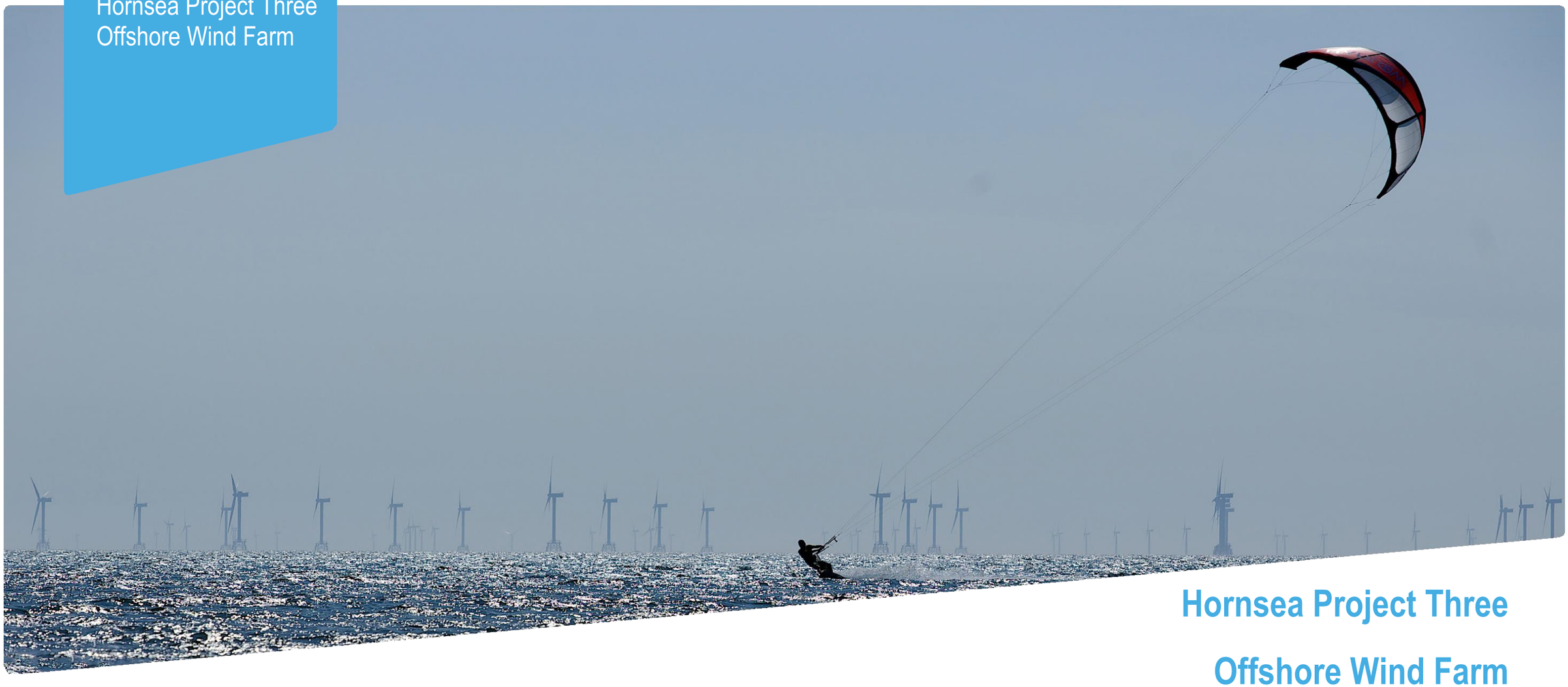
Hornsea Project Three
Offshore Wind Farm



Hornsea Project Three

Offshore Wind Farm

Environmental Statement:
Volume 3, Chapter 8 – Noise and Vibration

PINS Document Reference: A6.3.8
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Date: May 2018

Hornsea 3
Offshore Wind Farm

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Environmental Impact Assessment

Environmental Statement

Volume 3

Chapter 8 – Noise and Vibration

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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.
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. The baseline sound level is characterised by the standard noise metrics: L_{Aeq}, L_{A90} etc.
Decibel	Units of sound measurement and noise exposure measurement.
Environmental Noise Directive	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	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.
Onshore elements of Hornsea Three	Hornsea Three landfall area, onshore cable corridor, the onshore HVAC booster station, the onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main National Grid substation.
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}	Average downwind sound pressure level, as defined in ISO 9613-2
L_{A90}	See "*Background sound level*".
L_{den}	The 'Day-evening-night level' and is defined by: $L_{den} = 10 \times \log\left\{\frac{1}{24}\left[\left(12 \times 10^{\left(L_{day}/10\right)}\right) + \left(4 \times 10^{\left(L_{evening}+5/10\right)}\right) + \left(8 \times 10^{\left(L_{night}+10/10\right)}\right)\right]\right\}$ 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.

Terms	Definition
$L_{evening}$	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.
Local Authorities	Local Authorities in the context of this ES refers to the following local planning authorities; North Norfolk District Council, Broadlands District Council, and South Norfolk Council
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*"
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.
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.'
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
BS	British Standard
BSI	British Standards Institution
CEA	Cumulative Environmental Affects
CRTN	Calculation of Road Traffic Noise
CoCP	Code of Construction Practice
dBA	Decibels A-weighted
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DMRB	Design Manual for Roads and Bridges
EHO	Environmental Health Officer
HDD	Horizontal Directional Drilling (a Trenchless Technology)
HGV	Heavy Goods Vehicle
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current

Acronym	Description
Hz	Hertz
ISO	International Organization for Standardization
LOAEL	Lowest Observed Adverse Effect Level
NOEL	No Observed Effect Level
NPPF	National Planning Policy Framework
PPG-N	National Planning Practice Guidance
NMP	Noise Management Plan
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Projects
NSR	Noise and Vibration Sensitive Receptor
PPV	Peak Particle Velocity
PRoW	Public Right of Way
SLM	Sound Level Meter
SOAEL	Significant Observed Adverse Effect Level

Units

Unit	Description
GW	Gigawatt (power)
Hz	Hertz (frequency)
kV	Kilovolt (electrical potential)
kW	Kilowatt (power)
dB	Sound pressure level referenced to 20 µPa.
m	Metres (distance)
m/s	Metres per second (speed)
µPa	Micropascal (pressure)

8. Noise and Vibration

8.1 Introduction

8.1.1.1 This chapter of the Environmental Statement presents the results of the Environmental Impact Assessment (EIA) for the potential noise and vibration impacts of the Hornsea Three offshore wind farm (hereafter referred to as 'Hornsea Three'). Specifically, this chapter considers the potential impact of Hornsea Three landward of Mean High Water Springs, during its construction, operation and maintenance, and decommissioning phases.

8.1.1.2 Those noise and vibration impacts of Hornsea Three on ecology and nature conservation, and land use are assessed in chapter 3: Ecology and Nature Conservation and chapter 6: Land Use and Recreation respectively. Noise effects resulting from changes in traffic due to Hornsea Three are addressed in this chapter, whilst all other impacts relating to traffic are assessed in chapter 7: Traffic and Transport.

8.1.1.3 This chapter summarises information contained within technical reports, which are included in: volume 6, annex 8.1: Baseline Noise Survey; annex 8.2: Construction Noise Model Output; annex 8.3: Operational Noise Model Input; and annex 8.4: Operational Noise Model Output.

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) and it accompanies the application to the Secretary of State for Development Consent.

8.2.1.2 It is intended that the Environmental Statement will provide statutory and non-statutory consultees with sufficient information to complete the examination of Hornsea Three and will form the basis of agreement on the content of the DCO.

8.2.1.3 In particular, this Environmental Statement chapter:

- Presents the existing environmental baseline established from desk studies, baseline surveys and consultation;
- Presents the potential environmental effects associated with noise and vibration arising from Hornsea Three, based on the information gathered and the analysis and assessments undertaken;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or 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 Noise and vibration associated with the construction, operation and maintenance, and decommissioning phases have the potential for adverse 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 (NSRs).

8.3.1.2 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 on NSRs. The Hornsea Three noise and vibration study areas in this chapter have therefore 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.

8.3.1.3 During the construction and decommissioning phases, the Hornsea Three noise and vibration study area considers NSRs and Public Rights of Way (PRoWs) within approximately 1 km of the onshore elements of Hornsea Three (namely the Hornsea Three landfall area, the onshore cable corridor, the onshore HVAC booster station, the onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main National Grid substation) together with storage areas, compounds and accesses (see Figure 8.1).

8.3.1.4 Locations of potentially NSRs have been identified from the Ordnance Survey (OS) Address Base data, used across the project. Approximately 5,000 residential properties have been identified within the Hornsea Three noise and vibration study area. However, no schools or hospitals, or any other particularly noise sensitive class were identified.

8.3.1.5 A number of PRoWs cross the Hornsea Three noise and vibration study area including two National Trails (see chapter 6: Land Use and Recreation). Whilst users might experience elevated noise levels for short periods when using PRoWs in the area, this is not considered a mechanism for significant effect: from any publicly accessible locations, noise levels would be below the threshold for discomfort or auditory damage and most users of the PRoW would experience only transitory exposure to construction noise as they pass by.

8.3.1.6 For the operational assessment, the Hornsea Three noise and vibration study area is 1 km from the onshore HVDC converter/HVAC substation and HVAC booster station (see Figure 8.1).

8.3.1.7 The operation and maintenance phase will not generate significant noise along the Hornsea Three onshore cable corridor (due to there being no noise generated by the cable itself and no anticipated maintenance which would generate significant noise), therefore, no operational noise and vibration study area is defined for the Hornsea Three onshore cable corridor.

8.3.1.8 Where a particularly sensitive NSR has been identified slightly beyond the study areas outlined above (whereby their curtilage might fall within the study area), these have also been considered in the assessment as appropriate.

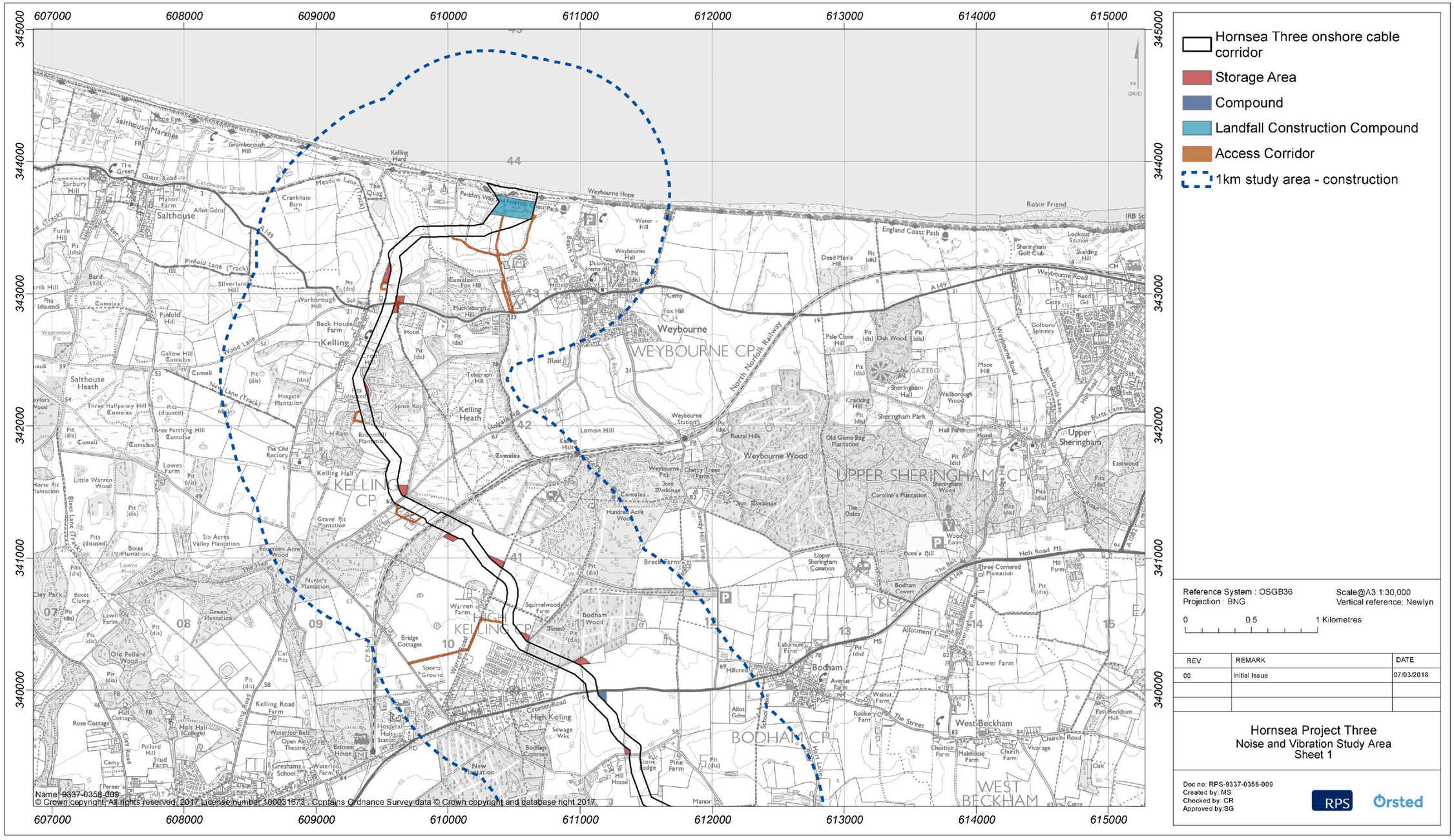
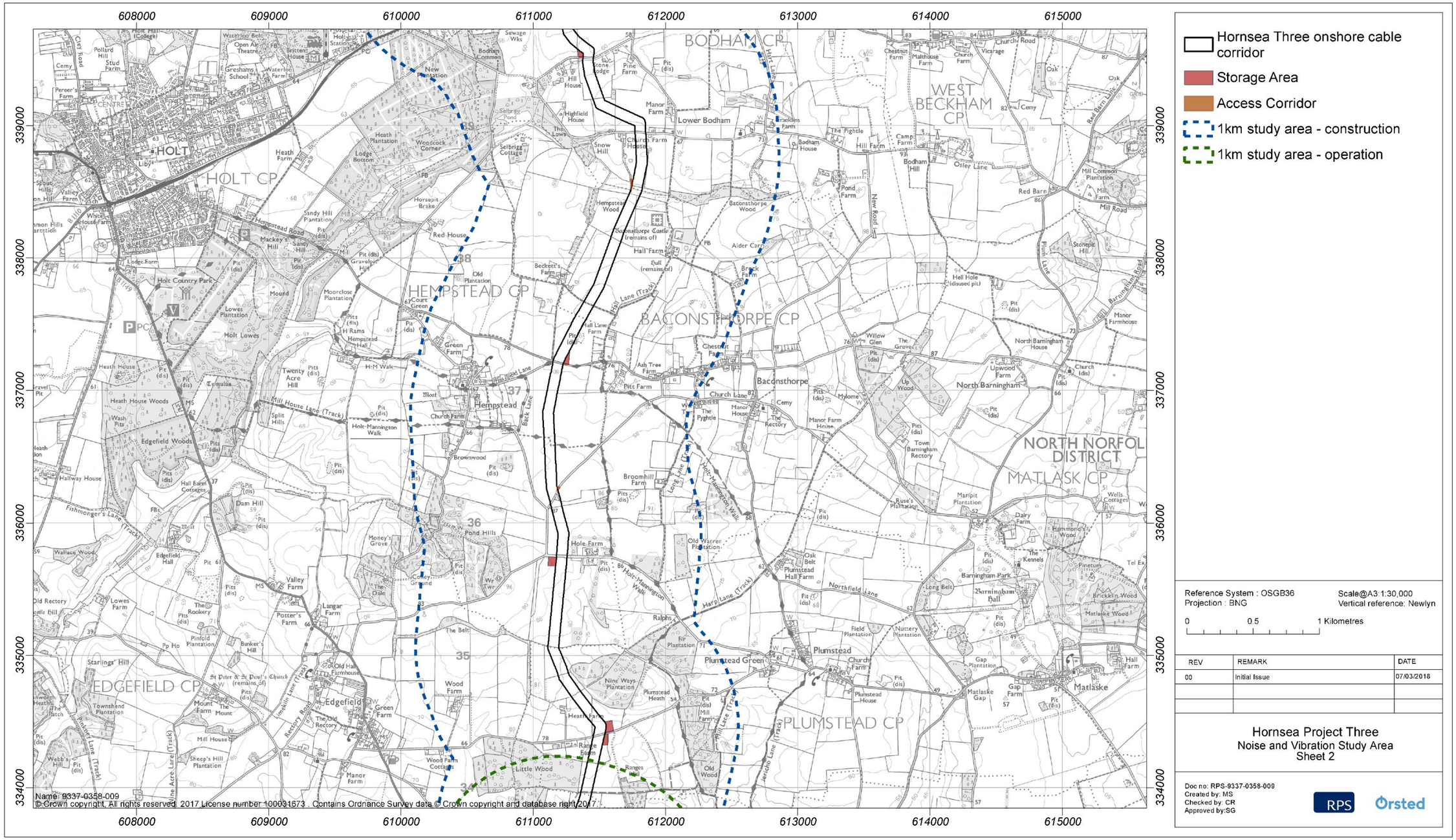


Figure 8.1: Hornsea Project Three noise and vibration study area.



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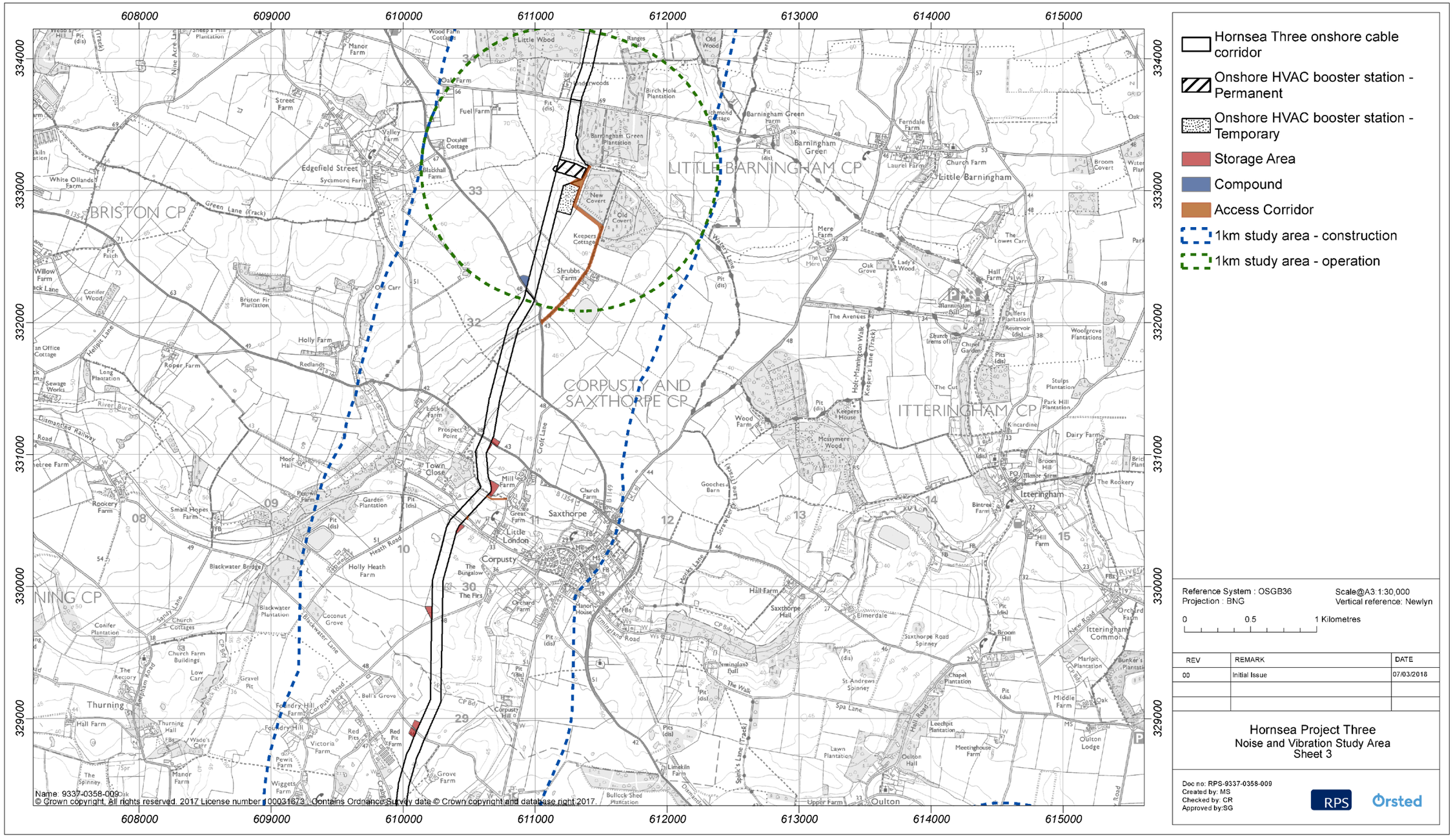

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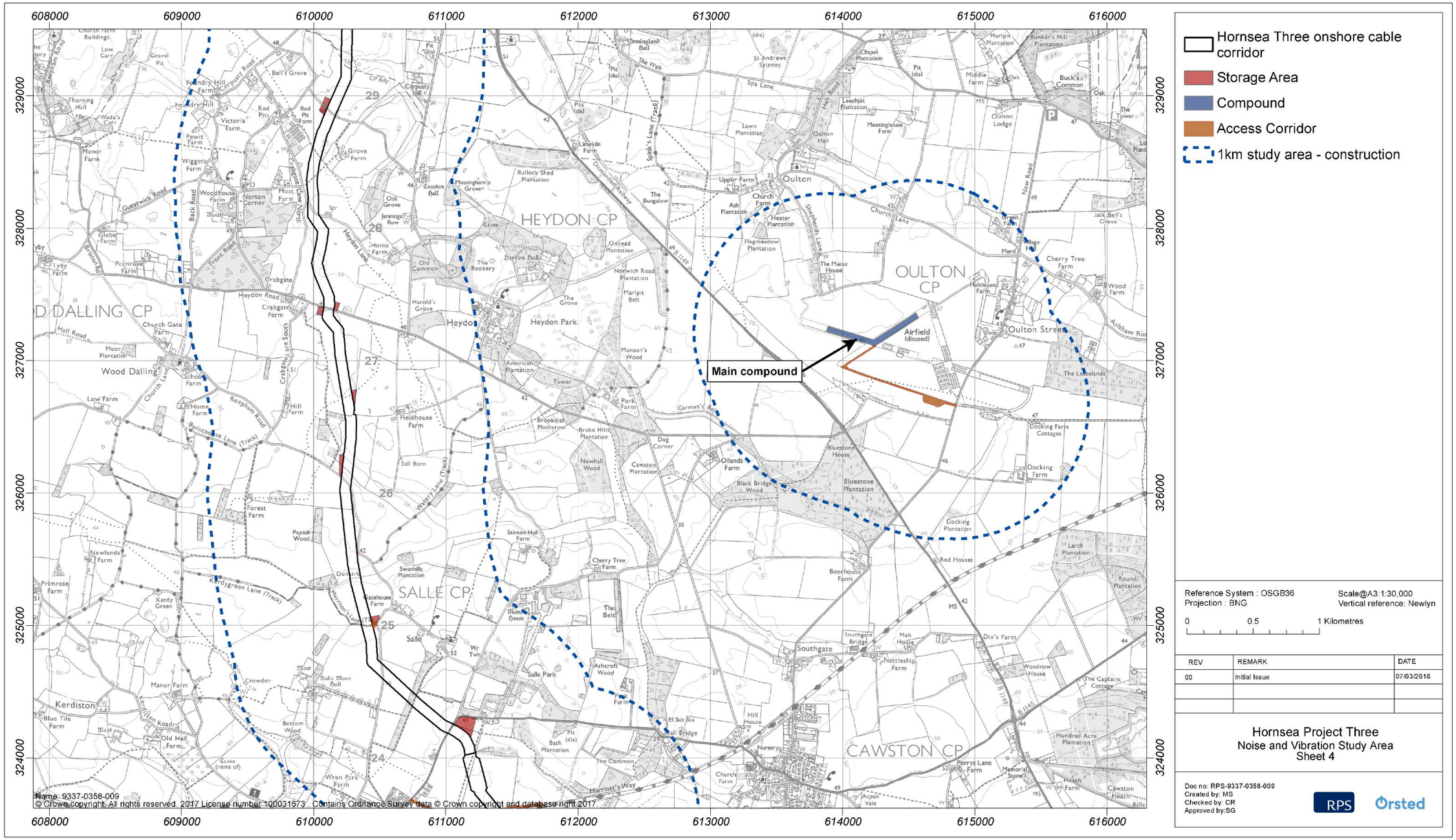

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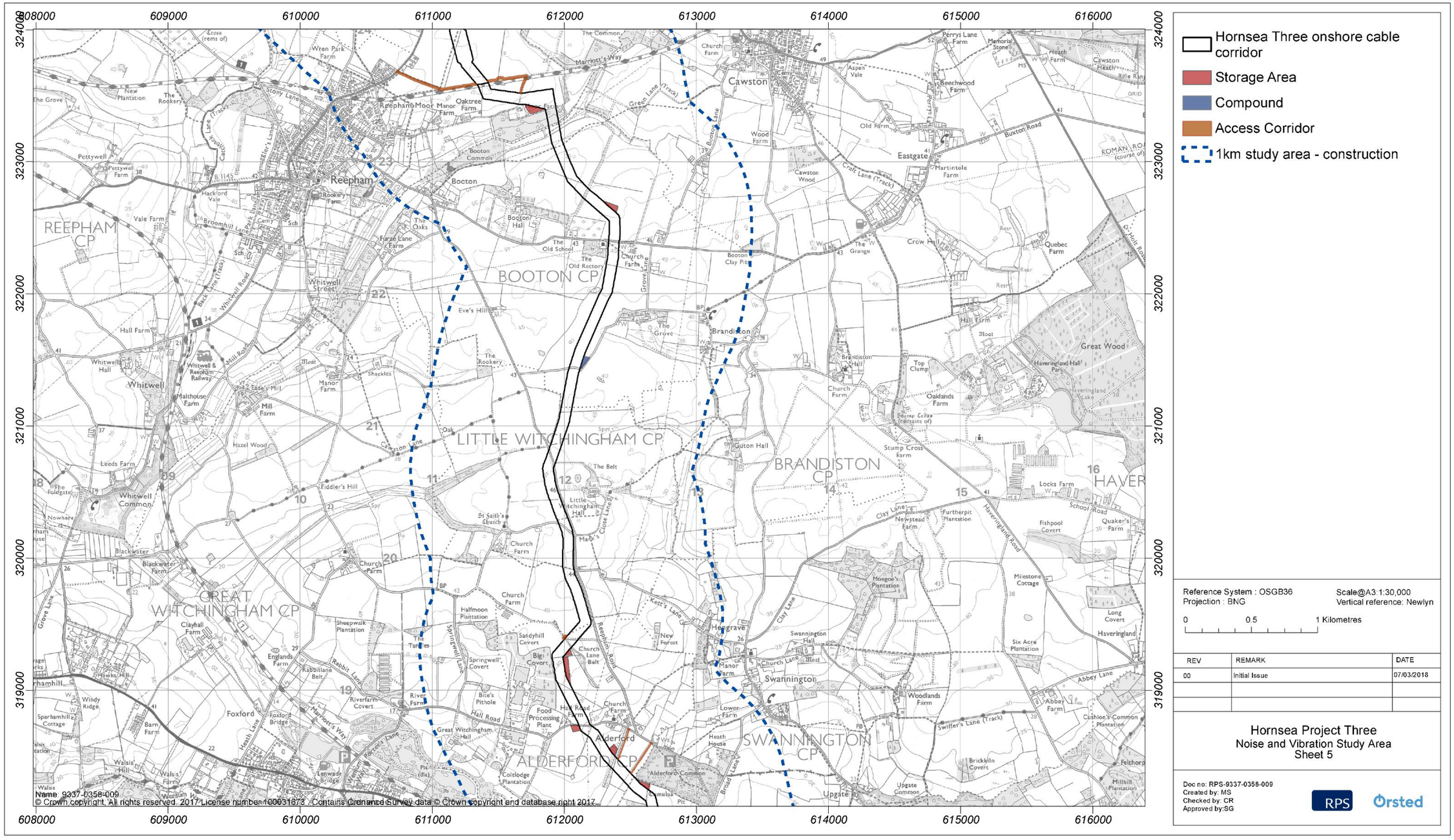

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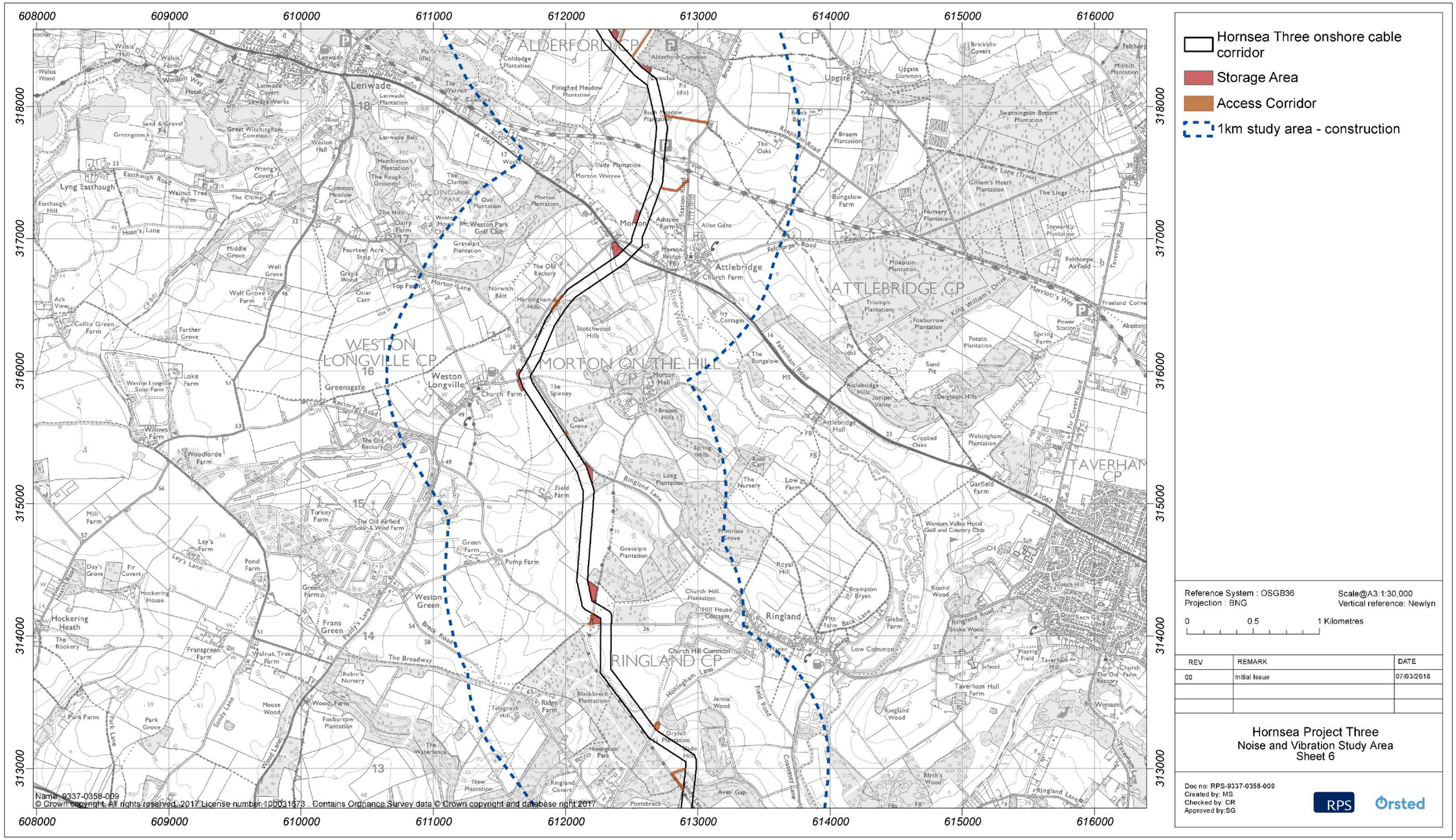

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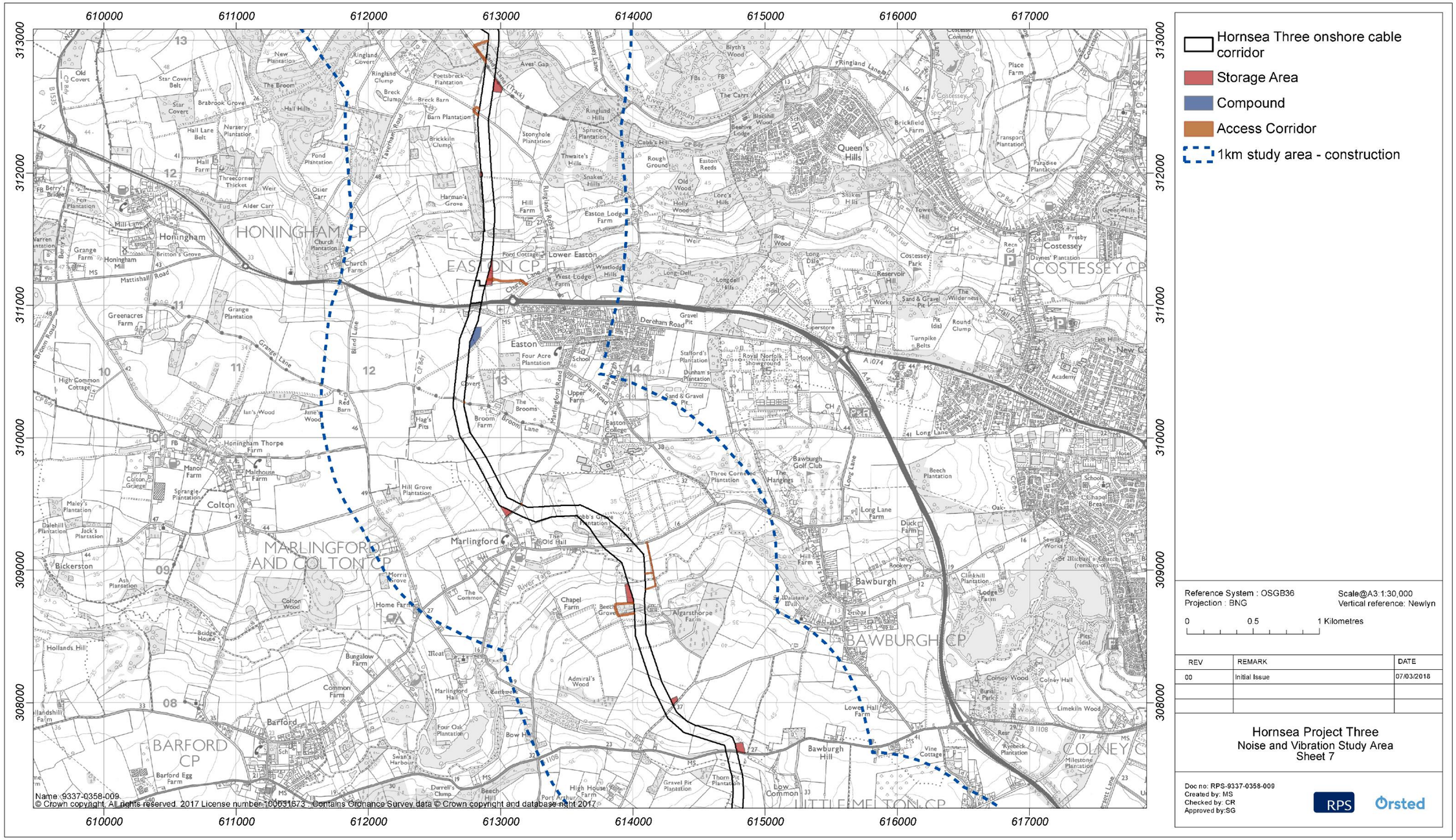

