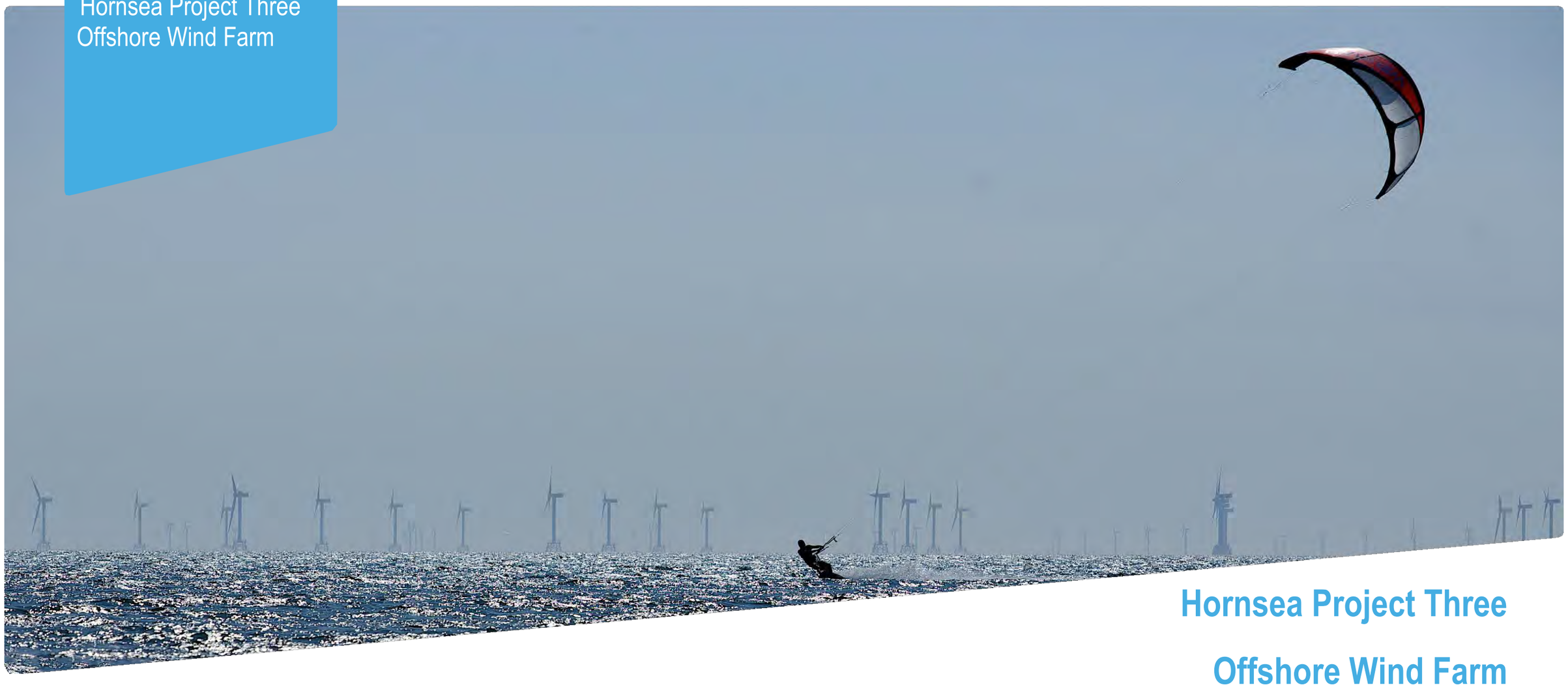
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Preliminary Environmental Information Report:
Chapter 8 – Noise and Vibration

Date: July 2017

Hornsea 3
Offshore Wind Farm

DONG energy

Environmental Impact Assessment

Preliminary Environmental Information Report

Volume 3

Chapter 8 – Noise and Vibration

Liability

This report has been prepared by RPS, with all reasonable skill, care and diligence within the terms of their contracts with DONG Energy Power (UK) Ltd.

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Front cover picture: Kite surfer near one of DONG Energy's UK offshore wind farms © DONG Energy Hornsea Project Three (UK) Ltd., 2016.

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Glossary

Terms	Definition
A-weighting/ A-weighted	Weighting of the audible frequencies designed to reflect the response of the human ear to sound. The ear is more sensitive to sound at frequencies in the middle of the audible range than it is to either very high or very low frequencies. Sound measurements are often A-weighted (using a dedicated filter) to compensate for the sensitivity of the ear.
Ambient sound level	BS 4142 (British Standards Institution (BSI), 2014a) defines the ambient sound level as the: "*totally encompassing sound in a given situation at a given time, usually from many sources near and far*". It is sometimes used to mean an environmental noise level defined specifically in terms of the L_{Aeq} index. The terms 'ambient' and 'background' may be colloquially synonymous when describing environmental noise levels.
Anthropogenic noise	Noise from man-made sources.
Background sound level	BS 4142 (BSI, 2014a) defines the background sound level $L_{A90,T}$ as the: "*A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibel*" (i.e. a sound level defined specifically in terms of the L_{A90} index). The ambient sound level is a measure of the residual sound and the specific sound when present. The terms 'ambient' and 'background' may be colloquially synonymous when describing environmental noise levels. Horizontal Guidance H3 Part 2 Noise Assessment and Control (Environment Agency, 2002) describes the L_{A90} background noise level as: "*Whilst it is not the absolute lowest level measured in any of the short samples, it gives a clear indication of the underlying noise level, or the level that is almost always there in between intermittent noisy events*".
Baseline sound levels/Baseline sound environment	The existing sound levels before construction or operation of a development commences.
Broadband	A sound containing a wide range of frequencies (for example, a whooshing sound like a waterfall or an out of tune analogue radio).
Decibel (dB)	Units of sound measurement and noise exposure measurement.
Directivity	The uniform/non-uniform directional characteristics of a sound source (as sound may be emitted from the source in different directions with varying intensities and frequencies).
Environmental Noise Directive (END)	Environmental Noise Directive (Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise). The aim of the Directive is to "*define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to the exposure to environmental noise*".
Environmental Noise Regulations (ENR)	Environmental Noise (England) Regulations 2006 (as amended). The Regulations came into force on 01 October 2006 in "*relation to measures relating to the assessment, management and control of environmental noise*''.
Equivalent continuous sound pressure level ($L_{Aeq,T}$)	Defined in BS 7445 (BSI, 2003) as the "*value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time*" (i.e. it is a measure of the noise dose or exposure over a period). It is a unit commonly used to describe construction noise and noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise. It is also the unit best suited to assessing community response.
Façade/Freefield	This applies to the positions for either measurement or prediction. A façade position is one that effectively represents sound levels at a building but is conventionally taken at a position 1 m from the building; this includes reflections from the building. A freefield position is one that is at least 3.5 m from a building where reflection effects are not significant. The difference between a sound level measured at a façade position and a freefield position, assuming that there is a specific sound source that causes reflections, is that levels are around 3 dB higher at the façade, due to the reflection effects.
Frequency	The pitch of the sound, measured in Hz. The tonal quality of a sound is described and measured in terms of the frequency content and is commonly expressed as octave or third octave bands, the latter being the division of the octave bands into three for finer analysis, across the frequency spectrum. The smaller the octave band or third octave band centre frequency number defined in terms of Hz, the lower the sound. For example, 63 Hz is lower than 500 Hz and is perceived as a deeper sound. The attenuation due to air absorption and natural barriers increases with frequency (i.e. low frequencies are always the most difficult to control/mitigate). Frequency ranges for commonly occurring sounds include: • The low notes on a bass guitar are typically around 40 – 50 Hz; • The lowest string on a guitar is typically about 80 Hz; • 'Middle C' is about 250 Hz; • The C above middle C is about 500 Hz; • Cars in a residential area are generally around 250 and 500 Hz; • Greenwich Mean-time signal (pips) is around 1 kHz; • Bird calls are generally around 2 to 5 kHz; and, • A 'Shhh' sound made by the mouth is mostly around 4 kHz and above.
Harmonic	An oscillation (e.g. sound wave) that has a frequency that is an integral multiple of a fundamental frequency.
Hertz (Hz)	The unit of frequency.
Immission	The act of immitting, or of sending in - the correlative of emission. Emissions are emitted by the sound source and immissions are received by the noise sensitive receptor.
$L_{Aeq,T}$	See "Equivalent continuous sound pressure level".
L_{Amax}	Maximum value of the A-weighted sound pressure level, measured using the fast (F) time weighting (in dBA).
L_{AT} (DW)	Average downwind sound pressure level, as defined in ISO 9613-2
L_{A90}	See "Background sound level".

Terms	Definition
L_{den}	The 'Day-evening-night level' and is defined by: $L_{den} = 10 \times \log\left\{\frac{1}{24}\left[\left(12 \times 10^{(L_{day}/10)}\right) + \left(4 \times 10^{(L_{evening}+5/10)}\right) + \left(8 \times 10^{(L_{night}+10/10)}\right)\right]\right\}$ The ENR, which transposes the requirements of the END, selected L_{den} and L_{night} as common indicators to assess annoyance and sleep disturbance, respectively.
L_{day}	The A-weighted long term average sound level as defined in BS 7445-2 (BSI, 1991a; ISO, 1996), which is determined over all the day periods (07:00 to 19:00 hours) of a year.
$L_{evening}$	The A-weighted long term average sound level as defined in BS 7445-2 (BSI, 1991a; ISO, 1996), which is determined over all the evening periods (19:00 to 23:00 hours) of a year.
L_{night}	The A-weighted long term average sound level as defined in BS 7445-2 (BSI, 1991a; ISO, 1996), which is determined over all the night (23:00 to 07:00 hours) periods of a year.
Loudness/Loud	The measure of the subjective impression of the magnitude or strength of a sound.
Noise and Sound	Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood. Sound can be measured by a sound level meter or other measuring system. Noise is related to a human response and is routinely described as unwanted sound, or sound that is considered undesirable or disruptive.
Octave	The range between two frequencies whose ratio is 2:1.
Octave bands	Groups of frequencies defined by standards where the upper frequency of each band is equal to twice the lower frequency of the next higher band. Octave bands are usually named by their geometric centre frequency. For example, the octave band extending between 44.7 Hz and 89.1 Hz is called the 63 Hz octave band. The octave band extending between 89.1 Hz and 178 Hz is called the 125 Hz octave band. The full complement of octave bands in the audible frequency range is as follows: 31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000 and 16,000 Hz.
Point/Line/Area Source	Noise sources can be modelled as point, line or area sources. Noise attenuation due to geometric spreading, which is the effect of acoustic energy being spread over an increasing surface with increasing distance from the source, can be different for the different types of source. When the distance from source to receptor is very much greater than the dimensions of the source, the attenuation due to geometric spreading from all source types is the same as for point sources.
Rating level, $L_{Ar,Tr}$	BS 4142 (BSI, 2014a) defines the rating level as 'The specific noise level plus any adjustment for the characteristic features of the noise.'
Reflection	Sound can be reflected by hard surfaces and reflection effects can affect sound levels.
Slow/Fast Time Weighting	The response speed of the detector in a sound level meter. Slow response time is 1 second; fast response time is 1/8 second (0.125 seconds) and will detect changes in sound levels more rapidly than measurements made with Slow time-weighting.
Sound	See "Noise and Sound"

Terms	Definition
Sound Power Level (SWL, Lw)	A sound power level is a measure of the total power radiated as sound by a source in all directions. It is a property of the source and is essentially independent of the measuring environment. The sound power level of a source is expressed in decibels (dB) and is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to a reference sound power. The reference sound power in air is normally taken to be 10^{-12} watt.
SoundPLAN®	A computer software package that uses a ray-tracing numerical modelling approach to predict acoustic propagation from industrial and/or transport sound sources. The prediction methodologies follow national and international standards, such as ISO 9613 part 1.
Sound Pressure Level (SPL)	Sound pressure is the dynamic variation of the static pressure of air and is measured in force per unit area. Sound pressure is normally represented on a logarithmic amplitude scale, which gives a better relationship to the human perception of hearing. The sound pressure level is expressed in decibels (dB) and is equal to 20 times the logarithm to the base 10 of the ratio of the sound pressure at the measurement location to a reference sound pressure. The reference sound pressure in air is normally taken to be 20 µPa, which roughly corresponds to the threshold of human hearing.
Sound spectrum	A sound represented by its frequency components.
Soundscape	The acoustic environment as perceived and understood by people in context.
Source term	The acoustic properties of a source defined as a sound power level or as a sound pressure level under specific measurement conditions. Source terms are sometimes provided as a spectrum.
Specific sound level, $L_{Aeq,Tr}$	BS 4142 (BSI, 2014a) defines the specific sound level as the 'equivalent continuous A-weighted sound pressure level produced by the specific sound source over a given reference time interval.'
Third-octave bands	Frequency ranges where each octave is divided into one-third octaves.
Tonal	Sound sources sometimes contain audible or measurable components that can be identified as hums, whistles etc. The presence of these tonal components is sometimes considered to add an extra, annoying quality to the sound.

Acronyms

Acronym	Description
BDEN	Burden of Disease from Environmental Noise (Fritschi *et al.*, 2011)
BS	British Standard
BSI	British Standards Institution
CEA	Cumulative Environmental Affects
CoCP	Code of Construction Practice
dBA	Decibels A-weighted
DCLG	Department for Communities and Local Government

Acronym	Description
DCO	Development Consent Order
DMRB	Design Manual for Roads and Bridges
EHO	Environmental Health Office
EIA	Environmental Impact Assessment
EPO	Environmental Protection Officer
HDD	Horizontal Directional Drilling (a Trenchless Technology)
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
Hz	Hertz
IPC	Infrastructure Planning Commission
LOAEL	Lowest Observed Adverse Effect Level
NNGL/NNG	Night Noise Guidelines for Europe (WHO, 2009)
NOEL	No Observed Effect Level
NPPF	National Planning Policy Framework (DCLG, 2012)
PPG-N	National Planning Practice Guidance – Noise (DCLG, 2014)
NPSE	Noise Policy Statement for England (Defra, 2010)
NSR	Noise and Vibration Sensitive Receptor
ONS	Office for National Statistics
OS	Ordnance Survey
PINS	Planning Inspectorate
PPV	Peak Particle Velocity
PRoW	Public Right of Way
SOAEL	Significant Observed Adverse Effect Level
SRI	Sound Reduction Index
TT	Trenchless Technology (including HDD, thrust boring, auger boring and pipe ramming).
WHO	World Health Organization

Units

Unit	Description
GW	Gigawatt (power)
kV	Kilovolt (electrical potential)
kW	Kilowatt (power)
dB	Sound pressure level referenced to 20 µPa
m	Metres (distance)
µPa	Micropascal (pressure)

8. Noise and Vibration

8.1 Introduction

8.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the preliminary results of the Environmental Impact Assessment (EIA) of the onshore elements of the Hornsea Three offshore wind farm (hereafter referred to as Hornsea Three) relevant to noise and vibration (namely the Hornsea Three landfall area, the onshore cable corridor search area, the onshore HVAC booster station, the onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main National Grid substation), during its construction, operation and maintenance, and decommissioning. The onshore cable corridor search area currently comprises a 200 m wide corridor within which the refined onshore cable corridor (80 m wide) will be located. The refined onshore cable corridor will be included in the application for Development Consent. The onshore HVAC booster station will only be required for the HVAC transmission option (see volume 1, chapter 3: Project Description).

8.1.1.2 This chapter summarises information contained within the technical report, which is included at volume 6, annex 8.1: Baseline Noise Information.

8.2 Purpose of this chapter

8.2.1.1 The primary purpose of the Environmental Statement is to support the Development Consent Order (DCO) application for Hornsea Three under the Planning Act 2008 (the 2008 Act). This PEIR constitutes the Preliminary Environmental Information for Hornsea Three and sets out the findings of the EIA to date to support pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for Development Consent.

8.2.1.2 The PEIR will form the basis for Phase 2 Consultation which will commence on 27 July and conclude on 20 September 2017. At this point, comments received on the PEIR will be reviewed and incorporated (where appropriate) into the Environmental Statement, which will be submitted in support of the application for Development Consent scheduled for the second quarter of 2018.

8.2.1.3 In particular, this noise and vibration chapter:

- Presents the existing environmental baseline established from desk studies, baseline surveys and consultation;
- Presents the potential environmental effects on noise and vibration arising from the onshore elements of Hornsea Three (paragraph 8.1.1.1), based on the information gathered and the analysis and assessments undertaken to date;
- Identifies any assumptions and limitations encountered in compiling the preliminary environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

8.3 Study area

8.3.1.1 Construction and operational noise and vibration have the potential for adverse impacts and effects on nearby people, which can affect the use of their residential property, their enjoyment of outdoor recreation areas, or other activities for which noise might otherwise disturb. Together, these uses are identified as noise and vibration sensitive receptors (NSR). For construction and decommissioning, the noise and vibration study area considers NSRs and Public Rights of Way (PRoWs) within approximately 1 km of the onshore elements identified in paragraph 8.1.1.1 plus the potential locations of the main compounds. The potential locations of the main compounds are identified in volume 1, chapter 3: Project Description. Additional construction compounds will be required to facilitate the construction process and will be identified in the Environmental Statement.

8.3.1.2 For the operational assessment, the noise and vibration study area is 1 km from the onshore HVDC converter/HVAC substation and HVAC booster station. The noise and vibration study area is shown in Figure 8.1.

8.3.1.3 There is no national government guidance or legislation on the extent/size of the study area to adopt for the assessment of noise and vibration effects from electrical infrastructure or the construction or operation of industrial facilities. The study areas in this chapter have been chosen on the basis of guidance contained within Design Manual for Roads and Bridges (DMRB) (Highways Agency *et al.*, 2011), professional judgment of the distances over which significant noise effects may occur and consideration of the likely magnitude and duration of impact and the sensitivity of receptors.

8.3.1.4 Construction and decommissioning effects are likely to be short term, whereas operational effects are likely to be long term and static. The operational phase will not generate significant noise along the onshore export cable route (there being no noise generated by the cable, no above-ground infrastructure and no anticipated maintenance), therefore, no operational noise and vibration study area is defined for the onshore export cable route.

8.3.1.5 The scope of the PEIR assessment for geology and ground conditions has been discussed with the local planning authorities leading up to the PEIR submission and further feedback is welcomed at this stage.

8.4 Planning policy context

8.4.1.1 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)

8.4.1.2 Specifically, the guidance provided within the NPS EN-3 was considered. The general guidance from paragraph 2.4.2 is that proposals for renewable energy infrastructure should demonstrate good design in respect of landscape and visual amenity, and in the design of the project to mitigate impacts such as noise and effects on ecology.

8.4.1.3 NPS EN-5 states in paragraph 2.9.1 that:

"Generic noise effects are covered in Section 5.11 of EN-1. In addition there are specific considerations which apply to electricity networks infrastructure as set out below.

