Galileo 03 Ltd.

Mynydd Ty-talwyn Energy Park - Environmental Statement Volume II

Main Written Statement– Chapter 9: Noise and Vibration

Project Reference: 663870

This chapter is summarised within the Non-Technical Summary of this Environmental Statement. A Welsh translation of the Non-Technical Summary is also available as part of the application.

Crynhoir y bennod hon yng Nghrynodeb Annhechnegol y Datganiad Amgylcheddol hwn. Mae cyfieithiad Cymraeg o'r Crynodeb Annhechnegol hefyd ar gael fel rhan o'r cais.

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CONTENTS

TABLES

Volume III: Supporting Technical Appendices

Volume IV: Supporting Figures and Plans

9 NOISE AND VIBRATION

9.1 Introduction

9.1.1 This chapter presents an assessment of likely significant effects arising from the construction, operation and decommissioning of the Proposed Development as a result of noise and vibration.

9.1.2 This chapter is supported by the following appendices presented in **ES Volume III**:

- **Appendix 9.1: Scoping Direction Response**;
- **Appendix 9.2: Legislation, Policy and Guidance**;
- **Appendix 9.3: Baseline Noise Survey**;
- **Appendix 9.4: Construction Phase Plant Lists and Project Assumptions**; and
- **Appendix 9.5: Proposed and Cumulative Wind Turbine Details**.

9.1.3 This chapter is supported by the following figures presented in **ES Volume IV**:

- **Figure 9.1: Site Overview**;
- **Figure 9.2: Cumulative Search Area and Study Areas**;
- **Figure 9.3: Baseline Monitoring Locations and Noise Sensitive Receptors**;
- **Figure 9.4: Proposed Development Wind Turbine Noise Contour Map**;
- **Figure 9.5: Cumulative Wind Turbine Noise Contour Map**; and
- **Figure 9.6: Solar and Substation Noise Contour Map**.

9.2 Consultation and Scope

Scoping Direction

9.2.1 The scope of this assessment has been established through an ongoing scoping process. This has involved the production of an EIA Scoping Report (provided in **ES Volume III, Appendix 1.1: EIA Scoping Report**), which was submitted to Planning and Environment Decisions Wales (PEDW) in November 2023. Further information on the scoping process can be found in **ES Volume II, Chapter 5: Approach to the EIA**.

9.2.2 The Scoping Direction, a full copy of which is included in **ES Volume III**, **Appendix 1.2: Scoping Direction**, was provided dated 11 April 2024. **Table 9.1** summarises the key Scoping Direction comments related to this assessment and sets out how these have been addressed by the Applicant. Further information can be found in **ES Volume III, Appendix 9.1: Scoping Direction Response**.

Table 9.1 Summary of Scoping Direction comments relevant to this assessment

ID no.	Issue	Summary of comment raised	Applicant response
ID.58	Study area and methodology	Key issue – Proposed cumulative study area to be increased.	The proposed cumulative study area (or Zone of Influence (ZoI)) has been extended to 5 km, as recommended in **ES Volume III, Appendix 1.2: Scoping Direction**.
ID.58	Study area and methodology	Key issue – Assessment should be based on the inclusion of smaller wind turbines (where data is available).	All operational, consented or proposed wind turbines within 5 km have been included within the assessment.
ID.58	Study area and methodology	Key issue – consultation regarding the survey methodology and assessment positions.	Consultation was undertaken with the Director and Principal Consultant from 24 Acoustics (acting on behalf of Bridgend County Borough Council (BCBC) and Neath Port Talbot Council (NPTC)) in 2024, which culminated in agreement that the baseline noise monitoring locations were appropriate, subject to micro-siting on the day of the installation.
ID.59	Monitoring locations	Key issue – rationale of the number and location for the monitoring locations.	Consultation was undertaken with the Director and Principal Consultant from 24 Acoustics (acting on behalf of BCBC/NPTC) in 2024, which culminated in agreement that the baseline noise monitoring locations are suitable for assessment in line with ETSU-R-97.

ID no.	Issue	Summary of comment raised	Applicant response
ID.60	Low frequency noise (LFN)	Key issue – LFN should be assessed and included in the ES.	LFN is considered within octave band specific noise emission and propagation modelling. The potential for adverse impacts from LFN is further discussed **ES Volume III, Appendix 9.2: Legislation, Policy and Guidance**.
ID 61	Noise and vibration from construction activities associated with the wind farm infrastructure	Key issue – potential adverse effects of noise and vibration from construction and request it is scoped in.	As requested in **ES Volume III, Appendix 1.2: Scoping Direction**, construction noise and vibration has been assessed and reported within this chapter.
ID.62	Amplitude modulation (AM)	Key issue – PEDW - there is inadequate information provided in the EIA Scoping Report to scope out AM. The Applicant should liaise with the LPAs on the supporting information to be provided with regards to amplitude modulation and agree a methodology for this assessment. The approach should be set out in the ES.	AM cannot be dealt with through assessment at the planning stage, as discussed in **Table 9.4**. A technical note was prepared and provided to inform BCBC and NPTC's representative on 13 February 2025. This note set out the proposed methodology for the assessment of AM in relation to scoping comment ID.62. The methodology presented represents current best practice for the assessment of AM from wind farms. No response to this technical note was received.
ID 36	Cultural heritage	Key issue – noise and vibration from the construction access route on heritage assets	Construction access route noise is considered within **Section 9.8**.

ID no.	Issue	Summary of comment raised	Applicant response
			When road surfaces are maintained in good condition and free from significant irregularities, vibration from vehicle movements on the public highway is typically negligible. Therefore, vibration impacts from construction vehicles using existing public highways for Site access routes have not been assessed further, as these routes are maintained to Highway Standards and any potential vibration effects would be minimal.

Additional Consultation

9.2.3 **Table 9.2** provides a summary of the additional consultation activities undertaken in support of the preparation of this assessment outside of the EIA Scoping process.

9.2.4 Consultation on behalf of both BCBC and NPTC has been undertaken by an appointed representative who is a Director and Principal Consultant of 24 Acoustics.

Table 9.2 Summary of Additional Consultation Undertaken

Consultee	Date of engagement	Summary of matters discussed	Applicant response
BCBC and NPTC	Via e-mail Wednesday 10 April 2024	Confirmation of the proposed monitoring locations and request for attendance during the installation of monitoring equipment.	Proposed receptor locations were confirmed as suitable (subject to micro-siting on the day of installation).
BCBC and NPTC	Via e-mail Friday, August 16, 2024	Monitoring methodology and installation details, following equipment installation.	Details of the monitoring methodology and installation are provided within

Consultee	Date of engagement	Summary of matters discussed	Applicant response
		Document Reference: 2061688-RSKA-TN-002-(03) - MTT - Monitoring Installation. BCBC and NPTC's representative was in attendance during the monitoring installation and agreed that the micro-siting of equipment was suitable.	**ES Volume III, Appendix 9.3: Baseline Noise Survey**.
BCBC and NPTC	Via e-mail Monday 10 February 2025	Provided review of consultation, proposed methodology and discussion of Scoping Direction points for comment.	N/A

Statutory Pre-application Consultation (PAC)

9.2.5 **Table 9.3** provides a summary of the responses received, in relation to noise and vibration, following the statutory PAC process, and the necessary action taken to update the assessment, where relevant. Where appropriate, the PAC responses have been summarised. The full consultee comments are set out in the standalone **Pre-application Consultation Report**, which is submitted in support of the DNS Application.

9.2.6 Consultation on behalf of both BCBC and NPTC has been undertaken by an appointed representative who is a Director and Principal Consultant of 24 Acoustics.

Table 9.3 PAC Comments and Responses

Consultee	Consultee comment	Applicant response
BCBC	The approach to cumulative noise assessment for operational noise effects due to wind turbines needs to be reviewed to align with the Institute of Acoustics Good Practice Guide where practicable;	The Applicant notes this comment. A review has been undertaken and the approach is in line with ETSU / IOA GPG.
BCBC	The construction noise assessment should be reviewed to ensure any mitigation measures are proportionate, will be effective and can be secured through inclusion within the CEMP or by condition;	The construction assessment has been reviewed, along with any proposed mitigation requirement. The mitigation measures proposed will be secured through inclusion within the CEMP or by condition.
BCBC	The background noise measurement data has been reviewed. Further analysis and clarification is required to demonstrate data is representative for assessment purposes and that processing data follows best practice;	Updates to the processing of the background noise data has been undertaken in response to the PAC comments. This includes, addition of time history charts, dawn chorus removal, data exclusion identification, polynomial line updates for minima and maxima, time stamp synchronisation confirmation and wind direction filtering review for MP2 and MP7. All undertaken in accordance with ETSU or the IOA GPG. Any changes are identified in response to each specific query below.
BCBC	Detailed review has not been undertaken for the operational noise assessment results. Further clarification and analysis is required including propagation calculations, cumulative assessment approach and background noise data prior to detailed review of assessment results.	The applicant acknowledges this comment. Responses relating to propagation calculations, cumulative assessment approach and background noise data has been provided below.
BCBC	Given that the proposals include new BESS and wind turbine noise sources consideration needs to be given to the cumulative impacts of these elements together on existing noise sensitive receptors;	BESS now removed as part of latest design. The assessment reported in this chapter and the associated appendices in **ES Volume III** have been

Consultee	Consultee comment	Applicant response
		updated to reflect the removal of BESS from the Proposed Development.
BCBC	Chapter 9 Noise – Table 9.9 Calculations of noise from wind turbines should not include the effect of screening from terrain using ground contours which may overestimate the level of screening provided. The Institute of Acoustics (IOA) Good Practice Guidance (GPG) advises no more that 2 dB attenuation due to screening from terrain should be applied. Please confirm if modelling includes screening effects due to terrain.	Screening has been applied in accordance with the IOA GPG. Abar is limited to 2 dB in line with the IOA GPG and no turbine propagation path for the Proposed Development is indicated to have benefited from screening. Abar of up to 2 dB is included for many propagation paths from turbines considered as part of the inter-project cumulative effects assessment due to the turbines relative position with reference to the Noise Sensitive Receptor (NSR) and intervening topographic conditions.
BCBC	Chapter 9 Noise – 9.3.44 Please confirm which propagation paths have concave ground profile corrections have been applied.	Concave ground profile corrections are applied in accordance with the IOA GPG.
BCBC	Chapter 9 Noise – 9.3.52 Please confirm which propagation paths have screening corrections been applied.	Screening has been applied in accordance with the IOA GPG.
BCBC	Chapter 9 Noise – 9.3.60 As per IOA GPG guidance cumulative assessment should be undertaken initially accounting for the consented noise limits for relevant existing turbine sites. Predicted noise levels based on manufacturers data can be used to inform the likely degree of headroom available.	Consented noise limits for the other wind farm projects considered within this assessment were not available at the time of undertaking the assessment. A cumulative wind turbine scheme candidate turbine +2 dB has been added to the sound power levels and used to calculate existing turbines noise levels with reference to

Consultee	Consultee comment	Applicant response
	Please review and clarify if existing noise limits are applicable and notable headroom within limits exists such that using predicted noise levels based on manufacturers data is appropriate.	manufacturers data; this follows the recommendations of the IOA GPG.
BCBC	Chapter 9 Noise – 9.3.66 This section indicates only daytime works are proposed. Please confirm if works are proposed during other time periods (i.e. evening, night-time or weekend periods). If works are proposed during these other time periods, please state threshold values and include appropriate assessment of potential impacts. If not please include a statement to confirm no works are proposed other than daytime. Management of potential impacts due to over-runs or exceptional works/activities (e.g. night-time road closures, out-of-hours deliveries) could be addressed within a Construction Environmental Management Plan.	As set out in **Section 2.6** of **ES Volume II, Chapter 2: Proposed Development Description**, standard core hours are proposed: Daytime (07.00−19.00) and Saturdays (07.00−13.00). Sundays and Public Holidays: No work permitted without prior approval. Exceptional events, such as the delivery of abnormal indivisible loads (AILs), may be delivered outside these hours when the road network is at its quietest to reduce traffic disturbance. These would be managed in accordance with a Construction Traffic Management Plan, and outline of which is provided in **ES Volume III, Appendix 12.1: Outline Construction Traffic Management Plan**. Additionally, turbine foundation concrete pours must take place continuously and so activity would only cease when the pour has been completed. Management of these exceptional events would be achieved through the Construction Environmental Management Plan (CEMP).
BCBC	Chapter 9 Noise – Table 9.17 The duration of vibration due to construction activity is a factor that should be considered within significance criteria.	**Table 9.16** has been updated to include reference to duration.

Consultee	Consultee comment	Applicant response
	Continuous vibration with a level of 0.9 mm/s Peak Particle Velocity (PPV) is likely to be more significant than a single event with a level of 1.0 mm/s.	In accordance with Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration, effects are deemed potentially significant if moderate to major vibration levels (i.e., PPV at or above 1.0 mm/s) are experienced for more than 10 days in any 15-day period, or for more than 40 days in any 6-month period.
BCBC	Chapter 9 Noise – Table 9.17 What is the change magnitude classification for construction noise which does not exceed duration criteria.	The magnitude of change remains as per **Table 9.16**. The wording has been updated for clarity. As per Section 3.19 of DMRB LA 111, construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for the durations identified in **Table 9.16**.
BCBC	Chapter 9 Noise – Section 9.6 This section is titled 'Assessment of Likely Effects (Without Additional Mitigation) but does not assess impacts or significance. Clarification is required if assessment has been undertaken with or without additional mitigation in this and following sections.	In order to determine whether any additional mitigation is required, an assessment has firstly been undertaken with embedded mitigation only. Where that assessment has identified that there is potential for likely significant effects to occur in the absence of additional mitigation measures, additional mitigation measures have been proposed in **Section 9.7**. The subsequent assessment of the residual effects following the implementation of this additional mitigation is presented in **Section 9.8**. Where no additional mitigation is required, to ensure consistency with other factor specific assessment chapters within this ES, the assessment findings have been reported in **Section 9.8**. The draft ES chapter submitted as part of the PAC process did not identify the need for any additional mitigation and

Consultee	Consultee comment	Applicant response
		therefore the assessment outcomes were reported in **Section 9.8** for consistency with other factor specific assessment chapters within this ES.
BCBC	Chapter 9 Noise – 9.7.4 Please see comments relating to Appendix 9.4 and plant source noise levels. Please review the need for additional mitigation measures including temporary noise barriers during construction. The assessment makes no reference to the duration of construction activities which is a factor in the determination of significance and the need for additional mitigation. Where necessary additional mitigation should be included within the Construction Environmental Management Plan.	Duration is considered within the determination of significance as per **Table 9.16.** Specific details relating to both the duration and exact location of a specific activity are not available at this stage, as no principal contractor has been appointed. Additional mitigation measures are required to mitigate noise emissions predicted, as outlined in **Section 9.7**. Such measures are also detailed in and secured by **ES Volume III, Appendix 2.1: Outline Construction Environmental Management Plan**. As per **paragraph 9.7.4**, temporary noise barriers will be used when the construction works associated with the access track are taking place within approximately 120m of noise sensitive receptors, as detailed in and secured by **ES Volume III, Appendix 2.1: Outline Construction Environmental Management Plan**.
BCBC	Chapter 9 Noise – 9.8.15 to 9.8.22 No consideration is given to the cumulative noise impact from proposed BESS and wind turbines. It is noted these are assessed under different methodologies however this is not considered within the context discussion section. Where BESS alone approaches a level which may result in adverse impacts, depending on the context, the combination with noise from new wind turbines may result in higher overall	The BESS has been removed as part of latest design; solar and substation are considered below in response to this comment. The substation/solar is predicted to be between 9-32 dB below the contribution of the wind turbines, which would therefore result in a negligible increase to the noise level from the Proposed Development. This has been reviewed

