

The Co-operative
Dearnside Petrol Filling Station
The Cross
Silkstone
Barnsley
S75 4LX

Plant Noise Impact Assessment

On behalf of

space.
engineering services

Project Reference: 88916 | Revision: 00 | Date: 14th November 2019

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Document Information

Project Name : **The Co-operative, Dearnside Petrol Station**
Project Reference : **88916**
Report Title : **Plant Noise Impact Assessment**
Doc Reference : **88916/NIA**
Date : **14th November 2019**

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Revision	Date	Description	Prepared	Reviewed/ Approved

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Executive Summary

Noise Solutions Limited has undertaken a noise impact assessment of new plant to be installed at the existing Co-operative store at Dearnside petrol filling station in Silkstone.

New plant is to be located externally adjacent to the east elevation of the main store building.

The assessment shows that noise from the new plant at the nearest residential receptors will be significantly below the existing background sound level and should therefore be acceptable to the local authority.

1.0 Introduction

- 1.1. Noise Solutions Ltd (NSL) has been commissioned by Space Engineering to provide a noise impact assessment of new plant serving the existing Co-operative store located at Dearnside petrol station at The Cross, Silkstone.
- 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 sound levels due to the new plant have been predicted at the nearest noise-sensitive receptors and assessed against the local authority's usual requirements and other recognised standard and guidance.
- 1.4. A glossary of acoustic terminology is given in [Appendix A](#).

2.0 Details of development proposals

- 2.1. The filling station and Co-operative store are located on the south side of the A628 Barnsley Road. The store occupies a standalone building with store offices etc. in a first floor extension.
- 2.2. It is proposed to replace the existing refrigeration plant serving the store and install new air conditioning (AC) units. Currently the plant is located adjacent to the east elevation of the main part of the store building. New plant will be in the same location and will comprise three AC units and a refrigeration pack and gas cooler.
- 2.3. The proposed refrigeration plant will potentially operate 24 hours a day, although it should be noted that these units operate as required to meet demand and generally at a reduced capacity at night. The AC units will operate only during store opening hours (05.00 hours to midnight, daily).
- 2.4. Plant noise data is shown in [0](#); the location of the proposed plant is shown in [Appendix D](#).

3.0 Nearest noise sensitive receptors

- 3.1. The nearest noise sensitive properties to the store are to the west along Barnsley Road (Receptor R1) and to the east on The Cross (Receptor R2).
- 3.2. The closest house to the west of the store (R1) is approximately 45m from the plant area but screened from it by the store building. The houses to the east of the store (R2) are approximately 40m from the plant area.

- 3.3. A community centre and playing field (Receptor R3) are located to the south of the store. The community centre is approximately 16m from the plant but screened from it by the store building.
- 3.4. **Appendix B** contains an aerial photograph showing the site and surrounding area.

