Point & Sandwick Trust

Noise Impact Assessment

Battery Point Energy Storage Park, Stornoway

19591540/rmg/R1/v3 – 18th April 2024

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Document Control Sheet

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Client	Point & Sandwick Trust
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v1	09/04/24	Rocco Giudice	Issued for review	Superseded
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v3	18/04/24	Rocco Giudice	Updated with latest masterplan	Final

	Name	Job Title	Signature
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Appendices

1. Introduction

1.1 Bureau Veritas was instructed by The Greenspan Agency on behalf of Point & Sandwick Trust to undertake a noise impact assessment for a proposed new energy storage park on land which is situated south of Newton Street, in Stornoway.

1.2 This assessment looks to establish the following:

- Identification of the closest sensitive receptors to the energy storage park.
- Preparation of an acoustic noise model with the inclusion of all noise generating equipment based on manufacturer's data.
- Preparation of daytime and night-time colour contour noise plots to determine the noise levels of the new energy storage park incident on the nearest receptors.
- Assessment of noise impact at the nearest sensitive receptors in line with the Comhairle Nan Eilean Siar requirements.

1.3 The noise impact assessment was facilitated by preparing a noise model using the CadnaA noise mapping software.

1.4 A glossary of acoustic terminology is included as Appendix A. The assessment criteria applicable to this site are reproduced in Section 3.

1.5 Scaled site plans of the proposed development were prepared by The Greenspan Agency. A copy of the proposed site plan can be found in Appendix B.

2. Description of Site & Sensitive Receptors

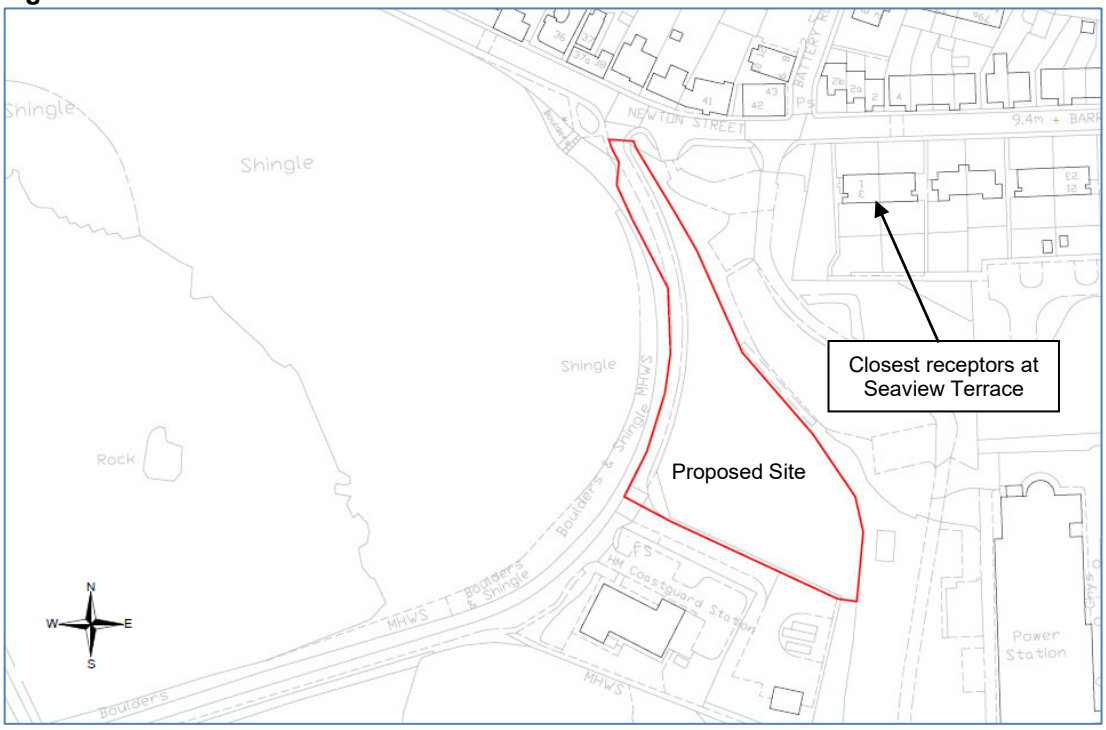
2.1 It is understood that the new energy storage park will be located on land situated south of Newton Street, west of Battery Point Power station and east of the Newton Marina in Stornoway. The surrounding area is a mixture of industrial and residential properties.

