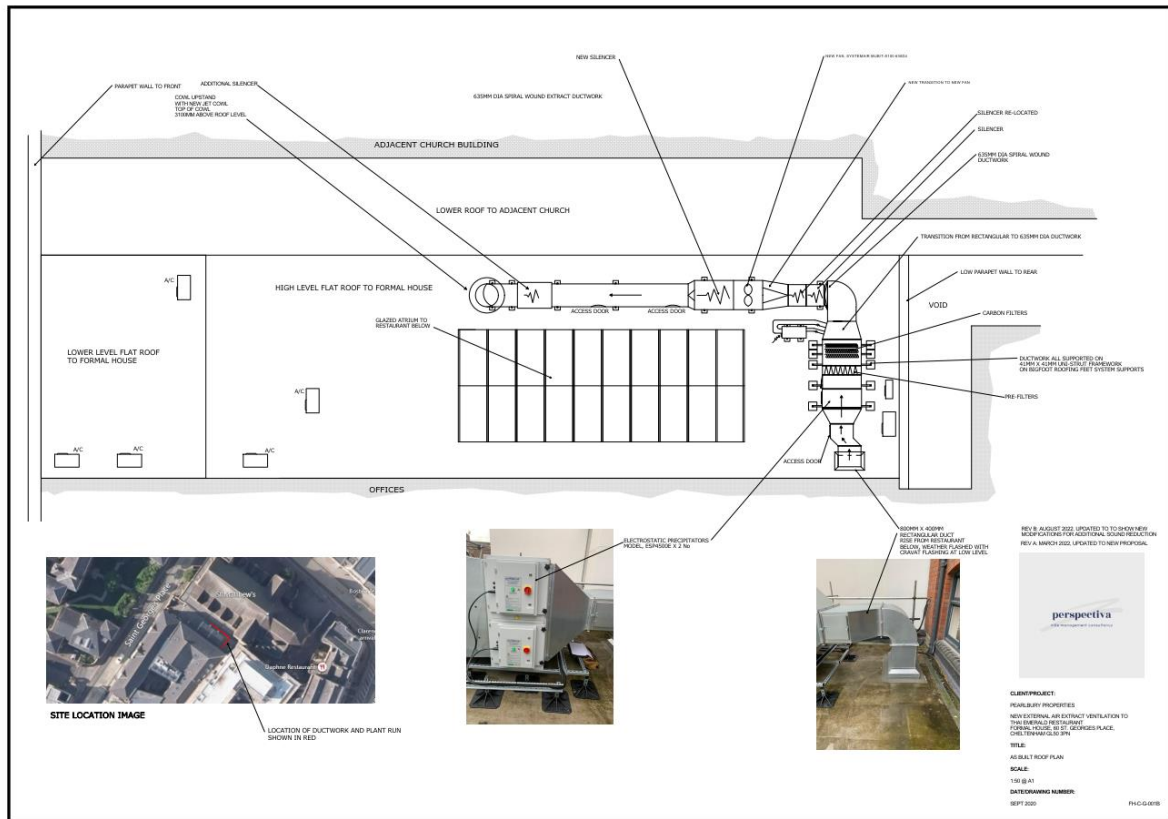
There are also some existing condenser units along the western side on the roof that pre-date the kitchen exhaust system and are part of the office development. In addition, there are also 3No. Louvres at ground level within the courtyard of Latherham House (residents to the east) that are currently contributing to the residual ambient noise levels at Latherham House, as well as the intake louvre along the office wall. The noise emission from the intake louvre was barely distinguishable against residual noise.

The BS4142:2014 assessment carried out below considers the noise emission of the new kitchen extract plant only (retrospective) and any pre-existing plant noise such as condenser units, ventilation louvres, should be considered as being part of the pre-existing noise climate. As stated below, it is not clear whether the background noise level considered in this assessment, taken immediately after the restaurant closed between 23:00 and 00:00 hours, considered the pre-existing 3no. Louvres at ground level within the courtyard and which should have been considered part of the original noise climate.

As these are understood to be associated with the restaurant, it is possible that once the restaurant closes, these are switched off as well, resulting in a lower level at Latherham House than that that should be considered from the BS4142 noise assessment point of view.

The client has provided the indicative building layout showing the current installation location.

Figure 1: Plant Currently Installed at roof level – August 2022 Survey



The site’s plant and nearest noise sensitive residential receivers are also shown below in the 3D Google map view and photos taken on site during our site visit.

Figure 2: 3D Google view of the existing site (showing old Kitchen extract plant)

