



MARSHALL DAY  
Acoustics 

DEVLINS BRIDGE WIND FARM  
PRELIMINARY NOISE ASSESSMENT

Rp 001 20240162 | 25 July 2024

Project: **DEVLINS BRIDGE WIND FARM**

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Report No.: **Rp 001 20240162**

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## SUMMARY

Devlins Bridge Wind Farm (the Project) is proposed to be developed by Stromlo Energy (the Proponent) and comprises the construction, operation and decommissioning of a wind farm, located approximately 25 km west of Narrandera, to the south of the Sturt Highway, in the Riverina region of New South Wales (NSW).

Marshall Day Acoustics Pty Ltd (MDA) have been commissioned to undertake a preliminary assessment of operational noise associated with the Project. The purpose of the assessment is to identify and describe preliminary noise assessment matters to be accommodated into the Project Scoping Report. The Scoping Report will be submitted as part of a request for Project specific Planning Secretary's Environmental Assessment Requirements (SEARs) as part of a future State Significant Development Application (SSDA).

The Project is proposed to have an installed capacity of up to 680 MW of renewable energy generated from up to ninety-four (94) wind turbines, each with a maximum tip height of up to 290 m above ground level.

A preliminary assessment of operational noise for the proposed Project has been conducted in accordance with the NSW Department of Planning and Environment<sup>1</sup> *NSW Wind Energy: Noise Assessment Bulletin* (NSW Noise Assessment Bulletin) dated December 2016.

The NSW Noise Assessment Bulletin specifies that the assessment of wind turbine noise is to be conducted in accordance with the South Australia EPA *Wind farms environmental noise guidelines* (SA Guidelines 2009), dated July 2009, subject to a set of supplementary procedures that are specific to NSW.

Noise assessment has been carried out based on a candidate turbine model, as nominated by the Proponent, with a generation capacity of 7.2 MW being representative of the size and type of turbine being considered for the Project. Noise emission data for the candidate wind turbine model has been reviewed and is consistent with the range of values expected for comparable types of multi megawatt wind turbine models.

The noise emission data has been used with international standard ISO 9613-2<sup>2</sup> to develop a 3D noise model allowing the prediction of the level of noise expected to occur at neighbouring receivers, under worst case noise propagation conditions. The ISO 9613-2 standard has been applied based on well-established input choices and adjustments, based on research and international guidance, that are specific to wind farm noise assessment. ISO 9613-2 (without reference to a specific version of the standard) is nominated as being an acceptable noise prediction method in the SA Guidelines 2009.

The predicted noise levels for the proposed wind turbine layout are below the base noise limit determined in accordance with the NSW Noise Assessment Bulletin, at all assessed receivers. The results of the noise modelling therefore demonstrate that the Project can be designed and operated to comply with the operational noise requirements of the NSW Noise Assessment Bulletin.

Assessment of cumulative wind turbine noise would typically consider noise from other wind turbines within 10 km of the Project boundary i.e. wind turbines associated with adjacent or nearby wind farms, within 10 km. The Proponent has advised that no existing or proposed wind farms are within 10 km.

Once the SEARs are issued for this Project, further detailed assessment will be undertaken to support the Environmental Impact Statement (EIS) as part of the SSDA, to be lodged with the NSW Department of Planning, Housing, and Infrastructure (DPHI). The detailed assessment would demonstrate how compliance would be achieved for the specific noise matters that would be defined by the SEARs.

This would include background noise monitoring at key receivers around the Project, a revised operational wind turbine noise modelling assessment and other noise considerations, including special noise characteristics, construction, and ancillary infrastructure.

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<sup>1</sup> Now under the purview of the NSW Department of Planning, Housing and Infrastructure (DPHI)

<sup>2</sup> ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*

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## 1.0 INTRODUCTION

Devlins Bridge Wind Farm (the Project) is proposed to be developed by Stromlo Energy (the Proponent) and comprises the construction, operation and decommissioning of a wind farm, located approximately 25km west of Narrandera, to the south of the Sturt Highway, in the Riverina region of New South Wales (NSW).

The Project is proposed to have an installed capacity of up to 680 MW of renewable energy generated from up to ninety-four (94) wind turbines, each with a maximum tip height of up to 290 m above ground level.

This report presents the results of a preliminary noise assessment prepared for submission with a Scoping Report and a Secretary's Environmental Assessment Requirements (SEARs) request.

The preliminary noise assessment has been prepared in accordance with the NSW Department of Planning and Environment's *Wind Energy: Noise Assessment Bulletin - For State significant wind energy development*, dated December 2016 (the NSW Noise Assessment Bulletin) and is based on:

- The minimum (base) operational noise limit determined in accordance the NSW Noise Assessment Bulletin;
- Preliminary noise modelling for the Project based on the current Project design comprising ninety-four (94) multi-megawatt wind turbines and a candidate turbine model representative of the size and type of turbine being considered for the Project; and
- A comparison of the predicted noise levels with the base noise limit.

The Proponent has advised that there are no existing or approved wind farms within 10 km of the proposed Project. Therefore, the assessment of potential cumulative noise is not applicable for the Project, at this stage.

Other noise considerations relating to the Project would also be assessed during the Environmental Impact Statement (EIS) stage of the Project. This would include the noise of construction and ancillary infrastructure associated with the Project, along with any other specific noise matters that would be defined by the SEARs for the Project when issued.

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

## 2.0 PROJECT DESCRIPTION

### 2.1 Overview

The Project area is proposed in an area south of the Sturt Highway and to the west of the township of Narrandera. It is in the Federal Electorate of Farrer, the State Electorate of Cootamundra, and the Narrandera LGA. The majority of the Project is located on 7,300 Ha. of private non-irrigated agricultural land which is primarily used for sheep grazing, cattle grazing, and cropping.

The Project, if approved, would have an installed capacity of up to 680 MW. At this stage, plans for the proposed Project comprise:

- Up to ninety-four (94) three-blade wind turbines, with a typical tip height up to 290 m above ground level, including hardstands and turbine laydown areas
- Permanent electrical infrastructure, including, underground and overhead cabling, primary terminal station connecting to the existing overhead 330kV transmission line, and collector station
- Permanent ancillary infrastructure including an operation and maintenance facility, meteorological masts, a washdown station, new access tracks, upgrades to existing access tracks, and an access point from the Sturt Highway
- Temporary facilities, including site compounds, laydown areas, stockpile areas, concrete batch plants and a potential gravel borrow pit.

The coordinates of the wind turbines are presented in tabular format in Appendix B.

Throughout this report, the term *receiver* is used to identify any dwelling identified by the Proponent in the vicinity of the proposed wind farm. Receivers are categorised as *associated receivers* i.e. host properties or receivers where an impact agreement specifically addressing noise is in place between the landowners and the Proponent, or *non-associated receivers* which comprises the remaining receivers without an agreement with the Proponent.

Based on ground truthing information provided by the Proponent, a total of eighty-six (86) receivers are located within 10 km from a proposed wind turbine location. This includes twenty-six (26) associated receivers, with the remaining receivers being non-associated receivers.

The coordinates of the receivers are tabulated in Appendix C.

A site layout plan illustrating the wind turbine layout and receivers is provided in Appendix D.

### 2.2 Candidate wind turbine model

The wind turbine model to be assessed in detail as part of the EIS will be determined from ongoing Project design development. Further, if the Project is approved, the final wind turbine model would only be selected after a tender process to procure the supply of wind turbines. The final selection would be made on account of a range of design requirements, including achieving compliance with relevant noise limits at surrounding noise sensitive receivers.

Accordingly, to assess the proposed development at this stage in the Project, it is necessary to use a representative candidate wind turbine model for the size and type of wind turbines being considered. The purpose of using a candidate wind turbine in this assessment is to inform a preliminary assessment of operational noise, accounting for the base noise limit and noise emission levels that are typical of the size of wind turbines being considered for the Project. For this assessment, the Proponent has nominated the Vestas V172-7.2MW as the candidate wind turbine model.

This model is a variable speed wind turbine, with the speed of rotation and the amount of power generated by the wind turbines being regulated by control systems which vary the pitch of the wind turbine blades (the angular orientation of the blade relative to its axis).

This assessment has been based on the wind turbines operating in an unconstrained mode of generation (i.e. without noise reduced operating modes) and with blade serrations. Blade serrations are now routinely used to reduce wind turbine noise emissions, and it is understood that their use is now the market standard for wind turbines being offered in the Australian market.

Details of the assessed candidate wind turbine are provided in Table 1.

**Table 1: Selected candidate wind turbine model**

Item	Detail
Make	Vestas
Model	V172
Rated power	7.2 MW
Rotor diameter	172 m
Hub height	204 m
Blade serrations	Yes
Cut-in wind speed (hub height)	3 m/s
Cut-out wind speed (hub height)	25 m/s

A candidate wind turbine model (or models) with specifications consistent with the Project design will be used in the Environmental Impact Statement (EIS), to reflect the candidate wind turbine models under consideration at the time. Accordingly, the noise assessment undertaken for the EIS would reflect those candidate wind turbine models.

### 3.0 OPERATIONAL WIND FARM NOISE CRITERIA

#### 3.1 Non-associated receivers

The NSW Noise Assessment Bulletin provides guidance on how noise impacts are to be assessed for large-scale wind energy development projects that are State Significant Development.

The NSW Noise Assessment Bulletin states that the South Australian EPA publication *Wind farms environmental noise guidelines* (SA Guidelines) dated July 2009 is to be used as the relevant assessment standard, subject to a set of variations that apply to the assessment of NSW projects. The variations are defined for:

- noise limits
- special noise characteristics; and
- noise monitoring.

