tnei

A specialist energy consultancy

Environmental Noise Impact Assessment

Knocknagael Battery Energy Storage (BESS) Development

Field

16292-005-R1

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COMMERCIAL IN CONFIDENCE

FIELD

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1 Introduction

TNEI was commissioned by Field (henceforth referred to as 'the Client') to undertake an environmental Noise Impact Assessment (NIA) in support of the Section 36 planning application for the proposed Knocknagael Battery Energy Storage System (BESS) development (henceforth referred to as 'the Proposed Development').

The Proposed Development is located approximately 2.5 km south of the city of Inverness in the Scottish Highlands at approximate Ordnance Survey coordinates 264923, 838972. The Proposed Development will have a storage capacity of 200 MW and will connect to the adjacent 132 kV Knocknagael Substation. The Proposed Development site is currently undeveloped agricultural/pastural land.

The local area around the site is rural in nature, predominantly consisting of agricultural and pastural land, but with a number of residential properties located nearby in various directions.

The purpose of this NIA is to:

- Identify the noise sensitive receptors in the vicinity of the Proposed Development;
- Identify the dominant sound sources associated with the operation of the Proposed Development;
- Calculate the likely levels of operational noise at the identified receptors to determine the likely noise impacts associated with the Proposed Development; and,
- Indicate any requirements for mitigation measures, if applicable, to provide sufficient levels of protection for all noise sensitive receptors.

For clarity, this NIA does not include an assessment of construction noise. This will be addressed at the post-submission stage if required.

All work undertaken to produce this report has been carried out by members of the TNEI Environment and Engineering Team, all of whom are affiliated with the Institute of Acoustics (IOA). Specifically, the following members of staff have been involved in the project:

- Will Conway, Tech IOA, BSc (Hons): Baseline Sound Level Survey;
- Ewan Watson, AMIOA, BEng (Hons), IOA Postgraduate Diploma in Acoustics and Noise Control: Noise Propagation Modelling, Assessment and Reporting; and,
- Jim Singleton, MIOA / AES, IOA Diploma in Acoustics & Noise Control, BSc (Hons) Music Technology: Quality Assurance.

1.1 Nomenclature

Please note the following terms and definitions, which are used throughout this report:

- **Emission** refers to the noise level emitted from a noise source, expressed as either a sound power level or a sound pressure level;
- **Immission** refers to the sound pressure level received at a specific location from a noise source;
- **SWL** indicates the sound power level in decibels (dB);
- **SPL** indicates the sound pressure level in decibels (dB);
- **NML** (Noise Monitoring Location) refers to any location where baseline noise levels have been measured;

- **NSRs** (Noise Sensitive Receptors) are all identified receptors that are sensitive to noise; and
- **NAL** (Noise Assessment Location) refers to any location where the noise immission levels are calculated and assessed.

A Glossary of Terms is also provided as Appendix A of this report.

All figures referenced within the report can be found in Appendix F.

Unless otherwise stated, all sound levels refer to free field levels i.e., sound levels without influence from any nearby reflective surfaces.

All grid coordinates refer to the Ordnance Survey grid using Eastings and Northings.

2 Project Description

The Proposed Development principally comprises a battery energy storage system (BESS) that will charge and discharge electricity from the adjacent, existing Knocknagael 132 kV Substation. It includes two battery compounds comprising battery storage units arranged into rows, medium-voltage (MV) skids (each skid comprising a MV transformer and two Power Conversion System (PCS) units) and associated ancillary equipment; a substation compound which accommodates high-voltage grid transformers, switchgear and a control building, as well as site-wide supporting infrastructure including underground cabling, access tracks, fencing, attenuation basins, and landscaping measures. Whilst the exact specifications of the Proposed Development are subject to detailed design, the principal components described form the basis of the planning application to allow environmental assessments and mitigation to be appropriately scoped.

Considering the above, the Proposed Development would introduce new sound sources to the local area. Specifically, the dominant sound sources considered within the assessment are:

- Battery Storage (DC) Unit Rows (104 of);
- MV Skid (AC) Units (52 of); and
- High-Voltage Grid Transformer Units (2 of).

A layout plan of the Proposed Development is included in Appendix B.

The sound level output of the ancillary infrastructure (e.g. switchgear, control building etc.) of the Proposed Development is considered insignificant in comparison to the primary sound sources detailed above. Accordingly, no other items of plant have been considered within the assessment.

2.1 Study Area

Noise Sensitive Receptors (NSRs) are properties that are sensitive to noise and, therefore, require protection from nearby noise sources. The study area for the assessment of environmental noise is usually defined through the identification of the closest NSRs to the development.

The assessment of noise attributable to the Proposed Development considers the nearest NSRs only, on the assumption that if sound levels at the closest receptors are deemed acceptable, then sound levels at NSRs at greater distances from the Proposed Development should also be within acceptable levels.

The nearest identified NSRs, which have a high level of sensitivity, are existing residential properties located to the north, southwest and south of the Proposed Development. The curtilage of the closest residential receptor is approximately 280 m to the north of the nearest noise emitting plant. Other residences are located approximately between 380 m and 750 m away.

Figure 1 within Appendix F details the study area and the closest NSRs considered within the assessment.

3 Assessment Methodology

3.1 Legislation and Policy Context

3.1.1 PAN 1/2011

At a national level, the relevant policy is PAN 1/2011 (PAN) *Planning and Noise* [(1)] and the associated Technical Advice Note (TAN) *Assessment of Noise* [(2)]. With regards to the assessment of environmental noise, Appendix 1 of the TAN describes a number of standards and guidelines that may be referred to and details British Standard (BS) 4142 as appropriate for use.

3.2 Assessment Method

3.2.1 BS 4142:2014 +A1:2019

BS 4142:2014 *'Methods for Rating and Assessing Industrial and Commercial Sound'* [(3)] is commonly used to assess the potential impacts of new sound sources on nearby receptors. The BS 4142 form of assessment is based on the predicted or measured levels of an assessed sound source compared to the measured background sound levels without the specific sound source present and uses, *'outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident'.*

Specifically, the assessment is made by subtracting the measured background sound level from a calculated or measured 'Rating Level'.

BS 4142 uses the following definitions:

Ambient Sound: Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, both near and far. Described using the metric, $L_{Aeq\ (t)}$.

Specific Sound Level: Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *Tr*. Described using the metric $L_{Aeq\ (t)}$. Also referred to in this report as the *Immission Level*.

Residual Sound Level: Equivalent continuous A-weighted sound pressure level of the residual sound without the specific sound source(s) present at the assessment location over a given time interval, *T*. Described using the metric $L_{Aeq\ (t)}$.

Background Sound Level: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using time weighting *F* and quoted to the nearest whole number of decibels. Described using the metric $L_{A90\ (t)}$.

Rating Level: The Specific Sound Level adjusted for the characteristics of the sound. The Rating Level is calculated by adding a penalty or penalties (if required) to the Specific Sound Level when the sound source contains audible characteristics such as tonal, impulsive or intermittent components. Described using the metric, $L_{Aeq\ (t)}$.

Supplementary information regarding the application of BS 4142 is provided within the Association of Noise Consultants' (ANC) BS 4142 Technical Note (March 2020) [(4)]. The technical note provides guidance on the appropriate interpretation and application of the standard, including clarifying the methodology for the derivation of representative background sound levels. Critically, the technical note states the following with regards to the application of the standard in the event measured background sound levels and predicted Rating Levels are low:

'*… the absolute level of sound can be of significance, where the residual values are low and where they are high, and should be taken into account when determining the overall impact of a particular specific*

sound source. The second paragraph [of BS 4142] *notes that absolute levels may be as, or more, important than relative outcomes where background and rating levels are low. It is important to note that both background and rating levels would need to be low for this particular caveat to apply. BS 4142 does not indicate how the initial estimate of impact should be adjusted when background and rating levels are low, only that the absolute levels may be more important than the difference between the two values. It is likely that where the background and rating levels are low, the absolute levels might suggest a more acceptable outcome than would otherwise be suggested by the difference between the values. For example, a situation might be considered acceptable where a rating level of 30dB is 10dB above a background sound level of 20dB, i.e. an initial estimate of a significant adverse impact is modified by the low rating and background sound levels.'*

With regards to what constitutes 'low', the technical note goes on to state:

'*BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB LA90, and low rating levels as being less than about 35 dB LAr,Tr. The WG suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate.'*

Extracts underlined by TNEI for emphasis.

The additional information provided within the ANC technical note has informed TNEI's approach to the NIA assessment criteria with regards to the application of BS 4142. This is discussed further in Section 3.3.

3.3 Environmental Health Officer (EHO) Consultation

To agree a set of operational noise assessment criteria, TNEI undertook extensive consultation with an EHO from The Highland Council (THC). All formal EHO consultation correspondence has been included within Appendix C of this report.

Initially, TNEI issued a letter to THC dated 9th April 2024 (document reference 16292-003-R0) after having undertaken a baseline sound level survey at the end of 2023 (detail of which is included in Section 4 of this report). The baseline data indicated 'very low' existing background sound levels in the area surrounding the Proposed Development (i.e. less than 30 dB L_{A90}). This coupled with initial propagation modelling results indicating 'low' immission levels at the nearby receptors (i.e. less than 35 dB $L_{Aeq(t)}$) prompted TNEI to write to THC to explain the approach set out within the ANC technical note, highlighting that a standard BS 4142 assessment would not be appropriate and that a fixed Rating Level of 35 dBA may be a more suitable target noise level.

On the 2nd May 2024, TNEI, the EHO and the Client had a virtual meeting to discuss the proposed assessment criteria. THC were receptive to the adoption of a fixed Rating Level limit but were not in agreement that 35 dBA was an appropriate level. TNEI followed up the meeting with a further letter dated 7th June 2024 (document reference 16292-004-R0), which demonstrated that additional mitigation work had been undertaken to reduce the predicted operational noise and suggested that 33 dBA would be an appropriate target limit. Ultimately, the EHO confirmed (via email on 17th June 2024) that a target Rating Level of **31 dBA** at all nearby NSRs would be deemed acceptable, during both the daytime and the night-time assessment periods.

In addition to the agreement of the fixed broadband Rating Level, THC also requested that the NIA report contain evidence that no tonal characteristics were expected in the immission levels incident at any of the nearby NSRs within the 100 Hz One-Third Octave frequency band.

Having discussed TNEI's on-site observations and spot measurements with THC, it was agreed that due to the lack of discernible noise immissions both near to the substation and at a further distance at the identified receptors, there was no requirement to consider the cumulative noise impact of the

existing Knocknagael substation within the assessment as it is considered negligible. More information is provided within Section 7 of this report.

3.3.1 Assessment Criteria

Considering all of the above, the assessment is made as follows:

- An assessment is undertaken at the nearest residential receptors against a fixed BS 4142 Rating Level value of 31 dBA, for both the daytime and night-time assessment periods.

3.4 Calculation Method

3.4.1 Noise Propagation Model (ISO 9613-2:2024)

In order to predict the noise immission levels attributable to the Proposed Development, a noise propagation model was created using the propriety noise modelling software, CadnaA [5]. Within the software, complex models can be produced to simulate the propagation of noise according to a range of international calculation standards.

For this assessment noise propagation was calculated in accordance with ISO9613 '*Acoustics – Attenuation of sound during propagation outdoors* [6] using the following input parameters:

- Temperature is assumed to be 10 °C and relative humidity as 70%;
- A ground attenuation factor of 1 (soft ground) has been used except for the developed ground of the Proposed Development area and the adjacent Knocknagael Substation, which has been modelled with a ground attenuation factor of 0 (hard ground); and
- Receiver heights have been set to 4 m.

3.4.2 Uncertainties and Limitations

The noise propagation model is designed to give a good approximation of the specific sound level and the contribution of each individual sound source; however, it is expected that measured levels are unlikely to be matched exactly with modelled values. As such, the following limitations in the model should be considered:

- In accordance with ISO 9613, all assessment locations are modelled as downwind of all sound sources and propagation calculations are based on a moderate ground-based temperature inversion, such as commonly occurs at night. These conditions are favourable to noise propagation;
- The predicted barrier attenuation provided by local topography, embankments, walls, buildings and other structures in the intervening ground between source and receiver can only be approximated and not all barrier attenuation will have been accounted for;
- The model assumes all sound sources are operating continuously and simultaneously; and,
- Modelled sound sources represent candidate plant only and a proposed site layout. The noise output of individual items of plant may vary from what is presented in this report after final plant specification.

4 Baseline Sound Level Monitoring

To inform the BS 4142 assessment, an unattended baseline sound level survey was undertaken at two Noise Monitoring Locations (NMLs) over an 8 day period between the 9th and 17th of November 2023. The noise monitoring equipment measured continually for the entire survey period, logging in 15-minute averaging intervals. In addition, attended spot measurements were undertaken at locations near to the Knocknagael Substation during both installation and decommissioning site visits for the baseline sound level survey, in an attempt to quantify any potential noise emissions from the Knocknagael substation that may need to be considered cumulatively within the assessment.

Table 4-1 details the unattended NMLs which, as well as the short-term spot measurement locations, are shown on Figure 1 in Appendix F. The NMLs were selected to be representative of the NSRs in the vicinity of the Proposed Development.

Table 4-1: Unattended Baseline Noise Monitoring Locations

NML		Coordinates		Comments
NML01	Located within the field to the south of Achvraid Farm	264566	838633	Representative of the nearest NSRs located to the south and southwest of the Proposed Development
NML02	Located within amenity area of dwelling adjacent to Essich Road	264853	839348	Representative of the nearest NSRs located to the north of the Proposed Development

All measurements were made with the sound level meters (SLMs) mounted approximately 1.2 m above the ground and away from nearby reflective surfaces i.e. building façades, fences etc. as practically possible.

The noise monitoring equipment consisted of two Rion NL-52 SLMs fitted with appropriate environmental wind shields. All noise monitoring equipment (calibrator, SLM and microphones) used for the study is categorised as Class 1, as specified in IEC 61672-1 *'Electroacoustics. Sound level meters. Specifications'* [7]. The equipment was calibrated onsite at the beginning and end of the measurement period with no significant deviations noted. Appendix D contains the equipment and laboratory calibration details for the SLMs and Calibrator.

Subjective observations made during the installation and collection of the survey equipment noted the following:

- At NML01, the soundscape consisted of birdsong, wind induced foliage rustle, road traffic noise from Essich Road (dominant when passing, but infrequent in occurrence), cattle lowing and sheep bleating. The substation was not audible at this location during both installation and decommissioning.
- At NML02, the soundscape consisted of birdsong, wind induced foliage rustle, road traffic noise from Essich Road (dominant when passing, but infrequent in occurrence), cattle lowing, sheep bleating and watercourse noise from the nearby Essich Burn. Again, the substation was not audible at this location during both installation and decommissioning.

Meteorological data was collected onsite with a Kestrel portable weather station and a tipping bucket rain gauge, which were installed alongside the SLMs. All sound level data recorded during (as well as 20 minutes before and 60 minutes after) a recorded precipitation event was removed to reduce the potential influence of raised sound levels from rainfall. The data was also filtered for periods when wind speeds were above 5 m/s, to remove any data when noise levels could be atypically increased due to wind induced noise.

The representative background sound level for each NML was determined with reference to the time history charts, statistical analysis charts and distribution analysis charts included in Appendix D, following the guidance in presented within the ANC technical note and BS 4142, which states:

'A representative level should account for the range of background sound levels and should not automatically be assumed to be either the minimum or modal value.'

With due consideration of the above, Table 4-2 details the representative background sound levels $L_{A90\ (15mins)}$ at each of the NMLs for the daytime and night-time periods.

Table 4-2: Representative Background Sound Level, dB L_{A90}, Derived Through Statistical Analysis

Noise Monitoring Location	Daytime $L_{A90\ (15\text{-}mins)}$	Night-time $L_{A90\ (15\text{-}mins)}$
NML01	27	23
NML02	36	36

Subjective observations on site noted that the soundscape at NML02 was influenced by water flowing from a nearby watercourse, Essich Burn (to the west). The influence of the watercourse is clearly visible in the time-history graph included within Appendix D. It was therefore considered that the data measured at NML01 was representative of the soundscape surrounding the Proposed Development in the absence of watercourse noise.

As can be seen from the values presented in Table 4-2, the NML01 representative background values can be deemed as "very low" when considering the guidance within the ANC technical note (i.e. less than 30 dB L_{A90}).

