G.3 NOISE ASSESSMENT

Rye Park Wind Farm

Modification

Environmental Noise Assessment

S3200C17

March 2020

sonus.

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1 INTRODUCTION

The Rye Park Wind Farm is proposed to be located 12 km north east of Yass and 42 km west of Crookwell. Development Consent was granted in May 2017 (Application Number SSD 6693) for up to 92 wind turbine generators (WTGs) with a tip height of up to 157m.

An environmental noise assessment of the operation and construction stage was made and summarised in Sonus report S3200C9 dated February 2016.

Modifications to the wind farm layout and tip height are proposed and a revised environmental noise assessment of the operation has been conducted.

This report summarises the environmental noise assessment of the operation of the proposed 80 wind turbine layout. The assessment has been based on the GE 158 5.5MW WTGs, with a maximum tip height of 200m above ground level (AGL), being a representative wind turbine and having one of the highest noise emissions of those currently in the market. Should approval be granted, the final turbine selection and final layout will be assessed prior to construction of the wind farm.

2 WIND TURBINE LAYOUT

The coordinates of the 80 WTG layout are provided in Table 1.

Table 1: Coordinates of wind turbine layout.

Turbine ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
1	676629	6186672
2	676471	6186291
3	676320	6185897
4	676320	6185509
5	677805	6185279
7	677490	6184967
9	677384	6184591
11	677266	6184203
12	677322	6183750
17	681368	6182678
20	681054	6182312
21	678588	6181965
22	679549	6181989
25	679389	6181591
26	678511	6181575
28	678484	6181184
30	679009	6180754
31	680367	6180463
32	678570	6180428
34	678899	6180032
36	680242	6180109
37	678987	6179642
39	680098	6179394
41	680008	6179119
42	680994	6179015
43	679027	6179114
48	681515	6177825

Turbine ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
49	681955	6177678
50	681372	6177446
51	681355	6177078
58	682400	6176161
61	680965	6176347
62	680830	6175999
63	682309	6175645
64	683431	6175508
65	684812	6175374
66	682384	6175319
67	680267	6175231
68	684506	6175044
69	682302	6174979
71	682195	6173075
72	682099	6172655
73	681120	6172346
74	681358	6172003
75	681388	6171634
76	680446	6171508
78	680782	6171250
79	680673	6170767
80	682014	6170267
82	682004	6169806
83	681810	6169398
84	681373	6167591
85	681917	6167300
86	681730	6166773

Turbine ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
87	681536	6166404
18	678502	6182471
119	683654	6152722
120	684987	6152789
122	683572	6152343
124	685103	6152217
125	684396	6152175
127	684307	6151723
128	683138	6151393
129	684402	6151298
131	683001	6150684
135	679301	6180383
136	680809	6181821
137	680652	6181414
138	680607	6181022
139	680934	6177688
141	680488	6175710
142	684592	6152523
143	681415	6167988
130	683127	6151016
146	684178	6174388
147	684451	6173978
148	684474	6173545
150	682052	6170803
145	686104	6154215
151	677325	6185689

3 RESIDENCES SURROUNDING THE WIND FARM

Residences located in the vicinity of the wind farm are listed in Table 2. The status of the land owners (associated or non-associated) of the residences are indicated, including residence R192 which has been acquired by the wind farm.

Table 2: Residences

ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
Associated Residences		
R01	677,418	6,187,127
R02	678,095	6,185,733
R14	677,807	6,183,115
R15	675,095	6,182,805
R16	677,297	6,181,991
R20	676,130	6,181,544
R25	677,075	6,178,323
R31	679,304	6,177,019
R34	681,817	6,174,338
R36	679,988	6,173,811
R40	678,605	6,171,136
R41	681,870	6,168,503
R42	683,370	6,168,206
R44	679,986	6,166,322
R46	681,835	6,164,679
R49	680,667	6,162,540
R51	680,970	6,161,588
R52	684,135	6,161,246
R54	683,514	6,155,819
R56	686,567	6,153,140
R59	684,670	6,149,654
R60	684,244	6,149,529
R61	684,489	6,149,335
R64	676,239	6,180,502
R66	683,628	6,159,544
R72	677,635	6,173,854
R73	677,725	6,173,856
R80	679,215	6,168,709
R113	684,054	6,179,129
R114	683,962	6,183,346
R128	678,848	6,183,498
R131	674,633	6,183,862
R132	675,005	6,182,884
R328	674,877	6,183,534
Associated Residences – Acquired by wind farm		
R192	675,172	6,179,170

ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
Non-Associated Residences		
R4	680,436	6,185,190
R06	681,484	6,184,020
R07	681,917	6,183,967
R08	682,339	6,183,864
R09	682,517	6,183,838
R10	682,842	6,183,767
R11	679,650	6,183,618
R17	676,127	6,181,740
R18	676,024	6,181,739
R19	676,412	6,181,665
R22	676,095	6,181,037
R24	683,597	6,178,847
R26	676,523	6,178,178
R28	684,090	6,177,918
R29	676,434	6,177,903
R38	679,623	6,173,620
R45	682,847	6,165,279
R47	680,155	6,162,689
R48	679,834	6,162,662
R50	680,701	6,161,784
R53	680,877	6,160,875
R63	683,875	6,148,991
R65	676,668	6,179,644
R67	683,606	6,159,059
R68	684,235	6,160,336
R69	676,002	6,175,948
R70	675,919	6,175,950
R71	675,814	6,175,406
R74	677,256	6,172,562
R75	677,851	6,172,291
R76	676,803	6,171,944
R77	677,654	6,169,542
R78	676,707	6,169,056
R79	676,671	6,168,992
R81	678,216	6,166,375
R82	677,982	6,165,692
R83	678,818	6,162,988
R85	680,217	6,161,078
R86	680,739	6,159,422

ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
Non-Associated Residences		
R87	682,469	6,156,694
R88	682,860	6,156,066
R89	681,098	6,154,853
R90	680,583	6,151,407
R91	680,875	6,148,463
R92	681,812	6,147,909
R93	680,723	6,147,619
R94	680,028	6,147,815
R95	680,529	6,147,037
R96	680,529	6,146,998
R97	681,049	6,146,176
R98	684,400	6,148,461
R99	689,280	6,153,857
R100	684,738	6,148,432
R101	688,189	6,154,931
R102	685,395	6,158,972
R103	688,158	6,159,213
R104	688,448	6,159,572
R105	688,749	6,159,082
R106	688,206	6,160,370
R107	686,879	6,160,480
R108	685,842	6,160,591
R109	684,831	6,165,424
R110	684,391	6,165,083
R111	684,234	6,167,383
R112	686,151	6,177,467
R115	684,767	6,183,708
R116	681,337	6,185,781
R117	681,030	6,186,528
R118	681,128	6,186,796
R119	679,979	6,187,579
R120	679,167	6,188,823
R121	673,113	6,188,366
R122	671,741	6,187,148
R124	673,168	6,185,478
R125	673,241	6,185,272
R126	673,137	6,186,723
R127	672,865	6,184,811
R129	687,424	6,148,652

ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
Non-Associated Residences		
R130	673,183	6,185,598
R133	680,562	6,147,046
R135	679,999	6,147,821
R137	686,573	6,148,420
R138	686,660	6,148,328
R139	687,199	6,148,339
R140	687,418	6,148,615
R141	687,456	6,149,042
R142	688,783	6,148,859
R143	688,712	6,149,106
R144	688,869	6,149,542
R145	678,834	6,149,712
R146	688,806	6,149,898
R147	678,909	6,150,247
R148	678,110	6,150,900
R149	678,227	6,152,209
R151	689,009	6,153,254
R152	678,918	6,153,120
R153	689,004	6,153,469
R154	679,214	6,154,085
R155	682,087	6,155,970
R156	682,424	6,156,503
R157	682,567	6,157,576
R158	679,832	6,158,239
R159	680,150	6,158,414
R160	686,516	6,163,209
R161	686,558	6,163,349
R162	686,194	6,163,423
R163	686,122	6,163,365
R164	686,179	6,163,303
R165	686,730	6,164,124
R166	686,578	6,164,097
R167	686,605	6,163,812
R168	686,585	6,163,793
R169	686,768	6,164,315
R170	683,284	6,165,017
R175	689,083	6,176,435
R177	675,210	6,178,587
R179	675,135	6,178,717
R180	675,088	6,178,761
R181	674,875	6,178,540
R182	675,037	6,178,486
R183	674,578	6,178,693
R184	673,469	6,178,896
R185	674,831	6,178,963
R186	675,142	6,178,988
R187	675,113	6,178,835
R188	675,224	6,179,170

ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
Non-Associated Residences		
R189	674,755	6,179,114
R190	674,929	6,179,085
R191	674,993	6,179,119
R193	675,059	6,178,927
R194	675,004	6,178,932
R195	674,752	6,178,927
R196	674,852	6,178,901
R197	675,003	6,178,871
R198	675,154	6,178,827
R199	675,207	6,178,841
R200	675,115	6,178,809
R202	684,519	6,179,497
R203	676,049	6,179,500
R204	675,863	6,179,390
R206	685,306	6,180,642
R207	672,288	6,187,479
R209	672,542	6,188,800
R210	672,541	6,189,270
R211	687,811	6,148,549
R212	689,159	6,149,506
R213	679,947	6,154,232
R214	679,299	6,153,729
R216	690,718	6,155,201
R217	679,547	6,155,316
R218	687,614	6,160,188
R219	686,206	6,164,280
R220	686,269	6,165,266
R223	674,862	6,178,409
R226	675,069	6,178,599
R230	675,291	6,179,035
R232	674,827	6,178,687
R234	674,816	6,178,852
R243	681,627	6,156,031
R244	679,843	6,157,268
R246	678,838	6,153,796
R259	679,376	6,155,053
R262	680,441	6,154,534
R266	676,126	6,178,067
R267	675,619	6,180,141
R268	675,798	6,179,747
R269	675,542	6,178,459
R270	675,545	6,178,651
R271	675,812	6,176,676
R272	675,077	6,178,674
R274	675,072	6,178,723
R276	674,959	6,179,291
R277	674,797	6,177,072
R278	674,900	6,178,637

ID	Coordinates (UTM WGS84 H44)	
	Easting	Northing
Non-Associated Residences		
R279	674,830	6,177,839
R280	674,827	6,178,559
R281	674,896	6,178,572
R282	672,813	6,183,624
R283	674,251	6,179,077
R284	674,150	6,179,201
R286	683,162	6,184,437
R288	675,035	6,179,594
R289	672,895	6,185,072
R290	685,210	6,146,484
R291	686,571	6,146,903
R292	674,883	6,178,516
R294	681,540	6,148,503
R295	689,276	6,153,049
R296	689,334	6,159,068
R298	677,624	6,169,761
R303	675,012	6,174,765
R304	673,912	6,168,651
R305	673,040	6,169,296
R307	674,148	6,169,506
R308	685,152	6,146,518
R309	681,194	6,187,371
R310	674,929	6,179,121
R311	668,973	6,166,709
R313	690,893	6,155,645
R314	688,121	6,159,393
R315	686,718	6,158,805
R316	686,237	6,162,634
R317	686,240	6,165,612
R318	686,391	6,166,303
R319	686,200	6,179,899
R323	679,280	6,152,986
R324	680,449	6,161,468
R325	675,154	6,178,653
R326	680,497	6,158,049
R327	670,573	6,166,151
R329	673,626	6,185,507
R330	675,185	6,183,010

4 OPERATIONAL NOISE

4.1 CRITERIA

The Conditions of Consent specify the following operational noise criteria:

Operational Noise Criteria – Wind Turbines

11. The Applicant must ensure that the noise generated by the operation of wind turbines does not exceed the relevant criteria in Table 4 at any non-associated residence.

Table 4: Noise criteria dB(A)

Residence	Criteria (dB(A)) with Reference to Hub Height Wind Speed (m/s)							
	5	6	7	8	9	10	11	12
R1	35	35	36	37	39	41	43	46
R6, R7, R8, R9, R10,	35	35	35	35	35	37	38	40
R11	35	35	35	35	37	39	41	44
R17, R19, R20, R22	36	36	36	37	38	39	40	42
R26, R29, R38	35	35	35	35	35	35	35	35
R40, R65	35	35	35	35	35	35	37	40
R45, R170	35	35	35	35	35	37	40	42
R47, R48	35	35	35	35	35	36	38	40
R50, R53, R324	35	35	35	35	35	37	39	41
R56	35	35	35	35	36	38	40	41
R63	36	37	38	39	41	42	44	45
All other non-associated residences	The higher of 35 dB(A) or the existing background noise level ($L_{A90\ (10\text{-minute})}$) plus 5 dB(A)							

Note: To identify the residences referred to in Table 4, see the applicable figure in Appendix 2.

Noise generated by the operation of the wind turbines is to be measured in accordance with the relevant requirements of the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2009* (or its latest version), as modified by the provisions in Appendix 4. If this guideline is replaced by an equivalent NSW guideline, then the noise generated is to be measured in accordance with the requirements in the NSW guideline.

However, these criteria do not apply if the Applicant has an agreement with the relevant owner/s of these residences to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

A criterion of 45 dB(A) has been applied for associated residences (being where the *Applicant has an agreement with the relevant owner/s to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement*). Residence R192 has been acquired by the wind farm and therefore has no noise limit applied.

4.2 ASSESSMENT

4.2.1 Layout and Details

Noise predictions have been based on GE 158 5.5MW WTGs with a tip height of 200m.

One-third octave band sound power level data for the WTG has been based on *Technical Documentation Wind Turbine Generator System 5.3-158-50Hz (Noise_Emission-NRO_5.3-158-50Hz_IEC_NRO100-105_EN_r02.docx)* and the addition of 1.5 dB(A) for uncertainty.

The sound power levels for the standard operating mode and noise reduced modes are summarised in Appendix A, with the uncertainty added. The one-third octave band data demonstrate that no penalty for the presence of tonal characteristics is warranted.

4.2.2 Noise Propagation Model – ISO 9613-2

ISO 9613-2[1] provides a methodology for predicting noise levels at sensitive land use receptors under meteorological conditions favourable to noise propagation. It is known as a downwind model, based on the conservative assumption of a receptor being downwind (resulting in the highest noise level) of all turbines simultaneously. The noise prediction model inputs are in accordance with the *May 2013 UK IOA Good Practice Guide*, including:

- 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; and,
- application of a 3 dB(A) correction where a "concave" ground profile exists as defined by the *May 2013 UK IOA Good Practice Guide*.

[1] *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors*

4.2.3 Predictions

The noise level at the residences has been predicted for wind speeds from cut in to rated power. Where the noise level is predicted to be 30 dB(A) or greater, Table 3 below provides the environmental noise criteria and predicted noise levels for each integer wind speed. Where the criteria are predicted to be exceeded, the values are in **RED**. A noise level contour is also provided, corresponding to wind speeds of 9-15m/s, being the wind speeds of the highest predicted noise level.

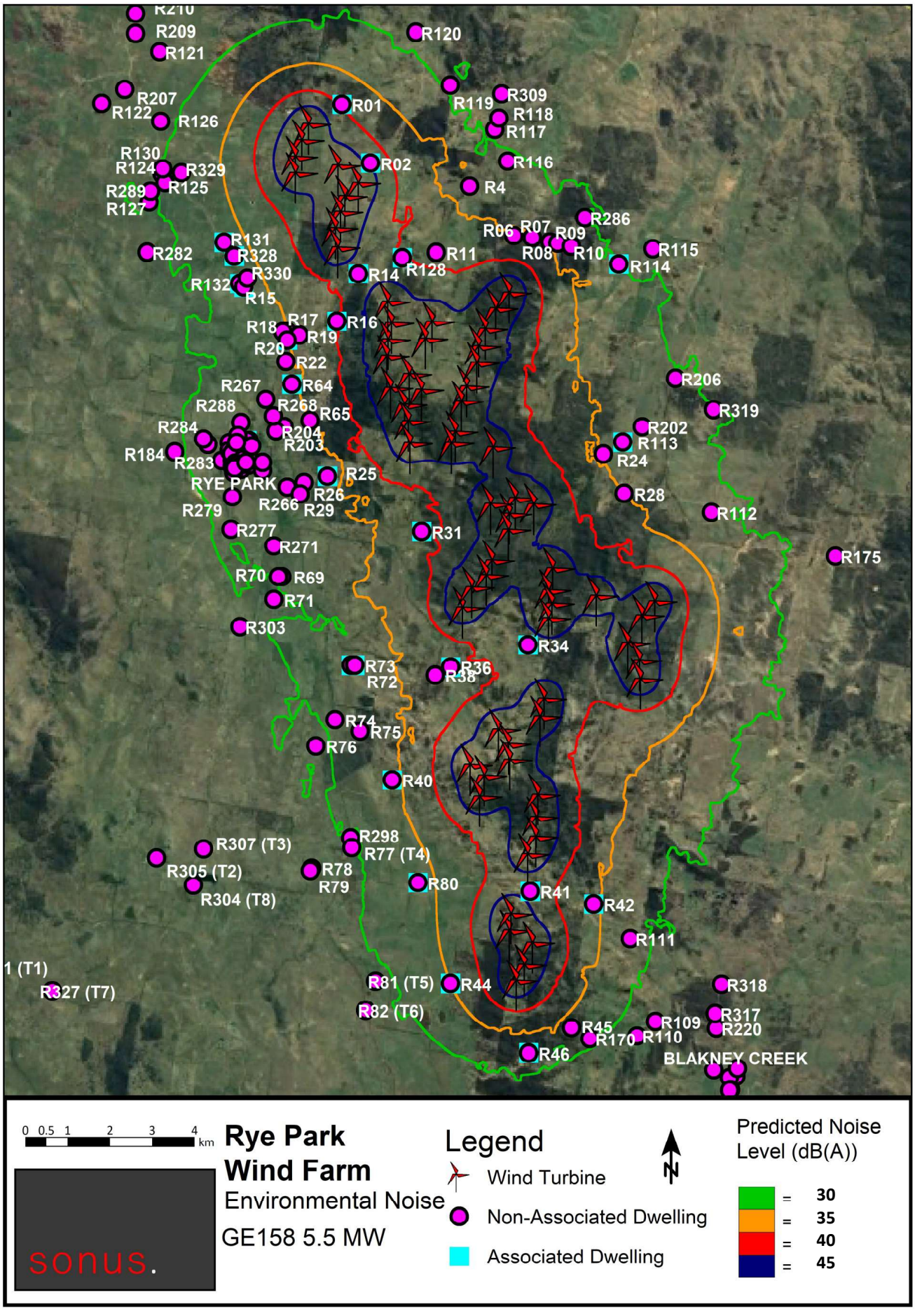
Table 3: Comparison of GE158 5.5MW Predicted Noise Levels with Operational Noise Criteria.

Residence	Predicted Noise Level and Operational Noise Criteria (dB(A)) at Hub Height (m) Integer Wind Speeds											
	4 m/s		5 m/s		6 m/s		7 m/s		8 m/s		9-15m/s	
	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.[2]
Associated Residences												
R01	29	45	30	45	33	45	36	45	39	45	40	45
R02	33	45	34	45	37	45	40	45	43	45	44	45
R14	31	45	32	45	35	45	38	45	41	45	42	45
R15	23	45	24	45	27	45	30	45	32	45	33	45
R16	29	45	30	45	33	45	36	45	39	45	40	45
R20	24	45	26	45	29	45	31	45	34	45	35	45
R25	23	45	25	45	27	45	30	45	33	45	34	45
R31	28	45	29	45	32	45	35	45	37	45	38	45
R34	32	45	33	45	36	45	39	45	41	45	42	45
R36	27	45	28	45	31	45	34	45	37	45	38	45
R40	23	45	25	45	28	45	30	45	33	45	34	45
R41	32	45	33	45	36	45	39	45	42	45	43	45
R42	25	45	26	45	29	45	32	45	35	45	36	45
R44	24	45	25	45	28	45	31	45	34	45	35	45
R46	22	45	23	45	26	45	29	45	31	45	32	45
R56	26	45	27	45	30	45	33	45	36	45	37	45
R59	24	45	26	45	28	45	32	45	34	45	35	45
R60	25	45	26	45	29	45	32	45	34	45	35	45
R61	23	45	24	45	27	45	30	45	33	45	34	45
R64	24	45	25	45	28	45	31	45	33	45	35	45
R72	21	45	23	45	25	45	28	45	30	45	31	45
R73	21	45	23	45	26	45	28	45	31	45	32	45
R80	23	45	24	45	27	45	30	45	33	45	34	45
R113	23	45	24	45	27	45	30	45	32	45	33	45
R114	20	45	22	45	24	45	27	45	29	45	30	45
R128	29	45	31	45	34	45	37	45	39	45	40	45
R131	23	45	24	45	27	45	30	45	32	45	33	45
R132	23	45	24	45	27	45	30	45	32	45	33	45
R328	23	45	24	45	27	45	30	45	32	45	34	45
Non-Associated Residence												
R04	23	35	24	35	27	35	30	35	32	35	33	35
R06	25	35	27	35	29	35	33	35	35	35	**36**	**35**
R07	25	35	26	35	29	35	32	35	35	35	**36**	**35**
R08	24	35	25	35	28	35	31	35	33	35	35	35
R09	23	35	25	35	27	35	30	35	33	35	34	35
R10	23	35	24	35	27	35	30	35	32	35	33	35
R11	28	35	29	35	32	35	35	35	**37**	**35**	**38**	**37**
R17	25	36	26	36	29	36	32	36	34	37	35	38
R18	24	35	26	35	28	35	31	35	34	35	35	35

[2] *Criteria based on 9m/s*

Residence	Predicted Noise Level and Operational Noise Criteria (dB(A)) at Hub Height (m) Integer Wind Speeds											
	4 m/s		5 m/s		6 m/s		7 m/s		8 m/s		9-15m/s	
	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.[2]
R19	25	36	27	36	30	36	32	36	35	37	36	38
R22	24	36	25	36	28	36	31	36	33	37	34	38
R24	24	35	25	35	28	35	31	35	33	35	34	35
R26	23	35	24	35	27	35	29	35	32	35	33	35
R28	25	35	26	35	29	35	32	35	34	35	35	35
R29	22	35	24	35	26	35	29	35	31	35	32	35
R38	27	35	28	35	31	35	34	35	**36**	**35**	**37**	**35**
R45	23	35	24	35	27	35	30	35	32	35	33	35
R63	22	36	24	36	27	37	30	38	32	39	33	41
R65	25	35	26	35	29	35	32	35	34	35	35	35
R69	20	35	22	35	24	35	27	35	29	35	30	35
R70	20	35	22	35	24	35	27	35	29	35	30	35
R71	20	35	21	35	24	35	26	35	29	35	30	35
R74	20	35	22	35	24	35	27	35	29	35	30	35
R75	21	35	22	35	25	35	27	35	30	35	31	35
R76	20	35	21	35	24	35	26	35	28	35	30	35
R77	20	35	21	35	24	35	27	35	29	35	30	35
R90	20	35	21	35	24	35	27	35	30	35	31	35
R98	20	35	21	35	24	35	27	35	29	35	30	35
R111	21	35	23	35	26	35	28	35	31	35	32	35
R112	22	35	23	35	26	35	29	35	31	35	32	35
R116	20	35	22	35	24	35	27	35	30	35	31	35
R119	19	35	21	35	23	35	26	35	28	35	30	35
R124	20	35	22	35	24	35	27	35	29	35	30	35
R125	20	35	22	35	24	35	27	35	29	35	31	35
R127	20	35	21	35	23	35	26	35	28	35	30	35
R130	20	35	22	35	24	35	27	35	29	35	30	35
R170	20	35	22	35	24	35	27	35	30	35	31	35
R177	21	35	23	35	25	35	28	35	30	35	31	35
R179	21	35	23	35	25	35	28	35	30	35	31	35
R180	21	35	23	35	25	35	28	35	30	35	31	35
R181	21	35	23	35	25	35	28	35	30	35	31	35
R182	21	35	22	35	25	35	28	35	30	35	31	35
R183	21	35	23	35	25	35	28	35	30	35	31	35
R184	20	35	21	35	24	35	26	35	29	35	30	35
R185	22	35	23	35	26	35	28	35	31	35	32	35
R186	21	35	23	35	25	35	28	35	30	35	32	35
R187	21	35	23	35	25	35	28	35	30	35	31	35
R188	22	35	23	35	26	35	28	35	31	35	32	35
R189	21	35	23	35	25	35	28	35	30	35	31	35
R190	22	35	23	35	26	35	28	35	30	35	32	35
R191	21	35	23	35	25	35	28	35	30	35	31	35
R193	21	35	23	35	25	35	28	35	30	35	31	35
R194	21	35	23	35	25	35	28	35	30	35	31	35
R195	22	35	23	35	26	35	28	35	31	35	32	35
R196	22	35	23	35	26	35	28	35	31	35	32	35
R197	21	35	23	35	25	35	28	35	30	35	31	35
R198	21	35	23	35	25	35	28	35	30	35	31	35
R199	21	35	23	35	25	35	28	35	30	35	31	35
R200	21	35	23	35	25	35	28	35	30	35	31	35
R202	22	35	23	35	26	35	29	35	31	35	32	35
R203	23	35	24	35	27	35	30	35	32	35	33	35
R204	22	35	24	35	26	35	29	35	32	35	33	35
R206	20	35	22	35	24	35	27	35	29	35	30	35
R223	21	35	22	35	25	35	28	35	30	35	31	35

Residence	Predicted Noise Level and Operational Noise Criteria (dB(A)) at Hub Height (m) Integer Wind Speeds											
	4 m/s		5 m/s		6 m/s		7 m/s		8 m/s		9-15m/s	
	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.[2]
R226	21	35	22	35	25	35	28	35	30	35	31	35
R230	22	35	23	35	26	35	28	35	31	35	32	35
R232	22	35	23	35	26	35	28	35	30	35	32	35
R234	22	35	23	35	26	35	28	35	31	35	32	35
R266	22	35	23	35	26	35	29	35	31	35	32	35
R267	22	35	24	35	26	35	29	35	32	35	33	35
R268	23	35	24	35	27	35	29	35	32	35	33	35
R269	21	35	23	35	25	35	28	35	30	35	31	35
R270	22	35	23	35	26	35	28	35	31	35	32	35
R271	21	35	22	35	25	35	27	35	30	35	31	35
R272	21	35	23	35	25	35	28	35	30	35	31	35
R274	21	35	23	35	25	35	28	35	30	35	31	35
R276	21	35	23	35	25	35	28	35	30	35	31	35
R277	21	35	22	35	25	35	27	35	30	35	31	35
R278	21	35	23	35	25	35	28	35	30	35	31	35
R279	21	35	22	35	25	35	28	35	30	35	31	35
R280	21	35	23	35	25	35	28	35	30	35	31	35
R281	21	35	23	35	25	35	28	35	30	35	31	35
R283	20	35	22	35	24	35	27	35	29	35	30	35
R284	20	35	22	35	24	35	27	35	29	35	30	35
R286	22	35	23	35	26	35	29	35	31	35	32	35
R288	22	35	23	35	26	35	28	35	31	35	32	35
R289	20	35	21	35	24	35	26	35	29	35	30	35
R292	21	35	22	35	25	35	28	35	30	35	31	35
R298	20	35	21	35	24	35	27	35	29	35	30	35
R310	21	35	23	35	25	35	28	35	30	35	31	35
R319	20	35	22	35	24	35	27	35	29	35	30	35
R325	21	35	23	35	25	35	28	35	30	35	31	35
R329	21	35	22	35	25	35	28	35	30	35	31	35
R330	24	35	25	35	28	35	30	35	33	35	34	35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R01
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R309
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R289
R127
R02
R116
R4
R286
R06
R07
R09
R08
R10
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R114
R131
R282
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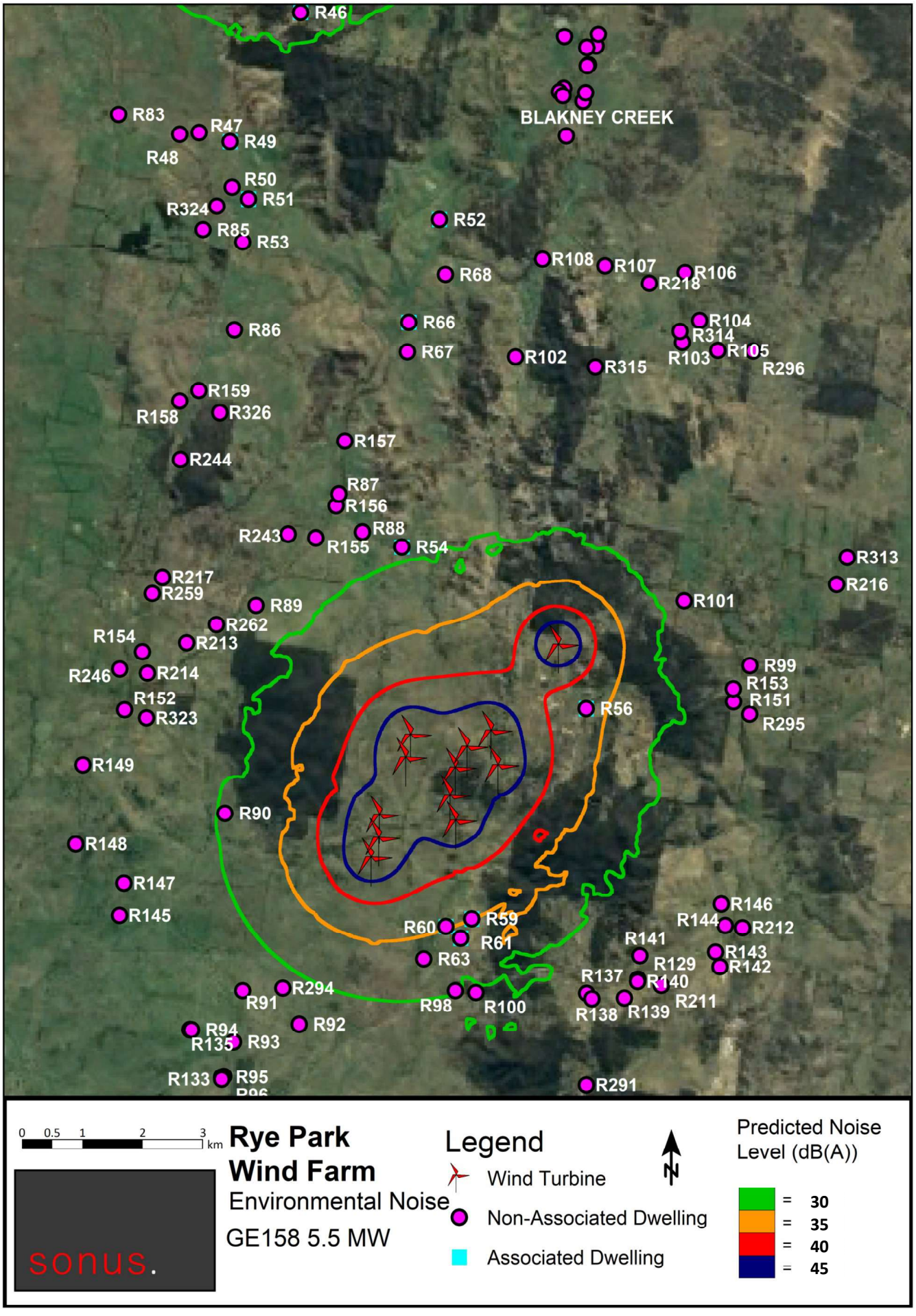
R22
R206
R267
R64
R319
R288
R268
R65
R284
R204
R202
R203
R113
R184
R283
R24
RYE PARK
R25
R28
R26
R266
R29
R279
R112
R277
R31
R271
R175
R70
R69
R71
R303
R34
R73
R72
R36
R38
R74
R75
R76
R40
R307 (T3)
R298
R77 (T4)
R305 (T2)
R78
R79
R80
R41
R42
R304 (T8)
R111
1 (T1)
R327 (T7)
R81 (T5)
R44
R318
R82 (T6)
R317
R45
R109
R220
R170
R110
R46
BLAKNEY CREEK
0 0.5 1 2 3 4 km
Rye Park
Wind Farm
Environmental Noise
GE158 5.5 MW
sonus.
Legend
Wind Turbine
Non-Associated Dwelling
Associated Dwelling
N
Predicted Noise Level (dB(A))
= 30
= 35
= 40
= 45


R46
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R324
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R53
R52
BLAKNEY CREEK
R108
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R218
R68
R66
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R153
R152
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R137
R140
R294
R91
R98
R100
R211
R138
R139
R92
R94
R135
R93
R133
R95
R291
0 0.5 1 2 3 km
Rye Park Wind Farm
Environmental Noise
GE158 5.5 MW
sonus.
Legend
Wind Turbine
Non-Associated Dwelling
Associated Dwelling
N
Predicted Noise Level (dB(A))
= 30
= 35
= 40
= 45

Based on the predictions in Table 3, the noise from the 80 *GE 158 6.5MW* WTGs will achieve the operational noise criteria at all residences in the vicinity of the wind farm, with the exception of R06, R07, R11 and R38.

4.2.4 Curtailment

A curtailment regime has been determined in order to ensure the noise from the wind farm achieves the criteria at all residences and under all wind speeds. The curtailment regime involves operating selected turbines in a noise reduced mode at the wind speeds where the predictions indicate that the criteria will be exceeded.

Table 4 summarises the noise criteria and predicted noise level for wind speeds which require turbines to be curtailed.

Table 4: Predicted noise level exceeds criteria.

Residence	Predicted Noise Level and Operational Noise Criteria (dB(A)) at Hub Height (m) Integer Wind Speeds					
	8 m/s		9m/s		10+ m/s	
	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.
R06	35	35	**36**	**35**	36	37
R07	35	35	**36**	**35**	36	37
R11	**37**	**35**	**38**	**37**	38	39
R38	**36**	**35**	**37**	**35**	**37**	**35**

Based on the above, the curtailment strategy has been determined using the reduced noise modes of the GE 158 turbine. The sound power level for the reduced noise modes are provided in Appendix A, with the 1.5 dB(A) uncertainty added.

Table 5 below provides the noise modes and applicable turbines which are required to operate in these modes in order to ensure the criteria are achieved.

Table 5: Curtailed operating strategy.

	Noise Reduced Mode Operation @ Hub Height (m) Integer Wind Speeds		
Turbine	**8 m/s**	**9m/s**	**10+ m/s**
12, 26, 137, 11	NRO 100	-	-
18, 22	NRO 100	NRO102	-
20	NRO 100	NRO103	-
17, 21, 25, 136	NRO 100	NRO104	-
71	-	NRO 105	NRO 105
74, 61	-	NRO 103	NRO 103
76	NRO 102	NRO 102	NRO 102
62	NRO 103	NRO 100	NRO 100
67, 141, 73	NRO 100	NRO 100	NRO 100

The following table provides the predicted noise levels at the specific residences where the criteria were predicted to be exceeded, with the turbines operating under the curtailment strategy described above.

Table6: Predicted noise level for curtailed operating strategy.

Residence	Predicted Noise Level and Operational Noise Criteria (dB(A)) at Hub Height (m) Integer Wind Speeds									
	8 m/s		9m/s		10 m/s		11 m/s		12+ m/s	
	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.	Pred.	Crit.
R06	32	35	35	35	36	37	36	38	36	40
R07	32	35	35	35	36	37	36	38	36	40
R11	35	35	37	37	38	39	38	41	38	44
R38	35	35	35	35	35	35	35	35	35	35

That is, with the curtailment strategy implemented for wind speeds of 8m/s and above, the noise level from the wind farm is predicted to achieve the noise criteria at all residences in the vicinity.

It is noted that the addition of 1.5 dB(A) to the sound power levels for uncertainty is a conservative approach and if the sound power levels of the installed turbines have lower sound power levels than assumed, a lesser curtailment strategy would be implemented.

The modelled turbine also has one of the highest noise emissions of those on the market. The need for curtailment and the final operating strategy will therefore be determined during the pre-construction noise assessment, once the final turbine selection, layout and guaranteed sound power levels are known.

5 CORONA AND AEOLIAN NOISE ASSESSMENT

As a part of the proposed wind farm modification, the location of an overhead electrical transmission line is proposed to be altered. Consideration has therefore been given to Corona and Aeolian noise from the transmission line, although these characteristics are infrequent and independent of the transmission line location.

As noted in the Sonus report S3200C9 February 2016, Corona and Aeolian noise can be generated from transmission lines.

Corona noise is electrically-induced and occurs under specific conditions when the transmission lines are operational.

Aeolian noise is wind-induced and occurs under specific conditions regardless of whether the transmission lines are operational or not.

Corona noise is infrequent and typically occurs in specific conditions of rain or high humidity when the air adjacent to a conductor of high voltage lines is ionised and becomes a conductor of electricity. The noise that is produced is typically at a low level that is rarely a problem at distances greater than 50 to 100m from the transmission lines.

Aeolian noise is also infrequent and occurs at times when there is a specific wind speed and direction to generate the mechanism of high velocity wind passing over thin structures. As Aeolian noise generally only occurs during high wind speeds, there are also generally high background noise levels. As such, the distances of influence are often similar to that for Corona noise.

Based on the above, the noise impact of transmission lines is generally dealt with by maintaining the separation distances required in the consideration of other factors related to the lines.

6 WIND FARM CONSTRUCTION

6.1 CRITERIA

The construction of a wind farm comprises activities such as road construction, civil works, excavation, foundation construction, electrical infrastructure works and turbine erection. These require processes such as heavy vehicle movements, crushing and screening, concrete batching, loaders, excavators, generators, cranes and subject to local conditions possibly blasting.

The Conditions of Development Consent for the approved wind farm include the following requirements relating to construction noise;

Construction & Decommissioning Noise

7. The Applicant must:

(a) minimise the construction or decommissioning noise of the development, including any associated traffic noise; and

(b) ensure that the noise generated by any construction or decommissioning activities is managed in accordance with the best practice requirements outlined in the Interim Construction Noise Guideline(DECC, 2009), or its latest version.

8. Unless the Secretary agrees otherwise, the Applicant must only undertake construction or decommissioning activities between:

(a) 7 am to 6 pm Monday to Friday;

(b) 8 am to 1 pm Saturdays; and

(c) at no time on Sundays and NSW public holidays.

The following construction or decommissioning activities may be undertaken outside these hours without the approval of the Secretary:

- *activities that are inaudible at non-associated residences;*
- *the delivery of materials requested by the NSW Police Force or other authorities for safety reasons; or*
- *emergency work to avoid the loss of life, property and/or material harm to the environment.*
- *Blasting*

9. The Applicant may only carry out blasting on site between 9 am and 5 pm Monday to Friday and between 8 am to 1 pm on Saturday. No blasting is allowed on Sundays or public holidays.

10. The Applicant must ensure that any blasting carried out on site does not exceed the criteria in Table 3.

Table 3: Blasting criteria

Location	*Airblast overpressure (dB(Lin Peak))*	*Ground vibration(mm/s)*	*Allowable exceedance*
Any non-associated residence	*120*	*10*	*0%*
	115	*5*	*5% of the total number of blasts or events over a rolling period of 12 months*

In accordance with the above, construction noise criteria have been determining based on the Department of Environment & Climate Change *Interim Construction Noise Guideline 2009* (the ICN Guideline).

As noted in the Sonus report S3200C9 February 2016, the ambient noise environment was monitored at 20 residences in the vicinity of the wind farm and the results were often below 30 dB(A). Therefore, in accordance with the INP, an RBL of 30 dB(A) has been considered for all residences in the assessment.

The ICN Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not set mandatory objective criteria. However, the ICN Guideline does establish a quantitative approach, whereby "management levels" are defined based on the existing RBL. The management levels as defined by the ICN Guideline are provided in Table 7 below.

Table 7: ICN Criteria.

Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:

		1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

6.2 Construction Activity Assessment

6.2.1 WTG Installation

The separation distance of the closest non-associated dwelling to a proposed WTG is approximately 1200m. A separation distance greater than 1200m will result in lower noise levels than that presented below in the table below. The required separation distance in order to achieve the 40 dB(A) criterion, which is 10 dB(A) above the RBL, is provided in Table 8 also.

Table 8: Predicted construction noise levels and distances.

