

APPENDIX G:

INDEPENDENT PEER REVIEW – NOISE ASSESSMENT

CRUDINE RIDGE WIND FARM NOISE IMPACT ASSESSMENT - PEER REVIEW

TG266-01F02 (REV 0) CRUDINE RIDGE WIND FARM PEER REVIEW

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Prepared for:

NSW Department of Planning and Infrastructure

GPO Box 39

SYDNEY NSW 2001

Attention: Ms Anna Timbrell



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1 INTRODUCTION

Renzo Tonin & Associates was engaged by the Department of Planning & Infrastructure ("**Department**") to conduct a specialist, independent audit of the Crudine Ridge Wind Farm Noise Impact Assessment prepared by Sonus Pty Ltd reference dated October 2012 ("**Sonus Report**") annexed to the Environmental Assessment dated December 2012 ("**EIS**").

Crudine Ridge is located approximately 45km south of Mudgee and 45km north of Bathurst in the State of New South Wales.

1.1 Objectives and Scope of Work

The objective of the study is to conduct an independent peer review of the Sonus Report. The review is to be undertaken by reference to the Director General's Requirements relating to operational noise and construction noise and vibration dated 17th March 2011 ("**DGR**").

A secondary requirement is to conduct a review of a report prepared by The Acoustic Group Pty Ltd "Peer Review of Environmental Noise Assessment Crudine Ridge Wind Farm" dated 27th March 2013 but only those sections directly relating to the subject wind farm ("**TAG Report**").

The scope of works includes the following:

- a) Review the above mentioned reports;
- b) Conduct a limited supplementary noise monitoring program, analyse the data in accordance with the requirements stipulated in the DGR and compare with the analysis in the Sonus Report; and,
- c) Comment on the adequacy of the information provided in the Sonus Report.

1.2 Conflict of Interest

The company Renzo Tonin & Associates (NSW) Pty Ltd and the authors of this report declare they have no actual, perceived, potential, pecuniary or non-pecuniary interest in the wind farm proponent or any of its associated companies or employees or the Department of Planning & Infrastructure or any member of staff of the Department which give rise to, or could be seen as giving rise to, a conflict of interest in relation to performing the scope of works defined above in an impartial manner and in the public interest.

1.3 Relevant Quality Standards

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

Appendix A contains a glossary of some of the technical terms used in this report.

2 DESCRIPTION OF THE SITE AND SURROUNDING RESIDENTIAL DWELLINGS

The proposed development at Crudine Ridge wind farm comprises one of two possible configurations:

1. Planning Layout A: 106 Acciona AW77 Turbines; or
2. Planning Layout B: 77 Siemens SWT2.3-101 Turbines.

The wind turbines are proposed to be located on the Crudine ridgeline (which rises approximately 100m above the surrounding landscape on the western side and 2-300m on the eastern side). The distance between the northern-most and southern-most turbines is approximately 26km and the total installed generating capacity is approximately 135MW.

The proposed wind turbines will have a hub height of between 80 and 110m above ground level¹ and a rotor diameter of between 77 and 101m. We note, however, that the calculations in the Sonus Report adopt an 80m hub height. The following table shows relevant details for each turbine type:

Table 1 Turbine Technical Data

Turbine Model	MW	Hub Height m *	Rotor Dia m	Cut-in Speed m/sec	Rated Speed m/sec	Cut-out Speed m/sec
Acciona AW77/1500	1.5	60-80	77	3.5	11.1	25
Siemens SWT-2.3-101	2.3	80	101	3-4	12-13	25

**As quoted in the technical brochure, however, height varies according to customer requirements*

Figures 1 and 2 show the physical location of each turbine for each respective layout configuration and the location of the three meteorological masts currently installed on the site. Detailed easting and northing co-ordinates are shown in Appendix A of the Sonus Report.

¹ 3.3.2 Environmental Assessment Vol 1, Dec 2012

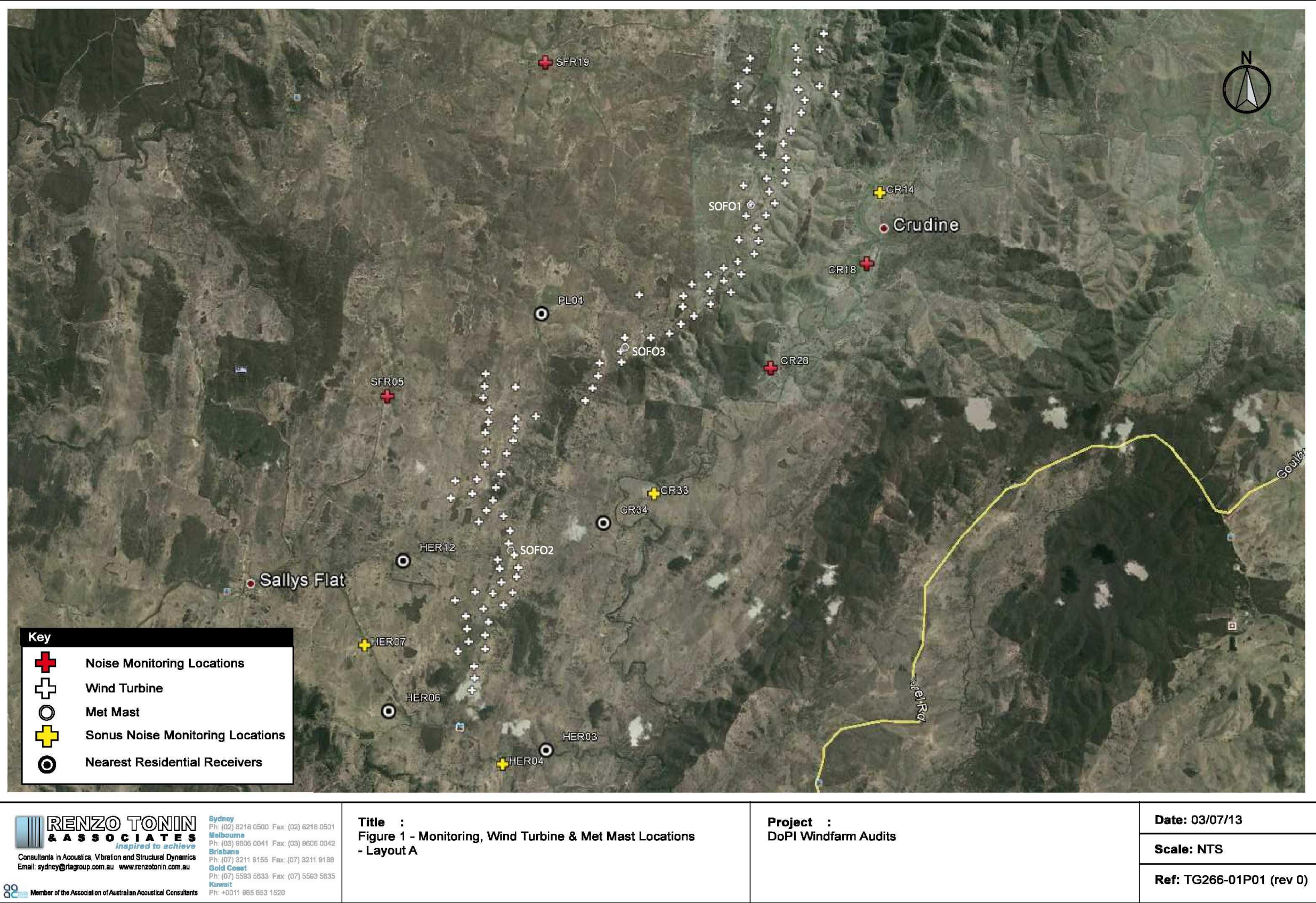


Figure 1 Monitoring, Wind Turbine & Met Mast Locations - Layout A

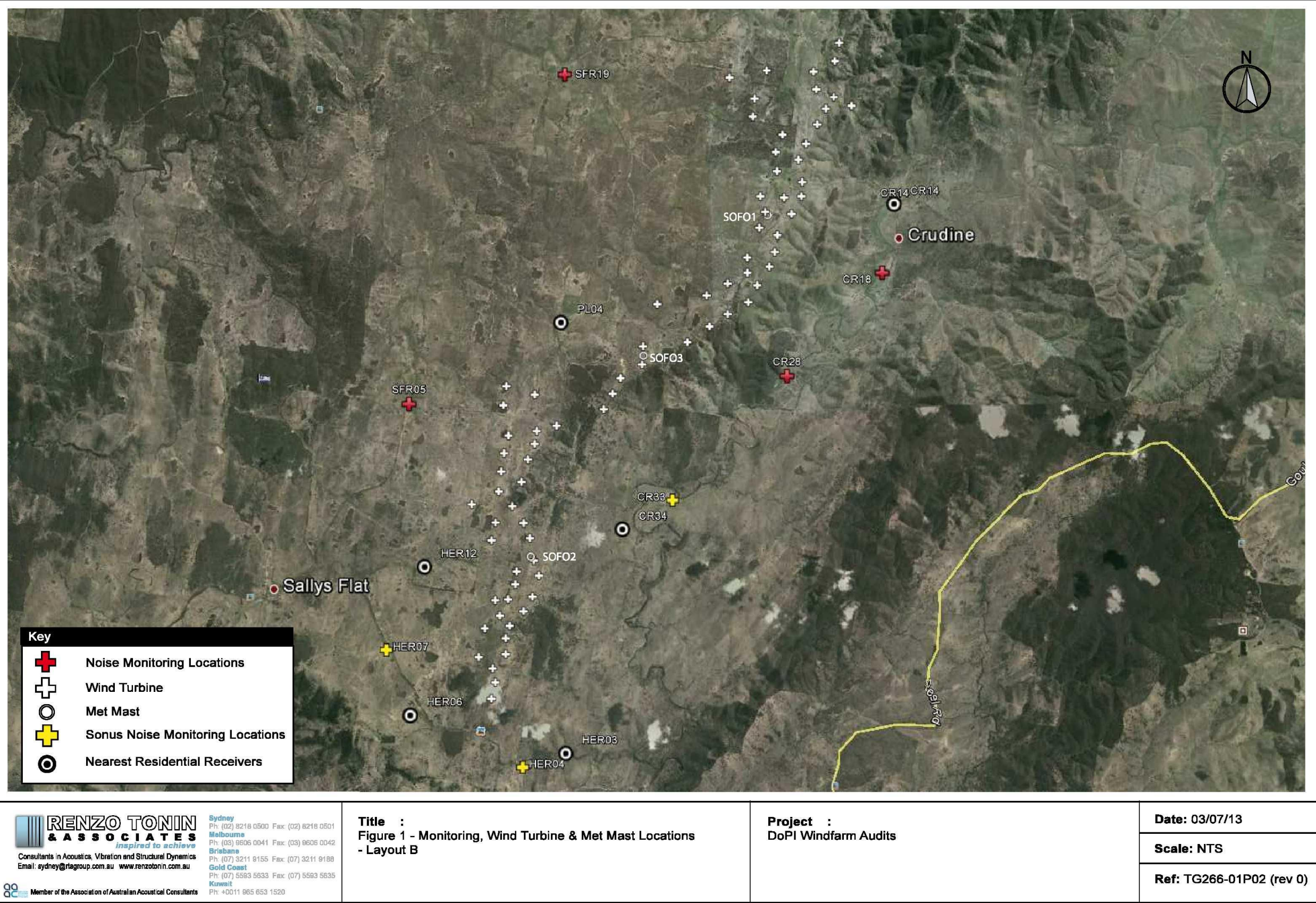


Figure 2 Monitoring, Wind Turbine & Met Mast Locations - Layout B

The following properties were selected for detailed noise monitoring in the Sonus Report (as shown in Figures 1 and 2 above).

Table 2 Monitoring Locations in Sonus Report

Residence ID	Property Name	Associated with Wind Farm	Nearest turbine ID	Distance to nearest turbine (m)
Planning Layout A – 106WTGs				
CR14	Athlone	Yes	A24	2053
CR18	Glen Daire	No	A34	2428
CR28	Willow Downs	No	A43	1993
CR33	Trelawney	No	A58	2452
HER04	Round Hill	No	A106	1719
HER07	Clare Hills	Yes	A102	1994
SFR05	Kotara	Yes	A62	2083
Planning Layout B – 77 WTGs				
CR14	Athlone	Yes	B19	2046
CR18	Glen Daire	No	B26	2423
CR28	Willow Downs	No	B33	1981
CR33	Trelawney	No	B42	2448
HER04	Round Hill	No	B77	1656
HER07	Clare Hills	Yes	B74	1990
SFR05	Kotara	Yes	B45	2085

Ideally, one would undertake noise monitoring at residences which are closest to wind turbines, especially those not associated with the proposal. However, it is stated in the Sonus Report that approval for access was not given by some residents and therefore substitute locations were chosen.

The following table is a list of the nearest residential dwellings (shown in Figures 1 and 2 above) which are within 2km (or just over 2km) of the nearest turbine.² In this table, the dwellings selected for noise monitoring in the Sonus Report are shown shaded.

² Source Sonus Report Appendix B

Table 3 Distance of Residential Dwellings to Nearest Turbine (m)

Residence ID	Associated with Wind Farm	Selected for Noise Monitoring	Nearest turbine ID	Distance to nearest turbine (m)
Planning Layout A – 106WTGs				
HER12	Yes	No	A92	1367
PL04	Yes	No	A55	1612
HER04	No	Yes	A106	1719
HER06	Yes	No	A106	1764
CR34	No	No	A83	1992
CR28	No	Yes	A43	1993
HER07	Yes	Yes	A102	1994
HER03	No	No	A106	2040
Planning Layout B – 77 WTGs				
HER12	Yes	No	B59	1522
PL04	Yes	No	B44	1654
HER04	No	Yes	B77	1656
HER06	Yes	No	B77	1735
CR28	No	Yes	B33	1981
HER07	Yes	Yes	B74	1990
CR34	No	No	B60	1996
HER03	No	No	B77	2005
CR14	Yes	Yes	B19	2046

An objective of the current study is to undertake supplementary measurements to check the analysis in the Sonus Report. The initial locations chosen were CR16, CR34, HER04 and SFR05 at which the highest noise levels above background were predicted. However, for various reasons (including refusal by property owners), those locations did not eventuate and instead the following locations were selected. Note that in respect of SFR19, we were directed by the Department to monitor at this location following a request by the owner.

Table 4 Resident Locations for Supplementary Measurements

Residence ID	Property Name	Associated with Wind Farm	Nearest turbine ID	Distance to nearest turbine (m)
Planning Layout A – 106WTGs				
SFR19	Woodlands	No	A9	4086
SFR05	147 Sally's Flat Road	Yes	A62	2083
CR28	Willow Downs	No	A43	1993
CR18	Gleindaire	No	A34	2428
Planning Layout B – 77 WTGs				
SFR19	Woodlands	No	B5	3546
SFR05	147 Sally's Flat Road	Yes	B45	2085
CR28	Willow Downs	No	B33	1981
CR18	Gleindaire	No	B26	2423

3 DIRECTOR-GENERAL'S REQUIREMENTS

The DGR requires the following in respect of noise impacts (for ease of reference, each clause is numbered accordingly):

Noise Impacts - the EA must:

1. *include a comprehensive noise assessment of all phases and components of the project including:*
 - 1.1 *turbine operation,*
 - 1.2 *the operation of the electrical substation,*
 - 1.3 *corona and / or aeolian noise from the transmission line,*
 - 1.4 *construction noise (focusing on high noise-generating construction scenarios and works outside of standard construction hours),*
 - 1.5 *traffic noise during construction and operation,*
 - 1.6 *and vibration generating activities (including blasting) during construction and / or operation.*
 - 1.7 *The assessment must identify noise / vibration sensitive locations (including approved but not yet developed dwellings),*
 - 1.8 *baseline conditions based on monitoring results,*
 - 1.9 *the levels and character of noise (eg. tonality, impulsiveness, low frequency etc.) generated by noise sources,*
 - 1.10 *noise / vibration criteria,*
 - 1.11 *modelling assumptions and*
 - 1.12 *worst case and representative noise / vibration impacts;*
2. *in relation to wind turbine operation,*
 - 2.1 *determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power),*
 - 2.2 *including impacts under meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines). The probability of such occurrences must be quantified;*
3. *include monitoring to ensure that there is adequate wind speed / profile data and ambient background noise data that is representative for all sensitive receptors;*
4. *provide justification for the nominated average background noise level used in the assessment process, considering any significant difference between daytime and night time background noise levels at background noise levels higher than 30 dB(A);*

5. *identify any risks with respect to tonal, low frequency or infra-noise (sic);*
6. *clearly outline the noise mitigation, monitoring and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been incorporated;*
7. *if any noise agreements with residents are proposed for areas where noise criteria cannot be met, provide sufficient information to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements; and*
8. *include a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and / or noise agreements with landowners not eventuate.*
9. *The assessment must be undertaken consistent with the following guidelines:*
 - i) *Wind Turbines - the South Australian Environment Protection Authority's Wind Farms - Environmental Noise Guidelines (2003);*
 - ii) *Substation – NSW Industrial Noise Policy (EPA, 2000);*
 - iii) *Site Establishment and Construction – Interim Construction Noise Guidelines (DECC, 2009);*
 - iv) *Traffic Noise – Environmental Criteria for Road Traffic Noise (NSW EPA, 1999); and*
 - v) *Vibration – Assessing Vibration: A Technical Guideline (DECC, 2006).*

Pertinently, operational noise emission from wind turbines is to be assessed in accordance with the South Australian Environment Protection Authority's - Environmental Noise Guidelines: Wind Farms (2003) ("**SA Guidelines**").

In addition, in respect of traffic noise impacts, the NSW Government approved the NSW Environment Protection Authority's Road Noise Policy ("**RNP**"), to replace the Environmental Criteria for Road Traffic Noise ("**ECRTN**") with effect from 1 July 2011. As the DGR were issued prior to that date, the Department should have been consulted to seek guidance on which document should be used. Whilst we understand there is no Departmental policy in respect of this issue and each case would be treated on its merits, given that both the ECRTN and RNP are NSW Government policy documents, in our opinion the more current policy document is likely to prevail.

4 REVIEW OF SONUS REPORT

We now turn to a review of the Sonus Report in responding to the DGR. The DGR are referred to in terms of the numbering established in the preceding section.

4.1 DGR 1.1 Noise Assessment of Turbine Operation

The Sonus Report presents a detailed assessment of operational noise levels from the wind turbines. It commences with a description of the measurement of background noise levels at representative receiver sites (as previously discussed), derivation of a mean regression line of the background noise levels referenced to a 10m high wind speed at the wind farm site, establishing the noise criteria in accordance with the SA Guidelines, a calculation of the expected operational noise levels using the prediction method ISO9613, comparison of those predicted noise levels with the criteria and a discussion of mitigation measures where those criteria area exceeded.

As stated in the Sonus Report, 10m high wind speeds were extrapolated from other measurement heights as permitted in the SA Guidelines. Table 3 of the Sonus Report provides details as to which mast data was used in the regression analysis. The Sonus Report does not provide details on the extrapolation formula used.

The measurement methodology as described in the Sonus Report complies with Section 3.1 and 3.2 of the SA Guidelines subject to the following further information being provided:

- i) We are instructed the noise logger at CR18 was moved by the property owner as it was in his way. This is not addressed in the report but in response to a query to Sonus on this issue, the following explanation was received:

The noise logger at CR18 was placed at a location considered to represent the background noise at the façade of the house. That is, it was placed an equal distance from trees that the house is from trees. On return to the property to collect the logger, it was found that it had been moved. A photograph of the location on placement and collection was included in the report.

The location where the logger was found on collection was further from trees and close to the façade of the shed, which blocked line of sight to the closest trees. As the increased distance and the blocking of line of sight was likely to reduce background noise levels, the data were used as a conservative approach.

In accordance with Page 6 of the SA Guidelines, the microphone should be located at least 5m from any reflecting surface and within 20m of the residence. The photograph in the Sonus Report shows the microphone is located about 1m from the shed façade and presumably the precise time at which the logger was moved is unknown.

Furthermore, the statement that the logger was placed "an equal distance from trees that the house is from trees" is not a requirement of the SA Guidelines.

However, as CR18 is a supplementary measurement point in this report the validity of the background noise levels can be reassessed.

- ii) Prior to 7 August 2011 wind data from mast SOF1 was used instead of SOF2 because SOF2 was not yet commissioned. There is no correlation analysis between SOF1 and SOF2 to demonstrate that use of SOF1 data would not result in any appreciable difference in the regression analysis. This analysis should be provided;
- iii) The use of 90mm microphone windshields to reduce wind noise at the microphone is not substantiated as required on Page 7 of the SA Guidelines. According to our review of current literature, the use of 7inch (178mm) microphone windshields is required as a minimum. If the development is approved, we recommend that background noise levels should be re-measured;
- iv) There is no information provided confirming that the background noise data covers the range of wind speeds and directions generally expected at the wind farm site as required on Page 8 of the SA Guidelines. This analysis should be provided.

Noise predictions are made using the ISO9613 prediction model which is standard practice. According to the Sonus Report, the following input parameters were used:

- warranted sound power levels;
- 10°C temperature;
- 70% relative humidity;
- 50% acoustically hard ground and 50% acoustically soft ground;
- barrier attenuation of no greater than 2 dB(A); and,
- 4m receiver height.

These parameters are in accord with current recommended good practice ³ except for the following:

- i) 80m Hub Height: As referred to earlier, there is a discrepancy between the hub height used in the calculations and the hub height referred to in the EIS. However, as the final turbine models have not been selected at this time, we recommend that any conditions of approval require the proponent to prepare a revised noise assessment incorporating the final turbine model and hub heights selected for the project;
- ii) Warranted Sound Power Levels: The term “warranted sound power levels” is not adequately defined in the Sonus Report and could take on a range of meanings. If the term means that a margin of uncertainty (normally 1-2dB) is included in the warranty then the use of the warranted sound power levels is appropriate, otherwise in accordance with recommended good practice, 2dB should be added;⁴
- iii) Propagation Across Ridge Line: Noise propagation across the Crudine Ridge to residential receivers to the east of the turbines requires special consideration. ISO9613

³ Good Practice Guide for Wind Turbine Noise IOA May 2013

⁴ Section 4.3.6 *Ibid*

has been shown to under-predict noise levels in situations where the propagation is across a valley or a ridge-line.^{5 6} In such circumstances, where a ground factor of 0.5 has been used, a further correction factor of +3dB should be added to the calculated overall A-weighted noise level. Alternatively, if a ground factor of 0 were to be used, then +1dB should be added. We recommend that noise levels should be recalculated in accordance with this best practice directive.

Finally, in presenting the results of calculations in Appendices G and H of the Sonus Report, the difference between the predicted noise level and the criterion is not at all clear to the reader. We recommend that a table of differences should be provided as well as graphs for the key receivers at which background noise levels were taken, showing together on each graph (dB vs wind speed) the background regression line, the noise criterion and the predicted noise level. A qualitative discussion should then follow after each graph explaining in layperson terms the expected audibility of turbines at each location. This approach is taken in this report.

4.2 DGR 1.2 Noise Assessment of Electrical Substation

A main collector substation and a secondary collector station are proposed at one of the alternative locations shown on Page 40 of the Sonus Report. A noise assessment of the electrical substations was undertaken according to the NSW EPA Industrial Noise Policy ("INP"). As stated in the Sonus Report, as the RBL for residential receivers is less than 30dB(A) then a value of 30dB(A) is adopted in accordance with the INP. The applicable intrusiveness criterion is therefore 35dB LAeq(15min) and the applicable amenity criterion is 40dB LAeq(period) for the night-time. The intrusiveness criterion of 35dB LAeq(15min) therefore is the more stringent.

It is assumed in the Sonus Report that a 5dB modifying factor is applicable for tonality (Section 4 of the INP) which results in an adjusted intrusiveness criterion of (35-5=)30dB LAeq(15min).

The sound power levels adopted in Table 11 of the Sonus Report are based on AS/NZS 60076.10:2009 and are reasonable.

The nearest residential dwellings are located more than 3km from the substations and the conclusion that the resulting noise levels are insignificant is reasonable.

4.3 DGR 1.3 Noise Assessment of Corona and/or Aeolian Noise from the Transmission Line

There is no assessment in the Sonus Report in respect of corona and aeolian noise from the transmission line and we recommend this should be rectified.

⁵ Section 4.3.9-4.3.11 Ibid

⁶ Evans & Cooper. Comparison of Predicted and Measured Wind Farm Noise Levels and Implications for Assessments of New Wind Farms. AA 28(40)(1) 2012

4.4 DGR 1.4 Construction Noise Assessment

The NSW EPA's Interim Construction Noise Guideline 2009 ("**ICNG**") is adopted for assessment of construction noise as required in the DGR. The ICNG management levels are correctly stated in Table 5 and it is assumed that the minimum RBL of 30dB(A) applies.

The minimum distance between any non-associated residential dwelling and any turbine construction site is 1.65km. The predicted noise levels at this distance are shown in Table 11 of the Sonus Report.

Some construction activities during the excavation and foundation stage are predicted to exceed the "noise affected" management level of RBL+10 which triggers the requirement for feasible and reasonable noise mitigation measures to be adopted as discussed in the Sonus Report.

The Sonus Report states that there will be no work conducted outside of the standard ICNG hours other than inaudible activities and tending to emergencies.

The preparation of a Construction Management Plan is regarded as an appropriate method for dealing with any noise impacting activities in accordance with the ICNG and an appropriate condition should be drafted if the development is approved.

4.5 DGR 1.5 Construction & Operational Traffic Noise Assessment

The issue of construction traffic is dealt with on Page 39 of the Sonus Report. As previously stated, the ECRTN is used to assess traffic noise on local roads, however, the RNP should have been used in our opinion. Regardless, the noise criteria limits for traffic generating development on local roads is numerically the same.

According to the EIS, construction will occur over an 18 month period. The Sonus Report concludes that noise from 20 passenger vehicle movements and 6 heavy vehicle movements in an hour will comply with the selected noise criterion of 55dB LAeq(1hr) at a dwelling that is situated 20m from the roadside.

In the event the level of 55dB LAeq(1hr) is exceeded, reasonable and feasible measures should be applied such as those listed on page 40 of the Sonus Report. Those requirements will need to be documented in the Construction Management Plan.

However, the number of vehicle movements adopted is inconsistent with Table 12.1 of the EIS which shows 20-40 passenger vehicle movements and 5-22 heavy vehicle movements in an hour. Therefore, a worst case scenario is not considered despite the assertions made on Page 9 of Volume 1 of the EIS which quotes a totally different rate of 10 passenger vehicle movements and 3 heavy vehicle movements an hour.

In addition, the use of what appears to be a nominal value of 20m for the distance separation between dwellings and the local road (10m in the EIS) is not substantiated nor is there any

discussion about the route those vehicles will take and the varied distances of dwellings from the road along the way.

We recommend a more detailed assessment of construction traffic noise impacts should be provided.

4.6 DGR 1.6 Construction & Operational Vibration Impact Assessment

The criteria adopted in respect of vibration from the construction and operation of the subject development is the NSW EPA publication *Assessing Vibration: A Technical Guideline* (DECC, 2006) ("**Vibration Guideline**").

The criteria stated in Table 6 of the Sonus Report does not properly describe the criteria in the Vibration Guideline in that the lower values of the ranges in Table 6 are the preferred values and the higher values are the maximum values. There is a reference in the EPA document describing how to approach the preferred and maximum values. In addition, there are different limits for the x and y axes. We recommend that in the Construction Management Plan, the relevant limits should be faithfully copied from the EPA document and that the proper descriptions as noted above should be provided.

We note that in section 9.2.5 of the EIS Volume 1 blasting may be required. On page 9 of the EIS Volume 1 it states that "*blasting impact and vibration levels have been assessed*" when in fact they have not. The relevant criterion for blasting recommended in the Vibration Guideline is the Australian and New Zealand Environment and Conservation Council document *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (ANZECC 1990).

We recommend that either a clear statement is made that no blasting will occur or a noise and vibration assessment provided.

4.7 DGR 1.7 Identification of Sensitive Locations

The identification and selection of sensitive receiver locations can be found on pages 9-10 of the Sonus Report and in Section 2 above and in our opinion is suitable and complies with the DGR.

4.8 DGR 1.8 Identification of Baseline Conditions

A description of the measurement and determination of the baseline conditions can be found on pages 9-12 of the Sonus Report and, subject to the observations and recommendations made in Section 4.1 of this report, in our opinion are suitable and compliant with the DGR.

4.9 DGR 1.9 Levels and Character of Noise

Page 23 of the Sonus Report provides a commitment that a guarantee will be sought from the manufacturer that the turbines will not exhibit tonal characteristics.

In respect of modulation (including impulsive noise effects), low frequency noise and infrasound these are discussed on pages 28-32 of the Sonus Report which in our opinion is a suitable treatment of these issues and compliant with the DGR.

4.10 DGR 1.10 Noise and Vibration Criteria

With the exception of comments made in Section 4.6 above, noise and vibration criteria are adequately considered in the Sonus Report and compliant with the DGR.

4.11 DGR 1.11 Modelling Assumptions

Modelling assumptions were discussed in Section 4.1 above.

4.12 DGR 1.12 Worst Case and Representative Noise & Vibration Impacts

We refer to the comments made in Sections 4.1 and 4.5 above which recommends further information be provided.

4.13 DGR 2.1 Determine Operational Wind Turbine Noise Impacts from Cut-in to Rated Power

We refer to the comments made in Section 4.1 above which recommends further information be provided.

4.14 DGR 2.2 Determine Operational Wind Turbine Noise Impacts that Exacerbate Impacts.

The predictions in the Sonus Report are made using the algorithm ISO9613 which is applicable to enhanced noise propagation, either for wind speeds of 1-5m/sec measured at height of 3-11m above ground or for propagation under a well-developed moderate ground-based temperature inversion such as commonly occurs on clear, calm nights.

In respect of wind speeds greater than 5m/sec in a direction from source to receiver, the sound level will be greater than that predicted by ISO9613 but so too will be the criterion level to be met as exemplified in the steady increase in background levels with wind speed in Table 4 of the Sonus Report.

As previously stated, provided the modelling assumptions stated in Section 4.1 are adopted, ISO9613 provides a conservative estimate of sound levels from wind farms.

The van den Berg effect is discussed on page 29 of the Sonus Report and it is noted that a specific assessment of meteorological conditions at the Crudine Ridge site with respect to the van den Berg effect has not been made.

Whilst there is no universally accepted method for assessing the probability of the van den Berg effect, an analysis of the propensity for high shear winds, for which it is postulated that the

effect occurs, should be made.⁷ This information would be available from the on-site meteorological masts. The incidence of F and G atmospheric stability classes is also required which would need to be provided by a meteorological expert.

We therefore recommend that an assessment should be made of meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines) and that the probability of such occurrences must be quantified as required by the DGR.

4.15 DGR 3. Adequate Monitoring Data to Represent all Sensitive Receptors

In our opinion, the ambient monitoring data provided in the Sonus Report is sufficiently robust and representative of all sensitive receptors subject to the additional information recommended in Section 4.1 being provided.

4.16 DGR 4. Day-time and Night-time Differences in Background Noise Levels

Day-time and night-time background regression data is provided in Tables 7 and 8 of the Sonus Report. However, these are referenced to 10m AGL and should instead be referenced to hub-height as required in the *Draft NSW Planning Guidelines Wind Farms* Dec 2011.

We recommend that Tables 7 and 8, Appendix F and Appendix H should be updated.

4.17 DGR 5. Risks of Tonal, Low Frequency or Infrasound Noise

This was discussed in Sections 4.9 and 4.14 above.

4.18 DGR 6. Noise Mitigation, Monitoring and Management Measures

A contingency strategy is discussed on Page 33 of the Sonus Report. The information provided is sparse and in our opinion should be supplemented with further information in order to provide clarity as required in the DGR:

- i) What are the operating modes referred to which will produce lower noise levels and what noise benefits will they produce;
- ii) What is the monitoring regime proposed to ensure those measures can be quickly adopted;
- iii) What management measures are proposed to mitigate non-compliance noise levels; and,
- iv) What factors are to be included in the Operational Noise Management Plan.

We recommend this further information should be provided in order to comply with the DGR.

⁷ Tonin. Sources of wind turbine noise and sound propagation. AA 40(1) 2012

4.19 DGR 7. Agreements with Associated Property Owners

The external noise criteria proposed in page 9 of the Sonus Report for associated receivers is a base level of 45dB(A).

A level of 45dB(A) is predicated upon an acceptable internal noise level of 30dB LAeq in the WHO Guidelines and a 15dB attenuation through an open window.⁸

In Australia, it is common to use an attenuation value of 10dB for open windows.⁹ Australia is a more temperate climate compared with European nations and it would therefore be expected that windows may be opened to a greater extent producing a lower noise reduction value. We therefore recommend an acceptable external base noise level for associated receivers of 40dB(A) rather than 45dB(A).

There would appear to be no associated receivers at which the use of a base level of 40dB(A) would cause the predicted noise level to exceed the applicable criterion.

4.20 DGR 8. Contingency Strategy for Additional Noise Attenuation

This is discussed in Section 4.18 above.

4.21 Summary of Compliance with DGR

We conclude in respect of the Sonus Report provided to the Department, that further information should be provided in order to comply with the DGR.

⁸ Pages xiii and Table 4.1 Guidelines for Community Noise WHO April 1999

⁹ Section 2.2.1 INP

5 REVIEW OF TAG REPORT

The TAG Report was commissioned by the Crudine Ridge Environment Protection Group to respond to the Sonus Report. In the TAG Report, there is commentary which conflicts with the DGR or is unrelated to the proposal. Our instructions are to review the sections of the TAG Report which relate to the proposal.

5.1 1.0 Introduction

In this section, the use of the SA Guidelines and the criteria contained there-in are expressed as a concern having *"no bearing on the actual acoustic environment of the area"*. This commentary conflicts with the DGR and is therefore ignored.

5.2 2.0 Qualifications of Reviewer

The author is a member of the Australian Acoustical Society and the Institution of Engineers Australia and is therefore an *"eligible acoustic engineer"* as defined on Page 10 of the SA Guidelines.

There are a number of assertions which are not substantiated and therefore ignored such as:

My testing identified the possibility that noise originating from the wind farm could affect individuals and that further testing/investigations were required.

There is also an assertion that the authors of the Sonus Report, in producing a document which is stated to be of a *"generic"* nature, may be breaching the code of ethics of the Australian Acoustical Society. Those comments are unfounded and are ignored.

5.3 3.0 The Sonus Assessment Report – General Observations

5.3.1 Noise Limits for Associated Receivers ¹⁰

In respect of the derivation of an acceptable external noise level for associated receivers (those properties that have commercial agreements with the proponent), the TAG Report is critical of the conversion of the acceptable internal noise levels quoted in the WHO Guidelines to an acceptable outdoor noise level.

As discussed in Section 4.19 above, we agree with the TAG Report and have recommended an acceptable external base noise level for associated receivers of 40dB(A) rather than 45dB(A).

5.3.2 Location of noise loggers ¹¹

The SA Guidelines clearly state the microphone should be at least 5m from any reflecting surface and *"in general"* within 20m of a house and in the direction of the wind farm.

¹⁰ Page 9 TAG Report

¹¹ *Ibid*

The statement in the Sonus Report on Page 10 that the microphone should be located in accordance with the SA Guidelines "*an equivalent distance from the façade of the dwelling as any significant trees*" is incorrect.

However, reference to the photographs in Appendix D of the Sonus Report shows that, as far as we are able to determine and with the exception of CR18 previously discussed, the microphone locations are in accordance with the SA Guidelines.

5.3.3 No of data points ¹²

The TAG Report questions missing data. I defer this to Sonus, however, I would presume that the missing data relates to wind speeds that are below the turbine cut-in speed or above a wind speed of 5m/sec at the microphone height or times of rain.

5.3.4 Location of equipment ¹³

This issue involves the relocation by the resident of the noise logger at CR18 which has been answered in Section 4.1 above.

5.3.5 RBL less than 30dB(A) set to 30dB(A) ¹⁴

The TAG Report refers to the use of a "nominal" level of 30dB(A) used in the Sonus Report as the RBL in circumstances when the actual background is below 30dB(A). This is exactly what is contemplated in the NSW INP at Section 3.1.2:

Rating background level (RBL)—the overall single figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). The rating background level is the level used for assessment purposes. Where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A).

This is a recurring issue in the TAG Report. Whilst not specifically stated in the INP, we understand the reason why the background is not set below 30dB(A) is that an intrusive noise at a very low level is unlikely to annoy notwithstanding that it is more than 5dB above the background noise level. For example, we note that in the current British Standard BS4142:1997 "*Method for rating industrial noise affecting mixed residential and industrial uses*" in which the same methodology is used to rate the intrusiveness of a noise by reference to its level above the background:

Scope

This British Standard describes methods for determining, at the outside of a building:

¹² *Ibid*

¹³ *Ibid*

¹⁴ Page 10 *ibid*

a) noise levels from factories, or industrial premises, or fixed installations, or sources of an industrial nature in commercial premises; and

b) background noise level.

The standard also describes a method for assessing whether the noise referred to in (a) is likely to give rise to complaints from people residing in the building. The method is not suitable for assessing the noise measured inside buildings or when the background and rating noise levels are both very low.

NOTE. For the purposes of this standard, background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low.

Therefore, the recurring argument in the TAG Report that an intruding noise level of less than 35dB(A) in a very low background noise level less than 30dB(A) can generate an adverse level of community reaction is not supported by either the INP or BS4142.

5.3.6 RNP supersedes ECRTN ¹⁵

As stated in Section 3 above, we agree that the RNP should have been referenced instead of the ECRTN. However, the numeric goals are the same.

5.3.7 Construction traffic on local roads ¹⁶

The TAG Report states in relation to the ECRTN that "the EPA policy in relation to traffic is related to the operational component not the construction component". This is incorrect.

Section 1.2 of the ICNG states as follows:

Examples of noise that is not covered by the Guideline are:

...

noise from public roads and construction traffic on public roads – this is assessed under the Environmental Criteria for Road Traffic Noise (EPA 1999) (currently under review).

5.3.8 Sleep disturbance ¹⁷

I refer to the statement at the bottom of Page 29 in the Sonus Report:

... the noise standards applied by the SA Guidelines to wind farms are significantly more onerous than limits established for the potential onset of sleep disturbance.

I understand this to mean that a base level of 35dB(A) outdoors equates to a level of 25dB(A) indoors with windows open which is lower than the 30dB LAeq values recommended in the WHO Guidelines.

¹⁵ Ibid

¹⁶ Page 11 *ibid*

¹⁷ Ibid

The NSW EPA's sleep disturbance policy relates to transient noise which rises above the background by more than 15dB. The policy does not relate to steady state noise or quasi-steady state noise such as from a wind farm.

I refer to the following comment in the TAG Report:

Communities in proximity to wind farms in South Australia, Victoria and New South Wales would dispute the above claim made by Sonus as apparently wind farms complying with the Guidelines continue to create sleep disturbance.

This statement is an inappropriate one for an expert to make because it advocates the views of another party. An expert should have regard to facts and to draw conclusions from those facts having regard to the expert's knowledge. There is no scientific evidence provided in the TAG Report of a nexus between noise emitted from wind farms designed to meet the criteria in the SA Guidelines and sleep disturbance.

5.3.9 Low Frequency Noise ¹⁸

The TAG Report states that a wind turbine noise spectrum at the residential receivers has not been presented. However, this is not a requirement of the SA Guidelines nor is there a requirement to present noise spectra in the DGR.

5.3.10 Infrasound tactile vibrations ¹⁹

The TAG Report states that there are technical errors on Page 31 of the Sonus Report without stating what they are and we therefore are unable to comment.

The following statement

It would appear both by research and response from communities that members of the public respond to infrasound levels well below what is being nominated as the threshold of hearing for those frequencies.

is not supported by any evidence. As previously stated, an expert should have regard to facts and to draw conclusions from those facts having regard to the expert's knowledge.

5.3.11 100-fold difference in loudness ²⁰

The Sonus Report at page 32 states that a level of 85dB(G) is 25dB below the perception threshold and that a difference of 25dB represents at least a 100-fold difference in energy content. The TAG Report states that this cannot be considered to be the same as a 100-fold difference in the loudness which is a correct statement however, that is not what the Sonus Report states.

¹⁸ Page 12 *ibid*

¹⁹ *Ibid*

²⁰ *Ibid*

5.3.12 Exceedence of ICNG management level ²¹

The TAG Report states that construction noise is predicted to be greater than 40dB(A) but the Sonus Report has failed to identify the acoustic environment of the area, that a level exceeding 40dB(A) is significantly greater than the background level and the report has failed to identify the community response to that excessive noise. As a consequence, the extent of acoustic screens or noise controls provided for construction would have to be greater than that indicated in the Sonus Report.

This statement is illogical and does not follow the procedures in the ICNG. The Sonus Report has assumed the RBL to be below 30dB(A) and therefore, in accordance with the INP, it is taken as 30dB(A). The "noise affected" level is therefore (30+10=)40dB(A). Where that level is exceeded, the proponent is required to apply all feasible and reasonable work practices to meet the noise affected level. This is the procedure explained and adopted in the Sonus Report and is consistent with the ICNG.

5.3.13 Noise impacts under conditions that exacerbate impacts ²²

The TAG Report states that the probability of noise impacts under meteorological conditions that exacerbates those impacts has not been addressed in the Sonus Report as required by the DGR. We agree and refer to our comments in Section 4.14 above.

5.3.14 Tonality, Low Frequency and infrasound not assessed ²³

The TAG Report states that the requirements of the DGR to "identify any risk with respect to tonal, low frequency or infra-noise (sic)" has not been addressed. We agree and refer our comments in Sections 4.9 and 4.14 above.

5.3.15 Section 3.2 Analysis - Impacts not addressed ²⁴

The TAG Report states that whilst noise levels have been predicted in the Sonus Report, the resultant impacts of those noise levels has not been addressed in a way that the community can understand. It refers to the failure of the report to describe how the operation of the proposed wind farm will affect the daily activities and night-time sleeping patterns of nearby residents. It refers to complaints from those residing near other wind farms.

In our opinion, the Sonus Report has discussed the audibility of the wind farm at Pages 28-32. The relevant acoustic standard to be met is established by the DGR as the SA Guidelines. The Sonus Report states at page 30:

At a distance from a wind farm, in an ambient environment where wind in the trees is present, it is therefore possible that only low frequencies remain audible and detectable, albeit at very low levels.

²¹ Ibid

²² Page 13 *ibid*

²³ Ibid

²⁴ Ibid

In other words, there is a clear indication to a lay person reading the text that noise from the wind farm will be audible on some occasions but that the sound will be at a very low level.

The fact that the emitted noise level may exceed a very low level of background but yet still be compliant with the SA Guidelines was discussed in Section 5.3.5 above. The issue of sleep disturbance was discussed in Section 5.3.8 above.

We agree with the TAG Report that there should be a better explanation of wind turbine noise audibility and have made a recommendation in Section 4.1 above.

5.3.16 Noise levels inside residences ²⁵

The TAG Report states that there is no material provided in respect of noise levels inside residences. We note there is no requirement in the DGR to provide this information.

5.3.17 Regression analysis does not continue below cut-in speed ²⁶

The TAG Report claims that there is a failure in the Sonus Report because it does not continue the regression analysis below the cut-in speed of the turbines.

We note in the SA Guidelines:

Data that has been collected at the extreme ends of the range of wind speeds (below and above the operating wind speeds of the WTG) can influence the slope of the fitted regression line and should not be included in the regression analysis.

We also note in the DGR:

2.1 determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power),

Therefore, there is no failure in the Sonus Report as claimed.

5.3.18 Wind data at microphone height ²⁷

The TAG Report claims that wind data was not measured at the microphone height, however, we note at Page 11 of the Sonus Report a weather station was deployed at HER07 at microphone height. Ideally there should have been three weather stations deployed to encompass the diverse geography of the area but, in principle, the claim in the TAG Report is incorrect.

5.3.19 Average background noise level and lowest ten-percentile background noise level ²⁸

The TAG Report states that in the assessment of industrial noise under the INP, the lowest 10 percentile of the background levels is used to obtain the RBL whereas in the SA Guidelines the

²⁵ Page 14 *ibid*

²⁶ *Ibid*

²⁷ *ibid*

²⁸ *Ibid*

regression line for the background levels is an average. Accordingly, it states, the industrial background level is different to the wind farm background level.

This is a valid statement, however, this wind farm is not assessed to the INP but to the SA Guidelines as specified in the DGR.

5.3.20 Noise floor of instrument ²⁹

The TAG Report states that a substantial number of background levels are below the noise floor of the meter. There are certainly some background levels that are below the noise floor of the meter (typically 16-18dB(A)) however it is not unusual for this to happen in a rural environment. However, as the base noise level specified in the SA Guidelines is 30dB(A), background noise levels less than 16-18dB(A) are unlikely to have an appreciable effect on the regression line.

5.3.21 Extending the regression line below cut-in wind speed ³⁰

The TAG Report is critical of the Sonus Report in not extending the regression curve below the cut-in speed. This issue was discussed in Section 5.3.17 above.

5.3.22 A wind farm noise level of 35dB(A) in a 20dB(A) background is a significant impact ³¹

This issue was discussed in Section 5.3.5 above.

5.3.23 Relevance of predicted noise levels ³²

The TAG Report states that

... it would be appropriate for the report to discuss the relevance of the predicted noise levels versus the regression curve and/or the minimum background levels that relate to the various wind speeds.

This was discussed in Section 5.3.15 above.

5.3.24 Worst case sound scenario for sound propagation ³³

The TAG Report states that the Sonus Report does not appear to identify the variation in noise levels for worst-case sound propagation, for example, when the turbines are operating and there is no wind at the residence.

This situation is most likely to occur at night in a stable atmosphere, that is, when there is a strong wind gradient with height and probably a temperature inversion. These conditions are inherent in the ISO9613 modelling as discussed in Section 4.14 above.

²⁹ Page 15 *ibid*

³⁰ *Ibid*

³¹ *Ibid*

³² *Ibid*

³³ *Ibid*

Noise monitoring was performed in the months of July and August which we would expect to result in cold nights conducive to the formation of temperature inversions and the conditions referred to in the TAG Report.

As discussed in Section 4.14 above, there is no information provided in the Sonus Report or in the EIS about the meteorology of the area and we have recommended there-in that further information be provided.

5.3.25 Adverse meteorological effects ³⁴

The TAG Report states that:

- i) there is no relationship provided of wind speed at hub height versus wind speed at receiver locations;
- ii) there is no correlation of the predicted noise levels under the wind scenarios that have been assessed;
- iii) there is no identification of effect of different wind directions;
- iv) there is no indication of frequency of temperature inversions and van den Berg effect;
- v) the result is that the wind farm will be clearly audible for a certain percentage of the time; and,
- vi) there must be some tolerance in the predictions which could alter the predicted noise levels.

In respect of item (i), the SA Guidelines do not require a correlation between the wind speed at hub height and the wind speed at receiver locations. The SA Guidelines correlate the wind speed at 10m height with the background noise level at the receiver locations. The predicted noise level at the receiver can then be correlated with the background noise level at the receiver under the relevant wind conditions. This is the methodology required by the DGR. The methodology proposed in the TAG Report is inconsistent with that requirement.

If item (ii) is meant to imply that there is no correlation between the predicted noise levels at the receiver locations with wind speed at the receiver locations, then that is correct. That is not the methodology adopted in the SA Guidelines.

In respect of items (iii) and (iv) we agree and have addressed this in Section 4.14 above.

In respect of item (v) and (vi) we note that ISO9613 predictions are conservative provided appropriate input parameters are used as discussed in Section 4.1 above and we refer to our recommendations made there-in.

5.3.26 3.3 Presentation of other material by Sonus ³⁵

The following two pertinent issues are raised in the TAG Report:

³⁴ Page 16 *ibid*

³⁵ Page 18 *ibid*

- i) An assumption by Sonus that the wind farm will not exhibit modulation or tonality and that little weight should be given to manufacturers guarantees; and,
- ii) The basis as to why this wind farm will not result in widespread complaints when others do.

In respect of (i), our review of the technical literature supports the proposition that the incidence of modulation is small.³⁶ In respect of tonality, and despite manufacturers guarantees, if turbines are found to be tonal then they should be the subject of the contingency strategy discussed in Section 4.18 above.

In respect of item (ii), this is an advocate's statement and not one for an expert to make. As previously stated, an expert should have regard to facts and to draw conclusions from those facts having regard to the expert's knowledge.

5.3.27 4.0 EPA Guidelines & Noise Impacts³⁷

This section of the TAG Report includes a critique of the SA Guidelines which does not directly relate to the proposed wind farm and is therefore beyond our scope of work. There are some comments in this section relating to the Sonus Report, however, these repeat the issues asserted in the sections above and have therefore been dealt with.

Also addressed are a discussion and review of the base criterion of 35dB(A) for rural areas, human wellbeing and amenity, low frequency noise impacts, sleep disturbance, annoyance, the US Shirley Wind Farm study and internal noise levels none of which require a response in respect of our scope of work.

5.3.28 5.0 Wind Farm Testing – Waterloo and Hallett³⁸

This section of the TAG Report is a discussion about experiences at Waterloo and Hallett which is outside of our scope of work.

5.3.29 6.0 Conclusions and Appendices³⁹

The conclusions and appendices raise no new matters which require addressing.

³⁶ University of Salford UK. Research into aerodynamic modulation of wind turbine noise. NANR233 July 2007.

³⁷ Page 19 *ibid*

³⁸ Page 40 *ibid*

³⁹ Page 41 *ibid*

An independent noise measurement survey was undertaken from **Thursday 6th June to Friday 21st June 2013**. As previously stated, the following residential premises were surveyed:

- SFR19 Woodlands
- SFR05 147 Sally's Flat Road
- CR28 Willow Downs
- CR18 Glendaire

Unattended noise surveys were conducted using RTA Technology type RTA05 and RTA06 noise loggers which incorporate NTi XL2 sound level meters. The loggers are a class 1 instrument having an accuracy suitable for field and laboratory use and incorporate 1/3 Octave band filters and continuous audio recording. The lower limiting frequency of the XL2 is flat to 5Hz and the residual noise floor is 19-21dB(A) depending upon the type of instrument.

The attended noise surveys were conducted using a Bruel & Kjaer Type 2250 sound level meter fitted with a Bruel & Kjaer 4189 microphone and is a class 1 instrument having an accuracy suitable for field and laboratory use. The lower limiting frequency of the Bruel & Kjaer Type 2250 and microphone is 4.2Hz and the residual noise floor is 17dB(A).

The instruments were calibrated prior and subsequent to measurements using a Bruel & Kjaer Type 4231 calibrator. No significant drift in calibration was observed.

All instrumentation complies with AS IEC 61672.1 2004 "Electroacoustics - Sound Level Meters" and carries current NATA certification (or if less than 2 years old, manufacturers certification).

The noise measurement methodology involved deployment of the unattended loggers for a total of two weeks at each residential receiver and in each case located within 20m of the residence in the direction of the proposed wind farm as specified in the SA Guidelines.

Attended surveys were also conducted on collection of the unattended loggers during the survey period. The measurement location was as close as possible to the loggers.

A Davis Vantage Vue weather logger was placed at 147 Sally's Flat Road and a second unit at Willow Downs at a height of approximately 1.8m above ground level. The logger enabled wind speed and direction to be determined at a height just above the standard microphone height of 1.5m. The 147 Sally's Flat Road weather logger wind speed and direction was applied to receiver locations SFR19 and SFR05, and the Willow Downs weather logger wind speed and direction was applied to receiver locations CR28 and CR18.

The unattended noise loggers continuously measured all statistical noise parameters over contiguous intervals of 10 minutes contemporaneously with wind speed and direction recorded by the anemometers installed at the wind farm site. In addition, the loggers recorded 1 second

over-all noise parameters and the 1 second Leq 1/3 octave band Leq spectrum from 5Hz to 20kHz as well as saving a compressed version of the audio file. It is possible using this instrumentation to interrogate any 10 minute period and replay the 1 second 1/3 octave band spectra in real time with synchronised audio.

Concurrent with the noise monitoring, the proponent's three meteorological masts (located as shown in Figure 1 and Figure 2) recorded the 10 minute wind speed and direction at various heights above ground level. Of the three met masts only met mast SOF02 provided 10 minute wind speed at 10m height. For the remaining met masts (SOF01 and SOF03), the 10 minute wind speed at 10m height were determined by using the data from the anemometer on each met mast closest to 10m height.

The 10 minute wind speed at 10m was determined using wind speed data for the highest and lowest anemometer located on the mast as follows:⁴⁰

$$\varepsilon = \left[\frac{\ln(U_{Zhigh}) - \ln(U_{Zlow})}{\ln(Zhigh) - \ln(Zlow)} \right] \quad \dots(1)$$

where,

ε = power law exponent

U_{Zhigh} = wind speed at height $Zhigh$

U_{Zlow} = wind speed at height $Zlow$

and,

$$U_{10} = U_{Zlow} \left[\frac{10}{Zlow} \right]^\varepsilon \quad \dots(2)$$

In respect of wind direction, there is no simple method of determining the wind direction at a height of 10m from a wind vane located at a different height. Therefore, the wind direction at the closest is assumed to apply at 10m. For the met masts SOF01, SOF02 and SOF03, the nearest height of wind vane used were 45.58m, 36.325m and 36m, respectively.

On this basis, the following three figures show the distribution of wind speed and direction for the survey period, obtained for each met mast.

⁴⁰ Sources of Wind Turbine Noise and Sound Propagation. Tonin. Acoustics Australia 40(1) 2012

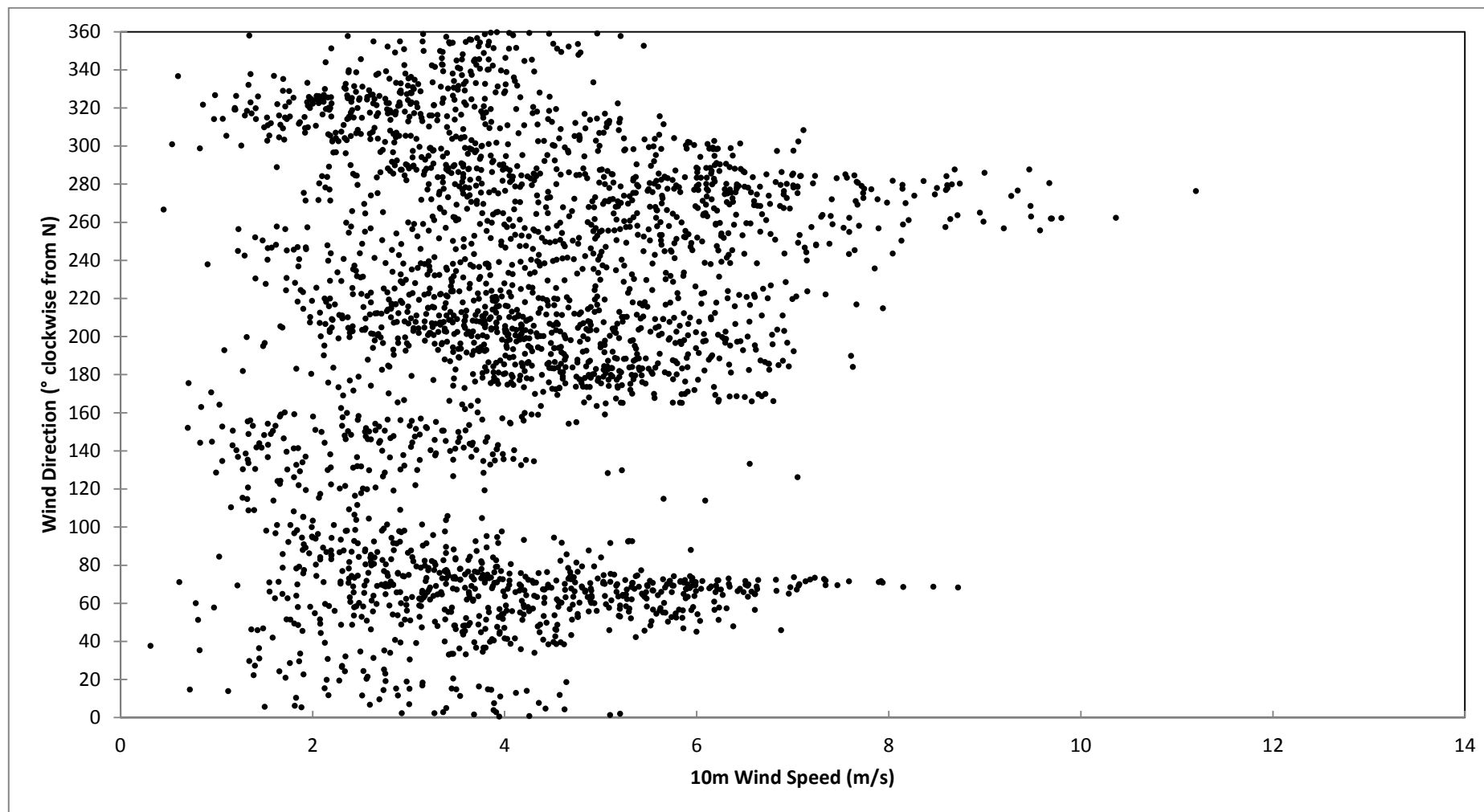


Figure 3 SOF01 Met Mast - 10m Wind Speed and Direction During the Survey Monitoring Period

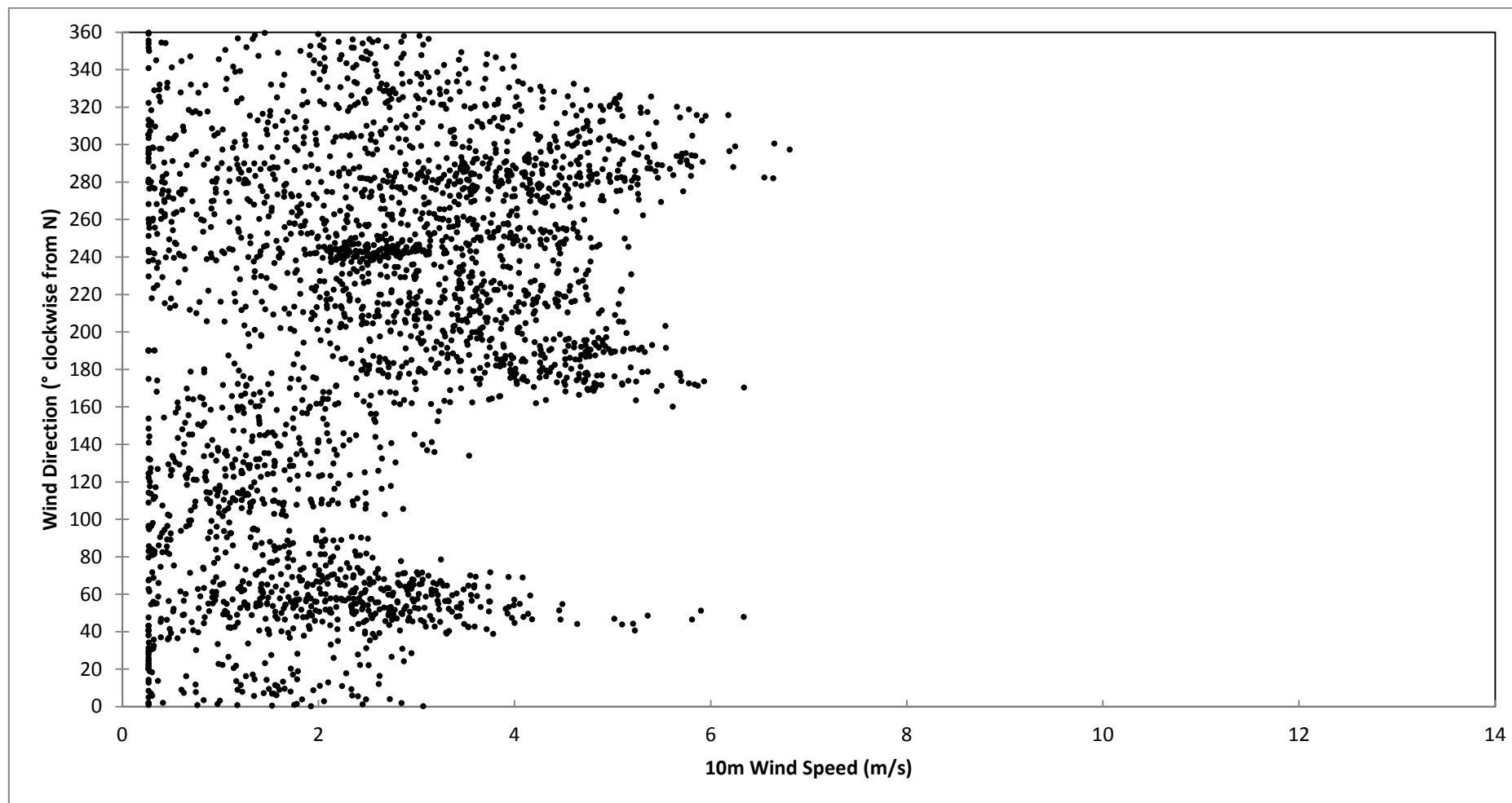


Figure 4 SOF02 Met Mast - 10m Wind Speed and Direction During the Survey Monitoring Period

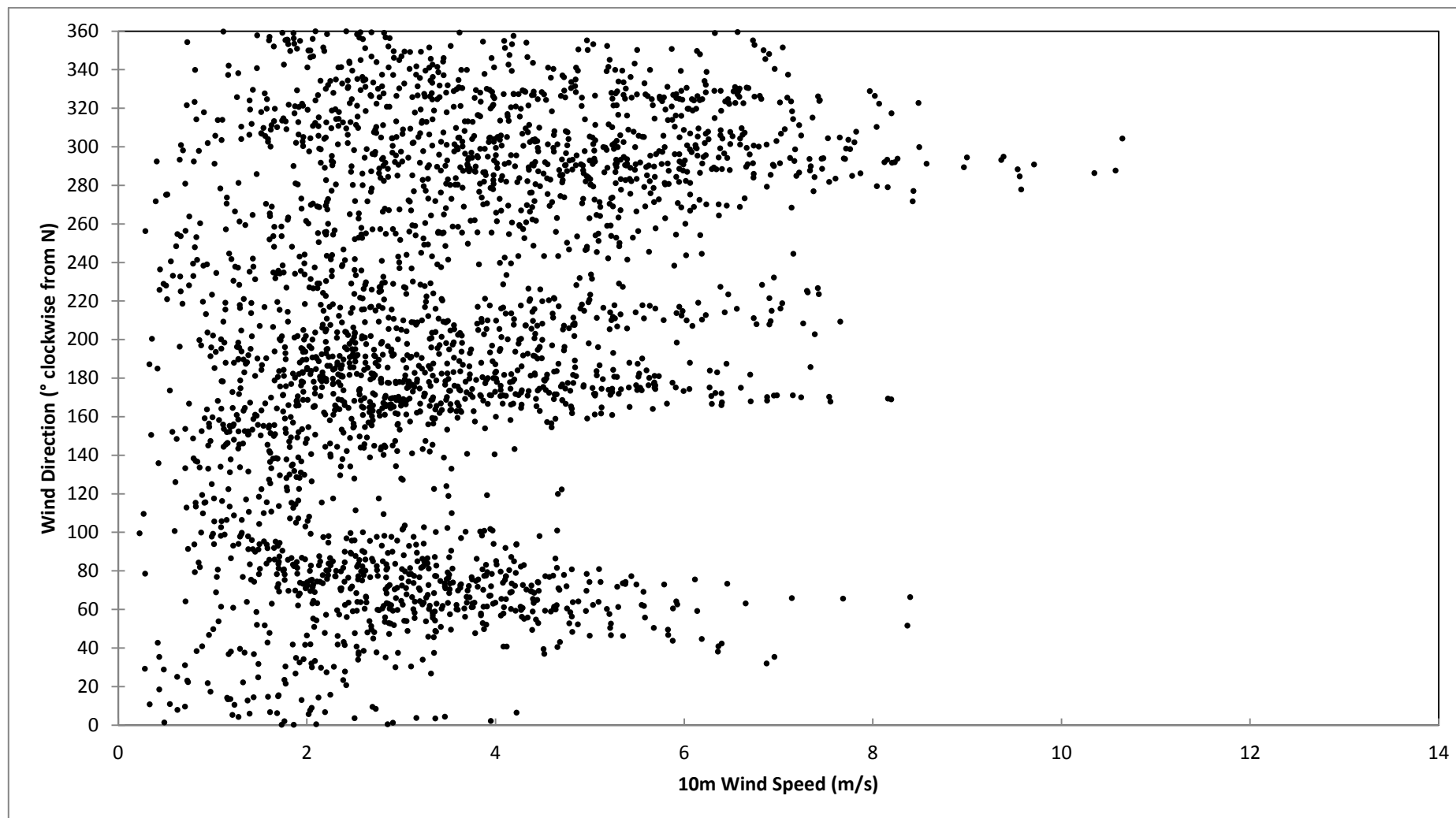


Figure 5 SOF03 Met Mast - 10m Wind Speed and Direction During the Survey Monitoring Period

The three figures show that the wind directions were predominantly W, ENE and S for the higher wind speeds. Low wind speeds below about 5m/s are more evenly distributed across all directions. There is no information provided in the Sonus Report in respect of wind directions which occurred during the Environmental Assessment.

The figures above show that the wind speed conditions during the time of the unattended measurement were generally low which exemplifies the importance of comparing this data with long term meteorological data, as previously stated in this report, to ensure that wind conditions during the time of measurement are typical of that encountered in the long term as required in the SA Guidelines.

For each residential receiver, a regression analysis was undertaken in accordance with the SA Guidelines. Noise samples that exhibited periods of high wind speed at the microphone (greater than 5m/sec at microphone height) or when rain fell were excluded from the sample. These extraneous periods are denoted by grey shading in the graphs in Appendices B-E to be described in the next section.

7 SUPPLEMENTARY MEASUREMENTS – ANALYSIS OF RESULTS

In this section, the detailed results of noise analysis in accordance with the SA Guidelines are reported for each residential receiver in turn.

7.1 SFR19 Woodlands

Woodlands is a non-involved property. The location selected for the noise monitoring is at the side of the property, adjacent to a planter/flower bed, at a distance of 11m from the dwelling in an easterly direction with line of sight to the proposed wind turbine locations. It is noted that this receiver was not one of the monitoring locations in the Sonus Report. Appendix B shows photographs of the measurement location and the unattended monitoring equipment.

7.1.1 Attended Noise Survey

An attended noise survey was conducted between 10:12-10:27am on Friday 21st June 2013 at the monitoring location. One fifteen minute sample was recorded. Wind conditions were still at the measurement location. Intermittent sounds of cows, sheep and other unknown animals dominated the measurement. The following figure shows the variation of sound level with time for the measurement sample.

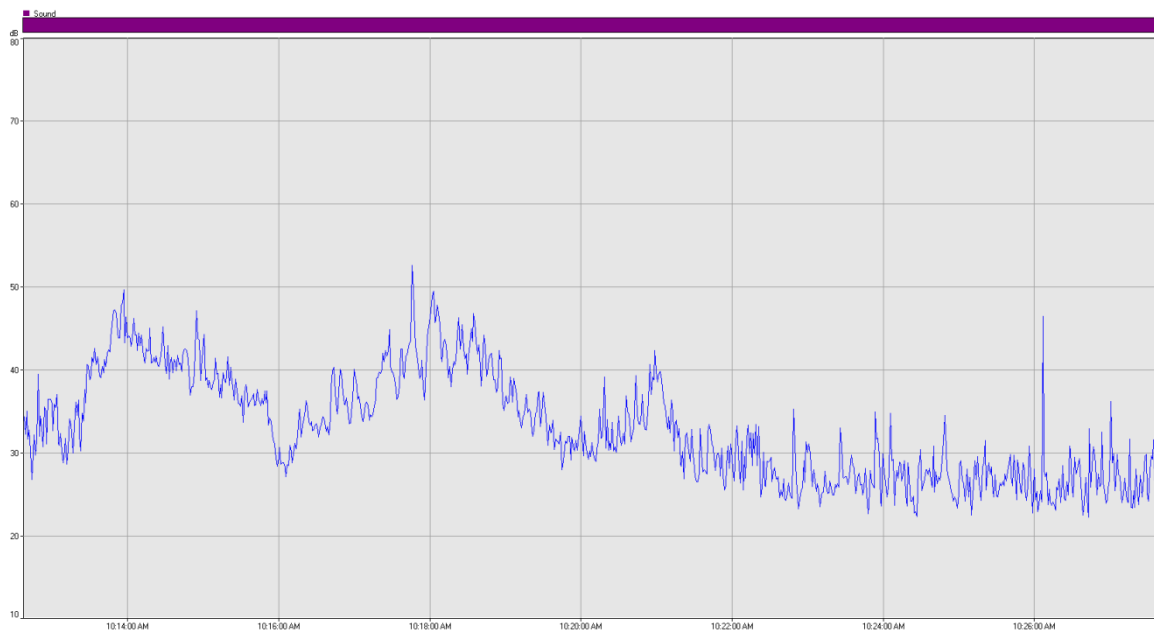


Figure 6 Sample of Sound Trace Recorded at SFR19 Woodlands at 10:12am 21/6/2013

7.1.2 Unattended Noise Survey

We now turn to the results of the unattended noise survey which are contained in Appendix B. The regression analysis is shown in Figure 7 wherein the third order polynomial resulted in the highest correlation coefficient. On the figure is shown the following:

- i) the blue line is the resultant background noise level and wind speed correlation curve;
- ii) the regression formula for the background noise level regression line;
- iii) the black crosses are the LA90(10min) values from the measurement period;

The compliance analysis is shown in Figure 8. On the figure is shown the following:

- i) in solid red, the Sonus Report consent limit;
- ii) in dashed red, the Sonus Report regression line;
- iii) in solid green, the consent limit from this study;
- iv) in dashed green, the regression line from this study;
- v) in solid black, the Sonus Report predicted noise levels from Layout A turbines operating; and,
- vi) in solid grey, the Sonus Report predicted noise levels from Layout B turbines operating.

Table 5 below summarises the data in tabular form:

Table 5 SFR19 Woodlands Compliance Assessment

	10m Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	36.0	38.0	40.5	43.6	47.3	51.9	57.3	63.8	71.3	80.0
Layout A Predicted		21.0	23.0	25.0	27.0	28.0	28.0	28.0	28.0	28.0	28.0			
Layout B Predicted		17.0	17.0	22.0	26.0	28.0	28.0	28.0	28.0	28.0	28.0			
Layout A Predicted – Criteria		-14.0	-12.0	-10.0	-9.0	-10.0	-12.5	-15.6	-19.3	-23.9	-29.3			
Layout B Predicted – Criteria		-18.0	-18.0	-13.0	-10.0	-10.0	-12.5	-15.6	-19.3	-23.9	-29.3			

The last two rows in this table demonstrate compliance with the nominated criteria for both Layout A and B.

It is noted that the Sonus regression values are higher than that measured in this study (except beyond 9m/s wind speeds where the Sonus regression curve cuts off and the curve is extended horizontally as explained in the Sonus Report).

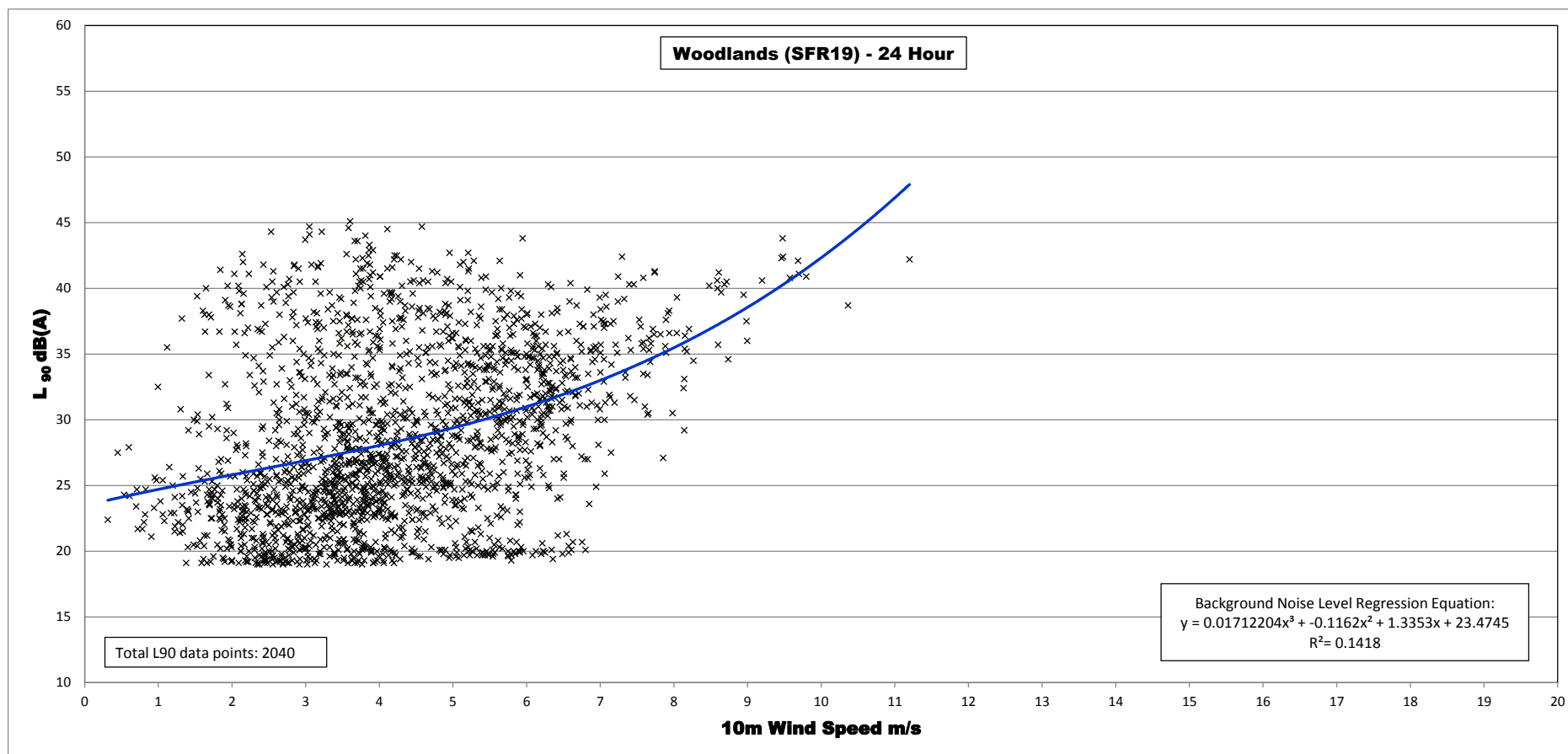


Figure 7 SFR19 Woodlands Regression Analysis

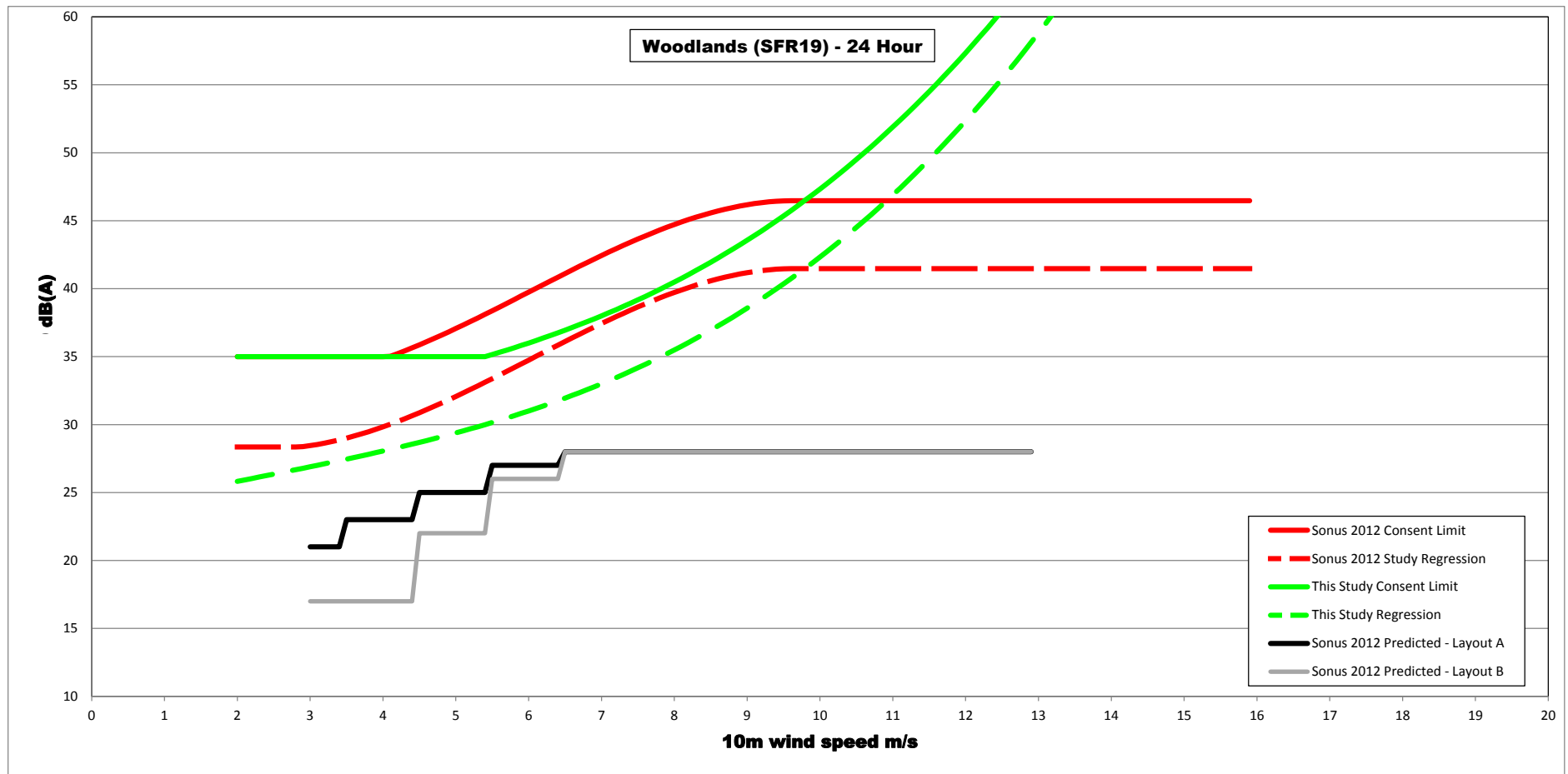


Figure 8 SFR19 Woodlands Compliance Analysis – 24 hour

Under the 2012 NSW Draft Guidelines regression analysis needs to be undertaken separately for daytime (7am to 10pm) and night-time (10pm to 7am), for wind speeds at hub height (80m). Using the same presentation style as Figure 7, the regressions for 24 hour, day and night are presented Figure 9, Figure 10 and Figure 11 respectively.

