

Unit 7 Wilmslow Park
Oxford Road
Manchester

**Plant Noise Impact
Assessment**

On behalf of

**chapman
ventilation**

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1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned to provide a Noise Impact Assessment for the new plant serving a proposed restaurant located on Oxford Road, 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. The cumulative plant noise level has been predicted at the nearest noise-sensitive receptors and assessed against recognised standards.
- 1.4. To assist with the understanding of this report a glossary of acoustic terms can be found 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 will be located in Unit 7, Wilmslow Park, Oxford Road, Manchester.
- 2.2. Three air conditioning (AC) condensers and two cold-store condensers will be installed in the service area behind the restaurant. The service area is within the ground floor of the building car park with no screening to the parking.
- 2.3. The restaurant general and WC extracts also vent into this service area with the respective extract fans installed within the premises.
- 2.4. The internal kitchen extract fan will vent air into the covered ground floor carpark entrance accessed from Hathersage Road via ductwork from the restaurant rear.
- 2.5. An internally installed supply fan will draw air into the restaurant via an intake louvre located above the restaurant entrance on Oxford Road.
- 2.6. The proposed restaurant and plant layout are shown in [Appendix C](#).

3.0 Nearest noise sensitive receptors

- 3.1. The area surrounding the site is mixed residential and commercial in nature with a park to the West, hospital buildings to the North and East and terraced housing to the South.
- 3.2. The Wilmslow Park building has retail units on the ground floor with residential properties above.

- 3.3. The flats above the shop front are the closest residences to any of the proposed plant being directly above the air intake, (Receptor R1).
- 3.4. The closest residential receptors to the kitchen extract are the first-floor flats above the carpark entrance on Hathersage Road (R2) although these properties benefit from significant levels of screening from the building. The hospital office building across the road from car park entrance has direct line of sight with the kitchen extract, (Receptor R3).
- 3.5. With the building service area located on the ground floor of a carpark there are no residential receptors close by with direct line of site. A flat in the first-floor courtyard in line with the carpark access ramp has been selected to assess the plant and kitchen extract noise impact in the courtyard, (Receptor R4).
- 3.6. An Assessment of the noise levels in the carpark has also been made directly below the kitchen extract, (Receptor R5).
- 3.7. All receptors are shown in [Appendix B](#).

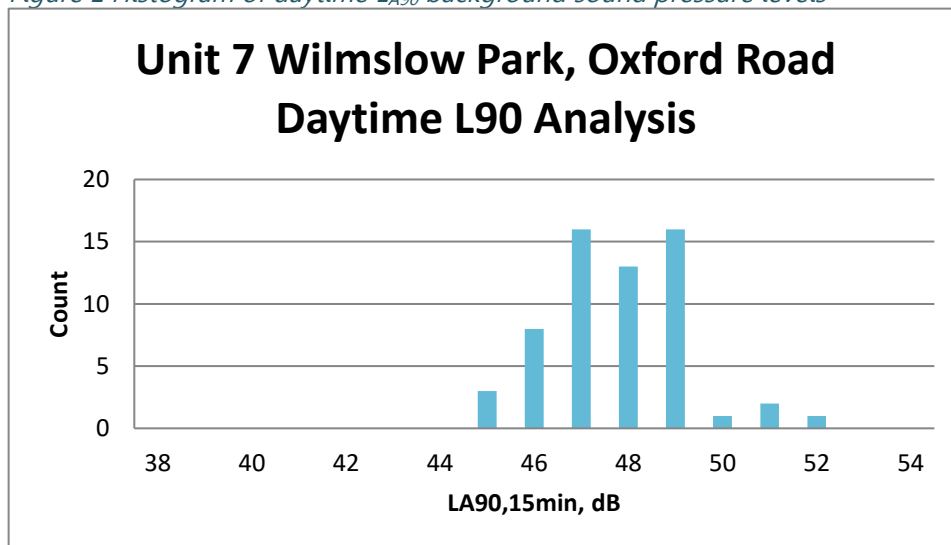
4.0 Existing noise climate

- 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)
Daytime (07.00 – 23.00 hours)	53-70	70-93	55-69	45-52
Night-time (23.00 – 07.00 hours)	46-58	59-87	49-60	39-45

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

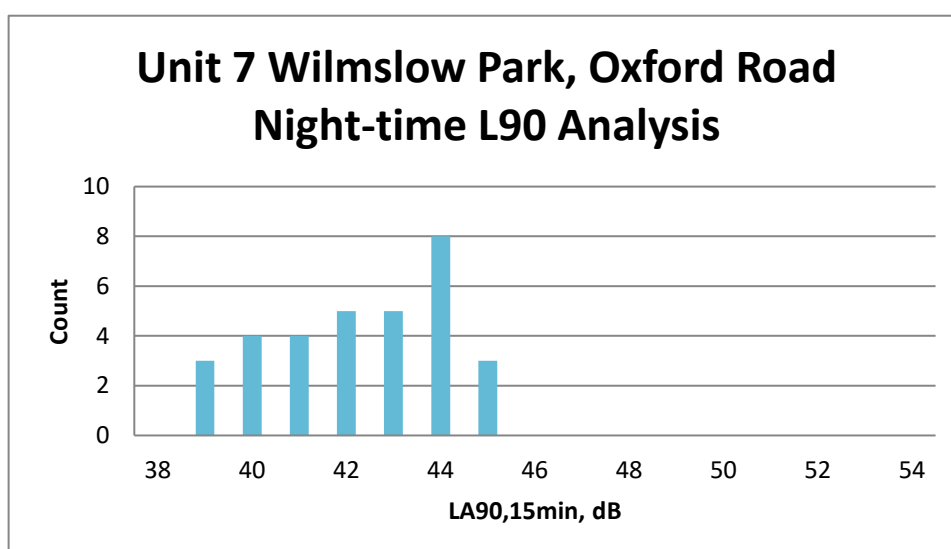


- 4.3. Further statistical analysis has been undertaken on the data, and the mean, mode and median values are shown in Table 2 below.

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

dB, L_{A90} daytime period	
mean	48
modal	47
median	48

Figure 2 Histogram of night-time L_{A90} background sound pressure levels



- 4.4. Further statistical analysis has been undertaken on the data and the mean, mode and median values are shown in Table 3 below.

