Cleve Wind Farm

Stage 1

Noise Impact Assessment

S7839C2

April 2025

sonus.

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GLOSSARY

A-weighting	Frequency adjustment applied to measured noise levels to replicate the frequency response of the human ear.
Ambient noise level	The noise level of the existing noise sources in the environment (in the absence of the Wind Farm).
Associated Receiver	An *Associated Receiver* is a premises where the Wind Farm developer has entered into an agreement with the landholder for use of their land for development of the Wind Farm.
Background noise level	The ambient noise level which excludes intermittent noise sources.
dB(A)	A-weighted noise or sound power level in decibels.
Dwelling	Building in which someone resides or has a valid development approval to build a residential dwelling
Equivalent noise level	Energy averaged noise level over a prescribed period of time
Guidelines	*Wind Farms Environmental Noise Guidelines (SA Environment Protection Authority, November 2021)*
ISO 9613-2	International Standard *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation*
IOA Guide	Institute of Acoustics UK *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* May 2013
Noise sensitive location	A location within 30m of a dwelling at either an *Associated Receiver* or *Non-associated Receiver*, at which noise measurements are taken
Non-associated Receiver	A premises, where the landowner does not have a commercial agreement with the wind farm developer for use of their land for development of the Wind Farm.
Sound power level	A measure of the sound energy emitted by a noise source.
The Wind Farm	Cleve Wind Farm
WTG	Wind turbine generator comprising a three bladed, upstream facing, horizontal axis turbine mounted on steel towers with a common set of generic design components comprising a foundation, tower, nacelle, hub, and blades

1 INTRODUCTION

A noise impact assessment has been prepared for the proposed Cleve Wind Farm (the **Wind Farm**), to be constructed between 5 and 25 kilometres northwest of the township of Cleve on South Australia's Eyre Peninsula.

This noise impact assessment has been prepared to support the planning application for the Wind Farm.

Noise from the Wind Farm has been predicted in accordance with the requirements of the South Australian Environment Protection Authority (**SA EPA**) document *Wind Farms Environmental Noise Guidelines* (2021) (the **Guidelines**). The predictions consider the wind speed at which the highest sound power level is generated by an indicative model of wind turbine generator (**WTG**), and the WTG layout of the Wind Farm.

The assessment has been based on the following:

- Wind Farm layout dated 7 September 2024.
- Dwelling locations provided 22 August 2024.
- Sound power level data for an indicative WTG model, provided 2 August 2024.
- Publicly available South Australian government elevation data with a 1-second resolution.
- The WTG being free of any excessive levels of tonality or any other special noise characteristics, when assessed at the dwellings.
- Background noise monitoring conducted at five representative noise sensitive locations (as shown in Figure 1) from 12 December 2024 to 28 February 2025.

An overview of the Wind Farm site and surrounding locality showing the site boundary, the location of WTGs, and dwellings in the vicinity of the wind farm is provided in Figure 1.

