Hornsea Project Four: Environmental Statement (ES)

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Chapter 8: Noise and Vibration

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Table of Contents

List of Tables

List of Figures

Annexes

Annex	Title
8.1	Hornsea Four Baseline Noise Survey

Glossary

Term	Definition
Commitment	A term used interchangeably with mitigation and enhancement 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.
Cumulative effects	The combined effect of Hornsea Four in combination with the effects from a number of different projects, on the same single receptor/resource. Cumulative impacts are those that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Project Four.
Design Envelope	A description of the range of possible elements that make up the Hornsea Project Four design options under consideration, as set out in detail in the project description. This envelope is used to define Hornsea Project Four for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
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.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Statement (ES).

Term	Definition
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Haul Road	The track along the onshore ECC which the construction traffic would use to access work fronts.
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.
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
National Grid Electricity Transmission (NGET) substation	The grid connection location for Hornsea Four.
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 onshore 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).
Planning Inspectorate (PINS)	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
Trenchless Techniques	Also referred to as trenchless crossing techniques or trenchless methods. These techniques include Horizontal Directional Drilling (HDD), thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.

Acronyms

Acronym	Definition
AAWT	Annual Average Weekday Traffic
BNL	Basic Noise Level
BPM	Best Practicable Means
CRTN	Calculation of Road Traffic Noise
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
ERYC	East Riding Yorkshire Council
ES	Environmental Statement
eVDV	Estimated Vibration Dose Value
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
LOAEL	Lowest Observed Adverse Effect Level
MHWS	Mean High Water Springs
MDS	Maximum Design Scenario
NGET	National Grid Electricity Transmission
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Project
NSR	Noise Sensitive Receptors
OnSS	Onshore Substation
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PPV	Peak Particle Velocity
SOAEL	Significant Observed Adverse Effect Level
TRL	Transport Research Laboratory
VDV	Vibration Dose Value

Units

Unit	Definition
dB(A)	A representation 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.
GW	Gigawatt
km	Kilometre
kV	Kilovolt
kW	Kilowatt
LAeq	A-weighted equivalent continuous sound level in decibels measured over a stated period of time
LAmax	Maximum A - weighted sound pressure level recorded over the period stated
LA10	The noise level just exceeded for 10% of the measurement period, A-weighted and calculated by statistical analysis
LA90	The noise level just exceeded for 90% of the measurement period, A-weighted and calculated by statistical analysis
m	Metre
mph	Miles Per Hour
µPa	Micropascal. A micropascal (µPa) is a decimal fraction of the pascal, which is the SI derived unit of pressure, stress, Young's modulus and ultimate tensile strength.

8.1 Introduction

8.1.1.1 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.

8.1.1.2 This chapter of the Environmental Statement (ES) presents the results of the Environmental Impact Assessment (EIA) for the potential impacts of Hornsea Four on noise and vibration. Specifically, this chapter considers the potential impact of Hornsea Four landward of Mean High-Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases.

8.1.1.3 This chapter incorporates a summary of the information contained within the baseline noise technical report, which is included at **Volume A6, Annex 8.1: Baseline Noise Survey Report**.

8.2 Purpose

8.2.1.1 The primary purpose of the ES is to support the Development Consent Order (DCO) application for Hornsea Four under the Planning Act 2008 (the 2008 Act). This ES constitutes the environmental information for Hornsea Four and sets out the findings of the EIA.

8.2.1.2 The ES has been finalised with due consideration of pre-application consultation to date (see **Volume B1, Chapter 1: Consultation Report** and **Table 8.4**) and the ES will accompany the application to the Planning Inspectorate (PINS) for Development Consent.

8.2.1.3 This ES chapter:

- Presents the existing environmental baseline established from desk studies, and consultation;
- Presents the potential environmental effects of noise and vibration arising from Hornsea Four, based on the information gathered and the analysis and assessments undertaken;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or additional mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

8.3 Planning and Policy Context

8.3.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to noise and vibration, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1) DECC, 2011a), the NPS for Renewable Energy Infrastructure (EN-3) (DECC, 2011b) and the NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c).

8.3.1.2 NPS EN-1 and NPS EN-5 include guidance on what matters are to be considered in the assessment. These are summarised in **Table 8.1**. Regarding noise and vibration assessment, NPS EN-3 refers to NPS EN-1.

Table 8.1: Summary of NPS provisions.

Summary of NPS EN-1 and EN-5 provisions	How and where considered in the ES
"*Where noise impacts are likely to arise, the applicant should include:* • *A description of the noise generating aspects of the development proposal leading to noise impacts including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise;* • *Identification of noise sensitive premises and noise sensitive areas that may be affected;* • *The characteristics of the existing noise environment;* • *A prediction of how the noise environment will change with the proposed development;* • *In the shorter term such as during the construction period;* • *In the longer term during the operating life of the infrastructure;* • *At particular times of the day, evening and night as appropriate;* • *An assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas; and* • *Measures to be employed in mitigating noise.* *The nature and extent of the noise assessment should be proportionate to the likely noise impact*" (EN-1, paragraph 5.11.4)	**Table 8.18** contains information on the noise generating aspects of Hornsea Four. Refer to **Section 8.10** for the potential noise and vibration assessment methodology, **Section 8.7.2** for details on the existing noise environment including the identification of noise sensitive receptors (**Figure 8.6** and **Figure 8.7**), and **Section 8.11** where any changes in noise levels as a result of the project are assessed, and any potential effects and potential mitigation measures are identified.
"*The noise impact of ancillary activities associated with the development, such as increased road and rail traffic movements, or other forms of transportation, should also be considered*" (EN-1, paragraph 5.11.5)	Refer to **Section 8.11** where any changes in noise levels as a result of Hornsea Four from ancillary works, for example vehicle movements, are assessed and any potential impacts and potential mitigation measures are identified.
"*Operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance. Further information on assessment of particular noise sources may be contained in the technology-specific NPSs. In particular, for renewables (EN-3) and electricity networks (EN-5) there are assessment guidance for specific features of those technologies. For the prediction, assessment*	The current relevant British Standards have been used within this assessment, as detailed in **Section 8.10**.

Summary of NPS EN-1 and EN-5 provisions	How and where considered in the ES
and management of construction noise, reference should be made to any relevant British Standards and other guidance which also give examples of mitigation strategies" (EN-1, paragraph 5.11.6)	
"*The applicant should consult Environment Agency (EA) and Natural England (NE), or the Countryside Council for Wales (CCW), as necessary and in particular with regard to assessment of noise on protected species or other wildlife. The results of any noise surveys and predictions may inform the ecological assessment. The seasonality of potentially affected species in nearby sites may also need to be taken into account*" (EN-1, paragraph 5.11.7)	Noise impacts on terrestrial protected species or other wildlife is considered within **Chapter 3: Ecology and Nature Conservation**.
"*While standard methods of assessment and interpretation using the principles of the relevant British Standards are satisfactory for dry weather conditions, they are not appropriate for assessing noise during rain. This is when overhead line noise mostly occurs, and when the background noise itself will vary according to the intensity of the rain. Therefore, an alternative noise assessment method to deal with rain-induced noise is needed, such as the one developed by National Grid as described in report TR (T) 94,199319. This follows recommendations broadly outlined in ISO 1996 (BS 7445:1991) and in that respect, is consistent with BS 4142:1997. The IPC* [hereafter the Secretary of State (SoS)] *is likely to be able to regard it as acceptable for the applicant to use this or another methodology that appropriately addresses these particular issues*" (EN-5, paragraph 2.9.8 – 2.9.9)	Construction of a new overhead line will not be required, and operational assessment of rain-induced noise is therefore not considered necessary.

8.3.1.3 NPS EN-1 also highlights several factors relating to the determination of an application and in relation to mitigation. These policy provisions are summarised in **Table 8.2**.

Table 8.2: Summary of NPS EN-1 policy on decision making relevant to noise and vibration.

Summary of NPS EN-1 provisions	How and where considered in the ES
"*The project should demonstrate good design through selection of the quietest cost-effective plant available; containment of noise within buildings wherever possible; optimisation of plant layout to minimise noise emissions; and, where possible, the use of landscaping, bunds or noise barriers to reduce noise transmission.* *The SoS should not grant development consent unless it is satisfied that the proposals will meet the following aims:* • *avoid significant adverse impacts on health and quality of life from noise;* • *mitigate and minimise other adverse impacts on health and quality of life from noise; and* • *where possible, contribute to improvements to health and quality of life through the effective management and control of noise.*	Refer to **Section 8.11** for the impact assessment. Good design is embedded through the route planning and site selection process (**Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**). It is secured through **Volume A1, Chapter 4: Project Description** and **Volume F2, Chapter 13: Outline Design Plan**.

Summary of NPS EN-1 provisions	How and where considered in the ES
When preparing the development consent order, the SoS should consider including measurable requirements or specifying the mitigation measures to be put in place to ensure that noise levels do not exceed any limits specified in the development consent" (EN-1, paragraph 5.11.8 – 5.11.10)	
"The SoS should consider whether mitigation measures are needed both for operational and construction noise over and above any which may form part of the project application. In doing so the SoS may wish to impose requirements. Any such requirements should take account of the guidance set out in Circular 11/95 (see Section 4.1) or any successor to it. *Mitigation measures may include one or more of the following:* • *engineering: reduction of noise at point of generation and containment of noise generated;* • *lay-out: adequate distance between source and noise-sensitive receptors; incorporating good design to minimise noise transmission through screening by natural barriers, or other buildings; and* • *administrative: restricting activities allowed on the site; specifying acceptable noise limits; and taking into account seasonality of wildlife in nearby designated sites.* *In certain situations, and only when all other forms of noise mitigation have been exhausted, it may be appropriate for the SoS to consider requiring noise mitigation through improved sound insulation to dwellings"* (EN-1, paragraph 5.1.11 – 5.11.13)	Where concluded as necessary through the assessment process, mitigation is addressed in **Section 8.11**.

8.3.2 National Planning Policy Framework

8.3.2.1 The National Planning Policy Framework (NPPF) (as revised in 2019) forms the basis of the Government's planning policies for England and how these should be applied. Paragraph 170 of the NPPF states planning policies and decisions should contribute to and enhance the natural and local environment by:

> *"……preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution……"*

8.3.2.2 Furthermore, Paragraph 180 states:

> *"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- *mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*
- *limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."*

8.3.2.3 The NPPF also refers to the Noise Policy Statement for England (NPSE) (Defra, 2010), as set out in **Section 8.3.3**.

8.3.3 Noise Policy Statement for England, 2010

8.3.3.1 The NPSE document was published by Defra in 2010 and paragraph 1.7 states three policy aims:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life."*

8.3.3.2 The first two points require that significant adverse impacts should not occur and that, where a noise level falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect:

"...all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur." (Paragraph 2.24, NPSE March 2010).

8.3.3.3 Section 2.20 of the NPSE introduces key phrases including 'significant adverse' and 'adverse' and two established concepts from toxicology that are being applied to noise impacts:

- *"NOEL – No Observed Effect Level; this is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise"*; and
- *"LOAEL – Lowest Observed Adverse Effect Level; this is the level above which adverse effects on health and quality of life can be detected"*.

8.3.3.4 Paragraph 2.21 of the NPSE extends the concepts described above and leads to a significant observed adverse effect level (SOAEL), which is defined as the level above which significant effects on health and quality of life occur.

8.3.3.5 The NPSE states:

> *"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations".* (Paragraph 2.22, NPSE March 2010).

8.3.3.6 Furthermore, paragraph 2.22 of the NPSE acknowledges that:

> *"Further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise".*

8.3.3.7 However not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

8.3.4 National Planning Practice Guidance for Noise, 2014

8.3.4.1 The National Planning Practice Guidance for Noise (NPPG Noise, December 2014), issued under the NPPF, states that:

> *"Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or making decisions about new development, there may also be opportunities to consider improvements to the acoustic environment."* (Paragraph: 001 Reference ID: 30-001-20190722, NPPG last updated July 2019).

8.3.5 Local Planning Policy

8.3.5.1 The Hornsea Four Order Limits are located wholly within the boundary of East Riding of Yorkshire Council (ERYC) local planning authority.

8.3.5.2 The ERYC Local Plan 2012 – 2029 Strategy Document (Adopted April 2016) contains strategic policies to guide decisions on planning applications.

8.3.5.3 Policy EC5 (Supporting the Energy Sector) states, in relation to noise:

> *"Proposals for the development of the energy sector, excluding wind energy but including the other types of development listed in Table 7, will be supported where any significant adverse impacts are addressed satisfactorily, and the residual harm is outweighed by the wider benefits of the proposal. Developments and their associated infrastructure should be acceptable in terms of:*
>
> *1. The cumulative impact of the proposal with other existing and proposed energy sector developments;*
>
> *.....*
>
> *3. The effects of development on:*
> *i. local amenity, including noise, air and water quality, traffic, vibration, dust and visual impact;."*

8.3.5.4 Wind energy as referenced in the Policy relates to onshore wind developments.

8.3.6 Legislation

8.3.6.1 This section provides details on key pieces of legislation which are relevant to this assessment.

Environmental Protection Act 1990

8.3.6.2 Section 79 of the Environmental Protection Act 1990 (the EPA 1990) defines statutory nuisance with regard to noise and determines that local planning authorities have a duty to detect such nuisances in their area.

8.3.6.3 The EPA 1990 also defines the concept of 'Best Practicable Means' (BPM) as:

- *"Practicable" means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;*
- *The means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;*
- *The test is to apply only so far as compatible with any duty imposed by law; and*
- *The test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances."*

8.3.6.4 Section 80 of the EPA 1990 provides local planning authorities with powers to serve an abatement notice requiring the abatement of a nuisance or requiring works to be executed to prevent their occurrence.

The Control of Pollution Act 1974

8.3.6.5 Section 60 of the Control of Pollution Act 1974 provides powers to local planning authority officers to serve an abatement notice in respect of noise nuisance from construction works.

8.3.6.6 Section 61 provides a method by which a contractor can apply for 'prior consent' for construction activities before commencement of works. The 'prior consent' is agreed between the local planning authority and the contractor and may contain a range of agreed working conditions, noise limits and control measures designed to minimise or prevent the occurrence of noise nuisance from construction activities. Application for a 'prior consent' is a commonly used control measure in respect of potential noise impacts from major construction works.

8.3.6.7 Further detail regarding noise nuisance is provided in **Volume F1, Chapter 4: Statutory Nuisance Statement**.

8.3.7 Guidance

8.3.7.1 The guidance in Table 8.3 has been applied to the noise and vibration assessment.

Table 8.3: Relevant guidance.

Document	Description
British Standard (BS) 4142:2014 – Method for Rating and Assessing Industrial and Commercial Sound	Describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incidental.
BS 5228-1:2007+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise	Part 1 provides recommendations for basic methods of noise and vibration control relating to construction and open sites where work activities/operations generate significant noise and/or vibration levels. The legislative background to noise and vibration control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. This BS provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it.
BS 5228-1:2007+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration	Part 2 gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels. The Standard includes tables of vibration levels measured during piling operations throughout the UK. It provides guidance concerning methods of mitigating vibration from construction, particularly with regard to percussive piling.
BS 6472-1:2008 – Guide to Evaluation of Human Exposure to Vibration in Buildings	Provides general guidance on human exposure to building vibration in the range of 1Hz to 80Hz and includes curves of equal annoyance for humans. It also outlines the measurement methodology to be employed. It introduces the concept of Vibration Dose Value (VDV) and estimated Vibration Dose Value (eVDV) for the basis of assessment of the severity of impulsive and intermittent vibration levels, such as those caused by a series of trains passing a given location.
BS 7445: Parts 1 and 2 – Description and Measurement of Environmental Noise	Provides details of the instrumentation and measurement techniques to be used when assessing environmental noise and defines the basic noise quantity as the continuous A-weighted sound pressure level (LAeq). Part 2 of BS 7445 replicates International Standards Organisation (ISO) 1996-2.

