



Assessment of Noise from Proposed Wind Turbine

Ingfield Farm, High Lane,
Ingbirchworth, S36 7GP

Client: AHH Planning Consultants Ltd, 2 Bar Lane, York, YO1 6JU

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Appendix 1 EWT DW52 500kW Wind Turbine - Manufacturer's Noise Report

1 Introduction

Holmes Environmental Health Ltd was instructed by Mr Magnus Gallie of AAH Planning Consultants Ltd to undertake a noise assessment for a proposed wind turbine at Ingfield Farm, High Lane, Ingbirchworth. The assessment is to form part of a planning application for the proposed development to be submitted to Barnsley Metropolitan Borough Council.

The proposal is to erect a single EWT DW52 500kW wind turbine in a field approximately 450m to the east of Ingfield Farm. The turbine would be mounted on a 50m high mast.

1.1 Scope

This report has been prepared on behalf of AAH Planning Consultants Ltd and Primenergy. It will form part of a planning application to be submitted to Barnsley MBC for a wind turbine at Ingfield Farm, High Lane, Ingbirchworth.

The purpose of the report is to:

- i) Detail appropriate Noise Criteria to be used to assess the noise
- ii) Report the results of background noise monitoring undertaken at nearest noise sensitive dwellings (where necessary)
- iii) Assess the Noise in accordance with the noise criteria

1.2 Disclaimer

Holmes Environmental Health Ltd (the consultancy) has, in undertaking the project subject of this report, relied on the information provided or published by the turbine manufacturer, AAH Planning Consultants Ltd, The Department of Energy and Climate Change and UK Renewables. Holmes Environmental Health Ltd has used this information in good faith and cannot be responsible for any omissions, errors or inaccuracy in the information provided.

2 Site Description

The proposed turbine would be located in a field 450m to the east of Ingfield Farm, High Lane, Ingbirchworth. The nearest noise sensitive properties not associated with the farm have been identified as follows:

- 450m north east – Willow Farm
- 450m south west – Far Royd Moor
- 620m south east – Reservoir House, Folly Lane

For the purpose of the report, noise levels are to be assessed at these three locations on the basis that if the assessment shows the turbine is acceptable in noise terms at the nearest properties, then it will be acceptable at other dwellings located at greater distance.

The key features are shown on the plan at Figure 2.1 and an aerial photograph at Figure 2.2.

