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Noise Report for a Vestas V117 Burngullow Wind Turbine

Clean Earth Energy Ltd

16024-007-R0
04 January 2024

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Document Control

Revision	Status	Prepared by	Checked by	Approved by	Date
D0	DRAFT	MC	JB	JB	18/12/2023
R0	FIRST ISSUE	MC	JB	JB	04/01/2024

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Executive Summary

TNEI Services Ltd (TNEI) has been contracted by Clean Earth Energy Ltd (CEE) to undertake a noise assessment for a proposed Wind Turbine at Burngullow.

Predictions of wind turbine noise have been made, based upon sound power level data for the Vestas V117 4.3MW Mode PO2 for the proposed Burngullow Wind Turbine. The same wind turbine model has also been used as part of cumulative predictions to account for three consented wind turbines (Longstones, East Karslake, Wheal Martyn). Four other nearby EWT DW54 (500 kW) wind turbines (which are already operational) are also considered in the cumulative predictions.

The turbine noise prediction model used is considered to provide a realistic impact assessment and considers current good practice, inclusive of the Institute of Acoustics document 'A Good Practice Guide to the Application of ETSU-R-97 for the Rating and Assessment of Wind Turbines' (IOA GPG) issued in May 2013. The predictions were undertaken at fourteen Noise Assessment Locations which are residential properties in the immediate and wider area and for which existing Total ETSU-R-97 Noise Limits (also referred to as the 'cumulative limit') were already set in the planning applications of Longstones (PA20/09318), East Karslake (PA21/12493) and Wheal Martyn (PA21/07216). In the context of cumulative renewable generation in the area, the fixed minimum criteria for the daytime period was reviewed and a fixed minimum 40dB was used for the cumulative assessment.

The assessment results show that predicted cumulative wind turbine noise levels are below the Total ETSU-R-97 Noise Limits at all the Noise Assessment Locations. Therefore no noise mitigation measures are required. This is based on the Vestas V117 4.3MW operating in full mode PO2 at Burngullow (in addition to other nearby Clean Earth Energy turbines) and indicates that the Vestas V117 4.3MW would be a suitable wind turbine model, in regard to noise, for the Burngullow Wind Turbine.

If Cornwall Council are minded to approve the use of the Vestas V117 4.3MW for the Burngullow Wind Turbine, it is recommended that conditioned noise limits are specific for the Burngullow Wind Turbine operating on its own. The noise conditions mechanism found in the recent planning conditions of Longstones, East Karslake and Wheal Martyn (and all other single turbines in the area) may be used, which involves conditioning the wind turbine based on its own predicted noise levels for an intended wind turbine model at all the nearest receptors. The noise predictions for the Burngullow Wind Turbine on its own are shown in Table 3.1 of this report.

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1 Introduction

1.1 Brief

To undertake predictions of the operational wind turbine noise levels from a Vestas V117 4.3MW wind turbine on a 76.5 m hub for the proposed Burngullow Wind Turbine.

To consider the concurrent operation of the Burngullow Wind Turbine with the existing operating wind turbines in the area and other nearby turbines consented at Longstones, East Karlake, Wheal Martyn. All schemes are being developed by Clean Earth Energy Ltd (CEE).

To compare the predicted noise levels at the nearest noise sensitive receptors against Total ETSU-R-97 Noise Limits and recommend noise mitigation measures for the Vestas V117, if required.

To produce a noise report presenting the results and to demonstrate whether the Vestas V117 is a suitable wind turbine model, with regards to noise.

1.2 Background

Between 2021 and 2022, the Longstones, East Karlake and Wheal Martyn Wind Turbines were separately granted planning permission by Cornwall Council for the installation of a wind turbine with a maximum blade tip height of 135 m, under planning applications PA20/09318, PA21/12493 and PA21/07216. TNEI prepared noise reports issued in September 2023 for the use of a Vestas 117 at these three sites and these were submitted to Cornwall County Council. This assessment and report uses similar assumptions and considers the additional proposed wind turbine at Burngullow.

2 Methodology

2.1 Assessing Compliance with the Noise Conditions

To undertake an assessment of the operational noise to determine compliance with the Total ETSU-R-97 Noise Limits, the following steps are required:

- Identify the nearest noise sensitive receptors and select a sample of the representative Noise Assessment Locations (NAL) at which Total ETSU-R-97 Noise Limits have already been established;
- Specify the grid coordinates and noise data of each wind turbine;
- Predict the cumulative wind turbine noise levels at each of the NALs and compare predictions with the Total ETSU-R-97 Noise Limits;
- If exceedances of the limits are found to occur, suggest noise mitigation measures as required.

The operational noise limits should not be breached. Consequently, the test applied to operational noise is whether the predicted wind turbine noise levels at all noise assessment locations lie below these noise limits.

2.2 Noise Assessment Locations

Noise Assessment Locations (NALs) are defined in this report as the boundary of the curtilage of a residential property that is closest to the wind turbines. This is where noise predictions are calculated to be compared to noise limits. Noise Monitoring Locations (NMLs) are defined as the points where background noise monitoring was previously undertaken to establish prevailing background noise levels.

The NMLs and NALs assumed in this report are identical to those presented in the previous TNEI noise reports¹. Figure A1.1a in Annex 1 shows the NMLs and NALs as well as the wind turbines considered. Table 2.1 below provides a list of the NALs, the relative distance to the consented turbines, and which NML was chosen to represent each NAL to set background noise levels.

Table 2.1 Noise Assessment Locations

NALs	X (Easting)	Y (Northing)	Distance to Burngullow WT (m)	Representative NML
NAL1 - Newgate	197946	53255	971	B
NAL2 - Prideaux	198384	53077	1048	B
NAL3 - 23 Carne Hill	198762	53393	827	B
NAL4 - Secret Cottage (2 properties)	199152	53871	825	B
NAL5 - Treglyn Gardens	199550	53677	1265	B
NAL6 - Area 51 campsite and house east of Greensplat Rd	200157	54074	1781	B
NAL7 - Biscovillack Farm	199576	54088	1204	B

¹ TNEI noise reports references 16024-002, 16024-003 and 16024-004 issued September 2023 for Vestas 117 at Longstones, East Karlake and Wheal Martyn.

NALs	X (Easting)	Y (Northing)	Distance to Burngullow WT (m)	Representative NML
NAL8 - Penisker Farm	199087	54161	718	B
NAL9 - Higher Biscovillack Farm	199385	54756	1198	B
NAL10 - Greystone Cottage	199819	54849	1617	D
NAL11 - Longstone Cottage	197688	55420	1475	A
NAL12 - Longstone House	197633	55346	1438	A
NAL13 - Carthew Farm Cottage	200287	55931	2634	C
NAL14 - Adit (property North of Carthew)	200287	56332	2925	C

2.3 Noise Limits

The Total ETSU-R-97 Noise Limits (also referred to as the ‘cumulative limit’) have already been set in the planning applications of Longstones (PA20/09318), East Karslake (PA21/12493) and Wheal Martyn (PA21/07216). The limits are detailed for each of the 14 NALs within noise reports from TNEI¹, dated September 2023. It should be noted that the limits assumed for property Greystone Cottage are based on the noise limits established in the decision notice of the Greensplat wind turbine (PA12/12138).

Having due regard to the guidance in ETSU-R-97 and considering the cumulative impacts of the proposed Burngullow wind turbine operating in conjunction with other consented and operational wind turbines, and cumulative renewable generation, the daytime fixed minimum limit relating to the Total ETSU-R-97 limits has been reviewed. The choice of the daytime fixed minimum limit within the range of 35-40 dB depends on three factors which are discussed on page 65 of ETSU-R-97 and in Section 3.2.4 of the IOA GPG. The IOA GPG notes that:

‘It can be argued that assessing these factors do not represent an acoustic consideration but ultimately a planning consideration, and therefore are difficult for noise consultants to fully determine.’

To assist the Planning Officer and Environmental Health Officer, a detailed review of the three criteria along with noise predictions and relevant graphics is included in Appendix 3 at the end of this report. Conclusions for each individual criteria suggest that the upper end of the range can be used, hence a 40dB fixed minimum criteria. It should be noted that this choice is for cumulative noise only and the Site Specific Noise Limit for Burngullow would be set separately on its own at values lower than the Total ETSU-R-97 limits. The Site Specific Noise Limit would be based on noise predictions for the proposed single wind turbine on its own, as was done for all other single wind turbines in the area.

The Total ETSU-R-97 Noise Limits are summarised in Table 2.2 (Quiet Daytime) and Table 2.3 (Night-time) below.

Table 2.2 Total ETSU-R-97 Noise Limits for Quiet Daytime

Location	Wind speed standardised from 80 to 10 metre height (m/s)									
	3	4	5	6	7	8	9	10	11	12
NAL1 - Newgate	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL2 - Prideaux	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL3 - 23 Carne Hill	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL4 - Secret Cottage (2 properties)	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL5 - Treglyn Gardens	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL6 - Area 51 campsite and house east of Greensplat Rd	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL7 - Biscovillack Farm	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL8 - Penisker Farm	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL9 - Higher Biscovillack Farm	40	40	40	40	40	40	40.4	42.6	44.8	44.8
NAL10 - Greystone Cottage	50	50	50	50	50	50	50	50	50	50
NAL11 - Longstone Cottage	40	40	40	40	40	40.1	41.6	43.1	44.6	44.6
NAL12 - Longstone House	40	40	40	40	40	40.1	41.6	43.1	44.6	44.6
NAL13 - Carthew Farm Cottage	40	40.3	41.5	42.7	43.8	45	46.2	47.3	48.5	49.7
NAL14 - Adit (property North of Carthew)	40	40.3	41.5	42.7	43.8	45	46.2	47.3	48.5	49.7

Table 2.3 Total ETSU-R-97 Noise Limits for Night-time

Location	Wind speed standardised from 80 to 10 metre height (m/s)									
	3	4	5	6	7	8	9	10	11	12
NAL1 - Newgate	43	43	43	43	43	43	43	43	43	43
NAL2 - Prideaux	43	43	43	43	43	43	43	43	43	43
NAL3 - 23 Carne Hill	43	43	43	43	43	43	43	43	43	43
NAL4 - Secret Cottage (2 properties)	43	43	43	43	43	43	43	43	43	43
NAL5 - Treglyn Gardens	43	43	43	43	43	43	43	43	43	43
NAL6 - Area 51 campsite and house east of Greensplat Rd	43	43	43	43	43	43	43	43	43	43
NAL7 - Biscovillack Farm	43	43	43	43	43	43	43	43	43	43
NAL8 - Penisker Farm	43	43	43	43	43	43	43	43	43	43
NAL9 - Higher Biscovillack Farm	43	43	43	43	43	43	43	43	43	43

NAL10 - Greystone Cottage	50	50	50	50	50	50	50	50	50	50
NAL11 - Longstone Cottage	43	43	43	43	43	43	43	43	43.5	43.5
NAL12 - Longstone House	43	43	43	43	43	43	43	43	43.5	43.5
NAL13 - Carthew Farm Cottage	43	43	43	43	43	43	44.2	45.5	46.7	47.9
NAL14 - Adit (property North of Carthew)	43	43	43	43	43	43	44.2	45.5	46.7	47.9

2.4 Wind Shear Considerations

The noise limits refer to wind speeds which have been measured at a height of 80 m and standardised to 10 m. As such, no site specific wind shear correction is required for the predictions of wind turbine noise. The proposed wind turbine model will have a hub height slightly below 80 m hub, however these limits remain applicable and are in fact worst-case for any hub height below 80 m.

2.5 Noise Emission Characteristics of the Wind Turbines

The wind turbines modelled are summarised in Table 2.4 below.

Table 2.4 Wind Turbine Noise Modelling Parameters

Wind Turbine Name / Status	Candidate Turbine	Hub Height Modelled (m)	Maximum Sound Power Level Modelled , inclusive of uncertainties added by TNEI:
Higher Goonamarth / Operating	EWT DW54 500kW	50	101
Greensplat / Operating	EWT DW54 500kW	35	101
Blackpool / Operating	EWT DW54 500kW	50	101
Gunheath / Operating	EWT DW54 500kW	50	101
Longstones / Consented	Vestas V117 4.3MW PO2	76.5	107
East Karslake / Consented	Vestas V117 4.3MW PO2	76.5	107
Wheal Martyn / Consented	Vestas V117 4.3MW PO2	76.5	107
Burngullow Proposed	Vestas V117 4.3MW PO2	76.5	107

Due to differences in the way in which noise levels are provided by the different manufacturers, TNEI has accounted for uncertainty in the noise data in accordance with the recommendations included within the IOA GPG.

The noise data supplied by EWT for the DW54 was adjusted by +1.5dB to match the maximum sound power of 101dB(LAeq) consented in the noise condition of the Higher Goonamarth Wind Turbine (PA14/12102). This results in the same sound power levels as assumed in the planning noise reports for the Longstones Wind Turbine, East Karslake Wind Turbine and Wheal Martyn Wind Turbine.

The noise data supplied by Vestas for the V117 4.3MW PO2 was adjusted by +1dB based on a statement on uncertainties issued by Vestas to Clean Earth Energy on 18th December 2023 which stated:

‘For clarity regarding sound power uncertainties for the Vestas V117-4.3MW at your potential Clean Earth Energy sites in the UK, Vestas would warrant up to +1dB above the sound power level values found in the attached documentation reference DMS 0090-2475 Performance Specification V117-4.30MW and dated 01-03-2020. As such, the independent consultant does not need to add more than +1dB uncertainty over the values in the document for their assessment.’

Quantification of tonal noise and subsequent calculation of any resulting penalty in accordance with ETSU-R-97 can usually only be undertaken once the turbines are operating. Independent test reports only consider tonal audibility at locations very close to a single turbine in accordance with the methodology of IEC 61400-11. This data cannot be used to determine whether an ETSU-R-97 tonal penalty would be required when undertaking noise predictions which are used to assess compliance with ETSU-R-97 limits at a distant receptor, and as such no tonal penalty was included in the predictions. This is recognised in the IOA GPG which states:

‘It is highly unlikely that any specific information on tonality at representative receptor separation distances in accordance with the ETSU-R-97 methodology will be available at the planning application

stage. When such information is available, it should be appropriately applied. It is standard to control the potential presence of tones in practice through the use of suitable planning conditions.’

The sound power data used for modelling, inclusive of uncertainties, is included in Annex 2. Please note that the Vestas data is under NDA and can not be published, it can however be obtained upon request.

2.6 Noise Propagation Parameters

The full version of the ISO 9613-2 model has been used to predict the wind turbine noise levels at the NALs.

All noise level predictions have been undertaken using a receiver height of 4.0m above local ground level, mixed ground (G=0.5) and air absorption coefficients based on a temperature of 10°C and 70 per cent relative humidity to provide a realistic impact assessment. These modelling parameters reflect current good practice as detailed within the IOA GPG.

A topographical assessment has been undertaken between each noise sensitive receptor and wind turbine location to determine whether any concave ground profiles exist between the source and receiver. Analysis undertaken using a combination of CadnaA and an Excel model found that, if the formula in the IOA GPG is applied directly, a +3 dB correction is required for some turbines at a number of receptors as summarised in Annex 2.

In addition, an assessment has been undertaken to determine whether any topographical screening effects of the terrain occur where there is no direct line of sight between the highest point on the turbine rotor and the receiver location. Upon analysis of each noise sensitive receptor it was found that a barrier correction of -2 dB could be applied for some turbines at a number of receptors as detailed in Annex 2.

The assessment has taken into account directivity effects in line with good practice. Directivity was applied in accordance with the IOA GPG and the worst-case cumulative wind direction was considered, that is typically wind blowing from the nearest wind turbines (in the cumulative scenario) towards the NALs. The TNEI noise model can consider the effect of directivity, and in line with current good practice the attenuation values used are in detailed in Table 2.5. These are based upon the examples given in the IOA GPG (Section 4.4.2), using interpolation where required.

Table 2.5 Wind Directivity Attenuation Factors used in Modelling

Direction (°)	0	15	30	45	60	75	90	105	120	135	150	165
Attenuation dB(A)	-10	-9.9	-9.3	-8.3	-6.7	-4.6	-2	0	0	0	0	0
Direction (°)	180	195	210	225	240	255	270	285	300	315	330	345
Attenuation (dB(A))	0	0	0	0	0	0	-2	-4.6	-6.7	-8.3	-9.3	-9.9

3 Noise Assessment Results

Figures A1.2a to A1.2n (included in Annex 1) show the cumulative noise predictions at each NAL (one figure per NAL) and on each figure a breakdown of the individual wind turbine predictions is also provided. The prediction results for cumulative and individual wind turbines are included in Table 3.1 below and the noise assessment results comparing Total ETSU-R-97 Noise Limits with cumulative predictions is included in Table 3.2 (Quiet Daytime) and Table 3.3 (Night-time). A negative exceedance level indicates that the predicted noise immission level is below the noise limit. Any exceedances are shown in **bold**.

Table 3.1 Predicted Wind Turbine Noise Levels

Noise Assessment Location	Wind Turbines being predicted	Wind speed standardised to 10 metre height (m/s)									
		3	4	5	6	7	8	9	10	11	12
NAL1	Cumulative (8 x WT)	-	28.9	31.3	33.8	35.5	36.2	36.7	36.7	36.7	36.7
	Existing and Operating (4 x WT)	-	27.7	29.3	30.9	32	33.1	34.1	34.1	34.1	34.1
	Consented L,EK and WM(3 x WT)	11.3	14.4	18.6	22.3	24.5	24.8	24.8	24.8	24.8	24.8
	Burngullow (1 x WT)	19	22.2	26.3	30	32.3	32.5	32.5	32.5	32.5	32.5
NAL2	Cumulative (8 x WT)	-	28	30.4	32.9	34.6	35.3	35.8	35.8	35.8	35.8
	Existing and Operating (4 x WT)	-	26.7	28.3	29.9	31	32.1	33.1	33.1	33.1	33.1
	Consented L,EK and WM(3 x WT)	10.7	13.9	18	21.8	24	24.3	24.3	24.3	24.3	24.3
	Burngullow (1 x WT)	18.2	21.3	25.5	29.2	31.4	31.7	31.7	31.7	31.7	31.7
NAL3	Cumulative (8 x WT)	-	29.7	32.5	35.3	37.2	37.7	38.1	38.1	38.1	38.1
	Existing and Operating (4 x WT)	-	27.6	29.2	30.8	31.9	33	34	34	34	34
	Consented L,EK and WM(3 x WT)	17.4	20.6	24.7	28.5	30.7	31	31	31	31	31
	Burngullow (1 x WT)	20.8	23.9	28	31.8	34	34.3	34.3	34.3	34.3	34.3
NAL4	Cumulative (8 x WT)	-	28.3	31.4	34.6	36.5	37	37.2	37.2	37.2	37.2
	Existing and Operating (4 x WT)	-	24.2	25.8	27.4	28.5	29.6	30.6	30.6	30.6	30.6
	Consented L,EK and WM(3 x WT)	17.3	20.4	24.6	28.3	30.5	30.8	30.8	30.8	30.8	30.8
	Burngullow (1 x WT)	20.8	23.9	28.1	31.8	34	34.3	34.3	34.3	34.3	34.3
NAL5	Cumulative (8 x WT)	-	23.8	26.9	30	32	32.4	32.7	32.7	32.7	32.7
	Existing and Operating (4 x WT)	-	20.8	22.4	24	25.1	26.2	27.2	27.2	27.2	27.2
	Consented L,EK and WM(3 x WT)	12.7	15.8	20	23.7	25.9	26.2	26.2	26.2	26.2	26.2
	Burngullow (1 x WT)	16.1	19.2	23.4	27.1	29.3	29.6	29.6	29.6	29.6	29.6
NAL6	Cumulative (8 x WT)	-	28.8	31.1	33.5	35.1	35.9	36.4	36.4	36.4	36.4
	Existing and Operating (4 x WT)	-	27.7	29.3	30.9	32	33.1	34.1	34.1	34.1	34.1
	Consented L,EK and WM(3 x WT)	16.7	19.8	24	27.7	30	30.2	30.2	30.2	30.2	30.2
	Burngullow (1 x WT)	15.1	18.2	22.4	26.1	28.3	28.6	28.6	28.6	28.6	28.6
NAL7	Cumulative (8 x WT)	-	29.1	32	35	36.9	37.4	37.7	37.7	37.7	37.7
	Existing and Operating (4 x WT)	-	26.7	28.3	29.9	31	32.1	33.1	33.1	33.1	33.1
	Consented L,EK and WM(3 x WT)	19	22.1	26.3	30	32.2	32.5	32.5	32.5	32.5	32.5
	Burngullow (1 x WT)	19.6	22.8	26.9	30.7	32.9	33.2	33.2	33.2	33.2	33.2
NAL8	Cumulative (8 x WT)	-	29.1	32.5	35.8	37.9	38.3	38.4	38.4	38.4	38.4
	Existing and Operating (4 x WT)	-	24.8	26.4	28	29.1	30.2	31.2	31.2	31.2	31.2
	Consented L,EK and WM(3 x WT)	19.2	22.4	26.5	30.2	32.5	32.7	32.7	32.7	32.7	32.7

