Hornsea Project Four

Clarification Note on Drill Arisings and Deposited Sediments

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Glossary

Term	Definition
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
Export cable corridor (ECC)	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Four array area to the Creyke Beck National Grid substation, within which the export cables will be located.
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
Order Limits	The limits within which Hornsea Four (the 'authorised' project) may be carried out.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).

Acronyms

Term	Definition
CFE	Controlled Flow Excavation
DCO	Development Consent Order
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
ES	Environmental Statement
MDS	Maximum Design Scenario
MMO	Marine Management Organisation
OWF	Offshore Wind Farm
PINS	Planning Inspectorate
VER	Valued Ecological Receptors

1 Introduction

1.1 Aim of this clarification note

1.1.1.1 Orsted Hornsea Project Four Limited (hereafter the Applicant) has submitted a Development Consent Order (DCO) application to the Planning Inspectorate (PINS), supported by a range of plans and documents including an Environmental Statement (ES) which set out the results of the Environmental Impact Assessment (EIA) on the Hornsea Project Four Offshore Wind Farm (hereafter Hornsea Four) and its associated infrastructure.

1.1.1.2 This clarification note has been prepared to provide a detailed response to the Relevant Representations made by the Marine Management Organisation (MMO) (RR-020) and Natural England (RR-029). This note aims to present sufficient information to provide confidence to these parties that the potential for the impact from drill arisings and deposited sediments associated with construction activities in the marine environment has been adequately considered in the Applicant's DCO Application.

1.1.1.3 This note has sought to complement information presented in the following DCO Application documents and therefore should be read in conjunction with:

- **A2.1: Marine Geology, Oceanography and Physical Processes (APP-013)**;
- **A2.2: Benthic and Intertidal Ecology (APP-014)**;
- **A2.3: Fish and Shellfish Ecology (APP-015)**; and
- **A4.4.4: Dredging and Disposal (Site Characterisation) (APP-042)**.

1.2 Key points raised

1.2.1.1 **Table 1** provides the key Relevant Representations made in relation to the potential impacts arising from drill arising material on benthic ecology and fish ecology resources, and the disposal of dredged material on benthic ecology resources.

1.2.1.2 **Table 2** provides the key submissions made during the examination process to date.

Table 1: Relevant Representations with regards to drill arisings and sediment deposition.

Interest Party	Relevant Representation	Section in this note where the concerns are addressed
MMO	**RR-020-3.3.4:** The dredge and disposal site characterisation report correctly highlights that dredging may lead to sediment plumes, which could create indirect effects on other receptors as a result of increased suspended sediment concentration, deposition and potential release of contaminants (noting these will be discussed in the relevant chapters for individual receptors). The report also highlights that the material to be dredged is predominantly coarse sand, and therefore the likelihood of persistent plumes is low. The MMO believes that this is an accurate conclusion.	This is welcomed by the Applicant and is not addressed further in this clarification note but has been included for completeness.
MMO	**RR-020-3.3.8:** The ES concludes that potential impacts related to dredging and disposal operations are negligible. The MMO agrees with this conclusion, based on the information provided, which suggests that material is likely to be comprised mostly of coarse sand with low levels of observed contamination.	This is welcomed by the Applicant and is not addressed further in this clarification note but has been included for completeness.
Natural England	**RR-029-APDX:F-E:** Identified impacts: Further consideration needs to be given to the impact of drill arising material being deposited on the seabed, as this could be different in composition to the surface sediments and may affect benthic communities. Monitoring at other windfarms have found drill arising mounds to persist in the environment for many years therefore the impacts of any such mounds left following construction need to be fully assessed. The impacts of contaminated sediments being disturbed, put into suspension, and re-deposited within the benthic study area is not fully assessed.	**Section 2** of this clarification note provides further information and assessment on the impact of drill arising material on benthic communities. Further clarification relating to the potential impacts of disturbing sediment-bound contaminants is provided in **G1.44 Hornsea Four Contaminated Sediments Clarification Note (REP4-032)** which was submitted into Examination at Deadline 4. That clarification note seeks to provide assurance that contaminated sediments have been appropriately and robustly assessed by the Applicant.
Natural England	**RR-029-APDX:F-24: Detailed comments – Volume A4.4.4: Dredging and Disposal (Site Characterisation)** Huge volumes of spoil requiring disposal are predicted to be produced across the array area and ECC from seabed preparation, drilling and cabling. However, there is no MDS calculation of area which will be affected by disposal of this material, either in terms of temporary habitat loss from smothering or change in substrate type (should particle size be significantly different). We request the Applicant provide this to allow impacts to be fully assessed.	The Applicant notes that Section 7.1.3 of **A4.4.4: Dredging and Disposal Site Characterisation (APP-042)** provides an assessment of the dispersal of drilled and dredged material and the impact of the disposal of this material. **Section 3** of this clarification note provides supporting information on MDS for the area that will be affected by disposal of material across the site during construction activities including seabed preparation, drilling and cabling and additional assessment information.