In addition, data points within the worst case wind direction, meaning a wind direction within 45degrees of an imaginary line drawn between the closest turbine and the receptor, are denoted by a blue circle instead of a black cross. The worst case wind direction presented in the regression analysis are for turbine Layout A. There is negligible difference between the worst case wind direction for Layout A and B, hence regression analysis is only presented for turbine Layout A.

Figure 12 presents a summary of all regression curves generated. Regression curves from the Sonus Report are also presented, adjusting from 10m wind speed to hub height (80m) wind speed using the following method: ⁴¹

$$V_s = V_z \left[\frac{\ln\left(\frac{z_{ref}}{z_{0ref}}\right)}{\ln\left(\frac{z}{z_0}\right)} \right] \quad \dots(3)$$

where, a roughness length of 0.05m is assumed applicable for the area (i.e. farmland with some vegetation).

For $z = 80\text{m}$ and $z_{ref} = 10\text{m}$ and $z_{0ref} = z_0 = 0.05\text{m}$,

$$V_s = V_z \times 0.7181 \quad \dots(4)$$

On the figure is shown the following:

- i) in dashed blue, the Sonus Report 24 hour regression line;
- ii) in dashed green, the Sonus Report Day regression line;
- iii) in dashed red, the Sonus Report Night regression line;
- iv) in solid blue, the 24 hour regression line from this study;
- v) in solid green, the Day regression line from this study; and,
- vi) in solid red, the Night regression line from this study.

At the mid range of wind speed around 8-9m/s it can be seen that the day regression curve is approximately 2dB(A) higher than the 24 hour regression line and the night regression curve is approximately 2dB(A) lower than the 24 hour regression line which is observed to be the general trend in this study.

⁴¹ IEC 61400-11 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques

It can be seen from the figure that for the 24 hour and day regression lines, this study's regression lines are generally lower than Sonus regression lines at lower wind speeds, below 9-10m/s, and generally higher at wind speeds above 9-10m/s. For night time the Sonus regression line is generally higher than this study for all wind speeds.

The predicted noise levels in the Sonus Report are adjusted from 10m wind speed to hub height (80m) wind speed using the formula presented above. A compliance analysis for day and night periods is shown in Figure 13 and Figure 14 respectively. Table 6 and Table 7 below summarises the data in tabular form:

Table 6 SFR19 Woodlands Compliance Assessment - Day

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.4	36.6	37.8	39.3	40.9	42.9	45.2	47.8	50.9	54.4
Layout A Predicted		21.0	21.0	23.0	23.0	25.0	27.0	27.0	28.0	28.0	28.0			
Layout B Predicted		17.0	17.0	17.0	17.0	22.0	26.0	26.0	28.0	28.0	28.0			
Layout A Predicted - Criteria		-14.0	-14.0	-12.0	-12.4	-11.6	-10.8	-12.3	-12.9	-14.9	-17.2			
Layout B Predicted - Criteria		-18.0	-18.0	-18.0	-18.4	-14.6	-11.8	-13.3	-12.9	-14.9	-17.2			

Table 7 SFR19 Woodlands Compliance Assessment - Night

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.3	38.0	40.7	43.5	46.2	48.7	50.8
Layout A Predicted		21.0	21.0	23.0	23.0	25.0	27.0	27.0	28.0	28.0	28.0			
Layout B Predicted		17.0	17.0	17.0	17.0	22.0	26.0	26.0	28.0	28.0	28.0			
Layout A Predicted - Criteria		-14.0	-14.0	-12.0	-12.0	-10.0	-8.0	-8.3	-10.0	-12.7	-15.5			
Layout B Predicted - Criteria		-18.0	-18.0	-18.0	-18.0	-13.0	-9.0	-9.3	-10.0	-12.7	-15.5			

The tables above demonstrate compliance with the nominated criteria for both Layout A and B.

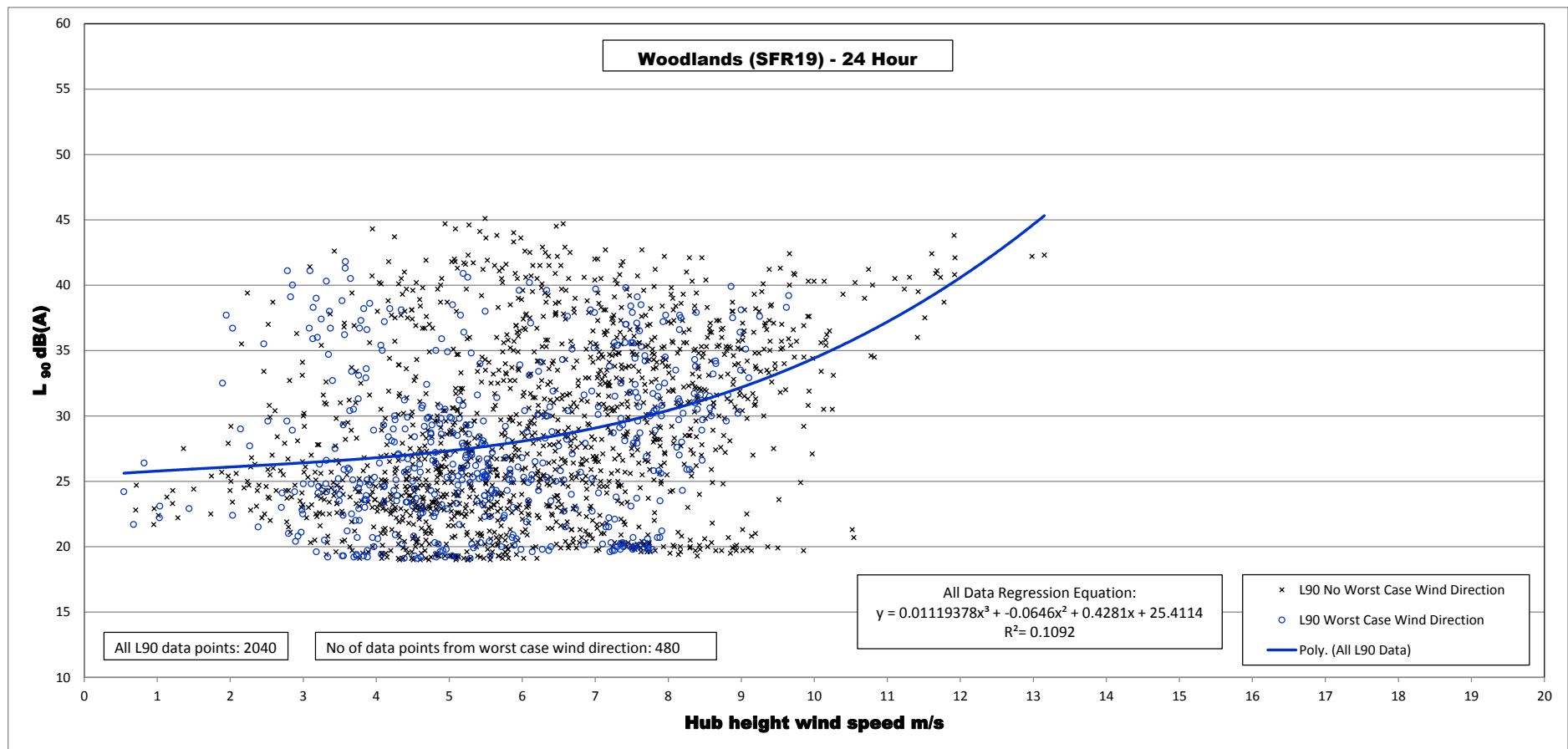


Figure 9 SFR19 Woodlands Regression Analysis – 24 hour

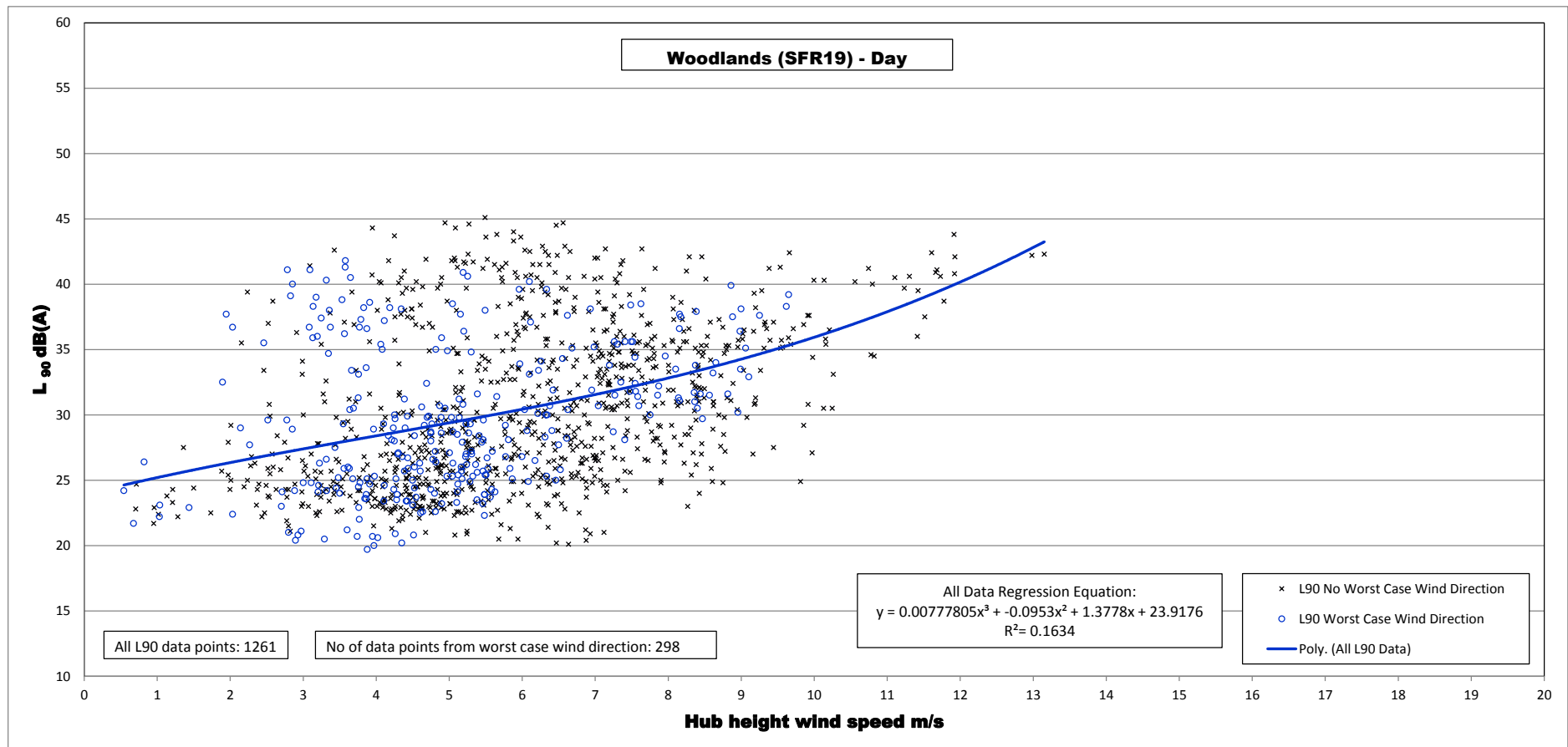


Figure 10 SFR19 Woodlands Regression Analysis – Day

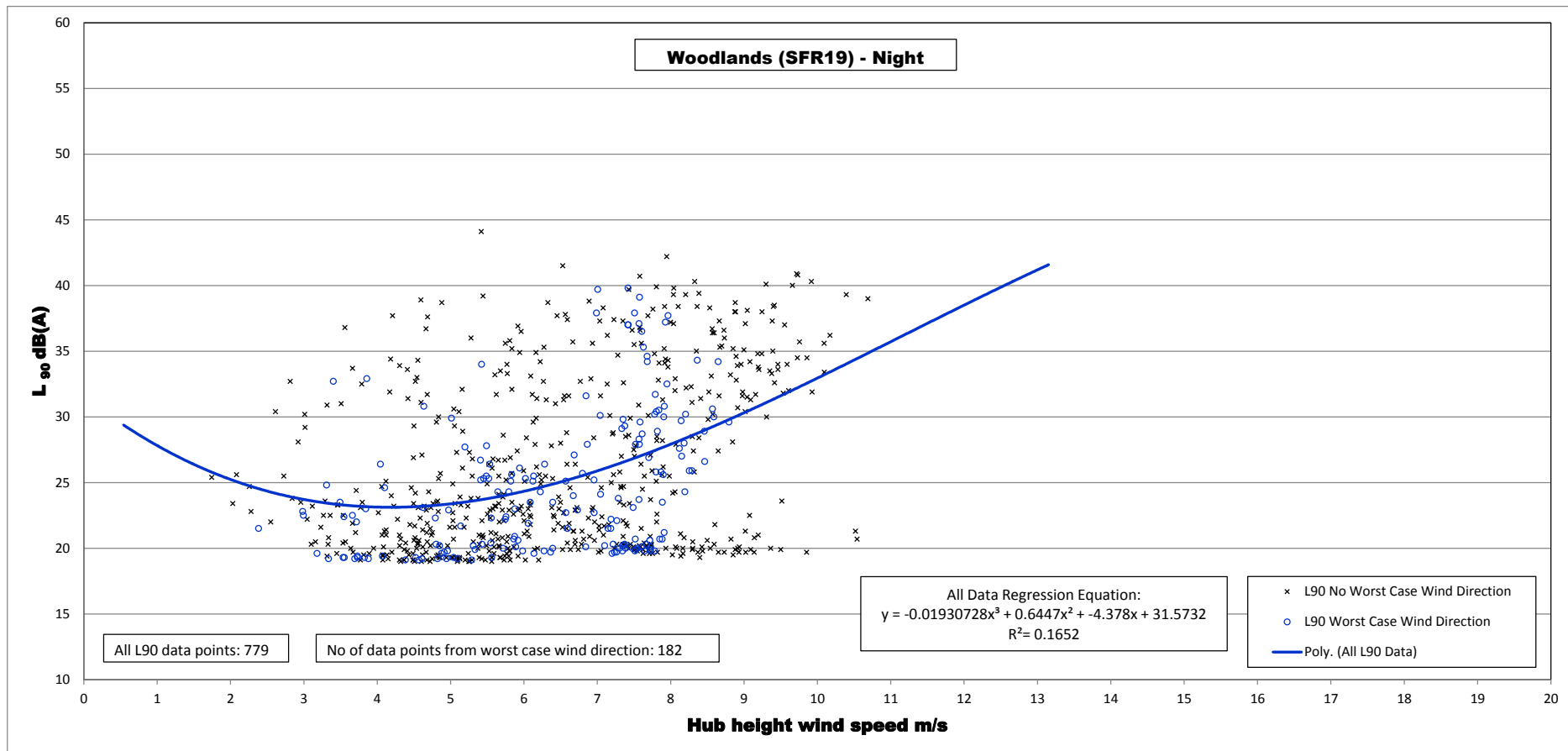


Figure 11 SFR19 Woodlands Regression Analysis – Night

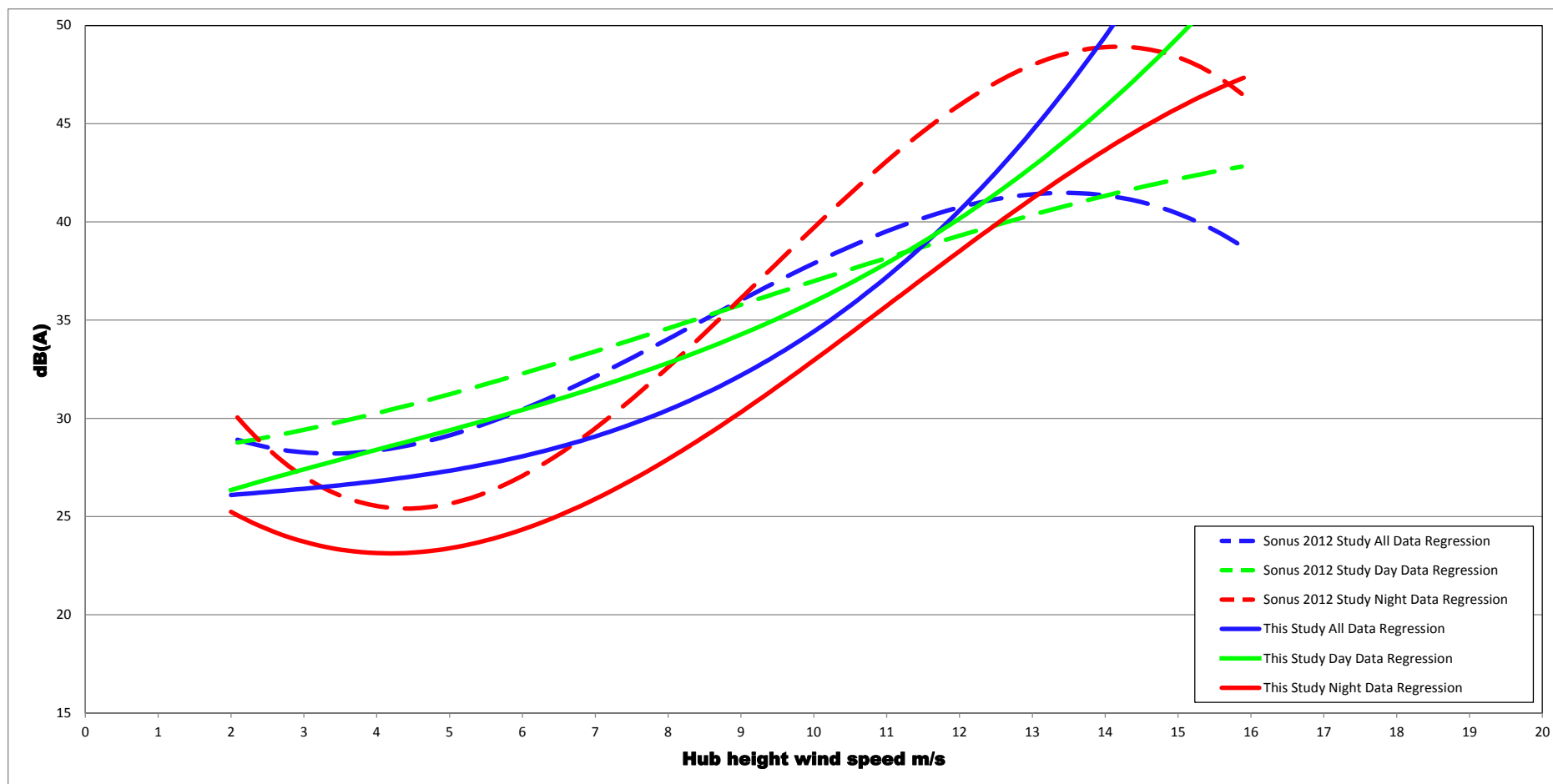


Figure 12 SFR19 Woodlands Regression Analysis Summary

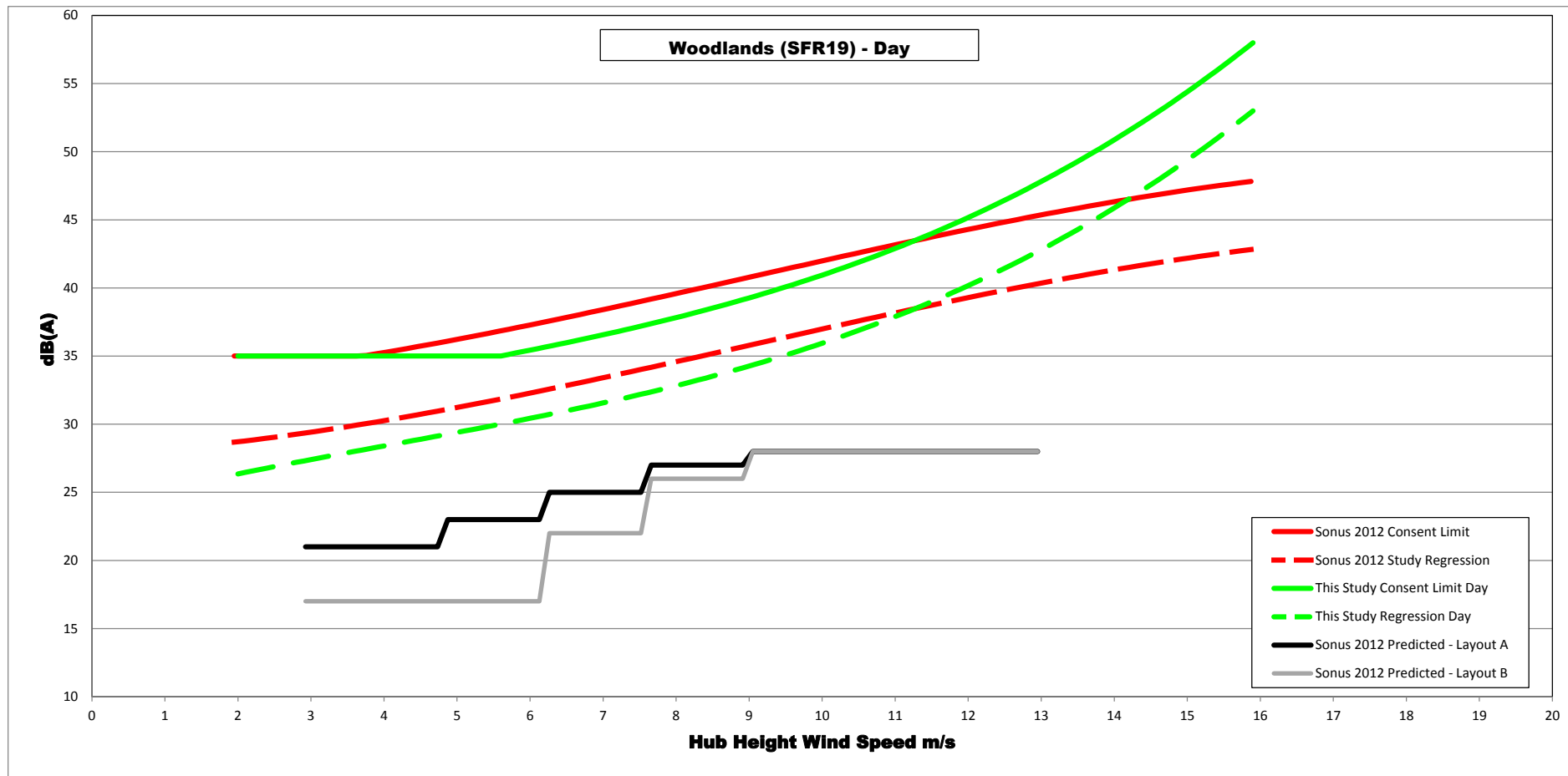


Figure 13 SFR19 Woodlands Compliance Analysis – Day

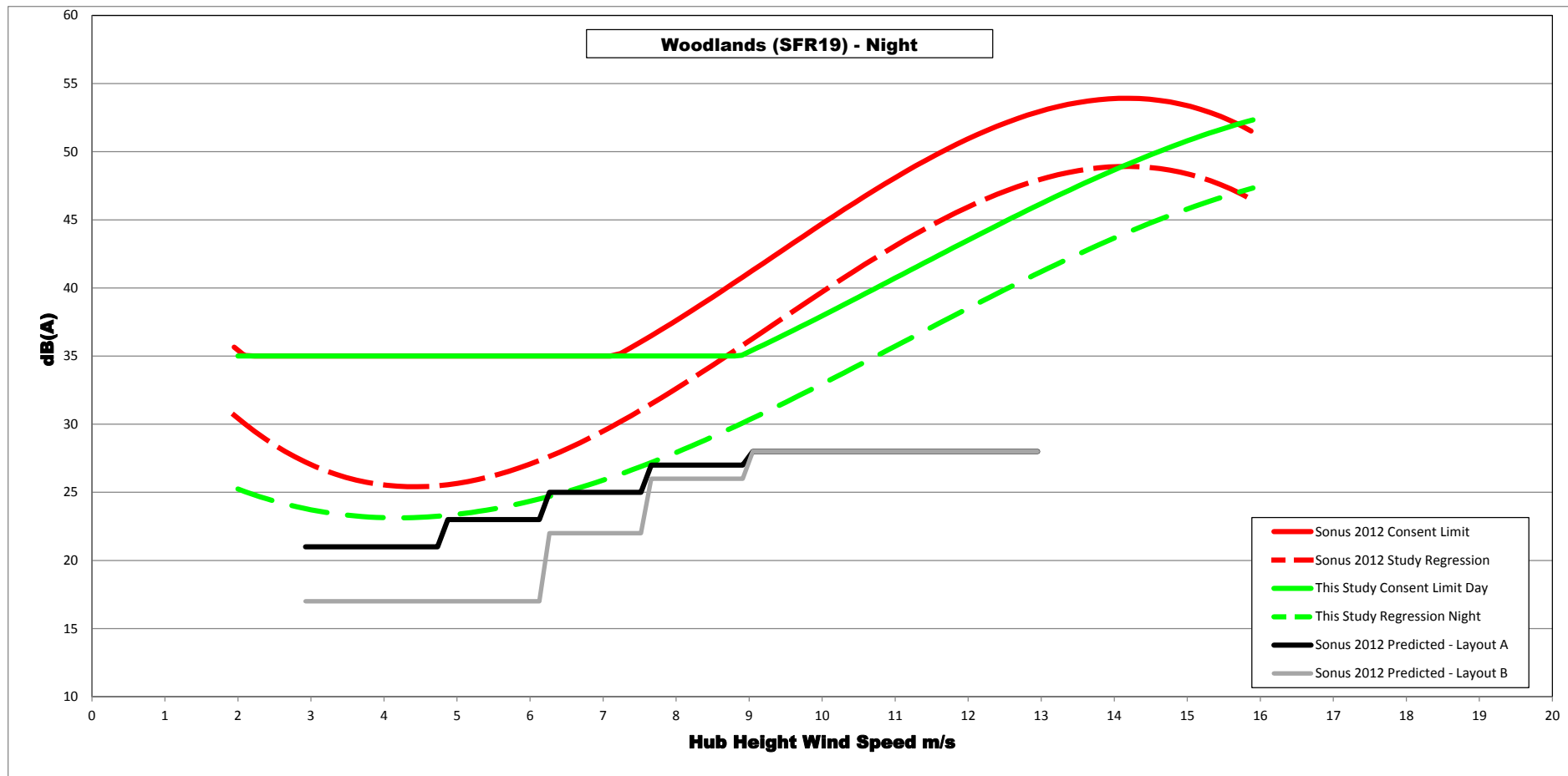


Figure 14 SFR19 Woodlands Compliance Analysis – Night

7.2 SFR05 147 Sally's Flat Road

147 Sally's Flat Road is an involved property. However, for the purpose of this analysis, it is treated as if it were a non-involved property as it is intended to apply the results to other nearby properties which are non-involved.

The location selected for noise monitoring is at the side of the property at a distance of 20m from the dwelling in an easterly direction with line of sight to the proposed wind turbine locations. The location selection is approximately 4m east of the monitoring location presented in the Sonus Report for this receiver. Appendix C shows photographs of the measurement location and the unattended monitoring equipment.

7.2.1 Attended Noise Survey

An attended noise survey was conducted between 11:18-11:33am on Friday 21st June 2013 at the unattended monitoring location. One fifteen minute sample was recorded. There was a 1.0m/sec wind at the measurement location. Intermittent sounds of insect cows, sheep and other unknown animals dominated the measurement. The following figure shows the variation of sound level with time for the measurement sample.

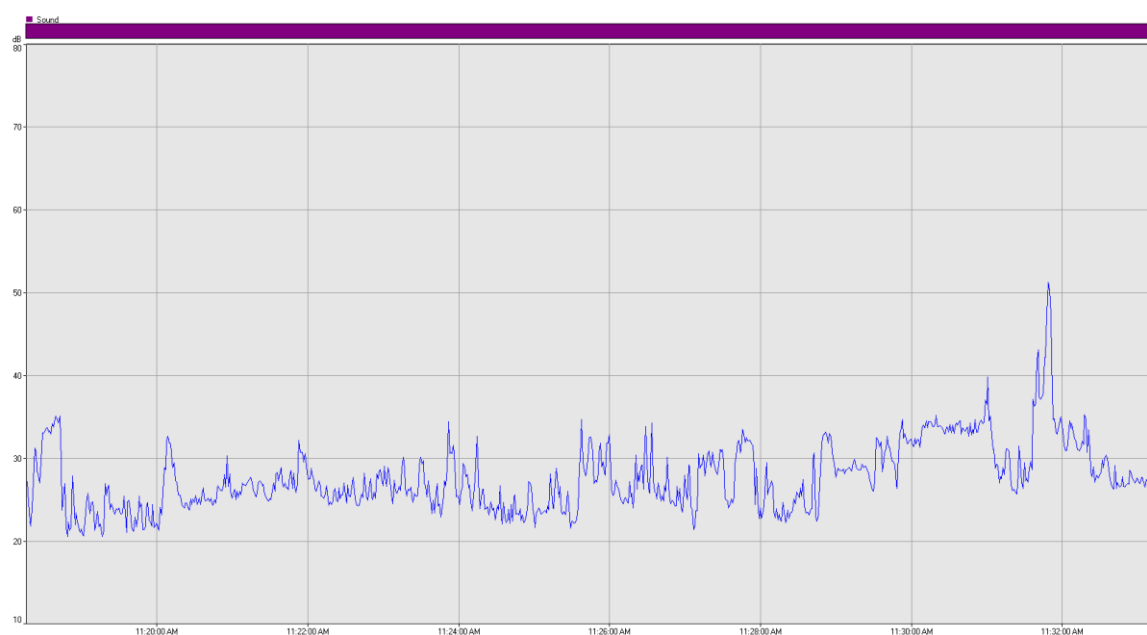


Figure 15 Sample of Sound Trace Recorded at SFR05 147 Sally's Flat Road at 11:18am 21/6/2013

7.2.2 Unattended Noise Survey

We now turn to the results of the unattended noise survey which are contained in Appendix C. The regression analysis is shown in Figure 16 wherein the third order polynomial resulted in the highest correlation coefficient. On the figure is shown the following:

- i) the blue line is the resultant background noise level and wind speed correlation curve;

- ii) the regression formula for the background noise level regression line;
- iii) the black crosses are the LA90(10min) values from the measurement period;

The compliance analysis is shown in Figure 17. On the figure is shown the following:

- i) in solid red, the Sonus Report consent limit;
- ii) in dashed red, the Sonus Report regression line;
- iii) in solid green, the consent limit from this study;
- iv) in dashed green, the regression line from this study;
- v) in solid black, the Sonus Report predicted noise levels from Layout A turbines operating; and,
- vi) in solid grey, the Sonus Report predicted noise levels from Layout B turbines operating.

Table 8 below summarises the data in tabular form:

Table 8 147 Sally's Flat Road Compliance Assessment

	10m Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.3	36.7	38.0	39.0	39.3	38.9	37.6	35.2	35.0	35.0	35.0
Layout A Predicted		28.0	30.0	32.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0			
Layout B Predicted		23.0	27.0	27.0	32.0	34.0	34.0	34.0	34.0	34.0	34.0			
Layout A Predicted – Criteria		-7.0	-5.0	-3.3	-2.7	-3.0	-4.0	-4.3	-3.9	-2.6	-0.2			
Layout B Predicted – Criteria		-12.0	-8.0	-8.3	-4.7	-4.0	-5.0	-5.3	-4.9	-3.6	-1.2			

The last two rows in this table demonstrate compliance with the nominated criteria for both Layout A and B.

It is noted that the Sonus regression values are higher than that measured in this study for practically all wind speeds.

Consistent with the approach adopted in the Sonus Report, at the higher wind speeds where the regression curve slopes downward because of the lack of measurement data at those wind speeds, a conservative approach is taken that the background noise level (and therefore the criterion) is constant with increasing wind speed. Ideally, however, the data should be supplemented by further measurements to resolve the uncertainty.

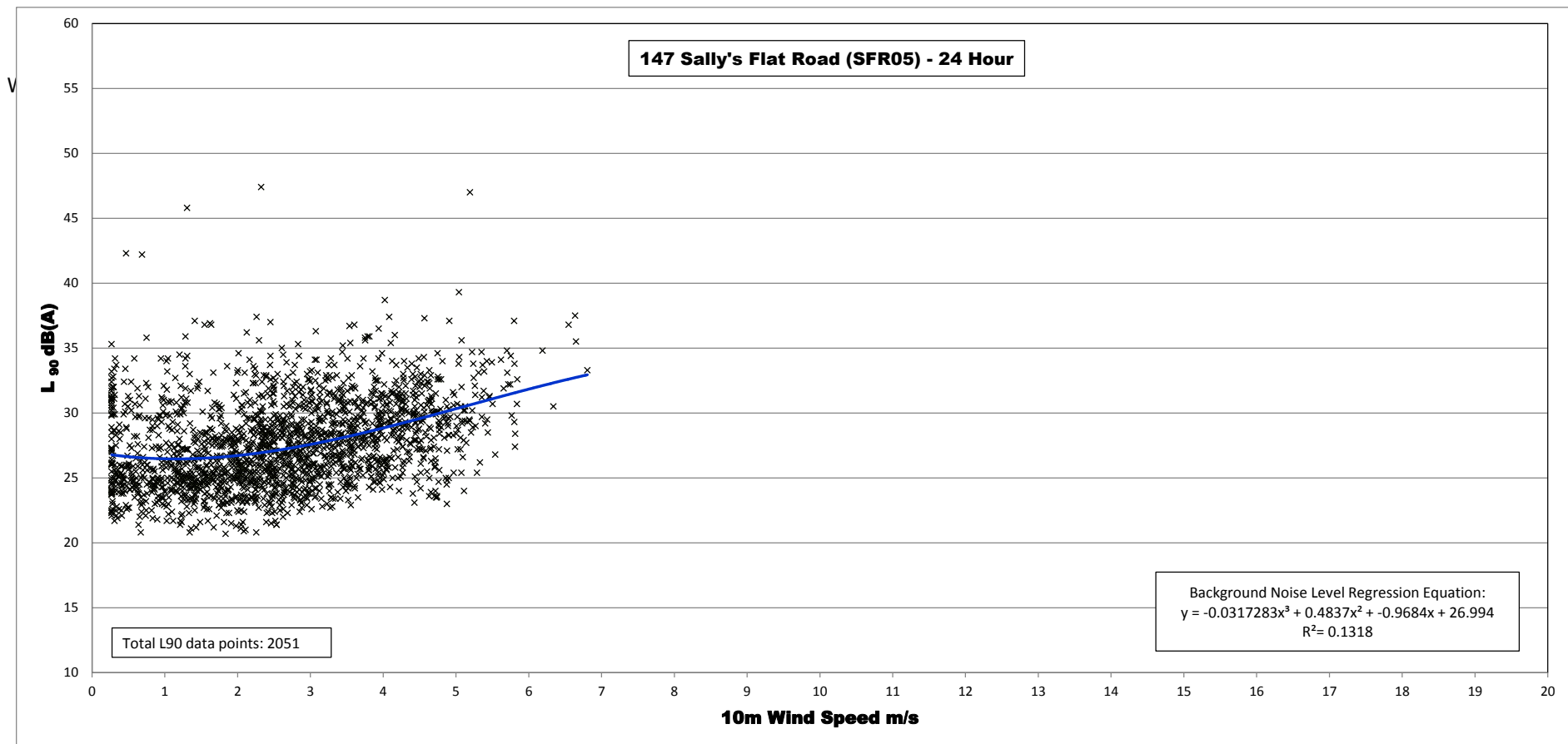


Figure 16 SFR05 147 Sally's Flat Road Regression Analysis

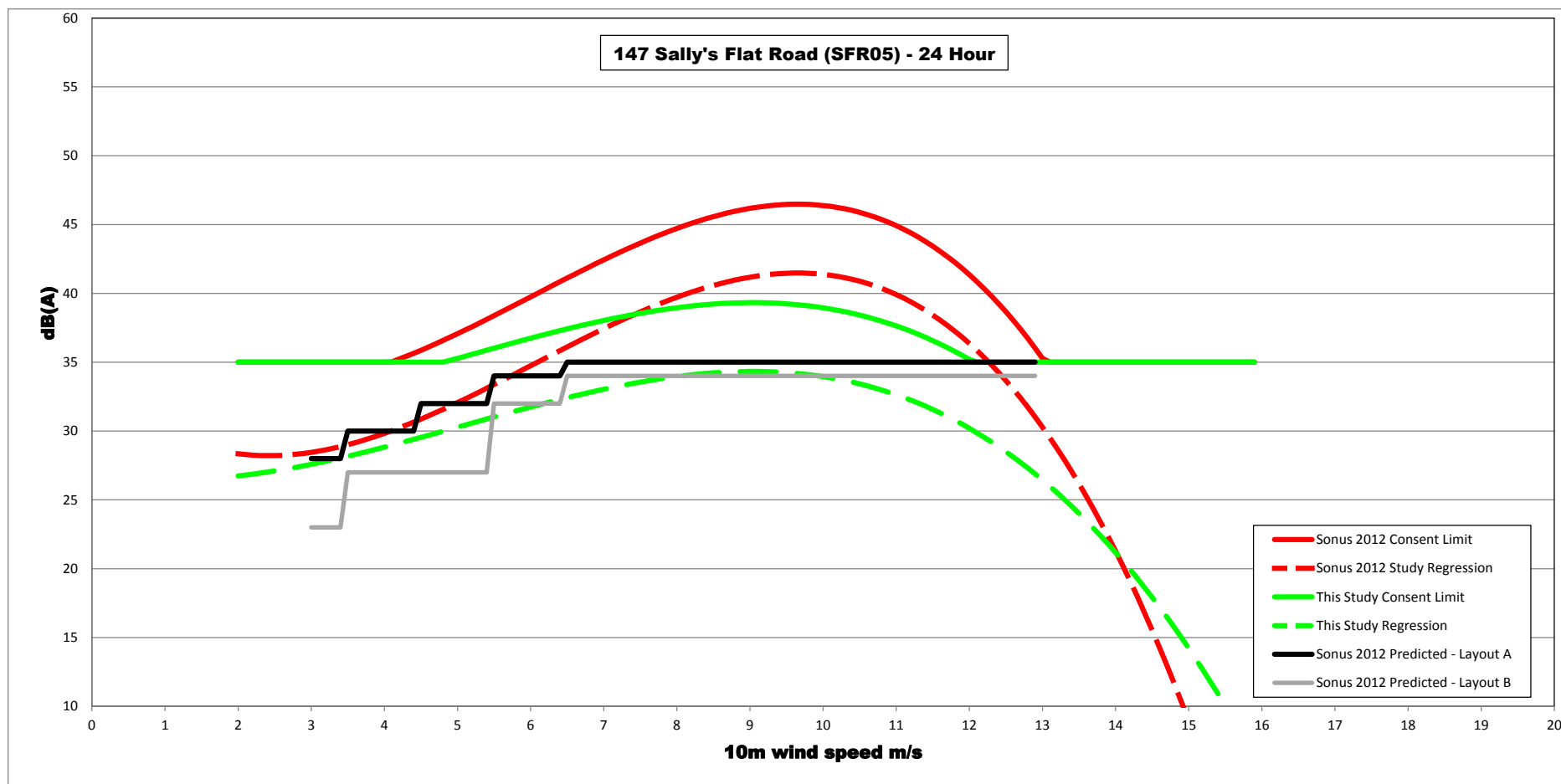


Figure 17 SFR05 147 Sally's Flat Road Compliance Analysis

In respect of assessing compliance with the 2012 NSW Draft Guidelines, we proceed in the same manner as for the previous residential location. The regressions for 24 hour, day and night are presented in Figure 18, Figure 19 and Figure 20 respectively. In addition, data points within the worst case wind direction, meaning a wind direction within 45degrees of an imaginary line drawn between the closest turbine and the receptor, are denoted by a blue circle instead of a black cross. The worst case wind direction presented in the regression analysis are for both turbine Layout A and B, which share the same worst case wind direction.

Figure 21 presents a summary of all regression curves generated. Regression curves from the Sonus Study are also presented, adjusting from 10m wind speed to hub height (80m) wind speed using the methodology presented in Section 6. On the figure is shown the following:

- i) in dashed blue, the Sonus Report 24 hour regression line;
- ii) in dashed green, the Sonus Report Day regression line;
- iii) in dashed red, the Sonus Report Night regression line;
- iv) in solid blue, the 24 hour regression line from this study;
- v) in solid green, the Day regression line from this study; and,
- vi) in solid red, the Night regression line from this study.

It can be seen from the figure that the regression lines for this study are generally lower than the respective Sonus regression lines. Large differences occur for wind speeds above 8m/s with up to a 17dB(A) difference between the night time regression lines.

The compliance analysis for day and night periods are shown in Figure 22 and Figure 23 respectively.

Table 9 and Table 10 below summarise the data in tabular form:

Table 9 SFR05 147 Sally's Flat Road Compliance Assessment - Day

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.2	36.2	37.1	37.8	38.2	38.2	37.6	36.4
Layout A Predicted		28.0	28.0	30.0	30.0	32.0	34.0	34.0	35.0	35.0	35.0			
Layout B Predicted		23.0	23.0	27.0	27.0	27.0	32.0	32.0	34.0	34.0	34.0			
Layout A Predicted - Criteria		-7.0	-7.0	-5.0	-5.0	-3.0	-1.2	-2.2	-2.1	-2.8	-3.2			
Layout B Predicted - Criteria		-12.0	-12.0	-8.0	-8.0	-8.0	-3.2	-4.2	-3.1	-3.8	-4.2			

Table 10 SFR05 147 Sally's Flat Road Compliance Assessment - Night

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.5	35.7	35.6	35.2
Layout A Predicted		28.0	28.0	30.0	30.0	32.0	34.0	34.0	35.0	35.0	35.0			
Layout B Predicted		23.0	23.0	27.0	27.0	27.0	32.0	32.0	34.0	34.0	34.0			
Layout A Predicted - Criteria		-7.0	-7.0	-5.0	-5.0	-3.0	-1.0	-1.0	0.0	0.0	-0.5			
Layout B Predicted - Criteria		-12.0	-12.0	-8.0	-8.0	-8.0	-3.0	-3.0	-1.0	-1.0	-1.5			

The tables above demonstrate compliance with the nominated criteria for both Layout A and B.

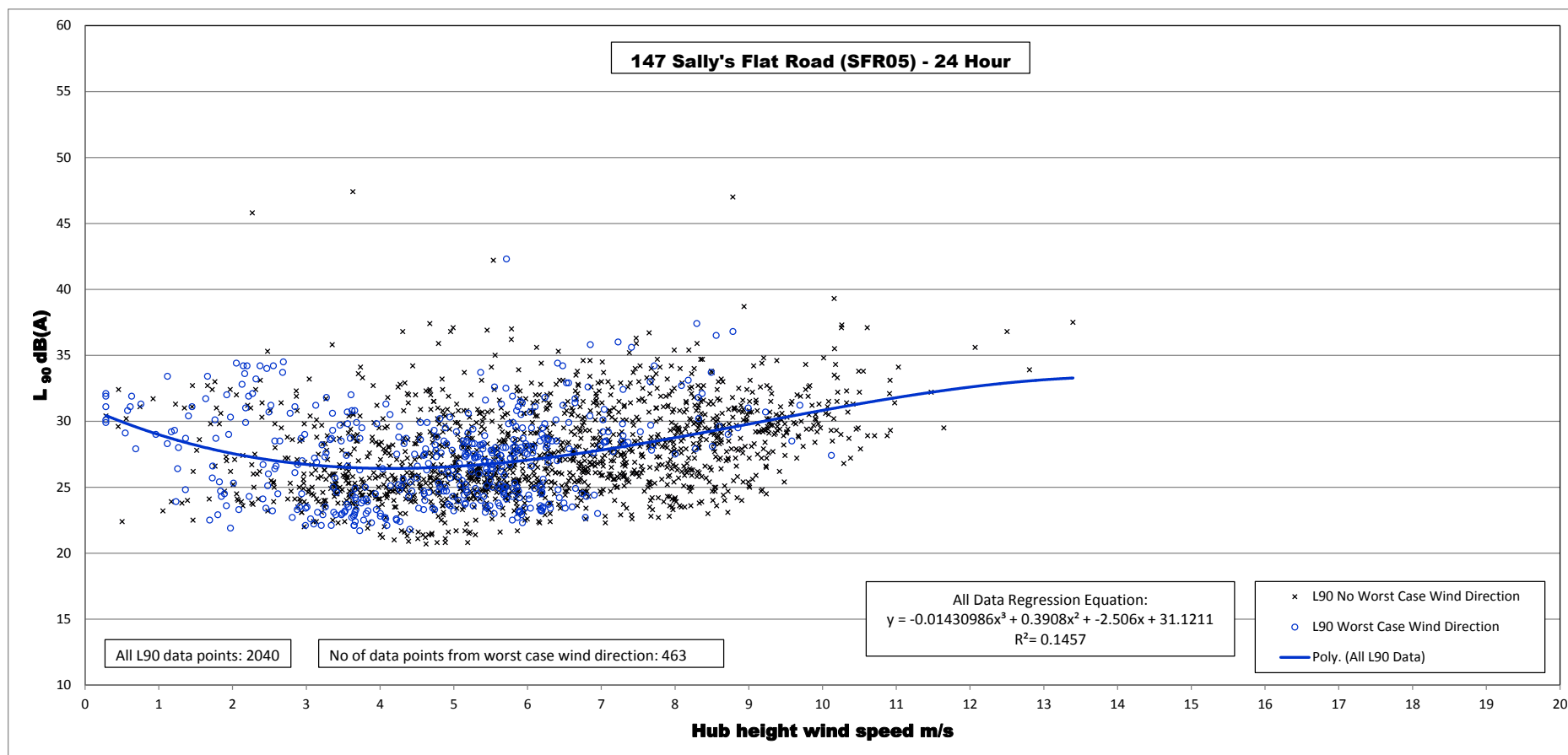


Figure 18 SFR05 147 Sally's Flat Road Regression Analysis – 24 hour

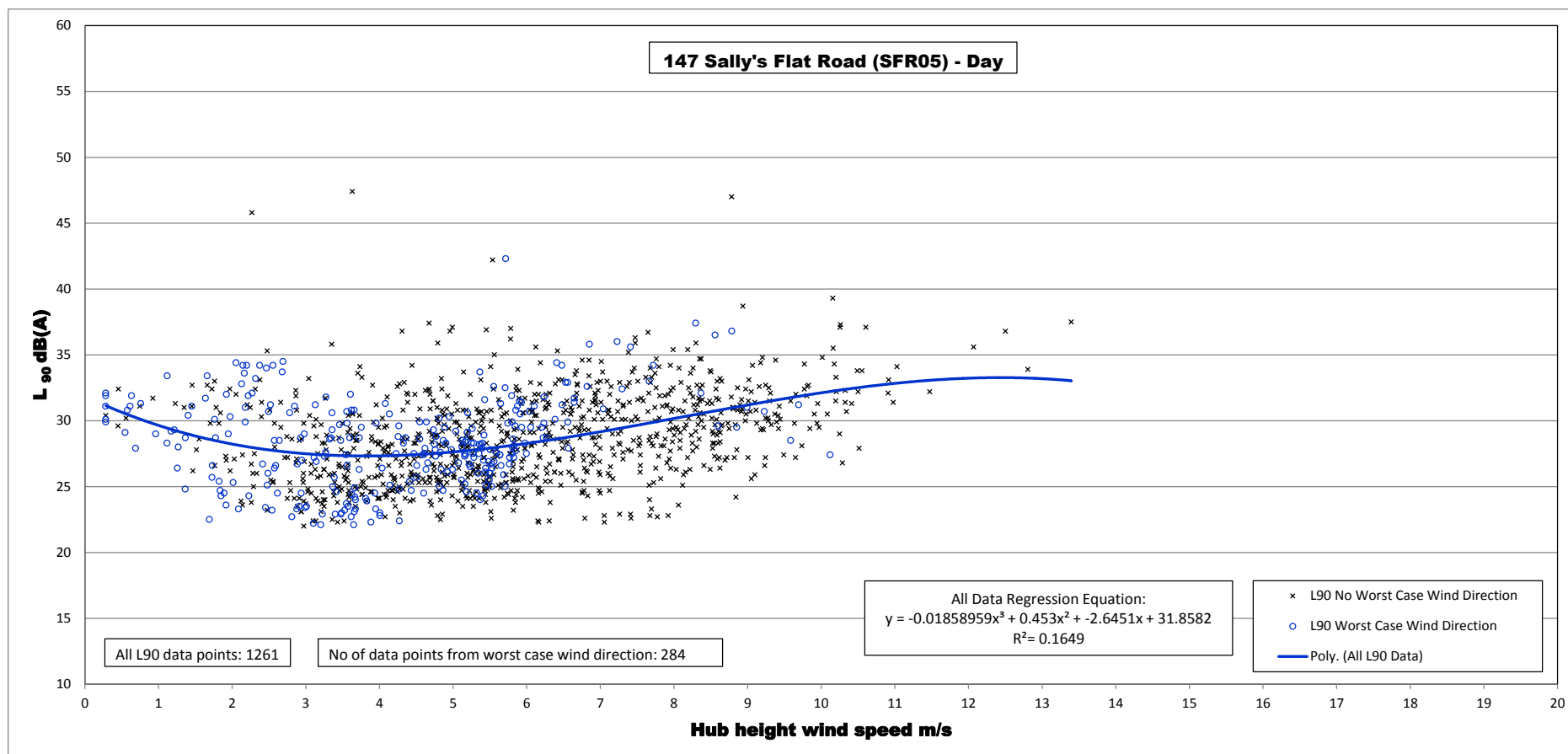


Figure 19 SFR05 147 Sally's Flat Road Regression Analysis – Day

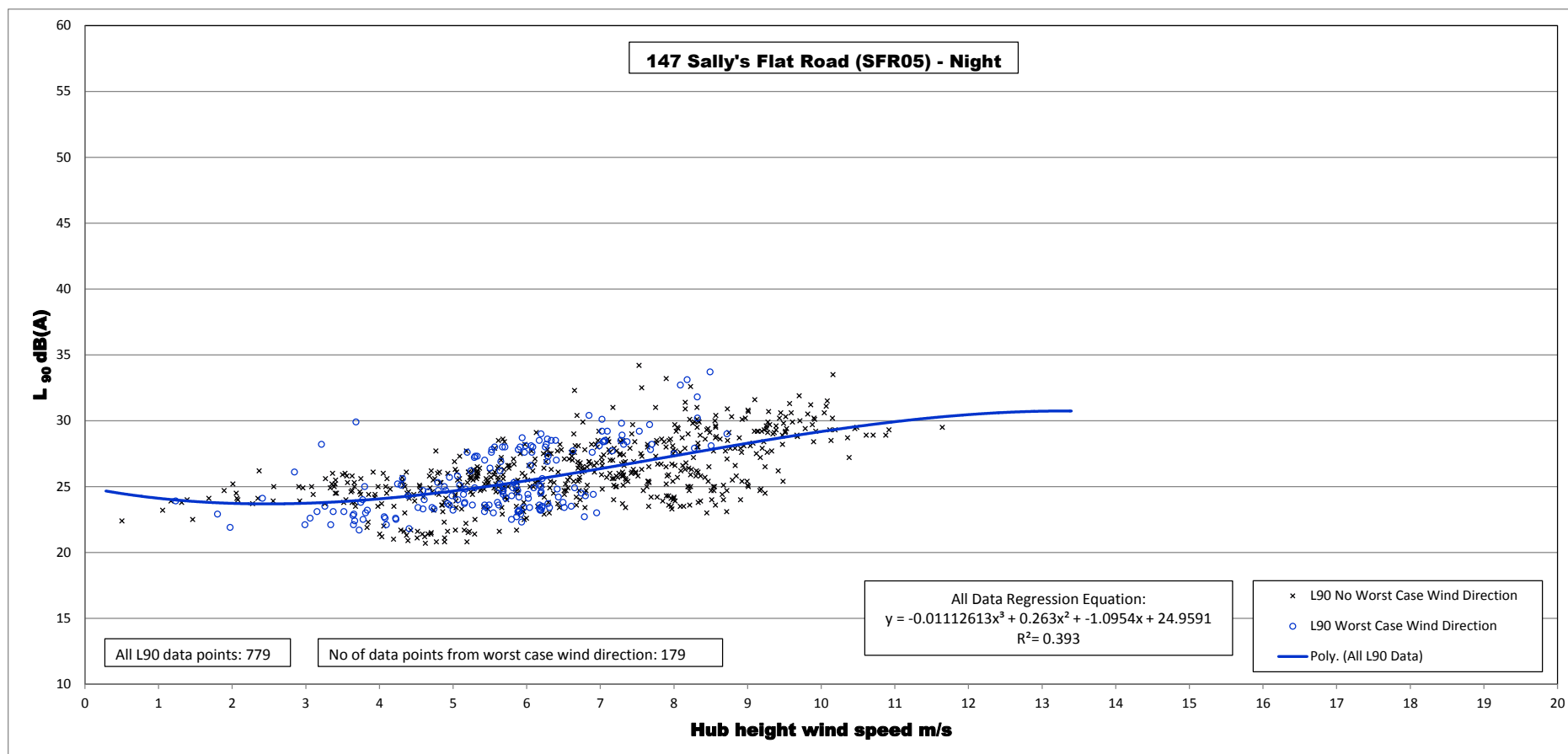


Figure 20 SFR05 147 Sally's Flat Road Regression Analysis – Night

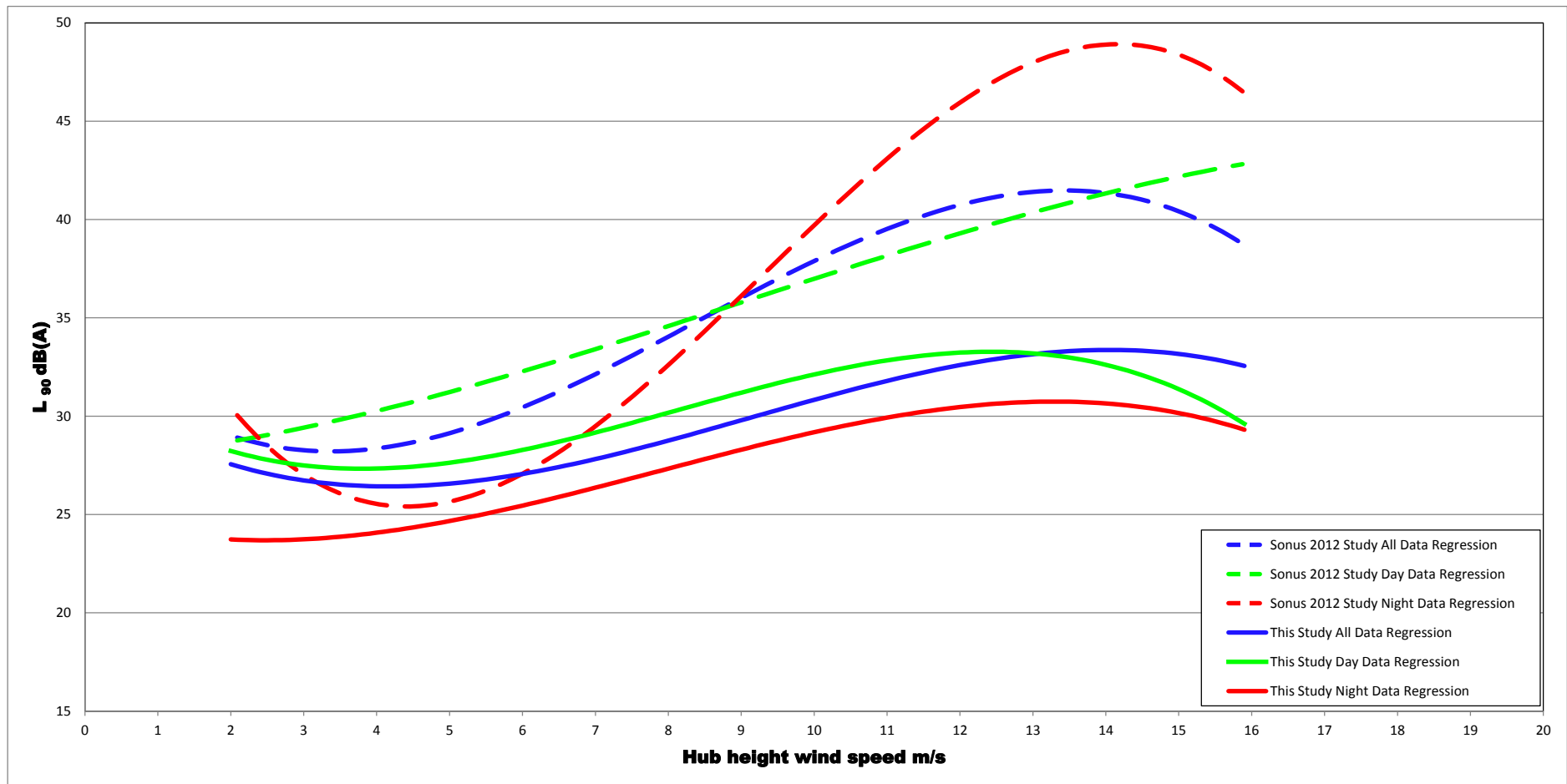


Figure 21 SFR05 147 Sally's Flat Road Regression Analysis Summary

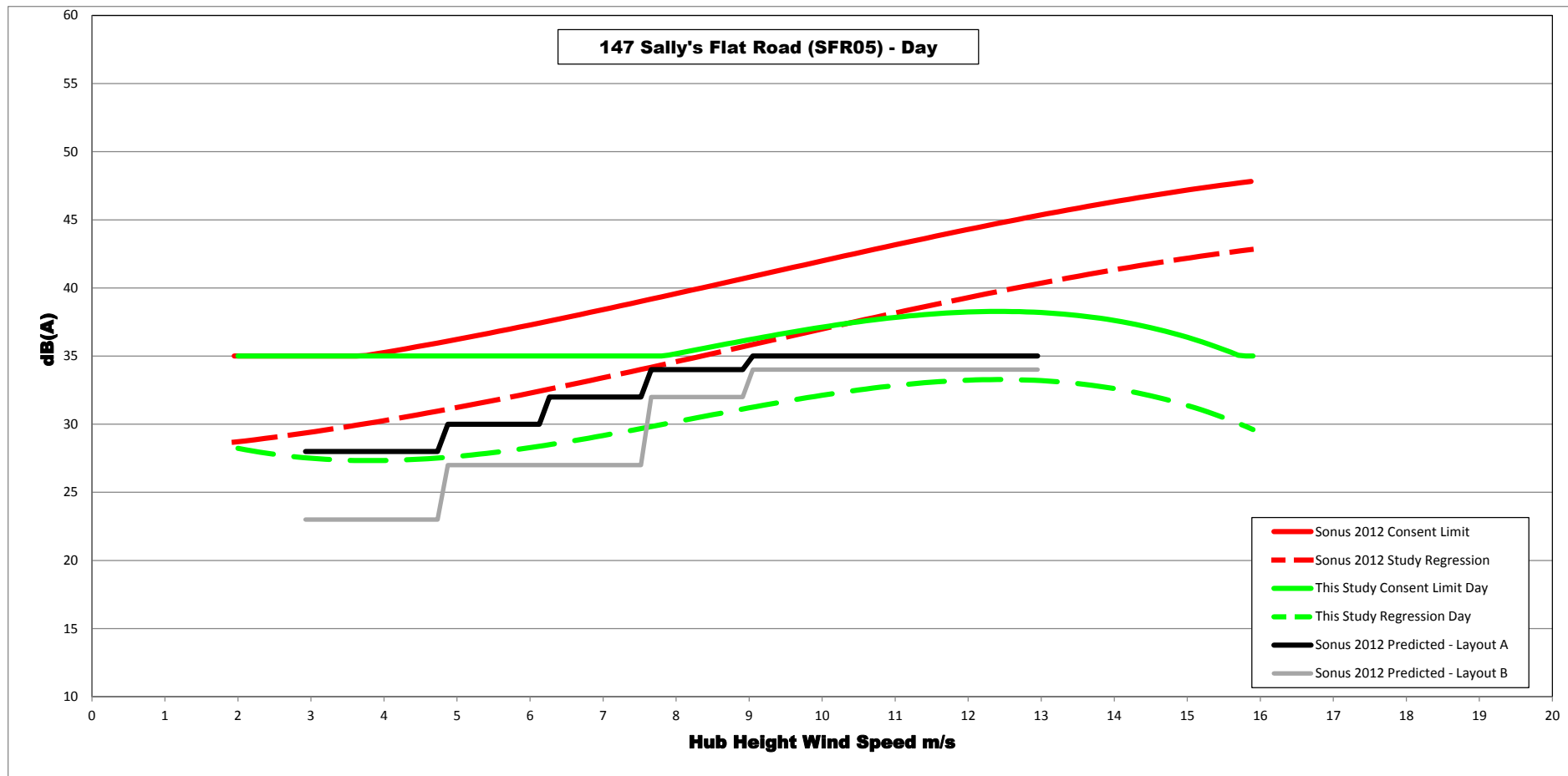


Figure 22 SFR05 147 Sally's Flat Road Compliance Analysis – Day

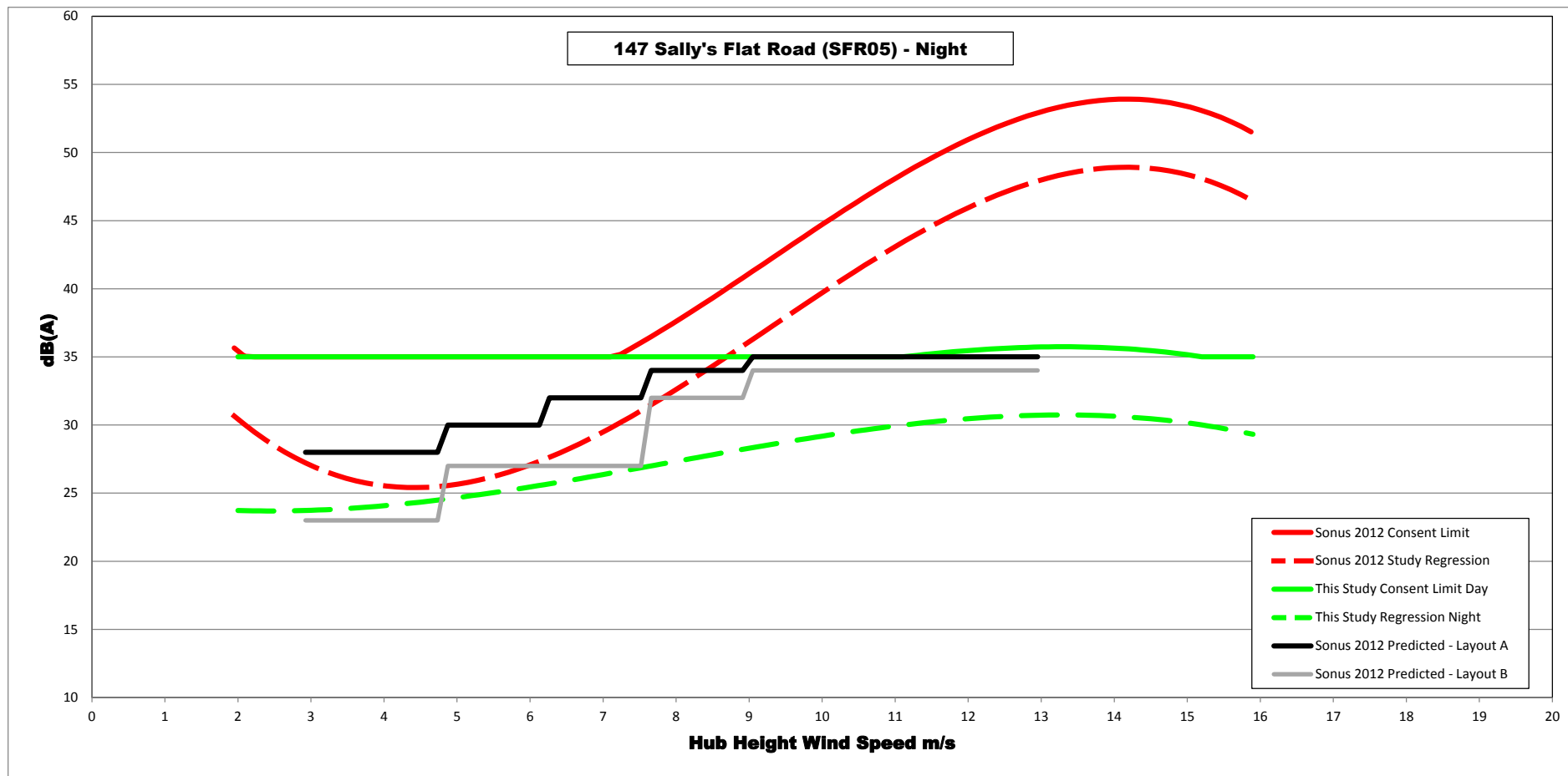


Figure 23 SFR05 147 Sally's Flat Road Compliance Analysis – Night

7.3 CR28 Willow Downs

Willow Downs is a non-involved property. The location selected for noise monitoring is at the rear of the property at a distance of 20m from the dwelling in a westerly direction with line of sight to the proposed wind turbine locations. This location is identical to that described in the Sonus Report. Appendix D shows photographs of the measurement location and the unattended monitoring equipment.

7.3.1 Attended Noise Survey

An attended noise survey was conducted between 12:49-1:04pm on Friday 21st June 2013 at the unattended monitoring location. One fifteen minute sample was recorded. There was a 1.2m/sec wind at the measurement location. Intermittent sounds of dogs, chickens and other unknown animals dominated the measurement. The following figure shows the variation of sound level with time for the measurement sample.

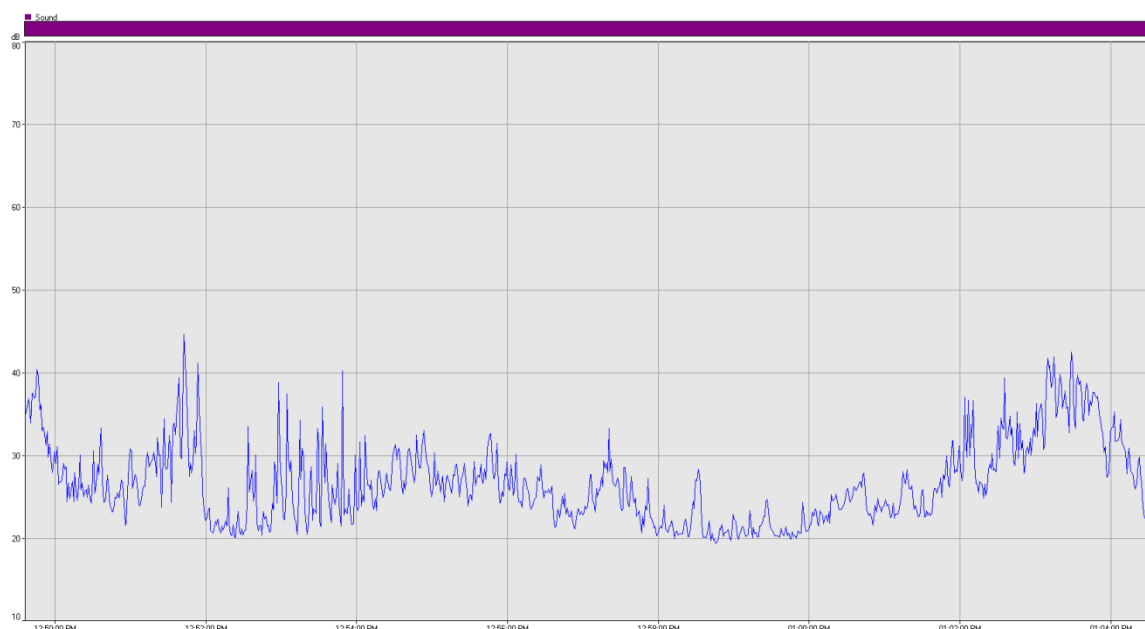


Figure 24 Sample of Sound Trace Recorded at CR28 Willow Downs at 12:49pm 21/6/2013

7.3.2 Unattended Noise Survey

We now turn to the results of the unattended noise survey which are contained in Appendix D. The regression analysis is shown in Figure 25 wherein the third order polynomial resulted in the highest correlation coefficient. On the figure is shown the following:

- the blue line is the resultant background noise level and wind speed correlation curve;
- the regression formula for the background noise level regression line;
- the black crosses are the LA90(10min) values from the measurement period;

The compliance analysis is shown in Figure 26. On the figure is shown the following:

- i) in solid red, the Sonus Report consent limit;
- ii) in dashed red, the Sonus Report regression line;
- iii) in solid green, the consent limit from this study;
- iv) in dashed green, the regression line from this study;
- v) in solid black, the Sonus Report predicted noise levels from Layout A turbines operating; and,
- vi) in solid grey, the Sonus Report predicted noise levels from Layout B turbines operating.

Table 11 below summarises the data in tabular form:

Table 11 CR28 Willow Downs Compliance Assessment

	10m Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Layout A Predicted		28.0	30.0	32.0	34.0	35.0	35.0	35.0	35.0	35.0	35.0			
Layout B Predicted		23.0	23.0	27.0	32.0	34.0	34.0	34.0	34.0	34.0	34.0			
Layout A Predicted – Criteria		-7.0	-5.0	-3.0	-1.0	0.0	0.0	0.0	0.0	0.0	0.0			
Layout B Predicted – Criteria		-12.0	-12.0	-8.0	-3.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0			

The last two rows in this table demonstrate compliance with the nominated criteria for both Layout A and B.

It is noted that the regression values in this study are generally low and never above 30dB(A). The criteria is therefore 35dB(A) at all wind speeds, corresponding to the minimum noise criterion stipulated in the SA Guidelines. For Layout A the predicted noise levels at this receiver is numerically equal to the criterion of 35dB(A) for wind speeds 7-12m/s.

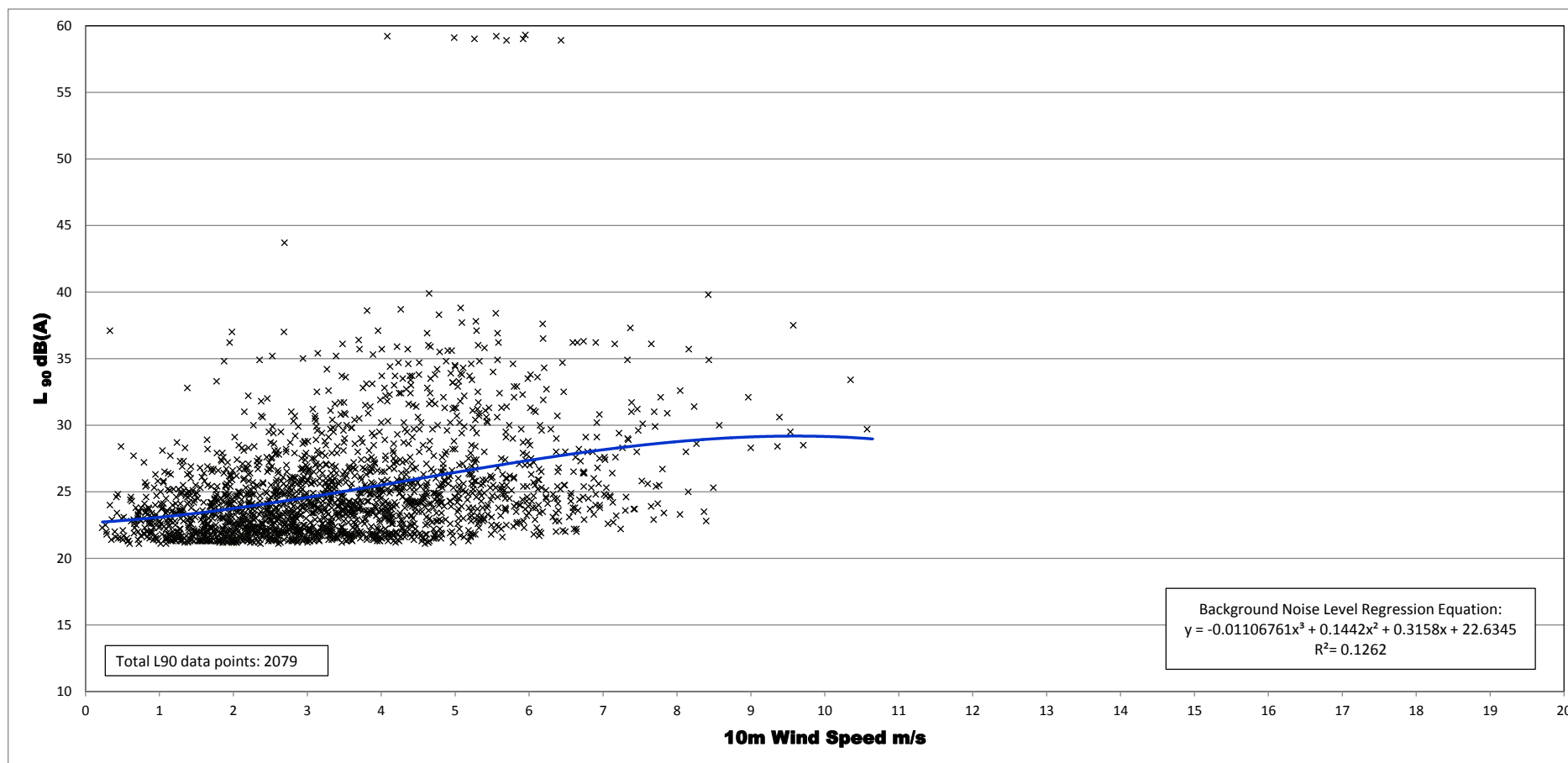


Figure 25 CR28 Willow Downs Regression Analysis

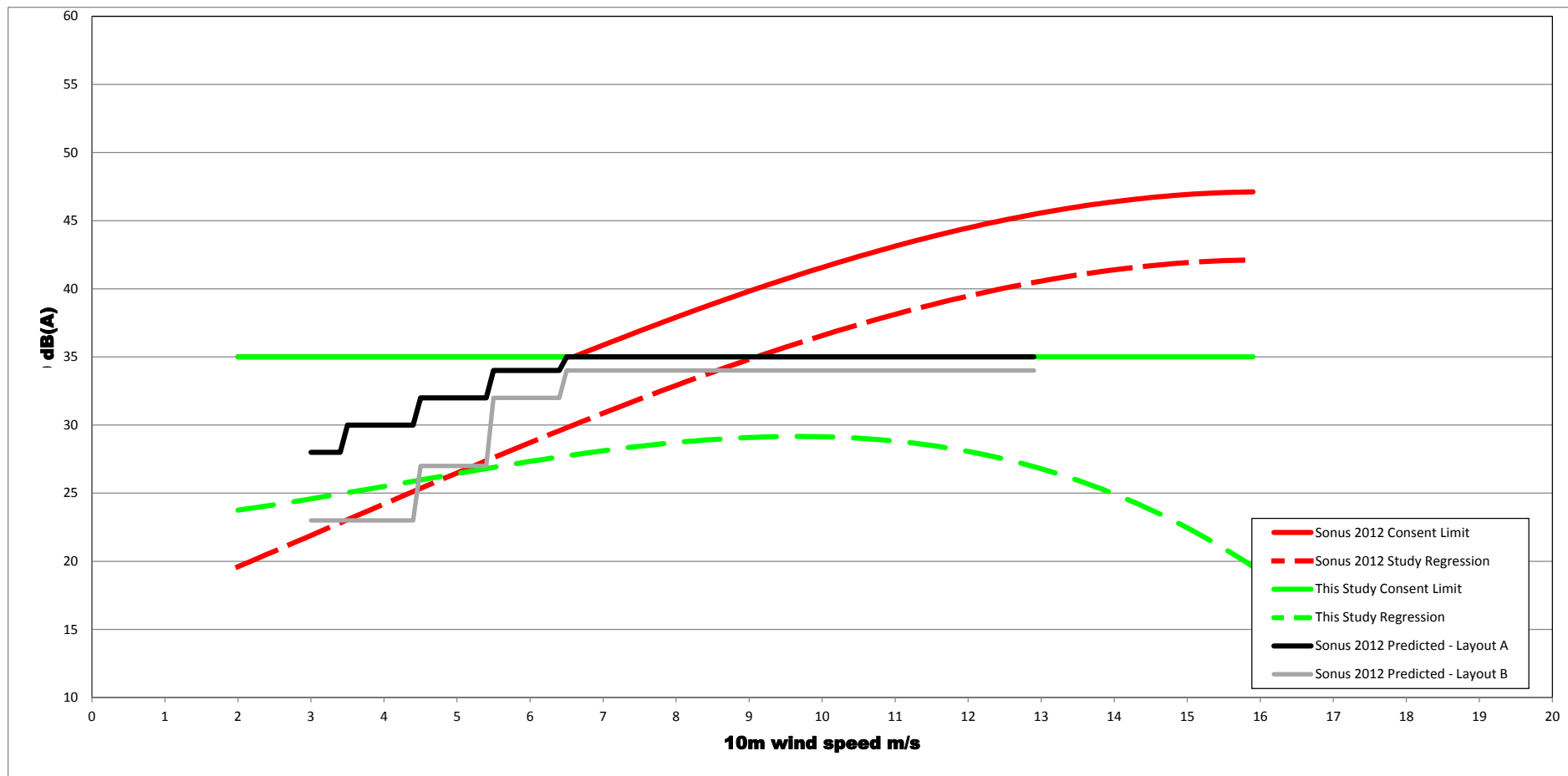


Figure 26 CR28 Willow Downs Compliance Assessment

An assessment against the 2012 NSW Draft Guidelines regression analysis was undertaken as previously described. The regressions for 24 hour, day and night are presented in Figure 27, Figure 28 and Figure 29 respectively. In addition, data points within the worst case wind direction, meaning a wind direction within 45 degrees of an imaginary line drawn between the closest turbine and the receptor, are denoted by a blue circle instead of a black cross. The worst case wind direction presented in the regression analysis are for both turbine Layout A and B, which share the same worst case wind direction.

