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PROPOSED 6 KW WIND TURBINE
SOPLEY PRIMARY SCHOOL

ASSESSMENT OF POTENTIAL NOISE IMPACT

Technical Report: R3056-1 Rev 0

Date: 30th October 2009

For: Hampshire County Council
Three Minsters House
High Street
Winchester

24 Acoustics Document Control Sheet

Project Title: Proposed 6 kW Wind Turbine, Sopley Primary School. Assessment of Potential Noise Impact

Report Ref: R3056-1 Rev 0

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1.0 SUMMARY

1.1 The purpose of this technical report is to assess the noise impact from the proposed single 6 kW wind turbine at Sopley Primary School. A detailed map of the local area, specific noise data and computer modelling have been used to generate an IMMI noise contour map which has predicted the noise levels at different residential locations near to the proposed wind turbine. IMMI is proprietary computer software which implements the propagation methods laid out in ISO 9613 (Attenuation of sound during propagation outdoors).

1.2 The report also provides the results of measurements of existing background noise levels at the nearest noise sensitive properties (1 and 2 South Ripley Cottages) and other properties in the vicinity. Background noise measurements were undertaken between the 12th and 22nd October 2009 in accordance with ETSU-R-97 (The Assessment and Rating of Noise from Wind Farms). The average windspeed at the turbine location was also measured (at a height of 10 metres above ground) and correlated with the background noise data.

1.3 The background noise level results were used in conjunction with the computer generated noise contour map to determine the effect of noise from the proposed wind turbine on the nearest affected residential properties. The assessment is related to ETSU-R-97 (The Assessment & Rating of Noise from Wind Farms), PPS 22 (Renewable Energy) and also a report produced for Hampshire County Council (Planning) by the ISVR at Southampton University (reference 8329-R01 written by RA Davis). It is relevant to note however that this assessment has been made primarily using the rating method given in BS 4142 rather than ETSU-R-97. The relevance of which standard is applicable is discussed further in the main report.

1.5 The extrapolated results of the noise survey indicate that the background noise level would be in the order of 43 dB L_{A90} with an associated windspeed of 8 m/s.

1.6 The results of the assessment suggest that for a windspeed of 8 m/s (the warranted level provided by the manufacturer), the predicted noise level at the nearest residential property would be 35 dB L_{Aeq}.

1.7 Although noise from the turbine would contain high frequency "swish" noise, it is considered unlikely that this would be sufficiently noticeable to warrant a character correction of the type advocated by ETSU or BS 4142: 1997.

1.8 On this basis, it is considered likely that noise from the proposed wind turbine is unlikely to cause harm to amenity for occupiers at the nearest residential properties.

2.0 INTRODUCTION AND BACKGROUND

Introduction

2.1 24 Acoustics Ltd has been instructed by Hampshire County Council to assess the noise impact associated with the operation of a 6 kW wind turbine for Sopley Primary School. In order to assess the potential noise impact of the proposal, our activities have included:

- background noise measurements at the nearest affected residential property over an extended period of 11 days (12th – 22nd October 2009);
- time synchronised (to the background noise survey) measurements of meteorological conditions over the same period;
- a visit to examine noise from an identical wind turbine, installed at Itchen Valley Country Park, Eastleigh;
- A review of relevant background literature to the proposal, including the report produced by the Institute of Sound and Vibration Research (ISVR) dated September 2009 (8329/R01) [Reference 1];
- An assessment of the noise impact from the wind turbine and under prevailing guidance.

2.2 An explanation of acoustical terms used in this report is provided in Appendix A.

Background

2.3 In order to assess noise issues associated with the proposal, Hampshire County Council (Planning) instructed the ISVR to undertake measurements and comment on the potential noise disturbance to occupiers of nearby dwellings.

2.4 Owing to time constraints leading up to the previous planning hearing on 7th October 2009, measurements were undertaken over a limited period, during which time, the highest recorded windspeed (expressed as a 10 minute average) was 3.5 m/s. The measurement methodology given in the ETSU-R-97 (ETSU) [Reference 2] document recommends that a period sufficient to obtain wind speeds of up to 10 m/s. Though there can be no guarantees in weather observations, a period of 2 weeks is normally considered typical.

2.5 The report by the ISVR notes this limitation and advised that caution should be attached to any extrapolated values. On this basis, concern was expressed by Edward Vandyck (Senior Environmental Health Officer) at New Forest District Council that the results contain an element of uncertainty.

2.6 Furthermore, the warranted manufacturer's noise data for the Proven 6 kW turbine [Reference 3], prepared by Sgurr Energy dated 2007, notes that the test conditions to assess the turbine sound power level in accordance with BS EN 61400-11: 2003 [Reference 4] should be treated as provisional. In view of this, 24 Acoustics Ltd contacted Proven Energy for further details and as a result has been supplied further noise source data for the turbine.

2.7 This uncertainty was also noted by Mr Vandyck who advised Hampshire County Council that he would not be able to withdraw an objection without further data and analysis. On this basis, 24 Acoustics Ltd was instructed to undertake a second survey of background noise levels and meteorological conditions.