Interest Party	Relevant Representation	Section in this note where the concerns are addressed
Natural England	**RR-029-APDX:F-28: Detailed comments – Volume A4.4.4: Dredging and Disposal (Site Characterisation)** Where there is near surface chalk and drilling is required for foundation installation, then drill arisings will be composed of chalk and may differ significantly in composition from the surface sediments (as acknowledged in 6.1.1.1) Monitoring of chalk drill arisings at Lynn and Inner Dowsing and Lincs OWF has shown these mounds to persist in the environment rather than be winnowed away. This has potential to change the biotopes locally and should be considered in this context in this report and the ES. Where the composition of the drill arising is different to that of the surface sediment, mitigation measures should be included within the DCO to reduce the impact on the benthic environment. It would be preferable to dispose of the material (which are a waste product of construction operations and are not integral to the project) at a licensed marine disposal /landfill site, as per standard best practise undertaken by other marine users. If removal is not possible then long term monitoring would be required of mounds post construction and may result in additional mitigation or decommissioning requirements if they are found to persist long term.	Section 2 of this clarification note provides further information and assessment on the impact of drill arising material on benthic and fish ecology resources. The Applicant can confirm that all material associated with Hornsea Four that requires disposal will be disposed of within the limits of the licensed disposal site(s). As the impact from drill arisings is not significant in EIA terms, further mitigation and monitoring is not deemed appropriate.
Natural England	**RR-029-APDX:F-32: Detailed comments – Volume A4.4.4: Dredging and Disposal (Site Characterisation): Point 32** Section 7.1.2.5: As above in point 28 Natural England have concerns that material depositing following drilling is likely to create mounds significantly different to surface sediments, which will persist in the environment rather than be winnowed away. This has potential to change the biotopes and topography locally and should be considered in the impact assessment for benthic ecology and marine processes.	Section 2 of this clarification note provides further information and assessment on the impact of drill arising material on benthic ecology resources. As presented in paragraph 4.4.4.3 of Volume A5, Annex 1.1: Marine Processes Technical Report (APP-067), the particle size of drill arisings is unknown at present and depends on many variables, not least; local rock type(s), size of drill, drill speed, drill pressure, etc. However, in some cases, semi-permanent cuttings piles have formed of relatively large clasts, for example at North Hoyle (DECC, 2008). Given the highly localised nature of these mounds they will only represent a fraction of the seabed in the array. Furthermore, the change in potential topography is akin to the presence of scour protection and

