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WHITESTONE SOLAR FARM

Volume 6: Environmental Statement

6.20 Appendix 14.4: Operational Noise Assessment

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Glossary

Term	Meaning
Ambient sound level, La = Laeq, T	The A-weighted equivalent continuous sound level of the totally encompassing sound for a given situation and time interval, T.
A-weighting	Frequency weighting applied to measured sound in order to account for the relative loudness perceived by the human ear.
Decibel (dB)	The logarithmically scaled measurement unit of sound.
Environmental Statement (ES)	The Environmental Statement which presents the environmental information relating to the Proposed Development. The ES has been

Term	Meaning
	prepared to present information for formal consultation in accordance with current EIA regulation.
$L_{A90,T}$	The A-weighted sound level exceeded for 90% of the measurement period. Often referred to as the background sound level.
$L_{Aeq,T}$	A-weighted equivalent continuous sound level over a given time period. It is the sound level of a steady sound that has the same energy as a fluctuating sound over the same time period.
Rating level, $L_{Ar,Tr}$	The specific sound level plus any adjustment for the characteristic features of the sound.
Specific sound level, $L_s = L_{Aeq,Tr}$	The A-weighted equivalent continuous sound pressure level produced by the specific sound source at the reference location over a reference time interval, T.
The Applicant	Whitestone Net Zero Ltd.
The Application	The Application submitted to the Secretary of State for a Development Consent Order.
The Proposed Development	The proposed Whitestone Solar Farm.
The Site	The land planned to be used for solar PV array and associated infrastructure, BESS, substation, and landscaping and habitat enhancement. The Site is split into W1, W2, and W3.
W1	The northern parcels of the Whitestone Solar Farm.
W2	The middle parcels of the Whitestone Solar Farm.
W3	The southern parcels of the Whitestone Solar Farm.

Acronyms

Acronym	Meaning
BESS	Battery Energy Storage System
ES	Environmental Statement
LOAEL	Lowest Observed Adverse Effect Level
PCS	Power Converter Station
SOAEL	Significance Observed Adverse Effect Level
W1	Whitestone 1
W2	Whitestone 2
W3	Whitestone 3

Units

Units	Meaning
dB	Decibel
m	Metre
mm	Milimetres
km	Kilometres
s	Second

14.4 Operational Noise Initial Assessment

Introduction

14.4.1 This Appendix supports **Environmental Statement (ES) Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]**. This Appendix presents:

- The methodology for the assessment of operational noise from the Proposed Development;
- The calculated operational noise levels for each relevant assessment location (presented in Table 14.2.1 of **ES Volume 3, Appendix 14.2: Baseline Conditions [EN0110020/APP/6.20]**; and
- An initial assessment of noise impacts during the operation of the Proposed Development in accordance with BS 4142 by establishing the rating level exceedance of the representative background noise level.

Study Area

14.4.2 The operational noise Study Area includes an area extending 2km from noise generating plant.

14.4.3 **ES Volume 3, Figures 14.1 – 14.3: Noise Monitoring Locations [EN0110020/APP/6.19]** present assessment locations which have been chosen to represent noise sensitive receptors within the Study Areas. An initial set of noise assessment locations (AL001 to AL115) was consulted and agreed with Rotherham Metropolitan Borough Council. City of Doncaster Council were consulted on 30th April 2025 regarding these proposed assessment locations, however, there has been no response to date.

14.4.4 Additional noise assessment locations (AL116 to AL146) were introduced to the assessment following updates to the design of the Proposed Development since the Statutory Consultation.

Methodology of the Initial Assessment

14.4.5 **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]** presents assessment criteria for the Proposed Development including details of Significance in relation to magnitude of impact.

14.4.6 Noise impacts associated with on-site operation have been assessed with reference to the criteria set out in BS 4142:2014+A1:2019 – Methods for rating and assessing industrial and commercial sound (BS 4142)[1].

