Tchelery Wind Farm

Preliminary Noise Impact Assessment

19 June 2023
Reference ID: 1-5

echo
Acoustic Consulting

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Abbreviations

Bulletin	*NSW Wind Energy: Noise Assessment Bulletin (EPA, 2016)*
dB(A)	Noise level in A-weighted decibels
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
ISO 9613-2	*ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*
kV	Kilovolts
L_{Aeq}	A-weighted equivalent time-averaged noise level
L_{A90}	A-weighted noise level exceeded for 90 percent of the measurement period
MW	Mega-Watts
NSW	New South Wales
SEARs	Secretary's Environmental Assessment Requirements
WTG	Wind Turbine Generator

Glossary

A-weighting	A mathematical adjustment to the measured noise levels to represent the human response to sound. An *A-weighted noise level* is presented as dB(A)
Ambient Noise Level	The noise level in the environment in the absence of the Project
Associated Dwellings	Dwellings where the landowner has an agreement with the Tchelery Wind Farm to accommodate infrastructure or a WTG/s
Background Noise Level	Minimum ambient noise level, evaluated as the level exceeded for 90 per cent of 10-minute sample periods ($L_{A90,10\ minute}$)
Baseline Noise Criterion	The lowest noise level criterion which applies at any WTG operational wind speed as established in the Bulletin. The Bulletin will enable an increase above the baseline noise criterion subject to high background noise levels in the ambient environment
Candidate WTG	A candidate WTG is used as an example in an assessment process to indicate the ability of the wind farm to comply with legislative requirements. Candidate WTGs are indicative of WTGs which might be procured at a future stage
Decibels	The logarithmic unit of measurement to define the magnitude of a fluctuating air pressure wave. Used as the unit for *sound* or *noise level*

Equivalent Noise Level	The A-weighted noise level which is equivalent to a noise level which varies over time
Frequency	Frequency is the number of pressure fluctuation cycles per second of a sound wave. Measured in units of Hertz (Hz)
Low Frequency	Noise containing excessive low frequency content as objectively identified using the test described in the Bulletin
Noise	An interchangeable term with sound but which is most often described as *unwanted sound*.
Non-Associated Dwellings	Dwellings where the landowner does not have an agreement with the Tchelery Wind Farm to accommodate infrastructure or a WTG/s
Octave Band	The segregation of sound into discrete frequency components. For example, the 63 Hz *octave band* is a low frequency component of sound/noise, and the 2000 Hz *octave band* is a high frequency component of sound/noise. The one-third (or 1/3) octave is more finite segregation (1/3rd) of each octave band
(the) Project	Tchelery Wind Farm
Sound	An activity or operation which generates a fluctuating air pressure wave. The ear drum can perceive both the frequency (pitch) and the magnitude (loudness) of the fluctuations to convert those waves to sound
Sound Pressure Level	The magnitude of sound (or noise) at a position. The sound pressure level can vary according to location relative to the noise source, and operational, meteorological and topographical influences
Sound Power Level	The amount of sound energy an activity produces for a given operation. The sound power level is a constant value for a given activity. The sound power level is analogous to the power rating on a light globe (which remains constant), whereas the lighting level in a space (sound pressure level in this analogy) will be influenced by the distance from the globe, shielding and different locations within the space
Tonality	Noise containing a perceptible pitch component as objectively identified using a one-third octave band test described in *ISO 1996.2: 2007 Acoustics - Description, measurement and assessment of environmental noise –Determination of environmental noise levels (Annex D – Objective method for assessing the audibility of tones in noise – Simplified method).*
Warranted Sound Power Level	The sound power level which the WTG supplier guarantees can be achieved inclusive of uncertainties

Introduction

NEOEN propose to construct and operate the Tchelery Wind Farm (the **Project**), a utility scale renewable energy development near Keri Keri in the Riverina Murray region of NSW. The Project would be approximately 790 kilometres (by road) west of Sydney, 35 kilometres (by road) east of Keri Keri, and 79 kilometres (by road) east of Balranald. The Project is within the Edward River Local Government Area (LGA), south of the Sturt Highway. The project site is traversed by Maude Road (north-south) and Boorooban-Tchelery Road (east-west). Existing land uses of the project site and surrounds are predominately livestock grazing and some areas of cropping.

Fully constructed, the Project would include up to 120 wind turbines providing a total capacity of up to approximately 800 MW, that would be connected into the National Electricity Market (NEM) potentially through EnergyConnect (NSW – Eastern Section) or the existing 220 kV transmission line. The Wind Turbine Generator (**WTG**) model for the Project is yet to be identified and would be confirmed during detailed design. The WTG would have a hub height of up to 185 metres and tip height of up to 285 metres.

The Project would also comprise the following infrastructure and associated works:

- construction vehicle and workforce vehicle parking
- concrete batching plant, crushing facilities and gravel pits
- construction laydown and stockpiles
- parking for operational staff
- internal access roads
- substation and switching station
- underground and overhead transmission lines
- meteorological masts
- operations and maintenance facility including site office and amenities
- potential on-site accommodation camp. NEOEN is in consultation with the Councils regarding potential accommodation options in the nearest towns.

It is expected that construction of the Project would commence in early 2026 and take about two to two and half years to complete. It is anticipated that the Project would be operational in late 2028 or early 2029.

The Project will be subject to assessment and determination by the NSW Minister for Planning and Public Spaces or the Independent Planning Commission, which require an Environmental Impact Statement (**EIS**) prepared in accordance with the Secretary's Environmental Assessment Requirements (**SEARs**) issued by the NSW Department of Planning and Environment (**DPE**).

The SEARs are informed by a Scoping Report which provides preliminary information on a project and its potential impacts.

This preliminary noise impact assessment (the **assessment**) will be included within the Scoping Report.

The noise levels generated by renewable energy projects are well understood and can be predicted with accuracy. Environmental noise impact assessments compare predicted noise levels against the relevant noise requirements. Where the requirements cannot be achieved, the assessments determine whether WTGs can be relocated, operational modes with reduced noise level implemented, or WTGs removed to achieve compliance. The assessments also identify areas where further investigations need to be made.

This assessment predicts the noise associated with the 120 proposed WTGs at all dwellings identified within 10km of the WTGs. It considers the use of the *Siemens Gamesa SG170-6.0MW* in *Application Mode 0* (which increases the WTG capacity to 6.2MW) as a *candidate WTG* for the Project.

The regional context of the project is shown in Figure 1 below and the site layout is shown in Figure 2 below.

Figure 1 Regional Context

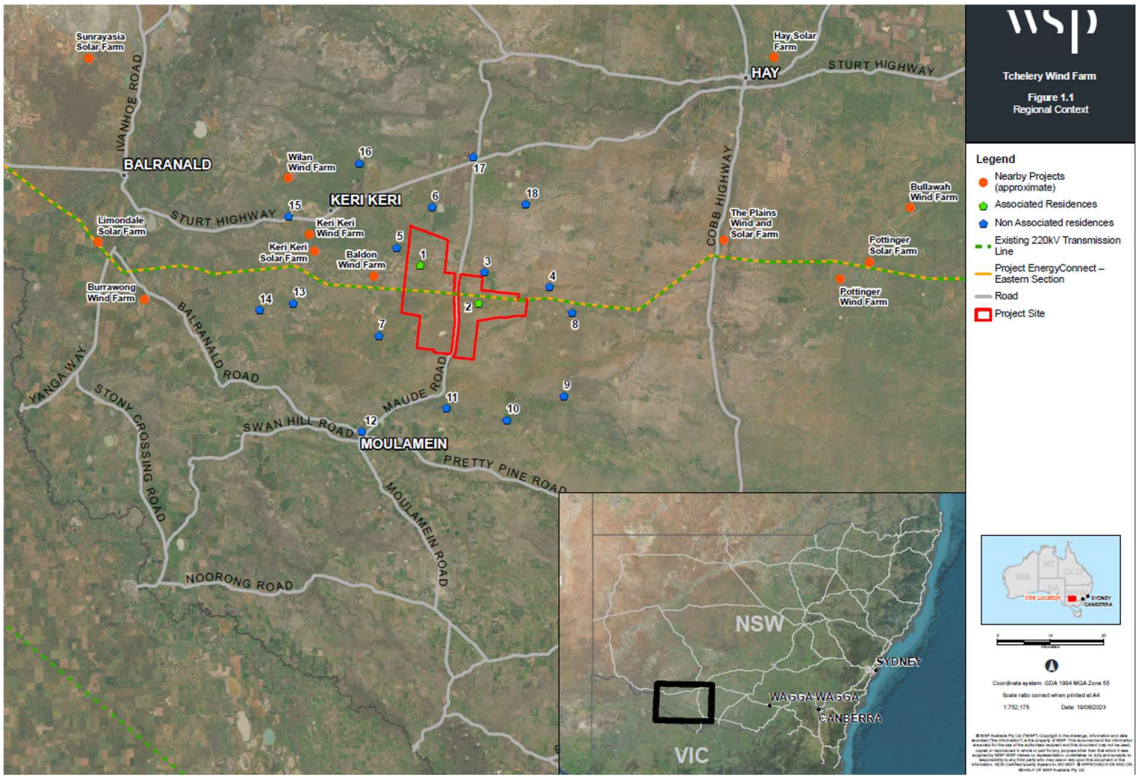
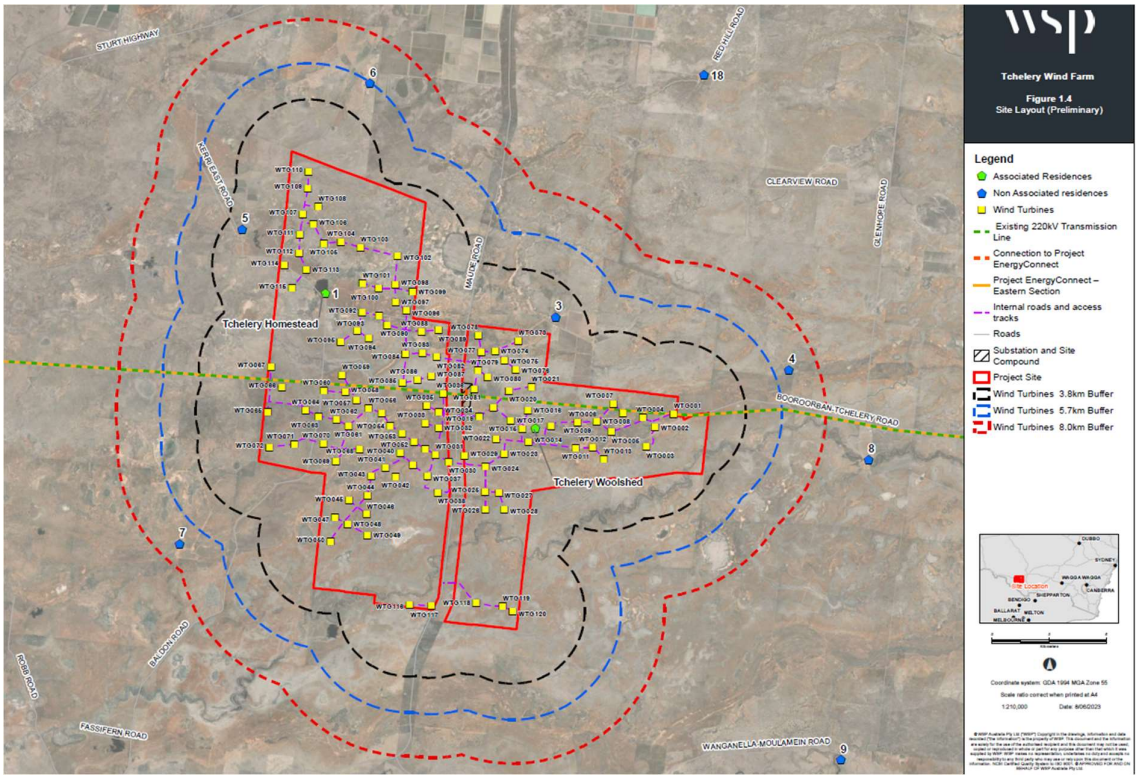


Figure 2 Site Layout (Preliminary)



Assessment Criteria

The SEARs for wind farms typically require that the EIS assess WTG noise in accordance with the NSW *Wind Energy: Noise Assessment Bulletin* (the **Bulletin**).

The Bulletin

The Bulletin provides a *baseline noise criterion* of 35 dB(A) at non-associated dwellings.

At associated dwellings, the Bulletin enables an increase above the baseline noise criterion of 35 dB(A), subject to a formal agreement and ensuring that the landowner is appropriately informed and understands the agreed noise levels.

Background noise level monitoring has been conducted as a proactive part of the future EIS process. The results of the background noise level monitoring can justify an increase in the Project noise assessment criteria above the baseline noise criterion of 35 dB(A) in the circumstance where the measured ambient noise levels are sufficiently high (which can occur at higher integer hub height wind speeds). The background noise monitoring results will be summarised in the EIS. The location and dates of monitoring are detailed in Table 1 below.

This assessment considers the Project against the baseline criterion of 35 dB(A) as a conservative and indicative approach.

Assessment

Wind Turbine Generators

Noise Model

A three-dimensional model of the Project has been developed based on the algorithm provided by *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (**ISO 9613-2**).

ISO 9613-2 specifies a method for predicting noise levels at a distance from a noise source under meteorological conditions favourable to noise propagation. The algorithm also conservatively assumes that these favourable propagation conditions (which include wind blowing from the WTG to the dwelling) occur simultaneously between all WTGs and all dwellings. The noise model is considered to represent worst case noise propagation conditions with the following inputs:

- dwellings identified within 10kms of the WTGs, with locations as detailed in Table 1
- the cumulative effect of all 120 WTGs operating concurrently, with WTG locations as detailed in Table 2
- topographical ground contours
- inputs detailed in accordance with the modelling recommendations of the *Institute of Acoustics* (UK) *"A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise"*:
    - warranted sound power level data for the candidate WTG
    - 10°C temperature
    - 70% relative humidity
    - 50% acoustically hard ground and 50% acoustically soft ground
    - barrier attenuation of no greater than 2 dB(A)
    - 4m receiver height at each dwelling
    - application of a 3 dB(A) correction where a "concave" ground profile exists.

Table 1 Dwelling Locations (within 10km) and Status

Dwelling Name	Associated	Background Noise Monitoring Dates	Co-ordinates (MGA Zone 55)	
			Easting	Northing
1 (Tchelery Homestead)	Yes	22/2/23 to 5/4/23	240764	6144509
2 (Tchelery Woolshed)	Yes		251817	6137380
3	No	22/2/23 to 5/4/23	252906	6143260
4	No	22/2/23 to 4/4/23	265186	6140466
5	No		236374	6147858
6	No	22/2/23 to 5/4/23	243104	6155542
7	No		233081	6131282

