



Acoustic Associates

P E T E R B O R O U G H

**Environmental noise assessment for a
backup power generator at Hickleton Energy
Park in Thurnscoe**

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SUMMARY

An environmental noise assessment has been carried out for the operation of a proposed back-up electricity generator at Hickleton Energy Park in Thurnscoe. The assessment was carried out in accordance with the National Planning Policy Framework (NPPF) and other relevant noise standards and guidance.

It includes attended and unattended noise monitoring, predictive noise modelling, assessment of the results and consideration of mitigation measures.

The assessment carried out shows that the noise is likely to be at or below the “*Lowest Observed Adverse Effect*” level using terminology from the National Policy Planning Guidance (NPPG).

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1 OBJECTIVES

- 1.1** To carry out a *noise assessment of a proposed back-up generator for Hickleton Energy Park, in accordance with the National Policy Planning Framework (NPPF Reference 1) and other relevant standards and guidance.
- 1.2** To recommend solutions to any problems identified by the assessment.

2 CONCLUSIONS

- 2.1** The noise impact has been assessed of a proposed back-up generator on local residents. The assessment included the cumulative effect of the following mitigation measures which are proposed following advice from Acoustic Associates (Peterborough):-
- A 5 metre high acoustic fence constructed immediately to the north of the generators on the footprint shown in the proposed site layout.
 - The complete enclosure of the generator unit within a canopy including attenuators added to the exhaust, inlet and outlet.
- 2.2** The assessment of noise carried out according to British Standard BS 4142:2014 (Reference 2) concludes that when the generator is running at full load:-
- The noise is assessed as being between “*minor impact*” and “*adverse impact*” in the daytime. The context of this is that this is a mixed use residential/industrial area with ambient noise levels generally 10dB higher than noise from the generator. Noise levels within dwellings and in amenity areas are likely to be acceptable (see sections 2.3 and 2.4).
 - The noise is assessed as being between “*adverse impact*” and “*significant adverse impact*” in the night-time. However the generator will run at night-time extremely rarely and even then will not cause excessive internal noise levels (see section 2.3).
- 2.3** When the generator is running at full load, noise levels internally at the nearest dwellings are likely to comply with criteria for internal noise given in British Standard BS 8233 (Reference 3) in both the daytime and night-time.
- 2.4** When the generator is running at full load, noise levels in the amenity areas of the nearest dwellings are likely to comply with criteria for external noise given in British Standard BS 8233 by a significant margin.

*** see Appendix 1 for a Glossary of Terms**

- 2.5** Overall noise emissions from the impact of generator noise on local residents would be regarded as being at or below the “*Lowest Observed Adverse Effect*” using NPPG terminology.

3 RECOMMENDATIONS

- 3.1** The plant should be located as shown in Figure 2. A 5 metre high acoustic wall should be built of an acoustically hard material on the footprint shown on the plans which has a surface density of at least 10 kg/m².
- 3.2** The plant should be serviced regularly and any fault which leads to a change in volume or tone of noise emissions should be addressed.

4 BACKGROUND

4.1 Introduction

Hickleton Energy Park in Thurnscoe hosts four generator sets within a building and these have been operational since 2001. These generators burn coal gas and occasionally natural gas to produce electricity for the grid.

It is now proposed to install a new generator set on the north of the site which will act AS a “back-up” for the grid by burning natural gas to produce electricity at times when demand is high.

The Energy Park is located on a hillside on Thurnscoe Industrial Estate. It is surrounded by commercial and industrial buildings. The nearest residents are located to the north on Leggett Road. Figure 1 shows a plan of the site and surrounding area.

Acoustic Associates (Peterborough) has been contracted to carry out a noise assessment for the site to assess the noise impact of its operations on the nearest residents.

4.2 Operating conditions

The following are the conditions of operation:

1.3 The existing generators, within the generation building, will continue to operate on coal mine methane, supplemented by natural gas.

1.4 The proposed generator, to be housed in a container, outside of the generation building, is to be used to provide back-up power to the Grid using natural gas as its fuel.

The back-up power generator will be called upon by the Grid to operate for only up to 1000 hours per year.