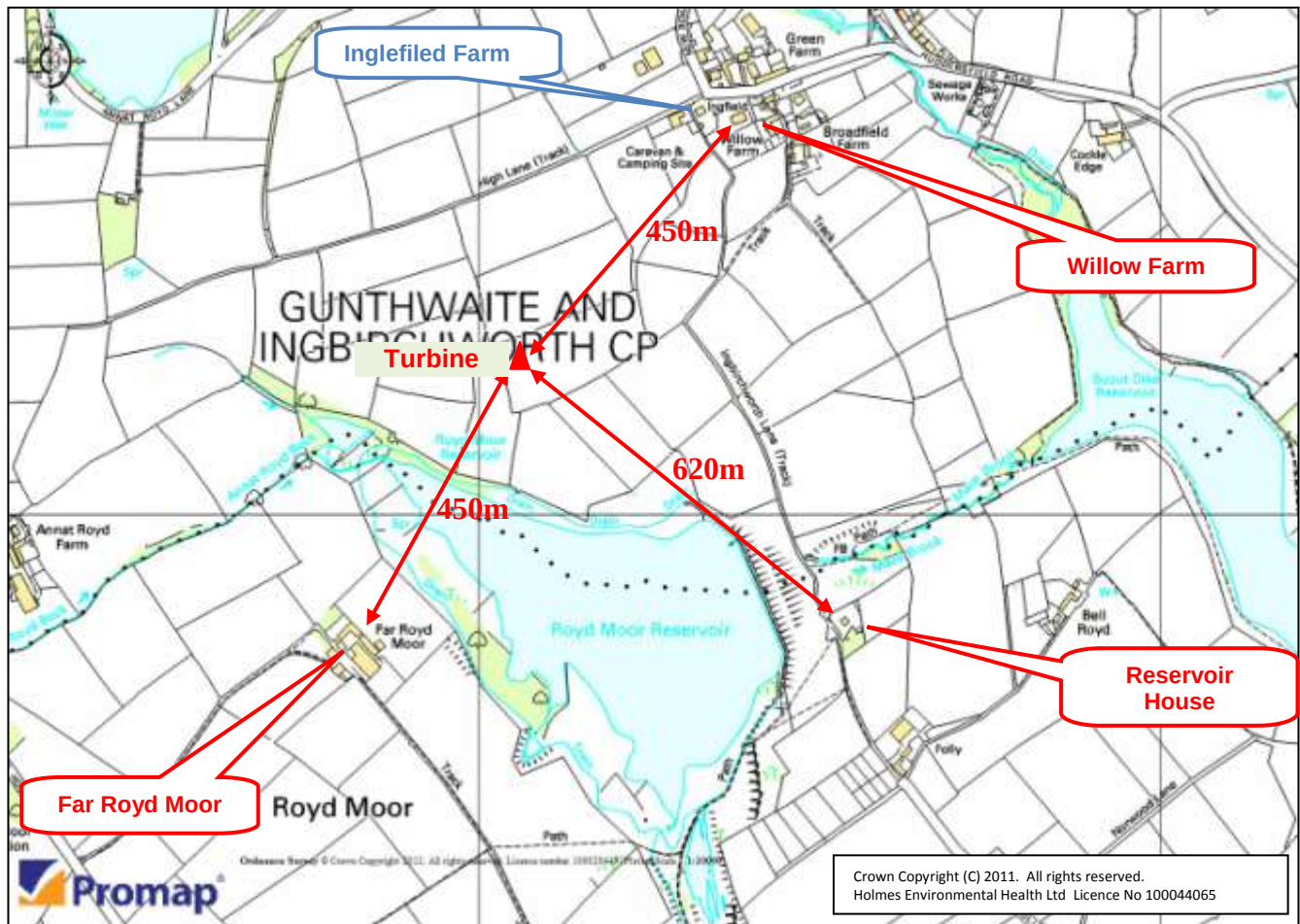


Figure 2.1 Plan showing location of the proposed turbine and nearest noise sensitive properties



Figure 2.2 Aerial Photograph showing site of the proposed turbine (shown by yellow pin) and key features (ref Google Earth)

3 Noise Assessment Criteria

The usual way to assess noise from a new development as it may affect existing property is to compare the “new” noise against the background noise that exists when the “new” noise is not being generated. Most regulatory noise standards are based on this method. The key point in any assessment is the amount of noise that is considered to be acceptable from the “new” noise when compared against the background noise level.

A number of noise criteria are detailed below along with how the methodology is either suitable or less suitable for use in assessing noise from wind turbines.

3.1 BS4142:1997

The usual way of assessing the environmental impact of a new development is to compare the noise level attributable to the development as a LA_{eq} value against the background noise level (as LA_{90}) existing prior to the development. A method most frequently used to assess the impact of a new noise in the environment as part of the planning process is that described in BS4142:1997 "*Method for rating industrial noise affecting mixed residential and industrial areas*".

In brief, the method requires measuring (or predicting) the noise level under consideration, the specific noise (in this case the turbine noise), as it affects noise-sensitive receptors and comparing it with the background noise level at the same location and similar time of day. The assessment uses outdoor sound level readings and thus generally applies to outdoor circumstances ie gardens etc.

The Background Noise Level is the sound level exceeded for 90% of the time (the L_{90}).

When the introduced noise has certain distinguishing characteristics such as a tonal element or bangs, whines screeches, hums etc or of a character that draws attention to itself, it is necessary to add a +5dB correction factor to the specific noise as it is perceived as being more annoying.

The difference between the Rating Level (which is the measured or predicted noise level adjusted for any tonal or other annoying characteristics if necessary) over the Background Noise Level is used to judge the likelihood of complaints.