Noise Assessment Location	Wind Turbines being predicted	Wind speed standardised to 10 metre height (m/s)									
		3	4	5	6	7	8	9	10	11	12
	Burngullow (1 x WT)	22.3	25.4	29.5	33.3	35.5	35.8	35.8	35.8	35.8	35.8
NAL9	Cumulative (8 x WT)	-	28.9	32.1	35.3	37.3	37.7	37.9	37.9	37.9	37.9
	Existing and Operating (4 x WT)	-	25.4	27	28.6	29.7	30.8	31.8	31.8	31.8	31.8
	Consented L,EK and WM(3 x WT)	22.1	25.2	29.4	33.1	35.3	35.6	35.6	35.6	35.6	35.6
	Burngullow (1 x WT)	16.7	19.8	24	27.7	29.9	30.2	30.2	30.2	30.2	30.2
NAL10	Cumulative (8 x WT)	-	31.9	34	36.3	37.8	38.6	39.2	39.2	39.2	39.2
	Existing and Operating (4 x WT)	-	31.1	32.7	34.3	35.4	36.5	37.5	37.5	37.5	37.5
	Consented L,EK and WM(3 x WT)	19	22.1	26.3	30	32.2	32.5	32.5	32.5	32.5	32.5
	Burngullow (1 x WT)	16.2	19.4	23.5	27.3	29.5	29.8	29.8	29.8	29.8	29.8
NAL11	Cumulative (8 x WT)	-	29.4	33.2	36.8	39	39.3	39.4	39.4	39.4	39.4
	Existing and Operating (4 x WT)	-	20.9	22.5	24.1	25.2	26.3	27.3	27.3	27.3	27.3
	Consented L,EK and WM(3 x WT)	24.9	28	32.2	35.9	38.1	38.4	38.4	38.4	38.4	38.4
	Burngullow (1 x WT)	17.3	20.5	24.6	28.3	30.6	30.8	30.8	30.8	30.8	30.8
NAL12	Cumulative (8 x WT)	-	29	32.8	36.4	38.5	38.8	38.9	38.9	38.9	38.9
	Existing and Operating (4 x WT)	-	21.3	22.9	24.5	25.6	26.7	27.7	27.7	27.7	27.7
	Consented L,EK and WM(3 x WT)	24.2	27.3	31.5	35.2	37.4	37.7	37.7	37.7	37.7	37.7
	Burngullow (1 x WT)	17.6	20.8	24.9	28.6	30.9	31.1	31.1	31.1	31.1	31.1
NAL13	Cumulative (8 x WT)	-	30.8	34.4	37.9	40	40.4	40.5	40.5	40.5	40.5
	Existing and Operating (4 x WT)	-	24.9	26.5	28.1	29.2	30.3	31.3	31.3	31.3	31.3
	Consented L,EK and WM(3 x WT)	26.3	29.4	33.6	37.3	39.5	39.8	39.8	39.8	39.8	39.8
	Burngullow (1 x WT)	10.4	13.5	17.7	21.4	23.6	23.9	23.9	23.9	23.9	23.9
NAL14	Cumulative (8 x WT)	-	33	36.7	40.2	42.4	42.7	42.8	42.8	42.8	42.8
	Existing and Operating (4 x WT)	-	26.4	28	29.6	30.7	31.8	32.8	32.8	32.8	32.8
	Consented L,EK and WM(3 x WT)	28.8	32	36.1	39.9	42.1	42.4	42.4	42.4	42.4	42.4
	Burngullow (1 x WT)	-1	2.1	6.3	10	12.2	12.5	12.5	12.5	12.5	12.5

Table 3.2 Compliance Table for Quiet Daytime

Location		Wind speed standardised to 10 metre height (m/s)									
		3	4	5	6	7	8	9	10	11	12
NAL1	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	28.9	31.3	33.8	35.5	36.2	36.7	36.7	36.7	36.7
	Exceedance Level	-	-11.1	-8.7	-6.2	-4.5	-3.8	-3.7	-5.9	-8.1	-8.1
NAL2	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	28	30.4	32.9	34.6	35.3	35.8	35.8	35.8	35.8
	Exceedance Level	-	-12	-9.6	-7.1	-5.4	-4.7	-4.6	-6.8	-9	-9
NAL3	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	29.7	32.5	35.3	37.2	37.7	38.1	38.1	38.1	38.1
	Exceedance Level	-	-10.3	-7.5	-4.7	-2.8	-2.3	-2.3	-4.5	-6.7	-6.7
NAL4	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	28.3	31.4	34.6	36.5	37	37.2	37.2	37.2	37.2
	Exceedance Level	-	-11.7	-8.6	-5.4	-3.5	-3	-3.2	-5.4	-7.6	-7.6
NAL5	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	23.8	26.9	30	32	32.4	32.7	32.7	32.7	32.7
	Exceedance Level	-	-16.2	-13.1	-10	-8	-7.6	-7.7	-9.9	-12.1	-12.1
NAL6	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	28.8	31.1	33.5	35.1	35.9	36.4	36.4	36.4	36.4
	Exceedance Level	-	-11.2	-8.9	-6.5	-4.9	-4.1	-4	-6.2	-8.4	-8.4
NAL7	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	29.1	32	35	36.9	37.4	37.7	37.7	37.7	37.7
	Exceedance Level	-	-10.9	-8	-5	-3.1	-2.6	-2.7	-4.9	-7.1	-7.1
NAL8	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	29.1	32.5	35.8	37.9	38.3	38.4	38.4	38.4	38.4
	Exceedance Level	-	-10.9	-7.5	-4.2	-2.1	-1.7	-2	-4.2	-6.4	-6.4
NAL9	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40	40.4	42.6	44.8	44.8
	Cumulative Noise (8 x WT)	-	28.9	32.1	35.3	37.3	37.7	37.9	37.9	37.9	37.9
	Exceedance Level	-	-11.1	-7.9	-4.7	-2.7	-2.3	-2.5	-4.7	-6.9	-6.9
NAL10	Total ETSU-R-97 Noise Limit	50	50	50	50	50	50	50	50	50	50
	Cumulative Noise (8 x WT)	-	31.9	34	36.3	37.8	38.6	39.2	39.2	39.2	39.2
	Exceedance Level	-	-18.1	-16	-13.7	-12.2	-11.4	-10.8	-10.8	-10.8	-10.8
NAL11	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40.1	41.6	43.1	44.6	44.6
	Cumulative Noise (8 x WT)	-	29.4	33.2	36.8	39	39.3	39.4	39.4	39.4	39.4
	Exceedance Level	-	-10.6	-6.8	-3.2	-1	-0.8	-2.2	-3.7	-5.2	-5.2
NAL12	Total ETSU-R-97 Noise Limit	40	40	40	40	40	40.1	41.6	43.1	44.6	44.6
	Cumulative Noise (8 x WT)	-	29	32.8	36.4	38.5	38.8	38.9	38.9	38.9	38.9
	Exceedance Level	-	-11	-7.2	-3.6	-1.5	-1.3	-2.7	-4.2	-5.7	-5.7
NAL13	Total ETSU-R-97 Noise Limit	40	40.3	41.5	42.7	43.8	45	46.2	47.3	48.5	49.7
	Cumulative Noise (8 x WT)	-	30.8	34.4	37.9	40	40.4	40.5	40.5	40.5	40.5
	Exceedance Level	-	-9.5	-7.1	-4.8	-3.8	-4.6	-5.7	-6.8	-8	-9.2
NAL14	Total ETSU-R-97 Noise Limit	40	40.3	41.5	42.7	43.8	45	46.2	47.3	48.5	49.7
	Cumulative Noise (8 x WT)	-	33	36.7	40.2	42.4	42.7	42.8	42.8	42.8	42.8
	Exceedance Level	-	-7.3	-4.8	-2.5	-1.4	-2.3	-3.4	-4.5	-5.7	-6.9

Table 3.3 Compliance Table for Night-time

Location		Wind speed standardised to 10 metre height (m/s)									
		3	4	5	6	7	8	9	10	11	12
NAL1	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	28.9	31.3	33.8	35.5	36.2	36.7	36.7	36.7	36.7
	Exceedance Level	-	-14.1	-11.7	-9.2	-7.5	-6.8	-6.3	-6.3	-6.3	-6.3
NAL2	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	28	30.4	32.9	34.6	35.3	35.8	35.8	35.8	35.8
	Exceedance Level	-	-15	-12.6	-10.1	-8.4	-7.7	-7.2	-7.2	-7.2	-7.2
NAL3	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	29.7	32.5	35.3	37.2	37.7	38.1	38.1	38.1	38.1
	Exceedance Level	-	-13.3	-10.5	-7.7	-5.8	-5.3	-4.9	-4.9	-4.9	-4.9
NAL4	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	28.3	31.4	34.6	36.5	37	37.2	37.2	37.2	37.2
	Exceedance Level	-	-14.7	-11.6	-8.4	-6.5	-6	-5.8	-5.8	-5.8	-5.8
NAL5	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	23.8	26.9	30	32	32.4	32.7	32.7	32.7	32.7
	Exceedance Level	-	-19.2	-16.1	-13	-11	-10.6	-10.3	-10.3	-10.3	-10.3
NAL6	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	28.8	31.1	33.5	35.1	35.9	36.4	36.4	36.4	36.4
	Exceedance Level	-	-14.2	-11.9	-9.5	-7.9	-7.1	-6.6	-6.6	-6.6	-6.6
NAL7	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	29.1	32	35	36.9	37.4	37.7	37.7	37.7	37.7
	Exceedance Level	-	-13.9	-11	-8	-6.1	-5.6	-5.3	-5.3	-5.3	-5.3
NAL8	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	29.1	32.5	35.8	37.9	38.3	38.4	38.4	38.4	38.4
	Exceedance Level	-	-13.9	-10.5	-7.2	-5.1	-4.7	-4.6	-4.6	-4.6	-4.6
NAL9	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43	43
	Cumulative Noise (8 x WT)	-	28.9	32.1	35.3	37.3	37.7	37.9	37.9	37.9	37.9
	Exceedance Level	-	-14.1	-10.9	-7.7	-5.7	-5.3	-5.1	-5.1	-5.1	-5.1
NAL10	Total ETSU-R-97 Noise Limit	50	50	50	50	50	50	50	50	50	50
	Cumulative Noise (8 x WT)	-	31.9	34	36.3	37.8	38.6	39.2	39.2	39.2	39.2
	Exceedance Level	-	-18.1	-16	-13.7	-12.2	-11.4	-10.8	-10.8	-10.8	-10.8
NAL11	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43.5	43.5
	Cumulative Noise (8 x WT)	-	29.4	33.2	36.8	39	39.3	39.4	39.4	39.4	39.4
	Exceedance Level	-	-13.6	-9.8	-6.2	-4	-3.7	-3.6	-3.6	-4.1	-4.1
NAL12	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	43	43	43.5	43.5
	Cumulative Noise (8 x WT)	-	29	32.8	36.4	38.5	38.8	38.9	38.9	38.9	38.9
	Exceedance Level	-	-14	-10.2	-6.6	-4.5	-4.2	-4.1	-4.1	-4.6	-4.6
NAL13	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	44.2	45.5	46.7	47.9
	Cumulative Noise (8 x WT)	-	30.8	34.4	37.9	40	40.4	40.5	40.5	40.5	40.5
	Exceedance Level	-	-12.2	-8.6	-5.1	-3	-2.6	-3.7	-5	-6.2	-7.4
NAL14	Total ETSU-R-97 Noise Limit	43	43	43	43	43	43	44.2	45.5	46.7	47.9
	Cumulative Noise (8 x WT)	-	33	36.7	40.2	42.4	42.7	42.8	42.8	42.8	42.8
	Exceedance Level	-	-10	-6.3	-2.8	-0.6	-0.3	-1.4	-2.7	-3.9	-5.1

The assessment results show that predicted cumulative wind turbine noise levels are below the Total ETSU-R-97 Noise Limits at all the Noise Assessment Locations. Therefore no noise mitigation measures are required.

4 Conclusion

Predictions of wind turbine noise have been made, based upon sound power level data for the Vestas V117 4.3MW Mode PO2 for the proposed Burngullow Wind Turbine. As part of cumulative predictions to account for other wind turbines in the area, the same wind turbine model was also assumed for the nearby consented Longstones, East Karslake and Wheal Martyn wind turbines. Four other nearby EWT DW500 kW wind turbines (which are already operational) are also considered in the predictions.

The turbine noise prediction model used is considered to provide a realistic impact assessment and considers current good practice, inclusive of the Institute of Acoustics document 'A Good Practice Guide to the Application of ETSU-R-97 for the Rating and Assessment of Wind Turbines' (IOA GPG) issued in May 2013. The predictions were undertaken at fourteen Noise Assessment Locations which are residential properties in the immediate area and for which existing Total ETSU-R-97 Noise Limits (which is sometimes referred to as the 'cumulative limit') were already set in the planning applications of Longstones, East Karslake and Wheal Martyn wind turbines. In the context of cumulative renewable generation in the area, the fixed minimum criteria in daytime was reviewed and set to 40dB, this is the only change to the existing Total ETSU-R-97 Noise Limits and this change only applies at lower wind speeds in daytime.

The assessment results show that predicted cumulative wind turbine noise levels are below the Total ETSU-R-97 Noise Limits at all the Noise Assessment Locations. Therefore no noise mitigation measures are required. This indicates that the Vestas V117 4.3MW would be a suitable wind turbine model, in regard to noise, for the Burngullow Wind Turbine.

If Cornwall Council are minded to approve the use of the Vestas V117 4.3MW for the Burngullow Wind Turbine, it is recommended that conditioned noise limits are specific for the Burngullow Wind Turbine operating on its own. The noise conditions mechanism found in the recent planning conditions of Longstones, East Karslake and Wheal Martyn (and all other single turbines in the area) may be used, and it involves conditioning the wind turbine based on its own predicted noise levels for an intended wind turbine model, at all the nearest receptors. The noise predictions for the Burngullow Wind Turbine on its own are shown in Table 3.1 of this report.

5 References

ETSU-R-97 'The Working Group on Noise from Wind Turbines: 'The Assessment and Rating of Noise from Wind farms', ETSU Report ETSU-R-97, 1996.

Institute of Acoustics (2013) 'Good Practice Guidance on the application of ETSU-R-97 for wind turbine noise assessment'

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

6 Glossary of Terms

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

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

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

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

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

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

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

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

L90: index represents the noise level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background noise level. The LA90,10min is the A-weighted background noise level over a ten minute measurement sample.

Noise emission: the noise energy emitted by a source (e.g. a wind turbine).

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

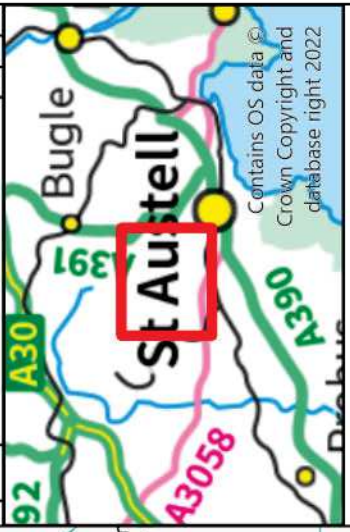
Tonal Noise: noise which covers a very restricted range of frequencies (e.g. a range of ≤ 20 Hz). This noise can be more annoying than broadband noise.

Annex 1 – Figures


NOTES

- Noise Monitoring Locations (NMLs)
- Noise Assessment Locations (NALs)
- ▲ Turbines
- ▲ Existing and Operating WTs
- ▲ Consented WTs
- ▲ Proposed Burrigullow WT

Rev	Date	Description	TS	MC	IC
01	18/12/2023	Issue for comment			
02	18/12/2023	Final design			
03	18/12/2023	Final design			
04	18/12/2023	Final design			
05	18/12/2023	Final design			
06	18/12/2023	Final design			
07	18/12/2023	Final design			
08	18/12/2023	Final design			
09	18/12/2023	Final design			
10	18/12/2023	Final design			



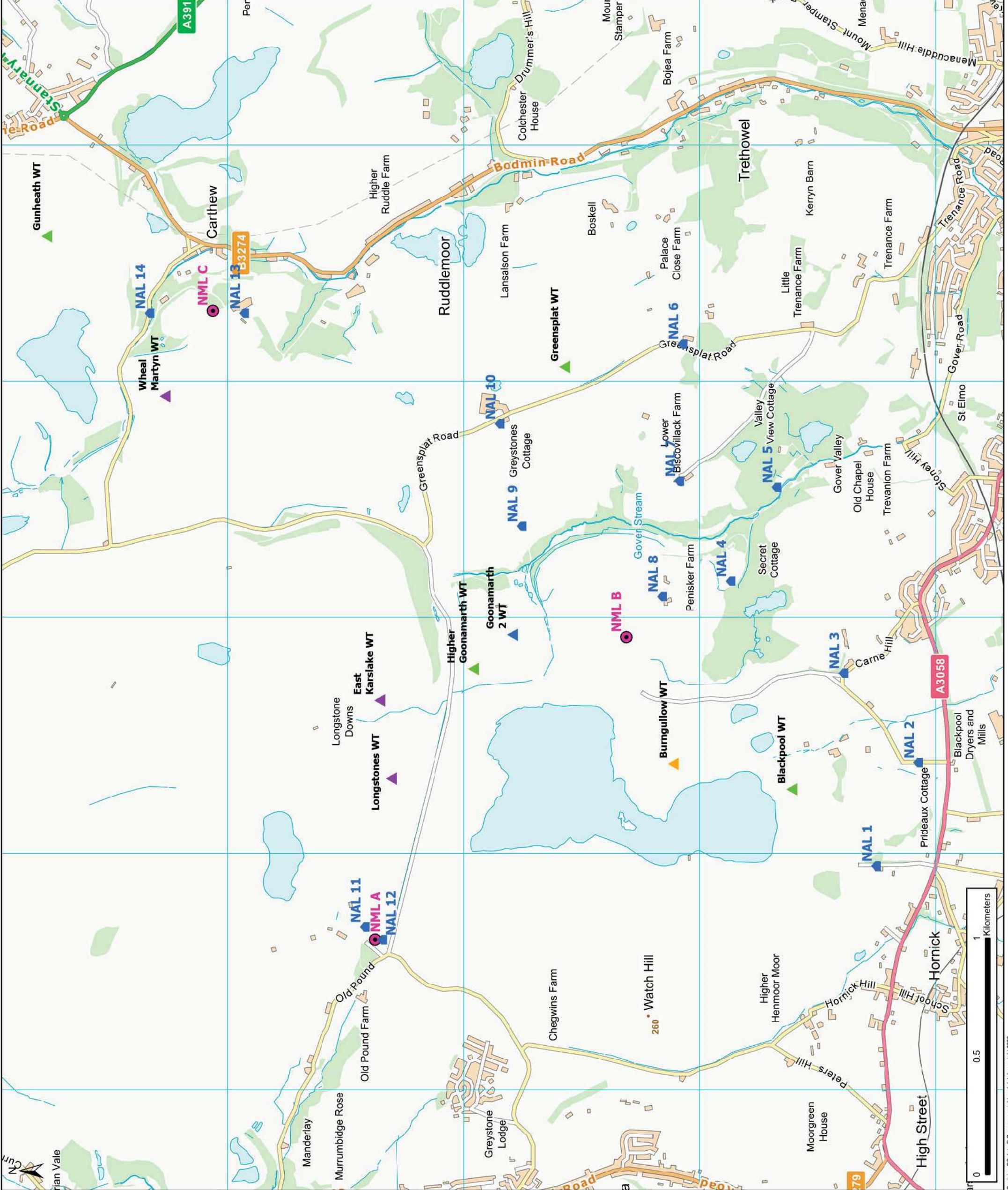
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FOR PLANNING

