Little Crow
Solar Park

Little Crow Solar Park, Scunthorpe

ENVIRONMENTAL STATEMENT: TECHNICAL APPENDICES

APPENDIX 4.9

NOISE IMPACT ASSESSMENT

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On behalf of INRG Solar (Little Crow) Ltd

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LITTLE CROW SOLAR PARK,

SCUNTHORPE

NOISE IMPACT ASSESSMENT

Report **14027-NIA-01 RevE**

Prepared on 19 November 2020

Issued For:

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Contents

List of Attachments

1.0 INTRODUCTION

Clement Acoustics has been commissioned by INRG Solar (Little Crow) Ltd to measure existing background noise levels at the proposed Little Crow Solar Park to the west of Appleby Lane, Scunthorpe DN20 0BG. The measured noise levels have been used to determine noise emission criteria for plant associated with a proposed solar park in agreement with the planning requirements of North Lincolnshire Council.

This report presents the results of the environmental survey followed by noise impact calculations and outlines any necessary mitigation measures.

2.0 SITE DESCRIPTION

The main element of the proposal is the construction, operation, maintenance and decommissioning of a ground mounted solar park and associated battery storage with an intended design capacity of over 50MWp (megawatts peak). As associated development, battery storage will allow the development to fully utilise the network connection capacity when the solar park is not exporting at peak capacity. The batteries would be available to store energy from and release electrical energy to the local electricity network.

Proposals will include the installation and operation of associated equipment and plant units.

Surrounding properties identified as residential are shown on the attached site plan and have been identified as the nearest affected receivers. These nearest noise sensitive receivers were identified through observations on-site. If there are any receivers closer to that identified within this report then a further assessment will need to be carried out. Therefore, the closest noise sensitive receptor should be confirmed by the client before the plant is installed or any noise mitigation measures are implemented.

The residential receivers are identified as follows, as reflected on the attached site plan:

- Receiver 1: Farm with associated dwellings to the north east,
- Receiver 2: Residential house to the north east,
- Receiver 3: Chicken farm with associated dwelling to the east,
- Receiver 4: Residential houses on South View and surrounding residential roads.

The receiver locations are shown in attached site plan 14027-SP1.

3.0 ENVIRONMENTAL NOISE SURVEY

3.1 Unattended Noise Survey Procedure

Measurements were undertaken at three positions as shown on the existing site in attached site plan 14027-SP1. The choice of these positions was based both on accessibility and on collecting representative noise data in relation to the nearest affected receivers.

The surroundings and position used for each monitoring location are described in Table 3.1.

Position No.	Description
1	The microphone was mounted on a tripod at the northeast of the site, towards receivers to the northeast. The microphone was positioned 1.5 m from the ground and away from any reflective surfaces. [1]
2	The microphone was mounted on a tripod at the east of the site, close to the existing farm premises. The microphone was positioned 1.5 m from the ground and away from any reflective surfaces. [1]
3	The microphone was mounted on a tripod at the southeast of the site. The microphone was positioned 1.5 m from the ground and away from any reflective surfaces. [1]

Table 3.1: Description of unattended monitoring locations

Note [1]: The position was considered to be free-field according to guidance found in BS 4142: 2014, and a correction for reflections has therefore not been applied.

Continuous automated monitoring was undertaken for the duration of the survey between 13:45 on 27 September 2018 and 19:00 on 30 September 2018.

The measurement procedure generally complied with BS 7445: 1991: '*Description and measurement of environmental noise, Part 2- Acquisition of data pertinent to land use*'.

3.2 Weather Conditions

At the time of set-up and collection of the monitoring equipment, the weather conditions were generally dry with light winds.

Weather conditions during the survey period have been obtained from the internet resource www.wunderground.com, which identified Humberside Airport as the nearest weather station. Wunderground.com indicates that there was no precipitation during the surveys, with windspeeds generally less than 12 mph, with only short periods with gusts above that.

It is considered that the weather conditions did not significantly adversely affect the measurements and are therefore considered suitable for the measurement of environmental noise.

3.3 Equipment

The equipment calibration was verified, by means of a field verification check, before and after use and no abnormalities were observed.

The equipment used was as follows.

- 2 No. Svantek Type 957 Class 1 Sound Level Meter
- 1 No. Svantek Type 971 Class 1 Sound Level Meter
- Norsonic Type 1251 Class 1 Calibrator

4.0 RELEVANT NOISE CRITERIA

4.1 Local Authority Statement of Common Ground

Further to liaison with the Local Authority, a Statement of Common Ground (Document Ref 9.4 LC OTH), has been established, wherein it has been agreed that British Standard 4142: 2014 '*Methods for rating and assessing industrial and commercial sound*' is the appropriate standard to assess the effects of operational noise of the solar park.

4.2 Operational Noise: BS 4142: 2014 Criteria

In a BS 4142 assessment, corrections are applied to noise levels in order to calculate a noise rating level for the effects of proposed activities on nearby noise sensitive receivers. Levels are calculated at the nearest residential window.

The available penalties for different characteristics are summarised in Table 4.1.

Characteristic	Comments	Maximum Penalty
Tonality	Can be converted to 2 dB for a tone which is just perceptible, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible	6 dB
Impulsivity	Can be converted to 3 dB for impulsivity which is just perceptible, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible	9 dB
Distinctiveness	Intended for sources that are neither tonal nor impulsive, but distinctive against background noise sources	3 dB
Intermittency	When the sound has identifiable on/off conditions	3 dB

Table 4.1: Available penalties according to BS4142

BS 4142 states that a noise rating 5 dB above the background noise level is likely to be an indication of an adverse impact. If the difference is 10 dB or more, then this is stated as likely to be an indication of a significant adverse impact. Where the rating level does not exceed the background noise level, this is stated as an indication of the sound source having a low impact.

4.3 Construction Noise: BS 5228-1: 2009 Criteria

The method for assessing the severity of construction noise on residential properties is presented as Example Method 1 (the ABC Method) of British Standard 5228-1: 2009 '*Code of practice for noise and vibration control on construction and open sites. Part 1: Noise*' (BS 5228), within section E.3.2.

Table E.1 from the standard is reproduced below in Table 4.2.

Assessment Category and threshold value period (L_{Aeq})	Category A[A]	Category B[B]	Category C[C]
Daytime (07:00 - 19:00) and Saturdays (07:00 - 13:00)	65	70	75
Note 1: A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold value for the category appropriate to the ambient noise level. Note 2: If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity. Note 3: Applied to residential receptors only.			
[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values [B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. [C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			

Table 4.2: Guidance on setting noise emission thresholds for construction sites

The measured ambient noise levels on site will be used to determine suitable criteria for construction noise, according to the above method.

5.0 RESULTS

The $L_{Aeq: 5min}$, $L_{Amax: 5min}$, $L_{A10: 5min}$ and $L_{A90: 5min}$ acoustic parameters were measured at the locations shown in site drawing 14027-SP1.

The measured noise levels are shown as time histories in Figures 14027-TH1 to TH3.

5.1 Background Noise Levels for BS 4142 Assessment

Analysis of the measured background noise levels has been undertaken in accordance with the statistical analysis method example as shown in Figure 4 of BS 4142: 2014. It should be noted that the guidance of the standard is as follows:

"The objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods."