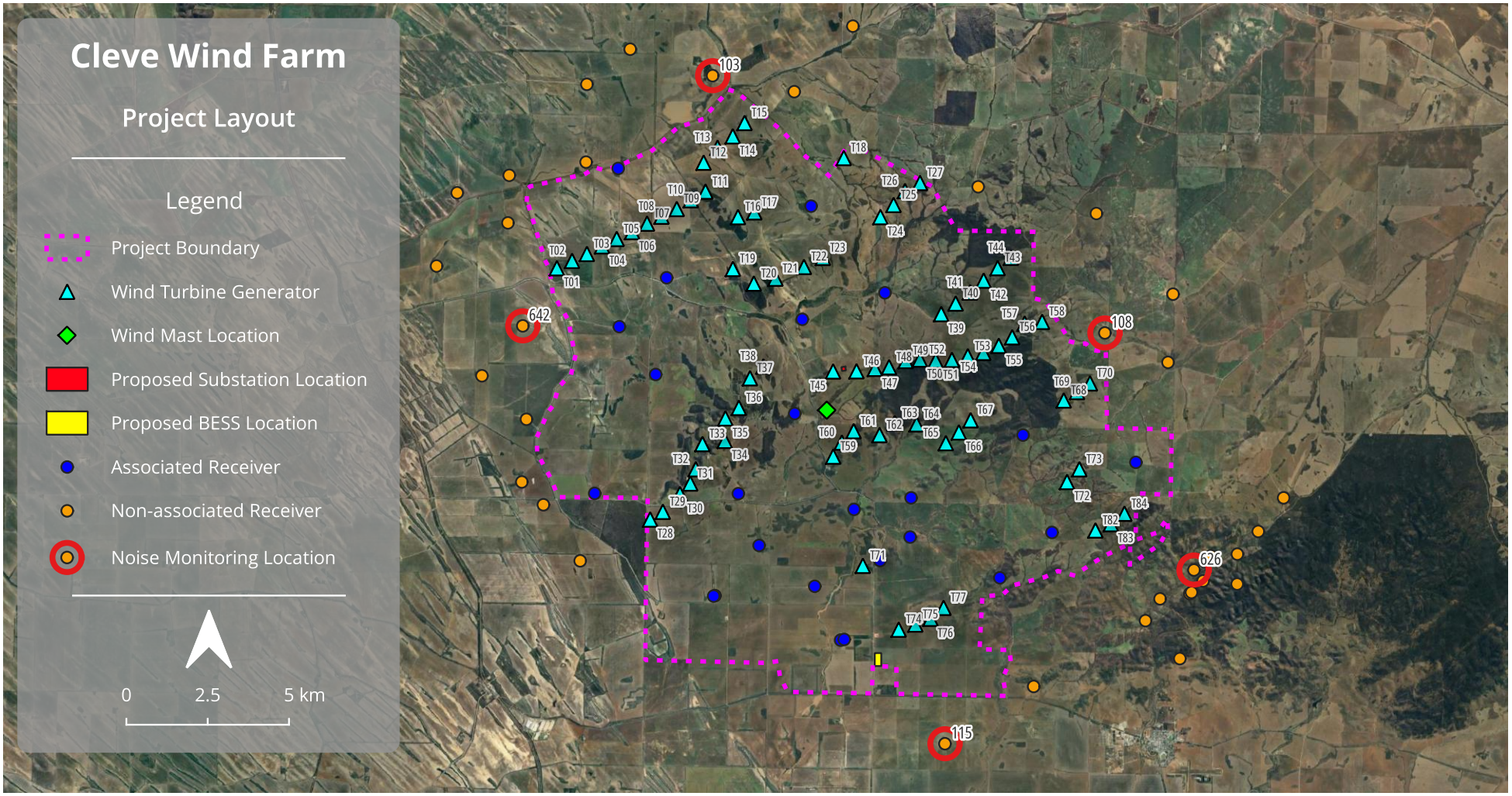


Figure 1: Locality overview

2 NOISE IMPACT ASSESSMENT

2.1 Methodology

Noise from the Wind Farm has been predicted in accordance with ISO 9613-2:1996 *"Acoustics – Attenuation of Sound during propagation outdoors - Part 2: General method of calculation"* (**ISO 9613-2**) using the SoundPLAN computer noise modelling software package. The noise model considers the following factors:

- The sound power level of each noise source (the WTGs).
- The location of each noise source (WTG), and the height above ground level (hub height and blade tip height).
- The distance from each noise source to each noise sensitive location.
- The topography between each noise source and each noise sensitive location.
- Shielding provided by terrain, barriers and other structures.
- The influence of the ground.
- Air absorption.
- Meteorological conditions.

The ISO 9613-2 noise propagation model describes a methodology for predicting noise levels at noise sensitive locations under meteorological conditions favourable to noise propagation and is one of the two noise prediction methods recommended by the Guidelines. The model is based on the conservative assumption of downwind propagation from all noise sources (WTGs) to all noise sensitive locations simultaneously, resulting in the highest noise levels. Inputs to the noise model have been selected consistent with the *Institute of Acoustics* (**IOA**) document *A Good Practice Guide to the Application of Etsu-R-97 for the Assessment and Rating of Wind Turbine Noise* (the **IOA Guide**), including the following:

- 10°C temperature
- 70% relative humidity
- 50% acoustically hard ground and 50% acoustically soft ground.
- Barrier attenuation of no greater than 2 dB(A).
- 4 metre noise sensitive location height.
- Application of a 3 dB(A) correction where a "concave" ground profile exists as defined by the IOA Guide.

2.2 Noise Sources

2.2.1 Layout

The predictions have considered the WTG layout dated 7 September 2024, as shown in Figure 1 and summarised in Appendix A.

2.2.2 WTG Model and Sound Power

The predictions are based on an indicative make/model of WTG (*Vestas V172-7.2 MW*) with blades with serrated trailing edges. These WTGs have a rated power output of 7.2 MW and a rotor diameter of 172m. A hub height of 150m has been assumed, resulting in a tip height of approximately 236 metres.

The predictions consider the highest broadband sound power level generated by the indicative WTG model of 107 dB(A), which occurs at hub height wind speeds of 8m/s and above.

The sound power data used for the assessment are summarised in Appendix E.

2.3 Criteria

2.3.1 Non-associated Receivers

In accordance with the Guidelines, the operational noise from the Wind Farm must not exceed the following external noise criteria at *non-associated receivers* (whichever is the greater):

- A baseline noise level of 35 dB(A) at non-associated receivers in localities which are primarily intended for rural living, or 40 dB(A) at non-associated receivers in other localities, or;
- The background noise level ($L_{A90,10}$) by more than 5 dB(A).

With reference to the South Australian *Planning and Design Code* (the **Code**), all identified noise sensitive locations associated with non-associated receivers within 5km of a WTG are located within the *Rural Zone*. In accordance with the *Indicative noise factor guidelines for the Environment Protection (Commercial and Industrial Noise) Policy 2023*, the *Rural Zone* is not considered to be primarily intended for rural living. On this basis, the 40 dB(A) baseline noise criterion has been applied at all non-associated receivers and adjusted based on background noise levels where applicable.

2.3.2 Associated Receivers

Although the criteria specified by the Guidelines have been developed to minimise the impact on the amenity at *non-associated receivers*, the Guidelines also note that a Wind Farm developer cannot absolve itself of its obligation to meet the 'general environmental duty' (under Section 25 of the *Environment Protection Act 1993*) by entering into an agreement with a landholder.

For *associated receivers*, the Guidelines note that operational noise from the Wind Farm should not exceed the following (whichever is the greater):

- Fixed noise levels of:
    - An internal noise level at night (10pm to 7am) of no more than 30 dB(A) to prevent sleep disturbance, and
    - An external noise level no more than 5 dB(A) less than the relevant *Indicative Noise Factor* from Table 2 of the *Environment Protection (Commercial and Industrial Noise) Policy 2023* (the **Policy**) for the zone in which the associated receiver is located during the day (7am to 10pm), or;
- The external background noise level ($L_{A90,10}$) by more than 5 dB(A).

All *associated receivers* are located within the *Rural Zone*. With reference to the Policy, a baseline criterion of 52 dB(A) during the day therefore applies at all *associated receivers*.

To achieve an internal noise level of 30 dB(A) at night (as recommended by the Guidelines), the *World Health Organisation Guidelines for Community Noise (1999)* (the **WHO Guidelines**) recommends a noise level of 45 dB(A) outdoors so that residents may sleep with their bedroom windows open[1]. This results in a criterion consistent with that adopted for *associated receivers* in other Australian jurisdictions.

Based on the above, the following baseline noise criteria (to be achieved outdoors) have been adopted at *associated receivers* for the purposes of the noise impact assessment:

- An average noise level (L_{eq}) of 52 dB(A) during the day (7:00am to 10:00pm)
- An average noise level (L_{eq}) of 45 dB(A) during the night (10:00pm to 7:00am).

