

Norfolk Boreas Offshore Wind Farm Outline Norfolk Boreas Haisborough Hammond and Winterton Special Area of Conservation Site Integrity Plan

DCO Document 8.20

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Glossary of Acronyms

AEol	Adverse Effect on Integrity
DCO	Development Consent Order
DML	Deemed Marine Licence
EIA	Environmental Impact Assessment
ES	Environmental Statement
HHW	Haisborough, Hammond and Winterton
HRA	Habitat Regulations Assessment
JNCC	Joint Nature Conservation Committee
MMO	Marine Management Organisation
SAC	Special Area of Conservation
SNCB	Statutory Nature Conservation Body
SIP	Site Integrity Plan
VPWL	Vattenfall Wind Power Limited

Glossary of Terminology

Array cables	Cables which link wind turbine to wind turbine, and wind turbine to offshore electrical platforms.
Interconnector cables	Offshore cables which link offshore electrical platforms within the Norfolk Boreas site
Landfall	Where the offshore cables come ashore at Happisburgh South
Project interconnector cable	Offshore cables which would link either turbines or an offshore electrical platform in the Norfolk Boreas site with an offshore electrical platform in one of the Norfolk Vanguard sites.
Project interconnector search area	The area within which the project interconnector cables would be installed.
Offshore cable corridor	The corridor of seabed from the Norfolk Boreas site to the landfall site within which the offshore export cables will be located.
Offshore electrical platform	A fixed structure located within the Norfolk Boreas site, containing electrical equipment to aggregate the power from the wind turbines and convert it into a suitable form for export to shore.
Offshore export cables	The cables which transmit power from the offshore electrical platform to the landfall.
Offshore project area	The area including the Norfolk Boreas site, project interconnector search area and offshore cable corridor.
Offshore service platform	A platform to house workers offshore and/or provide helicopter refuelling facilities. An accommodation vessel may be used as an alternative for housing workers.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.
The Applicant	Norfolk Boreas Limited
The project	Norfolk Boreas Wind Farm including the onshore and offshore infrastructure.

1 INTRODUCTION

1.1 Purpose of this Document

1. The purpose of this Outline Norfolk Boreas Haisborough, Hammond and Winterton (HHW) Special Area of Conservation (SAC) Site Integrity Plan (SIP) (herein referred to as the HHW SIP) is to set out the process for Norfolk Boreas Limited to agree all works and potential mitigation measures associated with offshore cable installation (including seabed preparation works and cable protection) and maintenance within the HHW SAC, with the Marine Management Organisation (MMO) in consultation with Natural England, in order to ensure there would be no adverse effect on integrity (AEoI) on the HHW SAC as a result of Norfolk Boreas.

1.2 Project Background

2. Norfolk Boreas Limited, ('the Applicant') is proposing to develop Norfolk Boreas (hereafter 'Norfolk Boreas' or 'the project'), an offshore wind farm in the southern North Sea.
3. Norfolk Boreas comprises the Norfolk Boreas site, within which wind farm array will be located (Figure 1.1). The Norfolk Boreas site would be connected to the shore by offshore export cables installed within the offshore cable corridor from the wind farm to a landfall point at Happisburgh South, Norfolk. From there onshore cables would transport power over approximately 60km to the onshore project substation near to Necton, Norfolk. A full project description is given in the Environmental Statement (ES), Chapter 5 Project Description (document reference 6.1.5).
4. Once built, Norfolk Boreas would have an export capacity of up to 1,800MW, with the offshore components comprising:
 - Wind turbines;
 - Offshore electrical platforms;
 - Offshore service platform;
 - Met masts;
 - Measuring equipment (LiDAR and wave buoys);
 - Array cables;
 - Interconnector cables or project interconnector cables¹; and
 - Export cables.

¹ There may be a requirement for cables to be placed within the project interconnector search area (Figure 5.1 of the ES) which would link the Norfolk Boreas project to the Norfolk Vanguard project (section 5.4.12 of ES Chapter 5 Project Description). Either "Interconnector cables", which would link platforms within the Norfolk Boreas site, would be installed or "project interconnector cables" would be installed. Under no scenario would both be required.

5. This Outline Site Integrity Plan (SIP) relates to a section of the offshore export cables, where they overlap with the Haisborough, Hammond and Winterton (HHW) Special Area of Conservation (SAC) (Figure 1.1).
6. The Norfolk Vanguard Offshore wind farm project is being developed by Norfolk Vanguard Limited which like Norfolk Boreas Limited is an affiliate company of Vattenfall Wind Power Limited (VWPL). The Norfolk Vanguard project is approximately one year ahead of Norfolk Boreas in its development and at the time of writing the DCO application is undergoing its examination.
7. A strategic approach has been taken to developing both Norfolk Boreas and Norfolk Vanguard (see Chapter 1 Introduction and Chapter 5 Project Description of the Norfolk Boreas ES and document 3.4 the Inter relationship Report for further details on the relationship between Norfolk Vanguard and Norfolk Boreas). This is particularly pertinent to the offshore cable corridors for both projects which have been identified in a strategic manner such that a single corridor would be sufficient for both projects in order to minimise potential impacts (see section 4.7 and 4.8.1 of Chapter 4 Site Selection and Assessment of Alternatives of the ES, document reference 6.1.4). Therefore, the area of the offshore cable corridor which overlaps with the HHW SAC is identical for both projects.
8. Norfolk Boreas Limited have included two scenarios within the DCO application; Scenario 1 where Norfolk Vanguard and Norfolk Boreas proceed to construction and Scenario 2 where Norfolk Vanguard does not. These two scenarios are presented in Chapter 5 Project Description of the ES (document reference 6.1.5). The two scenarios have not materially affected the drafting of this document as the worst case for impacts within the HHW SAC for the Norfolk Boreas project alone would be the same regardless of which ever scenario is taken forward. It should be noted however the worst case scenario for in combination impacts would occur under Scenario 1 and this is also considered throughout this document.
9. The Norfolk Boreas Environmental Impact Assessment (EIA) has followed a 'Rochdale' or 'design envelope' approach, as discussed in section 5.1.1 of ES Chapter 5 Project Description (document reference 6.1.5). The design envelope provides flexibility allowing the project to be optimised and refined prior to construction. Therefore, realistic worst case scenarios have been adopted in the ES (document 6.1) and Information to Support Habitats Regulations Assessment (HRA) report (document reference 5.3), to allow a precautionary and robust impact assessment.
10. The project design envelope on which this DCO submission is based was "frozen" in January 2019 to allow the DCO to be completed and submitted in June 2019. A summary of the worst case scenario based on this design freeze is provided in section 3, Table 3.1. It should be noted that the detailed design of Norfolk Boreas

(e.g. micro-siting of the cable route and the requirement for cable protection), on which the final HHW SIP will be based, will not be determined until post-consent (see section 3).

1.3 The Outline Site Integrity Plan background

11. Condition 9(1)(m) of Schedules 11 and 12 (The Transmission Deemed Marine Licences (DMLs)) of the Norfolk Boreas draft Development Consent Order (DCO) state:

“The licensed activities, or any phase of those activities must not commence until a site integrity plan which accords with the principles set out in the outline Norfolk Boreas Haisborough, Hammond and Winterton Special Area of Conservation Site Integrity Plan has been submitted to the MMO and the MMO (in consultation with the relevant statutory nature conservation body) is satisfied that the plan provides such mitigation as is necessary to avoid adversely affecting the integrity (within the meaning of the 2017 Regulations) of a relevant site, to the extent that sandbanks and Sabellaria spinulosa reefs are a protected feature of that site.”

12. Due to the long lead in times for the development of offshore wind farms it is not possible to provide final detailed method statements for construction prior to consent, and as a result, the detail of any required mitigation also cannot be finalised prior to consent. Key outstanding areas of uncertainty that will be addressed post consent through the SIP include:
- **The precise extent and location of the Annex 1 reef feature.** Due to the ephemeral nature of *S. spinulosa* reef which has the potential to vary greatly. This will be informed by pre-construction surveys which must be undertaken no earlier than 12 months prior to cable installation;
 - **The detailed installation methodology, cable crossings and requirement for any cable protection.** This will be informed by pre-construction surveys which must be undertaken no earlier than 12 months prior to cable installation; and
 - **The design of cable and pipeline crossings.** These will be determined by crossings agreements with cable and pipeline owners or operators which will be progressed post consent.
13. It is recognised that some existing offshore wind farms have been permitted to route cables through SACs without the need for a SIP. However, the Natural England (2018) report ‘Offshore wind cabling: ten years’ experience and recommendations’, notes that engineering considerations that were unforeseen at the consenting stage have resulted in a necessity for consent variations during construction.
14. The Applicant has therefore taken a conservative approach in the assessment, (e.g. by assessing a contingency for cable protection) in accordance with advice from

Natural England and the MMO during the Evidence Plan Process. The purpose of this approach is to avoid the need for post consent variations and to make a firm commitment through the SIP (as required by Condition 9(1)(m) of Schedule 11 and 12 to agree all works in the HHW SAC with the MMO in consultation with Natural England. This approach justifies a robust conclusion of no AEoI at the consenting stage on the basis that works cannot commence until the MMO is satisfied that there would be no AEoI.

15. The Outline SIP provides a framework for further post-consent consultation by Norfolk Boreas Limited with the MMO and Natural England, to agree the exact details of any required project related management measures. Indicative mitigation measures are outlined in section 5.1 of this Outline SIP which would be developed in consultation with the MMO and other relevant bodies, post consent based on the final design of Norfolk Boreas to ensure the mitigation will deliver no AEoI. The process that would be undertaken in finalising the SIP is outlined in Plate 1.1 below.

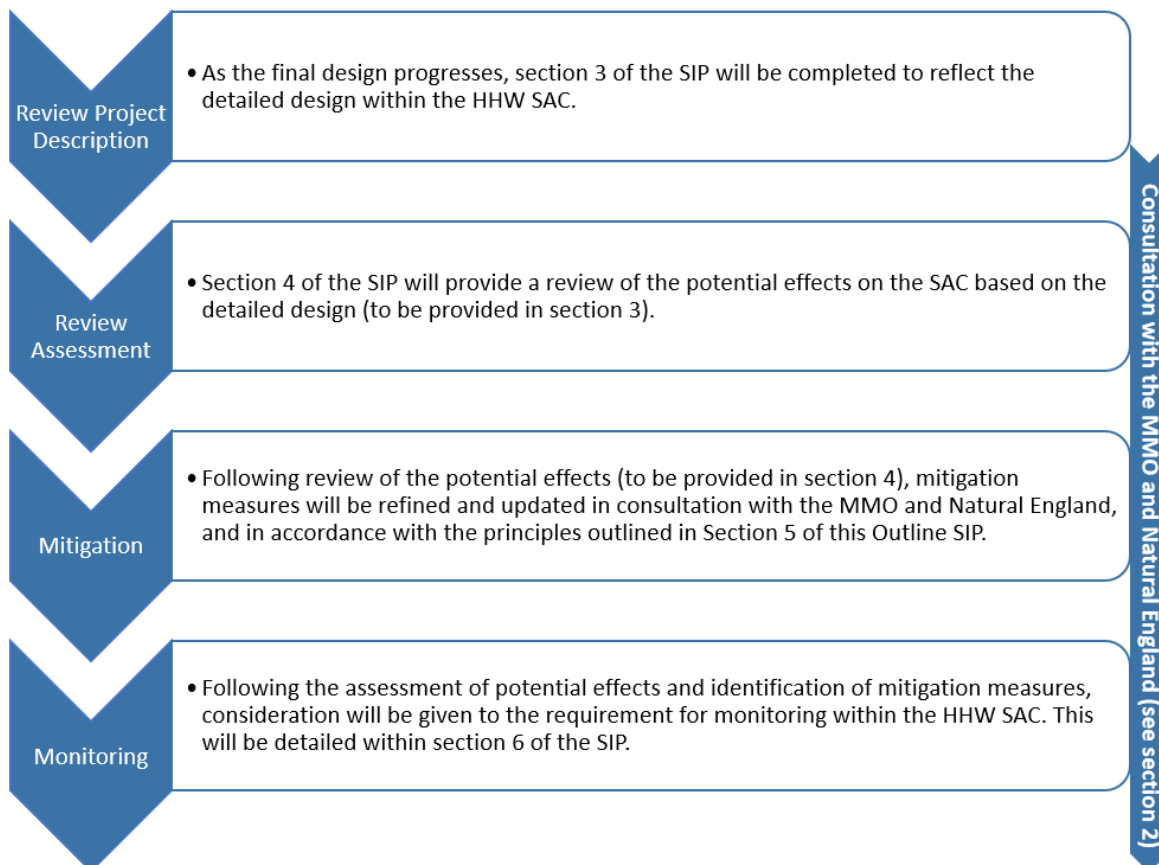


Plate 1.1 Site Integrity Plan Process

16. Condition 9(1)(m) of Schedules 11 and 12 of the draft DCO secure the requirement for the HHW SAC SIP within the DMLs, whilst allowing scope for refinement of the

precise mitigation measures to be adopted based on pre-construction surveys as well as latest guidance and evidence.