Phase	Main Plant and Equipment	Predicted Noise Level at 1200m	Separation to Achieve 40 dB(A) Criterion
Site Set-Up and Civil Works	Generator Transport truck Excavator Low loader	44 dB(A)	1650m
Road and Hard Stand Construction	Mobile crushing and screening plant Dozer Roller Low loader Tipper truck Excavator Scraper Transport truck	50 dB(A)	2400m

Phase	Main Plant and Equipment	Predicted Noise Level at 1200m	Separation to Achieve 40 dB(A) Criterion
Excavation and foundation construction	Excavator Front end loader Concrete batching plant Mobile crushing and screening plant Truck-mounted concrete pump Concrete mixer truck Mobile crane Transport truck Tipper truck	50 dB(A)	2400m
Electrical Installation	Rock trencher Concrete mixer truck Low loader Tipper truck Mobile crane	50 dB(A)	2400m
Turbine Delivery and Erection	Extendable trailer truck Low loader Mobile crane	45 dB(A)	1800m

Based on the predicted noise levels, it is expected that construction noise from the WTG installation will be greater than 40 dB(A) at a distance of 1200m. The predicted noise levels are significantly less than the 75 dB(A) upper limit provided in the ICN Guideline.

Based on the above, it is possible that a dwelling located between 1200m and up to 2400m from a WTG may be defined as “noise affected” but not “highly noise affected” by the ICN Guideline.

6.2.2 Access Roads

Access to the WTG sites will be via a specifically constructed road network. The separation distance of the closest non-associated dwelling to a designated access road is approximately 330m. The noise from typical road construction activity, such as described in Table 10 has been predicted to be 61 dB(A) at 330m.

Based on the above, it is possible that a dwelling located between 330m and up to 2400m from an access road may be defined as “noise affected” but not “highly noise affected” by the ICN Guideline.

6.2.3 Batching Plant

Three temporary batching plants have been proposed for the construction phase, at the locations in Table 9.

Table 9: Batching plant locations.

	Coordinates (UTM WGS84 H55)	
	Easting	**Northing**
Batching Plant 1	679110	6182542
Batching Plant 2	679163	6165826
Batching Plant 3	684101	6150395

The closest non-associated dwelling to a proposed batching plant is approximately 1100m away. The noise from typical batching plant machinery, such as cement trucks, loaders, and delivery trucks has been predicted to be 34 dB(A) at 1100m.

6.2.4 Noise Mitigation

Where residences are classed as "noise affected" by the ICN Guideline, the developer is required to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work.

"Feasible and reasonable" noise control strategies to minimise noise during construction may include engineering measures such as the construction of temporary acoustic barriers, the use of proprietary enclosures around machines, the use of silencers, the substitution of alternative construction processes and the fitting of broadband reversing signals. It may also include administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

The following mitigation measures are recommended to be implemented for the construction works and provide the framework for the development of a Construction Management Plan by the construction team once the final construction methods, timing, locations and equipment have been determined.

6.2.4.1 Scheduling

Construction works, including heavy vehicle movements into and out of the site, restricted to the hours between 7am and 6pm Monday to Friday, and between 8am and 1pm on Saturdays. Works carried out outside of the hours should only entail:

- works that do not cause noise emissions to be audible at any nearby residences not located on the site; or
- the delivery of materials as requested by Police or other authorities for safety reasons; or

- emergency work to avoid the loss of lives, property, and/or to prevent environmental harm.

If any other works are required outside of the specified hours, they will only be carried out with the prior consent of the relevant New South Wales authority.

6.2.4.2 Location of Fixed Noise Sources

Locate fixed noise sources such as crushing and screening plant, generators and compressors at the maximum practicable distance to the nearest dwellings, and where practicable, use existing landforms to block line of sight between the fixed noise source and the dwelling.

6.2.4.3 Provide Acoustic Screens around Fixed Noise Sources

Provide acoustic screens or mounding for fixed crushing and screening plant, and concrete batching plant wherever these noise sources are located within 2400m of a non-associated dwelling and do not have direct line of sight blocked to that dwelling, in accordance with the following requirements:

- Locate the screen as close as practicable to the noise source;
- Construct from mounding using excavated soil from the site or a material with a minimum surface density of 10 kg/m^2, such as 1.2mm thick sheet steel or 9mm thick compressed fibre cement sheeting, or use purpose built transportable sound barriers such as the Peace “Sound Barriers”;
- Construct to a minimum height that blocks direct line of sight between the noise source and any receiver within 2400m;
- Construct such that there are no air gaps or openings at joints;
- Extend such that the length is at least 5 times greater than its height or so that it is bent around the noise source;

In addition, the site topography, and other shielding features (e.g. large stationary machines, mounds of topsoil and piles of materials) should be used for increased shielding when locating fixed noise sources within the 2400m distance.

6.2.4.4 Enclose Generators and Compressors

Provide proprietary acoustic enclosures for site compressors and generators located within 2400m of a non-associated dwelling.

6.2.4.5 Alternative Processes

Investigate and implement alternative processes where feasible and reasonable, such as hydraulic or chemical splitters as an alternative to impact rock breaking, or the use of broadband reversing alarms in lieu of the high pitched devices. A broadband reversing alarm emits a unique sound which addresses the annoyance from the high pitched devices. The fitting of a broadband alarm should be subject to an appropriate risk assessment, with the construction team being responsible for ensuring the alarms are installed and operated in accordance with all relevant occupational, health and safety legislative requirements.

6.2.4.6 Site Management

- Select and locate centralised site activities and material stores as far from noise-sensitive receivers as possible;
- Care should be taken not to drop materials such as rock, to cause peak noise events, including materials from a height into a truck. Site personnel should be directed as part of a training regime to place material rather than drop it;
- Plant known to emit noise strongly in one direction, such as the exhaust outlet of an attenuated generator set, shall be orientated so that the noise is directed away from noise sensitive areas if practicable;
- Machines that are used intermittently shall be shut down in the intervening periods between works or throttled down to a minimum;
- Implement worksite induction training, educating staff.

6.2.4.7 Equipment and Vehicle Management

- Ensure equipment has Original Equipment Manufacturer (OEM) mufflers (or better) installed;
- Ensure equipment is well maintained and fitted with adequately maintained silencers which meet the OEM design specifications. This inspection should be part of a monitoring regime;
- Ensure silencers and enclosures are intact, rotating parts are balanced, loose bolts are tightened, frictional noise is reduced through lubrication and cutting noise reduced by keeping equipment sharp. These items should be part of a monitoring regime;
- Use only necessary power to complete the task;
- Inspect, as part of a monitoring regime, plant and equipment to determine if it is noisier than other similar machines, and replace or rectify as required.

6.2.4.8 Community Consultation

Implement the following noise and vibration elements into the overall community consultation process. The aim of the consultation is to ensure adequate community awareness and notice of expected construction noise.

The minimum elements should include:

- Regular Community Information newsletters, providing details of the construction plan and duration of the construction phases;
- A site notice board in a community location providing copies of the newsletters, updated construction program details, and contact details of relevant project team members;
- A feedback mechanism for the community to submit questions to the construction team, and for the construction team to respond;
- Regular updates on the construction activities to local authorities to assist in complaint management if necessary;
- Contact details of the project manager and/or site "Environmental Representative".

In addition, prior to any construction activity occurring within 2400m of a dwelling without a commercial agreement, or significant construction traffic periods or impacts on local road conditions:

- Contact the local community potentially affected by the proposed works and inform them of the proposed work, the location of the work, the day(s) and date(s) of the work and the hours involved[3];
- This contact shall be made a reasonable time before the proposed commencement of the work; and
- Contact details of the project manager and / or site "Environmental Representative" should be provided.

The above measures should be incorporated and implemented through a Construction Noise Management Plan for the site. The Plan should be developed by the construction team once the actual construction activities have been determined.

[3] It is preferable to overestimate the hours of work, rather than extending the work hours for longer than anticipated.

6.3 Blasting Assessment

In accordance with the Conditions of Consent, all blasting (if conducted) will be undertaken in a manner which achieves the objective noise and vibration requirements.

The separation distances between any potential blasting activity and the nearest dwellings are of the order of magnitude for which ground vibration and airblast levels have been adequately controlled at other sites.

Given the range of factors associated with both the generation and control of blasting, it is recommended that in the event of blasting occurring, a monitoring regime is implemented to ensure compliance with the Blasting criteria.