Document	Description
BS 8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings	Provides a methodology to calculate the noise levels entering a building through facades and facade elements and provides details of appropriate measures for sound insulation between dwellings. It includes recommended internal noise levels which are provided for a variety of situations and is based on World Health Organisation (WHO) recommendations.
Calculation of Road Traffic Noise (CRTN) 1988	Provides a method for assessing noise from road traffic in the UK and a method of calculating noise levels from the Annual Average Weekday Traffic (AAWT) flows and from measured noise levels. Since publication in 1988 this document has been the nationally accepted standard in predicting noise levels from road traffic. The calculation methods provided include correction factors to take account of variables affecting the creation and propagation of road traffic noise, accounting for the percentage of heavy goods vehicles (HGV), different road surfacing, inclination, screening by barriers and relative height of source and receiver.
Design Manual for Roads and Bridges (DMRB), 2020	LA111 Revision 2, May 2020 provides guidance on the environmental assessment of noise impacts from road schemes. DMRB contains advice and information on transport-related noise and vibration, which has relevance with regard to the construction and operational traffic impacts affecting sensitive receptors adjacent to road networks. It also provides guideline significance criteria for assessing traffic related noise impacts.
ISO 3744	Specifies a method for measuring the sound pressure levels on a measurement surface enveloping a noise source, under essentially free field conditions near one or more reflecting planes, in order to calculate the sound power level produced by the noise source.
ISO 717	Defines single-number quantities for airborne sound insulation in buildings and of building elements such as walls, floors, doors, and windows.
ISO 9613-2	Specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a noise source.
WHO (1999) Guidelines for Community Noise	These guidelines present health-based noise limits intended to protect the population from exposure to excess noise. They present guideline limit values at which the likelihood of particular effects, such as sleep disturbance or annoyance, may increase. The guideline values are 50 or 55dB LAeq during the day, related to annoyance, and 45dB LAeq or 60dB LAmax at night, related to sleep disturbance. The Guidance states:

Document	Description
	"The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30dB LAeq for continuous noise and 45dB LAmax for single sound events. Lower noise levels may be disturbing depending on the nature of the source." The WHO guidance also highlights that: *"Night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15dB.* *To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35dB LAeq. To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB LAeq on balconies, terraces and in outdoor living areas.* *To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB LAeq.* *Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."*
WHO (2009) Night Noise Guidelines for Europe	An extension to the WHO Guidelines for Community Noise (1999). It concludes that: *"Considering the scientific evidence on the thresholds of night noise exposure indicated by Lnight outside as defined in the Environmental Noise Directive (2002148/EC), an Lnight outside of 40dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly.* *Lnight outside value of 55dB is recommended as an interim target for those countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a stepwise approach."*

8.4 Consultation

8.4.1.1 Consultation is a key part of the DCO application process. Consultation regarding noise and vibration has been conducted through Evidence Plan Technical Panel meetings, the EIA scoping process (Orsted 2018) and formal consultation on the PEIR under section 42 of the 2008 Act. An overview of the project consultation process is presented within **Volume A1, Chapter 6: Consultation**. Agreements made with consultees within the Evidence Plan process are set out in the topic specific Evidence Plan Logs which are appendices to the Hornsea Four Evidence Plan (**Volume B1, Annex 1.1: Evidence Plan**), an annex of the Hornsea Four Consultation Report (**Volume B1, Chapter 1: Consultation Report**). All agreements within the Evidence Plan Logs have unique identifier codes which have been used throughout this document to signpost to the specific agreements made (e.g. ON-HUM-1.1).

8.4.1.2 Following receipt of the Scoping Opinion (PINS 2018) consultation regarding noise and vibration has been conducted through a Hornsea Four Human Environment Technical Panel in January 2019 and November 2019 in addition to email correspondence with ERYC.

8.4.1.3 A summary of the key issues raised during consultation specific to noise and vibration is outlined below in **Table 8.4**, together with how these issues have been considered in the production of this ES.

Table 8.4: Consultation responses.

Consultee	Date, Document, Forum	Comment	Response/Where addressed in the ES
PINS	November 2018 Scoping Opinion 4.20.2	*"Temporary noise and vibration from haul route access construction: construction phase:* *It is not clear how the distance restrictions in Co133 and 135 can practically operate given the estimated working width provided in the Scoping Report. Given the uncertainty that the proposed commitments can successfully reduce noise and vibration to below the standard criteria set out in the Scoping Report, the Inspectorate considers that the ES should assess this matter where significant effects are likely to occur."*	This impact is not considered in detail in this ES. Refer to **Section 8.8.1** for further details. Co133 (since replaced at ES with Co49) and Co135 were embedded into the design of Hornsea Four to maintain the distance restrictions, as detailed in **Volume A4, Annex 3.3: Selection and Refinement of the Onshore Infrastructure**.

Consultee	Date, Document, Forum	Comment	Response/Where addressed in the ES
PINS	November 2018 Scoping Opinion 4.20.7	*"Noise and vibration from operation of offshore HVAC booster:* *The location (and need for) the HVAC booster substation is not yet determined, although reference is made to a distance of 20km offshore in Section 7.8. However, no parameters have been presented in the Scoping Report for the booster substation location and design. This reduces confidence that significant effects will be avoided, and the Inspectorate expects to see an assessment of the impacts of the booster substation within the ES incorporating this information. "*	This impact is not considered in detail in this ES. Refer to **Section 8.8.1** for further details.
PINS	November 2018 Scoping Opinion 4.20.9	*"Baseline:* *The description in the Scoping Report lacks detail and does not highlight the settlements and other receptors identified in other topic chapters which may be relevant to the noise and vibration assessment. The Inspectorate would expect to see a robust baseline comprising a description of all potential receptors identified by the study area reported in the ES."*	The existing baseline is detailed in **Section 8.7.2**. See **Figure 8.6** and **Figure 8.7** regarding the identification of sensitive receptors.
Natural England	November 2018	Consideration should be given to noise levels and timings with regards noise sensitive receptors including designated sites and protected species. For example, the River Hull Headwaters SSSI supports a diverse breeding bird community and therefore consideration should be given to the degree and timing of disturbance of species.	Disturbance to species (including birds) is addressed in **Chapter 3: Ecology and Nature Conservation**.
ERYC	January 2019 (late Scoping Opinion)	The Council's Public Protection Officers have considered the Scoping Report and are agreeable with the approach and the potential impacts. Suitable noise assessment locations have been agreed separately with the Applicant.	Noted and agreed.
ERYC	January 2019 Human Environment Technical Panel	Noise from temporary construction compounds: ERYC confirmed that they were satisfied with the proposal to not consider noise from temporary logistics compounds in detail in the PEIR or ES (ON-HUM-3.5).	Agreed.
ERYC	January 2019	ERYC requested that a complaints procedure be implemented for construction noise	Relevant best-practice measures are

Consultee	Date, Document, Forum	Comment	Response/Where addressed in the ES
	Human Environment Technical Panel		detailed within Section 8.11.
ERYC	January 2019 Human Environment Technical Panel	ERYC requested that evidence be provided to support the scoping out of effects from the offshore HVAC Booster	Addressed in Table 8.16.
ERYC	January 2019 Human Environment Technical Panel	ERYC confirmed they do not typically expect to see assessment of non-residential receptors.	Disturbance to species (including birds) is addressed in Chapter 3: Ecology and Nature Conservation.
ERYC	February 2019 Baseline Noise Survey Technical Note	ERYC confirmed via email correspondence (21 February 2019) that the methodology and scope of the baseline noise survey, including survey locations (presented within the Technical Note), were appropriate.	A summary of the baseline noise survey is presented within Section 8.7.
ERYC	July 2019 Email correspondence	ERYC confirmed via email correspondence (22 July 2019) that they had no comments on the Impact Register (presented in Volume A4, Annex 5.1: Impacts Register).	The Noise and Vibration assessment has been undertaken in line with the Impacts Register (Volume A4, Annex 5.1: Impacts Register).
ERYC	October 2019 Human Environment Technical Panel	ERYC confirmed that they had no comments on the noise and vibration assessment presented in the PEIR.	Noted.
Hull County Council (HCC)	November 2019 Stakeholder Consultation Call	In response to the PEIR, HCC requested that the traffic and transport study area also be extended to include roads within their administration area.	The study area for the construction phase road traffic noise assessment was extended following traffic-specific consultation. This is captured in Section 8.10 and Section 8.11.

8.5 Study area

8.5.1.1 The onshore noise and vibration study area was defined by the extent of the Hornsea Four Order Limits which includes the following elements:

- Landfall;
- Onshore Export Cable Corridor (ECC); and
- Onshore substation (OnSS), Energy Balancing Infrastructure (EBI) and 400 kV National Grid Electricity Transmission (NGET) connection area.

8.5.1.2 The spatial scope of the construction noise assessment included the following geographic coverage:

- 500 m buffer around the onshore ECC;
- 2 km buffer around the landfall, OnSS and 400 kV NGET connection area; and
- Traffic routes subject to significant changes in traffic flows (and / or percentage HGV) associated with construction.

8.5.1.3 The extent of the noise and vibration study area for the construction phase road traffic noise and vibration assessment was based on details provided in **Chapter 7: Traffic and Transport** and agreed through traffic-specific consultation. The study area for the construction phase road traffic noise assessment was extended following traffic-specific consultation with HCC in November 2019 as detailed in **Chapter 7: Traffic and Transport**.

8.5.1.4 The noise and vibration study area is shown in **Figure 8.1** to **Figure 8.5**.

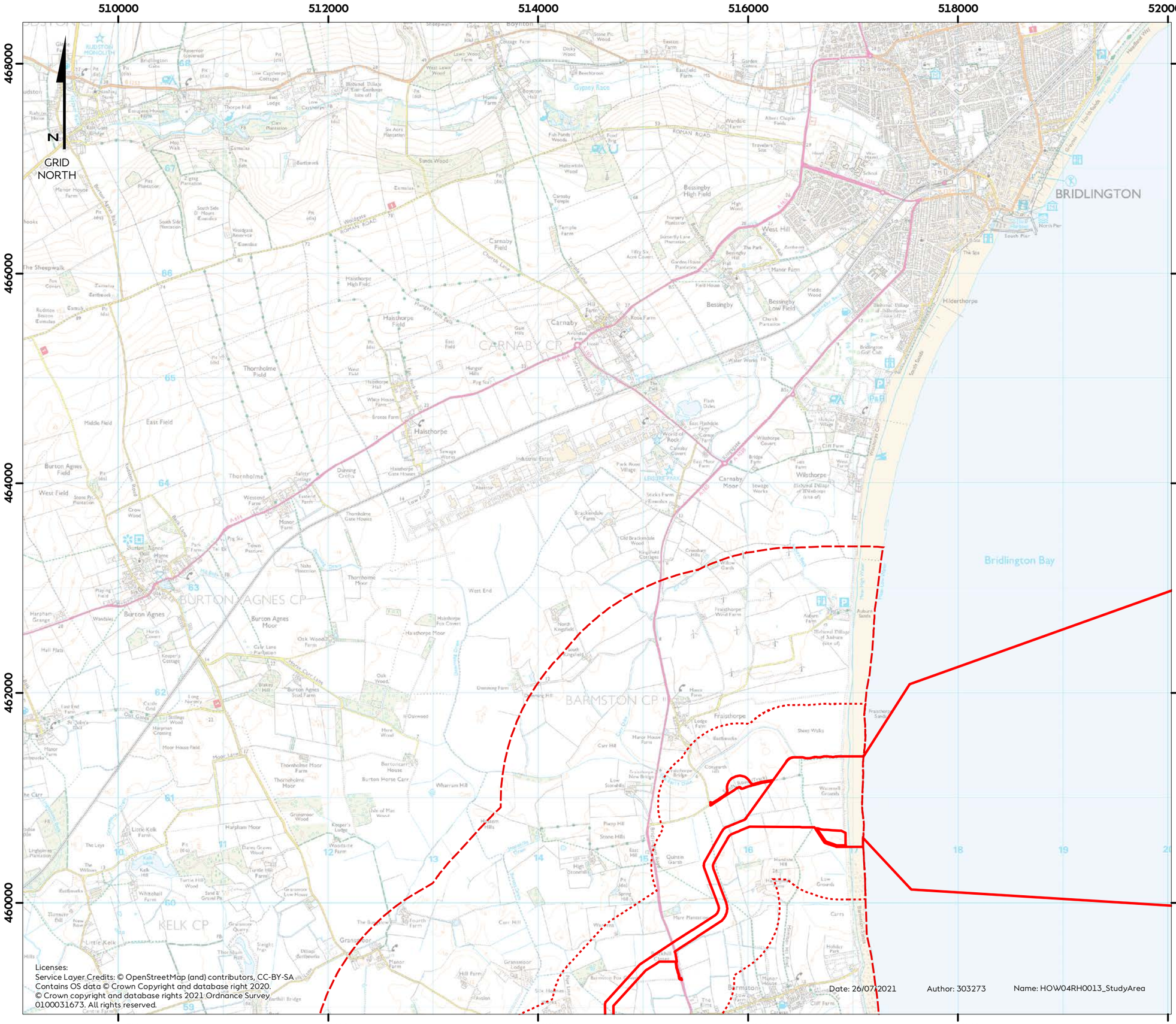
8.5.1.5 The noise and vibration assessment is informed by the information provided within **Volume A1 Chapter 4: Project Description** in order to define Maximum Design Scenarios (MDSs) for each potential impact, which is subsequently assessed in this chapter.

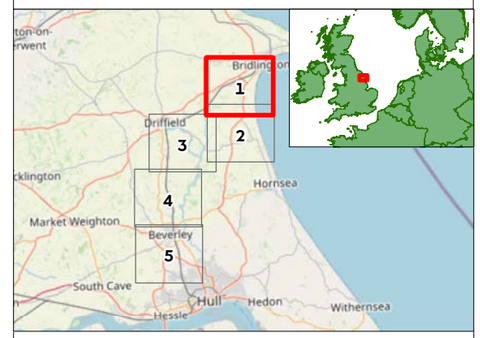
8.5.1.6 Baseline noise surveys were undertaken in April 2019, at pre-agreed locations which were considered to be representative of a range of noise sensitive receptors. It is typical for the baseline noise surveys to be undertaken around the time of when the noise impact assessment is undertaken; however, 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 discussed with the relevant regulator (ERYC) and deemed not to be required. 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).

Hornsea Four

Figure 8.1

Noise and Vibration Study Area (Landfall) - Sheet 1 of 5





Coordinate system: British National Grid

Scale@A3: 1:35,000

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0 0.5 1 Miles

REV	REMARK	DATE
	First Issue for PEIR	03/07/2019
A	Updated following PEIR consultations, for DCO	26/07/2021

Title: Noise and Vibration Study Area
Document no: HOW04RH0013
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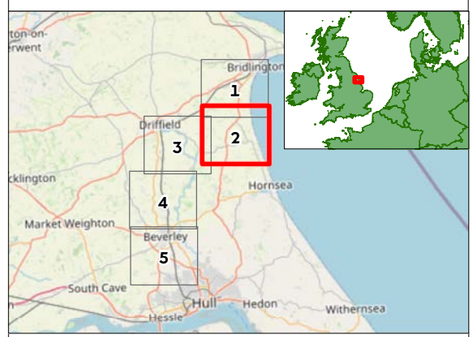
Hornsea Four

Figure 8.2

Noise and Vibration Study Area (Onshore ECC) - Sheet 2 of 5

- Order Limits
- 2 km Study Area
- 500 m Study Area



Coordinate system: British National Grid

Scale@A3: 1:35,000

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0 0.5 1 Miles

REV	REMARK	DATE
	First Issue for PEIR	03/07/2019
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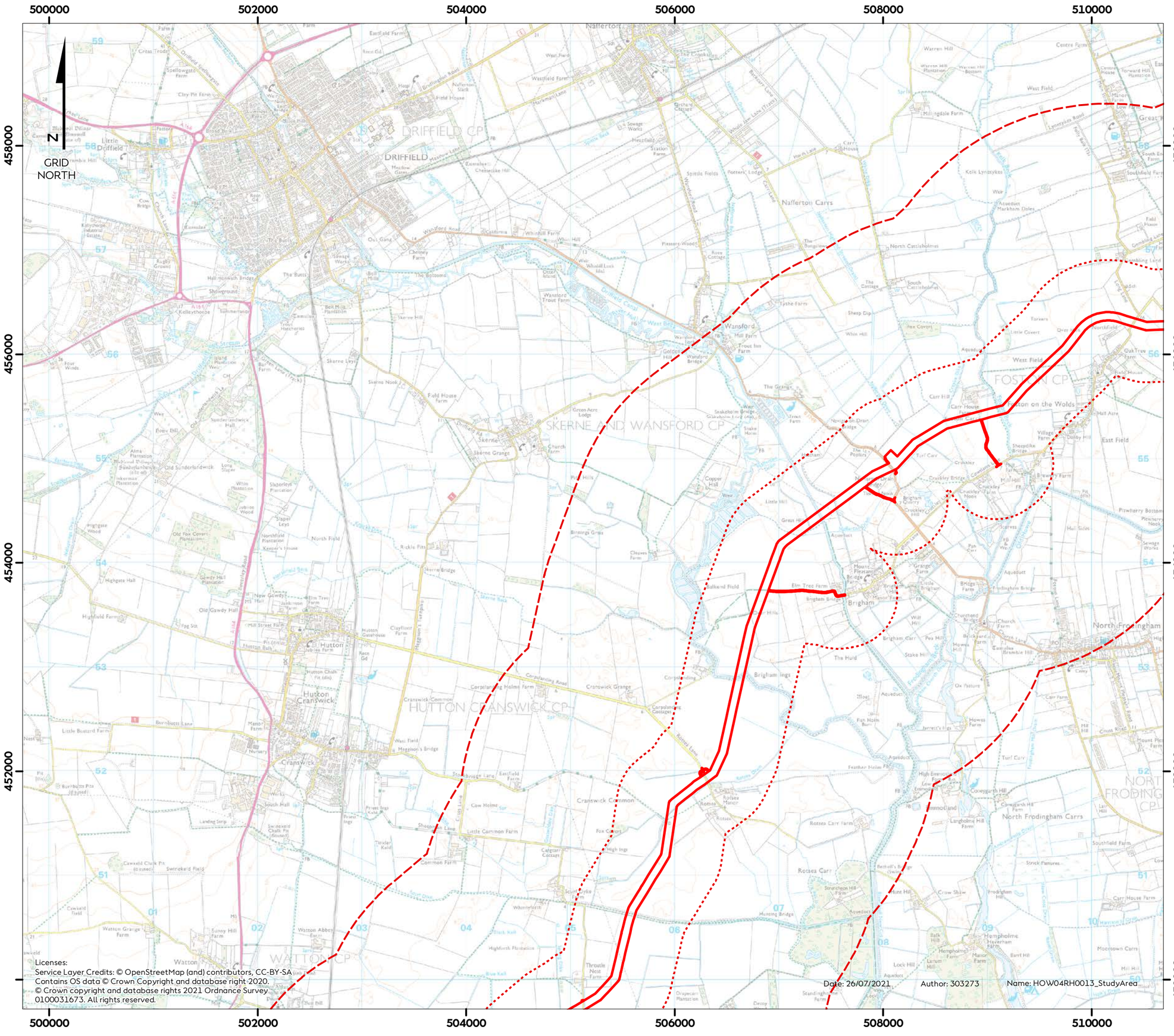
Figure 8.3

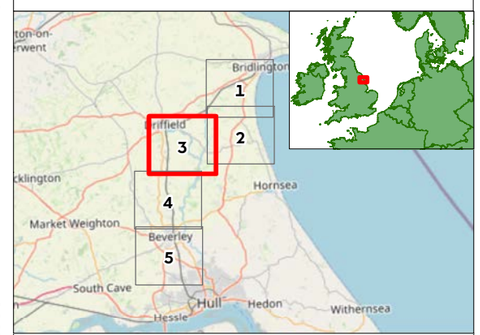
Noise and Vibration Study Area (Onshore ECC) - Sheet 3 of 5



Order Limits

2 km Study Area

500 m Study Area



Coordinate system: British National Grid

Scale@A3: 1:35,000

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0 0.5 1 Miles

REV	REMARK	DATE
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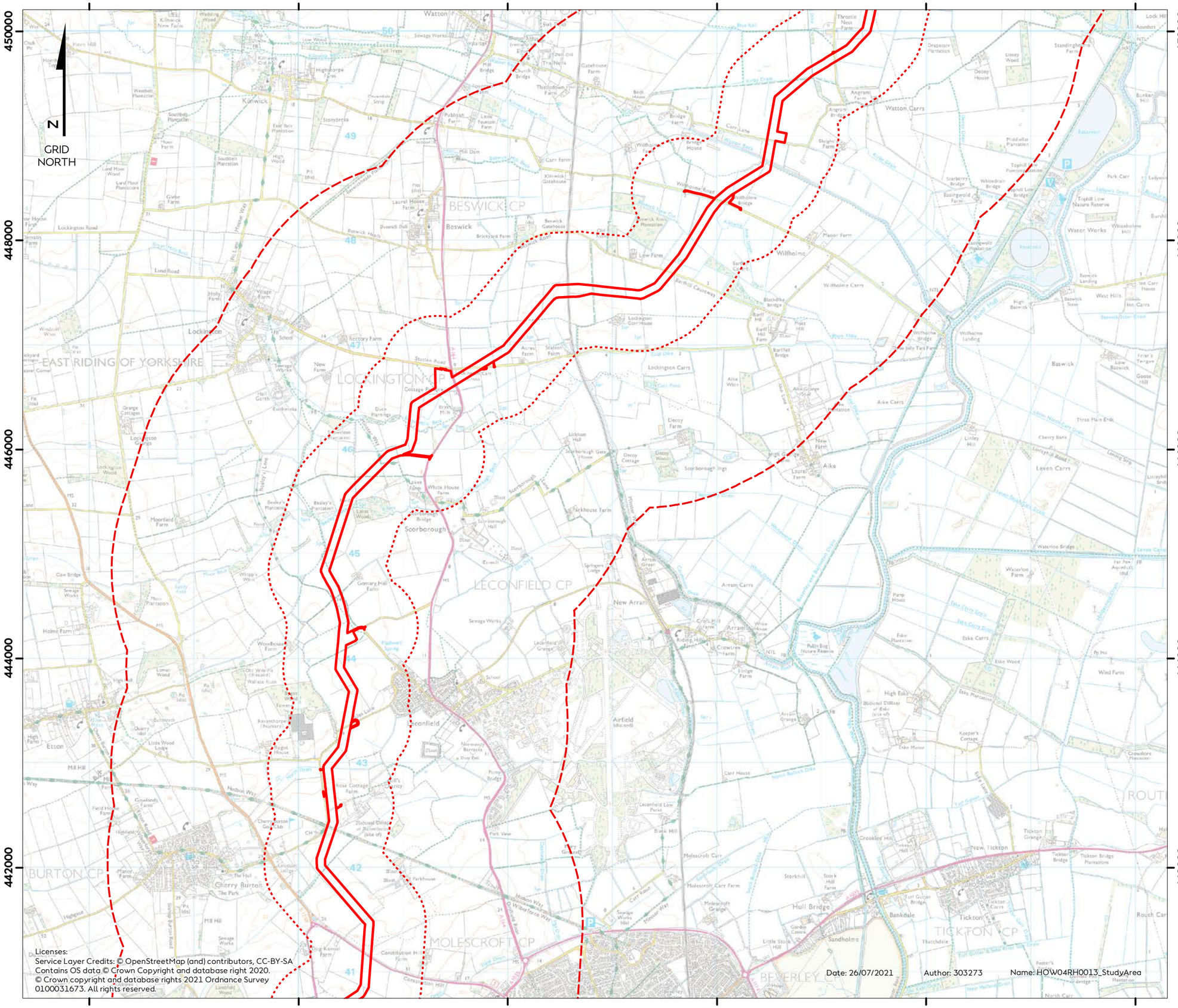
Figure 8.4

Noise and Vibration Study Area (Onshore ECC) - Sheet 4 of 5



Order Limits

2 km Study Area

500 m Study Area

Coordinate system: British National Grid

Scale@A3: 1:35,000

0 0.5 1 1.5 Kilometres

0 0.5 1 Miles

REV	REMARK	DATE
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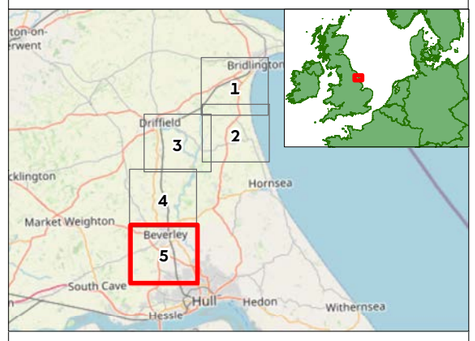
Figure 8.5

Noise and Vibration Study Area (OnSS) - Sheet 5 of 5

Order Limits

2 km Study Area

500 m Study Area



Coordinate system: British National Grid

Scale@A3: 1:35,000

0 0.5 1 1.5 Kilometres

0 0.5 1 Miles

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	First Issue for PEIR	03/07/2019
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8.6 Methodology to inform baseline

8.6.1 Desktop Study

8.6.1.1 A desk study was undertaken to obtain information on noise and vibration. Data were acquired within the onshore noise and vibration study area through a detailed desktop review of existing studies and datasets.

8.6.1.2 The following sources of information in Table 8.5 were consulted.

Table 8.5: Key Sources of noise and vibration data.

Source	Summary	Coverage
Google Maps Aerial Photography, 2019	Location of noise and vibration sensitive receptors within the noise and vibration study area.	Onshore noise and vibration study area.
Environment Agency Lidar Data	Digital Terrain Model, 2 m.	
Project infrastructure location data	Construction: • Landfall; • Onshore ECC; • Joint bays; • Crossing points; • OnSS; and • EBI. Operation: • OnSS; and • EBI.	
Project infrastructure data	Construction • Plant, equipment, activities and method. Operation • Plant, layout and sound power levels.	

8.6.2 Site Specific Surveys

8.6.2.1 To inform the EIA, site-specific surveys were undertaken, as agreed with ERYC (ON-HUM-1.5). A summary of surveys is outlined in Table 8.6. The baseline noise survey monitoring locations are shown in Figure 8.6 and Figure 8.7, and are representative of the sensitive noise receptors along the ECC and in the vicinity of the OnSS. The worst case scenarios for assessment based on these locations represent all sensitive receptors.

Table 8.6: Summary of site-specific survey data.

Title, year and reference	Summary	Coverage
Hornsea Four Baseline Noise Survey, 2019 See Volume A6, Annex 8.1: Baseline Noise Survey Report.	Long term unattended and short term attended noise measurements and weather measurements, 3 to 12 April 2019.	Six locations within 2 km of the OnSS, three locations within 400 m of the onshore ECC and three locations within 800 m of landfall as shown on Figure 8.6 and Figure 8.7.

8.7 Baseline environment

8.7.1 Existing baseline

8.7.1.1 The existing baseline environment of the Hornsea Four onshore infrastructure, including the landfall, onshore ECC, OnSS and 400 kV NGET connection area, is described within Volume A6, Annex 8.1: Baseline Noise Survey Report where details of monitoring locations, survey dates, durations and monitoring results are provided. A summary of the measured baseline noise data is provided in Table 8.7 and Table 8.8 and the baseline noise survey monitoring locations are shown in Figure 8.6 and Figure 8.7.

8.7.2 Baseline noise survey monitoring results

8.7.2.1 Table 8.7 and Table 8.8 provide a summary of the measured baseline noise data at the landfall during both the daytime and night-time surveys respectively.

Table 8.7: 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 8.8: 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

Hornsea Four

Figure 8.6

Baseline Noise Survey
Monitoring Locations - Landfall
Sheet 1 of 2

514000 516000 518000

464000 462000 460000 458000

N
GRID NORTH

LF1 LMP1 LF3 LMP3 LF2 LMP2

Bridlington Bay

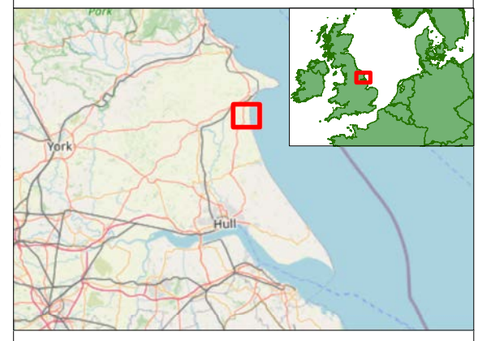
BARMSTON CP

ULROME CP

Order Limits

Noise Monitoring Locations

Noise Sensitive Receptors



Coordinate system: British National Grid
Scale@A3: 1:25,000

0 0.5 1 Kilometres

0 500 1,000 Yards

REV	REMARK	DATE
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Monitoring Locations - Landfall
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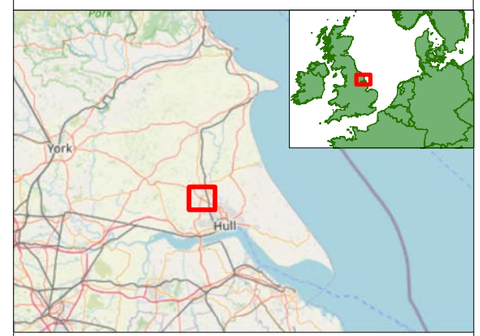
Hornsea Four

Figure 8.7

Baseline Noise Survey Monitoring Locations- OnSS and Onshore ECC Sheet 2 of 2

- Order Limits
- Noise Monitoring Locations
- Noise Sensitive Receptors

CMP1
CMP2
CMP3
SMP1
SMP2
SMP3
SMP4
SMP5
SMP6
SSR1
SSR2
SSR3
SSR4
SSR5
SSR6
SSR7
SSR8



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0 500 1,000 Yards

REV	REMARK	DATE
	First Issue for PEIR	05/07/2019
A	Updated following PEIR consultations, for DCO	26/07/2021

Title: Baseline Noise Survey Monitoring Locations - OnSS and Onshore ECC
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8.7.2.2 Table 8.9 and Table 8.10 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. CMP3 is most relevant for the 400 kV NGET connection area, which is included as part of this assessment.

Table 8.9: 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 8.10: 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 as agreed with ERYC (ON-HUM-1.5).*

8.7.2.3 Table 8.11 and Table 8.12 provides a summary of the measured baseline noise data at the OnSS during both daytime and night-time respectively.

Table 8.11: 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 8.12: 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

Deriving Background Levels

8.7.2.4 **Table 8.13** and **Table 8.14** 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 is presented to show the variability of background noise at each location. Statistical analysis is undertaken to ascertain a representative background sound level.

Table 8.13: 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 – 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 8.14: 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

8.7.2.5 The road links identified by the transport assessment as carrying construction traffic are presented in **Table 8.15** and in **Chapter 7: Traffic and Transport**, Figure 7.1. It has been identified that the earliest date construction could commence would be 2024. A baseline year for background traffic growth of 2024 has therefore been adopted in order to consider the greatest potential for change. Background traffic growth for a later start date would be subject to further growth and therefore increases in Hornsea Four traffic would be less significant.

