MONA OFFSHORE WIND PROJECT

Environmental Statement

Volume 7, Annex 9.3: Operation Noise Assessment

Reference Number: MOCNS-J3303-RPS-10138

Document Reference: F7.9.3

APFP Regulations: 5(2)(a)

February 2024

F01

Image of an offshore wind farm

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Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
F01	Application	RPS	Mona Offshore Wind Ltd.	Mona Offshore Wind Ltd.	February 2024

Prepared by:

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Prepared for:

Mona Offshore Wind Ltd.

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Glossary

Term	Meaning
A-weighting	A frequency weighting devised to attempt to account for the fact that human response to sound is not equally sensitive to all frequencies. It consists of an electronic filter in a sound level meter which attempts to build this variability into the indicative sound level reading so that it will correlate, approximately, with the human response.
Ambient sound level, $L_{Aeq,T}$	The steady sound level which, over a period of time T, contains the same amount of A-weighted sound energy as the time varying sound over the same period. Also known as the equivalent continuous sound pressure level.
Attenuation	The reduction in magnitude of sound energy.
Background sound level, $L_{A90,T}$	The 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 fast time-weighting, F, and quoted to the nearest whole number of decibels.
Broadband	A sound with energy distributed across a wide range of frequencies. Used to describe a single-figure sound level.
Decibel (dB)	The ratio between two physical quantities, typically expressed as a logarithmic power ratio.
Dimensionless	A pure number having no units attached and having a numerical value that is independent of whatever system of units may be used to derive it.
Directivity	A measure of the change in sound level with the direction of a source.
Fundamental frequency	The lowest frequency of a periodic waveform.
Ground factor, G	A dimensionless parameter which allows for the consideration of the acoustic properties of the ground surface between a sound source and the receptor.
Harmonics	A wave whose frequency is an integer (whole number) multiple of the fundamental frequency of the same reference wave
Hemispherical radiation	The emission of sound throughout a hemisphere in the presence of a single reflective surface (e.g. the ground). Corresponds to a radiation loss of 8dB.
Impulsivity	A method for describing how sudden or sharp a sound of short duration is. Examples of impulsive sounds include bangs or gun shots.
Intermittency	A measure of the 'on/off' nature of a sound source which may result in higher perceptibility at a receptor.
Noise	An unwanted or unexpected sound.
Porosity	A The ratio of space or holes and the total volume of a material. A means of defining the ability of a material to allow sound to transmit through it.
Propagation	The transmission of acoustic energy through a medium via a sound wave.
Rating Level, $L_{Ar,T}$	The specific sound level plus any adjustment for the characteristic features of the sound.
Residual sound level L_r=$L_{Aeq,T}$	The ambient sound level at a receptor in the absence of influence from the sound source under assessment.
Sound	Fluctuations of pressure within a medium (gas, solid or fluid) within the audible range of loudness and frequencies which excite the sensation of hearing.
Specific sound level, L_s	Specific Sound Level, $L_{Ar,Tr}$. The equivalent continuous A-weighted sound pressure level produced by the specific noise source at the assessment location over a given reference time internal, T_r.

Term	Meaning
Spectrum	The presentation of sound in terms of the amount of energy at different frequencies.
Tonality	A method to account for the dominance of a single frequency in a sound's spectrum which may be more perceptible at a receptor.
Wavelength	The distance between successive peaks of a wave.

Acronyms

Acronym	Description
BS	British Standard
DCO	Development Consent Order
ISO	International Organisation for Standardisation
MDS	Maximum Design Scenario
OS	Ordnance Survey

Units

Unit	Description
dB	Decibel
km	Kilometres
kV	Kilovolt
m	Metres

1 OPERATION NOISE ASSESSMENT

1.1 Introduction

1.1.1.1 This operation noise assessment provides the assessment criteria and methodology and assumptions adopted for the 3D acoustic modelling, and the subsequent results. The report informs the assessment of noise and vibration impacts in Volume 3, Chapter 9: Noise and vibration of the Environmental Statement.

1.1.1.2 The purpose of the operational noise technical report is to identify and assess the noise impacts on nearby noise sensitive receptors within the noise and vibration study area due to the operation of the Onshore Substation for the Mona Offshore Wind Project.

Study area

1.1.1.3 The Mona Offshore Wind Project noise and vibration study area focuses on receptors (landward of Mean High Water Springs) where potential impacts are most likely to occur on receptors sensitive to noise and vibration.

1.1.1.4 The Onshore Substation is the only operational noise source onshore which may impact the amenity of nearby receptors.

1.1.1.5 The noise and vibration study area relevant to this technical report is defined as:

- The area of land to be temporarily or permanently occupied during the operations and maintenance of the Mona Offshore Wind project (hereafter referred to as the Mona Onshore Substation)
- Noise sensitive receptors located within 1 km of the Onshore Substation.

1.1.1.6 The above descriptors are those set out in the Mona Offshore Wind Farm Environmental Impact Assessment Scoping Report (Mona Offshore Wind Ltd, 2022) and are presented graphically in Figure 1.1 below. The number of receptors and their location in relation to the noise and vibration study area are identified in Volume 7, Annex 9.2: Construction noise and vibration technical report of the Environmental Statement.

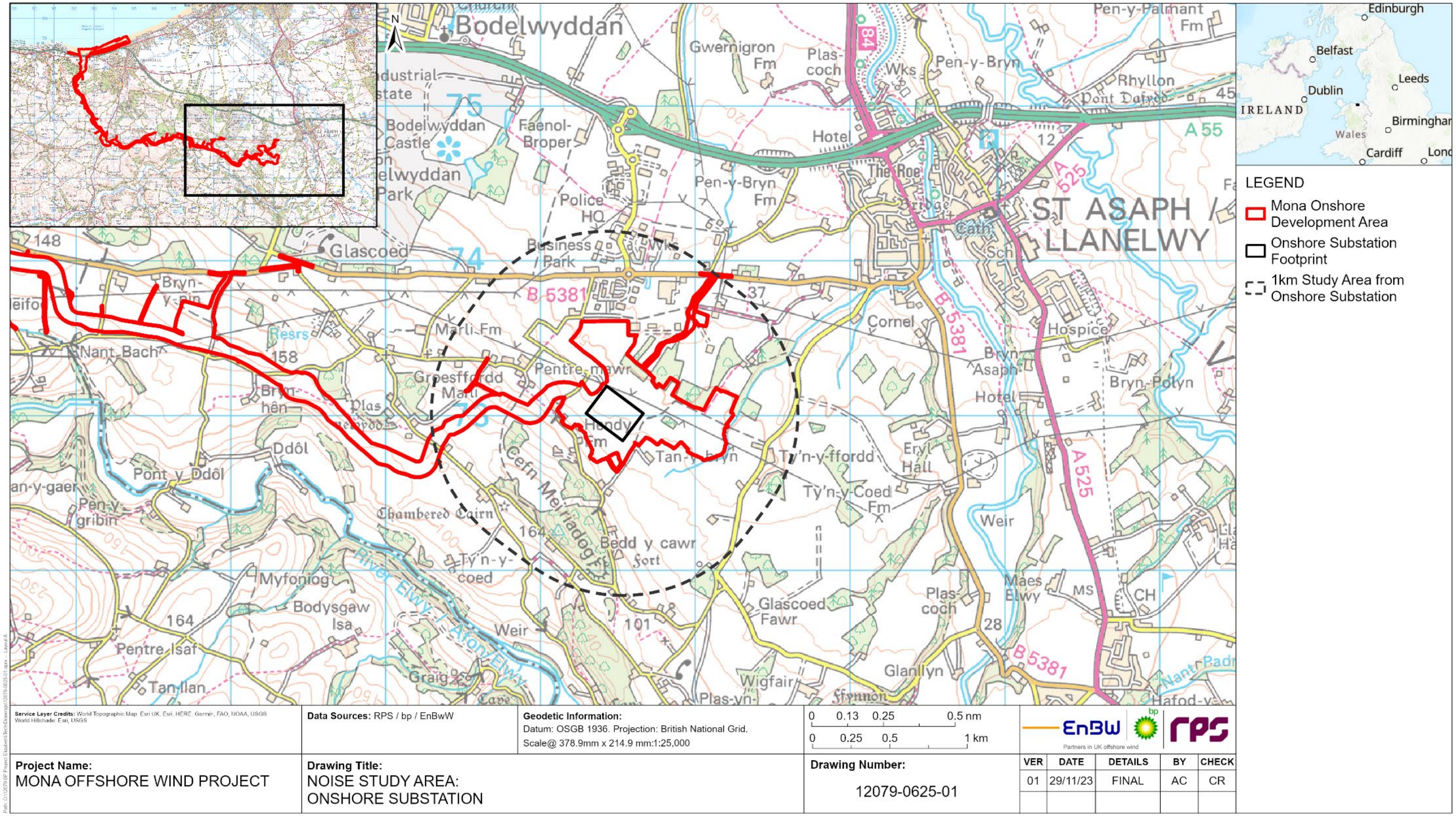


Figure 1.1: Noise study area.

