



Urban Wind

Mount Pleasant Farm, Great Houghton

Wind Turbine Noise Assessment

DC1446–R1



May 2014

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1.0 INTRODUCTION

Urban Wind has appointed Dragonfly Consulting to carry out a noise assessment relating to the proposed installation of two 23 metre high (to hub) wind turbines on land forming part of Mount Pleasant Farm, Great Houghton.

It is understood that the noise assessment is required to establish the noise levels at the nearest noise sensitive receptors due to the operation of the proposed turbines and to assess the impact of those noise levels against the requirements of ETSU-R-97, *“The Assessment and Rating of Noise from Wind Farms”*, and the requirements of the Local Authority. The assessment is to also consider the noise impact of the installation at nearby sensitive properties when considered in conjunction with any further proposed or existing turbines.

Whilst every effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix A.

2.0 SITE DESCRIPTION

2.1 Site Conditions

It is proposed to install two 'NPS-100' 100kW wind turbines on land forming part of Mount Pleasant Farm, Great Houghton. The turbines will be 23m high to the hub centre.

The noise data for the proposed turbines has been taken from the document "*Northern Power Systems NPS 100-24 Noise Information*" produced by Arcus Consultancy Services Ltd (Dated: December 2013). This is the data for the UK model of this turbine, which has a different energy production profile to the standard NPS-100 model and subsequently has a lower noise output.

The published noise data for this turbine has been reviewed with reference to the guidance detailed in the Institute of Acoustics document '*A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*'.

From the manufacturer's noise data the 'NPS-100' 100kW Turbine has a Sound Power Level of 92.3dB L_w at a wind speed of 10m/s without the inclusion of any uncertainty corrections. However once corrections for the tonal content of the turbine noise have been taken in to account, the turbine has a higher Sound Power Level of 94.5dB at 7m/s. This value has instead been used for calculations to ensure a robust assessment for wind speeds of 10m/s or below.

The proposed turbine locations are shown in Appendix B. The turbines are hereby referred to in this report as follows:

- 'Turbine 1' (X: 443535, Y: 407240)
- 'Turbine 2' (X: 443555, Y: 407125)

There are two residential properties, one with financial interest in the proposed turbine and one with no financial interest, situated closest to the proposed turbine location. The residential properties are located as follows:

	FI 'Mount Pleasant Farm'	NSR 'Garraby Close'
Co-ordinates	X: 443810 Y: 406960	X: 443163 Y: 406980
Turbine 1	395m	450m
Turbine 2	300m	400m

The FI and NSR are shown in Appendix B.

It is typical for the local authority to request a cumulative noise impact assessment. The assessment is to consider the noise impact of the installation at nearby sensitive properties when considered in conjunction with any existing turbines in the vicinity of the proposed installation. From the information provided to Dragonfly Consulting for this proposal it is considered that there are no existing wind turbines in the vicinity of the proposed installation that are required to be considered as part of a cumulative assessment.

3.0 GUIDANCE

Dragonfly Consulting considers that the guidance detailed in ETSU-R-97 should be taken as the appropriate guidance on the assessment of noise impact for a noise source of this type, also taking account of the latest guidance published by the Institute of Acoustics, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*.

The National Planning Policy Framework, published in March 2012, sets out the Government's objectives with respect to renewable energy sources for England. With respect to wind farm noise it states, in Section 97:

To help increase the use and supply of renewable and low carbon energy, local planning authorities should recognise the responsibility on all communities to contribute to energy generation from renewable or low carbon sources. They should:

- *have a positive strategy to promote energy from renewable and low carbon sources;*
- *design their policies to maximise renewable and low carbon energy development while ensuring that adverse impacts are addressed satisfactorily, including cumulative landscape and visual impacts;*
- *consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources;**
- *support community-led initiatives for renewable and low carbon energy, including developments outside such areas being taken forward through neighbourhood planning*
- *identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.*

**In assessing the likely impacts of potential wind energy development when identifying suitable areas, and in determining planning applications for such development, planning authorities should follow the approach set out in the National Policy Statement for Renewable Energy Infrastructure (read with the relevant sections of the Overarching National Policy Statement for Energy Infrastructure, including that on aviation impacts). Where plans identify areas as suitable for renewable and low-carbon energy development, they should make clear what criteria have determined their selection, including for what size of development the areas are considered suitable.*

The Overarching National Policy Statement for Energy Infrastructure (EN-1), published in July 2011, states in Section 5.11.6 (Noise and Vibration):

Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance.

