East Anglia ONE North and East Anglia TWO Offshore Windfarms

Clarification Note

Effects on Supporting Habitats of Outer Thames Estuary SPA

Applicants: East Anglia ONE North Limited and East Anglia TWO Limited
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Applicable to East Anglia ONE North and East Anglia TWO

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Glossary of Acronyms

CD	Chart Datum
ExA	Examining Authority
EIA	Environmental Impact Assessment
ES	Environmental Statement
HDD	Horizontal Directional Drilling
Km	Kilometre
MDD	Maximum Dive Depth
Mg	Milligrams
MMO	Marine Management Organisation
NE	Natural England
PINS	Planning Inspectorate
RMS	Root Mean Squared
SPA	Special Protection Area
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentrations
TTS	Temporary Threshold Shift

Glossary of Terminology

Applicant	East Anglia TWO Limited / East Anglia ONE North Limited
Construction, operation and maintenance platform	A fixed offshore structure required for construction, operation, and maintenance personnel and activities.
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia TWO windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and the information required to support HRA.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Inter-array cables	Offshore cables which link the wind turbines to each other and the offshore electrical platforms, these cables will include fibre optic cables.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land and connect to the onshore cables.
Offshore	Area to seaward of nearshore in which the transport of sediment is not caused by wave activity.
Offshore cable corridor	This is the area which will contain the offshore export cables between offshore electrical platforms and landfall.
Offshore development area	The East Anglia TWO / East Anglia ONE North windfarm site and offshore cable corridor (up to Mean High Water Springs).
Offshore electrical platform	A fixed structure located within the windfarm area, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Offshore export cables	The cables which would bring electricity from the offshore electrical platforms to the landfall. These cables will include fibre optic cables.
Offshore platform	A collective term for the construction, operation and maintenance platform and the offshore electrical platforms.
Platform link cable	Electrical cable which links one or more offshore platforms, these cables will include fibre optic cables.
Safety zone	A marine area declared for the purposes of safety around a renewable energy installation or works / construction area under the Energy Act 2004.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.

1 Introduction

1. This clarification note has been prepared by East Anglia TWO Limited and East Anglia ONE North Limited (the Applicants) to clarify aspects of the East Anglia TWO and East Anglia ONE North Development Consent Order (DCO) applications (the Applications).

2. This clarification note relates to comments raised by Natural England (NE) in their relevant representation (RR-059) regarding the effects of the export cables of the East Anglia TWO and East Anglia ONE North (the Projects) on the supporting habitats of the Outer Thames Estuary Special Protection Area (SPA). The Applicants addressed these comments in their response to the relevant representation (AS-042), however NE responded with further comments (REP1-158) to the effect that they consider the information provided in AS-042 presents an assessment in environmental impact assessment (EIA) terms rather than habitats regulations assessment (HRA) terms. This document therefore provides the assessment in the desired format.

3. This document is applicable to both the East Anglia ONE North and East Anglia TWO DCO Applications, and is therefore endorsed with the yellow and blue icon used to identify materially identical documentation in accordance with the Examining Authority's procedural decisions on document management of 23rd December 2019 (PD-004). Whilst this document has been submitted to both Examinations, if it is read for one project submission there is no need to read it for the other project submission.

2 Background

4. The East Anglia TWO and East Anglia ONE North windfarm sites are located outside of the Outer Thames Estuary SPA, however, the offshore cable corridors for each Project cross the SPA. There are therefore potential effects upon the supporting habitats of the SPA. These effects were considered in the EIA across the receptor topics of physical processes, benthic ecology and fish and shellfish ecology (***Chapter 7 Marine Geology, Oceanography and Physical Processes*** (APP-055), ***Chapter 9 Benthic Ecology*** (APP-057) and ***Chapter 10 Fish and Shellfish Ecology*** (APP-058). In addition, *'Indirect impacts through effects on habitats and prey species'* were assessed in the ornithology assessment and cross referenced the aforementioned chapters (see ***sections 12.6.1.2, 16.6.2.2 and 12.6.3.2*** of ***Chapter 12 Offshore Ornithology*** (APP-060)). The Applicants therefore assessed the supporting habitat effects within the EIA, but the supporting habitat was not screened into the HRA.

5. AS-042 provided a signposting of how these effects had been captured within the Applications. In their subsequent response to AS-042, Appendix F2b to the Natural England Deadline 1 Submission (REP1-158) NE state:

   "Natural England is concerned that impacts to Outer Thames Estuary SPA from sandwave levelling have not be screened into the Habitats Regulation Assessment (HRA). Please note that as there is an impact pathway due to changes to supporting SPA habitat, we believe that there is likely significant effect. In addition, we advise that including evidence from East Anglia ONE would strengthen some of the statements made in relation to cable protection, e.g. the amount and locations of cable protection along the export cable for that project."

6. NE continued with a series of points which are considered in turn in this document. ***Section 3*** to ***section 6***, address specific comments from the NE Deadline 1 Submission (REP1-158) (points 13, 17, 18, 19 and 32), whilst ***section 7*** brings this detail together in an assessment in terms of the relevant conservation objectives of Outer Thames Estuary SPA (Natural England 2019a).

3 Point 13

7. NE state:

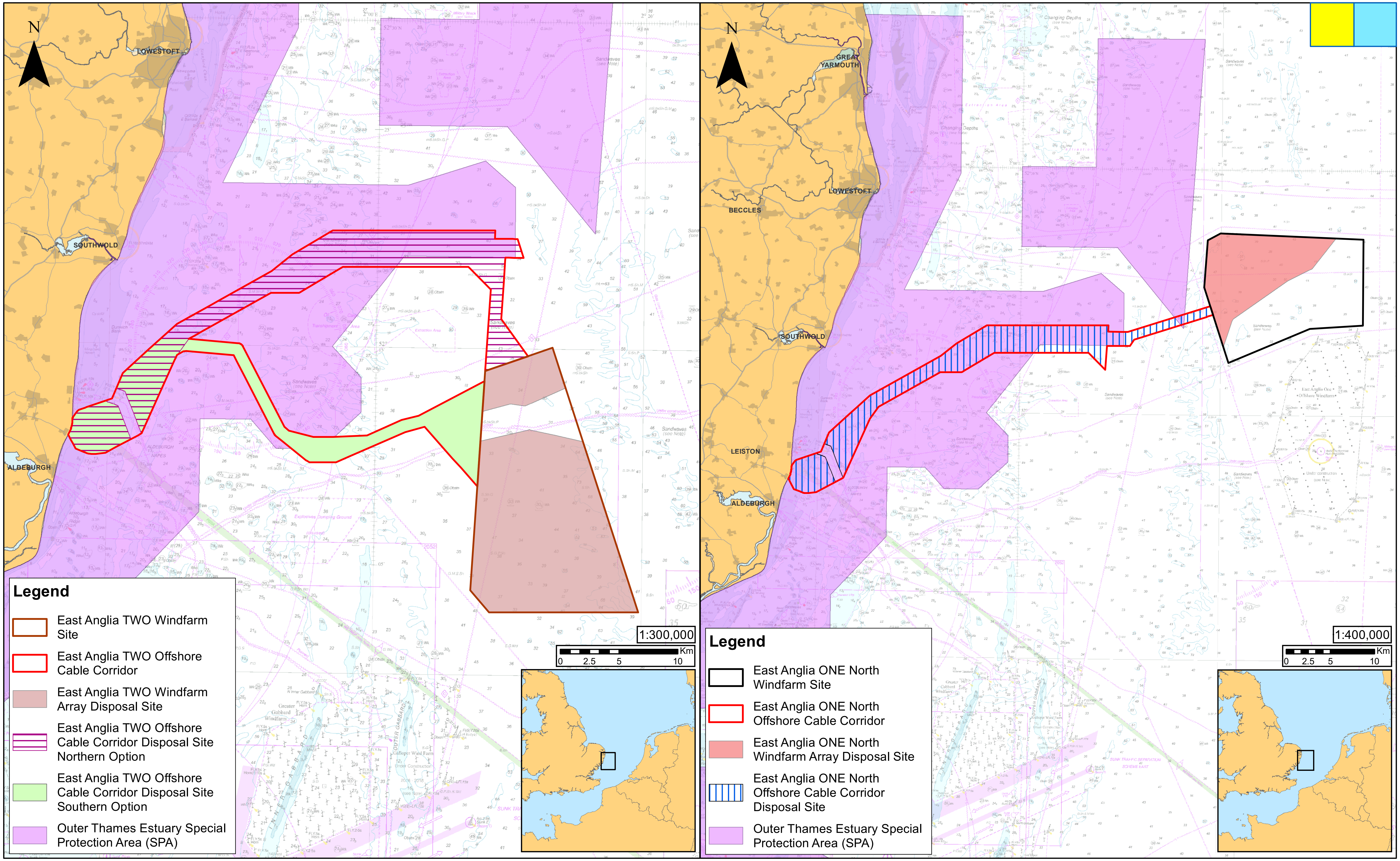
"It is not clear where any dredged sand will be deposited. We would welcome this to remain within the boundary of the SPA and upstream of the works so that no sediment is lost from the sandbank system and to aid recovery".

