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ACOUSTIC CONSULTANTS

ENVIRONMENTAL NOISE ASSESSMENT

PROPOSED GREAT ISLAND 110kV SUBSTATION, LAND AT GREAT ISLAND TOWNLANDS, KILMOKEA, CO. WEXFORD

REPORT REFERENCE NO. J004589-7310-LK-03

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Document Control Sheet

Details of Assessment	
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Client Address:	Company Address:
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	Name	Position
Prepared By	Liam Kavaney MIOA	Consultant
Checked By	Max de Salis PhD CEng MIOA	Director Principal

This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.

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1.0 SUMMARY

PDA Ltd was commissioned by Entrust Professional Services Ltd to carry out an environmental noise assessment for the proposed 110kV Substation development at Great Island townlands, Kilmokea, Co. Wexford.

The site is made up of a single land parcel and can currently be described as rough grassland. The site of the Great Island Power Station is located directly adjacent to the west of the proposed development site. The Greenlink Interconnector converter station is located to the south of the proposed site boundary. Open farmland dominates the other surrounding areas to the north and east of the site with scattered residential dwellings to the northwest and northeast. The closest dwelling is located approximately 480m to the northwest from the nearest point on the boundary of the proposed development.

Plant noise associated with the development (i.e. HVAC units, inverters, transformers and control buildings) has been assessed in accordance with the recommendations of good practice guidance, e.g. EPA NG4, BS8233 and WHO Guidelines for community noise.

In addition to the above proposed development it is understood that there are proposals within the same site boundary for an additional Battery Energy Storage System (BESS) and 38kV Substation and therefore a cumulative impact assessment of all the proposals have been carried out.

A 3-dimensional noise model has been created using Soundplan noise modelling software, and plant noise data supplied by the client. The calculated noise levels meet the recommended limits of good practice guidance, due to the separation distance to the noise sensitive receivers.

Our assessment would suggest that the impacts at the nearest noise sensitive receiver from the proposed battery installations and substations would be low, and additional receivers that are further away would experience lesser impacts. We would also note that the calculated noise levels would be below the external noise levels for amenity spaces as recommended in BS8233, WHO Guidelines and the Wexford County Development Plan.

A construction noise assessment has been undertaken based upon typical construction activities that may take place during the project. Calculations suggest that noise levels are unlikely to exceed good practice target criteria suggested by BS5228 at the nearest receivers during construction of the proposed development due to the separation distances involved. Good practice recommendations have been outlined to further reduce any likely noise impact of the construction works.

2.0 BRIEF FOR CONSULTANCY

PDA Ltd was commissioned by Entrust Professional Services Ltd to carry out the following for the proposed 110kV Substation development Great Island townlands, Kilmokea, Co. Wexford.

Noise Impact Assessment - Desktop

We will undertake a noise modelling exercise to determine the likely contribution of the new BESS Scheme the proposed Substations. This will be based upon the noise sources associated with the BESS scheme and substation. It is anticipated that the main noise sources will consist of inverters and battery units for dc to ac conversion. Calculations will take into account for the noise propagation path from source to receiver and will include shielding and reflection effects where required. It is assumed that you can provide details of the proposed plant and locations of the nearest noise sensitive receivers.

The results of this assessment will be compared with the guidelines contained within Environmental Protection Agency NG4 and BS8233 “Sound insulation and noise reduction for buildings”, and the requirements of the Local Authority.

We will prepare a full consultant’s report detailing descriptions of the noise models, the results and any conclusions with respect to necessary noise control. This report will be in a format suitable for submission to the Local Authority.

Construction Noise Assessment - Desktop

We will calculate noise generation from the proposed development in terms of construction noise during the construction phase. This will include for construction activities such as piling, footings, excavators, trenching, laying cables etc.

The noise impact of the construction on nearby noise sensitive properties will be determined in accordance with BS 5228 “Code of practice for noise and vibration control on construction and open sites”. Where the noise impact is predicted to be high we will propose suitable remedial measures for the construction stage. We will also offer generic advice for the control of construction noise.

