

Papa John's, Wrexham

Noise Impact Assessment

Report 17/0474/R1

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Report 17/0474/R1

Papa John's UK

Papa John's UK & European Campus
11 Northfield Drive
Milton Keynes
MK15 0DQ

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Noise Impact Assessment

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Glossary of Acoustic Terms

17/0474/SP1

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17/0474/TH1

Time history showing noise measurement results

17/0474/PNS1

Plant noise schedule

17/0474/CS1-12

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Noise Impact Assessment

1 Introduction

- 1.1 Planning permission is being sought for the conversion of an A1 category premises at 1A Regent House, Wrexham, LL11 1PR for use as an A3 category (takeaway) premises. As part of the conversion mechanical services plant items will be installed on the site.
- 1.2 Cole Jarman have conducted a noise survey at the site to quantify background noise levels at the nearest residences.
- 1.3 This report documents the methodology used to conduct the noise survey, calculate noise emissions from the proposed plant and calculate noise emissions from the proposed delivery service.

2 Site Description

- 2.1 Regent House, Wrexham is a multi-storey building which with retail use at ground floor level and offices above. The unit and surrounding area is shown on attached site plan 17/0474/SP1
- 2.2 Regent Street runs along the front of the proposed store, and runs into the centre of Wrexham. Caxton Place runs off Regent Street to the west of the property, and provides access to a small car park behind Regent House and a block of flats opposite.
- 2.3 Caxton Place houses two separate residential blocks, of equal height (4 storeys) to Regent House. The residential windows of these flats are taken to be the nearest noise sensitive receivers.
- 2.4 The proposed development will include the installation of a supply fan, oven extract fan and a Cold Room condenser.

3 Background Noise Survey

3.1 Methodology

- 3.1.1 An unattended noise survey was undertaken at the site commencing at 2100 hours on the 9th August terminating at 0300 hours on the 10th of August 2017.
- 3.1.2 Measurements of background noise levels were taken at a freefield position 3.5m above ground level at the rear of the property in the nearby car park. Illustrated as position MP1 in site plan 17/0474/SP1.
- 3.1.3 The location of the measurement position (MP1) was chosen to be best representative of the background noise levels at the closest noise sensitive dwellings on Caxton Place.



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- 3.1.4 Measurements of the L_{Aeq} , L_{Amax} and L_{A90} indices were measured over consecutive 15 minute periods for the duration of the survey using the equipment listed within table T1 (see attached Glossary of Acoustic Terms for an explanation of the noise units used).

Item	Manufacturer	Type
Sound Level Analyser	Rion	NL-52
Acoustic Calibrator	Rion	NC-74
Weatherproof windshield	Rion	WS-15

T1 Equipment used during unattended noise survey.

- 3.1.5 The microphone of the sound level meter was extended by cable and placed inside a weatherproof windshield with the sound level meter calibrated before and after the survey to confirm an acceptable level of accuracy. No significant drift was observed.
- 3.1.6 Weather conditions when setting up the noise monitor consisted of dry ground and cold temperatures. Some rain began to fall around 2am and continued until collection of the noise monitor at 0300, this was not thought to have affected results significantly.

3.2 Results

- 3.2.1 A time history of the noise measured during the survey is shown in 17/0474/TH1. Noise levels when setting up and picking up the monitor were affected by traffic on Regent Street.
- 3.2.2 The proposed opening hours of the store covers the quietest parts of the night, therefore in this case the representative noise levels for the opening and closed hours of the store are the same.
- 3.2.3 The representative background noise L_{A90} for both the Day and Night times for the property is detailed in table T2 below:

Location	Representative Background Noise Level, dB(A)	
	Opening Hours (1100-0300)	Closed (0300-1100)
MP1	31	31

T2 Representative measured background noise L_{A90} .



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4 Guidance

4.1 Criteria Relevant to Delivery Noise

National Planning Policy

4.1.1 Relevant national planning policy in Wales is set out within Planning Policy Wales, Edition 9, published November 2016 ('PPW') and the accompanying Technical Advice Note 11: Noise, published October 1997 ('TAN 11').

4.1.2 The Planning Policy Wales states the following on the subject of noise:

"Policies should be designed to ensure, as far as possible, that potentially noisy developments are located in areas where noise will not be such an important consideration or where its impact can be minimised. Local planning authorities should adopt policies to prevent potentially noisy developments in areas which have remained relatively undisturbed by noise. Development plan policies should have regard to any relevant Noise Action Plan, including the need to protect urban 'quiet areas' against an increase in noise."

4.1.3 The accompanying technical advice note Technical Advice Note 11: Noise states the following regarding noise generating developments in general:

"Local planning authorities must ensure that noise generating development does not cause an unacceptable degree of disturbance. They should also bear in mind that if subsequent intensification or change of use results in greater intrusion, consideration should be given to the use of appropriate conditions."