Higher noise criteria may apply based on the outcome of background noise monitoring (see Section 2.4 below).

[1] Based on the assumption of a 15 dB(A) noise reduction from outside to inside as noted by the WHO Guidelines

2.3.3 Staged and Cumulative Development

If multiple stages of the same wind farm belong to the same owner, the Guidelines recommend that the cumulative noise impact from all stages of the wind farm be assessed against the criteria.

Also, where a second stage or a separate Wind Farm development is proposed in close proximity, the noise criteria should be determined based on background noise levels without the influence of noise from any existing wind farms[2].

2.4 Background Noise Monitoring

Background noise monitoring has been conducted from 12 December 2024 to 28 February 2025. The background noise measurements were taken at five noise sensitive locations in different directions from the wind farm. The noise measurement locations are provided in Table 1 and visually in Figure 1.

Table 1: Background noise monitoring locations

Receiver ID	Noise Sensitive Location Coordinates (GDA94 / MGA zone 53)		Monitoring Period
	Easting	Northing	
103	624750	6290329	12/12/2024 – 23/1/2025
108	636766	6282432	12/12/2024 – 23/1/2025
115	631887	6269862	12/12/2024 – 23/1/2025
626	639539	6275153	12/12/2024 – 23/1/2025
642	618919	6282660	12/12/2024 – 28/2/2025[1]
[1.] An insufficient amount of data was captured which resulted in the redeployment of this logger.			

[2] The Guidelines note that a new wind farm should meet criteria based on the background noise levels as they existed before development of the first wind farm (or stage of the same wind farm) in the vicinity of a noise sensitive location. However, as background noise levels may change, it may not be appropriate to utilise background noise measurements from many years ago.

2.4.1 Equipment

The background noise was measured in 10-minute intervals using a combination of Rion Class 1 and Class 2 sound level meters with a noise floor of less than 20 dB(A), calibrated at the beginning and the end of the period with a Rion calibrator, with no significant drift observed. The microphones were positioned approximately 1.5m above ground level and fitted with Rion WS-15 double layer all weather windshields. An example of a typical on-site setup is shown in Figure 2.

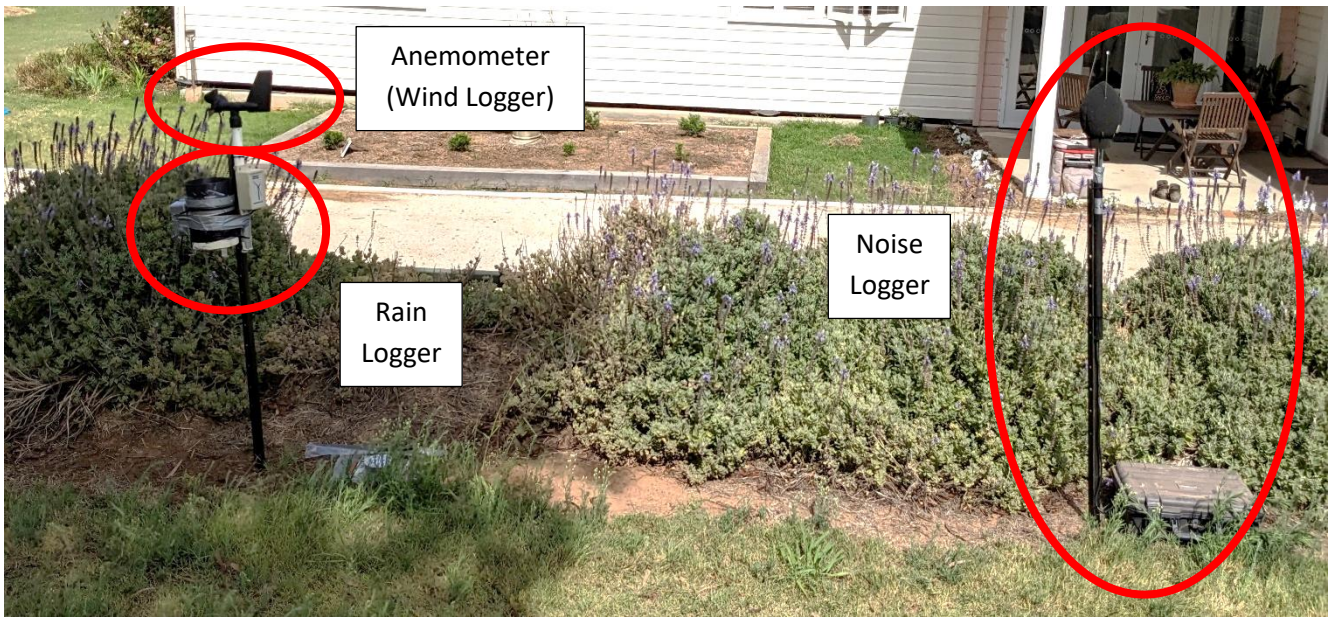


Figure 2: Typical Background Noise Monitoring Setup

Each noise logger was installed on the wind farm side of the dwelling in a location selected to minimise the influence of localised extraneous noise sources, such as air conditioning units and water pumps. Care was taken to ensure that the sound of the anemometer (wind logger) spinning was not audible at the noise logger location. Photographs of the noise monitoring equipment at each location are provided in Appendix B.

2.4.2 Hub Height Wind Speed

During the background noise monitoring regime, the wind speed was measured in 10-minute intervals at a location on the wind farm site. The location of the wind speed measurement equipment has been provided in Table 2 and shown in Figure 1.The wind data were sheared to a hub height of 150m before being provided to Sonus.

Table 2: Wind Measurement Location

Measurement Location	Coordinates (GDA94 / MGA zone 53)	
	Easting	Northing
CAM_MM1	628244	6280039

2.4.3 Data Analysis

During the background monitoring period, local wind and rain at the microphone location (approximately 1.5m above ground level) were measured using "Rainwise" wind and rain loggers positioned at various locations around the wind farm site, as summarised in Table 3.