The frequency distribution of background noise levels measured during the worst-case proposed hours of operation (07:00 to 17:00) are shown in Figures 5.1 to 5.3 for Positions 1 to 3 respectively.

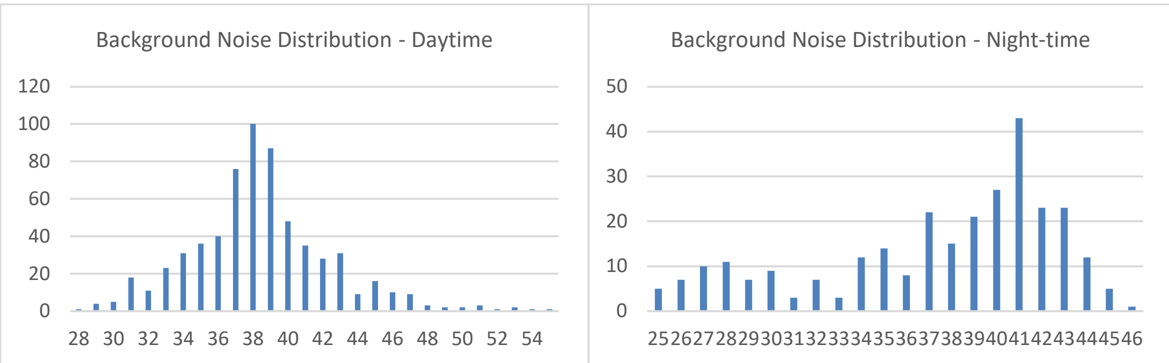


Figure 5.1: Statistical analysis of the background noise level at Position 1

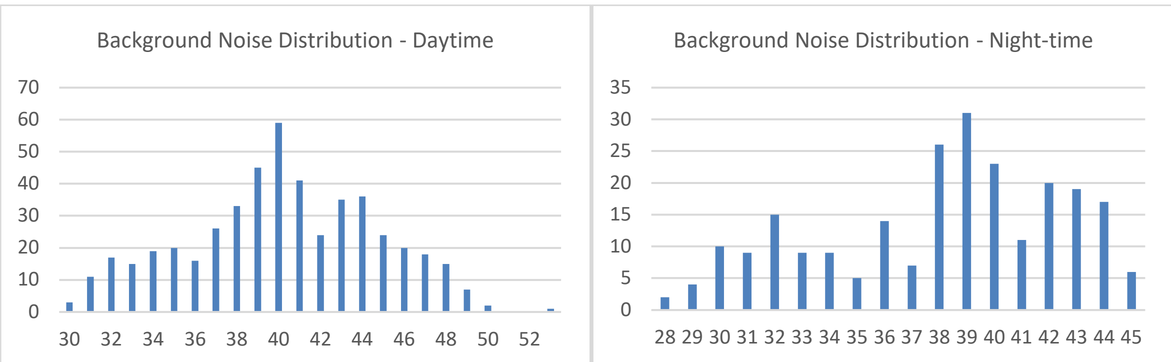


Figure 5.2: Statistical analysis of the background noise level at Position 2

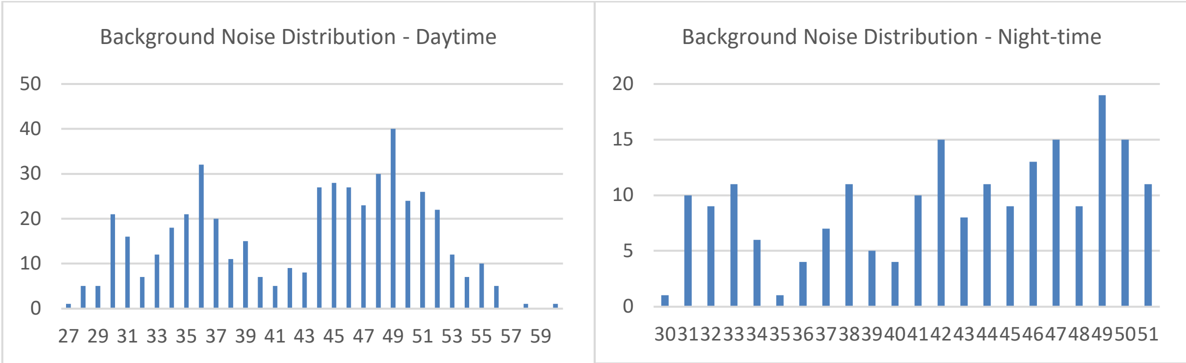


Figure 5.3: Statistical analysis of the background noise level at Position 3

Based on the analysis shown in Figures 5.1 to 5.3, the typical background noise level has been determined to be **36 dB(A) during daytime hours** and **32 dB(A) during night-time hours**. This is considered to be in accordance with the conclusions drawn from the same methodology when used in the BS 4142: 2014 example.

5.2 Ambient Noise Levels for BS 5228 Assessment

The data from the surveys has been analysed, with calculated ambient noise levels as shown in Table 5.1.

Period	Average Ambient Noise Level $L_{eq,T}$
POSITION 1 – NORTHEAST OF SITE	
Daytime [07:00 - 23:00]	47 dB(A)
Night-time [23:00 - 07:00]	43 dB(A)
POSITION 2 – EAST OF SITE	
Daytime [07:00 - 23:00]	47 dB(A)
Night-time [23:00 - 07:00]	42 dB(A)
POSITION 3 – SOUTHEAST OF SITE	
Daytime [07:00 - 23:00]	53 dB(A)
Night-time [23:00 - 07:00]	48 dB(A)

Table 5.1: Site noise levels for daytime and night time

By comparing the levels shown in Table 5.1 with the guidance shown in Table 4.2, it is shown that this site falls into Category A.

The guidance subsequently states that where the cumulative level due to construction noise and the existing ambient noise exceeds **65 dB(A)**, a significant effect has been deemed to occur.

As the existing ambient noise levels shown in Table 2.1 are more than 10 dB below this threshold value, this in effect becomes the threshold level for construction noise in isolation.

Calculations have been undertaken according to the guidance given in BS 5228 in order to predict worst-case levels of noise emissions.

6.0 PRELIMINARY NOISE IMPACT ASSESSMENT – OPERATIONAL NOISE

Exact details of the proposed plant installation are not currently known. However, a preliminary assessment has been undertaken in order to establish the likelihood of mitigation being required to avoid an unacceptable noise impact on the identified receptors.

Based on typical data for similar projects, and the known requirements for this project, and assessment has been undertaken considering the following indicative plant units:

- Battery Compound (16 Battery Containers)
  - 32 No. HVAC Units: Sound Power Level of Each 79 dB(A)
  - 36 No. Transformers: Sound Power Level of Each 70 dB(A)
  - 36 No. Inverters: Sound Power Level of Each 79 dB(A)
  - **Cumulative Sound Power Level 97.8 dB(A)**
- Substation Compound
  - 132 kV Transformer: Sound Power Level 90 dB(A)
- Inverter / Transformers (29 No. Distributed Around the Site)
  - Sound Pressure Level of Each (at 1 m) 85 dB(A)

The spectral content of noise emissions has been predicted using measured noise levels obtained from similar operational sites. In line with the guidance of BS 4142: 2014, a +3 dB penalty has been applied to the stated noise emissions, in order to account for potentially identifiable 'on/off' periods.

