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Sheringham Shoal
Cawston, Norfolk

Substation Noise Assessment Summary

Document title: Substation Noise Assessment Summary
Status: Final
Date: 13 March 2015
Project name: Sheringham Shoal, Cawston, Norfolk
Project number: PB2539
Client: Statkraft
Client contact: Fabio Spinato

Reference: Version 2.0
Drafted by: Stephen Wigham
Checked by: Dean Curtis
Date / initials check: 13 March 2015
Approved by: Dean Curtis
Date / initials approval: 13 March 2015

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This document consists of 34 pages.

Document History

Project number: PB2539			**Document reference: Noise Survey and Modelling Exercise**			
Revision	**Purpose Description**	**Originated**	**Checked**	**Reviewed**	**Authorised**	**Date**
Rev 1.0	Draft for internal review	SW	DC	DC		13 August 2014
Rev 1.1	Draft for client review	SW	DC	DC		14 August 2014
Rev 2.0	Final issue	SW	DC	DC	FS	13 March 2015

Client Signoff

Client	Statkraft
Project	Sheringham Shoal, Cawston. Norfolk
Document title	Noise Assessment Summary
Project No.	PB2539
Copy No.	Final issue

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1 Introduction

Section 1 Introduction

1.1 Introduction

This report is submitted to summarise the findings of recent noise surveys and recommendations for the Sheringham Shoal substation in Cawston, Norfolk.

This work follows a recent noise complaint made regarding the site and provides a review of existing noise levels in proximity to the site and consideration for the consented full build out of the substation to incorporate harmonic filters.

1.2 Site Description and Surrounding Area

The site lies approximately 0.5km to the west of the village of Cawston in north Norfolk. Access to the site is via the B1145 road that links the villages of Cawston and Reepham.

The site primarily consists of two large shunt reactors (approximately 5.5m high and 7m wide) and an office unit (approximately 25m x 17m x 5.5m).

The surrounding area is generally rural and agricultural in character. However, there are small clusters of residential properties approximately 400m to the west at Commonside and approximately 330m to the north-east at Glebe Crescent.

1.3 Noise Complaint

A recent complaint was made regarding noise from the site. The complaint originated from 21 Chapel Street, a property located to the north-east of the site. The complainant alleges that substation noise is audible in a rear bedroom under still meteorological conditions and an Environmental Health Officer (EHO) from Broadlands District Council (BDC) has visited the complainant's property and carried out initial investigations.

Royal HaskoningDHV also attended a joint visit with Tony Garland, EHO at BDC, to 21 Chapel Street on 29 July 2014. The findings of this joint survey are presented in Section 4.

2 Legislation and Guidance

Section 2 Legislation and Guidance

2.1 Legislation

Environmental Protection Act, 1990 (EPA)[1]

Section 79 of the Act defines statutory nuisance with regard to noise and determines that local planning authorities have a duty to detect such nuisances in their area.

Where noise is concerned the Act defines statutory nuisance as:

> *'noise emitted from premises so as to be prejudicial to health or a nuisance…….noise that is prejudicial to health or a nuisance and is emitted from or caused by a vehicle, machinery or equipment in a street'.*

Exemptions include:

> '*noise caused by aircraft other than model aircraft….by traffic, by any naval, military or air force of the Crown or by a visiting force…..or by a political demonstration or a demonstration supporting or opposing a cause or campaign'*

The term 'prejudicial to health' is defined within the Act as:

> '*injurious, or likely to cause injury, to health'*

The term 'health' is defined by the World Health Organisation (WHO) in the preamble to the 1952 Constitution as:

> '*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*'

With regard to the term 'nuisance', there is no specific definition in the Act. However, in common law, the following definition is often used:

> *'A nuisance is a material interference with a person's use or enjoyment of their land or property'*

Section 80 of the Act provides local planning authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.

With regard to the mitigation of noise, the Act also defines the concept of "Best Practicable Means" (BPM):

> *''practicable' means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;*
>
> *the means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;*
>
> *the test is to apply only so far as compatible with any duty imposed by law; and*
>
> *the test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances.'*

1 Environmental Protection Act 1990. HMSO, London.

Section 2 Legislation and Guidance

2.2 Guidance

British Standard (BS) 7445: Parts 1 and 2 - Description and measurement of environmental noise[2].

The Standard provides details of the instrumentation and measurement techniques to be used when assessing environmental noise, and defines the basic noise quantity as the continuous A-weighted sound pressure level (L_{Aeq}). Part 2 of BS 7445 replicates ISO standard 1996-2.

World Health Organisation (WHO) Guidelines for community noise[3]

The World Health Organisation provides the following guidelines on community noise levels with regard to their effects on annoyance, speech intelligibility and sleep disturbance. They are replicated in **Table 1**.

Table 1 WHO Guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	L_{Aeq} (dB)	Time base (hours)	L_{Amax} (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

The document also states that, for sources with low-frequency components:

> '*disturbances may occur even though the sound pressure level during exposure is below 30 dB(A)……when the noise is composed of a large proportion of low-frequency sounds a still lower guideline value is recommended'.*

The WHO guidelines do not expand on the statement above to offer guideline values for noise dominated by low frequencies. However in the British Standard 4142 document there is a section that considers an 'acoustic feature' penalty when assessing industrial noise sources. This is explored further below.

2 British Standards Institution, (2003). BS 7445-1:2003 - Description and measurement of environmental noise. Guide to quantities and procedures. BSI, London
3 Berglund et al. (1999) - Guidelines for Community Noise. Geneva, World Health Organisation (WHO).

Section 2 Legislation and Guidance

British Standard (BS) 4142: 1997 – Method for rating industrial noise affecting mixed residential and industrial areas

BS 4142[4] provides a methodology for assessing industrial and background noise levels outside residential buildings and for assessing whether existing and new industrial noise sources are likely to give rise to complaints from the occupants living in the vicinity.

Assessment of the likelihood of complaints is undertaken by subtracting the measured background noise level from the rating level, the greater this difference the greater the likelihood of complaints.

BS 4142 refers to the following:

> *'A difference of around +10 dB or more indicates that complaints are likely.*
>
> *A difference of around + 5 dB is of marginal significance.*
>
> *If the rating level is more than 10 dB below the measured background noise level then this is a positive indication that complaints are unlikely.'*

In general, the lower the value, the less likelihood those complaints will occur.