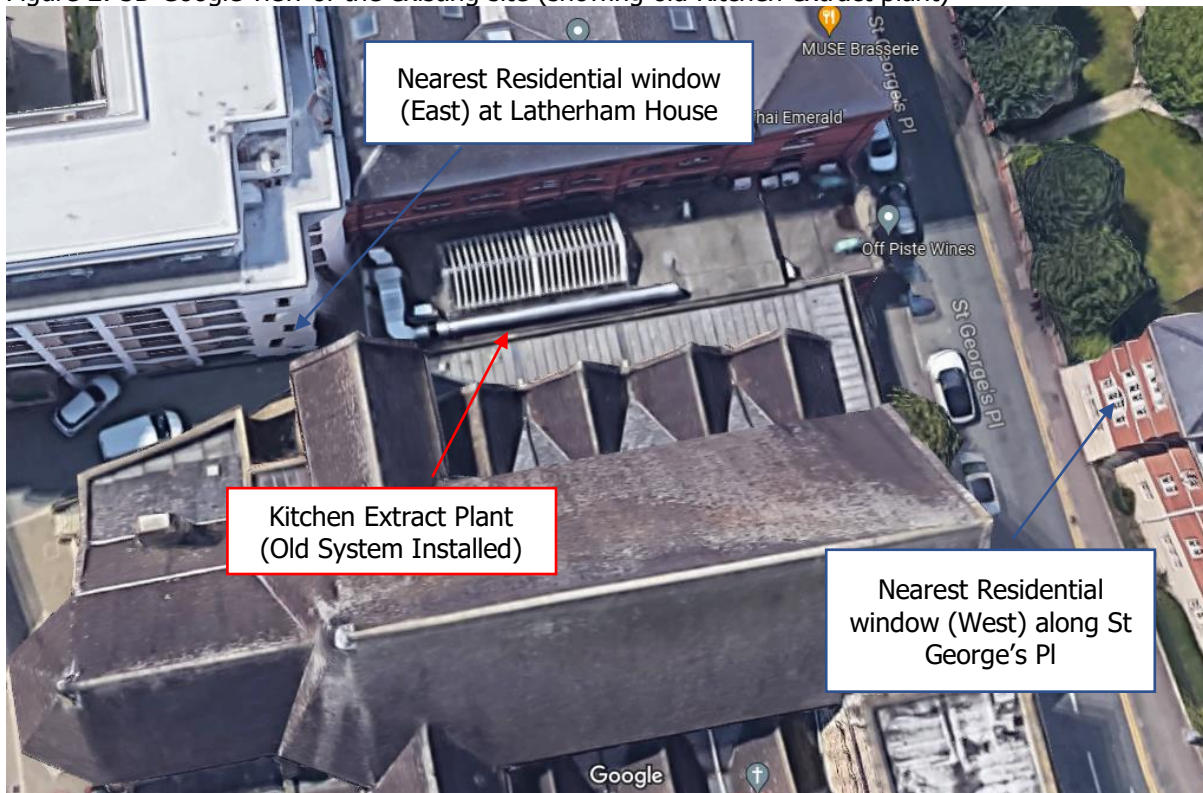


Figure 3: Nearest Residential Window to the West & Exhaust Jet Cowl Facing West

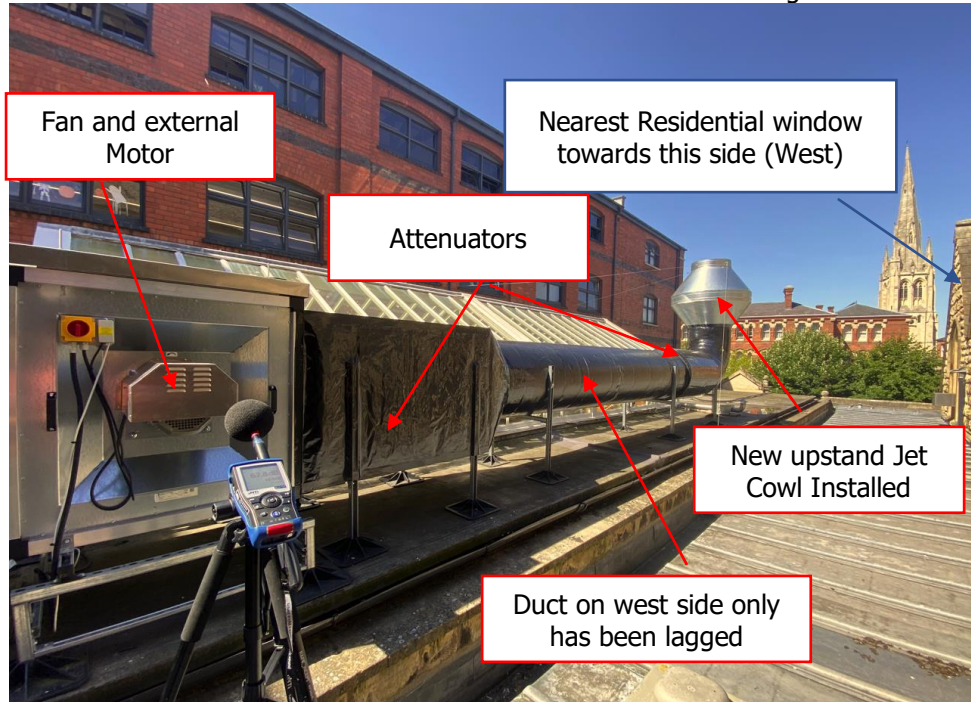


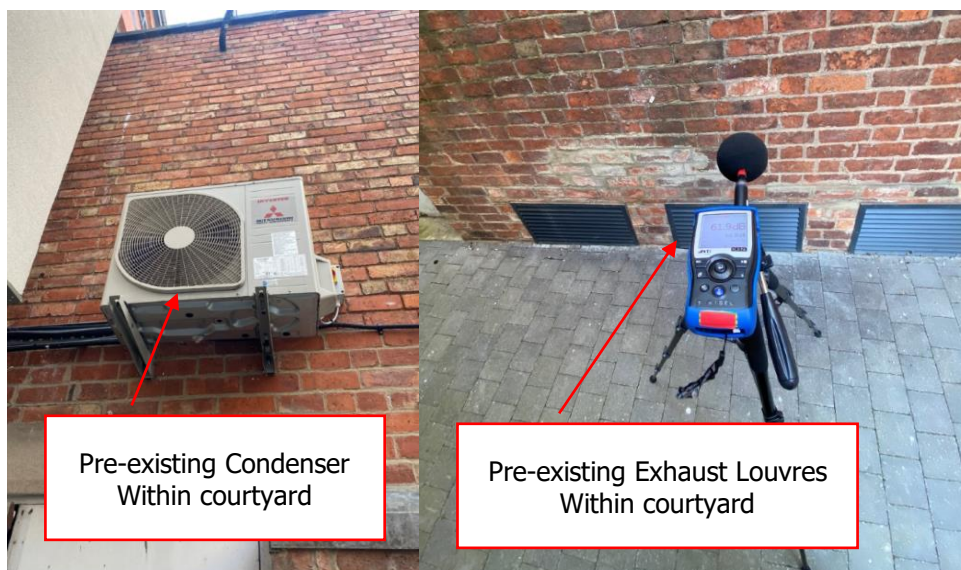
Figure 4: Nearest Residential Window to the East & Exhaust Terminal Facing West



Figure 5: Intake Louvres at Facade



Figure 6: Pre-Existing Exhaust Louvres and condenser Unit at ground level within the eastern receiver's yard



The current business opening hours are understood to be as follows:

- Monday: 3.00pm - 10.00pm
- Tuesday - Sunday: 9.30am - 2.30pm and 4.00pm - 10.00pm

It is also understood that the kitchen extract fan only runs typically at full speed during lunch/dinner times, around 12:00-14:00 to 17:00-22:00 hours, when the kitchen is preparing food. The assessment period between 21:00 and 22:00 hours can therefore be considered the worst assessment period during the generally assumed daytime assessment period in accordance with BS4142:2014 (07:00 to 23:00 hours).

3. Planning and Noise

3.1. Planning Condition

This report specifically addresses Planning Condition 4 of the consented scheme (Application Ref. No 22/00530/FUL) which requires the following:

"A noise survey shall be submitted to, and approved in writing by the Local Planning Authority within 2 months of the installation of the noise suppression measures shown on the approved plans, along with a programme for the installation of any further suppression measures required. Any such measures shall be installed in full in accordance with the programme and shall be retained as such thereafter.

Reason: To safeguard the amenity of adjacent properties and the general locality, having regard to adopted policy SL1 of the Cheltenham Plan (2020) and adopted policy SD14 of the Joint Core Strategy (2017)."

3.2. Abatement Notice in Respect to Nuisance (21/01690/NOIMAC)

It is understood that a Formal Abatement Notice with regards to the previous installed kitchen extract system was issued by Cheltenham Borough Council on the 1st July 2021, under section 80(1) of the Environmental Protection Act 1990 because it is satisfied that a statutory nuisance under section 79(1) (g) of the Act exists at the Thai Emerald Restaurant, 60 St Georges Place, Cheltenham, Gloucestershire, GL50 3PN, within the district of Cheltenham Borough Council arising from "A tonal hum arising from the use of the extraction system" and hereby required that the said nuisance is abated.