In relation to noise limits, the variation defined in the NSW Noise Assessment Bulletin sets the base criterion at a value of 35 dB  $L_{Aeq}$  for all projects, in lieu of the 35 to 40 dB  $L_{Aeq}$  base criterion range defined in the SA Guidelines. The criteria in the NSW Noise Assessment Bulletin are subsequently defined as follows:

*The predicted equivalent noise level ( $L_{Aeq,10\text{ minute}}$ )\*, adjusted for tonality and low frequency noise in accordance with these guidelines, should not exceed 35 dB(A) or the background noise ( $L_{A90(10\text{ minute})}$ ) by more than 5 dB(A), whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the wind turbine generator and each integer wind speed in between.*

*\* Determined in accordance with SA 2009, Section 4.*

Variations are also defined in the NSW Noise Assessment Bulletin for the assessment of special noise characteristics. These procedures would be referenced in subsequent detailed assessment phases for the Project.

The NSW Noise Assessment Bulletin notes the following in relation to the types of receivers where the noise limits apply:

*The criteria in this Bulletin have been developed to address potential noise impacts on the amenity of residents and other relevant receivers in the vicinity of a proposed wind energy project. Wind energy proponents commonly negotiate agreements with private land owners where applicable noise limits may not be achievable at relevant receiver locations. A negotiated agreement will be considered as part of the assessment of a wind energy project, as will the requirements of SA 2009 and this Bulletin. The proponent's EIS should clearly identify the expected noise levels at all receiver locations including host properties to ensure that affected persons are appropriately informed regarding the development proposal.*

#### 3.2 Associated receivers

The assessment criteria detailed in the previous section apply to all non-associated noise sensitive receivers. However, in accordance with the requirements of the NSW Noise Assessment Bulletin, predicted noise levels are also presented for associated receivers.

Notwithstanding the above, a reference level of 45 dB  $L_{Aeq}$  is presented as a base criterion for associated receivers in order to provide context to the predicted noise levels for these locations. This is consistent with the SA Guidelines which recommends a level of 45 dB for *financial stakeholders*. Comparisons between the predicted noise levels and the 45 dB reference level are provided for informative purposes only. Noise levels at these locations would ultimately need to be managed in accordance with the impact agreement addressing noise, established between the Proponent and the landowners.

#### 4.0 NOISE PREDICTION METHOD

Operational wind turbine noise levels are predicted using:

- Noise emission data for the candidate wind turbines;
- A 3D digital model of the Project and the surrounding environment; and
- International standards used for the calculation of environmental sound propagation.

The method selected to predict noise levels is International Standard ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2:1996). The prediction method is consistent with the guidance provided by the SA Guidelines (referenced in the NSW Noise Assessment Bulletin) and has been shown to provide a reliable method of predicting the typical levels of noise expected to occur in practice.

The ISO 9613-2 method is used in conjunction with a set of input choices and procedural modifications that are specific to wind farm noise assessment, based on international research and guidance.

Key elements of the noise prediction method are summarised in Table 2. Further discussion of the method and the calculation choices is provided in Appendix E.

**Table 2: Downwind prediction method**

Detail	Description
Software	Proprietary noise modelling software SoundPLANnoise version 9.0
Method	<p>International Standard ISO 9613-2:1996 <i>Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation</i> (ISO 9613-2:1996).</p> <p>Adjustments to the ISO 9613-2 method are applied on the basis of the guidance contained in the UK Institute of Acoustics publication <i>A good practice guide to the application of ETSU-R-97 for the assessment and rating of WTG noise</i> (UK Institute of Acoustics guidance).</p> <p>The adjustments are applied within the SoundPLANnoise modelling software and relate to the influence of terrain screening and ground effects on sound propagation.</p> <p>Specific details of adjustments are noted below and are discussed in Appendix E.</p>
Source characterisation	<p>To model the operational wind turbine noise associated with the Project, the following specific procedures are noted:</p> <ul style="list-style-type: none"> <li>• Calculations of wind turbine to receiver distances and average sound propagation heights are made on the basis of the point source being located at the position of the hub of the wind turbine.</li> <li>• Each wind turbine is modelled as a point source of sound.</li> <li>• The total wind turbine noise associated with the operation of the Project is then calculated on the basis of simultaneous operation of all wind turbines and summing the contribution from each.</li> <li>• Calculations of terrain related screening are made on the basis of the point source being located at the maximum tip height of each wind turbine. Further discussion of terrain screening effects is provided below.</li> </ul>
Terrain data	Digital terrain map with a cell size of 5 m throughout the Project and surrounds, sourced from ELVIS 3

<sup>3</sup> <https://elevation.fsd.org.au/>

Detail	Description
Terrain effects (wind turbine-specific procedures)	<p>Adjustments for the effect of terrain are determined and applied on the basis of the UK Institute of Acoustics guidance and research outlined in Appendix E.</p> <p><i>Valley effects:</i> +3 dB is applied to the calculated noise level of a wind turbine when a significant valley exists between the wind turbine and calculation point. A significant valley is determined to exist when the actual mean sound propagation height between the wind turbine and calculation point is 50 % greater than would occur if the ground were flat.</p> <p><i>Terrain screening effects:</i> only calculated if the terrain blocks line of sight between the maximum tip height of the wind turbine and the calculation point. The value of the screening effect is limited to a maximum value of -2 dB.</p> <p>For reference purposes, the ground elevations at the wind turbine and receivers are tabled in Appendix B and Appendix C respectively.</p> <p>The topography of the Project is depicted in the elevation map provided in Appendix F.</p>
Ground conditions	<p>Ground factor of <math>G = 0.5</math> on the basis of the UK Institute of Acoustics guidance and research outlined in Appendix E.</p> <p>The ground around the Project corresponds to acoustically soft conditions (<math>G = 1</math>) according to ISO 9613-2. The adopted value of <math>G = 0.5</math> assumes that 50 % of the ground cover is acoustically hard (<math>G = 0</math>) to account for variations in ground porosity and provide a cautious representation of ground effects.</p>
Atmospheric conditions	<p>Temperature 10 °C and relative humidity 80 %</p> <p>These represent conditions which result in relatively low levels of atmospheric sound absorption and are chosen on the basis of the UK Institute of Acoustics guidance and SA Guidelines.</p> <p>The calculations are based on sound speed profiles<sup>4</sup> which increase the propagation of sound from each wind turbine to each receiver, whether as a result of thermal inversions or wind directed toward each calculation point.</p> <p>The primary consideration for wind farm noise assessment is wind speed and direction. The noise level at each calculation point is assessed on the basis of being simultaneously downwind of every wind turbine at the Project. Other wind directions in which part or the entire wind farm is upwind of the receiver will result in lower noise levels. In some cases, it is not physically possible for a receiver to be simultaneously downwind of each wind turbine and the approach is therefore conservative in these instances.</p>
Receiver heights	<p>1.5 m above ground level.</p> <p>It is noted that the UK Institute of Acoustics guidance refers to predictions made at receiver heights of 4 m. Predictions in Australia are generally based on a lower prediction height of 1.5 m which results in lower noise levels. However, importantly, predictions in Australia do not generally subtract a margin recommended by the UK Institute of Acoustics guidance to account for differences between <math>L_{Aeq}</math> and <math>L_{A90}</math> noise levels. The magnitude of these differences is comparable and therefore balance each other out to provide similar predicted noise levels.</p> <p>This approach has been shown to be valid for predicting noise level of wind farms expected to be measured using the <math>L_{A90}</math> parameter (as per the NSW Noise Assessment Bulletin).</p>

<sup>4</sup> The sound speed profile defines the rate of change in the speed of sound with increasing height above ground

## 5.0 WIND TURBINE NOISE ASSESSMENT

### 5.1 Wind turbine noise emissions

The noise emissions of the wind turbines are described in terms of the sound power level for different wind speeds. The sound *power* level is a measure of the total sound energy produced by each wind turbine and is distinct from the sound *pressure* level which depends on a range of factors such as the distance from the wind turbine.

Sound power level data for the candidate wind turbine model, including sound frequency characteristics, has been sourced from the Vestas Power Solutions Technical Documentation *Third octave noise emission – EnVentus V172-7.2 MW 50/60 Hz*, dated 30 June 2022.

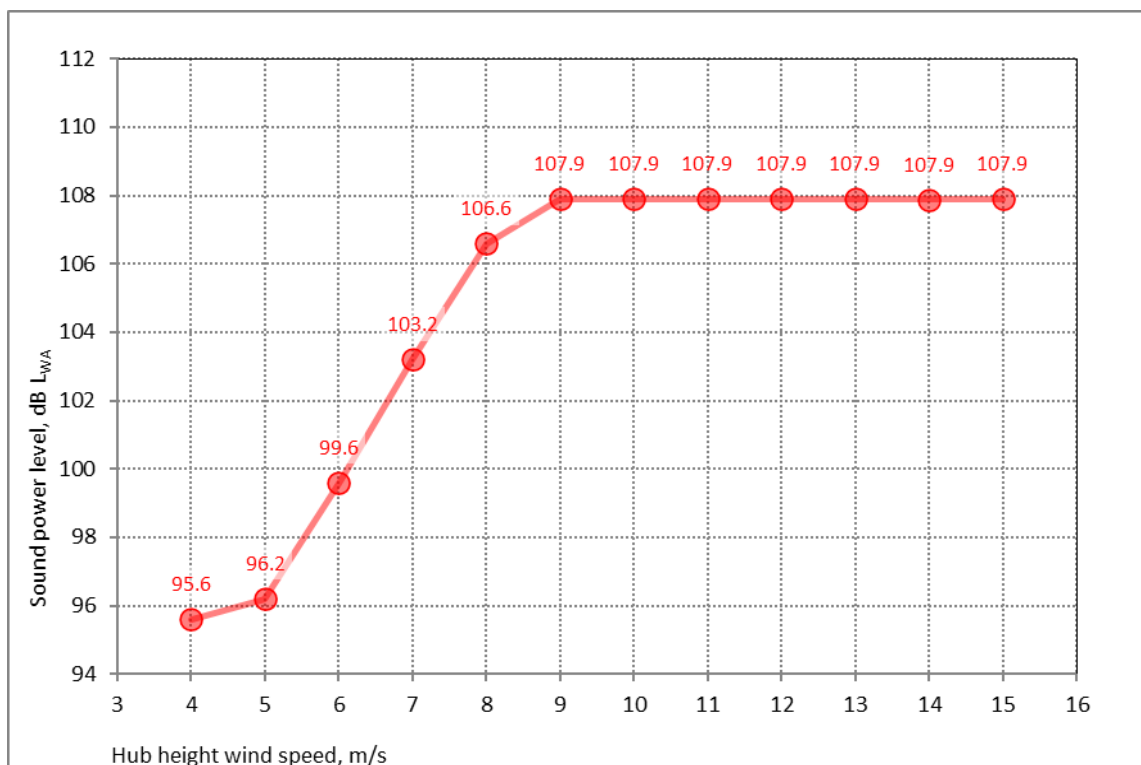
Based on the data sourced from the manufacturer’s documentation, the noise modelling undertaken for this assessment involved conversion of third octave band levels to octave band levels (where applicable), and adjustment by addition of +1.0 dB at each wind speed to provide a margin for typical values of test uncertainty. The modification for test uncertainty is in line with recommendations outlined in the UK Institute of Acoustics guidance.

The overall A-weighted sound power levels (including the +1.0 dB addition) as a function of hub height wind speed are presented in Table 3 and Figure 1. These represent the total noise emissions of the wind turbine, including the secondary contribution of ancillary plant associated with each wind turbine (e.g. cooling fans and internal transformer).

**Table 3: Wind turbine sound power levels versus hub height wind speed, dB L<sub>WA</sub>**

Hub height wind speed, m/s								
4	5	6	7	8	9	10	11	≥12
95.6	96.2	99.6	103.2	106.6	107.9	107.9	107.9	107.9

**Figure 1: Wind turbine sound power levels versus hub height wind speed, dB L<sub>WA</sub>**



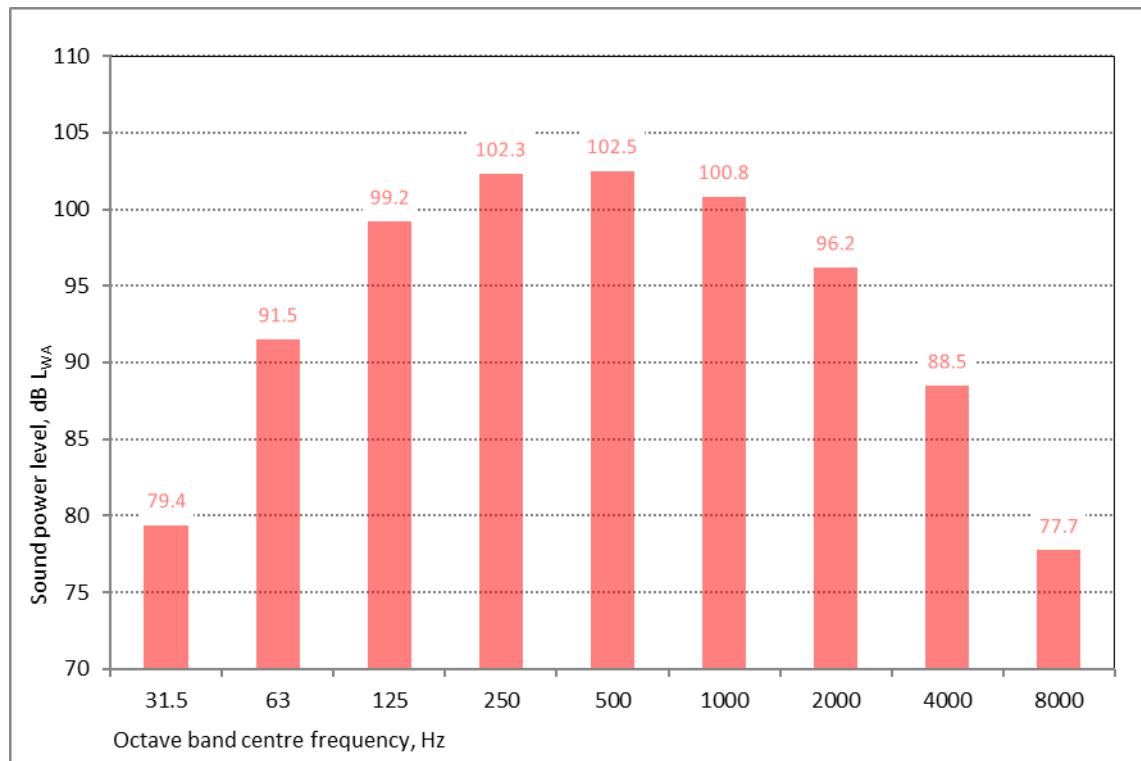
The sound power levels in Figure 1 are considered typical of the range of noise emissions associated with comparable multi-megawatt wind turbines. The data is therefore considered appropriate to reference in this preliminary assessment as a representation of the apparent sound power levels of the wind turbine if it were to be tested and rated in accordance with International Electrotechnical Commission publication IEC 61400-11:2012 *Wind turbines - Part 11: Acoustic noise measurement techniques* (IEC 61400-11).

The sound frequency characteristics of the wind turbine have been sourced from the manufacturer’s specification document. The reference spectrum used as the basis for this assessment is presented in Table 4 and Figure 2, and corresponds to the highest overall sound power level tabulated in Table 3, occurring at a hub height wind speed of 12 m/s (when considering cumulative low frequency content below 125 Hz and 250 Hz).

**Table 4: Wind turbine octave band sound power levels (at 12 m/s), dB L<sub>WA</sub>**

Octave band centre frequency, Hz									
31.5	63	125	250	500	1000	2000	4000	8000	Total
79.4	91.5	99.2	102.3	102.5	100.8	96.2	88.5	77.7	107.9

**Figure 2: Wind turbine octave band sound power levels (at 12 m/s), dB L<sub>WA</sub>**



Review of available sound power data for a range of wind turbine models has shown that there is not a clear relationship between wind turbine size, or power output, and the noise emission characteristics of a given wind turbine model. In practice, the overall noise emissions of a wind turbine are dependent on a range of factors, including the wind turbine size and power output, and other important factors, such as the blade design and rotational speed of the wind turbine.

While wind turbine sizes and power ratings of contemporary wind turbines have increased, the noise emissions of the wind turbines are comparable to, or lower than, previous generations of wind turbines. This is a result of design improvements, notably, measures to reduce the speed of rotation of the wind turbines, and enhanced blade design features such as serrations for noise control.

### 5.1.1 Tonality

The manufacturer specification for the candidate wind turbine model does not provide information about tonality.

The occurrence of tonality in the noise of contemporary multi-megawatt wind turbine designs is generally limited. This is supported by evidence of operational wind farms in Australia which indicates that the occurrence of tonality at receivers is atypical. On this basis, adjustments for tonality have not been applied to the predicted noise levels presented in this preliminary assessment.

Notwithstanding this, the subject of tonality would be addressed in subsequent assessment stages for the Project. As part of this, further information will need to be obtained from the manufacturer concerning tonality.

### 5.1.2 Low frequency noise

The other special noise characteristic which is assessable in accordance with the NSW Noise Assessment Bulletin is low frequency noise. While there is a prescribed criterion for the application of low frequency noise penalty adjustments in the NSW Noise Assessment Bulletin (based on C-weighted noise levels), there is no established or verified engineering prediction method of C weighted noise levels associated with the operation of wind turbines.

For the purposes of this report, a risk assessment approach has been adopted using a simplified prediction method to estimate the C-weighted noise levels. Details of the study have been provided in Appendix G.

## 5.2 Preliminary predicted noise levels

This section of the report presents the preliminary predicted A-weighted noise levels of the Project at surrounding receivers, and an assessment of compliance with the base noise limit.

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

Table 5 lists the predicted noise levels for all non-associated receivers that are above 30 dB  $L_{Aeq}$ . The minimum noise limit applicable to the wind farm at non-associated receivers is 35 dB  $L_{Aeq}$ .

The predicted noise levels are for conditions when the noise emissions of the candidate wind turbine have reached their highest level (corresponding to a hub height wind speed of 12 m/s), and the wind is directed from each turbine to each receiver. The predicted noise levels presented include the +1.0 dB allowance to account for turbine sound power level measurement uncertainty, as described in Section 5.1.

**Table 5: Predicted noise levels at non-associated receivers above 30 dB  $L_{Aeq}$**

Receiver	Distance to nearest wind turbine, m	Predicted noise level, dB $L_{Aeq}$
86	3,930	30.7
88	2,660	33.3
106	4,297	30.4
117	4,173	30.4

Predicted noise levels for each integer wind speed are tabulated in Appendix H for all receivers within 10 km of a wind turbine.

It can be seen from Table 5 that the predicted noise levels from the proposed Project are below the NSW Noise Assessment Bulletin base criterion of 35 dB  $L_{Aeq}$  at all non-associated receivers by at least 1.7 dB.

