Oweninny Wind Farm Phase 3

Environmental Impact Assessment Report

Appendix 13.3 Noise Modelling Assumptions and Inputs

Prediction calculations for turbine noise have been conducted in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, 1996. Guidance in terms of the calculation settings has been obtained from the Institute of Acoustics (IOA) Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA GPG) and its associated supplementary guidance notes. The following are the main aspects that have been considered in terms of the noise predictions presented in this instance.

Ground Effect:

Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depend on source height receiver height propagation height between the source and receiver and the ground conditions.

The ground conditions are described according to a variable defined as G, which varies between 0.0 for hard ground (including paving, ice concrete) and 1.0 for soft ground (includes ground covered by grass trees or other vegetation)

Noise Calculations have been conducted using a source height corresponding to the hub height of the turbines, a receiver height of 4m and an assumed ground factor of G=0.5.

Geometrical Divergence

This term relates to the spherical spreading in the free-field from a point sound source resulting in an attenuation depending on distance according to the following equation:

$$A_{geo} = 20 \times \log(d) + 11$$

where d = distance from the source

A wind turbine may be considered as a point source beyond a distance corresponding to one rotor diameter.

Atmospheric Adsorption	Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. In accordance with the guidance set out in the IOA GPG for calculations, a temperature of 10°C and a relative humidity of 70% have been used, which give relativity low levels of atmosphere attenuation and corresponding worst case noise predictions.
Barrier Attenuation	The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise. The barrier attenuations predicted by the ISO9613 model have been shown to be significantly greater than that measured in practice under down wind conditions.

Coordinates (ITM) for Noise Sensitive Locations (NSLs)

Name	Easting	Northing
R01	505,446	824,278
R02	505,623	824,318
R03	505,672	824,310
R04	505,959	824,275
R05	506,277	824,369
R06	506,324	824,364
R07	505,472	824,122
R08	505,911	824,193
R09	506,182	823,785
R10	504,856	822,094
R11	505,020	820,796
R12	505,033	820,520
R13	504,898	820,431
R14	504,778	820,489
R15	504,271	820,254
R16	503,892	820,017
R17	503,928	819,890
R18	504,014	819,955
R19	504,932	819,677
R20	504,999	819,655
R21	505,401	819,649
R22	505,611	819,590
R23	505,617	819,689
R24	505,715	819,816
R25	504,895	819,376
R26	504,773	819,110
R27	504,071	818,962
R28	504,112	818,972
R29	504,090	818,923
R30	504,221	818,950
R31	504,252	818,891
R32	504,560	818,886
R33	504,733	818,851
R34	504,797	818,764
R35	503,811	818,686
R36	502,999	818,517
R37	502,977	818,426
R38	502,927	818,186
R39	502,864	818,027
R40	502,899	817,769
R41	502,724	818,228
R42	502,566	818,235
R43	502,574	818,339
R44	502,546	818,347
R45	502,351	818,441
R46	502,306	818,450
R47	502,288	818,453
R48	502,246	818,476
R49	502,103	818,573
R50	502,067	818,582
R51	501,915	818,510

Name	Easting	Northing
R52	501,667	818,565
R53	502,799	817,392
R54	502,793	817,298
R55	502,630	817,267
R56	502,615	817,248
R57	502,529	817,376
R58	502,365	817,180
R59	502,000	817,213
R60	500,515	818,137
R61	500,011	817,445
R62	499,947	817,276
R63	499,180	817,708
R64	499,272	817,835
R65	499,042	819,613
R66	497,692	820,159
R67	496,858	820,026
R68	496,832	820,039
R69	496,798	820,082
R70	496,695	820,198
R71	497,356	820,704
R72	497,644	821,349
R73	497,719	821,641
R74	497,479	823,177
R75	497,534	823,322
R76	497,536	823,360
R77	496,844	820,031
R78	504,624	818,845
R79	504,639	819,180
R80	503,616	819,883

The following tables present the turbine sound power noise emission values used for the various wind farms development in the nose prediction model.

L_{WA} Levels Used for Prediction Model – GE158 5.5MW with 121 m Hub Height

Wind Speed (m/s at 10m Standardised Height)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	76.6	83.3	87.1	87.5	87.9	86.7	81.2	65.4	94.1
4	78.8	86.7	91.4	91.3	90.2	88.3	83.6	69.5	97.2
5	83.0	90.0	95.1	96.5	96.1	93.4	87.6	73.4	102.0
6	86.8	92.2	96.8	99.3	100.9	98.7	91.3	75.6	105.6
7	87.2	92.6	97.2	99.7	101.3	99.1	91.7	76.0	106.0
8	87.2	92.6	97.2	99.7	101.3	99.1	91.7	76.0	106.0
9	87.2	92.6	97.2	99.7	101.3	99.1	91.7	76.0	106.0

L_{WA} Levels Used for Prediction Model – Oweninny P1: SWT-3.2-113 - 119.5 m Hub Height

