SHARPS REDMORE
ACOUSTIC CONSULTANTS · Established 1990

Report

Papa Johns, 43 Theobald's Road, Holborn
Assessment of noise associated with fixed plant equipment

Prepared by
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Contents

Appendices

1.0 Introduction

1.1 Sharps Redmore (SR) has been instructed to undertake a noise assessment of the installed fixed plant equipment at Papa Johns, 43 Theobald's Road, Holborn, as part of a retro-spective planning application.

1.2 This assessment will review the noise from the installed plant at the nearest residential properties, and review potential mitigation requirements.

1.3 The plant has been installed on the flat roof area at the rear of the site. The nearest residential properties to the proposed plant equipment is the accommodation above and adjacent to the Papa Johns unit at 43 Theobald's Road.

1.4 The available methods of assessment and assessment criteria are presented at section 2.

1.5 Details of an Environmental noise survey undertaken to the rear of the site are presented in section 3, and an assessment of predicted plant noise levels is contained at section 4.

2.0 Assessment methodology and criteria

2.1 The National Planning Policy Framework (NPPF), February 2019, sets out the Government's planning policies for England and "these policies articulate the Government's vision of sustainable development." In respect of noise, Paragraph 180 of the NPPF states the following:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation".

2.2 Guidance on the interpretation of the policy aims contained within the NPPF is contained within National Planning Policy Guidance (NPPG). The NPPG introduces the concept of a noise exposure hierarchy based on likely average response. The guidance contained in the NPPG is summarised in the table below:

TABLE 1: Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate ad reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.3 The NPPF and NPPG reinforces the March 2010 DEFRA publication, "Noise Policy Statement for England" (NPSE), which states three policy aims, as follows:

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

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

2.4 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

2.5 Taking an overview of national policy aims and guidance it is clear that when considering the impact of noise, the fact noise can be heard and causes impact, is not a reason to refuse an application as consideration should also be given to the significance of the impact and the mitigation measures available.

2.6 It is standard and good practice to apply objective standards to the assessment of noise and the effect produced by the introduction of a certain noise source may be determined by several methods, as follows:

i) The effect may be determined by reference to guideline noise values, such as those contained in the World Health Organisation (WHO) "*Guidelines for Community Noise"*.

ii) Alternatively, the impact may be determined by considering the change in noise level that would result from the proposal, in an appropriate noise index for the characteristic of the noise in question. There are various criteria linking change in noise level to effect. This is the method that is suited to, for example, the assessment of noise from road traffic because it is capable of displaying impact to all properties adjacent to a road link irrespective of their distance from the road.

iii) Another method is described within BS 4142:2014+A1:2019 which focuses on determining the significance of sound impact from sources of industrial and/or commercial nature. The sources that the newly revised standard is intended to assess are sound from industrial and manufacturing processes, sound from fixed plant installations, sound from loading and unloading of goods at industrial and/or commercial premises and the sound from mobile plant and vehicles, such as forklift, train or ship movements.

2.7 The assessment of fixed plant noise is principally undertaken in accordance with the methodology in BS 4142:2014. The scope of this standard states that it is suitable for the assessment of:

"a) sound from industrial and manufacturing processes;

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

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

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

2.8 The significance of sound impact is to be determined according, in summary, to the following process:

i) Determine the typical background sound levels, in terms of the index L_{A90}, at the receptor locations of interest.

ii) Determine the specific sound level of the source being assessed, in terms of its L_{AeqT} level (T = 1 hour for day or 15 minutes for night), at the receptor location of interest.

iii) Apply a rating level acoustic feature correction if the source sound has tonal, impulsive, intermittent, or other characteristics which attract attention.

iv) Compare the rating sound level with the background sound level; the greater the difference between the two, the higher the likelihood of adverse impact.

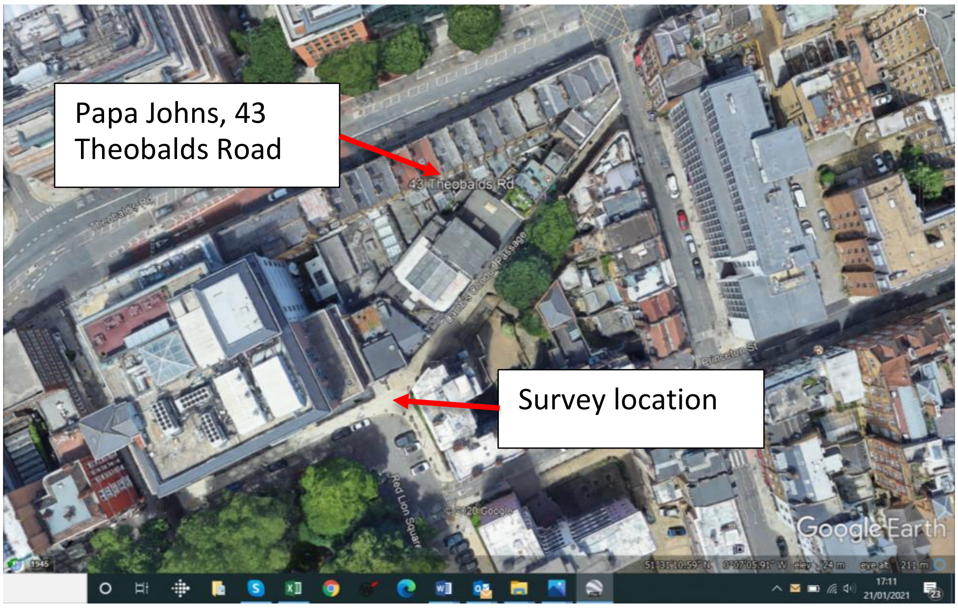
v) A difference (rating – background) of around +10 dB is an indication of significant adverse impact, depending on the context; a difference of +5 dB is an indication of an adverse impact, depending on the context. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending upon context.