17. This Outline SIP reflects the commitment of Norfolk Boreas Limited to undertake further mitigation measures that may be necessary to avoid the potential for Adverse Effects on Integrity of the Annex 1 Reef and Sandbank features of the HHW SAC.
18. A final detailed SIP will be submitted to the MMO for approval prior to the commencement of works in the HHW SAC, following revision and consultation as per the outline schedule in section 2.4. The final mitigation would be based on latest targets, guidance, pre-construction survey data and available evidence from other projects. Mitigation measures must be agreed with the MMO in consultation with Natural England.
19. This document is specifically designed to satisfy the condition within the Norfolk Boreas DCO alone, however as discussed above consideration will also be given to Norfolk Boreas's sister project, Norfolk Vanguard to ensure mitigation solutions are compatible for both projects.
20. As the two projects share an offshore cable corridor through the HHW SAC Norfolk Boreas Limited will have the advantage of being able to learn from the experience of the Norfolk Vanguard project.

1.4 The Haisborough Hammond and Winterton Special Area of Conservation

21. The HHW SAC is located to the west of Norfolk Boreas, and the offshore cable corridor passes through the SAC. The SAC is designated for Annex I Sandbanks which are slightly covered by seawater all the time and Annex I Reefs (*Sabellaria spinulosa*).
22. The sandbank ridges consist of sinusoidal banks which have evolved over the last 5,000 years and comprise of Haisborough Sand, Haisborough Tail, Hammond Knoll, Winterton Ridge and Hearty Knoll. Older sandbanks, Hewett Ridge and Smiths Knoll, are present along the outer site boundary and have formed over the last 7,000 years. The more geologically recent sandbanks of Newarp Banks and North and Middle Cross Sands lie on the south west corner of the SAC².
23. The Joint Nature Conservation Committee (JNCC) HHW Site Details² state that *S. spinulosa* reef has been recorded at Haisborough Tail, Haisborough Gat and between Winterton Ridge and Hewett Ridge. *S. spinulosa* reefs within the HHW SAC can have an elevation of 5cm to 10cm and in areas where reef has been recorded, this can have between 30% to 100% coverage.

² <http://jncc.defra.gov.uk/protectedsites/sacselection/sac.asp?EUCode=UK0030369>

24. As described above and shown in Figure 1.1, the Norfolk Boreas offshore cable corridor overlaps with the HHW SAC and therefore there is potential for the designated features of the SAC to be affected during the construction and maintenance of Norfolk Boreas.

1.4.1 Conservation Objectives

25. Conservation objectives are set by the JNCC and Natural England to ensure that, subject to natural change, the integrity of a site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:
- The extent and distribution of qualifying natural habitats and habitats of the qualifying species;
 - The structure and function (including typical species) of qualifying natural habitats;
 - The structure and function of the habitats of the qualifying species;
 - The supporting processes on which qualifying natural habitats and habitats of qualifying species rely;
 - The population of qualifying species; and
 - The distribution of qualifying species within the site.
26. The Conservation Objectives for the HHW SAC are as follows (JNCC and Natural England, 2013):
- *“Subject to natural change maintain the sandbanks in favourable condition, in particular the sub-features:*
 - *Low diversity dynamic sand communities*
 - *Gravelly muddy sand communities”*; and
 - *“Subject to natural change maintain or restore the reefs in favourable condition”.*
27. ‘Favourable Condition’ is the term used in the UK to represent ‘Favourable Conservation Status’ (FCS) for the interest features of SACs. For an Annex I habitat, FCS occurs under the Habitats Directive when (JNCC and Natural England, 2013):
- *“Its natural range and area it covers within that range are stable or increasing;*
 - *The specific structure and functions, which are necessary for its long-term maintenance, exist and are likely to continue to exist for the foreseeable future; and*
 - *The conservation status of its typical species is favourable”.*
28. Favourable condition of the sandbanks and reefs is assessed based on the long-term maintenance of the following (JNCC and Natural England, 2013):

- “Extent of the habitat (and elevation and patchiness for reef);
 - Diversity of the habitat;
 - Community structure of the habitat (population structure of individual species and their contribution to the functioning of the habitat); and
 - Natural environmental quality (e.g. water quality, suspended sediment levels).”
29. Supplementary Advice³ for the HHW SAC provides various qualitative targets associated with achieving the Conservation Objectives of the HHW SAC. Those of relevance to Norfolk Boreas are outlined in Table 1.1 below.
30. In their submissions to the Norfolk Vanguard examination Natural England advised that a recent condition assessment of the features within Haisborough Hammond and Winterton SAC has been undertaken. Based on this, it is Natural England’s latest view that the Annex 1 Reef and Sandbank features are in unfavourable condition and need to be restored to favourable condition. It should be noted that at the time of drafting the results of this condition assessment are not yet published. This is reflected in Natural England’s Supplementary Advice Targets outlined in Table 1.1.
31. The latest condition of Annex 1 Reef and Sandbanks, and the associated targets will be taken in to account at the time of finalising the SIP post-consent.

Table 1.1 Supplementary Advice Targets of Relevance to Norfolk Boreas

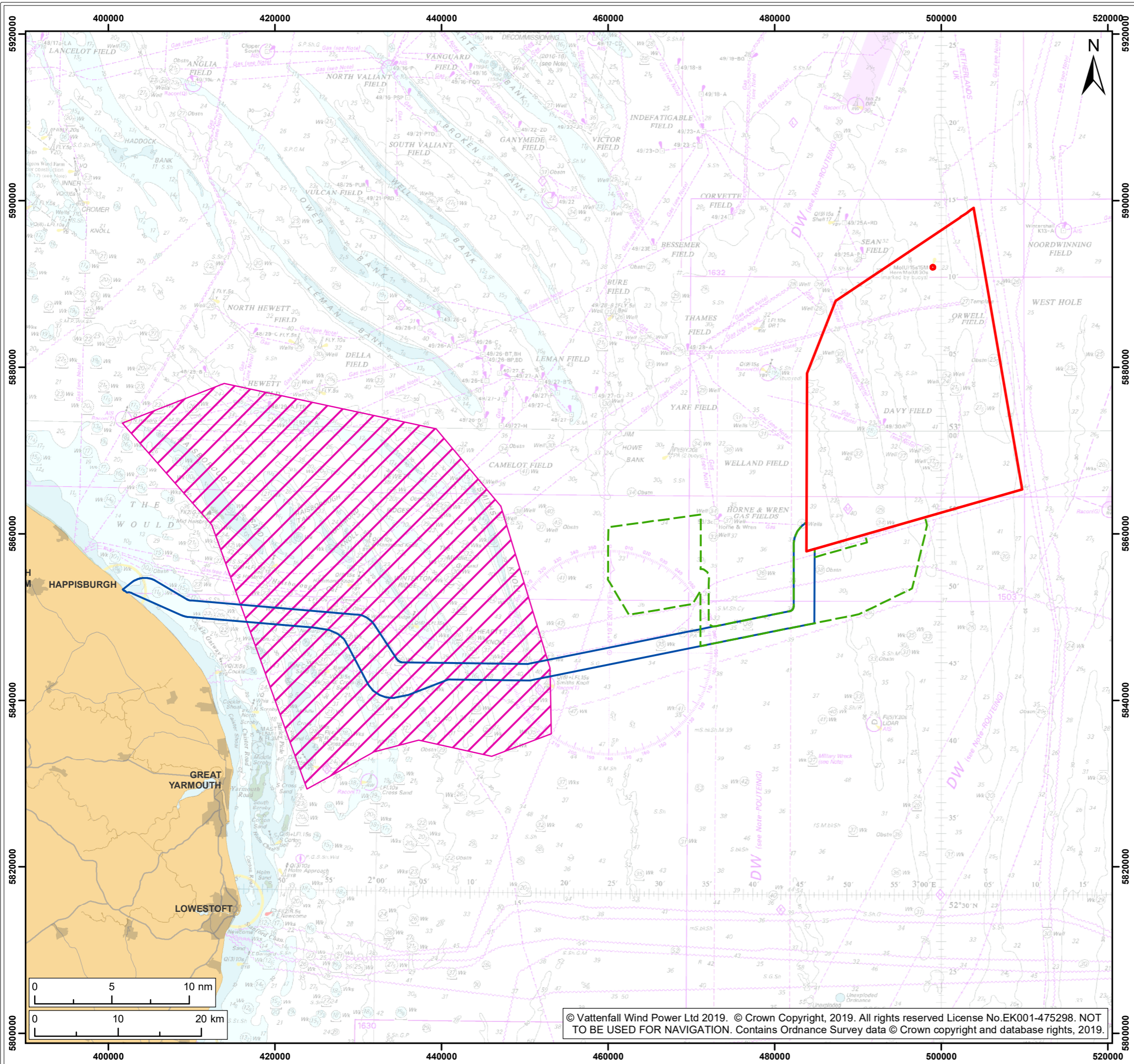
Attribute		Target
Reefs	Extent of subtidal biogenic reef	When <i>Sabellaria</i> reef develops within the site, its extent and persistence should not be compromised by human activities, accepting that, due to the naturally dynamic nature of the feature, its extent will fluctuate over time.
	Structure and function: presence and abundance of key structural and influential species	Maintain OR Recover OR Restore the abundance of listed species, to enable each of them to be a viable component of the habitat.
	Structure: non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.
	Structure: population density	Restore the density of <i>Sabellaria</i> species across the feature.
	Structure: species composition of component communities	Restore the species composition of component communities.
	Supporting processes: areas with conditions suitable for reef formation	Restore the environmental conditions in those locations that are known, or which become known, to be important for <i>Sabellaria</i> reef formation.
Sandbanks	Distribution: presence and spatial distribution of biological communities	Restore the presence and spatial distribution of subtidal sandbank communities.
	Extent and distribution	Restore the total extent and spatial distribution of subtidal sandbanks to ensure no loss of integrity, while allowing for natural change and succession.