Further information on assessment of particular noise sources may be contained in the technology-specific NPSs. In particular, for renewable (EN-3) and electricity networks (EN-5) there is assessment guidance for specific features of those technologies. For the prediction, assessment and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies.

The National Policy Statement for Renewable Energy Infrastructure (EN-3), published in July 2011, states in the following sections (Onshore Wind Farm Impacts – Noise and vibration):

Section 2.7.55

The method of assessing the impact of noise from a wind farm on nearby residents is described in the report, 'The Assessment and Rating of Noise from Wind Farms' (ETSU-R-97). This was produced by the Working Group on Noise from Wind Turbines Final Report, September 1996 and the report recommends noise limits that seek to protect the amenity of wind farm neighbours. The noise levels recommended by ETSU-R-97 are determined by a combination of absolute noise limits and noise limits relative to the existing background noise levels around the site at different wind speeds.

Therefore noise limits will often influence the separation of wind turbines from residential properties.

Section 2.7.56

The applicant's assessment of noise from the operation of the wind turbines should use ETSU-R-97, taking account of the latest industry good practice.

This should include any guidance on best practice that the Government may from time to time publish.

The Secretary of State has indicated that the IOA Document 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' should be considered as the relevant guidance for the consideration of calculating noise propagation from wind turbines

This provides clear guidance that the assessment of wind farm noise should reference only ETSU-R-97 and should take account of current best practice when undertaking assessments.

For the purposes of this desktop assessment it is assumed that the background noise levels are very low, and therefore the noise criteria for low noise environments are to be used. Noise source levels for the wind turbines should be taken from manufacturer's noise data.

3.1 ETSU-R-97

ETSU provides a framework for the measurement of wind farm noise and gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours.

ETSU recommends that noise levels at the nearest noise sensitive receptor should be limited to 5dB(A) above background noise levels.

For locations with very low noise levels, ETSU recommends that noise levels be limited to the range 35dB(A) to 40dB(A) during the daytime and 43dB(A) during the night time.

Where a single wind turbine is to be installed, or where there are very large separation distances between the turbines and the nearest noise sensitive property, ETSU considers that an absolute noise limit for the wind turbine of 35dB $L_{A90, 10min}$ offers sufficient protection to amenity such that no measurement of actual background noise is required. ETSU considers that for the purposes of calculation the $L_{A90, 10min}$ can be considered to be 1.5 to 2.5dB below the L_{Aeq} at the same position.

Where a property is under the ownership of persons considered to have a 'financial interest' in the development of the wind turbine the lower fixed limits at the property due to the operation of the

turbine can be increased to 45dB daytime and night time, with consideration given to higher limits above background noise level where the occupier has a financial involvement.

3.2 ISO 9613

The noise level predictions have been undertaken in accordance with the noise prediction framework set out in ISO 9613-2 *“Acoustics – attenuation of sound during propagation outdoors- Part 2 General method of calculation”*.

The noise prediction model assumes that wind turbines act as elevated spherical point sources, with the noise level reducing by 6dB for every doubling of distance from the noise source. The model takes into account the distance between the turbine and the receptors and the amount of attenuation due to ground effect and atmospheric absorption.

The model assumes downwind propagation, i.e. a wind direction that assists the propagation of noise from the source to all receptors and that the ground type is a combination of soft and hard ground ($G=0.5$) and a receptor height of 4m AGL has been used.

The assessment includes a number of variations from the methodology used in ISO9613-2. These variations are following the guidance detailed in the Institute of Acoustics document ‘*A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*’ This document presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine developments above 50kW, which includes some variation from the propagation methodologies.

4.0 ASSESSMENT

4.1 Assessment of Noise from Proposed Wind Turbine

Predicted noise level calculations have been completed for the nearest noise sensitive receptors.

