

Five Guys
17 Piccadilly
Manchester
M1 1LS

Plant Noise
Impact Assessment Report

On behalf of

chapman
ventilation

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T: 01252 519881
W: noisesolutions.co.uk
E: hello@noisesolutions.co.uk

Noise Solutions Ltd, Unit 5, Oriel Court, Omega Park, Alton, GU34 2YT Reg no. 3483481



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	Name	Qualifications	Initials	Date
Prepared by:	Miriam Pratap	BSc(Hons), AMIOA	MP	21 st December 2020
Reviewed and approved by:	Nigel Chandler	BSc(Hons,) MIOA	NAC	21 st December 2020
For and on behalf of Noise Solutions Ltd				

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Reg no. 3483481 Trading office Unit 5, Oriel Court, Omega Park, Alton, Hampshire, GU34 2YT

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1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned by Chapman Ventilation to undertake a noise impact assessment for new plant serving the proposed Five Guys restaurant to be located at a former building society at 17 Piccadilly in Manchester.
- 1.2. An environmental sound survey has been undertaken to establish the prevailing background sound pressure levels at a location representative of the sound levels outside the nearest noise sensitive receptors to the site.
- 1.3. Cumulative plant noise emission levels for the proposed plant have been predicted at the most affected noise sensitive receptors and assessed using criteria set out by the local authority, Manchester City Council.
- 1.4. A glossary of acoustic terminology is given in [Appendix A](#). An in-depth glossary of acoustic terms can be viewed online at www.acoustic-glossary.co.uk.

2.0 Details of development proposals

- 2.1. The proposed restaurant is to occupy the basement and ground floor of a seven-storey building on the corner of Piccadilly and Oldham Street in Manchester.
- 2.2. To facilitate this, new plant will be installed on site. A new air handling unit (AHU1), a kitchen extract fan (EF1) and general and toilet extract systems (EF2 – EF3) will be installed. The termination points are at first floor level at the rear of the building with the fans themselves within the building. Air conditioning (AC) units will be installed alongside the extract ducts, replacing the existing AC units.
- 2.3. All plant will be in operation between 07.00 and 01.00 hours daily and will be switched off between 01.00 and 07.00 hours.
- 2.4. [Appendix C](#) contains a table with the manufacturers' published sound pressure levels for the proposed plant.

3.0 Nearest noise sensitive receptors

- 3.1. The site is in a mixed residential and commercial area. The nearest and most affected residential receptor to the extract louvres and AC units is the north facing second floor flat above the restaurant (Receptor R1). The most affected residential receptor to the AHU is the west facing second floor flat above the restaurant (Receptor R2).

3.2. An aerial photograph provided in [Appendix B](#) identifies the site and receptors.

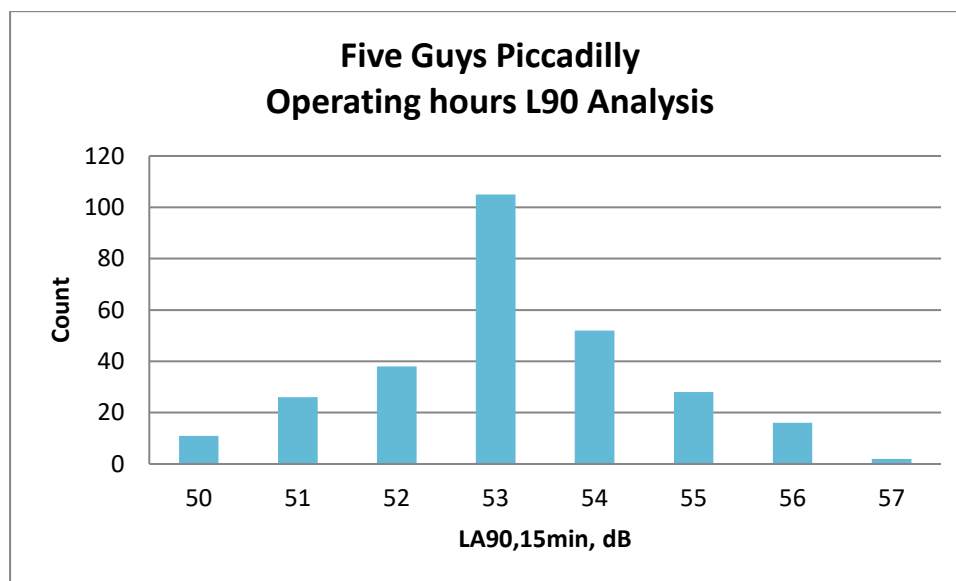
4.0 Noise survey

- 4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptors to the proposed plant area during the quietest times at which the plant will operate.
- 4.2. The results of the environmental sound survey are summarised in Table 1 below. The full set of measurement results and details of the survey methodology are presented in [Appendix D](#).