³<https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030369&SiteName=haisborough&SiteNameDisplay=Haisborough%2c+Hammond+and+Winterton+SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

Attribute	Target
Structure and function: presence and abundance of key structural and influential species	Maintain OR Recover OR Restore the abundance of listed species, to enable each of them to be a viable component of the habitat.
Structure: non-native species and pathogens	Restrict the introduction and spread of non-native species and pathogens, and their impacts.
Structure: sediment composition and distribution	Restore the distribution of sediment composition across the feature (and each of its sub-features).
Structure: species composition of component communities	Restore the species composition of component communities.
Structure: topography	Maintain the presence of topographic features, while allowing for natural responses to hydrodynamic regime, by preventing erosion or deposition through human-induced activity.
Structure: volume	Maintain the existing (where no previous evidence exists) or best-known (where some evidence exists) volume of sediment in the sandbank, allowing for natural change.
Supporting processes: sediment movement and hydrodynamic regime	Maintain all hydrodynamic and physical conditions such that natural water flow and sediment movement are not significantly altered or prevented from responding to changes in environmental conditions.

32. The species / communities listed by Natural England in the supplementary advice are:

- The infaunal and epifaunal communities found on the crests of sandbanks are relatively species poor as a result of the highly dynamic sediment environment and the associated impacts of disturbance, smothering and scour. The low diversity communities are dominated by polychaetes (primarily *Nephtys cirrosa* and *Ophelia* sp.) and the amphipods (*Bathyporeia elegans*, *Gastrosaccus* sp. and *Urothoe* spp.). Some brittlestars (*Ophiecten* sp.) and sandeel (*Ammodytes* sp.).
- Slightly higher diversity communities consist of hardy polychaetes and amphipods approximate to the biotope A5.233 (*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand).
- The areas of the site where sediment movements are reduced (flanks and troughs) support an abundance of attached bryozoans, hydroids and sea anemones. *S. spinulosa* and other tube building worms (e.g. keel worms and sand mason worms) are found, along with bivalves and crustaceans.



- Legend:
- Norfolk Boreas site
 - Offshore cable corridor
 - Project interconnector search area
 - Haisborough Hammond and Winterton Special Area of Conservation (SAC)¹

¹ JNCC, 2019.

Project: Norfolk Boreas	Report: Haisborough Hammond and Winterton SAC Site Integrity Plan
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Title:
Haisborough Hammond and Winterton SAC

Figure: 1.1 Drawing No: PB5640-007-012-001

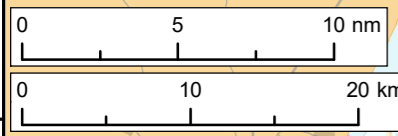
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VATTENFALL

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2 CONSULTATION

2.1 Pre-consent

33. Following an initial draft submitted to Natural England and the MMO for review in April 2019, the Norfolk Vanguard Outline SIP was submitted to the Examining Authority at Deadline 7 (2nd of May) of the Norfolk Vanguard Examination. This Norfolk Boreas Outline HHW SIP is based on the version of the Norfolk Vanguard SIP submitted to the Examining Authority at Deadline 7.
34. The MMO and Natural England will have the opportunity to review and provide comment on the Norfolk Boreas Outline HHW SIP during the Norfolk Boreas Examination. Norfolk Boreas Limited will update the document if required throughout the Examination process.

2.2 Post-consent

35. There will be an on-going requirement to engage with Natural England and the MMO throughout the detailed design stage of the project, including in the planning and review of pre-construction site investigation surveys in the HHW SAC, as well as during development of the final project design, construction plans and mitigation measures.

2.3 Project life

36. There will be an ongoing requirement to review and consult on the need for works associated with the maintenance of cables within the HHW SAC.

2.4 Schedule for Agreement

37. It is not possible at this stage to determine exact dates for agreement and refinement of the SIP as this will be determined by the final project timeline. However, key milestones are outlined in Table 2.1 to indicate the likely development of the SIP between consent and construction.

Table 2.1 Indicative milestones for refinement and agreement of the SIP

Indicative Stage	When	Action for Norfolk Boreas	Relevant Authority / Consultee	Status
Draft Norfolk Vanguard Outline SIP submitted for consultation	During Norfolk Vanguard examination (Q1 2019)	Draft Outline SIP was provided to MMO and Natural England for review	MMO and Natural England	Complete
Norfolk Vanguard Outline SIP submitted	During examination (Q2 2019)	Outline SIP submitted to the Examination	MMO and Natural England	Complete
Norfolk Boreas Outline SIP submitted as part	June 2019	Outline SIP to be submitted as part of the DCO application	The Planning Inspectorate	Complete

Indicative Stage	When	Action for Norfolk Boreas	Relevant Authority / Consultee	Status
of DCO application				
Norfolk Boreas Examination	Anticipated to be Q4 2019 to Q3 2020	Update based on comments provided by MMO and Natural England during the Examination	MMO and Natural England	To be completed
Consent determination and Appropriate Assessment (AA)	Anticipated to be Q4 2020	Review Outline SIP, identify areas for revisions/updates	Internal only	To be completed
Design of Pre-construction surveys	Pre-construction	Natural England and the MMO will be consulted during the design of the pre-construction surveys to ensure they will provide the information required to develop the final SIP and associated mitigation measures	MMO and Natural England	To be completed
Front End Engineering Design (FEED)	Pre-construction	Norfolk Boreas Limited will be refining the project design during the pre-construction period. Any updated project design will be considered in the SIP (see section 3).	Internal	To be completed
Submission and review of the draft full SIP and any associated documentation	Pre-construction, following site investigation surveys and FEED	The SIP will be updated to capture all relevant assessments and mitigation measures.	MMO and Natural England	To be completed
Iterations of the SIP, as required	Pre-construction, following site investigation surveys and FEED	The SIP will continue to be updated following review from MMO and Natural England and any further updates to the project design.	MMO, Natural England	To be completed
Final SIP sign-off	Minimum four months prior to commencement of works associated with cable installation	The SIP will be updated and finalised. The final SIP will be submitted four months prior to the commencement of works associated with cable installation, including seabed preparation works, for written approval from the MMO prior to any works commencing in the HHW SAC. This will remain a live document that may need to be updated throughout the life of the project	MMO for sign off	To be completed
Construction monitoring and reporting	Construction (not expected before 2024)	Monitoring/management reports will be submitted to the MMO.	MMO	To be completed

3 PROJECT DESCRIPTION WITHIN THE HHW SAC

38. A full description of the project design envelope and worst case scenarios are available in the Norfolk Boreas ES (see ES (document reference 6.1) Chapter 5 Project Description, ES Chapter 8 Marine Geology, Oceanography and Physical Processes, ES Chapter 10 Benthic Ecology and section 7.3.3 of the Information to Support HRA report (document reference 5.3)). A summary of the worst case scenario for works associated with the HHW SAC is provided in Table 3.1.
39. However, as the final design progresses, this section of the Outline SIP will be completed to reflect the cable installation plan within the HHW SAC, including:
- Technical specification of the offshore export cables (including fibre optic cables)
 - A detailed cable (including fibre optic cables) installation plan for the Order limits, including:
 - Proposed cable installation vessel and equipment
 - A burial risk assessment to ascertain suitable burial depths and cable laying techniques, including cable protection
 - Export cable installation schedule
40. The information included within the HHW SIP will align with the cable specification, installation and monitoring plan required under Condition 9(1)(g) of the Transmission DMLs (Schedules 11 and 12 of the DCO).
41. During the Norfolk Vanguard DCO Examination, Norfolk Vanguard Limited made a commitment to limit the potential length of unburied cable in the HHW SAC to 5% of the cable length instead of 10% which had been assessed in the ES for that project. This was based on an interim cable burial study, which formed an appendix to the Norfolk Vanguard HHW SIP (Norfolk Vanguard Limited, 2019), which indicated that at least 95% of the export cable within the SAC could be buried.
42. Due to the timing of the commitment in the Norfolk Vanguard DCO examination it was not possible for Norfolk Boreas to reflect this change in the assessments of the relevant chapters of the ES without unduly impacting on the timing of its DCO application submission. Therefore, the numbers provided in Table 3.1 are based on a worst case scenario of 10% of the export cable being protected in the HHW SAC as assessed in the Norfolk Boreas ES. However, Norfolk Boreas Limited is currently considering whether a similar commitment can be made.

Table 3.1 Worst Case Scenario in the HHW SAC

Impact	Parameter
Construction	
Temporary physical disturbance Annex 1 Sandbank	<ul style="list-style-type: none"> Boulder clearance – 0.0008km² (up to 22 boulders of 5m diameter) being placed outside the cable route. Pre-sweeping area – 0.25km² based on ES Appendix 5.1 Cable Installation Study, of this up to 0.05km² could be outside the footprint of the cable installation works. Cable installation - 2.4km² (based on maximum potential disturbance width of 30m for a 10m wide plough with 10m of spoil either side of the trench, along 80km of export cable trenching within the SAC) Anchor placement – 0.0003km² (based on two cable joints in the SAC, one per cable pair with a footprint of 150m² each, assuming up to 6 anchors per vessel) Other works (e.g. lifting of boulders and pre-lay grapnel run) associated with cable installation would be encompassed by the footprints outlined above. Therefore, the total footprint for temporary disturbance on sandbanks is 2.45km² Dredged material will be disposed of within disposal sites (see section 5.4 for further detail). The area affected by these disposal sites will be agreed with the MMO in consultation with Natural England. As discussed in the Sandwave Study by ABPmer (Appendix 7.1 of the Information to Support HRA report (document reference 5.3.7.1)), deposited sediment will immediately re-join the local and regional sediment transport system. The area affect will be in addition to the 2.45km² presented here.
Temporary physical disturbance on Annex 1 Reef	Cable installation works as outlined above, however the location and extent of <i>S. spinulosa</i> reef and therefore the overlap of the installation works with reef feature is unknown and will be detailed in the final SIP based on the pre-construction surveys.
Operation	
Temporary physical disturbance on Annex 1 Sandbank	<ul style="list-style-type: none"> An average of one repair per export cable pair every 10 years is estimated within the SAC. It is estimated that 300m sections would be removed and replaced per repair. Disturbance width of 10m = 3,000m² (0.003km²) per repair Anchor placement associated with repair works = 150m² based on 6 anchors per vessel Reburial of up to up to 10% of the cable length (4km per pair) every 5 years may be required should pre-sweeping <u>not</u> be undertaken. The disturbance width would be approximately 10m and therefore the total disturbance would be 80,000m² (0.08km²) every 5 years or approximately 480,000m² (0.4km²) over the indicative 30 year project life. If reburial is required, it is likely that this would be in relatively short sections (e.g. 1km) at any one time. If pre-sweeping is undertaken the requirement for (and likelihood of) cable reburial would be significantly reduced. The SIP requires that the installation strategy (e.g. use of pre-sweeping) is agreed with the MMO in consultation with Natural England.
Temporary physical disturbance on Annex 1 Reef	Maintenance works as estimated above, however the location and extent of <i>S. spinulosa</i> reef and therefore the overlap of the maintenance works with

Impact	Parameter
	reef feature is unknown and will be detailed in the final SIP based on the pre-construction surveys.
Persistent habitat loss on Annex 1 Sandbank	<p>Total habitat loss within the Haisborough, Hammond and Winterton SAC could be 0.05km² (0.003% of the 1,468km² SAC area) based on the following:</p> <ul style="list-style-type: none"> • <0.001km² clump weights based on cutting two existing disused cables and placing clump weights of up to 5m² on either end of the disused cables. • Six crossings for each of the export cable pairs (12 crossings in total) within the Haisborough, Hammond and Winterton SAC with a total footprint of 12,000m² in the SAC (100m length per crossing and 10m width of protection). • A contingency of up to 4km of cable protection per cable pair, 8km in total (10% of the length) could be required in the Haisborough, Hammond and Winterton SAC in the unlikely event that unsuitable ground conditions are encountered, resulting in a footprint of 40,000m² based on 5m width of cable protection.
Permanent habitat loss of Annex 1 Reef	<p>The Norfolk Boreas Information to support HRA report (document reference 5.3) does not assess the permanent loss of habitat in relation to Annex 1 <i>S. spinulosa</i> reef. The rationale being that it is possible for <i>S. spinulosa</i> reef to colonise cable protection and therefore installation of cable protection would not represent a loss of habitat as the colonised cable protection would perform the same function as suitable substrate would. The list of impacts assessed within the Information to Support HRA Report was agreed with stakeholders through the Evidence Plan Process (further information is provided in Chapter 7 Technical consultation of the ES). Norfolk Boreas Limited now understand that Natural England's position is that any colonisation of cable protection cannot be considered as Annex 1 reef (Natural England, 2019a). Norfolk Boreas Limited does not agree with Natural England's position in this respect, however, all mitigation measures will be agreed with the MMO in consultation with Natural England though the final HHW SIP, to ensure the mitigation will deliver no AEoI in the opinion of all parties.</p> <p>The worst case footprint of permanent infrastructure would be as outlined above, however the location and extent of <i>S. spinulosa</i> reef and therefore the overlap of the infrastructure with reef feature is unknown and will be detailed in the final SIP based on the pre-construction surveys. It is not expected that there will be any loss of reef where micro-siting can be undertaken (section 5.2).</p>
Decommissioning	
Temporary physical disturbance	Some or all of the offshore export cables may be removed. Cable protection would likely be left in situ (assessed as permanent, see above).