1.2 Methodology

1.2.1 Acoustic modelling methodology

1.2.1.1 A 3D acoustic model has been constructed using the SoundPLAN v8.2 software package. This software implements the outdoor sound propagation method detailed within International Organisation for Standardisation (ISO) 9613-2:1996: 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'. Sound levels have been predicted under light down-wind conditions based on hemispherical radiation with corrections added for atmospheric absorption, ground effects, screening, and source directivity, where each is appropriate. This standard is widely accepted as the industry-standard model.

1.2.1.2 The maximum design scenario (MDS) is outlined in Table 9.21 Volume 3, Chapter 9: Noise and Vibration of the Environmental Statement. The list of proposed plant items and maximum quantities is provided in Table 1.1 below. The MDS is represented by all plant operating continuously at maximum operational duty 24/7. The location of each plant item has been obtained from preliminary layout drawings for the Onshore Substation.

1.2.1.3 The input parameters relevant to the Mona Offshore Wind include the following.

Local topographical features

1.2.1.4 Variable local topography can affect the 'line of sight' of a receptor to the source and result in greater or fewer obstacles between the source of noise and the receptor such as ground cover, hills, and buildings**.**

1.2.1.5 The receptors and other buildings which may provide screening effects have been obtained by importing Ordnance Survey (OS) Mastermap Topography Layer for the Onshore Substation.

1.2.1.6 A digital ground model has been calculated using detailed OS Terrain 5 data for Onshore Substation area. The proposed topography for the Onshore Substation platform, including the indicative false cutting to the west of the Onshore Substation platform have also been included in the digital ground model to account for the future ground conditions.

Ground effects

1.2.1.7 Sound propagating outdoors comprises direct waves travelling straight from source to receiver and reflected waves which interact with the ground. Harder surfaces reflect more sound thereby resulting in enhanced noise levels at the receptor. Softer surfaces (such as grass, trees, or vegetation) have a higher porosity and thus can absorb reflected waves resulting in lower noise levels at the receptor.

1.2.1.8 The acoustic properties of the ground are accounted for using the ground factor G which is a dimensionless parameter between 0 and 1. ISO 9613-2:1996 specified a ground factor of 0 for hard surfaces and 1 for porous surfaces.

1.2.1.9 The area surrounding the Onshore Substation options is predominantly grassland and woodland and thus has been assigned a ground factor of $G = 0.5$.

1.2.1.10 The Onshore Substation platform area is assumed to comprise hard ground with a ground factor of $G = 0.3$.

Plant strategy and layout

1.2.1.11 The primary model input is the source noise levels of the proposed plant strategy and the operating conditions for the Onshore Substation.

1.2.1.12 The Maximum Design Scenario (MDS) is represented by a 220 kV Gas Insulated Switchgear Substation. The proposed plant strategy is outlined in section Table 1.1 along with the typical noise levels. Frequency spectra have been applied to the levels below which have been obtained from operational noise assessments for similar schemes (Hornsea Project Three Offshore Wind Farm, East Anglia TWO Offshore Windfarm, Sheringham Shoal and Dudgeon Extension Offshore Wind Farm). The full spectra are presented in Appendix A.

1.2.1.13 The heights of each plant item have been obtained from a 3D drawing of the proposed Onshore Substation layout, as shown in Figure 1.2 and Figure 1.3 below.

Figure 1.2: Proposed 2D layout of the Onshore Substation

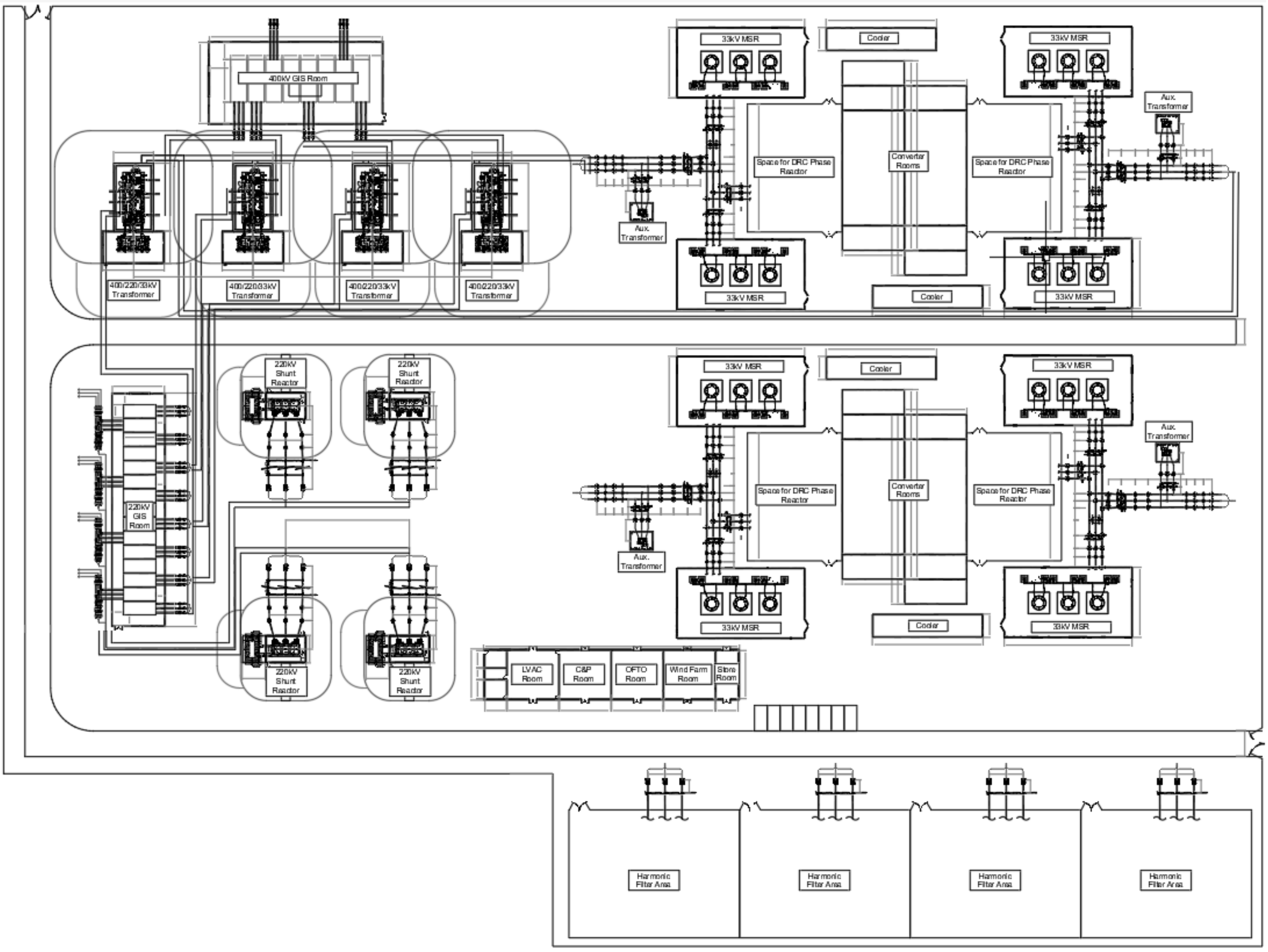
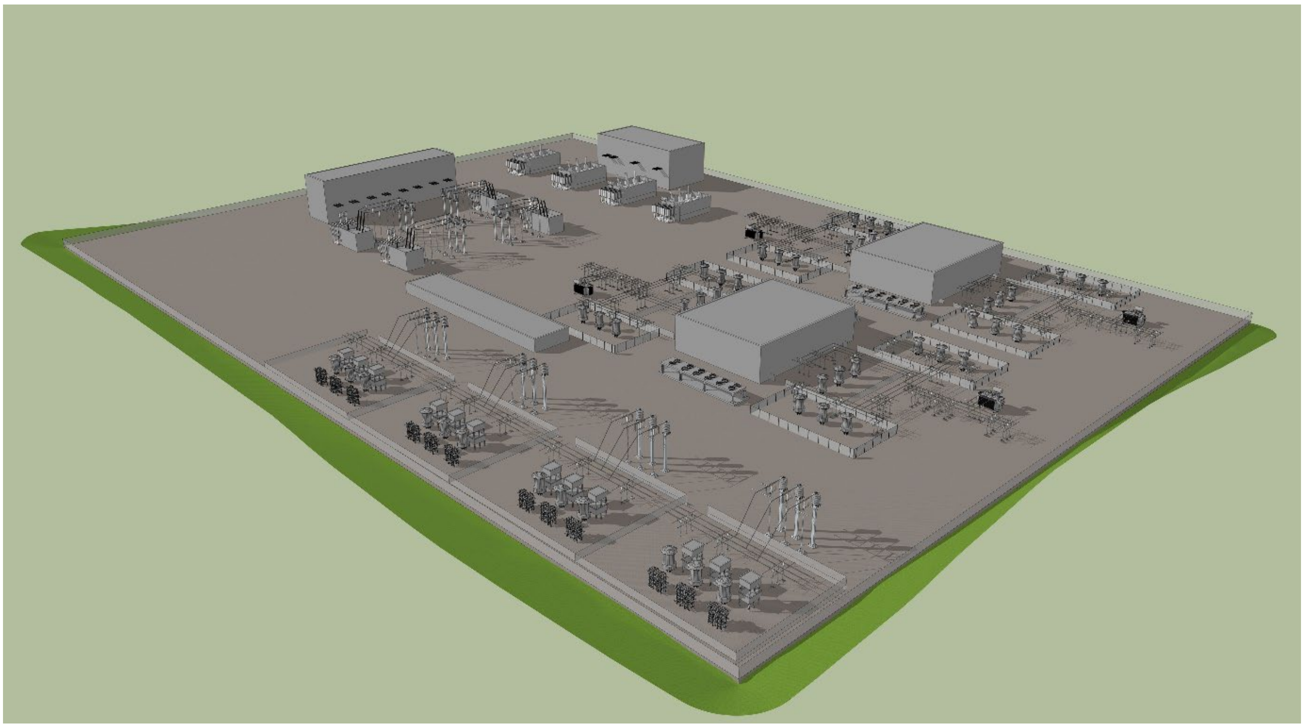