2.9 Based on the guidance available, this assessment has been undertaken in accordance with BS 4142:2014.

3.0 Environmental noise survey details

3.1 Due to the proximity of the surrounding residential properties, it would not be possible to establish the existing background noise climate without the influence of noise from the installed plant. Therefore in accordance with the guidelines in BS 4142:2014 (para 8.1.2) an alternative location was used to establish the background noise climate in the area, with no influence from the installed plant. An attended baseline noise survey was undertaken on between 2150 hours on 21st October 2020 until 0030 hours on 22nd October 2020, at a location representative of the noise climate at the closest properties to the proposed Papa Johns unit at 43 Theobald's Road. Noise measurements were taken during the last hour of the daytime period and in the early hours of the night time period. Typically at these times the lowest background noise level conditions are found.

FIGURE 1: Baseline noise measurement locations



3.2 The noise measurements were taken using a Norsonic 118 sound level meter. The sound level meter was calibrated at the start and end of each set of measurements and no variation in level observed. Measurements were taken over 5 minute periods to provide enhanced definition of the existing noise climate.

3.3 The sound level meter microphone was positioned approximately 1.5 metres above the ground in free field conditions.

3.4 The weather conditions during the survey were dry, 14°C with light south west winds. The weather conditions are not considered to have affected the noise measurements.

3.5 During the evening and night time periods the noise climate was dominated by local and distant road traffic sources.

3.6 The noise survey results are summarised in Table 2 below and presented in full at Appendix B.

Table 2: Summary of measured background noise levels

Measurement location	Background noise level dB $L_{A90\ T}$	
	Daytime	Night time
A	46	44

4.0 Fixed plant noise assessment

4.1 The objective assessment of plant sound sources in commercial premises is typically undertaken in accordance with British Standard 4142:2014+A1:2019. This Standard enables the resultant sound levels from new plant equipment to be compared against the existing typical background sound level (L_{A90}) of an area to establish the significance of the sound impact.

4.2 The installed plant layout is as follows :

Figure 2: Installed plant layout

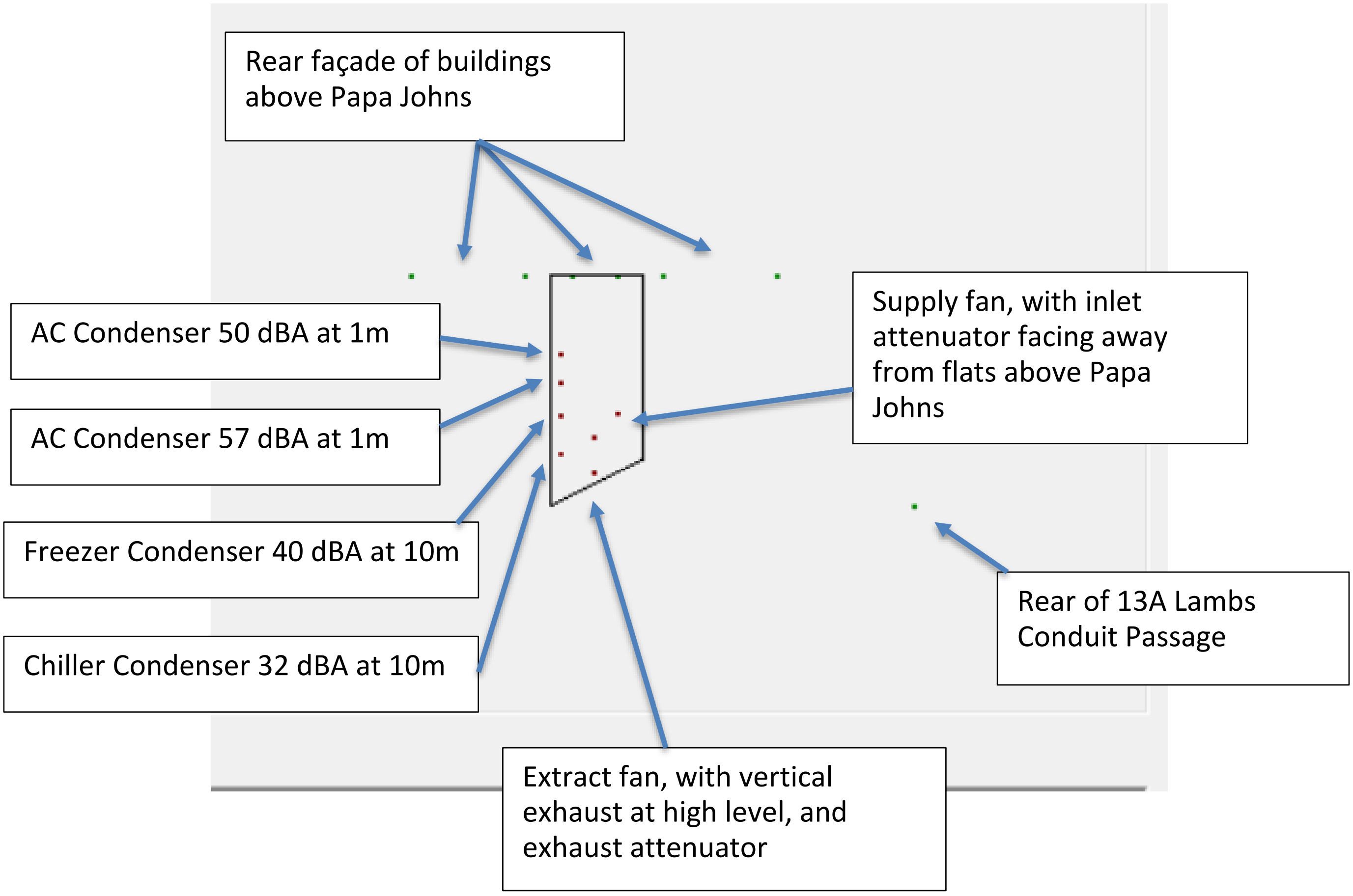


Table 3: Noise source data – as installed

Sound power levels (Lw) & sound pressure levels (Lp) for fans & other equipment											
Equipment name/reference	Lw/ Lp	Dist. (m)	On time D/N/A	Mid-frequency Octave Bands (Hz)							
				63	125	250	500	1k	2k	4k	8k
Chiller condenser	Lp	10	A	40	dBA						
Freezer condenser	Lp	10	A	32	dBA						
AC condenser	Lp	1	D	57	dBA						
AC condenser	Lp	1	D	50	dBA						
Extract fan exhaust	Lw		D	72	87	82	75	71	64	60	57
Extract fan casing radiated	Lw		D	66	70	61	45	37	26	20	20
Supply fan inlet	Lw		D	67	69	71	63	63	63	59	53