When assessing the noise from a source, which is classified as the Rated Noise Level, it is necessary to have regard to the acoustic features that may be present in the noise. In Section 8 of BS 4142 it states:

> *'Certain acoustic features can increase the likelihood of complaint over that expected from a simple comparison between the specific noise level and the background noise level. Where present at the assessment location, such features are taken into account by adding 5 dB to the specific noise level to obtain the rating level.'*
>
> *Apply a 5 dB correction if one or more of the following features occur, or are expected to be present for new or modified noise sources:*
>
> - *The noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.);*
> - *The noise contains distinct impulses (bangs, clicks, clatters, or thumps); and*
> - *The noise is irregular enough to attract attention."*

2.3 Application to the Existing Situation

Typically, a good starting point would be to compare site noise against the WHO guidelines internal night-time noise criterion of 30 dB $L_{Aeq,8hr}$. Assuming that an open window offers 10 – 15 dB attenuation (as stated in the guidance) this would equate to an external free-field noise level of 40 – 45 dB L_{Aeq}. However, as stated above the document recommends that, for sources with low-frequency component a lower guideline value is utilised.

It was not possible to conduct a retrospective BS 4142 assessment as Royal HaskoningDHV does not have noise data characterising the local background noise environment that existed before the commissioning of the new substation. Nevertheless the BS 4142 guidance is useful insofar as it suggests that, when assessing an industrial noise source, 5 dB is an appropriate 'penalty' to apply to noise that contains distinguishable tones (such as the 'hum' emitted by the substation in question).

[4] British Standard Institute (1999). BS4142: Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas. British Standard Institute

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3 Methodology

Section 3 Methodology

3.1 Baseline Noise Survey

3.1.1 Methodology

A noise survey was conducted between 24 June 2014 and 25 June 2014 to characterise the existing noise levels affecting the nearest noise sensitive receptors to the site.

During this time the weather conditions were considered favourable for noise measurements with wind speeds of less than 2 m/s, no rain and temperatures of around 19°C in the daytime and 15°C at night.

Noise measurements were conducted on an attended basis at two locations as illustrated in **Appendix A**.

3.1.2 Procedure

The noise measurements were taken using the instrumentation detailed in **Table 2**.

Table 2 Noise survey instrumentation

Instrument	Serial number	Calibration due date at time of survey
Norsonic 118 Type 1 Sound Level Meter	30545	29 May 2015
Norsonic 1251 Portable Calibrator	23517	10 December 2014

The sound level meter was fully calibrated, traceable to UKAS standards and satisfies the requirements of BS EN 61672: 2003[5] for a 'Type 1' Sound Level Meter (SLM).

The instrument was calibrated before and after the survey using the portable calibrator. No deviation in the calibration levels was noted.

Off-Site Noise Measurements

The noise measurements were conducted with the SLM mounted on a tripod at a height of between 1.2m and 1.5m above ground level, in free field conditions i.e. at least 3.5m from a vertical reflective surface.

The SLM was set to record L_{Aeq}, L_{A90}, L_{A10}, L_{Amax} data with a 'fast' time constant and A-weighting for several 15-minute periods during the day and night. **Appendix C** presents descriptions of these terms.

The measurement positions were selected at locations considered representative of No. 14 Glebe Crescent and No.5 Commonside, as far as was reasonably practicable.

On-Site Noise Measurements

In order to establish source noise levels associated with existing site plant, noise measurements were also conducted at a number of locations within the compound as illustrated in **Appendix A**.

[5] British Standards Institution (2003). BS EN 61672-1:2003 Electroacoustics. Sound level meters. Specifications. BSI, London

Section 3 Methodology

3.2 Noise Survey in 21 Chapel Street

3.2.1 Methodology

A noise survey was conducted on 29 July 2014 to characterise the existing noise levels at the substation site boundary and within the rear bedroom of 21 Chapel Street, Cawston. The survey was also attended by Tony Garland, EHO from BDC.

The weather was clear, warm (19°C) with winds <0.5m/s^{-1}. It was agreed with Tony Garland that under such conditions the noise emissions from the substation would represent an acceptable conservative assessment scenario.

3.2.2 Procedure

The noise measurements were taken using the instrumentation detailed in **Table 3**.

Table 3 Noise survey instrumentation

Instrument	Serial number	Calibration due date at time of survey
Brüel and Kjaer 2250 Type 1 Sound Level Meter	2590499	30 May 2015
Brüel and Kjaer 4231 Portable Calibrator	1850087	07 January 2015

The sound level meter was fully calibrated, traceable to UKAS standards and satisfies the requirements of BS EN 61672: 2003[6] for a 'Type 1' Sound Level Meter (SLM).

The instrument was calibrated before and after the survey using the portable calibrator. No deviation in the calibration levels was noted.

The SLM was set to record L_{Aeq}, L_{A90}, L_{A10}, L_{Amax} data with a 'fast' time constant and A-weighting. Appropriate narrowband (FFT) data was collected from the substation site boundary and in the complainant's bedroom. **Appendix C** presents descriptions of these terms.

[6] British Standards Institution (2003). BS EN 61672-1:2003 Electroacoustics. Sound level meters. Specifications. BSI, London

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4 Survey Results

Section 4 Survey Results

4.1 Baseline Noise Survey

4.1.1 Off-Site Survey - Measurement Summary

A summary of the measured data are presented in **Table 4** along with observations made regarding the character of noise and any specific noise sources audible during the survey.

Table 4 Noise level summary – neighbouring receptors

Location	Time start	dB $L_{Aeq,15min}$	dB $L_{Amax,15min}$	dB $L_{A10,15min}$	dB $L_{A90,15min}$	Comments
Commonside	15:17	50.3	63.7	54.0	40.3	Measurement included car-pass-bys. No site noise audible
	00:25	36.0	61.7	36.3	23.6	Measurement included car-pass-bys. Site noise just audible
	00:41	24.5	42.7	26.4	21.1	No vehicle movements. Site noise just audible
Glebe Crescent	15:52	66.0	81.2	71.3	36.5	Measurement included car-pass-bys. No site noise audible
	00:01	28.6	61.1	28.8	23.9	No vehicle movements. Site noise just audible
	01:07	51.7	80.2	29.3	23.0	Measurement included car-pass-bys. Site noise just audible

During the daytime noise levels were around 50 dB L_{Aeq} at Commonside and around 66 dB L_{Aeq} at Glebe Crescent. Site noise was not audible at the nearest noise sensitive receptors. Noise sources included vehicle movements on the B1145, birdsong and distant road traffic noise.

At night, during lulls of vehicle movements, external noise levels were in the region of 25 – 29 dB $L_{Aeq,15min}$ and noise from the site was just audible in the form of a continuous low frequency hum. Other noise sources during the night time measurement period included birdsong and distant road traffic noise.

