Mallard Pass
Solar Farm

Mallard Pass Solar Farm

Environmental Statement Volume 3
Appendix 10.5: Noise and Vibration Modelling [Tracked Changes]

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Appendix 10.5 - Noise Modelling

Construction Noise and Vibration

Construction noise

10.1.1. Appendix 10.1 [**EN010127/APP/6.2**] advises that BS 5228 part 1 **[Ref 1]** should be referenced for the assessment and prediction of construction noise.

10.1.2. Full details of the exact construction method, plant and duration for the Proposed Development are not available at this stage. The different construction activities set out in ***Chapter 5*** **[EN010127/APP/6.1]** were considered in turn. For each of the activities likely to generate substantial noise levels, construction equipment was assumed on a worst-case basis, based on the descriptions provided, professional judgement and experience of similar developments. Reference data for the noise emissions of the construction plant and activities set out in BS 5228-1 was used. The percentage of time the relevant plant will be in use during a working day was also estimated on a worst-case basis. **Table 1** lists the assumptions and the resulting overall sound power for each activity, obtained by summing up the total emission level accounting for percentage on-time in line with BS 5228 guidance.

Table 1: Construction plant and equipment assumptions (based on BS 5228-1 guidance)

Work Stage	Plant / Equipment Description	Maximum Power (sound power, L_{wA} (dB))	On-Time (% of working day)	Assumed Overall Sound Power L_{wA} (dB)
Earthworks	Tracked Excavator	106	70	111
	Dozer	108	70	
	Wheeled backhoe loader	96	50	
	Articulated dump truck	109	50	

Work Stage	Plant / Equipment Description	Maximum Power (sound power, L_{wA} (dB))	On-Time (% of working day)	Assumed Overall Sound Power L_{wA} (dB)
Solar array mounts	Tubular steel piling - hydraulic jacking - 240mm diameter	117	90	117
	Mobile Cranes	105	50	
	Wheeled backhoe loader	96	50	
Access Road works	Tracked Excavator (16t)	104	60	108
	Dumper (5t)	106	70	
	Tamper	91	50	
	Vibratory roller (3t)	101	50	
	Asphalt paver + tipper lorry	105	50	
Horizontal Directional Drilling (HDD)	HDD power unit and drill / HDD generator / Bentonite pump / Bentonite mixer / Generator for Site Offices	115	100	115
Construct temporary construction compounds / Onsite Substation	360 degree Excavators (Large)	105	100	115
	20-tonne Excavator	102	90	
	Wheeled backhoe loader	96	90	
	Vibratory roller	102	80	
	Dozer	108	80	
Cable trench works	Wheeled backhoe loader	96	80	105
	Lorry	106	20	
	Tracked Excavator (16t)	104	80	
Breaking concrete foundations	Concrete Crusher	112	80	115
	Power Tools	108	80	
	Lorries	106	50	

Work Stage	Plant / Equipment Description	Maximum Power (sound power, L_{wA} (dB))	On-Time (% of working day)	Assumed Overall Sound Power L_{wA} (dB)
	Fork Lifts	104	50	

10.1.3. The predictions of construction noise level estimates at different distances from the work have been undertaken in accordance the method set out in Annex F of with British Standard (BS) 5228-1. It has been conservatively assumed that there are no screening effects, and that the ground cover is characterised as 50% hard / 50% soft[1]. The resulting predictions are set out in **Table 2** below for a range of distances from the work: this can be referenced when considering different sensitive receptors located at different distances from each of the activities considered, as set out in **Chapter 10 [EN010127/APP/6.1]**.

Table 2: Predicted construction noise levels (L_{Aeq}, dB) over the working day for each of the activities – as function of distance from the work area to sensitive receptors (where potentially relevant)

Distance (m)	Earthworks	Solar array mounts	Access Road works	HDD works	Temporary site compound / Onsite Substation /concrete breaking	Cable trench work
20	77	83	74	-	-	71
40	71	77	68	-	-	65
50	68	74	65	-	73	63

[1] Most of ground cover around the Order limits and sensitive receptors is agricultural/cultivated land which would be considered 100% soft, therefore providing absorption which reduces noise during propagation. However, some area of paved/compacted ground may be considered as acoustically “hard”. Therefore the assumption made is a worst-case.

Distance (m)	Earthworks	Solar array mounts	Access Road works	HDD works	Temporary site compound / Onsite Substation /concrete breaking	Cable trench work
60	67	73	64	-	71	61
70	65	71	62	-	70	60
80	64	70	61	-	69	59
90	63	69	60	-	68	58
100	62	68	59	-	67	57
150	58	64	55	-	64	54
200	55	61	52	-	61	51
250	53	59	50	-	59	49
300	51	57	48	55	58	48
350	50	56	47	54	56	46
400	48	54	45	52	55	45
450	47	53	44	51	54	44
500	46	52	43	50	53	43
550	45	51	42	49	52	42
600	44	50	41	48	51	41
700	43	49	40	47	50	40
800	42	48	39	46	49	39
900	40	46	37	44	48	38
1000	39	45	36	43	47	37

Construction vibration

10.1.4. Vibration predictions have been undertaken using guidance from BS 5228 part 2 **[Ref** 1 **1]** (based on the review in ***Appendix 10.1***). The standard includes reference information for different vibratory plant and guidance on evaluating likely levels at different distances from the work.

10.1.5. Predictions were based on worst-case assumptions likely to over-estimate actual vibration levels in practice. Specifically, for vibratory ground compaction, predictions were made assuming a 0.8 mm drum vibration amplitude and a 1.5 m drum width, both for steady state and at start-up/run-down. For the percussive piling, predictions are based on toe at refusal with an 85 Joule hammer energy. These assumptions are at the upper end of the guidance values provided in Table E.1 of BS 5228-2. **Table** 3 **3** sets out the resulting predictions for different separation distances of up to 100 m. Beyond this distance, predicted levels reduce well below the relevant criteria (see ***Appendix 10.2***) and therefore do not require further consideration.

Table 3: Predicted worst-case vibration levels (PPV, mm/s) for key activities

Distance (m) from activity	Vibratory compaction, steady-state	Vibratory compaction, start-up/run-down	Percussive piling
20	1.0	1.4	0.9
40	0.4	0.6	0.4
50	0.3	0.5	0.3
70	0.2	0.3	0.2
100	0.1	0.2	0.1

10.1.6. Although HDD plant may also generate vibration locally, given this work is more than 500 m from the nearest sensitive receptors, it does not require further consideration. Other activities are unlikely to generate substantial levels of vibration based on BS 5228-2 guidance.

Construction traffic

10.1.7. The anticipated construction traffic assessment is set out in **Chapter 5: Project Description** and **Chapter 9, Transport and Access**: the highest volume of traffic generated by construction is expected to comprise an average of 54 daily trips (two way). This has been compared to future baseline traffic predicted for a future year of 2026, in accordance with the anticipated programme discussed within **Chapter 5** of the ES. The projected changes in traffic flow for 2026 are summarised in **Table 4.**

10.1.8. For traffic on Essendine Road, the values set out in the traffic assessment of the baseline traffic with the additional construction traffic are well below the flow volume of 1,000 vehicles per day (18-hour) that is required by the CRTN methodology to enable reliable predictions. It is therefore not possible to undertake a reliable prediction of the associated change in traffic noise levels along this route. However, based on the predicted noise levels that CRTN suggests for the lowest flow value, it can be deduced that the associated L_{Aeq} for the working day associated with this traffic for any receptor along this route would be below 65 dB.