Table 3 Statistical analysis of $L_{A90,15min}$ levels during the night-time period

dB, L_{A90} night-time period	
mean	42
modal	44
median	43

- 4.5. The following values are considered robustly representative of the existing background sound pressure levels at nearby noise sensitive premises:

- 46dB L_{A90} during the daytime period.
- 42dB L_{A90} during the night-time period.

5.0 Plant noise impact assessment

Manchester City Council

- 5.1. The Planning and Noise Technical Guidance document for Manchester City Council¹ provides the following guidance with regards to noise and vibration from fixed plant/equipment.

The noise assessment should be based on BS 4142, and any application for fixed plant, equipment or machinery must demonstrate that:

'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 (L_{A90}) level at the nearest noise sensitive location'.

BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound

- 5.2. BS 4142:2014 +A1:2019 is intended to be used to assess the likely effects of sound on people residing in nearby dwellings. The scope of BS 4142:2014² includes "sound from fixed plant installations which comprise mechanical and electrical plant and equipment".

¹ Planning and Noise, Technical Guidance, Manchester City Council, October 2022

² For brevity, references to BS 4142 and BS 4142:2014 should be read as BS 4142:2014 + A1:2019

- 5.3. The procedure contained in BS 4142:2014 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.
- 5.4. 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.
- 5.5. 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."*
- 5.6. 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."*
- 5.7. The assessment outcome results from a comparison of the rating level with the background sound level. The standard states:
- *Typically, the greater this difference, the greater the magnitude of the impact.*
 - *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
 - *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context;*
 - *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*
- 5.8. The standard does state that *"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."*
- 5.9. 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."*

- 5.10. 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."

- 5.11. BS 4142:2014 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.

Health Technical Memorandum 08-01: Acoustics (HTM 08-01)

- 5.12. The Health Technical Memorandum 08-01: Acoustics (HTM 08-01) provides best practice guidance for healthcare facilities. The most stringent internal ambient noise criterion for healthcare facilities is 35dB $L_{Aeq,1hour}$. Assuming a 15dB reduction for a tilted or half-open window (*WHO Guidelines for Community Noise: 2018*) this will be achieved when the plant noise impact does not exceed 50dB $L_{Aeq,T}$ at the most affected façade of the healthcare facility.

Summary of applicable emissions criteria

- 5.13. Manchester City Council typically require the specific sound level due to new plant, at the nearest noise-sensitive residential receptor to be 5dBA below the pre-existing representative background sound level.
- 5.14. The rating sound level due to the extract system should therefore not exceed the following limits:

Table 4 Plant noise emission limits at the nearest noise sensitive receptor

Receptor	Period	Cumulative plant rating level, dB $L_{Ar,Tr}$
Residential	Daytime (07.00 – 23.00 hours)	41
	Night-time (23.00 – 07.00 hours)	37
Hospital Buildings	At any time	50 dB L_{Aeq}

- 5.15. The above limits have not been approved by the local authority at this stage.

6.0 Plant noise impact assessment

- 6.1. Plant rating levels have been predicted at the nearest noise sensitive receptors. The assessment has taken account of the distance between the plant and the nearest receptors, orientations, screening, reflections and other propagation effects. Calculations also include the following attenuation:

Table 5 Proposed atmospheric side attenuators to ventilation systems

Attenuator	Insertion losses dB, at octave band centre frequencies (Hz)							
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
AHU Intake	5	9	17	25	33	27	20	12
Kitchen Extract Discharge	4	6	11	18	25	20	14	9

- 6.2. It should be noted that the proposed plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. All proposed plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems. However, a penalty of 3dB as described in BS 4142:2014 has been applied for the possible presence of "...characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment...".
- 6.3. The predicted noise levels from the plant are shown at the five receptor locations and can be seen in [Appendix F](#).
- 6.4. Table 6 summarises the results of the assessment outside the nearest noise-sensitive premises. Full calculations are shown in [Appendix F](#).

Table 6 Assessment of plant sound levels

Receptor	Period	Predicted rating level at receptor, $L_{Ar,Tr}$ (dB)	Proposed design criterion (dB)	Difference (dB)
R1 Flat above Shop front	Daytime hours (07.00 – 23.00 hours)	39	41	-2
R2 Flat above car park entrance	Daytime hours (07.00 – 23.00 hours)	27	41	-14
	Night-time hours (10.00 – 23.00 hours)	22	37	-15

Receptor	Period	Predicted rating level at receptor, $L_{Ar,Tr}$ (dB)	Proposed design criterion (dB)	Difference (dB)
R3 Hospital façade	Daytime hours (07.00 – 23.00 hours)	30*	50	-20
	Night-time hours (10.00 – 23.00 hours)	15*	50	-33
R4 Courtyard flat	Daytime hours (07.00 – 23.00 hours)	32	41	-9
	Night-time hours (10.00 – 23.00 hours)	27	37	-10
R5 Car park pedestrian walkway	Daytime hours (07.00 – 23.00 hours)	46*	50	-4
	Night-time hours (10.00 – 23.00 hours)	38*	50	-12

**specific sound level (dB L_{Aeq})*

Discussion

- 6.5. The different locations of the vents and condensers mean that not all the noise sources effect all the receptors.
- 6.6. The intake louvre on the shop front is the critical noise source for the flats above. An attenuator has been specified to meet the local authority criteria.
- 6.7. The proposed plant does not affect Receptor R2, the flat above the car park entrance, due to the significant levels of screening offered by the building.
- 6.8. The proposed plant does not affect Receptor R4, the courtyard flat even assuming minimal screening through the car park.
- 6.9. Receptor R3, the hospital office building on Hathersage Road will not be affected by the proposed plant with an attenuator on the kitchen extract vent.
- 6.10. Levels in the carpark below the kitchen extract vent (Receptor R5) have been reduced below 50dBA with the inclusion of an attenuator.

- 6.11. It should be noted that only the cold store condensers will operate 24 hours a day. The plant is not anticipated to exhibit any tonal or impulsive characteristics provided it is well maintained. All proposed external plant will be inverter driven and, therefore, will gently ramp up and down depending on the demands on the various systems.