The above findings support that the Project can be designed and operated to comply with the operational noise requirements of the NSW Noise Assessment Bulletin.

Predicted noise levels at associated receivers above 30 dB  $L_{Aeq}$  are provided in Table 6, for information.

**Table 6: Predicted noise level at associated receivers above 30 dB  $L_{Aeq}$**

Receiver	Distance to nearest wind turbine, m	Predicted noise level, dB $L_{Aeq}$
47	2,495	32.6
55	1,733	36.1
57	1,341	39.4
58	1,867	35.0
59	1,736	35.5
61	1,109	40.4
63	1,046	40.7
68	1,623	36.5
72	1,607	36.9
81	1,037	41.2
82	1,110	42.7
87	1,033	40.8
89	1,182	40.0
91	1,194	40.9
92	1,079	41.8
93	1,195	41.2
94	1,051	41.4
95	1,056	41.7
96	1,106	42.7
98	1,027	42.9
99	1,032	43.9
100	1,055	44.0
101	4,886	30.4
102	4,724	30.5
107	1,035	44.9
112	1,720	36.0

It can be seen from Table 6 that the predicted noise levels from the proposed Project are below the 45 dB  $L_{Aeq}$  reference level for all associated receivers by at least 0.1 dB.

The location of the total predicted 30 dB, 35 dB, 40 dB, and 45 dB  $L_{Aeq}$  noise contours is illustrated in Figure 3 with a zoomed view shown in Figure 4.

Figure 3: Highest predicted noise levels (corresponding to hub height wind speeds of 12 m/s or greater)

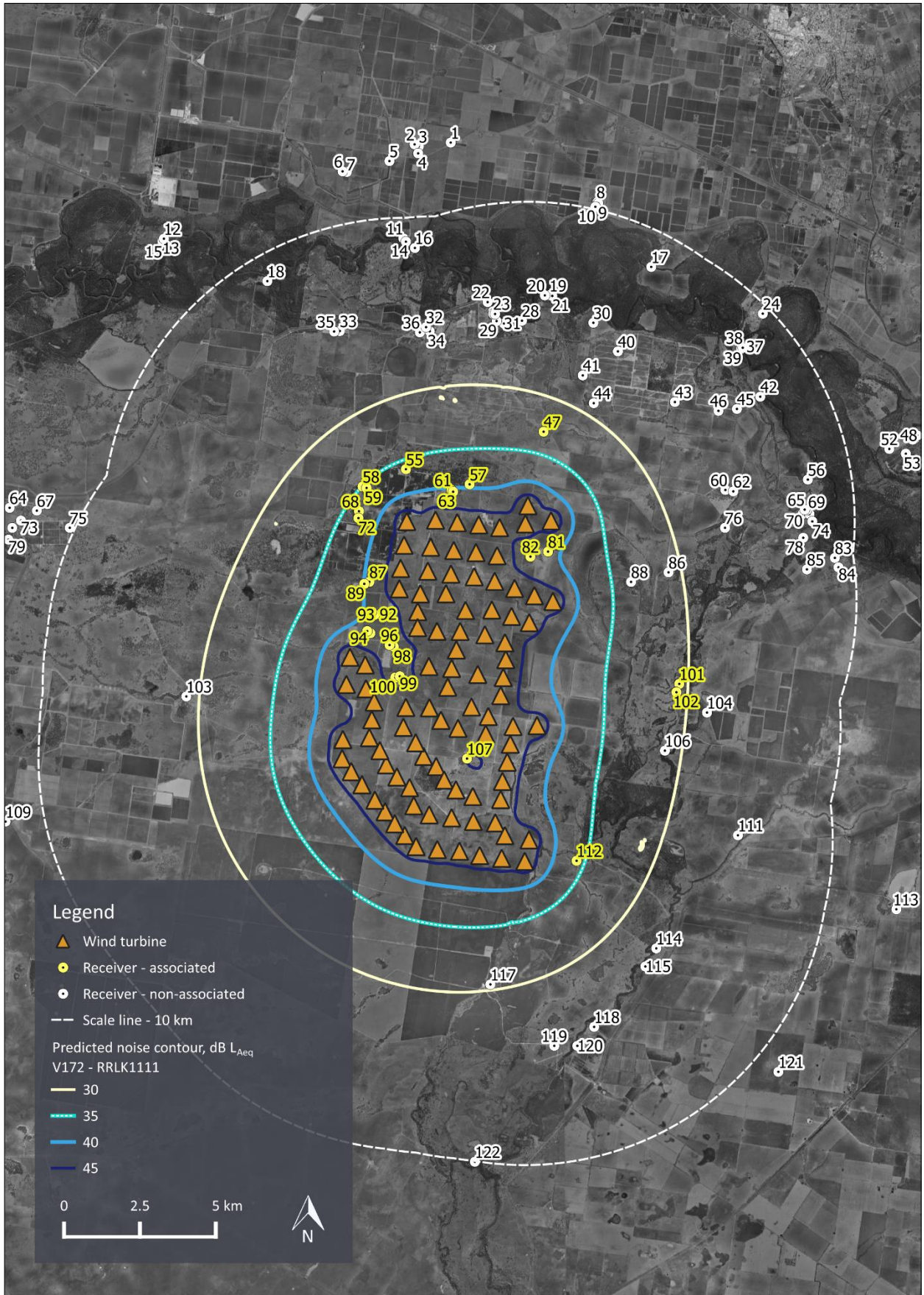
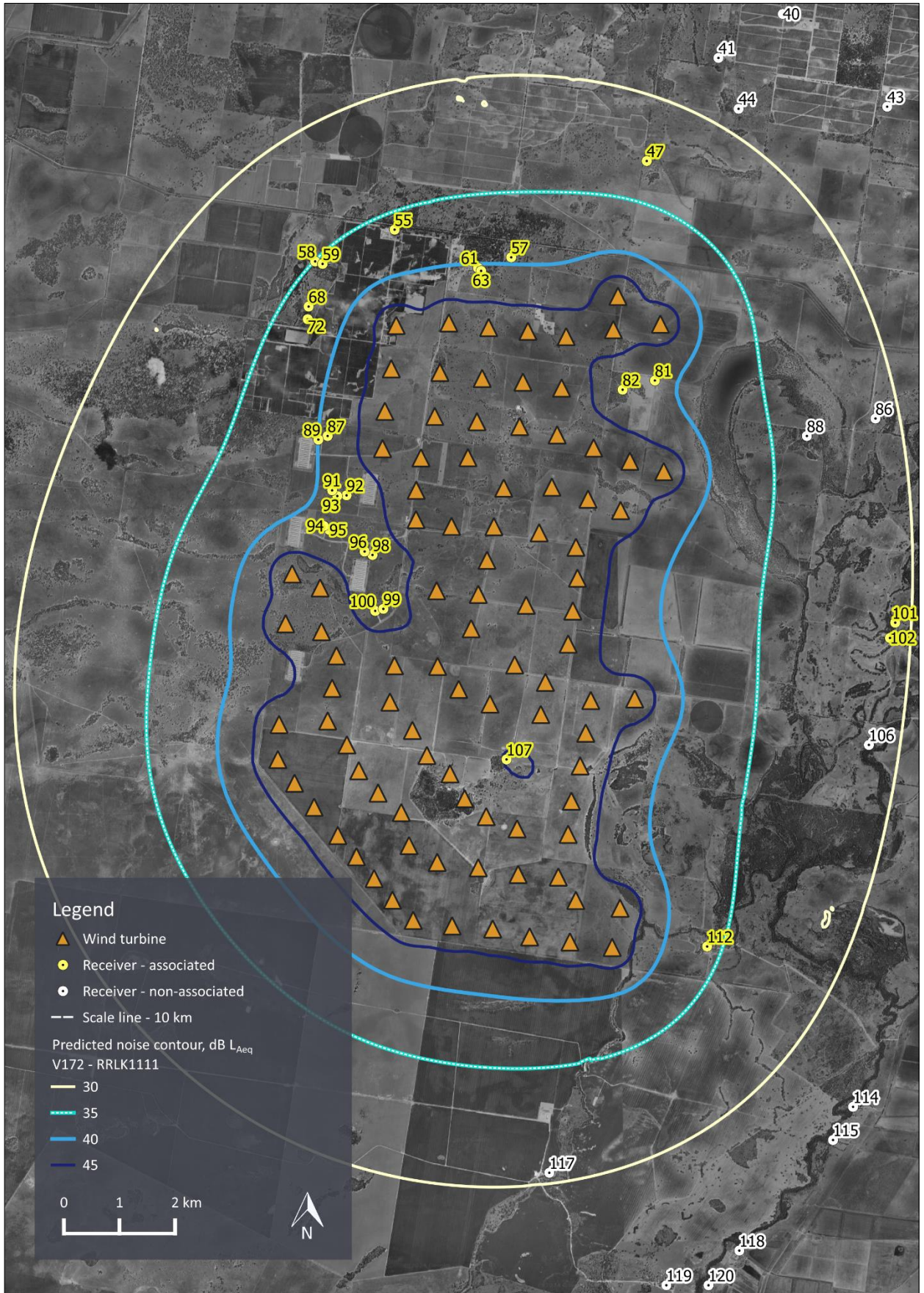


Figure 4: Highest predicted noise levels - zoomed (corresponding to hub height wind speeds of 12 m/s or greater)



### 5.3 Low-frequency noise

A risk assessment provided in Appendix G indicates calculated low frequency noise levels below the applicable thresholds at all non-associated receivers. It is noted that the margin between the predicted levels and the most stringent threshold is of a comparable magnitude to the uncertainty associated with C-weighted predictions.