Table 8.15: Peak construction road traffic flows – Earliest construction year (2024).

Link ID	Description	2024 Baseline flows AAWT		2024 Development Peak Traffic flows		Overall Change (%)	
		Total Vehicles	*Total HGVs*	*Total Vehicles*	*Total HGVs*	*Total Vehicles*	*Total HGVs*
1	A165 from Moor Ln to Fraisthorpe	12,297	302	16	0	0.1%	0.0%
2	Unnamed Road running south of Fraisthorpe	507	3	0	0	0.0%	0.0%
3	Unnamed Road from its junction with A165 south of Fraisthorpe	507	3	198	93	39.1%	3100.0%
4	A165 to the west of Fraisthorpe	12,297	302	16	0	0.1%	0.0%
5	A165 south of Fraisthorpe	12,297	302	201	93	1.6%	30.8%
6	A165 west of Barmston	11,598	450	320	122	2.8%	27.1%
7	A165 east of Lissett	9,854	313	320	122	3.2%	39.0%
8	A165 south of Lissett to Beeford	9,854	313	371	172	3.8%	55.0%
9	B1249 through Beeford	2,588	54	184	84	7.1%	155.6%
10	Foston Lane / Old Howe Lane	321	9	117	15	36.4%	166.7%
11	B1249 between Beeford and North Frodingham	4,442	84	70	70	1.6%	83.3%
12	B1249 through North Frodingham	4,442	84	70	70	1.6%	83.3%
13	B1249 Church Lane	4,442	84	438	70	9.9%	83.3%
14	Cruckley Lane / Cowslam Lane	554	8	124	23	22.4%	287.5%
15	Sheepdike Lane through Foston on the Wolds	554	8	7	0	1.3%	0.0%
16	Old Howe Lane	321	9	7	0	2.2%	0.0%
17	Long Lane	321	9	0	0	0.0%	0.0%
18	Gambling Lane	321	9	0	0	0.0%	0.0%
19	Out Gates	321	9	0	0	0.0%	0.0%
20	B1249 north of Brigham Lane	4,442	84	273	70	6.1%	83.3%
21	B1249 south of Wansford	4,442	84	177	70	4.0%	83.3%
22	B1249 through Wansford	4,442	84	82	70	1.8%	83.3%
23	B1249 Wansford to Driffield	5,910	93	82	70	1.4%	75.3%
24	B1249 Wansford Road / Scarborough Road	5,910	93	82	70	1.4%	75.3%
25	Brigham Lane	554	8	117	19	21.1%	237.5%
26	A164 south of Driffield	11,234	546	148	70	1.3%	12.8%
27	Beverley Road from A164 to River Head	11,535	208	0	0	0.0%	0.0%
28	Anderson Street / River Head	11,535	208	0	0	0.0%	0.0%
29	A164 between Driffield and Hutton Cranswick	11,234	546	148	70	1.3%	12.8%
30	Station Road / Main Street through Hutton Cranswick	2,531	35	130	32	5.1%	91.4%
31	Corpslanding Road / Howl Lane / Church Street / Hutton Road	562	8	98	0	17.4%	0.0%

Link ID	Description	2024 Baseline flows AAWT		2024 Development Peak Traffic flows		Overall Change (%)	
		Total Vehicles	*Total HGVs*	*Total Vehicles*	*Total HGVs*	*Total Vehicles*	*Total HGVs*
32	Maeggison's Turnpike	2,531	35	130	32	5.1%	91.4%
33	Corpslanding Road / Rotsea Lane	562	8	130	32	23.1%	400.0%
34	Carr Lane / Church Lane east of Watton	313	18	123	25	39.3%	138.9%
35	Church Lane east of Watton	313	18	123	25	39.3%	138.9%
36	A164, Hutton Cranswick to Watton	11,383	553	271	101	2.4%	18.3%
37	A614, Watton to Wilfholme Road	11,383	553	387	126	3.4%	22.8%
38	Wilfholme Road	81	0	110	12	135.8%	-
39	A164, Wilfholme Road to Beswick	10,340	254	489	138	4.7%	54.3%
40	Beswick Road / Barfhill Causeway	38	0	114	16	300.0%	-
41	A164, Beswick Road to Station Road	10,340	254	540	154	5.2%	60.6%
42	Station Road east of A164	317	9	112	14	35.3%	155.6%
43	Station Road west of A164	686	5	165	67	24.1%	1340.0%
44	A164 south of Station Road	10,340	254	631	245	6.1%	96.5%
45	A164 north of Leconfield	8,550	415	666	280	7.8%	67.5%
46	Old Road west of Leconfield	3,988	19	7	0	0.2%	0.0%
47	Unnamed Road west of junction with A164 to Old Road	3,988	19	140	35	3.5%	184.2%
48	Miles Lane west of Leconfield	3,988	19	7	0	0.2%	0.0%
49	Miles Lane east of B1248	3,988	19	109	11	2.7%	57.9%
50	B1248 north of the A1035	13,917	314	105	11	0.8%	3.5%
51	A1035 Constitution Hill	11,897	1,114	681	295	5.7%	26.5%
52	Beverley Northern Bypass	11,897	1,114	666	280	5.6%	25.1%
53	A1035 Dog Kennel Lane	16,680	1,096	709	323	4.3%	29.5%
54	A1174 east of the A1035	6,673	58	180	20	2.7%	34.5%
55	A1079, A1174 and A164	23,105	1,338	958	367	4.1%	27.4%
56	Newbald Road	1,773	1	122	24	6.9%	2400.0%
57	Killingwoldgraves Lane/Coppleflat Lane	3,335	76	560	24	16.8%	31.6%
58	Coppleflat Lane south of Newbald Road	3,335	76	536	0	16.1%	0.0%
59	Coppleflat Lane south of Walkington	3,335	76	223	12	6.7%	15.8%
60	A164 south of A1079	37,134	1,478	1,355	877	3.6%	59.3%
61	Unnamed Road south of Coppleflat Lane to junction with A164	2,546	25	227	33	8.9%	132.0%
62	A164 south of Coppleflat Lane	37,134	1,478	1,355	877	3.6%	59.3%
63	A164 north of Skidby	35,687	1,420	1,355	877	3.8%	61.8%
64	A165 Beeford to Brandesburton	9,645	615	625	257	6.5%	41.8%
65	Main Street / Froddingham Road, Brandesburton to North Frodingham	2,126	18	368	0	17.3%	0.0%
66	A165, Brandesburton to Leven	19,400	1,164	625	257	3.2%	22.1%

Link ID	Description	2024 Baseline flows AAWT		2024 Development Peak Traffic flows		Overall Change (%)	
		Total Vehicles	*Total HGVs*	*Total Vehicles*	*Total HGVs*	*Total Vehicles*	*Total HGVs*
67	A165, B1244 to A1035	19,400	1,164	626	257	3.2%	22.1%
68	A1035, A165 to A1174	22,591	1,355	678	257	3.0%	19.0%
69	A1035 Grange Way, north of Beverley	13,292	1,245	368	0	2.8%	0.0%
70	A1174 Swinemoor Lane	18,124	936	678	257	3.7%	27.5%
71	A1174 Hull Road	16,370	846	678	257	4.1%	30.4%
72	A164 Minster Way	10,903	522	493	257	4.5%	49.2%
73	A164, Minster Way to A1079	24,880	990	503	257	2.0%	26.0%
74	A1079, A164 to A1033	21,781	1,213	1,634	877	7.5%	72.3%
75	A1174 Beverly Road / Hull Road	16,994	916	228	0	1.3%	0.0%
76	A164, B1233 to Castle Road	37,134	1,478	1,327	877	3.6%	59.3%
77	A164, Castle Road to B1232	37,134	1,478	1,327	877	3.6%	59.3%
78	A164 south of B1232	19,724	1,056	1,270	877	6.4%	83.0%
79	A164 south of B1231	19,724	1,056	1,196	877	6.1%	83.0%
80	A15 Boothferry Road	30,955	2,457	877	877	2.8%	35.7%
81	A63 west of A15	57,570	7,465	877	877	1.5%	11.7%
82	A63 from the A15 to A1166	73,638	7,711	877	877	1.2%	11.4%
83	A15 Humber Bridge	26,925	1,988	298	0	1.1%	0.0%
84	A614 north of Driffield	12,436	651	32	0	0.3%	0.0%
85	Bridlington Bay Road, A614 to A165	9,289	821	41	0	0.4%	0.0%
86	A614 east of Driffield	13,487	1,019	148	70	1.1%	6.9%
87	A1079 through Bishop Burton	11,836	777	218	0	1.8%	0.0%
88	B1233 Harland Way / Northgate	13,104	153	0	0	0.0%	0.0%
89	Park Lane	1,271	24	0	0	0.0%	0.0%
90	B1230 through Walkington	3,335	76	536	0	16.1%	0.0%
91	A63 from the A1166 to Ferensway	68,085	6,564	877	877	1.3%	13.4%
92	A63 from the Ferensway to A1165	48,168	5,272	877	877	1.8%	16.6%
93	A1033 east of the A1165	44,646	4,930	898	877	2.0%	17.8%
94	A1165 Mount Pleasant	21,736	1,472	894	877	4.1%	59.6%
95	A1165 Holwell Road	29,448	2,114	1,282	877	4.4%	41.5%
96	A1033 Sutton Road	22,563	926	1,300	877	5.8%	94.7%
97	A1033 Thomas Clarkson Way	22,563	926	1,286	877	5.7%	94.7%
98	A1033 Raich Carter Way	20,532	843	1,341	877	6.5%	104.0%
99	A165 north east from Hull	17,496	1,356	325	257	1.9%	19.0%
100	A165 Holderness Road	30,011	774	349	257	1.2%	33.2%
101	A165 Ganstead Lane	11,373	973	349	257	3.1%	26.4%
102	A165 Northfeild Road	11,373	973	349	257	3.1%	26.4%
103	A165 through Skirlaugh	11,373	973	349	257	3.1%	26.4%
104	A165 south of A1035 to Skirlaugh	11,373	973	465	257	4.1%	26.4%

8.7.2.6 The current baseline description above provides an accurate reflection of the current state of the existing environment. The earliest possible date for the start of construction for the onshore elements of Hornsea Four is 2024 with an expected operational life of 35 years, and therefore there exists the potential for the baseline to evolve between the time of assessment and point of impact. Outside of short-term or seasonal fluctuations, changes to the baseline in relation to traffic and transport usually occur over an extended period of time (considered in **Section 8.7.3**). Based on current information regarding reasonably foreseeable events over the next four years, the baseline environment is not anticipated to have fundamentally changed from its current state at the point in time when impacts occur.

8.7.3 Evolution of the baseline

8.7.3.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included within the ES (EIA Regulations, Schedule 4, Paragraph 3). From the point of assessment, over the course of the lifetime of the Hornsea Four (anticipated to be 35 years), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that Hornsea Four is not constructed, using available information and specialist technical knowledge of traffic and transport. This approach allows long-term changes and trends to be taken into consideration in order to provide confidence that the assessment of long-term effects are valid.

8.7.3.2 The baseline noise monitoring survey provides a clear representation of the existing soundscape within the Hornsea Four noise and vibration study area.

8.7.3.3 Any potential future impacts to the prevailing soundscape should be minimised, avoided, or mitigated to suitable levels (in accordance with current legislation, policy and guidance), avoiding an adverse impact, where possible. In addition to planning controls there is a clear trend for noise from vehicle, commercial and industrial sources to be driven down in compliance with stricter legislation and guidance, therefore it is reasonable to predict a general steady baseline soundscape would be maintained within the Hornsea Four noise and vibration study area.

8.7.4 Data Limitations

8.7.4.1 The key data limitation with the baseline data and their ability to materially influence the outcome of the EIA is the inherent variability of the noise environment. To manage this variability and provide representative noise data for the OnSS area, data were collected over a week to allow for day to day variability as agreed during discussions to agree the approach and methodology to baseline noise surveys and the criteria to be used for the noise and vibration assessment (ON-HUM-1.5).

8.7.4.2 As a result of a route refinement process (as detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives**), the distance between eleven receptors along the onshore ECC to the Hornsea Four project boundary (now referred to as Order Limits) has changed since PEIR. The distance of eight of these eleven receptors in relation to the Hornsea Four Order Limits has increased which has resulted in further reducing the potential noise levels from construction activities to these eight receptors. The distance of the remaining three receptors has decreased and therefore has resulted in an increased prediction in noise levels at those receptors as a result of the construction activities associated with Hornsea Four at these locations.

8.7.4.3 Additional assessment, based on the original methodology was undertaken to determine the effect of the onshore route refinement in April 2020, and the changes in distance at the receptors identified above has not resulted in an increase in noise level above that assessed previously in the EIA, as presented at PEIR (Orsted 2019). Therefore, no further assessment is proposed to be presented in the ES (**Table 8.33**).

8.7.4.4 Further minor route refinement was undertaken during Spring 2021 which resulted in four alignment changes to the Order Limits. Of the changes identified, only one of them resulted in the Order limits being closer to an identified noise sensitive receptor.

8.7.4.5 A review was undertaken to determine if any of the Order Limit changes resulted in a change to the noise impact assessment and its conclusions, which in turn would require an updated noise impact assessment to be undertaken. The review indicated the following:

- The refinement of the Order Limits will bring part of the alignment closer to an identified noise sensitive receptor (CCR23) than it was previously. However, this alignment change is considered to be minimal and would not alter the overall noise impact on CCR23 and consequently no additional assessment or mitigation measures is required.
- No additional assessment is required for the revised location of the access route to the south of the Order Limits. A review of the new location of the access point identified that the change in location of the access route would not bring the access point of the route closer to identified noise sensitive properties. As the distance to the nearest noise sensitive properties remains greater than 150 m, an assessment of this route is scoped out, as set out in Co 135.

8.7.4.6 As part of ongoing refinement of the construction phase of the project, additional assessment was undertaken in Spring/Summer 2021 of the proposed HDD works along the onshore ECC and piling works associated with the construction of the OnSS. These assessments considered proposed changes to the numbers of plant associated with the individual activities and their potential impacts on nearby noise sensitive receptors.

8.7.4.7 The proposed changes to the HDD works increased the number of certain items of plant (as detailed in **Table 8.18**), which were then assessed in context of the Order Limits and their distance to nearby noise sensitive receptors. Although noise mitigation measures will remain to be required during the daytime, the scale of the mitigation will remain unchanged to that previous identified and incorporated within Co123. This is primarily due to the distances

between the proposed HDD locations and the noise sensitive receptors. The potential for HDD works to be undertaken during the evening (as a result of task completion, outside of normal working hours) was also considered. Based on the same working parameters as daytime working, it was determined that the lower noise threshold for evening working would result in more areas along the onshore ECC requiring noise mitigation.

8.7.4.8 The updated OnSS piling assessment considered an increase in both the number of piles and number of piling rigs that will be required at the OnSS. This assessment considered a worst-case scenario of locating all of the piling rigs no less than 180 m (in line with Co135) from the nearest noise sensitive receptor. The outcome of the assessment has shown that the noise levels will not exceed those previously predicted. The predicted noise levels at the OnSS will be managed through the implementation of appropriate mitigation measures such as, but not limited to, the use of temporary noise barriers, a reduction in the number of piling rigs used within areas immediately adjacent to noise sensitive receptors, and/or an increase in the distance between the noise sensitive receptor and the piling rigs.

8.8 Project basis for assessment

8.8.1 Impact register and impacts "Not considered in detail in the ES"

8.8.1.1 Upon consideration of the baseline environment, the project description outlined in **Volume A1, Chapter 4: Project Description**, the Hornsea Four Commitments (**Volume A4, Annex 5.2: Commitments Register**) and response to formal consultation on the PEIR, several potential impacts upon noise and vibration are "Not considered in detail in the ES". These impacts are outlined, together with a justification for why they are not considered further in **Table 8.16,** which should be read in conjunction with **Volume A4, Annex 5.1: Impacts Register**.

