DRAGONFLY acoustics

Hallmark Power Limited

New Buildings Farm, Hilderstone

Wind Turbine Noise Assessment

DC0906 – R1v5

September 2013

CONTENTS

APPENDICES

DC0906-R1v5 Report Version Issue Log

Report Number	Reason and Outcome of Change	Approval For Issue
DC0906-R1v5	Calculations changed due to new IOA Good Practice Guide (May 2013) and to reflect updated data for the WTN250	GP

© Dragonfly Acoustics Limited 2013

1.0 INTRODUCTION

Hallmark Power Limited has appointed Dragonfly Acoustics to carry out a planning noise assessment relating to the proposed installation of one 25 metre high (to hub) wind turbine on land forming part of New Buildings Farm, Hilderstone.

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 turbine, 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"*.

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.

© Dragonfly Acoustics Limited 2013

2.0 SITE DESCRIPTION

2.1 Site Conditions

It is proposed to install one Wind Technik Nord 'WTN' 250 kW wind turbine on land forming part of New Buildings Farm, Hilderstone. The turbine is 25m high to the hub centre with a rotor diameter of 30m.

The noise data for the proposed turbine have been taken from the document "WTN 250 Wind Turbine Noise Performance Assessment" technical report (Ref: DC0989-R2v4) produced by Dragonfly Acoustics Ltd. (Dated: June 2013). This report is approved by the manufacturer, and it is our understanding that the manufacturer warrants this data provided the stated uncertainties are included in all calculations.

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*'.

The third octave band data for this turbine is considered suitable for undertaking an assessment using ISO9613-2, Equation (9). All recommendations from Section 4.3 of the Good Practice Guide have been followed, and as the data is warranted, the uncertainty corrections have been included as stated within the original report.

From the manufacturer's noise data the WTN 250kW Turbine has a Sound Power Level of 99.7dB L_W at a wind speed of 10m/s without the inclusion of any uncertainty corrections.

The location of the proposed turbine is shown in Appendix B. Grid reference details are available in the planning documentation.

One financially interested residential property has been identified in the vicinity of the proposed turbine:

- Financially Interested Property (FI) – located approximately 295m from the turbine.

Two residential properties with no financial interest in the proposed turbine are also situated in the vicinity of the proposed location. These Noise Sensitive Receptors (NSRs) are located as follows:

- Noise Sensitive Receptor 1 (NSR1) – located approximately 295m from the turbine.
- Noise Sensitive Receptor 2 (NSR2) – located approximately 295m from the turbine.

The noise impact on the NSRs has been included in this assessment and noise levels have been shown to be acceptable against the fixed noise limit detailed by ETSU.

The locations of the FI property and the NSRs are shown in Appendix B.

© Dragonfly Acoustics Limited 2013

3.0 GUIDANCE

Dragonfly Acoustics 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*', which has been ratified by the Secretary of State.

The National Planning Policy Framework, published in March 2012, sets out the Government's objectives with respect to renewable energy sources for England. With regard 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.

© Dragonfly Acoustics Limited 2013

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.

To summarise, the National Policy Statement 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.

Following this guidance Dragonfly Acoustics considers that 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.

For the purposes of this 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 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.

© Dragonfly Acoustics Limited 2013

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 also 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.

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.

© Dragonfly Acoustics Limited 2013

4.0 ENVIRONMENTAL NOISE SURVEY

Background noise measurements were undertaken over the periods of 1st August 2012 to 14th August 2012 and 31st August 2012 to 25th September 2012 to establish existing background noise levels at 'NSR1' and 'NSR2'. As these receptors are adjacent to each other one measurement position has been used to establish the noise levels at both properties and is considered to be representative of typical noise levels at each NSR.

4.1 Survey Methodology

The measurements were carried out in accordance with the guidance detailed in ETSU-R-97 for the measurement of background noise levels. Wind speeds were measured close to the proposed locations of the turbine at a height of ten metres. Wind speeds were averaged over a ten minute period and compared against the measured background noise levels.

Background noise levels were measured following the guidance in ETSU-R97 at a position as close as practicable to the nearest noise sensitive receptor at a height of 1.5m above the ground. It is considered that the noise levels measured are representative of those that are incident on the noise sensitive receptors. Noise measurements were averaged over a ten minute period and the measurement period correlated directly with the wind measurements.