Table 2 WTG Locations

WTG ID	Co-ordinates (MGA Zone 55)		WTG ID	Co-ordinates (MGA Zone 55)		WTG ID	Co-ordinates (MGA Zone 55)	
	Easting	Northing		Easting	Northing		Easting	Northing
WTG001	259137	6138161	WTG041	243945	6135328	WTG081	248625	6139467
WTG002	258146	6137465	WTG042	244472	6134872	WTG082	246652	6141167
WTG003	257691	6136456	WTG043	243194	6134905	WTG083	245899	6141378
WTG004	257516	6137978	WTG044	243007	6133869	WTG084	244995	6141323
WTG005	255863	6137215	WTG045	242025	6133602	WTG085	244838	6139807
WTG006	255076	6137754	WTG046	242949	6132883	WTG086	245642	6139945
WTG007	255953	6138692	WTG047	241289	6132711	WTG087	246367	6140146
WTG008	256471	6138202	WTG048	241953	6132355	WTG088	245847	6142500
WTG009	254062	6137725	WTG049	242987	6131776	WTG089	246731	6142584
WTG010	252684	6137535	WTG050	241042	6131460	WTG090	244037	6142847
WTG011	253968	6136377	WTG051	246042	6136322	WTG091	243611	6143340
WTG012	254857	6136407	WTG052	245454	6136687	WTG092	242713	6143518
WTG013	255440	6135795	WTG053	244824	6137126	WTG093	242462	6142530
WTG014	251479	6136682	WTG054	244187	6137554	WTG094	243078	6142135
WTG015	251157	6137373	WTG055	243743	6138204	WTG095	241585	6141967
WTG016	251456	6138347	WTG056	243060	6138471	WTG096	245047	6143593
WTG017	250546	6137814	WTG057	242411	6138880	WTG097	244478	6144051
WTG018	249636	6138509	WTG058	241830	6139315	WTG098	244467	6144963
WTG019	248882	6138024	WTG059	241659	6140226	WTG099	245366	6144609
WTG020	250445	6139375	WTG060	240690	6139395	WTG100	243594	6144764
WTG021	251638	6139604	WTG061	241996	6137540	WTG101	242733	6145049
WTG022	249779	6136821	WTG062	241365	6137847	WTG102	244585	6146489
WTG023	250201	6136077	WTG063	240426	6138036	WTG103	242638	6146937
WTG024	249213	6135401	WTG064	239728	6138352	WTG104	241602	6147229
WTG025	249197	6134070	WTG065	237741	6138277	WTG105	240687	6147150
WTG026	249209	6133125	WTG066	238482	6139552	WTG106	240151	6148162
WTG027	249918	6134002	WTG067	237919	6140624	WTG107	239583	6148689
WTG028	250201	6133148	WTG068	242577	6136303	WTG108	240416	6149083
WTG029	248109	6135960	WTG069	241325	6135665	WTG109	239863	6150056
WTG030	247264	6135642	WTG070	240681	6136606	WTG110	239893	6150934
WTG031	246570	6136025	WTG071	239152	6136569	WTG111	239432	6147612
WTG032	246747	6137430	WTG072	237824	6136405	WTG112	239403	6146638
WTG033	246041	6137671	WTG073	250958	6141992	WTG113	239776	6145767
WTG034	246759	6138274	WTG074	249716	6141476	WTG114	238616	6145991
WTG035	246118	6138584	WTG075	250230	6140961	WTG115	239027	6144804
WTG036	246993	6139221	WTG076	250802	6140491	WTG116	245210	6128134
WTG037	246157	6134880	WTG077	248987	6141432	WTG117	246363	6128059
WTG038	246698	6134013	WTG078	248831	6142306	WTG118	248728	6128217
WTG039	245392	6135466	WTG079	248809	6140466	WTG119	250120	6128045
WTG040	244724	6136102	WTG080	249339	6140104	WTG120	250643	6127749

Candidate WTG

This assessment has been based on the *Siemens Gamesa SG6.0 170* WTG[1] with a hub height of up to 185m.

Sound Power Levels

Noise data has been provided by the WTG manufacturer for integer wind speeds (at hub height) from wind turbine cut-in wind speed to the wind speed associated with rated power.

This assessment has been based on the maximum equivalent noise level produced by the WTG in *Application Mode 0* at any wind speed (comprising a sound power level of 106 dB(A) at a hub height wind speed of 9m/s[2]) and the available noise data in "octave bands" and "one-third octave bands" between the frequencies of 10 Hz and 8 kHz.

The sound power level data have been utilised on the basis that they will be the warranted sound power levels (without further adjustment for uncertainty margins) for the Project, which ultimately will be subject to a future contractual and procurement procedure which can introduce specific guarantee, warranty, or uncertainty requirements.