Consultee	Consultee comment	Applicant response
	impacts. This is an indication mitigation should be considered to minimise impacts from the BESS to ensure the cumulative effect of different aspects of the scheme are reduced where possible. This should also be considered within the cumulative effects sections.	across all Standardised 10 m Wind Speeds (m/s) (3 m/s to 12 m/s). This indicates that the solar and substation noise emissions provide a negligible contribution to the noise environment when considered alongside the proposed wind turbines.
BCBC	Chapter 9 Noise – 9.11.5 to 9.11.18 Please see comments regarding propagation calculations, cumulative assessment approach and background noise data. Further clarification and analysis is required prior to detailed review of assessment results.	The Applicant notes this comment. Please see response to comments regarding propagation calculations, inter-project cumulative assessment approach and background noise data.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data The charts showing background noise measurement results and polynomial lines do not clearly show measurement results. It is difficult to see the datapoints in these charts which merge into each other. Please update these charts to show more clearly the measurement results, exclusions and trendlines. Given the large spread in results at some locations it is recommended time history charts are also provided to clarify data exclusions and show the effect wind speed has on each location. See IOA GPG SGN2.	Background noise measurement results and polynomial lines have been updated in **ES Volume III, Appendix 9.3: Baseline Noise Survey**. Time history charts including any data exclusions have now been provided in **ES Volume III, Appendix 9.3: Baseline Noise Survey**. Both are provided based on the IOA GPG SGN2.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data Background noise data has not been filtered to exclude periods affected by dawn chorus. Review of data clearly shows data is affected by dawn chorus.	Time history charts including any data exclusions have been provided in **ES Volume III, Appendix 9.3: Baseline Noise Survey** in accordance with the IOA GPG. The impact of dawn chorus has been investigated and (as suggested within the IOA SGN2 guidance) the removal of

Consultee	Consultee comment	Applicant response
	Please filter data to exclude the dawn chorus and in accordance with IOA GPG.	dawn chorus and its effect on the night-time noise limits is very small due to the ETSU-R-97 night-time fixed minimum limit of 43 dB (rather than the background noise level plus 5 dB).
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data Additional filtering has been applied to exclude unrepresentative or extraneous periods. This appears to include excluding data less than 20 dB $L_{A90,T}$ for several monitoring locations. It is not clear however how this has been completed or which periods have been excluded. This has the potential to affect the polynomial fit for background noise data. Please clarify how background data has been filtered and which periods are excluded. Exclusions should be marked on time history charts.	The Applicant notes this comment. No additional filtering has been applied for data below 20 dB $L_{A90,T}$.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data Given the exposed and rural nature of the majority of measurement locations it is expected background noise levels would be controlled by wind especially at higher wind speeds. Background measurement results at several locations however appear to have a weak correlation with wind speed. Please check and confirm datasets are time synchronised and relevant exclusions have been made which may affect correlation with wind speed.	The Applicant notes this comment. Datasets are confirmed as being matched to Coordinated Universal Time (UTC)+00:00.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data Several measurement locations appear to have a split in the data (e.g. MP2 Night, MP5 Night, MP6 Night, MP7 Night)	Wind direction data have been reviewed in line with IOA GPG SPG2 and it is confirmed that:

Consultee	Consultee comment	Applicant response
	which may be due to wind direction. Wind direction data has not been provided for review. Given that wind direction is considered within the operational noise assessment it is important that comparison of prediction results is made against background noise levels and derived limits representative for these conditions. There is potential that background noise levels are lower under certain wind direction conditions where resulting impacts are higher owing to wind direction. Please provide wind direction data for review and confirm if wind direction affects background noise level and assessment results.	MP7 Night-time: Removing degrees 45 – 135, i.e., E – ESE (direction of A4063 road) has no impact on the derived noise limits. MP2 Night-time: Removing degrees 30 – 120, i.e., E – ESE (direction of A4063 road) has no impact on the derived noise limits. At MP5 and MP6, there is no indication from observations on-site or desktop review that suggest further analysis would be required to assess influence of atypical noise sources.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data It is noted location MP4 is near to existing wind turbines. Please confirm if any corrections have been made to background measurement data to account for operational noise from existing wind turbines at MP4 or any other measurement locations.	MP6 monitoring location (without the influence of the existing turbines) has been used to provide a representative background noise level for the MP4 position, as agreed between the Applicant and BCBC via e-mail correspondence 16 August 2024.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data Given the exposed and rural nature of the majority of measurement locations it is expected background noise levels would be controlled by wind especially at higher wind speeds. Background measurement results at several locations however appear to have a weak correlation with wind speed (e.g. flat polynomial line or large spread in data). There is a large spread in measured background noise levels for several of the monitoring locations (e.g. MP5 indicates	Datasets are confirmed as being matched to Coordinated Universal Time (UTC)+00:00. The derived prevailing background noise polynomial lines have been updated so they do not extend beyond the range covered by adequate data points. The highest derived background noise level has been adopted as a constant value for all wind speeds above the point where this maximum occurs. Similarly, the lowest derived background noise level has been adopted as a constant

Consultee	Consultee comment	Applicant response
	background noise levels are between 25 and 50 dB $L_{A90,T}$ during the daytime). It is noted that polynomial best fit lines derived from data where a large spread in data occurs may result in higher limits and potential adverse impacts during operation of the proposed turbines (i.e. background noise levels may regularly be lower than assumed within derived limits). Whilst it is acknowledged using polynomial best fit lines is recommended within ETSU and the IOA GPG the underlying assumption is that background data is representative for assessment locations. Please check and confirm datasets are time synchronised and relevant exclusions have been made which may affect correlation with wind speed, and that data is representative for assessment purposes.	value for all wind speeds below the point where this minimum occurs as per IOA GPG 3.1.20-3.1.21. The data are considered as representative of the assessment locations. Updates have been made to **Section 9.6, Operational Noise (Wind Farm) Assessment** and **Section 9.11 Inter-Project Cumulative Effects** in **Table 9.37** and **Table 9.38**. **ES Volume III, Appendix 9.3. Baseline Noise Survey** has also been updated.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data The polynomial lines for several monitoring locations reduce at higher wind speeds resulting in lower derived limits for the highest wind speeds compared to lowers speeds. These should be limited to the maxima for highest wind speeds and similarly the minima for lower wind speeds if using third order polynomials. See IOA GPG 3.1.20-3.1.21. Please update derived background noise levels and ETSU limits accounting for these limitations in the data.	The derived prevailing background noise polynomial curves have been updated so they do not extend beyond the range covered by adequate data points. The highest derived background noise level has been adopted as a constant value for all wind speeds above the point where this maximum occurs. Similarly, the lowest derived background noise level has been adopted as a constant value for all wind speeds below the point where this minimum occurs as per IOA GPG 3.1.20-3.1.21. Updates have been made to **Section 9.6, Operational Noise (Wind Farm) Assessment** and **Section 9.11 Inter-Project Cumulative Effects** in **Table 9.37** and **Table 9.38**.

Consultee	Consultee comment	Applicant response
		ES Volume III, Appendix 9.3. Baseline Noise Survey has also been updated.
BCBC	Appendix 9.3: Baseline Noise Survey, & Raw Baseline Data Based on the above comments regarding background data, further analysis and clarification is required to demonstrate measured background noise levels are representative for assessment purposes.	The background data have been reviewed in line with the comments provided and the guidance provided in ETSU and the IOA GPG. In consideration of the dawn chorus, background sound levels have been adjusted for minima and maxima, time and date synchronisation between lidar and noise data and directivity. The updated data is provided within **ES Volume III, Appendix 9.3: Baseline Noise Survey**. All updates have resulted in limited change to the background noise level and derived noise limits. Based on the updates, the background noise data are considered representative for assessment purposes.
BCBC	Appendix 9.4: Construction Plant Lists and Project Assumptions – Table 1-6 Several plant items have very high source noise levels such as Dump Truck and Grader. Values selected from BS5228 refer to maximum drive-by noise levels instead of L_{eq} values. These levels should be reviewed to ensure construction noise is appropriately assessed.	**Table 1** to **6** of **ES Volume III, Appendix 9.4: Construction Phase Plant Lists and Project Assumptions** has been reviewed and updated. LAFmax emission levels from BS5228 have been corrected for one time within the calculation of total activity noise level.
BCBC	Appendix 9.4: Construction Plant Lists and Project Assumptions – Tables 1-6 The final column states 'Cumulative noise level'. The assessment does not consider noise impact from simultaneous or cumulative construction activities. This column should be renamed 'Total activity noise level' or similar.	The heading of the final column in **Table 1** to **6** in **ES Volume III, Appendix 9.4: Construction Phase Plant Lists and Project Assumptions** has been renamed from ‘Cumulative noise level’ to ‘Total activity noise level’.

Consultee	Consultee comment	Applicant response
BCBC	Appendix 9.5 - Proposed and Cumulative Wind Turbine Details Please see previous comment relating to approach for cumulative assessment which should be undertaken initially accounting for the consented noise limits for relevant existing turbine sites.	Where available, consented noise limits at shared receptors have been used. Where not available candidate turbine +2 dB has been used to calculate existing turbines.

Scope of the Assessment

9.2.7 Following the scoping process, the technical scope of the assessment reported in this chapter comprises:

- Construction/decommissioning noise;
- Construction/decommissioning vibration;
- Construction/decommissioning traffic noise; and
- Operational noise (wind turbines, solar and substation).

9.2.8 Operational noise from the BESS was previously proposed to be scoped into the assessment. As the BESS has now been removed from the Proposed Development, no assessment is required.

9.2.9 The following matters are considered unlikely to result in likely significant effects, and therefore have been scoped out of the assessment, as agreed through the EIA scoping process:

- Construction noise and vibration (blasting);
- Operational noise (infrasound – wind turbines); and
- Operational vibration (wind turbines, solar and substation).

9.2.10 **Table 9.4** summarises where the scope of the assessment has changed since the receipt of **ES Volume III, Appendix 1.2: Scoping Direction**.

Table 9.4 Receptor/Matters Changed Since the Scoping Direction

Receptor/matter	Phase	Justification
Amplitude Modulation (AM)	Operational (Wind turbine)	Presently, AM cannot be assessed pre-construction of a wind farm. Therefore, the assessment can only be conducted once the Proposed Development is operational. The document referenced within **ES Volume III, Appendix 1.2: Scoping Direction** (WSP, 2016) highlights that it is not possible to predict whether AM will or will not be prevalent on the Site. Further discussion of AM associated with the operation of wind turbines and appropriate assessment methods are provided in **ES Volume III, Appendix 9.2: Legislation, Policy and Guidance**.

9.3 Methodology

9.3.1 This assessment has been undertaken in accordance with the following legislation, and with regard to the following planning policy and guidance. It should be noted that this chapter does not assess the compliance of the Proposed Development against relevant planning policy. Such an assessment is presented in the standalone **Planning, Design and Access Statement** submitted as part of the DNS application.

Legislation

- Control of Pollution Act 1974 (UK Parliament, 1974) – The Act provides a framework for the regulation of both noise and vibration in the UK, particularly in relation to construction, demolition, and industrial activities; and
- The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 (Llywodraeth Cymru Welsh Government, 2017) (as amended) ("The 2017 Regulations") – The 2017 Regulations provide the requirements for assessing and mitigating significant environmental impacts for development projects in Wales.

National Planning Policy

- Future Wales: The National Plan 2040 - Policies 17 and 18 confirm that proposals for renewable and low carbon energy projects will be permitted subject to certain criteria including no unacceptable adverse impacts by way of noise;
- Planning Policy Wales 12 (Welsh Government Llywodraeth Cymru, 2024) – Section 6.7 Air Quality and Soundscape (Para 6.7.15) – Identifies the importance of creating appropriate soundscapes to enhance well-being, highlighting that planning authorities should consider both the positive and negative impacts of sound;
- Designing for Renewable Energy in Wales, November 2023. This guidance document sets out the key design objectives and considerations for the sensitive development of large-scale onshore wind and solar farms as well as ancillary development in Wales This document updates and expands on the previous Designing Wind Farms in Wales 2014 good practice guidance, published by the Design Commission for Wales. The guidance states that the Welsh Government has endorsed the current UK wind turbine assessment guidance as set out in ETSU-R-97, a Good Practice Guide on the application of ETSU-R-97, and Supplementary Guidance Notes; and
- Technical Advice Note (Wales) 11, Noise – October 1997 – Provides advice on how the planning system can be used to minimise adverse noise impacts and outlines noise exposure limits for residential receptors (Welsh Assembly Government, 1997).

Local Planning Policy

- Bridgend County Borough Local Development Plan 2018-2033, March 2024, Bridgend County Borough Council (BCBC):
  - SP13 Renewable and Low Carbon Energy Development:
    - It can be demonstrated that there will be no unacceptable impacts on the natural and historic environment or local communities (such as noise and air pollution) and that no other unacceptable cumulative impacts will arise;
  - DNP9: Natural Resource Protection and Public Health:
    - DNP9 seeks to ensure that the County's natural environment is protected from materially harmful development. This relates particularly to the effect of development on air, noise, light and water quality; …. new residential and other noise sensitive uses, such as hospitals and schools, will not be acceptable in close proximity to existing noise generating uses or activities;
- Neath Port Talbot County Borough Council Local Development Plan (2011-2026), January 2016, Neath Port Talbot County Borough Council (NPTCBC):
  - Policy SP 16 Environmental Protection:
    - Sets out the approach that will be taken to protect and improve the environment as far as possible;
  - Policy EN 8 Pollution and Land Stability:
    - In relation to noise, potentially noisy proposals should not be located close to sensitive uses (such as hospitals, schools and housing) and new noise-sensitive developments should not be located near to existing noisy uses (including industry and existing or proposed transport infrastructure) unless it can be shown that adverse effects can be dealt with through mitigation measures incorporated into the design. Where noise levels are likely to be a significant issue, developers may be required to provide information to show that no nuisance is likely to be caused through increased noise levels at sensitive locations if the development proceeds;
  - Policy EN 10 Quiet Areas:
- The quiet areas listed have been designated by the Welsh Government under the Environmental Noise (Wales) Regulations. Where development is proposed near to a quiet area, it will be assessed in relation to its effects on the 'pillars' of urban tranquillity, and will be required to ensure that there are no significant adverse effects; and
  - Policy RE 1 Criteria for the Assessment of Renewable and Low Carbon Energy Development:
  - Policy RE 1 highlights that all schemes need to demonstrate that the proposal would not cause any unacceptable noise impacts to the environment.

Guidance

- ETSU-R-97 The Assessment and Rating of Noise from Wind Farms (ETSU/DTI, 1996):
  - ETSU-R-97 presents the findings and recommendations of a working group on wind turbine noise. The report describes a framework for the assessment of wind farm noise with suggested noise limits.
- 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise', Institute of Acoustics, May 2013. (Institute of Acoustics, 2013) :OBJ
- The Institute of Acoustics (IOA) Good Practice Guide (GPG) (IOA GPG) and supplementary guidance notes were developed to standardise the approach to wind farm noise assessments in the UK and provide advice on the form of planning conditions that may be adopted.
- British Standard 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (BS4142:2014+A1 2019):
  - BS 4142 provides a method for rating industrial and commercial sound and a 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.
  - The rating method takes into account specific source characteristics, such as tonality, impulsivity and intermittency. The impact assessment procedure described in BS 4142:2014+A1:2019 is based on the comparison of the rating sound level with the background sound level prevailing at the assessment locations.
- 'Acoustics - Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors, International Organisation for Standardisation', (ISO 9613-2:2024):
  - Part 2 of ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors to enable the prediction of environmental noise at a distance from a variety of sources.
- 'Code of Practice for Noise and vibration control on construction and open sites - Part 1: Noise', British Standards Institution (BS 5228-1: 2009 + A1:2014); and
  - 'Code of Practice for Noise and vibration control on construction and open sites - Part 2: Vibration', British Standards Institution (BS 5228-2: 2009 + A1:2014)
  - BS 5228-1 and BS 5228-2 provide recommendations for basic methods of noise and vibration control relating to construction work. It also provides guidance concerning methods of predicting and measuring noise and vibration, and assessing its impact on those exposed to it.

- The Calculation of Road Traffic Noise (CRTN), Department of Transport Welsh Office (1988) (CRTN, 1988)
  - Sets out standard procedures for calculating noise levels from road traffic. The calculation method uses a number of input variables, including traffic flow volume, average vehicle speed and percentage of heavy-duty vehicles (HDV), to predict the LA10,18hour or LA10,1hour noise level for any receptor point at a given distance from the road.
- Design Manual for Roads and Bridges (DMRB), LA 111 Noise and Vibration (2020) (DMRB LA111, 2020)
  - DMRB document Ref. LA 111 'Noise and Vibration' provides guidance on the assessment of noise and vibration impacts due to road traffic. LA 111 includes impact magnitude criteria for changes in road traffic noise occurring during construction and operational phases, which is applicable across a range of projects.