2.8 Furthermore, 24 Acoustics Ltd met with Mr Vandyck at Itchen Valley County Park in an attempt to establish a working sound power level for the identical 6 kW turbine in operation. During the visit, it was obvious that noise from the nearby M27 motorway

would make this process impossible though it was possible to observe the noise character of the unit and this element of the visit was considered useful.

3.0 SITE DESCRIPTION

3.1 Sopley Primary School is located on the junction of Thatchers Lane and Harpway Lane in South Ripley, Hampshire. The site of the proposed wind turbine is located to the east of land owned by the school, adjacent to Thatchers Lane.

3.2 The nearest residential properties (1 and 2 South Ripley Cottages) are located to the west of the turbine at a distance (to the façade of the dwelling) of 100m. Residential properties are also located further away to the northwest and southwest of the proposed turbine.

3.3 The proposed turbine is manufactured by Proven Energy and rated at 6 kW. It would be mounted at a height of 15m above ground and make use of a rotor of 5m diameter.

3.4 The proposed wind turbine location and surrounding area is shown in Figure 1.

3.5 It is relevant to note that there are significant building works underway at Sopley Primary School. Noise from the works is clearly evident at 1 and 2 South Ripley Cottages. For the purposes of the assessment, noise during the working hours has been excluded from the assessment.

3.6 Other significant noise sources in the vicinity include aircraft movements (typically arrivals) to Bournemouth Airport and noise from vehicles using the local roads.

4.0 ASSESSMENT CRITERIA

Planning Policy Guidance 24

4.1 Planning Policy Guidance (PPG) 24 [Reference 5] provides advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business. The guidance states that noise from new industrial or commercial development should be assessed (where appropriate) using the guidance given in British Standard 4142.

BS 4142: 1997

4.2 Where noise from an industrial source is being assessed, PPG 24 refers to the methodology given in BS 4142: 1990 [Reference 6] (amended in 1997). Technically, it should be noted that the scope of BS 4142 is limited to assessing noise from new or existing industrial (or industry related) sources at existing dwellings.

4.3 The standard is based upon a comparison between the noise from the specific source being considered, measured as a time-averaged (L_{Aeq}) noise level, with the background noise level (measured as an L_{A90}) in the absence of the specific source. For rating purposes, the noise level measured with the source operating is increased by 5 dB if the source has any distinctive characteristics (such as whines, hums or bangs) or if it is irregular enough to attract attention.

4.4 It should be noted that when the background and rating noise level at night are both 'very low' as defined with BS 4142 the rating method is deemed not to apply. 'Very low' is defined as background noise levels below 30 dB $L_{A90,\ 5min}$ and rating levels below 35 dB $L_{Aeq,\ 5mins}$.

4.5 The standard states that if the rating level of the noise exceeds the background noise by around 10 dB or more then complaints about noise are 'likely'. An increase of 5 dB is of 'marginal significance' whilst a difference of −10 dB or less is a 'positive indication that complaints are unlikely'. When considering planning applications which relate to noise, many Local Planning Authorities seek not just to prevent nuisance occurring but also to reduce the likelihood of nuisance occurring and also to prevent creeping background. In practice, to maintain satisfactory amenity at nearby residential properties, most Local

Planning Authorities seek to achieve a difference between rating level and background noise level of between +5 dB and −10 dB depending on local circumstances.

Planning Policy Statement 22

4.6 Planning Policy Statement 22 (PPS 22) [Reference 7] recommends that '*The 1997 report by ETSU for the Department of Trade and Industry should be used to assess and rate noise from wind energy development*'.

ETSU-R-97

4.7 ETSU-R-97 provides a methodology for the assessment of noise from the operation of wind farms. Wind turbines operate at a range of wind speeds and the noise emission from the turbines varies according to wind speed. Background noise levels can also vary according to wind speed and hence the methodology suggests noise limits at receptor locations which vary according to windspeed (subject to lower absolute limits). The limits that are suggested for the daytime and night time periods are defined below:

- Quiet daytime periods (defined as weekday evenings- 18:00 and 23:00 hours, Saturdays between 13:00 and 23:00 and Sundays between 07:00 and 23:00), lower limit of 35 to 40 dB $L_{A90,}$ or 5 dB above the prevailing background noise level, whichever is greater;
- Night-time, lower limit of 43 dB L_{A90} or 5 dB above the prevailing background noise level, whichever is greater.

4.8 Where the occupier of a receptor is 'financially involved' with the project the lower daytime and night-time noise limits may be increased to 45 dB L_{A90}.

4.9 The guidance also provides a rationale for determining the noise limits and details recommendations relating to calculation and propagation methodology, means of measuring background noise levels and corresponding wind speeds etc.

Discussion

4.10 In recent years there has been disagreement between experts as to whether the ETSU guidance adequately assesses noise from wind turbines. Furthermore, the report from the ISVR [Reference 1] notes that whilst the use of ETSU may be justified when considering

larger scale windfarms "*owing to the wider benefits derived from a significant energy resource*", it would not be appropriate for a single turbine such as the type proposed. 24 Acoustics Ltd has consulted with other experts in the assessment of wind turbine noise who have advised that the national imperative for small scale wind generation does indeed provide a "wider benefit" and hence the ETSU assessment criteria would be appropriate for the proposed turbine at Sopley School.