Figure 30 presents a summary of all regression curves generated. Regression curves from the Sonus Report are also presented, adjusting from 10m wind speed to hub height (80m) wind speed using the methodology presented earlier. On the figure is shown the following:

- i) in dashed blue, the Sonus Report 24 hour regression line;
- ii) in dashed green, the Sonus Report Day regression line;
- iii) in dashed red, the Sonus Report Night regression line;
- iv) in solid blue, the 24 hour regression line from this study;
- v) in solid green, the Day regression line from this study; and,
- vi) in solid red, the Night regression line from this study.

No general trend can be determined between the Sonus regression lines and this study's regression lines. The regression lines for this study are higher at low wind speeds and lower at higher wind speeds compared to the Sonus regression lines. The crossover points for the 24 hour, day and night regressions are at approximately 6m/s, 4m/s and 8m/s, respectively

The compliance analysis for day and night periods are shown in Figure 31 and Figure 32 respectively.

Table 12 and Table 13 below summarises the data in tabular form:

Table 12 CR28 Willow Downs Compliance Assessment - Day

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.5	36.3	37.1	37.9
Layout A Predicted		28.0	28.0	30.0	30.0	32.0	34.0	34.0	35.0	35.0	35.0			
Layout B Predicted		23.0	23.0	23.0	23.0	27.0	32.0	32.0	34.0	34.0	34.0			
Layout A Predicted - Criteria		-7.0	-7.0	-5.0	-5.0	-3.0	-1.0	-1.0	0.0	0.0	-0.5			
Layout B Predicted - Criteria		-12.0	-12.0	-12.0	-12.0	-8.0	-3.0	-3.0	-1.0	-1.0	-1.5			

Table 13 CR28 Willow Downs Compliance Assessment - Night

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0
Layout A Predicted		28.0	28.0	30.0	30.0	32.0	34.0	34.0	35.0	35.0	35.0			
Layout B Predicted		23.0	23.0	23.0	23.0	27.0	32.0	32.0	34.0	34.0	34.0			
Layout A Predicted - Criteria		-7.0	-7.0	-5.0	-5.0	-3.0	-1.0	-1.0	0.0	0.0	0.0			
Layout B Predicted - Criteria		-12.0	-12.0	-12.0	-12.0	-8.0	-3.0	-3.0	-1.0	-1.0	-1.0			

The tables above demonstrate compliance with the nominated criteria for both Layout A and B. It is noted that at a wind speed of 9m/s the predicted noise levels are approximately 9dB(A) above the night time regression lines presented in both the Sonus Report and this study. Therefore at mid range wind speeds the operation of the turbines will be clearly audible at this receiver location.

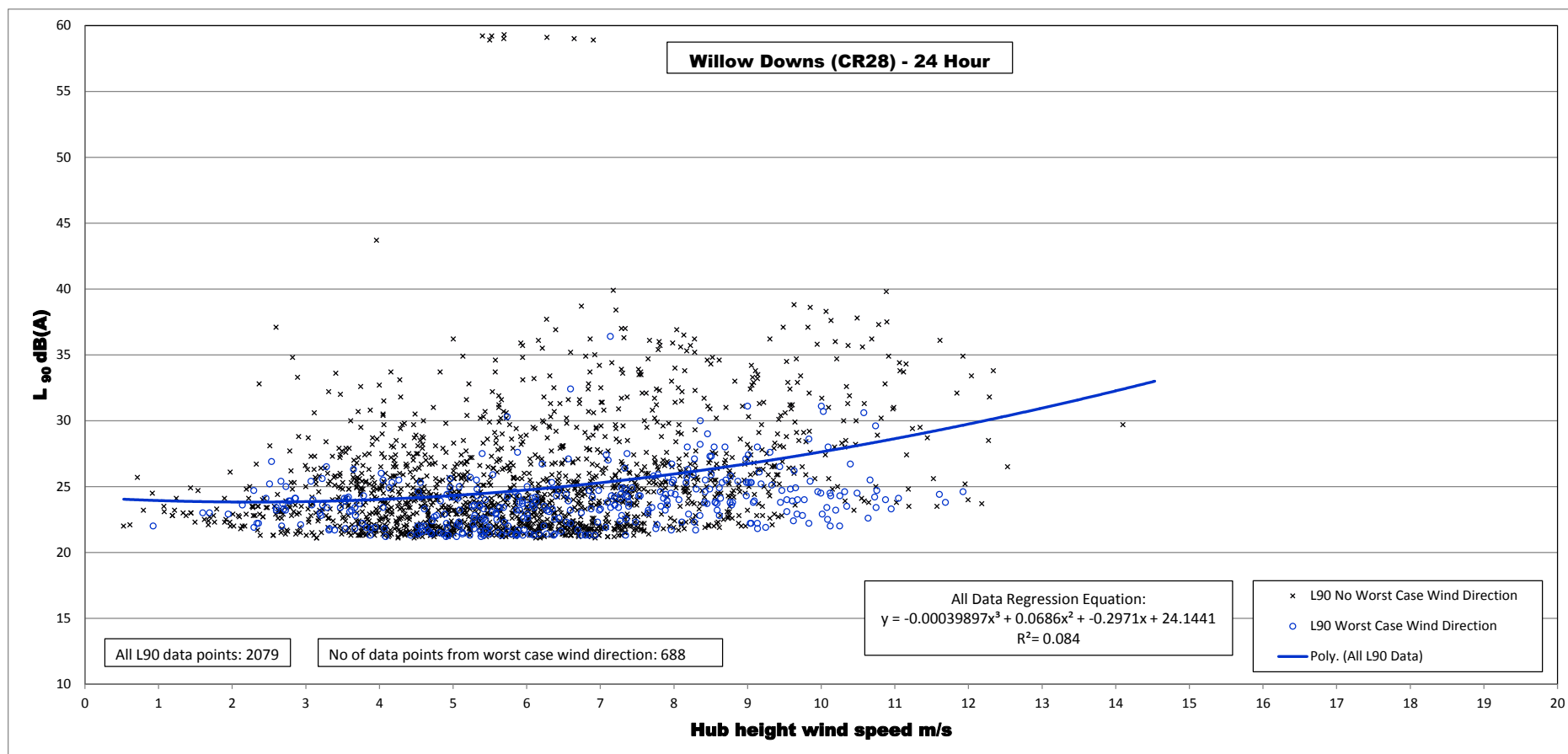


Figure 27 CR28 Willow Downs Regression Analysis – 24 hour

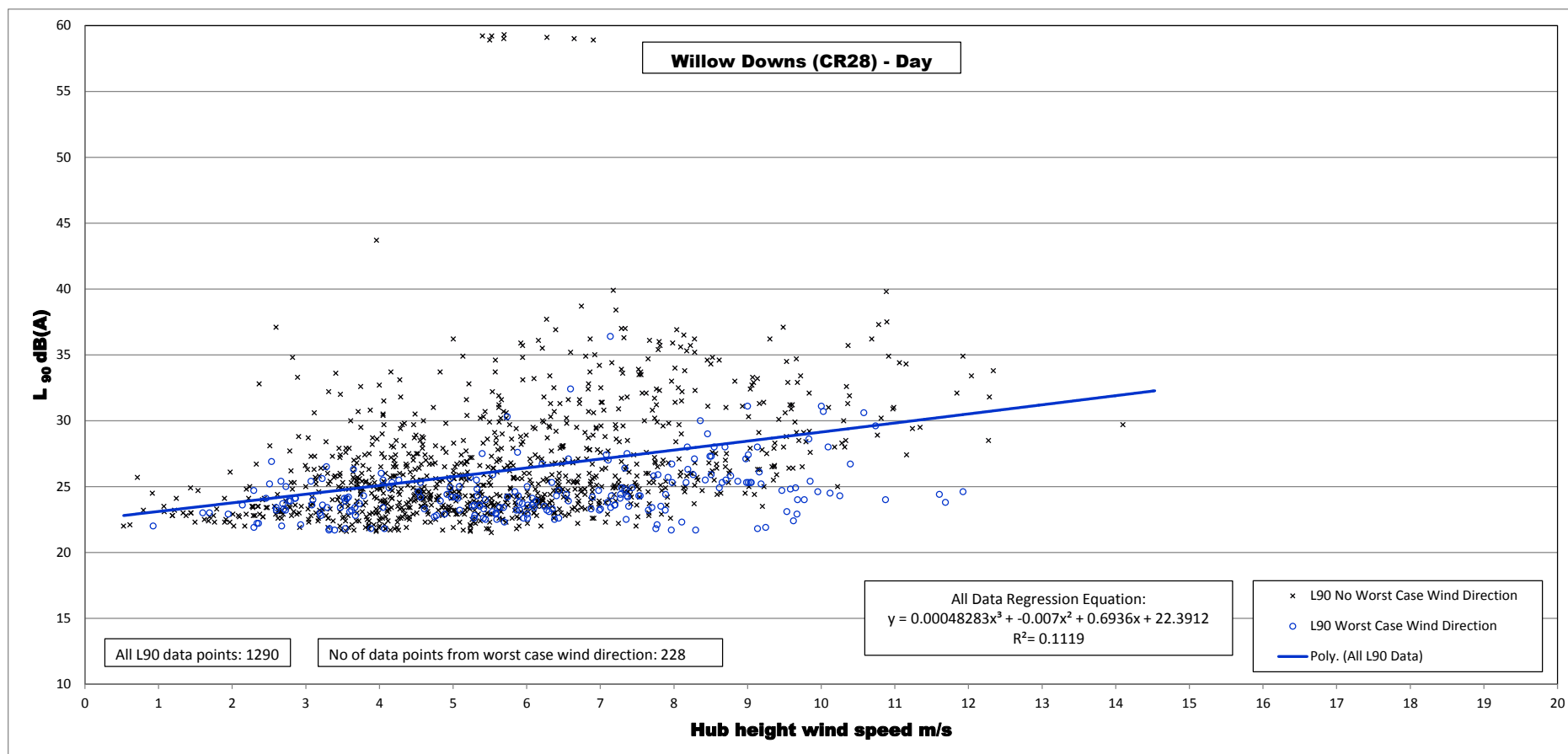


Figure 28 CR28 Willow Downs Regression Analysis – Day

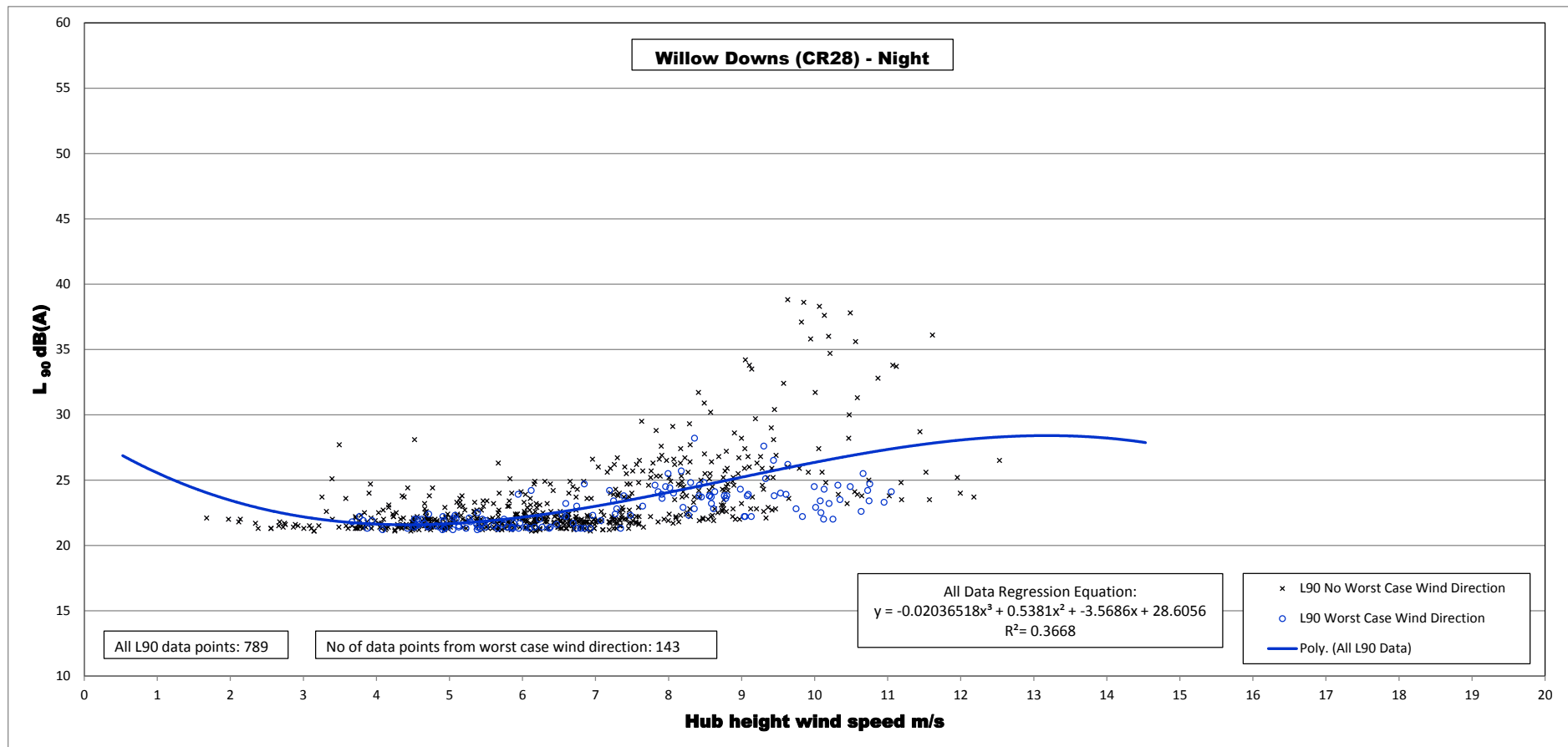


Figure 29 CR28 Willow Downs Regression Analysis – Night

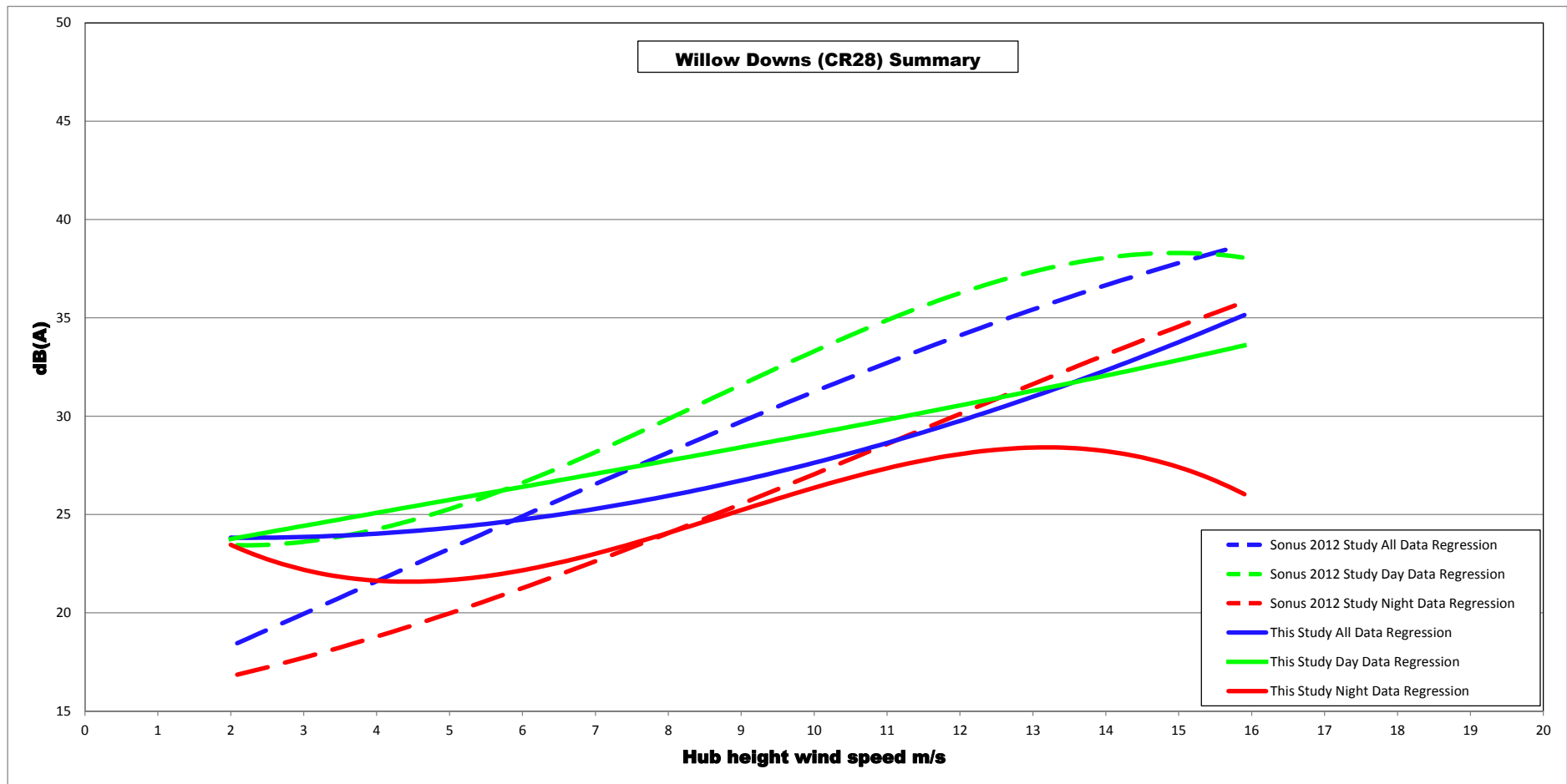


Figure 30 CR28 Willow Downs Regression Analysis Summary

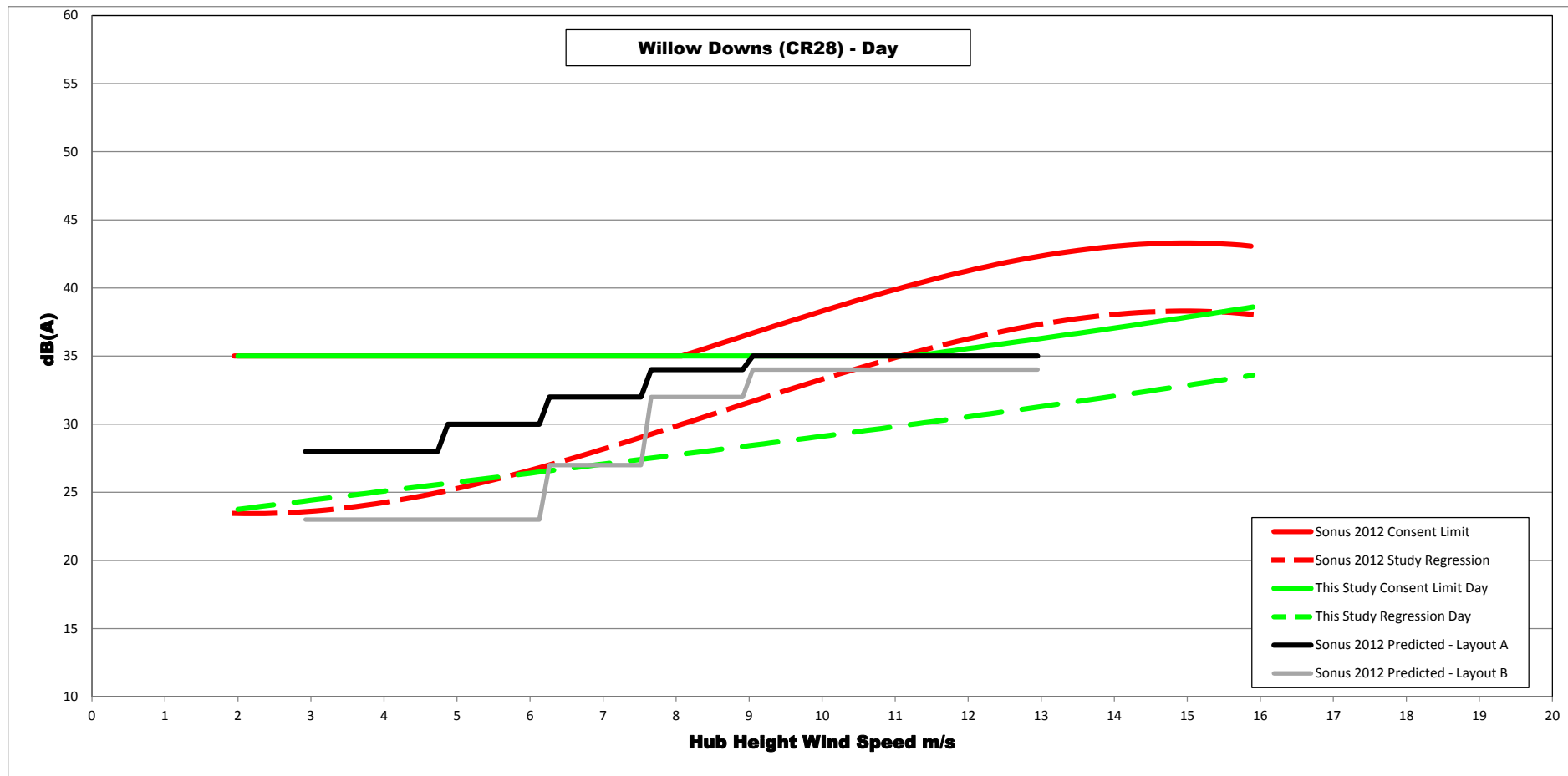


Figure 31 CR28 Willow Downs Compliance Analysis – Day

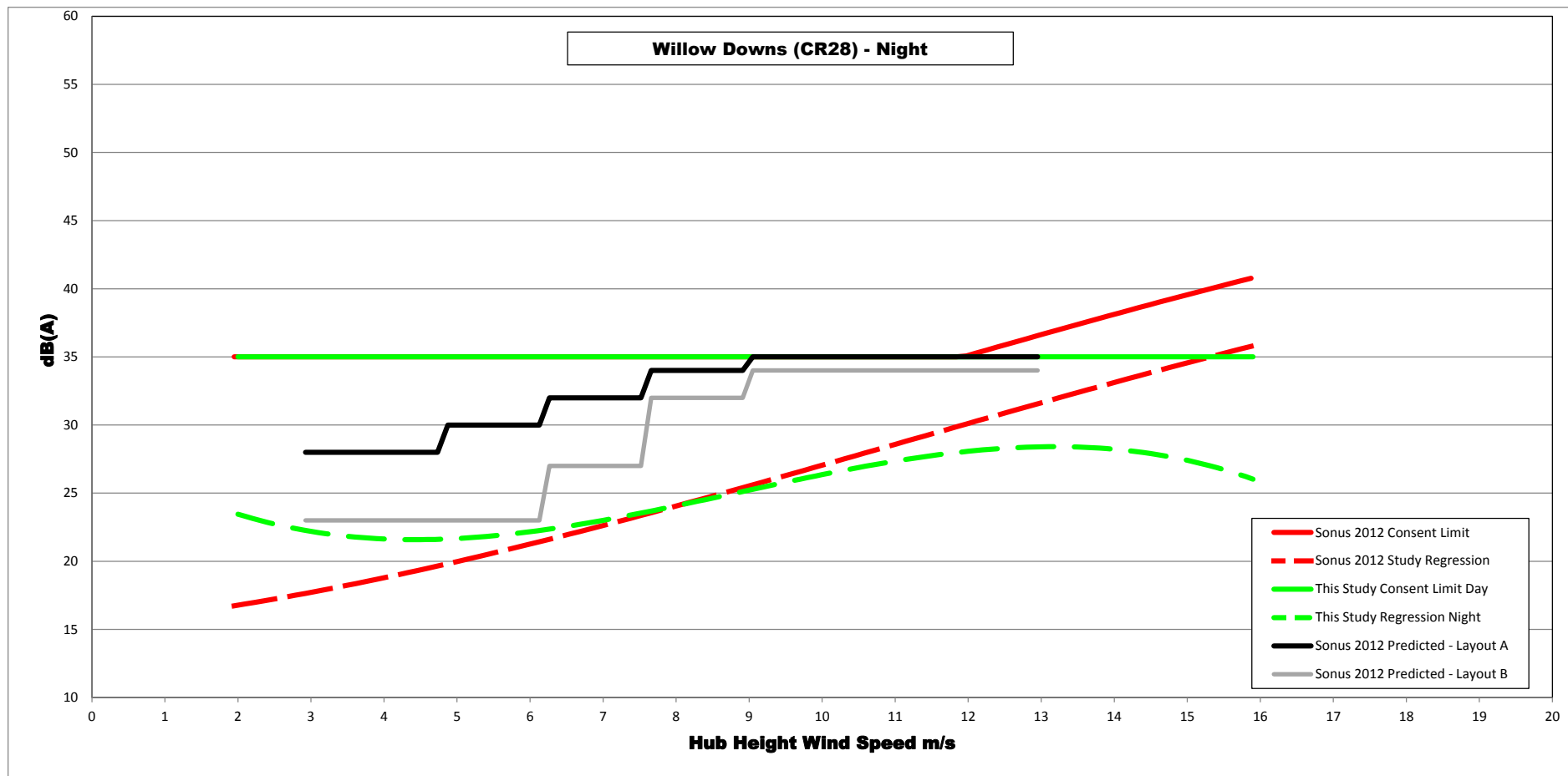


Figure 32 CR28 Willow Downs Compliance Analysis – Night

7.4 CR18 Glendaire

CR18 Glendaire is a non-involved property. It was observed while on site that a refrigeration unit within the garage located north west of the dwelling produced an intermittent humming noise during operation. This was assessed as likely to interfere with the measurement of background noise level and therefore the noise logger was placed on the other side of the dwelling to provide shielding from the intruding noise.

The location selected for the noise monitoring is at the front of the property at a distance of 20m from the dwelling in a south easterly direction with some line of sight to the proposed wind turbine locations. It is noted that the monitoring location presented in the Sonus Report was a few metres south of the garage location at deployment and was subsequently moved to the western façade of the garage. Appendix E shows photographs of the measurement location and the unattended monitoring equipment.

7.4.1 Attended Noise Survey

An attended noise survey was conducted between 1:47-2:02pm on Friday 21st June 2013 at the unattended monitoring location. One fifteen minute sample was recorded. There was a 1.0m/sec wind at the measurement location. Intermittent sounds of sheep, dogs and other unknown animals dominated the measurement. The following figure shows the variation of sound level with time for the measurement sample.

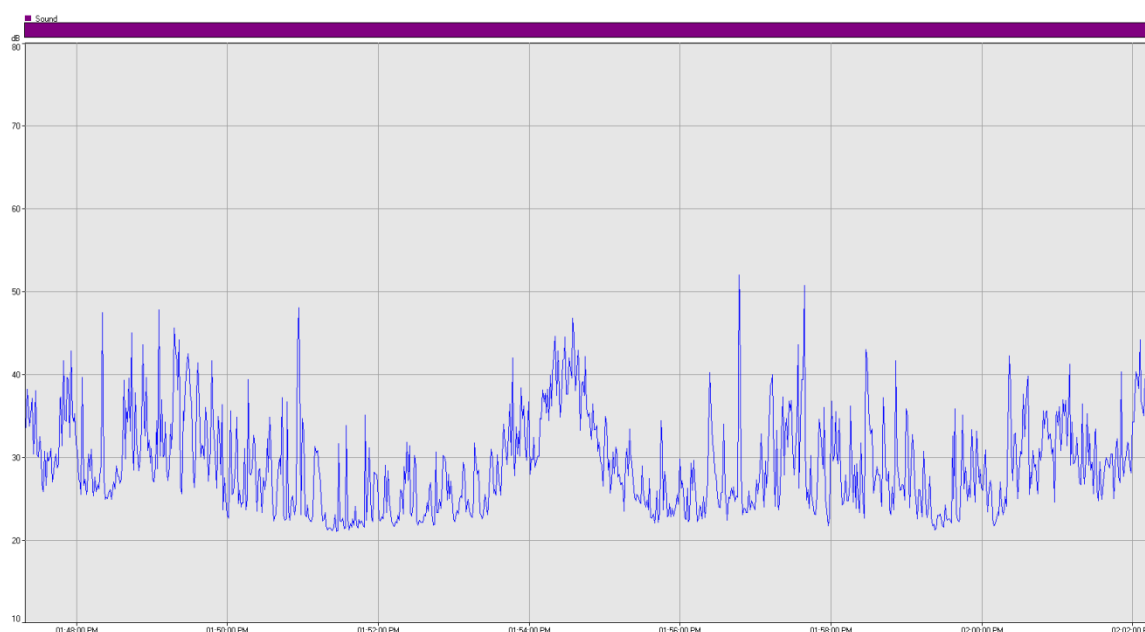


Figure 33 Sample of Sound Trace Recorded at CR18 Glendaire at 1:47pm 21/6/2013

7.4.2 Unattended Noise Survey

We now turn to the results of the unattended noise survey which are contained in Appendix E. The regression analysis is shown in Figure 34 wherein the third order polynomial resulted in the highest correlation coefficient. On the figure is shown the following:

- i) the blue line is the resultant background noise level and wind speed correlation curve;
- ii) the regression formula for the background noise level regression line;
- iii) the black crosses are the LA90(10min) values from the measurement period;

The compliance analysis is shown in Figure 35. On the figure is shown the following:

- i) in solid red, the Sonus Report consent limit;
- ii) in dashed red, the Sonus Report regression line;
- iii) in solid green, the consent limit from this study;
- iv) in dashed green, the regression line from this study;
- v) in solid black, the Sonus Report predicted noise levels from Layout A turbines operating; and,
- vi) in solid grey, the Sonus Report predicted noise levels from Layout B turbines operating.

Table 14 below summarises the data in tabular form:

Table 14 CR18 Glendaire Compliance Assessment

	10m Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	36.7	39.1	41.7	44.5	47.2	50.0	52.6	54.9	57.0
		28.0	30.0	32.0	34.0	34.0	34.0	35.0	35.0	35.0	35.0			
		23.0	23.0	28.0	32.0	34.0	34.0	34.0	34.0	34.0	34.0			
		-7.0	-5.0	-3.0	-1.0	-2.7	-5.1	-6.7	-9.5	-12.2	-15.0			
		-12.0	-12.0	-7.0	-3.0	-2.7	-5.1	-7.7	-10.5	-13.2	-16.0			

The last two rows in this table demonstrate compliance with the nominated criteria for both Layout A and B.

The Sonus regression lines and this study's regression lines show a similar trend for this receiver location.

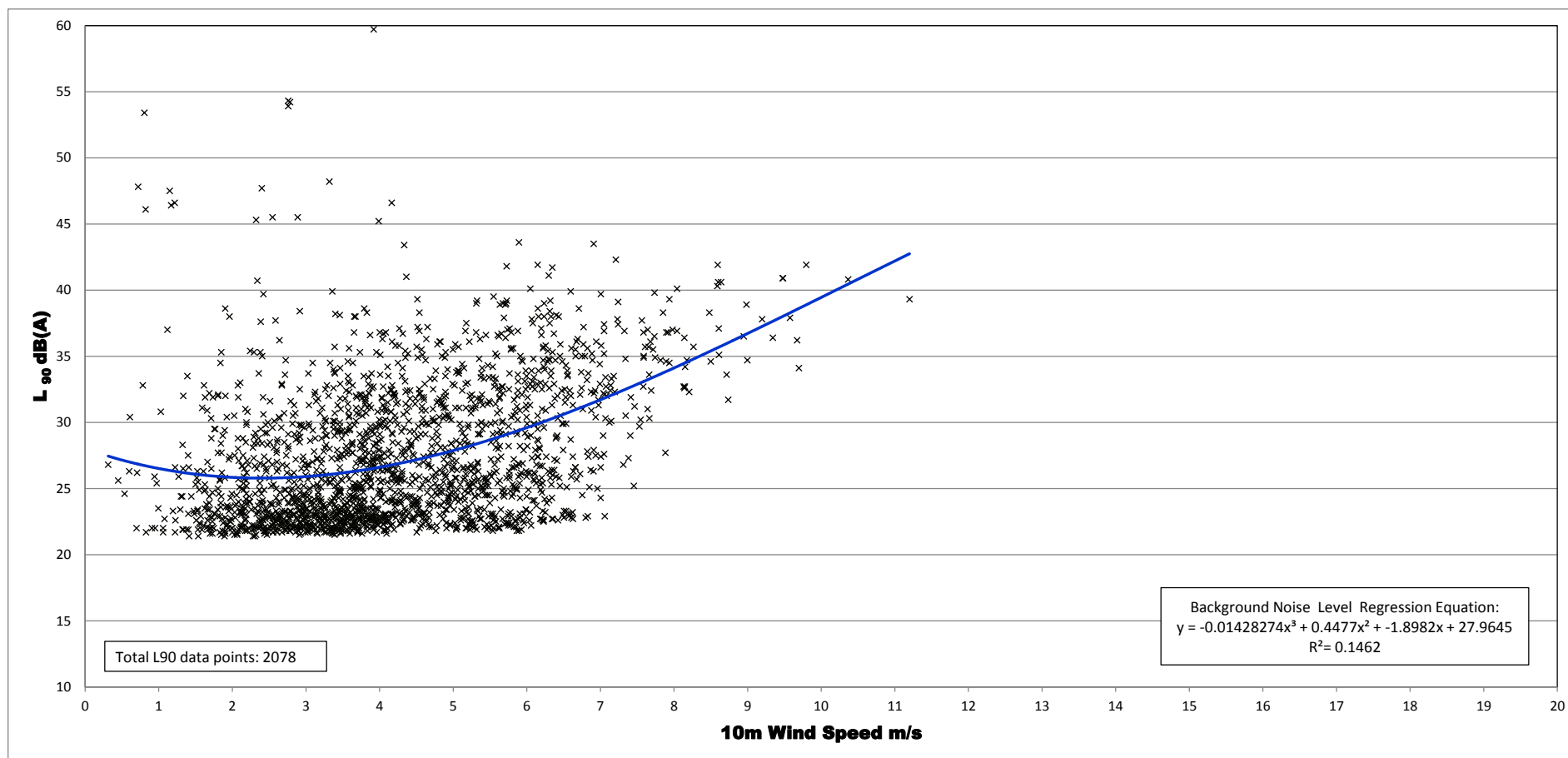


Figure 34 CR18 Glendaire Regression Analysis

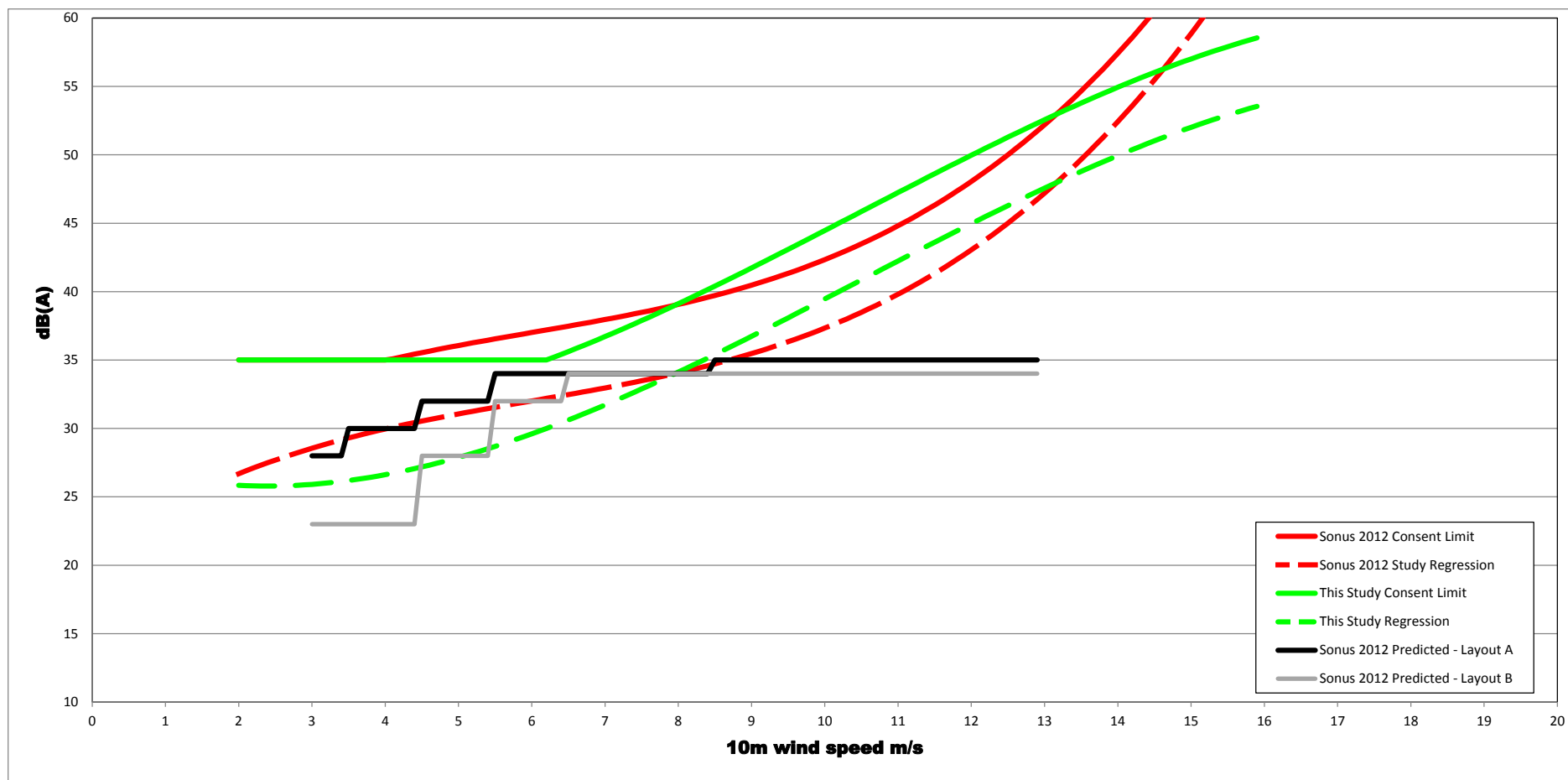


Figure 35 CR18 Glendaire Compliance Analysis

An assessment was made under the 2012 NSW Draft Guidelines. The regressions for 24 hour, day and night are presented in Figure 36, Figure 37 and Figure 38 respectively. In addition, data points within the worst case wind direction, meaning a wind direction within 45degrees of an imaginary line drawn between the closest turbine and the receptor, are denoted by a blue circle instead of a black cross. The worst case wind direction presented in the regression analysis are for both turbine Layout A and B, which share the same worst case wind direction.

Figure 39 presents a summary of all regression curves generated. Regression curves from the Sonus Report are also presented, adjusting from 10m wind speed to hub height (80m) wind speed using the methodology previously described. On the figure is shown the following:

- i) in dashed blue, the Sonus Report 24 hour regression line;
- ii) in dashed green, the Sonus Report Day regression line;
- iii) in dashed red, the Sonus Report Night regression line;
- iv) in solid blue, the 24 hour regression line from this study;
- v) in solid green, the Day regression line from this study; and,
- vi) in solid red, the Night regression line from this study.

It can be seen from the figure that the 24 hour and day regression lines trend reasonably well with Sonus regression lines. For night time the Sonus regression line is generally higher than this study for wind speeds up to approximately 10.5m/s at which point the curves cross and the opposite applies.

The compliance analysis for day and night periods are shown in Figure 40 and Figure 41 respectively.

Table 15 and Table 16 below summarise the data in tabular form:

Table 15 CR28 Willow Downs Compliance Assessment - Day

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.4	37.0	38.8	40.5	42.1	43.4	44.1	44.3	43.8
Layout A Predicted		28.0	28.0	30.0	30.0	32.0	34.0	34.0	34.0	34.0	35.0			
Layout B Predicted		23.0	23.0	23.0	23.0	28.0	32.0	32.0	34.0	34.0	34.0			
Layout A Predicted - Criteria		-7.0	-7.0	-5.0	-5.0	-3.4	-3.0	-4.8	-6.5	-8.1	-8.4			
Layout B Predicted - Criteria		-12.0	-12.0	-12.0	-12.0	-7.4	-5.0	-6.8	-6.5	-8.1	-9.4			

Table 16 CR28 Willow Downs Compliance Assessment - Night

	Hub Height (80m) Wind Speed m/s													
	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Criteria	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	37.6	41.9	47.3	54.1	62.3
Layout A Predicted		28.0	28.0	30.0	30.0	32.0	34.0	34.0	34.0	34.0	35.0			
Layout B Predicted		23.0	23.0	23.0	23.0	28.0	32.0	32.0	34.0	34.0	34.0			
Layout A Predicted - Criteria		-7.0	-7.0	-5.0	-5.0	-3.0	-1.0	-1.0	-1.0	-3.6	-6.9			
Layout B Predicted - Criteria		-12.0	-12.0	-12.0	-12.0	-7.0	-3.0	-3.0	-1.0	-3.6	-7.9			

The tables above demonstrate compliance with the nominated criteria for both Layout A and B.

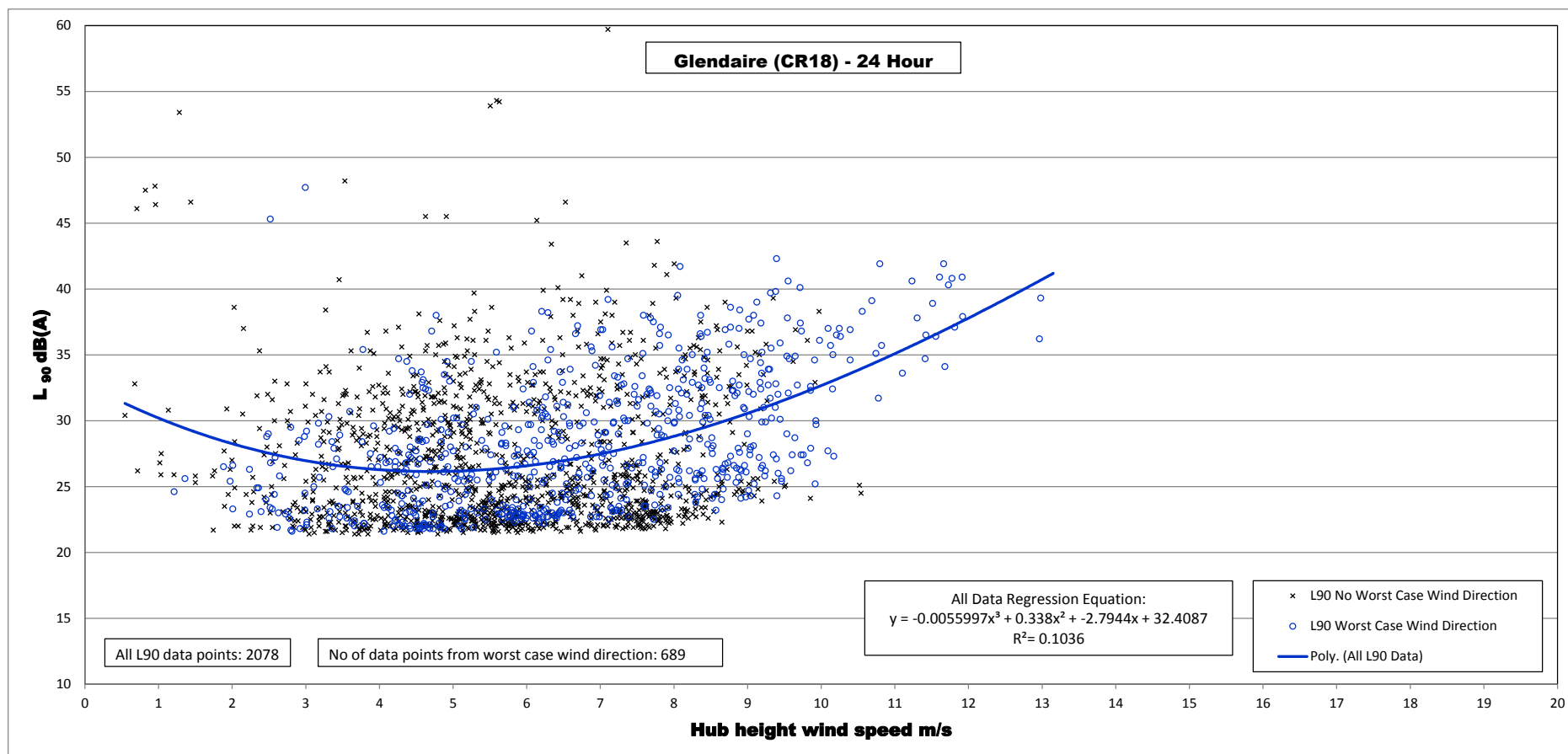


Figure 36 CR18 Glendaire Regression Analysis – 24 hour

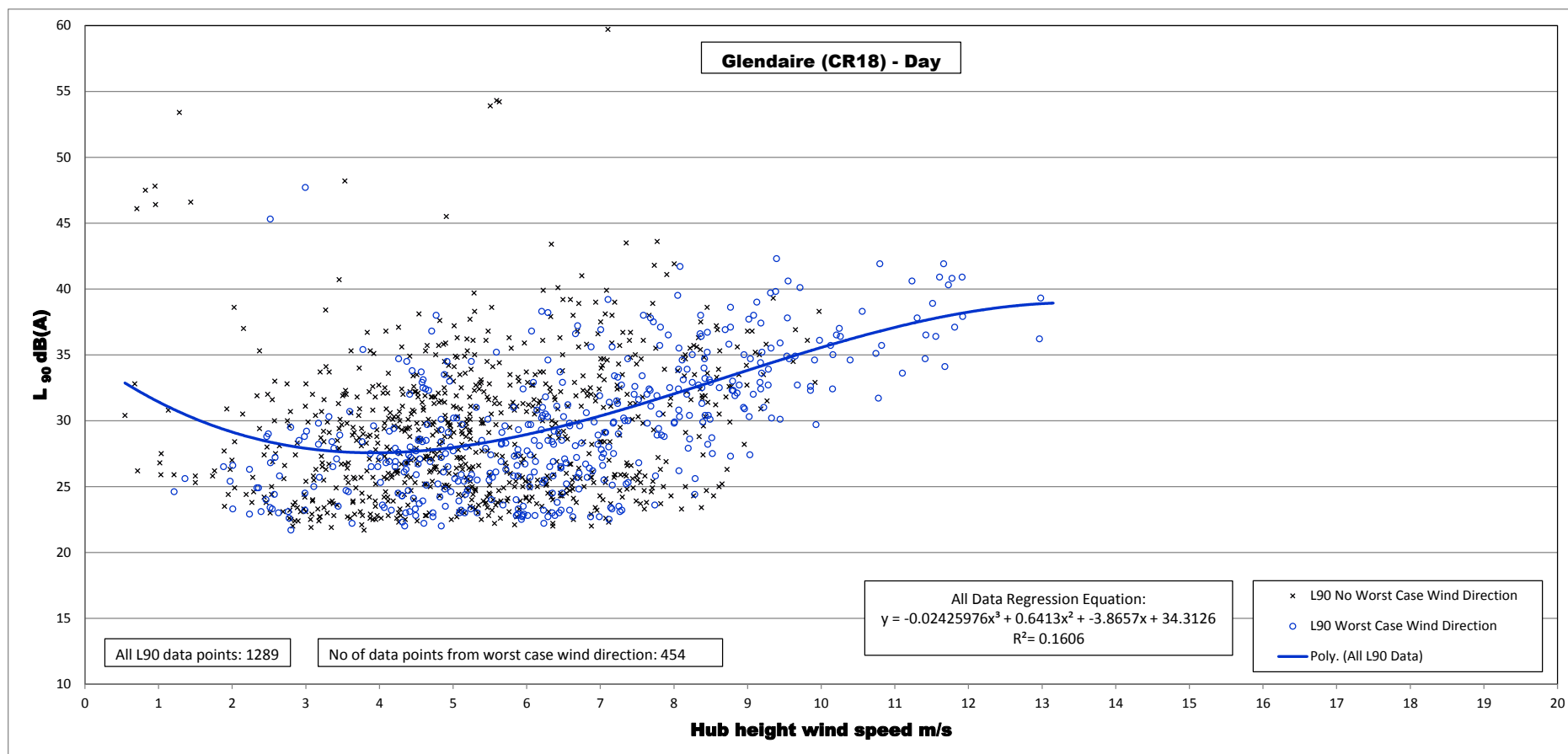


Figure 37 CR18 Glendaire Regression Analysis – Day

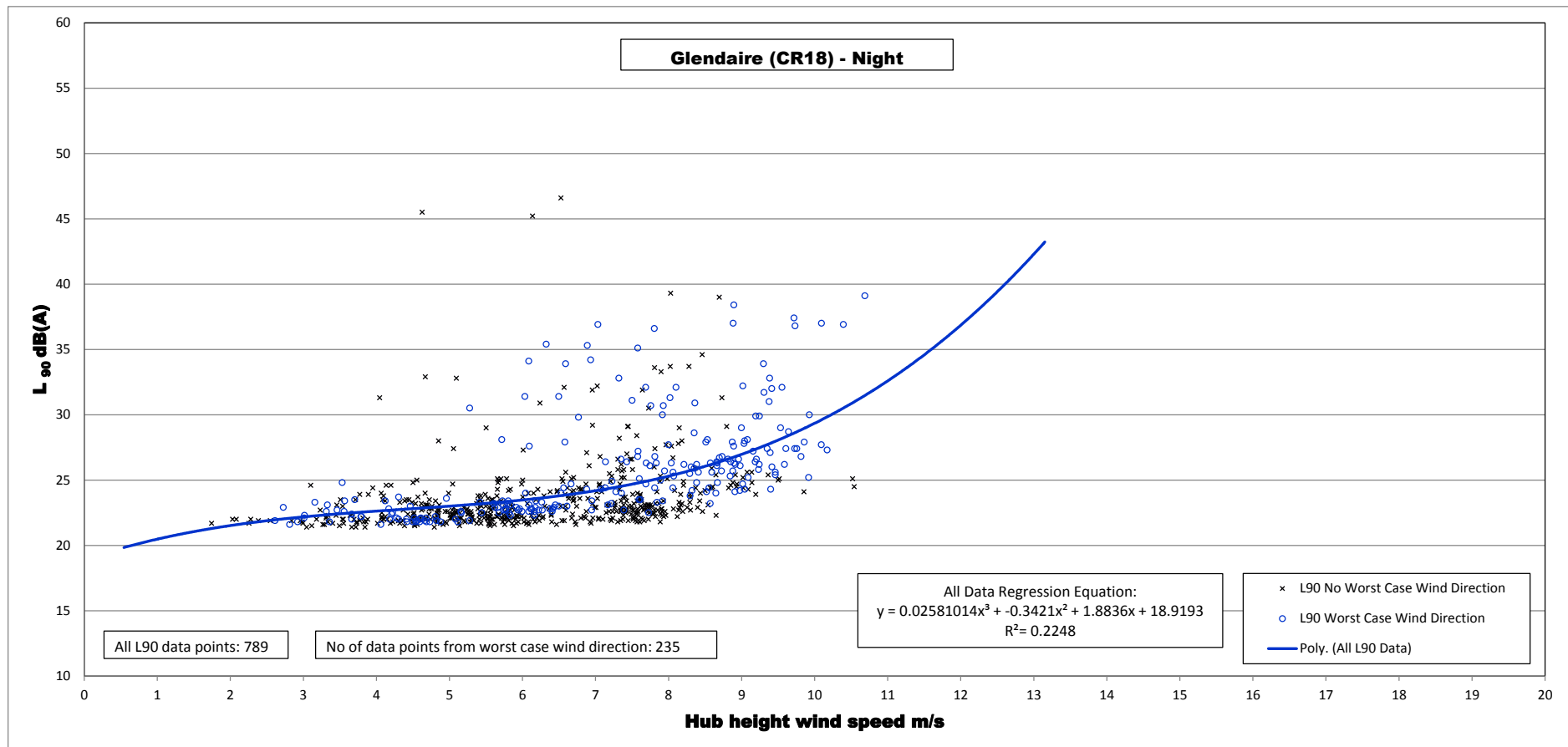


Figure 38 CR18 Glendaire Regression Analysis – Night

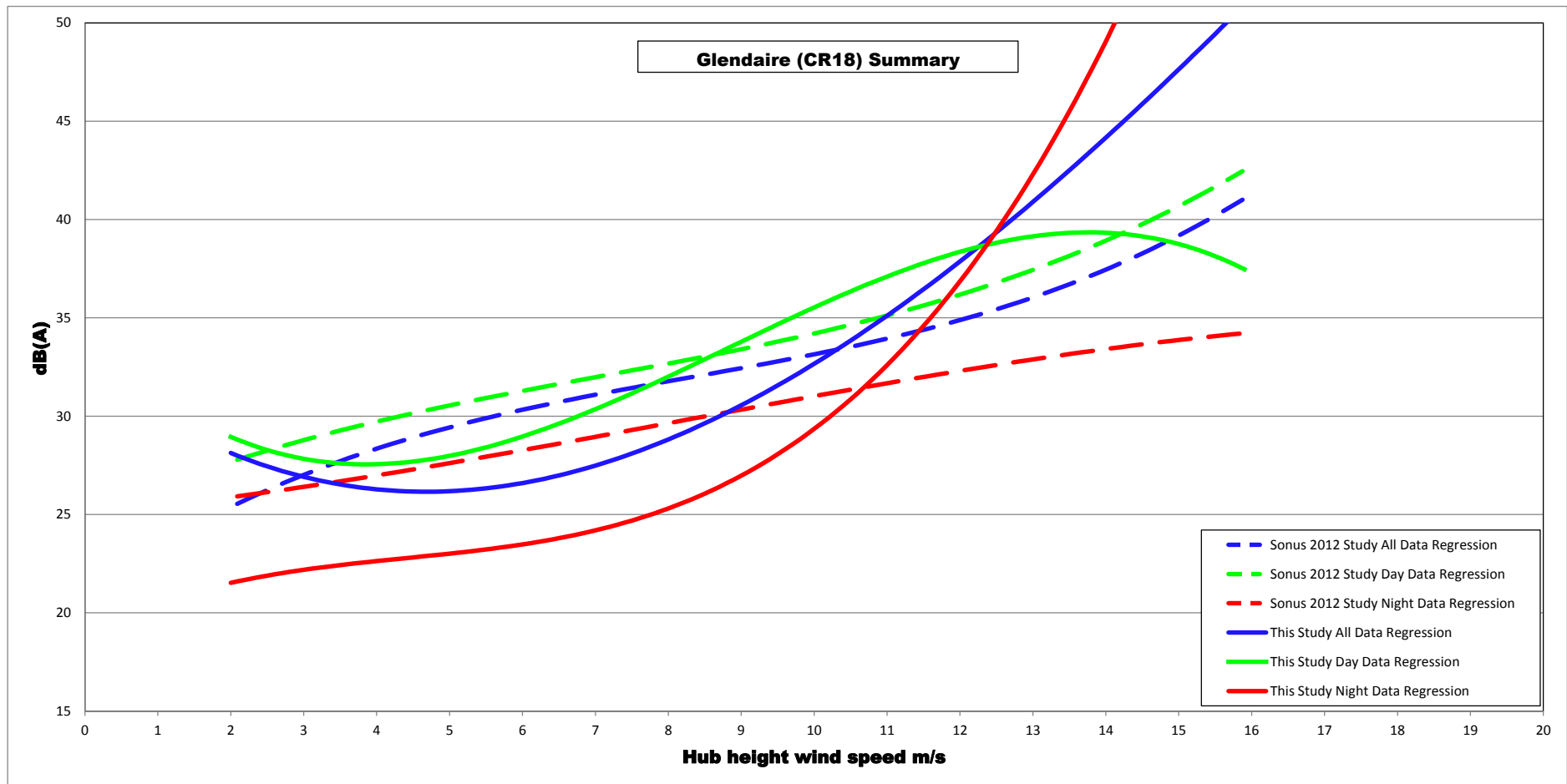


Figure 39 CR18 Glendaire Regression Analysis Summary

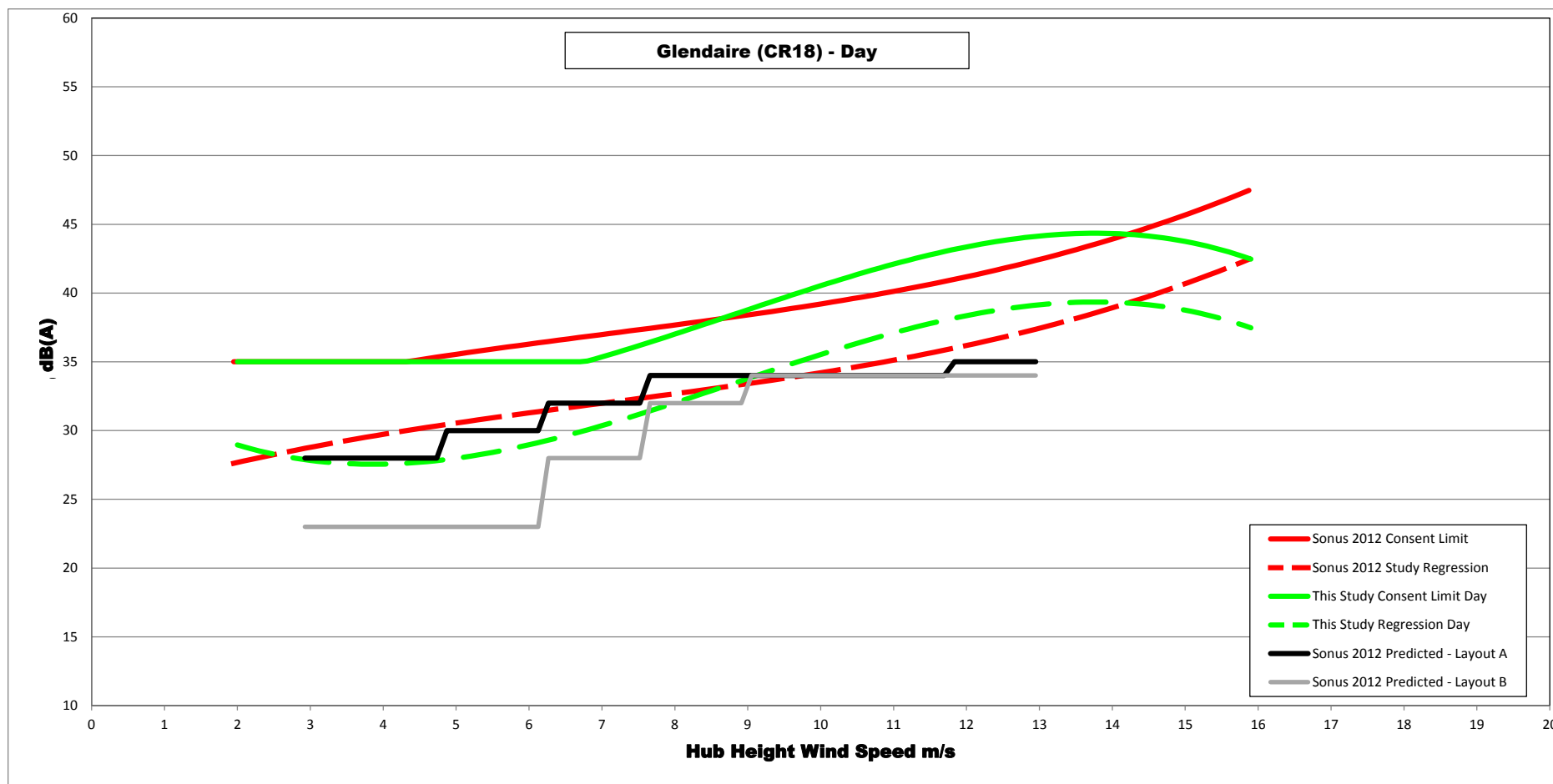


Figure 40 CR18 Glendaire Compliance Analysis – Day

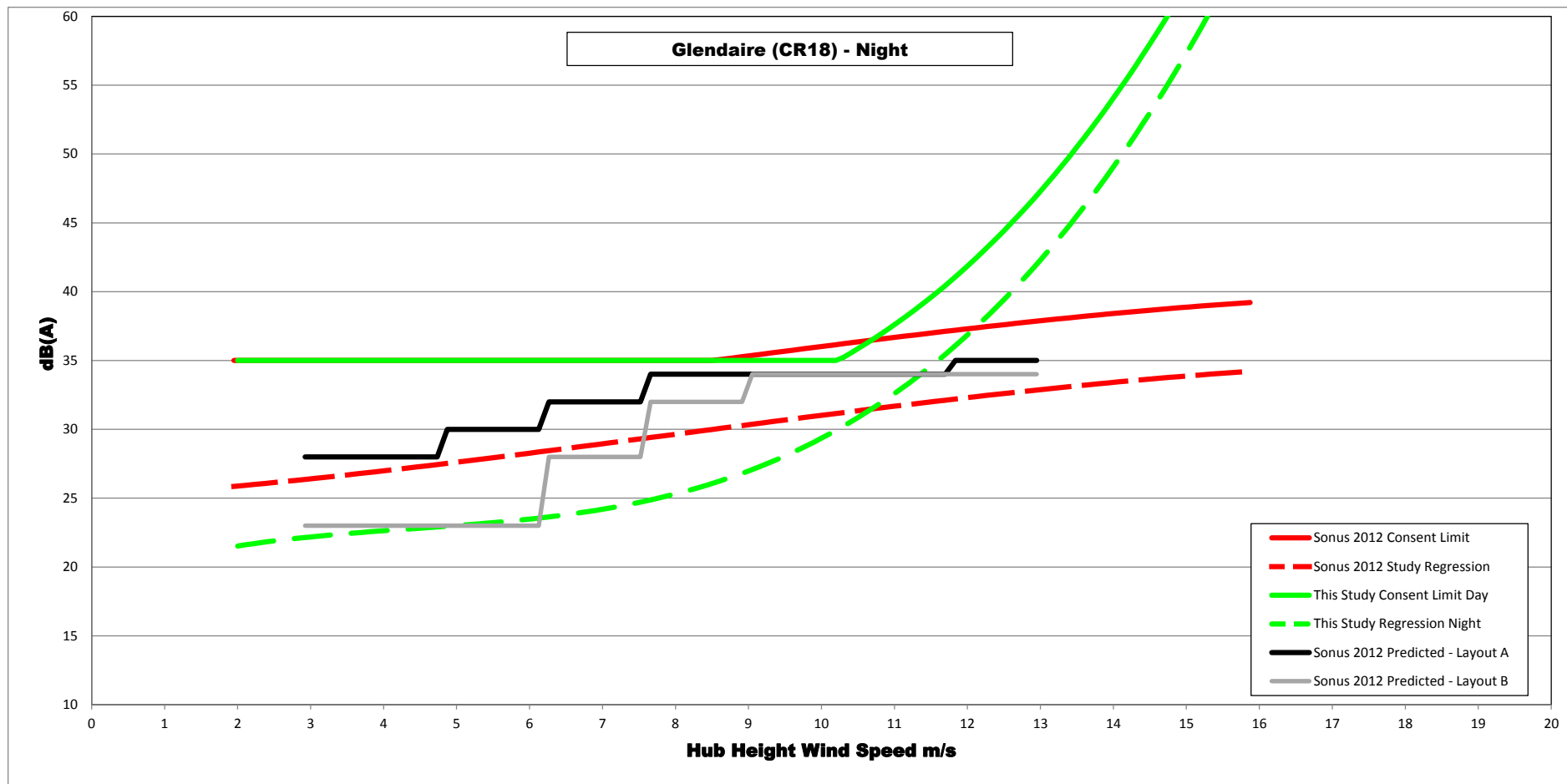


Figure 41 CR18 Glendaire Compliance Analysis – Night

8 CONCLUSION

Renzo Tonin & Associates has conducted an independent audit of the EIS Noise Impact Assessment for the proposed Crudine Ridge Wind Farm. The audit was undertaken by reference to and in accordance with the noise related DGRs and included a supplementary noise measurement program and assessment at a number of residential dwellings. A review of the The Acoustic Group report for sections directly relating to the subject wind farm was also conducted.

We conclude as follows:

- a) The EIS Noise Impact Assessment report provided to the Department by the proponent of the Crudine Ridge Wind Farm is generally adequate with certain areas of the report requiring more detailed analysis and clarification as nominated in Section 4 of this report;
- b) Issues related to the proposal and commentary which does not conflict with the DGRs in the The Acoustic Group have been discussed and addressed;
- c) A supplementary noise monitoring program and analysis of the data in accordance with the requirements stipulated in the noise-related DGRs was completed; and,
- d) In our opinion, and subject to the further information being provided as recommended in this report, we are able to confirm on the basis of all the measurement data and the computer based predicted noise levels in the proponent's EIS Noise Impact Assessment, that there is likely to be compliance with the DGR noise conditions.