Table 3: Local Weather Measurement Locations

Measurement Location	Equipment Type	Coordinates (GDA94 / MGA zone 53)	
		Easting	Northing
12 December 2024 to 23 January 2025			
115	Wind	631880	6269864
103	Wind	624750	6290313
108	Rain	636768	6282431
23 January 2025 to 28 February 2025			
642	Wind	618932	6282651
642	Rain	618924	6282665

The rainfall and windspeed data were used to determine the periods when local weather may have affected the background noise measurements. Data were excluded when rainfall was measured in a period or the periods either side of the period in question, and/or when the measured wind speed at the microphone height exceeded 5m/s for more than 90% of the measurement period. For locations where local weather was not measured, the conditions at the nearest weather monitoring have been taken as representative.

Any data for wind speeds below the cut in wind speed and above the rated power of the indicative turbine (Vestas *V172-7.2MW*) were also excluded. As such, any data for a wind speed less than 3m/s or greater than 13m/s has been excluded from the analysis. Noise from intermittent noise sources, such as from dogs barking or passing cars, have a negligible effect as the $L_{A90,10min}$ measured only considers the level of noise that is exceeded for 90% of the 10-minute time period (and as such these noise sources are inherently excluded).

Following the data filtering procedures, the following number of data points remained for each of the monitoring locations, as shown in Table 4.

Table 4: Data Points at Monitoring Locations

Measurement Location	Total points	Points (after data filtering)	Total Downwind* Points (before data filtering)
103	6000	5357	4002
108	6000	5636	1954
115	6000	5625	435
626	6000	5630	547
642	6097	5307	837

**Based on 95m indicative height wind direction data*

It is noted that the Guidelines require at least 500 points to be collected for the worst-case wind direction (downwind), however this was not able to be achieved at all receivers. It is noted that a six-week monitoring period is typically considered sufficient to provide a representative correlation between background noise and wind speed.

Notwithstanding, the assessment shows that compliance can achieve the 40 dB(A) baseline noise criterion (refer to predicted noise levels in Appendix D), and therefore there is no reliance on the background noise levels to demonstrate compliance with the Guidelines for the purpose of this Development Approval.

2.4.4 Background Noise Correlation

The background noise data collected at each monitoring location were correlated with the wind speed data measured at the wind mast location and referenced to a hub height of 150m for each 10-minute period.

The correlated noise data were then split into wind speed bins as required by the Guidelines. Each wind speed bin is 1m/s wide and is centred on the integer wind speeds between cut in and rated power. The arithmetic average noise level for each wind speed bin was then determined to give the background noise level at each integer wind speed. The data and the resultant average noise levels are shown on the figures in Appendix C. Also shown are the criteria which have been determined in accordance with the Guidelines as the higher of 40 dB(A) or the background noise level plus 5 dB(A).

Table 5 summarises the background noise level for each integer wind speed at a hub height of 150m between 3m/s and 13m/s.

Table 5: Measured Background Noise Levels ($L_{A90,15min}$), dB(A)

Measurement Location	Hub Height (150m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
103	28	27	27	31	33	34	35	35	37	37	40
108	27	26	27	29	29	29	30	30	32	34	34
115	27	28	29	30	31	32	31	31	33	34	36
626	26	25	26	28	29	30	30	30	31	33	35
642	21	22	25	29	32	34	35	37	38	39	42

2.4.5 Resultant Noise Criteria

The resultant noise criteria determined in accordance with the Guidelines are provided in Table 6, based on the measured background noise levels presented in Table 5. It is noted that the background noise levels measured at these residences may be used at other locations nearby where local conditions permit.

Table 6: Noise Criteria, dB(A)

Measurement Location	Hub Height (150m) Wind Speed										
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s	13m/s
103	40	40	40	40	40	40	40	40	42	42	45
108	40	40	40	40	40	40	40	40	40	40	40
115	40	40	40	40	40	40	40	40	40	40	41
626	40	40	40	40	40	40	40	40	40	40	40
642	40	40	40	40	40	40	40	42	43	44	47

2.5 Results

The highest predicted noise levels from WTGs (corresponding to the hub height wind speed of maximum WTG sound power level) are detailed for each residence in Appendix D and is shown graphically in Appendix F. Appendix F shows the predicted 30, 35, 40 and 45 dB(A) noise contours.

Based on the modelling, the criteria are predicted to be achieved at all noise sensitive locations.

APPENDIX A: WTG LOCATIONS

WTG ID	WTG Coordinates (GDA94 / MGA zone 53)	
	Easting	Northing
T01	619952	6284424
T02	620419	6284649
T03	620876	6284863
T04	621343	6285099
T05	621791	6285325
T06	622267	6285538
T07	622725	6285798
T08	623172	6286012
T09	623639	6286248
T10	624073	6286520
T11	624522	6286784
T12	624465	6287675
T13	624892	6288135
T14	625361	6288487
T15	625724	6288898
T16	625522	6285998
T17	626027	6286145
T18	628776	6287818
T19	625365	6284402
T20	626008	6283951
T21	626676	6284103
T22	627550	6284463
T23	628134	6284741
T24	629902	6285999
T25	630306	6286372
T26	630658	6286800
T27	631120	6287050
T28	622821	6276682
T29	623211	6276919
T30	623737	6277465
T31	624055	6277791
T32	624223	6278232

