12.0 Noise & Vibration

Introduction

12.1 This Chapter of the ES considers the potential noise and vibration impacts and likely significant noise effects from the Development; specifically, the predicted noise effects likely to be generated by the Development on noise sensitive receptors within the study area during the construction/ decommissioning works and operation of the Development.

12.2 The Chapter describes the legislation and planning policy of relevance to the Site in the context of noise and vibration; the baseline conditions currently existing at the Site; the methods used to assess the potential impacts and likely significant effects arising from the Development; and the residual effects following consideration of additional mitigation measures beyond those inherent within the design of the Development.

12.3 The chapter has been prepared by Neil Morgan MSc MIOA of inacoustic, who has over 20 years of specialist experience in the field of environmental acoustics and has been a full, corporate member of the Institute of Acoustics since 2004.

Planning Policy Context

National Planning Policy

Future Wales - The National Plan 2040 (2021) [i]

12.4 The National Plan states the following under the heading *'Developing Infrastructure Responsibly'*:

> ***'When proposing new transport infrastructure or new development, average population exposure to air and noise pollution should be reduced and soundscapes improved where it is practical and feasible to do so. At the very least, exposure to pollution should be minimised. This will include taking into account the long-term effects of current and predicted levels of air and noise pollution on individuals, society and the environment arising as a result of proposals for transport infrastructure or development.'***

12.5 Policy 18 of the document, entitled 'Renewable and Low Carbon Energy Developments of National Significance', states the following:

> ***'Proposals for renewable and low carbon energy projects (including repowering) qualifying as Developments of National Significance will be permitted subject to policy 17 and the following criteria:***
>
> ***...***
>
> ***7. there are no unacceptable adverse impacts by way of shadow flicker, noise, reflected light, air quality or electromagnetic disturbance;'***

Planning Policy Wales (2021) [ii]

12.6 Planning Policy Wales Edition 11 ('PPW') sets out the planning development policies of the Welsh Government. The document aims to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales.

12.7 With regard to the assessment of noise associated with development, paragraph 6.7.4 provides guidance on noise generation near protected areas:

> ***'The planning system should maximise its contribution to achieving the wellbeing goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution alongside action to tackle high pollution hotspots. In doing so, it should consider the long-term effects of current and predicted levels of air and noise pollution on individuals, society and the environment and identify and pursue any opportunities to reduce, or at least, minimise population exposure to air and noise pollution, and improve soundscapes, where it is practical and feasible to do so.'***

Well-being of Future Generations (Wales) Act 2015 [iii]

12.8 The Well-being of Future Generations (Wales) Act 2015 has a number of wellbeing goals to achieve through implementing sustainable development. Changes in noise levels can have an impact on the health of habitat and humans, as such the goals to create *'a resilient Wales'* and *'a healthier Wales'* are applicable.

Technical Advice Note (Wales) 11, Noise – October 1997 [iv]

12.9 Technical Advice Note 11 ('TAN 11'), provides technical guidance on noise generating development. In relation to noise generating developments, it states:

> ***'Local planning authorities must ensure that noise generating development does not cause an unacceptable degree of disturbance. They should also bear in mind that if subsequent intensification or change of use results in greater intrusion, consideration should be given to the use of appropriate conditions.'***

Local Planning Policy

Anglesey and Gwynedd Joint Local Development Plan, 2011-2026 (2017) [v]

12.10 Policy PCYFF 2 of the Anglesey and Gwynedd Joint Local Development Plan, 2011-2026 ('LDP'), entitled 'Development Criteria' states the following with reference to noise:

> ***'A proposal should demonstrate its compliance with:***
>
> ***1. Relevant Policies in the Plan;***
>
> ***2. National Planning Policy and guidance***
>
> ***... planning permission will be refused where the proposed development would have an unacceptable adverse impact on:***
>
> ***7. The health, safety or amenity of occupiers of local residences, other land and property uses or characteristics of the locality due to increased activity, disturbance, vibration, noise, dust, fumes, litter, drainage, light pollution, or other forms of pollution or nuisance'***

12.11 Policy ADN 2 of the LDP sets out the Council's requirements for solar energy installations. The policy does not specifically refer to noise or vibration, however, it does assert that any proposal '*will not result in significant harm to the safety or amenity of sensitive receptors'*.

12.12 Policy ADN 2 also goes on to state the requirement for a Construction Environmental Management Plan ('CEMP') to account for the effects from a proposed development during construction and decommissioning. An Outline CEMP (Appendix 5.1) accompanies Chapter 5 Construction Methodology and Phasing of the ES.

Legislative Context

Control of Pollution Act 1974 [vi]

12.13 The Control of Pollution Act, 1974, Part III – Noise ('the Act') is a combination and refinement of three earlier Acts: The Public Health Act, 1936 (replaced by the Public Health Act 1990, Part III), the Noise Abatement Act 1960 and the Public Health Act 1990, Part III). Section 60 of the Act enables a local planning authority to serve a notice on a person (this includes a company) who is carrying out, or who are planning to carry out, works of construction, demolition, roadworks, railway maintenance etc. in order to control the noise from those operations. Section 61 ('S61') of the Act also enables such a person to apply to the local authority for consent in respect of such works.

Assessment Methodology

Consultation

12.14 Table 12.1 summarises the consultation responses that have been received during the EIA scoping and local authority consultation process regarding the assessment of the Development's likely significant effects on noise and vibration.

Table 12.1: Consultation Responses

Consultee	Response	Where Addressed
Isle of Anglesey County Council ('IACC') Environmental Health Department ('EHD')	Operational Noise: Assessment in-line with current BS4142 guidance, having regard to any low-frequency sources. Baseline noise survey to run for as long as practicable. Construction Noise: Would be controlled by condition, with working hours limited to 08:00-18:00 Monday to Friday; 08:00-13:00 on Saturdays and no working on Sundays or Bank Holidays. Requirement for appropriate 'Best Practicable Means' ('BPM') measures.	Paragraph 12.68 to 12.106
Planning Inspectorate Wales (now Planning and Environment Decisions Wales ('PEDW'))	Vibration: *The SR does not provide details of the proposed method for installation and securing of the solar panels, or of other required ground works associated with the proposal. The Nantanog SSSI, which is designated for its geological interest, is located within the site boundary.* *Given the level of information currently available, it is not considered possible to rule out significant effects on the SSSI that might arise from vibration during construction.* *Vibration is therefore scoped in to the ES.* Noise: *The approach to assessment of noise set out in the SR is considered largely appropriate.* *The ES should also consider noise impacts under other topic chapters as appropriate, e.g.*	Paragraph 12.64 to 12.66

Consultee	Response	Where Addressed
	construction noise effects on protected sites and species, effects on the setting of heritage assets.	