On the above basis, adjustments for special noise characteristics referred to in the NSW Noise Assessment Bulletin have not been applied to the predicted noise levels for non-associated receivers presented in this assessment. However, assessment of these special noise characteristics would need to be carried out as part of the post-construction compliance assessment.

### 5.4 Cumulative wind farm noise

The Proponent has advised that there are no existing or approved wind farms within 10 km of the proposed Project. Therefore, the assessment of potential cumulative noise is not applicable for the Project, at this stage.

Notwithstanding the above, cumulative noise should be addressed during the EIS stage, with consideration given to other nearby wind farm developments, should they be announced.

## 6.0 DETAILED ASSESSMENT PHASE

A detailed assessment of a wind farm development in NSW involves addressing several environmental noise considerations detailed in project-specific SEARs. Whilst SEARs specific to the Project are yet to be issued, typical requirements include assessment of:

- operational wind turbine noise;
- ancillary infrastructure noise;
- construction noise;
- construction traffic noise;
- construction vibration; and
- consideration of cumulative impacts with other nearby wind farm projects.

Environmental noise considerations relating to construction and ancillary infrastructure will be addressed at the EIS stage of the assessment once the project specific SEARs have been issued.

Further detailed assessment work may involve background noise monitoring at key receivers to determine the applicable criteria in accordance with the NSW Noise Assessment Bulletin. The results of any background noise monitoring would be documented in the Noise Assessment Report prepared to accompany the EIS for the Project.

The NSW Noise Assessment Bulletin specifies additional criteria relating to *special characteristics*, defined as tonality and low frequency. While tonality cannot be readily predicted, in relation to low frequency noise, the bulletin states that:

*Noise assessments for proposed wind energy projects shall assess the potential for non-associated residential receiver locations to experience low frequency noise levels exceeding 60 dB(C).*

Low frequency noise characteristics are highly specific to the turbine being considered, and its assessment can involve detailed modelling using alternative procedures to those used for A-weighted noise levels. In accordance with the NSW Noise Assessment Bulletin, this modelling data is to be provided as part of an application to develop a wind farm. Accordingly, this modelling is to be undertaken and reported at the EIS stage of the assessment.

## 7.0 SUMMARY

A preliminary assessment of operational noise for the proposed Devlins Bridge Wind Farm has been carried out in accordance with the NSW Noise Assessment Bulletin.

The preliminary noise assessment has been prepared based on the current Project design comprising ninety-four (94) multi-megawatt wind turbines.

Noise modelling was carried out based on a candidate wind turbine model, as nominated by the Proponent, with a generation capacity of 7.2 MW and representative of the size and type of wind turbine being considered for the Project.

The results of the noise modelling demonstrate that the Project can be designed and operated to comply with the operational noise requirements of the NSW Noise Assessment Bulletin.

Once the SEARs are issued for this Project, further detailed assessment will be undertaken to support the Project EIS, to be lodged with DPHI. This would include background noise monitoring at key receivers around the Project, revised operational wind turbine noise modelling assessment and other noise considerations, including special noise characteristics, construction, and ancillary infrastructure.

## APPENDIX A GLOSSARY OF TERMINOLOGY

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics - Description measurement and assessment of environmental noise – 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, except as part of a direct quote of third-party information.

Term	Definition	Abbreviation
A-weighting	A method of adjusting sound levels to reflect the human ear’s varied sensitivity to different frequencies of sound.	See discussion above this table.
C- weighting	A method of adjusting sound levels to account for non-linear frequency response of the human ear at high noise levels (typically greater than 100 decibels).	-
A-weighted 90 <sup>th</sup> centile	The A-weighted pressure level that is exceeded for 90 % of a defined measurement period. It is used to describe the underlying background sound level in the absence of a source of sound that is being investigated, as well as the sound level of steady, or semi steady, sound sources.	$L_{A90}$
A-weighted equivalent level	The A-weighted equivalent continuous pressure level.	$L_{Aeq}$
C-weighted equivalent level	The C-weighted equivalent continuous pressure level.	$L_{Ceq}$
Decibel	The unit of sound level.	dB
Hertz	The unit for describing the frequency of a sound in terms of the number of cycles per second.	Hz
Low frequency	A sound with perceptible content in the audible frequency range typically below 200 Hz	-
Octave Band	A range of frequencies. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.	-
Sound power level	A measure of the total sound energy emitted by a source, expressed in decibels.	$L_w$
Sound pressure level	A measure of the level of sound expressed in decibels.	$L_p$
Special characteristics	A term used by the NSW Noise Assessment Bulletin to define sound characteristics that increase the likelihood of adverse reaction to the sound. The characteristics are tonality and low frequency.	-
Tonality	A characteristic to describe sounds which are composed of distinct and narrow groups of audible sound frequencies (e.g. whistling or humming sounds).	-

## APPENDIX B WIND TURBINE COORDINATES

The following table sets out the coordinates of the current proposed wind turbine layout supplied by the Proponent on 25 March 2024.

**Table 7: Wind turbine coordinates – GDA2020 MGA zone 55**

Turbine	Easting, m	Northing, m	Terrain elevation, m
1	435,709	6,160,962	137
2	432,667	6,160,485	136
3	436,471	6,160,462	137
4	431,721	6,160,439	136
5	433,383	6,160,401	136
6	435,625	6,160,363	137
7	434,090	6,160,334	136
8	434,778	6,160,237	137
9	431,633	6,159,659	136
10	432,507	6,159,596	136
11	433,267	6,159,486	136
12	434,000	6,159,420	136
13	434,696	6,159,313	136
14	431,517	6,158,895	135
15	432,414	6,158,804	135
16	433,173	6,158,709	136
17	433,941	6,158,621	136
18	434,615	6,158,471	136
19	435,271	6,158,236	137
20	431,475	6,158,224	134
21	433,011	6,158,062	135
22	432,166	6,158,058	135
23	435,923	6,157,998	137
24	436,533	6,157,811	137
25	434,520	6,157,531	136
26	433,655	6,157,514	136
27	432,081	6,157,475	134
28	435,170	6,157,316	137
29	435,755	6,157,112	137
30	432,077	6,156,948	135

Turbine	Easting, m	Northing, m	Terrain elevation, m
31	432,716	6,156,827	135
32	433,478	6,156,821	136
33	434,292	6,156,711	136
34	434,953	6,156,451	136
35	433,354	6,156,217	135
36	429,850	6,155,971	133
37	434,981	6,155,895	136
38	430,353	6,155,719	133
39	432,448	6,155,670	134
40	433,197	6,155,604	135
41	434,058	6,155,408	135
42	434,897	6,155,305	136
43	429,732	6,155,076	133
44	433,069	6,154,987	134
45	430,377	6,154,934	133
46	434,813	6,154,710	136
47	430,647	6,154,500	134
48	433,852	6,154,335	135
49	431,690	6,154,322	134
50	432,465	6,154,309	134
51	434,404	6,154,021	135
52	430,568	6,153,915	134
53	432,845	6,153,896	134
54	436,009	6,153,723	135
55	435,220	6,153,695	136
56	431,608	6,153,668	135
57	433,407	6,153,632	135
58	434,321	6,153,443	136
59	430,488	6,153,327	134
60	429,614	6,153,264	133
61	432,012	6,153,159	135
62	435,129	6,153,109	135
63	430,834	6,152,898	135

Turbine	Easting, m	Northing, m	Terrain elevation, m
64	432,273	6,152,707	135
65	429,593	6,152,634	133
66	435,029	6,152,520	135
67	431,048	6,152,433	134
68	432,687	6,152,378	134
69	429,893	6,152,209	133
70	431,395	6,152,032	134
71	432,952	6,151,930	134
72	434,871	6,151,886	135
73	430,245	6,151,777	135
74	431,812	6,151,681	134
75	433,340	6,151,608	134
76	433,895	6,151,388	134
77	434,812	6,151,290	135
78	430,671	6,151,269	134
79	431,951	6,151,087	134
80	431,006	6,150,887	133
81	432,458	6,150,786	134
82	433,196	6,150,687	134
83	433,913	6,150,569	135
84	434,636	6,150,522	135
85	431,324	6,150,493	134
86	431,654	6,150,107	134
87	434,951	6,150,102	135
88	435,746	6,149,961	134
89	432,027	6,149,743	134
90	432,726	6,149,643	134
91	433,456	6,149,588	134
92	434,121	6,149,445	134
93	434,846	6,149,355	135
94	435,605	6,149,256	135

## APPENDIX C RECEIVER LOCATIONS

The following table sets out the eighty-six (86) noise sensitive receivers located within 10 km of a proposed wind turbine and considered in the preliminary noise assessment, together with their respective distance to the nearest wind turbine. Data has been provided to MDA by the Proponent on 8 May 2024.

**Table 8: Receiver coordinates – GDA2020 MGA zone 55**

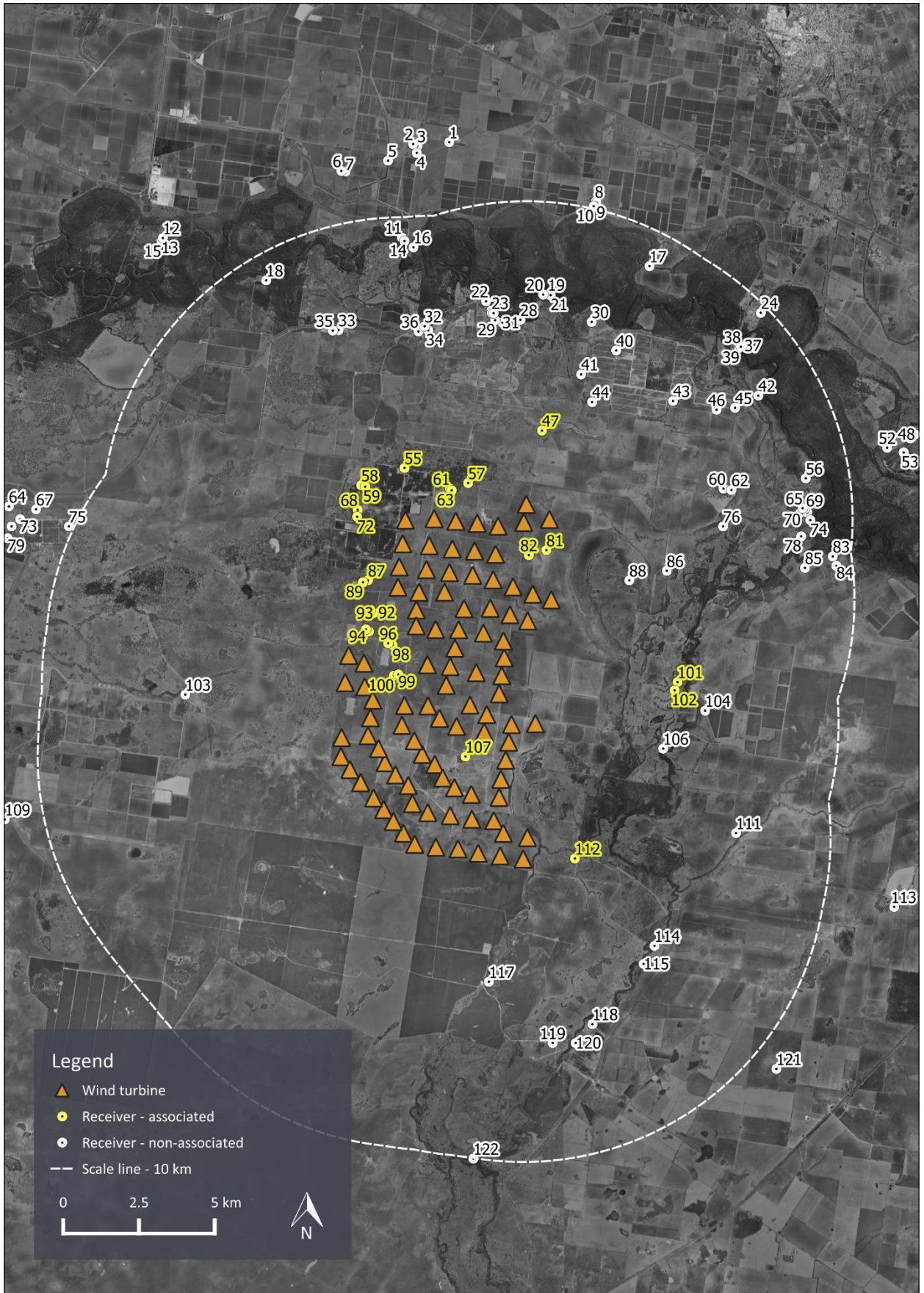
Receiver ID	Easting, m	Northing, m	Terrain elevation, m	Distance to nearest wind turbine, m
<i>Non-associated receiver</i>				
11	431,608	6,169,757	136	9,322
14	431,691	6,169,649	136	9,213
16	431,988	6,169,441	136	8,986
17	439,771	6,168,817	139	8,847
18	427,128	6,168,349	134	9,150
19	436,417	6,167,880	137	6,959
20	436,267	6,167,880	136	6,945
21	436,511	6,167,863	137	6,952
22	434,382	6,167,659	142	6,832
23	434,564	6,167,356	141	6,500
24	443,445	6,167,279	141	9,755
25	434,572	6,167,274	143	6,419
26	434,628	6,167,268	138	6,402
27	434,613	6,167,223	142	6,361
28	435,514	6,167,047	136	6,093
29	434,678	6,167,034	141	6,163
30	437,865	6,166,978	146	6,396
31	434,921	6,166,954	141	6,048
32	432,355	6,166,835	135	6,362
33	429,515	6,166,707	135	6,649
34	432,478	6,166,697	140	6,220
35	429,327	6,166,692	134	6,699
36	432,151	6,166,662	135	6,204
37	442,903	6,166,194	139	8,619
38	442,784	6,166,157	140	8,506
39	442,737	6,166,123	139	8,448
40	438,673	6,166,037	147	5,882

Receiver ID	Easting, m	Northing, m	Terrain elevation, m	Distance to nearest wind turbine, m
41	437,516	6,165,247	138	4,656
42	443,361	6,164,546	140	8,014
43	440,550	6,164,370	142	5,654
44	437,878	6,164,331	138	4,014
45	442,593	6,164,142	144	7,147
46	441,984	6,164,079	141	6,599
56	444,928	6,161,817	148	8,568
60	442,212	6,161,477	141	5,834
62	442,474	6,161,429	141	6,084
65	444,823	6,160,830	143	8,363
66	444,887	6,160,812	142	8,426
69	444,938	6,160,761	142	8,475
70	444,757	6,160,688	142	8,292
71	444,978	6,160,684	145	8,513
74	445,076	6,160,440	144	8,608
76	442,199	6,160,230	140	5,737
78	444,776	6,159,901	150	8,327
80	444,645	6,159,661	146	8,216
83	445,817	6,159,239	145	9,397
84	445,937	6,158,928	143	9,474
85	444,897	6,158,862	144	8,433
86	440,339	6,158,764	140	3,930
88	439,106	6,158,450	139	2,660
103	424,461	6,154,680	132	5,289
104	441,606	6,154,149	139	5,617
106	440,220	6,152,896	138	4,297
111	442,625	6,150,108	140	6,884
114	439,936	6,146,388	141	5,199
115	439,576	6,145,792	137	5,274
117	434,474	6,145,202	135	4,173
118	437,890	6,143,804	136	5,914
119	436,578	6,143,181	136	6,155
120	437,336	6,143,180	135	6,320

Receiver ID	Easting, m	Northing, m	Terrain elevation, m	Distance to nearest wind turbine, m
<i>Associated receiver</i>				
47	436,226	6,163,393	138	2,495
55	431,691	6,162,159	145	1,733
57	433,789	6,161,662	138	1,341
58	430,263	6,161,588	135	1,867
59	430,397	6,161,543	134	1,736
61	433,190	6,161,473	139	1,109
63	433,247	6,161,417	138	1,046
68	430,145	6,160,777	137	1,623
72	430,129	6,160,549	138	1,607
81	436,372	6,159,447	139	1,037
82	435,792	6,159,282	138	1,110
87	430,487	6,158,450	136	1,033
89	430,320	6,158,385	136	1,182
91	430,568	6,157,472	136	1,194
92	430,828	6,157,382	136	1,079
93	430,661	6,157,370	136	1,195
94	430,418	6,156,831	135	1,051
95	430,519	6,156,762	135	1,056
96	431,152	6,156,372	135	1,106
98	431,294	6,156,311	135	1,027
99	431,489	6,155,341	135	1,032
100	431,343	6,155,305	135	1,055
101	440,695	6,155,093	140	4,886
102	440,599	6,154,818	139	4,724
107	433,704	6,152,635	137	1,035
112	437,312	6,149,271	136	1,720

APPENDIX D SITE LAYOUT PLAN

Figure 5: Proposed wind turbine locations and noise sensitive receivers



## APPENDIX E NOISE PREDICTION MODEL

In Australia, wind turbine noise predictions are typically calculated using ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors - Part 2: General method of calculation* (ISO 9613-2:1996) with a set of conservative assumptions tailored to wind farm assessment, as detailed 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* (the UK Institute of Acoustics guidance).

A revised version of the standard, ISO 9613-2:2024<sup>5</sup>, was published earlier in 2024 based on broadly equivalent procedures to ISO 9613-2:1996, subject to refinements, clarifications, and supplementary advice for different types of sources. Notably, ISO 9613-2:2024 introduces an informative annex on wind turbine noise modelling to reflect the recommendations of the UK Institute of Acoustics guidance.

At the date of preparing this report, the revised standard has not yet been implemented in commonly used proprietary noise modelling software options. However, the core elements of the two versions (particularly with respect to wind farm noise modelling), are similar, and proprietary software options already implement the UK Institute of Acoustics guidance with respect to ISO 9613-2:1996.

On this basis ISO 9613-2:1996 continues to be used and referenced in Australia and has been chosen as the most appropriate method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. This method is considered the most robust and widely used international method for the prediction of wind farm noise.

The use of this standard is supported by international research publications, measurement studies conducted by MDA and direct reference to the standard in the South Australia EPA *Wind farms environmental noise guidelines*, NZS 6808:2010 *Acoustics – Wind farm noise* and AS 4959:2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators*.

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

To calculate far-field noise levels according to ISO 9613-2:1996, the noise emissions of each wind turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- Geometric divergence;
- Air absorption;
- Reflecting obstacles;
- Screening;
- Vegetation; and
- Ground reflections.

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<sup>5</sup> ISO 9613-2:2024 *Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors*

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

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

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613-2:1996 when a certain set of input parameters are chosen in combination. Specifically, the studies to date tend to support that the assignment of a ground absorption factor of  $G = 0.5$  for the source, middle and receiver ground regions between a wind farm and a calculation point tends to provide a reliable representation of the upper noise levels expected in practice, when modelled in combination with other key assumptions; specifically all wind turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 °C and relative humidity of 70 % to 80 %, with specific adjustments for screening and ground effects as a result of the ground terrain profile.