The operational hours of the generator will be dictated by the demands of the Grid, but are expected to be between 07:30 and 20:30 hours. However, from time to time, this generator may be called upon to run outside these hours, if National Grid instructs the site to run in emergency situations to fulfil the sites’ duties under a standing reserve contract. These types of emergencies are rare and are envisaged to only take place a relatively small number of days in any rolling year.

Even though the generator units are unlikely to run outside the above mentioned hours; the noise assessment, submitted with this application, uses a conservative range of hours of operation from 07:00 to 22:00 hours as its normal operating hours and has also considered the impact of the emergency overnight running of the generator.

3.1.2 The maximum projected output of electricity which would be exported from the site, at any one time, is to be about 5.2MW (Mega Watts).

3.5.4 The spark ignition generator engines that are proposed for this site will generate electricity from natural gas.

The engines are designed to run within the following emission limits:

Nitrous oxides (NO_x) < 500 mg/m³;

Carbon monoxide (CO) < 1400 mg/m³.

Nitrogen dioxide (NO₂) is the most relevant of the NO_x compounds in this case.

As can be seen operation between the hours of 22:00 and 07:00 is very rare.

4.3 Generator set

It is proposed to install a Jenbacher 620 Generator set and associated chiller unit at the site. Once the generator is installed it will be covered with an acoustic canopy of dimensions 15m x 4m x 4m. Alkane specify these units to achieve the following noise criteria.

- The noise level due to emissions only from the canopy will not exceed L_{Aeq} 65 dBA at any point 10 metres from any part of the canopy surface;
- The noise level due to emissions only from the associated radiator/chiller will not exceed L_{Aeq} 65 dBA at 10 metres;
- The noise level due to emissions only from the exhaust will not exceed L_{Aeq} 65 dBA at 10 metres.

The layout of the plant and chiller is shown in Appendix 2.

4.4 Mitigation

Following advice from Acoustic Associates (Peterborough), the following noise mitigation has been incorporated into the scheme.

- An acoustic fence of 5 metres height to be constructed immediately to the north of the generator. The footprint of the barrier is shown in Figure 2.
- The chillers are to be located to the south of the generator thereby using the taller generator set as a noise barrier;
- The exhaust is to be further attenuated so as to achieve 57 dB(A) at 10 metres, which is an 8 dB improvement on the usual (see section 4.3).

5 POLICY, GUIDANCE AND STANDARDS

5.1 National Policy Planning Framework

The National Policy Planning Framework (Reference 1) states the following with respect to noise (para 123).

“Planning policies and decisions should aim to:

avoid noise from giving rise to significant adverse impacts (27) on health and quality of life as a result of new development;

mitigate and reduce to a minimum other adverse impacts (27) on health and quality of life arising from noise from new development, including through the use of conditions;

recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established and

identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.”

The footnote 27 in the first two bullet points refers to the Noise Policy Statement for England (NPSE – Reference 4) in order to explain what it means by “adverse impact”.

5.2 Noise Policy Statement for England and National Policy Planning Guidance

The NPSE has stated that the impact of noise be classified according to an “effect level” (shown in column 3 below). The National Policy Planning Guidance (NPPG - Reference 5) has clarified what this effect level below means in terms of its perception by people at receptors and what action should be taken (columns 1 and 4 in Table 1 below).

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

Table 1 - National Policy Planning Guidance noise exposure hierarchy**5.3 British Standard BS 8233:2014**

British Standard BS8233:2014 (Reference 3) gives guidance on indoor ambient noise levels which are based on guidelines issued by the World Health Organisation (WHO – Reference 6) These are shown in Table 2.

Activity	Location	Noise criteria	
		07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Table 2 - BS 8233: 2014 guidance indoor ambient noise levels for dwellings.

Note 7 of the guidance states “Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.”

BS 8233 states the following for **amenity areas** “For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed **50 dB $L_{Aeq,T}$** , with an upper guideline value of **55 dB $L_{Aeq,T}$** which would be acceptable in noisier environments”.