Table 4: Projected traffic flows

Road	Without Development (2026)		With Development (2026)	
	Annual Average Daily Traffic (AADT) Flow	% Heavy Goods Vehicles	Annual Average Daily Traffic (AADT) Flow	% Heavy Goods Vehicles

Road	Without Development (2026)		With Development (2026)	
Essendine Road	390	12.4%	549	18.7%
A6121 Stamford Road	9161	10.0%	9259	10.2%
A6121 Turnpike Road	9073	9.0%	9170	9.2%
Ryhall Road East	4059	13.4%	4121	13.9%
Ryhall Road West	4665	11.0%	4727	11.4%
B1081 Old Great North Road	5795	10.8%	5857	11.2%
A6121 Ryhall Road (bridge)	7290	6.6%	7325	6.6%
A6121 Ryhall Road	7714	1.1%	7749	1.1%
Uffington Road	6389	2.8%	6424	2.8%
A1175 Main Road	11368	9.3%	11403	9.3%
A1175 Stamford Road	5756	2.8%	5791	2.8%
A15 (south of A1175)	12596	8.7%	12693	8.8%
A15 (west of Peterborough)	11928	8.4%	12025	8.5%
A6121 Bourne Road	8304	8.2%	8366	8.5%
A6121 Stamford Road (Carlby)	7469	9.5%	7531	9.8%
A6121 Stamford Road (Toft)	7629	10.1%	7691	10.3%
Raymond Mays Way	9000	9.6%	9062	9.8%
A15 (Northorpe Main Road)	17361	11.4%	17423	11.6%

10.1.9. For roads other than Essendine Road, using the values of **Table 4**, the methodology set out in CRTN has been used to determine the associated maximum total change in the average day-time traffic noise level due to construction of the Proposed Development at locations neighbouring each of the roads considered: see **Table** 5 **5**. The resulting increases identified do not exceed 0.1 dB.

Table 5: CRTN predicted increase in day-time average traffic noise levels associated with construction traffic ($L_{A10,18hour}$)

Road	Predicted increase, dB(A)
A6121 Stamford Road	0.1
A6121 Turnpike Road	0.1
Ryhall Road East	0.1
Ryhall Road West	0.1
B1081 Old Great North Road	0.1
A6121 Ryhall Road (bridge)	0.0
A6121 Ryhall Road	0.0
Uffington Road	0.0
A1175 Main Road	0.0
A1175 Stamford Road	0.0
A15 (south of A1175)	0.1
A15 (west of Peterborough)	0.1
A6121 Bourne Road	0.1
A6121 Stamford Road (Carlby)	0.1
A6121 Stamford Road (Toft)	0.1

Road	Predicted increase, dB(A)
Raymond Mays Way	0.1
A15 (Northorpe Main Road)	0.0

Operational noise

Onsite Substation

10.1.10. The 400/33 kV transformer is considered likely to represent the main source of noise at the Onsite Substation for the Proposed Development. Manufacturer information corresponding to an indicative selection for a suitable transformer indicated a total sound power of 95dB(A), which included the cooling which is potentially required in some conditions. This is considered robust as data also showed that lower-noise emission versions are also available, as well as based on experience of similar equipment, and was therefore assumed as a worst-case.

10.1.11. Additional plant likely to be used at the Onsite Substation may also include STATCOM reactive compensation and harmonic filter plant to regulate the current. In the absence of specific design information for the plant at this stage, and based on experience of similar recent developments, sound power levels of 95 and 90 dB(A) respectively were also assumed for this plant, which is considered robust. On this basis, a total sound power of 99 dB(A) for the Onsite Substation was obtained as the basis of this study by summation of the emission levels for all plant.

10.1.12. The resulting total sound power assumed is set out in **Table 6** below, with the octave band noise spectrum of the sound based on measurement for similar plant, which is dominated by lower to medium frequencies. The closest properties to Works Area 2, North Lodge House and North Lodge Farm, are 600 m away from where the sources identified may be located (as a worst-case). Modelling has therefore

been undertaken in accordance with ISO 9613-2 **[Ref 2]**. As there is cultivated ground between the substation and the receptors, this was modelled by assuming propagation over soft ground, except in proximity to the source where 50% hard / 50% soft ground was assumed (to reflect the harder nature of the ground near the substation). The resulting predictions are also included in **Table 6**: this shows a predicted overall level of 29 dB L_{Aeq}.

Table 6: Onsite Substation – assumed emission noise level and predicted noise level at 600m distance

Noise Source	Spectrum - Octave Band Centre Frequency (Hz)						dB(A)
	63	125	250	500	1000	2000	
Total assumed sound power	99	106	105	93	90	85	99
Predicted noise levels – 600 m distance	37	35	33	25	22	13	**29**

PV Arrays – noise emissions and preliminary study

10.1.13. The exact design of the solar installation will be the result of a future tendering process and therefore consideration of different options was first undertaken (in a preliminary study) to evaluate the likely worst case for different approaches.

10.1.14. This preliminary study is based on a representative 200 x 200m area layout: see **Figure 1.** Four different configurations have been assumed, both without and with Single Axis Tracking (SAT) technology, and with central or line inverter arrangements. In **Figure 1** the layouts indicate the locations of the inverters in each of the configurations considered.

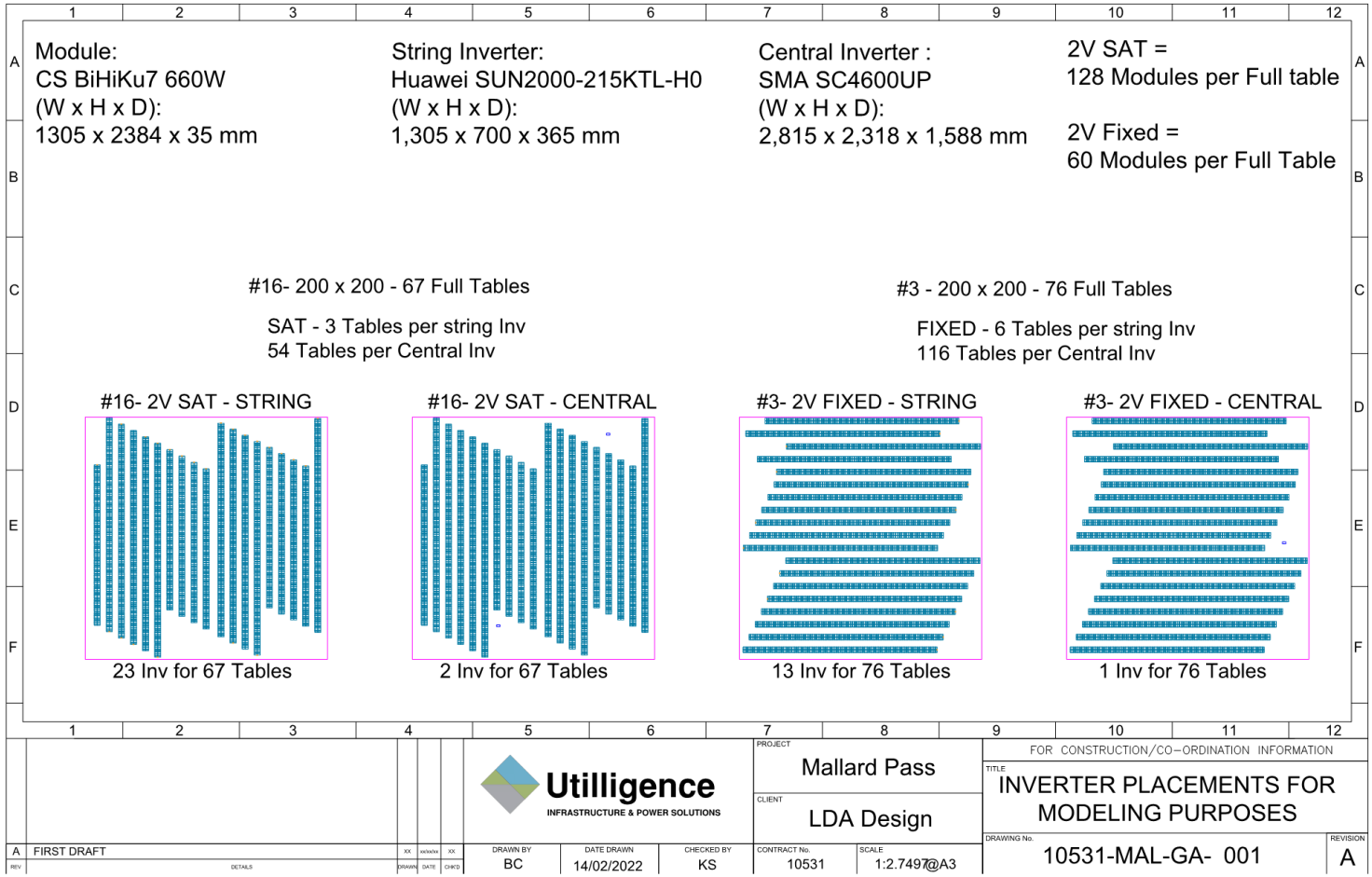


Figure 1– sample 200 x 200 m solar PV area showing different configurations modelled

10.1.15. For the SAT options, one motor was assumed to operate 100 m of solar array, so two motors located centrally were assumed for each 200 m solar panel line. Constant operation of the motor was assumed on a conservative basis despite indications this would only typically run for a few seconds every few minutes. For each configuration, one transformer was assumed to be located on one corner of the modelled area.