9.3.2 Further detail on the applicable legislation, policy and guidance is provided in **ES Volume III, Appendix 9.2: Legislation, Policy and Guidance**.

Baseline Characterisation

Extent of the Study Area

9.3.3 The noise and vibration sensitive receptors have been considered within the study areas provided in the below sections.

Construction/Decommissioning Phase

9.3.4 The study area for the construction phase assessment has considered noise sensitive receptors in the form of habitable properties that are located within and up to 300m beyond the Site boundary. This has been determined based on the guidance set out in BS 5228-1: 2009 + A1:2014 and other related guidance documents, including DMRB. This study area has been selected to include the Site, the nearby roads which are considered likely to be affected by the Proposed Development's construction generated traffic and the habitable properties likely to be affected by construction noise. The construction phase study area is shown in **ES Volume IV, Figure 9.2: Cumulative Search Area and Study Areas**.

9.3.5 DMRB states that a study area of 100 m from the closest construction activity with the potential to generate vibration is normally sufficient to encompass vibration sensitive receptors. This study area has been utilised for this assessment.

Operational Phase

9.3.6 In line with ETSU-R-97, the study area adopted for the operational phase assessment has considered noise sensitive receptors within the cumulative 35 dB L_{A90} contour limit up to 12 m/s wind speed from all existing and proposed turbines. The adopted study area reflects the area where the Proposed Development has potential to contribute to the cumulative noise level.

9.3.7 The study area for the solar and substation components of the Proposed Development considers the nearest or most exposed noise sensitive receptors to the proposed installations, in line with the assessment requirement of BS 4142:2014+A1:2019.

Desk study

9.3.8 In order to establish the baseline conditions within the study area, data have been obtained from the following sources:

- The detailed noise assessment (Philip Dundavin Acoustics Ltd, 2013) for Gelli Las Wind Farm, namely the comprehensive background noise surveys in 2012; and
- Potentially sensitive receptors have been identified based on OS AddressBase Plus land use datasets used alongside OS mapping.

Field Study(s)

9.3.9 A baseline noise survey was conducted between Wednesday 24 April and Wednesday 3 July 2024. The data collected was used to determine appropriate ETSU-R-97 and BS 4142:2014+A1:2019 criteria for the Proposed Development.

9.3.10 Meteorological data including wind direction, wind speed, and rainfall was collected concurrently with sound levels across the wind speed range 3 m/s – 12 m/s. Data points were averaged in ten-minute periods, as is standard practice for the assessment of wind turbines.

9.3.11 A Windcube LiDAR was installed on-site at approximate coordinates 285838E, 186090N, as indicated on **ES Volume IV, Figure 9.1: Site Overview**. Hub height wind speeds at 120m were standardised to 10m and correlated with the measured background sound levels.

9.3.12 Details of the measurement positions (MP) are provided in **Table 9.5** and also presented in **ES Volume IV, Figure 9.3: Baseline Monitoring Locations and Noise Sensitive Receptors**.

Table 9.5 Baseline Survey Locations

ID	Measurement location	Easting	Northing
MP1	Land near Uchaf Farm	284957	187358
MP2	Maes-Cadlawr	286654	187227
MP3	Pen-twyn	288886	186110
MP4	Baiden Farm	287017	184965
MP5	Pentyla Farm	285106	185265
MP6	Land near Pentre Farm	284328	185471
MP7	The Poultry Farm	288761	185293

9.3.13 Further details of the baseline survey are provided in **ES Volume III, Appendix 9.3: Baseline Noise Survey**.

Assessment Methodology

Construction Noise

9.3.14 Construction activities will involve the use of a variety of working methods, for which an estimate of the expected noise levels over a representative period has been prepared, in accordance with industry best practice. Noise levels from the construction works experienced by a receptor will vary over time as the distances to noise producing plant and the type of construction activity change.

9.3.15 Noise predictions have been undertaken based on the methodology contained within British Standard 5228-1:2009+A1:2014. The noise predictions have been used to determine whether the construction phase activities have the potential to result in significant adverse effects on the surrounding noise sensitive receptors. The prediction method considers the noise emission level of the proposed plant items, the separation distance between the source and the receptor and the intervening ground conditions.

9.3.16 **Table 9.6** provides details of the construction activities that are scheduled to take place, along with each activity assumed locations. Each activity location is identified graphically within **ES Volume IV, Figure 9.1: Site Overview**.

Table 9.6 Construction Activities

ID	Construction Activity	Location
C1	Site preparation works - establishment	All identified work areas
C2	Access track construction	Access track location
C3	Infrastructure solar: installation of solar modules, support structures and mounting	Solar panels
C4	Installation of inverters and transformers	Solar inverters and transformers
C5	Infrastructure substation: installation of substation transformers	Substation platform
C6	Turbine base construction and turbine erection	Turbine hard standings

9.3.17 Due to the nature of the land within the defined study area, soft ground attenuation has been adopted for the construction phase noise predictions. No allowance has been made for acoustic screening provided by intervening landforms or structures.

Construction Vibration

9.3.18 Certain construction works can produce ground-borne vibration, which has the potential to give rise to impacts at sensitive receptors including buildings, watercourses and buried structures. The main source of vibration associated with the Proposed Development is expected to be attributable to compaction and vibratory rolling during the access track construction.

9.3.19 Piling activities works could be associated with the installation of solar inverters and the turbine erection.

9.3.20 To establish whether the construction phase vibration levels have the potential to result in significant adverse effects, a quantitative assessment has been undertaken. This has been based on the prediction models, guidance and criteria contained in British Standard 5228-2:2009+A1:2014, and accounts for typical vibration generating plant/activities and the separation distances to sensitive receptors.

Assumptions and Limitations - Construction Noise and Vibration

9.3.21 Noise source assumptions for each of the above primary activities are provided within **ES Volume III, Appendix 9.4: Construction Phase Plant Lists and Project Assumptions**.

9.3.22 Vibration source assumptions for operation of rolling and compaction activities associated with access track activities are provided within **ES Volume III, Appendix 9.4: Construction Phase Plant Lists and Project Assumptions**.

9.3.23 No noise or vibration generating construction works, including site engineering and preparatory works, that are audible at the Site boundary will be carried out outside of normal construction working hours of 07:00 to 19:00 hours Monday to Friday and 07:00 to 13:00 hours on Saturdays, Sundays and Public Holidays without prior approval agreed with BCBC and NPTC.

9.3.24 The construction phase assessment has assumed the use of standard construction techniques commensurate for the type of works being undertaken. This approach enables an assessment of likely significant effects to be carried out. The final techniques, plant selection and programme are expected to be determined by the appointed contractor(s) prior to the commencement of construction.

Construction Traffic Noise (Off-site)

9.3.25 Construction vehicle movements on publicly accessible roads is considered within the construction traffic noise assessment, as the activity has the potential to impact nearby sensitive receptors. Construction traffic noise will be generated through vehicle movements associated with the Proposed Development.

9.3.26 The methodology contained within CRTN has been used to calculate the change in noise levels associated with increased road traffic flows. The CRTN assessment focuses on the change in basic noise level (BNL) that is likely to occur on road links as a result of the construction phase traffic.

9.3.27 Construction traffic noise predictions have been carried out at notional receptors located 10m from the edge of the carriageway and 1.5m above ground level. The selected receptor locations are considered to be representative of a wider receptor group and have been selected based on areas likely to result in the greatest effect (i.e. closest to the road network). This is considered to be a robust approach and is appropriate as it is the change in traffic noise level that is of interest, not the

absolute noise levels at any given receptor. The predicted changes in noise level would occur at noise-sensitive receptors along each of the roads considered, regardless of whether they have been specifically considered or not. The CRTN assessment has utilised the 18-hour Annual Average Weekday Traffic (AAWT) for the 2029 'baseline' and 'baseline plus construction' traffic scenarios.

Assumptions and Limitations - Traffic Noise (Off-site)

9.3.28 Traffic vehicle movement assumptions associated with the construction phase are provided within **ES Volume III, Appendix 9.4: Construction Phase Plant Lists and Project Assumptions**.

Construction Traffic Noise (On-site)

9.3.29 Vehicle movements on the constructed access track have been assessed using the haul road calculation formula contained within BS 5228-1 (Section F.2.5). The assessment has been undertaken using the estimated peak weekly vehicle movements throughout the programme.

9.3.30 Haul route vehicle movement assumptions associated with the construction phase are provided within **ES Volume III, Appendix 9.4: Construction Phase Plant Lists and Project Assumptions**.

9.3.31 To provide a conservative estimate of construction traffic noise, peak vehicle movements are based on the total 18-hour traffic movements along the proposed access track during a peak one-hour period.

Operational Noise - Solar and Substation

9.3.32 To establish whether the proposed solar and substation have the potential to result in significant adverse effects, an assessment has been undertaken which considers rating noise levels from the noise sources, compared with the background sound level, as defined in British Standard 4142:2014+A1: 2019 'Methods for rating and assessing industrial and commercial sound'.

9.3.33 According to BS 4142:2014+A1: 2019, where certain features of the specific noise level can increase the significance of impact of a sound level, a character correction is applied to provide a 'Rating Level'. The characteristics of a sound that are likely to cause an increase in the significance of impact are tonality, impulsivity, intermittency or other characteristic features such as an identifiable 'hiss'.

9.3.34 BS 4142:2014+A1: 2019 includes the addition of rating penalties (to the specific noise) as a factor of 'perceptibility', where the prominence of tonal or impulsive sound from a source can be readily distinguishable over the residual sound. For the purposes of the assessment, a rating correction of +3 dB has been applied to account for potential tonality or other acoustic characteristics which may be just perceptible at receptors when compared to existing sound levels.

Assumptions and Limitations - Solar/Substation

9.3.35 Assessment of the solar inverters and substation has been undertaken based on the layout in **ES Volume IV, Figure 2.1: Proposed Development Layout**.

9.3.36 It has been assumed that all operational phase plant/equipment has the potential to operate continuously during both daytime and night-time periods, i.e., no allowance has been made for reduced noise emissions during the hours of darkness. This represents a worst-case scenario as the noise emissions from the solar inverters are expected to reduce during hours of darkness.

9.3.37 Noise source assumptions relating to the solar and substation are provided within **Table 9.7** and **Table 9.8** respectively.

Table 9.7 Adopted Solar Sound Emission Data for Plant

Component	Sound Power Level per Unit, dB L_{wA}	No. of Units
String inverter	83	18
33 kV/0.4 kV auxiliary transformer	68	18

Table 9.8 Adopted 132kV Substation Sound Emission Data for Plant

Component	Sound Power Level per Unit, dB L_{wA}	No. of Units
Substation - Shunt reactor	88	1
Harmonic filter	85	1
Transformer	68	3

9.3.38 All noise source assumptions have been confirmed as representative of the proposed installations by the Applicant. All assumptions have been reviewed and agreed as appropriate by the Applicant.

Operational Noise - Propagation Modelling

9.3.39 The noise prediction method for operational noise is based on International Standard: ISO 9613-2:2024(E): 'Acoustics - Attenuation of sound during propagation outdoors - Part 2: Engineering method for the prediction of sound pressure levels outdoors'. The method considers the following major mechanisms of noise attenuation:

- geometrical divergence (also known as distance loss or geometric damping);
- atmospheric absorption;
- ground effect;
- reflection from surfaces; and
- screening by obstructions, barriers and buildings.

9.3.40 **Table 9.9** details the specific factors used in the modelling of the Proposed Development.

Table 9.9 Modelling Parameters

Item	Input Parameter
Algorithm	ISO 9613-2: 2024
Ground absorption	G = 0.5 – Wind farm G = 0.7 – Solar, Substation
Meteorological conditions	10 degrees Celsius, 70 % humidity
Receptor height	4m
Terrain	OS Terrain 10 ground contours

9.3.41 Sound absorption through the atmosphere is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent, with increasing attenuation towards higher frequencies.

9.3.42 The atmospheric absorption coefficients used in the model are shown in **Table 9.10**.

Table 9.10 Atmospheric Absorption Coefficients

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Atmospheric absorption coefficient (dB/km)	0.12	0.41	1.04	1.93	3.66	9.66	32.77	116.88

Operational Noise (Wind Farm)

9.3.43 The assessment of operational source levels from the proposed turbines is conducted in line with ETSU-R-97, following guidance outlined within the IOA GPG.

Operational Noise (Wind Farm) - Concave Ground Profile

9.3.44 The IOA GPG states that for wind farm assessments, where a receptor is positioned on the opposite side of a valley to a noise source, noise levels can be higher than predicted due to a reduced ground effect and/or the focussing effect of the ground shape. This phenomenon is known as 'concave ground profile' and it can be difficult to calculate its precise effect. The IOA GPG suggests a simplified approach; paragraph 4.3.9 states:

> *"A further correction of +3 dB (or +1.5 dB if using G=0.0) should be added to the calculated overall A-weighted noise level for propagation "across a valley", i.e. a concave ground profile, or where the ground falls away significantly, between the turbine and the receiver location."*

9.3.45 Site topography for the Proposed Development has been analysed within the model and corrections for significant concave ground profiles have been applied in accordance with the IOA GPG where appropriate.

9.3.46 In terms of noise criteria, ETSU-R-97 recommends that:

> *"The variation in background noise level with wind speed will be determined by correlating L_{A90} noise measurements taken over a period of time with the average wind speeds measured over the same 10-minute periods and then fitting a curve to these data."*

9.3.47 For the operational wind assessment, background noise levels during amenity and night-time hours have been derived by plotting the measured L_{A90} against the standardised 10m height wind speeds as described in ETSU-R-97 and the GPG. These are shown in **ES Volume III, Appendix 9.3: Baseline Noise Survey**. Amenity and night-time periods have been defined as per ETSU-R-97.

Operational Noise (Wind Farm) - Directivity

9.3.48 Noise predictions undertaken in accordance with ISO 9613-2 relate to 'worst-case' conditions (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions).

9.3.49 Where turbine noise propagates from opposing directions relative to a receptor location, the result would be a reduction in predicted noise, as the receptor would not experience simultaneous downwind conditions from both directions. This would be the case for the assessment of cumulative impacts of other wind farms. As a result, the IOA GPG suggests that the effects of propagation in different wind directions can be considered:

> *"Based on evidence from the Joule project in conjunction with advice in BS 8233 and ISO 9613-2, current practice suggests that for a range of headings from directly downwind (0°) up to 10 degrees from crosswind (80°), there may be little to no reduction in noise levels; once in crosswind directions (90°) then the reduction may be around 2 dB(A); and when at sufficient distance upwind the reduction would be at least 10 dB(A)."*

9.3.50 For the purposes of the inter-project cumulative assessment, predictions have considered both downwind propagation irrespective of wind direction, and also directional propagation using the attenuation profile provided in Figure 6b of the IOA GPG which accounts for complex landscapes. In line with the IOA GPG, the directional propagation has accounted for the following components for all cumulative wind farms:

- Distance from individual turbines to all receptors within the study area;
- Direction of individual turbines relative to all receptors within the study area; and
- The tip height of the turbine.

9.3.51 Directional noise predictions have been carried out in 45 degree wind direction increments. Where the distance between a turbine and receptor is greater than 18 x tip height, the attenuation adopted has been limited to the highest value presented in Figure 6b of the IOA GPG for the applicable direction (rounded to the nearest 5 degrees).

Operational Noise (Wind Farm) - Barrier Attenuation

9.3.52 The effect of any barrier between the noise source and the receiver position is that noise would be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise.

9.3.53 The IOA GPG states that for wind farm assessments

> *"Topographic screening effects of the terrain (ISO 9613-2, Equation 2) should be limited to a reduction of no more than 2 dB, and then only if there is no direct line of sight between the highest point on the turbine rotor and the receiver location".*

9.3.54 Topographic screening corrections have been incorporated within the predicted noise levels presented in this chapter, where applicable, and are limited to no more than 2 dB in line with the IOA GPG.

Operational Noise (Wind Farm) – Candidate Turbine

9.3.55 The sound power levels across standardised 10m wind speeds and spectral shape of the noise emissions are presented in **ES Volume III, Appendix 9.5 Cumulative Wind Turbine Details**.

9.3.56 Manufacturer data provided does not include reference to uncertainty levels. As such, a standard uncertainty level of 2 dB has been added to all wind turbine predictions.