In support of the use of ISO 9613-2:1996 and the choice of  $G = 0.5$  as an appropriate ground characterisation, the following references are noted:

- A factor of  $G = 0.5$  is frequently applied in Australia for general environmental noise modelling purposes as a way of accounting for the potential mix of ground porosity which may occur in regions of dry/compacted soils or in regions where persistent damp conditions may be relevant
- NZS 6808:2010 refers to ISO 9613-2:1996 as an appropriate prediction method for wind farm noise, and notes that soft ground conditions should be characterised by a ground factor of  $G = 0.5$
- In 1998, a comprehensive study (commonly cited as the Joule Report), part funded by the European Commission found that the ISO 9613-2:1996 model provided a robust representation of upper noise levels which may occur in practice and provided a closer agreement between predicted and measured noise levels than alternative standards such as CONCAWE and ENM. Specifically, the report indicated the ISO 9613-2:1996 method generally tends to marginally over predict noise levels expected in practice
- The UK Institute of Acoustics journal dated March/April 2009 published a joint agreement between practitioners in the field of wind farm noise assessment (the UK IOA 2009 joint agreement), including consultants routinely employed on behalf of both developers and community opposition groups, and indicated the ISO 9613-2:1996 method as the appropriate standard and specifically designated  $G = 0.5$  as the appropriate ground characterisation. This agreement was subsequently reflected in the recommendations detailed in the UK Institute of Acoustics guidance. It is noted that these publications refer to predictions made at receiver heights of 4 m. Predictions in Australia are generally based on a lower prediction height of 1.5 m which tends to result in higher ground attenuation for a given ground factor, however conversely, predictions in Australia do not generally incorporate a -2 dB factor (as applied in the UK) to represent the relationship between  $L_{Aeq}$  and  $L_{A90}$  noise levels. The result is that these differences tend to balance out to a comparable approach and thus supports the use of  $G = 0.5$  in the context of Australian prediction methods.

A range of measurement and prediction studies<sup>6,7,8</sup> for wind farms in which MDA staff have been associated in have provided further support for the use of ISO 9613-2:1996 and  $G = 0.5$  as an appropriate representation of typical upper noise levels expected to occur in practice.

The findings of these studies demonstrate the suitability of ISO 9613-2:1996 method to predict the propagation of wind turbine noise for:

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

In addition to the choice of ground factor referred to above, adjustments to ISO 9613-2:1996 for screening and valleys effects are applied based on recommendations of the Joule Report, UK IOA 2009 joint agreement and the UK Institute of Acoustics guidance. The following adjustments are applied to the calculations:

- Screening effects as a result of terrain are limited to 2 dB;
- Screening effects are assessed based on each wind turbine being represented by a single noise source located at the maximum tip height of the wind turbine rotor; and
- An adjustment of 3 dB is added to the predicted noise contribution of a wind turbine if the terrain between the wind turbine and receiver in question is characterised by a significant valley. A significant valley is defined as a situation where the mean sound propagation height is at least 50 % greater than it would be otherwise over flat ground.

The adjustments detailed above are implemented in the wind turbine calculation procedure of the SoundPLANnoise 9.0 software used to conduct the noise modelling. The software uses these definitions in conjunction with the digital terrain model of the Project and surrounds to evaluate the path between each wind turbine and receiver pairing, and then subsequently applies the adjustments to each wind turbine's predicted noise contribution where appropriate.

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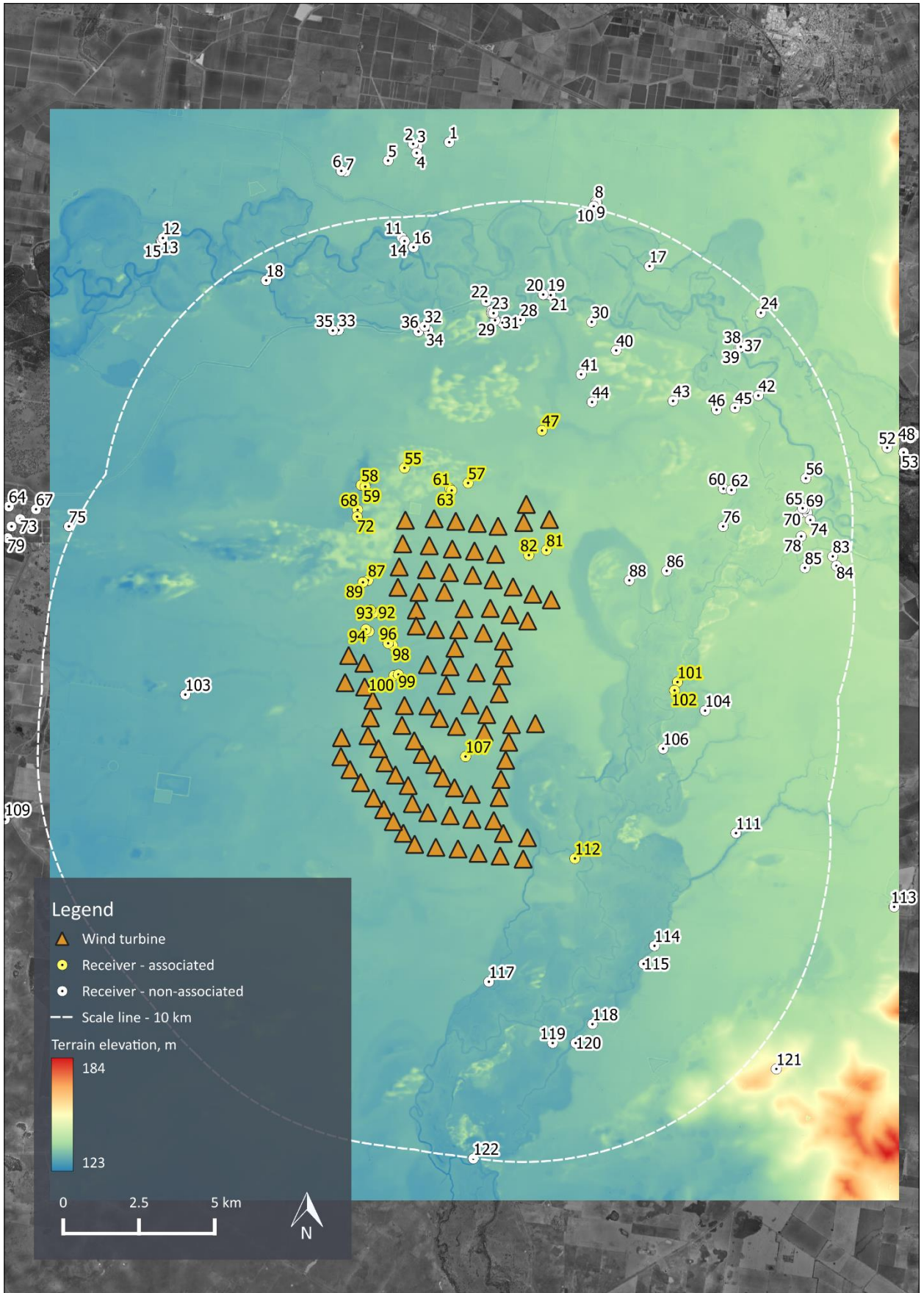
<sup>6</sup> Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions: The Risks of Conservatism*; Presented at the Second International Meeting on Wind Turbine Noise in Lyon, France September 2007.

<sup>7</sup> Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions and Comparisons with Measurements*; Presented at the Third International Meeting on Wind Turbine Noise in Aalborg, Denmark June 2009.

<sup>8</sup> Delaire, Griffin, & Walsh – *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*; Presented at the Fourth International Meeting on Wind Turbine Noise in Rome, April 2011.

APPENDIX F SITE TOPOGRAPHY

Figure 6: Terrain elevation map for the Project and surrounding area



## APPENDIX G C-WEIGHTING ASSESSMENT

### G1 Introduction

Presented below are details of the risk assessment carried out for the purpose of gauging whether penalties for low frequency, as detailed in the NSW Noise Assessment Bulletin, are applicable.

### G2 Assessment requirement

The following excerpt concerning C-weighted wind turbine noise have been reproduced from NSW Noise Assessment Bulletin.

#### ***Low Frequency Noise***

*The presence of excessive low frequency noise (a special noise characteristic) [ie noise from the wind farm that is repeatedly greater than 65 dBC during day time or 60 dBC during the night-time at any relevant receiver] will incur a 5 dB(A) penalty, to be added to the measured noise level for the wind farm, unless a detailed internal low frequency noise assessment demonstrates compliance with the proposed criteria for the assessment of low frequency noise disturbance (UK Department for Environment, Food and Rural Affairs (DEFRA, 2005) for a steady noise source.*

### G3 Prediction method

As stated in Section 5.1.2, there are no commonly used, practical methods to accurately predict the wind turbine low frequency noise levels at receptor locations.

In this case, the C-weighted noise levels at receptor locations have been estimated using a simplified approach which constitutes the same noise modelling methods as described above for A-weighted levels, but with the following modifications:

- The range of band frequencies has been expanded to include bands down to the 12.5 Hz frequency band; and
- The ground absorption parameter has been set to  $G = 0$  (hard ground) to account for the increased influence of ground reflections at low frequencies.

C-weighted noise levels have been predicted for the worst-case hub height wind speed in terms of C weighted levels being 12 m/s.

**G4 Results**

Table 9 presents the results of the preliminary C-weighted noise predictions for identified non-associated receivers within 10 km of a wind turbine.