10.1.16. The assumed noise emission levels, based on available manufacturer information, is set out in **Table 7**. The emission levels are considered robust based on experience of similar developments. Spectrum data (in octave bands) was based on manufacturer data, when available, or from experience of similar units. For the SAT motor, the acoustic energy was assumed to be contained in the 500 Hz band.

Table 7: PV Arrays – assumed noise levels

Noise Source	Model assumed	Octave Band Centre Frequency (Hz)						
		63	125	250	500	1000	2000	A
String Inverter	Huawei SUN2000-215KTL-H0	47	56	64	64	65	65	73
Transformer	Huawei STS-6000K-H1	66	72	71	66	64	64	70
Central Inverter	SMA SC4600UP	65	74	82	82	83	83	91
SAT motor	Nextracer NX Horizon	-	-	-	53	-	-	50

10.1.17. The resulting representative noise emission levels for each configuration were modelled using the CadnaA®[2] prediction software package implementing a calculation in line with ISO 9613-2 **[Ref 2]** assuming soft ground conditions, typical of cultivated land around the Solar PV area.

[2] DataKustik GmbH, Computer Aided Noise Abatement (CadnaA®) software package, (Link https://www.datakustik.com/products/cadnaa/cadnaa/)

Please note that the model did not consider any screening from the solar PV panels themselves which were not included in the noise model as solid elements: this is precautionary. The modelled result show that the noise from the SAT motors themselves is negligible. However, the increased number of inverters assumed in the SAT configurations means that this was considered to represent the worst-case. Resulting noise emissions at different distances are illustrated on **Figure 2** to Figure 5for all configurations and are summarised below in **Table 8** based on indicative receptor locations located at increasing distances of 50 to 300 m from the sample area modelled. The results also show that the central inverter configuration is noisier than the string arrangement, despite the increased number of sources in the latter.

10.1.18. The overall worst-case configuration is the SAT arrangement with central inverters, and this is therefore the basis of the assessment undertaken below. The results also show that, beyond a distance of 250 m from the central inverters, predicted noise levels are below 30 dB L_{Aeq} even in the worst-case. A tonal penalty of +4 dB is added to the calculated noise level (L_{Aeq}) to obtain a rated noise level (L_{Ar}), in accordance with guidance outlined in BS 4142 (see ***Appendix 10.1***). This corresponds to a clearly audible (but not highly audible) tonal character, which would be representative of the worst-case for the inverters: their noise emissions will be dominated by cooling equipment rather than the electrical components which are most likely to be tonal in nature. The resulting rated noise levels would not exceed 35 dB.

Table 8: Solar energy plant – representative calculated noise levels (L_{Aeq}, dB) for sample area at different distances.

Receptor location (direction and distance from edge of notional solar PV area modelled)	Fixed panels - string inverters	Fixed panels - central inverters	SAT -string inverters	SAT - central inverters
50m bottom centre	28	32	31	40
100m bottom centre	24	30	27	36
200m bottom centre	19	25	21	30
300m bottom centre	16	22	18	26
50m right centre	29	42	29	37
100m right centre	25	36	26	34
200m right centre	20	29	22	29
300m right centre	16	25	18	26
50m top centre	28	32	34	40
100m top centre	24	29	29	36
200m top centre	19	25	23	30
300m top centre	16	22	19	26
50m left centre	31	29	29	35
100m left centre	26	26	26	32
200m left centre	20	23	21	28
300m left centre	16	20	18	25

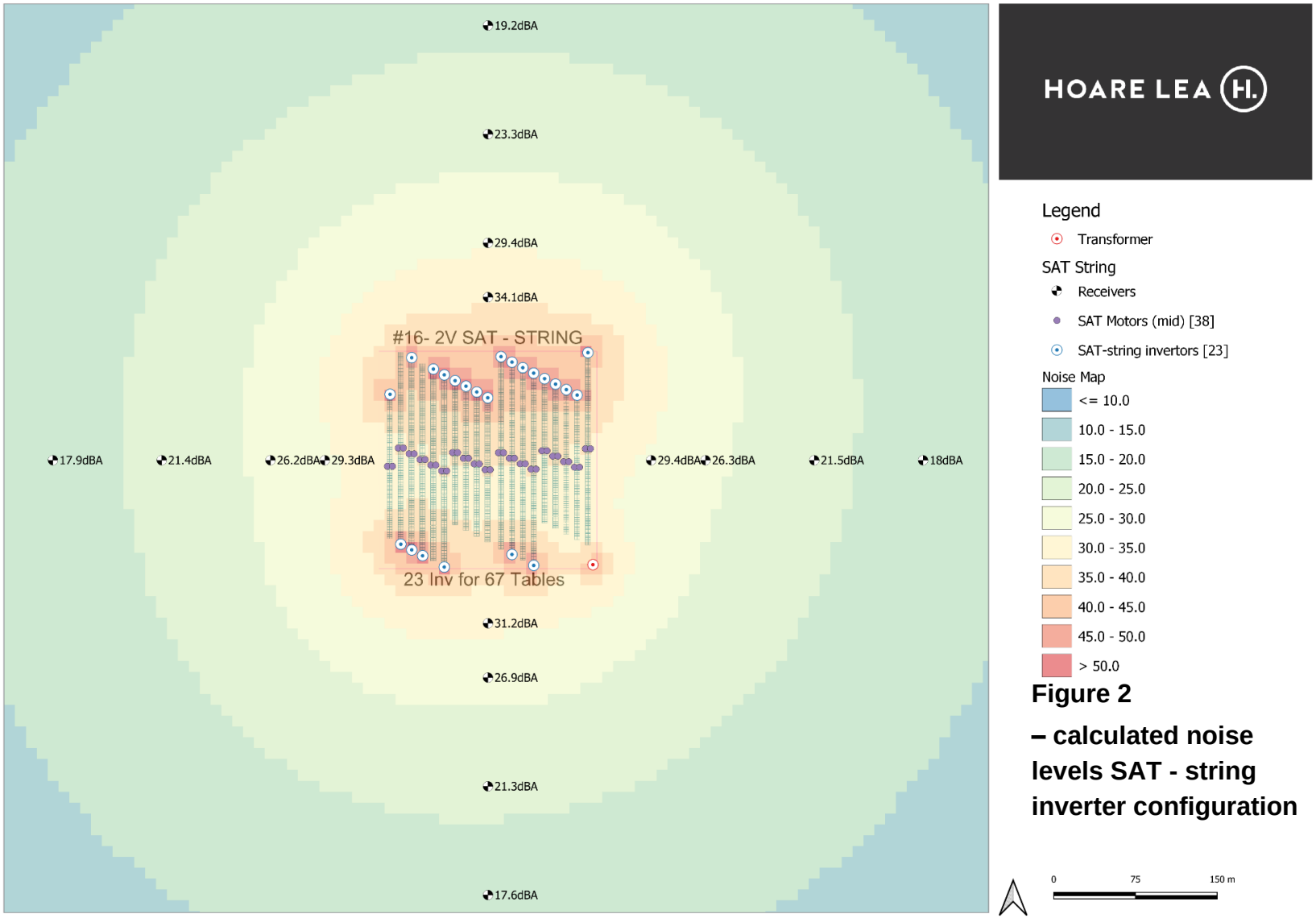
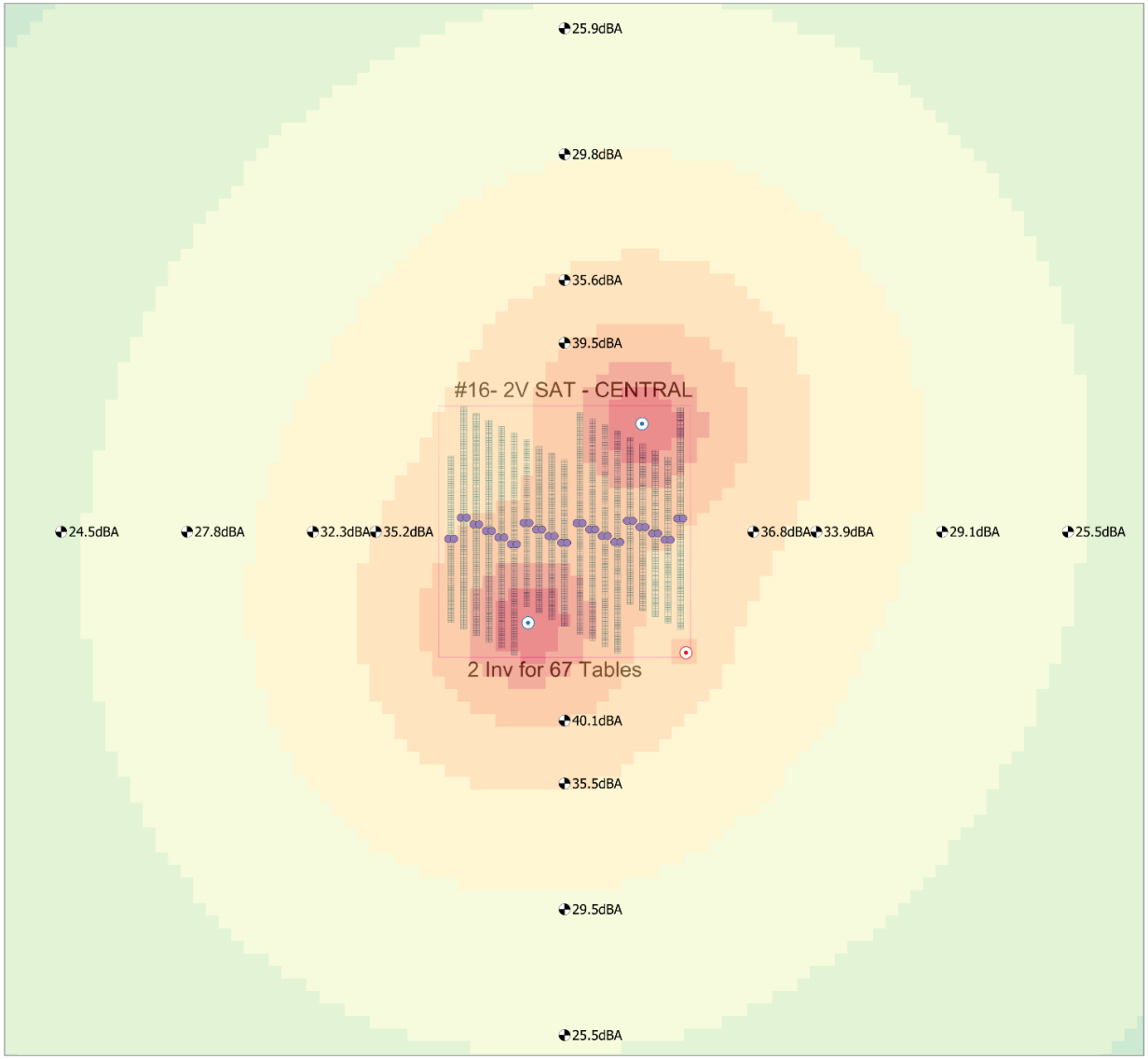