2.2 It is understood the battery storage park will comprise of 144no. battery modules, 6no inverters, 3no. Transformer & Ring Main Units, a 33kV substation and auxiliary transformer. It is understood that the battery storage park is likely to operate 24 hour per day, hence a daytime and night-time assessment is required. Due to the introduction of new noise sources in the area it will be necessary to assess the impact of the new development at the nearest sensitive receptors.

2.3 The nearest noise sensitive receptors have been identified as dwellings on Seaview Terrace immediately north of the development site. It is considered that 1 Seaview Terrace will be the most exposed property as this is situated closest to the nearest proposed noise generating equipment.

2.4 The figure below shows the location of the proposed development site.

Figure 2.1: Location Plan



3. Criteria for Noise Assessment

3.1. Bureau Veritas have been commissioned to undertake a noise impact assessment with a view to establishing whether the proposed development site is suitable for an energy storage park.

3.2. Jack Cook of the Greenspan Agency subsequently contacted Colm Fraser, Consumer and Environmental Services Manager at Comhairle Nan Eilean Siar to establish suitable noise criteria in order to assess the project. It was agreed that a noise assessment would be submitted with the planning application. Mr Fraser requested that the total noise from any mechanical and electrical plant be assessed against the following criteria:

- External noise: NR45 during the daytime, measured 1 metre from the façade of any adjacent residential property.
- Internal noise: NR25 during night-time within any adjacent residential property with the windows open at least 5 cm.

The time periods were defined as follows;

- Daytime: 07:00 to 23:00 hours
- Night-time: 23:00 to 07:00 hours

Noise Rating Curves

3.3. It is generally considered inappropriate to use only single-figure, A-weighted levels for mechanical plant noise intrusion due to the impact of the low frequency noise. A relatively common application of absolute criteria is to use Noise Rating Curves to provide a target level in design work.

3.4. Noise Rating or NR curves were developed by the International Organization for Standardization (ISO) to determine the acceptable indoor environment for hearing preservation, speech communication and annoyance. Therefore, it provides a single figure noise level that takes into account the frequency content of the noise.

3.5. The benefit of using a NR Curve is that it provides an absolute limit value in each octave band, whereas using an A-weighted level means that for a given dB(A) value, the allowable level of low frequency noise depends on the noise level at other frequencies. For a situation where there is little mid and high frequency noise transmission, a higher level of bass will be allowable without exceeding the dB(A) limit. The NR Curves therefore penalise low frequency noise as it is generally considered to cause more annoyance.

4. Noise Model

4.1 An acoustic model has been created showing the impact of the proposed new battery energy storage park using CadnaA noise mapping software Version 2023. The software calculates the contribution from sources, input as a point, line or area source at defined locations.

4.2 The model predicts noise levels based on hemispherical propagation, atmospheric absorption, ground effects, in plant reflections, screening and directivity based on the procedure detailed in ISO 9613-2, *"Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation".*

4.3 The model has been run using a receiver height of 1.6 metres above grade, equivalent to ear level at standing height for external noise and 4.0m above grade for the night-time to account for first floor bedrooms. The model accounts for equal sound radiation of noise sources in all directions.

4.4 ISO 9613-2 gives the estimated accuracy of the noise model as ±3 dB, for the calculation of broadband A-weighted sound levels, for receiver distances of up 1 km. The standard also states that errors in the calculation of individual octave bands may be somewhat larger than the estimated errors given for broadband A-weighted sound levels.

Acoustic Model Inputs

4.5 Noise data from manufacturer's technical data sheets has been included for the identified equipment associated with the battery energy storage park. A summary of the data used for the noise model can be seen in the following figures and table below.