8.4.1.4 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment. These are summarised in Table 8.1 below. Other planning policy and guidance relevant to this chapter includes:

- National Planning Policy Framework (NPPF) (2012);
- Web based Planning Practice Guidance is provided by the Department for Communities and Local Government (DCLG);
- Noise Policy Statement for England (Defra, 2010); and
- North Norfolk District Council Core Strategy (2008).

8.4.1.5 The planning process for Nationally Significant Infrastructure Projects (NSIPs) is administered by PINS, with the decision on the DCO being taken by the Secretary of State.

8.4.1.6 NPS EN-1 and NPS EN-3 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 8.1 below.

Table 8.1: Summary of NPS EN-1 and NPS EN-3 provisions and policy on decision making relevant to noise and vibration.

Summary of NPS EN-1 and NPS EN-3 policy on decision making (and mitigation)	How and where considered in the PEIR
Paragraph 5.11.4 of NPS EN-1 identifies the elements that should be included in the noise assessment.	Construction, operation and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant British Standard. Construction impacts are assessed in section 8.12.1 Operational impacts are assessed in section 8.12.2 Decommissioning impacts are assessed in section 8.12.3.
Paragraph 5.11.6 of NPS EN-1 refers to the need to assess operational and construction noise using the principles of the relevant British Standards (BS), for example BS 4142 'Method for rating and assessing industrial and commercial sound' (British Standards Institution (BSI), 2014a) and BS 5228 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise' (BS 5228 Part 1:2009+A1:2014) (BSI, 2014b).	Construction, operation and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant British Standard. Construction impacts are assessed in section 8.12.1 Operational impacts are assessed in section 8.12.2 Decommissioning impacts are assessed in section 8.12.3.
Paragraph 5.11.7 of NPS EN-1 refers to the need to consult Environment Agency and Natural England as necessary and in particular with regard to assessment of noise on protected species or other wildlife.	Noise impacts on wildlife are assessed in chapter 3: Ecology and Nature Conservation.
Paragraph 5.11.8 of NPS EN-1 refers to the need to demonstrate good design through the 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.	The design of the onshore HVAC booster station and the onshore HVDC converter/HVAC substation is described in volume 1, chapter 3: Project Description. The choice of equipment, layout of buildings and noise mitigation will be discussed in the Environmental Statement.
Paragraphs 5.11.9 and 5.11.10 of NPS EN-1 refer to mitigation of noise impacts and measurable requirements.	Designed-in mitigation measures are set out in Table 8.21. Measures for the operation of the onshore HVDC converter/HVAC substation will be reported in the Environmental Statement.

Summary of NPS EN-1 and NPS EN-3 policy on decision making (and mitigation)	How and where considered in the PEIR
Paragraph 2.4.2 of EN-3 refers to the need renewable energy infrastructure proposals to demonstrate noise mitigation in the design. NPS EN-3 provides guidance specific to renewable energy infrastructure, however the onshore elements of the guidance are focused on onshore wind farms, which are not directly relevant. Guidance for offshore wind farms considers all elements which may be part of an application (e.g. onshore substations) and states that the applicant should identify the impacts of a proposal and these impacts, together with proposals for their avoidance or mitigation. With regard to noise and vibration assessment, NPS EN-3 refers to NPS EN-1.	The design of the onshore HVAC booster station and onshore HVDC converter/HVAC substation is described in volume 1, chapter 3: Project Description. Noise mitigation measures are set out in Table 8.21. Construction, operation and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant British Standard. The assessment of the onshore elements of Hornsea Three is provided in 8.12 and designed-in mitigation measures are identified in Table 8.21.
NPS EN-5 provides guidance primarily relating to noise from overhead transmission lines, which is not directly relevant to Hornsea Three. It also refers to audible noise effects from substation equipment such as transformers. The guidance states that relevant assessment methodologies should be used and that the appropriate mitigation options have been considered and adopted. With regard to noise and vibration assessment, NPS EN-5 refers to NPS EN-1.	Construction, operation and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant British Standard. The assessment of the onshore elements of Hornsea Three is provided in 8.12 and designed-in mitigation measures are identified in Table 8.21.
Paragraph 5.11.6 of NPS EN-1 refers to the need to assess operational and construction noise using the principles of the relevant British Standard.	The construction, operation and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant BS. The impact assessment methodology and criteria are set out in 8.9. Construction impacts are assessed in section 8.12.1. Operational impacts are assessed in section 8.12.2. Decommissioning impacts are assessed in section 8.12.3. In accordance with best practice, the noise and vibration assessment has also considered the Noise Policy Statement for England (NPSE) and guidance listed below: • BS 4142 'Method for Rating industrial noise affecting mixed residential and industrial areas' (BSI, 2014a); • BS 5228 'Code of practice for noise and vibration control on construction and open sites' (BSI, 20014b; BSI, 2014c); • DMRB (Highways Agency, 2011); • Calculation of Road Traffic Noise (CRTN) (Department of Transport, 1988); • Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Impact Assessment (IEMA, 2004); • Institute of Environmental Assessment (IEA) Guidelines for the Environmental Assessment of Road Traffic (IEA, 2003); • BS 7445 'Description and measurement of environmental noise' (BSI, 1991a; 1991b; BSI, 2003); • International Organization for Standardization (ISO) (1996) 9613 (ISO 9613). Part 2: 'Acoustics: Attenuation of sound during propagation outdoors' (ISO, 1996); • Burden of disease from environmental noise (BDEN) (Fritschi *et al.*, 2011); • Night Noise Guidelines for Europe (NNGL) (WHO, 2009); and • British Standard 8233 Guidance on sound insulation and noise reduction for buildings' (BS 8233) (BSI, 2014d).

8.4.2 National Planning Policy Framework

8.4.2.1 The Department for Communities and Local Government (DCLG) published the National Planning Policy Framework (NPPF) in March 2012. This sets out the national planning policies for England and the Government's desire to enable sustainable development.

8.4.2.2 The NPPF does not contain any specific noise policy or noise limits, but it provides a framework for local people and local authorities to produce their own local and neighbourhood plans, which reflect the needs and priorities of their communities.

8.4.2.3 The NPPF does not have specific policies for NSIPs. It states in paragraph 3 that:

3. This Framework does not contain specific policies for nationally significant infrastructure projects for which particular considerations apply. These are determined in accordance with the decision-making framework set out in the Planning Act 2008 and relevant national policy statements for major infrastructure, as well as any other matters that are considered both important and relevant (which may include the National Planning Policy Framework). National policy statements form part of the overall framework of national planning policy, and are a material consideration in decisions on planning applications.

8.4.2.4 Consequently, the NPPF is given lesser weight in this assessment.

8.4.2.5 In Section 11, 'Conserving and enhancing the natural environment', paragraph 123 relates to noise and states:

"Planning policies and decisions should aim to:

- *avoid noise from giving rise to significant adverse impacts[27] on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts[27] on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;[28] and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

[27] See Explanatory Note to the Noise Policy Statement for England (Department for the Environment, Food and Rural Affairs).

[28] Subject to the provisions of the Environmental Protection Act 1990 and other relevant law."

8.4.3 National Planning Practice Guidance – Noise (PPG-N)

8.4.3.1 The PPG-N reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and British Standards (BS), and contains examples of acoustic environments commensurate with various effect levels. It is considered appropriate to NSIPs. A summary of the guidance from NPSE and PPG-N is set out in Table 8.2.

Table 8.2: Summary of guidance from NPSE and PPG-N.

Perception	Examples of Outcomes	Increasing Effect Level	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, for example 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, for example 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. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
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, for example regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm (e.g. auditory and non-auditory).	Unacceptable Adverse Effect	Prevent

8.4.3.2 The PPG-N describes noise that is not noticeable to be at levels below the No Observed Effect Level (NOEL). It describes a range of noise exposure that is noticeable but not to the extent there is a perceived change in quality of life. Noise exposures in this range are below the Lowest Observed Adverse Effect Level (LOAEL) and need no mitigation. On this basis, the audibility of noise from a development is not an appropriate criterion to judge noise effects.

8.4.3.3 The PPG-N advises that noise exposures above the LOAEL cause small changes in behaviour. Examples of noise exposures above the LOAEL provided in the PPG-N include: having to turn up the volume on the television; needing to speak more loudly to be heard; or, where there is no alternative ventilation, closing windows for some of the time because of the noise. In line with the NPPF and NPSE, the PPG-N states that consideration needs to be given to mitigating and minimising effects above the LOAEL but taking account of the economic and social benefits being derived from the activity causing the noise.

8.4.3.4 The PPG-N advises that noise exposures above the Significant Observed Adverse Effect Level (SOAEL) cause material changes in behaviour. An example of noise exposures above the SOAEL provided in the PPGN are, where there is no alternative ventilation, keeping windows closed for most of the time or avoiding certain activities during periods when the noise is present. In line with the NPPF and NPSE, the PPG-N states that effects above the SOAEL should be avoided and that whilst the economic and social benefits derived from the activity causing the noise must be taken into account, such exposures are undesirable.

8.4.3.5 As set out in section 8.9 negligible or minor impacts are generally considered to be below the LOAEL; moderate impacts between the LOAEL and SOAEL; and major impacts above the SOAEL.

8.4.4 Noise Policy Statement for England

8.4.4.1 Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) documents, via Section 5.11 of EN-1 have been taken into account in the production of the National Policy Statements. Local development plan policies may be relevant to determining local impacts, while PPS and PPG documents, although no longer in force, provide additional context. The Noise Policy Statement for England (NPSE) (Defra, 2010), aims to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion. Paragraphs 1.6 - 1.7 of the NPSE set out the long term vision and aims of Government noise policy:

"*Noise Policy Vision*

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development."

"*Noise 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."*

8.4.4.2 The aims require that all reasonable steps should be taken to avoid, mitigate and minimise adverse effects on health and quality of life whilst also taking into account the guiding principles of sustainable development, which include social, economic, environmental and health considerations.

8.4.5 Local planning policy

8.4.5.1 The onshore cable corridor search area is located within the districts of North Norfolk, Broadland and South Norfolk. The proposed onshore HVDC converter/HVAC substation site is in South Norfolk; the onshore HVAC booster station is located in North Norfolk.

8.4.5.2 The North Norfolk Core Strategy (2008) sets out a number of policies which refer to noise. The policies relevant to Hornsea Three are summarised below.

8.4.5.3 Policy EN 7 Renewable Energy states that proposal for renewable technology and associated infrastructure "*will only be permitted where individually, or cumulatively, there are no significant adverse effects on…residential amenity (noise…)*".

8.4.5.4 Policy EN 13 states that "*all development proposals should minimise, and where possible reduce, all emissions and other forms of pollution, including light and noise pollution….*"

8.4.5.5 The Core Strategy does not include polices relating to vibration.

8.4.5.6 The Broadland District Council and South Norfolk District Council have set out their strategic policies in a Joint Core Strategy Development Partnership Document (JCS DPD) together with Norwich City Council. The JCS DPD (adopted 2011) does not include any specific policies relating to noise and vibration.

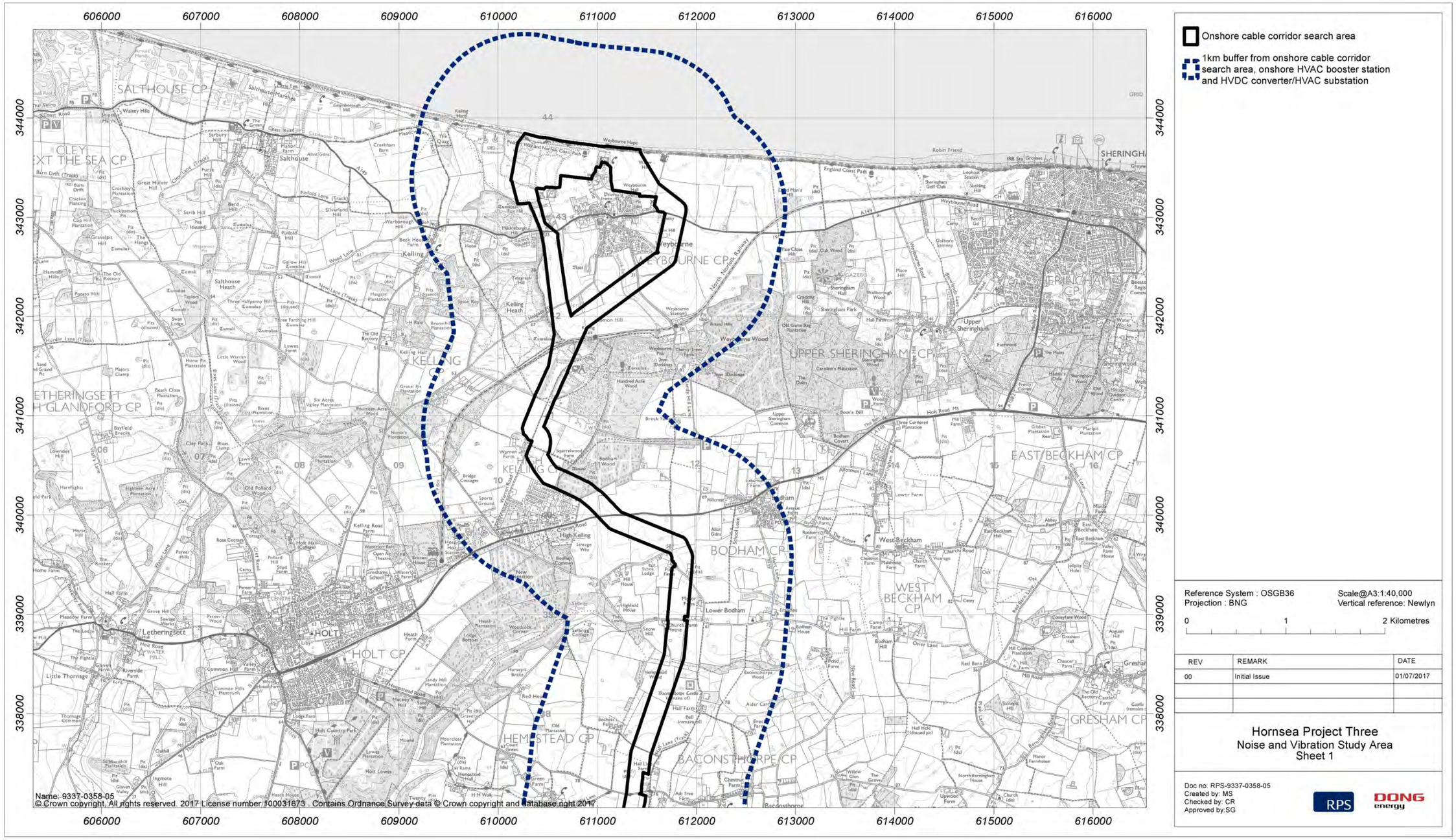

Figure 8.1: Hornsea Three noise and vibration study area.