4.1.4 With regards to fast food restaurants TAN 11 states the following:

"B18. Commercial developments such as fast food restaurants, discos, night clubs and public houses pose particular difficulties, not least because associated activities are often at their peak in the evening and late at night. Local planning authorities will wish to bear in mind not only the noise that is generated within the premises but also the attendant problems of noise that may be made by customers in the vicinity. Disturbance that can be caused by traffic and associated car parking should not be underestimated."

4.1.5 TAN 11 doesn't provide any specific guidance to assess the noise impact of a site and so guidance from the following sources has been used:

Absolute Noise Level Criteria - World Health Organisation

4.1.6 WHO Guidelines for Community Noise and BS8233¹. provide guidance correlating to annoyance to external absolute daytime noise levels. Thresholds of 55dB $L_{Aeq,16h}$ and 50dB

¹ BS 8233:2014 – Guidance on sound insulation and noise reduction for buildings



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$L_{Aeq,16h}$ are quoted within WHO guidelines, referring to “serious” and “moderate” annoyance respectively.

- 4.1.7 WHO document ‘Guidelines for Community Noise’ provides relevant guidance. Table 4.1 states the following aspirational criteria:

Specific Environment	Critical Health effect(s)	L_{Aeq} (dB)	Time Base (h)
Outdoor Living Area	Serious annoyance, daytime and evening	55	16
Outdoor Living Area	Moderate annoyance, daytime and evening	50	16
Outside Bedrooms	Sleep disturbance, window open (outdoor values)	45	8

T3 Partial replication of table 4.1 from WHO Guidelines for Community Noise

- 4.1.8 The time base period is related to the day or night time assessment periods. The levels for outdoor living areas apply to the 16 hour daytime period (0700-2300h). The levels for outside bedrooms only apply to the 8 hour night time period (2300-0700h).

- 4.1.9 BS 8233 reflects WHO guidelines in section 7.7.3.2 where the following is stated:

It is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable.

- 4.1.10 Although the outdoor living criteria are for open spaces (i.e. gardens), it also applies to outside the façade of the building during the day. This is in line with the criteria for internal levels, as achieving 50dBA at the façade will give the required 35dBA internally via a partially open window (which gives around 15dB reduction).

- 4.1.11 The same approach can also be taken with noise level during the night time period where achieving 45dBA at the façade will give the required 30dBA internally via a partially open window.

- 4.1.12 In summary achieving absolute noise levels, taking into account contributions from existing and new sources, below 50 dB $L_{Aeq,T}$ during the daytime and 45 dB $L_{Aeq,T}$ during the night time would be considered at worst a Minor impact.



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Noise Level Change Criteria

- 4.1.13 In addition to absolute noise levels, it is appropriate to assess the impact of noise level change due to a proposed development. In determining the correct procedures for assessing the potential noise impact of a development on nearby residents, there are various key documents to which one should refer for guidance.
- 4.1.14 The assessment criteria proposed is based upon guidance contained within DMRB², *Guidelines for Environmental Noise Impact Assessment* (2014).
- 4.1.15 Vehicle movements are likely to vary significantly over the course of a day and night time, for example during rush hours. It is therefore not appropriate to only consider noise levels in terms of $L_{Aeq,16 \text{ hour}}$ and $L_{Aeq,8 \text{ hour}}$ for full day and night time periods respectively, as these indices have the potential to not properly reflect the variable nature of road traffic on such low flow roads. Instead, changes in noise level are assessed in terms of $L_{Aeq,1 \text{ hour}}$ for each hour within a 24 hour day. The significance of the change in a given period can then be determined.
- 4.1.16 Table T2 shows the magnitude of impact criteria for vehicle noise provided within DMRBs. As noted above, the change in $L_{Aeq,1 \text{ hour}}$ for each period within a 24 hour should be considered.

Noise Change dB(A)	Magnitude of Impact	
	Short Term	Long Term
0	No change	No change
0.1 to 0.9	Negligible	Negligible
1.0 to 2.9	Minor	Negligible
3.0 to 4.9	Moderate	Minor
5.0 to 9.9	Major	Moderate
10+	Major	Major

T4 Noise impact descriptors

Ambient Noise Levels Criteria Summary

- 4.1.17 The table below provides the proposed assessment criteria based on the guidance above for absolute noise levels and variations in the existing noise climate, considering the more pessimistic short term impacts:

² Design Manual for Roads and Bridges, Volume 11, Section 3, 2011



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Free Field Absolute Noise Level	Noise Change dB(A)	Magnitude of Impact Short Term
Day Time (0700 – 2300h)		
$L_{Aeq,1h} < 50$ dB	0 0.1 to 0.9 1+	No change Negligible Minor
$50\text{dB} \leq L_{Aeq,1h} < 55\text{dB}$	0 0.1 to 0.9 1.0 to 2.0 3+	No change Negligible Minor Moderate
$L_{Aeq,1h} \geq 55$ dB	0 0.1 to 0.9 1.0 to 2.9 3.0 to 4.9 5.0 to 9.9 10+	No change Negligible Minor Moderate Major Major
Night Time (2300 – 0700h)		
$L_{Aeq,1h} < 45$ dB	0 0.1 to 0.9 1	No change Negligible Minor
$L_{Aeq,1h} \geq 45$ dB	0 0.1 to 0.9 1.0 to 2.9 3.0 to 4.9 5.0 to 9.9 10+	No change Negligible Minor Moderate Major Major

T5 Assessment Criteria, Ambient Noise Levels

- 4.1.18 When considering the noise impact above Negligible or Minor impacts would be expected to be consistent with the requirements of the PPW and TAN 11 to avoid significant adverse impacts.

4.2 Plant Noise Limits

- 4.2.1 The site falls within the jurisdiction of Wrexham County Borough Council ('the Council').
- 4.2.2 In the consultation response to the application, the Council's Public Protection Service Manager stated the following with regard to noise:



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“The rating level of any noise generated by air handling plant associated with the development shall not exceed background level by more than 5dB(A) at any time. The noise levels shall be determined at nearby noise sensitive premises and measurements and assessment shall be made in accordance with BS4142:2014 Methods for rating and assessing industrial and commercial sound.”

- 4.2.3 Considering the survey results and local authority requirements the plant noise limits to apply are as follows:

Location	Noise Limit, dB	
	Opening Hours (1100-0300)	Closed (0300-1100)
MP1	36	36

T6 Noise emission limits at the nearest noise sensitive properties.

- 4.2.4 The noise limits will be applied at the nearest noise sensitive dwellings.
- 4.2.5 The noise limits apply at 1m from the outside of the closest residential windows. Noise that consists of a tonal component would also be subject to a noise limit penalty.

5 Delivery Noise Assessment

5.1 Methodology

- 5.1.1 Deliveries from the store will be made throughout between 11:00h and 03:00h. It is understood that delivery activity will occur at the rear of site utilising the shared car park facility at the property.
- 5.1.2 Two assessment positions have been selected to determine the potential impact on the most exposed noise sensitive receptors. These positions are illustrated on the attached site plan 17/0474/SP1 and described below:
- AP1 – East facing residential window on flats to the northern end of Caxton Place,
 - AP2 – East facing residential window on flats to the southern end of Caxton Place
- 5.1.3 The impact to noise levels resulting from delivery operations at each position has been calculated from 21h00 to 03h00 when the unit is proposed to close. Evenings and nights are expected to present the worst case scenario, as the existing ambient noise levels will be lower than in the day.



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- 5.1.4 Delivery drivers are instructed to avoid interaction such as loud talking or shouting which could cause excessive noise. This process is managed by store management, to ensure that there is no unnecessary noise, except for in safety critical situations. The calculated noise is therefore limited to arrival and departure of individual customer collections and delivery vehicles including cars and includes no contributions from voices.
- 5.1.5 Typical numbers of delivery arrivals and departures have been provided by the client for a non-London based franchise and are set out in table T7 below.

Time Period	2100-0300
Monday	0
Tuesday	1
Wednesday	5
Thursday	3
Friday	6
Saturday	4
Sunday	5

T7 Predicted delivery operation movement

- 5.1.6 To calculate the impact from the deliveries on the existing residences, calculations have been made based on the quantity of deliveries, assumed location of loading, and exit and return routes. The relevant corrections have then been included for distance, angle of view and screening.
- 5.1.7 The noise data used in the calculations has been obtained from a library of data produced by Cole Jarman and was originally measured at façade incident locations.

Activity	Distance	Measured Sound Level, L_{AE}
Car pass	5	72
Car start up	5	70
Car door open/close	5	65
Moped pass	5	70
Moped start up	5	73

T8 Noise data, dB L_{AE} used in assessment calculations



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5.2 Assessment

- 5.2.1 The delivery numbers provided cover the full time period between 21:00 and 03:00 and so these traffic flows must be split up into 1 hour flows in order to assess over the proposed 1 hour time period. Practically, delivery numbers will not be evenly spread across the full hours of operation. Considering this the assessment has assumed that the total number of vehicles between 21:00 to 03:00 occurred in each one hour. In reality the deliveries are likely to be spread out within the opening times, with less occurring towards the end of the night, however this assessment ensures that the worst case possible noise levels have been assessed.
- 5.2.2 The assessment has been based on the Friday night traffic flows as these are the highest predicted. It is assumed that deliveries would be made either by car or motor bike. The calculation has been based on 4 car deliveries, 2 motorised bike deliveries.
- 5.2.3 Both AP1 and AP2 have been assessed, the results tabulated in the tables below:

Time Period	Existing Ambient Noise	Calculated Delivery Noise	AP1		Impact Criteria
			Sum of Existing and Calculated	Change in Ambient Noise Level	
	dB $L_{Aeq, 1h}$	dB $L_{Aeq, 1hr}$	dB $L_{Aeq, 1h}$	dB	
21h00-22h00	54.3	38.8	54.4	0.1	Negligible
22h00-23h00	51.8	38.8	52	0.2	Negligible
23h00-00h00	49.7	38.8	50	0.3	Negligible
00h00-01h00	46.3	38.8	47	0.7	Negligible
01h00-02h00	43.1	38.8	44.5	1.4	Minor
02h00-03h00	40.8	38.8	42.9	2.1	Minor

T9 Predicted noise impact associated with delivery operations at AP1



Noise Impact Assessment

Time Period	Existing Ambient Noise	Calculated Delivery Noise	AP2		Impact Criteria
			Sum of Existing and Calculated	Change in Ambient Noise Level	
	dB $L_{Aeq, 1h}$	dB $L_{Aeq, 1hr}$	dB $L_{Aeq, 1h}$	dB	
21h00-22h00	54.3	39	54.4	0.1	Negligible
22h00-23h00	51.8	39	52	0.2	Negligible
23h00-00h00	49.7	39	50.1	0.4	Negligible
00h00-01h00	46.3	39	57	0.7	Negligible
01h00-02h00	43.1	39	44.5	1.4	Minor
02h00-03h00	40.8	39	43	2.2	Minor

T10 Predicted noise impact associated with delivery operations at AP2

- 5.2.4 Results indicate the impact is at most “Minor”, with the majority falling under the “Negligible” category.
- 5.2.5 It must be stated that the results shown above are a worst case assessment, and are unlikely to be representative of the delivery figures when the store is operational. It is more than likely that deliveries would reduce in number later into the night. As this coincides with a reduction in ambient level, it is likely that the delivery noise impact will not be as onerous later into the night as assessed above.
- 5.2.6 Taking into account the results it is concluded that the proposed delivery activity will not pose a significant adverse impact upon nearby noise sensitive receptors.

6 Plant Noise Assessment

6.1 Proposed Installation

- 6.1.1 The proposed units to be installed are as follows:
- Cold Room Condenser: Karbox 2464
 - Extract Fan: Vent Axia Black Sabre BSC500/4
 - Intake Fan: Air Vent Tech Model 5
- 6.1.2 The extract and intake fans are both located within the proposed Hot Food Takeaway's demise. The duct runs from these fans and terminates at the side wall to the east. The condensing unit is positioned outside on the east wall of the property at a low level.
- 6.1.3 All the proposed plant will run during the opening hours of the proposed hot food takeaway's, 1100-0300 daily with only the cold store condenser running 24/7.



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6.2 Methodology

- 6.2.1 Our assessment is based on manufacturer's noise data for each plant item shown in attached document 17/0474/PNS1. The noise data indicates that no tonality correction need be applied.
- 6.2.2 The assessment has considered the nearest and most exposed receptors to the proposed plant, labelled on attached site plan 17/0474/SP1 and described as follows:
- AP1 – East facing residential window on flats at the north end of Caxton Place,
 - AP2 – East facing residential window on flats at the south end of Caxton Place
- 6.2.3 The noise levels caused by the equipment at the assessment positions have been calculated by correcting the plant noise levels for distance and radiation losses, façade reflections and screening where appropriate.

6.3 Results

- 6.3.1 Noise levels at each assessment position have been calculated shown in T11 below:

Receiver	Calculated Noise Levels, dB(A)	
	Opening Hours (1100-0300)	Closed (0300-1100)
AP1	30	9
AP2	24	17

T11 Noise assessment near noise sensitive receivers.

- 6.3.2 The results indicate that the noise limits can be achieved without the use of mitigation measures.
- 6.3.3 Full calculations are shown in 17/0474/CS1-12

7 Conclusion

- 7.1 Planning permission is sought for the instalment of a new hot food takeaway outlet at 1A Regent House, Wrexham, LL11 1PR.
- 7.2 Cole Jarman have conducted a noise survey to measure the existing noise climate at local residences.