Figure 4.1: CATL Battery Module Noise Levels

5.1 Test layout 1: the height of the measuring points is 1.2m

Test Mode	Position	Operating noise dB (A)					
		1st		2nd		3rd	
		Max	RMS	Max	RMS	Max	RMS
A: Self-circulation Mode	Point 1	47.5	47.4	47.5	47.4	47.5	47.4
	Point 2	47.4	47.3	47.4	47.3	47.4	47.3
	Point 3	37.8	37.6	37.6	37.4	37.7	37.5
	Point 4	49.8	49.7	49.9	49.8	49.9	49.8
	Point 5	48.4	48.3	48.5	48.4	48.5	48.4
	Point 6	47.8	47.7	47.7	47.6	47.8	47.6
B: Force-cooling / heating Mode	Point 1	71.5	70.2	72.0	71.0	71.7	71.0
	Point 2	71.2	70.1	71.8	70.9	71.5	70.8
	Point 3	62.3	61.0	62.4	61.6	62.2	61.7
	Point 4	66.4	65.1	66.9	65.9	66.4	65.8
	Point 5	63.6	62.4	64.2	63.2	63.9	63.2
	Point 6	61.1	59.9	61.4	60.6	61.2	60.6
Remarks:	background noise value at 27dB(A)-28dB(A)						

- The MAX value is the maximum value of the sound pressure level measured during the 8s time period collected at the measuring point;
- The RMS value is the Root mean square of the sound pressure level measured during the 8s time period collected at the measuring point.

Figure 4.2: CATL Battery Noise Measurement Locations

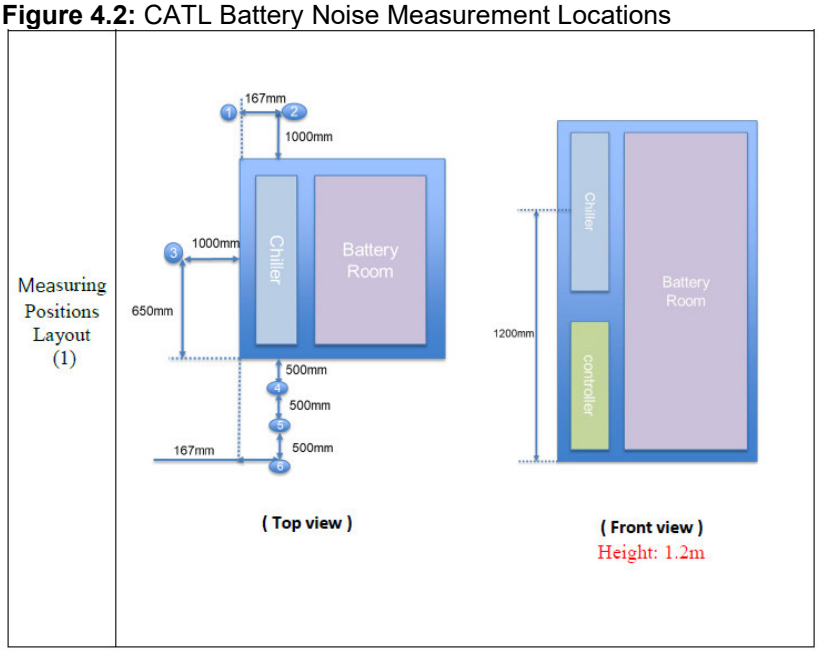


Figure 4.3: Power Electronic PCSK GEN3 Inverters Noise Levels (manufacturer has deemed 50% fan speed to be acceptable given Stornoway's climate).

Fan speed	100%	80%	70%	60%	50%
Sound power Lw	100.8 dB	95.8 dB	94.9 dB	93.6 dB	92.0 dB
Sound pressure L'p(ST)	81.3 dB	76.3 dB	75.4 dB	74.1 dB	72.6 dB

Figure 4.4: Noise Data

Equipment	Noise Level
Transformer & Ring Main Units	SPL <70dB at 1m
33kv Substation Auxiliary Transformers	L_w <58 dB(A)

Assumptions and Limitations

4.6 Night-time is considered to be between the hours of 23:00 and 07:00. As a conservative assessment we have run both the daytime and night-time scenarios with all equipment running continuously.

4.7 The receptor has been located on the first floor for the internal assessment which is considered to be worst case as it has a clearer line of sight to the noise sources. For the assessment of external noise, the model was run at 1.6m above ground, equivalent to ear level at standing height.