APPENDIX A - GLOSSARY OF ACOUSTIC TERMS

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A):	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
Lmax	The maximum sound pressure level measured over a given period.
Lmin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B - SFR19 WOODLANDS SURVEY RESULTS





SFR19 - Woodlands

BACKGROUND & AMBIENT NOISE MONITORING RESULTS NSW 'INDUSTRIAL NOISE POLICY', 2000

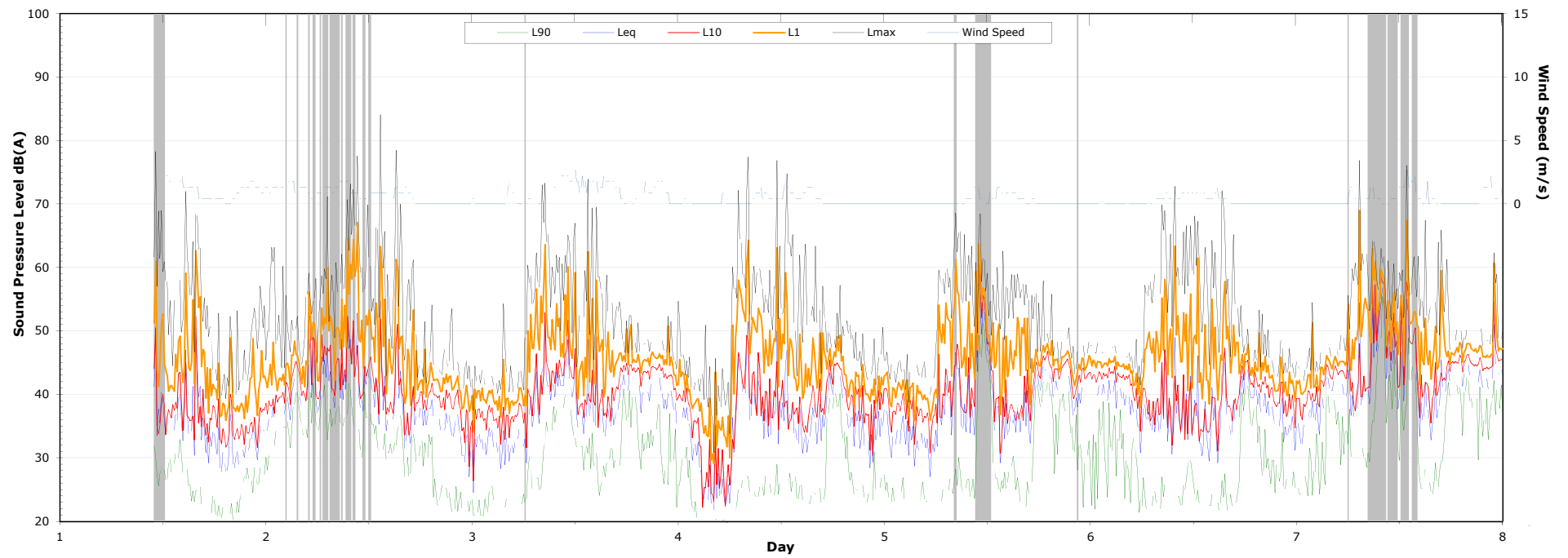
Day	L _{A90} Background Noise Levels ⁵			L _{Aeq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Thursday-06-June-2013	-	20	27	-	31	39
Friday-07-June-2013	29	22	21	44	36	33
Saturday-08-June-2013	26	31	20	42	41	36
Sunday-09-June-2013	23	24	23	41	39	34
Monday-10-June-2013	24	31	22	39	42	39
Tuesday-11-June-2013	22	26	25	40	39	39
Wednesday-12-June-2013	25	34	28	43	43	42
Thursday-13-June-2013	28	31	32	43	43	40
Friday-14-June-2013	32	31	25	43	43	40
Saturday-15-June-2013	27	29	20	41	42	31
Sunday-16-June-2013	24	30	20	42	42	31
Monday-17-June-2013	24	33	20	41	44	33
Tuesday-18-June-2013	23	22	20	41	40	31
Wednesday-19-June-2013	24	20	19	42	36	29
Thursday-20-June-2013	23	23	19	45	41	37
Friday-21-June-2013	-	-	-	-	-	-
Representative Level	24	29	21	42	41	36

Notes:

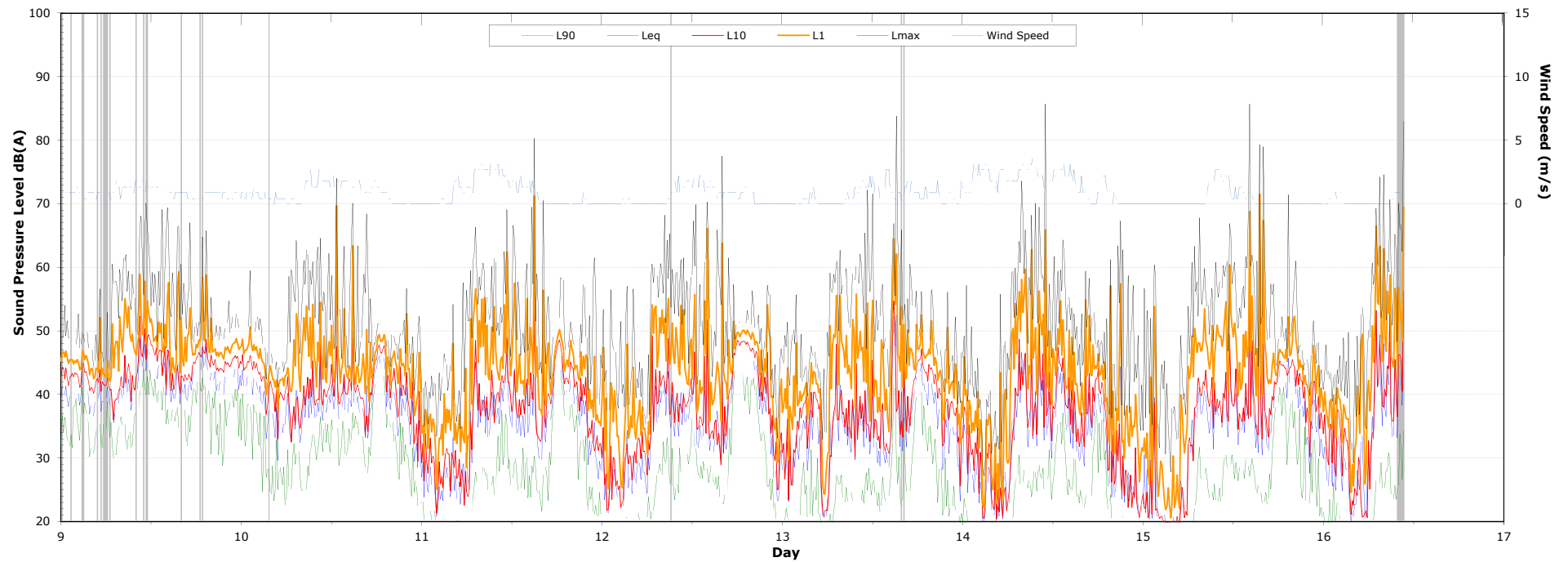
1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Rating Background Level (RBL) for L₉₀ and logarithmic average for Leq
5. Assessment Background Level (ABL)

noise logger results

Thursday, 6 June 2013 - Friday, 14 June 2013



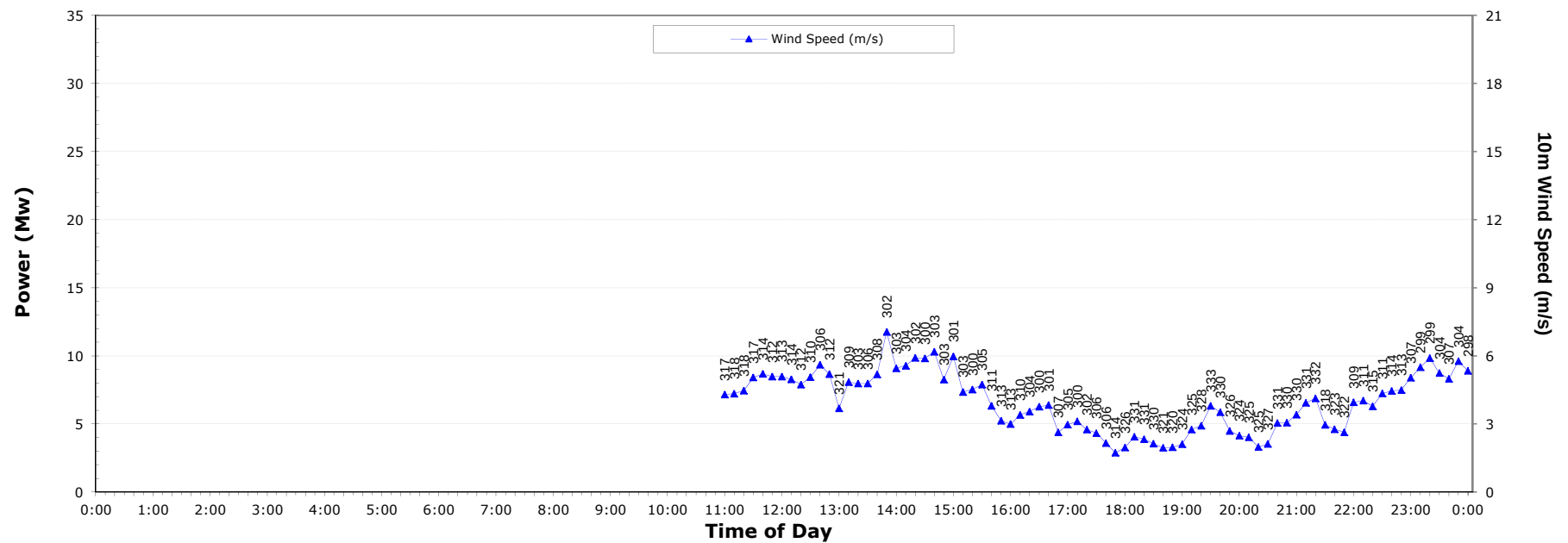
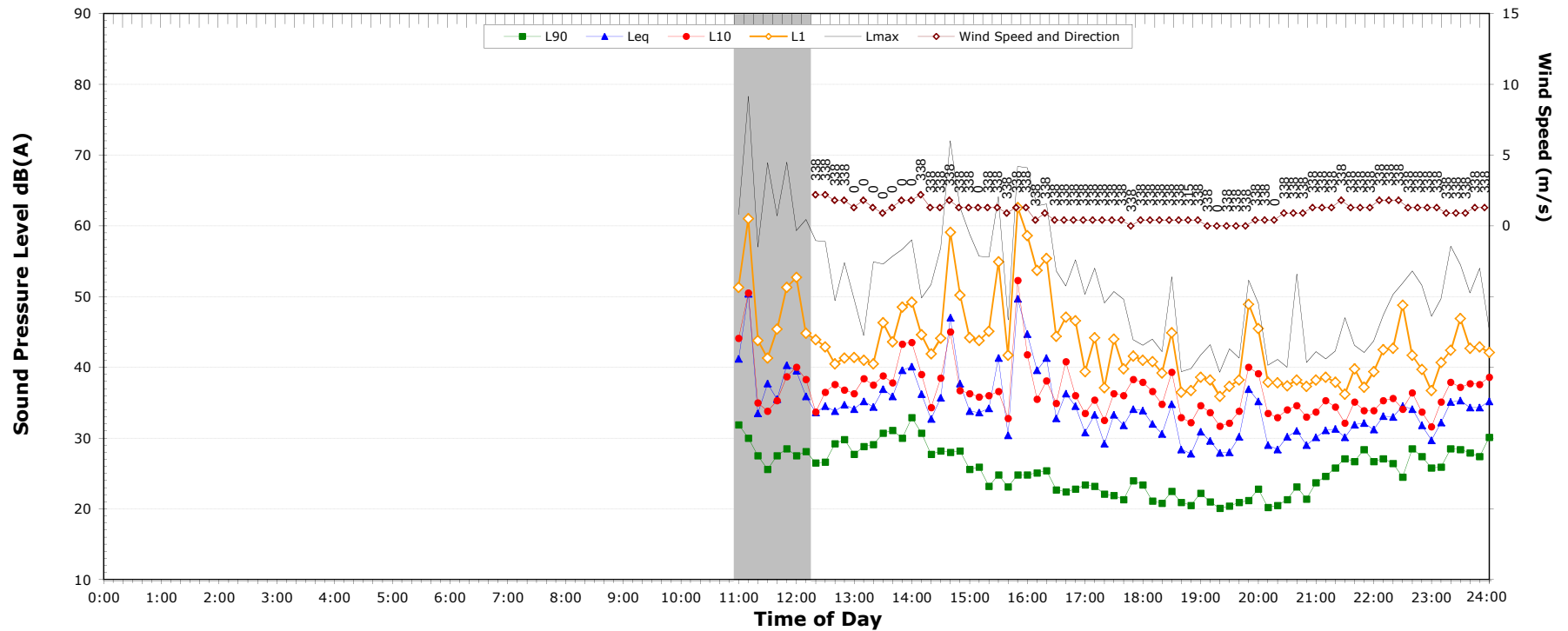
Saturday, 15 June 2013 - Saturday, 22 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

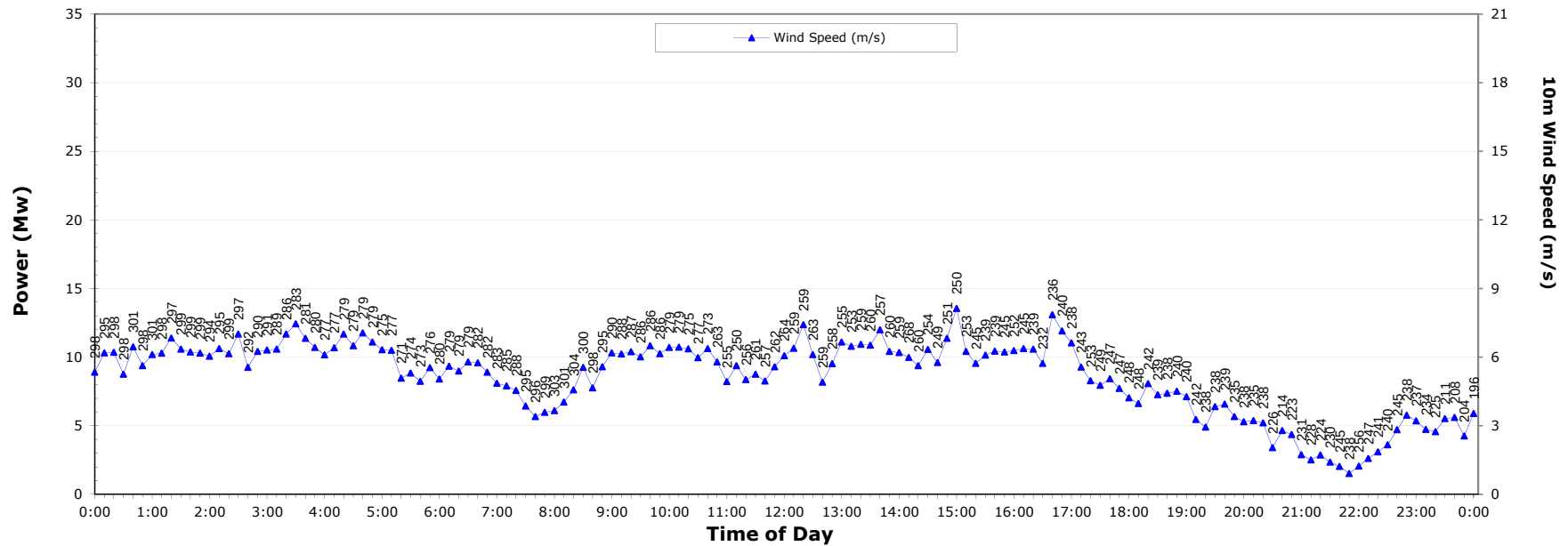
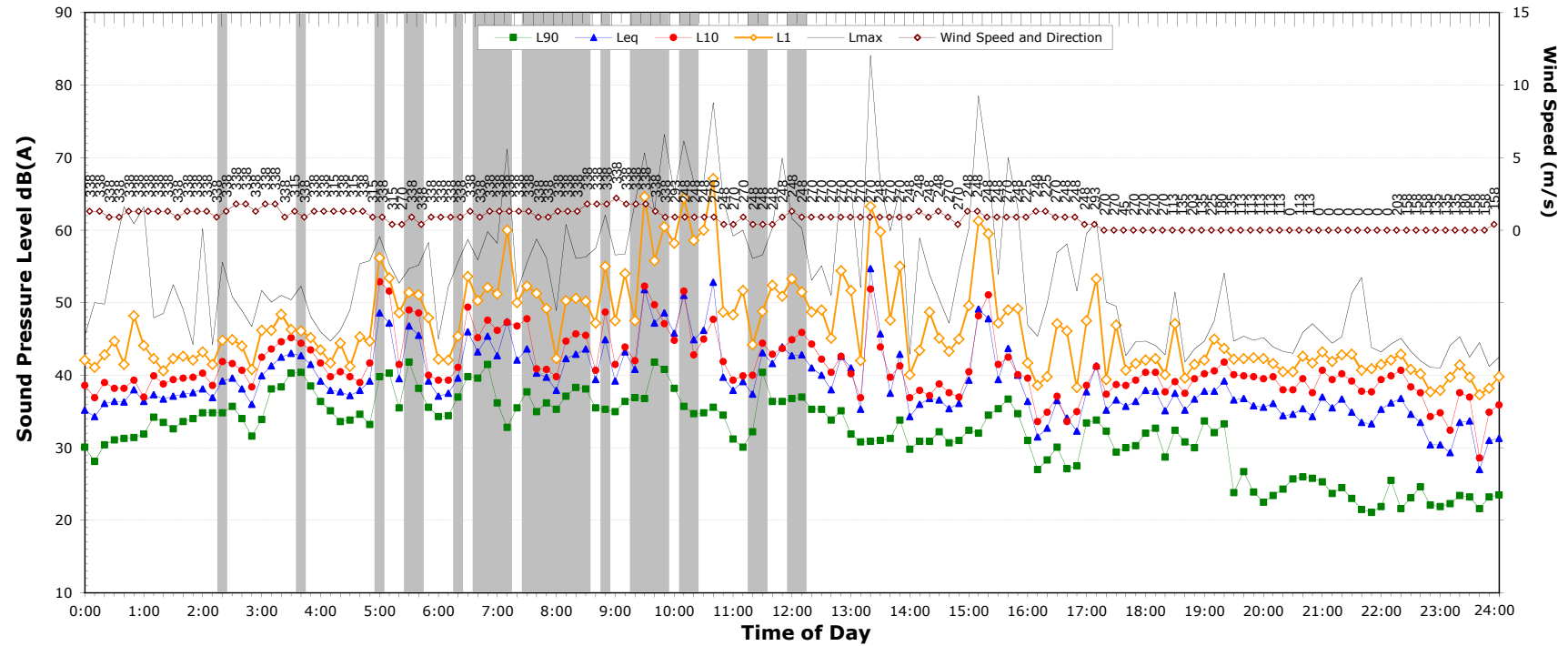
Thursday, 6 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

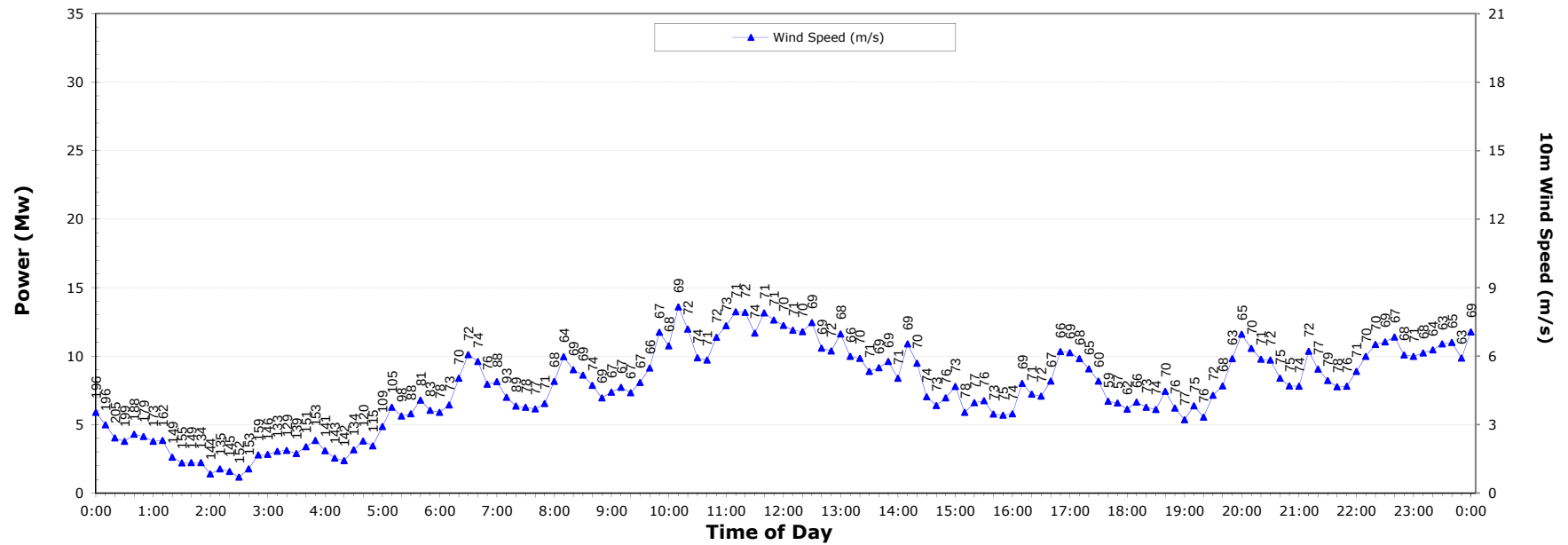
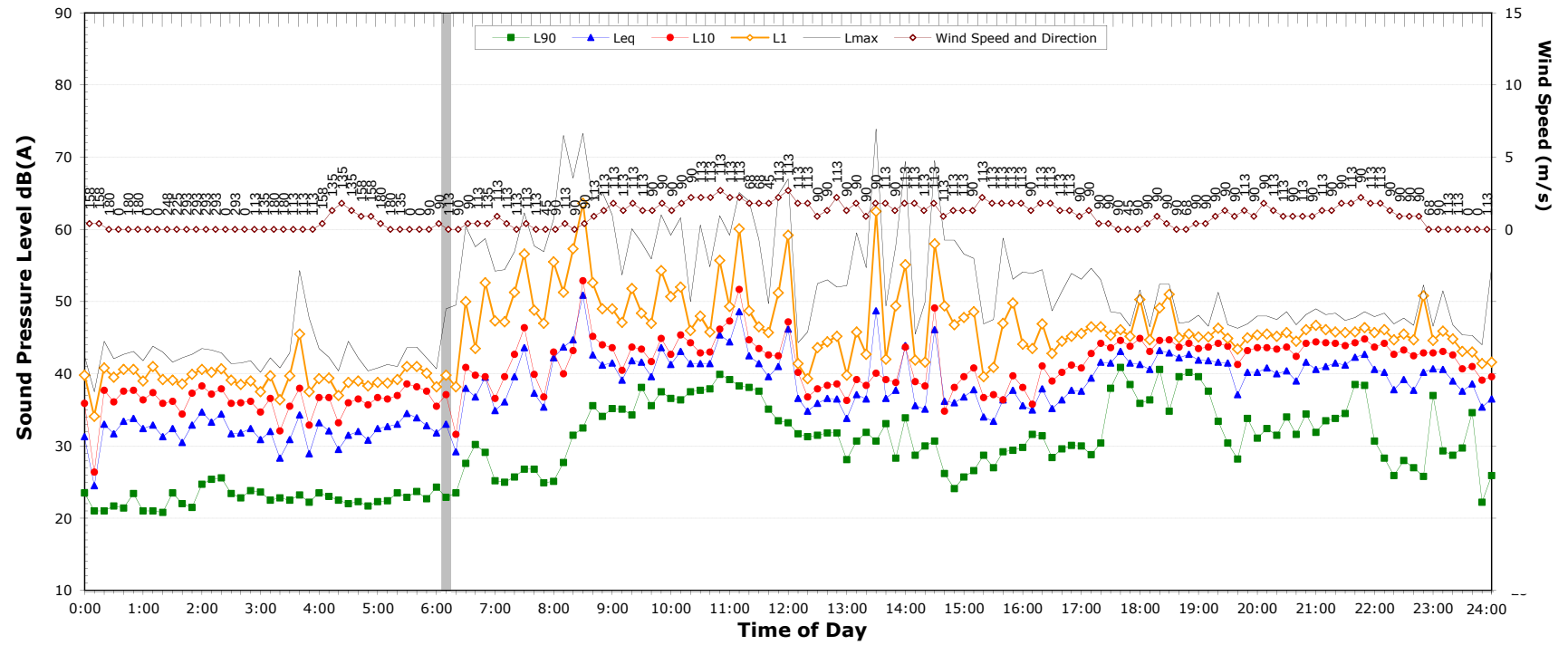
Friday, 7 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

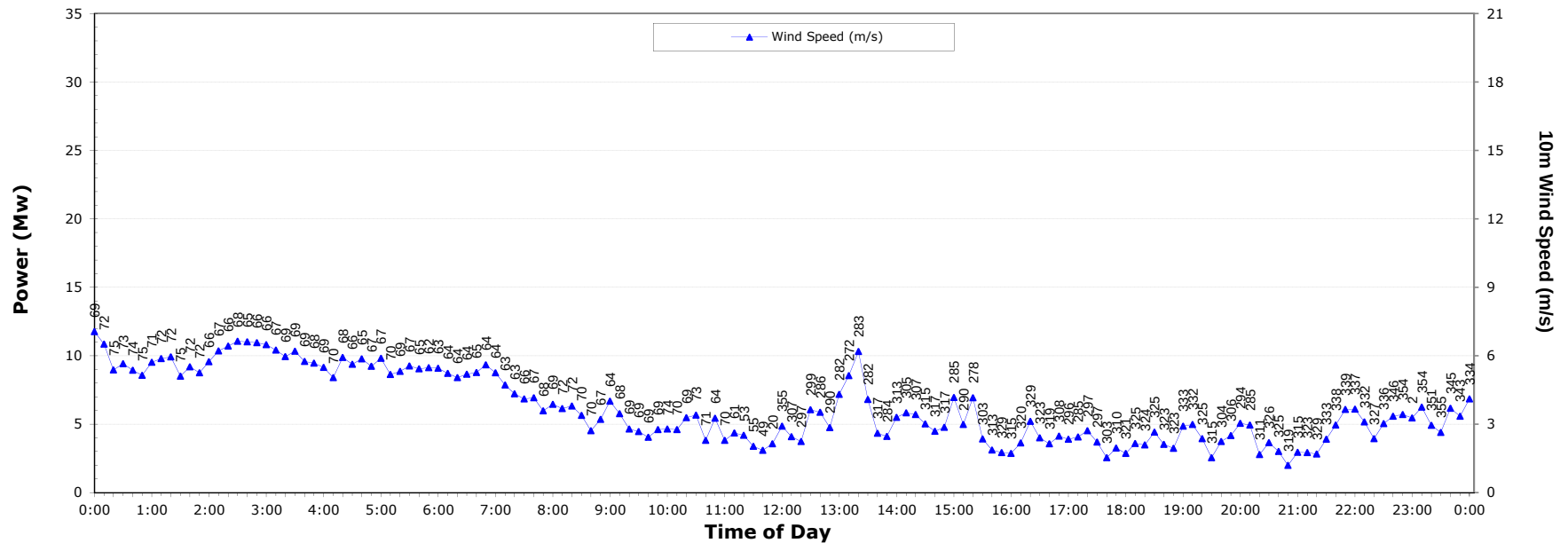
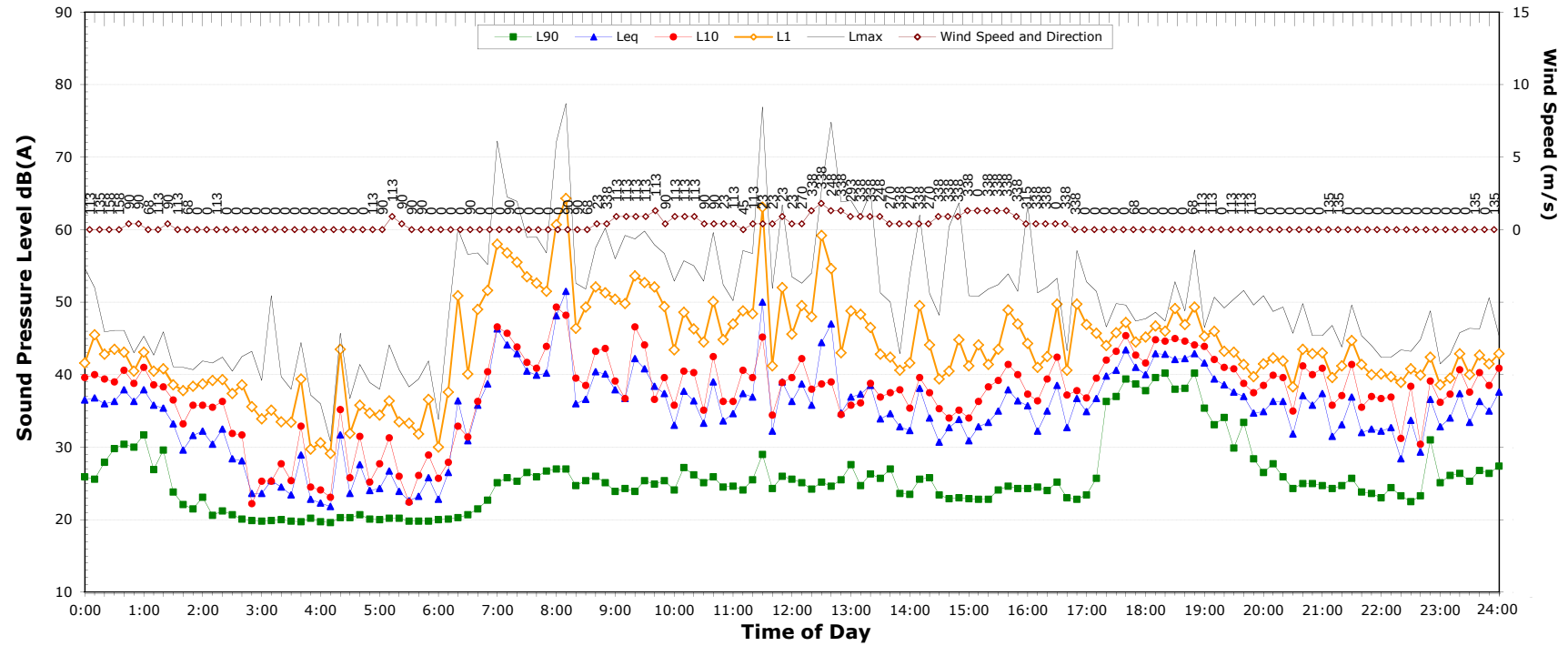
Saturday, 8 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

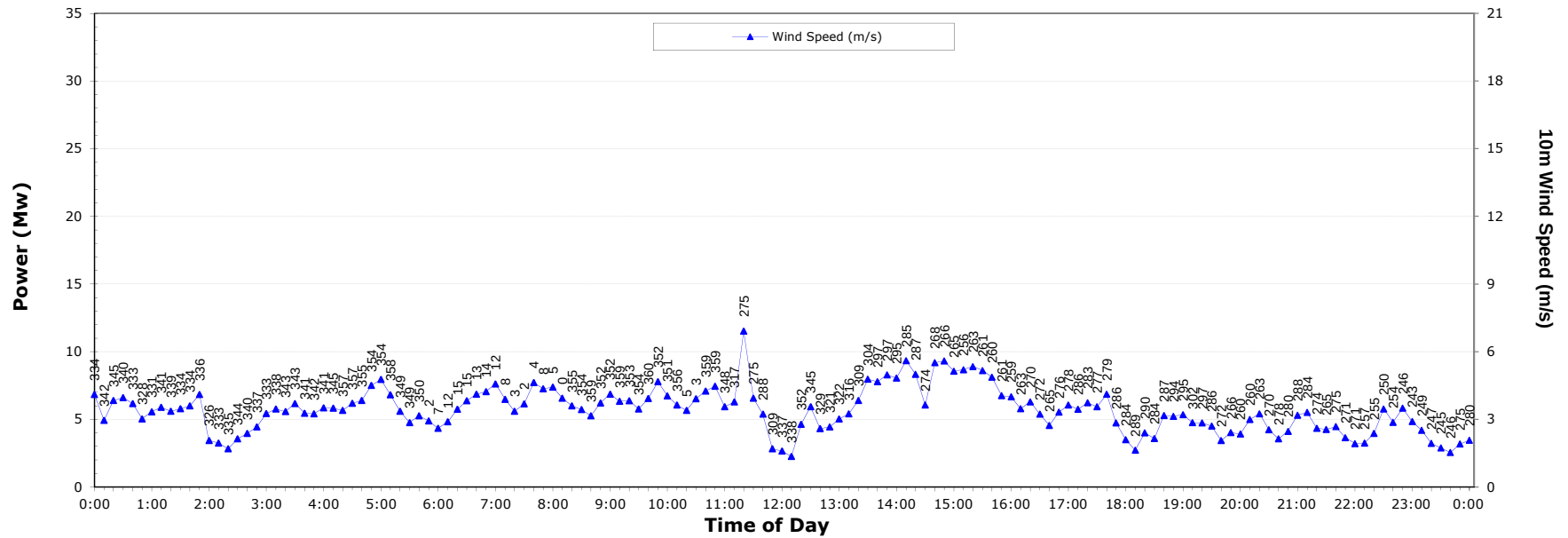
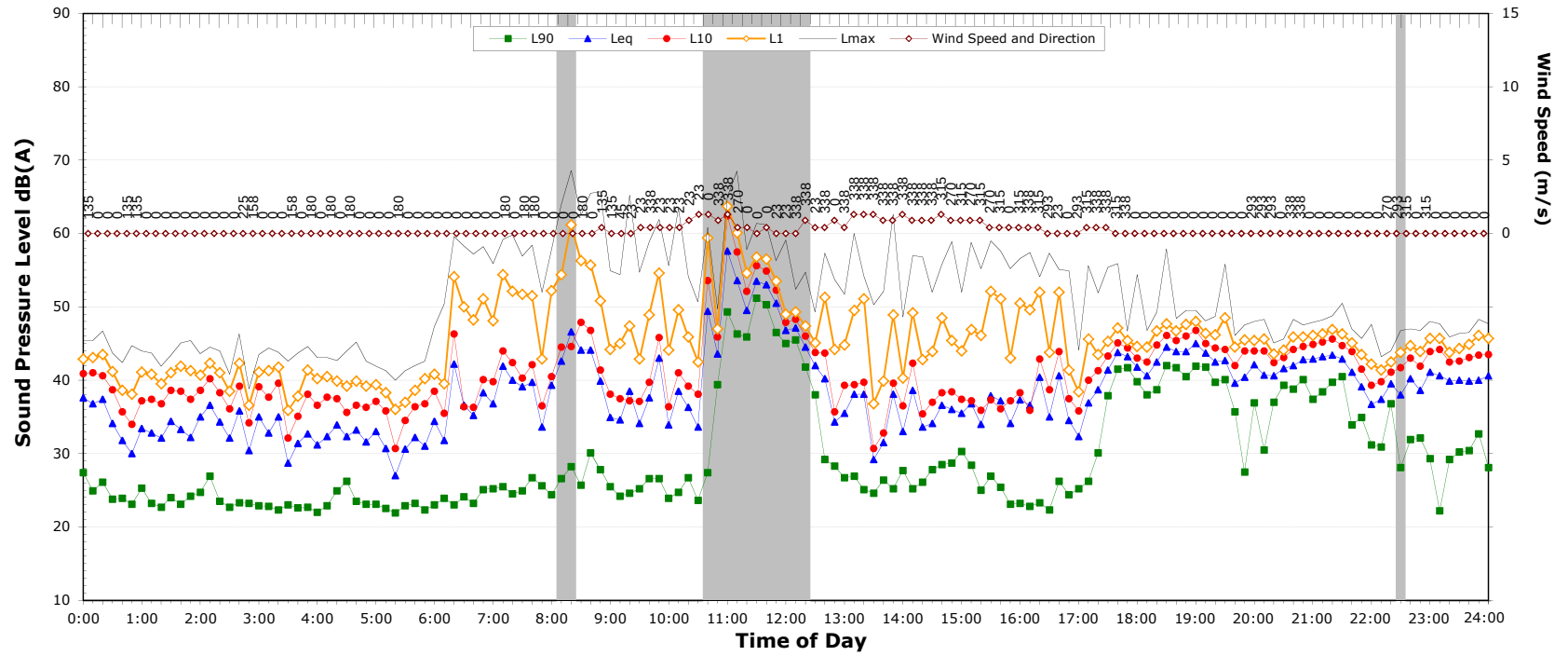
Sunday, 9 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

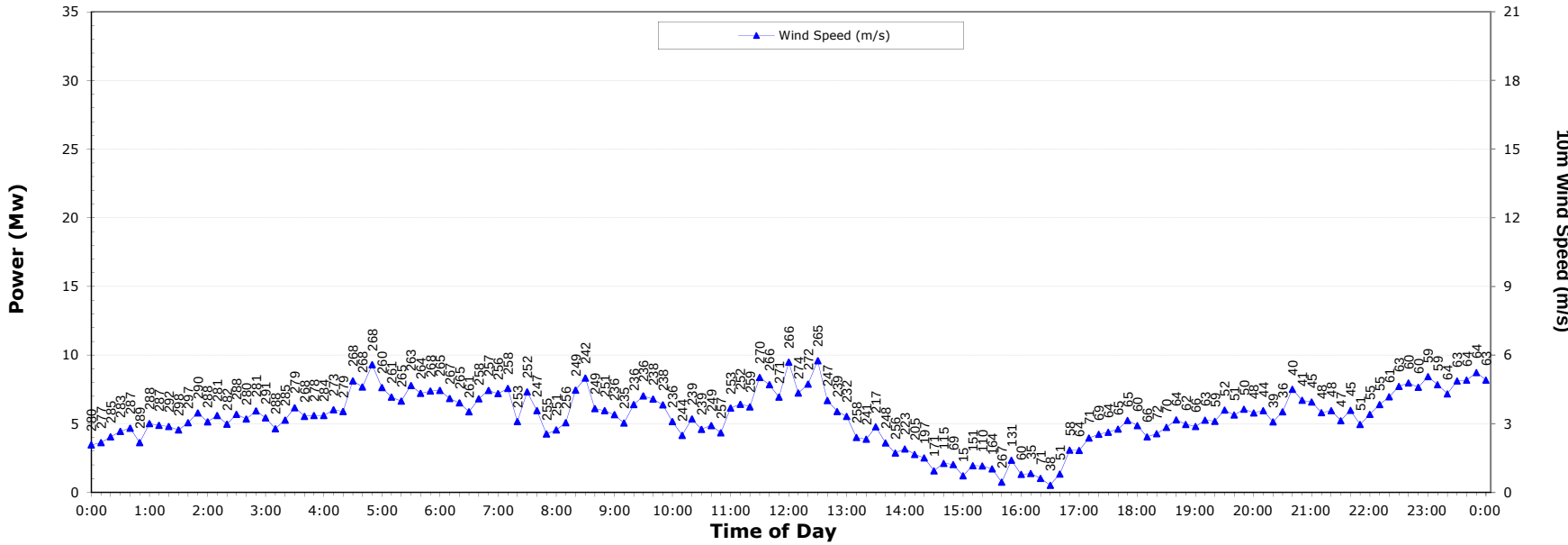
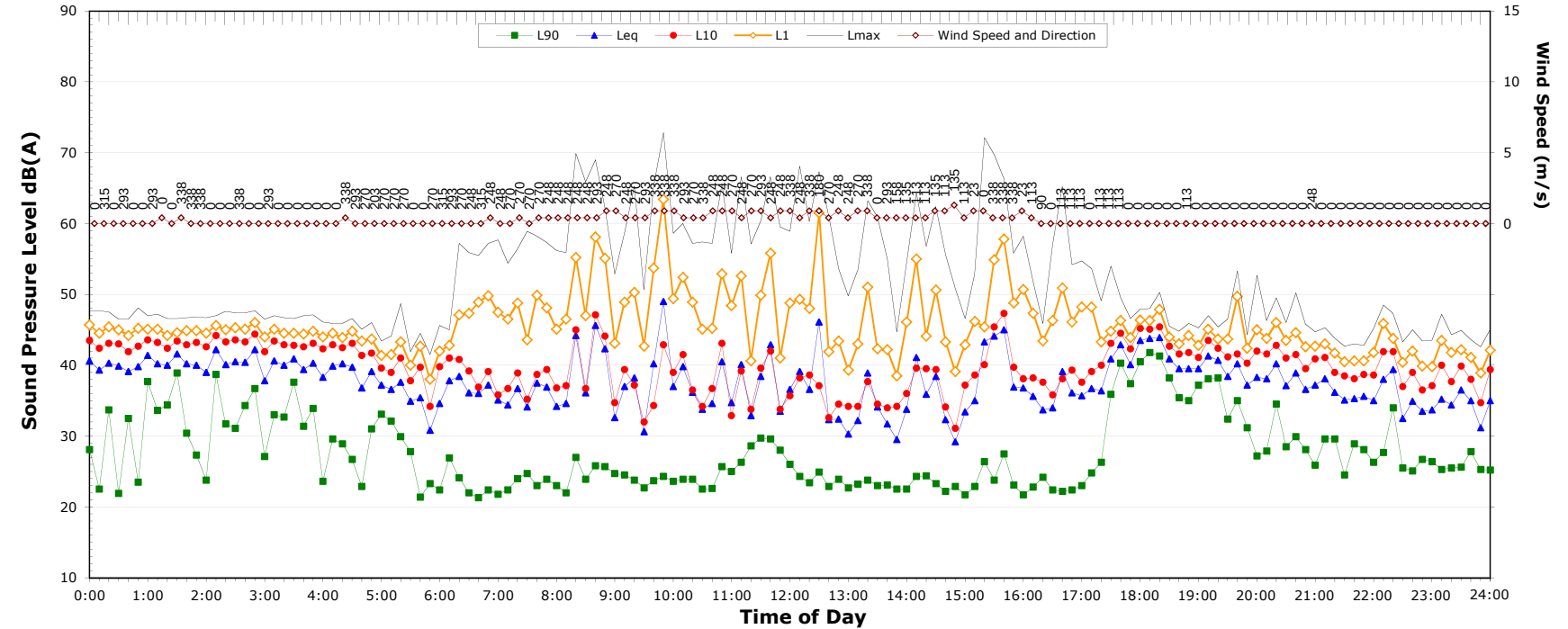
Monday, 10 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

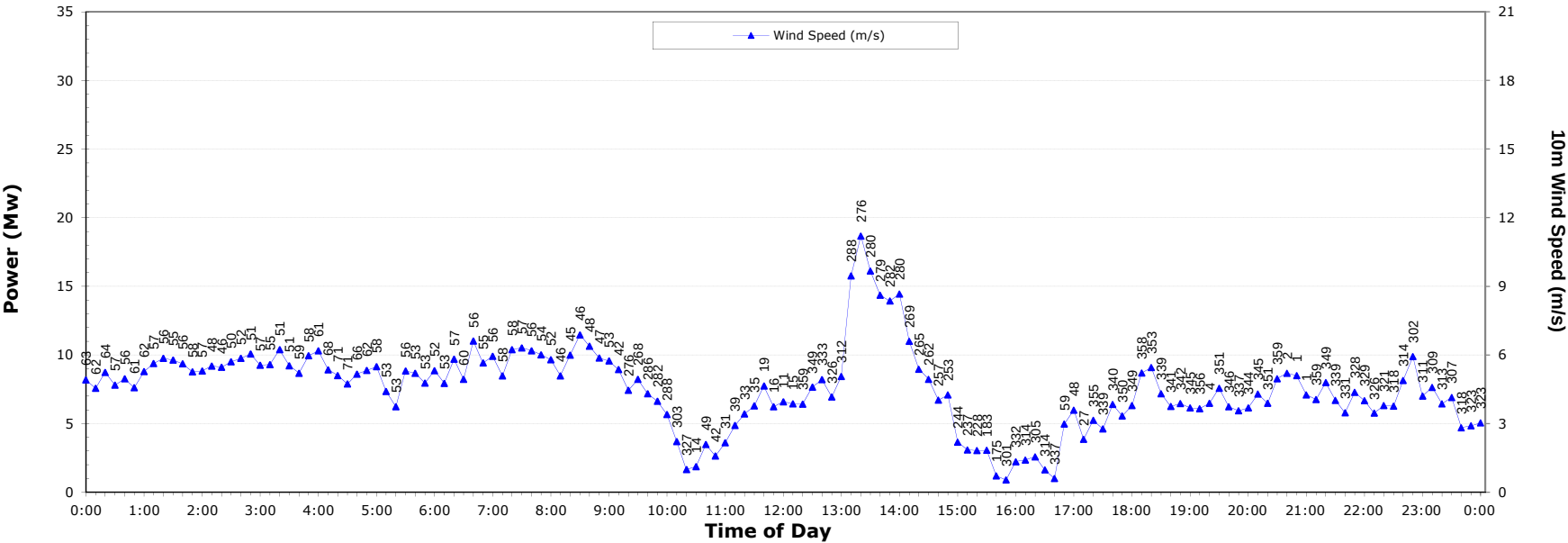
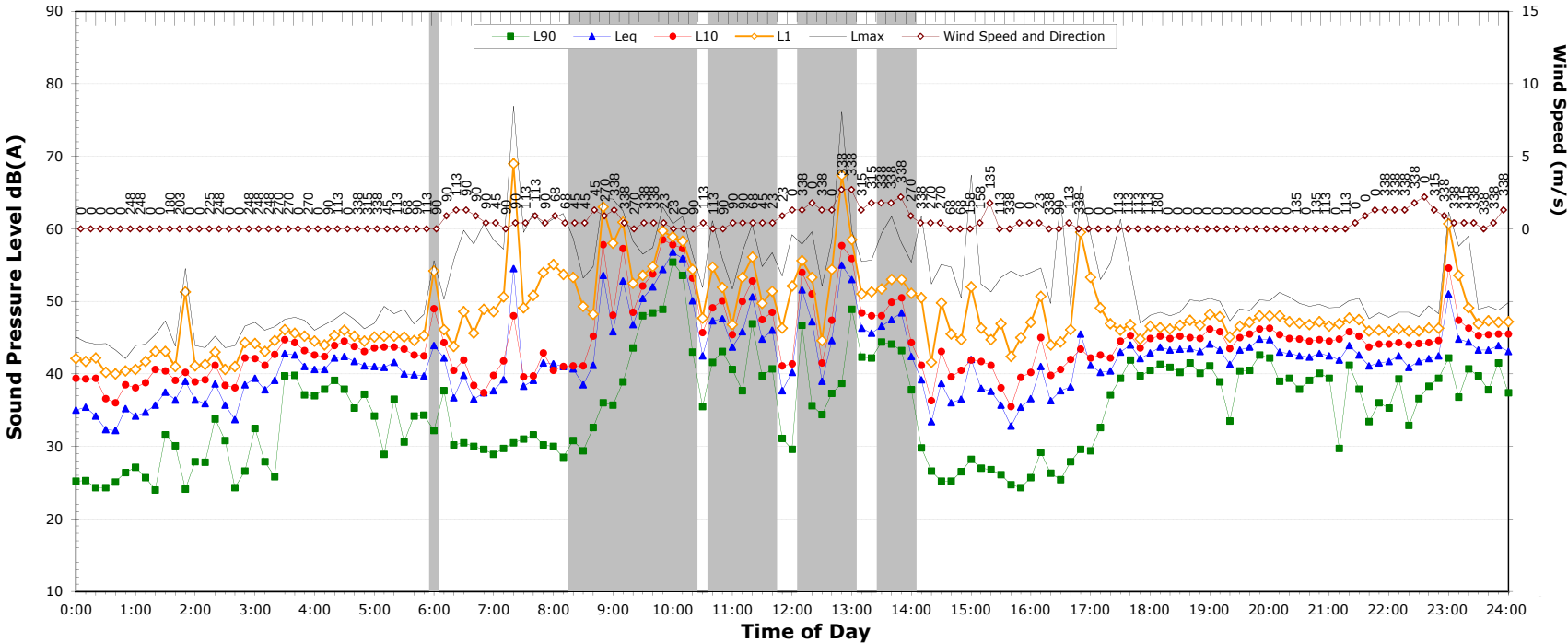
Tuesday, 11 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

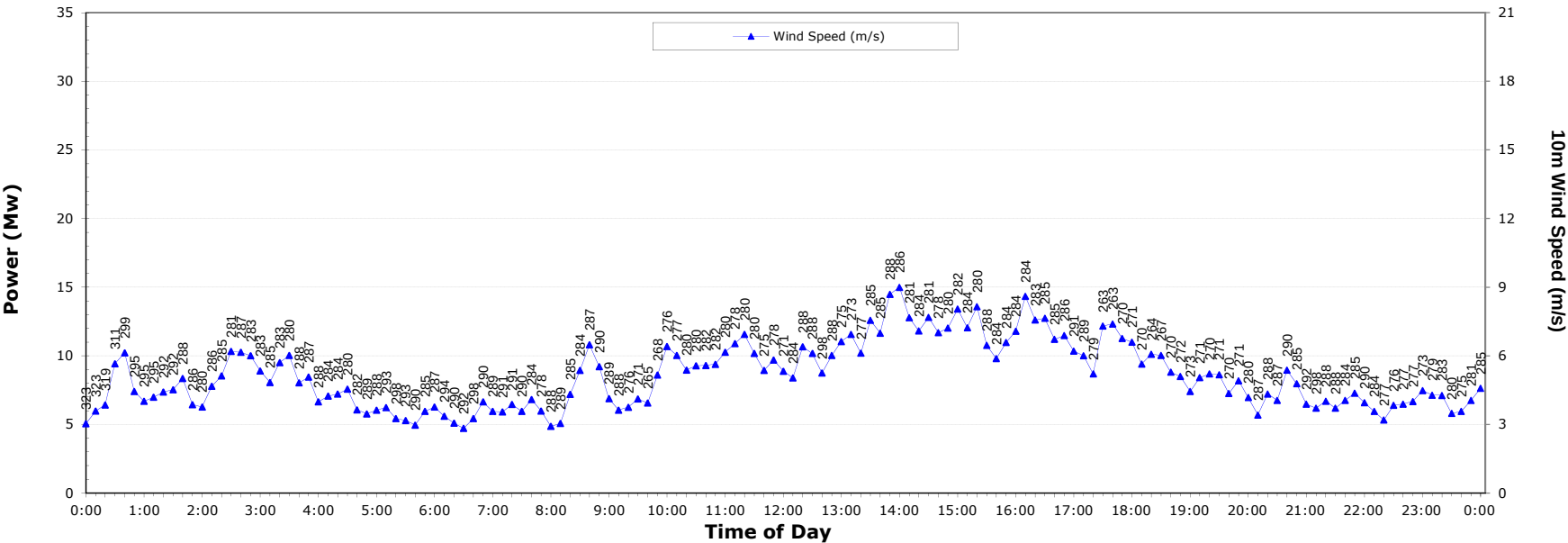
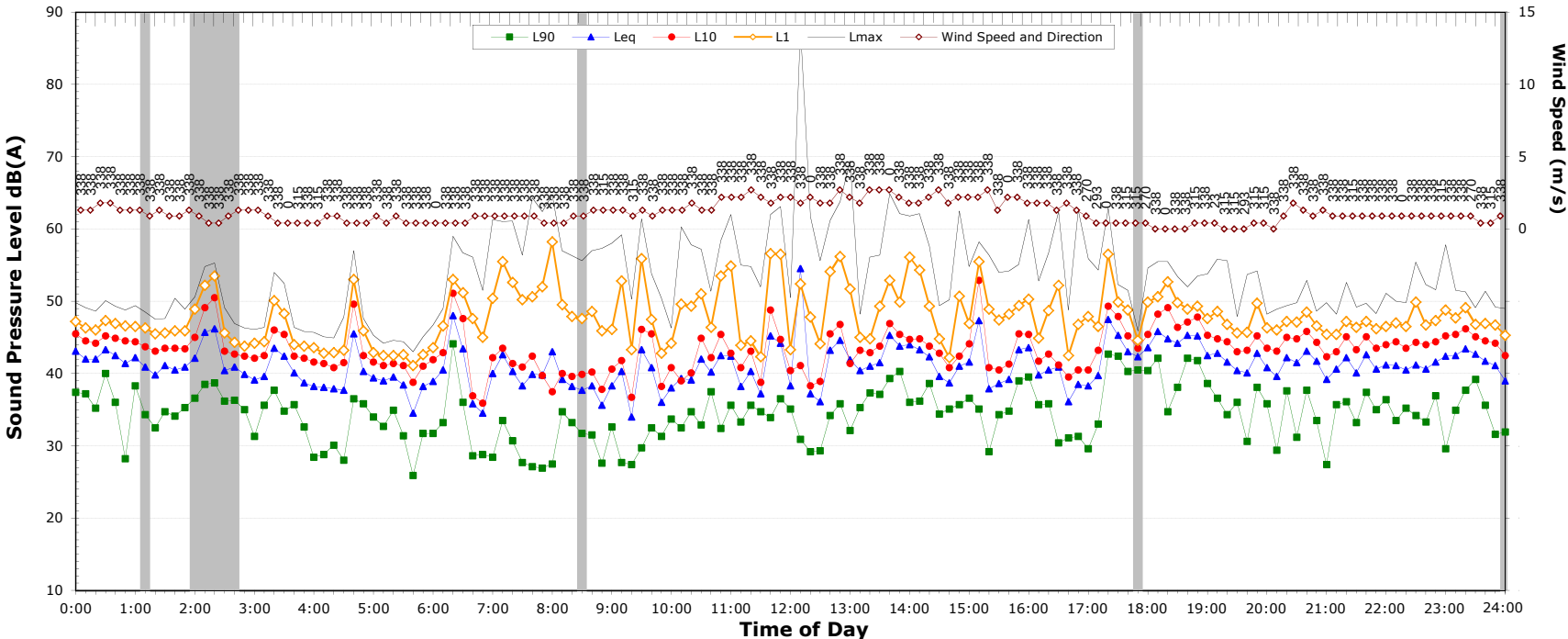
Wednesday, 12 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

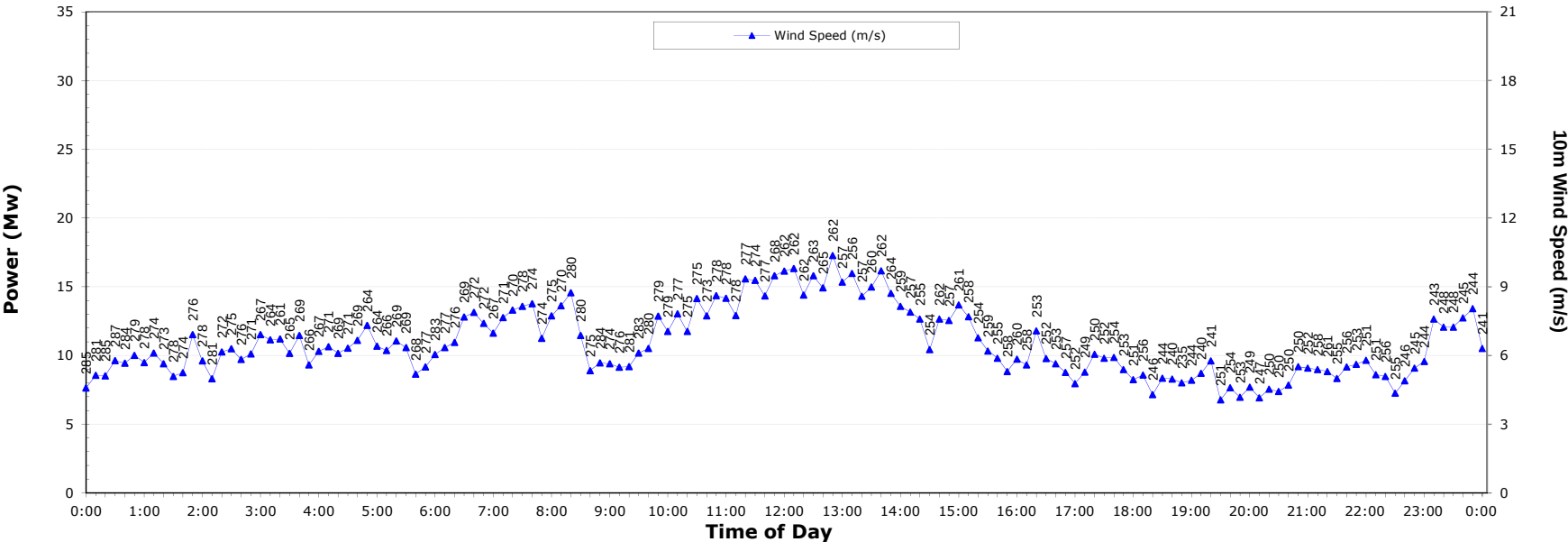
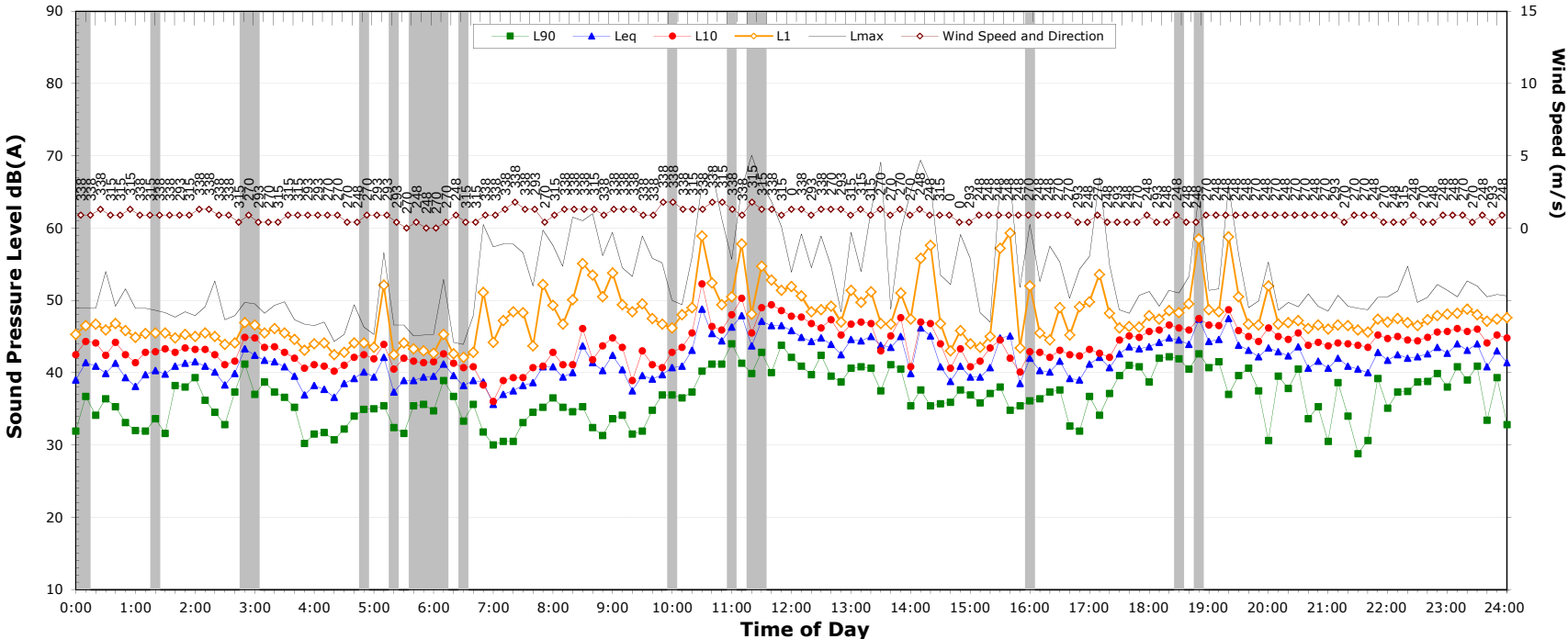
Thursday, 13 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

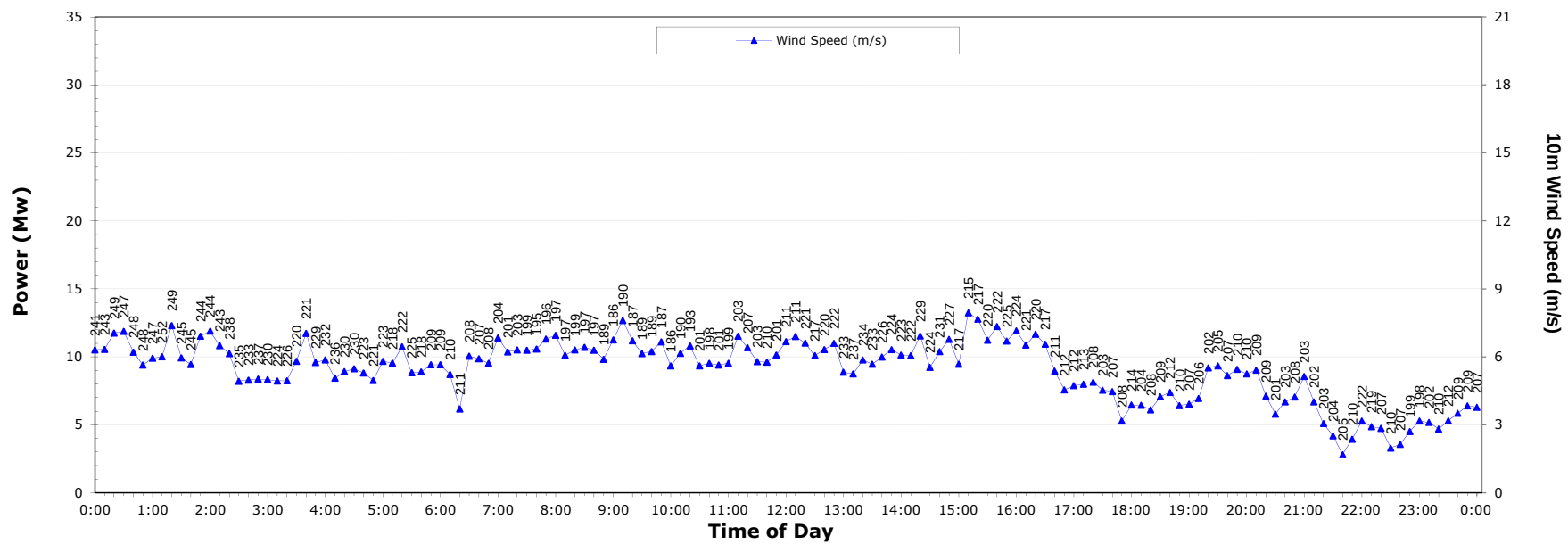
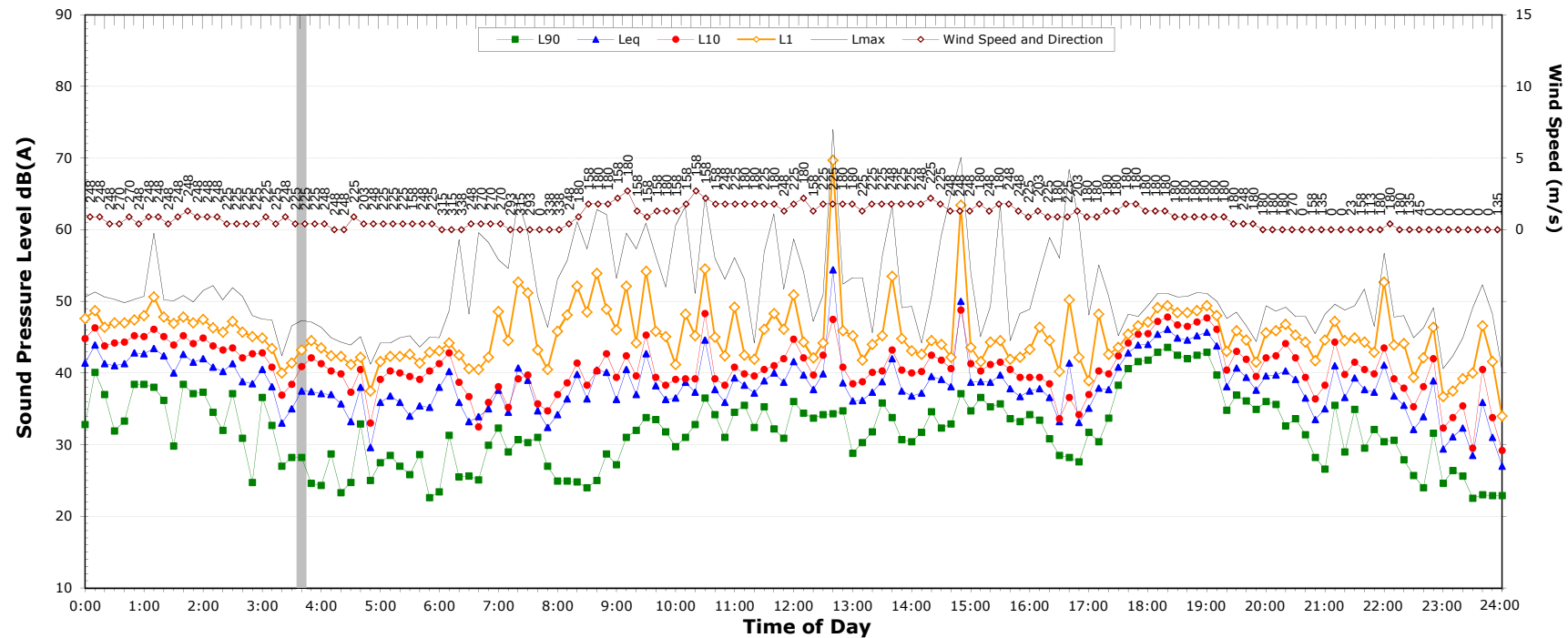
Friday, 14 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

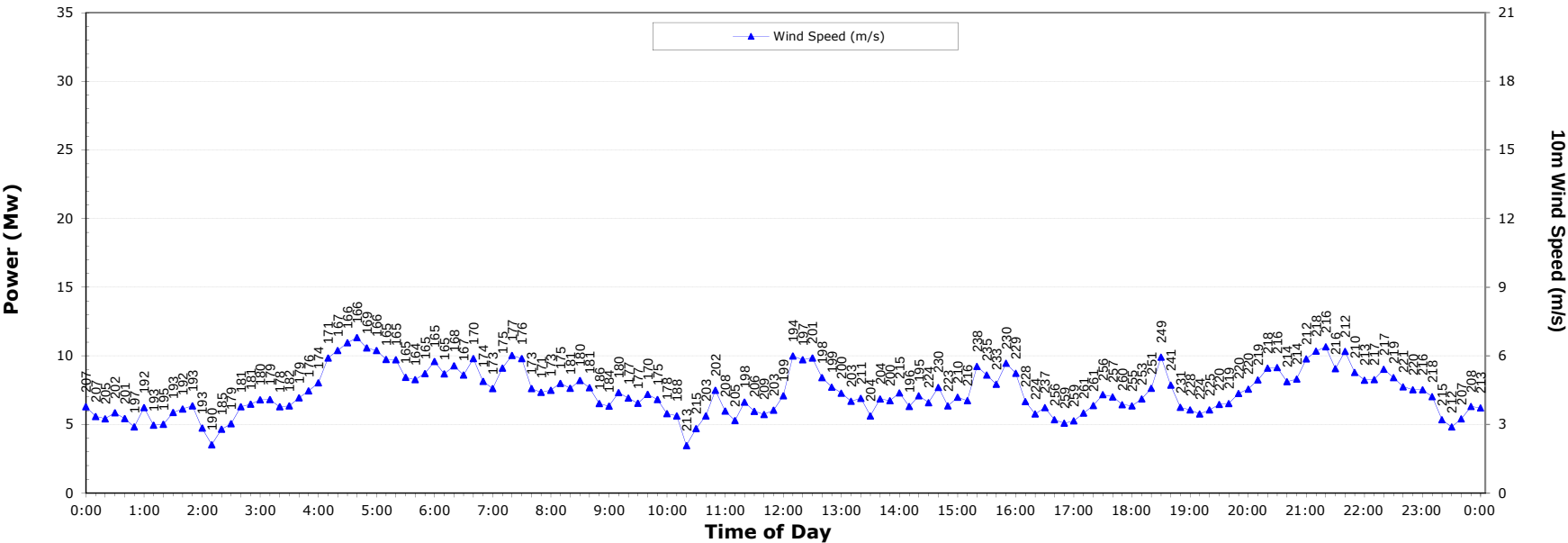
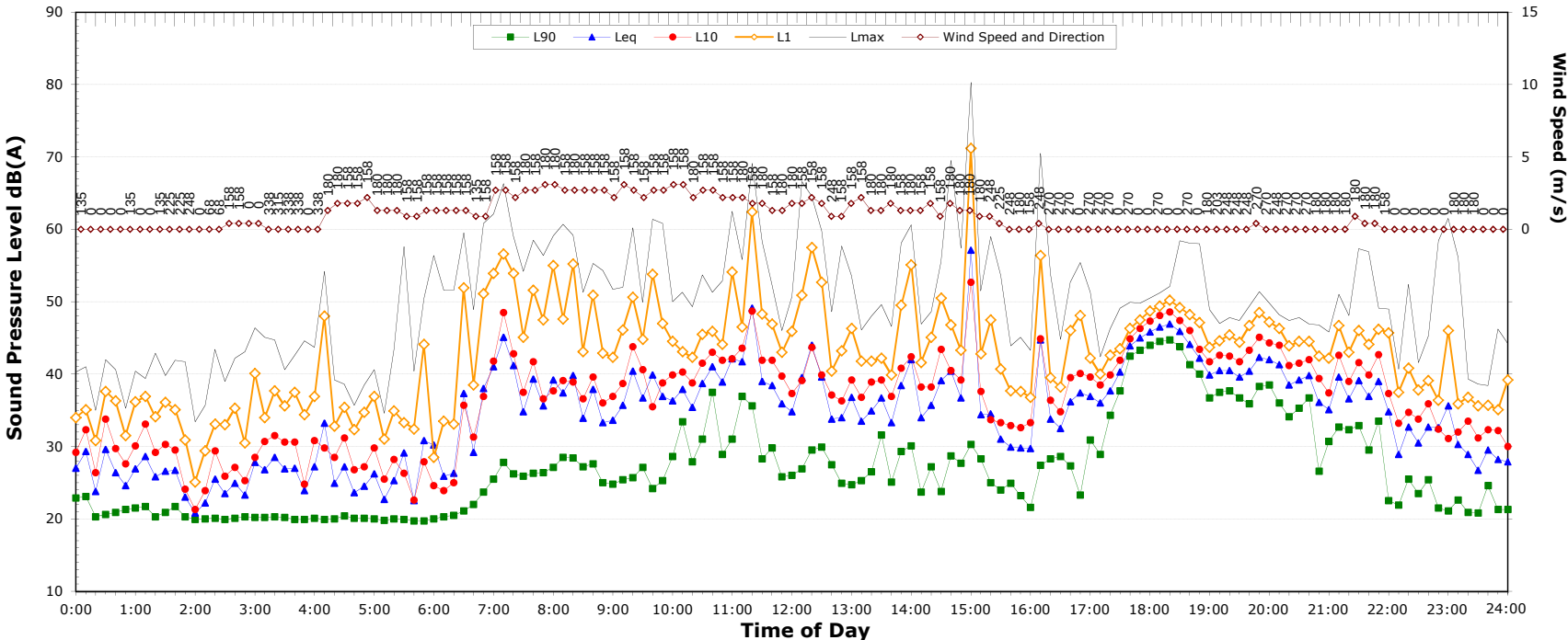
Saturday, 15 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

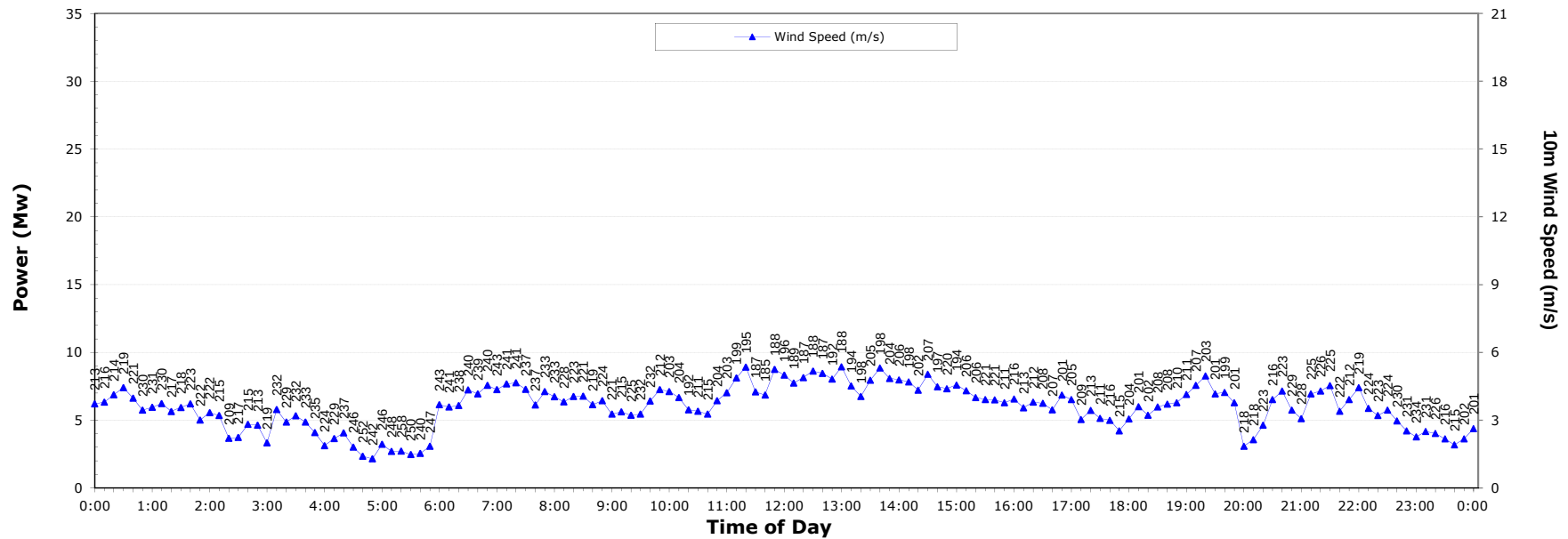
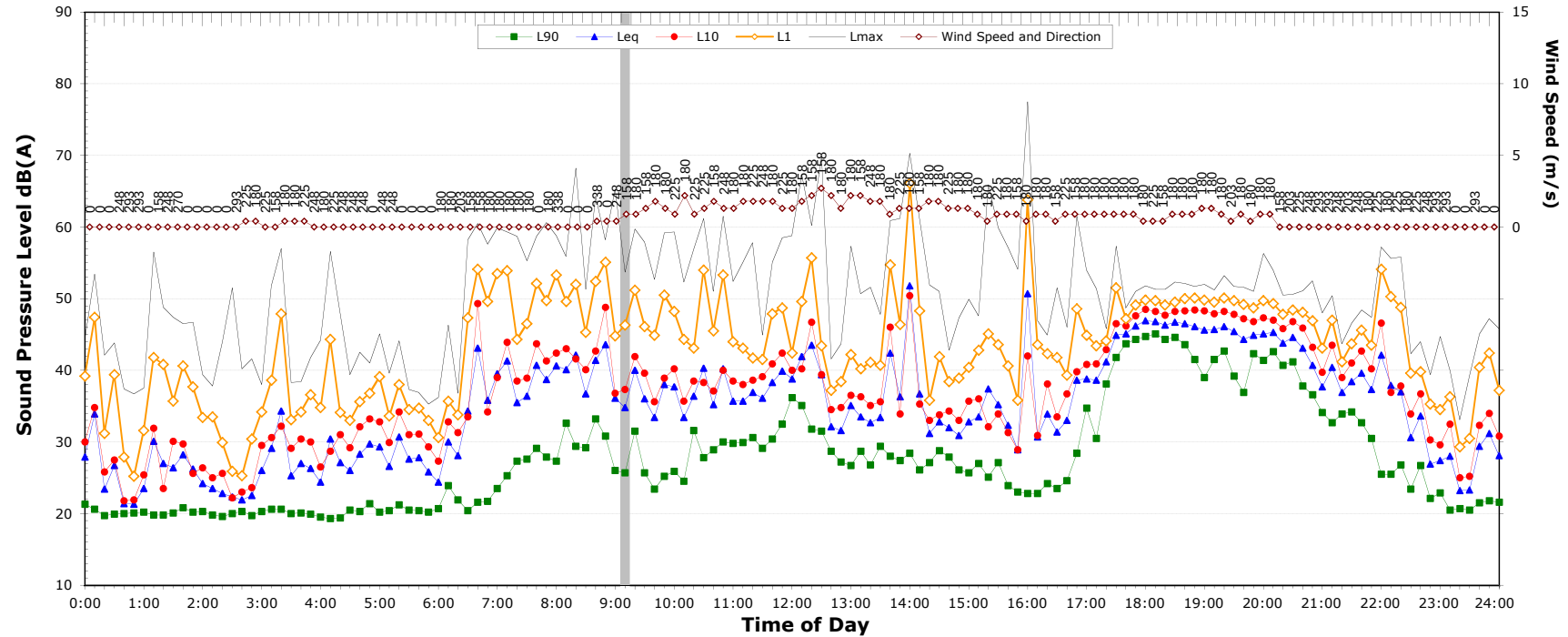
Sunday, 16 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

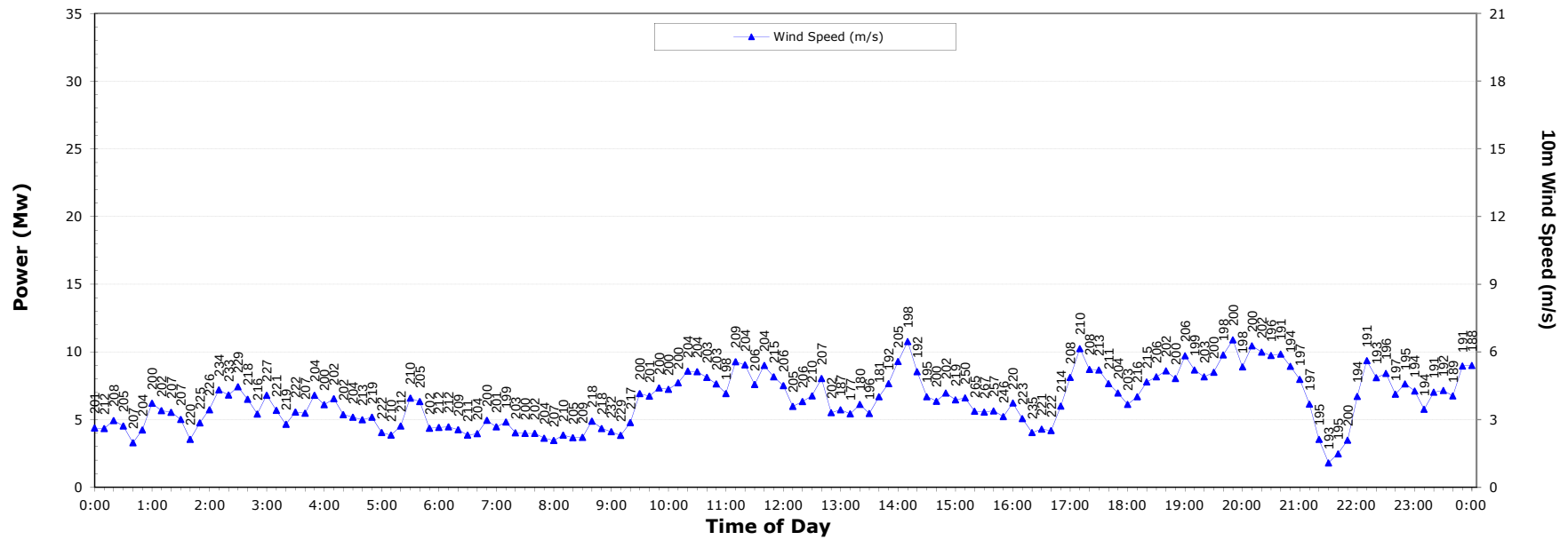
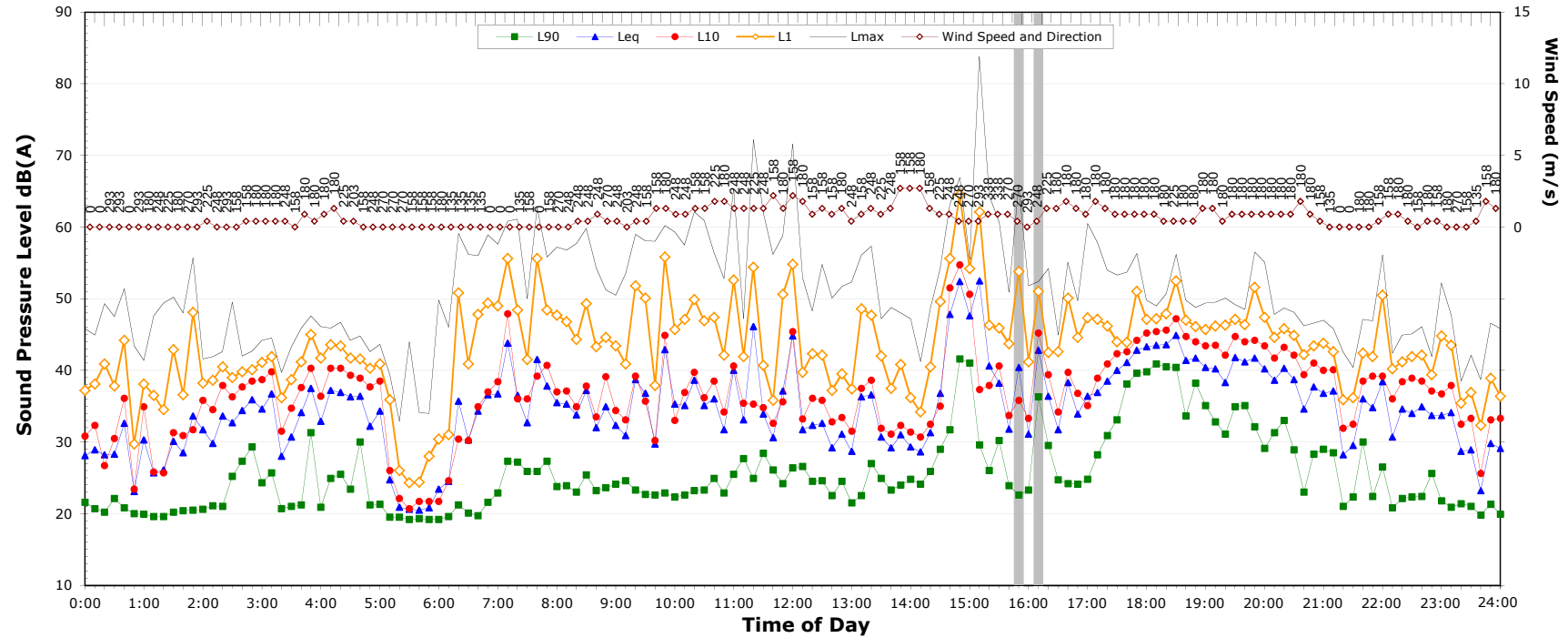
Monday, 17 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

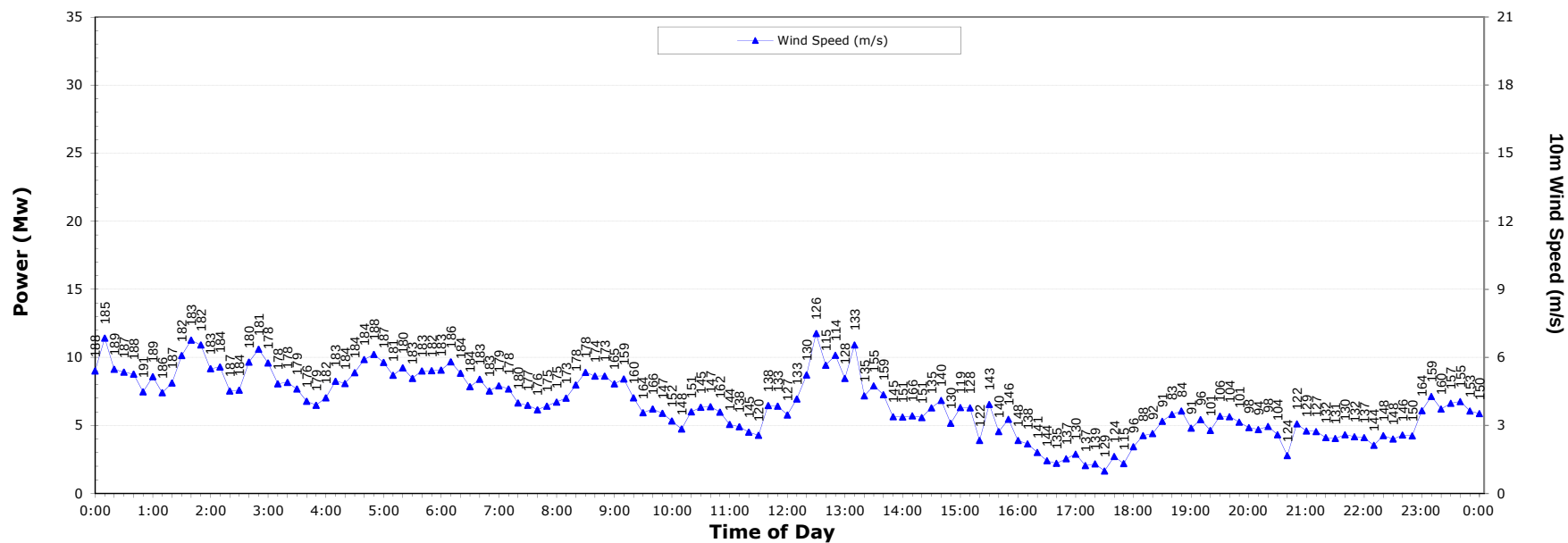
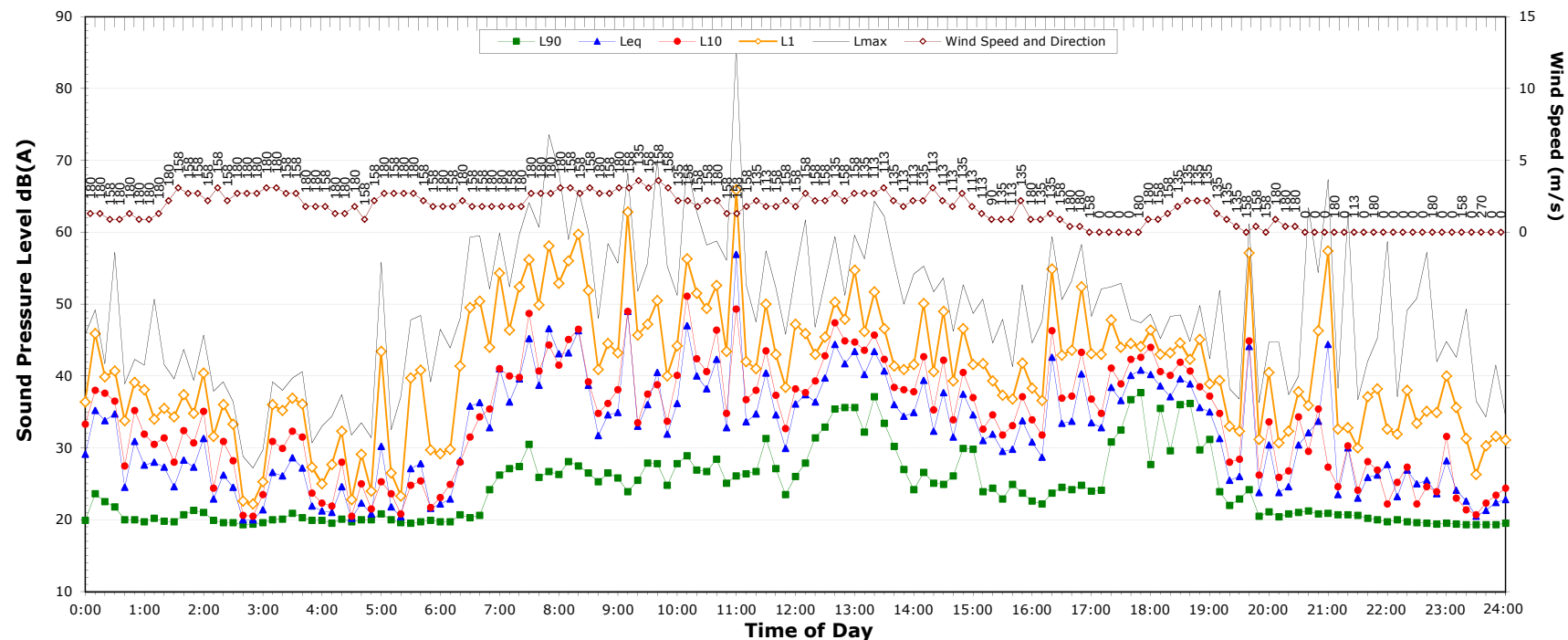
Tuesday, 18 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