Table 4: Attenuator performance – as installed

Atmospheric side dynamic insertion losses for noise control equipment								
Equipment name/reference	Mid-frequency Octave Bands (Hz)							
	63	125	250	500	1k	2k	4k	8k
Extract fan exhaust	2	3	6	8	11	10	8	6
Supply fan inlet	2	3	6	12	13	11	10	6

4.3 Based on the environmental noise model (see Section 5.0), the predicted noise levels without any additional mitigation are as follows:

Table 5 – Predicted noise levels – as installed

Location	Daytime (0700-2300)			Night (2300-0700)		
	Predicted L_{Aeq} (dB)	Background L_{A90} (dB)	Difference	Predicted L_{Aeq} (dB)	Background L_{A90} (dB)	Difference
Flats above Papa Johns	51dB	46 dB	+5	47 dB	44 dB	+3
Rear of 13A Conduit Passage	41 dB	46 dB	-5	39 dB	44 dB	-5

4.4 A comparison of the predicted noise levels against the background noise climate indicates noise from the installed plant is considered as an adverse impact, therefore additional mitigation is suggested.

4.5 Based on the close proximity of the plant to the surrounding residential properties, acoustic screening of the plant will not provide sufficient mitigation, therefore the proposal is to replace items of the installed plant with quieter alternatives, and replace the exhaust attenuator, with a higher performing attenuator.

Figure 3: Proposed plant

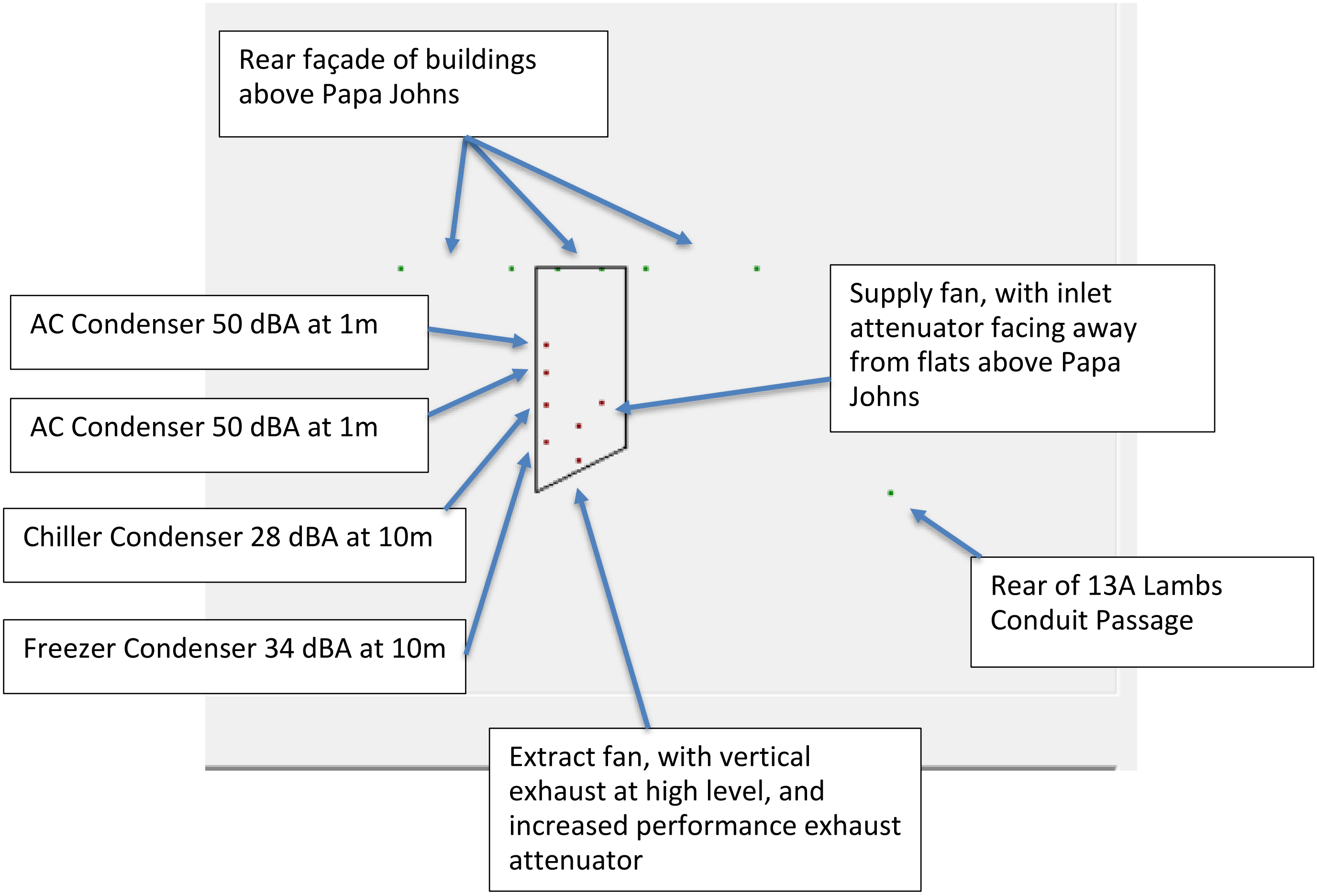


Table 6: Noise source data – proposed

Sound power levels (Lw) & sound pressure levels (Lp) for fans & other equipment											
Equipment name/reference	Lw/ Lp	Dist. (m)	On time D/N/A	Mid-frequency Octave Bands (Hz)							
				63	125	250	500	1k	2k	4k	8k
Freezer condenser	Lp	10	A	34	dBA						
Chiller condenser	Lp	10	A	28	dBA						
AC condenser A	Lp	1	D	50	dBA						
AC condenser B	Lp	1	D	50	dBA						
Extract fan exhaust	Lw	Rating level with +4 dB correction	D	76	91	86	79	75	68	64	61
Extract fan casing radiated	Lw	Rating level with +4 dB correction	D	70	74	65	49	41	30	24	24
Supply fan inlet	Lw		D	67	69	71	63	63	63	59	53

4.6 Based on our experience, with multiple noise sources, the overall resultant noise level at the receptor is generally quite bland in nature, therefore the specific noise level can be considered as being a rating noise level. However, based on the manufacturers octave band noise data (see Table 3) the extract fan could have a tonal character, therefore a 4 dB penalty has been applied to the extract fan source data, for a tone which is clearly perceptible, in accordance with BS 4142:2014.