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- 7.3 Cole Jarman have assessed the impact of deliveries and have shown that the impact will be either “Negligible” or “Minor”.
- 7.4 Cole Jarman have assessed the proposed mechanical services items based on limits set by Wrexham County Borough Council.
- 7.5 Full details of the survey and assessment methodology have been provided within this report, the assessment has shown that the noise limits set by the council will be achieved without any additional mitigation.

 End of Section



Noise Impact Assessment

Glossary of Acoustic Terms

L_{Aeq} :

The notional steady sound level (in dB) which over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measurement over that period. Values are sometimes written using the alternative expression dB(A) L_{eq} .

L_{Amax} :

The maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise when occasional loud noises occur, which may have little effect on the L_{Aeq} noise level. Unless described otherwise, L_{Amax} is measured using the “fast” sound level meter response.

L_{A10} & L_{A90} :

If non-steady noise is to be described, it is necessary to know both its level and degree of fluctuation. The L_{An} indices are used for this purpose. The term refers to the A-weighted level (in dB) exceeded for n% of the time specified. L_{A10} is the level exceeded for 10% of the time and as such gives an indication of the upper limit of fluctuating noise. Similarly L_{A90} gives an indication of the lower levels of fluctuating noise. It is often used to define the background noise.

L_{A10} is commonly used to describe traffic noise. Values of dB L_{An} are sometimes written using the alternative expression dB(A) L_n .

L_{AX} , L_{AE} or SEL

The single event noise exposure level which, when maintained for 1 second, contains the same quantity of sound energy as the actual time varying level of one noise event. L_{AX} values for contributing noise sources can be considered as individual building blocks in the construction of a calculated value of L_{Aeq} for the total noise. The L_{AX} term can sometimes be referred to as Exposure Level (L_{AE}) or Single Event Level (SEL).