WTG ID	WTG Coordinates (GDA94 / MGA zone 53)	
	Easting	Northing
T41	632660	6283679
T42	633076	6284041
T43	633507	6284427
T44	633917	6284745
T45	628447	6281244
T46	629167	6281249
T47	629734	6281324
T48	630168	6281375
T49	630683	6281564
T50	631114	6281610
T51	631601	6281575
T52	632100	6281600
T53	632589	6281711
T54	633069	6281817
T55	633541	6282033
T56	633955	6282297
T57	634337	6282718
T58	634875	6282771
T59	628450	6278620
T60	628717	6279051
T61	629079	6279404
T62	629875	6279284
T63	630341	6279649
T64	631015	6279616
T65	631914	6279035
T66	632315	6279365
T67	632677	6279739
T68	635540	6280349
T69	635951	6280607
T70	636347	6280876
T71	629362	6275255
T72	635641	6277837

T33	624429	6279006
T34	625116	6279105
T35	625135	6279797
T36	625549	6280121
T37	625891	6281033
T38	626302	6281397
T39	631772	6283010
T40	632216	6283336

T73	636021	6278230
T74	630464	6273289
T75	630978	6273446
T76	631444	6273625
T77	631844	6273960
T82	636515	6276345
T83	636991	6276540
T84	637407	6276861