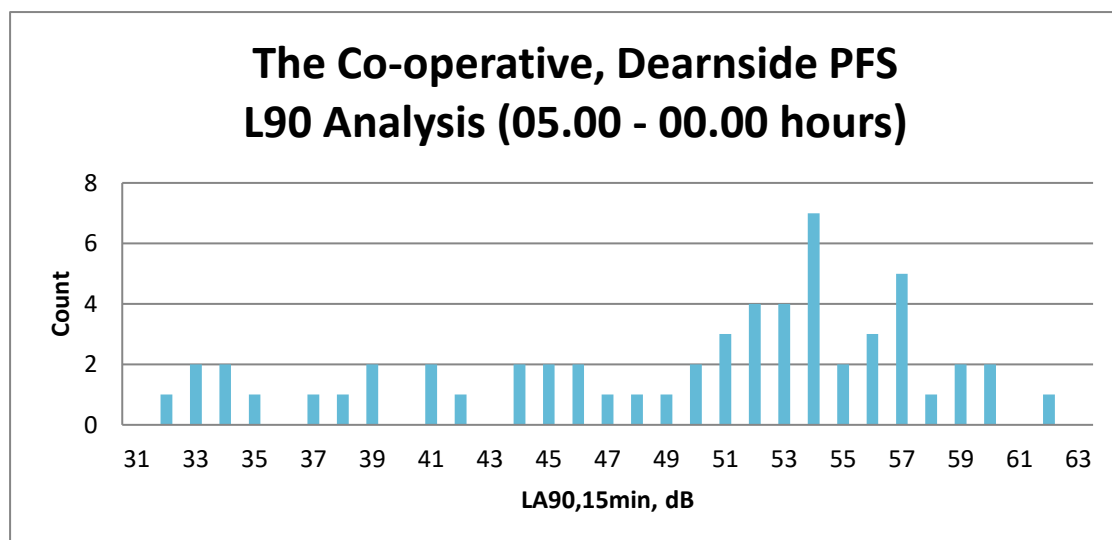
4.0 Existing noise climate

- 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 _{Amax} (15mins)	L _{A10} (15mins)	L _{A90} (15mins)
Daytime (07.00 – 23.00 hours)	52-69	67-88	56-73	34-62
Night-time (23.00 – 07.00 hours)	39-63	64-79	35-67	31-54
Store open (05.00 hours to midnight)	50-69	67-88	49-73	32-62
Store closed (midnight to 05.00 hours)	39-53	64-78	35-55	31-46

Figure 1 Histogram of L_{A90} background sound pressure levels (store opening hours)



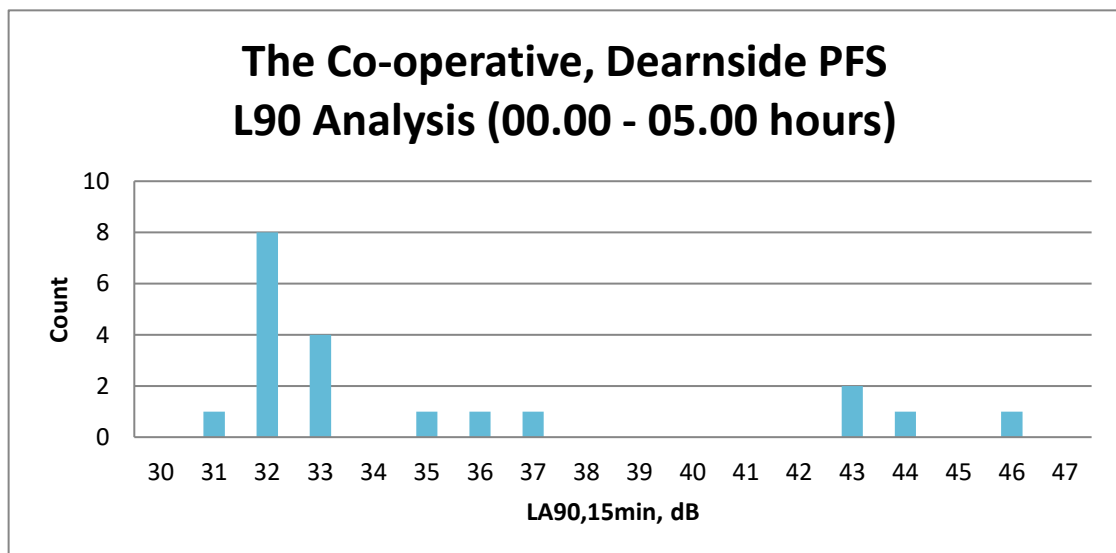
4.3. Additional statistical analysis has been undertaken. As shown in Table 2, the mean, median, and modal values have been calculated:

Table 2 Statistical analysis of $L_{A90,15min}$ levels during store opening hours

dB, L_{A90} store opening hours	
Mean	49
Median	54
Mode	52

4.4. The mean, median and modal values range from 49dB L_{A90} to 52dB L_{A90} . From review of the graph in Figure 1, 39dB L_{A90} has been considered as representative of the typical background sound level during store opening hours.