Inter-Project Cumulative Effects

9.3.57 The ZoI used for the noise and vibration inter-project cumulative effects assessment is 5 km, as recommended within **ES Volume III, Appendix 1.2: Scoping Direction**. The other developments presented in **Table 4.7** of **ES Volume II, Chapter 4: Approach to the EIA** within this ZoI have been subject to a screening assessment, which is reported in **Section 9.11**. The purpose of this screening exercise was to determine which other developments should be taken forward for the inter-project cumulative assessment.

9.3.58 In addition to the other developments presented in **Table 4.7** of **ES Volume II, Chapter 4: Approach to the EIA**, the inter-project cumulative assessment of operational source levels from the proposed and existing wind turbines has been conducted in line with ETSU-R-97, following guidance outlined within the IOA GPG.

9.3.59 Section 5 of the IOA GPG states:

> *"If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary. Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."*

9.3.60 **ES Volume IV, Figure 9.2: Cumulative Search Area** shows the defined study area.

9.3.61 When assessing the operational cumulative noise levels, consideration needs to be given to the noise limits applicable to each wind farm development. The IOA GPG advises that where there is no reasonable prospect of a cumulative wind farm development producing noise levels up to its consented (or proposed) limits, the GPG recommends that predicted noise levels should be used along with an additional safety margin. In this instance, in the absence of noise limits, the source sound power levels have been used to replicate cumulative wind farm predictions following the IOA GPG method described above. An additional margin of 2 dB has been applied to the predicted noise emissions from all wind farms and/or turbines.

Assessment Criteria

Receptor Sensitivity

9.3.62 The sensitivity of affected receptors has been considered on a scale of high, medium, low or negligible.

9.3.63 Receptor sensitivity criteria are defined in **Table 9.11**:

Table 9.11 Receptor Sensitivity

Value	Description
High	Residential properties, educational establishments, hospitals, places of worship, hotels, children's nurseries, nursing homes.
Medium	Commercial premises including offices, halls, public municipal areas, bars and restaurants.
Low	Industrial premises.
Negligible	All other areas such as those used primarily for agricultural purposes.

Magnitude of Change

9.3.64 The magnitude of change has been considered as the change experienced from the current baseline conditions at the sensitive receptor and has been considered on a scale of large, medium, small or negligible.

Construction Noise Criteria

9.3.65 Annex E of BS 5228-1 provides guidance on how to assess construction noise on sensitive receptors. Section E.3.2 details the 'ABC Method' of determining the potential effects of noise. This method defines threshold noise levels for different time periods which are dictated by the pre-construction ambient noise levels. If the construction phase noise levels exceed the appropriate threshold value and duration, then the impact is likely to result in a potential significant effect (as discussed in **Table 9.17**).

Table 9.12 Impact Threshold at Dwellings (BS 5228 Table E.1)

Assessment Category and Threshold Value Period	Threshold Value, $L_{Aeq,T}$ (dB) [1]		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00 – 07:00)	45	50	55
Evening and Weekends [D]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Note: A potential significant effect is indicated if the LAeq, T noise level arising from the Site exceeds the threshold level for the category appropriate to the ambient noise level. If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to Site noise. Applied to residential receptors only.			
[A] Category A used when ambient noise levels (when rounded to the nearest 5 dB(A)) are less than these values. [B] Category B used when ambient noise levels (when rounded to the nearest 5 dB) are the same as the category A values. [C] Category C used when the ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values. [D] 19.00 – 23.00 weekdays, 13.00-23.00 Saturdays and 07.00–23.00 Sundays			

9.3.66 Unless ambient noise levels within the defined study area are sufficiently high to provide masking of construction noise, the lower bound daytime threshold value of 65 dB $L_{Aeq,T}$ applies. For evening and night-time periods, this reduces to 55 dB $L_{Aeq,T}$ and 45 dB $L_{Aeq,T}$ respectively.

9.3.67 For the purpose of this assessment, a daytime construction noise threshold of 65 dB $L_{Aeq,12hrs}$ has been considered as the basis for identifying potential impacts. This is the lower bound cut-off value for daytime construction works. If works are extended into other periods beyond normal daytime hours, reduced threshold noise levels may apply, for which separate authorisation would be secured with the Council.

Construction Vibration Criteria

9.3.68 Annex B of BS 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Vibration' gives guidance on the significance of vibration effects in terms of human response to vibration and structural response to vibration.

9.3.69 The impact magnitude criteria for construction vibration have been derived from BS 5228-2. The impact magnitude criteria are shown in **Table 9.13**.

Table 9.13 Impact Magnitude Criteria & Effect Significance for Human Receptors (Annoyance) – Construction Vibration

Potential Impact	BS 5228-2 Peak Particle Velocity ($mm.s^{-1}$)	Magnitude of change
Construction vibration affecting human receptors	<0.3	Negligible
	<1.0	Small
	<10.0	Medium
	>10.0	Large

Construction Traffic Noise Criteria (Off-site)

9.3.70 DMRB LA 111 'Noise and Vibration' provides magnitude of impact criteria for noise sensitive receptors affected by increases in traffic resulting from construction works, as defined in **Table 9.14**.

Table 9.14 Significance Criteria for Construction Traffic on Public Highway

Magnitude of Impact	Increase in BNL on Public Roads Used for Construction Traffic (dB)
Large	Greater than or equal to 5.0
Medium	Greater than or equal to 3.0 and less than 5.0
Small	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

Construction Traffic Noise Criteria (On-site)

9.3.71 A daytime construction noise threshold level of 65 dB $L_{Aeq,1hr}$ has been considered as the basis for identifying likely impacts from construction traffic movements on the on-site access track. The approach to assessing the magnitude of impact, in relation to this threshold is set out in **Table 9.16**.

Operational Noise (Wind Farm) Criteria

9.3.72 In terms of noise criteria, ETSU-R-97 recommends that:

> *"The variation in background noise level with wind speed will be determined by correlating L_{A90} noise measurements taken over a period of time with the average wind speeds measured over the same 10-minute periods and then fitting a curve to these data."*

9.3.73 For the operational wind assessment, background noise levels during amenity and night-time hours have been derived by plotting the measured L_{A90} against the standardised 10 m height wind speeds as described in ETSU-R-97 and the GPG. These are shown in **ES Volume III, Appendix 9.3: Baseline Noise Survey**. Amenity and night-time periods have been defined as per ETSU-R-97.

9.3.74 The ETSU-R-97 noise criteria relate to two time periods, that are defined as amenity and night-time, defined below in **Table 9.15.**

Table 9.15 ETSU-R-97 Assessment Periods

Day	Time	Period
Monday – Friday	18:00 – 23:00	Amenity hours
Saturday	13:00 – 23:00	Amenity hours
Sunday	07:00 – 23:00	Amenity hours
All Days	23:00 – 07:00	Night-time

9.3.75 Noise criteria for daytime amenity hours are based on lower fixed limits of 35 dB L_{A90} or the measured background level plus 5 dB, whichever is greater. For night-time periods, a lower fixed limit of 43 dB L_{A90}, or the measured background level plus 5 dB, whichever is greater has been adopted. A financially involved lower limit of 45 dB L_{A90} has also been applied in accordance with ETSU-R-97.

Operational Noise (Solar and Substation) Criteria

9.3.76 For the operational solar and substation assessment, the assessment criteria and background noise levels have been determined using guidance from BS4142:2014+A1:2019. These are reported in **ES Volume III, Appendix 9.3: Baseline Noise Survey**.

Operational Noise Definition of Change Magnitude Criteria

9.3.77 The above criterion, and how they relates to the magnitude of change, are summarised in **Table 9.16**.

Table 9.16 Definition of Change Magnitude

Impact	Relevant guidance	Magnitude of change			
		Negligible	Small	Medium	Large
Construction noise [1][2]	BS 5228-1:2009 + A1+2014	≤ ABC criteria minus 5 dB	≤ ABC criteria	≥ ABC criteria to plus 10 dB	> ABC criteria plus 10 dB
Construction vibration	BS 5228-2:2009 + A1+201	< 0.3 PPV ($mm.s^{-1}$)	≥0.3 and < 1.0 PPV ($mm.s^{-1}$)	≥1.0 and <10.0 PPV ($mm.s^{-1}$)	≥10.0 PPV ($mm.s^{-1}$)
Construction traffic noise	CRTN DMRB	0 to <1dB	≥1 to <3 dB	≥3 to <5 dB	≥5 dB
Operational noise solar and substation [3][4]	BS4142:2014+ A1:2019	> 10 dB below $L_{A90, T}$	Between 10 dB below and 5 dB above $L_{A90, T}$	Between 5 dB and 10 dB above $L_{A90, T}$	> 10 dB above $L_{A90, T}$

Notes:

[1] Daytime construction phase noise levels are based on a time period 'T' which equates to the duration of a working day on site;

[2] The construction noise and vibration impact shall constitute a likely significant effect where it is determined that a large or medium magnitude of impact will occur for a duration exceeding ten or more days or nights in any 15 consecutive days or nights, or a total number of days exceeding 40 in any 6 consecutive months.

[3] Based on Rating level compared to the background sound level ($L_{A90, T}$) derived in accordance with BS 4142:2014+A1:2019; and

[4] Significance to be determined in line with BS 4142:2014+A1:2019 and is dependent on context.

9.3.78 Although the lowest measure of magnitude of impact is defined as 'negligible', it should be noted that noise and vibration levels may still be audible/perceptible.

9.3.79 For the purposes of this assessment, the guidance criteria within ETSU- R- 97 have been adopted. This assessment does not combine sensitivity and magnitude of change to determine the significance of effect.

Significance of Effect

9.3.80 The significance of effect is typically determined by combining the sensitivity of the receptor and the magnitude of impact, shown in **Table 9.11** and **Table 9.16**. The exception to this is the Operational Noise (Wind Farm) assessment which uses ETSU threshold criteria (as discussed in **paragraph 9.3.79)**. The assessment of significance relies on best practice, the relevant published standards and guidance documents and professional judgement.

9.3.81 The significance of an effect is reported as either 'significant' or 'not significant'. Where an effect is assessed as 'negligible' or 'minor', this is considered not significant. Where the effect is classed as 'moderate' or 'major', this is considered significant, and shaded grey in **Table 9.18**.

Table 9.17 Significance of Effect

Sensitivity	Magnitude			
	Large	Medium	Small	Negligible
High	Major	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

9.3.82 For the purposes of this assessment, the guidance criteria within ETSU- R- 97 have been adopted. A significant effect would be determined if the ETSU-R-97 derived noise limits (as set out in **paragraph 9.3.75**) are exceeded.

9.4 Baseline Conditions

Existing Baseline

9.4.1 Existing baseline conditions have been measured as described in **ES Volume III, Appendix 9.3: Baseline Noise Survey**.

Sensitive Receptors

9.4.2 **Table 9.18** sets out the sensitive receptors considered within the study area, as identified in **ES Volume IV, Figure 9.2: Cumulative Search Area and Study Areas**.

9.4.3 All habitable noise sensitive receptors within the study area have been considered. The selected assessment points included within the table represent the habitable properties which are most exposed to the Proposed Development. These may represent more than one receptor in the surrounding area.

9.4.4 Three properties; Maescadlawr Farm (NSR5), Bryn-Cyan (NSR6), Cwmrisca Farm (NSR13) and Baiden Farm (NSR15) are financially involved with the Proposed Development.

Table 9.18 Noise and Vibration Sensitive Receptor Locations

ID	NSR Address	Easting	Northing
NSR1	Ty'nton	285235	187650
NSR2	Gilfach Ganol Farm	284903	187560
NSR3	Gilfach Uchaf Farm	284856	187590
NSR4	The Windsor Barn	284903	187609
NSR5	Maescadlawr Farm	286612	187154
NSR6*	Bryn-Cynan	286327	187812
NSR7*	Gadly's Farm	286055	187925
NSR8*	Cefn Ydfa	287760	186622
NSR 9*	Gellis Las Farm	288099	186579
NSR10*	Pen-twyn	288913	186122
NSR11*	Cilduady Farm	288625	185291
NSR12*	The Poultry Farm	288744	185307
NSR13	Cwmrisca Farm	288028	184670
NSR14	Ton Phillip Farm	286701	184720
NSR15	Baiden Farm	287052	185062
NSR16	Pentyla Farm	285110	185236
NSR17*	Ffynnon Iago Farm	284893	185009
NSR18*	Ffynnon Iago Farm	284856	185055
NSR19	Ty Talwyn Farm	285760	184730
NSR20*	The Old Stables	285820	184724
NSR21**	Swn y Nant	288125	184512
NSR22**	Park Farm	287968	184298
NSR23*	Near Pentre Farm	284133	185499
NSR24*	Tyn-y-Rheat Farm	284134	185333
NSR25*	Pentre Lodge	284192	185397
NSR26*	Ty Trisant 2	284208	185427
NSR27*	Ty Trisant	284231	185423
NSR28*	Pentre Farm	284233	185414
NSR29*	Pant Isaf	284117	185428
NSR30*	Ton Mawr Farm	282438	186262
NSR31	Brynfro Farm	287060	187287
NSR32	Y Graig	287277	186766

Note:

* Operational phase only.

** Outside of wind turbine assessment study area.

9.4.5 Background sound levels from the baseline survey and data obtained through the desk-based assessment have been used to derive background sound levels for each assessment location, as presented in **Table 9.19**.

Table 9.19 Baseline Survey Data to Receptors

ID	BS 4142: 2014+A1:2019	ETSU
NSR1	MP1	MP1
NSR2	MP1	MP1
NSR3	MP1	MP1
NSR4	MP1	MP1
NSR5	MP2	MP2
NSR6	MP2	MP2
NSR7	MP2	MP2
NSR8	MP2	NSR8
NSR9	MP2	NSR9
NSR10	MP3	MP3
NSR11	MP7	MP7
NSR12	MP7	MP7
NSR13	MP4	MP6
NSR14	MP4	MP6
NSR15	MP4	MP6
NSR16	MP5	MP5
NSR17	MP5	MP5
NSR18	MP5	MP5
NSR19	MP5	MP5
NSR20	MP5	MP5
NSR21	-	MP4
NSR22	-	MP4
NSR23	MP6	MP6
NSR24	MP6	MP6
NSR25	MP6	MP6
NSR26	MP6	MP6
NSR27	MP6	MP6
NSR28	MP6	MP6
NSR29	MP6	MP6
NSR30	MP6	MP6

ID	BS 4142: 2014+A1:2019	ETSU
NSR31	MP2	MP2
NSR32	MP2	MP2

Future Baseline in the Absence of the Proposed Development

9.4.6 Given the rural setting of the Proposed Development, there are generally not expected to be significant natural changes to the baseline conditions in the future.

9.4.7 There is potential for an increase in traffic flows in the future baseline scenario. However, in the absence of significant alterations to the wider road network, the variation in traffic flows would be expected to be incremental and therefore unlikely to give rise to perceptible changes in the acoustic environment.

9.5 Mitigation Embedded into the Design

9.5.1 This assessment has been based on the principle that measures have been 'embedded' into the design of the Proposed Development to remove potential significant effects as far as practicable, for example by the considered placement of infrastructure. The embedded mitigation relevant to this assessment is detailed in **Table 9.20**.

Table 9.20 Embedded Mitigation

Embedded mitigation measure relevant	Function
Serrated trailing edge to turbine blades (Mode PO7200 (Blades with serrated trailing edge))	Reduction of noise emission from the candidate turbine for the Proposed Development.
Solar inverters (each)	Solar inverter specification which reduces the overall noise emissions to 80 dB L_{wA}.

9.6 Assessment of Likely Effects (Without Additional Mitigation)

Construction

Construction Noise

9.6.1 **Table 9.21** presents the predicted unmitigated construction phase noise levels at a reference distance of 10m based on the plant lists provided in **ES Volume III, Appendix 9.3: Baseline Noise Survey**. The table also includes the separation distance within which the daytime 65 dB $L_{Aeq,12hrs}$ threshold level is predicted to be exceeded.

Table 9.21 Predicted Construction Noise Levels

ID	Construction Activity	Overall Activity Noise Level at 10m	Distance where threshold may be exceeded
C1	Site preparation works - establishment and hoarding[1]	83 dB $L_{Aeq, T}$	85m
C2	Access road construction	82 dB $L_{Aeq, T}$	75m
C3	Infrastructure solar: installation of solar modules, support structures and mounting	81 dB $L_{Aeq, T}$	70m
C4	Infrastructure solar: Installation of inverters and transformers	79 dB $L_{Aeq, T}$	60m
C5	Infrastructure substation: installation of substation transformers	78 dB $L_{Aeq, T}$	50m
C6	Turbine base construction and turbine erection	86 dB $L_{Aeq,T}$	110m
Note: Site preparation works assumed to occur within the turbine, solar, substation and access track construction activity areas as identified within **ES Volume IV, Figure 9.1: Site Overview**.			