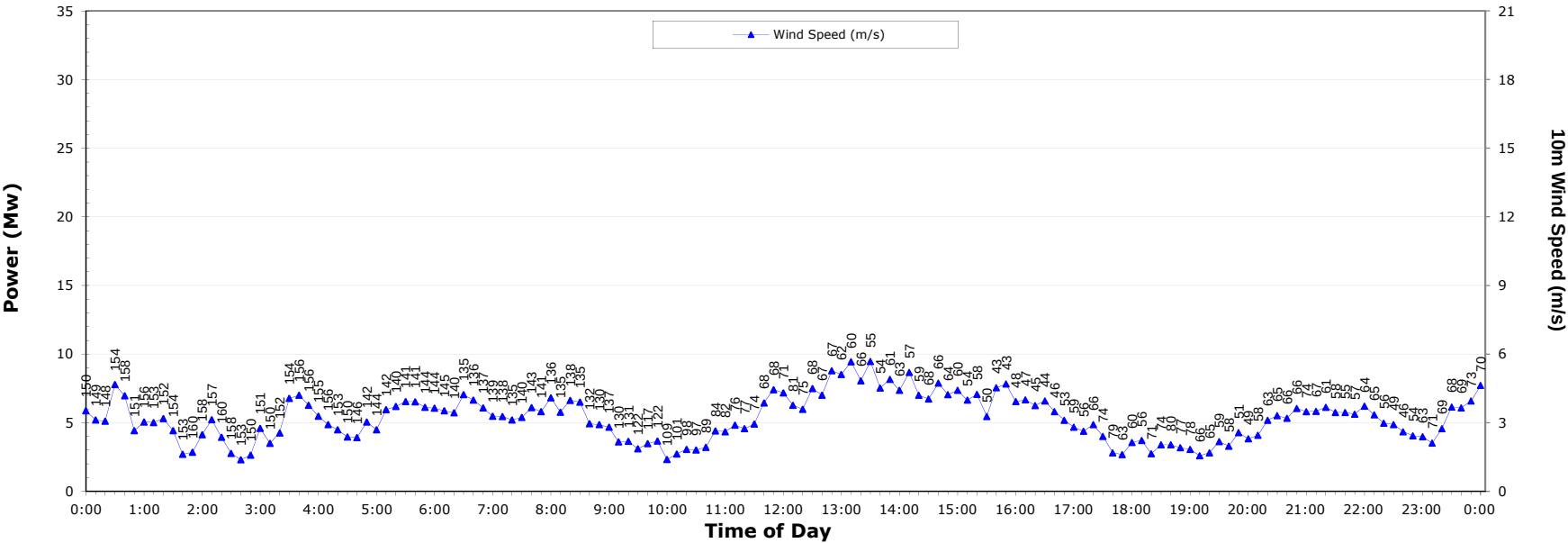
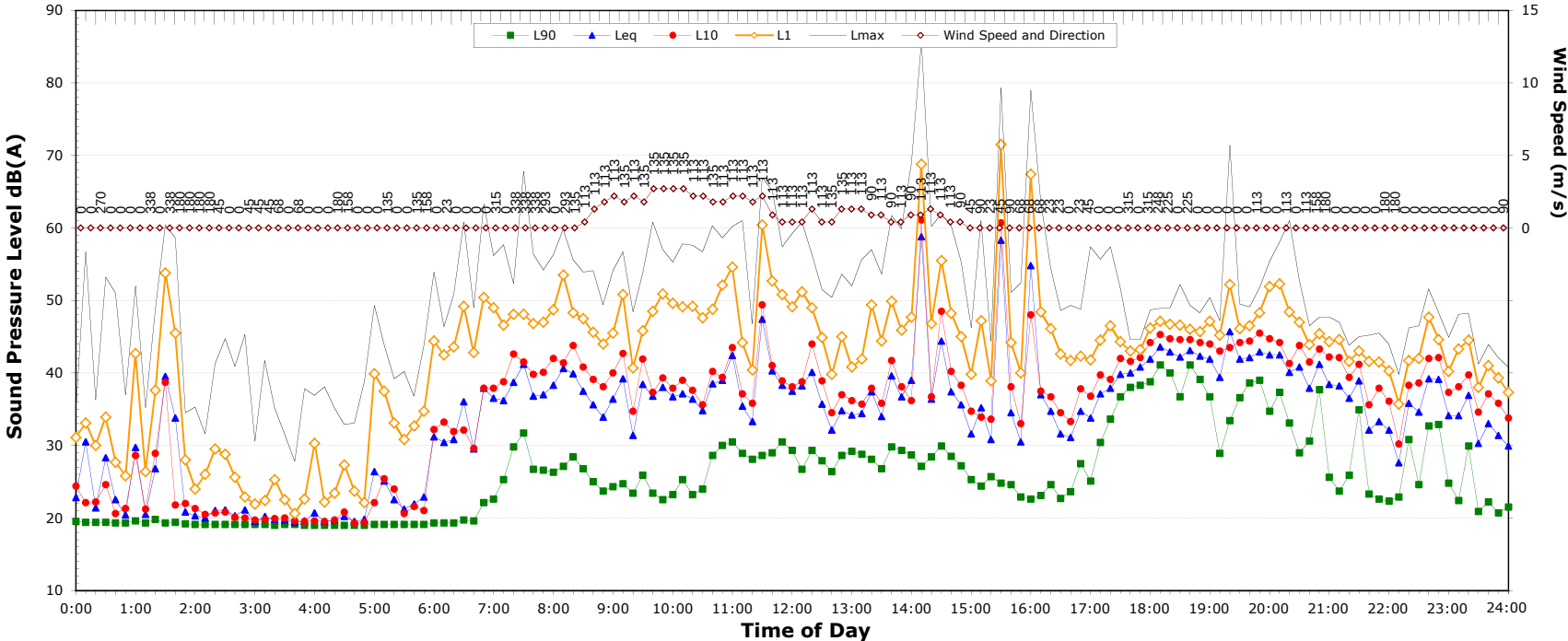
Wednesday, 19 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

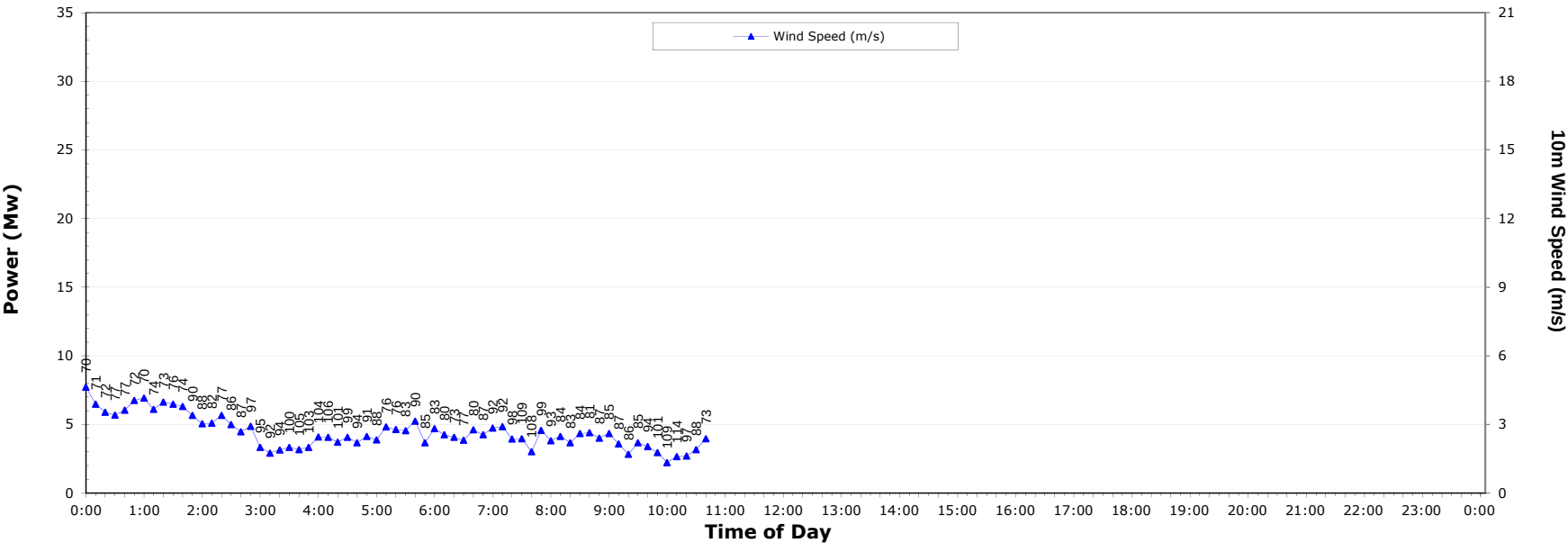
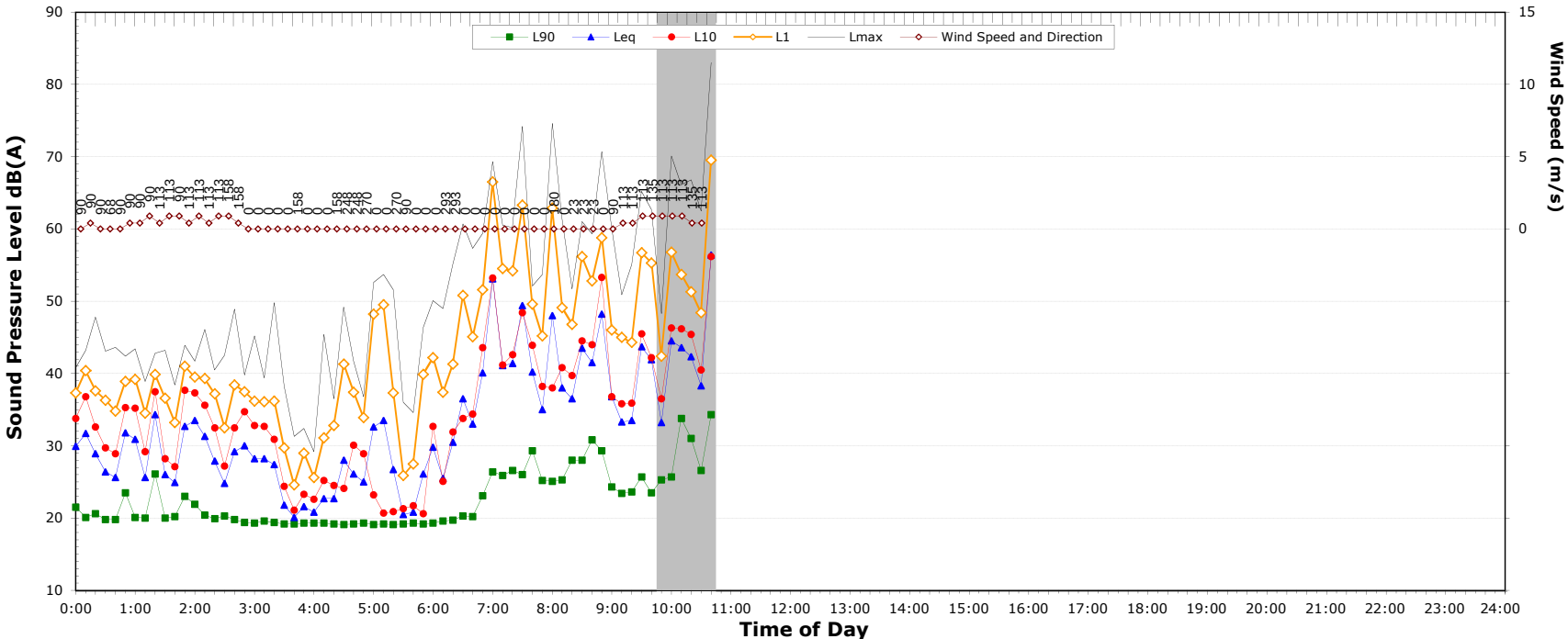
Thursday, 20 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR19 - Woodlands

Friday, 21 June 2013



APPENDIX C - SFR05 147 SALLY'S FLAT ROAD SURVEY RESULTS





SFR05 - 147 Sally's Flat Road

BACKGROUND & AMBIENT NOISE MONITORING RESULTS NSW 'INDUSTRIAL NOISE POLICY', 2000

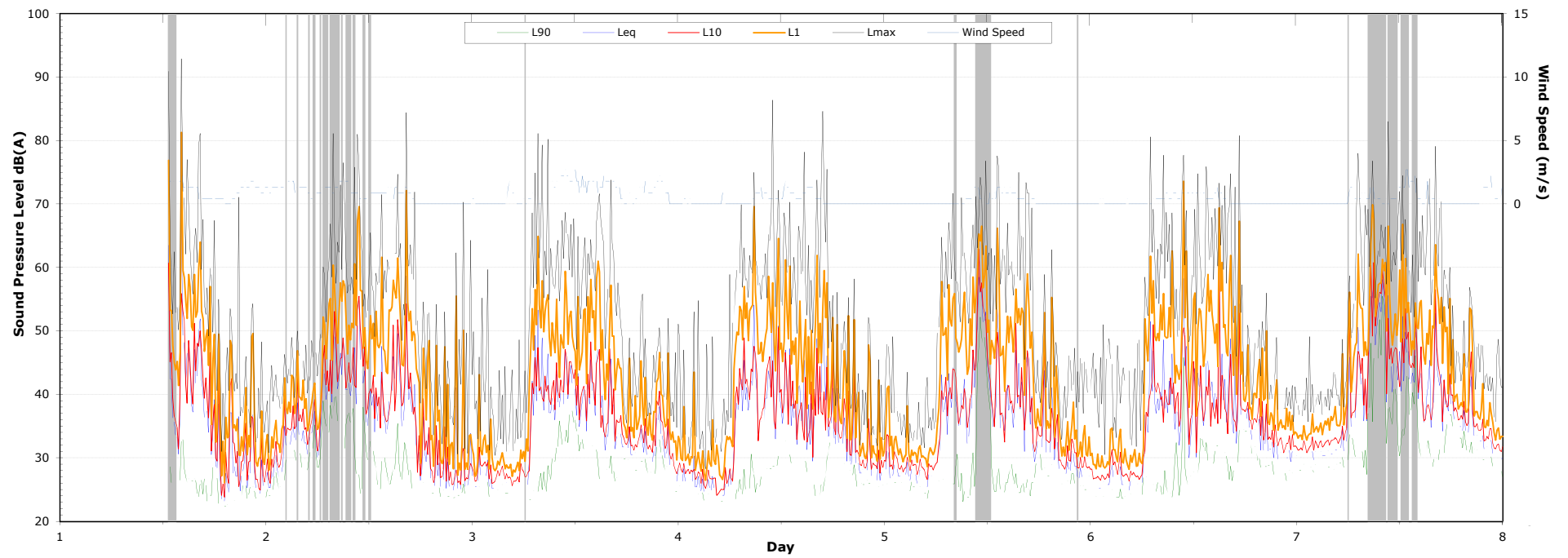
Day	L _{A90} Background Noise Levels ⁵			L _{Aeq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Thursday-06-June-2013	-	22	24	-	31	32
Friday-07-June-2013	25	24	24	46	30	31
Saturday-08-June-2013	26	28	23	42	33	29
Sunday-09-June-2013	25	26	25	44	34	31
Monday-10-June-2013	24	25	24	42	34	35
Tuesday-11-June-2013	25	27	27	46	34	34
Wednesday-12-June-2013	30	30	26	43	36	33
Thursday-13-June-2013	27	26	26	50	33	37
Friday-14-June-2013	29	29	27	49	40	35
Saturday-15-June-2013	27	28	25	43	34	34
Sunday-16-June-2013	27	29	24	43	35	33
Monday-17-June-2013	24	29	24	42	36	32
Tuesday-18-June-2013	24	25	24	43	34	41
Wednesday-19-June-2013	24	25	21	46	31	30
Thursday-20-June-2013	23	27	22	45	34	31
Friday-21-June-2013	-	-	-	-	-	-
Representative Level	25	27	24	44	34	33

Notes:

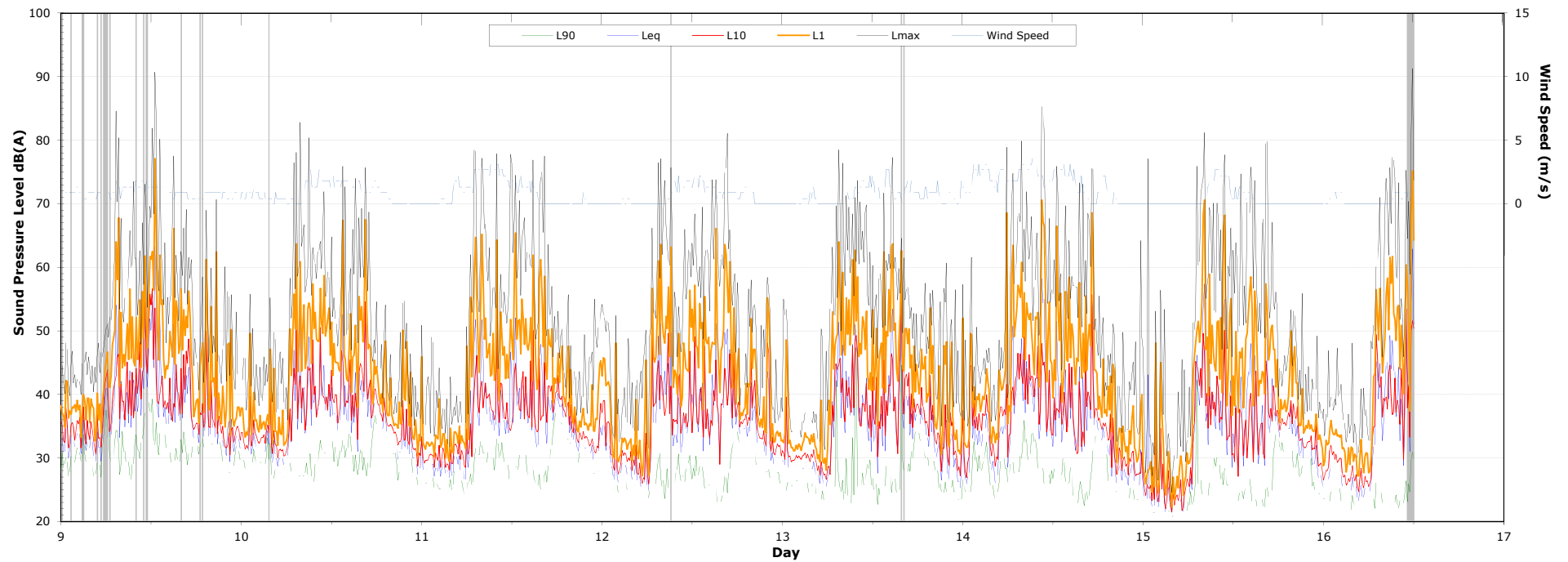
1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Rating Background Level (RBL) for L90 and logarithmic average for Leq
5. Assessment Background Level (ABL)

noise logger results

Thursday, 6 June 2013 - Friday, 14 June 2013



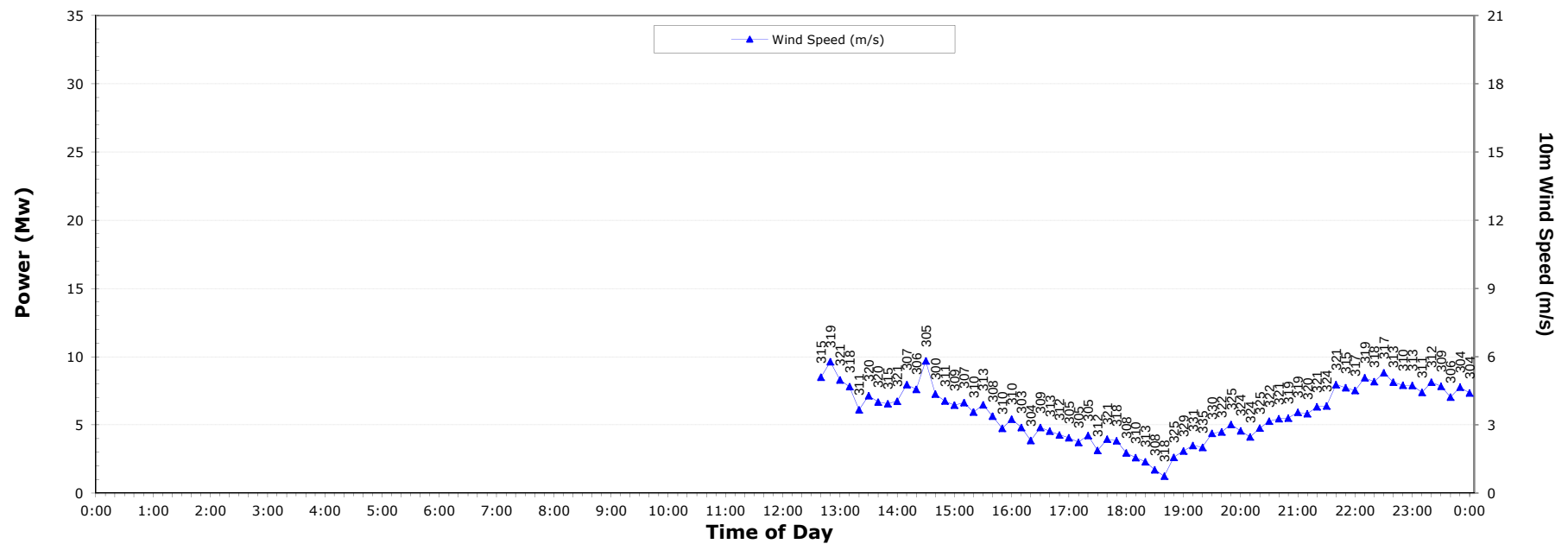
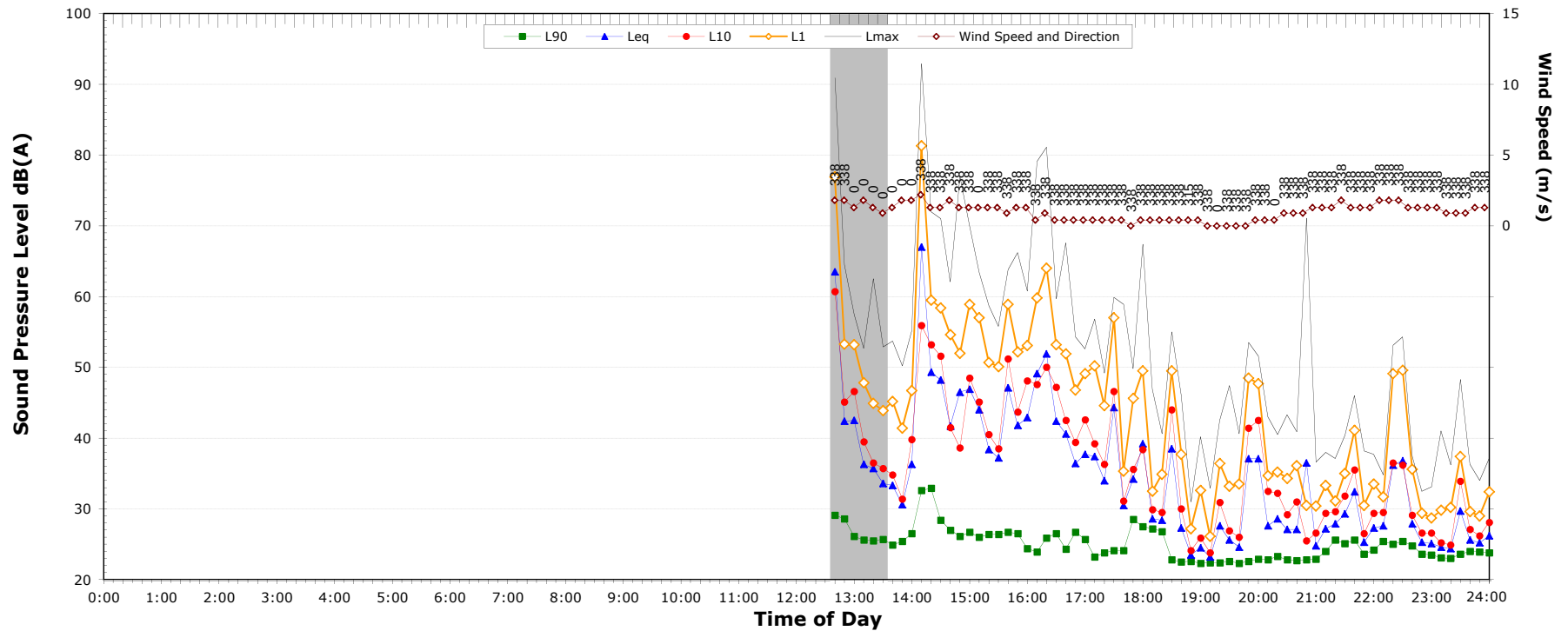
Saturday, 15 June 2013 - Saturday, 22 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

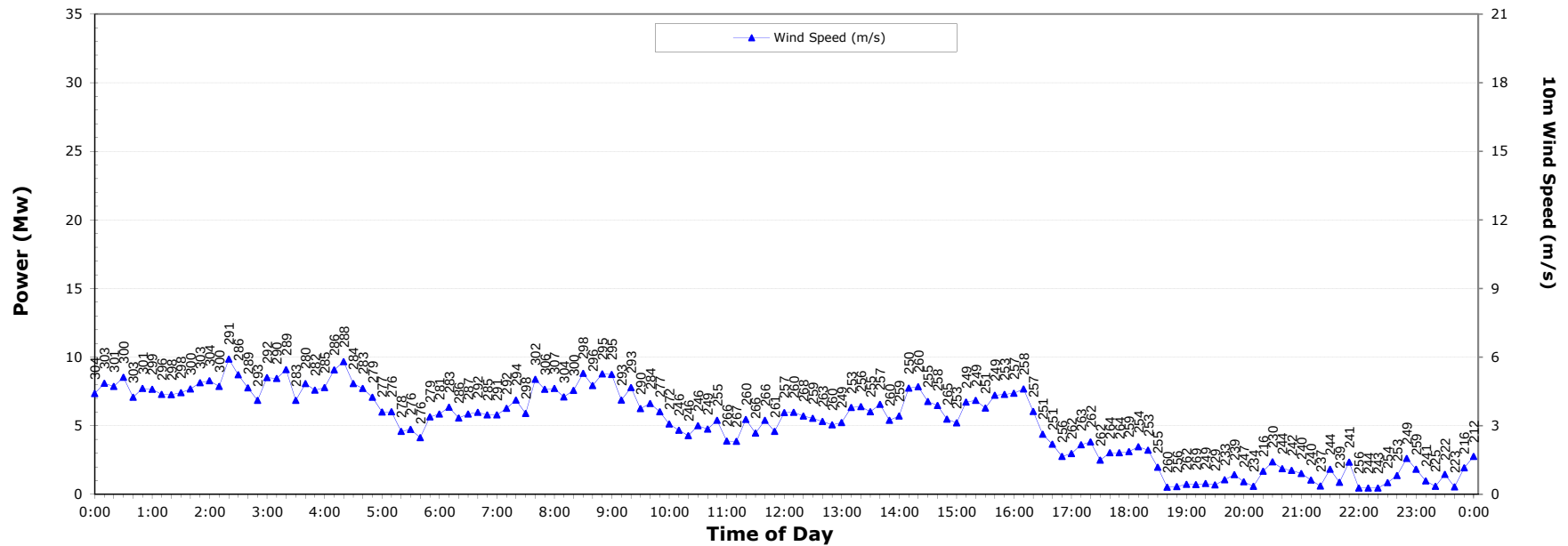
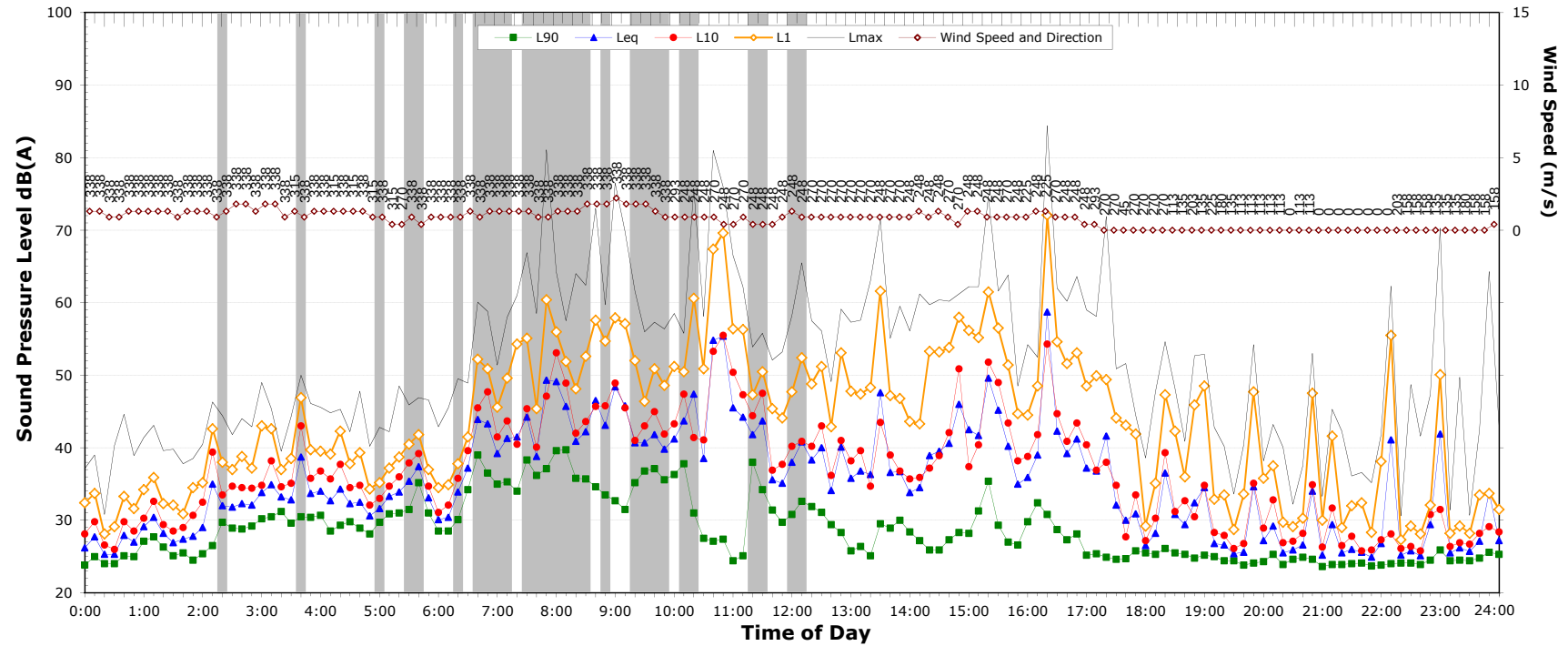
Thursday, 6 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

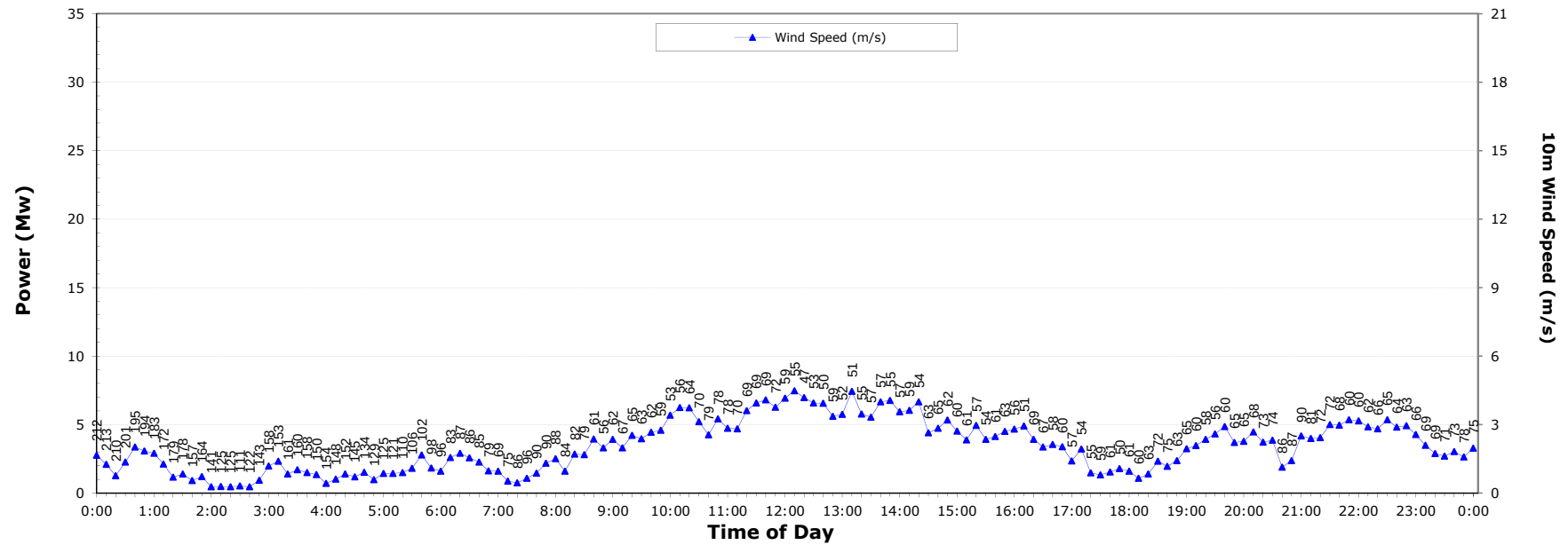
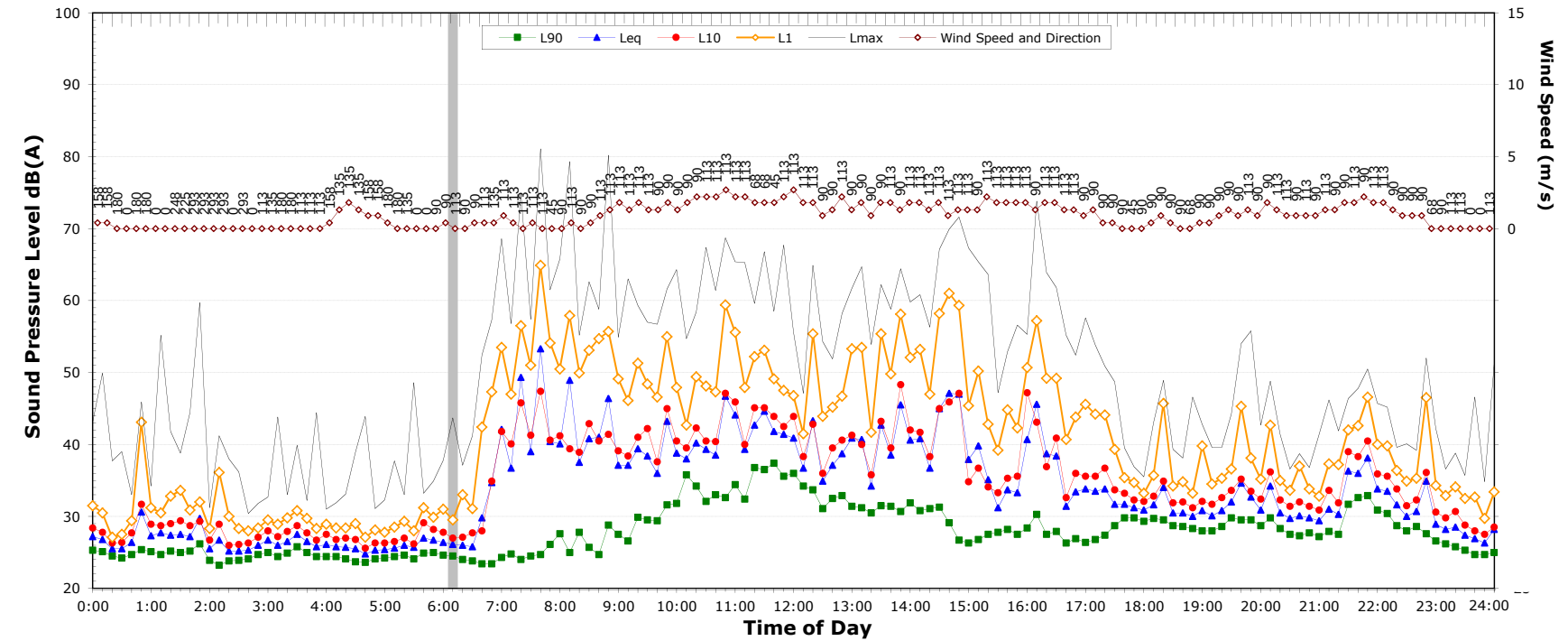
Friday, 7 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

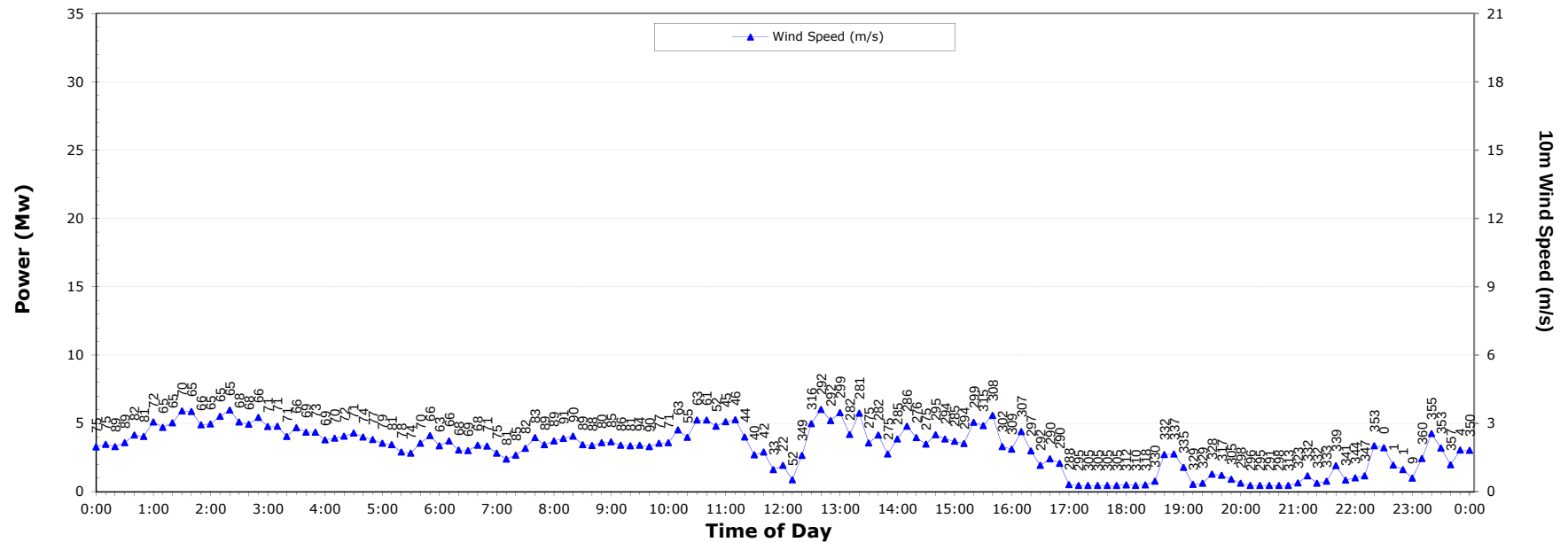
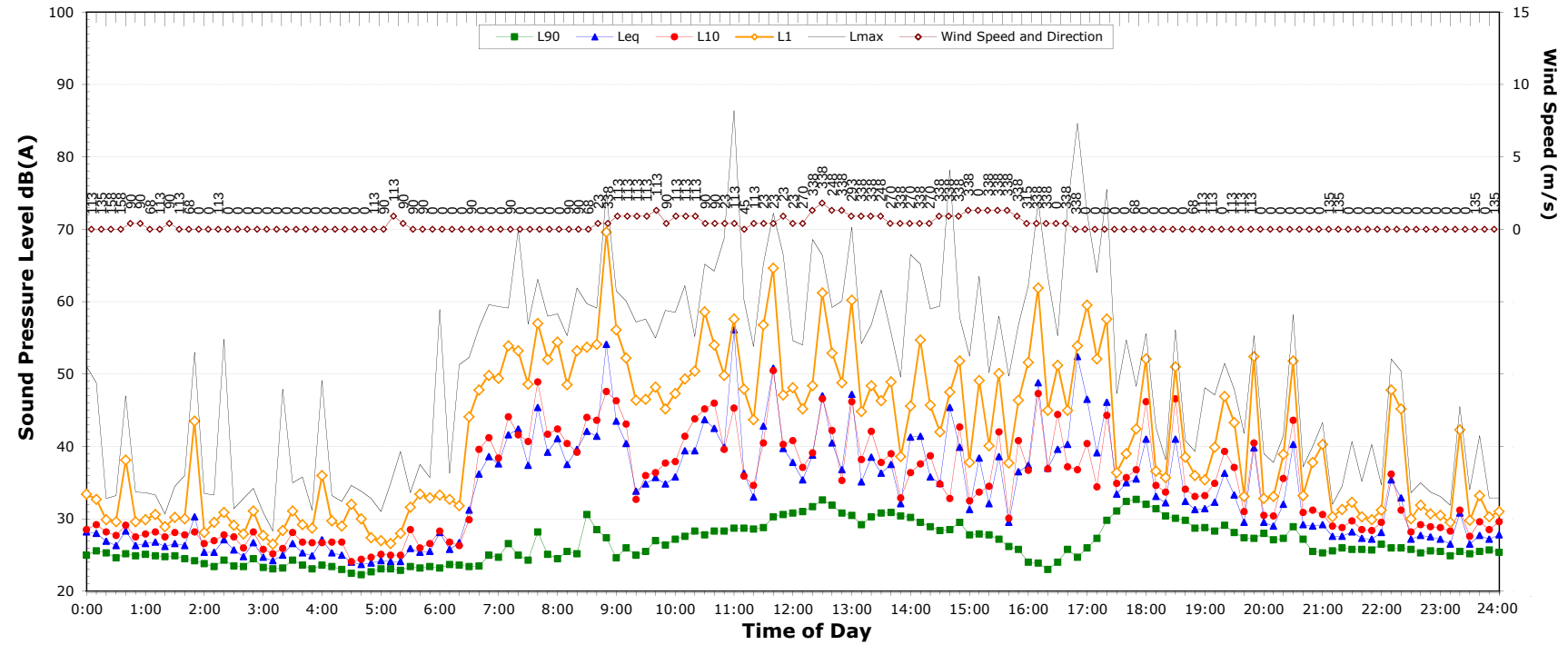
Saturday, 8 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

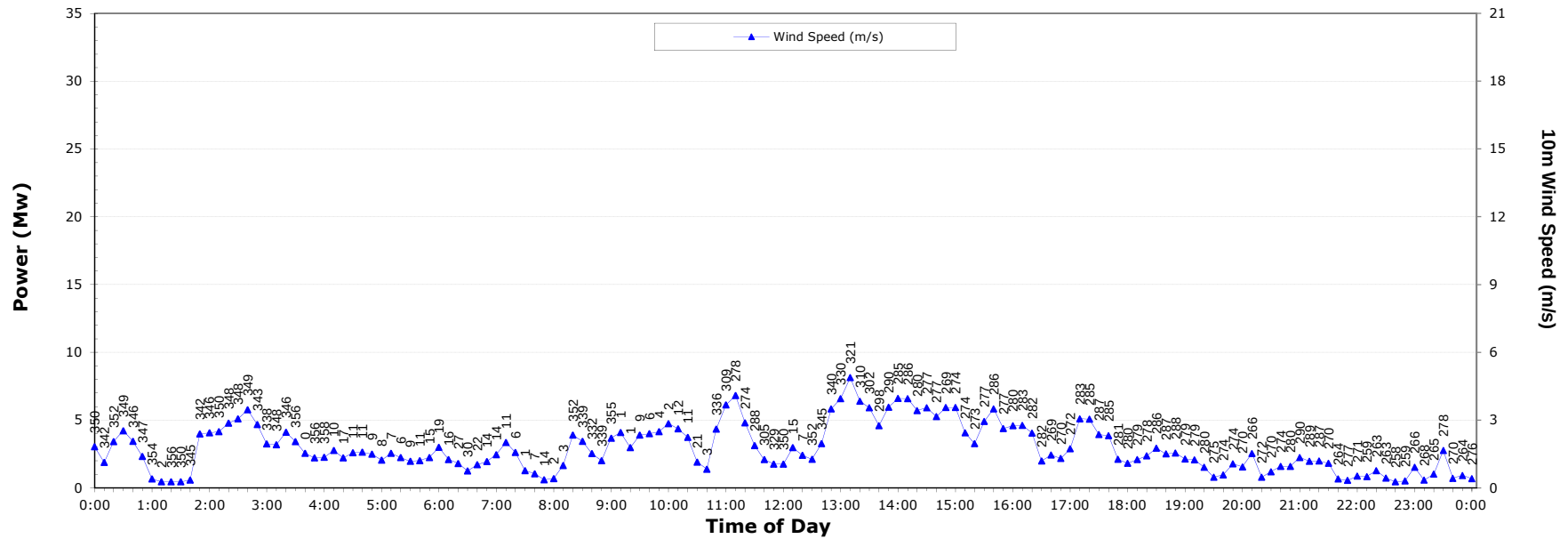
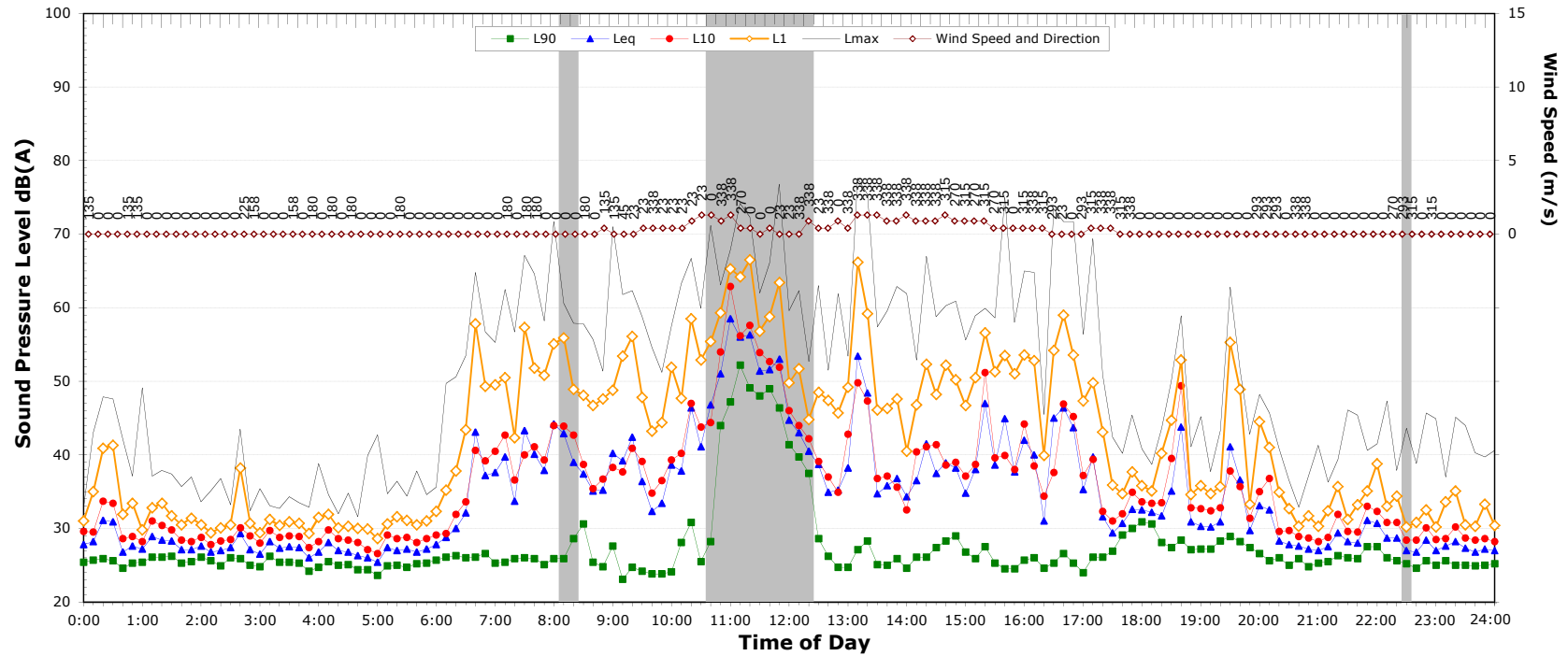
Sunday, 9 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

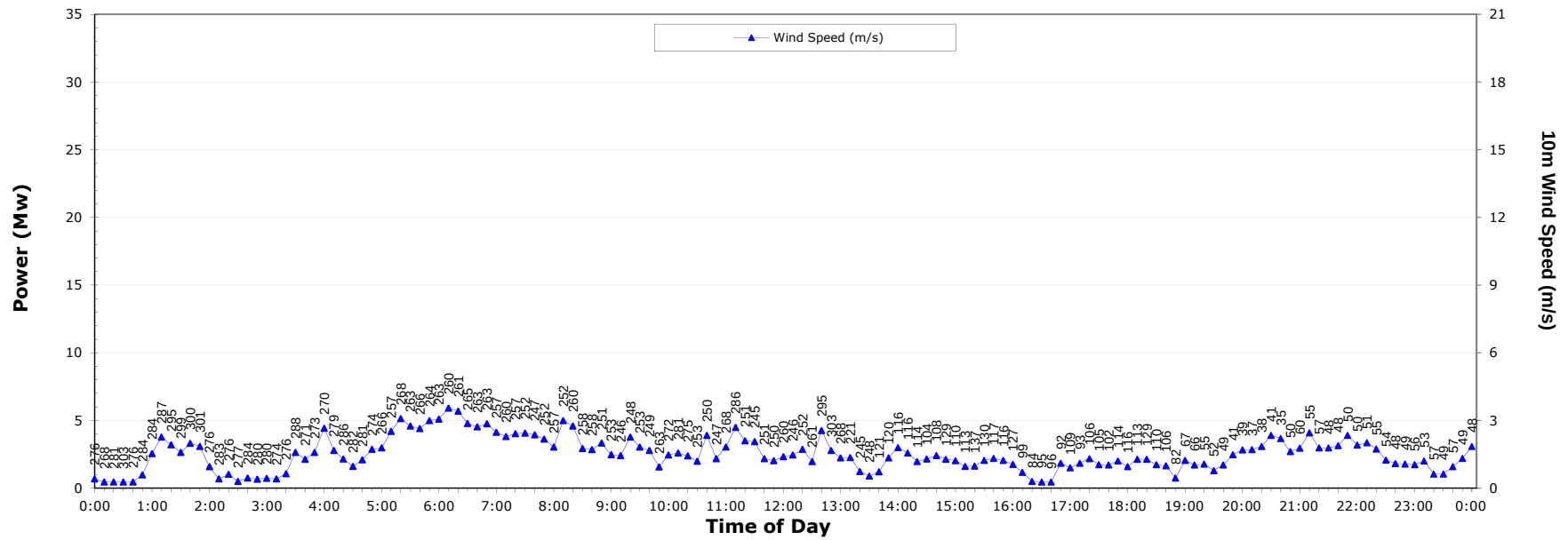
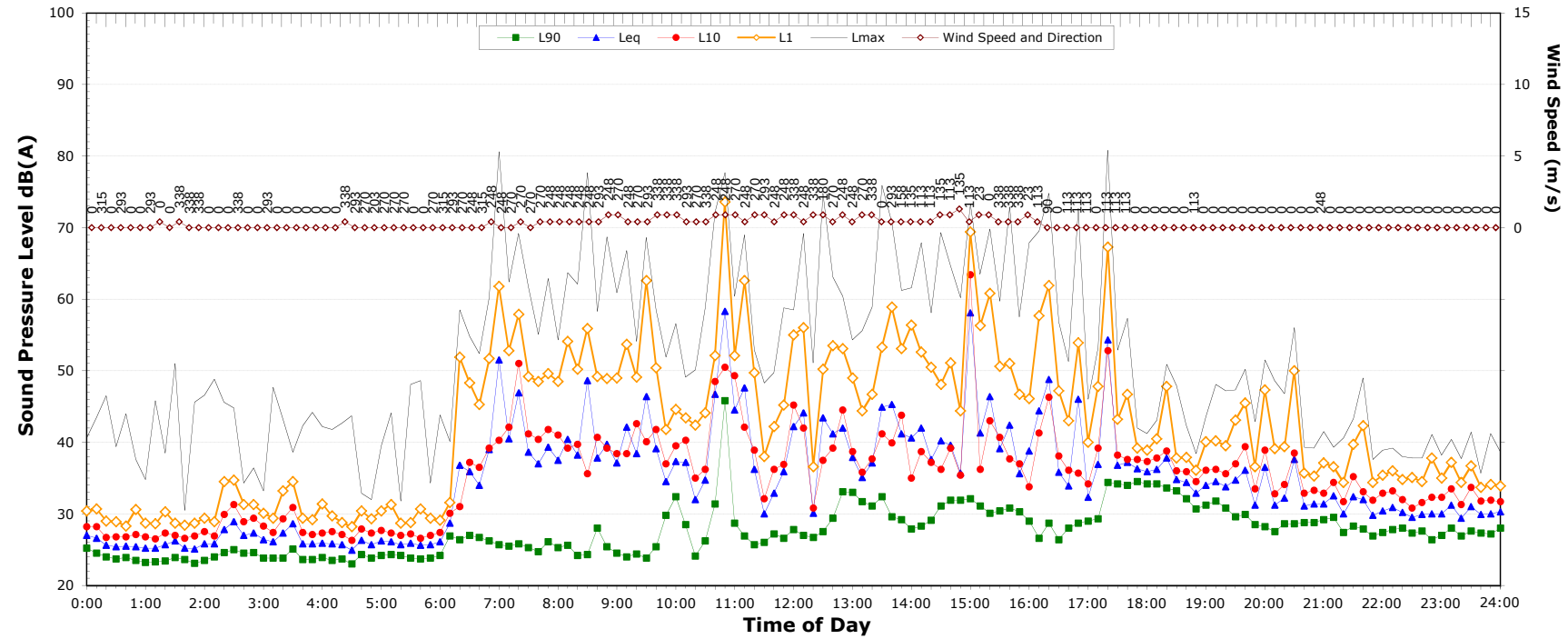
Monday, 10 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

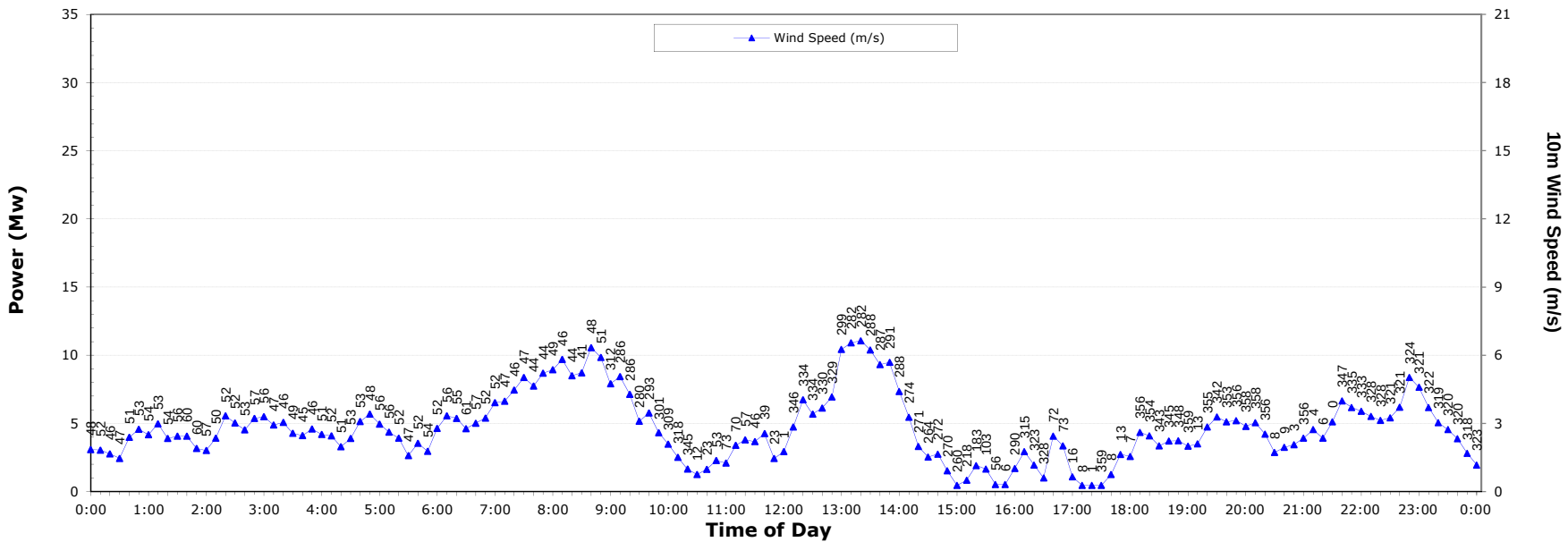
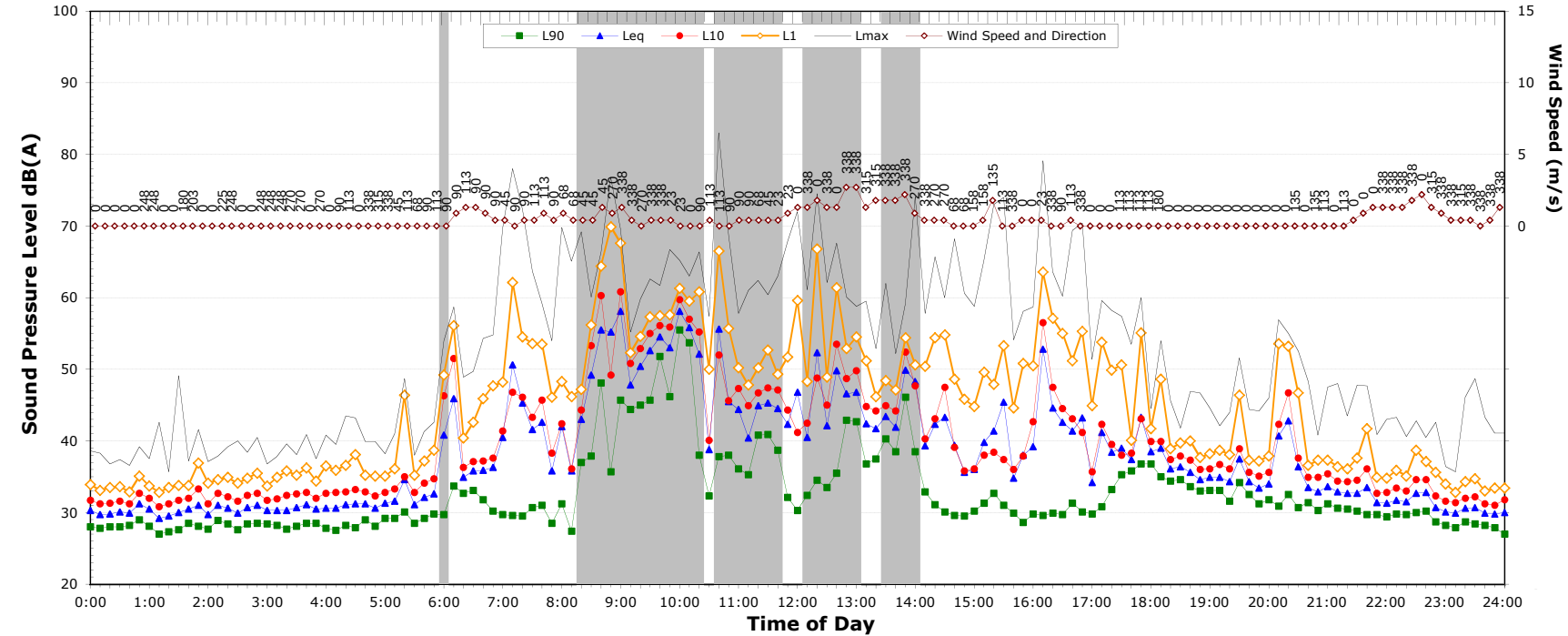
Tuesday, 11 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

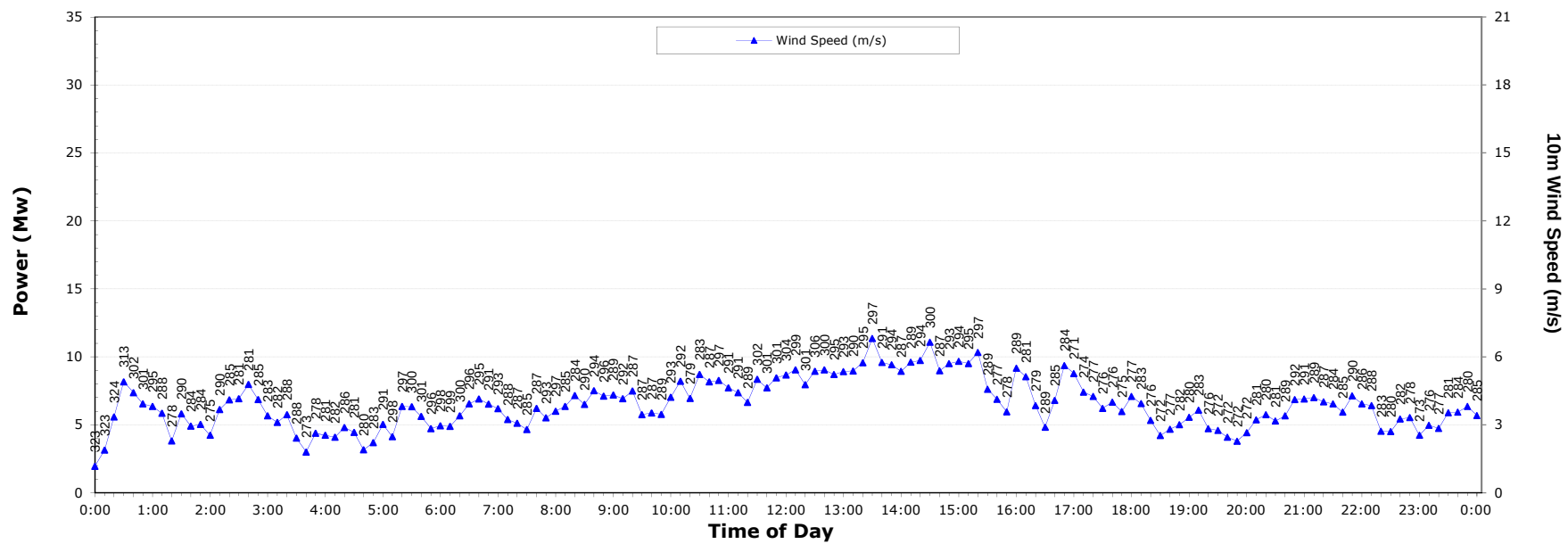
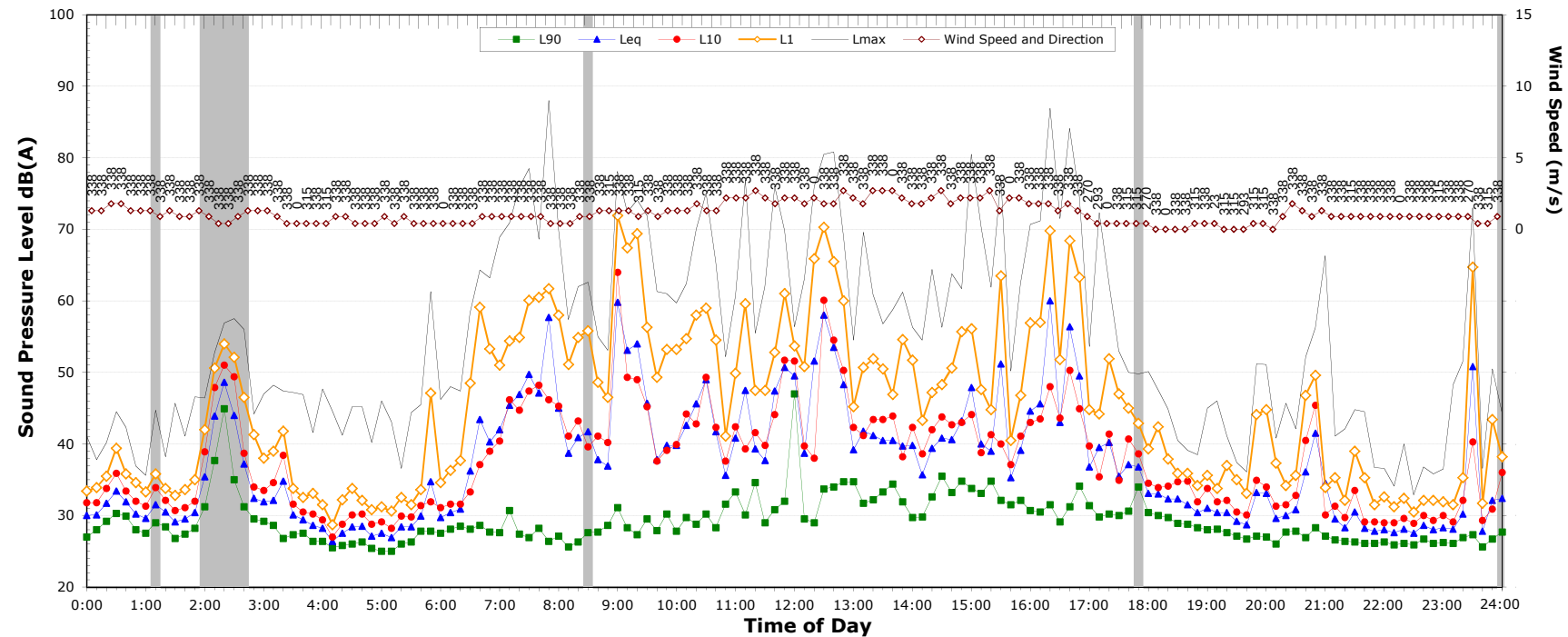
Wednesday, 12 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

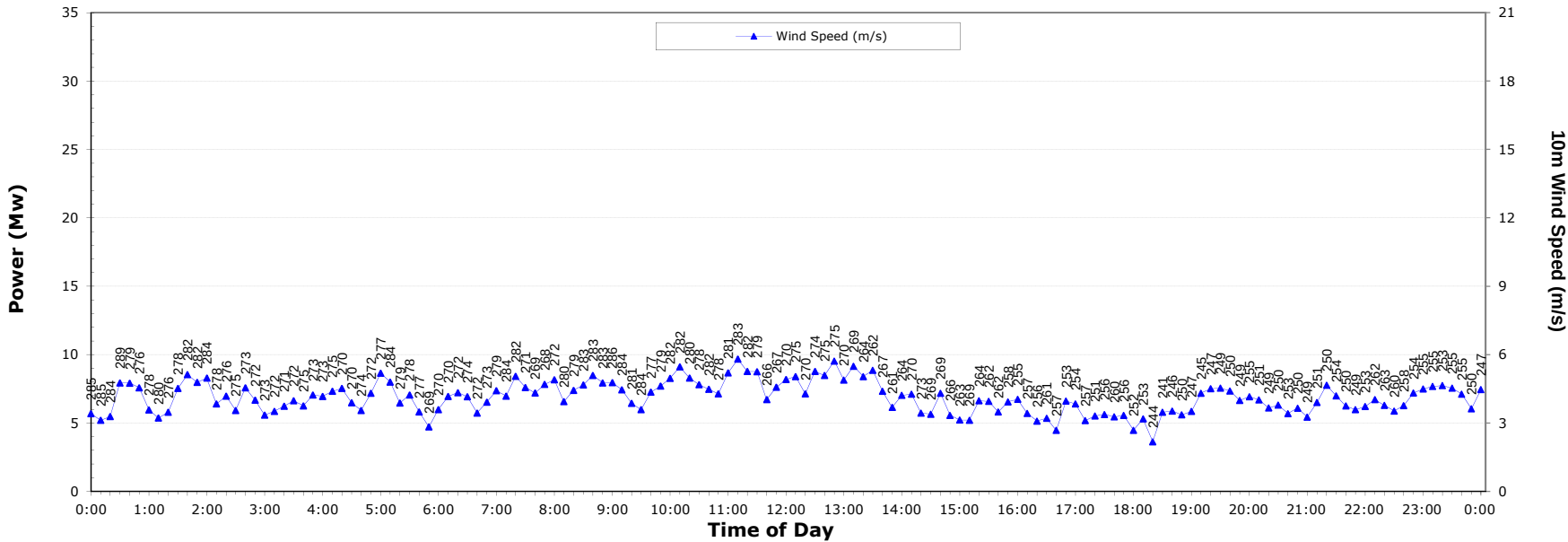
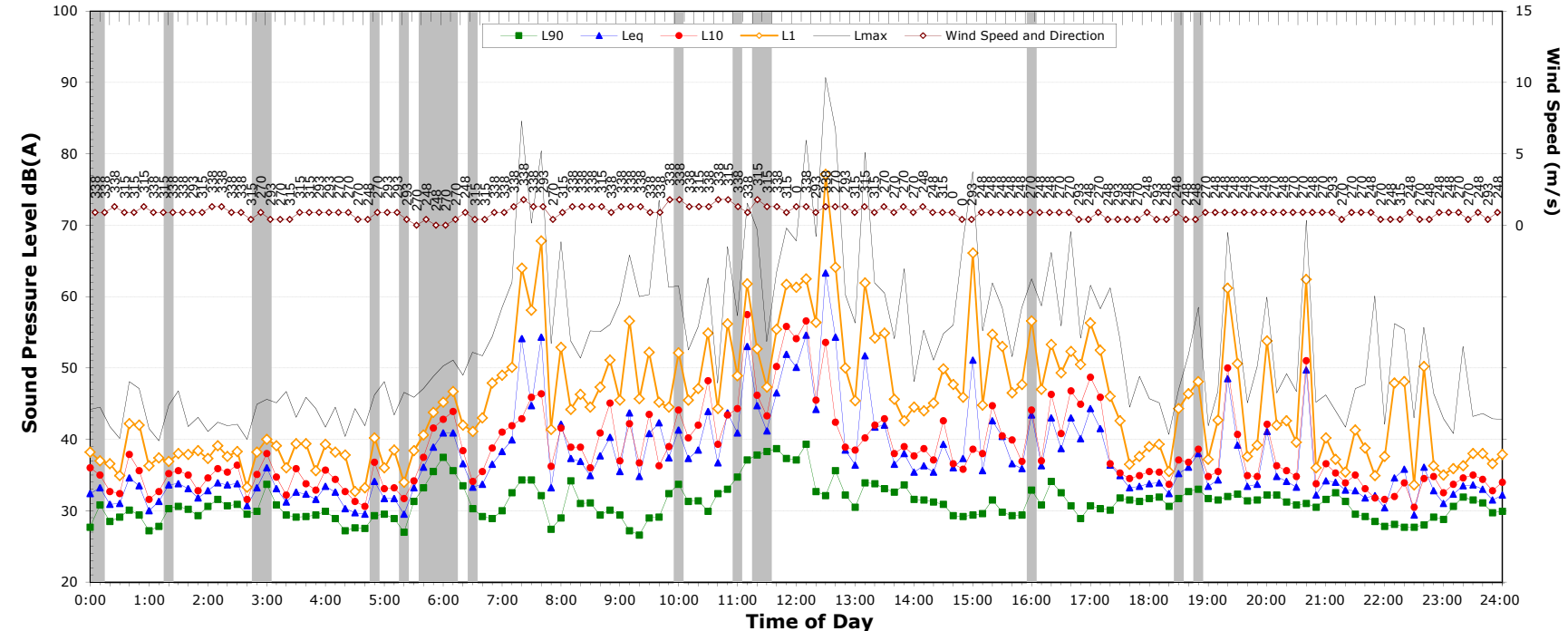
Thursday, 13 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

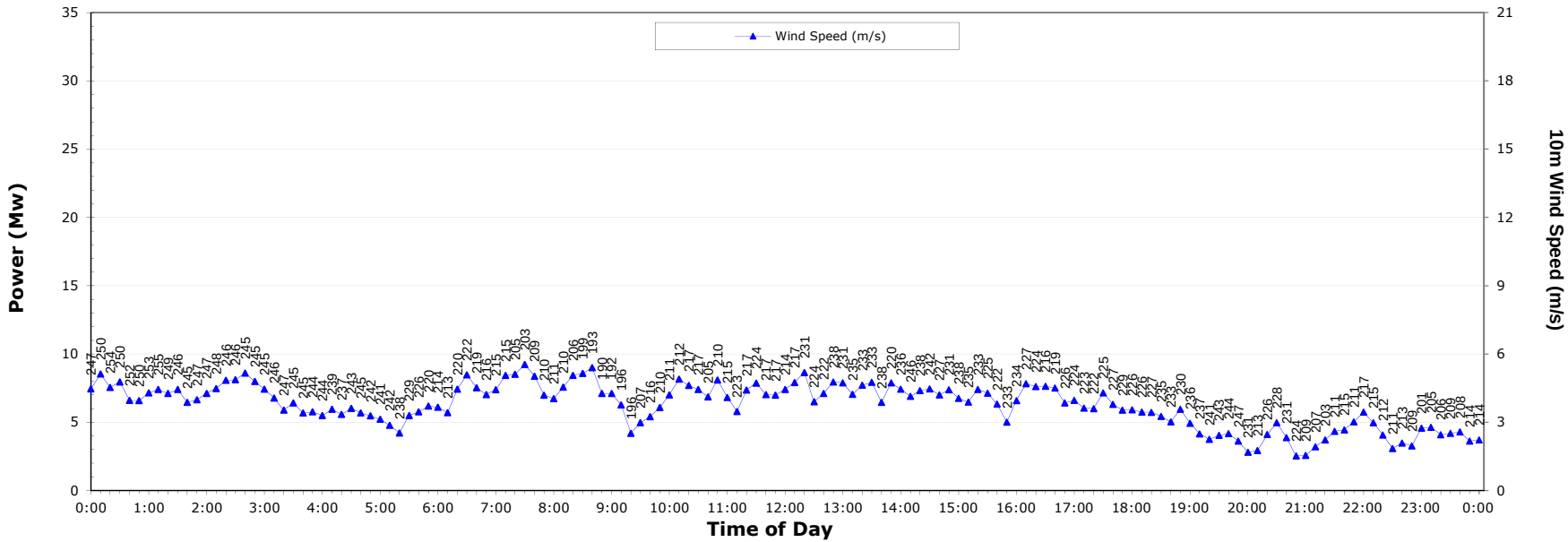
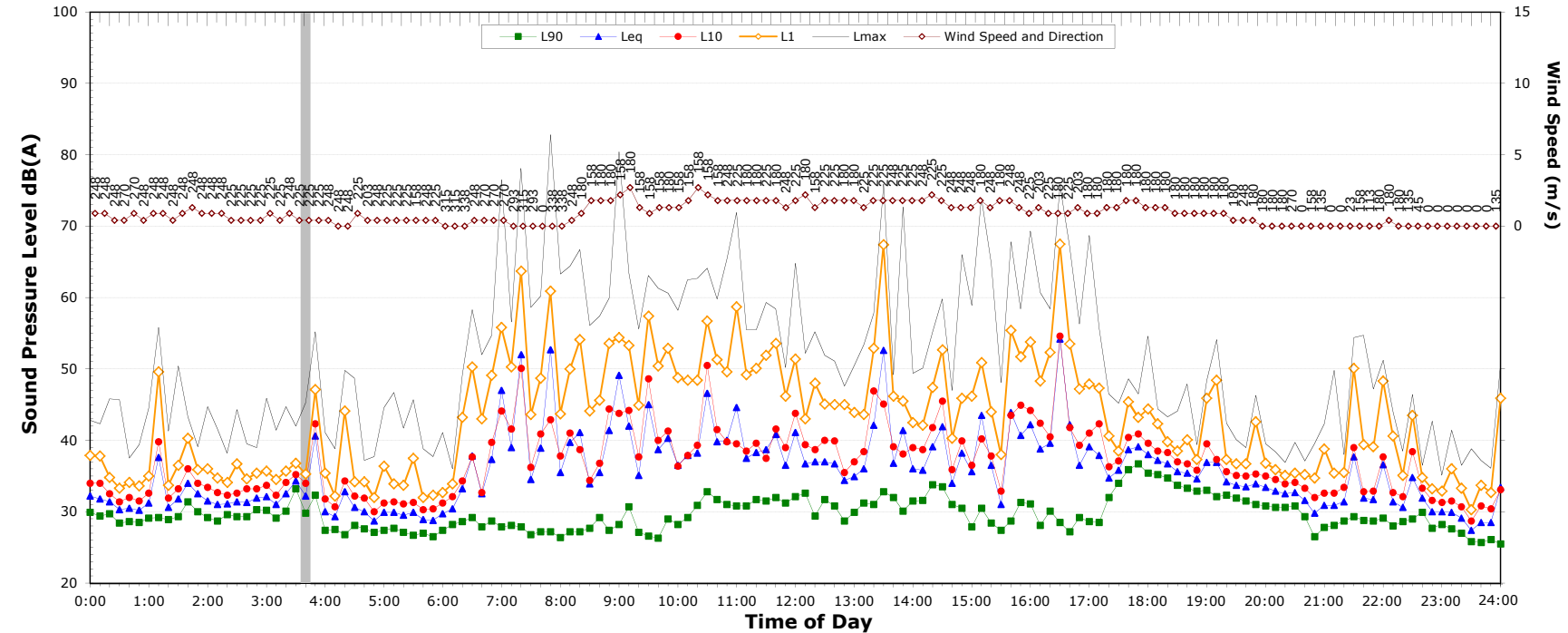
Friday, 14 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

