MARSHALL DAY Acoustics

RYAN CORNER WIND FARM
PRE-CONSTRUCTION NOISE ASSESSMENT

Rp 003 R03 20180786 | 10 June 2021

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EXECUTIVE SUMMARY

This report presents the results of an updated assessment of operational wind turbine noise for the approved Ryan Corner Wind Farm (the wind farm) that is being developed by Global Power Generation Australia Pty Ltd (GPG).

The amended planning permit for the wind farm issued 21 December 2017 allows for the development of fifty-six (56) wind turbines with an overall height of up to 180 m above ground level, and related on-site infrastructure.

Condition 31 of the planning permit requires the operation of the wind farm to comply with the noise criteria specified in NZS 6808:2010 *Acoustics – Wind farm noise*, consistent with current wind farm noise guidelines in Victoria.

A noise assessment in accordance with NZS 6808:2010 was prepared in 2017 to accompany the application to amend the planning permit for the wind farm. The 2017 noise assessment was based on three (3) candidate wind turbines which were representative of the size and type of turbine being considered for the project. GPG have since nominated a preferred turbine model for the site and elected to revise the layout considered in the 2017 noise assessment by removing four (4) turbines, and slightly relocating thirteen (13) turbines. GPG therefore commissioned this report to update the operational noise compliance assessment for the preferred turbine selection and the revised turbine layout.

The updated assessment has been carried out on the basis of the proposed layout comprising fifty-two (52) Vestas V136-4.2MW wind turbines with a hub height of 112 m.

Vestas performance specifications for the V136-4.2MW were provided as the basis for the assessment, comprising noise emissions data based on results in accordance with IEC 61400-11:2012 *Wind turbines – Part 11: Acoustic noise measurement techniques* (IEC 61400-11:2012) for a range of configurations of the turbine. The standard power optimised configuration of the turbine has been selected for the Ryan Corner Wind Farm, which incorporates serrated turbine blades and does not utilise sound management modes. The noise emission data for the standard configuration is consistent with the range of values expected for the class of turbine being installed at the site.

The noise emission data has been used with international standard ISO 9613-2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613-2) to predict the level of noise expected occur at neighbouring sensitive receiver locations. The ISO 9613-2 standard has been applied on the basis of well-established input choices and adjustments, based on research and international guidance, that are specific to wind farm noise assessment.

The results of the noise predictions for the Ryan Corner Wind Farm demonstrate that the predicted noise levels for the preferred turbine model and revised wind farm layout achieve the noise limits defined in the planning permit for the Ryan Corner Wind Farm.

The updated noise assessment therefore demonstrates that the Ryan Corner Wind Farm is expected to comply with the operational noise requirements of the planning permit.

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1.0 INTRODUCTION

This report presents the results of a pre-development operational noise assessment for the approved Ryan Corner Wind Farm.

The Ryan Corner Wind Farm (the wind farm) is a consented project located in Moyne Shire, near the township of Port Fairy, Victoria. The planning permit for the wind farm includes conditions which specify requirements for the control of environment noise associated with the project.

The planning permit[1] for the wind farm allows for the use and development of a wind energy facility comprising a maximum of fifty-six (56) wind turbines and associated on-site infrastructure, subject to a set of conditions relating to matters including environmental noise levels.

Marshall Day Acoustics (MDA) prepared a noise assessment report in 2017[2] (the 2017 noise assessment) to accompany the application to amend the planning permit for the wind farm. The 2017 noise assessment was prepared in accordance with NZS 6808:2010[3], as required by the Victorian Government's *Development of Wind Energy Facilities in Victoria – Policy and Planning Guidelines* (current version dated March 2019).

Global Power Generation Australia Pty Ltd (GPG) is developing the wind farm and have nominated a preferred turbine for the site and revised the layout considered in the 2017 noise assessment by removing four (4) turbines, and slightly relocating thirteen (13) turbines. GPG has therefore commissioned this report to address these changes and provide an updated pre-construction noise assessment.

The updated noise assessment presented in this report is based on:

- Operational noise limits derived in accordance with the planning permit
- Predicted noise levels for the proposed Ryan Corner Wind Farm design comprising a revised layout of fifty-two (52) Vestas V136-4.2MW wind turbines with rated power 4.2 MW per turbine
- A comparison of the predicted noise levels with the criteria derived in accordance with NZS 6808:2010 as specified in the planning permit.

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

Throughout this report, the term receiver refers to noise sensitive locations, comprising any dwelling existing on land in the vicinity of the proposed wind energy facility as of 28 February 2017 as stated in the planning permit.

This report makes reference to the most recent background noise monitoring carried out at the site, as documented in the background noise report[4]. The background noise report was prepared as a standalone document detailing background noise levels and derived noise limits which can be referenced in other noise assessment documentation, as required (including the noise assessment presented herein, and subsequently, in any post-construction noise assessment reports).

[1] Planning Permit No.: 20060222-A as amended 21 December 2017

[2] MDA report Rp 001 R02 2014362ML dated 21 April 2017

[3] New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* (NZS6808:2010)

[4] MDA report Rp 002 R03 20180786 dated 10 June 2021

2.0 PROJECT DESCRIPTION

2.1 Overview

The Ryan Corner Wind Farm is to comprise fifty-two (52) wind turbines, extending over an area spanning approximately 6 km from north to south and 4 km east to west.

The proposed layout corresponds to the endorsed layout of the wind farm, as accounted for in the 2017 noise assessment report, revised by the removal of four (4) turbines (B35, B39, B41 and B47), and the relocation of thirteen (13) turbines (B8, B10, B15, B16, B17, B18, B20, B21, B22, B25, B31, B63 and B70). The coordinates of the proposed turbine locations are tabulated in Appendix B.

A total of one hundred and fifty-seven (157) receivers within 5 km of the proposed turbines were identified[5] as existing dwellings as of 28 February 2017 (as referenced in the planning permit) to consider in the noise assessment, comprising:

- One hundred and forty-nine (149) dwellings located outside of the wind farm site boundary, which are collectively referred to as noise sensitive locations (receivers)
- Nine (9) dwellings where a noise agreement exists between the landowner and the proponent, six (6) of which are located within the wind farm site boundary, these are collectively referred to as *stakeholder receivers* herein.

In accordance with Section 2.4 of NZS 6808:2010, noise sensitive locations are defined as follows:

> *The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site.*

Accordingly, noise limits determined in accordance with the standard do not apply to the six (6) stakeholder receivers located within the wind farm site boundary.

The coordinates of the receivers are tabulated in Appendix C.

Site layout plans illustrating the turbine layout, receiver locations, and terrain elevations are provided in Appendix D.

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[5] Data provided by consultants ERM on 31 May 2021

2.2 Wind turbine model

The wind farm is to comprise fifty-two (52) Vestas V136-4.2MW wind turbines with a rotor diameter of 136 m and a hub height of 112 m.

The Vestas V136-4.2MW model is a variable speed wind turbine, with the speed of rotation and the amount of power generated by the turbines being regulated by control systems which vary the pitch of the turbine blades (the angular orientation of the blade relative to its axis).

The standard power optimised configuration of the turbine has been selected for the Ryan Corner Wind Farm, which incorporates serrated turbine blades and does not utilise sound management modes.

Details of the proposed wind turbines are provided in Table 1.