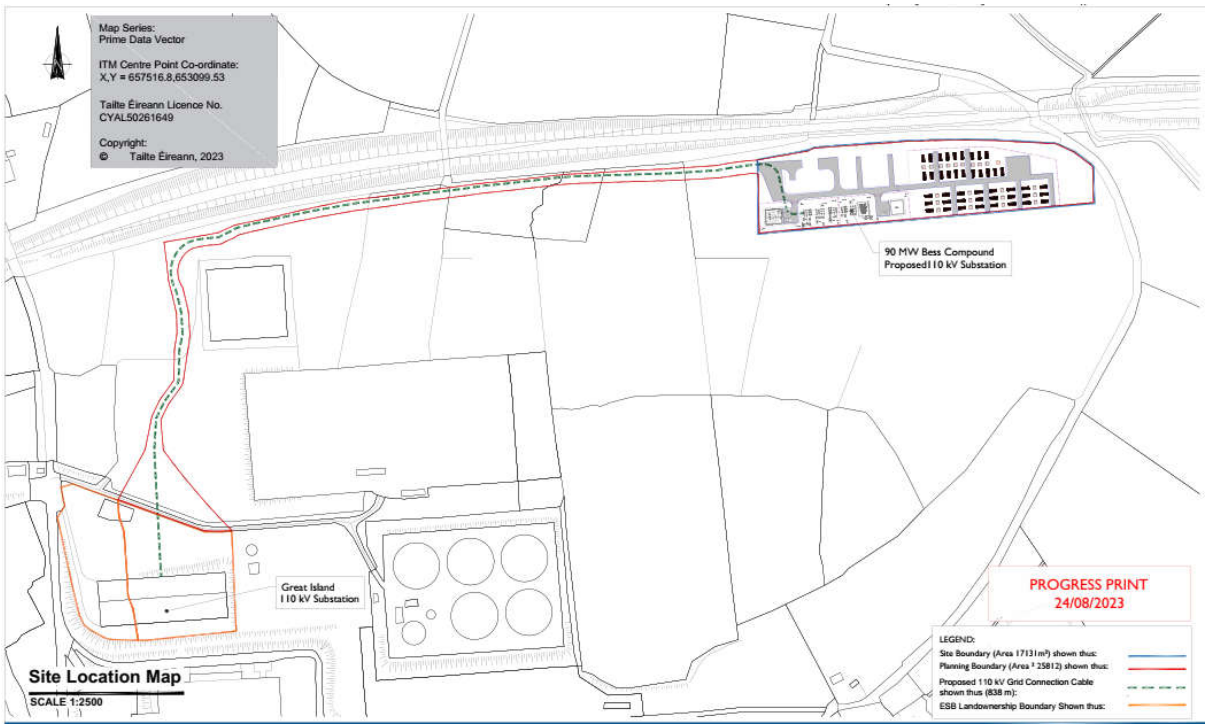
3.0 SITE DESCRIPTION

The proposed 110kV Substation development is located on land at Great Island townlands, Kilmokea, Co. Wexford.

The site is made up of a single land parcel and can currently be described as rough grassland. The site of the Great Island Power Station is located directly adjacent to the west of the proposed development site. The Greenlink Interconnector converter station is located to the south of the proposed site boundary. Open farmland dominates the other surrounding areas to the north and east of the site with scattered residential dwellings to the northwest and northeast. The closest dwelling is located approximately 480m to the northwest from the nearest point on the boundary of the proposed development.

A site plan showing the location of the site and surrounding local area is shown in Figure 1 below.

Figure 1. Site plan and Local Area



4.0 NOISE ASSESSMENT CRITERIA

4.1 National Planning Framework

The National Planning Framework (2018) for Ireland was published in December 2020, and updated in November 2021. With regard to Noise the Framework states the following;

Noise Quality

Noise is unwanted sound but is an inevitable consequence of everyday life, arising from environmental noise (created by human activity outdoors such as transport, construction and industry), with different tolerance levels varying from person to person. It becomes a problem when it occurs in the incorrect place or at the incorrect time or on a frequent or recurring basis.

As we seek to promote more compact and efficient forms of development within our settlements, it is important to more proactively manage noise. In addressing these issues the NPF will support:

- *Noise Management and Action Planning*

Measures to avoid, mitigate, and minimise or promote the pro-active management of noise, where it is likely to have significant adverse impacts on health and quality of life, through strategic noise mapping, noise action plans and suitable planning conditions.