9.6.2 All noise source assumptions have been derived following review of available information or data obtained from the Applicant. All assumptions have been reviewed and agreed as appropriate by the Applicant.

9.6.3 Based on the overall activity noise levels presented in **Table 9.21**, noise predictions have been made for the noise sensitive receptors located within the defined study area, as presented in **Table 9.22**.

Table 9.22 Predicted Noise Levels by Construction Activity, dB $L_{Aeq,T}$

Noise Sensitive Receptor	C1	C2	C3	C4	C5	C6	Magnitude of change
NSR1	49	41	47	35	34	43	Negligible
NSR2	49	48	47	34	32	41	Negligible
NSR3	48	48	46	33	32	40	Negligible
NSR4	48	47	46	33	32	40	Negligible
NSR5	47	54	45	33	34	43	Negligible
NSR13	53	63	51	26	25	33	Small
NSR14	47	38	45	26	25	37	Negligible
NSR15	49	46	47	26	25	37	Negligible
NSR16	41	38	39	30	29	41	Negligible

Noise Sensitive Receptor	C1	C2	C3	C4	C5	C6	Magnitude of change
NSR19	43	35	41	26	25	38	Negligible
NSR20	44	35	42	26	25	38	Negligible
NSR21	60	68	58	21	20	35	Medium
NSR22	60	51	58	21	20	35	Negligible
NSR31	61	60	59	30	30	39	Small
NSR32	55	46	53	30	29	44	Negligible
Note: Predictions have been made at 1m from the façade of the NSR, accounting for reflection by adding 3 dB to the calculated (free field) levels.							

9.6.4 It can be seen from **Table 9.28** that, in the absence of additional mitigation measures, the 65 dB $L_{Aeq,T}$ threshold criterion is likely to be achieved at all assessment locations, aside from NSR21.

9.6.5 The sensitivity of all nearby residential receptors is considered to be **high**. The magnitude of change at NSR21 is considered to be **medium**. Therefore, there is likely to be a direct, temporary, short-term, **moderate adverse** effect at NSR21 in the absence of additional mitigation, which is considered to be **significant**.

9.6.6 The pre-additional mitigation assessment has determined that the Proposed Development would result in **no significant noise effects** as a result of construction at all but one receptor (NSR21). Additional mitigation is set out in **Section 9.7**.

Construction Vibration

9.6.7 The operation of piling, rolling and compaction activities have the potential to generate vibration and cause adverse impacts in close proximity to the construction site.

9.6.8 Piling is considered unlikely to cause significant adverse effects due to the separation distances between the proposed activity locations and nearby receptors.

9.6.9 The nearest potential piling activity to a receptor would be associated with the construction activity C3 - Infrastructure Solar: Installation of solar modules, support structures and mounting, which occurs approximately 250m from the nearest residential receptor. This distance is beyond the 100m study area and is therefore unlikely to cause significant adverse effects.

Construction Phase – On-Site Traffic Movements (Access Track)

9.6.10 The movement of vehicular traffic along the on-site tracks has the potential to result in adverse noise effects on surrounding residential receptors.

9.6.11 The pre-additional mitigation assessment has determined that the Proposed Development would result in **no significant noise effects** as a result of on-site traffic movements and therefore no additional mitigation is required. In order to maintain consistency with other factor specific assessment chapters within this ES, the results of this assessment have been reported in **Section 9.8**.

Construction Traffic Noise (Off-site)

9.6.12 The increase in vehicular traffic, including HDVs, on the road network surrounding the Site has the potential to result in adverse noise effects on surrounding residential receptors.

9.6.13 The pre-additional mitigation assessment has determined that the Proposed Development would result in **no significant noise effects** as a result of construction traffic noise (off-site) and therefore no additional mitigation is required. In order to maintain consistency with other factor specific assessment chapters within this ES, the results of this assessment have been reported in **Section 9.8**.

Operation

Operational Noise (Solar and Substation)

9.6.14 The Proposed Development will introduce a range of noise sources which have the potential to result in significant effects at surrounding sensitive receptors. These include the proposed solar and substation.

9.6.15 The pre-mitigation assessment has determined that the Proposed Development would result in **no significant noise effects** as a result of the operation of the solar and substation and therefore no additional mitigation is required. In order to maintain consistency with other factor specific assessment chapters within this ES, the results of this assessment have been reported in **Section 9.8**.

Operational Noise (Wind Farm) Assessment

9.6.16 A summary of the ETSU-R-97 derived noise limits is presented for both the daytime amenity hours (**Table 9.23**) and night-time (**Table 9.24)** assessment periods for each receptor.

Table 9.23 Daytime Amenity Assessment Noise Limits, dB L_{A90}

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	36.1	36.1	36.3	36.7	37.3	38.3	39.7	41.5	41.5	41.5
NSR2	36.1	36.1	36.3	36.7	37.3	38.3	39.7	41.5	41.5	41.5
NSR3	36.1	36.1	36.3	36.7	37.3	38.3	39.7	41.5	41.5	41.5
NSR4	36.1	36.1	36.3	36.7	37.3	38.3	39.7	41.5	41.5	41.5
NSR5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR7	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
NSR8	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR9	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR10	40.4	40.9	41.5	42.1	42.7	43.3	43.3	43.3	43.3	43.3
NSR11	40.4	40.9	41.5	42.1	42.7	43.3	43.3	43.3	43.3	43.3
NSR12	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3	42.3
NSR13	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR14	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR15	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR16	35.5	36.3	37.5	38.8	40.1	41.2	41.2	41.2	41.2	41.2
NSR17	35.5	36.3	37.5	38.8	40.1	41.2	41.2	41.2	41.2	41.2
NSR18	35.5	36.3	37.5	38.8	40.1	41.2	41.2	41.2	41.2	41.2
NSR19	35.5	36.3	37.5	38.8	40.1	41.2	41.2	41.2	41.2	41.2
NSR20	35.5	36.3	37.5	38.8	40.1	41.2	41.2	41.2	41.2	41.2
NSR21	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR22	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR23	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR24	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR25	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR26	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR27	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR28	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR29	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR30	36.7	36.9	37.5	38.5	39.7	41.2	41.2	41.2	41.2	41.2
NSR31	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
NSR32	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8

Table 9.24 Night-time Assessment Noise Limits, dB L_{A90}

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR2	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR3	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR4	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR5	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR6	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR7	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR8	43.0	43.0	43.0	43.0	43.0	44.1	46.0	48.3	51.0	51.0
NSR9	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.6	43.6
NSR10	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4	43.4	43.4
NSR11	43.0	43.0	43.0	43.0	43.0	43.0	43.4	43.4	43.4	43.4
NSR12	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR13	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR14	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR15	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
NSR16	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR17	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR18	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR19	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR20	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR21	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR22	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR23	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR24	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR25	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR26	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR27	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR28	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR29	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR30	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR31	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NSR32	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

9.6.17 It is anticipated that the limits detailed within **Table 9.23** and **Table 9.24** would be secured via a suitably worded planning condition.

Operational Noise (Wind Farm) Assessment

9.6.18 Predicted L_{A90} noise levels from the proposed wind turbines have been presented at 32 assessment locations, which represent sensitive receptors within the defined study area. The predictions across standardised 10m wind speeds of 3 m/s – 12 m/s are shown in **Table 9.25**. The corresponding noise contour plot based on

the maximum sound power level is presented in **ES Volume IV, Figure 9.4: Proposed Development Wind Turbine Noise Contour Map**.

9.6.19 The predictions presented within **Table 9.25** are based on the Vestas V162-7.2 MW including operating using Mode PO7200 (Blades with serrated trailing edge).

Table 9.25 Predicted Wind Turbine Noise Levels, dB L_{A90}

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	26.6	27.6	30.9	36.7	37.2	37.4	37.6	38.1	38.1	38.1
NSR2	25.6	26.6	29.9	35.7	36.2	36.4	36.6	37.1	37.1	37.1
NSR3	25.1	26.1	29.4	35.2	35.7	35.9	36.1	36.6	36.6	36.6
NSR4	25.1	26.1	29.4	35.2	35.7	35.9	36.1	36.6	36.6	36.6
NSR5	28.5	29.5	32.8	38.6	39.1	39.3	39.5	40.0	40.0	40.0
NSR6	25.0	26.0	29.3	35.1	35.6	35.8	36.0	36.5	36.5	36.5
NSR7	24.8	25.8	29.1	34.9	35.4	35.6	35.8	36.3	36.3	36.3
NSR8	24.8	25.8	29.1	34.9	35.4	35.6	35.8	36.3	36.3	36.3
NSR9	22.3	23.3	26.6	32.4	32.9	33.1	33.3	33.8	33.8	33.8
NSR10	17.7	18.7	22.0	27.8	28.3	28.5	28.7	29.2	29.2	29.2
NSR11	16.2	17.2	20.5	26.3	26.8	27.0	27.2	27.7	27.7	27.7
NSR12	15.6	16.6	19.9	25.7	26.2	26.4	26.6	27.1	27.1	27.1
NSR13	18.7	19.7	23.0	28.8	29.3	29.5	29.7	30.2	30.2	30.2
NSR14	23.0	24.0	27.3	33.1	33.6	33.8	34.0	34.5	34.5	34.5
NSR15	24.3	25.3	28.6	34.4	34.9	35.1	35.3	35.8	35.8	35.8
NSR16	25.8	26.8	30.1	35.9	36.4	36.6	36.8	37.3	37.3	37.3
NSR17	23.6	24.6	27.9	33.7	34.2	34.4	34.6	35.1	35.1	35.1
NSR18	23.8	24.8	28.1	33.9	34.4	34.6	34.8	35.3	35.3	35.3
NSR19	22.7	23.7	27.0	32.8	33.3	33.5	33.7	34.2	34.2	34.2
NSR20	21.6	22.6	25.9	31.7	32.2	32.4	32.6	33.1	33.1	33.1
NSR21	19.5	20.5	23.8	29.6	30.1	30.3	30.5	31.0	31.0	31.0
NSR22	20.1	21.1	24.4	30.2	30.7	30.9	31.1	31.6	31.6	31.6
NSR23	24.0	25.0	28.3	34.1	34.6	34.8	35.0	35.5	35.5	35.5
NSR24	22.8	23.8	27.1	32.9	33.4	33.6	33.8	34.3	34.3	34.3
NSR25	23.6	24.6	27.9	33.7	34.2	34.4	34.6	35.1	35.1	35.1
NSR26	23.8	24.8	28.1	33.9	34.4	34.6	34.8	35.3	35.3	35.3
NSR27	23.9	24.9	28.2	34.0	34.5	34.7	34.9	35.4	35.4	35.4
NSR28	24.2	25.2	28.5	34.3	34.8	35.0	35.2	35.7	35.7	35.7
NSR29	23.4	24.4	27.7	33.5	34.0	34.2	34.4	34.9	34.9	34.9

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR30	14.9	15.9	19.2	25.0	25.5	25.7	25.9	26.4	26.4	26.4
NSR31	25.4	26.4	29.7	35.5	36.0	36.2	36.4	36.9	36.9	36.9
NSR32	27.7	28.7	32.0	37.8	38.3	38.5	38.7	39.2	39.2	39.2

9.6.20 To assess the significance of effect, predictions have been compared with the derived ETSU-R-97 noise daytime and night-time criteria, as shown in **Table 9.26** and **Table 9.27**. Exceedances are shown in **bold**.

Table 9.26 Excess Over Daytime Noise Criteria, dB(A)

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	-9.5	-8.5	-5.4	0.0	-0.1	-0.9	-2.1	-3.4	-3.4	-3.4
NSR2	-10.5	-9.5	-6.4	-1.0	-1.1	-1.9	-3.1	-4.4	-4.4	-4.4
NSR3	-11.0	-10.0	-6.9	-1.5	-1.6	-2.4	-3.6	-4.9	-4.9	-4.9
NSR4	-11.0	-10.0	-6.9	-1.5	-1.6	-2.4	-3.6	-4.9	-4.9	-4.9
NSR5	-16.5	-15.5	-12.2	-6.4	-5.9	-5.7	-5.5	-5.0	-5.0	-5.0
NSR6	-20.0	-19.0	-15.7	-9.9	-9.4	-9.2	-9.0	-8.5	-8.5	-8.5
NSR7	-14.0	-13.0	-9.7	-3.9	-3.4	-3.2	-3.0	-2.5	-2.5	-2.5
NSR8	-20.2	-19.2	-15.9	-10.1	-9.6	-9.4	-9.2	-8.7	-8.7	-8.7
NSR9	-22.7	-21.7	-18.4	-12.6	-12.1	-11.9	-11.7	-11.2	-11.2	-11.2
NSR10	-22.7	-22.2	-19.5	-14.3	-14.4	-14.8	-14.6	-14.1	-14.1	-14.1
NSR11	-24.2	-23.7	-21.0	-15.8	-16.0	-16.3	-16.1	-15.6	-15.6	-15.6
NSR12	-26.7	-25.7	-22.4	-16.6	-16.1	-15.8	-15.6	-15.1	-15.1	-15.1
NSR13	-26.3	-25.3	-22.0	-16.2	-15.7	-15.5	-15.3	-14.8	-14.8	-14.8
NSR14	-13.7	-12.9	-10.2	-5.4	-6.1	-7.4	-7.2	-6.7	-6.7	-6.7
NSR15	-20.7	-19.7	-16.4	-10.6	-10.1	-9.9	-9.7	-9.2	-9.2	-9.2
NSR16	-9.7	-9.5	-7.4	-2.9	-3.7	-4.6	-4.4	-3.9	-3.9	-3.9
NSR17	-11.9	-11.7	-9.6	-5.1	-5.9	-6.8	-6.6	-6.1	-6.1	-6.1
NSR18	-11.7	-11.5	-9.4	-4.9	-5.7	-6.6	-6.4	-5.9	-5.9	-5.9
NSR19	-12.8	-12.6	-10.5	-6.0	-6.8	-7.7	-7.5	-7.0	-7.0	-7.0
NSR20	-13.9	-13.7	-11.6	-7.1	-7.9	-8.8	-8.6	-8.1	-8.1	-8.1
NSR21	-17.2	-16.4	-13.7	-8.9	-9.6	-10.9	-10.7	-10.2	-10.2	-10.2
NSR22	-16.6	-15.8	-13.1	-8.3	-9.0	-10.3	-10.1	-9.6	-9.6	-9.6
NSR23	-12.7	-11.9	-9.2	-4.4	-5.1	-6.4	-6.2	-5.7	-5.7	-5.7
NSR24	-13.9	-13.1	-10.4	-5.6	-6.3	-7.6	-7.4	-6.9	-6.9	-6.9

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR25	-13.1	-12.3	-9.6	-4.8	-5.5	-6.8	-6.6	-6.1	-6.1	-6.1
NSR26	-12.9	-12.1	-9.4	-4.6	-5.3	-6.6	-6.4	-5.9	-5.9	-5.9
NSR27	-12.8	-12.0	-9.3	-4.5	-5.2	-6.5	-6.3	-5.8	-5.8	-5.8
NSR28	-12.5	-11.7	-9.0	-4.2	-4.9	-6.2	-6.0	-5.5	-5.5	-5.5
NSR29	-13.3	-12.5	-9.8	-5.0	-5.7	-7.0	-6.8	-6.3	-6.3	-6.3
NSR30	-21.8	-21.0	-18.3	-13.5	-14.2	-15.5	-15.3	-14.8	-14.8	-14.8
NSR31	-13.4	-12.4	-9.1	-3.3	-2.8	-2.6	-2.4	-1.9	-1.9	-1.9
NSR32	-11.1	-10.1	-6.8	-1.0	-0.5	-0.3	-0.1	**0.4**	**0.4**	**0.4**

Table 9.27 Excess Over Night-time Noise Criteria, dB(A)