Table 7: Improved exhaust attenuator performance

Atmospheric side dynamic insertion losses for noise control equipment								
	Mid-frequency Octave Bands (Hz)							
Equipment name/reference	63	125	250	500	1k	2k	4k	8k
Extract fan exhaust	2	9	12	14	14	12	10	8

4.7 Based on the environmental noise model (see Section 5.0), the predicted noise levels based on the proposed scheme are as follows:

Table 8 – predicted noise levels – as installed

Location	Daytime (0700-2300)			Night (2300-0700)		
	Predicted rating level L_{Aeq} (dB)	Background L_{A90} (dB)	Difference	Predicted rating level L_{Aeq} (dB)	Background L_{A90} (dB)	Difference
Flats above Papa Johns	46 dB	46 dB	0	40 dB	44 dB	-4
Rear of 13A Conduit Passage	37 dB	46 dB	-9	30 dB	44 dB	-14

4.8 A comparison of the predicted noise levels against the background noise climate, indicates that noise from the proposed plant will not exceed the existing background during the day or night, which in accordance with BS 4142:2014, is considered as a low impact.

5.0 The noise model and prediction methodology

5.1 The noise model employed has been written in-house to provide an accurate prediction method for assessing environmental noise from, in particular, plant and equipment items which can be perceived as being point sources. It has been mainly used for the prediction of noise emanating from superstores.

5.2 There are three input spreadsheets containing:

- noise sources data
- receiver data
- acoustic screening data

These are included in Appendix B.

5.3 The noise sources data include one of the following forms for each item of plant:

- either, octave band sound power levels in the range of 63 to 8000Hz – this being available from manufacturer of many of the supply and extract fans.
- or, octave band sound pressure levels in the range of 63 to 8000Hz – this is available usually for the small, externally mounted split units' condenser fans from the manufacturer's product catalogue when measured at one metre in anechoic conditions, thus allowing straight forward calculation of the equivalent sound power levels.
- or, single value sound pressure levels at a stated distance

5.4 The relative location of the plant using X and Y co-ordinates with an arbitrary datum point and a Z (height) co-ordinate based on supporting steel and screening heights from the main contractor and then the equipment heights based, in this case, on the mechanical services contractor drawings.

5.5 Where known, the area and orientation of the noise outlet is entered together with its location adjacent to either one, two or three reflective surfaces so that the calculation can establish the directivity pattern and outlet reflection losses.

5.6 The receiver data needed are the X, Y and Z co-ordinates so that the relative distance and angle can be calculated between the source and the receiver.

5.7 Finally, several types of acoustic screening may be entered. In this case, this is designated "R" meaning a ring barrier, in this case indicating the flat roof area of the building.

5.8 The noise model carries out "text book" atmospheric side calculations at each receiver position from each source allowing for the attenuation from such as the calculated distance and screening. The calculations are performed in eight Octave bands from 63 to 8000Hz but can then be summarised as dBA, NR or NC for convenience. In this case, the overall summary levels are in dBA. Calculations for the plant are included in Appendix C and D for daytime and night operating. The computer maintains a logarithmic total of the noise levels in Octave bands.

5.9 At the end of each program “run”, the overall day or night time noise level at each receiver position are calculated and ranked in descending order of noise level. Where this ranking shows that the receiver position’s noise level exceeds the noise criterion, each calculation can be interrogated to determine the plant items needing more detailed inspection to establish the attenuation needed. The process is repeated until either the noise level meets the noise criterion or the program demonstrates that other noise control methods are needed. This may take the form of restricting the offending plant’s period of operation or improving the screening or re-selection to give quieter plant.

5.10 Plant noise predictions are shown in summary form; full calculations of noise from each source to each receptor are available on request

6.0 Assessment conclusions

6.1 This assessment considers noise associated with Papa Johns unit at 43 Theobald’s Road, London.

6.2 Based on current installation, the predicted noise levels indicate an adverse impact at the nearest residential properties.

6.3 Based on the mitigation referred to in this report, the predicted noise do not exceed the existing background noise climate for day and night time use, which is accordance with BS 4142:2014, is considered to be a low impact.

6.4 This assessment objectively demonstrates that predicted rating noise levels from Papa Johns plant equipment would comply with the requirements of the NPPF to avoid significant adverse impact.

APPENDIX A

NOISE MODEL INPUT DATA

Sharps Redmore Partnership
The White House, London Road, Copdock, Ipswich, IP8 3JH

Filename:	c:\Noysplot\Papa Johns Holborn\080121_1 to match background rev 1 +4 ext fan dB
Date:	22 January 2021
Entries by:	MT
Project no:	
Project title:	Holdorn
Client's name:	Papa John's
Map/plot details:	

Length:	3200
Width:	3200
Height:	250

Sharps Redmore Partnership
The White House, London Road, Copdock, Ipswich, IP8 3JH

Source data - description, co-ordinates, outlet size, percentage to atmosphere, directivity, sound levels and running period

Filename: c:\Noysplot\Papa Johns Holborn\080121_1 to match background rev 1 +4 ext fan dB