From the manufacturer's noise data the 'NPS-100' 100kW Turbine has a Sound Power Level of 94.5dB L_W at a wind speed of 7m/s with the inclusion of uncertainty corrections.

The resultant noise levels (L_{Aeq}) have been calculated following the guidance in ISO 9613 and the guidance from the IOA Good Practice Guide. The calculated noise levels and comparison with the ETSU guidance are therefore as follows:

Table 4.1
ETSU guidance Criteria

Receptor	ETSU Criteria		
	Daytime	Night time	Single Turbine ($L_{A90,10min}$)
FI	45	45	--
NSR	35-40	43	35

Table 4.2
Noise Levels from Proposed Wind Turbines for FI – (L_{Aeq}), free-field, dB

Receptor	Turbine 1	Turbine 2
Slant Distance Between Turbine and Receptor in m	395	301
Distance Correction (A_{div})	62.9	60.6
Ground Effect Correction (A_{gr})	-3.00	-3.00
Atmospheric Absorption (A_{atm})	0.4	0.3
L_{Aeq} at Noise Sensitive Receptor	34.2	36.6
L_{90} at Noise Sensitive Receptor	32.2	34.6
Cumulative L_{Aeq} at Noise Sensitive Receptor		38.6
Cumulative L_{90} at Noise Sensitive Receptor		36.6

Table 4.3
Noise Levels from Proposed Wind Turbines for NSR – (L_{Aeq}), free-field, dB

Receptor	Turbine 1	Turbine 2
Slant Distance Between Turbine and Receptor in m	450	400
Distance Correction (A_{div})	64.1	63.1
Ground Effect Correction (A_{gr})	-3.00	-3.00
Atmospheric Absorption (A_{atm})	0.5	0.4
L_{Aeq} at Noise Sensitive Receptor	33.0	34.0
L_{90} at Noise Sensitive Receptor	31.0	32.0
Cumulative L_{Aeq} at Noise Sensitive Receptor	36.6	
Cumulative L_{90} at Noise Sensitive Receptor	34.6	

The data displayed in Tables 4.2 and 4.3 is summarised in Table 4.4 below:

Table 4.4
Summary of Cumulative Noise Levels from all proposed turbines – free field, dB

Receptor	Combined Noise Level (L_{Aeq})	Combined Noise Level (L_{90})
FI	38.6	36.6
NSR	36.6	34.6

For the Financially Interested property (FI):

- The calculated turbine noise levels are below the daytime and night time noise criteria recommended by ETSU.
- It is considered that the predicted noise levels from the proposed turbines will satisfy all of the noise limits specified by ETSU at this property.

For the Noise Sensitive Receptor (NSR):

- The calculated turbine noise levels are below the daytime and night time noise criteria recommended by ETSU.
- It is considered that the predicted noise levels from the proposed turbines will satisfy all of the noise limits specified by ETSU at this property.

4.2 Uncertainty

There is an inherent uncertainty factor within noise propagation calculations as they are based upon assumptions as to the atmospheric and ground conditions, which may vary over time. The inherent uncertainty of the measurements completed has been assessed broadly following the procedure detailed in ISO 9613-2. This evaluation of the uncertainty estimates that the uncertainty of the calculations in this assessment will be +/- 1dB.

5.0 CONCLUSION

Urban Wind has appointed Dragonfly Consulting to carry out a noise assessment relating to the proposed installation of two 23 metre high (to hub) wind turbines on land forming part of Mount Pleasant Farm, Great Houghton.

It is understood that the noise assessment is required to establish the noise levels at the nearest noise sensitive receptor due to the operation of the proposed turbines and to assess the impact of those noise levels against the requirements of ETSU-R-97, *"The Assessment and Rating of Noise from Wind Farms"*.

For all the properties assessed the calculated turbine noise levels are below the daytime and night time noise criteria recommended by ETSU. It is considered that the predicted noise levels from the proposed turbines will satisfy all of the noise limits specified by ETSU at all the properties assessed.

6.0 CLOSURE

This report has been prepared by Dragonfly Consulting with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client.