Section 4 Survey Results

4.1.2 Spectral Component of Off-Site Data

The third octave band noise data, acquired at night for the two off-site measurements during the absence of extraneous noise sources, are presented as charts in Figures 1 and 2.

Figure 1 Spectral content of noise measured at Glebe Crescent (third octave band)

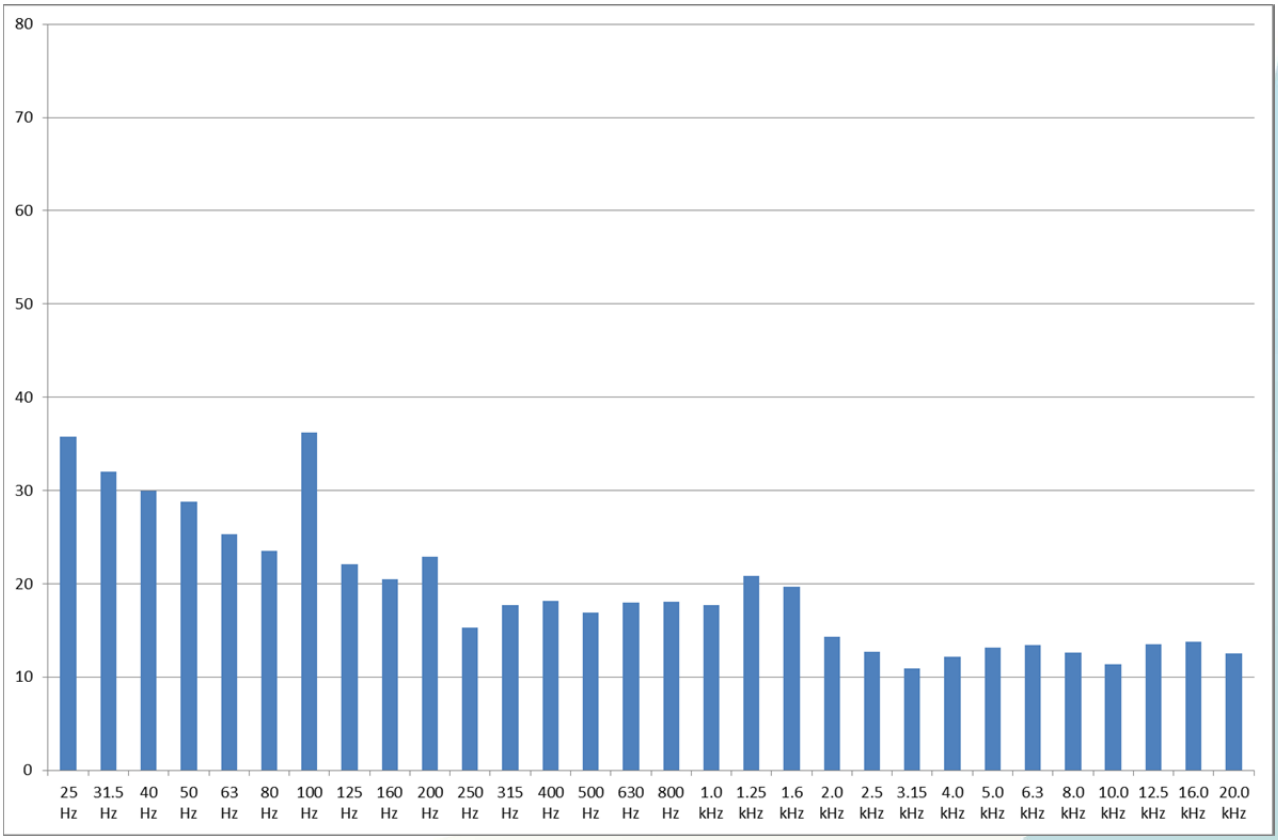

Figure 1 highlights at this location, there was a distinct peak in the noise data at 100 Hz.

Section 4 Survey Results

Figure 2 Spectral content of noise measured at Commonside (third octave band)

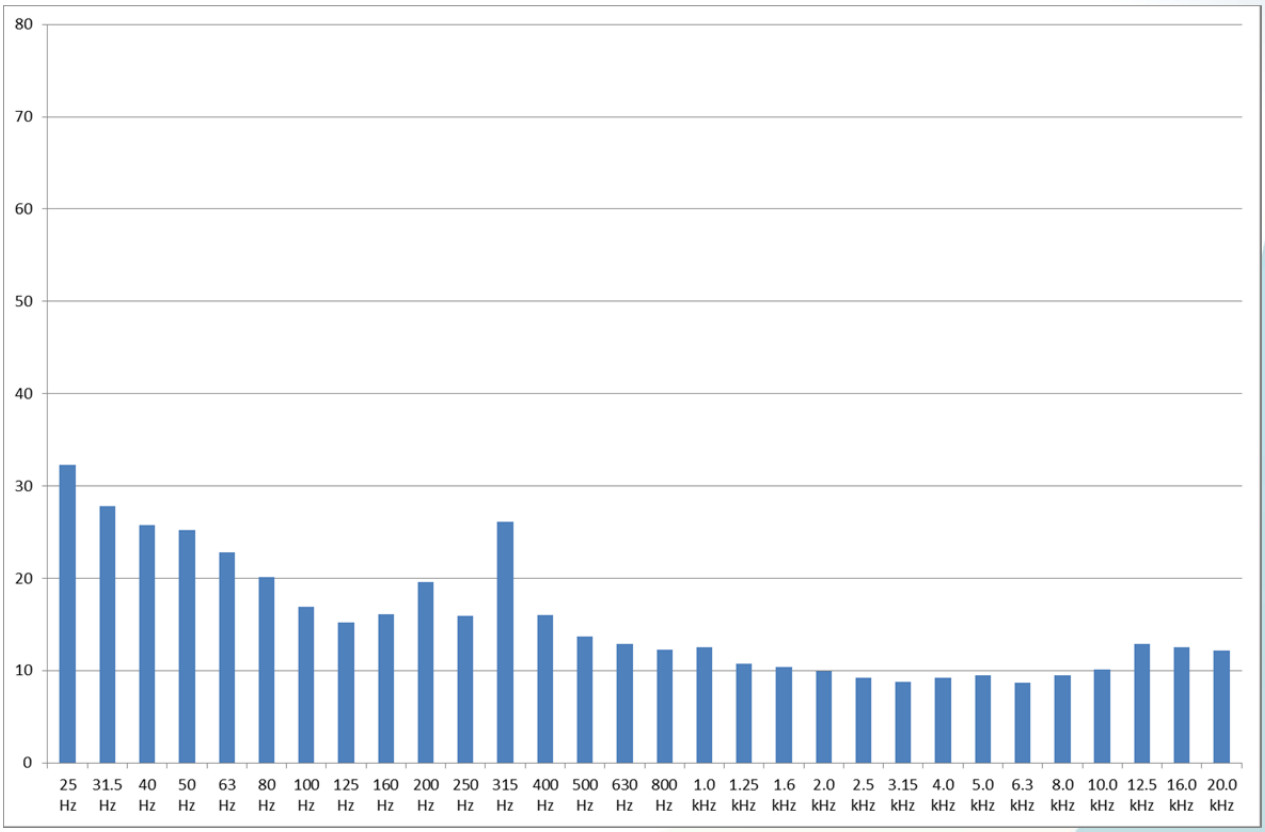

Figure 2 highlights at this location, there was a distinct peak in the noise data at 315 Hz.

