Appendix 12-3 - Noise Model 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.

The atmospheric attenuation outlined in Table A12-1 were used for all calculations in accordance with the guidance outlined in the IOA GPG. No meteorological corrections were applied to all calculations.

*Table A12**Error! No text of specified style in document.**-1 Atmospheric Attenuation Assumed for Noise Calculations (dB per km)*

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

Table A12-2 Coordinates (ITM) for Noise Sensitive Locations (NSLs)

Name	Easting	Northing	Name	Easting	Northing
H001	611235	609827	H142	613422	599934
H002	611166	609496	H143	613386	599896
H003	611034	608880	H144	613331	599838
H004[1]	611116	608017	H145	613033	599613
H005[1]	610865	607760	H146	616024	601590
H006	610377	606320	H147	616052	601606
H007	610450	606238	H148	615986	601431
H008	610438	606153	H149	616071	601433
H009	610896	605992	H150	616361	601291
H010	610367	606058	H151	616602	601240
H011	609802	606075	H152	616647	601195
H012	610395	605951	H153	615109	602345
H013	610354	605821	H154	614957	602397
H014	610472	605568	H155[1]	614884	601882
H015[1]	610909	605577	H156	615087	601600
H016	611255	605611	H157	615117	601539
H017	611246	605658	H158	615062	601437
H018	610578	604998	H159	615611	600978
H019	610557	604799	H160	615807	600891
H020	610680	604552	H161	615910	600844
H021	610781	604552	H162	616161	600709
H022	610634	604262	H163	616253	600678
H023	610378	604355	H164	616375	600556
H024	610648	604195	H165	613909	601587
H025	610736	604095	H166	613964	601383
H026	610628	604042	H167	614005	601171
H027	614227	608291	H168	614109	601081
H028	614334	608208	H169	614059	600840
H029	614155	608159	H170	614037	600680

Name	Easting	Northing	Name	Easting	Northing
H030	614116	608101	H171	614044	600522
H031	614078	608043	H172	614131	600489
H032	614078	608005	H173	614153	600300
H033[1]	613581	607637	H174	614139	599866
H034	612547	605452	H175	614169	599859
H035[1]	611944	605186	H176	614073	599588
H036	611110	604988	H177	615527	599808
H037	611882	604572	H178	611461	600145
H038	611840	603807	H179	613522	599357
H039	611500	602414	H180	614717	598916
H040	611494	602551	H181	616368	600124
H041	612126	603556	H182	615100	598834
H042	612000	603608	H183	614947	599031
H043	611989	603981	H184	616345	600313
H044	611876	604452	H185	614788	599129
H045	611426	601167	H186	614764	598877
H046	612617	599828	H187	614727	598995
H047	612576	599837	H188	614694	599048
H048	612557	599873	H189	613398	599389
H049	612611	599939	H190	613351	599388
H050	612816	599899	H191	612571	599770
H051	612563	599957	H192	612995	599590
H052	612495	600014	H193	614035	598884
H053	612568	600095	H194	614277	599137
H054	612399	600366	H195	613644	598986
H055	612720	600431	H196	613647	599216
H056	612684	600535	H197	611429	600151
H057	612611	600549	H198	611564	600130
H058	612686	600582	H199	611389	600156
H059	612639	600809	H200	615570	599743
H060	612965	600843	H201	616699	600267
H061	612668	601079	H202	616643	600383
H062	612673	601179	H203	616552	600444
H063	612761	601285	H204	616432	600382
H064	612658	601326	H205	616327	600130
H065	612472	601314	H206	616282	600293
H066	612296	601173	H207	614844	598850
H067	612225	601138	H208	614888	599158
H068	612567	601512	H209	614821	598899
H069	612734	601625	H210	614673	598962
H070	612828	601615	H211	616546	600386
H071	612656	601758	H212	616296	600263
H072	612640	602063	H213	614043	598982
H073	612087	602259	H214	614368	599046
H074	612072	602224	H215	614038	598924
H075	612840	602659	H216	614324	599041
H076	613038	603061	H217	614330	599166
H077	612951	603181	H218	614146	599106
H078	613001	603624	H219	613011	599534

Name	Easting	Northing	Name	Easting	Northing
H079	613118	603712	H220	613466	599356
H080	613140	603773	H221	613547	599302
H081	613123	604057	H222	613964	599149
H082	612781	604042	H223	614186	599135
H083	612857	604306	H224	616466	600421
H084	612773	604403	H225	612967	599512
H085	613003	604279	H226	614160	598667
H086	613191	604315	H227	616598	600442
H087	613201	604344	H228	611292	600779
H088	613121	605013	H229	613121	604950
H089	612936	605123	H230	611906	604328
H090	612926	605250	H231	613256	599702
H091	614162	607979	H232	615294	601217
H092	614161	607969	H233	615252	601522
H093[1]	614256	607714	H234	616793	603088
H094[1]	614858	607004	H235	616164	603533
H095	615106	605334	H236	613162	604513
H096	615485	604405	H237[1]	610479	606289
H097	615533	604415	H238	616934	606235
H098	615737	604053	H239	616969	606101
H099	615775	603904	H240	616835	606478
H100	615819	603889	H241	616869	606514
H101	615887	603829	H242	618004	605037
H102	616313	603433	H243	617803	604792
H103	616292	603396	H244	617258	606607
H104	616519	603099	H245	618006	605242
H105	616514	602985	H246	618016	605148
H106	616534	602910	H247	617718	604971
H107	616613	602830	H248	617127	606589
H108	616652	602768	H249	617223	606859
H109	616409	601980	H250	617886	604972
H110	616870	603242	H251	617909	604674
H111	616814	603102	H252	618015	604537
H112	616688	603029	H253	617820	605561
H113	616644	602996	H254	617855	604887
H114	616505	602938	H255	617808	604843
H115	616311	602959	H256	617811	604891
H116	616358	602886	H257	616675	607227
H117	616206	602650	H258	617440	606739
H118	616069	602556	H259	616989	603312
H119	615976	602525	H260	617056	603436
H120	615927	602514	H261	617075	603568
H121[2]	615866	602423	H262	617066	603729
H122	616126	601893	H263	617093	603758
H123	615567	601985	H264	617344	603761
H124	615540	601667	H265	617135	603768
H125	615494	601519	H266	617097	603926
H126	615430	601346	H267	617368	604005
H127	615404	601345	H268	617437	604977