8. Both the windfarm site and the offshore cable corridor are proposed as disposal areas as detailed in the ***Site Characterisation Report (Windfarm Site)*** (APP-592) and ***Site Characterisation Report (Offshore Cable Corridor)*** (APP-593). The proposed locations for disposal licensing are provided in these documents (see Figure 1 in APP-592 and APP-593). Only the offshore cable corridor overlaps with the SPA.

9. Material will be disposed of in proximity to the dredge location. Expert-based assessment suggests that most of the sediment released at the water surface from the dredger vessel would rapidly (within minutes or tens of minutes) fall to the sea bed as a highly turbid dynamic plume immediately upon its discharge. This assessment is supported by the findings of a review of the evidence base into the physical impacts of marine aggregate dredging on sediment plumes and sea bed deposits (Whiteside et al. 1995; John et al. 2000; Hiscock and Bell 2004; Newell et al. 2004; Tillin et al. 2011; Cooper and Brew 2013). It is envisaged the vessel would dispose sediment in transit to aid dispersion, a process which will also be aided by natural processes. This approach will reduce mounding (see ***Chapter 6 project Description*** (APP-054), ***section 6.5.10.15*** for more details on the dredging process).

10. The reason for designating both the windfarm and the offshore cable corridor as disposal sites is to avoid the need for lengthy transits for disposal of material. Each disposal site has a limit of the volume of material which can be deposited within it based upon the worst case for either the windfarm site or the offshore cable corridor (see ***draft Development Consent Order (DCO)*** (APP-023) schedule 13, part 1, paragraph 2(1)(i) and schedule 14, part 1, paragraph 2(1)(i).

11. ***Figure 1*** shows the locations of the disposal areas in relation to the SPA.



SCOTTISHPOWER RENEWABLES

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2	08/12/2020	AB	Second Issue.	Prepared:	AB
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East Anglia ONE North and East Anglia TWO

East Anglia TWO and East Anglia ONE North Disposal Areas

Drg No	EA1N-EA2-DEV-DRG-IBR-001251
Rev	2
Date	08/12/20
Figure	1

Datum: WGS 1984
Projection: Zone 31N

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4 Point 17

12. NE state:

"Please note that Natural England advises that it is not appropriate to compare the impacts against the total area of the Outer Thames Estuary SPA. Our main concern is the supporting habitats of the interest features of the SPA. Therefore we advise that the impacts should relate to each of the supporting habitat types and how installation and operation and maintenance activities may alter the structure and function of these habitats and in turn the SPA features."

13. Detailed mapping of the supporting habitat types was not available pre-application. This was provided by NE to enable this refined approach presented below to be progressed.

14. NE identified five benthic habitats as the supporting features of the SPA. These are shown in ***Table 1*** along with the total area of each within the SPA.

Table 1 Supporting habitats of the SPA

Habitat type	Extent within the SPA (ha)
Subtidal Coarse Sediment	73,606.64
Subtidal Sand	220,295.55
Subtidal Mud	12,549.14
Subtidal Mixed Sediment	62,100.63
Circalittoral rock	335.2

15. From the data provided by NE, the Applicants were able to determine the extent of each habitat type located within the offshore cable corridor for each Project. The potential effects of the Projects could then be determined by working out the maximum area of each that could be affected within the SPA boundary.

4.1 Construction effects

4.1.1 Benthos

16. The potential effects during construction relate to temporary habitat disturbance from two sources (as stated in ***Table 9.2*** of ***Chapter 9 Benthic Ecology*** (APP-057); 1) the pre-lay grapnel run (PLGR) which is required for the full length of the offshore cable corridor with a 20m swathe for each cable; and 2) sand wave levelling which could total 800,000m^2 in the offshore cable corridor. The potential effect on each was then calculated as follows:

- PLGR – the total length of each habitat type within the SPA and within the offshore cable corridor was calculated by drawing indicative routes within the corridor which intersected with the habitat types. These indicative routes were drawn to intersect as much of each habitat type as possible whilst remaining realistic (see ***Figure 2***). The length of each habitat type within the indicative routes was totalled and the 20m swathe for PLGR was used to determine the area of effect for each cable (i.e. total swathe = 40m). In addition, the length of indicative cable route in waters of <20m depth was calculated as Duckworth et al. (2020) show that during foraging, almost all dives by red-throated diver had a maximum dive depth (MDD) of <20 metres, therefore it is these shallow areas that are considered most relevant to red-throated diver.
- Sand wave levelling – it is not known where sand wave levelling may be required. Therefore, as a worst case assumption, the sand wave levelling footprint estimated for the entire offshore cable corridor (800,000m^2) was assumed to take place within the overlap with the SPA.
- As East Anglia TWO has two offshore cable corridor options the areas of habitats within each option were compared in order to ensure that the worst case was captured.

17. ***Table 2*** and ***Table*** 3 show the habitat overlaps for East Anglia TWO, from these the worst case was determined. The worst cases are shown in red and carried across to the assessment of effects. ***Table 4*** and ***Table 5*** then show the potential effects of the two construction impacts for the Projects.