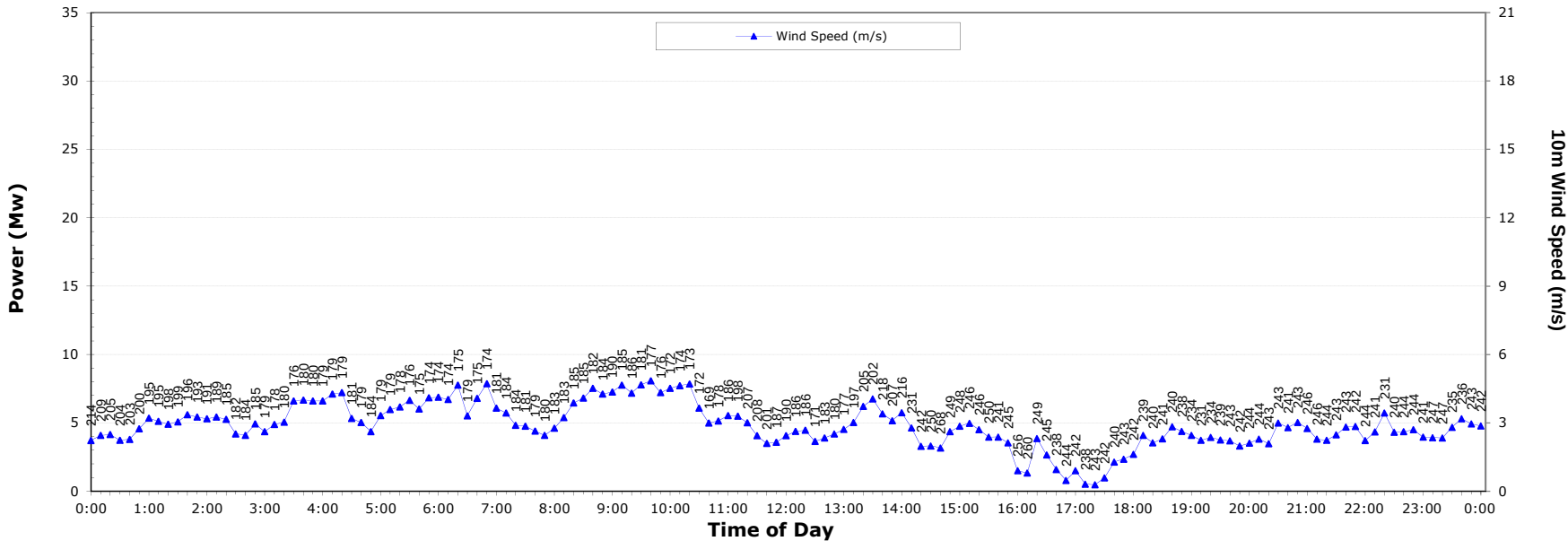
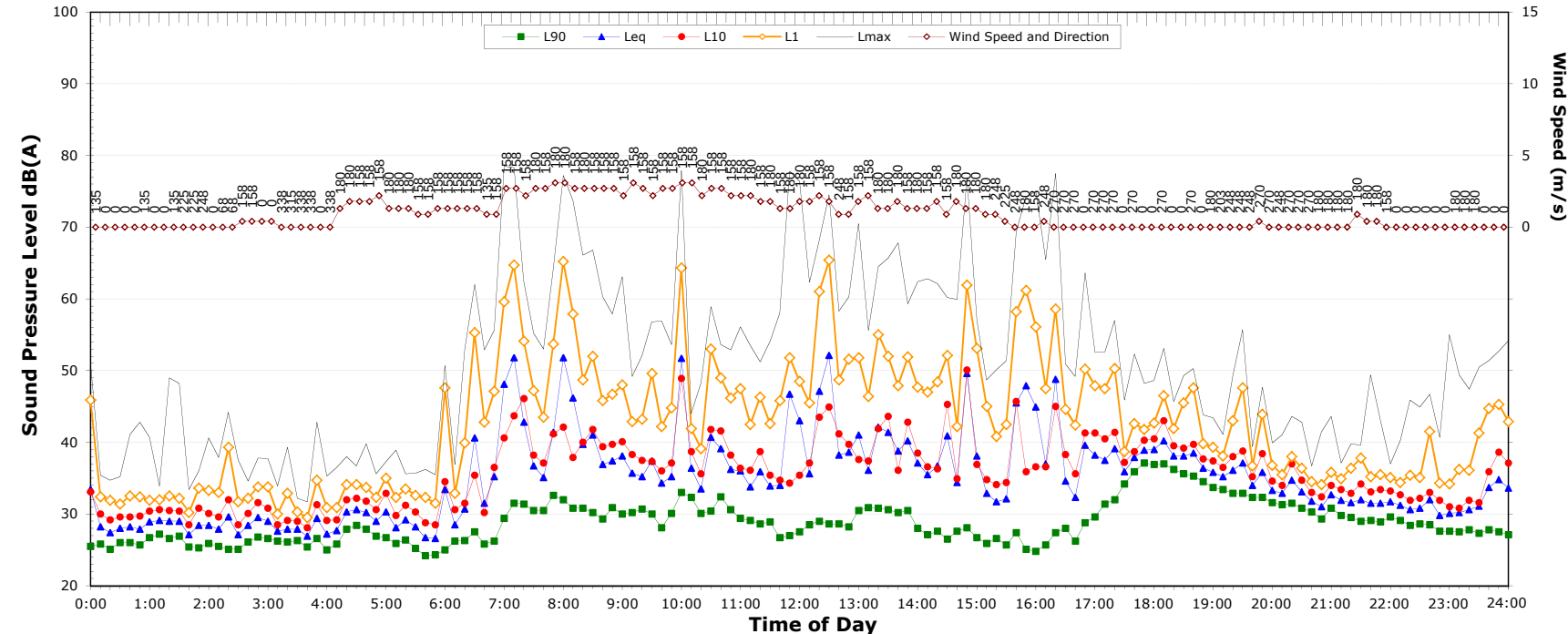
Saturday, 15 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

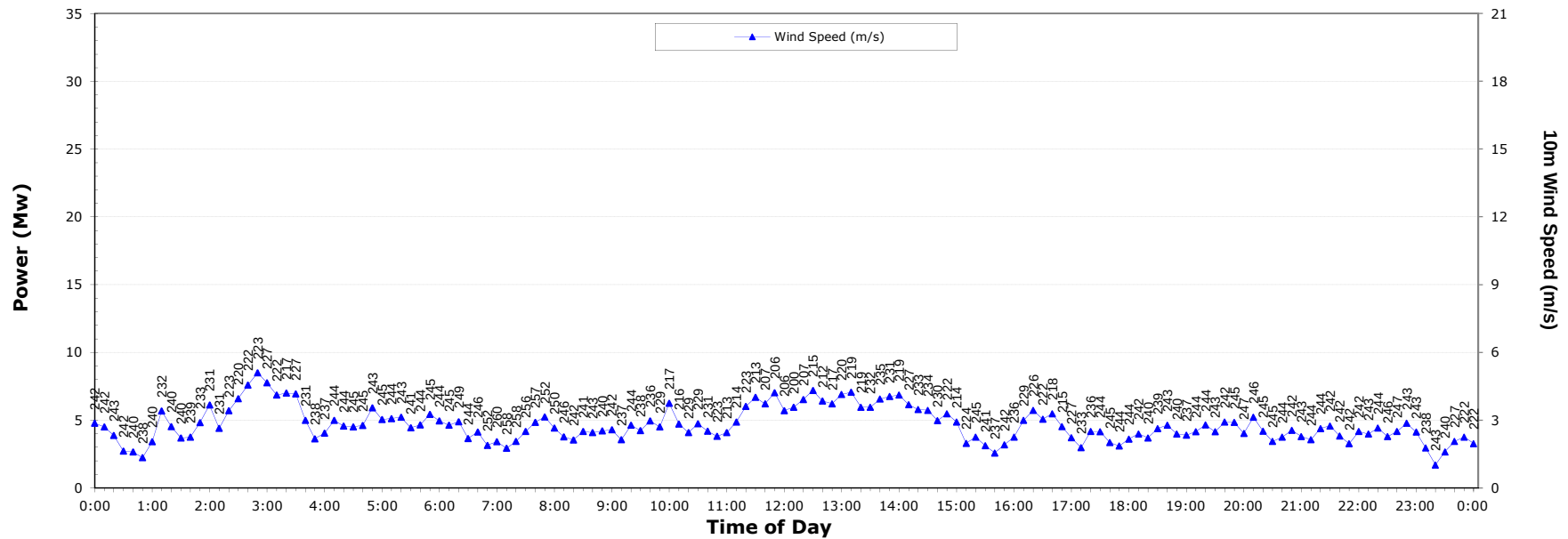
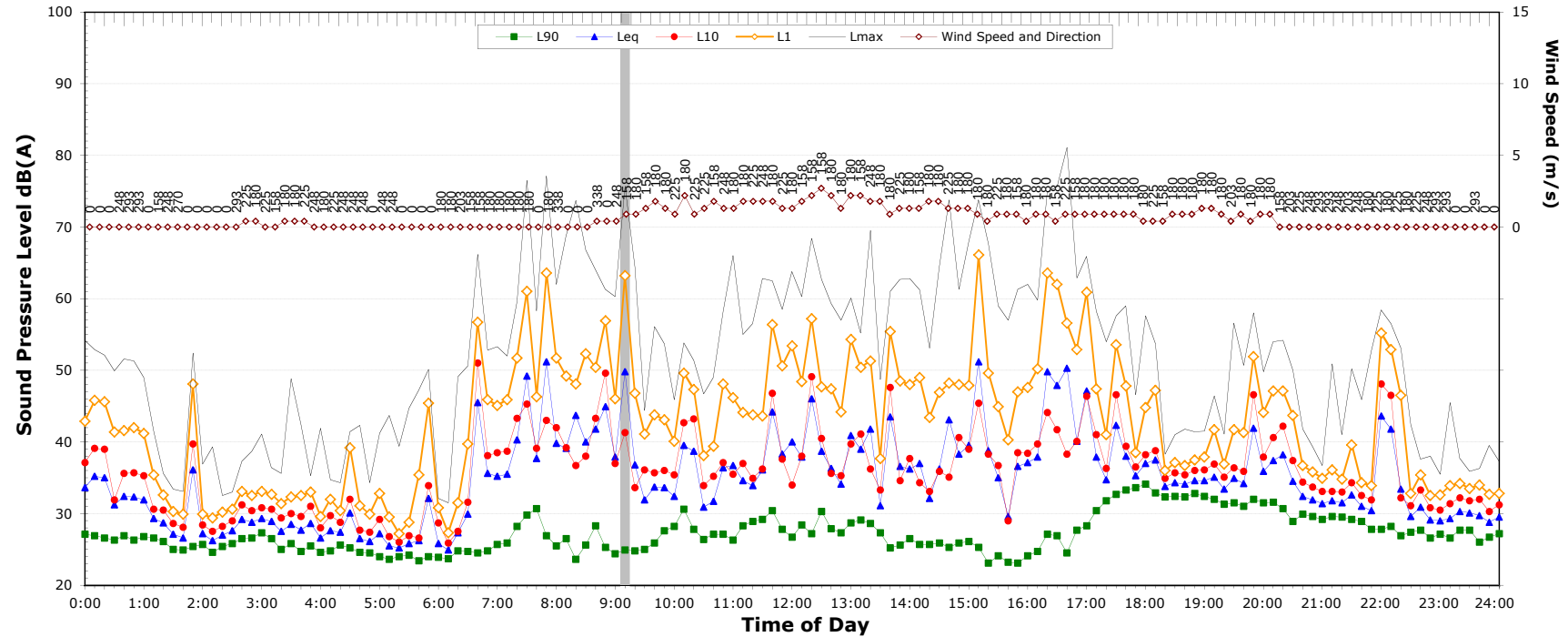
Sunday, 16 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

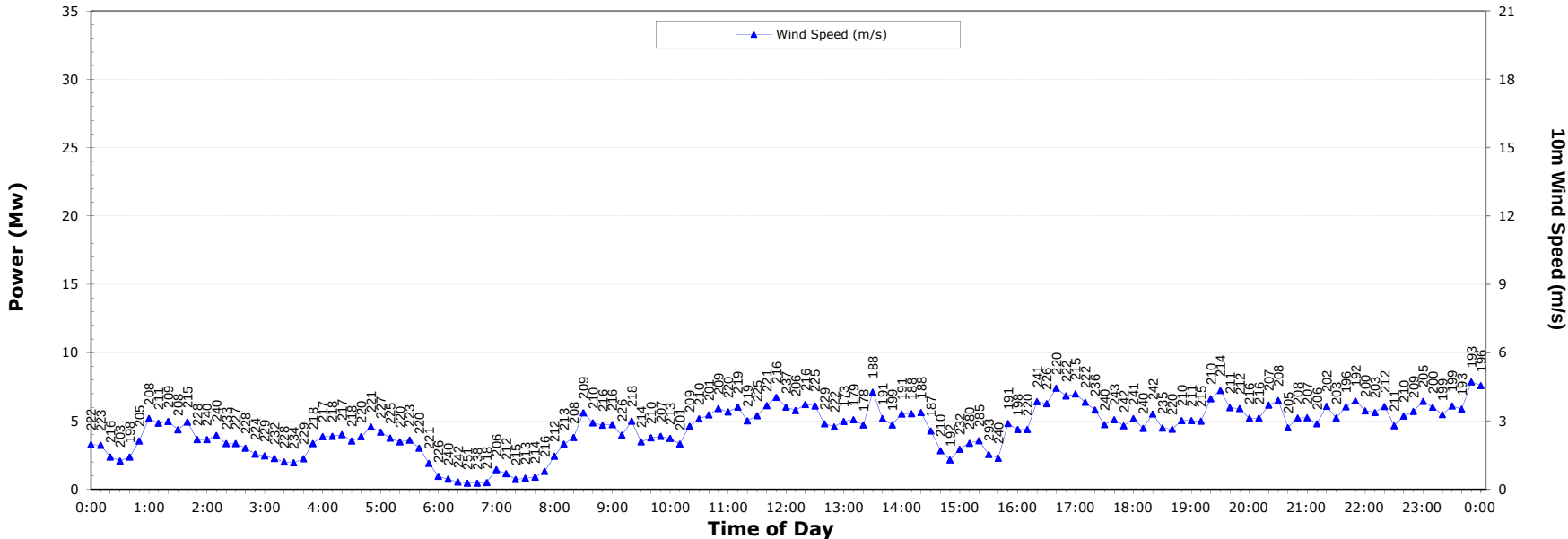
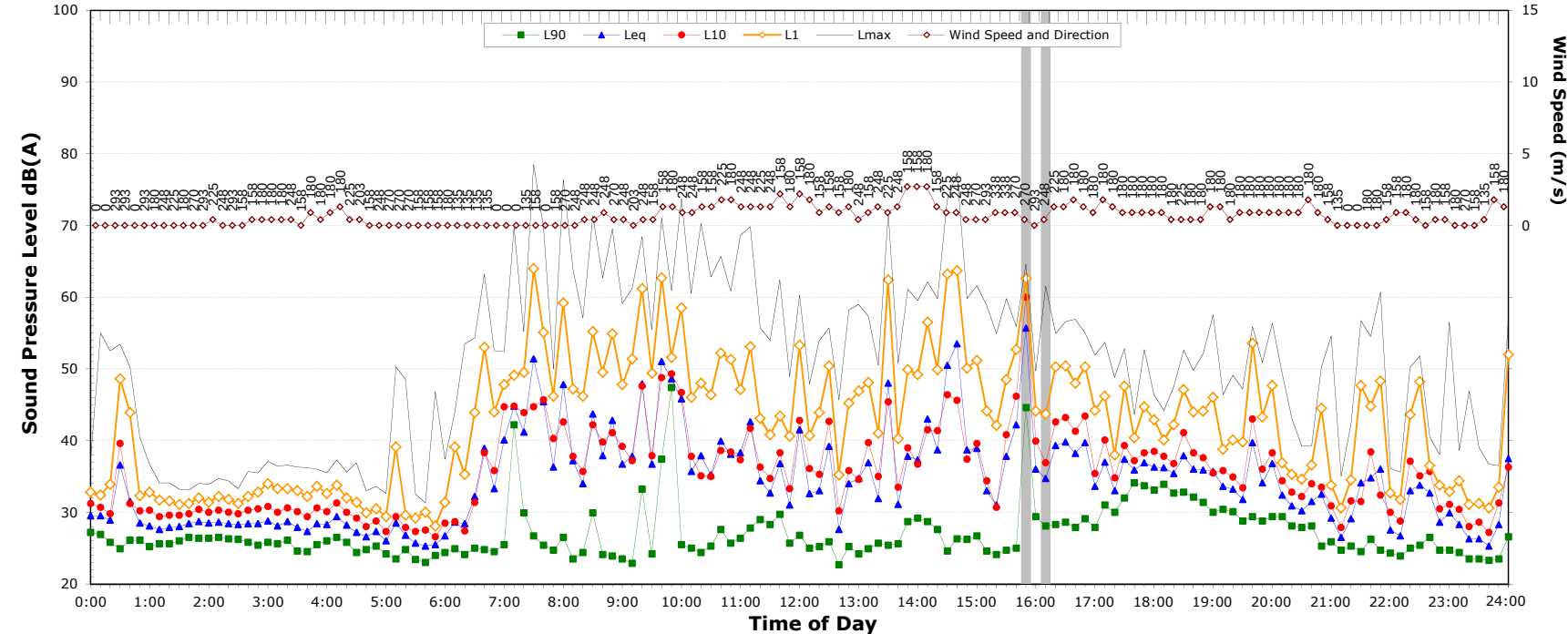
Monday, 17 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

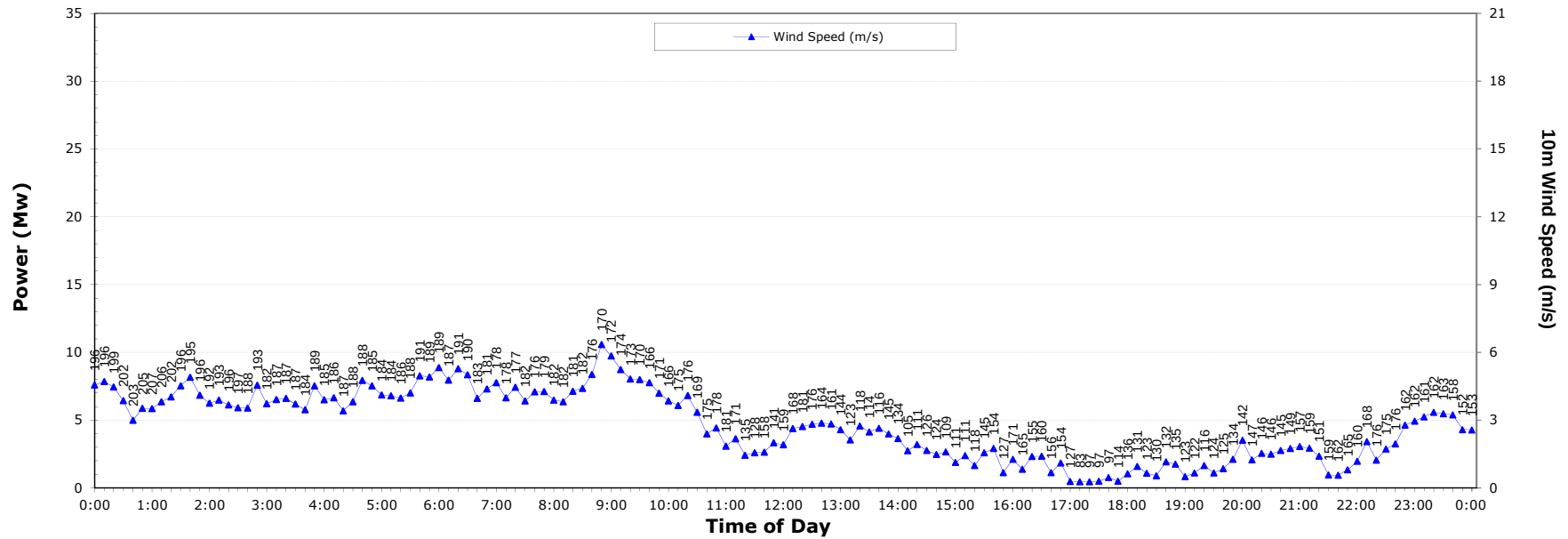
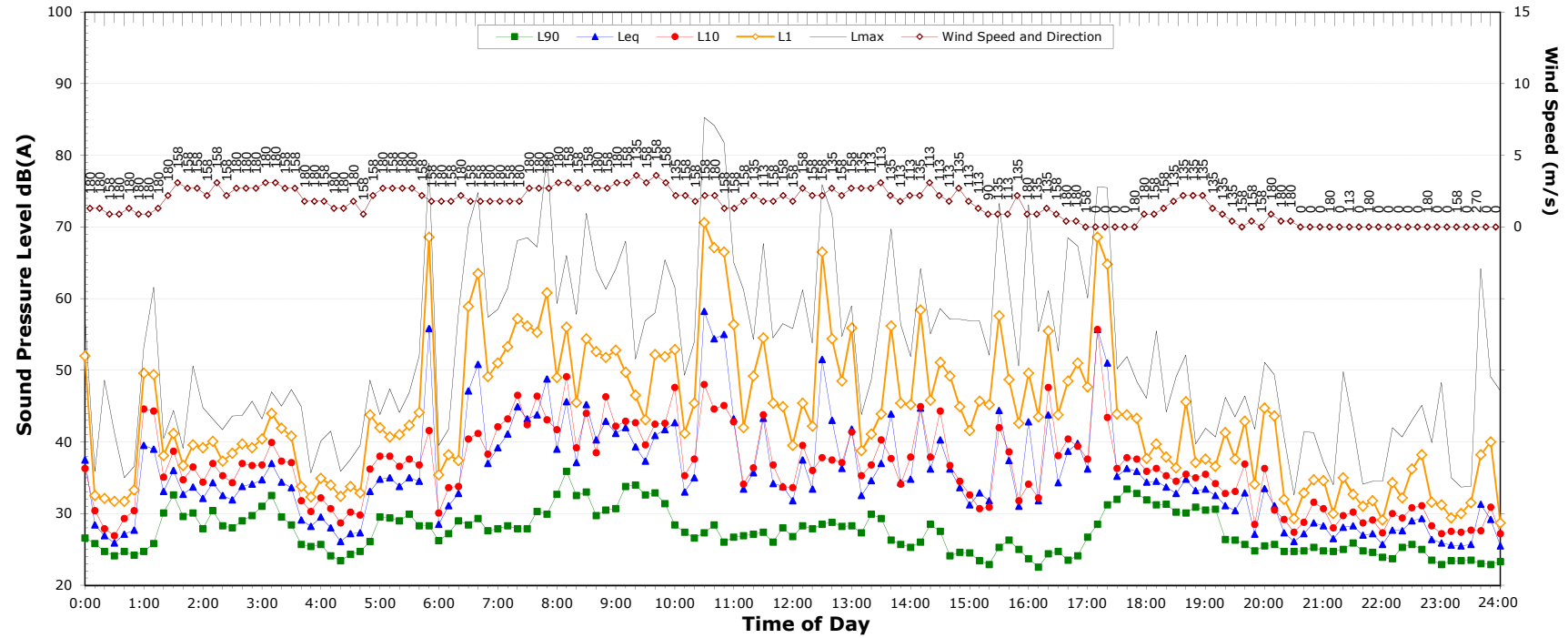
Tuesday, 18 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

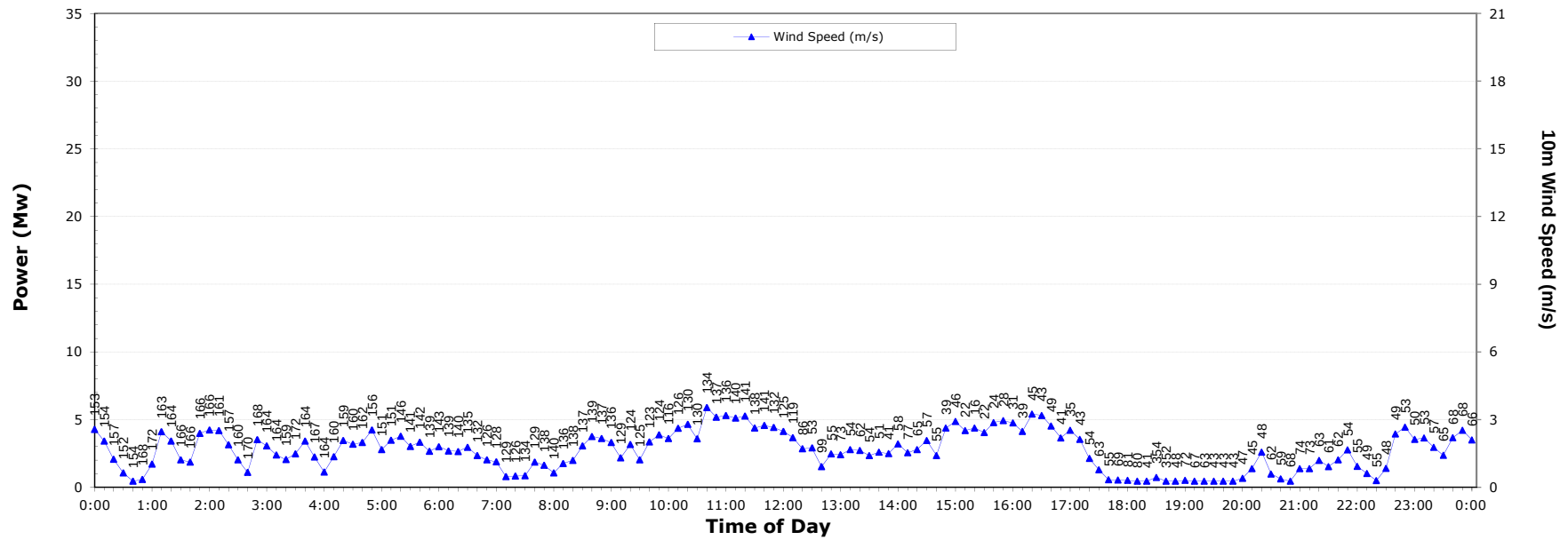
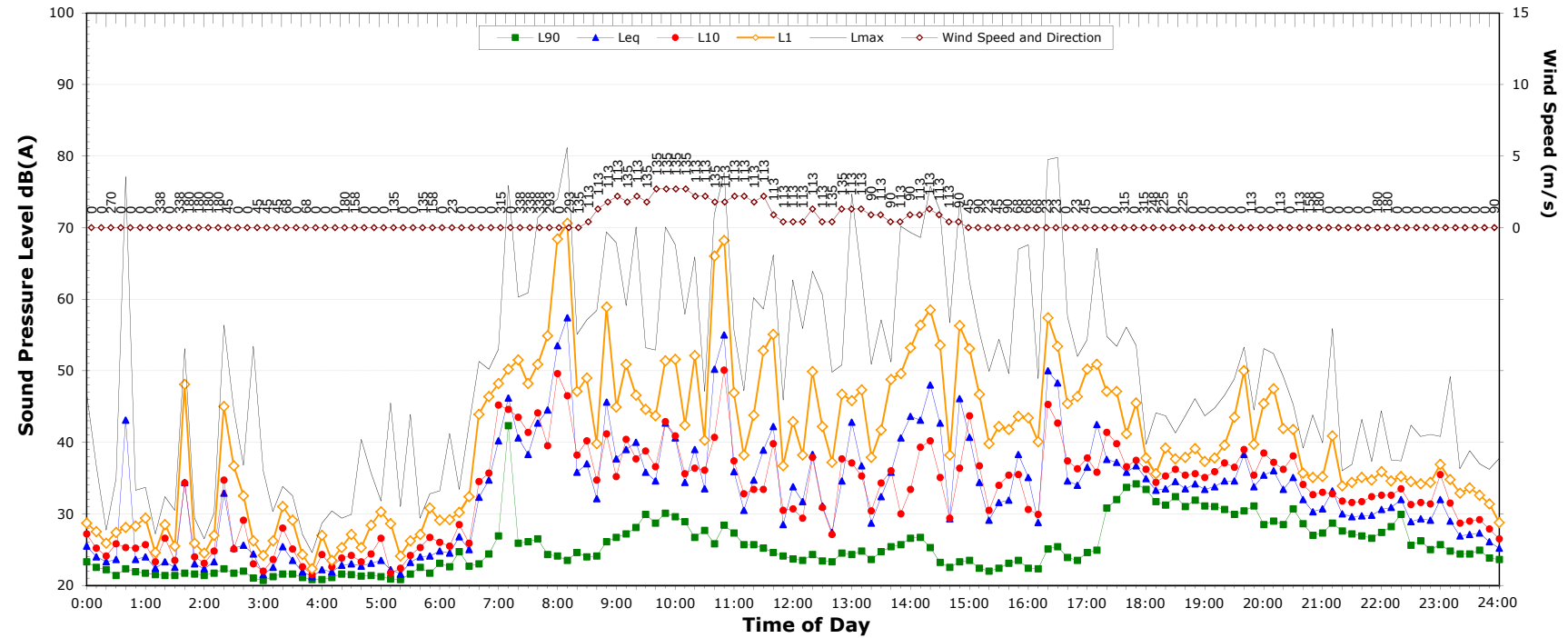
Wednesday, 19 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

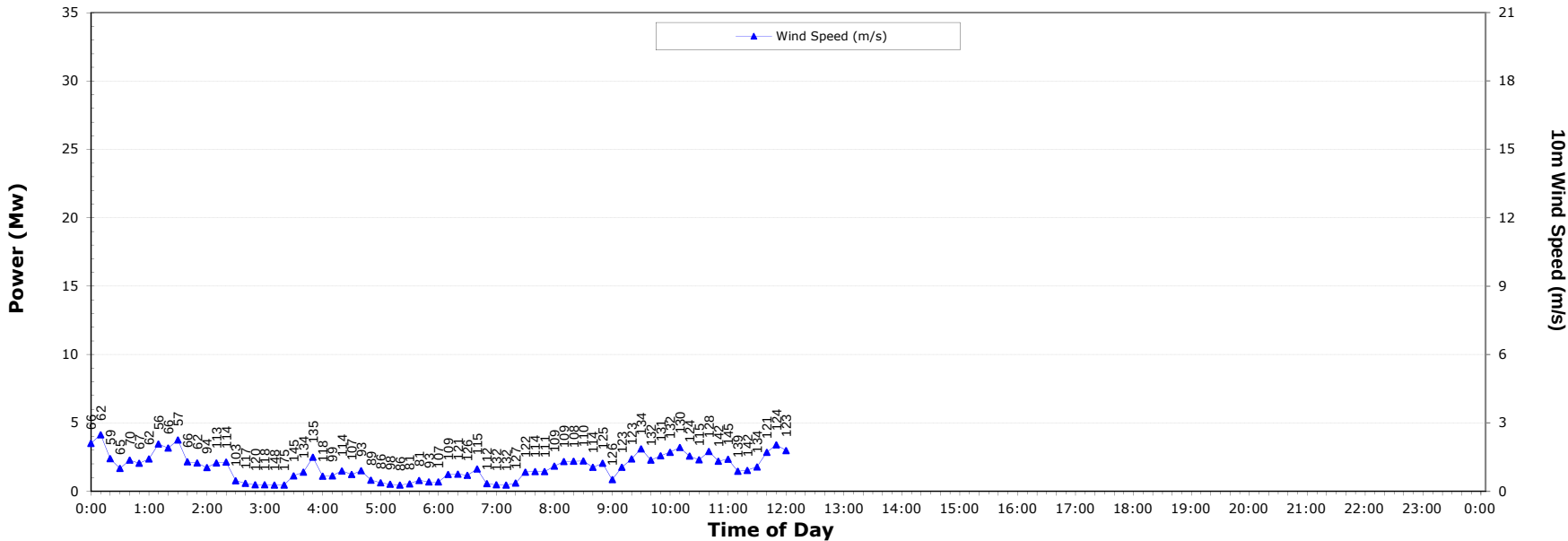
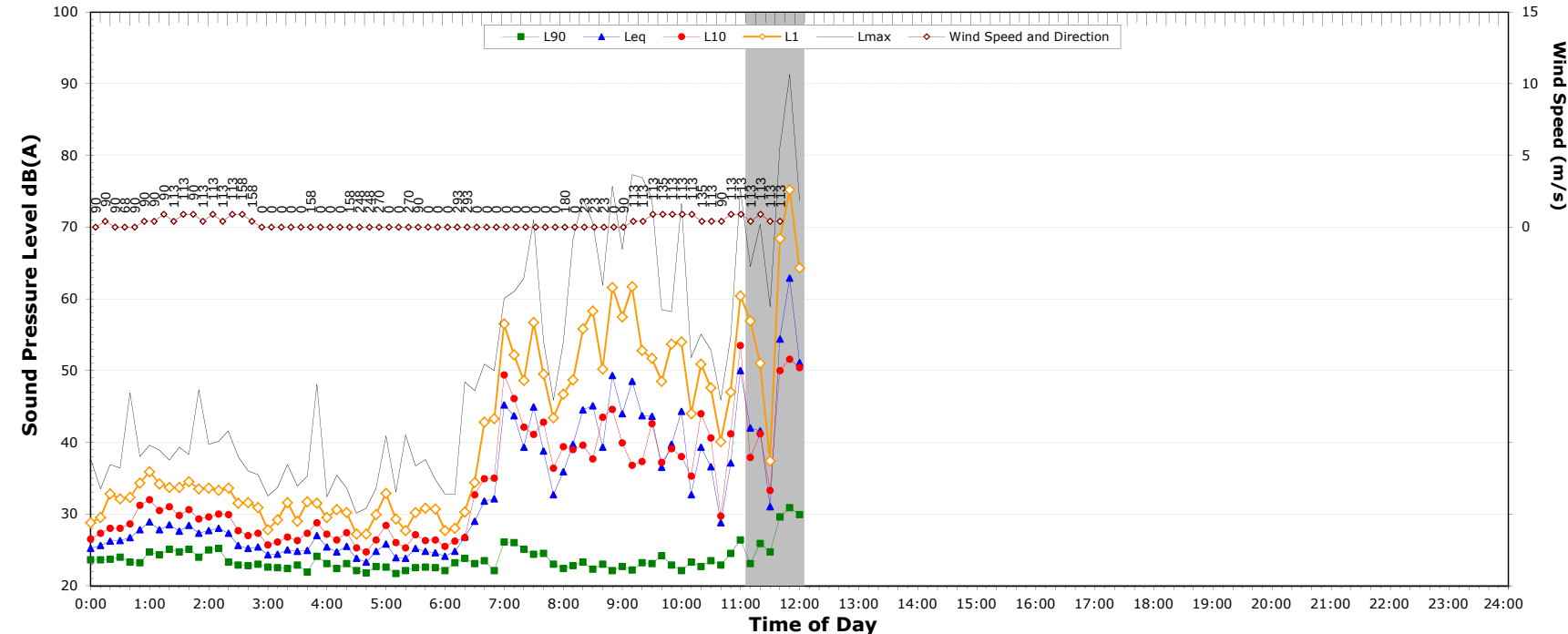
Thursday, 20 June 2013



EXISTING AMBIENT NOISE LEVELS

SFR05 - 147 Sally's Flat Road

Friday, 21 June 2013



APPENDIX D - CR28 WILLOW DOWNS SURVEY RESULTS





CR28 - Willow Downs

BACKGROUND & AMBIENT NOISE MONITORING RESULTS NSW 'INDUSTRIAL NOISE POLICY', 2000

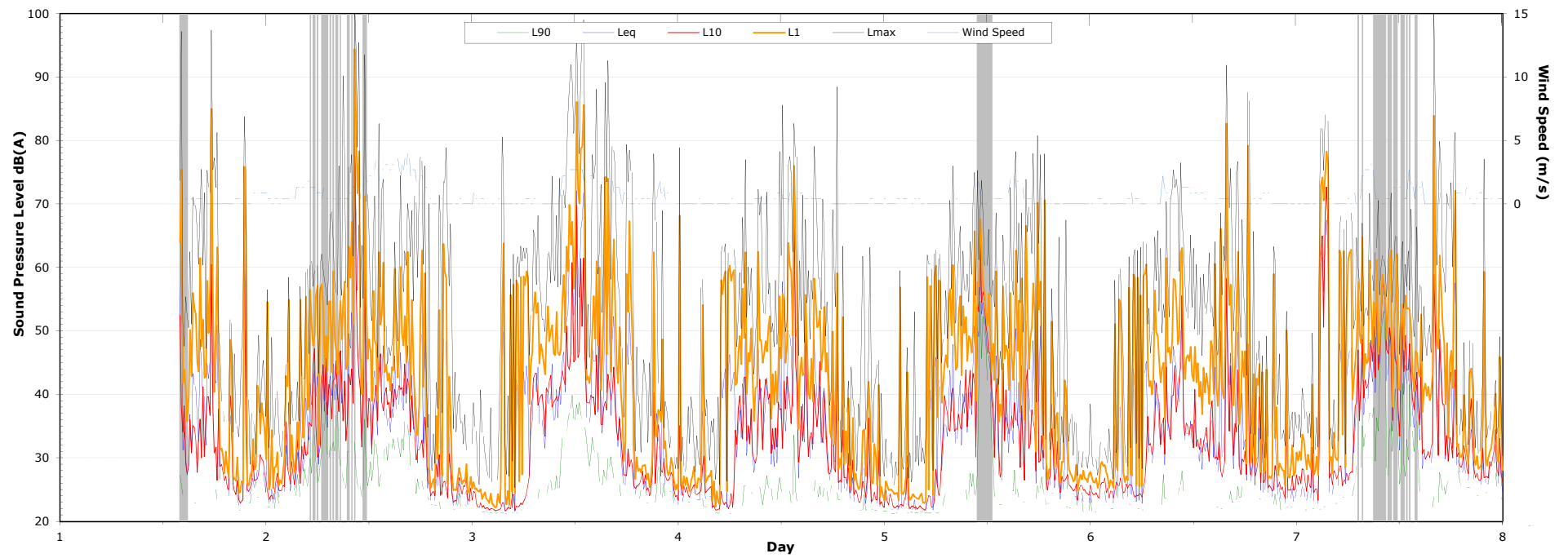
Day	L _{A90} Background Noise Levels ⁵			L _{Aeq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Thursday-06-June-2013	-	22	22	-	50	33
Friday-07-June-2013	25	22	21	54	42	38
Saturday-08-June-2013	24	23	21	59	42	39
Sunday-09-June-2013	23	22	21	52	44	35
Monday-10-June-2013	23	22	22	44	44	35
Tuesday-11-June-2013	22	23	22	51	51	54
Wednesday-12-June-2013	23	24	22	54	45	40
Thursday-13-June-2013	25	24	24	42	29	42
Friday-14-June-2013	26	26	25	43	41	40
Saturday-15-June-2013	25	24	22	53	40	47
Sunday-16-June-2013	24	23	22	45	36	41
Monday-17-June-2013	24	23	21	62	53	38
Tuesday-18-June-2013	23	24	22	56	42	40
Wednesday-19-June-2013	23	22	21	47	38	47
Thursday-20-June-2013	23	22	21	49	55	40
Friday-21-June-2013	-	-	-	-	-	-
Representative Level	24	23	22	51	42	40

Notes:

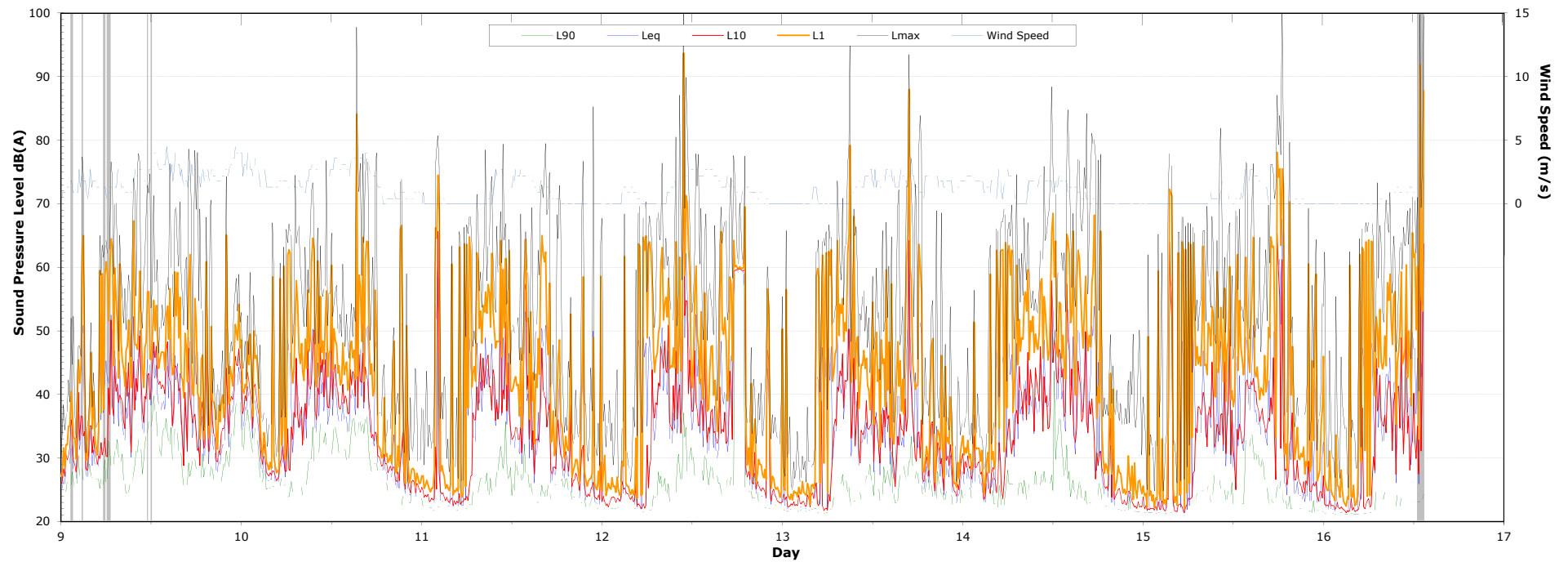
1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Rating Background Level (RBL) for L₉₀ and logarithmic average for Leq
5. Assessment Background Level (ABL)

noise logger results

Thursday, 6 June 2013 - Friday, 14 June 2013



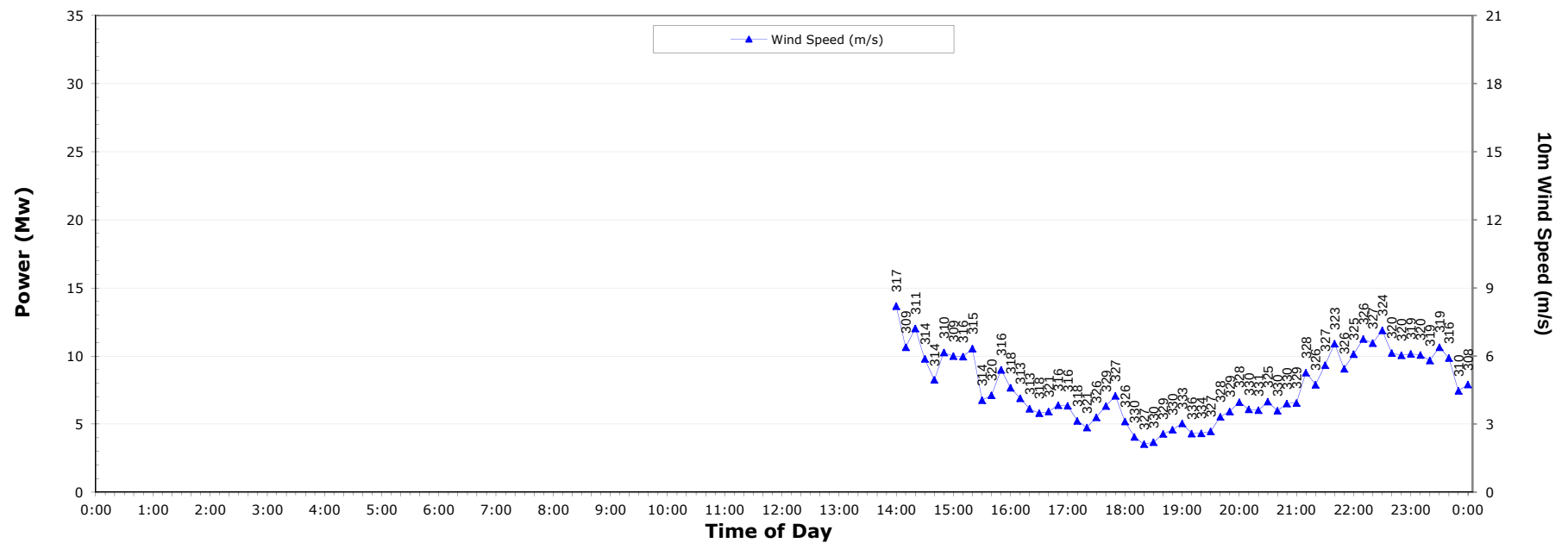
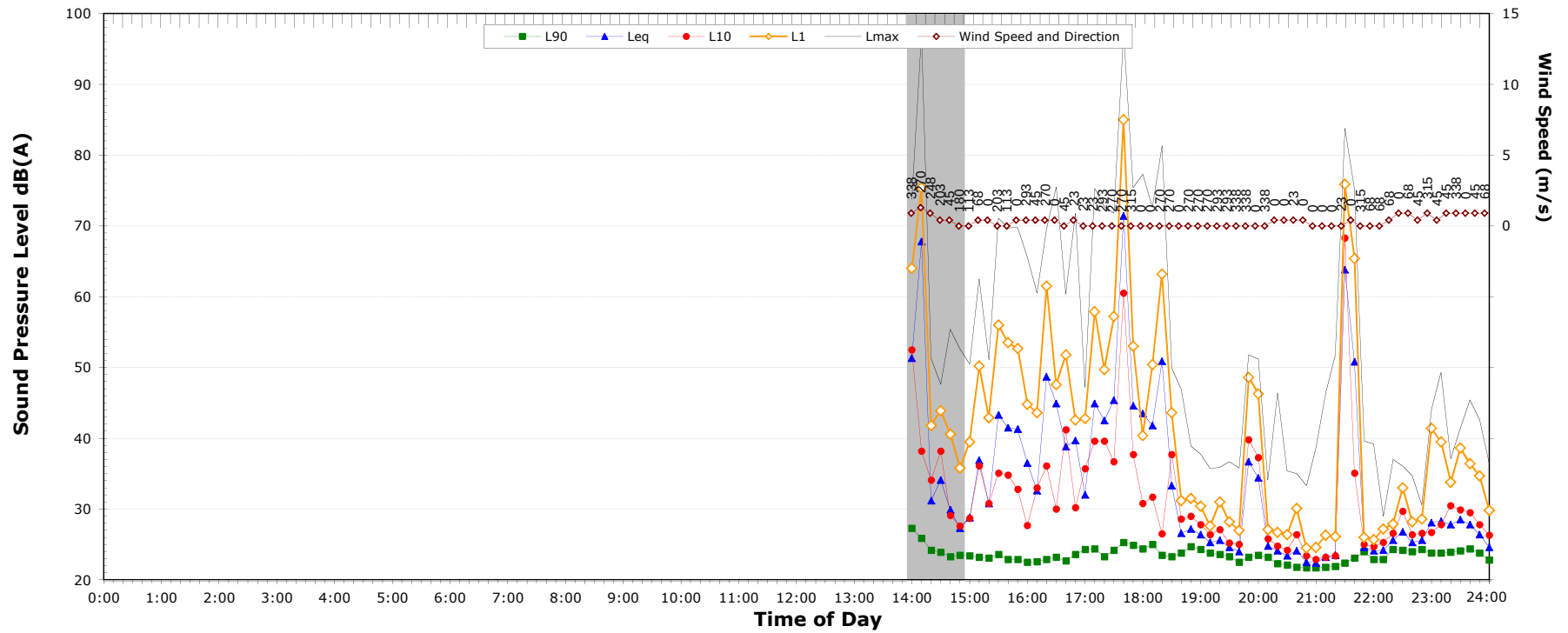
Saturday, 15 June 2013 - Saturday, 22 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

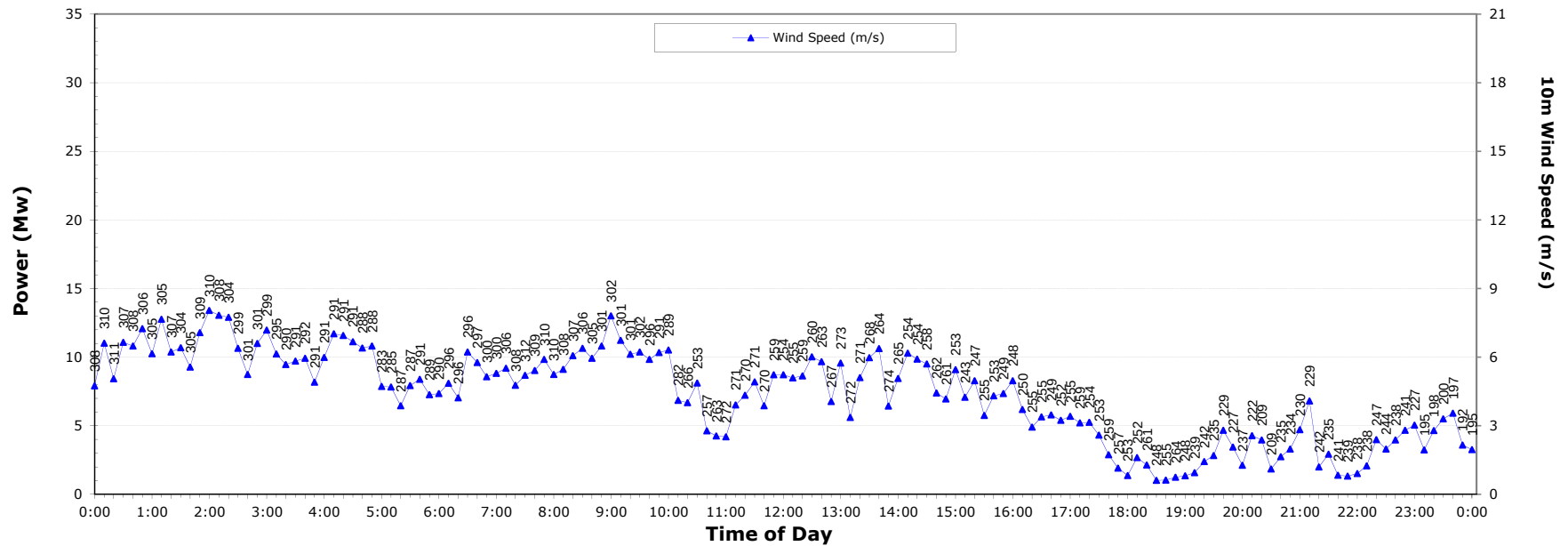
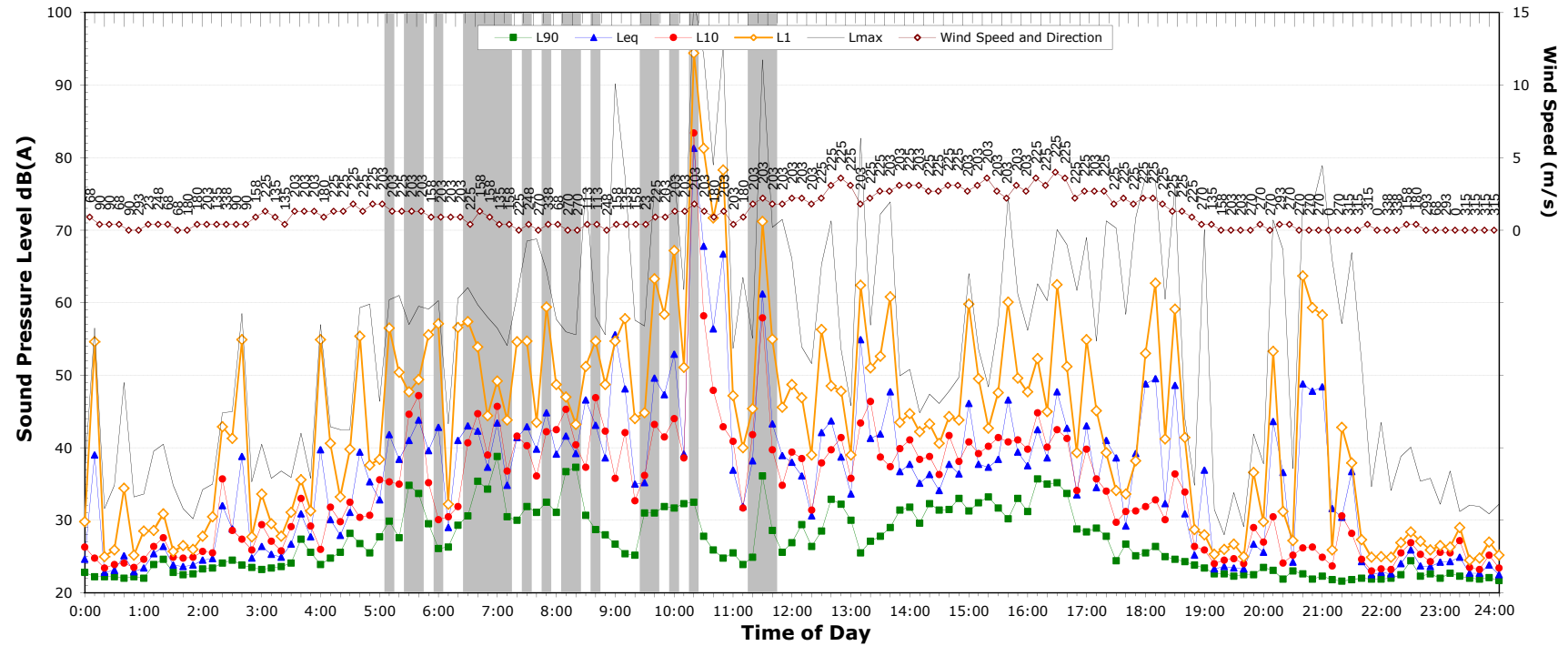
Thursday, 6 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

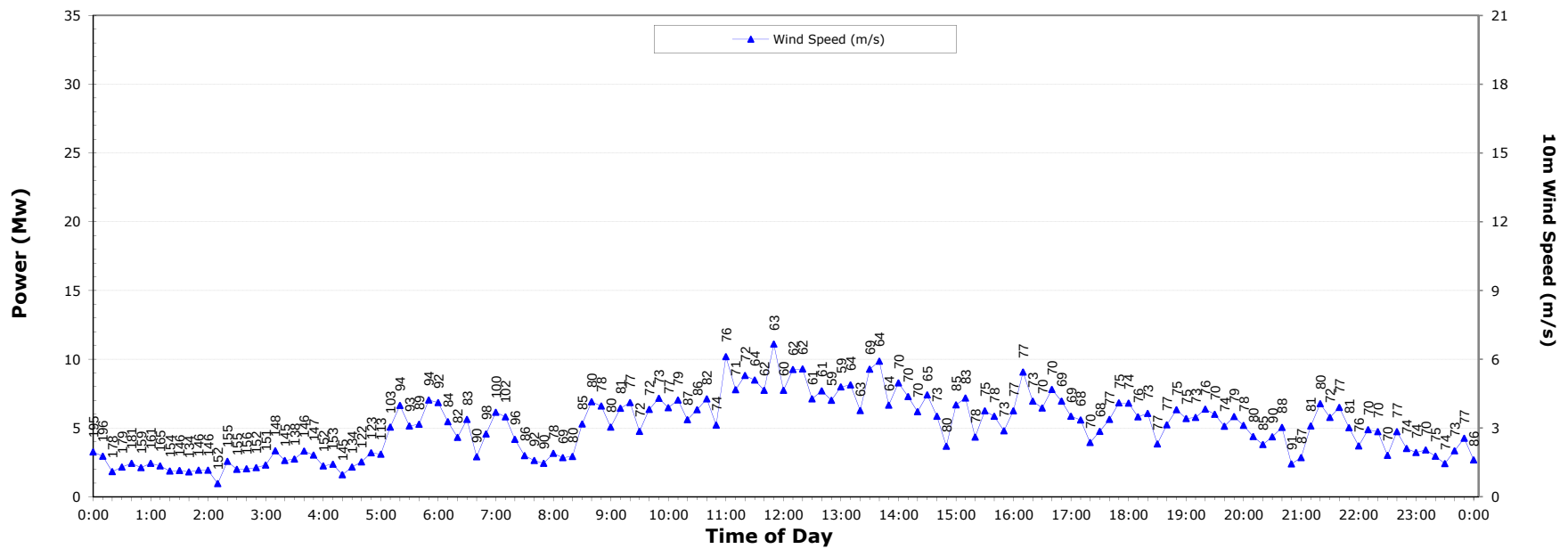
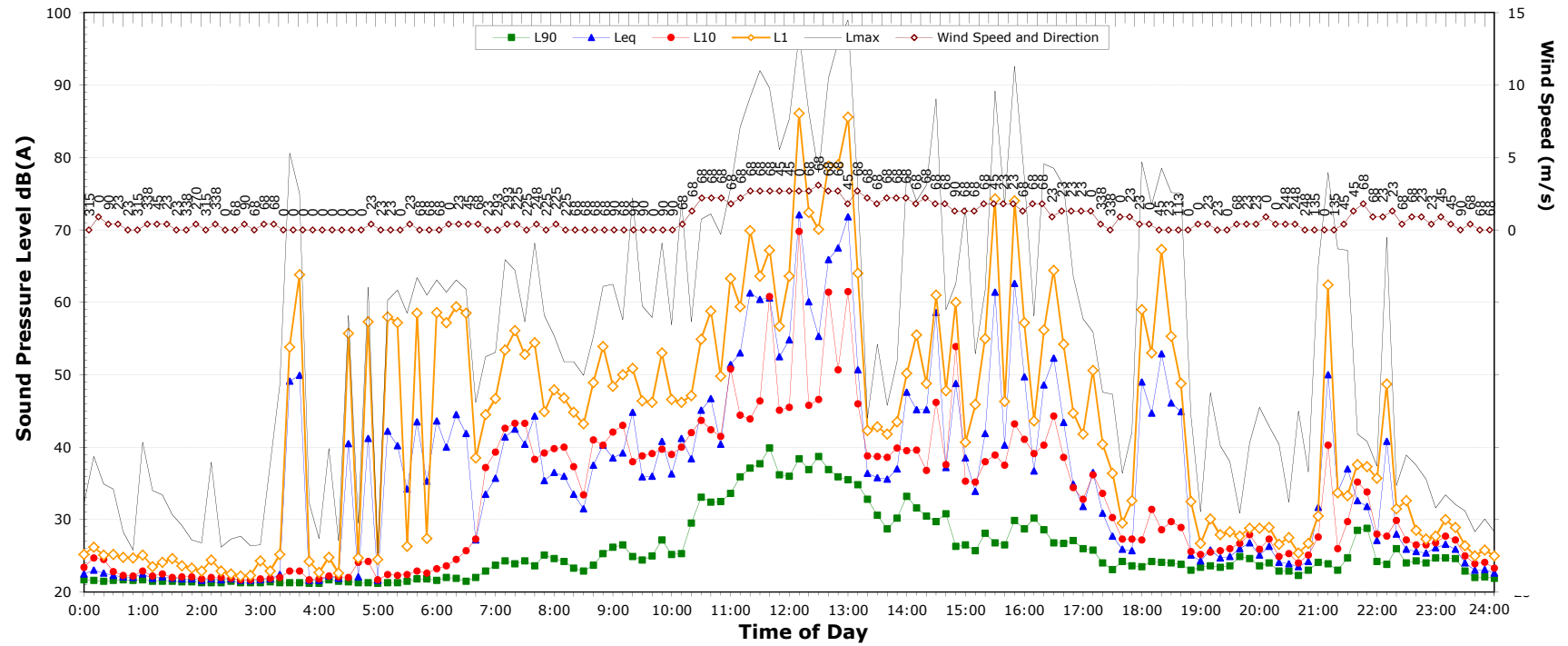
Friday, 7 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

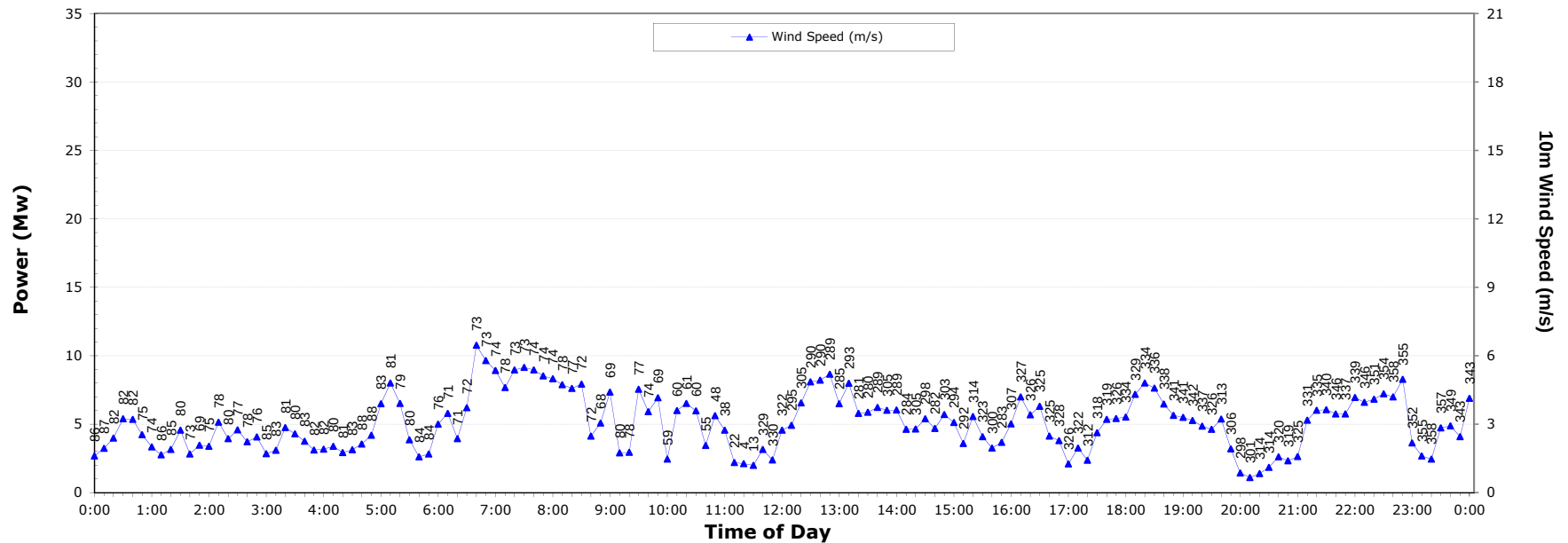
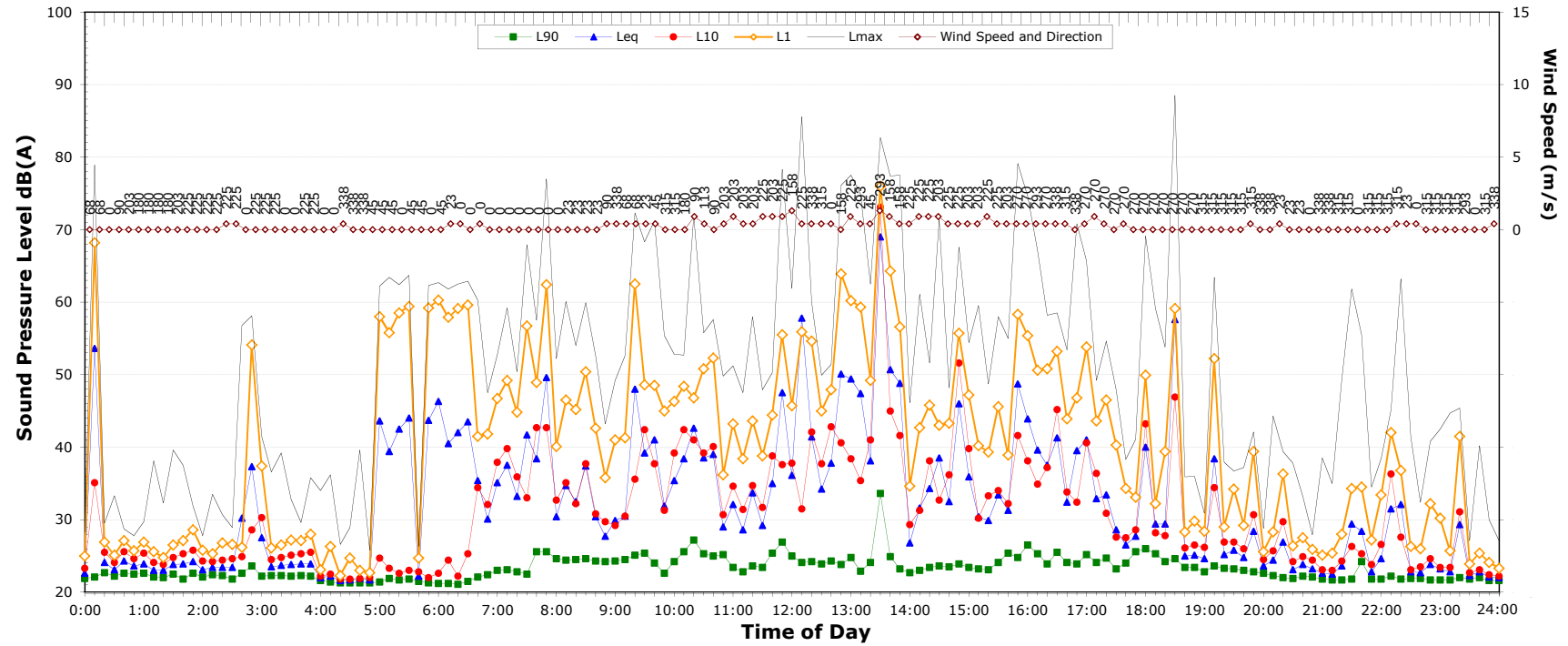
Saturday, 8 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

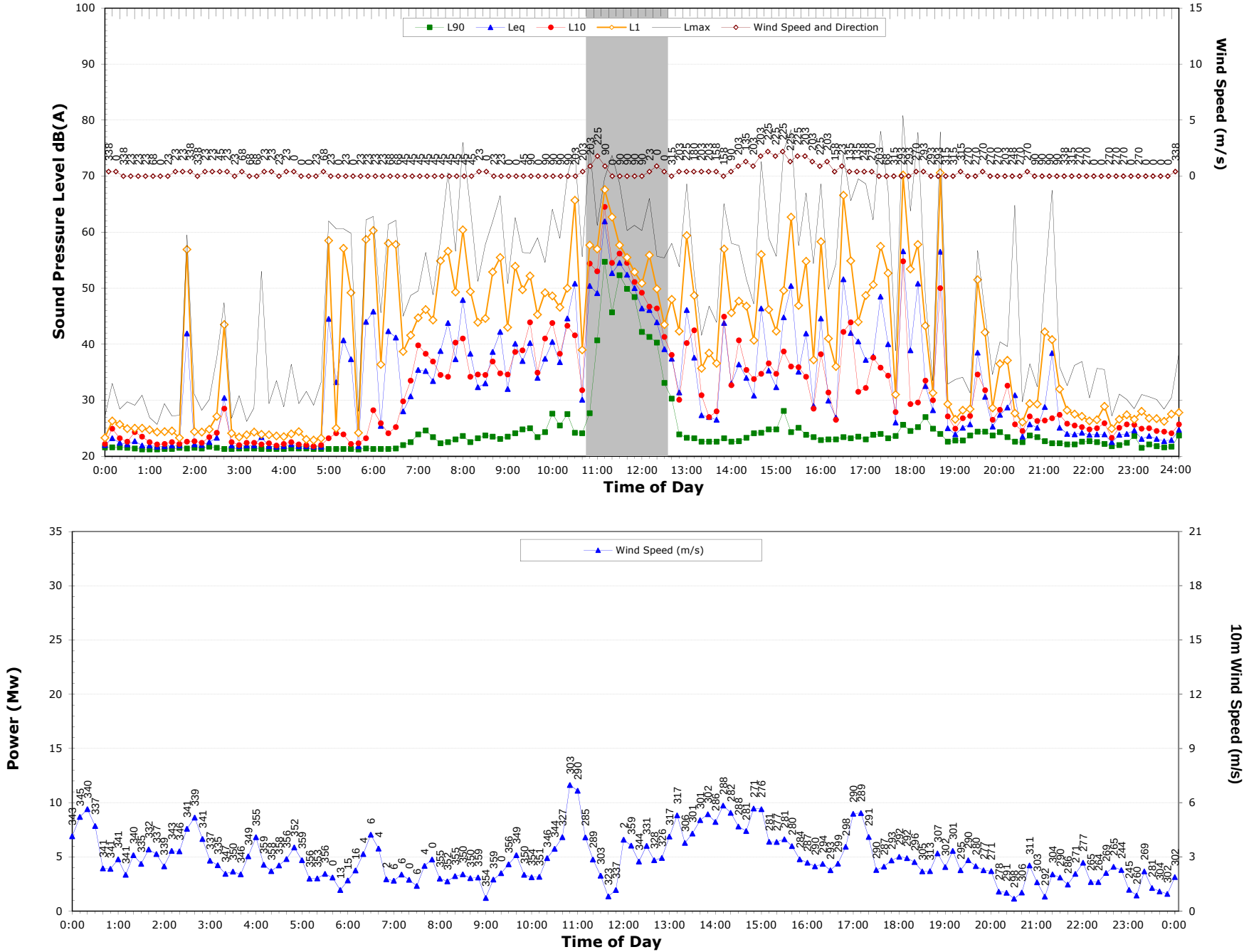
Sunday, 9 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

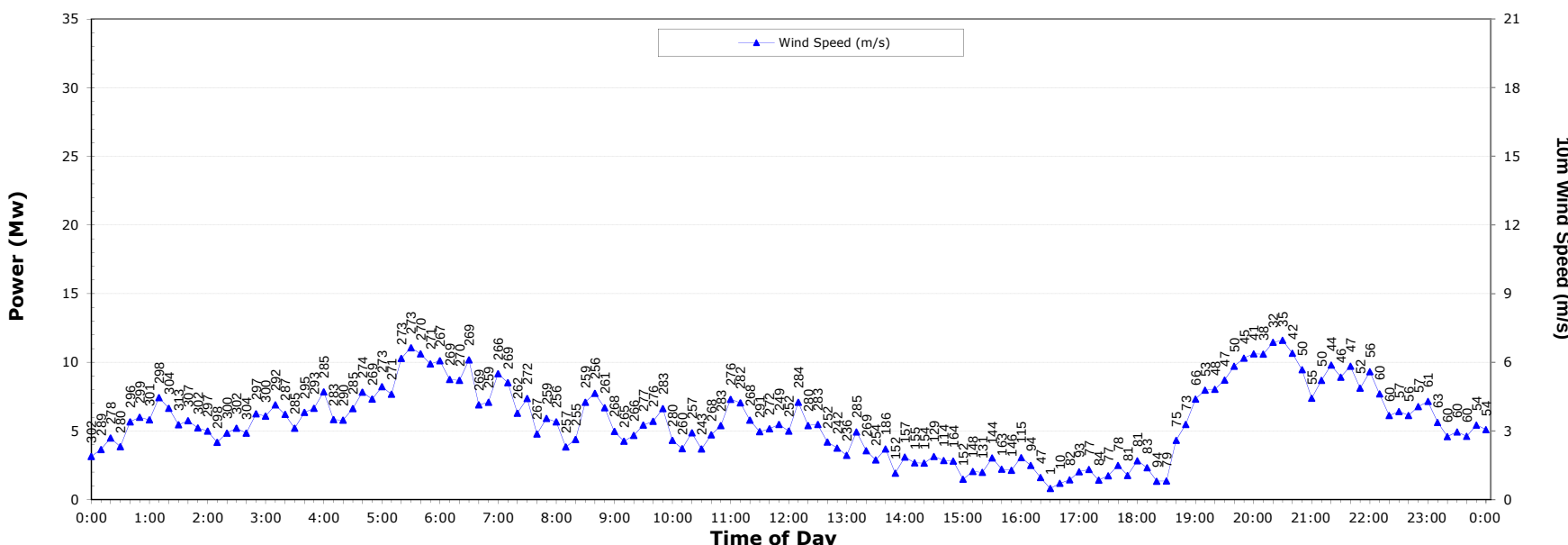
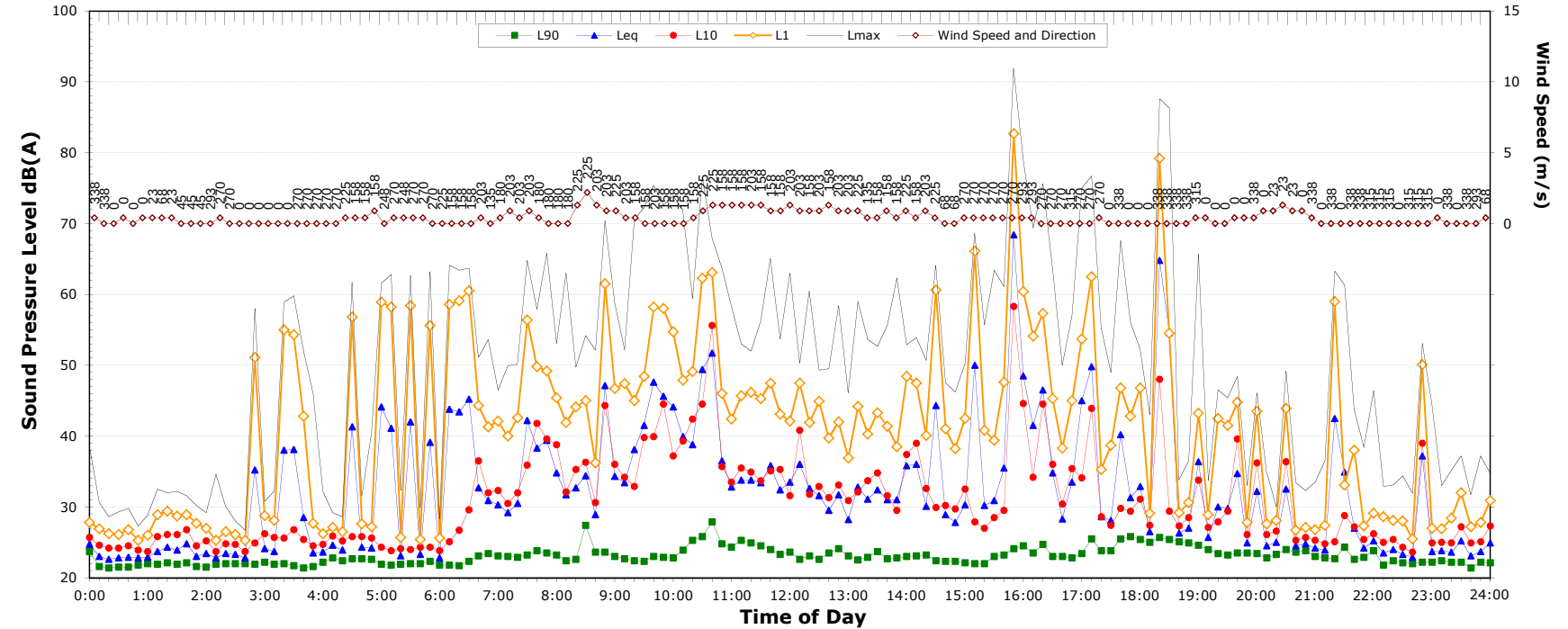
Monday, 10 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