The wind measurements were recorded using a double windshield external microphone system to minimise the direct effects of wind on the microphone at higher wind speeds.

The equipment used during the survey is detailed in Appendix B. The sound level meter was calibrated before and after the measurements and no significant calibration drifts were found to have occurred. All of the noise monitoring equipment had been calibrated by the manufacturer to a traceable standard within the twelve months preceding the survey. Calibration certificates are available on request.

The microphone was positioned 1.5m from the ground in conditions that were considered to be free-field. The measurement location is shown in Appendix C and is hereby referred to as follows:

- 'Location 1'– sound level meter positioned on land belonging to the Client adjacent to the FI and NSRs.

The measurement location was agreed following consultation with the Local Authority. It was considered that 'Location 1' was the most appropriate measurement location to achieve representative ambient and background noise levels for all the properties in the vicinity of the location of the proposed turbine.

Records of the prevailing weather conditions were collated throughout the duration of the survey and, when significant precipitation had occurred, the results during that period were excluded from the assessment.

© Dragonfly Acoustics Limited 2013

4.2 Survey Results - Typical Background Noise Levels

In accordance with the guidance in ETSU-R-97 the measured background noise levels have been plotted relative to the prevailing wind speed during the night time period (2300hrs to 0700hrs) and the quiet daytime periods as stipulated by ETSU. These quiet daytime periods as specified by ETSU are as follows:

- Monday to Friday 1800hrs to 2300hrs
- Saturday 1300hrs to 2300hrs
- Sunday 0700hrs to 2300hrs

In a report issued in the Institute Of Acoustics Bulletin (Mar-Apr 2009) *Bowdler et al* highlight that there may be a difference between the amount of wind shear (the variation of wind speed with height above the ground) between the application site for a wind turbine and the location at which the wind turbine sound power was originally assessed.

These authors hypothesise that this variation in wind shear value may lead to inaccuracies being introduced when calculated turbine noise level and background noise levels are compared referenced against wind speed at 10m height above the ground. To counteract this, the authors suggest that all noise levels should be referenced against wind speed at turbine hub height.

As no site specific wind shear data is available for this site a calculated value for wind shear has been used. This calculated value uses a wind shear exponent value to calculate a hub height wind speed from a measured 10m height wind speed. This calculation utilises the following formula:

$$V_H = V_{10} \times (H/10)^{\wedge}E_V$$

V_H = Hub Height Wind Speed

V_{10} = 10m Height Measured Wind Speed

H = Hub Height

E_V = Wind Speed Dependant Exponent

The exponent values utilised in this calculation area as follows:

Table 4.1
Wind Shear Exponent Values, dB

	Wind Speed at Reference Height, m/s						
	4	**5**	**6**	**7**	**8**	**9**	**10**
Wind Shear Exponent Value Daytime	0.43	0.38	0.32	0.29	0.29	0.28	0.28
Wind Shear Exponent Value Night time	0.53	0.44	0.39	0.34	0.29	0.29	0.28

© Dragonfly Acoustics Limited 2013

A 'line of best fit' has been produced to calculate the typical background noise level at each integer wind speed. Linear 'lines of best fit' have been used as these were considered most appropriate to the data set to achieve the most accurate representation of the noise levels.

The plots for the daytime and the night time periods are shown at Appendix D. The integer wind speed values corresponding with the plots shown at Appendix D are as follows:

Table 4.1
Measured Noise Levels – free-field, dB

		Wind Speed at Reference Height, m/s								
		4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Noise Measurement Location 1	**Typical Daytime Background Noise Level, $L_{90,\ 10min}$ dB**	30.8	32.7	34.5	36.4	38.3	40.2	42.0	43.9	45.8
	Typical Night time Background Noise Level, $L_{90,\ 10min}$ dB	28.3	30.0	31.6	33.2	34.8	36.4	38.1	39.7	41.3

It is noted that measurements at the full range of wind speeds were not achieved within the duration of the survey. However the plots of both the wind speed and noise level sets of data provide clear trends, which are followed by the lines of best fit. Therefore it is considered that the predicted background noise levels are representative of the site.

© Dragonfly Acoustics Limited 2013

5.0 ASSESSMENT

5.1 Assessment of Noise from Proposed Wind Turbine

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

As the FI and the two NSRs are adjacent to one another, a single measurement location was used to calculate the noise levels at all three properties.