14.4.7 The assessment method described in BS 4142 uses outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling used for residential purposes.

14.4.8 As discussed in **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]**, BS 4142 does not seek to propose Lowest Observed Adverse Effect Level (LOAEL) and Significance Observe Adverse Effects Level (SOAEL). However, it provides guidance on determining the Significance of the effect, based on a comparison between operational noise and background sound levels, with emphasis on the context in which the operational noise occurs.

14.4.9 BS 4142 defines the following terms, which are referred to in this assessment:

- **Specific Sound Level, L_s**: the A-weighted sound level of the sound source being assessed;
- **Rating Level, $L_{Ar,Tr}$**: the specific sound level plus any adjustment for characteristic features of the sound;
- **Residual Sound Level, L_r**: the A-weighted sound level remaining when the specific sound level is sufficiently suppressed so as not to contribute to the ambient sound level; and
- **Background Sound Level, $L_{A90,T}$**: the L_{90} statistical measure of the residual sound level. The background sound level is an underlying level of sound over a time period, T. It does not reflect the occurrence of transient and / or higher sound level events and is generally governed by continuous or semi-continuous sounds.

14.4.10 The initial assessment compares the difference between the background sound level and the rating level at the assessment location.

14.4.11 The rating level is derived from the specific sound level of the operational noise source with the addition of any corrections to account for any audible characteristic features of the sound at the assessment location.

14.4.12 BS 4142 describes the following characteristic features and provides guidance on how to apply each correction:

- **Tonality:** up to +6dB;
- **Impulsivity:** up to +9dB;
- **Intermittency:** up to +3dB; and
- **Other Sound Characteristics** (neither tonal nor impulsive but still readily distinctive): up to +3dB.

14.4.13 With reference to the difference between the rating level and background sound level, BS 4142 states:

"…

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10dB or more is likely to be an indication of Significant Adverse impact, depending on the context.

c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context

d) The lower the rating level is relative to the measured background sound level, the less likely is that the specific sound source will have an adverse impact or a Significant Adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having low impact, depending on the context

Note: Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact."

Consideration of Context

14.4.14 BS 4142 requires that the initial assessment is modified based on the context in which the sound occurs when determining the Significance of the effect. This is inherently outside of the scope of the initial assessment, and therefore this is presented in the determination of Significance of effect in Section 14.7 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]** rather than in this Technical Appendix.

Calculation Methodology

14.4.15 The operational noise assessment makes use of the following information:

- Baseline noise monitoring data presented in **ES Volume 3, Appendix 14.2: Baseline Conditions [EN0110020/APP/6.20]**;
- The works plans drawings presented in **Works Plans [EN0110020/APP/2.3]**;
- Preliminary layout and general arrangement drawings of fixed plant (see **ES Volume 3, Figure 5.1: Illustrative Masterplan [EN0110020/APP/6.19]**); and
- Indicative equipment noise source data and operating times based on professional experience of equipment specifications from similar developments.

14.4.16 The main noise sources during the operational phase will consist of fixed plant, including power conversion systems (primarily the inverter units), Battery Energy Storage System (BESS) equipment; and substation transformers, as presented in **Table 14.4-1**.

14.4.17 Operational noise has been calculated using Datakustik CadnaA 2026: an industry-recognised 3D noise modelling software package that incorporates the sound propagation methods set out in ISO 9613-2:2024 *Acoustics — Attenuation of sound during propagation outdoors* (ISO 9613).

14.4.18 Ground topography has been included in the model. A global ground assumption of G=0.5 has been applied throughout calculations. Screening from buildings has not been included, other than screening from the BESS units, and therefore calculations are conservative. Other calculation parameters include a BESS unit reflection loss of 0.5dB, and a maximum order of reflections of 3.

14.4.19 **Table 14.4-1** presents a list of equipment that is likely to produce noise during the operation of the Proposed Development and their respective expected maximum sound power levels both with and without attenuation.