Figure 2

– calculated noise levels SAT - string inverter configuration



HOARE LEA

Legend

Transformer

SAT Central

Receivers

SAT Motors (mid) [38]

Central inverter [2]

Noise Map

<= 10.0

10.0 - 15.0

15.0 - 20.0

20.0 - 25.0

25.0 - 30.0

30.0 - 35.0

35.0 - 40.0

40.0 - 45.0

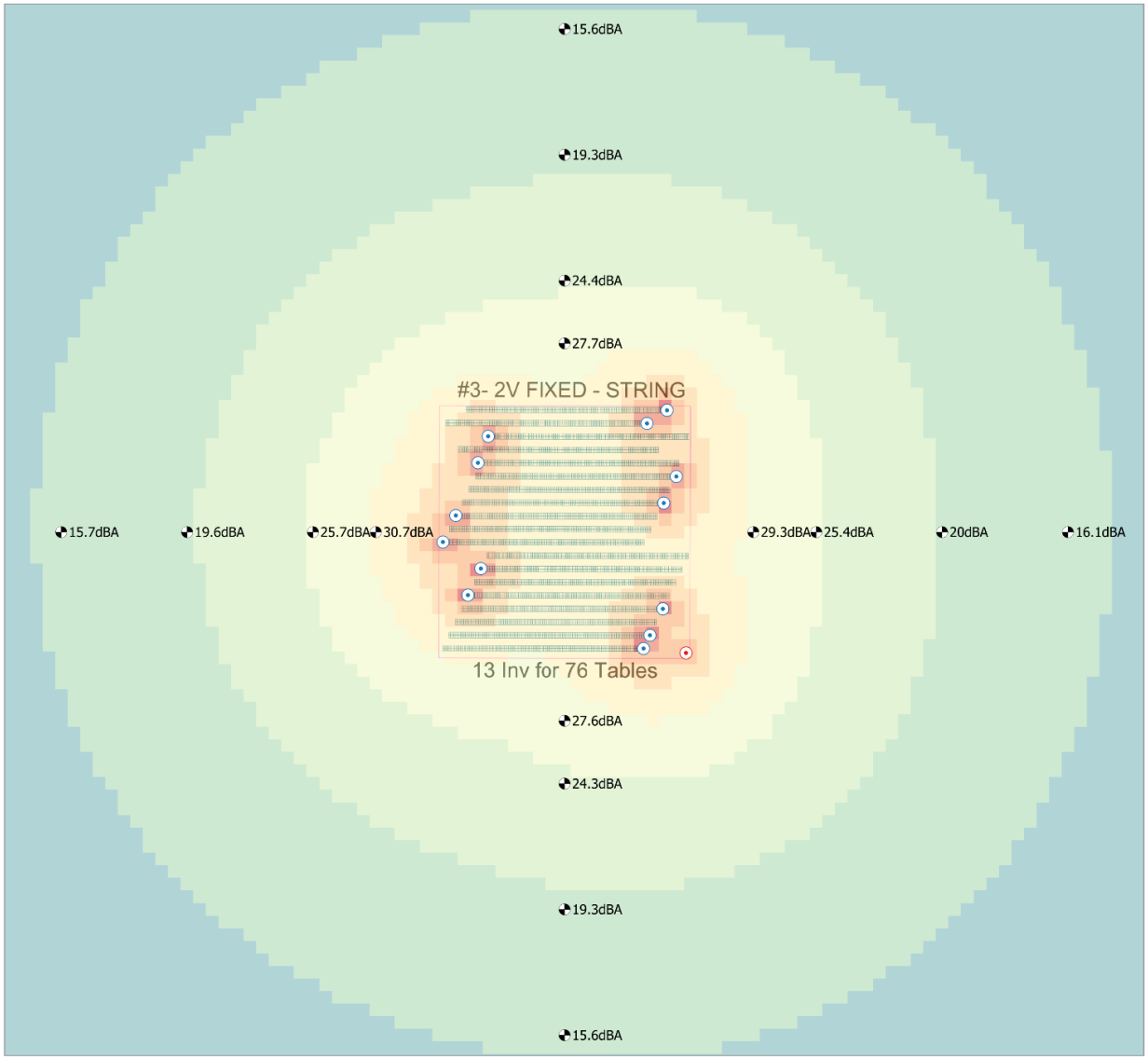
45.0 - 50.0

> 50.0

0 75 150 m

Figure 3

– calculated noise levels SAT – central inverter configuration



HOARE LEA

Legend

Transformer

Fixed String

Receivers

Fixed String [13]