Table 2 Habitat types within the East Anglia TWO Northern Offshore Cable Corridor

Habitat Type	Area within OCC (ha)	Length of cable overlap (m)	Length of cable overlap <20m (m)
Subtidal Coarse Sediment	5,137.63	21.81	0.55
Subtidal Sand	4,154.09	16.08	4.52
Subtidal Mud	297.63	3.26	3.26
Subtidal Mixed Sediment	1,740.52	5.36	5.36
Circalittoral rock	0	0	0

Table 3 Habitat types within the East Anglia TWO Southern Offshore Cable Corridor

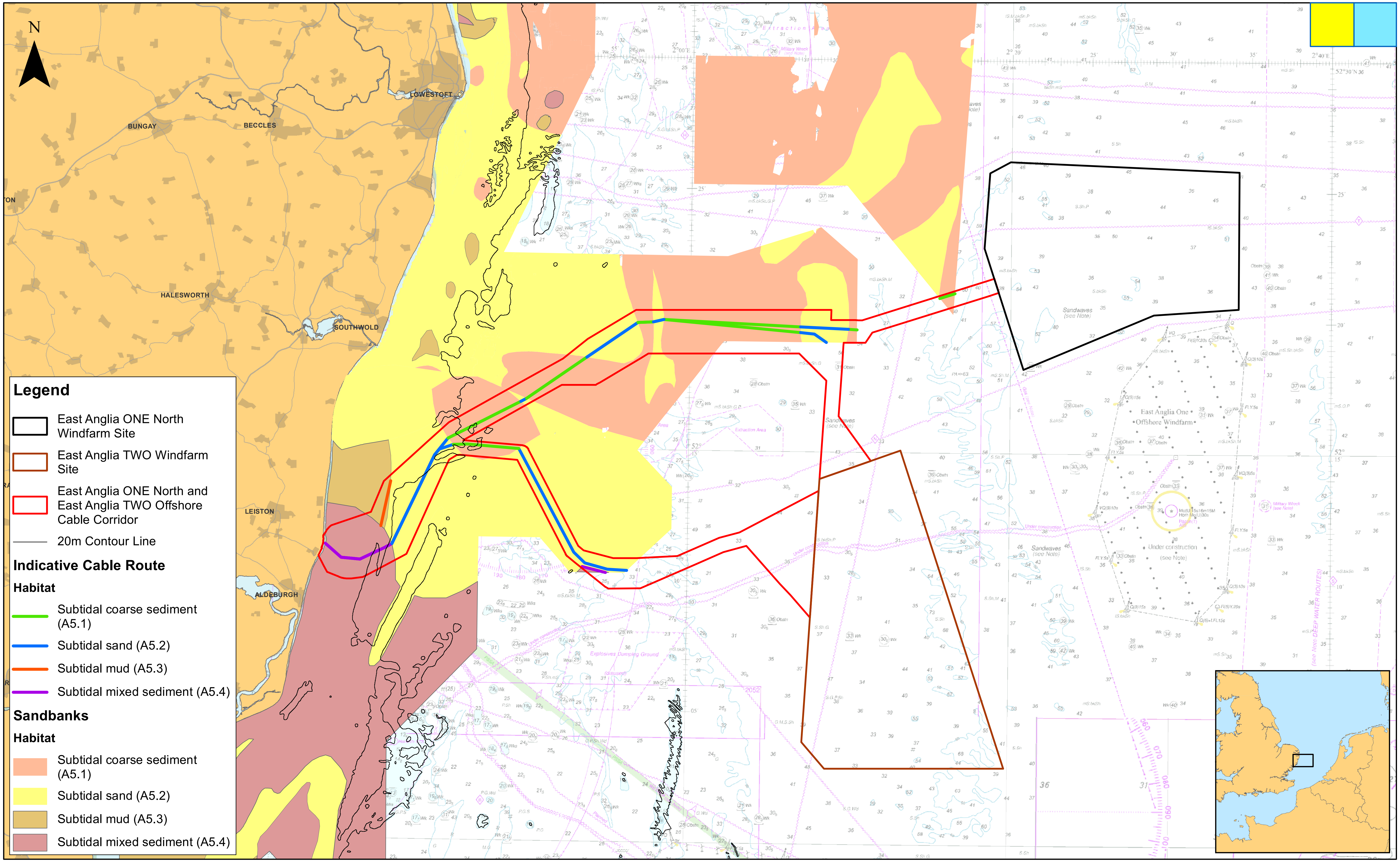
Habitat Type	Area within OCC (ha)	Length of cable overlap (m)	Length of cable overlap <20m (m)
Subtidal Coarse Sediment	413.50	4.63	0.65
Subtidal Sand	3,499.45	21.01	4.83
Subtidal Mud	297.63	3.26	3.26
Subtidal Mixed Sediment	1,776.71	7.07	5.36
Circalittoral rock	0	0	0

Table 4 Effect upon supporting habitat – East Anglia ONE North

Habitat type	Area within SPA (ha)	Length of cable overlap (m)	Effect Area (ha)	Effect area as % total habitat type within SPA	Length of cable overlap <20m (m)	Effect area in <20m as % total habitat type within SPA
PLGR						
Subtidal Coarse Sediment	73,606.64	23,513	94	0.128	550	0.003
Subtidal Sand	220,295.55	17,471	70	0.032	4,520	0.008
Subtidal Mud	12,549.14	3,261	13	0.104	3,260	0.104
Subtidal Mixed Sediment	62,100.63	5,363	21.5	0.035	5,360	0.035
Circalittoral rock	0	0	n/a	n/a	n/a	n/a
Sand wave levelling						
Habitat type	**Area within SPA (ha)**		**Effect Area (ha)**		**Effect area as % total habitat type within SPA**	
Subtidal Sand	220,295.55		80		0.04	

Table 5 Effect upon supporting habitat – East Anglia TWO

Habitat type	Area within SPA (ha)	Length of cable overlap (m)	Effect Area (ha)	Effect area as % total habitat type within SPA	Length of cable overlap <20m (m)	Effect area in <20m as % total habitat type within SPA
PLGR						
Subtidal Coarse Sediment	73,606.64	21,806.25	87	0.119	650	0.004
Subtidal Sand	220,295.55	21,010.08	84	0.038	4,830	0.009
Subtidal Mud	12,549.14	3,260.82	13	0.104	3,260	0.104
Subtidal Mixed Sediment	62,100.63	7,068.41	28	0.046	5,360	0.035
Circalittoral rock	0	0	n/a	n/a	n/a	n/a
Sand wave levelling						
Habitat type	**Area within SPA (ha)**		**Effect Area (ha)**		**Effect area as % total habitat type within SPA**	
Subtidal Sand	220,295.55		80		0.04	



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East Anglia ONE North and East Anglia TWO

Indicative Cable Routeing and Habitat Interaction

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Rev	2
Date	08/12/20
Figure	2

Datum: WGS 1984
Projection: Zone 31N

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18. ***Table 4*** and ***Table 5*** show the affected area of each habitat type within the offshore cable corridor and what proportion of the total habitat area of each within the wider SPA this represents. In each case, the area is no more than 0.13% of the entire area of the habitat type within the SPA. In addition, for the PGLR it has been possible to determine the likely area of effect which lies within <20m. This is the depth range in which it is considered that 95% of foraging of red-throated diver would occur (Duckworth et al. 2020). In the case of subtidal coarse sediment and subtidal sand, only a fraction of the total habitat area potentially affected would be ecologically important to red-throated diver (0.003% and 0.008% respectively for East Anglia ONE North, 0.004% and 0.009% respectively for East Anglia TWO).

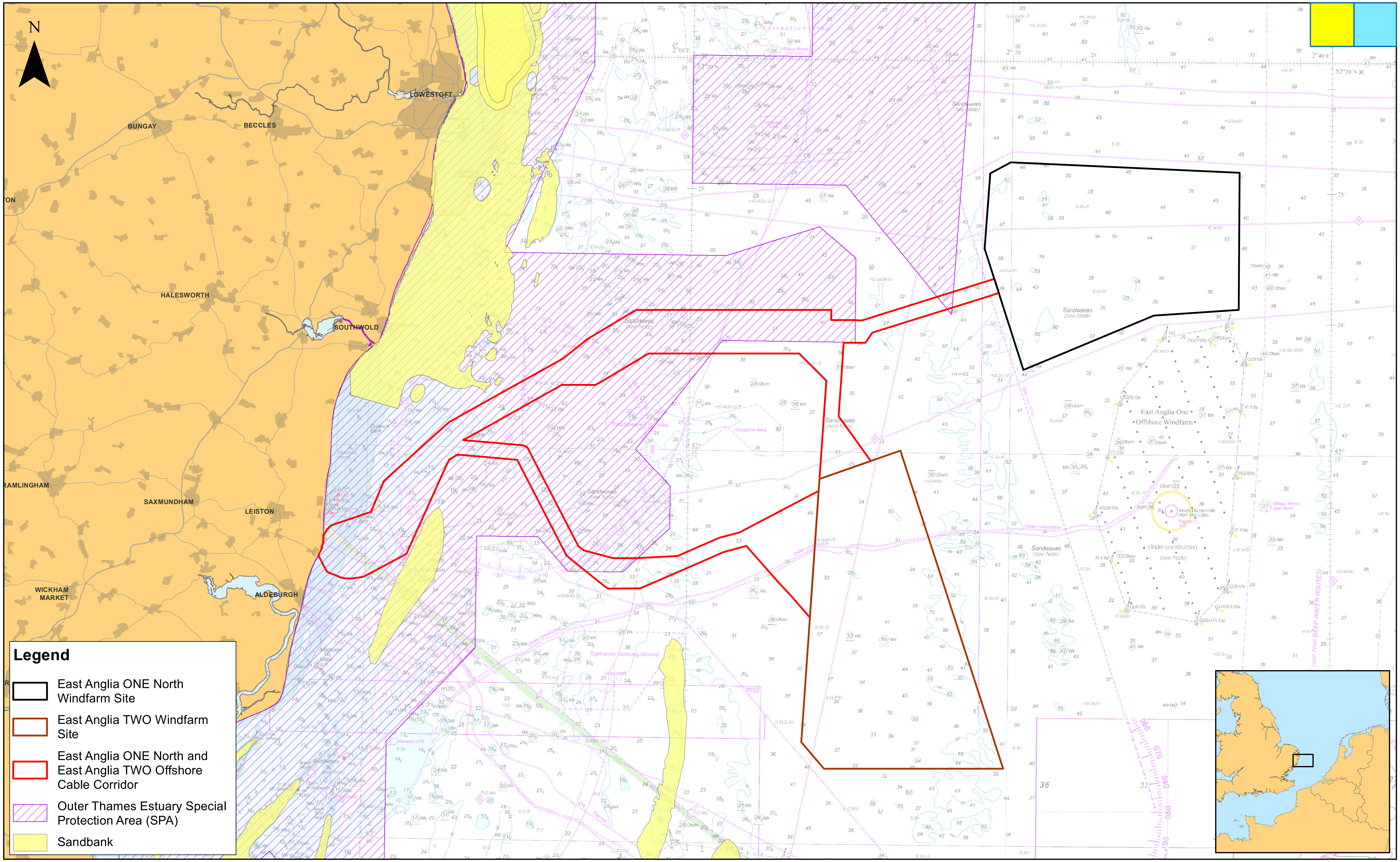
19. Direct impacts on the mapped sandbanks have been avoided through the site selection process (***Chapter 4 Site Selection and Assessment of Alternatives***) (APP-052) (***Figure 3***) and unmapped shallow sand banks would be avoided as far as possible by micro-siting. Offshore export cable installation would take place in two six month periods (see ***section 6.8*** of ***Chapter 6 Project Description*** (APP-054)), so this would be the maximum duration of effect for the whole route and does not represent six months of constant activity in any location. Due to the nature of the sediment and the dynamic physical processes in the area, recovery of the substratum is likely to be rapid in areas which are temporarily disturbed. Given the tolerance and recoverability of the benthic communities present (see ***Table 9.12*** of ***Chapter 9 Benthic Ecology*** (APP-057) recovery is expected quickly following cessation of installation. A review of post construction monitoring reports from all UK offshore windfarms for which data was available have concluded no significant impacts on benthic habitats and associated faunal communities due to cable laying (MMO 2014).

20. The interpretation of these results is provided in terms of the conservation objectives ***in section 7.***

4.1.2 Fish

21. Red-throated diver mainly forage for fish that live near the surface or in the main water column, although in the winter they will sometimes take bottom-dwelling fish (Natural England, 2012). Key prey species include sand eels, sprat, flatfish and members of the cod family, and herring being particularly important in the southern North Sea (Natural England, 2019b). Their diet can also include crustaceans, molluscs and marine worms (Natural England, 2012).

22. ***Table 6*** presents the overlap of spawning and nursery areas of the species listed above with the SPA and the cable corridor (this is based upon the mapping of spawning and nursery areas presented in the ES (***Chapter 10 Fish and***



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SCOTTISHPOWER RENEWABLES

East Anglia ONE North and East Anglia TWO

Mapped Sandbanks

Drg No	EA1N-EA2-DEV-DRG-IBR-001253
Rev	2
Date	08/12/20
Figure	3

Datum: WGS 1984
Projection: Zone 31N

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Shellfish Ecology (APP-058)) and in ***Applicant's Comments on Relevant Representations - Appendix 3: Fish and Shellfish Ecology Clarification Note*** (AS-040). For species such as herring and sandeel, the coarser sediment types are favoured habitats (see ***Appendix 10.2 Fish and Shellfish Ecology Technical Appendix*** (APP-463)). In summary, whilst there are overlaps of areas of spawning and nursery grounds within the SPA (and the offshore cable corridor where it intersects the SPA), the SPA is not an especially key area for any these species, whilst the SPA overlaps with areas considered 'high intensity' spawning or nursery grounds these areas are vast, covering large sections of the North Sea (as shown in ***Table 6***). As shown in ***section 4.1.1***, only a limited area of the supporting habitats would be affected temporarily by disturbance during construction and effects on these fish would therefore be of low magnitude. This is reflected in the conclusions of the ES (***section 10.6.1.1.1*** of ***Chapter 10 Fish and Shellfish Ecology*** (APP-058)).

Table 6 Red-throated diver prey species: Spawning and Nursery areas in relation to the SPA (mapping based on Coull et al 1998, Ellis et al 2010 presented in Chapter 10 Fish and Shellfish Ecology)

Species	Spawning area within SPA	Within offshore cable corridor	Nursery area within SPA	Within offshore cable corridor
Dover sole	Yes, part of high intensity area from Norfolk to the English Channel	Yes	Yes, low intensity nursery from the Humber to the English Channel, high intensity nursery within inner Thames.	Yes
Plaice	Yes, part of high intensity area from across southern North Sea to the English Channel	No	Yes, low intensity nursery from the Humber to the English Channel	Yes
Cod	Yes, part of low intensity area from across southern North Sea to the English Channel	No	Yes, low intensity nursery across southern North Sea to the English Channel.	Yes
Herring	Yes, spawning off Kent	No	Yes, part of high intensity area from Norfolk to the English Channel	Yes

Species	Spawning area within SPA	Within offshore cable corridor	Nursery area within SPA	Within offshore cable corridor
Sole	Yes, spawning from across southern North Sea to the English Channel	Yes	Yes, nursery from across southern North Sea to the English Channel	Yes
Sprat	Yes, spawning from across southern North Sea to the English Channel	No	Yes, nursery from across southern North Sea to the English Channel	Yes
Sandeel	Yes, part of low intensity area from across southern North Sea to the English Channel	No	Yes, low intensity nursery across southern North Sea to the English Channel.	Yes

23. The interpretation of these results is provided in terms of the conservation objectives in ***section 7***.

4.2 Operational effects

4.2.1 Benthos

24. During operation there are two potential effects; 1) permanent loss of habitat from presence of surface laid cable protection and 2) disturbance from maintenance works.