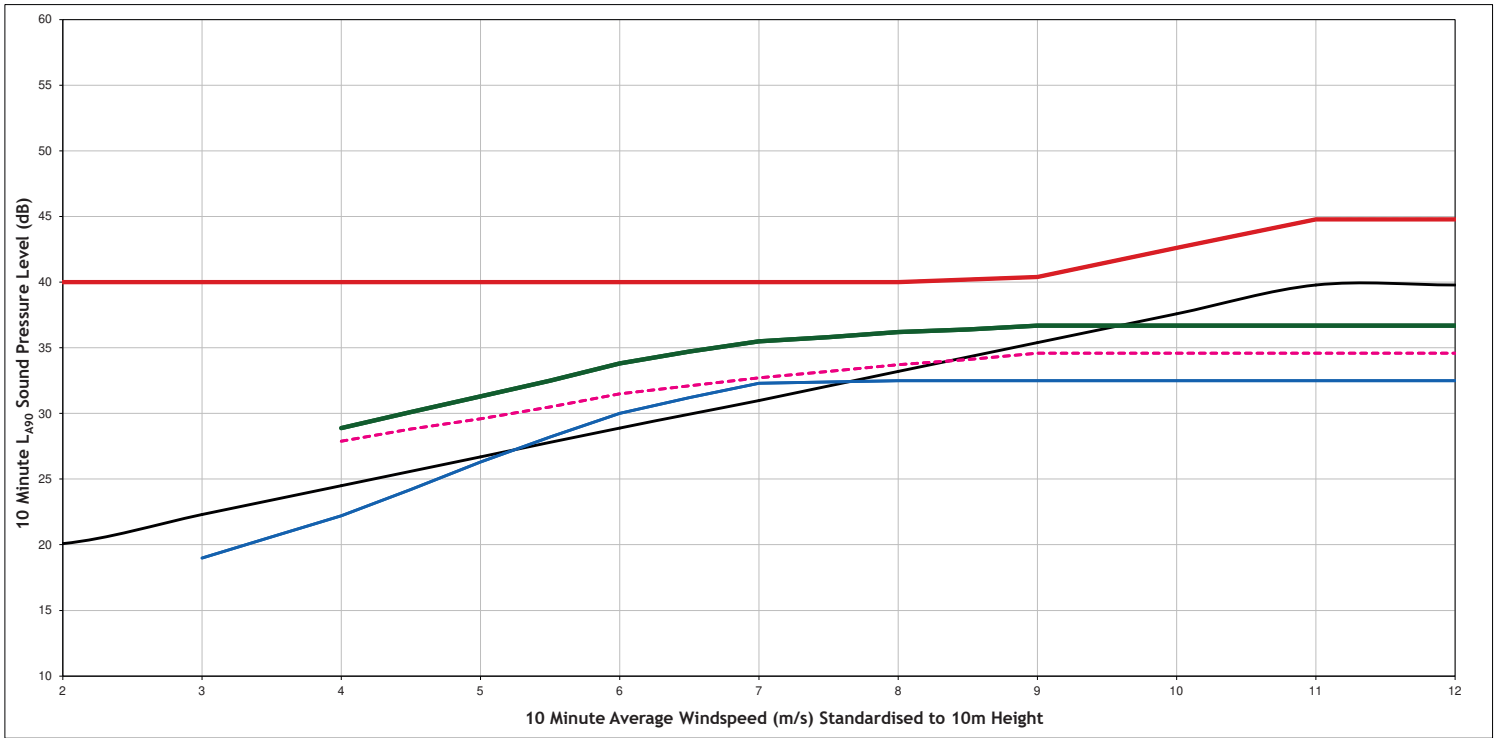
IMERY'S WIND TURBINES

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Drawing Number	16024-008	Date	04/01/2024
		Approved	MC
		Revision	00

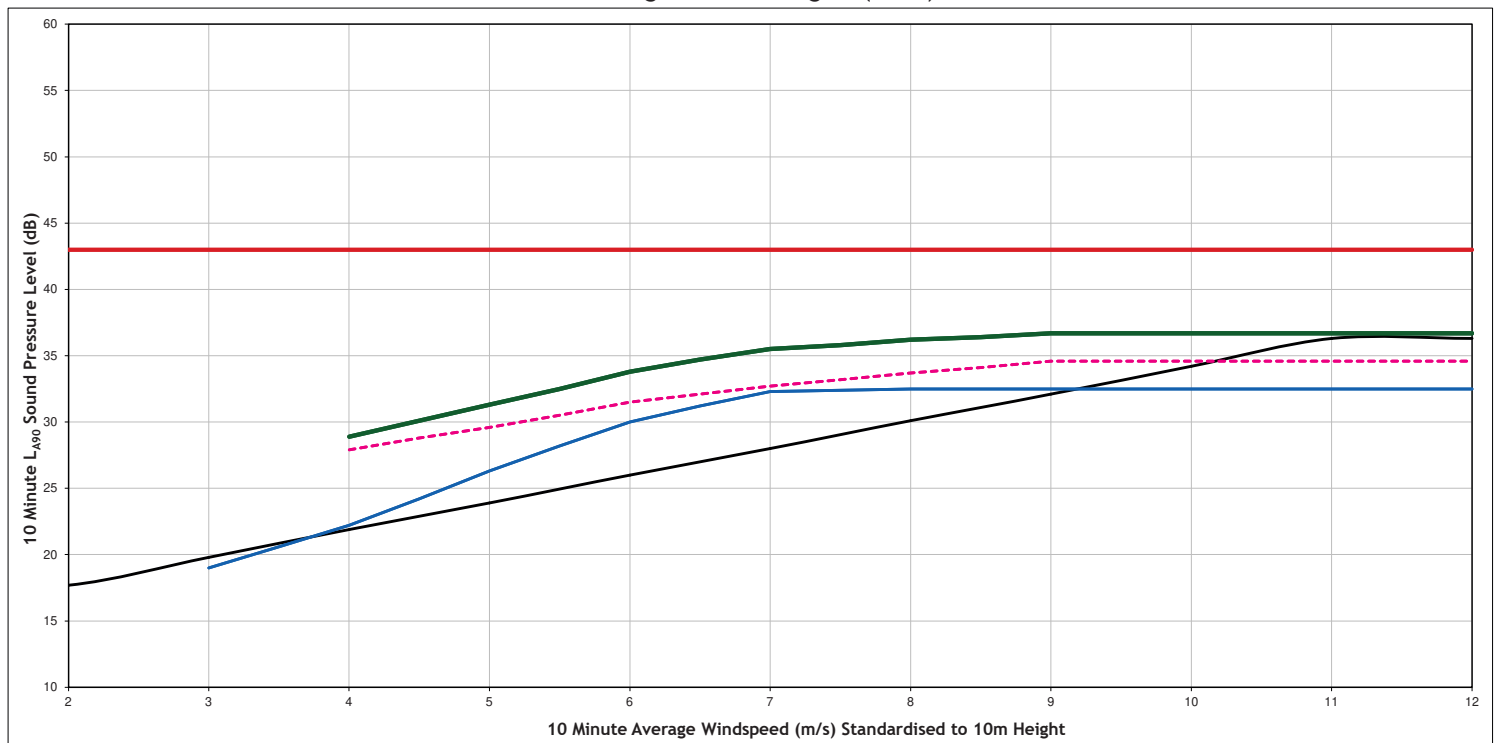


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Daytime - Newgate (NAL1)



Night Time - Newgate (NAL1)



Legend:

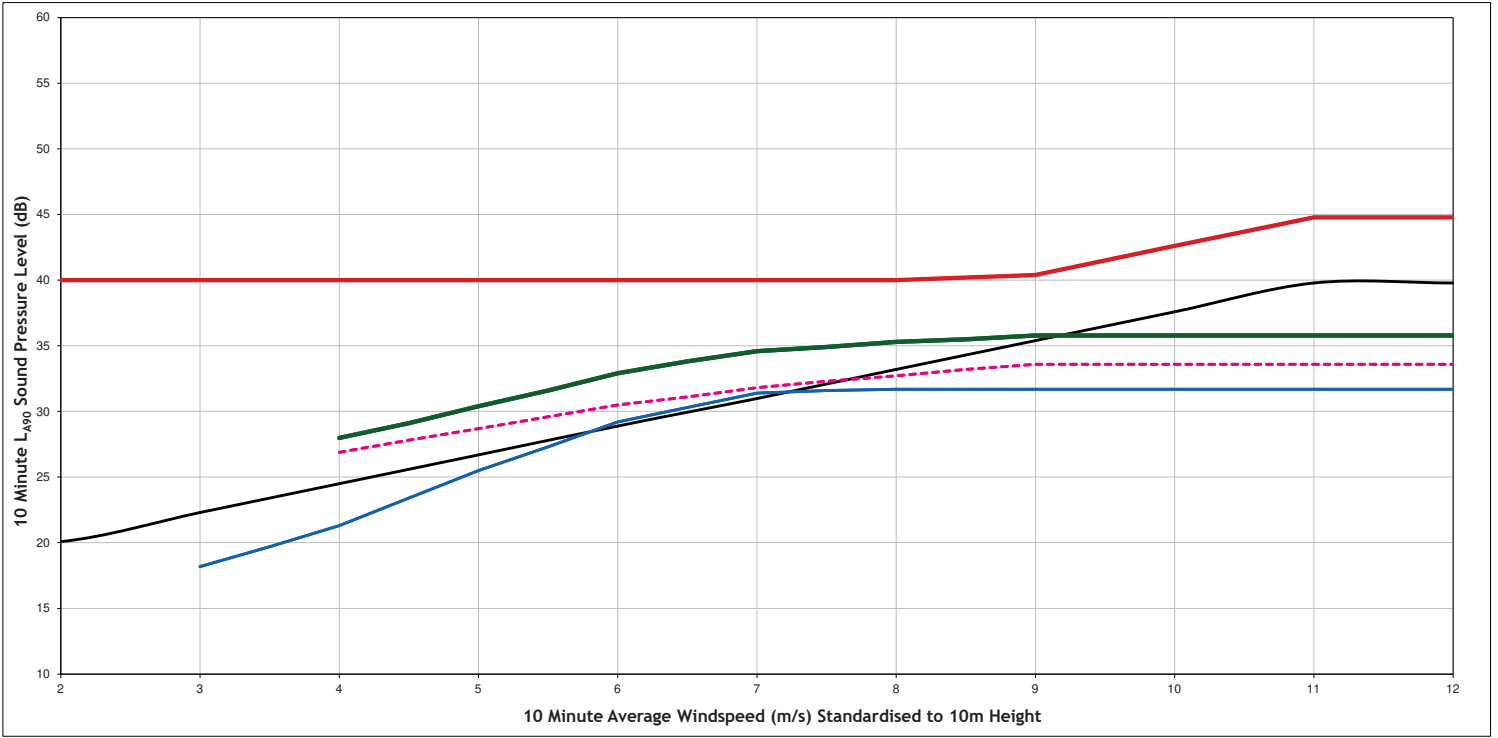
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- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Newgate (NAL1)
Figure Number	Figure A1.2a
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

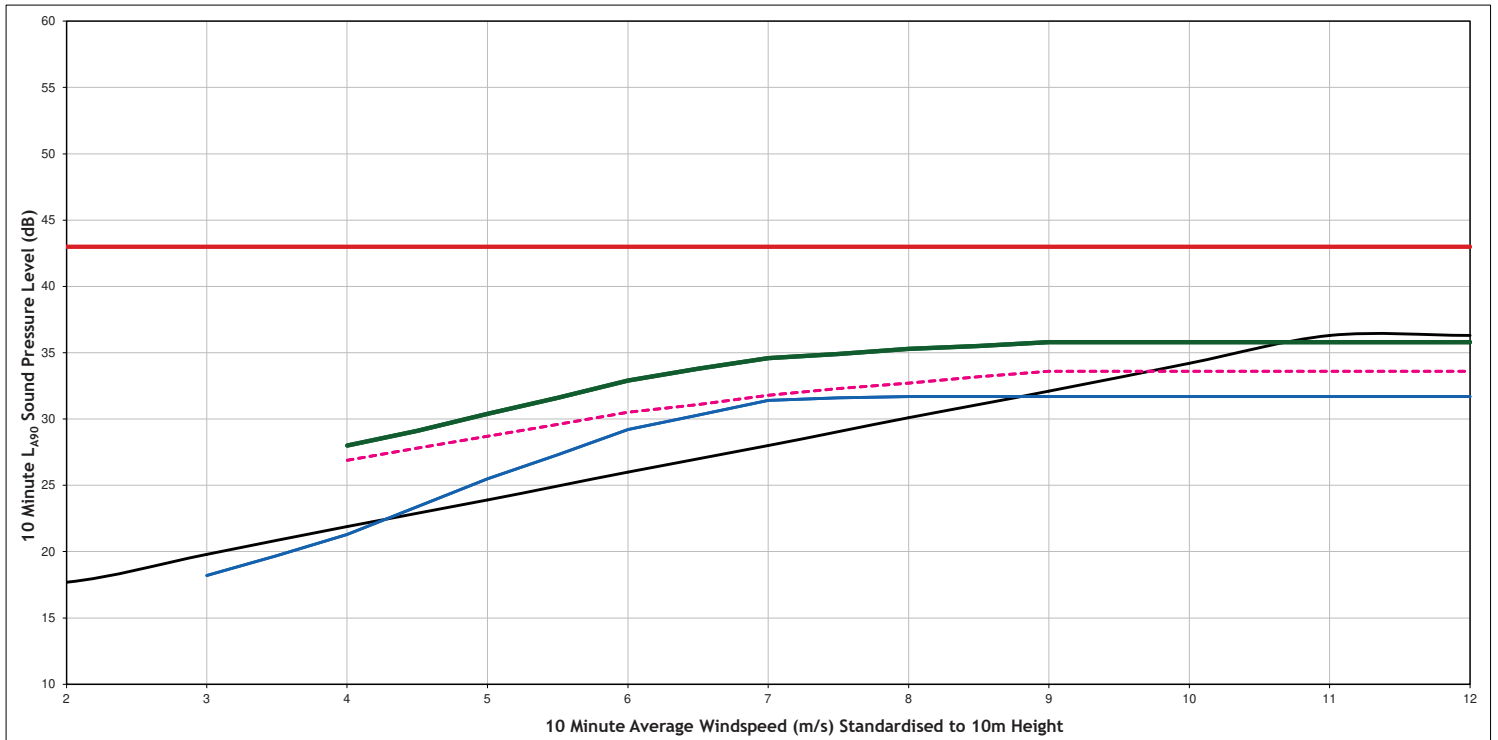


* Wind direction considered is 0 degrees.

Daytime - Prideaux (NAL2)



Night Time - Prideaux (NAL2)



Legend:

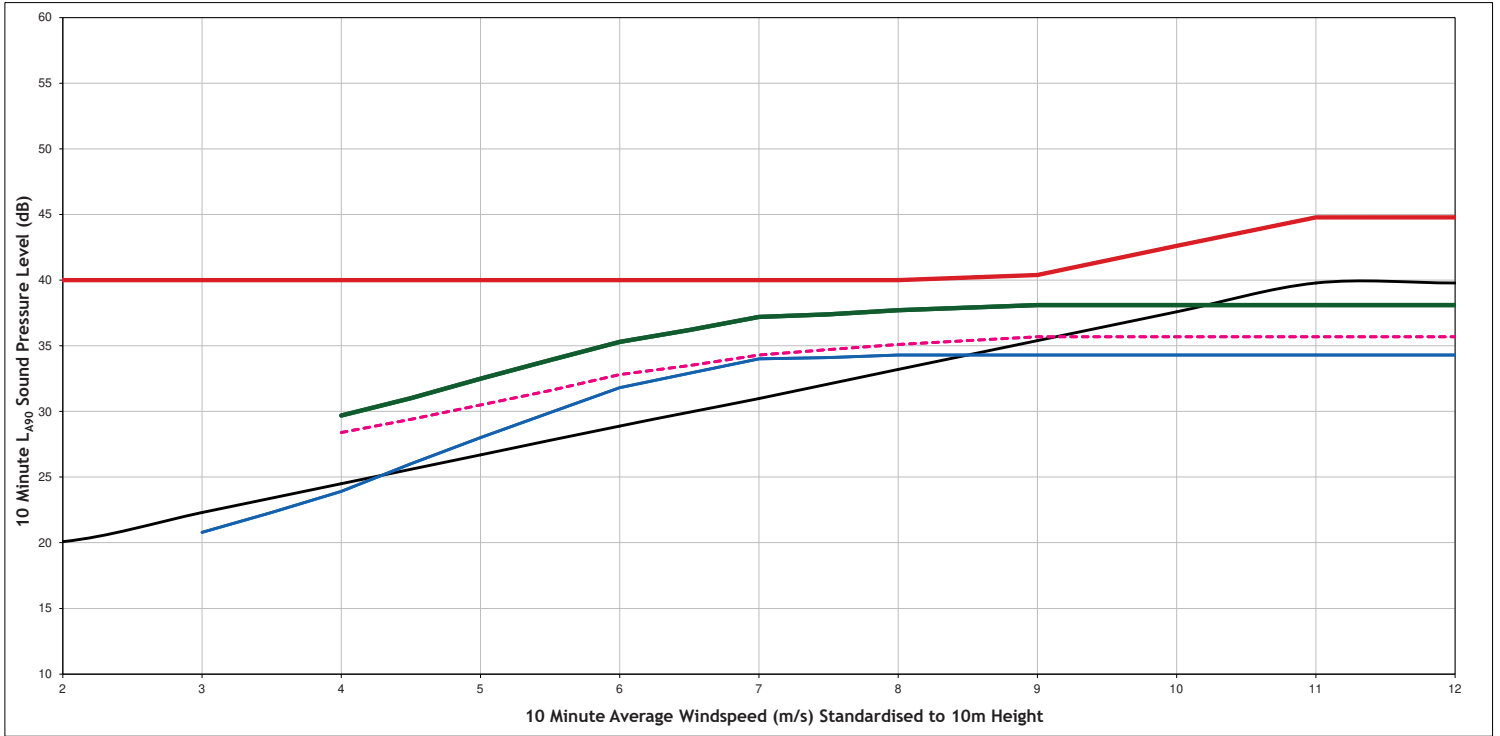
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Prideaux (NAL2)
Figure Number	Figure A1.2b
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

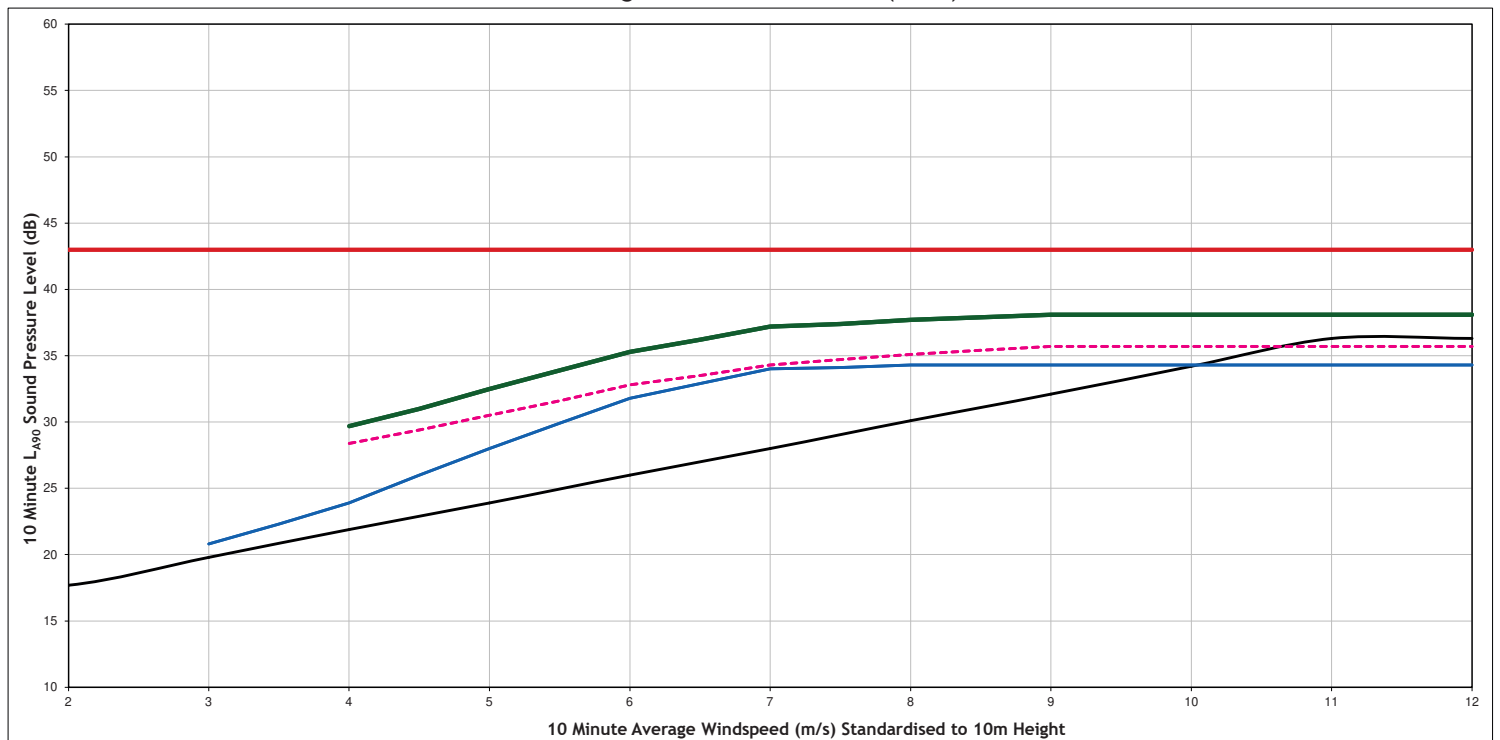


* Wind direction considered is 0 degrees.