- *Noise, Amenity and Privacy*

This includes but is not limited to, good acoustic design in new developments, in particular residential development, through a variety of measures such as setbacks and separation between noise sources and receptors, good acoustic design of buildings, building orientation, layout, building materials and noise barriers and buffer zones between various uses and thoroughfares.

- *Quiet Areas*

The further enjoyment of natural resources, such as our green spaces and sea frontage, through the preservation of low sound levels or a reduction in undesirably high sound levels, is particularly important for providing respite from high levels of urban noise. As part of noise action plans, an extra value placed on these areas, in terms of environmental quality and the consequential positive impact on quality of life and health, due to low sound levels and the absence of noise, can assist in achieving this.

To achieve the above, the National Planning Framework sets out the following within National Policy Objective 65:

- *Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans.*

Although no specific noise limits have been defined as to what constitutes a significant adverse impact, it is considered that guidance from other acoustic standards may be employed to determine suitable levels within the overall principal of the National Planning Framework.

4.2 Environmental Noise Guidance for Local Authority Planning & Enforcement Departments

The Environmental Noise Guidance for Local Authority Planning & Enforcement Departments document authored by the Association of Acoustic Consultants of Ireland (AACI), dated January 2021 sets out a review of the regulation of environmental noise issues in the Republic of Ireland. There is no sector specific guidance with regards to Battery Energy Storage Systems or substation developments, however

the Environmental Noise Guidance document does include a section on Industrial Installations which suggests:

Industrial installations regulated by the EPA are typically subject to noise limits drawn from EPA document NG4 Guidance note for noise: Licence applications, surveys and assessments in relation to scheduled activities (2016). On this basis, NG4 is also arguably the most relevant guidance document with respect to industrial facilities regulated by Local Authorities.

4.3 Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

The Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) document authored by the Environmental Protection Agency Office of Environmental Enforcement (OEE), dated January 2016 has been prepared to assist licensed sites with the assessment of their potential and actual noise impact on the local environment.

The document gives General Guidance and Limits for Licensed Sites, and states the following Typical Limit Values for Noise from Licensed Sites, depending on the time period that the noise source operates:

- Daytime (07:00 to 19:00hrs) 55dB $L_{Ar,T}$;
- Evening (19:00 to 23:00hrs) 50dB $L_{Ar,T}$;
- Night-time (23:00 to 07:00hrs) 45dB $L_{Aeq,T}$.

The document clarifies the noise limits as follows:

During daytime and evening periods rigorous efforts should be made to avoid clearly audible tones and impulsive noise at all sensitive locations. A penalty of 5dB for tonal and/or impulsive elements is to be applied to the daytime and evening measured $L_{Aeq,T}$ values to determine the appropriate rating level ($L_{Ar,T}$). In all cases, an assessment by a competent person will be required.

During the night-time period no tonal or impulsive noise from the facility should be clearly audible or measurable at any NSL.

The document goes on to suggest that: *in particularly quiet areas, such as remote or rural settings, where the background noise levels are very low, lower noise limits may be more appropriate and this may be reflected in more stringent licence limits being set.* The document recommends the following noise limit criteria depending on location.

Table 1 Recommended Noise Limit Criteria

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night-time Noise Criterion, dB $L_{Aeq,T}$ (23:00 to 07:00hrs)
Quiet Area	Noise from the licensed site to be at least 10dB below the average daytime background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10dB below the average evening background noise level measured during the baseline noise survey.	Noise from the licensed site to be at least 10dB below the average night-time background noise level measured during the baseline noise survey.
Areas of Low Background Noise	45dB	40dB	35dB
All other Areas	55dB	50dB	45dB

4.4 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Dwelling houses, flats and rooms in residential use

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 1. BS8233 recommended indoor ambient noise levels

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	–
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	–
Sleeping (daytime resting)	Bedrooms	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

It should however be stressed that the above criterion relates to steady noise, in this case from road traffic etc. excluding unusual noise events departing from the typical noise character of the area.

BS8233 would also suggest that, '*for traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments*'.

4.5 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following internal noise levels are applicable within dwellings.