Noise Map

<= 10.0

10.0 - 15.0

15.0 - 20.0

20.0 - 25.0

25.0 - 30.0

30.0 - 35.0

35.0 - 40.0

40.0 - 45.0

45.0 - 50.0

> 50.0

0 75 150 m

Figure 4

– calculated noise levels Fixed panels - string inverter configuration

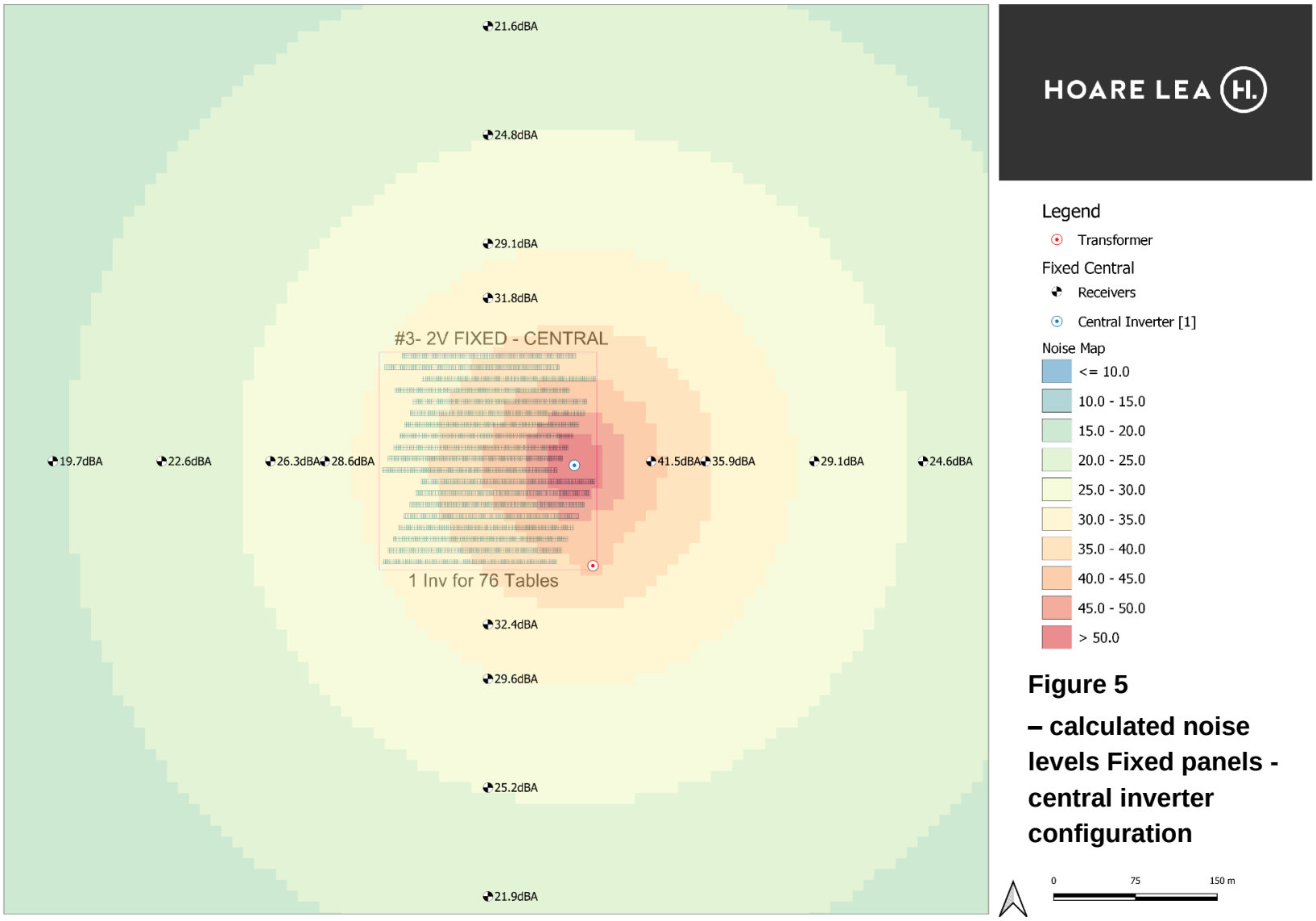


Figure 5

– calculated noise levels Fixed panels - central inverter configuration

Total Operational noise modelling

10.1.19. The assessment then considers the noise-sensitive residential receptors around the Solar PV area: these receptors are listed in **Table 9** below and can be seen shown on **Figure 10.1 [EN010127/APP/6.3]**.

Table 9: Representative noise-sensitive receptors considered (with ID reference as shown in Figure 10.1) and approximate distance (m) to the Solar PV Site (Works Area 1).

ID	Receptor name	Easting	Northing	Distance (m)	ID	Receptor name	Easting	Northing	Distance (m)
1	The Heath	501205	314521	670	30	Bourne Road 3	504866	312662	570
2	Mill View	502097	314561	630	31	Bourne Road 4	504708	312734	500
3	Manor Farm	502239	314574	600	32	Church Farm	504932	312677	510
4	Lodge Farm	502355	314198	220	33	Crownfield House	505202	313593	540
5	Barber's Hill House	502830	313977	210	34	School House	505258	313154	320
6	Vale Farm	502737	313661	60	35	Grange Farm Cottage	506477	313118	310
7	Heath House	501978	313044	420	36	Braceborough Grange	506747	313058	250
8	Heath Cottage	501860	312885	500	37	Redroofs	507071	313184	490
9	Ryhall Grange	502805	312221	460	38	Walland House	507948	312962	1150
10	Ryhall Farm Cottage	503025	312365	260	39	Ryhall 1	504071	311002	790

ID	Receptor name	Easting	Northing	Distance (m)	ID	Receptor name	Easting	Northing	Distance (m)
11	Top Farm	503074	311641	570	40	Ryhall 2	504114	310954	790
12	Turnpike Road	503324	311362	810	41	Belmesthorpe 1	504257	310369	920
13	Steabba's Close	503729	311594	400	42	Belmesthorpe 2	504588	310377	660
14	Essendine Road 1	503750	311633	360	43	Belmesthorpe 3	504403	310162	690
15	Essendine Road 2	503792	311692	290	44	Ridgeview Farm	504619	309831	330
16	Sunny Acres 1	504001	311889	100	45	Green Lane Farm	504779.8	309651.8	90
17	Sunny Acres 2	504012	311900	100	46	Cobbs Nook Farm	504662	309283	180
18	Heath Farm	503592	313637	150	47	Pelham Cottage	504570	309156	330
19	Manor Farm	504624	313114	460	48	Newstead Hall	504708	309170	260
20	Plover Road	504390	312807	180	49	Folly Farm	505175	308581	730
21	Stamford Rd 1	504307	312331	200	50	Wood Farm Cottages	505806	309965	60
22	Stamford Rd 2	504403	312427	320	51	Wood Farm	505600	309788	160
23	Stamford Rd 3	504487	312504	420	52	Lower Home Farm	505999	308375	1140
24	Glen Crescent 1	504507	312342	400	53	The Stables	506374	308628	930

ID	Receptor name	Easting	Northing	Distance (m)	ID	Receptor name	Easting	Northing	Distance (m)
25	Glen Crescent 2	504556	312389	460	54	Grange Farm	506684	309625	360
26	Glen Crescent 3	504483	312379	380	55	North Lodge House	505251	310946	130
27	Station Road	504631	312472	550	56	North Lodge Farm	505303	310990	140
28	Bourne Road 1	504660	312631	500	57	Banthorpe Lodge	506111	311027	220
29	Bourne Road 2	504890	312727	560	58	Glen Lodge	506181	310987	240

10.1.20. The noise from the whole of the equipment within the Solar PV Site in addition the Onsite Substation, was then modelled at all receptor locations included in **Table 9.**

10.1.21. Based on the preliminary study described above, the SAT arrangement with central inverters represents the worst-case solar panel configuration, and this site configuration has been modelled using CadnaA® prediction software, with the noise emission levels set out in **Table 6** and **Table** 7 **7**. The model did not include the SAT motors or transformers (outside of the Onsite Substation) as the preliminary study showed that these represented a negligible contribution to noise levels. The locations of the central inverters around the site are based on a representative site design (**Figure 4.3 [EN010127/APP/6.3])** which incorporates the design principle of a minimum buffer distance of 250m and 50m from residential properties and PRoWs respectively.