4.8 In terms of ground effect, mixed terrain was used (i.e. a mixture of hard and soft).

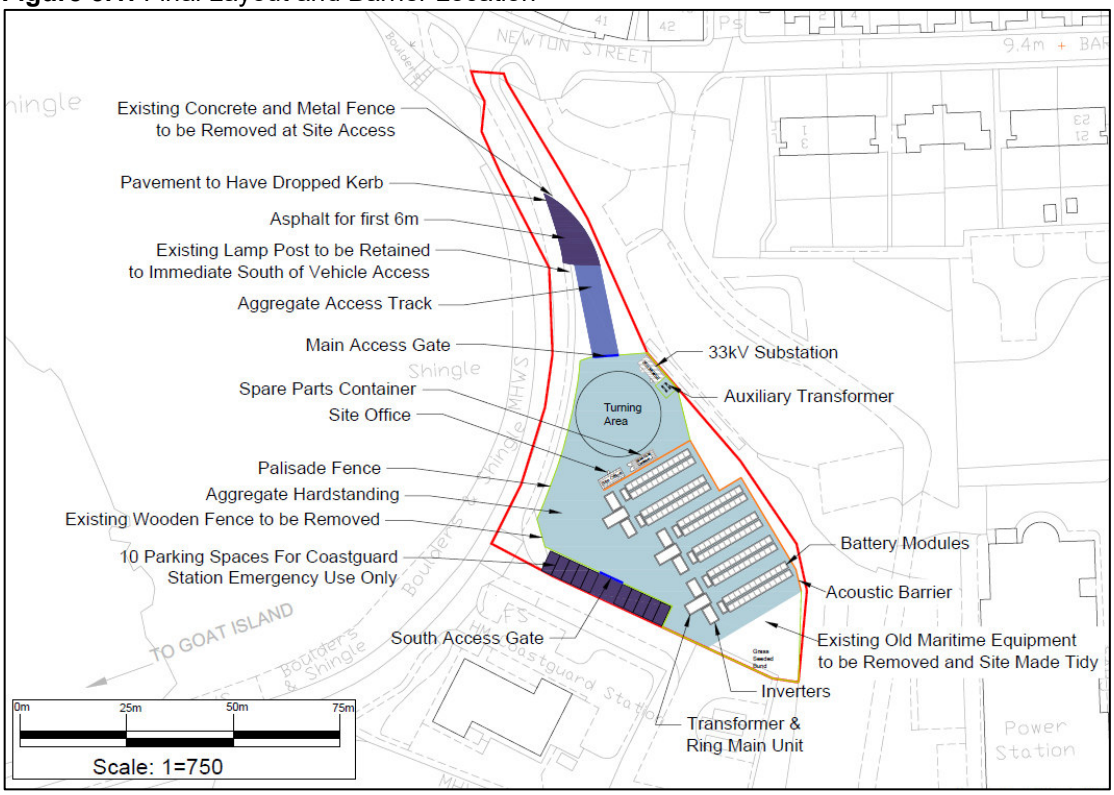
4.9 Conservative climatic conditions, favourable to noise propagation, were selected i.e. downwind conditions. It is envisaged however that due to the short propagation distance with which the receptors lie, atmospheric conditions will have very little impact on projected noise levels.

5. Assessment

5.1 Bureau Veritas have been working with Greenspan Energy for several months to determine the best layout and mitigation measures for the proposed energy storage park so that its noise impact on the surrounding environment will be minimised.

5.2 In order to reduce noise impacts, a 4m acoustic barrier was introduced around the battery units which were found to be the dominant noise source. This can be seen in the layout plan in Figure 5.1 below. A high-resolution version of this plan is provided in Appendix B and the acoustic barrier is marked by an orange line. The assessment has therefore been based on this layout and these mitigation measures.

Figure 5.1: Final Layout and Barrier Location



5.3 The acoustic barrier should be continuous with no gaps, either between sections or at the base or sides of the barrier. The mass of a barrier should be at least 10kg/m^2. As 19mm thick softwood boards have a mass of approximately 10.5kg/m^2 they would be suitable for the proposed barrier as long as it was suitably maintained. The barrier could also be constructed of brickwork. The location of the barriers can be seen in Appendix C.

Results

5.4 The results of the CadnaA noise model have been used to generate colour contour noise maps (see Appendix C) which are able to help assess the suitability of the site for the new battery energy storage park.

5.5 The results of the noise modelling have shown that the impact of the energy storage park will be between $L_{Aeq,t}$ 41-42 dB during the daytime and night-time with all equipment running.

5.6 Table 5.1 below shows the highest noise levels calculated at the most exposed receptor, i.e. 1 Seaview Terrace at first floor level, which was found to be the highest noise level encountered in the study.