It is considered that the nearest noise sensitive properties will be the following approximate distances from the proposed location of the turbine:

- Financially Interested Property (FI) – New Buildings Farm – located approximately 295m from the proposed location of the turbine
- Noise Sensitive Receptor '1' (NSR 1) – Worker's Cottage 1 – located approximately 295m from the proposed location of the turbine
- Noise Sensitive Receptor '2' (NSR 2) – Worker's Cottage 2 – located approximately 295m from the proposed location of the turbine.

Sound Power levels (L_W) for the proposed turbine have been taken from the document "WTN 250 Wind Turbine Noise Performance Assessment" technical report (Ref: DC0989-R2v4) produced by Dragonfly Acoustics Ltd. (Dated: June 2013). This report is approved by the manufacturer, and it is our understanding that the manufacturer warrants this data provided the stated uncertainties are included in all calculations.

Displayed as octave band noise levels the sound power (including uncertainty) of the wind turbine is as follows:

© Dragonfly Acoustics Limited 2013

Table 5.1
'WTN 250 kW' Sound Power Levels (L_W) at Hub Height, dB

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	Uncertainty
5m/s									
Sound Power Level (dB_A)	70.6	82.1	85.6	86.6	88.7	87.1	80.9	70.0	1.2
6m/s									
Sound Power Level (dB_A)	73.3	83.1	86.7	86.8	88.5	87.5	82.4	73.7	1.3
7m/s									
Sound Power Level (dB_A)	73.1	84.5	89.1	89.8	90.6	89.7	84.0	72.3	1.7
8m/s									
Sound Power Level (dB_A)	74.5	85.2	89.6	89.9	91.0	89.8	84.2	72.4	0.9
9m/s									
Sound Power Level (dB_A)	75.0	86.1	90.5	90.8	91.4	90.3	85.1	75.0	1.0
10m/s									
Sound Power Level (dB_A)	77.3	88.1	92.5	92.4	92.7	91.4	86.4	77.2	1.7

The manufacturer's noise data does not indicate that the noise from this turbine contains any discreet tones. Therefore the above Sound Power Levels include no correction for tonality.

It is noted that rated Sound Power Levels at integer wind speeds below 5m/s are not contained within the manufacturer's noise data.

© Dragonfly Acoustics Limited 2013

The calculated turbine noise levels at each integer wind speed at the FI and the NSRs are as follows:

Table 5.2
Calculated Turbine Noise Levels – free-field, dB

Wind Speed at Reference Height, m/s	5	6	7	8	9	10
All Properties Noise Level $L_{Eq,\ 10min}$ dB	34.1	34.5	37.3	36.8	37.6	38.9

The turbine noise limits have been calculated following the guidance in ETSU-R-97, based on the criteria of the measured background noise level plus (+) 5dB.

Turbine noise levels have been corrected to convert to L_{90} values by the subtraction of 2dB(A).

The resultant noise limits have been compared with the calculated turbine noise levels. The results are detailed in the following tables:

- Table 5.3 – Noise Sensitive Receptors for the daytime period
- Table 5.4 – Noise Sensitive Receptors for the night time period

© Dragonfly Acoustics Limited 2013

Table 5.3
Turbine Noise Levels FI and NSR, Daytime – free-field, dB

Wind Speed at Reference Height, m/s	5	6	7	8	9	10
Typical Daytime Background Noise Level, $L_{90, 10min}$ dB	32.7	34.5	36.4	38.3	40.2	42.0
ETSU-R-97 Maximum Permitted Turbine Noise Level, $L_{90, 10min}$ dB	37.7	39.5	41.4	43.3	45.2	47.0
NSR Predicted Turbine Noise Level, $L_{90, 10min}$ dB	32.1	32.5	35.3	34.8	35.6	36.9
Difference: Criterion minus Turbine Noise Level	5.6	7.0	6.1	8.5	9.6	10.1

Table 5.4
Turbine Noise Levels FI and NSR, Night Time – free-field, dB

Wind Speed at Reference Height, m/s	5	6	7	8	9	10
Typical Night time Background Noise Level, $L_{90, 10min}$ dB	30.0	31.6	33.2	34.8	36.4	38.1
ETSU-R-97 Maximum Permitted Turbine Noise Level, $L_{90, 10min}$ dB	35.0	36.6	38.2	39.8	41.4	43.1
NSR Predicted Turbine Noise Level, $L_{90, 10min}$ dB	32.1	32.5	35.3	34.8	35.6	36.9
Difference: Criterion minus Turbine Noise Level	2.9	4.1	2.9	5.0	5.8	6.2

© Dragonfly Acoustics Limited 2013

The calculated noise levels at the FI property are below the fixed lower noise limit of 45dB.