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4.1.3 On-Site Survey - Measurement Summary

Table 5 Summary – substation source noise levels

Location	Description	dB L_{Aeq}
1	5m from Shunt Reactor 1	68.9
		68.2
2	5m from Shunt Reactor 2	70.1
		70.6
3	North-east corner of compound	59.7
4	South-west corner of compound	56.7
5	Western boundary of compound, near office	66.4
6	North-west corner of compound	66.8

The primary noise sources operating at the site were the two-shunt reactors. The measurements show that noise levels associated with the shunt reactors were in the range of 68 – 71 dB L_{Aeq}.at a distance of 5m.

4.1.4 Spectral Component of On-Site Data

The third octave band noise data acquired for the four measurements made close to the shunt reactors have been logarithmically averaged. A chart to show the spectral component of noise associated with the shunt reactors is presented in **Figure 3**.

Section 4 Survey Results

Figure 3 Spectral content of noise source data (third octave band)

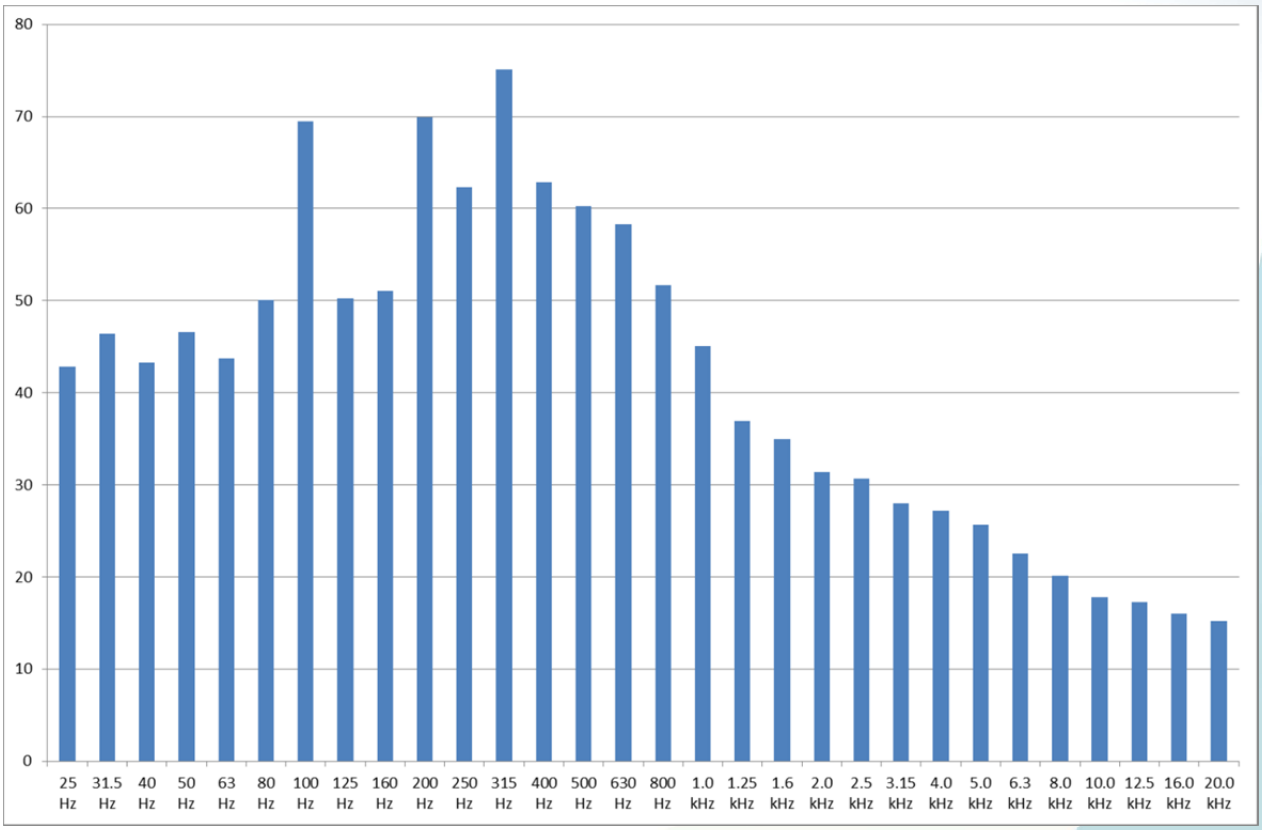


Figure 3 highlights that there were distinct peaks in the source noise data at 100 Hz, 200 Hz and 315 Hz.

4.1.5 Baseline Noise Survey Results Analysis

The results of the noise survey show that, in lulls of extraneous noise sources, site attributed external noise levels were up to 29 dB $L_{Aeq,15min}$ at nearest noise sensitive receptors.

WHO guidelines suggest that an open window offers around 10 - 15 dB attenuation. With this in mind it is anticipated that site attributed noise levels would be around 14 – 19 dB(A) inside the properties. This is at least 10 dB below the night noise threshold suggested by WHO.

Nevertheless, a noise complaint regarding a low frequency tone has been submitted and the spectral analysis of noise measured at the two assessed receptors correlates with the frequency content exhibited by the noise sources. Figure 1 and Figure 2 highlight that, , the noise levels measured at the receptor positions were approximately 10 - 15 dB higher at the third octave band centre frequencies of 100 Hz and 315 Hz than adjacent third octave bands.