Interest Party	Relevant Representation	Section in this note where the concerns are addressed
		therefore the Applicant's position is that no further assessment is required on physical processes.
Natural England	**RR-029-APDX:F-34: Detailed comments – Volume A4.4.4: Dredging and Disposal (Site Characterisation): Point 34** Section 8.1.1.3: As above (point 32) Natural England are concerned that drill arisings (specifically those containing chalk) will have lasting impact on the seabed (as seen at LID and Lincs OWF). Natural England appreciate it is not possible to know when or where drilling to install foundations will be necessary at this stage, but ask that necessary steps are taken to reduce the impacts related to the deposition of the drill arising material. Where the composition of the drill arising is different to that of the surface sediment, mitigation measures should be included within the DCO to reduce the impact on the benthic environment. It would be preferable to dispose of the material (which are a waste product of construction operations and are not integral to the project) at a licensed marine disposal /landfill site, as per standard best practise undertaken by other marine users. If removal is not possible then long term monitoring would be required of mounds post construction and may result in additional mitigation or decommissioning requirements if they are found to persist long term.	See response to RR-029-APDX:F-28 above..
Natural England	**Detailed comments – Volume A2.3 Fish and Shellfish Ecology: Point 4** Section 3.11.1.20: Natural England do not feel the impacts associated with drilling foundations, in particular the mounds formed following disposal of drill material, have been considered in the impact assessment (as raised previously in Nov 2020). This also applies to the benthic chapter. Whilst the impacts from increased suspended sediment are considered, there is no mention of temporary or long-term habitat loss/change in habitat as a result of drill arisings forming persistent mounds or changing surface substrate type. Whilst the area affected might be less than the presence of the infrastructure itself, the area impacted by disposal will be in addition to the infrastructure itself and therefore needs to be considered in the impact assessment.	Section 2 of this clarification note provides further information and assessment on the impact of drill arising material on benthic ecology resources.

Table 2: Other Representations made to date in the examination process

Interest Party	Deadline 2 Representations	Applicant's Response at Deadline 3	Section in this note where the concerns are addressed
Natural England	Further consideration needs to be given to the impact of drill arising material being deposited on the seabed. Impact of contaminated sediments The impact of drill arising is still an outstanding concern of Natural England REP066 has gone some way to clarifying the level of contaminants within sediments however the document doesn't provide sufficient confidence on the impact these might have to the benthos.	The Applicant can confirm that further consideration is being given to the impact of drill arisings with a clarification note due to be submitted into Examination at Deadline 5. An update will be made to G1.44 Clarification Note on Marine Sediment Contaminants following Natural England's contaminants comments and this will be submitted at Deadline 4.	**Section 2** of this clarification note which provides further information and assessment on the impact of drill arising material on benthic ecology resources. Sections 4.2 and 4.3 of **G1.44 Clarification Note on Marine Sediment Contaminants (REP4-032)** provides further evidence that the levels of contamination present will not have significant adverse impacts on benthic ecology. This document was re-submitted at Deadline 4.
Natural England	The Applicant has suggested that an assessment is provided in Section 7.1.3 of Volume A4.4.4 (APP-042) however this refers to effects of sediment plumes with no references to impacts once sediment settles. Natural England would like to see extent figures estimating the area affected by the settlement of sediment plumes	The Applicant can confirm that further consideration is being given to the impact of drill arisings and settled sediment plumes with a clarification note due to be submitted into Examination at Deadline 5.	**Section 3** of this clarification note provides supporting information on MDS for the area that will be affected by disposal of material across the site during construction activities including seabed preparation, drilling and cabling and additional assessment information.
Natural England	Natural England note the applicants comment that any area impacted by drill arising will be within the footprint of seabed preparation works, however the impacts from drill arisings are likely to be different to those arising from the use of GBS. Therefore, it is still Natural England's position that impacts associated will drill arisings should be assessed in the context of Fish and Shellfish as well as other receptors within the ES.	The Applicant can confirm that further consideration is being given to the impact of drill arisings with a clarification note due to be submitted into Examination at Deadline 5.	**Section 2** of this clarification note provides further information and assessment on the impact of drill arising material on benthic ecology resources.

Interest Party	Deadline 2 Representations	Applicant's Response at Deadline 3	Section in this note where the concerns are addressed
	(N.B We have changed the RAG status from yellow to align with similar comments made in relation to benthic ecology and that we would like this issue to be considered further).		