Where the difference +5dB(A) it is deemed to be of marginal significance. A difference of +10dB(A) demonstrates that complaints are likely, but a difference of -10dB(A) is evidence that complaints are unlikely.

However, there are circumstances when this approach is not always suitable. Firstly it relates to industrial noise in mixed industrial and residential areas, and more importantly in this circumstance, the background noise level is required to be measured in calm weather conditions - wind speeds of 5 m/s or less, which is close to the point that wind turbines cut-in. Therefore in very calm conditions, the turbine will not be rotating and thus no noise is produced. As the wind speed increases the background noise level increases caused by the sound of the wind gusting which is exacerbated by obstacles such as tall trees, buildings and other structures. Whilst an increase in wind speed will increase the rotation speed of the wind turbine and thus the noise emitted, the corresponding increase in background noise will have a tendency to reduce the impact of the noise and may “mask” it altogether at distance. The DW52 turbine is asynchronous, which means it does not rotate faster at higher wind speeds and thus it creates lower noise levels than turbines that have an uncontrolled rotation speed.

By virtue of the suitability of sites for erecting wind turbines, it follows that they are usually in exposed locations and frequently subjected to high winds.

As wind turbines do not operate in calm weather conditions (cut in point typically 3m/s - 4m/s) BS4142 is not wholly applicable, although the general principles of rating the noise may be applied but become complex due to the increase in background and noise rating levels with increasing wind speed.

A tonal characteristic of an environmental noise is recognised as causing greater annoyance than a broad-spectrum noise of equal intensity. A wind turbine will be considered to be tonal if any of the 1/3rd octave bands are higher than both its adjacent bands by the following:

- 15dB in the low frequency bands (50Hz to 125Hz)
- 8dB in the mid-frequency bands (160Hz to 400Hz)
- 5dB in the high frequency bands (500Hz to 10,000 Hz).

(ISO 1996-2:2007; Annex D)

In determining tonality it is recommended that the frequency spectrum should be that measured at receiver locations where distance attenuation will reduce the overall sound level and air absorption may reduce the higher frequencies in particular.

3.2 The Assessment and Rating of Noise from Wind Farms – The Working Group on Noise from Wind Turbines (Report ETSU-R-97)

Whilst this document is aimed at larger turbines on wind farms on a larger scale, the methodology addresses the effect of increasing background noise and an increase in turbine noise with increasing wind speed. It is suggested, that the broad principles of this method can be used to assess the noise from wind turbines such as the DW52 to overcome the problem of varying noise emissions and background noise levels with wind speed.

Unusually wind turbine noise is assessed as an LA_{90} value rather than the LA_{eq} value, but where the noise is steady and constant these criteria will be very close to each other. **The guidance assumes that the LA_{90} value is 2dB lower than the LA_{eq} .**

Simplified Assessment

The Noise Working Group Report states that, for single turbines, if noise is limited to an $LA_{90 (10min)}$ 35dB(A) up to wind speeds of 10m/s at 10m height, *then background noise surveys would be unnecessary. ...even in sheltered areas when wind speeds exceeds 10m/s on the wind farm site, some additional background noise will be generated which will increase background levels at the property.* Also, 35dB(A) is considered to be “very low” in terms of the noise rating level in BS4142:1997, and it is not appropriate to use BS4142 at levels below this.

For a predicted wind turbine noise outside any dwelling which has a noise rating level of 35dB LA_{90} or lower at a wind speed of 10m/s the ETSU Guidance assumes no further assessment is required on the grounds that there will be no detrimental effect on amenity.

Separate assessments are made for both daytime and night-time, and for reasons that are explained below, different criteria are used. The reason for this is that the protection of external amenity becomes less important at night, when the emphasis should be on preventing sleep disturbance.

Daytime Assessment

The Noise Working Group recommend that the assessment should be made relative to the existing background noise at the nearest noise sensitive premises. Daytime assessments are based on the background noise level measured at “quiet daytime” periods, defined as :

- All evenings 6pm – 11pm
- Saturday afternoon from 1pm to 6pm
- All day Sunday 7am – 6pm

The assessment uses free field measurements.