Section 4 Survey Results

4.2 Noise Survey at 21 Chapel Street

4.2.1 Substation Site Boundary - Measurement Summary

A summary of the measured data are presented in **Table 6.**

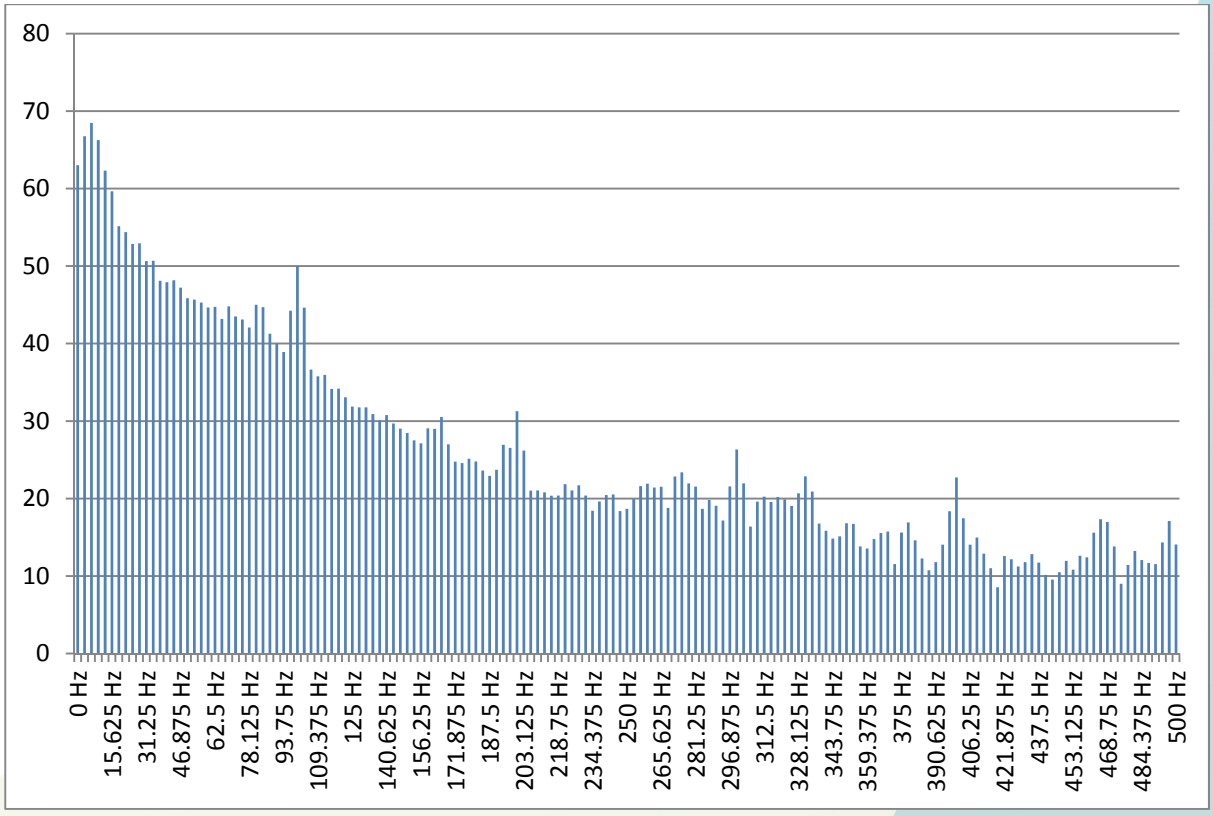
Table 6 Measured noise levels at substation site boundary (roadside)

Name	Start time	dB L_{Aeq}	dB L_{AF10}	dB L_{AF90}	dB L_{AFmax}	dB L_{Zeq} 100Hz	dB L_{Aeq} 100Hz
Total	29/07/2014 22:40	37.0	39.4	34.3	48.1	50.6	31.5

4.2.2 Spectral Component of Substation Site Boundary Data

The third octave band noise data, acquired during the night time period at the substation site boundary in the absence of extraneous noise sources, are presented as charts in **Figure 4** and **Figure 5**.

Figure 4 Narrowband spectrum of substation noise at site boundary (linear)



At the site boundary location, adjacent to the B1145, dominant tones were detected at the following frequencies (linear):

- 100Hz 50.0dB
- 200Hz 31.3dB
- 300Hz 26.3dB
- 400Hz 22.7dB

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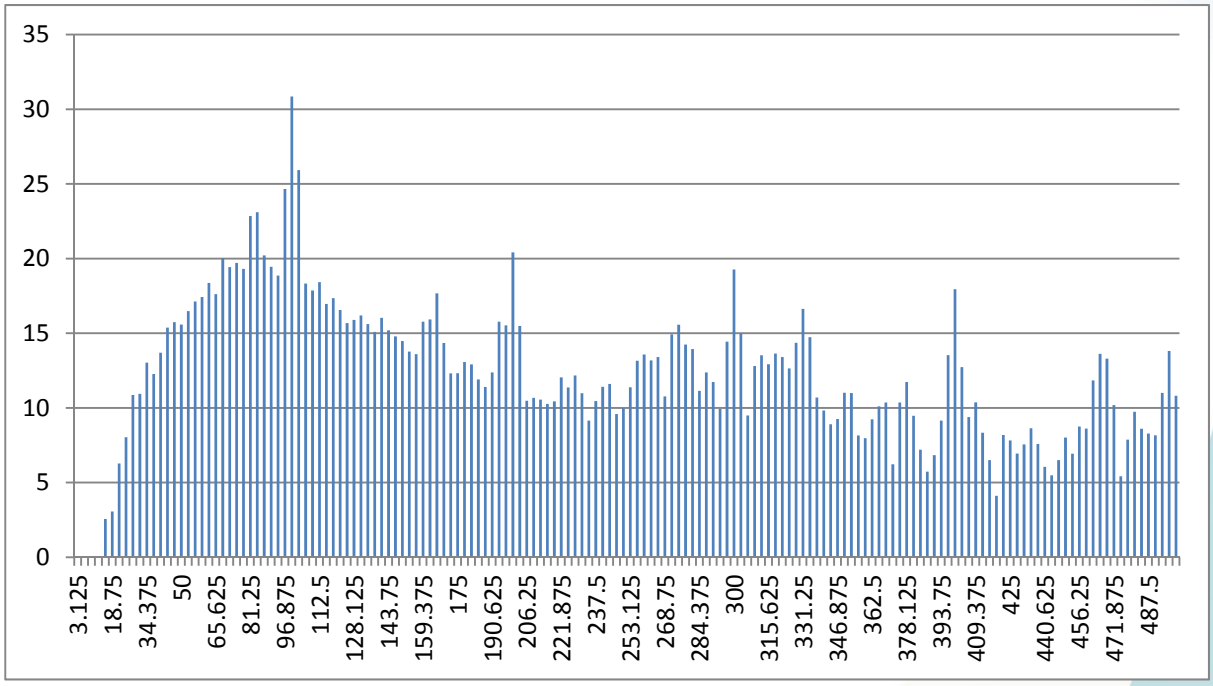
Figure 5 Narrowband spectrum of substation noise at site boundary (A-weighted)