It is understood that the mitigation measures previously installed in an attempt to solve the noise related issues were not sufficient and consequently a new kitchen extract system including new fan and upstand jet cowl have now been installed.

The committee report dated 22nd of May 2022 (application No. 22/00530/FUL) provides comments made by the Environmental Health Officer on the 25th March 2022 with regards to the retrospective application and new kitchen extract system.

*Environmental Health
25th March 2022*

I have just had a look through the planning submission and I will be not raising an objection from an EH perspective. There is an active Abatement Notice in place and so I am hopeful these proposals will resolve the noise issues I have been investigating for some time now.

I would like to point out that this is the second attempt at mitigation to resolve the noise issue and so regardless of planning permission being granted, if the noise issue

is not resolved on completion of the works I will be requesting further works be undertaken to achieve compliance with the Abatement Notice."

The committee report document also states the following in section 6.21, 6.22 and 6.24 which can be considered relevant to this application in respect to noise impact assessment:

"6.21 The application has been prompted by the involvement of an Environmental Health Officer (EHO) who has been investigating noise complaints.

6.22 The additional equipment proposed i.e. upstand, cowl, silencer and works within the acoustic chamber are welcomed by the EHO who is confident that they will bring noise down to acceptable levels.

6.24 Officers are therefore satisfied that the proposed alterations to the equipment will result in a scheme which has an acceptable impact upon neighbouring properties. It is accepted that there may be some residual impact and that the equipment will be visible from some of the residential units nearby, however it is considered that this will bring any impact to within tolerable levels, bearing in mind that some disturbance is inevitable when living in the town centre. Nevertheless a condition is attached requiring the submission of a noise survey once the equipment is installed in order to ensure that it is performing correctly and achieving the anticipated improvements upon noise emissions. A condition is also attached requiring the installation of these measures within 2 months of the decision."

Plant noise measurements have been made to the new extract plant, and a noise impact assessment in accordance with BS4142:2014+A1:2019 has been provided.

This assessment methodology has been previously used by ACL to assess the noise impact of the restaurant's kitchen extract plant upon the NSRs. This methodology has been discussed and accepted by the Environmental Health Officer on the 11th August 2021 during the meeting held on site to discuss our first issued report (9136, 60 St Georges Place, Cheltenham, GL50 3PN, dated 28th July 2021).

It was also agreed that by meeting the background noise level at the NSR in accordance with BS4142, the level impacting upon the receivers would be considered acceptable in planning /nuisance terms. However, as stated above it is understood that there "*may be some residual impact*" and that "*some disturbance is inevitable when living in the town centre*".

4. Assessment Methodology

4.1. British Standard 2014:2014+A1:2019

For industrial and commercial noise, the most relevant guidance is provided within British Standard 4142:2014+A1:2019. The methods described in the British Standard use outdoor sound levels to assess the likely effects of sound upon people who might be inside or outside a dwelling or other premise used for residential purposes.

The initial estimate principle is that of establishing the 'difference' between the 'rating level' and the 'background sound level'. The 'rating level' is the 'specific sound level' of the source over a period of one hour during the day (07:00 to 23:00 hours) and over a period of 15 minutes during the night (23:00 to 07:00 hours). Clause 9 entitled 'Rating Level' states:

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

An acoustic character correction should be added to the 'specific sound level' if it exhibits any tonality, impulsivity, other specific characteristics and/or intermittency at the assessment location. The value of the character correction varies, dependent on the prominence of the character of the sound source at the assessment location. In Clause 11 of the Standard, entitled 'Assessment of the Impacts', it states:

"Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9), and consider the following."

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

Based on the initial assessment outcomes of BS4142, and depending on context, it is our opinion that the NOEL, LOAEL and SOAEL levels stated in the Noise Policy Statement for England would generally fall within the following categories when considered in conjunction with the effect levels of the NPPG Noise.

Table 1: BS4142 Difference in Relation to Effect Levels

BS4142 Assessment Difference	Corresponding Effect Level*	Action*
≤-10 dB	No Observed Effect	No specific measures required
-9.9 dB to 0 dB	No Observed Adverse Effect	No specific measures required
	Lowest Observed Adverse Effect Level	
0.1 dB to 5 dB	Observed Adverse Effect	Mitigate and reduce to a minimum
	Significant Observed Adverse Effect Level	
5.1 dB to 10 dB	Significant Observed Adverse Effect	Avoid
≥10.1 dB	Unacceptable Adverse Effect	Prevent

* BS4142 states that “where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration”. Therefore, the assessment levels and effect levels above are not definitive and can be modified due to context.

It should be noted that the numerical outcome only represents the initial estimate of impact, as stated in the first paragraph of Clause 11, and that contextual matters should be considered before determining what the potential impact is. This paragraph states:

The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An 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 (see Clause [8](#)) from the rating level (see Clause [9](#)).

NOTE 1 More than one assessment might be appropriate.

The second part of Clause 11 sets out three contextual matters that should be taken into account once the initial numerical estimate has been determined. It is important to note that the three listed are not exhaustive and all pertinent factors should be considered.

5. Noise Monitoring

An assessment to BS4142:2014 requires the baseline noise levels for the area in the absence of the new kitchen extract plant to be determined. As the restaurant was already operating, a background noise survey was undertaken from the 13th of July 2021 to the 14th of July 2021. The background sound levels obtained after the restaurant closed have been used in the assessment below.

Furthermore, we conducted brief measurement samples on August 10th of 2022, after the installation of the new kitchen extract system, which was operating at full speed (typically during cooking periods), in various locations throughout the plant. We also performed additional measurements on September 6th of 2023, subsequent to the installation of further noise control measures. The measurement locations remained consistent across all the on-site measurements conducted in 2021, 2022, and 2023.

The noise breaking out from the installed fan was considered to form the predominant noise source affecting the nearest residents. The noise previously breaking out from the inlet ventilation ducts/bends as well as through small duct junctions, which was found to be uncontrolled during our measurements in 2022, is now considered sufficiently controlled following the installation of additional lagging and measurements carried out in 2023.

The noise emissions from the ducted exhaust terminal (uphold jet cowl) were indistinguishable when compared to the noise levels radiated from the east side area on the roof, which again were determined to be from the fan.

5.1. Monitoring Equipment

Sound Pressure Levels were measured using a Sound Level Meter with a half-inch condenser microphone, using the 'fast' setting. The equipment is checked regularly using a Quality System meeting the requirements of British Standard EN ISO/IEC 17025:2005 and in accordance with British Standard EN 10012:2003 and traceable to the National Standards.