10.1.22. The Inverter and the Onsite Substation source locations were modelled at a height of 2 m and receivers were modelled at a height of 4 m to be representative of a first-floor window of a residential property. A calculation search radius was set to cover the entire Solar PV Site area and surroundings and a 10m-by-10m calculation resolution grid was produced.

10.1.23. **Table 10** below lists the predicted noise levels. As discussed above, rated noise levels are obtained by the addition of a precautionary correction of +4 dB to account for potential tonal character in the noise.

Table 10: Predicted noise levels and rated levels at receptors

Noise-sensitive receptor				Predicted noise level (L_{Aeq}, dB)	Predicted rated noise level (L_{Ar}, dB)
ID	Name	Easting	Northing		
1	The Heath	501205	314521	19	23
2	Mill View	502097	314561	21	25
3	Manor Farm	502239	314574	21	25
4	Lodge Farm	502355	314198	29	33
5	Barber's Hill House	502830	313977	30	34
6	Vale Farm	502737	313661	29	33
7	Heath House	501978	313044	26	30
8	Heath Cottage	501860	312885	25	29
9	Ryhall Grange	502805	312221	25	29
10	Ryhall Farm Cottage	503025	312365	28	32
11	Top Farm	503074	311641	22	26
12	Turnpike Road	503324	311362	21	25
13	Steabba's Close	503729	311594	24	28
14	A6121 Road 1	503750	311633	25	29
15	A6121 Road 2	503792	311692	25	29
16	Sunny Acres 1	504001	311889	27	31
17	Sunny Acres 2	504012	311900	27	31
18	Heath Farm	503592	313637	30	34
19	Manor Farm	504624	313114	24	28
20	Plover Road	504390	312807	27	31
21	Stamford Road 1	504307	312331	27	31
22	Stamford Road 2	504403	312427	27	31
23	Stamford Road 3	504487	312504	26	30
24	Glen Crescent 1	504507	312342	26	30

Noise-sensitive receptor				Predicted noise level (L_{Aeq}, dB)	Predicted rated noise level (L_{Ar}, dB)
ID	Name	Easting	Northing		
25	Glen Crescent 2	504556	312389	26	30
26	Glen Crescent 3	504483	312379	26	30
27	Station Road	504631	312472	26	30
28	Bourne Road 1	504660	312631	25	29
29	Bourne Road 2	504890	312727	25	29
30	Bourne Road 3	504866	312662	25	29
31	Bourne Road 4	504708	312734	25	29
32	Church Farm	504932	312677	25	29
33	Crownfield House	505202	313593	21	25
34	School House	505258	313154	25	29
35	Grange Farm Cottage	506477	313118	26	30
36	Braceborough Grange	506747	313058	25	29
37	Redroofs	507071	313184	21	25
38	Walland House	507948	312962	15	19
39	Ryhall 1	504071	311002	24	28
40	Ryhall 2	504114	310954	24	28
41	Belmesthorpe 1	504257	310369	22	26
42	Belmesthorpe 2	504588	310377	24	28
43	Belmesthorpe 3	504403	310162	23	27
44	Ridgeview Farm	504619	309831	25	29
45	Green Lane Farm	504780	309652	28	32
46	Cobbs Nook Farm	504662	309283	24	28
47	Pelham Cottage	504570	309156	22	26
48	Newstead Hall	504708	309170	23	27

Noise-sensitive receptor				Predicted noise level (L_{Aeq}, dB)	Predicted rated noise level (L_{Ar}, dB)
ID	Name	Easting	Northing		
49	Folly Farm	505175	308581	19	23
50	Wood Farm Cottages	505806	309965	31	35
51	Wood Farm	505600	309788	32	36
52	Lower Home Farm	505999	308375	16	20
53	The Stables	506374	308628	17	21
54	Grange Farm	506684	309625	24	28
55	North Lodge House	505251	310946	31	35
56	North Lodge Farm	505303	310990	32	36
57	Banthorpe Lodge	506111	311027	30	34
58	Glen Lodge	506181	310987	30	34

10.1.24. **Table 11** and **Table** 12 **12** below list the BS 4142 noise assessment results at all the receptor locations included in **Table 9**, for the day-time and night-time periods respectively, based on the background noise levels derived in ***Appendix 10.4***. Results indicate either a negligible or minor magnitude of impact at the noise sensitive assessment receptors in most cases.

Table 11: BS 4142 assessment results: day-time

ID	Receptor Name	Typical day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
1	The Heath	31	-8	Negligible
2	Mill View	31	-7	Negligible
3	Manor Farm	31	-6	Negligible
4	Lodge Farm	31	+2	Low

ID	Receptor Name	Typical day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
5	Barber's Hill House	31	+3	Low
6	Vale Farm	31	+2	Low
7	Heath House	31	-1	Low
8	Heath Cottage	31	-2	Low
9	Ryhall Grange	31	-2	Low
10	Ryhall Farm Cottage	31	+1	Low
11	Top Farm	31	-5	Negligible
12	Turnpike Road	37	-12	Negligible
13	Steabba's Close	37	-9	Negligible
14	A6121 Road 1	37	-8	Negligible
15	A6121 Road 2	37	-8	Negligible
16	Sunny Acres 1	37	-6	Negligible
17	Sunny Acres 2	37	-6	Negligible
18	Heath Farm	31	+3	Low
19	Manor Farm	31	-3	Low
20	Plover Road	31	+0	Low
21	Stamford Road 1	37	-6	Negligible
22	Stamford Road 2	37	-7	Negligible
23	Stamford Road 3	37	-7	Negligible
24	Glen Crescent 1	37	-7	Negligible
25	Glen Crescent 2	37	-7	Negligible
26	Glen Crescent 3	37	-7	Negligible
27	Station Road	37	-7	Negligible
28	Bourne Road 1	37	-8	Negligible
29	Bourne Road 2	37	-8	Negligible

ID	Receptor Name	Typical day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
30	Bourne Road 3	37	-8	Negligible
31	Bourne Road 4	37	-8	Negligible
32	Church Farm	37	-8	Negligible
33	Crownfield House	37	-12	Negligible
34	School House	37	-8	Negligible
35	Grange Farm Cottage	31	-1	Low
36	Braceborough Grange	31	-2	Low
37	Redroofs	31	-6	Negligible
38	Walland House	31	-12	Negligible
39	Ryhall 1	31	-3	Low
40	Ryhall 2	31	-3	Low
41	Belmesthorpe 1	31	-5	Negligible
42	Belmesthorpe 2	31	-3	Low
43	Belmesthorpe 3	31	-4	Low
44	Ridgeview Farm	31	-2	Low
45	Green Lane Farm	31	+1	Low
46	Cobbs Nook Farm	31	-3	Low
47	Pelham Cottage	31	-5	Negligible
48	Newstead Hall	31	-4	Low
49	Folly Farm	31	-8	Negligible
50	Wood Farm Cottages	31	+4	Low
51	Wood Farm	31	+5	**Medium**
52	Lower Home Farm	31	-11	Negligible
53	The Stables	31	-10	Negligible

ID	Receptor Name	Typical day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
54	Grange Farm	31	-3	Low
55	North Lodge House	31	+4	Low
56	North Lodge Farm	31	+5	**Medium**
57	Banthorpe Lodge	31	+3	Low
58	Glen Lodge	31	+3	Low

Table 12: BS 4142 assessment results: night-time

ID	Receptor Name	Typical night-time~~day~~ background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
1	The Heath	26	-3	Low
2	Mill View	26	-2	Low
3	Manor Farm	26	-1	Low
4	Lodge Farm	26	+7	Low
5	Barber's Hill House	26	+8	Low
6	Vale Farm	26	+7	Low
7	Heath House	26	+4	Low
8	Heath Cottage	26	+3	Low
9	Ryhall Grange	26	+3	Low
10	Ryhall Farm Cottage	26	+6	Low
11	Top Farm	26	+0	Low
12	Turnpike Road	32	-7	Negligible
13	Steabba's Close	32	-4	Low
14	A6121 Road 1	32	-3	Low
15	A6121 Road 2	32	-3	Low

