Hornsea Project Four: Environmental Statement (ES)

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Volume A6, Annex 8.1: Baseline Noise Survey Report

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Glossary

Term	Definition
Commitment	A term used interchangeably with mitigation and enhancement measures. Commitments are Embedded Mitigation Measures. The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSEs), in EIA terms. Primary (Design) or Tertiary (Inherent) are both embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or ES). Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are acceptable.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Energy balancing infrastructure (EBI)	The onshore substation includes energy balancing Infrastructure. These provide valuable services to the electrical grid, such as storing energy to meet periods of peak demand and improving overall reliability.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Landfall	The generic term applied to the entire landfall area between Mean Low Water Spring (MLWS) tide and the Transition Joint Bay (TJB) inclusive of all construction works, including the offshore and onshore ECC, intertidal working area and landfall compound. Where the offshore cables come ashore east of Fraisthorpe.
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four at Creyke Beck.
Onshore substation (OnSS)	Comprises a compound containing the electrical components for transforming the power supplied from Hornsea Project Four to 400 kV and to adjust the power quality and power factor, as required to meet the UK Grid Code for supply to the National Grid. If a HVDC system is used the OnSS will also house equipment to convert the power from HVDC to HVAC.
Order Limits	The limits within which Hornsea Project Four (the 'authorised project') may be carried out.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).

Acronyms

Acronym	Definition
BS	British Standard
CRTN	Calculation of Road Traffic Noise
DCO	Development Consent Order
EBI	Energy Balancing Infrastructure
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ERYC	East Riding of Yorkshire Council
ES	Environmental Statement
MHWS	Mean High Water Spring
NGET	National Grid Electricity Transmission
OnSS	Onshore Substation
PEIR	Preliminary Environmental Information Report

Units

Unit	Definition
dB(A)	A unit of noise level derived from the logarithm of the ratio between the value of a quantity and a reference value. For sound pressure level the reference quantity is 20 µPa. Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness.
km	kilometre
kV	Kilovolt
L_{Aeq}	The equivalent continuous sound pressure level over the measurement period.
L_{Amax}	The maximum sound pressure level occurring within the defined measurement period.
L_{A90}	The sound pressure level exceeded for 90% of the measurement period.
L_{A10}	The sound pressure level exceeded for 10% of the measurement period.

1 Introduction

1.1 Project background

1.1.1.1 Orsted Hornsea Project Four Limited (the 'Applicant') is proposing to develop Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four'). Hornsea Four will be located approximately 69 km offshore the East Riding of Yorkshire in the Southern North Sea and will be the fourth project to be developed in the former Hornsea Zone. Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall and on to an onshore substation (OnSS) with energy balancing infrastructure (EBI), and connection to the electricity transmission network.

1.1.1.2 Royal HaskoningDHV was commissioned to undertake a baseline noise survey in proximity to the Hornsea Four Order Limits (i.e. the landfall search area, onshore export cable corridor (ECC), OnSS including EBI, and 400 kV National Grid Electricity Transmission (NGET) connection area). The location of the baseline noise survey monitoring locations is illustrated on **Figure 1** and **Figure 2**.

1.1.1.3 All identified baseline noise survey monitoring locations and the survey methodology was agreed with East Riding of Yorkshire Council (ERYC) prior to the surveys commencing in April 2019. Agreement was achieved via email correspondence between 21st January 2019 and 24th February 2019, following the first Human Environment technical panel meeting held on the 7th January 2019 (ON-HUM-1.5).

1.1.1.4 The baseline noise survey was undertaken in April 2019 and at the agreed locations considered to be representative of a range of noise sensitive receptors. It is typical and industry accepted for the baseline noise survey to be undertaken around the time of when the assessment is undertaken; however it is not unreasonable or uncommon for data that is a year or more old to be considered representative of the baseline noise levels for the area of interest. In addition, it is also recognised that due to the COVID-19 pandemic that there have been changes in land (road and rail) and air movements. As these are temporary changes, the requirement for an updated baseline noise survey was not deemed required and the 2019 baseline noise survey remains valid and representative for purposes of establishing the baseline noise conditions. This conclusion was agreed with ERYC in September 2021 (ON-HUM-1.16).