This equipment was checked and calibrated as noted below and the certificates are available for inspection upon request. Table 2 below provides the equipment and calibration status.

Table 2: Equipment and Calibration Status

Equipment Description / Manufacturer /Type	Serial Number	Date of Calibration	Calibration Certification Number
2021 Measurements			
SLM, NTI, XL2	A2A-11041-E0	12/07/2021	UK-21-061
Pre-Amp, NTI, MA220	1822	12/07/2021	UK-21-061
Microphone, NTI, MC230A	9583	12/07/2021	UK-21-061
Calibrator, Larson Davis, CAL200	18273	15/12/2021	39760
2022 Measurements			
SLM, NTI, XL2	A2A-11041-E0	12/07/2021	UK-21-061
Microphone, NTI, MC230	9583	12/07/2021	UK-21-061
Pre-Amp, NTI, MA220	1822	12/07/2021	UK-21-061
SLM, NTI, XL2	A2A-11041-E0	12/07/2021	UK-21-061
2023 Measurements			
SLM, NTI, XL2	A2A-13617-E0	30/03/2022	40614
Pre-Amp, NTI, MA220	7727	30/03/2022	40614
Microphone, NTI, MC230A	A16151	30/03/2022	40613

The measuring system was checked for calibration before and after the tests and no significant drift was detected.

5.2. Weather Conditions

During the baseline noise measurements carried out between the 13th of July 2021 to the 14th of July 2021, the weather was mainly dry with an average temperature of approximately 13-22 degrees Celsius.

During the attended surveys on the 10th of August 2022 and 6th of September, the temperatures were of approximately 28 and 25 degrees Celsius respectively.

On all occasions, the measurements were made with clear sky and relatively low wind speed. These weather conditions are not expected to have adversely affected the measured noise data.

5.3. Noise Monitoring Procedure

5.3.1. Baseline Noise Levels – July 2021

Baseline noise levels representative of the noise climate of the nearest noise sensitive receivers were determined between the 13th and 14th of July 2021.

During the noise monitoring exercise, the restaurant was operating and therefore it was not possible to measure the background noise levels in the absence of any plant noise from the kitchen extract system during its likely worst-case operational hour (assumed to be the last business hours when the system is typically running between 21:00 to 22:00 hours).

Background noise levels $L_{A90, 1 \text{ hour}}$ are likely to be similar or lower on the subsequent hour periods (22:00 to 24:00 hours) when the plant is turned off. Therefore, the period between 23:00 to 00:00 hours was used and is considered to be representative of the worst-case background noise climate at the nearest noise sensitive receivers.

As stated above, we have also determined, during the survey carried out on the 10th of August 2022, that there are also 3No. Louvres at ground level within the courtyard of Latherham House. These louvres are considered to be pre-existing and are not part of the proposals (retrospective) and should therefore be considered as being part of the background noise level in the area.

However, it is not clear whether these louvres were running between the assumed worst case background period between 23:00 to 00:00 hours after the restaurant closed, but as they are pre-existing and as part of the restaurant, it is possible that these items of plant have been OFF. The same applies to the existing condenser units associated with the offices, which might have been OFF during the evening and where offices tend to be closed.

It means that by considering a background noise level that is lower than the background noise expected during the worst-case restaurant opening hours (21:00 to 22:00 hours), the impact of noise determined in accordance with BS4142 and provided below might be actually higher than in reality and where potentially the baseline noise level should be higher.

5.3.2. **Attended plant Noise Measurements in 2022 and 2023 (relocated plant configuration)**

Attended plant noise measurements were carried out on the 10th of August 2022 at multiple locations surrounding the then newly installed kitchen exhaust system within the restaurant's roof to determine plant noise level emissions that could be impacting upon the nearest sensitive receivers. These measurements were repeated on the 6th September 2023 following the advice provided in 2022 by ACL and following the installation of additional duct lagging and sealing towards the east of the fan.

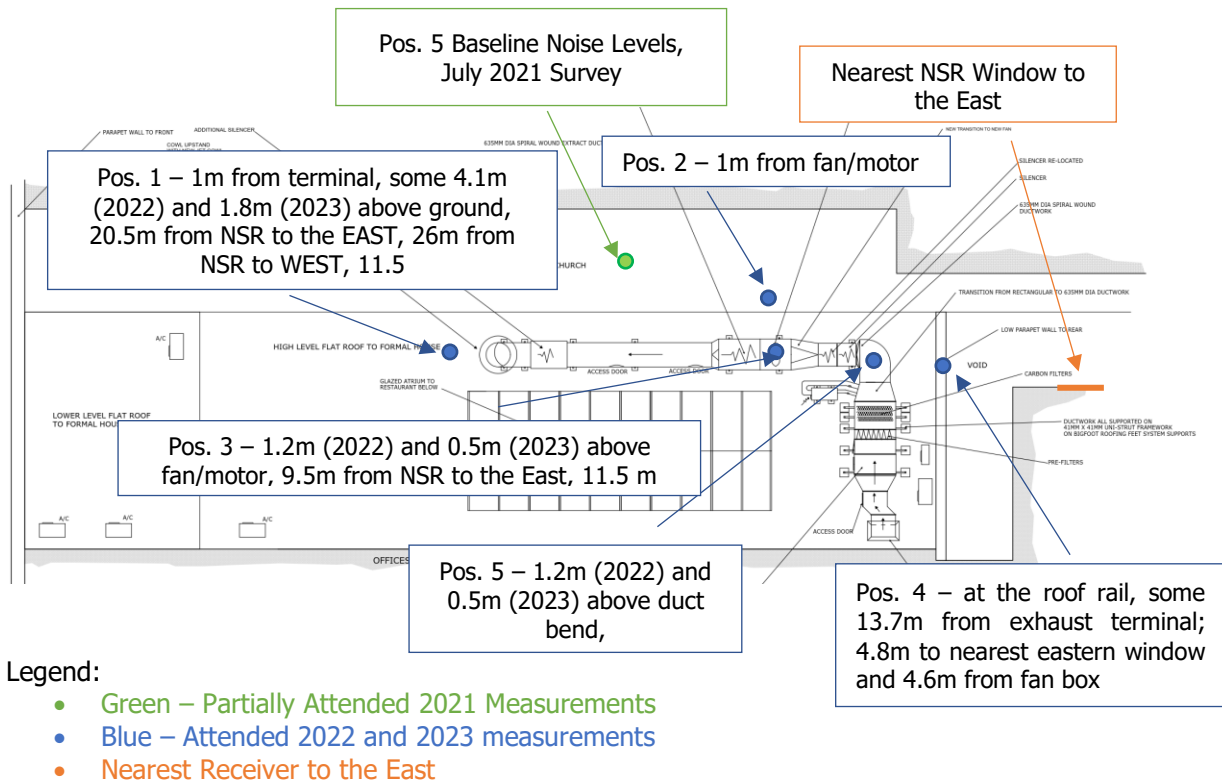
The kitchen extract fan, which is typically used during lunch/dinner meal preparations, was understood to be running at its full speed capacity during each survey. The fan noise breakout emissions were now considered to form the mainly predominant noise source affecting the surrounding areas within the rooftop.