2 Potential adverse effects of deposited material associated with drilling operations

2.1 Drilling operations

2.1.1.1 As detailed in **A4.4.4 Dredging and Disposal Site Characterisation (APP-042)**, the impact of drilling operations mainly relates to the release of drilling spoil at or above the water surface which will release material into suspension and the subsequent re-deposition of that material to the seabed. The nature of this disturbance will be determined by the rate and total volume of material to be drilled, the seabed and sub-bottom material type, and the drilling method which affects the texture and grain-size distribution of the drill spoil.

2.1.1.2 Monopile foundations and pin-piled jacket foundations would be installed using standard drilling techniques. In some locations, the particular geology may present some obstacle to piling, in which case some or all of the seabed material might be drilled within the pile footprint to assist pile installation. It is assumed that drilling of the full pile depth may be required at up to 10% of pile locations. However, it should be noted that drilling (though consented) was not required at Hornsea Project One, which represents broadly similarly regional seabed characteristics to those at Hornsea Four.

2.1.1.3 Sediment deposition because of drilling for a single pile location could deposit coarse-grained and clastic sediment within an area in the order of approximately 10 – 100 m downstream and a few tens of metres wide from individual foundation locations, with an average thickness in the order of 1 – 10 m.

2.1.1.4 It is noted that, whilst the absolute width, length, shape and thickness of local sediment deposition as a result of drilling is estimated, it cannot be predicted with certainty and is likely to vary due to the nature of the drill spoil, the local water depth, and the ambient environmental conditions during the drilling activity. If the total volume of drill arisings were distributed equally across the relevant disposal site (array or offshore ECC), the increase in bed elevation would be almost immeasurable. However, in reality, the change will consist of a series of smaller, discrete, overlapping and non-overlapping deposits distributed throughout parts of the array area and offshore ECC where foundations are located. Monitoring of drill arising mounds on the Lynn and Inner Dowsing Offshore Wind Farm found that after four months, mounds had been reduced from 3 m to 1.2 m due to natural processes, however this figure is only presented as a guide as sediment and oceanographic conditions may be slightly different at Hornsea Four.

2.1.1.5 Section 4.4.6.5 of **A5.1.1: Marine Processes Technical Report (APP-067)** notes that Sheringham Shoal Offshore Wind Farm (90 km to the south of Hornsea Four) also encountered Cretaceous Chalk but was still able to drive all piles into the seabed without the need of drilling (Carotenuto *et al.* 2018). This project is closer to Hornsea Four in terms of geology and is likely to be more representative of the chalk likely to be encountered.

2.1.1.6 Based on the available evidence, the predicted Maximum Design Scenario (MDS) for the coarse-grained and clastic sediment mounds, which could also consist of chalk due to the underlying geology, has the potential to result in a maximum footprint of 0.027 km^2. This equates to approximately 0.005% of the total array area. Furthermore, deposited material is also likely to be winnowed away by natural processes and therefore it is also potentially a temporary effect with seabed recovery likely despite level of smothering. The magnitude of impact is therefore considered to be **negligible** based on the very localised and small scale nature of the impact. Irrespective of the sensitivity of the benthic and fish ecological receptors, the significance of the impact is considered to be **not significant** as defined in the

assessment of significance matrix (Table 2.15 of A2.2: Benthic and Intertidal Ecology (APP-014)) and is therefore not required to be considered further.

2.2 Benthic Ecology

2.2.1.1 Despite the result of the magnitude assessment in Section 2.1 above, additional explanation is provided here to address concerns from consultees (Table 1 & Table 2) on the impact of a discrete loss of habitat across the array area on benthic ecology resources.

2.2.1.2 As presented in Section 2.11.2 of A2.2: Benthic and Intertidal Ecology (APP-014), the species and habitats identified during the characterisation study are typical of the wider region. All biotopes identified within the Hornsea Four Order Limits have been assessed according to the MarESA criteria as having no resistance to long-term or permanent habitat loss / change, with recovery assessed as very low as the change at the pressure benchmark is at worst case permanent. The sensitivity of subtidal receptors is therefore considered to be at worst-case **high** according to the EIA assessment values

2.2.1.3 A change of subtidal biotopes as a result of the drill mounds would alter the character of the biotope leading to reclassification and the loss of the sedimentary community. However, while the impact will be locally significant and comprise a long-term or potentially permanent change the footprint of the area affected is highly localised. Furthermore, as the habitats and characterising biotopes are common and widespread throughout the wider region, the loss of these habitats is assessed as barely discernible.