■ End of Section



Figure 17/0474/SP1

Title:
Site Plan indicating measurement
and assessment positions



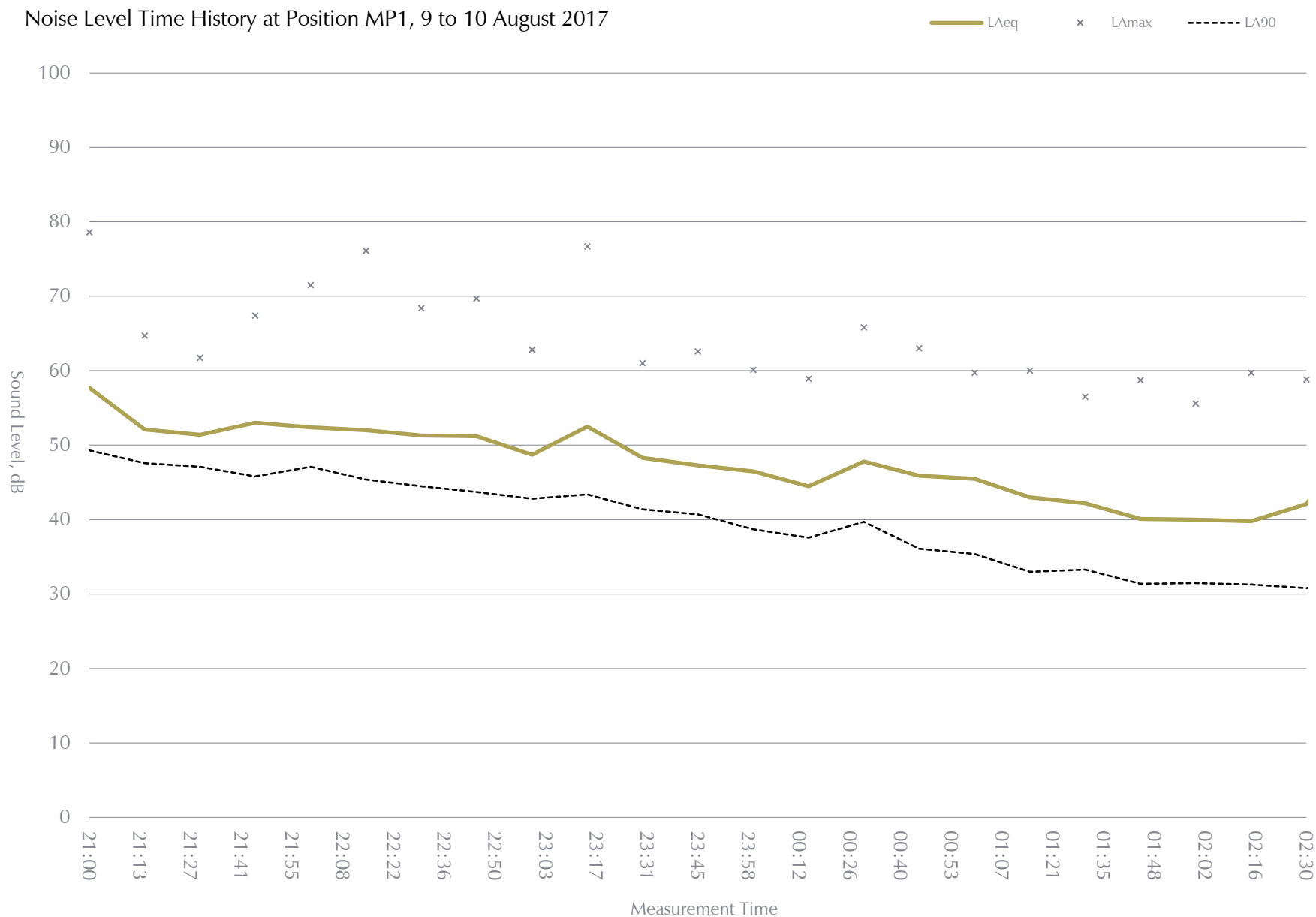
Project:
Papa John's, Wrexham

Date: 15th August 2017
Revision: -

Scale:
Not to scale



Figure 17/0474/TH01





Schedule of Plant and Air Handling Equipment Sound Levels, dB

Reference	Description	Volume (m3/s)	Data ¹ Source	Noise Level Type	Noise Levels (dB)							
					63	125	250	500	1k	2k	4k	8k
EX1	Vent Axia Black Sabre BSC500/4		Man	Sound Power, Lw	80	79	76	72	75	75	68	61
SF1	Air Vent Tech Model 5		Man	Sound Power, Lw	77	79	73	74	77	77	74	69
CR1	Karbox 2464		Man	Sound Power, Lw	64	61.5	61.5	63	59.4	57.3	54.1	46.9

Notes

1 - Man refers to data supplied by the equipment manufacturer or supplier, Emp refers to data calculated using empirical formulae, and Meas refers to data measured by Cole Jarman



Project Name Papa John's, Wrexham

Project Reference 17/0474

Receiver Reference AP1 - Day

Description Flats Calcot Place

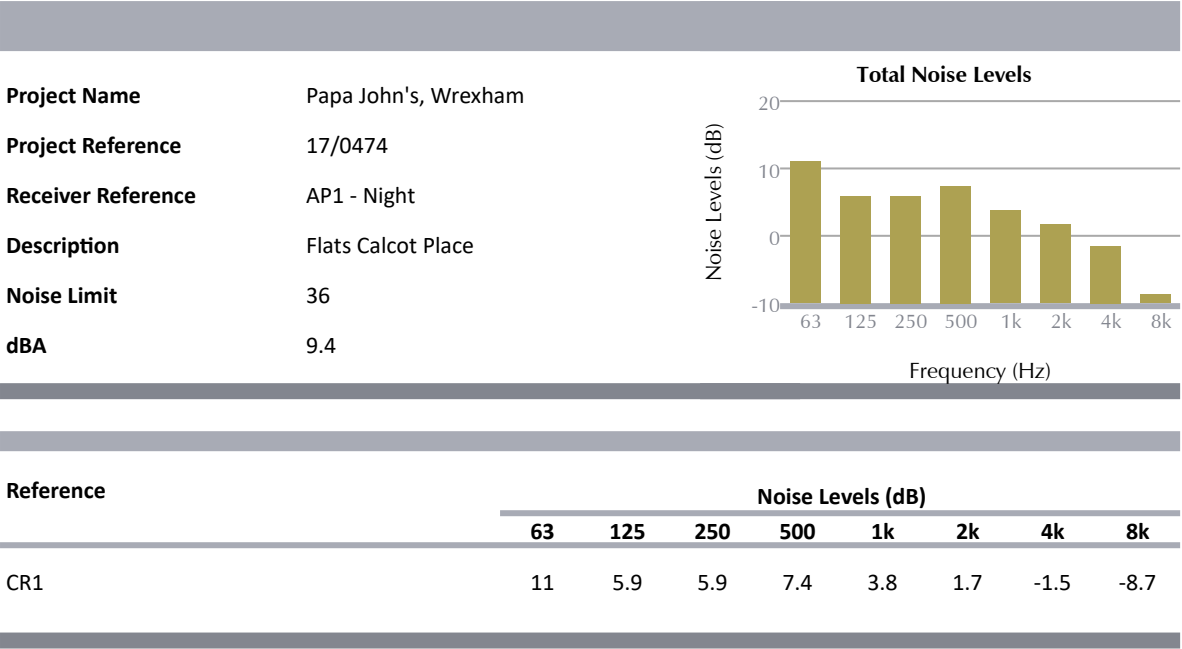
Noise Limit 36

dBA 29.8

Total Noise Levels

Frequency (Hz)	Noise Levels (dB)
63	26
125	31
250	31
500	25
1k	25
2k	24
4k	17
8k	10