8.8.1.2 In July 2019, Highways England issued an update to the DMRB significance matrix (see **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**). Impacts formerly assessed within the category medium sensitivity and minor magnitude, as Minor (Not Significant), under the new guidance are now within the significance range of Slight or Moderate and therefore require professional judgement. Following a review of impacts, it was considered that the changes do not alter the overall significance of the impacts assessed at Scoping and in the PEIR (see **Volume A4, Annex 5.1: Impacts Register**). Therefore, impacts assessed as not significant at PEIR have not been considered in detail within this ES chapter, unless there has been a material change to Hornsea Four, baseline characterisation, or the assessment methodology that necessitates re-assessment. A summary of the justification for this consideration is provided in **Table 8.16**.

Table 8.16: Noise and vibration impact register - impacts not considered in detail in the ES and justification.

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
Indicative temporary works area - temporary noise and vibration from onshore cable installation (excluding HDD works) (NV-C-1)	Not significant	Scoped Out	No likely significant effect. Agreed by PINS to be scoped out. (Scoping Opinion, November 2018, ID:4.20.1).
Operation: Noise from buried cable (NV-O-9)	Not significant	Scoped Out	No likely significant effects. Agreed by PINS to be scoped out (Scoping Opinion, November 2018, ID:4.20.3, ID:4.20.4, ID:4.20.5 and ID:4.20.6).
Operational Traffic Noise (NV-O-10)			
Noise and vibration from routine maintenance activities (NV-O-11)			
Operational Vibration (NV-O-12)			
Decommissioning: Temporary noise and vibration from plant along the cable route (NV-D-14)	Not significant	Scoped Out	No likely significant effects. Agreed by PINS to be scoped out (Scoping Opinion, November 2018, ID:4.20.8).
Temporary noise and vibration from constructing the haul road access points (NV-C-5)	Not significant	Not considered in detail in the ES	Assessment of noise impacts due to the haul road access points along the Onshore ECC indicated that no likely significant effect is expected. There are three instances identified at ES where the haul road access points come closer than the 150 m set out in Co 135 (CCR8, CCR11 and CCR40). The closest receptor is CCR8 which is approximately 52m from the nearest Haul Road access point. At this distance the noise level from the HDD works (the plant required for construction of the access points/roads will be no greater in number and nature to that assessed for HDD) will be slightly below the 65dB noise level threshold limit (as set out for Category A (ABC Method) in BS5228:2009 +A1:2014 Part 1). However, through the use of appropriate mitigation measures as set out in **Volume F2, Chapter 13: Outline Design Plan**, then this will reduce the potential noise level received at the property further below 65dB.

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			It was agreed to not consider this impact further in the ES through consultation with ERYC, on the 7th January 2019 (ON-HUM-1.5).
Noise from operation of the offshore HVAC booster (NV-O-13)	Not significant	Not considered in detail in the ES	No likely significant effects due to the distance (>20 km) offshore are predicted. Simple calculations based on the plant and equipment located at the OnSS shows that predicted noise levels from the booster are expected to be below 15 dB at onshore receptors. It was agreed to not consider this impact further in the ES through consultation with ERYC, on the 7th January 2019 (ON-HUM-1.5).
Decommissioning: Temporary noise and vibration from plant at the onshore substation (NV-D-15)	Not significant	Not considered in detail in the ES	Decommissioning of the onshore infrastructure for Hornsea Four will comprise the following activities: • Buried export cables left in situ, with cable ends cut, sealed and securely buried. Partial removal of cables at landfall occur for aluminium/steel recycling; • Joint Bays and Link boxes will typically be left in situ, or removed if feasible; and • The OnSS above ground electrical equipment and infrastructure will be removed, along with building foundations and security fencing. The site will be returned to its previous condition. Further details will be provided and secured within a Decommissioning Plan (Co127), agreed with stakeholders prior to decommissioning commencing. The construction of Hornsea Four presents the highest potential for significant environmental effects. Impacts during decommissioning would result in an effect of equal significance, at worst. Primary, tertiary and secondary mitigation measures that are necessary to reduce significant effects during construction to acceptable levels would be secured for decommissioning activities. In line with the proportionate approach to EIA,

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			effects during decommissioning are therefore scoped out of the EIA for Hornsea Four. It was agreed to not consider this impact further in the ES through consultation with ERYC, on the 5th November 2019 (ON-HUM-3.3).
Indicative temporary works area - temporary noise and vibration from HDD works and other trenchless technologies. (NV-C-2)	Not significant	Not considered in detail in the ES	This impact was assessed as part of the EIA, as set out in PEIR (Orsted, 2019) and confirmed in **Volume A4, Annex 5.1: Impacts Register**, and no likely significant effect was identified. It was agreed to not consider this impact in further detail in the ES through consultation with ERYC, on the 5th November 2019 (ON-HUM-3.5). Proposed changes to the HDD works along the onshore ECC were re-assessed in spring/summer 2021. The outcome of which has shown no significant changes to the previous assessment with the implementation of the appropriate noise mitigation measures secured through Co123. Further information on the mitigation measures that will be implemented for the temporary works are provided in **Volume F2, Chapter 2: Outline Code of Construction Practice**.
Temporary noise and vibration from constructing the jointing bays. (NV-C-4)	Not significant	Not considered in detail in the ES	This impact was assessed as part of the EIA, as set out in PEIR (Orsted, 2019) and confirmed in **Volume A4, Annex 5.1: Impacts Register**, and no likely significant effect was identified. It was agreed to not consider this impact further in the ES through consultation with ERYC, on the 5th November 2019 (ON-HUM-3.5).
Temporary noise and vibration from construction of the onshore substation. (Includes the temporary impacts of tubular steel piling (percussive piling) (NV-C-6)	Not significant	Not considered in detail in the ES	This impact was assessed as part of the EIA, as set out in PEIR (Orsted, 2019) and confirmed in **Volume A4, Annex 5.1: Impacts Register**, and no likely significant effect was identified. It was agreed to not consider this impact further in the ES through consultation with ERYC, on the 5th November 2019 (ON-HUM-3.5).

Project activity and impact	Likely significance of effect	Approach to assessment	Justification
			Proposed changes to the OnSS piling works, which includes the increased number of piles to be installed and the number of piling rigs, were re-assessed in spring/summer 2021. The outcome of this re-assessment has shown no significant change to the conclusions of the previous assessment with the implementation of the appropriate noise mitigation measures.
Noise from the onshore substation (NV-O-8)	Not significant	Not considered in detail in the ES	This impact was assessed as part of the EIA, as set out in PEIR (Orsted, 2019) and confirmed in **Volume A4, Annex 5.1: Impacts Register**, and no likely significant effect was identified (with the inclusion of Co159). OnSS noise modelling mitigation has been undertaken in compliance with Co159, and the outcome and subsequent mitigation detailed within **Volume F2, Chapter 13: Outline Design Plan**. It was agreed to not consider this impact further in the ES through consultation with ERYC, on the 5th November 2019 (ON-HUM-3.5).

Notes:
Grey - Potential impact is scoped out at EIA Scoping and both PINS and Hornsea Four agree.
Red – Potential impact is not considered in detail in the ES with no consensus between PINS and Hornsea Four at EIA Scoping and further justification provided during the pre-application stage.
Purple - Not considered in detail in the ES. No likely significant effect identified at PEIR.

8.8.2 Commitments

8.8.2.1 Hornsea Four has adopted commitments (primary design principles inherent as part of Hornsea Four, installation techniques and engineering designs/modifications) as part of it's pre-application consultation and design phase, to eliminate and/or reduce the likely significant effect (LSE) of a number of impacts. These are outlined in **Volume A4, Annex 5.2: Commitments Register**. Further commitments (adoption of best practice guidance), referred to as tertiary commitments in **Table 8.17** below, are embedded as an inherent aspect of the EIA process. Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are reduced to environmentally acceptable levels.

8.8.2.2 The commitments adopted by Hornsea Four in relation to noise and vibration are presented in Table 8.17.

Table 8.17: Relevant noise and vibration commitments.

Commitment ID	Measure Proposed	How the measure will be secured
Co36	Primary: Core working hours for the construction of the onshore components of Hornsea Four will be as follows: • Monday to Friday: 07:00 - 18:00 hours; • Saturday: 07:00 - 13:00 hours; Up to one hour before and after core working hours for mobilisation ("mobilisation period"), i.e. 06:00 to 19:00 weekdays and 06:00 to 14:00 Saturdays; and • Maintenance period 13:00 to 17:00 Saturdays. *Activities carried out during mobilisation and maintenance will not generate significant noise levels (such as piling, or other such noisy activities).* In circumstances outside of core working practices, specific works may have to be undertaken outside the core working hours. ERYC will be informed in writing of such circumstances.	DCO Requirement 17 Code of Construction Practice (CoCP)
Co41	Primary: All HDD crossings will be undertaken by non-impact methods in order to minimise construction vibration beyond the immediate location of works.	DCO Requirement 17 (CoCP)
Co49	Primary: There will be no permanent High Voltage infrastructure installed above surface within 110 m of residential properties and sub surface infrastructure (including the onshore export cable) within 50 m of residential properties.	DCO Requirement 7 (Detailed design approval onshore)
Co123	Tertiary: Based on noise modelling results, where noise has the potential to cause significant adverse effects, mufflers and acoustic barriers will be used where HDD is being undertaken.	DCO Requirement 17 (CoCP)
Co124	Tertiary: A Code of Construction Practice (CoCP) will be developed in accordance with the outline CoCP. The outline CoCP will include measures to reduce temporary disturbance to residential properties, recreational users and existing land users.	DCO Requirement 17 (CoCP)
Co127	Tertiary: An Onshore Decommissioning Plan will be developed prior to decommissioning in a timely manner. The Onshore Decommissioning Plan will include provisions for the removal of all onshore above ground infrastructure and the decommissioning of below ground infrastructure and details relevant to flood risk, pollution prevention and avoidance of ground disturbance. The Onshore Decommissioning Plan will be in line with the latest relevant available guidance.	DCO Requirement 24 (Onshore decommissioning)
Co134	Primary: Cable installation works at the landfall area will be located at least 200 m from residential receptors.	DCO Works Plan - Onshore

Commitment ID	Measure Proposed	How the measure will be secured
Co135	Primary: Temporary construction highway access points along the onshore export cable corridor (ECC) will be located at least 150 m from residential receptors, with the exception of three receptors: Bridge Farm Holiday Cottages; Arms Farm and Elm Tree Farm, in Brigham, Driffield.	DCO Requirement 18 (Construction traffic management plan)
Co137	Tertiary: HGV movements associated with operation and planned maintenance of the onshore infrastructure will operate only between the hours of. 0700 – 2300. HGV movements may however be subject to unscheduled maintenance activities outside these hours. In this event the council will be informed via writing.	DCO Requirement 18 (Construction traffic management plan)
Co144	Tertiary: A Construction Traffic Management Plan (CTMP) will be developed in accordance with the outline CTMP to be submitted with the DCO application. The CTMP will set standards and procedures for: 1. Managing the numbers and routeing of HGVs during the construction phase; 2. Managing the movement of employee traffic during the construction phase; 3. Details of localised road improvements necessary to facilitate safe use of the existing road network; and 4. Details of measures to manage the safe passage of HGV traffic via the local highway network	DCO Requirement 18 (Construction traffic management plan)
Co159	Secondary: Operational noise from the onshore substation will be at a noise level no greater than 5dB above the representative background (LA90,T) during the day time and night at the identified noise Sensitive Receptors, as stated within the onshore noise assessment (document reference A3.8).	DCO requirement 21 (Control of noise during operational phase)
Co169	Secondary: Piling at the OnSS will not be undertaken within 180 m of any noise sensitive receptors.	DCO Requirement 7 (Detailed design approval onshore)

8.9 Maximum Design Scenario (MDS)

8.9.1.1 This section describes the parameters on which the noise and vibration assessment has been based. These are the parameters which are judged to give rise to the maximum levels of effect for the assessment undertaken, as set out in **Volume A1, Chapter 4: Project Description** on noise and vibration sensitive receptors. Should Hornsea Four be constructed to different parameters within the design envelope, then impacts would not be any greater than those set out in this ES using the MDS presented in **Table 8.18**.

Table 8.18: Maximum design scenario for impacts on noise and vibration.

Impact and Phase	Embedded Mitigation Measures	MDS / Rochdale Envelope	Justification
Construction			
Landfall, nearshore and intertidal area - temporary noise and vibration from cable installation works. (NV-C-3)	Primary: Co36 Co41 Co49 Co134 Tertiary: Co123 Co124	**Landfall:** • Construction duration: 32 months; • Landfall compound: Number: 1, Total Area: 40,000 m^2, Duration: 32 months; • Beach closure: 0 months, i.e. no beach closure is planned unless an unforeseen and unplanned event occurs requiring access; • Noise levels during construction of Transition Joint Bays: 115 dB; • HDD Number: 8; • HDD required at night, using largest equipment, pit open two months, eight vessels near (5 km2 area) shore; • HDD noise level: 120 dB; and • Simultaneous HDDs: Number: 3. **Construction Equipment (Per HDD):** • Simultaneous drilling with up to 2 rigs; • Tracked Excavator: Number: 1, Noise Level: 103 dB(A), 20% ontime; • HDD Drilling Rigs, 107dB(A) SWL each, 90% ontime; • Water Pumps, 93dB(A) SWL each, 90% ontime; • Dumper: Number: 1, Noise Level: 106 dB(A), 20% ontime; • Generator: Number: 1, Noise Level: 105 dB(A), 80% ontime;. • Mud Recycling Unit, 1 Noise Level 101 dB(A) 90% ontime; and • Tractor and Trailer, 1, Noise Level 86 dBA, 40 % ontime.	HDD involves the most equipment/complexity and has the potential for night-time working which has the potential to create significant impacts on residential receptors.
Traffic noise (NV-C-7)	Primary: Co135 Tertiary:	The maximum Annual Average Daily Traffic (AADT) movements generated by Hornsea Four is 556 total vehicles, of which 320 are Heavy Duty Vehicles (HDVs).	The MDS relates to the maximum number of movements on any one link to create the AAWT.

Impact and Phase	Embedded Mitigation Measures	MDS / Rochdale Envelope	Justification
	Co144	The derivation of the construction flows has been carried out as part of the Traffic and Transport assessment on behalf of the applicant in accordance with the MDS for Traffic and Transport. Refer to Impact ID TT-C-2 to TT-C-8 (see **Chapter 7: Traffic and Transport**). The derivation of the peak construction flows has been carried out as part of the Traffic and Transport assessment (**Chapter 7: Traffic and Transport**) in accordance with the MDS for that assessment. Traffic flows are provided as both peak traffic AAWT and more detailed Average flow AAWT to present two cases (MDS and then average provided for context).	Establishing the maximum daily vehicle movements (as AADT flows) and routes taken by construction traffic along which impacts at receptors may occur
Operation			
No likely significant effects identified not considered in detail in the ES.			
Decommissioning			
Scoped out of assessment			

8.10 Assessment methodology

8.10.1.1 The assessment methodology for noise and vibration is consistent with that presented in Annex C of the Scoping Report (Orsted, 2018) and subsequent consultation feedback (**Section 8.4**).

8.10.1.2 Potential noise and vibration impacts associated with onshore construction was assessed using the guidance contained in BS 5228:2009+A1:2014 (Code of Practice for Noise and Vibration Control on Construction and Open Sites), which defines the accepted prediction methods and source data for various construction plant and activities.

8.10.1.3 Construction noise and vibration impacts were based on the identified construction programme and associated activities and plant, including earthworks, piling (if required at the OnSS), directional drilling, cable trenching and associated construction traffic.

8.10.1.4 Operational impacts include noise generation associated with the onshore substation. The guidance and methodology contained in BS 4142:2014 (BSI, 2014c) Methods for rating and assessing industrial and commercial sound was used to assess potential noise impacts. Following the identification of the Hornsea Four Order Limits, liaison with the Human Environment Technical Panel (attended by the Applicant and ERYC), including the ERYC Environmental Health Officer, was undertaken to agree the approach and methodology to baseline noise surveys and the criteria to be used for the noise and vibration assessment (ON-HUM-1.5). HCC were further consulted in November 2019 and amendments to the study area agreed (ON-HUM-1.13).

8.10.1.5 A SoundPLAN noise model has been used in the construction and operational phase assessment. The model incorporated the MDS for each identified impact (as described in **Table 8.18**), nearby residential dwellings and other buildings, intervening ground cover and topographical information.

8.10.1.6 Noise levels for the construction phase were calculated using the methods and guidance in BS 5228-1:2009+A1:2014. This Standard provides methods for predicting receptor noise levels from construction works based on the number and type of construction plant and activities operating on site, with corrections to account for:

- The "*on-time*" of the plant, as a percentage of the assessment period;
- Distance from source to receptor;
- Acoustic screening by barriers, buildings or topography; and
- Ground type.

8.10.2 Impact assessment criteria

8.10.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. The terms used to define sensitivity and magnitude

are based on those used in the Design Manual for Roads and Bridges (DMRB) methodology, which is described in further detail in **Volume A1, Chapter 5: EIA Methodology**.

8.10.2.2 The aims of the NPPF and the NPSE require that a SOAEL should be "*avoided*" and that where a noise level which falls between SOAEL and LOAEL, then according to the explanatory notes in the statement:

> *"...reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."*

8.10.2.3 Further guidance can be found in the Planning Practice Guidance (PPG) notes which summarise the noise exposure hierarchy based on the likely average response, as summarised in **Table 8.19**.

Table 8.19: Definitions of sensitivity levels for noise exposure hierarchy (reproduced from the PPG).

Perception	Examples of outcomes	Increasing effect levels	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep.	Significant Observed Adverse Effect	Avoid

Perception	Examples of outcomes	Increasing effect levels	Action
	Quality of life diminished due to change in acoustic character of the area.		
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

8.10.2.4 Sensitive receptors, in the context of noise and vibration, are typically residential premises but can also include schools, places of worship and noise sensitive commercial premises. **Table 8.20** presents the definitions used relating to the sensitivity of the receptor. Ecological and heritage receptors are assessed within the respective chapters (**Chapter 3: Ecology and Nature Conservation** and **Chapter 5: Historic Environment**).

Table 8.20: Definition of terms relating to receptor sensitivity.

Sensitivity	Definition	Examples
Very High	Receptor has very limited tolerance of effect	Noise Receptors have been categorised as very high sensitivity where noise may be detrimental to vulnerable receptors. Such receptors include certain hospital wards (e.g. operating theatres or high dependency units) or care homes at night. Vibration Receptors have been categorised as very high sensitivity where the receptors are listed buildings or Scheduled Monuments.
High	Receptor has limited tolerance of effect	Noise Receptors have been categorised as high sensitivity where noise may cause disturbance and a level of protection is required but a level of tolerance is expected. Such subgroups include residential accommodation, private gardens, hospital wards, care homes, schools, universities, research facilities, national parks, (during the day); and temporary holiday accommodation at all times. Vibration Receptors have been categorised as high sensitivity where the receptor is not a listed building or Scheduled Monument
Medium	Receptor has some tolerance of effect	Noise Receptors have been categorised as medium sensitivity where noise may cause short duration effects in a recreational or work setting although particularly high noise levels may cause a moderate effect. Such receptors include offices, shops, outdoor amenity areas, long distance footpaths, doctor's surgeries, sports facilities and places of worship.

Sensitivity	Definition	Examples
		Vibration Receptors have been categorised as medium sensitivity where the structural integrity of the structure is expected to be high. The level of vibration required to cause damage is very high and such levels are not expected to be reached during the project.
Low	Receptor generally tolerant of effect.	Noise Receptors have been categorised as low sensitivity where noise is not expected to be detrimental. Such subgroups include warehouses, light industry, car parks, and agricultural land. Vibration Receptors have been categorised as low sensitivity where vibration is not expected to be detrimental.

8.10.2.5 All identified noise receptors considered within this assessment are classed as being of high sensitivity.

8.10.2.6 The criteria for defining magnitude of an effect in this chapter are outlined below.

Construction Phase Noise Assessment

8.10.2.7 The assessment approach utilised in this assessment is the threshold based "*ABC method*". The method is detailed within BS 5228-1:2009+A1:2014, which specifies a construction noise limit based on the existing ambient noise level and for different periods of the day. The predicted construction noise levels were assessed against noise limits derived from advice within Annex E of BS 5228. **Table 8.21**, reproduced from BS 5228-1:2009+A1:2014 Table E.1 (BSI, 2014a), presents the criteria for selection of a noise limit for a specific receptor location.

Table 8.21: Construction noise threshold levels based on the ABC Method (BS 5228:2009+A1:2014).

Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A[A]	*Category B*[B]	*Category C*[C]
Night time (23.00 – 07.00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 – 13.00)	65	70	75

A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

D) 19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

8.10.2.8 The "*ABC method*" described in BS 5228-1:2009+A1:2014 (BSI, 2014a) establishes that there is no significant impact below the three thresholds presented above.

8.10.2.9 BS 5228-1:2009+A1:2014 (BSI, 2014a) states:

> "*If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.*"

8.10.2.10 Construction noise impacts were assessed using the impact magnitude presented in **Table 8.22** for the daytime period, **Table 8.23** for the evening and weekend periods, and **Table 8.24** for the night time.

Table 8.22: Day time construction noise impact magnitude criteria.

Impact magnitude	Construction noise level, decibels (dB)		
	A 65dB threshold	*B 70dB threshold*	*C 75dB threshold*
Negligible Impact	<65.9	<70.9	<75.9
Minor Impact	>66.0 - <67.9	>71.0 - <72.9	>76.0 - <77.9
Moderate Impact	>68.0 - <69.9	>73.0 - <74.9	>78.0 - <79.9
Major Impact	>70	>75	>80

Table 8.23: Evening and weekends construction noise impact magnitude criteria.

Impact magnitude	Construction noise level, decibels (dB)		
	A 55dB threshold	*B 60dB threshold*	*C 65dB threshold*
Negligible Impact	<55.9	<60.9	<65.9
Minor Impact	>56.0 - <57.9	>61.0 - <62.9	>66.0 - <67.9
Moderate Impact	>58.0 - <59.9	>63.0 - <64.9	>68.0 - <69.9
Major Impact	>60	>65	>70

Table 8.24: Night-time construction noise impact magnitude criteria.

Impact magnitude	Construction noise level, decibels (dB)		
	A 45dB threshold	*B 50dB threshold*	*C 55dB threshold*
Negligible Impact	<45.9	<50.9	<55.9
Minor Impact	>46.0 - <47.9	>51.0 - <52.9	>56.0 - <57.9
Moderate Impact	>48.0 - <49.9	>53.0 - <54.9	>58.0 - <59.9
Major Impact	>50	>55	>60

8.10.2.11 Details of plant and equipment requirements for each construction activity is provided in **Table 8.18**. Noise modelling was undertaken based on the MDS for HDD activities.

Construction Phase Traffic Noise and Vibration Impact Magnitude

8.10.2.12 Following the methodology contained in DMRB (LA111 Revision 2, May 2020) an initial screening assessment was undertaken to assess whether there would be any significant changes in traffic volume and composition on surrounding local roads as a result of the project. Any road links with a predicted increase in traffic volume of 25% or a decrease of 20% were identified. Such changes in traffic volume would correspond to a 1 dBA change in noise level at the relevant road link. A change in noise level of less than 1 dBA in the short term is regarded as being imperceptible, and therefore of negligible magnitude. If there are no increases greater than 25% or a decrease of 20% or greater, then the DMRB guidance indicates that no further assessment needs to be conducted.

8.10.2.13 Links showing an increase of greater than 25% were assessed following the Basic Noise Level (BNL) calculation procedure within the Department of Transport (Welsh Office) Technical Memorandum Calculation of Road Traffic Noise (CRTN), 1988 to predict a dB change for each link. The calculation also incorporates a correction for mean traffic speed and the percentage of heavy vehicles.

8.10.2.14 Construction phase road link dB change was assessed using the impact magnitude criteria in **Table 8.25.** The thresholds for differentiating the criteria are taken from DMRB for short-term impacts and are an indication of the relative change in ambient noise as a result of the project.

Table 8.25: Magnitude criteria for relative change due to road traffic (short term)

Change in noise level ($L_{A10\,(18\,hour)}$ dB)	Impact magnitude
Less than 1.0	Negligible Impact
1.0 – 2.9	Minor Impact
3.0 – 4.9	Moderate Impact
Greater than or Equal to 5.0	Major Impact

8.10.2.15 Paragraph 3.32 of DMRB (2011) states that:

> *"[peak particle velocity (PPV)] PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1 mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic".*

8.10.2.16 Vibration effects on buildings along the transport routes are, therefore, not considered further within this assessment.

Construction Phase Vibration Impact Magnitude

8.10.2.17 Ground-borne vibration can result from construction works and may lead to perceptible levels of vibration at nearby receptors, which at higher levels can cause annoyance to residents. In extreme cases, cosmetic or structural building damage can occur, however vibration levels must be of a significant magnitude for this effect to be manifested and such cases are rare.

8.10.2.18 High vibration levels generally arise from 'heavy' construction works such as piling, deep excavation, or dynamic ground compaction. The use of piling during the construction of the onshore substation may be required.

8.10.2.19 Annex E of BS 5228-2:2009+A1:2014 (BSI, 2014b) contains empirical formulae derived by Hiller and Crabb (2000) from field measurements relating to resultant PPV with a number of other parameters for vibratory compaction, dynamic compaction, percussive and vibratory piling, the vibration of stone columns and tunnel boring operations. Use of these empirical formulae enables resultant PPV to be predicted and for some activities (vibratory compaction, vibratory piling and vibrated stone columns) they can provide an indicator of the probability of these levels of PPV being exceeded.

8.10.2.20 The empirical equations for predicting construction-related vibration provide estimates in terms of PPV. Therefore, the consequences of predicted levels in terms of human perception

and disturbance can be established through direct comparison with the BS 5228-2:2009+1A:2014 guidance vibration levels.

8.10.2.21 Ground-borne vibration assessments may be drawn from the empirical methods detailed in BS 5228-2:2009+1A:2014, in the Transport and Road Research Laboratory (TRRL) report 246: Traffic induced vibrations in buildings, and within the Transport Research Laboratory (TRL) Report 429 (2000): Ground-borne vibration caused by mechanical construction works.

8.10.2.22 It is noted that these calculation methods rely on detailed information, including the type and number of plants being used, their location and the length of time they are in operation. Given the mobile nature of much of the plant that has the potential to impart sufficient energy into the ground, and the varying ground conditions in the immediate vicinity of the construction works, it was considered that an accurate representation of vibration conditions using these predictive methods was not possible.

8.10.2.23 Consequently, a series of calculations, following the methodologies referred to above, were carried out based on typical construction activities that have the potential to impart sufficient energy into the ground, applying reasonable worst-case assumptions in order to determine set-back distances at which critical vibration levels may occur.

8.10.2.24 Humans are very sensitive to vibration, which can result in concern being expressed at energy levels well below the threshold of damage. Guidance on the human response to vibration in buildings is found in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting.

8.10.2.25 BS 6472 describes how to determine the VDV from frequency-weighted vibration measurements. VDV is defined by the following equation:

$$VDV_{b/d,\ day/night} = (\int_0^T a^4(t)dt)^{0.25}$$

8.10.2.26 The VDV is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop.

8.10.2.27 BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

8.10.2.28 BS 6472 contains a methodology for assessing the human response to vibration in terms of either the VDV, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as PPV. The VDV is determined over a 16-hour daytime period or 8-hour night-time period.

8.10.2.29 The response of a building to ground-borne vibration is affected by the type of foundation, ground conditions, the building construction and the condition of the building. For

construction vibration, the vibration level and effects detailed in **Table 8.26** were adopted based on BS 5228-2:2009+1A:2014. Limits for transient vibration, above which cosmetic damage could occur, are given numerically in terms of PPV.

Table 8.26: Transient vibration guide values for cosmetic damage.

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4Hz to 15Hz	*15Hz and above*
1	Reinforced or framed structures Industrial and heavy commercial buildings	50mms^{-1} at 4Hz and above	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15mms^{-1} at 4Hz increasing to 20mms^{-1} at 15Hz	20mms^{-1} at 15Hz increasing to 50mms^{-1} at 40Hz and above

8.10.2.30 **Table 8.27** lists the minimum set-back distances at which vibration levels of reportable significance for other typical construction activities may occur. BS 5228-2:2009+1A:2014 calculation methods were used to derive the set-back distances outlined in **Table 8.27**.

Table 8.27: Predicted distances at which vibration levels may occur.

Name	Set-back distance at which vibration level (PPV) occurs			
	0.3 mm/s	*1.0 mm/s*	*10 mm/s*	*15 mm/s*
Vibratory Compaction (Start-up)	166 m	65 m	9 m	6 m
Vibratory Compaction (Steady State)	102 m	44 m	8 m	6 m
Percussive Piling	48 m	19 m	3 m	2 m
HGV Movement* on uneven Haul Route	277 m	60 m	3 m	2 m

*Vibration level based on a HGV moving at 5 mph

8.10.2.31 **Table 8.28**, reproduced from research (Rockhill et al., 2014), details minimum safe separation distance for piling activities from sensitive receptors to reduce the likelihood of cosmetic damage occurrence.

Table 8.28: Receptor proximity for indicated piling methods.

Building type (limits on vibrations from Eurocode 3)	Piling Method		
	Press-in	*25kJ drop hammer*	*170 kW 27Hz vibrohammer*
Architectural merit	2.6 m	29.6 m	27.7 m
Residential	0.5 m	11.8 m	13.8 m
Light commercial	0.14 m	5.9 m	5.5 m

Building type (limits on vibrations from Eurocode 3)	Piling Method		
	Press-in	*25kJ drop hammer*	*170 kW 27Hz vibrohammer*
Heavy industrial	0.06 m	3.9 m	3.7 m
Buried services	0.03 m	2.9 m	2.2 m

8.10.2.32 For construction vibration from sources other than blasting, the vibration level and effects presented in **Table 8.29** were adopted based on Table B-1 of BS 5228-2:2009+1A:2014. These levels and effects are based on human perception of vibration in residential environments.

Table 8.29: Construction vibration - impact magnitude.

Vibration limit PPV (mm/s)	Interpreted significance to humans	Impact magnitude
< 0.3	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction	Negligible Impact
0.3 to 1.0	Vibration might just be perceptible in residential environments	Minor Impact
1.0 to <10.0	It is likely that vibration at this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents	Moderate Impact
>10.0	Vibration is likely to be intolerable for any more than a brief exposure to this level	Major Impact

Operational Phase Noise Impact Magnitude

8.10.2.33 Where there are noise sources such as fixed plant associated with onshore assets, the most appropriate assessment guidance is BS 4142:2014 (BSI,2014c). The guidance describes a method of determining the level of noise of an industrial noise source and the existing background noise level.