4 ASSESSMENT OF NO ADVERSE EFFECT ON INTEGRITY

43. The Information to Support HRA Report (document reference 5.3) provides an assessment of the potential effects based on the worst case scenario of the design envelope.
44. In order to conclude no AEoI on the HHW SAC as a result of offshore cable installation (including seabed preparation works and cable protection) and maintenance for Norfolk Boreas, the SIP will provide a review of the potential effects on site integrity based on the final detailed design (to be provided in section 3). This will take into account the preferred cable route and installation methods, as well as the substrate type and up-to-date habitat data from the pre-construction surveys.
45. Mitigation measures would be identified following this process to ensure effects are minimised and to allow the conclusion of no AEoI (see Section 5). This will allow mitigation measures to reflect the current status of the features of the HHW SAC.
46. The Statutory Nature Conservation Body (SNCB) Draft Conservation Objectives and Advice on Operations (JNCC & Natural England, 2009) and Formal advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 (as amended), and Regulation 18 of The Offshore Marine Conservation Regulations (Natural Habitats, &c.) Regulations 2007 (as amended) (JNCC & Natural England, 2013) identifies the following pressures that are of relevance to Norfolk Boreas:
 - Physical loss; and
 - Physical damage (i.e. disturbance).
47. The Information to Support HRA Report provides consideration of the following impacts and scenarios:
 - Disturbance to Sandbanks during construction (Information to Support HRA Report section 7.4.1.1.1);
 - Disturbance to Sandbanks during maintenance (Information to Support HRA Report section 7.4.1.1.2 under the title “Temporary physical disturbance”);
 - Sandbank habitat loss from cable protection (Information to Support HRA Report section 7.4.1.1.2 under the title “Permanent habitat loss”);
 - Disturbance to reef if micrositing is possible (Information to Support HRA Report section 7.4.2.1.1 under the title “Temporary physical disturbance” paragraph 510 to 515);
 - Disturbance to reef if micrositing is not possible (Information to Support HRA Report section 7.4.2.1.1 under the title “Temporary physical disturbance” paragraph 516 to 535);
 - Disturbance to Reef during maintenance (Information to Support HRA Report section 7.4.2.1.2); and

- In-combination effects (Information to Support HRA Report section 7.4.2.2).
48. Norfolk Boreas Limited concludes there would be no AEoI of the HHW SAC, however it is recognised that Natural England has identified uncertainty associated with the assessment (e.g. the extent of Reef at the time of construction and therefore the ability to microsite cables). As a result of this uncertainty, Norfolk Boreas Limited has committed to a SIP to provide a framework to further assess the effects based on the best available information prior to construction. The wording of the Transmission DMLs (DCO Schedules 11 and 12), Condition 9(1)(m) ensures that a conclusion of ‘no adverse effect beyond reasonable scientific doubt’ (no AEoI) can be made at the consenting stage as construction cannot commence until the MMO (in consultation with Natural England) is satisfied that there is no AEoI on the HHW SAC. Section 5 of this document outlines the process and commitments to delivering mitigation measures to ensure no AEoI.

4.1 Fisheries closure area

49. Two fisheries closure areas have been proposed within the HHW SAC which would overlap with the Norfolk Boreas offshore cable corridor. The proposed closure areas have not yet been formally ratified and would not apply to Norfolk Boreas as they relate specifically to restrictions on bottom towed fishing gear.
50. The closure areas have been identified with the aim of protecting the priority areas to be managed as reef (Figure 5.1). These areas have been identified as those where the existing reef has the potential to increase in extent if the recurring impact from bottom towed fishing gear ceases in these areas. Should the closures be implemented, they would continue to be subject to review and could be increased or decreased, where evidence supports such a change. Section 5.2 outlines the process that will be undertaken by Norfolk Boreas Limited to minimise impacts on these priority management areas.

4.2 Revised Assessment

51. As discussed above, in order to conclude no AEoI on the HHW SAC, the final SIP will provide a review of the potential effects on site integrity based on the following:
- Final detailed design (to be provided in section 3), including the preferred cable route and installation methods,
 - Up-to-date habitat data from the pre-construction surveys.
52. An outline of the approach is provided in sections 4.2.1 to 4.2.3 below.

4.2.1 Pre-construction habitat mapping

53. Norfolk Boreas Limited has committed to undertaking a pre-construction survey in accordance with Condition 13 of the Transmission DMLs (Schedules 11 and 12 of the

DCO) which will inform the final design (to be presented in Section 3), as well as informing the review of potential effects on site integrity and requirements for mitigation.

54. The survey will be undertaken within 12 months of construction commencing, in order to:
- Determine the location and extent of any *S. spinulosa* reef within areas of the Order limits in which it is proposed to carry out construction works within the SAC to inform the appropriate mitigation if found; and
 - Provide a high-level biotope habitat map for the Order limits within the SAC.

4.2.2 Sensitivity

55. The sensitivity of biotopes recorded during the pre-construction surveys will be determined based on the latest available information (e.g. the Marine Evidence based Sensitivity Assessment (MarESA)⁴. Where sensitivity information is unavailable, an appropriate proxy biotope or expert judgement will be agreed with the MMO in consultation with Natural England.

4.2.3 Potential AEoI

56. Natural England (2019b) states that there are no thresholds for determining an AEoI, however in order for Natural England to advise that there is no likelihood of an AEoI, the project would need to demonstrate the following:
- *“That the loss is not on the priority habitat/feature/ sub feature/ supporting habitat; and/or*
 - *That the loss is temporary and reversible (within guidelines above); and/or*
 - *That the scale of loss is so small as to be de minimis alone; and/ or*
 - *That the scale of loss is inconsequential including other impacts on the site/ feature/ sub feature”*
57. A map will be produced showing the final offshore export cable route and location of cable protection, along with the pre-construction habitat and *S. spinulosa* reef mapping to identify the predicted exposure of each habitat to pressures associated with Norfolk Boreas. This would be used to determine whether any loss or disturbance is on a priority habitat/feature/sub-feature/supporting habitat and therefore whether further consideration of the reversibility or scale is required.
58. Consideration of the scale of loss would be undertaken for the HHW SAC as a whole, based on the 1,467.59 km² (146,759 hectares (ha)) total site area. Consideration will also be given to the scale of loss on a feature based on the following areas quoted in

⁴ https://www.marlin.ac.uk/sensitivity/sensitivity_rationale

the Natura 2000 Standard Data Form⁵ subject to further available information at the time of completing the SIP:

- Sandbanks 668.928km² (66,892.8ha)
 - Reef 0.88km² (88.06ha)
59. It is unlikely that it will be possible to determine the scale of loss for a sub-feature. This would require habitat mapping across the whole HHW SAC to determine the extent of sub-features. This is beyond the scope of Norfolk Boreas.
60. Mitigation associated with minimising the effect on features of the HHW SAC is outlined in section 5.

⁵ <http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=UK0030369>

5 MITIGATION

61. Norfolk Boreas Limited is committed to minimising potential effects on the HHW SAC. As outlined in section 4, the final SIP will provide a review of the potential effects on site integrity based on the final project design and pre-construction survey data for the HHW SAC. Following this process, mitigation measures will be refined and updated on the basis of the principles outlined in the sections below and the commitments provided in section 5.7, to ensure effects are minimised and to allow the conclusion of no AEOI.
62. For the mitigation measures identified, information will be provided in the final SIP to detail how the measure will allow the conclusion of ‘no adverse effect on integrity beyond reasonable scientific doubt’ on the HHW SAC.

5.1 Embedded mitigation

63. During the pre-application stage, Norfolk Boreas Limited made the following commitments, informed by consultation with Natural England and the MMO through the Evidence Plan Process.

5.1.1 Minimising export cabling

64. Norfolk Boreas Limited has taken the decision to use an HVDC export solution in order to reduce the number of cables and cable protection. This results in the following mitigating features:
 - There will be two cable trenches instead of six for Norfolk Boreas (and the same for Norfolk Vanguard);
 - The volume of sediment arising from pre-sweeping and cable installation works is reduced by 67%;
 - The area of disturbance for pre-sweeping and cable installation is reduced by 67%;
 - The space required for cable installation is reduced, increasing the space available within the cable corridor for micro-siting to avoid constraints *S. spinulosa* reef if necessary;
 - The potential requirement for cable protection in the unlikely event that cables cannot be buried is reduced due to the reduction in the number of cables; and
 - The number of export cables required to cross existing cables and pipelines and the associated cable protection is reduced.

5.1.2 Pre-construction survey

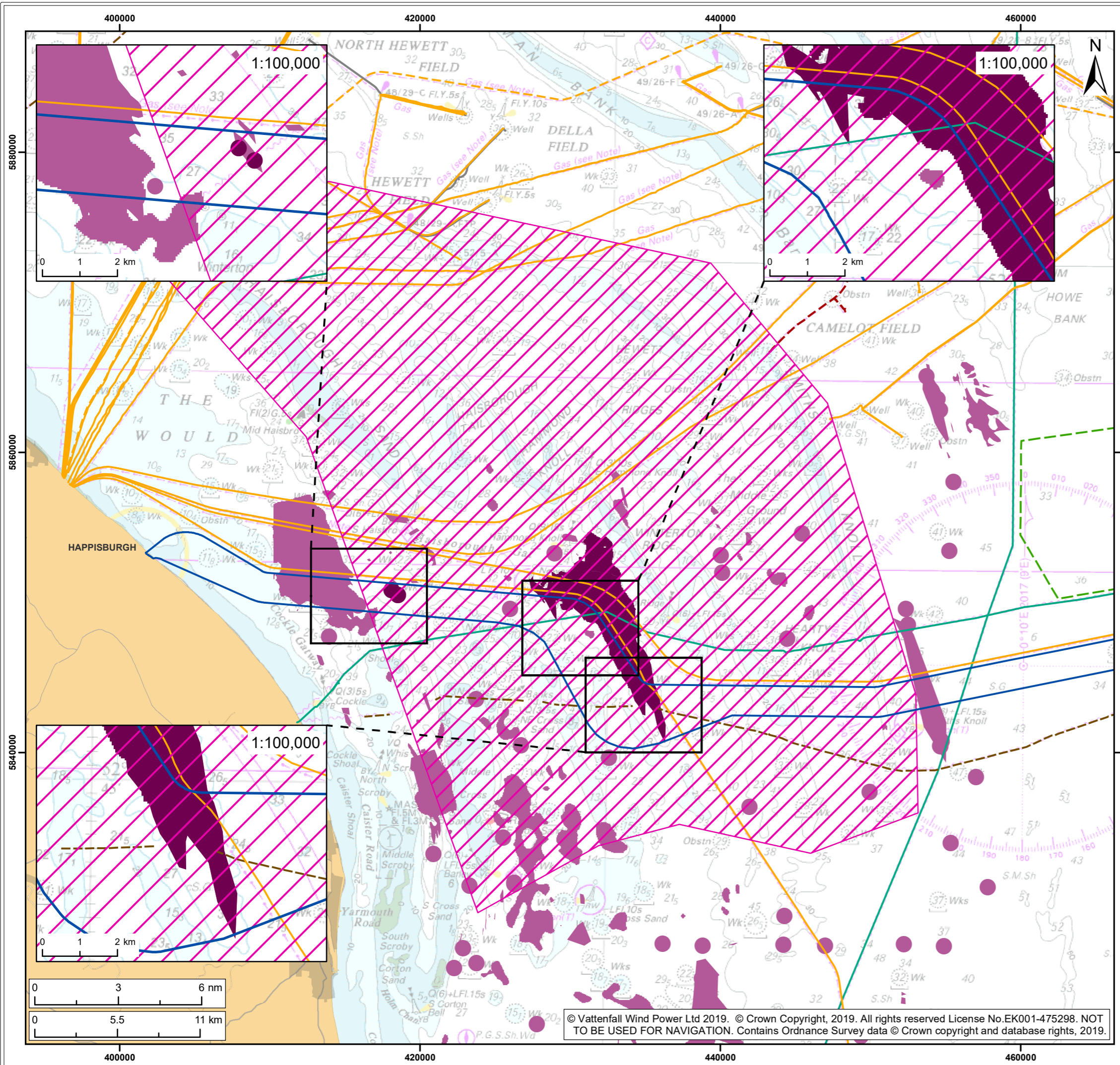
65. A pre-construction survey will be undertaken within 12 months of any cable installation works and the methodology for the pre-construction surveys will be agreed with the MMO in consultation with Natural England.