2.2.1.4 Overall, it is predicted that the sensitivity of the benthic subtidal habitats located across the Hornsea Four benthic ecology study area is at worst-case **high** according to the detailed MarESA assessments and the magnitude is **negligble**. The **high** sensitivity and **negligble** magnitude of the impact on benthic receptors results in a **slight** (not significant) effect (as per the matrix in Table 2.15 of A2.2: Benthic and Intertidal Ecology (APP-014)).

2.3 Fish Ecology

2.3.1.1 Despite the result of the magnitude assessment in Section 2.1 above, additional explanation is provided here to address concerns from consultees (Table 1 & Table 2) on the impact of a discrete loss of habitat across the array area on fish and shellfish ecology resources.

2.3.1.2 As presented in Section 3.11.2 of A2.3: Fish and Shellfish Ecology (APP-015), herring and sandeel are demersal spawners and are reliant upon the presence of suitable substrates for spawning (i.e. gravelly sediments for herring and sandy sediments for sandeel). Furthermore, as well as laying demersal eggs, sandeel also have specific habitat requirements throughout their juvenile and adult life history. On account of this, these species are considered to be more vulnerable to long term habitat loss depending on the availability of habitat within the wider region. Sandeel and herring are consequently deemed to be of high vulnerability to long-term changes in substrate, with limited ability for recovery, and of regional importance within the southern North Sea, and therefore are both considered to be of **high** sensitivity.

2.3.1.3 Crab and *Nephrops* have burrowing habits during varying life stages, whilst scallops prefer softer sediment and as such, the introduction of hard substrate over the softer sediments within the Hornsea Four will reduce the habitat availability for these species. However, these species are substrate dependent rather than being philopatric and can therefore fully utilise adjacent, unaffected areas. As such, these receptors are considered to be of medium vulnerability and high recoverability and therefore considered to be of **medium** sensitivity.

2.3.1.4 All other VERs are generalists and relatively insensitive to local variations in seabed substrate with widely distributed spawning and feeding grounds. Therefore, these receptors are considered to be of low vulnerability and high recoverability to long term changes in

seabed substrate and of regional importance within the southern North Sea and therefore are all considered to be **low** sensitivity.

2.3.1.5 Long-term habitat loss will represent a long-term and continuous impact throughout the lifetime of the project. However only a relatively small proportion of the fish and shellfish habitats are likely to be affected in the context of wider habitats in the area. Most receptors are predicted to have some tolerance to this impact. Overall, the magnitude of the impact has been assessed as **negligble** for all species. The sensitivity of fish ecology receptors is worst-case assessed as **high**. The **high** sensitivity and **negligble** magnitude of the impact on benthic receptors results in a **slight** (not significant) effect (as per the matrix in Table 3.13 of **A2.3: Fish and Shellfish Ecology (APP-015)**).

3 Potential adverse effects of deposited material associated with disposal activities

3.1 Disposal activities

3.1.1.1 This section provides details on the potential depth of deposited sediments and associated areas for disposal activities at Hornsea Four. The MDS involves seabed preparation by suction hopper dredger with release of dredged material at the sea surface, as well as sandwave clearance and cable installation by Controlled Flow Excavation (CFE) (Table 2.12 of **A2.2: Benthic and Intertidal Ecology (APP-014)**).

3.1.1.2 It should be noted there has been a reduction in the MDS for sandwave clearance since the submission of the ES. As part of the analysis of the latest site-specific geophysical data, the Applicant has proposed to reduce the bedform clearance volumes for cable installation (**G3.6: Clarification Note: Justification of Offshore Maximum Design Scenarios (REP3-035)**).