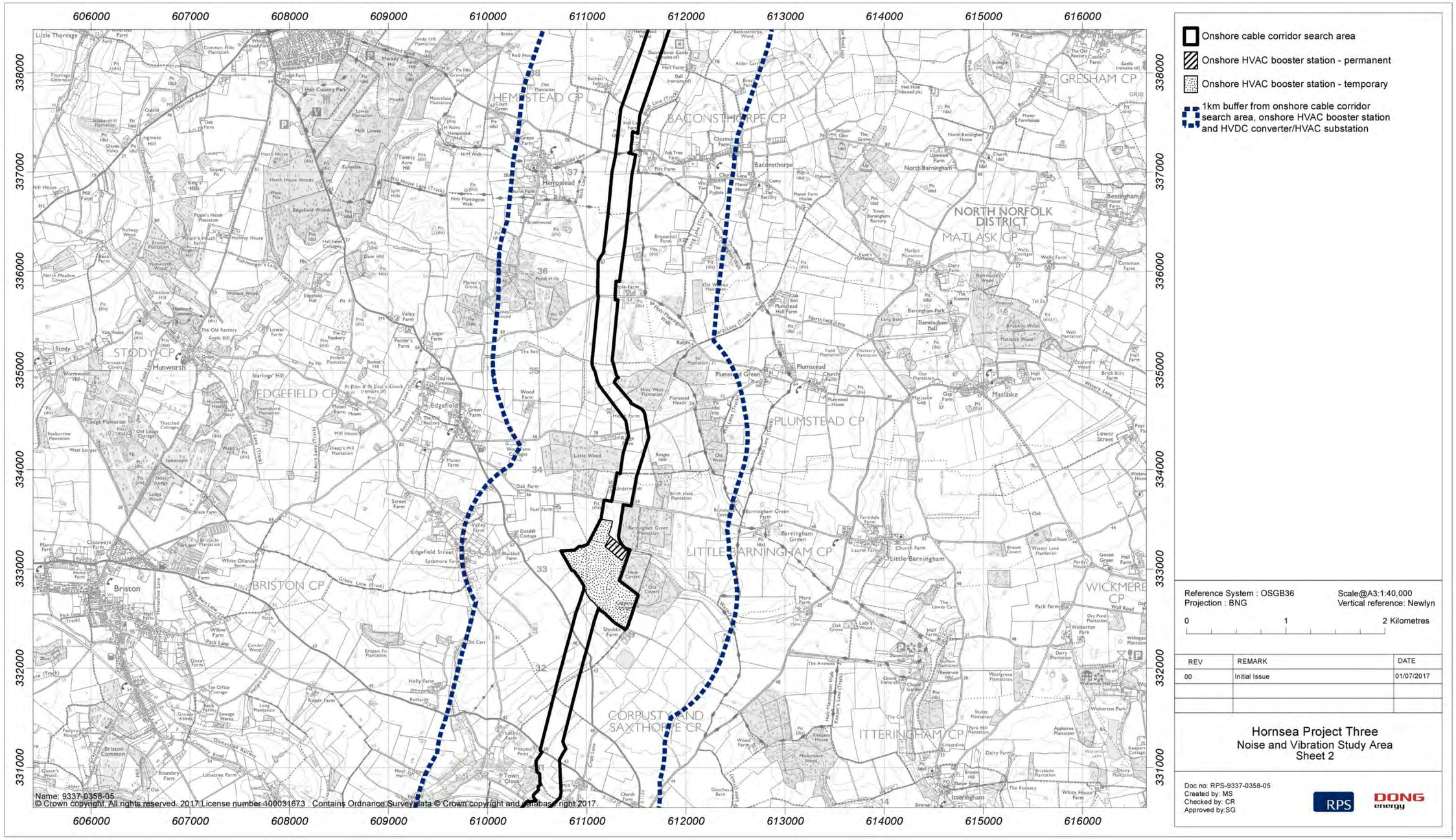

Figure 8.1: Hornsea Three noise and vibration study area

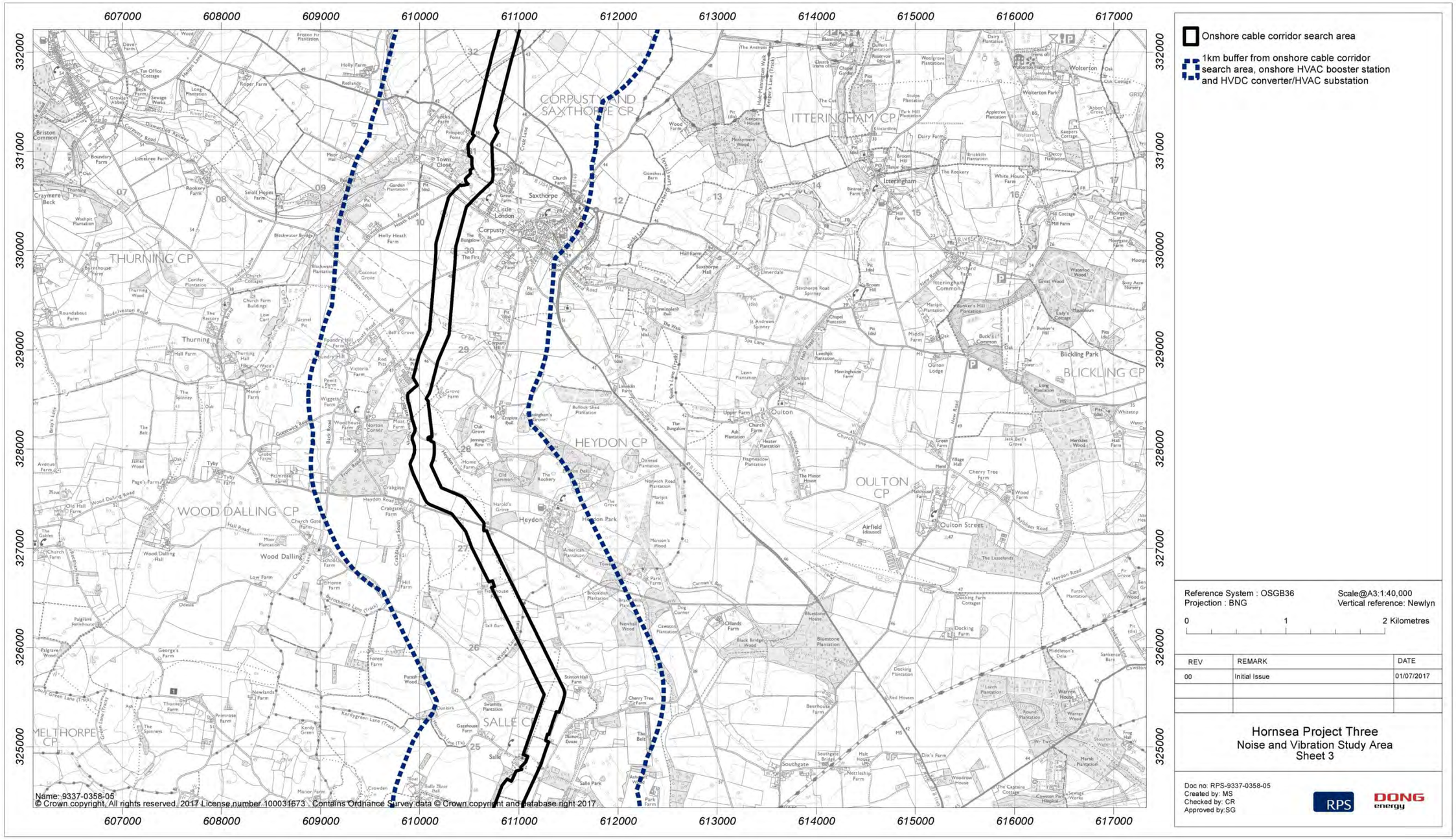

Figure 8.1: Hornsea Three noise and vibration study area.

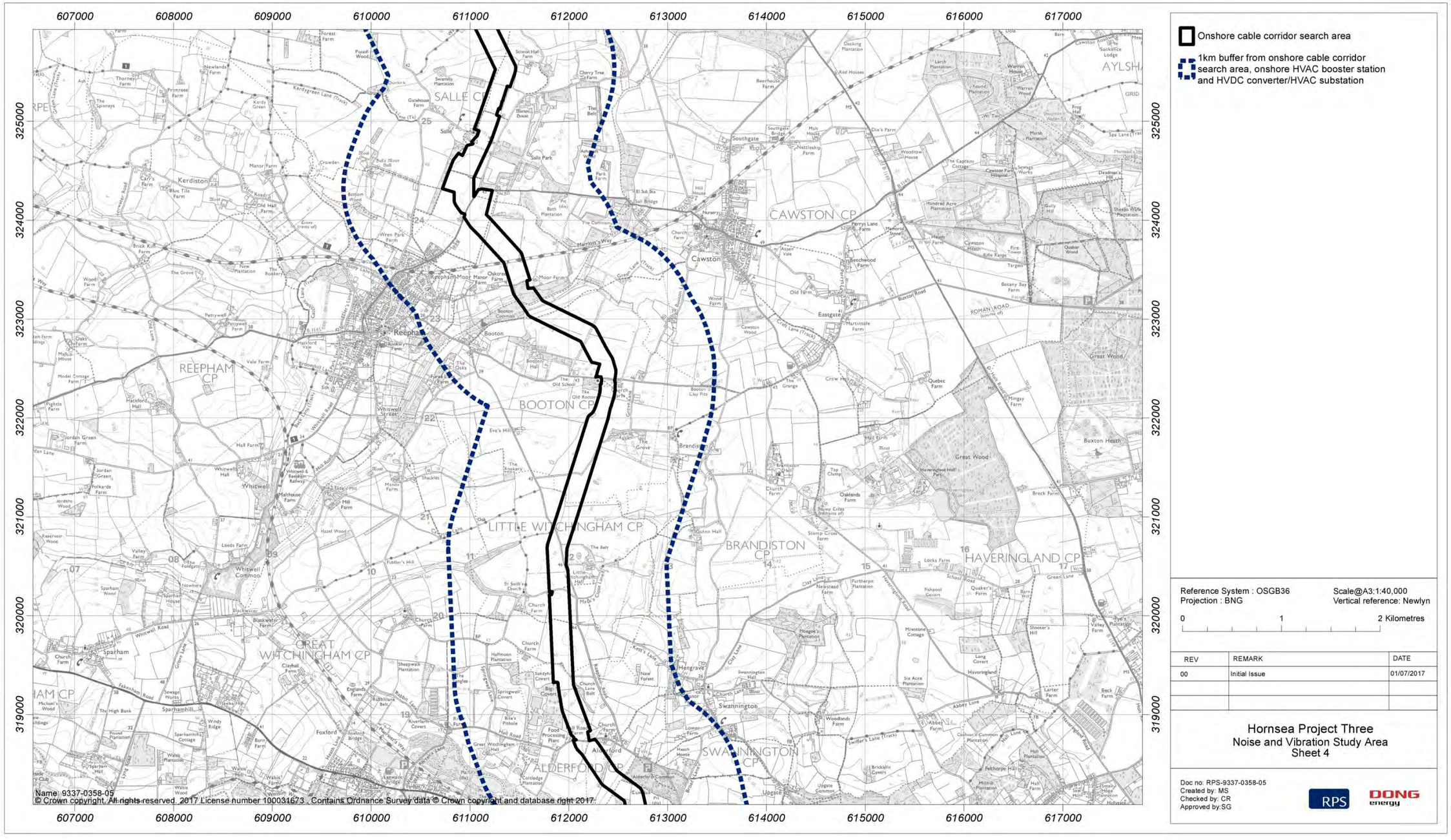

Figure 8.1: Hornsea Three noise and vibration study area.

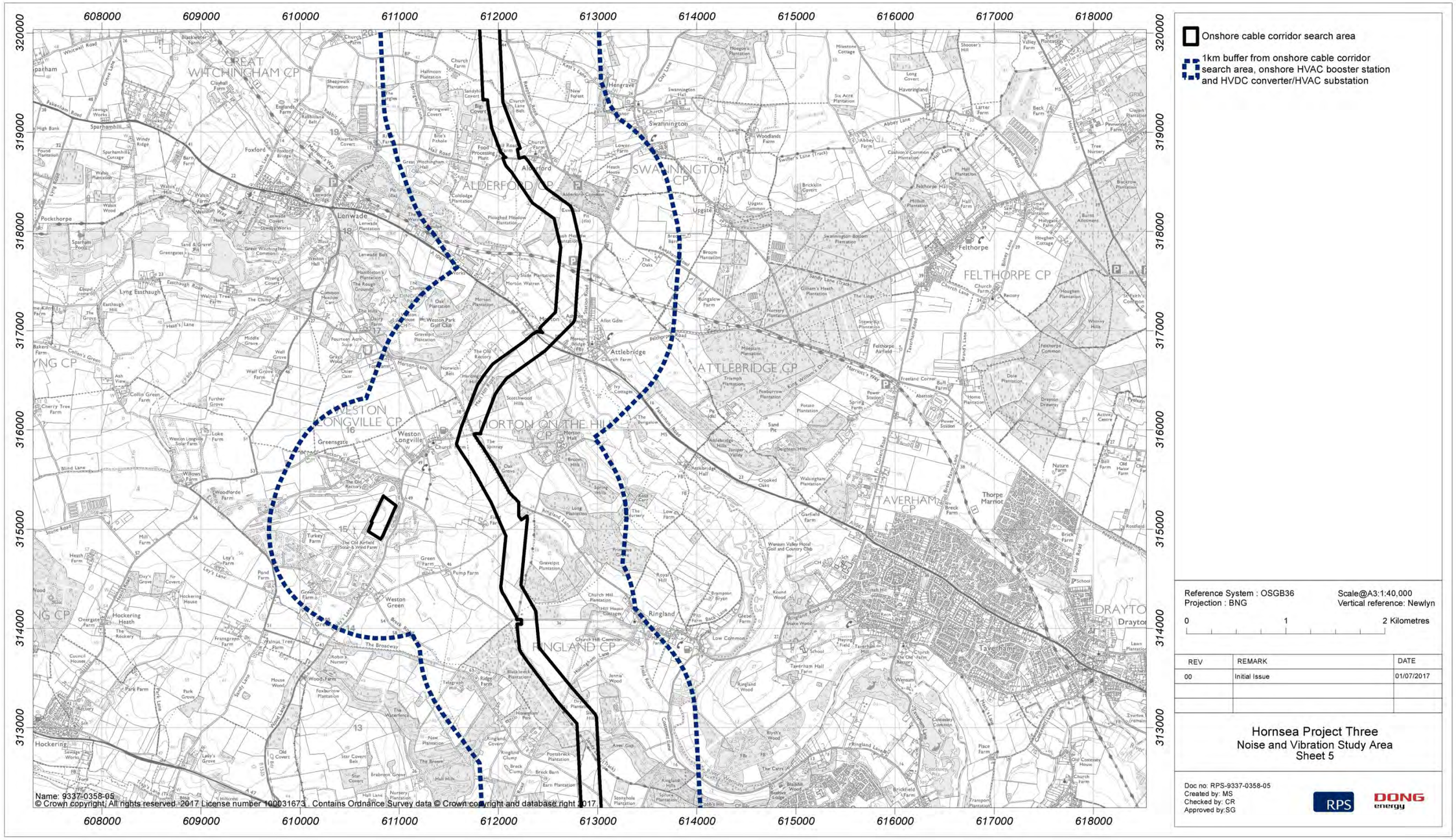

Figure 8.1: Hornsea Three noise and vibration study area.

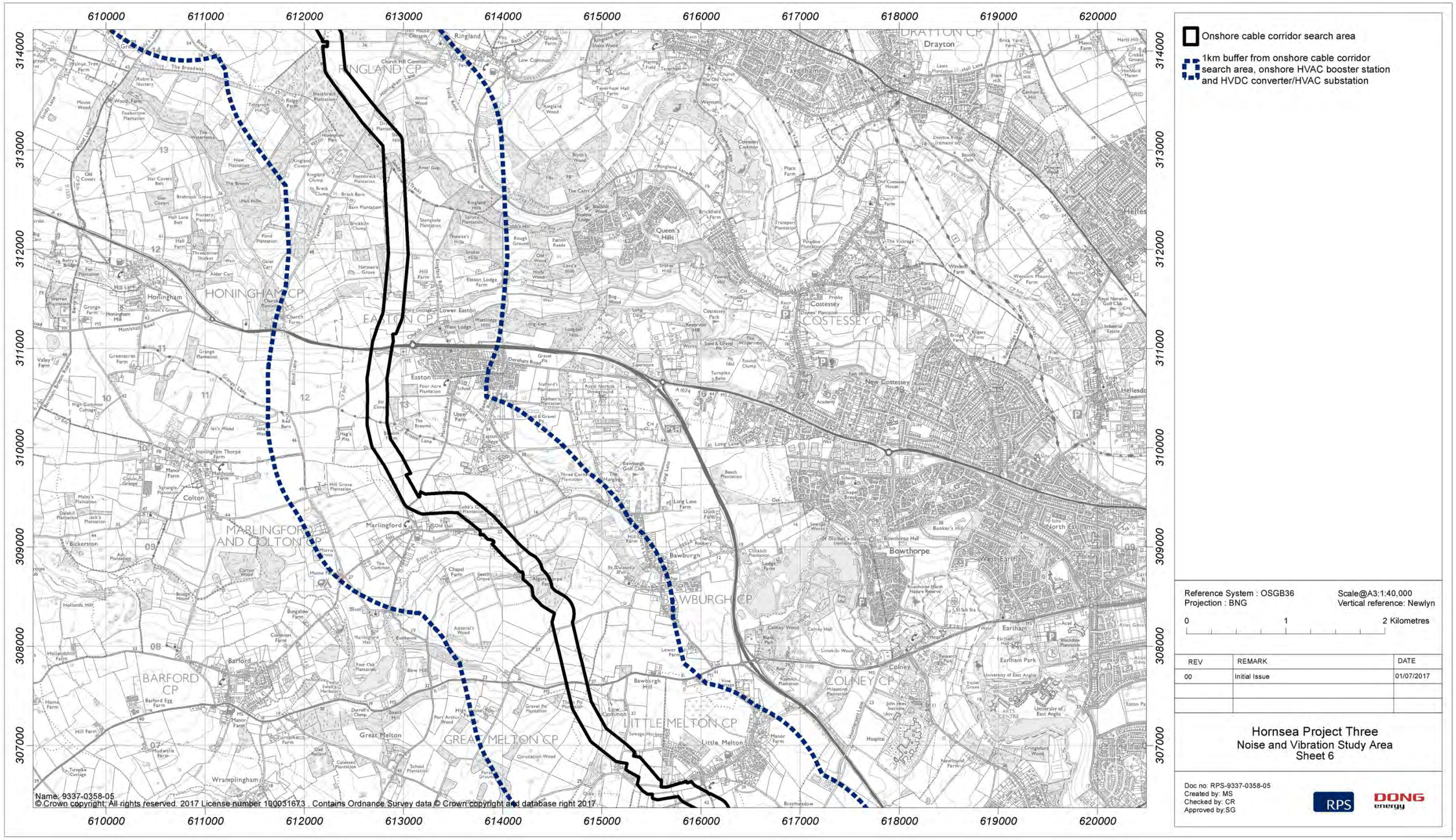

Figure 8.1: Hornsea Three noise and vibration study area.

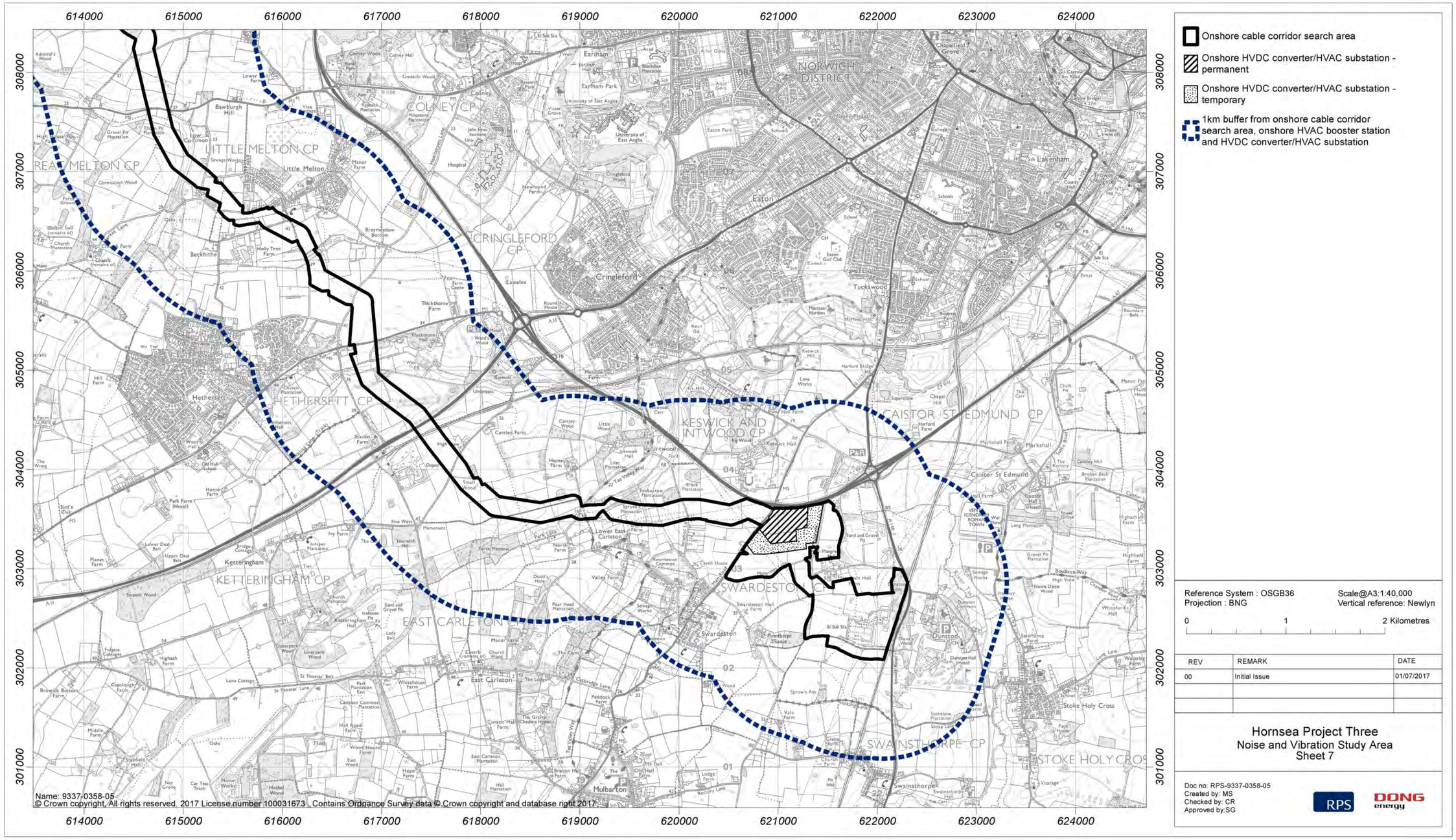

Figure 8.1: Hornsea Three noise and vibration study area.