Daytime - 23 Carne Hill (NAL3)



Night Time - 23 Carne Hill (NAL3)



Legend:

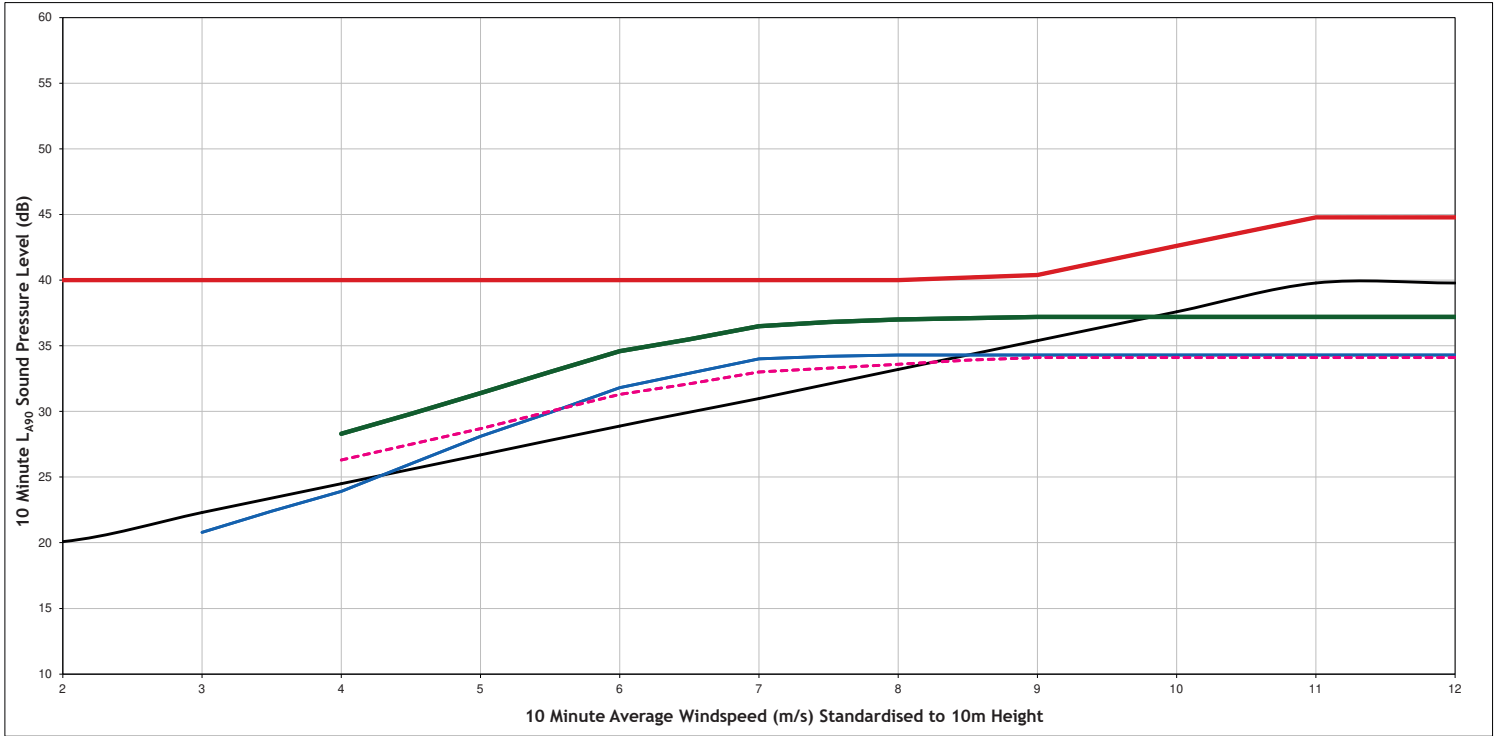
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 23 Carne Hill (NAL3)
Figure Number	Figure A1.2c
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

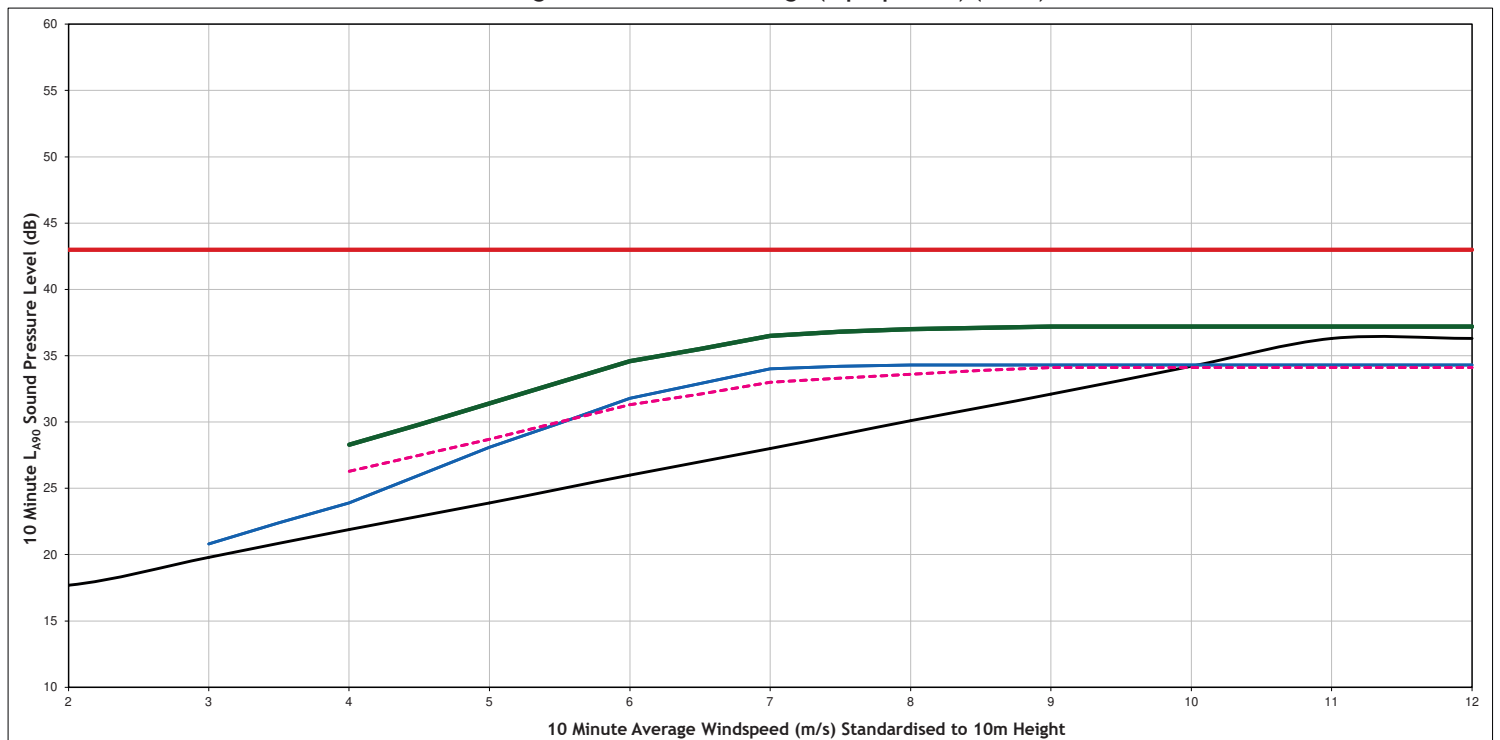


* Wind direction considered is 0 degrees.

Daytime - Secret Cottage (2 properties) (NAL4)



Night Time - Secret Cottage (2 properties) (NAL4)



Legend:

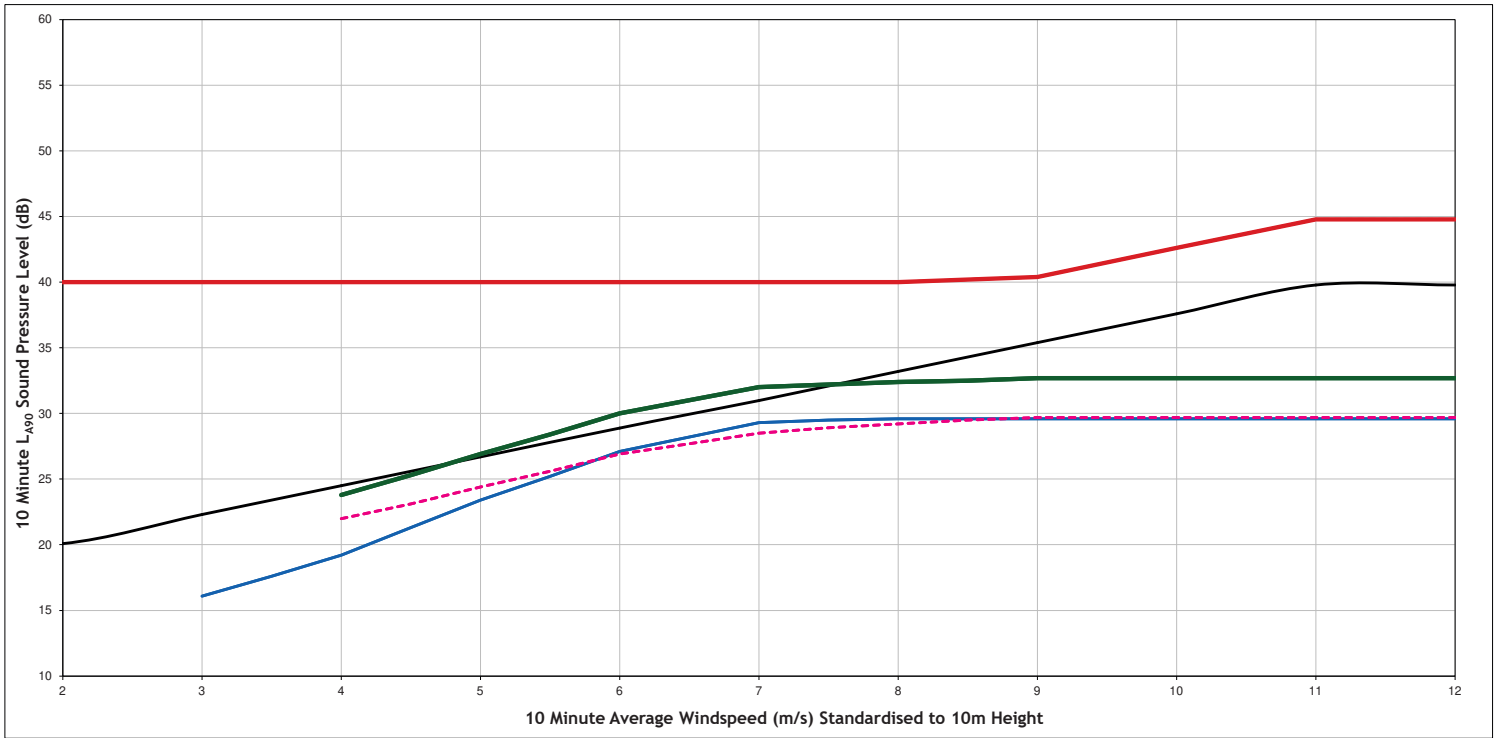
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Secret Cottage (2 properties) (NAL4)
Figure Number	Figure A1.2d
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

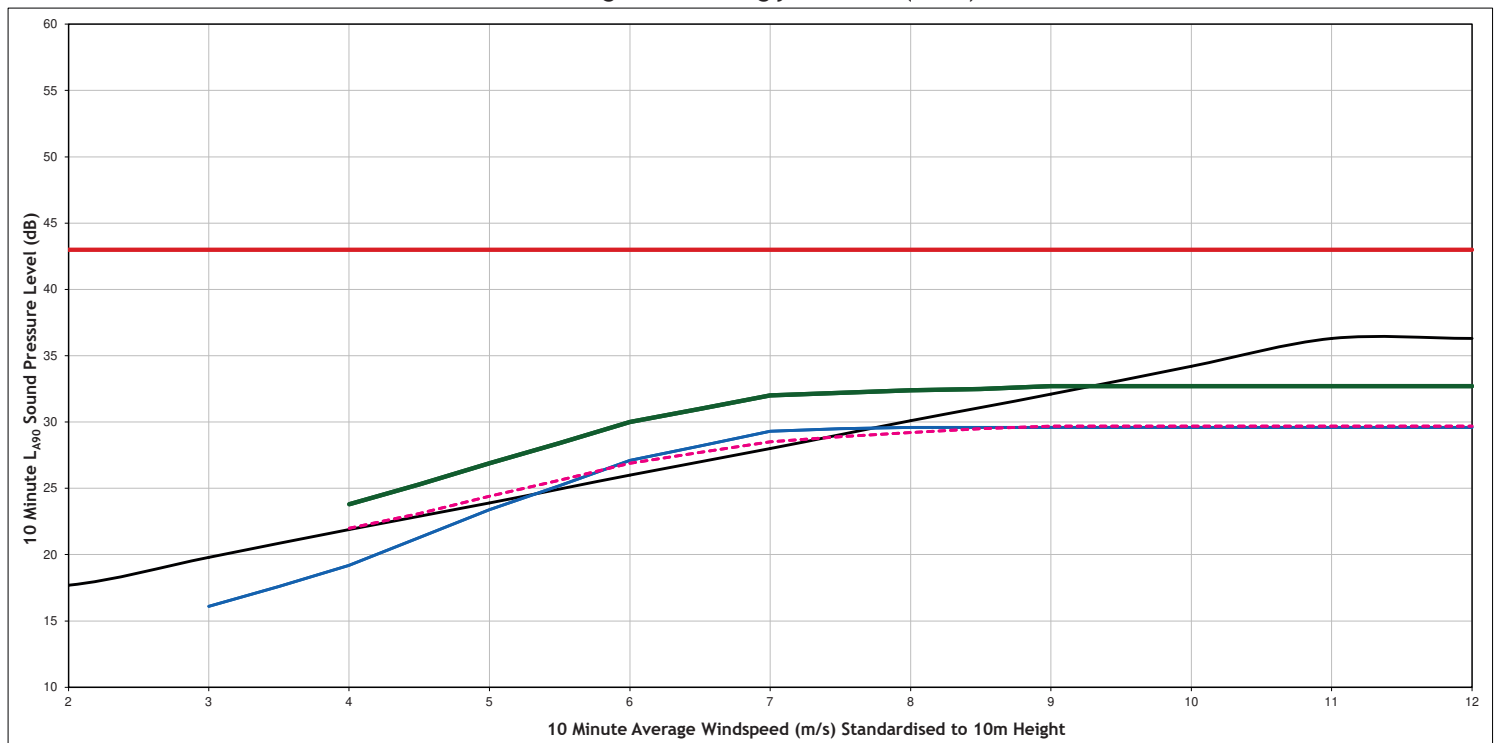


* Wind direction considered is 330 degrees.

Daytime - Treglyn Gardens (NAL5)



Night Time - Treglyn Gardens (NAL5)



Legend:

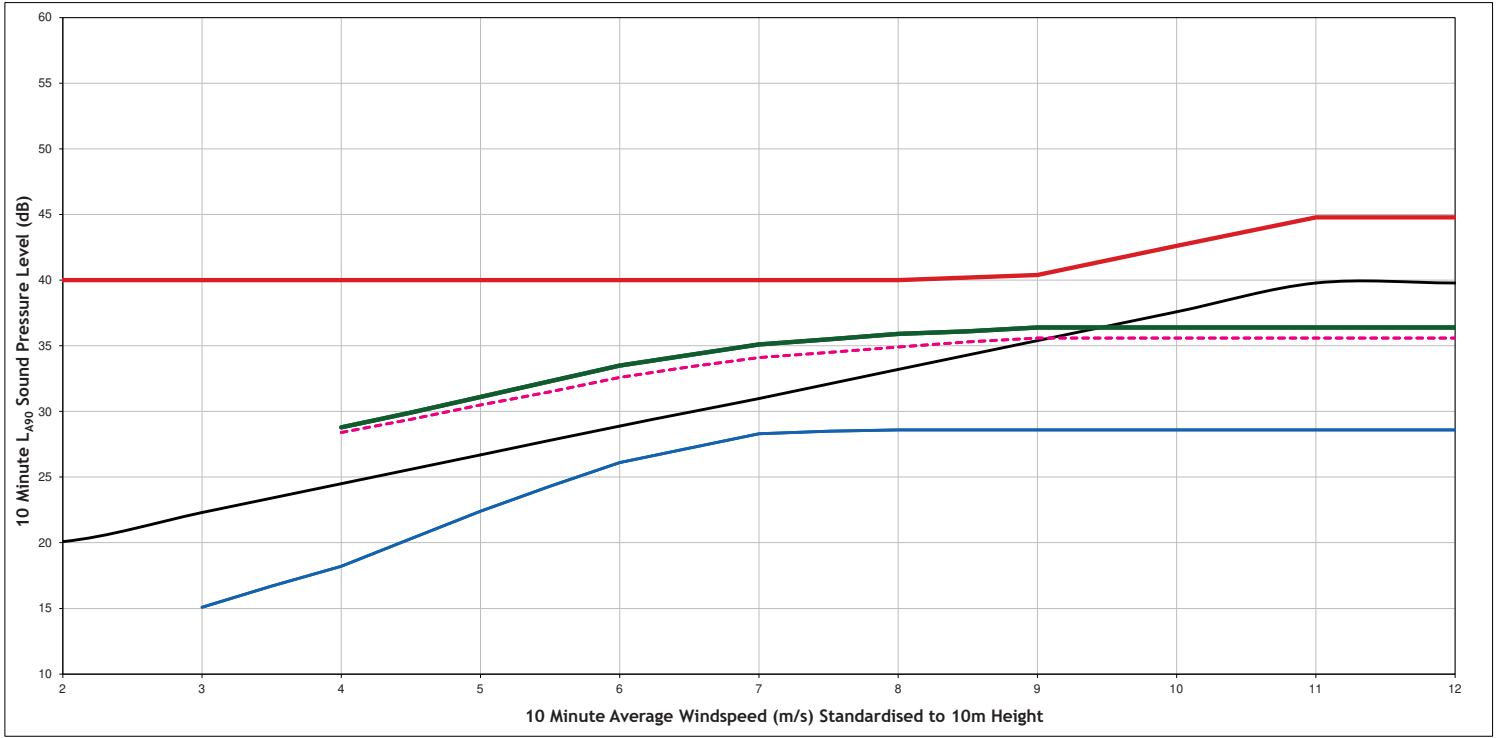
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Treglyn Gardens (NAL5)
Figure Number	Figure A1.2e
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

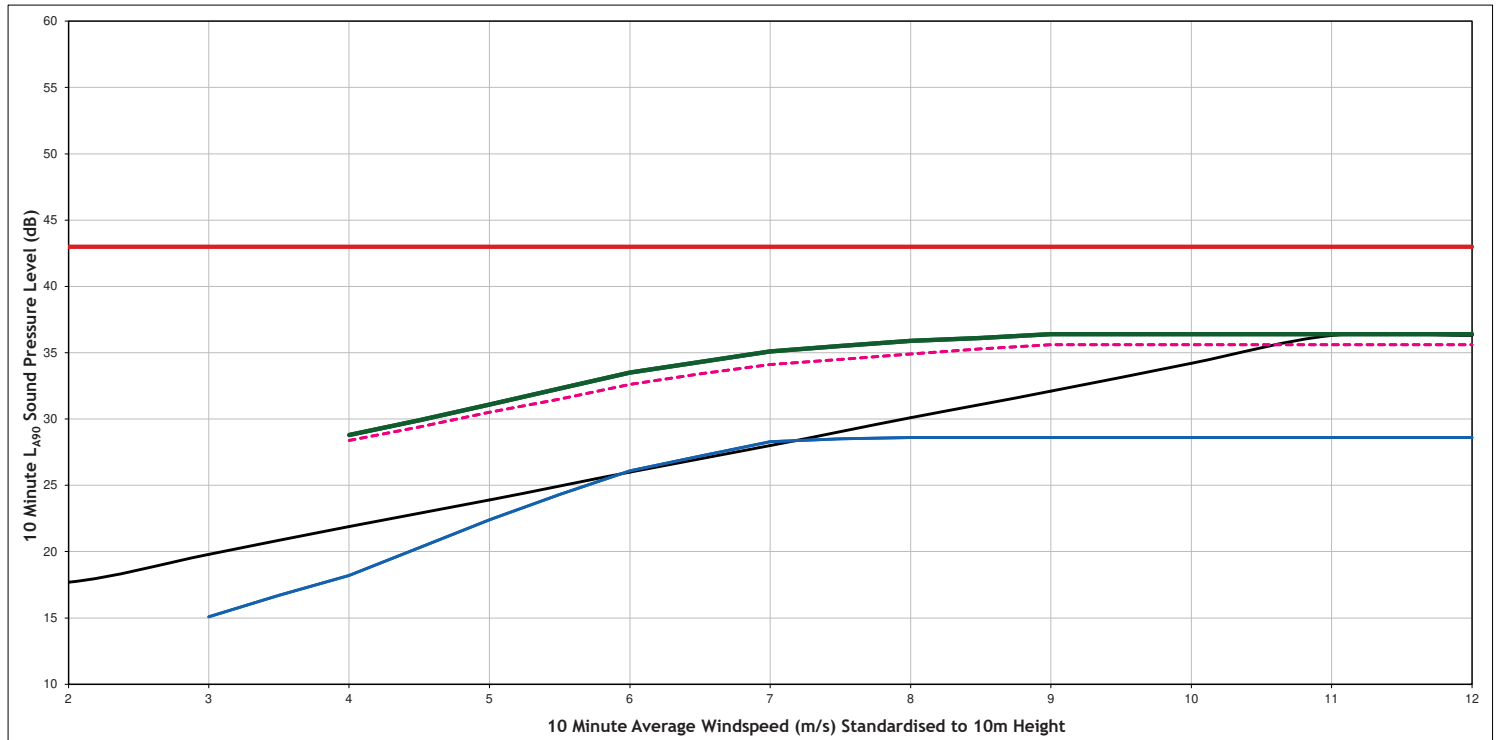


* Wind direction considered is 330 degrees.