Figure 1.3: 3D model of the Onshore Substation



1.2.1.14 The proposed plant has been modelled in two ways:

- Industrial buildings: The industrial building feature in SoundPLAN allows for any larger plant items to be modelled as boxes with all outside surfaces radiating with an assigned sound power level. The sound power level per façade has been calculated by distributing the total sound power level over each individual face of the plant item based upon the area
- Point sources: Smaller plant items have been modelled as point sources which radiate in such a way that the sound attenuates proportionally with the square of the inverse of the distance from the source.

Table 1.1 Proposed plant strategy for the Onshore Substation.

Plant item	Quantity	Modelled Height (m)	A-Weighted Sound Power Level, L_W dB(A)	Modelled Source Type
400/220/33 kV Super Grid Transformer (SGT)	4	8	90	Industrial Building
Forced Cooling System (SGT Radiator)	4	5	81	Industrial Building
220 kV Shunt Reactor	4	7	90	Industrial Building
Forced Cooling System (Shunt Reactor Radiator)	4	5	81	Industrial Building
Dynamic Reactive Power Compensator Phase Reactors	12	5	85	Point Source
Dynamic Reactive Power Compensator (DRC)Coolers	4	3	85	Industrial Building
2x 33 kV Mechanically Switched Reactors	24	5	85	Point Source
220 kV Filter	4	10	82[i]	Point Source
33/0.4 kV Auxiliary Transformer	4	2	80	Industrial Building
DRC Heating, Ventilation and Air Conditioning Units	2	3	80[ii]	Point Source
Control Building Heating, Ventilation and Air Conditioning Units	5	2	80[iii]	Point Source

1.2.1.15 Additional notes on the assumptions adopted for the Onshore Substation plant noise emission levels are as follows:

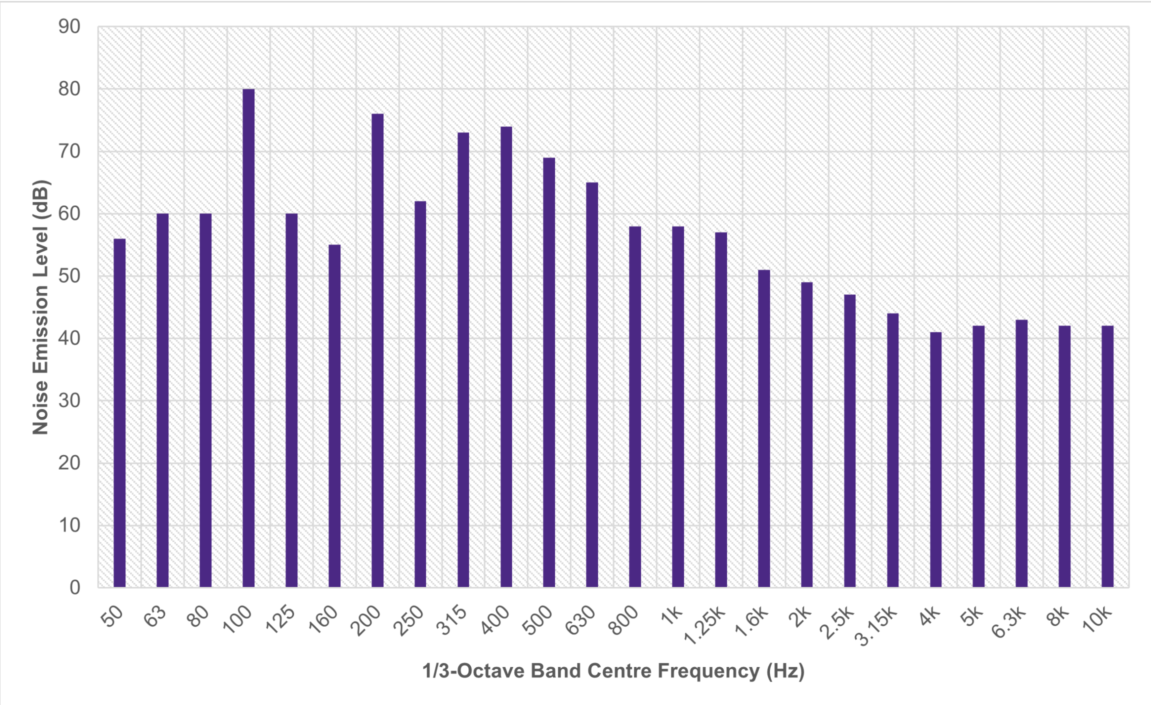
i. There are four spaces shown on the Onshore Substation layout for harmonic filters. Each of these spaces is shown to contain 3 220 kV filter phases each comprising 2 capacitor banks per phase. The upper range sound power level provided for the 220 kV filters is L_W 85 dB(A). It has been assumed that this is the sound power level per phase and thus each capacitor bank has a sound power level of L_W 82 dB(A).

ii. The DRC Heating, Ventilation and Air Conditioning units are not specifically shown on any of the drawings for the Onshore Substation. As such, they are assumed to be located within an area adjacent to the converter rooms with one on each of the sides facing northeast and southwest.

iii. The Control Building Heating, Ventilation and Air Conditioning Units are also not shown on any of the proposed layout drawings. As such, it has been assumed that these units will be situated in an area externally along the southwest façade of the control room.

1.2.1.16 The frequency content of similar plant which have been applied to the broadband sound power levels in Table 1.1 highlight that the Super Grid Transformers and Shunt Reactors typically contain tonal components to their noise emission spectra at low frequency which could potentially cause disturbance to nearby receptors. The fundamental frequency where the tonal components are generally present is the 100 Hz 1/3-octave frequency band, as shown in Figure 1.4 below which shows the shape of a typical transformer spectrum (Gange, 2011). Subsequent harmonics to the fundamental frequency can be seen at higher frequencies. However, low frequency sound energy travels further due to the long wavelengths associated with the 100 Hz frequency band in comparison to the air through which the energy is transferred. As such, it is the low frequency sound rather than the higher frequency harmonics which requires most consideration.

Figure 1.4: Typical high voltage transformer noise emission spectrum.



1.2.1.17 As such, where these plant items are most influential to the overall receptor noise level, a correction of +2 dB, +4 dB, or +6 dB has been applied corresponding to 'just perceptible', 'clearly perceptible', and 'highly perceptible', respectively, in terms of BS 4142:2014+A1:2019.