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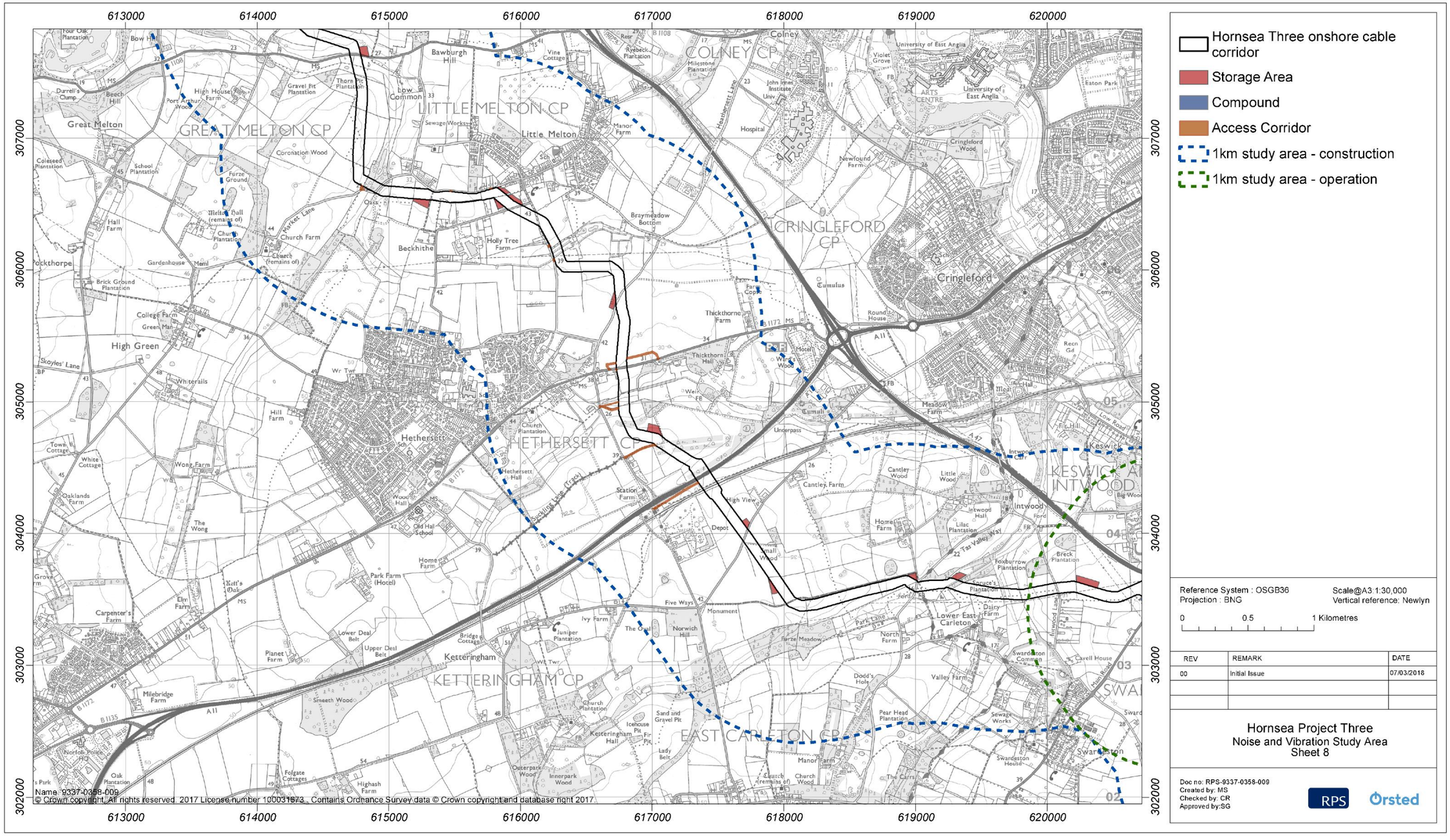

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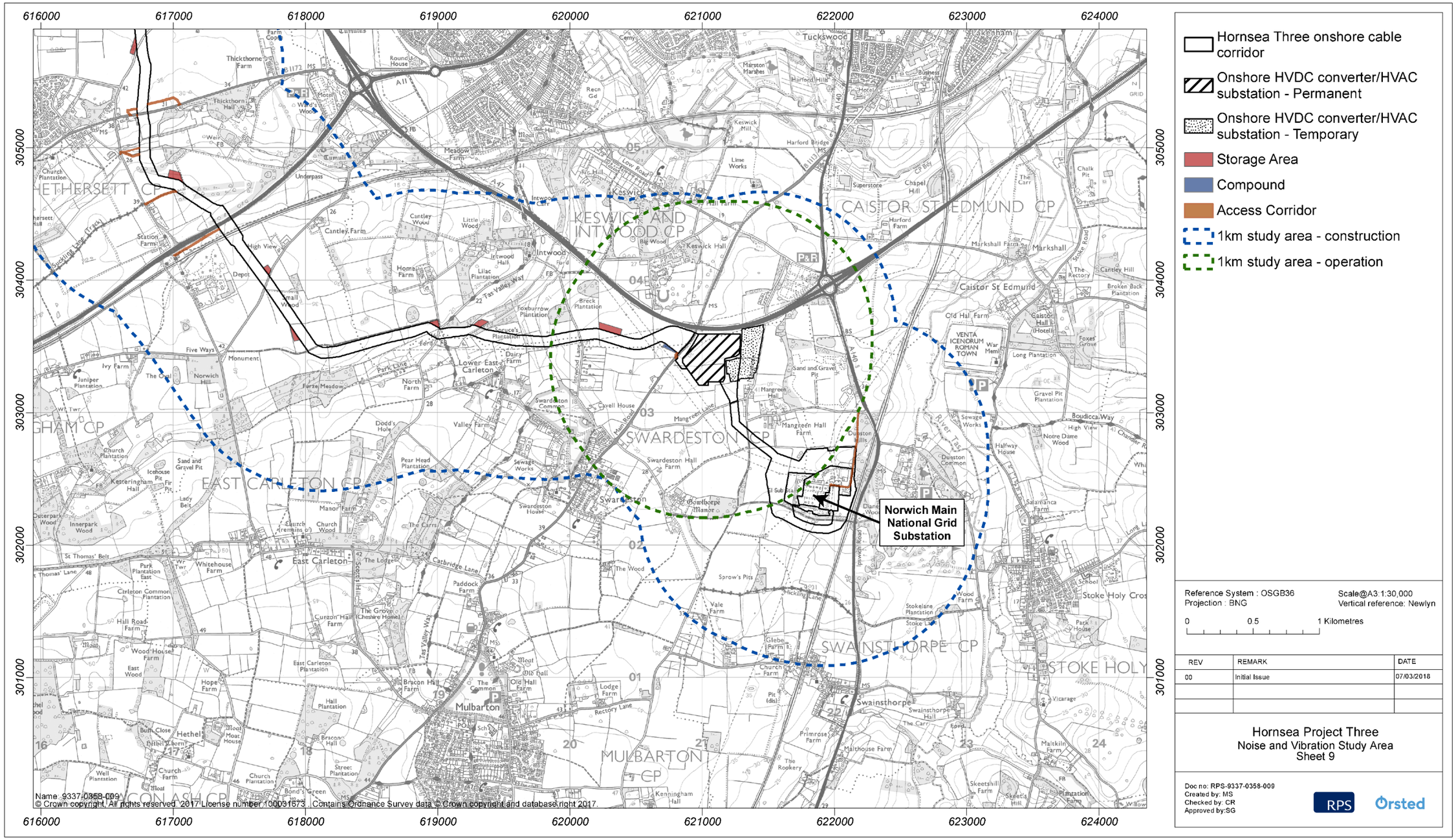

Figure 8.1: Hornsea Project Three noise and vibration study area.

8.4 Planning policy context

8.4.1 National Policy Statement

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) (Department of Energy and Climate Change (DECC), 2011a), the NPS for Renewable Energy Infrastructure (EN-3) DECC, 2011b) and the NPS for Electricity Networks Infrastructure (EN-5) (DECC, 2011c). The NPSs form the primary source of policy for NSIPs, supported by other relevant guidance.

8.4.1.2 Specifically, the guidance provided within the NPS EN-3 was considered. The general guidance (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-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.

8.4.1.5 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment, as well as a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 8.1.

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 Environment Statement
Paragraph 5.11.4 of NPS EN-1 identifies the elements that should be included in the noise assessment.	Construction, operation and maintenance, and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant British Standard (BS). The existing noise environment is described in volume 6, annex 8.1: Baseline Noise Survey. Construction impacts are assessed in section 8.12.1. Operation and maintenance impacts are assessed in section 8.12.2. Decommissioning impacts are assessed in section 8.12.3. Construction noise management is set out in the draft Outline Code of Construction Practice (CoCP (document reference A8.5)) with specific mitigation identified within this chapter as necessary. Residential receptors within the Hornsea Three noise and vibration study area are identified in volume 6, annex 8.2: Construction Noise Model Output for construction and volume 6, annex 8.4: Operational Noise Model Output for operation.
Paragraph 5.11.5 of NPS EN-1 refers to noise impacts from ancillary activities associated with the development, such as increased road traffic movements.	Construction and operational noise traffic assessments within Section 8.12 assess ancillary activities.
Paragraph 5.11.6 of NPS EN-1 refers to the need to assess operational noise using the principles of the relevant BSs, for example BS 4142 'Method for rating and assessing industrial and commercial sound' (British Standards Institution (BSI), 2014a)	Operation phases of Hornsea Three have been assessed using the principles in the relevant BSs (see section 8.9 for details of guidance documents). Operation and maintenance impacts are assessed in section 8.12.2.
Paragraph 5.11.7 of NPS EN-1 refers to the need to consult the 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. An indicative layout and the list of equipment is set out in volume 6, annex 8.3: Operational Noise Model Input, and annex 8.4: Operational Noise Model Output.
Paragraphs 5.11.9 to 5.11.13 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 are discussed in volume 6, annex 8.4: Operational Noise Model Output.

Summary of NPS EN-1 and NPS EN-3 policy on decision making (and mitigation)	How and where considered in the Environment Statement
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 maintenance and decommissioning phases of Hornsea Three have been assessed using the principles in the relevant BS. The assessment of the onshore elements of Hornsea Three is provided in section 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 BS.	The construction, operation and maintenance, 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 section 8.9. Construction impacts are assessed in section 8.12.1. Operational and maintenance 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 (Fritschi *et al.*, 2011); • Night Noise Guidelines for Europe (World Health Oragnisation, 2009); and • BS 8233 Guidance on sound insulation and noise reduction for buildings' (BS 8233) (BSI, 2014d).

8.4.2 Other relevant policies

8.4.2.1 A number of other policies are relevant to noise and vibration including:

- National Planning Policy Framework (NPPF) (Department for Communities and Local Government (DCLG), 2012);
- National Planning Practice Guidance (DCLG, 2014); and
- North Norfolk Core Strategy (North Norfolk District Council, 2008).

8.4.2.2 Key provisions of these policies are set out in Table 8.2 along with details as to how these have been addressed within the assessment. No relevant polices were identified with regards to Broadland District and South Norfolk District Councils.

Table 8.2: Summary of other relevant policies relevant to noise and vibration.

Summary of provision	How and where considered in the Environmental Statement
National Planning Policy Framework	
The NPPF states that: "*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.*" (paragraph 3)	The NPPF is consequently given lesser weight in this assessment.
The NPPF guidance relating directly to noise impacts states: *"Planning policies and decisions should aim to:* • *avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;* • *mitigate and reduce to a minimum other adverse impacts 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; 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.* *See Explanatory Note to the Noise Policy Statement for England (Department for the Environment, Food and Rural Affairs).* *Subject to the provisions of the Environmental Protection Act 1990 and other relevant law."* (paragraph 123)	Potential noise impacts on NSRs during construction, operation maintenance, and decommissioning phases are assessed in section 8.12. Where appropriate, possible mitigation measures have been suggested.

Summary of provision	How and where considered in the Environmental Statement
Local Planning Policy	
The North Norfolk Core Strategy (2008) 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…)*".	Potential noise impacts on NSRs during construction, operation maintenance, and decommissioning phases are assessed in section 8.12, while cumulative impacts are assessed in section 8.14.
Policy EN 13 of the North Norfolk Core Strategy states that "*all development proposals should minimise, and where possible reduce, all emissions and other forms of pollution, including… noise pollution*".	Measures to minimise and reduce noise impacts are outlined in this chapter. Measures which are inherent to the design are outlined in Table 8.21 and possible additional are included in section 8.12.

8.5 Consultation

8.5.1.1 Table 8.3 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 Environmental Statement or how the Applicant has had regard to them. Further information on the consultation activities undertaken for Hornsea Three can be found in the Consultation Report (document reference number A5.1) that accompanies the application for Development Consent.

8.5.1.2 Table 8.3 captures those key comments from statutory consultees that refer to the methodology and results of the assessment. Comments relating to other issues and from other stakeholders (e.g. parish councils, members of the public etc.) are presented in the Consultation Report which accompanies the DCO application (document reference A5.1).