8.10.2.34 BS 4142:2014 (BSI,2014c) describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident, and combines procedures for assessing the impact in relation to sound from:

- industrial and manufacturing processes;
- fixed installations which comprise mechanical and electrical plant and equipment;
- the loading and unloading of goods and materials at industrial and/or commercial premises; and

- mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

8.10.2.35 This standard is applicable to the determination of the following levels at outdoor locations:

- *"a) rating levels for sources of sound of an industrial and/or commercial nature; and*
- *b) ambient, background and residual sound levels, for the purposes of:*
  - *investigating complaints;*
  - *assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and*
  - *assessing sound at proposed new dwellings or premises used for residential purposes."*

8.10.2.36 The standard incorporates a requirement for the assessment of uncertainty in environmental noise measurements and introduces the concepts of "*significant adverse impact*" rather than likelihood of complaints. Common principles with the previous edition are the consideration of the characteristics of the sound under investigation, time of day and frequency of occurrence.

8.10.2.37 The standard applies to industrial/commercial and background noise levels outside residential buildings and for assessing whether existing and new industrial/commercial noise sources are likely to give rise to significant adverse impacts on the occupants living in the vicinity.

8.10.2.38 Assessment is undertaken by subtracting the measured background noise level from the rating level; the greater this difference, the greater the magnitude of the impact.

8.10.2.39 BS 4142:2014 (BSI,2014c) refers to the following:

- *"A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and*
- *The lower the rating level relative to the measured background sound level the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context".*

8.10.2.40 When assessing the noise from a source, which is classified as the Rated Noise Level, it is necessary to have regard to the acoustic features that may be present in the noise. Section 9.1 of BS 4142:2014 (BSI,2014c) states:

"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where

such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level."

8.10.2.41 An operational assessment in accordance with BS 4142:2014 (BSI,2014c) has been undertaken for the OnSS (including the EBI) as it is the only noise source associated with the operation and maintenance phase. Due to the separation distance and existing ambient soundscape no penalty corrections for intermittency, tonality or impulsivity have been included. These acoustic features are added based on perceptibility at the receptor location.

8.10.2.42 The determination of the specific sound level free from sounds influencing the ambient sound at the assessment location is obtained by measurement or a combination of measurement and calculation. This is to be measured in terms of the $L_{Aeq,T}$, where 'T' is a reference period of:

- 1 hour during daytime hours (07:00 to 23:00 hours); and
- 15 minutes during night-time hours (23:00 to 07:00 hours).

8.10.2.43 The assessment of noise from proposed fixed plant associated with the project was considered at the nearest receptors.

8.10.2.44 To predict the noise from the operational aspects of the project, SoundPLAN noise modelling software was utilised. The model incorporated proposed fixed plant associated with the project. The model also included nearby residential dwellings and other buildings in the onshore project area, intervening ground cover and topographical information.

8.10.2.45 Noise levels for the operational phase were predicted at the same NSR locations detailed in **Section 8.7.2**. The calculation algorithm described in ISO 9613 was used in the operational noise propagation modelling exercise.

8.10.2.46 The magnitude of impacts that will be applied to the operational assessment, based on a quantitative assessment of noise impact using BS 4142:2014 (BSI,2014c), are summarised in **Table 8.30**.

Table 8.30: Substation Operational Noise Impact Magnitude Criteria.

BS4142 Rating level (LAr, Tr dB)	BS4142 Impact magnitude
<3 dB above L90 dBA	Negligible Impact
> L90 dBA + >3 dB to <5 dB	Minor Impact
> L90 dBA + >5 dB to 9.9 dB	Moderate Impact
L90 dBA + ≥10 dB	Major Impact

8.10.2.47 Noise levels associated with any maintenance activities are not expected to be greater than the noise of the operational substation itself. Therefore, specific reference to maintenance activity is not considered further in this assessment.

8.10.2.48 The significance of the effect upon noise and vibration sensitive receptors is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in **Table 8.31**. Where a range of significance of effect is presented in **Table 8.31** the final assessment for each effect is based upon expert judgement.

8.10.2.49 For the purposes of this assessment, any effects with a significance level of slight or less have been concluded to be not significant in terms of the EIA Regulations.

Table 8.31: Matrix used for the assessment of the significance of the effect.

		Magnitude of impact (degree of change)			
		Negligible	*Minor*	*Moderate*	*Major*
Environmental value (sensitivity)	*Low*	Neutral or Slight (Not Significant)	Neutral or Slight (Not Significant)	Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)
	Medium	Neutral or Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)	Moderate or Large (Significant)	Moderate or Large (Significant)
	High	Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)	Moderate or Large (Significant)	Large or Very Large (Significant)
	Very High	Slight (Not Significant)	Moderate or Large (Significant)	Large or Very Large (Significant)	Very Large (Significant)

8.11 Impact assessment

8.11.1 Construction

8.11.1.1 The noise and vibration impact of the onshore construction of Hornsea Four has been assessed. The environmental impacts arising from the construction of Hornsea Four are listed in Table 8.32 to Table 8.33 along with the MDS against which each construction phase impact has been assessed.

8.11.1.2 A description of the potential noise and vibration effect receptors caused by each identified impact is given below.

Landfall, nearshore and intertidal area - Temporary noise and vibration from cable installation works. (NV-C-3)

Magnitude of impact

Noise

8.11.1.3 As a MDS, three HDDs have been assumed to be in operation simultaneously at the HDD locations for 24 hours a day and assessed accordingly; for all other construction activities at the landfall the assessment is based on construction between the hours of 07:00 to 18:00 Monday to Friday and 07:00 to 13:00 Saturday.

8.11.1.4 Whilst HDD activities have been assessed as operational 24 hours a day this would be an extremely rare occurrence (if at all). Commitment Co36 details the commitment to daytime working hours only, except in particular circumstances.

8.11.1.5 HDD activities would be planned to occur during working hours (as detailed in Co36); Overnight working will only occur where HDD has commenced (during working hours) and needs to conclude, however normal management practices mitigate such occurrences. Nevertheless, due to unforeseen circumstances drilling may need to continue continuously until the HDD is complete.

8.11.1.6 Table 8.32 presents the predicted noise level due to HDD at the nearest residential receptors to the landfall.

Table 8.32: Landfall construction noise for Hornsea Four – predicted impacts HDD.

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Worst Case Predicted Receptor Noise level dBA	Worst Case Impact Magnitude
LFR1	Daytime	A (65)	40.2	Negligible
	Evening	A (55)	40.2	Negligible
	Night	A (45)	40.9	Negligible
LFR2	Daytime	A (65)	46.9	Negligible

Receptor Identifier	BS5228 Reference Period	BS5228 Derived Threshold Category dBA	Worst Case Predicted Receptor Noise level dBA	Worst Case Impact Magnitude
	Evening	A (55)	46.9	Negligible
	Night	A (45)	47.5	Minor
LFR3	Daytime	A (65)	32.8	Negligible
	Evening	A (55)	32.8	Negligible
	Night	A (45)	32.8	Negligible

8.11.1.7 The results show that predicted noise levels from construction works for Hornsea Four at the landfall location are below the derived threshold limits for all receptors during the daytime, evening and night time periods, with the exception of receptor LFR2, where there is a predicted exceedance of the threshold during the night time period only.

8.11.1.8 The impact at landfall receptors is predicted to be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude of three HDD rigs operating together is therefore, considered to be **negligible** at the assessed receptors LFR1, and LFR3 during the daytime, evening and night time periods. The magnitude is considered to be **negligible** at the assessed receptor LFR2 during the daytime and evening, and **minor** during the night time period. Irrespective of the sensitivity of the receptor, the significance of the impact is **not significant** as defined in the assessment of significance matrix (see **Table 8.31**) and is not considered further in this assessment.

Vibration

8.11.1.9 Operation of HDD rigs and ancillary equipment is expected to produce the greatest vibration impacts and is therefore taken forward as the MDS for the vibration assessment.

8.11.1.10 Vibration levels decay very rapidly with distance from a source (BS 5228-2:2009+A1:2014). A representative example of HDD given within BS 5228-2:2009+A1:2014 (BSI, 2014b) is for boring through silts overlying sandstone with a PPV of 8 mm/s at 4.5m from the source, decreasing to a PPV of 2.7mm/s at 7m from the source and 1.8mm/s at 12m from the source.

8.11.1.11 Given the distances between sources of vibration (commitment Co 49 and Co 134) during the construction works and the NSRs it is clear that PPV levels would be below the criteria outlined in **Table 8.29** at the NSRs along the proposed onshore development area. Vibration impacts from construction works would be of negligible magnitude. Therefore, no additional mitigation is required.

8.11.1.12 Vibration impacts from construction works would be of **negligible** magnitude. Irrespective of the sensitivity of the receptor, the significance of the impact is **not significant** as defined in the assessment of significance matrix (see **Table 8.31**) and is not considered further in this assessment.

Significance of the effect

8.11.1.13 Irrespective of the sensitivity of the receptor, the magnitude **negligible** and the significance of the impact is **not significant** as defined in the assessment of significance matrix (see Table 8.31) and is not considered further in this assessment

Traffic noise (NV-C-7)

8.11.1.14 Table 8.33 shows road links identified as carrying construction traffic. Only road links likely to experience an increase in traffic flows greater than 25% have been assessed further by undertaking calculations of BNL. Assessment against the 2024 baseline is presented in Table 8.33. This is considered the MDS year for assessment as this is the earliest year for the start of construction so provides for the baseline with lowest predicted noise without the Hornsea Four construction traffic. Any later years would have higher baseline traffic flows and therefore a lesser impact magnitude.

Table 8.33: Calculated BNL – 2024 baseline only vs. 2024 baseline and Hornsea Four Traffic.

Link ID	Description	2024 Baseline BNL, dBA L10,18hr	2024 Baseline and the proposed Hornsea Four BNL, dBA, L10,18hr	Overall Change dBA	Impact Magnitude
3	Unnamed Road from its junction with A165 south of Fraisthorpe	53.2	54.6	1.5	Minor
5	A165 south of Fraisthorpe	72.2	72.3	0.1	Negligible
6	A165 west of Barmston	71.9	72.1	0.1	Negligible
7	A165 east of Lissett	71.2	71.4	0.1	Negligible
8	A165 south of Lissett to Beeford	71.2	71.4	0.2	Negligible
9	B1249 through Beeford	60.2	60.6	0.3	Negligible
10	Foston Lane / Old Howe Lane	56.4	57.7	1.4	Minor
11	B1249 between Beeford and North Frodingham	67.8	67.8	0.1	Negligible
12	B1249 through North Frodingham	62.6	62.7	0.1	Negligible
13	B1249 Church Lane	67.8	68.2	0.4	Negligible
14	Cruckley Lane / Cowslam Lane	58.7	59.6	0.9	Negligible
20	B1249 north of Brigham Lane	67.8	68.0	0.3	Negligible
21	B1249 south of Wansford	67.8	68.0	0.2	Negligible
22	B1249 through Wansford	62.6	62.7	0.1	Negligible
23	B1249 Wansford to Driffield	69.0	69.1	0.1	Negligible
24	B1249 Wansford Road / Scarborough Road	63.8	63.9	0.1	Negligible
25	Brigham Lane	53.5	54.4	0.8	Negligible
30	Station Road / Main Street through Hutton Cranswick	60.1	60.4	0.2	Negligible
32	Maeggison's Turnpike	65.3	65.6	0.2	Negligible

Link ID	Description	2024 Baseline BNL, dBA L10,18hr	2024 Baseline and the proposed Hornsea Four BNL, dBA, L10,18hr	Overall Change dBA	Impact Magnitude
33	Corpslanding Road / Rotsea Lane	58.8	59.7	0.9	Negligible
34	Carr Lane / Church Lane east of Watton	56.3	57.7	1.5	Minor
35	Church Lane east of Watton	56.3	57.7	1.5	Minor
38	Wilfholme Road	50.4	54.1	3.7	Moderate
39	A164, Wilfholme Road to Beswick	71.4	71.7	0.2	Negligible
40	Beswick Road / Barfhill Causeway	47.1	53.1	6.1	Major
41	A164, Beswick Road to Station Road	71.4	71.7	0.2	Negligible
42	Station Road east of A164	56.3	57.6	1.3	Minor
43	Station Road west of A164	59.7	60.6	1.0	Minor
44	A164 south of Station Road	71.4	71.7	0.3	Negligible
45	A164 north of Leconfield	65.4	65.8	0.3	Negligible
47	Unnamed Road west of junction with A164 to Old Road	67.3	67.5	0.2	Negligible
49	Miles Lane east of B1248	67.3	67.4	0.1	Negligible
51	A1035 Constitution Hill	70.5	70.7	0.2	Negligible
52	Beverley Northern Bypass	70.5	70.7	0.2	Negligible
53	A1035 Dog Kennel Lane	71.9	72.1	0.2	Negligible
54	A1174 east of the A1035	69.5	69.7	0.1	Negligible
55	A1079, A1174 and A164	76.4	76.6	0.2	Negligible
56	Newbald Road	60.4	60.7	0.3	Negligible
57	Killingwoldgraves Lane / Coppleflat Lane	66.5	67.2	0.7	Negligible
60	A164 south of A1079	75.4	75.6	0.2	Negligible
61	Unnamed Road south of Coppleflat Lane to junction with A164	65.4	65.7	0.4	Negligible
62	A164 south of Coppleflat Lane	75.4	75.6	0.2	Negligible
63	A164 north of Skidby	75.2	75.4	0.2	Negligible
64	A165 Beeford to Brandesburton	66.0	66.3	0.3	Negligible
68	A1035, A165 to A1174	71.5	71.6	0.1	Negligible
69	A1035 Grange Way, north of Beverley	70.9	71.1	0.1	Negligible
70	A1174 Swinemoor Lane	68.7	68.9	0.2	Negligible
71	A1174 Hull Road	68.3	68.4	0.2	Negligible
72	A164 Minster Way	70.1	70.3	0.2	Negligible
73	A164, Minster Way to A1079	71.9	72.0	0.1	Negligible
74	A1079, A164 to A1033	74.7	75.0	0.3	Negligible
76	A164, B1233 to Castle Road	75.4	75.6	0.2	Negligible
77	A164, Castle Road to B1232	73.7	73.8	0.2	Negligible
78	A164 south of B1232	74.3	74.5	0.3	Negligible
79	A164 south of B1231	74.3	74.5	0.3	Negligible

Link ID	Description	2024 Baseline BNL, dBA L10,18hr	2024 Baseline and the proposed Hornsea Four BNL, dBA, L10,18hr	Overall Change dBA	Impact Magnitude
80	A15 Boothferry Road	72.9	73.0	0.1	Negligible
94	A1165 Mount Pleasant	71.3	71.5	0.2	Negligible
95	A1165 Holwell Road	72.7	72.8	0.2	Negligible
96	A1033 Sutton Road	71.5	71.7	0.3	Negligible
97	A1033 Thomas Clarkson Way	71.5	71.7	0.3	Negligible
98	A1033 Raich Carter Way	71.1	71.4	0.3	Negligible
100	A165 Holderness Road	72.7	72.8	0.1	Negligible
101	A165 Ganstead Lane	68.5	68.7	0.1	Negligible
102	A165 Northfeild Road	68.5	68.7	0.1	Negligible
103	A165 through Skirlaugh	68.5	68.7	0.1	Negligible
104	A165 south of A1035 to Skirlaugh	68.5	68.7	0.2	Negligible

8.11.1.15 An assessment to predict the potential noise impact of vehicles using the proposed access route to the OnSS during the construction phase of Hornsea Four has been undertaken. The proposed alignment of the OnSS access road was modelled within SoundPLAN along with traffic figures (as shown in **Table 8.34**) and an assumed speed limit of 25mph. This allowed for assessment of both 'typical' and 'peak' use of the road during the construction phase.

Table 8.34: Predicted OnSS Access Road Traffic Movements.