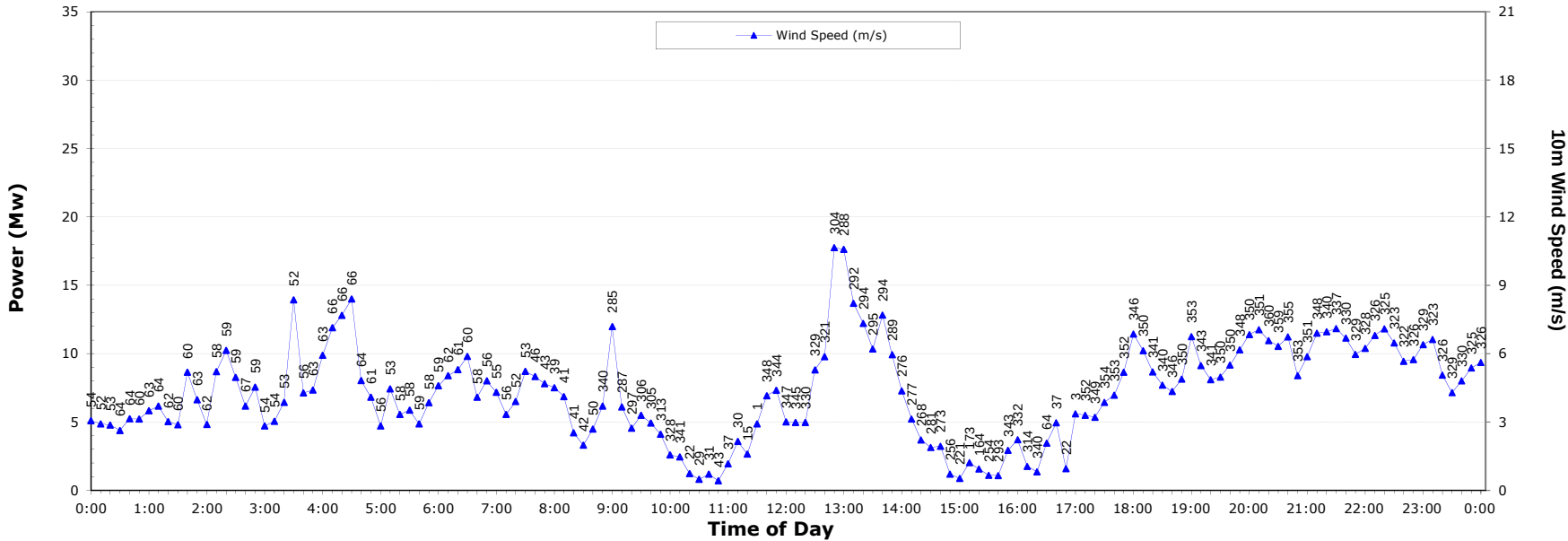
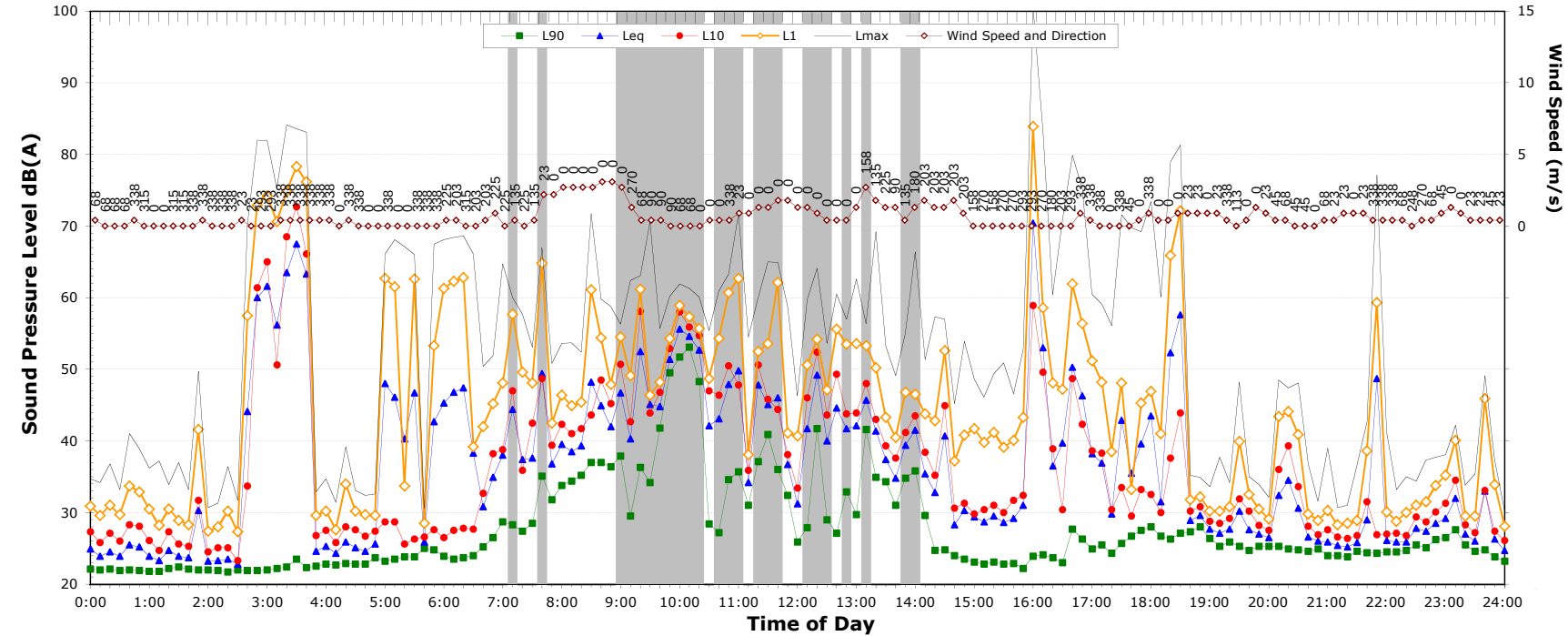
Tuesday, 11 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

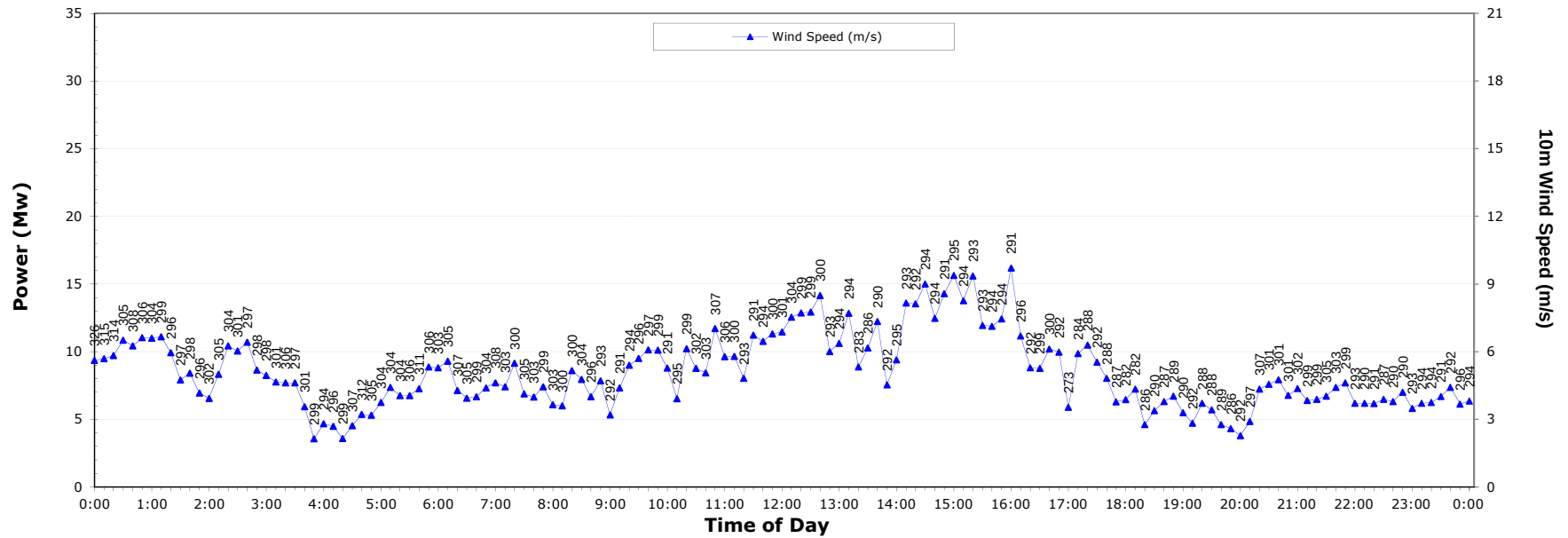
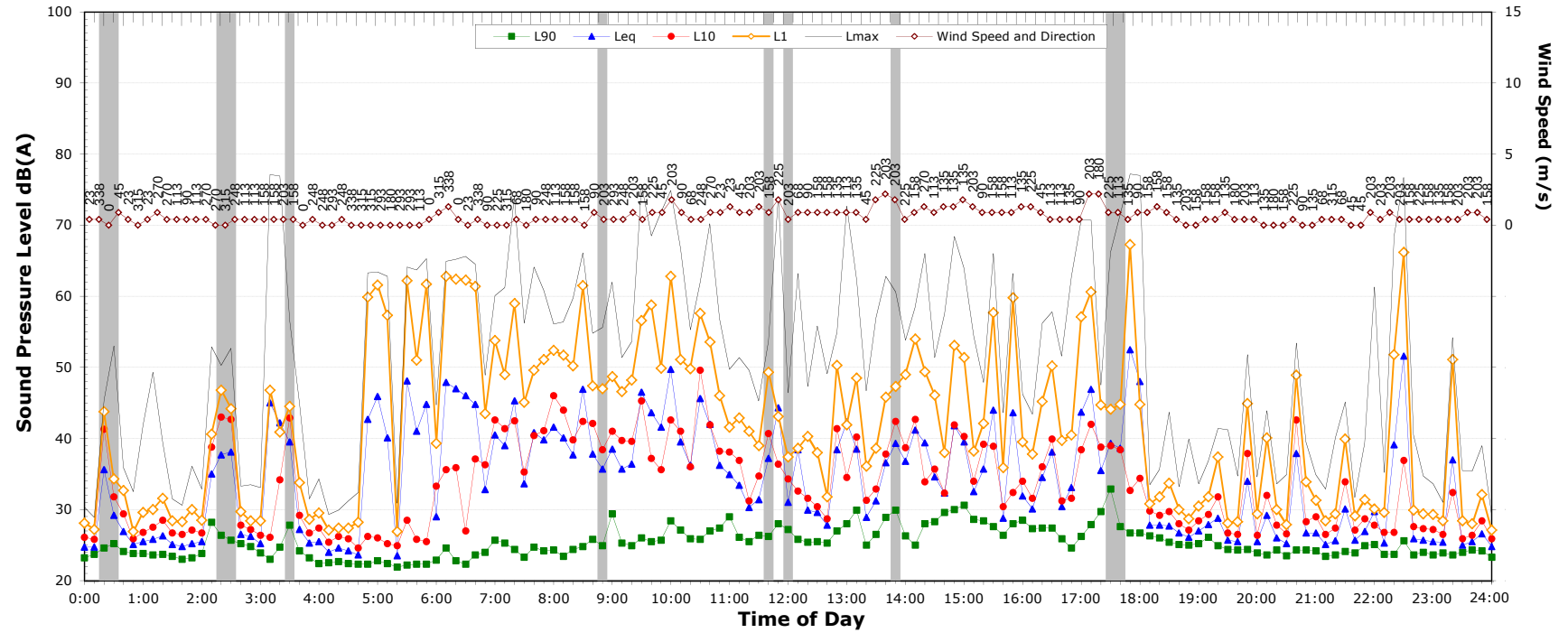
Wednesday, 12 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

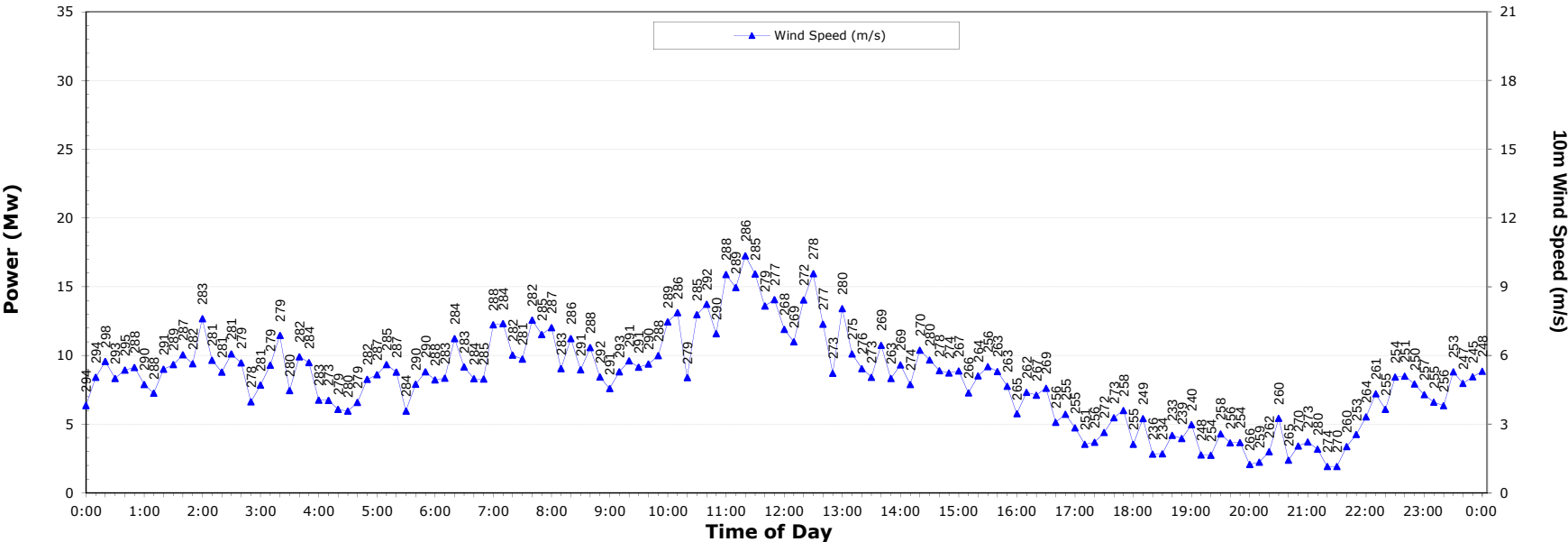
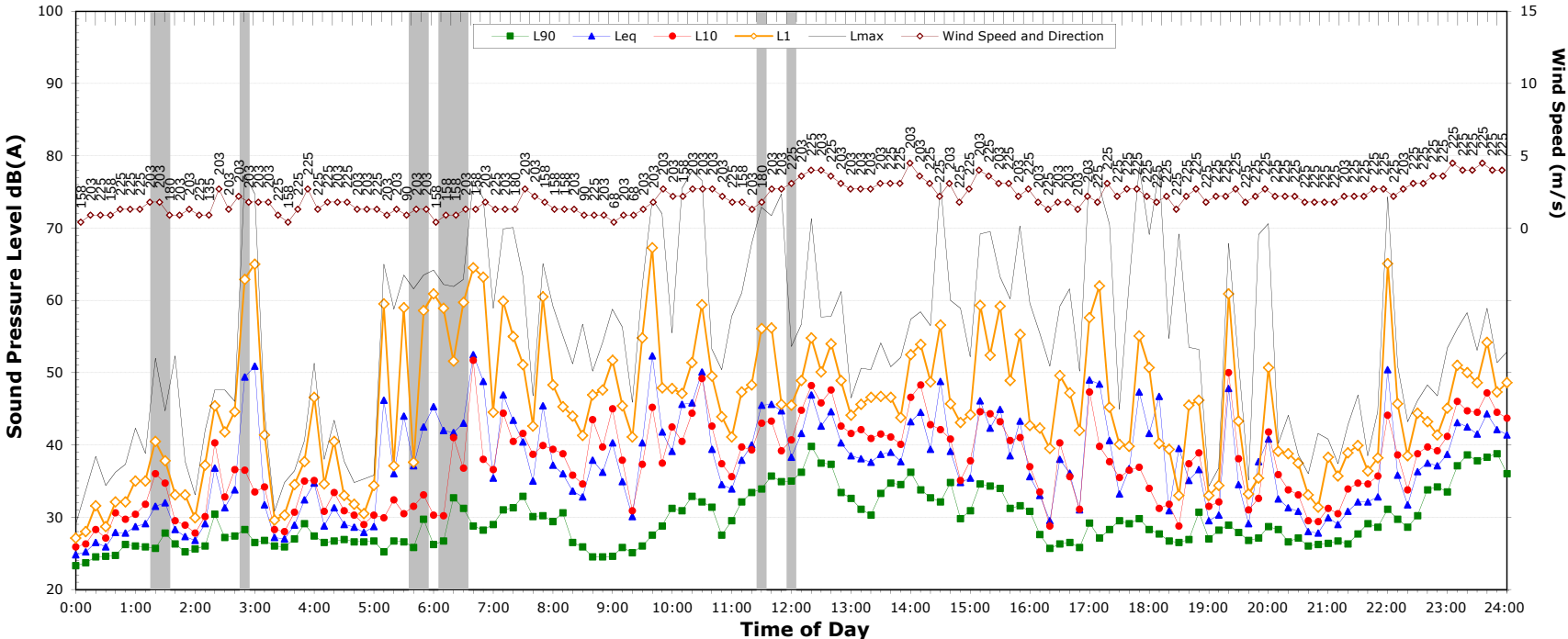
Thursday, 13 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

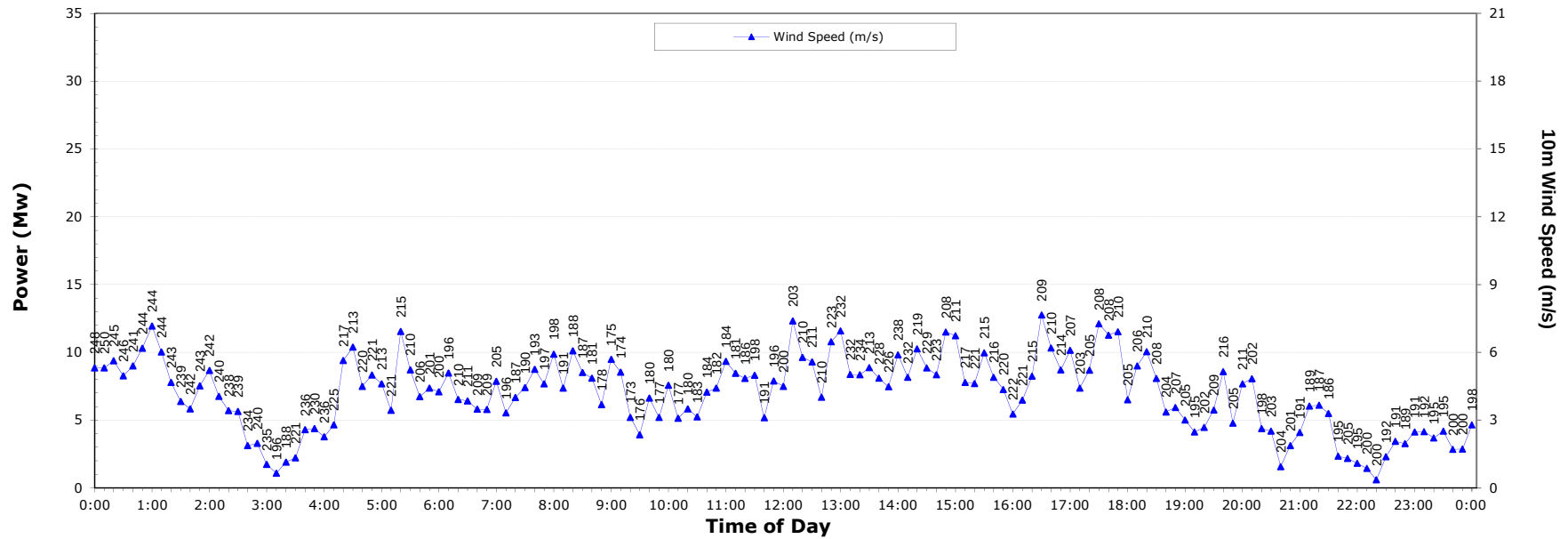
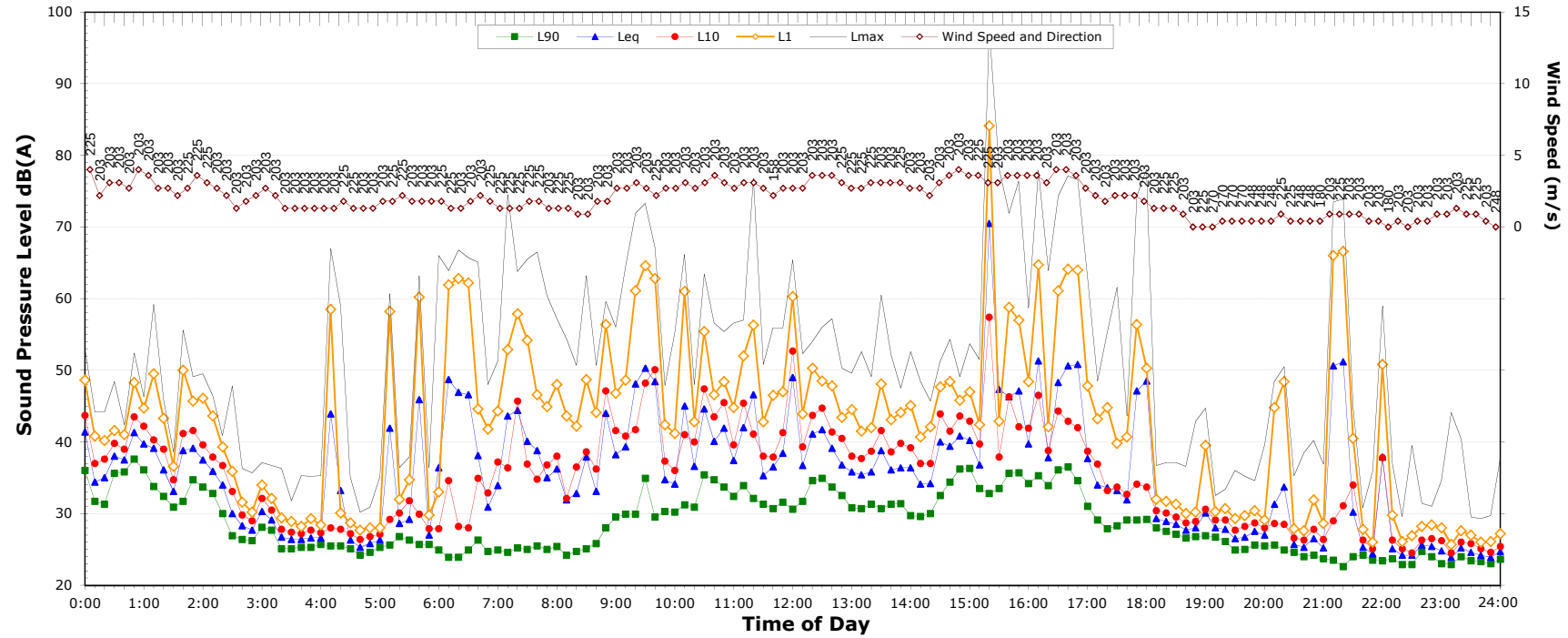
Friday, 14 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

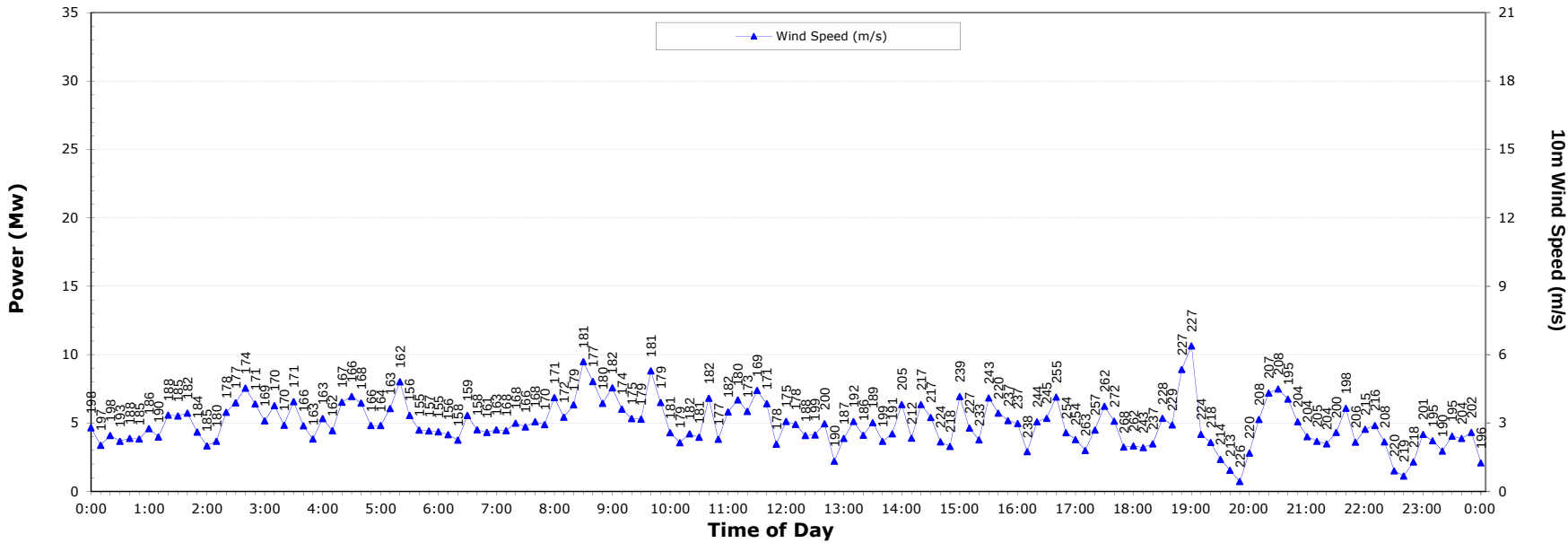
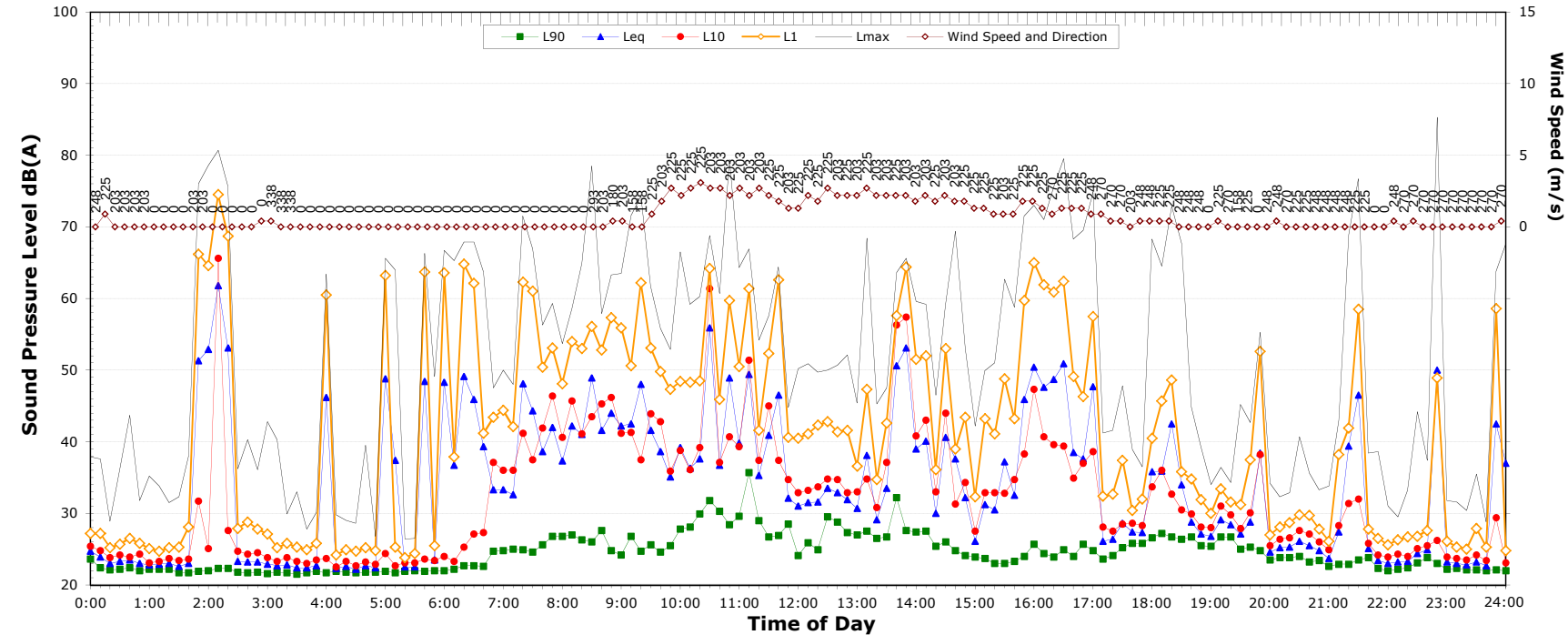
Saturday, 15 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

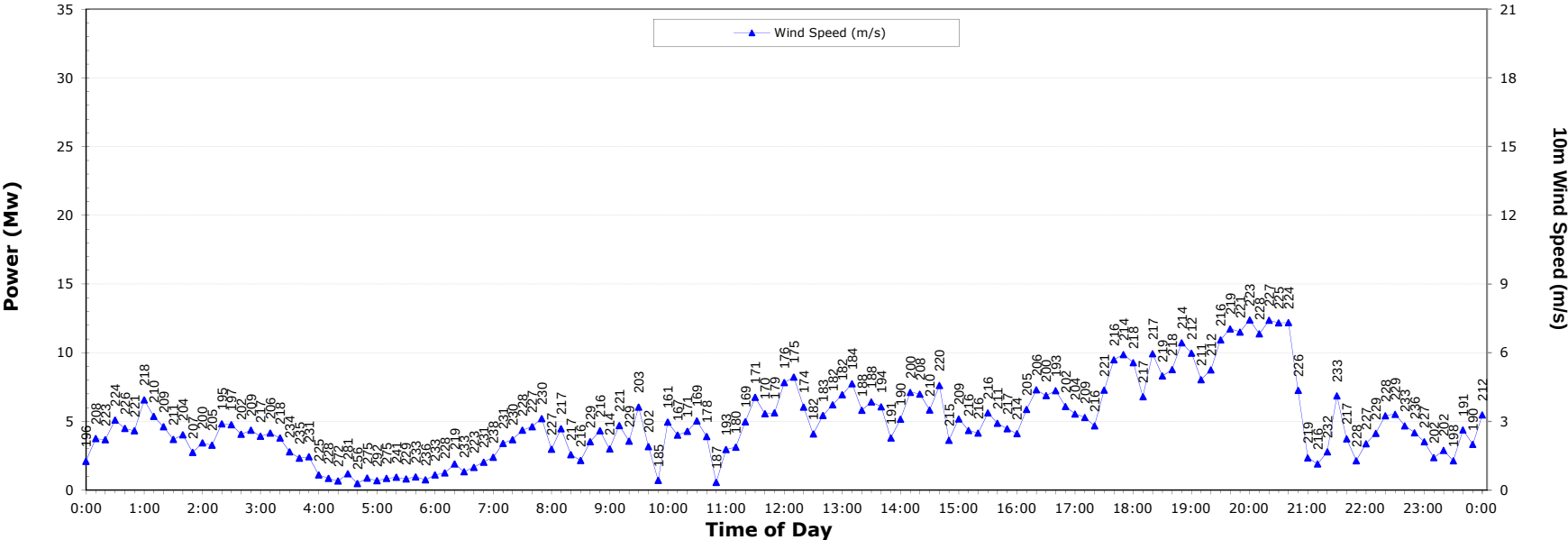
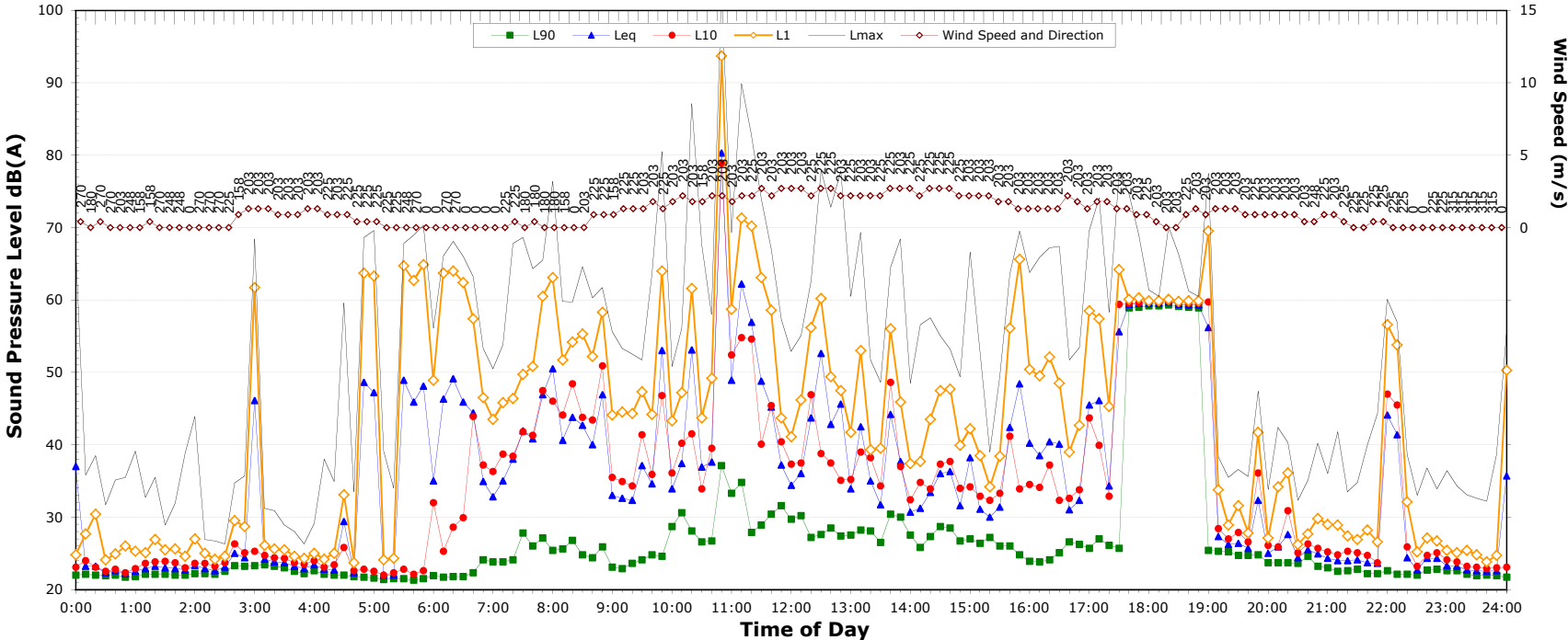
Sunday, 16 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

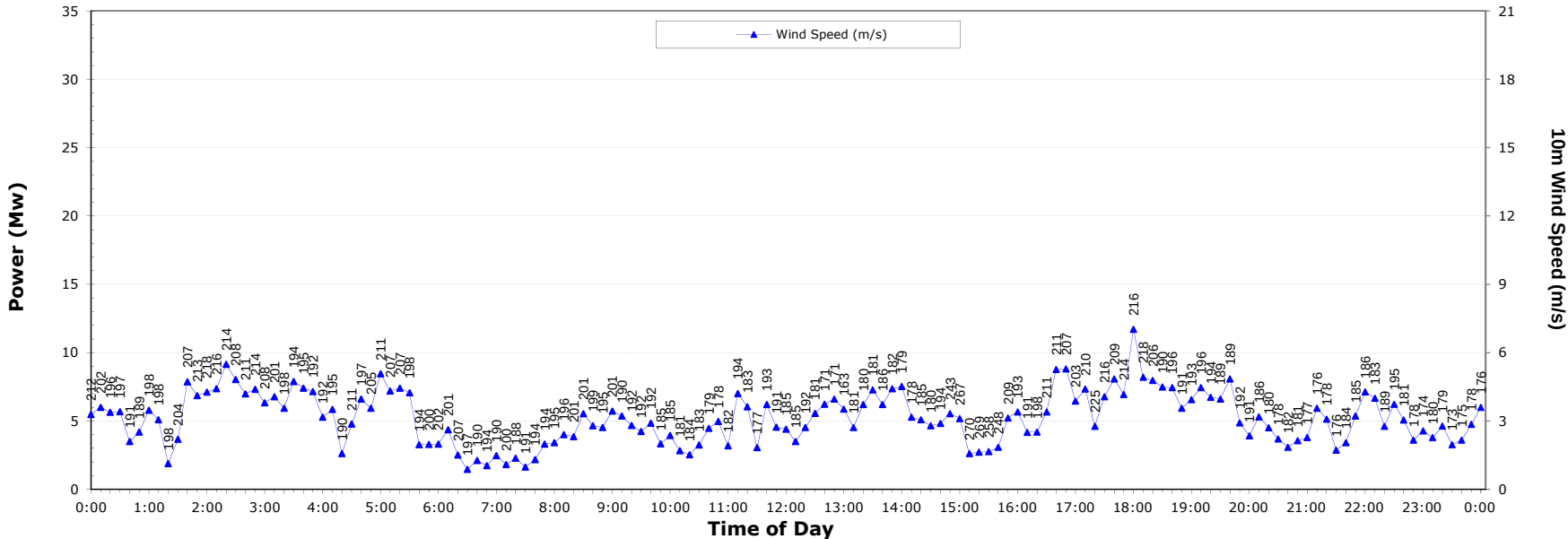
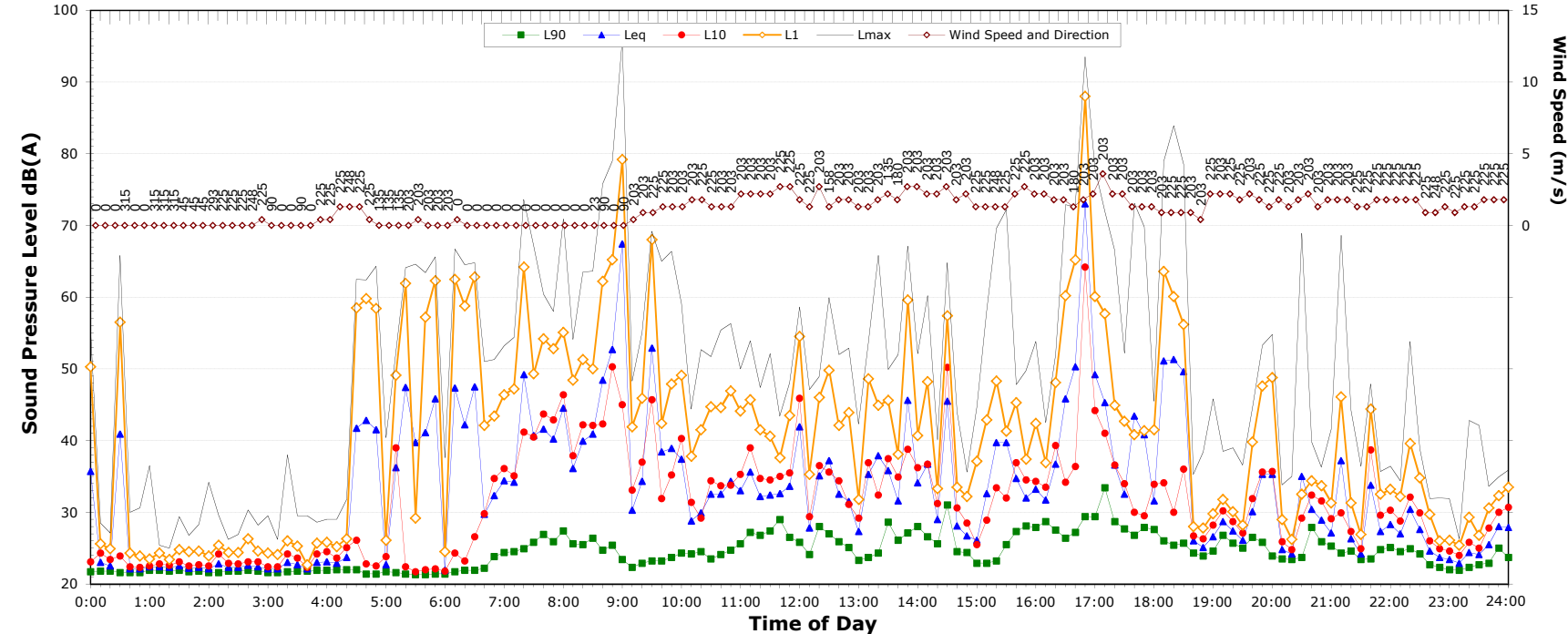
Monday, 17 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

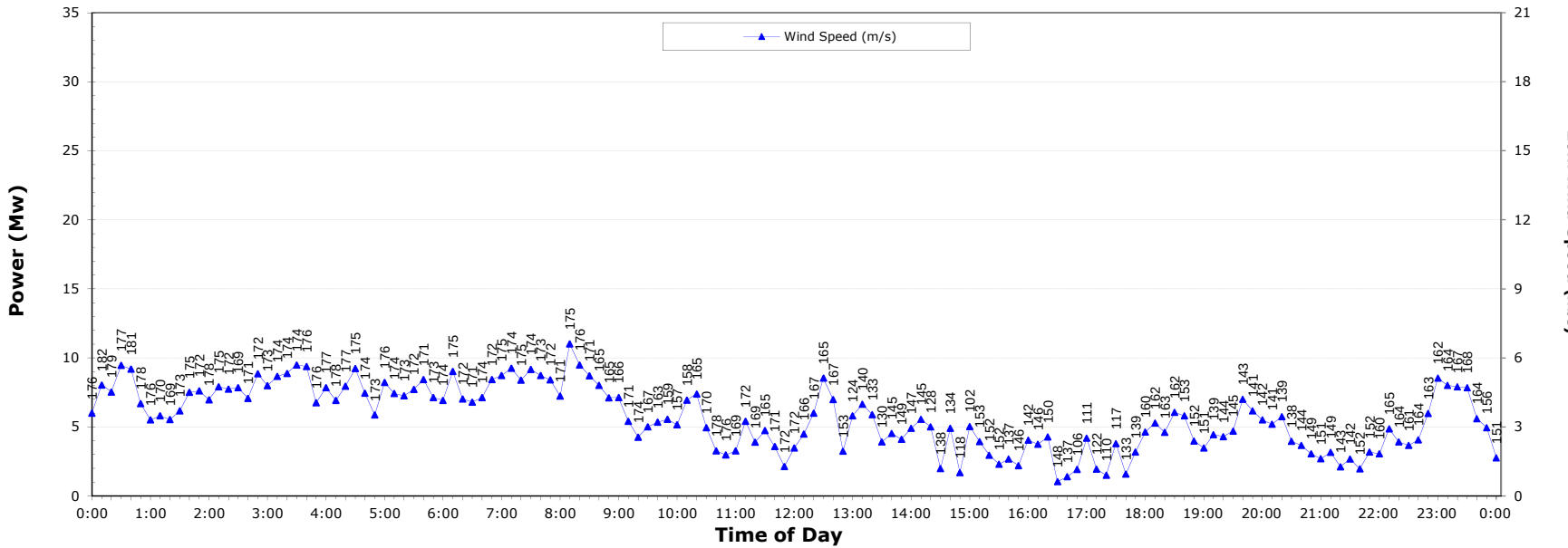
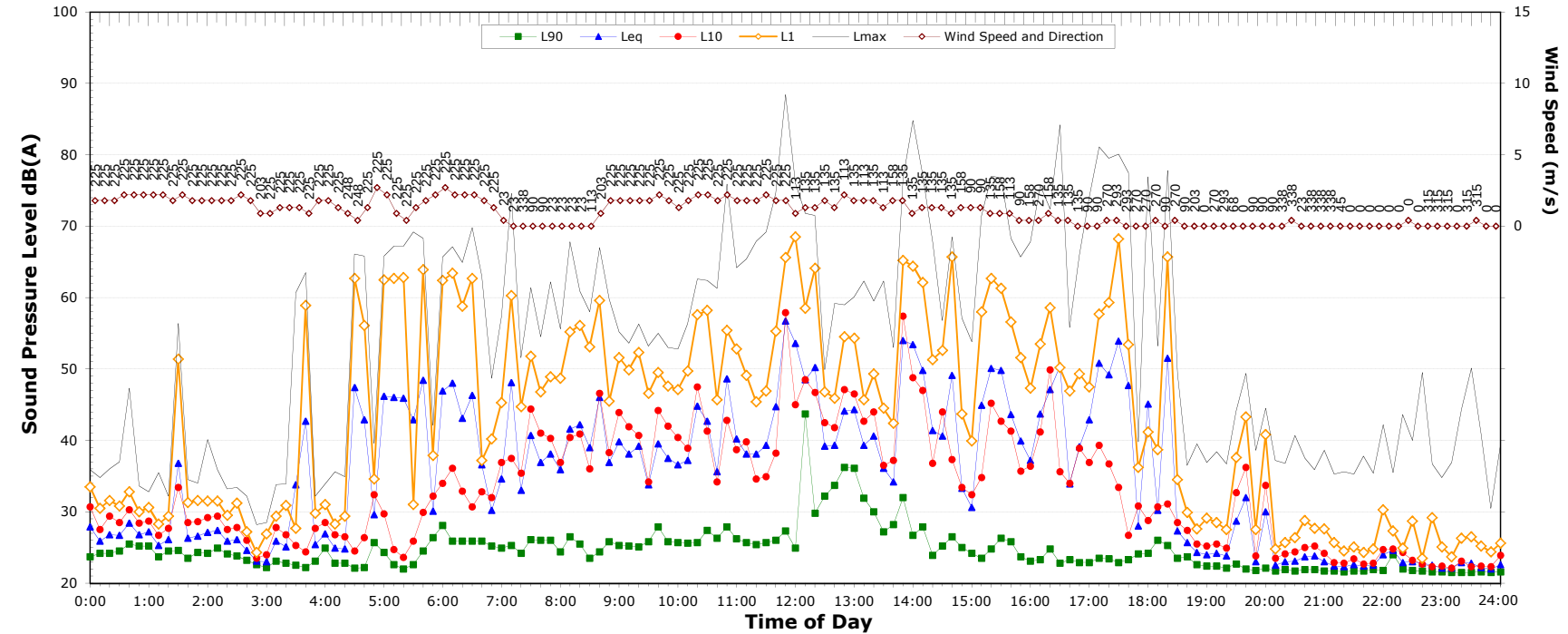
Tuesday, 18 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

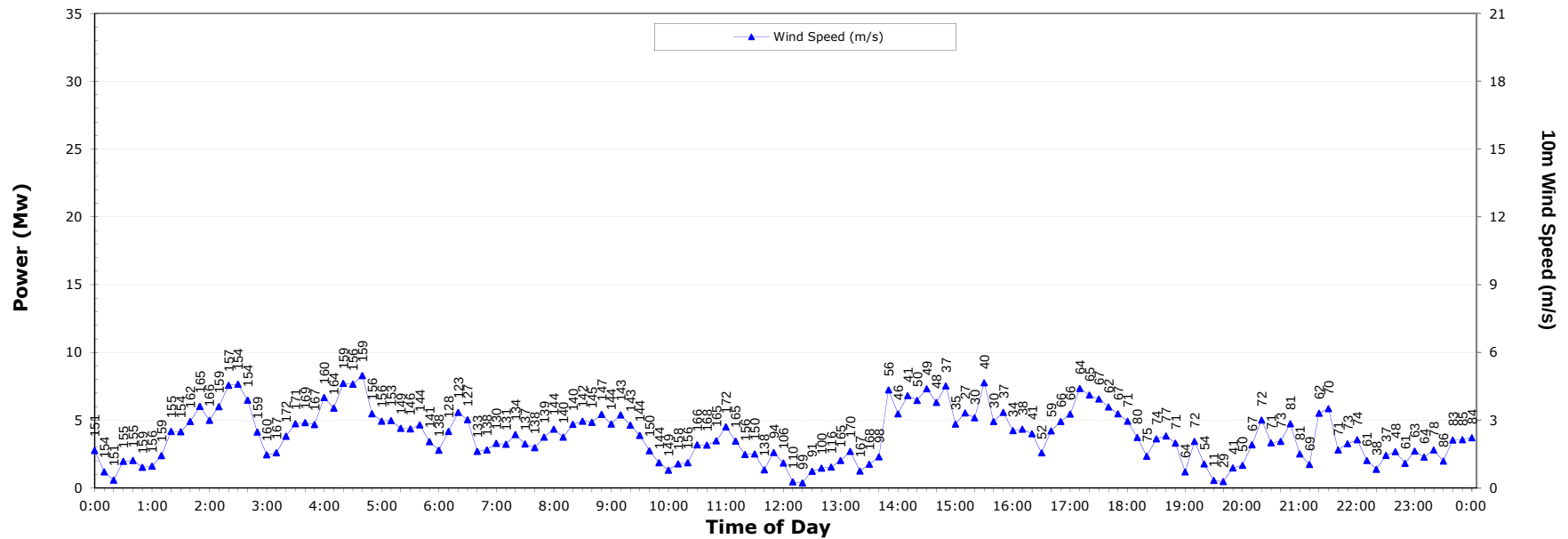
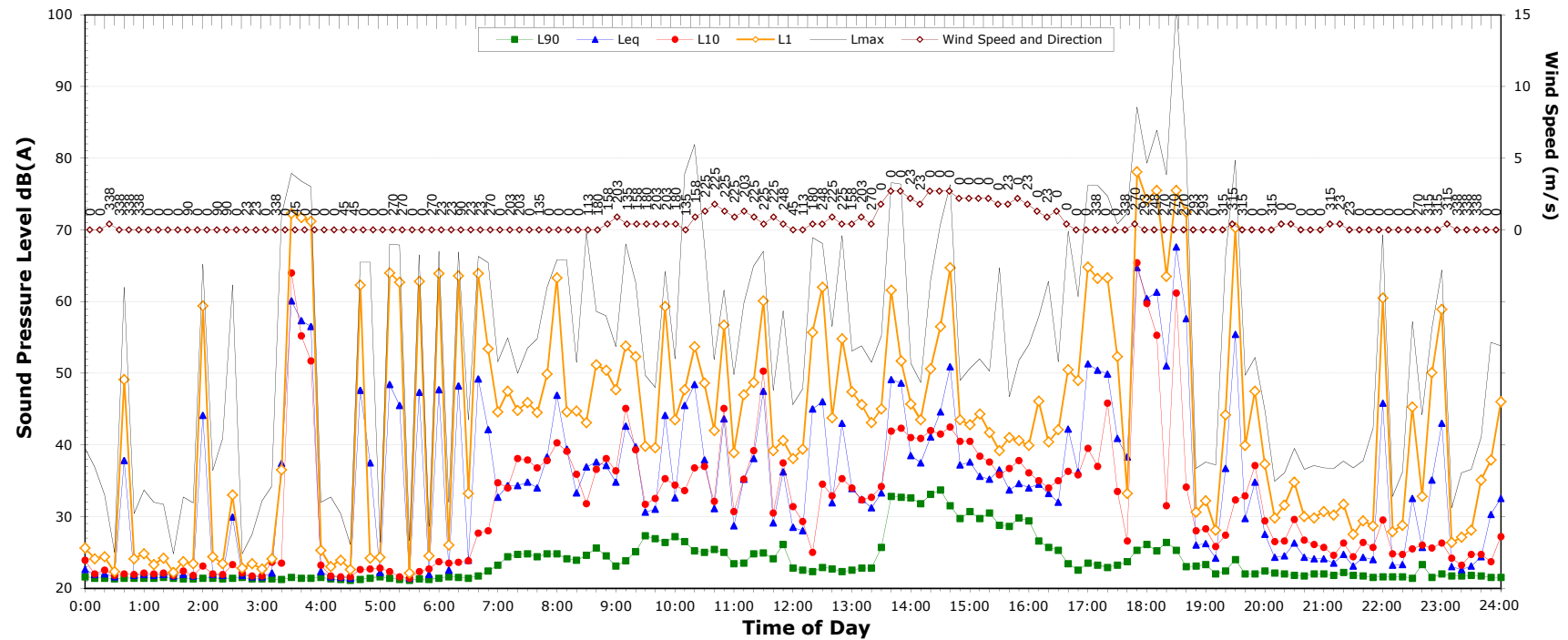
Wednesday, 19 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

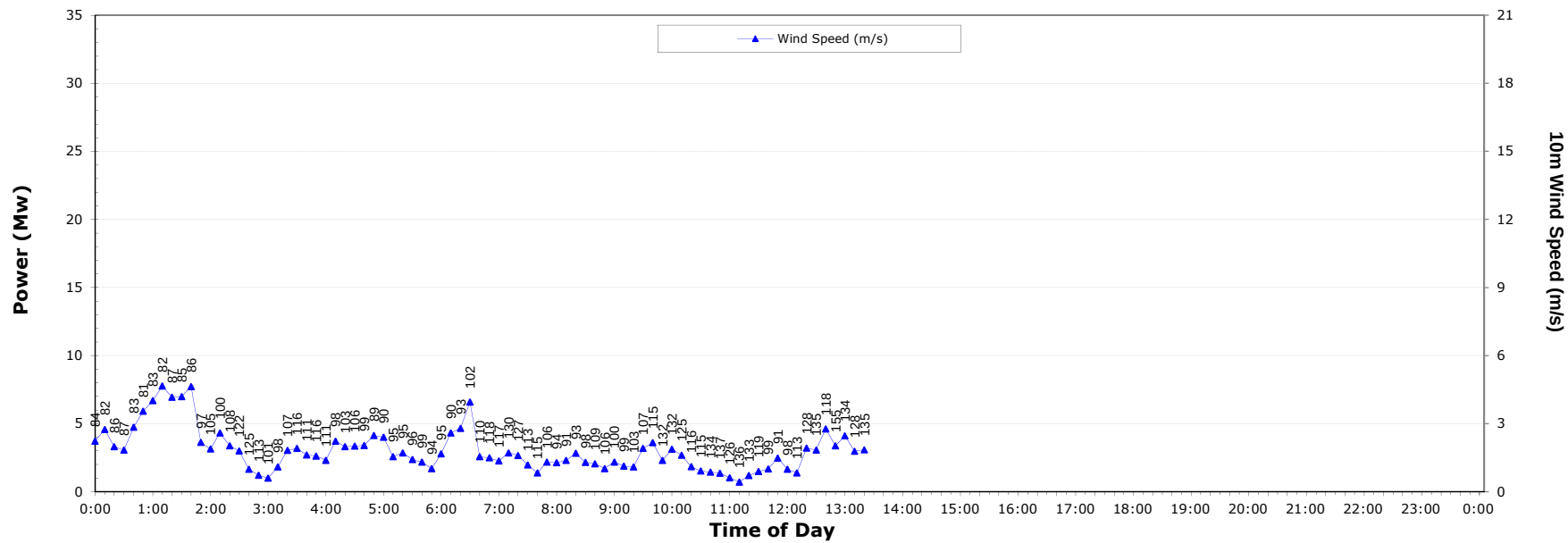
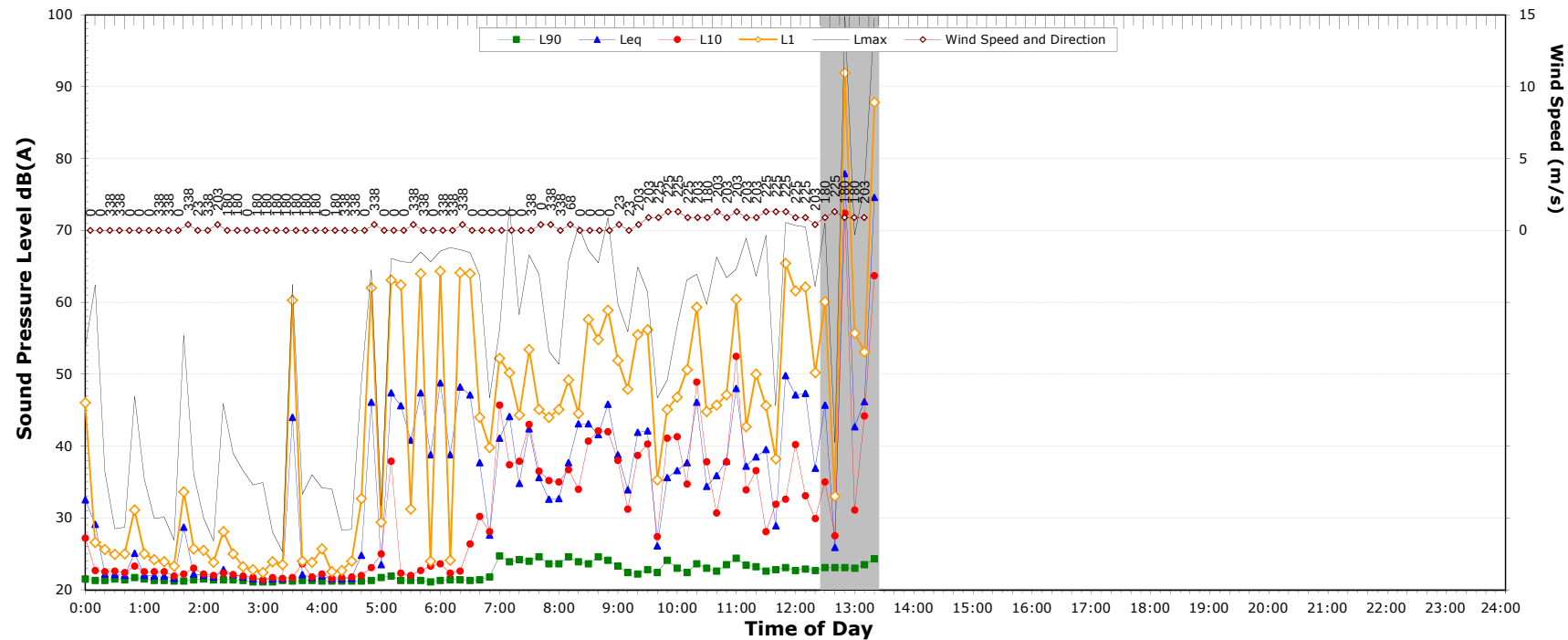
Thursday, 20 June 2013



EXISTING AMBIENT NOISE LEVELS

CR28 - Willow Downs

Friday, 21 June 2013



APPENDIX E - CR18 GLENDAIRE SURVEY RESULTS





CR18 - Glendaire

BACKGROUND & AMBIENT NOISE MONITORING RESULTS NSW 'INDUSTRIAL NOISE POLICY', 2000

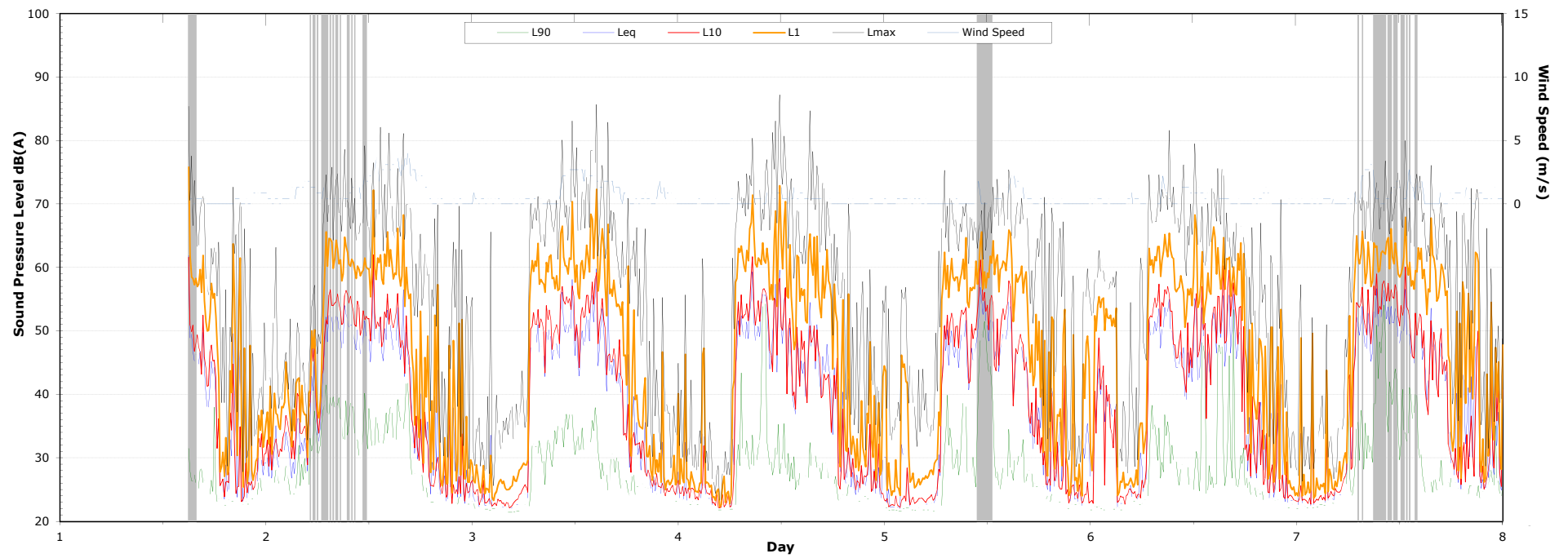
Day	L _{A90} Background Noise Levels ⁵			L _{Aeq} Ambient Noise Levels		
	Day	Evening	Night	Day	Evening	Night
Thursday-06-June-2013	-	22	24	-	39	33
Friday-07-June-2013	27	22	22	50	34	35
Saturday-08-June-2013	26	23	22	51	35	36
Sunday-09-June-2013	27	23	22	51	36	36
Monday-10-June-2013	26	22	22	48	36	39
Tuesday-11-June-2013	26	23	22	50	34	38
Wednesday-12-June-2013	25	24	23	48	41	36
Thursday-13-June-2013	28	23	23	49	35	35
Friday-14-June-2013	30	26	25	50	40	39
Saturday-15-June-2013	30	24	22	50	40	38
Sunday-16-June-2013	26	25	23	55	40	39
Monday-17-June-2013	27	24	22	52	44	37
Tuesday-18-June-2013	27	23	23	48	40	38
Wednesday-19-June-2013	25	22	22	49	36	36
Thursday-20-June-2013	26	22	22	50	34	36
Friday-21-June-2013	26	-	-	52	-	-
Representative Level	26	23	22	50	36	36

Notes:

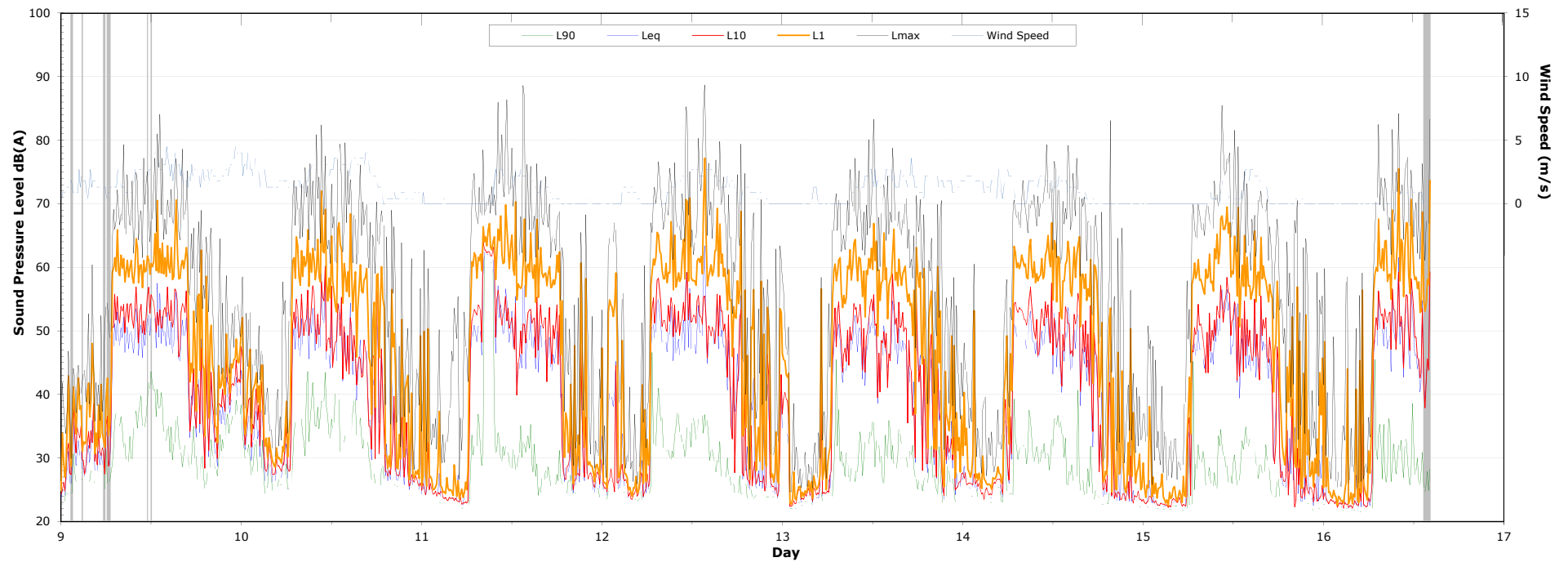
1. Day is taken to be 7:00am to 6:00pm
2. Evening is taken to be 6:00pm to 10:00pm.
3. Night is taken to be the remaining periods.
4. Rating Background Level (RBL) for L₉₀ and logarithmic average for Leq
5. Assessment Background Level (ABL)

noise logger results

Thursday, 6 June 2013 - Friday, 14 June 2013



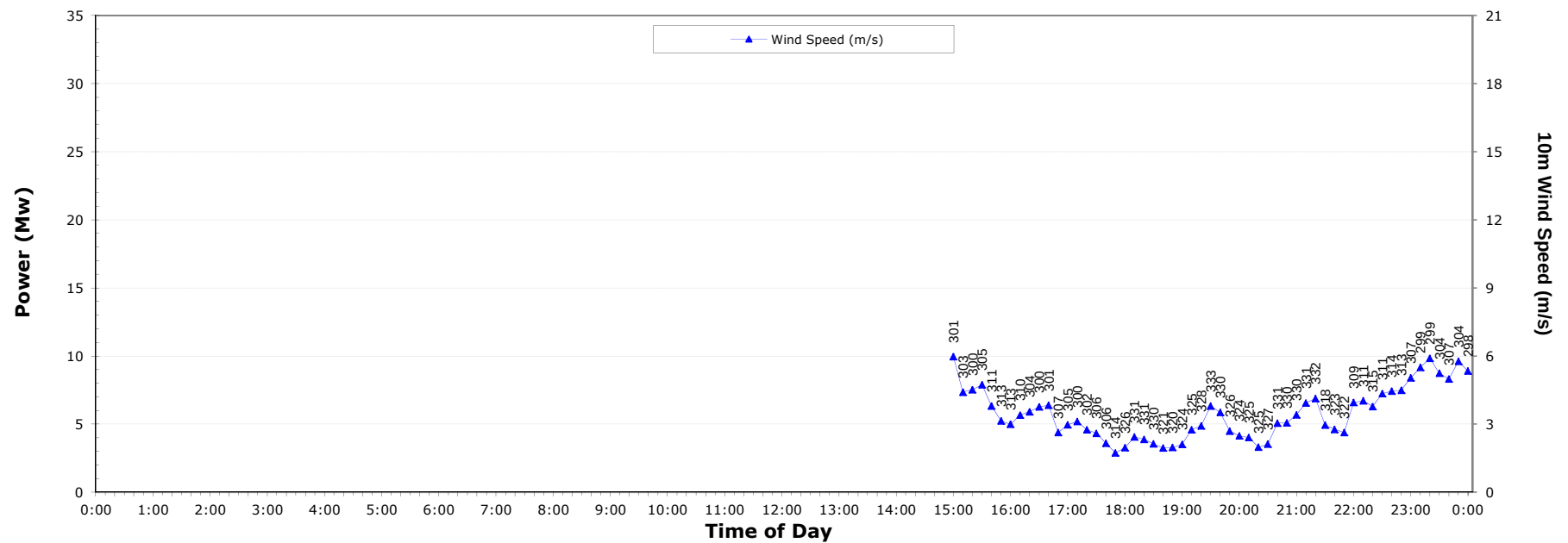
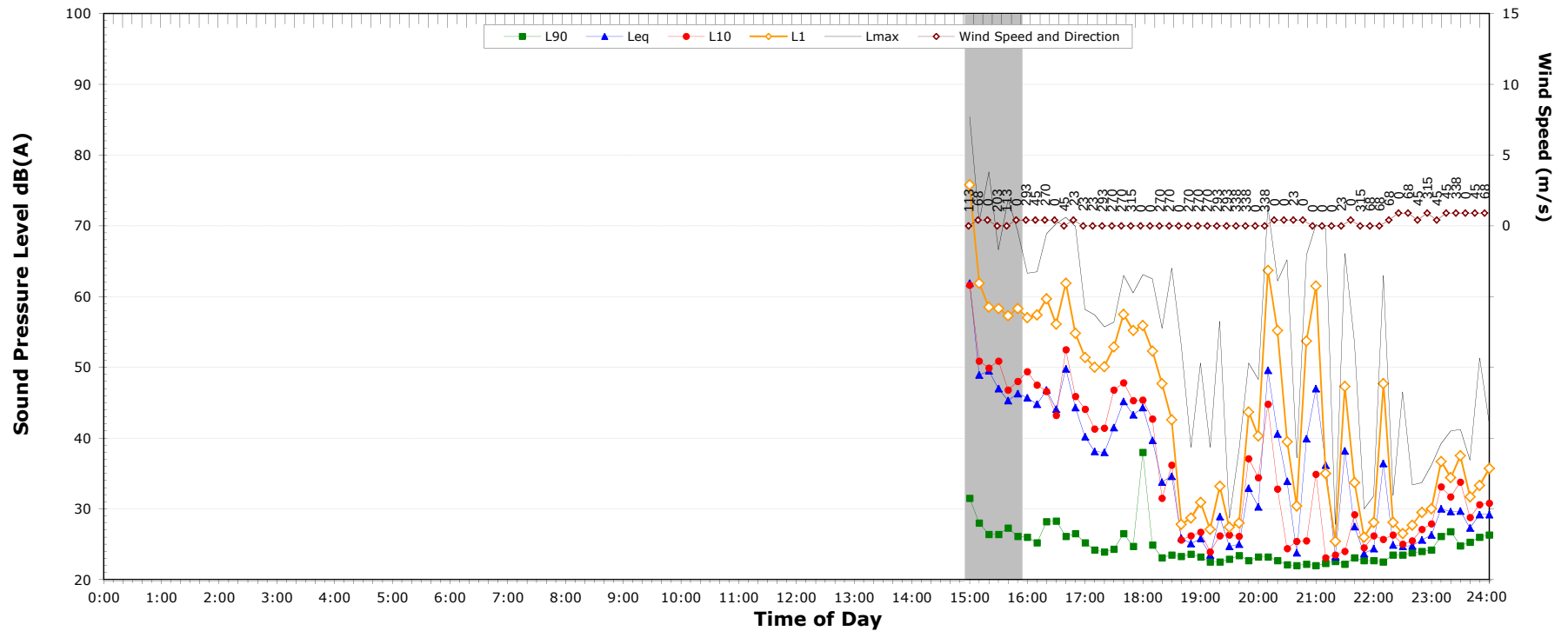
Saturday, 15 June 2013 - Saturday, 22 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendale

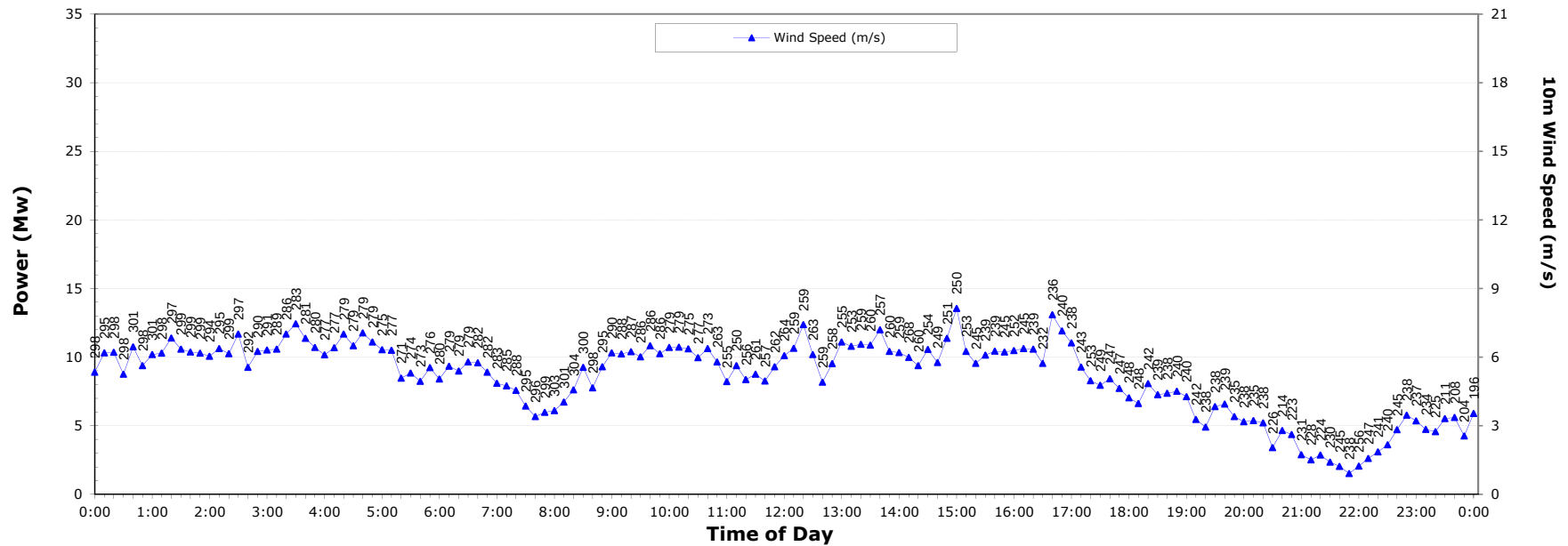
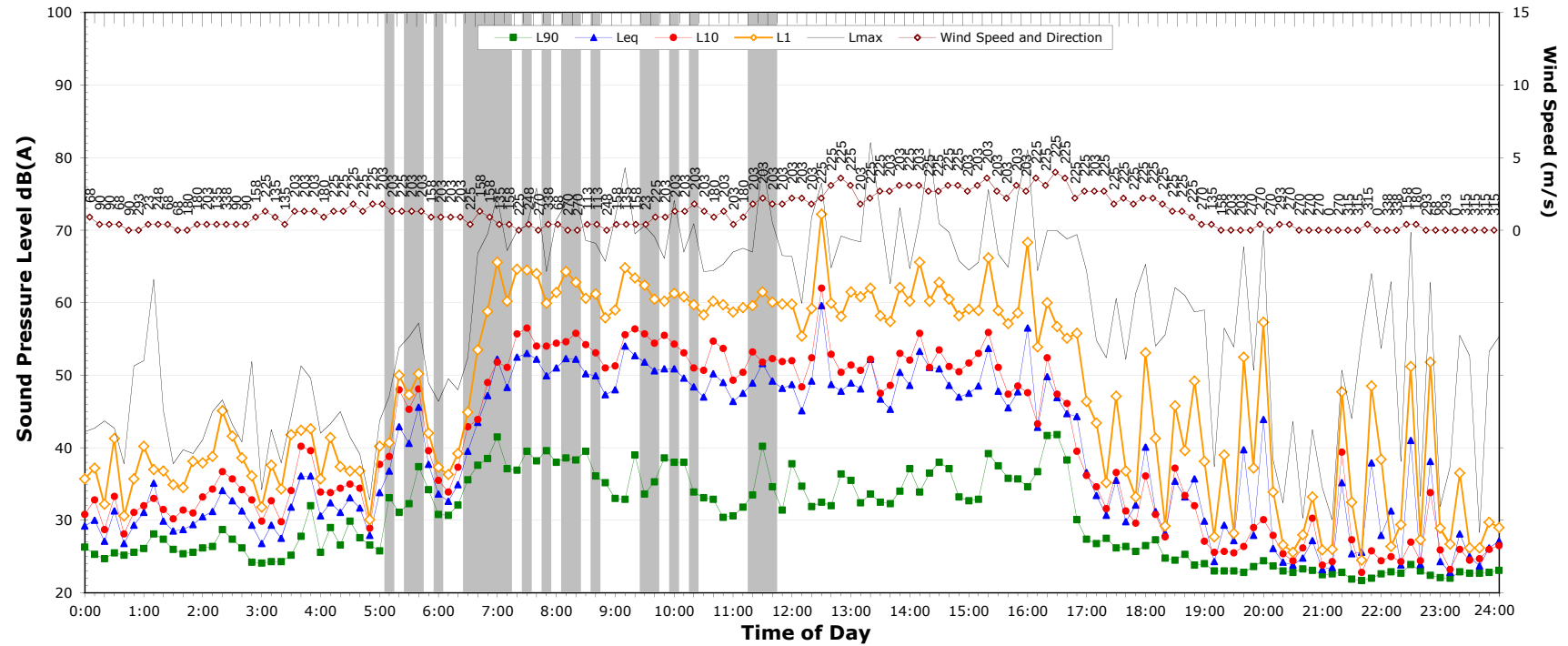
Thursday, 6 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