Source description	__Co-ordinates__			______Outlet details______					Run	Lp/	dBA	Dist	____Mid frequency octave bands (Hz)_____							
	X m	Y m	Z m	Amm	Bmm	Ang.	%	Q	dna	Lw	Y/N	(m)	63	125	250	500	1k	2k	4k	8k
Chiller condenser	200.5	192.3	4.0	0	0	0	100	2	A	P	Y	10.0	34							
Freezer condenser	200.5	193.9	4.0	0	0	0	100	2	A	P	Y	10.0	28							
AC condenser A	200.5	196.6	4.0	0	0	0	100	1	D	P	Y	1.0	50							
AC condenser B	200.5	195.4	4.0	0	0	0	100	1	D	P	Y	1.0	50							
Extract fan exhaust	202.0	191.5	5.5	400	400	360	100	2	D	W	N	0.0	76	91	86	79	75	68	64	61
Extract fan casing radiated	202.0	193.0	4.0	0	0	0	100	2	D	W	N	0.0	70	74	65	49	41	30	24	24
Supply fan inlet	203.0	194.0	4.0	400	400	180	100	2	D	W	N	0.0	67	69	71	63	63	63	59	53

Sharps Redmore Partnership
The White House, London Road, Copdock, Ipswich, IP8 3JH

Receptor data - description and co-ordinates

Filename: c:\Noysplot\Papa Johns Holborn\080121_1 to match background rev 1 +4 ext far

Receptor description	__Co-ordinates__			
	X m	Y m	Z m	DNA
Flats above Papa Johns 1st	201.0	200.0	4.5	A
Flats above Papa Johns 2nd	201.0	200.0	7.5	A
Flats above Papa Johns 3rd	201.0	200.0	10.5	A
Flats above Papa Johns 1st	203.0	200.0	4.5	A
Flats above Papa Johns 2nd	203.0	200.0	7.5	A
Flats above Papa Johns 3rd	203.0	200.0	10.5	A
Adjacent property 1st	199.0	200.0	4.5	A
Adjacent property 2nd	199.0	200.0	7.5	A
Adjacent property 3rd	199.0	200.0	10.5	A
Adjacent property 1st	205.0	200.0	4.5	A
Adjacent property 2nd	205.0	200.0	7.5	A
Adjacent property 3rd	205.0	200.0	10.5	A
13A Lambs Conduit Passage	216.0	190.0	7.5	A
Adjacent property 1st	210.0	200.0	4.5	A
Adjacent property 2nd	210.0	200.0	7.5	A
Adjacent property 3rd	210.0	200.0	10.5	A
Adjacent property 1st	194.0	200.0	4.5	A
Adjacent property 2nd	194.0	200.0	7.5	A
Adjacent property 3rd	194.0	200.0	10.5	A

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Barrier data - description and co-ordinates

Filename: c:\Noysplot\Papa Johns Holborn\080121_1 to match background rev 1 +4 ext far

Barrier description	________Co-ordinates________					
		Start			End	
	X m	Y m	Z m	X m	Y m	Z m
R	200.0	200.0	3.0	204.0	200.0	3.0
R	204.0	200.0	3.0	204.0	192.0	3.0
R	204.0	192.0	7.0	200.0	190.0	7.0
R	200.0	190.0	3.0	200.0	200.0	3.0

APPENDIX B

ENVIRONMENTAL NOISE SURVEY DATA

Environmental survey data 21st to 22nd October 2020					
	Noise level dB				
Time	LAeq	LAFmax	LAFmin	LAF,10	LAF,90
21:50	50	59	45	53	46
21:55	51	62	44	53	46
22:00	53	71	44	54	46
22:05	51	60	45	54	47
22:10	57	79	45	55	47
22:15	56	79	44	56	47
22:20	52	63	45	54	48
22:25	53	71	46	56	48
23:55	53	67	44	55	46
00:00	50	66	43	53	44
00:05	48	57	42	51	44
00:10	49	58	43	52	45
00:15	50	68	42	52	44
00:20	49	56	43	52	45
00:25	51	63	43	54	45

APPENDIX C

PROPOSED PLANT PREDICTED NOISE LEVELS – DAYTIME SUMMARY

Overall receptor listings

Period: Day time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Flats above Papa Johns 1st	61	57	49	40	36	34	34	36	46
Adjacent property 1st	61	57	49	40	36	34	34	36	46
Flats above Papa Johns 1st	60	57	49	40	35	34	33	35	46
Adjacent property 2nd	59	57	48	39	34	33	32	34	46
Flats above Papa Johns 2nd	59	57	48	39	34	33	32	34	46
Flats above Papa Johns 2nd	59	57	48	39	34	33	32	34	46
Adjacent property 1st	59	57	48	39	34	32	32	34	45
Adjacent property 2nd	58	56	48	38	33	32	31	33	45
Flats above Papa Johns 3rd	57	54	48	40	35	32	31	33	45
Adjacent property 3rd	57	54	48	40	35	32	31	33	45
Flats above Papa Johns 3rd	57	54	48	40	35	32	31	32	45
Adjacent property 3rd	56	54	48	40	35	32	30	32	44
Adjacent property 1st	57	54	46	37	32	31	30	32	43
Adjacent property 2nd	57	54	46	36	32	30	29	31	43
Adjacent property 1st	55	54	46	36	31	29	28	30	43
Adjacent property 2nd	55	54	46	36	31	29	28	30	43
Adjacent property 3rd	55	52	47	37	31	29	28	30	42
Adjacent property 3rd	54	52	47	37	31	28	27	29	42
13A Lambs Conduit Passage	51	49	41	29	25	23	22	24	37

Source noise levels at receiver: Flats above Papa Johns 1st

Period: Day time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	56	46	39	33	30	29	29	31	39
AC condenser A	56	46	39	33	30	29	29	31	39
Extract fan casing radiated	48	52	43	27	19	8	2	2	38
AC condenser B	54	44	37	31	28	27	27	29	37
Freezer condenser	52	42	35	29	26	25	25	27	35
Supply fan inlet	39	41	39	24	20	22	16	14	33
Total Free field Lp and dBA	61	57	49	40	36	34	34	36	46

Source noise levels at receiver: Flats above Papa Johns 2nd

Period: Day time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	55	45	38	32	29	28	28	30	38
Extract fan casing radiated	47	51	42	26	18	7	1	1	37
AC condenser A	53	43	36	30	27	26	26	28	36
AC condenser B	52	42	35	29	26	25	25	27	35
Freezer condenser	51	41	34	28	25	24	24	26	34
Supply fan inlet	38	40	38	23	19	21	15	13	32
Total Free field Lp and dBA	59	57	48	39	34	33	32	34	46