In addition, the final WTG selection can be different to the *candidate WTGs* due to advancements in technologies and the commercial market which exists at the time of procurement[1].

The noise assessment during the EIS will reflect any changes to the candidate WTG, the guaranteed/warranted sound power level data, the need for adjustment for uncertainty margins, and the layout, that arise during the design stage of the Project.

Special Noise Characteristics

The Bulletin defines the presence of excessive low frequency noise and tonality as special noise characteristics. The presence of these characteristics means that the noise experienced from the wind farm at a dwelling is noticeably different to that associated with a typical wind farm.

The assessment has been made on the basis that the WTG selection will not exhibit tonal characteristics or excessive low frequency content. The one-third octave band and low frequency data available for the *Siemens Gamesa SG6.0 170* WTG correlate with this assumption.

Notwithstanding the above, the contractual arrangement with the manufacturer of the final WTG should include a guarantee that the WTG will not exhibit tonal characteristics or excessive low frequency content. If the final WTG selection does exhibit special noise characteristics, then the predicted noise levels should be adjusted in accordance with the Bulletin.

[1] Turbines used in this assessment are indicative only and are based on technology available at the time of assessment. Turbine selection would be subject to available technology during design refinement and as updated in the EIS

[2] The noise generated from a WTG increases with wind speed and then plateaus. The maximum equivalent sound power level occurs at a hub height wind speed of 9m/s for the candidate WTG.

Predicted Noise Levels

Noise level predictions have been made using the noise model, inputs and assumptions detailed above.

The predicted noise level at the identified dwellings for operation of the *Siemens Gamesa SG6.0 170* (in *Application Mode 0)* at its maximum equivalent noise level (corresponding to hub height wind speeds of 9m/s, or greater) is provided in Table 3. The distance to the closest WTG from each dwelling is also provided in Table 3.

Table 3 Predicted Noise Levels

Dwelling ID	Agreement with Project	Closest WTG (m)	Noise Criterion (dB(A))	Maximum Equivalent Noise Level (dB(A))
1 (Tchelery Homestead)	Yes	1600	-	35
2 (Tchelery Woolshed)	Yes	660	-	42
3	No	2324	35	29
4	No	6473	35	<25
5	No	2918	35	28
6	No	5616	35	<25
7	No	6981	35	<25

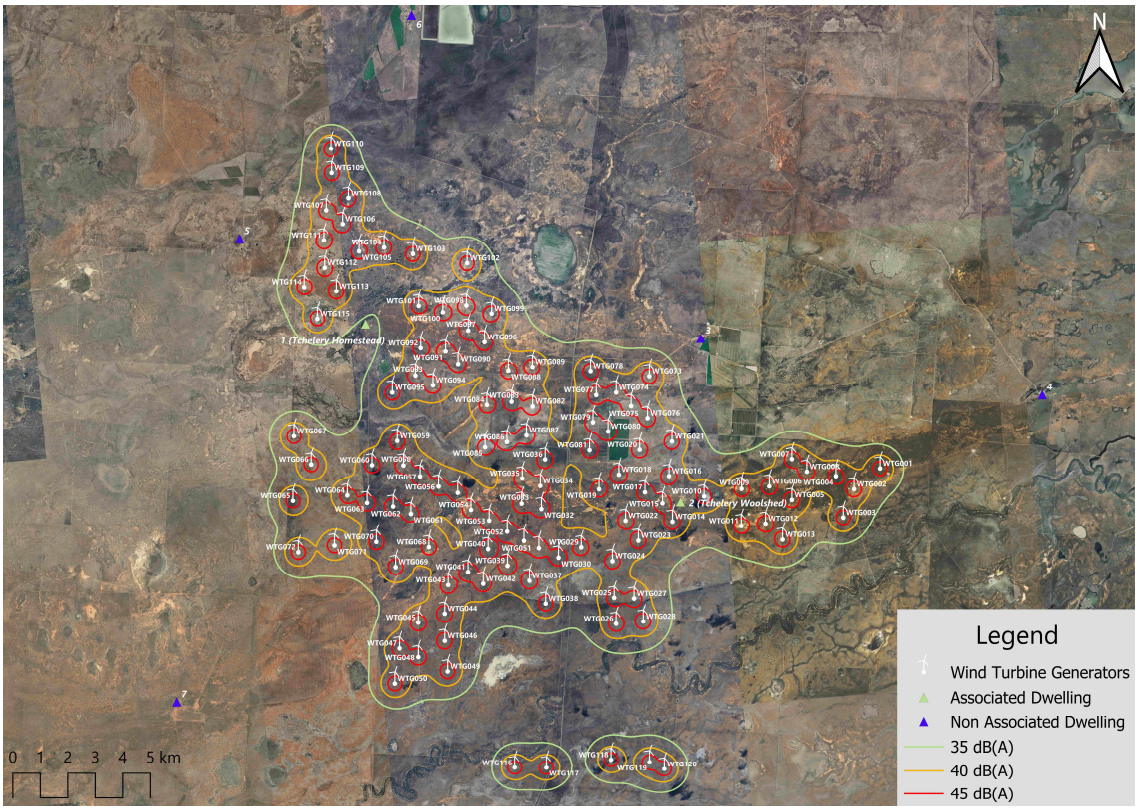
The predicted noise levels indicate that the 35 dB(A) baseline criterion applicable to non-associated dwellings can be achieved at all locations.