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	L _{Aeq} (15mins)	L _{Amax} (15mins)	L _{A10} (15mins)	L _{A90} (15mins)
Operating hours (07.00 – 01.00 hours)	52-58	54-78	53-62	51-57

Figure 1 Histogram of daytime L_{A90} background sound pressure levels



- 4.3. Additional statistical analysis has been undertaken. As shown in Table 2, the mean, median, and modal values have been calculated:

Table 2 Statistical analysis of $L_{A90,15min}$ levels during the daytime period

dB, L_{A90} daytime period	
Mean	53
Median	53
Mode	53

- 4.4. The mean, median and modal values all equal 53dB L_{A90} . From review of the graph in Figure 1, 53dB L_{A90} has been considered as representative of the typical background sound level during the operating period.

5.0 Design criteria

Manchester City Council

- 5.1. On recently approved planning applications by Manchester City Council the guidance on noise criteria has been:

"Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location."

- 5.2. It can be assumed that a similar condition may be applied for this planning application.

BS 4142:2014 'Methods for Rating and Measuring Industrial and Commercial Sound'

- 5.3. British Standard (BS) 4142:2014 describes a method for rating and assessing sound of an industrial or commercial nature, which includes:
- Sound from industrial and manufacturing processes;
 - Sound from fixed installations which comprise mechanical and electrical plant and equipment;
 - Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and
 - 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.

-
- 5.4. The industrial or commercial sound is assessed outside a dwelling or premises used for residential purposes, upon which sound is incident.
- 5.5. The procedure contained in BS 4142 is to quantify the "specific sound level", which is the measured or predicted level of sound from the source in question over a one hour period for the daytime and a 15-minute period for the night-time. Daytime is defined in the standard as 07:00 to 23:00 hours, and night-time as 23:00 to 07:00 hours.
- 5.6. The specific sound level is converted to a rating level by adding penalties on a sliding scale to account for either potentially tonal or impulsive elements. The standard sets out objective methods for determining the presence of tones or impulsive elements, but notes that it is acceptable to subjectively determine these effects.
- 5.7. The penalty for tonal elements is between 0dB and 6dB, and the standard notes: *"Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible."*
- 5.8. The penalty for impulsive elements is between 0dB and 9dB, and the standard notes: *"Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."*
- 5.9. The background sound level should be established in terms of the L_{A90} noise index. The standard states that the background sound level should be measured over a period of sufficient length to obtain a representative value. This should not normally be less than 15-minute intervals. The standard states that: *"A representative level ought to account for the range of background sound levels and ought not automatically to be assumed to be either the minimum or modal value."*
- 5.10. The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:
- a) *Typically, the greater this difference, the greater the magnitude of the impact.*
 - b) *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
 - c) *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
 - d) *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*
- Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."*
-

5.11. The standard goes on to note that: *"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."*

5.12. In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014 edition places emphasis upon an appreciation of the context, as follows:

"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."

5.13. BS 4142 requires uncertainties in the assessment to be considered, and where the uncertainty is likely to affect the outcome of the assessment, steps should be taken to reduce the uncertainty.

Proposed criteria

5.14. It is considered appropriate that the cumulative plant noise rating level of proposed plant should be controlled to a level that does not exceed 5dB below the representative L_{A90} background sound level at the nearest residential property.

5.15. The cumulative noise level for the proposed plant at the nearest residential windows should therefore not exceed the limits shown in the table below:

Table 3 Proposed plant noise emissions level limits at noise sensitive residential receptors

Period	Cumulative plant rating noise level, dB(A)
Operating hours (07.00 – 01.00 hours)	48

6.0 Plant noise impact assessment

6.1. The cumulative plant noise level at the most affected noise sensitive receptor has been predicted. The predictions are based on the manufacturer noise data for the proposed plant.

6.2. The predictions during the operating period have been based on all proposed plant operating simultaneously at full capacity. During all other times there will be no item of plant in operation.

