

Hornsea Project Three
Offshore Wind Farm



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Preliminary Environmental Information Report:
Annex 8.1 – Baseline Noise Information

Date: July 2017

Environmental Impact Assessment
Preliminary Environmental Information Report

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Annex 8.1 – Baseline Noise Information

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1. Introduction

1.1.1.1 This annex provides background information on the baseline noise survey work that was carried out to inform the noise assessment for Hornsea Three at PEIR stage. The annex confirms the survey locations that were selected and agreed with the local planning authorities, and the outcomes of those surveys. The annex also confirms the draft equipment list that has been used to inform the PEIR noise assessment, at Appendix B.

2. Survey Information

2.1 Survey Locations and Periods

2.1.1.1 Long-term monitors were set out in representative locations on 8 March 2017. The survey locations are shown in Figure 1 and Figure 2. Two of the three monitors ran until collection on 17 March 2017. The locations at which the monitors were located and the duration for which they ran are presented in Table 1. These locations were discussed and agreed with North Norfolk District Council and South Norfolk Council prior to survey work being carried out.

2.1.1.2 Information regarding the exact locations of the monitors, audible noise sources at each location, details of weather and details of the set up and calibration of each monitor can be found in Appendix A

Table 1: Survey Locations and Duration.

Location Reference	Address	Start	End	Notes
ONSS 1 (Substation)	House on the Hill, Main Rd, Swardeston, Norwich NR14 8DU, UK	8 March 2017 11:55	17 March 2017 10:57	-
BS1 (Booster Station)	Fuel Farm, Barningham Road, Edgefield, Melton Constable NR24 2AW, UK	8 March 2017 13:45	17 March 2017 12:23	-
BS2 (Booster Station)	Unnamed Road, Melton Constable NR24 2AT, UK	17 March 2017 12:07	22 March 2017 13:12	Equipment failure found on 17/03. Meter replaced and ran until 22/03

2.2 Equipment Issues

2.2.1.1 The monitor at the BS2 location was found on 17th March 2017 to have failed and data had not been recorded. The original sound level meter was replaced and the new meter was run between 17 and 22 March 2017.

2.3 Access Issues

2.3.1.1 Initially it was proposed that unattended monitoring would be carried out at a further location in proximity to residential receptors near the onshore HVDC converter/HVAC substation. Access could not be agreed however and no recordings were taken. It is considered however that the location ONSS 1, where recordings were taken, is representative of all residential properties in the vicinity of the onshore HVDC converter/HVAC substation site.

2.4 Instrumentation

2.4.1.1 Sound level measurements were made using a 'Class 1' Rion NL-52 sound level meters (SLM) in accordance with BS 7445-2:1991. The monitors were programmed to measure various parameters including the $L_{Aeq,T}$, L_{AFmax} and $L_{A90,T}$ values, logging at contiguous 15 minute intervals throughout the monitoring period.

2.4.1.2 The equipment calibration level was checked prior to and after the monitoring periods – no significant changes were noted.

2.4.1.3 The measurements conformed to the requirements of BS 7445:2003.

2.5 Meteorological Conditions

2.5.1.1 Meteorological conditions were monitored and logged at for the duration of the surveys. Wind and rain data for each location are presented on each 15-minute time history chart, along with a wind rose is presented for each meteorological location in Appendix A. Meteorological results have been assessed alongside the measured sound level and it is considered that sound data has not been affected by weather conditions. Therefore no data have been excluded from the dataset due to meteorological conditions.

3. Results and Representative Levels

3.1.1.1 The time history plots for all long term monitoring locations are provided in Appendix A.

3.1.1.2 A summary of the measured baseline sound levels for all locations are provided in Table 2 for the daytime period, defined in BS: 4142:2014, as 07.00 – 23.00 hrs, and in Table 3 for the night-time period, defined as 23.00 – 07.00 hrs.

Table 2: Measured Baseline Sound Levels, Daytime 07:00 - 23:00 hrs.

Site	Location	Measured Sound Levels, dB				
		L _{Aeq, 15min}	L _{AFmax}	L _{A10, 15min}	L _{A50, 15min}	L _{A90, 15min}
OnSS	ONSS 1	55	94	55	50	44
Booster Station	BS 1	52	89	49	39	28
	BS 2	54	91	55	45	33

Table 3: Measured Baseline Sound Levels, Night-time 23:00 - 07:00 hrs.

Site	Location	Measured Sound Levels, dB				
		L _{Aeq, 15min}	L _{AFmax}	L _{A10, 15min}	L _{A50, 15min}	L _{A90, 15min}
OnSS	ONSS 1	49	87	50	37	29
Booster Station	BS 1	48	88	42	22	18
	BS 2	43	83	45	40	33

3.1.1.3 Table 4 below provides the measured 8 hour and 16 hour levels at receptors around the selected sites. The 25th percentile level, or lower quartile (LQ), has also been calculated from the 15 minute data.