It is understood the Battery and Substation Compounds could be operational at any time, whereas the Inverter / Transformers around the site will be operational during daylight hours only.

It should be noted that there are currently two proposals for the layout of the site (Work No. 2A and Work No. 2B), with the location of the battery compound yet to be finalised. Figure 6.1 shows the two proposed layouts for the northern tip of the site.

In Work No. 2A (the preferred location), the battery compound will be located in a protrusion from the north surrounded by trees, while in Work No. 2B, the battery compound is located just to the north of the Substation Compound.

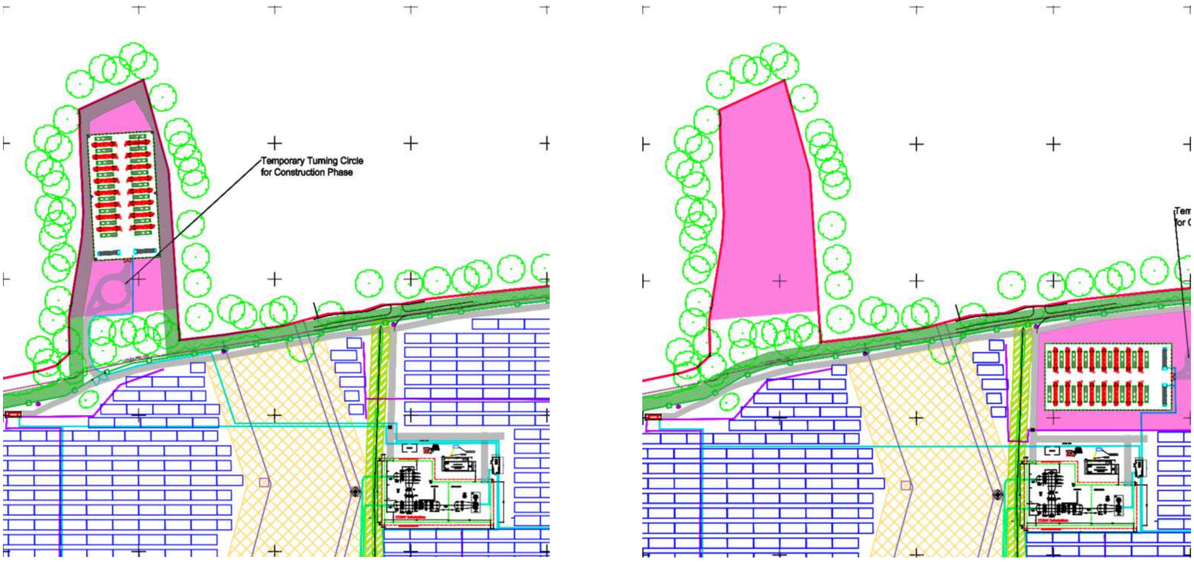


Figure 6.1: Indication of Battery Compound location in Work No. 2A and Work No. 2B

Based on the noise sources shown above and the topography, noise modelling has been undertaken to investigate complex propagation through the area.

The noise model was constructed using the proprietary noise modelling software package Cadna A. Noise emissions to the identified receptors have been predicted using the calculation methodology outlined in ISO 9613-2.

The noise model was constructed utilising the following assumptions and parameters:

- Locations of obstacles such as screens or barriers in the propagation path
- Presence of reflecting surfaces
- Hardness of the ground between the sources and receivers
- Attenuation due to atmospheric absorption

The proposed layout of the site including locations of noise generating equipment has been established using the Key Plan (Document Ref 2.10 LC DRW).

Modelling has been undertaken for the two proposed layout options.

The model constructed for the Work No. 2A layout is shown in Figure 6.2, overlaid on the Key Plan (Document Ref 2.10 LC DRW).

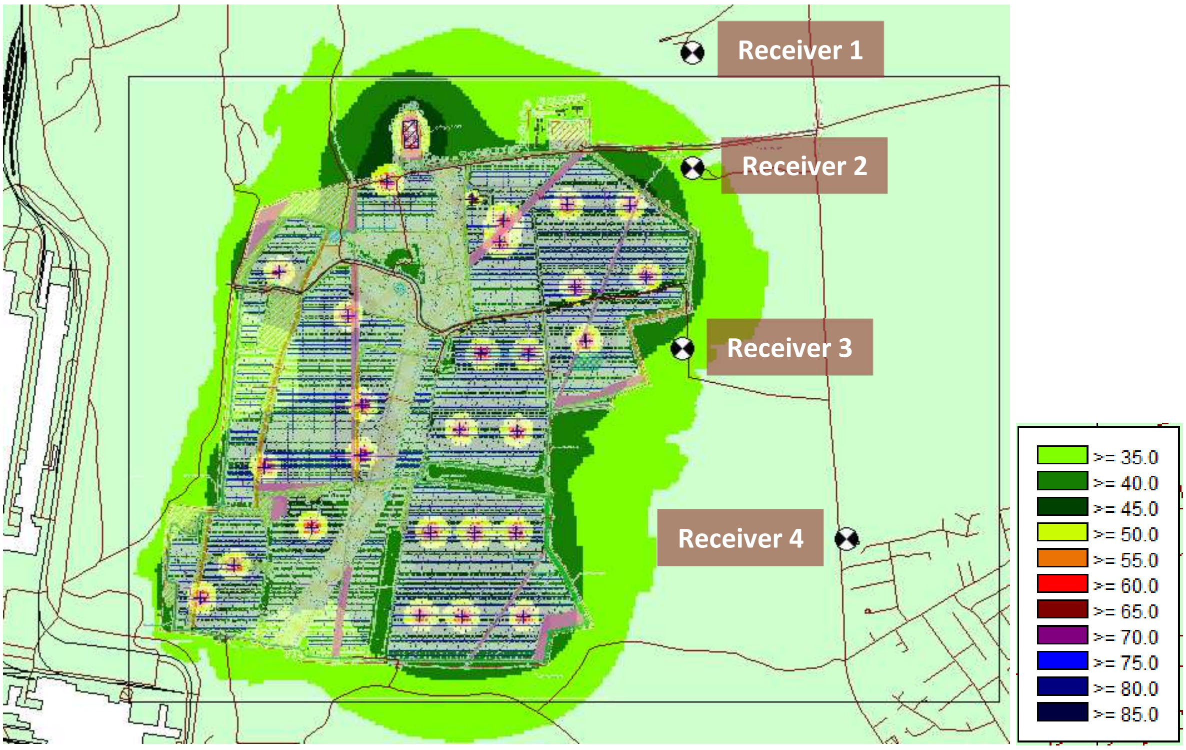


Figure 6.2: View of Noise Map for Work No. 2A Layout

The resulting calculated noise levels at each receiver are summarised in Tables 6.1 and 6.2 for daytime and night-time operation of plant respectively, where they are compared with the established background noise levels.