Reference	Noise Levels (dB)							
	63	125	250	500	1k	2k	4k	8k
EX1	25.9	30.2	30.7	24.1	24.2	23.2	16.2	9.2
SF1	10.3	14.8	12.6	13	11	8	5	0
CR1	11	5.9	5.9	7.4	3.8	1.7	-1.5	-8.7





Reference	Noise Levels (dB)							
	63	125	250	500	1k	2k	4k	8k
EX1	21.8	26	26.3	19.3	18.8	16.7	8.1	-0.9
CR1	11.3	6.7	6.7	8.2	4.6	2.5	-0.7	-7.9



Reference	Noise Levels (dB)							
	63	125	250	500	1k	2k	4k	8k
SF1	10.9	16.7	13	13.4	11.4	8.4	5.4	0.4
CR1	11.3	6.7	6.7	8.2	4.6	2.5	-0.7	-7.9



17/0474/CS5

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Point Source Radiation Loss									
Radiation - Spherical									
Single Figure Read	11.0								
		-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
Point Source Distance Loss									
Start Distance (m)	1.0								
End Distance (m)	46.0								
		-33.3	-33.3	-33.3	-33.3	-33.3	-33.3	-33.3	-33.3
Maekawa Screening Loss									
Path Difference (m)	-1.0								
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Facade Reflection									
Reflection (dB)	3.0								
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver									
External Receiver - AP1 - Day									
Sound Pressure, Lp		25.9	30.2	30.7	24.1	24.2	23.2	16.2	9.2



Calculation Sheet

17/0474/CS6

SF1 to AP1 - Day

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - SF1									
Sound Power Levels		77.0	79.0	73.0	74.0	77.0	77.0	74.0	69.0
Silencer									
Silencer - SF1									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Unlined Duct Losses CJ									
Width (mm)	500.0								
Height (mm)	500.0								
Length (m)	4.0								
		-3.0	-2.4	-1.2	-0.6	-0.6	-0.6	-0.6	-0.6
Bend Loss CJ									
Dimension (mm)	500.0								
No. of Bends (no.)	1.0								
Type - Radiussed Bend - With Vanes									
		0.0	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0
End Reflection									
Width/Diameter (m)	0.5								
Length (m)	0.5								
Rec or Circ - Rectangular									
Free or Flush - Flush									
		-8.5	-4.1	0.0	0.0	0.0	0.0	0.0	0.0



17/0474/CS6

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
External Grille Directivity									
Width (m)	0.5								
Height (m)	0.5								
Vertical (°)	0.0								
Horizontal (°)	90.0								
		0.0	0.2	0.2	0.0	-4.0	-7.0	-7.0	-7.0
Point Source Radiation Loss									
Radiation - Hemispherical									
Single Figure Read	8.0								
		-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
Point Source Distance Loss									
Start Distance (m)	1.0								
End Distance (m)	47.0								
		-33.4	-33.4	-33.4	-33.4	-33.4	-33.4	-33.4	-33.4
Maekawa Screening Loss									
Path Difference (m)	6.0								
		-16.7	-19.6	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Facade Reflection									
Reflection (dB)	3.0								
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver									
External Receiver - AP1 - Day									
Sound Pressure, Lp		10.3	14.8	12.6	13.0	11.0	8.0	5.0	0.0



Calculation Sheet

17/0474/CS7

CR1 to AP1 - Day

Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CR1								
Sound Power Levels	64.0	61.5	61.5	63.0	59.4	57.3	54.1	46.9
Silencer								
Silencer - Louvres								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Point Source Radiation Loss								
Radiation - Quarterspherical								
Single Figure Read	5.0							
	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Point Source Distance Loss								
Start Distance (m)	1.0							
End Distance (m)	48.0							
	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6
Maekawa Screening Loss								
Path Difference (m)	7.0							
	-17.4	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Facade Reflection								
Reflection (dB)	3.0							
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver								
External Receiver - AP1 - Day								
Sound Pressure, Lp	11.0	5.9	5.9	7.4	3.8	1.7	-1.5	-8.7



Calculation Sheet

17/0474/CS8

CR1 to AP1 - Night

Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CR1								
Sound Power Levels	64.0	61.5	61.5	63.0	59.4	57.3	54.1	46.9
Silencer								
Silencer - Louvres								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Point Source Radiation Loss								
Radiation - Quarterspherical								
Single Figure Read	5.0							
	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Point Source Distance Loss								
Start Distance (m)	1.0							
End Distance (m)	48.0							
	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6	-33.6
Maekawa Screening Loss								
Path Difference (m)	7.0							
	-17.4	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Facade Reflection								
Reflection (dB)	3.0							
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver								
External Receiver - AP1 - Night								
Sound Pressure, Lp	11.0	5.9	5.9	7.4	3.8	1.7	-1.5	-8.7