Table 2. WHO Guidelines for Community Noise criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours)*
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16
Inside bedrooms	Sleep disturbance, night time	30	8
Outside Bedrooms	Sleep disturbance, window open (outdoor values)	45⁺	8
Outdoor living area	Serious annoyance, daytime and evening	55	16
Outdoor living area	Moderate annoyance, daytime and evening	50	16

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.
⁺ The WHO Guidelines assumes that for indoor sound pressure levels of 30 dB L_{Aeq}, an open window provides a reduction from outside to inside of 15 dB.

WHO guidelines state, '*To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}.*'

4.6 Wexford County Development Plan 2022-2028

Section 2.6 Amenity of the Wexford County Development Plan document suggests that all developments should be designed to protect the amenities of adjoining properties and properties in the vicinity. In relation to noise it states:

Noise

Noise emanating from any proposed development shall not cause to be measured at the facing elevation (outside) of any dwelling in the area, during the hours 0700 – 2100 a noise level of 55 dB(A) (L_{Aeq} 1 hour) and during the hours 2100 – 0700 and Sundays and Bank Holidays a noise level of 42 dB(A) (L_{Aeq} 1 hour). The noise shall not be impulsive in nature or have any tonal element which is 4 dB(A) above the adjacent frequencies.

As and when required by the Planning Authority, a survey of noise levels at monitoring stations on adjacent properties (to be agreed with the Planning Authority) shall be undertaken by an agreed professional (at the expense of the developer) and the results submitted to the Planning Authority within one month of such a request.

5.0 NOISE EGRESS CALCULATIONS

5.1 Proposed Plant – 110kV Substation (Current Application Scheme)

For this development, potential impacts have been identified as the externally mounted plant associated with the proposed Battery Energy Storage System (BESS) and 110kV Substation.

Battery Storage Units

The facility will consist of 44 no. battery units located in containers (battery storage units).

We have been informed that the predicted noise level of the equipment within the battery containers is low, and that the noise of the battery containers will be dominated by the HVAC systems located externally to the units. There are typically 4 no. HVAC units per battery container. We have been provided with a datasheet which suggests the measured noise level at 1m from the HVAC unit is 72dBA. The noise levels of the HVAC units have been converted to sound power levels for input into the noise model, which would suggest a sound power level of 80 dBA SWL per HVAC unit, or 86 dBA SWL per container. It is assumed that the units run at reduced duty during night time hours. We have been provided with a separate datasheet for a typical inverter unit which indicates a reduction of 11dB for running at 50% fan operation. This reduction has been assumed to be representative of potential night time operation.

Table 3. Proposed Battery Energy Storage System (BESS) plant

Item	Sources	Sound Pressure Level (SPL), dBA (each HVAC unit)	Sound Power Level (SWL) used in model, dBA (each container)
Battery Unit (Day)	44	72 at 1m per HVAC	86
Battery Unit (Night)	44	61 at 1m per HVAC	75

110kV Substation

For the substation part of the development, potential impacts have been identified as the externally mounted plant associated with the proposed substation installation, consisting of a 110 kV transformer, individual current and voltage transformers, a combined current/voltage transformer and substation building. We have been informed that the exact plant is yet to be selected, however the proposed transformer plant will not have a sound pressure level value greater than <65dB(A) at 10m. It is understood this value is indicative of the worst case value available. Given that the level above is the worst case (highest likely noise level), any selection of plant with a noise level less than this would lead to a lower noise level predicted at the nearby noise sensitive receivers, and therefore a lower impact upon them.

These levels have been converted to sound power levels for input into the noise model. BS5228-1 would suggest, *'for a single noise source, the dimensions of which are small in relation to 10m, generating noise at a constant level, the equivalent continuous sound pressure level at 10m distance is 28 dB(A) below the sound power level'*. This would equate to a sound power level of 93 dBA SWL for each unit (65 + 28 = 93dB(A)). From the information provided and the drawings it has been assumed that there will be 4 no. transformers with further potential noise assumed from the substation building.