Table 1: Proposed wind turbine model

Detail	Description
Make	Vestas
Model	V136
Rated power	4.2 MW
Rotor diameter	136 m
Hub height	112 m
Tip height	180 m
Blade orientation	Upwind
Turbine regulation method	Variable blade pitch
Cut-in wind speed (hub height)	3.0 m/s
Rated power wind speed (hub height)	13.0 m/s
Cut-out wind speed (hub height)	25.0 m/s

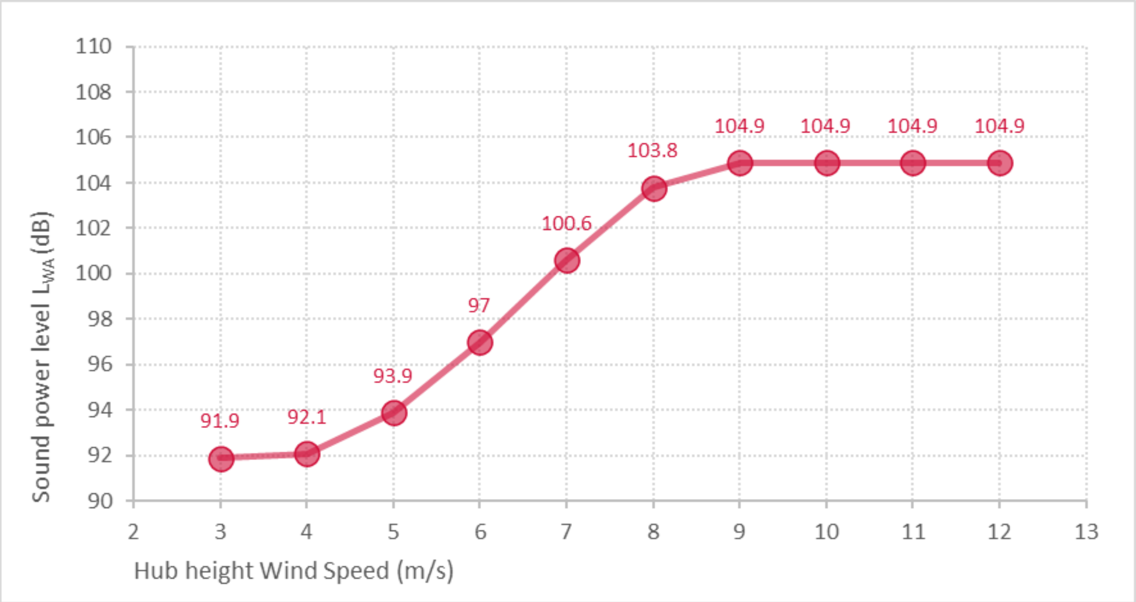
2.3 Wind turbine noise emissions

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 turbine and is distinct from the sound pressure level which depends on a range of factors such as the distance from the turbine.

Sound power level data for the proposed turbine model were sourced from Vestas document *V136-4.0/4.2 MW Third octave noise emission (Document no. DMS 0067-4732 V03)* dated 3 March 2018 (data supplied by ERM on behalf of GPG on 10 September 2020). The sound power data has been adjusted by the addition of +1.0 dB at each wind speed to provide a margin for typical values of test uncertainty.

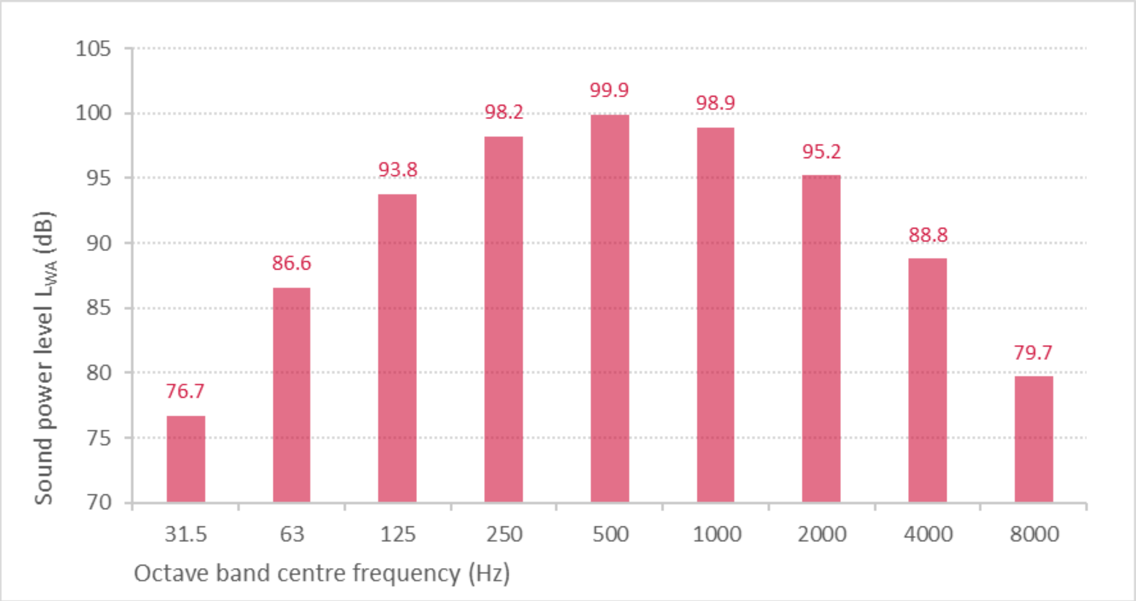
The sound power levels referenced in this assessment (including the +1 dB adjustment) for the standard configuration of the turbine (PO1 operating mode with serrated trailing edge – sound management modes not utilised), are summarised in Figure 1 and represent the total emissions of the turbines, including the secondary contribution of ancillary plant associated with the turbines (e.g. cooling fans).

Figure 1: Vestas V136-4.2MW sound power level versus hub height wind speed, dB L_{WA}



Frequency spectrum data is available for a range of wind speeds (3 m/s to 20 m/s) for the Vestas V136-4.2MW turbine. The data was reviewed to identify the spectrum which would result in the highest predicted noise levels, which typically occurs when the sum of the noise levels in the 31.5 Hz to 250 Hz octave bands is highest. For the Vestas V136-4.2MW turbine, this spectrum occurs at 18 m/s. The reference spectrum used as the basis for this assessment is illustrated in Figure 2, and corresponds to the highest overall sound power level of 104.9 dB L_{WA} (including the +1 dB adjustment) presented in Figure 1.

Figure 2: Vestas V136-4.2MW assessment sound power level spectrum, dB L_{WA}



The sound power levels illustrated in Figure 1 and Figure 2 are considered typical of the upper range of noise emissions associated with comparable multi-megawatt wind turbines.

Test emission data indicating tonal audibility levels (for the Vestas V136-4.2MW turbine were sourced from Vestas document titled *V136-4.2 MW 50 Hz, PO1, 230933 – Results of acoustic noise measurements according to IEC 61400-11 Edition 3.0* (Report No.: 10161571-A-1-A dated 9 September 2019), supplied by ERM on behalf of GPG on 22 October 2020.

The results are reproduced in Table 2.

Table 2: Measured tonal audibility and corresponding frequency

Hub height wind speed (m/s)	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**	**10.5**	**11.0**	**11.5**
Tonal audibility, dB $\Delta L_{a,k}$	1.30	0.10	0.03	-0.75	-0.17	-1.23	-1.14	-2.91
Frequency, Hz	121	2185	1389	2187	2191	2190	2186	2193

The data presented in Table 2 indicates very low tonal audibility values determined from sound power level testing in proximity of the turbines (i.e. less than 200 m from a turbine). Tonal audibility levels at greater distances from the turbines, corresponding to the location of receivers, are generally lower than those measured close to the turbines. This is particularly the case for higher frequency tones (e.g. tones above 1000 Hz) which attenuate rapidly with distance as a result of the effects of atmospheric absorption. Accordingly, based on the data in Table 2, tonality is not expected to be a characteristic of the wind farm at receiver locations. Further, the occurrence of tonality in the noise emissions of contemporary multi-megawatt turbine designs is generally limited. Adjustments for tonality have therefore not been applied to the predicted noise levels presented in this assessment.

3.0 ASSESSMENT CRITERIA

3.1 Planning permit

Conditions 31 to 34 of the planning permit[6] for the Ryan Corner Wind Farm establish requirements relevant to operational noise associated with the project.

A brief summary of the conditions is provided in Table 3 below. Full details of the conditions are reproduced in Appendix E.

Table 3: Planning Permit – summary of operational noise related requirements

Condition	Summary Requirement
31	Specifies the criteria that operational wind farm noise must comply with at receivers, specifies exemptions for dwellings where an agreement exists between a land owner and the project developer, and specifies the application of penalties for special audible characteristics.
32	Establishes a requirement and time frame for post-construction noise assessments to be undertaken following commissioning of the first turbine.
33	Establishes a requirement for post-construction noise monitoring results to be forwarded to the Minister for Planning within a set time frame following commissioning of the first turbine of the wind farm.
34	Establishes a requirement for the post-construction noise compliance reports to be accompanied by a report from an environmental auditor.

The planning permit refers to NZS 6808:2010 as the applicable standard for:

- the measurement and analysis of background noise levels; and
- the measurement, rating and assessment of operational wind farm noise levels, including the assessment of any special audible characteristics associated with the sound of the wind farm.

[6] Planning permit No.: 20060222-A as amended 21 December 2017

3.2 Operational noise criteria

Condition 31(a) of the planning permit specifies the operational noise criteria in accordance with NZS 6808:2010 as 40 dB or the background L_{A90} + 5 dB, whichever is higher.

At the time of preparing the 2017 noise assessment, which accompanied the application to amend the planning permit for the wind farm, an updated background noise survey was yet to be undertaken (the available data at the time was collected in 2006 in accordance with the now superseded version of the New Zealand Standard, NZS 6808:1998). Accordingly, in lieu of updated background noise data at that time, a conservative assessment was presented on the basis of the minimum limit of 40 dB.

In the time since the 2017 noise assessment was prepared, an updated background noise survey was completed in 2020. The updated background noise levels were measured at multiple receiver locations in the vicinity of the wind farm for the purpose of setting noise criteria in accordance with the planning permit. The results are documented in the background noise report, which also details the applicable noise limits determined in accordance with the planning permit. The noise limits detailed in Section 3.2 of the background noise report are reproduced in Table 4 and Table 5.

Table 4: All-time period operational wind farm noise limits, dB L_{A90}

Location	Hub height wind speed (m/s) [1]												
	3	4	5	6	7	8	9	10	11	12	13	14	15
10	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.7	42.4	44.4	46.5	48.8	51.4
26	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.8	42.8	45.1	47.6	50.2
27	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8	44.0	46.3	48.8	51.5
29	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	43.3	45.3	47.5	49.8	52.3
31	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.2	43.0	44.9	47.0	49.3

Note 1: 112 m above ground level at 596543 m E, 5762211 N (AGD66 Zone 54)

Table 5: Night-time period operational wind farm noise limits, dB L_{A90}

Location	Hub height wind speed (m/s) [1]												
	3	4	5	6	7	8	9	10	11	12	13	14	15
7	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.5	43.3	45.3	47.5
10	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.0	43.1	45.4	48.1	51.2
11	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.8	44.7	47.8
26	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.7	44.5	47.6
27	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.5	43.5	46.7	50.2
29	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.4	44.2	47.4	50.8
31	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.9	43.1	45.5

Note 1: 112 m above ground level at 596543 m E, 5762211 N (AGD66 Zone 54)

In accordance with the planning permit and NZS 6808:2010, the noise criteria do not apply at stakeholder receivers where an agreement exists between a landowner and the proponent.

4.0 NOISE PREDICTION METHODOLOGY

Operational wind farm noise levels have been predicted on the basis of:

- The noise emissions of the Vestas V136-4.2MW wind turbines as outlined in Section 2.3
- A 3D digital model of the site and the surrounding environment
- International standards used for the calculation of environmental sound propagation, with input settings and adjustments specifically suited to wind farm noise assessment.

The prediction method is consistent with the guidance provided by NZS 6808:2010, as referenced in the planning permit, and the prediction method used for the 2017 noise assessment report. This method has been shown to provide a reliable method of predicting the upper level of noise expected in practice.

The noise prediction method is summarised in Table 6 below.

Table 6: Downwind prediction methodology

Detail	Description
Software	Proprietary noise modelling software SoundPLAN version 8.2
Method	International Standard ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation* (ISO 9613-2). Adjustments to the ISO 9613-2 method are applied on the basis of the guidance contained in the 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). The adjustments are applied within the SoundPLAN modelling software and relate to the influence of terrain screening and ground effects on sound propagation. Specific details of adjustments are noted below. Further discussion of the prediction method is provided in Appendix F.
Source characterisation	Each wind turbine is modelled as a point source of sound. The total sound of the wind farm is then calculated on the basis of simultaneous operation of all wind turbines and summing the contribution of each. Calculations of 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 turbine. Calculations of terrain related screening are made on the basis of the point source being located at the maximum tip height of each turbine. Further discussion of terrain screening effects is provided below.
Terrain data	10 m interval contour data, as referenced in the 2017 noise assessment report
Terrain effects	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 F. Valley effects: + 3dB 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 turbine and calculation point is 50 % greater than would occur if the ground was flat. Terrain screening effects: only calculated if the terrain blocks line of sight between the maximum tip height of the turbine and the calculation point. The value of the screening effect is limited to a maximum value of 2 dB.

Detail	Description
Ground conditions	Ground factor of G = 0.5 on the basis of the UK good practice guide and research outlined in Appendix F. The ground around the site corresponds to acoustically soft conditions (G=1) according to ISO 9613-2. The adopted value of G = 0.5 assumes that 50 % of the ground cover is acoustically hard (G = 0) to account for variations in ground porosity and provide a cautious representation of ground effects.
Atmospheric conditions	Temperature 10 ^{o}C and relative humidity 70 % 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. The calculations are based on sound speed profiles[7] which increase the propagation of sound from each turbine to each receiver location, whether as a result of thermal inversions or wind directed toward each calculation point.
Receiver heights	1.5 m above ground level

[7] The sound speed profile defines the rate of change in the speed of sound with increasing height above ground

5.0 ASSESSMENT

This section of the report presents the predicted noise levels of the Ryan Corner Wind Farm at surrounding receivers, and an assessment of compliance with the applicable noise limits.

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.

The receiver locations where operational wind farm noise levels are predicted to be higher than 35 dB L_{A90} are listed in Table 7, along with the predicted noise levels when the wind farm's noise emissions have reached their highest level (corresponding to hub-height wind speeds of 9 m/s and above). The location of the predicted 35 dB and 40 dB L_{A90} noise contours is illustrated in Figure 3.

Table 7: Predicted noise level at receivers on or within the 35 dB L_{A90} predicted noise contour

Receiver	Highest predicted noise level dB L_{A90}	Compliance with NZS 6808:2010 base noise limit of 40 dB L_{A90}
6	35.1	Yes
7	36.5	Yes
8 (S)	39.0	Not applicable
10	36.9	Yes
11	37.2	Yes
26	37.2	Yes
27	37.0	Yes
28 (S)	39.0	Not applicable
29	36.9	Yes
30 (S)	36.2	Not applicable
31	35.7	Yes
32	35.3	Yes
78 (S)	39.5	Not applicable
79 (S)	38.6	Not applicable
113	35.8	Yes

(S) Stakeholder receiver

The results presented in Table 7 demonstrate that the predicted noise levels are below the minimum limit of 40 dB at all non-stakeholder receivers.

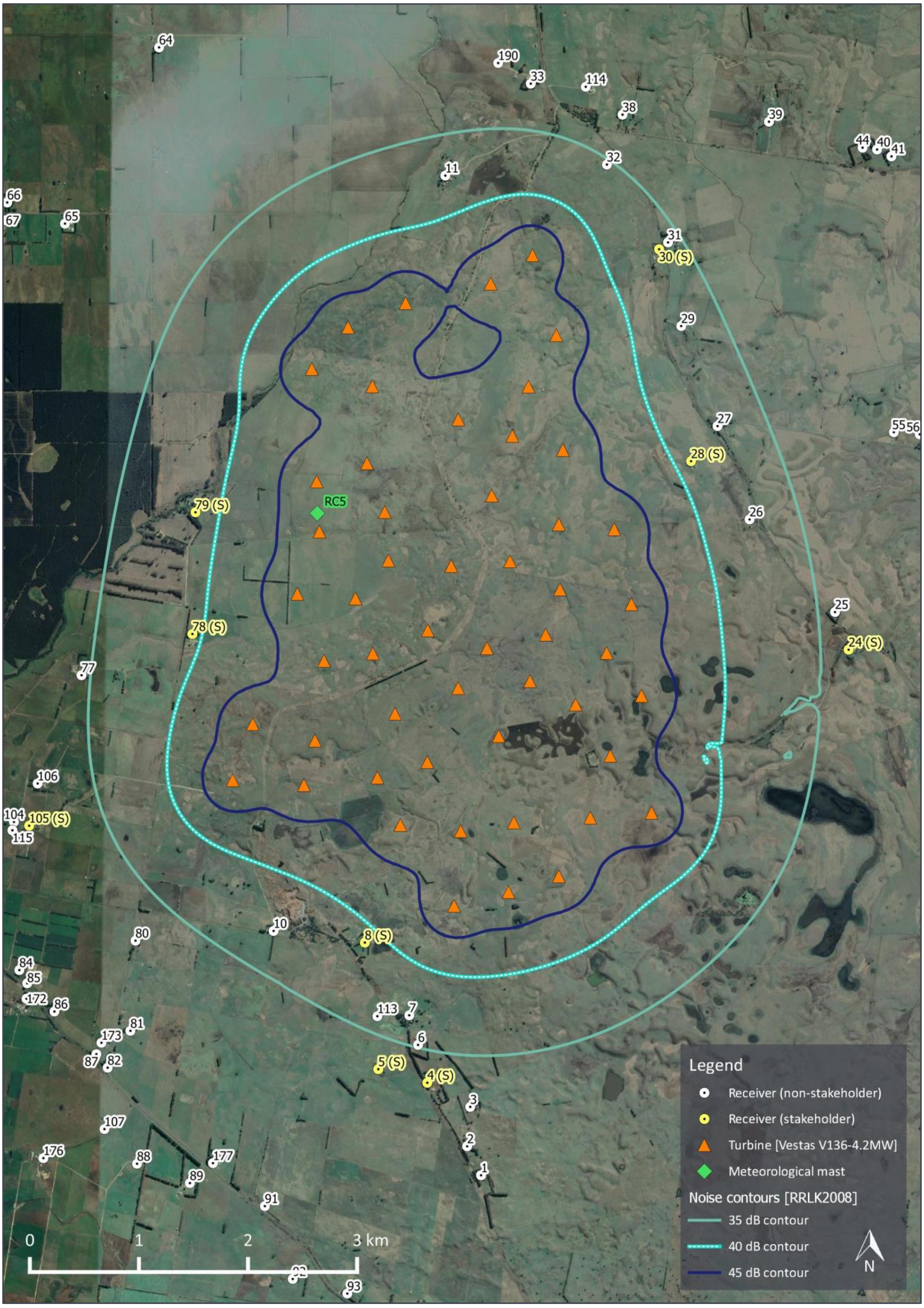
The predicted noise levels at all other receivers not listed in Table 7 are less than 35 dB L_{A90} (see Appendix G for results at these locations).

The results therefore demonstrate that the Ryan Corner Wind Farm is predicted to comply with the operational noise requirements of the permit.

Further, while the noise criteria do not apply at stakeholder receivers, the results presented in Table 7 also demonstrate predicted noise levels below 40 dB L_{A90} at stakeholder receivers.

In addition to the assessment of compliance presented in this section, a comparison of the updated predicted noise levels and those of the 2017 noise assessment is presented in Appendix H.

Figure 3: Ryan Corner Wind Farm - highest predicted noise level contours (corresponding to hub-height wind speeds of 9 m/s or greater)



6.0 SUMMARY

An updated assessment of operational wind turbine noise for the Ryan Corner Wind Farm has been carried out.

The assessment has been undertaken on the basis of the proposed layout comprising fifty-two (52) Vestas V136-4.2MW wind turbines. Vestas performance specifications for the V136-4.2MW were provided as the basis for the assessment. The data for the standard power optimised configuration incorporating serrated turbine blades and without sound management modes was referenced for the updated assessment. The noise emission data for this standard power optimised configuration is consistent with the range of values expected for the class of turbine being installed at the site.

The results of the noise predictions for the Ryan Corner Wind Farm demonstrate that the predicted noise levels for the preferred turbine model and the revised turbine layout achieve the noise criteria established by the planning permit. The updated noise assessment therefore demonstrates that the Ryan Corner Wind Farm is expected to comply with the operational noise requirements of the planning permit.

APPENDIX A GLOSSARY OF TERMINOLOGY

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 below this table.
A-weighted 90th centile	The A-weighted sound 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}
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
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 Audible Characterises	A term used to define a set group of Sound characteristics that increase the likelihood of adverse reaction to the sound. The characteristics comprise tonality, impulsiveness and amplitude modulation.	SAC
Tonality	A characteristic to describe sounds which are composed of distinct and narrow groups of audible sound frequencies (e.g. whistling or humming sounds).	-

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 dB L_A. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used within this report.

APPENDIX B TURBINE COORDINATES

The following table sets out the coordinates of the proposed locations of fifty-two (52) wind turbines of the Ryan Corner Wind.

Data was supplied by ERM on 6 April 2021 in GDA94 datum. For consistency with previous reports, the coordinates have been converted to AGD66.

Table 8: Ryan Corner Wind Farm turbine coordinates – AGD66 zone 54*

Turbine	Easting	Northing	Turbine	Easting	Northing
B6	598756	5758884	B38	598478	5763372
B8	599606	5759466	B40	598733	5763844
B9	599045	5759421	B43	598515	5764577
B10	597796	5758613	B44	598132	5764316
B13	597857	5759298	B45	597352	5764138
B14	597304	5759354	B46	596824	5763915
B15	597551	5759931	B48	596492	5763534
B16	597255	5760374	B49	597047	5763375
B17	597834	5760609	B52	596998	5762670
B18	598205	5760169	B54	596537	5762502
B20	599228	5759988	B55	597161	5762223
B21	599514	5760538	B58	596562	5762043
B22	598911	5760458	B59	597194	5761778
B23	598492	5760673	B60	597770	5761728
B24	599195	5760931	B62	596359	5761472
B25	598636	5761099	B63	596892	5761430
B26	598098	5760974	B64	597555	5761138
B28	599421	5761378	B66	596604	5760859
B29	598767	5761513	B67	597052	5760926
B30	598309	5761771	B69	595951	5760279
B31	599264	5762065	B70	595767	5759765
B32	598756	5762109	B72	596521	5760128
B33	598793	5762791	B73	597093	5759789
B34	598142	5762373	B74	596420	5759720
B36	598331	5762921	B75	598344	5759377
B37	597835	5763071	B76	598295	5758739

APPENDIX C RECEIVER LOCATIONS

The following table sets out the one hundred and fifty-seven (157) receivers within 5 km of the proposed wind turbines identified as existing dwellings as of 28 February 2017 (as referenced in the planning permit).

The receiver data was supplied by ERM on 31 May 2021 in both AGD66 and GDA94 datum. For consistency with previous reports, the coordinates have been presented in AGD66 datum.

Table 9: Ryan Corner Wind Farm receiver locations – AGD66 zone 54

Receiver	Easting (m)	Northing (m)	Distance to nearest turbine (m)	Receiver	Easting (m)	Northing (m)	Distance to nearest turbine (m)
1	598,044	5,756,143	2,484	37	598,390	5,768,614	4,040
2	597,916	5,756,409	2,210	38	599,340	5,765,865	1,534
3	597,945	5,756,770	1,852	39	600,682	5,765,800	2,491
4 (S)	597,551	5,756,991	1,644	40	601,673	5,765,545	3,305
5 (S)	597,102	5,757,116	1,654	41	601,806	5,765,482	3,415
6	597,466	5,757,338	1,321	42	603,031	5,766,154	4,785
7	597,386	5,757,610	1,089	43	603,159	5,766,370	4,979
8 (S)	596,978	5,758,276	891	44	601,541	5,765,562	3,184
10	596,142	5,758,383	1,370	49	604,117	5,762,114	4,755
11	597,716	5,765,307	1,080	50	603,916	5,759,537	4,312
20	603,423	5,758,524	3,933	55	601,827	5,762,954	2,715
21	602,936	5,759,688	3,339	56	602,064	5,762,934	2,934
22	602,632	5,760,114	3,097	60	597,150	5,768,185	3,859
23	602,373	5,760,786	2,872	61	596,928	5,768,512	4,245
24 (S)	601,413	5,760,961	1,948	62	596,550	5,767,522	3,479
25	601,288	5,761,306	1,872	63	596,396	5,766,993	3,013
26	600,505	5,762,155	1,249	64	595,093	5,766,481	3,098
27	600,211	5,763,011	1,343	65	594,230	5,764,866	2,627
28 (S)	599,968	5,762,689	947	66	593,701	5,765,060	3,183
29	599,878	5,763,928	1,154	67	593,688	5,764,897	3,120
30 (S)	599,676	5,764,631	1,167	68	593,580	5,765,027	3,274
31	599,758	5,764,694	1,253	69	593,243	5,765,020	3,574
32	599,197	5,765,408	1,080	70	592,418	5,765,031	4,342
33	598,499	5,766,149	1,576	71	593,341	5,766,815	4,533
34	598,403	5,767,756	3,183	72	593,335	5,765,840	3,911
35	598,352	5,768,236	3,664	73	593,365	5,765,031	3,468
36	603,628	5,757,011	4,714	74	593,332	5,764,466	3,296

(S) Stakeholder receiver

Receiver	Easting (m)	Northing (m)	Distance to nearest turbine (m)
75	593,353	5,763,089	3,172
76	592,972	5,761,092	3,090
77	594,382	5,760,727	1,636
78 (S)	595,398	5,761,105	1,000
79 (S)	595,426	5,762,221	1,151
80	594,876	5,758,294	1,723
81	594,830	5,757,467	2,484
82	594,621	5,757,129	2,876
83	593,600	5,758,160	2,699
84	593,812	5,758,024	2,620
85	593,884	5,757,903	2,650
86	594,133	5,757,644	2,679
87	594,518	5,757,253	2,807
88	594,891	5,756,249	3,625
89	595,375	5,756,072	3,512
91	596,062	5,755,861	3,255
92	596,318	5,755,193	3,728
93	596,818	5,755,059	3,688
94	597,494	5,754,936	3,691
95	597,081	5,753,836	4,831
96	598,840	5,754,144	4,591
97	599,036	5,754,289	4,500
104	593,762	5,759,382	2,044
105 (S)	593,902	5,759,348	1,915
106	593,980	5,759,734	1,791
107	594,592	5,756,567	3,409
113	597,093	5,757,601	1,237
114	599,003	5,766,120	1,623
115	593,748	5,759,305	2,074
116	592,622	5,760,932	3,356
117	591,412	5,760,976	4,522
118	591,407	5,760,529	4,428

(S) Stakeholder receiver

Receiver	Easting (m)	Northing (m)	Distance to nearest turbine (m)
119	591,124	5,760,273	4,672
120	591,370	5,760,178	4,418
121	591,224	5,759,957	4,548
122	590,853	5,759,343	4,934
123	591,150	5,759,312	4,640
124	591,268	5,759,278	4,526
125	591,756	5,759,331	4,036
126	592,018	5,759,435	3,765
127	591,860	5,758,711	4,048
128	591,842	5,758,642	4,084
129	592,482	5,758,552	3,504
130	592,404	5,758,481	3,602
131	592,495	5,758,396	3,549
132	592,631	5,758,505	3,381
133	592,619	5,758,418	3,426
134	592,618	5,758,359	3,450
135	592,664	5,758,296	3,435
136	592,853	5,758,484	3,185
137	592,895	5,758,311	3,221
138	592,991	5,758,225	3,177
139	593,156	5,758,154	3,069
140	593,204	5,758,303	2,953
141	593,072	5,758,351	3,046
142	593,005	5,758,366	3,098
143	592,934	5,758,524	3,095
144	592,990	5,758,461	3,070
145	593,023	5,758,455	3,043
146	593,044	5,758,451	3,026
147	593,061	5,758,449	3,011
148	593,106	5,758,440	2,974
149	593,114	5,758,479	2,950
150	593,116	5,758,501	2,939

Receiver	Easting (m)	Northing (m)	Distance to nearest turbine (m)
151	592,959	5,758,650	3,023
152	592,978	5,758,596	3,026
153	593,016	5,758,584	2,996
154	593,050	5,758,583	2,966
155	593,102	5,758,568	2,923
156	593,129	5,758,570	2,899
157	593,129	5,758,607	2,883
158	593,117	5,758,630	2,884
159	593,336	5,758,867	2,594
159	593,336	5,758,867	2,594
160	593,133	5,758,701	2,843
161	593,332	5,758,776	2,630
162	593,207	5,758,736	2,761
163	593,183	5,758,599	2,837
164	593,180	5,758,563	2,854
165	593,236	5,758,549	2,810
166	593,359	5,758,589	2,682
167	593,320	5,758,413	2,798
168	593,287	5,758,278	2,894
169	593,311	5,758,265	2,880

Receiver	Easting (m)	Northing (m)	Distance to nearest turbine (m)
170	593,454	5,758,283	2,749
171	593,402	5,758,191	2,843
172	593,877	5,757,762	2,756
173	594,564	5,757,358	2,693
174	593,034	5,756,607	4,178
175	592,733	5,756,224	4,665
176	594,032	5,756,300	3,876
177	595,586	5,756,254	3,234
178	599,317	5,754,021	4,829
179	603,553	5,758,727	4,017
180	598,694	5,767,847	3,277
181	597,784	5,769,450	4,929
182	591,966	5,765,263	4,847
183	591,869	5,765,035	4,861
184	592,930	5,759,008	2,938
185	593,140	5,757,922	3,211
186	592,826	5,758,229	3,319
191	603,285	5,757,248	4,266
192	603,868	5,759,611	4,297

APPENDIX D SITE LAYOUT PLAN

Figure 4: Site layout map & receivers

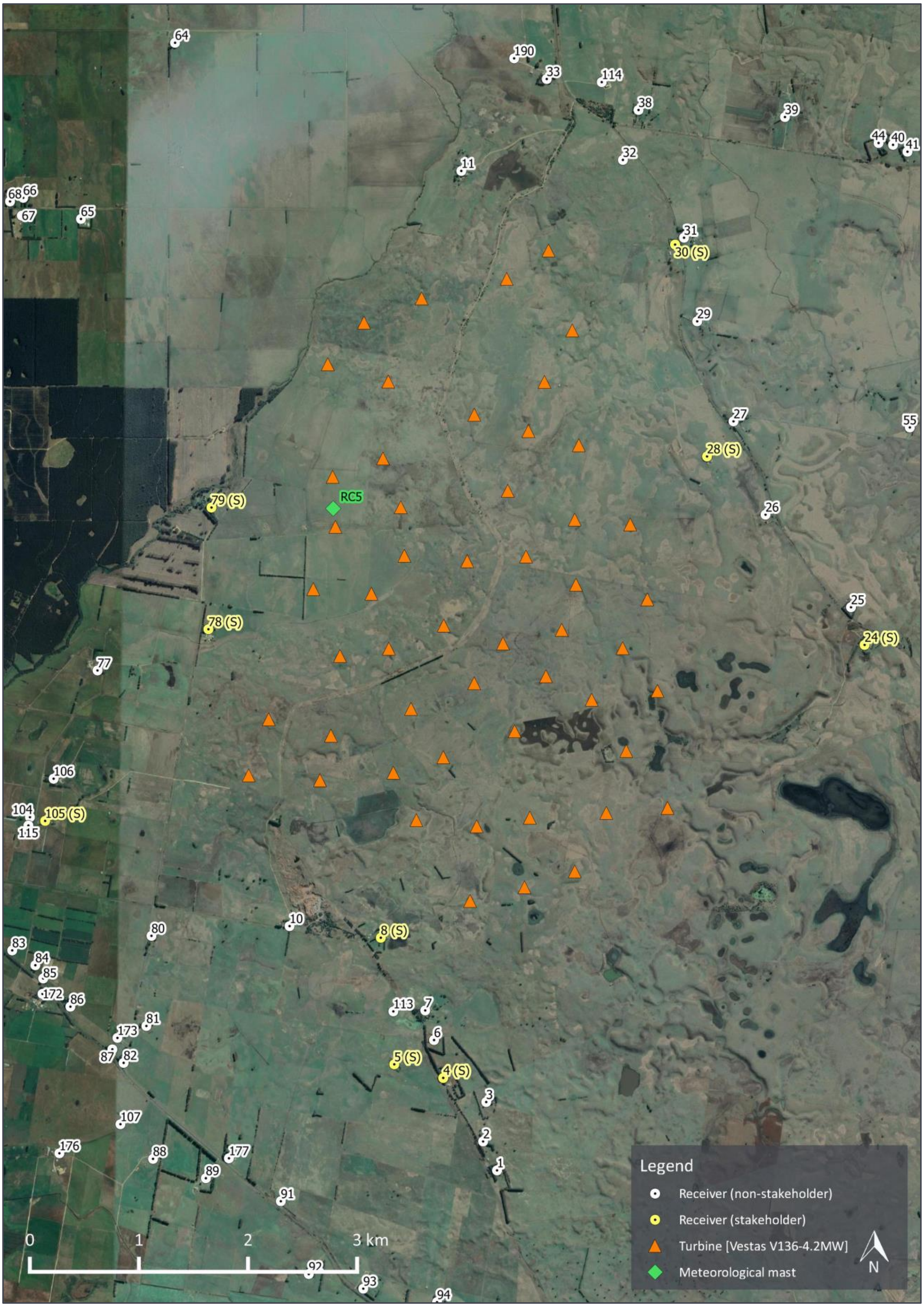
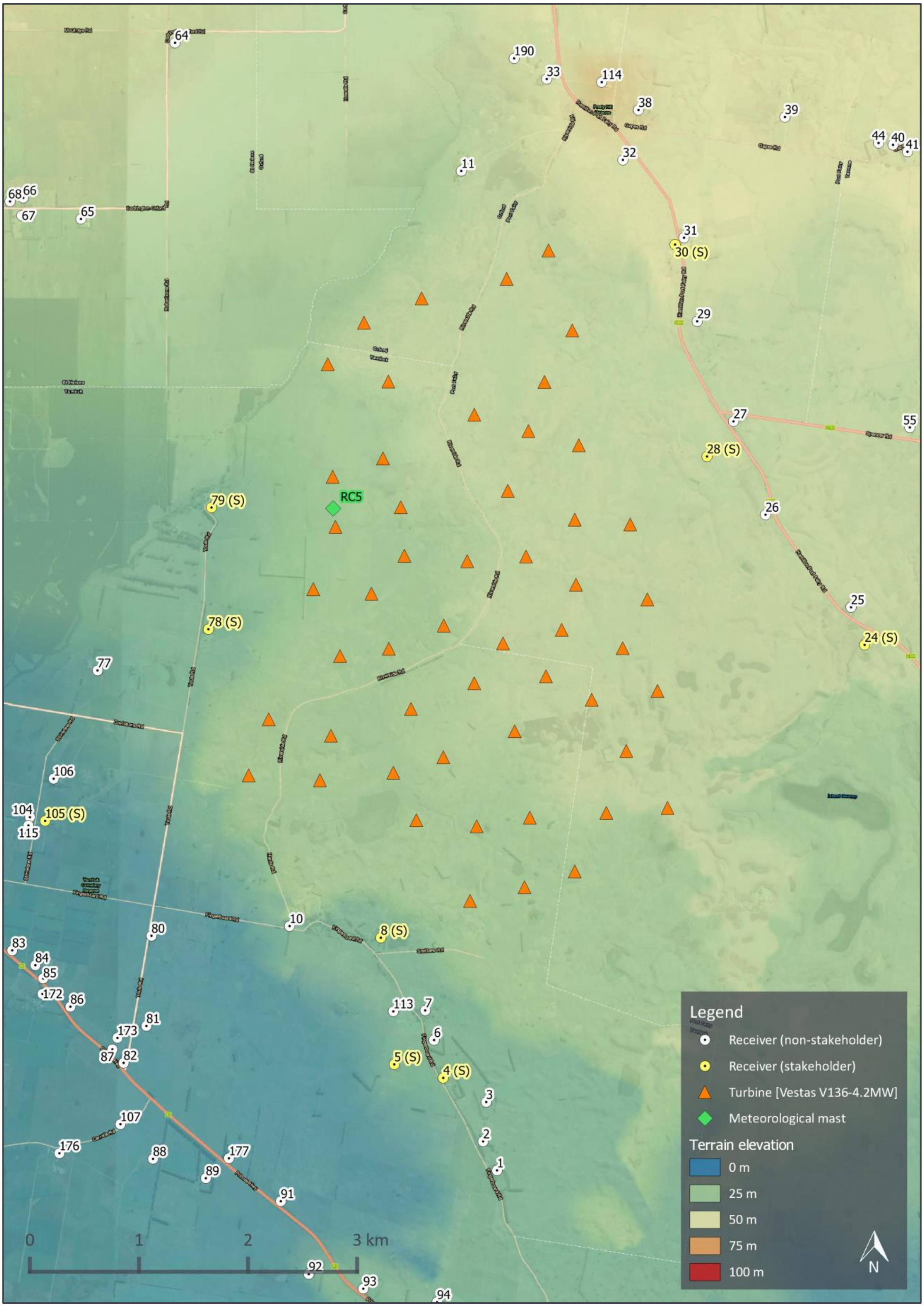