Table 14.4-1: Operational Noise Emitting Equipment and Assumed Sound Power Level

Equipment / Technology Name	Location	Number of Units	Unattenuated Sound Power Level per Unit L_{WA} dB	Attenuated Sound Power Level per Unit L_{WA} dB	Assumed Octave Band Frequency Spectrum dB Hz [1]							
					63	125	250	500	1000	2000	4000	8000
Inverter units	Solar panel areas across Whitestone 1 (W1), Whitestone 2 (W2) and Whitestone 3 (W3)	140	91.9 (100% load – daytime)	85.9 (100% load – daytime)	60.0	79.9	89.5	86.0	81.5	70.0	60.8	53.9
			75.8 (20% load – night-time)	71.1 (20% load – night-time)								
BESS Containers	Proposed BESS area within the northern region of W2	332	88.5	85.5	52.3	66.3	66.3	64.3	59.3	56.3	47.3	43.3
Power Conversion Systems	Proposed Power Converter Station (PCS) area within the northern region of W2	166	92.0	89.0	55.7	69.7	69.7	67.7	62.7	59.7	50.7	46.7
Primary Transformers	Primary and satellite substations	7	92.0	86.0	71.1	77.2	84.8	87.0	87.0	82.0	76.2	70.8

Equipment / Technology Name	Location	Number of Units	Unattenuated Sound Power Level per Unit L_{WA} dB	Attenuated Sound Power Level per Unit L_{WA} dB	Assumed Octave Band Frequency Spectrum dB Hz [1]							
					63	125	250	500	1000	2000	4000	8000
	within W1 and W2											
Aux Transformers	Primary and satellite substations within W1 and W2	7	84.0	78.0	63.1	69.2	76.8	79.0	79.0	74.0	68.2	62.8

[1]. Frequency spectra were scaled to the sound power level of the noise source.

14.4.20 In general, it is not expected attenuation would be required to comply with noise criteria, except where specifically highlighted in the embedded mitigation, which is presented in Section 14.7 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]**. **ES Volume 3, Figures 14.7 – 14.9: Embedded Operational Noise Mitigation [EN0110020/APP/6.19]** present the areas where embedded mitigation is included in the design.

Initial Assessment

14.4.21 Noise level calculations have been carried out in line with the assumptions, exclusions, and limitations stated in Section 14.4 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]** and include embedded mitigation presented in Section 14.6 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]**.

14.4.22 Table 14.2.5 of **ES Volume 3, Appendix 14.2: Baseline Conditions [EN0110020/APP/6.20]** presents the representative background sound level for each assessment location. These values have been used in conjunction with the modelled rating noise levels to calculate the magnitude of impact in accordance with the methodology set out in Section 14.4 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]**.

14.4.23 A correction of + 3dB has been applied to the specific level to account for potential acoustic features.

14.4.24 **Table 14.4-2** presents the representative background noise level, the calculated specific and rating levels for the operation of the Proposed Development, and the rating level exceedances of background for all assessment locations. This is then presented as a magnitude of impact in Section 14.7 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14].**

Table 14.4-2: Initial Assessment of Operational Noise

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL001	45	41	33	17	36	20	-9	-21
AL002	45	41	34	18	37	21	-8	-20
AL003	45	41	33	17	36	20	-9	-21
AL004	45	41	30	14	33	17	-12	-24
AL005	44	43	38	22	41	25	-3	-18
AL006	44	43	36	20	39	23	-5	-20
AL007	33	29	33	17	36	20	+3	-9
AL008	33	29	33	17	36	20	+3	-9
AL009	33	29	31	15	34	18	+1	-11
AL010	33	29	34	18	37	21	+4	-8
AL011	44	43	33	17	36	20	-8	-23
AL012	44	43	36	20	39	23	-5	-20
AL013	33	29	33	17	36	20	+3	-9
AL014	43	39	36	20	39	23	-4	-16
AL015	43	39	32	16	35	19	-8	-20
AL016	33	29	31	15	34	18	+1	-11
AL017	33	29	29	13	32	16	-1	-13
AL018	33	29	34	18	37	21	+4	-8
AL019	44	43	32	16	35	19	-9	-24