At the site boundary location, adjacent to the B1145, dominant tones were detected at the following A-weighted frequencies:

- 100Hz 30.9dB
- 200Hz 20.4dB
- 300Hz 19.3dB
- 400Hz 18.0dB

4.2.3 Background Location (Reepham) - Measurement Summary

A summary of the measured data are presented in **Table 7.**

Table 7 Measured external background noise levels near Reepham

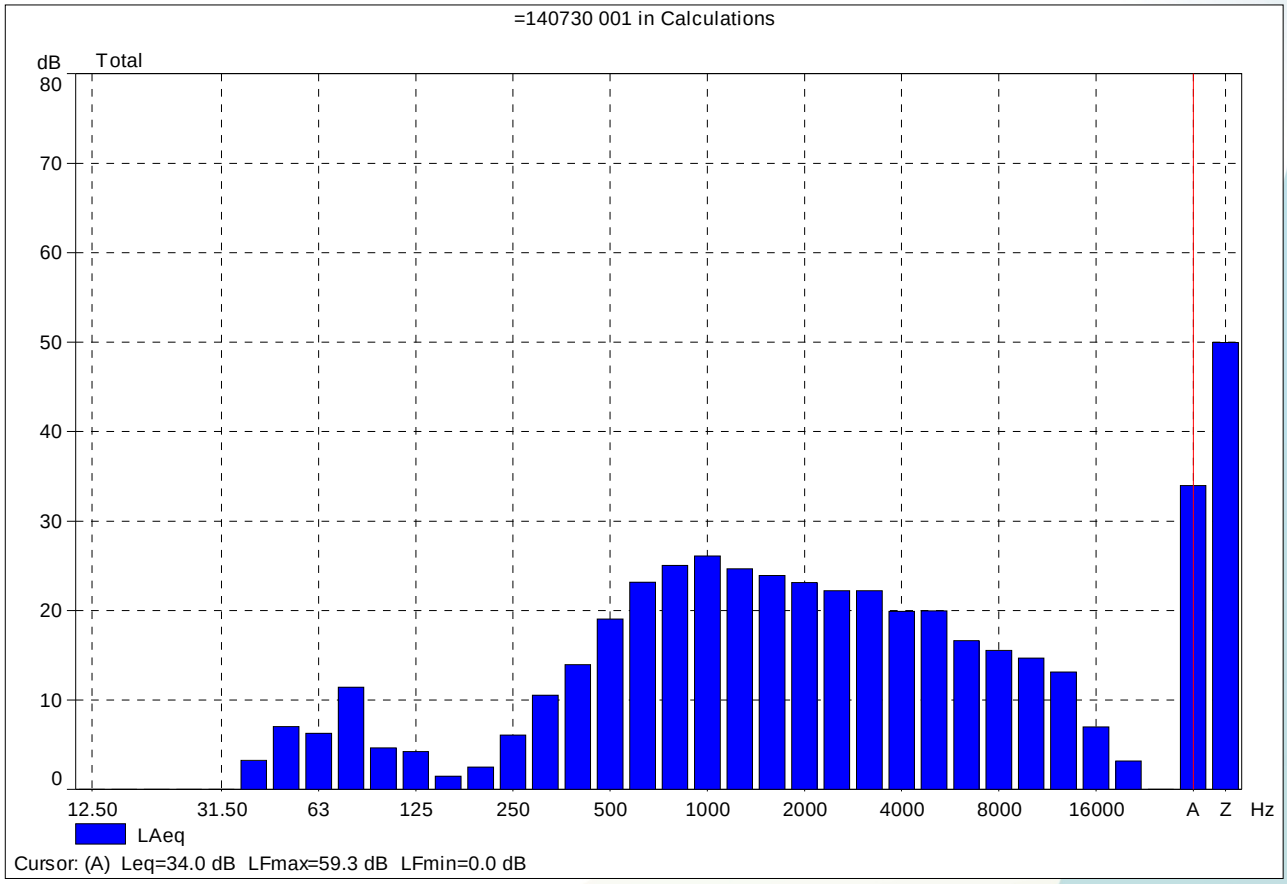
Name	Start time	dB L_{Aeq}	dB L_{AF10}	dB L_{AF90}	dB L_{AFmax}	dB L_{Aeq} 100Hz
Total	30/07/2014 00:13	34.0	34.8	23.2	59.3	4.7

4.2.4 Spectral Component of Background Location (Reepham)

The third octave band noise data, acquired during the night-time period at the background location near Reepham in the absence of extraneous noise sources, are presented as a chart in **Figure 6**.

Section 4 Survey Results

Figure 6 Spectral content of measured noise data (third octave band)



4.2.5 Rear Bedroom of 21 Chapel Street - Measurement Summary

A summary of the measured data are presented in **Table 8** along with observations made regarding the character of noise and any specific noise sources audible during the survey.

Table 8 Measured noise levels in rear bedroom

Name	Start time	dB L_{Aeq}	dB L_{AF10}	dB L_{AF90}	dB L_{AFmax}	dB L_{Zeq} 100Hz	dB L_{Aeq} 100Hz
Total	29/07/2014 23:21	37.8	39.7	35.6	43.8	31.9	12.8

4.2.6 Spectral Component of Measured Bedroom Level Data

The third octave band noise data, acquired at night in the first floor rear bedroom of 21 Cawston Street, are presented as charts in **Figure 7** and **Figure 8**.