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	-16.4	-15.4	-12.1	-6.3	-5.8	-5.6	-5.4	-4.9	-4.9	-4.9
NSR2	-17.4	-16.4	-13.1	-7.3	-6.8	-6.6	-6.4	-5.9	-5.9	-5.9
NSR3	-17.9	-16.9	-13.6	-7.8	-7.3	-7.1	-6.9	-6.4	-6.4	-6.4
NSR4	-17.9	-16.9	-13.6	-7.8	-7.3	-7.1	-6.9	-6.4	-6.4	-6.4
NSR5	-16.5	-15.5	-12.2	-6.4	-5.9	-5.7	-5.5	-5.0	-5.0	-5.0
NSR6	-20.0	-19.0	-15.7	-9.9	-9.4	-9.2	-9.0	-8.5	-8.5	-8.5
NSR7	-18.2	-17.2	-13.9	-8.1	-7.6	-7.4	-7.2	-6.7	-6.7	-6.7
NSR8	-18.2	-17.2	-13.9	-8.1	-7.6	-8.5	-10.2	-12.0	-14.7	-14.7
NSR9	-20.7	-19.7	-16.4	-10.6	-10.1	-9.9	-9.7	-9.6	-9.8	-9.8
NSR10	-25.3	-24.3	-21.0	-15.2	-14.7	-14.5	-14.7	-14.2	-14.2	-14.2
NSR11	-26.8	-25.8	-22.5	-16.7	-16.2	-16.0	-16.2	-15.7	-15.7	-15.7
NSR12	-27.4	-26.4	-23.1	-17.3	-16.8	-16.6	-16.4	-15.9	-15.9	-15.9
NSR13	-26.3	-25.3	-22.0	-16.2	-15.7	-15.5	-15.3	-14.8	-14.8	-14.8
NSR14	-20.0	-19.0	-15.7	-9.9	-9.4	-9.2	-9.0	-8.5	-8.5	-8.5
NSR15	-20.7	-19.7	-16.4	-10.6	-10.1	-9.9	-9.7	-9.2	-9.2	-9.2
NSR16	-17.2	-16.2	-12.9	-7.1	-6.6	-6.4	-6.2	-5.7	-5.7	-5.7
NSR17	-19.4	-18.4	-15.1	-9.3	-8.8	-8.6	-8.4	-7.9	-7.9	-7.9
NSR18	-19.2	-18.2	-14.9	-9.1	-8.6	-8.4	-8.2	-7.7	-7.7	-7.7
NSR19	-20.3	-19.3	-16.0	-10.2	-9.7	-9.5	-9.3	-8.8	-8.8	-8.8
NSR20	-21.4	-20.4	-17.1	-11.3	-10.8	-10.6	-10.4	-9.9	-9.9	-9.9
NSR21	-23.5	-22.5	-19.2	-13.4	-12.9	-12.7	-12.5	-12.0	-12.0	-12.0
NSR22	-22.9	-21.9	-18.6	-12.8	-12.3	-12.1	-11.9	-11.4	-11.4	-11.4

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR23	-19.0	-18.0	-14.7	-8.9	-8.4	-8.2	-8.0	-7.5	-7.5	-7.5
NSR24	-20.2	-19.2	-15.9	-10.1	-9.6	-9.4	-9.2	-8.7	-8.7	-8.7
NSR25	-19.4	-18.4	-15.1	-9.3	-8.8	-8.6	-8.4	-7.9	-7.9	-7.9
NSR26	-19.2	-18.2	-14.9	-9.1	-8.6	-8.4	-8.2	-7.7	-7.7	-7.7
NSR27	-19.1	-18.1	-14.8	-9.0	-8.5	-8.3	-8.1	-7.6	-7.6	-7.6
NSR28	-18.8	-17.8	-14.5	-8.7	-8.2	-8.0	-7.8	-7.3	-7.3	-7.3
NSR29	-19.6	-18.6	-15.3	-9.5	-9.0	-8.8	-8.6	-8.1	-8.1	-8.1
NSR30	-28.1	-27.1	-23.8	-18.0	-17.5	-17.3	-17.1	-16.6	-16.6	-16.6
NSR31	-17.6	-16.6	-13.3	-7.5	-7.0	-6.8	-6.6	-6.1	-6.1	-6.1
NSR32	-15.3	-14.3	-11.0	-5.2	-4.7	-4.5	-4.3	-3.8	-3.8	-3.8

9.6.21 During daytime amenity hours, the Proposed Development's predicted noise levels are below the ETSU-R-97 noise criteria at all receptor locations apart from NSR32. At NSR32, daytime amenity hours, the Proposed Development's predicted noise levels are above the ETSU-R-97 noise criteria by 0.4 dB(A) during wind speeds of 10 – 12 m/s.

9.6.22 During the night-time, the Proposed Development's predicted noise levels are below the ETSU-R-97 noise criteria at all receptor locations by a minimum of 3.8 dB(A).

Operational Noise (Wind Farm) – Directional Propagation

9.6.23 Directional noise predictions have been carried out in 45- degree wind direction increments and this confirms that there are no predicted residual exceedances of the criteria when accounting for directional propagation.

Decommissioning

9.6.24 The noise and vibration effects from on-site activities during the decommissioning phase are anticipated to be equivalent to (or less than) the construction phase, with the same plant and equipment being utilised for the proposed decommissioning tasks.

9.7 Additional Mitigation Measures

9.7.1 As concluded in **Section 9.6**, additional mitigation is only required for NSR21 during access track activities (when they occur within 120 m of the sensitive receptor).

9.7.2 BS 5228-1 advises that the approximate acoustic attenuation provided by a barrier will be 5 dB when the top of the plant is just visible to the receiver over the noise barrier, and 10 dB when the barrier completely obscures the noise source from the receiver.

9.7.3 Temporary noise barriers would be erected when the construction works associated with the access track are taking place within approximately 120m of NSR21. The height of the temporary barrier would be sufficient to block line of sight to the surrounding receptors.

9.7.4 Temporary noise barriers may comprise earth bunds, solid fencing, or proprietary acoustic screening systems. Noise barriers would be installed as close to sources as practicable, or along the closest Site boundaries to sensitive receptors with no gaps or joints. Barrier material must have a mass per unit surface area exceeding 7 kg/m².

9.7.5 The temporary noise barriers are secured through the **ES Volume III, Appendix 2.1: Outline Construction Environmental Management Plan**.

9.7.6 In addition to the temporary noise barriers and in accordance with standard good practice, the construction and decommissioning phases of the Proposed Development would be undertaken in accordance with Best Practicable Means (BPM), as set out in **ES Volume III, Appendix 2.1: Outline Construction Environmental Management Plan** and summarised below.

9.7.7 BPM as defined by the Control of Pollution Act 1974 would be implemented, which would serve to minimise the potential noise and vibration impacts at receptors in the vicinity of the construction works. Typical BPM measures are listed below:

- as far as is reasonably practicable, the location and orientation of semi-static equipment to be chosen to minimise the noise impact on sensitive receptors;
- where practicable, temporary enclosures to be used to screen all static or semi-static plant from noise sensitive receptor locations;
- minimise drop heights of materials, i.e., lorry with lifting boom or dumper carefully depositing materials;
- operators of moving plant to be briefed on a regular basis with an emphasis on the importance of noise and vibration mitigation, including avoidance of vehicle movements over irregular surfaces where feasible (which tends to create more noise/vibration emissions);
- at all times, workers' shouting or raised voices to be kept to a minimum;
- machines in intermittent use to be shut down or throttled down to a minimum during periods between works;
- where safe to do so, noise from reversing alarms would be controlled and limited as far as possible through the use of a banksman or other means;
- all plant, equipment and noise control measures applied to plant and equipment to be maintained in good and efficient working order and operated such that noise emissions are minimised as far as reasonably practicable. Any plant,

equipment or items fitted with noise control equipment found to be defective would not be operated until repaired; and

- all personnel on-site are to undergo site-specific inductions and briefings. Where relevant, specific noise and vibration control measures would be incorporated into the contractor's method statements.

9.7.8 In addition to the above BPM, community liaison and communication during the construction phase would be undertaken to provide information to people residing in properties located within the defined study area. This typically serves to reduce the likelihood of complaints.

9.7.9 Details relating to liaison with the local community would be managed by the Contractor, as approved by the Applicant. It is envisaged that community liaison would provide local residents with the following information in relation to the construction works:

- the nature of the works being undertaken;
- the expected duration of the works;
- the contractor's working hours;
- mitigation measures that have been adopted to minimise noise; and
- contact details in the event of a noise disturbance.

9.8 Assessment of Residual Effects (With Additional Mitigation)

Construction Phase

Construction Noise

9.8.1 Based on the overall activity noise levels presented in **Table 9.21**, noise predictions have been made for the noise sensitive receptors located within the defined study area, as presented in **Table 9.28**.

Table 9.28 Predicted Noise Levels by Construction Activity, dB $L_{Aeq,T}$

Noise Sensitive Receptor	C1	C2	C3	C4	C5	C6	Magnitude of change
NSR1	49	41	47	<40	<40	43	Negligible
NSR2	49	48	47	<40	<40	41	Negligible
NSR3	48	48	46	<40	<40	40	Negligible
NSR4	48	47	46	<40	<40	40	Negligible
NSR5	47	54	45	<40	<40	43	Negligible
NSR13	53	63	51	<40	<40	<40	Small
NSR14	47	<40	45	<40	<40	<40	Negligible
NSR15	49	46	47	<40	<40	<40	Negligible

Noise Sensitive Receptor	C1	C2	C3	C4	C5	C6	Magnitude of change
NSR16	41	<40	<40	<40	<40	41	Negligible
NSR19	43	<40	41	<40	<40	<40	Negligible
NSR20	44	<40	42	<40	<40	<40	Negligible
NSR21	60	58	58	<40	<40	<40	Negligible
NSR22	60	51	58	<40	<40	<40	Negligible
NSR31	61	60	59	<40	<40	<40	Small
NSR32	55	46	53	<40	<40	44	Negligible
Note: Predictions have been made at 1m from the façade of the NSR, accounting for reflection by adding 3 dB to the calculated (free field) levels.							

9.8.2 It can be seen from **Table 9.28** that, following the implementation of additional mitigation measures, the 65 dB $L_{Aeq,T}$ threshold criterion is likely to be achieved at all assessment locations.

9.8.3 The sensitivity of all nearby residential receptors is considered to be **high**. The magnitude of change is considered to be **small** at NSR13 and NSR31. Therefore, there is likely to be a direct, temporary, short-term, **minor adverse** residual effect at NSR13 and NSR31 which is considered to be **not significant**. Residual effects at all other receptors are considered to be **negligible adverse** and **not significant**.

Construction Vibration

9.8.4 A prediction of the likely construction vibration levels for vibratory roller and compaction activities is presented in **Table 9.29**. The peak particle velocity (PPV) levels generated by vibratory roller activities at various setback distances are provided.

9.8.5 Vibration levels are calculated in accordance with BS 5228: 2009 Part 2, Table E.1 of Annex E.

Table 9.29 Predicted Vibration Levels from Vibratory Roller and Compactors on Access Track

Construction Activity	Approximate distance (m)	Predicted PPV ($mm.s^{-1}$) Vibratory Roller and Compactor Setting	
		Steady State	Start up and Run Down
Access Track Construction	10	6.6	6.7
	25	1.9	2.3
	50	0.7	1.0

Construction Activity	Approximate distance (m)	Predicted PPV (mm.s^{-1}) Vibratory Roller and Compactor Setting	
		Steady State	Start up and Run Down
(Vibratory Roller and Compactor)	100	0.3	0.4

9.8.6 At levels of between 1.0 and 10 mm/s^{-1} vibration has the potential to cause complaint but can be tolerated if prior warning and explanation has been given to residents.

9.8.7 Due to the distance between residential receptors and the proposed works, there is no potential for significant impacts during vibratory roller and compaction activities, as the closest residential receptor to the proposed access tracks is NSR 13, which is approximately 95m from the proposed activity areas.

9.8.8 The sensitivity of nearby residential receptors is considered to be **high**. The magnitude of change is considered to be **small**. Therefore, there is likely to be a direct, temporary, short-term, **minor adverse** residual effect, which is considered to be **not significant**.

Construction Phase On-Site Traffic Movements (Access Track)

9.8.9 **Table 9.30** presents the predicted free-field noise levels generated by the peak vehicle movements on the on-site access track.

Table 9.30 Predicted Noise Levels from Vehicle Movements on Access Track

Noise Sensitive Receptor	Approximate Distance from site access track (m)	Predicted Noise Levels, dB $L_{Aeq,1hr}$	Magnitude of change
NSR1	700	35	Negligible
NSR2	350	38	Negligible
NSR3	375	38	Negligible
NSR4	400	37	Negligible
NSR5	205	40	Negligible
NSR13	95	44	Negligible
NSR14	875	34	Negligible
NSR15	425	37	Negligible
NSR16	900	34	Negligible
NSR19	1250	33	Negligible
NSR20	1250	33	Negligible
NSR21	55	46	Negligible

Noise Sensitive Receptor	Approximate Distance from site access track (m)	Predicted Noise Levels, dB $L_{Aeq,1hr}$	Magnitude of change
NSR22	135	42	Negligible
NSR31	115	43	Negligible
NSR32	450	37	Negligible

9.8.10 It can be seen from **Table 9.30** that the 65 dB $L_{Aeq,T}$ threshold criterion is not predicted to be exceeded as a result of construction traffic movements on the Site access track.

9.8.11 Based on the above, the sensitivity of nearby residential receptors is considered to be **high**. The magnitude of change is considered to be **negligible**. Therefore, there is likely to be a direct, temporary, short-term, **negligible adverse** residual effect, which is considered to be **not significant**.

Construction Traffic Noise (Off-site)

9.8.12 The predicted increase in 18-hour AAWT traffic flows on the public highway as a result of the Proposed Development are presented in **Table 9.31**.

Table 9.31 Predicted Noise Levels on the Public Highway

Road Link	18 hr AAWT Baseline Traffic Flows (%HDV)	18hr AAWT Baseline + Construction Traffic (%HDV)	Change in Noise Level (dB $L_{A10,18hr}$)	Magnitude of change
ATC 1	16378 (2.4 %)	17216 (3.0 %)	0.4	Negligible
ATC 2	18471 (1.0 %)	19401 (1.5 %)	0.4	Negligible
ATC 3	14416 (0.7 %)	15184 (1.3 %)	0.6	Negligible
ATC 4	14156 (0.5 %)	14973 (1.4 %)	0.6	Negligible
ATC 5	16691 (0.6 %)	17580 (1.2 %)	0.6	Negligible
ATC 6	1505 (0.2 %)	1574 (0.6 %)	0.4	Negligible
ATC 7	1591 (0.2 %)	1715 (2.5 %)	1.5	Small
ATC 8	5122 (0.2 %)	5343 (0.3 %)	0.3	Negligible

9.8.13 All road links are predicted to experience a change in road traffic noise less than 1 dB on all but one link where a change of 1.5 dB is predicted (ATC7). The assessment is based on traffic flows occurring during the peak construction period and therefore represents a worst case assessment; the noise levels will be lower during non-peak periods of construction.

9.8.14 Based on the results provided in **Table 9.31**, the sensitivity of nearby residential receptors is considered to be **high**. The magnitude of change is considered to be **small** from ATC 7. Therefore, there is likely to be a direct, temporary, short-term, **minor adverse** residual effect, which is considered to be **not significant**.

Construction Phase Summary

9.8.15 **Table 9.32** provides a summary of the residual effects during the construction phase.

Table 9.32 Residual Effects during the Construction Phase

Receptor / receptor groups	Description of impact	Magnitude of Change	Description of residual effect
Receptors NSR13 and 31 (**high** sensitivity)	Construction Noise	Small	**Minor adverse Not Significant**
Receptors NSR1-12 14-31 and 32 (**high** sensitivity)	Construction Noise	Negligible	**Negligible Not Significant**
Receptors NSR 13 (**high** sensitivity)	Construction Vibration	Small	**Minor adverse Not Significant**
Receptors NSR 1-12, 14 – 32 (**high** sensitivity)	Construction Vibration	Negligible	**Negligible Not Significant**
Receptors NSR 1-32 (**high** sensitivity)	Construction Phase – On-Site Traffic Movements (Access track)	Negligible	**Negligible Not Significant**
Receptors NSR 1-32 (High sensitivity)	Construction Traffic Noise (Off-site)	Negligible	**Minor adverse Not Significant**

Operational Phase

Operational Noise (Solar and Substation)

9.8.16 **Table 9.33** provides a comparison of predicted rating levels (inclusive of any rating penalties), against the representative background sound level in accordance with BS 4142. **Bold** values represent results where the predicted rating level exceeds the background sound level.