5 Operational Noise Impacts

5.1 Modelling of Individual Sound Sources

The noise model considers all of the sound sources detailed within Section 2 of the report. The following section describes how each sound source has been incorporated into the noise model. All items of plant have been modelled as area sources i.e. each side and top of each unit are modelled as individual sound sources and are assumed to be operating concurrently, continually and with a constant sound level output.

Noise modelling is based on candidate plant typical for the size and class of the Proposed Development. It should be noted that final plant specifications may vary during the tendering process. Where possible, noise modelling data is shown within Appendix E, however, some data has been omitted from the appendix and redacted within the report text due to confidentiality reasons. Where data cannot be published, TNEI would be happy to discuss this data in more detail with the Local Authority, if required.

[redacted]

5.1.1 Battery Storage (DC) Unit Rows

[redacted]

Table 5-1: One-Third Octave Band SWL (dBA) values used to model the Battery Storage Unit Rows

	Frequency (Hz)					
[redacted]	50	63	80	100	125	160
	[redacted]					
	200	250	315	400	500	630
	[redacted]					
	800	1000	1250	1600	2000	2500
	[redacted]					
	3150	4000	5000	6300	8000	10000
	[redacted]					

5.1.2 MV Skid (AC) Units

[redacted]

Table 5-2: One-Third Octave Band SWL (dBA) values used to model the MV Skid (AC) Unit (30% Load)

	Frequency (Hz)					
[redacted]	50	63	80	100	125	160
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	200	250	315	400	500	630
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	800	1000	1250	1600	2000	2500
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	3150	4000	5000	6300	8000	10000
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

5.1.3 High-Voltage Grid Transformer Units

Two High Voltage (HV) grid transformers have been included within the noise model. In the absence of provided data form the Client, TNEI have used in-house One-Third Octave Band SWL data for a representative ABB candidate within the noise model. The data for the unit, which has an overall SWL of 88 dBA, is included within Appendix E and is shown below in Table 5-3:

Table 5-3: One-Third Octave Band SWL (dBA) values used to model the HV Grid Transformers

	Frequency (Hz)					
	50	**63**	**80**	**100**	**125**	**160**
	64	48	55	72	69	78
	200	**250**	**315**	**400**	**500**	**630**
HV Grid Transformer	74	77	80	77	77	79
ABB Candidate	**800**	**1000**	**1250**	**1600**	**2000**	**2500**
	79	77	75	72	70	69
	3150	**4000**	**5000**	**6300**	**8000**	**10000**
	68	67	65	62	60	58

5.2 Additional Mitigation Measures

Acoustic barriers have been included in the design to reduce noise immission levels at the closest NSRs. The barriers, the location of which can be seen within Figure 2 of Appendix F, have been modelled at a height of 4 m around the perimeter of Western BESS compound and the Substation compound, and at a height of 3 m around the western and northern perimeters of the Southern BESS compound. The barrier has been modelled with no specific noise absorption coefficient value but does assume a minimum mass of 10 kg/m^2. The barrier should have no air gaps and be sufficiently robust so as not to develop any air gaps during the lifetime of the development.

5.3 Calculated Immission Levels

Noise immission levels have been calculated at four Noise Assessment Locations (NALs), which have been selected to represent the closest NSRs to the Proposed Development. Each NAL has been set on the side of the property facing the Proposed Development. The NALs are detailed in Table 5-4 and on Figure 2 in Appendix F:

Table 5-4: Noise Assessment Locations

Noise Assessment Location			
NAL ID	**NAL Descriptor**	**Eastings**	**Northings**
NAL01	Achvraid House	264509	838683
NAL02	Achvraid	264494	838889
NAL03	Essich Farm Cottage	264845	839361
NAL04	Balrobert	265255	839731

The immission levels (Specific Sound Level) were calculated assuming all plant is operating continuously and concurrently. The model assumes, as a worst case, that noise levels do not fluctuate and remain the same for both daytime and night-time periods. The noise immission levels at the NALs are detailed in Table 5-5 below. The immission levels are also illustrated as a noise contour plot shown in Figure 2 of Appendix F.

Table 5-5: Predicted Immission Levels, dB $L_{Aeq(t)}$

Noise Assessment Location		Immission Level, dB $LA_{eq(t)}$
NAL ID	**NAL Descriptor**	
NAL01	Achvraid House	30
NAL02	Achvraid	31
NAL03	Essich Farm Cottage	29
NAL04	Balrobert	22

6 Noise Impact Assessment

6.1 BS 4142 Rating Level

To assess the immission levels against the agreed criteria, the Specific Sound Level must be converted into a Rating Level. The Rating Level allows for character corrections to be added to account for particular characteristics of the sound that may be perceived as more annoying. In particular, the Rating Level considers tonality, impulsivity and intermittency of the sound, as well other sound characteristics that are neither tonal, impulsive, or intermittent, but are otherwise readily distinctive against the residual acoustic environment.

6.1.1.1 Tonality

With regards to tonality, BS 4142 states:

'For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.'

Electrical plant, such as power transformers, are often tonal at source, typically in the 100 Hz frequency band. BS 4142 corrections, however, are only applied if the noise characteristics are present at the receptor location, not at the source location.

Consideration of the predicted one-third octave band levels at the identified receptors against the assessment criteria presented in BS 4142's 'One-Third Octave Band Objective Method of Assessment' indicates that no tonality is likely to be present. Details of the tonal analysis is presented in Appendix G. As such, no tonal character correction needs to be applied.

6.1.1.2 Impulsivity

With regards to impulsivity, BS 4142 states:

'A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible.'

Impulsivity is not considered to be a relevant sound characteristic of a BESS as when operational, the noise level will be predictable and consistent.

6.1.1.3 Intermittency

The intermittency of the sound source needs to be considered when it has identifiable on/off conditions with regards to intermittency, BS 4142 states:

'If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.'

As with impulsivity, intermittency is not considered to be a relevant sound characteristic in this case. Once operational, noise levels may fluctuate by a small amount over long periods of time, but no step changes in noise level are anticipated.

6.1.1.4 Other Sound Characteristics

With regards to other sound characteristics, BS 4142 states:

'Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.'

Based on TNEI's understanding and experience of this type of plant, we do not anticipate any additional sound characteristics that would be considered readily distinctive against the residual acoustic environment.

6.1.2 Calculation of the Rating Level

With due regard to the above, no character corrections are required. Therefore, the BS 4142 Rating Levels are equal to the Specific Sound Levels.

6.1.3 Assessment of the Impacts

Table 6-1 presents a comparison of the Rating Levels to the agreed fixed level limit of 31 dBA, which is applicable to both daytime and night-time periods:

Table 6-1: Margin Above / Below (+/-) Fixed Rating Level Limit, dB.

Noise Assessment Location		Rating Level, dBA	Fixed Rating Level Limit, dBA	Margin Above/Below (+/-) Fixed Rating Level Limit, dB
NAL ID	NAL Descriptor			
NAL01	Achvraid House	30	31	-1
NAL02	Achvraid	31	31	0
NAL03	Essich Farm Cottage	29	31	-2
NAL04	Balrobert	22	31	-9

As shown in Table 6-1, the Rating Level is below or equal to the agreed fixed limit at all NALs. In addition, it is noted that the noise model assumes all plant is operating concurrently and continuously, however not all cooling units will necessarily be required to operate at the same time and as such, overall noise levels are likely to be lower than predicted.

The Proposed Development is expected to meet the agreed target level of 31 dBA at all receptors.

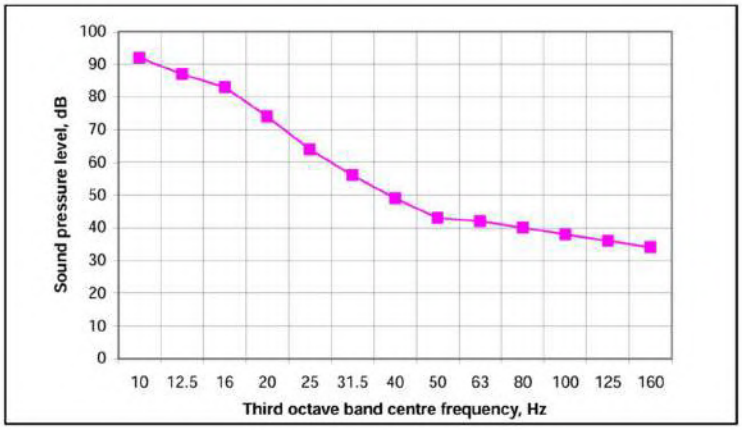
With due regard to THC's concern regarding the noise level specifically at a frequency of 100 Hz, it is helpful to look at the absolute level of the noise predicted within this frequency band, (as opposed to just relying on an assessment of tonality), and the DEFRA approved study by Salford University; '*NAN-R-45 Procedure for the assessment of low frequency noise complaints'* [8] is helpful in this regard.

NAN-R-45 presents guidance with the aim of developing a method for the assessment of low frequency noise for use by Environmental Health practitioners in the UK. It provides a criterion curve to aid such an assessment, suggesting that if any particular frequency exceeds the curve this may indicate a source of low frequency noise that could cause disturbance.

The dB levels that define the curve are for noise levels measured inside a dwelling. This is reproduced as **Error! Reference source not found.** overleaf:

Figure 6-1: NAN-R-45 Assessment Criterion Curve

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB, Leq	92	87	83	74	64	56	49	43	42	40	38	36	34



At 100 Hz, the criterion curve level is 38 dB_Z. Appendix G presents the calculated one third octave band noise levels at the closest NALs. At all of the NALs the predicted external noise levels attributable to the Proposed Development are below 38 dB_Z. Given that the external noise levels at 100 Hz are lower the internal NAN-R-45 criterion curve, it is considered highly unlikely that noise levels at 100 Hz will cause any disturbance to residents.

7 Cumulative Impacts

7.1 Knocknagael 132 kV Substation

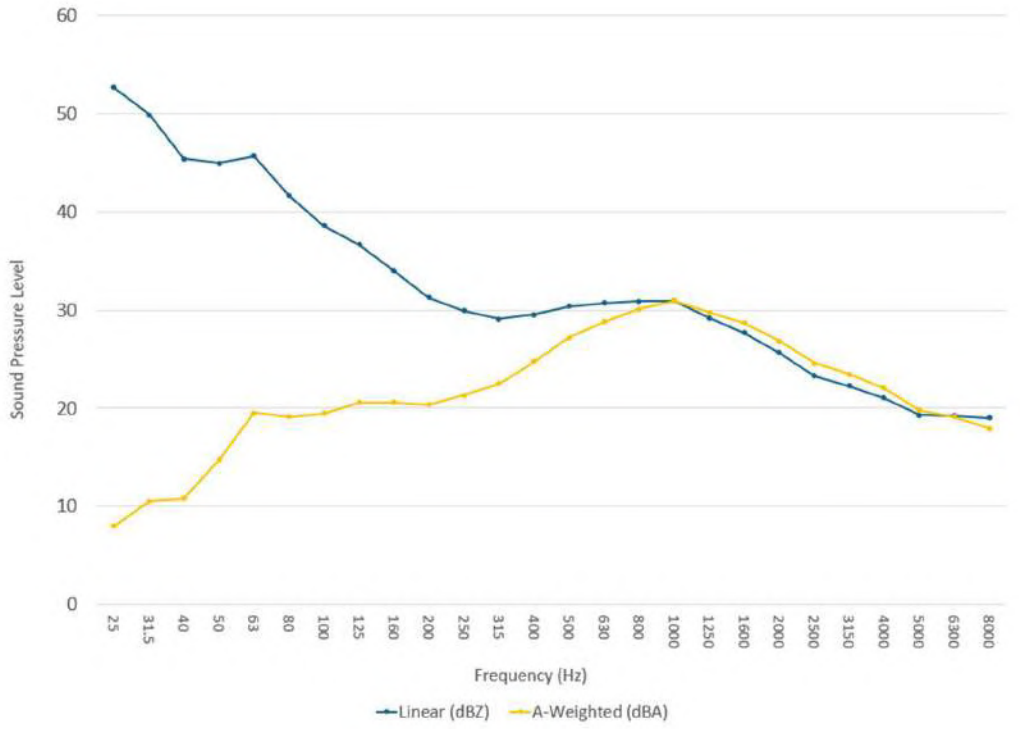
During TNEI site visits, subjective observations and short-term spot measurements (locations of which are shown on Figure 01) were undertaken near to the existing Knocknagael 132 kV substation. It was noted that no discernible noise emissions were emanating from the substation.

During a call with the EHO on 2nd May 2024, TNEI discussed the substation's infrastructure with the aid of aerial imagery, showing that the development predominantly consists of switching circuits and a control building (i.e. non-noise-generating). The only obvious noise-generating equipment identified were two power transformers, as highlighted in Figure 7-1 below:

Figure 7-1: Knocknagael 132 kV Substation, with Transformers Highlighted

If the transformers were emitting audible noise it would be expected to be predominantly within the 100 Hz frequency band; however, attended spot measurements (measured in 1-minute intervals) approximately 200 m to the southeast of the substation indicated no discernible peak in the SPLs at 100Hz, suggesting the substation is having very little influence on the existing noise environment (see averaged $L_{eq\ (1\text{-}minute)}$ values in Figure 7-2 below).

Figure 7-2: Sound Pressure Levels, (Leq (1-minute)) dBZ and dBA, measured at Spot Measurement Location A



Considering all of the above, it was agreed with THC that the NIA is not required to consider cumulative effects from the substation in any more detail.

8 Summary

To predict the noise immission levels of the Proposed Development, TNEI has produced a noise propagation model in accordance with ISO 9613 based on candidate plant typical for this type of development. The noise model assumes that all plant will be operating continuously and concurrently, however, this is unlikely to occur for the majority of the time. Accordingly, the noise assessment is inherently conservative.

The noise model assumes the inclusion of noise attenuating barriers with a height of 4 m around the perimeter of Western BESS compound and the Substation compound, and a height of 3 m around the western and northern perimeters of the Southern BESS compound of the Proposed Development.

As agreed with the Environmental Health Officer at the Highland Council, the NIA concludes that the Proposed Development will be able to meet the specified target Rating Level of 31 dBA during both the daytime and night-time at the nearby residential receptors. Operational noise from the Proposed Development is also not expected to have any tonal characteristics present in any frequency band (100 Hz or otherwise) when incident at the receptors. As such, the Proposed Development is not expected to have an adverse noise impact on the local area.

Should the Scottish Ministers be minded to grant consent, TNEI would welcome continued consultation with THC and the Energy Consents Unit to help draft an appropriate set of planning conditions relating to operational noise, prior to a decision notice being issued.

9 References

1. **The Scottish Government.** *PAN 1/2011 Planning and Noise.* Scotland : The Crown, 2011.

2. —. *Technical Advice Note (TAN) 'Assessment of Noise'.* Scotland : The Crown, 2011.

3. **British Standards Institute.** *Methods for Rating and Assessing Industrial and Commercial Sound.* UK : BSI, 2014. BS4142:2014 + A1:2019.

4. **The Association of Noise Consultants (ANC).** *BS 4142:2014+A1:2019 - Technical Note.* s.l. : The Association of Noise Consultants (ANC), 2020.

5. **Datakustik GmbH.** CadnaA. 2024.

6. **(ISO), International Organization for Standardization.** *Acoustics – Attenuation of Sound During Propagation Outdoors: Part 2 – General Method of Calculation.* Geneva : (ISO), International Organization for Standardization, 2024. ISO 9613-2:2024.

7. **Commission Electrotechnique Internationale (IEC).** *Electroacoustics - Sound level meters - Part 1: Specifications.* Geneva : IEC, 2013. IEC 61672-1:2013.

8. **University of Salford, Manchester.** *Procedure for the assessment of low frequency noise disturbance.* s.l. : DEFRA, 2011.

Appendix A – Glossary of Terms

Attenuation: the reduction in level of a sound between the source and a receiver due to any combination of effects including: distance, atmospheric absorption, acoustic screening, the presence of a building façade, etc.

Background Sound Level: the sound level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or night-time periods. The LA90 indices (see below) are typically used to represent the background sound level.

Broadband Noise: noise with components over a wide range of frequencies.