APPENDIX A: WTG Sound Power Levels

Table 3: GE 158 5.5MW Sound Power Levels: Normal Operating Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	44.7	47.8	50.4	53.0
16 Hz	48.8	49.0	51.2	54.3	56.9	59.4
20 Hz	54.1	54.2	56.4	59.5	62.1	64.6
25 Hz	58.9	58.8	61.1	64.2	66.8	69.3
31.5 Hz	63.1	63.1	65.3	68.5	71.1	73.6
40 Hz	66.9	66.9	69.2	72.3	75.1	77.5
50 Hz	69.9	70.0	72.3	75.4	78.2	80.8
63 Hz	72.7	73.3	75.4	78.4	81.0	83.7
80 Hz	75.1	76.2	78.2	80.8	83.3	85.9
100 Hz	77.3	79.0	80.9	83.1	85.3	87.7
125 Hz	79.7	81.7	83.7	85.6	87.5	89.5
160 Hz	81.3	83.5	85.8	87.6	89.4	91.1
200 Hz	82.7	84.8	87.5	89.4	91.2	92.7
250 Hz	83.6	85.6	88.7	90.9	92.8	94.2
315 Hz	84.3	85.8	89.3	92.0	94.1	95.5
400 Hz	83.9	84.8	88.8	92.1	94.4	95.9
500 Hz	84.0	84.5	88.5	92.4	95.1	96.7
630 Hz	83.9	84.1	88.0	92.3	95.4	97.2
800 Hz	83.9	83.6	87.5	91.9	95.4	97.5
1 kHz	84.2	83.6	87.2	91.7	95.4	97.8
1.25 kHz	84.9	84.1	87.3	91.8	95.5	98.2
1.6 kHz	84.0	83.5	86.1	90.3	94.0	96.8
2 kHz	83.2	83.3	85.4	89.0	92.6	95.5
2.5 kHz	82.0	82.6	84.4	87.4	90.7	93.4
3.15 kHz	80.1	81.2	83.0	85.6	88.4	90.8
4 kHz	77.1	78.6	80.4	82.9	85.2	87.3
5 kHz	73.0	74.7	76.8	79.4	81.5	83.3
6.3 kHz	66.3	68.3	70.7	73.4	75.6	77.2
8 kHz	55.7	58.1	60.8	63.7	66.1	67.7
10 kHz	41.6	44.0	47.2	50.5	53.3	55.1
Total SWL (dB(A))	95.3	96.0	99.1	102.5	105.4	107.5

Table 3: GE 158 5.5MW Sound Power Levels: NRO 105 Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	44.4	47.6	50.2	52.0
16 Hz	48.8	48.9	50.9	54.1	56.7	58.4
20 Hz	54.1	54.1	56.1	59.3	61.9	63.6
25 Hz	58.8	58.8	60.8	64.0	66.6	68.3
31.5 Hz	63.0	63.1	65.1	68.3	70.9	72.6
40 Hz	66.9	66.9	68.9	72.1	74.9	76.5
50 Hz	69.9	70.0	72.1	75.2	78.0	79.8
63 Hz	72.7	73.3	75.2	78.2	80.8	82.7
80 Hz	75.1	76.2	78.0	80.6	83.1	84.9
100 Hz	77.3	78.9	80.6	82.9	85.1	86.7
125 Hz	79.6	81.7	83.5	85.4	87.3	88.5
160 Hz	81.3	83.5	85.6	87.4	89.2	90.1
200 Hz	82.6	84.8	87.3	89.2	91.0	91.7
250 Hz	83.6	85.5	88.4	90.7	92.6	93.2
315 Hz	84.2	85.7	89.1	91.8	93.9	94.5
400 Hz	83.9	84.8	88.5	91.9	94.2	94.9
500 Hz	84.0	84.5	88.3	92.2	94.9	95.7
630 Hz	83.9	84.1	87.8	92.1	95.2	96.2
800 Hz	83.9	83.6	87.3	91.7	95.2	96.5
1 kHz	84.2	83.6	87.0	91.4	95.2	96.8
1.25 kHz	84.8	84.0	87.1	91.6	95.3	97.2
1.6 kHz	83.9	83.5	85.9	90.1	93.8	95.8
2 kHz	83.2	83.3	85.1	88.8	92.4	94.5
2.5 kHz	82.0	82.5	84.2	87.2	90.4	92.4
3.15 kHz	80.1	81.2	82.8	85.4	88.1	89.8
4 kHz	77.1	78.5	80.2	82.7	85.0	86.3
5 kHz	73.0	74.7	76.6	79.2	81.3	82.3
6.3 kHz	66.3	68.3	70.5	73.2	75.4	76.2
8 kHz	55.7	58.1	60.6	63.5	65.9	66.7
10 kHz	41.6	44.0	46.9	50.3	53.0	54.1
Total SWL (dB(A))	95.3	96.0	98.9	102.3	105.2	106.5

Table 3: GE 158 5.5MW Sound Power Levels: NRO 104 Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	44.3	47.4	50.0	50.9
16 Hz	48.8	48.9	50.8	53.9	56.4	57.3
20 Hz	54.1	54.1	56.0	59.1	61.7	62.5
25 Hz	58.8	58.8	60.7	63.8	66.4	67.2
31.5 Hz	63.0	63.1	65.0	68.1	70.7	71.5
40 Hz	66.9	66.9	68.8	72.0	74.7	75.5
50 Hz	69.9	70.0	71.9	75.1	77.8	78.8
63 Hz	72.7	73.3	75.0	78.0	80.6	81.8
80 Hz	75.1	76.2	77.8	80.4	82.9	84.0
100 Hz	77.3	78.9	80.4	82.7	84.9	85.9
125 Hz	79.6	81.7	83.3	85.2	87.1	87.9
160 Hz	81.3	83.5	85.4	87.2	89.0	89.6
200 Hz	82.6	84.8	87.1	89.0	90.8	91.2
250 Hz	83.6	85.5	88.2	90.5	92.4	92.7
315 Hz	84.2	85.7	88.9	91.6	93.7	94.0
400 Hz	83.9	84.8	88.4	91.7	94.0	94.3
500 Hz	84.0	84.5	88.1	92.0	94.7	95.0
630 Hz	83.9	84.1	87.6	91.9	95.0	95.4
800 Hz	83.9	83.6	87.2	91.5	95.0	95.5
1 kHz	84.2	83.6	86.8	91.3	94.9	95.6
1.25 kHz	84.8	84.0	86.9	91.4	95.0	95.8
1.6 kHz	83.9	83.5	85.7	89.9	93.5	94.3
2 kHz	83.2	83.3	85.0	88.6	92.1	92.9
2.5 kHz	82.0	82.5	84.0	87.0	90.2	91.0
3.15 kHz	80.1	81.2	82.6	85.2	87.9	88.6
4 kHz	77.1	78.5	80.1	82.6	84.8	85.3
5 kHz	73.0	74.7	76.4	79.0	81.1	81.4
6.3 kHz	66.3	68.3	70.3	73.0	75.2	75.5
8 kHz	55.7	58.1	60.4	63.3	65.7	66.0
10 kHz	41.6	44.0	46.8	50.2	52.8	53.3
Total SWL (dB(A))	95.3	96.0	98.7	102.1	105.0	105.5

Table 3: GE 158 5.5MW Sound Power Levels: NRO 103 Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	44.7	47.8	49.8	49.8
16 Hz	48.8	48.9	51.2	54.2	56.2	56.2
20 Hz	54.1	54.1	56.4	59.4	61.4	61.4
25 Hz	58.8	58.8	61.0	64.1	66.1	66.1
31.5 Hz	63.0	63.1	65.3	68.4	70.4	70.4
40 Hz	66.9	66.9	69.1	72.3	74.4	74.4
50 Hz	69.9	70.0	72.2	75.4	77.6	77.6
63 Hz	72.7	73.3	75.3	78.3	80.4	80.4
80 Hz	75.1	76.2	77.9	80.7	82.7	82.7
100 Hz	77.3	78.9	80.4	82.9	84.6	84.6
125 Hz	79.6	81.7	83.1	85.3	86.8	86.8
160 Hz	81.3	83.5	85.2	87.2	88.6	88.6
200 Hz	82.6	84.8	86.9	88.9	90.4	90.4
250 Hz	83.6	85.5	88.1	90.4	91.9	91.9
315 Hz	84.2	85.7	88.9	91.5	93.2	93.2
400 Hz	83.9	84.8	88.5	91.6	93.4	93.4
500 Hz	84.0	84.5	88.4	92.1	94.1	94.1
630 Hz	83.9	84.1	87.9	92.1	94.4	94.4
800 Hz	83.9	83.6	87.5	91.9	94.4	94.4
1 kHz	84.2	83.6	87.4	91.7	94.4	94.4
1.25 kHz	84.8	84.0	87.5	91.8	94.6	94.6
1.6 kHz	83.9	83.5	86.3	90.5	93.2	93.2
2 kHz	83.2	83.3	85.4	89.2	91.8	91.8
2.5 kHz	82.0	82.5	84.3	87.5	89.9	89.9
3.15 kHz	80.1	81.2	82.9	85.6	87.6	87.6
4 kHz	77.1	78.5	80.3	82.9	84.5	84.5
5 kHz	73.0	74.7	76.6	79.2	80.8	80.8
6.3 kHz	66.3	68.3	70.5	73.2	74.8	74.8
8 kHz	55.7	58.1	60.6	63.6	65.3	65.3
10 kHz	41.6	44.0	46.9	50.4	52.4	52.4
Total SWL (dB(A))	95.3	96.0	98.9	102.3	104.5	104.5