8.5 Consultation

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

8.5.1.2 Table 8.3 below summarises the issues raised relevant to noise and vibration, which have been identified during consultation activities undertaken to date. Table 8.3 also indicates either how these issues have been addressed within this PEIR or how the Applicant has had regard to them.

Table 8.3 Summary of key consultation issues raised during consultation activities undertaken for Hornsea Three relevant to noise and vibration.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
6 December 2016	PINS – Scoping Opinion	Table 12.12 of the Scoping Report proposes that noise and vibration from the operation and maintenance of the landfall cable, the HVAC/HVDC substation and onshore HVAC booster station be scoped out. The Secretary of State considers that there is potential for these activities to create noise that may disturb birds using the intertidal area and therefore does not agree to this aspect being scoped out.	The potential for noise and vibration impacts associated with the operation and maintenance of Hornsea Three landfall and cable route is limited given that there would be no perceptible noise or vibration above the surface of the cable. Any maintenance requirements for the cable route and landfall would be minimal. Potential noise impacts from the operation of the onshore HVAC booster station and HVDC converter/HVAC substation are included in the assessment (see paragraphs 8.12.2.1 to 8.12.2.25). Effects on birds are assessed in volume 2, chapter 5: Offshore Ornithology and volume 3, chapter 3: Ecology and Nature Conservation. The onshore HVAC booster station and onshore HVDC converter/HVAC substation are located some distance from landfall and therefore, activities at these locations are unlikely to disturb birds in the intertidal area.
		The Environmental Statement should clearly set out the reasoning for the study area, explaining how any boundary is justified. Currently the study area does not include any areas outside of the onshore ECR corridor. In terms of noise and vibration, justification of this approach will be required in the Environmental Statement. The route has the potential to involve works near to settlements and as such impacts on such to those settlements will need to be assessed within the Environmental Statement.	The noise and vibration study area is defined in section 8.3 and follows guidance from DMRB, extending to include the closest NSRs to any permanent or temporary land-take associated with the project. These will include receptors out to a distance such as are demonstrated to have no significant impact.
		The Secretary of State welcomes the intent to identify receptors for which surveys will be undertaken and the level of discussion and agreement reached with the local authorities and environmental health officers in this regard.	Receptors for which surveys have been undertaken are identified in volume 6, annex 8.1: Baseline Noise Information and discussion/agreement reached with the local authorities and environmental health officers.
		The Scoping Report does not provide information on the likely duration of monitoring. This will be an important consideration in the adequacy of the assessment and should be agreed with relevant consultees.	Surveys were scheduled for one week durations, at a time representative of the quieter time of the year. Survey durations and results are provided in volume 6, annex 8.1: Baseline Noise Information.
		The Scoping Report at paragraph 12.5.6 notes that baseline data included within Environmental Statement's for other developments will be reviewed. The Environmental Statement should explain this approach and justify the applicability of this information to the proposed development.	This position has been reconsidered, and the assessment now relies upon survey data undertaken specifically for this project, as documented in volume 6, annex 8.1: Baseline Noise Information
		The assessment should explain the specific impacts of construction on receptors.	The assessment explains the specific impacts of construction on receptors in section 8.12.1
		The Scoping Report sets out that a Code of Construction Practice (CoCP) and decommissioning plan will be developed as part of the DCO application. No mention is made however of a noise mitigation plan. The Applicant is requested to consider the appropriateness of such a plan.	Construction noise mitigation will be included within a CoCP, which will be included in the Environmental Statement. Operational mitigation will be specified in the assessment, if required. Any ongoing operational mitigation requirements will form part of the site operating procedure.
17 January 2017	South Norfolk District Council - meeting	Discussion and agreement of noise assessment methodologies and locations of noise sensitive receptors.	Methodology and results of baseline noise survey is provided in volume 6, annex 8.1 Baseline Noise Information.
7 February 2017	North Norfolk District Council - meeting	Discussion and agreement of noise assessment methodologies and locations of noise sensitive receptors. Also agreed that the proposed noise survey monitoring locations were appropriate and no further monitoring locations were required.	Methodology and results of baseline noise survey is provided in volume 6, annex 8.1 Baseline Noise Information.
14 June 2017	South Norfolk District Council – meeting	Discussion of the presentation of the noise assessment at PEIR, and explanation that the operational noise model for the HVDC converter/HVAC substation has been developed with no assumed mitigation. As a result significant effects are reported, however it is expected that these will be reduced to acceptable levels through ongoing design of attenuation measures, which Hornsea Three will consult with the relevant local planning authorities on shortly, along with the development of an operation phase Noise Management Plan (NMP).	Approach to assessment and forthcoming work on designed in mitigation and noise attenuation plan discussed in the impact assessment section, and outlined as next steps.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
14 June 2017	North Norfolk District Council - meeting	Discussion of the presentation of the noise assessment at PEIR, and explanation that the operational noise model for the HVAC Booster Station has been developed with no assumed mitigation. As a result significant effects are reported, however it is expected that these will be reduced to acceptable levels through ongoing design of attenuation measures, which Hornsea Three will consult with the relevant local planning authorities on shortly, along with the development of an operation phase NMP.	Approach to assessment and forthcoming work on designed in mitigation and noise attenuation plan discussed in the impact assessment section, and outlined as next steps.

8.6 Methodology to inform the baseline

8.6.1 Desktop study and data sources

8.6.1.1 Information on noise and vibration within the noise and vibration study area was collected through a detailed review of datasets. These are summarised at Table 8.4 below.

Table 8.4: Summary of desktop reports.

Title	Source	Year	Author
OS Opendate Terrain 50	Ordnance Survey	2013	Ordnance Survey
OS_MasterMap_375358_492083_OS_ Mastermap.dwg	Ordnance Survey	2016	Ordnance Survey
GoogleEarth Imagery	Google Earth	2016 2017	Google Get mapping plc

8.6.2 Site specific surveys

8.6.2.1 The operation of the onshore HVAC booster station and HVDC converter/HVAC substation and noise assessment methodology requires a comparison to be made between the existing daytime and night-time noise environments (i.e. noise levels) at the NSRs and the future noise levels that would be expected to occur at those locations when the onshore HVAC booster station and HVDC converter/HVAC substation are operational.

8.6.2.2 The existing representative noise levels across the scheme can also be used to determine appropriate construction noise limits. In practice, however, for a quiet area such as this, fixed lower construction noise limits are adopted, independent of existing noise levels.

8.6.2.3 Noise surveys were undertaken in March 2017 to identify baseline noise levels. The survey was undertaken at the locations representative of the NSRs with the greatest potential to be affected by the proposed onshore HVAC booster station and the HVDC converter/HVAC substation (see Table 8.5).

Table 8.5: Survey Locations and Duration.

Location Reference	Address	Start	End	Notes
ONSS 1 (Substation)	House on the Hill, Main Rd, Swardeston, Norwich NR14 8DU, UK	08/03/2017 11:55	17/03/2017 10:57	N/A
BS1 (Booster Station)	Fuel Farm, Barningham Road, Edgefield, Melton Constable NR24 2AW, UK	08/03/2017 13:45	17/03/2017 12:23	N/A
BS2 (Booster Station)	Unnamed Road, Melton Constable NR24 2AT, UK	17/03/2017 12:07	22/03/2017 13:12	Equipment failure found on 17/03. Meter replaced and run until 22/03

8.6.2.4 Three noise survey locations were selected (two at the proposed onshore HVAC booster station and one at the HVDC converter/HVAC substation). Details of the survey scope and methodology was discussed and agreed with North Norfolk District Council and South Norfolk District Council. The scope of the surveys is set out in volume 6, annex 8.1: Baseline Noise Information.

8.6.3 Equipment Issues

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

8.6.4 Access Issues

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

8.6.5 Instrumentation

8.6.5.1 Sound level measurements were made using a ‘Class 1’ Rion NL-52 sound level meter (SLM) over a period of approximately seven days. The calibration of the instrumentation was checked both prior to and immediately following the surveys, to ensure that no significant drift had occurred over the survey period. All instrumentation was within the manufacturers' periods of calibration, as specified in BS 7445 Part 1: Guide to environmental quantities and procedures (BSI, 2003).

8.6.5.2 Baseline measurements in accordance with BS 7445-2:1991. The monitors were taken following the guidance set out in BS 4142:2014 (BSI, 2014a). BS 4142:2014 requires a "*representative background sound level*" to be adopted for the assessment of noise effects at residential receptors during the operation of the facility. The standard notes *"In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods"*.

8.6.5.3 The background sound levels were determined on the basis of professional judgement (as opposed to a prescriptive numerical method) based on surveyed 1-hour L_{A90} values obtained over a week.

8.6.5.4 Weather data were obtained from temporary meteorological stations established near two of the noise surveys. These data were used to ensure that wind speeds and rainfall were broadly within the limits specified in BS 4142:2014. Where exceedances occurred, noise data was considered for its appropriateness. This document suggests that measurement data can be used for wind speeds up to 5 m/s, (i.e. it states that "*For the purposes of this standard, windshields are generally effective up to wind speeds of 5 m/s*"). BS 4142 also implies that measurements should not be taken during heavy rainfall. It suggests that "*heavy rain, falling on the microphone windshield or nearby surfaces can cause noise interference*".

8.6.5.5 No significant sources of vibration within the noise and vibration study area have been identified. Consequently, no vibration baseline surveys were undertaken.

8.6.5.6 Traffic surveys are proposed to be undertaken in July 2017 to predict changes in traffic levels during construction (see chapter 7: Traffic and Transport). The traffic data will be used to assess the noise impacts from construction traffic and will be presented in the Environmental Statement.

Table 8.6: Summary of site-specific surveys.

Title	Extent of survey	Overview of survey	Survey contractor	Year	Reference to further information
Hornsea Three onshore baseline noise surveys	Representative locations at the proposed onshore HVAC booster station and HVDC converter/HVAC substation sites	An unattended noise survey at three locations using a sound level meter collecting sound level measurements over period of up to 7 days.	RPS	2017	Volume 6, annex 8.1: Baseline Noise Information

8.7 Baseline environment

8.7.1 Measured baseline sound levels

8.7.1.1 The measured baseline sound levels at the survey locations and the representative sound levels are presented in volume 6, annex 8.1: Baseline Noise Information. Daytime and night-time measured sound levels are summarised in Table 8.7 and Table 8.8 below.

8.7.1.2 The noise assessment carried out at PEIR stage has not considered potential impacts arising from the construction of the onshore cable route. When the onshore cable route has been refined, and the 80 m wide construction area confirmed, Hornsea Three will identify potential receptor locations for further assessment, which will be carried out as part of the noise assessment that will be reported in the Environmental Statement. Hornsea Three will have regard to the potential for noise impacts when refining the onshore cable route and, where feasible, consider siting noisier activities like HDD compounds, away from sensitive receptors. Where that cannot be achieved, Hornsea Three will develop appropriate mitigation measures in consultation with the relevant local planning authorities.

Table 8.7: Measured baseline sound levels, daytime 07:00 – 23:00 hrs.

Site	Location	Measured Sound Levels, dB				
		$L_{Aeq, 15min}$	L_{AFmax}	$L_{A10, 15min}$	$L_{A50, 15min}$	$L_{A90, 15min}$
Onshore HVDC converter/HVAC substation	ONSS 1	55	94	55	50	44
Onshore HVAC booster station	BS 1	52	89	49	39	28
	BS 2	54	91	55	45	33

Table 8.8: Measured baseline sound levels, night-time 23:00 – 07:00 hrs.

Site	Location	Measured Sound Levels, dB				
		$L_{Aeq, 15min}$	L_{AFmax}	$L_{A10, 15min}$	$L_{A50, 15min}$	$L_{A90, 15min}$
Onshore HVDC converter/HVAC substation	ONSS 1	49	87	50	37	29
Onshore HVAC booster station	C1	48	88	42	22	18
	C2	43	83	45	40	33

8.7.2 Seasonal temporal change

8.7.2.1 Ambient and background sound levels are subject to seasonal variations due to a number of factors (e.g. wind and rain). Baseline sound monitoring was undertaken during spring (in March 2017). As detailed in section 8.6 a 'representative' background sound level has been adopted, which is considered to be representative of the background sound level during calm weather conditions (e.g., with little or no wind or precipitation, when background sound levels are likely to be lower). The background sound level could potentially occur at any time throughout the year, although this would be considered to be the worst case, as opposed to turbulent weather conditions (e.g. high, strong and/or gusty winds, with heavy rain, where background sound levels are likely to be higher), which can also potentially occur at any time throughout the year. No significant seasonal variation in noise attenuation occurs.

8.7.2.2 It has been assumed that noise emissions from the transformers, filters and reactors associated with the onshore HVDC converter/HVAC substation are likely to be constant throughout the year and not significantly affected by seasonal variation, regardless of load. A similar assumption is made for the onshore HVAC booster station.

8.7.2.3 It is assumed that noise emissions from the cooling plant associated with the onshore HVDC converter/HVAC substation may be temperature dependant (i.e. only cut-in above a certain ambient temperature). The cooling plant may therefore be louder, run for longer and/or run more frequently during the summer months when the ambient temperatures are higher. However, this assessment assumes that all cooling plant is operating continuously throughout the year, regardless of temperature. A similar assumption is made for any onshore HVAC booster station cooling plant.

8.7.2.4 Noise from construction and decommissioning activities will not be affected by seasonal variation, although noise levels will vary as activity varies.

8.7.3 Medium and Long Term Temporal Change

8.7.3.1 For the purposes of this assessment, medium term temporal change is defined as from one month to up to two years and long term temporal change is defined as two years or more.

8.7.3.2 Regular routine maintenance will ensure that the plant will not get any nosier in the medium or long term.

8.7.3.3 For the decommissioning phase, it is possible that technological advances will result in quieter equipment being available for this phase.

8.7.4 Designated sites

8.7.4.1 There are no international, national or local designations specifically related to noise and vibration, or how it should be controlled.

8.7.5 Future baseline scenario

8.7.5.1 No significant change to the future baseline scenario, in the absence of the development, is anticipated.

8.7.6 Data limitations

8.7.6.1 The following data limitations and uncertainty have been identified:

Baseline sound survey data

8.7.6.2 If the baseline sound surveys were repeated, it is possible that the measured sound levels would be slightly different; this would be due to seasonal variations and variations in repeatability/reproducibility. However, this limitation has been managed by adopting a 'representative' background sound level, using professional judgement. This is a standard approach and is considered to be an acceptable and robust method in accordance with BS 7445-2:1991 and BS 7445:2003.B36.

Construction methodology

8.7.6.3 The number and type of plant and working methods cannot be specified at this stage of the project. However, this limitation has been managed by undertaking an assessment based on typical construction activities for this type of infrastructure, using sound source terms from BS 5228-1 (BSI, 2014b) and professional judgement. This is a standard approach and is considered to be an acceptable and robust method.

Construction traffic

8.7.6.4 The noise impacts from construction traffic have not been assessed in this PEIR chapter as the traffic surveys will not be undertaken until July 2017. The results of the assessment will be reported in the Environment Statement.

Sound source data

8.7.6.5 An initial kit list has been provided for operation plant. Within the proposed locations of the HVAC booster station and HVDC converter/HVAC substation the specific acoustic design of the operational plant cannot be fixed at this stage of the project. However, this limitation has been managed by selecting sound source terms from the RPS source term library, using professional judgement of similar plant. This is a standard approach and is considered to be an acceptable and robust method. In the absence of any building information, all plant are assumed to be outside and unscreened.

Prediction methods

8.7.6.6 There are uncertainties in any prediction methodology. International Organisation for Standardization 9613 (ISO 9613) Part 2 (ISO, 1996) provides a method for predicting acoustic propagation outdoors. The method is applicable in practice to a great variety of sound sources and environments. It is applicable (directly or indirectly) to most situations including industrial sound sources, construction activities and many other ground-based sound sources. The estimated accuracy for values of the average downwind sound pressure level, L_{AT} (DW) is stated as +/-3 dB for a mean source/receptor height of up to five metres and source/propagation separation distance of up to 1 km. This is a standard approach and is considered to be an acceptable prediction methodology.

8.8 Key programmed to measure various parameters for assessment

8.8.1 Maximum design scenario

8.8.1.1 The maximum design scenarios identified in Table 8.9 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the details provided in the project description (volume 1, chapter 3: Project Description). Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope, to that assessed here be taken forward in the final design scheme.

8.8.1.2 The provisional results of the noise and vibration assessment at PEIR will be used to inform the design layout and mitigation strategy of the onshore HVDC converter/HVAC substation and onshore HVAC booster station. Hornsea Three will engage with the relevant local planning authorities regarding the scope of potential noise mitigation measures, and the development of a NMP. A draft of that plan, which will confirm applicable noise attenuation targets to be achieved through physical external and integrated noise attenuation measures, will be developed as part of the final DCO application.

8.8.2 Impacts scoped out of the assessment

8.8.2.1 On the basis of the baseline environment and the project description outlined in volume 1, chapter 3: Project Description, a number of impacts are proposed to be scoped out of the assessment for noise and vibration. These impacts are outlined, together with a justification for scoping them out, in Table 8.10.

Table 8.9: Maximum design scenario considered for the assessment of potential impacts with regards to noise and vibration.

