

The Co-operative
201 London Road
Reading
RG1 3NU

**Plant Noise
Impact Assessment**

On behalf of



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Contents

1.0	Introduction	1
2.0	Details of development proposals.....	1
3.0	Nearest noise sensitive receptors	1
4.0	Existing noise climate	1
5.0	Plant noise design criteria	3
	Reading Borough Council.....	3
	BS 4142:2014 'Methods for Rating and Measuring Industrial and Commercial Sound;	4
	Proposed criteria	6
6.0	Plant noise impact assessment.....	6
7.0	Summary	8

Appendices

Appendix A	Acoustic terminology
Appendix B	Aerial photograph site showing areas of interest
Appendix C	Environmental sound survey
Appendix D	Drawings showing proposed plant layout
Appendix E	Plant information and manufacturer published sound pressure levels
Appendix F	Summary calculations
Appendix G	Plantroom calculations

Executive Summary

Noise Solutions Ltd (NSL) has been commissioned by Upland's Retail to undertake a noise impact assessment for proposed replacement plant serving an existing Co-op store on London Road in Reading.

The results of the assessment demonstrate that cumulative plant noise emissions will comply with the proposed noise limits, which have been established in line with typical noise conditions set by the local authority, provided the attenuators specified in this report are installed.

Plant noise therefore should not be a reason for refusal of planning permission.

1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned by Uplands Construction to provide a noise impact assessment for plant serving an existing Co-operative store located on London Road in Reading.
- 1.2. An environmental sound survey has been undertaken to establish the prevailing background sound pressure levels at a location representative of 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 against standard criteria set by the local authority.
- 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 Co-op food store is located at 201 London Road, Reading.
- 2.2. The replacement plant will be in the same location as the existing plant, in an internal plantroom at the rear of the store. Air will intake to and discharge from the plantroom through louvres on the northern side of the store. In addition, there will be a single refrigeration condensing unit located on the rear of the store.

3.0 Nearest noise sensitive receptors

- 3.1. The area surrounding the site is predominantly residential in nature. The nearest noise sensitive property to the plantroom louvres, receptor R1, will be the house on Cumberland Road, approximately 16m away from the plantroom louvres.
- 3.2. A site plan showing the site and surrounding area, the nearest noise sensitive properties and noise monitoring location used in this assessment is presented in **Appendix B**.

4.0 Existing noise climate

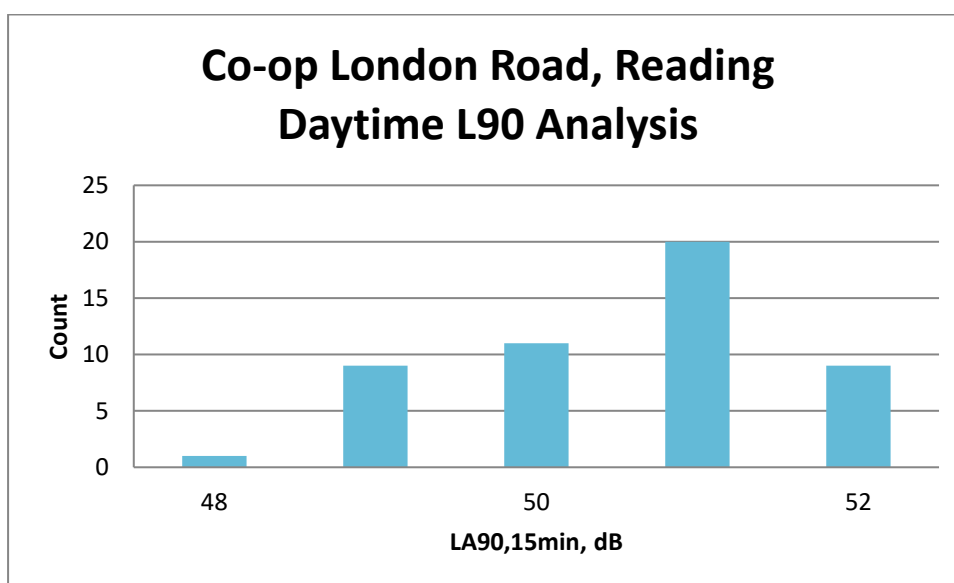
- 4.1. An environmental noise survey was undertaken to establish the typical background sound levels at a location representative of the noise climate outside the façades of the nearest noise sensitive receptors to the proposed plant area during the quietest times at which the plant will operate.

- 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 C](#).