General

12.15 In the context of this assessment, noise is defined as unwanted or undesirable sound derived from sources such as road traffic, commercial/industrial processes or construction works that interfere with normal activities, including conversation, sleep or recreation. Vibration is defined as the transmission of energy through the medium of ground or air resulting in small movements of the transmitting medium, such as a building, which can cause discomfort to people or even damage to structures if the movements are large enough.

12.16 The prediction of future noise and vibration levels generated by the construction, operational and decommissioning phases of the Development and the significance of their potential effects have been assessed in accordance with the appropriate British Standards, which are discussed below.

Construction Phase

Noise

12.17 Noise levels generated by construction plant and activities have the potential to impact upon nearby noise-sensitive receptors.

12.18 British Standard 5228-1:2009+A1:2014 ('BS5228')[vii] sets out an appropriate methodology for predicting, assessing, and controlling noise levels arising from a wide variety of construction plant and related activities. As such, it can be used to predict noise levels arising from the operations at proposed construction sites. BS5228 also sets out tables of sound power levels generated by a wide variety of construction plant to facilitate such predictions.

12.19 The magnitude of the potential impact on sensitive receptors would depend upon a number of variables, the following of which are of particular relevance to this assessment:

- The amount of noise generated by plant and equipment being used at the Site, generally expressed as a sound power level;
- The periods of operation of the plant at the Site, known as the 'on-time';
- The distance between the noise source and the receptor, known as the 'stand-off';
- The attenuation due to ground absorption or barrier screening effects; and
- The reflection of noise due to the presence of hard vertical faces such as walls.

12.20 In order to determine the likely effect of noise during the construction phase of the Development, noise predictions have been carried out in accordance with the procedures presented in BS5228, taking full account of BPM. The prediction method described in BS5228 comprises taking the source noise level of each item of plant and correcting it for the following variables:

- distance effects between source and receiver;
- percentage operating time of the plant;
- barrier attenuation effects;
- ground absorption; and
- facade corrections.

12.21 BS5228 gives several examples of acceptable limits for construction noise. The most simplistic is based upon the exceedance of fixed noise limits and Annex E.2 states that: *'Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut.'*

12.22 Annex E.2 goes on to state: 'Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the Site boundary should not exceed: 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise or 75 decibels (dBA) in urban areas near main roads in heavy industrial areas. These limits are for daytime working outside living rooms and offices.'

12.23 In respect of potentially more sensitive residential receptors, this assessment considers the criteria set out in Annex E.3 of BS 5228, which considers impact significance based upon the change in ambient noise associated with construction activities. BS5228 states that this can be considered as *'an alternative and/or additional method to determine the significance of construction noise levels'*.

12.24 Paragraph E.3.2 describes Example Method 1 (The ABC Method), which considers the existing ambient noise environment (the LAeq noise level environment) at the neighbouring sensitive receptors and identifies levels that if exceeded, would be considered to result in a significant adverse effect and is noted to apply to residential receptors only.

12.25 Table E.1 of BS5228 sets out significance effect threshold values at receptors. The process for determining this requires the determination of the ambient noise level at the relevant receptor (rounded to the nearest 5dB), which is then compared to the total noise level, including the predicted construction noise level. If the combined noise level exceeds the appropriate category value, then the impact is deemed to be significant. The relevant statistics from Table E.1 are set out in Table 12.2 below. Compliance with these guidance levels would ensure that no significant adverse effects are experienced at receptor locations.

Table 12.2: Construction Noise Impact Significance Criteria

Assessment category and threshold value period (L_{Aeq})	Threshold value in decibels – dB(A)		
	Category A	Category B	Category C
Daytime	*65*	*70*	*75*
NOTE 1 A significant effect has been deemed to occur if the total LAeq noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.			
NOTE 2 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total LAeq noise level for the period increases by more than 3 dB due to construction activity.			
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.			

12.26 In addition to the above method of assessing impacts, BS 5228 also suggests the 5 dB(A) change method. This states that noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient noise 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 LAeq,T, from construction 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 a significant impact.

Vibration

12.27 Vibration may be impulsive such as that due to hammer-driven piling; transient such as that due to vehicle movements along a railway; or continuous such as that due to vibratory driven piling.

12.28 The primary cause of community concern in relation to vibration generally relates to building damage from both construction and operational sources of vibration, although, the human body can perceive vibration at levels which are substantially lower than those required to cause building damage.

12.29 Damage to buildings associated solely with ground-borne vibration is not common and although vibration may be noticeable, there is little evidence to suggest that they produce cosmetic damage such as a crack in plaster unless the magnitude of the vibration is excessively high. The most likely impact, where elevated levels of vibration do occur during the demolition and construction phases, is associated with perceptibility.

12.30 There are currently no British Standards that provide a methodology to predict levels of vibration from construction activities, other than that contained within BS5228: Part 2[viii], which relates to percussive or vibratory piling only. Therefore, it is not possible to accurately predict levels of vibration during the Site preparation and construction phases of development. As such, to control the impact of vibration during site preparation and construction of a development, limits relating to the perceptibility of vibration are typically set.

12.31 BS5228 indicates that the threshold of human perception to vibration is around 0.15 mm/s, although it is generally accepted that for the majority of people vibration levels in excess of between 0.15 and 0.3mm/s peak particle velocity ('PPV') are just perceptible, which forms the basis of the recommend maximum permitted vibration levels of 1 mm/s PPV within occupied residential dwellings.

12.32 BS5228 also sets out the distances (based on historical field measurements) at which certain activities could give rise to a just perceptible level of vibration. These distances are presented in Table 12.3.