7.0 Summary

- 7.1. Noise Solutions Ltd (NSL) has been commissioned to provide a Noise Impact Assessment for the new plant serving a proposed restaurant located on Oxford Road, Manchester.
- 7.2. 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.
- 7.3. Cumulative plant noise emission levels for the proposed plant have been predicted, inclusive of mitigation measures, at the most affected noise sensitive receptors and assessed using the typical requirements of Manchester City Council and should therefore be acceptable
- 7.4. The assessment has demonstrated compliance with national and local policies. Therefore, noise from the plant proposals should not be a reason for refusal of planning permission

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 Aerial photograph site showing areas of interest

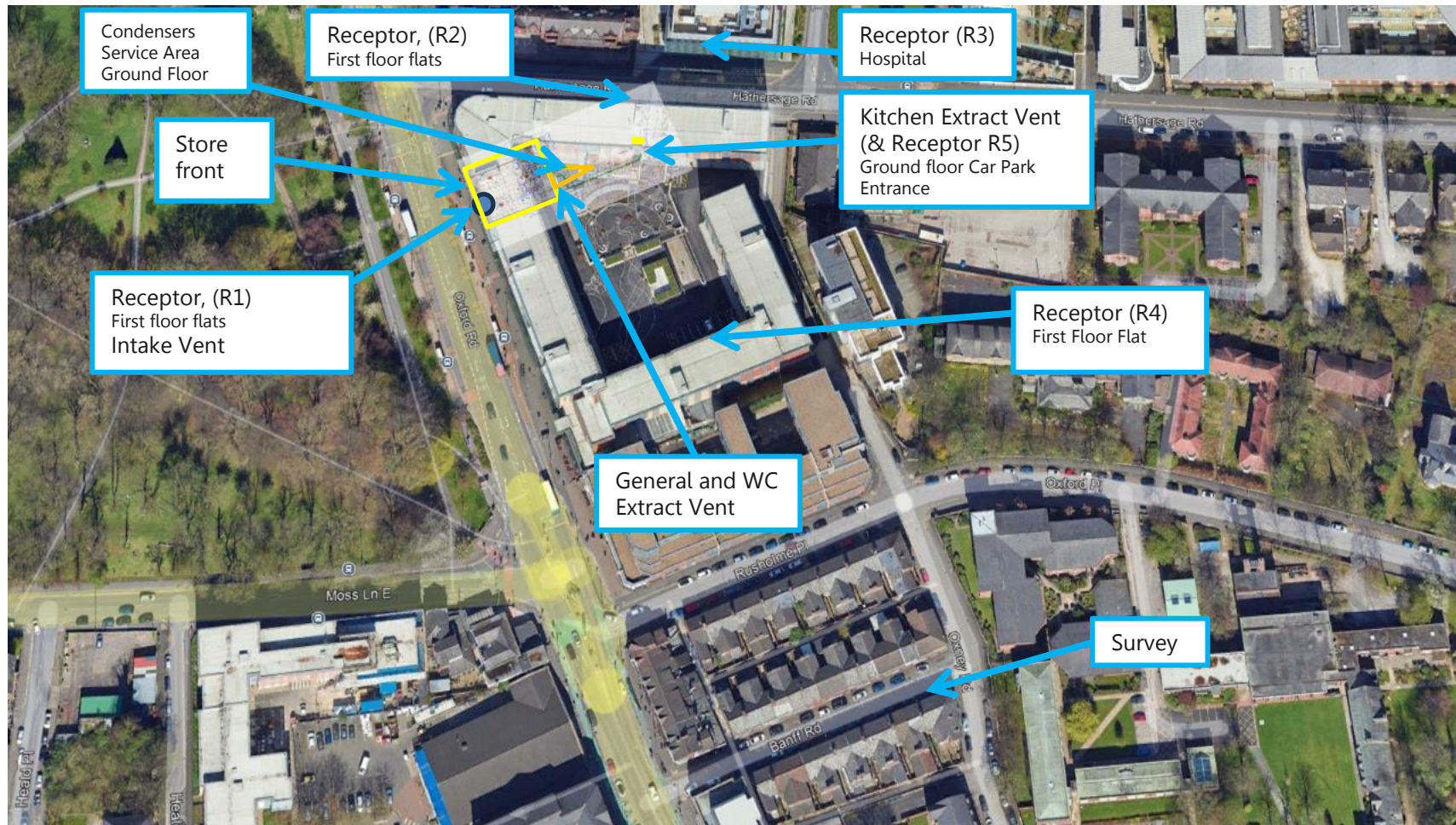


Figure showing the shop front on Oxford Road

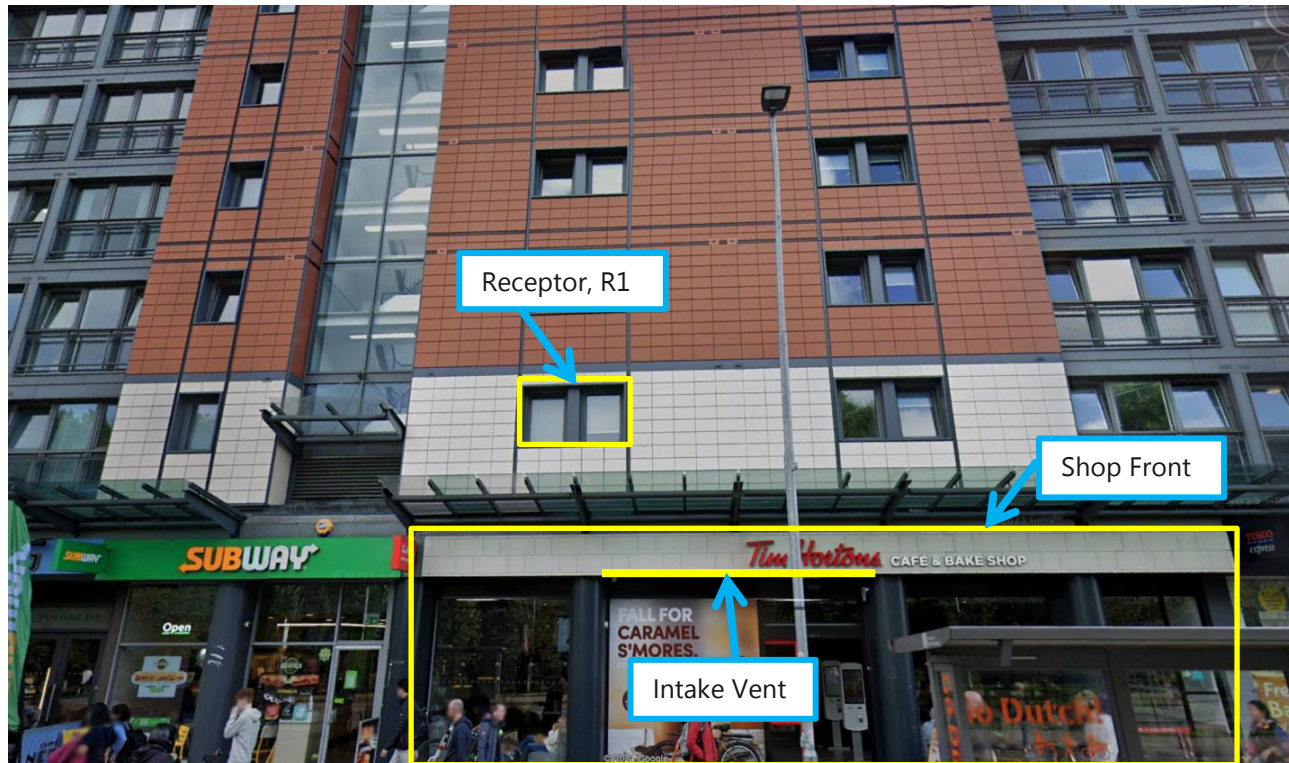
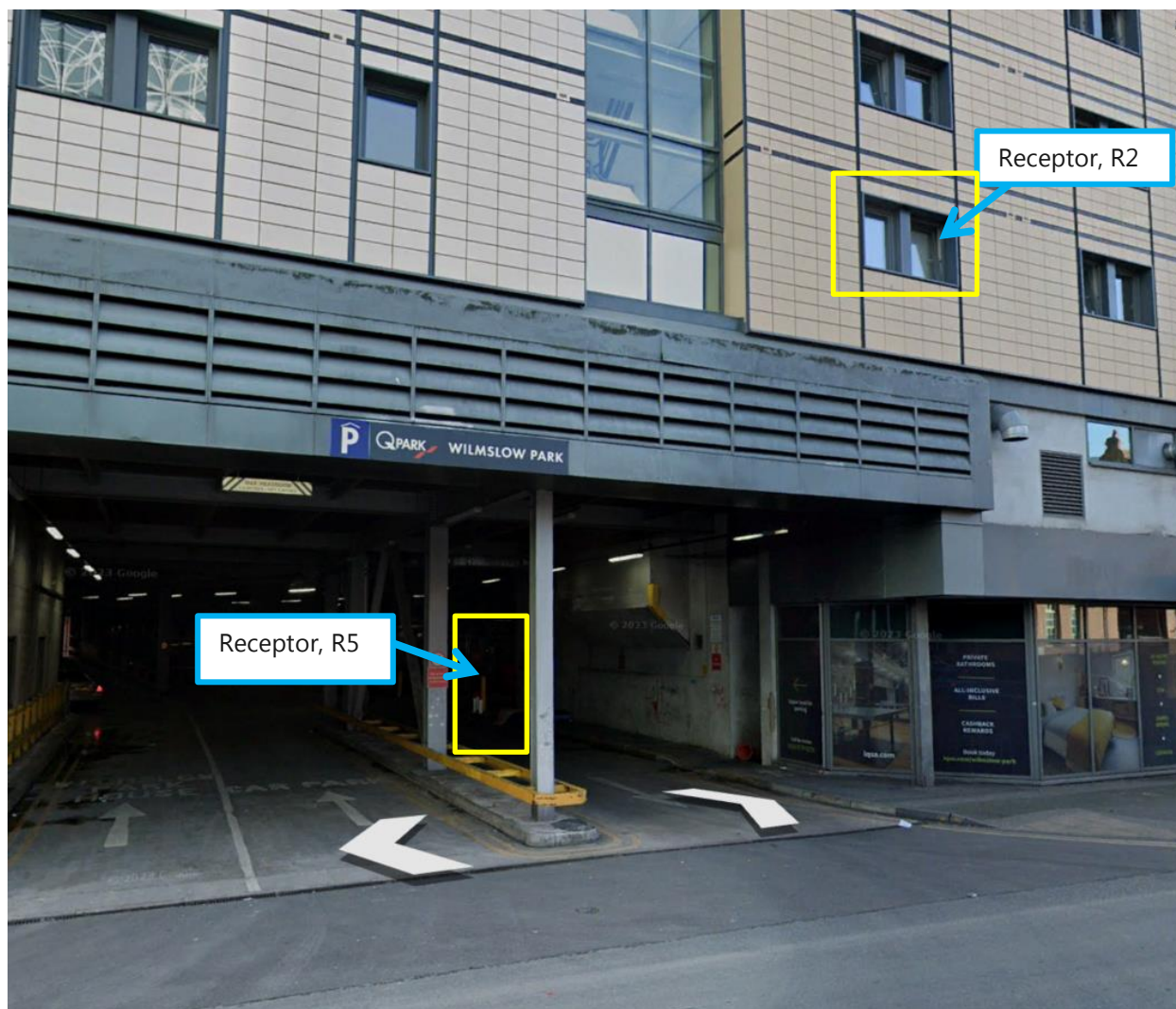
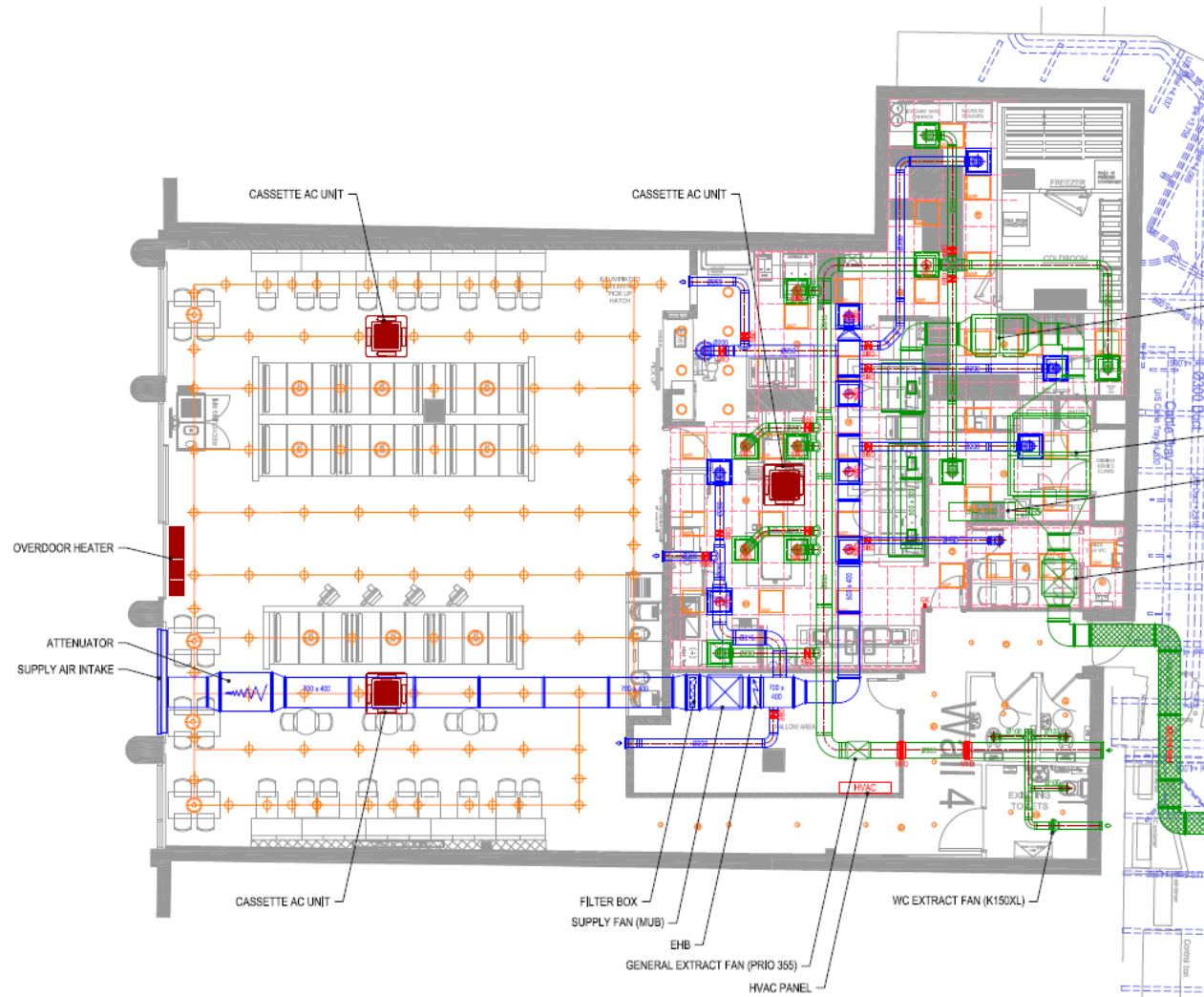