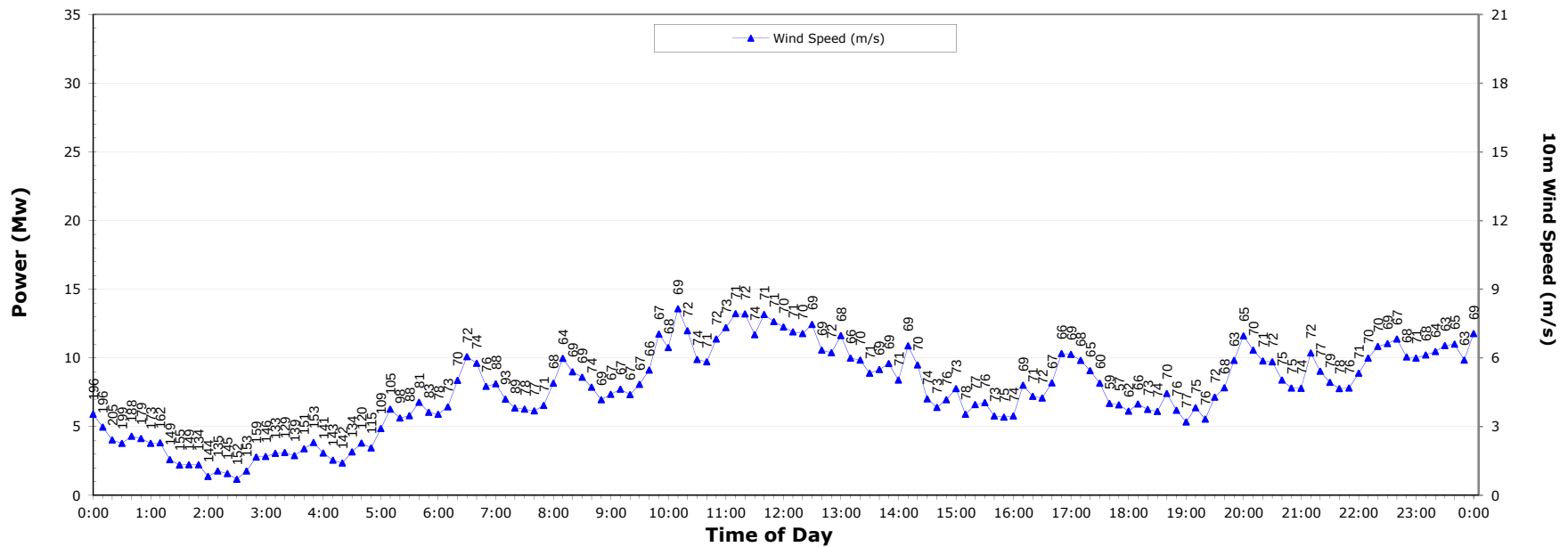
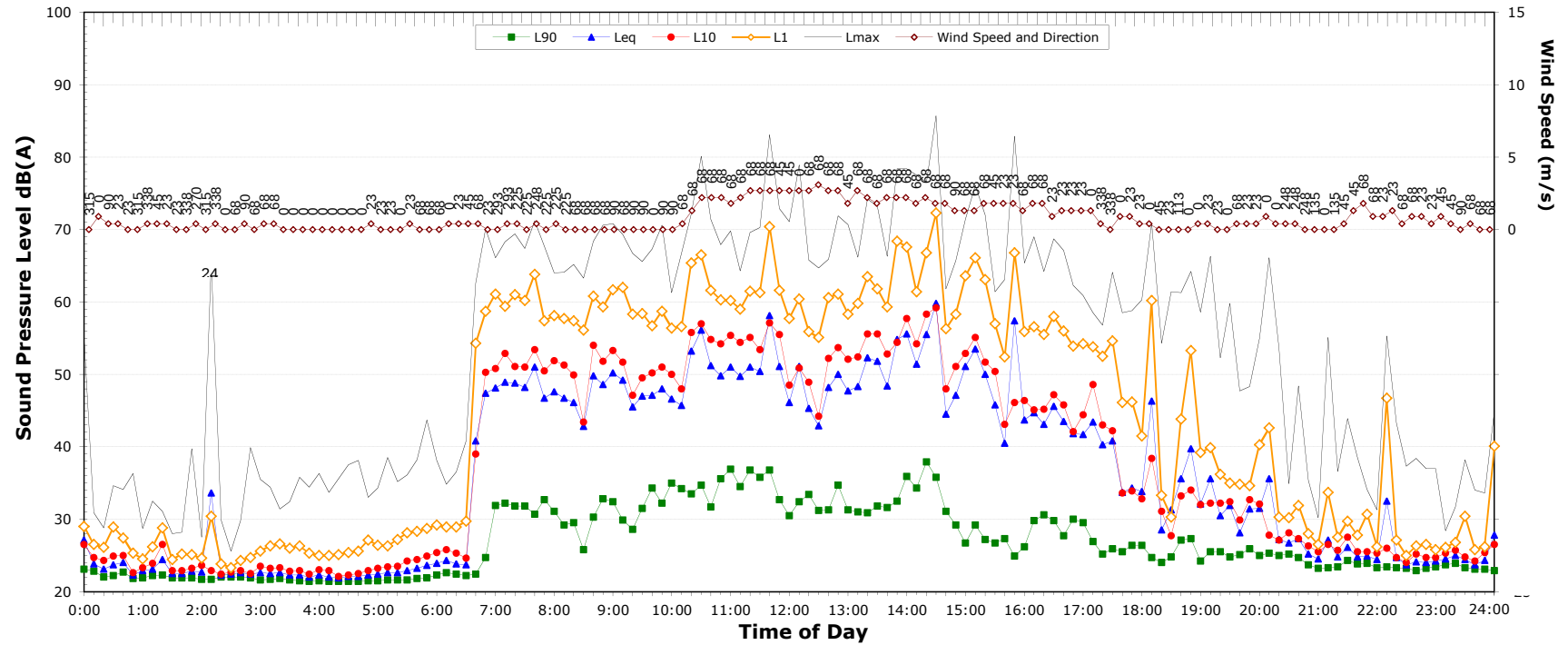
Friday, 7 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendale

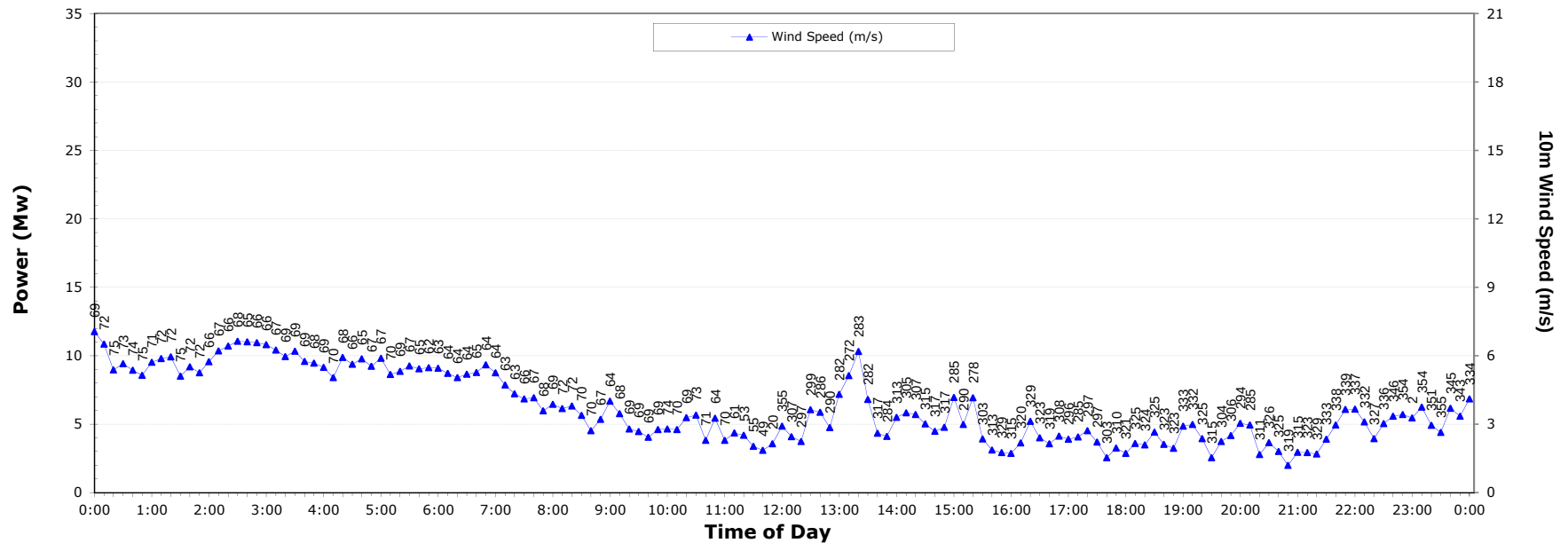
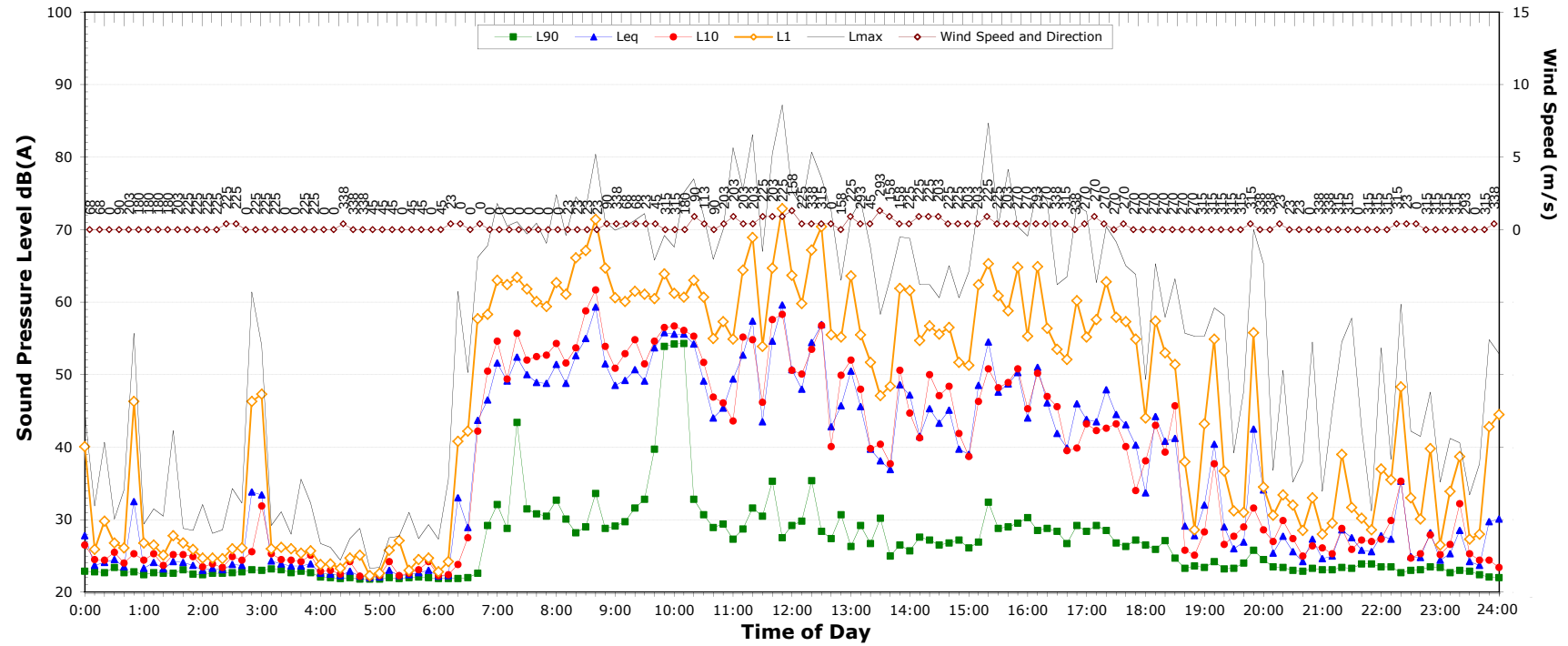
Saturday, 8 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendale

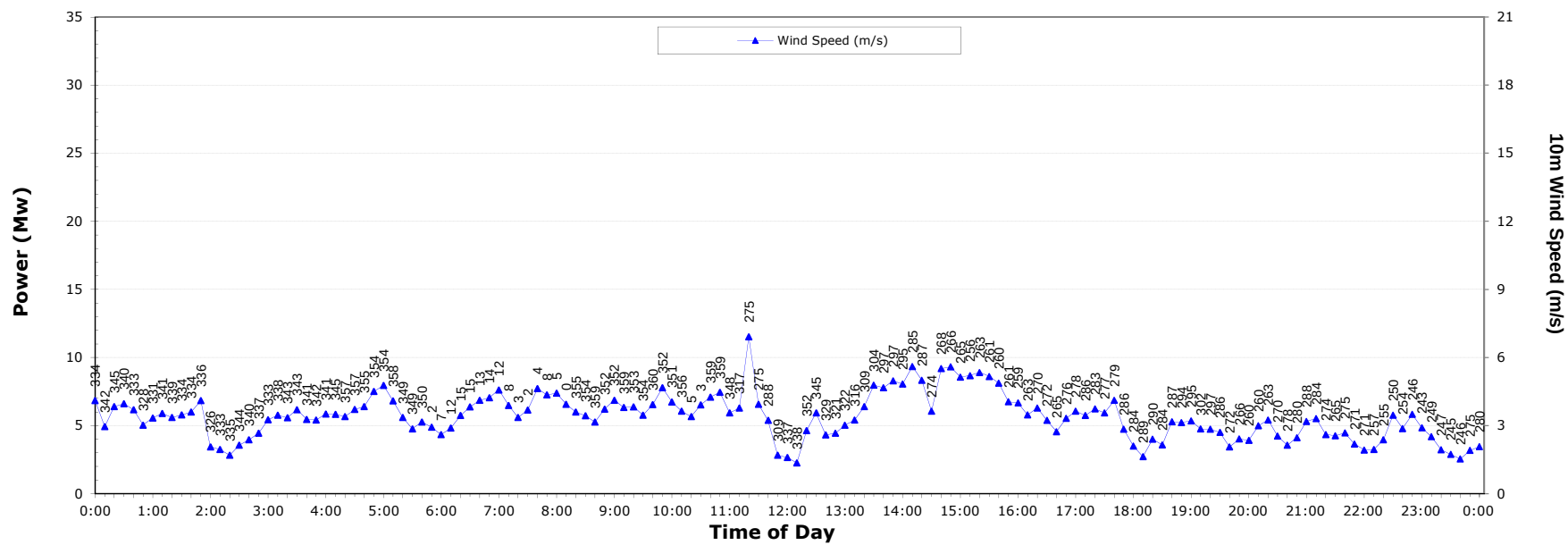
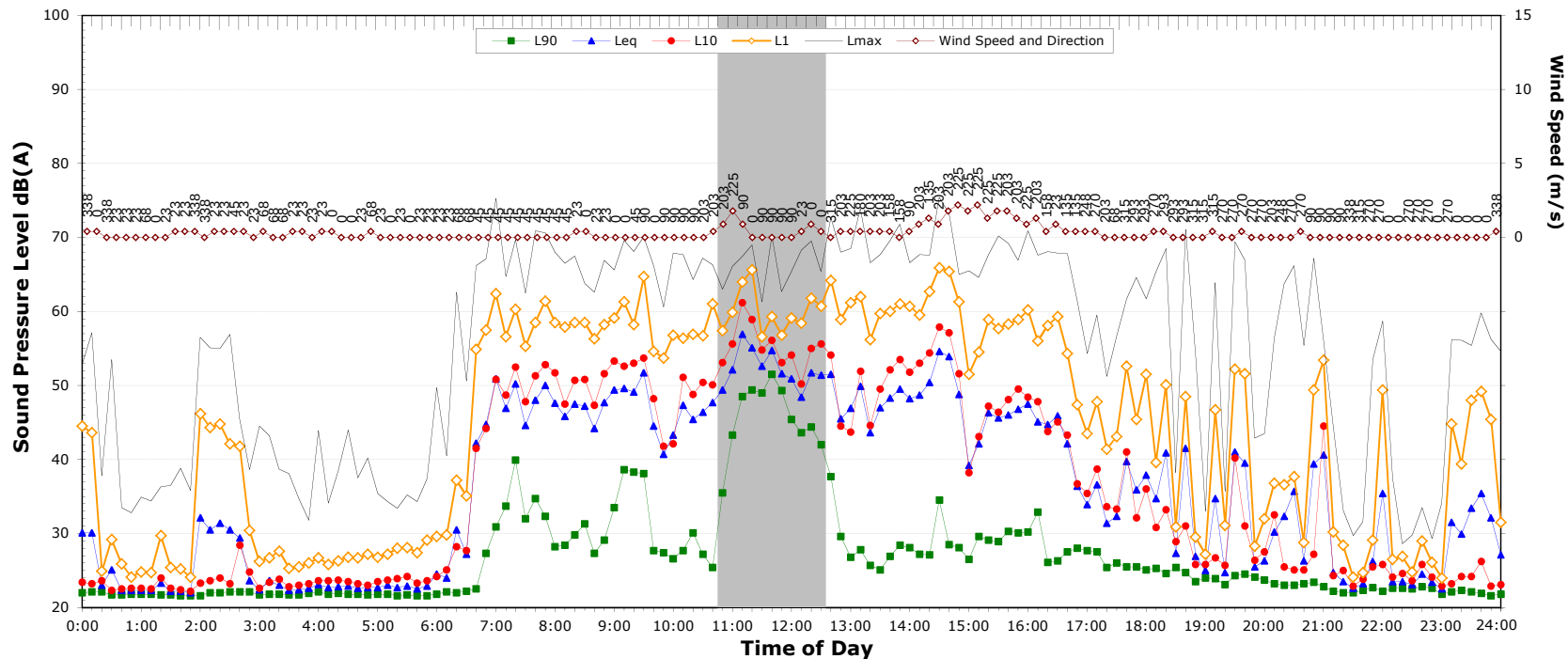
Sunday, 9 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

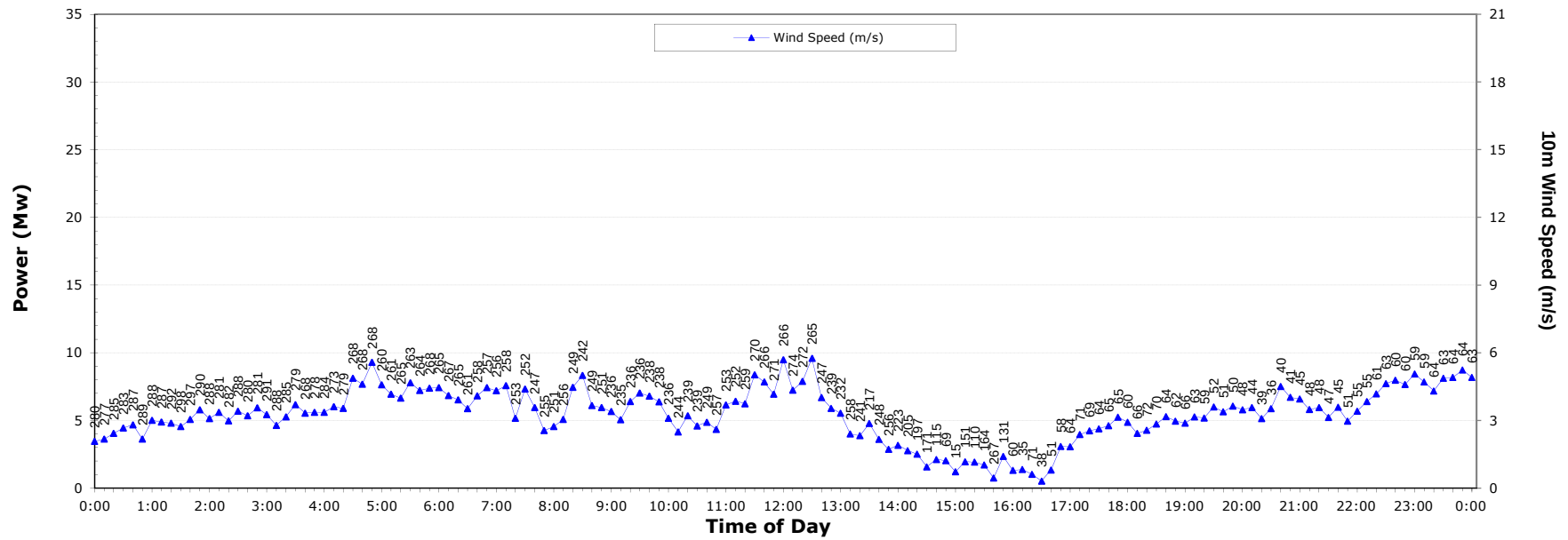
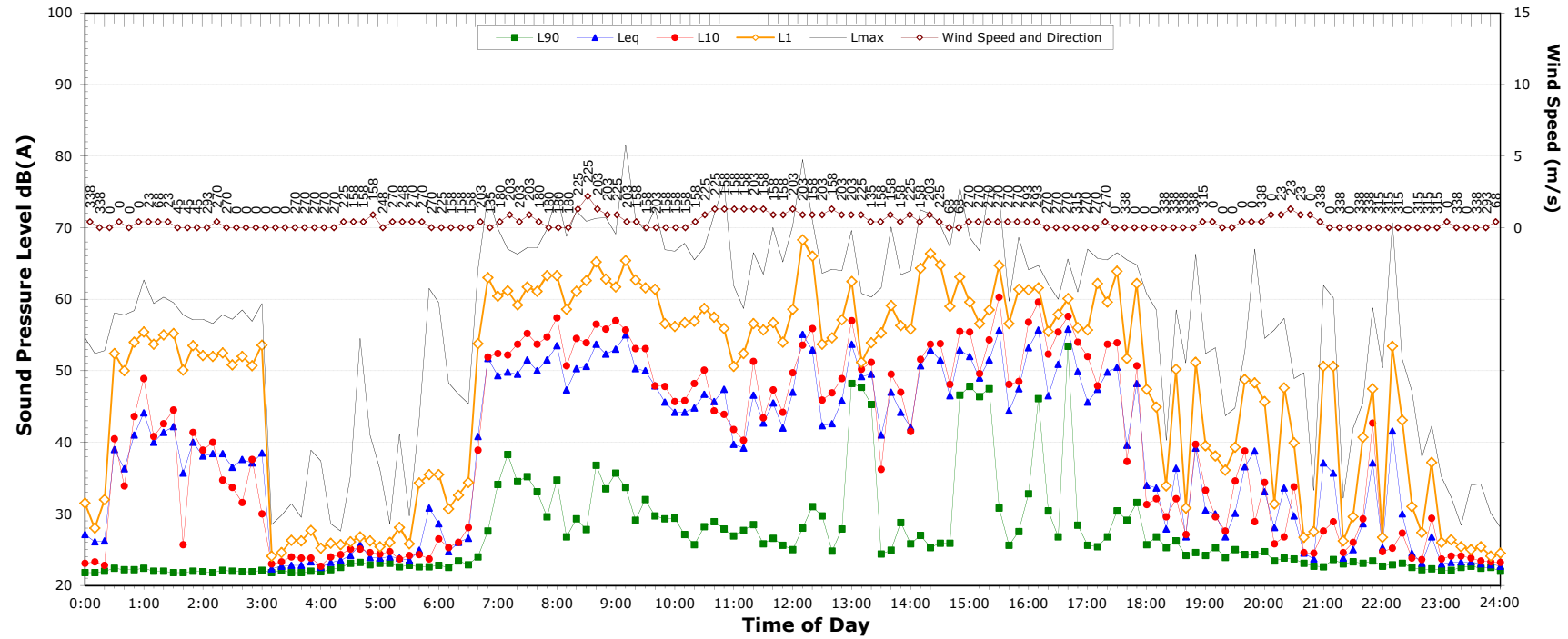
Monday, 10 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

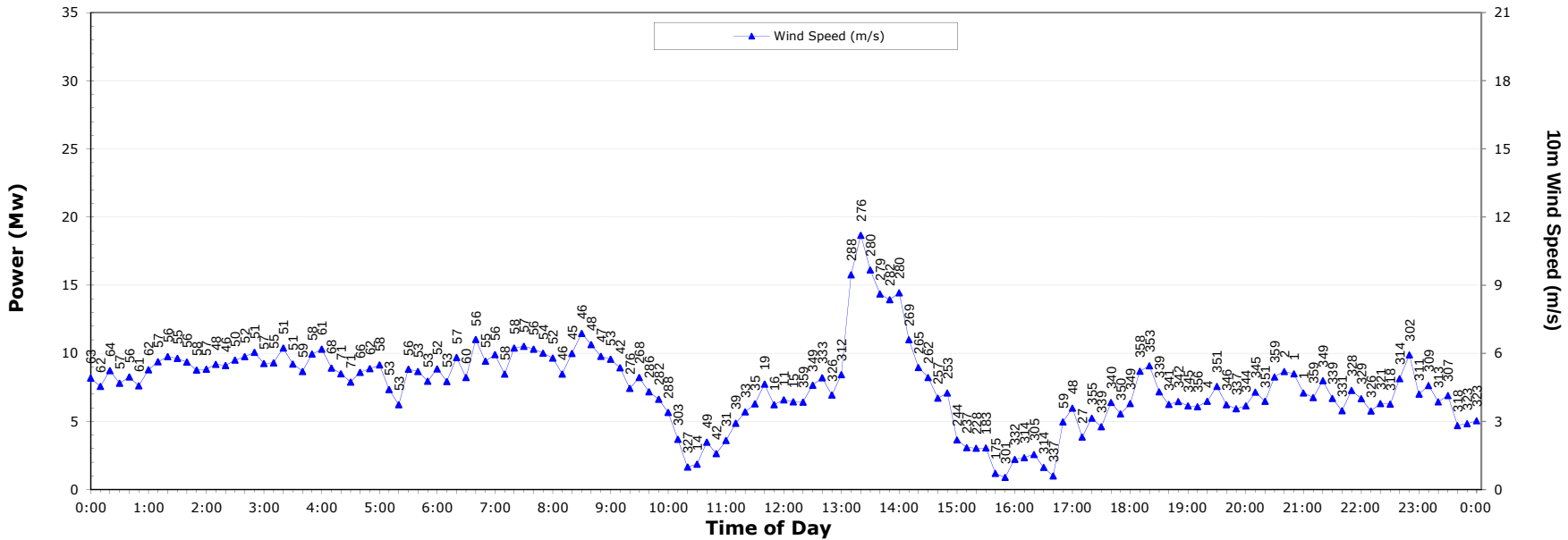
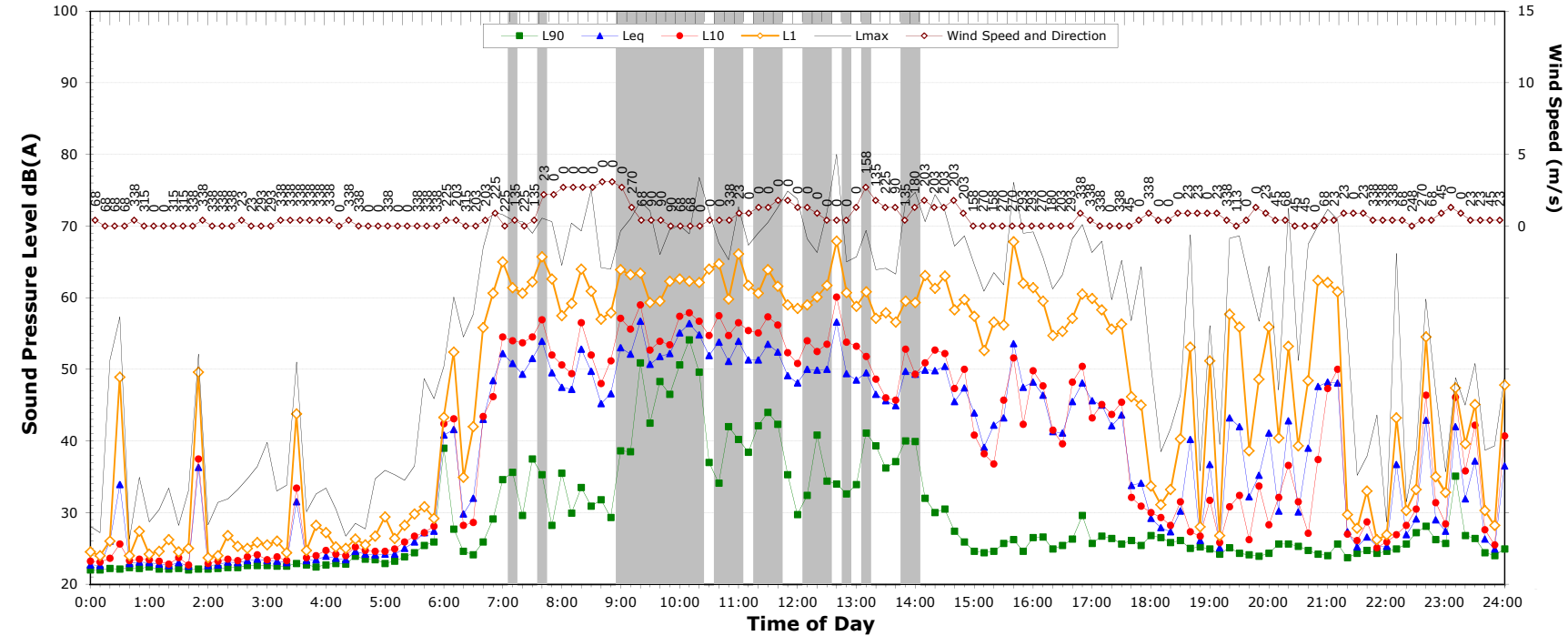
Tuesday, 11 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

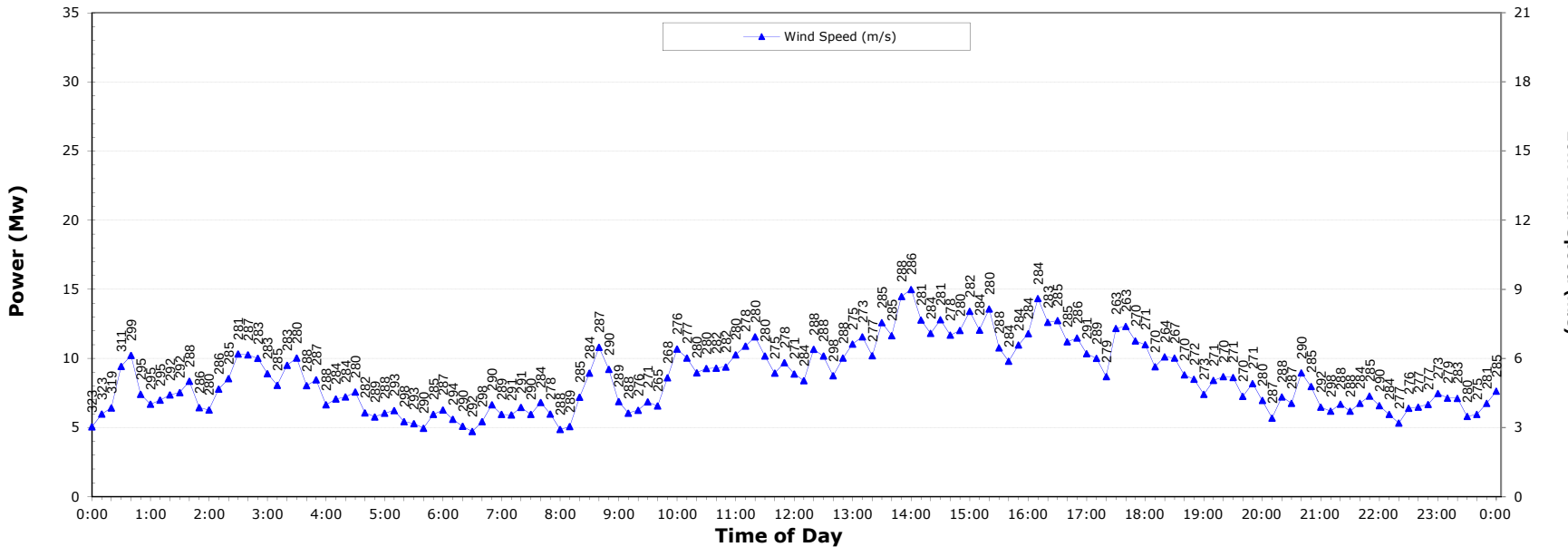
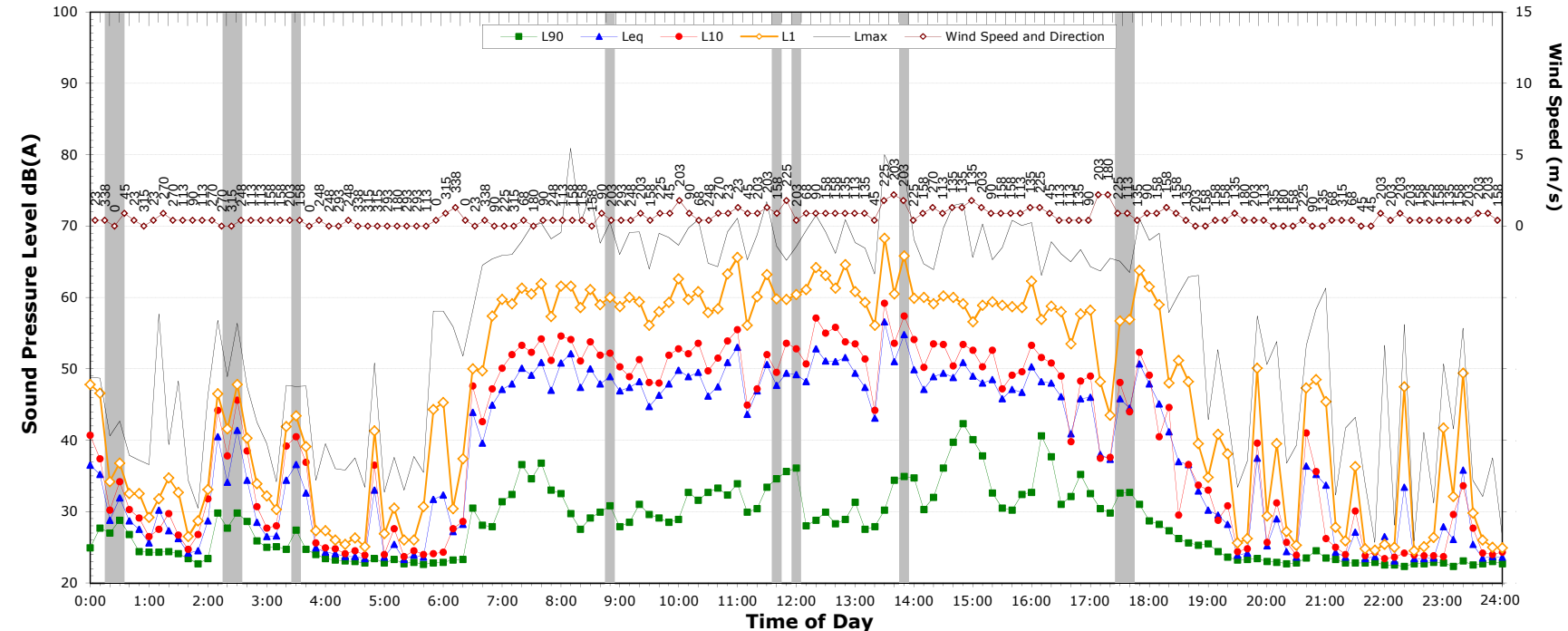
Wednesday, 12 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

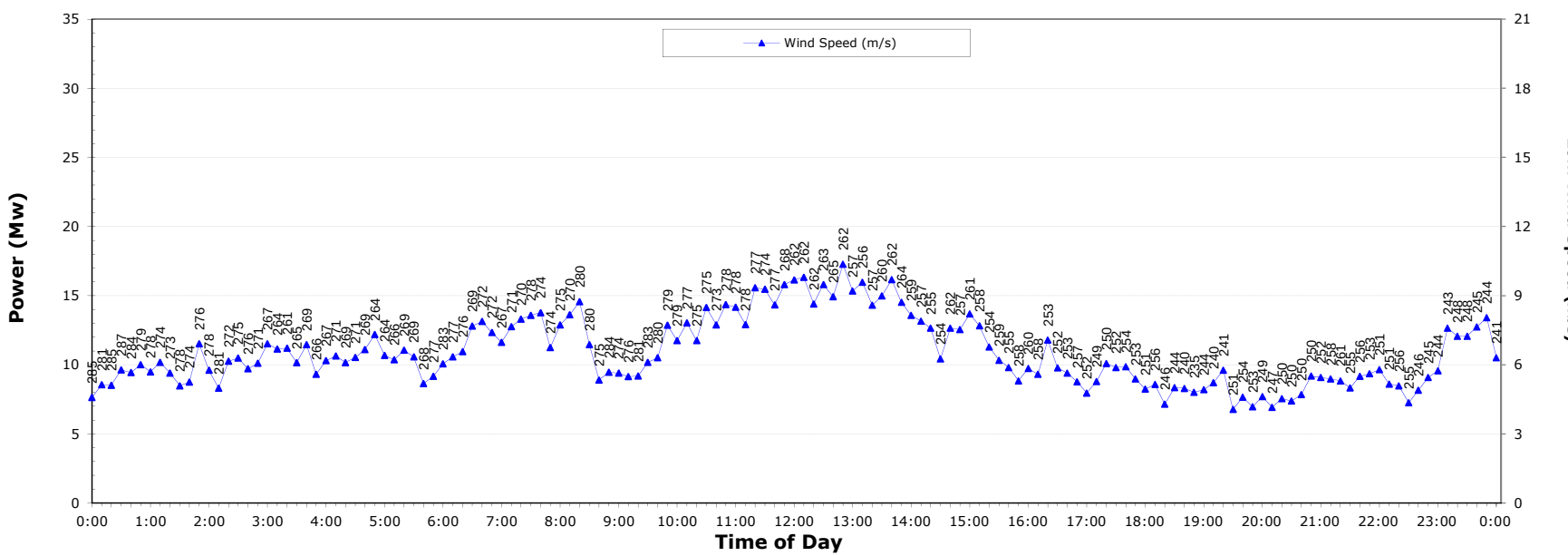
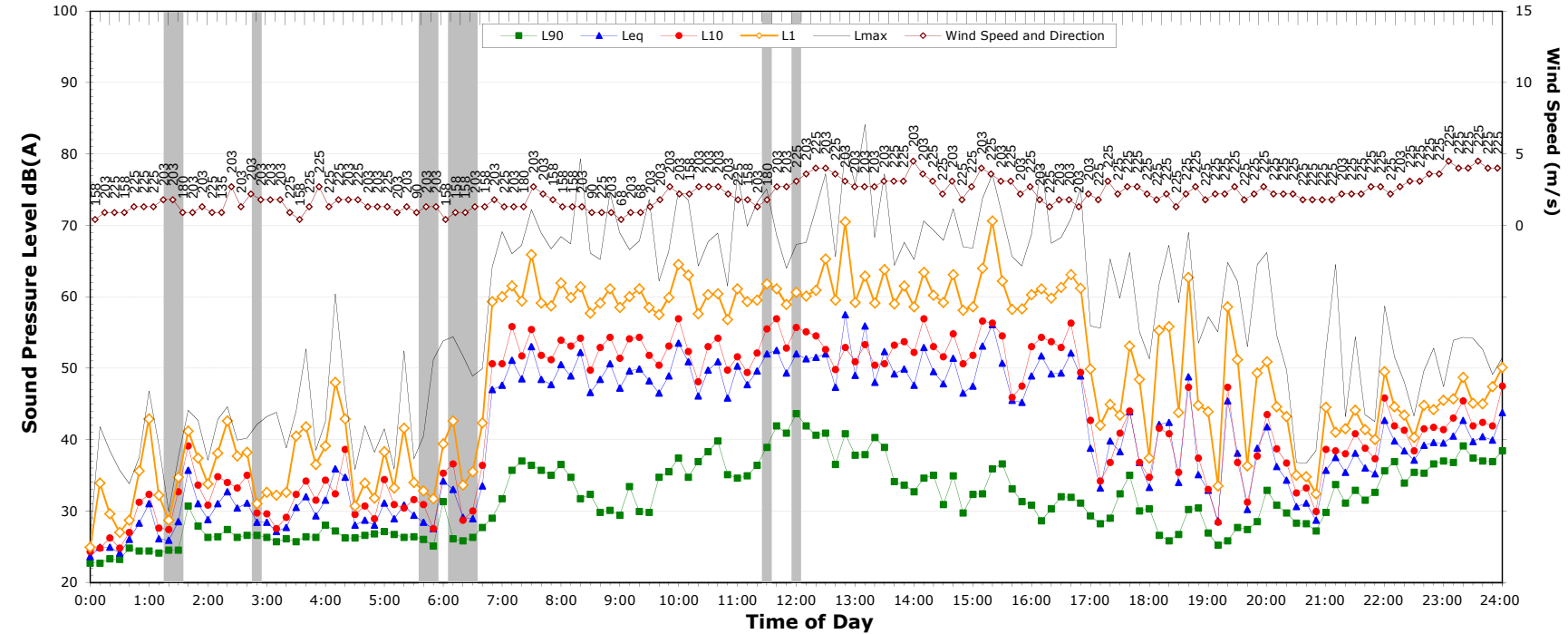
Thursday, 13 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

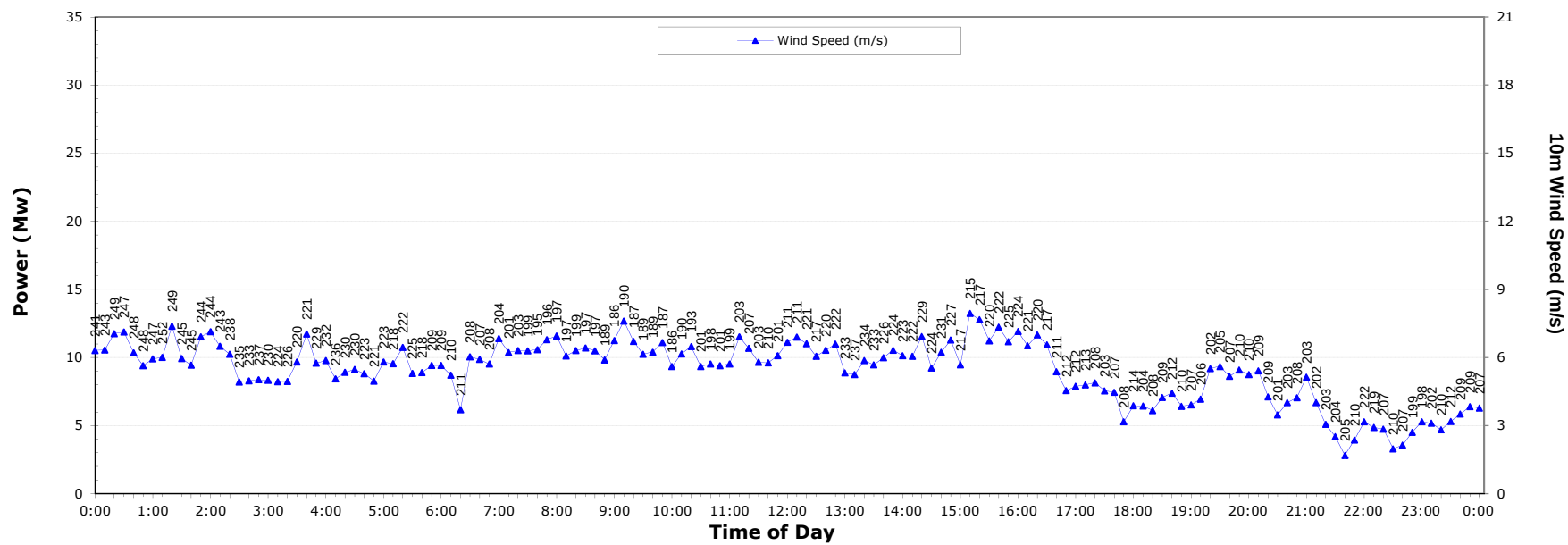
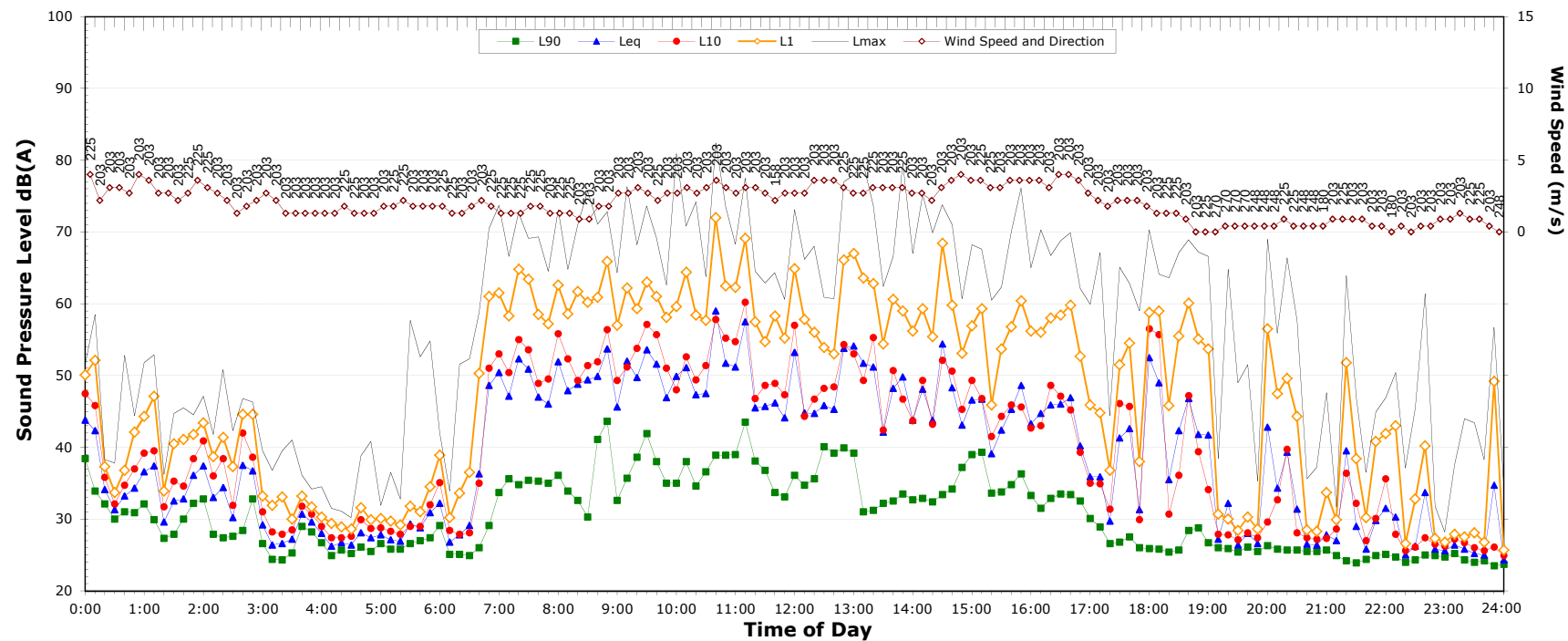
Friday, 14 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

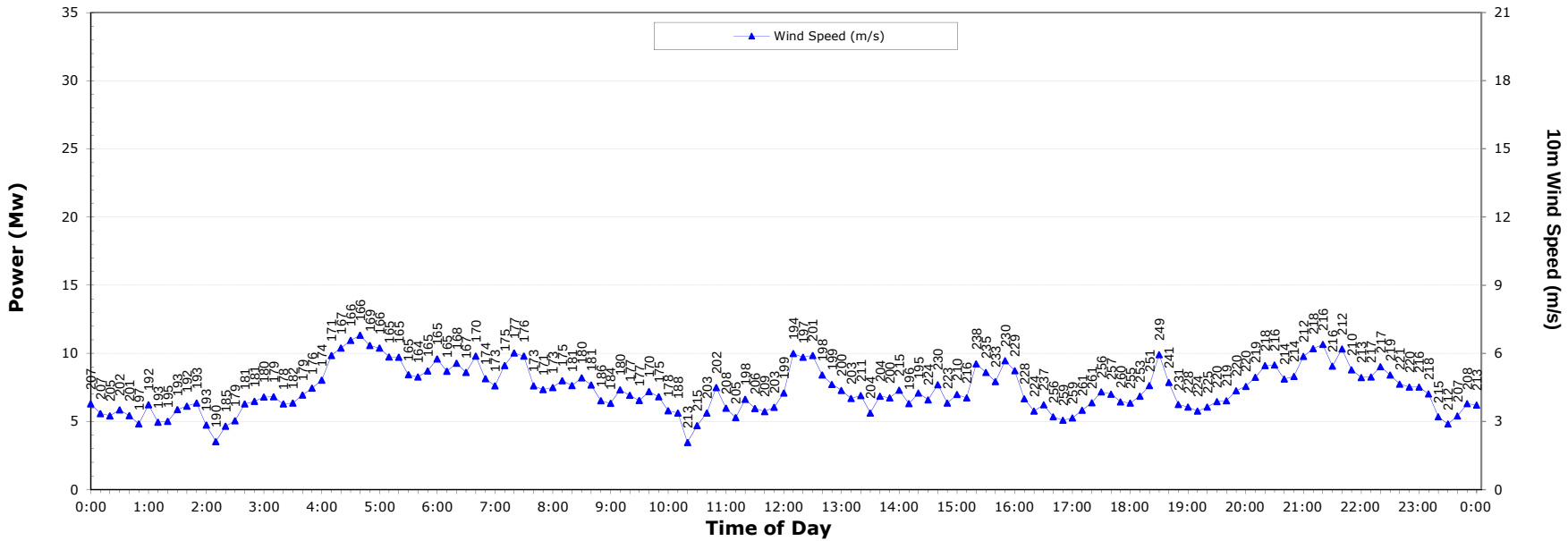
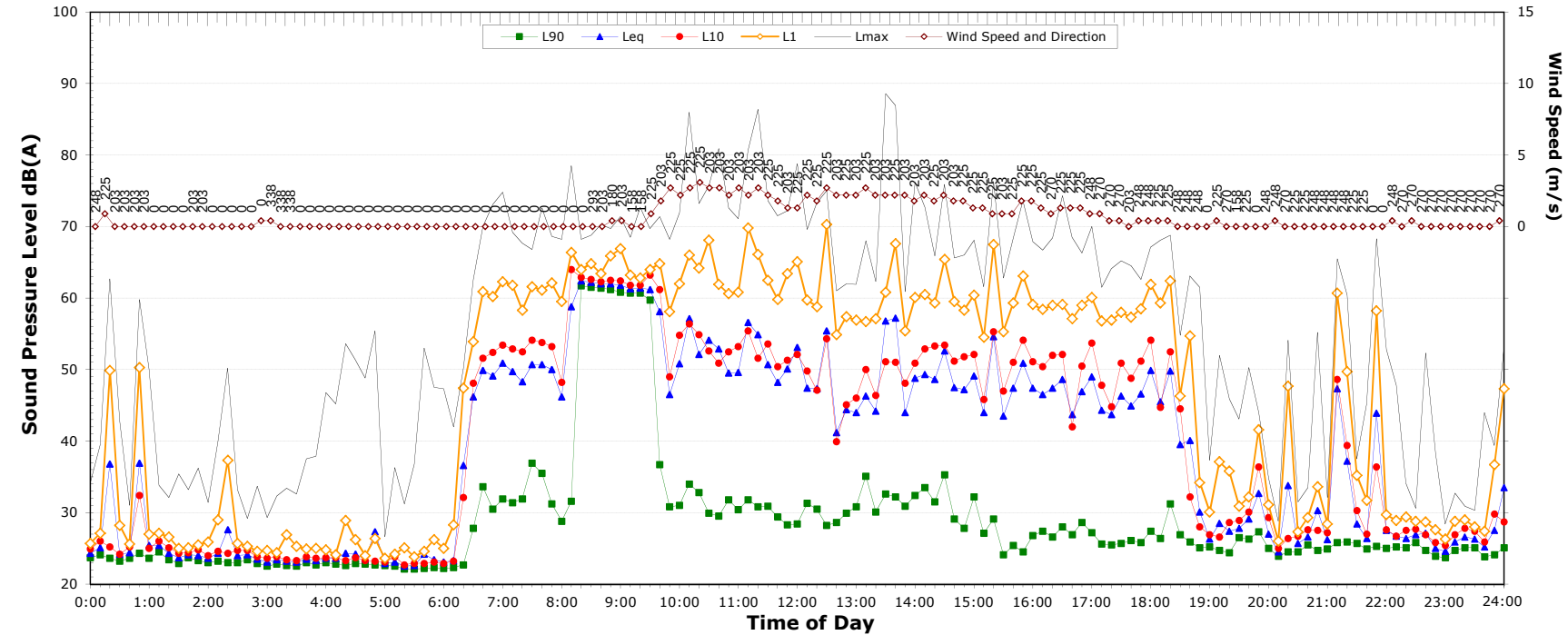
Saturday, 15 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

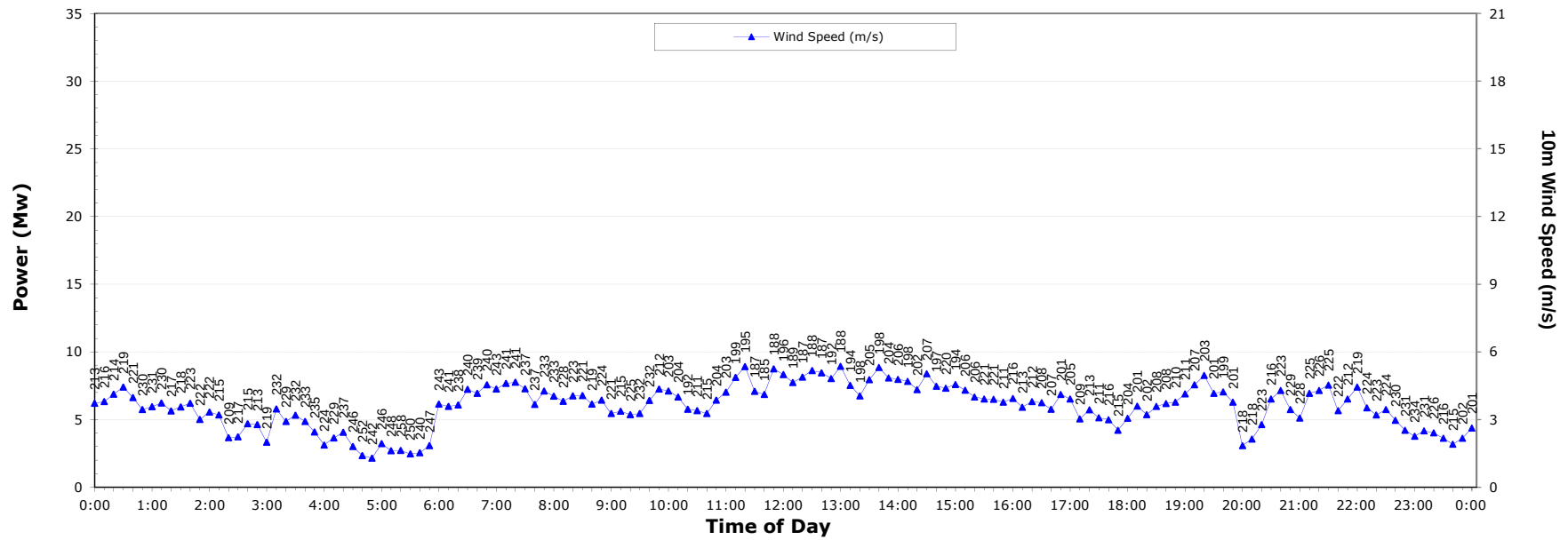
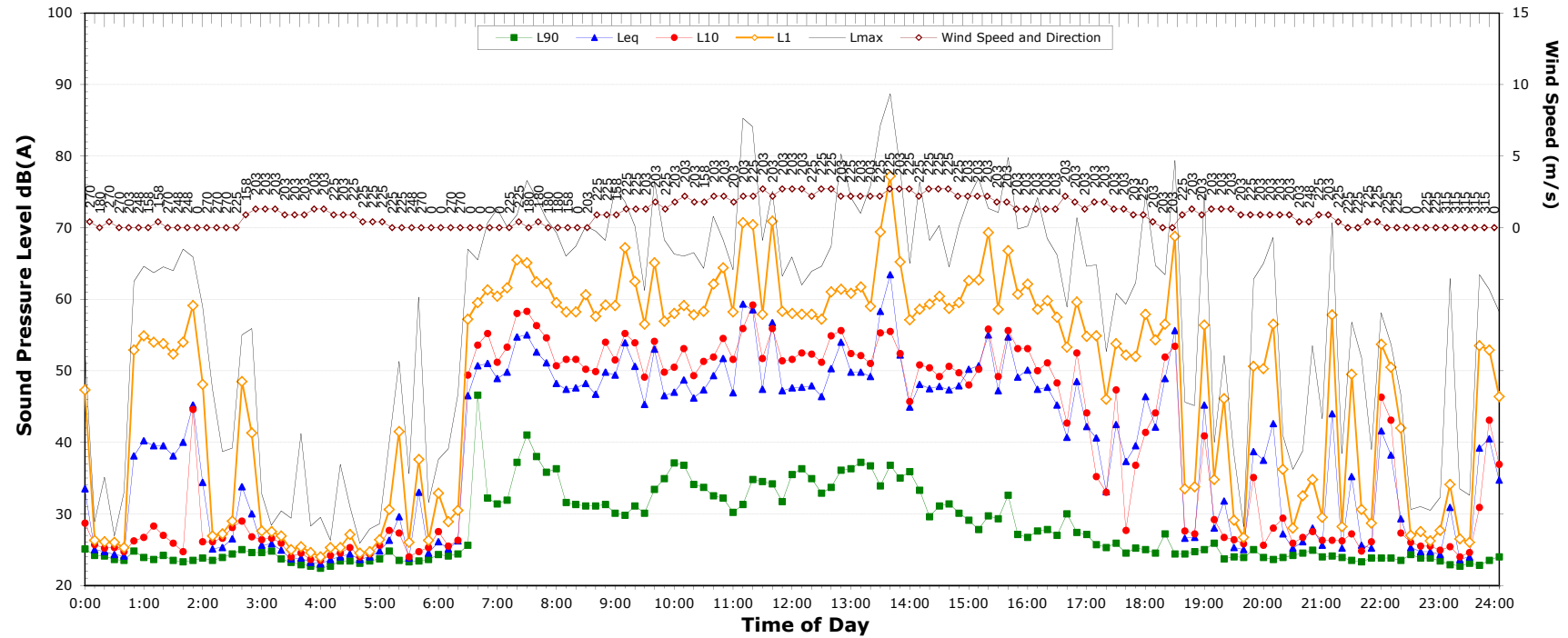
Sunday, 16 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

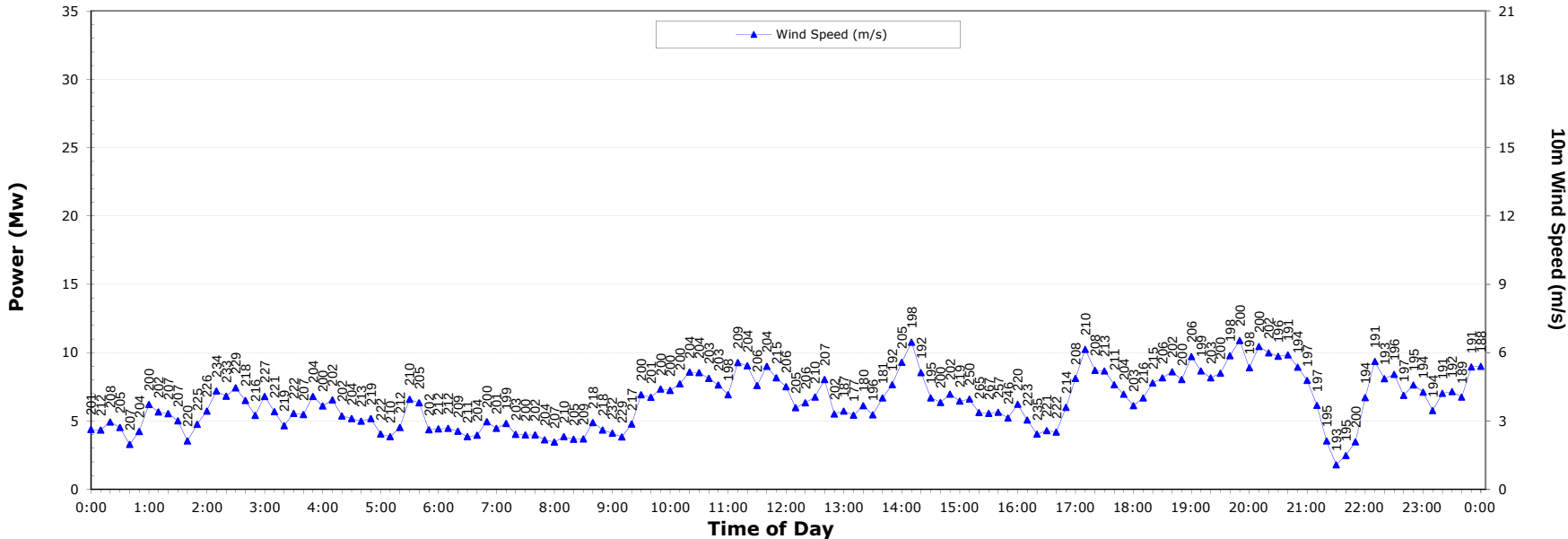
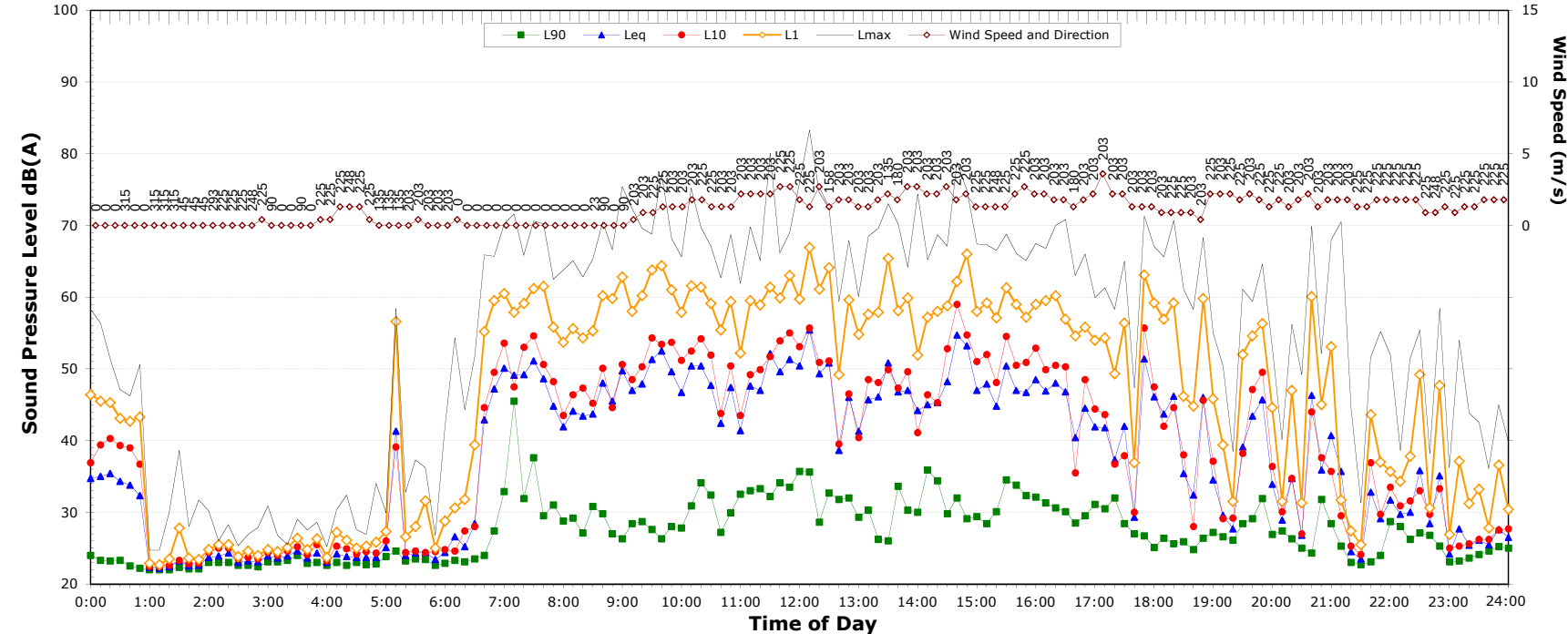
Monday, 17 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

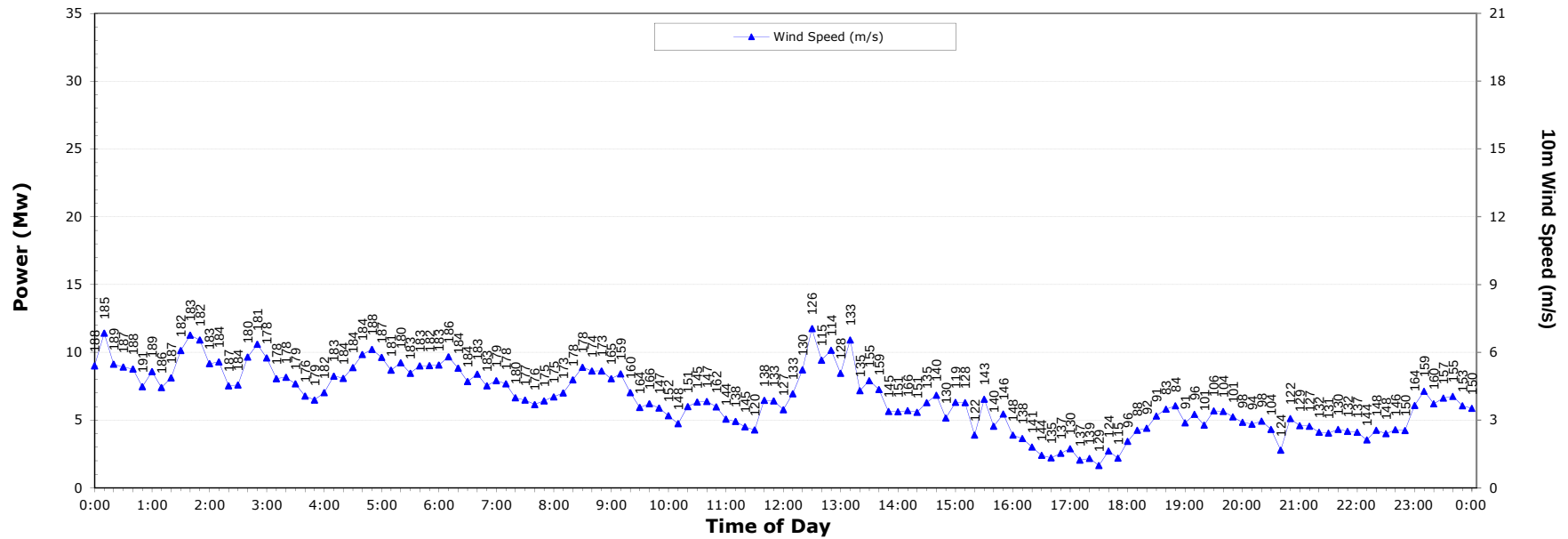
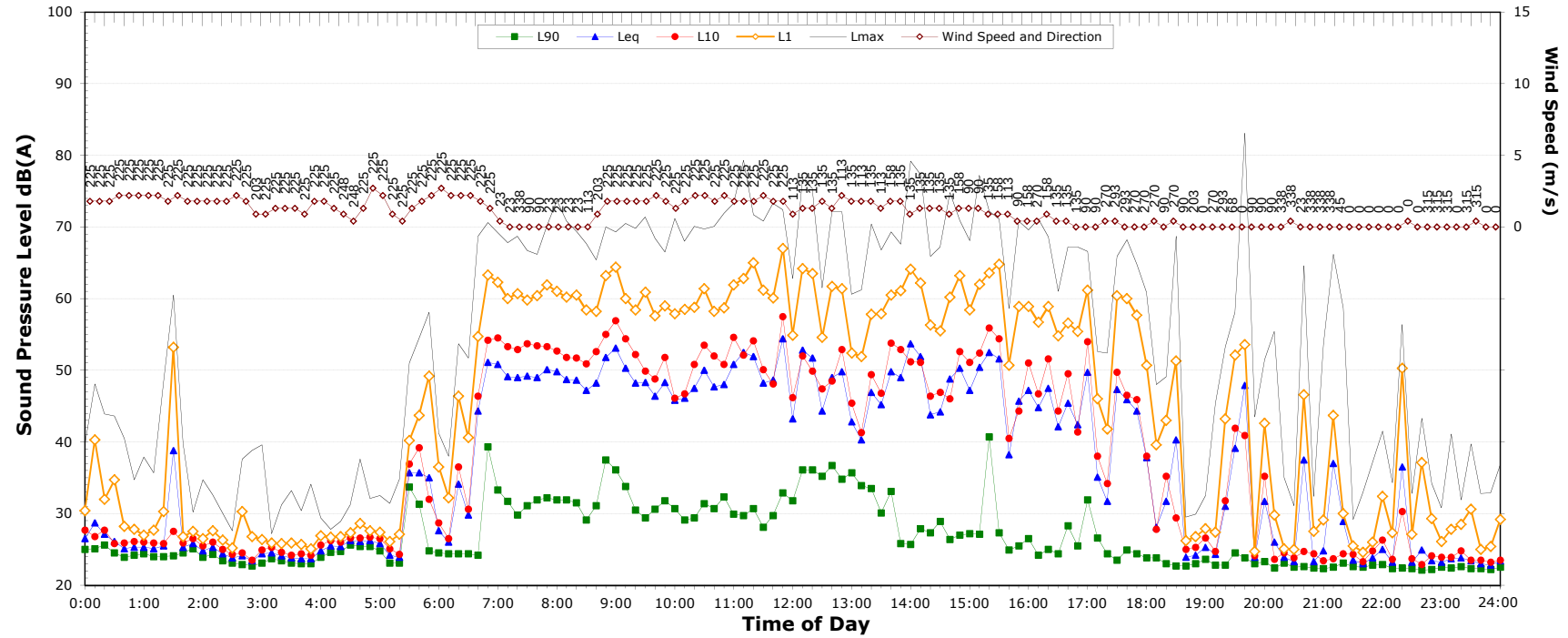
Tuesday, 18 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

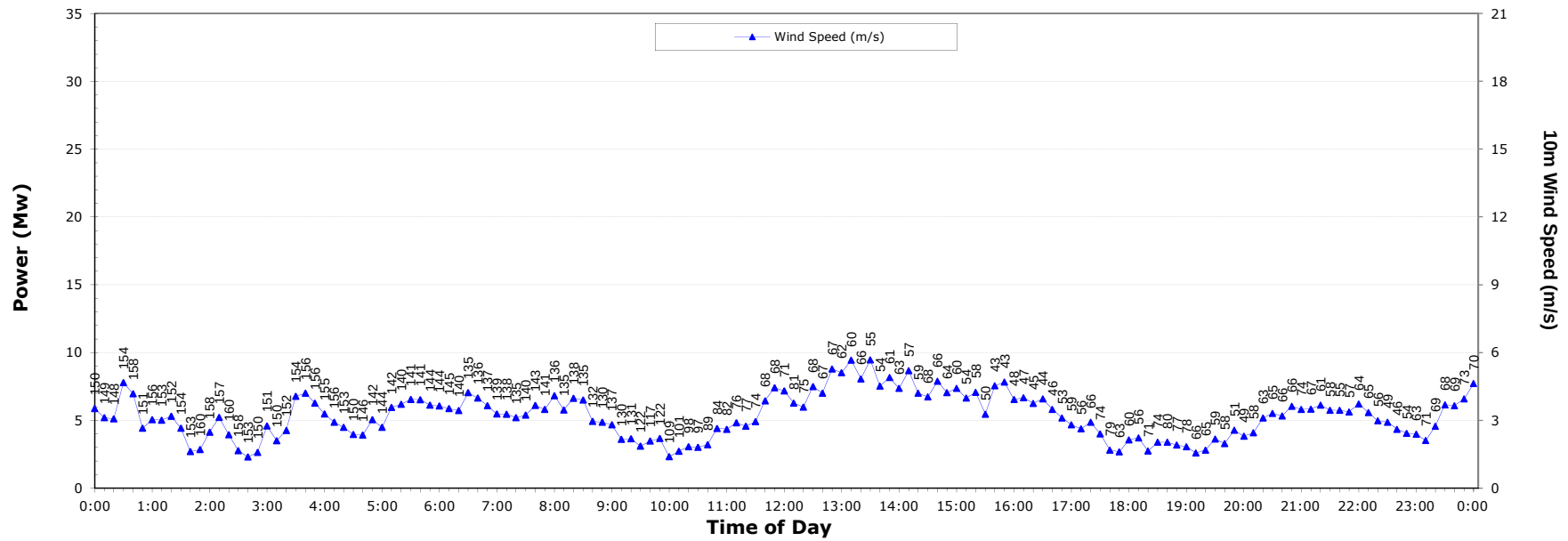
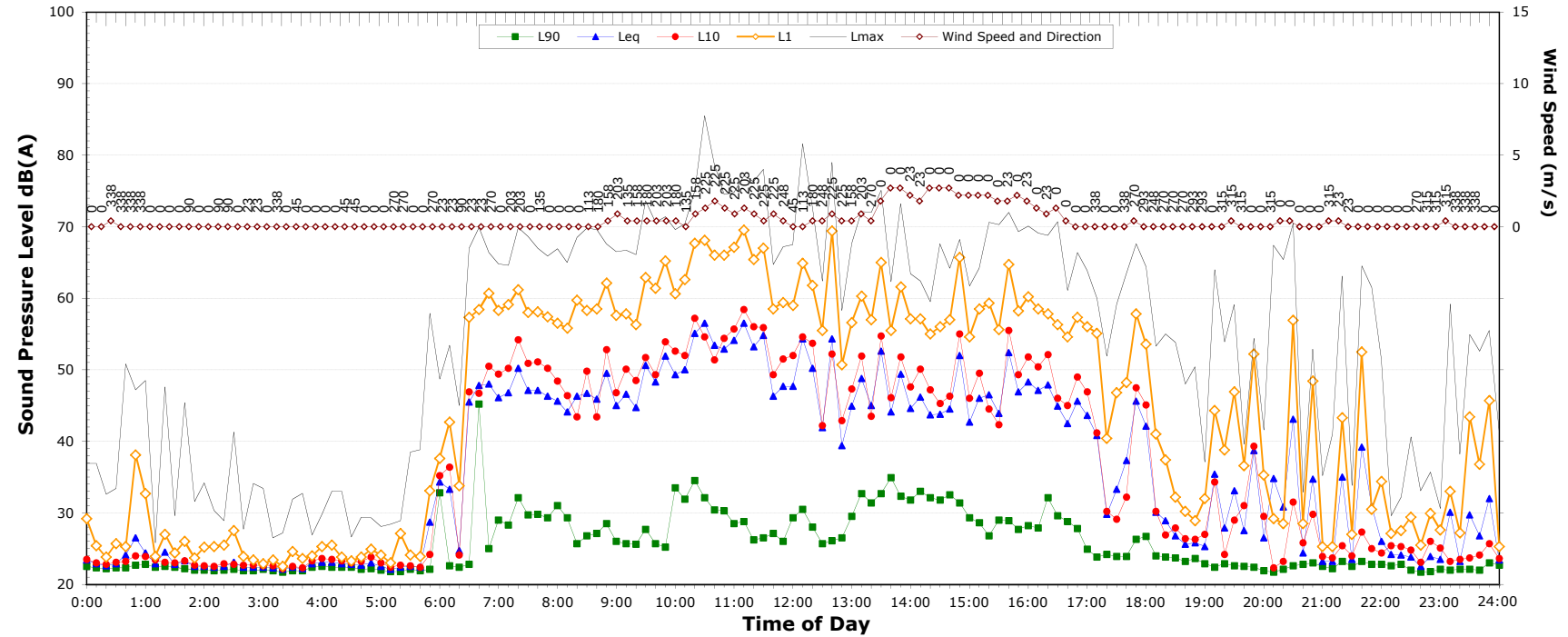
Wednesday, 19 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

Thursday, 20 June 2013



EXISTING AMBIENT NOISE LEVELS

CR18 - Glendaire

Friday, 21 June 2013