66. The results of this survey will be used to plan the routing of cables including micrositing where possible (see section 5.2).

5.2 Micrositing

67. Norfolk Boreas Limited is committed to micrositing around Annex 1 reef where there is sufficient space to do so. This will be based on the extent of reef identified during the pre-construction surveys and the two priority Areas to be Managed as Reef (Figure 5.1). The commitments made by Norfolk Boreas Limited to date (section 5.1), in particular the HVDC export solution to decrease the number of cable trenches from six to two, greatly increases the likelihood that micrositing will be possible.
68. As discussed in section 5.1.2 and section 4.2.1, a pre-construction survey would be undertaken within 12 months of any cable installation works and the results of this survey would inform the routing/micrositing of cables.
69. The initial pre-construction survey will be used to plan the cable routes for the two Norfolk Boreas cable trenches as well as the two Norfolk Vanguard⁶ trenches. Depending on the duration between cable installation, further pre-construction surveys may be required to ensure these are undertaken within 12 months of the installation works. Further small scale micrositing would be undertaken where possible within the confines of the initial cable route plan, should reef have developed since the first pre-construction survey.
70. Plate 5.1 shows the process of identifying micrositing mitigation following the pre-construction surveys. This reflects Norfolk Boreas Limited's commitment to avoiding areas of reef identified during the pre-construction surveys and to take routes which would have the least effect on the two priority Areas to be Managed as Reef (Figure 5.1).

⁶ This document relates to Norfolk Boreas alone, however consideration will also be given to Norfolk Vanguard to ensure mitigation solutions are compatible for both projects.



Legend:

- Offshore cable corridor
- Project interconnector search area
- Haisborough Hammond and Winterton Special Area of Conservation (SAC)¹
- Priority areas to be managed as *S. spinulosa* reef²
- Potential areas to be managed as *S. spinulosa* reef²

Subsea Cables³

- Active
- Disused

Pipelines⁴

- Abandoned
- Active
- Precommission
- Not in use

¹ JNCC, 2019
² Natural England/MALSF, 2013/2011
³ KisOrca, 2018.
⁴ Oil & Gas UK Ltd, 2019.

Project: Norfolk Boreas	Report: Haisborough Hammond and Winterton SAC Site Integrity Plan
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Title:
Annex 1 Reef identified in the Norfolk Boreas offshore cable corridor within the SAC

Figure:	5.1	Drawing No:	PB5640-007-012-001		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	24/04/2019	LB	KC	A3	1:250,000

Co-ordinate system: ETRS 1989 UTM Zone 31N EPSG: 25831

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together

71. As shown in Plate 5.1 , should there not be sufficient space to route cables around reef identified during the pre-construction surveys the route which would result in the least temporary disturbance would be proposed. This route would then be subject to further assessment and a conclusion of no AEoI would have to be reached by the MMO in consultation with Natural England. If such a finding could not be reached, construction could not commence and the onus would be on Norfolk Boreas Limited to consider alternative solutions. For example, this could include: minor amendments to the redline boundary in discrete areas where the cable route interacted with reef to provide space for micrositing; or a variation to the Transmission DML Condition 9(1)(m) to allow a finding of AEoI should the project satisfy the HRA Assessment of Alternatives, Imperative Reasons of Overriding Public Interest (IROPI) and Compensatory Measures tests.
72. The detailed cable route, including micrositing will be determined based on the results of the pre-construction survey and must be agreed with the MMO in consultation with Natural England before any installation works, including seabed preparation can commence.

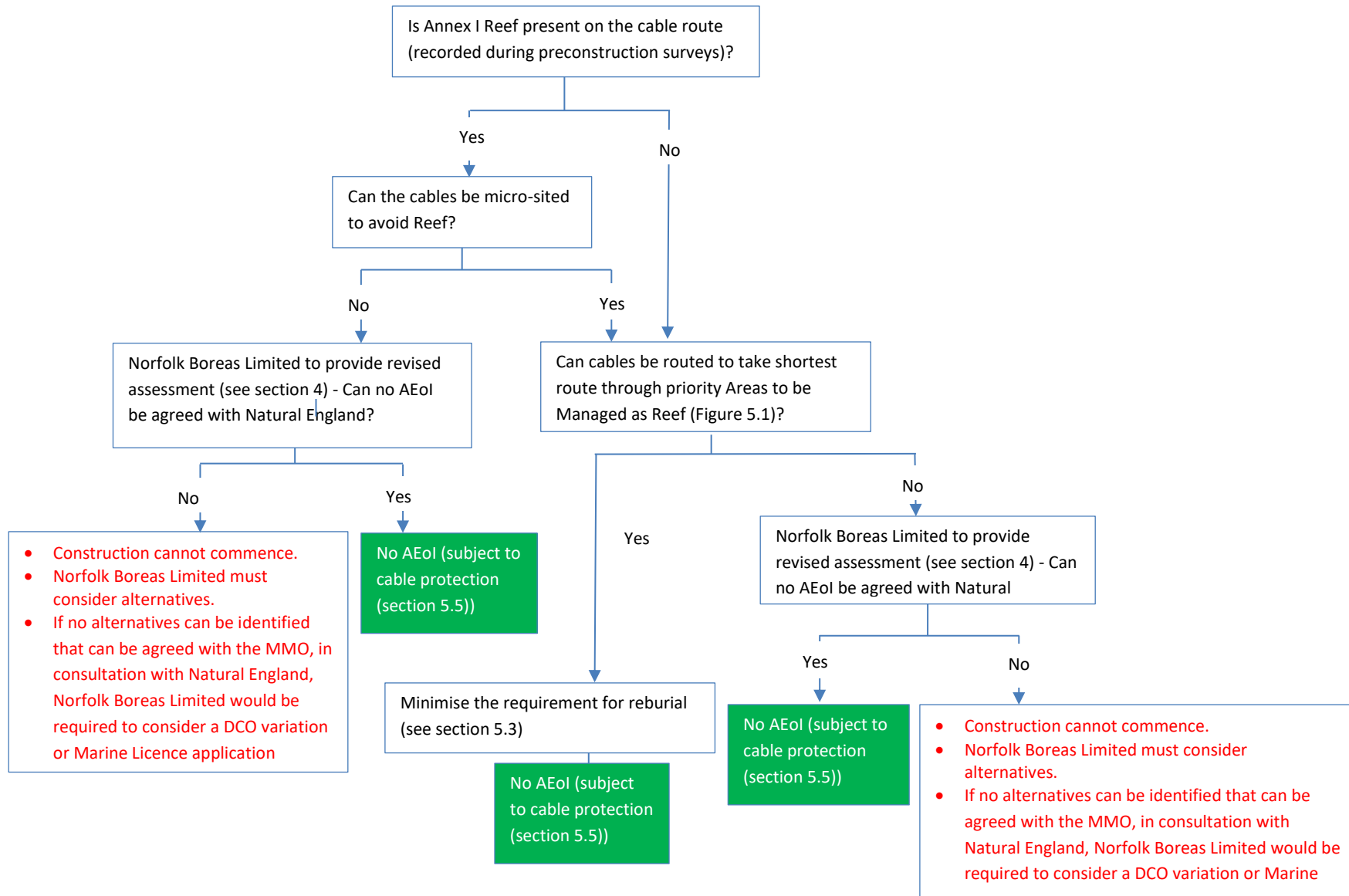


Plate 5.1 Micrositing around Annex 1 Reef decision process

5.2.1 Likelihood of Successful Micrositing

73. As discussed in the Information to Support HRA report (document reference 5.3), Norfolk Boreas and Norfolk Vanguard Limited commissioned a Cable Constructability Assessment to be completed by Global Marine Systems Ltd (provided in Appendix 4.2 of the ES) to determine an appropriate cable corridor width of approximately 2km to 4.7km. This study along with all the site selection work has been undertaken for a combined corridor for Norfolk Boreas and Norfolk Vanguard projects.
74. The space available for micrositing within the offshore cable corridor where it overlaps with the HHW SAC is approximately 1.05km along most of the route (where the corridor width is 2km), with up to 3.75km of micrositing available in the 'dog-leg' area (where the corridor width is 4.7km). This takes into account the space required for Norfolk Boreas export cables⁷. The space available for micrositing is based on the following:
- Up to four export cable trenches (four cables in two trenches for Norfolk Boreas and four cables in two trenches for Norfolk Vanguard) with spacing as shown in Plate 5.2;
 - The cable corridor is typically 2km in width, with a wider section of up to 4.7km where there is a dog-leg in the corridor within the SAC;
 - A total width of approximately 1.35km is required for Norfolk Boreas and Norfolk Vanguard; which includes up to four cables (laid in pairs, i.e. two trenches) for each project, a contingency of 440m (0.4km), an anchor placement zone, and a buffer for potential anchor placement and cable replacement works (GMSL, 2016 unpublished; Plate 5.2); and
 - The remaining width of the offshore cable corridor within the SAC is therefore approximately 0.65km to 3.35km plus the built-in contingency of 0.4km, resulting in approximately 1.05km to 3.75km available for micrositing.

⁷ This SIP is for Norfolk Boreas alone, however the space available for micrositing within the cable corridor must take account of Norfolk Vanguard.

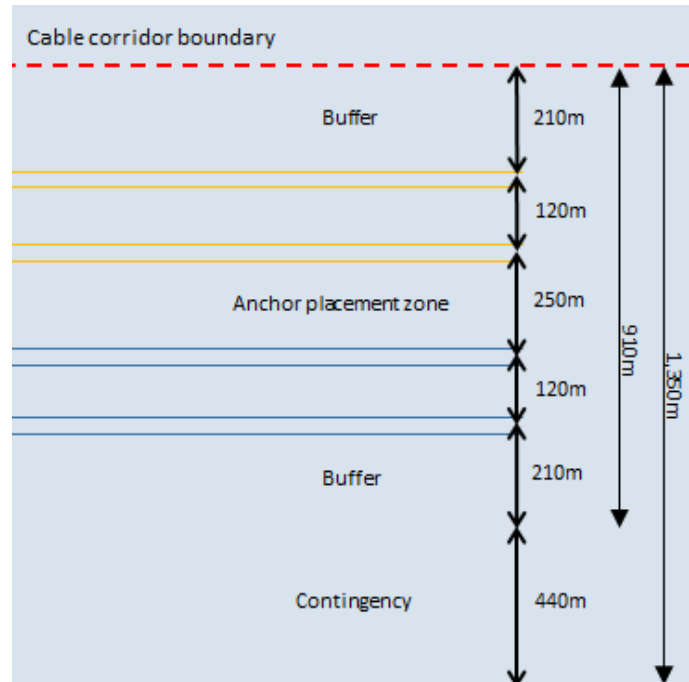


Plate 5.2 Export cables layout (two pairs of cables for Norfolk Boreas (blue) and two pairs of cables for Norfolk Vanguard (yellow)) based on 48m water depth⁸

5.3 Cable installation and seabed preparation

75. As described above, the commitments made by Norfolk Boreas Limited to date (section 5.1), in particular the HVDC export solution, greatly reduce the impact area and duration of cable installation by reducing the number of cable trenches from six to two.
76. Cables will be buried where the substrate allows burial to a depth of at least 1m. Should burial not be possible (e.g. in hard clay and sedimentary rocks), the approach to remedial action under these conditions (e.g. a requirement for cable protection) would be agreed with the MMO in consultation with Natural England (see section 5.5.2).
77. In response to requests from Natural England during the Norfolk Vanguard Examination, an Interim Cable Burial Study was commissioned (Norfolk Vanguard Limited, 2019) which was based on geophysical, geotechnical and environmental survey carried out by Fugro Survey B.V. in 2016 with 100% coverage of the offshore export cable corridor, including the area within the HHW SAC. The study which considered both Norfolk Boreas and Norfolk Vanguard export cables has identified that at least 95% of the offshore export cable length within the HHW SAC is likely to be able to be buried. As discussed previously the Norfolk Boreas DCO application is based on a project design envelope that was frozen in January 2019 and this uses the

⁸ The separation between cables is determined by the potential space required to undertake a cable repair which is a factor of the water depth. Depth in the SAC is less than 48m and therefore this represents a conservative worst case scenario

precautionary assumption that 90% of the export cable would be buried. However, further consideration is being given to whether the Norfolk Boreas project design envelope can also incorporate the assumption that 95% of export cable will be buried and therefore less cable protection will be required.

78. Section 5.4.13 of ES Chapter 5 provides a description of the cable laying process, including seabed preparation and potential installation methods. This includes:
- Boulder clearance (if required)
 - Pre-lay grapnel run
 - An option of pre-sweeping to level sandwaves to a reference seabed level that would minimise the potential for cables becoming unburied
 - Cable burial methods, e.g.:
 - Ploughing
 - Trenching or cutting
 - Jetting
79. There will be a minimum separation of 75m between cable pairs (as shown in Figure 11 of the Export Cable Installation Study, ES Appendix 5.2) and the maximum width of disturbance from cable installation is 37m (section 7.3.3.2.1 of the Information to Support HRA report), therefore there would be no repeated disturbance of the same footprint during construction.
80. If sandwave levelling is undertaken as part of the installation strategy, this would be completed at an appropriate period before the installation of each cable pair to ensure that recovery of sandwaves does not occur prior to the installation of cables. This is likely to be in the order of weeks prior to cable installation.
81. Where substrate conditions allow, the cable installation strategy in the SAC would aim to bury cables below the mobile sandwaves to avoid or minimise the requirement for re-burial of cables during the operational phase. This will be considered through the design and execution of the installation process, taking account of relevant knowledge regarding seabed morphology and mobility. In order to achieve this aim, it is acknowledged that some seabed preparation activities may be required prior to cable installation. While appropriate steps should be taken to control and mitigate the additional impacts of these works (e.g. sediment disposal, see section 5.4), the aim of securing the long-term burial and protection of the cables is the priority.
82. Norfolk Boreas Limited acknowledges that Natural England has experienced situations (notably during and after the construction of other offshore wind projects in the Greater Wash area) where the outcome of cable installation operations has fallen short of the undertakings that were made by developers and contractors prior

to construction. Norfolk Boreas can benefit from this experience, and underpin the proposed plans (i.e. detailed design and installation methodology) by establishing a comprehensive evidence base to provide confidence that execution of the burial strategy will meet the relevant burial requirements. Where applicable, this should be achieved by citing previous projects where similar design approaches, installation methods and tools have been used together with evidence that comparable, successful outcomes were achieved. Norfolk Boreas will be in a unique position when finalising its plans for export cable installation as it will be able to draw upon the site-specific experience of its sister project, Norfolk Vanguard. This will enable Norfolk Boreas to have a very high degree of confidence in the predicted outcomes.

83. Section 4.2 outlines a scope of work that Norfolk Boreas Limited intends to carry out in order to develop detailed plans for installation of cables in the HHW SAC, and the associated evidence base to support these plans.
84. The methodology will be informed by the pre-construction survey data and any available evidence from Norfolk Vanguard and any other relevant projects and must be agreed with the MMO in consultation with Natural England.

Table 5.1 Process for identifying a burial strategy

Brief description	Activities and aims
Learning from other projects	Norfolk Boreas Limited will undertake a 'lessons learned' exercise focusing on other projects with challenges regarding installation of subsea cables (including that of Norfolk Vanguard, if appropriate) in mobile sediments. The aim will be to identify the key areas of under-performance, the primary causes of the under-performance, and 'steps to take' to avoid similar adverse outcomes.
Identifying successes	Norfolk Boreas Limited will undertake a review of subsea cable installation projects which have also faced challenges relating to mobile sediments, but where burial objectives were generally achieved. The aim will be to compile evidence relating to successful design approaches, methods and tools.
Designing interim survey of SAC	Norfolk Boreas Limited will design an offshore survey campaign to inform the development of the SIP. The primary aim of the survey will be to inform understanding of the extent and character of <i>Sabellaria</i> reef within the cable corridor. The extent and location of this survey campaign will be informed by the pre-construction survey campaign undertaken for Norfolk Vanguard.
Execution of interim survey	Norfolk Boreas Limited will procure and manage the survey activity as per the survey design (see previous row).
Defining burial targets	Norfolk Boreas Limited will undertake a geotechnical assessment of the seabed in the SAC, and a Cable Burial Risk Assessment (CBRA) to determine the required depth of burial for the export cables through the SAC.
Burial tool capability study	Norfolk Boreas Limited will undertake a review of the burial tool market, informed by the initial geotech and CBRA work described above. The aim will be to identify tools that will be suitable for the burial requirements in the SAC, and to define the key technical requirements (relating to tool design and burial capability) to be used for procurement of the cable installation contract.
Sandwave installation strategy	Norfolk Boreas Limited will undertake a sandwave characterisation study, focusing on the part of the cable corridor that falls within the SAC. In parallel, Norfolk Boreas Limited will also develop a strategy for installation of cables through areas of sandwaves. This strategy will define the seabed preparation works that would be required, the required timing of these works in relation to the cable installation activity, and the relationships between the preparation works, the reference seabed level, the target burial depth and the capability of the burial tool itself. The strategy will also consider the suitability of different methods/tools for sandwave levelling, and

Brief description	Activities and aims
	the selection of areas in the SAC for disposal of seabed material arising from this process.

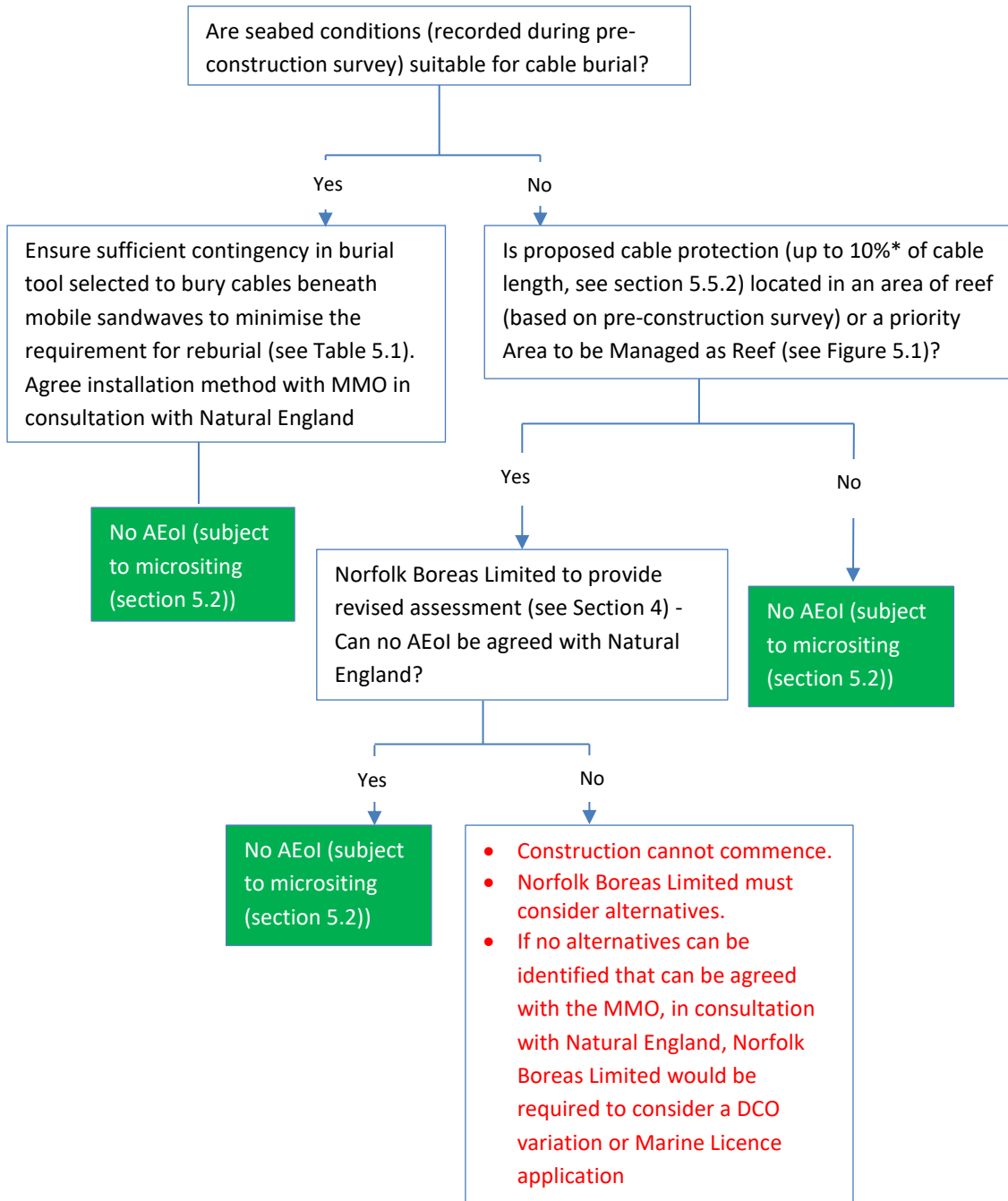
5.4 Sediment disposal

85. Norfolk Boreas Limited has committed to depositing of sediment removed from the seabed within the HHW SAC back into the SAC to ensure no sediment is lost from the system, enabling recovery of the sandbanks (discussed further in section 5.4 of Appendix 7.1 of the Information to Support HRA report (document reference 5.3.7.1)).
86. A disposal licence is being applied for as part of the Norfolk Boreas DCO application which will include the Norfolk Boreas Order Limits within the HHW SAC. Up to 500,000m³ of sediment arising from the SAC could be deposited within the SAC based on the analysis of pre-sweeping volumes presented in ES Appendix 5.2 Cable Installation Study.
87. The location(s) of sediment disposal, must include a minimum buffer of 50m from *S. spinulosa* reef, and will therefore be informed by the pre-construction surveys.
88. The methodology for disposal (i.e. release near the seabed or water surface) will be informed by the detailed design following the pre-construction surveys.
89. A primary aim of the sediment disposal strategy (i.e. locations and methodology for disposal) will be to facilitate recovery. The strategy will therefore also be informed by any available evidence regarding recovery from other relevant projects.
90. The location(s) and methodology for disposal must be agreed with the MMO in consultation with Natural England before works can commence.