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
December 2016	PINS – Scoping Opinion	Table 12.12 of the Scoping Report (see volume 4, annex 5.5: Scoping Report and PINS Scoping Opinion) 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 the Hornsea Three landfall area and onshore cable corridor is limited given that there would be no perceptible noise or vibration above the surface of the cable. Any routine maintenance requirements for the Hornsea Three onshore cable corridor and Hornsea Three landfall area 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 from paragraphs 8.12.2.1). Effects on birds are assessed in volume 2, chapter 5: Offshore Ornithology and 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 Hornsea Three landfall area.
		The Environmental Statement should clearly set out the reasoning for the Hornsea Three noise and vibration study area, explaining how any boundary is justified. Currently the study area does not include any areas outside of the Hornsea Three onshore cable 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 Hornsea Three noise and vibration study areas are defined in section 8.3 and extend to 1 km from the onshore elements of Hornsea Three and the compounds, storage areas and accesses. As a result, the study area will capture the noise impacts of works near to settlements. The extent of the Hornsea Three noise and vibration study area follows guidance from DMRB and professional judgment of the distances over which significant noise effects may occur.
		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 Survey and discussion/agreement reached with the local authorities and environmental health officers (EHOs).
		The Scoping Report (see volume 4, annex 5.5: Scoping Report and PINS Scoping Opinion) 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. Survey methodology and results are provided in volume 6, annex 8.1: Baseline Noise Survey. The survey locations were agreed with North Norfolk and South Norfolk District Councils.
		The Scoping Report at paragraph 12.5.6 (see volume 4, annex 5.5: Scoping Report and PINS Scoping Opinion) 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 due to the lack of baseline data from other developments in the Hornsea Three noise and vibration study areas at the onshore HVAC booster station and HVDC converter/HVAC substation. The assessment now relies upon survey data undertaken specifically for Hornsea Three, as documented in volume 6, annex 8.1: Baseline Noise Survey.
		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 (see volume 4, annex 5.5: Scoping Report and PINS Scoping Opinion) sets out that an Outline CoCP (document reference A8.5) 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 is set out in the Outline CoCP (document reference A8.5), which accompanies the DCO application. Although a "noise mitigation plan" as such is not being proposed for construction, more detailed construction noise measures will be developed for specific construction activities and agreed with the relevant local authorities through the CoCP prior to construction works commencing. The type(s) of mitigation to be implemented at the onshore HVDC converter/HVAC substation will be agreed and demonstrated to be sufficient during detailed design.
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 are provided in volume 6, annex 8.1: Baseline Noise Survey.
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 are provided in volume 6, annex 8.1: Baseline Noise Survey.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
June 2017	South Norfolk District Council – meeting	Discussion of the noise assessment, 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).	The indicative layout of the onshore HVDC converter/HVAC substation has been assessed and a noise threshold has been identified below which significant effects would not occur. Mitigation would be applied to achieve this threshold (see volume 6, annex 8.4: Operational Noise Model Output). An operational Noise Management Plan (NMP) would be prepared post consent. This indicative layout/design has been modelled in the absence of detailed design, however the mitigation has been identified in such a way that even if the chosen layout or design would result in a greater noise at source (under unmitigated scenario), sufficient mitigation would be put in place to maintain impacts that are not materially different or greater.
June 2017	North Norfolk District Council - meeting	Discussion of the noise assessment, 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.	The indicative layout of the onshore HVAC booster station has been assessed and a noise threshold has been identified below which significant effects would not occur (see volume 6, annex 8.4: Operational Noise Model Output). An operational NMP would be prepared post consent. Designed in mitigation measures are set out in Table 8.21. This indicative layout/design has been modelled in the absence of detailed design, however the mitigation has been identified in such a way that even if the chosen layout or design would result in a greater noise at source (under unmitigated scenario), sufficient mitigation would be put in place to maintain impacts that are not materially different or greater.
September 2017	Norfolk County Council– Section 42 Response	The Local Member strongly urges the County Council to insist that the developers provide detailed mitigating measures as part of their submission in respect of: height, visibility and noise – relating to the HVAC booster station at Little Barningham.	The indicative layout of the onshore HVAC booster station has been assessed and a noise threshold has been identified below which significant effects would not occur (see volume 6, annex 8.4: Operational Noise Model Output). An operational NMP would be prepared post consent. Designed in mitigation measures are set out in Table 8.21. This indicative layout/design has been modelled in the absence of detailed design, however the mitigation has been identified in such a way that even if the chosen layout or design would result in a greater noise at source (under unmitigated scenario), sufficient mitigation would be put in place to maintain impacts that are not materially different or greater. Landscape and Visual effects are assessed in chapter 4: Landscape and Visual Resources.
September 2017	Broadland District Council – Section 42 Response	The impact on local communities and residential amenities as a result of the increased vehicular activity including heavy plant associated with the construction phases of the onshore export cable route including the removal of excavated material, the delivery of large sections of cables and the traffic movements associated with delivering backfill material. In addition, the impact of the traffic movements being centred around the identified temporary construction compounds and the additional construction compounds that the PEIR states 'will be required to facilitate the construction process will be identified in the Environmental Statement' and the resulting noise disturbance/light pollution in these locations and traffic routes that are in close proximity to residential properties. Figure 8.1 on page. 8 of Chapter 8 - Noise and vibration does not include the main compound identified at Oulton Street or the alternative cable route west of Salle Park within the 1 km noise and vibration study area buffer as shown in the 'Phase 2 Statutory Consultation Plan'. The district Council expects the imposition of conditions to set out the permitted hours of working, permitted activities at the temporary construction compounds and maximum permitted noise levels to reduce the impact on the nearby local communities.	The PEIR did not assess the noise impacts from the compound or the alternative cable corridor west of Salle Park. The onshore cable corridor has been refined since the PEIR and the alternatives have been incorporated. A construction compound strategy has been developed that identifies the proposed use and location of the compounds. Noise impacts caused by traffic movements including at the compounds are assessed in section 8.12.1, and in volume 6, annex 8.2: Construction Noise Model Output. The locations of the compounds are shown in Figure 8.1. Measures which will be implemented during the construction phase are set out in the Outline CoCP (document reference A8.5) which accompanies the application. The Outline CoCP identifies proposed working hours and standard management measures. This chapter assess potential noise impacts which may occur as a result of changes in traffic during construction on the local road network (section 8.12.1). Impacts on traffic are assessed in chapter 7: Traffic and Transport.
September 2017	North Norfolk District Council – Section 42 Response	The PEIR indicates that the HVAC booster station will be screen planted and this is welcomed. Further, the District Council would expect opportunities to enclose the HVAC site in woodland planting to be explored so as to help address potential noise impacts associated with these facilities.	Details of the landscape planting are provided in the Outline Landscape Management Plan (document reference A8.7) which accompanies the DCO application. The effect of screening due to the proposed landscape planting has not been included in the operational noise model to ensure a maximum design scenario is assessed. The indicative layout of the HVAC booster station assumes that the equipment will be enclosed (see volume 6, annex 8.3: Operational Noise Model Input). The results of the noise assessment are presented in volume 6, annex 8.4: Operational Noise Model Output.

Date	Consultee and type of response	Issues raised	Response to issue raised and/or where considered in this chapter
		Whilst further detail is still to be provided as to specifics of the construction process, the Council's Environmental Protection Manager is content with work being undertaken by DONG Energy for assessing noise impacts from this activity.	Noise from the construction process is set out in volume 6, annex 8.2: Construction Noise Model Output and assessed within this chapter.
		The Horizontal Directional Drilling (HDD) process involves mechanical drilling which can create noise and vibration impacts. It will be important for the final Environmental Statement to set out the details of where HDD is proposed and identify the vibration and noise sensitive receptors that could be affected and any mitigation that may be necessary to minimise adverse impacts.	The proposed location of the HDDs and predicted noise and vibration levels are identified in volume 6, annex 8.2: Construction Noise Model Output. Mitigation measures such as core working hours are set out in the Outline CoCP (document reference A8.5). Construction noise management measures will be agreed with the relevant local authorities prior to the start of construction.
		The Council's Environmental Protection Manager remains confident that the noise levels from equipment and cooling fans at the HVAC booster station can be reduced to a position there would be no impact on the local community as they are only just over background noise levels and could be sufficiently reduced through effective design.	The indicative layout of the HVAC booster station assumes that the equipment will be enclosed (see volume 6, annex 8.3: Operational Noise Model Input). The results of the noise assessment are presented in volume 6, annex 8.4: Operational Noise Model Output.
September 2017	South Norfolk District Council – Section 42 Response	Noise from the construction phase has the potential to have an impact on the residents of the surrounding area. The PEIR outlines measures that will be taken to address this issue which are considered acceptable but the detail will need to be agreed at the appropriate time. Noise from the infrastructure is Low Frequency Noise (particularly in the 50Hz third octave band) which tends to be associated with electrical equipment (e.g. transformers). The PEIR outlines measures that will be taken to address this issue which are considered acceptable but the detail will need to be agreed at the appropriate time.	Since the PEIR, the construction model has been refined to include construction traffic flows and further information on the construction process and location and use of compounds. As a result, the assessment of noise impacts is more detailed. Measures to manage construction impacts are set out in the Outline CoCP (document reference A8.5) and more detailed construction noise management measures will be agreed with the relevant local authorities prior to the start of construction.

8.6 Methodology to inform the baseline

8.6.1 Desktop study

8.6.1.1 Baseline information on noise and vibration within the Hornsea Three noise and vibration study area was collected through a detailed review of datasets. These are summarised in Table 8.4.

Table 8.4: Summary of key desktop sources.

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

8.6.1.2 Those noise sensitive receptors identified are outline in volume 6, annexes 8.2: Construction Noise Model Output and 8.4: Operational Noise Model Output.

8.6.2 Site specific surveys

8.6.2.1 In order to inform the noise assessment and supplement the desk top study, site specific surveys were undertaken in March 2017 to establish baseline noise levels in the vicinity of proposed operational plant. Where existing noise levels are generally low, construction criteria are independent of the precise noise levels, and this determined to be the case during the scoping of the surveys. Consequently, no noise surveys were undertaken for locations where only construction noise was predicted to be generated.

8.6.2.2 The surveys were undertaken at 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). Three noise survey locations were selected (two at the proposed onshore HVAC booster station and one at the HVDC converter/HVAC substation) as described in Table 8.5. Details of the survey scope and methodology was discussed and agreed with North Norfolk District Council and South Norfolk District Council prior to deployment of the monitoring equipment. Broadland District Council were not consulted, as no surveys were proposed for those areas. The scope, methodology, results of the surveys, and survey locations (Figures 2.1 and 2.2) are set out in volume 6, annex 8.1: Baseline Noise Survey.

Table 8.5: Survey Locations and Duration.

Location Reference	Address	Start	End	Notes
4	House on the Hill, Main Rd, Swardeston, Norwich NR14 8DU, UK	08/03/2017 11:55	17/03/2017 10:57	None
8	Off 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
9	Fuel Farm, Barningham Road, Edgefield, Melton Constable NR24 2AW, UK	08/03/2017 13:45	17/03/2017 12:23	None

8.6.2.3 Data collected at locations previously considered for the HVAC booster station and HVDC converter/HVAC substation (Locations 1-3 and 5-7), see volume 1, chapter 4: Site Selection and Consideration of Alternatives, have not directly been used in the noise assessment, but have been included in volume 6, annex 8.1: Baseline Noise Survey to provide context of the baseline noise in the wider area.

Equipment Issues

8.6.2.4 The monitor at location 8 was found 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. Data collected at this location between the 17 and 22 March is considered representative of this survey location, and as such, equipment issues are not considered to have affected the robustness of the baseline data.

Access Issues

8.6.2.5 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. However, landowners did not grant access and no recordings were taken. It is considered, however, that the location 4, where recordings were taken, is representative of all residential properties in the vicinity of the HVDC converter/HVAC substation. The location which was surveyed is likely to have the lowest baseline noise levels (due to orientation with the A47) and as such only having data from there for the assessment is considered precautionary and no additional monitoring was considered necessary.

Instrumentation

8.6.2.6 Sound level measurements were made using a ‘Class 1’ Rion NL-52 sound level meter 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).

8.6.2.7 Baseline measurements were taken following the guidance set out in BS 4142:2014 (BSI, 2014a) and in accordance with BS 7445-2:1991. 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"*.

8.6.2.8 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.

Meteorological conditions

8.6.2.9 Weather data was obtained from temporary meteorological stations established near two of the noise survey locations. These data were used to ensure that wind speeds and rainfall were broadly within the limits specified in BS 4142:2014, which 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*". Where exceedances of these thresholds occurred, noise data was considered and removed from the dataset where appropriate to ensure compliance with the Standard.

Further surveys

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

8.6.2.11 Traffic surveys were undertaken in 2017 to predict changes in traffic levels during construction (see chapter 7: Traffic and Transport and volume 6, annex 7.3: Base Traffic Flows). The traffic data was used to assess the noise impacts from construction traffic and is presented in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.6: Summary of site-specific surveys.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Hornsea Three onshore baseline noise surveys	Representative locations at the proposed onshore HVAC booster station and HVDC converter/HVAC substation areas.	An unattended noise survey at three locations using a sound level meter collecting sound level measurements over a period of nine consecutive days at locations 4 and 9, and five consecutive days at location 8.	RPS	March 2017	Volume 6, annex 8.1: Baseline Noise Survey.
Baseline traffic flows	Automatic Traffic Counters (ATCs) deployed on various public highways surrounding the proposed onshore HVAC booster station and HVDC converter/HVAC substation areas.	ATCs deployed at locations on public highways surrounding the proposed sites.	Countsequential	July 2017	Chapter 7: Traffic and Transport and volume 6, annex 7.3: Base Traffic Flows.

8.7 Baseline environment

8.7.1 Measured baseline sound levels

8.7.1.1 The measured baseline data as well as the adopted representative sound levels are presented in volume 6, annex 8.1: Baseline Noise Survey. Daytime and night-time measured sound levels are summarised in Table 8.7 and Table 8.8 below.

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

Site	Location	Measured Sound Levels, dB				
		$L_{Aeq, 16hr}$	L_{AFmax}	$L_{A10, 16hr}$	$L_{A50, 16hr}$	$L_{A90, 16hr}$
Onshore HVDC converter/HVAC substation	4	55	94	55	50	44
Onshore HVAC booster station	8	54	91	55	45	33
	9	52	89	49	39	28

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

Site	Location	Measured Sound Levels, dB				
		$L_{Aeq, 8hr}$	L_{AFmax}	$L_{A10, 8hr}$	$L_{A50, 8hr}$	$L_{A90, 8hr}$
Onshore HVDC converter/HVAC substation	4	49	87	50	37	29
Onshore HVAC booster station	8	43	83	45	40	33
	9	48	88	42	22	18

8.7.2 Designated sites

8.7.2.1 There are no international, national or local designations specifically related to noise and vibration. It should be noted, however, that low noise levels within rural areas and areas of specific natural interest (such as public access woodland) are often key features of the environment and as such, should be considered in the determination of significance of noise impacts on receptors within these areas.

8.7.3 Future baseline scenario

8.7.3.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that *"an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge"* is included within the Environmental Statement.

8.7.3.2 In the event that Hornsea Three does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

8.7.3.3 No significant change to the future baseline scenario, in the absence of Hornsea Three, is anticipated. There is no evidence to suggest receptors would be introduced which would be closer than those which we have assessed; therefore, the assessment is considered to have taken a maximum design scenario approach.

8.7.3.4 The future baseline traffic data indicates that there would be a minor increase in baseline noise levels from road traffic due to natural growth. However, the increases are very low and are unlikely to have an influence on the assessment. Therefore, these changes have only been accounted for within the noise assessments considering road traffic as they are unlikely to influence the assessment undertaken in this chapter.

8.7.4 Data limitations

Baseline sound survey data

8.7.4.1 Baseline sound survey data is presented in volume 6, annex 8.1: Baseline Noise Survey.

8.7.4.2 Ambient and background sound levels are subject to seasonal variations due to a number of factors (e.g. wind and rain); the metrics derived from the noise monitoring, however, reduce the effects of seasonal variation. Baseline sound monitoring was undertaken in March 2017. As detailed in section 8.6, a 'representative' background L_{A90} 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. No significant seasonal variation in noise attenuation occurs.

8.7.4.3 If the baseline sound surveys were repeated, it is possible that the measured sound levels would be slightly different due to seasonal variations and variations in repeatability/reproducibility. However, this limitation has been managed by adopting a 'representative' background L_{A90} 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, BS 7445:2003 and BS 4142:2014.

Construction methodology

8.7.4.4 Details of the indicative plant, sound sources and programme are provided in volume 6, annex 8.2: Construction Noise Model Output. The specific 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.

Sound source data

8.7.4.5 Details of the indicative construction plant to be used during the construction of Hornsea Three (with regards to noise) are provided in volume 6, annex 8.2: Construction Noise Model Output. Details of the indicative components used to calculate the operational noise for the onshore HVAC booster station and HVDC converter/HVAC substation are set out in volume 6, annex 8.3: Operational Noise Model Input and described in volume 1, chapter 3: Project Description.

8.7.4.6 The operational noise assessment is based on indicative layouts of the onshore HVAC booster station and HVDC converter/HVAC substation. This is a standard approach and is considered to be an acceptable and robust method. Unless otherwise specified, all plant is assumed to be outside and unscreened as this represents the maximum design scenario.

Prediction methods

8.7.4.7 There are uncertainties in any prediction methodology. ISO 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. For a mean source height between 5 and 30 m, the estimated accuracy is given as +/-1 dB for a source/propagation separation distance of 0 to 100 m and +/-3 dB for a source/propagation separation distance of >100 m. This is a standard approach and is considered to be an acceptable prediction methodology. The full results of the predictions are provided in volume 6, annex 8.4: Operational Noise Model Output.

8.8 Key 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 within the noise and vibration study area. These scenarios have been selected from the details provided in the project description (volume 1, chapter 3: Project Description). The NSRs included within the assessment have been identified from Ordnance Survey mapping and Ordnance Survey Address Base data and are listed and shown in volume 6, annex 8.4: Operational Noise Model Output. 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 results of the noise and vibration assessment have been used to inform the design layout and mitigation strategy of the onshore HVDC converter/HVAC substation and onshore HVAC booster station.

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 open cut cable installation during construction may affect receptors sensitive to noise or vibration. The temporary impact of cable installation by HDD (excluding duct installation at the Hornsea Three landfall area) may affect receptors sensitive to noise or vibration.	<u>Hornsea Three onshore cable corridor</u> • Up to 1,650,000 m^2 (5 m x 55,000 m x 6) from installation of up to six cable trenches; • On average 0.6 m stabilised backfill in each 2 m deep trench; • Up to 99,000 m^2 from jointing bays (based on 440 jointing bays (each jointing bay is 9 m x 25 m)). • Up to 3,960 m^2 from link boxes (based on 440 link boxes (each link box: is 3 m x 3 m)). Link boxes are permanent sub surface structures; • Up to 396,000 m^2 from installation of temporary haul road/accesses (6 m x 66,000 m per phase); • Up to 120 HDD locations per phase (up to 105 minor HDDs and 15 major HDDs per phase), up to 54,000 m^2 from major HDD compounds (based on 15 HDD compounds (each compound is 60 m x 60 m); • Up to five secondary compounds; • Up to 55 storage areas; and • The haul road would be surfaced with aggregate on geotextile and would be removed at the end of each construction phase. The maximum duration over which construction could occur at the onshore cable corridor would be 5.5 years incorporating two phases (assuming a three-year gap between the two phases). The work in each phase is expected to progress along the Hornsea Three onshore cable corridor with a typical active construction works duration of three months at any particular location.	The maximum design scenario for noise and vibration for the installation of the Hornsea Three onshore cable corridor 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 Hornsea Three onshore 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 at the Hornsea Three landfall area may affect receptors sensitive to noise or vibration.	<u>Hornsea Three landfall area</u> HDD at the Hornsea Three landfall area including: • Up to 42,000 m^2 compound area and up to 1,500 m^2 from transition joint bays (based on 250 m^2 x 6); and • Up to six cables. The maximum duration over which works could occur at the landfall would be 5.5 years (assuming a three year gap between the two phases).	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 Hornsea Three landfall area, 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 Hornsea Three onshore cable corridor may affect receptors sensitive to noise or vibration.	Construction accesses would be required from the Hornsea Three onshore cable corridor to the existing road network. The haul road would be surfaced with aggregate on geotextile and would be removed at the end of each construction phase.	The maximum design scenario for noise and vibration would assume a 360° tracked excavator and a dump truck.

Potential impact	Maximum design scenario	Justification
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 HVAC booster station</u> Up to 30,407m^2 for permanent area of site plus a temporary works area up to 25,000 m^2. Maximum building footprint of 9,000 m^2 (based on single building scenario (120 m length and 75 m width) and height up to 12.5 m). Up to 30,000 m^3 excavated for basement (based on 5m deep and area of 6,000 m^2). The maximum duration over which construction could occur at the onshore HVAC booster station would be five years incorporating two phases assuming a three-year gap with no active construction activity between the two phases. <u>Onshore HVDC converter/HVAC substation</u> Up to 149,302 m^2 for permanent area of site (including an area which may be used for landscaping) plus a temporary works area of 91,000 m^2. Maximum building dimensions: up to 220 m length, 75 m width and 25 m height for main buildings. The maximum duration over which construction could occur at the onshore HVDC converter/HVAC substation would be six years incorporating two phases assuming a three-year gap with between the two phases.	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 has been undertaken based on typical construction activities for this type of infrastructure. The dimensions of the main buildings at the onshore HVDC converter/HVAC substation represent the maximum design scenario for noise and vibration as it represents the largest area of disturbance. 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.
Operation and maintenance phase		
The operational impact of the 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. Noise assessment assumes the maximum design scenario of the noisiest components located closest to the most sensitive receptors as shown on the indicative layout.	The maximum design scenario for noise and vibration assumes that mitigation will be provided to achieve a noise threshold at the surrounding NSRs.
The operational impact of the 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. Noise assessment assumes the maximum design scenario of the noisiest components located closest to the most sensitive receptors. Indicative layout assumes that equipment will be located within open-roofed enclosures.	The maximum design scenario for noise and vibration assumes that building enclosures will be provided around the onshore HVAC booster station as shown on the indicative layout.
Decommissioning phase		
The temporary impact of onshore HVDC converter/HVAC substation and HVAC booster station 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	
Vibration associated with the construction of the Hornsea Three onshore cable corridor.	No significant vibration-generation plant will be used during the trenched cable construction process. All HDD 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 from buried cable.	Based on professional experience it is considered that the buried cable will generate no perceptible noise above the surface.
Operational vibration.	Operational vibration from the onshore HVAC booster station and HVDC converter/HVAC substation will be controlled at source and is unlikely to be perceptible beyond the immediate structure of the buildings. No vibration would be generated by the operational cable. Consequently, no assessment criteria are provided.
Vehicle movements associated with operation and maintenance of the onshore infrastructure.	It is predicted that as a result of the operation and maintenance of the onshore infrastructure, vehicle movements on the local highway network will not significantly increase (see chapter 7: Traffic and Transport). As such, it is considered that the operation of the onshore infrastructure will generate a negligible increase in road traffic noise levels (less than 1 dB) as a result of 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.	Routine maintenance will generate no significant noise or vibration.
Decommissioning phase	
Noise and vibration associated with decommissioning of the Hornsea Three onshore cable corridor.	The onshore cable will remain in situ, therefore no significantly noisy or vibration-generation plant will be required for the decommissioning of the Hornsea Three onshore cable. Decommissioning of other onshore infrastructure is considered within this chapter.

8.9 Impact assessment methodology

8.9.1 Overview

8.9.1.1 The chapter has followed the methodology set out in volume 1, chapter 5: Environmental Impact Assessment Methodology. Specific to the noise and vibration assessment, the following guidance documents have also been considered:

- BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' (BSI, 2014b);
- 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' (BSI, 1993);
- BS 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BSI, 2014e);
- International Standard (ISO) 9613-2:1996 'Acoustics: Attenuation of sound during propagation outdoors. Part 2: General method of calculation' (ISO, 1996);
- DMRB, Volume 11, Section 3, Part 7 'Noise and Vibration' (Highways Agency, 2011);
- National Planning Practice Guidance – Noise (DCLG, 2014); and
- NPSE (2010).

8.9.1.2 In addition, the noise and vibration EIA has considered the legislative framework as defined by:

- Environmental Noise Directive (2002/49EC); and
- Control of Pollution Act (1974).

8.9.2 Impact assessment criteria

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. 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.

Sensitivity

8.9.2.2 There is no nationally adopted guidance on how the sensitivities of NSRs should be determined. Therefore for this chapter, the sensitivity of classes of receptor is defined through consideration of the vulnerability, recoverability and value/importance of that receptor class. The criteria for defining sensitivity in this chapter are outlined in Table 8.11.

8.9.2.3 Site-specific information may not always match the description provided in Table 8.11 and therefore, professional judgement has also been used to determine which level of sensitivity is appropriate. The allocation of residential properties to medium sensitivity reflects their adaptability to noise and allows for an appropriate match between the magnitude of impact and significance of effect within the adopted guidance and criteria; consequently, for a 'typical receptor', a moderate impact would have a moderate effect.

Table 8.11: Definition of terms relating to the sensitivity of the receptor.

Sensitivity	Typical NSRs Identified
Very High	Subject to particular circumstance: Theatres, Auditoria and Studios.
High	Subject to particular circumstance: Theatres, Auditoria, Studios and Schools during the daytime. Hospitals, residential care homes.
Medium	Residential properties.
Low	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.

Magnitude

Noise and Vibration assessment criteria for magnitude

8.9.2.4 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. The noise and vibration threshold criteria identified within this section has been used to inform the impact assessment criteria in section 8.9.2 of this report.

Construction noise

8.9.2.5 The magnitude of construction noise impacts has been determined in accordance with Annex E of BS 5228-1:2009+A1:2014. The 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; 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.*"

8.9.2.6 From this, the existing representative noise levels (i.e., the *pre-construction ambient noise* above) across Hornsea Three are used to determine appropriate construction noise limits. In practice, however, for a quiet area such as the Hornsea Three noise and vibration study area, fixed lower construction noise limits are adopted, independent of existing noise levels.

8.9.2.7 Table 8.12 summarises the criteria that have been used for the assessment of construction noise impacts for residential dwellings and other NSRs of medium and high sensitivity, based on the guidance in BS 5228-1:2009+A1:2014. Determination of impact also includes consideration of duration, absolute noise levels and management of the noise sources, all of which make up the context. For NSRs that have low sensitivity, professional judgement has been applied to determine the overall level of impact.

Table 8.12: 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})	Impact Magnitude Threshold value [a] (dB)			
	No/Negligible	Minor Adverse	Moderate Adverse	Major Adverse
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

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

8.9.2.8 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 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. The average percentage on-time comes from estimates of the time that the plant will be operating at full power.

8.9.2.9 Where predicted construction noise levels are <5 dB below the lower cut-off values stated above for the relevant time period, or of short duration (<1 month), there is considered to be 'no change' or a negligible magnitude of impact.

8.9.2.10 For works of significant duration (>1 month) where predicted noise levels are between 5 dB below and equal to the lower cut-off values, this is considered to result in a minor adverse impact depending on the context and duration of the works. Where the lower cut-off values are exceeded by up to 10 dB, this is considered to be a moderate adverse impact depending on the context and duration of the works. Predicted noise levels greater than 10 dB above the lower cut-off values are considered to result in a major adverse magnitude of impact depending on the context and duration of the works.

8.9.2.11 For the majority of NSRs, noise levels are likely to result in the criteria set within the lower cut-off values given in Table 8.12 above, (i.e. the most stringent limits). As such, the lower cut-off values are used throughout the construction assessment. This follows a precautionary approach.

Construction traffic

8.9.2.12 The noise changes identified in Table 8.13 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 Hornsea Three. 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. These DMRB criteria best reflect the temporary nature of the construction impacts; the short term response to a temporary change is found to best match the long-term response to a permanent change.

Table 8.13: Classification of magnitude of temporary noise impacts within DMRB.

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

Construction vibration

8.9.2.13 Criteria for assessing construction vibration are provided in BS 5228-2:2009+A1:2014. Table 8.14 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 impacts on human receptors.

Table 8.14: Guidance on impacts of vibration levels.

Magnitude of Impact	Peak Particle Velocity	Description
Negligible	>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.
Minor	>0.3 mm/s	Vibration might just be perceptible in residential environments.
Moderate	>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.
Major	>10 mm/s	Vibration is likely to be intolerable for any more than a brief exposure to this level.

8.9.2.14 Vibration from construction activities may impact on adjacent buildings. The criteria set out in Table 8.15 have been used in this assessment and relate to the potential for cosmetic damage, based on the vibration limits contained within BS 5228-2:2009+A1:2014. Minor structural damage is possible at vibration levels that are greater than twice those given in Table 8.15, whilst major structural damage may occur at values greater than four times the tabulated values. The criteria set out in Table 8.15 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 8.15: Threshold vibration values for the evaluation of cosmetic building damage.

Building Classification	Frequency of Range of Vibration (Hz)	PPV mm/s [a]	
		Transient Vibration	Continuous Vibration
Unreinforced or light framed structures [b] Residential or light commercial type buildings [b]	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
	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
[a] Values relate to the base of the building.			
[b] 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

8.9.2.15 The magnitude of noise impacts 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.

8.9.2.16 From the above and following the guidance in BS 4142:2014, Table 8.16 can be used to define the magnitude of impact.

8.9.2.17 The noise assessment methodology for the operation of the onshore HVAC booster station and HVDC converter/HVAC substation 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.

Table 8.16: Operational noise - determination of magnitude of impact

Magnitude of Impact	Difference between Rating Level and Background Noise Level	BS 4142 Semantic Description
Major	> 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.
Moderate	5 to 10 dB	A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
Minor	0 to 5 dB	Where the rating level does not exceed the

Magnitude of Impact	Difference between Rating Level and Background Noise Level	BS 4142 Semantic Description
Negligible	-10 to 0 dB	background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
No change	< -10 dB	-

8.9.2.18 The assessment criteria for operational noise above is determined not only on the basis of the initial estimate of impact significance from the numerical BS 4142:2014 assessment, but also with reference to the examples of outcomes described within the National Planning Practice Guidance – Noise (PPG-N), considered the context of the sound. It is necessary to consider all pertinent factors, including:

- the absolute level of the sound;
- the character and level of the residual sound compared to the character and level of the specific sound; and
- the sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

National Planning Practice Guidance

8.9.2.19 The PPG-N reiterates general guidance on noise policy and assessment methods provided in the NPPF, NPSE and BSs, 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 8.17.

Table 8.17: 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

8.9.2.20 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 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.

8.9.2.21 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.

8.9.2.22 The PPG-N advises that noise exposures above the Significant Observed Effect Level (SOAEL) cause material changes in behaviour. An example of noise exposures above the SOAEL provided in the PPG-N 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 impacts 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.

8.9.2.23 As a guiding principle, magnitudes of impact have been ranked none, negligible or minor for impacts within current guidelines; moderate for effects marginally exceeding current guidelines; and major for effects significantly exceeding current guidelines (Table 8.18).

Table 8.18: 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	

Terms of magnitude used in this chapter

8.9.2.24 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)*".

8.9.2.25 Based on RPS professional judgement, it is considered that (for the construction phase, operation and maintenance 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.

8.9.2.26 The criteria for defining magnitude in this chapter are outlined in Table 8.19. This builds on the criteria provided in Table 8.16, Table 8.17 and Table 8.18. The magnitude of the impact is defined through consideration of the spatial extent, duration, frequency and reversibility of that impact. The descriptions in Table 8.19 inform professional judgement to pull together the disparate magnitudes of impact for construction vibration and operation into a single magnitude of impact table.

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.

Significance

8.9.2.27 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.

8.9.2.28 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					
Sensitivity of receptor		***No change***	***Negligible***	***Minor***	***Moderate***	***Major***
	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.

8.10.1.2 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.

8.10.1.3 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.

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

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). As there is a commitment to implementing these measures, they are considered inherently part of the design of Hornsea Three and have therefore been considered in the assessment presented in section 8.12 below (i.e. the determination of magnitude and therefore significance assumes implementation of these measures). These measures are considered standard industry practice for this type of development.

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

Measures adopted as part of Hornsea Three	Justification
Best Practicable Means, 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.
Construction noise management measures for specific construction activities will be agreed with the relevant local authorities prior to the start of construction and added to the CoCP.	To ensure compliance with local authority requirements.
Mitigation will be developed during the detailed design stage of the onshore HVDC converter/HVAC substation to achieve a noise rating level not exceeding 34 dB $L_{Ar,Tr}$ at any surrounding residential NSR.	To ensure no significant operational noise effects caused by the onshore HVDC converter/HVAC substation.
Prior to the start of noise generating works an Operational NMP will be agreed with the relevant local planning authority.	To ensure compliance with local authority requirements.

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 potential impacts arising from the construction of Hornsea Three are listed in Table 8.9 along with the maximum design scenario against which each construction phase impact has been assessed.

8.12.1.2 For the purposes of this Environmental Statement chapter, construction effects are typically temporary, being short to medium 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. For the NSRs identified within the Hornsea Three noise and vibration study area, other than where specifically identified, only residential receptors are considered sensitive with regards to construction noise.

8.12.1.4 A number of PRoWs cross the Hornsea Three noise and vibration study area including two National Trails (see chapter 6: Land Use and Recreation). Whilst users may experience elevated noise levels for short periods when using PRoWs in the area, this is not considered a mechanism for significant effect.

8.12.1.5 Construction works would be undertaken in accordance with measures set out in the Outline CoCP (document reference A8.5), detailing the overarching principles of construction, contractor protocols, construction-related environmental management measures, pollution prevention measures, the selection of appropriate construction techniques and monitoring processes. This will be further development post consent in consultation with the relevant local authorities to identify construction noise management measures relating to specific construction activities.

8.12.1.6 The Outline CoCP (document reference A8.5) sets out the standard working hours. Whilst construction works will generally be limited to the daytime, works may also be required during the evening or night-time periods, by exception and prior agreement with the local authorities. Whilst evening and night-time works would typically be of a lesser magnitude than during the day, the assessment criteria used are more stringent. Control of noise emissions to an acceptable level, therefore, will be agreed with the relevant local authority EHO in consultation with relevant stakeholders (e.g. third party asset owner) as required.

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

8.12.1.7 Construction effects associated with the trenched cable route would be temporary at any one receptor, occurring for only a fraction of the overall construction period. The duration of construction for the onshore cable corridor is set out in Table 8.9 and assumes that works over any particular location could extend to three months.

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

Magnitude of impact

8.12.1.9 During construction, noise will be generated from small scale plant operations such as earthmoving activity associated with the construction of the onshore cable corridor.

8.12.1.10 The calculations which inform the data below are provided in the volume 6, annex 8.2: Construction Noise Model Output. Based on the assumptions of likely plant activity and their resulting noise generation, calculations of distances to impact boundaries for the day period are provided. Figures showing the impact bands are also provided in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.22: Summary of impact distances – onshore cable corridor construction works (assuming open cut).

Magnitude of Impact Boundary	Distance to NSRs [a]
	Daytime
Negligible	47+ m
Minor	29 - 47 m
Moderate	12 - 29 m
Major	0 - 12 m

[a] Distances are taken from the edge of the working area. The given distances represent the boundary at which the associated magnitude of impact will occur within.

8.12.1.11 In Table 8.22, it can be seen that residential NSRs within approximately 29 m of the onshore cable corridor would experience a moderate (or major within 12 m) impact during daytime works. If evening or night-time works take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.12 Counts of residential properties within each of the impact boundaries identified above have been undertaken for the daytime period. These are provided in Table 8.23 below.

Table 8.23: Summary of Property Count within Construction Noise Impact Band; Trenched Hornsea Three onshore cable corridor.

Magnitude of Impact (Day)	Residential Property Count
Minor	18
Moderate	11
Major	1

8.12.1.13 Within the separation distance of 29 m for moderate or major magnitude, noisy works would be unlikely to occur for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months which BS 5228-1:2009+A1:2014 identifies as a potentially significant impact. Furthermore, works will be undertaken in accordance with the Outline CoCP (document reference A8.5) to minimise potential noise impacts. In consideration of this, associated construction impact is limited to being of minor impact with regards to noise.

8.12.1.14 Construction vibration will be minimised as far as is reasonably practicable. At this stage, blasting or impact piling is considered unlikely. As such, construction vibration would be unlikely to be significant beyond the works boundary for the onshore elements of Hornsea Three. Off-site vibration from Heavy Goods Vehicles (HGVs) etc. on haul roads or the public highway would be negligible at all locations assuming the roads are maintained. No significant vibration-generation plant will be used during open trench construction of the onshore cable corridor so vibration is unlikely to be greater than a minor adverse impact.

8.12.1.15 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. With consideration of the duration of the works, the magnitude of impact is considered to be minor for receptors within 47 m (i.e. at 18 residential properties); and negligible beyond.

Sensitivity of the receptor

8.12.1.1 Residential receptors are considered to be medium sensitivity. No other NSRs have been identified within the noise and vibration study area.

Significance of the effect

8.12.1.2 Overall, it is predicted that the sensitivity of the residential receptors is medium and the magnitude of the impact is deemed to be negligible to minor. The effect of construction noise will, therefore, be of **negligible** to **minor adverse** significance, which is not significant in EIA terms.

8.12.1.3 Construction vibration would likely be of **negligible** significance and no greater than **minor adverse** significance, which is not significant in EIA terms.