Source noise levels at receiver: Flats above Papa Johns 3rd

Period: Day time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	40	51	46	39	33	28	24	23	42
Chiller condenser	54	44	37	31	28	27	27	29	37
Extract fan casing radiated	45	49	40	24	16	5	0	0	35
AC condenser A	50	40	33	27	24	23	23	25	33
AC condenser B	49	39	32	26	23	22	22	24	32
Freezer condenser	49	39	32	26	23	22	22	24	32
Supply fan inlet	36	38	36	21	17	19	13	11	30
Total Free field Lp and dBA	57	54	48	40	35	32	31	33	45

Source noise levels at receiver: Flats above Papa Johns 1st

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	56	46	39	33	30	29	29	31	39
Extract fan casing radiated	48	52	43	27	19	8	2	2	38
AC condenser A	54	44	37	31	28	27	27	29	37
AC condenser B	53	43	36	30	27	26	26	28	36
Freezer condenser	52	42	35	29	26	25	25	27	35
Supply fan inlet	39	41	39	24	20	22	16	14	33
Total Free field Lp and dBA	60	57	49	40	35	34	33	35	46

Source noise levels at receiver: Flats above Papa Johns 2nd

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	55	45	38	32	29	28	28	30	38
Extract fan casing radiated	47	51	42	26	18	7	1	1	37
AC condenser A	52	42	35	29	26	25	25	27	35
AC condenser B	51	41	34	28	25	24	24	26	34
Freezer condenser	51	41	34	28	25	24	24	26	34
Supply fan inlet	38	40	38	23	19	21	15	13	32
Total Free field Lp and dBA	59	57	48	39	34	33	32	34	46

Source noise levels at receiver: Flats above Papa Johns 3rd

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	40	51	46	39	33	28	24	23	42
Chiller condenser	54	44	37	31	28	27	27	29	37
Extract fan casing radiated	45	49	40	24	16	5	0	0	35
AC condenser A	49	39	32	26	23	22	22	24	32
AC condenser B	49	39	32	26	23	22	22	24	32
Freezer condenser	49	39	32	26	23	22	22	24	32
Supply fan inlet	36	38	36	21	17	19	13	11	30
Total Free field Lp and dBA	57	54	48	40	35	32	31	32	45

Source noise levels at receiver: Adjacent property 1st

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	56	46	39	33	30	29	29	31	39
AC condenser A	56	46	39	33	30	29	29	31	39
Extract fan casing radiated	47	51	42	26	18	7	1	1	37
AC condenser B	53	43	36	30	27	26	26	28	36
Freezer condenser	52	42	35	29	26	25	25	27	35
Supply fan inlet	38	40	38	23	19	21	15	13	32
Total Free field Lp and dBA	61	57	49	40	36	34	34	36	46

Source noise levels at receiver: Adjacent property 2nd

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	55	45	38	32	29	28	28	30	38
Extract fan casing radiated	47	51	42	26	18	7	1	1	37
AC condenser A	53	43	36	30	27	26	26	28	36
AC condenser B	51	41	34	28	25	24	24	26	34
Freezer condenser	51	41	34	28	25	24	24	26	34
Supply fan inlet	37	39	37	22	18	20	14	12	31
Total Free field Lp and dBA	59	57	48	39	34	33	32	34	46

Source noise levels at receiver: Adjacent property 3rd

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	40	51	46	39	33	28	24	23	42
Chiller condenser	54	44	37	31	28	27	27	29	37
Extract fan casing radiated	45	49	40	24	16	5	0	0	35
AC condenser A	50	40	33	27	24	23	23	25	33
AC condenser B	49	39	32	26	23	22	22	24	32
Freezer condenser	49	39	32	26	23	22	22	24	32
Supply fan inlet	35	37	35	20	16	18	12	10	29
Total Free field Lp and dBA	57	54	48	40	35	32	31	33	45

Source noise levels at receiver: Adjacent property 1st

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Chiller condenser	55	45	38	32	29	28	28	30	38
Extract fan casing radiated	47	51	42	26	18	7	1	1	37
AC condenser A	52	42	35	29	26	25	25	27	35
AC condenser B	51	41	34	28	25	24	24	26	34
Freezer condenser	50	40	33	27	24	23	23	25	33
Supply fan inlet	39	41	39	24	20	22	16	14	33
Total Free field Lp and dBA	59	57	48	39	34	32	32	34	45

Source noise levels at receiver: Adjacent property 2nd

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	45	54	45	35	28	23	18	17	41
Extract fan casing radiated	47	51	42	26	18	7	1	1	37
Chiller condenser	54	44	37	31	28	27	27	29	37
AC condenser A	51	41	34	28	25	24	24	26	34
AC condenser B	50	40	33	27	24	23	23	25	33
Freezer condenser	50	40	33	27	24	23	23	25	33
Supply fan inlet	38	40	38	23	19	21	15	13	32
Total Free field Lp and dBA	58	56	48	38	33	32	31	33	45

Source noise levels at receiver: Adjacent property 3rd

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	40	51	46	39	33	28	24	23	42
Chiller condenser	53	43	36	30	27	26	26	28	36
Extract fan casing radiated	45	49	40	24	16	5	0	0	35
AC condenser A	48	38	31	25	22	21	21	23	31
AC condenser B	48	38	31	25	22	21	21	23	31
Freezer condenser	48	38	31	25	22	21	21	23	31
Supply fan inlet	36	38	36	21	17	19	13	11	30
Total Free field Lp and dBA	56	54	48	40	35	32	30	32	44

Source noise levels at receiver: 13A Lambs Conduit Passage

Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan casing radiated	42	46	37	21	13	2	0	0	32
Extract fan exhaust	37	44	34	21	12	4	0	0	30
Supply fan inlet	28	32	35	20	15	17	10	8	28
Chiller condenser	47	36	29	22	18	16	15	15	28
Freezer condenser	44	34	27	21	18	17	17	19	27
AC condenser B	43	33	26	20	17	16	16	18	26
AC condenser A	42	32	25	19	16	15	15	17	25
Total Free field Lp and dBA	51	49	41	29	25	23	22	24	37