Receptor	Background Noise Level	Work No. 2A Noise Rating Level	Difference	Work No. 2B Noise Rating Level	Difference
Receiver 1	L_{A90} 36 dB	L_{Aeq} 34.7 dB	-1.3 dB	L_{Aeq} 35.0 dB	-1.0 dB
Receiver 2		L_{Aeq} 40.5 dB	+ 4.5 dB	L_{Aeq} 40.6 dB	+ 4.6 dB
Receiver 3		L_{Aeq} 41.9 dB	+ 5.9 dB	L_{Aeq} 41.9 dB	+ 5.9 dB
Receiver 4		L_{Aeq} 31.3 dB	-4.7 dB	L_{Aeq} 31.4 dB	-4.6 dB

Table 6.1: BS 4142 Assessment for Receivers - Daytime

Receptor	Background Noise Level	Work No. 2A Noise Rating Level	Difference	Work No. 2B Noise Rating Level	Difference
Receiver 1	L_{A90} 32 dB	L_{Aeq} 26.4 dB	-5.6 dB	L_{Aeq} 28.3 dB	-3.7 dB
Receiver 2		L_{Aeq} 27.0 dB	-5.0 dB	L_{Aeq} 29.2 dB	-2.8 dB
Receiver 3		L_{Aeq} 23.9 dB	-8.1 dB	L_{Aeq} 27.2 dB	-4.8 dB
Receiver 4		L_{Aeq} 14.4 dB	-17.6 dB	L_{Aeq} 16.2 dB	-15.8 dB

Table 6.2: BS 4142 Assessment for Receivers – Night-time

As shown in Tables 6.1 and 6.2, there are some exceedances during daytime hours, while night-time levels are expected to comply.

Mitigation has therefore been investigated in the subsequent sections.

6.1 Discussion of Mitigation

As shown in Table 6.1, Receivers 2 and 3 could be subject to levels that exceed desirable levels during daytime hours. A study of partial levels has identified the closest noise sources, which are causing the exceedance.

The identified Inverter / Transformers that could require mitigation are indicated in Figure 6.3, circled in yellow. These have been marked on the Key Plan (Document Ref 2.10 LC DRW).

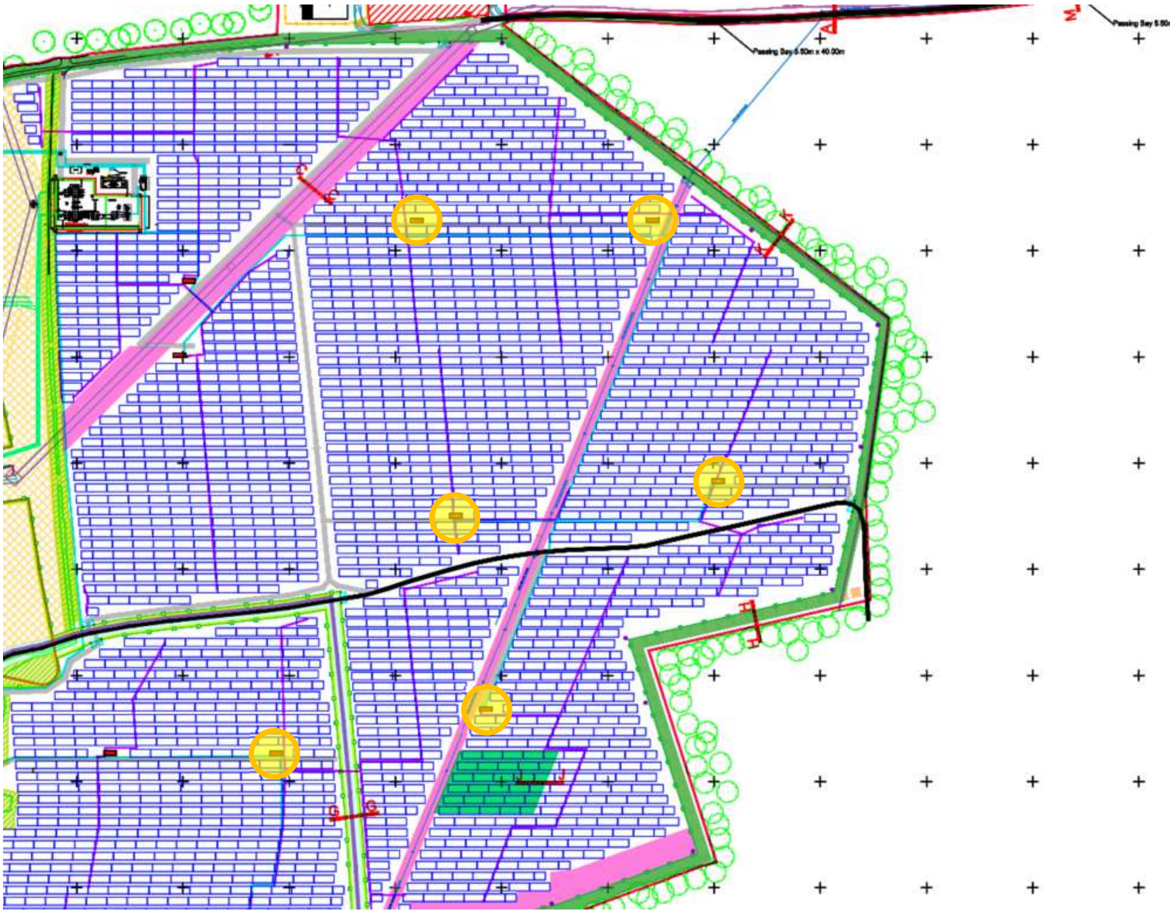


Figure 6.3: View of East of Site, With Mitigation Requirements Indicated

With these 6 Inverter Transformers each reduced by 8 dB, calculations indicate that acceptable conditions could be achieved for all receptors.

For these Transformer Inverters, with source noise levels as currently assumed, an uplift of approximately 8 dB in the acoustic reduction of each container is therefore anticipated as being required.

Note: The above advice is preliminary only, based on the anticipated levels of noise. It is understood that the predicted noise emissions are worst case. Calculations should be undertaken using noise data for the final plant selection before any mitigation is applied.

Through the above measures, it will be demonstrated that any installed plant will not be expected to have a negative impact on the amenity of nearby noise sensitive receivers.

7.0 NOISE IMPACT ASSESSMENT – CONSTRUCTION NOISE

7.1 Description of Sources

Anticipated worst case noise emissions associated with the proposed construction works are summarised in Table 7.1, where typical noise emission levels for the loudest processes are shown. Guidance on typical noise levels has been taken from available manufacturer data and Annexe C of BS 5228.

The loudest anticipated phase of works comprises the installation of fence posts around the perimeter of the site and around the various compounds, and the installation of supports for the solar panels across the site.

This item of works has therefore formed the basis of this assessment.

The anticipated works during this period will be assessed cumulatively. Descriptions of the source data used in calculations and comments on assumptions made are summarised in Table 7.1.

Noise Source	Measured Sound Pressure Level (at stated distance)	Comments	Assumptions
Pushing Panels for Solar Panels and Fence Posts	L_{Aeq} 75 dB, at 10 m[1]	Manufacturer supplied 'maximum noise'. Assumed to be indicative of pushing operations	Assumed to be in use for 50% of the assessment period
Wheeled Excavator (idling)	L_{Aeq} 67 dB, at 10 m	Noise source taken from BS 5228 of similar machinery idling	Assumed to be idling whenever not in use, i.e. 50% of the time

Table 7.1: Noise sources used in assessment

[1] This is a representative level, taken from manufacturer data for an example of self-propelled post-pushing machinery. The stated 'maximum noise' is assumed to be the ambient noise level during loudest operations, in order to present a robust assessment. The measurement distance is not stated, which is assumed to be 10 m as a worst case.