Figure showing the shop front on Hathersage Road

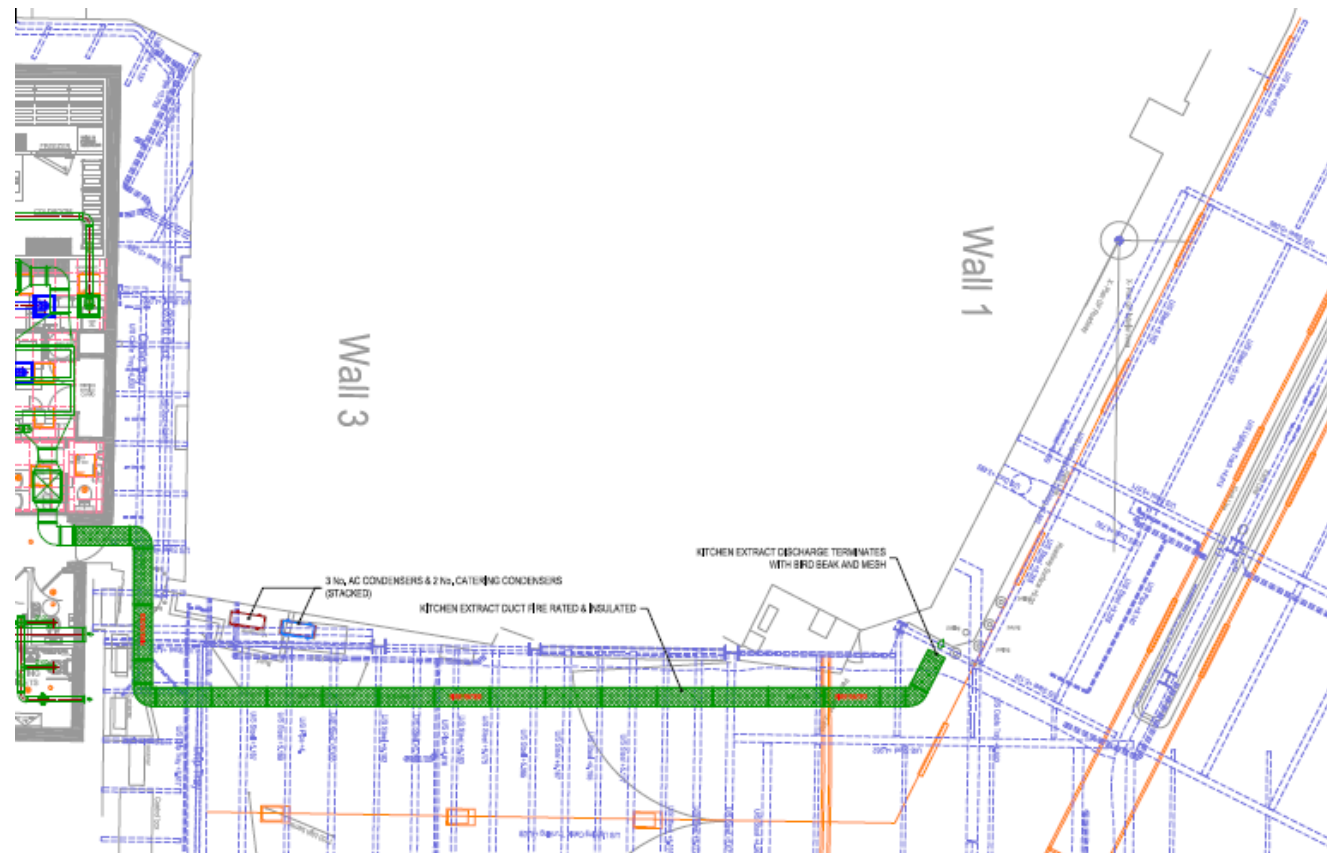


Appendix C Development Plans

Restaurant layout.