Table 12.3: Distances at which Vibrations may be just perceptible

Construction Activities	Distance from activity when vibration may just be perceptible (metres)
Excavation	10 - 15
Heavy Vehicles (e.g. dump trucks)	4 - 10
Hydraulic Breaker	15 - 20
Rotary Bored Piling	20 - 30

12.33 The approach described above, has therefore been adopted within this assessment.

12.34 In accordance with the guidance given in BS5228, 1 mms^{-1} PPV has been selected as the target criteria to control the impact of demolition and construction vibration, with the criteria for assessing the magnitude of vibration impacts according to the margin by which this target criterion is achieved or exceeded presented in Table 12.3. This target criterion is based on the guidance contained within BS 5228, experience from previous sites and accepted vibration policy criteria across a range of enforcing authorities elsewhere in the UK. The limits are presented in terms of PPV as it is the simplest indicator for both perceptibility and building damage.

Table 12.4: Demolition and Construction Vibration Significance criteria

Vibration Level, $mm.s^{-1}$ PPV	Significance of Effect
>1.0	Major Adverse
0.30 - 1.0	Moderate Adverse
0.15 - 0.30	Minor Adverse
<0.15	Negligible
Notes *The above vibration limits relate to maximum PPV ground borne vibration occurring in any one of three mutually perpendicular axes (one of which may be vertical). Vibration is to be measured on the foundation or on an external façade no more than 1m from the ground, or failing this, solid ground as near to the building façade as possible.*	

12.35 It is again worth noting that the purpose of the target construction vibration criteria is to control the impact of construction vibration insofar as is reasonably practicable and is entirely based on the likelihood of the vibration being perceptible, rather than causing damage to property. Hence, although vibration levels in excess of 1 mms^{-1} PPV would be considered major adverse in respect of the likelihood of perceptibility, they would not be considered significant in terms of the potential for building damage, which would require levels of at least 15 mms^{-1} PPV to result in minor cosmetic damage in light / unreinforced buildings.

Operational Phase

Noise

12.36 British Standard 4142:2014+A1:2019[ix] *'Method for rating and assessing industrial and commercial sound'* sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity of these noise sources.

12.37 The procedure contained in BS4142:2014+A1:2019 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ 'specific sound level', immediately outside the dwelling, with the $L_{A90,T}$ background sound level.

12.38 Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ 'rating sound level'. A correction to include the consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

12.39 BS4142:2014+A1:2019 states: 'The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs'. An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

> ***'Typically, the greater this difference, the greater the magnitude of the impact.'***
>
> ***'A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.'***
>
> ***'A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.'***
>
> ***'The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.'***

Receptors

12.40 The receptors considered in the assessment are set out in Table 12.5 and marked on Figure 12.1.

Table 12.5: Receptors Considered in the Assessment

Receptor	Receptor Type	Potential Effects	Sensitivity
R1 Nantanog	Residential	Construction and Operational	High
R2 Chwaen Goch	Residential	Construction and Operational	High
R3 Maen Hir	Residential	Construction and Operational	High

R4 Wilpol	Residential	Construction and Operational	High
R5 Ty Newydd Penbryn	Residential	Construction and Operational	High
R6 Pen Lidiard	Residential	Construction and Operational	High
R7 Traian	Residential	Construction and Operational	High
R8 Chwaen Bach	Residential	Construction and Operational	High
R9 Parc Newydd	Residential	Construction and Operational	High
R10 Ffridd	Residential	Construction and Operational	High
R11 Pennant	Residential	Construction and Operational	High
R12 Cefn Gribyn	Residential	Construction and Operational	High
R13 *address unknown*	Residential	Construction and Operational	High
R14 Tan Rallt	Residential	Construction and Operational	High
R15 Rhiw Goch Fawr	Residential	Construction and Operational	High
R16 Ty Newydd	Residential	Construction and Operational	High
R17 Glan y Gors	Residential	Construction and Operational	High
R18 Brynsannan	Residential	Construction and Operational	High
R19 Caerwrli	Residential	Construction and Operational	High
R20 Nantanog SSSI	Geological	Construction Vibration	Moderate

12.41 All considered receptors, with the exception of R20, are human/residential in nature, which represent the closest and most sensitive receptors to the Development.

Figure 12.1: Receptor Locations

Limitations and Assumptions

12.42 In terms of limitations; as the precise infrastructure components/models for the Development have not yet been specified, the assessment considers a maximum acoustic performance specification that will feed into the procurement process for the site equipment.

12.43 Regarding assumptions, traffic numbers will be low during construction/decommissioning and particularly during operation, as set out within Chapter 5 Construction Methodology and Phasing. Furthermore, in terms of limitations, traffic levels are below the calculable range of the Calculation of Road Traffic Noise methodology, meaning that the change in basic noise level calculation method would be unreliable and results potentially disproportionate, given the very low baseline flows.

12.44 Taking the above into account, plus the fact that traffic noise generation has not been raised as a concern during the scoping process, road traffic noise from the Development has been scoped out of the assessment as likely significant effects are not anticipated.

Baseline Conditions

General

12.45 The prevailing background noise conditions in the area have been determined by an environmental noise survey conducted during both daytime and night-time periods between Thursday 18th and Wednesday 24th March 2021.

12.46 The survey was undertaken during the Covid-19 pandemic, and therefore road traffic movements were reduced, giving the dataset used to derive the background sound level a high degree of statistical robustness.

12.47 The installation of the survey was overseen by an Environmental Health Officer from IACC.

Measurement Details

12.48 All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of British Standard 7445: 2003: *Description and measurement of environmental noise* [x].

12.49 All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672: 2013: *Electroacoustics. Sound level meters.* Part 1 *Specifications* [xi]. A full inventory of this equipment is shown in Table 12.6 below.

Table 12.6: Inventory of Sound Measurement Equipment

Position	Make, Model & Description	Serial Number
MP1	Rion NL-32 Sound Level Meter	01213696
	Rion NH-21 Preamplifier	36327
	Rion UC-53A Microphone	318715
MP2	Rion NL-52 Sound Level Meter	01265463
	Rion NH-25 Preamplifier	65465
	Rion UC-59 Microphone	10691
MP3	Rion NL-52 Sound Level Meter	00943282
	Rion NH-25 Preamplifier	43298
	Rion UC-59 Microphone	07045
MP4	Svan 957 Sound Level Meter	21890
	Svantek SV12L Preamplifier	24215
	ACO 7052E Microphone	58524
All	Larson Davis CAL200 Acoustic Calibrator	15314

12.50 Measurement equipment used during the survey was field calibrated at the start and end of the measurement period. A calibration laboratory had calibrated the field calibrator used within the 12 months preceding the measurements.