3.1.1.3 In the case of dredging, when dredged material is released, approximately 90% will fall directly to the seabed (termed the dynamic plume phase). The remaining 10% will become more dispersed and stay in suspension (termed the passive plume phase). Sand-sized material could remain in suspension for a short time and be transported downstream (depending on the flood/ebb tides at the time of release). Finer sediment could remain suspended for longer, in the order of hours to days. Modelling of spoil disposal (Appendix C of **A5.1.1: Marine Processes Technical Report (APP-067)**) demonstrated that the scale of tidal advection where the silt fraction determines the material held in suspension to form a plume would be approximately 6 km within the array area, and 10 km in the offshore ECC (although conservative estimates of 10 km and 15 km representing a full spring tidal excursion have been assumed, respectively). Away from the point of release, concentrations are predicted to be around 10 mg/l but are expected to dissipate in the order of hours to days from the point of release.

3.1.1.4 For sandwave clearance and cable trenching using CFE, the height of release is at or near the seabed, and there is far less potential for persistent plumes or significant deposition away from the location of the activity.

3.1.1.5 In terms of bed-level changes associated with dredging for all disposal activities, if the total volume of dredged material were deposited within the disposal site (array or offshore ECC), the increase in bed level height for light smothering (<5 cm as defined by the Marlin MarESA assessment), would result in a total maximum footprint of 26 km^2 in the export cable and 48 km^2 in the array area. This equates to approximately 10% of the total seabed area within the Hornsea Four array area and 9% within the Hornsea Four ECC / temporary works area.

3.1.1.6 With regards to heavy smothering (5-30 cm as defined by the Marlin MarESA assessment), if the total volume of dredged material were deposited it would result in a total maximum footprint of 4 km^2 in the export cable and 8 km^2 in the array area. This equates to approximately 1% of the total seabed area within the Hornsea Four array area and 2% within the Hornsea Four ECC / temporary works area.

3.1.1.7 **Figure 1** provides a spatial representation of the total area of deposition for both light and heavy smothering, whilst the exact area of impact cannot be defined, it provides a useful schematic of the scale of impact.

3.1.1.8 In practice, the bed-level change will compromise a series of discrete deposits (smaller overlapping or non-overlapping deposits, potentially from multiple dredging cycles around each dredged area), distributed throughout the parts of the array area and export cable corridor where works are required. Away from the point of release, silts are not expected to settle to a discernible thickness.

3.1.1.9 Based on the available evidence, the predicted MDS for deposited is consistent with the evidence present within the relevant ES assessments (**A2.2: Benthic and Intertidal Ecology (APP-014)** and **A2.3: Fish and Shellfish Ecology (APP-015)**). In relation the benthic ecology resources, deposition from construction activities is expected to be short-term, intermittent and of localised extent. All biotopes and VERs are distributed widely throughout the Southern North Sea, and therefore taking the wider environment into context, the magnitude of the impact on all VERs is therefore assessed as being **minor**.

3.1.1.10 The same magnitude of **minor** is concluded for fish and shellfish resources, due to the short-term, intermittent and of localised extent of the bed level changes associated with depostied sediments.

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GRID NORTH

6025000
6000000
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5950000

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Date: 24/05/2022 Author: BenBlakeman Name: HOW04GB0396_Sediment_Deposition

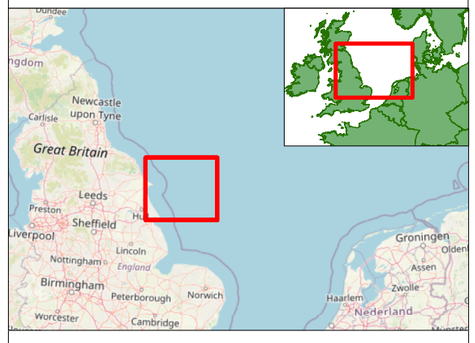
Hornsea Four

Figure 1
Sediment Deposition within
Hornsea Four Offshore Wind Farm

- Order Limits
- Array Area
- HVAC Booster Station Works Area
- Offshore Temporary Works Area
- Offshore Export Cable Corridor