Potential impact	Maximum design scenario	Justification
Construction phase		
The temporary impact of cable installation during construction may affect receptors sensitive to noise or vibration.	<u>Onshore export cable corridor</u> Temporary onshore cable corridor 80 m wide and 55 km long (including 60 m wide permanent onshore cable corridor (wider where obstacles occur)). Up to six cable trenches (each containing one circuit) each trench is 5 m wide and 2 m deep. Depth of stabilised backfill up to 1.5 m. Up to 330 junction bays and link boxes. Closest separation distance between junction bay and link box: - 750 m. Up to two temporary haul roads 5 m wide (7 m wide at passing places) constructed using soil stabilisation. The majority of the onshore cable route would be installed using open cut techniques.	The maximum design scenario for noise and vibration for the installation of the onshore export cable would result from the use of open cut techniques as this represents the nosiest construction method. The HVAC transmission presents the maximum design scenario at the onshore export cable corridor due to the greater number of cables (and junction bays and link boxes). These works would typically be undertaken by a tracked continuous bucket type trenching machine supported by a 360° tracked excavator. Source terms for typical plant have been taken from BS 5228-1 (BSI, 2014b).
The temporary impact of cable installation by HDD (including duct installation at the Hornsea Three landfall may affect receptors sensitive to noise or vibration.	Up to 50 HDD crossings across surface watercourses and key infrastructure. A HDD compound would be located at both ends of the HDD crossing each with a footprint of up to 4,900 m^2 (70 m x 70 m) with permeable surfacing.	The maximum design scenario for noise and vibration would result from the use of HDD as this represents the noisiest potential method for the crossing of surface watercourses and key infrastructure. A large HDD rig would include a large diesel power-pack for the drill rig; pumps and auxiliary plant for the processing of bentonite, slurry and cuttings with associated power generation plant; and generators for site lighting and welfare facilities. Source terms for typical plant have been based on available sources of information including BS 5228-1 (BSI 2014b).
The temporary impact of constructing the construction accesses on the onshore export cable route may affect receptors sensitive to noise or vibration.	Construction accesses would be required from the onshore export cable route to the existing road network.	The maximum design scenario for noise and vibration would assume a 360° tracked excavator and a dump truck.
The temporary impacts of onshore HVAC booster station and HVDC converter/HVAC substation construction including the temporary impacts of tubular steel piling (percussive piling) may affect receptors sensitive to vibration.	<u>Onshore HVDC converter/HVAC substation</u> Permanent area of site is 128,000 m^2 (including an area which may be used for landscaping) plus a temporary works area of 100,000 m^2. The transmission option with the greatest number of buildings and largest footprint is the HVDC converter station – up to five buildings. The main building (single building scenario) for the HVDC converter station will have a footprint of 11,250 m^2 (75 m x 150 m). Dimensions for the multiple building scenario would be reduced proportionately but the overall footprint would be the same. <u>Onshore HVAC booster station</u> Permanent area of site is 25,000 m^2 plus a temporary works area up to 25,000 m^2. Building scenario with the largest footprint - single building with area of 4,500 m^2 (150 m length and 30 m width) and height up to 12.5 m.	The HVAC transmission presents the maximum design scenario in terms of noise and vibration as it requires an additional building (i.e. the HVAC booster station) to be constructed. The HVAC booster station is not required for the HVDC transmission. At this stage of the project, precise quanta and type of plant and working methods cannot be specified but an assessment can be undertaken based on typical construction activities for this type of infrastructure. The maximum design scenario for noise and vibration at the onshore HVDC converter/HVAC substation is the HVDC transmission as it requires the largest footprint for single and multiple building options. The assessment has considered the following six example scenarios to enable a quantitative assessment to be undertaken: Site clearance and ground works using 30° tracked excavators/bulldozers; Piling (4-tonne hydraulic hammer inserting tubular steel piles); Foundation formation using 24-hour concrete pour; and Equipment installation using lorries. Source terms for typical plant have been taken from BS 5228-1 (BSI, 2014b). Piling is likely. Tubular steel piling (percussive piling) is the most unlikely piling method, but is taken here as the maximum design scenario.

Potential impact	Maximum design scenario	Justification
Operation and maintenance phase		
The operational impact of an onshore HVDC converter/HVAC substation may affect receptors sensitive to noise.	Detailed assessment undertaken for the operation of the onshore plant using generic spectral shapes for each noise source to enable a spectral assessment to be undertaken and tonality of noise immissions to be considered. No specific layout is assumed at PEIR assessment and thus a worst case scenario is assumed.	The maximum design scenario for noise and vibration is that no building enclosures will be provided around the onshore HVDC converter/HVAC substation as this represents the noisiest option.
The operational impact of an onshore HVAC booster station may affect receptors sensitive to noise.	Detailed assessment undertaken for the operation of the onshore plant using generic spectral shapes for each noise source to enable a spectral assessment to be undertaken and tonality of noise immissions to be considered. No specific layout is assumed at PEIR assessment and thus a worst case scenario of the nosiest components located closest to the most sensitive receptors is assumed.	The maximum design scenario for noise and vibration is that no building enclosures will be provided around the onshore HVAC booster station as this represents the noisiest option.
Decommissioning phase		
The temporary impacts of cable decommissioning may affect receptors sensitive to noise or vibration.	Cables will be left in place in the ground. The ends would be cut, sealed and securely buried.	This represents the most likely maximum design scenario.
The temporary impact of onshore substation site decommissioning may affect receptors sensitive to noise or vibration.	If complete decommissioning is required, the onshore facilities will be removed and the site re-instated to a comparable condition. Decommissioning has been assessed on the basis that the concrete foundations would be broken up using hydraulic peckers. Source terms for typical plant have been taken from BS 5228-1 (BSI, 2014b).	This is the maximum design scenario for noise and vibration as it represents the noisiest of the potential methods.

Table 8.10: Impacts scoped out of the assessment for noise and vibration.

Potential impact	Justification
Construction phase	
Construction vibration associated with cable route	No significant vibration-generation plant will be used during the trenched cable construction process. All trenchless crossings and piling will be undertaken by non-impact methods. As such construction vibration would be unlikely to be significant beyond the immediate site.
Operation and maintenance phase	
Operational noise and vibration from buried cable	The buried cable will generate no perceptible noise or vibration above the surface.
Vehicle movements associated with operation of the onshore infrastructure	Operation of the onshore infrastructure will generate negligible additional vehicle movements on the surrounding road network.
Maintenance associated with onshore HVDC converter/HVAC substation or onshore HVAC booster station may affect receptors sensitive to noise or vibration.	Regular maintenance will generate no significant noise or vibration.
Decommissioning phase	
Decommissioning vibration associated with cable route	Cable will remain in situ, therefore no significant vibration-generation plant will be required.

8.9 Impact assessment criteria

8.9.1 Noise and Vibration Assessment Criteria

8.9.1.1 This section describes how the magnitude of impacts relating to noise and vibration, have been identified for the construction, operation and maintenance, and decommissioning phases.

Construction Noise

8.9.1.2 The magnitude of construction noise impacts has been determined in accordance with Annex E of BS 5228-1:2009+A1:2014. The significance criteria for assessing noise impact from construction works have been based on Example Method 2 contained within Annex E.3.3 of BS 5228-1:2009+A1:2014, as referred to above; this indicates that:

"*Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB LAeq, Period, from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect.*"

8.9.1.3 Table 8.11 summarises the criteria that have been used for the assessment of construction noise effects for residential dwellings and other NSRs of Medium and High sensitivity. The guidance in BS 5228-1:2009+A1:2014 applies to residential dwellings only; therefore, for NSRs that have Low sensitivity, professional judgement has been applied to determine the overall level of effect.

Table 8.11: Construction Noise Levels Lower Cut-off Values which Might Result in Various Probabilities of Adverse Impact at Residential Building Facades.

Assessment category and threshold value period (L_{Aeq})	Threshold value[1], in decibels (dB)			
	No/Negligible	**Minor**	Moderate	Major
Night-time (23.00 to 07.00 hours)	<40	40 - 45	45 – 55	>55
Evenings (19.00 to 23.00 hours weekdays). Weekends (13.00 to 23.00 hours Saturdays and 07.00 to 23.00 hours Sundays)	<50	50 - 55	55 – 65	>65
Daytime (07.00 to 19.00 hours) weekdays and Saturdays (07.00 to 13.00 hours)	<60	60 - 65	65 - 75	>75

Subject to duration criteria and where ambient noise levels are low.

8.9.1.4 The calculation method of BS 5228-1:2009+A1:2014 takes account of the duration of an activity per hour, the 'on-time'; and the attenuation of sound due to the effects of distance, ground attenuation and barrier effects. The assessment will be based on reasonably expected construction phases, plant items and on-times based on the information provided within BS 5228-1:2009+A1:2014.

8.9.1.5 Where predicted construction noise levels are up to 5 dB below the level criteria given in paragraph 8.9.1.2 above or of short duration (less than 1 month), this is considered to be a 'no change' or negligible adverse magnitude of impact. Works of significant duration (of one month or more) would be considered to have a minor adverse impact (where levels are from -5 dB below to being equal to the criteria above). Where the criteria are exceeded by up to 10 dB, this is considered to be a moderate adverse impact. Noise levels greater than 10 dB above the criteria are considered a major adverse impact depending on the context and duration of the works.

8.9.1.6 For the majority of NSRs, noise levels are likely to result in the criteria set within the lower cut-off levels given in Table 8.11 above, the most stringent limits. As such, the lower cut-off levels are used throughout the construction assessment.

8.9.1.7 The noise changes identified in Table 8.12 below have been used in the assessment of noise impacts associated with construction traffic on the local road network and from temporary diversion routes resulting from construction of the Scheme. These are based on the guidance in DMRB, Volume 11, Section 3, Part 7 'Noise and Vibration' for the classification of magnitude of noise impacts in the long term. Although construction works have their effects in the short-term, the temporary nature of the works decreases the rating of impacts.

Table 8.12: Classification of Magnitude of Temporary Noise Impacts.

Noise Change, $L_{Aeq,T}/L_{A10,18h}$	Magnitude of Impact
0	No change
0 1– 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

Construction Vibration

8.9.1.8 Criteria for assessing the significance of construction vibration are provided in BS 5228-2:2009+A1:2014. Table 8.13 below details potential vibration levels measured in terms of Peak Particle Velocity (PPV) based on the guidance in BS 5228-2:2009+A1:2014 and provides a semantic scale for construction vibration effects on human receptors.

Table 8.13: Guidance on Effects of Vibration Levels.

Peak Particle Velocity	Description	Magnitude of Impact
0.14 mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Negligible
0.3 mm/s	Vibration might just be perceptible in residential environments.	Minor
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	Moderate
10 mm/s	Vibration is likely to be intolerable for any more than a brief exposure to this level.	Major

8.9.1.9 Vibration from construction activities may impact on adjacent buildings. The criteria used in this assessment relate to the potential for cosmetic damage, not structural damage. Table 8.14 below provides the vibration limits contained within BS 5228-2:2009+A1:2014 above which cosmetic damage could occur. Minor damage is possible at vibration magnitudes that are greater than twice those given in Table 8.14 and major damage to a structure may occur at values greater than four times the tabulated values. The limits are the same as are found in BS 7385-2:1993 'Evaluation and measurement of vibration in buildings - Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings' which would be applicable for effects beyond the construction phase.

Table 8.14: Threshold Vibration Values for the Evaluation of Cosmetic Building Damage.

Building Classification	Frequency of Range of Vibration (Hz)	PPV mm/s [1]	
		Transient Vibration	Continuous Vibration
Unreinforced or light framed structures[2]	4 Hz to 15 Hz	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz
Residential or light commercial type buildings[2]	15 Hz and above	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	4 Hz and above	50	25

[1] Values relate to the base of the building.

[2] For lightweight structures, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

Operational Noise

8.9.1.10 The significance of the noise effects associated with the operation of the onshore HVAC booster station and HVDC converter/HVAC substation has been determined based upon the methodology contained within BS 4142:2014 as described above; this requires the following:

- Determination and characterisation of the baseline sound environment to derive a representative background noise level for the periods of interest;
- Development of a noise model that includes the significant sound generating items of plant and activities; this model predicts noise levels at the NSRs included within the model – this provides the specific noise level at each NSR (a SoundPLAN noise model will be developed which utilises prediction methodology contained within International Standard (ISO) 9613-2:1996 'Acoustics: Attenuation of sound during propagation outdoors. Part 2: General method of calculation');

- Specification of any character corrections as required and described in Section 9 of BS 4142:2014 including those for tonality, impulsivity, other sound characteristics and intermittency – when any corrections are made to the Specific Noise Level, this then becomes the Rating Level, $L_{Ar,Tr}$ (if no corrections are made, the level is still termed the Rating Level); and then
- Determination of the difference at each NSR between the $L_{Ar,Tr}$ and the background noise level. The difference determines the impact which can be described in accordance with Section 11 of BS 4142:2014 but this also requires consideration of the context.

8.9.1.11 The location of NSRs may affect where plant can be located on site (i.e. locating sound sources as far away from receptors and/or using the proposed building as a sound attenuation screen).

8.9.1.12 From the above and following the guidance in BS 4142:2014, Table 8.15 can be used to define the magnitude of effects.

Table 8.15: Operational Noise - Determination of Magnitude of Effect.

Difference between Rating Level and Background Noise Level	BS 4142 Semantic Description	Magnitude of Effect
> 10 dB	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.	Major
5 to 10 dB	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.	Moderate
0 to 5 dB	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.	Minor
-10 to 0 dB		Negligible
< -10 dB	-	No change

8.9.1.13 The assessment criteria for operational noise above, based on BS 4142:2014, also requires the context and connotation of the specific noise to be considered.

8.9.1.14 The overall change in noise levels can also be considered. Both for the assessment of plant noise and with regards to changes in noise environment from site-generated traffic on the surrounding road infrastructure. The criteria in Table 8.16 can be used in this instance.

Table 8.16: Classification of Magnitude of Permanent Noise Impacts.

Noise Change, $L_{Aeq,T}$	Magnitude of Impact
0	No change
0 1– 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Medium
5 +	Major

Operational Vibration

8.9.1.15 Operational vibration from the onshore HVAC booster station and HVDC converter/HVAC substation will be controlled at source and would be most unlikely to be perceptible beyond the immediate structure of the buildings. Off-site vibration would be a negligible impact at all locations. No vibration would be generated by the operational cable. Consequently, no assessment criteria are provided.

Magnitude of Impacts

8.9.1.16 As a guiding principle, magnitudes of impact have been ranked none, negligible or small for effects within current guidelines; medium for effects marginally exceeding current guidelines; and large for effects significantly exceeding current guidelines (Table 8.17). At this stage specific noise sensitive receptors have not yet been identified and therefore a range of magnitude is shown in the assessment. Specific NSRs will be identified and included within the assessment for the Environmental Statement.

Table 8.17: Magnitude of Impacts (Noise and Vibration).

Magnitude of Impacts	Description	Notes
None	Effects within current guidelines NOEL/LOAEL	N/A
Negligible		N/A
Minor		N/A
Moderate	Effects marginally exceeding current guidelines LOAEL/SOAEL	Threshold between marginal/significant exceedance will be specific to the aspect being considered
Major	Effects significantly exceeding current guidelines. SOAEL	

8.9.2 Impact Assessment

8.9.2.1 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.

8.9.2.2 The terms used to define sensitivity and magnitude are based on those used in the DMRB methodology, which is described in further detail in volume 1, chapter 5: Environmental Impact Assessment Methodology.

8.9.2.3 The sensitivity of a receptor considers the susceptibility of people or operations to being disturbed or distracted by noise. This is based primarily on the use of the receptor. There is no nationally adopted guidance on how the sensitivity of an NSR should be determined. The semantic scale adopted for this project is provided in Table 8.18.

8.9.2.4 For residential receptors, sensitivity is defined as medium. Specific local circumstances may not always match the system described in the Table 8.18 below and professional judgement must also determine which level of sensitivity is appropriate. The duration of the impact must also be taken into account when determining the sensitivity, especially during the construction phase where NSRs are affected for one month or longer for a significant impact to occur.

8.9.2.5 The criteria for defining sensitivity in this chapter are outlined in Table 8.18 below.

Table 8.18: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	NSRs Identified
Very High	Subject to particular circumstance: Theatres, Auditoria, Studios.
High	Subject to particular circumstance: Theatres, Auditoria, Studios, Schools during the daytime. Hospitals, residential care homes.
Medium	Residential properties
Low	Public Rights of Way (PRoW), Quiet outdoor areas used for transitory recreation. Sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls).
Negligible	Noisy sports grounds

8.9.2.6 There is no nationally adopted guidance to relate the numerical relative impact magnitude of noise from construction or industrial sites to the impact magnitude scale described below. There is evidence (Fritschi *et al.*, 2011) that human response in terms of annoyance and sleep disturbance to noise from transportation sources is not linearly related to noise dose. Notwithstanding this, the noise assessment has adopted 5 dB steps in noise level to correspond to the divisions of the semantic scale based upon the following comment in Guidelines for Community Noise (Berglund et al., 2000): "*The concept of an environmental noise impact analysis is central to the philosophy of managing environmental noise. Such an analysis should be required before implementing any project that would significantly increase the level of environmental noise in a community (typically, greater than a 5 dB increase)*".

8.9.2.7 Based on RPS professional judgement, it is considered that, for the construction phase, operational phase and decommissioning phase, short-term is defined as less than one month, medium term is defined as one month to two years and long term is defined as greater than two years.

8.9.2.8 The criteria for defining magnitude in this chapter are outlined in Table 8.19 below.

Table 8.19: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition used in this chapter
Major	An effect where a limit or standard may be exceeded by a significant margin. Above the SOAEL.
Moderate	An effect around the accepted limits and standards. Moderate impacts may cover a broad range, although the emphasis is on demonstrating that the effect has been reduced to a level that is as low as reasonably practical, such effects should be recognised and addressed in consultation with particular stakeholders. Between the LOAEL and SOAEL
Minor	An effect considered sufficiently small (with or without mitigation) to be well within accepted standards. No action is required if it can be controlled by adopting normal good working practices. Below the LOAEL
Negligible	An effect that is found not to be significant in the context of the stakeholder/regulator objectives or legislative requirements. Below the LOAEL
No change	No discernible effect. Below the NOEL.

8.9.2.9 The significance of the effect with regards to noise and vibration is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The particular method employed for this assessment is presented in Table 8.20. Where a range of significance of effect is presented in Table 8.20, the final assessment for each effect is based upon expert judgement. At this stage, there is a level of uncertainty regarding the significance of effect given in the assessment of this chapter. This is as a result of the potential magnitude of impacts reported resultant of no specific NSRs identified at this stage. Specific NSRs will be identified and included within the assessment for the Environmental Statement which will reduce the level of uncertainty.

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

Table 8.20: Matrix used for the assessment of the significance of the effect.

		Magnitude of impact				
		No change	***Negligible***	***Minor***	***Moderate***	***Major***
Sensitivity of receptor	***Negligible***	Negligible	Negligible	Negligible or minor	Negligible or minor	Minor
	Low	Negligible	Negligible or minor	Negligible or minor	Minor	Minor or moderate
	Medium	Negligible	Negligible or minor	Minor	Moderate	Moderate or major
	High	Negligible	Minor	Minor or moderate	Moderate or major	Major or substantial
	Very high	Negligible	Minor	Moderate or major	Major or substantial	Substantial

8.10 Probability

8.10.1.1 BS 4142 (BSI, 2014a) requires that the determination of specific noise emissions from a development to be the value of the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location, $L_{Aeq,Tr}$. Abnormal operation of the development, commissioning operations and emergency procedures are short term, temporary, atypical and unrepresentative events. Therefore, the noise effects considered in this chapter are representative of the effects that are likely to occur for the majority of the time.

8.11 Measures adopted as part of Hornsea Three

8.11.1.1 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on noise and vibration sensitive receptors (see Table 8.21). This approach has been employed in order to demonstrate commitment to measures by including them in the design of Hornsea Three and have therefore, been considered in the assessment presented in 8.12 below. These measures are considered standard industry practice for this type of development. Assessment of sensitivity, magnitude and therefore, significance includes implementation of these measures.

Table 8.21: Designed-in -measures adopted as part of Hornsea Three.