APPENDIX B: NOISE MONITORING PHOTOS

Appendix B.1: Receiver 103

Appendix B.2: Receiver 108

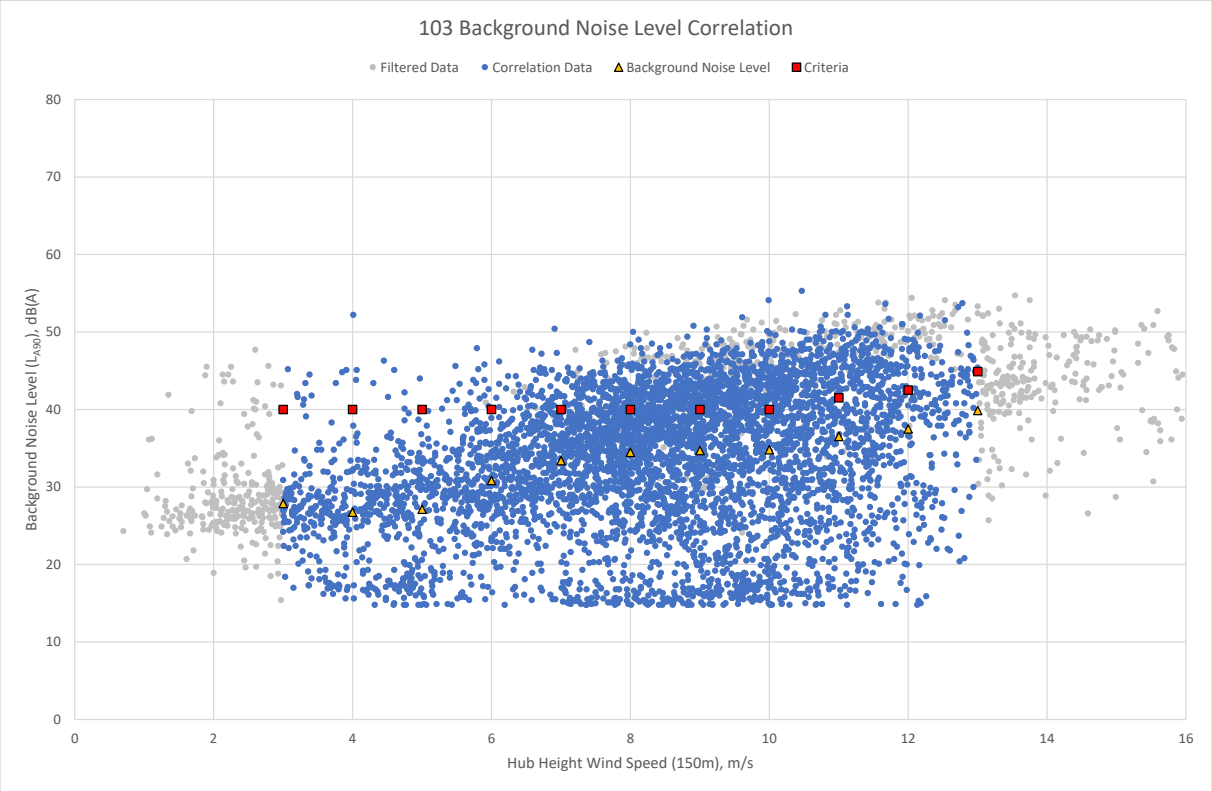
Appendix B.3: Receiver 115

Appendix B.4: Receiver 626

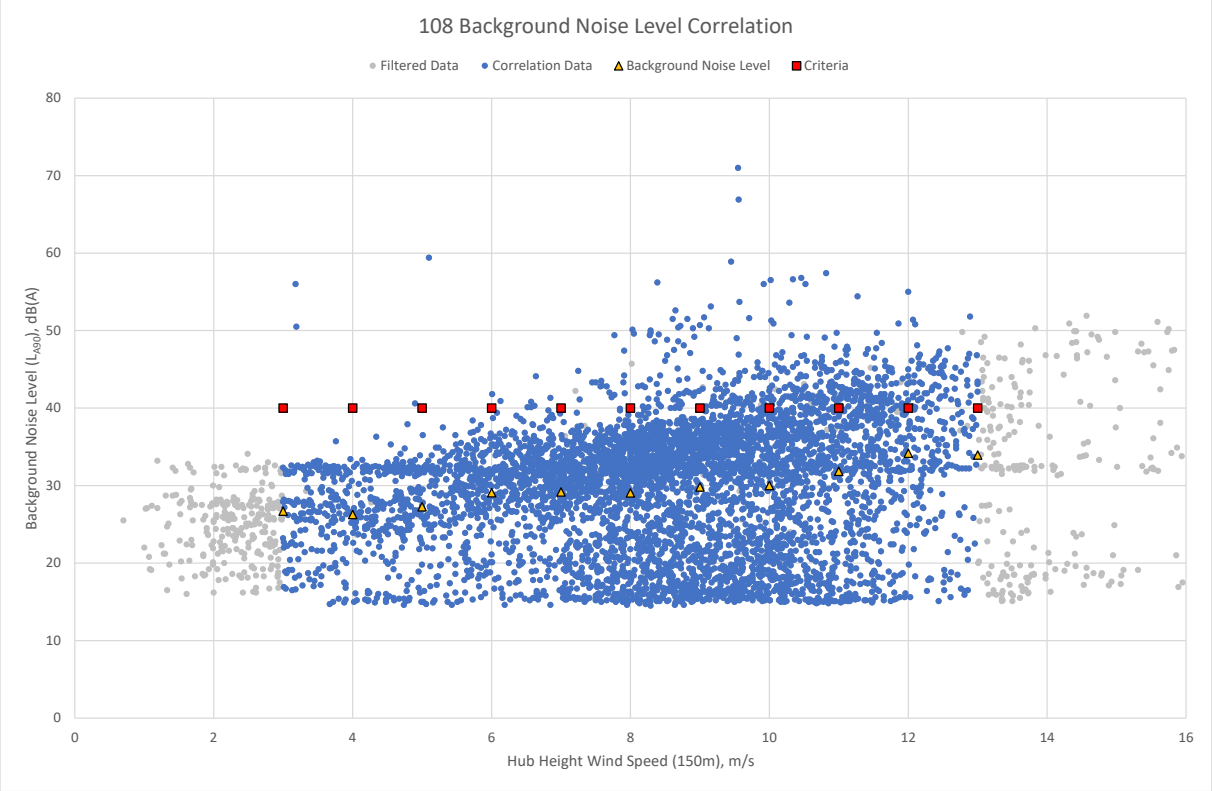
Appendix B.5: Receiver 642

APPENDIX C: BACKGROUND NOISE CORRELATION GRAPHS

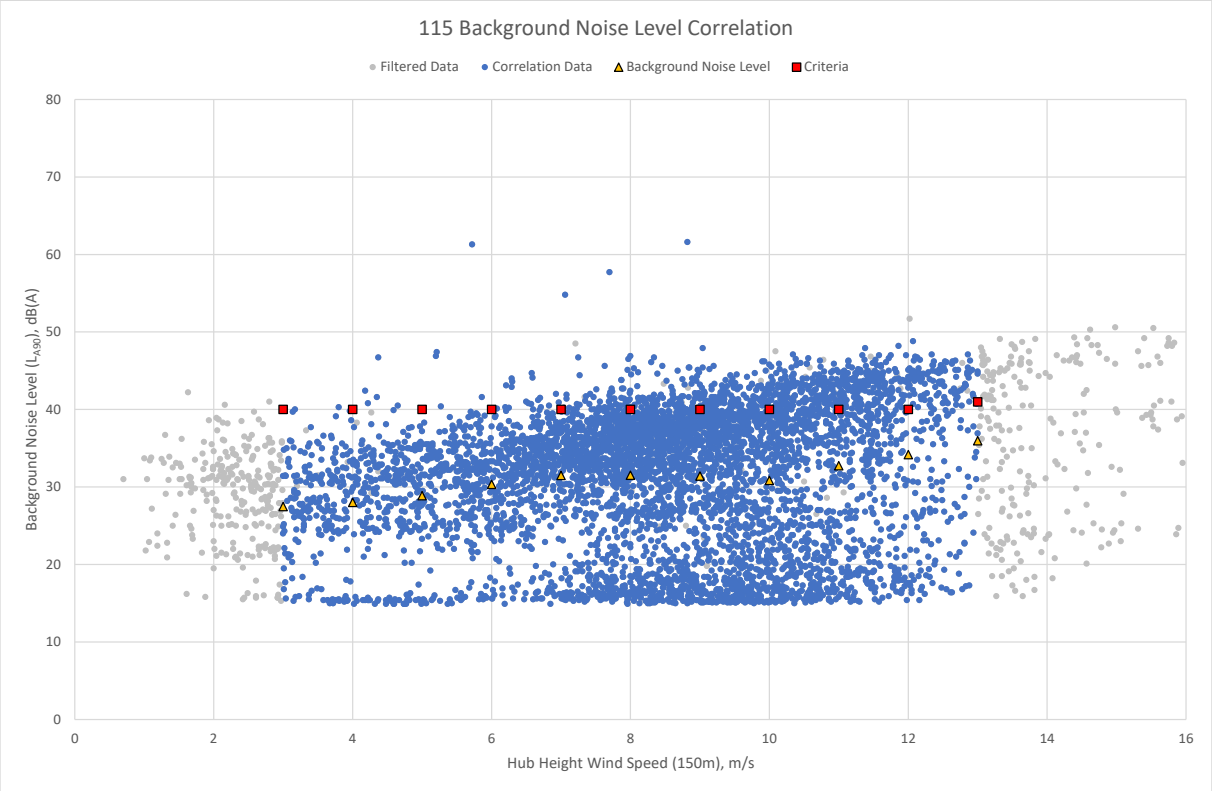
Appendix C.1: Receiver 103



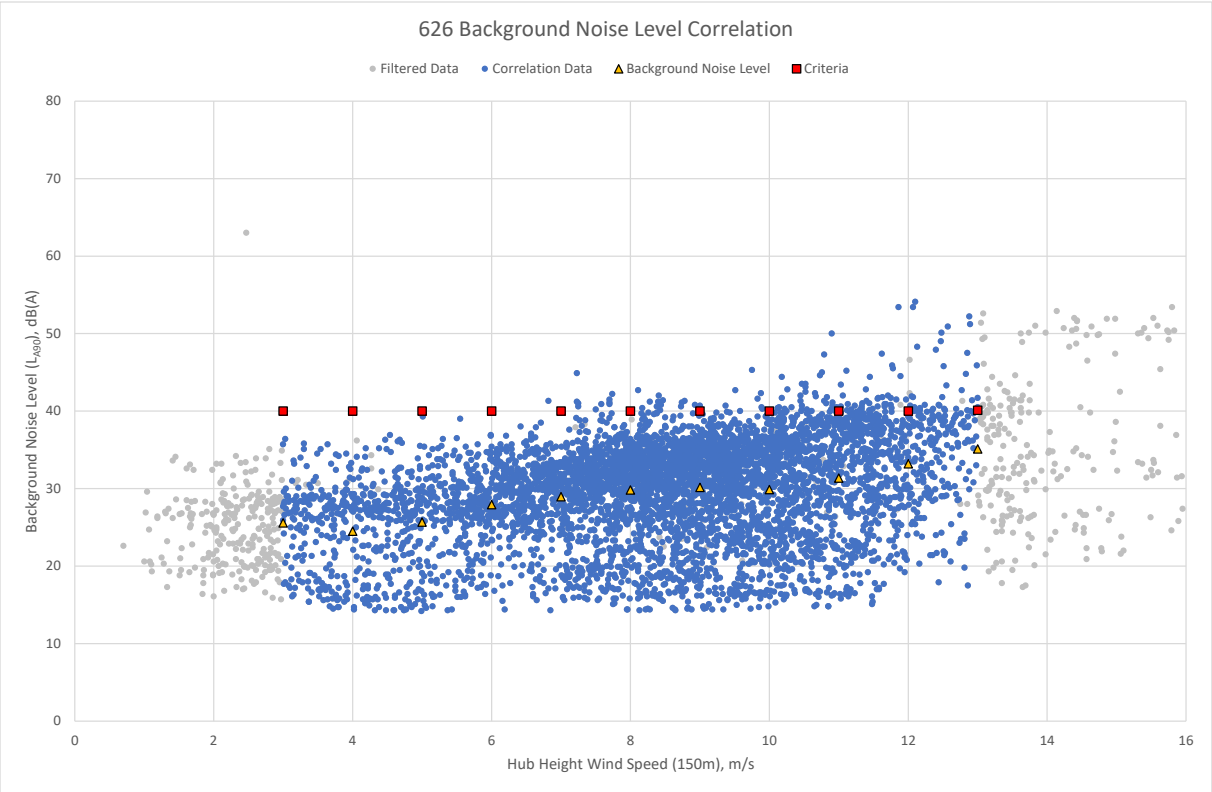
Appendix C.2: Receiver 108



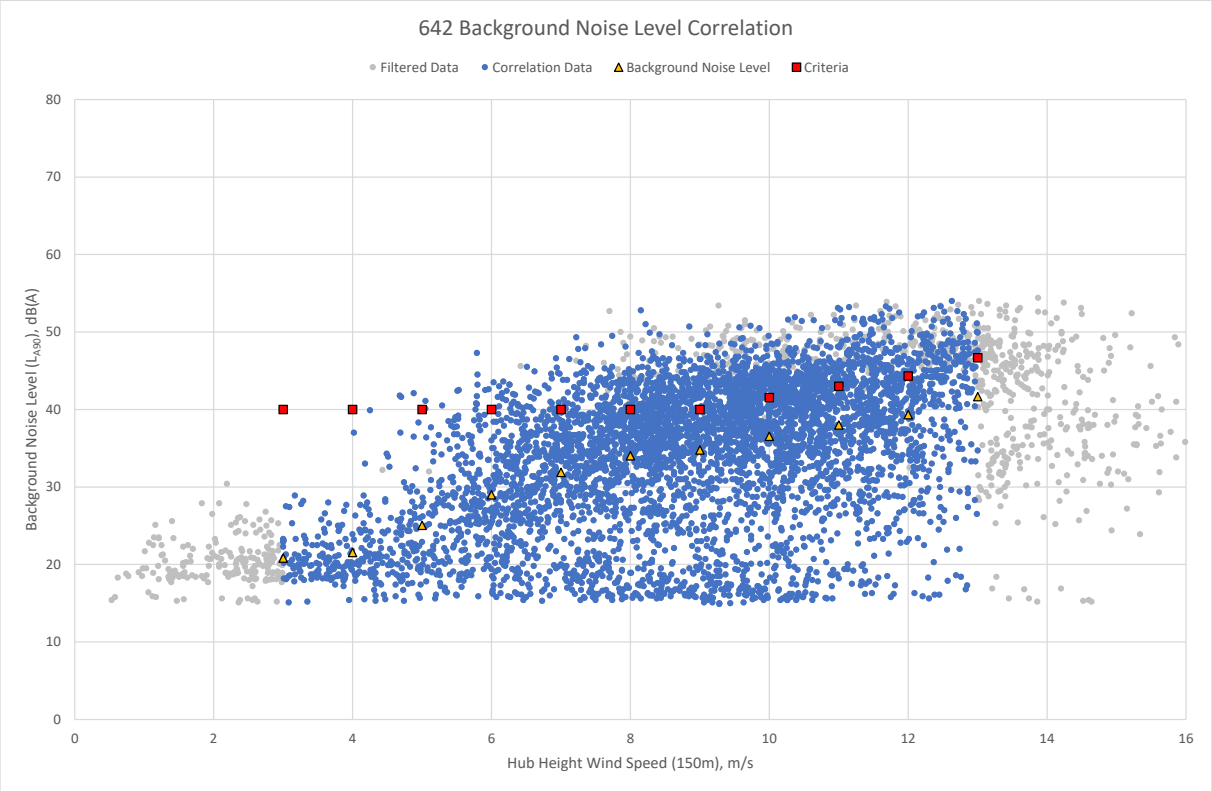
Appendix C.3: Receiver 115



Appendix C.4: Receiver 626



Appendix C.5: Receiver 642



APPENDIX D: NOISE SENSITIVE LOCATIONS WITHIN 5KM FROM NEAREST TURBINE

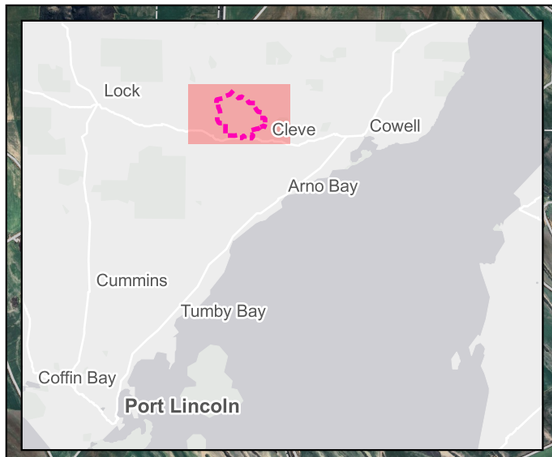
Receiver ID	Noise Sensitive Location Coordinates (GDA94 / MGA zone 53)		Associated Yes / No	Nearest WTG	Distance to Nearest WTG [m]	Predicted Noise Level [dB(A)]
	Easting	Northing				
1	627769	6286335	Yes	T23	1635	38
2	623327	6284128	Yes	T06	1764	38
3	627498	6282847	Yes	T21	1501	39
4	630040	6283665	Yes	T39	1851	38
5	621871	6282621	Yes	T03	2453	34
6	622990	6281148	Yes	T35	2535	34
7	627265	6279944	Yes	T60	1705	39
8	634288	6279281	Yes	T68	1646	36
9	637757	6278441	Yes	T84	1619	36
10	621114	6277485	Yes	T28	1886	33
11	625532	6277477	Yes	T31	1510	38
12	629090	6276992	Yes	T59	1750	36