6.3. Noise levels for the proposed ventilation plant have been predicted taking into account ductwork system losses, aperture size, directivity of sound propagation and distance attenuation. The predictions are inclusive of the following atmospheric sided silences fitted to the fans:

Table 4 Proposed atmospheric sided attenuators to ventilation systems

Attenuator	Insertion losses dB, at octave band centre frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
Kitchen extract	5	9	16	25	31	28	22	15
AHU	6	11	21	34	41	41	38	31
General extract	3	10	14	24	30	29	28	21
WC extract	2	3	6	12	13	11	9	7

- 6.4. It should be noted that all proposed plant is high-quality and no impulsive characteristics are anticipated provided the equipment is well maintained. All plant items are inverter driven, which means the fans gently ramp to cope with system demands. As a result, the plant items are not considered to operate intermittently. Although 1/3 octave band data is not available from the unit manufacturers to assess tonality, experience of comparable plant operating at other similar sites indicates that no tonal components are present.
- 6.5. Table 5, below, summarises the results of the assessment at the nearest noise-sensitive windows. All other nearby receptors benefit from increased distance/screening to the plant. The full set of calculations can be found in [Appendix E](#).

Table 5 Assessment of predicted noise levels at nearby receptors

Receptor	Period	Predicted plant noise level at receptor, L_{Aeq} (dB)	Proposed design criterion (dB)	Difference (dB)
R1 - residential	Operating hours (07.00 – 01.00 hours)	48	48	0
R2 - residential	Operating hours (07.00 – 01.00 hours)	45	48	-3

- 6.6. The above assessment demonstrates that noise from the proposed plant will comply with the proposed limit in Table 3, inclusive of the atmospheric-sided attenuators specified above.
- 6.7. The following must, also be taken into consideration when determining the potential impact that may be experienced:
- The assessment is undertaken at the nearest residential window. The impact on other nearby residential windows will be lower due to screening and distance attenuation.
 - The assessment has been made with all plant operating at maximum capacity, as this is not always the case, the assessment is an absolute worst-case scenario.

- The Five Guys will be located alongside existing commercial properties with associated plant already in operation.

6.8. Where possible uncertainty in the above assessments has been minimised by taking the following steps:

- The meter and calibrator used have a traceable laboratory calibration and the meter was field calibrated before and after the measurements.
- Uncertainty in the calculated impacts has been reduced by the use of a well-established calculation method.
- Care was taken to ensure that the measurement positions were representative of the noise climate outside the nearby receptors and not in positions where higher noise levels were present.