Daytime - Area 51 campsite and house east of Greensplat Rd (NAL6)



Night Time - Area 51 campsite and house east of Greensplat Rd (NAL6)



Legend:

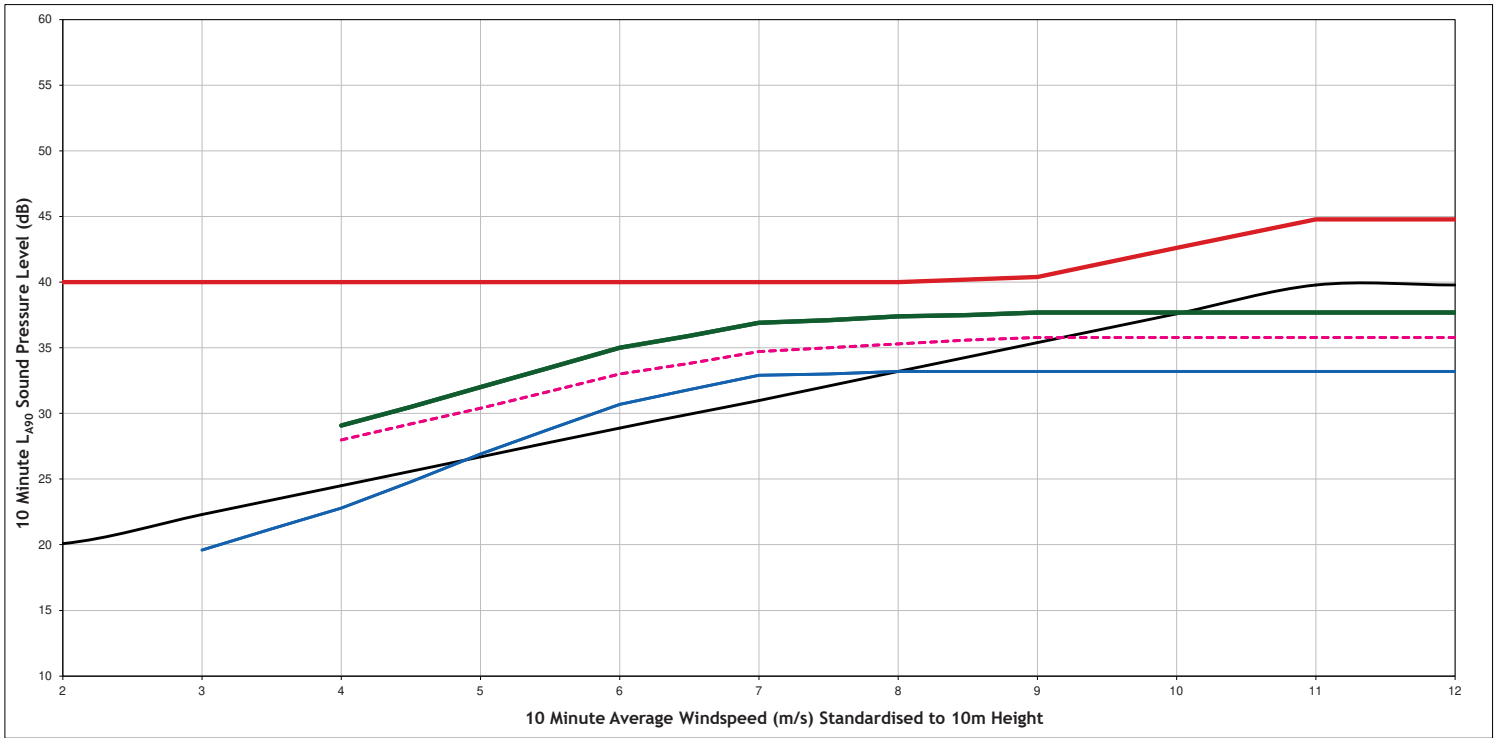
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Area 51 campsite and house east of Greensplat Rd (NAL6)
Figure Number	Figure A1.2f
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

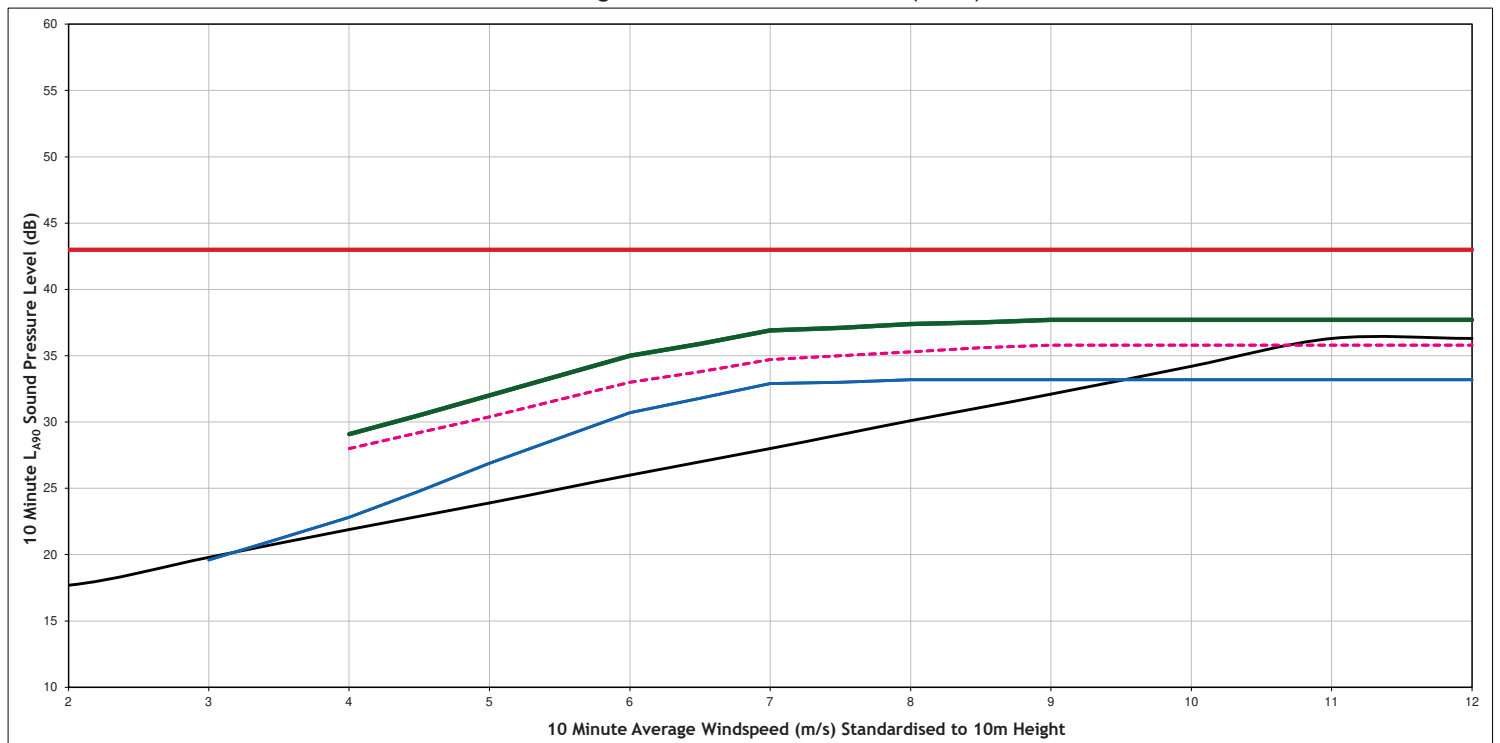


* Wind direction considered is 300 degrees.

Daytime - Biscovillack Farm (NAL7)



Night Time - Biscovillack Farm (NAL7)



Legend:

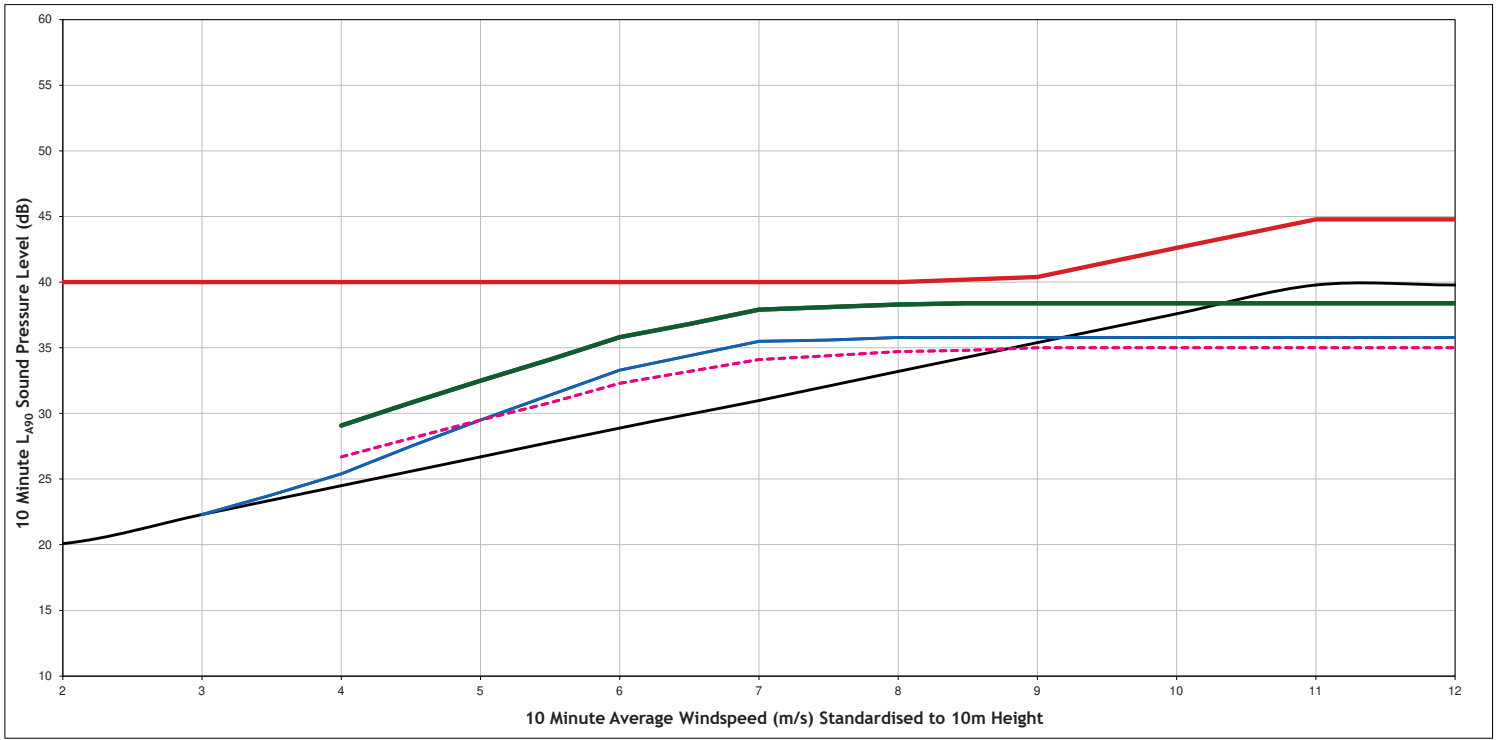
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Biscovillack Farm (NAL7)
Figure Number	Figure A1.2g
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

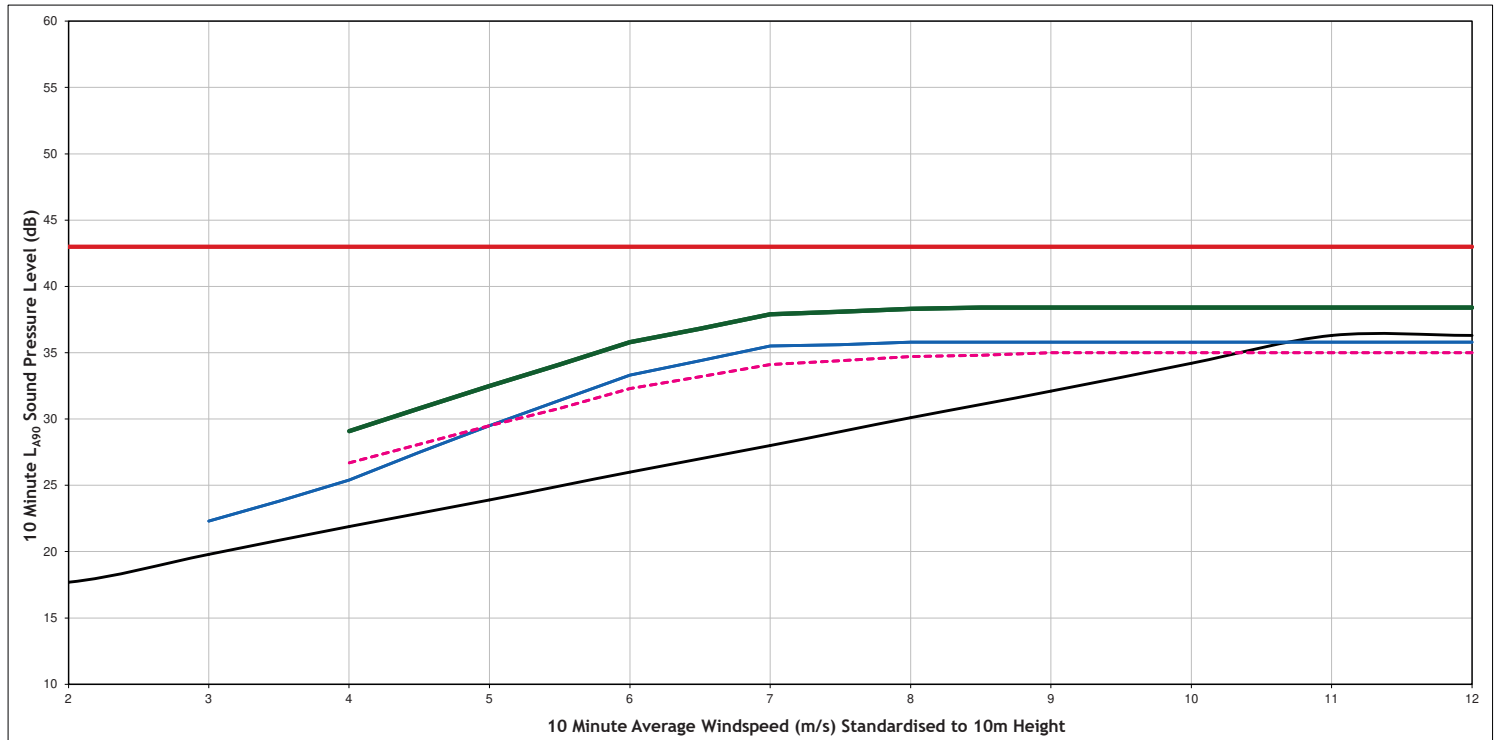


* Wind direction considered is 330 degrees.

Daytime - Penisker Farm (NAL8)



Night Time - Penisker Farm (NAL8)



Legend:

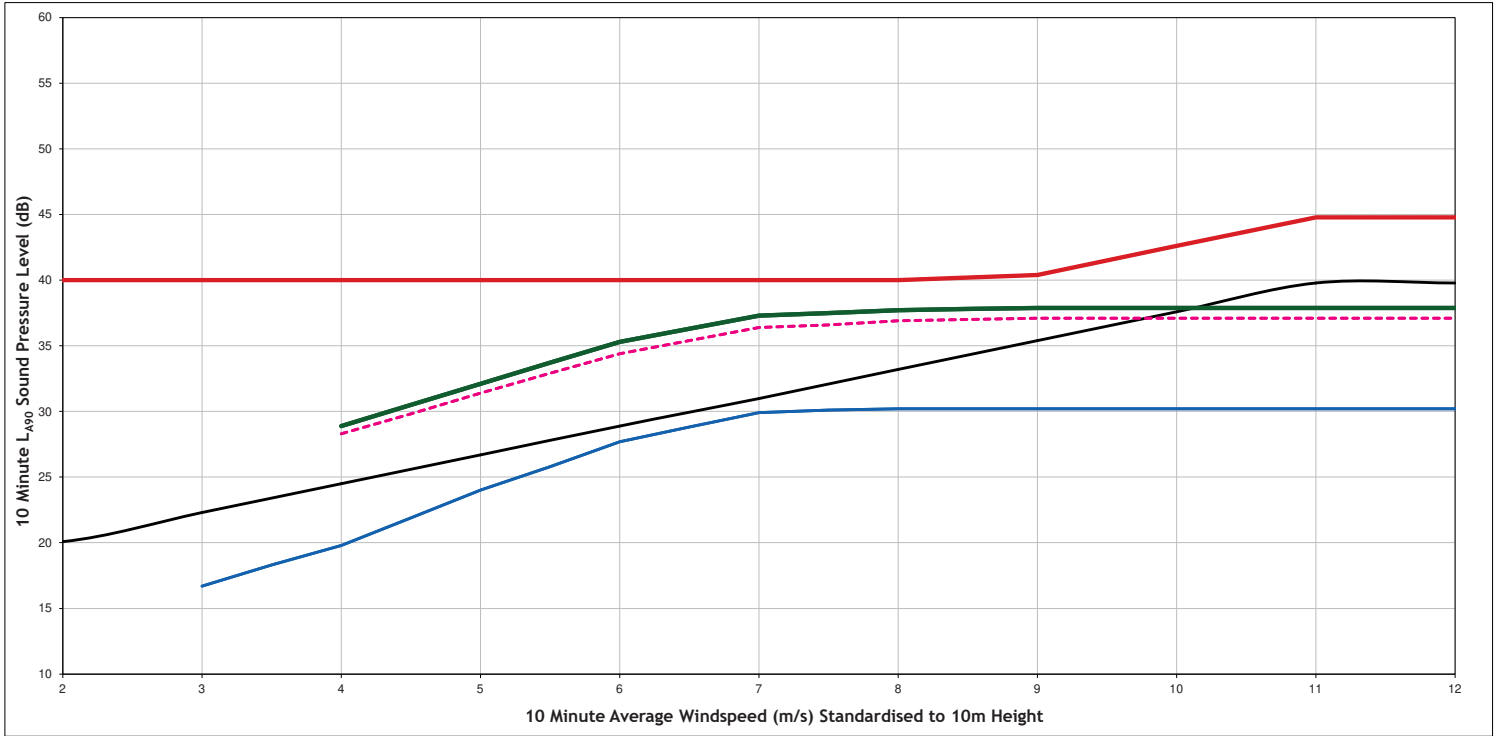
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Penisker Farm (NAL8)
Figure Number	Figure A1.2h
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