Table 4: Measured Baseline Sound Levels.

Period	Measured Sound Levels, dB			
	L _{Aeq,T}	LQ L _{Aeq, 15min}	L _{A90,T}	LQ L _{A90,15min}
ONSS 1				
Daytime, T=16hr	55	52	44	45
Night-time, T=8hr	49	40	29	30
BS 1				
Daytime, T=16hr	52	41	28	31
Night-time, T=8hr	48	26	18	19
BS 2				
Daytime, T=16hr	54	45	33	39
Night-time, T=8hr	43	38	33	33

3.1.1.4 Representative levels have been extracted from the data above.. All receptors in this area lie a similar distance to the A47, which was observed to be the main source of noise during the site visits.

3.1.1.5 At BS 1 and BS 2 during the daytime measured levels were generally similar and therefore the lower of the two is considered to be representative of receptors in the local area. During the night-time there was a significant difference between levels measured at BS 1 and BS 2 and levels at BS 1 were extremely low. In this period, it is considered that the arithmetic average of levels measured at the two locations is representative of receptors in the local area.

3.1.1.6 A summary of the representative levels is presented in Table 5 below. The 25th percentile (lower quartile) values have been used in the assessment as these levels are representative of the lower range of sound levels, which are likely to be experienced at the noise sensitive receptors. The levels used in the assessment are shown below.

Table 5: Representative Sound Levels.

Period	Representative Sound Levels, dB			
	L _{Aeq,T}	L _Q L _{Aeq, 15min}	L _{A90,T}	L _Q L _{A90,15min}
Onshore HVDC converter/HVAC substation				
Daytime, T=16hr	55	52	44	45
Night-time, T=8hr	49	40	29	30
Onshore HVAC Booster Station				
Daytime, T=16hr	52	41	28	31
Night-time, T=8hr	46	32	26	26

4. References

British Standards Institution (BSI) (2014) British Standard 4142: Methods for rating and assessing industrial and commercial sound. Milton Keynes, BSI.

British Standards Institution (BSI) (1991) British Standard 7445: Description and measurement of environmental noise. Part 2: Guide to the acquisition of data pertinent to land use. Milton Keynes, BSI.

British Standards Institution (BSI) (2003) British Standard 7445: Description and measurement of environmental noise. Part 1: Guide to environmental quantities and procedures. Milton Keynes, BSI.



Figure 1: Onshore HVAC booster station baseline survey locations.