Figure 2 Histogram of L_{A90} background sound pressure levels outside store opening hours



4.5. From review of the graph in Figure 2, 32dB L_{A90} has been considered as representative of the typical background sound level outside store opening hours.

4.6. The following values, therefore, are considered as representative of the existing background sound pressure levels at nearby noise sensitive premises:

- 39dB L_{A90} during store opening hours (05.00 hours to midnight); and
- 32dB L_{A90} outside store opening hours.

5.0 Plant noise design criteria

Barnsley Metropolitan Borough Council

- 5.1. Barnsley MBC's local plan was adopted in January 2019. The document requires noise from new developments to be assessed but does not refer to assessment methods or specific noise targets. A review of recent planning decisions for similar plant installations indicates that each case is judged individually and there are no "standard" noise requirements applied across the Borough.
- 5.2. It is therefore appropriate to assess noise from the proposed plant using the method described in BS 4142:2014.

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. In the absence of defined local authority requirements, it is considered appropriate that the rating noise level due to the new plant should not exceed the existing representative background sound level at the nearest residential windows. According to the method described in BS 4142:2014 this would result in, at worst, a "low impact". The cumulative noise level for the proposed plant at the nearest residential windows should not therefore 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)
Store open (05.00 hours – midnight)	39
Store closed (midnight – 05.00 hours)	32

- 5.15. To avoid excessive disturbance to the operation of the community centre and playing fields, it is also proposed that the plant noise level at the closest façade of the community centre should not exceed 45 dB(A).
- 5.16. The above limits have not been approved by the local authority at this stage.

6.0 Plant noise assessment

- 6.1. The plant noise level at each of the most affected noise sensitive receptors has been predicted. The assessment has considered distance losses, surface acoustic reflections and, where applicable, screening provided by buildings between the source and receiver.
- 6.2. Typically, the plant used for stores of this type does not 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. Table 5 summarises the results of the assessment at the most affected residential properties. All other nearby receptors benefit from increased distance/screening to the plant. Calculations are based on the proposed plant operating at maximum duty at all times during their operating periods. The full set of calculations can be found in **Appendix F**.

Table 5: Assessment of predicted noise levels at Receptor

Receptor	Period	Predicted rating level at receptor, L_{Aeq} (dB)	Proposed design criterion (dB)	Difference (dB)
R1	Store open (05.00 hours – midnight)	15	39	-24
	Store closed (midnight – 05.00 hours)	9	32	-23
R2	Store open (05.00 hours – midnight)	34	39	-5
	Store closed (midnight – 05.00 hours)	28	32	-4
R3	Store open (05.00 hours – midnight)	21*	45*	-14

**Plant specific sound level (not Rating level)*

- 6.4. The predicted plant rating noise levels at the nearest residential receptors are below the criteria proposed in Paragraph 5.14 and therefore below the existing representative background sound level at all times. In addition, plant noise levels at the community centre and playing field will be below the recommended 45dBA upper-limit described in Paragraph 5.15.

Context and uncertainties

- 6.5. 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 windows. 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 during the operating periods. As this is not always the case, the assessment is an absolute worst case scenario.
- 6.6. 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.