17/0474/CS9

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Point Source Radiation Loss									
Radiation - Spherical									
Single Figure Read	11.0								
		-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0	-11.0
Point Source Distance Loss									
Start Distance (m)	1.0								
End Distance (m)	42.0								
		-32.5	-32.5	-32.5	-32.5	-32.5	-32.5	-32.5	-32.5
Maekawa Screening Loss									
Path Difference (m)	0.0								
		-4.9	-5.0	-5.2	-5.5	-6.2	-7.3	-8.8	-10.9
Facade Reflection									
Reflection (dB)	3.0								
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver									
External Receiver - AP2 - Day									
Sound Pressure, Lp		21.8	26.0	26.3	19.3	18.8	16.7	8.1	-0.9



Calculation Sheet

17/0474/CS10

SF1 to AP2 - Night

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - SF1									
Sound Power Levels		77.0	79.0	73.0	74.0	77.0	77.0	74.0	69.0
Silencer									
Silencer - SF1									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rect Unlined Duct Losses CJ									
Width (mm)	500.0								
Height (mm)	500.0								
Length (m)	4.0								
		-3.0	-2.4	-1.2	-0.6	-0.6	-0.6	-0.6	-0.6
Bend Loss CJ									
Dimension (mm)	500.0								
No. of Bends (no.)	1.0								
Type - Radiussed Bend - With Vanes									
		0.0	0.0	-1.0	-2.0	-3.0	-3.0	-3.0	-3.0
End Reflection									
Width/Diameter (m)	0.5								
Length (m)	0.9								
Rec or Circ - Rectangular									
Free or Flush - Flush									
		-6.6	-2.1	0.0	0.0	0.0	0.0	0.0	0.0



17/0474/CS10

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
External Grille Directivity									
Width (m)	0.5								
Height (m)	0.5								
Vertical (°)	0.0								
Horizontal (°)	90.0								
		0.0	0.2	0.2	0.0	-4.0	-7.0	-7.0	-7.0
Point Source Radiation Loss									
Radiation - Hemispherical									
Single Figure Read	8.0								
		-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
Point Source Distance Loss									
Start Distance (m)	1.0								
End Distance (m)	45.0								
		-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1	-33.1
Maekawa Screening Loss									
Path Difference (m)	9.0								
		-18.4	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Facade Reflection									
Reflection (dB)	3.0								
		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver									
External Receiver - AP2 - Night									
Sound Pressure, Lp		10.9	16.7	13.0	13.4	11.4	8.4	5.4	0.4



Calculation Sheet

17/0474/CS11

CR1 to AP2 - Day

Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CR1								
Sound Power Levels	64.0	61.5	61.5	63.0	59.4	57.3	54.1	46.9
Silencer								
Silencer - Louvres								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Point Source Radiation Loss								
Radiation - Quarterspherical								
Single Figure Read	5.0							
	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Point Source Distance Loss								
Start Distance (m)	1.0							
End Distance (m)	44.0							
	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9
Maekawa Screening Loss								
Path Difference (m)	8.0							
	-17.9	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Facade Reflection								
Reflection (dB)	3.0							
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver								
External Receiver - AP2 - Day								
Sound Pressure, Lp	11.3	6.7	6.7	8.2	4.6	2.5	-0.7	-7.9



Calculation Sheet

17/0474/CS12

CR1 to AP2 - Night

Octave Band Centre Frequency (Hz)								
	63	125	250	500	1k	2k	4k	8k
Noise Source								
Noise Source - CR1								
Sound Power Levels	64.0	61.5	61.5	63.0	59.4	57.3	54.1	46.9
Silencer								
Silencer - Louvres								
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Point Source Radiation Loss								
Radiation - Quarterspherical								
Single Figure Read	5.0							
	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Point Source Distance Loss								
Start Distance (m)	1.0							
End Distance (m)	44.0							
	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9	-32.9
Maekawa Screening Loss								
Path Difference (m)	8.0							
	-17.9	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Facade Reflection								
Reflection (dB)	3.0							
	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
External Receiver								
External Receiver - AP2 - Night								
Sound Pressure, Lp	11.3	6.7	6.7	8.2	4.6	2.5	-0.7	-7.9

Cole Jarman Limited Reg. in England and Wales No. 7102436
Head Office +44 (0)1932 829007
John Cree House, 24B High Street, Addlestone, Surrey, KT15 1TN

info@colejarman.com www.colejarman.com
Manchester Office +44 (0)161 2093644
Peter House, 1 Oxford Street, Manchester, M1 5AN