Decibel (dB): the ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. A logarithmic scale is used in sound level measurements because of this wide range. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound level.

dB(A): the ear has the ability to recognise a particular sound depending on its pitch or frequency. Microphones cannot differentiate sound in the same way as the ear, and to counter this weakness the sound measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) weighting is internationally accepted and has been found to correspond well with people's subjective reaction to sound levels and noise. Some typical subjective changes in sound levels are:

- a change of 3dB(A) is just perceptible;
- a change of 5dB(A) is clearly perceptible; and
- a change of 10dB(A) is twice (or half) as loud.

Directivity: the property of a sound source that causes more sound to be radiated in one direction than another.

Emission: the sound energy emitted by a sound source (e.g. a wind turbine).

Frequency: the pitch of a sound in Hz or kHz. See Hertz.

Ground Effects: the modification of sound at a receiver location due to the interaction of the sound waves with the ground along its propagation path from source to receiver. Described using the term 'G', and ranges between 0 (hard ground), 0.5 (mixed ground) and 1 (soft ground).

Hertz (Hz): sound frequency refers to how quickly the air vibrates, or how close the sound waves are to each other (in cycles per second, or Hertz (Hz)).

Immission: the sound pressure level detected at a given location (e.g. the nearest dwelling).

Noise: unwanted sound.

L_w: is the sound power level. It is a measure of the total sound energy radiated by a sound source and is used to calculate sound levels at a distant location. The *LWA* is the A-weighted sound power level.

L_{eq}: is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the ambient noise encompassing all noise at a given time. The LAeq, T is the A-weighted equivalent continuous sound level over a given time period (T).

L_{90}: index represents the sound level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background sound level. The LA90,10min is the A-weighted background sound level over a ten-minute measurement sample.

Sound Level Meter: an instrument for measuring sound pressure level.

Sound Pressure Level: a measure of the sound pressure at a point, in decibels.

Tonal Noise: noise which covers a very restricted range of frequencies (e.g. a range of ≤20 Hz). This noise is subjectively more annoying than broadband noise.

Appendix B – Development Information

1 Indicative Site Layout Plan
Scale 1:1000 @ A0

Notes

1. All dimensions are shown in metres unless noted otherwise.
2. Do not scale from this drawing.
3. This drawing is indicative only and the site layout is likely to change as more information becomes available.

Legend

- Planning Boundary
- Access Track - Unbound Finish
- Access Track - Asphalt Finish
- Attenuation Basin
- Palisade Fence
- 4m Acoustic Fence
- 3m Acoustic Fence
- Stock Proof Fence
- Indicative Underground Cable Route
- Site Landscaping and Planting
- Existing Trees to Remain

1:10	0	100mm 200mm 300mm 400mm 500mm 600mm 700mm 800mm 900mm		1m
1:20		0.5m 1m 1.5m		2m
1:25		0.5mm 1m 1.5m 2m		2.5m
1:50		1m 2m 3m 4m		5m
1:100	1m	2m 3m 4m 5m 6m 7m 8m 9m		10m
1:200		5m 10m 15m		20m
1:250		5m 10m 15m 20m		25m
1:500		10m 20m 30m 40m		50m
1:1000	0	10m 20m 30m 40m 50m 60m 70m 80m 90m		100m

REV	DATE	DESCRIPTION	BY	CHK'D
3	27.06.2024	Landscaping and planting area amended	JH	AP
2	20.06.2024	Drainage and landscaping amended. Annotations added.	JH	AP
1	30.05.2024	Site layout amended	JH	JM
0	28.03.2024	Site Layout Plan - Original	JH	AP

Field
Fora Montacute Yards,
186 Shoreditch High Street,
London,
E1 6HU

PROJECT
Knocknagael

TITLE
Indicative Site Layout Plan

DISCIPLINE
PLANNING

DRAWING STATUS
FOR PLANNING

SCALE	DATE	DRAWN BY	CHECKED BY	APPROVED BY
1:1000 @ A0	28.03.2024	JH	AP	JM

PROJECT NO.	DRAWING NO.	REV.
BTGBKNO01	001.1	03

Appendix C – EHO Consultation Data

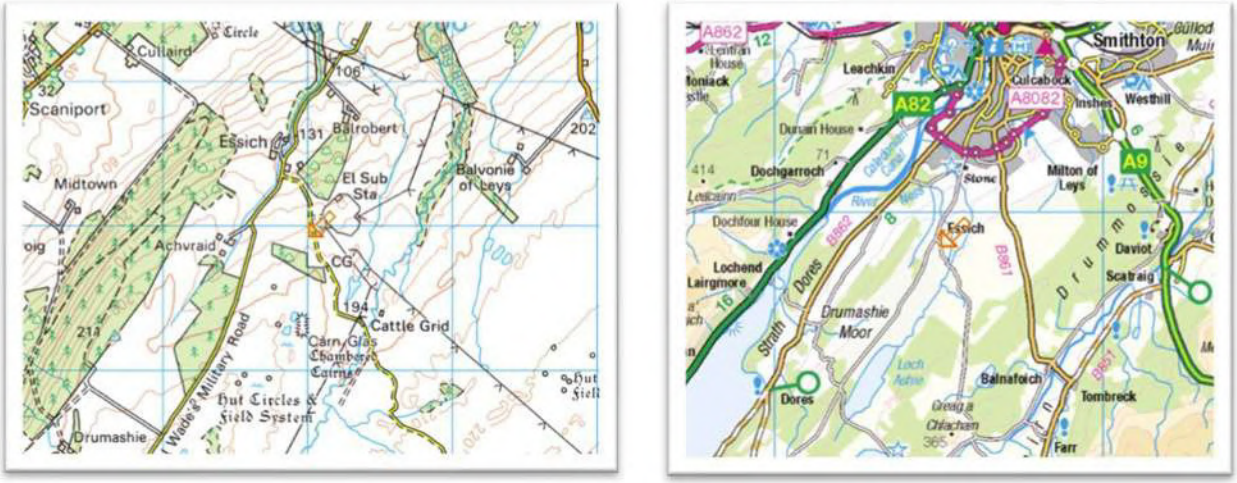
Knocknagael Battery Energy Storage System: Noise Impact Assessment

To:	[redacted]	Planning Authority:	The Highland Council
Address:	Highland Council, Community Services, 38 Harbour Road, Inverness, IV1 1UF	TNEI Ref.:	16292-002-R0
Date:	3 November, 2023		

Dear [redacted]

TNEI Services Ltd (TNEI) have been commissioned by Field Energy to undertake a Noise Impact Assessment (NIA) to support the planning application for a Battery Energy Storage System (BESS) located near Inverness, Highlands, at approximate coordinates, 264999, 838919. Image 1 details the approximate location.

Image 1: Approximate site location



The proposed development will introduce new sound sources into the area in the form of externally located battery banks, inverters and transformers.

Figure 1 (appended) details an indicative red line boundary and the nearest identified Noise Sensitive Receptors (NSRs).

Proposed Assessment Method

TNEI propose to undertake an assessment in line with BS 4142:2014+A1-2019 *Methods for Rating and Assessing Industrial and Commercial Sound* (BS 4142), however, we recognise there are a number of alternative methods of assessment available, such as the use of fixed guideline levels e.g. BS 8233:2014 or Noise Rating (NR) curves. Accordingly, if you would like us to consider any alternative approaches, then please advise and we would be happy to incorporate this into our assessment.

Proposed Baseline Survey

In order to inform the BS 4142 assessment TNEI will be undertaking a baseline survey, which we anticipate will occur week commencing 6th November. If you would like to comment on the survey requirements, then it would be much appreciated if you could come back to us before this date.

The assessment will consider the closest NSRs only, on the assumption that if noise is within acceptable levels at these locations, it will also be acceptable at more distant receptors. Figure 1 details the closest residential NSRs that we have identified to the proposed development. The NSRs are grouped together by colour.

We propose to monitor at three Noise Monitoring locations (NMLs). The NMLs have been coloured to match the NSRs that they will represent e.g. the data measured at the yellow NML will be used to represent all of the NSRs marked as yellow. In some cases, we have marked areas, rather than points, which represent the approximate area that the Sound Leve meter (SLM) will be installed in. Exact locations to be determined during the site visit.

Continuous unattended monitoring will be undertaken for a period of at least 7 days at NML01 and NML02 (Figure 1), with the noise levels being logged in 15-minute intervals. TNEI does not have permission to install fixed noise monitoring equipment at the properties to the northeast of the site. As such, we plan to undertake a number of spot measurements (during both the kit installation and collection site visits) in the purple area seen in Figure 1. These measurements will allow us to determine which of the fixed NMLs best represents the receptors northeast of the proposed development. We will install a rain gauge and a small wind speed monitor at one of the NMLs. All data measured during periods of adverse weather will be removed from the dataset. Similarly, all data will be removed during periods of high winds.

Summary

We hope the above provides you with a clear explanation as to the approach that we intend to adopt for this assessment. We would be very grateful if you could confirm your acceptance of this approach, or otherwise. If there is any aspect of the proposed survey or assessment method you would like to discuss in more detail, or if you would like further information with regards to the nature of the development, then please do not hesitate to get in touch.

[redacted]

Document Control

Revision	Status	Prepared by	Checked by	Approved by	Date
R0	FIRST ISSUE	TS	JS	JS	03/11/2023

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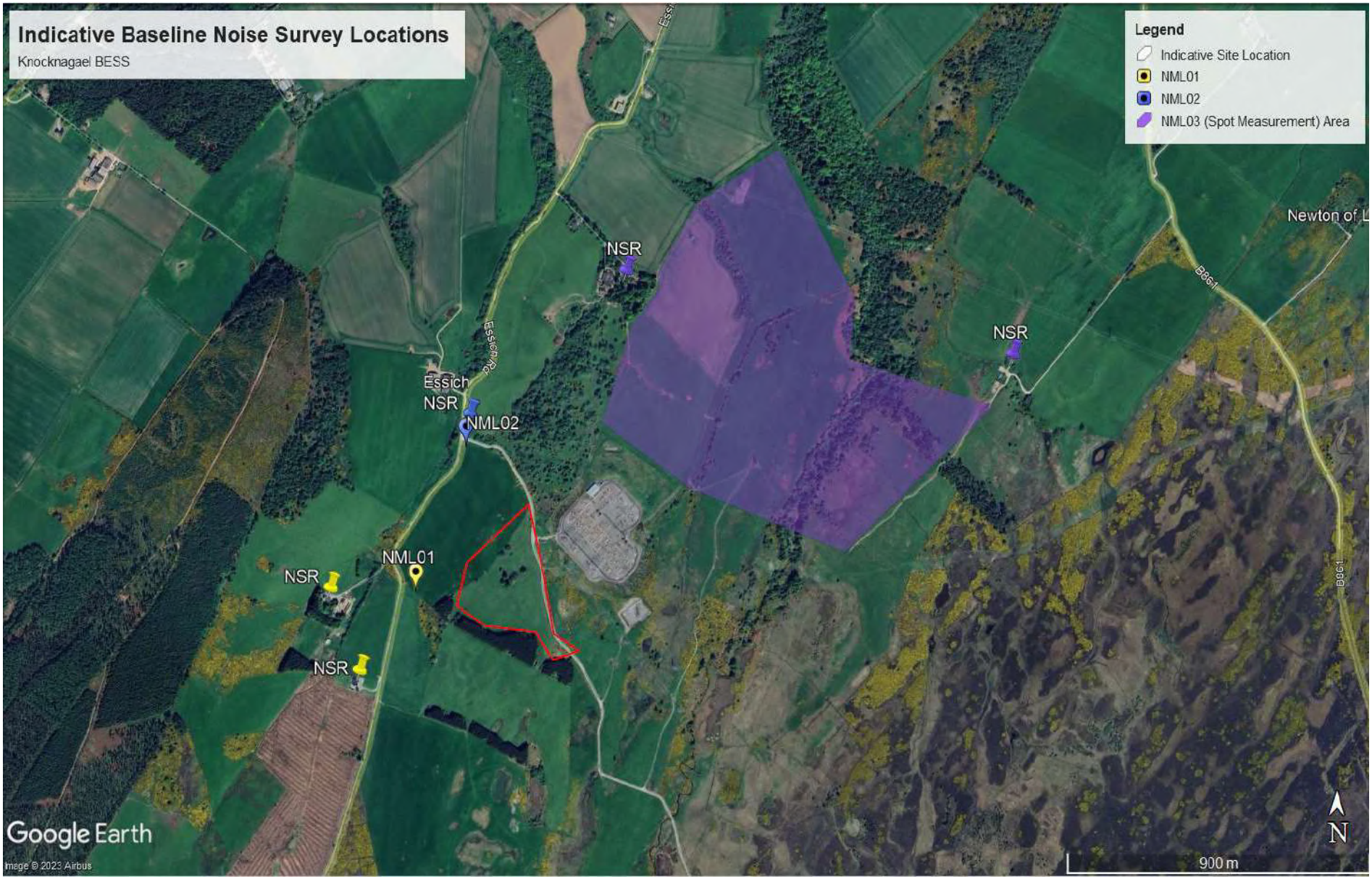
Figure 1: NIA Study Area



A specialist energy consultancy

Knocknagael Battery Energy Storage System (BESS) Development: Noise Impact Assessment – Target Noise Level Limits

To:	[redacted]	Planning Authority:	The Highland Council
Address:	Highland Council, Community Services, 38 Harbour Road, Inverness, IV1 1UF	TNEI Document Ref.:	16292-003-R1
Date:	10 April, 2024		

Dear [redacted]

As you are aware, TNEI Services Ltd (TNEI) have been commissioned by Field to carry out a Noise Impact Assessment (NIA) to support the Section 36 planning application for a proposed Battery Energy Storage System (BESS) development located near to Essich in Inverness, Highlands. The proposed site location and the nearest identified residential Noise Sensitive Receptors (NSRs) are shown in Figure 1 overleaf.

TNEI sent a letter to Highland Council (Document Reference 16292-002-R0) on the 3rd November 2023, detailing our proposed methodology and baseline noise survey locations and to invite feedback on our proposed assessment methodology. We received a prompt response from yourself on 17th November 2023, setting out the following three assessment criteria;

- *Noise arising from the development, when measured and/or calculated as an $L_{Zeq(5\text{-}minutes)}$, in the 100Hz one third octave frequency band must not exceed 30 dB, at the curtilage of any noise sensitive premises;*
- *Noise arising from the development shall not exceed NR 20 as calculated or measured within any noise sensitive property; and,*
- *The Rating Level of noise arising from the use of plant, machinery or equipment installed or operated in association with this development shall not exceed the agreed background level at the curtilage of any noise sensitive premises. The Rating Level should be calculated in accordance with BS 4142: 2014+A1:2019 Methods for rating and assessing industrial and commercial sound.*

We have since undertaken the baseline survey at the site and would like to report the measured levels to yourselves, whilst seeking some clarification regarding the assessment criteria to be used.

Figure 1 - Indicative BESS footprint and Nearest Identified Noise Sensitive Receptors (NSRs)

Baseline levels and BS 4142

A baseline survey was undertaken from the 9th to the 17th of November 2023. Monitoring was undertaken continually at two Noise Monitoring Locations (NMLs) and logged in 15-minute periods. The derived representative background sound levels are detailed in Table 1 and the measured sound levels are appended in a series of charts.

Table 1 – Knocknagael BESS Representative Background Sound Levels

Noise Monitoring Location (NML)	Daytime L_{A90}	Night-time L_{A90}
NML01	27	23
NML02	36	36

The NMLs are detailed within Figure 2 overleaf.

Figure 2 - Noise Monitoring Locations (NMLs)

Subjective observations on site noted that the soundscape at NML02 was influenced by water flowing from a nearby watercourse, Essich Burn (to the west), so whilst the measured levels can be said to be representative of the NSR immediately adjacent to this monitoring location, they cannot be applied to any of the other nearby receptors. Influence of noise from the water course is clear to see in the appended time history charts.

The daytime and night-time background sound levels are particularly low at NML01, and as such, TNEI do not feel that it is appropriate to rely on BS 4142 as an assessment method. In this regard, the Associate of Noise Consultants' '*BS4142:2014+A1:2019 Technical Note*' (March 2020), states:

"…. the absolute level of sound can be of significance, where the residual values are low and where they are high, and should be taken into account when determining the overall impact of a particular specific sound source. The second paragraph notes that absolute levels may be as, or more, important than relative outcomes where background and rating levels are low. It is important to note that both background and rating levels would need to be low for this particular caveat to apply. BS 4142 does not indicate how the initial estimate of impact should be adjusted when background and rating levels are low, only that the absolute levels may be more important than the difference between the two values. It is likely that where the background and rating levels are low, the absolute levels might suggest a more acceptable outcome than would otherwise be suggested by the difference between the values. For example, a situation might be considered acceptable where a rating level of 30dB is 10dB above a background sound level of 20dB, i.e. an initial estimate of a significant adverse impact is modified by the low rating and background sound levels.