Table 1 Summary of survey results

Measurement period	Range of recorded sound pressure levels (dB)			
	L _{Aeq} (15mins)	L _{AFmax} (15mins)	L _{A10} (15mins)	L _{A90} (15mins)
Daytime (07.00 – 23.00 hours)	52-67	66-93	54-62	48-52
Night-time (23.00 – 07.00 hours)	48-54	61-77	50-56	45-49

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



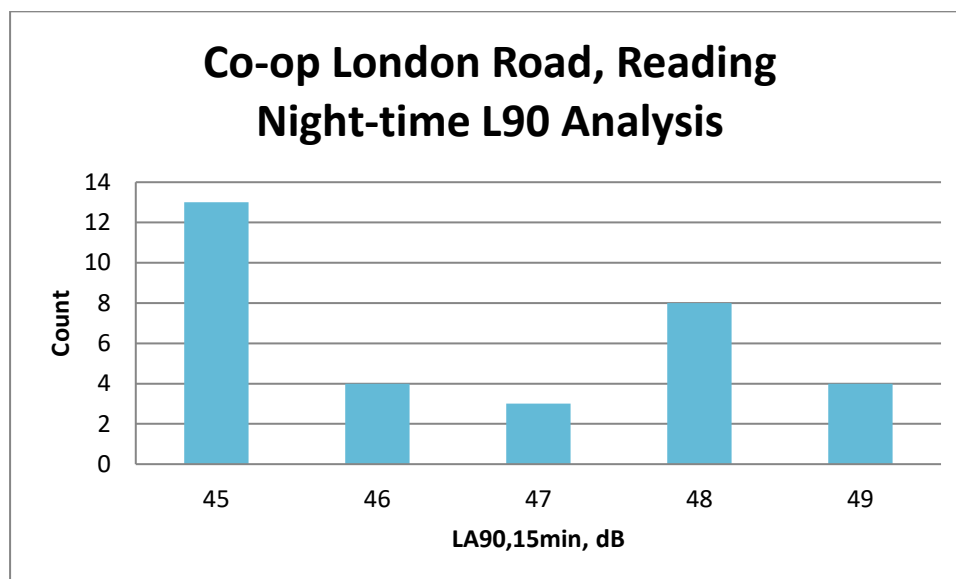
- 4.3. Further statistical analysis has been carried out on the data, and the mean and median values are shown in table 2 below.

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

dB, L _{A90} daytime period	
mean	50
modal	51
median	51

- 4.4. In order to be robust, 49dB has been selected to be representative of the background noise level during the daytime period.

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



- 4.5. Further statistical analysis has been carried out on the data and the mean 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	47
modal	45
median	46

- 4.6. The lowest recorded value of 45 dB has been selected to be representative of the background noise climate during the night-time period.
- 4.7. Therefore, the following values are considered representative of the existing background sound pressure levels at nearby noise sensitive premises:
- 49dB L_{A90} during the daytime period; and
 - 45dB L_{A90} during the night-time period

5.0 Plant noise design criteria

Reading Borough Council

- 5.1. The below is taken from a planning condition involving noise for a similar site in the jurisdiction of Reading Borough Council.

The rating level of the plant/equipment hereby approved, $L_{Ar,Tr}$ (specific sound level plus any adjustment for the characteristic features of the sound) as measured at a point 1 metre

external to sensitive facades, shall be at least 10dB below the existing background sound level, LA90,T when all plant/equipment (or any part of it) is in operation.

Reason: To safeguard the amenities of the adjoining premises and the area generally, in accordance with Policy CS34 of the Reading Borough LDF Core Strategy 2008 (Altered 2015) and Policy DM4 of the Reading Borough LDF Sites and Detailed Policies Document 2012 (Altered 2015).

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

- 5.2. 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.
- 5.3. The industrial or commercial sound is assessed outside a dwelling or premises used for residential purposes, upon which sound is incident.
- 5.4. 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.
- 5.5. 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.
- 5.6. 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."

- 5.7. 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."
- 5.8. 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."*
- 5.9. 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."*
- 5.10. 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."
- 5.11. 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."*
- 5.12. 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

- 5.13. In order to comply with the local authority criteria outlined above, the plant noise rating levels should not exceed the limits specified in Table 4 below.