5.5 Cable protection

91. Norfolk Boreas Limited is committed to minimising cable protection and has already made significant reductions through embedded mitigation, in particular the commitment to use HVDC cables, requiring two cable pairs as opposed to six individual cables and therefore reducing the total number of crossings and the potential length of cable which may be unburied (section 5.1.1).
92. Norfolk Boreas Limited is committed to using only essential cable protection (i.e. where required for cable/pipeline crossings (see section 5.5.1) and should burial not be possible for sections of the cable length (see section 5.5.2)), in order to minimise effects on the HHW SAC.
93. Section 5.4.14 of ES Chapter 5 provides a description of the types of cable protection that may be deployed at Norfolk Boreas, however, only essential cable protection up to the maximum values referred to in section 5.5.3 will be used. This will be

determined based on the results of the pre-construction survey and any crossings agreements. Plate 5.3 outlines the decision process when identifying a requirement for cable protection. Prior to installation the need, type, sources, quantity, distribution and installation method (up to the maximum values presented below) must be agreed with the MMO in consultation with Natural England. As shown in Plate 5.3, if it is not possible to reach a conclusion of no AEoI construction cannot commence and the onus would be on Norfolk Boreas Limited to consider alternative solutions, in consultation with Natural England and the MMO. If a solution cannot be agreed, the Applicant would need to consider a DCO variation or a Marine Licence application. For example, this could include: minor amendments to the redline boundary in discrete areas where the cable route interacted with reef to provide space for micrositing; or a variation to the Transmission DML Condition 9(1)(m) to allow a finding of AEoI should the project satisfy the HRA Assessment of Alternatives, Imperative Reasons of Overriding Public Interest (IROPI) and Compensatory Measures tests.



* It should be noted that this figure is likely to reduce to 5% see section 3 for further detail

Plate 5.3 Cable protection decision process

5.5.1 Cable and Pipeline Crossings

94. A precautionary estimate of five existing cables and one pipeline within the HHW SAC which each Norfolk Boreas export cable would need to cross has been included in the calculation of the total area and volume of cable protection assessed in the ES and Information to Support HRA report and included in the parameters secured in the DCO. The estimated maximum width and length of cable protection for crossings would be 10m and 100m, respectively. The maximum height of crossings is 0.9m.

95. In addition, there are likely to be disused cables within the HHW SAC. Subject to agreement of the owner/operator and engineering constraints, any disused cables would be cut, and a section removed to avoid the need for a crossing using cable protection.
96. Following the pre-construction survey and identification of preferred cable routes, Norfolk Boreas Limited would identify potential crossing requirements and consult with the owner/operators of the cable or pipeline.
97. Consultation would be undertaken with Natural England and the MMO at the earliest opportunity to allow both parties to provide advice on the proposed location, extent, type and quantity of cable protection associated with crossings.
98. Should additional unregistered cables/pipelines be identified during the pre-construction surveys, Natural England and the MMO will be consulted at the earliest opportunity. If an additional crossing can be accommodated using cable protection that is within the maximum values presented in section 5.5.3, no consent variation would be required. However, the proposed location, extent, type and quantity of cable protection associated with crossing the unregistered cable/pipeline would be agreed with the MMO in consultation with Natural England, should it not be possible to remove a section of the unregistered cable/pipeline.

5.5.2 Potential Unburied Cable Due to Ground Conditions

99. As discussed previously, Norfolk Boreas Limited is committed to burying cables where substrate conditions allow and therefore minimising cable protection. In addition, in response to requests from Natural England during the Norfolk Vanguard Examination, an Interim Cable Burial Study was commissioned (Norfolk Vanguard Limited, 2019) which identified that at least 95% of the offshore export cable length within the HHW SAC is likely to be able to be buried. However as discussed in section 3, Norfolk Boreas Limited are currently considering whether it is possible to commit to 95% cable burial within the SAC and as such the length of potential cable protection required for unburied cable remains at 10% of the Norfolk Boreas offshore export cable length within the HHW SAC. This is in addition to cable protection for cable/pipeline crossings (see sections 5.5.1 and 5.5.3). Only essential cable protection within the 10% (which is likely to reduce to 5%) will be used where burial is not possible due to encountering hard substrates (e.g. hard clay and sedimentary rocks) within the top 1-2m of the seabed. As discussed in section 5.3, the circumstances within which cable burial would be deemed not possible and the approach (e.g. number of burial attempts) if these circumstances are encountered would be agreed with the MMO in consultation with Natural England, prior to construction.

100. Prior to installation, the location, extent, type and quantity of any cable protection must be agreed with the MMO in consultation with Natural England.

5.5.3 Total area and volume of cable protection in the SAC

101. The total area and volume of cable protection in the SAC for unburied cables and cable/pipeline crossing will not exceed 52,000m² and 30,800m³ based on the parameters described above.

5.5.4 Decommissioning of Cable Protection

102. At the time of writing, it is considered unlikely that decommissioning of cable protection will be possible. However, this will be reviewed and considered as a potential mitigation measure if this becomes practicable at the stage of producing the final SIP prior to construction, or at the time of decommissioning Norfolk Boreas, for the type of cable protection installed.

5.6 Maintenance

103. During the life of the project, there should be no need for scheduled repair or replacement of the subsea cables. However periodic inspection would be required and if necessary, reactive repairs and reburial would be undertaken. This is considered further below.

5.6.1 Cable repairs

104. While it is not possible to determine the number and location of unscheduled repair works that may be required during the life of the project, a precautionary estimate of one export cable repair every 10 years on average within the SAC is included in the Information to Support HRA.
105. It will be critical that repairs can be instigated rapidly upon identifying a failure, therefore a protocol for undertaking repairs would be agreed with the MMO in consultation with Natural England, prior to construction.
106. Upon identifying a requirement to undertake a repair in the HHW SAC, the repair would be instigated in accordance with agreed protocol and the MMO and Natural England would be notified.
107. The protocol for any subsequent repairs would then be reviewed (if necessary) and agreed with the MMO and Natural England.
108. It is acknowledged that *S. spinulosa* reef can be expected to recover following cable installation and therefore has potential to be affected during maintenance if a repair is required at the location of a reef.

109. The repair protocol would include consideration of circumstances where *S. spinulosa* reef may be present at the repair location and would be agreed with the MMO in consultation with Natural England in advance of construction.

5.6.2 Cable reburial

110. As discussed in section 5.3, the aim of the installation strategy for cables in the SAC would be to bury cables below the mobile sandwaves where substrate conditions allow, to avoid or minimise the requirement for routine re-burial of cables during the operational phase.
111. The Information to Support HRA report (document reference 5.3) considers a worst case scenario that cables could become exposed due to moving sand waves, if sandwave levelling/pre-sweeping were not adopted during the installation phase. During the life of the project, periodic surveys would be required to ensure the cables remain buried and if they do become exposed, re-burial works would be undertaken.
112. Reburial of up to 4km per cable within the SAC at approximately 5 year intervals has been estimated and assessed in the Information to Support HRA report based on a worst case scenario that no pre-sweeping is undertaken during cable installation.
113. It will be critical that reburial can be instigated rapidly upon identifying exposed cable, therefore the protocol for undertaking reburial would be agreed with the MMO in consultation with Natural England, prior to construction.
114. Upon identifying a requirement to undertake reburial in the HHW SAC, the MMO and Natural England would be notified. The protocol for any subsequent reburial would then be discussed and agreed with the MMO and Natural England.
115. Should sandwave mobility be such that the cables have become unburied, it is unlikely that *S. spinulosa* reef would have formed in this location. However, as discussed above, reburial works would be agreed with the MMO in consultation with Natural England and this would include consideration of any *S. spinulosa* reef at the reburial location.

5.6.3 Cable protection

116. If cable protection were to be required during maintenance, this would be subject to an additional Marine Licence.

5.7 Overview of Mitigation Commitments in the HHW SAC

Table 5.2 Overview of Mitigation Commitments in the HHW SAC

Pre-consent Mitigation Commitments	Status	Final Mitigation solution following detailed design	Agreed with MMO in consultation with Natural England
Use of HVDC export cable solution to reduce the no. of cable trenches from six to two	Not subject to change	N/A	✓
Pre-construction survey to be undertaken within 12 months of commencing works	Survey methodology to be agreed with MMO in consultation with Natural England	To be confirmed	To be confirmed
Seabed preparation – potential use of pre-sweeping to minimise reburial	To be confirmed based on the pre-construction survey data, any relevant available evidence from other projects and agreed with the MMO in consultation with Natural England	To be confirmed	To be confirmed
Sediment disposal - up to 500,000m ³ of sediment arising from the SAC may be deposited within the SAC	The volume (up to this maximum) will be a factor of whether/or to what extent pre-sweeping is used (see above) and this will be agreed with the MMO in consultation with Natural England. The location and method for disposal will be agreed with the MMO in consultation with Natural England as shown below.	To be confirmed	To be confirmed
Sediment disposal – location(s) to be agreed with MMO in consultation with Natural England	To be confirmed based on the pre-construction survey data and detailed design and agreed with the MMO in consultation with Natural England.	To be confirmed	To be confirmed
Sediment disposal - method to be agreed with MMO in consultation with Natural England	To be confirmed based on the pre-construction survey data, any relevant available evidence from other projects and agreed with the MMO in consultation with Natural England	To be confirmed	To be confirmed
Cable installation – at least 90% of the cable length in the SAC will be buried to at least 1m. Any areas of unburied cable will be discussed with Natural England and the MMO (see also Cable Protection below)	To be confirmed based on the pre-construction survey data and detailed design and agreed with the MMO in consultation with Natural England	To be confirmed	To be confirmed
Cable installation – micrositing and cable route to be agreed with the MMO in consultation with Natural England	To be confirmed based on the pre-construction survey data and detailed design and agreed with the MMO in consultation with Natural England	To be confirmed	To be confirmed
Cable installation method to be agreed	To be confirmed based on the pre-construction survey data and	To be confirmed	To be confirmed

Pre-consent Mitigation Commitments	Status	Final Mitigation solution following detailed design	Agreed with MMO in consultation with Natural England
with the MMO in consultation with Natural England	detailed design and agreed with the MMO in consultation with Natural England		
Cable protection – up to 10%* of the cable length within the SAC may require cable protection	To be confirmed based on the pre-construction survey data and detailed design and agreed with the MMO in consultation with Natural England	To be confirmed	To be confirmed
The total area and volume of cable protection in the SAC will not exceed 52,000m ² and 30,800m ³ , respectively	Only essential cable protection up to these maximum values will be used and prior to installation the location, extent, type and quantity must be agreed with the MMO in consultation with Natural England. This will be determined based on the results of the pre-construction survey and any crossings agreements.	To be confirmed	To be confirmed
Cable repairs – approximately one cable repair every 10 years within the SAC has been assessed but any repairs would be agreed with the MMO in consultation with Natural England	The methodology for undertaking repairs would be agreed with the MMO in consultation with Natural England, prior to construction. Upon identifying a requirement to undertake a repairs in the HHW SAC, the MMO and Natural England would be notified, and the methodology for undertaking repairs would be agreed. The approach for any subsequent repairs would then be discussed and agreed with the MMO and Natural England.	To be confirmed	To be confirmed

* It should be noted that this figure is likely to reduce to 5% see section 3 for further detail

6 MONITORING

117. Following the assessment of potential effects and identification of mitigation measures, consideration will be given to the requirement for monitoring within the HHW SAC.
118. The details of monitoring in the HHW SAC will be agreed with the MMO in consultation with Natural England prior to construction. Table 6.1 provides an overview of the likely monitoring within the HHW SAC.