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Figure 7 Narrowband spectrum in 21 Cawston Street rear bedroom (linear) – Night time

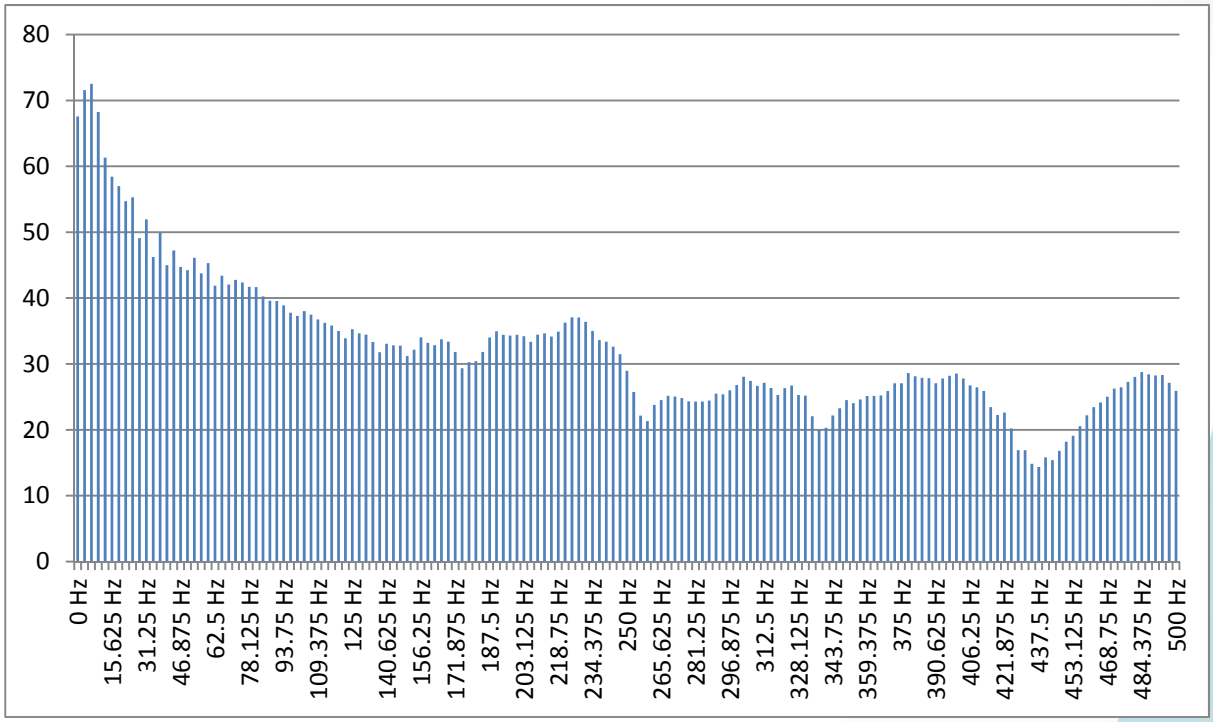

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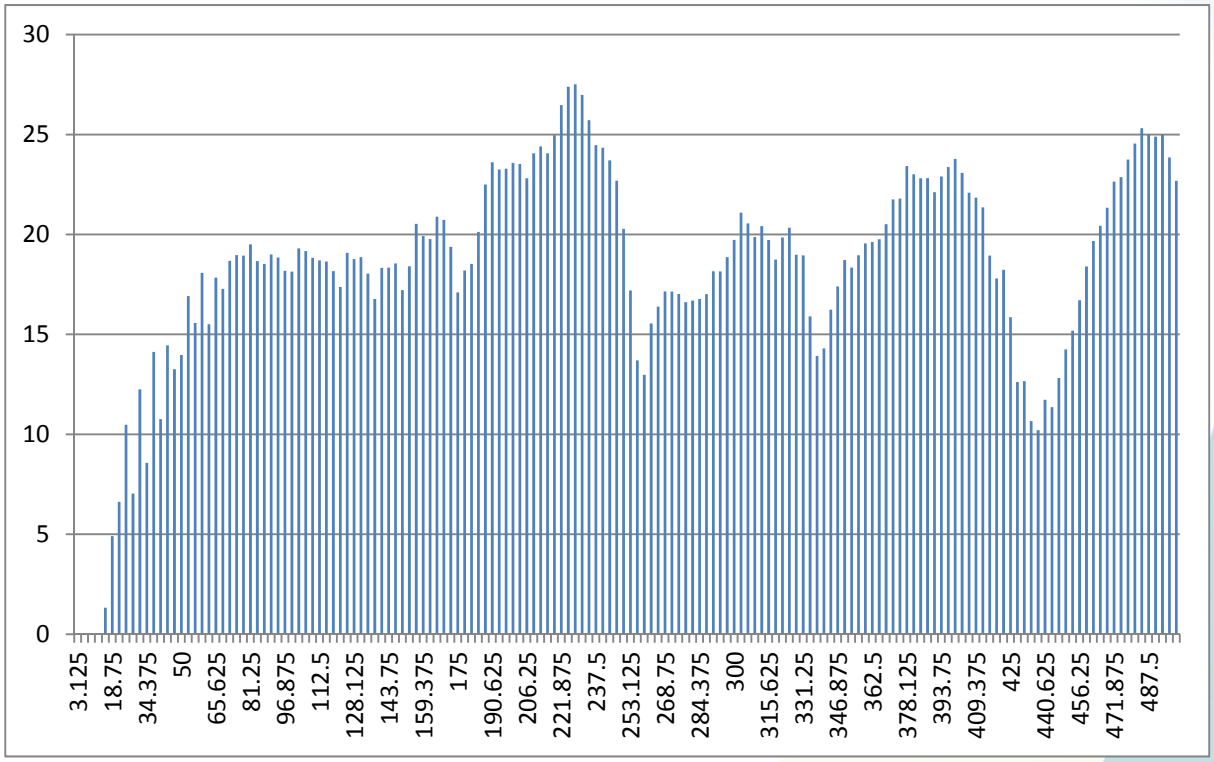
Figure 8 Narrowband spectrum in 21 Cawston Street rear bedroom (A-weighted) – Night time



Figures 7 and **8** indicate that the dominant tones identified at the substation site boundary are not present in the bedroom. The above narrowband assessment will include household electrical noise present at the time of the survey.

4.2.7 21 Chapel Street Noise Survey Results Analysis

Figures 7 and **8** indicate that the dominant tones identified at the substation site boundary are not present in the bedroom.

The 100Hz tone from the Cawston substation site was audible when very close to the open bedroom window, although this was at a very low level. The tone was not detectable within the bedroom, as **Figures 7** and **8** indicate, and Tony Garland confirmed that the noise did not constitute a statutory nuisance on this occasion. The conclusions of the joint noise survey were relayed to Mr Sutton and Mr Livingstone immediately following the survey.

Mr Sutton explained that he has written to other residents in the village requesting their opinion on the substation noise and has urged them to pursue a noise complaint through BDC if they believe the noise to be a nuisance. Tony Garland will need to investigate each complaint on its own merit, however it can be concluded that a likely similar conclusion would be drawn if other residents were to lodge a complaint.