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

8.12.1.4 Cable installed by HDD will involve potentially more noisy works than those associated with open cut trenching.

8.12.1.5 Small HDDs will be used for most crossings, with larger HDD crossing plant required for the landfall crossing and major HDDs (e.g. across main watercourses). The major HDD crossings (i.e. typically longer than 200 m in length) will require a compound to contain the drilling rig, equipment and the drill entry and exit pit. These compounds will be contained within the onshore cable corridor.

Magnitude of impact

8.12.1.6 The anticipated extent of any impact of such works has been estimated for day period; predicting the distances which that within impacts would occur. Calculations are summarised in Table 8.24.

8.12.1.7 The calculations which inform the data below are provided in the volume 6, annex 8.2: Construction Noise Model Output. Figures showing the impact bands are also provided in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.24: Summary of impact distances – HDD crossings works.

Impact Boundary	Distance to NSRs [a]
	Daytime
Negligible	154+ m
Minor	97 - 154 m
Moderate	39 - 97 m
Major	0 - 39 m
[a] Distances are taken from the edge of the working area.	

8.12.1.1 From Table 8.24, it can be seen that residential NSRs within approximately 97 m of the Hornsea Three onshore cable corridor may experience a moderate impact during daytime works, whilst residential NSRs within approximately 39 m of the Hornsea Three onshore cable corridor may experience a major impact during daytime works. Where night-time works take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.2 Counts of residential properties within each of the impact boundaries identified above have been undertaken for the daytime period. These are provided in Table 8.25.

Table 8.25: Summary of property count within construction noise impact band; route HDDs.

Impact, Day	Residential Property Count
Minor	124
Moderate	70
Major	11

8.12.1.3 Works associated with the cable HDD sites are distributed along the Hornsea Three onshore cable corridor. Within the separation distance of 97 m for moderate or major impacts, significant noisy works would be unlikely to occur for the period of 10 or more days in any 15 consecutive days, or for 40 or more days in any six consecutive months, which BS 5228-1:2009+A1:2014 identifies as a potentially significant impact. In consideration of this, the construction impact of works associated with the cable HDD sites is limited to being of minor impact with regards to noise.

8.12.1.4 A number of PRoWs cross the Hornsea Three noise and vibration study area including two National Trails (see chapter 6: Land Use and Recreation). HDD is proposed across several PRoW (e.g. Marriots Way) and these are highlighted on the onshore crossing schedule in volume 4, annex 3.5. 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.

8.12.1.5 Construction vibration will be minimised as far as is reasonably practicable. At this stage, no blasting or impact piling is predicted. All HDD crossing and piling will be undertaken by non-impact methods. As such, construction vibration from HDD would be unlikely to be greater than a minor adverse impact.

8.12.1.6 Off-site vibration from HGVs etc. on haul roads or the public highway would have a negligible impact at all locations assuming the roads are maintained.

8.12.1.7 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 that most works will be limited to the daytime, the magnitude is considered to be minor for receptors within 154 m; and negligible beyond.

Sensitivity of the receptor

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

Significance of the effect

8.12.1.9 Overall, it is predicted that the sensitivity of the residential receptors is considered to be medium and the magnitude of the impact 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. This represents the worst-case significance of effect, at medium sensitivity receptors.

8.12.1.10 PRoWs would experience a minor magnitude of impact and are of low sensitivity. The effect of construction noise will, therefore, be of **negligible** to **minor adverse** significance, which is not significant in EIA terms.

8.12.1.11 Construction vibration would likely be of **negligible** significance and no greater than **minor adverse** significance, which is not significant in EIA terms.

The temporary impact of cable installation at the Hornsea Three landfall area may affect receptors sensitive to noise or vibration.

8.12.1.12 The landfall cable installed by HDD from the landfall worksite will involve potentially more noisy works than for most of the cable laying or other HDD sites. The temporary works areas associated with landfall works requires a larger working corridor than for the HDD crossings previously considered.

8.12.1.13 From the indicative list of plant required for the landfall cable installation (see volume 6, annex 8.2: Construction Noise Model Output), two plant items were identified as warranting additional mitigation, being the largest contributor to construction noise emissions. The main drilling rig will be quietened to a noise level of approximately 89 dB at 10 m distance; the 250 kVA generator will be quietened to a noise level of approximately 83 dB at 10 m distance. It is considered that this mitigation can be readily achieved, and is taken as the base assessment case.

8.12.1.14 Hornsea Three will agree with the relevant local planning authorities the scope of potential noise mitigation measures for specific construction activities and will include applicable noise attenuation targets to be achieved through physical external and integrated noise attenuation measures.

Magnitude of impact

8.12.1.15 The anticipated extent of any impact of such works has been estimated for the daytime period, predicting the distances which that within impacts would occur. Calculations are summarised in Table 8.26.

8.12.1.16 The calculations which inform the data below are provided in the volume 6, annex 8.2: Construction Noise Model Output. Figures showing the impact bands are also provided in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.26: Summary of impact distances – landfall works.

Impact Boundary	Distance to NSRs [a]
	Daytime
Negligible	211+ m
Minor	133 - 211 m
Moderate	53 - 133 m
Major	0 - 53 m
[a] Distances are taken from the edge of the working area.	

8.12.1.17 From Table 8.26, it can be seen that residential NSRs within approximately 211 m of the Hornsea Three onshore cable corridor may experience a minor impact during daytime works. While residential NSRs within approximately 133 m of the Hornsea Three onshore cable corridor may experience a moderate or a major impact during daytime works. Where night-time works of a similar magnitude take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.18 Counts of residential properties within each of the daytime impact boundaries identified above have been undertaken for the daytime period. These are provided in Table 8.27 below.

Table 8.27: Summary of property count within construction noise impact band; landfall HDD with mitigation.

Impact, Day	Residential Property Count
Minor	0
Moderate	0
Major	0

8.12.1.19 Although some evening or night works may be required, any significantly noisy works would be unlikely to occur for the period of 10 or more nights of working in any 15 consecutive days or for a total number of nights exceeding 40 in any six consecutive months which BS 5228-1:2009+A1:2014 identifies as a potentially significant impact. In consideration of this, associated construction impact is limited to being of minor impact with regards to noise.

8.12.1.20 A PRoW passes near the landfall HDD worksite (see chapter 6: Land Use and Recreation). Whilst users might experience elevated noise levels for short periods when using PRoWs in the area, this is not considered a mechanism for significant effect.

8.12.1.21 Construction vibration will be minimised as far as is reasonably practicable. At this stage, no blasting or impact piling is predicted. All HDD crossing and piling will be undertaken by non-impact methods. As such, construction vibration would be unlikely to be greater than a minor adverse impact. 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.

8.12.1.22 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 but of limited duration, the magnitude is considered to be minor for receptors within 211 m, and negligible beyond.

Sensitivity of the receptor

8.12.1.23 Residential receptors within the distances above are considered to be medium sensitivity. The PRoWs are considered to be of low sensitivity.

Significance of the effect

8.12.1.24 Overall, it is predicted that the sensitivity of the residential receptors is considered to be medium and the magnitude of the impact 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. This represents the worst-case significance of effect, at medium sensitivity receptors.

8.12.1.25 The sensitivity of the PRoWs is considered to be low and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms.

8.12.1.26 Construction vibration would likely be of **negligible** significance and no greater than **minor adverse** significance, which is not significant in EIA terms.

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

Magnitude of impact

8.12.1.27 The installation of construction accesses and haul roads to allow vehicular access will require earth moving plant, such as excavators, rollers and HGVs. Construction effects associated with the construction of accesses for the Hornsea Three onshore cable corridor would occur for only a fraction of the overall construction period, and are considered temporary (see volume 1, chapter 3: Project Description).

8.12.1.28 The anticipated extent of any impact of such works has been estimated for daytime period, predicting the distances within which impacts would occur. Calculations are summarised in Table 8.28.

8.12.1.29 The calculations which inform the data below are provided in the volume 6, annex 8.2: Construction Noise Model Output. Figures showing the impact bands are also provided in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.28: Summary of impact distances – constructing the accesses for the onshore cable corridor.

Impact Boundary	Distance to NSRs [a]
	Daytime
Negligible	79+ m
Minor	50 - 79 m
Moderate	20 - 50 m
Major	0 - 20 m
[a] Distances are taken from the edge of the working area.	

8.12.1.30 From Table 8.28, it can be seen that residential NSRs within approximately 50 m of the access route works may experience a moderate (or major within 20 m) impact during daytime works. If evening or night-time works take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.31 Counts of residential properties within each of the impact boundaries identified above have been undertaken for the daytime period. These are provided in Table 8.29. Figures showing the accesses and associated impact bands are provided in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.29: Summary of property count within construction noise impact band; access construction.

Magnitude of Impact, Day	Residential Property Count
Minor	21
Moderate	27
Major	8

8.12.1.32 Works associated with the construction of the accesses to the onshore cable corridor, however, will be of relatively short duration within the overall construction programme. Within the separation distance of 27 m for moderate or major impacts, significant noisy works would be unlikely to occur for the period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months which BS 5228-1:2009+A1:2014 identifies as a potentially significant impact. In consideration of this, the associated construction impact is limited to being of minor impact with regards to noise.

8.12.1.33 Construction vibration will be minimised as far as is reasonably practicable. At this stage, no blasting or impact piling is predicted. 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.

8.12.1.34 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 minor for receptors within 79 m; and negligible beyond.

Sensitivity of the receptor

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

Significance of the effect

8.12.1.36 Overall, it is predicted that the sensitivity of the residential receptors is considered to be medium and the magnitude of the impact 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. This represents the worst-case significance of effect, at medium sensitivity receptors.

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

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

8.12.1.38 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. The construction compounds associated with the onshore HVAC booster station and HVDC converter/HVAC substation are described in volume 1, chapter 3: Project Description and the Outline CoCP (document reference A8.5).

8.12.1.39 During construction, noise will be generated from small scale plant operations such as earthmoving activity and general construction activity associated with the onshore substation and booster station.

Magnitude of impact

8.12.1.40 The anticipated extent of any impact of such works has been estimated for the daytime period, predicting the distances within which impacts would occur. Calculations are summarised in Table 8.30.

8.12.1.41 The calculations which inform the data below are provided in the volume 6, annex 8.2: Construction Noise Model Output. Figures showing the impact bands are also provided in volume 6, annex 8.2: Construction Noise Model Output.

Table 8.30: Summary of impact distances – HVDC converter/HVAC substation and HVAC booster station.

Impact Boundary	Distance to NSRs [a]
	Daytime
Negligible	71+ m
Minor	45 - 71 m
Moderate	18 - 45 m
Major	0 - 18 m
[a] Distances are taken from the edge of the working area.	

8.12.1.42 From Table 8.30, it can be seen that residential NSRs within approximately 45 m of the onshore HVDC converter/HVAC substation and HVAC booster station may experience a moderate (or major within 18 m) impact during daytime works. Where night-time works take place, then any NSRs within a greater distance would potentially be affected.

8.12.1.43 Counts of residential properties within each of the impact boundaries identified above have been undertaken for the daytime period. These are provided in Table 8.31 below.

Table 8.31: Summary of property count within construction noise impact band; onshore HVAC booster station and HVDC converter/HVAC substation construction.

Impact, Day	Residential Property Count
Minor	0
Moderate	0
Major	0

8.12.1.44 Construction vibration will be minimised as far as is reasonably practicable. 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 boundaries of the onshore HVAC booster station and HVDC converter/HVAC substation areas. The impacts of off-site vibration from HGVs etc. on haul roads or the public highway would be negligible at all locations assuming the roads are maintained.

8.12.1.45 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. For daytime works, as no NSRs have been identified within 71 m of the site, the magnitude is considered to be negligible.

8.12.1.46 The nearest PRoWs would experience a negligible impact for the sections nearest to the onshore HVAC booster station and HVDC converter/HVAC substation.

Sensitivity of the receptor

8.12.1.47 Residential receptors within the distances above are considered to be medium sensitivity. The PRoWs are considered to have a low sensitivity.

Significance of the effect

8.12.1.48 Overall, it is predicted that the sensitivity of the residential receptors is considered to be medium and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms. This represents the worst-case significance of effect, at medium sensitivity receptors.

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

8.12.1.50 The PRoWs have a low sensitivity and the magnitude of impact is deemed to be negligible. The effect, will therefore be of **negligible** significance, which is not significant in EIA terms.

The temporary impact of increased vehicles on the existing road network associated with all construction works may affect receptors sensitive to noise or vibration.

8.12.1.51 The construction works will result in additional vehicle movements on the existing road network. A high proportion of these additional vehicles will be HGVs. Predicted traffic flows have been provided by the Transport consultant and are discussed in chapter 7: Traffic and Transport. The methodology for selection of these links is also discussed in chapter 7.

8.12.1.52 Noise change calculations have been undertaken for each of the 37 links where traffic data has been provided. The noise change predicted for each link reflects the anticipated noise change experienced by any residential property for which that link is already the dominant noise source.

Magnitude of impact

8.12.1.53 The anticipated extent of any impact of construction traffic on the public highway has been estimated for the 18-hour daytime period, following the criteria set out in Table 8.13. This reflects the calculation methodology of CRTN and is considered to also correlate directly with changes over a 12-hour or 16-hour day.

8.12.1.54 Road links with calculated magnitude of impact are summarised in Table 8.32 below with full links and calculations which inform the data below provided in the volume 6, annex 8.2: Construction Noise Model Output.

Table 8.32: Summary of construction traffic impacts.

Road Link	Daytime Noise Change (dB)	Impact Magnitude
(1) A148, west of The Street and east of Green Lane	0.3	Negligible
(2) A148 west of Holt and east of Letheringsett	0.4	Negligible
(3) A148, east of the B1149 roundabout and west of Station Road	0.3	Negligible
(4) B1354 between the Swanton Road junction and B1110 junctions	0.0	No change
(5) B1354 east of Melton Constable and west of Briston	0.0	No change
(6) B1149 at Edgefield, north of the village hall and south of Hempstead Road	1.0	Negligible
(7) A148 at High Kelling, south of Kelling Hospital	0.3	Negligible
(8) A148, east of Bodham and west of the Woodlands Leisure centre	0.3	Negligible
(9) A148, west of the B1436 junction and east of the Lion's Mouth junction	0.3	Negligible
(10) B1436, east of Felbrigg	0.6	Negligible
(11) A140, south of Roughton and north of the Topshill Road junction	0.5	Negligible
(12) A149 west of Weybourne and east of The Pheasant Hotel	0.0	No change

Road Link	Daytime Noise Change (dB)	Impact Magnitude
(13) A149 east of Weybourne, west of the North Norfolk Railway Line	0.5	Negligible
(14) A1067, north of Bridge Road and east of Little Ryburgh	0.2	Negligible
(15) B1145 at Bawdeswell, between The Street junction and Hall Road junction	0.0	No change
(16) B1145, west of Reepham and east of the Old Lane junction	0.0	No change
(17) B1145 east of Cawston, west of the B1149 crossroads	0.9	Negligible
(18) B1145 east of the B1149 crossroads junction, west of Cawston Park Hospital	0.0	No change
(19) A140, south of Aylsham's B1145 / A140 roundabout, and north of Marsham	0.3	Negligible
(20) A1067, between Attlebridge and the Fir Covert Road junction	0.3	Negligible
(21) A140 between the A47 and B1113 junctions	0.2	Negligible
(22) B1113, south of the A47 near Norwich Sports ground	0.6	Negligible
(23) A47 at Honingham (Highways England)	0.1	Negligible
(24) A47 at Bawburgh (Highways England)	0.1	Negligible
(25) A47 at Intwood (Highways England)	0.1	Negligible
(26) A11 at Hethersett (Highways England)	0.1	No change
(27) A47, between A140 and A146 junctions	0.1	Negligible
(28) A1065, north of Swaffham	0.4	Negligible
(29) A1065, east of Weasenham	0.6	Negligible
(30) A1082, south of Sheringham	0.5	Negligible
(31) A1270 northern Distributor Road between A1067 and B1149 junction	0.2	Negligible
(32) B1149 between A1270 northern Distributor Road and Buxton Road junctions	0.5	Negligible
(33) A1270 northern Distributor Road between B1149 and A140 junctions	0.3	Negligible
(34) A1270 northern Distributor Road between A140 and A47 junctions	0.3	Negligible
(35) A140 between A1270 and B1145	0.4	Negligible
(36) A1270 between A140 and A47 (Near junction with A47)	0.2	Negligible
(37) A47 east of A1270 junction	0.0	No change

8.12.1.55 From Table 8.32, it can be seen that for the road links identified, any noise increase will be below 3 dB; of no or negligible impact. This would correspond with no or negligible impact at any residential or PRoW NSRs for which these links are currently the dominant noise source. Although construction traffic movement may occur during the night hours, these are predicted to be limited and would be agreed with the local authorities through the Outline CoCP (document reference A8.5), therefore, no assessment in respect to noise and vibration is required.

Sensitivity of the receptor

8.12.1.56 Residential receptors within the distances above are considered to be medium sensitivity. PRoWs are considered to be low sensitivity with regards to construction traffic noise. No other NSRs have been identified.

Significance of the effect

8.12.1.57 Overall, it is predicted that the sensitivity of the residential receptors is considered to be medium and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms. This represents the worst-case significance of effect, at medium sensitivity receptors.

8.12.1.58 The sensitivity of the PRoWs is considered to be low and the magnitude of the impact is deemed to be negligible. The effect of noise arising from construction vehicles on the public highway will, therefore, be of **negligible** significance, which is not significant in EIA terms.

Future monitoring

8.12.1.59 No noise and vibration monitoring to test the predictions made within the construction phase impact assessment is considered necessary.