4.11 A review of Planning Inquiries concerning a single wind turbine points to an approval of the ETSU methodology by Planning Inspectors. The Inspector's decision from an Appeal in 2006 (APP/J0405/A/06/2016613/NWF) [Reference 8] notes:

> *The most relevant government advice is contained in PPS 22 Renewable Energy and the associated Planning for Renewable Energy - a Companion Guide to PPS 22. PPS 22 seeks to promote the development of renewable energy 'where the technology is viable and environmental, economic and social impacts can be addressed satisfactorily'. The Companion Guide provides detailed practical guidance and includes a section on noise.*
>
> *While the advice in the Companion Guide derives from work on wind farms with their much larger turbines, its essential principles are applicable to domestic scale turbines as well. Four of those principles are of particular relevance here. First, the most appropriate approach to controlling turbine noise is through the application of noise limits at the nearest noise-sensitive properties. Second, noise limits should be applied to external locations and should apply only to those areas frequently used for relaxation or activities for which a quiet environment is highly desirable. Third, noise limits set relative to the background noise are appropriate in the majority of cases. Fourth, separate noise limits should apply for day and night time, as during the night (generally defined as 2300 -0700 hours) the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance.*

Summary

4.12 It is considered that for the purposes of this report, a full discussion on the merits of both approaches would be substantially beyond the brief required to make a proper assessment. Accordingly, use of the following noise criteria has been made in this assessment:

- BS 4142 in respect of the exterior free-field noise level, subject to the comments given above regarding strict applicability;

- ETSU in respect of quiet daytime noise levels externally and night-time levels (based on internal noise levels).

5.0 ENVIRONMENTAL NOISE MEASUREMENTS

Measurement Instrumentation and Procedure

5.1 A precision sound level meter was used to measure background noise levels in the rear garden of 1 South Ripley Cottages. The instrumentation was setup at the same location used by the ISVR, at a distance of approximately 5m from the rear of the house and 1.5m above ground level. A photograph of the monitor is shown in Figure 2.

5.2 Environmental noise levels were measured using the following equipment:

Rion Type 1 precision sound level meter	Type NL32;
Bruel and Kjaer acoustic calibrator	Type 4231.

5.3 The meter was equipped with an environmental microphone powered by external batteries, stored in a weatherproof case. The measurement location is shown in Figure 1. The calibration of the instrumentation was checked before and after the tests and no signal variation occurred. Calibration of 24 Acoustics' equipment is traceable to National Standards.

5.4 Measurements were obtained over the period 12th to 22nd October 2009. The noise monitor was configured to continuously measure and store overall A-weighted statistical parameters such as L_{Aeq} and L_{A90} (all measured on fast response) in 10 minute intervals. Measurements were made in accordance with BS 7445: 1991 "Description and measurement of environmental noise Part 2 - Acquisition of data pertinent to land use [Reference 9]. The instrument was also set up to automatically record periods of audio which exceeded a pre-determined threshold, to enable source identification and analysis.

5.5 The principal noise sources during the survey included aircraft movements, noise from the adjacent building works (removed from the analysis), contributions from nearby road

traffic and general environmental sounds (ie, birdsong, trees rustling). The weather was mostly dry throughout the survey.

5.6 The owner of 1 South Ripley Cottages advised that during a period of strong winds in the night-time of 19th and 20th October, a large agricultural tarpaulin was blown free of its fixings causing significantly higher than normal noise levels at the measurement location. This data has also been removed from the analysis.

5.7 Time synchronous measurements were made of the wind speed at a position representative of the proposed turbine. The weather station, comprising a rotating anemometer was installed at a height of 10m and was configured to measure and store average windspeed and direction in 10 minute samples throughout the survey. A photograph of the installation is shown in Figure 3.

6.0 RESULTS AND ASSESSMENT

Results

6.1 The results of the background noise and windspeed surveys are shown in Figure 4. In noise terms, the results show that the prevailing daytime and night-time noise climate is low. With extraneous sources removed, typical ambient noise levels during the daytime were in the range 25 to 40 dB $L_{A90\ 10\ min}$ whilst typical ambient levels at night were in the region of 17 - 25 dB $L_{A90\ 10\ min}$.

6.2 The average windspeed (as assessed over 10 minute samples) varied between 0 m/s and 6.5 m/s (higher gusts were recorded). The predominant wind directions were northerly (first part of the survey) and SW (latter part).

Assessment

6.3 A comparison for wind speed and associated background noise level (throughout the day evening and night-time periods) is shown in Figure 5. As noted above, periods of construction activity and noise from the tarpaulin have been removed. It is relevant to note that a review of the correlation at night-time only showed gave inconclusive data – hence it was agreed between 24 Acoustics Ltd and the ISVR that presentation of the correlated data over the daytime, evening and night-time periods would be most representative. A second order best fit line of regression suggests that the background noise level at higher wind speeds would be in the order of 43 dB L_{A90} at speeds of 8 to 10 m/s at all times.