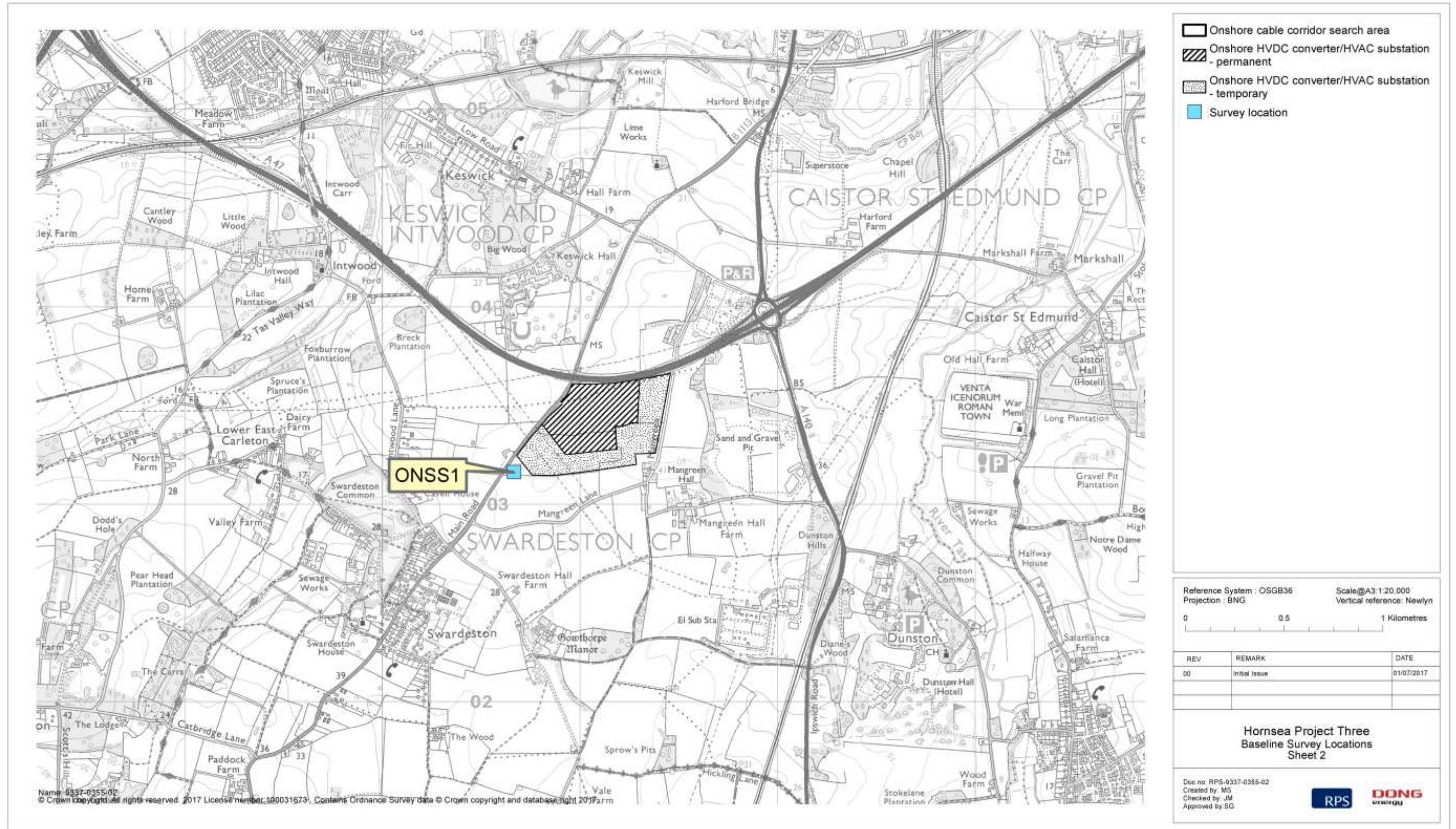


Figure 2: Onshore HVDC converter/HVAC substation baseline survey locations.

Appendix A Baseline Survey Details and Results

A.1.1 Onshore HVAC booster station baseline survey location 1

Table A6: Onshore HVAC booster station baseline survey location 1 daytime (07:00 - 23:00) measured noise levels.

Start	Duration	L _{Aeq,16h} (dB)	L _{AFmax} (dB)	L _{A10,16h} (dB)	L _{A50,16h} (dB)	L _{A90,16h} (dB)
9 March 2017 07:00	16:00:00	53	89	52	43	29
10 March 2017 07:00	16:00:00	49	83	46	40	28
11 March 2017 07:00	16:00:00	54	87	49	38	30
12 March 2017 07:00	16:00:00	50	84	49	37	20
13 March 2017 07:00	16:00:00	52	86	50	39	30
14 March 2017 07:00	16:00:00	56	85	58	45	33
15 March 2017 07:00	16:00:00	53	85	53	41	30
16 March 2017 07:00	16:00:00	51	81	54	44	32

Table A7: Onshore HVAC booster station baseline survey location 1 night-time (23:00 - 07:00) measured noise levels.

Start	Duration	L _{Aeq,8h} (dB)	L _{AFmax} (dB)	L _{A10,8h} (dB)	L _{A50,8h} (dB)	L _{A90,8h} (dB)
8 March 2017 23:00	08:00:00	49	84	43	23	19
9 March 2017 23:00	08:00:00	50	81	41	22	18
10 March 2017 23:00	08:00:00	48	79	41	24	19
11 March 2017 23:00	08:00:00	53	84	43	25	20
12 March 2017 23:00	08:00:00	47	80	43	24	19
13 March 2017 23:00	08:00:00	49	83	45	23	19
14 March 2017 23:00	08:00:00	58	88	46	22	19
15 March 2017 23:00	08:00:00	53	83	45	22	18
16 March 2017 23:00	08:00:00	48	86	43	27	21

Table A8: Onshore HVAC booster station baseline survey location 1 sound measurement system and location information.

Onshore HVAC booster Station Baseline Survey Location 1						
Relevant Guidance/Standard		BS 7445-1:2003/BS 7445-2:1991/BS 4142:2014 / BS 8233:2014				
Sound Measurement System						
RPS ID	Manufacturer/Model	Serial Number	Last Lab Verification	Filename	Memory Card ID	
124	Rion NL-52	164421	3 March 2016	0131		
Microphone Height	Measurement Interval	Dynamic Range	Time Weighting	Frequency Weighting	Façade / Freefield	Photo?
1.2 m	100 ms	25-138	Fast	A	Freefield	-
			START	END		
Personnel		JA		JA		
Date/time		8 March 2017 13:45		17 March 2017 12:23		
Calibrator	RPS ID	15		14		
	Manufacturer / Model	RION NC-74		RION NC-74		
	Serial Number	110090		110118		
	Date last verification	09 November 2016		01 April 2016		
	Reference level	94		94		
	Meter reading	94		93.9		
Wind speed (m/s) & dir'n Av.	NW	~4		NE	~1	
Cloud cover (100%= 8 oktas)	8			8		
Temperature (degrees Celsius)	7			10		
Likely temp. inversion/Precipitation/Fog/Wet ground/Frozen ground/Snow cover? (tick boxes)	TI	P	F	W	Fr	Sn
		x				
Subjective description/additional details	Light breeze			Breezy, very light rain		

Table A9: Onshore HVAC booster station baseline survey location 1 site description.