Table 5.1: Noise Level at the most exposed receptor

Closest Receptor	Octave Band Centre Frequency, dB								
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
1 Seaview Terrace (Ground level)	48	43	47	45	40	32	26	20	6
1 Seaview Terrace (1st floor)	49	44	48	46	41	33	27	21	7

Noise Rating Curves

5.7 An assessment of the energy storage park with respect to Noise Rating Curves has been made in line with the criteria recommended by the Local Authority. A façade limit of NR45 was recommended for the daytime. Additionally, it will be necessary to meet NR25 inside sensitive receptors at night.

5.8 The NR criteria is displayed below and shows the octave band levels which must not be exceeded during the daytime (outside) and at night (indoors).

Table 5.2: Noise Rating Criteria (dB levels which must not be exceeded)

Criteria	Octave Band Centre Frequency, dB								
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
NR 45 (Daytime, 1m from façades)	86	71	61	54	48	45	42	40	38
NR 25 (Night-time, internally)	72	55	44	35	29	25	22	20	18

External Noise Assessment

5.9 The tables below compare the façade noise levels at the most exposed receptor against the daytime criterion of NR45. It should be noted that this assessment represents a worst-case scenario as all equipment was modelled as operational.

Table 5.3: Daytime External Noise Assessment

	Octave Band Centre Frequency, dB								
	31.5Hz	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
External noise level at 1 Seaview Terrace	48	43	47	45	40	32	26	20	6
NR 45 Criterion	86	71	61	54	48	45	42	40	38
Criteria Met?	✓	✓	✓	✓	✓	✓	✓	✓	✓

5.10 The results in Table 5.3 show that the external daytime criteria of NR45 will be met at the most exposed residential receptor. The corresponding external noise levels has been calculated to meet NR36.

Internal Noise Assessment Curves

5.11 Internal noise levels have been calculated based on the now surpassed, BS 8233:1999, which stated that a partially open window, which allows for ventilation, provides approximately 10 – 15 dB(A) attenuation. For the purposes of this assessment, we have assumed 13 dB(A) attenuation.

5.12 Additionally, a research paper produced by The Building Performance Centre School of the Built Environment at Napier University; NANR116: *"Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows"* concludes that a partially open window can provide between D_w 14-18 dB of attenuation depending on the type of window used. Therefore -13 dB is considered to be an acceptable and conservative assumption.

5.13 Please note because the plant is considered to operate continuously, the noise levels will not change i.e. the daytime noise levels are the same during the night. The calculated internal noise levels can be seen below.

Table 5.4: Internal Plant Noise Calculation

	Octave Band Centre Frequency, dB								
	31.5Hz	63 Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Façade noise level at 1 Seaview Terrace (1st floor)	49	44	48	46	41	33	27	21	7
Partially Open Window	-13	-13	-13	-13	-13	-13	-13	-13	-13
Internal Level	36	31	35	33	28	20	14	8	-6
NR 25 Criterion	72	55	44	35	29	25	22	20	18
Criteria Met?	✓	✓	✓	✓	✓	✓	✓	✓	✓

5.14 It can be seen from the results displayed in Table 5.4 above that the noise arising from the plant associated with the Battery Point Energy Storage Park is likely to meet the internal noise criterion of NR25. The calculated internal noise level was found to meet NR24 with an open window. With a closed window this is expected to reduce further.

6. Conclusions

6.1 Bureau Veritas have undertaken a noise impact assessment for a proposed energy storage park at Battery point in Stornoway.

6.2 A noise model was prepared using the modelling software CadnaA, in order to predict the impact of equipment associated with the proposed development.

6.3 The noise model inputs were based on technical data sheets provided by manufacturers. A conservative assessment was undertaken with all equipment running continuously during the daytime and night-time. The assessment was based on the most exposed receptor at 1 Seaview Terrace, first-floor level was used for the internal noise assessment, and ground floor level for the external noise assessment.

6.4 Several iterations of the development were proposed as the original layout resulted in an adverse impact until a final decision was made using best available techniques. The final layout incorporates a large 4m acoustic barrier which helps to control noise from the battery units, which were found to be the dominant noise source.

6.5 The acoustic barrier should be continuous with no gaps, either between sections or at the base or sides of the barrier. The mass of a barrier should be at least 10kg/m^2. As 19mm thick softwood boards have a mass of approximately 10.5kg/m^2 they would be suitable for the proposed barrier as long as it was suitably maintained. The barrier could also be constructed of brickwork. The location of the barrier can be seen in Figure 5.1 and Appendix B.