**Table 9: Predicted C-weighted noise levels**

Receiver ID	Predicted noise level, dB L <sub>Ceq</sub>
<i>Non-associated receiver</i>	
11	50.3
14	50.4
16	50.5
17	50.0
18	50.3
19	51.4
20	51.5
21	51.4
22	51.8
23	52.1
24	49.5
25	52.1
26	50.7
27	52.2
28	52.2
29	52.3
30	51.7
31	52.3
32	52.2
33	52.0
34	52.6
35	51.9
36	52.6
37	50.2
38	50.2
39	50.3
40	52.1
41	53.2
42	50.7

Receiver ID	Predicted noise level, dB L <sub>ceq</sub>
43	52.2
44	53.8
45	51.2
46	51.6
56	50.7
60	52.5
62	52.4
65	51.0
66	51.0
69	51.0
70	50.6
71	50.5
74	51.0
76	53.0
78	51.3
80	51.4
83	50.8
84	50.7
85	51.4
86	55.1
88	56.7
103	54.2
104	54.1
106	54.8
111	52.7
114	53.0
115	52.8
117	54.6
118	52.3
119	52.2
120	52.0

**APPENDIX H TABULATED PREDICTED NOISE LEVEL DATA**

**Table 10: Predicted noise levels, dB L<sub>Aeq</sub>, for receivers within 10 km of a wind turbine**

Receiver	Hub-height wind speed, m/s								
	4	5	6	7	8	9	10	11	≥12
<i>Non-associated receiver</i>									
11	12.1	15.5	19.1	22.5	23.8	23.8	23.8	23.8	23.8
14	12.2	15.6	19.2	22.6	23.9	23.9	23.9	23.9	23.9
16	12.4	15.8	19.4	22.8	24.1	24.1	24.1	24.1	24.1
17	11.7	15.1	18.7	22.1	23.4	23.4	23.4	23.4	23.4
18	12.0	15.4	19.0	22.4	23.7	23.7	23.7	23.7	23.7
19	13.8	17.2	20.8	24.2	25.5	25.5	25.5	25.5	25.5
20	13.8	17.2	20.8	24.2	25.5	25.5	25.5	25.5	25.5
21	13.8	17.2	20.8	24.2	25.5	25.5	25.5	25.5	25.5
22	14.4	17.8	21.4	24.8	26.1	26.1	26.1	26.1	26.1
23	14.7	18.1	21.7	25.1	26.4	26.4	26.4	26.4	26.4
24	10.9	14.3	17.9	21.3	22.6	22.6	22.6	22.6	22.6
25	14.8	18.2	21.8	25.2	26.5	26.5	26.5	26.5	26.5
26	13.5	16.9	20.5	23.9	25.2	25.2	25.2	25.2	25.2
27	14.9	18.3	21.9	25.3	26.6	26.6	26.6	26.6	26.6
28	14.9	18.3	21.9	25.3	26.6	26.6	26.6	26.6	26.6
29	15.1	18.5	22.1	25.5	26.8	26.8	26.8	26.8	26.8
30	14.2	17.6	21.2	24.6	25.9	25.9	25.9	25.9	25.9
31	15.2	18.6	22.2	25.6	26.9	26.9	26.9	26.9	26.9
32	15.1	18.5	22.1	25.5	26.8	26.8	26.8	26.8	26.8
33	14.5	17.9	21.5	24.9	26.2	26.2	26.2	26.2	26.2
34	15.5	18.9	22.5	25.9	27.2	27.2	27.2	27.2	27.2
35	14.4	17.8	21.4	24.8	26.1	26.1	26.1	26.1	26.1
36	15.4	18.8	22.4	25.8	27.1	27.1	27.1	27.1	27.1
37	11.9	15.3	18.9	22.3	23.6	23.6	23.6	23.6	23.6
38	12.0	15.4	19.0	22.4	23.7	23.7	23.7	23.7	23.7
39	12.0	15.4	19.0	22.4	23.7	23.7	23.7	23.7	23.7
40	14.8	18.2	21.8	25.2	26.5	26.5	26.5	26.5	26.5
41	16.5	19.9	23.5	26.9	28.2	28.2	28.2	28.2	28.2
42	12.5	15.9	19.5	22.9	24.2	24.2	24.2	24.2	24.2

Receiver	Hub-height wind speed, m/s								
	4	5	6	7	8	9	10	11	≥12
43	14.9	18.3	21.9	25.3	26.6	26.6	26.6	26.6	26.6
44	17.5	20.9	24.5	27.9	29.2	29.2	29.2	29.2	29.2
45	13.4	16.8	20.4	23.8	25.1	25.1	25.1	25.1	25.1
46	13.9	17.3	20.9	24.3	25.6	25.6	25.6	25.6	25.6
56	12.6	16.0	19.6	23.0	24.3	24.3	24.3	24.3	24.3
60	15.3	18.7	22.3	25.7	27.0	27.0	27.0	27.0	27.0
62	15.0	18.4	22.0	25.4	26.7	26.7	26.7	26.7	26.7
65	13.0	16.4	20.0	23.4	24.7	24.7	24.7	24.7	24.7
66	12.9	16.3	19.9	23.3	24.6	24.6	24.6	24.6	24.6
69	12.9	16.3	19.9	23.3	24.6	24.6	24.6	24.6	24.6
70	12.6	16.0	19.6	23.0	24.3	24.3	24.3	24.3	24.3
71	12.5	15.9	19.5	22.9	24.2	24.2	24.2	24.2	24.2
74	12.9	16.3	19.9	23.3	24.6	24.6	24.6	24.6	24.6
76	15.8	19.2	22.8	26.2	27.5	27.5	27.5	27.5	27.5
78	13.3	16.7	20.3	23.7	25.0	25.0	25.0	25.0	25.0
80	13.5	16.9	20.5	23.9	25.2	25.2	25.2	25.2	25.2
83	12.5	15.9	19.5	22.9	24.2	24.2	24.2	24.2	24.2
84	12.5	15.9	19.5	22.9	24.2	24.2	24.2	24.2	24.2
85	13.4	16.8	20.4	23.8	25.1	25.1	25.1	25.1	25.1
86	19.0	22.4	26.0	29.4	30.7	30.7	30.7	30.7	30.7
88	21.6	25.0	28.6	32.0	33.3	33.3	33.3	33.3	33.3
103	17.7	21.1	24.7	28.1	29.4	29.4	29.4	29.4	29.4
104	17.4	20.8	24.4	27.8	29.1	29.1	29.1	29.1	29.1
106	18.7	22.1	25.7	29.1	30.4	30.4	30.4	30.4	30.4
111	15.3	18.7	22.3	25.7	27.0	27.0	27.0	27.0	27.0
114	16.0	19.4	23.0	26.4	27.7	27.7	27.7	27.7	27.7
115	15.8	19.2	22.8	26.2	27.5	27.5	27.5	27.5	27.5
117	18.7	22.1	25.7	29.1	30.4	30.4	30.4	30.4	30.4
118	15.0	18.4	22.0	25.4	26.7	26.7	26.7	26.7	26.7
119	14.9	18.3	21.9	25.3	26.6	26.6	26.6	26.6	26.6
120	14.6	18.0	21.6	25.0	26.3	26.3	26.3	26.3	26.3

Receiver	Hub-height wind speed, m/s								
	4	5	6	7	8	9	10	11	≥12
<i>Associated receiver</i>									
47	20.9	24.3	27.9	31.3	32.6	32.6	32.6	32.6	32.6
55	24.4	27.8	31.4	34.8	36.1	36.1	36.1	36.1	36.1
57	27.7	31.1	34.7	38.1	39.4	39.4	39.4	39.4	39.4
58	23.3	26.7	30.3	33.7	35.0	35.0	35.0	35.0	35.0
59	23.8	27.2	30.8	34.2	35.5	35.5	35.5	35.5	35.5
61	28.7	32.1	35.7	39.1	40.4	40.4	40.4	40.4	40.4
63	29.0	32.4	36.0	39.4	40.7	40.7	40.7	40.7	40.7
68	24.8	28.2	31.8	35.2	36.5	36.5	36.5	36.5	36.5
72	25.2	28.6	32.2	35.6	36.9	36.9	36.9	36.9	36.9
81	29.5	32.9	36.5	39.9	41.2	41.2	41.2	41.2	41.2
82	31.0	34.4	38.0	41.4	42.7	42.7	42.7	42.7	42.7
87	29.1	32.5	36.1	39.5	40.8	40.8	40.8	40.8	40.8
89	28.3	31.7	35.3	38.7	40.0	40.0	40.0	40.0	40.0
91	29.2	32.6	36.2	39.6	40.9	40.9	40.9	40.9	40.9
92	30.1	33.5	37.1	40.5	41.8	41.8	41.8	41.8	41.8
93	29.5	32.9	36.5	39.9	41.2	41.2	41.2	41.2	41.2
94	29.7	33.1	36.7	40.1	41.4	41.4	41.4	41.4	41.4
95	30.0	33.4	37.0	40.4	41.7	41.7	41.7	41.7	41.7
96	31.0	34.4	38.0	41.4	42.7	42.7	42.7	42.7	42.7
98	31.2	34.6	38.2	41.6	42.9	42.9	42.9	42.9	42.9
99	32.2	35.6	39.2	42.6	43.9	43.9	43.9	43.9	43.9
100	32.3	35.7	39.3	42.7	44.0	44.0	44.0	44.0	44.0
101	18.7	22.1	25.7	29.1	30.4	30.4	30.4	30.4	30.4
102	18.8	22.2	25.8	29.2	30.5	30.5	30.5	30.5	30.5
107	33.2	36.6	40.2	43.6	44.9	44.9	44.9	44.9	44.9
112	24.3	27.7	31.3	34.7	36.0	36.0	36.0	36.0	36.0