Source noise levels at receiver: Adjacent property 1st
Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	43	52	43	33	26	21	16	15	39
Chiller condenser	51	42	35	29	26	25	25	27	35
Extract fan casing radiated	44	48	39	23	15	4	0	0	34
AC condenser A	47	37	30	24	21	20	20	22	30
Freezer condenser	47	37	30	24	21	20	20	22	30
AC condenser B	47	37	30	24	21	20	20	22	30
Supply fan inlet	36	38	36	21	17	19	13	11	30
Total Free field Lp and dBA	55	54	46	36	31	29	28	30	43

Source noise levels at receiver: Adjacent property 2nd
Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	43	52	43	33	26	21	16	15	39
Chiller condenser	52	42	35	29	26	25	25	27	35
Extract fan casing radiated	44	48	39	23	15	4	0	0	34
Freezer condenser	47	37	30	24	21	20	20	22	30
AC condenser A	46	36	29	23	20	19	19	21	29
AC condenser B	46	36	29	23	20	19	19	21	29
Supply fan inlet	35	37	35	20	16	18	12	10	29
Total Free field Lp and dBA	55	54	46	36	31	29	28	30	43

Source noise levels at receiver: Adjacent property 3rd
Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	38	49	45	35	27	22	16	15	39
Chiller condenser	51	41	34	28	25	24	24	26	34
Extract fan casing radiated	43	47	38	22	14	3	0	0	33
Freezer condenser	46	36	29	23	20	19	19	21	29
AC condenser A	45	35	28	22	19	18	18	20	28
AC condenser B	45	35	28	22	19	18	18	20	28
Supply fan inlet	34	36	34	19	15	17	11	9	28
Total Free field Lp and dBA	54	52	47	37	31	28	27	29	42

Source noise levels at receiver: Adjacent property 1st
Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	43	52	43	33	26	21	16	15	39
Chiller condenser	54	44	37	31	28	27	27	29	37
Extract fan casing radiated	44	48	39	23	15	4	0	0	34
AC condenser A	50	40	33	27	24	23	23	25	33
Freezer condenser	49	39	32	26	23	22	22	24	32
AC condenser B	49	39	32	26	23	22	22	24	32
Supply fan inlet	34	36	34	19	15	17	11	9	28
Total Free field Lp and dBA	57	54	46	37	32	31	30	32	43

Source noise levels at receiver: Adjacent property 2nd
Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	43	52	43	33	26	21	16	15	39
Chiller condenser	53	43	36	30	27	26	26	28	36
Extract fan casing radiated	44	48	39	23	15	4	0	0	34
AC condenser A	49	39	32	26	23	22	22	24	32
Freezer condenser	48	38	31	25	22	21	21	23	31
AC condenser B	48	38	31	25	22	21	21	23	31
Supply fan inlet	34	36	34	19	15	17	11	9	28
Total Free field Lp and dBA	57	54	46	36	32	30	29	31	43

Source noise levels at receiver: Adjacent property 3rd
Period: Day time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Extract fan exhaust	38	49	45	35	27	22	16	15	39
Chiller condenser	52	42	35	29	26	25	25	27	35
Extract fan casing radiated	43	47	38	22	14	3	0	0	33
AC condenser A	47	37	30	24	21	20	20	22	30
Freezer condenser	47	37	30	24	21	20	20	22	30
AC condenser B	47	37	30	24	21	20	20	22	30
Supply fan inlet	33	35	33	18	14	16	10	8	27
Total Free field Lp and dBA	55	52	47	37	31	29	28	30	42

APPENDIX D

PROPOSED PLANT PREDICTED NOISE LEVELS – NIGHT TIME SUMMARY

Overall receptor listings

Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Flats above Papa Johns 1st	57	47	40	34	31	30	30	32	40
Adjacent property 1st	57	47	40	34	31	30	30	32	40
Flats above Papa Johns 1st	57	47	40	34	31	30	30	32	40
Adjacent property 2nd	56	46	39	33	30	29	29	31	39
Flats above Papa Johns 2nd	56	46	39	33	30	29	29	31	39
Adjacent property 1st	56	46	39	33	30	29	29	31	39
Flats above Papa Johns 2nd	56	46	39	33	30	29	29	31	39
Flats above Papa Johns 3rd	55	45	38	32	29	28	28	30	38
Adjacent property 3rd	55	45	38	32	29	28	28	30	38
Flats above Papa Johns 3rd	55	45	38	32	29	28	28	30	38
Adjacent property 2nd	55	45	38	32	29	28	28	30	38
Adjacent property 1st	55	45	38	32	29	28	28	30	38
Adjacent property 2nd	54	44	37	31	28	27	27	29	37
Adjacent property 3rd	54	44	37	31	28	27	27	29	37
Adjacent property 3rd	53	43	36	30	27	26	26	28	36
Adjacent property 2nd	53	43	36	30	27	26	26	28	36
Adjacent property 1st	52	43	36	30	27	26	26	28	36
Adjacent property 3rd	52	42	35	29	26	25	25	27	35
13A Lambs Conduit Passage	49	38	31	25	21	20	19	20	30

Source noise levels at receiver: Flats above Papa Johns 1st

Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	56	46	39	33	30	29	29	31	39
Freezer condenser	52	42	35	29	26	25	25	27	35
Total Free field Lp and dBA	57	47	40	34	31	30	30	32	40

Source noise levels at receiver: Flats above Papa Johns 2nd

Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	55	45	38	32	29	28	28	30	38
Freezer condenser	51	41	34	28	25	24	24	26	34
Total Free field Lp and dBA	56	46	39	33	30	29	29	31	39

Source noise levels at receiver: Flats above Papa Johns 3rd

Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	54	44	37	31	28	27	27	29	37
Freezer condenser	49	39	32	26	23	22	22	24	32
Total Free field Lp and dBA	55	45	38	32	29	28	28	30	38

Source noise levels at receiver: Flats above Papa Johns 1st

Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	56	46	39	33	30	29	29	31	39
Freezer condenser	52	42	35	29	26	25	25	27	35
Total Free field Lp and dBA	57	47	40	34	31	30	30	32	40

