THE PLANNING ACT 2008

THE INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

Natural England, Marine Management Organisation & Cefas review of G4.9 Marine Processes Supplementary Report - Revision: 01 [REP4-043]

For:
The construction and operation of Hornsea Project Four Offshore Wind Farm, located approximately 69 km from the East Riding of Yorkshire in the Southern North Sea, covering an area of approximately 468 km^2.

Planning Inspectorate Reference EN010098

20th June 2022

Memo

To:	Hornsea Project Four & Planning Inspectorate
From:	Natural England, Marine Management Organisation (MMO) and Cefas (Centre for Environment, Fisheries and Aquaculture Science)
Date:	14th June 2022
Subject:	Hornsea Four: Marine Processes Supplementary Report, Doc. Ref. No: G4.9 (Rev 01) [REP4-043]

We welcome the Hornsea Four Marine Processes Supplementary Report, Document Ref. No: G4.9 (Rev. 01) [REP4-043] and the additional analysis and information that has been provided. Natural England, the MMO and Cefas have reviewed this report and have the following detailed comments on this report to inform the ongoing Technical Panel discussions regarding Smithic Bank and Flamborough Front. All parties did meet for a technical panel discussion on 10th June 2022 to discuss Marine Processes issues arising from Hornsea Four development in more detail and we submitted this Memo to Orsted following that meeting.

1. Smithic Bank

1.1 Characterisation

We note that it is only the lower resolution 1979 bathymetric survey that provides near full coverage of Smithic Bank (with the exception of the most southerly tip), whilst the later, higher resolution surveys carried out in 2011, 2016 and 2020/22 provide only partial coverage of the sandbank. Furthermore, there exists only a very small area of overlap between the 2011 and 2016 surveys and the 2020/2021 survey data across the southern part of Smithic Bank. These data limitations have also been highlighted in Section 1.2.2.2 of the Supplementary Report. Consequently, only broad-scale changes have been assessed between 1979, 2011, and 2020/2021, and it is only the period 2011-2016 where it has been possible to map changes in detail. Furthermore, the bathymetry interpretation that has been carried out is based on cross-sections at specific locations. Interpretation of individual bedform-scale movements drawn from the comparison of these cross-sections is subjective. For example, the nine cross-sectional profiles presented in Figures 4 & 5, 9-11, 12 & 13, 15 & 16 represent short two-dimensional profiles of the morphology at the northern tip and along the western flank of Smithic Bank. There are insufficient data (both temporally and spatially) to draw any broader conclusions about the overall direction and rate of bedform migration. Mapping migration of sandwaves through comparison of cross-sectional profiles for data from different years is highly subjective as it is based on the premise that specific individual bedforms can be identified several years apart. Therefore, whilst we agree that bedform asymmetry exists across North Smithic Bank, and that this is a highly dynamic region of large-scale mobile bedforms, there are insufficient data to conclusively demonstrate the direction and rate of bedform migration.

The comparative study of bathymetric data presented in the report shows a general trend of lowering of South Smithic and the westward migration of the western flank of the sandbank. However, we note that there is no estimate of sandbank volumetric change over the time periods analysed. This would be useful as it would provide some indication of the volume of sediment being lost from the sandbank over time and, therefore, we would advise that this analysis be carried out. Moreover, whilst we are content that the data shows evidence of bedform asymmetry across North Smithic, there is insufficient evidence to allow comparison of individual bedforms between survey years and, in turn, assess their migration directions and rates.

Section 2.3.3.3 correlates the lack of sediment observed in the deeper area to the west of South Smithic with “little exchange of sediment between Smithic Bank and the Bridlington foreshore”. However, this correlation is hypothetical and, conversely, it is possible that under a specific set of wind wave, ebb tidal flow, and wind conditions onshore sediment transport could occur towards the coastline. Furthermore, with the exception of the 1979 bathymetric data, there are no bathymetric survey data for the southern part of South Smithic and, thus, no information on the changes to sandbank morphology or sediment transfer between the sandbank and coastline at this location.

Section 2.3.4.1 states that “rotational sand transport around Smithic Bank is likely to be contained within Bridlington Bay, with little or no transport from this source south along the Holderness Coast.”. However, Pye et al (2015) showed that sediment from the southern parts of Smithic Bank exhibit a high degree of similarity to beach sediment from between Fraisthorpe and Skipsea. Moreover, Section 2.3.3.2 in the Supplementary Report discusses the sediment accumulation due to the clockwise movement of the tidal gyre, yet Pye et al. (2015) also provide evidence of a net sediment transport pathway driven by anticlockwise residual circulation from the nearshore towards the southern part of Smithic Bank. Therefore, whilst it is acknowledged that Smithic Bank is at the centre of a tidal gyre, and that the sandbank(s) acts as a sediment depository, it cannot be inferred that this is a predominantly self-contained system without supporting evidence. This is a complex sedimentary system and could potentially be a semi-enclosed system, or even a dynamically leaking system.

A vital part of establishing the pre-construction baseline for the Hornsea Four marine processes impact assessment, with regard to Smithic Bank, is defining the geographical extent of the sandbank. Figure 1 below shows the comparison of the 1979 and 2020/21 bathymetric data, what is not clear is the location of the geomorphological eastern boundary (flank) of Smithic Bank relative to the Dogger Bank A & B Cable Crossing location. The combined effect of increased seabed roughness, decreased water depth, and a potential barrier to sediment as a result of the crossing elevating the seabed could influence sediment transport processes, which in turn could trigger morphological change(s). We would, therefore, advise that the geomorphological boundary and extent of Smithic Bank should be defined as accurately as possible, presented on the latest Dogger Bank A & B Cable Crossing map, and agreed with Natural England, MMO and Cefas.

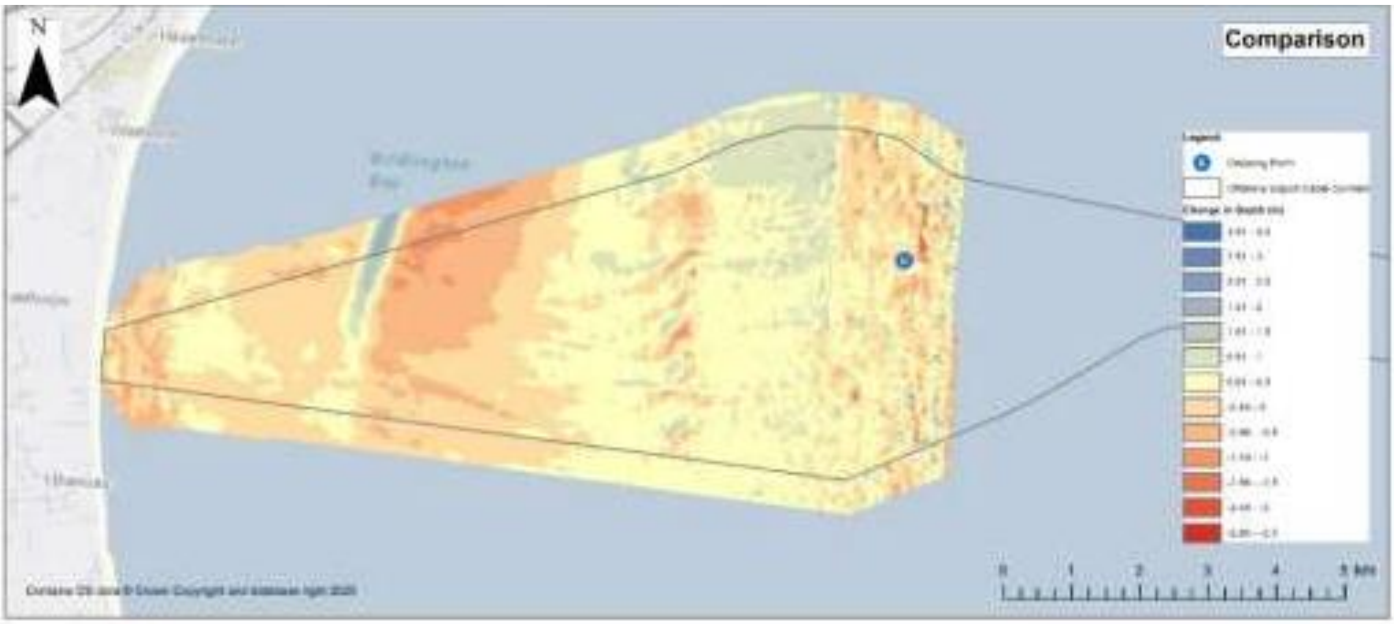

Figure 1. Comparison of 1979-2020/21 bathymetric survey data (taken from Ørsted, 2022)