The substation tonal noise was also detectable at a very low level at the junction of Chapel Street and High Street. The noise was akin to that emitted from a street light when a bulb requires replacement. As the noise was at such a low level, it can be concluded that it would not likely be detectable inside a dwelling, even with a bedroom window open.

4.3 Historical Survey Work

dB Attenuation Ltd. examined the noise levels in and around the original substation since energisation and their report Ref: dB/SR/23073/JB/002 (February 2012) provides a comparison to the previously completed acoustic report, document

Section 4 Survey Results

dB/SR/2224/JB/001. It was concluded through a predictive assessment that there would be noise content at 100Hz in the region of 34dB outside the Eastern cottages. This conclusion aligns with the monitoring results presented in **Section 4.1**.

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5 Harmonic Filters

Section 5 Harmonic Filters

5.1 Noise from Proposed Harmonic Filters

It is understood that there are proposals to install harmonic filters at the Cawston site, which involves works consented as part of the original Sheringham Shoal substation development. No noise data is currently available for this equipment. In order to avoid the potential for increased noise emission from the site it is recommended that noise from the new equipment is controlled such that the contribution is at least 10dB below existing noise levels. Assuming that the new equipment will be located in close proximity to the existing plant (i.e. no closer to noise sensitive receptors), this should result in no observable cumulative increase from the site and noise from the existing shunt reactors would remain entirely dominant. **Table 9** presents the data from **Figure 3** in tabular format along with recommended maximum noise levels, at 5m distance, for the proposed harmonic filters.

Table 9 Noise spectrum from existing shunt reactors (at 5m distance) and recommended upper limit for noise associated with proposed plant (at 5m distance)

Frequency	Existing Plant Noise Level at 5m distance (dB)	Recommended Upper Limit for Noise Associated with Proposed Plant at 5m distance (dB)
25 Hz	42.8	32.8
31.5 Hz	46.4	36.4
40 Hz	43.2	33.2
50 Hz	46.6	36.6
63 Hz	43.7	33.7
80 Hz	50.1	40.1
100 Hz	69.5	59.5
125 Hz	50.2	40.2
160 Hz	51.1	41.1
200 Hz	69.9	59.9
250 Hz	62.4	52.4
315 Hz	75.1	65.1
400 Hz	62.8	52.8
500 Hz	60.2	50.2
630 Hz	58.3	48.3
800 Hz	51.7	41.7
1.0 kHz	45.1	35.1
1.25 kHz	36.9	26.9
1.6 kHz	35.0	25.0
2.0 kHz	31.4	21.4
2.5 kHz	30.7	20.7
3.15 kHz	28.0	18.0
4.0 kHz	27.2	17.2
5.0 kHz	25.6	15.6
6.3 kHz	22.6	12.6
8.0 kHz	20.1	10.1
10.0 kHz	17.8	7.8
12.5 kHz	17.2	7.2
16.0 kHz	16.1	6.1
20.0 kHz	15.2	5.2

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6 Summary and Conclusions

Section 6 Summary and Conclusions

6.1 Summary and Conclusions

6.1.1 Baseline noise survey

A noise survey was conducted between 24 June 2014 and 25 June 2014 to characterise the existing noise levels affecting the nearest noise sensitive receptors to the site.

The primary noise sources operating at the site were the two shunt reactors. The measurements show that noise levels associated with the shunt reactors were in the range of 68 – 71 dB L_{Aeq} at a distance of 5m.

The results of the off-site noise survey show that, in lulls of extraneous noise sources, site attributed external noise levels were up to 29 dB $L_{Aeq,15min}$ at nearest noise sensitive receptors.

WHO guidelines suggest that an open window offers around 10 - 15 dB attenuation. With this in mind it is anticipated that site attributed noise levels would be around 14 – 19 dB(A) inside the properties. This is at least 10 dB below the night noise threshold suggested by WHO.

The results of the noise survey align with the previous predictive work undertaken by dB Attenuation Ltd.

6.1.2 Noise survey at 21 Chapel Street

A noise survey was conducted on 29 July 2014 to characterise the existing noise levels at the substation site boundary (roadside) and within the rear bedroom of 21 Chapel Street, Cawston The survey concluded that the 100Hz tone attributed to the plant operating at the Cawston substation was audible when very close to the open rear bedroom window, although this was at an extremely low level. The tone was not detectable within the bedroom. Tony Garland, EHO at BDC, confirmed that the noise did not constitute a statutory nuisance on this occasion. Tony Garland also informed Mr Sutton and Mr Livingstone of the conclusions following the survey.

6.1.3 Harmonic filter installation

To avoid the potential for increased noise emission from the substation following the installation of the harmonic filters, the assessment has concluded that noise from the new equipment is controlled such that the contribution is at least 10 dB below existing noise levels. Assuming that the new equipment will be located in close proximity to the existing plant (i.e. no closer to noise sensitive receptors), this should result in no observable cumulative increase from the site and noise from the existing shunt reactors would remain entirely dominant.

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Appendix A

Site Plan

Appendix A

Baseline Site and Off-Site Measurement Locations

Appendix A

21 Chapel Street Survey

Substation and Complainant Monitoring Locations

Background Monitoring Location (Reepham)

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Appendix B

Acoustic Terminology

Appendix B

Term	Description
Decibel (dB)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 µPa, the threshold of normal hearing is 0dB, and 140dB is the threshold of pain. A change of 1dB is only perceptible under controlled conditions. Under normal conditions a change in noise level of 3dB(A) is the smallest perceptible change.
dB(A)	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 level 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).
FFT	Fast Fourier Transfer. A digital signal processing technique that converts a time record into a narrow band constant bandwidth filtered spectrum. Measurements are defined by specifying the frequency span and a number of lines (or filters).
$L_{Aeq,T}$	The equivalent continuous sound level – the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,\,T}$ is used to describe many types of noise and is the conventional descriptor of environmental noise, and this is defined below. $$L_{eq,T} = 10 \times \log\left[\frac{1}{T}\int \frac{\rho^2(t)\,\partial t}{\rho_0^2}\right] \text{dB}$$
$L_{A10,T}$	The A weighted noise level exceeded for 10% of the specified measurement period (T). L_{A10} is the index generally adopted to assess traffic noise.
$L_{A90,\,T}$	The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 1990 it is used to define the 'background' noise level.
L_{Amax}	The maximum A-weighted sound pressure level recorded during a measurement.
L_{Amin}	The minimum A-weighted sound pressure level recorded during a measurement.
R_w	The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory to BS EN ISO 140-3:1997 and ratings to BS EN ISO 717-1:1997. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings (apparent weighted sound reduction index) and measured to BS EN ISO 140-4:1998