Table 4 Plant noise emissions limits at residences

Period	Cumulative plant noise rating level, dB(A)
Daytime (07.00 – 23.00 hours)	39
Night-time (23.00 – 07.00 hours)	35

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

6.0 Plant noise impact assessment

- 6.1. The cumulative plant noise levels at the nearest noise sensitive receptors have been predicted. The assessment has considered the reverberant conditions within the plantroom, the aperture size, directivity, existing screening between source and receivers and distance attenuation. The predictions are inclusive of the losses due to attenuators with the following acoustic performances:

Table 1 Insertion losses (dB) for plantroom attenuators at octave band centre frequencies (Hz)

Attenuator	Insertion losses dB, at octave band centre frequencies (Hz)							
	63	125	250	500	1k	2k	4k	8k
Plantroom Intake	6	13	26	41	45	45	43	36
Plantroom Discharge	8	16	29	42	45	45	45	39

- 6.2. The predictions during the daytime and night-time period have been based on the proposed refrigeration plant operating at full capacity.
- 6.3. 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...".
- 6.4. Table 2 summarises the results of the assessment at the most affected property. All other nearby receptors benefit from increased distance/screening to the plant such that resultant noise levels will be lower than at the receptor considered. The full set of calculations can be found in [Appendix F](#).

Table 2 Assessment of predicted noise levels at the nearest noise sensitive receptors

Receptor	Period	Predicted rating level at receptor, L_{Aeq} (dB)	Design criterion (dB)	Difference (dB)
R1. Residential	Daytime (07.00 - 23.00 hours)	37	39	-2
	Night-time (23.00 - 07.00 hours)	35	35	0

- 6.5. The noise level predictions demonstrate that cumulative noise emissions from the proposed plantroom will comply with the planning condition at the nearest noise sensitive properties, inclusive of suitable attenuators being fitted to the plantroom apertures.
- 6.6. As BS 4142:2014 advises, the impact must be considered within the context of the site and the surrounding acoustic environment. The following must, therefore, 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 all 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 plant room is in the same location as the existing. Therefore there is already a precedent for refrigeration plant in this area.
- 6.7. 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 residential dwellings and not in positions where higher noise levels were present.

7.0 Summary

- 7.1. Noise Solutions Ltd has been commissioned by Uplands Construction to provide a noise impact assessment noise emissions for replacement plant serving a Co-operative store located on London Road in Reading.
- 7.2. An environmental noise survey has been undertaken to establish the existing prevailing noise levels at a location representative of the nearest noise sensitive receptors to the plant room.
- 7.3. The cumulative plant noise emission levels for the proposed plant (incorporating noise control measures) have been predicted at the most affected noise sensitive receptor location and assessed based on typical criteria from Reading Borough Council.
- 7.4. Mitigation measures in the form of suitable attenuators fitted to the plantroom apertures will be required.
- 7.5. Noise from the plant proposals as noted in this report 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



Appendix C Environmental sound survey

Details of sound surveys

- C.1 Measurements of the existing background sound levels were undertaken between 13:30 hours on Monday 7th October and 09:30 hours on Tuesday 9th October 2019.
- C.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 15-minute sample periods for the duration of the noise survey.

Measurement position

- C.3 The representative measurement position was located on a lamppost on Cumberland Road in an area representative of the nearest noise sensitive receptor (location indicated on the site plan in [Appendix B](#)).
- C.4 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

- C.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.

Environmental noise survey

Description	Model / serial no.	Calibration date	Calibration certificate no.
Class 1 Sound level meter	Svantek 977 / 36190	06/07/2018	15444
Condenser microphone	ACO Pacific 7052E / 57366		
Preamplifier	Svantek SV12L / 41504		
Calibrator	CEL 284/2 /4/03326334	24/05/2019	TCRT19/1408