The noise levels measured at the upstand jet cowl location to the west (the exhaust terminal location) were primarily influenced by breakout noise emissions from the fan/ducted fan area to the east. Nevertheless, it appears that the current noise emissions from this terminal position have significantly decreased and been effectively managed following the introduction of attenuators and the Jet Cowl, when compared to the original 2021 configuration that resulted in numerous noise complaints and triggered both an Environmental Health Officer's (EHO) noise investigation and an abatement notice.

The microphone was situated on a tripod with variable height above the ground/source. This is indicated in each measurement location shown in Figure 7 below and were considered to be between 0.5 to 1.5 metres above ground/from source.

Figure 7 below provides the monitoring locations used in this assessment.

Figure 7: Monitoring Locations of baseline noise levels and plant noise levels



5.4. Measured Baseline & Plant Noise Levels

5.4.1. Baseline Noise Levels – July 2021

The following chart shows the trend in the measured levels over the whole measurement period obtained during the monitoring exercise carried out in July 2021.

Chart 1: Chart showing trend in measured noise levels (obtained through XL2 NTi software) in July 2021

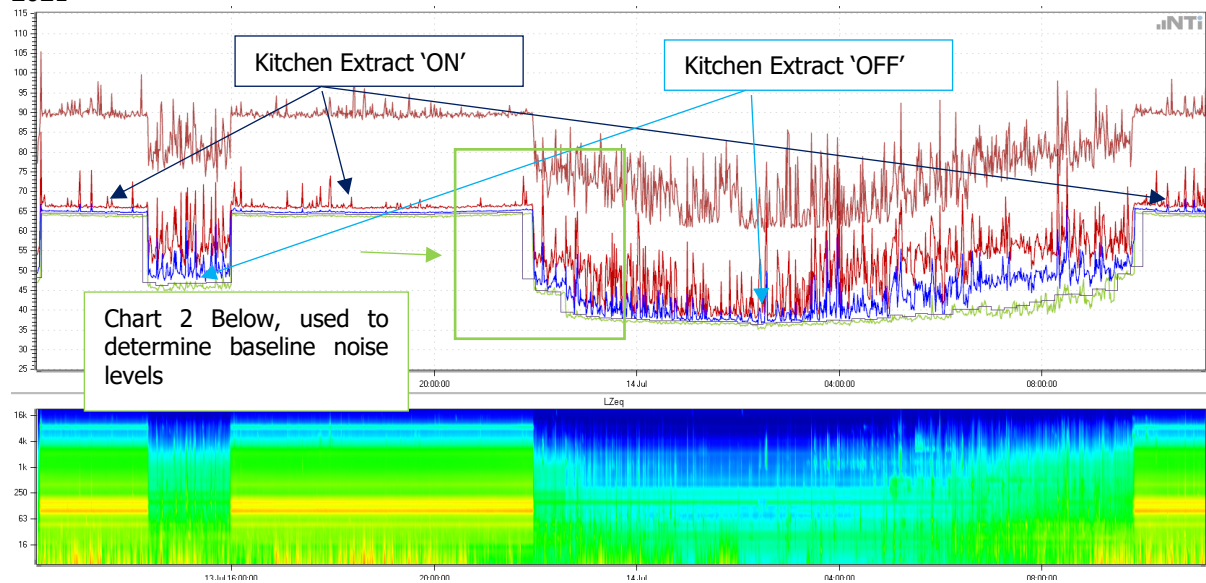
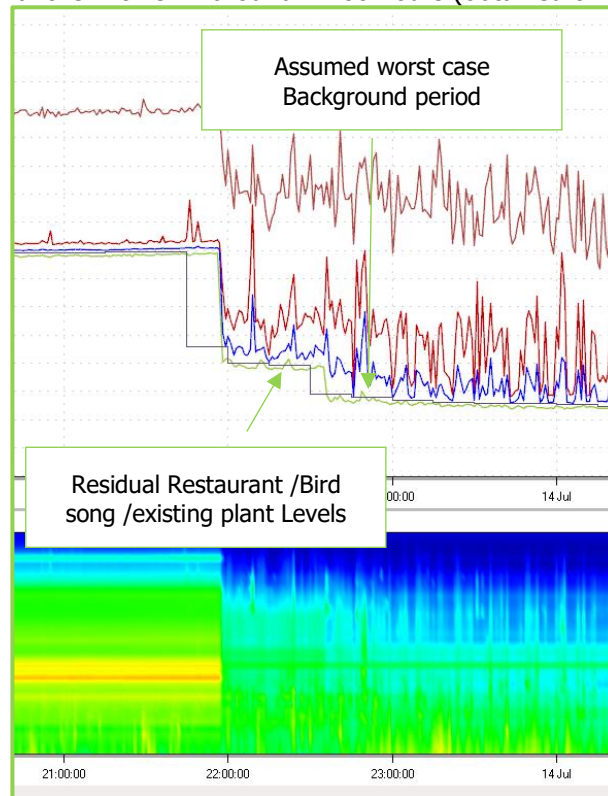


Chart 2: Chart showing Plant 'ON' & 'OFF' around 22:00 hours (obtained through XL2 NTi software)



With reference to Chart 1 and Chart 2 above, it can be seen that the typical background noise levels in the area when the restaurant plant is not running, during the most critical time of the day assumed to be during the evening period between 23:00 and 24:00 hours is 38dB LA90(1 hour).

The equivalent noise level during the same period was determined to be around 41dB LAeq,(1 hour) This will be the level used in our BS4142 assessment below and assumed to be representative of the background noise levels at the nearest noise sensitive receivers.

5.4.2. Kitchen Extract Plant Noise Levels – August 2022 & September 2023

The samples of kitchen extract plant obtained at the monitoring Positions shown above in August 2022 are shown in Table 3 below.