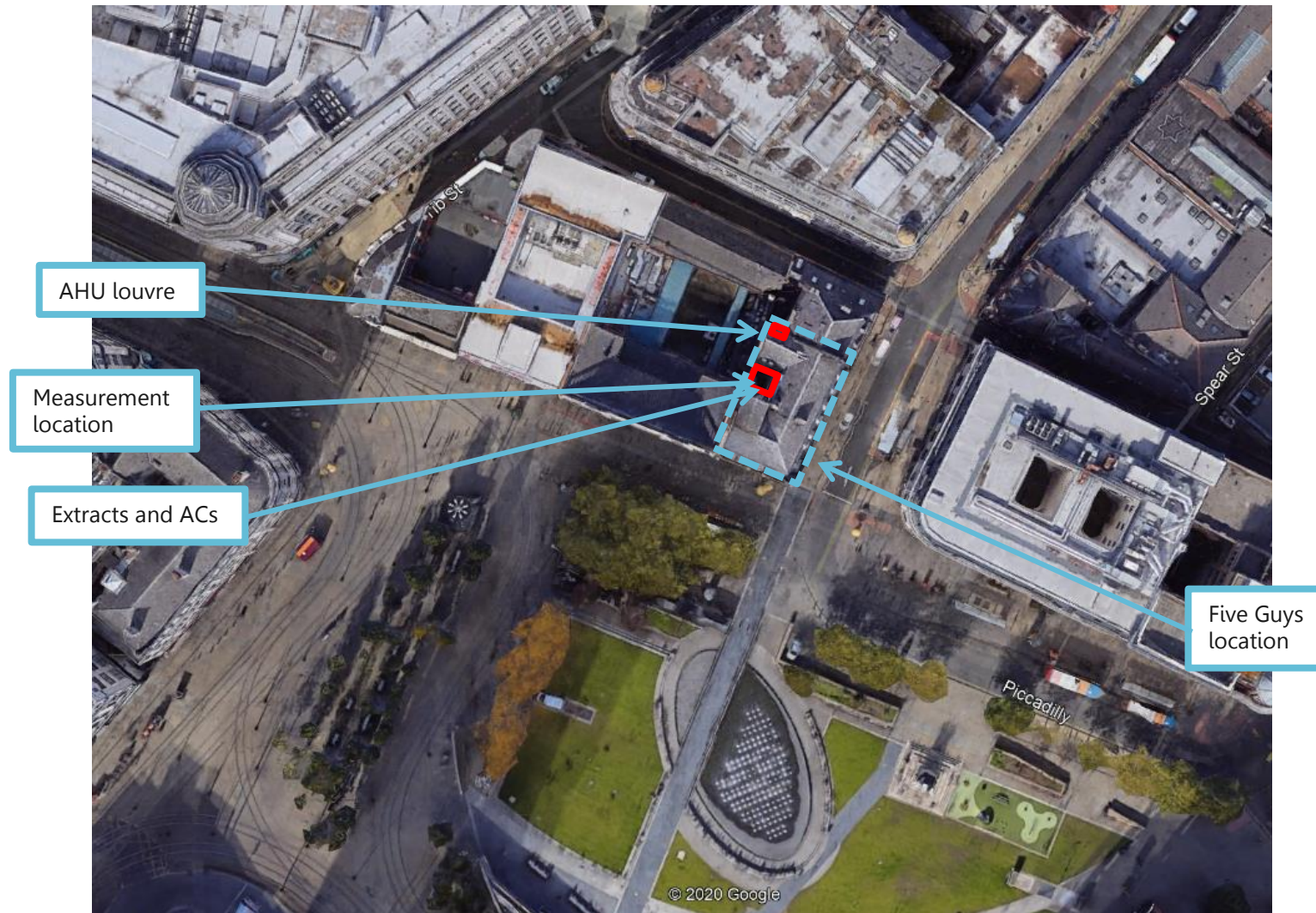
7.0 Summary

- 7.1. Noise Solutions Ltd (NSL) has been commissioned by Chapman Ventilation to undertake a noise impact assessment for new plant at the proposed Five Guys restaurant located at 17 Piccadilly in Manchester.
- 7.2. An environmental noise survey has been undertaken to establish the existing prevailing noise levels at a location representative of the noise climate outside the nearest noise sensitive receptors to the plant area.
- 7.3. The cumulative plant noise emission levels for the proposed plant have been predicted at the most affected noise sensitive receptor and assessed against the requirements of Manchester City Council.
- 7.4. The results of the assessment demonstrate that cumulative noise levels at the most affected noise sensitive windows will comply with the noise criteria, inclusive of suitable atmospheric-sided attenuators to the ventilation fans.