Copyright in this report (including the data it incorporates) is owned by Dragonfly Consulting. It is provided for the exclusive use of Urban Wind; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from Dragonfly Consulting.

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Appendix A – Glossary of Terminology

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A-1
Sound Levels Commonly Found in the Environment

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Acoustic Terminology

dB (decibel) The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2×10^{-5} Pa).

dB(A) A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

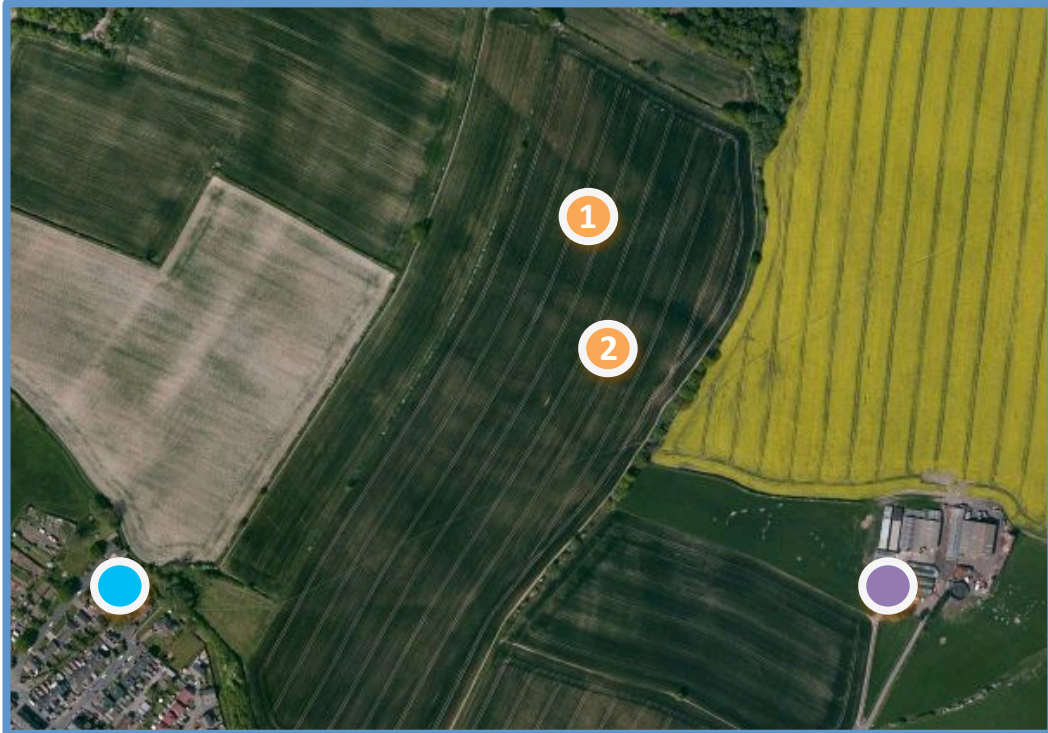
L_{Aeq} Defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

L_{10} & L_{90} If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index when describing traffic noise.

L_{Amax} The maximum A - weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment.

Appendix B – Turbine Locations

**Figure B-1
Turbine Location Plan**



-  Nearest Noise Sensitive Receptor (NSR)
-  Financially Interested property (FI)
-  Approximate proposed 'NPS-100' 100kW turbine locations

Appendix C – Limitations to this Report

This entails a physical investigation of the site with a sufficient number of sample measurements to provide quantitative information concerning the type and degree of noise and vibration affecting the site. The objectives of the investigation have been limited to establishing sources of noise and vibration material to carrying out an appropriate assessment.

The number and duration of noise and vibration measurements have been chosen to give reasonably representative information on the environment within the agreed time, and the locations of measurements have been restricted to the areas unoccupied by building(s) that are easily accessible without undue risk to our staff.

As with any sampling, the number of sampling points and the methods of sampling and testing cannot preclude the existence of “hotspots” where noise or vibration levels may be significantly higher than those actually measured due to previously unknown or unrecognised noise or vibration emitters. Furthermore, noise or vibration sources may be intermittent or fluctuate in intensity and consequently may not be present or may not be present in full intensity for some or all of the survey duration.