	Peak Daily Movements		Annual Average Daily Movements	
	All vehicles	*HGVs*	*All vehicles*	*HGVs*
Daily Movements	885	287	683	137

8.11.1.16 The results set out in **Table 8.35** detail the predicted noise impact at the closest noise receptor to the proposed OnSS access road (SAR1: Jillywood Farm). The closest representative baseline noise monitoring position is SMP5. This baseline measurement location is also considered to be representative of SAR1, taking into account factors such as the proximity to existing dominant noise sources, for example the A1079.

8.11.1.17 Using the calculation methodology set out in CRTN, noise levels were predicted at receptor SAR1 which were then compared against the closest baseline noise monitoring position, SMP5. The predicted noise impact from the use of the access road, either at 'peak' or during more typical or average times, is considered to be negligible

Table 8.35: Predicted Noise Levels at SAR1.

Receptor	Vehicle Flow Type	Measured Background Noise Level (dB LA10,T)	Access Road Predicted Noise Level (dB LA10,18h)	Combined Noise Level (dB LA10,T)	Difference in Noise Level (dB)	Impact Magnitude
SAR1	Annual Average Daily Movements	55.4	43.2	55.7	0.3	Negligible
	Peak Daily Movements	55.4	45.6	55.7	0.4	Negligible

Sensitivity of the receptor

8.11.1.18 The receptors adjacent to affected links are deemed to be of **high** sensitivity.

Significance of the effect

8.11.1.19 Overall, it is predicted that the sensitivity of the receptor is high. Of the 66 roads assessed, 58 are predicted to have a negligible magnitude, six minor, one moderate and one of major magnitude. Only where the predicted magnitude is moderate or major (e.g. Beswick Road / Barfhill Causeway) is there a forecast effect of **moderate** (at one link) **to large adverse** (at one link) significance, which is significant in EIA terms. All other locations are forecast to have non-significant noise impacts from construction traffic.

Further mitigation

8.11.1.20 The effect is of moderate adverse significance at Wilfholme Road (Link ID 38) and of large adverse significance at Beswick Road / Barfhill Causeway (Link ID 40) and requires further mitigation.

8.11.1.21 An outline CTMP forms appendix F of the outline CoCP (**Volume F2, Chapter 2**) and this sets out all appropriate mitigation to manage the traffic flows and speeds, where appropriate along the affected link and hence reduces the impact magnitude and the relative noise change along these links. It should be noted that these links are in rural areas and, hence, do not have a large number of receptors in proximity. The mitigation measures will be agreed with ERYC and secured in the final CTMP post consent.

8.11.1.22 As identified in **Chapter 7: Traffic and Transport**, and captured in the outline CTMP (which forms appendix F of **Volume F2, Chapter 2: Outline Code of Construction Practice**) the further mitigation may comprise measures such as:

- Travel planning for employees, e.g. promoting car-sharing;
- Use of an escort vehicle; or

- Committing to limiting Hornsea Four's traffic speeds or number of movements to acceptable levels during construction, where appropriate.

8.11.1.23 Following mitigation residual impacts are predicted to be **not significant** to **slight adverse** significance.

Future monitoring

8.11.1.24 Mitigation measures and good practice will ensure that effects due to construction works and traffic are minimised. Future traffic noise monitoring is therefore not proposed.

8.12 Cumulative effect assessment (CEA)

8.12.1.1 Cumulative effects can be defined as:

- effects upon a single receptor to arise as a result of impact interaction between different environmental topics from Hornsea Four; and
- incremental effects on that same receptor from other proposed and reasonably foreseeable projects and developments in combination with Hornsea Four. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind projects.

8.12.1.2 The overarching method followed in identifying and assessing potential cumulative effects in relation to the onshore environment is set out in **Volume A4, Annex 5.5: Onshore Cumulative Effects** and **Volume A4, Annex 5.6: Location of Onshore Cumulative Schemes**. The approach is based upon the Planning Inspectorate (PINS) Advice Note 17: Cumulative Effects Assessment (PINS, 2017). The approach to the CEA is intended to be specific to Hornsea Four and takes account of the available knowledge of the environment and other activities around the Hornsea Four Order Limits.

8.12.1.3 The CEA has followed a four-stage approach developed from PINS Advice Note 17. These stages are set out in Table 2 of **Volume A4, Annex 5.5: Onshore Cumulative Effects**, with Table 4 detailing the onshore long list search areas extents or ZoIs for each topic area. The proposed tier structure that is intended to ensure that there is a clear understanding of the level of confidence in the cumulative assessments provided in the Hornsea Four ES is set out in Table 3 of **Volume A4, Annex 5.5: Onshore Cumulative Effects**.

8.12.2 CEA Stage 2 Shortlist and Stage 3 Information Gathering

8.12.2.1 A reduced list of projects for CEA has been produced using the screening buffer/criteria set out in Table 2 of **Volume A4, Annex 5.5: Onshore Cumulative Effects**. Information regarding all projects is provided in **Volume A4, Annex 5.5: Onshore Cumulative Effects** and **Volume A4, Annex 5.6: Location of Onshore Cumulative Schemes**.

8.12.2.2 Four projects have been identified for inclusion on the short-list of projects to be assessed cumulatively for noise and vibration. The remaining projects have not been considered as resulting in likely cumulative significant effects (for this topic) as they are located in excess of 2 km from the Hornsea Four OnSS Order Limits or 500 m from the Hornsea Four ECC/Landfall Order Limits or do not overlap in terms of construction and/or operational stage. Summary information on the shortlist projects progressing through this exercise (i.e. the short-list of other projects) for assessment land use and agriculture is provided below in **Table 8.36**.

8.12.3 CEA Stage 3 Assessment

8.12.3.1 As stated in Table 2 of **Volume A4, Annex 5.5: Onshore Cumulative Effects,** the assessment is undertaken in two phases:

- **Table 8.36** sets out the potential impacts assessed in this chapter and identifies the potential for cumulative effects to arise, providing a rationale for such determinations; and
- **Table 8.37** sets out the CEA for each of the projects/developments that have been identified on the short-list of projects screened.

8.12.3.2 It should be noted that the second phase of this assessment is only undertaken if the first phase identifies that cumulative effects are possible. This summary assessment is set out in **Table 8.37.**

Table 8.36: Potential cumulative effects.

Impact	Potential for Cumulative Effect?	Rationale
Construction		
Impact of construction noise and vibration on sensitive receptors.	Yes	Potential for cumulative noise and vibration impacts could occur if other developments which generate construction noise and vibration take place concomitantly with the construction phase of Hornsea Four.
Operation		
Impact of operational noise on sensitive receptors	Yes	Potential for cumulative noise impacts could occur if other developments which generate operational noise take place concomitantly with the operational phase of Hornsea Four.
Decommissioning		
The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan will be provided. As such, cumulative impacts during the decommissioning stage are assumed to be the same as those identified during the construction stage. Additionally, PINS have stated in their Scoping Opinion that cumulative decommissioning effects are scoped out of the EIA.		

8.12.3.3 The second phase of the CEA is a project specific assessment of the potential for any significant cumulative effects to arise due to the construction and/or operation and maintenance of Hornsea Four. To identify whether this may occur each shortlisted project is discussed in **Table 8.37**.

8.12.3.4 The CEA has been based on information available on each potential project (e.g. as set out on ERYC planning portal or in an attendant, available ES) and it is noted that the project details available may change in the period up to construction or may not be available in detail at all. The assessment presented here is therefore considered to be conservative, with the level of impacts expected to be reduced compared to those presented here.

8.12.3.5 The CEA has not identified any potential impacts that are considered to be of any greater significance than those identified in isolation and no cumulative effects of significance are forecast.

Table 8.37: CEA for noise and vibration.

Project Name	Tier	Discussion	Likelihood and Significance of Cumulative Effects
Jocks Lodge Highway Improvement Scheme	1	Due to the overlap of the proposed project boundaries and the potential for construction activities concurrently with Hornsea Four construction may result in direct and / or indirect impacts on the receptors identified within the chapter. However, based on the assumption that appropriate mitigation measures (e.g. CEMP, CoCP) have been incorporated into the design of the Jocks Lodge development, no cumulative impacts on the receptors identified are predicted.	No potential for significant cumulative effects.
Lawns Farm Park Battery Storage	1	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified. The implementation of acoustic mitigation presented in **Volume F2, Chapter 13: Outline Design Plan** and Co159 (operational noise level to be no greater than 5dB above the representative background) thus limits the potential for cumulative effects to occur.	No potential for significant cumulative effects.
Dogger Bank A and B	1	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified. Based on the statement in Section 12.1.6 of the Dogger Bank Creyke Beck Environmental Statement that 35dB LAr,5min would be achieved at the closest noise sensitive properties with the use of appropriate	No potential for significant cumulative effects.

Project Name	Tier	Discussion	Likelihood and Significance of Cumulative Effects
		mitigation, a high level assessment of the potential cumulative effects has been undertaken at SSR6 (Poplar's Farm). The predicted operational noise level for SSR6 as shown in Table 8.39 of PEIR Volume 3, Chapter 8 'Noise and Vibration' (Orsted 2019) was reduced by 6 dB(A) to account for the acoustic character correction, and then logarithmically added to the 35 dB LAr, 5min to produce a cumulative noise level. The resultant change in noise level at SSR6 was a negligible increase of 0.4 dB. This increase in noise level at SSR6 does not change the overall impact at SSR6. The implementation of acoustic mitigation presented in **Volume F2, Chapter 13: Outline Design Plan** and Co159 (operational noise level to be no greater than 5dB above the representative background) thus limits the potential for cumulative effects to occur.	
Albanwise Solar Farm	1	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified. The Outline Construction Environmental Management Plan submitted to support the solar farm planning application includes measures to manage construction noise impacts. Equally, the Hornsea Four Outline CoCP (**Volume F2, Chapter 2**) secures noise mitigation measures, thus limiting the potential for cumulative effects to occur. The operational noise impact assessment for the solar farm concluded that effects on noise sensitive receptors would be negligible following the implementation of acoustic mitigation measures where necessary. The implementation of acoustic mitigation presented in **Volume F2, Chapter 13: Outline Design Plan** and Co159 (operational noise level to be no greater than 5dB above the representative background) thus limits the potential for cumulative effects to occur.	No potential for significant cumulative effects.

Project Name	Tier	Discussion	Likelihood and Significance of Cumulative Effects
Creyke Beck Substation Expansion	3	Due to the proximity of the development to the project there is the potential for cumulative effects of a direct and / or indirect nature on the receptors identified. Due to the nature of the development and the regulatory regime under which it will be constructed, it is assumed (with high confidence) that appropriate mitigation measures will be incorporated into the design. Furthermore, through the implementation of acoustic mitigation presented in **Volume F2, Chapter 13: Outline Design Plan** and Co159 (operational noise level to be no greater than 5dB above the representative background) the potential for cumulative effects to occur will be limited.	No potential for significant cumulative effects.
Scotland England Green Link 2 (SEGL2)	3	Depending on the finalised route chosen for the SEGL2 cable corridor, there is a potential for a cumulative impact associated with construction works. Due to the nature of the development and the regulatory regime under which it will be constructed, it is assumed (with high confidence) that appropriate mitigation measures will be incorporated into the design thus limiting the potential for cumulative effects to occur.	No potential for significant cumulative effects.

8.12.3.6 The CEA for noise and vibration does not identify any reasonably foreseeable projects or developments where significant cumulative effects could arise.

8.13 Transboundary effects

8.13.1.1 A screening of transboundary impacts has been carried out and is presented in Appendix K of the Scoping Report (Orsted, 2018). This screening exercise identified that there was no potential for significant transboundary effects regarding noise and vibration from the onshore components of Hornsea Four upon the interests of other EEA States and this is not discussed further.

8.14 Inter-related effects

8.14.1.1 Inter-related effects consider impacts from the construction, operation or decommissioning of Hornsea Four on the same receptor (or group). The potential inter-related effects that could arise in relation to noise and vibration are presented in **Table 8.38**. Such inter-related effects include both:

- **Project lifetime effects**: i.e. those arising throughout more than one phase of the project (construction, operation, and decommissioning) to interact to potentially create a more significant effect on a receptor than if just one phase were assessed in isolation; and
- **Receptor led effects**: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor (or group). Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

8.14.1.2 A description of the process to identify and assess these effects is presented in Section 2 of **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**.

Table 8.38: Inter-related effects assessment for noise and vibration.

Project phase(s)	Nature of inter-related effect	Inter-related effects assessment
Project-lifetime effects		
Construction, Operation and, decommissioning	Increases in noise and vibration as a result of construction, operation and decommissioning.	Impacts associated with noise and vibration will only be experienced for the duration of each phase. The phases of the project cannot overlap temporally, therefore there is no potential for inter-related noise and vibration impacts to occur. Impacts at human receptors were not predicted to be significant for the construction or operational phase subject to appropriate mitigation. The decommissioning phase is not anticipated to give rise to impacts any greater in magnitude than those considered for construction.
Receptor-led effects		
Construction	An inter-related effect due to the combination of noise, visual, air quality and traffic effects on human receptors	Due to concurrent multiple activities, the construction phase presents the most likely opportunity for receptor-led effects. A range of effective onshore construction phase mitigation is proposed as part of Hornsea Four, which would be implemented through the CoCP (Co124). An outline CoCP has been provided as part of the ES (**Volume F2, Chapter 2: outline Code of Construction Practice**). Given the effectiveness of the mitigation proposed, many effects during construction

Project phase(s)	Nature of inter-related effect	Inter-related effects assessment
		would be negligible to slight adverse and not significant. These are detailed in the respective chapters. Construction effects would be temporary. Effects in relation to construction views, noise, traffic and dust are not predicted to be significant. The proposed measures would control construction effects as far as reasonably practicable. The highest level of significance has been assigned to visual effects during construction at the OnSS, which may be up to large adverse. The assessment is presented in **Chapter 4: Landscape and Visual**. Overall, whilst inter-related effects on residents may arise from some locations on a temporary basis, they are unlikely to exceed the level reported for visual effects (large adverse). On the basis of the assessment undertaken, in combination with the commitment to implement the appropriate mitigation measures, no significant residual effects are anticipated..

8.14.1.3 The assessment concludes that there are no significant inter-related impacts from the construction, operation or decommissioning of Hornsea Four on noise and vibration receptors.

8.15 Conclusion and summary

8.15.1.1 This chapter of the ES has assessed the potential impact from the onshore development of Hornsea Four on noise and vibration receptors.

8.15.1.2 **Table 8.39** presents a summary of the significant impacts assessed within this ES, any mitigation and the residual effects.

8.15.1.3 In accordance with the assessment methodology, this table should only be used in conjunction with the additional narrative explanations provided in **Section 8.11**. which demonstrate that provided mitigation measures (both embedded and additional) are in place to prevent impacts on receptors from the project, potential impacts are anticipated to be **not significant** to **slight adverse** in relation to noise and vibration receptors.

Table 8.39: Summary of potential impacts assessed for noise and vibration.

Impact and Phase	Receptor and value/sensitivity	Magnitude and significance	Mitigation	Residual impact
Construction				
Landfall, nearshore and intertidal area - temporary noise and vibration from cable installation works. (NV-C-3)	Landfall receptors, medium sensitivity	Negligible to slight magnitude of impact Not significant	None proposed beyond existing Commitments (Co36, Co41, Co49, Co123, Co124, Co134)	Not significant
Traffic noise (NV-C-7)	Receptors adjacent to traffic routes, medium sensitivity	Negligible to major magnitude of impact Not Significant to Large adverse significance. (Of the 66 roads assessed, 58 are predicted to have a negligible magnitude of impact, six minor magnitude of impact, one moderate magnitude of impact and one of major magnitude of impact).	None proposed beyond existing Commitments (Co135, Co144)	Slight adverse

8.16 References

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