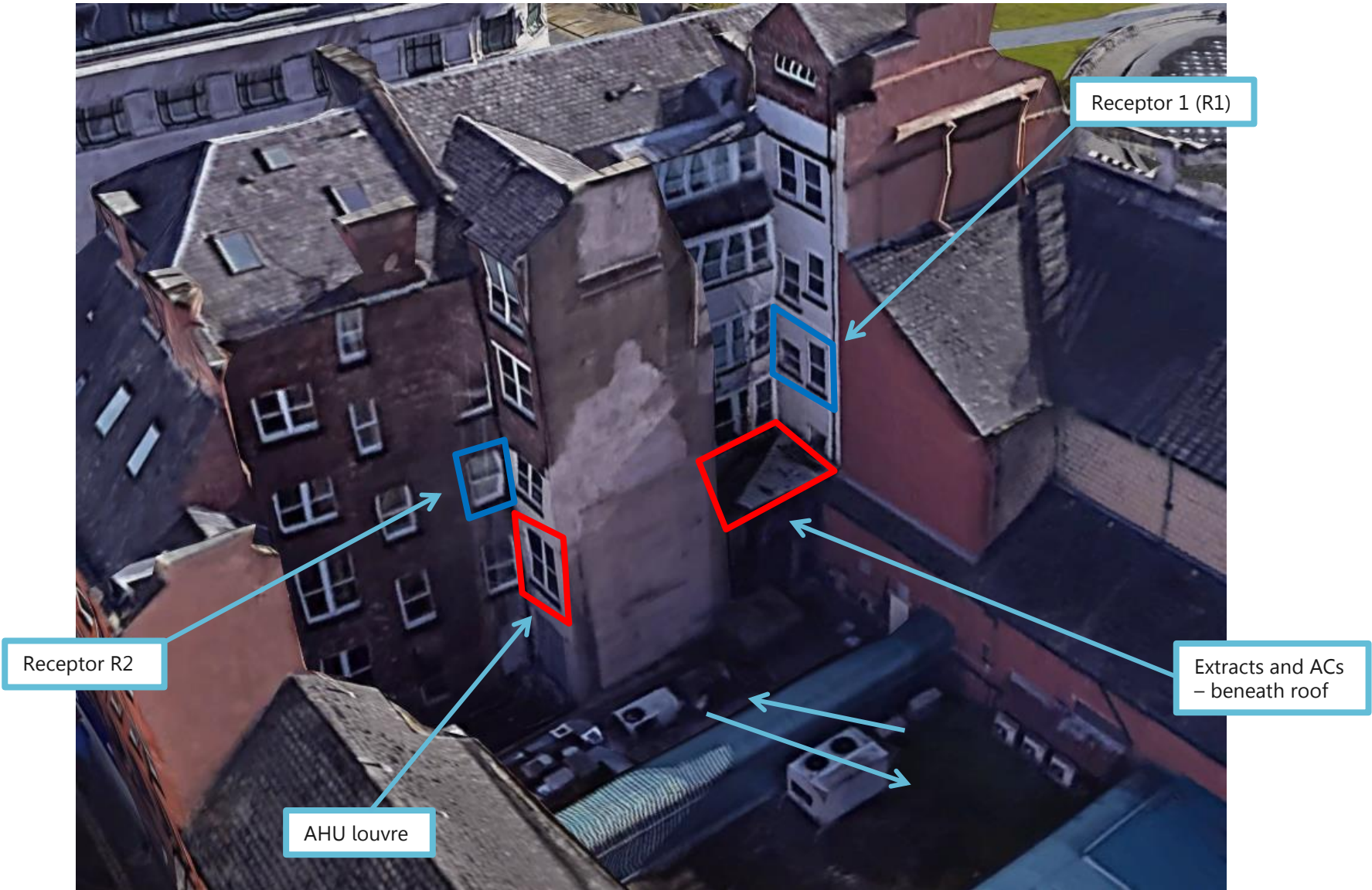
Appendix A Acoustic terminology

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s_1 and s_2 is given by $20 \log_{10} (s_1/s_2)$. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is $20\mu\text{Pa}$. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).
Fast Time Weighting	Setting on sound level meter, denoted by a subscript F, that determines the speed at which the instrument responds to changes in the amplitude of any measured signal. The fast time weighting can lead to higher values than the slow time weighting when rapidly changing signals are measured. The average time constant for the fast response setting is 0.125 (1/8) seconds.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
Façade	Sound pressure level measured at a distance of 1 metre in front of a large sound reflecting object such as a building façade.
$L_{Aeq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level recorded during a noise event with a period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. $L_{A10,18h}$ is the A-weighted arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06:00-24:00.
$L_{90,T}$	A noise level index. The noise level that is exceeded for 90% of the measurement time interval, T. It gives an indication of the lower levels of fluctuating noise. It is often used to describe the background noise level and can be considered to be the "average minimum" noise level and is a term used to describe the level to which non-specific noise falls during quiet spells, when there is lull in passing traffic for example.

Appendix B Photographs of site showing areas of interest



Photographs Courtesy of Google Earth



Appendix D Environmental sound survey

Details of environmental sound survey

- D.1 Measurements of the existing background sound levels were undertaken from 10.55 hours on Wednesday 16th December to 10.00 hours on Thursday 17th December 2020.
- D.2 The sound level meter was programmed to record the A-weighted L_{eq} , L_{90} , L_{10} and L_{max} noise indices for consecutive five-minute sample periods for the duration of the survey.

Measurement position

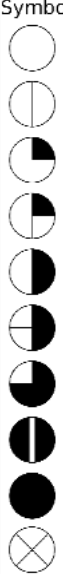
- D.3 The representative measurement position was located on a tripod at the rear of the property where the plant is to be located, outside receptor R1 (location indicated on the site plan in [Appendix B](#)). In accordance with BS 7445-2:1991 '*Description and measurement of environmental noise – Part 2: Guide to the acquisition of data pertinent to land use*', the measurements were undertaken under free-field conditions.

Equipment

- D.4 Details of the equipment used during the survey are provided in the table below. The sound level meter was calibrated before and after the survey; no significant change (± 0.2 dB) in the calibration level was noted.

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Rion NL-52 / 00876023	02/04/2019	TCRT19/1237
Condenser microphone	Rion UC-59 /14826		
Preamplifier	Rion NH-25 / 87474		
Calibrator	Rion NC-74 /34235932	20/08/2020	TCRT20/1469