6.6 Using the results of the noise modelling study, an assessment of the new Battery Point Energy Storage Park was undertaken with reference to NR curves put forward by Comhairle Nan Eilean Siar in pre-application correspondence:

- External noise: NR45 during the daytime, measured 1 metre from the façade of any adjacent residential property.
- Internal noise: NR25 during night-time within any adjacent residential property with the windows open at least 5cm.

6.7 The results of the noise modelling found that the external daytime noise criterion of NR45 would be met with a level of NR36 calculated which is considered to be a good level of amenity for gardens areas.

6.8 With respect to internal noise levels, these were found to meet the NR25 criterion with a partially open window at the most exposed receptor, with all equipment running at first floor level. This therefore presents a good level of amenity for resting / sleeping conditions.

Appendix A

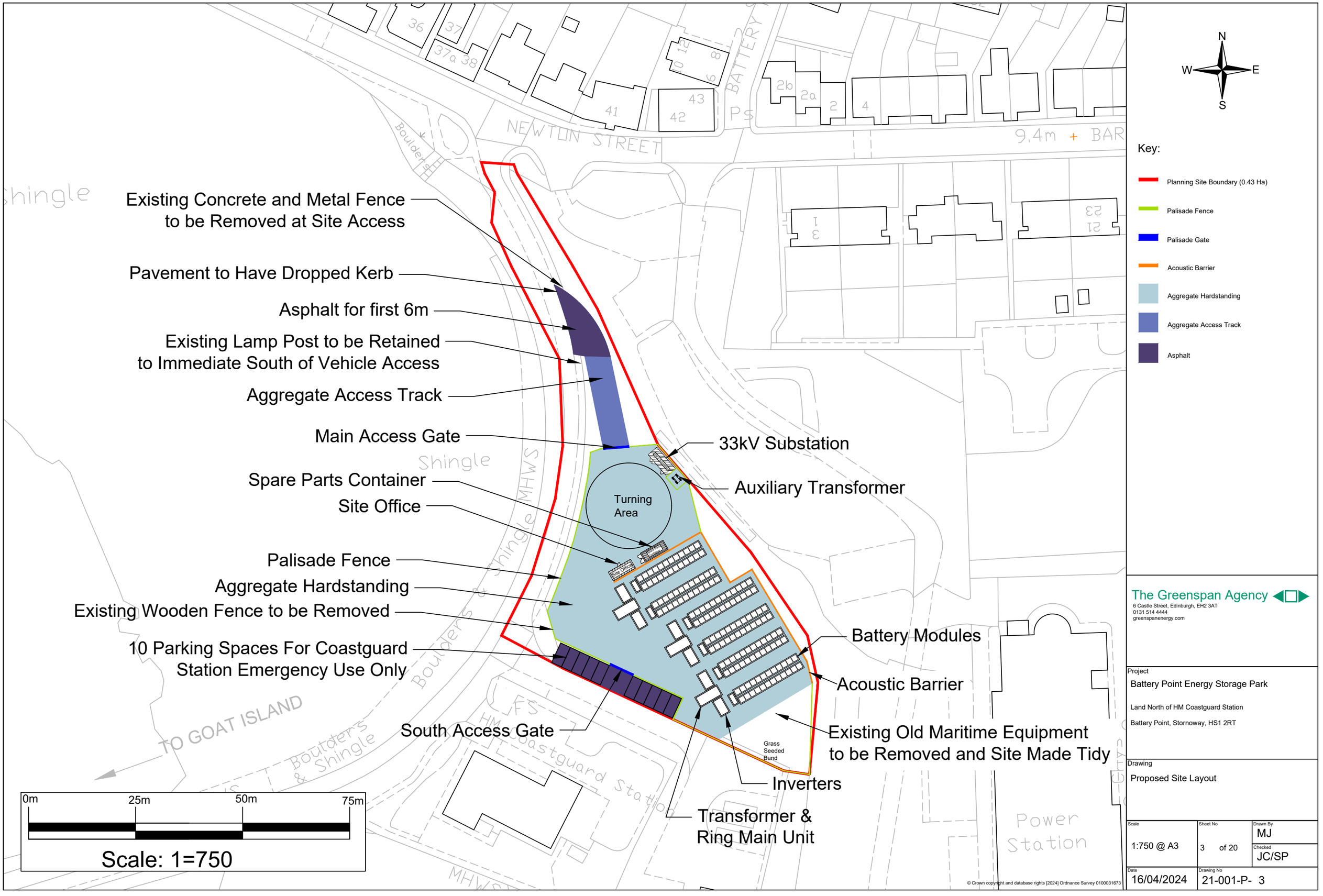
Glossary of Acoustic Terminology

"A" Weighting (dB(A))	The human ear does not respond uniformly to different frequencies. "A" weighting is commonly used to simulate the frequency response of the ear. It is used in the assessment of the risk of damage to hearing due to noise.
Decibel (dB)	The range of audible sound pressures is approximately 2 x 10^{-5} Pa to 200 Pa. Using decibel notation presents this range in a more manageable form, 0 dB to 140 dB. Mathematically: Sound Pressure Level (dB) = 20 log {p(t) / P_o} where P_o = 2 x 10^{-5} Pa
Frequency (Hz)	The number of cycles per second, for sound this is subjectively perceived as pitch.
Frequency Spectrum	Analysis of the relative contributions of different frequencies that make up a noise.
L_{eq}(T)	The equivalent continuous sound level. It is that steady sound level which would produce the same energy over a given time period T as a specified time varying sound.
L_{Amax}(T)	The maximum RMS A-weighted sound pressure level occurring within a specified time period.
L_{AE} or SEL	A measure of A-weighted sound energy used to describe noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted sound energy as the event. The relationship between $L_{Aeq,(T)}$ and SEL is as follows: $L_{Aeq,(T)}$ = 10 log [antilog SEL_1/10 + antilog SEL_2/10 +... Total time period in seconds where SEL_n is the measured single event level for a given event