Service Area layout



Appendix D Environmental noise survey

Details of environmental sound survey

- D.1 Measurements of the existing environmental sound levels were undertaken between 11.00 hours on Thursday 26th September and 10.00 hours on Friday 27th September 2024.
- 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 fifteen-minute sample periods for the duration of the survey.

Measurement position

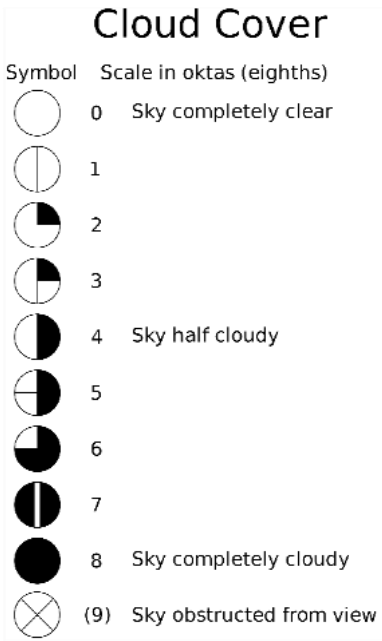
- D.3 The representative measurement position was located on a lamp post on Banff Road (location indicated on the site plan in Appendix B). This location is approximately representative of the levels of road traffic noise at the closest elevation of the building.
- D.4 The survey location was chosen such that the lowest background noise levels were similar to those at the nearest residential receptor (R1) but exclude any potential effect of noise from existing plant serving the store.

Equipment

- D.5 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	Svantek 977D / 99070	11/05/2023	Factory conformation certificate
Condenser microphone	Microtech MK255 / 25429		
Preamplifier	Svantek SV12L / 126981		
Calibrator	Rion NC-74 / 35094453	03/09/2024	1509491-1

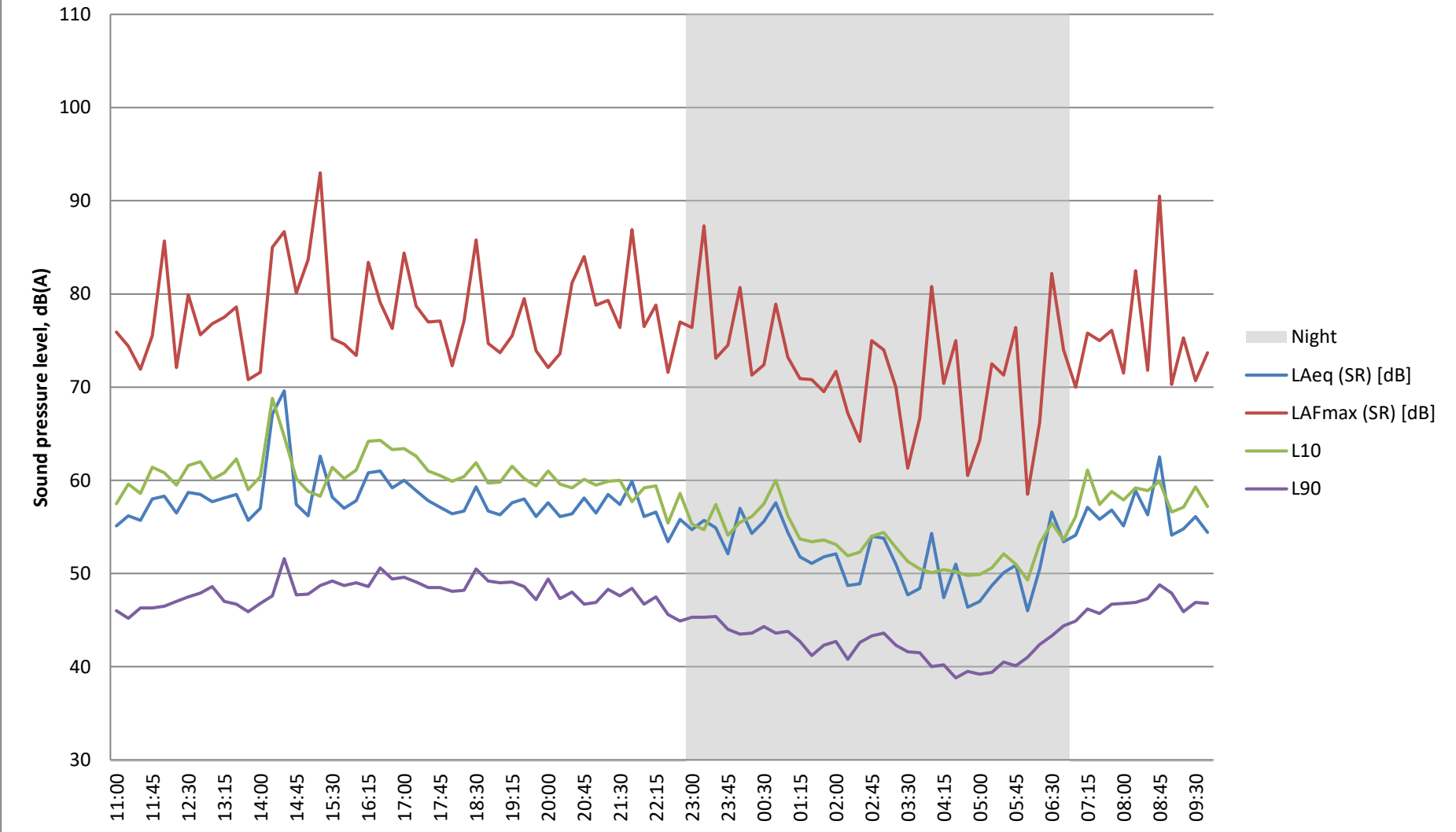
- D.6 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

Weather Conditions				
Measurement Location	Time/Date	Description	Beginning of Survey	End of Survey
As indicated on Appendix B	12.00 Tues 23 rd September -11.15 Wednesday 24 th September	Temperature (°C)	14	12
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:	Y	N
		Cloud cover (oktas – see guide)	8	2
		Presence of fog/snow/ice	N	N
		Presence of damp roads/wet ground	Y	N
		Wind Speed (m/s)	0.3	0.5
		Wind Direction	E	E
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	N	N

Results

- D.7 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 distant traffic with local road traffic, pedestrian and some construction noise. The results of the survey are presented in a time history graph overleaf.