5.4 British Standard BS 4142:2014

5.4.1 BS 4142 (Reference 2) is a standard which describes a method for assessing whether the ‘specific noise’ from an industrial source is likely to give rise to complaints from residents of the adjacent dwellings. The ‘specific noise’ levels are determined outside dwellings. The specific noise level is determined for reference time periods of 1-hour for the daytime (7am to 11pm) and 15 minutes for the night time. Tonal or impulsive characteristics of a noise are likely to increase the scope for complaints and this is taken into account by adding a value to the specific noise source level to obtain the ‘rating level’. The value may be between 0 and 15 dB depending on objective and subjective measures detailed in the standard. The following table detail the values added for the subjective method which is the method used in this assessment.

Characteristics of noise	Noise at receptor	Value to add to specific noise level for rating level
Noise has tonal characteristics	Just perceptible	+2 dB
	Clearly perceptible	+4 dB
	Highly perceptible	+6 dB
Noise has impulsive characteristics	Just perceptible	+3 dB
	Clearly perceptible	+6 dB
	Highly perceptible	+9 dB
Other - characteristics that are neither tonal nor impulsive but are readily distinctive against the residual acoustic environment,	-	+ 3 dB
Intermittency	If intermittency is readily distinctive in the residual acoustic environment	+3 dB

Table 3 – BS 4142 – Corrections to noise to calculate rating level – subjective method

5.4.2 BS 4142 requires that the rating Level of a noise is compared with the existing background noise ($L_{A90,T}$). Guidance given in the standard states the following regarding the difference between the rating level and the background noise.

- A difference of 0 dB is indicative of a “*minor impact*”;
- A difference of +5 dB is indicative of an “*adverse impact*”;
- A difference of +10 dB is indicative of a “*significant adverse impact*”.

5.5 Criteria for this assessment

This statement uses BS 4142 in its assessment of industrial noise. BS 8233 is used to assess noise inside dwellings and in amenity areas. The overall noise impact with mitigation in place is classified according to criteria given in NPPG.

6 NOISE ASSESSMENT

6.1 Ambient Noise

Noise monitoring equipment was set up on a commercial site close to the nearest resident. Noise was continuously monitored from 25th August until Monday 28th August 2017. The monitoring location is shown in Figure 1 as Location A. In addition short-term noise monitoring at two locations was carried out on the 25th August (Figure 1, Locations B and C). All noise monitoring locations were in free-field conditions at a height of 1.5 metres above ground level. Appendix 2 gives details of the noise instrumentation used. Appendix 3 documents the measurements.

6.2 Assessment Locations this assessment

Two residential dwellings were selected to assess the noise (see Figure 1).

- 1. Lidget Lane – This end of terrace house is the closest to the site.
- 2. Oaklea – This end of terrace house is located to the north of some residents who are closer to the site but is more exposed to site noise than other houses due to the topography.

For each dwelling noise was assessed in a free field (at 3.5 metres from the façade) on the ground and first floor.

6.3 Computer noise model of the site and surrounding area

A computer noise model of the site and surrounding area was generated using Woelfel IMMI Computer Noise Modelling Software (Reference 7) which uses the methods given in ISO 9613 – 2 (Reference 8) to calculate noise levels given a topographical model of the site. A noise source was added to the model to represent the generator and it's level was calibrated with noise data supplied by Alkane Ltd (see section 4.2).

7 RESULTS

7.1 Ambient noise levels

The results of the unattended ambient noise monitoring are shown graphically in Appendix A3.1 and summarised in table 4 below.

Period	“Energy” average ambient noise $L_{Aeq,T}$ dB(A)	Background Noise level dB(A)			
		Minimum $L_{A90,15minutes}$	Maximum $L_{A90,15minutes}$	Arithmetic average $L_{A90,15minutes}$	*Statistically Typical $L_{A90,15minutes}$
Daytime (07:00-23:00)	52.2	35.1	52.5	41.7	41
Night-time (23:00-07:00)	46.6	25.5	45.0	35.7	36

*Most frequently occurring – using method described in example in section 8.1. of BS 4142

Table 4 - Background noise levels

The dominant noise at the monitoring location was from passing traffic. Noise from the adjacent glassworks (particularly fork lift truck movements) is likely to have been significant on Saturday daytime.