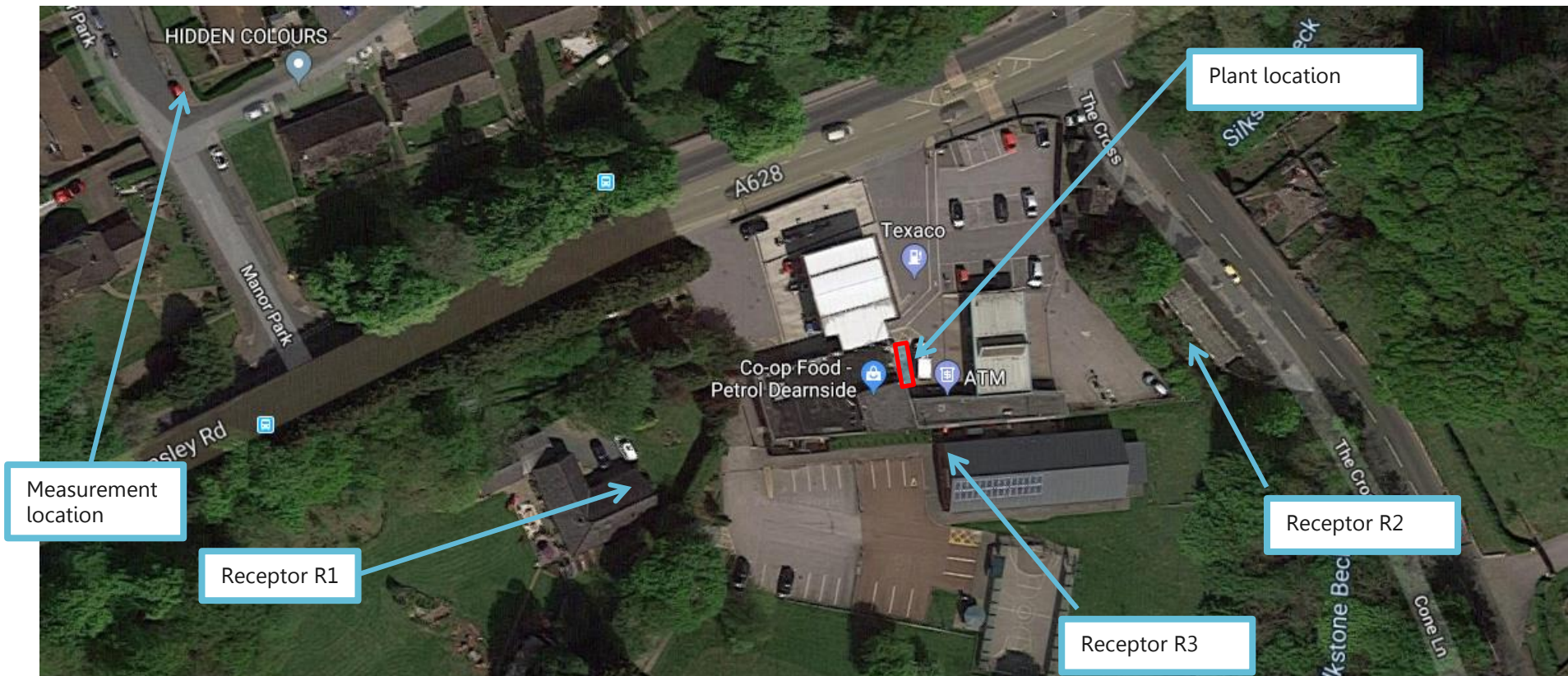
7.0 Summary

- 7.1. Noise Solutions Ltd (NSL) has been commissioned by Space Engineering to provide a noise impact assessment of new plant serving the existing Co-operative store located at Dearnside petrol station, Silkstone.
- 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 assessment shows that noise from the proposed plant will be significantly below the existing background sound level at all nearby noise-sensitive receptors and should therefore be acceptable to the local authority.

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 Photograph of site showing areas of interest



Photograph 1 Courtesy of Google Earth

Appendix C Environmental sound survey

Details of environmental sound surveys

- C.1 Measurements of the existing background sound levels were undertaken from 15.30 hours on Wednesday 6th November to 11.00 hours on Thursday 7th November 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 fifteen-minute sample periods for the duration of the survey.

Measurement position

- C.3 The representative measurement position was located on a lamppost along Manor Park (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.
- C.4 The survey location was chosen to avoid extraneous noise from running water close to the nearest receptors and minimise the effects of tyre noise on the wet A628 Barnsley Road.

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.