Description of site (location of equipment, general surroundings, nature of ground between NSR and sound source(s) (hard/soft ground, topography, intervening features, reflecting surfaces))
On grassy area on northern edge of field just east of farm track ~50 m SE of farmhouse
Description of sound environment at start of survey (principal environmental and natural sound sources, which sources are dominant, character of the sound environment cf. to the character of the new source)
Loud aircraft passing overhead, wind in trees, birds
Description of sound environment at end of survey (principal environmental and natural sound sources, which sources are dominant, character of the sound environment cf. to the character of the new source)
Wind in trees, birds, distant banging sound

A.1.2 Onshore HVAC booster station baseline survey location 2

Table A10: Onshore HVAC booster station baseline survey location 2 daytime (07:00 - 23:00) measured noise levels.

Start	Duration	L _{Aeq,16h} (dB)	L _{AFmax} (dB)	L _{A10,16h} (dB)	L _{A50,16h} (dB)	L _{A90,16h} (dB)
18 March 2017 07:00	16:00:00	51	75	55	43	34
19 March 2017 07:00	16:00:00	54	74	58	51	41
20 March 2017 07:00	16:00:00	55	91	56	45	33
21 March 2017 07:00	16:00:00	53	85	56	48	32


Table A11: Onshore HVAC booster station baseline survey location 2 night-time (23:00 - 07:00) measured noise levels.

Start	Duration	L _{Aeq,8h} (dB)	L _{AFmax} (dB)	L _{A10,8h} (dB)	L _{A50,8h} (dB)	L _{A90,8h} (dB)
17 March 2017 23:00	08:00:00	53	77	57	51	46
18 March 2017 23:00	08:00:00	48	70	52	44	36
19 March 2017 23:00	08:00:00	43	79	45	40	35
20 March 2017 23:00	08:00:00	44	68	48	41	33
21 March 2017 23:00	08:00:00	41	83	40	26	20

Table A12: Onshore HVAC booster station baseline survey location 2 sound measurement system and location information.

Onshore HVAC booster Station Baseline Survey Location 2													
Relevant Guidance/Standard		BS 7445-1:2003/BS 7445-2:1991/BS 4142:2014/BS 8233:2014											
Sound Measurement System													
RPS ID	Manufacturer/Model	Serial Number	Last Lab Verification	Filename	Memory Card ID								
115	Rion NL-52	943366	27 January 2017	0132									
Microphone Height	Measurement Interval	Dynamic Range	Time Weighting	Frequency Weighting	Façade / Freefield	Photo?							
1.2 m	100 ms	25-138	Fast	A	Freefield	x							
			START	END									
Personnel		JA		JA									
Date / time		17 March 2017 12:07		22 March 2017 13:12									
Calibrator	RPS ID	15		14									
	Manufacturer / Model	RION NC-74		RION NC-74									
	Serial Number	110090		110118									
	Date last verification	09 November 2016		01 April 2016									
	Reference level	94		94									
	Meter reading	94		94									
Wind speed (m/s) & dir'n Av.		S	~2	SW	~3								
Cloud cover (100%= 8 oktas)		8		8									
Temperature (degrees Celsius)		7		11									
Likely temp. inversion/Precipitation/Fog/Wet ground/Frozen ground/Snow cover? (tick boxes)		TI	P	F	W	Fr	Sn	TI	P	F	W	Fr	Sn
Subjective description/additional details		Light breeze				Moderate breeze, bright							

Table A13: Onshore HVAC booster station baseline survey location 2 site description.

Description of site (location of equipment, general surroundings, nature of ground between NSR and sound source(s) (hard/ soft ground, topography, intervening features, reflecting surfaces))

Description of site (location of equipment, general surroundings, nature of ground between NSR and sound source(s) (hard/ soft ground, topography, intervening features, reflecting surfaces))
On eastern edge of field on opposite side of track to house ~30 m west of house
Description of sound environment at start of survey (principal environmental and natural sound sources, which sources are dominant, character of the sound environment cf. to the character of the new source)
Distant cars on road to S, wind in trees, aircraft overhead
Description of sound environment at end of survey (principal environmental and natural sound sources, which sources are dominant, character of the sound environment cf. to the character of the new source)
Distant cars on road to S, wind in trees, some noise from industrial area to S

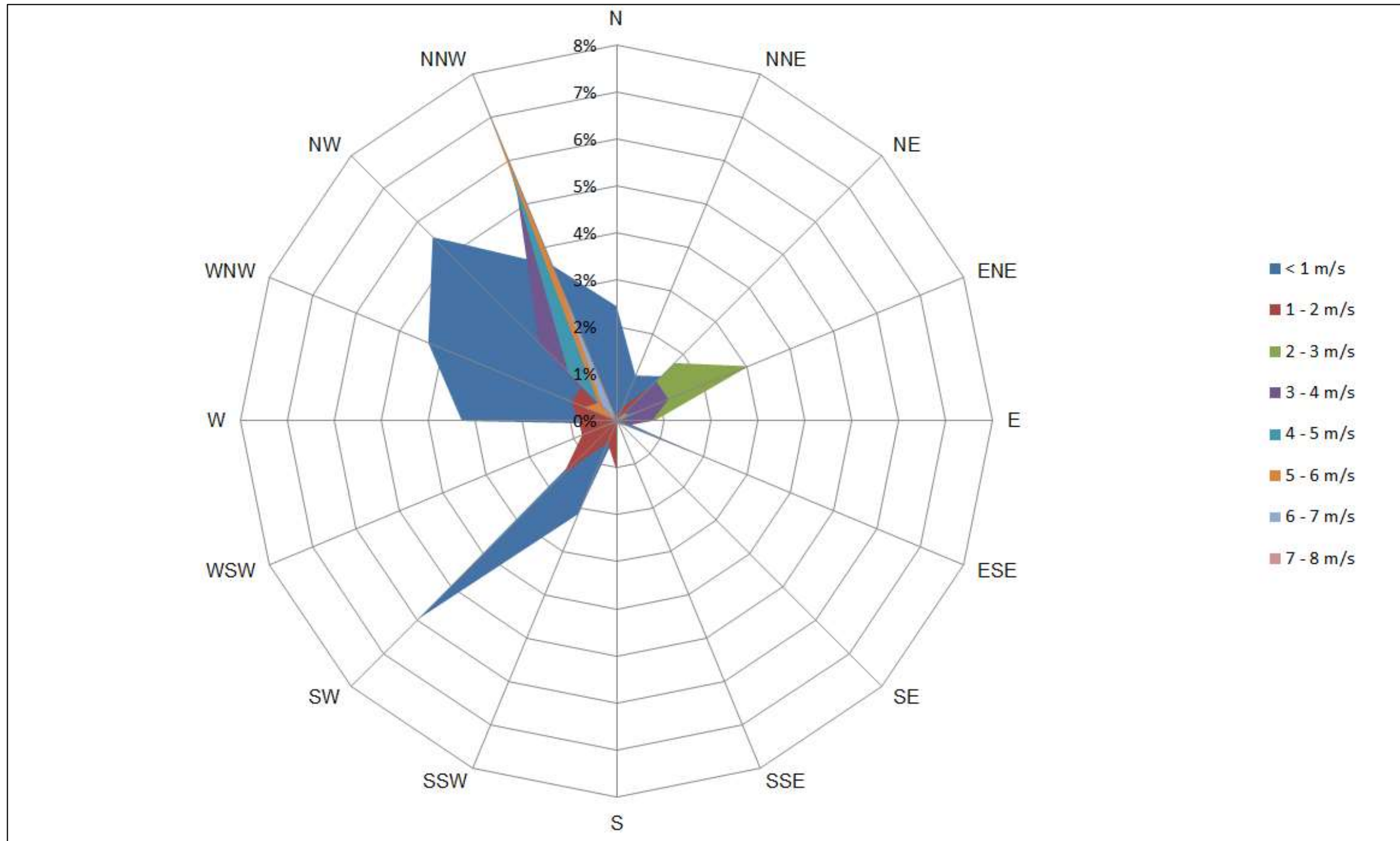


Figure A1: Onshore HVAC booster station baseline survey location 2 – Noise Rose.

A.1.3 Onshore HVDC converter/HVAC substation - Measured Noise Levels

Table A14: Onshore HVAC converter/HVAC substation daytime (07:00 - 23:00) measured noise levels.

Start	Duration	L _{Aeq,16h} (dB)	L _{AFmax} (dB)	L _{A10,16h} (dB)	L _{A50,16h} (dB)	L _{A90,16h} (dB)
9 March 2017 07:00	16:00:00	59	86	62	58	53
10 March 2017 07:00	16:00:00	55	87	55	50	42
11 March 2017 07:00	16:00:00	55	83	54	50	44
12 March 2017 07:00	16:00:00	58	90	56	51	44
13 March 2017 07:00	16:00:00	55	78	57	53	46
14 March 2017 07:00	16:00:00	57	87	59	54	49
15 March 2017 07:00	16:00:00	54	81	57	52	45
16 March 2017 07:00	16:00:00	56	94	58	53	46


Table A15: Onshore HVAC converter/HVAC substation night time (23:00 - 07:00) measured noise levels.