Sediment Deposition

- Light (<5cm)
- Heavy (5-30cm)



Coordinate system: ETRS 1989 UTM Zone 31N
Scale@A3: 1:375,000

0 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
....	First issue post DCO Application	24/05/2022

Sediment
Deposition
Document no: HOW04GB0396
Created by: BPHB
Checked by: AdB
Approved by: LK

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3.2 Key receptors

3.2.1.1 The Hornsea Four ES provides a detailed impact assessment relating to disposal activities associated with construction activities on sensitive biological receptors, including benthic ecology resources and fish and shellfish ecology resources. **Table 3** provides a summary of the key impacts on the receptors assessed within the ES. The relevant section of the ES, where further details of these impact assessments can be found, is also provided.

3.2.1.2 It should be noted that with regards to benthic ecology, all VERs that were found within the Hornsea Four Order Limits and wider secondary impact zone have been assessed for both heavy and light deposition (Section 2.11.1 of **A2.2: Benthic and Intertidal Ecology (APP-014)**). Whilst it is unlikely that all biotopes will be impacted by heavy smothering (particularly in the secondary impact zone as heavy smothering is only likely to occur in close proximity to the point of the release), the ES has undertaken an assessment based on the worst-case scenario that all biotopes and habitats will be impacted by both heavy and light smothering.

Table 3: Summary of impacts from disposal of sandwave clearance, dredged and drilled seabed material on benthic ecology and fish and shellfish ecology resources within the boundaries and wider study area of Hornsea Four.

Potential impacts	Relevant section of environmental statement	Sensitivity of receptor	Magnitude of impact	Significance of effect including designed in measures
Benthic Subtidal and Intertidal Ecology				
Temporary increase in SSC and sediment deposition in the Hornsea Four array area and offshore ECC	Section 2.11.1 of **A2.2: Benthic and Intertidal Ecology (APP-014)**	Worst case Medium	Minor adverse	Slight (Not significant)
Temporary increases in SSC and sediment deposition in the intertidal area	Section 2.11.1 of **A2.2: Benthic and Intertidal Ecology (APP-014)**	The magnitude is negligible therefore receptor sensitivity is not considered further in this assessment, as it will not lead to a significant effect based on the matrix used for the assessment of significance and expert judgement.	Negligible	Neutral
Fish and Shellfish Ecology				
Direct damage (e.g. crushing) and disturbance to mobile demersal and pelagic fish and shellfish species arising from construction activities.	Section 3.11.1 of **A2.3: Fish and Shellfish Ecology (APP-015)**	Worst case High	Minor adverse	Slight (Not significant)
Temporary localised increases in SSC and smothering.	Section 3.11.1 of **A2.3: Fish and Shellfish Ecology (APP-015)**	Worst case High	Minor adverse	Slight (Not significant)

4 Conclusions

4.1.1.1 This clarification note has been prepared to provide a detailed response to the Relevant Representations made by the MMO and Natural England and provide additional assurance for issues raised by representations during the examination process. This note aims to provide sufficient information to provide confidence for the regulators that the potential adverse effects of deposited material associated with drilling operations and the potential adverse effects of deposited material associated with disposal activities has been adequately considered in the Applicant's DCO Application. This note has sought to complement information presented in the following DCO Application documents.

4.1.1.2 It is the Applicant's position that the findings of the assessments in the Hornsea Four DCO Application remain valid, and that this supplementary assessment provides additional evidence that there will be no significant impact in EIA terms in relation to drilling and disposal activities associated with construction activities at Hornsea Four.

5 References

Carotenuto, P., Meyer, P. J., Strøm, P. J., Cabarkapa, Z., St John, H., Jardine, R., Buckley, R. (2018). Installation and axial capacity of the Sheringham Shoal offshore wind farm monopiles – a case history. Engineering in Chalk: Proceedings of the Chalk 2018 Conference. doi:https://doi.org/10.1680/eiccf.64072.117

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