12.51 The weather conditions during the survey were monitored via the deployment of a rain tipping gauge and anemometer, thus ensuring the exclusion of any weather affected periods from the dataset.

12.52 The microphones were fitted with protective windshields for the measurements which are described below and identified on Figure 12.2:

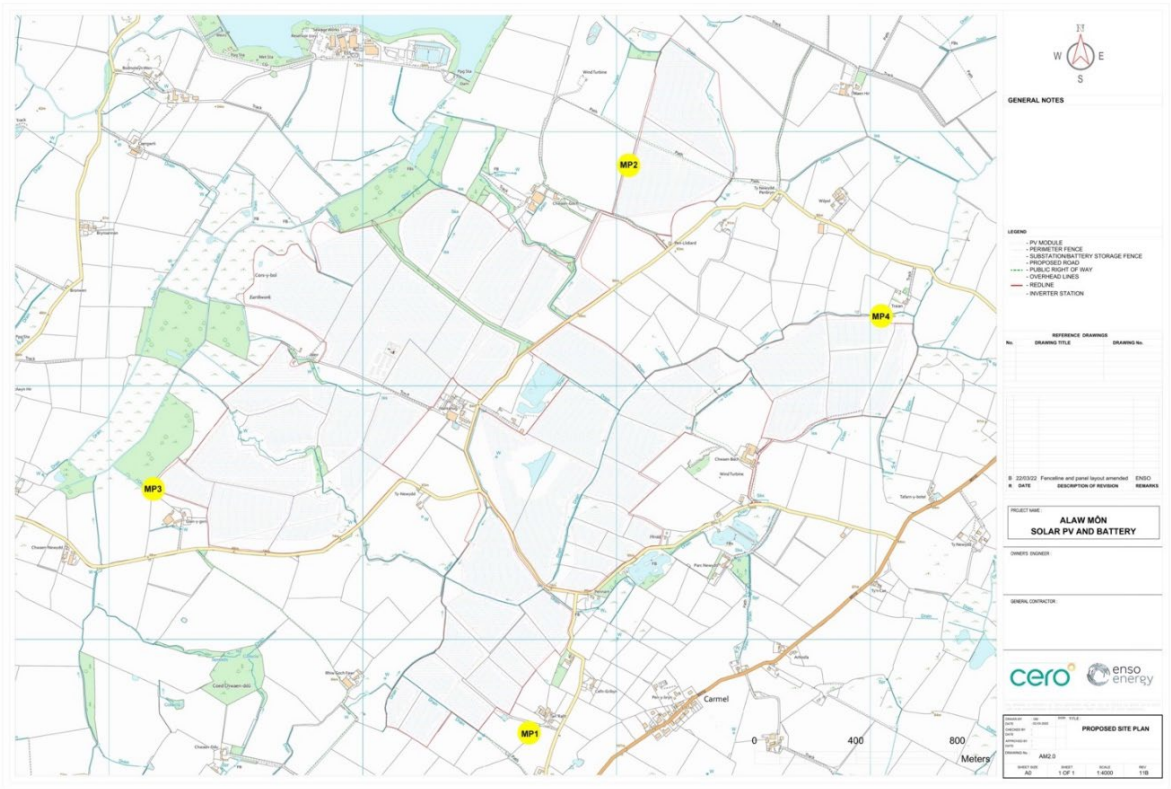
- MP1 – a predominantly unattended measurement of baseline sound adjacent to the hamlet of Carmel, to the south-east of the Site. The microphone was located at a height of 1.5 metres above local ground level, under free-field conditions. The background sound environment was entirely influenced by natural sources, such as wind-induced vegetation movement and animal activity;

- MP2 - a predominantly unattended measurement of baseline sound within the vicinity of Chwaen-Goch, to the north-west of the Site. The microphone was located at a height of 1.5 metres above local ground level, under free-field conditions. The background sound environment was influenced by natural sources, such as wind-induced vegetation movement and animal activity, with some barely audible contributions arising from a wind turbine to the north;

- MP3 - a predominantly unattended measurement of baseline sound within the vicinity of Chwaen-Newydd and Glan-y-gors, to the south-west of the Site. The microphone was located at a height of 1.5 metres above local ground level, under free-field conditions. The background sound environment was influenced by natural sources, such as wind-induced vegetation movement and animal activity; and

- MP4 - a predominantly unattended measurement of baseline sound adjacent to Traian, to the north-east of the Site. The microphone was located at a height of 1.5 metres above local ground level, under free-field conditions. The background sound environment was influenced by natural sources, such as wind-induced vegetation movement and animal activity, with some contributions arising from domestic activity nearby.

Figure 12.2: Baseline Noise Measurement Locations



Summary of Results

12.53 The summarised results of the environmental noise measurement are presented in Table 12.7, with a measured time history and statistical analyses presented within Appendix 12.2.

Table 12.7: Summary of Noise Measurement Results

Position	Period	Noise Level, dB			
		$L_{Aeq,T}$	L_{A90}	L_{A10}	L_{AFMax}
MP1	Daytime – 07:00-23:00	43	27	39	66
	Night-time – 23:00-07:00	43	20	30	72
MP2	Daytime – 07:00-23:00	51	29	46	77
	Night-time – 23:00-07:00	45	21	35	74
MP3	Daytime – 07:00-23:00	48	23	34	69
	Night-time – 23:00-07:00	36	20	25	63
MP4	Daytime – 07:00-23:00	50	28	45	72
	Night-time – 23:00-07:00	48	25	33	62

Future Baseline

12.54 The future baseline, in the absence of any development at the Site or its immediately surrounding area is not anticipated to significantly change, due to the absence of any significant development or transport infrastructure in the area, which may have the potential to generate greater levels of baseline noise than those measured under Covid-19 pandemic lockdown conditions.