Weather conditions

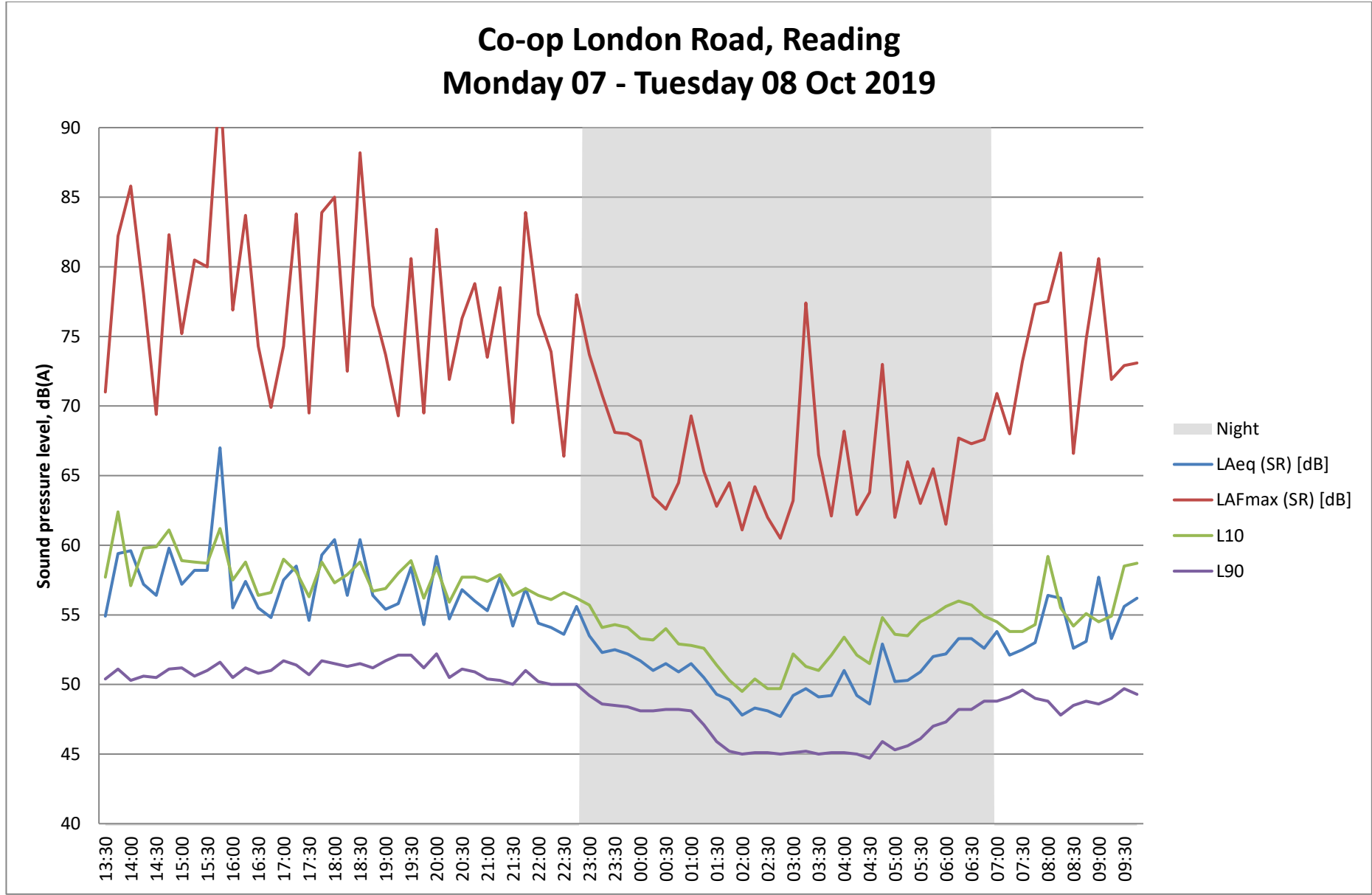
- C.6 Weather conditions were determined both at the start and on completion of the survey. It is considered that the meteorological conditions were appropriate for environmental noise measurements. The table below presents the weather conditions recorded on site at the beginning and end of the survey.

Weather Conditions				
Measurement Location	Date/Time	Description	Beginning of Survey	End of Survey
As indicated on Appendix B	13:30 07/10/2019 – 09:30 08/10/2019	Temperature (°C)	15	15
		Precipitation:	Low	No
		Cloud cover (oktas - see guide)	8	7
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Damp	Damp
		Wind Speed (m/s)	2	<1
		Wind Direction	South East	South East
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No
		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		