Table 3: GE 158 5.5MW Sound Power Levels: NRO 102 Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	44.5	47.6	49.0	49.0
16 Hz	48.8	48.9	51.0	54.1	55.4	55.4
20 Hz	54.1	54.1	56.2	59.3	60.6	60.6
25 Hz	58.8	58.8	60.9	64.0	65.3	65.3
31.5 Hz	63.0	63.1	65.2	68.3	69.6	69.6
40 Hz	66.9	66.9	69.0	72.2	73.6	73.6
50 Hz	69.9	70.0	72.1	75.3	76.8	76.8
63 Hz	72.7	73.3	75.1	78.2	79.7	79.7
80 Hz	75.1	76.2	77.8	80.5	82.0	82.0
100 Hz	77.3	78.9	80.3	82.7	84.0	84.0
125 Hz	79.6	81.7	83.0	85.1	86.2	86.2
160 Hz	81.3	83.5	85.0	87.0	88.0	88.0
200 Hz	82.6	84.8	86.7	88.8	89.7	89.7
250 Hz	83.6	85.5	88.0	90.3	91.2	91.2
315 Hz	84.2	85.7	88.7	91.4	92.4	92.4
400 Hz	83.9	84.8	88.3	91.5	92.6	92.6
500 Hz	84.0	84.5	88.2	91.9	93.1	93.1
630 Hz	83.9	84.1	87.8	92.0	93.3	93.3
800 Hz	83.9	83.6	87.4	91.7	93.3	93.3
1 kHz	84.2	83.6	87.3	91.6	93.2	93.2
1.25 kHz	84.8	84.0	87.4	91.7	93.4	93.4
1.6 kHz	83.9	83.5	86.2	90.3	92.0	92.0
2 kHz	83.2	83.3	85.3	89.0	90.7	90.7
2.5 kHz	82.0	82.5	84.1	87.4	88.9	88.9
3.15 kHz	80.1	81.2	82.7	85.5	86.7	86.7
4 kHz	77.1	78.5	80.1	82.7	83.7	83.7
5 kHz	73.0	74.7	76.5	79.1	80.1	80.1
6.3 kHz	66.3	68.3	70.3	73.1	74.1	74.1
8 kHz	55.7	58.1	60.4	63.4	64.5	64.5
10 kHz	41.6	44.0	46.8	50.2	51.5	51.5
Total SWL (dB(A))	95.3	96.0	98.8	102.2	103.5	103.5

Table 3: GE 158 5.5MW Sound Power Levels: NRO 101 Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	45.1	48.1	48.1	48.1
16 Hz	48.8	48.9	51.6	54.5	54.5	54.5
20 Hz	54.1	54.1	56.8	59.7	59.7	59.7
25 Hz	58.8	58.8	61.5	64.4	64.4	64.4
31.5 Hz	63.0	63.1	65.8	68.7	68.7	68.7
40 Hz	66.9	66.9	69.6	72.7	72.7	72.7
50 Hz	69.9	70.0	72.7	75.7	75.7	75.7
63 Hz	72.7	73.3	75.8	78.6	78.6	78.6
80 Hz	75.1	76.2	78.4	81.0	81.0	81.0
100 Hz	77.3	78.9	81.0	83.2	83.2	83.2
125 Hz	79.6	81.7	83.7	85.5	85.5	85.5
160 Hz	81.3	83.5	85.8	87.4	87.4	87.4
200 Hz	82.6	84.8	87.5	89.2	89.2	89.2
250 Hz	83.6	85.5	88.7	90.6	90.6	90.6
315 Hz	84.2	85.7	89.4	91.7	91.7	91.7
400 Hz	83.9	84.8	89.0	91.8	91.8	91.8
500 Hz	84.0	84.5	88.8	92.2	92.2	92.2
630 Hz	83.9	84.1	88.4	92.3	92.3	92.3
800 Hz	83.9	83.6	88.0	92.0	92.0	92.0
1 kHz	84.2	83.6	87.8	91.9	91.9	91.9
1.25 kHz	84.8	84.0	87.9	92.0	92.0	92.0
1.6 kHz	83.9	83.5	86.7	90.7	90.7	90.7
2 kHz	83.2	83.3	85.8	89.5	89.5	89.5
2.5 kHz	82.0	82.5	84.8	87.8	87.8	87.8
3.15 kHz	80.1	81.2	83.4	85.9	85.9	85.9
4 kHz	77.1	78.5	80.8	83.2	83.2	83.2
5 kHz	73.0	74.7	77.1	79.5	79.5	79.5
6.3 kHz	66.3	68.3	71.0	73.5	73.5	73.5
8 kHz	55.7	58.1	61.1	63.8	63.8	63.8
10 kHz	41.6	44.0	47.5	50.6	50.6	50.6
Total SWL (dB(A))	95.3	96.0	99.4	102.5	102.5	102.5

Table 3: GE 158 5.5MW Sound Power Levels: NRO 100 Mode.

SWL (dB(A)) for each One-third Octave Band Centre Frequency	Hub Height Wind Speed (m/s)					
	4	5	6	7	8	9 +
12.5 Hz	42.1	42.4	45.3	47.4	47.4	47.4
16 Hz	48.8	48.9	51.8	53.8	53.8	53.8
20 Hz	54.1	54.1	57.0	59.0	59.0	59.0
25 Hz	58.8	58.8	61.6	63.7	63.7	63.7
31.5 Hz	63.0	63.1	65.9	68.0	68.0	68.0
40 Hz	66.9	66.9	69.7	71.9	71.9	71.9
50 Hz	69.9	70.0	72.8	75.0	75.0	75.0
63 Hz	72.7	73.3	75.9	77.9	77.9	77.9
80 Hz	75.1	76.2	78.5	80.4	80.4	80.4
100 Hz	77.3	78.9	81.1	82.6	82.6	82.6
125 Hz	79.6	81.7	83.8	85.0	85.0	85.0
160 Hz	81.3	83.5	85.9	86.9	86.9	86.9
200 Hz	82.6	84.8	87.6	88.5	88.5	88.5
250 Hz	83.6	85.5	88.8	89.9	89.9	89.9
315 Hz	84.2	85.7	89.5	90.9	90.9	90.9
400 Hz	83.9	84.8	89.1	90.8	90.8	90.8
500 Hz	84.0	84.5	89.0	91.1	91.1	91.1
630 Hz	83.9	84.1	88.5	91.0	91.0	91.0
800 Hz	83.9	83.6	88.1	90.7	90.7	90.7
1 kHz	84.2	83.6	87.9	90.6	90.6	90.6
1.25 kHz	84.8	84.0	88.0	90.8	90.8	90.8
1.6 kHz	83.9	83.5	86.8	89.5	89.5	89.5
2 kHz	83.2	83.3	86.0	88.4	88.4	88.4
2.5 kHz	82.0	82.5	84.9	86.9	86.9	86.9
3.15 kHz	80.1	81.2	83.5	85.2	85.2	85.2
4 kHz	77.1	78.5	80.9	82.5	82.5	82.5
5 kHz	73.0	74.7	77.2	78.9	78.9	78.9
6.3 kHz	66.3	68.3	71.1	72.8	72.8	72.8
8 kHz	55.7	58.1	61.2	63.1	63.1	63.1
10 kHz	41.6	44.0	47.6	49.7	49.7	49.7
Total SWL (dB(A))	95.3	96.0	99.5	101.5	101.5	101.5