Likely Significant Effects

Development Design

12.55 The Development has been designed, such that all noise generating plant is optimally located and distributed throughout the Site, such that acoustic effects at sensitive receptors are minimised. This approach, coupled to the use of candidate plant specifications, to be adopted as design targets effectively designs out the operational noise effects of the Development.

12.56 The construction techniques to be used for the Development have been specifically selected, such that the noise and vibration effects at all sensitive receptors are appropriately managed and minimised.

Construction Phase

Construction Noise

12.57 Noise level predictions have been undertaken to provide an estimate of the noise emissions from the Site during the construction works at the nearest receptors. From these predictions, it has been possible to determine whether the adopted target noise criterion of 65 dB $L_{Aeq,T}$ is likely to be met during the noisiest stages of the works. The magnitude of any impact has then been determined and the requirement for further mitigation measures considered.

12.58 The Site lies within a sparsely populated area. However, residential uses are located in the vicinity of the Site, with the nearest off-Site sensitive receptors lying adjacent to the Site boundary.

12.59 Construction noise level predictions have been based on the construction noise assumptions on the plant to be used and the source noise data provided in BS5228. These are provided in Appendix 12.3.

12.60 Predicted noise levels have been based on a worst-case scenario, where the noisiest item of construction plant is located at the closest point of the proposed construction works to the sensitive off-site receptors. The predictions assume no screening between the source and receiver, so represent a worst-case scenario.

12.61 The results of the noise predictions are presented in Table 12.8.

Table 12.8: Predicted Construction Noise Levels at Off-Site Receptors

Receptor	Predicted $L_{Aeq,T}$ - dB		
	Site Preparation	Foundations/Mini Piles	Structure/Framework
R1 Nantanog	50	45	44
R2 Chwaen Goch	54	49	48
R3 Maen Hir	46	41	40
R4 Wilpol	45	40	39
R5 Ty Newydd Penbryn	49	44	43
R6 Pen Lidiard	51	46	45
R7 Traian	58	53	52
R8 Chwaen Bach	55	50	49
R9 Parc Newydd	48	43	42
R10 Ffridd	54	49	48
R11 Pennant	54	49	48
R12 Cefn Gribyn	57	52	51
R13 *address unknown*	52	47	46
R14 Tan Rallt	54	49	48
R15 Rhiw Goch Fawr	52	47	46
R16 Ty Newydd	62	57	56
R17 Glan y Gors	56	51	50
R18 Brynsannan	41	36	35
R19 Caerwrli	42	37	36

12.62 The predictions presented in Table 12.8 identify that noise levels are not predicted to exceed the adopted 65 dB(A) limit when works are undertaken at the closest point of the works to the closest off-site sensitive receptor, equating to a temporary effect of negligible to minor adverse significance which is not significant.

12.63 Consequently, mitigation measures are not considered necessary. However, the 'Mitigation Measures' section of the Chapter sets out a series of good practice measures have been incorporated into the Outline CEMP (Appendix 5.1 of the ES).

Construction Vibration

12.64 The separation distances between the closest construction works and the closest residential receptors, coupled with the low-intensity nature of the construction works, would ensure that construction vibration impacts on these receptors would be no greater than negligible.

12.65 With specific regard to the Nantanog geological SSSI; although the Development will involve piling for the photovoltaic ('PV') frame legs, the method to be employed will be micro-piling, to a potential maximum depth of 1.5m to 2m. This technique gives rise to vibration levels that are sufficiently low so as to ensure that effects are perceptibly insignificant beyond 10m from the source i.e. they cannot be felt or detected and will therefore have no structural significance in very close proximity to the source (with thresholds for structural significance being much higher than the threshold of human perceptibility).

12.66 Consequently, although appropriate offset distances will be adopted to prevent any direct disturbance of the Nantanog geological SSSI, no specific mitigation measures will be required given this piling technique's low level of vibration generation, thus ensuring no vibration impacts on the SSSI would occur.

Grid Connection

12.67 The grid connection works would be additional to those considered above and would be located in a trench within the public highway, leading to the National Grid substation at Wylfa. These works would be of a low impact significance; being both brief in duration and giving rise to no more of an effect than typical utilities maintenance works, that residents of the area would be accustomed to. Its effect is therefore not considered significant.

Operational Phase

Noise Source Information

12.68 The sound source levels used in the assessment are set out in Table 12.9. It is important to note that these are candidate plant selections, used for the purposes of this assessment and that individual plant specifications may differ.

Table 12.9: Sound Source Data

Plant	Quantity	Sound Power Level – dB(A)
Acoustically Enclosed PV Inverter Stations	36	71
Grid Connection Transformer	1	78
Acoustically Attenuated Battery Storage Units	42	76
Acoustically Enclosed BESS Inverter Stations	21	71

Calculation Process

12.69 Calculations were carried out using Cadna/A software, which undertakes its calculations in accordance with guidance given in ISO9613-1:1993[xii] and ISO9613-2:1996[xiii].

Sound Data Assumptions

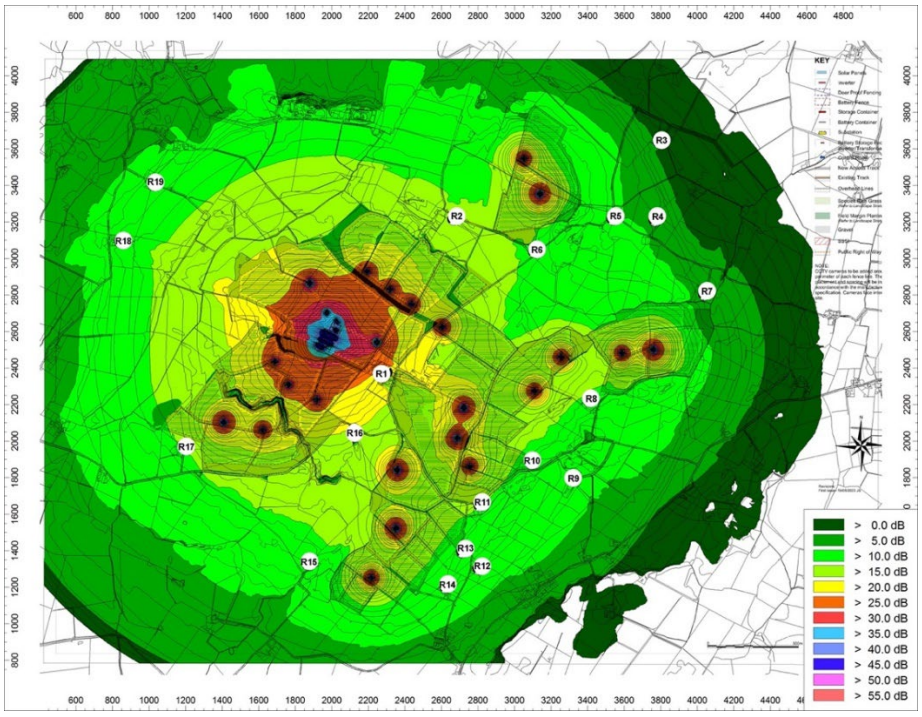
12.70 Given that the land between Development and nearest receptors is predominantly soft, the ground factor has been set to 0.9, within the calculation software.