Start	Duration	L _{Aeq,8h} (dB)	L _{AFmax} (dB)	L _{A10,8h} (dB)	L _{A50,8h} (dB)	L _{A90,8h} (dB)
08 March 2017 23:00	08:00:00	51	86	53	37	30
09 March 2017 23:00	08:00:00	52	87	52	41	29
10 March 2017 23:00	08:00:00	47	77	48	34	29
11 March 2017 23:00	08:00:00	48	74	51	43	36
12 March 2017 23:00	08:00:00	50	79	54	44	36
13 March 2017 23:00	08:00:00	51	84	52	38	32
14 March 2017 23:00	08:00:00	51	83	52	43	33
15 March 2017 23:00	08:00:00	53	86	50	38	30
16 March 2017 23:00	08:00:00	50	77	53	43	35

Table A16: Survey Location ONSS1 - Technical Detail and Site Observations.

Onshore HVAC converter/HVAC substation - Baseline Sound Level Survey Record – ONSS 1														
Relevant Guidance / Standard					BS 7445-1:2003/BS 7445-2:1991/BS 4142:2014/BS 8233:2014									
Sound Measurement System														
RPS ID	Manufacturer / Model		Serial Number	Last Lab Verification	Filename	Memory Card ID								
127	Rion NL-52		164424	03/03/2016	0011									
Microphone Height	Measurement Interval	Dynamic Range	Time Weighting	Frequency Weighting	Facade / Freefield	Photo?								
1.2 m	100 ms	25-138	Fast	A	Freefield	x								
			START	END										
Personnel			JA			JA								
Date / time			08 March 2017 11:55			17 March 2017 10:57								
Calibrator	RPS ID		15		14									
	Manufacturer / Model		RION NC-74		RION NC-74									
	Serial Number		110090		110118									
	Date last verification		09 November 2016		01 April 2016									
	Reference level		94		94									
	Meter reading		94		93.9									
Wind speed (m/s) & dir'n Av.			~1	NE		~1	NE							
Cloud cover (100%= 8 oktas)			7			7								
Temperature (degrees Celsius)			10			10								
Likely temp. inversion / Precipitation / Fog / Wet ground / Frozen ground / Snow cover? (tick boxes)			Tl	P	F	W	Fr	Sn	Tl	P	F	W	Fr	Sn
Subjective description / additional details			Light breeze					Gentle breeze						

Table A17: Survey location ONSS1 site description.

Description of site (location of equipment, general surroundings, nature of ground between NSR and sound source(s) (hard/soft ground, topography, intervening features, reflecting surfaces))

In rear garden of House on the Hill, ~12m east of house, attached to garden fence, microphone mounted above hedge height
Description of sound environment at start of survey (principal environmental and natural sound sources, which sources are dominant, character of the sound environment cf. to the character of the new source)
Road traffic, wind in bushes, chickens, dogs barking
Description of sound environment at end of survey (principal environmental and natural sound sources, which sources are dominant, character of the sound environment cf. to the character of the new source)
Road traffic, wind in bushes, chickens, dogs barking