6.4 These figures are marginally greater than those given in Figure 5.6.1 of the ISVR report which shows a level of 40 dB L_{A90} at a windspeed of 10 m/s. It should be noted that the ISVR regression line is likely to be somewhere near the minimum expected, as daytime and evening noise levels have been removed from the analysis.

6.5 Figure 5 shows a comparison between the ISVR and 24 Acoustics' regression lines. 24 Acoustics Ltd has consulted with the ISVR and agreed that whilst a small difference exists, the correct value, on the balance of probabilities most likely occurs between the two values.

6.6 The predicted noise emission from the turbine has been developed using IMMI v6.3 noise-mapping software and has used the propagation methodology given in ISO 9613 [Reference 10] which takes into account the effects of distance, ground absorption, atmospheric absorption and screening (from changes in topography as well as barrier screening). The model has been developed using the following assumptions:

a) Turbine height of 15m;
b) Turbine Sound Power Level - 85.4 dBA (at windspeed of 8 m/s);
c) Receptor height - 1.5m;
d) Soft ground intervening (ie, absorptive);
e) Downwind propagation equally in all directions (as per ISO 9613).

6.7 The results of the model are shown in Figure 6 as a series of noise contours. The noise level at the nearest property arising from the turbine operating at a windspeed of 8 m/s is calculated to be 35 dBA. For a windspeed of 10 m/s, the resultant level is expected to be approximately 38 dBA. These values are consistent with those given in the ISVR report for soft ground conditions (ie, 1 to 2 dB lower than those shown in Figure 5.6.1).

6.8 The calculated noise levels at other windspeeds are plotted against the background noise level in Figure 7.

6.9 In the context of ETSU (which is usually considered less stringent than BS 4142), a resultant noise level of 38 dBA would be acceptable as this would be below the required night-time level of 43 dBA and also be within the notional limit of "*35 to 40 dB L_{A90}, or 5 dB above the prevailing background noise level, whichever is greater*" for daytime and evening periods.

6.10 With regard to the requirements of BS 4142, the following assessment is made.

Description	**1 and 2 South Ripley Cottages**
BS 4142 Specific Noise Level	35 dB L_{Aeq}
Character Correction	+0 dB
BS 4142 Rating Level	35 dB L_{Aeq}
Background Noise Level	36 dB L_{A90}
Difference between Rating and Background	**- 1 dB**

Table 1: BS 4142 Assessment (Warranted speed of 8 m/s)

6.11 The assessment provides an outcome for both locations that is lower than "*marginal significance*". If a character correction of + 5 dB were applicable (24 Acoustics Ltd has discussed this further with the ISVR and concluded that this would not be the case), then the rating would be + 4 dB which would give a rating of "*marginal significance*".

6.12 It is relevant to note also that the more stringent (ISVR) background noise data has been used in the analysis above. In the event a background noise level of 43 dB L_{A90} was used (without character correction) a rating noise level of –8 dB would be given. This is closer to "*a positive indication that complaints are unlikely*".

6.13 It is relevant also to note that the model assumes light downwind propagation in all directions (as per the requirements of the standard). The prevailing wind direction is generally from the SW which means that a marginally lower noise could be expected for the majority of the time.

6.14 On the basis of the above assessment it is considered that noise from the proposed turbine is unlikely to cause a reduction in amenity to occupiers of the nearest residential properties.

