MARSHALL DAY Acoustics

YASS VALLEY WIND FARM

Addendum for reports Rp001 R01 2008237SY and Rp002 2008237SY

Rp 001 R03 2013109SY

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1.0 INTRODUCTION

Epuron Pty Ltd is developing a preferred Project Report for the Yass Valley Wind Farm which is currently on exhibition. The project comprises of the originally proposed Coppabella and Marilba Wind Farms, with amendments to turbine layouts and transmission infrastructure.

We understand that the Department of Planning and Infrastructure (DPI) has specified the following noise information be included in the preferred Project Report:

- *The noise impact assessment is to be updated to include "worst case" noise predictions of the revised turbine layout (construction and operational) for all identified receivers. This is to be inclusive of the approved Conroy's Gap wind farm turbines.*

- *Identify the relevant receivers where the noise criteria will be exceeded with all turbines within the revised layout operating at maximum output (and at what wind speed this would occur).*

- *The noise impact assessment is to be updated to include construction noise predictions for all receivers in proximity of the revised transmission line route.*

- *The noise impact assessment is to include a revised "worst case" noise contour map inclusive of all identified receivers (on A3 size paper)*

- *The response is to have regard to the draft Wind Farm Planning Guidelines, and in particular the assessment of low frequency noise.*

This document has been prepared as an addendum to the two previous reports for the development, *Rp 001 R01 2008237SY Coppabella Hills Noise Impact Assessment* dated 9 September 2009 and *Rp002 2008237SY Marilba Hills Noise Impact Assessment* dated 22 April 2009. These two previous assessments are herein referred to collectively as the "2009 assessment".

The main sections of this addendum shadow the document structure of the 2009 assessment. Subheadings have been included as required and renumbered for this document. Key changes to the 2009 assessment are outlined in each of the relevant sections below. Where there are no significant changes, the section has been left blank.

A key item of this addendum is consideration of the *Draft NSW Planning Guidelines: Wind Farms* (the draft NSW guidelines). In particular, the following tasks are documented:

- Reanalysis of the background noise data with hub-height wind speed data (in lieu of the 10m height data referenced in the 2009 assessment)

- Determination of noise limits for separate daytime and night-time periods.

- Prediction of low-frequency noise levels, supplemented by qualitative text concerning tonality and amplitude modulation

- Cumulative operational wind farm noise assessment based on limits applicable to the combined noise of all sites, in contrast the individual contribution of neighbouring sites as specified under the relevant SA guidelines referenced in the 2009 assessment

We note that the addendum specifically addresses the DPI requirements and provides additional information in recognition of the draft NSW guidelines. In relation to the draft NSW guidelines, we note that this addendum primarily considers the analysis and assessment methodologies suggested in the draft NSW guidelines, based on the original baseline noise data collected for the 2009 assessment.

A glossary of the acoustic terminology used in this report is provided in Appendix A.

2.0 SITE DESCRIPTION

The Yass Valley Wind Farm is proposed to be located approximately 15km west of Yass and south of the township of Binalong. For the 2009 assessment, two separate schemes were assessed, Marilba Hills which consisted of 66 turbines and Coppabella Hills which consisted of 86 turbines. For the revised assessment, the two schemes have been merged to create the Yass Valley Wind Farm project and a total 147 turbines are proposed for the development.

Epuron have identified 148 receiver locations around the site of the proposed wind farm. The total number of receiver locations differs from that presented in the 2009 assessment. Additionally, revised coordinates have been provided for some receivers. We have been advised by Epuron that the changes in receiver information are due to:

- improved accuracy when capturing the receiver location
- identification of new receivers
- removal of redundant assessment positions.

The receiver list also includes receiver locations surrounding Conroy's Gap Wind Farm. Please refer to Appendix B for a summary of the receiver changes from the 2009 to the 2013 assessment.

2.1 Proposed wind farm layout

As part of the detailed design process, the total number and location of turbines have changed since the 2009 assessment. As per the 2009 assessment, two turbines options are considered for the revised assessment, namely the Repower MM92 and the Vesta V90 turbines. Sound power level information has been taken from the reports referenced in Table 1.

Table 1: Turbine test report references

Turbine type	Reference document
MM92	Windtest report reference *Excerpt from the acoustic test report SE06010N1B1 about the wind turbine type Repower MM92 at St Michaelisdonn/ Germany*
V90	DELTA Test Report reference *AV 148/09 DANAK 100/2699 Rev. 2 revised 10 December 2009*

Table 2 provides a summary of the turbine specifications. Please refer to Appendix B for a full list of the turbine coordinates.

Table 2: WTG manufacturer specifications

	Turbine 1	Turbine 2
Make	REPower	Vestas
Model	MM92 2.05MW	V90 3MW
Rotor Diameter (m)	92.5	90
Hub Height (m)	80	80
Orientation	Upwind	Upwind
Rotor speed (rpm)	7.8 - 15.0	8.6-18.4
Cut-in Wind Speed (hub height, m/s)	3	3.5
Rated Wind Speed (hub height, m/s)	13	16
Cut-out Wind Speed (hub height, m/s)	25	25
Maximum Sound Power L_{WA} (10m AGL dB)	104.2 (at 8m/s)	107.1 (at 10m/s)
Tonality audibility ($\Delta L_{a,k}$)	Maximum value of -2.96	Maximum value of -1.7

Table 3 below presents the reported trend of sound power levels vs wind speed, referenced to hub height wind speeds (m/s). To obtain the turbine sound power levels referenced to hub height wind speeds, the 10m AGL wind speeds from the test reports have been extrapolated using the standard roughness value of z_0=0.05.

Table 3: Sound power levels vs wind speed for the candidate turbine models

L_{AW} (dB)										
Extrapolated Integer hub height wind speed (m/s)	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Vesta V90*	98.8	101.1	103.2	105	106.1	106.6	106.6	106.4	106.7	107.1
Repower MM92*	-	-	102.5	103.6	104.2	104.2	103.8	103.1	-	-

* Measured test sound power levels + uncertainty

The relationship between A-weighted sound power levels and integer hub height wind speeds for the candidate turbines is presented in Figure 1 below.

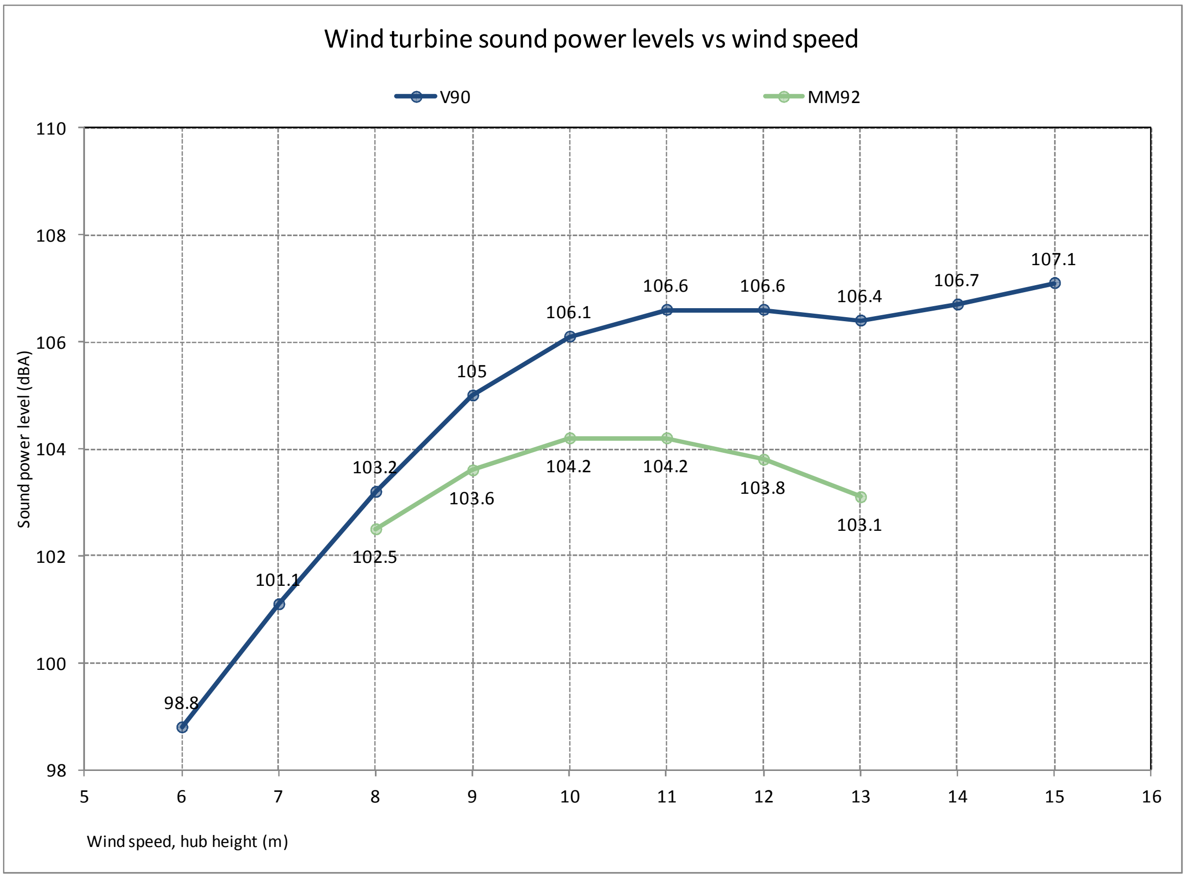

Figure 1: Hub height sound power level profiles (V90 and MM92)

Tabular octave band values for each turbine type are presented in Table 4.

Table 4: Reference A-weighted octave band sound power levels for the candidate turbines

	Octave Band Centre Frequency (Hz)								
L_{WA} (dB)	63	125	250	500	1000	2000	4000	8000	Overall
Vesta V90	95.4	94.0	96.6	99.3	101.4	101.1	96.6	86.3	107.1
Repower MM92	84.3	92.5	98.1	99.8	97.8	92.1	85.4	82.2	104.2

The spectra presented in Figure 2 have been scaled to the highest reported sound power level for each turbine as detailed in Table 3 above.

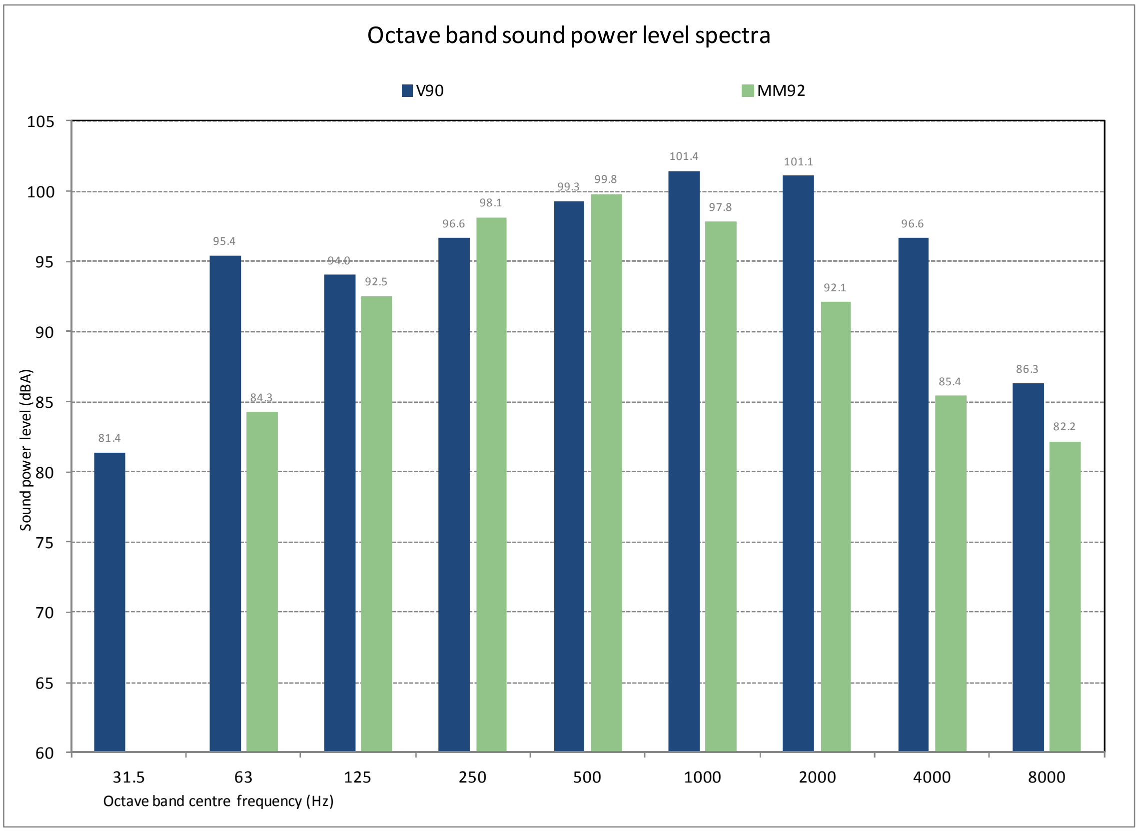

Figure 2: Turbine Spectral Values

Further details on relevant sound power level data can be found in Appendix D.

2.2 Tonality

Tonal audibility ($\Delta L_{a,k}$) will typically decrease with increasing distances from a turbine due to geometric divergence and atmospheric absorption effects.

A tonality assessment undertaken in accordance with IEC61400-11 *Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques* (IEC61400-11) for the Repower MM92 and Vesta V90 turbines is provided in the documents outlined in Table 1.

These reports provide tonal audibility ($\Delta L_{a,k}$) for the most prevalent tone at each integer wind speed in the range 6-9 m/s at 10m AGL for each proposed turbine type. The largest reported values for $\Delta L_{a,k}$, for measurements made close to the turbine at a distance of approximately 150m, are -2.96 dB and -1.7dB for the REpower and Vestas turbines respectively, as detailed in Table 2 above.

3.0 NOISE ASSESSMENT GUIDELINES

In addition to the core assessment documents detailed in the 2009 assessment, this addendum also considers the following guidance documents:

- *Interim Construction Noise Guideline* (CNG) published by the Department of Environment and Climate Change (DECC) (July 2009)
- *Draft NSW Planning Guidelines: Wind Farms* (draft NSW guidelines) published by the NSW Department of Planning and Infrastructure (December 2011)

Discussion of these documents is provided in Appendix E.

4.0 ASSESSMENT METHODOLOGY

Noise levels from wind farms have been the subject of a number of studies and noise modelling methodologies have been refined to reflect the findings of the studies. In particular, in 1998 a comprehensive study[1] (commonly cited as the *Joule Report*), part funded by the European Commission provided a number of recommendations for the modelling of wind turbines. The key recommendations of the Joule Report have been implemented for this assessment.

The assessment methodology for this noise impact assessment is detailed in the 2009 assessment with the exception of the following variations to the noise predictions methods for operational wind farm noise (in accordance with Joule Report recommendations):

- A ground factor of G = 0.5 (50% hard ground) has been used
- Barrier attenuation is based on the screening expected for the source located at the tip height of the turbine
- A 3dB correction is applied where the ground falls away significantly between the source and receiver

Please refer to Appendix F for a detailed description and justification of the prediction methodology used for this assessment.

The 2003 SA Guidelines propose a 5dB penalty for characteristics of turbine operation that may be deemed as annoying, such as tonality.

One means of determining tonality is in accordance with IEC61400-11 *Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques* (IEC61400-11). As detailed in Section 2.1, the maximum reported tone audibility ($\Delta L_{a,k}$) is less than 0dB. Version 3.0 of the IEC61400-11 test standard, published in 2012, states that a "*tone is audible if the tonal audibility is above* 0dB".

[1] Bass, Bullmore and Sloth - *Development of a wind farm noise propagation prediction model; Contract JOR3-CT95-0051, Final Report*, January 1996 to May 1998.

It is therefore considered that a tonal correction need not apply for any of the assessed wind speeds.

5.0 RELEVANT RECEIVER ASSESSMENT

Using the methodology presented in the 2009 assessment and the changes outlined in Section 4.0, we have determined the relevant receivers that are located within the 35dB L_{Aeq} noise contour. The revised set of relevant receivers is presented in Table 5. A number of receivers were not included in the 2009 assessment and therefore do not have a corresponding representative background monitoring location. For these receivers, noise levels have been compared to the base criteria (as defined in Table 5).

Table 5: Relevant receivers (MGA94 Zone 55)

Location	Easting	Northing	Distance to closest turbine (km)	Representative background monitoring location	Base criteria	Relevant receiver for 2009 assessment?
C02 *	636019	6153226	1.7	C02	45	Yes
C03 *	637337	6151337	1.4	C03	45	Yes
C04 *	641145	6150582	2.3	C04	45	Yes
C25 *	650905	6151073	0.7	C26	45	No
C26 *	650347	6153681	1.5	C26	45	Yes
C27 *	651322	6154526	1.1	C26	45	No
C55 *	636410	6151623	1.7	-	45	No
C56 *	637828	6151304	1.4	-	45	No
C68 *	651108	6154402	1.3	-	45	No
C74	639283	6160379	3.2	-	35	No
G11	661209	6147630	1.7	G12	35	No
G12 *	660201	6149381	1.8	G12	45	Yes
G13 *	660057	6151077	2.0	G14	45	No
G14	659607	6150702	1.4	G14	35	Yes
G15 *	655374	6149637	1.2	G15	45	Yes
G16	655016	6147518	1.2	G30	35	No
G31 *	651691	6149344	1.5	M18	45	No
G38 *	659982	6150849	1.8	-	45	No
M08	660245	6151580	2.4	G14	35	No
M18 *	652314	6149832	0.9	M18	45	No

Location	Easting	Northing	Distance to closest turbine (km)	Representative background monitoring location	Base criteria	Relevant receiver for 2009 assessment?
M20	658743	6154508	1.9	M04	35	No
M21 *	651854	6155574	1.4	C26	45	No
M32 *	652110	6146643	1.9	-	45	No
M41 *	651736	6155517	1.4	-	45	No
M42	653648	6155444	1.1	M42	35	No
M48 *	655766	6149602	1.5	-	45	No

** Involved receiver*

The background noise data collected for the 2009 assessment has been reanalysed using wind speeds referenced to hub height. This is consistent with the Draft NSW guidelines.

For receiver M42, data collected in 2013 has been used to determine the noise criteria for the receiver. Receiver M42 was not identified for the 2009 assessment and due to the proximity of the turbines to receiver M42, noise monitoring was conducted to develop background specific noise criteria. Please refer to Appendix G for further details on the monitoring conducted at receiver M42.

Where there is no proxy location for the receiver, a base noise limit has been assumed. Figure 3 presents an overview of the resulting 24 hour noise criteria for all receivers.

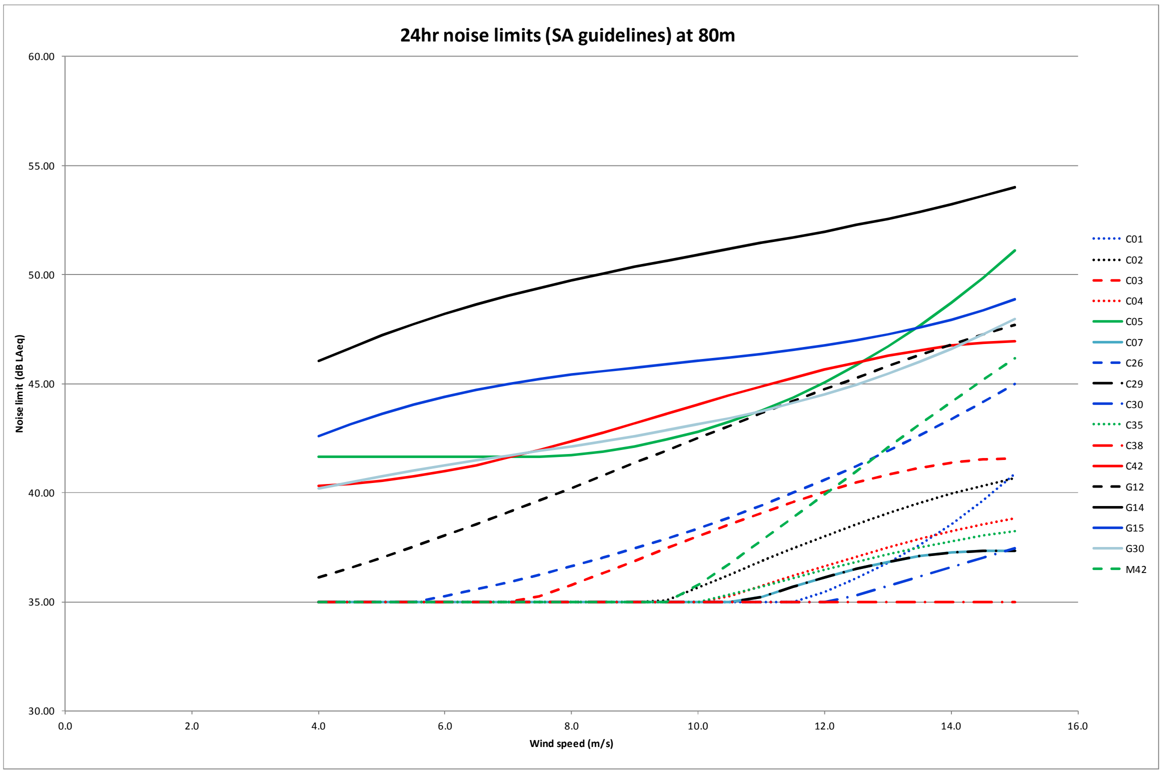

Figure 3: Hub height noise criteria

We note the criteria derived from receivers C05, C42, G14, G15 and G30 are higher than the rest of the receivers. These receivers are located close to a major highway or local road and therefore it is likely the elevated background noise levels are due to noise from traffic movements. The elevated background noise level experienced at the receivers is reflected in the derived noise criteria.

Further details for the revised data analysis are presented in Appendix G. Consideration of the daytime and night-time limits and an overview of the resulting noise limits are discussed in Appendix H.

6.0 NOISE LEVEL PREDICTIONS

Wind farm noise levels have been calculated in accordance with ISO9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* and the Joule Report recommendations as discussed in Section 4.0. The predicted noise level at each of the relevant receivers is presented in Table 6 for the V90 and MM92 turbines.

Noise levels in environmental assessment work are typically reported to the nearest integer to reflect the practical use of measurement and prediction data. In the case of wind farm layout design however, significant layout modifications may only give rise to fractional changes in the predicted noise level. This is a result of the relatively large number of sources influencing the total predicted noise level, as well as the typical separating distances between the turbine locations and surrounding assessment positions. It is therefore necessary to consider the predicted noise levels at a finer resolution than can be perceived or measured in practice. It is for this reason that the levels presented below are reported to one decimal place

Table 6: Worst case[#] predicted levels for relevant receivers (L_{Aeq}) in dB

	MM92	Compliance at all wind speeds?	V90	Compliance at all wind speeds?
C02*	37.8	✓	39.7	✓
C03*	37.1	✓	39.3	✓
C04*	35.7	✓	37.9	✓
C25*	39.9	✓	42.2	✓
C26*	35.8	✓	38.2	✓
C27*	37.1	✓	39.3	✓
C55*	35.8	✓	38.1	✓
C56*	37.8	✓	40.1	✓
C68*	36.5	✓	39.1	✓
C74	<35	✓	35.2	×
G11	<35	✓	37.2	✓

	MM92	Compliance at all wind speeds?	V90	Compliance at all wind speeds?
G12*	37.0	✓	38.9	✓
G13*	35.1	✓	37.4	✓
G14	37.3	✓	39.3	✓
G15*	40.2	✓	42.3	✓
G16	39.5	✓	41.7	✓
G31*	37.4	✓	39.6	✓
G38*	35.8	✓	38.1	✓
M08	<35	✓	36.2	✓
M18*	41.0	✓	43.1	✓
M20	<35	✓	35.2	✓
M21*	35.2	✓	37.1	✓
M32*	<35	✓	36.0	✓
M41*	<35	✓	37.5	✓
M42	35.1	✓	36.3	✓
M48*	39.5	✓	41.3	✓

#Predicted noise level using maximum reported sound power level (plus uncertainty tolerance) and the prediction methodology detailed in Appendix F

** Involved receiver*

The predicted noise levels comply with the relevant noise criteria for all relevant receivers for the MM92 turbine type. For the V90 turbine, the predicted noise levels comply with the relevant noise criteria all relevant receivers with the exception of receiver C74. Receiver C74 is a new receiver and was not assessed in the 2009 assessment. Therefore, noise limits derived from background data are not available for this receiver and a baseline noise criterion of 35dB L_{Aeq} has been applied across all wind speeds.

If background noise level measurements are carried out at C74 and background dependent noise limits are established then there is a possibility that the predicted wind farm noise level may comply with the background limits. However, in the absence of revised noise levels demonstrating compliance, curtailment strategies may be necessary to reduce the level of wind farm noise at this location for selected wind speeds. For details on the predicted noise levels for all receivers, please refer to Appendix I.

Appendix J provides further informative comparison of the predicted noise levels with the noise limits for the daytime and night-time periods (derived with regard to the NSW draft guidelines).

Please refer to Appendix K for indicative noise contour maps for the modelled scenarios.

6.1 Cumulative Effect of Other Wind Farm Developments

Cumulative noise impacts have been considered for Conroy's Gap Wind Farm. Conroy's Gap Wind Farm comprises 18 Repower MM92 turbines located directly south of the eastern section of the proposed Yass Valley Wind Farm. Please refer to Appendix C for the coordinates of the turbines.

As noted previously, the receiver list presented in Appendix B includes the receivers surrounding Conroy's Gap Wind Farm. Predicted noise levels for receivers are detailed below where the inclusion of the Conroy's Gap turbines:

a) Result in the overall noise level being greater than 35dB L_{Aeq} and

b) Change the overall predicted noise level at the receiver

The cumulative predicted noise levels for the Yass Valley Wind Farm and consented Conroy's Gap Wind Farm are presented in .

Table 7: Cumulative noise levels at relevant receiver predicted levels (L_{Aeq}) in dB

Receiver	Conroy's Gap	Yass noise level		Cumulative noise level (Yass + Conroy's Gap)		Comply?
		MM92	V90	MM92	V90	
Conroy's Gap relevant receivers						
G10*	40.2	29.4	31.6	40.5	40.7	✓
G60*	35.5	26.7	29.4	36.1	36.5	✓
Yass Valley relevant receiver (if noise level has increased with Conroy's Gap included)						
G11*	26.4	<35	37.2	35.2	37.5	✓
G12*	24.2	37	38.9	37.2	39.1	✓
G13*	21.2	35.1	37.4	35.3	37.5	✓
G16*	26.3	39.5	41.7	39.7	41.8	✓
M32*	23.0	<35	36	34.2	36.2	✓

When including noise emissions from Conroy's Gap Wind Farm, the predicted noise has increased at 5 receivers when compared to the Yass Valley Wind Farm predicted noise levels alone. The cumulative predicted noise level is less than the criteria for all 5 receivers.

6.2 Transformer Noise Levels

The layout for the substations proposed for the 2009 assessment has been revised. There are two substation layout options proposed for the Yass Valley Wind Farm:

- **Option A –** Two substations, one with a 200MVA transformer and one with a 300 MVA transformer; or
- **Option B –** One substation with a 500MVA transformer

The transformer sound power levels presented in Table 8 have been estimated from Figure ZA1 – Sound Power levels from *AS/NZS60076.10:2009 Power transformers Part 10: Determination of sound levels.*

Table 8: Estimated transformer sound power levels

Option	Reference name	Size (MVA)	L_{WA} (dB)
A	COP_300	300	101
A	MRL_200	200	98
B	COP_500	500	104

Noise levels have been predicted for the Option A and Option B configuration to the dwellings closest to the substations. It is noted that transformers commonly display tonality at 100Hz, therefore a penalty of +5dB has been applied to the predicted results. Predicted noise levels, adjusted for tonality in accordance with Table 4.1 of the *NSW Industrial Noise Policy, January 2000* (NSW INP), are detailed in Table 9. Noise criteria have been developed in accordance with the NSW INP (please refer to 2009 assessment for further information).

Table 9: Predicted transformer noise levels (L_{Aeq}) in dB

Dwelling	Distance to closest substation (km)	Closest transformer?	Predicted noise level (dB L_{Aeq})		Night-time RBL (dB L_{A90})	INP intrusiveness criteria (RBL +5dB)	Comply?
			Option A	Option B			
C04	3.6	COP_300	<10	<10	36	41	✓
C25	1.4	MRL_200	16	16	30	35	✓
C67	0.8	COP_500	<10	29	30	35	✓

The predicted levels summarised in Table 9 indicate the noise levels from the closest substations will be below the NSW INP intrusiveness criteria.

7.0 SITE CONSTRUCTION NOISE IMPACT ASSESSMENT

7.1 Construction Site Noise Limits

Background noise levels for the day period have been determined in accordance with the procedure detailed in Table 3.1 *Methods for determining background noise* from the NSW INP. Table 10 summarises the daytime background noise level or the rating background level (RBL) for each receiver. Where there is no background noise monitoring data to determine a site specific RBL value, the minimum value of 30dB L_{A90} has been used.

As detailed in Appendix E, it is considered appropriate to allow the construction noise level when measured over a 15-minute period ($L_{Aeq,15\ min}$) to exceed the background level (L_{A90}) by up to 10dB.

It should be noted that predicted noise levels are for those receivers closest to the construction activities. Where a group of receivers is located in one area, one receiver is chosen as being a worst case representation of all receivers.

Predicted noise levels at the selected receiver locations are based on a 15-minute assessment period, which is in line with the monitoring period outlined within the NSW Industrial Noise Policy.

Table 10 summarises the predicted noise levels at each relevant receiver location. Where the predicted noise level exceeds the management level, the predicted levels are shown in bold.

Table 10: Predicted construction noise level (L_{Aeq}) at each relevant receiver location

Location	Background Noise Level	Management level (L_{90}+ 10 dB)	Access Road Construction	Turbine Foundation Construction	Cable Trench Digging	WTG Assembly	Batching plant	Transmission line constriction	Management level exceeded?
C25*	30	40	**45-50**	**45-50**	**40-45**	30-35	30-35	**45-50**	Yes
C67	30	40	25-30	25-30	20-25	15-20	15-20	**40-45**	Yes
G15*	34	44	**40-45**	**40-45**	35-40	30-35	15-20	25-30	Yes
G16	34	44	**40-45**	**40-45**	**40-45**	30-35	10-15	25-30	Yes
M13*	30	40	25-30	25-30	25-30	15-20	<10	**45-50**	Yes
M18*	30	40	35-40	35-40	30-35	20-25	25-30	**40-45**	Yes
M48*	30	40	**40-45**	**40-45**	35-40	25-30	15-20	25-30	Yes

* Involved landowner

From the results detailed in Table 10, it can be seen that predicted noise levels associated with the construction of the wind farm are expected to exceed the noise affected levels, as defined by the CNG, for some stages of the project.

The predicted noise levels are up to 10dB greater than the noise affected managements level, but more than 25dB below the threshold of highly affected levels defined by the CNG.

The predictions indicate that noise levels are sufficient to warrant notification of working times and durations to the residents of these locations, as per the advice of the CNG.

In applying the management levels, the CNG requires that all feasible and reasonable work practices be employed. We understand that this would be addressed through an environmental management plan for construction. It is expected that this management plan will include measures to inform residents of key working hours and phases, and a requirement to notify affected residents of any proposed work outside of standard hours, such as turbine deliveries.

APPENDIX A GLOSSARY OF TERMINOLOGY

dB	Decibel. The unit of sound level.
Frequency	Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 8000Hz (8kHz). This is roughly equal to the range of frequencies on a piano.
Octave band	Sound, which can occur over a range of frequencies, may be divided into octave bands for analysis. The audible frequency range is generally divided into 8 octave bands. The octave band frequencies are 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz and 8kHz.

Noise is often not steady. Traffic noise, music noise and the barking of dogs are all examples of noises that vary over time. When such noises are measured, the noise level can be expressed as an average level, or as a statistical measure, such as the level exceeded for 90% of the time.

L_{A90}	The A-weighted noise level exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L_{Aeq}	The A-weighted equivalent continuous sound level. This is commonly referred to as the average noise level.
L_{WA}	The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
$L_{pAL,F}$	The A-weighted sound pressure level at low frequencies, found by summing the sound pressure levels in each one-third octave band from 10 Hz to 160 Hz.

APPENDIX B RECEIVER LOCATION CHANGES

As discussed in Section 5.0, there have been a number of receiver location changes since the 2009 assessment. Table B1 below provides a glossary of the terminology used to explain the 2013 receiver status and Table B2 gives the receiver coordinates for the 2013 revised assessment.