Figure 5: Site layout map & receivers with terrain elevation mapping



APPENDIX E PLANNING PERMIT – NOISE REQUIREMENTS

The planning permit for the Ryan Corner Wind Farm (Permit No.: 20060222-A), as amended 21 December 2017, contains the following requirements that are relevant to noise.

NOISE STANDARD

31. *Except as provided below in this condition, the operation of the wind energy facility must comply with New Zealand Standard 6808:2010 Acoustics — Wind farm noise in relation to any dwelling existing on land in the vicinity of the wind energy facility as at 28 February 2017, to the satisfaction of the Minister of Planning. In determining compliance with the standard, the following requirements apply:*

    (a) *The sound level from the wind energy facility, when measured outdoors within 10 metres of a dwelling at any relevant nominated wind speed, must not exceed the background level (LA90) by more than 5 dB or a level of 40 dB LA90, whichever is the greater. If access cannot be gained to undertake testing within 10 metres of a property, consent from the Minister for Planning may be sought to test at another location.*

    (b) *Compliance at night must be separately assessed with regard to night-time data. For these purposes the night is defined as 10.00pm to 7.00am.*

    (c) *Where special audible characteristics, including tonality, impulsive sound or excessive amplitude modulation occur, the measured noise level with the identified special audible characteristics will be modified by applying a penalty of up to +6 dB LA90 in accordance with Section 5.4 of the Standard.*

    The limits specified under this condition do not apply if an agreement has been entered into with the relevant landowner waiving the limits. Evidence of the agreement must be provided to the satisfaction of the Minister for Planning upon request, and be in a form that applies to the land for the life of the wind energy facility.

NOISE COMPLIANCE ASSESSMENT

32. *An independent post-construction noise monitoring program must be commissioned by the proponent within 2 months from the commissioning of the first turbine and continue for 12 months after the commissioning of the last turbine, to the satisfaction of the Minister for Planning. The independent expert must have experience in acoustic measurement and analysis of wind turbine noise. The program must be carried out in accordance with New Zealand Standard 6808:2010 as varied by Condition 31 above. The operator under this permit must pay the reasonable costs of the monitoring program.*

33. *The results of the post-construction noise monitoring program, data and details of compliance and non-compliance with the New Zealand Standard must be forwarded to the Minister for Planning within 14 months after the commissioning of any turbine. The results must be written in plain English and formatted for reading by laypeople.*

34. *All noise compliance reports must be accompanied by a report from an environmental auditor appointed under the Environment Protection Act 1970 with their opinion on the methodology and results contained in the noise compliance testing plan. If a suitable auditor cannot be engaged, the proponent may seek the written consent of the Minister for Planning to obtain an independent peer review of the noise report instead.*

APPENDIX F NOISE PREDICTION MODEL

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

The use of this standard is supported by international research publications, measurement studies conducted by Marshall Day Acoustics and direct reference to the standard in the South Australian EPA 2009 wind farm noise guidelines, AS 4959:2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators* and NZS 6808:2010 *Acoustics – Wind farm noise*.

The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 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 the ISO 9613, the noise emissions of each turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

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

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

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

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613 when a certain set of input parameters are chosen in combination. Specifically, the studies to date tend to support that the assignment of a ground absorption factor of G=0.5 for the source, middle and receiver ground regions between a wind farm and a calculation point tends to provide a reliable representation of the upper noise levels expected in practice, when modelled in combination with other key assumptions; specifically all turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 ^{o}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 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 as an appropriate prediction methodology for wind farm noise, and notes that soft ground conditions should be characterised by a ground factor of G=0.5
- In 1998, a comprehensive study (commonly cited as the Joule Report), part funded by the European Commission found that the ISO 9613 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 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 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 publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (UK IOA good practice guide). 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 methodologies.

A range of measurement and prediction studies[8, 9, 10] for wind farms in which Marshall Day Acoustics' staff have been involved in have provided further support for the use of ISO 9613 and G=0.5 as an appropriate representation of typical upper noise levels expected to occur in practice.

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

- the types of noise source heights associated with a modern wind farm, extending the scope of application of the method beyond the 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.

[8] 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.

[9] 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.

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

In addition to the choice of ground factor referred to above, adjustments to the ISO 9613 standard for screening and valleys effects are applied on the basis of recommendations of the Joule Report, UK IOA 2009 joint agreement and the UK IOA good practice guide. The following adjustments are applied to the calculations:

- screening effects as a result of terrain are limited to 2 dB
- screening effects are assessed on the basis of each turbine being represented by a single noise source located at the maximum tip height of the turbine rotor
- an adjustment of 3 dB is added to the predicted noise contribution of a turbine if the terrain between the 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 SoundPLAN 8.2 software used to conduct the noise modelling. The software uses these definitions in conjunction with the digital terrain model of the site to evaluate the path between each turbine and receiver pairing, and then subsequently applies the adjustments to each turbine's predicted noise contribution where appropriate.