Table 9.33 Solar and Substation – BS 4142 Assessment

Noise Sensitive Receptor	Rating Level	Background Sound Level, $L_{A90,T\ min}$, dB		Exceedance above representative background sound level, dB		Predicted magnitude of change	
	$L_{Ar,Tr}$, dB	Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
NSR1	22	25	24	-3	-2	Small	Small
NSR2	21	25	24	-4	-3	Small	Small
NSR3	20	25	24	-5	-4	Small	Small
NSR4	20	25	24	-5	-4	Small	Small
NSR5	23	29	24	-6	-1	Small	Small
NSR6	19	29	24	-10	-5	Negligible	Small
NSR7	19	29	24	-10	-5	Negligible	Small
NSR8	18	29	24	-11	-6	Negligible	Small
NSR9	16	29	24	-13	-8	Negligible	Small
NSR10	11	32	30	-21	-19	Negligible	Negligible

Noise Sensitive Receptor	Rating Level	Background Sound Level, $L_{A90,T\ min}$, dB		Exceedance above representative background sound level, dB		Predicted magnitude of change	
	$L_{Ar,Tr}$, dB	Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
NSR11	10	33	29	-22	-20	Negligible	Negligible
NSR12	10	33	29	-22	-20	Negligible	Negligible
NSR13	24	32	26	-2	-1	Small	Small
NSR14	23	32	26	-3	-2	Small	Small
NSR15	25	32	26	-1	0	Small	Small
NSR16	20	22	20	-2	0	Small	Small
NSR17	18	22	20	-4	-2	Small	Small
NSR18	18	22	20	-4	-2	Small	Small
NSR19	15	22	20	-7	-5	Small	Small
NSR20	14	22	20	-8	-6	Small	Small
NSR21	11	32	26	-15	-14	Negligible	Negligible
NSR22	11	32	26	-15	-14	Negligible	Negligible
NSR23	17	26	26	-9	-8	Small	Small
NSR24	13	26	26	-13	-12	Negligible	Negligible
NSR25	17	26	26	-9	-8	Small	Small
NSR26	17	26	26	-9	-8	Small	Small

Noise Sensitive Receptor	Rating Level	Background Sound Level, $L_{A90,T\ min}$, dB		Exceedance above representative background sound level, dB		Predicted magnitude of change	
	$L_{Ar,Tr}$, dB	Daytime	Night-time	Daytime	Night-time	Daytime	Night-time
NSR27	17	26	26	-9	-8	Small	Small
NSR28	18	26	26	-8	-7	Small	Small
NSR29	17	26	26	-9	-8	Small	Small
NSR30	8	26	26	-18	-17	Negligible	Negligible
NSR31	29	29	24	**0**	**5**	Small	Small
NSR32	21	29	24	-8	-3	Small	Small

9.8.17 The results of the initial assessment indicate that the predicted rating level exceeds the background sound level by a small or negligible magnitude of change at multiple receptors during the daytime and night-time. In accordance with BS 4142:2014+A1:2019, a difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

9.8.18 Where the results of the initial assessment are below the existing background sound level, this is an indication of the solar and substation installations having a low impact, depending on the context.

9.8.19 The context of the noise is considered in the below section.

Context Discussion

9.8.20 BS 4142:2014+A1:2019 states that where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

9.8.21 The specific sound levels at each receptor are predicted to be ≤ 26 dB $L_{Aeq,T}$ outside of dwellings. This is considered to be very low and would generally be masked by local sources of noise. It is unlikely that the predicted sound levels would be clearly audible within dwellings such that the quality of the environment would be significantly affected.

9.8.22 The predicted rating levels are predicted to exceed the background sound level by up to 5 dB at NSR31. The levels are considered to be ‘small’ or ‘negligible’ in magnitude and, after accounting for context, are unlikely to give rise to significant adverse effects.

9.8.23 Therefore, based on a **high** receptor sensitivity for residential dwellings and a **small** magnitude of change for operational phase noise levels, this would represent a **minor adverse** residual effect, which is considered to be **not significant**.

Cumulative Operational Noise

9.8.24 An assessment of in-combination cumulative effects considering noise emissions from all the proposed operational noise sources associated with the Proposed Development has been undertaken.

9.8.25 The substation/solar is shown to be between 9-32 dB below the contribution of the proposed wind turbines and therefore would result in a negligible increase to the noise level from the Proposed Development. This has been reviewed across all Standardised 10m Wind Speeds (m/s) (3 m/s to 12 m/s).

9.8.26 This indicates that the solar and substation noise emissions provide negligible contribution to the noise environment when considered alongside the operational noise from the wind farm.

Operational Phase Summary

9.8.27 **Table 9.34** provides a summary of the residual effects from wind turbine noise during the operational phase.

Table 9.34 Residual Effects during the Operational Phase

Receptor / Receptor Groups	Description of impact	Magnitude of Change	Residual effect
Receptors NSR1-9, NSR13-20, NSR23, NSR25-29 and NSR31-32 (**high** sensitivity)	Operational Noise (Solar and Substation)	Small	**Minor adverse** **Not significant**
Receptors NSR10-12, NSR21-22, NSR24 and NSR30 (**high** sensitivity)	Operational Noise (Solar and Substation)	Negligible	**Negligible adverse** **Not significant**
Receptors NSR 1-32 (**high** sensitivity)	Operational Noise (Wind Farm) Daytime amenity hours	Small (below noise limit)	**Minor adverse** **Not significant**
Receptors NSR 1-32 (**high** sensitivity)	Operational Noise (Wind Farm) Noise night-time hours	Small (below noise limit)	**Minor adverse** **Not significant**

9.8.28 The turbine selection for the Proposed Development is not yet fixed. Should an alternative turbine to that assessed be proposed, it may be necessary to amend the mitigation strategy such that the derived ETSU predicted noise levels are achieved, in accordance with the IOA GPG guidance.

Decommissioning

9.8.29 As set out in **Section 9.6**, the noise and vibration effects from on-site activities during the decommissioning phase are anticipated to be equivalent to (or less than) the construction phase, with the same plant and equipment being utilised for the proposed decommissioning tasks.

9.8.30 The sensitivity of nearby residential receptors is considered to be **high**. The magnitude of change is considered to be (at worst) **small**. Therefore, there is likely to be a direct, temporary, short-term, **minor adverse** residual effect, which is considered to be **not significant**.

9.9 Opportunities for Environmental Enhancement

9.9.1 No opportunities for environmental enhancement have been identified within this assessment.

9.10 Difficulties and Uncertainties

9.10.1 The following difficulties and uncertainties have been encountered during the undertaking of this assessment.

Construction

9.10.2 Detailed construction information is not yet available (given that the construction contractor has not yet been appointed) and therefore this assessment draws upon the experience and assessments undertaken for other similar projects.

9.10.3 The construction assessment is quantitative, with construction noise thresholds (limit values) based upon existing ambient sound levels. Despite being based on indicative assumptions on construction activities, the assessment is considered to be a reasonable worst-case estimation of construction activities.

Operation

9.10.4 Assumptions have been made to inform the computer modelling and assessment of the Proposed Development, as identified within **Section 0**. This presents an example how the ETSU noise limits can be achieved with available wind turbines; noise predictions may vary upon final turbine selection however the ETSU noise limits would remain the same.

9.10.5 As discussed within **Section 0**, for the inter-project cumulative assessment, when assessing cumulative noise levels from wind turbines, consideration needs to be given to the noise limits applicable to each development. The IOA GPG advises that where there is no reasonable prospect of a cumulative development producing noise levels up to its consented (or proposed) limits, the GPG recommends that predicted noise levels should be used along with an additional safety margin. In this instance, a margin of 2 dB has been applied to the predicted noise emissions from all wind farms and/or turbines.

9.10.6 No accepted or reliable methodology exists for assessing AM before a wind farm/turbine becomes operational. This is discussed further in **ES Volume III, Appendix 9.2: Legislation, Policy and Guidance**.

Decommissioning

9.10.7 The assessment addresses the decommissioning phase by assuming equivalent plant, equipment, and noise emissions to the construction phase. While uncertainty exists regarding these assumptions due to the project's 50-year lifespan and potential technological and methodological changes, this approach represents a reasonable worst-case scenario for assessment purposes.

9.11 Inter-Project Cumulative Effects

Screening Other Developments Within the Zone of Influence

9.11.1 The inter-project cumulative effects assessment has been undertaken in accordance with Nationally Significant Infrastructure Projects: Advice on Cumulative Effects Assessment (Planning Inspectorate, 2024), as detailed in **ES Volume II, Chapter 4: Approach to the EIA**.

9.11.2 **Table 9.35** sets out the findings of a screening assessment undertaken to identify those other developments located within 5 km of the Site boundary which have the potential to result in significant noise effects in combination with the Proposed Development..

Table 9.35 Inter-Project Cumulative Effects: Screening

Other development	Development description	Potential for significant inter-project cumulative effects?
CAS-02505-N3T6M4 Foel Trawsnant Wind Farm Connection	66 kV electricity network infrastructure comprising overhead lines and underground cables.	No. While within the ZoI, significant inter-project cumulative effects are considered unlikely. Construction noise and vibration will be controlled through the application of a CEMP when construction information is available. Operational noise and vibration are scoped out either 'practically quiet' or generating no operational sound.
P/24/753/SOR WEPA Vesta (Paper Machine)	New plant producing tissue paper machine at Bridgend and decommissioning and dismantling of old machine.	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely. No noise information is available within the scoping report for construction or operational noise.
DNS CAS-03613-S7Y6S4 Prosiect Egni Glan Llynfi (Modular Nuclear)	The project will include 4 PWR-20 Modular Nuclear Reactor units, which will provide clean, carbon-free baseload electricity and heat to	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely. No noise information is available within the scoping

Other development	Development description	Potential for significant inter-project cumulative effects?
	local industrial users. There will also be Grid, as well as private electricity & steam connections. There will be no air or water emissions from the plant.	report for construction or operational noise.
CAS-01977-L5K6R7 Eirlys Solar Farm	Solar PV electricity generating project and associated ancillary architecture including a substation and battery energy storage systems (BESS).	No. Whilst within the ZoI, with some shared noise sensitive receptors (AP3, AP8 and AP9), significant inter-project cumulative effects are considered unlikely. The assessment of commercial or industrial noise is proposed to be undertaken in accordance with BS4142: 2014+A1: 2019. No predictions at the shared receptors are available. No details of construction program or activity are available; however, as these become available, it is expected that the contractor would apply BPM as defined under Section 72 of the Control of Pollution Act 1974 to minimise noise and vibration impacts.
DNS/3264571 Y Bryn Wind Farm	Wind Farm - 18 turbines, 250m in height.	Yes (operational phase) – progress to assessment stage. Noise emissions from the Y Bryn Wind Farm are considered to have the potential to result in significant inter-project cumulative effects with the Proposed Development.
P/23/218/FUL HyBont Green Hydrogen	Development of a green hydrogen production facility.	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely based on the activity proposed, the

Other development	Development description	Potential for significant inter-project cumulative effects?
		distances between the HyBont Green Hydrogen development and the Proposed Development (2.55 km) and the lack of shared receptors.
DNS CAS-04421-B8S4Q5 Y Bryn Wind Farm Grid Connection	An up to 132 kV (kilovolt) electricity connection comprising underground cables and overhead lines between Y Bryn Wind Farm and the National Grid Substation at Margam.	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely. No noise information is available within the scoping report for construction or operational noise.
P/22/225/FUL Great Western Avenue, Coity Road, Battery Energy Storage	Installation of a battery energy storage facility, substation, underground cabling and ancillary infrastructure & equipment to include security fence, CCTV & gates.	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely, based on the scale of the activity proposed and the distances between the Great Western Avenue, Coity Road, Battery Energy Storage development and the Proposed Development (4.15 km).
DNS/3279521 Ty'n Y Waun Solar	Solar development	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely, based on the activity proposed and the distance between the two sites (4.69 km).
P2021/1255 Land West of Junction 38 M4	Full planning application of the development of a metal processing facility	No. Whilst within the ZoI, significant inter-project cumulative effects are considered unlikely, based on the activity proposed, the distance between the two sites (4.83 km) and the lack of shared sensitive receptors.

9.11.3 As outlined in **Table 9.35** above, the other (cumulative) development considered appropriate to take forward to assessment is Y Bryn Wind Farm, in terms of operational noise only. No significant inter-project cumulative effects are anticipated during the Proposed Development's construction phase.

9.11.4 In addition to Y Bryn Wind Farm and in accordance with **ES Volume III, Appendix 1.2: Scoping Direction**, some smaller operational turbines and wind farms have been considered in the inter-project cumulative effects assessment (for operational noise only). These comprise:

- Newlands Wind Farm (P2013/0300);
- Cefn Park (P12429FUL);
- Baiden Farm Ffordd Y (P13355FUL);
- Gelli Las Farm (P12740FUL); and
- Cwm Risca Farm (P10306FUL).

9.11.5 **Table 9.36** presents the other wind farm developments that have been considered in the inter-project cumulative assessment, for operational noise only. Further information regarding these developments is provided in **ES Volume III, Appendix 9.5: Proposed and Cumulative Wind Turbine Details**.

Table 9.36 Wind Farm Developments Included in the Inter-Project Cumulative Effects Assessment (for Operational Noise Only)

Wind Farm	Number of Turbines	Hub Height (m)	Sound Power Level, dB(A)	Turbine Model
Y Bryn	12[1]	120	109.2	Nordex T163 5.7 STE Turbine
Newlands	1	50	100.5	EWT DW54 500kW
Cefn Park	1	9	88.3	Kingspan KW6
Baiden Farm Ffordd Y	2	18.3	88.1	Gaia-Wind GW11
Gelli Las Farm	2	30	99.2	Norwin 29/225kW
Cwm Risca Farm	1	18.3	88.1	Gaia-Wind GW11
Notes: 1: Y Bryn Wind Farm has 18 wind turbines, only 12 are within the 5 km cumulative search study area.				

Assessment

Operational Phase

Downwind Propagation

9.11.6 The predicted L_{A90} cumulative noise levels across standardised 10m wind speeds of 3 m/s – 12 m/s are presented in **Table 9.37**. The predictions consider downwind propagation from all wind farms listed in **Table 9.36** irrespective of the wind direction. The corresponding noise contour plot based on the maximum sound power level is presented in **ES Volume IV, Figure 9.5: Cumulative Wind Turbine Noise Contour Map**.