Wind Speed (m/s at 10m Standardised Height)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	77.0	79.6	82.9	83.5	85.1	84.3	80.8	71.9	91.1
4	81.9	84.5	87.8	88.4	90.0	89.2	85.7	76.8	96.0
5	86.7	89.3	92.6	93.2	94.8	94.0	90.5	81.6	100.8
6	91.4	94.0	97.3	97.9	99.5	98.7	95.2	86.3	105.5
7	91.9	94.5	97.8	98.4	100.0	99.2	95.7	86.8	106.0
8	93.0	95.6	98.9	99.5	101.1	100.3	96.8	87.9	107.1
9	93.4	96.0	99.3	99.9	101.5	100.7	97.2	88.3	107.5

L_{WA} Levels Used for Prediction Model – Oweninny P2: Nordex N149 117.5 m Hub Height

Wind Speed (m/s at 10m Standardised Height)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
3	77.1	83.7	86.6	87.6	88.0	86.2	80.5	71.3	94.0
4	78.5	85.1	88.0	89.0	89.4	87.6	81.9	72.7	95.3
5	81.9	88.5	92.2	94.3	95.6	93.7	84.1	76.2	100.6
6	85.9	92.5	96.2	98.3	99.6	97.7	88.1	80.2	104.6
7	87.4	93.9	97.6	99.7	101.0	99.2	89.6	81.7	106.1
8	87.8	94.0	97.7	100.3	101.0	98.5	90.9	82.9	106.1
9	87.8	94.0	97.7	100.3	101.0	98.5	90.9	82.9	106.1

It was subsequently confirmed that the installed turbines at Oweninny Phase 2 Wind Farm are Nordex N117 at a hub height of 117.3 m. The noise model assumed a worst case i.e. Nordex N149 at a hub hight of 117.5 m. The maximum turbine sound power noise emission for the Nordex N117 are outlined in the table below for reference. Across all the frequency ranges, the N149 used in the model has higher sound power noise emission levels that the installed turbines.

Maximum L_{WA} Levels for installed turbines at Oweninny P2: Nordex N117

Details	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
Maximum turbine noise levels for N117 (STE)	84.2	90.4	93.3	93.8	96.6	98.0	97.0	87.7	103.5

Source: Nordex document F008_256_A14_EN Revision 01, 2020-01-24

LWA Levels Used for Prediction Model – Sheskin Wind Farm: Vestas V112 3.0MW 119 m Hub Height

Wind Speed (m/s at 10m Standardised Height)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
4	76.4	83.8	86.0	87.7	87.5	85.3	82.0	71.2	93.7
5	78.5	85.9	88.1	89.8	89.6	87.4	84.1	73.3	95.8
6	81.1	88.5	90.7	92.4	92.2	90.0	86.7	75.9	98.4
7	83.7	91.1	93.3	95.0	94.8	92.6	89.3	78.5	101.0
8	86.0	93.4	95.6	97.3	97.1	94.9	91.6	80.8	103.3
9	87.7	95.1	97.3	99.0	98.8	96.6	93.3	82.5	105.0
10	88.7	96.1	98.3	100.0	99.8	97.6	94.3	83.5	106.0
11	89.2	96.6	98.8	100.5	100.3	98.1	94.8	84.0	106.5

The following tables present the turbine coordinates used for the various wind farms development in the nose prediction model.

Turbine Location Coordinates for Oweninny Wind Farm Phase 1

Turbine Ref.	Co-ordinates (ITM)	
	X	Y
T01	500,679	825,900
T02	501,885	826,011
T03	500,201	825,741
T04	501,097	825,748
T05	502,287	825,640
T06	501,500	825,507
T07	499,736	825,368
T08	500,696	825,374
T09	501,882	825,225
T10	502,707	825,322
T12	499,611	824,951
T13	500,264	825,007
T14	501,005	824,996
T15	502,312	824,929
T23	499,479	824,493
T24	500,039	824,570
T25	501,682	824,600
T29	499,767	824,160
T30	500,712	824,225
T31	502,311	824,317
T37	501,394	824,010
T41	498,975	823,591
T42	500,061	823,736
T44	502,016	823,723
T45	498,521	823,145

T46	499,305	823,276
T67	498,288	822,487
T68	498,678	822,140
T69	499,365	822,186

Turbine Location Coordinates for Oweninny Wind Farm Phase 2

Turbine Ref.	Co-ordinates (ITM)	
	Easting	Northing
T11	495,474	824,971
T18	495,876	824,813
T19	495,051	824,580
T20	496,248	824,591
T21	495,495	824,385
T22	496,761	824,355
T27	494,793	824,169
T28	495,923	824,181
T33	494,342	823,881
T34	494,695	823,724
T35	495,248	823,885
T36	496,429	823,868
T39	494,314	823,446
T40	495,619	823,550
T51	494,705	823,015
T52	495,156	823,287
T53	495,392	822,935
T54	496,176	823,310
T55	496,111	822,744
T64	495,246	822,497
T65	495,630	822,204
T66	496,627	822,512
T79	495,028	822,060
T80	496,141	822,085
T81	495,443	821,807
T82	496,582	821,837
T87	494,965	821,622
T88	495,432	821,388
T89	495,886	821,677
T90	495,971	821,255
T91	496,454	821,284