APPENDIX G TABULATED PREDICTED NOISE LEVEL DATA

Table 10: Highest predicted noise levels at all receivers

Receiver	Predicted noise level, dB L_{A90}	Receiver	Predicted noise level, dB L_{A90}	Receiver	Predicted noise level, dB L_{A90}
1	30.5	40	28.3	81	30.7
2	31.4	41	28.2	82	29.6
3	32.8	42	25.3	83	29.4
4 (S)	33.6	43	24.8	84	29.6
5 (S)	33.6	44	28.5	85	29.6
6	35.1	49	26.3	86	29.7
7	36.5	50	26.6	87	29.6
8 (S)	39.0	55	31.2	88	28.2
10	36.9	56	30.6	89	28.4
11	37.2	60	26.4	91	28.6
20	26.9	61	25.7	92	27.3
21	28.8	62	27.7	93	25.3
22	29.7	63	28.9	94	27.2
23	30.6	64	28.6	95	24.9
24 (S)	33.9	65	30.1	96	25.5
25	34.3	66	28.6	97	25.7
26	37.2	67	28.8	104	31.5
27	37.0	68	28.4	105 (S)	32.0
28 (S)	39.0	69	27.7	106	32.7
29	36.9	70	26.2	107	28.4
30 (S)	36.2	71	25.5	113	35.8
31	35.7	72	26.8	114	32.3
32	35.3	73	28.0	115	31.4
33	32.7	74	28.6	116	28.9
34	27.5	75	30.0	117	26.2
35	26.4	76	29.8	118	26.2
36	24.9	77	34.6	119	25.6
37	25.6	78 (S)	39.5	120	26.0
38	32.8	79 (S)	38.6	121	25.7
39	29.9	80	33.0	122	24.8

(S) Stakeholder receiver

Receiver	Predicted noise level, dB L_{A90}
123	25.3
124	25.5
125	26.4
126	27.0
127	26.3
128	26.2
129	27.4
130	27.1
131	27.2
132	27.6
133	27.5
134	27.5
135	27.5
136	28.1
137	28.0
138	28.1
139	28.4
140	28.7
141	28.4
142	28.3
143	28.3
144	28.4
145	28.4

Receiver	Predicted noise level, dB L_{A90}
146	28.5
147	28.5
148	28.6
149	28.7
150	28.7
151	28.5
152	28.5
153	28.6
154	28.6
155	28.7
156	28.8
157	28.9
158	28.9
159	29.7
159	29.7
160	29.0
161	29.6
162	29.2
163	29.0
164	28.9
165	29.0
166	29.4

Receiver	Predicted noise level, dB L_{A90}
167	29.1
168	28.8
169	28.8
170	29.2
171	29.0
172	29.3
173	29.9
174	26.1
175	25.1
176	27.1
177	29.0
178	25.1
179	26.8
180	27.2
181	24.0
182	25.2
183	25.3
184	28.8
185	28.0
186	27.8
191	25.9
192	26.7

APPENDIX H COMPARISON WITH 2017 NOISE ASSESSMENT REPORT

The following table summarises the predicted noise levels for the three candidate turbines and turbine layout used in the 2017 noise assessment report, alongside the predictions for the Vestas V136-4.2MW turbine and revised turbine layout presented in the revised assessment herein. The results are presented for the receivers where predicted noise levels were greater than 35 dB L_{A90} in the 2017 noise assessment report.

A difference range has been included to illustrate the changes between the maximum and minimum predicted noise levels for each receiver and candidate turbine in the 2017 noise assessment report, and the results of the updated assessment. A negative number represents a decrease in predicted noise level, and a positive number likewise represents an increase. The results demonstrate that the updated predicted noise levels are below, or at the lower end of, the range of predicted noise levels presented in the 2017 noise assessment report.

Table 11: Results of 2017 assessment comparison to Vestas V136-4.2MW

	2017 assessment turbine models			Updated assessment	
Receiver	**Vestas V126**	**Senvion 3.0M122**	**GE 3.2-130**	**Vestas V136-4.2MW**	**Difference range**
4 (S)	34.7	33.1	35.4	33.6	-1.8 to +0.5
5 (S)	34.9	33.3	35.6	33.6	-2.0 to +0.3
6	36.4	34.8	37.1	35.1	-2.0 to +0.3
7	37.9	36.3	38.5	36.5	-2.0 to +0.2
8 (S)	40.4	38.9	41.0	39.0	-2.0 to +0.1
10	38.2	36.7	38.8	36.9	-1.9 to +0.2
11	39.4	37.9	40.0	37.2	-2.8 to -0.7
24 (S)	35.3	33.7	36.0	33.9	-2.1 to +0.2
25	35.8	34.2	36.5	34.3	-2.2 to +0.1
26	38.7	37.2	39.4	37.2	-2.2 to 0
27	39.2	37.6	39.8	37.0	-2.8 to -0.6
28 (S)	41.0	39.5	41.6	39.0	-2.6 to -0.5
29	39.4	37.9	40.1	36.9	-3.2 to -1.0
30 (S)	38.6	37.0	39.2	36.2	-3.0 to -0.8
31	38.0	36.4	38.6	35.7	-2.9 to -0.7
32	37.4	35.8	38.0	35.3	-2.7 to -0.5
33	34.9	33.3	35.6	32.7	-2.9 to -0.6
38	34.9	33.2	35.5	32.8	-2.7 to -0.4
77	36.0	34.4	36.7	34.6	-2.1 to +0.2
78 (S)	40.8	39.3	41.5	39.5	-2.0 to +0.2
79 (S)	40.1	38.6	40.7	38.6	-2.1 to 0

(S) Stakeholder receiver

APPENDIX I DOCUMENTATION

(a) Map of the site showing topography, turbines and residential properties: See Appendix D

(b) Noise sensitive locations: See Section 2.1 and Appendix C

(c) Wind turbine sound power levels, L_{WA} dB (also refer to Section 2.3)

Sound power levels (including + 1dB margin for uncertainty)

	Hub height wind speed (m/s)									
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**≥12**
dB L_{WA}	91.9	92.1	93.9	97	100.6	103.8	104.9	104.9	104.9	104.9

Reference octave band spectrum adjusted to 104.9 dB L_{WA}

	Octave Band Centre Frequency (Hz)								
	31.5	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
dB L_{WA}*	76.7	86.6	93.8	98.2	99.9	98.9	95.2	88.8	79.7

* Based on octave band spectral information at 18 m/s

(d) Wind turbine model: Vestas V136-4.2MW, details provided in Table 1 of Section 2.2

(e) Turbine hub height: 112 m

(f) Distance of noise sensitive locations from the wind turbines: See Appendix C

(g) Calculation procedure used: ISO 9613-2:1996 prediction algorithm as implemented in SoundPLAN v8.2 (See Section 4.0 and Appendix F)

(h) Meteorological conditions assumed:

- Temperature: 10 °C
- Relative humidity: 70 %
- Atmospheric pressure: 101.325 kPa

(i) Air absorption parameters:

	Octave band mid frequency (Hz)							
Description	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Atmospheric attenuation (dB/km)	0.12	0.41	1.04	1.93	3.66	9.66	32.8	116.9

(j) Topography/screening: 10 m elevation contours, screening effects in accordance with ISO 9613-2:1996 prediction algorithm as detailed in Section 4.0 and Appendix F

(k) Predicted far-field wind farm sound levels: See Table 7 of Section 5.0 and Appendix G.