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

- 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	Time/Date	Description	Beginning of Survey	End of Survey
As indicated on Appendix B	15.30 6 Nov – 11.00 7 Nov 2019	Temperature (°C)	6	6
<p>Cloud Cover</p> <p>Symbol Scale in oktas (eighths)</p> <p>○ 0 Sky completely clear</p> <p>◐ 1</p> <p>◑ 2</p> <p>◒ 3</p> <p>◓ 4 Sky half cloudy</p> <p>◔ 5</p> <p>◕ 6</p> <p>◖ 7</p> <p>◗ 8 Sky completely cloudy</p> <p>⊗ (9) Sky obstructed from view</p>		Precipitation:	Yes	Yes
		Cloud cover (oktas – see guide)	8	8
		Presence of fog/snow/ice	No	No
		Presence of damp roads/wet ground	Wet	Wet
		Wind Speed (m/s)	<1	<1
		Wind Direction	-	-
		Conditions that may cause temperature inversion (i.e. calm nights with no cloud)	No	No

Results

- C.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 traffic noise from the A628, with intermittent traffic on Manor Park and occasional aircraft. The results of the survey are presented in a time history graph overleaf.

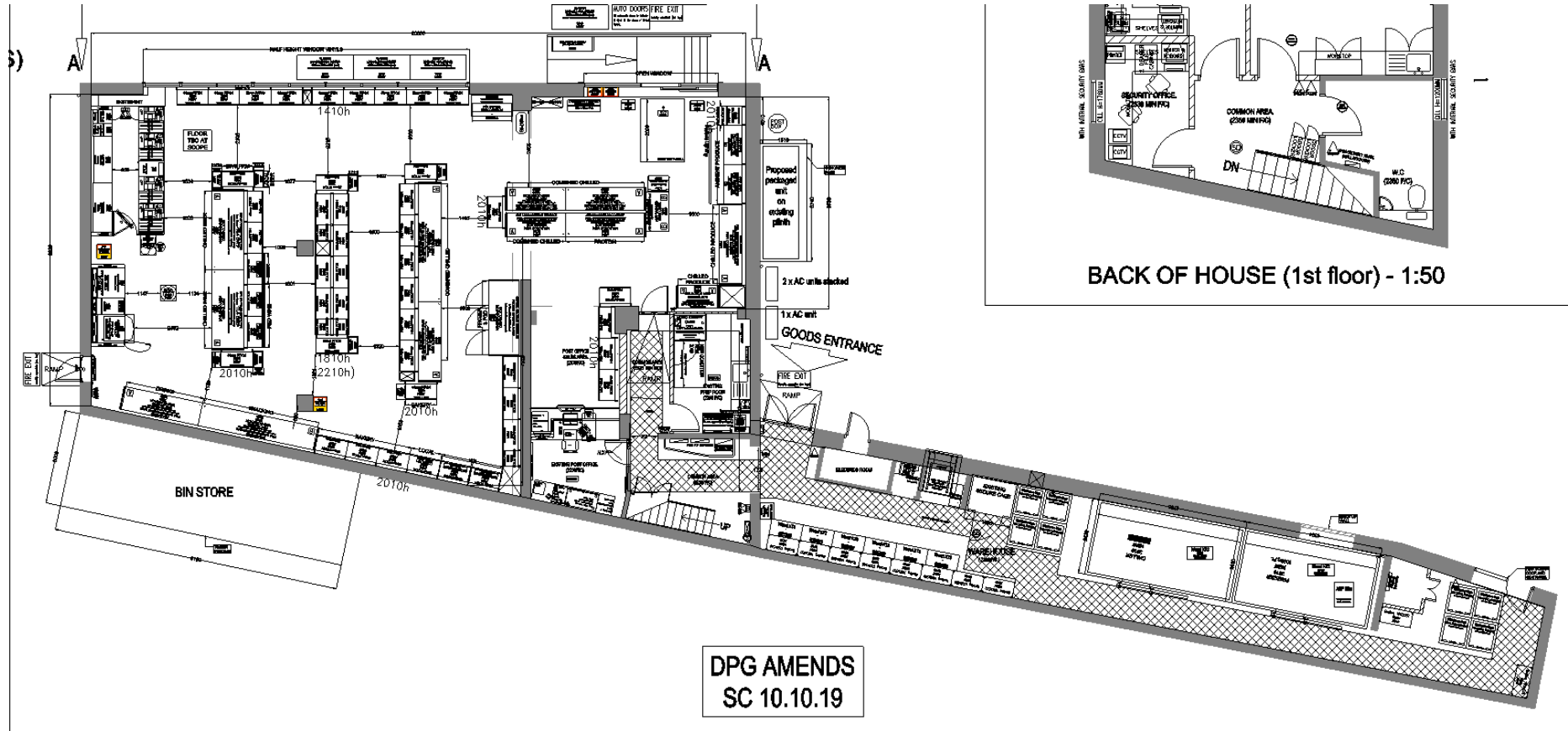
The Co-operative, Dearnside PFS Wednesday 06 - Thursday 07 Nov 2019