The Outline Construction Traffic Management Plan (Document Ref 7.36 LC TA9.2) details typical working hours as 07:00 to 18:00 on weekdays, with reduced hours of 08:00 to 13:30 on Saturdays. No works are proposed on Sundays / Bank Holidays.

It is understood a minimum of six machines for post-pushing will be on site at any one time, although they are not expected to all be in use simultaneously. The assessed scenario is details in Section 7.3, and has been designed to provide a worst-case assessment.

7.2 Primary Mitigation

Primary mitigation comprises the adoption of the Construction Environment Management Plan [CEMP] (Document Ref 7.8 LC TA4.1), which details ways in which construction noise will be minimised and controlled.

In order to present a robust assessment, the calculations in this report assume worst-case scenarios, i.e. no mitigation or restrictions being applied to the typical levels.

7.3 Assessed Scenario

It is understood the construction works include installation of approximately 80,000 supports for solar panels, as well as fence posts around the perimeter of the site and the compounds.

To provide a particularly robust assessment, it is assumed that 6 machines could be operational at one time, although this is unlikely to be the case.

The assessed scenario is for the cumulative effect of the following proposed sources of noise.:

- Pushing of fence posts using machinery:
    - 3 Machines operational at the closest point of the boundary to Receiver 3 (distance 130 m)
    - East post is understood to take up to 4mins
    - Moving between posts (i.e. machinery idling) assumed to be as little as 4mins, to present a robust assessment.
- Pushing of solar panel supports using machinery:
    - 3 Machines operational at a representative nearby point of the site to Receiver 3 (distance 200 m)
    - East support is understood to take up to 4mins
    - Moving between supports (i.e. machinery idling) assumed to be as little as 4mins, to present a robust assessment.

7.4 Noise Impact Assessment

The closest identified receiver to the closest proposed construction works on the boundary of the Order Limits (Document Ref LC ES CH1) is Receiver 3, at a distance of 130 m. In order to present a particularly onerous assessment, it will be assumed that post pushing works could be occurring on the closest site boundary to Receiver 3 for an entire working day (07:00 to 18:00), in addition to support pushing works on a representative nearby point of the site.

The closest area of site boundary is shown in Figure 7.1 in a zoomed in section of the Key Plan (Document Ref 2.10 LC DRW), which shows the boundary following a corner line around the existing chicken farm. The proposed fence line is denoted in a solid green line.

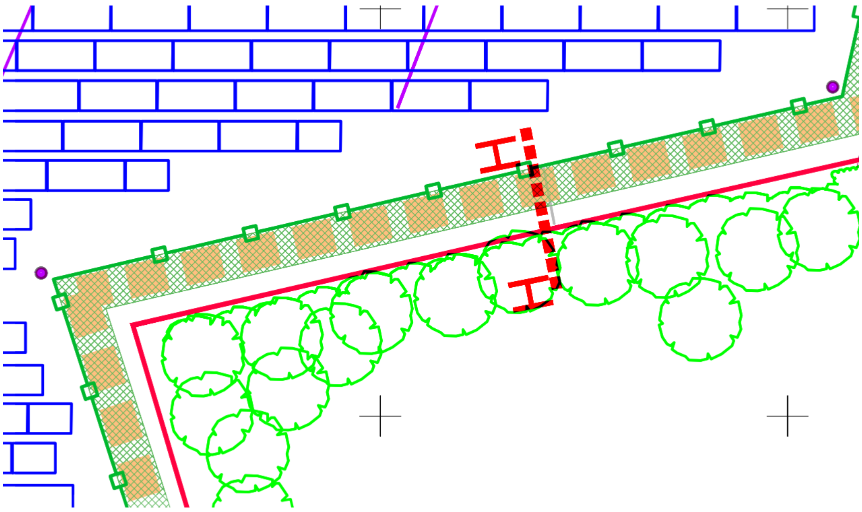


Figure 7.1: View of closest site boundary line to Receiver 3

In order to calculate the correction due to the distance separation to the receivers, the following formula has been used, as defined in Formula F.2 in Annexe F of the standard. This is the appropriate formula to use when the distance separation exceeds 25 m, as is applicable here:

$$K_s = \left(25\log_{10}\frac{R}{10}\right) - 2$$

Where K_s is the distance adjustment and R is the distance separation.

With all corrections as specified in BS 5228 applied, the noise rating levels would be as shown in Table 7.2. Detailed calculations are shown in Appendix B.

Receiver	Threshold for Significant Effects	Calculated Construction Noise at Receiver
Receiver 3	65 dB(A)	53 dB(A)

Table 7.2: Calculated construction noise levels for receivers

As shown in Table 7.2, noise emissions from the worst-case anticipated construction operations at the closest receiver are expected to be below the established threshold for significant effects.

8.0 COMMENTS ON VIBRATION

8.1 Vibration due to Proposed Operations

Vibration is only typically a concern when works are proposed below ground level, involve significant drops, involve movement with mechanical fixings to hard ground or are undertaken in close proximity to receptors.

Proposals are to site all equipment according to manufacturer guidance. The proposed operations do not include any below ground works or significant drops.

Based on the nature of the ground observed in the surroundings (soft ground) and the significant distance to identified receptors, vibration caused by onsite works is expected to be negligible and significantly below the lowest thresholds defined in British Standard 6472:2008 '*Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting*'.

8.2 Vibration due to Construction

In the CEMP (Document Ref 7.8 LC TA4.1), it is clarified that piling will not be undertaken for any foundations or similar. With this sort of piling constituting the main cause of construction vibration, this drastically reduces the likelihood of construction vibration causing a significant effect.

The main source of construction activity will be the pushing of supports for fence posts and solar panel supports. Although a large number of posts and panels require pushing, the amount of vibration anticipated for each element is small.

Further, BS5228-2:2009 '*Code of practice for noise and vibration control on construction and open sites. Vibration*' gives a methodology to predict the transmission of vibration due to piling at receivers. All available formulae have a distance parameter that does not exceed 110 m, indicating that vibration cannot be accurately predicted beyond this distance even for piling operations.

Based on the minimum distance to the closest identified receiver (Receiver 3, at 130 m) and the lack of piling on this site, vibration is therefore expected to be at a level that cannot be predicted or detected and would therefore be considered insignificant.

Further, the ground in the surroundings is observed to be soft, which further reduces the potential for vibration transmission.

9.0 CONCLUSION

An environmental noise survey has been undertaken at the proposed Little Crow Solar Park to the west of Appleby Lane, Scunthorpe DN20 0BG. The results of the survey have enabled criteria to be set for noise emissions from proposed plant units in accordance with the requirements of the Local Authority and relevant British Standards.

A preliminary noise impact assessment has been undertaken using typical worst-case noise data to predict the noise levels, due to the proposed plant, at the nearby noise sensitive receivers.

Preliminary noise modelling indicates that mitigation may be required for a small number of plant units closest to the receptors, but this should be confirmed once more specific details are known.

Further calculations have demonstrated that construction noise is not expected to constitute a significant effect, even during worst-case assumed activity.