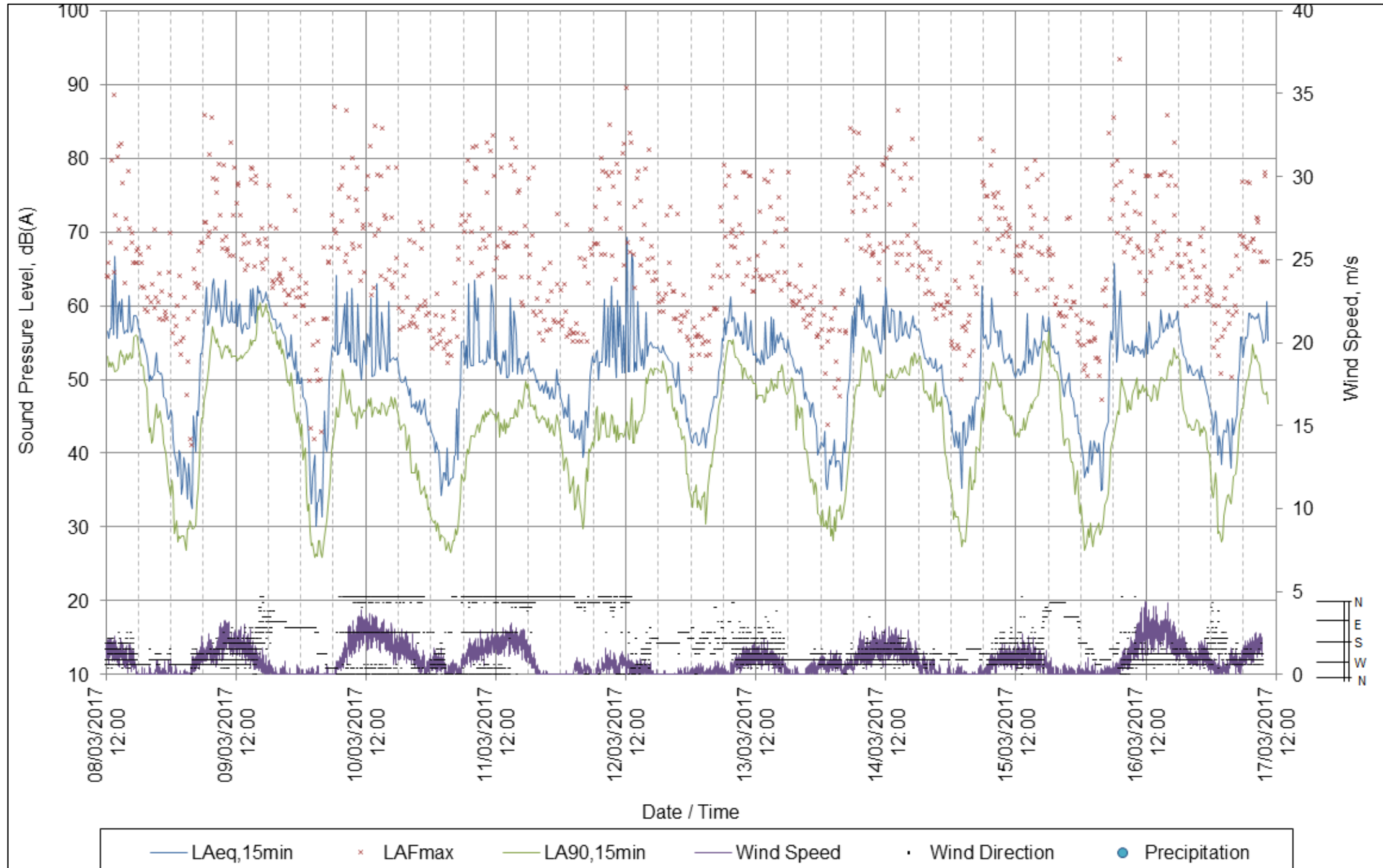


Figure A2: Onshore HVAC converter/HVAC substation – 15 Minute Time History.