Measures adopted as part of Hornsea Three	Justification
Best Practicable Means (BPM), for example the use of quieter alternative methods, plant and/or equipment, where reasonably practicable; the use of site hoardings, enclosures, acoustic barriers, portable screens and/or screening nosier items of plant, where reasonably practicable; and maintaining and operating all vehicles, plant and equipment in an appropriate manner, to ensure that extraneous sound from mechanical vibration, creaking and squeaking is kept to a minimum.	To minimise noise and vibration, where reasonably practicable.
A Written Scheme for Construction Noise Management Measures relevant to those works will be agreed with the relevant local authorities prior to the start of construction. Those measures will be set out as part of the CoCP for Hornsea Three.	To ensure compliance with local authority requirements.
Prior to the start of noise generating works a Written Scheme for Operational Noise Management Measures (NMP) will be agreed with the relevant local planning authority.	To ensure compliance with local authority requirements.
At PEIR assessment, with regards to operational noise, no built-in mitigation is assumed	The results of the PEIR will inform the design-mitigation.

8.11.1.2 In some cases there may be additional mitigation measures required that are not "built-in" to the project design ahead of the assessment. These are to be discussed in the sections on Further Mitigation and Future Monitoring sections below.

8.12 Assessment of significance

8.12.1 Construction phase

8.12.1.1 The impacts of the onshore construction of Hornsea Three have been assessed with regards to noise and vibration. The environmental impacts arising from the construction of Hornsea Three are listed in Table 8.9 above along with the maximum design scenario against which each construction phase impact has been assessed.

8.12.1.2 For the purposes of this PEIR, construction effects are typically temporary or short-term. This would include effects resulting from construction of the onshore elements of Hornsea Three such as noise and vibration from construction plant and machinery.

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

The temporary impact of cable installation during construction may affect receptors sensitive to noise or vibration.

8.12.1.4 Construction effects associated with the trenched cable route works would be temporary at any one receptor, occurring for only a fraction of the overall construction period. On similar projects, the onshore cable was installed at an approximate 10 to 20 days per kilometre.

8.12.1.5 Trenching works would be interspersed with jointing bays and trenchless crossings, where these are necessary.

Magnitude of impact

8.12.1.6 The majority of the works would be undertaken during the daytime. In exceptional circumstances, it may be necessary for evening, night or weekend works to occur. The anticipated extent of any impact of such works has been estimated for day, with distances also provided for evening and night; predicting the distances which that within impacts would occur. These distances are summarised in Table 8.22 below and calculations are provided in the volume 6, annex 8.1: Baseline Noise Information.

Table 8.22: Summary of impact distances – trenched cable route works.

Impact Boundary	Distance to Impact Magnitude (NSRs)/m		
	Daytime	Evening	Night
Negligible/Low	65	163	411
Low/Medium	41	103	259
Medium/High	16	41	103

8.12.1.7 From Table 8.22, it can be seen that residential NSRs within approximately 41 m of the cable route would experience a medium (or high within 16 m) impact during daytime works. If evening or night-time works take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.8 A number of PRoWs cross the noise and vibration study area including two National Trails (see chapter 7: Land Use and Recreation). Whilst users might experience elevated noise levels for short periods when using PRoWs in the area, this is likely to be no more than a minor impact with regards to noise.

8.12.1.9 Construction vibration will be minimised as far as is reasonably practicable. No blasting or impact piling is anticipated. All trenchless crossing and piling will be undertaken by non-impact methods. As such, construction vibration would be unlikely to be significant beyond the immediate location of works. Off-site vibration from HGVs etc. on haul roads or the public highway would be negligible impact at all locations assuming the roads are maintained.

8.12.1.10 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude is considered to be **major** for receptors within 16 m; **moderate** for receptors within 41 m; **minor** for receptors within 65 m; and **negligible** beyond. No receptors within 16 m of the cable route Lode have been identified.

Sensitivity of the receptor

8.12.1.1 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the onshore export cable route are considered to be **low** sensitivity. No other NSRs have been identified.

Significance of the effect

8.12.1.2 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **moderate**. The effect will, therefore, be of **negligible** to **moderate adverse** significance, which is significant in EIA terms. Further construction noise mitigation will be applied as is reasonably practicable.

8.12.1.3 Construction vibration would be of **negligible** significance.

8.12.1.4 For the reasons discussed at section 8.9 above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Further mitigation

8.12.1.5 Construction noise mitigation will be applied as is reasonably practicable.

The temporary impact of cable installation by HDD (including duct installation at landfall) may affect receptors sensitive to noise or vibration.

8.12.1.6 Cable installed by HDD will involve potentially more noisy works than for most of the cable laying. At these locations, whilst most works will be limited to the daytime, works may also occur during the evening or night-time periods. The Temporary Construction Areas (TCA) associated with trenchless crossings will often require a wider working corridor than for the proposed onshore export cable, however for the purpose of this PEIR, they would be located within the onshore cable corridor search area. The location of the HDD crossings and the TCAs would be confirmed in the Environmental Statement.

Magnitude of impact

8.12.1.7 The majority of the works would be undertaken during the daytime with some evening, night or weekend works likely to occur. The anticipated extent of any impact of such works has been estimated for day, with distances also provided for evening and night; predicting the distances which that within impacts would occur. Calculations are summarised in Table 8.23 below and calculations are provided in the volume 6, annex 8.1: Baseline Noise Information:

Table 8.23: Summary of impact distances – HDD/Trenchless cable route works.

Impact Boundary	Distance to Impact Magnitude (NSRs)/m		
	Daytime	Evening	Night
Negligible/Low	154	388	975
Low/Medium	97	245	615
Medium/High	39	97	245

8.12.1.8 From Table 8.23, it can be seen that residential NSRs within approximately 97 m of the onshore export cable route would experience a medium (or high within 39 m) impact during daytime works. Where night-time works take place, then any NSRs within a greater distance would potentially be affected, to a distance of approximately 615 m of the cable route for a medium impact (or high within 245 m) impact during night time.

8.12.1.9 A number of PRoWs cross the noise and vibration study area including two National Trails (see chapter 7: Land Use and Recreation). Whilst users might experience elevated noise levels for short periods when using PRoWs in the area, this is likely to be no more than a minor impact with regards to noise.

8.12.1.10 Construction vibration will be minimised as far as is reasonably practicable. No blasting or impact piling is anticipated. All trenchless crossing and piling will be undertaken by non-impact methods. As such, construction vibration would be unlikely to be significant beyond the immediate site. Off-site vibration from HGVs etc. on haul roads or the public highway would be negligible impact at all locations assuming the roads are maintained.

8.12.1.11 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. Given the likelihood of night-time working, the magnitude is considered to be **major** for receptors within 245 m; **moderate** for receptors within 615 m; **minor** for receptors within 975 m; and **negligible** beyond.

Sensitivity of the receptor

8.12.1.12 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the onshore export cable route are considered to be **low** sensitivity.

Significance of the effect

8.12.1.13 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **major**. The effect will, therefore, be of **negligible** to **major adverse** significance, which is significant in EIA terms.

8.12.1.14 Construction vibration would be of negligible significance.

8.12.1.15 For the reasons discussed at section 8.9 above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Further mitigation

8.12.1.16 Construction noise mitigation will be applied as is reasonably practicable.

The temporary impact of constructing the cable route construction accesses may affect receptors sensitive to noise or vibration.

8.12.1.17 Construction effects associated with the onshore export cable route construction access construction at any one receptor, occurring for only a fraction of the overall construction period, and are considered temporary.

Magnitude of impact

8.12.1.18 The majority of the works would be undertaken during the daytime. In exceptional circumstances, it may be necessary for evening, night or weekend works to occur. The anticipated extent of any impact of such works has been estimated for daytime, with distances also provided for evening and night; predicting the distances which that within impacts would occur. Calculations are summarised in Table 8.24 below and calculations are provided in the volume 6, annex 8.1: Baseline Noise Information:

Table 8.24: Summary of impact distances – constructing the cable route construction accesses.

Impact Boundary	Distance to Impact Magnitude (NSRs)/m		
	Daytime	Evening	Night
Negligible/Low	57	144	362
Low/Medium	36	91	228
Medium/High	14	36	91

8.12.1.19 From Table 8.24, it can be seen that residential NSRs within approximately 36 m of the access route works would experience a medium (or high within 14 m) impact during daytime works. If evening or night-time works take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.20 Construction vibration will be minimised as far as is reasonably practicable. No blasting or impact piling is anticipated. As such, construction vibration would be unlikely to be significant beyond the immediate site. Off-site vibration from HGVs etc. on haul roads or the public highway would be negligible impact at all locations assuming the roads are maintained.

8.12.1.21 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude is considered to be **major** for receptors within 14 m; **moderate** for receptors within 36 m; **minor** for receptors within 57 m; and **negligible** beyond. No receptors within 14 m of the cable route accesses have been identified.

Sensitivity of the receptor

8.12.1.22 Residential receptors within the distances above are considered to be **medium** sensitivity.

Significance of the effect

8.12.1.23 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **moderate**. The effect will, therefore, be of **negligible** to **moderate adverse** significance, which is significant in EIA terms.

8.12.1.24 Construction vibration would be of negligible significance.

8.12.1.25 For the reasons discussed at section 8.9 above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Further mitigation

8.12.1.26 Construction noise mitigation will be applied as is reasonably practicable.

The temporary impacts of onshore HVDC converter/HVAC substation and HVAC booster station construction may affect receptors sensitive to noise or vibration.

8.12.1.27 Construction of the onshore HVDC converter/HVAC substation and HVAC booster station will involve potentially more noisy works than for most of the cable laying. At these two locations, whilst most works will be limited to the daytime, works may also occur during the evening or night-time periods. The Temporary Construction Areas (TCA) associated with the onshore HVAC booster station and HVDC converter/HVAC substation and are identified in Figure 8.1.

Magnitude of impact

8.12.1.28 The majority of the works would be undertaken during the daytime with some evening, night or weekend works likely to occur. The anticipated extent of any impact of such works has been estimated for day, with distances also provided for evening and night; predicting the distances which that within impacts would occur. Calculations are summarised in Table 8.25 below and calculations are provided in the volume 6, annex 8.1: Baseline Noise Information:

Table 8.25: Summary of impact distances – HVDC converter/HVAC substation and HVAC booster station.

Impact Boundary	Distance to Impact Magnitude (NSRs)/m		
	Daytime	Evening	Night
Negligible/Low	71	178	447
Low/Medium	45	112	282
Medium/High	18	45	112

8.12.1.29 From Table 8.25, it can be seen that residential NSRs within approximately 45 m of the cable route would experience a medium (or high within 18 m) impact during daytime works. Where night-time works take place, then any NSRs within a greater distance would potentially be affected, to a distance of approximately 282 m of the cable route for a medium impact (or high within 112 m) impact during night time.

8.12.1.30 Construction vibration will be minimised as far as is reasonably practicable. Other than tubular steel piling, identified below, no impact piling, or other significantly vibratous activity such as blasting would be required. As such, construction vibration would be unlikely to be significant beyond the immediate site. Off-site vibration from HGVs etc. on haul roads or the public highway would be negligible impact at all locations assuming the roads are maintained.

8.12.1.31 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. Given the likelihood of night-time working, the magnitude is considered to be **major** for receptors within 112 m; **moderate** for receptors within 282 m; **minor** for receptors within 447 m; and **negligible** beyond.

Sensitivity of the receptor

8.12.1.32 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the cable route are considered to be **low** sensitivity.

Significance of the effect

8.12.1.33 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **major**. The effect will, therefore, be of **negligible** to **major adverse** significance, which is significant in EIA terms.

8.12.1.34 Construction vibration would be of negligible significance.

8.12.1.35 For the reasons discussed at section 8.9 above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the unknown specific NSRs at this stage.

Further mitigation

8.12.1.36 Construction noise mitigation will be applied as is reasonably practicable.

Future monitoring

8.12.1.37 No future monitoring is proposed.

8.12.2 Operational and maintenance phase

8.12.2.1 The impacts of the onshore operation and maintenance of Hornsea Three have been assessed with regards to noise and vibration. The environmental impacts arising from the operation and maintenance of Hornsea Three are listed in Table 8.9 along with the maximum design scenario against which each operation and maintenance phase impact has been assessed.

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

The operational impact of an onshore HVDC converter/HVAC substation may affect receptors sensitive to noise.

Magnitude of impact

8.12.2.3 This section contains detail on the magnitude of the impact of the above the onshore operation and maintenance of Hornsea Three.

8.12.2.4 Predictions have been made to three residential NSRs within around 1 km of the proposed onshore HVDC converter/HVAC substation, considered representative of the wider area. Noise from the site is assumed to be neither tonal nor impulsive when considered from the surrounding NSRs. Any plant noise specification will either require this, or require that a more stringent overall noise level is achieved. Details of the predicted noise levels, and the assessment against representative background noise levels and anticipated noise change is summarised in Table 8.26 and Table 8.27 below and calculations are provided in the volume 6, annex 8.1: Baseline Noise Information.

Table 8.26: Onshore HVDC converter/HVAC substation BS4142 Rating Level assessment.

Location	Background Sound Level, dB L_{A90}	Specific Sound Level, dB L_{Aeq}	Rating Level, dB $L_{Ar,Tr}$	Rating Level - Background	Impact magnitude
Day					
2 Bridle Lane	45	44	44	-1	Minor
House on the Hill	45	44	44	-1	Minor
Pond Cottage	45	47	47	+2	Minor
Night					
2 Bridle Lane	30	44	44	+14	Major
House on the Hill	30	44	44	+14	Major
Pond Cottage	30	47	47	+17	Major

Table 8.27: Onshore HVDC converter/HVAC substation noise change assessment.

Location	Baseline Ambient Sound Level, dB $L_{Aeq,T}$	Specific Sound Level, dB $L_{Aeq,T}$	Combined Sound Level dB $L_{Aeq,T}$	Change in Sound Level dB	Impact magnitude
Day					
2 Bridle Lane	52	44	53	+1	Minor
House on the Hill	52	44	53	+1	Minor
Pond Cottage	52	47	53	+1	Minor
Night					
2 Bridle Lane	40	44	46	+6	Major
House on the Hill	40	44	46	+6	Major
Pond Cottage	40	47	48	+8	Major

Note calculations are made on unrounded numbers, resulting in the above numbers not matching numerically.

8.12.2.5 NSR locations detailed in Table 8.26 and Table 8.27 are shown on Figure 8.2.

8.12.2.6 With regards to context, the impact is predicted to be of local spatial extent, long term duration, continuous and of full reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is considered to be **minor** to **major**.

8.12.2.7 From a qualitative assessment, operation of the substation would generate no significant vibration beyond the site boundary. At the nearest NSR, approximately 300 m from the site boundary, there would be no significant vibration impact.

Sensitivity of the receptor

8.12.2.8 The receptors identified above are identified as residential. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of the effect

8.12.2.9 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **major**. The effect will, therefore, be of **moderate or major adverse** significance, which is significant in EIA terms.

8.12.2.10 Note that at PEIR assessment, no by-design or built-in mitigation is assumed. The significance of effect identified above is therefore worst-case and likely to reduce once designed in mitigation has been identified. Design work for the onshore HVDC converter/HVAC substation is ongoing and the development of a noise mitigation strategy, in consultation with the local planning authority, will be completed prior to the final assessment being presented within the Environmental Statement.

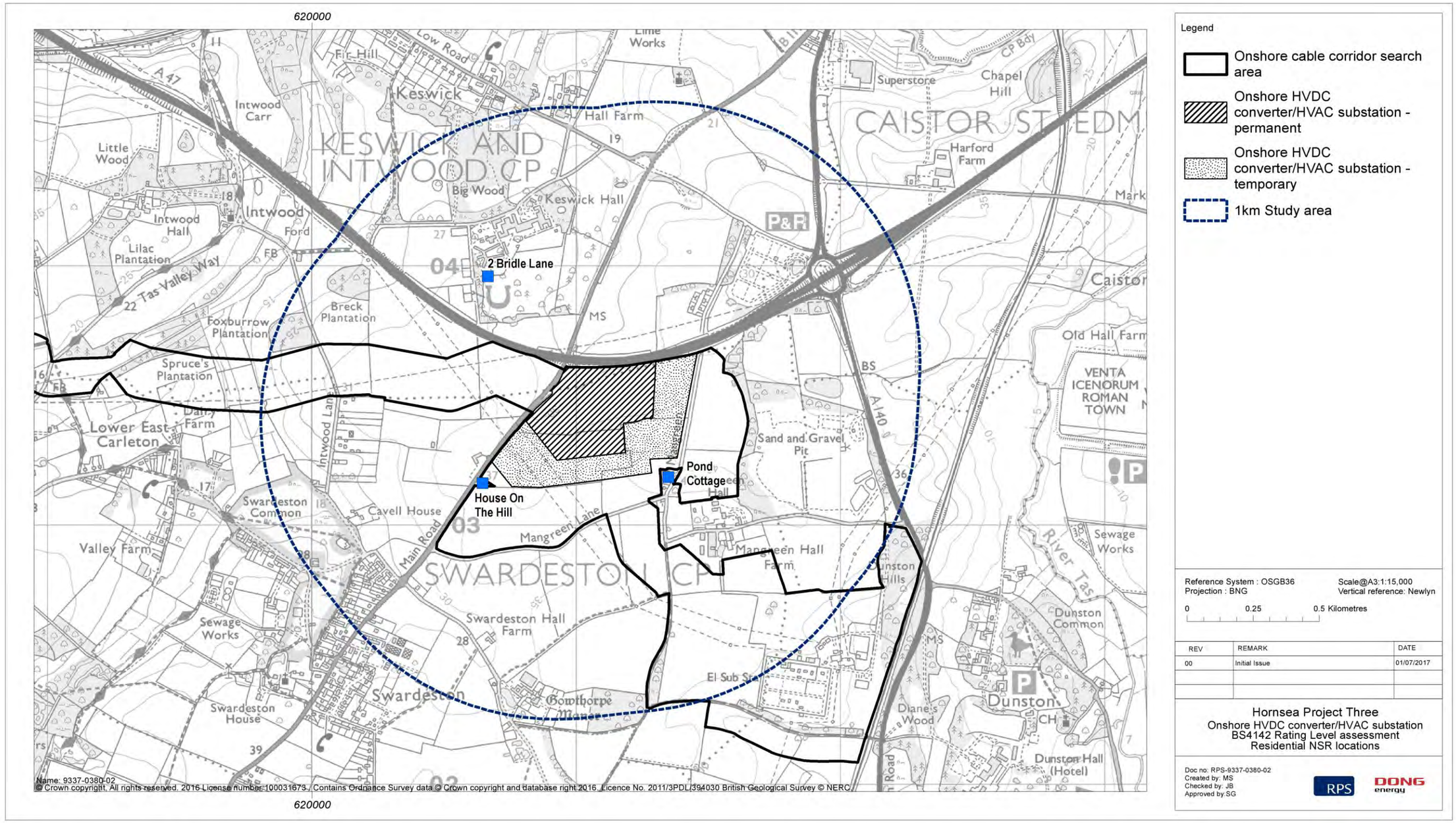

Figure 8.2: Onshore HVDC converter/HVAC substation BS4142 Rating Level assessment Residential NSR locations.

8.12.2.11 For the reasons discussed above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Further mitigation

8.12.2.12 Built-in mitigation will be required if noise from the onshore HVDC converter/HVAC substation is to be reduced to an acceptable level. Mitigation measures could include partial or full enclosure of some or all plant; selection/specification of quieter plant.