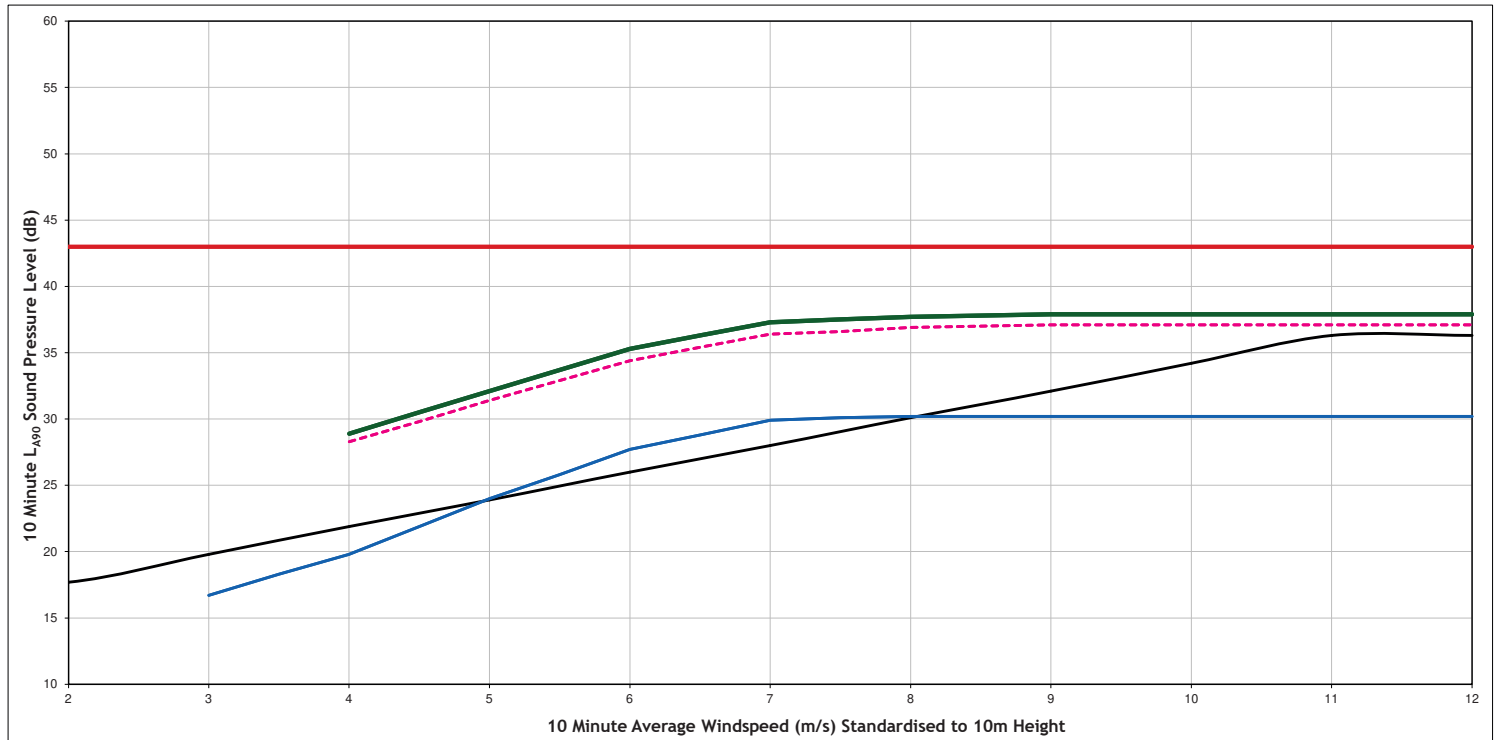


* Wind direction considered is 300 degrees.

Daytime - Higher Biscovillack Farm (NAL9)



Night Time - Higher Biscovillack Farm (NAL9)



Legend:

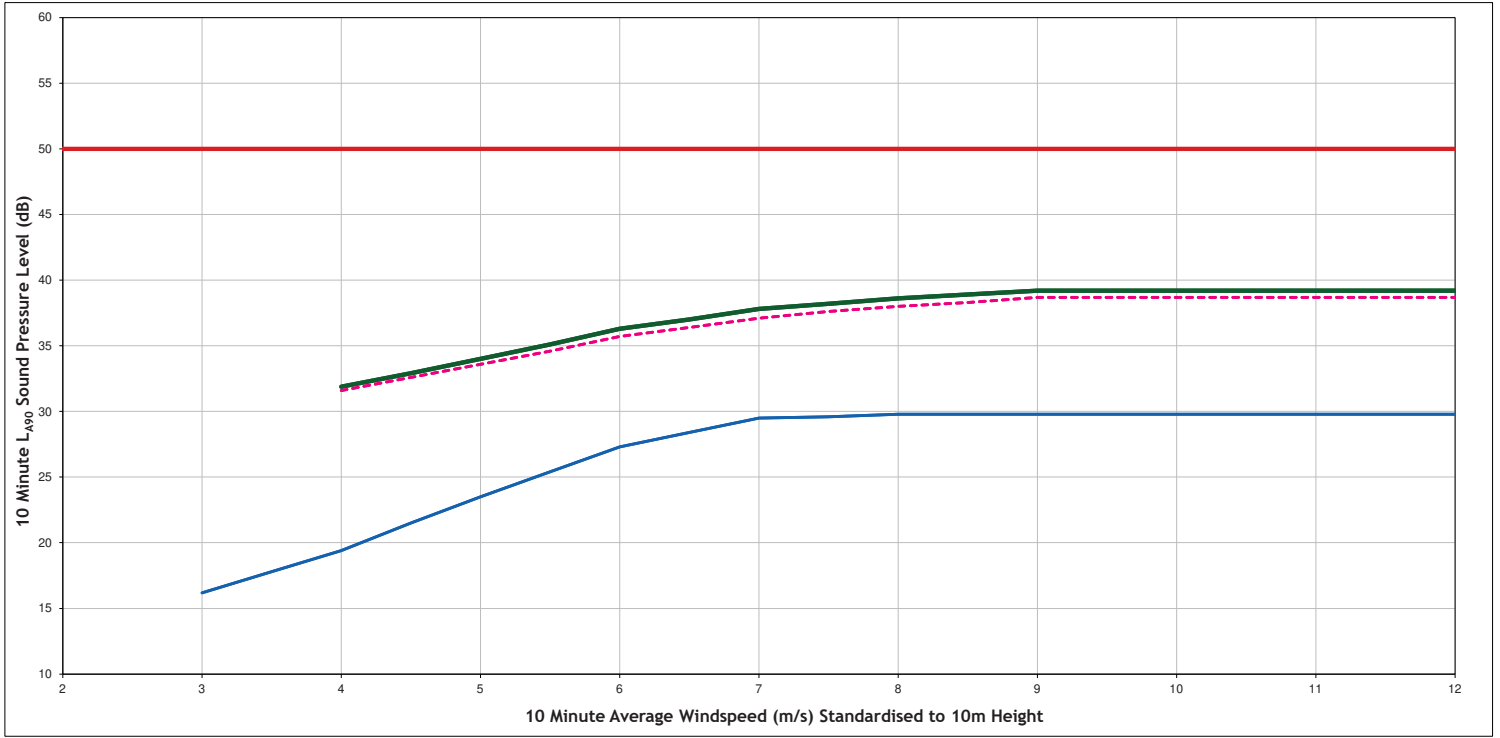
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Higher Biscovillack Farm (NAL9)
Figure Number	Figure A1.2i
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

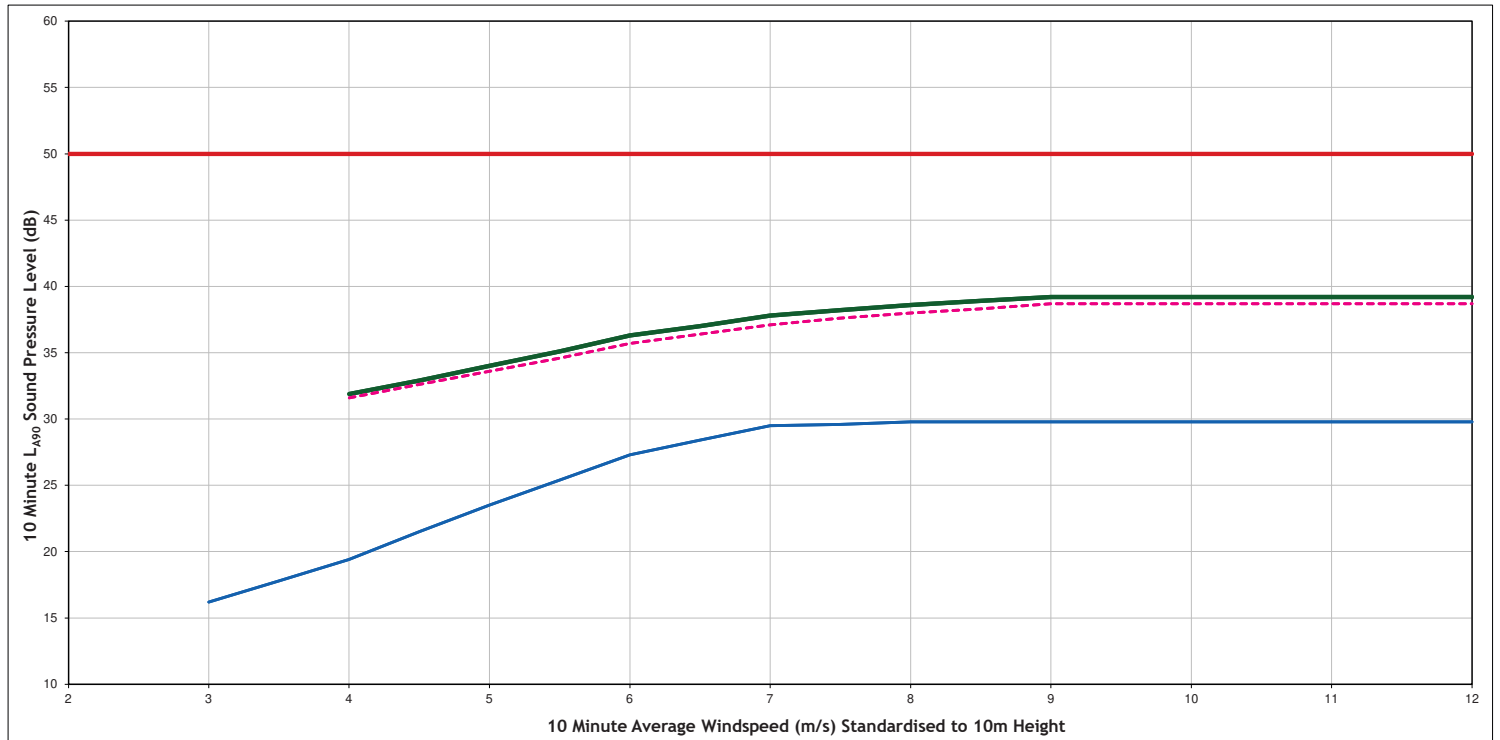


* Wind direction considered is 300 degrees.

Daytime - Greystone Cottage (NAL10)



Night Time - Greystone Cottage (NAL10)



Legend:

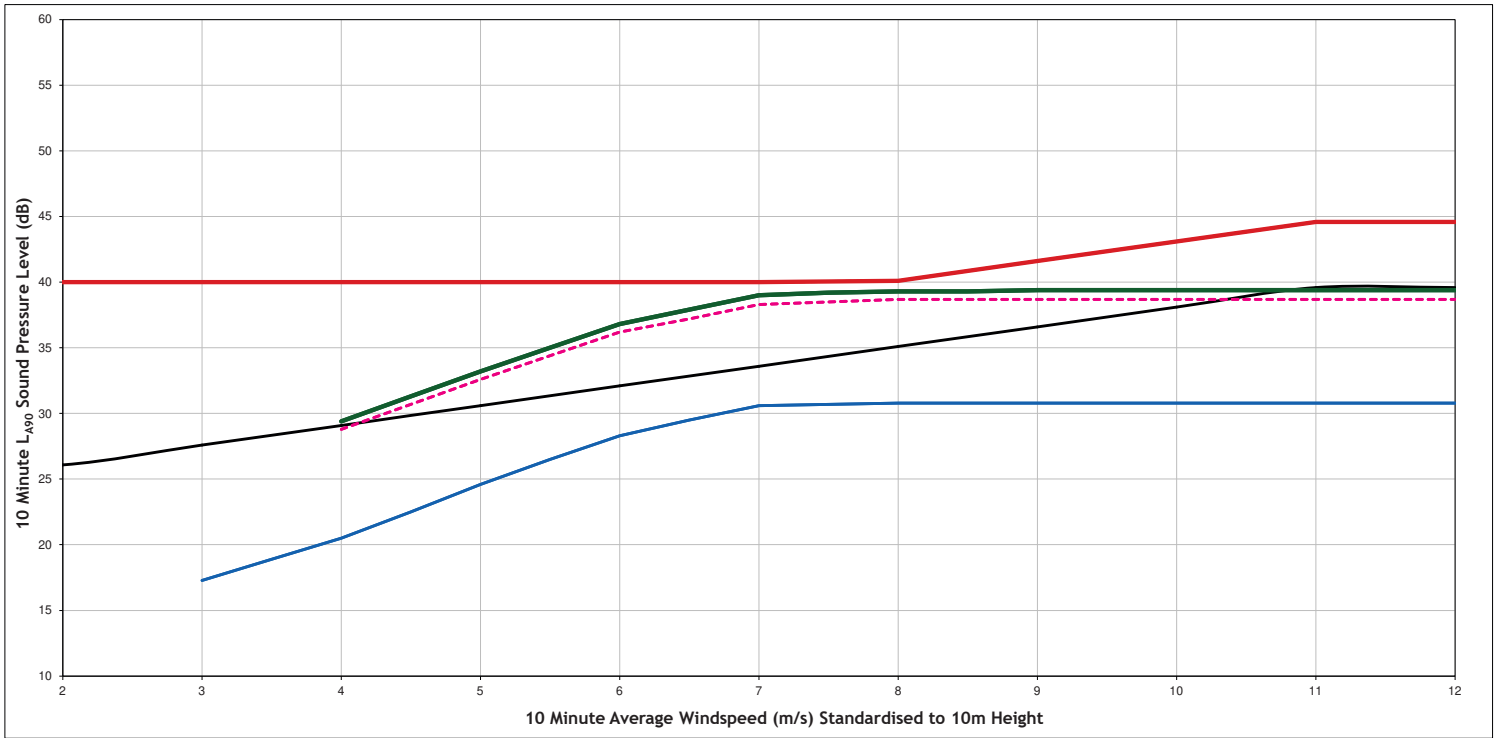
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Greystone Cottage (NAL10)
Figure Number	Figure A1.2j
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

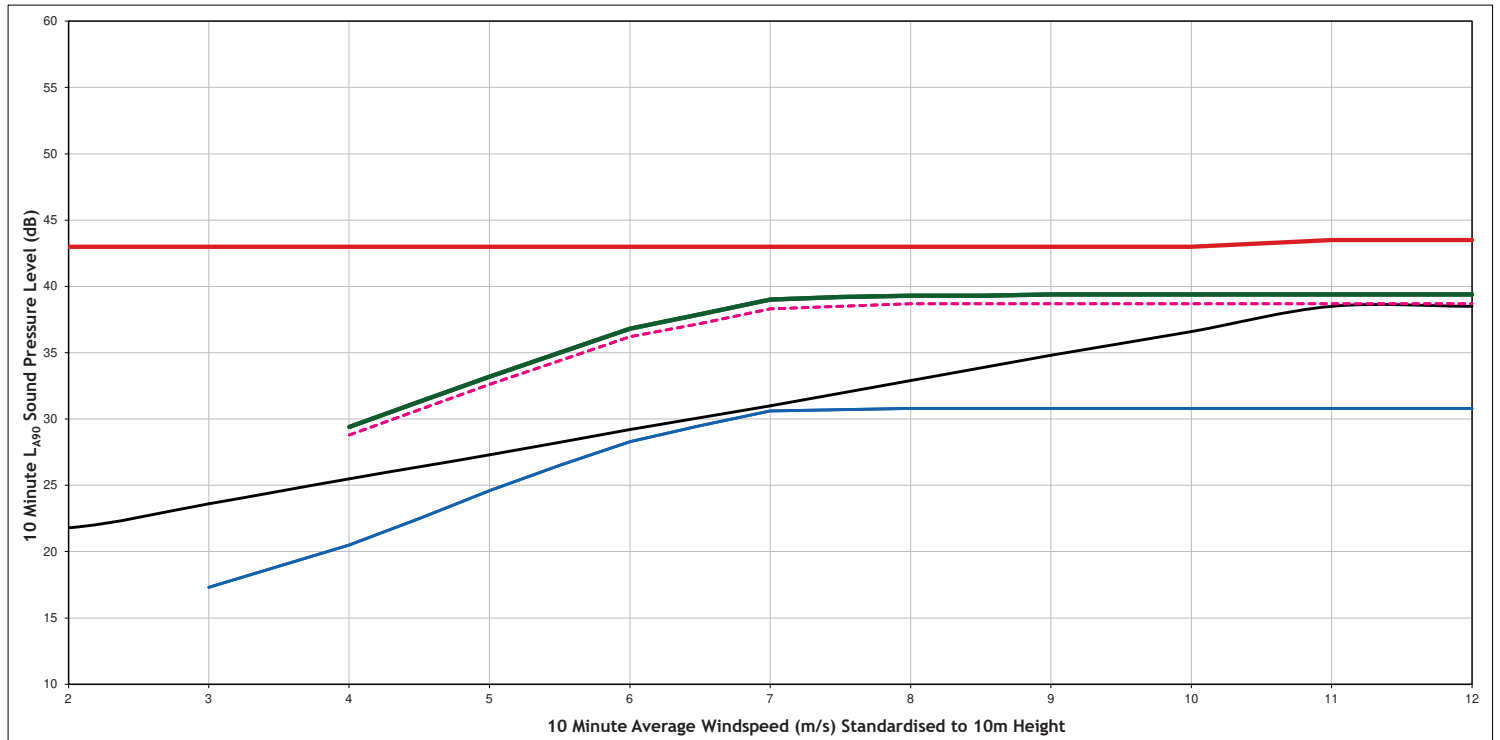


* Wind direction considered is 210 degrees.