Based on the above, the background noise is assumed to be $L_{A90,15minutes}$ **41 dB(A)** in the daytime and $L_{A90,15minutes}$ **36 dB(A)** in the night-time for the BS 4142 Assessment.

7.2 Specific noise level

The noise levels due to emission from the proposed generator set were predicted by the model and are shown in Figure 3 as noise contours. The predicted noise levels at the assessment locations are shown below.

Assessment Location	Specific noise level $L_{Aeq,T}$ dB(A)	
	Ground floor	First floor
Lidget Lane	39.4	40.7
Oaklea	40.8	40.8

Table 5 - Specific noise level at the assessment location façades

As can be seen, noise levels are loudest at Oaklea during the daytime and night-time.

7.3 Assessment

The following table details the assessment for the most affected location at Oaklea. Noise is assessed at the first floor for the night-time (when residents are assumed to be in their bedrooms) and on the ground floor in the daytime.

Description	Night-time noise Assessment (first floor)	Daytime noise assessment (ground floor)	Comment
Specific noise level at house $L_{Aeq,T}$ dB(A)	41	41	See Table 5.
BS 4142 Assessment			
Acoustic feature correction added dB	2	2	Assumed that the noise will be faintly perceptible we add 2 dB (see Table 3)
Rating Level $L_{A,T}$ dB(A)	43	43	Specific + acoustic feature
Background noise L_{A90} dB(A)	36	41	From Table 4
Difference	+7	+2	Difference between rating and background.
BS 4142 Assessment	<i>Between "Adverse impact" (+5) and "Significant adverse impact" (+10). Context is night-time operation which is very rare (see section 4.3). Internal noise levels are acceptable (see below)</i>	<i>Between "Minor impact (0 dB) and Adverse impact (+5 dB). Context is daytime operation in mixed use residential/industrial area. Internal noise levels and in amenity areas are acceptable (see below)</i>	See section 5.2
Internal noise (BS 8233 criteria)			
Likely internal levels	26-31 dB(A)	23-28 dB(A)	Noise levels within a property are 10-15 dB lower than external level with partially open window.
Comparison with BS 8233 criterion	Likely to comply with BS 8233 criterion for bedrooms	Significantly below BS 8233 criterion of 35 dB(A) for living rooms in daytime.	See Table 2 for criteria.
Amenity areas (BS 8233 criteria)			
Levels in amenity area	-	<= 41 dBA	Amenity area. Compare with BS 8233 criterion level of $L_{Aeq,T}$ 50 dB(A)
Comparison with BS 8233 external level of $L_{Aeq,T}$ 50 dB(A)	-	Significantly better than BS 8233 criterion of L_{Aeq} 50 dB(A) in amenity areas.	See section 5.3 for criterion.

Table 6 - Assessment at Oaklea

7.4 Conclusions

7.4.1 Night-time

The BS 4142 Assessment concludes that when running at full load and with all mitigation measures in place the level due to noise from the generator is likely to be between “*adverse impact*” and “*significant adverse impact*” at night-time. However, as discussed in section 4.2 night-time operation is extremely rare and even under these conditions, noise levels within bedrooms with partially open windows are likely to be acceptable when compared against BS 8233 criteria.

7.4.2 Daytime

The BS 4142 Assessment concludes that, with all mitigation measures in place the level due to noise from the generator is a level BS4142 is likely to be between “*minor impact*” and “*adverse impact*” in the daytime. The context is that this is a mixed used residential/industrial area with ambient daytime levels generally 10-15 dB higher. Noise levels within dwellings with partially open windows and noise levels in amenity areas are likely to be acceptable when compared against BS 8233 criteria.

8 DISCUSSIONS

8.1 Uncertainties

The assessment relies principally on noise data supplied by Alkane. Based on measurements taken at other already commissioned Alkane sites the generators we have found Alkane noise data to be reliable.

The decision to apply a 2 dB penalty to daytime noise may be over-onerous given that ambient levels are on average 10 dB higher than noise levels from the plant in the daytime.

The background noise is very variable over the night-time. However the assumptions over background noise in this assessment are endorsed by another assessment carried out this year (Reference 9).