1.2 Aims

1.2.1.1 Baseline noise survey monitoring measurements were collected to characterise the existing noise climate within, and in proximity to, the Hornsea Four Order Limits to provide a baseline against which to assess impacts and identify if any additional mitigation may be required for both construction and operational phases of the project.

1.2.1.2 This technical report provides details of the methodology used in undertaking the baseline noise survey and presents the results of the survey.

2 Methodology

2.1 General Survey Practice

2.1.1.1 Baseline noise survey monitoring measurements were undertaken in accordance with current industry best practice, specifically British Standard (BS) 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound, and BS 7445-2:1991 Description and Measurement of Environmental Noise.

2.1.1.2 Traceable calibrated Class 1 Sound Level Meters were used for all measurements during the survey. For all baseline measurement locations, measurements captured the following noise criteria:

- L_{Aeq} – the equivalent continuous sound pressure level over the measurement period. This parameter was standardised as pertinent for land use within BS 7445-2:1991;
- L_{Amax} – the maximum sound pressure level occurring within the defined measurement period;
- L_{A90} – the sound pressure level exceeded for 90% of the measurement period and is indicative of the background noise level; and
- L_{A10} - the sound pressure level exceeded for 10% of the measurement period. The L_{A10} index is used within the Calculation of Road Traffic Noise (CRTN) as an appropriate descriptor of traffic noise.

2.1.1.3 The equivalent continuous sound pressure level (L_{Aeq}) is the conventional descriptor of environmental noise and is defined as:

$$L_{eq,T} = 10 \times \log\left[\frac{1}{T}\int \frac{\rho^2(t)\partial t}{\rho_0^2}\right] dB$$

2.1.1.4 Noise measurements are normally taken with an A-weighting (denoted by a subscript 'A') to approximate the frequency response of the human ear and in free-field conditions (i.e. away from any reflecting surfaces other than the ground).

2.1.1.5 A record of the meteorological conditions during the baseline monitoring survey was made using a portable weather station installed at monitoring location SMP1 and cross referenced with the recorded baseline noise data. Baseline noise measurements taken during periods of rain or when average wind speeds exceeded 5 ms^{-1} were excluded from the data.

2.2 Data Acquisition

2.2.1 Landfall

2.2.1.1 Baseline noise measurements were undertaken at three receptor locations identified as the closest noise sensitive receptors to the Hornsea Four Order Limits at landfall (**Table 1**). Short-term attended measurements were taken during the daytime (30 minutes) and night time (15 minutes) reference periods.

Table 1: Baseline Noise Survey Monitoring Locations – Landfall Search Area.

Description	Measurement Location	Baseline Noise Receptor Identifier*	X	Y	Nearest Postcode
Tennant James Ltd, Manor House Farm, Bridlington	LMP1	LFR1	515508	461771	YO15 3QU
Jackson R T & Sons Caravan Park, Auburn Farm, Fraisthorpe, Bridlington	LMP2	LFR2	516347	459686	YO15 3QU
CN Warkup & Sons, Hamilton Hill Road, Driffield	LMP3	LFR3	516622	462633	YO25 8PW

* Note: receptor identifiers relate to the locations originally identified during EIA scoping and consultation for the baseline noise survey.

2.2.2 Onshore ECC

2.2.2.1 Baseline noise measurements were undertaken at three receptor locations (Table 2). Short-term attended measurements were taken during the daytime (30-60 minutes) and night time (15 minutes) reference periods.

Table 2: Baseline Noise Monitoring Locations – Onshore ECC.