1.2.1.18 In addition to the above tonality corrections, a correction of +3 dB correction has been applied at nearby receptors to account for the fact that the acoustic character of the Onshore Substation is not in keeping with the existing acoustic environment. This represents the MDS.

1.2.1.19 Mitigation measures will be adopted as part of the design process to aid in the reduction of noise from the Onshore Substation plant at nearby receptors.

1.2.1.20 The plant layout will be designed to reduce noise impacts as much as is reasonably practicable and additional mitigation measures such as acoustic enclosures, attenuators, and acoustic barriers may be implemented as part of the Mona Offshore

Wind Project. The exact measures will be determined as the design progresses; and consideration has been given to the limiting plant noise emission levels and the type of mitigation measures which may allow for these levels to be achieved.

1.2.1.21 Acoustic enclosures are available which attenuate sound at 100 Hz by around 20 dB (National Grid, 2021). An enclosure which can achieve this amount of low frequency attenuation will reduce noise levels at higher frequencies by a greater amount. However, an overall noise reduction of 20 dB has been applied as a conservative assumption in the absence of a full enclosure specification.

1.2.1.22 Other mitigation options are available for the remaining plant items including, but not limited to:

- The selection of quieter plant
- Acoustic enclosures
- Acoustic barriers
- Silencers for fans.

1.2.1.23 The losses for each measure and where they have been applied are presented in Table 1.2 below.

Table 1.2: Indicative noise mitigation measures.

Plant item	Acoustic Mitigation Measure	Insertion Loss (dB)
400/220/33 kV Super Grid Transformer (SGT)	Enclosure	20
Forced Cooling System (SGT Radiator)	Quieter Plant/Barrier/Enclosure	15
220 kV Shunt Reactor	Enclosure	20
Forced Cooling System (Shunt Reactor Radiator)	Quieter Plant/Barrier/Enclosure	15
Dynamic Reactive Power Compensator (DRC) Coolers	Quieter Plant/Louvred Enclosure/Barrier	15
2x 33 kV Mechanically Switched Reactors	Quieter Plant/Barrier/Enclosure	10
220 kV Filter	Quieter Plant/Tall Barrier	17
33/0.4 kV Auxiliary Transformer	Quieter Plant/Barrier/Enclosure	10
DRC Heating, Ventilation and Air Conditioning Units	Quieter Plant/Barrier/Enclosure	10
Control Building Heating, Ventilation and Air Conditioning Units	Quieter Plant/Barrier/Enclosure/Silencers	10

1.2.2 Noise sensitive receptors

1.2.2.1 The nearest noise sensitive receptors to the Onshore Substation are presented graphically in Figure 1.5. The relative distance of each receptor to the substation boundary is presented in Table 1.3 below. These distances have been calculated using geographical information software and correspond to the distance of the OS AddressBase data point to the Onshore Substation platform boundary.

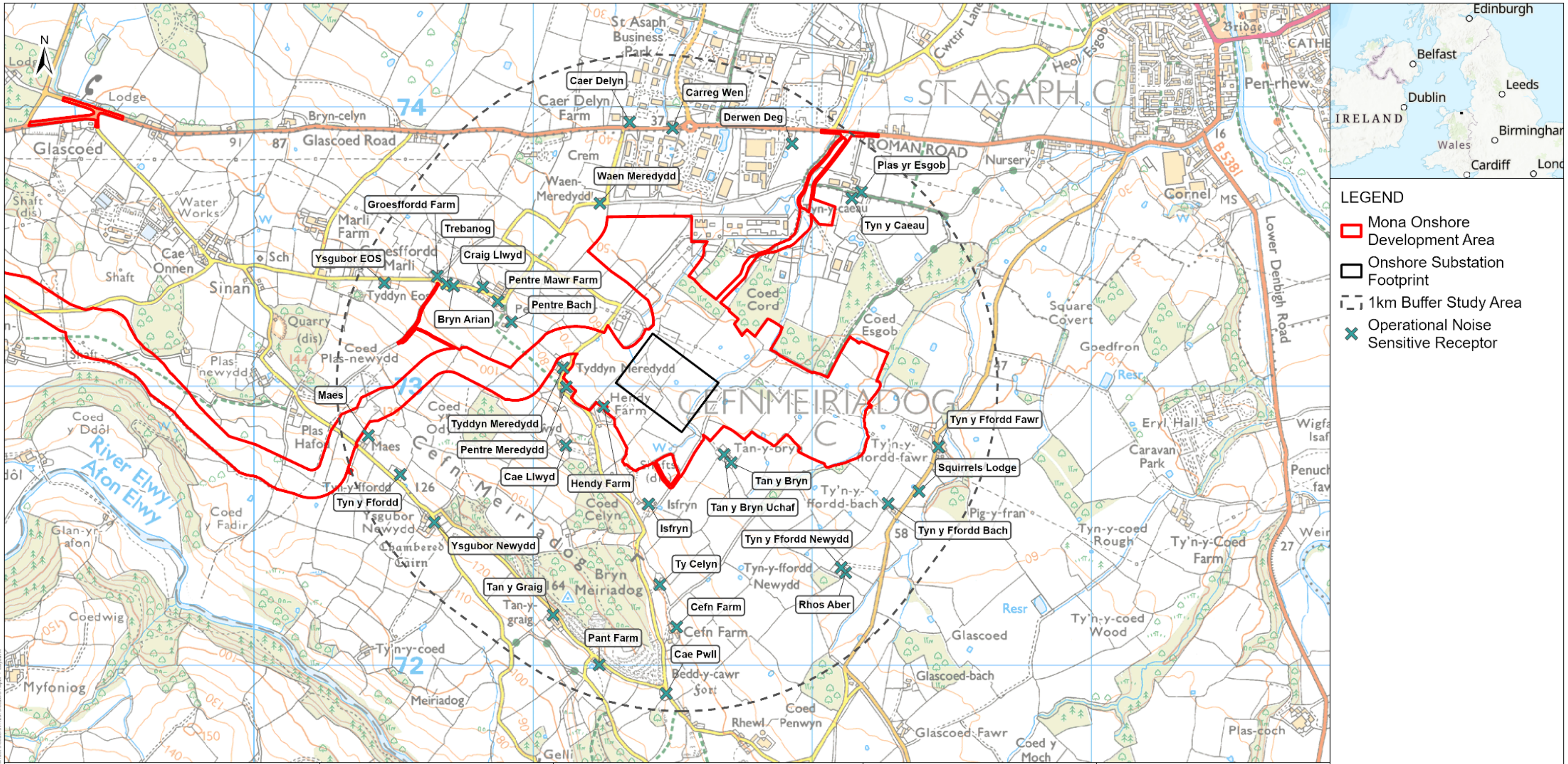
1.2.2.2 The daytime noise emission levels have been assessed to a receptor situated 1 m from the most exposed façade of the noise-sensitive receptors at a height of 1.5 m above local ground level. This height corresponds roughly to the centre of a ground floor window.

1.2.2.3 The night-time noise emission levels have been assessed to a receptor situated 1 m from the most exposed façade at a height of 4.5 m above local ground level. This height corresponds roughly to the centre of a first-floor window since it is assumed residents will be in bedrooms situated on the first-floor during the night-time period.

1.2.2.4 It should be noted that the closest receptor to the Onshore Substation is Hendy Farm which is currently unoccupied. This receptor has been considered within the assessment for robustness, however, the mitigation measures have been specified based on the predicted noise impacts at the nearest currently occupied receptors.

Table 1.3: Distance of noise sensitive receptors to Onshore Substation boundary.

Receptor	Distance to Onshore Substation boundary (m)
Bryn Arian	677
Cae Llwyd	287
Cae Pwll	938
Caer Delyn	762
Carreg Wen	739
Cefn Farm	698
Craig Llwyd	587
Derwen Deg	844
Groesffordd Farm	745
Hendy Farm	94
Isfryn	284
Maes	907
Pant Farm	885
Pentre Bach	433
Pentre Mawr Farm	514
Pentre Meredydd	178
Plas yr Esgob	854
Rhos Aber	774
Squirrels Lodge	817
Tan y Bryn	208
Tan y Bryn Uchaf	170
Tan y Graig	801
Trebanog	703
Ty Celyn	552
Tyddyn Meredydd	196
Tyn y Caeau	815
Tyn y Ffordd	839
Tyn y Ffordd Bach	746
Tyn y Ffordd Fawr	821
Tyn y Ffordd Newydd	750
Waen Meredydd	503
Ysgubor EOS	903
Ysgubor Newydd	820



Service Layer Credits: World Topographic Map: Esri UK, Esri, HERE, Garmin, FAO, NOAA, USGS World Hillshade: Esri, USGS	Data Sources: RPS / bp / EnBwW	Geodetic Information: Datum: OSGB 1936. Projection: British National Grid. Scale@ 378.9mm x 214.9 mm:1:15,000	0 0.05 0.1 0.2 nm; 0 0.13 0.25 0.5 km
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Figure 1.5: Operational noise sensitive receptors.