Table 4. Proposed 110kV substation installation plant

Item	Sources	Sound Pressure Level (SPL), dBA (each unit)	Sound Power Level (SWL) used in model, dBA (each unit)
Transformer / Substation Room	5	65 at 10m	93

Figure 2. Proposed Battery Energy Storage Units and 110kV Substation layout

Tonality Assessment

The proposed equipment is yet to be confirmed, therefore an assessment of tonality cannot be undertaken. The noise spectra for the units used in the model has been taken from a similar proposed units from our database, which would indicate that no tonal elements are present within the noise spectrum. It should be ensured that the selected equipment does not display tonality. Where tonality is present, penalties may need to be applied and if so, it is recommended that the overall noise level above should be reduced accordingly in line with the requirements of the Environmental Protection Agency NG4 guidance document.

5.2 Proposed Plant – BESS & 38kV Substation (Adjacent Application Schemes)

In addition to the above proposed development it is understood that there are proposals within the same site boundary for an additional Battery Energy Storage System (BESS) and 110kV Substation and therefore cumulative impact assessment of the two proposals have been carried out.

Battery Storage Units

The facility will consist of 44 no. battery units located in containers (battery storage units).

Table 5. Proposed Battery Energy Storage System (BESS) plant

Item	Sources	Sound Pressure Level (SPL), dBA (each HVAC unit)	Sound Power Level (SWL) used in model, dBA (each container)
Battery Unit (Day)	16	72 at 1m per HVAC	86
Battery Unit (Night)	16	61 at 1m per HVAC	75

38kV Substation

For the substation part of the development, potential impacts have again been identified as the externally mounted plant associated with the proposed substation installation, consisting of a 110kV transformer, individual current and voltage transformers, a combined current/voltage transformer and substation building. From the information provided and the drawings it has been assumed that there will be 4 no. transformers with further potential noise assumed from the substation building.

Table 6. Proposed 38kV substation installation plant

Item	Sources	Sound Pressure Level (SPL), dBA (each unit)	Sound Power Level (SWL) used in model, dBA (each unit)
Transformer / Substation Room	5	65 at 10m	93

Figure 3. Proposed Battery Energy Storage Units and 38kV Substation layout

5.3 Proposed Noise Criteria

From the guidance given in Section 4, it is recommended that noise levels do not exceed 40 dBA during the daytime/evening, and 35 dBA during the night time, at the façade of the nearest receivers. If higher levels are desired, it may be necessary to undertake a background noise survey and assessment according to EPA NG4 guidance. The noise limits above would also meet the requirements of the Wexford County Development Plan detailed in Section 4.6.

It is considered that achieving the above noise levels or lower at the façade of the closest noise sensitive receivers would result in the proposed development having a low impact upon existing receivers.

5.4 Calculated Plant Noise Levels – Residential Receivers

A 3-dimensional noise model has been created using Soundplan noise modelling software. The software uses the method of ISO 9613 '*Acoustics – attenuation of sound during propagation outdoors – general method of calculation'* and takes into account geometric spreading, ground effects, air attenuation, barrier attenuation and reflections.

The model is based upon the proposed Site Layout Map drawings 05951-DR-001, dated August 2023 & 05-951-DR-201, dated August 2023 provided by Entrust. A ground absorption coefficient of 0.9 has been used representative of the predominantly soft surfaces (fields, grassland, etc.). No barriers/fences or other landforms have been taken into account in the model, except for existing buildings. The impact and contributions of all such plant and equipment for both the 110kV and 38kV proposals have been incorporated into the overall noise impact assessment model. The transformers and BESS units are modelled at a height of 2.4m above ground based upon information supplied by the Client. The Combined Inverter & Transformer and BESS units are modelled as point sources with the sound power level for each unit as per that detailed in Tables 3, 4, 5 and 6.

To provide a noise spectrum for the assessment, we have used the spectrum from similar transformer and BESS units taken from the PDA Ltd database, considered representative of those on-site. The relative spectra have been corrected to the overall quoted dBA values.

We have scrutinised available third-octave and octave noise spectrum for the units used in the model (taken from a similar proposed unit from our database data) which would suggest that there are no tones according to the objective method for assessing the audibility of tones in sound, one-third octave method in Annex C of BS4142:2014 as per ISO 1996-2:2007. We would note that it is not possible to assess the audibility of tones at the receiver directly from measurements undertaken at source, as the audibility is dependent on the background masking noise apparent at the receiver. In addition, where plant noise emission is made up of contributions from a number of different sources as is the case here, items with individual tonality or other characteristics even if they do exist will be masked by the other contributions.