Description	Measurement Location	Baseline Noise Receptor Identifier*	X	Y	Nearest Postcode
Killingwold Cottage, Bishop Burton, Beverley	CMP1	CCR1	500141	439641	HU17 8QX
Broadgate Farm Holiday Cottages, Walkington	CMP2	CCR2	501223	437767	HU17 8RP
Sharry Gangs, Dunswell Road, Cottingham	CMP3	CCR3	504701	435077	HU16 4JS

* Note: receptor identifiers relate to the locations originally identified during EIA scoping and consultation for the baseline noise survey.

2.2.3 OnSS

2.2.3.1 Since the baseline noise methodology was agreed with ERYC (ON-HUM-1.5), amendments to the survey approach within the OnSS search area was necessary due to landowner access agreements not being possible for all proposed noise monitoring locations. The proposed measurement locations at baseline noise receptor identifier locations SSR2, SSR5, SSR7 and SSR8 were moved due to issues with landowner access agreement. These are shown in bold in Table 3.

2.2.3.2 Baseline noise survey monitoring measurements were undertaken at six receptor locations that had been identified as being the closest noise sensitive receptors to the OnSS (Table 3). Long term unattended measurements were taken continuously over a period of one week. The baseline noise survey monitoring locations are shown on Figure 1 and Figure 2.

Table 3: Baseline Noise Monitoring Locations – OnSS.

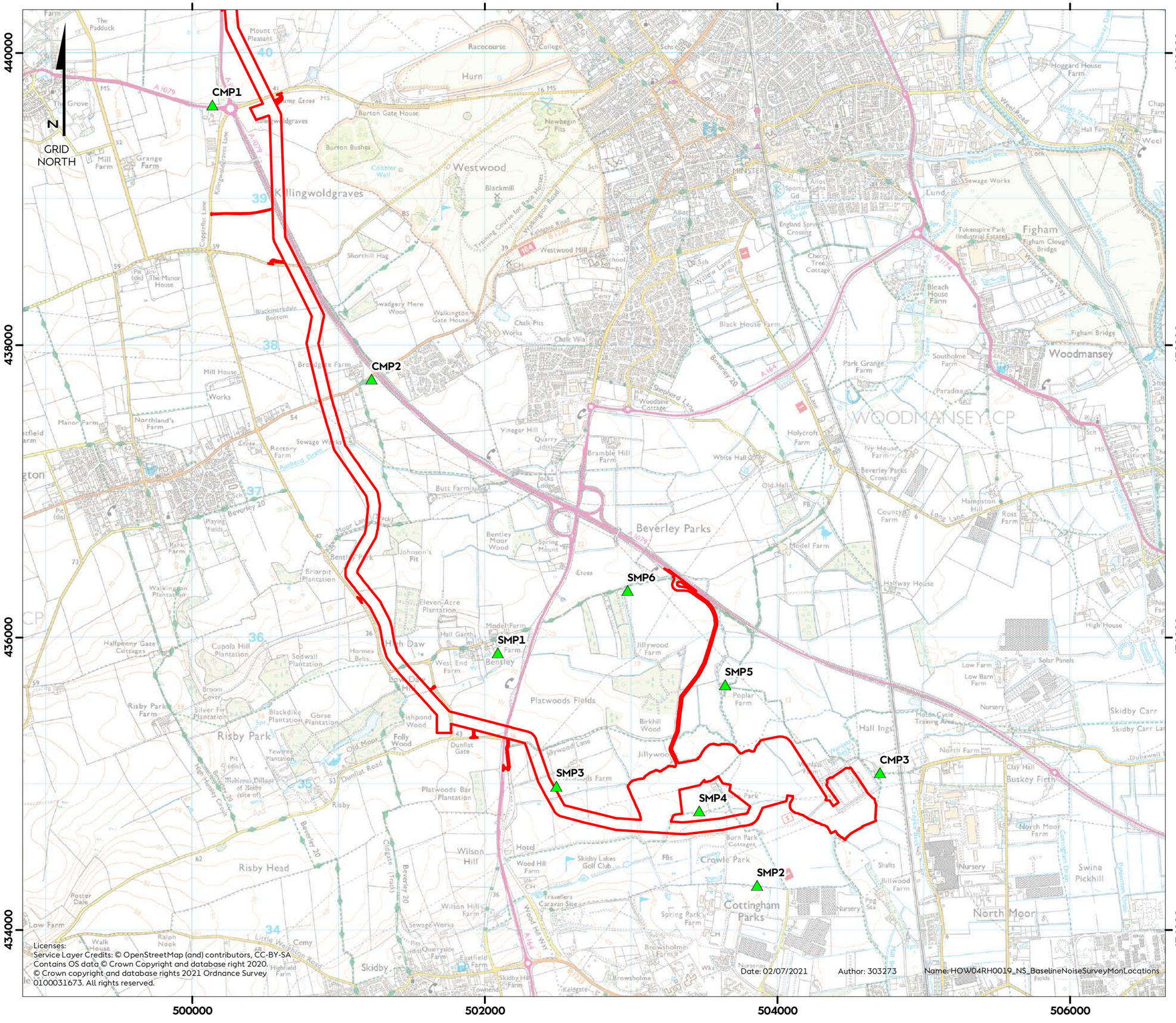
Description	Measurement Location	Baseline noise Receptor Identifier*	X	Y	Nearest Postcode
Woodmansey G & Son Ltd, Manor Farm, Beverley	SMP1	SSR1	502093	435895	HU17 8PP
Lazaat, Wood Hill Way, Cottingham /	SMP2	**SSR2**	503418	434636	HU16 5SX
Welbourn farm, Plattwood Farm / Beverley Road, Cottingham	SMP3	SSR3	502483	434991	HU16 5FF
Residential Property, Skidby, Cottingham	SMP4	SSR4	503464	434811	HU16 5RZ
A Taylor & Son, Burn Park Farm, Park Lane, Cottingham	SMP2	**SSR5**	503418	434636	HU16 5RZ
Farm on Park Lane, Cottingham	SMP5	SSR6	503644	435681	HU16 5SA
Residential property south east of A1079, Beverley	SMP6	**SSR7**	502977	502977	HU17 8PP
Residential property West off A164 Road, Beverley	SMP6	**SSR8**	502977	502977	HU17 8PP