Table 3: Measured noise levels from Kitchen Extract System - August 2022 and September 2023 Surveys

Measurement Location	Sound Pressure Spectrum levels in dB								LAeq (dB)
	63 Hz	125 Hz	250 Hz	500 Hz	1Khz	2KHz	4KHz	8KHz	
2022 - Position 1 1m from terminal	67	72	59	58	51	46	40	34	60 ^(b)
2023 - Position 1 3.3m from terminal ^(g)	63	73	60	55	47	41	43	33	59 ^(b)
2022 - Position 2, Side of Fan at 1 metre	72	79	67	64	59	55	49	42	67 ^(c)
2023 - Position 2, Side of Fan at 1 metre	67	79	68	67	58	53	58	52	69 ^(c, d)
2022 - Position 3, above Fan at 1.2	68	80	72	65	56	51	46	40	68 ^(c)
2023 - Position 3, above Fan at 0.5	67	83	72	59	51	44	51	43	69
2022 - Position 4, at roof's rail	69	75	66	61	53	49	46	41	64
2023 - Position 4, at roof's rail	65	71	64	57	51	46	48	36	61 ^(e, f)
2022 - Position 5, Above bend	68	75	63	59	55	50	46	42	63
2023 - Position 5, Above bend	65	72	62	59	50	45	48	37	61 ^(e)
2022 - Position 5 (Kitchen Extract Off) Above bend, residual existing plant levels ^(a)	59	57	57	51	47	44	37	27	53 ^(a)

^(a) as it can be seen, the residual levels from surrounding existing plant/distant traffic is around 10dB below the level measured at same location with the kitchen extract system operating, therefore there is no need to logarithmically subtract the residual levels from the kitchen plant levels. While we haven't conducted a similar exercise in 2023, we anticipate a similar outcome given the absence of noise from the kitchen extract fan.

(b) last measurements made in 6th of October 2021 on site to the previous kitchen extract system, following the attempt to reduce noise level emissions by the inclusion of an extra attenuator, was determined to be around 73dB(A) at 1 metre from the terminal. It can therefore be seen that there is an improvement at the duct terminal by the inclusion of the Upstand Jet Cowl. The level measured at this location might in fact be from the fan noise breakout emission location as this noise source locations was found to be predominant on site. Noise level emissions at the Jet Cowl/terminal location might in fact be lower than the levels measured of 60dB(A) (2022) / 59dBA (2023).

(c) last measurements made in 6th of October 2021 on site to the previous kitchen extract system, following the attempt to reduce noise level emissions by the inclusion of an extra attenuator/lagging the atmospheric side ducts section was determined to be around 65dB(A) at 1 metre from the fan. It can be seen when comparing with the noise levels measured recently on site on both 2022 and 2023 that there is an increase in terms of fan noise emissions only, which was clearly noticeable on site when compared to previous site visits. The new fan 'box type' has its motor exposed.

(d) The measurements taken near the fan indicate that the noise levels recorded in 2023 are approximately 2 decibels higher (dBA) than in previous measurements. This increase in noise can likely be attributed to the use of a 'continuous' dial setting, which, although set at approximately 'position 5' during cooking, can result in slight variations in noise emission levels with small adjustments to the dial.

(e) It is evident that the lagging and sealing of the ducts had a positive impact, as evidenced by the reduced noise levels. The fan noise emissions, particularly from the exposed motor of the main extract fan, were identified as the primary noise source at this location, contributing significantly to the overall plant noise levels at the roof level.

(f) This is the level used to assess the noise impact in accordance with BS4142 at the nearest noise sensitive receivers and where the source location is considered to be at the fan position which is some 9.6 metres (4.8m+4.6m) from the nearest receiver window.

(g) Extending the noise meter to its prior position was not feasible due to the type of tripod used in 2023. However, it became evident that noise levels at this particular location were predominantly influenced by the axial fan rather than the Jet Coil. The contrast between measurements taken in 2022 and 2023 at different positions strongly indicates that noise levels in proximity to the Jet Coil are not attributable to it but rather originate from a distant source.

6. BS4142:2014 Noise Assessment

6.1. Predicted Specific Sound Level

A British Standard 4142:2014 assessment has been undertaken at the sensitive receivers around the site.

The calculations and predicted specific sound level at the windows of the nearest noise sensitive residential receivers to the west and east are shown below in Table 4.

Table 4: Predicted specific sound level at the nearest noise sensitive receivers

Calculation Notes	Octave Band Centre Frequency (Hz), (dB)								dBA
	63	125	250	500	1k	2k	4k	8k	
Receiver to the West									
Sound Pressure Noise Level at 1 metre (Position 1)	67	72	59	58	51	46	40	34	60
Correction for Distance attenuation (26 metres)	-28	-28	-28	-28	-28	-28	-28	-28	
Predicted Level at receiver Position 1	39	44	31	30	23	18	12	6	32
Sound Pressure Noise Level at 1 metre (Position 2, Side of Fan)	72	79	67	64	59	55	49	42	67
Correction for Distance attenuation (38 metres)	-32	-32	-32	-32	-32	-32	-32	-32	
Predicted Level at receiver	40	47	35	32	27	23	17	10	36
Cumulative At Western Receiver	43	49	37	34	29	24	18	12	37
Receiver to the East (Latherham House)									
Sound Pressure Noise Level at 1 metre (Position 1)	67	72	59	58	51	46	40	34	60
Correction for Distance attenuation & Sound Pressure (20 metres)	-26	-26	-26	-26	-26	-26	-26	-26	
Predicted Level at receiver	41	46	33	32	25	20	14	8	34
Sound Pressure Noise Level at roof rail (Position 4) (source at the fan position)	69	75	66	61	53	49	46	41	64
Correction for Distance attenuation & Sound Pressure (20LOG(1/9.4))	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	
Predicted Level at receiver	45	51	45	38	31	27	28	17	41
Cumulative at EASTERN Receiver	47	52	45	39	32	28	28	17	42

6.2. Initial Estimate

6.2.1. Background Sound Level

From the measured data we have determined the worst-case free-field design background sound level to be 38 dB $L_{A90(1 \text{ hour})}$ during the day, immediately after the restaurant closed between the period of 23:00 to 00:00 hours at a location representative of the noise sensitive receivers. This assumed background noise level in fact already falls within the night-time period (23:00 to 07:00 hours). This is considered a worst-case scenario for all the above reasons explained in section 5.3.1.

6.2.2. Specific Sound Level

The cumulative specific sound level at the worst-case receiver to the west and east is 37 dB $L_{Aeq(1, \text{ hour})}$ and 42 dB $L_{Aeq(1, \text{ hour})}$ respectively (free-field level). This is the level determined at the noise sensitive receivers without any character corrections applied.

6.2.3. Character Corrections

Character corrections should be added to the 'specific sound level' if it exhibits any *tonality, impulsivity, other sound characteristics and/or intermittency* at the assessment location. Based on our site visit the character corrections to be applied are as follows:

- **Tonality** – The proposed plant was not considered to be tonal in accordance with the objective method for assessing the audibility of tones in sound: one-third octave band (BS4142 Annex C);
- **Impulsivity** – The plant is not considered to have impulsive features and therefore we have not applied correction for impulsivity.
- **Intermittency** – We do not consider that the intermittency of the plant will be distinguishable at the sensitive receiver over the residual noise climate and we have not applied correction for intermittency. It is also understood that the plant is running continuously during most of the assessment period during the daytime period.
- **Other Sound Characteristics** – We do not believe a character correction is necessary for other sound characteristics.

