Willogoleche Stage 2 Wind Farm

Noise Impact Assessment

S7711C5

May 2026

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EXECUTIVE SUMMARY

An environmental noise impact assessment has been conducted for the proposed Willogoleche Stage 2 Wind Farm and Battery Energy Storage System (**BESS**) project (the **Project**).

The Project will comprise up to 20 *Wind Turbine Generators* (**WTGs**) with a total power generation capacity in the order of 110 MW and associated auxiliary infrastructure (including electrical sub-stations, transmission lines and terminal station). In addition, a BESS will be constructed as part of the Project, with a nameplate capacity of up to 200 MW and 800 MWh.

The noise assessment has been conducted as part of the *Environmental Impact Report* (**EIR**) prepared under the licensing and approvals process of the *Hydrogen and Renewable Energy Act 2023* (the **HRE Act**).

Under the HRE Act, authorised operations that have or may have adverse effects on the environment must be managed so as to reduce environmental damage as far as reasonably practicable. As per the HRE Act, the environment includes public health, safety, or amenity. A key issue for public amenity is often noise.

As required under the HRE Act, noise from the Project has been assessed in accordance with the relevant legislation and standards at receptors to be considered by EIRs. Specifically, noise from the wind farm component of the Project has been assessed in accordance with the South Australian Environment Protection Authority (**SA EPA**) document *Wind Farms Environmental Noise Guidelines* (2021) (the **Wind Farms Guidelines**). Noise from the BESS component of the project has been assessed against the *Environment Protection (Commercial and Industrial) Noise Policy 2023* (the **Policy**).

In accordance with the Wind Farms Guidelines, as all receivers in the vicinity of the Project are located within the *Rural zone* (in accordance with the South Australian *Planning and Design Code* (the **Code**)), the predicted equivalent noise level ($L_{eq,\ 10\ min}$) from the wind farm component of the Project (adjusted for tonality) should not exceed:

- 40 dB(A), or the background noise level ($L_{A90,\ 10\ min}$) by more than 5 dB(A) at *Non-Associated Receivers*
- 45 dB(A), or the background noise level ($L_{A90,\ 10\ min}$) by more than 5 dB(A) at *Associated Receivers*

whichever is greater, at all relevant receivers for wind speed from cut-in to rated power of the WTG and each integer wind speed in between.

In accordance with the Wind Farms Guidelines, noise from *auxiliary structures such as electrical substations, switches and service yards* should be assessed cumulatively with noise from the WTGs against criteria determined in accordance with the Wind Farms Guidelines.

In accordance with the Policy, noise from the BESS component of the Project, when assessed at nearby residences within the *Rural Zone*), should not exceed:

- An average (L_{eq}) noise level of 57 dB(A) during the Policy "day" period (from 7:00 am to 10:00 pm)
- An average (L_{eq}) noise level of 50 dB(A) during the Policy "night" period (from 10:00 pm to 7:00 am)

As the BESS is assessed under the HRE Act (and therefore does not require development approval under the PDI Act) the provisions of Part 5 of the Policy do not apply.

A predictive noise model has been prepared for the proposed wind farm layout and locations of the ancillary infrastructure (and the BESS), which enables noise predictions to be made for each noise source including representative WTGs, transformers and BESS components.

Based on the assessment, noise from the Project is predicted to achieve the relevant criteria determined in accordance with the Wind Farms Guidelines and the Policy for the wind farm and BESS components of the Project respectively. In doing so, it is considered that noise from both aspects of the Project will not result in environmental damage with regard to public amenity.

A final noise assessment will be conducted to confirm compliance with the relevant criteria, once the wind farm and BESS equipment selection are finalised at the procurement stage of the project, with sound power levels provided by the respective manufacturers. A final noise assessment report will be submitted to the relevant authorities prior to the commencement of construction. Further, noise level monitoring during operation of the wind farm is also typically required to confirm ultimate compliance with the Wind Farms Guidelines.

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 Dwelling* is a dwelling where the Project 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.
BESS	Battery Energy Storage System
The Code	The *South Australian Planning and Design Code*
DEM	The South Australian Department for Energy and Mining
dB(A)	A-weighted noise or sound power level in decibels.
EIR	The *Environmental Impact Report* for the Project prepared under the HRE Act
Equivalent noise level	Energy averaged noise level over a prescribed period of time
HRE Act	The *Hydrogen and Renewable Energy Act 2023* (SA)
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
Non-associated Receiver	A residential location where the landowner does not have a commercial agreement with the wind farm developer.
PDI Act	The *Planning, Development and Infrastructure Act 2016* (SA)
The Policy	The *Environment Protection (Commercial and Industrial Noise) Policy 2023* (SA)
Policy Guidelines	*Guidelines for the use of the Environment Protection (Commercial and Industrial Noise) Policy 2023*
The Project	Willogoleche Stage 2 Wind Farm and Battery Energy Storage System project
Receivers	*Associated* and *Non-associated Receivers*
SA EPA	South Australian Environment Protection Authority
SAPPA	The *South Australian Policy and Planning Atlas*
SLM	Sound Level Meter
Sound power level	A measure of the sound energy emitted from a source of noise.
The WHO Guidelines	The *World Health Organisation Guidelines for Community Noise (1999)*
The Wind Farm	Willogoleche Stage 2 Wind Farm
Wind Farms Guidelines	*Wind Farms Environmental Noise Guidelines* (SA Environment Protection Authority, November 2021)
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

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1 INTRODUCTION

An environmental noise impact assessment has been conducted for the proposed Willogoleche Stage 2 Wind Farm and Battery Energy Storage System (**BESS**) project (the **Project**).

The noise assessment has been conducted as part of the *Environmental Impact Report* (**EIR**) prepared under the licensing and approvals process of the *Hydrogen and Renewable Energy Act 2023* (the **HRE Act**).

Noise from the wind farm component of the Project has been assessed in accordance with the requirements of the South Australian Environment Protection Authority (**SA EPA**) document *Wind Farms Environmental Noise Guidelines* (2021) (the **Wind Farms Guidelines**).

Noise from the BESS component of the project has been assessed against noise criteria derived in accordance with the *South Australian Planning and Design Code* (the **Code**) and the *Environment Protection (Commercial and Industrial) Noise Policy 2023* (the **Policy**).

The assessment has been based on the following:

- WTG coordinates provided in Appendix A.
- *Associated* and *Non-associated Receiver* locations, provided in Appendix B.
- Sound power level data for an indicative WTG model, provided in Appendix E.
- Data for an indicative supplier of BESS equipment provided in Appendix G.
- Background noise monitoring conducted at four representative locations in the vicinity of the wind farm component of the Project between 6 March and 17 April 2025.
- 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 residences.

2 PROJECT OVERVIEW

The Project will be constructed on a ridgeline which runs generally north-south, between 4 and 10 kilometres north-west of Hallett, and approximately 200 kilometres north of Adelaide in South Australia's mind-north region. The Project will be constructed generally to the north of the existing Willogoleche Wind Farm, and to the north-east of the existing Bluff Wind Farm (both currently operational).

The Project is being developed by Engie, and therefore for the purposes of the Wind Farms Guidelines the wind farm component of the Project will be considered to represent an additional stage of Engie's existing Willogoleche Wind Farm.

The Project will comprise the following components:

- Willogoleche Stage 2 wind farm, comprising:
    - Up to 20 WTGs with a total power generation capacity in the order of 110 MW
    - associated hard stand areas and access roads
    - an operations and maintenance building and compound with associated car parking
    - an electrical substation.
- BESS facility with a nameplate capacity of 200 MW and 800 MWh.

The predominant land use in the areas surrounding the Project is open farmland, used for cropping or grazing. Accordingly, outside of the township of Hallett the surrounding area is a *Rural zone* in accordance with the *South Australian Property and Planning Atlas* (**SAPPA**).

Relevant noise sensitive land uses in the vicinity of the Project (with the potential to be impacted by noise from the Project) comprise isolated rurally located dwellings not associated with the Project (*Non-associated Receivers*), many of which are already exposed to noise from existing wind farm developments (such as Willogoleche and Bluff wind farms).

An overview of the Project site and surrounding locality (showing the site boundary, the location of major components of the Project, existing wind farm developments and *Associated and Non-associated Receivers* in the vicinity of the Wind Farm) is provided in Figure 1 below.

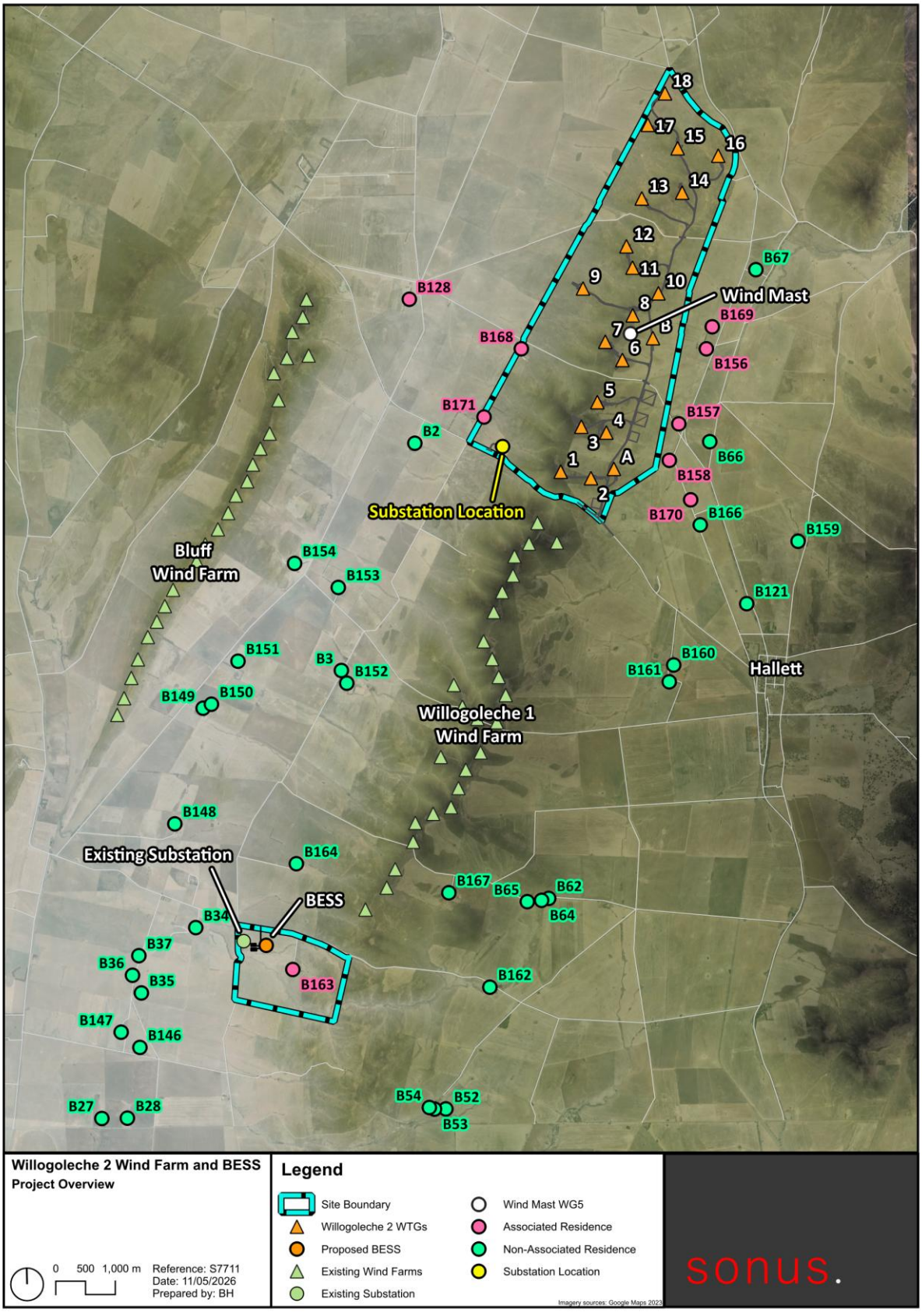


Figure 1: Locality Overview

3 REGULATORY REQUIREMENTS

3.1 Hydrogen and Renewable Energy Act

Grid-scale renewable energy and hydrogen production facility developments with a nameplate capacity of 5 MW or greater are subject to the provisions of the HRE Act.

The HRE Act requires that authorised operations that have or may have adverse effects on the environment are managed so as to reduce environmental damage as far as reasonably practicable. As per the Act, the environment includes public health, safety, or amenity. A key issue for public amenity is often noise.

In granting licences and approvals, the HRE Act requires an EIR to be prepared which assesses potential environmental impacts and outlines management controls to minimise such impacts. For project which are subject to the HRE Act, the approvals process under the HRE Act takes the place of the *Planning, Development and Infrastructure Act 2016* (the **PDI Act**) development approval process.

To assist with impact assessment, the South Australian *Department for Energy and Mining* (**DEM**) has produced a document *Environmental Impact Assessment Criteria - Hydrogen and Renewable Energy Act 2023* which outlines the relevant legislation, standards, and receptors to be considered by EIRs. In accordance with Guidance Table 1 of Appendix A, the Policy is the relevant legislative instrument applicable to noise impacts. Guidance Table 1 also identifies the SA EPA Wind Farms Guidelines as an *applicable non-legislated standard*.

3.2 Environment Protection (Commercial and Industrial Noise) Policy

The Policy provides objective noise criteria to assess the environmental noise emissions from commercial and industrial facilities, including BESS facilities. The noise criteria provided by the Policy are based on the *World Health Organisation Guidelines for Community Noise (1999)*[1] (the **WHO Guidelines**) to prevent community annoyance, sleep disturbance and adverse impacts on the amenity of a locality. Therefore, compliance with the Policy will satisfy the WHO Guidelines and the requirements of the HRE Act relating to environmental noise with regards to the BESS component of the Project.

[1] Berglund B, Lindvall T & Schwela DH 1999, *Guidelines for Community Noise,* World Health Organisation (WHO), Geneva, Switzerland.

It is noted that under Clauses 16 and 22 of the Policy, wind farm noise is subject to the provisions of the Wind Farms Guidelines in lieu of the general noise control provisions of Part 4 of the Policy.

Therefore, noise from the wind farm component of the Project will be assessed against the Wind Farms Guidelines.

3.3 Wind Farms Environmental Noise Guidelines

The Wind Farms Guidelines have been developed by the SA EPA to provide the framework for measurement, prediction and assessment of noise from wind farms within South Australia.

In accordance with Section 4.3 of the Wind Farms Guidelines, the predicted wind farm noise level ($L_{Aeq,\ 10\ min}$) should not exceed the following at *Relevant Receivers* (when adjusted for tonality if needed):

- 35 dB(A) in localities which are primarily intended for rural living, or;
- 40 dB(A) in localities in other zones, or;
- the background noise ($L_{A90,\ 10\ min}$) by more than 5 dB(A)

whichever is the greater, at all Relevant Receivers, for wind from cut-in power the WTG and each integer wind speed in between. For the purposes of this assessment, it is considered that *Relevant Receivers* refers to *Non-associated Receivers* (i.e. receivers without a commercial agreement with the Wind Farm developer).

All noise sensitive receivers (including both *Associated* and *Non-associated Receivers*) in the vicinity of the wind farm component of the Project are located within the *Rural* zone. With reference to the EPA *Indicative noise factor guidelines for the Environment Protection (Commercial and industrial Noise) Policy 2023*, only the 'Rural Industry' Land Use Category applies to the *Rural* zone. Therefore, for the purposes of the Wind Farms Guidelines, the *Rural* zone is not primarily intended for 'Rural Living', and as such the 40 dB(A) baseline noise criterion applies to all nearby *Non-associated Receivers*.

The noise criteria applicable to each *Non-associated Receiver* in the vicinity of the Project (when the influence of background noise levels is considered) is provided in Section 4.2 below.

3.3.1 Agreements with Wind Farm Developers (Associated Receivers)

The criteria provided by the Wind Farms Guidelines have been developed to minimise the impact on the amenity of premises that do not have an agreement with wind farm developers (i.e. *Non-associated Receivers*). However, the Wind Farms 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* (i.e. receivers with an agreement with the developer of a wind farm), the Wind Farms Guidelines note that, in addition to the background plus 5 dB(A) limits, the *Indicative Noise Factors* set out in Table 2 of the Policy (less 5 dB(A)) may be used as a baseline noise level to determine a sufficient level of amenity for stakeholders (i.e. *Associated Receivers*), as long as an internal noise level of 30 dB(A) is also met (consistent with the recommendation of the *World Health Organisation* (**WHO**) *Guidelines for Community Noise (1999)*[2] (the **WHO Guidelines**).

Based on the above, a baseline noise level benchmark of 45 dB(A) (to be achieved outdoors at any time during the day or night) has been adopted at *Associated Receivers* for the purposes of this assessment. Meeting this level will result in noise levels consistent with the WHO Guidelines 30 dB(A) internal noise level[3], and the *Indicative Noise Factors* of Table 2 of the Policy applicable in the *Rural Zone*.

The benchmark noise levels applicable to each *Associated Receiver* in the vicinity of the Project (when the influence of background noise levels is considered) is provided in Section 4.2 below.

[2] Berglund B, Lindvall T & Schwela DH 1999, *Guidelines for Community Noise,* World Health Organisation (WHO), Geneva, Switzerland.

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

3.3.2 Auxiliary Infrastructure

In accordance with the Wind Farms Guidelines, noise from *auxiliary structures such as electrical substations, switches and service yards* should be assessed cumulatively with noise from the WTGs against criteria determined in accordance with the Wind Farms Guidelines.

While electrical substations, switches and service yards are essential for operation of a wind farm, this is not the case for a BESS proposed to be constructed in association with a wind farm. In accordance with advice provided by the SA EPA, noise from the BESS component of the Project will be assessed against the Policy as described above.

3.3.3 Staged and Cumulative Development

If multiple stages of the same wind farm belong to the same owner, the Wind Farms 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.

It is understood that, while Willogoleche Stage 2 Wind Farm will be developed by and within the same ownership as the existing Willogoleche wind farm, the two wind farms will technically be separate entities (and could therefore operate as separate wind farms). Notwithstanding, in the interest of a conservative assessment, this assessment considers the cumulative noise from both wind farms (as would be required for a staged wind farm in accordance with the Wind Farms Guidelines).

4 WIND FARM NOISE ASSESSMENT

4.1 Background Noise Monitoring

In order to quantify the existing noise environment, background noise monitoring was conducted in the vicinity of the wind farm component of the Project between 6 March and 17 April 2025. The background noise monitoring was conducted in accordance with the Wind Farms Guidelines.

4.1.1 Noise Monitoring Locations

Background noise monitoring was conducted at four locations in the vicinity of the wind farm component of the Project. The background monitoring locations were selected based on the *Non-associated Receiver* locations in each direction with the highest potential to be impacted by wind farm noise from the Project. Where a suitable *Non-associated Receiver* location was not available for a particular direction, a representative *Associated Receiver* location was used instead to provide a relevant background noise dataset.

The background noise monitoring locations are summarised in Table 4-1 below.

Table 4-1: Monitoring locations and periods.

Monitoring Location ID	Status	Monitoring Dates	Coordinates [WGS84 UTM Zone 54S]	
			Easting	Northing
B66	Non-associated	6 March to 17 April 2025	303106	6305039
B67	Non-associated	6 March to 17 April 2025	303881	6307931
B166	Non-associated	6 March to 17 April 2025	302946	6303639
B171	Associated Receiver	6 March to 17 April 2025	299314	6305453

The noise monitoring equipment at each background noise monitoring location was positioned in accordance with the requirements of the Wind Farms Guidelines. Specifically, the microphones were placed at a height of between 1.2 and 1.5 metres, at least 5 metres from vertical reflecting surfaces, less than 30 metres from the residence and generally on the side of the residence closest to the Project.

Photographs of the noise monitoring equipment installed at each location are provided in Appendix C.

4.1.2 Equipment

As required by the Wind Farms Guidelines, the background noise monitoring was conducted using sound level meters (**SLMs**) of at least Class 2 certification (in accordance with AS/NZS IEC 61672.1:2019 *Electroacoustics – Sound Level Meters, Part 1: Specifications*), with a noise floor less than 20 dB(A). All microphones were fitted with weatherproof windshields greater than 90 mm in diameter supplied by the manufacturer.

The sound level meters were calibrated at the beginning and end of the measurement period with a calibrator suitable for use with Type 1 and Type 2 SLMs and compliant with AS IEC 60942:2004 *Electroacoustics - Sound calibrators* as required by the Wind Farms Guidelines.

The wind speed at approximately the microphone height was logged at each location and the rainfall was monitored at two locations, on opposite sides of the wind farm. The rainfall and wind speed data were collected to determine the periods when weather on the microphone may have influenced the measured background noise levels in the vicinity.

4.1.3 Data Collection

The background noise level ($L_{A90,10\ min}$) was measured continuously in 10-minute intervals at each monitoring location over the respective monitoring periods.

Throughout the background noise monitoring period, average wind speed and direction data were measured by a wind mast installed at the wind farm site at 121 metres and 150 metres above ground level in 10-minute intervals, synchronised with the background noise monitoring intervals. The coordinates of the wind mast are provided in Table 4-2 below.

Table 4-2: Wind mast details

Mast ID	Coordinates [WGS84 UTM Zone 54S]		Measurement Heights (m)
	Easting	Northing	
WG5	301774	6306853	121 m and 150 m

The background noise monitoring data were correlated against wind speeds measured at the proposed hub height of 150 metres as required by the Wind Farms Guidelines.

4.1.4 Data Analysis

Prior to the correlation and analysis, the following data were filtered:

- data points corresponding to any periods of measured rainfall (including during the 10-minute periods before and after the relevant period)
- data points where the measured wind speed exceeding 5 m/s at the microphone height for more than 90% of the measurement period
- data points corresponding to wind speeds below the cut-in (3 m/s) and above the rated power (13 m/s) of the indicative WTG model considered by this assessment
- data points clearly influenced by extraneous noise sources.

The number of data points collected, the number of data points filtered, and the number of data points remaining following the above data filtering procedure are is summarised in Table 4-3 below. It is noted that, following the data filtering procedure, greater than 2,000 data points remained at each monitoring location, of which more than 500 corresponded to the downwind direction with respect to the nearest proposed WTG location (as required for a valid assessment in accordance with the Wind Farms Guidelines).

Table 4-3: Data Points

Monitoring Location ID	Total Measured Data Points	Data Points Removed For:			Data Points after Filtering	Downwind Data Points after Filtering
		Below Cut-in / above rated power	Local Wind	Local Rainfall		
B66	6000	1011	43	21	4955	2521
B67	6000	1011	43	24	4951	2475
B166	6000	1011	43	21	4955	1377
B171	6000	1011	107	18	4948	1621

Note that in some instances, a data point may be filtered for more than one reason (for example, where wind and rain occurred within the same period). As such, the total number of data points filtered may be less than the sum of the data points filtered for each reason.

4.1.5 Measured Background Noise Levels

The background noise dataset at each monitoring location was correlated with the wind speed data measured at the on-site wind mast. The correlated noise data were sorted into 1 m/s wide wind speed bins centred on integer hub height wind speeds between cut-in and rated power, with the resulting background noise level for each wind speed bin determined by the arithmetic average of the noise levels within that bin (as required by the Wind Farms Guidelines).

The resulting background noise levels at each monitoring location in integer wind speed bins are provided in Table 4-4 below, and graphically in Appendix D.

Table 4-4: Background Noise Levels

Monitoring Location ID	Measured Background Noise Level [dB(A)] Per Hub Height Wind Speed (m/s)										
	3	4	5	6	7	8	9	10	11	12	13
B66	25	25	26	27	27	28	29	31	35	36	37
B67	28	28	29	31	31	31	33	35	39	41	43
B166	24	25	26	29	30	31	34	36	40	42	43
B171	26	27	28	31	31	33	34	35	38	39	41

4.1.6 Influence of Existing Wind Farms

In accordance with the Wind Farms Guidelines, where a wind farm development is to occur in close proximity to existing wind farms or previous stages of the same wind farm, the noise criteria should be determined based on background noise levels without the influence of noise from any existing wind farms.

As background noise monitoring data from before construction of Willogoleche 1 wind farm is not available for all receivers, a comparison was made between bin analyses conducted for the background noise levels measured during upwind (+/- 45°) and downwind (+/- 45°) conditions at each monitoring location (relative to the existing Willogoleche 1 wind farm).

Based on the comparison, noise levels from the downwind direction were generally lower than those from the upwind direction at all locations, indicating that noise from Willogoleche 1 Wind Farm did not significantly influence the background noise monitoring results. Therefore, data from all wind directions were retained for the bin analysis results presented in Table 4-4 above. The upwind and downwind bin analysis results are included in the bin analysis results presented in Appendix D for reference.

4.2 Criteria

The background noise monitoring (described in Section 4.1 above) has been used to establish wind farm noise criteria and benchmarks at each *Non-associated* and *Associated Receiver* respectively where the predicted noise level from the wind farm exceeds 30 dB(A) (including the influence of auxiliary infrastructure). Where background noise monitoring has not been conducted at a residence, the criteria have been adopted based on the nearest background noise monitoring location with apparent similarity in background noise conditions (i.e. considering the presence and similarity of nearby vegetation and any other noise sources).

The background noise monitoring locations, and the receivers represented by each location (including *Associated* and *Non-associated* Receivers) are summarised in Table 4-5 below. *Associated Receivers* are indicated by italics.

Table 4-5: Representative Background Noise Monitoring Locations

Monitoring Location ID	Represented Noise Sensitive Receivers
B66	B66, *B157, B158, B170*
B67	B67, *B156, B169*
B166	B166
B171	B2, *B128, B168, B171*

4.2.1 Relevant Receiver Criteria (Non-associated Receivers)

Wind farm noise criteria for Relevant Receivers (i.e. *Non-associated Receivers*) where a wind farm noise level of at least 30 dB(A) is predicted have been established considering the baseline noise limit of 40 dB(A) applicable to *Non-associated Receivers* within the *Rural zone*, and considering the relevant background noise monitoring results, and are summarised in Table 4-6 below.

Table 4-6: Wind Farm Noise Criteria - Relevant Receivers (Non-associated Receivers)

ID	Monitoring Location	Status	Noise Criteria [dB(A)] Per Hub Height Wind Speed (m/s)										
			3	4	5	6	7	8	9	10	11	12	13
B2	B171	Non Associated	40	40	40	40	40	40	40	40	43	44	46
B66	B66	Non Associated	40	40	40	40	40	40	40	40	40	41	42
B67	B67	Non Associated	40	40	40	40	40	40	40	40	44	46	48
B166	B166	Non Associated	40	40	40	40	40	40	40	41	45	47	48

As per the Wind Farm Guidelines, the specified criteria apply to the cumulative noise impact from the Wind Farm (including auxiliary infrastructure) and from the existing Willogoleche Wind Farm Stage 1.

4.2.2 Associated Receivers

Wind farm noise targets have been established for *Associated Receivers* (i.e. receivers with an agreement with the wind farm developer) where a wind farm noise level of at least 30 dB(A) is predicted. The targets consider the 45 dB(A) baseline noise level adopted for this assessment and the relevant background noise monitoring results, and are summarised in Table 4-7 below.

Table 4-7: Wind farm noise targets – Associated Receivers

ID	Monitoring Location	Status	Noise Criteria [dB(A)] Per Hub Height Wind Speed (m/s)										
			3	4	5	6	7	8	9	10	11	12	13
B128	*B171*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*46*
B156	*B67*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*46*	*48*
B157	*B66*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
B158	*B66*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
B168	*B171*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*46*
B169	*B67*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*46*	*48*
B170	*B66*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*
B171	*B171*	*Associated*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*45*	*46*

4.3 Noise Prediction Methodology

4.3.1 Noise Sources

Noise from the wind farm component of the Project has been predicted based on the following:

- A representative WTG selection comprising the *Vestas* V172-7.2 MW with serrated blade trailing edges, a hub height of 150 metres, and a rotor diameter of 172 metres.
- Sound power level data for the representative WTG selection operating in “PO7200” power-optimised mode (i.e. “normal” mode) as provided in Appendix E.
- A total of 20 WTGs at the coordinates provided in Appendix A.
- A substation with a total sound power level of 98 dB(A) constructed at the location identified in Table 4-8 below.

Table 4-8: Substation Coordinates

ID:	Coordinates [WGS84 UTM Zone 54S]	
	Easting	Northing
Substation	299625	6304957

It is noted that the representative WTG model considered by this assessment has a hub height of 150 metres and a tip height of 236 metres. In the circumstance where a WTG model with an alternative hub/tip height is ultimately installed it not expected that this will have a material impact on the assessment (this will be confirmed via a final noise assessment at the procurement stage of the Project based on the specific model of WTG to be installed).

4.3.2 Noise Propagation Model

Noise from the wind farm aspect of the Project has been predicted in accordance with ISO 9613-2 *"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 predictive noise model considers the following factors:

- The sound power level of each noise source (the WTGs and the substation)
- The location of each noise source (WTG or substation), and the height above ground level (hub height)
- The distance from each noise source to each receiver (*Associated and Non-associated Residences*)
- The topography between each noise source and each noise sensitive receiver location
- Shielding by terrain, barriers and other structures
- The influence of the ground
- Air absorption and meteorological conditions.

The ISO 9613-2 noise propagation model describes a methodology for predicting noise levels at noise sensitive receiver locations under meteorological conditions favourable to noise propagation, and is one of the two noise prediction methods recommended by the Wind Farms Guidelines. The model is based on the conservative assumption of downwind propagation from all noise sources (WTGs and the substation) to all noise sensitive receivers simultaneously, resulting in the highest noise levels.

4.3.3 Inputs

Inputs to the predictive 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 receiver height.
- Application of a 3 dB(A) correction where a "concave" ground profile exists as defined by the IOA Guide.

The Wind Farms Guidelines specifically reference these inputs as suitable modelling parameters for wind turbines.

4.4 Results

The highest predicted noise levels due to operation of the WTGs and the substation (corresponding to hub height wind speeds at which the maximum sound power level is generated) are presented for each *Associated and Non-associated Receiver* in Table 4-9 below (results for *Associated Receivers* are shaded and *italicised*). The results are also presented graphically as noise contours in Appendix F.

Table 4-9: Predicted Noise Levels

ID	Status	Baseline Noise Criterion [dB(A)]	Predicted Noise Level Willogoleche 2 [dB(A)]	Complies?
B2	Non-associated	40	32	Yes
B66	Non-associated	40	37	Yes
B67	Non-associated	40	37	Yes
B128	*Associated*	*45*	*32*	*Yes*
B156	*Associated*	*45*	*41*	*Yes*
B157	*Associated*	*45*	*40*	*Yes*
B158	*Associated*	*45*	*41*	*Yes*
B166	Non-associated	40	35	Yes
B168	*Associated*	*45*	*39*	*Yes*
B169	*Associated*	*45*	*41*	*Yes*
B170	*Associated*	*45*	*37*	*Yes*
B171	*Associated*	*45*	*38*	*Yes*

Based on the above, noise from operation of the wind farm component of the Project (including auxiliary infrastructure) achieves the baseline noise criterion at all *Non-associated* and *Associated Receiver* locations. Therefore, for the indicative WTG selection, compliance with the Wind Farms Guidelines is achieved at all receiver locations without any reliance on background noise levels.

4.5 Cumulative Noise Impact

The cumulative noise impact from the wind farm component of the Project operating together with Stage 1 of the Willogoleche Wind Farm has also been predicted (as required by the Wind Farms Guidelines). The predictions consider the predicted noise levels for Willogoleche Stage 2 (presented in the previous section), and the noise levels from the as-built Willogoleche Stage 1 wind farm predicted in accordance with the Wind Farms Guidelines considering the highest sound power levels generated by the WTGs installed at Willogoleche Stage 1 (understood to be *GE* 130-3.8 MW and *GE* 130-3.4 MW).

Based on the above, the following cumulative noise levels are predicted at each identified *Associated* and *Non-associated Receiver* (results for *Associated Receivers* are shaded and *italicised*).

Table 4-10: Cumulative Wind Farm Noise Impact - Willogoleche 1 and Willogoleche 2

ID	Status	Baseline Noise Criterion [dB(A)]	Predicted Noise Levels [dB(A)]			Complies?
			Willogoleche Stage 1	Willogoleche Stage 2	Cumulative	
B2	Non-associated	40	32	32	35	Yes
B66	Non-associated	40	27	37	38	Yes
B67	Non-associated	40	18	37	37	Yes
B128	*Associated*	*45*	*23*	*32*	*32*	*Yes*
B156	*Associated*	*45*	*23*	*41*	*41*	*Yes*
B157	*Associated*	*45*	*28*	*40*	*41*	*Yes*
B158	*Associated*	*45*	*31*	*41*	*41*	*Yes*
B166	Non-associated	40	31	35	36	Yes
B168	*Associated*	*45*	*28*	*39*	*39*	*Yes*
B169	*Associated*	*45*	*22*	*41*	*41*	*Yes*
B170	*Associated*	*45*	*31*	*37*	*38*	*Yes*
B171	*Associated*	*45*	*33*	*38*	*39*	*Yes*

Based on the above, compliance is predicted to be achieved at all locations within the 30 dB(A) contour for Willogoleche 2. Outside of the 30 dB(A) contour, predicted noise levels from Willogoleche 2 are more than 10 dB(A) lower than the baseline criterion which applies to receivers in the vicinity of Willogoleche 1, and therefore will not contribute to an exceedance of the baseline criterion at these locations.

It is noted that the above predictions have been prepared based on the wind speed at which the highest sound power level is generated by the indicative WTG model, with all WTGs operating simultaneously at full capacity and assuming downwind noise propagation from each WTG to each *Associated* and *Non-associated Receiver*. Lower noise levels would be predicted for lower wind speeds (at which lower sound power levels are generated by the WTGs), and for wind blowing in a single direction.

4.6 Tonality

Under the Wind Farms Guidelines, where noise from a wind farm exhibits a tonal characteristic, a 5 dB(A) penalty is to be applied to the predicted or measured noise level.

This assessment has been conducted based on the assumption that WTG model to be installed will be free of excessive tonality. Review of the one-third octave band data for the indicative WTG model used as the basis for this assessment (provided in Appendix E) indicates that that the indicative model is free of tonality.

On this basis, a 5 dB(A) penalty for tonality has not been applied to the predicted noise from the wind farm component of the Project.

4.7 Other Annoying Characteristics

The Wind Farms Guidelines have been developed with the fundamental characteristics of wind farm noise (e.g. amplitude modulation associated with the passing blades ("swishing") and infrequent and short-term braking noise) taken into consideration. These noise characteristics are inherent to the operation of a wind farm and some level of these characteristics are expected to occur.

The Wind Farms Guidelines note that, while there is the potential for effects associated with higher levels of amplitude modulation or low frequency noise to occur in some circumstances (due to certain climatic conditions, for example), such effects are rare and are not expected to impact on receivers). The Wind Farms Guidelines do not specify a procedure for assessing such characteristics or a mechanism for penalising such characteristics.

Nonetheless, this assessment has been conducted based on the assumption that the WTG model to be installed will be free of excessive modulation, low frequency noise and other annoying noise characteristics.

5 BATTERY ENERGY STORAGE SYSTEM ASSESSMENT

5.1 Criteria

With reference to the *South Australian Property and Planning Atlas* (**SAPPA**), and the *Indicative Noise Factor Guidelines for the Environment Protection (Commercial and Industrial Noise) Policy* 2023, the subject site and all surrounding *Noise Sensitive Receivers* (Residences) are located within the *Rural Zone*.

On this basis, the following goal noise levels apply to noise from the BESS component of the Project when assessed at nearby residences within the *Rural Zone*):

- An average (L_{eq}) noise level of 57 dB(A) during the Policy "day" period (from 7:00 am to 10:00 pm)
- An average (L_{eq}) noise level of 50 dB(A) during the Policy "night" period (from 10:00 pm to 7:00 am)

As the BESS component of the Project is assessed under the HRE Act (and therefore does not require development approval under the PDI Act) the provisions of Part 5 of the Policy do not apply.

5.1.1 Penalties for Noise Character

When predicting noise levels for comparison with the Policy, adjustments may be made to the average noise levels for each "annoying" characteristic of tonality, impulsiveness, low frequency, modulation and intermittency (during the "night" period only) of the noise source. The characteristic must be dominant in the acoustic environment and therefore the application of penalties can vary depending on the assessment location, time of day, the noise source being assessed, and the predicted noise level. The application of penalties to noise from the BESS is discussed further in the Section 5.2.4.

5.2 Assessment

5.2.1 Methodology

Noise from the BESS component of the Project has been predicted using the CONCAWE[4] noise propagation model implemented within the SoundPLAN computer noise modelling software package. The CONCAWE propagation model is recommended by the *Guidelines for the Use of the Environment Protection (Commercial and Industrial) Noise Policy 2023* (the **Policy Guidelines**) for predictions over distances greater than 100 metres, and considers the following factors:

- The sound power levels of the noise sources and their locations
- The separation distance between the noise sources and noise sensitive receivers
- Shielding provided by terrain and other structures
- Ground and air absorption
- Meteorological conditions (as per the below).

Consistent with the Policy Guidelines, the predictions consider "worst case" meteorological and atmospheric conditions, corresponding to CONCAWE Category 6 (downwind propagation at night under stable atmospheric conditions). Ground conditions consistent with the CONCAWE noise propagation model have also been considered, comprising "hard" ground for concrete or water (and the BESS sites in this instance), and ground with finite acoustic impedance (or "soft" ground) for all other surfaces (including grass).

5.2.2 Noise Sources

The predictions consider noise emissions from the BESS based on the following configuration (corresponding to a 200 MW / 800 MWh capacity):

- 45 *Power Conversion System* (**PCS**) units operating at 100% fan speed
- 180 BESS containers operating at 100% fan speed
- 2 grid transformers (325 MVA each)

The sound power level data for the above equipment (with the exception of the grid transformers) was provided by Engie for a previous project, and is provided in Appendix G.

[4] Manning CJ 1981, "Report no. 4/81: The propagation of noise from petrochemical complexes to neighbouring communities", the oil companies' international study group for conservation of clean air and water in Europe (CONCAWE), Den Haag.

The sound power levels for the transformers have been determined based on the those calculated for a previous (larger) project based on *Australian/New Zealand Standard AS/NZS 60076.10:2009, Power transformers – Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)*.

The above equipment quantities correspond to a BESS facility with a 200 MW / 800 MWh rating. In the interests of a conservative assessment, the worst-case (i.e. highest sound power levels) operating modes have been used (corresponding to a 100% fan speed) irrespective of the time of day (or night), resulting in the highest noise levels from the proposed BESS facility.

Where fewer batteries or PCS units are installed (as would be the case for a facility with a lower power rating or energy storage rating), or where lower fan speeds occur (as would occur during cooler temperatures at night and during times of lower charge or discharge rates) lower noise levels would occur. Therefore, where compliance with the relevant noise criteria is achieved for the 200 MW / 800 MWh scenario operating at 100% fan speed then compliance will also be achieved for other scenarios.

5.2.3 Predicted Noise Levels

Based on the above, the "worst case" predicted noise levels at noise sensitive receivers in the vicinity of the BESS site are provided in Table 5-1 below, and presented graphically in Appendix H. The predictions are provided for all residences where a noise level of 30 dB(A) or higher is predicted, and are based on the 200 MW / 800 MWh configuration operating at 100% fan speed. Receivers which are associated with the Project are shaded grey and *italicised*.

Table 5-1: Predicted Noise Levels - BESS

ID	Status	Criterion [dB(A)]	Predicted Noise Level [dB(A) L_{eq}]	Complies
B34	Non-associated	50	41	Yes
B35	Non-associated	50	33	Yes
B36	Non-associated	50	32	Yes
B37	Non-associated	50	34	Yes
B146	Non-associated	50	30	Yes
B148	Non-associated	50	31	Yes
B163	*Associated*	*50*	*49*	*Yes*
B164	Non-associated	50	39	Yes

Lower noise levels are predicted for other BESS configurations (comprising fewer batteries and/or PCS), lower fan speeds (as would occur during cooler temperatures at night and during times of lower charge or discharge rates), for residences further from the site and for meteorological conditions less conducive to noise propagation.

Based on the above, noise from the BESS is predicted to achieve the 50 dB(A) Policy criterion applicable during the "night" period at all nearby noise sensitive receivers. By extension, noise from the BESS will also achieve the less stringent 57 dB(A) criterion applicable during the "day" period.

It is noted that the highest noise level is predicted at B163. This residence is within the project boundary (as well as being within the same allotment as the proposed BESS and the existing Willogoleche Wind Farm Stage 1 substation) and is an *Associated Receiver* for the wind farm component of the Project. This receiver would therefore unlikely be considered a relevant noise sensitive receiver for the purposes of the Policy. At all other residences a compliance margin of at least 9 dB(A) is predicted.

5.2.4 Penalties for Noise Character

Noise from a typical BESS facility (when operating) would generally comprise broadband, steady state noise without any fluctuating or impulsive components, and would therefore not typically attract a penalty for these noise characteristics under the Policy.

Review of the provided noise spectra for the indicative BESS containers and PCS indicate that there may be the potential for a tonal noise characteristic to be associated with the BESS if all PCS units operate at the same fan speed simultaneously. As the fan speeds of each unit are regulated individually based on the temperature of the unit, it is unlikely that there would be a single fan speed with an audible tone.

Nonetheless, in the interests of a conservative assessment, a 5 dB(A) penalty has been applied and is included in the noise levels presented in Table 5-1 above (and in Appendix H). It is noted that with this penalty applied, compliance with the Policy "night" criterion is predicted at all residences (including B163 which is associated with the Project and is therefore unlikely to considered a relevant receiver for the purposes of the Policy).

6 CONCLUSION

An environmental noise impact assessment has been conducted for the proposed Willogoleche Stage 2 Wind Farm and Battery Energy Storage System (**BESS**) project (the **Project**).

The noise assessment has been conducted as part of the *Environmental Impact Report* (**EIR**) prepared under the licensing and approvals process of the *Hydrogen and Renewable Energy Act 2023* (the **HRE Act**).

Under the HRE Act, authorised operations that have or may have adverse effects on the environment must be managed so as to reduce environmental damage as far as reasonably practicable. As per the HRE Act, the environment includes public health, safety, or amenity. A key issue for public amenity is often noise.

As required under the HRE Act, noise from the Project has been assessed in accordance with the relevant legislation, standards, and receptors to be considered by EIRs. Specifically, noise from the wind farm component of the Project has been assessed in accordance with the South Australian Environment Protection Authority (**SA EPA**) document *Wind Farms Environmental Noise Guidelines* (2021) (the **Wind Farms Guidelines**). Noise from the BESS component of the project has been assessed against the *Environment Protection (Commercial and Industrial) Noise Policy 2023* (the **Policy**).

The assessment has considered indicative selections for the WTGs to be installed for the wind farm component of the Project, and for the BESS containers and *Power Conversion Systems* (**PCS**) to be installed for the BESS component of the Project.

Based on the assessment, noise from the Project is predicted to achieve the relevant criteria determined in accordance with the Wind Farms Guidelines and the Policy for the wind farm and BESS components of the Project respectively. In doing so, it is considered that noise from both aspects of the Project will not result in environmental damage with regards to public amenity.

A final noise assessment will be conducted to confirm compliance with the relevant criteria once the wind farm and BESS equipment selection are available at the procurement stage of the project, with sound power levels provided by the respective manufacturers. A final noise assessment report will be submitted to the relevant authorities prior to the commencement of construction. Further, noise level monitoring during operation of the wind farm is also typically required by the EPA to confirm ultimate compliance with the Wind Farms Guidelines.

APPENDIX A: WTG LOCATIONS

WTG ID	Coordinates [WGS 84 / UTM zone 54S]	
	Easting	Northing
1	300601	6304533
2	301110	6304424
3	300948	6305289
4	301368	6305191
5	301217	6305703
6	301638	6306412
7	301351	6306719
8	301812	6307163
9	300976	6307614
10	302243	6307533
11	301808	6307965
12	301706	6308323
13	301964	6309129
14	302642	6309226
15	302566	6309972
16	303248	6309847
17	302066	6310366
18	302354	6310896
A	301495	6304580
B	302151	6306779

APPENDIX B: RECEIVER LOCATIONS

ID	Status	Coordinates [WGS84 UTM Zone 54S]		Nearest WTG	Distance to Nearest WTG [m]
		Easting	Northing		
B2	Non-associated	298151	6305012	1	2497
B3	Non-associated	296916	6301190	1	4975
B27	Non-associated	292892	6293657	1	13331
B28	Non-associated	293321	6293663	1	13083
B34	Non-associated	294470	6296867	1	9816
B35	Non-associated	293556	6295768	1	11246
B36	Non-associated	293407	6296065	1	11111
B37	Non-associated	293514	6296395	1	10792
B52	Non-associated	298672	6293818	2	10883
B53	Non-associated	298482	6293815	1	10926
B54	Non-associated	298395	6293842	1	10917
B62	Non-associated	300400	6297358	2	7101
B64	Non-associated	300281	6297326	2	7147
B65	Non-associated	300040	6297303	2	7201
B66	**Non-Associated**	**303106**	**6305039**	A	1675
B67	**Non-Associated**	**303881**	**6307931**	10	1686
B121	Non-associated	303727	6302314	A	3181
B128	*Associated*	*298058*	*6307433*	*9*	*2923*
B146	Non-associated	293532	6294852	1	11988
B147	Non-associated	293217	6295108	1	11974
B148	Non-associated	294118	6298611	1	8781
B149	Non-associated	294594	6300556	1	7205
B150	Non-associated	294733	6300623	1	7051
B151	Non-associated	295180	6301347	1	6289
B152	Non-Associated	297008	6300977	1	5056
B153	Non-associated	296864	6302587	1	4213
B154	Non-associated	296131	6302991	1	4729
B156	*Associated*	*303049*	*6306600*	*B*	*916*
B157	*Associated*	*302586*	*6305338*	*4*	*1227*
B158	*Associated*	*302427*	*6304725*	*A*	*943*
B159	Non-associated	304590	6303364	A	3325
B160	Non-associated	302500	6301283	2	3435

ID	Status	Coordinates [WGS84 UTM Zone 54S]		Nearest WTG	Distance to Nearest WTG [m]
		Easting	Northing		
B161	Non-associated	302425	6301001	2	3667
B162	Non-associated	299412	6295865	2	8726
B163	*Associated*	*296101*	*6296162*	*1*	*9504*
B164	Non-Associated	296160	6297941	1	7948
B166	**Non-associated**	**302946**	**6303639**	A	1730
B167	Non-associated	298722	6297453	1	7326
B168	*Associated*	*299940*	*6306600*	*7*	*1416*
B169	*Associated*	*303148*	*6306970*	*B*	*1015*
B170	*Associated*	*302785*	*6304061*	*A*	*1391*
B171	***Associated***	***299314***	***6305453***	*1*	*1582*

Notes:
- Associated Receiver locations are shown in *italics* and shaded grey
- Background noise monitoring locations are shown as **bold**

APPENDIX C: NOISE MONITORING EQUIPMENT PHOTOGRAPHS

B66

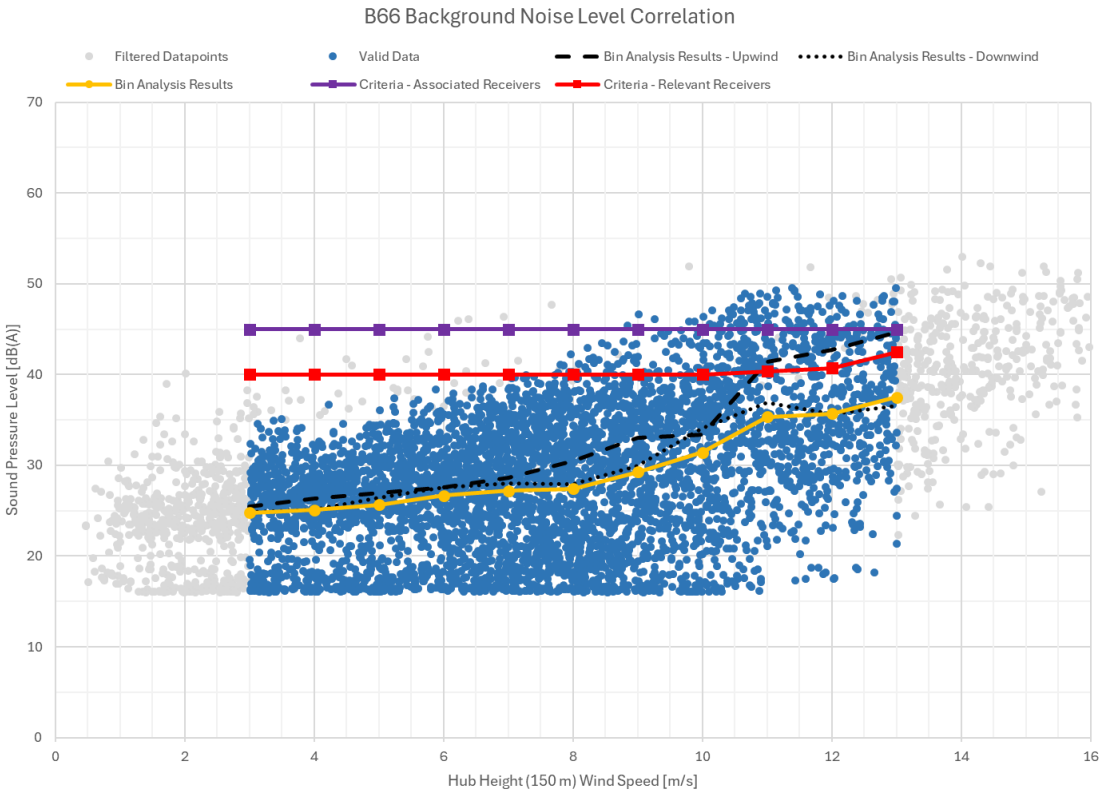


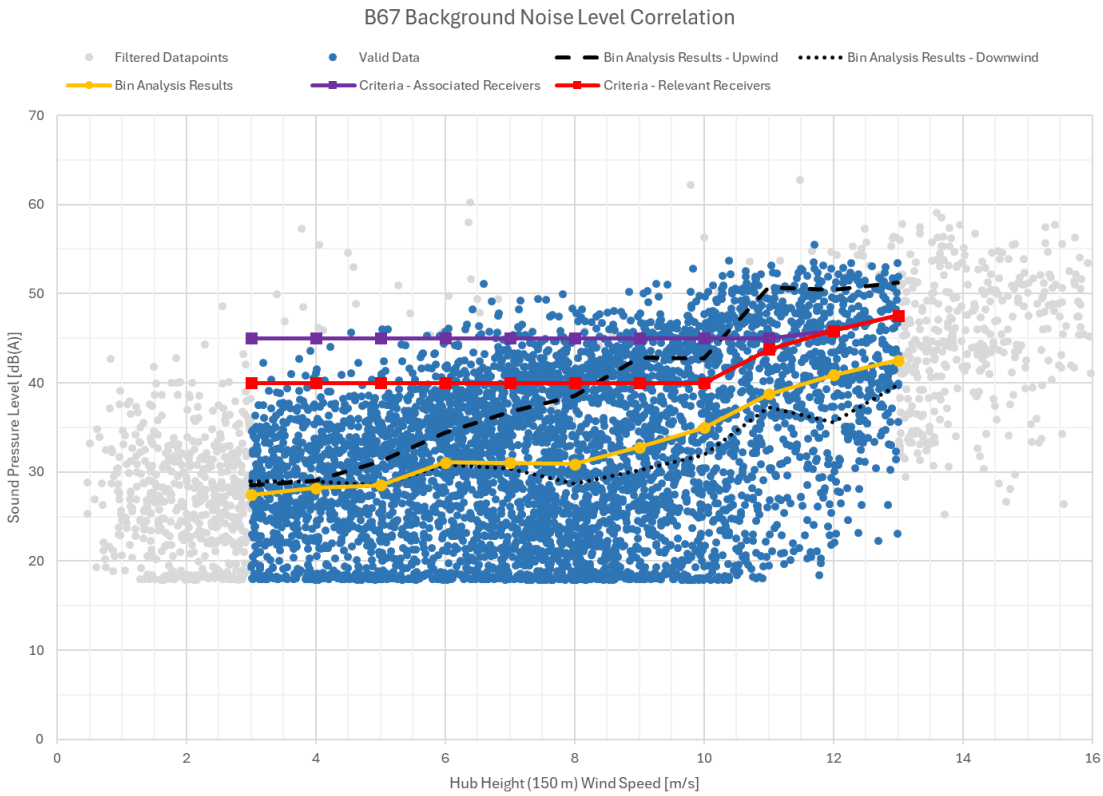

B67

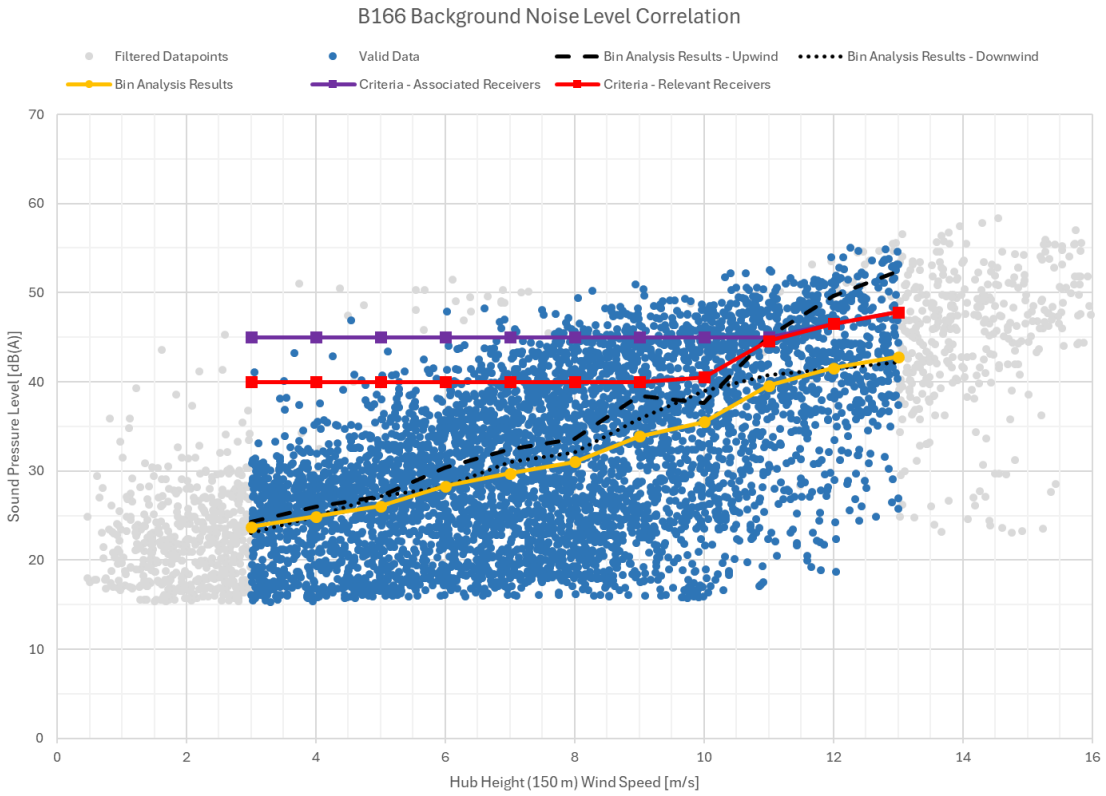
B166

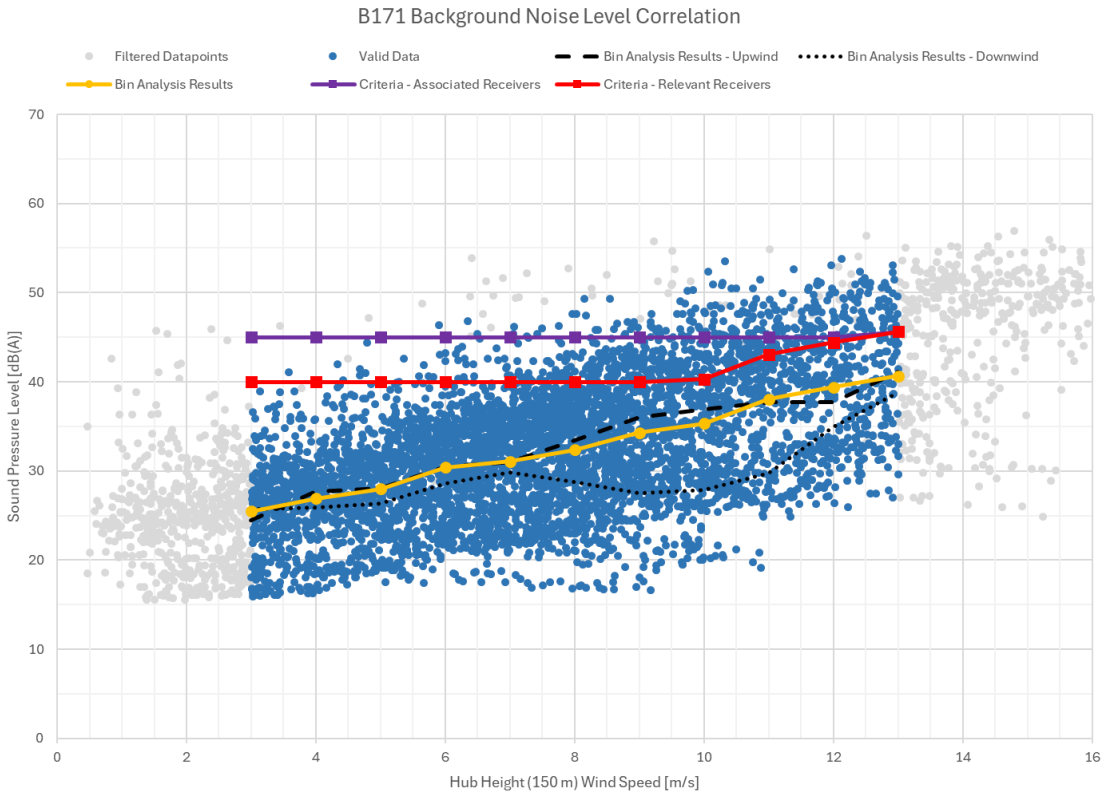
B171

APPENDIX D: BACKGROUND NOISE LEVELS VS WIND SPEED





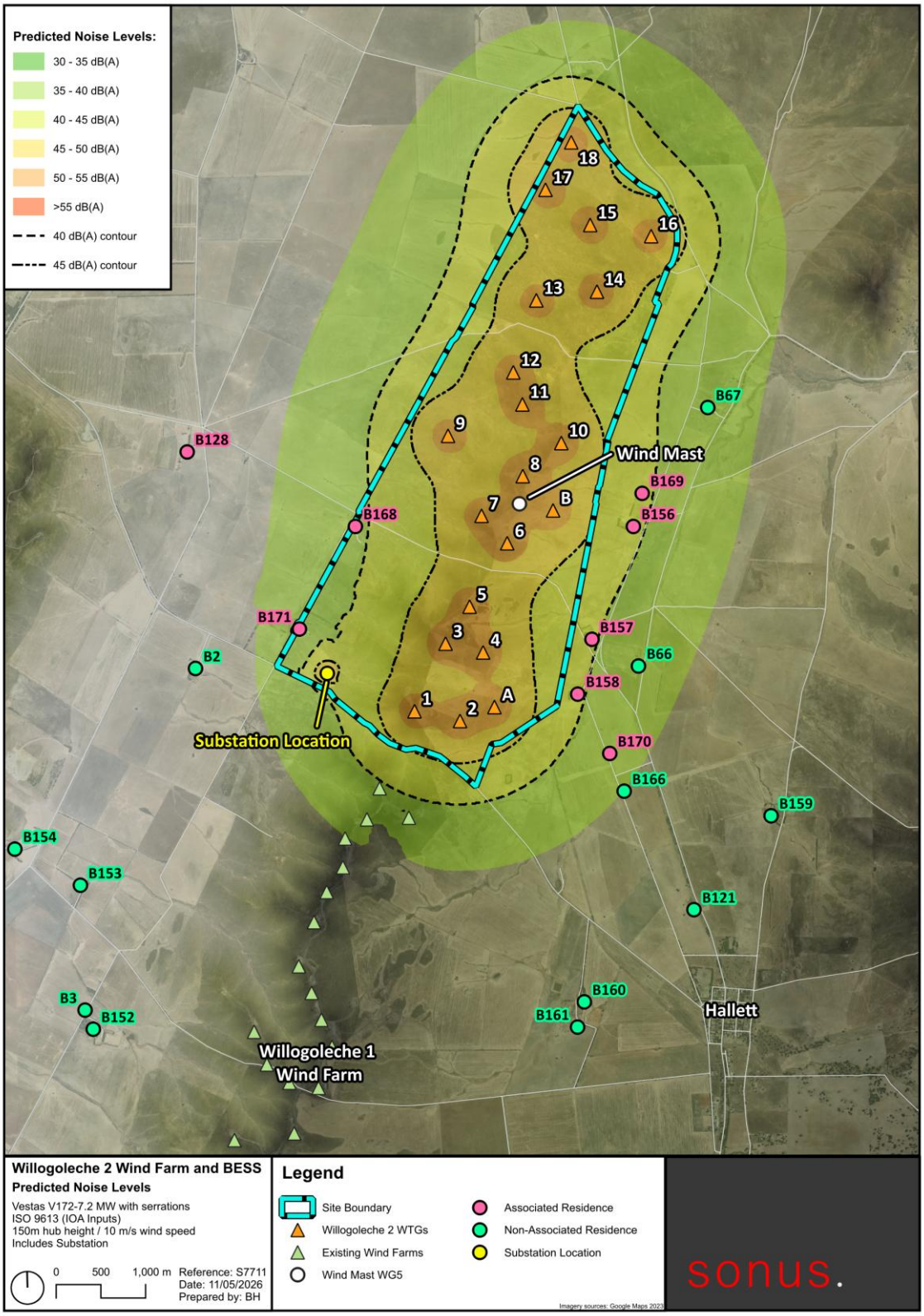

B166 Background Noise Level Correlation
Filtered Datapoints
Valid Data
Bin Analysis Results - Upwind
Bin Analysis Results - Downwind
Bin Analysis Results
Criteria - Associated Receivers
Criteria - Relevant Receivers
Sound Pressure Level [dB(A)]
Hub Height (150 m) Wind Speed [m/s]


B171 Background Noise Level Correlation
Filtered Datapoints
Valid Data
Bin Analysis Results - Upwind
Bin Analysis Results - Downwind
Bin Analysis Results
Criteria - Associated Receivers
Criteria - Relevant Receivers
Sound Pressure Level [dB(A)]
Hub Height (150 m) Wind Speed [m/s]

APPENDIX E: SOUND POWER DATA – WIND TURBINE GENERATORS

Frequency	Sound Power Levels [dB(A)] at Hub height wind speeds [m/s] ("PO7200" Mode with Serrated Blade Trailing Edges)												
	3	4	5	6	7	8	9	10	11	12	13	14	15
10 Hz	32.1	31.9	33.7	36.2	45.1	45.9	47.2	48.8	48.8	48.8	48.8	48.8	48.8
12.5 Hz	37.0	37.5	39.2	41.4	49.7	50.6	51.8	53.4	53.4	53.4	53.4	53.4	53.4
16 Hz	41.9	43.0	44.6	46.6	54.2	55.2	56.4	58.1	58.1	58.1	58.1	58.1	58.1
20 Hz	46.7	48.6	50.0	51.7	58.7	59.9	61.0	62.7	62.7	62.7	62.7	62.7	62.7
25 Hz	51.9	54.9	56.1	56.9	63.9	65.4	66.4	67.9	67.9	67.9	67.9	67.9	67.9
31.5 Hz	56.7	60.5	61.6	62.1	68.5	70.0	71.0	72.6	72.6	72.6	72.6	72.6	72.6
40 Hz	61.3	65.0	66.1	67.3	71.9	73.4	74.6	76.4	76.4	76.4	76.4	76.4	76.4
50 Hz	78.3	78.9	79.3	80.6	81.4	82.3	78.7	81.0	81.0	81.0	81.0	81.0	81.0
63 Hz	84.0	84.5	84.9	86.2	86.7	87.5	82.3	84.9	84.9	84.9	84.9	84.9	84.9
80 Hz	85.0	85.5	85.9	87.1	87.9	88.8	84.8	87.2	87.2	87.2	87.2	87.2	87.2
100 Hz	86.1	86.5	87.0	88.0	89.3	90.3	87.7	89.7	89.7	89.7	89.7	89.7	89.7
125 Hz	87.1	87.5	88.0	88.9	90.6	91.8	90.3	92.0	92.0	92.0	92.0	92.0	92.0
160 Hz	85.8	86.3	86.7	87.7	89.9	91.4	91.8	93.6	93.6	93.6	93.6	93.6	93.6
200 Hz	85.4	85.9	85.8	87.2	89.6	91.8	93.9	95.7	95.7	95.7	95.7	95.7	95.7
250 Hz	86.4	86.4	85.6	87.3	89.9	92.7	95.4	97.2	97.2	97.2	97.2	97.2	97.2
315 Hz	85.6	85.4	84.2	86.3	89.2	92.3	95.2	96.9	96.9	96.9	96.9	96.9	96.9
400 Hz	85.0	84.5	83.2	85.4	88.3	91.5	94.1	95.8	95.8	95.8	95.8	95.8	95.8