Table B1: Receiver status glossary

Status	Description
No change	For the stated receiver ID, there has been no change in the easting or northing coordinate between the 2009 and the 2013 assessment
New location	For the stated receiver ID, the easting or northing coordinate has changed between the 2009 and the 2013 assessment. This is due to improved accuracy when capturing receiver locations.
Relabelled	Improved accuracy when capturing receiver locations has identified that a previous receiver is no longer identified as a dwelling and as such the label has been reused by the proponent or a redundant receiver position has been identified.
New receiver	There is no corresponding receiver ID location for the 2009 assessment

Table B2: Receiver location summary

ID	2013 Easting	2013 Northing	Status	2009 assigned label*	Change in easting	Change in northing
C01	634542	6152998	No change			
C02	636019	6153226	New location		*9.07*	*-5.35*
C03	637337	6151337	New location		*-16.48*	*66.91*
C04	641145	6150582	New location		*-3.9*	*-9.7*
C05	644196	6148247	No change			
C06	645148	6147453	No change			
C07	631744	6154014	No change			
C08	645794	6147060	New location		*11.14*	*-30.02*
C09	630849	6153136	No change			
C10	632778	6150353	No change			
C12	634100	6149266	New location		*-14.07*	*1.53*
C13	634466	6150956	No change			
C22	641632	6147823	No change			
C25	650905	6151073	No change			
C26	650347	6153681	No change			
C27	651322	6154526	No change			
C28	648493	6156983	No change			

ID	2013 Easting	2013 Northing	Status	2009 assigned label*	Change in easting	Change in northing
C28a	648498	6156870	New receiver			
C29	645491	6156830	No change			
C30	643944	6159581	No change			
C33	644012	6160671	No change			
C34	643485	6160766	No change			
C35	639487	6159590	New location		*-152.56*	*-25.54*
C37	635366	6159643	New location		*-91.46*	*-14.74*
C38	632048	6157837	No change			
C39	631508	6158555	No change			
C41	646816	6146818	New location		*-6.18*	*-20.65*
C42	649156	6147589	New location		*10.91*	*12.37*
C46a	649054	6147292	New receiver			
C47	649752	6146654	No change			
C48	649388	6146699	No change			
C52	649584	6157888	No change			
C53	635285	6160772	New receiver			
C55	636410	6151623	New receiver			
C56	637828	6151304	New receiver			
C58	642782	6147349	New receiver			
C59	643544	6145985	New receiver			
C60	645430	6146811	New receiver			
C61	648066	6145891	New receiver			
C62	649389	6147137	New receiver			
C63	649566	6146693	New receiver			
C64	649625	6146616	New receiver			
C65	649666	6146568	New receiver			
C66	649801	6146592	New receiver			
C67	649305	6148446	New receiver			
C68	651108	6154402	New receiver			
C69	652031	6157308	New receiver			
C71	645410	6156831	New receiver			
C72	648197	6144474	New receiver			
C73	631318	6154627	New receiver			
C74	639283	6160379	New receiver			
C75	643338	6147618	New receiver			
C76	638649	6148574	New receiver			

ID	2013 Easting	2013 Northing	Status	2009 assigned label*	Change in easting	Change in northing
C76a	639065	6148250	New receiver			
C77	649502	6147085	New receiver			
E20	635355	6148215	New receiver			
G01	656955	6140691	New location		*-0.28*	*-0.33*
G02	655830	6142160	New location		*-0.09*	*0.23*
G02a	656066	6141866	New location		*-0.48*	*0.11*
G03	654913	6142552	New location		*0.36*	*-0.13*
G04	658616	6142092	New location		*-0.09*	*-0.2*
G05	660294	6142075	New location		*0.45*	*0.02*
G06	661339	6142115	New location		*-0.19*	*0.16*
G07	659736	6143497	New location		*-0.37*	*0.11*
G08	659548	6143435	New location		*0.04*	*0.47*
G09	660108	6143295	New location		*0.14*	*-0.43*
G10	657463	6144500	No change			
G11	661209	6147630	No change			
G12	660201	6149381	No change			
G13	660057	6151077	New receiver			
G14	659607	6150702	New location		*58.7*	*43.02*
G15	655374	6149637	No change			
G16	655016	6147518	New location		*-11.29*	*24.48*
G18	662442	6150000	No change			
G19	662998	6149342	New location		*66.11*	*-55.43*
G20	661622	6145660	No change			
G23	661185	6144412	No change			
G24	660294	6144222	No change			
G26	654589	6142433	New location		*0.15*	*0.43*
G27	654255	6139595	New location		*-103.39*	*16.5*
G28	653616	6137305	New receiver			
G29	654670	6144842	New location		*-19.59*	*167.41*
G30	639014	6147881	Relabelled	C20		
G31	651691	6149344	New location		*-3.18*	*-10.26*
G32	638449	6147803	New receiver			
G36	662352	6150964	No change			
G38	659982	6150849	Relabelled	G13		
G39	662856	6150456	Relabelled	G35		
G40	662318	6147348	New receiver			

ID	2013 Easting	2013 Northing	Status	2009 assigned label*	Change in easting	Change in northing
G41	662876	6146549	New receiver			
G42	658194	6138495	New location		*-0.84*	*3.95*
G43	656466	6137655	New location		*-2.99*	*3.41*
G44	662582	6145905	New receiver			
G45	655427	6136235	Relabelled	G44		
G46	654615	6142308	New receiver			
G47	658778	6136871	Relabelled	G32		
G53	662637	6135668	New receiver			
G54	654307	6142203	New receiver			
G55	663370	6146057	New receiver			
G56	664478	6146720	New receiver			
G57	662900	6146056	New receiver			
G58	662725	6145918	New receiver			
G59	659823	6143216	New receiver			
G60	659368	6143377	New receiver			
G61	663768	6144604	New receiver			
H30	640134	6147863	New receiver			
K52	647463	6143653	New receiver			
M01	658885	6154626	No change			
M02	658967	6154884	No change			
M03	658590	6154878	No change			
M04	658548	6154933	New location		*-9.35*	*-11.27*
M05	661995	6152897	No change			
M06	661362	6152923	No change			
M07	662307	6152429	No change			
M08	660245	6151580	No change			
M09	650243	6146581	New location		*24.83*	*13.12*
M13	650548	6145967	No change			
M18	652314	6149832	New location		*-19.04*	*-44.06*
M20	658743	6154508	No change			
M21	651854	6155574	No change			
M22	654105	6156790	No change			
M24	658623	6154599	New receiver			
M25	650051	6146376	New receiver			
M26	649993	6146306	New receiver			
M27	650120	6146322	New receiver			

ID	2013 Easting	2013 Northing	Status	2009 assigned label*	Change in easting	Change in northing
M28	650095	6146256	New receiver			
M29	650134	6146219	New receiver			
M30	650156	6146155	New receiver			
M31	650227	6146088	New receiver			
M32	652110	6146643	New receiver			
M33	662430	6152891	New receiver			
M34	658644	6155236	New receiver			
M35	658445	6155225	New receiver			
M36	658630	6155598	New receiver			
M37	658208	6155434	New receiver			
M38	658294	6155812	New receiver			
M39	657388	6155956	New receiver			
M40	654760	6157037	New receiver			
M41	651736	6155517	New receiver			
M42	653648	6155444	New receiver			
M43	650710	6159059	New receiver			
M44	652027	6160045	New receiver			
M44a	651766	6159729	New receiver			
M44b	651827	6159558	New receiver			
M46	660983	6152974	New receiver			
M48	655766	6149602	New receiver			
M81	651222	6136844	New receiver			
M92	651370	6135593	New receiver			

*Where different from 2009 assessment

APPENDIX C TURBINE COORDINATES

Table C1: Yass Valley Wind Farm Turbine Coordinates

Turbine ID	Easting	Northing	Turbine ID	Easting	Northing
1	641,135	6,156,615	30	640,070	6,154,676
2	642,183	6,155,309	31	640,038	6,155,010
3	641,934	6,155,584	32	639,618	6,154,648
4	641,683	6,155,973	33	639,464	6,153,582
5	641,228	6,156,306	34	638,607	6,154,188
6	644,704	6,153,528	35	638,391	6,153,940
7	643,949	6,154,128	36	639,022	6,154,556
8	643,690	6,154,400	37	638,704	6,154,914
9	642,410	6,155,033	38	639,088	6,155,044
10	642,697	6,154,767	39	638,176	6,153,691
11	644,507	6,153,820	40	637,724	6,153,002
12	645,386	6,153,102	41	637,724	6,152,676
13	645,920	6,153,005	42	637,890	6,153,483
14	645,844	6,152,689	43	638,123	6,153,103
15	643,186	6,154,579	44	637,501	6,153,978
16	640,374	6,156,085	45	637,821	6,154,164
17	640,731	6,155,502	46	638,091	6,154,423
18	640,494	6,155,780	47	639,088	6,152,412
19	641,174	6,155,340	48	639,374	6,152,965
20	642,992	6,152,607	49	639,508	6,153,251
21	642,127	6,153,127	50	639,733	6,152,377
22	642,273	6,152,772	51	639,315	6,152,655
23	641,835	6,152,804	52	637,982	6,155,133
24	640,458	6,154,180	53	637,955	6,154,807
25	639,997	6,154,114	54	637,553	6,154,697
26	640,620	6,153,560	55	637,558	6,155,411
27	641,397	6,153,772	56	638,860	6,155,385
28	641,085	6,153,590	57	638,692	6,155,728
29	641,753	6,154,245	58	638,239	6,155,953

Turbine ID	Easting	Northing	Turbine ID	Easting	Northing
59	638,546	6,156,147	86	653,296	6,150,233
60	637,143	6,155,777	87	653,274	6,150,848
61	636,904	6,155,521	88	653,192	6,150,541
62	636,707	6,155,235	89	653,780	6,148,628
63	636,604	6,154,848	90	654,147	6,148,953
64	637,973	6,156,390	91	654,115	6,150,552
65	638,118	6,156,671	92	653,718	6,149,738
66	638,884	6,156,320	93	654,280	6,149,247
67	639,241	6,156,706	94	654,247	6,150,108
68	638,060	6,157,008	95	653,887	6,147,211
69	635,163	6,156,152	96	653,864	6,147,510
70	635,491	6,156,697	97	653,912	6,147,888
71	635,449	6,156,374	98	653,867	6,148,186
72	635,867	6,156,842	99	654,114	6,149,534
73	646,131	6,150,401	100	657,779	6,152,902
74	646,521	6,150,162	101	657,711	6,152,609
75	645,789	6,149,787	102	657,513	6,152,339
76	646,174	6,149,496	103	657,608	6,151,700
77	645,814	6,149,346	104	657,688	6,151,403
78	644,751	6,150,491	105	657,457	6,151,129
79	644,471	6,150,212	106	657,822	6,150,824
80	644,204	6,150,650	107	650,962	6,152,365
81	643,496	6,151,799	108	651,069	6,151,739
82	643,622	6,152,119	109	650,984	6,152,044
83	653,720	6,150,014	110	653,972	6,153,876
84	653,194	6,149,608	111	652,405	6,154,318
85	653,260	6,149,921	112	653,843	6,154,217

Turbine ID	Easting	Northing	Turbine ID	Easting	Northing
114	653,391	6,154,324	132	658,027	6,149,117
115	652,514	6,153,210	133	658,117	6,149,707
116	653,431	6,154,025	134	658,264	6,149,275
117	653,839	6,151,769	135	658,102	6,148,798
118	653,821	6,152,082	136	658,275	6,150,211
119	654,059	6,153,012	137	658,094	6,148,517
120	653,830	6,152,394	138	658,049	6,148,242
121	653,872	6,152,719	139	658,435	6,147,613
122	652,364	6,153,913	140	658,581	6,147,858
123	656,466	6,152,373	141	658,136	6,147,895
124	656,362	6,152,085	142	659,406	6,147,513
125	656,577	6,151,809	143	659,500	6,147,766
126	636,929	6,157,657	144	659,241	6,146,899
127	637,065	6,157,311	145	658,870	6,146,506
128	637,560	6,157,324	146	658,957	6,147,198
129	637,674	6,157,619	147	658,828	6,147,521
130	635,896	6,156,000	148	658,963	6,146,742
131	658,270	6,149,928			

Table C2 summarises the turbine coordinates for the Conroy's Gap Wind Farm.

Table C2: Conroy's Gap Wind Farm Turbine Coordinates

Turbine ID	Easting	Northing
CG 1	657799	6146676
CG 2	657750	6146446
CG 3	657825	6146181
CG 4	658201	6146049
CG 5	658046	6145858
CG 6	658525	6145724
CG 7	658125	6145513
CG 8	658127	6145276
CG 9	658245	6145036
CG 10	658386	6144811
CG 11	657799	6143205
CG 12	657776	6142954
CG 13	657225	6142566
CG 14	657150	6142126
CG 15	658451	6140700
CG 16	658501	6140303
CG 17	658400	6140025
CG 18	658599	6139325

APPENDIX D TURBINE SOUND POWER LEVELS

Table D1 presents the measured plus uncertainty sound power levels for the V90 and MM92 turbines.

Table D1: Turbine sound power levels *

L_{AW} (dB)							
Wind speed (m/s) 10m AGL standardised	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Vesta V90	98.4	101.6	104.5	106.1	106.7	106.4	107.1
Repower MM92	-	-	103	104.1	104.2	103.5	-

**Based on measured plus uncertainty levels*

Table D2 summarises the octave band data as presented in the test reports for the V90 and MM92 turbine.

Table D2: Reference A-weighted octave band sound power levels for the candidate turbines

	Octave Band Centre Frequency (Hz)								
L_{WA} (dB)	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Overall**
Vesta V90	94.2	92.8	95.4	98.1	100.2	99.9	95.4	85.1	105.9
Repower MM92	83.2	91.4	97	98.7	96.7	91	84.3	81.1	103.1

APPENDIX E ADDITIONAL GUIDELINES

E1 Construction Noise Guidelines

E2 Construction Noise Guidelines

Construction noise guidelines were discussed in section 3.3 of the 2009 assessments.

The initial assessment was conducted in line with the Environmental Noise Control Manual (ENCM). Since the 2009 assessment, the Interim Construction Noise Guideline (CNG) was published by the DECC (July 2009).

We have provided a summary of the criterion from the two documents in this section.

Environmental Noise Control Manual (ENCM) summary

The ENCM recommends different criteria for different construction periods. While the construction duration associated with the proposed development is estimated to take 12 – 24 months in total, due to the size of the wind farm site intensive work will be located in any one location for a short period of time. Therefore we consider the criteria for between 4 and 26 weeks of construction to be appropriate for this assessment. The ENCM recommend for construction periods longer than 4 weeks and not exceeding 26 weeks, the noise emissions from construction should not exceed the RBL + 10dB L_{A10}.

Interim Construction Noise Guideline (CNG) summary

The CNG does not specify criteria for noise emissions, it instead refers to managements levels and in contrast to the ENCM, the construction period does not affect the recommended management levels.

The CNG outlines two management noise levels. Where construction occurs during the recommended standard hours (Monday to Friday 7am to 6pm and Saturday from 8am to 1pm), a receiver is considered a “noise affected” receiver where the predicted noise level is greater than RBL + 10dB L_{Aeq} and considered to be a “highly noise affected” receiver where the predicted noise level is greater than 75dB L_{Aeq}. Different management processes are recommended depending on whether a receiver is considered a “noise affected” receiver or a “highly noise affected” receiver.

Proposed criteria

The criterion recommended by the ENCM is similar to the management level for “noise affected” receivers specified in the CNG. As the CNG is the NSW current guideline and the specified noise management levels are similar to the criteria used for the 2009 assessment, we consider the CNG to be an appropriate guideline for the revised assessment.

E3 Draft NSW Guideline – Wind farms

The NSW Department of Planning and Infrastructure released the draft *NSW Planning Guidelines: Wind Farms* (the *draft NSW guidelines*) in December 2011 to enable public consultation on a proposed regulatory framework for the development of wind farms in NSW. No final guidelines have been published, however as required by the DGR, the noise assessment has taken account of the proposed noise criteria contained in the draft NSW guidelines.

Appendix B of the draft NSW guidelines outlines a proposed noise assessment methodology for wind farms. The proposed methodology includes draft noise criteria for receivers not involved with the project and details of relevant noise prediction, background monitoring and compliance monitoring requirements. The noise criteria are:

> *For a new wind farm development the predicted (L_{eq}, 10 minute), adjusted for any excessive levels of tonality, amplitude modulation or low frequency, but including all other normal wind farm characteristics, should not exceed:*
>
> > *35dB(A) or the background noise (L_{90}) by more than 5dB(A), whichever is greater, at all relevant receivers not associated with the wind farm, for wind speed from cut-in to rated power of the WTG at each integer wind speed in between. The noise criteria must be established on the basis of separate daytime (7am to 10pm) and night-time (10pm to 7am) periods.*

Appendix B of the draft NSW guidelines also provides a discussion of the basis for these criteria and notes the following:

> *To ensure that the amenity of an area is not compromised, criteria have been set to restrict noise generated by wind turbines to 5dB(A) below the lowest acceptable noise criteria for a suburban or rural amenity (which is 40dB(A) at night) unless the area experiences background noise levels higher than the average 30dB(A) in which case the noise criteria can be up to 5dB(A) above the L90 background noise level. These criteria apply to all periods of the day regardless of whether the acceptable amenity is higher during the day or night.*

Importantly, the minimum noise limit derived according to the proposed criteria in the draft NSW guidelines is 35dB L_{Aeq} irrespective of the measured background noise level.

The draft NSW guidelines refer to negotiated agreements between wind farm proponents and owners of private land suitable for hosting wind turbines. In this context, the draft NSW guidelines specifically clarify that the proposed criteria are intended to minimise the impact on the amenity on neighbouring that do not have an agreement with the wind farm proponent. Whilst the draft NSW guidelines do not specifically define criteria applicable to involved land owners, it is implicit from this advice that the draft criteria provided for non-involved receivers should not be applied to involved receivers.

The draft NSW guidelines note that the proposed criteria for A-weighted noise levels have been specifically developed in recognition of the fundamental characteristics of the noise associated with a correctly functioning wind farm. In instances where the noise of a wind farm contains excessive levels of specific noise characteristics, the draft NSW guidelines propose relevant procedures in the section titled *Data analysis* within Appendix B.

Importantly, the procedures documented for these characteristics are documented as data analysis requirements which implicitly relate to post-construction compliance studies. However, Section 1.3(a) of the draft NSW guidelines detail planning assessment requirements for specific situations where a wind farm proposal seeks to place turbines within 2km of existing residences. In these instances, the draft NSW guidelines indicate that the application should include the following where written consent has not been obtained from residences with 2km:

> *predicted levels of noise at any houses within the 2km zone (including low frequency noise)*

Section 1.3(a) of the draft NSW guidelines does not detail specific information requirements for low frequency noise. However, the proposed data analysis procedures of Appendix B suggest a threshold for external noise levels to trigger a detailed assessment of low frequency noise, stating the following:

> *If it is shown that the C-weighted noise (measured from 20Hz upwards) from a wind farm (excluding any wind induced or extraneous C-weighted noise) is repeatedly greater than 65dB(C) during the daytime or 60dB(C) during the night-time a more detailed low frequency noise assessment should be undertaken.*

Whilst the proposed trigger for detailed low frequency noise assessments is stated to apply to the measured noise levels of an operational wind farm, the proposed draft criteria provide a guide to the type of information required in specific situations where a proposed wind farm includes turbine positions within 2km of dwellings.

Preliminary low frequency noise predictions have been conducted and the results are summarised in Appendix I.

The draft NSW guidelines do permit the use of the L_{A90} parameter for compliance measurements, but importantly, specifies that an addition of 1.5dB must be applied to these values to yield an equivalent noise level L_{Aeq} (effectively a form of average noise level) for comparison with the noise criteria.

APPENDIX F ASSESSMENT METHODOLOGY DISCUSSION

Noise levels from the proposed Yass Valley Wind Farm have been predicted using the implementation of ISO9613-2:1996 with SoundPLAN version 7.2.

The international standard ISO 9613 *Acoustics – Attenuation of sound during propagation outdoors* has been chosen as the most appropriate method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. This method is considered to be the most robust and widely used international method for the prediction of wind farm noise.

The use of this standard is supported by international research publications, measurement studies conducted by Marshall Day Acoustics and direct reference to the standard in the South Australian Environment Protection Authority 2009 wind farm noise guidelines, draft NSW Guidelines, AS4959:2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators* and NZS6808:2010 *Acoustics – Wind farm noise*.

The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1m/s and 5m/s, measured at a height of 3m to 11m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. In this respect, it is noted that at the wind speeds relevant to noise emissions from wind turbines, atmospheric conditions do not favour the development of thermal inversions throughout the propagation path from the source to the receiver.

To calculate far-field noise levels according to the ISO 9613, the noise emissions of each turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- Geometric divergence
- Air absorption
- Reflecting obstacles
- Screening
- Vegetation
- Ground reflections

The octave band attenuation factors are then applied to the noise emission data to determine the corresponding octave band and total calculated noise level at receiver locations.

Calculating the attenuation factors for each effect requires a relevant description of the environment into which the sound propagation such as the physical dimensions of the environment, atmospheric conditions and the characteristics of the ground between the source and the receiver.

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613 when a certain set of input parameters are chosen in combination. Specifically, the studies to date tend to support that the assignment of a ground absorption factor of G=0.5 for the source, middle and receiver ground regions between a wind farm and a calculation point tends to provide a reliable representation of the upper noise levels expected in practice, when modelled in combination with other key assumptions; specifically all turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 degrees and relative humidity of 70% to 80%, with specific adjustments for screening and ground effects as a result of the ground terrain profile.

In support of the use of ISO 9613 and the choice of G=0.5 as an appropriate ground characterisation, the following references are noted:

- A factor of G=0.5 is frequently applied in Australia for general environmental noise modelling purposes as a way of accounting for the potential mix of ground porosity which may occur in regions of dry/compacted soils or in regions where persistent damp conditions may be relevant
- NZS6808:2010 refers to ISO 9613 as an appropriate prediction methodology for wind farm noise, and notes that soft ground conditions should be characterised by a ground factor of G=0.5
- A range of comparative measurement and prediction studies[2, 3, 4] for wind farms in which Marshall Day Acoustics' staff have been involved in have provided further support for the use of ISO 9613 and G=0.5 as an appropriate representation of typical upper noise levels expected to occur in practice.

The key findings of these studies demonstrated the suitability of the ISO 9613 method to predict the propagation of wind turbine noise for:

- the types of noise source heights associated with a modern wind farm, extending the scope of application of the method beyond the 30m maximum source heights considered in the original ISO 9613;
- the types of environments in which wind farms are typically developed, and the range of atmospheric conditions and wind speeds typically observed around wind farm sites. Importantly, this supports the extended scope of application to wind speeds in excess of 5m/s.

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[2] Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions: The Risks of Conservatism*; Presented at the Second International Meeting on Wind Turbine Noise in Lyon, France September 2007

[3] Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions and Comparisons with Measurements*; Presented at the Third International Meeting on Wind Turbine Noise in Aalborg, Denmark June 2009

[4] Delaire, Griffin, & Walsh – *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*; Presented at the Fourth International Meeting on Wind Turbine Noise in Rome, April 2011

In addition to the choice of ground absorption factor referred to above, the ISO 9613 standard has also been used with due regard to the recommended adjustments for terrain presented in the Joule Report. The following adjustments have been made:

- In instances where the ground terrain provides marginal or partial acoustic screening, the barrier effect should be limited to not more than 2dB
- Barrier attenuation calculated based on the screening expected for the source located at the tip height of the turbine
- In instances where the ground falls away significantly between the source and receiver, such as valleys, an adjustment of 3dB should be added to the calculated sound pressure level. A terrain profile in which the ground falls away significantly is defined as one where the mean sound propagation height is at least 50% greater than would occur over flat ground

These methodologies are also supported by the UK Institute of Acoustics document *A Good Practice Guide to the application of ESTU-R-97 for the Assessment and Rating of Wind Turbine Noise.*

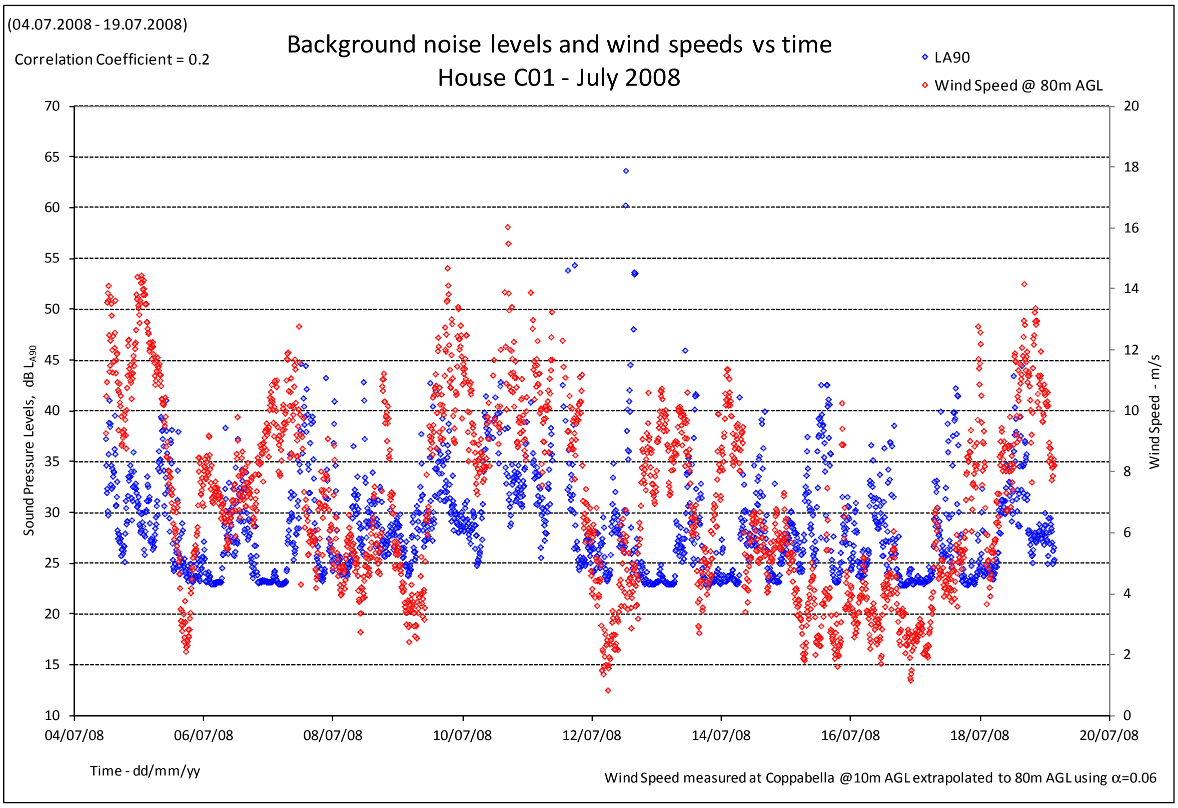
APPENDIX G 24HR NOISE CRITERIA REFERENCED TO HUB HEIGHT WIND SPEEDS

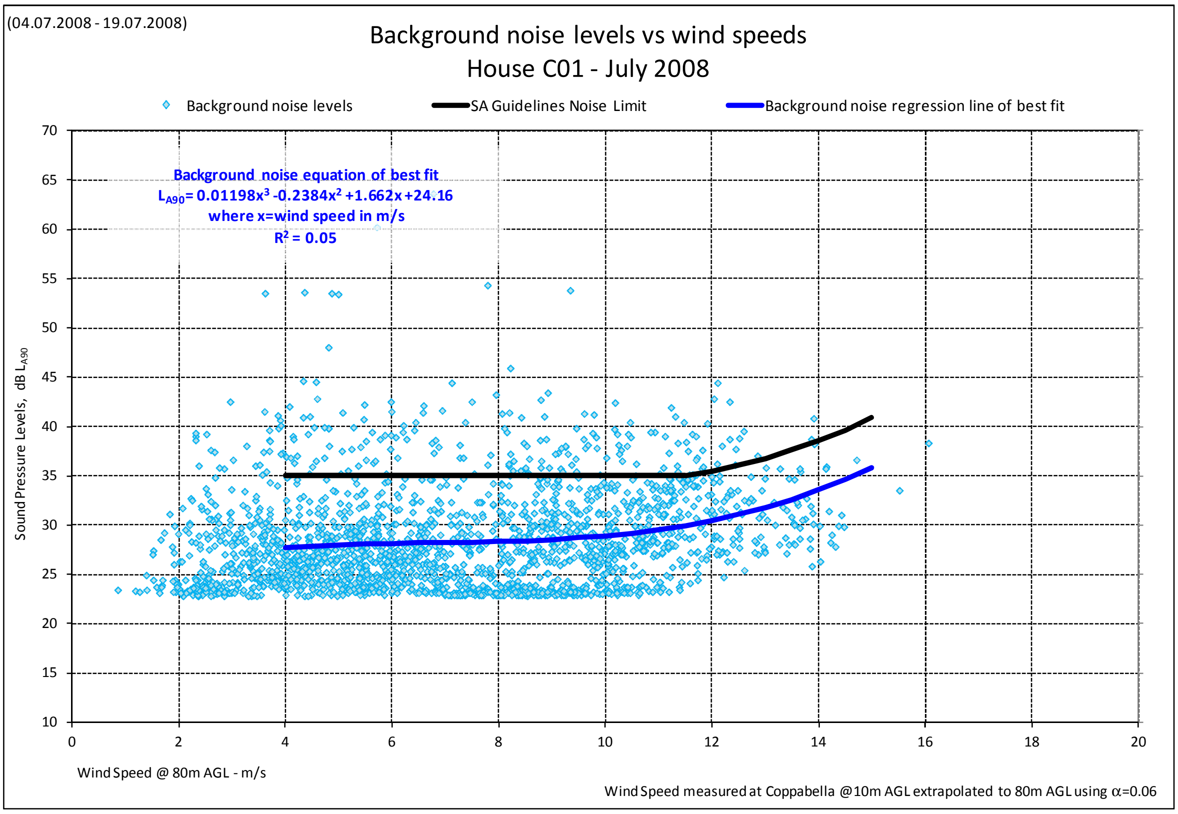
G1 Noise criteria from 2009 noise monitoring

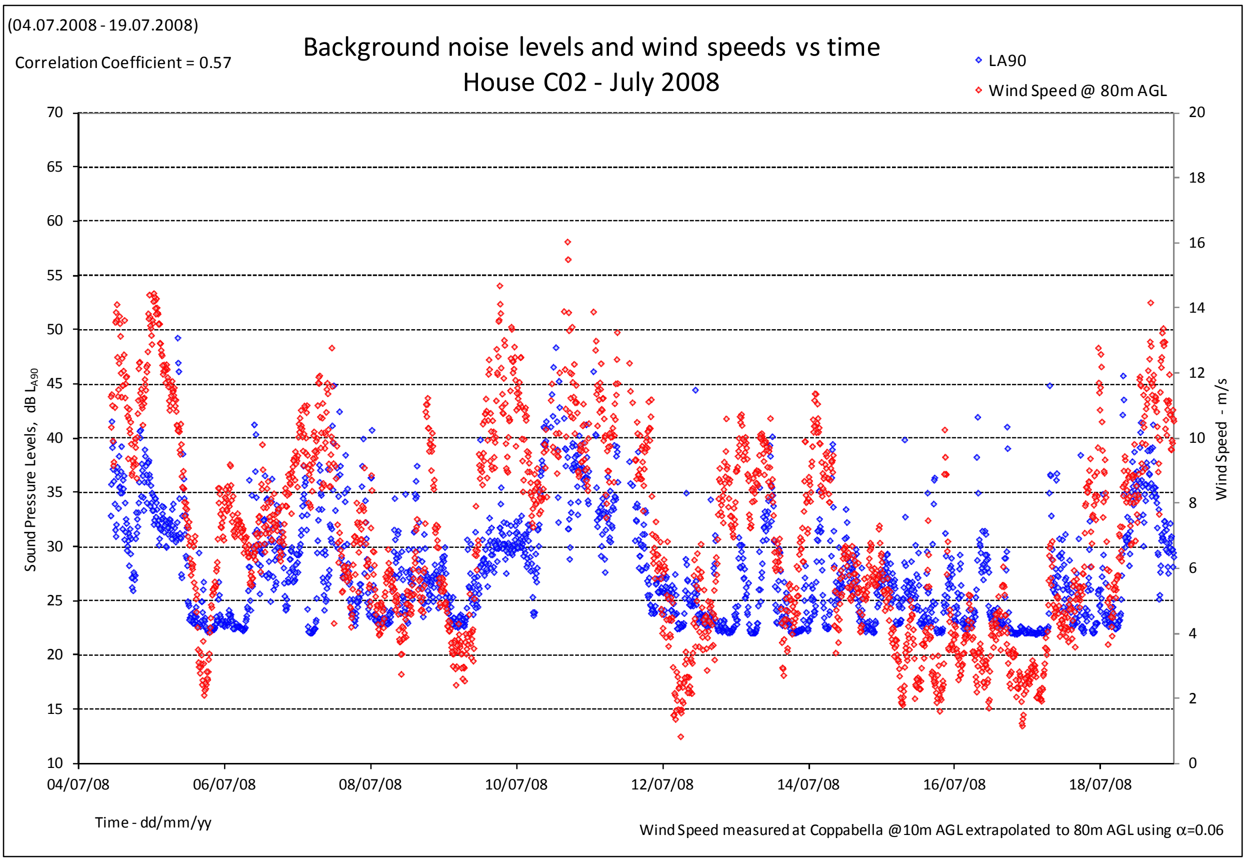
For the 2009 assessment, background noise data was referenced to 10m AGL wind speeds. For the 2013 assessment, the measured background noise levels from the 2009 monitoring have been re-referenced to hub height wind speeds and regression trends have been reassessed.

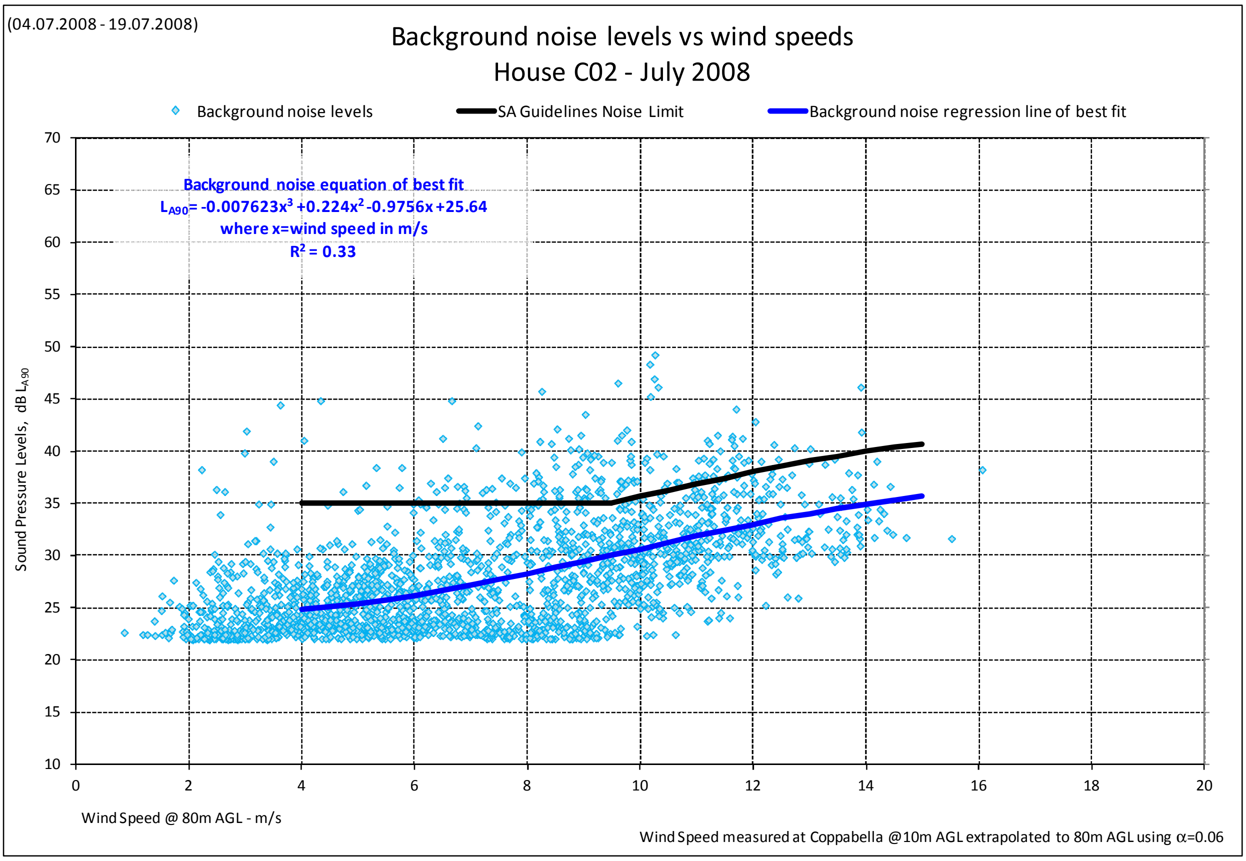
As a result of this revised analysis, the correlation coefficients and regression curves for each monitoring location have been recalculated. In general, the correlation coefficient for the data sets has decreased since the 2009 assessment. A decrease in correlation coefficients is not unusual when changing the wind speed reference height from 10m AGL to hub height AGL.

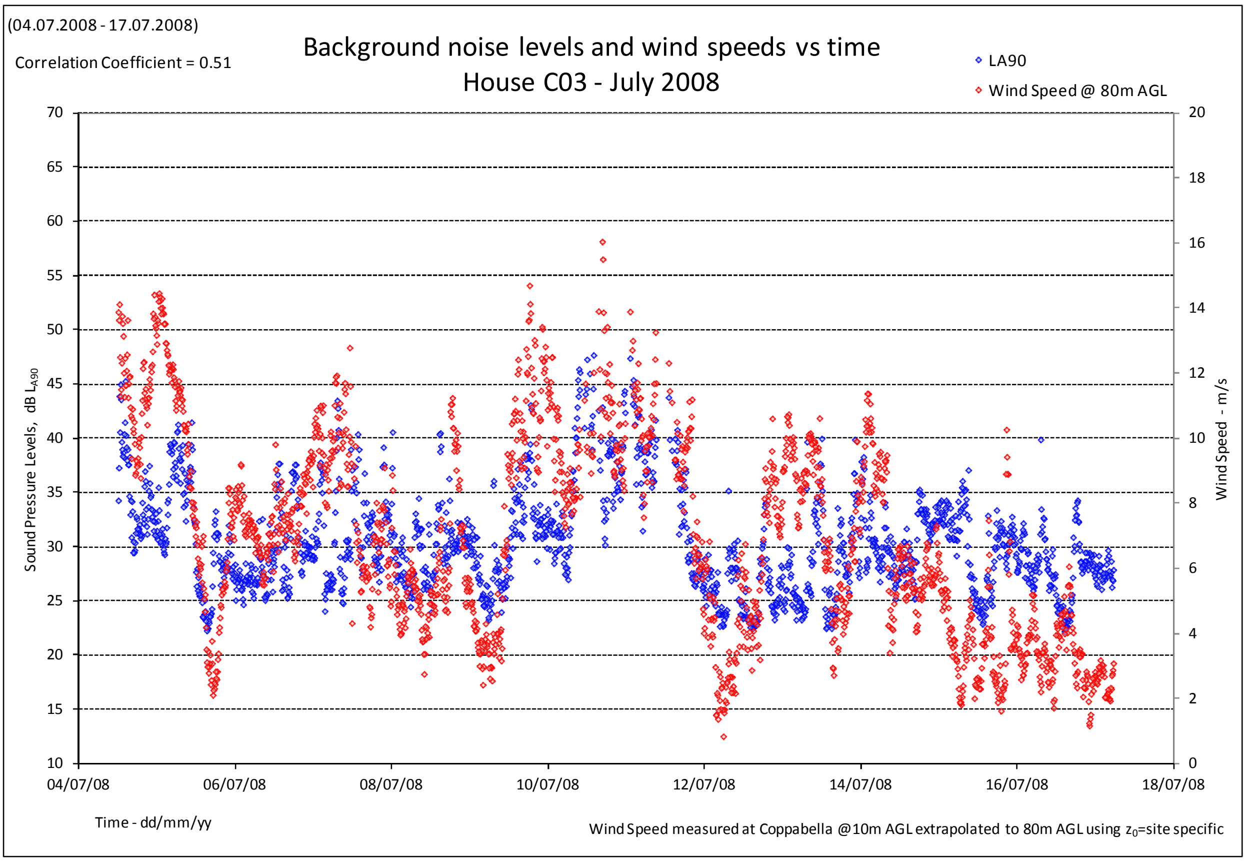
As noted above the SA Guidelines 2003 require that where the local wind speed at the monitoring site was greater than 5m/s and/or rainfall occurred the associated measured noise levels must be excluded from the analysis. The revised analysis has identified additional periods at some monitoring locations which have been removed due to likely rain or local wind speed effects. Removing these data points has also had a minor effect on the correlation coefficients for some data sets.


(04.07.2008 - 19.07.2008)
Correlation Coefficient = 0.2
Background noise levels and wind speeds vs time
House C01 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
04/07/08
06/07/08
08/07/08
10/07/08
12/07/08
14/07/08
16/07/08
18/07/08
20/07/08
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

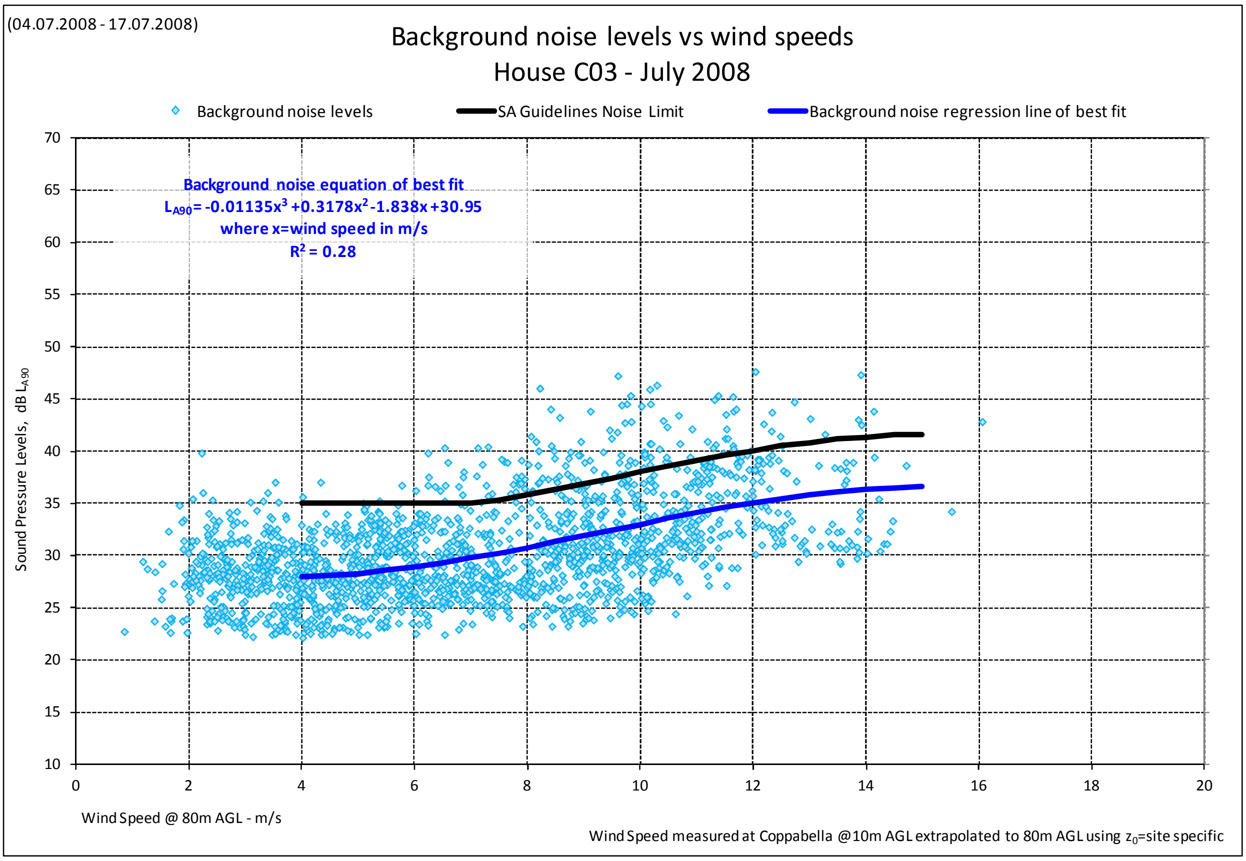

(04.07.2008 - 19.07.2008)
Background noise levels vs wind speeds
House C01 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.01198x³ -0.2384x² +1.662x +24.16
where x=wind speed in m/s
R^2 = 0.05
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06


(04.07.2008 - 19.07.2008)
Correlation Coefficient = 0.57
Background noise levels and wind speeds vs time
House C02 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
04/07/08
06/07/08
08/07/08
10/07/08
12/07/08
14/07/08
16/07/08
18/07/08
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

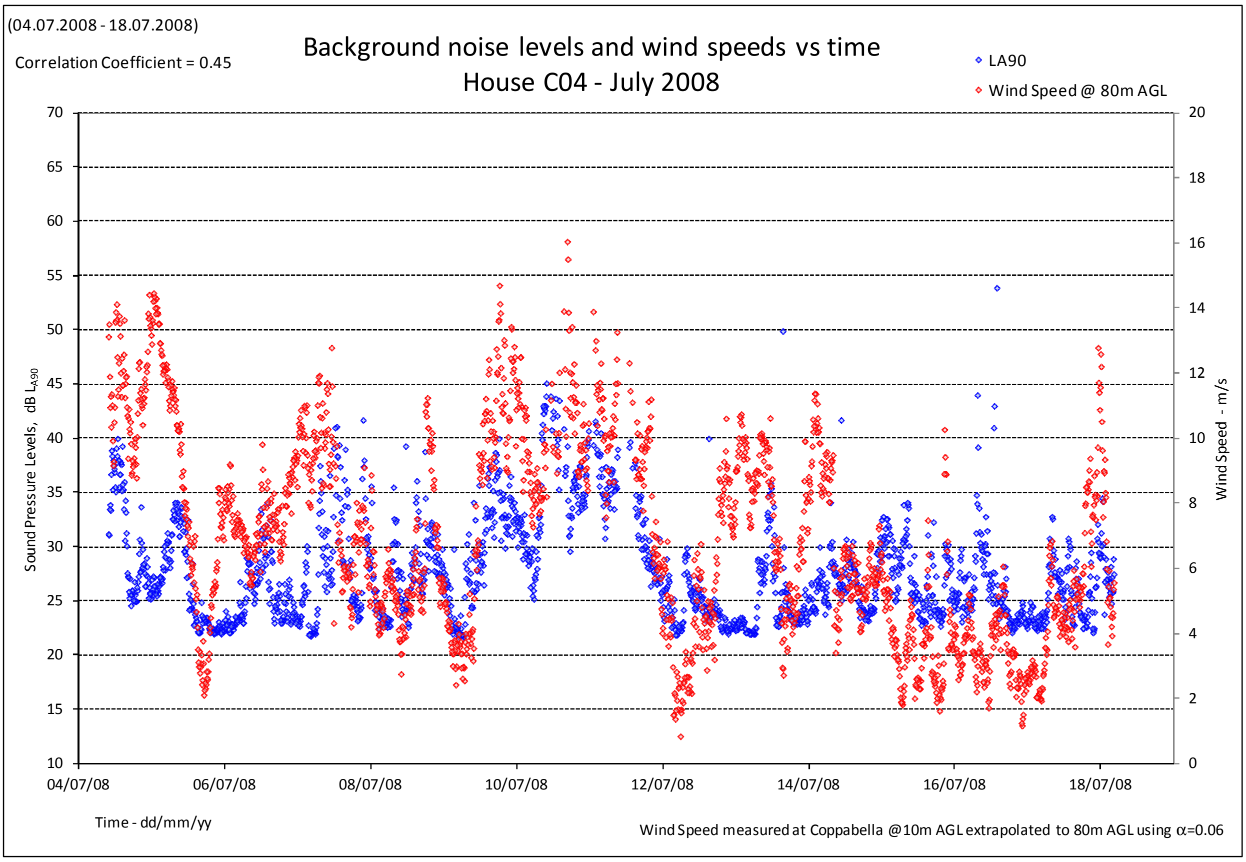

(04.07.2008 - 19.07.2008)
Background noise levels vs wind speeds
House C02 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.007623x^3 +0.224x^2 -0.9756x +25.64
where x=wind speed in m/s
R^2 = 0.33
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06



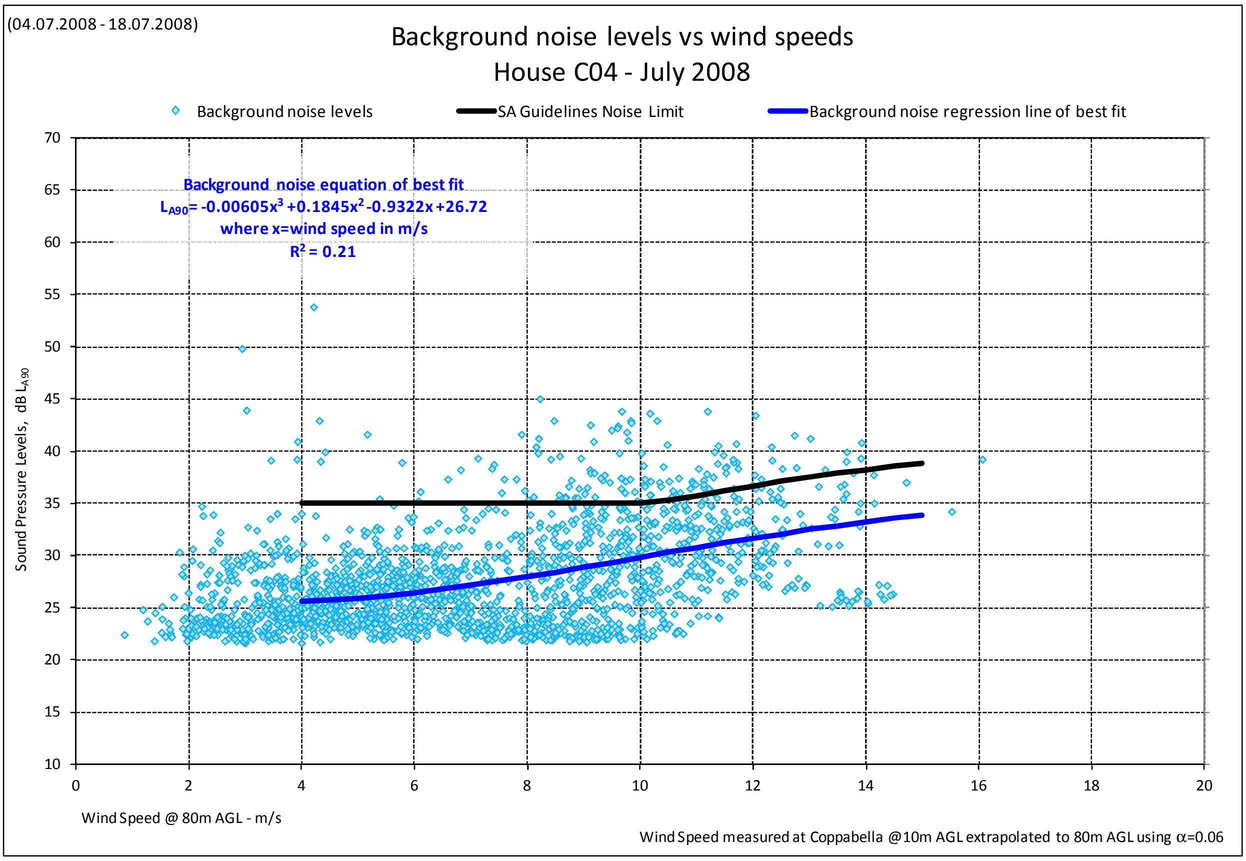
(04.07.2008 - 17.07.2008)
Correlation Coefficient = 0.51
Background noise levels and wind speeds vs time
House C03 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
04/07/08
06/07/08
08/07/08
10/07/08
12/07/08
14/07/08
16/07/08
18/07/08
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using z_0=site specific



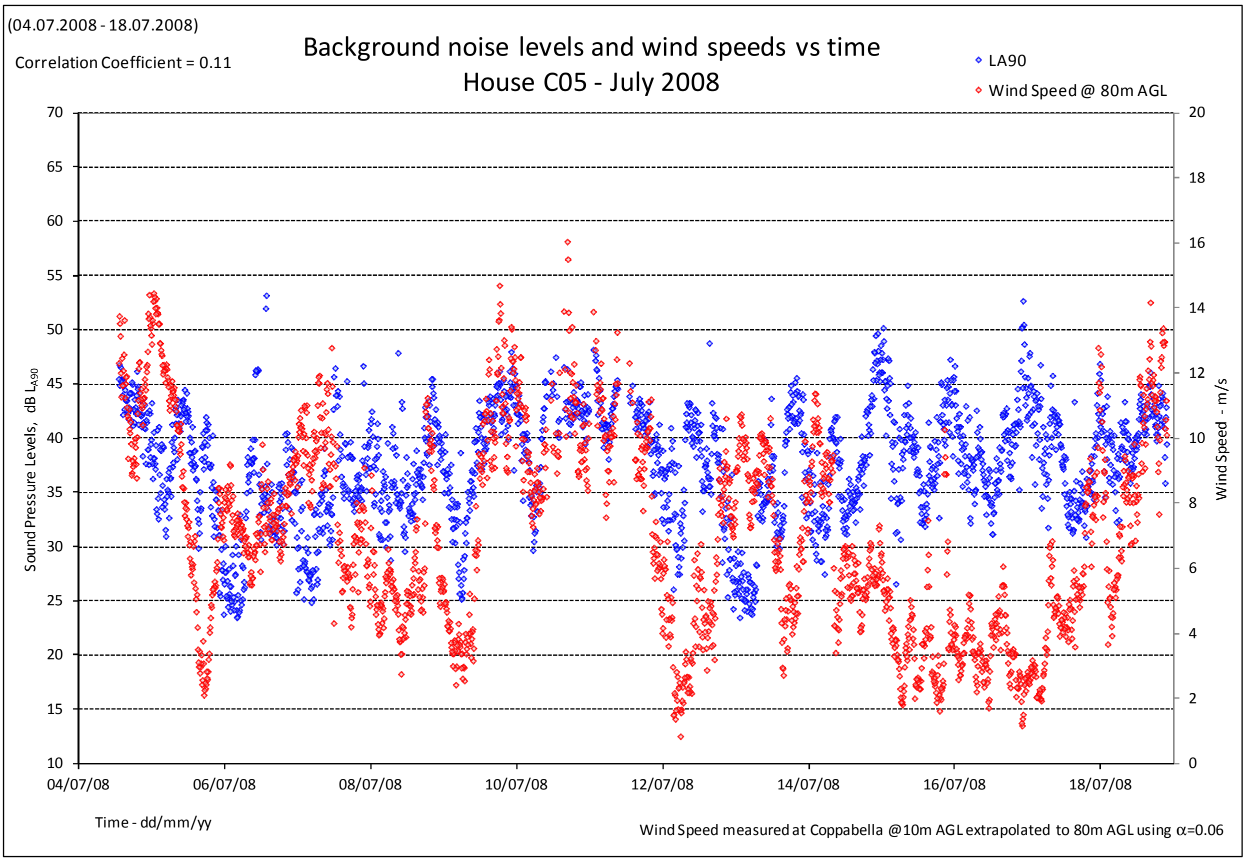
(04.07.2008 - 17.07.2008)
Background noise levels vs wind speeds
House C03 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.01135x^3 +0.3178x^2-1.838x+30.95
where x=wind speed in m/s
R^2 = 0.28
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using z_0=site specific

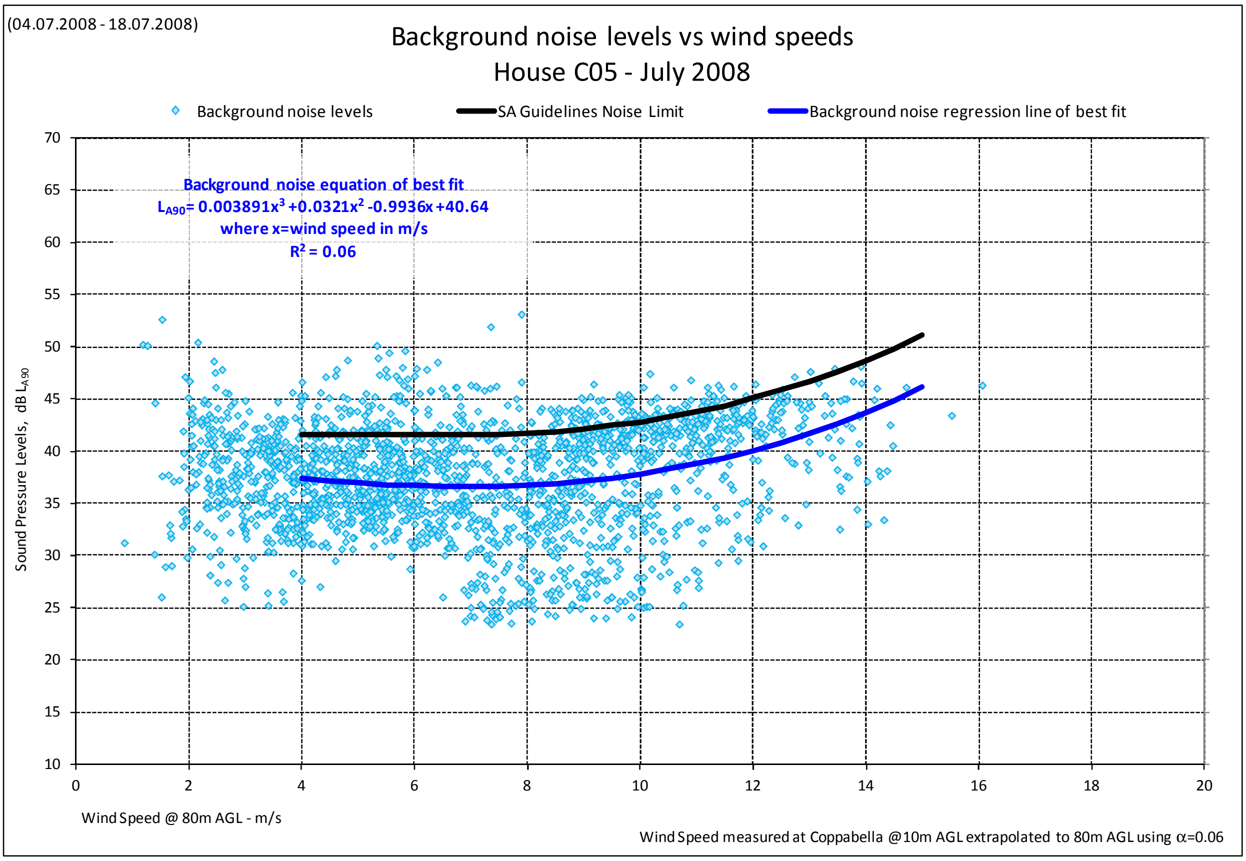


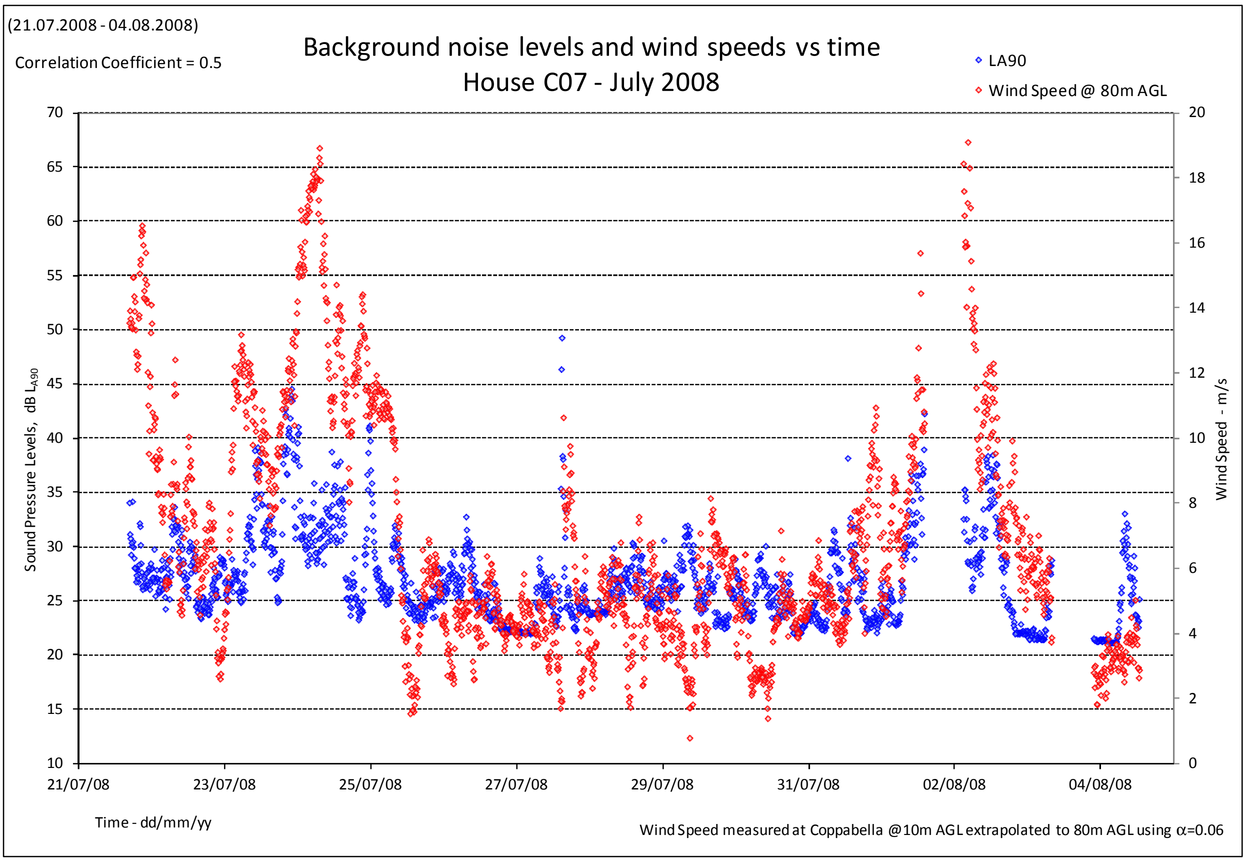
(04.07.2008 - 18.07.2008)
Correlation Coefficient = 0.45
Background noise levels and wind speeds vs time
House C04 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB LA90
Wind Speed - m/s
04/07/08
06/07/08
08/07/08
10/07/08
12/07/08
14/07/08
16/07/08
18/07/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

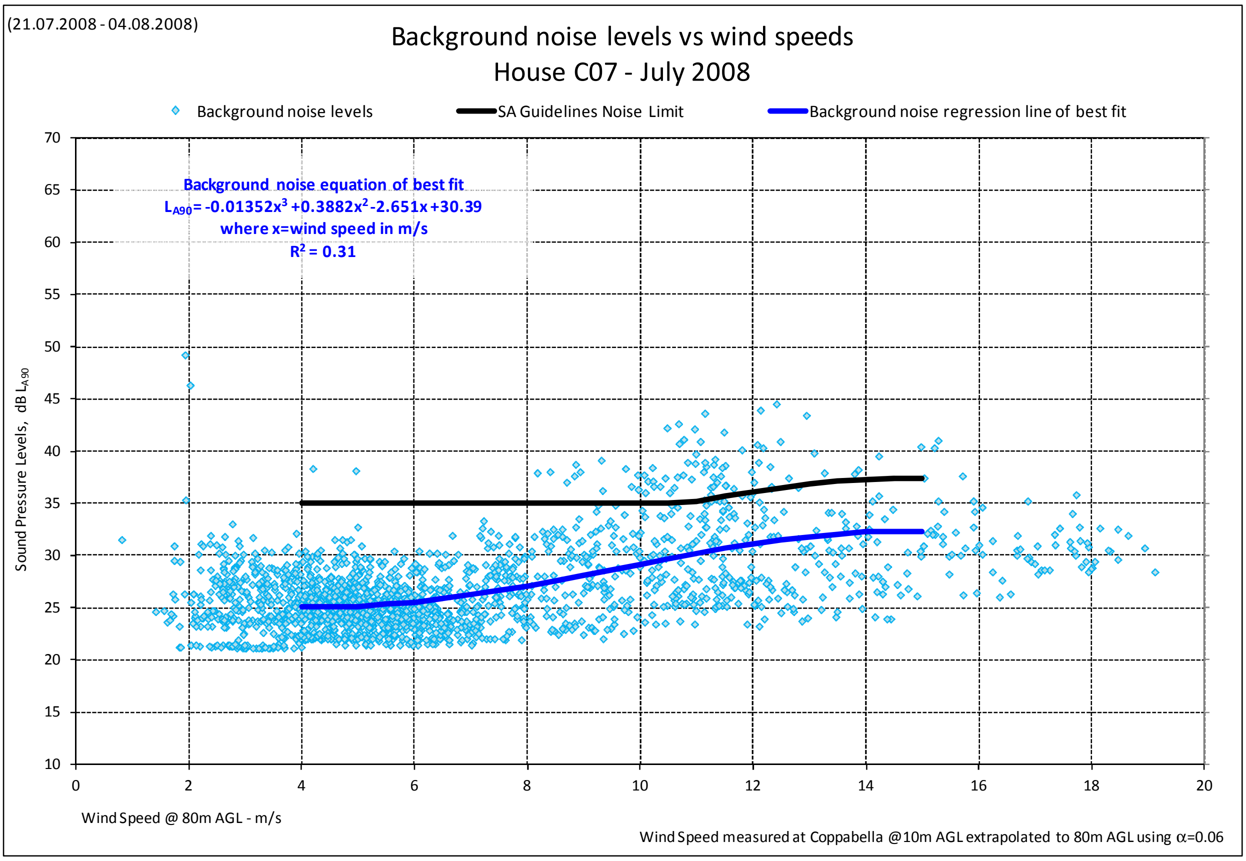


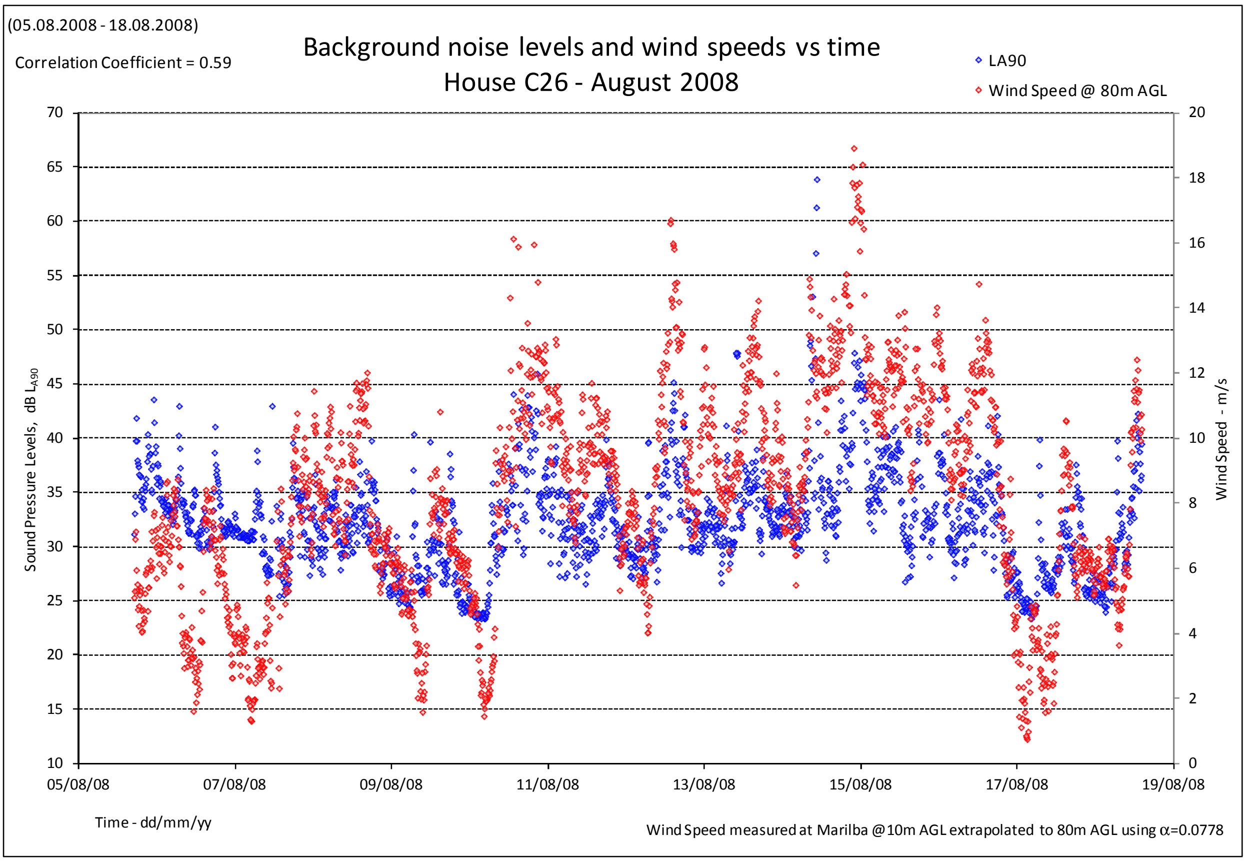
(04.07.2008 - 18.07.2008)
Background noise levels vs wind speeds
House C04 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
LA90= -0.00605x3 +0.1845x2 -0.9322x +26.72
where x=wind speed in m/s
R2 = 0.21
Sound Pressure Levels, dB LA90
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

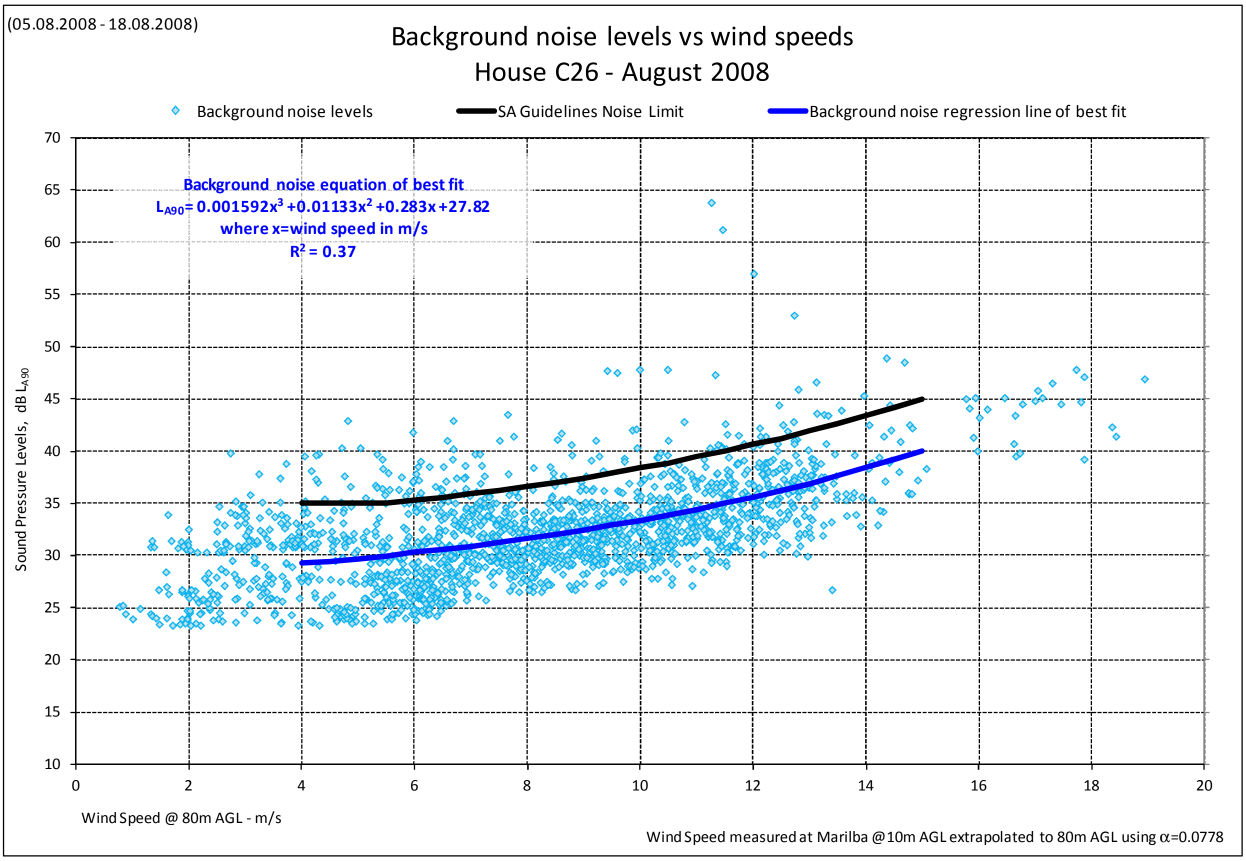

(04.07.2008 - 18.07.2008)
Correlation Coefficient = 0.11
Background noise levels and wind speeds vs time
House C05 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
70
65
60
55
50
45
40
35
30
25
20
15
10
20
18
16
14
12
10
8
6
4
2
0
04/07/08
06/07/08
08/07/08
10/07/08
12/07/08
14/07/08
16/07/08
18/07/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

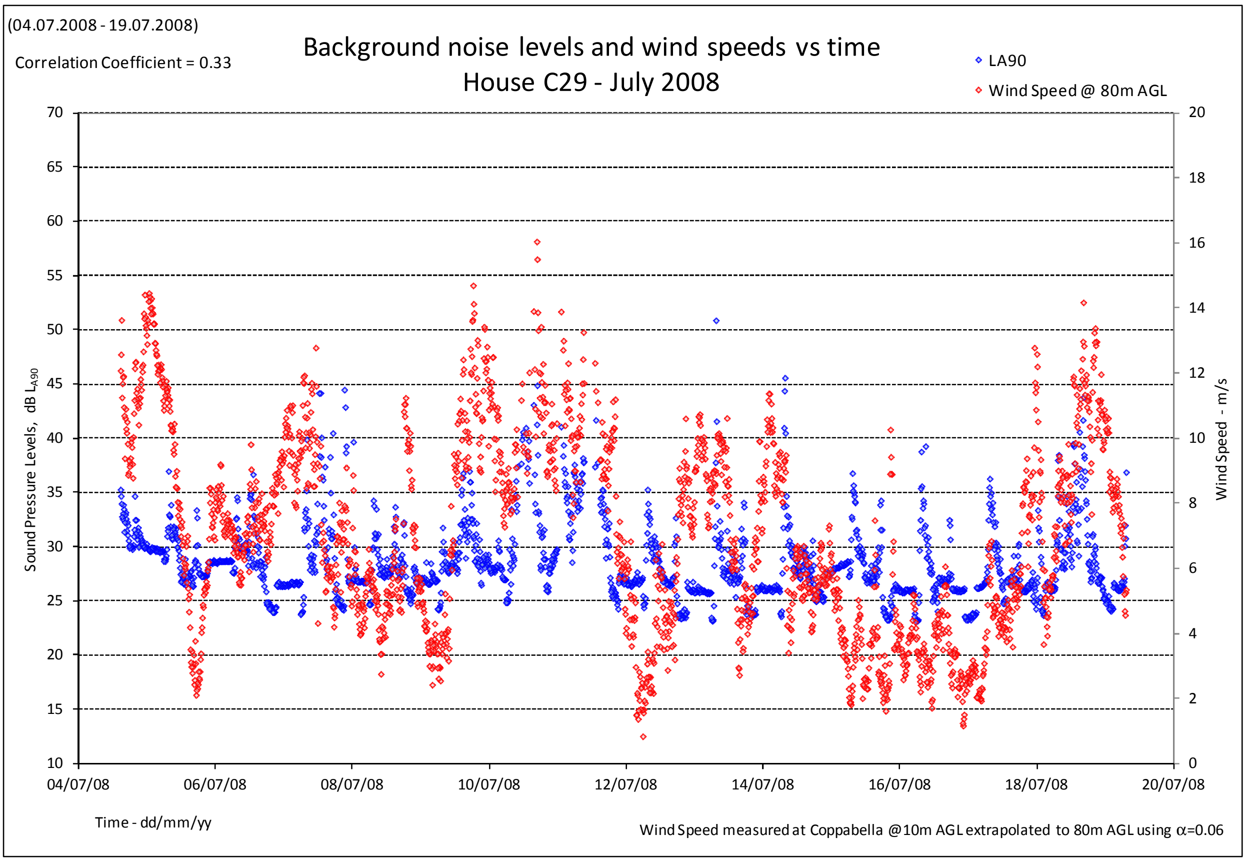

(04.07.2008 - 18.07.2008)
Background noise levels vs wind speeds
House C05 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.003891x³ +0.0321x² -0.9936x +40.64
where x=wind speed in m/s
R² = 0.06
Sound Pressure Levels, dB L_{A90}
70
65
60
55
50
45
40
35
30
25
20
15
10
0
2
4
6
8
10
12
14
16
18
20
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

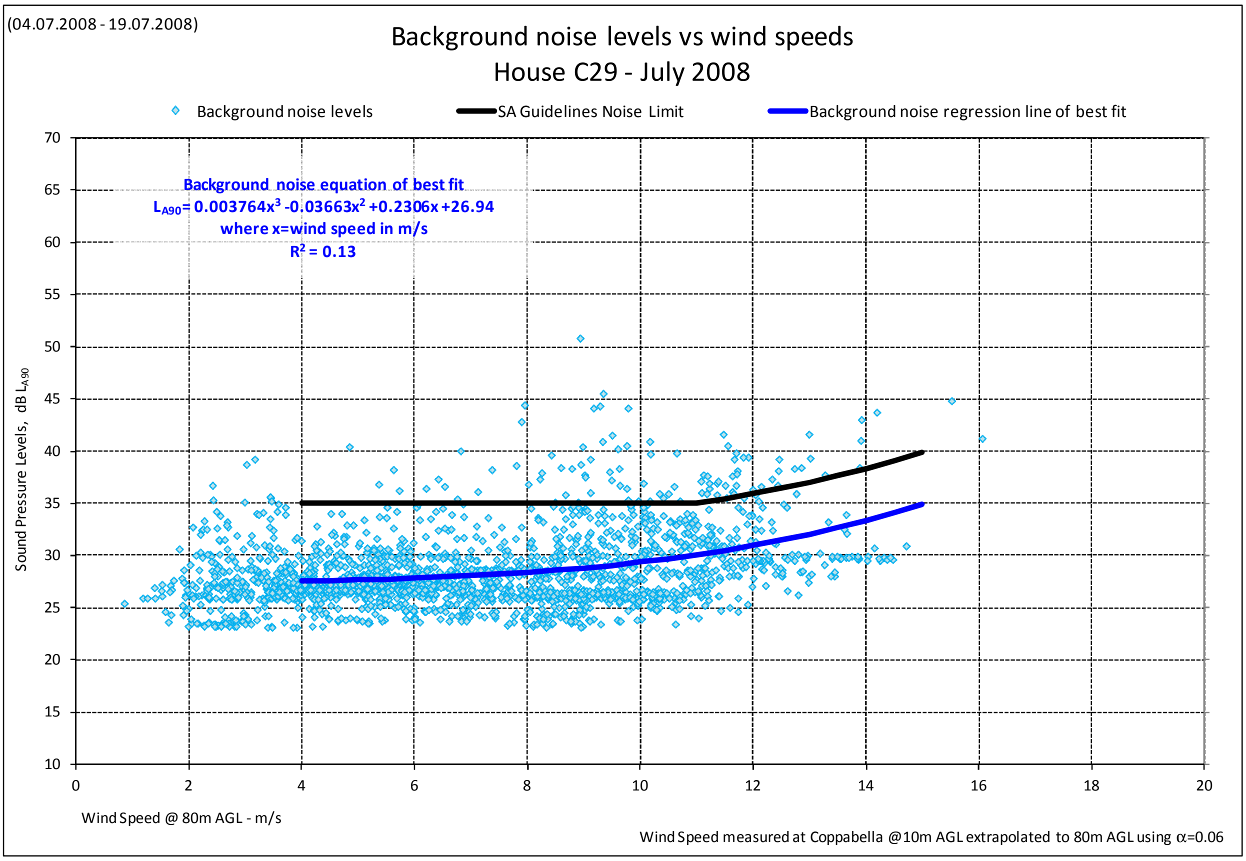

(21.07.2008 - 04.08.2008)
Correlation Coefficient = 0.5
Background noise levels and wind speeds vs time
House C07 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
21/07/08
23/07/08
25/07/08
27/07/08
29/07/08
31/07/08
02/08/08
04/08/08
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

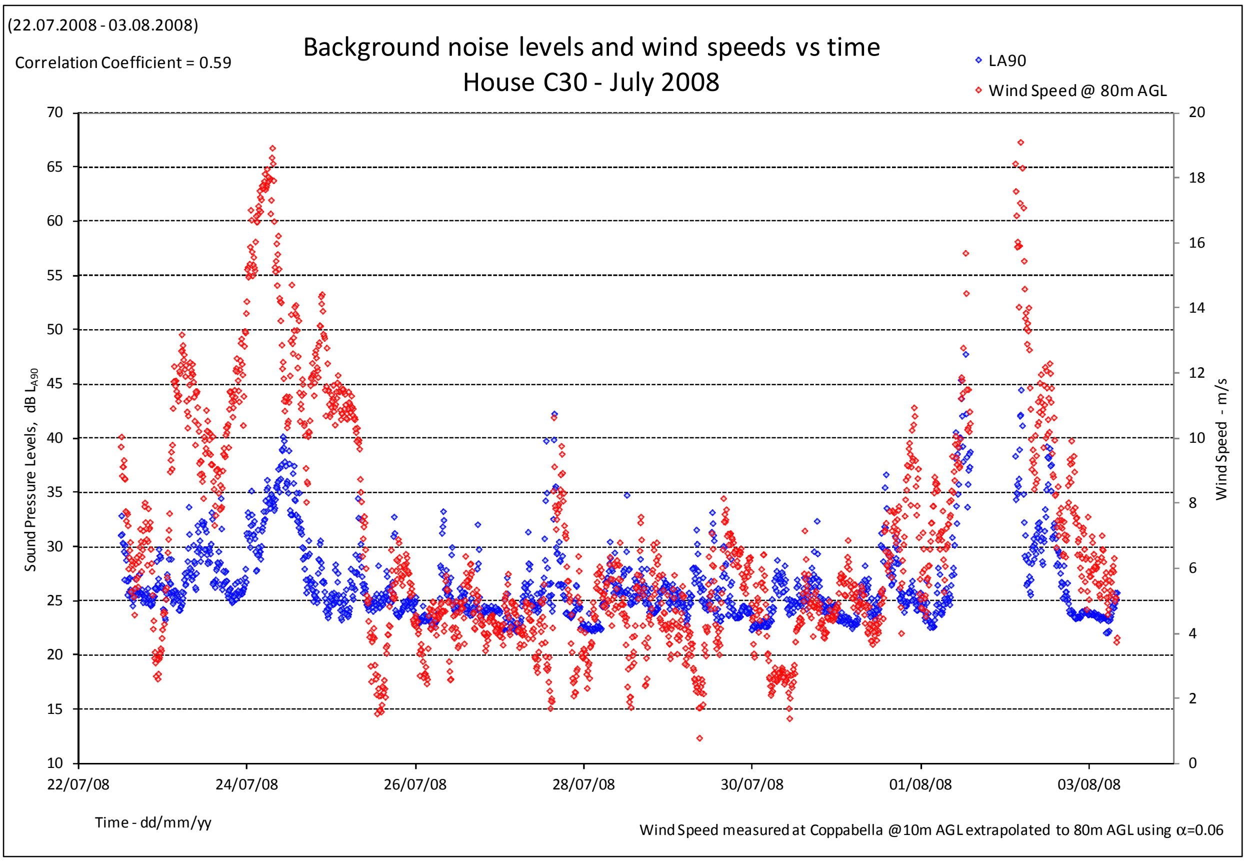

(21.07.2008 - 04.08.2008)
Background noise levels vs wind speeds
House C07 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.01352x³ +0.3882x² -2.651x +30.39
where x=wind speed in m/s
R^2 = 0.31
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06


(05.08.2008 - 18.08.2008)
Correlation Coefficient = 0.59
Background noise levels and wind speeds vs time
House C26 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
05/08/08
07/08/08
09/08/08
11/08/08
13/08/08
15/08/08
17/08/08
19/08/08
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

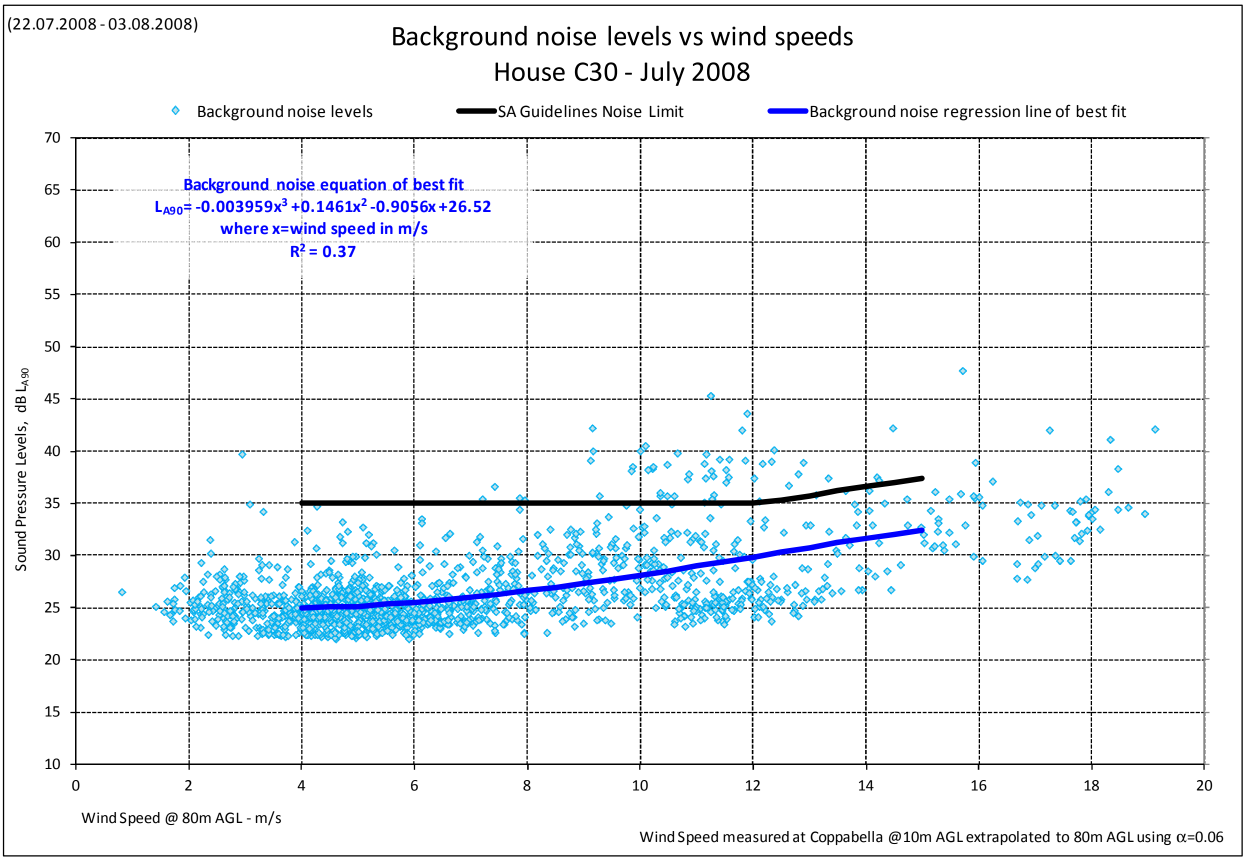

(05.08.2008 - 18.08.2008)
Background noise levels vs wind speeds
House C26 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.001592x³ +0.01133x² +0.283x +27.82
where x=wind speed in m/s
R² = 0.37
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778


(04.07.2008 - 19.07.2008)
Correlation Coefficient = 0.33
Background noise levels and wind speeds vs time
House C29 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
04/07/08
06/07/08
08/07/08
10/07/08
12/07/08
14/07/08
16/07/08
18/07/08
20/07/08
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

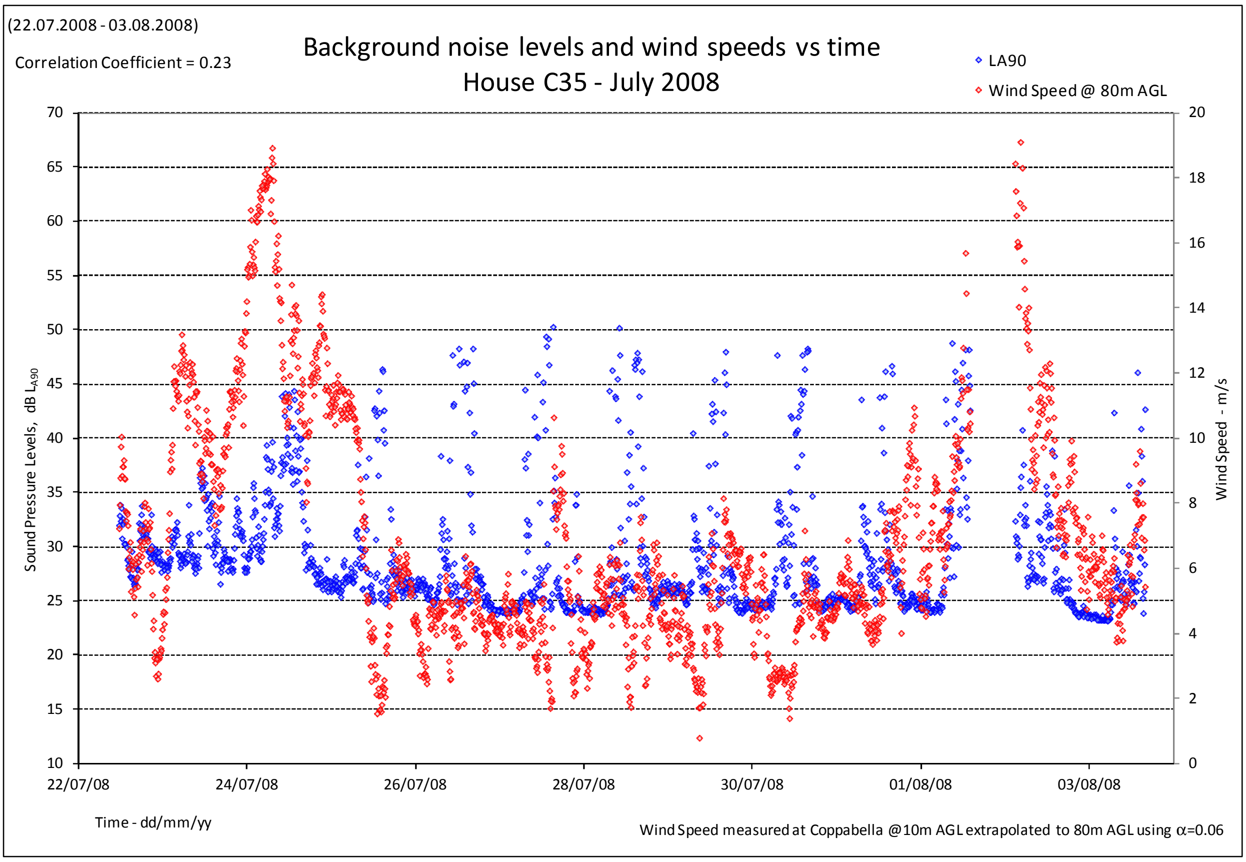

(04.07.2008 - 19.07.2008)
Background noise levels vs wind speeds
House C29 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.003764x³ -0.03663x² +0.2306x +26.94
where x=wind speed in m/s
R² = 0.13
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

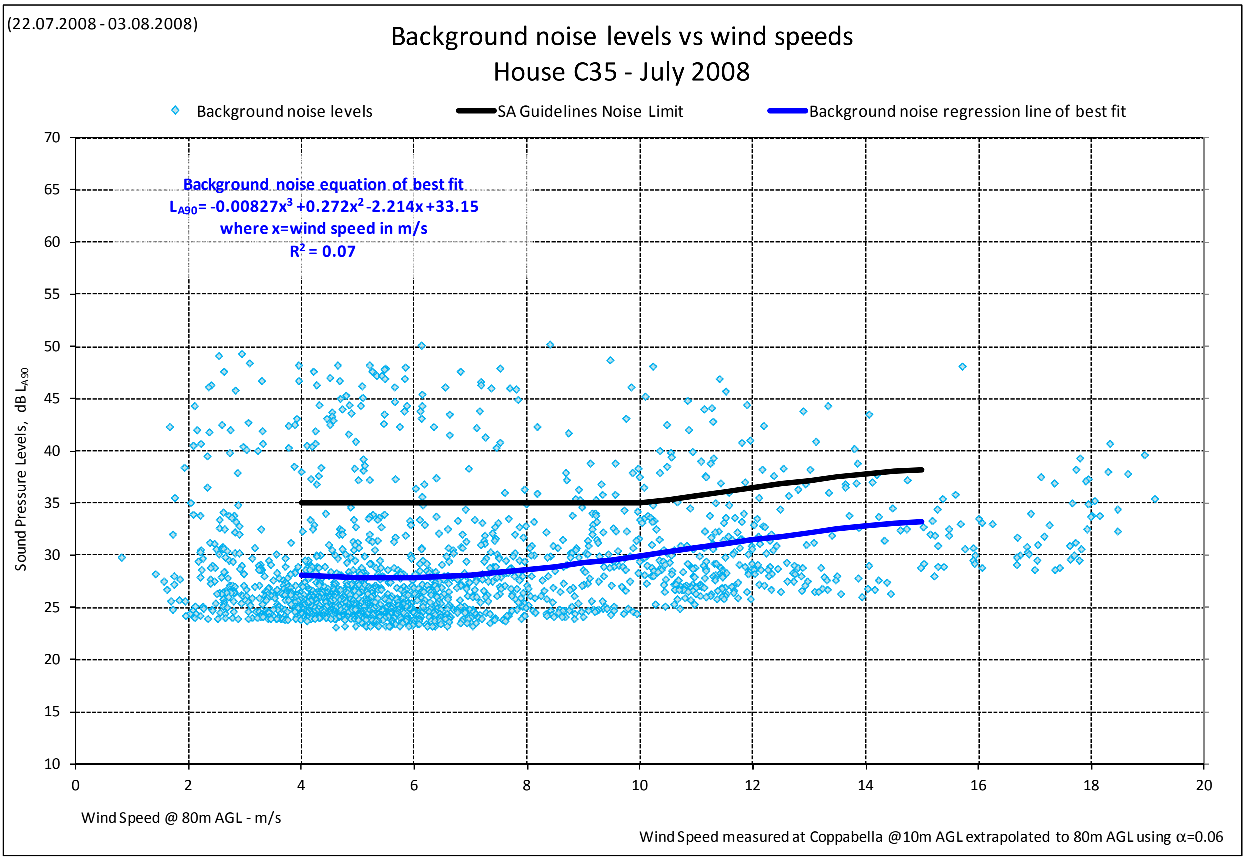


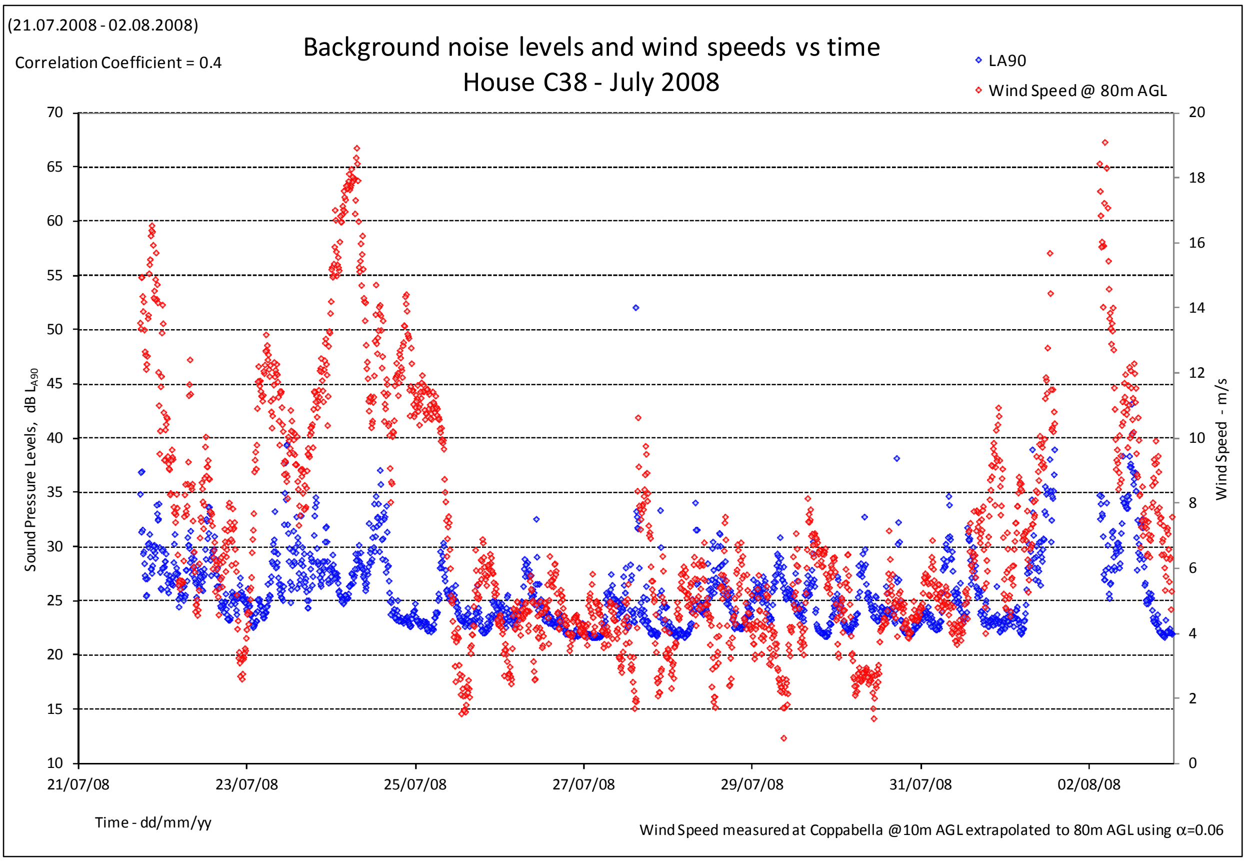
(22.07.2008 - 03.08.2008)
Correlation Coefficient = 0.59
Background noise levels and wind speeds vs time
House C30 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
22/07/08
24/07/08
26/07/08
28/07/08
30/07/08
01/08/08
03/08/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

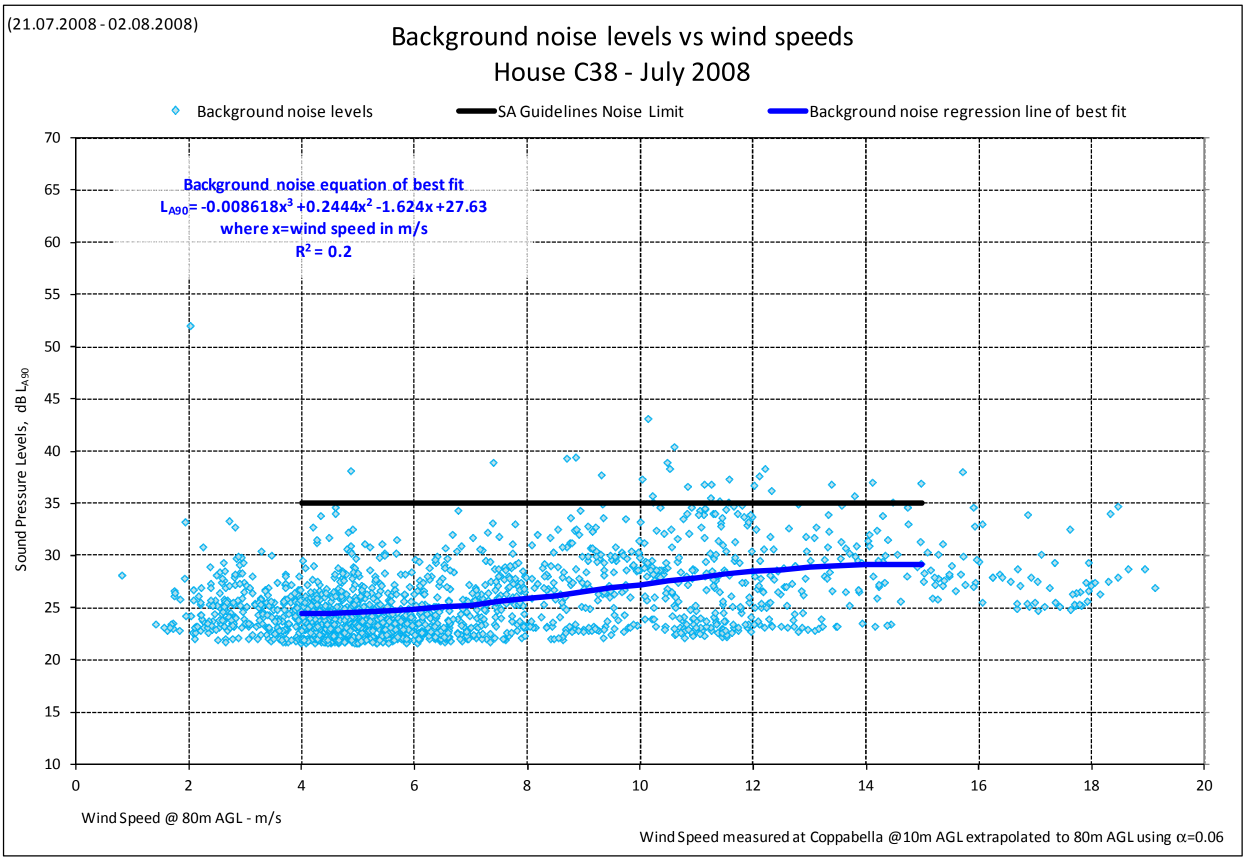


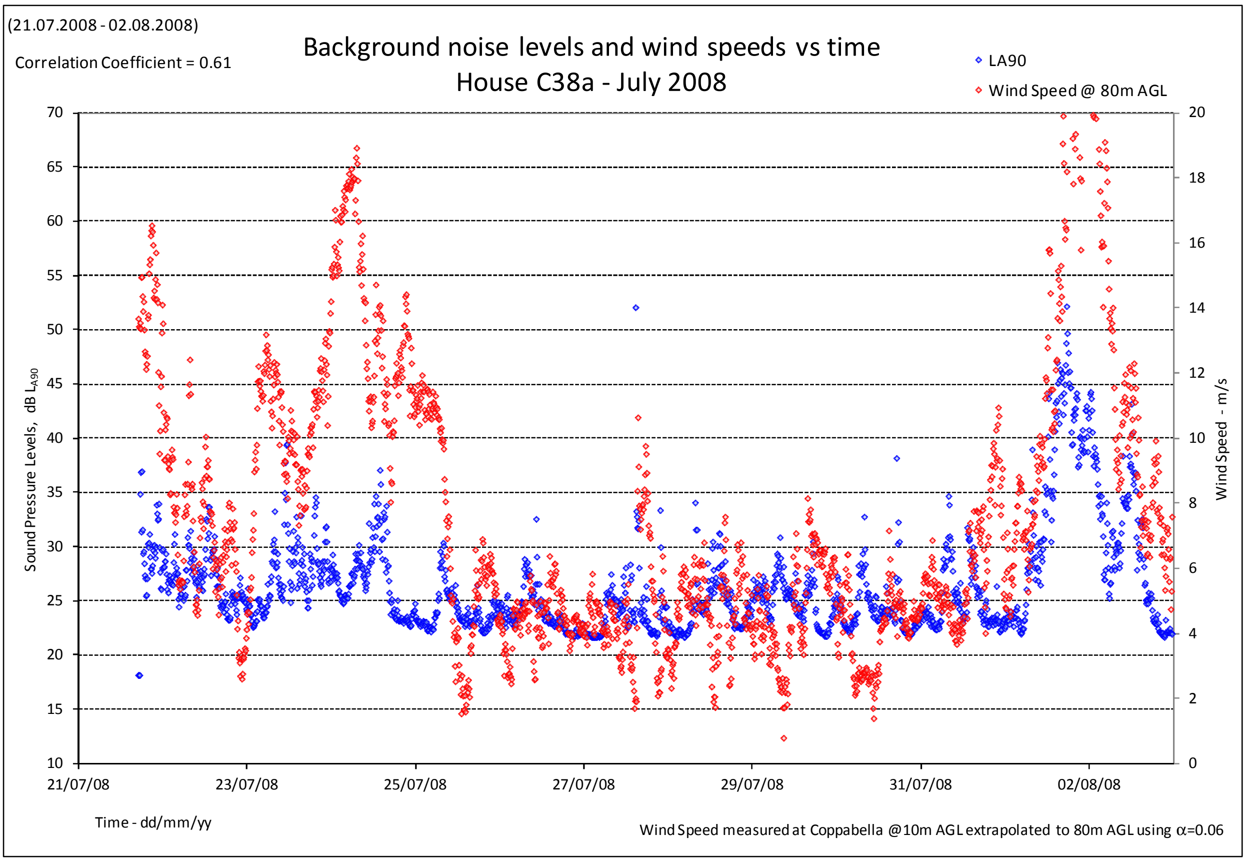
(22.07.2008 - 03.08.2008)
Background noise levels vs wind speeds
House C30 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.003959x^3 +0.1461x^2 -0.9056x +26.52
where x=wind speed in m/s
R^2 = 0.37
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

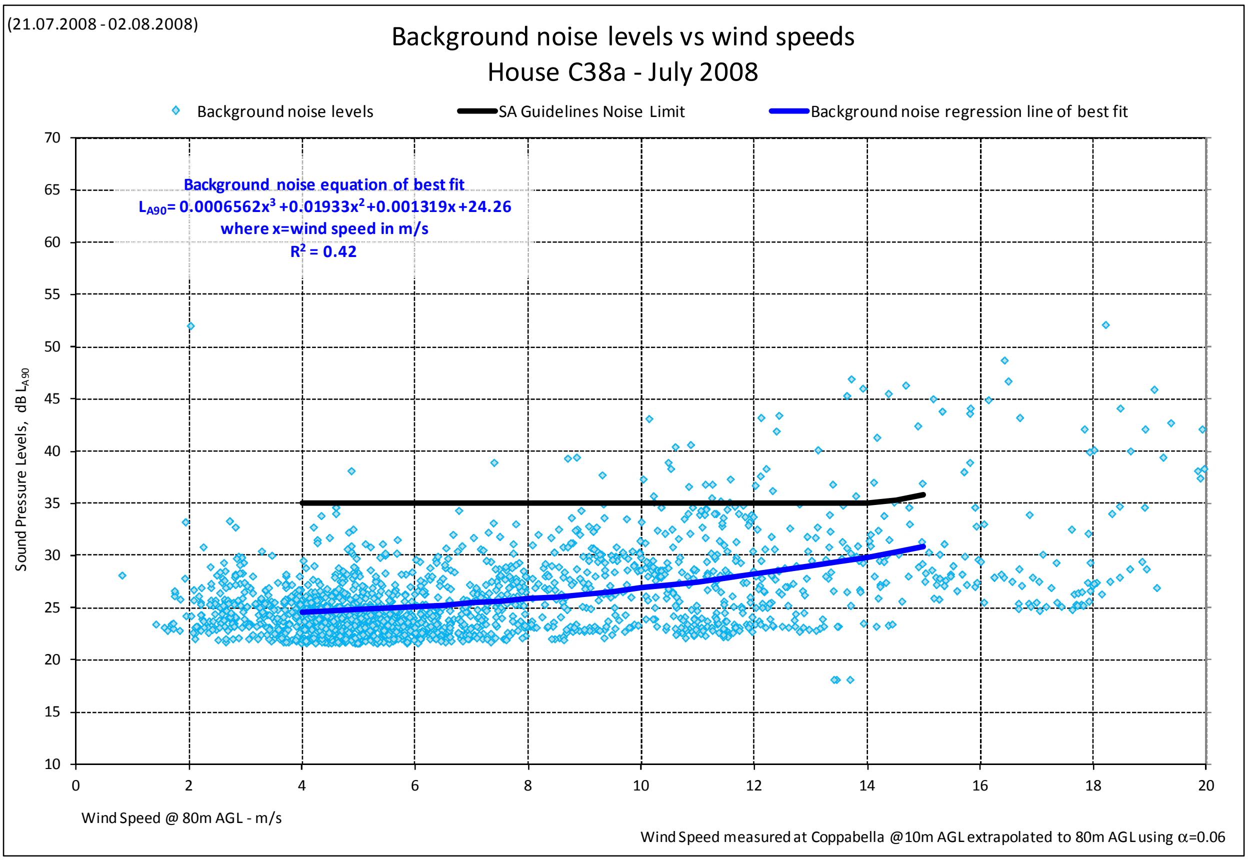

(22.07.2008 - 03.08.2008)
Correlation Coefficient = 0.23
Background noise levels and wind speeds vs time
House C35 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
22/07/08
24/07/08
26/07/08
28/07/08
30/07/08
01/08/08
03/08/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

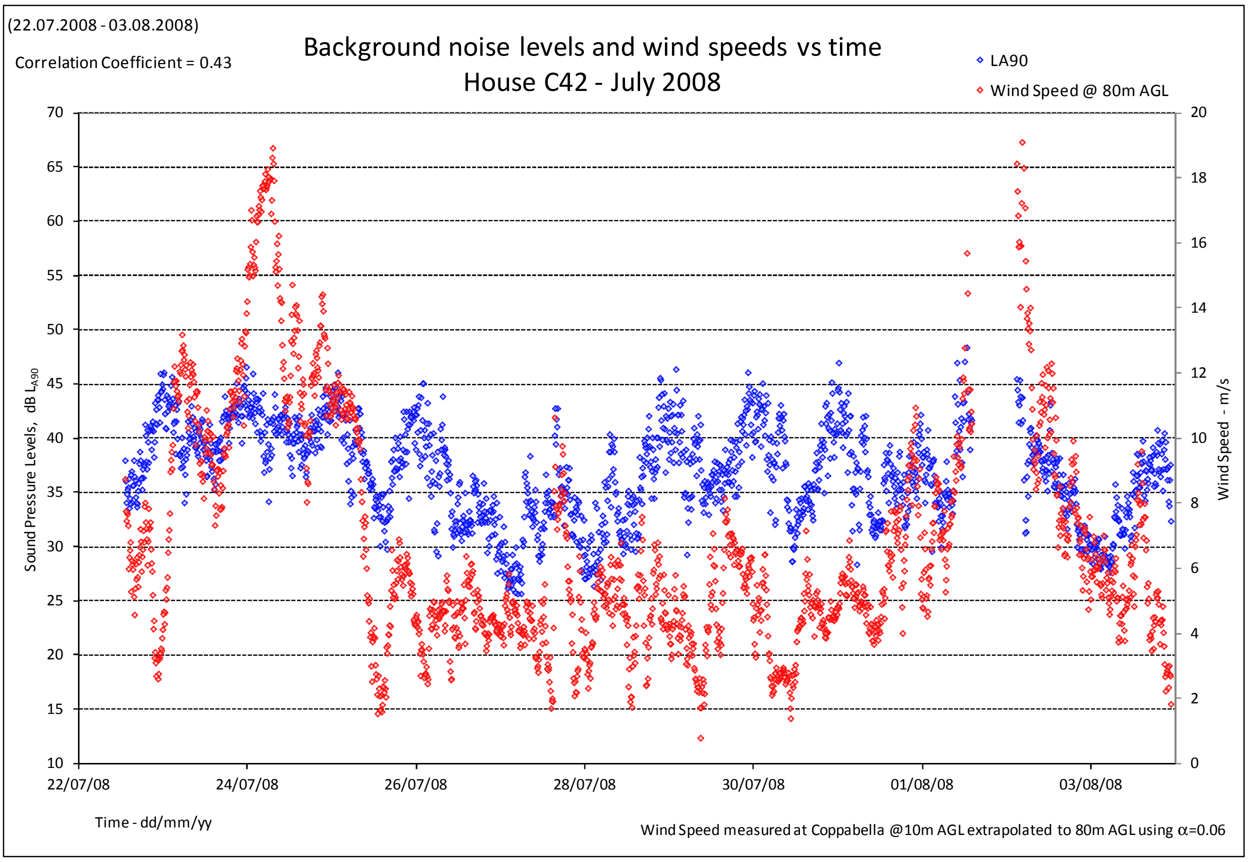

(22.07.2008 - 03.08.2008)
Background noise levels vs wind speeds
House C35 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.00827x³ +0.272x² -2.214x +33.15
where x=wind speed in m/s
R^2 = 0.07
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06


(21.07.2008 - 02.08.2008)
Correlation Coefficient = 0.4
Background noise levels and wind speeds vs time
House C38 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB LA90
Wind Speed - m/s
21/07/08
23/07/08
25/07/08
27/07/08
29/07/08
31/07/08
02/08/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

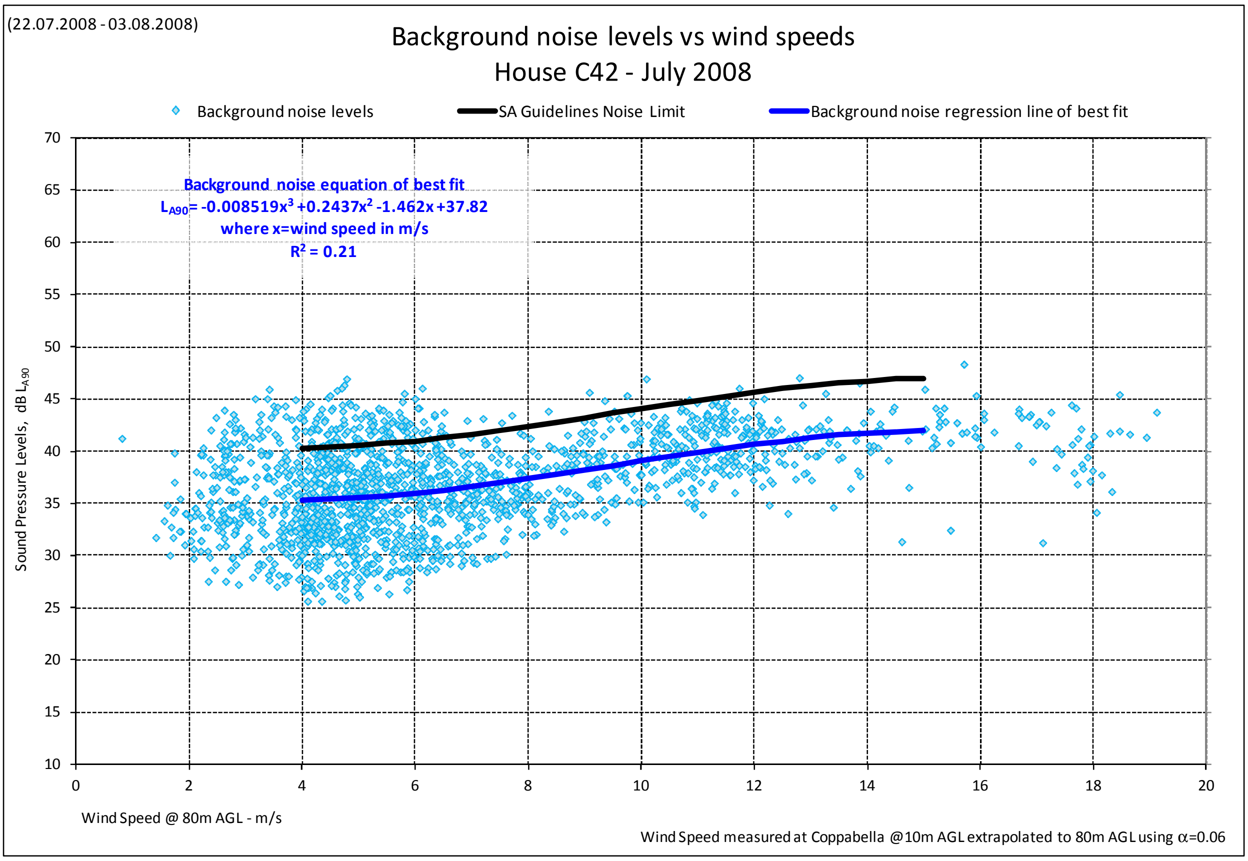

(21.07.2008 - 02.08.2008)
Background noise levels vs wind speeds
House C38 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
LA90= -0.008618x3 +0.2444x2 -1.624x +27.63
where x=wind speed in m/s
R2 = 0.2
Sound Pressure Levels, dB LA90
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06


(21.07.2008 - 02.08.2008)
Correlation Coefficient = 0.61
Background noise levels and wind speeds vs time
House C38a - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB LA90
Wind Speed - m/s
70
65
60
55
50
45
40
35
30
25
20
15
10
20
18
16
14
12
10
8
6
4
2
0
21/07/08
23/07/08
25/07/08
27/07/08
29/07/08
31/07/08
02/08/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

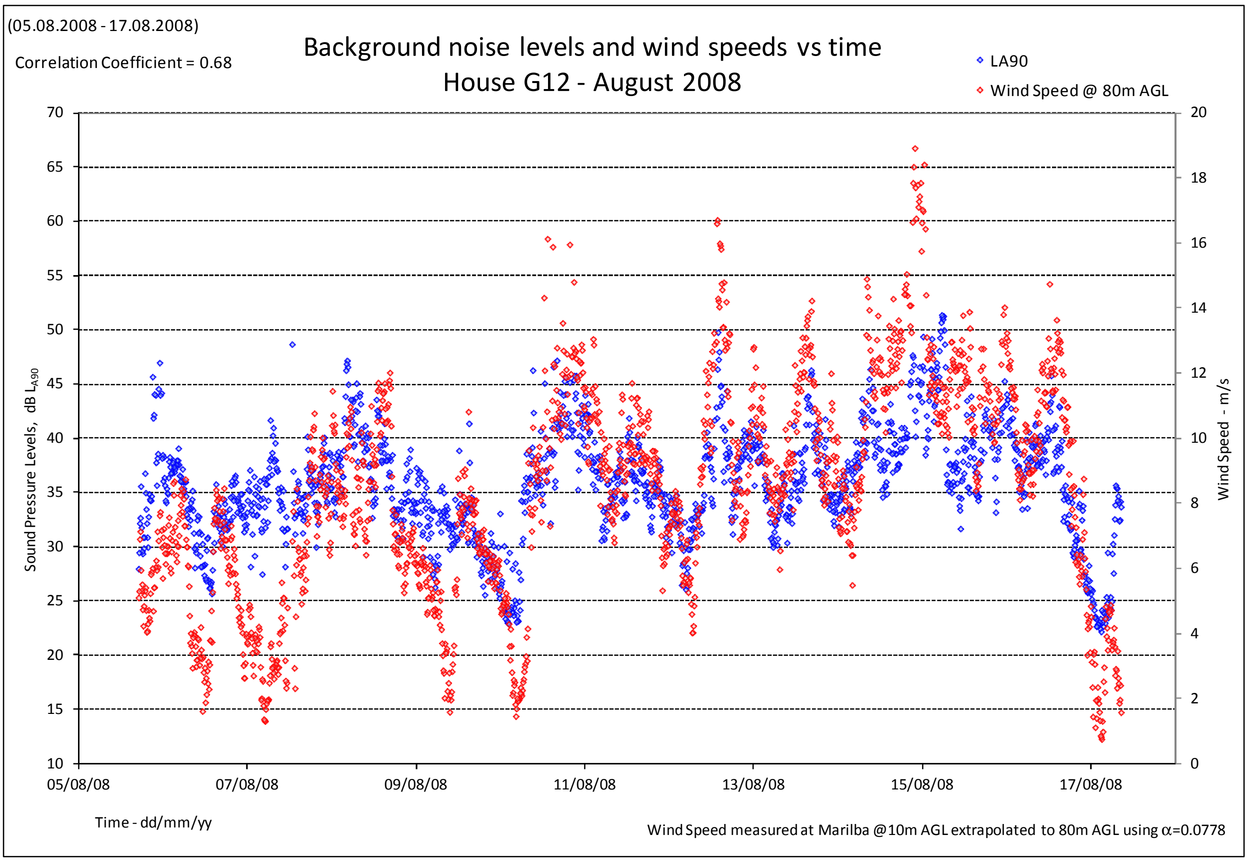

(21.07.2008 - 02.08.2008)
Background noise levels vs wind speeds
House C38a - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
LA90= 0.0006562x3 +0.01933x2+0.001319x+24.26
where x=wind speed in m/s
R2 = 0.42
Sound Pressure Levels, dB LA90
70
65
60
55
50
45
40
35
30
25
20
15
10
0
2
4
6
8
10
12
14
16
18
20
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

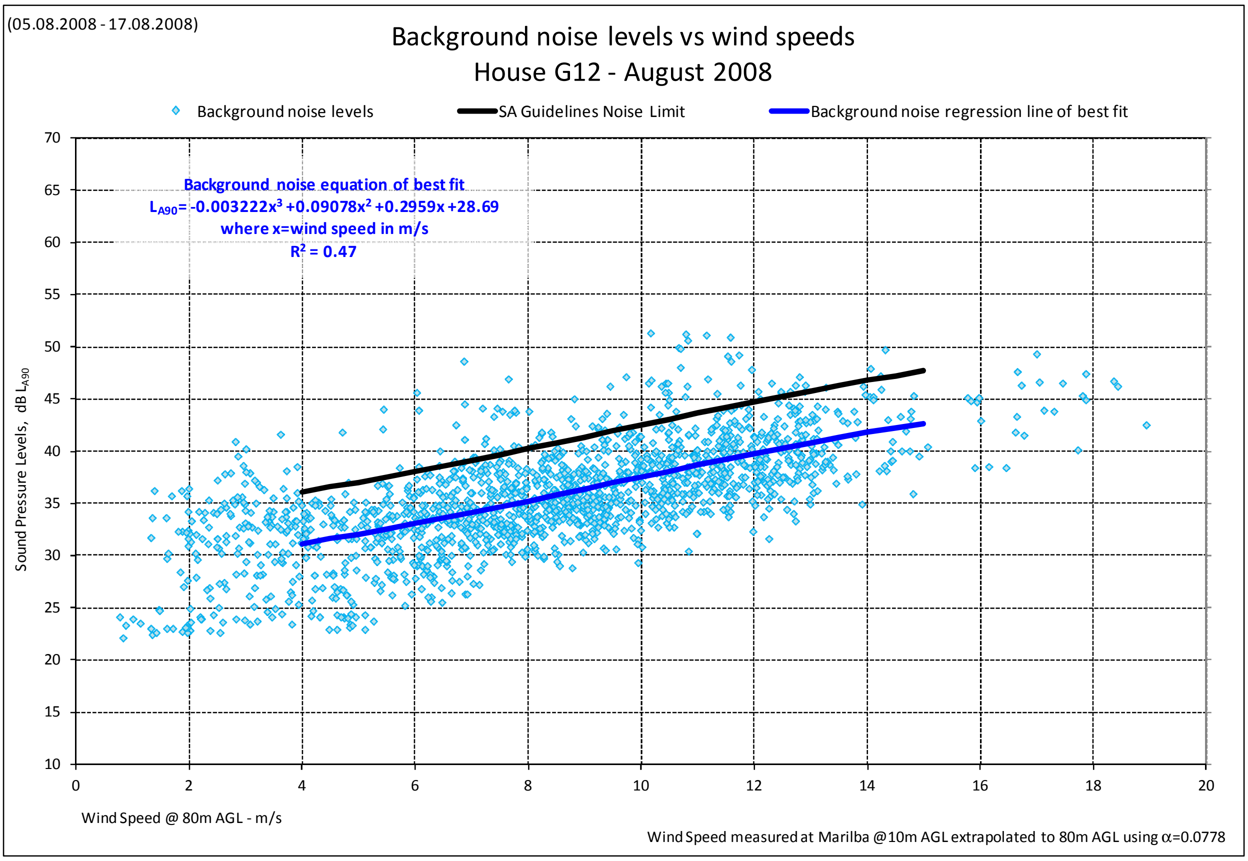


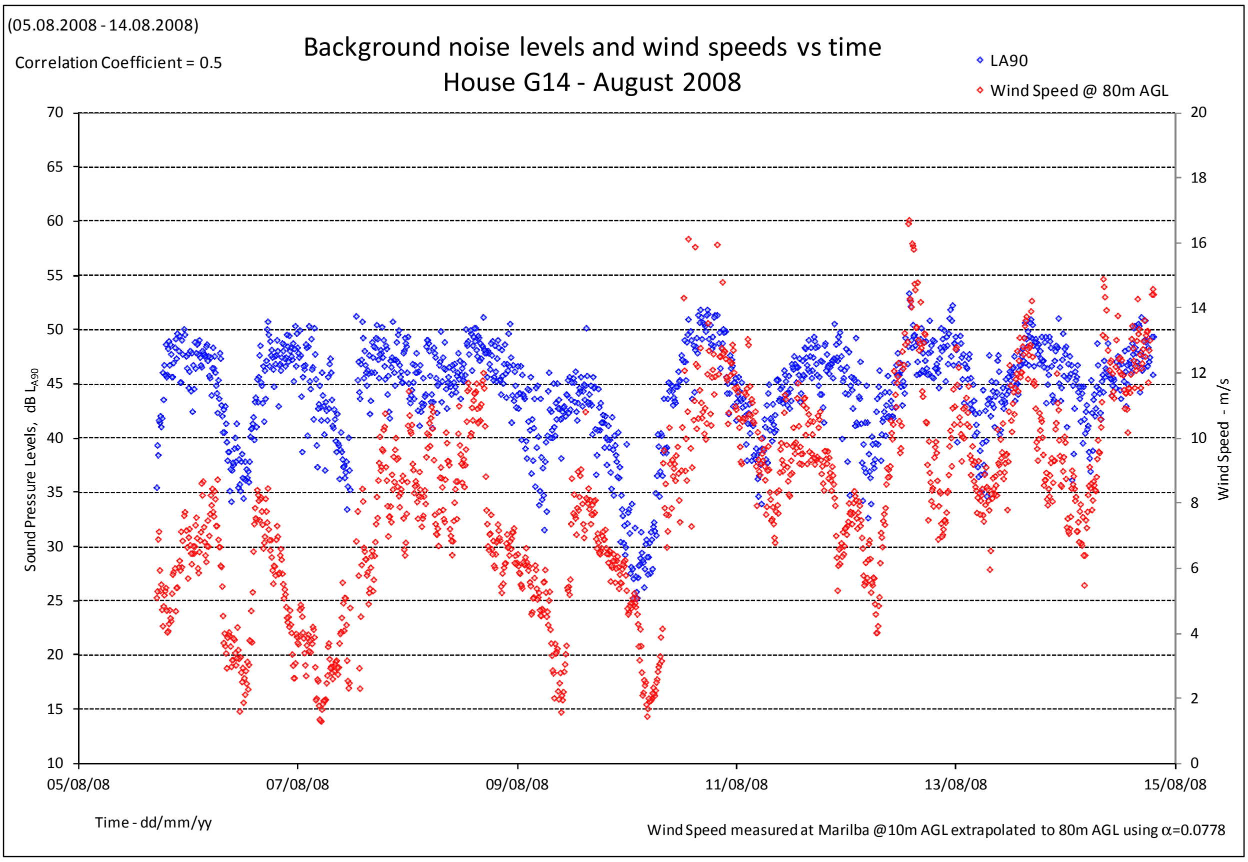
(22.07.2008 - 03.08.2008)
Correlation Coefficient = 0.43
Background noise levels and wind speeds vs time
House C42 - July 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
22/07/08
24/07/08
26/07/08
28/07/08
30/07/08
01/08/08
03/08/08
Time - dd/mm/yy
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

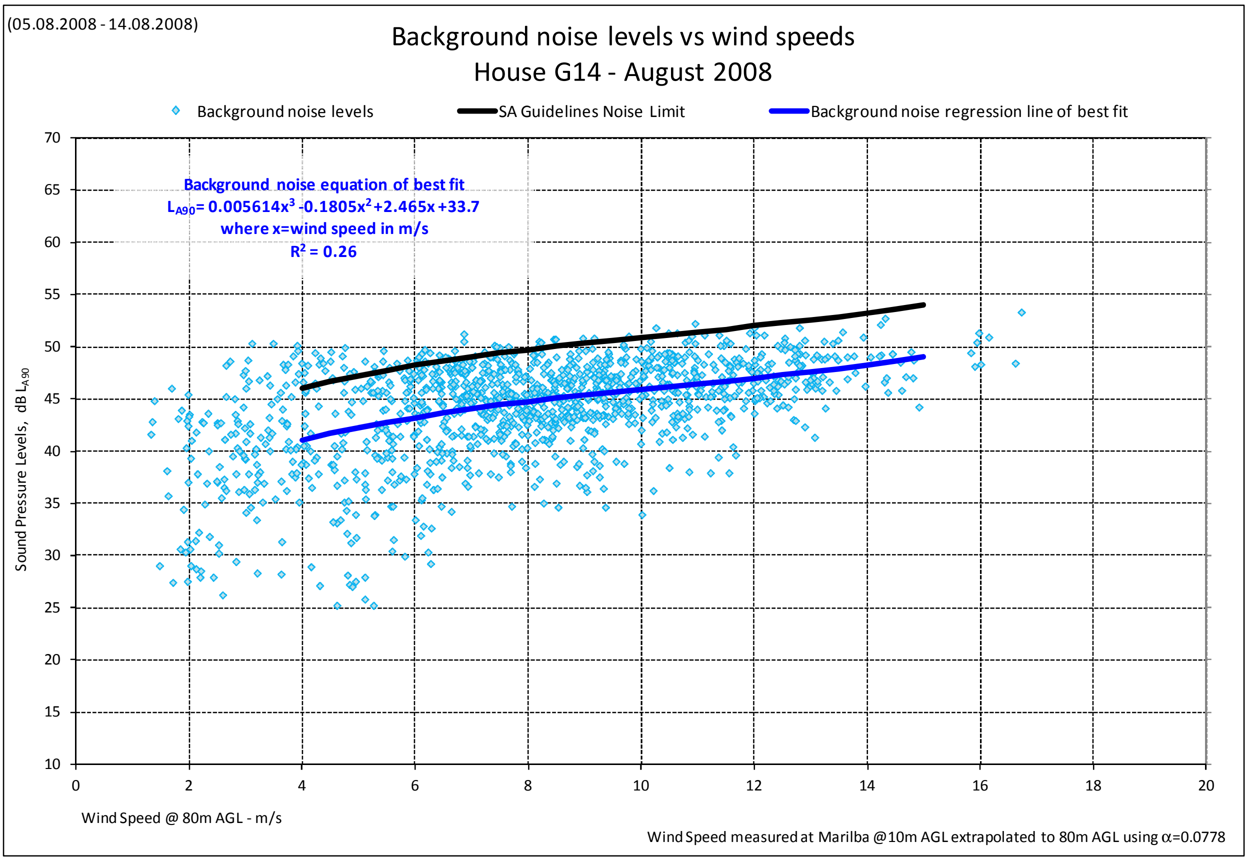


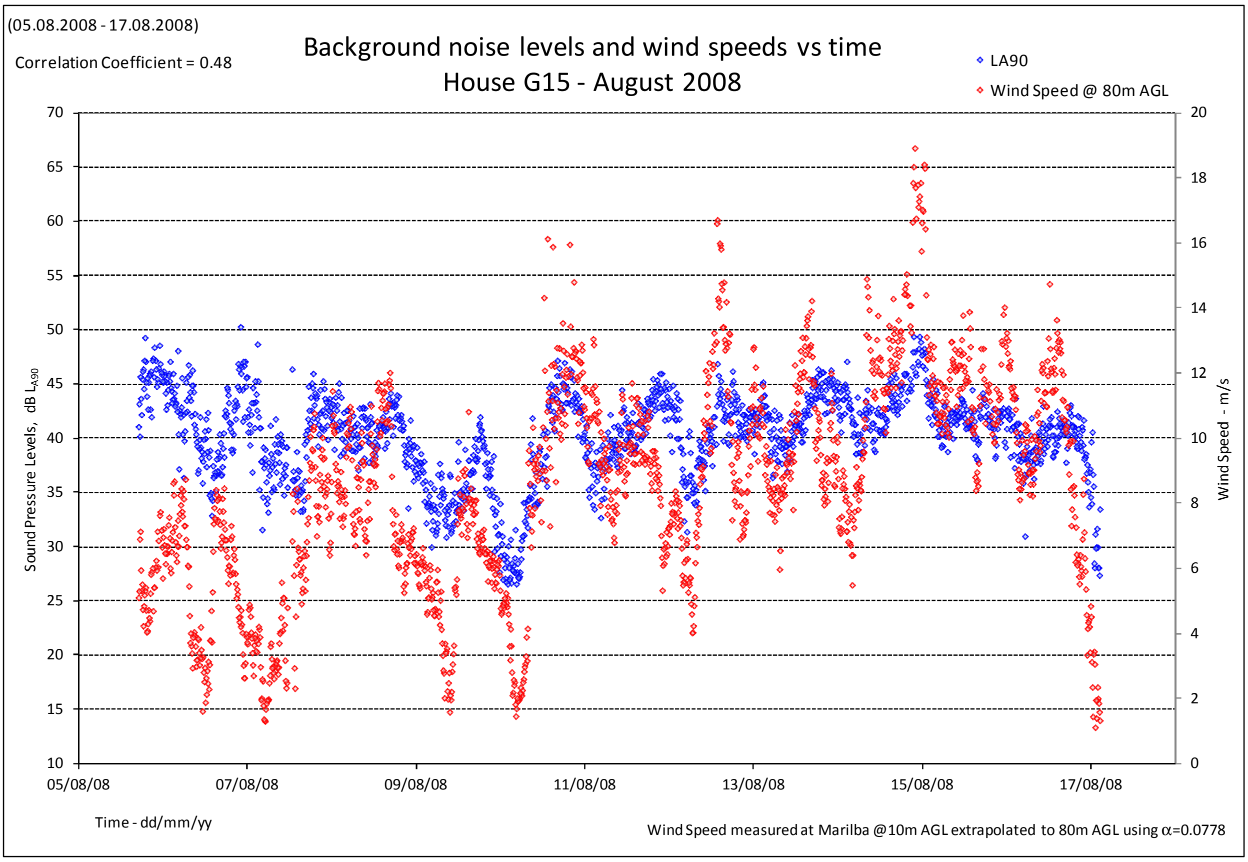
(22.07.2008 - 03.08.2008)
Background noise levels vs wind speeds
House C42 - July 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.008519x³ +0.2437x² -1.462x +37.82
where x=wind speed in m/s
R² = 0.21
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Coppabella @10m AGL extrapolated to 80m AGL using α=0.06

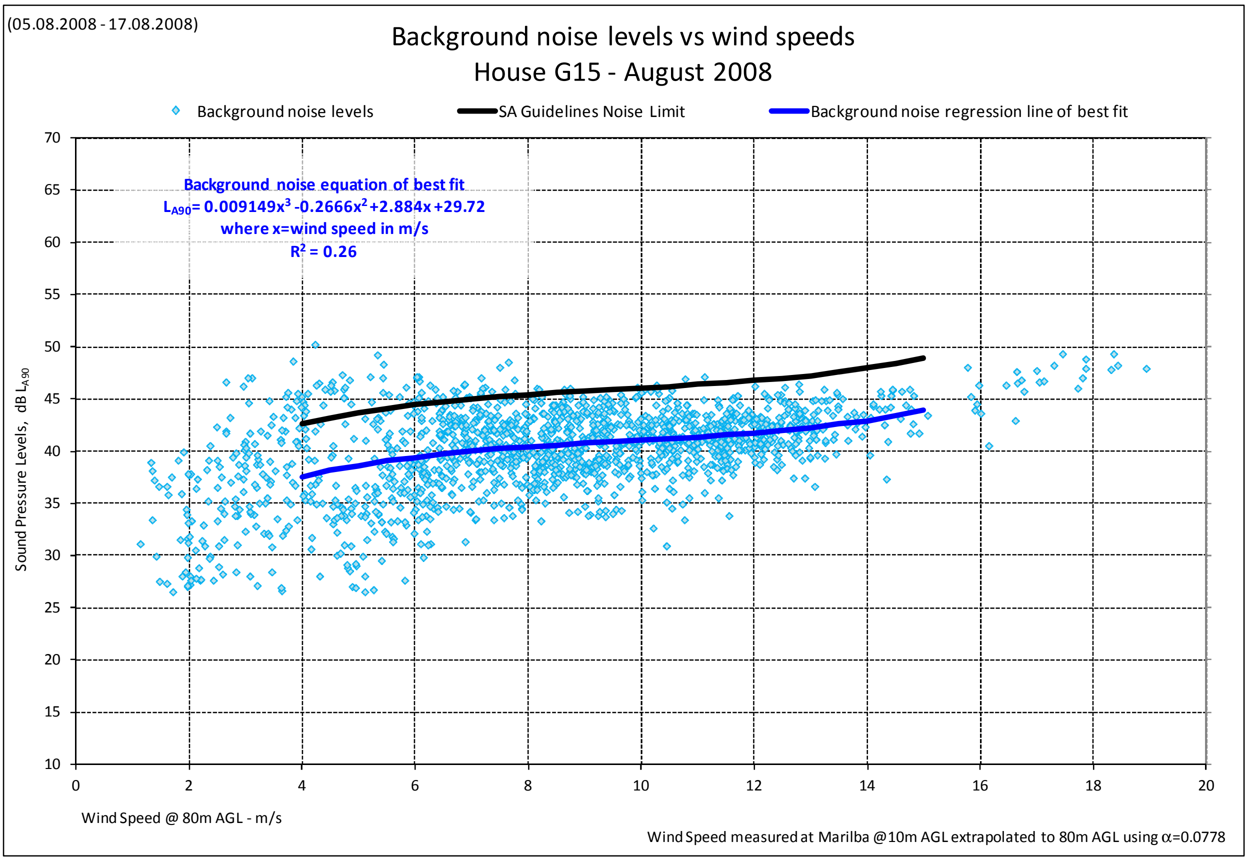

(05.08.2008 - 17.08.2008)
Correlation Coefficient = 0.68
Background noise levels and wind speeds vs time
House G12 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
05/08/08
07/08/08
09/08/08
11/08/08
13/08/08
15/08/08
17/08/08
Time - dd/mm/yy
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

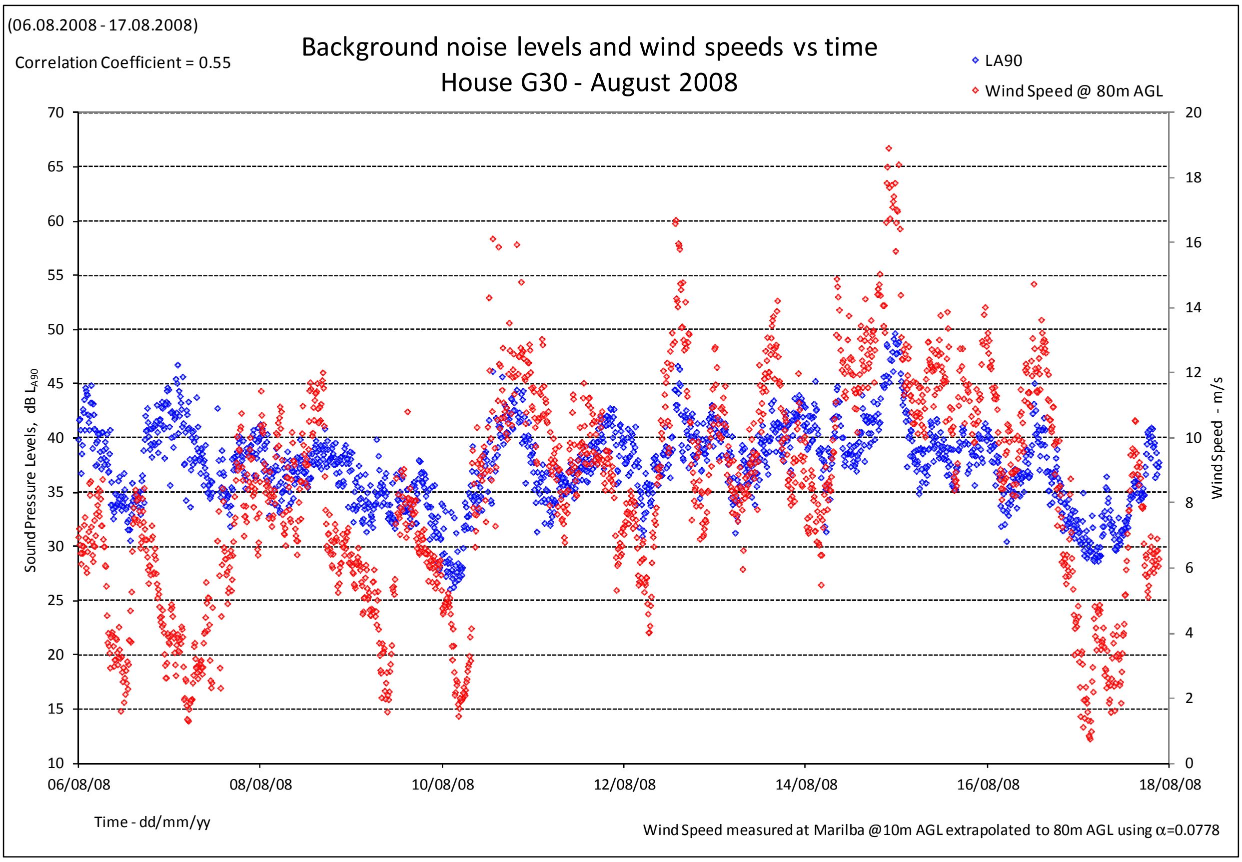

(05.08.2008 - 17.08.2008)
Background noise levels vs wind speeds
House G12 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.003222x³ +0.09078x² +0.2959x +28.69
where x=wind speed in m/s
R^2 = 0.47
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

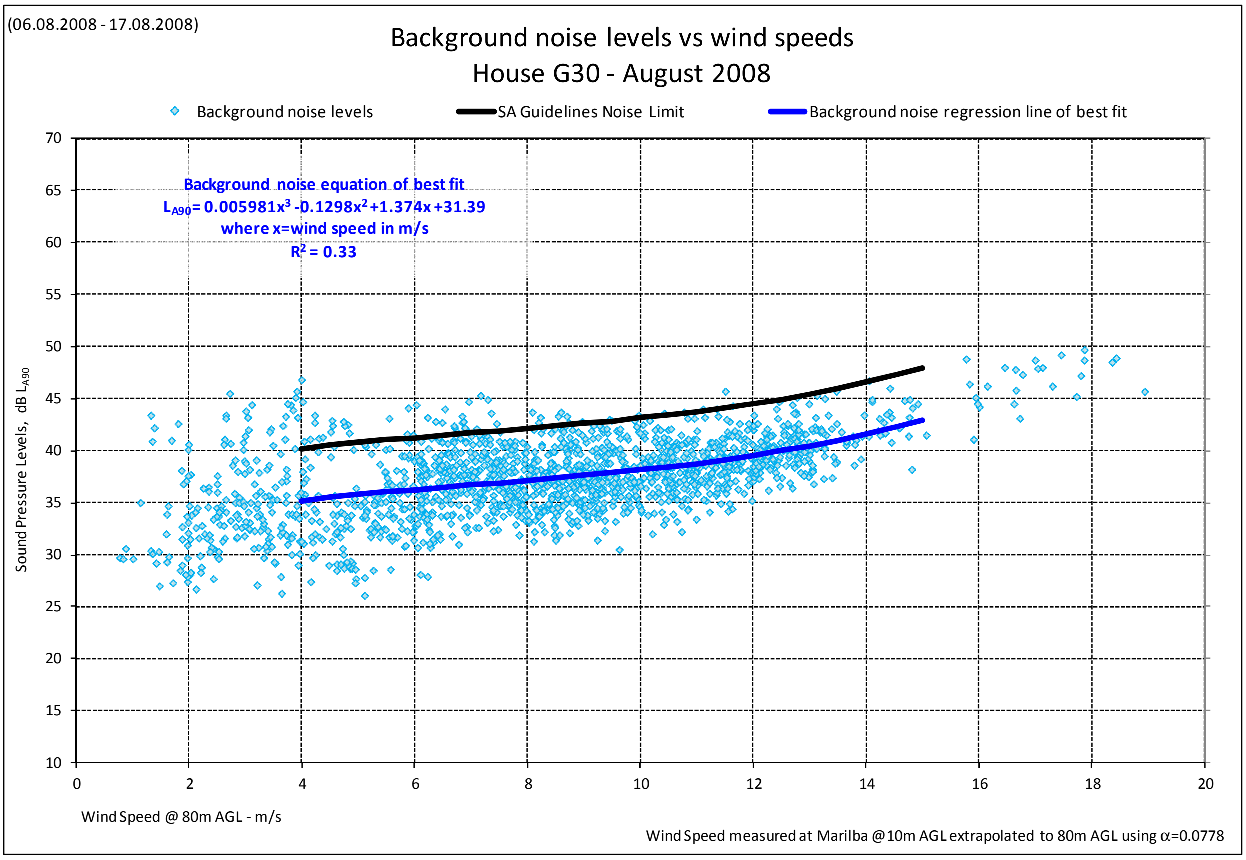

(05.08.2008 - 14.08.2008)
Correlation Coefficient = 0.5
Background noise levels and wind speeds vs time
House G14 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
05/08/08
07/08/08
09/08/08
11/08/08
13/08/08
15/08/08
Time - dd/mm/yy
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

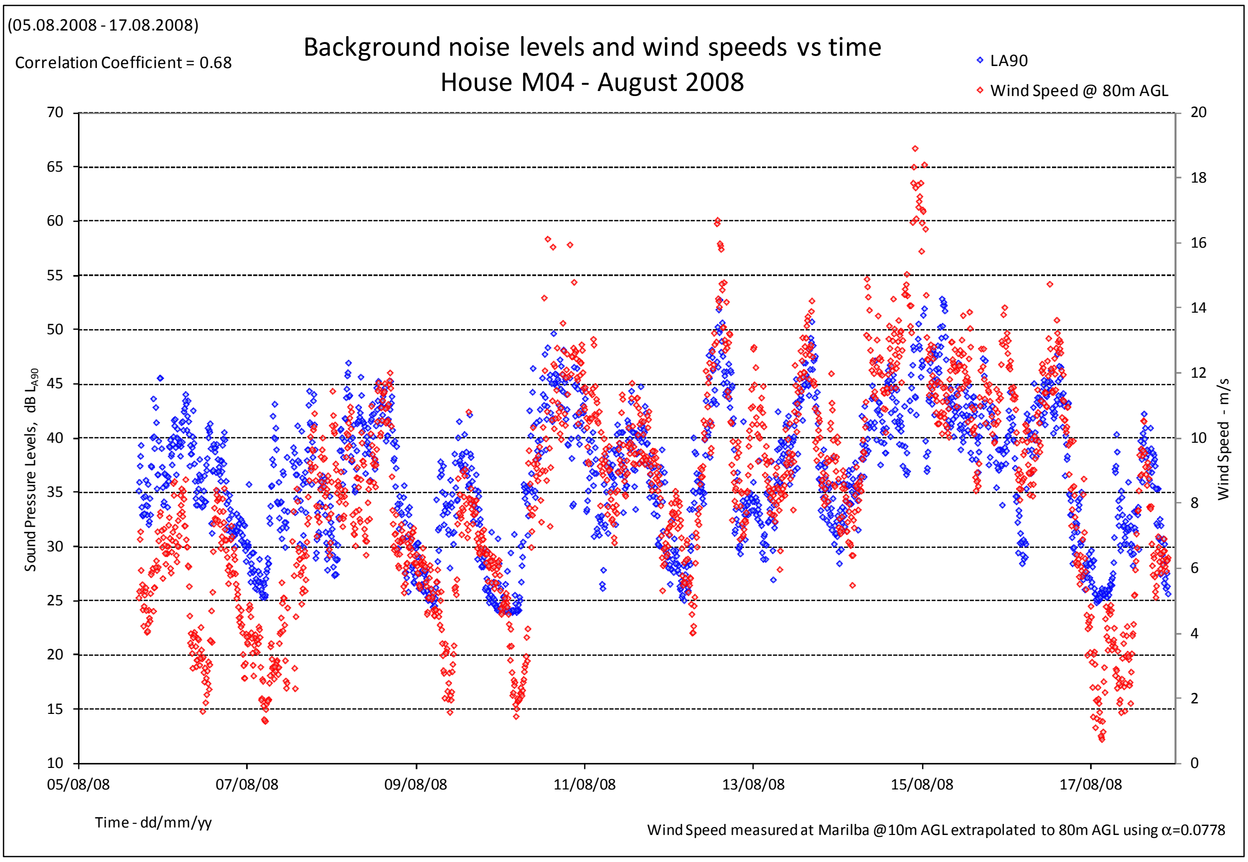

(05.08.2008 - 14.08.2008)
Background noise levels vs wind speeds
House G14 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.005614x³ -0.1805x²+2.465x+33.7
where x=wind speed in m/s
R^2 = 0.26
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

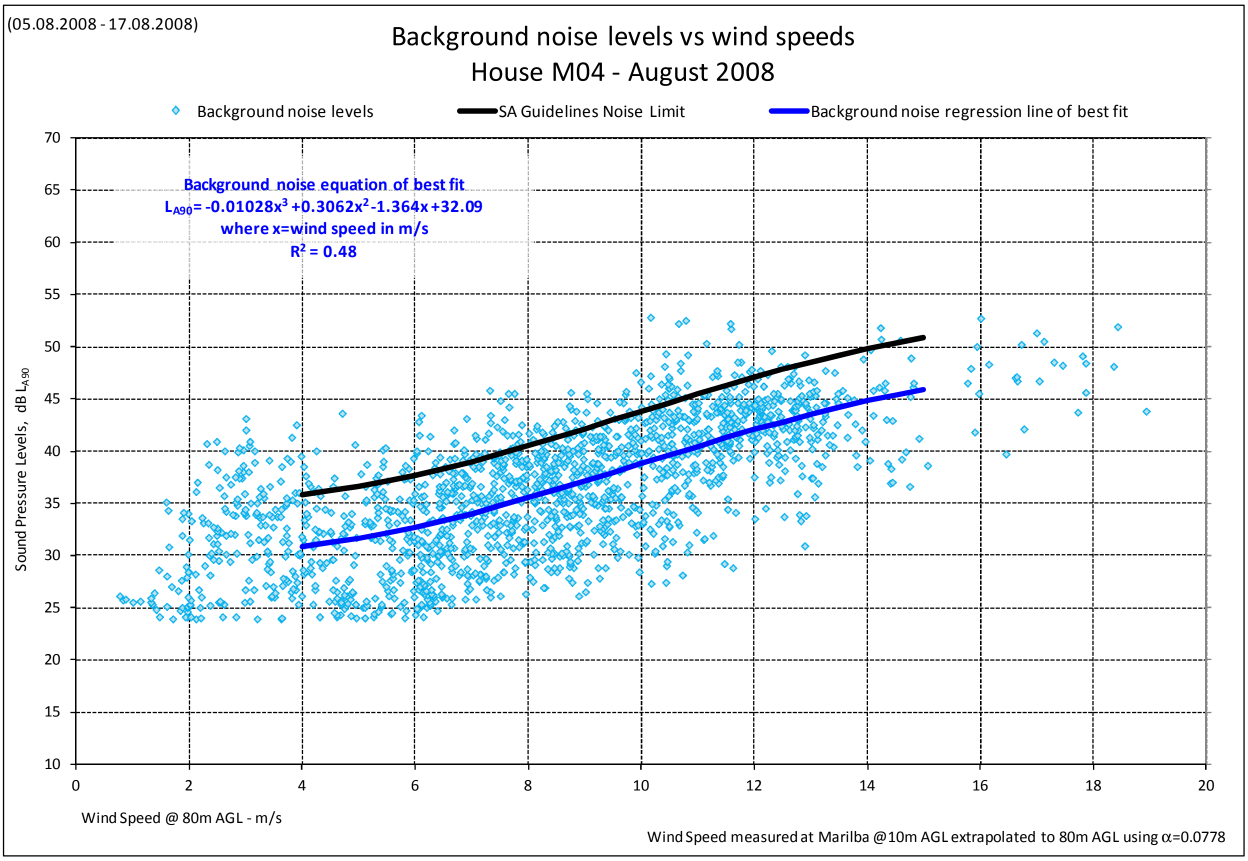

(05.08.2008 - 17.08.2008)
Correlation Coefficient = 0.48
Background noise levels and wind speeds vs time
House G15 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
05/08/08
07/08/08
09/08/08
11/08/08
13/08/08
15/08/08
17/08/08
Time - dd/mm/yy
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

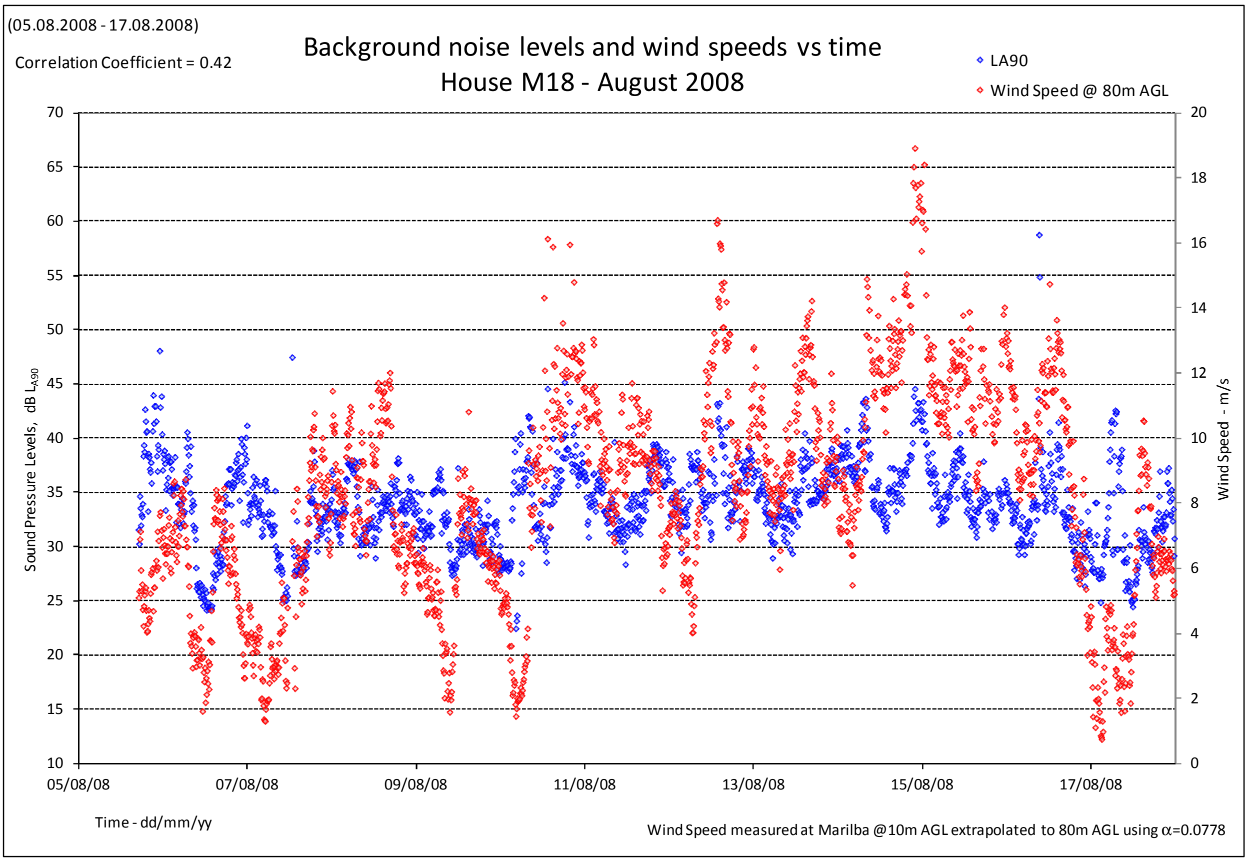

(05.08.2008 - 17.08.2008)
Background noise levels vs wind speeds
House G15 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.009149x³ -0.2666x² +2.884x +29.72
where x=wind speed in m/s
R^2 = 0.26
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

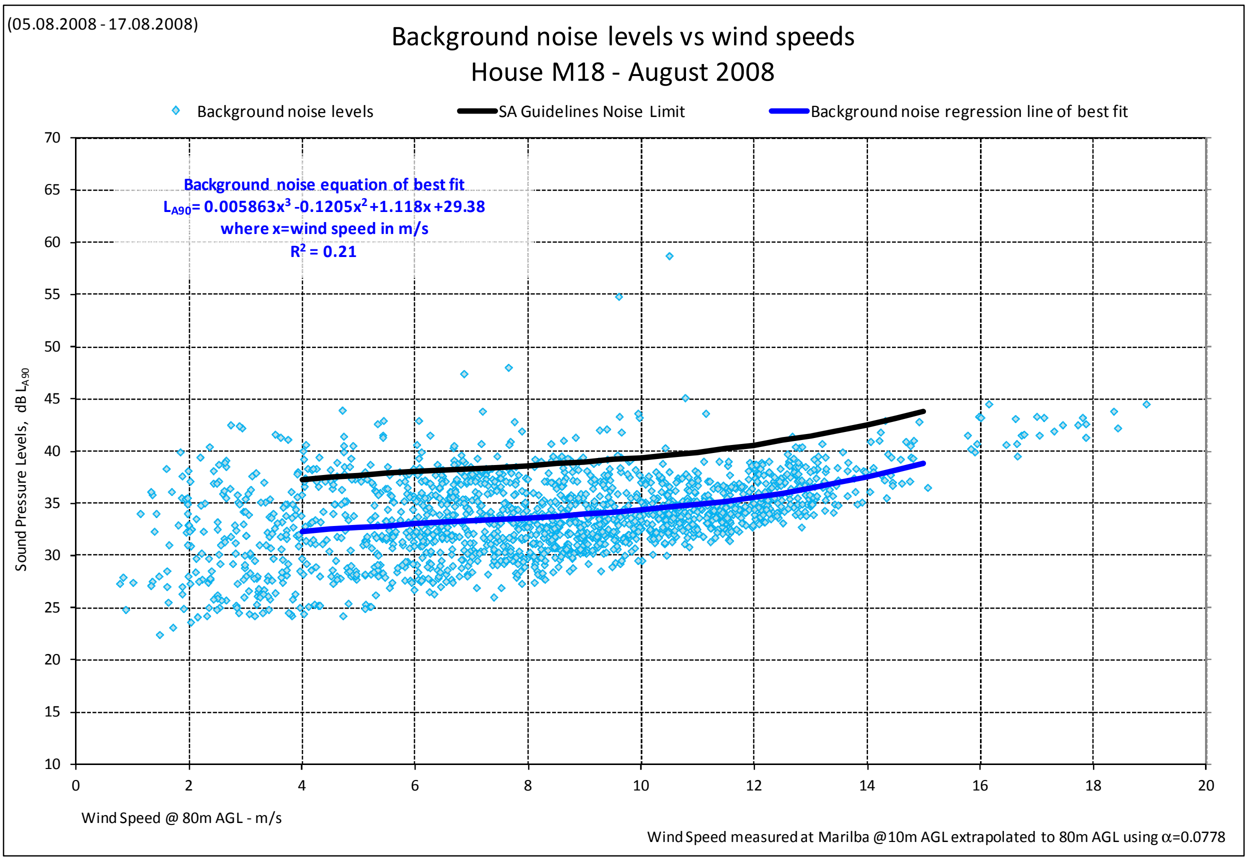

(06.08.2008 - 17.08.2008)
Correlation Coefficient = 0.55
Background noise levels and wind speeds vs time
House G30 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
Time - dd/mm/yy
06/08/08
08/08/08
10/08/08
12/08/08
14/08/08
16/08/08
18/08/08
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778


(06.08.2008 - 17.08.2008)
Background noise levels vs wind speeds
House G30 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.005981x³ -0.1298x² +1.374x +31.39
where x=wind speed in m/s
R^2 = 0.33
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778


(05.08.2008 - 17.08.2008)
Correlation Coefficient = 0.68
Background noise levels and wind speeds vs time
House M04 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
05/08/08
07/08/08
09/08/08
11/08/08
13/08/08
15/08/08
17/08/08
Time - dd/mm/yy
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778


(05.08.2008 - 17.08.2008)
Background noise levels vs wind speeds
House M04 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.01028x³ +0.3062x²-1.364x+32.09
where x=wind speed in m/s
R^2 = 0.48
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778


(05.08.2008 - 17.08.2008)
Correlation Coefficient = 0.42
Background noise levels and wind speeds vs time
House M18 - August 2008
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
05/08/08
07/08/08
09/08/08
11/08/08
13/08/08
15/08/08
17/08/08
Time - dd/mm/yy
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778


(05.08.2008 - 17.08.2008)
Background noise levels vs wind speeds
House M18 - August 2008
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= 0.005863x³ -0.1205x² +1.118x +29.38
where x=wind speed in m/s
R^2 = 0.21
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marilba @10m AGL extrapolated to 80m AGL using α=0.0778

G2 Noise criteria for receiver M42

A new receiver, M42, was identified for the 2013 assessment. As the predicted noise levels for receiver M42 were above the minimum criteria of 35dB L_{Aeq}, noise monitoring was conducted on-site by Epuron in accordance with the 2003 SA Guidelines to determine background dependant limits. We understand local monitoring of meteorological conditions was not undertaken during the survey period.

Noise monitoring was conducted for two periods, the first from the 17 April to 26 April 2013 and then from 30 May to 12 June 2013 using a Type 2 Rion NL42 noise logger.

Epuron have stated the monitoring location was positioned 1.2m above the ground at least 5m from any reflecting surface. Figure G1 shows the monitoring location.

Figure G1: M42 monitoring location

Table G1 provides details of the monitoring location and the number of data points used to generate the regression curve for the site.

Table G1: Details of monitoring location

Location	Easting[#]	Northing[#]	Data points analysed
M42	653700	6155468	1999*

[#] MGA94 Zone 55

** Total data set of 3257 points*

As no local measurements of meteorological conditions were undertaken, the weather information from the closest Bureau of Meteorology station at Bowning AWS was reviewed to assist with determining whether the meteorological conditions were acceptable during the noise monitoring. Only one reading per day was available from this weather station. Epuron has reviewed the available rain fall information and advised on the noise data to be excluded when determining the noise criteria for the site.

With regard to the data to be excluded from the analysis, Epuron have provided the following statement:

> *Concurrent rainfall data was attained by the proponent from the Bureau of Meteorology using the closest weather station with available data. On days where daily rainfall greater than 0.2mm were detected concurrent background noise data that was deemed likely to be affected and removed from the analysis.*

The measured rainfall data from the Bowning AWS weather station for the periods of monitoring is provided Figure G1 below.

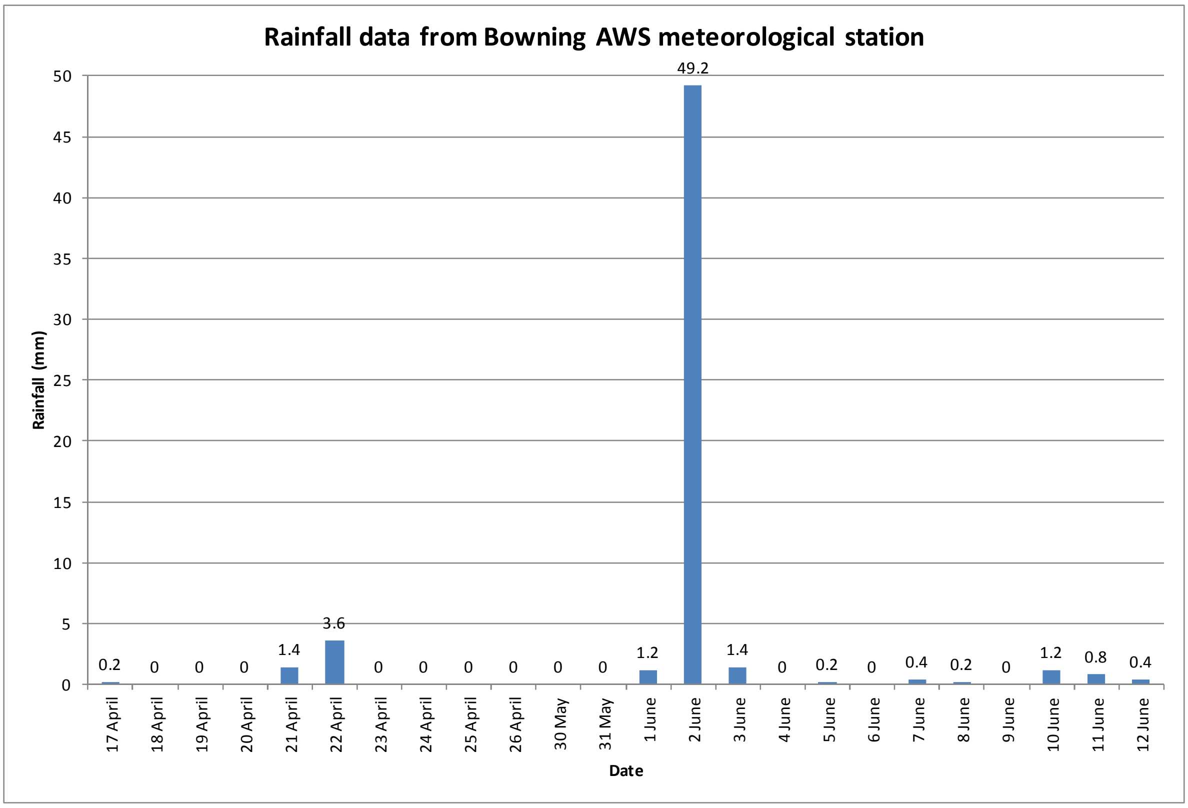
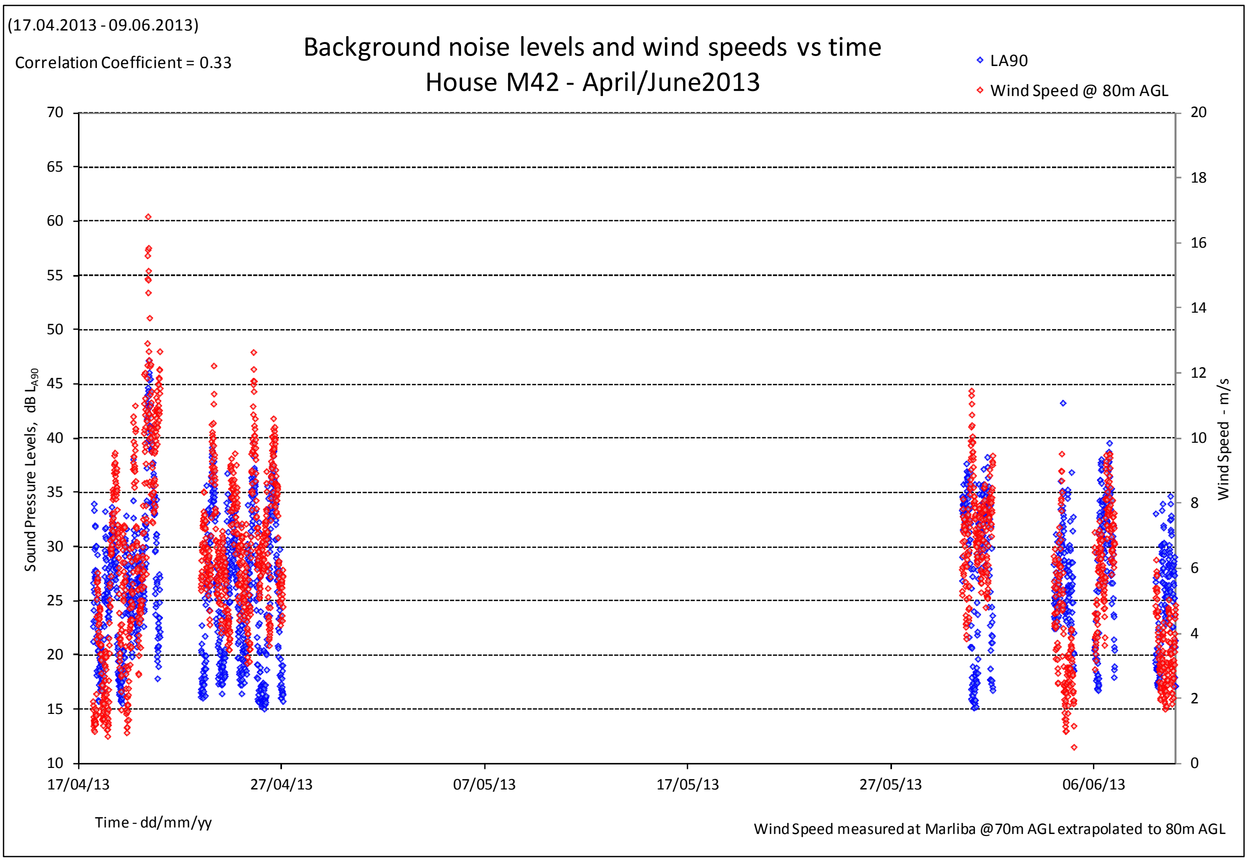
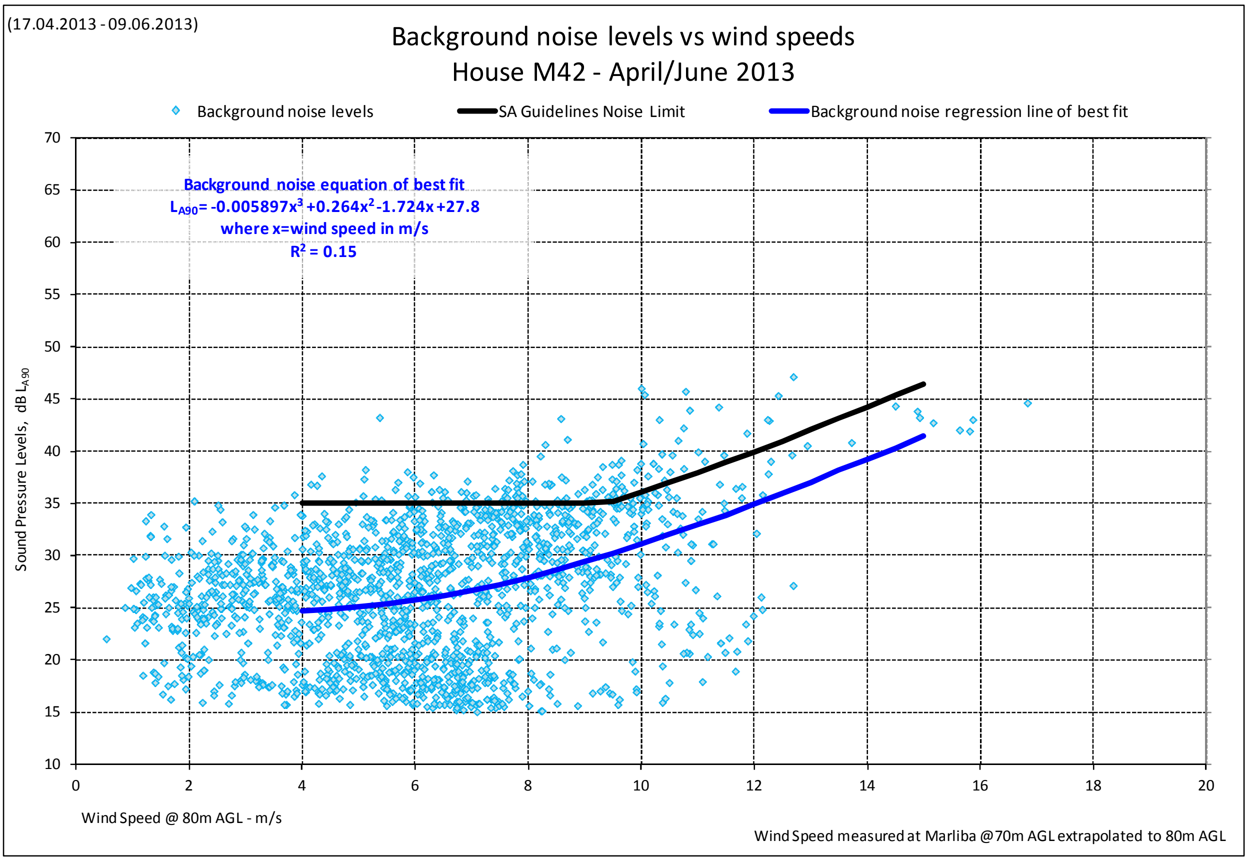


Figure G1: Rainfall data from Bowning AWS weather station for duration of monitoring period

Marshall Day was not involved in the noise monitoring or determining which data to exclude for the analysis. Noise data has been excluded based on Epuron's advice, and then processed to generate the regression curves for the data set. The reliability of the data is the responsibility of Epuron.


(17.04.2013 - 09.06.2013)
Correlation Coefficient = 0.33
Background noise levels and wind speeds vs time
House M42 - April/June2013
LA90
Wind Speed @ 80m AGL
Sound Pressure Levels, dB L_{A90}
Wind Speed - m/s
17/04/13
27/04/13
07/05/13
17/05/13
27/05/13
06/06/13
Time - dd/mm/yy
Wind Speed measured at Marliba @70m AGL extrapolated to 80m AGL


(17.04.2013 - 09.06.2013)
Background noise levels vs wind speeds
House M42 - April/June 2013
Background noise levels
SA Guidelines Noise Limit
Background noise regression line of best fit
Background noise equation of best fit
L_{A90}= -0.005897x³ +0.264x² -1.724x +27.8
where x=wind speed in m/s
R^2 = 0.15
Sound Pressure Levels, dB L_{A90}
Wind Speed @ 80m AGL - m/s
Wind Speed measured at Marliba @70m AGL extrapolated to 80m AGL

APPENDIX H NOISE CRITERIA FOR DAYTIME AND NIGHT-TIME PERIODS

H1 Daytime period (0700 to 2200 hours)

The background noise data collected for the 2009 assessment and data collected in 2013 for receiver M42 has been reanalysed to look at the daytime period only, which is stated to be between 7am and 10pm. Please refer to Figure H1 for an overview of the potential daytime criteria.

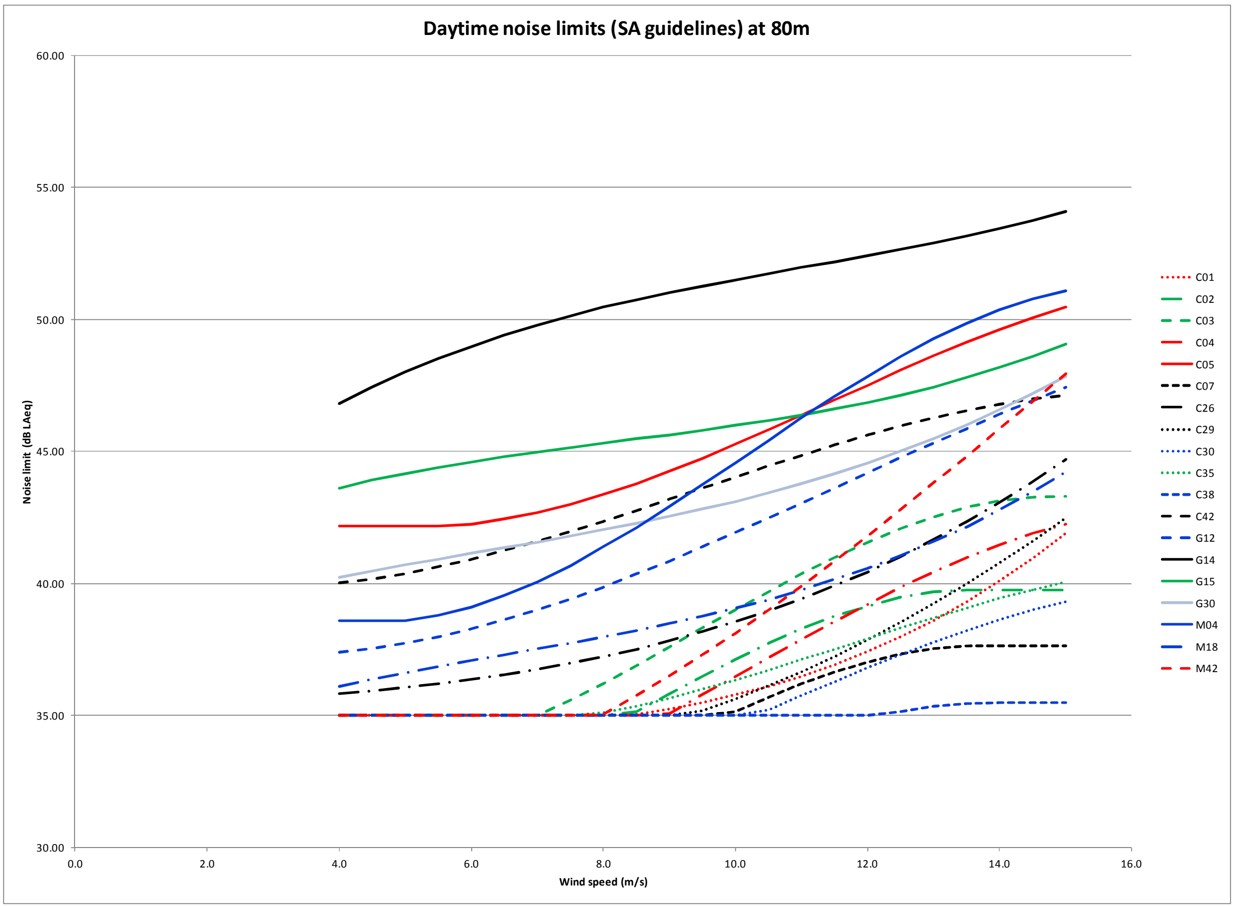


Figure H1: Noise criteria based on daytime data only

H2 Night-time period (2200 to 0700 hours)

The background noise data collected for the 2009 assessment and data collected in 2013 for receiver M42 has been reanalysed to look at the night-time period only, which is stated to be between 10pm and 7am. Please refer to Figure H2 for an overview of the potential night-time criteria.

We note for most receivers there is only a limited data set available for the night-time period and the data covers a limited range of wind speeds. The criteria presented below are for information only.

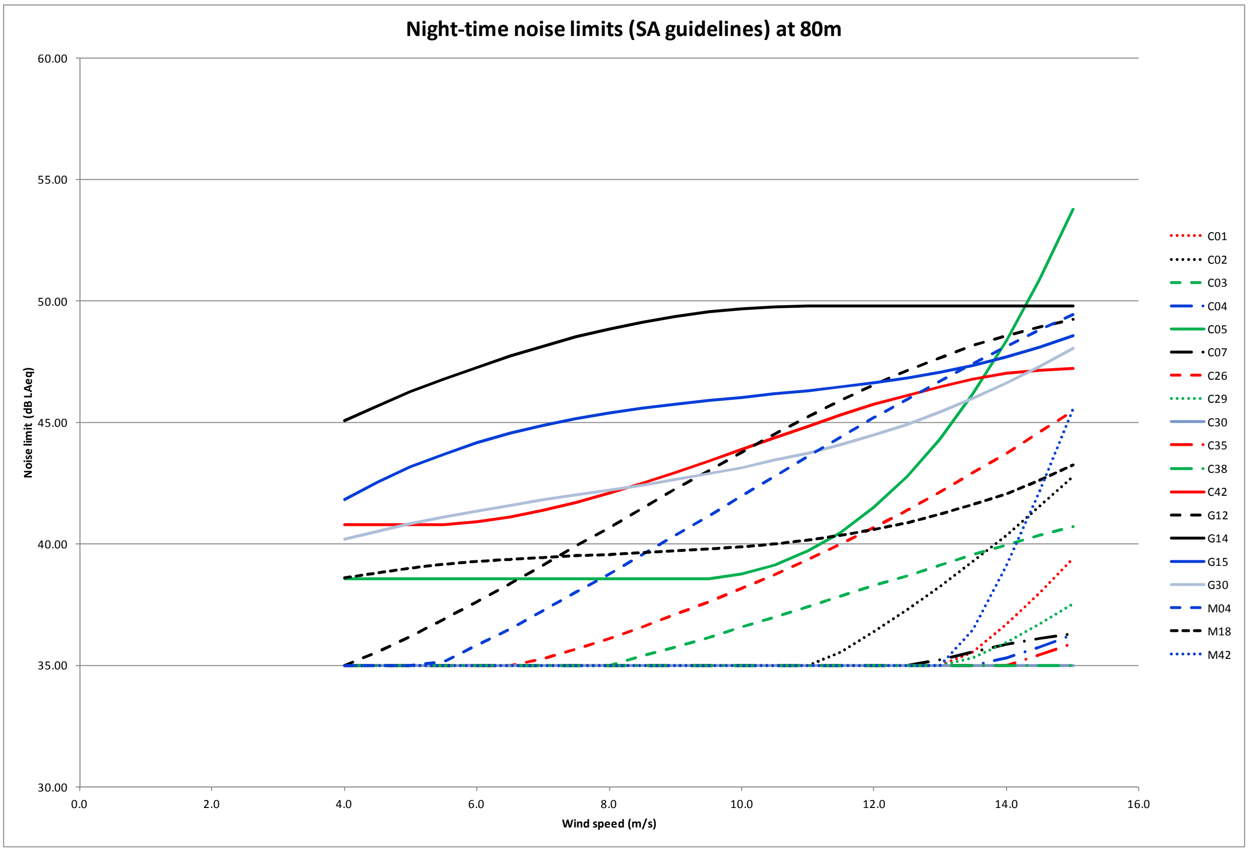


Figure H2: Noise criteria based on night-time data only

APPENDIX I PREDICTED NOISE LEVELS AT INTEGER WIND SPEEDS FOR ALL RECEIVERS

Table I1 summarises the predicted noise levels for all receivers at hub height integer wind speeds using the MM92 turbines. Relevant receivers for the current assessment are highlighted using italic text. The relevant receivers for the 2009 assessment are shown using bold text.

Table I1: Predicted noise levels at integer hub height wind speeds for MM92 turbines

Receiver ID	8	9	10	11	12	13
C01	**30.1**	**31.2**	**31.8**	**31.8**	**31.4**	**30.7**
C02	***36.1***	***37.2***	***37.8***	***37.8***	***37.4***	***36.7***
C03	***35.4***	***36.5***	***37.1***	***37.1***	***36.7***	***36.0***
C04	***34.0***	***35.1***	***35.7***	***35.7***	***35.3***	***34.6***
C05	**31.5**	**32.6**	**33.2**	**33.2**	**32.8**	**32.1**
C06	30.2	31.3	31.9	31.9	31.5	30.8
C07	**22.2**	**23.3**	**23.9**	**23.9**	**23.5**	**22.8**
C08	29.0	30.1	30.7	30.7	30.3	29.6
C09	20.6	21.7	22.3	22.3	21.9	21.2
C10	22.8	23.9	24.5	24.5	24.1	23.4
C12	25.8	26.9	27.5	27.5	27.1	26.4
C13	28.2	29.3	29.9	29.9	29.5	28.8
C22	27.4	28.5	29.1	29.1	28.7	28.0
C25	38.2	39.3	39.9	39.9	39.5	38.8
C26	***34.1***	***35.2***	***35.8***	***35.8***	***35.4***	***34.7***
C27	*35.4*	*36.5*	*37.1*	*37.1*	*36.7*	*36.0*
C28	*27.2*	*28.3*	*28.9*	*28.9*	*28.5*	*27.8*
C28a	27.1	28.2	28.8	28.8	28.4	27.7
C29	**30.4**	**31.5**	**32.1**	**32.1**	**31.7**	**31.0**
C30	**28.4**	**29.5**	**30.1**	**30.1**	**29.7**	**29.0**
C33	26.4	27.5	28.1	28.1	27.7	27.0
C34	26.8	27.9	28.5	28.5	28.1	27.4
C35	**30.5**	**31.6**	**32.2**	**32.2**	**31.8**	**31.1**
C37	28.9	30.0	30.6	30.6	30.2	29.5
C38	**26.4**	**27.5**	**28.1**	**28.1**	**27.7**	**27.0**
C39	24.0	25.1	25.7	25.7	25.3	24.6
C41	28.3	29.4	30.0	30.0	29.6	28.9
C42	**28.8**	**29.9**	**30.5**	**30.5**	**30.1**	**29.4**
C46a	27.8	28.9	29.5	29.5	29.1	28.4

Receiver ID	8	9	10	11	12	13
C47	27.6	28.7	29.3	29.3	28.9	28.2
C48	27.3	28.4	29.0	29.0	28.6	27.9
C52	26.2	27.3	27.9	27.9	27.5	26.8
C53	28.3	29.4	30.0	30.0	29.6	28.9
C55	*34.1*	*35.2*	*35.8*	*35.8*	*35.4*	*34.7*
C56	*36.1*	*37.2*	*37.8*	*37.8*	*37.4*	*36.7*
C58	27.7	28.8	29.4	29.4	29.0	28.3
C59	26.7	27.8	28.4	28.4	28.0	27.3
C60	28.3	29.4	30.0	30.0	29.6	28.9
C61	26.3	27.4	28.0	28.0	27.6	26.9
C62	27.8	28.9	29.5	29.5	29.1	28.4
C63	27.8	28.9	29.5	29.5	29.1	28.4
C64	27.6	28.7	29.3	29.3	28.9	28.2
C65	27.8	28.9	29.5	29.5	29.1	28.4
C66	27.5	28.6	29.2	29.2	28.8	28.1
C67	29.7	30.8	31.4	31.4	31.0	30.3
C68	*34.8*	*35.9*	*36.5*	*36.5*	*36.1*	*35.4*
C69	28.0	29.1	29.7	29.7	29.3	28.6
C71	30.4	31.5	32.1	32.1	31.7	31.0
C72	24.0	25.1	25.7	25.7	25.3	24.6
C73	22.8	23.9	24.5	24.5	24.1	23.4
C74	*30.4*	*31.5*	*32.1*	*32.1*	*31.7*	*31.0*
C75	28.7	29.8	30.4	30.4	30.0	29.3
C76	27.9	29.0	29.6	29.6	29.2	28.5
C76a	27.7	28.8	29.4	29.4	29.0	28.3
C77	27.1	28.2	28.8	28.8	28.4	27.7
E20	25.7	26.8	27.4	27.4	27.0	26.3
G01	18.2	19.3	19.9	19.9	19.5	18.8
G02	22.3	23.4	24.0	24.0	23.6	22.9
G02a	22.3	23.4	24.0	24.0	23.6	22.9
G03	23.7	24.8	25.4	25.4	25.0	24.3
G04	21.5	22.6	23.2	23.2	22.8	22.1
G05	21.0	22.1	22.7	22.7	22.3	21.6
G06	18.7	19.8	20.4	20.4	20.0	19.3
G07	25.3	26.4	27.0	27.0	26.6	25.9

Receiver ID	8	9	10	11	12	13
G08	24.9	26.0	26.6	26.6	26.2	25.5
G09	24.3	25.4	26.0	26.0	25.6	24.9
G10	27.7	28.8	29.4	29.4	29.0	28.3
G11	*32.9*	*34.0*	*34.6*	*34.6*	*34.2*	*33.5*
G12	***35.3***	***36.4***	***37.0***	***37.0***	***36.6***	***35.9***
G13	*33.4*	*34.5*	*35.1*	*35.1*	*34.7*	*34.0*
G14	***35.6***	***36.7***	***37.3***	***37.3***	***36.9***	***36.2***
G15	***38.5***	***39.6***	***40.2***	***40.2***	***39.8***	***39.1***
G16	*37.8*	*38.9*	*39.5*	*39.5*	*39.1*	*38.4*
G18	28.1	29.2	29.8	29.8	29.4	28.7
G19	27.0	28.1	28.7	28.7	28.3	27.6
G20	28.7	29.8	30.4	30.4	30.0	29.3
G23	25.5	26.6	27.2	27.2	26.8	26.1
G24	25.3	26.4	27.0	27.0	26.6	25.9
G26	23.8	24.9	25.5	25.5	25.1	24.4
G27	18.0	19.1	19.7	19.7	19.3	18.6
G29	29.6	30.7	31.3	31.3	30.9	30.2
G30	**27.3**	**28.4**	**29.0**	**29.0**	**28.6**	**27.9**
G31	*35.7*	*36.8*	*37.4*	*37.4*	*37.0*	*36.3*
G32	27.2	28.3	28.9	28.9	28.5	27.8
G36	26.6	27.7	28.3	28.3	27.9	27.2
G38	*34.1*	*35.2*	*35.8*	*35.8*	*35.4*	*34.7*
G39	25.2	26.3	26.9	26.9	26.5	25.8
G40	29.2	30.3	30.9	30.9	30.5	29.8
G41	27.2	28.3	28.9	28.9	28.5	27.8
G42	13.2	14.3	14.9	14.9	14.5	13.8
G44	27.2	28.3	28.9	28.9	28.5	27.8
G46	23.4	24.5	25.1	25.1	24.7	24.0
G54	22.3	23.4	24.0	24.0	23.6	22.9
G55	24.0	25.1	25.7	25.7	25.3	24.6
G56	21.9	23.0	23.6	23.6	23.2	22.5
G57	26.1	27.2	27.8	27.8	27.4	26.7
G58	26.8	27.9	28.5	28.5	28.1	27.4
G59	24.5	25.6	26.2	26.2	25.8	25.1
G60	25.0	26.1	26.7	26.7	26.3	25.6

Receiver ID	8	9	10	11	12	13
G61	23.0	24.1	24.7	24.7	24.3	23.6
H30	27.2	28.3	28.9	28.9	28.5	27.8
K52	23.3	24.4	25.0	25.0	24.6	23.9
M01	30.0	31.1	31.7	31.7	31.3	30.6
M02	29.0	30.1	30.7	30.7	30.3	29.6
M03	30.0	31.1	31.7	31.7	31.3	30.6
M04	**29.6**	**30.7**	**31.3**	**31.3**	**30.9**	**30.2**
M05	26.5	27.6	28.2	28.2	27.8	27.1
M06	28.1	29.2	29.8	29.8	29.4	28.7
M07	25.7	26.8	27.4	27.4	27.0	26.3
M08	*32.1*	*33.2*	*33.8*	*33.8*	*33.4*	*32.7*
M09	27.5	28.6	29.2	29.2	28.8	28.1
M13	27.7	28.8	29.4	29.4	29.0	28.3
M18	***39.3***	***40.4***	***41.0***	***41.0***	***40.6***	***39.9***
M20	*31.2*	*32.3*	*32.9*	*32.9*	*32.5*	*31.8*
M21	*33.5*	*34.6*	*35.2*	*35.2*	*34.8*	*34.1*
M22	28.8	29.9	30.5	30.5	30.1	29.4
M24	31.0	32.1	32.7	32.7	32.3	31.6
M25	27.6	28.7	29.3	29.3	28.9	28.2
M26	27.7	28.8	29.4	29.4	29.0	28.3
M27	27.5	28.6	29.2	29.2	28.8	28.1
M28	27.6	28.7	29.3	29.3	28.9	28.2
M29	27.6	28.7	29.3	29.3	28.9	28.2
M30	27.4	28.5	29.1	29.1	28.7	28.0
M31	27.2	28.3	28.9	28.9	28.5	27.8
M32	*32.1*	*33.2*	*33.8*	*33.8*	*33.4*	*32.7*
M33	25.9	27.0	27.6	27.6	27.2	26.5
M34	27.9	29.0	29.6	29.6	29.2	28.5
M35	29.0	30.1	30.7	30.7	30.3	29.6
M36	27.7	28.8	29.4	29.4	29.0	28.3
M37	29.1	30.2	30.8	30.8	30.4	29.7
M38	27.1	28.2	28.8	28.8	28.4	27.7
M39	27.3	28.4	29.0	29.0	28.6	27.9
M40	28.0	29.1	29.7	29.7	29.3	28.6
M41	*33.2*	*34.3*	*34.9*	*34.9*	*34.5*	*33.8*

Receiver ID	8	9	10	11	12	13
M42	*33.4*	*34.5*	*35.1*	*35.1*	*34.7*	*34.0*
M43	23.6	24.7	25.3	25.3	24.9	24.2
M44	23.4	24.5	25.1	25.1	24.7	24.0
M44a	24.0	25.1	25.7	25.7	25.3	24.6
M44b	24.2	25.3	25.9	25.9	25.5	24.8
M46	29.0	30.1	30.7	30.7	30.3	29.6
M48	*37.8*	*38.9*	*39.5*	*39.5*	*39.1*	*38.4*

Table I2 summarises the predicted noise levels for all receivers at hub height integer wind speeds using the V90 turbines. Relevant receivers for the current assessment are highlighted using italic text. The relevant receivers for the 2009 assessment are shown using bold text.

Table I2: Predicted noise levels at integer hub height wind speeds for V90 turbines

Receiver ID	6	7	8	9	10	11	12	13	14	15
C01	**24.8**	**27.1**	**29.2**	**31.0**	**32.1**	**32.6**	**32.6**	**32.4**	**32.7**	**33.1**
C02	***31.4***	***33.7***	***35.8***	***37.6***	***38.7***	***39.2***	***39.2***	***39.0***	***39.3***	***39.7***
C03	***31.0***	***33.3***	***35.4***	***37.2***	***38.3***	***38.8***	***38.8***	***38.6***	***38.9***	***39.3***
C04	***29.6***	***31.9***	***34.0***	***35.8***	***36.9***	***37.4***	***37.4***	***37.2***	***37.5***	***37.9***
C05	**26.3**	**28.6**	**30.7**	**32.5**	**33.6**	**34.1**	**34.1**	**33.9**	**34.2**	**34.6**
C06	25.7	28.0	30.1	31.9	33.0	33.5	33.5	33.3	33.6	34.0
C07	**17.4**	**19.7**	**21.8**	**23.6**	**24.7**	**25.2**	**25.2**	**25.0**	**25.3**	**25.7**
C08	24.5	26.8	28.9	30.7	31.8	32.3	32.3	32.1	32.4	32.8
C09	16.4	18.7	20.8	22.6	23.7	24.2	24.2	24.0	24.3	24.7
C10	18.4	20.7	22.8	24.6	25.7	26.2	26.2	26.0	26.3	26.7
C12	22.9	25.2	27.3	29.1	30.2	30.7	30.7	30.5	30.8	31.2
C13	24.1	26.4	28.5	30.3	31.4	31.9	31.9	31.7	32.0	32.4
C22	22.8	25.1	27.2	29.0	30.1	30.6	30.6	30.4	30.7	31.1
C25	*33.9*	*36.2*	*38.3*	*40.1*	*41.2*	*41.7*	*41.7*	*41.5*	*41.8*	*42.2*
C26	***29.9***	***32.2***	***34.3***	***36.1***	***37.2***	***37.7***	***37.7***	***37.5***	***37.8***	***38.2***
C27	*31.0*	*33.3*	*35.4*	*37.2*	*38.3*	*38.8*	*38.8*	*38.6*	*38.9*	*39.3*
C28	23.8	26.1	28.2	30.0	31.1	31.6	31.6	31.4	31.7	32.1
C28a	23.4	25.7	27.8	29.6	30.7	31.2	31.2	31.0	31.3	31.7
C29	**26.2**	**28.5**	**30.6**	**32.4**	**33.5**	**34.0**	**34.0**	**33.8**	**34.1**	**34.5**
C30	**25.1**	**27.4**	**29.5**	**31.3**	**32.4**	**32.9**	**32.9**	**32.7**	**33.0**	**33.4**
C33	23.4	25.7	27.8	29.6	30.7	31.2	31.2	31.0	31.3	31.7
C34	23.8	26.1	28.2	30.0	31.1	31.6	31.6	31.4	31.7	32.1
C35	**25.5**	**27.8**	**29.9**	**31.7**	**32.8**	**33.3**	**33.3**	**33.1**	**33.4**	**33.8**
C37	23.9	26.2	28.3	30.1	31.2	31.7	31.7	31.5	31.8	32.2
C38	**22.3**	**24.6**	**26.7**	**28.5**	**29.6**	**30.1**	**30.1**	**29.9**	**30.2**	**30.6**
C39	19.5	21.8	23.9	25.7	26.8	27.3	27.3	27.1	27.4	27.8
C41	24.1	26.4	28.5	30.3	31.4	31.9	31.9	31.7	32.0	32.4
C42	**25.2**	**27.5**	**29.6**	**31.4**	**32.5**	**33.0**	**33.0**	**32.8**	**33.1**	**33.5**
C46a	24.1	26.4	28.5	30.3	31.4	31.9	31.9	31.7	32.0	32.4
C47	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9
C48	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9

Receiver ID	6	7	8	9	10	11	12	13	14	15
C52	23.4	25.7	27.8	29.6	30.7	31.2	31.2	31.0	31.3	31.7
C53	25.1	27.4	29.5	31.3	32.4	32.9	32.9	32.7	33.0	33.4
C55	*29.8*	*32.1*	*34.2*	*36.0*	*37.1*	*37.6*	*37.6*	*37.4*	*37.7*	*38.1*
C56	*31.8*	*34.1*	*36.2*	*38.0*	*39.1*	*39.6*	*39.6*	*39.4*	*39.7*	*40.1*
C58	23.3	25.6	27.7	29.5	30.6	31.1	31.1	30.9	31.2	31.6
C59	24.0	26.3	28.4	30.2	31.3	31.8	31.8	31.6	31.9	32.3
C60	23.9	26.2	28.3	30.1	31.2	31.7	31.7	31.5	31.8	32.2
C61	22.9	25.2	27.3	29.1	30.2	30.7	30.7	30.5	30.8	31.2
C62	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9
C63	24.4	26.7	28.8	30.6	31.7	32.2	32.2	32.0	32.3	32.7
C64	24.0	26.3	28.4	30.2	31.3	31.8	31.8	31.6	31.9	32.3
C65	24.1	26.4	28.5	30.3	31.4	31.9	31.9	31.7	32.0	32.4
C66	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9
C67	25.4	27.7	29.8	31.6	32.7	33.2	33.2	33.0	33.3	33.7
C68	*30.8*	*33.1*	*35.2*	*37.0*	*38.1*	*38.6*	*38.6*	*38.4*	*38.7*	*39.1*
C69	24.4	26.7	28.8	30.6	31.7	32.2	32.2	32.0	32.3	32.7
C71	26.2	28.5	30.6	32.4	33.5	34.0	34.0	33.8	34.1	34.5
C72	21.2	23.5	25.6	27.4	28.5	29.0	29.0	28.8	29.1	29.5
C73	18.1	20.4	22.5	24.3	25.4	25.9	25.9	25.7	26.0	26.4
C74	*26.9*	*29.2*	*31.3*	*33.1*	*34.2*	*34.7*	*34.7*	*34.5*	*34.8*	*35.2*
C75	23.7	26.0	28.1	29.9	31.0	31.5	31.5	31.3	31.6	32.0
C76	23.4	25.7	27.8	29.6	30.7	31.2	31.2	31.0	31.3	31.7
C76a	23.8	26.1	28.2	30.0	31.1	31.6	31.6	31.4	31.7	32.1
C77	22.3	24.6	26.7	28.5	29.6	30.1	30.1	29.9	30.2	30.6
E20	23.0	25.3	27.4	29.2	30.3	30.8	30.8	30.6	30.9	31.3
G01	14.6	16.9	19.0	20.8	21.9	22.4	22.4	22.2	22.5	22.9
G02	18.1	20.4	22.5	24.3	25.4	25.9	25.9	25.7	26.0	26.4
G02a	18.5	20.8	22.9	24.7	25.8	26.3	26.3	26.1	26.4	26.8
G03	20.3	22.6	24.7	26.5	27.6	28.1	28.1	27.9	28.2	28.6
G04	16.9	19.2	21.3	23.1	24.2	24.7	24.7	24.5	24.8	25.2
G05	16.6	18.9	21.0	22.8	23.9	24.4	24.4	24.2	24.5	24.9
G06	14.3	16.6	18.7	20.5	21.6	22.1	22.1	21.9	22.2	22.6
G07	21.3	23.6	25.7	27.5	28.6	29.1	29.1	28.9	29.2	29.6
G08	20.0	22.3	24.4	26.2	27.3	27.8	27.8	27.6	27.9	28.3
G09	20.4	22.7	24.8	26.6	27.7	28.2	28.2	28.0	28.3	28.7

Receiver ID	6	7	8	9	10	11	12	13	14	15
G10	23.3	25.6	27.7	29.5	30.6	31.1	31.1	30.9	31.2	31.6
G11	*28.9*	*31.2*	*33.3*	*35.1*	*36.2*	*36.7*	*36.7*	*36.5*	*36.8*	*37.2*
G12	***30.6***	***32.9***	***35.0***	***36.8***	***37.9***	***38.4***	***38.4***	***38.2***	***38.5***	***38.9***
G13	*29.1*	*31.4*	*33.5*	*35.3*	*36.4*	*36.9*	*36.9*	*36.7*	*37.0*	*37.4*
G14	***31.0***	***33.3***	***35.4***	***37.2***	***38.3***	***38.8***	***38.8***	***38.6***	***38.9***	***39.3***
G15	***34.0***	***36.3***	***38.4***	***40.2***	***41.3***	***41.8***	***41.8***	***41.6***	***41.9***	***42.3***
G16	*33.4*	*35.7*	*37.8*	*39.6*	*40.7*	*41.2*	*41.2*	*41.0*	*41.3*	*41.7*
G18	24.5	26.8	28.9	30.7	31.8	32.3	32.3	32.1	32.4	32.8
G19	23.4	25.7	27.8	29.6	30.7	31.2	31.2	31.0	31.3	31.7
G20	24.7	27.0	29.1	30.9	32.0	32.5	32.5	32.3	32.6	33.0
G23	21.2	23.5	25.6	27.4	28.5	29.0	29.0	28.8	29.1	29.5
G24	20.4	22.7	24.8	26.6	27.7	28.2	28.2	28.0	28.3	28.7
G26	20.5	22.8	24.9	26.7	27.8	28.3	28.3	28.1	28.4	28.8
G27	15.2	17.5	19.6	21.4	22.5	23.0	23.0	22.8	23.1	23.5
G29	25.5	27.8	29.9	31.7	32.8	33.3	33.3	33.1	33.4	33.8
G30	**23.9**	**26.2**	**28.3**	**30.1**	**31.2**	**31.7**	**31.7**	**31.5**	**31.8**	**32.2**
G31	*31.3*	*33.6*	*35.7*	*37.5*	*38.6*	*39.1*	*39.1*	*38.9*	*39.2*	*39.6*
G32	24.1	26.4	28.5	30.3	31.4	31.9	31.9	31.7	32.0	32.4
G36	21.9	24.2	26.3	28.1	29.2	29.7	29.7	29.5	29.8	30.2
G38	*29.8*	*32.1*	*34.2*	*36.0*	*37.1*	*37.6*	*37.6*	*37.4*	*37.7*	*38.1*
G39	20.2	22.5	24.6	26.4	27.5	28.0	28.0	27.8	28.1	28.5
G40	25.1	27.4	29.5	31.3	32.4	32.9	32.9	32.7	33.0	33.4
G41	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9
G42	9.8	12.1	14.2	16.0	17.1	17.6	17.6	17.4	17.7	18.1
G44	23.5	25.8	27.9	29.7	30.8	31.3	31.3	31.1	31.4	31.8
G46	20.0	22.3	24.4	26.2	27.3	27.8	27.8	27.6	27.9	28.3
G54	17.9	20.2	22.3	24.1	25.2	25.7	25.7	25.5	25.8	26.2
G55	18.8	21.1	23.2	25.0	26.1	26.6	26.6	26.4	26.7	27.1
G56	16.9	19.2	21.3	23.1	24.2	24.7	24.7	24.5	24.8	25.2
G57	22.3	24.6	26.7	28.5	29.6	30.1	30.1	29.9	30.2	30.6
G58	23.2	25.5	27.6	29.4	30.5	31.0	31.0	30.8	31.1	31.5
G59	20.9	23.2	25.3	27.1	28.2	28.7	28.7	28.5	28.8	29.2
G60	21.1	23.4	25.5	27.3	28.4	28.9	28.9	28.7	29.0	29.4
G61	19.7	22.0	24.1	25.9	27.0	27.5	27.5	27.3	27.6	28.0
H30	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9

Receiver ID	6	7	8	9	10	11	12	13	14	15
K52	21.3	23.6	25.7	27.5	28.6	29.1	29.1	28.9	29.2	29.6
M01	25.0	27.3	29.4	31.2	32.3	32.8	32.8	32.6	32.9	33.3
M02	24.3	26.6	28.7	30.5	31.6	32.1	32.1	31.9	32.2	32.6
M03	24.7	27.0	29.1	30.9	32.0	32.5	32.5	32.3	32.6	33.0
M04	**24.4**	**26.7**	**28.8**	**30.6**	**31.7**	**32.2**	**32.2**	**32.0**	**32.3**	**32.7**
M05	22.8	25.1	27.2	29.0	30.1	30.6	30.6	30.4	30.7	31.1
M06	24.4	26.7	28.8	30.6	31.7	32.2	32.2	32.0	32.3	32.7
M07	21.3	23.6	25.7	27.5	28.6	29.1	29.1	28.9	29.2	29.6
M08	*27.9*	*30.2*	*32.3*	*34.1*	*35.2*	*35.7*	*35.7*	*35.5*	*35.8*	*36.2*
M09	23.1	25.4	27.5	29.3	30.4	30.9	30.9	30.7	31.0	31.4
M13	24.1	26.4	28.5	30.3	31.4	31.9	31.9	31.7	32.0	32.4
M18	***34.8***	***37.1***	***39.2***	***41.0***	***42.1***	***42.6***	***42.6***	***42.4***	***42.7***	***43.1***
M20	*26.9*	*29.2*	*31.3*	*33.1*	*34.2*	*34.7*	*34.7*	*34.5*	*34.8*	*35.2*
M21	*28.8*	*31.1*	*33.2*	*35.0*	*36.1*	*36.6*	*36.6*	*36.4*	*36.7*	*37.1*
M22	24.3	26.6	28.7	30.5	31.6	32.1	32.1	31.9	32.2	32.6
M24	26.6	28.9	31.0	32.8	33.9	34.4	34.4	34.2	34.5	34.9
M25	23.5	25.8	27.9	29.7	30.8	31.3	31.3	31.1	31.4	31.8
M26	23.9	26.2	28.3	30.1	31.2	31.7	31.7	31.5	31.8	32.2
M27	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9
M28	23.8	26.1	28.2	30.0	31.1	31.6	31.6	31.4	31.7	32.1
M29	23.7	26.0	28.1	29.9	31.0	31.5	31.5	31.3	31.6	32.0
M30	23.8	26.1	28.2	30.0	31.1	31.6	31.6	31.4	31.7	32.1
M31	23.2	25.5	27.6	29.4	30.5	31.0	31.0	30.8	31.1	31.5
M32	*27.7*	*30.0*	*32.1*	*33.9*	*35.0*	*35.5*	*35.5*	*35.3*	*35.6*	*36.0*
M33	22.5	24.8	26.9	28.7	29.8	30.3	30.3	30.1	30.4	30.8
M34	22.9	25.2	27.3	29.1	30.2	30.7	30.7	30.5	30.8	31.2
M35	24.5	26.8	28.9	30.7	31.8	32.3	32.3	32.1	32.4	32.8
M36	23.3	25.6	27.7	29.5	30.6	31.1	31.1	30.9	31.2	31.6
M37	24.8	27.1	29.2	31.0	32.1	32.6	32.6	32.4	32.7	33.1
M38	21.9	24.2	26.3	28.1	29.2	29.7	29.7	29.5	29.8	30.2
M39	22.7	25.0	27.1	28.9	30.0	30.5	30.5	30.3	30.6	31.0
M40	23.6	25.9	28.0	29.8	30.9	31.4	31.4	31.2	31.5	31.9
M41	*29.2*	*31.5*	*33.6*	*35.4*	*36.5*	*37.0*	*37.0*	*36.8*	*37.1*	*37.5*
M42	*28.0*	*30.3*	*32.4*	*34.2*	*35.3*	*35.8*	*35.8*	*35.6*	*35.9*	*36.3*
M43	20.4	22.7	24.8	26.6	27.7	28.2	28.2	28.0	28.3	28.7

Receiver ID	6	7	8	9	10	11	12	13	14	15
M44	21.5	23.8	25.9	27.7	28.8	29.3	29.3	29.1	29.4	29.8
M44a	22.1	24.4	26.5	28.3	29.4	29.9	29.9	29.7	30.0	30.4
M44b	22.0	24.3	26.4	28.2	29.3	29.8	29.8	29.6	29.9	30.3
M46	25.2	27.5	29.6	31.4	32.5	33.0	33.0	32.8	33.1	33.5
M48	*33.0*	*35.3*	*37.4*	*39.2*	*40.3*	*40.8*	*40.8*	*40.6*	*40.9*	*41.3*

APPENDIX J CONSIDERATION OF DRAFT NSW WIND FARM PLANING GUIDELINES

The *Draft NSW Planning Guidelines – Wind Farms* were released in December 2011 (the draft NSW guidelines) by the DPI. As outline in Section 0, the DPI has requested the addendum "have regard" to the draft NSW guidelines. The key differences between the draft NSW guidelines and the South Australian Wind Farm Guidelines 2003 are as follows:

- Noise criteria to be developed separately for the daytime period (7am to 10pm) and night-time period (10pm to 7am)
- Consideration and prediction of expected low frequency noise emissions
- Differences in compliance monitoring

We have provided a more detailed assessment in the following sections.

The baseline noise levels referenced in this assessment have been sourced from surveys conducted in 2009 with the exception of receiver M42 and therefore prior to the release of the draft NSW guidelines. Baseline noise levels have not been remeasured as part of this addendum, with the exception of one additional location surveyed in 2013.

J1 Informative analysis of night-time noise criteria

In general, the night-time criteria for a given receiver are lower than the 24 hour or daytime criteria, as shown in Appendix H.

To provide an indication of the potential affect the application of night-time noise criteria could have for the project, the predicted noise levels for the identified relevant receivers have been compared to the night-time criteria developed from the data collected for the 2009 assessment.

The analysis shows only one receiver, receiver M42, may be affected by the application of night-time criteria. Figure J1 shows the predicted noise levels for receiver M42 and the 24hr and night-time criteria. Based on the 24hr criteria, the predicted noise levels achieve compliance at all integer wind speeds. However, when considering the night-time noise criteria, the predicted noise levels for the V90 turbine exceed the criteria by up to 0.6dB between 10 and 13m/s and the predicted levels for the MM92 turbines exceed the criteria by up to 0.1dB between 10 and 11m/s.

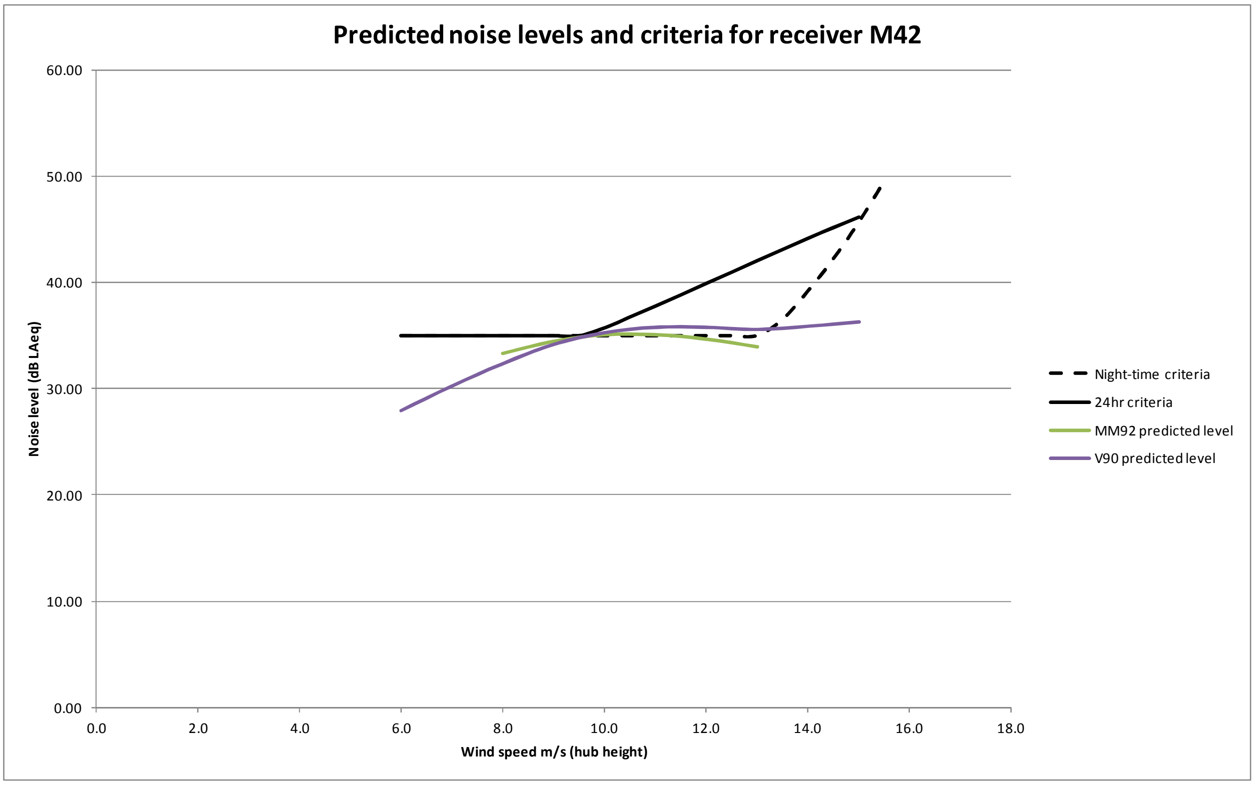


Figure J1: Predicted noise levels and criteria for receiver M42

As stated in section H2 of Appendix H, the night-time criteria is not deemed robust as the data set from which the criteria has been developed has a limited number of data points and the data covers a limited range of wind speeds., Low Frequency Noise Levels

Discussion

Detailed guidance on proposed noise assessment methods is contained in Appendix B of the draft NSW guidelines, and does not explicitly indicate a requirement to predict low-frequency noise levels. The proposed methodology does however nominate a method of identifying the presence of low frequency special audible characteristics which may result in the application of a 5dB penalty to predicted or measured noise levels.

The Site Compatibility Certificate application referred to in Section 1.3 of the draft NSW guidelines makes reference to the prediction of low-frequency noise levels at dwellings within 2km where consent has not been obtained. Whilst specific details of the low frequency noise predictions that are required are not specified in Section 1.3, we anticipate that the intent of the draft NSW guidelines is that the prediction of C-weighted noise levels is required, in line with the advice provided in Appendix B of the draft NSW guidelines.

The C-weighting refers to the way in which the frequency content of the noise is adjusted to produce a total decibel value for the noise level. The most common form of assessment relies on the A-weighting which is intended to adjust noise frequencies in a way that results in a total noise level corresponding to general human perception of loudness. The A-weighting is however recognised as being less appropriate for noise levels characterised by significant or prominent low-frequency components (specifically, frequencies of noise lying below approximately 200Hz). The value of noise levels which are predicted or measured using the C-weighting are more sensitive to the influence of low-frequency noise, and are therefore often referred to as an indicative measure when evaluating low-frequency considerations. For a given noise source and character, the noise level measured using a C-weighting will be greater than measured using an A-weighting in most cases.

The low frequency noise criteria presented in the draft NSW guidelines are summarised as follows:

- Day: 65dB L_{Ceq}
- Night: 60dB L_{Ceq}

To be able to present this information requires:

- Turbine manufacturers' noise emission data at frequencies below the minimum range that may be available, and at frequencies outside the validated range of the international test standard used for rating turbine emissions (IEC 61400:11)
- Prediction of noise levels at frequencies below the validated range of the methodologies commonly used in Australia (referred to in the draft NSW guidelines - ISO 9613 and CONCAWE). Alternative methods are available for predicting noise at lower frequencies (notably the Danish method NORD 2000), however to our knowledge these methods are not routinely applied in Australia (for wind farm or other general applications) or other countries such as New Zealand or the United Kingdom (countries in which we are familiar with noise assessment legislation and practices).

In the absence of an international standard engineering prediction method specifically developed for the prediction of C-weighted noise levels, the ISO 9613 methodology has also been used to produce low frequency noise level predictions at non-involved receivers within 2km of a proposed turbine location. These predictions are provided to address the information requirements proposed in the draft NSW guidelines. It must however be recognised that ISO 9613 and other similar prediction methods are not specifically intended for this purpose, and involves applying the prediction methodology to frequencies outside the stated scope of the standard. As a result, the prediction of C-weighted noise levels is subject to a greater level of uncertainty.

Predictions

Table J1 presents the maximum predicted noise levels at each of the non-involved receiver locations where a wind turbine is proposed to be located within 2km. The predicted noise levels presented in Table J1 are based on the octave band noise level measured test data for frequencies upwards of 20Hz and correspond to the wind speeds where the maximum predicted noise levels occurred.

In the case of the MM92 candidate turbine, the available test data is limited to 50Hz and above. The influence of noise emissions between 20Hz and 50Hz has been estimated based on the test data for the V90 turbine with the valued corrected so the overall A-weighted was that of the maximum sound power level.

Table J1: Maximum C-weighted predicted receiver noise levels L_{eq} dBC

		Criteria achieved?			Criteria achieved?	
Location	**MM92**	**Daytime**	**Night-time**	**V90**	**Daytime**	**Night-time**
G11	56	✓	✓	61	✓	✗
G14	58	✓	✓	63	✓	✗
G16	60	✓	✓	64	✓	✗
M42	58	✓	✓	63	✓	✗

For the MM92 turbine, the predicted dBC value is below both the daytime and night-time criteria. For the V90 turbine, the predicted dBC values are below the daytime criteria of 65dBC but exceed the night-time criteria 60dBC. According to the draft NSW guidelines, further detailed low frequency noise assessment may be required.

The prediction of low frequency noise levels are however subject to increased margins of uncertainty. This uncertainty relates to the use of sound power level data below the normal frequency range reported by turbine manufacturers, combined with the application of engineering prediction methods specifically intended for the calculation of A-weighted noise levels. In relation to these uncertainties, the following considerations are noted:

- The prediction of environmental noise levels involves calculation of a number of atmospheric and environmental effects. In relation to key items, the following considerations are noted:
  - The ISO 9613 prediction method assumes an equal noise contribution from the reflected ground wave at 63Hz, and therefore applies no ground attenuation at this frequency irrespective of the selected ground absorption for the calculation. This effectively equates to a hard ground condition and therefore a hemi-spherical noise propagation pattern. In extending the application of ISO 9613 to C-weighted noise level calculations, frequencies below 63Hz are treated in a similar manner and therefore do not benefit from ground absorption
  - The ISO 9613 calculation method includes an attenuation factor related to atmospheric absorption. At low frequencies, this absorption is negligible, and the corresponding calculated attenuation equates to less than 0.1dB

Based on the above considerations, the ISO 9613 calculation of C-weighted noise levels can only be regarded as indicative predictions. The uncertainty associated with the C-weighted predicted noise levels is expected to be similar to, or greater than, than the uncertainty associated with the C-weighted sound power of the turbines.

J2 Noise Predictions and Compliance Monitoring

Appendix F provides a discussion on the noise prediction methodology used to predict noise emission for this assessment. The method applied is that of *ISO 9613-2: 1996- Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO9613 2:1996).

The draft NSW guidelines do not explicitly prescribe the noise prediction method to be used, but does refer to ISO 9613-2 and CONCAWE as two methods commonly used for wind farm noise predictions.

The selection of these parameters has been justified on the basis of field studies comparing predictions and measurements. These comparisons are however based on compliance testing according to a specific methodology. Specifically, compliance measurements based on the L_{A90} parameter which is a measure the underlying constant noise present in given measurement period (in this case, a 10 minute sample measurement). The draft NSW guidelines do permit the use of the L_{A90} parameter for compliance measurements, but importantly, specifies that an addition of 1.5dB must be applied to these values to yield an equivalent noise level L_{Aeq} (effectively a form of average noise level) for comparison with the noise criteria.

Therefore, whilst the prediction method presented in this addendum conforms to the method presented in the draft NSW guidelines, and demonstrates compliance with the same noise criteria which apply under the draft NSW guidelines, the proposed compliance measurement method introduces a risk. This risk is directly related to the compliance values being increased by 1.5dB. At locations where the predicted noise level is close to the limit value the 1.5dB adjustment to the compliance measurements could result in a non-compliance. Whilst this is technically a post-consent consideration, and the compliance methodology is only in draft form, the issue may represent a potential point of challenge to the noise assessment.

An additional factor with respect to the predictions relates to micro-siting. Appendix B of the draft NSW guidelines states that:

> *Micro-siting of turbines up to 100m from each turbine's nominated location will generally be permitted. Noise levels at receivers must be based on the 'worst case' turbine layout / configuration having regard to any micro-siting.*

The draft NSW guidelines do not prescribe how micro-siting should be accounted for. In general terms, a 100m change in the separating distance associated with wind farms is unlikely to give rise to a significant change in noise level; particularly given that it is unlikely that all turbines would shift 100m as part of micro-siting, and would also be unlikely to shift all in a single direction. However, in worst case terms, a theoretical shift of all turbines 100m in a single direction could give rise to an increase in noise level of approximately 0.5-1dB in some cases. In instances where the predicted noise levels are very close to the limit margin, an increase of this order would be sufficient to result in a predicted noise level above the 35dB minimum limit. We emphasise this is only a theoretical worst case, and is unlikely to transpire in practice, but may represent an avenue of challenge if the draft NSW guidelines were to be applied to the assessment.

APPENDIX K NOISE CONTOUR MAPS

It is not presently possible to directly apply Joule Report adjustments in the SoundPlan modelling software or any other proprietary noise prediction software package that we are aware of. In lieu of this, the adjustments are applied to the outputs of the noise model on the basis of source-receiver pairings.

The noise contour maps generated by SoundPlan are also not able reflect the Joule Report adjustments directly. Therefore, the following maps only provide an estimate of Joule Report adjusted predicted noise levels by presenting noise contours using a ground attenuation factors of G=0.

Using this estimated approach for the contours, the majority of the receivers are located within the correct 5dB contour band. We have identified the receivers which are not located in correct 5dB contour band in Table K1 and Table K2 below. Where the Joule reported noise level for a receiver is lower than the noise level presented in the grid noise maps, the receiver is said to be located in a higher contour. Where the Joule reported noise level for a receiver is higher than the noise level presented in the grid noise maps, the receiver is said to be located in a lower contour.

Table K1: Receivers located in incorrect contour band for MM92 scenario

Location	
C25*	Higher contour
G11	Higher contour
G16	Higher contour
M08	Higher contour
M41*	Higher contour
M42	Lower contour

Table K2: Receivers located in incorrect contour band for V90 scenario

Location	
C56*	Lower contour
C74	Lower contour
M20	Lower contour

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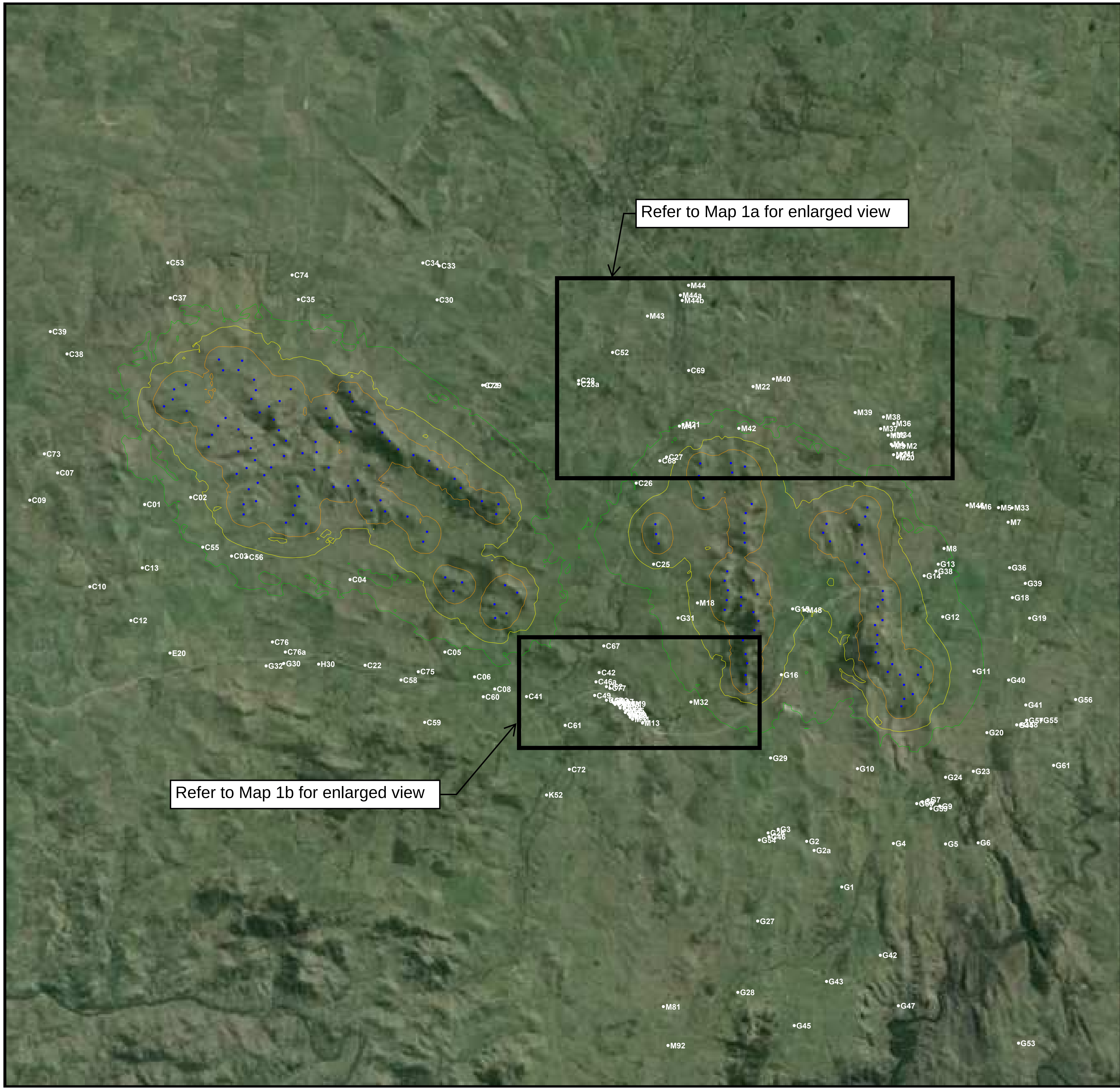


2013109SY

Yass Valley Wind Farm

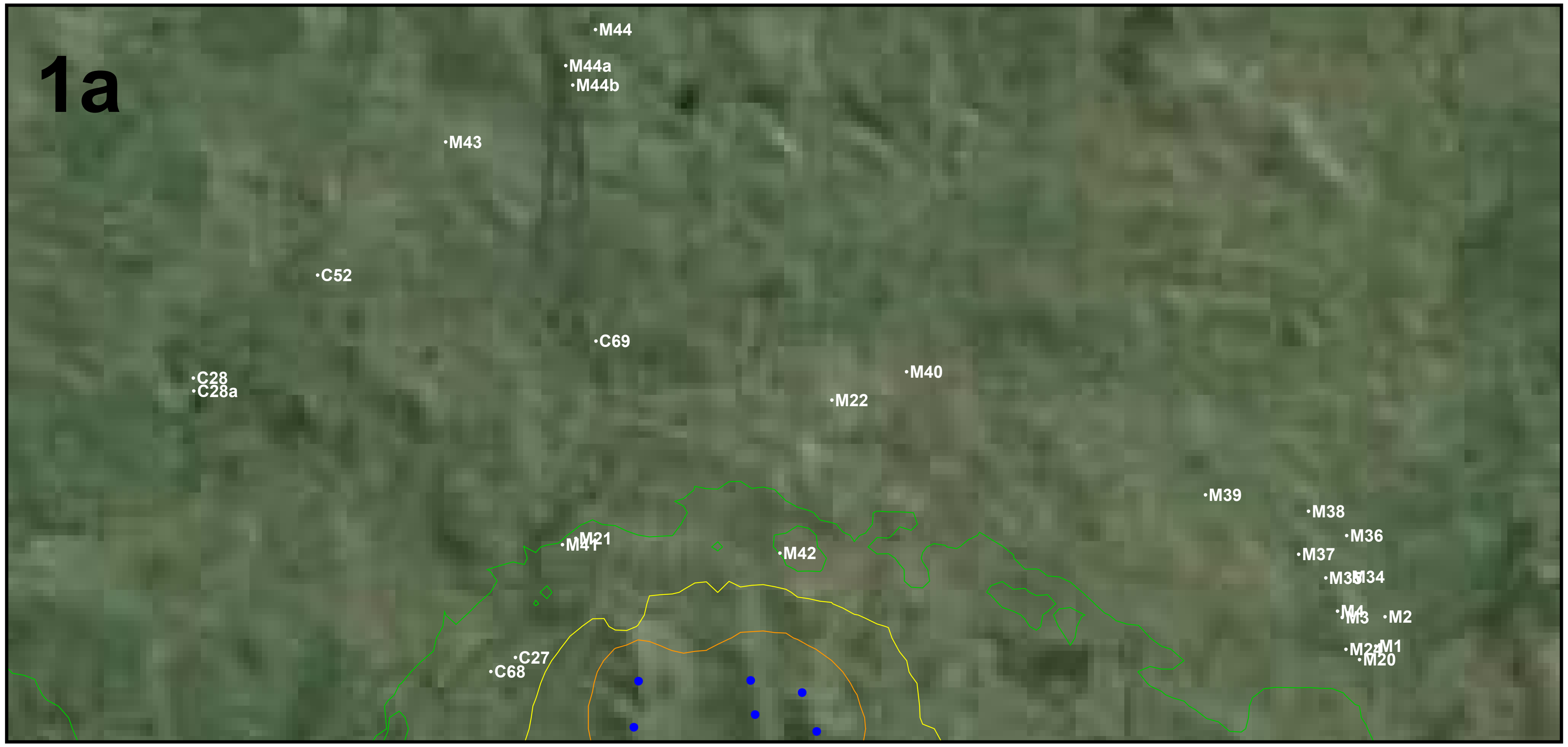
Map 1
MM92 turbines
Yass Valley Wind Farm
26 July 2013