Unit 7 Wilmslow Park, Oxford Road Thursday 26 - Friday 27 Sep 2024



Appendix E Equipment Manufacturer's Noise Data

Reference	Make/Model	No. of units	Notes	Octave band centre frequency, Hz							
				63	125	250	500	1000	2000	4000	8000
EF1	Systemair MUB/T-S 630D4	1	Discharge L _w	85	95	91	88	84	79	76	70
AHU1	Systemair MUB 560 D4 Multibox	1	Intake L _w	79	79	84	81	80	75	72	68
EF2	Systemair PRIO Duct Fan PRIO 355 EC	1	Discharge L _w	78	79	66	66	59	59	53	45
EF3	Systemair Duct FAN K 200 L	1	Discharge L _w	78	79	66	66	59	59	53	45

Reference	Make / Model	No. units	Sound level
CU1, CU2, CU3 Air Conditioning condenser	Toshiba RAV-GM1401ATP-E	3	57dBA at 1m each
CC1, CC2 Cold store condenser	Typical*	2	35dBA at 10m

*Model to be finalised. Sound pressure level at 10m is typical for catering condensing units used at similar restaurants

Appendix F Calculations

Intake Vent

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	79	84	81	80	75	72	68	84
System losses					-14	-10	-4	-2	-2	-2	-2	-2	
Atmospheric side attenuator				I.L.	-5	-9	-17	-25	-33	-27	-20	-12	
Sound power level leaving terminal					60	60	63	54	45	46	50	54	59
Receptor R1		V angle	H angle										
Directivity correction		15	90	2400 x 230 (15,90)	1	1	1	1	-4	-7	-7	-7	
Distance correction		5	m	5 m	-22	-22	-22	-22	-22	-22	-22	-22	
Screening correction		Screened:		$\delta =$	-5	0	0	0	0	0	0	0	
Surface corrections etc													
Resultant at Receptor R1				L_p	39	39	42	33	19	17	21	25	36

Kitchen Discharge

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	85	95	91	88	84	79	76	70	90	
System losses				-37	-33	-22	-9	-6	-6	-6	-6		
Atmospheric side attenuator			I.L.	-4	-6	-11	-18	-25	-20	-14	-9		
Sound power level leaving terminal				44	56	58	61	53	53	56	55	63	
Receptor R5		V angle	H angle										
Directivity correction		90	0	500 x 300 (90,0)	0	0	0	0	-4	-7	-7	-7	
Distance correction		3	m	3 m	-18	-18	-18	-18	-18	-18	-18	-18	
Screening correction		Screened:		δ=	-3	0	0	0	0	0	0	0	
Surface corrections etc													
Resultant at Receptor R5				L _p	26	38	40	43	31	28	31	30	42
Receptor R2		V angle	H angle										
Directivity correction		45	0	500 x 300 (45,0)	1	2	2	3	3	4	4	4	
Distance correction		18	m	18 m	-33	-33	-33	-33	-33	-33	-33	-33	
Screening correction		Screened:	25	δ=	7	-17	-20	-23	-26	-29	-32	-35	-38
Surface corrections etc													
Resultant at Receptor R2				L _p	-5	5	4	5	-6	-8	-8	-12	4
Receptor R3		V angle	H angle										
Directivity correction		0	0	500 x 300 (0,0)	1	2	3	4	5	6	6	6	
Distance correction		36	m	36 m	-39	-39	-39	-39	-39	-39	-39	-39	
Screening correction		Screened:		δ=	-36	0	0	0	0	0	0	0	
Surface corrections etc													
Resultant at Receptor R3				L _p	6	19	22	26	19	20	23	22	29
Receptor R4		V angle	H angle										
Directivity correction		10	180	500 x 300 (10,180)	-1	-2	-3	-7	-9	-8	-8	-8	
Distance correction		65	m	65 m	-44	-44	-44	-44	-44	-44	-44	-44	
Screening correction		Screened:		δ=	-65	0	0	0	0	0	0	0	
Surface corrections etc													
Resultant at Receptor R4				L _p	-1	10	11	10	0	1	4	3	12

General Discharge

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	78	79	66	66	59	59	53	45	68
System losses				-1	-1	-1	-1	-1	-1	-1	-1	
Atmospheric side attenuator			I.L.	0	0	0	0	0	0	0	0	
Sound power level leaving terminal				77	78	65	65	58	58	52	44	67
Receptor R5			V angle	H angle								
Directivity correction	0	0		0 x 0 (0,0)	1	2	3	4	5	6	6	
Distance correction	28	m		28 m	-37	-37	-37	-37	-37	-37	-37	
Screening correction	Screened:		δ=	-28	0	0	0	0	0	0	0	
Surface corrections etc												
Resultant at Receptor R5				L _p	41	43	31	32	26	27	21	34
Receptor R2			V angle	H angle								
Directivity correction	15	45		0 x 0 (15,45)	1	2	2	3	3	4	4	
Distance correction	38	m		38 m	-40	-40	-40	-40	-40	-40	-40	
Screening correction	Screened:	46	δ=	8	-18	-21	-24	-27	-30	-33	-36	-39
Surface corrections etc												
Resultant at Receptor R2				L _p	20	19	3	1	-9	-11	-20	5
Receptor R3			V angle	H angle								
Directivity correction	0	45		0 x 0 (0,45)	1	2	2	3	3	4	4	
Distance correction	58	m		58 m	-43	-43	-43	-43	-43	-43	-43	
Screening correction	Screened:	63	δ=	5	-16	-19	-22	-25	-28	-31	-34	-37
Surface corrections etc												
Resultant at Receptor R3				L _p	19	18	2	0	-10	-12	-21	4
Receptor R4			V angle	H angle								
Directivity correction	5	45		0 x 0 (5,45)	1	2	2	3	3	4	4	
Distance correction	68	m		68 m	-45	-45	-45	-45	-45	-45	-45	
Screening correction	Screened:	75	δ=	7	-17	-20	-23	-26	-29	-32	-35	-38
Surface corrections etc												
Resultant at Receptor R4				L _p	16	15	-1	-3	-13	-15	-24	1