25. ***Section 9.6.2.1.2*** of ***Chapter 9 Benthic Ecology*** (APP-057), provides the estimated footprint of cable protection required within the offshore cable corridor for each of the Projects. ***Table 7*** shows the effect of cable protection on each of the habitat types using a worst case assumption that all of the required cable protection footprint for the entire offshore cable corridor occurs within each of the habitat types. The worst case assumptions used in the ES and in ***Table 7*** are based upon 5% of the export cables being protected in addition to cable protection at crossings. Note that the East Anglia ONE project which also passes through the Outer Thames Estuary SPA installed cable protection along 2.11% of its first export cable and along 2.12% of its second export cable. This was mainly in areas of hard ground or at cable crossings. Therefore, the 5% estimated for the Projects is a conservative worst case.

26. As can be seen, even with this worst case assumption the percentage of the area of each habitat type affected by cable protection is less than 0.1% of the entire area of the habitat type within the SPA.

27. With regard to habitat disturbance, ***section 9.6.2.2*** of ***Chapter 9 Benthic Ecology*** (APP-057) provides the estimated footprint of disturbance as 1,800m^2 (0.18ha) every five years for each Project. This is based on the assumption of repair and reburial of 300m of export cable every five years.

28. Although placement of cable protection would represent permanent habitat loss, this area is small in relation to the overall area of each habitat type. Temporary disturbance from maintenance events would have a very small footprint and, as with disturbance from construction, recovery is expected quickly following cessation of maintenance activities.

29. The interpretation of these results is provided in terms of the conservation objectives in ***section 7***.

Table 7 Footprint of cable protection of maintenance disturbance

Habitat Type	Extent within the SPA (ha)	Maximum area of cable protection (ha)	Effect area as % total habitat type within SPA (%)
East Anglia ONE North cable protection footprint			
Subtidal Coarse Sediment	73,606.64	11.08	0.02
Subtidal Sand	220,295.55	11.08	0.01
Subtidal Mud	12,549.14	11.08	0.09
Subtidal Mixed Sediment	62,100.63	11.08	0.02
East Anglia TWO cable protection footprint			
Subtidal Coarse Sediment	73,606.64	10.88	0.01
Subtidal Sand	220,295.55	10.88	0.00
Subtidal Mud	12,549.14	10.88	0.09
Subtidal Mixed Sediment	62,100.63	10.88	0.02
Footprint of Maintenance Disturbance (5 years) (either Project)			
Subtidal Coarse Sediment	73,606.64	0.18	0.0002

Habitat Type	Extent within the SPA (ha)	Maximum area of cable protection (ha)	Effect area as % total habitat type within SPA (%)
Subtidal Sand	220,295.55	0.18	0.0001
Subtidal Mud	12,549.14	0.18	0.0014
Subtidal Mixed Sediment	62,100.63	0.18	0.0003

4.2.2 Fish

30. Given that the SPA area is not a key area for these species and, as shown in ***section 4.2.1***, a limited area of the supporting habitats would be affected temporarily by disturbance during maintenance or permanently through cable protection, effects on these fish would be of low magnitude. This is reflected in the conclusions of the ES (***section 10.6.2*** of ***Chapter 10 Fish and Shellfish Ecology*** (APP-058)).

31. The interpretation of these results is provided in terms of the conservation objectives in ***section 7***.

5 Points 18 & 19

32. NE state:

"Points 18 and 19 present a series of statements indicating that sandwaves and sandbanks will recover, but no evidence is presented to support these statements, or that specifies the duration of any recovery. This occurs throughout the document, but is highlighted in these points. Such evidence would support the understanding of potential impacts, i.e. recovery of sandbanks will take X months/years, which will impact Y species for Z seasons. Currently, the focus is on EIA impacts rather than HRA, such as impacts to supporting habitats of the SPA species."

33. Evidence was presented in ***Chapter 7 Marine Geology, Oceanography and Physical Processes*** (APP-055) as referenced in AS-042. This is summarised in the following paragraphs.

34. Up to 1,000,000m^3 of sediment may be released as a result of levelling for the export cables. The dynamic nature of the sand waves in this area means that any direct changes to the sea bed elevation associated with sand wave levelling are likely to recover over a short period of time due to natural sand transport pathways. Any excavated sediment due to sand wave levelling for the export cables within the SPA would be disposed of within the portion of the offshore cable corridor within the SPA (on the assumption that the pre-construction surveys do not identify extensive area of *Sabellaria* reef, to which we have committed to avoiding the release of dredge material, where practicable, through the *Sabellaria* Reef Management Plan (REP1-044)) . This means there will be no net loss of sand from the site. It is likely that some of this sand would be disposed in areas of the offshore cable corridor where tidal currents would, over time, re-distribute the sand back over the levelled area (as re-formed sand waves). The extent of sand wave levelling required and specific disposal locations within the offshore cable corridor would be determined post consent following detailed geophysical surveys, however, given the relatively low volumes of sand likely to be affected, the overall effect of changes to the sea bed would be minimal.

35. Changes in suspended sediment levels were discussed in relation to models undertaken for foundation installation, a process which would release much more sediment than sandwave clearance. The Delft3D plume modelling studies for East Anglia ONE (ABPmer 2012) considered the bed level changes resulting from deposition of sediments from the passive plume due to sea bed preparation for 15 foundations. This involved a worst case near-surface sediment release of

22,500m^3 per foundation. For the most part, the deposited sediment layer across the wider sea bed was found to be less than 0.2mm thick and did not exceed 2mm anywhere. The area of sea bed upon which deposition occurred (at these low values) extended a considerable distance from the site boundary (around 50km), but in doing so only covered a very narrow width of sea bed (a few hundred metres). This is because the dispersion of the plume followed the axis of tidal flow. The East Anglia ONE assessment also concluded that this deposited sediment has the potential to become re-mobilised and therefore would rapidly become incorporated into the mobile sea bed sediment layer, thus further reducing any potential effect. The changes in suspended sediment concentration due to export cable installation would be lower than those arising from the disturbance of near-surface sediments during foundation installation activities. Therefore, the magnitude of bed level changes would also be lower. It is estimated therefore that sea bed level changes of up to 2mm would be observed within a few hundred metres of the inshore sections of the offshore cable corridor and further afield the sea bed level changes are not expected to be measurable.

36. Impacts on the mapped sandbanks have been avoided through the site selection process (***Chapter 4 Site Selection and Assessment of Alternatives***) (APP-052) and unmapped shallow sand banks would be avoided as far as possible by micro-siting. ***Table 4*** and***Table*** 5 show the small areas of subtidal sand that could be affected by sand wave levelling.