8.12.2 Operation 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 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 The operation of above-ground electrical infrastructure can result in noise from plant associated with cooling or switching; noise around transformers can be caused by stray magnetic fields resulting in the enclosure and accessories to vibrate; and magnetostriction as a second source of vibration, in which the core iron changes shape minutely when exposed to magnetic fields. The intensity of the fields, and thus the "hum" intensity, is a function of the applied voltage. As the magnetic flux density is strongest twice every electrical cycle, the fundamental "hum" frequency will be around 100 Hz, twice the electrical frequency. Additional harmonics above 100 Hz may also arise (at 200 Hz, 300 Hz etc.). Around high-voltage power lines, corona discharge may result in a low level of crackling noise.

8.12.2.4 Predictions have been made to all 315 residential NSRs identified within the study area of just over 1 km of the onshore HVDC converter/HVAC substation. Noise from the onshore HVDC converter/HVAC substation has been modelled as being neither tonal nor impulsive in character when considered from the surrounding NSRs, although the source data on which the model is based contains tonal elements as appropriate. Any plant noise specification will either be required to achieve this, or require that a more stringent overall noise level is achieved. Details of the predicted noise levels, spectra and modelling are provided in volume 6, annex 8.3: Operational Noise Model Input. The assessment against representative background noise levels and anticipated noise change is summarised in Table 8.33 and calculations are provided in the volume 6, annex 8.4: Operational Noise Model Output.

8.12.2.5 The acceptable level above which no impact magnitude greater than minor will occur at any and all residential NSRs is that a noise rating level of 34 dB $L_{Ar,Tr}$ (with $L_{Ar,Tr}$ as defined in BS 4142:2014) will not be exceeded at any residential NSR. This will ensure that the noise rating level from the operation of the onshore HVDC converter/HVAC substation is less than 5 dB above the representative background sound level of 30 dB $L_{A90,night}$ during normal operation.

8.12.2.6 For the operational plant assessed (based on a HVAC 2x3x540 MVA SGT layout (see volume 6, annex: 8.3: Operational Noise Model Input)), an overall noise level design reduction of at least 12 dB in the noise levels experienced at the nearer surrounding residential receptors is necessary to achieve the noise rating level limit of 34 dB $L_{Ar,Tr}$ such that no more than minor adverse impacts at all residential NSRs occurs. Therefore, for the particular scenario modelled, with mitigation provided to achieve an overall reduction of -12 dB to overall noise emitted from the site, the overall noise emitted from the onshore HVDC converter/HVAC substation would reduce to a maximum of 34 dB $L_{Ar,Tr}$ at the nearest (or any) residential NSR as shown in Table 8.33.

8.12.2.7 The type of mitigation that will be implemented to achieve the maximum of 34 dB $L_{Ar,Tr}$ at the nearest (or any) residential NSR will be agreed and demonstrated to be sufficient during the detailed design stage. Mitigation is likely to include the use of acoustic enclosures, placing equipment inside buildings, or other potential measures to be agreed prior to the commencement of works. Provided that the resulting rating level (corrected for character if appropriate) does not exceed 34 dB $L_{Ar,Tr}$ at any receptor, it is not necessary for a particular level of reduction (for example, the -12 dB reduction identified above) to be demonstrated at every receptor. The contours and predicted levels following mitigation therefore, are indicative of likely levels rather than committed levels. The mitigation commitment is that a rating level that does not exceed 34 dB $L_{Ar,Tr}$ at any receptor is achieved.

8.12.2.8 Should alternate operational plant be adopted, such as the onshore HVDC converter station option, the requirement that a noise rating level of 34 dB $L_{Ar,Tr}$ not be exceeded at any residential NSR will continue to afford them the same level of protection.

8.12.2.9 Noise prediction contours for the operational site as assessed (based on an indicative layout) with -12 dB mitigation are provided in volume 6, annex 8.4: Operational Noise Model Output and demonstrates that a noise rating level of 34 dB $L_{Ar,Tr}$ not being exceeded at any residential NSR.

8.12.2.10 From the calculation and assessment undertaken for all 315 residential NSRs, four example properties have been identified, reflecting the closer properties in each of four directions from the onshore HVDC converter/HVAC substation. Survey location 4, which was chosen to be representative of the nearest sensitive residential receptors for the baseline noise survey, is situated approximately 230 m from the onshore HVDC converter/HVAC substation. The specific calculations for these properties are provided as an example in Table 8.33, with full calculations provided in volume 6, annex 8.4: Operational Noise Model Output. Predicted noise levels arising from the operation of the site (with design mitigation) are provided in Figure 8.2.

Table 8.33: Onshore HVDC converter/HVAC substation BS 4142 Rating Level assessment with design mitigation

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					
1 Brooks Green	45	29	29	-16	None/Negligible
2 Bridle Lane	45	26	26	-19	None/Negligible
House on the Hill	45	29	29	-16	None/Negligible
Pond Cottage	45	32	32	-13	None/Negligible

Location	Background Sound Level, dB L_{A90}	Specific Sound Level, dB L_{Aeq}	Rating Level, dB $L_{Ar,Tr}$	Rating Level - Background	Impact magnitude
Night					
1 Brooks Green	30	30	30	+0	Minor
2 Bridle Lane	30	28	28	-3	Minor
House on the Hill	30	29	29	-1	Minor
Pond Cottage	30	34	34	+4	Minor

8.12.2.11 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. With design mitigation, the magnitude of impact is considered to be negligible to minor.

8.12.2.12 Operational noise beyond the onshore HVDC converter/HVAC substation site boundary is below levels which would result in any detriment to outdoor public use of space. The nearest PRoW, south of Mangreen Lane, would experience levels of below 30 dB L_{Aeq}, equating to negligible impact for its section nearest the site.

Sensitivity of the receptor

8.12.2.13 The residential receptors identified above have a sensitivity considered to be medium. The PRoW has low sensitivity.

Significance of the effect

8.12.2.14 Overall, it is predicted that the sensitivity of the residential receptors is considered to be medium and the magnitude of the impact 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.

8.12.2.15 The sensitivity of the PRoW south of Mangreen Lane is considered to be low and the magnitude of impact is deemed to be negligible. The effect of operational noise will, therefore, be of **negligible** significance, which is not significant in EIA terms.

8.12.2.16 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.

8.12.2.17 In the longer term and in general, baseline noise levels (in the absence of Hornsea Three) would tend to increase with future development. This trend would tend to reduce the impacts reported above. The assessment is therefore considered robust in the longer-term.

8.12.2.18 In addition to the impact/effect assessment, calculation as to the likely change in noise environment resulting from Hornsea Three is considered. For the four specific properties identified, the change in L_{Aeq} as a result of Hornsea Three is provided in Table 8.34 for both day and night periods.

Table 8.34: Onshore HVDC converter/HVAC substation noise change assessment with design mitigation

Location	Baseline Ambient Sound Level, dB $L_{Aeq,T}$ dB	Specific Sound Level, dB $L_{Aeq,T}$ dB	Combined Sound Level $L_{Aeq,T}$ dB	Change in Sound Level dB	Magnitude of change
Day					
1 Brooks Green	52	29	52	+0.0	No change
2 Bridle Lane	52	26	52	+0.0	No change
House on the Hill	52	29	52	+0.0	No change
Pond Cottage	52	32	52	+0.0	No change
Night					
1 Brooks Green	40	29	41	+0.3	Negligible
2 Bridle Lane	40	26	41	+0.2	Negligible
House on the Hill	40	29	41	+0.3	Negligible
Pond Cottage	40	32	41	+0.6	Negligible
** Figures have been rounded to the nearest whole number*					

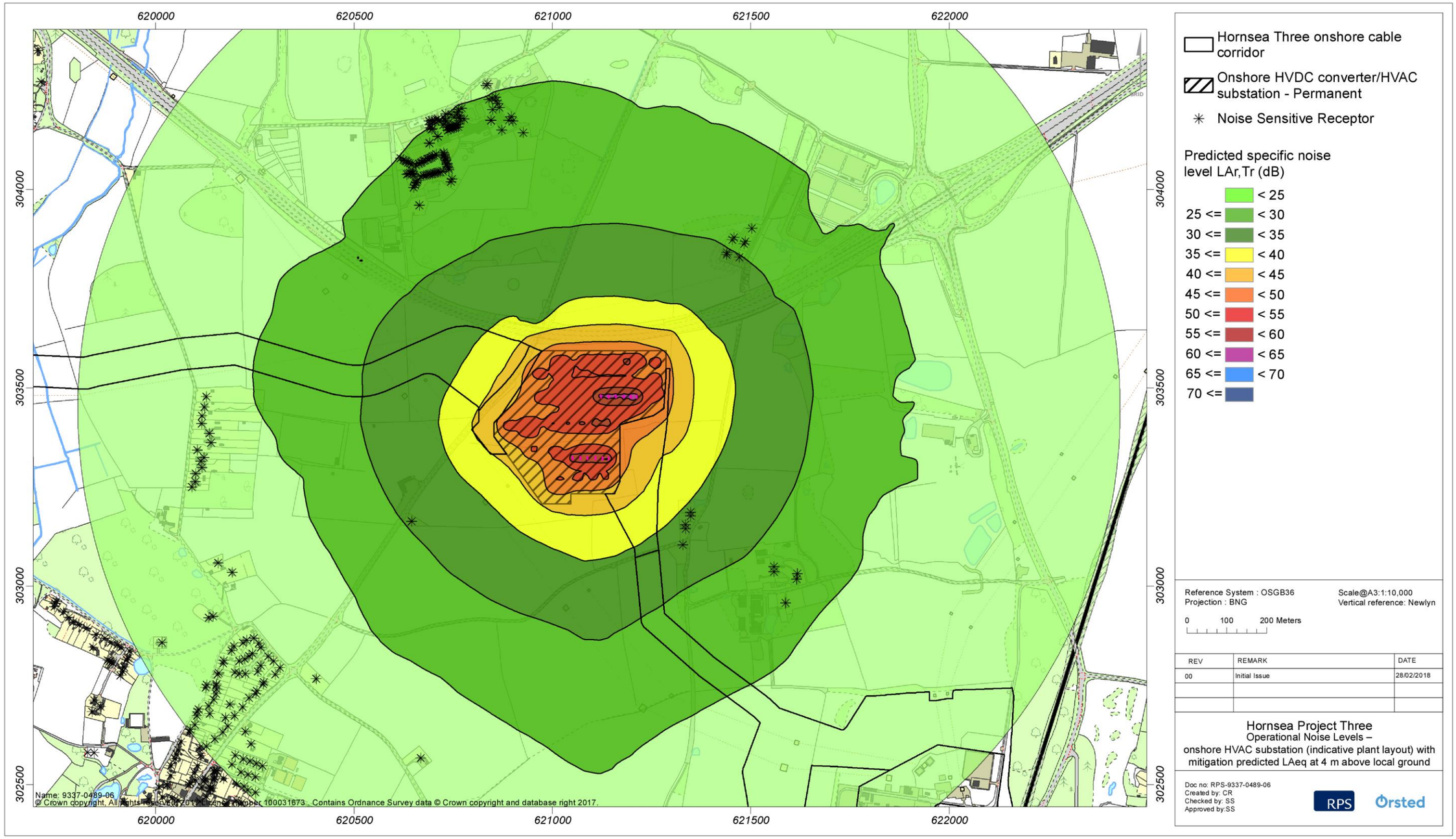

Figure 8.2: Operational noise levels - onshore HVAC substation (indicative plant layout) with mitigation predicted LAr,Tr at 4m above local ground.

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

8.12.2.19 The operational plant proposed for the HVAC booster station comprises six 220kV 300MVAr Variable SHR (Shunt Reactors). These will be enclosed. Details of the proposed plant is provided in volume 6, annex 8.3: Operational Noise Model Input.

Magnitude of impact

8.12.2.20 Predictions have been made to all 18 residential NSRs identified within around 1 km of the proposed onshore HVAC booster station. Noise from the site has been modelled as being neither tonal nor impulsive.

8.12.2.21 Details of the predicted noise levels, the assessment against representative background noise levels, and anticipated noise change are summarised in Table 8.36 with the calculations and locations provided in volume 6, annex 8.4: Operational Noise Model Output. Unlike for construction, assessment of operational noise considers each receptor specifically, taking into account site layout and surrounding topography. As such, there is not a distance/impact band summary as has been provided for construction impacts.

Table 8.35: Onshore HVAC booster station property impact count.

Impact	Residential Property Count	
	Day	Night
None/Negligible	18	5
Minor	0	13
Moderate	0	0
Major	0	0

8.12.2.22 From the calculation and assessment undertaken for all 18 residential NSRs, three example properties have been identified, reflecting the closer properties in each of three directions from the site (Table 8.35). The specific calculations for these properties are provided as an example in Table 8.36, with full calculations provided in volume 6, annex 8.4: Operational Noise Model Output.

Table 8.36: 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					
Fuel Farm Cottage	31	24	24	-8	None/Negligible
Keepers Cottage	31	25	25	-7	None/Negligible
Pimlico House	31	24	24	-8	None/Negligible
Night					
Fuel Farm Cottage	26	24	24	-2	Minor
Keepers Cottage	26	25	25	-1	Minor
Pimlico House	26	24	24	-2	Minor

8.12.2.23 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 minor adverse.

8.12.2.24 Operational noise beyond the onshore HVAC booster station area boundary is below levels which would result in any detriment to outdoor public use of space. The nearest PRoW, running through Barringham Green Plantation and around New Covert woods, would experience levels of below 35 dB L_{Aeq}, equating to negligible impact for its section nearest the site.

Sensitivity of the receptor

8.12.2.25 The residential receptors identified above have a sensitivity considered to be medium. The PRoW has low sensitivity.

Significance of the effect

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

8.12.2.27 The sensitivity of the PRoW through Barringham Green Plantation and around New Covert woods is considered to be low and the magnitude of the impact is deemed to be negligible. The effect of operational noise will, therefore, be of **negligible** significance, which is not significant in EIA terms.

8.12.2.28 In addition to the impact/effect assessment, calculation as to the likely change in noise environment resulting from Hornsea Three is considered. For the four specific properties identified, the change in L_{Aeq} as a result of Hornsea Three is provided in Table 8.37 for both day and night periods.

Table 8.37: Onshore HVAC booster station noise change assessment.

Location	Baseline Ambient Sound Level, dB LAeq,T dB	Specific Sound Level, dB LAeq,T dB	Combined Sound Level LAeq,T dB	Change in Sound Level dB	Magnitude of change
Day					
Fuel Farm Cottage	41	24	41	+0.1	No change
Keepers Cottage	41	25	41	+0.1	No change
Pimlico House	41	24	41	+0.1	No change
Night					
Fuel Farm Cottage	32	24	33	+0.6	Negligible
Keepers Cottage	32	25	33	+0.8	Negligible
Pimlico House	32	24	33	+0.6	Negligible
** Figures have been rounded to the nearest whole number.*					

Future monitoring

8.12.2.29 No noise and vibration monitoring to test the predictions made within the operation and maintenance phase impact assessment is considered necessary.

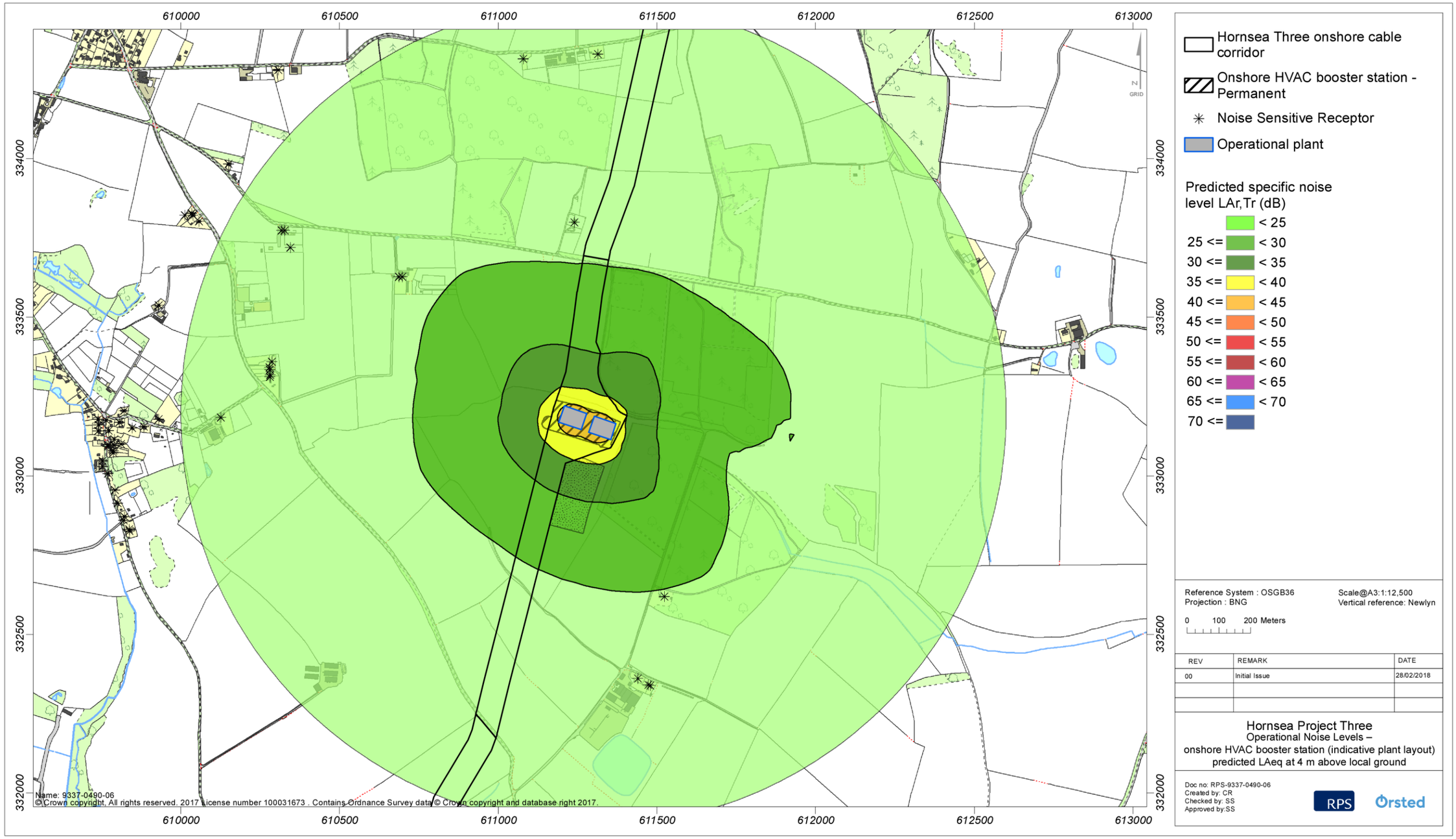

Figure 8.3: Operational noise levels – onshore HVAC booster station (indicative plant layout) predicted LAeq at 4 m above local ground.