The ETSU Guidance recommends the criterion for day-time noise is Background Noise Level +5dB(A) as an LA₉₀.

Night-time Assessment

The Working Group recommend that at night the Background Noise Level + 5dB(A) criterion should still apply but also that a fixed night-time noise limit should be 43dB(A). This limit is derived from the 35dB(A) sleep disturbance criteria referred to in PPG 24. An allowance of 10dB(A) has been made for attenuation through an open window (free-field to internal) and 2dB subtracted to account for the use of LA₉₀ rather than LA_{eq}.

The ETSU Guidance recommends the criterion for night-time noise is Background Noise Level +5dB(A) as an LA₉₀ or 43dB(A), whichever is the greater.

Criteria where there is a financial benefit involved

At properties where the occupier receives a financial benefit from the wind turbine (such as a farmhouse on the farm at which the turbine is located) the ETSU-R-97 guidance suggests that a higher limit of 45dB(A) may be appropriate.

The ETSU Guidance recommends that the criterion at properties where the occupants of which have a financial interest in the turbine is 45dB(A).

4 Noise Rating of the EWT DW52 500kW Wind Turbine

Noise performance data of the EWT 52 has been provided by the turbine supplier.

The manufacturer's noise data report is shown at Appendix 1.

The DW52 Turbine has a Sound Power Level rating of 100.5 dB(A) at a wind speed of 10 m/s at 10m height reference level.

The DW52 turbine is asynchronous which means the noise levels do not rise sharply with increasing wind speed.

The change in sound power level with wind speed as shown in Appendix I is reproduced in Table 4.1.

Wind Speed m/s (10m)	Sound Power Level dB(A)
5	96.5
6	97.5
7	98.5
8	99.5
9	100.3
10	100.5

Table 4.1 Variation in Sound Power Level of the DW52 with wind speed

5 Predicted noise levels from the wind turbine

The noise levels at each of the relevant properties can be calculated by applying simple distance attenuation using the equation for **spherical propagation** of sound:

$$\text{SPL} = \text{SWL} - (20 \log_{10} r + 11)$$

Where SPL = sound pressure level

SWL = sound power level

r = distance from source

Equation 1

The proposed noise criterion for this development is 35dB(A) or 5dB(A) above the measured “quiet-day” background noise level as the LA₉₀ value whichever is the greater (**it is assumed the LA90 value = LAeq-2dB as referred to in the ETSU Guidance**). For reasons stated above, due to the variation in both the background noise level and noise output at varying wind speeds this cannot be easily applied.

To undertake a full assessment of background noise across the whole range of wind speeds for the time period recommended in the ETSU Guidance is prohibitively expensive for a single small to medium wind turbine.

Also, an assessment based on the methodology in BS4142:1997 is not appropriate due to varying background noise levels and noise emissions with changes in wind speed

It is therefore proposed to evaluate the noise at nearest noise sensitive dwellings using a range of criteria as detailed below.

Simplified Assessment

The ETSU Guidance does not require an assessment against background noise levels where the predicted noise level of the turbine at a wind speed of 10m/s at 10m height does not exceed 35dB as LA₉₀.

The nearest non-associated noise sensitive properties are 450m from the proposed wind turbine (Far Royd Moor and Willow Farm). Reservoir House is

620m from the proposed turbine. The predicted noise level of the DW52 at 450m at a wind speed of 10m/s at 10m height is 34.4dB LA₉₀.

As the other nearest non-associated dwellings are at a distance greater than these it follows that the sound level from the turbine alone will be less than 35db LA₉₀ also as shown in Table 5.1.

Property	Distance from Wind Turbine m	Predicted noise level for 10m/s at 10m height wind speed. dB LA90
Far Royd Moor	450	34.4
Willow Farm	450	34.4
Reservoir House	620	31.7

Table 5.1 Predicted noise levels from the wind turbine at 10m/s wind speed at 10m height (assumes LA₉₀ = LAeq – 2dB)

No account of soft ground attenuation or air absorption has been made so in reality the noise level from the turbine will probably be lower than those stated.