The Tchelery Homestead and Tchelery Woolshed are associated dwellings and under the Bulletin can establish a higher noise level criterion, which will be the subject of a formal agreement between the Project and landowner/s.

The noise prediction contours for the operation of the *Siemens Gamesa SG6.0 170* candidate WTGs at their maximum equivalent noise level output (corresponding to hub height wind speeds of 9m/s, or greater) are provided in Figure 3.

The noise prediction contours for the operation of the WTGs at their maximum equivalent noise level output depicts that all *inhabited* non-associated dwellings are outside (have a lower noise level than) the baseline noise criterion contour of 35 dB(A).

Figure 3 Noise Prediction Contours



Conclusion

Environmental noise assessments predict the noise levels based on established input data and compares those noise levels against specific requirements.

The preliminary noise assessment for the Tchelery Wind Farm considers 120 WTGs and the use of the *Siemens Gamesa SG170-6.0MW* in *Application Mode 0* as the *candidate WTG*.

The assessment determines the Tchelery Wind Farm can achieve the allowable noise levels of the NSW *Wind Energy: Noise Assessment Bulletin* at all non-associated dwellings.

This preliminary noise assessment considers the noise generated by WTGs only, and the Environmental Impact Statement will consider the following additional noise sources:

1. ancillary infrastructure, such as transformers, assessed in accordance with the *NSW Noise Policy for Industry* (EPA, 2017)
2. construction activity assessed in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) and *Assessing Vibration: A Technical Guideline* (DECC, 2006)
3. traffic movements assessed in accordance with the *NSW Road Noise Policy* (DECCW, 2011).

The Environmental Impact Statement will also reflect any changes to the candidate WTG, the warranted sound power levels, the need for adjustment for uncertainty margins, and/or the layout, that arise during the design stage of the Project, and will consider the presence of excessive low frequency noise and tonality as special noise characteristics in accordance with the Bulletin.

References

Institute of Acoustics (UK) *"A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise", 2013*

ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

NSW Planning & Environment – Wind Noise Assessment Bulletin, December 2016

Siemens Gamesa SG6.0 170 Standard Acoustic Emission, Rev. 0, AM0-M7, IEC Ed.3, D2359593/002 dated 27 February 2020

WSP - *Tchelery Wind Farm Regional Context, PS131616_F101,_r1v4*

WSP - *Tchelery Wind Farm Site Layout Preliminary, PS131616_F104,_r1v5*

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