500 Hz	85.1	84.5	83.0	85.3	88.2	91.5	93.8	95.4	95.4	95.4	95.4	95.4	95.4
630 Hz	85.1	84.5	83.6	86.0	89.0	92.3	94.6	95.6	95.6	95.6	95.6	95.6	95.6
800 Hz	85.2	84.8	84.8	87.4	90.5	93.7	96.0	96.2	96.2	96.2	96.2	96.2	96.2
1 kHz	85.2	84.9	85.4	88.1	91.3	94.5	96.8	96.4	96.4	96.4	96.4	96.4	96.4
1.25 kHz	84.6	84.3	85.0	87.7	90.9	94.3	96.8	96.0	96.0	96.0	96.0	96.0	96.0
1.6 kHz	84.1	84.1	84.9	87.3	90.5	94.3	97.0	95.5	95.5	95.5	95.5	95.5	95.5
2 kHz	83.4	83.5	84.6	86.8	90.2	94.1	96.9	95.2	95.2	95.2	95.2	95.2	95.2
2.5 kHz	81.2	80.9	82.0	84.3	88.5	92.1	95.0	94.6	94.6	94.6	94.6	94.6	94.6
3.15 kHz	78.5	77.6	78.6	81.2	86.8	89.8	92.8	94.8	94.8	94.8	94.8	94.8	94.8
4 kHz	76.3	75.0	76.1	78.7	85.1	87.8	90.9	94.3	94.3	94.3	94.3	94.3	94.3
5 kHz	72.5	70.7	71.8	73.9	80.4	83.6	86.5	90.0	90.0	90.0	90.0	90.0	90.0
6.3 kHz	68.0	65.4	66.4	67.5	73.9	78.1	80.5	83.7	83.7	83.7	83.7	83.7	83.7
8 kHz	64.3	61.1	62.1	62.6	69.2	73.9	76.1	79.4	79.4	79.4	79.4	79.4	79.4
10 kHz	60.6	56.8	57.9	57.8	64.5	69.7	71.6	75.2	75.2	75.2	75.2	75.2	75.2
TOTAL	**97.6**	**97.6**	**97.7**	**99.5**	**102.2**	**105.0**	**107.1**	**107.8**	**107.8**	**107.8**	**107.8**	**107.8**	**107.8**

APPENDIX F: WIND FARM NOISE CONTOURS



APPENDIX G: SOUND POWER DATA – BATTERY ENERGY STORAGE SYSTEM

Table G-1: Battery container sound power levels.

One-third Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
25	55
31.5	59
40	62
50	64
63	64
80	69
100	65
125	64
160	68
200	69
250	65
315	68
400	71
500	71
630	72
800	74
1000	77
1250	73
1600	72
2000	71
2500	69
3150	67
4000	64
5000	61
6300	59
8000	56
10000	54
12500	51
16000	49
20000	47
Total (per unit)	**84**

Table G-2: PCS sound power levels.

One-third Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
25	42
31.5	49
40	54
50	60
63	66
80	66
100	72
125	68
160	74
200	74
250	79
315	82
400	90
500	85
630	84
800	85
1000	81
1250	80
1600	80
2000	80
2500	80
3150	78
4000	70
5000	89
6300	75
8000	68
10000	69
12500	65
16000	59
20000	49
Total (per unit)	**96**

Table G-3: 325 MVA grid transformer sound power levels.

One-third Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
31.5	65
40	70
50	76
63	73
80	79
100	89
125	82
160	91
200	99
250	86
315	87
400	89
500	87
630	84
800	84
1000	80
1250	76
1600	76
2000	76
2500	73
3150	72
4000	72
5000	71
6300	71
8000	69
10000	66
12500	61
16000	52
20000	42
Total (each unit)	**101**

APPENDIX H: BESS NOISE CONTOURS