$L_{A10,T}$	Road traffic noise level. The A-weighted sound pressure level of the residual noise in decibels exceeded for 10% of a given time interval.
$L_{A90,T}$	Background noise level. The A-weighted sound pressure level of the residual noise in decibels exceeded for 90% of a given time interval.
Noise	Unwanted sound.
Octave Band	A range of frequencies defined by an upper limit which is twice the lower limit. Octave bands are identified by their centre frequency.
R_{TRA} (dB)	The Traffic Noise Reduction Sound Insulation is derived by taking into account a typical spectrum of road traffic in town and city centres
R_W (dB)	The weighted sound reduction incorporates a correction for the ear's response and has been derived in accordance with BS 5821:1984.

Specific Noise	The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval.
Rating Level, $L_{Ar,T}$	The specific noise level plus any adjustment for the character of the noise.
Ambient Noise	Totally encompassing sound in a given situation at any given time composed of noise from many sources, near and far.
Residual Noise	The ambient noise remaining at a given position in a given situation when the specific noise source is suppressed to a degree such that it does not contribute to the ambient noise.

Appendix B

Site Plan



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Project
Battery Point Energy Storage Park

Land North of HM Coastguard Station

Battery Point, Stornoway, HS1 2RT

Drawing
Proposed Site Layout

Scale	Sheet No	Drawn By
1:750 @ A3	3 of 20	MJ
		Checked JC/SP
Date 16/04/2024	Drawing No 21-001-P- 3	

Appendix C

Noise Model Results

0 <= ... < 35	
35 <= ... < 40	
40 <= ... < 45	
45 <= ... < 50	
50 <= ... < 55	
55 <= ... < 60	
60 <= ... < 65	
65 <= ... < 70	
70 <= ... < 75	
75 <= ... < 80	
80 <= ...	

Project:	19591540 - NIA, Battery Point Energy Park, Stornoway
Description:	Proposed Development - Outdoor Noise
Condition:	Acoustic Barrier
Modelled:	N MacDonald
Reviewed:	R Giudice
Date:	16.04.24

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0 <= ... < 35	
35 <= ... < 40	
40 <= ... < 45	
45 <= ... < 50	
50 <= ... < 55	
55 <= ... < 60	
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65 <= ... < 70	
70 <= ... < 75	
75 <= ... < 80	
80 <= ...	

Project:	19591540 - NIA, Battery Point Energy Park, Stornoway
Description:	Proposed Development - Indoor Noise
Condition:	Acoustic Barrier
Modelled:	N MacDonald
Reviewed:	R Giudice
Date:	16.04.24

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