Table 9.37 Predicted Cumulative Noise Levels (Downwind Propagation), dB L_{A90}

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	28.8	29.4	33.2	38.3	38.8	38.9	39.1	39.4	39.4	39.4
NSR2	28.5	29.1	33.0	38.0	38.4	38.5	38.6	39.0	39.0	39.0
NSR3	28.4	28.9	32.8	37.8	38.2	38.3	38.4	38.8	38.8	38.8
NSR4	28.5	29.0	33.0	37.9	38.3	38.4	38.5	38.8	38.8	38.9
NSR5	29.4	30.2	33.4	38.9	39.4	39.6	39.8	40.3	40.4	40.5
NSR6	26.9	27.5	31.0	36.3	36.7	36.9	37.1	37.5	37.6	37.6
NSR7	26.9	27.5	31.2	36.4	36.9	37.0	37.2	37.6	37.6	37.6
NSR8	33.5	33.7	35.2	38.0	38.8	39.6	40.3	41.2	42.0	42.9
NSR9	35.7	35.8	37.0	38.8	39.8	40.8	41.8	42.8	43.8	44.9
NSR10	28.2	28.3	29.7	32.0	32.9	33.8	34.6	35.6	36.5	37.4
NSR11	24.2	24.3	25.8	28.8	29.5	30.2	30.9	31.7	32.3	33.1
NSR12	23.7	23.8	25.3	28.3	29.0	29.7	30.4	31.2	31.9	32.7
NSR13	34.2	34.2	34.4	35.2	35.4	35.5	35.6	35.8	35.8	35.9
NSR14	29.8	30.1	31.2	34.5	34.9	35.0	35.2	35.6	35.6	35.7
NSR15	37.1	37.1	37.5	38.8	39.0	39.1	39.2	39.4	39.5	39.5
NSR16	27.4	28.1	30.9	36.3	36.8	37.0	37.1	37.6	37.6	37.6
NSR17	25.7	26.3	29.0	34.2	34.7	34.9	35.1	35.5	35.5	35.5
NSR18	25.9	26.5	29.2	34.4	34.9	35.1	35.3	35.7	35.7	35.7
NSR19	26.0	26.5	28.5	33.2	33.7	33.9	34.1	34.5	34.6	34.6
NSR20	27.4	27.7	29.0	32.8	33.2	33.3	33.5	33.9	34.0	34.0
NSR21	24.7	25.0	27.7	32.2	32.6	32.8	32.9	33.2	33.2	33.2
NSR22	24.4	24.8	27.5	32.1	32.5	32.7	32.9	33.2	33.2	33.2
NSR23	26.0	26.6	29.8	35.1	35.5	35.7	35.9	36.3	36.3	36.3
NSR24	25.1	25.7	28.8	33.9	34.4	34.6	34.7	35.2	35.2	35.2

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR25	25.6	26.2	29.4	34.6	35.1	35.2	35.4	35.8	35.8	35.8
NSR26	25.7	26.4	29.6	34.8	35.3	35.5	35.6	36.1	36.1	36.1
NSR27	25.8	26.5	29.6	34.9	35.4	35.5	35.7	36.1	36.1	36.1
NSR28	25.9	26.6	29.7	35.0	35.5	35.7	35.9	36.3	36.3	36.3
NSR29	25.6	26.2	29.4	34.5	35.0	35.2	35.4	35.8	35.8	35.8
NSR30	27.2	27.2	30.5	34.3	34.6	34.7	34.7	34.8	34.8	34.8
NSR31	35.8	35.9	35.7	37.7	37.7	37.5	37.5	37.7	37.9	38.1
NSR32	35.3	35.5	35.8	38.9	39.1	39.2	39.2	39.6	39.7	39.8

9.11.7 To assess the significance of the inter-project cumulative effect, the cumulative predictions have been compared with the derived ETSU-R-97 noise daytime and night-time criteria, as shown in **Table 9.38** and **Table 9.39** respectively. A negative value in the tables represents noise levels below the relevant acoustic criterion, whereas **bold** cells identify an exceedance of the derived criteria.

Table 9.38 Excess Over Daytime Noise Criteria (Downwind Propagation), dB(A)

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	-7.4	-7.1	-3.8	**0.5**	-0.1	-1.5	-3.1	-5.0	-5.0	-5.0
NSR2	-7.7	-7.4	-4.0	**0.2**	-0.5	-1.9	-3.6	-5.4	-5.4	-5.4
NSR3	-7.8	-7.6	-4.2	0.0	-0.7	-2.1	-3.8	-5.6	-5.6	-5.6
NSR4	-7.7	-7.5	-4.0	**0.1**	-0.6	-2.0	-3.7	-5.6	-5.6	-5.5
NSR5	-15.6	-14.8	-11.6	-6.1	-5.6	-5.4	-5.2	-4.7	-4.6	-4.5
NSR6	-18.1	-17.5	-14.0	-8.7	-8.3	-8.1	-7.9	-7.5	-7.4	-7.4
NSR7	-11.9	-11.3	-7.6	-2.4	-1.9	-1.8	-1.7	-1.3	-1.3	-1.2
NSR8	-11.5	-11.3	-9.8	-7.0	-6.2	-5.4	-4.7	-3.8	-3.0	-2.1
NSR9	-9.3	-9.2	-8.0	-6.2	-5.2	-4.2	-3.2	-2.2	-1.2	-0.1
NSR10	-12.2	-12.6	-11.8	-10.1	-9.8	-9.5	-8.7	-7.7	-6.8	-5.9
NSR11	-16.2	-16.5	-15.6	-13.3	-13.2	-13.1	-12.4	-11.6	-10.9	-10.1
NSR12	-18.6	-18.5	-17.0	-14.0	-13.3	-12.6	-11.9	-11.1	-10.4	-9.6
NSR13	-10.8	-10.8	-10.6	-9.8	-9.6	-9.5	-9.4	-9.2	-9.2	-9.1
NSR14	-6.9	-6.8	-6.3	-4.0	-4.8	-6.2	-6.0	-5.6	-5.6	-5.5
NSR15	-7.9	-7.9	-7.5	-6.2	-6.0	-5.9	-5.8	-5.6	-5.5	-5.5
NSR16	-8.1	-8.2	-6.6	-2.5	-3.3	-4.2	-4.1	-3.6	-3.6	-3.6
NSR17	-9.8	-10.0	-8.5	-4.6	-5.4	-6.3	-6.1	-5.7	-5.7	-5.7
NSR18	-9.6	-9.8	-8.3	-4.4	-5.2	-6.1	-5.9	-5.5	-5.5	-5.5

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR19	-9.5	-9.8	-9.0	-5.6	-6.4	-7.3	-7.1	-6.7	-6.6	-6.6
NSR20	-8.1	-8.6	-8.5	-6.0	-6.9	-7.9	-7.7	-7.3	-7.2	-7.2
NSR21	-12.0	-11.9	-9.8	-6.3	-7.1	-8.4	-8.3	-8.0	-8.0	-8.0
NSR22	-12.3	-12.1	-10.0	-6.4	-7.2	-8.5	-8.3	-8.0	-8.0	-8.0
NSR23	-10.7	-10.3	-7.7	-3.4	-4.2	-5.5	-5.3	-4.9	-4.9	-4.9
NSR24	-11.6	-11.2	-8.7	-4.6	-5.3	-6.6	-6.5	-6.0	-6.0	-6.0
NSR25	-11.1	-10.7	-8.1	-3.9	-4.6	-6.0	-5.8	-5.4	-5.4	-5.4
NSR26	-11.0	-10.5	-7.9	-3.7	-4.4	-5.7	-5.6	-5.1	-5.1	-5.1
NSR27	-10.9	-10.4	-7.9	-3.6	-4.3	-5.7	-5.5	-5.1	-5.1	-5.1
NSR28	-10.8	-10.3	-7.8	-3.5	-4.2	-5.5	-5.3	-4.9	-4.9	-4.9
NSR29	-11.1	-10.7	-8.1	-4.0	-4.7	-6.0	-5.8	-5.4	-5.4	-5.4
NSR30	-9.5	-9.7	-7.0	-4.2	-5.1	-6.5	-6.5	-6.4	-6.4	-6.4
NSR31	-3.0	-2.9	-3.1	-1.1	-1.1	-1.3	-1.3	-1.1	-0.9	-0.7
NSR32	-3.5	-3.3	-3.0	**0.1**	**0.3**	**0.3**	**0.4**	**0.7**	**0.8**	**0.9**

Table 9.39 Excess Over Night-time Noise Criteria (Downwind Propagation), dB(A)

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR1	-14.2	-13.6	-9.8	-4.7	-4.2	-4.1	-3.9	-3.6	-3.6	-3.6
NSR2	-14.5	-13.9	-10.0	-5.0	-4.6	-4.5	-4.4	-4.0	-4.0	-4.0
NSR3	-14.6	-14.1	-10.2	-5.2	-4.8	-4.7	-4.6	-4.2	-4.2	-4.2
NSR4	-14.5	-14.0	-10.0	-5.1	-4.7	-4.6	-4.5	-4.2	-4.2	-4.1
NSR5	-15.6	-14.8	-11.6	-6.1	-5.6	-5.4	-5.2	-4.7	-4.6	-4.5
NSR6	-18.1	-17.5	-14.0	-8.7	-8.3	-8.1	-7.9	-7.5	-7.4	-7.4
NSR7	-16.1	-15.5	-11.8	-6.6	-6.1	-6.0	-5.8	-5.4	-5.4	-5.4
NSR8	-9.5	-9.3	-7.8	-5.0	-4.2	-4.5	-5.7	-7.1	-9.0	-8.1
NSR9	-7.3	-7.2	-6.0	-4.2	-3.2	-2.2	-1.2	-0.6	**0.2**	**1.3**
NSR10	-14.8	-14.7	-13.3	-11.0	-10.1	-9.2	-8.8	-7.8	-6.9	-6.0
NSR11	-18.8	-18.7	-17.2	-14.2	-13.5	-12.8	-12.5	-11.7	-11.1	-10.3
NSR12	-19.3	-19.2	-17.7	-14.7	-14.0	-13.3	-12.6	-11.8	-11.1	-10.3
NSR13	-10.8	-10.8	-10.6	-9.8	-9.6	-9.5	-9.4	-9.2	-9.2	-9.1
NSR14	-13.2	-12.9	-11.8	-8.5	-8.1	-8.0	-7.8	-7.4	-7.4	-7.3
NSR15	-7.9	-7.9	-7.5	-6.2	-6.0	-5.9	-5.8	-5.6	-5.5	-5.5
NSR16	-15.6	-14.9	-12.1	-6.7	-6.2	-6.0	-5.9	-5.4	-5.4	-5.4

Noise Sensitive Receptor	Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
NSR17	-17.3	-16.7	-14.0	-8.8	-8.3	-8.1	-7.9	-7.5	-7.5	-7.5
NSR18	-17.1	-16.5	-13.8	-8.6	-8.1	-7.9	-7.7	-7.3	-7.3	-7.3
NSR19	-17.0	-16.5	-14.5	-9.8	-9.3	-9.1	-8.9	-8.5	-8.4	-8.4
NSR20	-15.6	-15.3	-14.0	-10.2	-9.8	-9.7	-9.5	-9.1	-9.0	-9.0
NSR21	-18.3	-18.0	-15.3	-10.8	-10.4	-10.2	-10.1	-9.8	-9.8	-9.8
NSR22	-18.6	-18.2	-15.5	-10.9	-10.5	-10.3	-10.1	-9.8	-9.8	-9.8
NSR23	-17.0	-16.4	-13.2	-7.9	-7.5	-7.3	-7.1	-6.7	-6.7	-6.7
NSR24	-17.9	-17.3	-14.2	-9.1	-8.6	-8.4	-8.3	-7.8	-7.8	-7.8
NSR25	-17.4	-16.8	-13.6	-8.4	-7.9	-7.8	-7.6	-7.2	-7.2	-7.2
NSR26	-17.3	-16.6	-13.4	-8.2	-7.7	-7.5	-7.4	-6.9	-6.9	-6.9
NSR27	-17.2	-16.5	-13.4	-8.1	-7.6	-7.5	-7.3	-6.9	-6.9	-6.9
NSR28	-17.1	-16.4	-13.3	-8.0	-7.5	-7.3	-7.1	-6.7	-6.7	-6.7
NSR29	-17.4	-16.8	-13.6	-8.5	-8.0	-7.8	-7.6	-7.2	-7.2	-7.2
NSR30	-15.8	-15.8	-12.5	-8.7	-8.4	-8.3	-8.3	-8.2	-8.2	-8.2
NSR31	-7.2	-7.1	-7.3	-5.3	-5.3	-5.5	-5.5	-5.3	-5.1	-4.9
NSR32	-7.7	-7.5	-7.2	-4.1	-3.9	-3.8	-3.8	-3.4	-3.3	-3.2

9.11.8 During daytime amenity hours, the predicted cumulative wind farm noise levels are predicted to exceed the derived ETSU-R-97 noise criteria at NSR1, NSR2, NSR4 and NSR32. At all other NSRs, the predicted cumulative wind farm noise levels are predicted to achieve the derived ETSU-R-97 noise criteria for daytime amenity hours.

9.11.9 The derived night-time ETSU-R-97 noise criteria is exceeded at NSR9 only during wind speeds of 11 and 12 m/s. There are no other predicted exceedances of the derived ETSU-R-97 noise criteria during the night-time period.

9.11.10 The Proposed Development wind turbines are contributing to the predicted cumulative noise levels during the daytime. Therefore, further consideration is given to propagation directivity.

9.11.11 During the night-time, the Proposed Development wind turbines are not contributing to the predicted cumulative noise levels (more than 10 dB below) at NSR9. Therefore, no further consideration is given to propagation directivity as the proposed wind farm produces noise levels are not within 10 dB of any existing wind farm/s, and a cumulative noise impact assessment is not necessary, in line with the IOA GPG.

Directional Propagation

9.11.12 Directional noise predictions have been carried out in 30- degree wind direction increments. The resulting noise levels have been compared with the derived ETSU-R-97 daytime and night-time criteria. **Table 9.40** identifies where there are predicted to be exceedances of the ETSU criteria when accounting for directional propagation during the daytime.

Table 9.40 Excess Over Daytime Noise Criteria (Directional Propagation), dB(A)

Noise Sensitive Receptor	Wind Direction	Standardised 10m Wind Speed (m/s)								
		4	5	6	7	8	9	10	11	12
NSR1	S			0.3						
	NE			0.5						
	E			0.4						
	SE			0.4						
NSR2	E			0.1						
	NE			0.2						
NSR4	NE			0.1						
NSR32	S							0.5	0.6	0.7
	NE						0.2	0.7	0.8	0.9
	E						0.1	0.6	0.7	0.8
	SE							0.6	0.7	0.8

9.11.13 When accounting for directional propagation, exceedances of the derived daytime ETSU-R-97 noise criteria remain, albeit in the order of 1 dB or less in all instances. The marginal exceedances only occur under a limited set of wind conditions.

9.11.14 On the basis that **Table 9.40** indicates that there is predicted to be exceedances of the derived ETSU-R-97 noise criteria during the daytime, the cumulative wind farm noise levels would give rise to a **significant** inter-project cumulative effect during the daytime. Futher mitigation has therefore been proposed to address the marginal exceedances, as discussed below.

9.11.15 During the night-time, the Proposed Development wind turbines are not contributing to the predicted cumulative noise levels (more than 10 dB below). Therefore, no further consideration is given to propagation directivity as the proposed wind farm produces noise levels are not within 10 dB of any existing wind farm/s, and a cumulative noise impact assessment is not necessary, in line with the IOA GPG. Based on this, no additional mitigation is required during the night-time and the Proposed Development would give rise to a **not significant** effect during the night-time.

Additional Mitigation

9.11.16 To address the marginal exceedances of the derived acoustic criteria from the inter-project cumulative effects assessment, alternative operating modes have been considered for the proposed wind turbines.

9.11.17 On the basis of the candidate turbine, operating modes would be necessary to reduce the Proposed Developments' noise emissions so that:

- the total cumulative wind farm noise levels fall below the derived criteria; or
- the contribution of the proposed wind turbine noise levels is at least 10 dB below the cumulative noise levels from the other third-party wind farms.

9.11.18 The reduced turbine operating mode would only need to be adopted under a limited set of wind speeds and directions, as noted below. For all other wind speeds or directions, turbine embedded operating mode PO7200 (blades with serrated trailing edge) would apply or a turbine with an equivalent sound power level, as shown in **ES Volume III, Appendix 9.5: Proposed and Cumulative Wind Turbine Details**.

Table 9.41 Turbine Operating Mode Conditions

Time Period	Turbine	Standardised Wind Speed	Wind Direction	Turbine Operating Mode
As Daytime	T05	6 m/s	S	SO1
	T05	6 m/s	SE, E, NE	SO2
	T01	9 m/s	S, NE, E, SE	SO1
	T01	10 m/s, 11 m/s	S, E, SE	SO2
	T02	11 m/s	SW	SO1
	T01	12 m/s	S, E, SE	SO2
	T02	12 m/s	S, NE, E	SO1
Note: 1 Modes as shown within Performance Specification EnVentus™ V162-7.2MW 50/60Hz Document no.: 0114-3777 V04				

Table 9.42 Vestas V162-7.2 MW Sound Power Levels Modes

Mode	Sound Power Level (dB L_{Aeq}) by Standardised 10m Wind Speed (m/s)									
	3	4	5	6	7	8	9	10	11	12
SO1	94.0	94.0	94.0	95.0	98.3	101.5	103.3	103.4	103.5	103.5
SO2	94.0	94.0	94.0	95.0	98.3	101.3	102.0	102.0	102.0	102.0

Assessment of Residual Inter-Project Cumulative Effects (with Additional Mitigation)

9.11.19 Assuming the design and wind turbine noise levels are consistent with those incorporated within this assessment and the adoption of additional mitigation measures in the form of alternative operating modes, the residual effects for the operational noise inter-project cumulative effects assessment are **not significant**.

9.11.20 Residential receptors are of **high** sensitivity. The operational phase activities will likely result in a **small** magnitude of change. Therefore, there is likely to be a direct, temporary, short-term **minor adverse** residual inter-project cumulative effect on residential receptors, which is considered to be **not significant**.

9.12 References

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