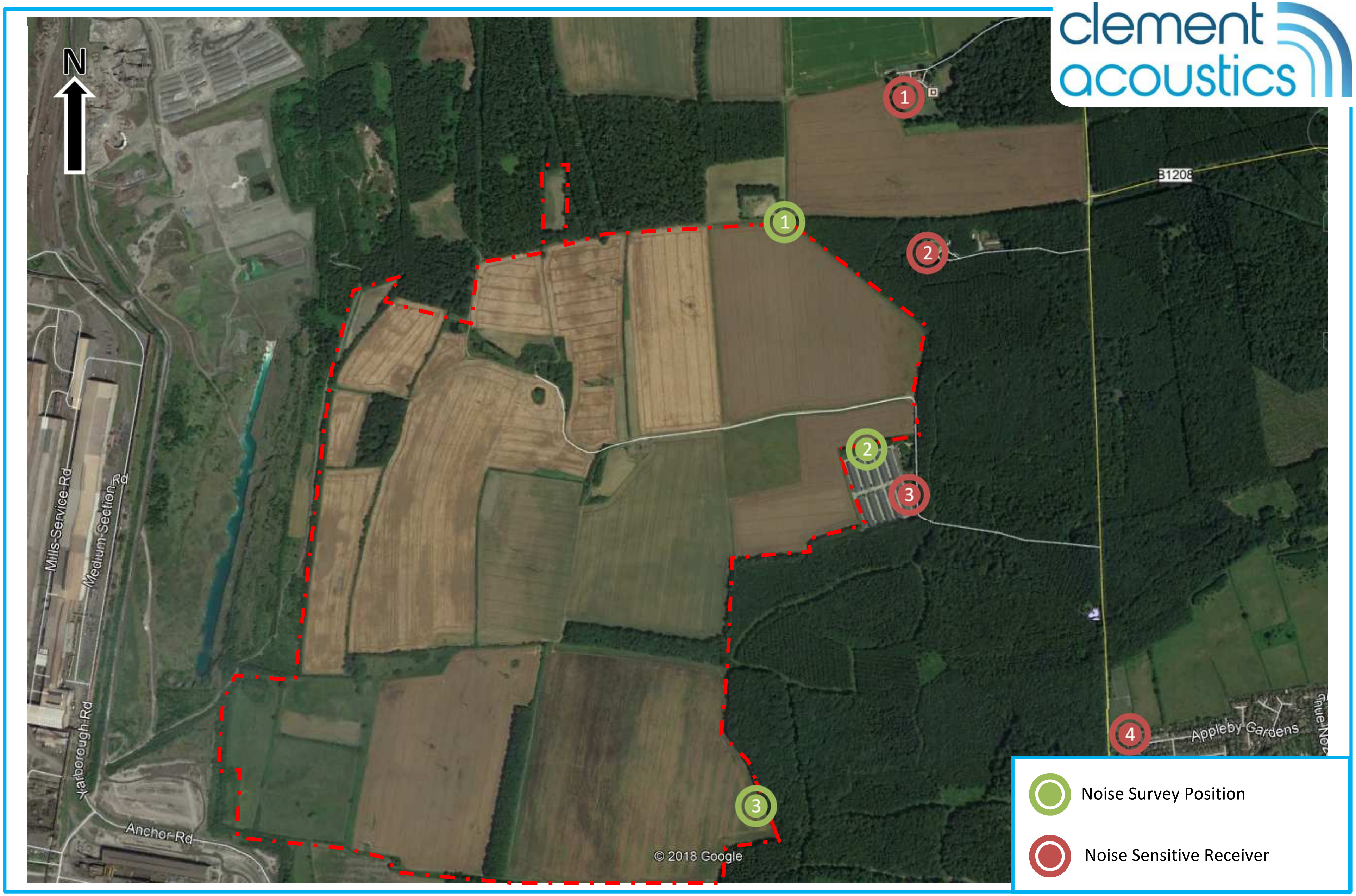
Vibrations is not expected to present a significant effect for this development.

Report by

Duncan Martin MIOA

Checked by

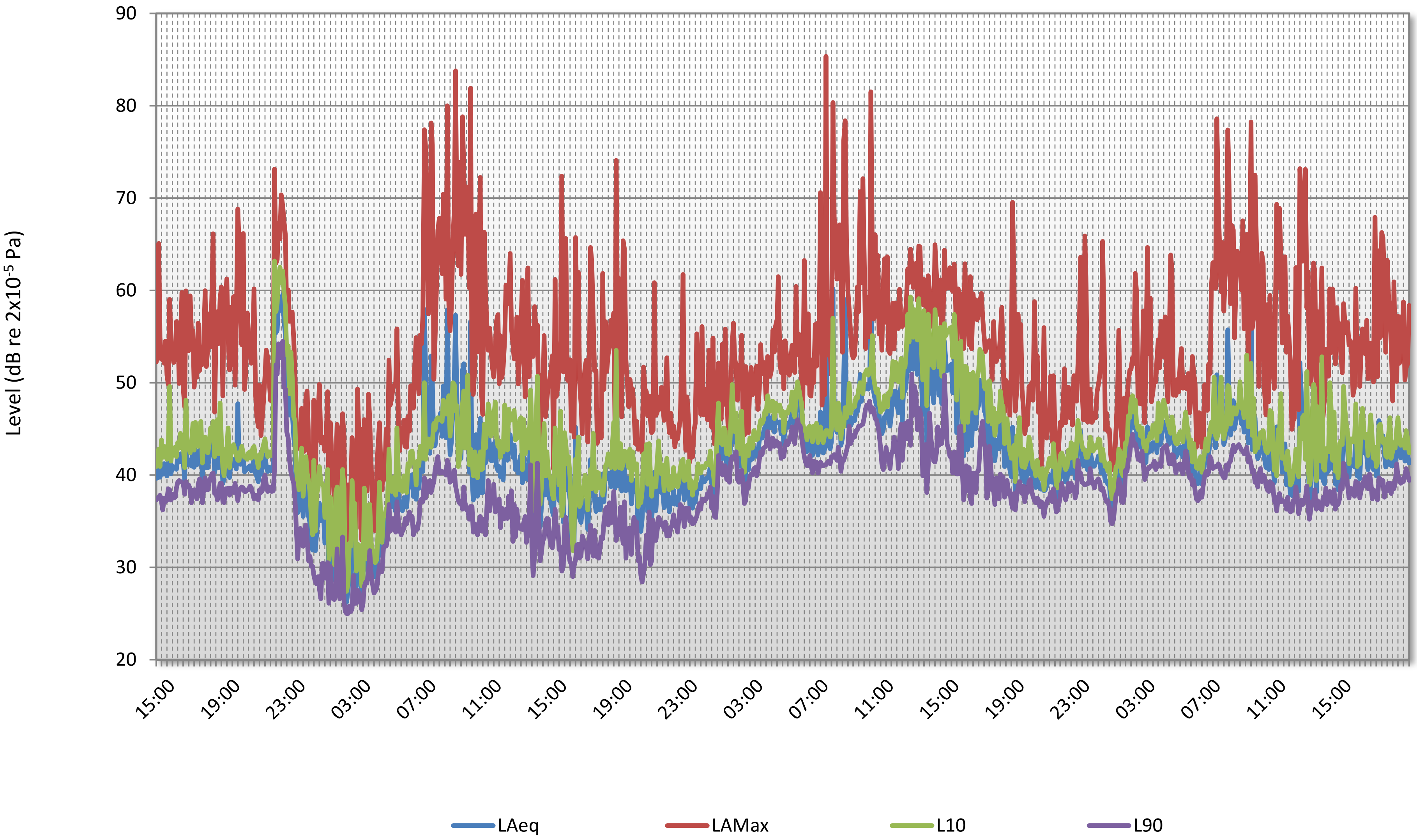
John Smethurst MIOA



14027-SP1 Indicative site plan indicating noise monitoring positions and identified noise sensitive receivers **Date:** 19 November 2020