* Note: receptor identifiers relate to the locations originally identified during EIA scoping and consultation for the baseline noise survey.

Hornsea Four

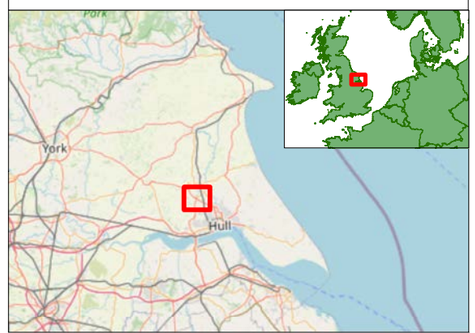
Figure 1

Baseline Noise Survey Monitoring Locations



Order Limits

Noise Monitoring Locations



Coordinate system: British National Grid

Scale@A3: 1:25,000

0 0.5 1 Kilometres

0 500 1,000 Yards

REV	REMARK	DATE
	First Issue for PEIR	05/07/2019
A	Updated following PEIR consultations, for DCO	02/07/2021

Title: Baseline Noise Survey Monitoring Locations
Document no: HOW04RH0019
Created by: AZ
Checked by: AB
Approved by: CS

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Figure 2

Baseline Noise Survey Monitoring Locations

514000 516000 518000

464000 462000 460000 458000

N

GRID NORTH

LMP1

LMP2

LMP3

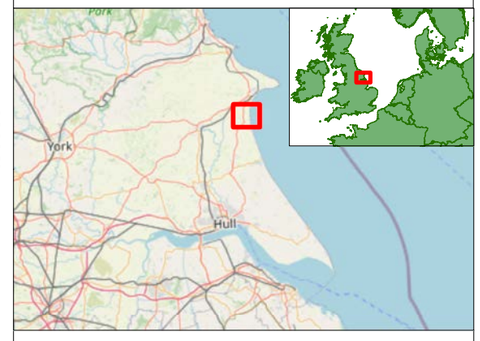
Bridlington Bay

BARMSTON CP

ULROME CP

Order Limits

Noise Monitoring Locations



Coordinate system: British National Grid

Scale@A3: 1:25,000

0 0.25 0.5 1 Kilometres

0 250 500 1,000 Yards

REV	REMARK	DATE
	First Issue for PEIR	05/07/2019
A	Updated following PEIR consultations, for DCO	18/06/2021

Title: Baseline Noise Survey Monitoring Locations

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3 Baseline noise survey monitoring results

3.1.1.1 Table 4 and Table 5 provide a summary of the measured baseline noise data at the landfall during both the daytime and night-time surveys respectively.

Table 4: Baseline Noise Monitoring Data – Landfall, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
LMP1	11 April 2019	16:14:34	16:44:34	52.1	79.2	47.9	34.3
LMP2	11 April 2019	14:48:58	15:18:58	49.5	78.7	40.9	35.7
LMP3	11 April 2019	15:37:55	16:07:55	51.0	73.3	49.4	39.2

Table 5: Baseline Noise Monitoring Data – Landfall, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
LMP1	12 April 2019	00:54:00	01:10:00	37.1	63.3	33.8	30.2
LMP2	12 April 2019	00:12:16	00:27:16	34.4	56.0	34.4	29.7
LMP3	12 April 2019	00:34:09	00:50:09	42.2	65.7	37.3	31.0

3.1.1.2 Table 6 and Table 7 summarise the measured baseline noise data along the onshore ECC during both the daytime and night-time respectively. Result data at CMP1, CMP2 and CMP3 includes a distance correction accounting for the monitoring positions being closer to the road than the respective receptors at those locations.

Table 6: Baseline Noise Monitoring Data – Onshore ECC, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
CMP1	11 April 2019	12:16:11	12:46:11	56.1	73.2	59.2	48.1
CMP2	11 April 2019	12:54:32	13:27:32	58.6	71.2	62.8	47.4
CMP3	12 April 2019	13:02:47	14:02:47	50.8	73.1	50.4	46.2

Table 7: Baseline Noise Monitoring Data – Onshore ECC, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
CMP1	12 April 2019	23:02:02	23:17:02	50.1	69.0	51.3	39.3
CMP2	12 April 2019	23:24:35	23:39:35	54.2	74.8	53.9	36.0

* Note: no night time noise monitoring was undertaken at CMP3.

3.1.1.3 Table 8 and Table 9 provides a summary of the measured baseline noise data at the OnSS during both daytime and night-time respectively.

Table 8: Baseline Noise Monitoring Data – OnSS, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
SMP1	3– 11 April 2019	12:15:00	11:45:00	56.8	100.7	55.5	50.4
SMP2	3– 11 April 2019	14:50:23	10:45:23	45.0	86.3	44.0	37.6
SMP3	3– 11 April 2019	13:00:00	10:10:00	45.1	85.4	44.2	39.2
SMP4	3– 11 April 2019	15:10:07	10:50:07	44.2	86.2	41.4	36.5
SMP5	3– 11 April 2019	13:30:02	10:30:02	51.7	89.0	50.3	43.0
SMP6	3– 11 April 2019	16:10:03	12:00:03	53.9	84.0	55.4	48.4

Table 9: Baseline Noise Monitoring Data – OnSS, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	LA_{eq}	LA_{max}	LA_{10}	LA_{90}
SMP1	3– 11 April 2019	23:00:00	07:00:00	53.5	99.6	49.9	37.3
SMP2	3– 11 April 2019	23:00:23	07:00:23	42.4	76.3	39.1	33.4
SMP3	3– 11 April 2019	23:00:00	07:00:00	43.5	88.0	39.3	32.7
SMP4	3– 11 April 2019	23:00:07	23:00:07	41.8	86.8	37.2	32.4
SMP5	3– 11 April 2019	23:00:02	07:00:02	49.4	79.1	43.8	32.7
SMP6	3– 11 April 2019	23:00:03	07:00:03	52.6	85.3	49.7	38.0