WC Discharge

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	78	79	66	66	59	59	53	45	68	
System losses					0	0	0	0	0	0	0	0		
Atmospheric side attenuator				I.L.	0	0	0	0	0	0	0	0		
Sound power level leaving terminal					78	79	66	66	59	59	53	45	68	
Receptor R5		V angle	H angle											
Directivity correction		0	0		0 x 0 (0,0)	1	2	3	4	5	6	6		
Distance correction		28	m		28 m	-37	-37	-37	-37	-37	-37	-37		
Screening correction		Screened:		δ=	-28	0	0	0	0	0	0	0		
Surface corrections etc														
Resultant at Receptor R5					L _p	42	44	32	33	27	28	22	14	35
Receptor R2		V angle	H angle											
Directivity correction		15	45		0 x 0 (15,45)	1	2	2	3	3	4	4	4	
Distance correction		38	m		38 m	-40	-40	-40	-40	-40	-40	-40	-40	
Screening correction		Screened:	46	δ=	8	-18	-21	-24	-27	-30	-33	-36	-39	
Surface corrections etc														
Resultant at Receptor R2					L _p	21	20	4	2	-8	-10	-19	-30	6
Receptor R3		V angle	H angle											
Directivity correction		0	45		0 x 0 (0,45)	1	2	2	3	3	4	4	4	
Distance correction		58	m		58 m	-43	-43	-43	-43	-43	-43	-43	-43	
Screening correction		Screened:	63	δ=	5	-16	-19	-22	-25	-28	-31	-34	-37	
Surface corrections etc														
Resultant at Receptor R3					L _p	20	19	3	1	-9	-11	-20	-31	5
Receptor R4		V angle	H angle											
Directivity correction		5	45		0 x 0 (5,45)	1	2	2	3	3	4	4	4	
Distance correction		68	m		68 m	-45	-45	-45	-45	-45	-45	-45	-45	
Screening correction		Screened:	75	δ=	7	-17	-20	-23	-26	-29	-32	-35	-38	
Surface corrections etc														
Resultant at Receptor R4					L _p	17	16	0	-2	-12	-14	-23	-34	2

Condenser Contributions

F.1 To Receptor R2

Unit	Make / Model	Source Sound Level		Distance Correction		Directivity	Screening	Sound pressure level at Receptor, dBA
		L _{pA}	at / m	m	dB			
CU1	Toshiba RAV-GM1401ATP-E	57	1	32	-30	3	-12	18
CU2	Toshiba RAV-GM1401ATP-E	57	1	32	-30	3	-12	18
CU3	Toshiba RAV-GM1401ATP-E	57	1	32	-30	3	-12	18
CC1	Cold store condenser	35	10	32	-10	3	-12	16
CC2	Cold store condenser	35	10	32	-10	3	-12	16

F.2 To Receptor R3

Unit	Make / Model	Source Sound Level		Distance Correction		Directivity	Screening	Sound pressure level at Receptor, dBA
		L _{pA}	at / m	m	dB			
CU1	Toshiba RAV-GM1401ATP-E	57	1	51	-34	3	-12	14
CU2	Toshiba RAV-GM1401ATP-E	57	1	51	-34	3	-12	14
CU3	Toshiba RAV-GM1401ATP-E	57	1	51	-34	3	-12	14
CC1	Cold store condenser	35	10	51	-14	3	-12	12
CC2	Cold store condenser	35	10	51	-14	3	-12	12

F.3 To Receptor R4

Unit	Make / Model	Source Sound Level		Distance Correction		Directivity	Screening	Sound pressure level at Receptor, dBA
		L _{pA}	at / m	m	dB			
CU1	Toshiba RAV-GM1401ATP-E	57	1	68	-37	3	0	23
CU2	Toshiba RAV-GM1401ATP-E	57	1	68	-37	3	0	23
CU3	Toshiba RAV-GM1401ATP-E	57	1	68	-37	3	0	23
CC1	Cold store condenser	35	10	68	-17	3	0	21
CC2	Cold store condenser	35	10	68	-17	3	0	21

F.4 To Receptor R5

Unit	Make / Model	Source Sound Level		Distance Correction		Directivity	Screening	Sound pressure level at Receptor, dBA
		L _{pA}	at / m	m	dB			
CU1	Toshiba RAV-GM1401ATP-E	57	1	20	-26	6	0	37
CU2	Toshiba RAV-GM1401ATP-E	57	1	20	-26	6	0	37
CU3	Toshiba RAV-GM1401ATP-E	57	1	20	-26	6	0	37
CC1	Cold store condenser	35	10	20	-6	6	0	35
CC2	Cold store condenser	35	10	20	-6	6	0	35

Summary

Plant	Resultant at Receptor (dBA)				
	R1	R2	R3	R4	R5
AHU1 Intake	36	-	-	-	-
EF1 Kitchen Extract Discharge	-	4	29	12	42
EF2 General Extract Discharge	-	5	4	1	34
EF3 WC Extract Discharge	-	6	5	2	35
CU1 AC Condenser	-	18	14	23	37
CU2 AC Condenser	-	18	14	23	37
CU3 AC Condenser	-	18	14	23	37
CC1 Cold Store Condenser	-	16	12	21	35
CC2 Cold Store Condenser	-	16	12	21	35
DAYTIME – ALL PLANT RUNNING					
Combined L_{Aeq}	36	24	30	29	46
BS 4142:2014 feature correction	3	3	n/a	3	n/a
Rating level at receptor, L_{Ar,Tr}	39	27	30*	32	46*
NIGHT-TIME – COLD STORE CONDENSERS ONLY RUNNING					
Combined L_{Aeq}	-	19	15	24	38
BS 4142:2014 feature correction	-	3	n/a	3	n/a
Rating level at receptor, L_{Ar,Tr}	-	22	15*	27	38*

**Specific sound level, dB LAeq*