Daytime - Longstone Cottage (NAL11)



Night Time - Longstone Cottage (NAL11)



Legend:

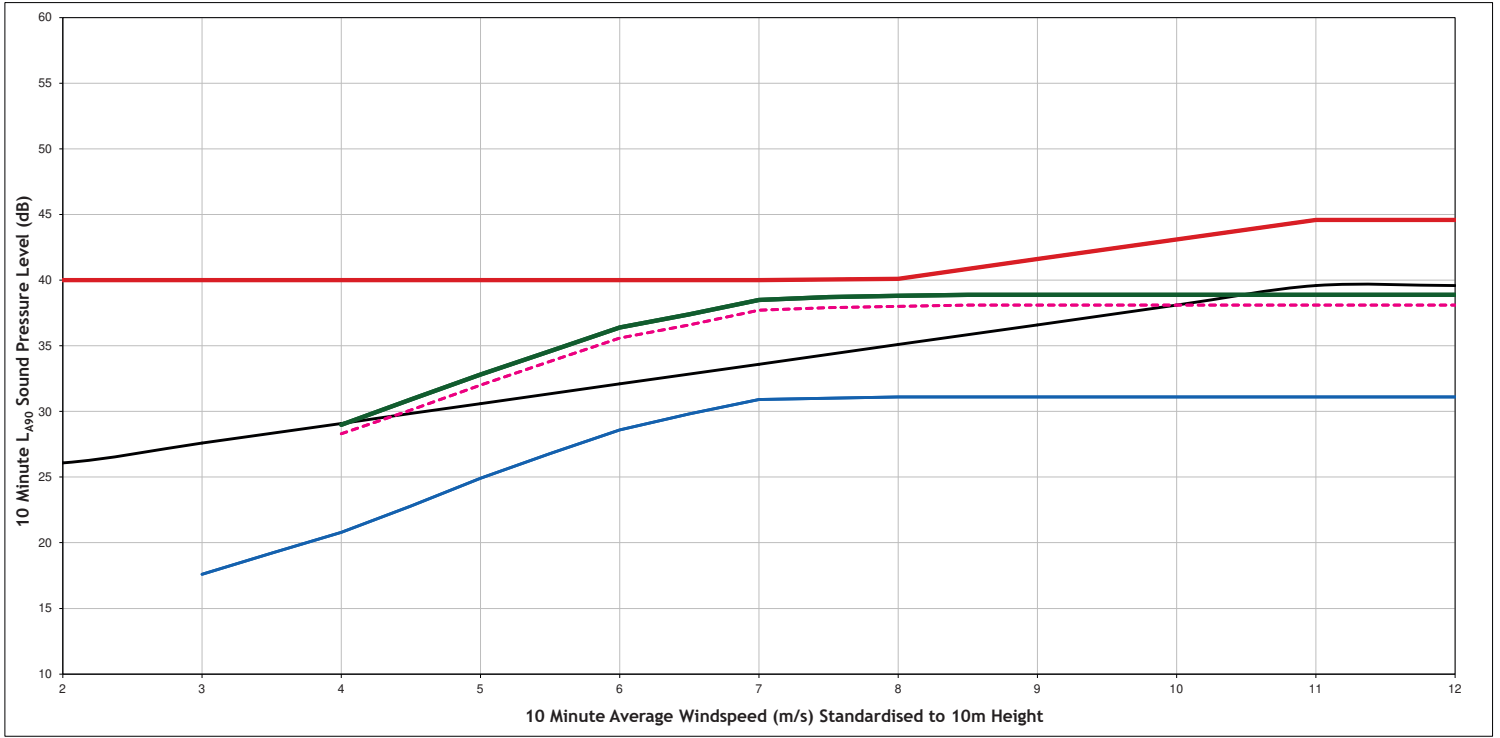
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Longstone Cottage (NAL11)
Figure Number	Figure A1.2k
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

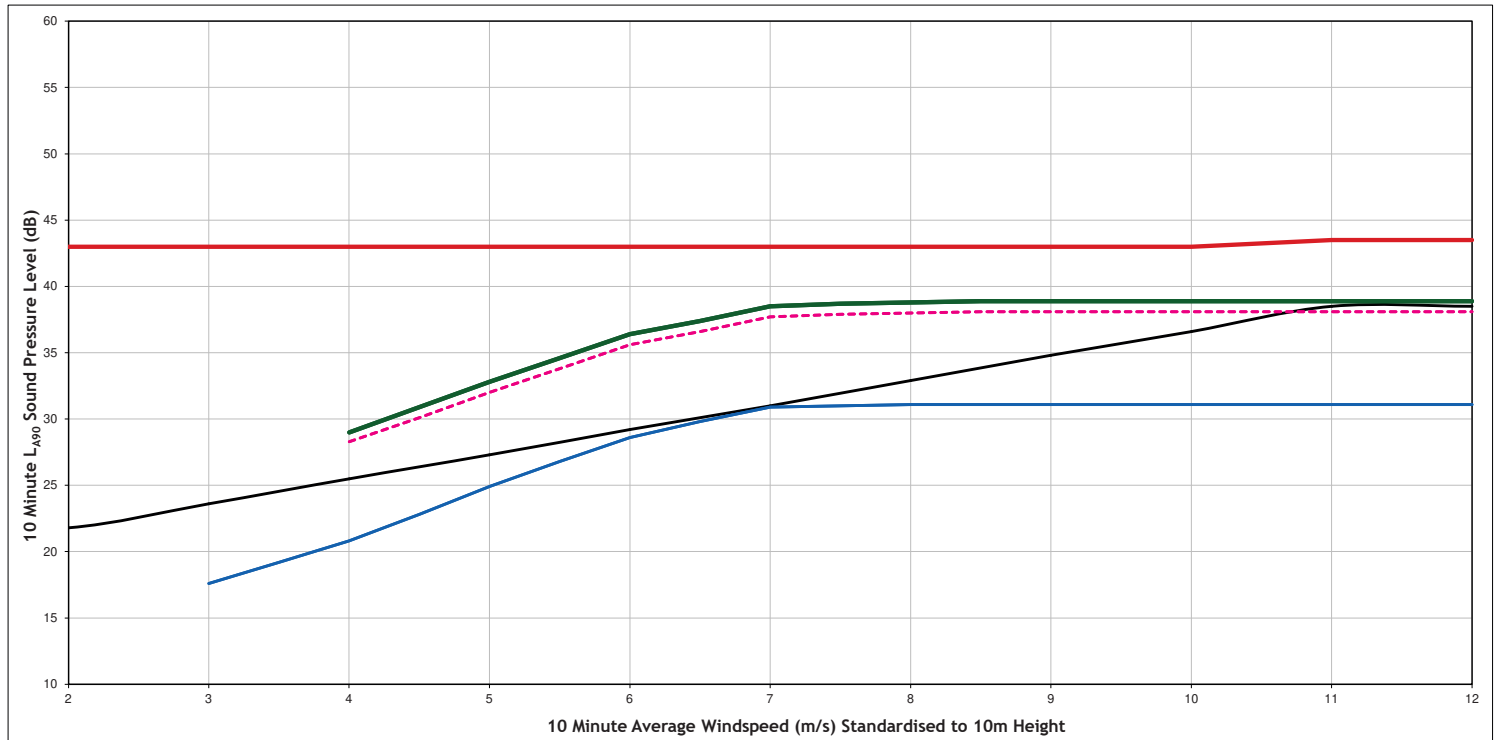


* Wind direction considered is 90 degrees.

Daytime - Longstone House (NAL12)



Night Time - Longstone House (NAL12)



Legend:

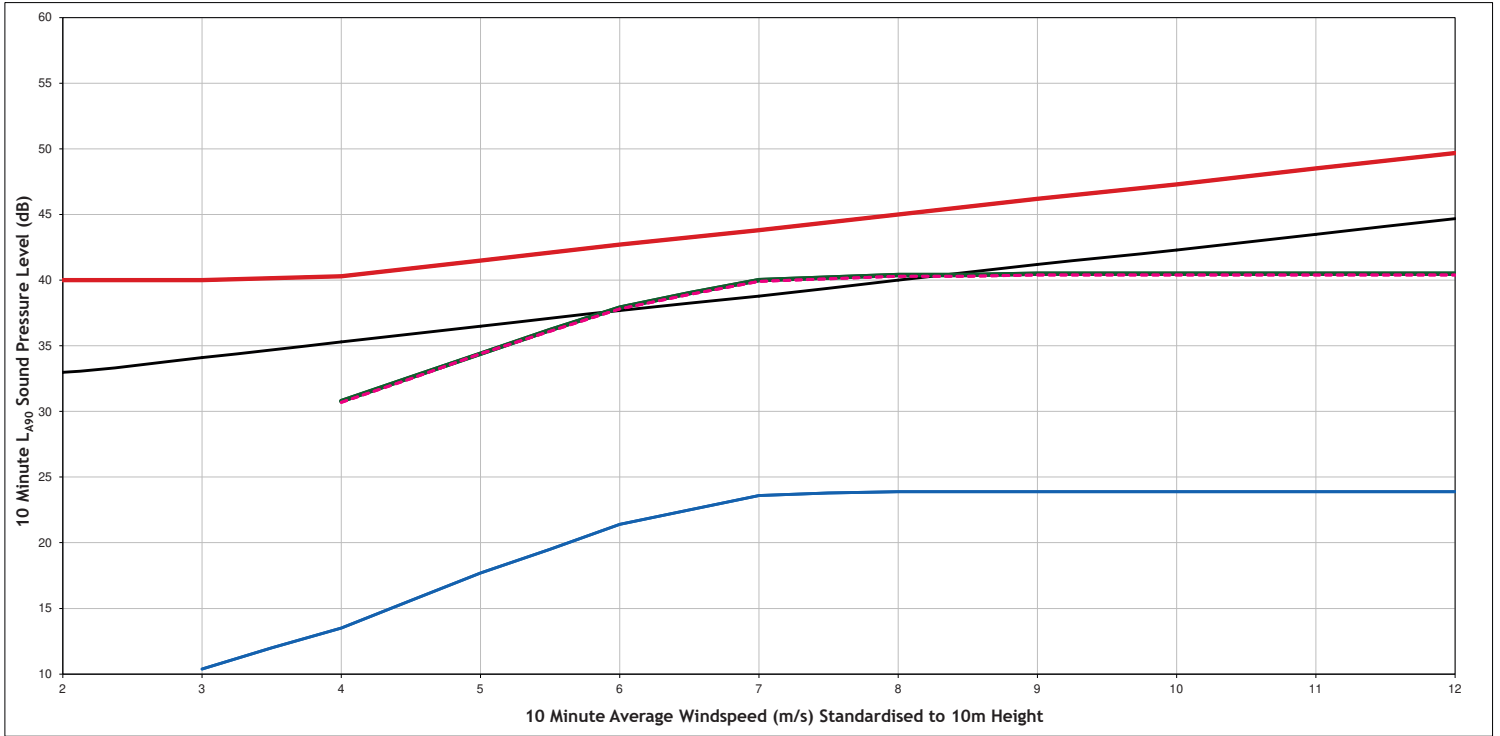
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Longstone House (NAL12)
Figure Number	Figure A1.2I
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

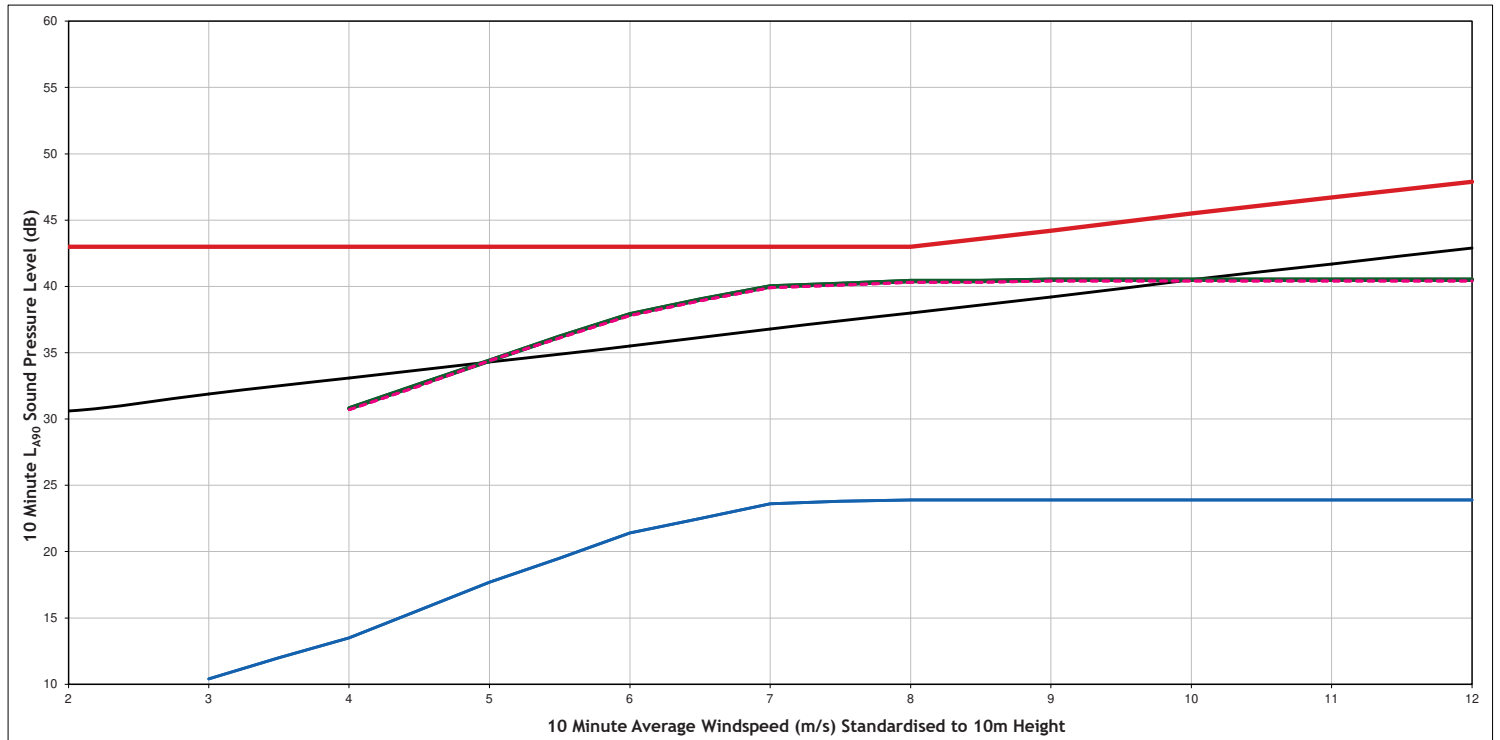


* Wind direction considered is 90 degrees.

Daytime - Carthew Farm Cottage (NAL13)



Night Time - Carthew Farm Cottage (NAL13)



Legend:

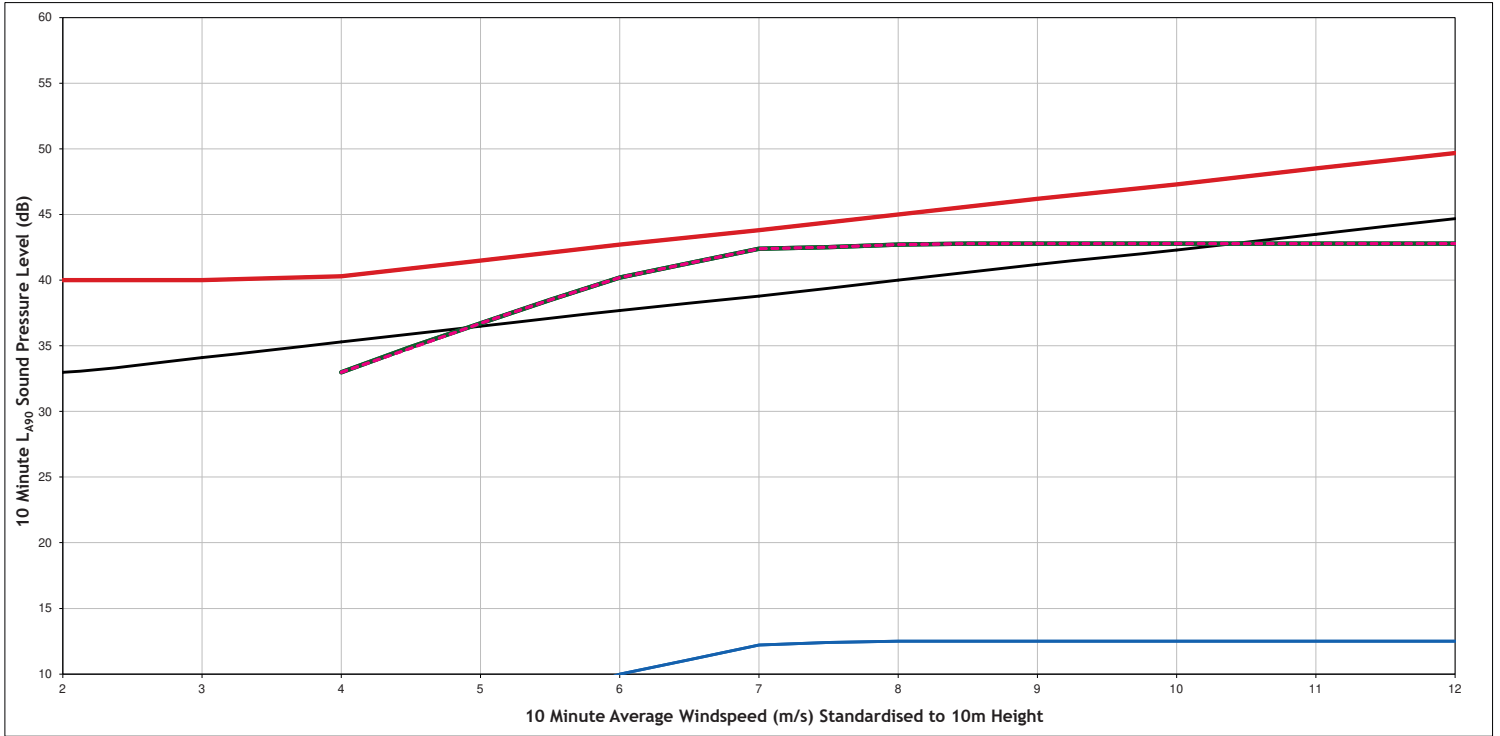
- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Carthew Farm Cottage (NAL13)
Figure Number	Figure A1.2m
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model

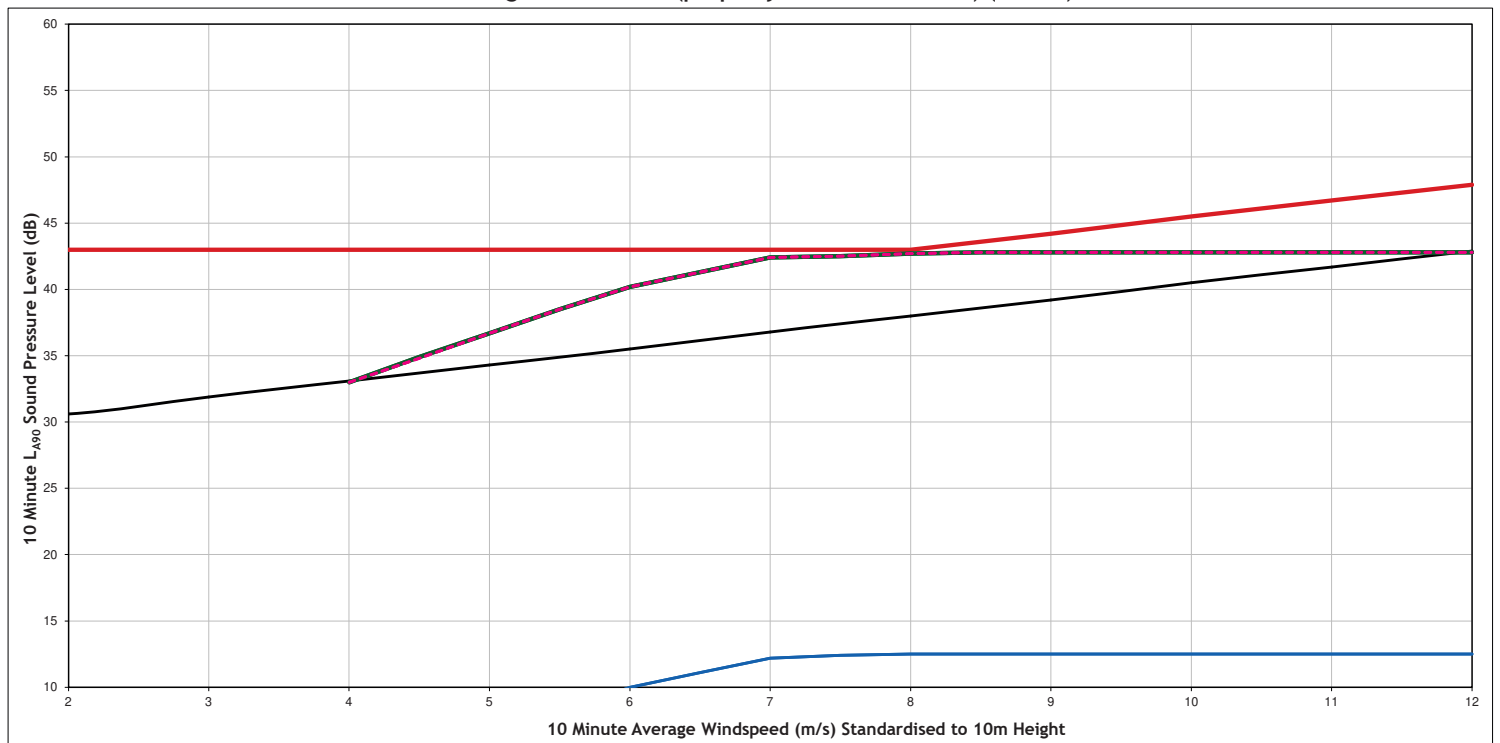


* Wind direction considered is 300 degrees.

Daytime - Adit (property North of Carthew) (NAL14)



Night Time - Adit (property North of Carthew) (NAL14)



Legend:

- Background Noise Trendline (Indicative)
- Total ETSU-R-97-Limit
- Cumulative All - 4 x existing+3 x consented+Burngullow without mitigation*
- Burngullow (1 x V117 without mitigation)*
- Cumulative without Burngullow *

Project	Burngullow Wind Turbine
Client	Clean Earth Energy
Title	Noise Predictions for Vestas 117 Adit (property North of Carthew) (NAL14)
Figure Number	Figure A1.2n
Scale	NTS
Drawn	MC
Checked	JB
Date	18/12/2023
Document Reference	16024-ETSU Model



* Wind direction considered is 330 degrees.

Annex 2 – Noise data, wind turbine coordinates and topographic adjustments

Table B1: Sound Power Level Data LAeq (dB)

Wind Farm	Wind Turbine Model	Hub height of source data	Uncertainty Included	Reference Wind Speed (ms ⁻¹) Standardised to 10m Height									
				3	4	5	6	7	8	9	10	11	12
Longstones, East Karslake, Wheal Martyn, Burngullow	VESTAS V117 4.3 MW PO2	76.5		Restricted data, available on request. Maximum sound power as modelled is 107dB.									
Higher Goonamarth, Greensplat, Blackpool and Gunheath	EWT DW54 500kw	50	1.2 - 1.5	-	-	96.2	97.8	98.9	100.0	101.0	101.0	101.0	101.0

Table B2: Octave Band Data LAeq (dB)

Scheme	Turbine Modelled	Octave Band (Hz)								
		63	125	250	500	1000	2000	4000	8000	Overall
Longstones, East Karslake, Wheal Martyn, Burngullow, Goonamarth 2	VESTAS V117 4.3 MW PO2	Restricted data, available on request.								
Gunheath	EWT DW54 500kw	83.1	89.3	94.6	95.9	94.5	92.0	85.1	73.3	101.0

Table B3: Topographic adjustments (-2 when no line of sight and +3 when concave profile) and WT Coordinates

Wind Farm	Hub height	T ID	Assessment Locations														x	y	Model
			1	2	3	4	5	6	7	8	9	10	11	12	13	14			
Higher Goonamarth WT	50	1	-2	-2	3	0	-2	3	3	0	0	3	0	0	3	-2	198780	54963	DW54 500kw
Blackpool WT	50	2	0	0	0	0	-2	3	3	0	-2	3	3	3	3	-2	198270	53615	DW54 500kw
Greensplat WT	50	3	-2	3	3	3	-2	0	0	3	0	0	-2	3	3	-2	200059	54577	DW54 500kw
Gunheath WT	50	4	-2	-2	3	-2	-2	-2	-2	3	-2	3	-2	-2	3	0	200613	56770	DW54 500kw
Wheal Martyn WT	76.5	5	-2	-2	3	3	-2	-2	3	3	3	3	-2	-2	0	0	199935	56269	V117 4.3MW
Longstones WT	76.5	6	-2	-2	3	0	-2	3	0	0	0	3	0	0	0	-2	198316	55310	V117 4.3MW
East Karslake WT	76.5	7	-2	-2	3	0	-2	3	3	0	0	0	0	0	0	-2	198647	55360	V117 4.3MW
Burngullow WT	76.5	8	0	0	0	0	0	0	3	3	0	0	3	3	3	-2	198378	54117	V117 4.3MW

Annex 3 – Choice of daytime fixed minimum

Table A3-1 : CHOICE OF QUIET DAYTIME FIXED MINIMUM LIMIT IN THE ALLOWABLE RANGE 35-40dB, FOR CUMMULATIVE

Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	TNEI commentary
<p>1) The number of noise affected properties</p>	<p><i>“The planning process is trying to balance the benefits arising out of the development of renewable energy sources against the local environmental impact. The more dwellings that are in the vicinity of a wind farm the tighter the limits should be as the total environmental impact will be greater. Conversely if only a few dwellings are affected, then the environmental impact is less and noise limits towards the upper end of the range may be appropriate. Developers still have to consider the interests of individuals as protected under the Environmental Protection Act 1990.”</i></p>	<p><i>“The number of neighbouring properties will depend on the nature of the area, (rural, semi-rural, urban) and is sometimes considered in relation to the size of the scheme and study area. The predicted 35 dB LA90 contour (at maximum noise output up to 12 m/s) can provide a guide to the dwellings to be considered in this respect.”</i></p>	<p>The proposed wind farm development itself is located in a rural area with a relatively low number of scattered dwellings which surround the site. Considering Bunrgullow Wind Turbine only with an unmitigated Vestas V117, then 33.2 dB, 35.8 dB and 30.2 dB are predicted at Biscovillack Farm(NAL7), Penisker Farm(NAL8) and Higher Biscovillack Farm(NAL9) at 12 m/s. These are the three properties above where cumulative noise is anticipated above 35 dB(A) L90 at 12m/s in the immediate surrounding. To offer a comparison, the cumulative predictions (with all other turbines included) are 37.7 dB, 38.4 dB and 37.9 dB at NAL7,NAL8 and NAL9 at 12 m/s. More predictions and analysis are shown in Figures A3-1 to A3-4 below. The cumulative context is important here as this is what the choice of fixed minimum limit is being appraised on. Overall there are only a very small number of properties affected by this choice of fixed minimum daytime limit, for cumulative consideration.</p> <p>Consideration of this test suggests that a quiet daytime fixed minimum criteria towards the upper end of the 35-40 range permitted in ETSU-R-97 would be appropriate for cumulative purposes.</p>
<p>2) The effect of using tighter limits on the potential power output of the wind farm:</p>	<p><i>“Similar arguments can be made when considering the effect of noise limits on uptake of wind energy. A single wind turbine causing noise levels of 40dB(A) at several nearby residences would have less planning merit (noise considerations only) than 30 wind turbines also causing the same amount of noise at several nearby residences.”</i></p>	<p><i>“A decision on the amenity lower fixed limit for the proposed wind farm cumulatively with any other wind farms in the locality should be agreed. Cumulatively, the power generation will have increased due to proposed additional wind turbines, as well as potential noise impact. ...The consideration of the various wind farms as a single entity may result in the cumulative amenity lower fixed limit relating to the proposed wind farm in combination with the existing wind farms, differing from the existing individual wind farm’s amenity lower fixed limit.”</i></p>	<p>The benefits arising out of the development of renewable is important in the current context of net-zero ambitions and climate change. Cornwall Council Climate Emergency Development Plan Document is a clear indication that the Council has targets to support renewable energy development with Policy RE1 Renewable and Low Carbon Energy stating:</p> <p>“1) Proposals for renewable and low carbon energy-generating and distribution networks, will be supported in the context of sustainable development and climate change, where: a) they contribute to meeting Cornwall’s target of 100% renewable electricity supply by 2030; and b) they balance the wider environmental, social and economic benefits of renewable electricity, heat and/or fuel production and distribution; and c) It will not result in significant adverse impacts on the local environment that cannot be satisfactorily mitigated, including cumulative landscape and visual impacts, the special qualities of all nationally important landscapes, and the significance of heritage assets including their settings, including the outstanding universal value of Cornwall and West Devon Mining Landscape World Heritage Site and the character of wider historic townscapes, landscapes and seascapes; and...</p> <p>2) Wind energy development proposals will be permitted where they: ... c) Avoid or adequately mitigate shadow, flicker, noise and adverse impact on air traffic operations, radar and air navigational installations ...”</p> <p>The cumulative context is very important here as this is what the choice of fixed minimum limit is being appraised on (not for a single turbine on its own), and each turbine recently consented in the area have already 4.3MW renewable generation capacity each with older operating wind turbine circa 500kW renewable generation capacity each. Any new turbine added at Burngullow will add around 4.3MW which is a considerable cumulative renewable generation capacity.</p>

Factor	Guidance in ETSU-R-97	Guidance in IOA GPG	TNEI commentary
			<p>If the Total ETSU-R-97 Noise Limit (Cumulative limits) was derived based on a lower end of the 35-40 range, hence not considering the cumulative renewable generation, it would result in the derivation of lower limits and loss of renewable energy generation.</p> <p>Consideration of this test suggests that a quiet daytime fixed minimum criteria towards the upper end of the 35-40 range permitted in ETSU-R-97 would be appropriate for cumulative purposes.</p>
<p>3) The duration of exposure of these properties.</p>	<p><i>“The proportion of the time at which background noise levels are low and how low the background noise level gets are both recognised as factors which could affect the setting of an appropriate lower limit. For example, a property which experienced background noise levels below 30dB(A) for a substantial proportion of the time in which the turbines would be operating could be expected to receive tighter noise limits than a property at which the background noise levels soon increased to levels above 35dB(A). This approach is difficult to formulate precisely and a degree of judgement should be exercised.”</i></p>	<p><i>“This last test is more difficult to formulate. But ETSU-R-97 notes that the likely excess of turbine noise relative to background noise levels should be a relevant consideration. In rural areas, this will often be determined by the sheltering of the property relative to the wind farm site. Account can also be taken of the effects of wind directions (including prevailing ones at the site) and likely directional effects. For cumulative developments, in some cases the effective duration of exposure may increase because of cumulative effects.”</i></p>	<p>Background noise levels in general are relatively low and are broadly consistent with levels measured at rural locations in the UK. The duration of exposure is demonstrated in broad terms in the below analysis in Figures A3-1 to A3-4 below, taking account noise predictions in 4 wind directions and potential cumulative limits in daytime. All predictions shown assume full unmitigated operation for Burngullow (and all others). The fixed minimum criteria would be beneficial only in northerly and westerly winds, in daytime 6-7m/s so duration of exposure is judged to be very low when considering the potential cumulative noise impact.</p> <p>Consideration of this test suggests that a quiet daytime fixed minimum criteria towards the upper end of the 35-40 range permitted in ETSU-R-97 would be appropriate for cumulative purposes.</p>

Figure A3-1 : Map focusing on locations of NAL7, NAL8 and NAL9 in context of proposed Burngullow WT

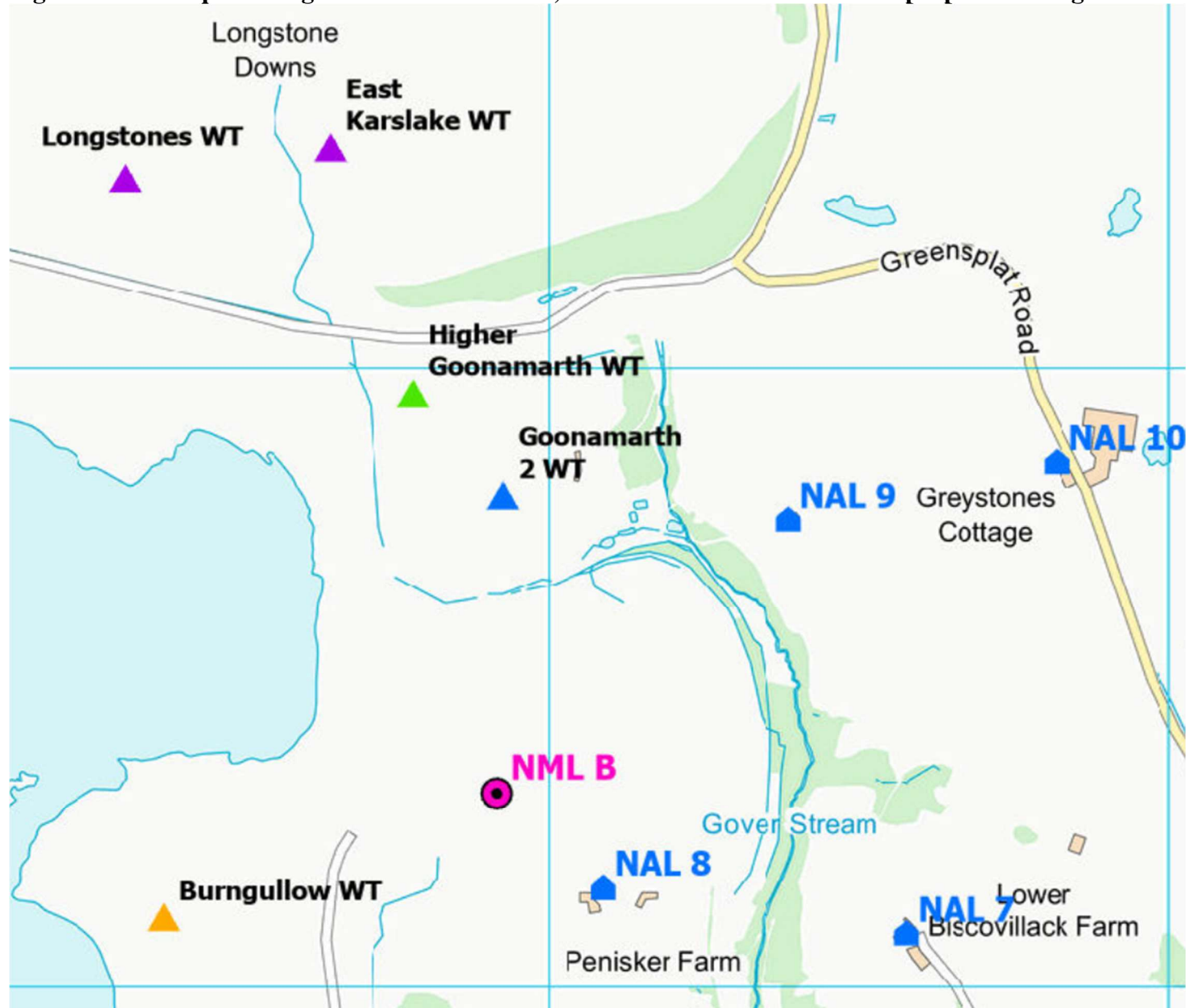


Figure A3-2 : Analysis at Biscovillack Farm (NAL7), predictions in four separate wind directions

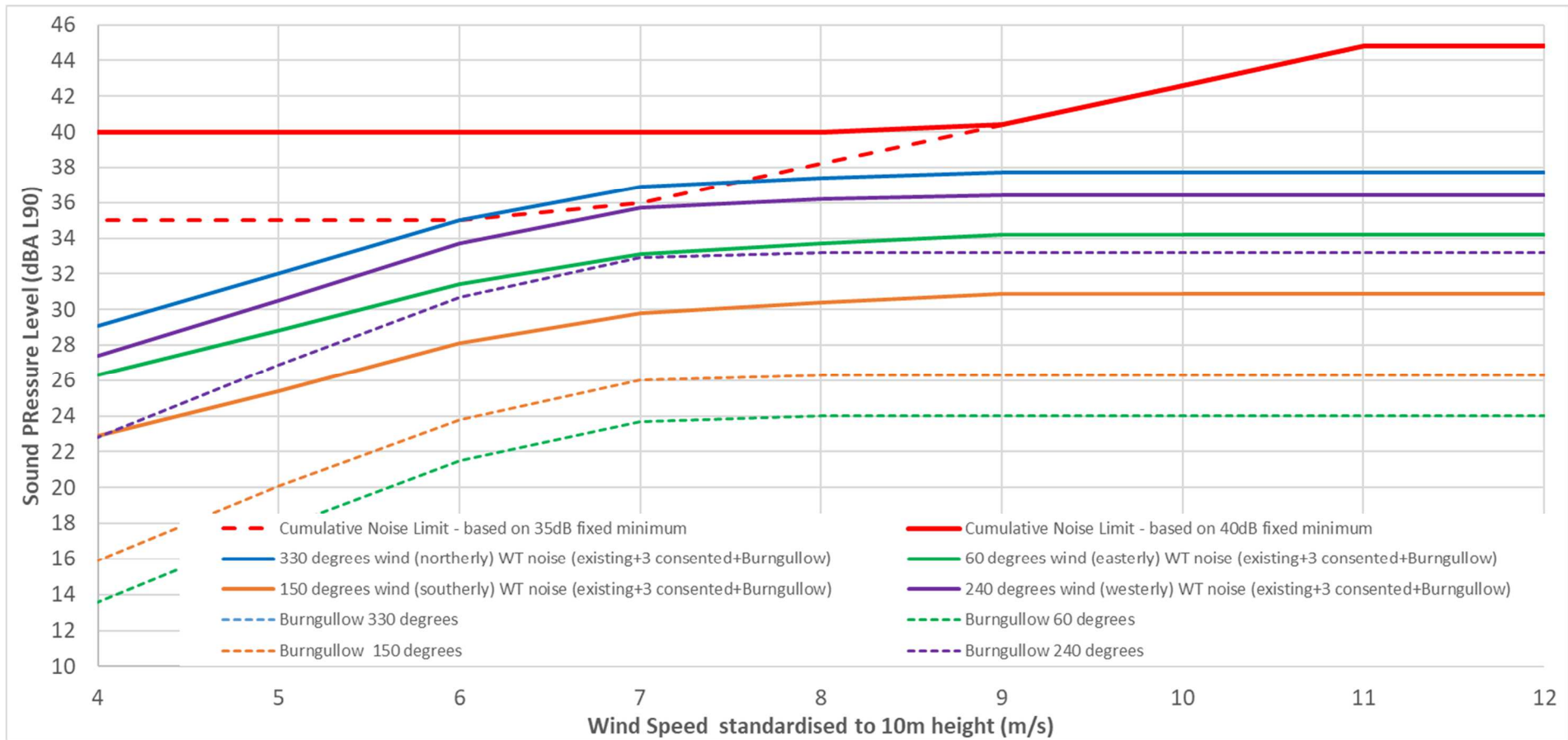


Figure A3-3 : Analysis at Penisker Farm (NAL8), predictions in four separate wind directions

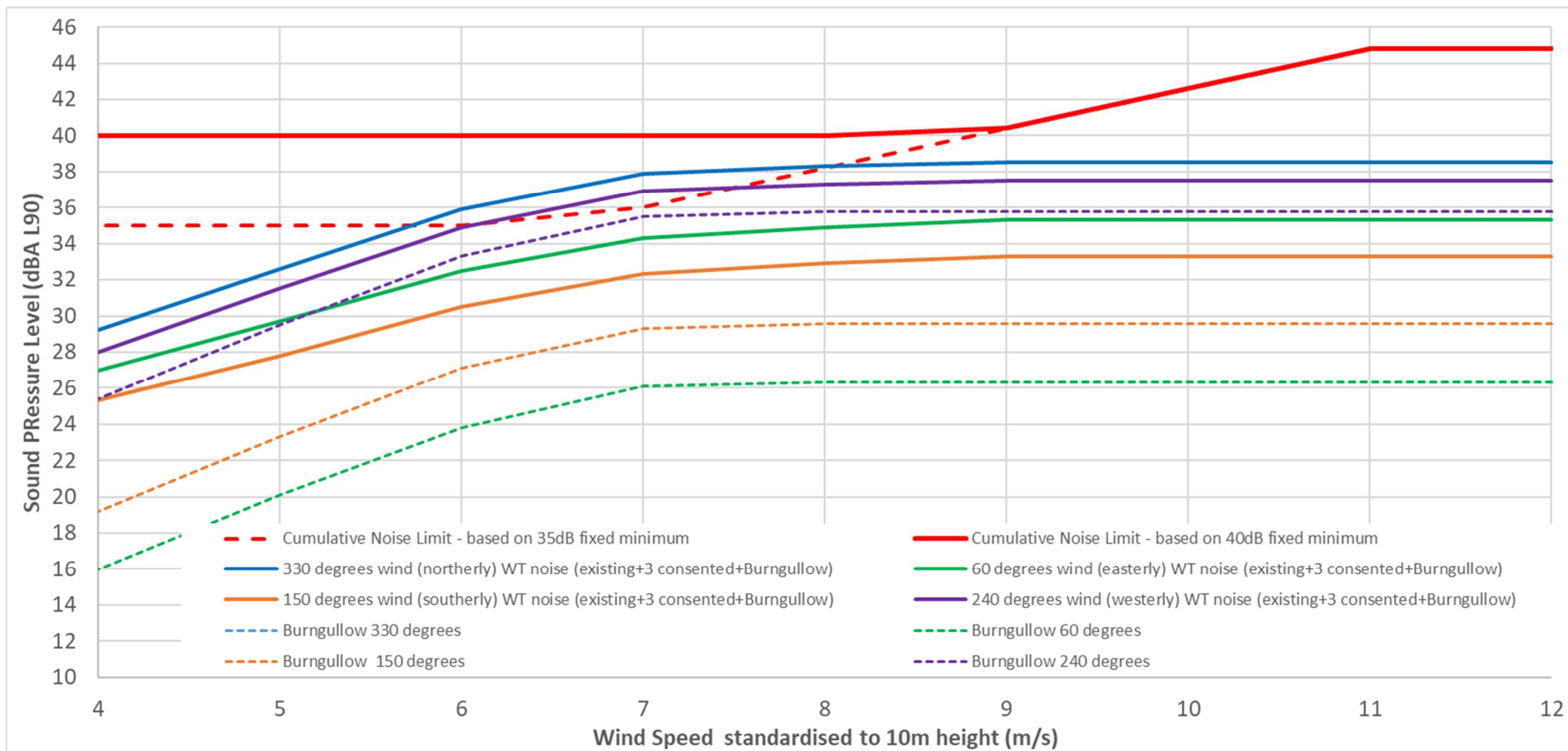


Figure A3-4 : Analysis at Higher Biscovillack Farm (NAL9), predictions in four separate wind directions