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL020	33	29	28	12	31	15	-2	-14
AL021	43	32	30	14	33	17	-10	-15
AL022	43	32	30	14	33	17	-10	-15
AL023	43	39	30	14	33	17	-10	-22
AL024	40	33	31	14	34	17	-6	-16
AL025	40	33	32	16	35	19	-5	-14
AL026	40	33	36	20	39	23	-1	-10
AL027	40	33	34	19	37	22	-3	-11
AL028	43	39	36	21	39	24	-4	-15
AL029	43	32	33	20	36	23	-7	-9
AL030	43	39	32	18	35	21	-8	-18
AL031	43	39	29	13	32	16	-11	-23
AL032	54	33	34	23	37	26	-17	-7
AL033	54	33	34	22	37	25	-17	-8
AL034	43	39	35	27	38	30	-5	-9
AL035	38	32	38	30	41	33	+3	+1
AL036	40	32	31	20	34	23	-6	-9
AL037	48	43	37	26	40	29	-8	-14
AL038	37	31	38	26	41	29	+4	-2
AL039	48	43	41	26	44	29	-4	-14

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL040	48	43	35	25	38	28	-10	-15
AL041	44	39	36	22	39	25	-5	-14
AL042	38	31	36	21	39	24	+1	-7
AL043	38	31	33	18	36	21	-2	-10
AL044	38	31	29	16	32	19	-6	-12
AL045	38	31	32	16	35	19	-3	-12
AL046	48	43	34	18	37	21	-11	-22
AL047	48	43	36	19	39	22	-9	-21
AL048	44	39	38	22	41	25	-3	-14
AL049	44	39	41	25	44	28	+0	-11
AL050	44	39	41	26	44	29	+0	-10
AL051	44	39	39	24	42	27	-2	-12
AL052	44	39	39	23	42	26	-2	-13
AL053	46	41	39	36	42	39	-4	-2
AL054	44	43	35	19	38	22	-6	-21
AL055	33	29	31	15	34	18	+1	-11
AL056	44	43	29	13	32	16	-12	-27
AL057	46	41	39	35	42	38	-4	-3
AL058	46	41	38	29	41	32	-5	-9
AL059	46	41	38	35	41	38	-5	-3

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL060	46	41	32	18	35	21	-11	-20
AL061	39	32	27	11	30	14	-9	-18
AL062	39	32	27	11	30	14	-9	-18
AL063	46	41	29	13	32	16	-14	-25
AL064	44	39	28	16	31	19	-13	-20
AL065	54	46	46	46	49	49	-5	+3
AL066	54	46	45	45	48	48	-6	+2
AL067	54	46	39	38	42	41	-12	-5
AL068	52	41	37	35	40	38	-12	-3
AL069	52	41	37	34	40	37	-12	-4
AL070	46	41	36	34	39	37	-7	-4
AL071	48	43	33	16	36	19	-12	-24
AL072	48	43	31	15	34	18	-14	-25
AL073	53	46	40	39	43	42	-10	-4
AL074	53	46	41	40	44	43	-9	-3
AL075	57	49	41	40	44	43	-13	-6
AL076	33	23	23	7	26	10	-7	-13
AL077	33	23	25	12	28	15	-5	-8
AL078	33	23	30	17	33	20	+0	-3
AL079	33	23	28	14	31	17	-2	-6