12.71 The assessment considers open sound propagation from the Site, and assumes that there are no proposed perimeter acoustic barriers which could reduce noise levels at sensitive receptors.

Specific Sound Level Map

12.72 The sound map showing the specific sound level emissions from the Development is shown in Figure 12.3.

Figure 12.3: Specific Sound Level Map



Specific Sound Level Summary

12.73 A summary of the predicted specific sound levels at the identified receptors, based on the sound map shown in Figure 12.3 can be seen in Table 12.10.

Table 12.10: Predicted Specific Sound Level Summary

Receptor	Predicted Specific Sound Level – dB(A)
R1 Nantanog	19.3
R2 Chwaen Goch	16.1
R3 Maen Hir	4.5
R4 Wilpol	8.3
R5 Ty Newydd Penbryn	10.2
R6 Pen Lidiard	14.5
R7 Traian	8.0
R8 Chwaen Bach	13.9
R9 Parc Newydd	11.3
R10 Ffridd	13.3
R11 Pennant	15.0
R12 Cefn Gribyn	13.7
R13 *address unknown*	12.1
R14 Tan Rallt	12.6
R15 Rhiw Goch Fawr	12.9
R16 Ty Newydd	13.6
R17 Glan y Gors	15.4
R18 Brynsannan	13.3
R19 Caerwrli	12.4

Assessment of Likely Significant Effects from Operational Noise

Rating Penalty Principle

12.74 Section 9 of BS4142:2014+A1:2019 describes how the rating sound level should be derived from the specific sound level, by determining a rating penalty. BS4142:2014+A1:2019 states:

> ***'Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:***
>
> ***a) subjective method;***
> ***b) objective method for tonality;***
> ***c) reference method.'***

12.75 Given that the Development is proposed and not currently operational, the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014+A1:2019, which states:

> ***'Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.***

Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources.'

12.76 BS4142:2014+A1:2019 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

Tonality

12.77 A rating penalty of +2 dB is applicable for a tone which is '"just perceptible", +4 dB where a tone is "clearly perceptible", and +6 dB where a tone is "highly perceptible"'.

Impulsivity

12.78 A rating penalty of +3 dB is applicable for impulsivity which is '"just perceptible", +6 dB where it is "clearly perceptible", and +9 dB where it is "highly perceptible"'.

Other Sound Characteristics

12.79 BS4142:2014+A1:2019 states that where 'the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied'.

Intermittency

12.80 BS4142:2014+A1:2019 states that when the 'specific sound has identifiable on/off conditions, the specific sound level ought to 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 +3 dB can be applied.'

Rating Penalty Assessment

12.81 Considering the content above, an assessment of the various sound sources associated with the Development, in terms of whether any rating penalties are applicable, has been carried out and has been detailed in Table 12.11.

Table 12.11: Rating Penalty Assessment

Source	Tonality	Impulsivity	Intermittency	Other Sound Characteristics	Discussion
PV Inverters and Transformers	+2 dB	0 dB	0 dB	0 dB	The PV inverters and transformers will operate as demand requires, however, once operating, do not cycle on and off. Tonality may be "just perceptible" at some receptors, due to a low to mid-frequency bias at source, but the residual acoustic environment will substantially mask any significant tones.

Battery Storage	+2 dB	0 dB	0 dB	0 dB	The HVAC for battery storage could operate continuously. Tonality may be "just perceptible" at some receptors, due to a potential low to mid-frequency bias at source, but the residual acoustic environment will substantially mask any significant tones.

12.82 In summary, a rating penalty of +2 dB has been included in the assessment.

Uncertainty in Calculations

12.83 11.73 BS4142:2014+A1:2019 requires that the level of uncertainty in the measured data and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of uncertainty.

Measurement Uncertainty

12.84 BS4142:2014+A1:2019 states that measurement uncertainty depends on a number of factors, including the following, which are applicable to the Development:

> '….
>
> **b) the complexity and level of variability of the residual acoustic environment;**
>
> **….**
>
> **d) the location(s) selected for taking the measurements;**
>
> **….¶**
>
> **g) the measurement time intervals;**
>
> **h) the range of times when the measurements have been taken;**
>
> **i) the range of suitable weather conditions during which measurements have been taken;**
>
> **....**
>
> **k) the level of rounding of each measurement recorded; and**
>
> **l) the instrumentation used.'**

12.85 Each of the measurement uncertainty factors outlined above have been considered and discussed in Table 12.12.

Table 12.12: Measurement Uncertainty Factors

Measurement Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Residual acoustic environment is relatively constant, hence no correction for a complex residual acoustic environment.
d)	0 dB	Measuring at locations representative of the closest affected receptors to the Site has enabled the determination of robust background sound levels.
g)	0 dB	Measurement time intervals were set in accordance with BS4142:2014+A1:2019, hence no further correction needs to be made.
h)	0 dB	Measurements were undertaken over seven consecutive daytime and night-time periods.
i)	0 dB	Where periods of wind or precipitation were measured, they were removed from the dataset.
k)	0 dB	Measured values were rounded to 0.1 dB, therefore rounding would not have had a significant impact on the overall typical background sound levels.
l)	0 dB	The acoustic measurement equipment accorded with Type 1 specification of British Standard 61672.