Therefore, the British Standard 4142:2014 initial estimate of the noise impact at the most sensitive location for the two noise models created above, are as follows:

Table 5: British Standard 4142:2014 Initial Estimate at worst case receivers

Parameters	Daytime Period	
	Western Receiver	Eastern Receiver (Latherham House)
Background Sound Level, L_{A90} (1 hr) dB	38	38
Specific Sound Level, L_{Aeq} (1 hr) dB	37	42
Acoustic Character Correction, dB	0	0
Rating Sound Level L_{Ar} (1 hr) dB	37	42
Difference between rating and background, dB	-1	+4

With reference to Table 5 above, it can be seen that the operation of the existing restaurant plant results in a level of 37dBA and 42dBA at the nearest dwelling windows to the west and east (Latherham House) respectively during the restaurant opening hours. This is some -1dB (West) below and +4dB (East) above the existing background noise level during the restaurant opening hours (worst case assumed background; see 5.3.1).

BS 4142 states that "A difference of around +5 dB or more is likely to be an indication of an adverse impact, depending on the context."

It should also be noted that the numerical outcome of BS4142 assessment only represents the initial estimate of impact, as stated in the first paragraph of Clause 11, and that contextual matters should be considered before determining what the impact will be.

6.3. Context

With regard to context, BS4142 states "*Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following:*"

6.3.1. Absolute Levels

With regard to 'absolute levels', the most relevant guidance is British Standard 8233:2014. Section 7.7.2 Table 4 of the British Standard provides internal ambient noise levels for dwellings from noise sources 'without a specific character'. We would advise the rating level is considered to allow for the character of the source.

The guideline states that noise levels should not exceed 35 dB $L_{Aeq(16hr)}$ within living rooms/bedrooms during the daytime (07:00 to 23:00 hours). The internal level is approximately 15 dB quieter than the external free-field level (as stated by the BS8233:2014 and WHO 1999) allowing for the attenuation of a partially open window. Therefore, based on the predicted rating levels noted above, the internal absolute levels are as follows.

Table 6: Comparison with British Standard 8233:2014 at Worst-Case Receiver

Parameter	Predicted Level dB L _{Ar}	Open Window Correction dB(A)	Predicted Internal Level dB(A)	Within BS8233 Criteria?
Day (Receiver to West)	37	-15	22	YES
Day (Receiver to East)	42	-15	27	YES

As can be seen from the above table, the predicted level internally to the NSR achieves the absolute internal limits stated within British Standard 8233 at the nearest NSR room to the West and to the East (worst case receiver).

6.3.2. Residual and background noise levels

The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound, to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/or commercial nature is likely to be perceived and how people react to it."

We have compared the residual noise climate, i.e. *the ambient sound at the assessment location when the specific sound source (plant equipment) is suppressed to such a degree that it does not contribute to the ambient sound*, to the specific sound level (plant) and rating level (plant noise level with character correction applied).

This is summarised below:

Table 7: Residual Noise Climate

Parameter	Daytime - Eastern Receiver (Latherham House)
Residual Sound Level L _{Aeq,T} (23:00 to 00:00, worst case)	41 dB
Rating Sound Level L _{Ar(1hour)}	42 dB
Difference	+1

As can be seen, the rating sound level (with character) is approximately 1 dB above the typical residual sound during the assumed worst-case period immediately after all the restaurant's plant is turned off.

Also, based on the reasons explained in section 5.3.1, it is also considered that the residual noise levels considered in the assessment period above between 23:00 and 00:00 hours and after the restaurant closes, are not entirely representative of the residual noise levels during the daytime hours and when the external noise sources around the vicinity of the site, such as road traffic and pre-existing plant (3no. louvres and roofs surrounding plant associated with the restaurant/ offices) were present.

For all of the above reasons, we would consider the noise source would not be dominant over the residual noise climate.

Therefore, following the "initial estimate", we would consider that due to the context implication and once all pertinent factors (i.e. context) are considered, it is an indication that plant noise will be of a low impact when assessed to British Standard 4142:2014.

6.3.3. Existing Plant impacting upon NSRs

During a site visit on October 6, 2021, at 20 Latheram House, which is farther from the plant than the NSR in this report, outdoor and indoor noise levels were measured at 52dB(A) and 34dB(A) respectively. When the kitchen extract plant was turned off, these levels decreased to 48dB(A) (outdoors) and 32dB(A) (indoors).

In 2022, noise levels near the roof rail (position 4) were found to be 6 decibels lower than those recorded in 2021. This suggests that overall plant noise levels may have decreased, potentially yielding more favourable levels at NSRs, especially when assessed internally. Further reductions of 3 decibels were observed in the 2023 measurements.

It's important to note that closer receivers are nearer to 3no. existing extract louvres within the courtyard of Latherham House, possibly subjecting them to a higher residual noise climate. These louvres have been in operation since the restaurant's inception.

In the BS4142:2014 assessment conducted above, background noise levels were derived from a meter situated at roof level, shielded from the louvres. Consequently, during restaurant operating hours, it is plausible that the background noise levels at the window location of Latherham House (eastern receivers), which has a direct line of sight to these louvres, may exceed the assumed level of 38dB L_{A90}. It means that it is possible that in these circumstances the assessment could result in a reduced and more manageable noise impact originating from the kitchen exhaust system.

6.4. Summary of British Standard 4142:2014 Assessment

As it can be seen, when all the contextual matters are considered (see section 6.3 above), the rating level is expected to be below the recommended internal BS8233:2014 daytime noise level of 35dB $L_{Aeq,16 \text{ hours}}$ at the nearest noise sensitive receivers and are therefore considered to be acceptable in accordance with BS4142. Also, we would consider the noise source would not be dominant over the residual noise climate.

7. Summary & Conclusions

Pearlbury Properties Limited appointed Acoustic Consultants Limited (ACL) to undertake a noise impact assessment in respect to the relocation of extraction equipment (retrospective) and proposed alterations to the extraction equipment at roof level associated with the Thai Emerald restaurant.

It is understood that Thai Emerald has decided to replace the previously installed kitchen extract plant in an attempt to solve the plant noise related issues. It is understood that the Environmental Department is hopeful that the current proposals will resolve the noise related issues that have been previously investigated by the EHO and ACL.

This report addresses Planning Condition 4 which requires measurements and assessment of the new installed plant upon the nearest noise sensitive receivers.

A BS4142 assessment of the existing restaurant kitchen extract system resulted in a rating level of 37dBA and 42dBA at the nearest dwelling windows to the west and east respectively during the restaurant opening hours. This is some -1dB (West) below and +4dB (East) above the existing background noise level during the restaurant opening hours (worst case assumed background; see 5.3.1).