Name	Easting	Northing	Name	Easting	Northing
H128[2]	615383	601327	H269	617384	605055
H129[1]	615346	601299	H270	617196	605224
H130	615341	601271	H271	617011	605919
H131	615225	601135	H272	616980	605982
H132	614216	600458	H273	616927	605998
H133	614033	600433	H274	616831	606165
H134	614007	600345	H275	616849	606253
H135	613930	600351	H276	616566	606816
H136	613886	600402	H277	616039	606888
H137	613828	600400	H278	615852	606919
H138	613656	600315	H279	616341	607024
H139	613633	600270	H280	616269	607055
H140	613618	600199	H281	618046	604676
H141	613610	600144	H282	616792	606615

[1] Derelict Property – does not meet definition for NSL classification under WEDGs.
[2] Commercial Property

Table A12-3 to A12-6 present the turbine sound power noise emission values used for the various wind farms development in the nose prediction model.

Table A12-3 L_{WA} Levels Used for Prediction Model – Nordex N149 110.5 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	78.4	85.0	87.9	88.9	89.3	87.5	81.8	72.6	95.3
5	81.7	88.3	92.0	94.1	95.4	93.5	83.9	76.0	100.4
6	85.7	92.3	96.0	98.1	99.4	97.5	87.9	80.0	104.4
7	87.5	94.0	97.7	99.8	101.1	99.3	89.7	81.8	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

Table A12-4 L_{WA} Levels Used for Prediction Model – Nordex N163 103.5 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	81.0	85.7	88.0	88.5	88.9	86.8	77.3	58.4	95.0
4	82.4	87.1	89.4	89.9	90.3	88.2	78.7	59.8	96.4
5	86.8	91.5	93.8	94.3	94.7	92.6	83.1	64.2	100.8
6	91.2	95.9	98.2	98.7	99.1	97.0	87.5	68.6	105.2
7	92.5	97.2	99.5	100.0	100.4	98.3	88.8	69.9	106.5
8	92.6	97.3	99.6	100.1	100.5	98.4	88.9	70.0	106.6
9	92.6	97.3	99.6	100.1	100.5	98.4	88.9	70.0	106.6

Table A12-5 L_{WA} Levels Used for Prediction Model – SG 6.0 155 107.5 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	72.6	80.0	84.6	86.9	86.7	87.0	80.4	65.4	93.0
4	77.6	85.0	89.6	91.9	91.7	92.0	85.4	70.4	98.0
5	82.4	89.8	94.4	96.7	96.5	96.8	90.2	75.2	102.8
6	83.6	91.1	97.0	98.5	99.6	98.4	92.7	76.9	105.0
7	83.6	91.1	97.0	98.5	99.6	98.4	92.7	76.9	105.0
8	86.1	92.3	97.3	97.6	99.3	98.9	93.0	76.1	105.0
9	86.1	92.3	97.3	97.6	99.3	98.9	93.0	76.1	105.0

Table A12-6 L_{WA} Levels Used for Prediction Model – V162 104 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	75.2	82.7	87.3	89.1	88.0	84.1	77.3	67.7	94.0
4	75.9	83.6	88.2	89.9	88.8	84.6	77.6	67.5	94.8
5	80.2	87.8	92.4	94.1	93.0	88.8	81.8	71.8	99.0
6	84.5	92.0	96.6	98.3	97.2	93.1	86.2	76.2	103.2
7	85.9	93.4	98.0	99.7	98.6	94.5	87.6	77.7	104.6
8	86.2	93.6	98.1	99.9	98.8	94.8	88.0	78.3	104.8
9	86.2	93.6	98.2	100.1	99.0	95.2	88.6	79.1	105.0
10	86.3	93.8	98.5	100.4	99.5	95.9	89.4	80.2	105.4
11	86.0	93.6	98.4	100.5	99.7	96.2	89.9	80.8	105.5

The following tables present the turbine coordinates used for proposed Dyrick Hill Wind Farm development in the nose prediction model.

Table A12-7 Turbine Location Coordinates for Dyrick Hill Wind Farm

Turbine Ref.	Co-ordinates (ITM)	
	X	Y
T01	616,513	604,876
T02	616,391	604,419
T03	616,112	605,076
T04	615,638	605,321
T05	616,077	605,659
T06	615,263	605,811
T08	614,802	606,341
T09	614,800	604,594
T10	614,805	605,146
T11	614,522	605,476
T12	614,284	605,998
T13	614,188	606,460