13	630845	6277349	Yes	T65	1997	34
14	635178	6276281	Yes	T82	1338	37
15	626170	6275881	Yes	T31	2850	33
16	629889	6275416	Yes	T71	551	41
17	630815	6276139	Yes	T71	1701	35
18	633574	6274884	Yes	T77	1962	31
19	624773	6274322	Yes	T29	3031	31
20	624814	6274335	Yes	T29	3041	31
21	627881	6274623	Yes	T71	1610	34
22	628677	6272963	Yes	T74	1816	33
23	628788	6272986	Yes	T74	1704	33
34	642301	6277348	No	T84	4918	21
57	619016	6279768	No	T01	4749	27
58	618873	6277836	No	T28	4113	26
59	619537	6277134	No	T28	3315	28
93	636543	6286107	No	T44	2959	27
94	620668	6275406	No	T28	2502	30
95	621838	6287496	Yes	T07	1916	37
96	620849	6287691	No	T05	2547	34
97	618446	6285819	No	T01	2053	33

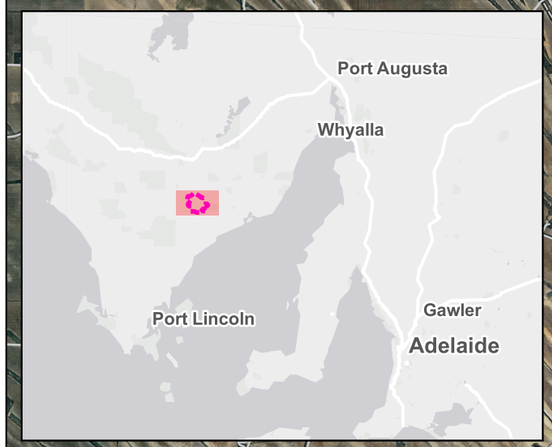
98	616885	6286745	No	T01	3847	28
99	618486	6287284	No	T01	3214	30
101	616251	6284489	No	T01	3701	25
102	622206	6291169	No	T13	4052	27
103	624741	6290353	No	T15	1756	34
104	627251	6289861	No	T15	1805	33
107	638900	6283622	No	T70	3750	27
108	636804	6282428	No	T70	1618	35
110	629054	6291880	No	T18	4071	28
115	631885	6269772	No	T75	3784	27
619	634614	6271536	No	T77	3681	24
620	639110	6272394	No	T83	4656	21
621	638501	6274236	No	T83	2755	26
622	638054	6273563	No	T83	3161	26
623	639418	6274396	No	T84	3181	27
624	639468	6274434	No	T84	3184	27