8.12.2.13 A noise level reduction of at least 12 dB in the resulting noise levels is required at one or more residential receptor. If noise from the site is tonal or impulsive then a further reduction will be required. To achieve a rating difference of 0 dB, a noise level reduction of at least 17 dB will be required. Additional reduction will be required if the noise, as perceived at NSRs is tonal or impulsive.

8.12.2.14 All noise emissions will be reduced as far as is reasonably practicable.

The operational impact of an onshore HVAC booster station may affect receptors sensitive to noise or vibration.

Magnitude of impact

8.12.2.15 This section contains detail on the magnitude of the impact of the above named issue only.

8.12.2.16 Predictions have been made to six residential NSRs within around 1 km of the proposed onshore HVDC converter/HVAC substation. Noise from the site is assumed to be neither tonal nor impulsive.

8.12.2.17 Details of the predicted noise levels, the assessment against representative background noise levels, and anticipated noise change are summarised in Table 8.28 and Table 8.29 below, while the calculations are provided in volume 6, annex 8.1: Baseline Noise Information. The locations are shown on Figure 8.3.

Table 8.28: Onshore HVAC booster station BS4142 Rating Level assessment.

Location	Background Sound Level, dB L_{A90}	Specific Sound Level, dB L_{Aeq}	Rating Level, dB $L_{Ar,Tr}$	Rating Level - Background	Impact magnitude
Day					
55 Sweetbriar Lane	31	23	23	-8	Negligible
Dotsill Cottages	31	26	26	-6	Negligible
Fuel Farm	31	29	29	-2	Minor
Keeper's Cottage	31	31	31	-1	Minor
North of Sweetbriar Lane	31	33	33	+2	Minor
Richmond Cottage	31	23	23	-8	Negligible
Night					
55 Sweetbriar Lane	26	23	23	-3	Minor
Dotsill Cottages	26	26	26	0	Minor
Fuel Farm	26	29	29	+4	Minor
Keeper's Cottage	26	31	31	+5	Moderate
North of Sweetbriar Lane	26	33	33	+7	Moderate
Richmond Cottage	26	23	23	-3	Minor

Table 8.29: Onshore HVAC booster station Noise Change assessment.

Location	Baseline Ambient Sound Level, dB $L_{Aeq,T}$	Specific Sound Level, dB $L_{Aeq,T}$	Combined Sound Level $L_{Aeq,T}$ dB	Change in Sound Level dB	Impact magnitude
Day					
55 Sweetbriar Lane	41	23	41	+0.1	No change
Dotsill Cottages	41	26	41	+0.1	Negligible
Fuel Farm	41	29	42	+0.3	Negligible
Keeper's Cottage	41	31	42	+0.4	Negligible
North of Sweetbriar Lane	41	33	42	+0.6	Negligible
Richmond Cottage	41	23	41	+0.1	No change
Night					
55 Sweetbriar Lane	32	23	32	+0.5	Negligible
Dotsill Cottages	32	26	33	+0.9	Negligible
Fuel Farm	32	29	34	+1.9	Minor
Keeper's Cottage	32	31	34	+2.5	Minor
North of Sweetbriar Lane	32	33	35	+3.5	Moderate

Location	Baseline Ambient Sound Level, dB $L_{Aeq,T}$	Specific Sound Level, dB $L_{Aeq,T}$	Combined Sound Level $L_{Aeq,T}$ dB	Change in Sound Level dB	Impact magnitude
Richmond Cottage	32	23	32	+0.5	Negligible

8.12.2.18 With regards to context, the impact is predicted to be of local spatial extent, long term duration, continuous and of full reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is considered to be **no change to moderate**.

8.12.2.19 Operation of the HVAC booster station would generate no significant vibration beyond the site boundary. At the nearest NSR, approximately 400 m from the site boundary, there would be no significant vibration impact.

Sensitivity of the receptor

8.12.2.20 The receptors identified above are identified as residential. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of the effect

8.12.2.21 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **moderate**. The effect will, therefore, be of **moderate adverse** significance, which is significant in EIA terms.

8.12.2.22 Note that at PEIR assessment, no by-design or built-in mitigation is assumed. The significance of effect identified above is therefore worst-case and likely to reduce once by-design/built-in mitigation has been identified. Design work for the onshore HVDC converter/HVAC substation is ongoing and the development of a noise mitigation strategy, in consultation with the local planning authority, will be completed prior to the final assessment being presented with the DCO application

8.12.2.23 For the reasons discussed at above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Further mitigation

8.12.2.24 By-design and/or built-in mitigation will be required if noise from the onshore HVAC booster station is to be reduced to an acceptable level. Mitigation measures could include partial or full enclosure of some or all plant; selection/specification of quieter plant.

8.12.2.25 A noise level reduction of at least 3 dB in the resulting noise levels is required at one or more residential receptor. To achieve a rating difference of 0 dB, a noise level reduction of at least 8 dB will be required. Additional reduction will be required if the noise, as perceived at NSRs is tonal or impulsive.

Future monitoring

8.12.2.26 No future monitoring is proposed.

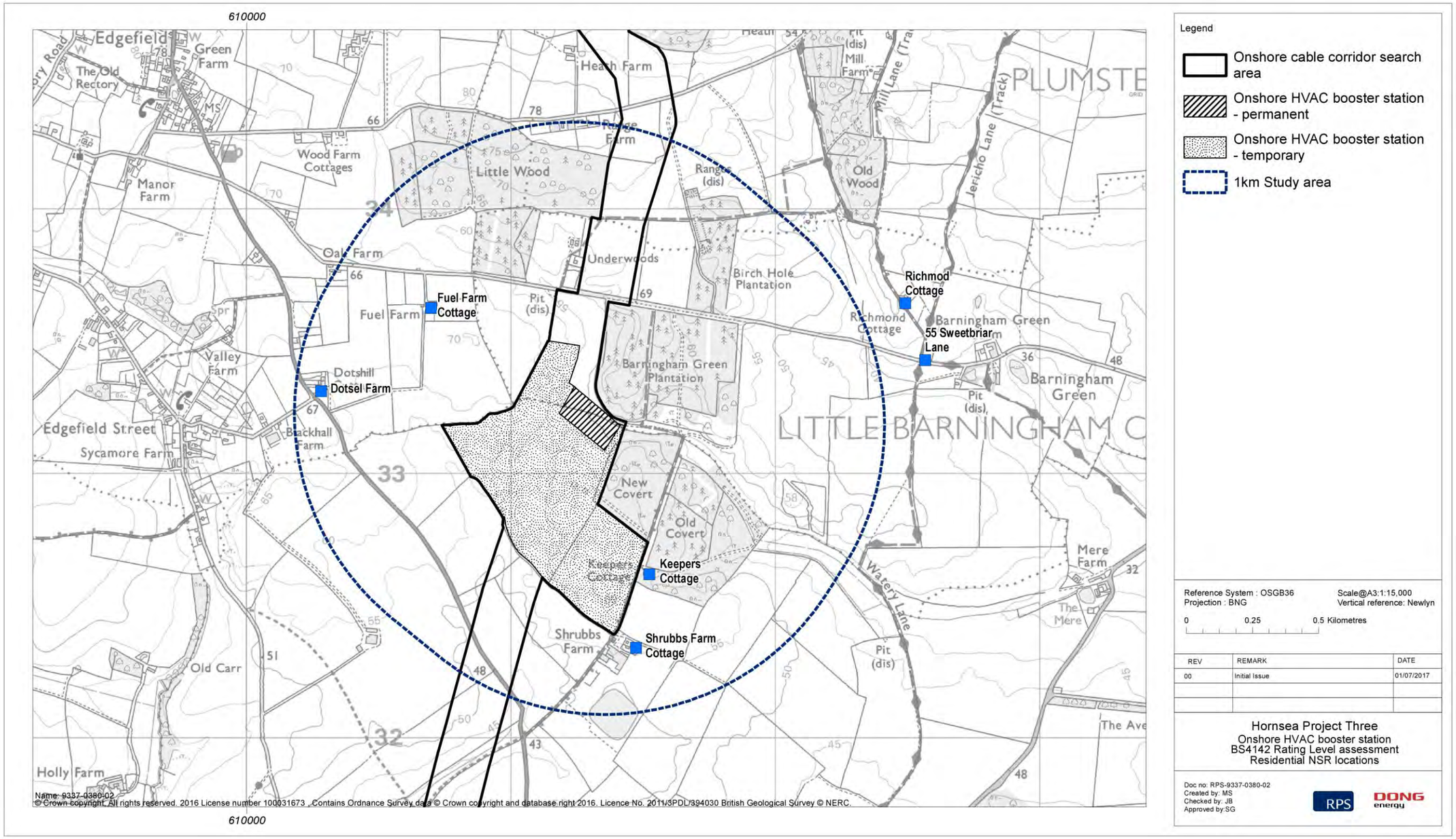

Figure 8.3: Onshore HVAC booster station BS4142 Rating Level assessment Residential NSR locations.

8.12.3 Decommissioning phase

8.12.3.1 The impacts of the onshore decommissioning of Hornsea Three have been assessed with regards to noise and vibration. The environmental effects arising from the decommissioning of Hornsea Three are listed in Table 8.9 along with the maximum design scenario against which each decommissioning phase impact has been assessed.

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

The temporary impacts of cable decommissioning may affect receptors sensitive to noise or vibration.

8.12.3.3 During decommissioning, it is anticipated that the cable ends would be cut and sealed. It is possible that technological advances will result in quieter equipment being available for these tasks.

Magnitude of impact

8.12.3.4 It is anticipated that noise impacts would be no greater than those predicted for the installation (in reality, impacts should be less as cables may be left in situ).

8.12.3.5 The impact at the nearest residential NSRs is predicted to be local, short term duration, intermittent and temporary. It is predicted that the impact will affect the receptors directly. The results of the assessment indicate that the magnitude of impact is therefore considered to be **negligible**.

Sensitivity of the receptor

8.12.3.6 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the onshore export cable route are considered to be **low** sensitivity.

Significance of the effect

8.12.3.7 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible**. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms.

The temporary impacts of onshore HVDC converter/HVAC substation booster station decommissioning may affect receptors sensitive to noise or vibration.

8.12.3.8 During decommissioning, the equipment and activities used are likely to be broadly similar to those used during construction. It is possible that technological advances will result in quieter equipment being available for these tasks

Magnitude of impact

8.12.3.9 It is anticipated that noise impacts would be no greater than those predicted for the installation (in reality, impacts should be less as demolition techniques improve).

8.12.3.10 The impact at the nearest residential NSRs is predicted to be local, short term duration, intermittent and temporary. It is predicted that the impact will affect the receptors directly. The results of the assessment indicate that the magnitude of impact is therefore considered to be **negligible** to **minor.**

Sensitivity of the receptor

8.12.3.11 Residential receptors within the distances above are considered to be **medium** sensitivity.

Significance of the effect

8.12.3.12 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **minor**. The effect will, therefore, be of **negligible** to **minor adverse** significance, which is not significant in EIA terms.

8.12.3.13 For the reasons discussed at section 8.9 above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Future monitoring

8.12.3.14 No future monitoring is proposed at this stage. Once final operation phase modelling with attenuation as necessary has been completed, further discussions with the local planning authority will take place regards the need, or otherwise for future monitoring.

8.13 Cumulative Effect Assessment methodology

8.13.1 Screening of other projects and plans into the Cumulative Effect Assessment

8.13.1.1 The Cumulative Effect Assessment (CEA) takes into account the impacts associated with Hornsea Three together with other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise undertaken as part of the 'CEA long list' of projects (see volume 4, annex 5.1: Cumulative Effects Screening Matrix and Location of Schemes). Each project on the CEA long list has been considered on a case by case basis for scoping in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

8.13.1.2 In undertaking the CEA for Hornsea Three, it is important to bear in mind that other projects and plans under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside Hornsea Three. For example, relevant projects and plans that are already under construction are likely to contribute to cumulative impact with Hornsea Three (providing effect or spatial pathways exist), whereas projects and plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors. For this reason, all relevant projects and plans considered cumulatively alongside Hornsea Three have been allocated into 'Tiers', reflecting their current stage within the planning and development process. This allows the CEA to present several future development scenarios, each with a differing potential for being ultimately built out. Appropriate weight may therefore be given to each Tier in the decision making process when considering the potential cumulative impact associated with Hornsea Three (e.g. it may be considered that greater weight can be placed on the Tier 1 assessment relative to Tier 2). An explanation of each tier is included below:

- Tier 1: Hornsea Three considered alongside other project/plans currently under construction and/or those consented but not yet implemented, and/or those submitted but not yet determined and/or those currently operational that were not operational when baseline data was collected, and/or those that are operational but have an on-going impact;
- Tier 2: All projects/plans considered in Tier 1, as well as those on relevant plans and programmes likely to come forward but have not yet submitted an application for consent (the PINS programme of projects is the most relevant source of information, along with the planning register held by the relevant local planning authorities). Specifically, this Tier includes all projects where the developer has submitted a Scoping Report; and
- Tier 3: All projects/plans considered in Tier 2, as well as those on relevant plans and programmes likely to come forward but have not yet submitted an application for consent (the PINS programme of projects is the most relevant source of information). Specifically, this Tier includes all projects where the developer has advised PINS in writing that they intend to submit an application in the future but have not submitted a Scoping Report.

8.13.1.3 The specific projects scoped into this CEA and the Tiers into which they have been allocated, are outlined in Table 8.30. The distance to Hornsea Three relates to the distance from the onshore elements of Hornsea Three (as defined in 8.1.1.1). The projects included as operational in this assessment have been commissioned since the baseline studies for this project were undertaken and as such were excluded from the baseline assessment.

Table 8.30: List of other projects and plans considered within the CEA.

Tier	Phase	Type of development	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
1	***Residential***							
		Residential	PF/14/0859 Erection of sixteen dwellings	<1 km	Introduces new NSRs to the area	Approved 19 June 2005	Slight potential	N/A
		Residential	PF/15/1223 Erection of twenty two residential units (Class C3) with associated highway and landscape works.	<1 km	Introduces new NSRs to the area	Undecided Awaiting Decision as of 24 January 2017 Decision Target Date 1 February 2017	Slight potential	N/A
		Residential	PF/14/0328 Erection of extension to provide twelve supported residential units	<1 km	Introduces new NSRs to the area	Approved 20 May 2014	Slight potential	N/A
		Residential	2015/2082 Outline application for the residential development 10 dwellings	<1 km	Introduces new NSRs to the area	Approved 22 June 2016	Slight potential	N/A
		Residential	2015/1681 Reserved matters for appearance, layout, scale and landscaping of the first phase of development for 126 dwellings in relation to outline permission 2011/1804	<1 km	Introduces new NSRs to the area	Approved 18 February 2016	Slight potential	N/A
		Residential	2015/1594 Residential development of 95no dwellings with associated open space and infrastructure.	<1 km	Introduces new NSRs to the area	Approved 18 December 2015	Slight potential	N/A
		Residential	2012/1429 Residential development (Use Class C3) of 9 dwellings including 2 affordable homes, landscaping, associated access onto Low Road, and associated carriageway works to Low Road; and provision of a village green space adjacent to the Keswick Parish Room	<1 km	Introduces new NSRs to the area	Approved 21 March 2013	Slight potential	N/A
		Residential	2015/2630 Residential Development for 8no. dwellings, car parking and amenity space including 2no. affordable dwellings which form part of planning reference 2015/0253	<1 km	Introduces new NSRs to the area	Approved 30 August 2016	Slight potential	N/A

Tier	Phase	Type of development	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
		Residential	2015/1697 Erection of 27 dwellings, access, roads, open space, parking areas and associated works	<1 km	Introduces new NSRs to the area	Approved 27 June 2016	Slight potential	N/A
		Residential	2013/0092 Outline application for up to 20 residential units and associated highways works with all matters reserved	<1 km	Introduces new NSRs to the area	Approved 20 March 2014	Slight potential	N/A
		Residential	2013/0086 Outline application including means of access for residential development and ancillary works	<1 km	Not noise sensitive or significantly noise-generating	Approved 30 April 2014	Slight potential	N/A
		Residential	2012/1836 Outline application for residential development (20 Dwellings) and associated infrastructure works, including highway improvement works at the Mill Road/School Lane/Burnthouse Lane junction	<1 km	Introduces new NSRs to the area	Approved 29 April 2014	Slight potential	N/A
		Residential	20151644 Demolition of 4 Existing Units and Development of 10 Residential Units, Together with Associated Access (Outline)	<1 km	Introduces new NSRs to the area	Approved 10 June 2016	Slight potential	N/A
		Residential (non-conventional)	PF/12/1263 Change of use of land from agriculture to 53 units tent-only campsite and formation of vehicular access	<1 km	Introduces new NSRs to the area	Approved 24 January 2013	Slight potential	N/A
		Residential (non-conventional)	PF/13/1026 Creation of 20 hard standings (former rally field Area A) for the siting of 20 woodland lodges with associated access and infrastructure. Demolition of chicken sheds (Area B), change of use of land and creation of hard standings for the siting of 17 static caravans with associated access and infrastructure.	<1 km	Introduces new NSRs to the area	Approved 1 November 2013	Slight potential	N/A
		Residential/Mixed use	PM/16/1204 Reserved matters submission of appearance, landscaping, layout and scale; for erection of 214 dwellings, public open space, highway and other infrastructure, in respect of outline planning application PO/16/0253	<1 km	Introduces new NSRs to the area	Undecided Awaiting Decision as of 24 January 2017 Target Decision Date: 29 November 2016	Slight potential	N/A

Tier	Phase	Type of development	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
		Residential/Mixed use	PO/16/0253 Erection of up to 215 dwellings, employment land (A3, A4, B1, B2, B8, C1, C2, D1 and D2 class uses), public open space and provision of roundabout and vehicular link road from Cromer Road (A148) to Heath Drive with associated landscaping and infrastructure (Outline application)	<1 km	Introduces new NSRs to the area	Approved 15 August 2016	Slight potential	N/A
		Residential/Mixed use	2014/2611 The erection of 890 dwellings; the creation of a village heart to feature an extended primary school, a new village hall, a retail store and areas of public open space; the relocation and increased capacity of the allotments; and associated infrastructure including public open space and highway works.	<1 km	Introduces new NSRs to the area	Approved 1 November 2016	Slight potential	N/A
1	***Employment***							
		Mixed use	2016/0764 Outline Application for Proposed employment development consisting of B1, B2 and B8 uses, associated access and landscaping; and proposed link road between the A140 and the B1113 with some matters reserved	<1 km	N/A	Pending Consideration when checked on 24 January 2017	Slight potential	N/A
	Energy							
		Energy	PF/14/0177 Installation of landfall transition pit and buried electrical cable system (revisions to previously approved scheme) and changes to the construction configuration at the landfall	<1 km	Decision notice specifies that works must commence no later than 22 June 2017, with a 2 year construction programme. Therefore it is very unlikely that construction will not have completed by the time Hornsea Three commences.	Approved 6 October 2014	Slight potential	N/A
		Energy (photovoltaic)	20131702 Installation of Ground Mounted Photovoltaic (PV) Solar Arrays to Provide 5 MW Generation Capacity Together with Transformer Stations; Landscaping; Security Fencing; Access Gate; and Ancillary Infrastructure	<1 km	Not noise sensitive nor significantly noise generating.	Approved 4 March 2014	Potential	N/A