Predictive modelling to ISO 9613-2 carries an uncertainty of +/- 3 dB. However, pessimistic assumptions have been made within the model most notably that of downwind propagation from source to receiver. Even assuming levels were 3 dB higher than estimated this would be at the limit of perceptibility.

There are no other known uncertainties affecting this assessment.

REFERENCES

1. *National Policy Planning Framework*; DCLG, 2012.
2. *British Standard BS 4142:2014, Methods of rating and assessing industrial and commercial sound*; BSI, 2014.
3. *British Standard BS 8233, Guidance on sound insulation and noise reduction for buildings*; BSI, 2014.
4. *Noise Policy Statement for England*; DEFRA, 2010.
5. *National Policy Planning Guidance, 2014, DEFRA*.
6. *World Health Organisation Guidance, Guidelines for Community Noise*; WHO, 1999.
7. *Wolfel IMMI Computer Noise Modelling Software*. ; www.woelfel.de, 2014.
8. *ISO 9613-2 Acoustics of sound during propagation outdoors, Part 2: General method of calculation*; ISO, 1996.
9. CSP Acoustics. *Noise impact assessment for Balmoral Tanks Ltd Ref 1154 002PR V1*;;, 2017.

Appendix 1 – Glossary of terms

Sound Pressure	The variation of ambient pressure that is detected by the ear as sound.
Noise	Unwanted sound
decibel (dB)	Ten times the logarithm of the square of the ratio of the Sound Pressure to a reference pressure (20 micro-Pascal's).
Sound Pressure Level (L_p)	The decibel version of the Sound Pressure.
A-Weighting	A frequency weighting which simulates the response of the ear. An A-Weighted Sound Pressure Level is denoted by L _{pA} and has units of dB(A)
L_{Aeq,T}	The value of the A-weighted sound pressure level, in decibels [dB(A)], of a continuous steady sound that within a specified time interval (T), for example 16 hours, has the same mean-square sound pressure as a sound that varies with time. Therefore, the average over a 16 hour period would be denoted as L _{Aeq,16h}
L_{Amax,T}	The maximum A-Weighted sound pressure level that was encountered during the measurement period.
L_{A90,T}	The A-Weighted sound pressure level that is exceeded for 90% of the time (T). This is usually used a measure of background noise.
Free Field	Where noise can propagate freely without any reflections from buildings etc.
Octave Band	A band of frequencies the upper limit of which is twice the lower limit. They are known by their centre frequency, e.g., 63, 125, 250, 500, 1000, 2000
NPSE Criteria	
NOEL	No Observed Effect Level
LOAEL	Lowest Observed Adverse Effect Level
SOAEL	Significant Observed Adverse Effect Level

BS 4142 Terms

T_r	The reference time interval over which an equivalent continuous A-weighted sound pressure is determined. Day time = 1 hour Night-time = 15 minutes
T_m	The measurement time interval over which measurements are taken.
Ambient Noise	Total sound in a given situation at a given time.
Residual Noise	The ambient noise remaining at a given position in a given situation when the specific noise is suppressed to a degree such that it does not contribute to the ambient noise.
Specific Noise Level Rating Level L_{Ar,T_r}	The dB L_{Aeq,T_r} of the noise sources being assessed at a site. The specific noise level plus any correction (+5 dB) for the character of the noise, known as the Rating Level.
Assessment Level	Difference between Rating Level ($L_{Ar,T}$) and Background Noise ($L_{A90,T}$)
Sound Power Level (L_{WA})	The noise level from the source in terms of sound power, in dB(A).