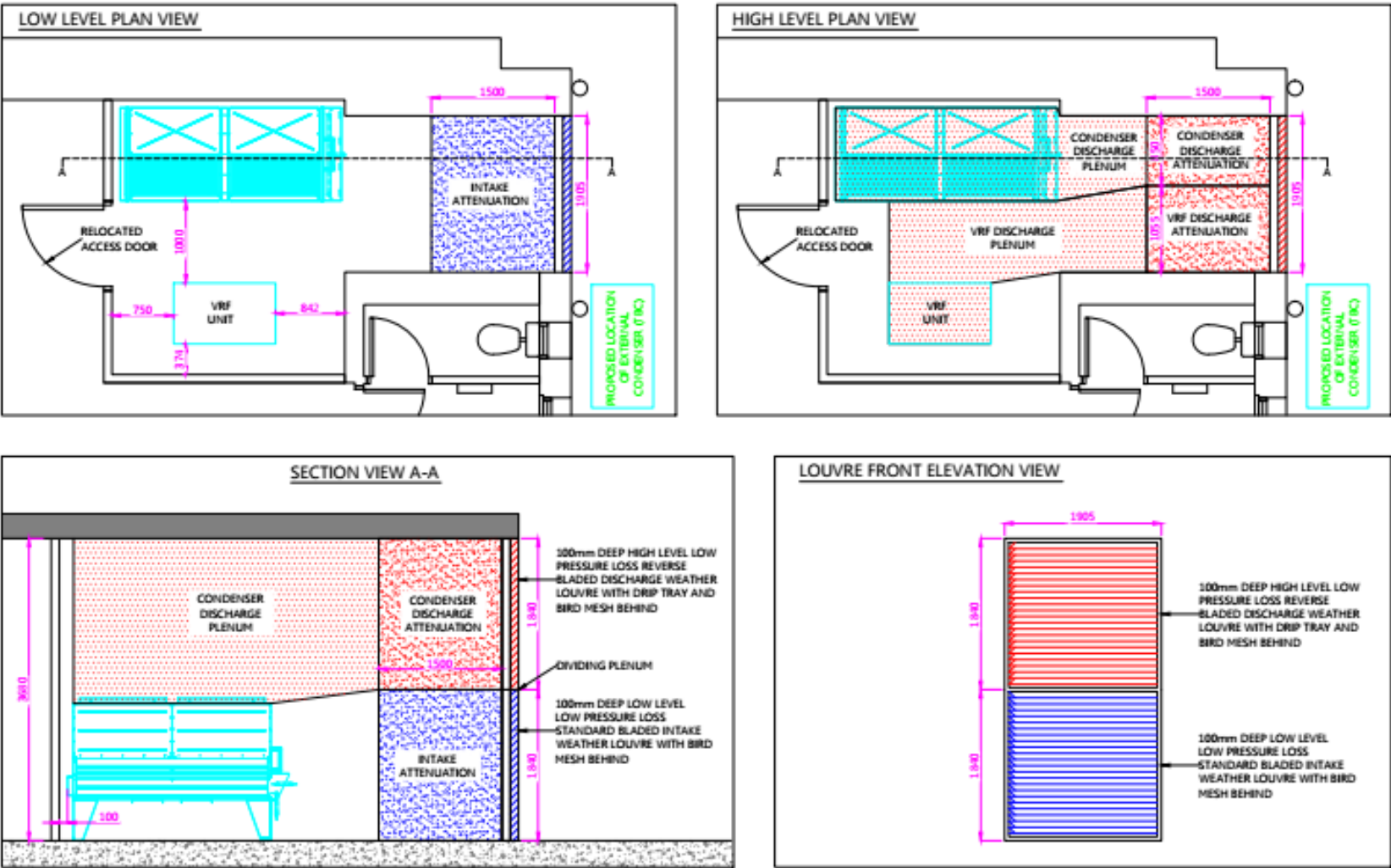
Results

- C.7 The results of the environmental survey are considered to be representative of the background sound pressure levels at the façades of the nearest noise sensitive receptors during the quietest times at which the plant will operate. The noise climate during the survey period was dominated by traffic noise on the High Street, occasional traffic on Cumberland Way and plant noise from the chip shop. The results of the survey are presented in a time history graph overleaf.

Co-op London Road, Reading Monday 07 - Tuesday 08 Oct 2019



Appendix D Drawings showing proposed plant layout



Appendix E Plant information and manufacturer published sound pressure levels

Plant item	Unit / Model	Period	Notes	Sound power level (dB) at octave band centre frequencies (Hz)								dBA
				63	125	250	500	1000	2000	4000	8000	
Condenser	Kelvion/ GE-MA102G4/5677439	All hours	L _w	85	85	81	74	74	72	68	64	80
AC Unit	Mitsubishi/PUHY-P350YNW-A	Daytime only	L _w	83	83	83	81	76	72.5	72	66	80
Refrigeration condenser	RC Scutt/Slimline QL-45-ZF09EC	Daytime	L _p at 10m									29
		Night-time	L _p at 10m									19