12.86 In summary, a correction of 0 dB has been included in the assessment, to account for measurement uncertainty.

Calculation Uncertainty

12.87 BS4142:2014+A1:2019 states that calculation uncertainty depends on a number of factors, including the following, which are applicable to the Development:

> **'…**
>
> **b) uncertainty in the operation or sound emission characteristics of the specific sound source and any assumed sound power levels;**
>
> **c) uncertainty in the calculation method;**
>
> **d) simplifying the real situation to "fit" the model (user influence on modelling); and**
>
> **e) error in the calculation process.'**

12.88 Each of the calculation uncertainty factors outlined above have been considered and discussed in Table 12.13.

Table 12.13: Calculation Uncertainty Factors

Calculation Uncertainty Factor Reference	Level of Uncertainty	Discussion
b)	0 dB	Sound source levels for all plant are based on candidate data for currently available equipment, which will be achieved by the design.
c)	0 dB	Calculations were undertaken in accordance with ISO 9613-2, which is considered a "validated method" by BS4142:2014+A1:2019.
d)	0 dB	The real situation has been simplified for the purposes of this assessment, with the majority of on-site screening effects removed, resulting in a worst-case propagation model.
e)	+1 dB	ISO 9613-2 indicates that there is a ±3 dB accuracy to the prediction method, dependent upon input variables and propagation complexities.

12.89 In summary, an uncertainty budget of ±1 dB has been considered in the assessment, to account for calculation uncertainty. The overall uncertainty is considered to be small enough that it would not affect

the conclusions of the assessment. It is also noted that because the assessment considers a worst-case scenario, such as downwind sound propagation (which in reality cannot happen at all NSRs at the same time) the relevance of the uncertainty is further reduced.

Rating Sound Level

12.90 Incorporating the rating penalties detailed in Table 12.11 with the predicted specific sound levels, as detailed in Table 12.10, the rating sound levels have been derived and have been detailed in Table 12.14.

Table 12.14: Rating Sound Levels

Receptor	Predicted Specific Sound Level – dB(A)	Predicted Rating Sound Level – dB(A)
R1 Nantanog	19	21
R2 Chwaen Goch	16	18
R3 Maen Hir	5	7
R4 Wilpol	8	10
R5 Ty Newydd Penbryn	10	12
R6 Pen Lidiard	15	17
R7 Traian	8	10
R8 Chwaen Bach	14	16
R9 Parc Newydd	11	13
R10 Ffridd	13	15
R11 Pennant	15	17
R12 Cefn Gribyn	14	16
R13 *address unknown*	12	14
R14 Tan Rallt	13	15
R15 Rhiw Goch Fawr	13	15
R16 Ty Newydd	14	16
R17 Glan y Gors	15	17
R18 Brynsannan	13	15
R19 Caerwrli	12	14

BS4142:2014+A1:2019 Assessment of Operational Effects

12.91 The rating sound level, as calculated from the predicted specific sound level, has been assessed in accordance with BS4142:2014+A1:2019, at all residential noise sensitive receptors ('NSRs').

12.92 The resultant assessment summary, during the daytime period, is shown in Table 12.15.

Table 12.15: Daytime BS4142 Assessment Summary

Receptor	Rating Sound Level - dB	Daytime Background Sound Level – dB(A)	Excess of Rating over Daytime Background Sound Level - dB
R1 Nantanog	21	29	-8
R2 Chwaen Goch	18	29	-11
R3 Maen Hir	7	29	-22
R4 Wilpol	10	29	-19
R5 Ty Newydd Penbryn	12	29	-17
R6 Pen Lidiard	17	29	-12
R7 Traian	10	28	-18
R8 Chwaen Bach	16	26	-10
R9 Parc Newydd	13	26	-13
R10 Ffridd	15	26	-11
R11 Pennant	17	26	-9
R12 Cefn Gribyn	16	26	-10
R13 *address unknown*	14	26	-12
R14 Tan Rallt	15	26	-11
R15 Rhiw Goch Fawr	15	26	-11

Receptor	Rating Sound Level - dB	Daytime Background Sound Level – dB(A)	Excess of Rating over Daytime Background Sound Level - dB
R16 Ty Newydd	16	23	-7
R17 Glan y Gors	17	23	-6
R18 Brynsannan	15	23	-8
R19 Caerwrli	14	23	-9

12.93 As shown in Table 12.15, the Development is likely to have a 'low impact' at the sensitive receptors during the daytime period, giving rise to a negligible effect.

12.94 The resultant assessment summary, during the night-time period, is shown in Table 12.16.

Table 12.16: Night-time BS4142 Assessment Summary

Receptor	Rating Sound Level - dB	Night-time Background Sound Level – dB(A)	Excess of Rating over Night-time Background Sound Level - dB
R1 Nantanog	21	21	0
R2 Chwaen Goch	18	21	-3
R3 Maen Hir	7	21	-14
R4 Wilpol	10	21	-11
R5 Ty Newydd Penbryn	12	21	-9
R6 Pen Lidiard	17	21	-4
R7 Traian	10	25	-15
R8 Chwaen Bach	16	20	-4
R9 Parc Newydd	13	20	-7
R10 Ffridd	15	20	-5
R11 Pennant	17	20	-3
R12 Cefn Gribyn	16	20	-4
R13 *address unknown*	14	20	-6
R14 Tan Rallt	15	20	-5
R15 Rhiw Goch Fawr	15	20	-5
R16 Ty Newydd	16	20	-4
R17 Glan y Gors	17	20	-3
R18 Brynsannan	15	20	-5
R19 Caerwrli	14	20	-6

12.95 As shown in Table 12.16, the Development is likely to have a ‘low impact’ and consequently, a negligible effect at the sensitive receptors during the night-time period.

12.96 The results set out above identify that the operation of the Development would occur without affecting the amenity of the closest residential receptors to the Site, equating to a negligible effect.

Mitigation Measures

Construction Phase

12.97 Although the assessment of construction noise and vibration has identified no significant impact, the following good practice measures have been incorporated into the Outline CEMP. A full explanation of measures to control construction noise would be incorporated within a detailed CEMP.