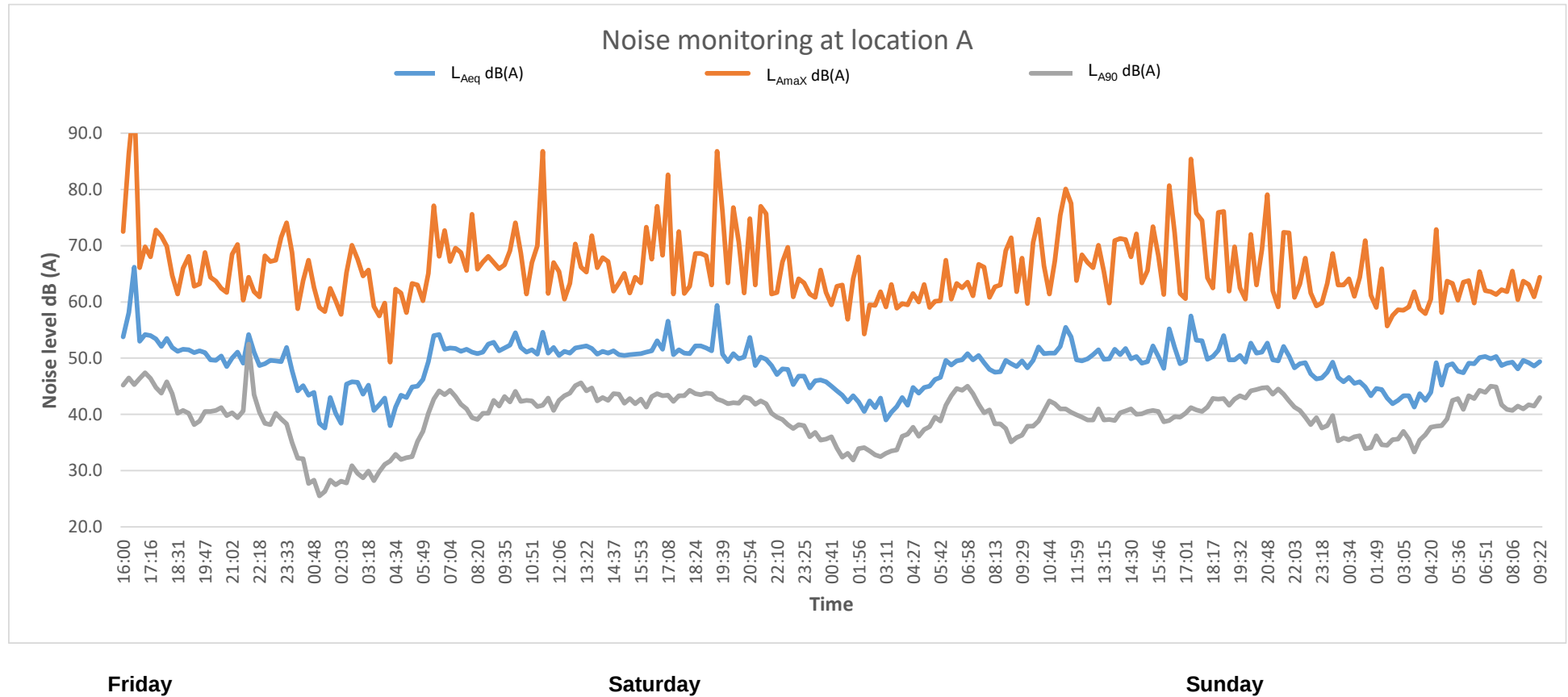
Appendix 2 – Noise instrumentation

Type	Manufacturer	Description	Serial Number	Last Calibration Date	Calibration Certificate No.
Svan 949	Svantek	Sound level meter	8101	17/01/2017	164983
4230	Brüel & Kjær	Sound level calibrator	781674	17/01/2017	164984
CR:821A	Cirrus	Sound level meter	B15091FE	20/05/2016	160698
CRL 511E	Cirrus	Sound level calibrator	-	20/05/2016	160697

The calibration of the instrumentation was checked at the start and end of the tests and there was no significant drift.

Appendix 3 – Results of Noise monitoring on site

A3.1 Results of long-term monitoring on site at location A



The weather during monitoring was dry with wind speed < 5m/s average and varying in direction. Average temperatures were 15° – 22° centigrade. When the meter was dropped off and picked up, noise from traffic was dominant. Noise from the nearby electricity substation was not significant at this location.