The locations of the closest noise sensitive dwellings to the development have been identified and are shown in Figure 4. The Soundplan model would suggest the following noise levels calculated at the closest noise sensitive receivers. For other receivers further away a lower noise level would be experienced due to greater distance attenuation provided. Floor levels are calculated at 1.5m for the ground floor and an additional 3m for each additional storey where required. It is noted that the receivers are a mix of single and two-storey dwellings, as identified using Google Earth software. It is understood that on the southern boundary of the site is an existing derelict farmhouse, and this location has not been assessed.

Table 7. Calculated noise levels at the closest receivers

Location	Calculated external noise level, dB L_{Aeq}	
	Daytime	Night Time
Receiver 1	34	31
Receiver 3	31	28
Receiver 2	30	28
Receiver 4	25	21

Figure 4. Noise level breakout from proposed BESS plants and 38kV & 110kV substations

NB. Noise Levels for each position are given as [Floor][Noise Level dBA L_{eq}]

5.5 Discussion

The calculated noise levels meet the proposed outdoor noise limits detailed in Section 5.2, mainly due to the separation distance to the noise sensitive receivers.

In addition, taking into account the sound insulation of 15dB for dwelling façades with partially open windows for background ventilation, internal noise levels within the nearest dwellings would be no more than 19dBA, which is likely to be masked by contributions from other sources within the dwellings, e.g. heating, fridges, occupants breathing, etc. In addition, the calculated noise levels meet the EPA NG4 limits, for 'areas of low background noise' for daytime and evening, and night time use.

We would suggest that the proposed BESS installations and substations will have a low impact upon the nearby noise sensitive receivers, and additional receivers that are further away would experience lesser impacts.

6.0 CONSTRUCTION NOISE ASSESSMENT

6.1 BS 5228:2009(+A1:2014) Code of Practice for noise and vibration control on construction and open sites

BS5228 gives guidance on noise control for sites where noisy work is performed outdoors such as during construction projects. The guidance recommends that the developer submits a construction noise management plan which shows predicted noise levels, impacts and impact durations on noise sensitive properties for each construction stage and determines remedial measures or limits on operations where appropriate. Following agreement of the construction plan with the Local Planning Authority and a programme of information and consultation with the affected property owners the construction work is performed in accordance with the agreed plan.

With regard to the impact of construction noise on a noise sensitive residence the standard gives two example methods of how the impact should be calculated in Appendix E. These two methods are detailed below:

E.3.2 Example method 1 – The ABC method

A1 Table E.1 shows an example of the threshold of potential significant effect at dwellings when the site noise level, rounded to the nearest decibel, exceeds the listed value. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the site noise level. If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect. A1

Table E.1 Example threshold of A1 potential significant A1 effect at dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) A1 ($L_{Aeq,T}$) A1		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23.00–07.00)	45	50	55
Evenings and weekends [D]	55	60	65
Daytime (07.00–19.00) and Saturdays (07.00–13.00)	65	70	75

A1 *NOTE 1 A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.*

NOTE 2 If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. A1

NOTE 3 Applied to residential receptors only.

[A] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

[B] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

[C] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

[D] 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

E.3.3 Example method 2 – 5 dB(A) change

Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$, from site noise alone, for the daytime, evening and night-time periods respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect.

These evaluative criteria are generally applicable to the following resources:

- *residential buildings;*
- *hotels and hostels;*
- *buildings in religious use;*
- *buildings in educational use;*
- *buildings in health and/or community use.*

Based on the methods presented above, BS5228 would suggest noise level limits for the construction works of 65 dBA would be suitable during daytime hours (07:00 – 19:00 hours weekday, 07:00 – 13:00 hours Saturday) when considered at the nearby noise sensitive receivers. The Local Authority should be consulted as to their permitted operational hours for construction works which may differ from the above, however it is assumed that no construction works would take place during the evening or night time.