1.2.3 Assessment methodology

1.2.3.1 Noise levels during the operation of the Onshore Substation at the nearest receptors have been predicted from a 3D acoustic model. The predicted noise levels have been assessed with reference to the guidance in British Standard (BS) 4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound'.

1.2.3.2 The nearest receptors to the Onshore Substation are presented graphically in Figure 1.5 above.

British Standard 4142:2014+A1:2019

1.2.3.3 BS 4142:2014+A1:2019 – 'Methods for rating and assessing industrial and commercial sound' provides a method for rating industrial and commercial sound and method for assessing resulting impacts upon people. The method is applicable to fixed plant installations, sound from industrial and manufacturing process and other associated activities.

1.2.3.4 In summary, this standard provides guidance on determining 'rating sound levels' by correcting the 'specific sound level' from the site or operations under consideration for acoustic character corrections such as tonality, impulsivity, and intermittency. The standard provides the following corrections to be applied where each is appropriate:

- '*Tonality -For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible*
- *Impulsivity - 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*
- *Intermittency - When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. … If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied*
- *Other sound characteristics - 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 3dB can be applied.*'

1.2.3.5 An initial estimate of the impact of the source is obtained by subtracting the measured background sound level from the rating sound level of the proposed plant. Background sound levels at the receptors were identified from a baseline sound survey undertaken in November 2022 (see Volume 7, Annex 9.1: Baseline Sound Survey of the Environmental Statement).

1.2.3.6 The representative background sound levels at each receptor are presented in Table 9.11 of Volume 3, Chapter 9: Noise and Vibration of the Environmental Statement. The local sound climate at receptors near the Mona Onshore Substation location was noted to be low.

1.2.3.7 In particular, the representative background sound levels $L_{A90,T}$ at measurement position on the land of Tyn-y-Ffordd Newydd (position LT8 in Volume 7, Annex 9.1: Baseline Sound survey of the Environmental Statement) were determined to be 27 dB and 25 dB during the day and night-time, respectively.

1.2.3.8 Acoustic character corrections are applied to the specific sound level at the receptor, as presented in Table 1.5 and Table 1.6 below.

1.2.3.9 Typically, the greater the difference between the measured background sound level and the rating sound level, the greater the magnitude of the impact. The operational noise criteria adopted for the Mona Offshore Wind Project are presented in Table 9.18 of Volume 3, Chapter 9: Noise and Vibration of the Environmental Statement and in Table 1.4 below for brevity and ease of reference.

Table 1.4: Operational noise criteria

Magnitude of impact	BS 4142:2014+A1:2019 semantic description	Difference Δ between rating sound level $L_{Ar,Tr}$ and background sound level $L_{A90,T}$ (dB)
High	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.	Δ ≥ 10
Medium	A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.	5 ≤ Δ < 10
Low	Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.	0 ≤ Δ < 5
Negligible		-10 ≤ Δ ≤ 0
No change	-	Δ < -10

1.2.3.10 A contextual assessment of the likely impacts is then required to assess the significance of the effect. The matrix used for the assessment of the significance of the effect is presented in Table 9.14 of Volume 3, Chapter 9: Noise and Vibration of the Environmental Statement.

1.3 Operational noise limits

1.3.1.1 Operational noise impacts are proposed to be controlled via noise limits at the nearest receptors to be secured as requirement of the Development Consent Order (DCO).

1.3.1.2 The operational noise limits have been derived based on the representative background sound level measured during the night-time at the most exposed receptor to the Mona Onshore Substation.

1.3.1.3 The closest receptor has been identified in Table 1.3 as Hendy Farm. However, as stated in paragraph 1.2.2.4, Hendy Farm is currently unoccupied and derelict and, as such, operational noise limits have been derived based on the background sound levels at Tan y Bryn Uchaf and Pentre Meredydd.

1.3.1.4 The representative background sound level at these receptors during the night-time was measured to be 30 dB $L_{A90,T}$. The impact magnitude criteria in Table 1.4 have been derived based on the guidance in BS 4142:2014+A1:2019 which, as outlined in section 1.2.3 above, states that a difference between the rating sound level of all plant operating concurrently and the representative background sound level of +5 dB is indicative of an adverse impact. As such, a rating level with a magnitude less than +5 dB above the background sound level indicates that adverse impacts have been avoided, depending on the context.

1.3.1.5 Based on the above, the operational noise limit in Table X below is proposed to control operational noise impacts at the nearest noise sensitive receptors.

Table 1.5 Operational noise emission limit for the Mona Onshore Substation

Receptor	Operational Noise Emission Limit, $L_{Ar,T}$ (dB)
Tan y Bryn Uchaf	34

1.3.1.6 Compliance with this limit ensures that the magnitude of impacts due to the Mona Onshore Substation will be low.

1.3.1.7 This limit may be contextualised by allowing for a typical loss of 12 dB(A) due to a partially open window. A noise level of 34 dB(A) externally results in an internal noise level of 22 dB(A) which is 8 dB(A) below the internal ambient noise criteria of 30 dB $L_{Aeq,8h}$ outlined in BS 8233:2014 – 'Guidance on sound insulation and noise reduction for buildings' (appropriate in bedrooms to provide suitable conditions for sleeping).

1.4 Operational noise model output and assessment

Baseline Scenario

1.4.1.1 The results of the baseline (unmitigated) scenario for the substation operation are presented in Table 1.5 below, with noise contours for both the day and night scenarios presented in Figure 1.6 and Figure 1.7, respectively.

1.4.1.2 There are a number of high impacts during the night-time period where background sound levels are lower. It should be noted that the sound power levels used are in the upper range for the type of plant assessed and, as outlined in Table 1.2, mitigation measures have been proposed to assess the levels required to avoid significant adverse effects.

1.4.1.3 It should further be noted that the receptor at Hendy Farm is currently unoccupied. This has been considered in the contextual assessment outlined in Volume 3, Chapter 9: Noise and Vibration of the Environmental Statement as part of the assessment of significant effects.

Mitigated Scenario

1.4.1.4 The mitigated rating levels at receptors are presented in Table 1.6 below. These results include the required noise reductions outlined in Table 1.2, with noise contours for both the day and night scenarios presented in Figure 1.8 and Figure 1.9., respectively.

1.4.1.5 Employing these measures reduces the rating levels at receptors sufficiently such that significant adverse effects are avoided. The results also highlight the following:

- Compliance with the operational noise limit defined in Table 1.5 above results in negligible to low impacts are all other receptors.
- Operational noise levels at Hendy Farm are also predicted to comply with the proposed limit thereby minimising noise impacts for any potential future occupants.