Little Crow Solar Park, Scunthorpe - *Position 1*

Environmental Noise Time History
27 September 2018 to 30 Septemer 2018



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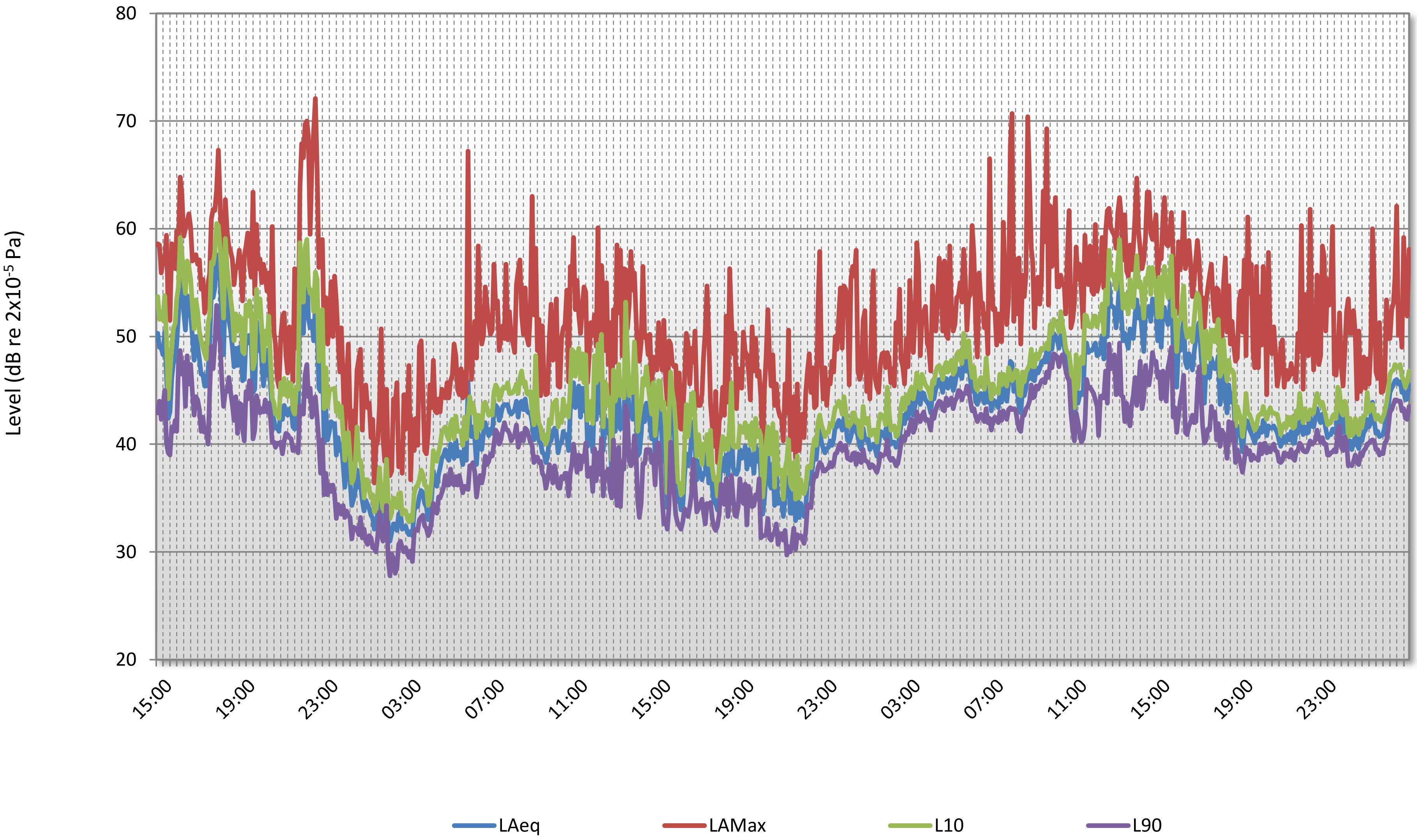
Little Crow Solar Park, Scunthorpe - *Position 2*

Environmental Noise Time History
27 September 2018 to 30 September 2018



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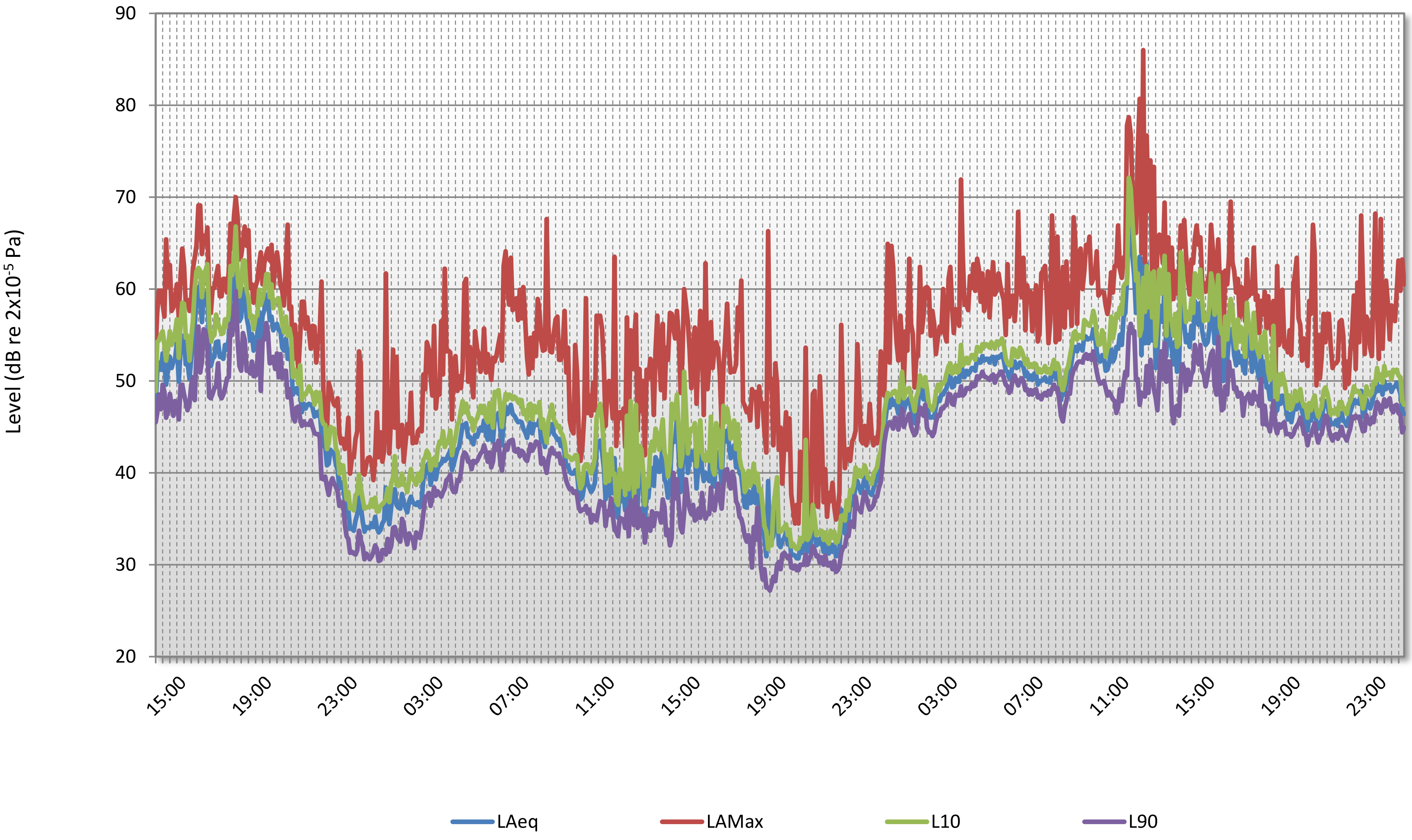
Little Crow Solar Park, Scunthorpe - *Position 3*