Source noise levels at receiver: Flats above Papa Johns 2nd
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	55	45	38	32	29	28	28	30	38
Freezer condenser	51	41	34	28	25	24	24	26	34
Total Free field Lp and dBA	56	46	39	33	30	29	29	31	39

Source noise levels at receiver: Flats above Papa Johns 3rd
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	54	44	37	31	28	27	27	29	37
Freezer condenser	49	39	32	26	23	22	22	24	32
Total Free field Lp and dBA	55	45	38	32	29	28	28	30	38

Source noise levels at receiver: Adjacent property 1st
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	56	46	39	33	30	29	29	31	39
Freezer condenser	52	42	35	29	26	25	25	27	35
Total Free field Lp and dBA	57	47	40	34	31	30	30	32	40

Source noise levels at receiver: Adjacent property 2nd
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	55	45	38	32	29	28	28	30	38
Freezer condenser	51	41	34	28	25	24	24	26	34
Total Free field Lp and dBA	56	46	39	33	30	29	29	31	39

Source noise levels at receiver: Adjacent property 3rd
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	54	44	37	31	28	27	27	29	37
Freezer condenser	49	39	32	26	23	22	22	24	32
Total Free field Lp and dBA	55	45	38	32	29	28	28	30	38

Source noise levels at receiver: Adjacent property 1st
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	55	45	38	32	29	28	28	30	38
Freezer condenser	50	40	33	27	24	23	23	25	33
Total Free field Lp and dBA	56	46	39	33	30	29	29	31	39

Source noise levels at receiver: Adjacent property 2nd
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	54	44	37	31	28	27	27	29	37
Freezer condenser	50	40	33	27	24	23	23	25	33
Total Free field Lp and dBA	55	45	38	32	29	28	28	30	38

Source noise levels at receiver: Adjacent property 3rd
Period: Night-time

	Mid frequency octave bands (Hz)								
	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	53	43	36	30	27	26	26	28	36

	63	125	250	500	1k	2k	4k	8k	dBA
Freezer condenser	48	38	31	25	22	21	21	23	31
Total Free field Lp and dBA	54	44	37	31	28	27	27	29	37

Source noise levels at receiver: 13A Lambs Conduit Passage
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	47	36	29	22	18	16	15	15	28
Freezer condenser	44	34	27	21	18	17	17	19	27
Total Free field Lp and dBA	49	38	31	25	21	20	19	20	30

Source noise levels at receiver: Adjacent property 1st
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	51	42	35	29	26	25	25	27	35
Freezer condenser	47	37	30	24	21	20	20	22	30
Total Free field Lp and dBA	52	43	36	30	27	26	26	28	36

Source noise levels at receiver: Adjacent property 2nd
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	52	42	35	29	26	25	25	27	35
Freezer condenser	47	37	30	24	21	20	20	22	30
Total Free field Lp and dBA	53	43	36	30	27	26	26	28	36

Source noise levels at receiver: Adjacent property 3rd
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	51	41	34	28	25	24	24	26	34
Freezer condenser	46	36	29	23	20	19	19	21	29
Total Free field Lp and dBA	52	42	35	29	26	25	25	27	35

Source noise levels at receiver: Adjacent property 1st
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	54	44	37	31	28	27	27	29	37
Freezer condenser	49	39	32	26	23	22	22	24	32
Total Free field Lp and dBA	55	45	38	32	29	28	28	30	38

Source noise levels at receiver: Adjacent property 2nd
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	53	43	36	30	27	26	26	28	36
Freezer condenser	48	38	31	25	22	21	21	23	31
Total Free field Lp and dBA	54	44	37	31	28	27	27	29	37

Source noise levels at receiver: Adjacent property 3rd
Period: Night-time

Mid frequency octave bands (Hz)

	63	125	250	500	1k	2k	4k	8k	dBA
Chiller condenser	52	42	35	29	26	25	25	27	35
Freezer condenser	47	37	30	24	21	20	20	22	30
Total Free field Lp and dBA	53	43	36	30	27	26	26	28	36

APPENDIX E

ACOUSTIC TERMINOLOGY

Acoustic Terminology

E1 Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sounds is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase in level of 3 dB, i.e. 50 dB + 50 dB = 53 dB. Increases in continuous sound are perceived in the following manner:

1 dB increase - barely perceptible.

3 dB increase - just noticeable.

10 dB increase - perceived as twice as loud.

E2 Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz (Hz) = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 18000Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.

E3 To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability automatically to weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).

E4 The second important characteristic of sound is amplitude or level. Two units are used to express level, a) sound power level - L_w and b) sound pressure level - L_p. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity, etc. The sound level that is measured on a meter is the sound pressure level, L_p.

E5 External sound levels are rarely steady but rise or fall in response to the activity in the area - cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on the type and temporal distribution of a particular type of noise. A set of statistical indices have been developed for the subjective response to these different noise sources.

E6 The main noise indices in use in the UK are:

L_{A90}: The sound level (in dBA) exceeded for 90% of the time. This level gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background sound level" of an area.

L_{Aeq}: The equivalent continuous sound level in dBA. This unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the intermittent noise". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as aircraft and trains.

L_{A10}: The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used over many years to measure and assess road traffic noise.

L_{AMAX}: The maximum level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles, etc.

E7 The sound energy of a transient event may be described by a term SEL - Sound Exposure Level. This is the L_{Aeq} level normalised to one second. That is the constant level in dBA which lasting for one second has the same amount of acoustic energy as a given A weighted noise event lasting for a period of time. The use of this unit allows the prediction of the L_{Aeq} level over any period and for any number of events using the equation;

$$L_{AeqT} = SEL + 10 \log n - 10 \log T \text{ dB.}$$

Where

n = Number of events in time period T.

T = Total sample period in seconds.

E8 In the open, known as free field, sound attenuates at a rate of 6 dB per each doubling of distance. This is known as geometric spreading or sometimes referred to as the Inverse Square Law. As noise is measured on a Logarithmic scale, this attenuation in distance = 20 Log (ratio of distances), e.g. for a noise level of 60 dB at ten metres, the corresponding level at 160 metres is:

$$60 - 20 \text{ Log } {}^{160}/{}_{10} = 60 - 24 = 36 \text{ dB.}$$