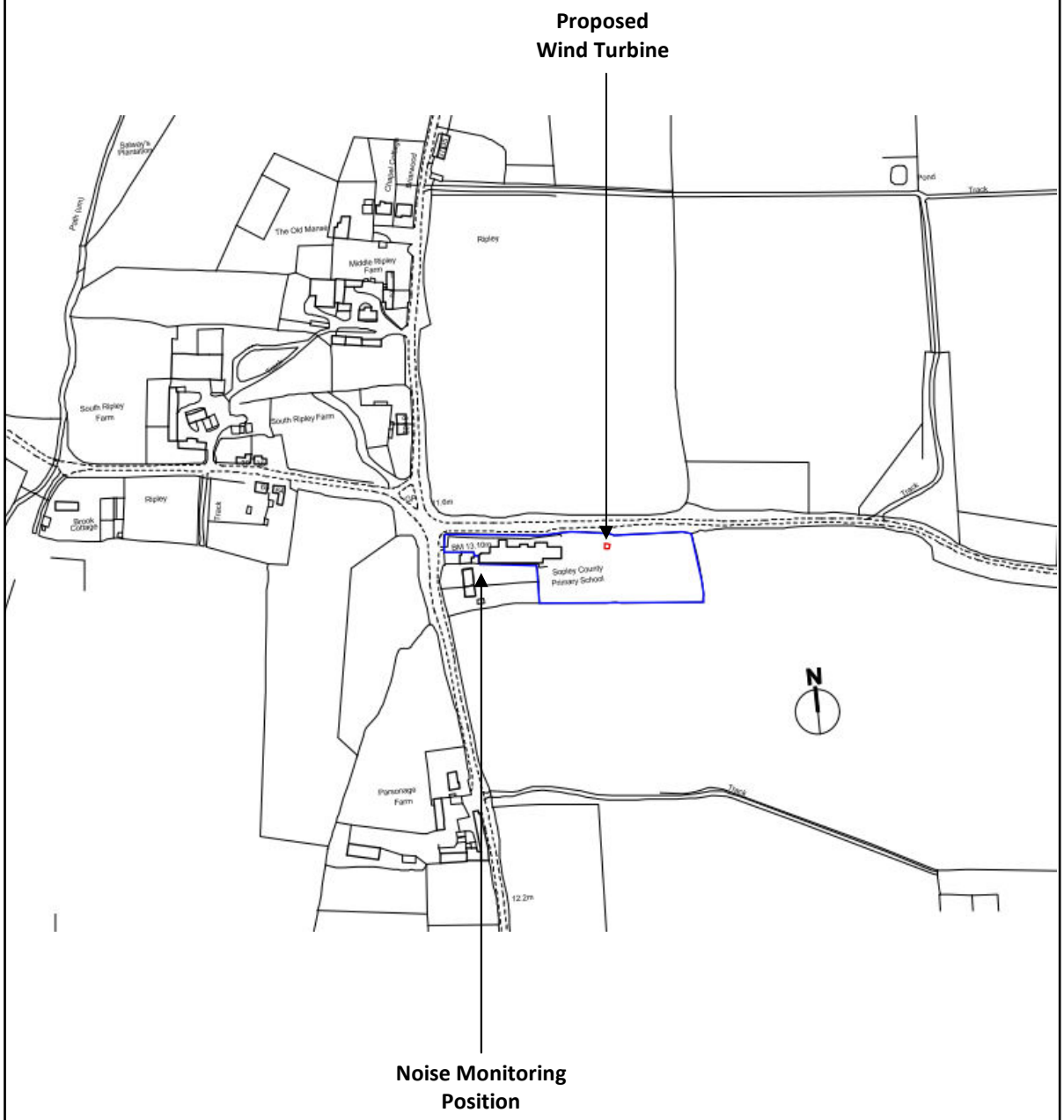
7.0 CONCLUSIONS

7.1 24 Acoustics Ltd has assessed the potential noise impact from the proposed wind turbine at Sopley Primary School.

7.2 A noise survey at the location of the nearest noise sensitive properties has been undertaken to establish the prevailing noise environment during daytime, evening and night-time periods. The prevailing noise climate in the area is typically controlled by aircraft movements, local road traffic and general environmental sounds.

7.3 The impact of noise from the turbine at the nearest properties indicated, over the range of operation, compliance with ETSU guidelines. The noise level is also likely to be lower than of "marginal significance" when assessed using BS 4142.

7.4 On the basis of the measured noise levels and detailed modelling, it has been established that noise from the proposed turbine is not likely to cause disturbance to occupiers of the nearest residential properties (1 and 2 South Ripley Cottages).



Project: Sopley Primary School	**Title:** Site Plan and Measurement Positions	24Acoustics
DWG No: Figure 1	**Scale:** N.T.S.	**Rev:** A
Date: 27-10-09	**Drawn By:** SG	**Job No:** 3056-1

Project: Sopley Primary School	**Title:** Photograph of Noise Monitor		24Acoustics
DWG No: Figure 2	**Scale:** N.T.S.	**Rev:** A	
Date: 27-10-09	**Drawn By:** SG	**Job No:** 3056-1	

Project: Sopley Primary School	**Title:** Photograph of Weather Station	24Acoustics
DWG No: Figure 3	**Scale:** N.T.S.	**Rev:** A
Date: 27-10-09	**Drawn By:** SG	**Job No:** 3056-1