37. In terms of effects on the benthos, these are discussed within ***Chapter 9 Benthic Ecology*** (APP-057). The benthic communities present within the Outer Thames Estuary SPA (see ***Figure 9.4a*** (APP-118)) that would be directly impacted by cable installation activities, exhibit high recoverability and tolerance to physical disturbance (see ***Chapter 9 Benthic Ecology*** (APP-057) ***section 9.5.2.3*** and ***Table 9.12***). For the EIA, sensitivity definitions were agreed through the Evidence Plan Process. The sensitivity of a receptor was determined through its ability to accommodate change and reflects on its ability to recover if it is affected and is dependent upon adaptability, tolerance and recoverability characteristics. The sensitivity of benthic biotopes was assessed using the Marine Evidence based Sensitivity Assessment (MarESA) and through the examination of online resources or through published research (Tyler-Walters et al. 2018; 2011 and 2004). Natural England have agreed the benthic methodology in their Statement of Common Ground.

38. The interpretation of these results is provided in terms of the conservation objectives in ***section 7***.

6 Point 32

39. NE state:

"Unexploded Ordnance (UXO) clearance should also consider how detonations impact on sediment and ability to support the SPA".

40. The footprint of craters created by detonation of UXO devices was estimated by Ordtek (2018), this report states that *"there is very limited open-source information available on crater sizes produced by detonations underwater and we are not aware of any comprehensive figures, tables or research on this subject."* The Ordtek (2018) report presents estimates of theoretical crater sizes for the Norfolk Vanguard project for a range of UXO charge sizes, using two different methods and compares those results with field observations of craters resulting from UXO clearance at windfarms. The Norfolk Vanguard project, located approximately 20km from the SPA at its nearest point, has similar sea bed conditions to the SPA. The UXO in that area is of the type likely to be encountered anywhere in the Southern North Sea and indeed the report uses information from the UXO Risk Assessment for East Anglia ONE as one of its references. Therefore, this report is considered relevant and likely to be the best available evidence of the effects of UXO on the seabed.

41. In the EIA, the Applicants assumed a maximum number of 80 UXO clearances with a maximum UXO size of 700kg (net explosive quantity (NEQ)) see ***Chapter 11 Marine Mammals, Table 11.2*** (APP-059). Ordtek (2018) also use a maximum of 700kg NEQ device in their estimates for crater footprint, which gives a crater diameter of 21m[1] (giving an area of approximately 346m^2 or 0.0346ha per crater). The total footprint for each Project would therefore be 2.78ha across the entirety of the offshore development area (assuming each UXO is of the largest size).

42. It is not known where the UXO would be, therefore for the purposes of illustration, it has been assumed that all the UXO would be of the largest size as assessed as a worst case in the ES (700kg NEQ)[2] and would be found within the offshore cable corridor, within the SPA and all within a single supporting habitat type. The results are presented in ***Table 8***.

[1] For the purposes of this assessment we have used the worst case estimate (i.e. Table 7.1 in Ordtek, 2018) rather than field observations as the field observations data were from smaller devices than 700kg NEQ

[2] It should be noted that 700kg UXO devices is a worst case scenario and that for context, East Anglia ONE recorded 1x 700kg, 2x 499kg, 15x 200-300kg and 45x <200kg with an overall average charge weight of 137kg.

Table 8 Footprint of UXO clearance assuming all within offshore cable corridor (either East Anglia ONE North or East Anglia TWO), within SPA and within a single habitat type

Habitat Type	Extent within the SPA (ha)	Maximum area of disturbance (ha) (all devices in one habitat type)	Effect area as % total habitat type within SPA (%)
Subtidal Coarse Sediment	73,606.64	2.78	0.004
Subtidal Sand	220,295.55	2.78	0.001
Subtidal Mud	12,549.14	2.78	0.022
Subtidal Mixed Sediment	62,100.63	2.78	0.004

43. Even with the unrealistically precautionary assumptions presented above the footprints of disturbance on supporting habitats would be trivial. The dynamic nature of the sediment in this area means that any direct changes to the sea bed elevation associated with craters are likely to recover over a short period of time due to natural sediment transport pathways. In addition, many of the UXO cleared are likely to be within the footprint of the PLGR which would cover the full route of the export cables. Therefore, not all of the affected locations would be additional to the areas of disturbance already presented in ***section 4***.

44. Note that it would be unusual to detect further UXO in the operational phase (as UXO will have been cleared from the vicinity of installed infrastructure during construction).

45. Given that there would be little additional effect from UXO clearance over and above the disturbance footprints of PLGR and sand wave clearance, UXO clearance is not considered further in this report.

7 Section 2.7

46. NE State:

"This section is focused on the EIA rather than changes to the structure and function of supporting habitat of the interest features of the SPA. Further consideration should be given to these interest features and the conservation advice package for the site."

47. The preceding sections of this report provided responses on each of the specific points made by Natural England with regard to effects of construction and operation on the supporting habitats of the Outer Thames Estuary SPA. This section therefore puts this information into the context of the conservation objectives for the supporting habitats only (shown in green below). Other conservation objectives which relate directly to red-throated diver (i.e. population and distribution of red-throated diver) are not considered as these are covered elsewhere in on-going work to determine the effects of displacement.

7.1 Conservation objectives

48. The conservation objectives for the Outer Thames Estuary SPA are as follows (Natural England, 2019)

"With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- *The extent and distribution of the habitats of the qualifying features*
- *The structure and function of the habitats of the qualifying features*
- *The supporting processes on which the habitats of the qualifying features rely*
- *The population of each of the qualifying features, and,*
- *The distribution of the qualifying features within the site"*

49. Further detail on these objectives is provided in the Supplementary Advice which was updated in September 2019 (Natural England, 2019b).

50. ***Table*** 9 lists out the attributes and targets associated with the conservation objectives and also provides a screening of which of these attributes are considered for further assessment. For those attributes screened in it is considered that there is potential for Likely Significant Effect from the Projects. Full assessment is provided in ***section 7.2***.

Table 9 Conservation Objectives: Attributes and Targets for Supporting Habitats of the OTE SPA and effect screening

Attribute	Target	Screened in / out
Supporting habitat: air quality	Maintain concentrations and deposition of air pollutants at below the site-relevant Critical Load or Level values given for this feature of the site on the Air Pollution Information System (www.apis.ac.uk).	Out Offshore air quality was screened out of the EIA Air quality is not relevant to benthic habitats
Supporting habitat: conservation measures	Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised.	In
Supporting habitat: extent and distribution of supporting habitat for the non-breeding season	Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding) at the following levels: Subtidal sand (220,295.55); Subtidal coarse sediment (73,606.64); Subtidal mixed sediments (62,100.63 ha); Subtidal mud (12,549.14 ha); Circalittoral rock (335.2 ha); and Water column	In Note however that the 'water column' habitat is not screened in as there is no pathway for seabed effects of the Projects to change the extent and distribution of the overlying waters as there will be no infrastructure in the water column or at the surface within the SPA.
Supporting habitat: food availability	Maintain the distribution, abundance and availability of key food and prey items (e.g. fish) at preferred sizes.	In
Supporting habitat: water depth	Maintain the depth of inshore waters currently used as feeding or moulting sites.	Out