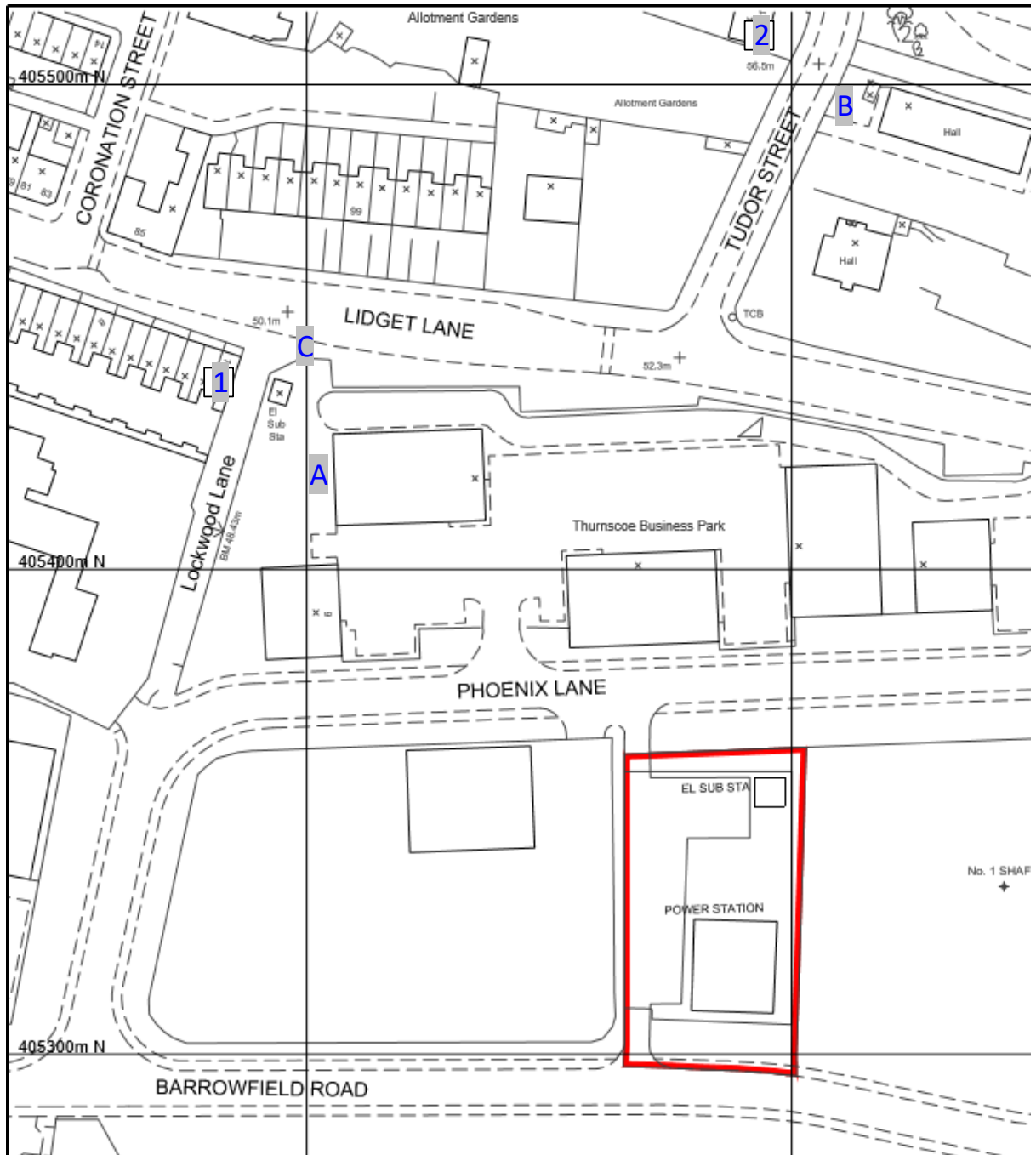
A3.2 Short-term monitoring at location B and C

Location (see Figure 1)	Time	Noise level dB(A)			
		L _{Amax} ,15minutes	L _{Aeq} ,15minutes	L _{A10} ,15minutes	L _{A90} ,15minutes
Loc. B	15:36	88.2	62.4	64.1	46
Loc.C	16:03	89.3	67.2	69	50.4

The weather was dry, 70% cloudy, temperature 22°C with westerly winds <3m/s

The average noise was dominated by passing local traffic. In the lulls distant traffic noise was dominant.