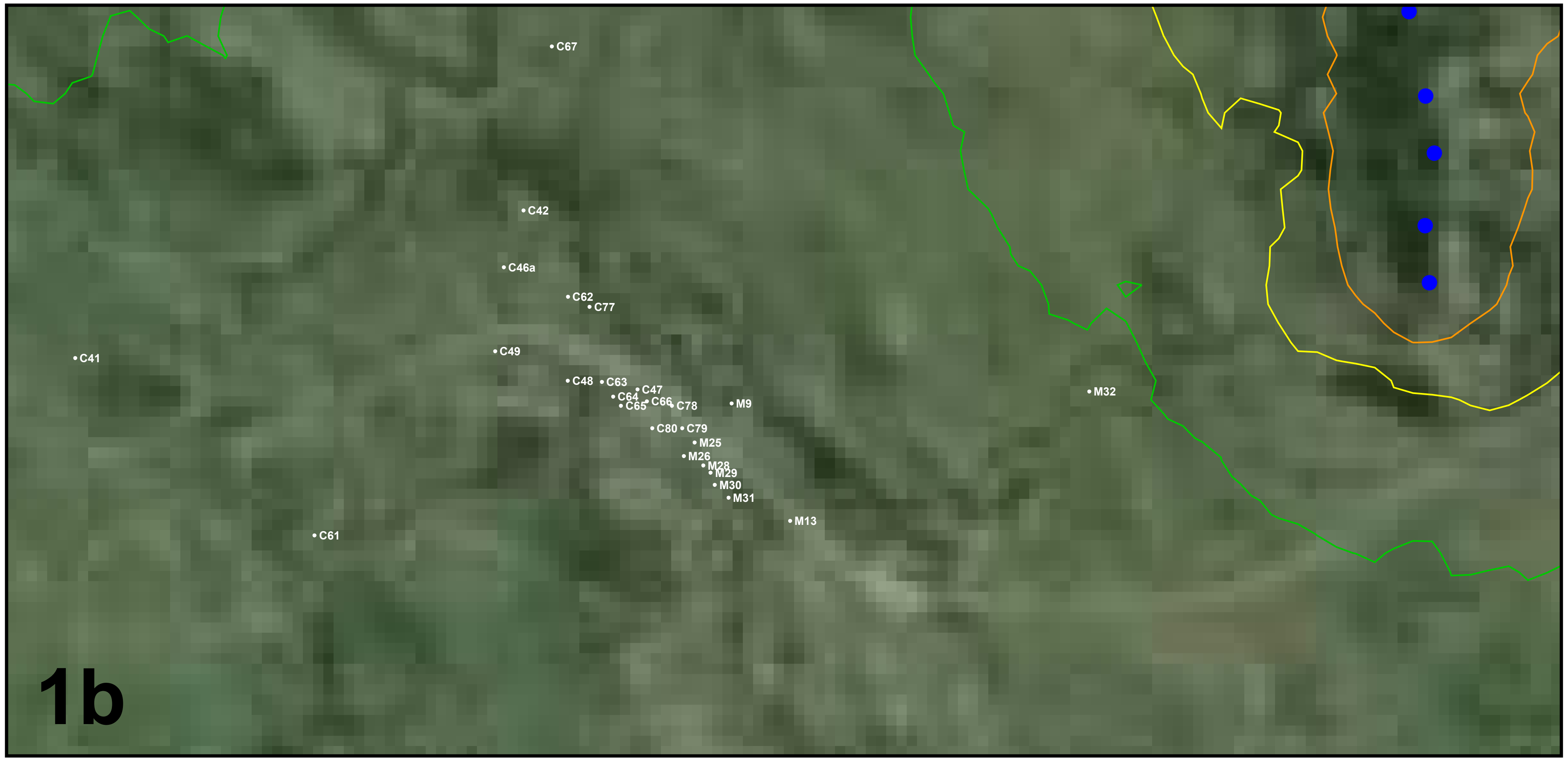
Predictions in accordance with ISO9613-2
Joule effect not applied
Representative noise levels only
(100% hard ground used for calculations)

Noise level
(LAeq dB)

= 35
= 40
= 45

MARSHALL DAY Acoustics





2013109SY

Yass Valley Wind Farm

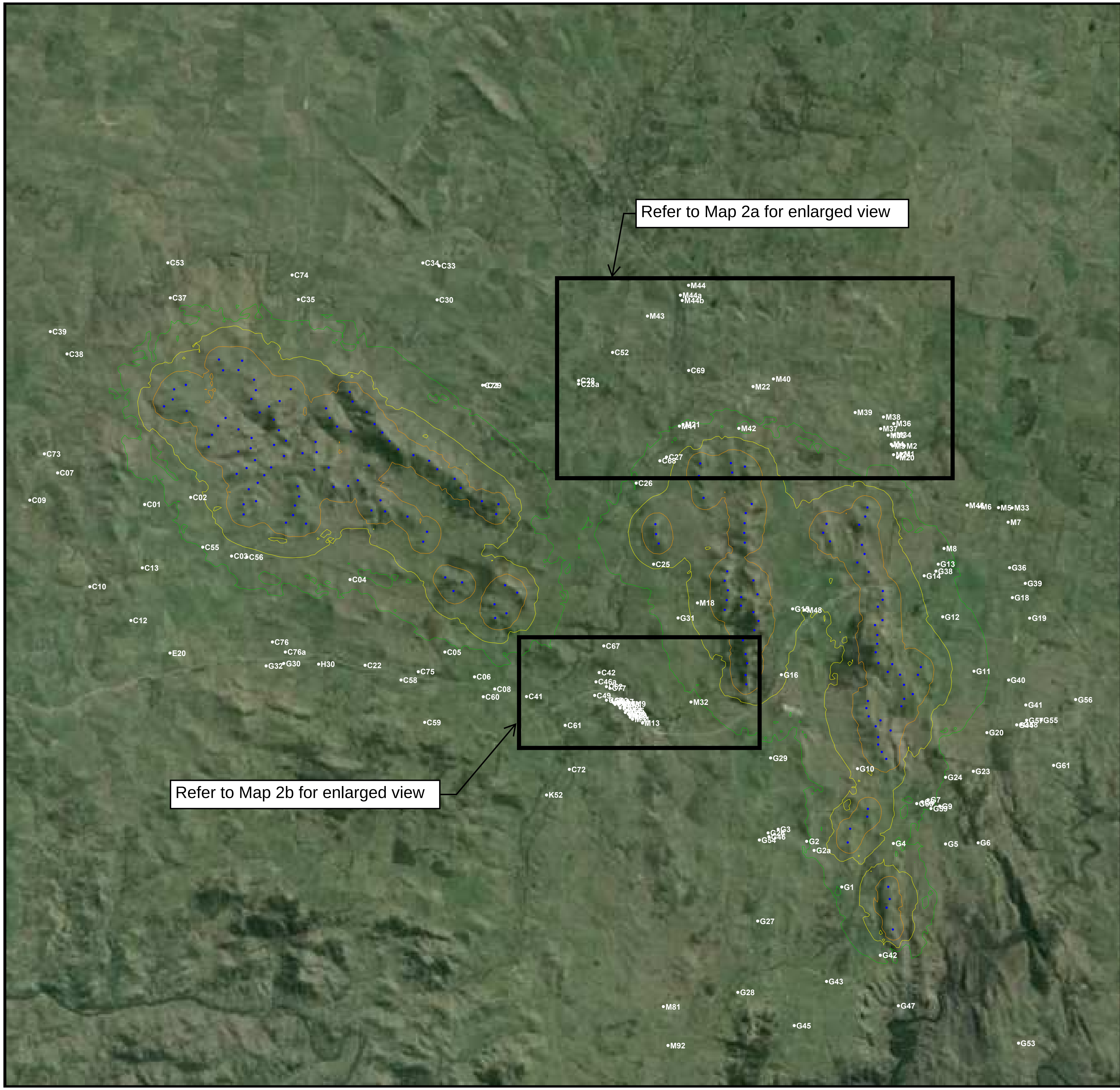
Map 1a and 1b (enlarged view)
MM92 turbines
Yass Valley Wind Farm
26 July 2013

Predictions in accordance with ISO9613-2
Joule effects not applied
Representative noise levels only
(100% hard ground used for calculations)

Noise level
(LAeq dB)

= 35
= 40
= 45

MARSHALL DAY Acoustics



2013109SY

Yass Valley Wind Farm

Map 2

MM92 turbines

Yass Valley and Conroy's Gap Wind Farms

26 July 2013

Predictions in accordance with ISO9613-2

Joule effects not applied

Representative noise levels only

(100% hard ground used for calculations)

Noise level

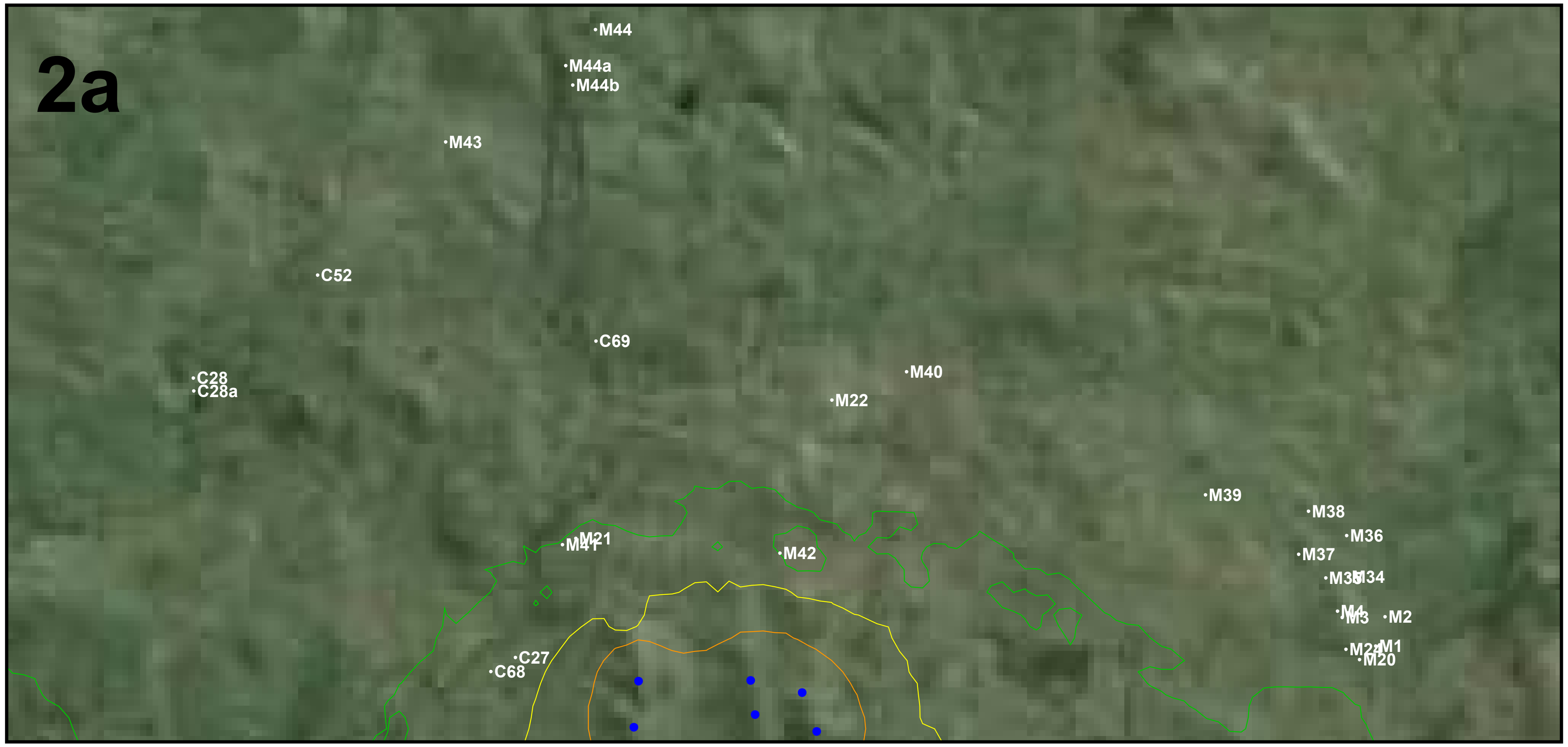
(LAeq dB)

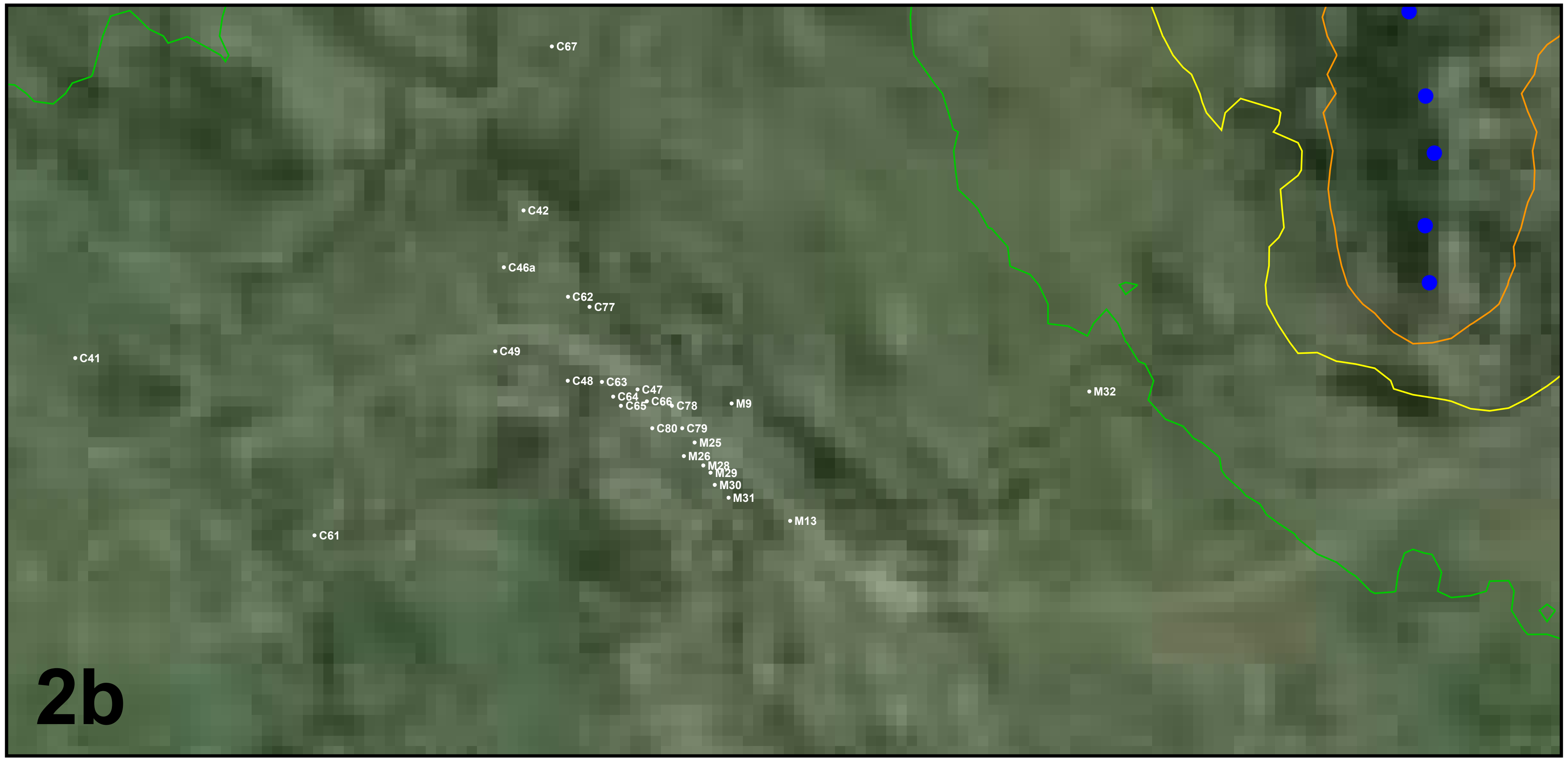
= 35

= 40

= 45

MARSHALL DAY Acoustics





2013109SY

Yass Valley Wind Farm

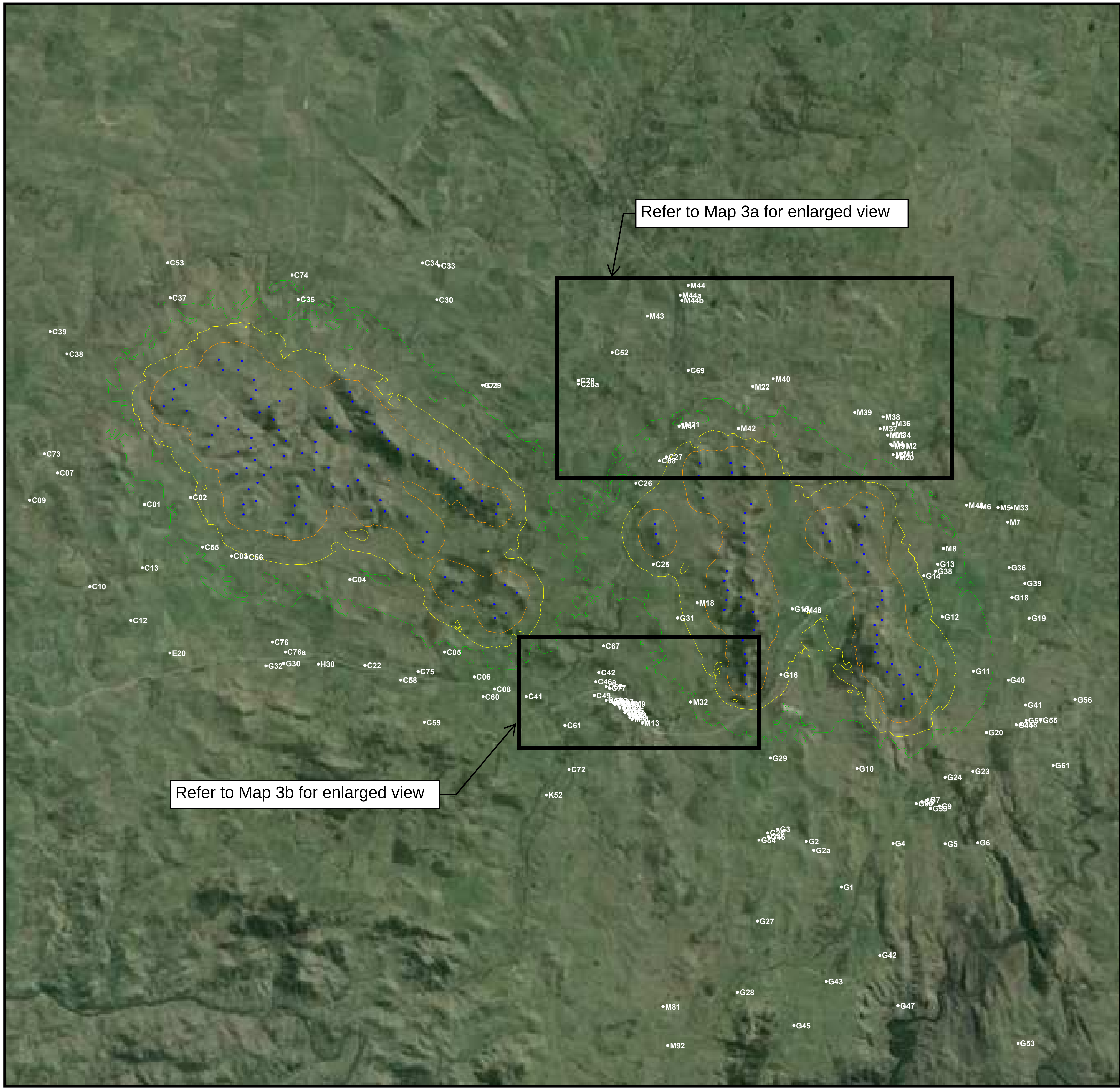
Map 2a and 2b (enlarged view)
MM92 turbines
Yass Valley and Conroy's Gap Wind Farms
26 July 2013

Predictions in accordance with ISO9613-2
Joule effects not applied
Representative noise levels only
(100% hard ground used for calculations)

Noise level
(LAeq dB)

= 35
= 40
= 45

MARSHALL DAY Acoustics



2013109SY

Yass Valley Wind Farm

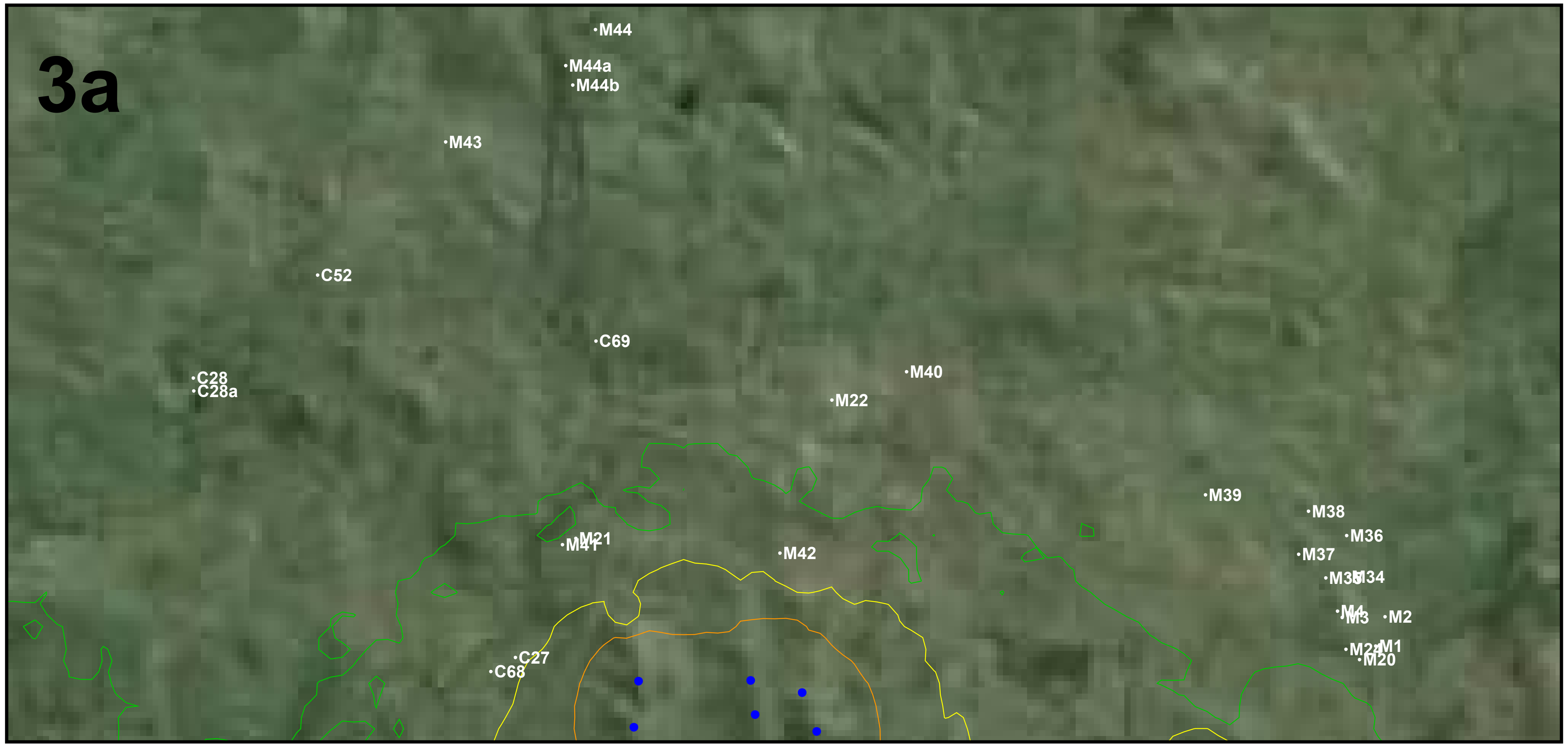
Map 3
V90 turbines
Yass Valley Wind Farm
26 July 2013

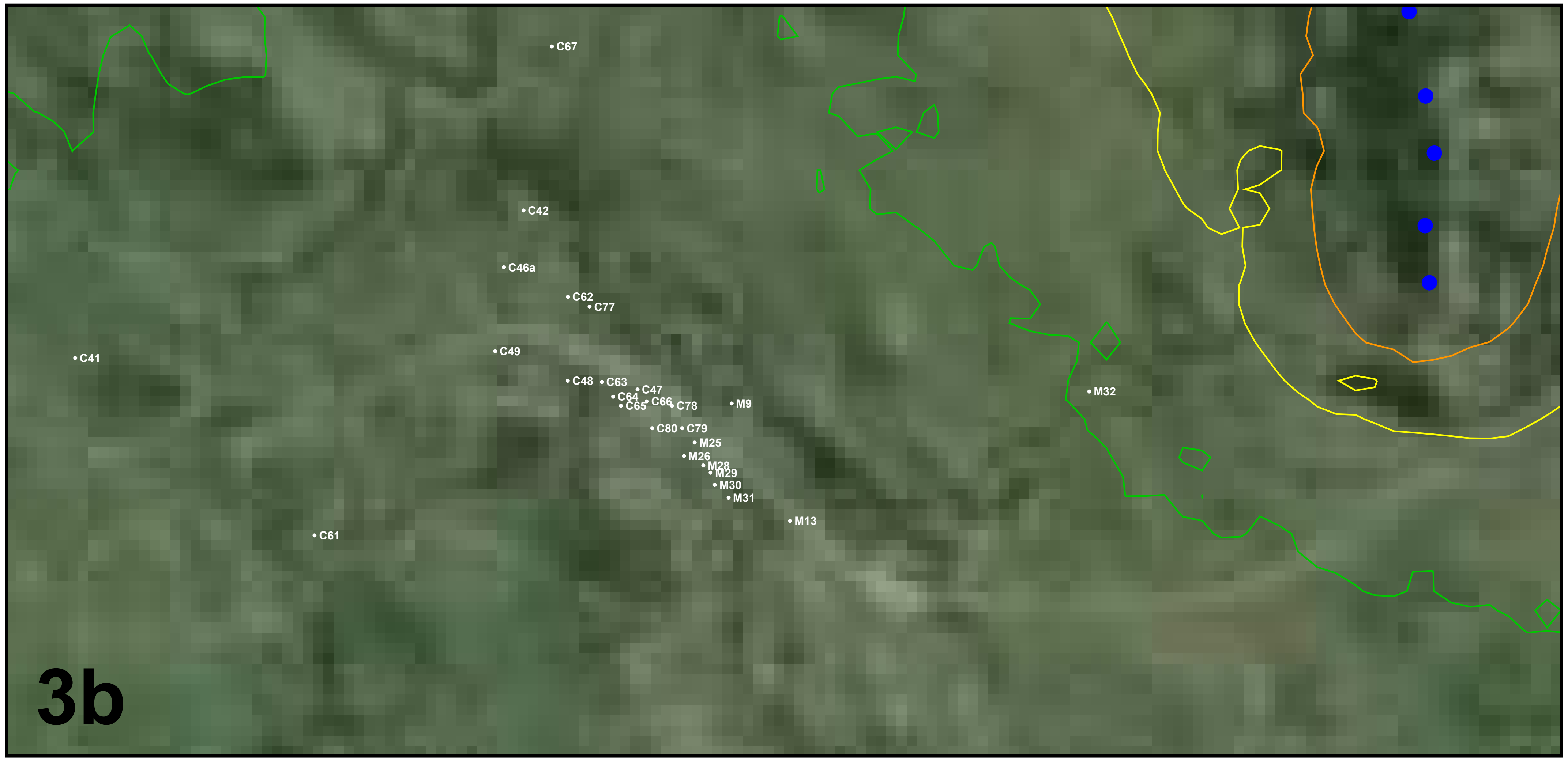
Predictions in accordance with ISO9613-2
Joule effect not applied
Representative noise levels only
(100% hard ground used for calculations)

Noise level
(LAeq dB)

= 35
= 40
= 45

MARSHALL DAY
Acoustics





2013109SY

Yass Valley Wind Farm

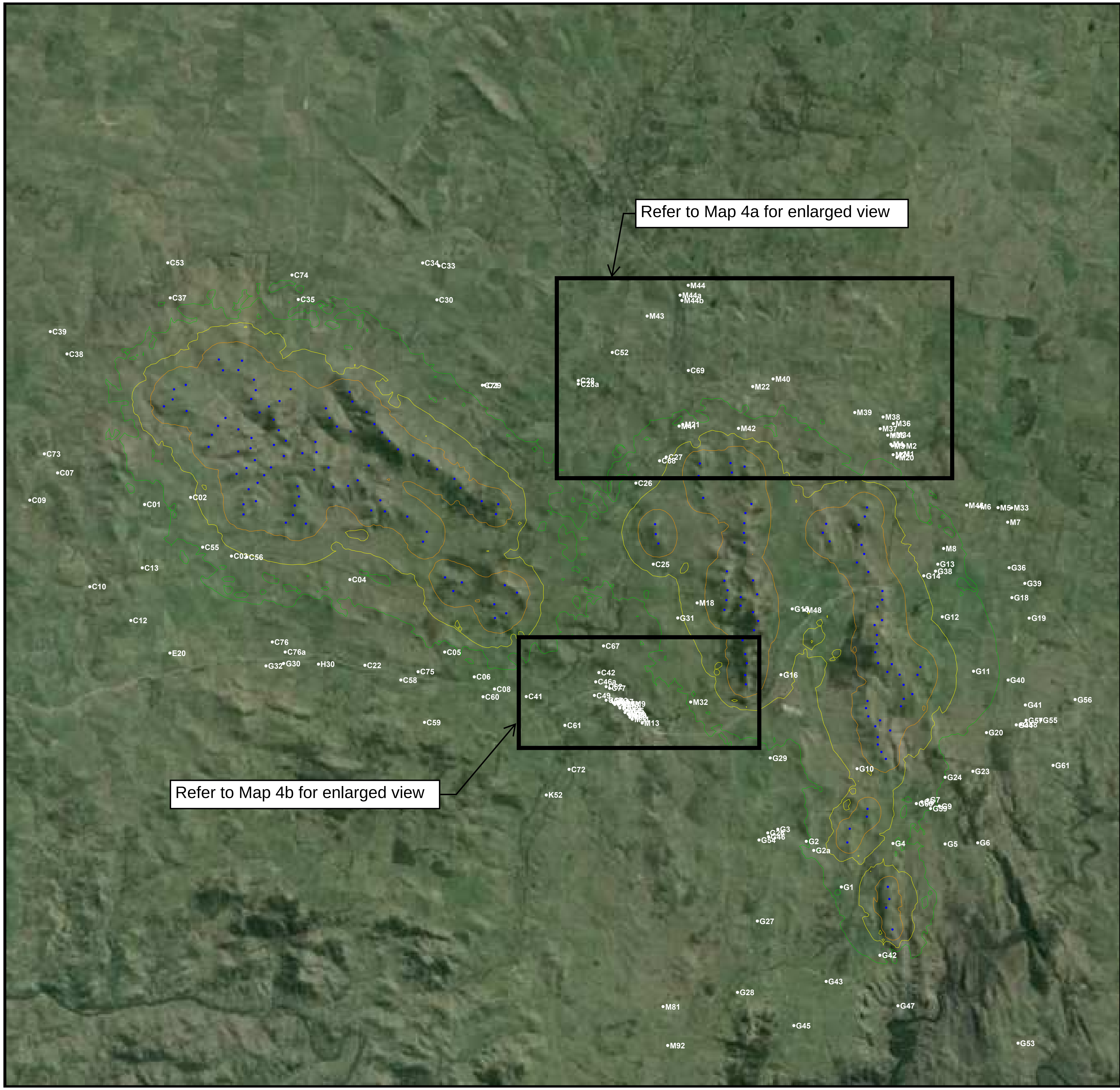
Map 3a and 3b (enlarged view)
V90 turbines
Yass Valley Wind Farm
26 July 2013

Predictions in accordance with ISO9613-2
Joule effects not applied
Representative noise levels only
(100% hard ground used for calculations)

Noise level
(LAeq dB)

= 35
= 40
= 45

MARSHALL DAY Acoustics



2013109SY

Yass Valley Wind Farm

Map 4

V90 turbines

Yass Valley and Conroy's Gap Wind Farms

26 July 2013

Predictions in accordance with ISO9613-2

Joule effect not applied

Representative noise levels only

(100% hard ground used for calculations)

Noise level

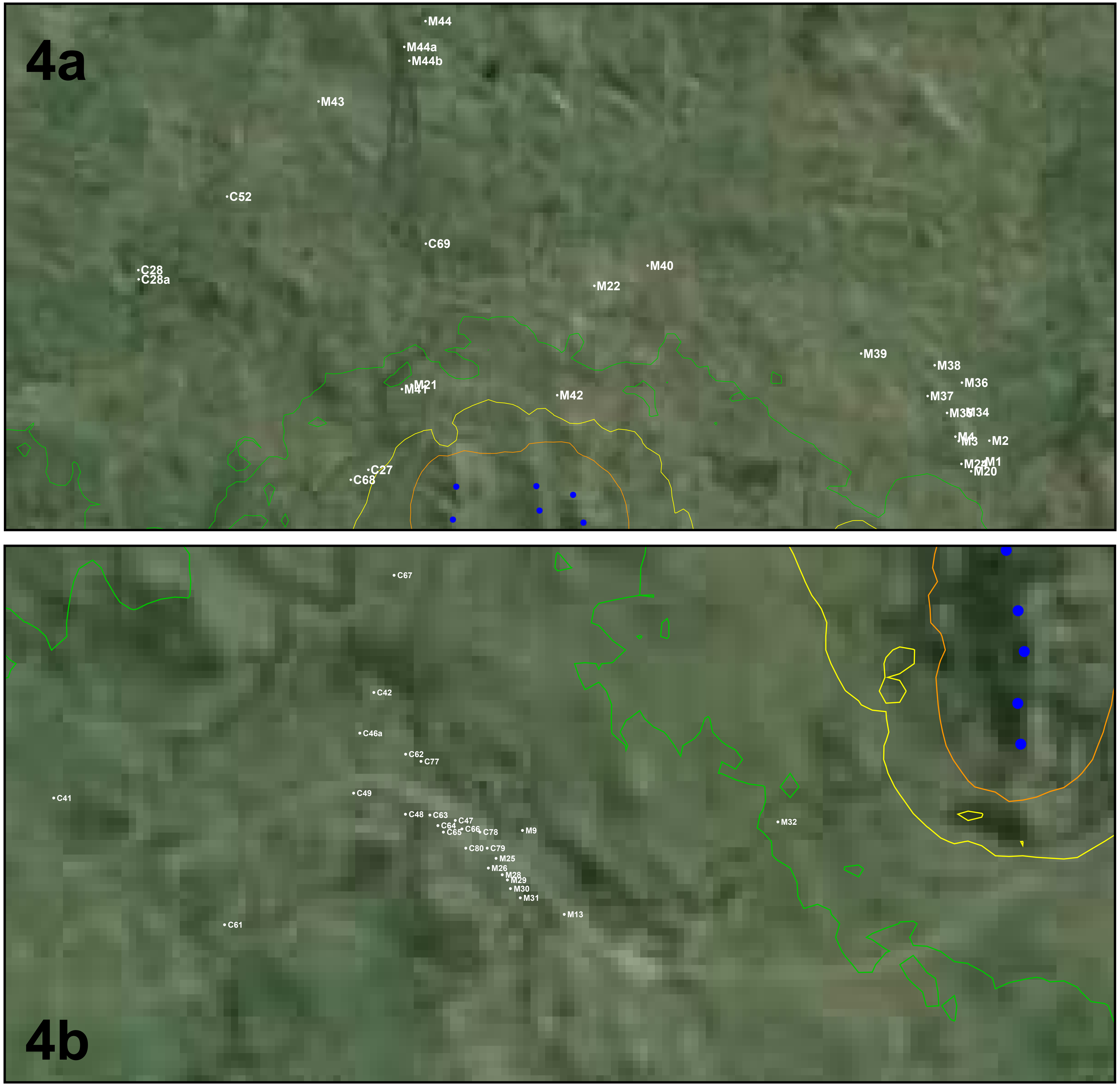
(LAeq dB)

= 35

= 40

= 45

MARSHALL DAY Acoustics



2013109SY

Yass Valley Wind Farm

Map 4a and 4b (enlarged view)
V90 turbines
Yass Valley and Conroy's Gap Wind Farms
26 July 2013

Predictions in accordance with ISO9613-2
Joule effects not applied
Representative noise levels only
(100% hard ground used for calculations)

Noise level
(LAeq dB)

= 35
= 40
= 45

MARSHALL DAY
Acoustics