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 onshore HVDC converter/HVAC substation and HVAC booster station decommissioning may affect receptors sensitive to noise or vibration.

8.12.3.3 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

8.12.3.4 It is anticipated that noise impacts would be no greater than those predicted during the construction period.

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 to minor.

Sensitivity of the receptor

8.12.3.6 Residential receptors within the distances above are considered to be medium sensitivity. The PRoWs are considered to be low sensitivity.

Significance of the effect

8.12.3.7 Overall, it is predicted that the sensitivity of the residential receptors 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.

8.12.3.8 The sensitivity of the PRoWs is considered to be low and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms.

Future monitoring

8.12.3.9 No noise and vibration monitoring to test the predictions made within the decommissioning phase impact assessment is considered necessary.

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 5.2: Cumulative Effects Screening Matrix and, annex 5.3: Location of Cumulative 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:
  - Those with consent, and, where applicable (i.e. for low carbon electricity generation projects), that have been awarded a Contract for Difference (CFD) but have not been implemented; 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 project/plans that have consent but, where relevant (i.e. for low carbon electricity generation projects) have no CFD; and/or
  - Submitted but not yet determined.
- 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 and the adopted development plan including supplementary planning documents are the most relevant sources of information from the relevant planning authorities regarding planned major works being consulted upon, but not yet the subject of a consent application). Specifically, this Tier includes all projects where the developer has advised PINS in writing that they intend to submit an application in the future, those projects where a Scoping Report is available and/or those projects which have published a PEIR.

8.13.1.3 It is noted that offshore wind farms seek consent for a maximum design scenario and the as built offshore wind farm will be selected from the range of consented scenarios. In addition, the maximum design scenario quoted in the application (and the associated Environmental Statement) are often refined during the determination period of the application. For example, it is noted that the Applicant for Hornsea Project One considered a maximum of 332 turbines within the Environmental Statement, but has gained consent for 240 turbines. Similarly, Hornsea Project Two has gained consent for an overall maximum number of turbines of 300, as opposed to 360 considered in the Environmental Statement and the as built number of turbines is likely to be less than this. A similar pattern of reduction in the project envelope from that assessed in the Environmental Statement, to the consented envelope and the 'as built' project is also seen across other offshore wind farms of relevance to this CEA. This process of refinement can result in a reduction to associated project parameters, for example, the number of cable trenches or the height of onshore substations. The CEA presented in this noise and vibration chapter has been undertaken on the basis of information presented in the Environmental Statements for the other projects, plans and activities. Given that this broadly represents a maximum design scenario, the level of impact on noise and vibration would likely be reduced from those presented here.

8.13.1.4 The specific projects scoped into this CEA and the Tiers into which they have been allocated, are outlined in Table 8.38. 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.

8.13.1.5 No Tier 1 projects have been identified and therefore, only Tier 2 and 3 assessments have been undertaken.

Table 8.38: List of other projects and plans considered within the CEA.

Tier	Phase	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	Construction/Operation and Maintenance/Decommissioning	C/7/2014/7030	0 m	(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. Approved 2 October 2017	2017 to 2024	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2011/1804/O	0 m	Residential led mixed use development of 1196 dwellings and associated uses including Primary School, Local Services (up to 1,850 sq.mtrs (GIA) of A1, A2, A3, A4, A5, D1 & B1 uses) comprising shops, small business units, community facilities/ doctors' surgeries, sports pitches, recreational space, equipped areas of play and informal recreational spaces. Extension to Thickthorn Park and Ride including new dedicated slip road from A11. Approved 22 July 2013 Reserved matters (2017/0151) proposed residential development (phase A1-B) comprising 91 dwellings including 20% affordable housing and associated open space and infrastructure. Approved 17 May 2017	2017 to 2026	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2013/0092	7 m	Outline application for up to 20 residential units and associated highways works with all matters reserved	2021 to 2022	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2014/2611	21 m	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. Approved 01 November 16	2018 to 2028	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	20170789	55 m	Erection of Grain Store (Revised Proposal). Full Approval 19 July 2017	2020	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	20170052	303 m	Greater Norwich Food Enterprise Zone. Approved 31 October 2017	Unknown	Yes	Yes

Tier	Phase	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	Construction/Operation and Maintenance/Decommissioning	2015/1644	310 m	Demolition of 4 Existing Units and Development of 10 Residential Units, Together with Associated Access (Outline). Approved 10 June 2016	2022-2024	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2015/1697	312 m	Erection of 27 dwellings, access, roads, open space, parking areas and associated works. Approved 27 June 16	2019-2020	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2012/1836	338 m	Outline application for residential development (20 Dwellings) and associated infrastructure works, including highway improvement works at the Mill Road/School Lane/Burnthouse Lane junction. Approved 29 April 2014	2018 to 2020	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2015/2082	922 m	Outline application for the residential development of 10 dwellings. Approved 22 June 2016	2021 to 2022	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2012/1880	1.16 km	Proposed offices, laboratories and academic space for principally research and development activities, buildings for health and health related uses and buildings for further ancillary uses. Associated car parking, access, infrastructure, internal access roads and strategic landscaping. Approved 23 August 2013	2017 to 2026	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2013/1494	1.21 km	Outline planning application with all matters reserved (save access) for the creation of up to 650 residential dwellings (use class C3), up to 2,500 sq mtrs of use class A1, A2, A3, A4, A5 and D1 floorspace, together with highways works, landscaping, public realm, car parking and other associated works. Appeal Allowed 7 January 2016	2019 to 2024	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	2013/1793	1.64 km	Outline planning permission for a development for up to 650 dwellings together with a small local centre, primary school with early years facility, two new vehicular accesses off Colney Lane, associated on-site highways, pedestrian and cycle routes, public recreational open space, allotments, landscape planting and community woodland. Approved 20 July 16	2019 to 2028	Yes	Yes

Tier	Phase	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	Construction/Operation and Maintenance/Decommissioning	2012/1477	1.84 km	Outline application for new offices and laboratories for research and development activities along with ancillary and complimentary uses with access from Colney Lane and Hethersett Lane and all other matters reserved. Demolition and reprovision of existing buildings. Associated car parking, infrastructure, internal access roads, landscaping and cycle parking. Approved 13 June 2013	2017 to 2026	Yes	Yes
	Operation and Maintenance	TR010015	1.93 km	The Norwich Northern Distributor Road (NDR) is a 20km dual carriageway road under construction to run from the A47 at Postwick, east of Norwich, to the A1067 Fakenham Road north of Taverham.	Finishing in 2018	Yes	Yes
	Construction/Operation and Maintenance/Decommissioning	PO/16/0253	2.08 km	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). Approved 15 August 2016	2019 to 2025	Yes	Yes
3	Construction/Operation and Maintenance/Decommissioning	EN010079	0 m	Norfolk Vanguard is a proposed offshore windfarm with an approximate capacity of 1800 MW off the coast of Norfolk. Pre-application stage PEIR October 2017	2020-2024	Yes	Yes

8.13.2 Maximum design scenario

8.13.2.1 The maximum design scenarios identified in Table 8.39 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 8.39: 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 open cut 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 area) 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. Consecutive or parallel construction works affecting existing NSRs.
The temporary impact of constructing the construction accesses on the Hornsea Three onshore cable corridor 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 and Maintenance 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, and works will potentially be ongoing on both locations 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.
The operational impact of an onshore booster station may affect receptors sensitive to noise or vibration.	Noise from Hornsea Three in operation.	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 impact of onshore HVDC converter/HVAC substation and HVAC booster station 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 A description of the significance of cumulative effects upon noise and vibration sensitive receptors arising from each identified impact is given below.

8.14.1.2 Most schemes lie within 1 km of the Hornsea Three onshore cable corridor. 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 Hornsea Three onshore cable corridor.

8.14.1.3 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 the following sections.

8.14.1.4 No developments within 1 km of the onshore HVAC booster station have been identified and as such no cumulative effects associated with the HVAC booster station are anticipated.

8.14.2 Construction phase

8.14.2.1 A description of the significance of cumulative effects upon NSRs arising from each identified impact is given below.

8.14.2.2 Construction effects associated with the Hornsea Three onshore cable corridor are of much shorter duration and so the likelihood of simultaneous or sequential construction works happening at any particular NSR are much reduced.

8.14.2.3 Due to the variable nature of construction noise, the cumulative effects of construction are generally no greater than arise for individual works. Most commonly, one of construction projects dominates the other in terms of noise immissions at any NSR; the cumulative effect is then very similar to that for the more noisy project alone. Hypothetically, where two sets of works are equal in noise immissions, the cumulative increase in construction noise is limited to a maximum of 3 dB. However, this would only occur if the works are very close and similar in activity. In respect to Hornsea Three, it is 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 developments.

8.14.2.4 The duration for which construction noise occurs may be extended if different projects are constructed non-concurrently. However if each development follows the guidance contained within BS 5228 and given the localised nature of noise impacts associated with the construction of each development it is unlikely that cumulative impacts will occur. Consequently, the cumulative effects due to Hornsea Three construction works overlapping with other projects would be unlikely to be greater than for Hornsea Three alone.

The temporary impact of cable installation during construction 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. Whilst the most likely cumulative outcome is that the magnitude is considered to be minor for receptors within 47 m and negligible beyond, as a worst case, minor impacts could occur within 66 m of cumulative works.

Sensitivity of the receptor

8.14.2.6 Residential receptors within the distances above are considered to be medium 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 of the impact 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.

The temporary impact of cable installation by HDD (including duct installation at Hornsea Three landfall area) 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 term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. Whilst the most likely cumulative outcome is that the magnitude of impact is considered to be minor for receptors within 154 m and negligible beyond, as a worst case, minor effects could occur within 218 m of cumulative works.

8.14.2.9 At the Hornsea Three landfall area 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. Whilst the most likely cumulative outcome is that the magnitude is considered to be minor for receptors within 471 m and negligible beyond, as a worst case, minor impacts could occur within 665 m of cumulative works.

Sensitivity of the receptor

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

Significance of the effect

8.14.2.11 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude of the impact 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.

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

Magnitude of impact

8.14.2.12 The impact is predicted to be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptors directly. Whilst the most likely cumulative outcome is that the magnitude of impact is considered to be minor for receptors within 79 m and negligible beyond, as a worst case, minor impacts could occur within 112 m of cumulative works.

Sensitivity of the receptor

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

Significance of the effect

8.14.2.14 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude of the impact 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.

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

Magnitude of impact

8.14.2.15 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. For daytime works, as no NSRs have been identified within 71 m of the site, the magnitude of impact is considered to be negligible.

Sensitivity of the receptor

8.14.2.16 Residential receptors within the distances above are considered to be medium sensitivity. The sensitivity of PRoWs is considered to be low.

Significance of the effect

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

8.14.2.18 The sensitivity of the PRoWs is considered to be low and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms.

Future monitoring

8.14.2.19 No noise and vibration monitoring to test the predictions made within the construction phase cumulative impact assessment is considered necessary.

8.14.3 Operation and maintenance phase

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

Magnitude of impact

8.14.3.1 The extension and restoration of Mangreen Quarry overlaps with the operation of Hornsea Three, with Mangreen Quarry operations limited to within the daytime period by their planning permission. Overall noise emitted by the operation of the onshore HVDC converter/HVAC substation will be mitigated to achieve a maximum level that would avoid a significant effect at any time, achieving this by a margin of 18 dB during the daytime. Consequentially, the onshore HVDC converter/HVAC substation would not significantly contribute to any cumulative effect with Mangreen Quarry during the daytime.

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.

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 of the impact is deemed to be minor. The effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.

Future monitoring

8.14.3.5 No noise and vibration monitoring to test the predictions made within the operation and maintenance phase cumulative impact assessment is considered necessary.

8.14.4 Decommissioning phase

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

Magnitude of impact

8.14.4.1 Any predicted impact would be of local spatial extent, short term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude of impact is considered to be negligible to minor.

Sensitivity of receptor

8.14.4.2 The sensitivity of the residential receptor is considered to be medium. The sensitivity of the PRoW is considered to be low.

Significance of Effect

8.14.4.3 Overall, it is predicted that the sensitivity of the receptor is considered to be medium and the magnitude of the impact 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.

8.14.4.4 The sensitivity of the PRoWs is considered to be low and the magnitude of the impact is deemed to be negligible. The effect will, therefore, be of **negligible** significance, which is not significant in EIA terms.

Future monitoring

8.14.4.5 No noise and vibration monitoring to test the predictions made within the decommissioning phase cumulative impact assessment is considered necessary.

8.15 Transboundary effects

8.15.1.1 A screening of transboundary impacts has been carried out and is presented in volume 4, annex 5.4: 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, operation 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 Hornsea Three onshore cable corridor, 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 11: Inter-Related Effects (Onshore).

8.17 Conclusion and Summary

8.17.1.1 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.

8.17.1.2 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.

8.17.1.3 No specific mitigation measures have been identified beyond those incorporated into the design. 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 Hornsea Three onshore cable corridor, HDD works, onshore HVAC booster station and onshore HVDC converter/HVAC substation are likely to be mitigated to **negligible** to **minor adverse**.

8.17.1.4 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 Hornsea Three would be **negligible** to **minor adverse**, due to the identified noise attenuation which would be integrated into the design.

8.17.1.5 During decommissioning, effects would be limited to activities at the onshore HVAC booster station and onshore HVDC converter/HVAC substation. The results of the noise and vibration assessment indicate that the significance of noise and vibration effects from decommissioning of the onshore HVAC booster station and onshore HVDC converter/HVAC substation would be **negligible** to **minor adverse**.

8.17.1.6 Screening of potential transboundary impacts (as presented in volume 4, annex 5.4: Transboundary Impacts Screening Note) has identified that there was no potential for significant transboundary effects with regard to noise and vibration.

8.17.1.7 A summary of the findings of the noise and vibration EIA are presented in Table 8.40.

Table 8.40: 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 open cut cable installation during construction may affect receptors sensitive to noise or vibration.	See Table 8.21	Negligible to Minor	Medium – residents	**Negligible** to **Minor Adverse** (not significant in EIA terms)	None	N/A	None
The temporary impact of cable installation by HDD (excluding duct installation at the Hornsea Three landfall area) may affect receptors sensitive to noise or vibration.	See Table 8.21	Negligible to Minor Minor	Medium – residents Low - PRoW	**Negligible** to **Minor Adverse** (not significant in EIA terms)	None	N/A	None
The temporary impact of cable installation at the Hornsea Three landfall area may affect receptors sensitive to noise or vibration	See Table 8.21	Negligible to Minor Negligible	Medium – residents Low - PRoW	**Negligible** to **Minor Adverse** (not significant in EIA terms) **Negligible** (not significant in EIA terms)	None	N/A	None
The temporary impact of constructing the construction accesses on the onshore cable corridor may affect receptors sensitive to noise or vibration.	See Table 8.21	Negligible to Minor	Medium- residents	**Negligible** to **Minor Adverse** (not significant in EIA terms)	None	N/A	None
The temporary impact of increased vehicles on existing road network associated with construction works may affect receptors sensitive to noise.	See Table 8.21	Negligible to Minor	Medium – residents Low - PRoW	**Negligible** (not significant in EIA terms)	None	N/A	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	Negligible	Medium – residents Low - PRoW	**Negligible** (not significant in EIA terms)	None	N/A	None
Operation and Maintenance Phase							
The operational impact of the onshore HVDC converter/HVAC substation may affect receptors sensitive to noise.	None	Negligible to Minor	Medium- residents Low - PRoW	**Negligible** to **Minor Adverse** (not significant in EIA terms)	None	N/A	None
The operational impact of the onshore HVAC booster station may affect receptors sensitive to noise.	None	Negligible to Minor	Medium - residents Low - PRoW	**Negligible** to **Minor Adverse** (not significant in EIA terms)	None	N/A	None

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
Decommissioning Phase							
The temporary impacts of onshore HVDC converter/HVAC substation and HVAC booster station decommissioning may affect receptors sensitive to noise or vibration.	See Table 8.21	Negligible to Minor	Medium – residents Low – PRoW	**Negligible** to **Minor Adverse** (not significant in EIA terms)	None	N/A	None

8.18 References

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