With regards to what constitutes 'low', the document goes on to state:

"*BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB LA90, and low rating levels as being less than about 35 dB LAr,Tr. The WG suggest that similar values*

would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate."

Extracts underlined by TNEI for emphasis.

With regards to the above, both the daytime and night-time background sound levels at NML01 would be classed as *'very low'*.

TNEI do not yet know the exact Rating Levels from the proposed development, as our client is still considering a number of different site layouts and plant specifications, however, preliminary modelling suggests that these will also be 'low' i.e. no more than 35 dBA. Accordingly, it is considered more appropriate to make an assessment against an absolute noise limit of 35 dB $L_{Aeq\ (15mins)}$., rather than *no exceedance of the background sound level*, as suggested in your initial response. We would propose to use this assessment criteria for all NSRs, included the nearest NSR to NML02.

Additional Assessment Criteria (NR Curves)

As requested, we also propose to undertake a noise level assessment against a Noise Rating (NR) curve of NR20. We would note, however, that whilst we understand the advantage that a NR noise limit can provide, we would advise against setting internal noise level limits within a planning condition, as it is particularly difficult to demonstrate compliance with, especially where the limits are set so low (as in NR20). Monitoring inside a residential property is invasive, can be difficult to arrange and is often subject to interference from other (internal) sound sources.

In addition, the spectral content of the sound measured within a building is not something that can be controlled by the Developer and any spectral characteristics occurring internally could be due to specific glazing configurations, internal room shape and size, wall and floor finishes etc, all of which are outside the control of the Developer - the Developer can only control the noise up to the point of the external façade, and cannot control how or if it passes through that façade or how the sound interacts with the rooms on the inside of the property. As such, it is our opinion that setting an internal noise limit is contrary to '*Planning Circular 4/1998: the use of conditions in planning permissions',* in that the condition is not enforceable and not reasonable.

Notwithstanding the above, an assessment will be included within our NIA and will be carried out as follows;

- External noise levels will be calculated in octave bands external to each NSR;
- The levels detailed in Table 2 will be subtracted from each of the predicted octave band levels to consider the level of attenuation provided by a partially open window; and,
- The calculated internal levels will be compared to the NR20 criteria.

Table 2: Assumed Octave Band Levels of Attenuation from Partially Open Window

Frequency (Hz)	63	125	250	500	1000	2000	4000
Attenuation (dB)	17	11	11	13	11	14	16

The values detailed in Table 2 are derived as follows:

Octave band attenuation levels for a partially open window are detailed in NANR116: *'Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows*[1]. The image below, which is taken from

[1] NANR116: 'Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows – Research Study Conducted for Department for Environment, Food and Rural Affairs (Defra) by The Building Performance Centre, School of the Built Environment, Napier University, April 2007

NANR116, shows average levels of attenuation at different frequencies after considering multiple window types. We use the data from an opening size of 200 mm^2, which equates to a single figure outside-to-inside level difference of 16 dB.

	Octave Band Centre Frequency (Hz)							
Opening size	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	$D_{n,e,w}$ ($C;C_{tr}$)
50k (mm^2)	23	17	19	20	16	21	23	19 (0; -1)
100k (mm^2)	22	16	17	18	15	19	21	18 (-1; -1)
200k (mm^2)	20	14	14	16	14	17	19	16 (0; -1)

Table 5-6. Statistically Derived $D_{n,e}$ insulation ratings for window openings (dB)

The *Acoustics, Ventilation and Overheating Guide (AVO), Appendix C*[2], however, suggests a single figure outside-to-inside level difference of 13 dB. Therefore, we reduce the above values in each frequency band so that the equivalent single figure value equals 13 dB. We believe this offers a conservative approach to the assessment, but also offers a realistic approach as to how sound will be attenuated in octave bands through a window, as opposed to simply adopting a single figure value.

If Highland Council would like the comfort of an NR 20 internal noise level limit, then we would suggest an equivalent external limit is calculated using the values detailed in Table 2. for any planning condition.

Additional Assessment Criteria (100 Hz noise limit)

We suggest that the assessment criteria "*Noise arising from the development, when measured and/or calculated as an $L_{Zeq\ (5\text{-}minutes)}$, in the 100Hz one third octave frequency band must not exceed 30 dB, at the curtilage of any noise sensitive premises*" be changed to a value of 30 dB $L_{Aeq\ (5\text{-}minutes)}$, otherwise this does not align with the NR20 requirement. The noise level limit in the 125 Hz octave band (which includes 100 Hz) for NR 20 is 39 dBZ i.e. 9 dB higher than the suggested 100 Hz noise limit. It does not make sense for the external limit to be more stringent than the internal limits. We would suggest that the 100 Hz limit be set as 30 dB $L_{Aeq(t)}$ or simply rely on an external NR limit to achieve an appropriate level of protection. We would note that a level of 30 dBZ is extremely low and expect that noise levels in the area are already higher than this at 100 Hz. We would be happy to discuss with you in more detail if you would like to propose a call.

Assumptions to be Made in the Assessment

In addition to the assessment criteria that has been discussed above, you have requested the following is assumed within the assessment:

1. *The expectation is that any assessment is based on a worst-case scenario of 100% cooling load; and,*
2. *For avoidance of doubt, the above limits would apply to cumulative noise from the BESS and the Substation.*

Regarding Point 1 - noise modelling assuming 100% fan capacity is not representative of typical BESS plant in the UK. We have, for example, sound power level data for Telsa Megapack units for all fan speeds from 0% to 100% in 10% steps, however, these units are designed to run in all types of environments, such as high temperature desert locations and would never run at 100% fan speed in the UK. Accordingly, we will model the fan speeds of the selected plant running at the highest fan duties expected for this particular site (based on manufacturer recommendations), rather than assuming all fans are operating at 100% capacity. We will,

[2] Acoustics, Ventilation and Overheating, Residential Design Guide, published by the Institute of Acoustics (IOA) and the Association of Acoustics & Noise Consultants (ANC), January 2020. Appendix C entitled "Sound Insulation of a Partially Open Window".

however, assume all plant is running continuously and concurrently i.e. worst-case scenario. All assumptions regarding cooling load will be accompanied with technical data sheets from the relevant manufacturers to demonstrate that the modelled fan capacities are appropriate and can be considered worst case based on the specific environment of the site.

Regarding Point 2, TNEI are happy to include any known substation noise levels within a cumulative impacts section of our report, however, we would note that during installation and collection of noise monitoring equipment the substation was not audible at the monitoring locations. If Highland Council are aware of an NIA report for the substation development that sets out substation noise levels, we would be happy to incorporate these within our assessment.

We would note that **TNEI do not believe that a cumulative noise limit is appropriate or passes the planning condition tests detailed in *Planning Circular 4/1998*,** as it is outside the BESS Developer's control as to how the substation operates and as such, they cannot influence the substation noise level. Any conditions set should relate to the proposed development only.

We hope the above provides you with clear explanations and reasoning behind our proposed assessment methodologies and would welcome any feedback you may have on the above. If you would like to discuss any of the above in more detail, then please do not hesitate to get in touch and we can look to arrange a meeting.

Document Control

Revision	Status	Prepared by	Checked by	Approved by	Date
R0	FIRST ISSUE	EW	JS	JS	09/04/2024
R1	CLIENT COMMENTS	EW	JS	JS	10/04/2024

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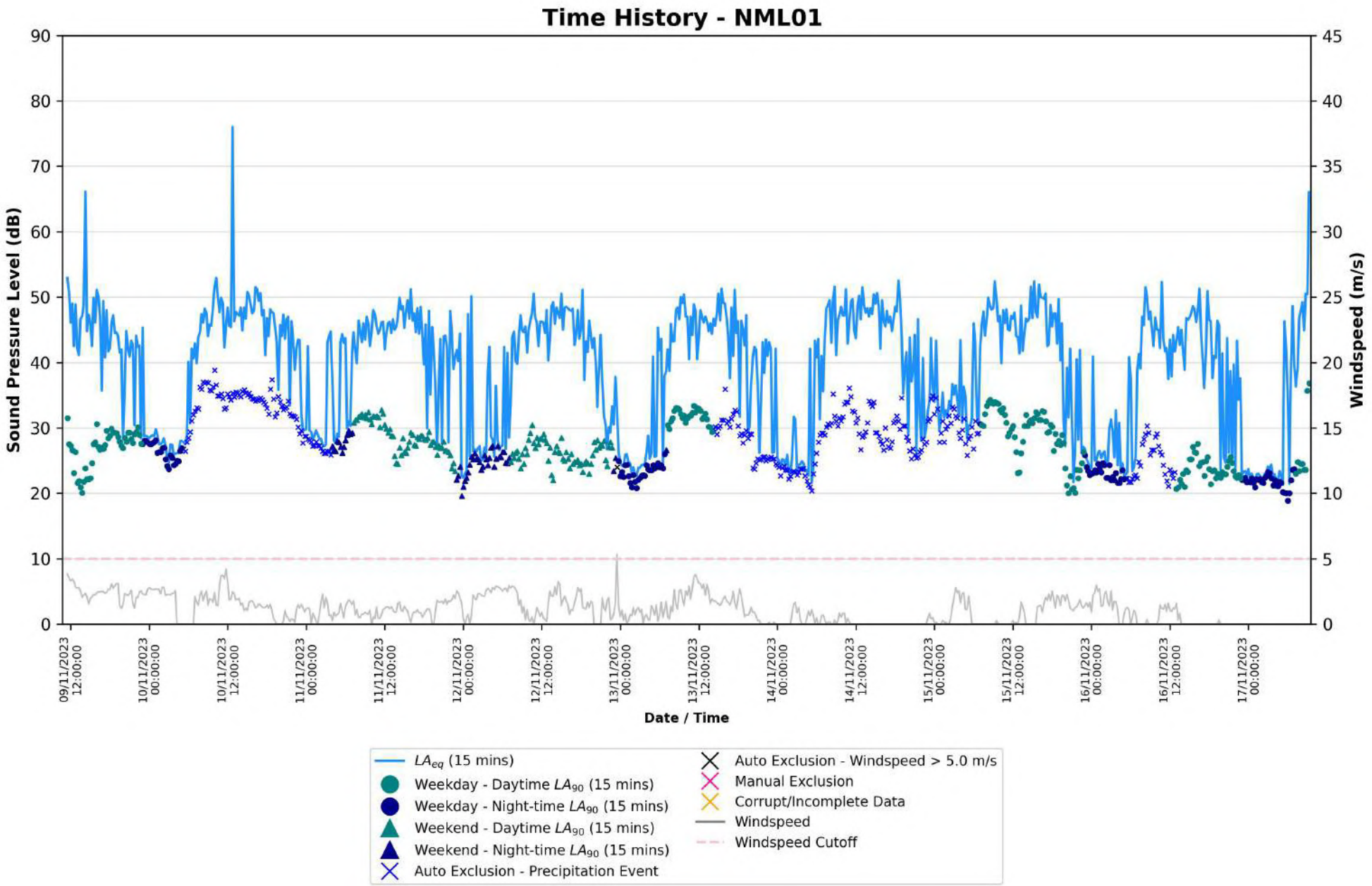
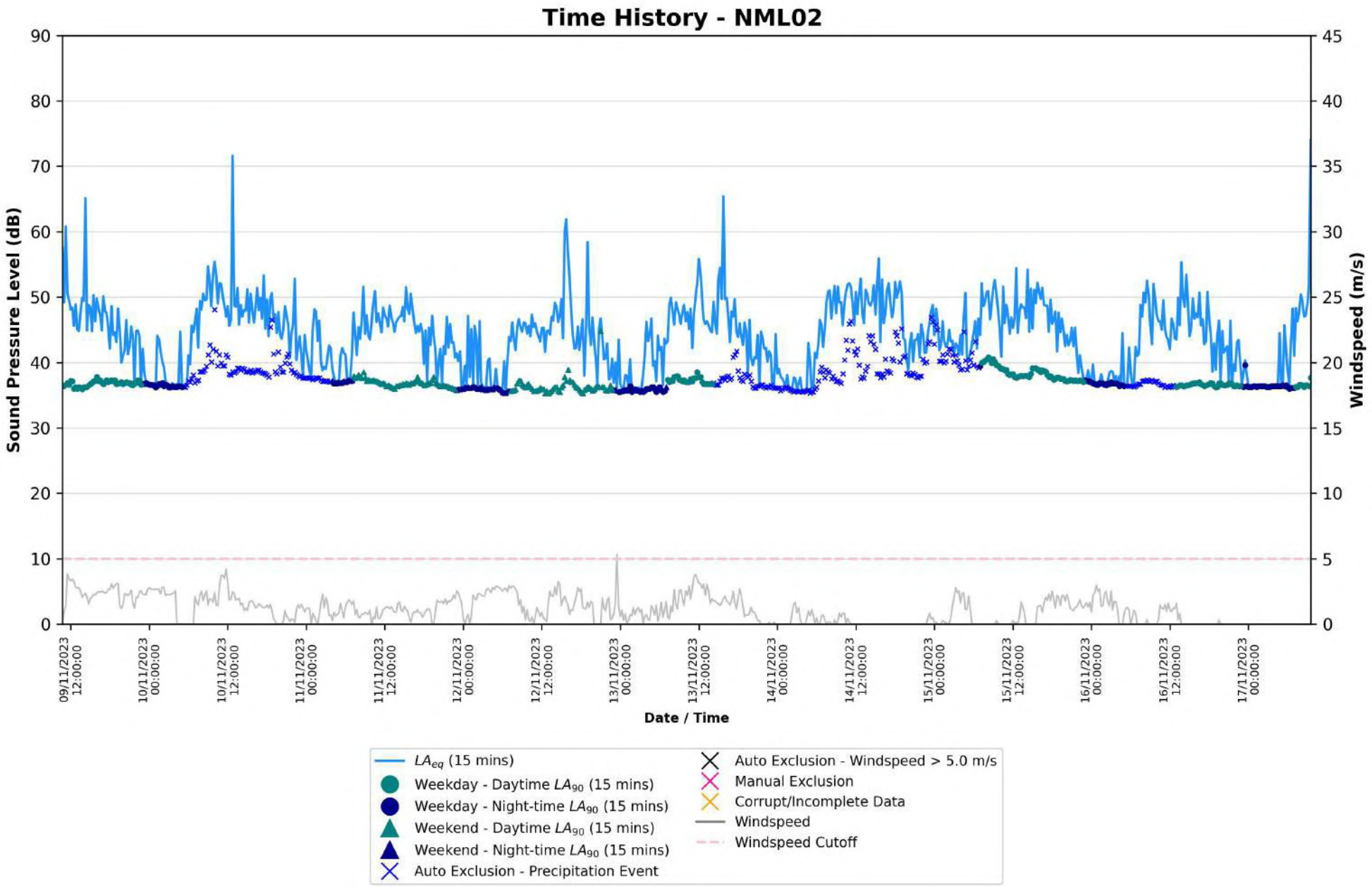
Appendix A – Supporting Information