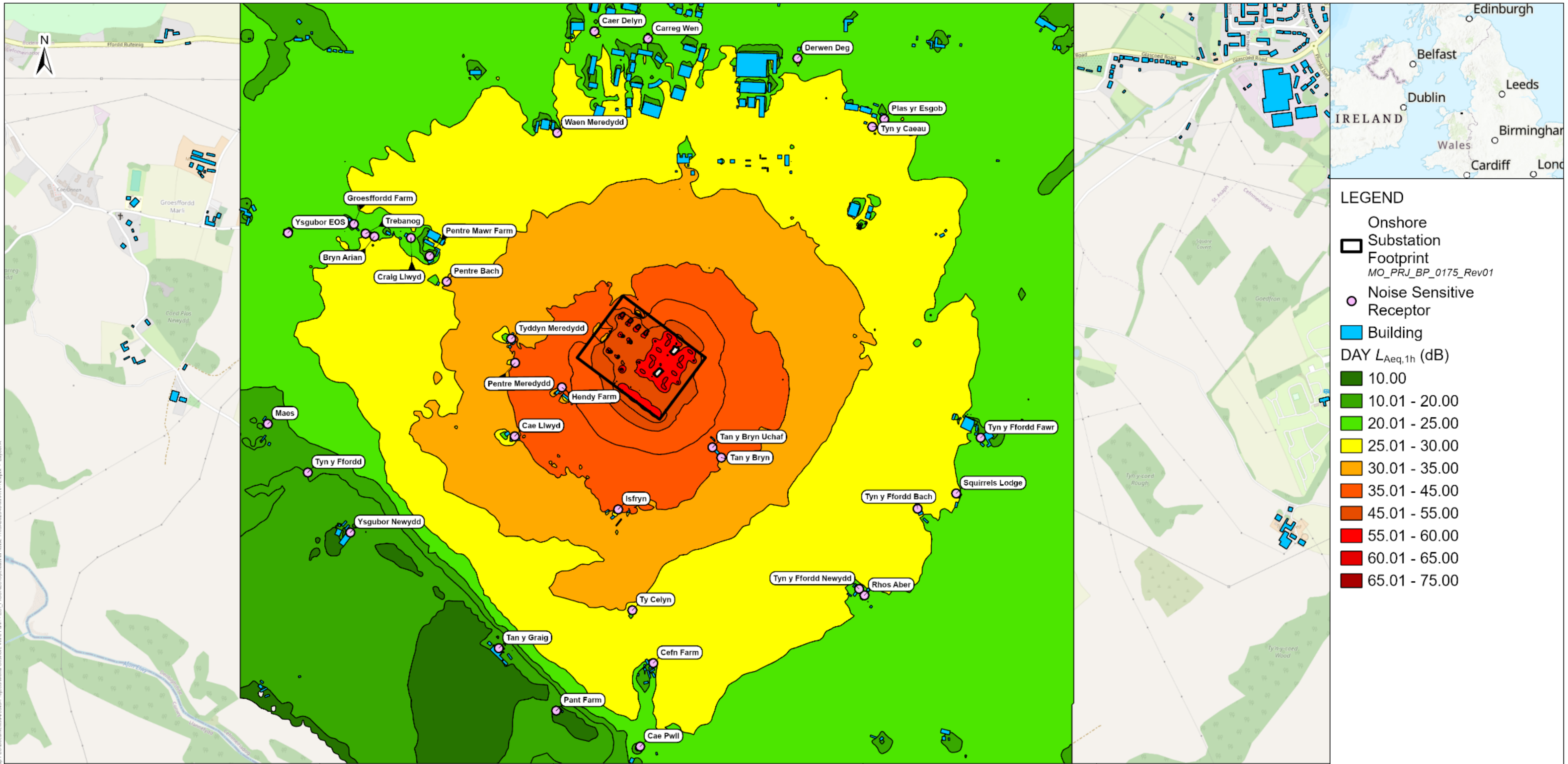

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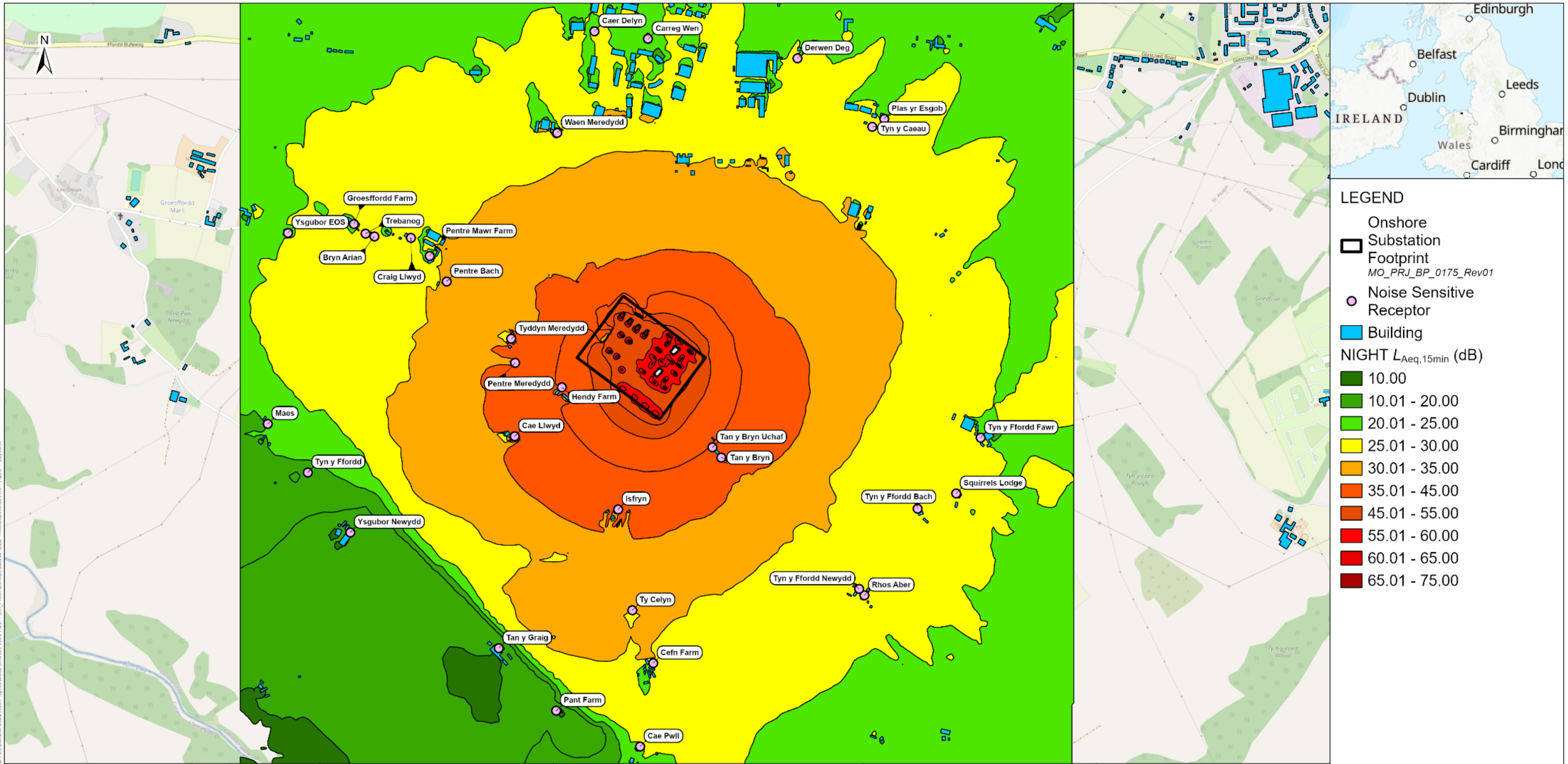
Figure 1.6: Baseline daytime operational noise levels



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Data Sources: RPS / bp / EnBwW

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0 0.13 0.25 0.5 km

Project Name:	Drawing Title:	Drawing Number:
MONA OFFSHORE WIND PROJECT	MONA ONSHORE SUBSTATION: BASELINE NIGHT-TIME OPERATIONAL NOISE LEVELS	JAJ02546-MN-NV-11

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Figure 1.7: Baseline night-time operational noise levels

Table 1.6: Operational noise assessment results (baseline scenario).