12.98 Effective co-ordination and time management of construction operations would be important in avoiding noise and vibration nuisance to surrounding uses. Early and helpful communications with the surrounding receptors would assist reducing potential for and in managing any complaints arising during the construction works of the Development.

12.99 Contractors would be required to ensure that works are carried out in accordance with BPM as stipulated in the Control of Pollution Act 1974. A full explanation of measures to control construction noise would

be incorporated within a detailed CEMP and detailed in all demolition and construction method statements.

12.100 The proposals in regard to general noise mitigation would be in accordance with BPM as specified in BS5228 and would comprise the following, where possible:

- Using 'silenced' plant and equipment;
- Switching off engines where vehicles are standing for a significant period of time;
- Fitting of acoustic enclosures to suppress noisy equipment as appropriate;
- Operating plant at low speeds and incorporating of automatic low speed idling;
- Selecting electrically driven equipment in preference to internal combustion powered, hydraulic power in preference to pneumatic and wheeled in lieu of tracked plant;
- Properly maintaining all plant (greased, blown silencers replaced, saws kept sharpened, teeth set and blades flat, worn bearings replaced, etc.);
- Considering the use of temporary screening or enclosures for static noisy plant to reduce noise emissions as appropriate;
- Certifying plant to meet any relevant EC Directive standards; and
- Undertaking awareness training of all contractors in regards to BS5228 (Parts 1 and 2) which would form a prerequisite of their appointment.

12.101 Typically, adopting BPM would have the potential to reduce overall construction noise levels by approximately 5 dB; however, this is dependent upon the type and extent of activities being carried out.

12.102 Should any non-routine activities be identified that would make it impracticable to work to the target criterion, provisions would be set out in advance and with the agreement of IACC, to minimise and noise or vibration impacts.

12.103 Noise monitoring would be carried out during particularly noisy phases of work and when work is undertaken in close proximity to the Site boundary so that such situations can be actively managed in accordance with the detailed CEMP for the Site.

12.104 For any proposed construction works to be undertaken outside of the permitted working day, particularly at night, prior consent would be sought from IACC. Dispensation procedures for works would be agreed in advance and included within Construction Method Statements and the detailed CEMP or S61 Agreement where adopted. S61 of the Act allows a contractor to apply to IACC for prior consent for construction works.

12.105 Deliveries and removal of material off-Site, would be subject to the following controls:

- Ensuring that construction traffic is parked off the public highway;
- Controlling the discharge of trucks from Site to avoid congestion; and
- Implementing traffic management systems at the entrance to the Site at all times to control the traffic into the Site.

Operational Phase

12.106 No mitigation measures for the Development’s operational phase are considered necessary, beyond an appropriately worded, noise-limiting planning condition.

Residual Effects

Construction Phase

12.107 The adoption measures set out in the Outline CEMP is expected to minimise the potential for noise and vibration impacts rather than achieve significant reductions, on the basis of the input parameters considered.

12.108 Consequently, the predicted impacts remain unchanged, with no worse than temporary effects of negligible to minor adverse significance anticipated.

Operational Phase

12.109 On the basis of the worst-case scenario input parameters considered within the assessment, no mitigation measures are considered necessary, and therefore predicted operational noise effects will remain unchanged, equating to no worse than negligible residual effects.

Cumulative Effects

12.110 As stated in Chapter 2 EIA Methodology, the Development is not anticipated to result in likely significant cumulative effects with other schemes. No significant cumulative effects in respect of noise and vibration are anticipated from either the construction or operational phases of the Development.

Decommissioning

12.111 Noise effects during the decommissioning stage of works, after the Development has completed its modelled operational 40-year lifespan are anticipated to be similar to or lesser than those predicted for the Development's construction phase, which have been predicted to be of negligible to minor adverse significance. Many of the activities will be replicated, but in reverse and with the benefits of technological advancements that will inevitably have occurred during the lifespan of the Proposed Development, which would be anticipated to reduce noise generation and working duration.

Summary

12.112 The assessment of noise and vibration, arising from construction activities has considered a robust set of input parameters and concluded that effects will typically be temporary negligible to no worse than minor adverse, at the closest receptor to any works.

12.113 No mitigation measures are considered necessary on this basis. However, a range of measures have been set out within the Outline CEMP, which will ensure that all construction noise and vibration effects will be kept to an absolute minimum.

12.114 The assessment has considered a set of worst-case, candidate input parameters and on this basis has been predicted to give rise to no worse than a negligible impact at the assessed receptors.

12.115 Table 12.16 contains a summary of the likely significant effects of the Development on noise and vibration.

Table 12.16: Table of Significance – Noise and Vibration

Potential Effect	Nature of Effect (Permanent/Temporary)	Significance (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)	Mitigation / Enhancement Measures	Geographical Importance*							Residual Effects (Major/Moderate/Minor) (Beneficial/Adverse/Negligible)
				I	UK	W	R	C	B	L	
Construction Phase											
Effects from Construction Noise	Temporary	Minor Adverse	None required, but CEMP to minimise effect							X	Negligible
Effects from Construction Vibration – Residential Receptors	Temporary	Negligible	None required, but CEMP to minimise effect							X	Negligible
Effects from Construction Vibration – Nantanog Geological SSSI	Temporary	Negligible	None required, but CEMP to minimise effect							X	Negligible
Operational Phase											
Effects from Operational Plant Noise	Permanent	Negligible	Noise Limiting Planning Condition							X	Negligible
Cumulative Effects											
None identified											

*** Geographical Level of Importance**
I = International; UK = United Kingdom; W = Wales; R = Regional; C = County; B = Borough; L = Local

REFERENCES

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[vi] Secretary of State, 1974. *The Control of Pollution Act*. HMSO.
[vii] BSI, British Standard 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites. Noise.*
[viii] BSI, British Standard 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites. Vibration.*
[ix] BSI, British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound.*
[x] BSI, British Standard 7445-1:2003 *Description and measurement of environmental noise. Guide to quantities and procedures.*
[xi] BSI, British Standard EN 61672-1:2013 *Electroacoustics. Sound level meters. Specifications.*
[xii] ISO 9613-1:1993 *Acoustics — Attenuation of sound during propagation outdoors — Part 1: Calculation of the absorption of sound by the atmosphere.*
[xiii] ISO 9613-1:1996 *Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation.*