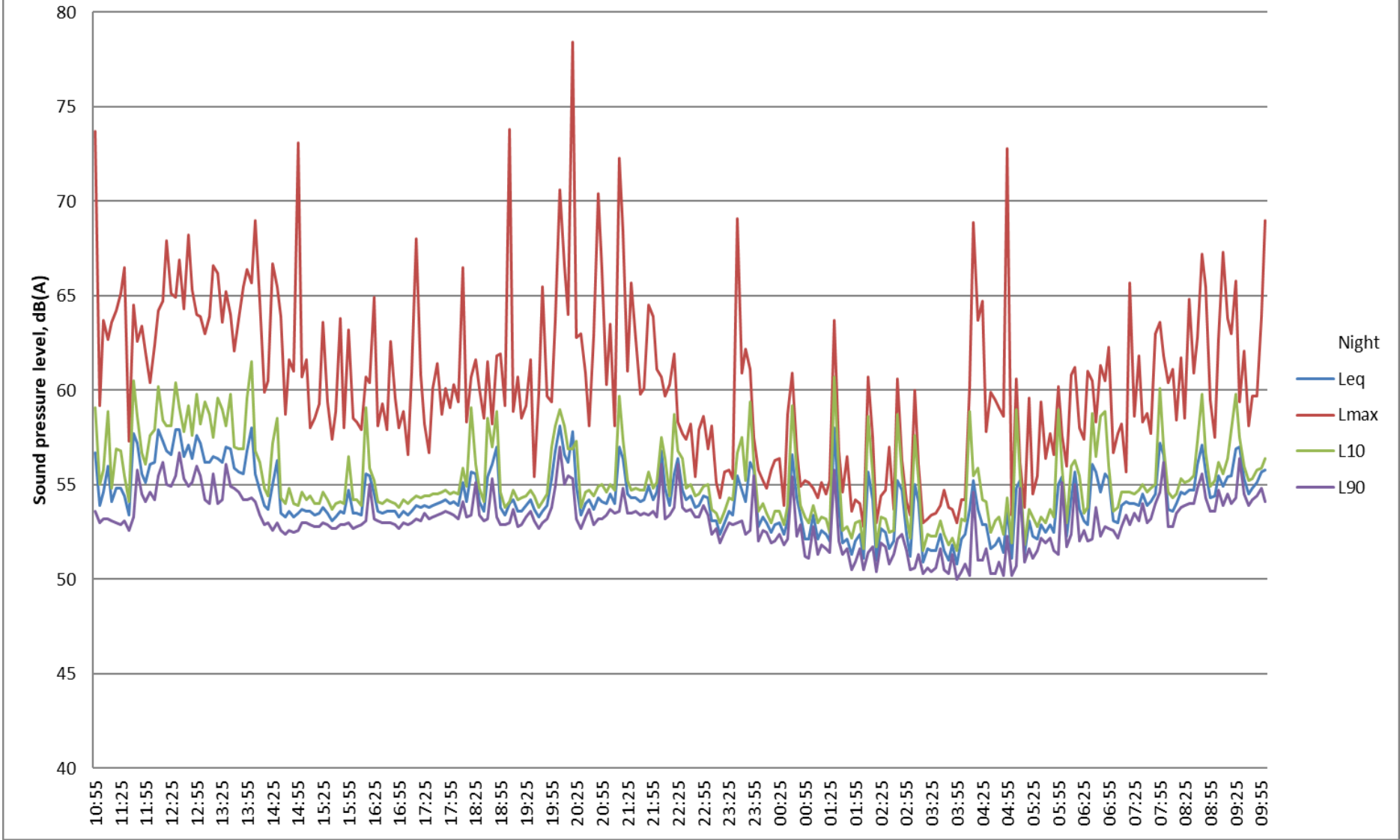
- D.5 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

Weather Conditions				
Measurement Location	Time/Date	Description	Beginning of Survey	End of Survey
As indicated on Appendix B	10.55 16/12/2020 – 10.00 17/12/2020	Temperature (°C)	9	7
Cloud Cover  Symbol Scale in oktas (eighths) 0 Sky completely clear 1 2 3 4 Sky half cloudy 5 6 7 8 Sky completely cloudy (9) Sky obstructed from view		Precipitation:	Yes	No
		Cloud cover (oktas – see guide)	8	3
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Yes	Damp
		Wind Speed (m/s)	<1	<1
		Wind Direction	N/A	N/A
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

Results

- D.6 The results of the survey are considered to be representative of the background sound pressure levels at the façades of the most affected noise sensitive receptors to the plant area during the quietest times at which the plant will operate. The noise climate at the measurement position was dominated by plant operating in adjacent commercial properties. The results of the survey are presented in a time history graph overleaf.