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, $L_{Aeq,T}$ (dB)		Acoustic Character Correction (dB)		Rating Level, $L_{Ar,T}$ (dB)		Difference Between Rating Level and Background Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Bryn Arian	37	35	30	32	3	3	33	35	-4	0	**Negligible**	**Low**
Cae Llwyd	35	30	38	41	7	7	45	48	10	18	**High**	**High**
Cae Pwll	30	30	28	31	3	3	31	34	1	4	**Low**	**Low**
Caer Delyn	38	32	29	31	0	0	29	31	-9	-1	**Negligible**	**Negligible**
Carreg Wen	38	32	26	28	0	0	26	28	-12	-4	**Negligible**	**Negligible**
Cefn Farm	30	30	33	35	3	3	36	38	6	8	**Medium**	**Medium**
Craig Llwyd	37	35	30	33	3	3	33	36	-4	1	**Negligible**	**Low**
Derwen Deg	38	32	29	31	3	3	32	34	-6	2	**Negligible**	**Low**
Groesffordd Farm	37	35	29	31	3	3	32	34	-5	-1	**Negligible**	**Negligible**
Hendy Farm	35	30	44	46	9	9	53	55	18	25	**High**	**High**
Isfryn	30	30	40	42	7	7	47	49	17	19	**High**	**High**
Maes	30	30	24	26	0	0	24	26	-6	-4	**Negligible**	**Negligible**
Pant Farm	30	30	15	17	0	0	15	17	-15	-13	**Negligible**	**Negligible**
Pentre Bach	37	35	34	36	5	5	39	41	2	6	**Low**	**Medium**
Pentre Mawr Farm	37	35	33	34	3	3	36	37	-1	2	**Negligible**	**Low**
Pentre Meredydd	35	30	40	42	5	5	45	47	10	17	**High**	**High**
Plas yr Esgob	38	32	30	32	0	3	30	35	-8	3	**Negligible**	**Low**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, $L_{Aeq,T}$ (dB)		Acoustic Character Correction (dB)		Rating Level, $L_{Ar,T}$ (dB)		Difference Between Rating Level and Background Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Rhos Aber	30	30	28	31	3	3	31	34	1	4	**Low**	**Low**
Squirrels Lodge	30	30	30	32	3	3	33	35	3	5	**Low**	**Medium**
Tan y Bryn	35	30	37	41	3	3	40	44	5	14	**Medium**	**High**
Tan y Bryn Uchaf	35	30	43	45	5	5	48	50	13	20	**High**	**High**
Tan y Graig	30	30	14	15	0	0	14	15	-16	-15	**Negligible**	**Negligible**
Trebanog	37	35	26	30	0	0	26	30	-11	-5	**Negligible**	**Negligible**
Ty Celyn	30	30	35	37	3	3	38	40	8	10	**Medium**	**High**
Tyddyn Meredydd	35	30	39	40	9	9	48	49	13	19	**High**	**High**
Tyn y Caeau	38	32	31	32	0	3	31	35	-7	3	**Negligible**	**Low**
Tyn y Ffordd	30	30	17	21	0	0	17	21	-13	-9	**Negligible**	**Negligible**
Tyn y Ffordd Bach	34	30	31	32	3	3	34	35	0	5	**Low**	**Medium**
Tyn y Ffordd Fawr	34	30	30	31	3	3	33	34	-1	4	**Negligible**	**Low**
Tyn y Ffordd Newydd	30	30	26	31	3	3	29	34	-1	4	**Negligible**	**Low**
Waen Meredydd	33	30	32	34	3	3	35	37	2	7	**Low**	**Medium**
Ysgubor EOS	37	35	26	28	0	0	26	28	-11	-7	**Negligible**	**Negligible**
Ysgubor Newydd	30	30	16	18	0	0	16	18	-14	-12	**Negligible**	**Negligible**

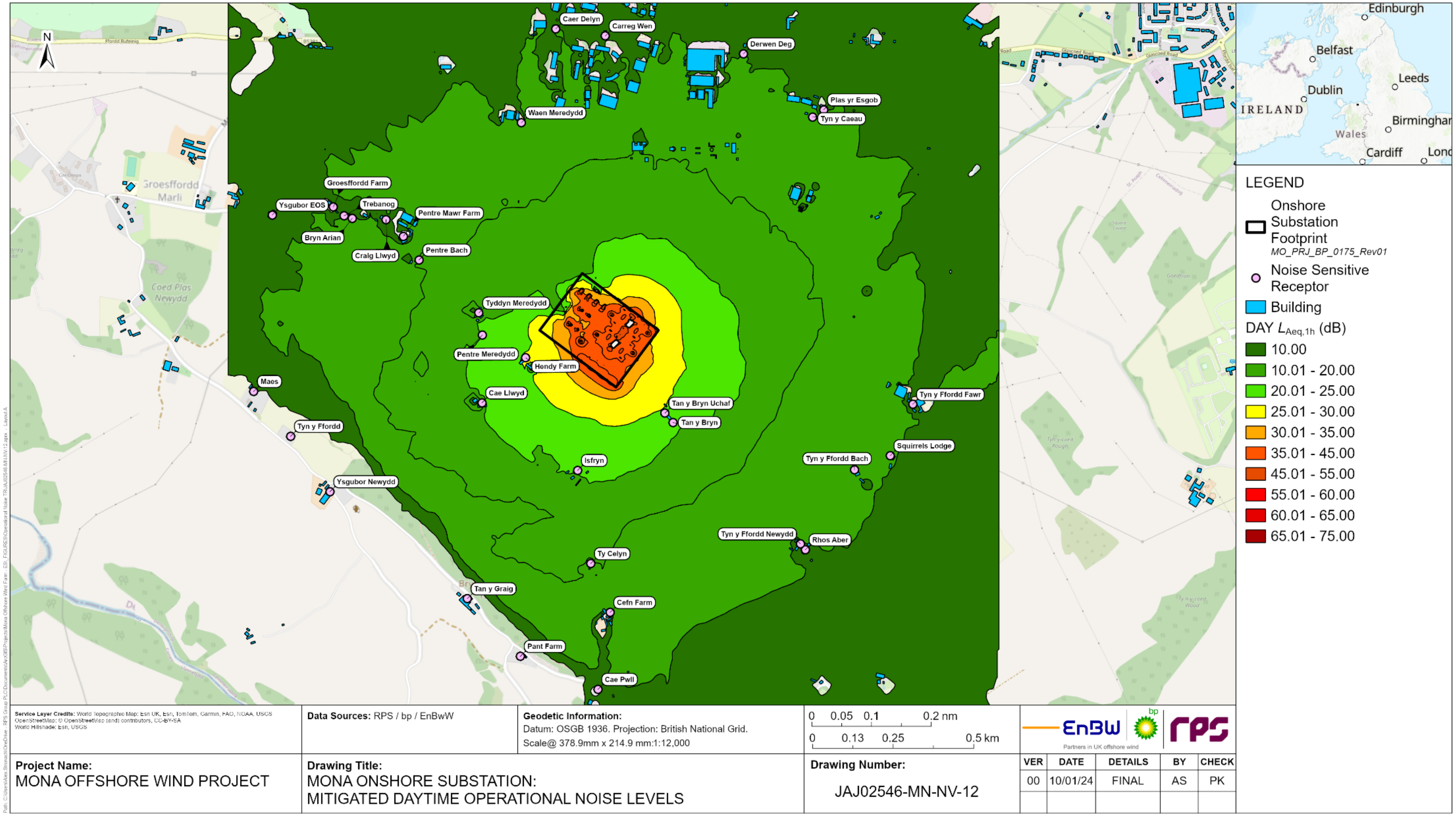
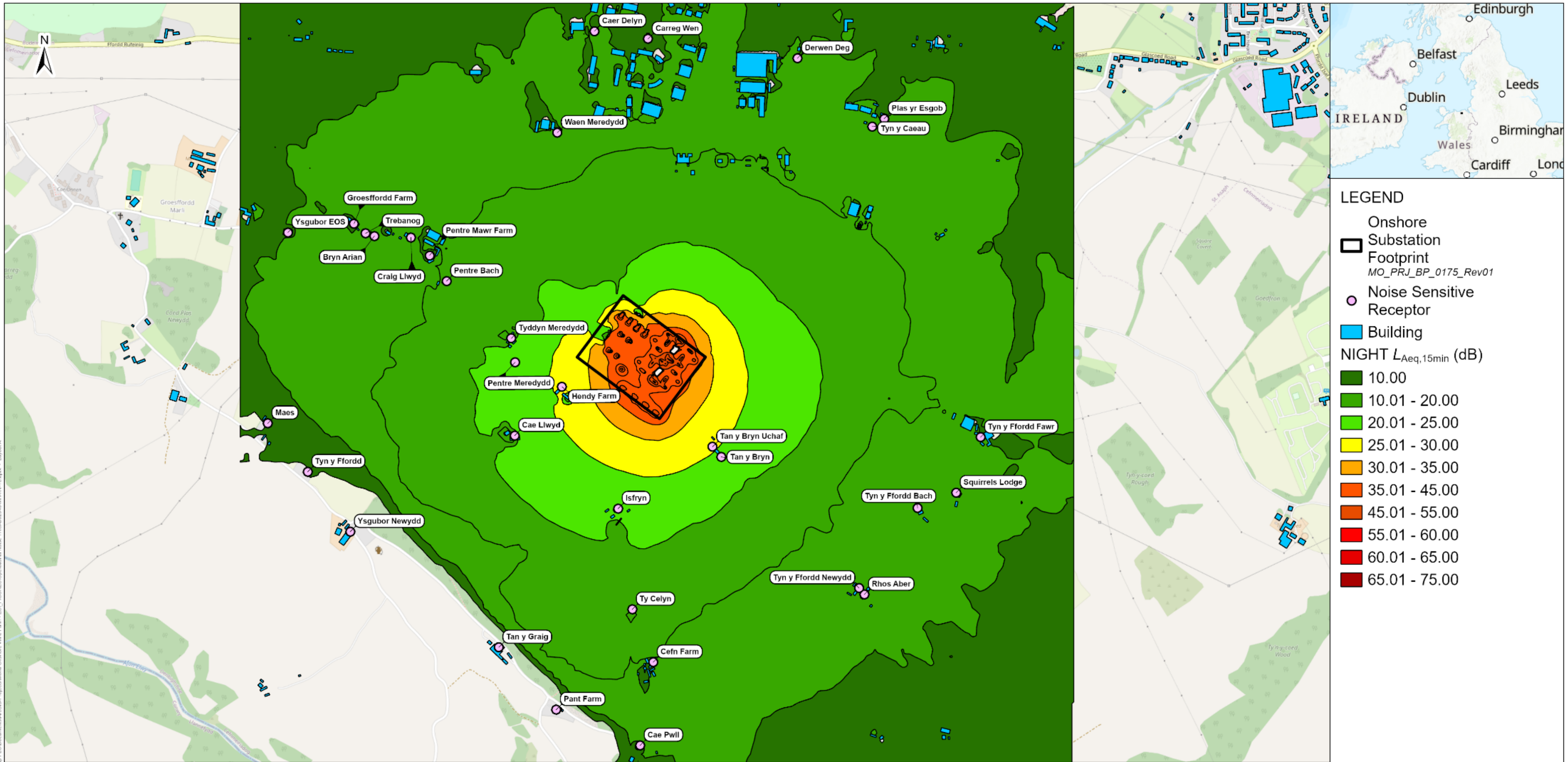