ID	Receptor Name	Typical night-~~time~~day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
16	Sunny Acres 1	32	-1	Low
17	Sunny Acres 2	32	-1	Low
18	Heath Farm	26	+8	Low
19	Manor Farm	26	+2	Low
20	Plover Road	26	+5	Low
21	Stamford Road 1	32	-1	Low
22	Stamford Road 2	32	-2	Low
23	Stamford Road 3	32	-2	Low
24	Glen Crescent 1	32	-2	Low
25	Glen Crescent 2	32	-2	Low
26	Glen Crescent 3	32	-2	Low
27	Station Road	32	-2	Low
28	Bourne Road 1	32	-3	Low
29	Bourne Road 2	32	-3	Low
30	Bourne Road 3	32	-3	Low
31	Bourne Road 4	32	-3	Low
32	Church Farm	32	-3	Low
33	Crownfield House	32	-7	Negligible
34	School House	32	-3	Low
35	Grange Farm Cottage	26	+4	Low
36	Braceborough Grange	26	+3	Low
37	Redroofs	26	-1	Low
38	Walland House	26	-7	Negligible
39	Ryhall 1	26	+2	Low
40	Ryhall 2	26	+2	Low

ID	Receptor Name	Typical night-timeday background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
41	Belmesthorpe 1	26	+0	Low
42	Belmesthorpe 2	26	+2	Low
43	Belmesthorpe 3	26	+1	Low
44	Ridgeview Farm	26	+3	Low
45	Green Lane Farm	26	+6	Low
46	Cobbs Nook Farm	26	+2	Low
47	Pelham Cottage	26	+0	Low
48	Newstead Hall	26	+1	Low
49	Folly Farm	26	-3	Low
50	Wood Farm Cottages	26	+9	Low
51	Wood Farm	26	+10	**Medium***
52	Lower Home Farm	26	-6	Negligible
53	The Stables	26	-5	Negligible
54	Grange Farm	26	+2	Low
55	North Lodge House	26	+9	Low
56	North Lodge Farm	26	+10	**Medium***
57	Banthorpe Lodge	26	+8	Low
58	Glen Lodge	26	+8	Low

10.1.25. At Wood Farm and North Lodge Farm, predicted levels are marginally above the 35 dB threshold considered in the criteria of ***Appendix 10.2***. As the predicted rated levels were at least 5 dB above derived background noise levels during quiet day-time periods, this represents a medium impact magnitude.

10.1.26. Although the rated noise levels are just 10 dB above the typical night-time background noise levels for these properties, as the absolute levels are only 1 dB[3] above the lower threshold of 35 dB considered, it was determined based on professional judgement, considering the context of the noise as required in BS 4142, that this also represented a medium impact magnitude (as highlighted* in **Table 12** above).

10.1.27. Furthermore, as discussed in **Chapter 10**, operation of the plant at full duty during night-time periods is particularly unlikely. Nevertheless, additional mitigation is proposed below in the relevant section.

10.1.28. A noise map (**Figure 6**) has also been produced displaying the calculated L_{Aeq} sound levels around the Order limits, for illustrative purposes, showing the residential receptor locations considered ( ).

10.1.29. In addition, public rights of way (PRoW) in the area are shown as black lines. This map shows that a large majority of the PRoWs are located outside the calculated 30-35 dB noise contour because they are away from the proposed noise sources. In some instances, PRoWs are located in closer proximity to potential inverter locations, based on the design principle of a 50 m minimum separation. **Figure 7** shows two instances representative of this worst-case, with inverters located in relative proximity to two portions of PRoW paths E169/1 (left image) and BrAW/1/1 (right image). At these locations, portions of the are located within a 45-50 dB predicted noise contour. Predicted noise levels at the two closest points are of 41 and 49 dB L_{Aeq} respectively. No further mitigation is required in these instances.

[3] It is generally accepted that the human ear cannot distinguish differences of less than 3 dB between different noise levels outside of carefully controlled conditions, i.e. in a laboratory.

Figure 6– Noise predictions with SAT central inverter arrangement, including receptor locations (black/white dots) and PRoW (black lines).

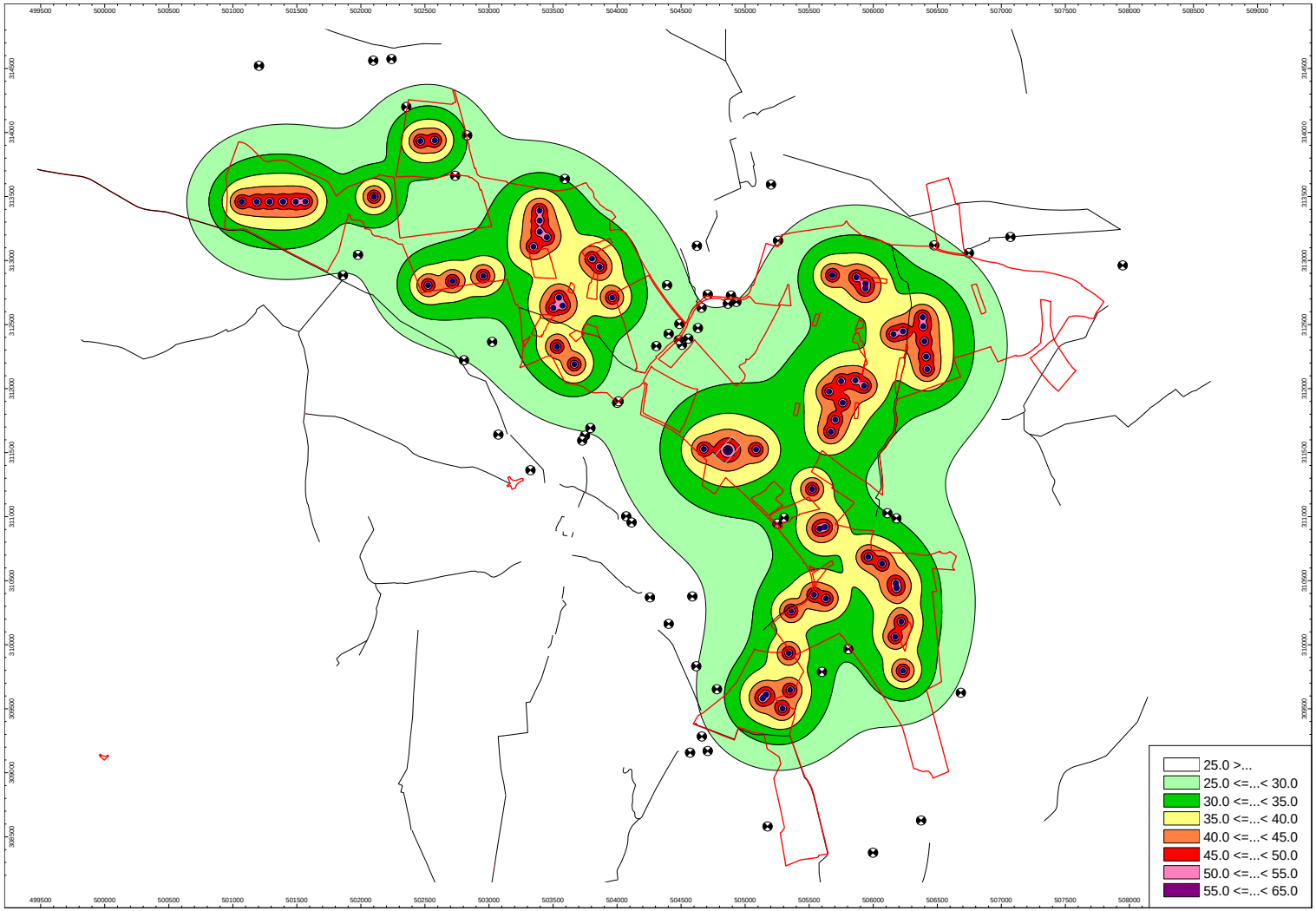
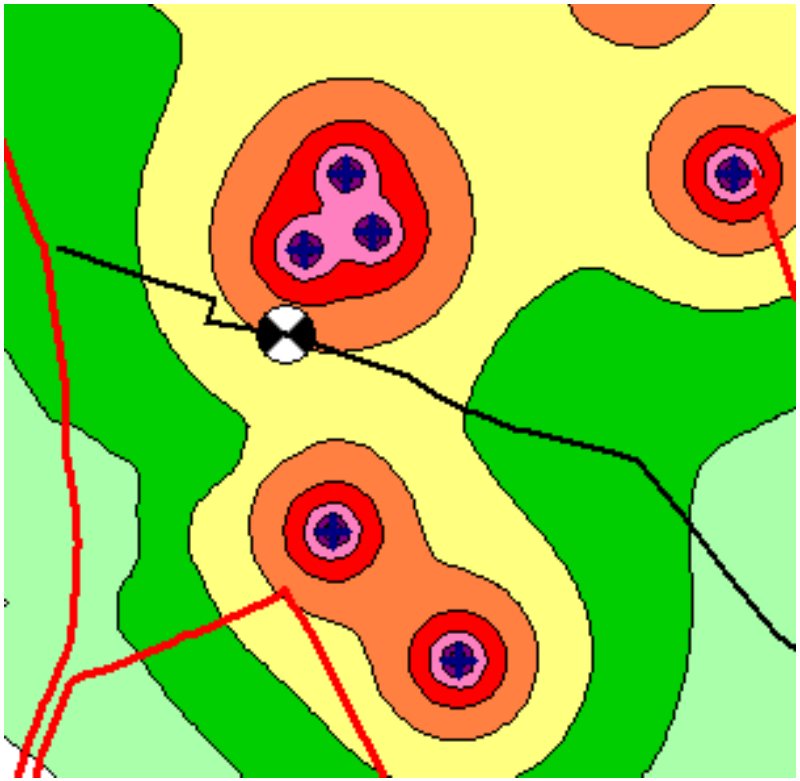
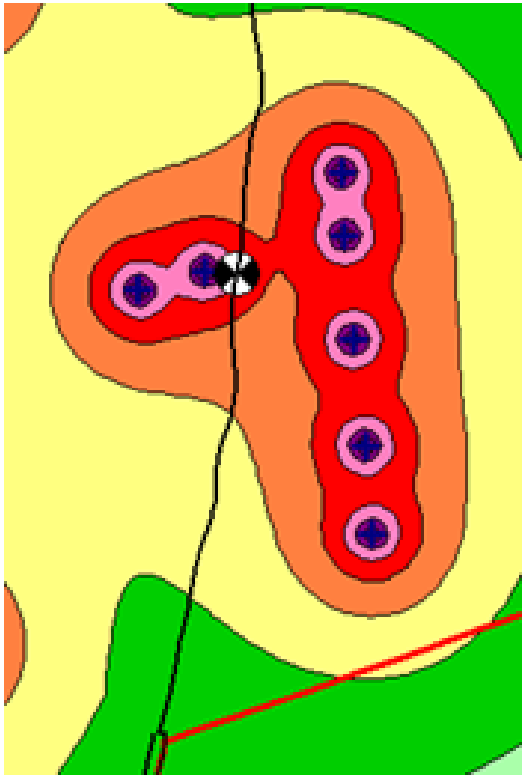