- Knocknagael BS 4142 Sound Level Survey Report

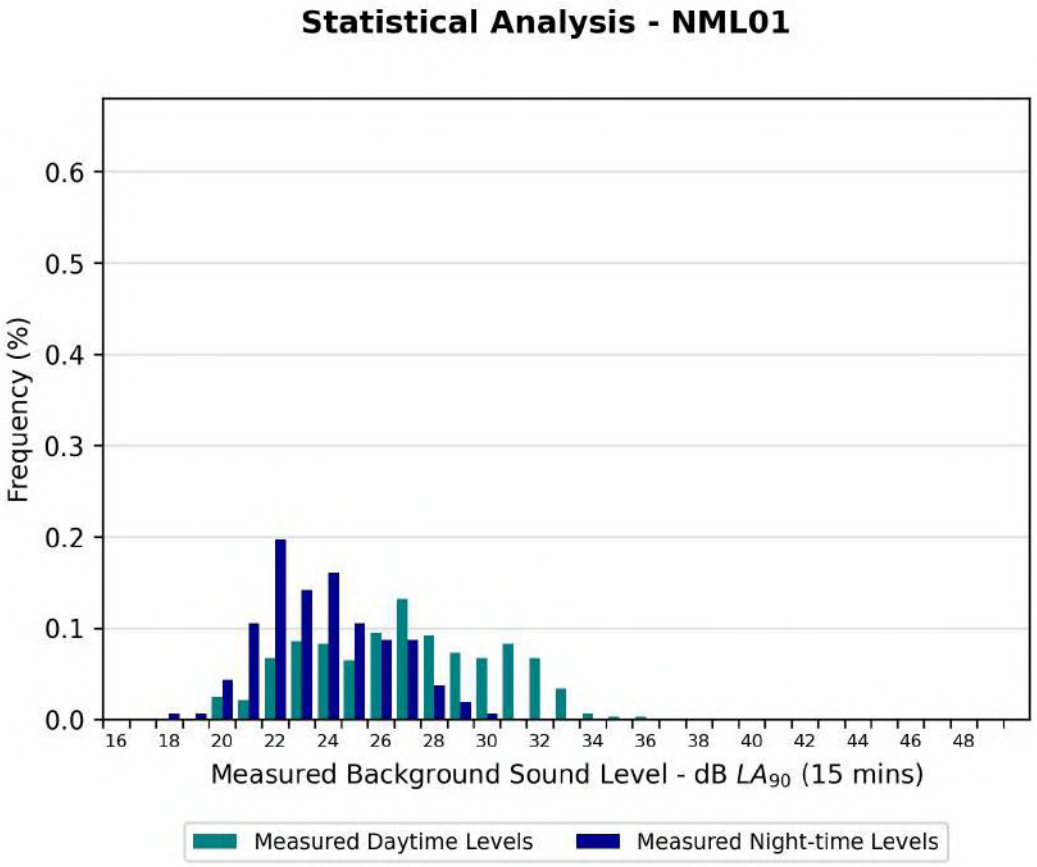
16292 - Knocknagael BESS - Measured Sound Levels:

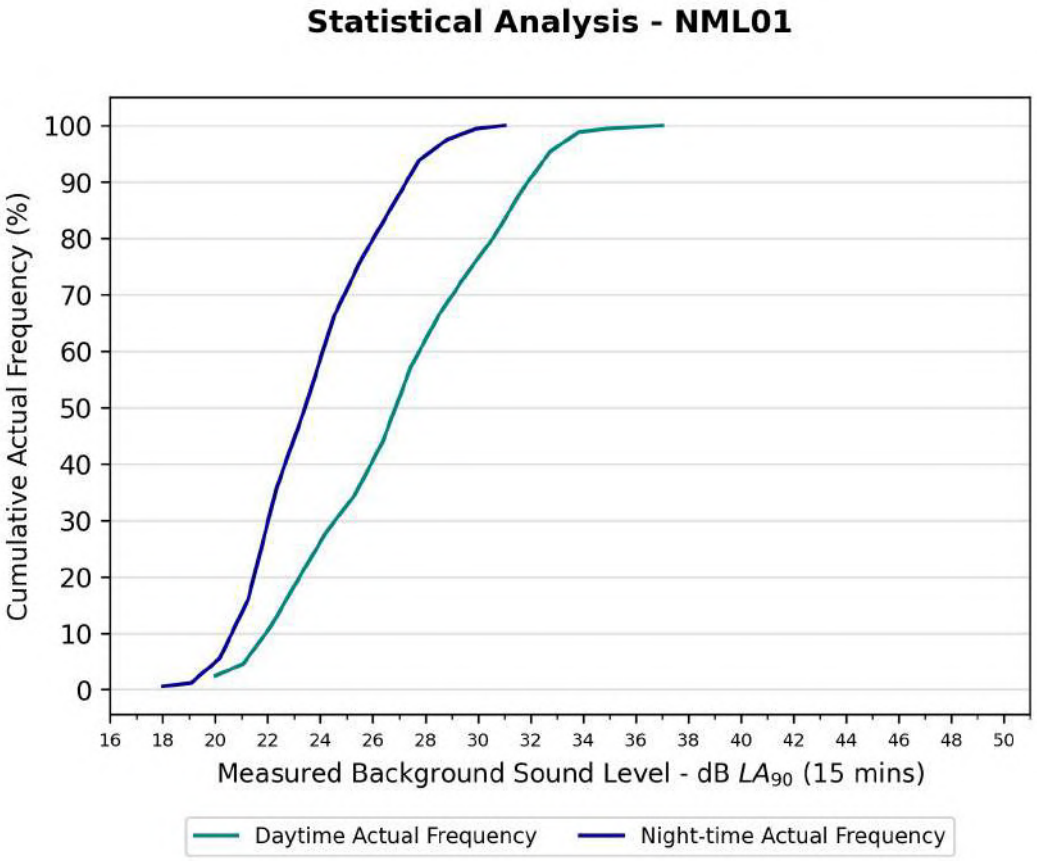


16292 - Knocknagael BESS - Measured Sound Levels:

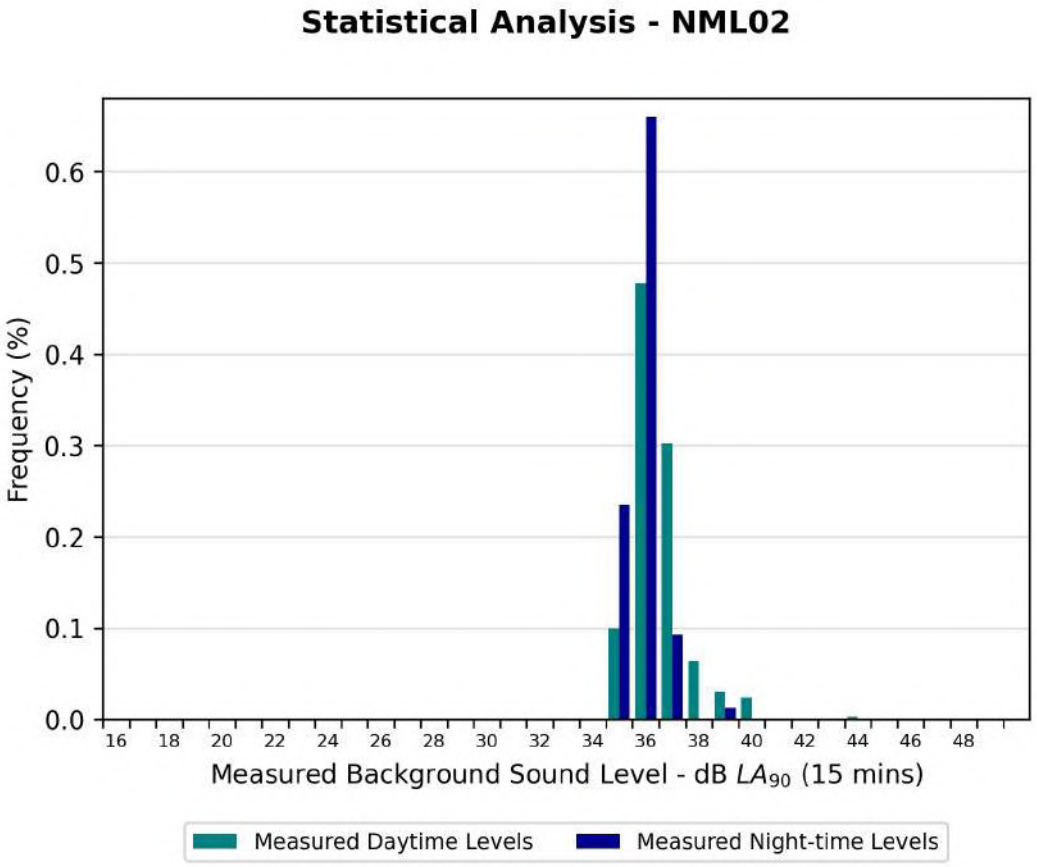


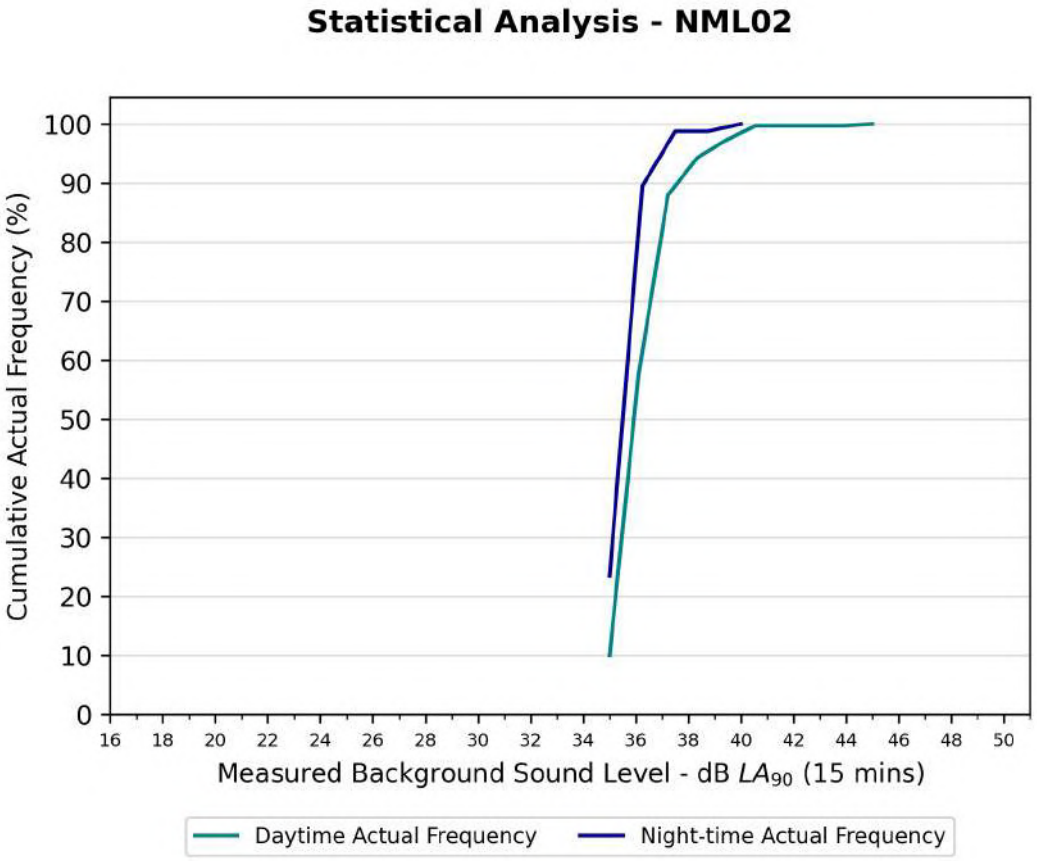
16292 - Knocknagael BESS - Measured Sound Levels:





16292 - Knocknagael BESS - Measured Sound Levels:





A specialist energy consultancy

Knocknagael Battery Energy Storage System (BESS) Development: Noise Impact Assessment – Further Correspondence

To:	[redacted]	Planning Authority:	The Highland Council
Address:	The Highland Council, Community Services, 38 Harbour Road, Inverness, IV1 1UF	TNEI Document Ref.:	16292-004-R0
Date:	7 June, 2024		

Dear [redacted]

I am writing to you following the virtual meeting that took place between The Highland Council (henceforth abbreviated to THC), TNEI and Field (the developer) on 2nd May 2024, during which the Noise Impact Assessment (NIA) methodology for the proposed Knocknagael BESS development (the Proposed Development) was discussed. We believe a constructive discussion took place regarding an appropriate set of assessment criteria but acknowledge that a final agreement was not reached as to exactly what should be the applicable levels and additional information is required for THC to help aid this decision. The purpose of this letter is to propose revised noise assessment criteria for THC's consideration, supported by additional information where required. TNEI would like to come to an agreement with THC as soon as possible to allow us to produce the NIA report in support of the proposed development's planning application, the submission of which is targeted for the **28th of June 2024**.

Revised Noise Propagation Modelling

Since the meeting, Field and TNEI have revisited the noise propagation modelling with the intention to reduce the predicted noise immission levels at the nearest receptors further. Firstly, the noise attenuating barriers have been increased by 1 m, from 3 m to 4 m.

During our meeting, we discussed the source noise data in detail, explaining how fan speed/loading percentages have been assumed to reflect typical operating cycles for BESS developments in the UK i.e. reflecting real-time data collected by the supplier, factoring in average ambient temperatures and operational patterns etc. We have been informed that the original design was actually oversized for added operational flexibility i.e. there are more inverter units included in the design than the minimum

number required, which allows them to run at lower capacities. Accordingly, the inverters will generate lower sound levels than was previously assumed and this has now been reflected in the noise model.

The result of the above revisions is that predicted noise levels at the worst affected Noise Sensitive Receptors (NSRs) are now in region of **30-31 dB $L_{Aeq(t)}$**, as opposed to **34-35 dB $L_{Aeq(t)}$** predicted previously. It should be noted that these values are not yet finalised, as the modelling has not yet been approved for use within the NIA report. However, the preliminary predicted levels remain low and, as previously discussed, we believe this, along with accompanying very low measured background sound levels, is robust justification for the adoption of an absolute noise level limit, as opposed to a traditional qualitative BS 4142 assessment.

Absolute Noise Level Limits

During our meeting, we discussed the adoption of a fixed noise level limit, as opposed to the traditional BS 4142 assessment methodology, due to both the low predicted noise levels (Rating Level of less than 35 dB $L_{Aeq(t)}$) and the very low measured Background Sound Levels (less than 30 dB $L_{A90(15mins)}$), as detailed within the Association of Noise Consultants (ANC) BS 4142 Technical Note. This proposal was met with general agreement from yourself, however, you did raise concerns a suggested limit of **35 dB $L_{Aeq(t)}$**, pointing out that this would effectively be 12 dB above background during the night-time. As such, we are now looking to seek approval to assess against a fixed daytime and night-time absolute noise level criterion of **33 dB $L_{Aeq(t)}$**.

TNEI note your particular concern with regard to the possible effects of operational noise from the Proposed Development upon residents of nearby NSRs when using their outdoor amenity spaces, especially during the evening time when baseline noise levels are likely to be lower than the middle of the day. To provide some context on this, analysis of the $L_{Aeq\ (15\text{-}minute)}$ values measured at NML01 (the location most representative of the nearest NSRs) has been undertaken, which indicates an average Residual Sound Level of **44 dBA** during the entire daytime period (07:00 – 23:00), which drops to **39 dBA** when considering an evening period of 18:00 – 23:00 only**.**

If the proposed development was operating at approximately 31 dBA (as currently predicted, though not yet finalised), against a Residual Sound Level of 39 dBA during the evening time, this would represent an increase (logarithmically added) in sound level of just 0.6 dB. This is considerably below the threshold of sound increase that is generally considered *'just perceptible'* (3 dB change). Similarly, if the development operated at a limit of 33 dBA, the overall increase would only be 1 dB.

Further to this, it is pertinent to note that the noise propagation modelling TNEI have undertaken is inherently conservative. Not only does it assume that all items of plant are operating concurrently (which is unlikely in practice), the modelling parameters favour noise propagation (e.g. assuming that all receptors are located downwind of all noise sources simultaneously). Accordingly, it is expected that operation of the Proposed Development will, in actuality, result in lower noise immission values at the nearest NSRs than predicted.

Considering the above, TNEI believe that a fixed daytime and night-time absolute noise level criterion of **33 dB $L_{Aeq(t)}$** offers both appropriate protection to the amenity of the nearby residential NSRs, whilst also offering a realistic and achievable noise level that does not unduly restrict the development of important energy infrastructure.