Figure 1.8: Mitigated daytime operational noise levels



Service Layer Credits: World Topographic Map: Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS OpenStreetMap © OpenStreetMap (and) contributors, CC-BY-SA World Hillshade: Esri, USGS	Data Sources: RPS / bp / EnBwW	Geodetic Information: Datum: OSGB 1936. Projection: British National Grid. Scale@ 378.9mm x 214.9 mm:1:12,000	0 0.05 0.1 0.2 nm; 0 0.13 0.25 0.5 km
Project Name: MONA OFFSHORE WIND PROJECT	Drawing Title: MONA ONSHORE SUBSTATION: MITIGATED NIGHT-TIME OPERATIONAL NOISE LEVELS	Drawing Number: JAJ02546-MN-NV-13	

VER	DATE	DETAILS	BY	CHECK
00	10/01/24	FINAL	AS	PK

Figure 1.9: Mitigated night-time operational noise levels

Table 1.7: Operational noise assessment results (mitigated scenario).

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, $L_{Aeq,T}$ (dB)		Acoustic Character Correction (dB)		Rating Level, $L_{Ar,T}$ (dB)		Difference Between Rating Level and Background Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Bryn Arian	37	35	15	17	0	0	15	17	-22	-18	**Negligible**	**Negligible**
Cae Llwyd	35	30	23	27	0	0	23	27	-12	-3	**Negligible**	**Negligible**
Cae Pwll	30	30	14	16	0	0	14	16	-16	-14	**Negligible**	**Negligible**
Caer Delyn	38	32	15	16	0	0	15	16	-23	-16	**Negligible**	**Negligible**
Carreg Wen	38	32	11	14	0	0	11	14	-27	-18	**Negligible**	**Negligible**
Cefn Farm	30	30	19	20	0	0	19	20	-11	-10	**Negligible**	**Negligible**
Craig Llwyd	37	35	15	18	0	0	15	18	-22	-17	**Negligible**	**Negligible**
Derwen Deg	38	32	15	16	0	0	15	16	-23	-16	**Negligible**	**Negligible**
Groesffordd Farm	37	35	15	16	0	0	15	16	-22	-19	**Negligible**	**Negligible**
Hendy Farm	35	30	30	31	3	3	33	34	-2	4	**Negligible**	**Low**
Isfryn	30	30	26	27	0	0	26	27	-4	-3	**Negligible**	**Negligible**
Maes	30	30	10	12	0	0	10	12	-20	-18	**Negligible**	**Negligible**
Pant Farm	30	30	1	2	0	0	1	2	-29	-28	**Negligible**	**Negligible**
Pentre Bach	37	35	19	21	0	0	19	21	-18	-14	**Negligible**	**Negligible**
Pentre Mawr Farm	37	35	18	19	0	0	18	19	-19	-16	**Negligible**	**Negligible**
Pentre Meredydd	35	30	26	28	0	3	26	31	-9	1	**Negligible**	**Low**
Plas yr Esgob	38	32	16	17	0	0	16	17	-22	-15	**Negligible**	**Negligible**

Receptor	Background Sound Level, $L_{A90,T}$ (dB)		Specific Sound Level, $L_{Aeq,T}$ (dB)		Acoustic Character Correction (dB)		Rating Level, $L_{Ar,T}$ (dB)		Difference Between Rating Level and Background Level (dB)		Magnitude of Impact	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Rhos Aber	30	30	14	16	0	0	14	16	-16	-14	**Negligible**	**Negligible**
Squirrels Lodge	30	30	15	17	0	0	15	17	-15	-13	**Negligible**	**Negligible**
Tan y Bryn	35	30	23	27	0	3	23	30	-12	0	**Negligible**	**Low**
Tan y Bryn Uchaf	35	30	29	31	0	3	29	34	-6	4	**Negligible**	**Low**
Tan y Graig	30	30	-1	0	0	0	-1	0	-31	-30	**Negligible**	**Negligible**
Trebanog	37	35	12	15	0	0	12	15	-25	-20	**Negligible**	**Negligible**
Ty Celyn	30	30	21	22	0	0	21	22	-9	-8	**Negligible**	**Negligible**
Tyddyn Meredydd	35	30	24	25	0	0	24	25	-11	-5	**Negligible**	**Negligible**
Tyn y Caeau	38	32	16	17	0	0	16	17	-22	-15	**Negligible**	**Negligible**
Tyn y Ffordd	30	30	2	5	0	0	2	5	-28	-25	**Negligible**	**Negligible**
Tyn y Ffordd Bach	34	30	16	18	0	0	16	18	-18	-12	**Negligible**	**Negligible**
Tyn y Ffordd Fawr	34	30	15	17	0	0	15	17	-19	-13	**Negligible**	**Negligible**
Tyn y Ffordd Newydd	30	30	11	16	0	0	11	16	-19	-14	**Negligible**	**Negligible**
Waen Meredydd	33	30	17	18	0	0	17	18	-16	-12	**Negligible**	**Negligible**
Ysgubor EOS	37	35	11	14	0	0	11	14	-26	-21	**Negligible**	**Negligible**
Ysgubor Newydd	30	30	2	3	0	0	2	3	-28	-27	**Negligible**	**Negligible**

1.5 References

Mona Offshore Wind Ltd (2022) Mona Offshore Wind Project EIA Scoping Report. Available: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010137/EN010137-000011-EN010137%20-%20Scoping%20Report.pdf . Accessed December 2022.

British Standards Institution (2019) 'British Standard 4142:2014+A1:2019 – *'Methods for rating and assessing industrial and commercial sound'.*

British Standards Institution (2014) 'British Standard 8233:2014– *'Guidance on sound insulation and noise reduction for buildings'.*

Gange. M (2011), *'Low-frequency and Tonal Characteristics of Transformer Noise'*, Proceedings of ACOUSTICS 2011, Gold Coast, Australia

International Organisation for Standards (1996) *'ISO 9613-2:1996 – Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'.*

National Grid (2021), Operational Noise Assessment for the Proposed Little Horsted 400 kV Substation, Available: https://planning.wealden.gov.uk/plandisp.aspx?recno=153380. Accessed November 2023

Appendix A: Operational Noise Model Source Spectra

Table A. 1: Operational noise model input spectra (excluding Super Grid Transformer)

Plant Item	Sound Power Level (dB) at 1/1-Octave Band Centre Frequency (Hz)								dB(A)
	63	125	250	500	1k	2k	4k	8k	
275 kV Shunt Reactor incl. Coolers	89	94	92	87	86	79	69	59	**90**
400kV Shunt Reactor incl. Coolers	55	100	66	76	78	50	50	52	**85**
Dynamic Reactive Power Compensator (SVC) Phase Reactors	88	88	92	87	86	80	69	59	**90**
Dynamic Reactive Power Compensator (SVC) Coolers	47	99	75	84	27	26	26	28	**85**
2x 33kV Mechanically Switched Reactors (MSR)	83	88	93	78	60	40	40	38	**85**
275 kV Filter	83	88	93	78	60	40	40	38	**85**
400kV Filter	101	92	78	68	62	54	52	72	**80**
33/0.4 kV Auxiliary Transformer	84	89	76	76	75	72	65	64	**80**

Table A. 2: Super Grid Transformer input spectrum

Sound Power Level (dB) at 1/3-Octave Band Centre Frequency (Hz)																								dB(A)
50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	
72	76	76	96	76	71	92	78	89	90	85	81	74	74	73	67	65	63	60	57	58	59	58	58	**90**