Figure 7– Noise predictions – Close up views of Figure 6 showing the E169/1 (left image) and BrAW/1/1 (right image) PRoW paths. A representative calculation point is shown for each PRoW.





Additional mitigation

10.1.30. To consider how the medium impact magnitudes identified in the above assessment at Wood Farm and North Lodge Farm would be mitigated based on the worst-case assumptions made, additional engineering noise reductions were considered based on the layout of sources assumed as the basis for the modelling. A 3 dB reduction in the noise emission levels of the central inverters is considered straightforward to achieve either through selection of quieter plant units or through standard noise attenuation measures for the fan noise likely dominating the noise emission from this plant.

10.1.31. By assuming a 3 dB reduction to the 2 inverters closest to Wood Farm and the 3 inverters closest to North Lodge Farm, reduced noise levels are obtained in **Table 13**, as shown for the last 40 properties considered (with negligible changes at other locations compared to **Table 10**).

Table 13: Predicted noise levels and rated levels following mitigation

Noise-sensitive receptor (ID 40 onwards, negligible changes at other locations)				**Predicted noise level (L_{Aeq}, dB)**	**Predicted rated noise level (L_{Ar}, dB)**
ID	**Name**	**Easting**	**Northing**		
40	Ryhall 2	504114	310954	24	28
41	Belmesthorpe 1	504257	310369	22	26
42	Belmesthorpe 2	504588	310377	24	28
43	Belmesthorpe 3	504403	310162	22	26
44	Ridgeview Farm	504619	309831	24	28
45	Green Lane Farm	504780	309652	28	32
46	Cobbs Nook Farm	504662	309283	24	28
47	Pelham Cottage	504570	309156	21	25
48	Newstead Hall	504708	309170	23	27
49	Folly Farm	505175	308581	18	22

Noise-sensitive receptor (ID 40 onwards, negligible changes at other locations)				Predicted noise level (L_{Aeq}, dB)	Predicted rated noise level (L_{Ar}, dB)
ID	**Name**	**Easting**	**Northing**		
50	Wood Farm Cottages	505806	309965	30	34
51	Wood Farm	505600	309788	31	35
52	Lower Home Farm	505999	308375	16	20
53	The Stables	506374	308628	16	20
54	Grange Farm	506684	309625	24	28
55	North Lodge House	505251	310946	30	34
56	North Lodge Farm	505303	310990	31	35
57	Banthorpe Lodge	506111	311027	30	34
58	Glen Lodge	506181	310987	30	34

10.1.32. **Table 15** and **table 15**below set out the corresponding BS 4142 noise assessment results at all the receptor locations of **Table** 13 **13**, taking into account the mitigation applied. This shows that negligible or low impact magnitudes are determined at all receptors.

Table 14: BS 4142 assessment results: day-time-with mitigation

ID	Receptor Name	Typical day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
40	Ryhall 2	31	-3	Low
41	Belmesthorpe 1	31	-5	Negligible
42	Belmesthorpe 2	31	-3	Low
43	Belmesthorpe 3	31	-5	Negligible
44	Ridgeview Farm	31	-3	Low

ID	Receptor Name	Typical day background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
45	Green Lane Farm	31	+1	Low
46	Cobbs Nook Farm	31	-4	Low
47	Pelham Cottage	31	-6	Negligible
48	Newstead Hall	31	-4	Low
49	Folly Farm	31	-9	Negligible
50	Wood Farm Cottages	31	+3	Low
51	Wood Farm	31	+4	Low
52	Lower Home Farm	31	-11	Negligible
53	The Stables	31	-11	Negligible
54	Grange Farm	31	-3	Low
55	North Lodge House	31	+3	Low
56	North Lodge Farm	31	+4	Low
57	Banthorpe Lodge	31	+3	Low
58	Glen Lodge	31	+3	Low

Table 15: BS 4142 assessment results: night-time-with mitigation

ID	Receptor Name	Typical night-time~~day~~ background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
40	Ryhall 2	26	+2	Low
41	Belmesthorpe 1	26	+0	Low
42	Belmesthorpe 2	26	+2	Low
43	Belmesthorpe 3	26	+0	Low
44	Ridgeview Farm	26	+2	Low

ID	Receptor Name	Typical night-timeday background noise level (dB)	Difference between rated and background noise level (dB)	Magnitude of Impact
45	Green Lane Farm	26	+6	Low
46	Cobbs Nook Farm	26	+2	Low
47	Pelham Cottage	26	-1	Low
48	Newstead Hall	26	+1	Low
49	Folly Farm	26	-4	Low
50	Wood Farm Cottages	26	+8	Low
51	Wood Farm	26	+9	Low
52	Lower Home Farm	26	-6	Negligible
53	The Stables	26	-6	Negligible
54	Grange Farm	26	+2	Low
55	North Lodge House	26	+8	Low
56	North Lodge Farm	26	+9	Low
57	Banthorpe Lodge	26	+8	Low
58	Glen Lodge	26	+8	Low

References

Ref 1 BSI (2014). BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise and Part 2: Vibration

Ref 2 International Organization for Standardization (ISO) (1996). ISO 9613 Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation.