

Project: **LAL LAL WIND FARM**

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1.0 INTRODUCTION

This report presents the results of the most recent background noise monitoring undertaken for the Lal Lal Wind Farm.

An amended Planning Permit for the Lal Lal Wind Farm was issued in March 2017 to allow for the development of up to sixty (60) wind turbines, subject to a set of conditions relating to matters including environmental noise levels.

Lal Lal Wind Farms Pty Ltd propose to develop the wind farm, and commissioned this survey to obtain updated background noise data which could be used to:

- Determine operational noise limits in accordance with the planning permit
- Assist the analysis of noise data obtained from compliance monitoring after the wind farm commences operating.

This report documents the survey methodology and the results of the background noise monitoring, along with the derived noise limits which would be used to assess the wind farm's compliance with operational noise conditions contained in the planning permit.

In addition to the most recent monitoring, background noise monitoring had been previously undertaken at a receiver location near the Lal Lal wind farm site in 2016. The combined results of the monitoring conducted in 2016, and the most recent monitoring conducted in 2017, represent the updated pre-development background noise monitoring dataset. The consolidated dataset is therefore presented in this report for completeness.

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:20016 *Acoustics - Description measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures*. Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this report. For example, sound pressure levels measured using an "A" frequency weighting are expressed as L_A dB. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report.

Acoustic terminology used throughout this report is presented in Appendix A.

Throughout this report, the term receiver is used to identify any dwelling existing on land in the vicinity of the approved wind energy facility as at 29 October 2010 as stated in the planning permit.

2.0 BACKGROUND NOISE SURVEY & ANALYSIS METHODOLOGY

The background noise survey and analysis has been conducted in accordance with the following:

- The planning permit for the Lal Lal Wind Farm (Planning Permit No. PL-SP/05/0461/A amended March 2017). The relevant extracts from the planning permit are reproduced in Appendix B
- New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010), as referenced in the planning permit
- Supplementary guidance contained in UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* dated May 2013 (UK IOA good practice guide).

This section of the report presents:

- An overview of the survey methodology
- Details of the selected noise monitoring locations
- A summary of the data analysis procedures.

2.1 Monitoring locations

Background noise monitoring was carried out at seven (7) receiver locations listed in Table 1.

Table 1: Background noise monitoring locations

Receiver	Direction from wind farm	Distance from nearest turbine (m)
H18aa	ESE	739
K15aa	NNW	949
K34aa ^[1]	SW	887
L18aa	SSW	1042
M29aa	NNW	1162
N31ab	WSW	842
P30aa	WSW	1054

Note 1: 2016 monitoring location

The location of each of these receivers is illustrated in Figure 1.

The monitoring locations were selected on the basis of:

- A total of sixty (60) turbines located at the coordinates detailed in Appendix C
- The operational noise requirements detailed in the planning permit
- The noise monitoring procedures outlined in NZS 6808:2010
- Upper predicted operational wind farm noise levels prepared at the time of the survey planning¹.

The above information was used to identify the locations where background noise levels were required for the purpose of assessing the wind farm's compliance with the noise criteria established by the planning permit.

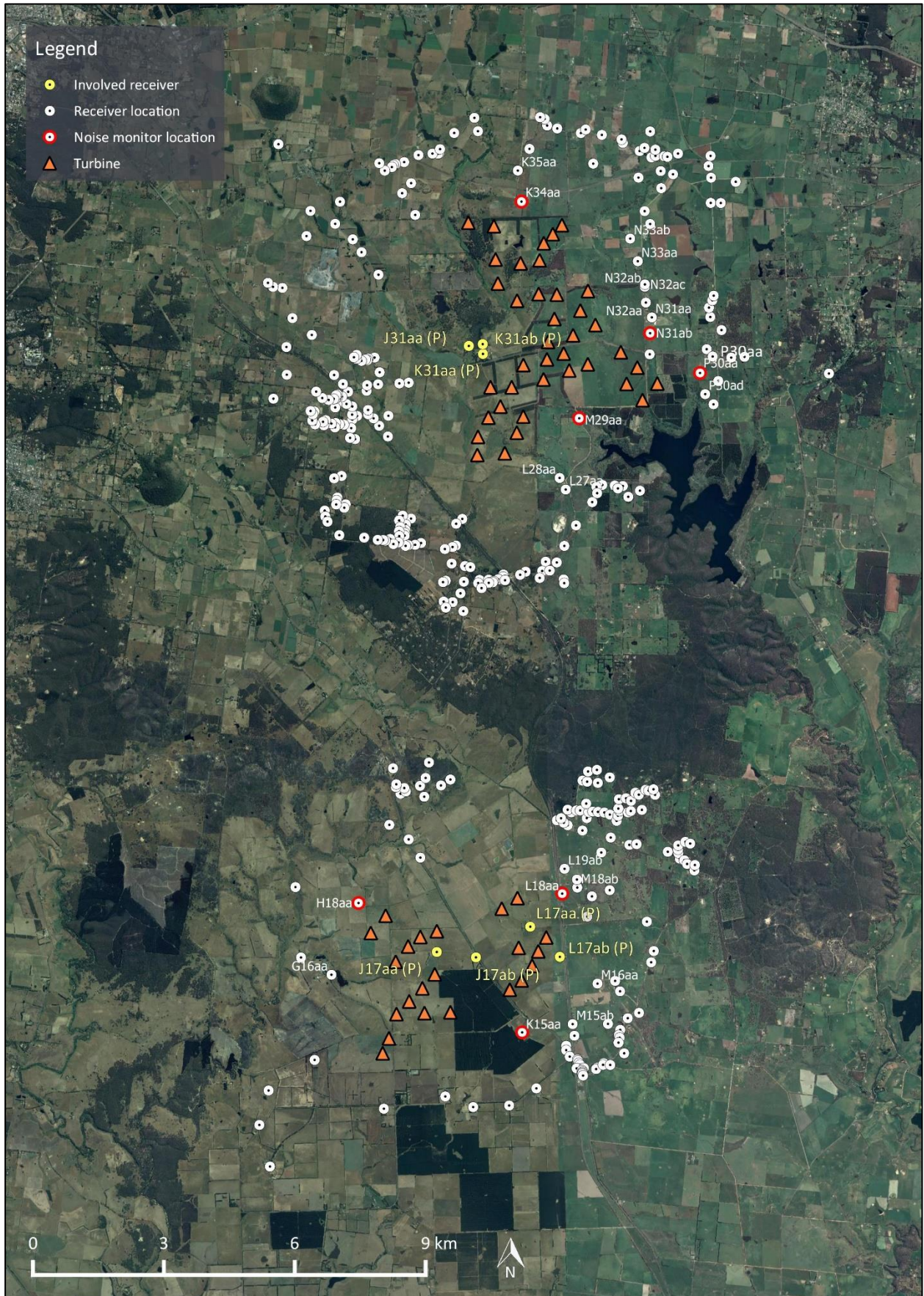
¹ Mm 001 20170649 dated 01/06/2017

At each of the receiver locations where noise monitoring was carried out, the choice of location relative to the dwelling was made on account of the range of considerations specified in NZS 6808:2010. The following specific considerations were factored:

- The noise monitors were located on the approved wind farm side of the dwelling
- The noise monitors were located at least 5 m away from the dwelling and any significant vertical reflecting structures
- The noise monitors were located as far as practical from taller vegetation at each dwelling and any obvious sources of extraneous noise.

Coordinates and photographs for the noise monitoring locations are provided in Appendix F to Appendix L.

Figure 1: Monitoring locations relative to the approved Lal Lal Wind Farm



2.2 Survey description

The background noise survey comprised unattended monitoring over a number of weeks to measure sound levels for a range of environmental conditions. Site wind speeds and local weather conditions were simultaneously recorded throughout the survey, along with periodic audio samples, to enable the relationship between background noise levels and site winds to be assessed.

The key elements of the background noise survey are summarised in Table 2 below.

Table 2: Summary of key elements of background noise survey

Item	Description
Monitoring locations	Seven (7) residential receiver locations as described in Section 2.1.
Monitoring Period	02/08/17 to 06/09/17 equating to approximately five (5) weeks at each location 20/10/17 to 12/12/17 equating to more than six (6) weeks at K15aa as part of a repeat survey K34aa was separately surveyed between 27/4/2016 to 1/6/16 The duration was chosen to satisfy the guidance of NZS 6808:2010 which indicates the measurements should be made for a representative range of wind speeds and directions for the site, and that a minimum of 1,440 individual 10-minute measurements, equivalent to 10 days of monitoring is normally required to obtain a satisfactory range.
Sound level meters	Class 1 automated sound loggers (most accurate class rating for field usage). Microphones mounted at approximately 1.5 m above ground level and fitted with enhanced wind shielding systems based on the design recommendations detailed in the UK IOA good practice guide. See equipment specifications and calibration records in Appendix C.
Noise measurement data	A-weighted average and statistical sound pressure levels. One-third octave band frequency noise levels and a brief audio sample every ten (10) minutes to aid the identification of extraneous noise influences.
Local wind speed and rainfall data	A weather station was installed beside one of the noise monitoring locations to concurrently record rainfall and wind speeds at microphone height. This data was recorded to identify periods when local weather conditions may have resulted in excessive extraneous noise at the microphone (i.e. rainfall).
Site wind speed data	Hub height wind speeds for correlating background noise levels with site wind speeds. Site wind speed data was sourced from Elaine and Yendon masts, each incorporating anemometry at multiple heights up to 80 m above ground level (AGL). Hub height wind speed data (93 m above ground level) were derived by Aurecon, extrapolating the results of simultaneous wind speed measurements at multiple heights on each reference mast. A description of the analysis undertaken by Aurecon is reproduced in Appendix E.

2.3 Data analysis

The analysis of the survey data has been conducted in accordance with the NZS 6808:2010 as referenced in the planning permit.

This analysis broadly involves:

- Collating the measured noise levels, site wind speeds and local weather data into a single dataset
- Filtering the data set to remove measurement results affected by extraneous or atypical noise
- Filtering the data for the range of site wind speeds in which the turbines are expected to operate
- Filtering the data where necessary to account for site wind directions
- Plotting a chart of noise levels versus wind speeds and determining the line of best fit to the data.

A summary of the key steps in the analysis of the data is presented in Table 3.

Table 3: Background noise data analysis

Process	Description
Data collation	Time stamps for each source of measurement data are reviewed to clarify start or end times and measurement time zone. Measured noise levels, site wind speeds and local weather conditions are then collated for each ten-minute measurement interval.
Local weather data filtering	10-minute intervals are identified and filtered from the analysis if rainfall was identified for any ten-minute measurement interval.
Extraneous noise filtering	The measured sound frequencies (one-third octave bands) in each 10-minute interval are used to identify periods that are significantly affected by bird or insect sounds. 10-minute intervals have been identified, and filtered from the analysis, when the following conditions ² are satisfied: • the highest A-weighted one-third octave band noise level is within 5 dB of the broadband A-weighted background noise level for that interval; and • the identified one-third octave band A-weighted noise level is greater than a level of 20 dB L_{A90}.
Time periods	In accordance with the planning permit, the data sets are considered for separate periods as follows: • All periods: no restriction on hours (i.e. data during day and night hours included) • Night period: 2200 to 0700 hours.

² Griffin, D., Delaire, C., & Pischedda, P. (2013). Methods of identifying extraneous noise during unattended noise measurements. *20th International Congress of Sound & Vibration*.

Process	Description
Regression analysis	Two datasets are plotted on a chart of noise levels versus wind speeds: • All data points that have been removed from the analysis using the above processes • The filtered dataset comprising all retained measurement data. The chart of filtered noise levels versus wind speed is reviewed to determine if there are any distinctive trends or gaps in the data which could warrant separation of the measurement results into subgroups (e.g. subgroups for time of day or wind direction). A line of best fit is determined for the filtered data and, where applicable, any subgroups of the filtered data. The line of best fit is determined using a regression analysis of the range of noise levels and wind speeds or, where necessary, analysis of noise levels at individual wind speeds.
Noise limits	Noise limits are defined at each wind speed in accordance with NZS 6808:2010 by a value of 40 dB or the background plus 5 dB, whichever is higher. The value of the background noise level at each integer wind speed is defined by the line of best to the measurement results. In accordance with the planning permit, these noise limits are separately defined for all periods (i.e. including all hours of the day and night) and the night period.

3.0 SURVEY & ANALYSIS RESULTS

This section presents a summary of the background noise measurement results, analysed in accordance with the methodology described in Section 2.2.

The analysis results include the noise limits which would be used during compliance monitoring to assess the operational noise of the Lal Lal Wind Farm.

3.1 Background noise levels

The tabulated data presented in Table 4 and Table 5 summarises the derived background noise levels for the all-time and night-time periods respectively.

The data in these tables is provided for the key hub height wind speeds, relevant to the assessment of wind farm noise. The results for all surveyed wind speeds are illustrated graphically for each receiver location in Appendix F to Appendix L.

The analysis indicated that the results obtained during two (2) separate surveys at K15aa were affected by local sources of noise which are believed to relate to a number of sources close to the dwelling, including domestic air-conditioning systems. As a result, the data for this location is not considered suitable for representing typical background noise levels during other times which may be quieter in the absence of extraneous noise. This background noise data therefore cannot be relied upon for deriving noise limits or assessing post-construction noise compliance.

However, the results of this monitoring for this location are included in Sections G2 and G3 of Appendix G for completeness of records.

Table 4: All-time period – background noise levels (dB L_{A90})

Location	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
H18aa ^[1]	28.3	29.7	31.5	33.6	35.9	38.4	41.0	43.6	46.2	48.6	50.9	52.9
K34aa ^[2]	24.3	25.9	27.7	29.8	32.0	34.3	36.7	39.1	41.5	43.9	46.1	48.2
L18aa ^[1]	28.0	29.4	31.1	32.9	34.9	37.0	39.1	41.2	43.2	45.2	47.0	48.6
M29aa ^[2]	27.1	28.0	29.2	30.6	32.2	34.0	35.9	37.9	39.9	42.0	44.1	46.1
N31ab ^[2]	26.3	27.6	29.1	30.8	32.6	34.5	36.4	38.4	40.3	42.2	44.0	45.6
P30aa ^[2]	26.7	28.2	30.0	32.1	34.3	36.7	39.2	41.7	44.2	46.6	48.9	51.1

Table 5: Night-time period – background noise levels (dB L_{A90})

Location	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
H18aa ^[1]	24.1	25.5	27.4	29.7	32.4	35.3	38.4	41.6	44.7	47.7	50.4	52.9
K34aa ^[2]	20.7	22.0	23.8	26.0	28.5	31.2	34.1	37.0	39.9	42.6	45.1	47.3
L18aa ^[1]	25.2	26.6	28.4	30.3	32.5	34.8	37.2	39.6	41.9	44.2	46.4	48.3
M29aa ^[2]	26.1	26.2	26.8	27.8	29.2	31.0	33.0	35.2	37.5	39.9	42.4	44.8
N31ab ^[2]	22.5	23.6	25.1	26.8	28.8	30.9	33.1	35.4	37.7	40.0	42.2	44.3
P30aa ^[2]	23.2	24.4	26.0	28.1	30.4	32.9	35.7	38.5	41.4	44.2	46.9	49.5

Table Notes [1] 93 m above ground level at 234574 E, 5817575 N (MGA 94 Zone 55H)

[2] 93 m above ground level at 238268 E, 5830852 N (MGA 94 Zone 55H)

3.2 Noise limits

The limits presented herein are based on background noise levels presented in Section 3.1 and the status of each receiver at the time of preparation of this report. In particular, the receivers are considered uninvolved locations and the minimum limit is therefore set at 40 dB L_{A90} in accordance with the planning permit and NZS 6808:2010.

As per the background noise data, the tabulated data is provided for the key wind speeds relevant to the assessment of wind farm noise. The derived noise limits for all surveyed wind speeds are illustrated in the graphical data provided for each receiver location in Appendix F to Appendix L.

Table 6: All-time period operational wind farm noise limits (dB L_{A90})

Location	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
H18aa ^[1]	40.0	40.0	40.0	40.0	40.9	43.4	46.0	48.6	51.2	53.6	55.9	57.9
K34aa ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	41.7	44.1	46.5	48.9	51.1	53.2
L18aa ^[1]	40.0	40.0	40.0	40.0	40.0	42.0	44.1	46.2	48.2	50.2	52.0	53.6
M29aa ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	40.9	42.9	44.9	47.0	49.1	51.1
N31ab ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	41.4	43.4	45.3	47.2	49.0	50.6
P30aa ^[2]	40.0	40.0	40.0	40.0	40.0	41.7	44.2	46.7	49.2	51.6	53.9	56.1

Table 7: Night-time period operational wind farm noise limits (dB L_{A90})

Location	Hub height wind speed (m/s)											
	4	5	6	7	8	9	10	11	12	13	14	15
H18aa ^[1]	40.0	40.0	40.0	40.0	40.0	40.3	43.4	46.6	49.7	52.7	55.4	57.9
K34aa ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.0	44.9	47.6	50.1	52.3
L18aa ^[1]	40.0	40.0	40.0	40.0	40.0	40.0	42.2	44.6	46.9	49.2	51.4	53.3
M29aa ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.2	42.5	44.9	47.4	49.8
N31ab ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.4	42.7	45.0	47.2	49.3
P30aa ^[2]	40.0	40.0	40.0	40.0	40.0	40.0	40.7	43.5	46.4	49.2	51.9	54.5

Table Notes [1] 93 m above ground level at 234574 E, 5817575 N (MGA 94 Zone 55H)

[2] 93 m above ground level at 238268 E, 5830852 N (MGA 94 Zone 55H)

4.0 SUMMARY

Background noise monitoring has been conducted at seven (7) receiver locations around the approved Lal Lal Wind Farm.

The survey and analysis has been carried out on the basis of:

- The planning permit for the Lal Lal Wind Farm as amended March 2017
- New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010), as referenced in the planning permit, as required by the planning permit.

The results at one of the locations (K15aa), over two (2) separate surveys, was found to have been influenced by a local noise source in the vicinity of the monitoring locations. As a result, the data for this location is not considered suitable for representing typical background noise levels, and therefore cannot be relied upon for deriving noise limits or assessing post-construction noise compliance.

The results for the remaining six (6) have been analysed to derive noise limits in accordance with the planning permit. Specifically, noise limits have been derived at integer hub-height wind speeds as the greater of a minimum limit (40 dB) and the background level plus 5 dB.

The results of the measurements are to be referenced during the compliance monitoring phase of the project as an indication of potential background noise levels contributing to the compliance measurements.

APPENDIX A GLOSSARY

dB	Decibel. The unit of sound level.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
L_{Aeq}	The A-weighted equivalent continuous sound level and is measured in dB.
L_{A90}	The A-weighted noise level exceeded for 90% of the measurement period, measured in dB. This is commonly referred to as the background noise level.

APPENDIX B PLANNING PERMIT – RELEVANT NOISE EXTRACTS

The planning permit for the Lal Lal Wind Farm (Planning Permit No. PL-SP/05/0461/A as amended 20 March 2017) contains the following requirements that are relevant to the background noise monitoring (in terms of the requirement for background noise data and the applicable standard).

NOISE LIMITS

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23. *Except as provided below in this condition, the operation of the wind energy facility must comply with New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (the Standard) as modified by this condition to the satisfaction of the Minister for Planning.*

In determining compliance the following requirements apply:

- a) The operator must ensure that at any wind speed, wind farm sound levels, determined in accordance with the Standard at noise sensitive locations (as defined in the Standard) do not exceed a noise limit of 40dB LA90,10min or background (LA90,10min) plus 5dB, whichever is greater.*
- b) Compliance must be assessed separately for all-time and night time. For the purpose of this requirement, night time is defined as 10.00pm to 7.00am, and*
- c) Where special audible characteristics, including tonality, impulsive sound or excessive amplitude modulation occur, the measured noise level with the identified special audible characteristics will be modified by applying a penalty of up to + 6 dB L90 in accordance with section 5.4 of the Standard.*

Any dwelling on the subject land may be exempt from this condition. This exemption will be given effect through an agreement with the landowner and must be registered on title, unless varied through the written consent of the Minister for Planning. Such dwellings will be known as host dwellings.

APPENDIX C TURBINE COORDINATES

The following table sets out the coordinates of the sixty (60) turbine layout of the Lal Lal Wind Farm (Rev. 8 layout supplied by Lal Lal Wind Farms Pty Ltd on 5/11/2017).

Table 8: Moorabool South Wind Farm turbine coordinates – MGA 94 zone 55H

Turbine	Easting	Northing	Turbine	Easting	Northing
ESWT01	233512	5817821	YSWT10	236427	5832689
ESWT02	233853	5818217	YSWT11	236867	5832295
ESWT03	234084	5817161	YSWT12	237362	5832449
ESWT04	234368	5817513	YSWT13	237778	5832435
ESWT05	234648	5817731	YSWT14	237722	5831876
ESWT06	235027	5817862	YSWT15	237577	5831353
ESWT07	236515	5818378	YSWT16	238492	5832517
ESWT08	236876	5818621	YSWT17	238318	5832069
ESWT10	234101	5815965	YSWT18	238663	5831739
ESWT11	234393	5816255	YSWT19	238151	5831503
ESWT12	234695	5816555	YSWT20	237011	5830822
ESWT13	234979	5816876	YSWT21	236257	5830315
ESWT14	234744	5815988	YSWT22	236743	5830314
ESWT15	235337	5816007	YSWT23	236485	5829872
ESWT16	236903	5817482	YSWT24	236209	5829620
ESWT17	236699	5816524	YSWT25	237009	5829643
ESWT18	236972	5816736	YSWT26	235970	5829179
ESWT19	237212	5817071	YSWT27	236860	5829275
ESWT20	237353	5817401	YSWT28	235956	5828763
ESWT21	237536	5817719	YSWT29	236585	5828803
ESWT23	233785	5815068	YSWT30	237553	5830953
ESWT24	233928	5815408	YSWT31	237935	5831086
YSWT01	235749	5834082	YSWT32	239245	5831116
YSWT02	236335	5834001	YSWT33	237473	5830494
YSWT03	237895	5834026	YSWT34	238063	5830698
YSWT05	237479	5833611	YSWT35	238489	5830840
YSWT06	237686	5833818	YSWT36	239624	5830764
YSWT07	236374	5833239	YSWT38	239378	5830392
YSWT08	236947	5833151	YSWT39	240083	5830399

APPENDIX D SURVEY INSTRUMENTATION

Table 9: Sound level measurement instrumentation summary

Item	Description
Equipment type	Automated/unattended integrating sound levels
Make & model	01dB CUBE & 01dB DUO
Instrumentation class	Certified to Type1 / Class 1 (precision grade) standards in accordance with AS 1259.2-1990 ³ and IEC 61672.1-2004 ⁴
Instrumentation noise floor	Less than 20 dB
Time synchronisation	Internal clocks synchronised by GPS
Wind shielding	Enhanced wind shielding system based on the design recommendations detailed in the UK IOA good practice guide. The system comprises an inner solid primary wind shield and an outer secondary large diameter hollow wind shield.

Table 10: Sound level meter installation records

Receiver	System	Unit serial number	Microphone serial number	Independent calibration date ¹
H18aa	01dB DUO	10194	136832	15/11/2016
K15aa – 1 st survey	01dB CUBE	10516	161879	10/06/2016
K15aa – 2 nd survey	01dB DUO	10498	207226	16/09/2016
K34aa	01dB DUO	10447	144898	12/01/2016
L18aa	01dB CUBE	10517	161870	11/07/2016
M29aa	01dB CUBE	10418	207568	31/03/2016
N31ab	01dB DUO	10498	207226	16/09/2016
P30aa	01dB CUBE	10513	255767	28/10/2016
Sound level calibrator	01dB-Stell CAL21	34924044	-	17/05/2017
Sound level calibrator 2 nd survey at K15aa	01dB-Stell CAL21	34164985	-	03/07/2017

Note 1: Independent (laboratory) calibration date to be within 2 years of measurement period as per AS 1055-1:1997⁵ for sound level meters and within 1 year of measurement period for sound level calibrators

Note 2: Difference between reference level checks during deployment and collection of instruments

Note 3: Calibration drift should not be greater than 1 dB as specified in AS 1055-1:1997

³ AS 1259-2:1990: *Acoustics - Sound level meters - Integrating - Averaging*

⁴ IEC 61672-1:2004: *Electroacoustics - Sound level meters - Specification*

⁵ AS 1055-1:1997 *Acoustics – Description and measurement of environmental noise - Part 1: General Procedures*

Table 11: Wind speed measurement instrumentation

Wind speeds	Description
Local wind speeds	Vaisala WTX 520 weather station positioned at receiver H18aa
	Vaisala WTX 520 weather station positioned at receiver N31ab
	Vaisala WTX 520 weather station positioned at receiver K34aa
	Vaisala WTX 520 weather station positioned at receiver K15aa during the 2 nd survey
Site wind speeds	Third party owned and operated system comprising two (2) meteorological masts with anemometry at multiple heights. Further information provided in Appendix E.

APPENDIX E SITE WIND SPEED DATA DERIVATION

The following statement was provided by wind analysis consultants for the project, Aurecon (received 26/10/2017) to describe the method used to determine hub height wind speeds (93 m AGL) based on the data from two 80 m high meteorological masts at the site:

The wind speed at 80 and 93 m hub heights was calculated for each 10-minute period using a power law wind shear profile fit to the valid wind speeds at 83 and 62 m measured during the 10-minute period, limited to a symmetrical range of shear exponent of -0.2 to +0.7. For 10-minute periods in which valid data was available from only one of these anemometers, it was not possible to calculate a power law profile and therefore the appropriate hourly value of the 24-hour mean diurnal wind shear profile from the entire dataset was applied. This time-step based shear methodology was chosen in order to best capture the strong trend at this site of low wind shear exponent (very little variation with height) during the day and high wind shear exponent during the night.

APPENDIX F RECEIVER H18AA DATA

F1 Receiver H18aa location data

Table 12: Receiver H18aa dwelling and noise monitor coordinates– MGA 94 Zone 55

Location	Easting	Northing
Dwelling location	233189	5818529
Background noise monitoring location	233231	5818507

Figure 2: Receiver H18aa aerial view - dwelling and noise monitor locations

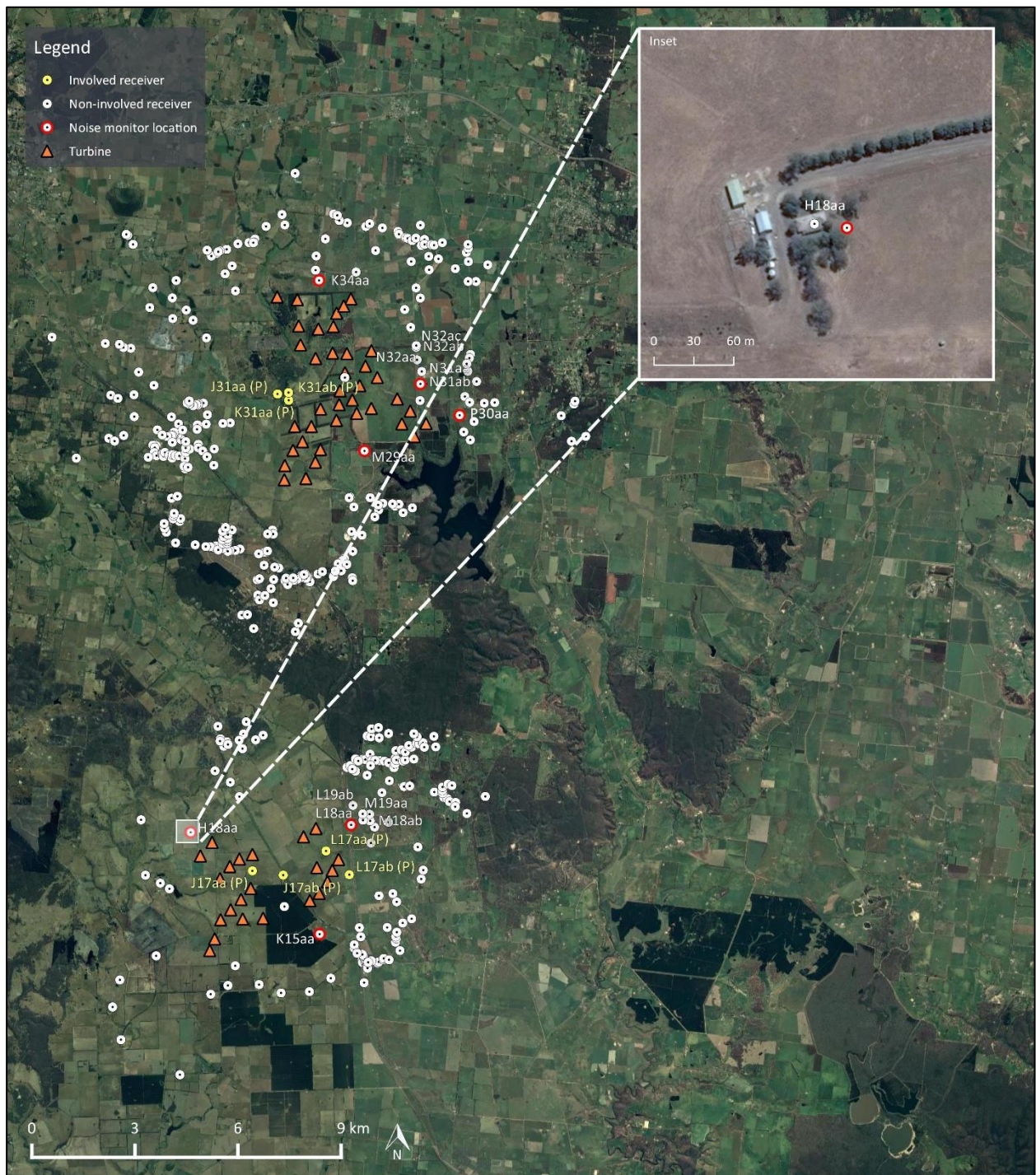


Table 13: Receiver H18aa monitor installation photos

Looking North	Looking East
	
Looking South	Looking West
	

F2 Receiver H18aa measurement data summary

Table 14: Receiver H18aa background noise level analysis summary

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4952	1850
Number of data points removed	1352	564
Number of data points for analysis	3600	1286

Figure 3: Receiver H18aa background noise level and wind speed time history

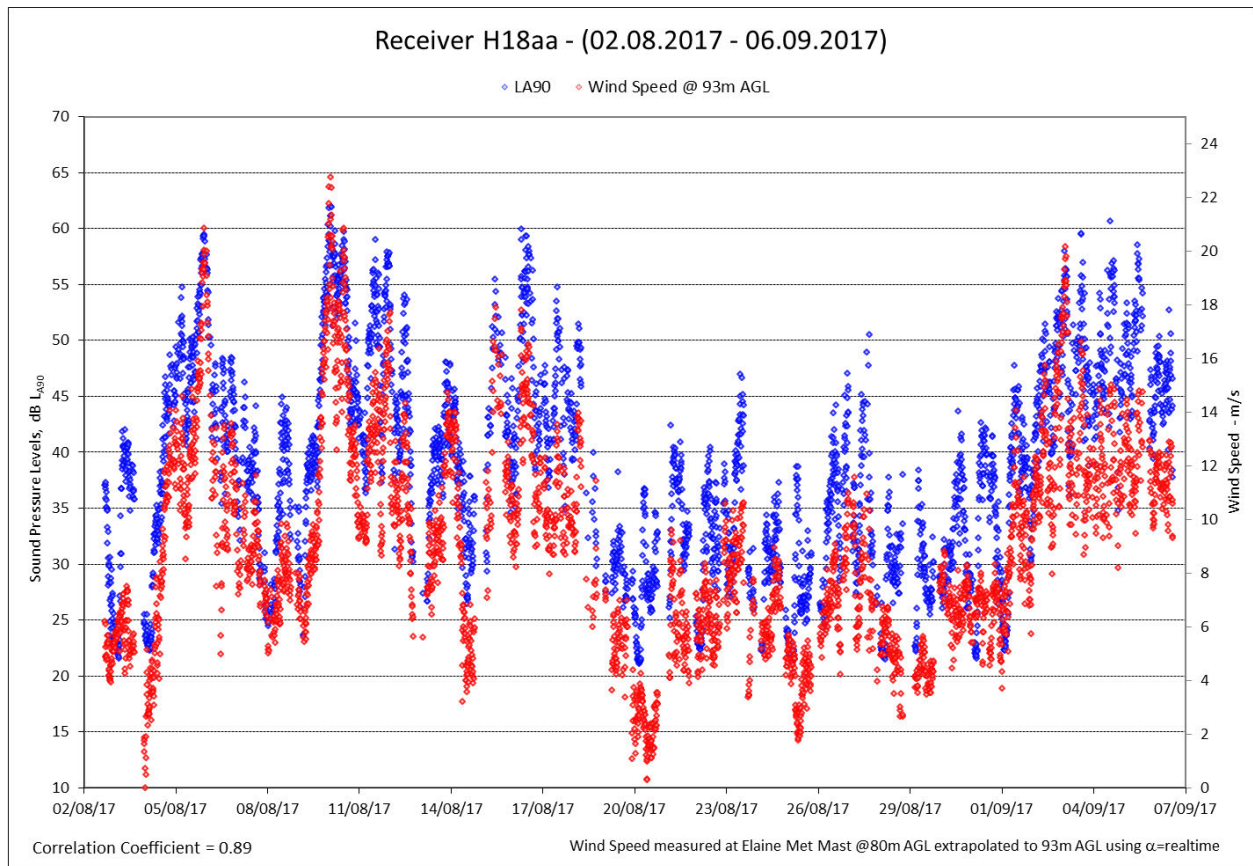


Figure 4: Receiver H18aa all-time periods – derived background noise levels and noise limits

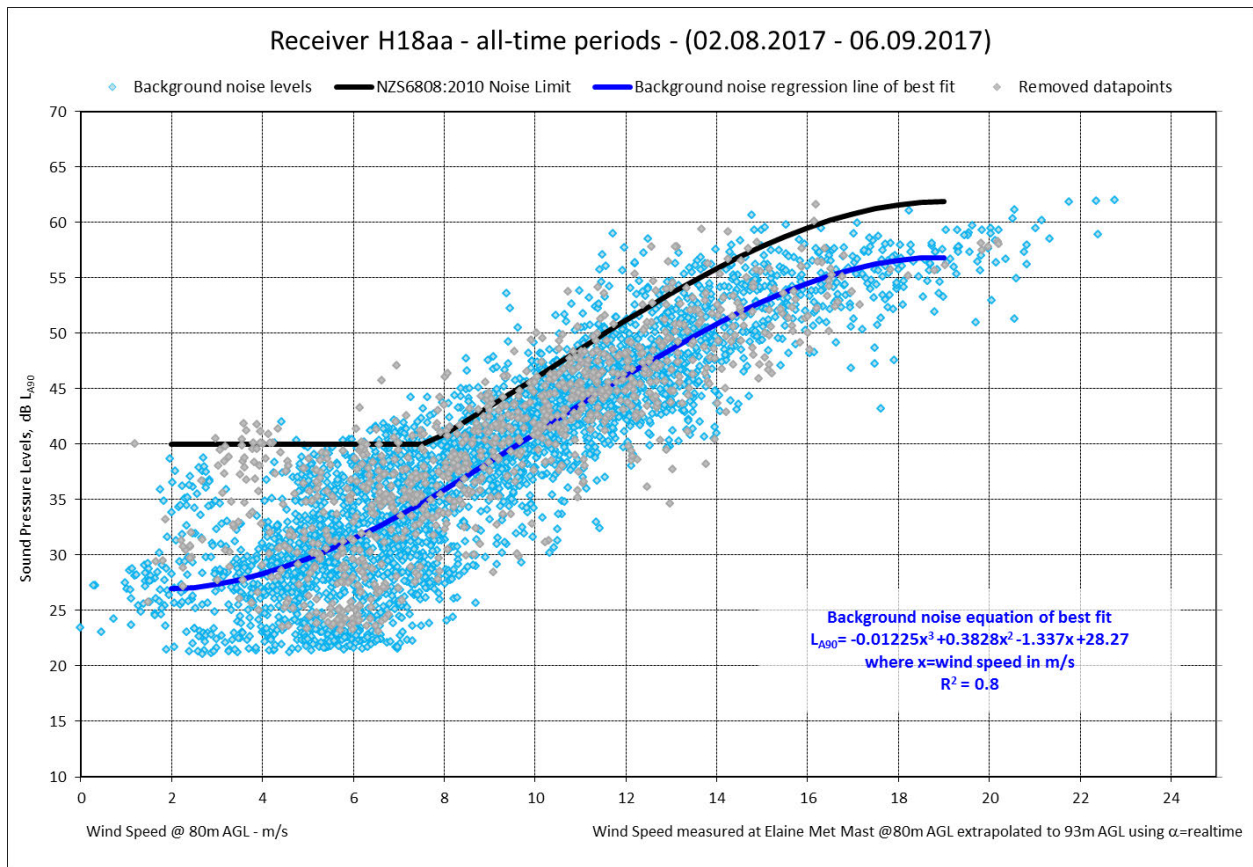


Figure 5: Receiver H18aa night-time periods – derived background noise levels and noise limits

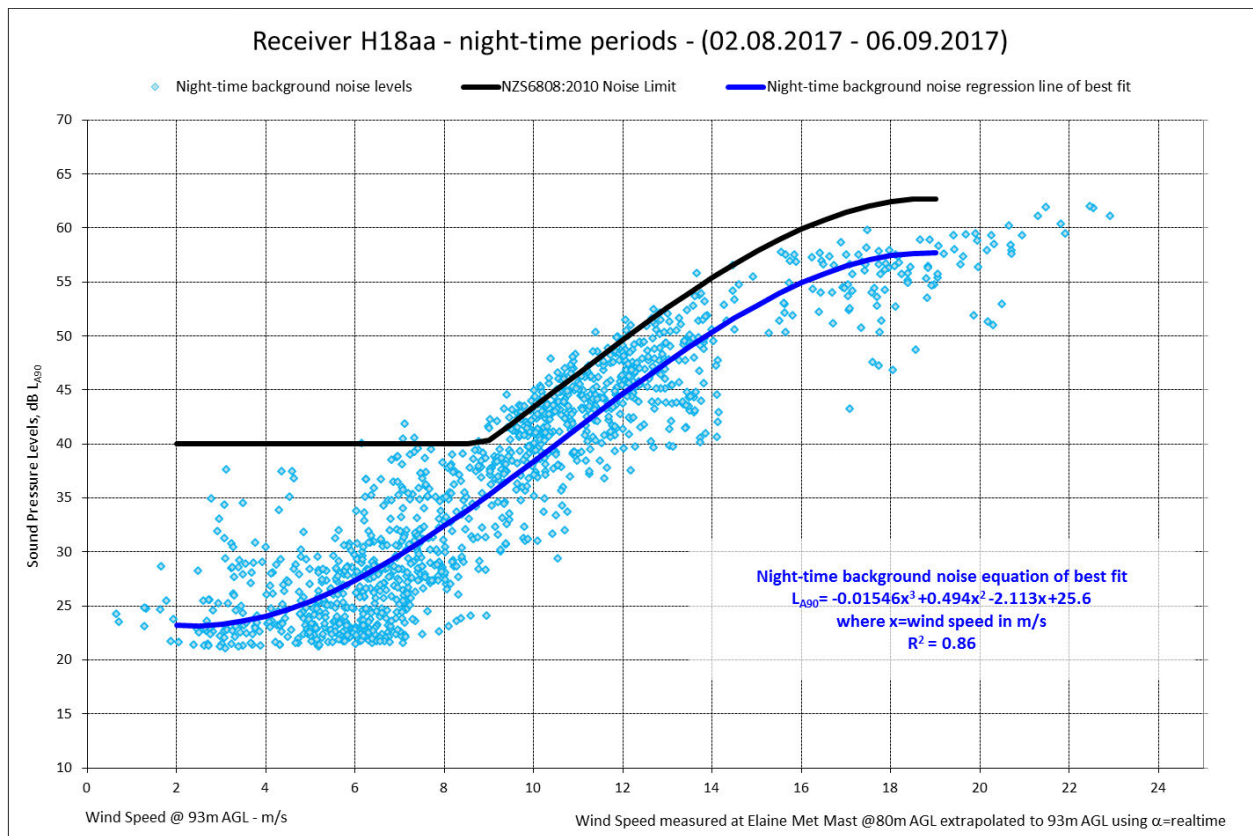


Table 16: Receiver K15aa monitor installation photos – 1st survey

Looking North	Looking East
	
Looking South	Looking West
	

Figure 7: Receiver K15aa aerial view - dwelling and noise monitor locations – 2nd survey



Table 17: Receiver K15aa monitor installation photos – 2nd survey

Looking North	Looking East
	
Looking South	Looking West
	

G2 Receiver K15aa measurement data summary – 1st survey

The analysis indicated that the results obtained at K15aa were affected by a local source of noise which is believed to relate to a domestic air-conditioning system. As a result, the data for this location is not considered suitable for representing typical background noise levels and therefore, cannot be relied upon for deriving noise limits or assessing post-construction noise compliance.

Repeat measurements were therefore undertaken at K15aa between 26 October and 12 December 2017, as detailed in Section G3.

The results of the monitoring for the first survey at this location are included herein for completeness of records.

Table 18: Receiver H18aa background noise level analysis summary – 1st survey

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4828	1784
Number of data points removed	1663	698
Number of data points for analysis	3165	1086

Figure 8: Receiver K15aa background noise level and wind speed time history – 1st survey

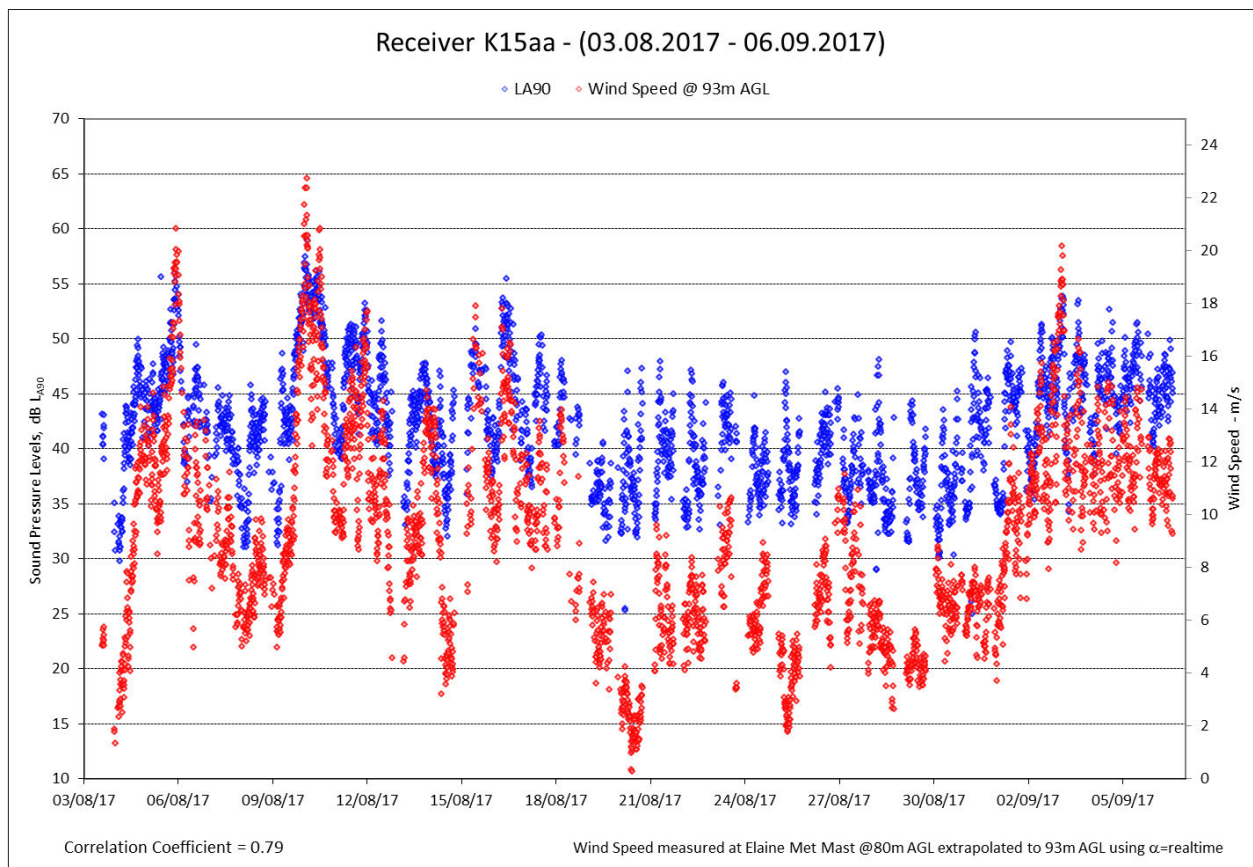


Figure 9: Receiver K15aa all-time periods – derived background noise levels and noise limits – 1st survey

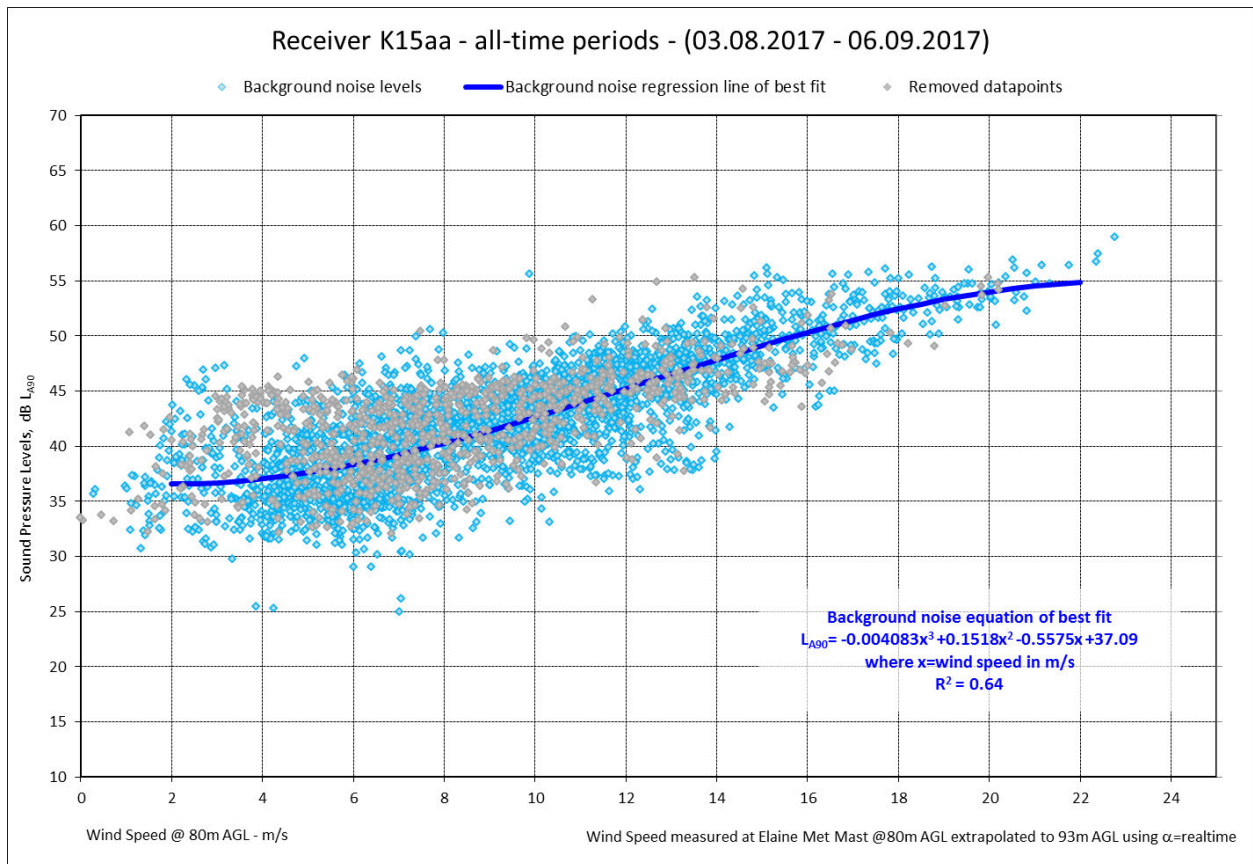
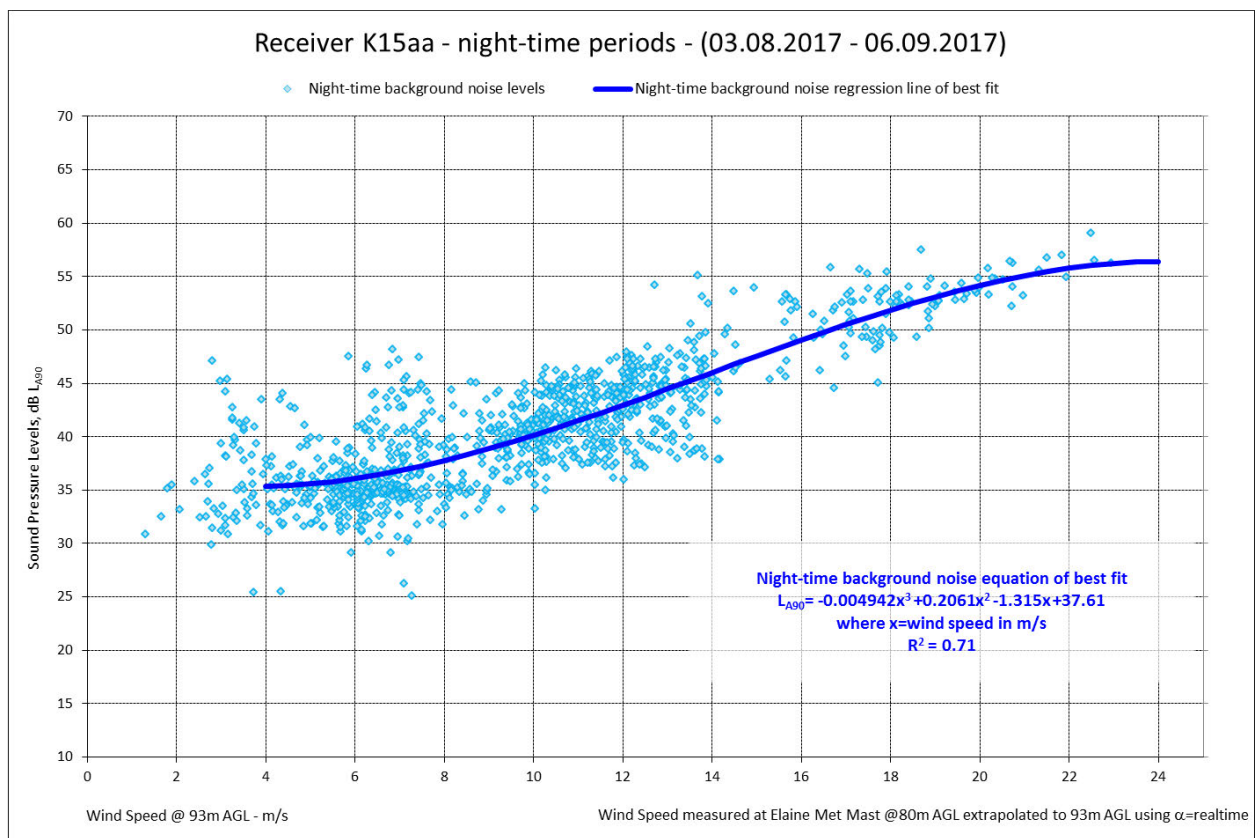


Figure 10: Receiver K15aa night-time periods – derived background noise levels and noise limits – 1st survey



G3 Receiver K15aa measurement data summary – 2nd survey

For the second survey, the noise monitor was relocated towards the front (eastern side) of the dwelling further away from the domestic air-conditioning system which was identified as the likely source of extraneous noise during the first survey. This location was identified as the only alternative position for placing the noise monitor in accordance with NZS 6808:2010, at a location representative of the noise environment around the dwelling.

The analysis of the data collected during the second survey still indicated that the results obtained at K15aa were affected by local sources of noise which are believed to relate to a number of sources close to the dwelling, including domestic air-conditioning systems. As a result, the data measured during the 2nd survey for this location is not considered suitable for representing typical background noise levels during other times which may be quieter in the absence of extraneous noise. This background noise data therefore cannot be relied upon for deriving noise limits or assessing post-construction noise compliance.

However, the results of the monitoring for this location are included herein for completeness of records.

Table 19: Receiver H18aa background noise level analysis summary – 2nd survey

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	6,616	2,448
Number of data points removed	2,690	1,344
Number of data points for analysis	3,926	1,104

Figure 11: Receiver K15aa background noise level and wind speed time history – 2nd survey

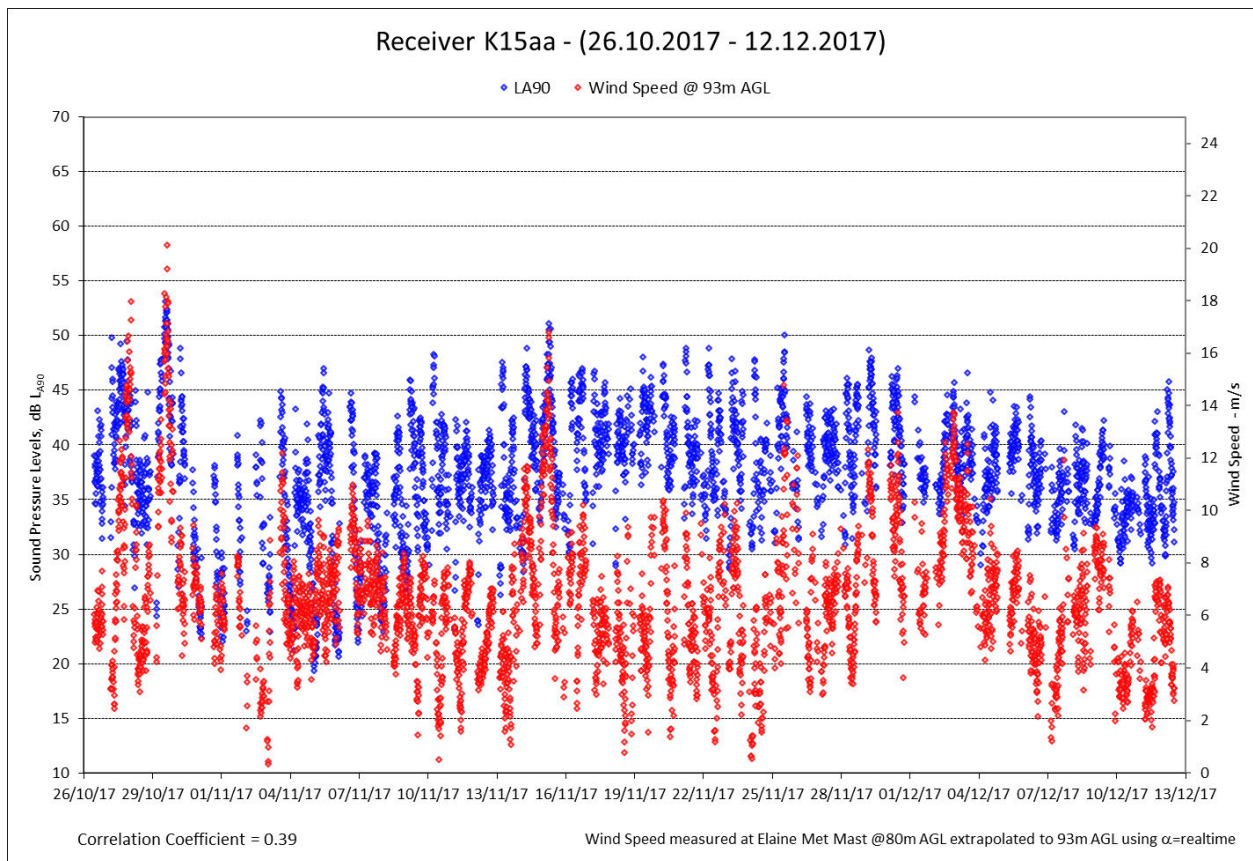


Figure 12: Receiver K15aa all-time periods – derived background noise levels and noise limits – 2nd survey

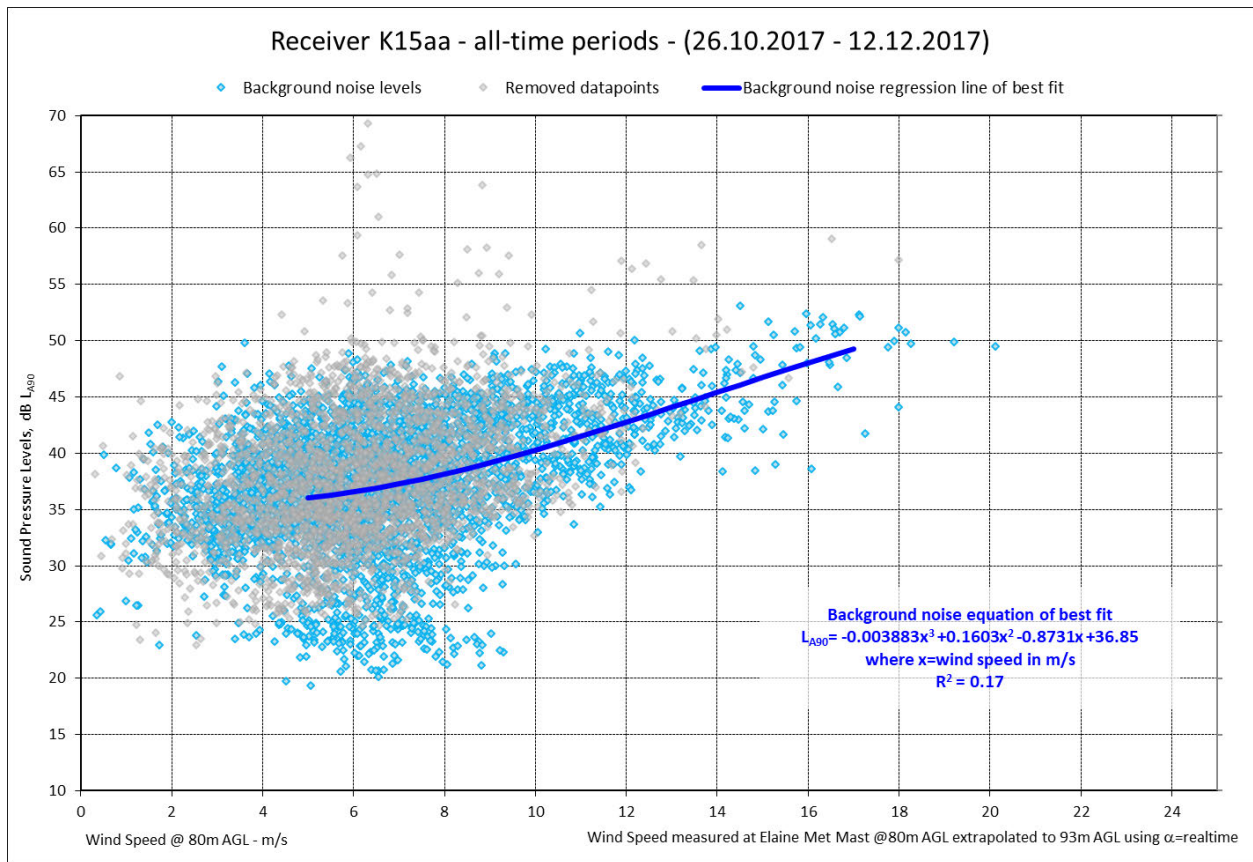
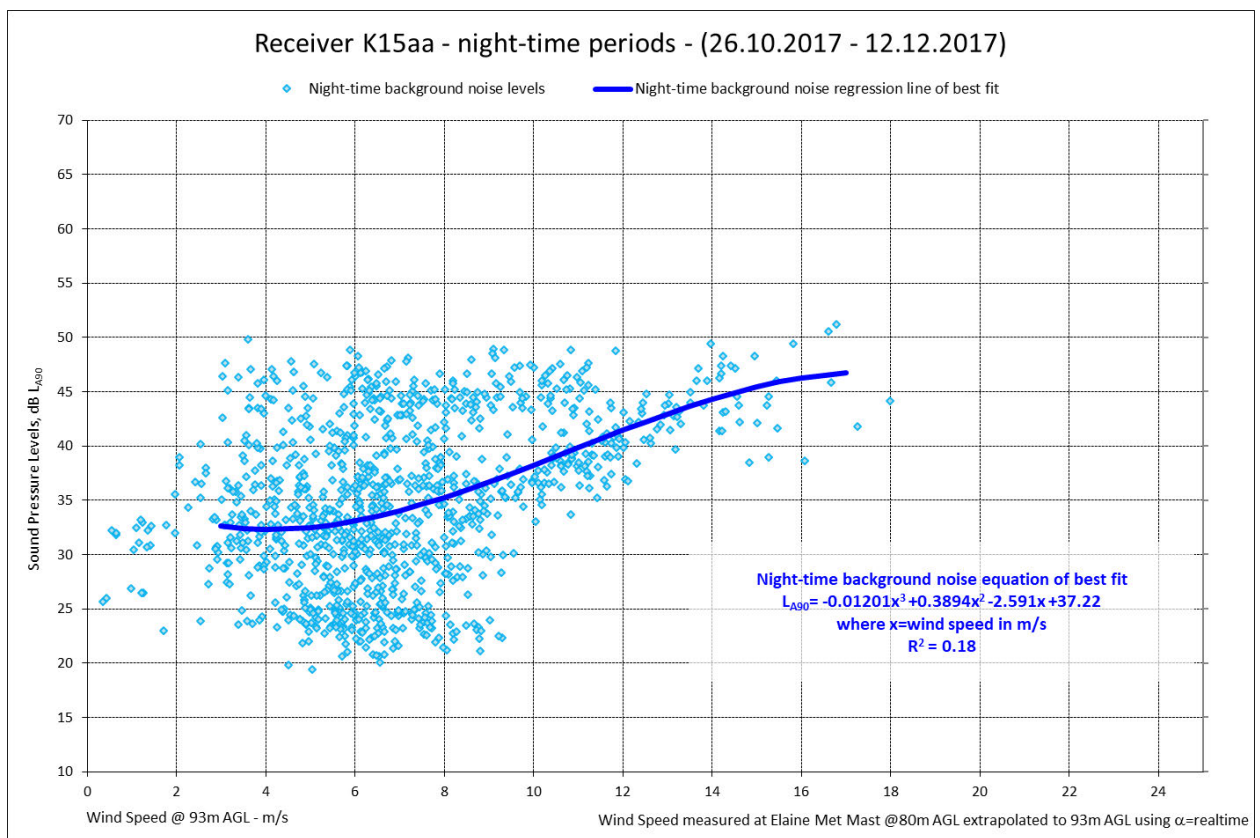


Figure 13: Receiver K15aa night-time periods – derived background noise levels and noise limits – 2nd survey



APPENDIX H RECEIVER K34aa DATA

H1 Receiver K34aa location data

Table 20: Receiver K34aa dwelling and noise monitor coordinates – MGA 94 Zone 55

Location	Easting	Northing
Dwelling location	236991	5834590
Background noise monitoring location	236968	5834563

Figure 14: Receiver K34aa aerial view - dwelling and noise monitor locations

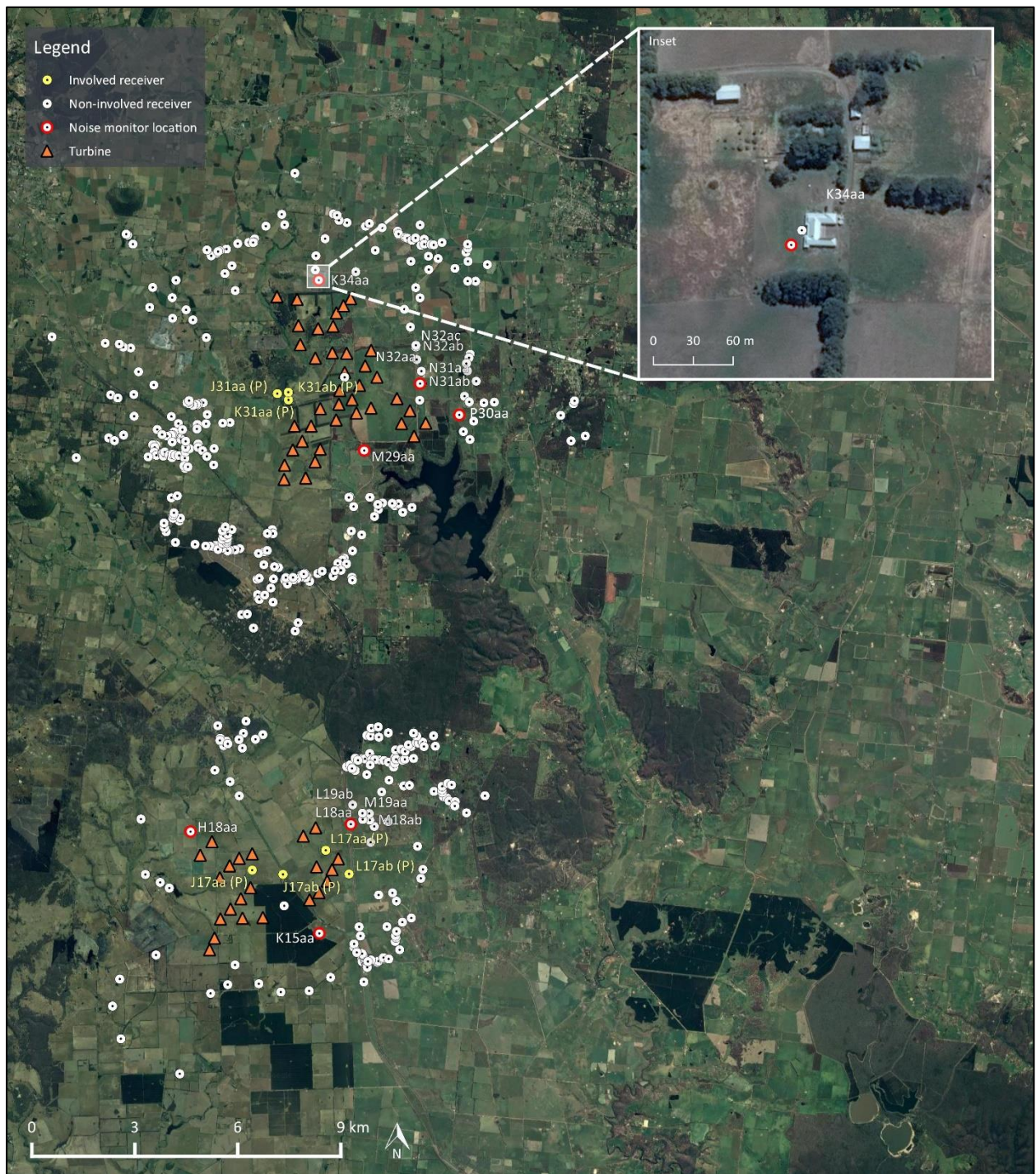


Table 21: Receiver K34aa monitor installation photos

Looking North	Looking East
	
Looking South	Looking West
	

H2 Receiver K34aa measurement data summary

Table 22: Receiver K34aa background noise level analysis summary

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4898	1827
Number of data points removed	492	84
Number of data points for analysis	4406	1743

Figure 15: Receiver K34aa background noise level and wind speed time history

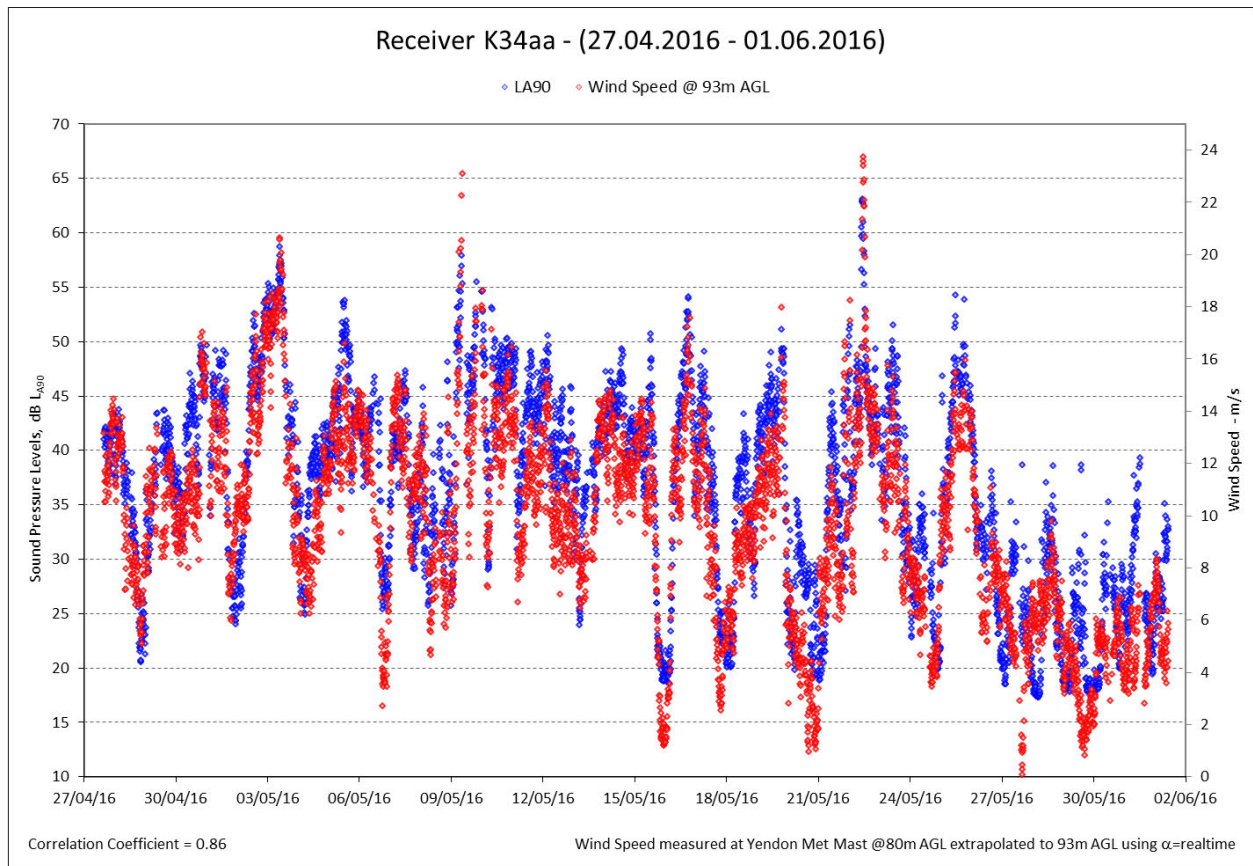


Figure 16: Receiver K34aa all-time periods – derived background noise levels and noise limits

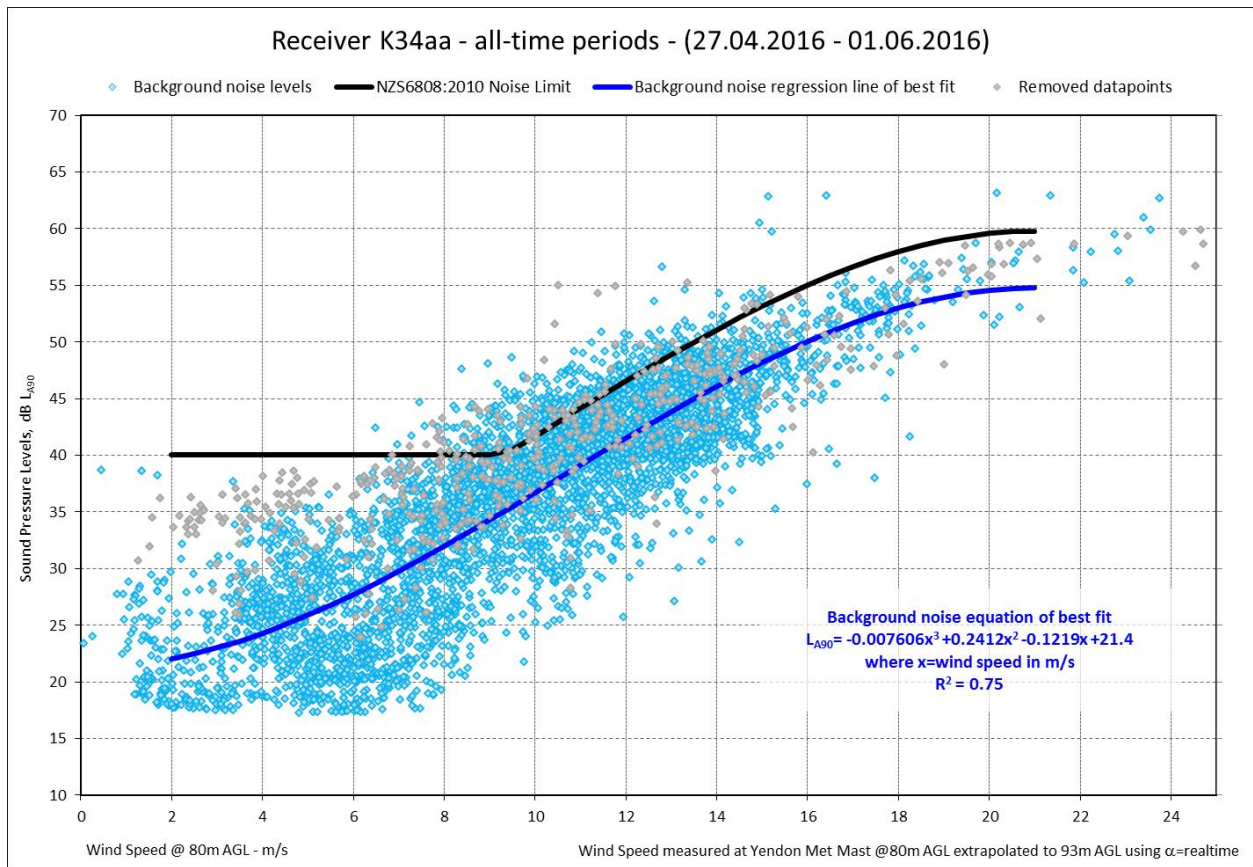
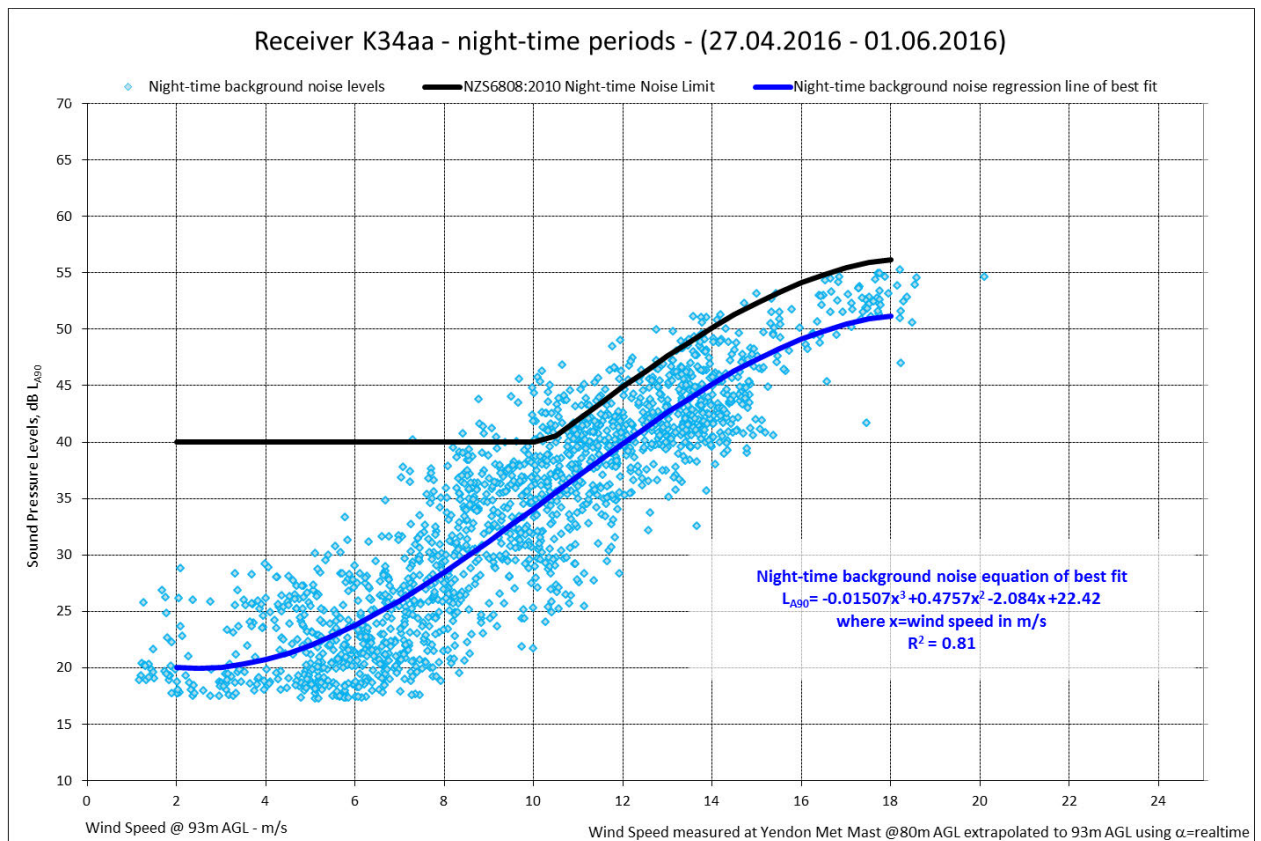


Figure 17: Receiver K34aa night-time periods – derived background noise levels and noise limits



APPENDIX I RECEIVER L18aa DATA

I1 Receiver L18aa location data

Table 23: Receiver L18aa dwelling and noise monitor coordinates – MGA 94 Zone 55

Location	Easting	Northing
Dwelling location	237913	5818705
Background noise monitoring location	237902	5818722

Figure 18: Receiver L18aa aerial view - dwelling and noise monitor locations

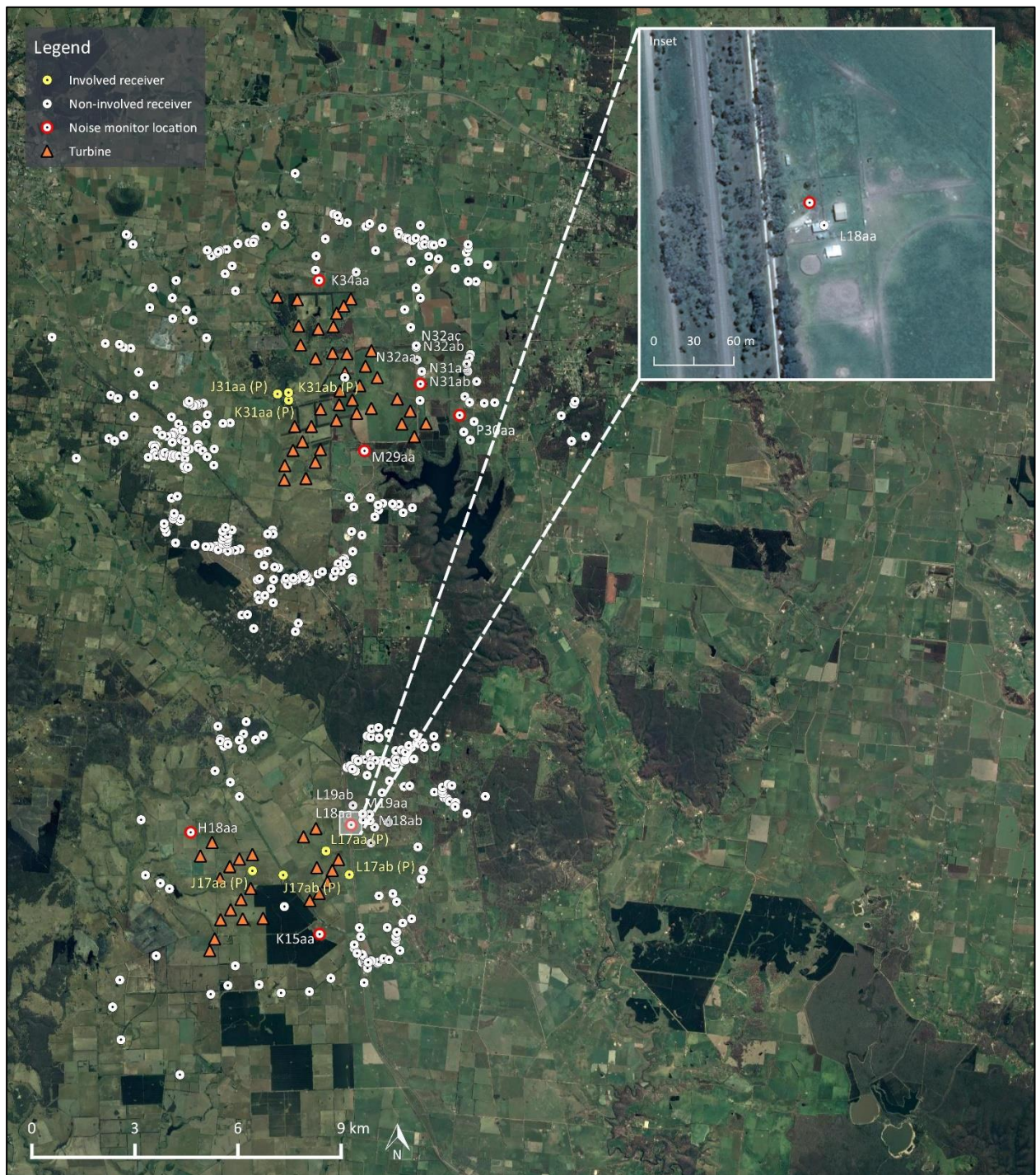


Table 24: Receiver L18aa monitor installation photos

Looking North	Looking East
	
Looking South	Looking West
	

I2 Receiver L18aa measurement data summary

Table 25: Receiver L18aa background noise level analysis summary

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4809	1775
Number of data points removed	1605	684
Number of data points for analysis	3204	1091

Figure 19: Receiver L18aa background noise level and wind speed time history

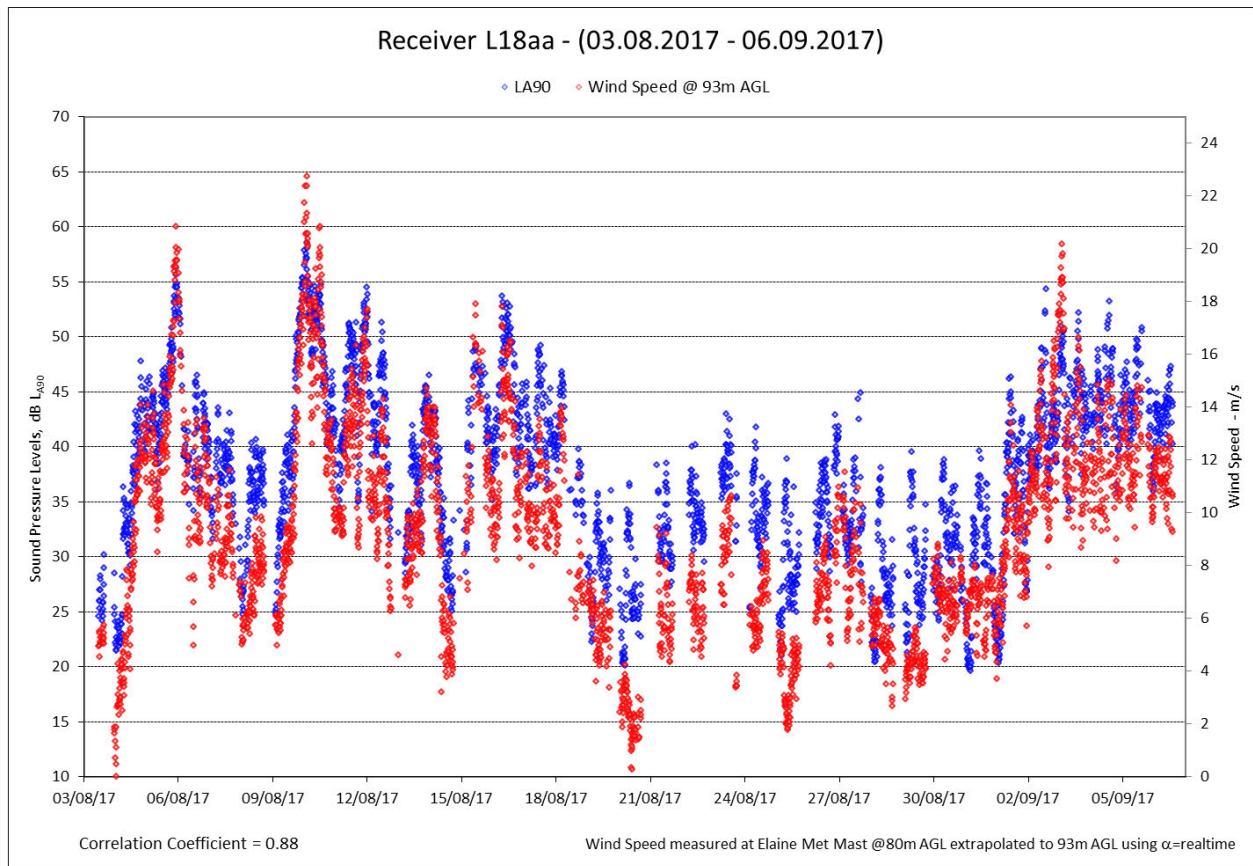


Figure 20: Receiver L18aa all-time periods – derived background noise levels and noise limits

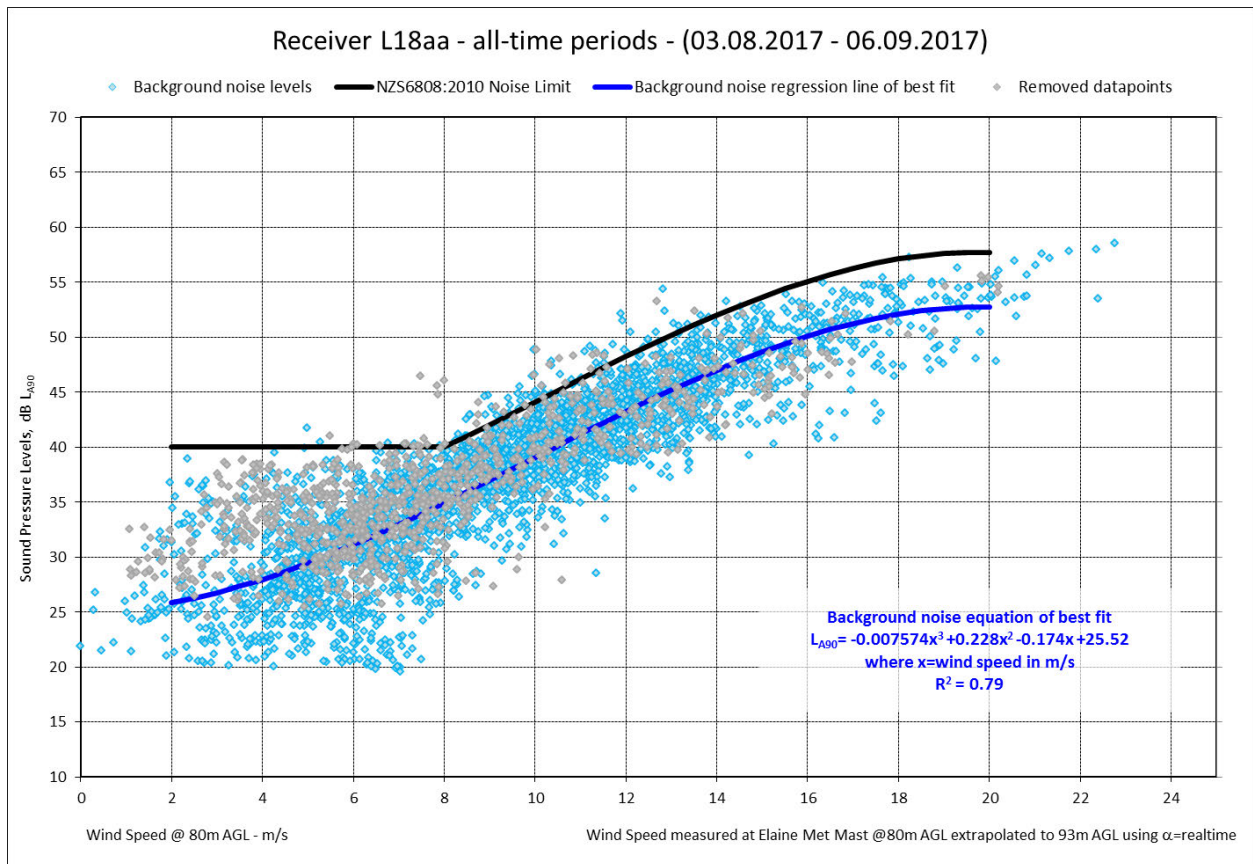
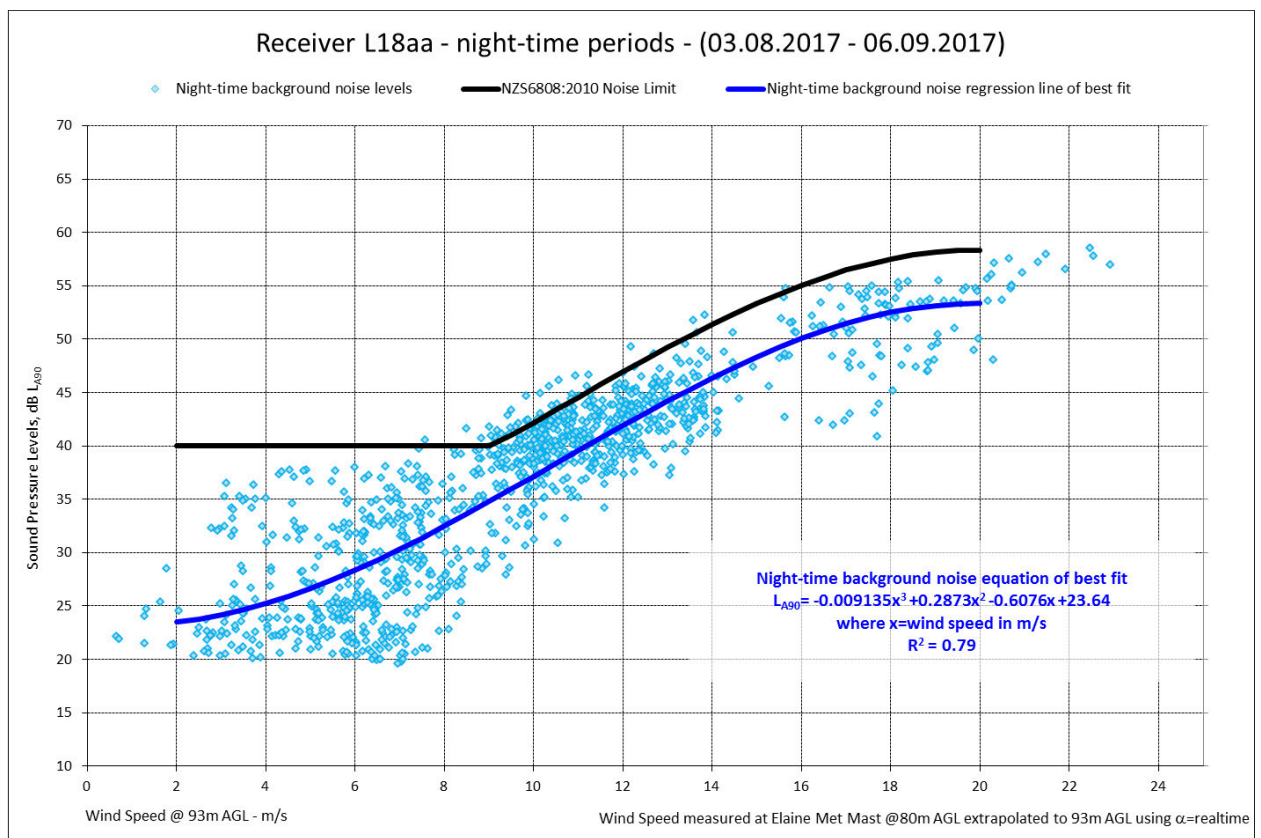


Figure 21: Receiver L18aa night-time periods – derived background noise levels and noise limits



APPENDIX J RECEIVER M29aa DATA

J1 Receiver M29aa location data

Table 26: Receiver M29aa dwelling and noise monitor coordinates – MGA 94 Zone 55

Location	Easting	Northing
Dwelling location	238304	5829565
Background noise monitoring location	238292	5829603

Figure 22: Receiver M29aa aerial view - dwelling and noise monitor locations

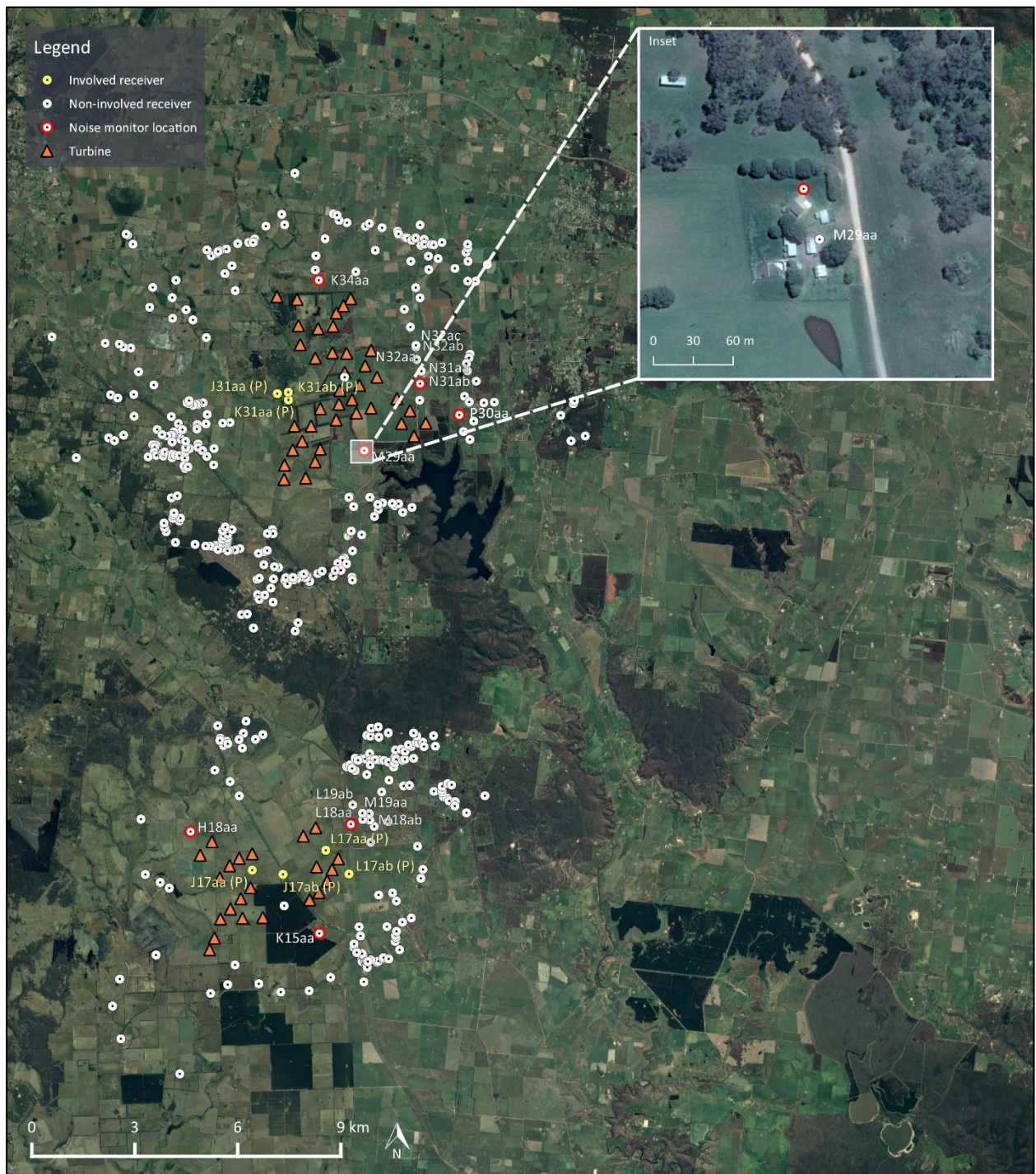


Table 27: Receiver M29aa monitor installation photos

Looking North	Looking East
	
Looking South	Looking West
	

J2 Receiver M29aa measurement data summary

Table 28: Receiver M29aa background noise level analysis summary

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4820	1787
Number of data points removed	1366	534
Number of data points for analysis	3454	1253

Figure 23: Receiver M29aa background noise level and wind speed time history

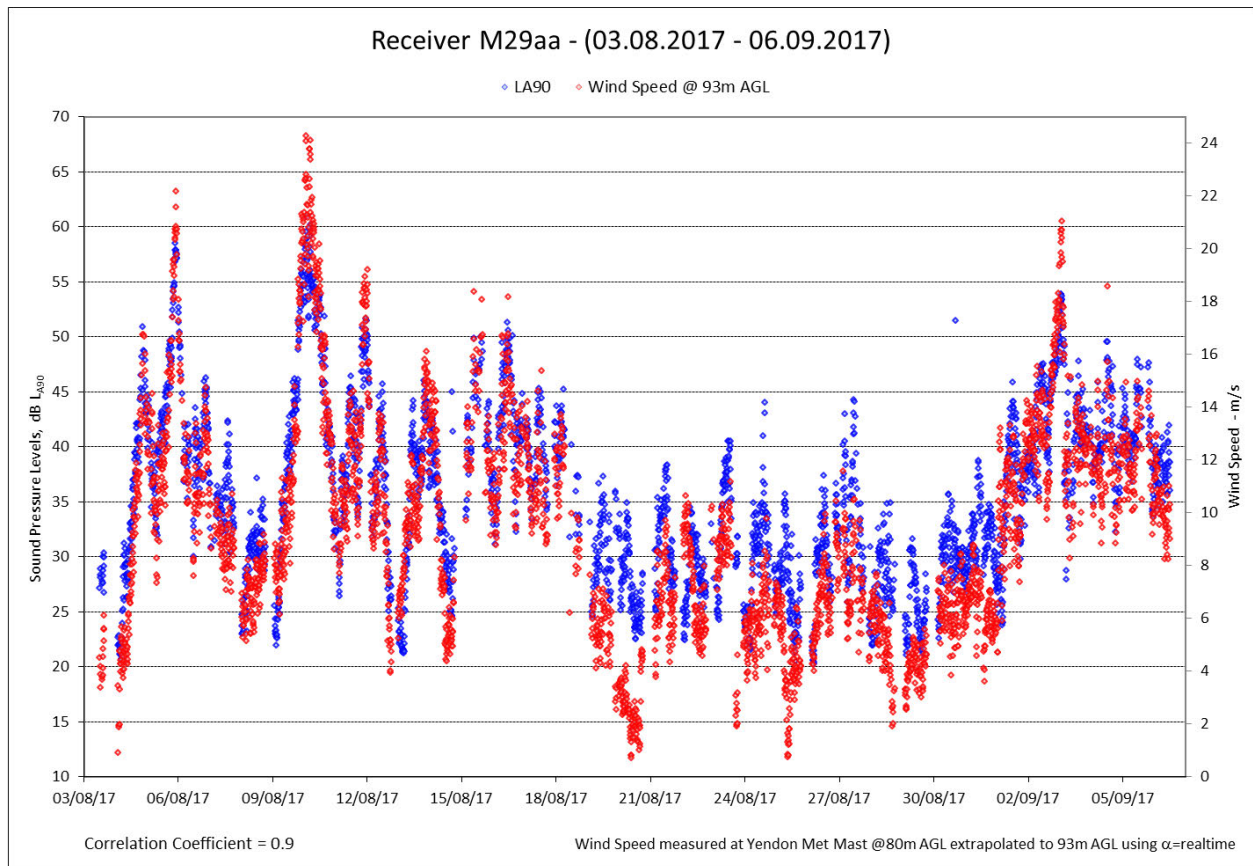


Figure 24: Receiver M29aa all-time periods – derived background noise levels and noise limits

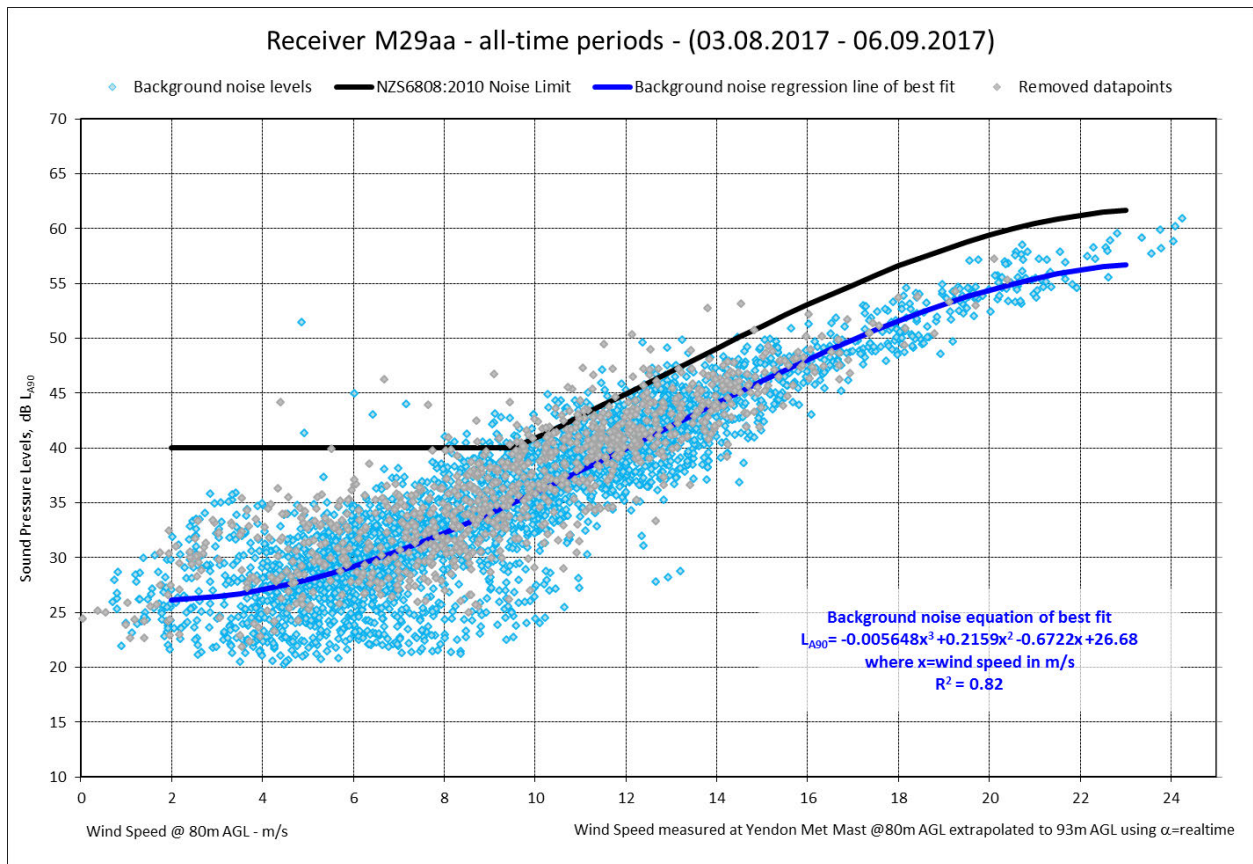
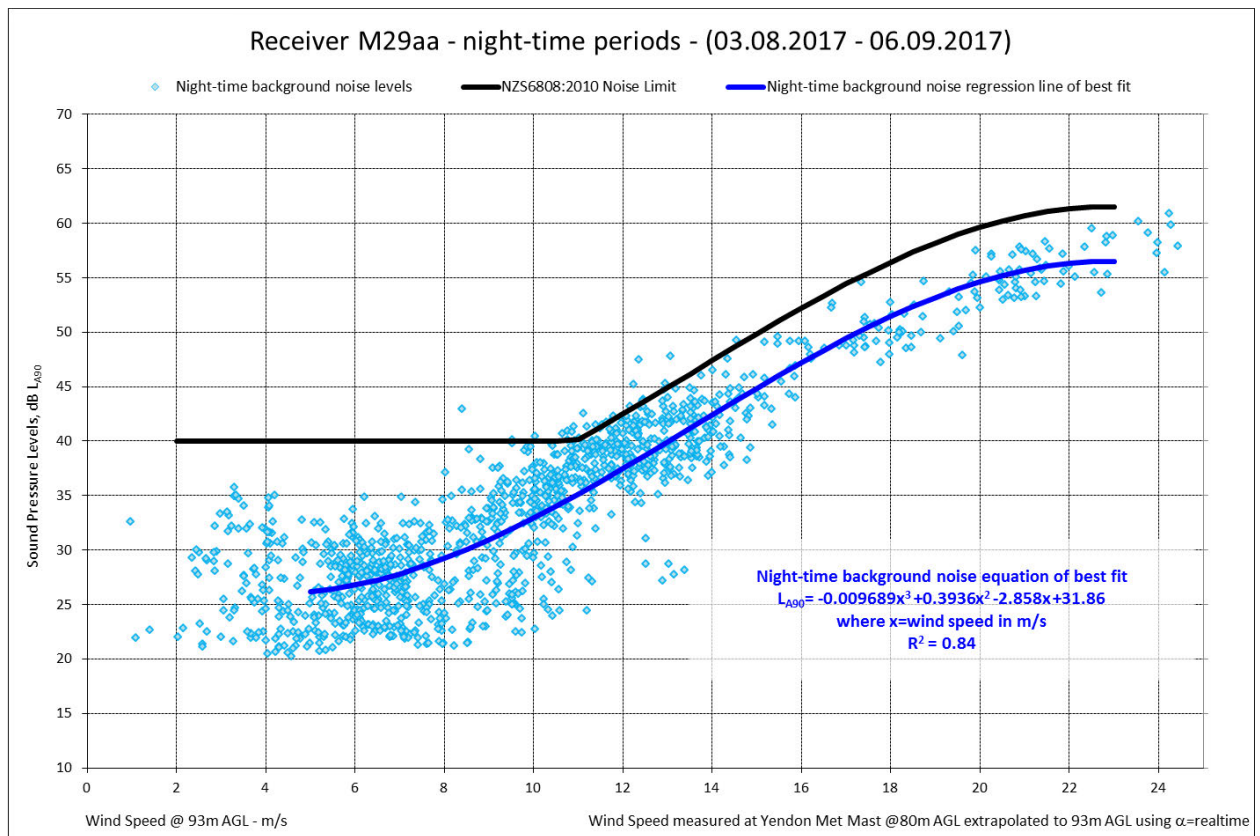


Figure 25: Receiver M29aa night-time periods – derived background noise levels and noise limits



APPENDIX K RECEIVER N31ab DATA

K1 Receiver N31ab location data

Table 29: Receiver N31ab dwelling and noise monitor coordinates – MGA 94 Zone 55

Location	Easting	Northing
Dwelling location	239974	5831555
Background noise monitoring location	239917	5831551

Figure 26: Receiver N31ab aerial view - dwelling and noise monitor locations



Table 30: Receiver N31ab monitor installation photos

Looking North	Looking East
	
Looking South	Looking West
	

K2 Receiver N31ab measurement data summary

Table 31: Receiver N31ab background noise level analysis summary

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4843	1792
Number of data points removed	1580	594
Number of data points for analysis	3263	1198

Figure 27: Receiver N31ab background noise level and wind speed time history

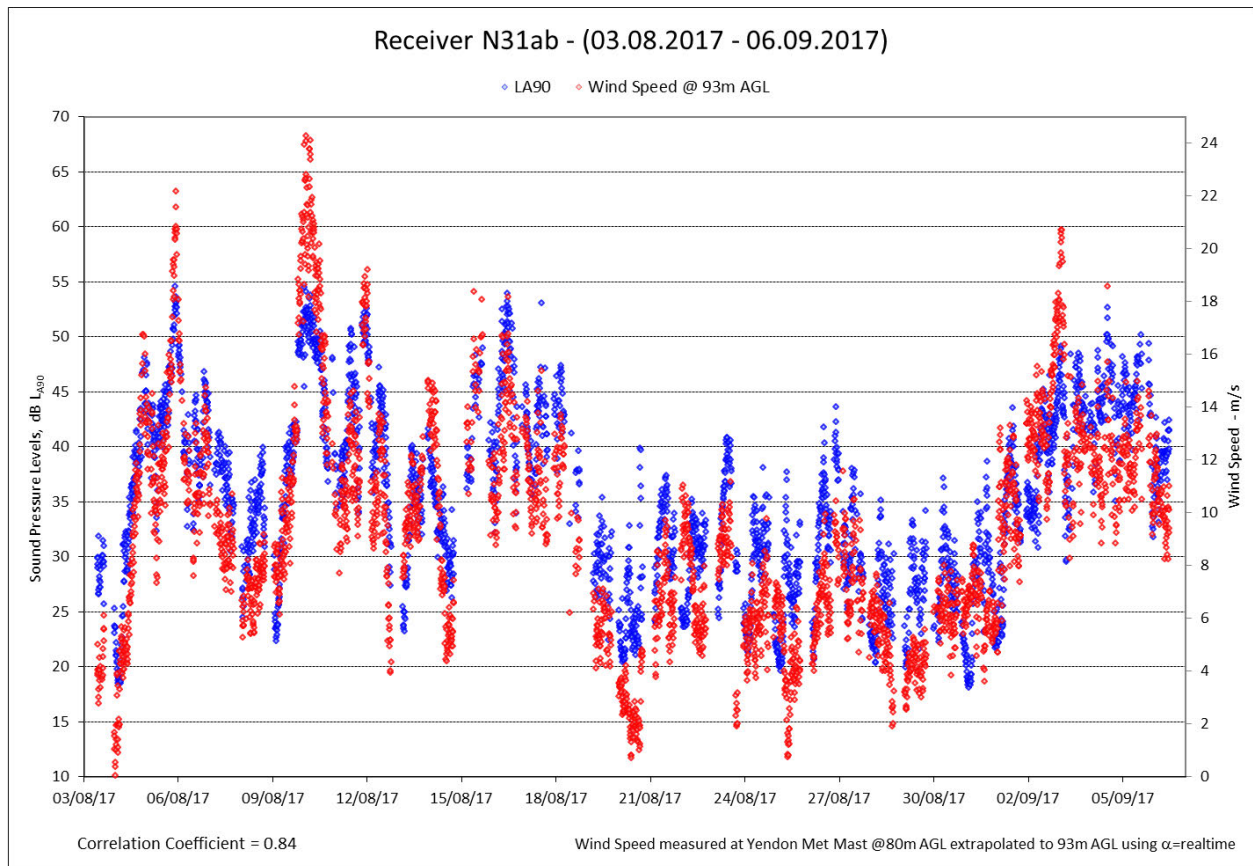


Figure 28: Receiver N31ab all-time periods – derived background noise levels and noise limits

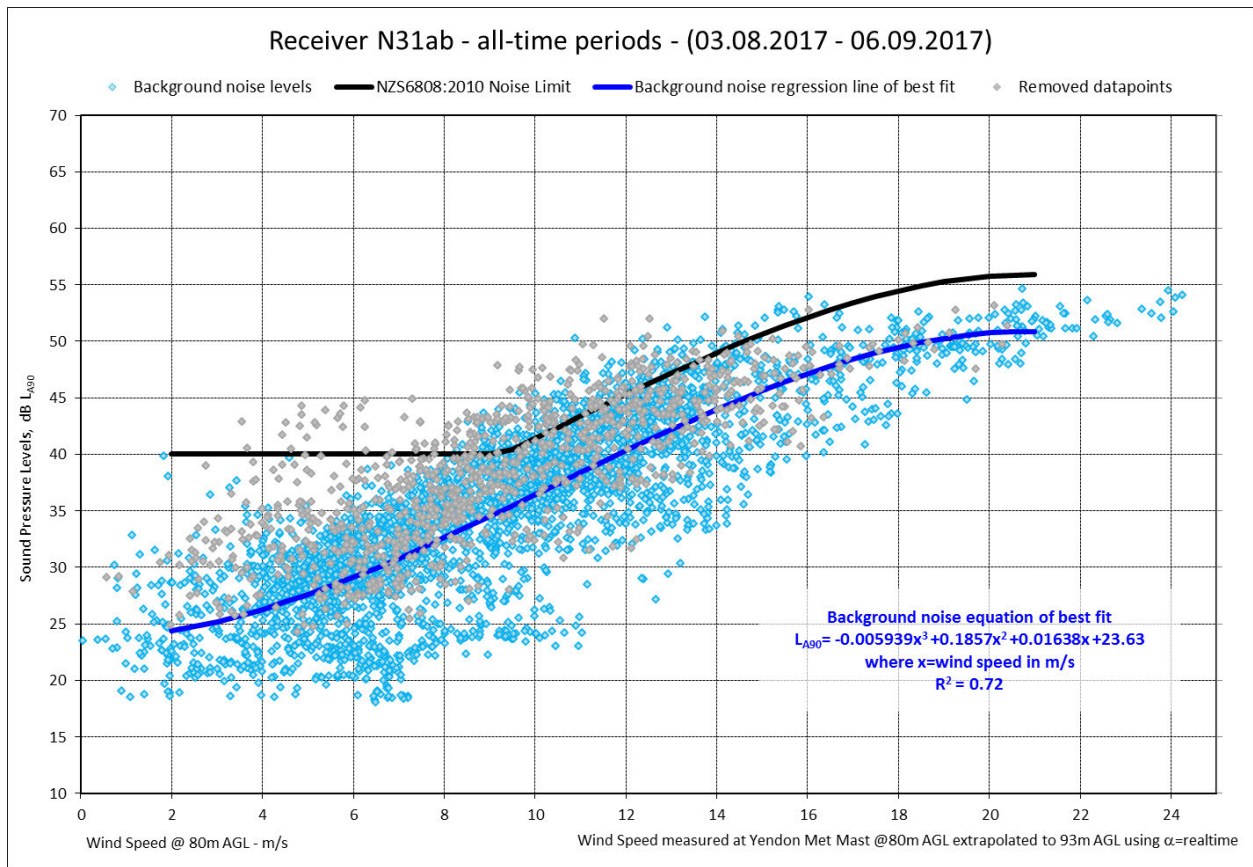
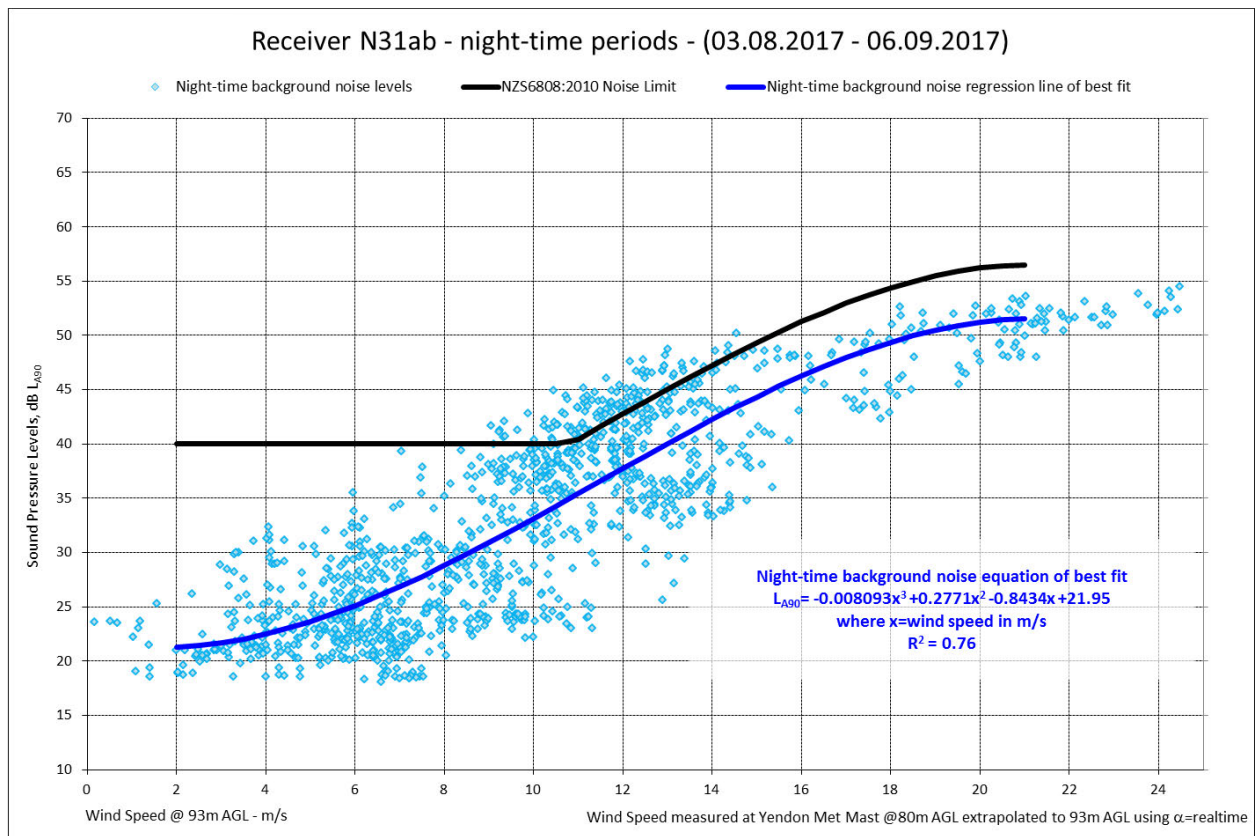


Figure 29: Receiver N31ab night-time periods – derived background noise levels and noise limits



APPENDIX L RECEIVER P30aa DATA

L1 Receiver P30aa location data

Table 32: Receiver P30aa dwelling and noise monitor coordinates for– MGA 94 Zone 55

Location	Easting	Northing
Dwelling location	241097	5830670
Background noise monitoring location	241062	5830640

Figure 30: Receiver P30aa aerial view - dwelling and noise monitor locations

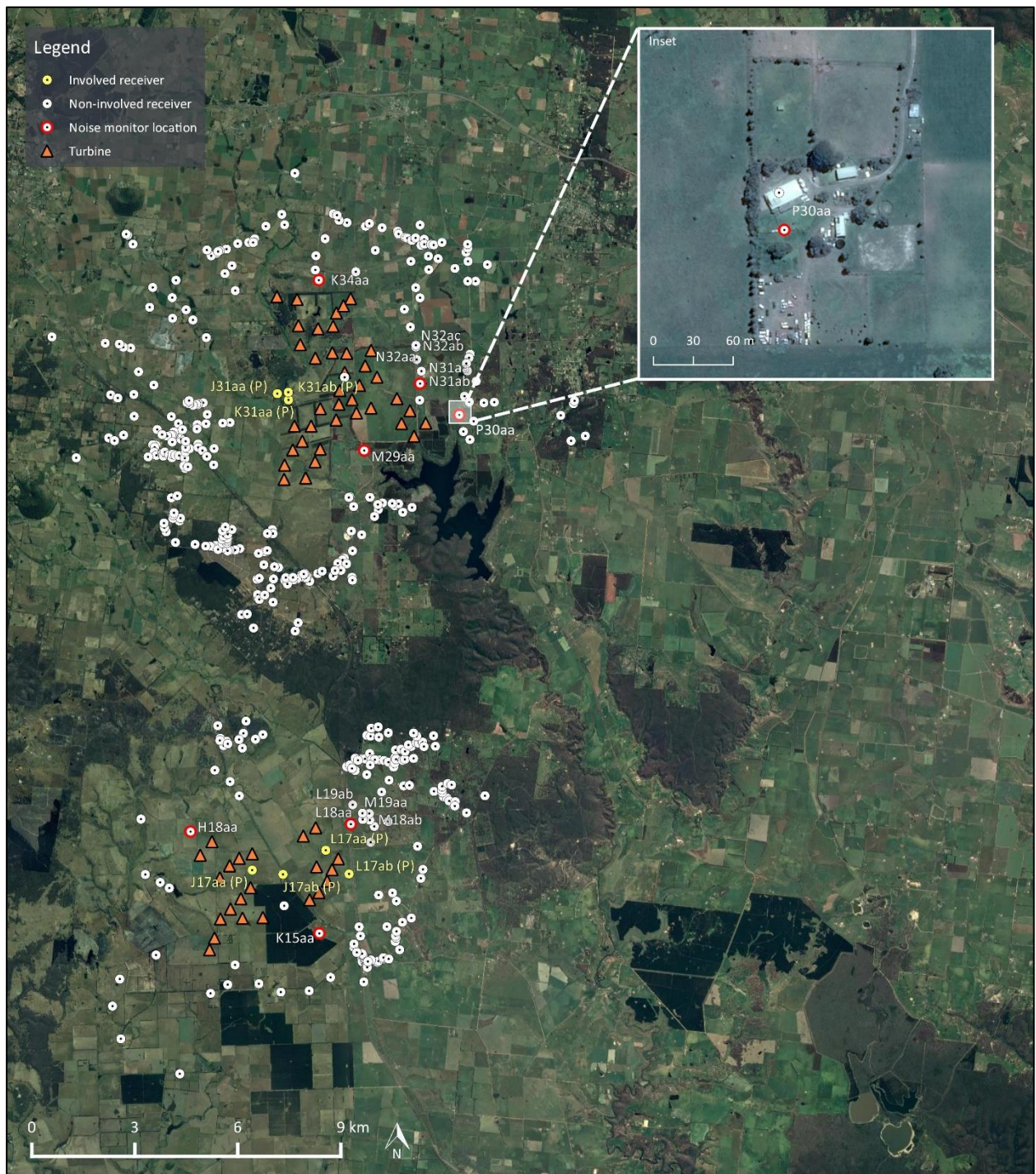


Table 33: Receiver P30aa monitor installation photos

Looking North	Looking East
	
Looking South	Looking West
	

L2 Receiver P30aa measurement data summary

Table 34: Receiver P30aa background noise level analysis summary

Item	All-time (day & night combined)	Night-time (2200 – 0700 hrs)
Number of data points collected	4896	1833
Number of data points removed	976	305
Number of data points for analysis	3920	1528

Figure 31: Receiver P30aa background noise level and wind speed time history

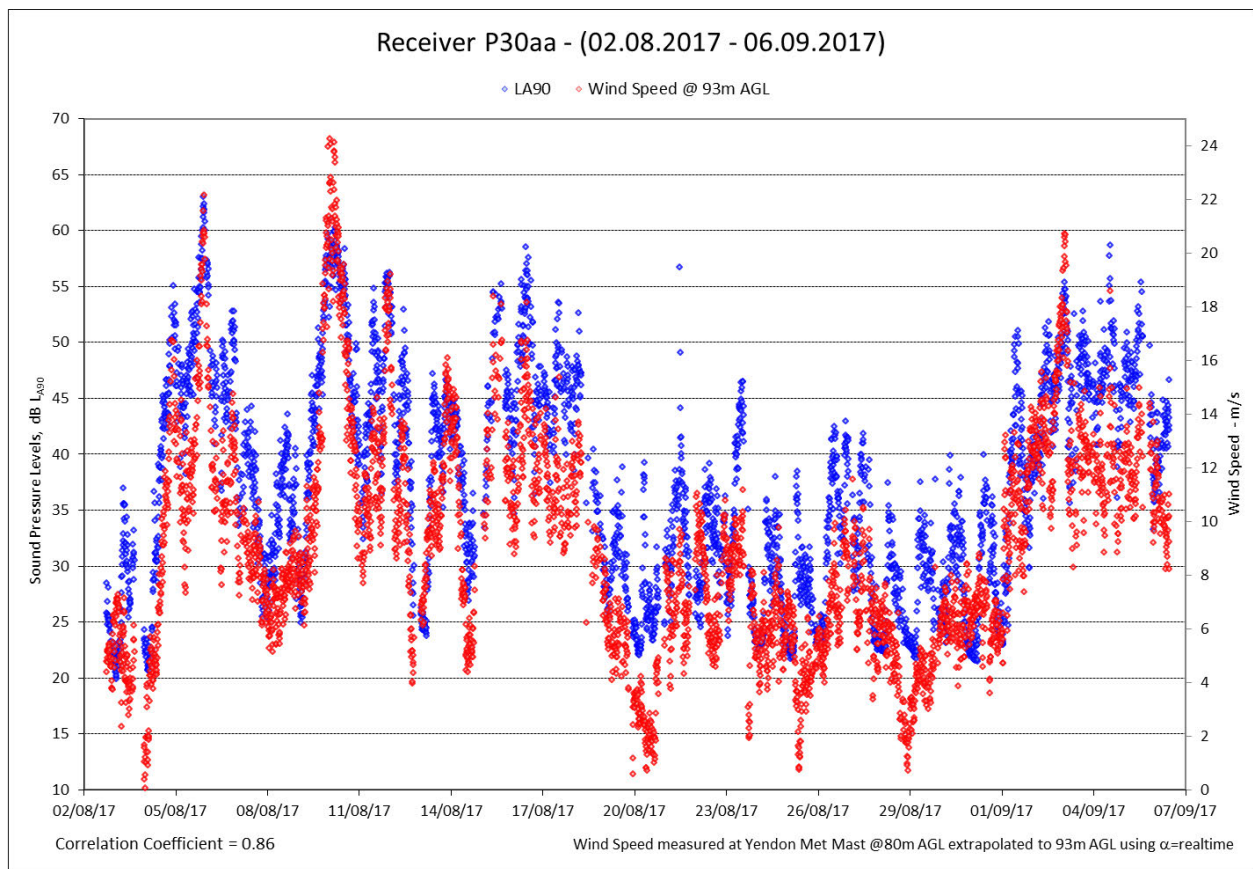


Figure 32: Receiver P30aa all-time periods – derived background noise levels and noise limits

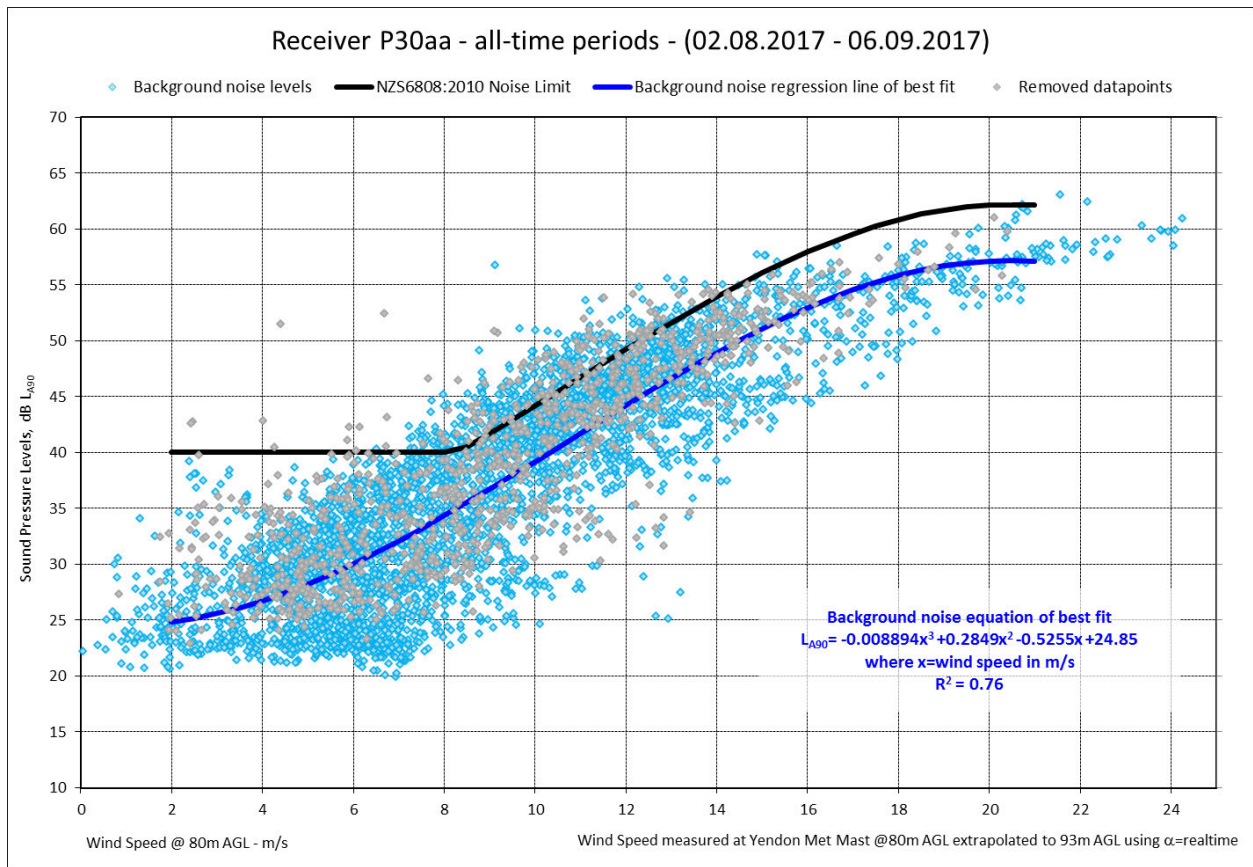


Figure 33: Receiver P30aa night-time periods – derived background noise levels and noise limits