Environmental Noise Time History
27 September 2018 to 30 September 2018



APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

dB(A)

The human ear is less sensitive to low (below 125Hz) and high (above 16kHz) frequency sounds. A sound level meter duplicates the ear's variable sensitivity to sound of different frequencies. This is achieved by building a filter into the instrument with a similar frequency response to that of the ear. This is called an A-weighting filter. Measurements of sound made with this filter are called A-weighted sound level measurements and the unit is dB(A).

L_{eq}

The sound from noise sources often fluctuates widely during a given period of time. An average value can be measured, the equivalent sound pressure level L_{eq}. The L_{eq} is the equivalent sound level which would deliver the same sound energy as the actual fluctuating sound measured in the same time period.

L_{10}

This is the level exceeded for not more than 10% of the time. This parameter is often used as a "not to exceed" criterion for noise

L_{90}

This is the level exceeded for not more than 90% of the time. This parameter is often used as a descriptor of "background noise" for environmental impact studies.

L_{max}

This is the maximum sound pressure level that has been measured over a period.

Octave Bands

In order to completely determine the composition of a sound it is necessary to determine the sound level at each frequency individually. Usually, values are stated in octave bands. The audible frequency region is divided into 10 such octave bands whose centre frequencies are defined in accordance with international standards.

Addition of noise from several sources

Noise from different sound sources combines to produce a sound level higher than that from any individual source. Two equally intense sound sources operating together produce a sound level which is 3dB higher than one alone and 10 sources produce a 10 dB higher sound level.

Attenuation by distance

Sound which propagates from a point source in free air attenuates by 6dB for each doubling of distance from the noise source. Sound energy from line sources (e.g. stream of cars) drops off by 3dB for each doubling of distance.

Subjective impression of noise

Sound intensity is not perceived directly at the ear; rather it is transferred by the complex hearing mechanism to the brain where acoustic sensations can be interpreted as loudness. This makes hearing perception highly individualised. Sensitivity to noise also depends on frequency content, time of occurrence, duration of sound and psychological factors such as emotion and expectations. The following table is a reasonable guide to help explain increases or decreases in sound levels for many acoustic scenarios.

Change in sound level (dB)	Change in perceived loudness
1	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	About twice as loud
20	About 4 times as loud

Barriers

Outdoor barriers can be used to reduce environmental noises, such as traffic noise. The effectiveness of barriers is dependent on factors such as its distance from the noise source and the receiver, its height and its construction.

Reverberation control

When sound falls on the surfaces of a room, part of its energy is absorbed and part is reflected back into the room. The amount of reflected sound defines the reverberation of a room, a characteristic that is critical for spaces of different uses as it can affect the quality of audio signals such as speech or music. Excess reverberation in a room can be controlled by the effective use of sound-absorbing treatment on the surfaces, such as fibrous ceiling boards, curtains and carpets.

APPENDIX B

Little Crow Solar Park, Scunthorpe

APPENDIX B: Assessment for Construction Works

RECEIVER 3

Location: Post Pushing at Closest Section of Site Boundary

	Frequency, Hz								
	63	125	250	500	1k	2k	4k	8k	dB(A)
Pushing of Fence Posts									
Stated noise emission level at 10 m [1]	71	63	63	62	68	69	70	66	75
Correction for no. of machines (3 no.)	5	5	5	5	5	5	5	5	
Calculated Distance Adjustment Ks (R = 130 m)	-26	-26	-26	-26	-26	-26	-26	-26	
Correction for percentage on-time (50%)	-3	-3	-3	-3	-3	-3	-3	-3	
Noise Rating Level at Receiver	**47**	**39**	**39**	**38**	**44**	**45**	**46**	**42**	**51**
Idling Between Posts									
Stated noise emission level at 10 m	67	66	59	58	56	53	44	35	61
Correction for no. of machines (3 no.)	5	5	5	5	5	5	5	5	
Calculated Distance Adjustment Ks (R = 130 m)	-26	-26	-26	-26	-26	-26	-26	-26	
Correction for percentage on-time (50%)	-3	-3	-3	-3	-3	-3	-3	-3	
Noise Rating Level at Receiver	**43**	**42**	**35**	**34**	**32**	**29**	**20**	**11**	**37**
Calculated Noise Level at Receiver due to Boundary Works	**49**	**44**	**41**	**40**	**44**	**45**	**46**	**42**	**51**

[1] Spectral levels assumed based on BS 5228 levels for a similar noise source (hydraulic hammer rig)

Location: Support Pushing at Representative Nearby Area of Site

	Frequency, Hz								
	63	125	250	500	1k	2k	4k	8k	dB(A)
Pushing of Fence Posts									
Stated noise emission level at 10 m [1]	71	63	63	62	68	69	70	66	75
Correction for no. of machines (3 no.)	5	5	5	5	5	5	5	5	
Calculated Distance Adjustment Ks (R = 200 m)	-31	-31	-31	-31	-31	-31	-31	-31	
Correction for percentage on-time (50%)	-3	-3	-3	-3	-3	-3	-3	-3	
Noise Rating Level at Receiver	**43**	**35**	**35**	**34**	**40**	**41**	**42**	**38**	**47**
Idling Between Posts									
Stated noise emission level at 10 m	67	66	59	58	56	53	44	35	61
Correction for no. of machines (3 no.)	5	5	5	5	5	5	5	5	
Calculated Distance Adjustment Ks (R = 200 m)	-31	-31	-31	-31	-31	-31	-31	-31	
Correction for percentage on-time (50%)	-3	-3	-3	-3	-3	-3	-3	-3	
Noise Rating Level at Receiver	**39**	**38**	**31**	**30**	**28**	**25**	**16**	**7**	**32**
Calculated Noise Level at Receiver due to Onsite Works	**44**	**39**	**36**	**35**	**40**	**41**	**42**	**38**	**47**

[1] Spectral levels assumed based on BS 5228 levels for a similar noise source (hydraulic hammer rig)

Cumulative Level at Receiver due to Onsite Works	**50**	**45**	**42**	**41**	**46**	**46**	**47**	**43**	**53**