Figure 4

Measured Background Noise Level and Windspeed 12th - 22nd October 2009

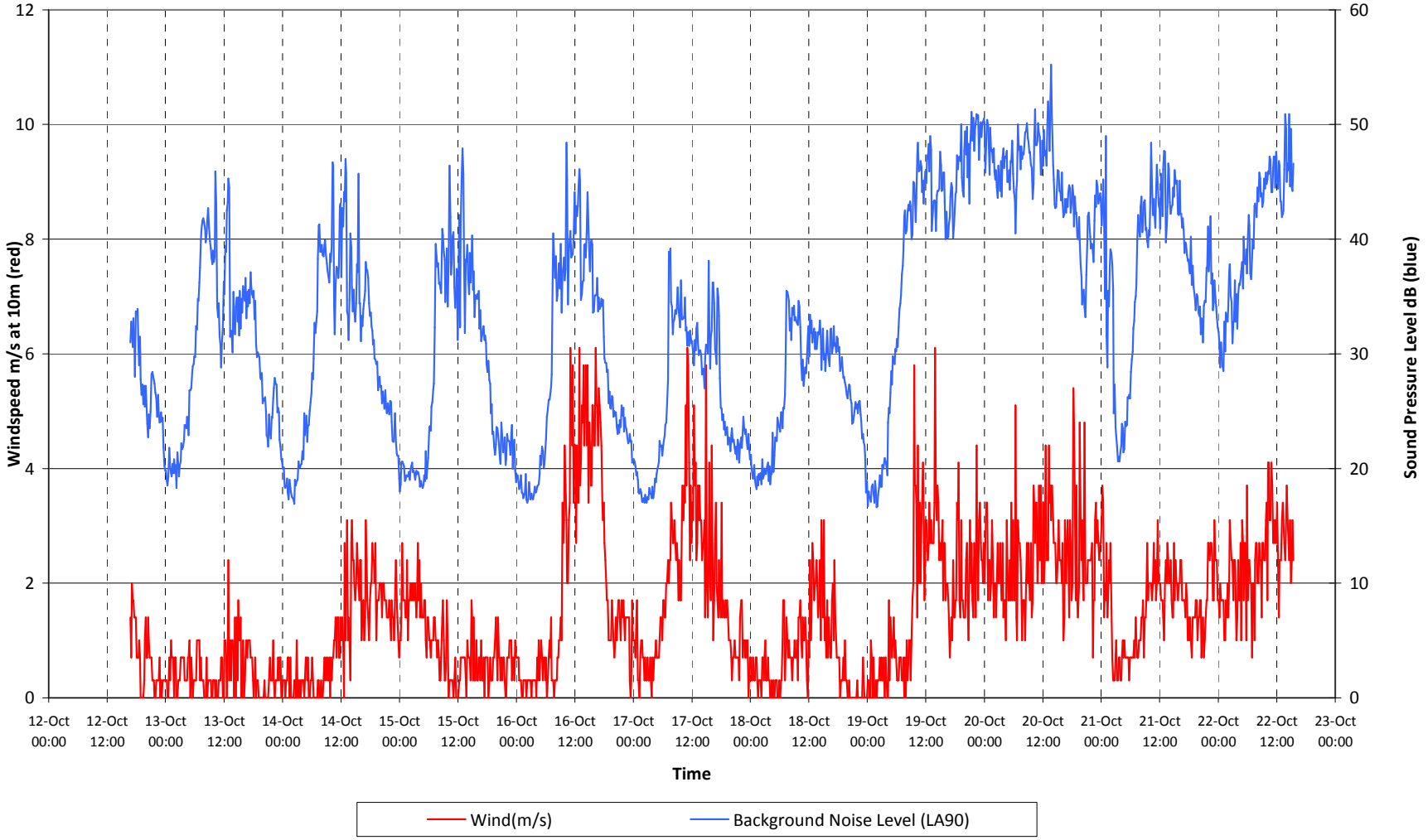