3.1.1.4 Table 10 and Table 11 contain statistical analysis of the measured background noise levels, L_{A90}, at the OnSS during both daytime and night-time respectively. The mean, mode and mean +/- one standard deviation are presented to show the variability of background noise at each location. Statistical analysis is undertaken to ascertain a representative background sound level.

Table 10: L_{A90} Statistical Analysis – OnSS, Daytime Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	Average LA_{90}	Mode	Average – 1 standard deviation	Average + 1 standard deviation
SMP1	3– 11 April 2019	12:15:00	11:45:00	50.4	50.0	46.4	54.4
SMP2	3– 11 April 2019	14:50:23	10:45:23	37.6	37.0	34.4	40.8
SMP3	3– 11 April 2019	13:00:00	10:10:00	39.2	37.0	35.9	42.4
SMP4	3– 11 April 2019	15:10:07	10:50:07	36.5	37.0	33.9	39.2
SMP5	3 April – 11 April 2019	13:30:02	10:30:02	43.0	45.0	38.5	47.5
SMP6	3– 11 April 2019	16:10:03	12:00:03	48.4	50.0	44.6	52.2

Table 11: L_{A90} Statistical Analysis – OnSS, Night-time Free Field, dB.

Noise Monitoring Location	Date	Start time	End time	Average LA_{90}	Mode	Average – 1 standard deviation	Average + 1 standard deviation
SMP1	3– 11 April 2019	12:15:00	11:45:00	37.3	30.0	28.4	46.3
SMP2	3– 11 April 2019	14:50:23	10:45:23	33.4	34.0	29.7	37.1
SMP3	3– 11 April 2019	13:00:00	10:10:00	32.7	30.0	27.2	38.1
SMP4	3– 11 April 2019	15:10:07	10:50:07	32.4	31.0	28.7	36.2
SMP5	3– 11 April 2019	13:30:02	10:30:02	32.7	29.0	24.5	40.9
SMP6	3– 11 April 2019	16:10:03	12:00:03	38.0	34.0	30.1	45.8

4 Conclusion and Discussion

4.1.1.1 To characterise the baseline noise environment and conditions in proximity to the Hornsea Four Order Limits a baseline noise survey was undertaken at agreed sensitive receptor/measurement locations (as agreed with ERYC, ON-HUM-1.5) between 3 April and 11 April 2019. Amendments to the agreed methodology (moving/combining baseline monitoring locations) were made at the onshore project substation due to access restrictions. These amendments i.e. baseline noise monitoring locations that form the basis of this report do not materially impact the baseline identification compared to the locations identified originally.

4.1.1.2 Baseline noise data was collated for each monitoring location with L_{Aeq}, L_{A90}, L_{A10}, L_{Amax} levels determined from each specific measurement period. Background noise levels were obtained from the baseline measurements. The background noise levels for the unattended measurement periods were assessed using statistical analysis of the measured L_{A90} values. Assessment values for receptor locations at the OnSS have been derived from long term and short-term measurements.

4.1.1.3 As stated in Paragraph 1.1.1.4, the requirement for an updated baseline noise survey was not identified and this conclusion was agreed with ERYC in September 2021 (ON-HUM-1.16. Therefore, the 2019 baseline noise monitoring surveys are considered representative (and generally consistent with similar rural locations) of Hornsea Four Order Limits and were undertaken at the landfall, along the onshore ECC and within the OnSS.

5 References

BSI Standards Publication (2014) BS4142:2014 Methods for rating and assessing industrial and commercial sound.

BSI Standards Publication (1991) BS7445-2:1991 Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use.