Five Guys Piccadilly
Wednesday 16 - Thursday 17 Dec 2020



Appendix E Noise level predictions

Summary

Plant	Resultant at Receptor (dBA)	
	R1	R2
AHU	-1	45
EF1 - kitchen extract	41	15
EF2 – general	42	14
EF3 – toilet	40	11
AC Condenser CU1	40	20
AC Condenser CU2	40	20
AC Condenser CU3	33	15
AC Condenser CU4	29	11

BS 4142:2014 feature correction	0	0
Cumulative Day	48	45
Day rating	48	45

Condensers

Receptor R1

Unit	Distance				Directivity	Screening	Result
	L _{pA}	at / m	m	dB			
CU1	57	1	4	-12	0	-5	40
CU2	57	1	4	-12	0	-5	40
CU3	52	1	5	-14	0	-5	33
CU4	48	1	5	-14	0	-5	29

Receptor R2

Unit	Distance				Directivity	Screening	Result
	L _{pA}	at / m	m	dB			
CU1	57	1	12	-22	0	-15	20
CU2	57	1	12	-22	0	-15	20
CU3	52	1	12	-22	0	-15	15
CU4	48	1	12	-22	0	-15	11

Air Handling Unit

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (Unattenuated)	In-duct L_w	66	68	80	75	67	65	61	59	76
System losses		-5	-2	-1	-2	-3	-4	-3	-3	
Atmospheric sided attenuator		-6	-11	-21	-34	-41	-41	-38	-31	
Sound power level leaving terminal	L_w	55	55	58	39	23	20	20	25	50

Receptor R1

Directivity correction	(0,180)	-3	-7	-9	-8	-8	-8	-8	-8	
Distance correction	16m	-32	-32	-32	-32	-32	-32	-32	-32	
Screening correction		-10	-10	-10	-10	-10	-10	-10	-10	
Resultant at Receptor R1	L_p	10	6	7	-11	-27	-30	-30	-25	-1

Receptor R2

Directivity correction	(0,45)	2	3	3	4	4	4	4	4	
Distance correction	1m	-8	-8	-8	-8	-8	-8	-8	-8	
Screening correction		0	0	0	0	0	0	0	0	
Resultant at Receptor R2	L_p	49	50	53	35	19	16	16	21	45

Kitchen Extract Exhaust

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (Unattenuated)	In-duct L _w	79	76	85	82	85	81	79	78	89
System losses		-11	-4	-2	-5	-7	-9	-7	-7	
Atmospheric sided attenuator		-5	-9	-16	-25	-31	-28	-22	-15	
Sound power level leaving terminal	L_w	63	63	67	52	47	44	50	56	61

Receptor R1

Directivity correction	(0,90)	0	0	0	0	-4	-7	-7	-7	
Distance correction	2m	-14	-14	-14	-14	-14	-14	-14	-14	
Screening correction		-5	-5	-5	-5	-5	-5	-5	-5	
Resultant at Receptor R1	L_p	44	44	48	33	24	18	24	30	41

Receptor R2

Directivity correction	(0,135)	-1	-1	-3	-6	-9	-8	-8	-8	
Distance correction	15m	-32	-32	-32	-32	-32	-32	-32	-32	
Screening correction		-10	-10	-10	-10	-10	-10	-10	-10	
Resultant at Receptor R2	L_p	20	20	22	4	-4	-6	0	6	15

General Extract Exhaust

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (Unattenuated)	In-duct L_w	68	60	83	79	81	78	67	56	84
System losses		-10	-6	-2	0	-2	-4	-6	-6	
Atmospheric sided attenuator		-3	-10	-14	-24	-30	-29	-28	-21	
Sound power level leaving terminal	L_w	55	44	67	55	49	45	33	29	60

Receptor R1

Directivity correction	(0,90)	0	0	0	0	-4	-7	-7	-7	
Distance correction	1.5m	-12	-12	-12	-12	-12	-12	-12	-12	
Screening correction		-5	-5	-5	-5	-5	-5	-5	-5	
Resultant at Receptor R1	L_p	38	27	50	38	28	21	9	5	42

Receptor R2

Directivity correction	(0, 135)	-1	-1	-3	-6	-9	-8	-8	-8	
Distance correction	16m	-32	-32	-32	-32	-32	-32	-32	-32	
Screening correction		-10	-10	-10	-10	-10	-10	-10	-10	
Resultant at Receptor R2	L_p	12	1	22	7	-2	-5	-17	-21	14

Toilet Extract Exhaust

Description	Notes.	Sound level (dB) at octave band centre frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Source noise level (Unattenuated)	In-duct L_w	42	54	50	68	71	68	62	58	74
System losses		-14	-10	-5	-2	-1	-1	-1	-1	
Atmospheric sided attenuator		-2	-3	-6	-12	-13	-11	-9	-7	
Sound power level leaving terminal	L_w	26	41	39	54	57	56	52	50	62