Tier	Phase	Type of development	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
1	***Road Schemes***							
		Road Scheme	20140883 Proposed Dual Carriageway between A1067 Fakenham Road Nr Attlebridge and A47 Trunk Road, Postwick (NDR)	<1 km	N/A	Approved by SOS on 29 June 2015 Observation (ref: 20151419) made on the discharge of condition 24 September 2015	Slight potential	N/A
1	***Enterprise Zone***							
		Enterprise Zone	20170052 Greater Norwich Food Enterprise Zone	<1 km	Introduces new noise source to the area	Pending Consideration (when checked on 2 February 17)	Slight potential	N/A
1	***Mineral Extraction***							
		Mineral Extraction	C/7/2010/7016 Continued recycling of former building materials and use of concrete batching plant until 31 May 2029: Site entrance improvements including hardening of site access road: Hardening of remainder of concrete batching compound: Highway improvements: Construction of car park and footpath: Erection of estate fencing around ice house: Restoration of the site in accordance with an improved restoration scheme by 31 May 2030 with public access to former quarry and adjoining land and woodland for informal recreational purposes	<1 km	No significant change with regards to noise	Approved 5 March 2012	Slight potential	N/A
1	***Waste***							
		Waste	C/1/2010/1005 Erection of plant to accommodate an anaerobic digestion facility, provision of ancillary office and weighbridge, retention of existing landfill gas engines, construction of access road and provision of landscaping	<1 km	N/A	Approved 28 April 2014	Slight potential	N/A
		Waste	C/5/2015/5007 Resubmission of application for change of use from B8: Warehousing to a Sui Generis use for waste processing and the production of refuse derived fuel (RDF) with an annual throughput of 150,000 tonnes; installation of office, 2 x weighbridges and photovoltaic panels	<1 km	N/A	Pending Consideration (when checked on 24 January 2017)	Slight potential	N/A

Tier	Phase	Type of development	Project/Plan	Distance from Hornsea Three	Details	Date of Construction (if applicable)	Overlap of construction phase with Hornsea Three construction phase	Overlap of operation phase with Hornsea Three operation phase
2	***Mineral Extraction***							
		Mineral Extraction	C/7/2014/7030 (I) For a southern extension to Mangreen Quarry and ancillary works with progressive restoration to agriculture and nature conservation by the importation of inert restoration materials; (II) Retention of existing consented facilities at Mangreen Quarry; (III) Establishment of crossing point over Mangreen Lane; and (IV) Proposed variation to approved restoration scheme	<1 km	Introduces new noise source to the area	Approved 2 October 2015	Slight potential	Operation is not noise-sensitive. Cumulative effects on other NSRs is only of slight potential.

8.13.2 Maximum design scenario

8.13.2.1 The maximum design scenarios identified in Table 8.31 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative impact presented and assessed in this section have been selected from the details provided in the Hornsea Three project description (volume 1, chapter 3: Project Description), as well as the information available on other projects and plans, in order to inform a 'maximum design scenario'. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the project Design Envelope, to that assessed here be taken forward in the final design scheme.

Table 8.31: Maximum design scenario considered for the assessment of potential cumulative impacts during construction on Noise and Vibration.

Potential impact	Maximum design scenario	Justification
Construction phase		
The temporary impact of cable installation during construction may affect receptors sensitive to noise or vibration.	Consecutive or parallel construction works affecting existing NSRs	The maximum design scenario would occur as a result of an overlap of construction programmes, resulting in the greatest potential for construction noise impacts on NSRs.
The temporary impact of cable installation by HDD (including duct installation at the Hornsea Three landfall may affect receptors sensitive to noise or vibration.	Consecutive or parallel construction works affecting existing NSRs	The maximum design scenario would occur as a result of an overlap of construction programmes, resulting in the greatest potential for construction noise impacts on NSRs.
The temporary impact of constructing the construction accesses on the onshore export cable route may affect receptors sensitive to noise or vibration.	Consecutive or parallel construction works affecting existing NSRs	The maximum design scenario would occur as a result of an overlap of construction programmes, resulting in the greatest potential for construction noise impacts on NSRs.
The temporary impacts of HVDC converter/HVAC substation and HVAC booster station construction may affect receptors sensitive to noise or vibration including the temporary impacts of tubular steel piling (percussive piling) may affect receptors sensitive to vibration.	Consecutive or parallel construction works affecting existing NSRs	The maximum design scenario would occur as a result of an overlap of construction programmes, resulting in the greatest potential for construction noise impacts on NSRs.
Operation phase		
The operational impact of an onshore HVDC converter/HVAC substation may affect receptors sensitive to noise or vibration.	Noise from Hornsea Three in operation combining with Mangreen Quarry	Mangreen Quarry is the closet planned project to the HVDC converter station/HVAC substation site, and works will potentially be ongoing on both sites at the same time. It is most unlikely that any additional NSRs will be subject to a significant adverse effect due to the cumulative works.
Decommissioning phase		
The temporary impacts of cable decommissioning may affect receptors sensitive to noise or vibration.	Hornsea Three decommissioned in parallel with future proposed projects as yet unidentified.	Other projects to be identified at time of decommissioning.
The temporary impact of onshore substation site decommissioning may affect receptors sensitive to noise or vibration.	Hornsea Three decommissioned in parallel with future proposed projects as yet unidentified.	Other projects to be identified at time of decommissioning.

8.14 Cumulative Effect Assessment

8.14.1.1 Most schemes lie within 1 km of the cable route. The potential for cumulative impact is likely to occur in the construction phase as there are no noise impacts associated with the operation of the cable route. Only one scheme has been identified within 1 km of the HVDC converter/HVAC substation. The potential for cumulative impacts may occur in the construction and operational phases and are described below.

8.14.1.2 Construction effects associated with the cable route are of much shorter duration and so the likelihood of simultaneous or sequential construction works happening at any particular NSR are much reduced.

8.14.1.3 In addition, the combined effects of construction works tend not to be greater than the effects associated with each works individually (i.e. it is most unlikely that any additional NSRs will be subject to a significant adverse effect due to the cumulative works, above those NSRs already identified for an adverse effect due to each work individually). Nor would NSRs predicted to experience an impact from the development alone be likely to experience an increased impact due to the cumulative works.

8.14.1.4 Cumulative effects are, therefore, only likely to occur where a new noise-sensitive receptor is introduced into an area where a significant impact from this scheme has already been identified. This would mostly apply to proposed residential developments that will be constructed and occupied prior to the completion of Hornsea Three construction works.

8.14.1.5 One permitted development has been identified falling within 1 km of the HVDC converter/HVAC substation: "*C/7/2014/7030 (I) For a southern extension to Mangreen Quarry and ancillary works with progressive restoration to agriculture and nature conservation by the importation of inert restoration materials; (II) Retention of existing consented facilities at Mangreen Quarry; (III) Establishment of crossing point over Mangreen Lane; and (IV) Proposed variation to approved restoration scheme at Mangreen Quarry*." The potential for cumulative operational effects will be considered within the EIA.

8.14.1.6 No developments within 1 km of the onshore HVAC booster station have been identified.

8.14.1.7 A description of the significance of cumulative effects upon noise and vibration sensitive receptors arising from each identified impact is given below.

8.14.2 Construction phase

The temporary impact of cable installation during construction may affect receptors sensitive to noise or vibration.

Magnitude of impact

8.14.2.1 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude is considered to be **major** for receptors within 16 m; **moderate** for receptors within 41 m; **minor** for receptors within 65 m; and **negligible** beyond.

Sensitivity of the receptor

8.14.2.2 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the cable route are considered to be **low** sensitivity.

Significance of the effect

8.14.2.3 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **moderate**. The effect will, therefore, be of **negligible** to **moderate adverse** significance, which is significant in EIA terms.

Further mitigation

8.14.2.4 Construction noise mitigation will be applied as is reasonably practicable.

The temporary impact of cable installation by HDD (including duct installation at Hornsea Three landfall) may affect receptors sensitive to noise or vibration.

Magnitude of impact

8.14.2.5 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude is considered to be **major** for receptors within 245 m; **moderate** for receptors within 615 m; **minor** for receptors within 975 m; and **negligible** beyond.

Sensitivity of the receptor

8.14.2.6 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the cable route are considered to be **low** sensitivity.

Significance of the effect

8.14.2.7 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **major**. The effect will, therefore, be of **negligible** to **major adverse** significance, which is significant in EIA terms.

The temporary impact of constructing the construction accesses on the onshore export cable route may affect receptors sensitive to noise or vibration.

Magnitude of impact

8.14.2.8 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude is considered to be **major** for receptors within 14 m; **moderate** for receptors within 36 m; **minor** for receptors within 57 m; and **negligible** beyond. No receptors within 14 m of the cable route accesses have been identified.

Sensitivity of the receptor

8.14.2.9 Residential receptors within the distances above are considered to be **medium** sensitivity.

Significance of the effect

8.14.2.10 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **moderate**. The effect will, therefore, be of **negligible** to **moderate adverse** significance, which is significant in EIA terms.

The temporary impacts of HVDC/HVAC substation and HVAC booster station construction may affect receptors sensitive to noise or vibration including the temporary impacts of tubular steel piling (percussive piling) may affect receptors sensitive to vibration.

Magnitude of impact

8.14.2.11 The impact is predicted to be of local spatial extent, short to medium term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. The magnitude is considered to be **major** for receptors within 112 m; **moderate** for receptors within 282 m; **minor** for receptors within 447 m; and **negligible** beyond.

Sensitivity of the receptor

8.14.2.12 Residential receptors within the distances above are considered to be **medium** sensitivity. PRoW, where they cross or pass close to the cable route are considered to be **low** sensitivity.

Significance of the effect

8.14.2.13 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude is deemed to be negligible to high. The effect will, therefore, be of **negligible** to **major adverse** significance, which is significant in EIA terms.

8.14.3 Operation and maintenance phase

The operational impact of an onshore HVDC converter/HVAC substation may affect receptors sensitive to noise.

8.14.3.1 Only one permitted development has been identified falling within 1 km of the onshore HVDC converter/HVAC substation: *C/7/2014/7030 (I) For a southern extension to Mangreen Quarry and ancillary works with progressive restoration to agriculture and nature conservation by the importation of inert restoration materials; (II) Retention of existing consented facilities at Mangreen Quarry; (III) Establishment of crossing point over Mangreen Lane; and (IV) Proposed variation to approved restoration scheme at Mangreen Quarry*. The potential for cumulative operational effects will be considered within the EIA.

Magnitude of impact

8.14.3.2 With regards to context, the impact is predicted to be of local spatial extent, long term duration, continuous and of full reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is considered to be **minor** to **major**.

Sensitivity of the receptor

8.14.3.3 The receptors identified above are identified as residential. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of the effect

8.14.3.4 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **major**. The effect will, therefore, be of **moderate** or **major adverse** significance, which is significant in EIA terms.

8.14.3.5 Note that at PEIR assessment, no by-design or built-in mitigation is assumed. The significance of effect identified above is therefore worst-case and likely to reduce once by-design/built-in mitigation has been identified. Design work for the onshore HVDC converter/HVAC substation is ongoing and the development of a noise mitigation strategy, in consultation with the local planning authority, will be completed prior to the final assessment being presented with the DCO application.

8.14.3.6 For the reasons discussed at above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Future monitoring

8.14.3.7 No future monitoring is proposed.

8.14.4 Decommissioning phase

The temporary impacts of cable decommissioning may affect receptors sensitive to noise or vibration.

8.14.4.1 At present, no projects have been identified where construction or demolition would temporally overlap with that of Hornsea Three. Decommissioning effects associated with the onshore cable route are of lesser magnitude and much shorter duration than construction and so the likelihood of simultaneous or sequential construction works happening at any particular NSR are much reduced.

8.14.4.2 In addition, the combined effects of construction works tend not to be greater than the effects associated with each works individually. Specifically, it is most unlikely that any additional NSRs will be subject to a significant adverse effect due to the cumulative works, above those NSRs already identified for an adverse effect due to each work individually.

8.14.4.3 Notwithstanding the above, the process of identification and consideration of proposed projects should be repeated prior to the decommissioning phase.

The temporary impacts of onshore HVDC converter/HVAC substation booster station decommissioning may affect receptors sensitive to noise or vibration.

Magnitude of impact

8.14.4.4 Any predicted impact would be 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 is considered to be **negligible** to **minor .**

Sensitivity of receptor

8.14.4.5 Any receptors identified are identified as residential. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of Effect

8.14.4.6 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **negligible** to **minor**. The effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.

8.14.4.7 For the reasons discussed at above there is a level of uncertainty attached to this level of significance. This uncertainty has been addressed through the adoption of precautionary thresholds, which demonstrates a possibility of effect, rather than certainty of effect due to the undefined impact upon specific NSRs at this stage.

Future monitoring

8.14.4.8 No future monitoring is proposed.

8.15 Transboundary effects

8.15.1.1 A screening of transboundary impacts has been carried out and is presented in volume 4, annex 5.3: Transboundary Impacts Screening Note. This screening exercise identified that there was no potential for significant transboundary effects with regard to noise and vibration from Hornsea Three upon the interests of other EEA States.

8.16 Inter-related effects

8.16.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, operational and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. noise and vibration effects from piling, operation of the onshore HVDC converter/HVAC converter station and decommissioning).
- Receptor led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects with regards to noise and vibration, such as installing the onshore export cable, noise from piling, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short term, temporary or transient effects, or incorporate longer term effects.

8.16.1.2 A description of the likely inter-related effects arising from Hornsea Three with regards to noise and vibration is provided in chapter 12: Inter-Related Effects (Onshore).

8.17 Conclusion and Summary

8.17.1.1 A summary of the preliminary findings of the EIA that have been completed to date and which relate to noise and vibration are presented in Table 8.32 below.

8.17.1.2 The potential noise and vibration effects from construction, operation and decommissioning of the onshore elements of the proposed Hornsea Three have been predicted and assessed in accordance with international, national and local standards and guidance.

8.17.1.3 Surveys have been undertaken to determine the measured baseline sound levels at locations representative of the potentially most affected noise sensitive receptors. Long term baseline sound monitoring was undertaken in March 2017.

8.17.1.4 No specific mitigation measures have been identified at PEIR stage. However, taking likely practicable measures into account, the results of the noise and vibration assessment indicate that the significance of noise and vibration effects from the construction of the onshore cable route, HDD works, onshore HVAC booster station and onshore HVDC converter/HVAC substation are likely to be mitigated to **negligible** to **moderate adverse**. This will be investigated further in the Environmental Statement

8.17.1.5 Modelling of the available information for the onshore HVAC booster station and onshore HVDC converter/HVAC substation indicates that the significance of noise and vibration effects due to the operation of the project would be **moderate** to **major adverse,** prior to identification of by-design or built-in mitigation.

8.17.1.6 During decommissioning, effects would be limited to activities at the transition joint bays and at the onshore HVAC booster station and onshore HVDC converter/HVAC substation sites. It has been assumed that effects arising along the cable route would be no greater than those during construction. Taking this into account, the results of the noise and vibration assessment indicate that the significance of noise and vibration effects from decommissioning of the cable route and the onshore HVAC booster station and onshore HVDC converter/HVAC substation would be **negligible** to **minor**.

8.18 Next Steps

8.18.1.1 Prior to production of the Final Environmental Statement, further construction and design choices will be made. As part of that work, detailed plans for noise attenuation will be developed, in consultation with the relevant local planning authorities.

8.18.1.2 Those mitigation measures could include both physical noise attenuation features and designed in mitigation to the equipment itself. Noise may also be attenuated through careful siting of equipment, and plant selection. Hornsea Three will develop an NMP which will set out agreed principles and parameters for noise attenuation, which will be incorporated into future noise modelling, as part of the final DCO application.

8.18.1.3 Measures to manage potential construction effects will be further developed and set out in the CoCP. Again, those measures will be developed in consultation with the relevant local planning authorities. This will also include proposed construction hours, covering the different construction sites and types of construction activities that are anticipated for Hornsea Three.

8.18.1.4 Hornsea Three will continue to develop the design of the onshore HVAC booster station and HVDC converter/HVAC substation, and update the noise assessment accordingly. The PEIR assessment has considered a worst case scenario for the assessment of impacts at those sites, and it is expected that once the design work is finalised, with equipment layouts and noise mitigation measures confirmed, the potential impact on the nearest receptors will be reduced to acceptable levels.

Table 8.32: Summary of potential environment effects, mitigation and monitoring.

Description of impact	Measures adopted as part of the project	Magnitude of impact	Sensitivity of receptor	Significance of effect	Additional measures	Residual effect	Proposed monitoring
Construction Phase							
The temporary impact of cable installation during construction may affect receptors sensitive to noise or vibration.	See Table 8.21	Minor to Major	Medium – residents Low - PROW	Negligible to Moderate Adverse	Construction noise will be applied as is reasonable practicable.	TBC	None
The temporary impact of cable installation by HDD (including duct installation at the Hornsea Three landfall) may affect receptors sensitive to noise or vibration.	See Table 8.21	Minor to Major	Medium – residents Low - PROW	Negligible to Major Adverse	Construction noise will be applied as is reasonable practicable.	TBC	None
The temporary impact of constructing the cable route construction accesses may affect receptors sensitive to noise or vibration.	See Table 8.21	Minor to Major	Medium	Negligible to Moderate Adverse	Construction noise will be applied as is reasonable practicable.	TBC	None
The temporary impacts of HVDC converter/HVAC substation and HVAC booster station construction may affect receptors sensitive to noise or vibration.	See Table 8.21	Minor to Major	Medium	Negligible to Major Adverse	Construction noise will be applied as is reasonable practicable.	TBC	None
Operation Phase							
The permanent impact of an onshore HVAC/HVDC connector substation may affect receptors sensitive to noise.	None	Minor to Major	Medium	Moderate or Major Adverse	Built-in mitigation will be identified in the Final Environmental Statement	TBC	None
The permanent impact of an onshore HVAC booster station may affect receptors sensitive to noise.	None	No change to Moderate	Medium	Moderate Adverse	Built-in mitigation will be identified in the Final Environmental Statement	TBC	None
Decommissioning Phase							
The temporary impacts of cable decommissioning may affect receptors sensitive to noise or vibration.	See Table 8.21	Negligible	Medium – residents Low - PROW	Negligible	None	TBC	None
The temporary impacts of connector substation and booster station decommissioning may affect receptors sensitive to noise or vibration.	See Table 8.21	Negligible to Minor	Medium	Negligible	None	TBC	None

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