BS 4142 states that "A difference of around +5 dB or more is likely to be an indication of an adverse impact, depending on the context."

It should also be noted that the numerical outcome of BS4142 assessment only represents the initial estimate of impact, as stated in the first paragraph of Clause 11, and that contextual matters should be considered before determining what the impact will be.

When all the contextual matters are considered (see section 6.3 above), the rating level is expected to be below the recommended internal BS8233:2014 daytime noise level of 35dB $L_{Aeq,16 \text{ hours}}$ at the nearest noise sensitive receivers and are therefore considered to be acceptable in accordance with BS4142. Also, we would consider the noise source would not be dominant over the residual noise climate.

It is clear that the current insertion loss (IL) provided by the installed attenuators are sufficient to control duct fan noise emissions at the Upstand Jet Cowl terminal. Additionally, it is evident that the duct lagging and sealing have significantly improved noise emissions from the roof area, especially towards the eastern receivers.

Breakout noise from the fan located on the eastern side of the roof remains perceptible within the roof area. Nevertheless, we believe that its impact on the nearest dwellings will be within acceptable limits when compared to BS8233:2014 internally. While there are more costly mitigation options available to completely suppress fan noise emissions, these are not suitable for the client and are not in our opinion necessary based on the observations highlighted above.

It's worth noting that the noise emissions from pre-existing plant that have been affecting the residents of Latherham House should also be taken into consideration. This plant noise might not have been factored in when determining the background noise levels measured at roof level, especially when screened from these sources or when they were not operational.

Furthermore, it's worth noting that the current noise emissions from the plant, as per BS4142 standards, are significantly lower, with reductions of 23dB and 14dB compared to the levels determined in 2021 that led to environmental health investigations and an abatement notice. Our client has informed us that following the relocation of the kitchen extract plant and the implementation of additional mitigation measures, they have not received any further noise-related complaints. This serves as compelling evidence of the significant improvements in site noise levels, which were previously clearly audible and disruptive.

As stated in section 6.24 of the committee report dated 22nd of May 2022 (application No. 22/00530/FUL) which provides comments made by the Environmental Health Officer with regards to the retrospective application and new kitchen extract system, *"It is accepted that there may be some residual impact and that the equipment will be visible from some of the residential units nearby, however it is considered that this will bring any impact to within tolerable levels, bearing in mind that some disturbance is inevitable when living in the town centre."*

Site measurements indicate that there is currently no noticeable tonality. The mitigation measures implemented have effectively resolved any potential tonal characteristics of the plant. With this understanding, we believe that the requirements of the abatement notice have also been satisfactorily addressed.

8. Appendix 1 – Glossary of Acoustic Terminology

A-weighted sound pressure p_A – value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network

A-weighted sound pressure level, L_{pA} - quantity of A-weighted sound pressure given by the following formula in decibels (dBA)

$$L_{pA} = 10 \log_{10} (p_A/p_0)^2$$

where:

p_A is the A-weighted sound pressure in pascals (Pa);
 p₀ is the reference sound pressure (20 μPa)

Background sound level, L_{A90, T} – A-weighted sound pressure level that is exceeded by the residual sound assessment location for 90% of a given time interval, T, measured using weighting F and quoted to the nearest whole number of decibels

Break-in - noise transmission into a structure from outside.

Decibel (dB) – The decibel is the unit used to quantify sound pressure levels. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro-Pascals to 100 Pascals). Therefore, a logarithmic scale is used to describe sound pressure levels and also sound intensity and power levels. The logarithms are taken to base 10. Hence an increase of 10 dB in sound pressure level is equivalent to an increase by a factor of 10 in the sound pressure level (measured in Pascals). Subjectively, this increase would correspond to a doubling of the perceived loudness of sound.

Equivalent continuous A-weighted sound pressure level, L_{Aeq, T} – value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, T = t₂ – t₁, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{AeqT} = 10 \log_{10} \left\{ (1/T) \int_{t_1}^{t_2} [p_A(t)^2/p_0^2] dt \right\} \quad (1)$$

where:

p₀ is the reference sound pressure (20 μPa); and

p_A(t) is the instantaneous A-weighted sound pressure (Pa) at time t

NOTE The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

Facade level – sound pressure level 1 m in front of the façade. Facade level measurements of L_{pA} are typically 1 dB to 3 dB higher than corresponding free-field measurements because of the reflection from the facade.

Free-field level – sound pressure level away from reflecting surfaces. Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the source).

Octave and Third Octave Bands – The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz and is generally more sensitive to medium and high frequencies than to low frequencies within the range. There are many methods of describing the frequency content of a noise. The most common methods split the frequency range into defined bands, in which the mid-frequency is used as the band descriptor and in the case of octave bands is double that of the band lower. For example, two adjacent octave bands are 250 Hz and 500 Hz. Third octave bands provide a fine resolution by dividing each octave band into three bands. For example, third octave bands would be 160 Hz, 250 Hz, 315 Hz for the same 250 Hz octave band.

Sound pressure level – Sound pressure level is stated on many of the charts. It is the amplitude of the acoustic pressure fluctuations in a sound wave, fundamentally measured in Pascals (Pa), typically from 20 micro-Pascals to 100 Pascals, but commonly simplified onto the decibel scale.

Sound reduction index, R – laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.

Specific sound level, $L_s = L_{Aeq, T_r}$ – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

Structure-borne noise – audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements

Rating level, L_{Ar, T_r} – Specific sound level plus any adjustment for the characteristic features of the sound.

Reverberation Time, T – The reverberation time is defined as the time taken for a noise level in an enclosed space to decay by 60 dB from a steady level, once the noise source has stopped. It is measured in seconds. Often a 60-dB decay cannot be measured so the reverberation time is measured over a lesser range and corrected back to the time for a 60-dB drop assuming a constant decay rate. Common parameters are T20 (time taken for a 20-dB decay multiplied by three) and T30 (time taken for a 30-dB decay multiplied by two).

Vibration Dose Value, VDV – measure of the total vibration experienced over a specified period of time.

Estimated Vibration Dose Value, eVDV – estimation of the total vibration experienced over a specified period of time. This is usually based on the number of events and shortened measurement data.

Weighted sound reduction index, R_w – Single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The weighted sound reduction index is used to characterize the insulation of a material or product that has been measured in a laboratory (see BS EN ISO 717-1).

Weighted standardized impact sound pressure level, $L'_{nT, w}$ - single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies. NOTE weighted standardized impact sound pressure level is used to characterize the insulation of floors in buildings (see Annex C and BS EN ISO 717-2).

Weighted standardized level difference, $D_{nT, w}$ – single-number quantity that characterizes the airborne sound insulation between rooms. NOTE Weighted standardized level difference is used to characterize the insulation between rooms in a building (see Annex C and BS EN ISO 717-1).



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