Appendix D Plant noise data

Plant Ref		Operating Hours	Sound pressure level
ACU-1	Mitsubishi PUZ-ZM125YKA	Store opening only	52dB(A) at 1m
ACU-2	Mitsubishi PUZ-ZM125YKA	Store opening only	52dB(A) at 1m
ACU-3	Mitsubishi PUZ-ZM100YKA	Store opening only	51dB(A) at 1m
Gas Cooler		Day and night	22dB(A) at 10m
Pack		Day and night	30dB(A) at 10m

Appendix E Plant layout drawing



Appendix F Plant noise calculations

Receptor R1 – House to west

Plant item	Source Sound level (dBA)	Distance		Directivity Correction (dB)	Screening (dB)	BS 4142:2014 feature correction	Cumulative plant rating level at receptor L _{Aeq} (dB)
		Distance to Receptor (m)	Correction (dB)				
ACU-1	52dB(A) at 1m	45	-33	0	-12	3	10
ACU-2	52dB(A) at 1m	45	-33	0	-12	3	10
ACU-3	51dB(A) at 1m	45	-33	0	-12	3	9
Gas Cooler	22dB(A) at 10m	45	-13	0	-12	3	0
Pack	30dB(A) at 10m	45	-13	0	-12	3	8
Cumulative plant rating level (05.00 hours to midnight)							15
Cumulative plant rating level (midnight to 05.00)							9

Receptor R2 – Houses to east

Plant item	Source Sound level (dBA)	Distance		Directivity Correction (dB)	Screening (dB)	BS 4142:2014 feature correction	Cumulative plant rating level at receptor L _{Aeq} (dB)
		Distance to Receptor (m)	Correction (dB)				
ACU-1	52dB(A) at 1m	40	-32	6	0	3	29
ACU-2	52dB(A) at 1m	40	-32	6	0	3	29
ACU-3	51dB(A) at 1m	40	-32	6	0	3	28
Gas Cooler	22dB(A) at 10m	40	-12	6	0	3	19
Pack	30dB(A) at 10m	40	-12	6	0	3	27
Cumulative plant rating level (05.00 hours to midnight)							34
Cumulative plant rating level (midnight to 05.00)							28

Receptor R3 – Community centre and playing fields

Plant item	Source Sound level (dBA)	Distance		Directivity Correction (dB)	Screening (dB)	BS 4142:2014 feature correction	Cumulative plant noise level at receptor L _{Aeq} (dB)
		Distance to Receptor (m)	Correction (dB)				
ACU-1	52dB(A) at 1m	16	-24	0	-12	n/a	16
ACU-2	52dB(A) at 1m	16	-24	0	-12	n/a	16
ACU-3	51dB(A) at 1m	16	-24	0	-12	n/a	15
Gas Cooler	22dB(A) at 10m	16	-4	0	-12	n/a	6
Pack	30dB(A) at 10m	16	-4	0	-12	n/a	14
Cumulative plant noise level (05.00 hours to midnight)							21