Table 6.1 In Principle Monitoring within the HHW SAC

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
Changes in seabed topography, including scour processes	Sandbanks	Pre-construction	<ul style="list-style-type: none"> Engineering and design purposes Input in to benthic and other related ecological surveys and monitoring requirements as agreed with the MMO in consultation with SNCBs 	A single survey within the agreed array and cable corridor survey areas using full sea floor coverage swath-bathymetric undertaken to IHO S44ed5 Order 1a standard and side-scan surveys of the area(s) within the Order limits in the SAC in which it is proposed to carry out construction works, including a 500m buffer area around the site of each works. (The “site of each works” being the area within the Order limits which is actually taken forwards to construction noting that it is possible that certain areas within the Order limits may not be developed.)	Scope of surveys and programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works.
		Post-construction	<ul style="list-style-type: none"> Structural integrity / engineering (scour) Cable burial Monitoring of recovery at the location of works 	A single survey within the agreed cable corridor survey areas using full sea floor coverage swath-bathymetric surveys undertaken to IHO S44ed5 Order 1a standard and side scan sonar surveys around the footprint of the cable installation works to assess any changes in seabed topography. For this purpose the undertaker will, prior to the first such survey, submit a desk based assessment	
Effects on <i>S. spinulosa</i> reef	<i>S. spinulosa</i> reef	Pre-construction	Determine the location and extent of any <i>S. spinulosa</i> reef within areas of the Order limits in the SAC in which it is proposed to carry out construction works to inform the appropriate mitigation if found	<ul style="list-style-type: none"> A single geophysical (sidescan or Multi-Beam Echo Sounder) survey of those areas of the SAC within which it is proposed that seabed works will be carried out at a resolution sufficient to identify potential <i>S. spinulosa</i> reef; and In areas where potential <i>S. spinulosa</i> reef is identified from the review of the geophysical data, further survey e.g. drop down video will be deployed to confirm presence, extent and elevation. 	<ul style="list-style-type: none"> Survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works. Surveys may occur up to 12 months prior to the proposed construction works

Potential Effect	Receptor/s	Phase	Headline reason/s for monitoring	Monitoring Proposal	Details
		Post-construction	The requirement for post-construction monitoring will be dependent on the findings of the pre-construction surveys.	<ul style="list-style-type: none"> Where no <i>S. spinulosa</i> reef is identified by the pre-construction geophysical survey of the proposed works (and associated buffers), no further post-construction surveys will be undertaken; Where <i>S. spinulosa</i> reef is identified during the pre-construction survey and cannot be entirely avoided through micro-siting, a single post-construction survey, specifically targeting those reefs identified in the baseline survey will be undertaken as a check on their condition using the same methodology set out for pre-construction monitoring. 	<ul style="list-style-type: none"> If required, survey programmes and methodologies for the purposes of monitoring shall be submitted to the MMO for written approval at least 4 months prior to the commencement of any survey works and conducted within the first year post commissioning of the proposed wind farm. The duration over which monitoring of recovery is required would be agreed with the MMO following review of the post-construction survey data.

7 SUMMARY

119. The offshore cable corridor for Norfolk Boreas and Norfolk Vanguard have been identified using a combined strategic approach in order to minimise impacts. Therefore, it is appropriate that both projects aim to secure no AEoI through the SIP process.
120. The final Norfolk Boreas SIP will be used to assess any effects on the Annex 1 Sandbank and Reef features of the HHW SAC based on the pre-construction surveys and detailed design of the project. This process will also identify any mitigation and monitoring requirements to ensure the MMO is satisfied, in consultation with Natural England, that there is 'no adverse effect beyond reasonable scientific doubt' on the HHW SAC.
121. The following engineering work streams and offshore surveys have been identified to inform the development of the final SIP:
- Review of available information from other offshore wind and cabling projects (including extensive review of experience from the Norfolk Vanguard Project);
 - Pre-construction survey(s);
 - Geophysical survey within the offshore cable corridor in the HHW SAC;
 - Targeted *S.spinulosa* reef surveys within the offshore cable corridor in the HHW SAC;
 - Geotechnical assessment of the seabed within the offshore cable corridor in the HHW SAC;
 - A Cable Burial Risk Assessment;
 - A Burial tool capability study;
 - A Sandwave characterisation study; and
 - Cable installation strategy.
122. These will be developed and undertaken in consultation with the MMO and Natural England. The results of these studies will inform the review of effects on the integrity of the SAC (section 4) and the identification of mitigation measures (section 5) in the final HHW SAC SIP.

8 REFERENCES

JNCC & Natural England, 2009 Offshore Special Area of Conservation: Haisborough, Hammond and Winterton Draft Conservation Objectives and Advice on Operations. Available at: http://jncc.defra.gov.uk/pdf/HaisboroughHammondandWinterton_ConObsAOO_FINAL_2_0_030909.pdf

JNCC & Natural England, 2013 Haisborough, Hammond and Winterton candidate Special Area of Conservation Formal advice under Regulation 35(3) of The Conservation of Habitats and Species Regulations 2010 (as amended), and Regulation 18 of The Offshore Marine Conservation Regulations (Natural Habitats, &c.) Regulations 2007 (as amended) Available at: http://jncc.defra.gov.uk/pdf/HHW_Reg%2035_Conservation%20Advice_v6.0.pdf

Natural England (2018) Offshore wind cabling: ten years' experience and recommendations available at: <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010080/EN010080-001240-Natural%20England%20-%20Offshore%20Cabling%20paper%20July%202018.pdf>

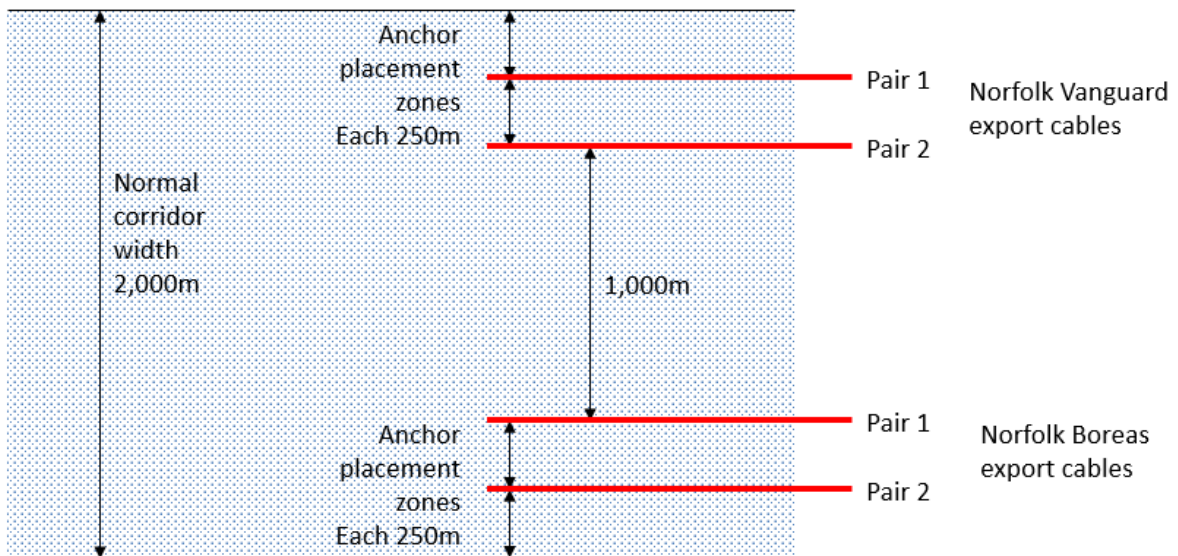
Natural England (2019a) Schedule of Natural England's responses to Examining Authority's second round of written questions. REP4 – 062 available at: [https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-002637-DL4%20-%20Natural%20England%20-%20Deadline%20Submission.pdf\(2019\)](https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010079/EN010079-002637-DL4%20-%20Natural%20England%20-%20Deadline%20Submission.pdf(2019))

Natural England (2019b) advice note regarding consideration of small scale habitat loss within Special Areas of Conservation (SACs) in relation to cable protection

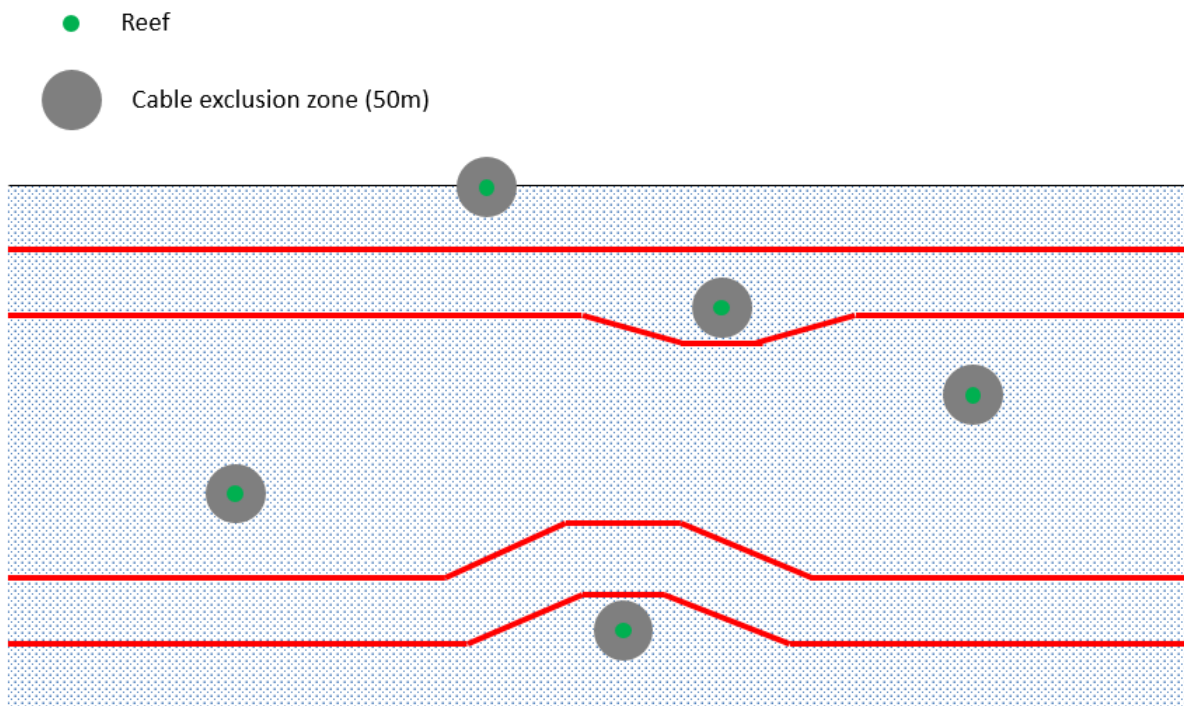
Norfolk Vanguard Limited (2019) Norfolk Vanguard Offshore Wind Farm Outline Norfolk Vanguard Haisborough Hammond and Winterton Special Area of Conservation Site Integrity Plan.

APPENDIX 1 – INDICATIVE MICROSITING OPTIONS

'Normal' placement of cables within the corridor, no constraints



Placement of cables with small areas of reef



Placement of cables with larger areas of reef

- Reef
- Cable exclusion zone (50m)