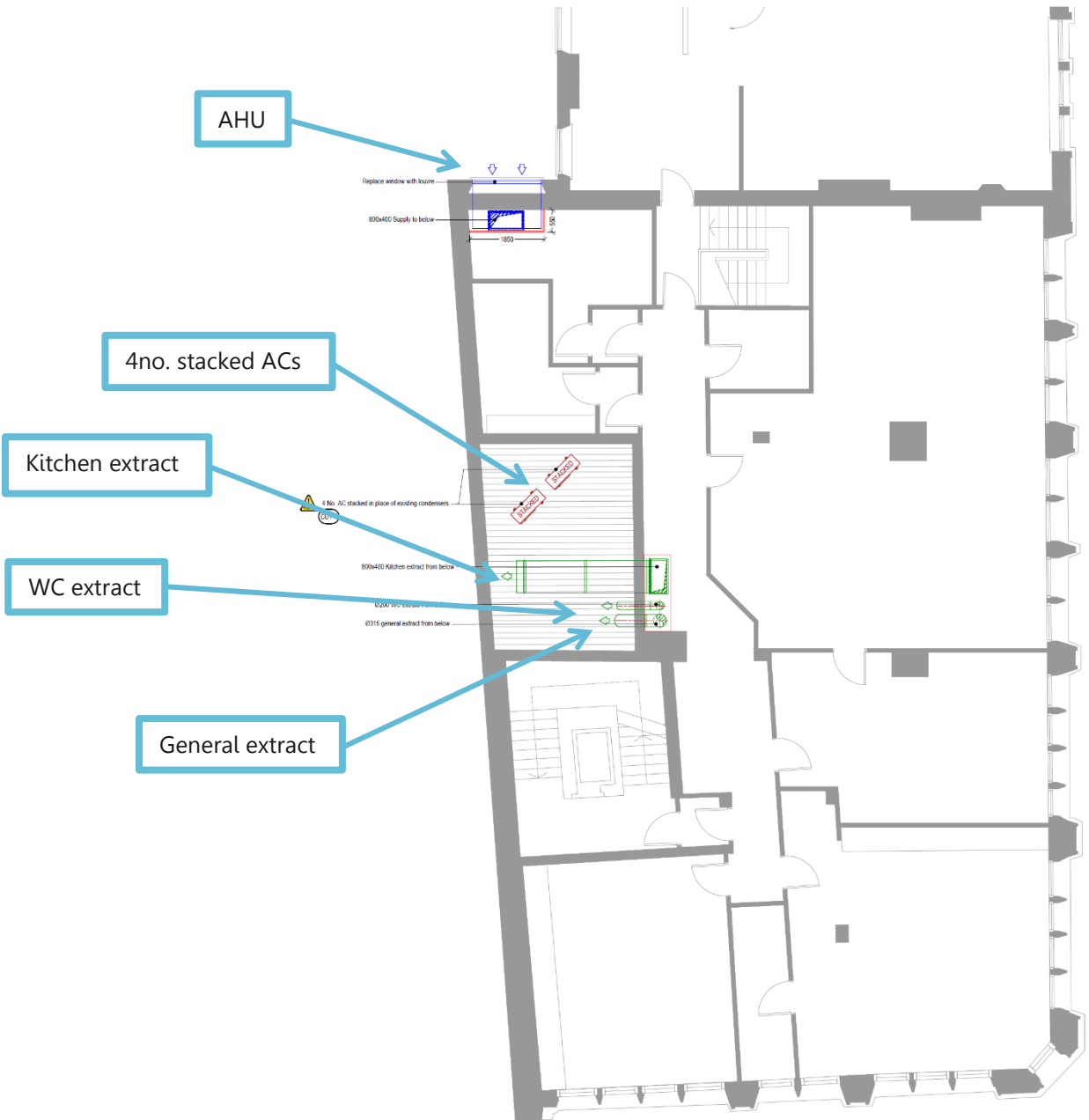
Receptor R1

Directivity correction	(0,90)	0	0	0	0	-4	-7	-7	-7	
Distance correction	1.5m	-12	-12	-12	-12	-12	-12	-12	-12	
Screening correction		-5	-5	-5	-5	-5	-5	-5	-5	
Resultant at Receptor R1	L_p	9	24	22	37	36	32	28	26	40

Receptor R2

Directivity correction	(0,135)	-1	-1	-3	-6	-9	-8	-8	-8	
Distance correction	16m	-32	-32	-32	-32	-32	-32	-32	-32	
Screening correction		-10	-10	-10	-10	-10	-10	-10	-10	
Resultant at Receptor R2	L_p	-17	-2	-6	6	6	6	2	0	11

Appendix F Plant drawings



First Floor Plan