6.2 Identification of Noise Sensitive Receivers

As noted in the previous section, the nearest noise sensitive receivers to the proposed development site is considered to be the dwelling located to the northwest of the proposed site, which is approximately 480m from the closest point that the BESS and substation construction works may take place (Receiver no. 1 in Figure 4).

It is noted that for the installation of the underground cable connections to the existing Camplile and Great Island substations each located approximately 370m and 530m away to the southwest, installation will be undertaken within the access road to the east of the site, and therefore the closest noise sensitive receiver (Receiver no. 2 in Figure 4) to the nearest point of this installation is approximately 150m to the northwest from the construction works.

6.3 Construction Noise

The activities as detailed in Table 8 may be expected to take place on-site and generate noise at the boundary of the proposed site. The construction details are taken from a similar previous schemes outline construction methodology. Predicted noise levels are based on noise source data as detailed within Annex C and D of BS5228-1, with distance to receivers and screening as appropriate.

All calculations have been undertaken in accordance with the methodology contained within BS5228-1 section F.2.3. This is detailed as follows:

Distance Attenuation – This is based upon the equation $K_s' = (25 \log_{10} R) + 1$, where K_s is the distance adjustment in dB, and R is the separation distance between source and receiver in meters. The ground at the site is assumed to be soft.

On Time Correction – This is the period of time the plant is likely to work during the period of interest, which is generally the 10 hour daytime period.

Mobile Plant in defined area – The prediction based upon the terms described above will predict noise from a source in a defined area. However mobile plant will operate over the entire site. The noise level will be significantly reduced when the item of plant is furthest from the receiver. We have therefore undertaken a correction to the noise source based upon distance ratio (traverse length/minimum distance to receiving position). Based upon the site layout the minimum separation distance is 480m to Receiver 1 for the BESS and substation and 150m to Receiver 2 for the cable installation.

We would note that we have assumed that static plant (compressors, generators, etc.) is located at least 480m from the closest point on the substation site to the receiver. It should be ensured that static plant is located at the furthest possible distance on the site from the receivers, or locally screened with barriers.

The activities are generic examples for typical construction projects and all activities may not be applicable to this build:

Table 8. Calculated construction noise levels at the closest Receiver 1

Phase / Activity	Site Operation	Sound Power (dBA)	% Usage	Shortest separating distance (m)	Distance Ratio	L_{Aeq} (dB) Dwellings
Noise limit from BS5228		-	-	-	-	**65**
Substation Build	Tracked Excavator	107	75	480	0.1	38
	360 Excavator (Breaker)	114	75	480	0.1	45
	Tracked Dumper	108	75	480	0.1	39
	Tractor and trailer	107	75	480	0.1	38
	Crane	106	75	480	0.1	37
	Hoist	104	75	480	0.1	35
	Pneumatic Circular Saw	112	50	480	0.1	41
	Metal frame work	101	50	480	0.1	30
	Scaffolding	100	50	480	0.1	29
	Site Deliveries	108	3/day	410	-	45
	Diesel Generator	102	100	480	-	34
	Angle Grinder	108	25	480	0.1	34
	Impact wrench	110	25	480	0.1	36
	Vibratory Roller	108	50	480	0.1	37
	Compressor	103	100	480	-	35
	Total combined level					**51**
	Assessment			No Mitigation required		
Trenching/ Cable Installation	Tracked Excavator	107	66	410	0.2	39
	Tractor and trailer	107	66	410	0.2	39
	Total combined level					**42**
	Assessment			No Mitigation required		

Table 9. Calculated construction noise levels at the closest Receiver 2

Phase / Activity	Site Operation	Sound Power (dBA)	% Usage	Shortest separating distance (m)	Distance Ratio	L_{Aeq} (dB) Dwellings
Noise limit from BS5228		-	-	-	-	**65**
Substation Build	Tracked Excavator	107	75	570	0.1	38
	360 Excavator (Breaker)	114	75	570	0.1	45
	Tracked Dumper	108	75	570	0.1	39
	Tractor and trailer	107	75	570	0.1	38
	Crane	106	75	570	0.1	37
	Hoist	104	75	570	0.1	35
	Pneumatic Circular Saw	112	50	570	0.1	41
	Metal frame work	101	50	570	0.1	30
	Scaffolding	100	50	570	0.1	29
	Site Deliveries	108	3/day	20	-	58
	Diesel Generator	102	100	570	-	34
	Angle Grinder	108	25	570	0.1	34
	Impact wrench	110	25	570	0.1	36
	Vibratory Roller	108	50	570	0.1	37
	Compressor	103	100	570	-	35
	Total combined level					**58**
	Assessment			No Mitigation required		
Trenching/ Cable Installation	Tracked Excavator	107	66	150	0.7	49
	Tractor and trailer	107	66	150	0.7	49
	Total combined level					**52**
	Assessment			No Mitigation required		