Cumulative Considerations

As discussed within the meeting, concerns were raised about the potential cumulative effect of operational noise from the nearby Knocknagael substation development, located to the northeast of the proposed development. TNEI explained that whilst staff were onsite during the baseline sound level survey, noise emissions from the substation were not audible at the nearest noise sensitive receptors and as such were deemed not to be contributing to the soundscape. Additionally, TNEI discussed the

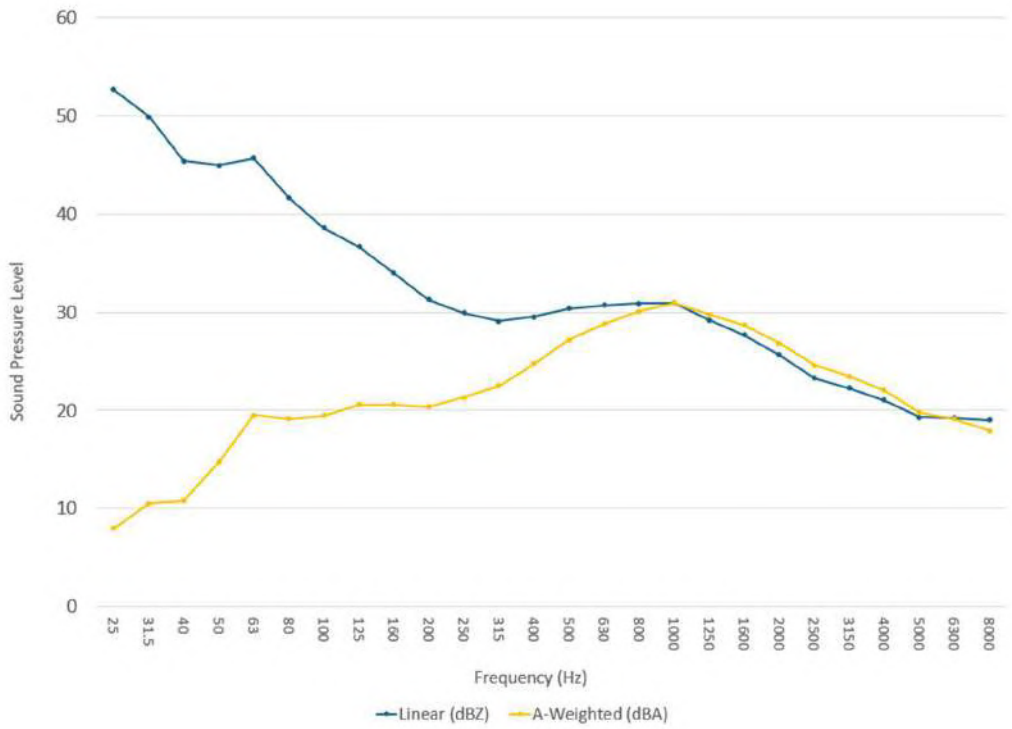
substation's infrastructure with the aid of aerial imagery, showing that the development predominantly consists of (non-noise-generating) switching circuits and a control building with just two power transformers, as highlighted in Figure 1 below:

Figure 1 – Knocknagael Substation, with Transformers Highlighted

The only likely significant noise emitting items of plant within the substation would be power transformers, the noise emission output of which would be expected to predominantly within the 100 Hz frequency band, however, attended spot measurements (measured in 1-minute intervals) approximately 200 m to the southeast of the substation, at the location shown in **Figure 2** below (labelled as NML03), indicated no discernible spike in sound pressure level values measured in the 100 Hz band, suggesting the substation is having very little influence on the existing noise environment (see averaged $L_{eq\ (1\text{-}minute)}$ values in **Figure 3** below). As such, it is expected that the sound emissions from the substation are unlikely to be audible at the NSRs and TNEI propose that the NIA is not required to consider cumulative effects from the substation in any more detail.

Figure 2 – Spot Monitoring Location (NML03)

Figure 3 - Sound Pressure Levels, ($L_{eq\ (1\text{-}minute)}$) dBZ and dBA, measured at NML03



NR Curves

The use of NR curves as an assessment criterion was originally requested by THC within our initial consultation, specifically NR 20 during the night-time and NR 35 during the daytime. Within the meeting, however, it was explained that this was no longer a requirement of THC and would not need to be considered within the NIA. Nonetheless, TNEI believe consideration of NR curve criterion within the NIA report can be useful to give additional context to the assessment, especially to assess the spectral content of the predicted immission levels at the receptors, so we may continue to include this within the report.

100 Hz Noise Level Limit

It was explained by THC at the meeting that a 100 Hz noise limit of 30 dB $L_{Zeq\ (5\text{-}minutes)}$ was an assessment criterion that was being implemented across most BESS developments within THC. The reason behind this was to protect against the possible 100 Hz tone that is typically associated with large-scale electrical infrastructure (although, should be noted, not necessarily attributable to BESS developments). TNEI remain unmoved with regard to our view of this limit and as explained in our previous letter, we suggest that is changed to a A-weighted level (dBA), as opposed to a Linear level (dBZ).

We appreciate that this criterion has been applied to other developments in THC area but do not believe that this on its own is justification to continue to apply the criterion on future developments. We have not seen any evidence that the proposed limit is appropriate, for example by comparing it to recommended levels in British or International standards or guidelines. We can, however, provide some examples ourselves of limits and or assessment methodologies regarding 100 Hz and other low frequencies to give some context.

Example 1: In 2005 the University of Salford published NAN R 45 *Procedure for the assessment of low frequency noise complaints* on behalf of DEFRA[1]. The document includes a criterion curve that sets out a level at which noise complaints should be further investigated if measured levels are exceed. The criterion curve sets a level of 38 dB $L_{zeq(t),}$ which is 8 dB higher than that proposed in the THC 100 Hz limit, and is for **internal levels**, whereas the assessment criterion requested by THC is related to **external levels**, which would naturally be higher.

Example 2: The proposed 100 Hz limit is 30 dB (L_{Leq}), whereas the limit in the 125 Hz[2] band of the often-used NR 20 limit is 39 dB (L_{Leq}). This limit, although stringent, is still considerably higher than the one proposed by THC, both in terms of absolute levels and the fact that the above limits are set internally, whereas the proposed criterion is set externally.

We hope the above provides you with requisite additional information to allow you to reach a conclusion and allow us to agree upon an appropriate assessment methodology. We would welcome any feedback you may have on the above and if you feel that a further call would be beneficial to finalise things, do not hesitate to get in touch and we can look to arrange this. Given the target submission date of 28th of June, it would be very much appreciated if you could endeavour to get back to us with the suggested assessment criteria as soon as possible to allow us to complete the NIA report.

[1] Department for Environment, Food and Rural Affairs (DEFRA)

[2] No limit is detailed at 100 Hz but it would be just slightly higher than the limits quoted at 125 Hz

Document Control

Revision	Status	Prepared by	Checked by	Approved by	Date
R0	FIRST ISSUE	EW	JS	JS	07/06/2024

TNEI Services Ltd

Company Registration Number: 03891836 **VAT Registration Number: 239 0146 20**

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Niagara Road & Tyger Falls Blvd
Belville
Cape Town7530
South Africa,
Tel: +27 (0)72 855 6999

Ewan Watson

From: [redacted]
Sent: 17 June 2024 14:37
To: Ewan Watson
Cc:
Subject: [redacted]

Hi Ewan, unfortunately my line manager is on leave for a couple of days. However, I think what we could do is qualify the condition so that it only applies where the noise is identified as being tonal. I understand the data you have demonstrates that this is not the case so there should be no issues and no requirement for any further monitoring or assessment.

Regards,

[redacted]
Environmental Health Officer
Highland Council, 38 Harbour Road, Inverness, IV1 1UF
Telephone: [redacted]

From: Ewan Watson <ewan.watson@tneigroup.com>
Sent: Monday, June 17, 2024 11:37 AM
[redacted]
Subject: RE: Knocknagael BESS - Noise Impact Assessment - Further Information

Good morning [redacted]

Apologies for the keen chase, but have you had any further thoughts on the 100 Hz limit discussion below?

We really need to bottom this out as quickly as possible in order to produce the NIA report. If there is requirement for additional monitoring or assessment work, please can you make us aware of this today?

Kind regards,

Ewan

tnei

Ewan Watson
Senior Consultant
[redacted]
[redacted]
www.tneigroup.com

From: Ewan Watson [redacted]
Sent: Friday, June 14, 2024 4:44 PM
[redacted]

Thanks very much, [redacted]

Have a good weekend!

Ewan

tnei

Ewan Watson
Senior Consultant
[redacted]
www.tneigroup.com

[redacted]
Subject: RE: Knocknagael BESS - Noise Impact Assessment - Further Information

Hi Ewan, I'll discuss with my line manager and see what we can do. I'll get back to you ASAP.

Regards,
[redacted]
Environmental Health Officer
Highland Council, 38 Harbour Road, Inverness, IV1 1UF
Telephone: [redacted]

From: Ewan Watson [redacted]
Sent: Friday, June 14, 2024 3:51 PM
[redacted]

Hi [redacted]

Thank you for the feedback and noted re the target broadband limit of 31 dBA.

We do have 1/3 octave band source data for the BESS candidate that we are using within our Noise Propagation Model, and although there is nothing to suggest that the data is tonal in the 100 Hz band, we are currently predicting around 36 dBZ in the 100 Hz band at the nearest receptor.

Re additional monitoring – we did try to arrange some additional monitoring last week, as TNEI staff were in that neck of the woods anyway, but unfortunately it didn't come to fruition. The next best thing we have is some 1/3 octave band short-term measurement data that we took as part of the initial baseline survey. We undertook 27 individual 1-minute measurements at the following location (turquoise pin):

These measurements were taken during the return trip to decommission the fixed kits. Initially the purpose of this was to quantify the influence of the substation (as we had done on the installation trip, the data for which was summarised in our latest technical note) but we actually couldn't get access through the gate as we had done previously so inadvertently took measurements at a more distant location, which ended up being a similar set back distance from the substation as NSR01.

The average $L_{Zeq(1\text{-}min)}$ value in the 100 Hz band for this measurement period was 46 dB, so considerably above the 30 dBZ limit. Although I appreciate that this period was measured during the daytime. We unfortunately do not have such data for the night-time.

As we are now approaching submission, can you suggest anything alternative that we could do to address this matter? If you definitely require us to go and measure 1/3 Octave Band data at night, this will certainly cause delays but it would be good to get a definitive answer on this as soon as possible.

Feedback on the above would be much appreciated as soon as you possibly can. Happy to look to arrange a call early next week if beneficial.

Kind regards

Ewan

Ewan Watson
Senior Consultant
[redacted]
www.tneigroup.com

[redacted]

To: Ewan Watson [redacted]

Subject: RE: Knocknagael BESS - Noise Impact Assessment - Further Information

Hi Ewan, apologies for the delay in responding. I note that your revised assessment has predicted levels down to 31dB(A) which is very welcome. I also note the confirmation that the noise propagation modelling is inherently conservative, assuming all plant are operating concurrently, and all receptors are downwind of all noise sources simultaneously. Therefore, it is expected that noise levels will actually be lower than predicted. On that basis, I would be happy to accept a fixed limit of 31dB(A). Given that this is still 7dB above the night time background I don't really see any need to increase it to 33dB(A).

With regard to noise at 100Hz, the limit we have stated follows a prolonged investigation into a noise complaint at a large substation. Above this level, the noise was still very audible in low background conditions such as we have here. My understanding is that battery sites don't normally involve a significant source at 100Hz however, in some cases they might include other equipment which does, either at the time of application or in the future, which is why this limit is in place. I note the assessment does not include any predicted levels at 100Hz. Is this information unavailable or are predicted levels not meeting the 30dB(Z) limit? I think we also discussed that if the development did not increase existing noise levels then that would also be acceptable. I think you were going to look at whether you had any 100Hz data from your previous monitoring.

I'll be out for part of the morning but should be around most of the afternoon if you want to discuss further.

Regards,
[redacted]
Environmental Health Officer
Highland Council, 38 Harbour Road, Inverness, IV1 1UF
Telephone: [redacted]

From: Ewan Watson [redacted]
Sent: Thursday, June 13, 2024 5:13 PM
[redacted]
Subject: Re: Knocknagael BESS - Noise Impact Assessment - Further Information

Hi [redacted]

Have you had a chance to review the attached at all?

We would really appreciate your input as we are looking to submit the NIA imminently.

Kind regards

Ewan

Sent from Outlook for iOS

tnei

Ewan Watson
Senior Consultant
[redacted]
www.tneigroup.com

From: Ewan Watson [redacted]
Sent: Friday, June 7, 2024 12:13:37 PM
[redacted]
Subject: Knocknagael BESS - Noise Impact Assessment - Further Information

Hi [redacted]

Hope you are well.

I am contacting you regarding the call that took place on the 2nd May between The Highland Council, TNEI and Field regarding the required assessment criteria for the Noise Impact Assessment (NIA) to support the planning application for the proposed Knocknagael BESS Development near Essich, Inverness.

As per the conclusion of the meeting, I attach a letter that provides additional information and a revised suggested criteria for the NIA. I hope the attached will allow you to provide TNEI with a definitive set of assessment criteria that can be reflected in the NIA report.

Considering the imminent target submission date for the application (currently targeted for the 28th June), we would very much appreciate your feedback on the attached and provision of a final set of assessment criteria, if possible, by **Friday 14th June at the latest**. This will allow TNEI sufficient time to then complete the NIA report before the target submission date.

If you have any additional queries on the above or attached, please do not hesitate to get in touch.