Attribute	Target	Screened in / out
		Changes in depth could only occur where surface laid cable protection is present. At worst 11ha of cable protection (from each project) could be deployed within an area of 392451.66ha or 0.003% of the entire SPA and this would be in discrete locations and approximately 1m in height above the seabed (a maximum height of 2.25m was assumed in the EIA).
Supporting habitat: water quality - contaminants	Reduce aqueous contaminants to levels equating to High Status according to Annex VIII and Good Status according to Annex X of the Water Framework Directive, avoiding deterioration from existing levels.	Out Sediment disturbance could lead to the mobilisation of contaminants which may be lying dormant within sediment and which could be harmful to the benthos, fish and shellfish. Given the low level of contaminants present in the sediments within the offshore cable corridor (*Table 8.11 in Chapter 8 Marine Water and Sediment Quality* (APP-056)), changes in water and sediment quality due to re-suspension or disposal of contaminants during construction have been assessed as negligible (see *Chapter 9 Benthic Ecology (section 9.6.1.3)* (APP-057) and *Chapter 10 Fish and Shellfish Ecology (section 10.6.1.3)* (APP-058)). MarESA (MarLIN 2017) shows that, where contaminant levels are within environmental protection standards, marine species and habitats are not sensitive to changes that remain within these standards. All relevant construction activities would be covered by the Project Environment Management Plan as well as emergency plans in the case of an accidental spillage or leak to ensure no release of contaminants as a result of the project. In addition to this, all vessels must adhere to the requirements of the

Attribute	Target	Screened in / out
		MARPOL Convention Regulations with appropriate preventative and control measures. In their SoCG, Natural England has agreed with the conclusions of the benthic and fish ecology assessments.
Supporting habitat: water quality - dissolved oxygen	Maintain the dissolved oxygen (DO) concentration at levels equating to High Ecological Status (specifically ≥ 5.7 mg per litre (at 35 salinity) for 95 % of the year), avoiding deterioration from existing levels.	Out Excessive nutrients and/or high turbidity can lead to a drop in DO, there is no pathway for this effect from the Projects as they are not a source of nutrients or high turbidity.
Supporting habitat: water quality - nutrients	Maintain water quality at mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features, avoiding deterioration from existing levels.	Out There is no pathway for this effect from the Projects as they are not a source of nutrients
Supporting habitat: water quality - turbidity	Maintain natural levels of turbidity (e.g. concentrations of suspended sediment, plankton and other material) across the habitat.	Out There is no pathway for this effect from the Projects as they are not an on-going source of suspended sediments

7.2 Assessment

51. Although there is a great deal of cross-over between the attributes, this section assesses each of the conservation objective attributes separately to ensure that the assessment is robust.

7.2.1 Conservation Measures

52. The target of this attribute is to:

"Maintain the structure, function and supporting processes associated with the feature and its supporting habitat through management or other measures (whether within and/or outside the site boundary as appropriate) and ensure these measures are not being undermined or compromised."

53. Further supporting notes are provided:

"Red-throated diver are seabirds and do not come ashore during the overwintering period. At-sea conservation measures are required to minimise the impact of marine industry upon red-throated diver through disturbance and habitat loss.

It is envisaged that the main conservation measure required for red-throated divers within the Outer Thames Estuary SPA is to effectively manage activities which lead to disturbance and displacement, as detailed in other attributes."

54. Direct effects on red-throated diver are not considered in this report. When considering the structure and function of these supporting habitats, it is important to consider how they are being used by red-throated diver. Activities of the red-throated diver are listed in the conservation objectives as roosting, foraging, feeding, moulting and loafing. Of these, only foraging and feeding are relevant to the seabed supporting habitats. Therefore, the relevant part of this target is considered by the Applicants to relate to habitat loss and effects on prey species within this footprint.

7.2.1.1 Construction

55. ***Section 4.1*** details the temporary disturbance effects from cable installation upon each of the supporting habitat types within the SPA. The areas affected are small in absolute terms and relative to the total extent of each of the habitat types as shown in ***Table 4*** and ***Table 5***. Duckworth et al. (2020) show that during foraging, almost all dives by red-throated diver had a maximum dive depth (MDD) of <20m, therefore it is these shallow areas that are considered most relevant supporting habitat to red-throated diver. For subtidal coarse sediment and subtidal sand therefore, the small percentages of sea bed habitat affected by construction are further reduced when considering the areas that are ecologically important for red-throated divers. In the case of East Anglia ONE North for example, 0.13%

subtidal coarse sediment is temporarily disturbed in worst case, of which only 2% is in waters <20m (0.0026% of the total extent of the habitat type in the SPA).

56. Effects on prey such as crustaceans, molluscs and marine worms would be directly related to this area footprint and duration of disturbance. Effects of prey such as fish would likely be greatest in areas of coarser sediment (see ***section 4.1.2***) and again the footprint within affected supporting habitats is small. Information for these prey species presented in the EIA (see ***Chapter 9 Benthic Ecology (section 9.4.3)*** (APP-057) and ***Chapter 10 Fish and Shellfish Ecology (section 10.4.3)*** (APP-058)) shows that the species have medium to low sensitivity to the effects of habitat loss, increased suspended sediments and sediment deposition and physical disturbance (as agreed by Natural England). The sensitivity is a reflection of the dynamic nature of the conditions in the Southern North Sea. Given that the areas of supporting habitat affected are small relative to the supporting habitat available and that prey species will have limited sensitivity, it is considered that there would be no Adverse Effect on Integrity from either Project during construction in relation to this attribute.

7.2.1.2 Operation

57. ***Section 4.2*** details the temporary disturbance effects from cable maintenance and the habitat loss from cable protection upon each of the supporting habitat types within the SPA. The areas affected are small in absolute terms and relative to the total extent of each of the habitat types as shown in ***Table 6***.

58. Effects on prey would be directly related to this effect footprint and duration and prey would have medium to low sensitivity to the effects of habitat loss, increased suspended sediments and sediment deposition and physical disturbance as discussed in ***section 7.2.1.1***. Given that the areas of supporting habitat affected are small relative the supporting habitat available and that prey species will have limited sensitivity, it is considered that there would be no Adverse Effect on Integrity from either Project during operation in relation to this attribute.

7.2.1.3 In-combination effects

59. The only relevant projects which have potential overlaps with the Outer Thames Estuary SPA are East Anglia THREE, ONE North and TWO (see Cumulative Impacts sections of the relevant EIA chapters ***Chapter 7 Marine Geology, Oceanography and Physical Processes*** (APP-055)***, Chapter 9 Benthic Ecology (section 9.4.3)*** (APP-057) and ***Chapter 10 Fish and Shellfish Ecology***). These are the projects considered in this and the subsequent in-combination assessments. East Anglia THREE would have similar requirements for PLGR, sandwave clearance and cable protection as the Projects. As that project did not assess effects on the supporting habitats of the SPA in its HRA, it

has been assumed that the footprint of effects would be equivalent to the Projects as East Anglia THREE also has two export cables[3].

60. In the event of concurrent cable laying activities within the SPA, effects would be limited to a fraction of 1% of each of the supporting habitats and would be temporary (as per ***section 7.2.1.1***). Locations of effect would be discrete and as the offshore cable corridor for East Anglia THREE within the SPA is over 8km from the Projects' offshore cable corridor the same areas would not be affected.

61. In the most likely case, construction would be sequential, and effects would be of a similar magnitude to the project alone case but expressed on several occasions with recovery in between. Although the benthos and fish resource would be affected multiple times, as previously noted they have limited sensitivity to these effects.

62. During operation, disturbance events would be episodic and spatially discrete. The permanent habitat loss from cable protection (assuming a worst case of all cable protection being within the SPA and maximum overlap with each habitat type) is small in absolute terms and relative to the total extent of each of the habitat types, even if multiple projects are considered.

63. In conclusion, it is considered that there would be no Adverse Effect on Integrity from in-combination effects in relation to this attribute.

7.2.2 Extent and distribution of supporting habitat for the non-breeding season

64. The target of this attribute is to:

"Maintain the extent, distribution and availability of suitable habitat (either within or outside the site boundary) which supports the feature for all necessary stages of the non-breeding/wintering period (moulting, roosting, loafing, feeding)."

65. Further supporting notes are provided:

"Marine development and construction can result in habitat loss for this sensitive species. Red-throated diver have been shown to be especially sensitive to offshore wind farms, and their construction may result in the displacement of red-throated diver from an area of their range. Other activities such as aggregates dredging, fishing and commercial shipping may be adding to the cumulative displacement of red-throated diver from parts of the site. This results in habitat loss for this species, or the use of sub-optimal foraging areas. The extent of suitable supporting habitat should be maintained."

[3] East Anglia THREE assumed 23ha of cable protection in the entire offshore cable corridor of 166km (EATL, 2015).

66. Disturbance from vessels associated with cable installation on red-throated diver are not considered in this report. When considering the function of the supporting habitats, it is important to consider how they are being used by red-throated diver. Activities of the red-throated diver are listed in the conservation objectives as roosting, feeding, moulting and loafing[4]. Of these, only feeding is relevant to the seabed supporting habitats. Therefore, the relevant part of this target is considered by the Applicants to relate to habitat loss and effects on prey species within this footprint.

7.2.2.1 Construction

67. As discussed in ***section 4.1***, the extent of effects is small in absolute terms and relative to the total extent of each of the habitat types as shown in ***Table 4*** and ***Table 5***. The effects will be temporary with no long-term loss of extent. As previously discussed, the relevant areas in terms of red-throated diver feeding are only those in areas of <20m depth. Effects on prey would be directly related to this effect footprint and duration, and prey would have medium to low sensitivity to the effects of habitat loss, increased suspended sediments, sediment deposition and physical disturbance as discussed in ***section 7.2.1.1***.

68. The distribution of the supporting habitat types could conceivably be changed if the installation processes resulted in large volumes of suspended sediment being redistributed over a wide area. The consideration of suspended sediment and sediment deposition based upon numerical modelling (see ***Chapter 7 Marine Geology, Oceanography and Physical Processes*** (APP-055)) does not provide any evidence that this would occur, therefore it is considered that there is no pathway for changes to the distribution of supporting habitat types. In addition, as discussed in ***section 3***, dredged material would be released close to the area of dredging, settle rapid and be disposed of in transit to prevent mounding.

69. The availability of the supporting habitats to red-throated diver would relate to the footprint of the effect and also the duration of effect. Given that the footprint is small in absolute terms and relative to the total extent of each of the habitat types (as shown in ***Table 4*** and ***Table 5***) and that the effects will be temporary, there would be limited effects on the availability of the supporting habitats. As previously discussed, the relevant areas in terms of red-throated diver feeding are only those in areas of <20m depth.

70. Given that the areas of supporting habitat affected are small relative to the supporting habitat available, that prey species will have limited sensitivity, and that duration of effect would be temporary it is considered that there would be no

[4] Note that foraging is not included with the text on the attribute target.

Adverse Effect on Integrity from either Project during construction in relation to this attribute.

7.2.2.2 Operation

71. ***Section 4.2*** details the temporary disturbance effects from cable maintenance and the habitat loss from cable protection upon each of the supporting habitat types within the SPA. The areas affected are small in absolute terms and relative to the total extent of each of the habitat types as shown in ***Table 7***.

72. Effects on prey would be directly related to this effect footprint (and duration in the case of disturbance effects) and prey would have medium to low sensitivity to the effects of habitat loss, increased suspended sediments and sediment deposition and physical disturbance as discussed in ***section 7.2.1.1***. The availability of the supporting habitats to red-throated diver would also relate to the footprint of the effect and, in the case of disturbance, to the duration of effect. Given that the areas of supporting habitat affected are small relative the supporting habitat available, that prey species will have limited sensitivity, it is considered that there would be no Adverse Effect on Integrity from either Project during operation in relation to this attribute.

7.2.2.3 In-combination effects

73. In relation to effects on extent during construction, as previously discussed, even allowing for multiple projects, effects are small in absolute terms and relative to the total extent of each of the habitat types. The effects will be temporary with no long-term loss of extent. As previously discussed, the relevant areas in terms of red-throated diver feeding are only those in areas of <20m depth.

74. The distribution of habitats will not be affected (see ***section 7.2.2.1***).

75. The availability of the supporting habitats to red-throated diver either during construction or operation would relate to the footprint of the effect and also the duration of effect. Again, effects are small in absolute terms and relative to the total extent of each of the habitat types.

76. In conclusion, it is considered that there would be no Adverse Effect on Integrity from in-combination effects in relation to this attribute.

7.2.3 Food availability

77. The target of this attribute is to:

"Maintain the distribution, abundance and availability of key food and prey items (e.g. fish) at preferred sizes."

78. Further supporting notes are provided:

"Red-throated diver feed opportunistically, pursuing their prey underwater and exploiting whichever small demersal fish prey are available. Key prey species include sand eels, sprat, flatfish and members of the cod family, and herring being particularly important in the southern North Sea. Red-throated diver forage within waters 0-20m deep.

Prey availability is threatened by direct competition from fishing vessels and displacement from marine industries and habitat loss. The abundance of red-throated diver prey species and the extent of suitable foraging waters should be maintained to ensure sufficient food availability for this species."

79. Disturbance from vessels associated with cable installation on red-throated diver are not considered in this report.

7.2.3.1 Construction

80. The assessments in ***section 7.2.1*** and ***7.2.2*** cover construction effects and the conclusion with regard to Adverse Effect on Integrity. However, it is worth emphasising the point that *"Red-throated diver feed opportunistically, pursuing their prey underwater and exploiting whichever small demersal fish prey are available"*. This is particularly relevant for construction as it shows that red-throated divers are flexible in their behaviour and therefore have a low sensitivity to these kinds of temporary disturbance.

81. It is considered that there would be no Adverse Effect on Integrity from either Project during construction in relation to this attribute.

7.2.3.2 Operation

82. As discussed in ***section 7.2.2.2***, given that the areas of supporting habitat affected are small relative to the supporting habitat available and that prey species will have limited sensitivity there will be limited effects on prey availability during operation

83. It is considered that there would be no Adverse Effect on Integrity from either Project during operation in relation to this attribute.

7.2.3.3 In-combination effects

84. The availability of prey to red-throated diver either during construction or operation would relate to the footprint of the effect and also the duration of effect. Again, effects are small in absolute terms and relative to the total extent of each of the habitat types.

85. It is considered that there would be no Adverse Effect on Integrity from in-combination effects in relation to this attribute.

8 Conclusions

86. The document provides an assessment of the effects of cable installation and operation from the Projects upon the supporting habitats of the Outer Thames Estuary SPA. These effects were considered in EIA terms in the Applications but were not included in the HRA. This was not commented on by stakeholders pre-application.

87. This assessment concludes that there would be no Adverse Effect on Integrity of the SPA in relation to the effects of cable installation and operation from the Projects, either alone or in-combination.

88. The HRA Screening and Integrity Matrices (APP-046) will be updated to reflect this assessment.

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