As the noise level at all non-associated neighbouring properties is less than 35dB(A) at 10m/s wind speed at 10m height the simplified assessment as described in the ETSU Guidance applicable. It is therefore not necessary to assess the noise against background noise level as, according to the ETSU Guidance “...even in sheltered areas when wind speeds exceeds 10m/s on the wind farm site, some additional background noise will be generated which will increase background levels at the property”.

6 Tonality

As with BS4142, it is appropriate to add a “penalty” to the predicted noise level if the noise has a tonal characteristic.

The ETSU Guidance recommends applying a tonal penalty of an amount dependent on the audibility of the tone. The manufacturers noise report states that a tonal penalty of 2.5dB should be applied to the noise level at 5m/s in line with ETSU-R-97.

The Sound Power Level of the DW52 wind turbine at 5m/s is 96.5dB(A). This is increased to 99dB(A) with the +2.5dB tonal penalty applied.

The predicted noise levels from the wind turbine at 5m/s wind speed at 10m height at the assessment locations are shown in Table 6.1.

Property	Distance from Wind Turbine m	Predicted noise level for 5m/s at 10m height wind speed with tonal penalty. dB LA90
Far Royd Moor	450	32.9
Willow Farm	450	32.9
Reservoir House	620	30.2

Table 7.1 Predicted noise levels from the wind turbine at 5m/s wind speed at 10m height with +2.5dB tonal penalty applied (assumes $LA_{90} = LA_{eq} - 2dB$)

Table 7.1 shows that even with the tonal penalty applied the noise level at 5m/s is below the 35dB(A) assessment criterion by a significant margin.

7 Conclusion of the assessment

Section 3 of this report describes a set of criteria against which the noise from the turbine should be assessed.

From the above data and calculations the noise level from the turbine in this location meets the requirements ETSU Guidance at all noise sensitive locations by virtue of it being less than the 35dB LA_{90} criterion at a wind speed of 10m/s at 10m height.

Appendix I

Manufacturer's Noise Report



Emergya Wind Technologies BV

Engineering

Category:	Specification	Page 1 / 2
Doc code:	S-1005020	

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Specification

Sound power warranty levels DW52/54 500kW

Revision	Date	Author	Approved	Description of changes
02	14-03-12	AB	TY	Modifications based on new IEC measurements
01	09-12-11	AB	TY	correction
-	-	-	-	-
-	-	-	-	-
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-	-	-	-	-

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	Category:	Specification	Revision: 02
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Sound power levels

The warranted sound power levels are presented with reference to IEC 61400-11:2002.

V_{wind} at 10m height	DW52	DW54
5 m/s	96,5 dB(A)	97.0 dB(A)
6 m/s	97.5 dB(A)	98.0 dB(A)
7 m/s	98.5 dB(A)	99.0 dB(A)
8 m/s	99.5 dB(A)	100.0 dB(A)
9 m/s	100.3 dB(A)	100.5 dB(A)
10 m/s	100.5 dB(A)	100.5 dB(A)

Sound power level L_w in dB(A)

The warranted sound power levels are based on actual measurements executed by an independent noise measurement institute according to the preferred methods set out in IEC-61400-11.

Uncertainty levels are included in the warranted sound power levels.

At 5m/s a maximum tonal noise penalty of 2,5dB shall be considered according to ETSU-R-97 guidelines.

The measured third octave sound power levels are available upon request.

The values given in the table are valid for normal operational mode (rotation speed 0-24 RPM)

The calculation of the standardized wind speed at 10m height according to IEC 61400-11 is based on a terrain roughness length $Z_0=0,05m$.

In case validation measurements have to be performed, they should be executed according to the preferred methods set out in IEC-61400-11 by an independent measurement institute which is accredited to ISO/IEC 17025 to conduct measurements of wind turbine noise emissions.

EWT reserves the right to make modifications or adjust settings in order to comply with the warranted sound power levels.