625	639825	6274788	No	T84	3185	26
626	639544	6275125	No	T84	2753	29
627	639890	6275381	No	T84	2891	25
628	640879	6275614	No	T84	3689	23
629	640070	6275557	No	T84	2965	27
630	641521	6276312	No	T84	4150	23
631	640873	6274692	No	T84	4089	26
632	638746	6281522	No	T70	2484	31
642	618903	6282646	No	T01	2064	31
643	617647	6281108	No	T01	4039	25

APPENDIX E: SOUND POWER DATA

One-third Octave Band Centre Frequency [Hz]	Sound Power Level (dB(A) re 1 ρW)
6.3	33
8	40
10	46
12.5	52
16	57
20	62
25	67
31.5	72
40	77
50	81
63	85
80	88
100	91
125	93
160	95
200	96
250	97
315	97
400	97
500	97
630	97
800	96
1000	95
1250	94
1600	92
2000	90
2500	88
3150	85
4000	82
5000	79
6300	75
8000	71
10000	67
12500	62
16000	57
Total	107

APPENDIX F: NOISE CONTOUR PLOT





0 1 2 3 4 5 km

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Imagery ©2025 Airbus, CNES / Airbus,
Landsat / Copernicus

CLEVE WIND FARM

Noise Impact Statement
150m Hub Height
13m/s Hub Height Wind Speed
With Serrated Trailing Edges

Project Number: S7839
Date Generated: 3 April 2025

Legend

- Associated Receiver
- Non-associated Receiver
- Wind Turbine Generator
- Noise Monitoring Locations
- Wind Mast Location
- Project Boundary
- Roads
- Unformed Roads

Noise Contours

- 45 dB(A)
- 40 dB(A)
- 35 dB(A)
- 30 dB(A)

sonus.