The calculated turbine noise level at the Noise Sensitive Receptors for all reference wind speeds available at the time of writing the report is below the daytime and night time noise criteria recommended by ETSU.

It is considered that the predicted noise levels from the proposed turbine will satisfy all of the noise limits specified by ETSU.

© Dragonfly Acoustics Limited 2013

6.0 CONCLUSION

Hallmark Power Limited has appointed Dragonfly Acoustics to carry out a noise assessment relating to the proposed installation of one 25 metre high (to hub) wind turbine on land forming part of New Buildings Farm, Hilderstone.

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 turbine 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"*.

This report therefore describes analysis to determine the noise levels due to the proposed turbine at the nearest noise sensitive receptors; it then compares the results with the adopted criteria.

The calculated noise levels at the FI property are below the fixed lower noise limit of 45dB.

The calculated turbine noise level at the Noise Sensitive Receptors for all reference wind speeds available at the time of writing the report is below the daytime and night time noise criteria recommended by ETSU.

It is considered that the predicted noise levels from the proposed turbine will satisfy all of the noise limits specified by ETSU.

© Dragonfly Acoustics Limited 2013

7.0 CLOSURE

This report has been prepared by Dragonfly Acoustics with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Hallmark Power Limited; 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 Acoustics.

Dragonfly Acoustics disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

© Dragonfly Acoustics Limited 2013

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 ($2x10^{-5}$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.

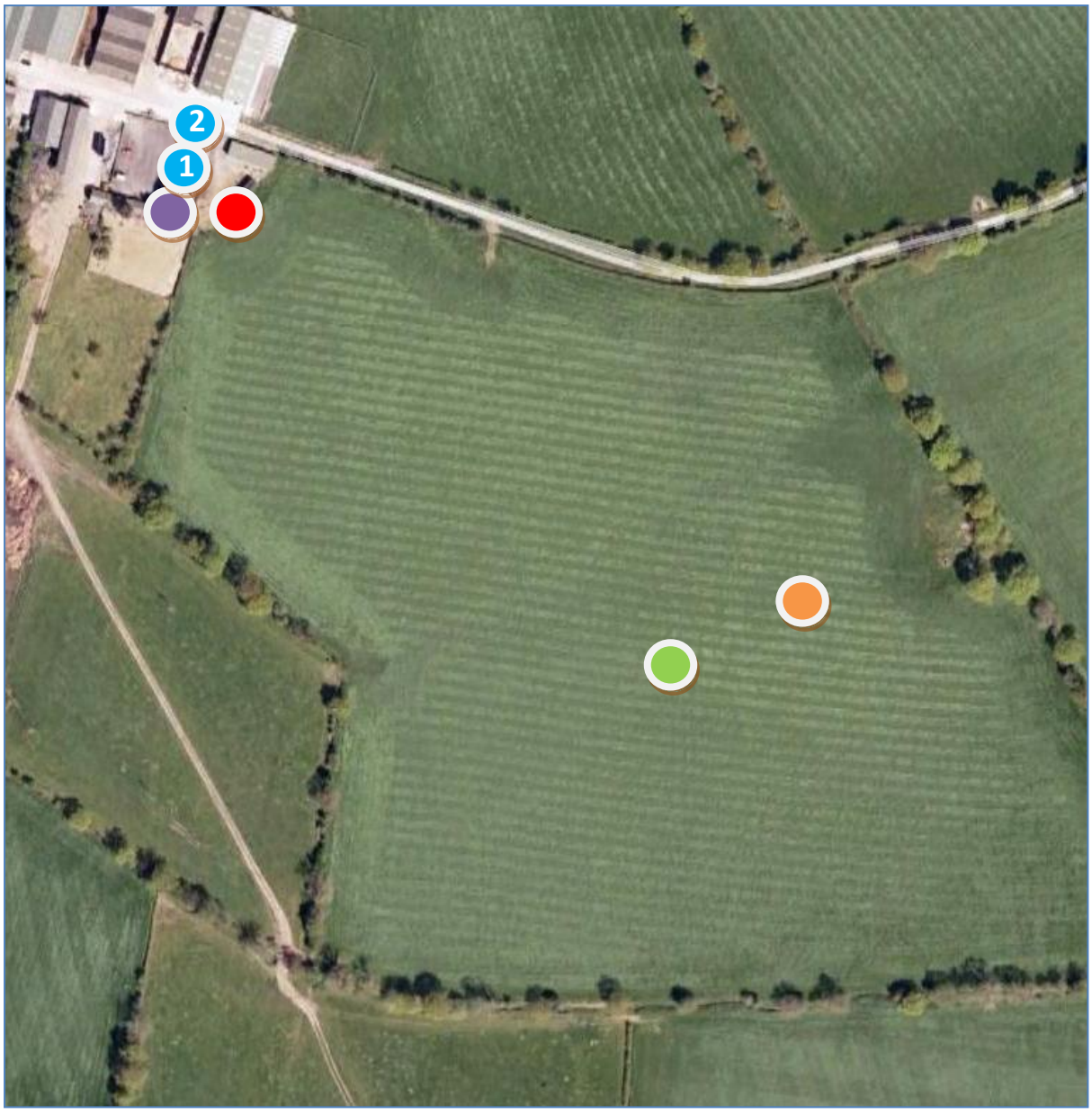
L_{10} & L_{90} If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can 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.