It should be borne in mind that the above calculations have been undertaken when construction activities are located nearest to the noise sensitive receivers and consequently these results may be considered worst case. For the majority of the time, it is expected works will take place further into the site, where noise levels will be lower due to increased distance attenuation.

Additional good practice measures are noted below to further reduce the likely impact of the construction works. These include:

- Informing residents of timing and duration of piling, construction works and groundwork operations;
- Ensure use of practical noise measures on site. Management on site to reduce coincidence of noisy activities, or reduce number of noisy vehicles used simultaneously;
- Enclose, partially enclose or screen stationary plant, e.g. generators and compressors, wherever possible. Locate plant as far from the noise sensitive receivers as is practically possible;
- Route access paths to maintain maximum distance to noise sensitive receivers.
- Aim to reduce all plant sound power levels (SWL) to 110dBA and below where possible using silencing;
- Compliance checks at regular intervals to ensure that noise levels plant and trucks accessing the site are not excessively high;
- Only undertake work during construction hours within the daytime as set out by the Local Authority or BS5228 guidance above;
- Eliminate queuing at the site entrance outside construction hours;
- Inform of progress and alleviate concerns by developing a good relationship with local residents and building owners thereby minimising complaints. Liaison with surrounding sensitive occupiers

/ residents, e.g. leafleting or personal calls, to forewarn of periods of unusually high noise. Implement complaints procedures and actions where necessary;
- Staging of operations to ensure minimum exposure to high noise levels;
- Determine activities causing excessive noise emission levels through manned measurement of noise levels if necessary;
- Set-up meetings between complainants and other stakeholders to discuss impacts during the project if necessary.

7.0 CONCLUSIONS

PDA Ltd was commissioned by Entrust Professional Services Ltd to carry out an environmental noise assessment for the proposed 110kV Substation development at Great Island townlands, Kilmokea, Co. Wexford.

The site is made up of a single land parcel and can currently be described as rough grassland. The site of the Great Island Power Station is located directly adjacent to the west of the proposed development site. The Greenlink Interconnector converter station is located to the south of the proposed site boundary. Open farmland dominates the other surrounding areas to the north and east of the site with scattered residential dwellings to the northwest and northeast. The closest dwelling is located approximately 480m to the northwest from the nearest point on the boundary of the proposed development.

Plant noise associated with the development (i.e. HVAC units, inverters, transformers and control buildings) has been assessed in accordance with the recommendations of good practice guidance, e.g. EPA NG4, BS8233 and WHO Guidelines for community noise.

In addition to the above proposed development it is understood that there are proposals within the same site boundary for an additional Battery Energy Storage System (BESS) and 38kV Substation and therefore a cumulative impact assessment of all the proposals have been carried out.

A 3-dimensional noise model has been created using Soundplan noise modelling software, and plant noise data supplied by the client. The calculated noise levels meet the recommended limits of good practice guidance, due to the separation distance to the noise sensitive receivers.

Our assessment would suggest that the impacts at the nearest noise sensitive receiver from the proposed battery installations and substations would be low, and additional receivers that are further away would experience lesser impacts. We would also note that the calculated noise levels would be below the external noise levels for amenity spaces as recommended in BS8233, WHO Guidelines and the Wexford County Development Plan.

A construction noise assessment has been undertaken based upon typical construction activities that may take place during the project. Calculations suggest that noise levels are unlikely to exceed good practice target criteria suggested by BS5228 at the nearest receivers during construction of the proposed development due to the separation distances involved. Good practice recommendations have been outlined to further reduce any likely noise impact of the construction works.

APPENDIX A – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq}. Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB L_{An}. It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max}, dB L_{Amax}, etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.