Figure 1 - Location Plan of the existing site



1 and 2

Assessment locations 1 – Lidget Lane and 2 – Oaklea

A, B and C

Noise measurement locations

Site plan shown bounded in **red** and in Figure 2.

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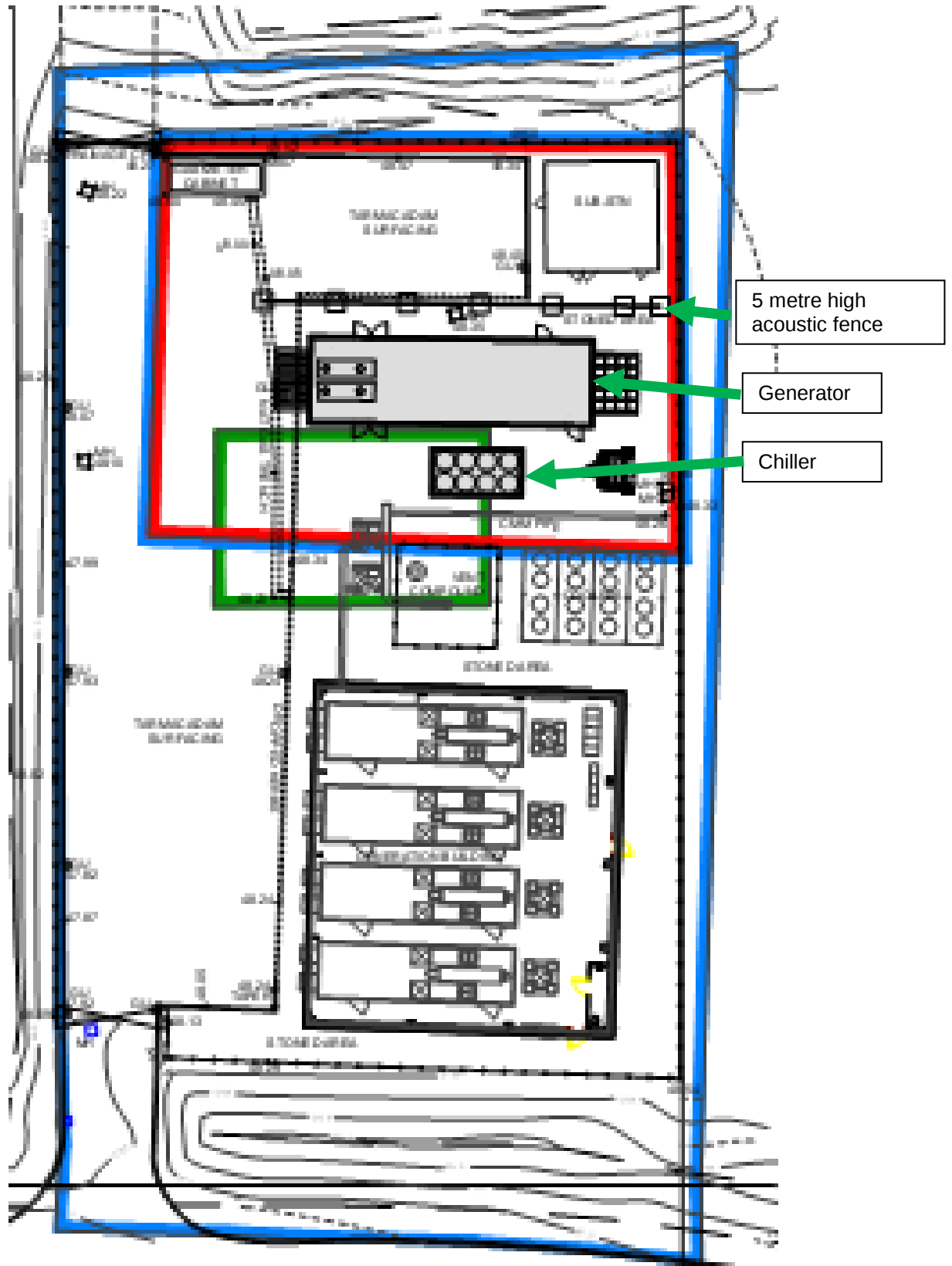


Figure 3 – Noise contours at 4.5 metres height