© Dragonfly Acoustics Limited 2013

Appendix B – Proposed Turbine and Measurement Locations

Figure B-1
Turbine Location Plan



Nearest Financially Interested (FI) property

Nearest Noise Sensitive Receptors (NSRs)

Approximate proposed turbine location – 'WTN 250 kW'

Approximate wind measurement position

Approximate noise measurement position

© Dragonfly Acoustics Limited 2013

Appendix C – Monitoring Equipment

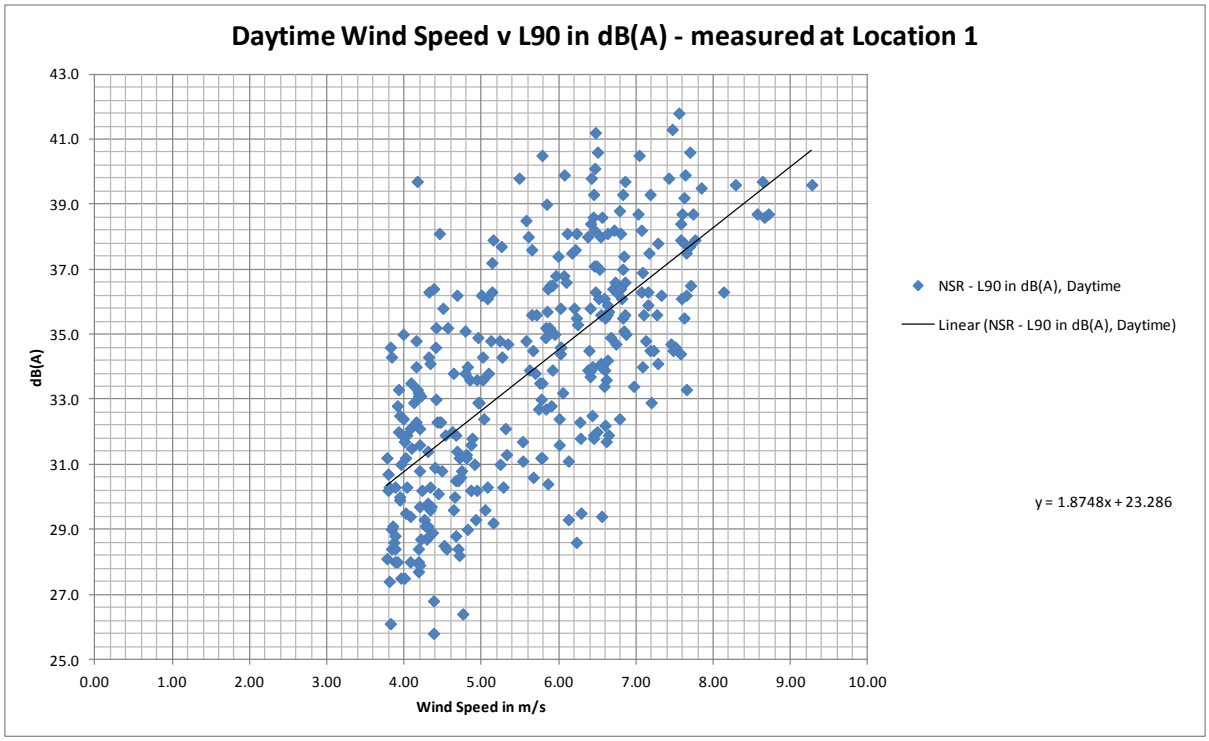
Table C-1
Monitoring Equipment

Equipment	Serial Number
Norsonic NOR140 Sound Level Meter	1403298