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL080	33	23	25	11	28	14	-5	-9
AL081	33	23	27	14	30	17	-3	-6
AL082	33	23	31	18	34	21	+1	-2
AL083	33	23	28	15	31	18	-2	-5
AL084	33	23	33	19	36	22	+3	-1
AL085	33	23	33	19	36	22	+3	-1
AL086	33	23	27	14	30	17	-3	-6
AL087	33	23	26	13	29	16	-4	-7
AL088	33	23	30	16	33	19	+0	-4
AL089	33	23	21	5	24	8	-9	-15
AL090	33	23	21	9	24	12	-9	-11
AL091	36	26	30	14	33	17	-3	-9
AL092	45	39	38	22	41	25	-4	-14
AL093	45	39	37	21	40	24	-5	-15
AL094	45	39	27	11	30	14	-15	-25
AL095	45	39	25	8	28	11	-17	-28
AL096	45	39	26	10	29	13	-16	-26
AL097	45	39	27	11	30	14	-15	-25
AL098	33	23	34	22	37	25	+4	+2
AL099	46	41	40	36	43	39	-3	-2

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL100	50	45	35	19	38	22	-12	-23
AL101	33	25	32	16	35	19	+2	-6
AL102	33	25	31	15	34	18	+1	-7
AL103	33	25	29	13	32	16	-1	-9
AL104	50	45	26	10	29	13	-21	-32
AL105	33	25	28	12	31	15	-2	-10
AL106	50	45	26	10	29	13	-21	-32
AL107	33	25	27	11	30	14	-3	-11
AL108	36	26	27	11	30	14	-6	-12
AL109	45	39	22	6	25	9	-20	-30
AL110	36	29	30	14	33	17	-3	-12
AL111	45	39	28	12	31	15	-14	-24
AL112	33	23	15	0	18	3	-15	-20
AL113	57	49	22	6	25	9	-32	-40
AL114	57	49	22	6	25	9	-32	-40
AL115	57	49	30	29	33	32	-24	-17
AL116	50	45	21	6	24	9	-26	-36
AL117	33	25	19	3	22	6	-11	-19
AL118	50	45	7	-10	10	-7	-40	-52
AL119 to AL120 are outside of the operational noise Study Area and are therefore exclude from the initial assessment.								

AL ID	Representative Background Level L_{A90} dB		Specific Level, L_s dB		Rating Level, $L_{Ar,Tr}$ dB		Rating Level Exceedance of Representative Background Level dB	
	Day	Night	Day	Night	Day	Night	Day	Night
AL121	33	25	19	3	22	6	-11	-19
AL122	50	45	20	4	23	7	-27	-38
AL123	50	45	23	7	26	10	-24	-35
AL124	50	45	27	11	30	14	-20	-31
AL125	33	25	31	14	34	17	+1	-8
AL126	33	25	28	11	31	14	-2	-11
AL127	33	25	28	12	31	15	-2	-10
AL128	33	25	26	10	29	13	-4	-12
AL129	51	47	29	28	32	31	-19	-16
AL130	52	47	35	35	38	38	-14	-9
AL131	57	49	36	36	39	39	-18	-10
AL132	57	49	34	34	37	37	-20	-12
AL133	54	46	36	35	39	38	-15	-8
AL134	57	49	34	33	37	36	-20	-13
AL135	43	32	31	20	34	23	-9	-9
AL136 to AL141 are outside of the operational noise Study Area and are therefore exclude from the initial assessment.								
AL142	44	43	34	18	37	21	-7	-22
AL143	44	43	34	18	37	21	-7	-22
AL144	50	45	25	9	28	12	-22	-33
AL145 to AL146 are outside of the operational noise Study Area and are therefore exclude from the initial assessment.								

14.4.25 Table 14.13 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]** summarises the impacts of the assessment presented in **Table 14.4-2**.

Assessment of Likely Significant Effects

14.4.26 This Appendix presents the findings of the initial assessment in accordance with BS 4142 only. An assessment of the likely significant effects is presented in Section 14.8 of **ES Volume 2, Chapter 14: Noise and Vibration [EN0110020/APP/6.14]**.

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References

[1] British Standards Institution. *BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound*. s.l.: BSI, 2019. ISBN 978 0 539 02069 4 [Online]