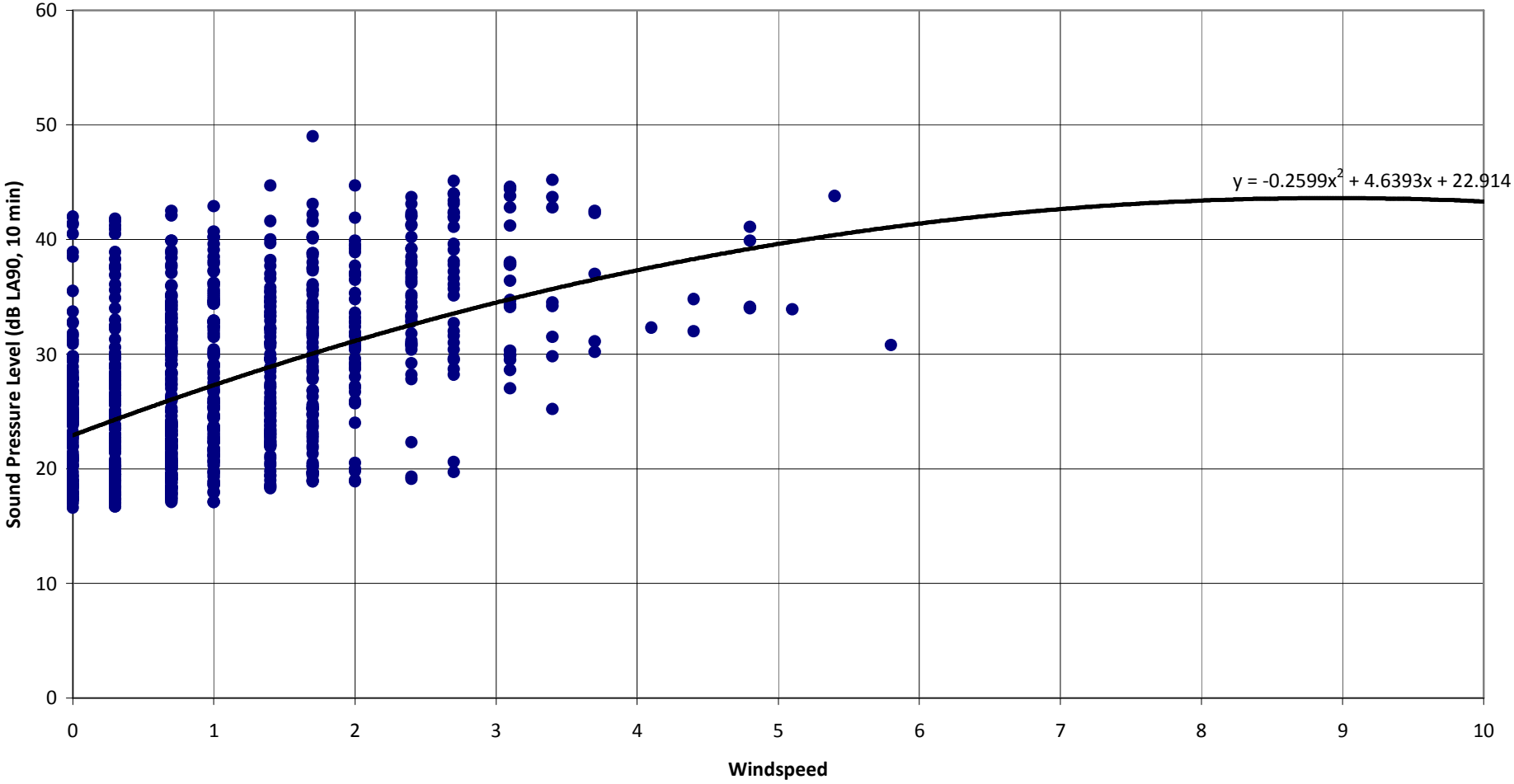
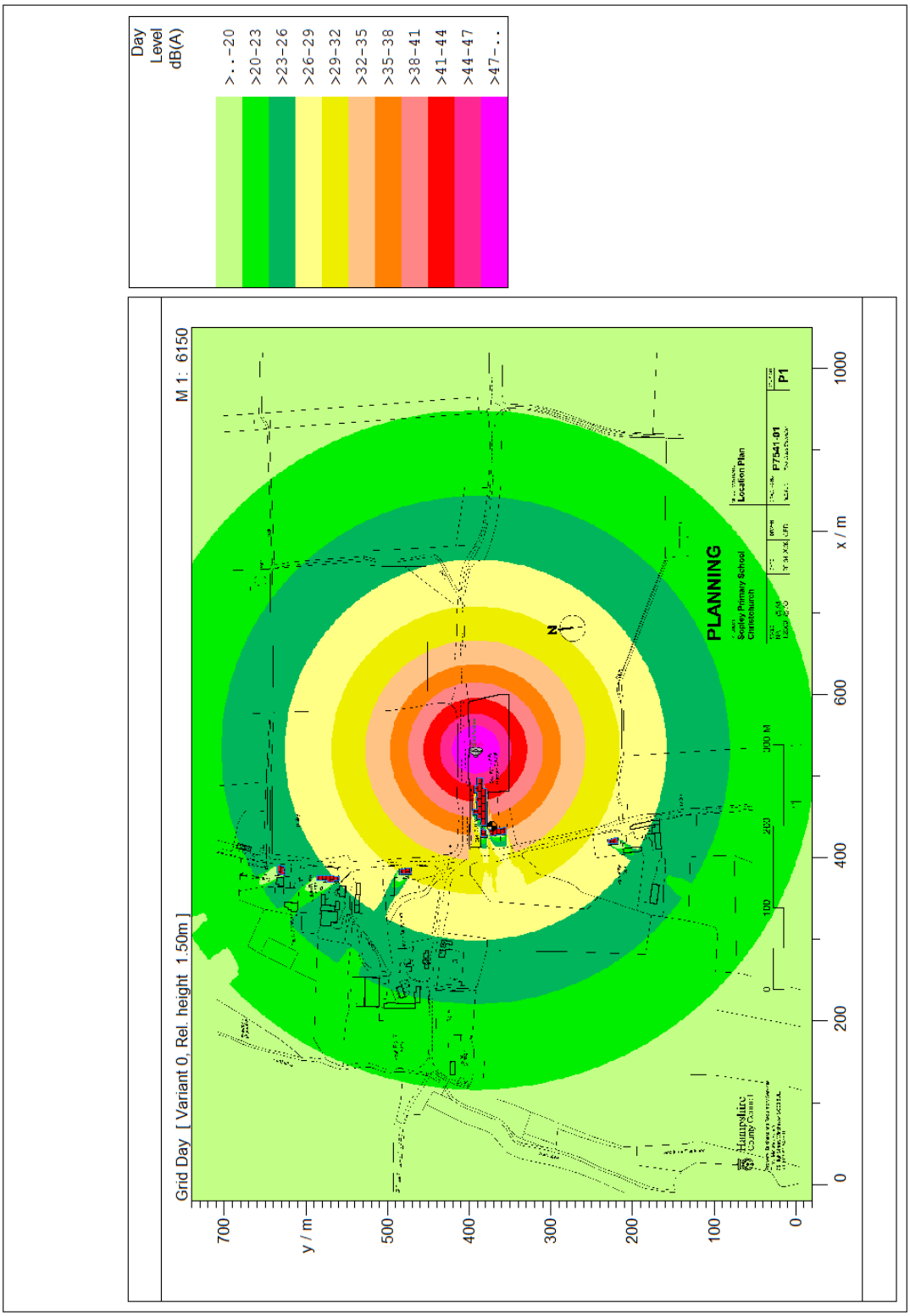