Norsonic 1209 Microphone	12549
Norsonic NOR1284 Humidifier	221
Castle GA607 Calibrator	042382
Logic Energy LeWL Data Logger	v5.2.3sd
10m telescopic mast	N/A
Davis Pro-D Anemometer and Wind Vane	N/A

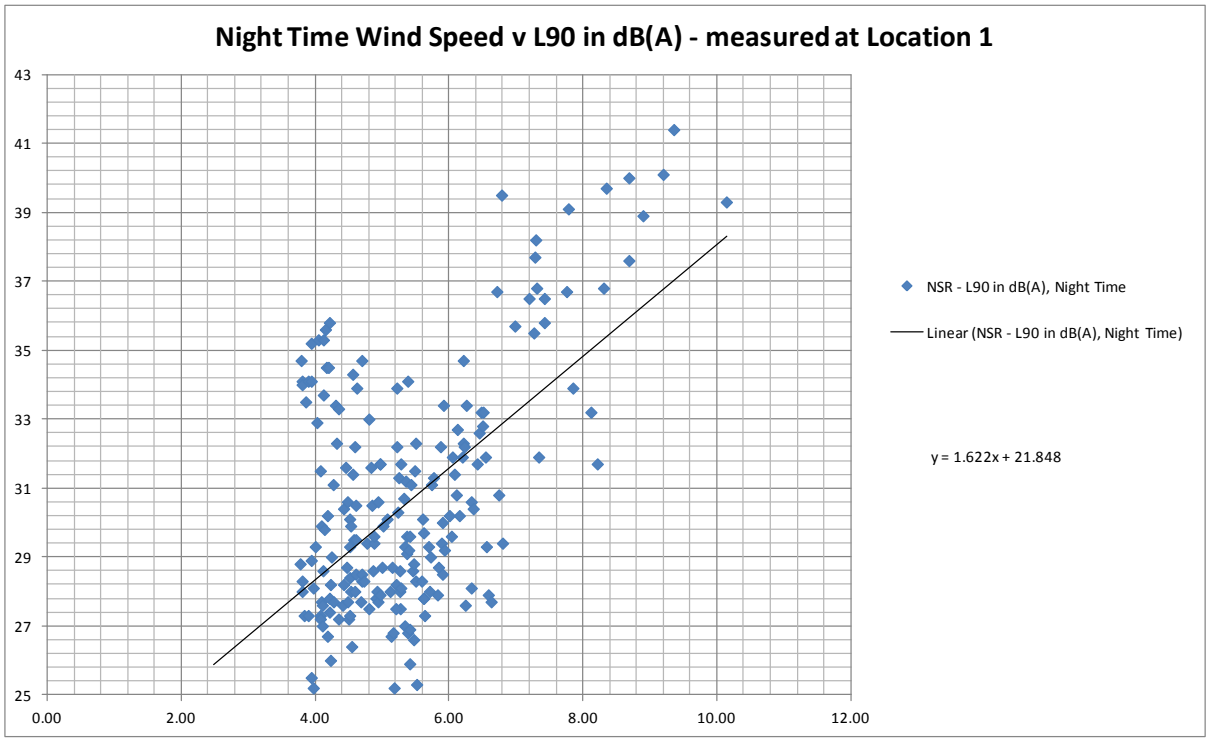
© Dragonfly Acoustics Limited 2013

Appendix D – Graphical Representations

Graph D-1
Daytime Wind Speed v L90 in dB(A) – 'Location 1'



Graph D-2
Night Time Wind Speed v L90 in dB(A) – 'Location 1'



© Dragonfly Acoustics Limited 2013

Appendix E – 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.

© Dragonfly Acoustics Limited 2013