Kind regards,

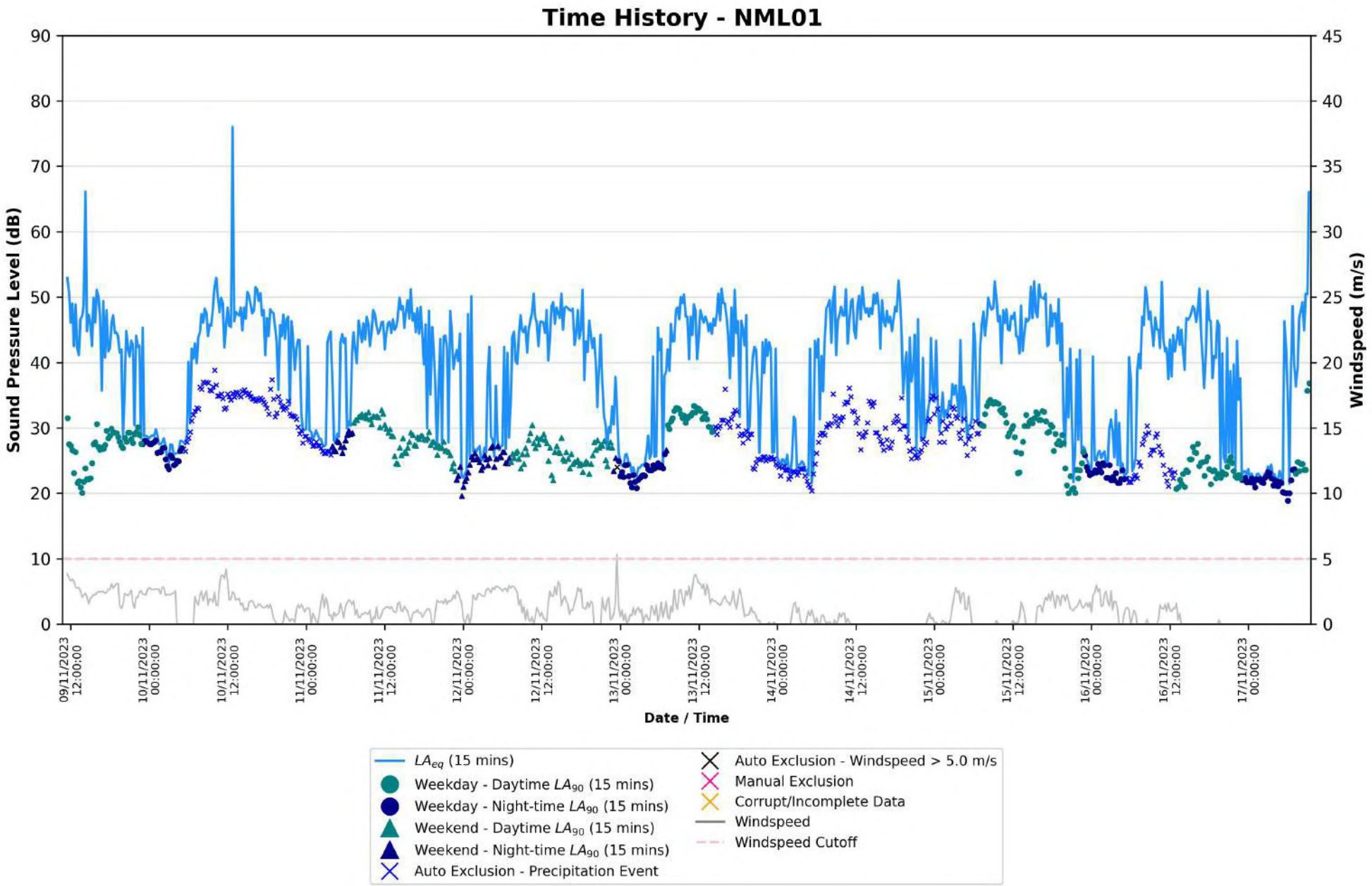
Ewan

Ewan Watson
Senior Consultant
[redacted]
www.tneigroup.com

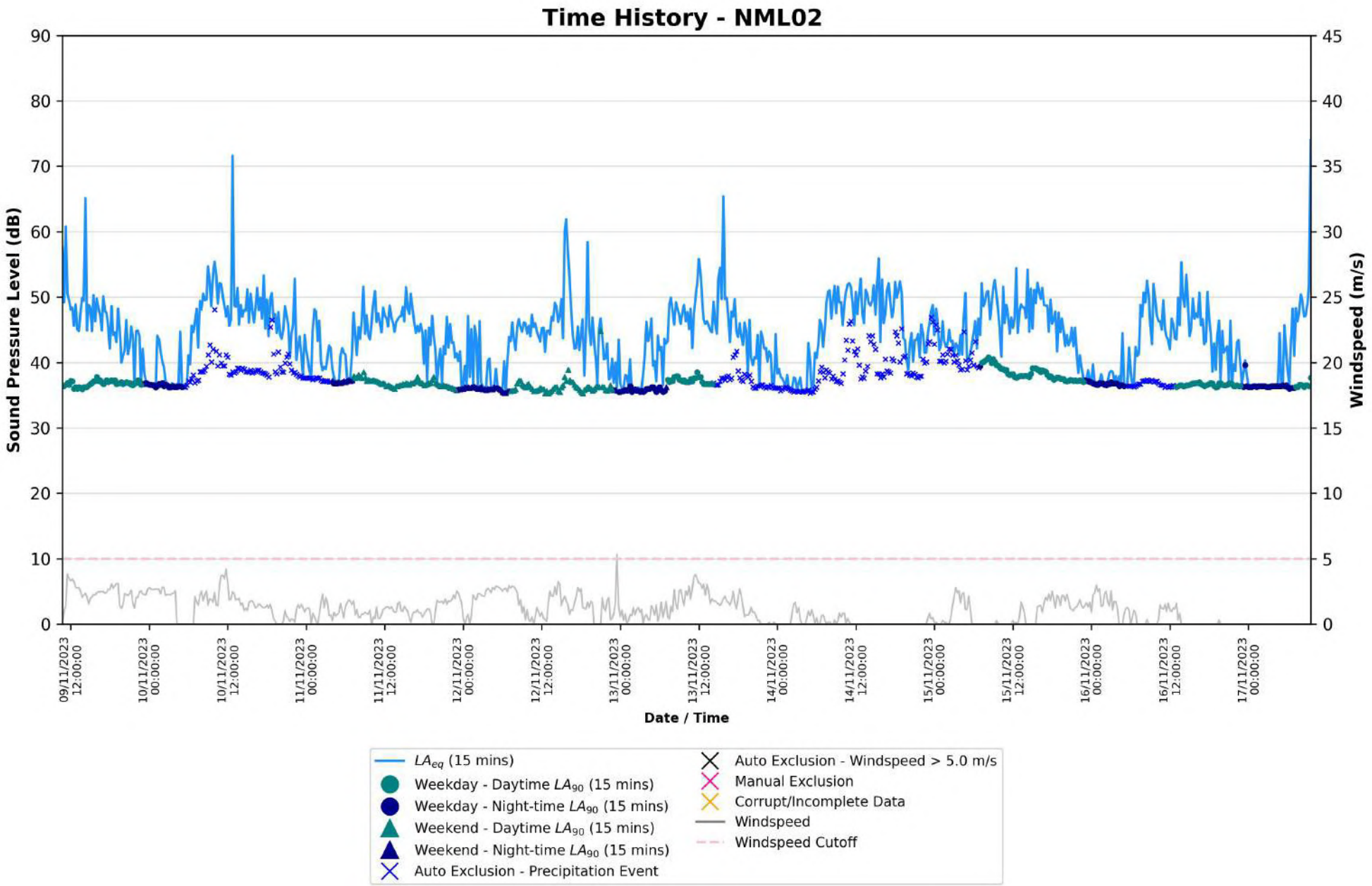
7th Floor, 80 St Vincent Street, Glasgow, G2 5UB, United Kingdom

Appendix D – Baseline Survey Data

16292 - Knocknagael BESS - Measured Sound Levels:



16292 - Knocknagael BESS - Measured Sound Levels:



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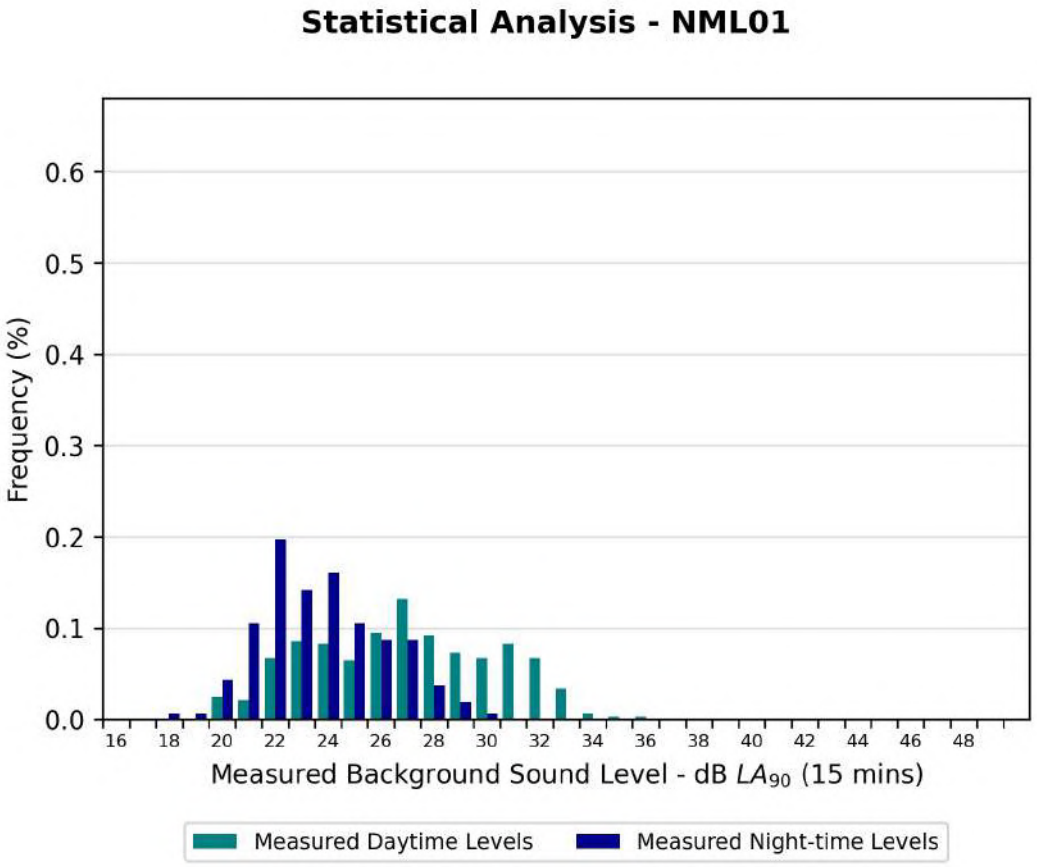

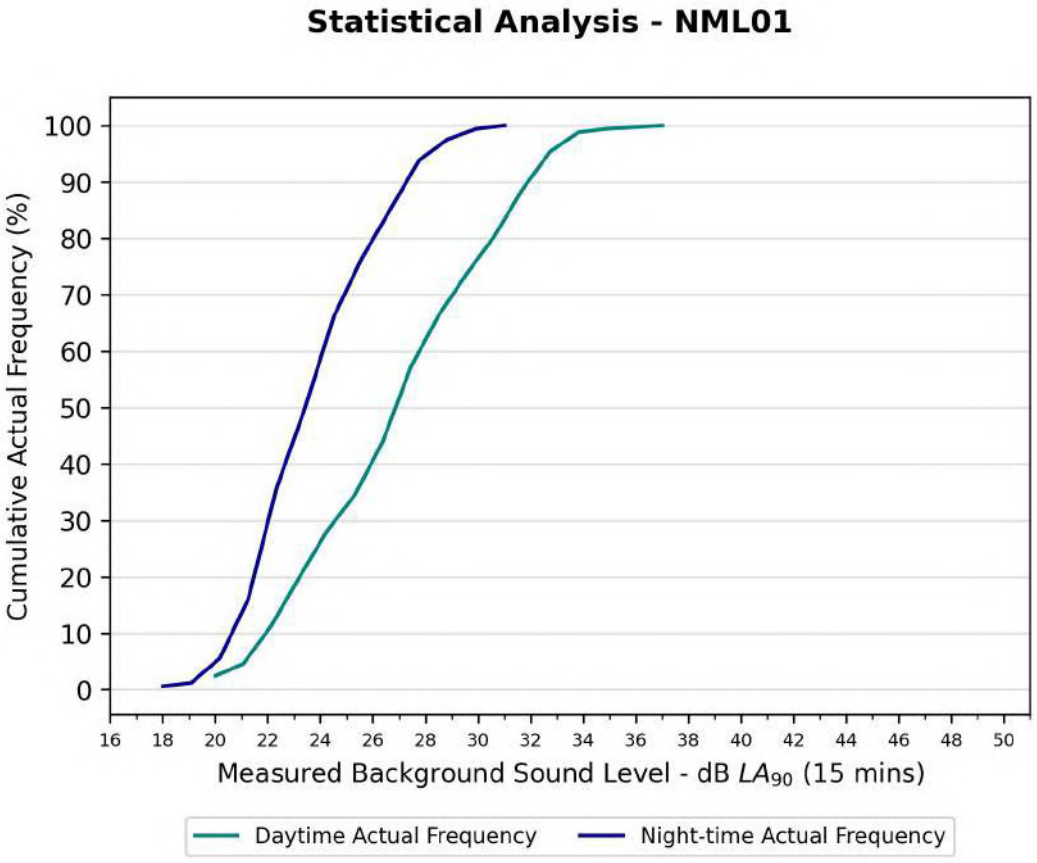

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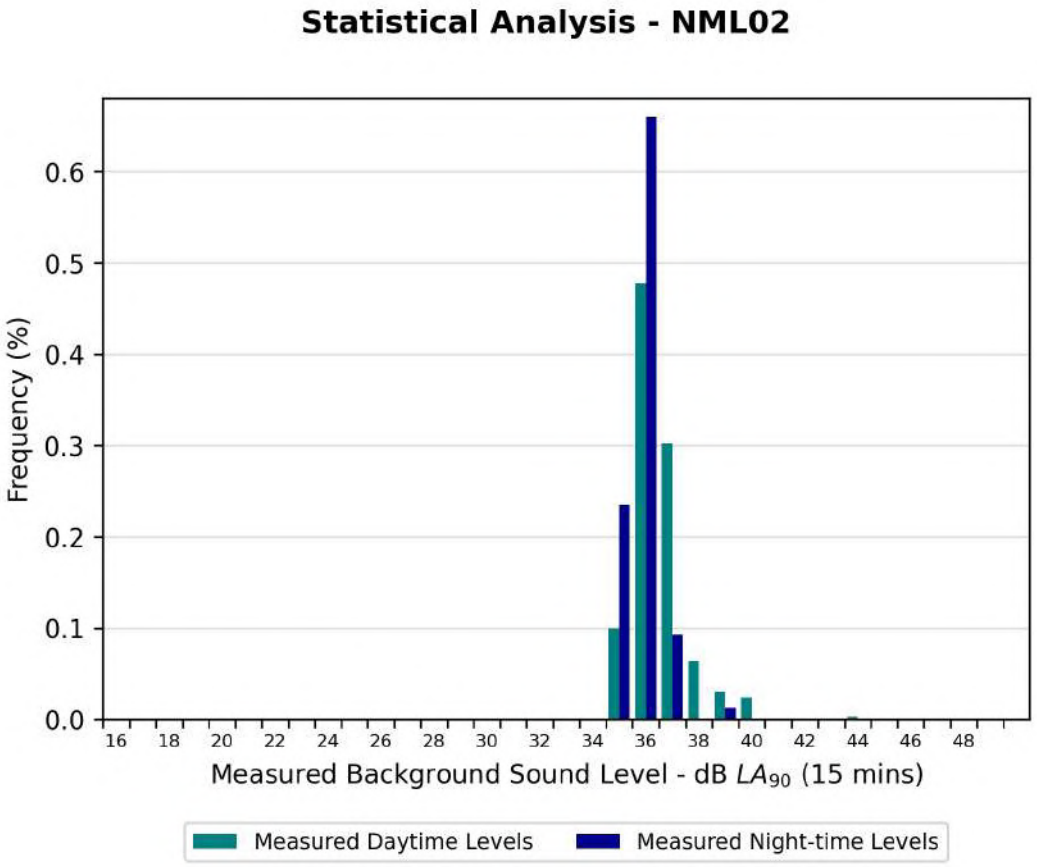

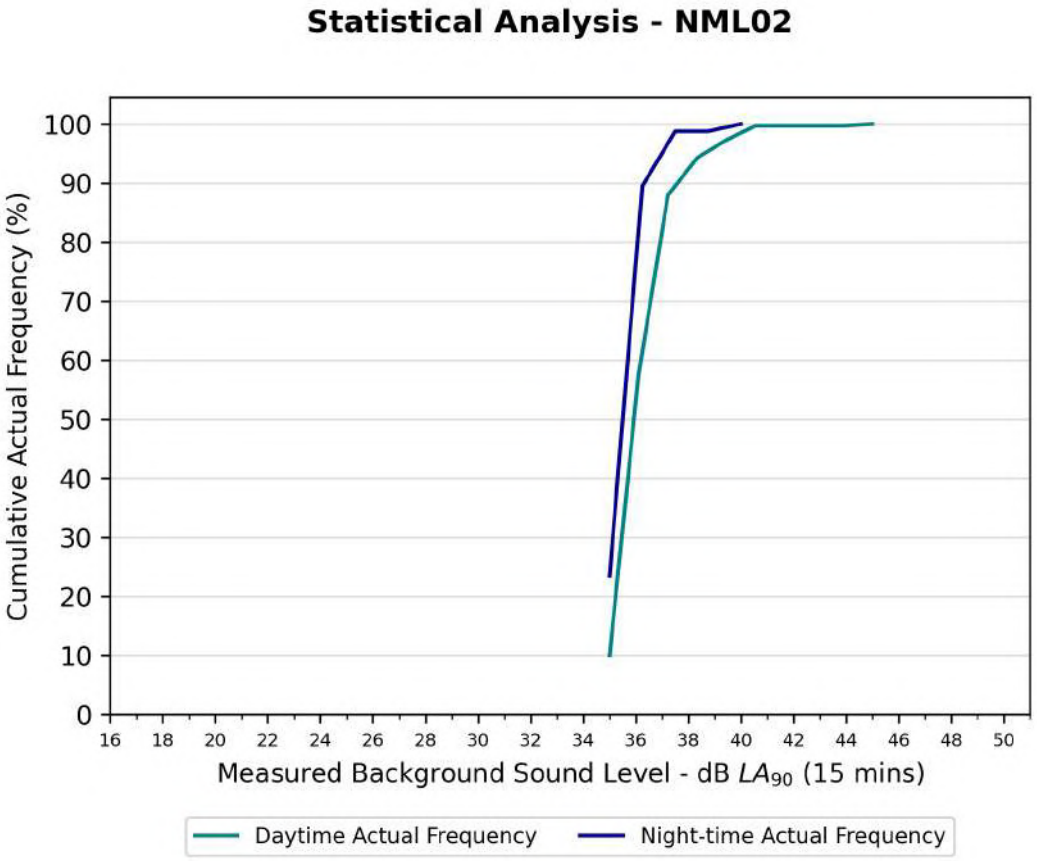

16292 – Knocknagael BESS - Noise Monitoring Location (NML) Photos

NML01

NML02

Project Nb.& Name	Knocknagael BESS - 16292
Client	Field

MONITORING LOCATION DETAILS

NML Nb. and Name	NML01 – Achvraid Farm
NML Contact Details (Name, address, phone nb..)	-
Description/Reason for exact location and Grid Coordinates	Representative of the nearest NSRs located to the south and southwest of the Proposed Development X: 264566 Y: 838633

MONITORING EQUIPMENT DETAILS

	TNEI Id Nb.	Model	Serial Number	Last Cal.
Sound Level Meter	SLM 58	NL-52	00721000	05/09/2022
Pre Amplifier				
Microphone				
Calibrator				

MONITORING EQUIPMENT SETTINGS AT START **(TO BE CHECKED AT EACH SITE VISITS)**

	Setting	Comment
Index (Leq,L90..)	L_{eq}, L_{90}	
Network (A,B,Z)	A	
Time Interval (10min,10s..)	15 mins	
Time Weighting (Fast/Slow)	Fast	
Measurement Range (20-110 ..)	20-110	
Audio (No ,Yes 16Khz/16bit ...)	No	
Other (GMT/BST)	BST	
Resident Comments Sheet	N/A	
Resident consent to use photographs	N/A	

SITE VISIT HISTORY (VISITS 1 TO 4)

Visit Nb	Surveyor Initials	File Name (on SLM)	Start Date&Time (on watch)	End Date&Time (on watch)	Calibration at Start	Calibration at End	File Name	Index & Network (LAeq,LA90...)	Time Interval (10min,10s..)	Time Weighting (Fast ...)	Range (20-110 ...)	Batteries	Photographs (Kit+ SLM)	Write Notes on sound audible...	Snow/River Present?
1	WC	0101	09/11/2023 11:30	17/11/2023 09:31	94.0	93.9									
2															
3															
4															

Visit Nb	NOTES / SITE OBSERVATIONS / Sounds Audible During Each Visits
1	**Installation** - Foggy, mild temperature. - Cows lowing and sheep bleating. - Some wind induced foliage rustle. - Traffic noise dominant when passing but infrequent. - Substation not audible.
	Decomissioning - Soundscape similar to installation.