Receptor R1 daytime period

Receptor R1 Night-time period

Plant Item	Sound pressure level	at distance	Distance correction		Directivity dB	Acoustic Screening dB	BS4142 Penalty dB	Rating level at façade L _{Aeq} (dB)
	dBA	m	m	dB				
Refrigeration Condenser	19	10	16	-4	3	0	3	21
Plantroom	See Appendix G							35
						Cumulative Daytime		35

Appendix G Plantroom calculations

Daytime

Description	Notes	Leq (dB)								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Intake										
Reverberant level in plant room	Rev Lp	88	88	85	80	75	71	69	64	83
All plant running										
Opening area (m2)	3.50	5	5	5	5	5	5	5	5	
SRI of opening	I.L	-6	-13	-26	-41	-45	-45	-43	-36	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	82	75	59	39	30	26	25	27	61
R1										
Directivity correction	(1900,0deg x 1840,45deg)	2	3	3	4	4	4	4	4	
Distance correction (m)	16	-32	-32	-32	-32	-32	-32	-32	-32	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	54	48	33	14	5	1	0	2	34
Discharge										
Condenser Discharge										
Sound power	Lw	88	88	84	77	77	75	71	67	83
End reflection	1.564	-1	0	0	0	0	0	0	0	
SRI of opening	I.L	-8	-16	-29	-42	-45	-45	-45	-39	
Lw of opening		79	72	55	35	32	30	26	28	58
R1										
Directivity correction	(850,0deg x 1840,45deg)	1	2	2	3	4	4	4	4	
Distance correction (m)	16	-32	-32	-32	-32	-32	-32	-32	-32	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	51	45	28	9	6	5	1	3	31

Description	Notes	Leq (dB)								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
AC Unit Discharge										
Sound power	Lw	83	83	83	81	76	73	72	66	83
End reflection	1.932	-3	-1	0	0	0	0	0	0	
SRI of opening	I.L	-8	-16	-29	-42	-45	-45	-45	-39	
Lw of opening		72	66	54	39	31	28	27	27	52
R1										
Directivity correction	(1050,0deg x 1840,45deg)	2	2	3	4	4	4	4	4	
Distance correction (m)	16	-32	-32	-32	-32	-32	-32	-32	-32	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	44	39	28	13	6	2	2	2	26

SUMMARY

Receptor R1

Intake
Condenser Discharge
VRV Discharge

Cumulative

63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
------	-------	-------	-------	--------	--------	--------	--------

54	48	33	14	5	1	0	2	34
51	45	28	9	6	5	1	3	31
44	39	28	13	6	2	2	2	26
56	50	35	17	11	8	6	7	36

Night-time

Description	Notes	Leq (dB)								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
Plant room										
Intake										
Reverberant level in plant room	Rev Lp	87	87	83	75	73	69	65	61	80
All plant running										
Opening area (m2)	3.5	5	5	5	5	5	5	5	5	
SRI of opening	I.L	-6	-13	-26	-41	-45	-45	-43	-36	
Inside-outside correction		-6	-6	-6	-6	-6	-6	-6	-6	
Lw of opening	Lw	80	73	56	33	27	24	22	25	59
R1										
Directivity correction	(1900,0deg x 1840,45deg)	2	3	3	4	4	4	4	4	
Distance correction (m)	16.0	-32	-32	-32	-32	-32	-32	-32	-32	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	53	47	31	8	2	-1	-3	0	33
Discharge										
Condenser Discharge										
Sound power	Lw	88	88	84	77	77	75	71	67	83
End reflection	1.6	-1	0	0	0	0	0	0	0	
SRI of opening	I.L	-8	-16	-29	-42	-45	-45	-45	-39	
Lw of opening		79	72	55	35	32	30	26	28	58
R1										
Directivity correction	(850,0deg x 1840,45deg)	1	2	2	3	4	4	4	4	
Distance correction (m)	16.0	-32	-32	-32	-32	-32	-32	-32	-32	
Surface Directivity		0	0	0	0	0	0	0	0	
BS4142		3	3	3	3	3	3	3	3	
Resultant at receptor R1	Lp @ R1	51	45	28	9	6	5	1	3	31

Description	Notes	Leq (dB)								LAeq (dB)
		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
SUMMARY		63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	
	Receptor R1									
	Intake	53	47	31	8	2	-1	-3	0	33
	Condenser Discharge	51	45	28	9	6	5	1	3	31
	Cumulative	55	49	33	12	8	6	2	5	35