Figure 5
Background Noise Level vs Windspeed (Extraneous Sources Excluded)

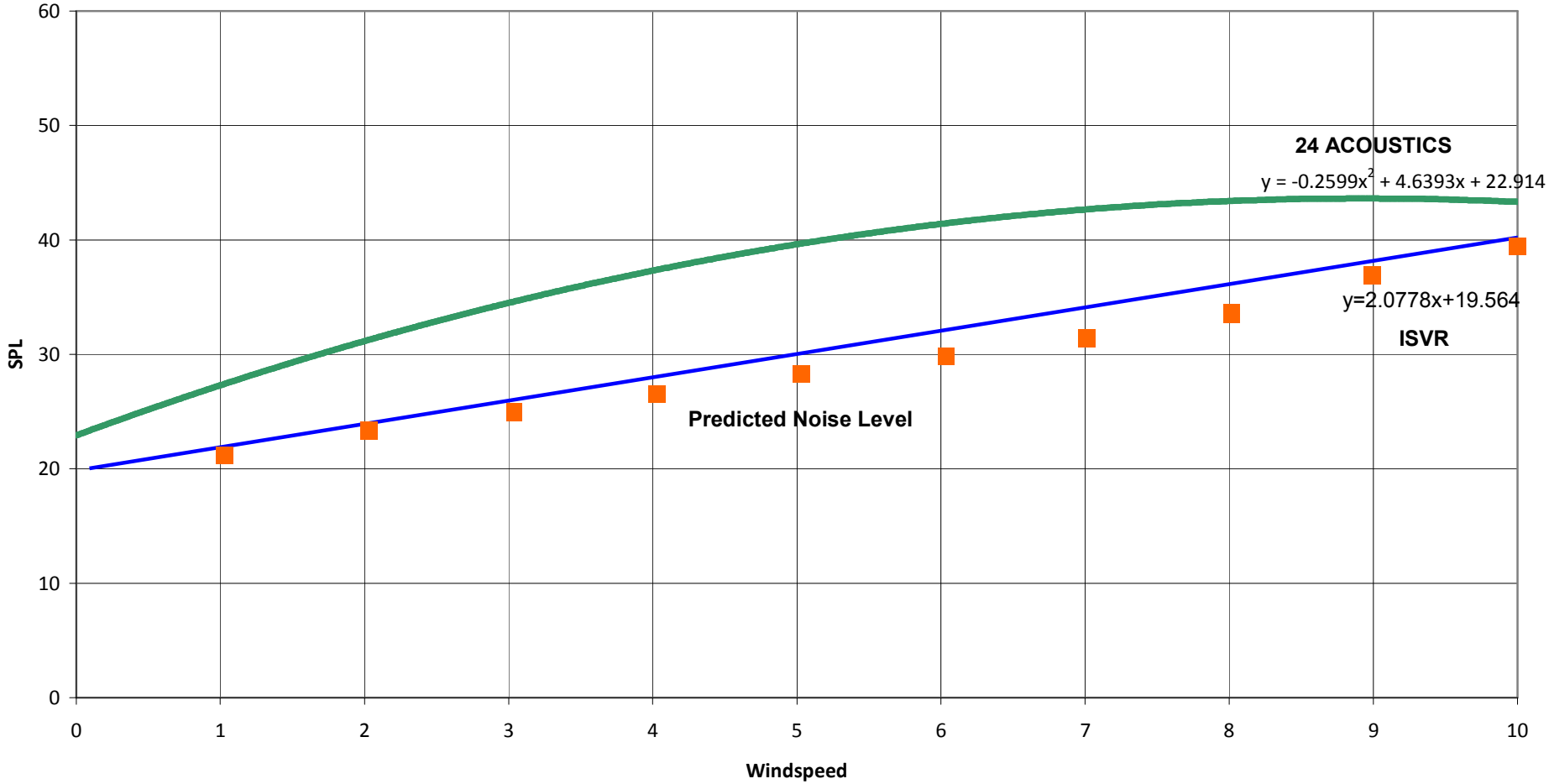




Project: Sopley Primary School	**Title:** Noise Model Output		24Acoustics
DWG No: Figure 6	**Scale:** N.T.S.	**Rev:** A	
Date: 27-10-09	**Drawn By:** SG	**Job No:** 3056-1	

Figure 7

Background Noise Level vs Windspeed (Comparison Between 24 Acoustics Ltd and ISVR Data)



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APPENDIX A: ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. The range of audible sound is from 0 to 140 dB. The frequency response of the ear is usually taken to be around 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in important by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dB(A) weighting. This is an internationally accepted standard for noise measurements.

For variable sources, such as traffic, a difference of 3 dB(A) is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dB(A). The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/ decrease of 10 dB(A) corresponds to a doubling/ halving in perceived loudness.

External noise levels are rarely steady, but rise and fall according to activities within an area. In attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

i) The L_{Amax} noise level

This is the maximum noise level recorded over the measurement period.

ii) The L_{Aeq} noise level

This is "equivalent continuous A-weighted sound pressure level, in decibels" and is defined in British Standard BS 7445 [1] as the " value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time internal, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".

It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. In more straightforward terms, it is a measure of energy within the varying noise.

iii) The L_{A10} noise level

This is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.

iv) The L_{A90} noise level

This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during the quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.