Project Nb.& Name	Knocknagael BESS - 16292
Client	Field

MONITORING LOCATION DETAILS

NML Nb. and Name	NML02 – Dwelling on Essich Road
NML Contact Details (Name, address, phone nb..)	-
Description/Reason for exact location and Grid Coordinates	Representative of the nearest NSRs located to the north of the Proposed Development X: 264853 Y: 839348

MONITORING EQUIPMENT DETAILS

	TNEI Id Nb.	Model	Serial Number	Last Cal.
Sound Level Meter	SLM 59	NL-52	00721001	05/09/2022
Pre Amplifier				
Microphone				
Calibrator				

MONITORING EQUIPMENT SETTINGS AT START **(TO BE CHECKED AT EACH SITE VISITS)**

	Setting	Comment
Index (Leq,L90..)	L_{eq}, L_{90}	
Network (A,B,Z)	A	
Time Interval (10min,10s..)	15 mins	
Time Weighting (Fast/Slow)	Fast	
Measurement Range (20-110 ..)	20-110	
Audio (No ,Yes 16Khz/16bit ...)	No	
Other (GMT/BST)	BST	
Resident Comments Sheet	N/A	
Resident consent to use photographs	N/A	

SITE VISIT HISTORY (VISITS 1 TO 4)

Visit Nb	Surveyor Initials	File Name (on SLM)	Start Date&Time (on watch)	End Date&Time (on watch)	Calibration at Start	Calibration at End	File Name	Index & Network (LAeq,LA90...)	Time Interval (10min,10s..)	Time Weighting (Fast ...)	Range (20-110 ...)	Batteries	Photographs (Kit+ SLM)	Write Notes on sound audible...	Snow/River Present?
1	WC	0101	09/11/2023 11:30	17/11/2023 09:20	94.0	94.0									
2															
3															
4															

Visit Nb	NOTES / SITE OBSERVATIONS / Sounds Audible During Each Visits
1	**Installation** - Foggy, mild temperature. - Cows lowing and sheep bleating. - Some wind induced foliage rustle. - Traffic noise dominant when passing but infrequent. - Watercourse audible. - Substation not audible.
	Decomissioning - Soundscape similar to installation.

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 28 March 2023

Certificate Number: UCRT23/1424

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory [redacted]

K. Mistry

Customer	TNEI Floor 7 80 St Vincent Street Glasgow G2 5UB
Order No.	5001
Test Procedure	Procedure TP 14 Calibration of Sound Calibrators (60942:2017)
Description	Acoustic Calibrator

Identification

Manufacturer	*Instrument*	*Model*	*Serial No.*
Rion	Calibrator	NC-75	35002724

Public evidence of Type Approval: Yes — Approved by: PTB

The calibrator has been tested as specified in Annex B of IEC 60942:2017. As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2017, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2017.

ANV Job No.	UKAS23/03225
Date Received	27 March 2023
Date Calibrated	28 March 2023

Previous Certificate

Dated	21 March 2022
Certificate No.	UCRT22/1402
Laboratory	0653

Measurements

The sound pressure level generated by the calibrator (averaged over a 20 to 25 second period) in its WS2 configuration was measured five times (rotating the calibrator on the microphone each time) by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below.

The frequency of the sound from the calibrator was measured five times over a 20 to 25 second period and the average frequency calculated.

The total distortion + noise of the sound from the calibrator was measured, using a rejection filter distortion factor meter, five times over a 20 to 25 second period and the average distortion + noise calculated.

Test Microphone — *Manufacturer*: Brüel & Kjær — *Type*: 4134

Nominal Setting dB / Hz	Mean Level dB rel 20 µPa	Frequency	Distortion + Noise
94 / 1000	94.01 ± 0.10	1000.00 ± 0.12Hz	(0.12 ± 0.02) %

Environmental conditions during tests	Start	End		
Temperature	21.24	21.12	± 0.30	°C
Humidity	38.5	38.8	± 3.0	%RH
Ambient Pressure	100.858	100.849	± 0.030	kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

Note: Calibrator adjusted prior to calibration? NO

Additional Comments: The results on this certificate only relate to the items calibrated as identified above.
None

Calibrated by: B. Bogdan

R 2

END

SLM58

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**05 September 2022**
Customer	**TNEI Services Ltd**
Certificate Number	**CONF092203**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00721000
Preamplifier	Rion	NH-25	22106
Microphone	Rion	UC-59	21938

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2013 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed [redacted]..... Position. Calibration Technician Date. 05 September 2022

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
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SLM[redacted]59

MEASUREMENT SYSTEMS

CERTIFICATE OF CONFORMANCE

Date of Issue	**05 September 2022**
Customer	**TNEI Services Ltd**
Certificate Number	**CONF092202**

	Manufacturer	**Type**	**Serial Number**
Sound Level Meter	Rion	NL-52	00721001
Preamplifier	Rion	NH-25	22107
Microphone	Rion	UC-59	21939

This is to certify that the instrument was tested and calibrated at the Manufacturer's factory according to their specification and that the product satisfied all the relevant requirements of the following Standards:

IEC 61672-1:2013 Class 1.

The instrument also received a functional check by ANV Measurement Systems prior to despatch in the UK, in accordance with our standard procedures.

Signed. [redacted] ..... Position. Calibration Technician Date. 05 September 2022

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Appendix E – Noise Modelling Data

TEST REPORT

Sound Level

Serial No. : 1ZPL001134582

Combination of sound level measurements

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			
100	33	100	262.43		8	

	Frequency	Measurement 1 Sound Power Level	Measurement 4 Sound Power Level		Combined Sound Power Level
	[Hz]	[dB(A)]	[dB(A)]		[dB(A)]
Total Sound Level		76.9	87.8		88.2
Octave Band	63	39.6	64.4		64.4
	125	59.5	79.6		79.6
	250	76.1	81.2		82.3
	500	67.3	82.6		82.7
	1000	56.3	81.7		81.7
	2000	51.6	75.4		75.4
	4000	54.1	71.3		71.4
	8000	57.4	64.2		65.0
⅓ Octave Band	50	36.1	63.8		63.8
	63	37.0	47.4		47.8
	80	0.0	55.1		55.1
	100	58.4	71.9		72.1
	125	47.5	68.5		68.6
	160	51.3	78.4		78.4
	200	63.1	73.7		74.1
	250	60.9	76.4		76.5
	315	75.8	78.0		80.1
	400	61.2	77.0		77.1
	500	63.7	76.9		77.1
	630	62.5	79.2		79.3
	800	53.7	78.6		78.6
	1000	51.4	76.7		76.7
	1250	47.1	74.5		74.5
	1600	47.0	72.4		72.4
	2000	46.7	70.2		70.2
	2500	46.9	68.5		68.5
	3150	48.4	67.5		67.6
	4000	49.6	66.9		67.0
	5000	49.9	64.8		64.9
	6300	51.2	61.5		61.9
	8000	52.9	58.8		59.8
	10000	53.6	56.4		58.2

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			

	Frequency				Combined Sound Power Level
	[Hz]				[dB(A)]
Total Sound Level					
Octave Band	63				
	125				
	250				
	500				
	1000				
	2000				
	4000				
	8000				
⅓ Octave Band	50				
	63				
	80				
	100				
	125				
	160				
	200				
	250				
	315				
	400				
	500				
	630				
	800				
	1000				
	1250				
	1600				
	2000				
	2500				
	3150				
	4000				
	5000				
	6300				
	8000				
	10000				

Appendix F – Figures

N

NML02

NML01

Spot Measurement Location A

Spot Measurement Location B

Carn Glas Chambered Cairns

0 0.5 1 Kilometre

LEGEND

- Red Line Boundary
- Spot Measurement Locations

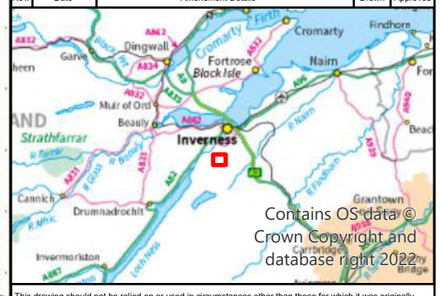
Noise Monitoring Locations (NMLs)

- NML01
- NML02

Nearest Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML01
- NSRs Represented by NML02

Rev.	Date	Amendment Details	Drawn	Approved
0	20/06/2024	FIRST ISSUE	JCM	MC



tnei

Client: FIELD

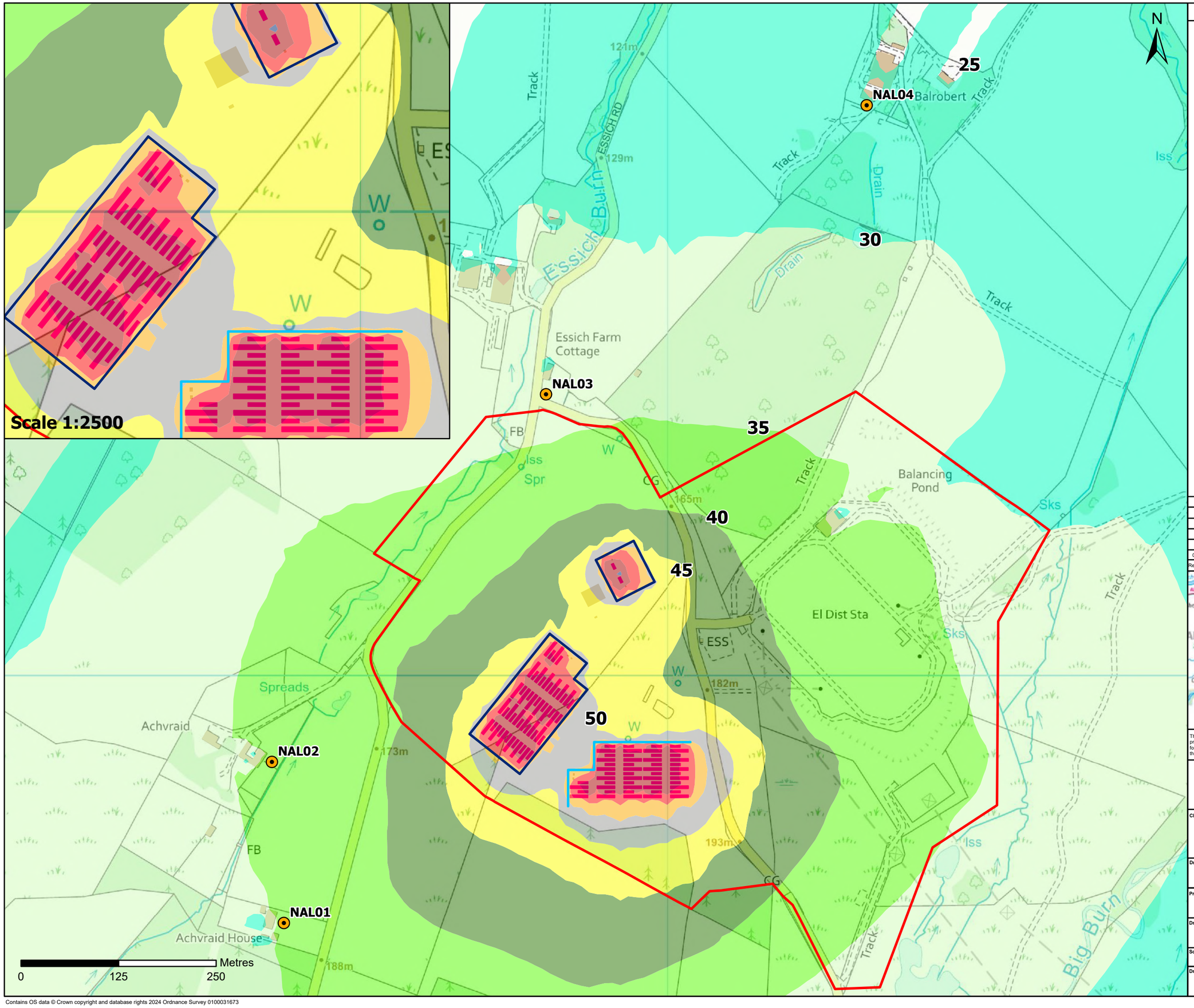
Drawing Status: FOR PLANNING

Project Title: KNOCKNAGAEL BESS

Drawing Title: FIGURE 01: STUDY AREA

Scale:	Original Size:	Spatial Reference:
1:7,500	A3	British National Grid

Drawing Number: 16292-006



LEGEND

- Red Line Boundary
- Noise Attenuating Barriers (4 m)
- Noise Attenuating Barriers (3 m)
- Noise Assessment Locations (NALs)
- Modelled Buildings
- Modelled Noise Sources

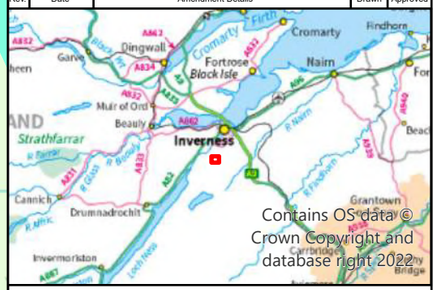
Predicted Noise Levels (dBA)

20 - 25	45 - 50
25 - 30	50 - 55
30 - 35	55 - 60
35 - 40	60 - 65
40 - 45	65 - 70

Noise contours modelled in accordance with ISO 9613 Part 2:2024 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise source assumed to be operating concurrently and continuously

All levels shown as dB LAeq(t).

Rev.	Date	Amendment Details	Drawn	Approved
0	20/06/2024	FIRST ISSUE	JCM	MC



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Client

FIELD

Drawing Status: FOR PLANNING

Project Title: KNOCKNAGAEL BESS

Drawing Title: FIGURE 02: NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:4,500	A3	British National Grid

Drawing Number: 16292-007

Appendix G – One-Third Octave Band Predicted Levels (dBZ)

Noise Assessment Location (NAL)	Predicted Noise Levels, dB(Z)																										
	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
NAL01 – Achvraid House	46	44	42	41	39	37	35	31	29	28	27	26	23	23	21	23	-	-	-	-	-	-	-	-	-	-	-
NAL02 - Achvraid	47	45	43	42	39	37	36	31	30	29	27	26	23	23	21	23	23	17	15	-	-	-	-	-	-	-	-
NAL03 – Essich Farm Cottage	45	43	41	40	37	34	35	30	31	27	26	26	22	21	20	20	19	13	-	-	-	-	-	-	-	-	-
NAL04 - Balrobert	39	37	35	34	31	29	29	24	24	21	20	19	15	15	13	14	13	7	4	-	-	-	-	-	-	-	-

Where a dash (-) is presented, predicted values were negligibly low (0 dB or below), and as such were not included within the table.