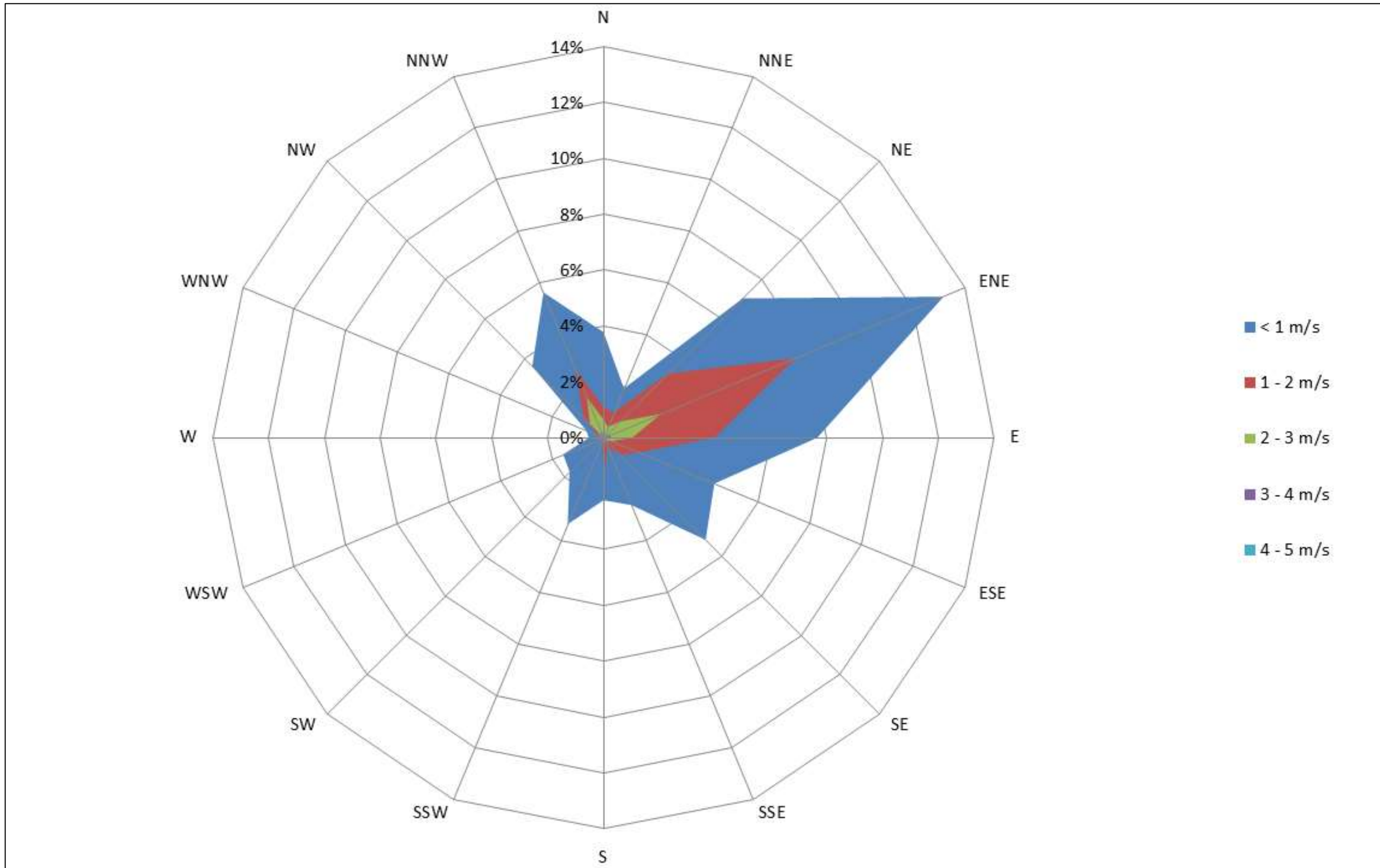


Figure A3: Onshore HVAC converter/HVAC substation - Noise Rose.

Appendix B Draft Equipment List – Onshore HVDC Converter Substation

Table B1: Draft Equipment List – Onshore HVDC converter substation.

Component	Number	Noise emission. SWL Sound Power Level	AC/DC	Point/Line/Area/Volume source	Dimensions	Height	Enclosed/external	Spectrum			
								(A) Tonal	(B) Harmonic	(C) LF 100-250Hz	(D) Broadband
Main Power Transformer (3 single phase transformers per 1.2GW)	2 (sets of 3)	102 (per set of 3)	AC side	Point	Not needed for now	2.5 m	External			✓	
Converter Reactors (set of 6 reactors per 1.2GW)	2 (sets of 6)	100 (per set of 6)	AC side	Point	Not needed for now	3 m	External			✓	
400kV filter (taken from HVAC case). If there are 3 export circuits there will be 3 x 400kV filters, each having 1 air core reactor per phase and each having 1 capacitor bank per phase	3	91 (per item)	AC	Line	Not needed for now	10 m for capacitors	External		✓		
	3	91 (per item)	DC side	Point	Not needed for now	3 m for air core reactors	No		✓		
Cooling Towers/valve cooling (24 fans per set per 1.2 GW)	2 (sets of 24)	108 (per set of 24)	DC side	Area	Not needed for now	2 m	External	✓			
Transformer coolers	6	93 (per item)	DC side	Vertical area	Not needed for now	3 m	External	✓			
Air Handling Unit (3 external AHU per 1.2GW system)	2 (sets of 3)	93 (per set of 3)	DC side	Point	Not needed for now	3 m	External	✓			

Appendix C Draft Equipment List – Onshore HVAC Substation

Table C1: Draft Equipment List – Onshore HVAC substation.

Component	Number	Noise emission. SWL Sound Power Level (per item)	AC/DC	Point/Line/Area/Volume source	Dimensions	Height	Enclosed/external	Spectrum			
								(A) Tonal	(B) Harmonic	© LF 100-250Hz	(D) Broadband
540 MVA SGT	6	93 dB(A)	AC	Line	Not needed for now	10 m	External				✓
150-300 Mvar VSR	12	97 dB(A)	AC	Line	Not needed for now	8 m	External				✓
300Mvar DRC (incl. cooler)	6	93 dB(A)	AC	Line	Not needed for now	10 m	External			✓	
320MVA step up transformer	6	91 dB(A)	AC	Volume	Not needed for now	10 m	External	✓			
200 Mvar 220kV filter	6	91 dB(A)	AC	Line	Not needed for now	8 m	External		✓		
150 Mvar 400 kV filter	3	91 dB(A)	AC	Line	Not needed for now	10 m	External		✓		
150 Mvar 400kV Shunt reactor	3	93 dB(A)	AC	Line	Not needed for now	7.5 m	Ditto				✓

Appendix D Draft Equipment List – Onshore HVAC Booster Station

Table D1: Draft Equipment List – Onshore HVAC booster Station.

Component	Number	Noise emission. SWL Sound Power Level (per item)	AC/DC	Point/Line/Area/Volume source	Dimensions	Height	Enclosed/external	Spectrum			
								(A) Tonal	(B) Harmonic	© LF 100-250Hz	(D) broadband
300 Mvar SR	6	97 dB(A)	AC	Line	Will be taken from HVAC layout provided	10 m	External				✓