1.2 Impacts from cable installation

Whilst it is anticipated that the volume of sediment removed due to cable installation across Smithic Bank may be small compared to sediment loss due to natural processes, given that this is a semi-contained system, we would advise that sediment removed from the sandbank be retained within this system in order to ensure that the integrity of the sandbank is maintained. In other words, we would advise that Bank sediments removed through cable installation should be deposited on Smithic Bank and thus be retained in this circulatory system. Natural England and MMO/Cefas request further information on the likely disposal locations that can be used by Hornsea 4 to ensure that material removed from Smithic Bank can be retained within the sandbank system.

We also remain concerned with the installation of cables (and any associated protection) across or near Smithic Bank when considered in-combination with multiple developments (e.g. Dogger Bank A & B, SEGL2, Dogger Bank South etc). Successive cable (and cable protection) installations could act cumulatively to increase morphological alteration of the sandbank through the combined influence of sediment removal through dredging, and potential changes to sediment transport pathways arising from the presence of cable protection. Therefore, we would advise that a detailed assessment of the cumulative impacts of multiple developments on Smithic Bank needs to be carried out. Similarly, the potential impact of cable reburial, cable replacement, and cable remediation activities through the lifetime of the project (including climate change impacts) need to be adequately assessed.

We note that in section 2.4.1.2 of G4.9 Marine Processes Supplementary Report it is stated that sand-wave clearance will not be required along the cable corridor across Smithic bank and therefore there is no pathway to sandbank lowering. This was new information that does not appear within the Clarification Note: Justification of Offshore Maximum Design Scenarios (Ørsted, 2022). Whilst Natural England and the MMO/Cefas would welcome this commitment (and wish to see it secured in the DCO/dML) it is not the only mechanism by which sandbank lowering could occur as it is not known what barrier affect the cable crossing to the east might have on sediment supply and sandbank stability. Furthermore, owing to the uncertainty regarding whether South Smithic is an erosional or depositional environment, we are also concerned that burial of the export cable may not be achieved.

Due to the dynamic nature of the sandbank margins and uncertainly around the effects of cable installation and crossings in this area, we advise monitoring of Smithic Bank, and the area between the Holderness Coastline and the Dogger Bank Cable Crossing by swath bathymetry pre- and post-cable installation and five years later. This should be secured through a licence condition.

1.3 Impacts from the placement of cable protection

We note that the Applicant proposes 5% cable protection along the length of the ECC that that extends across Smithic Bank. We remain concerned that the placement of cable protection on Smithic Bank by the Hornsea Four project alone or in-combination with other projects could alter hydrodynamics and sediment transport with the potential for associated morphological impacts. Consequently, our position is that cable protection should **not** be placed on Smithic Bank and that this should be secured in the DCO/dML. We would therefore like to better understand the likely need for this level of protection, the likely locations of rock placement, and to understand the inter-relationship between the commitment not to undertake sandwave clearance and the anticipated need for cable protection.

Furthermore, the current commitment is for there to be no cable protection out to 350m, which we do not consider to sufficient to exclude impacts to nearshore hydrodynamics, sediment transport processes, and morphological change. It is not simply cumulative effects which are concerning, but cumulative effects of protection measures in a dynamic environment over the lifetime of these projects. It is therefore our position that cable protection should not be permitted westward of the eastern morphological boundary of Smithic Bank.

1.4 Dogger Bank A & B Cable Crossing

Figure 1 above shows comparison of the 1979 and 2020/21 bathymetric data for the Dogger Bank A & B Cable Crossing. This shows that there is evidence for up to 2.5m bathymetric change at the Dogger Bank A & B Cable Crossing site over the period 1979-2020/21 which raises concerns regarding the potential for morphological change.

Figure 2 below shows the Hornsea Four/Dogger Bank A & B Order Limits Interaction and rock protection area. The Dogger Bank A & B Cable Crossing includes 12 cable crossings with individual rock berms at each cable crossing that have maximum length and width of approximately 500m by 20.2m, and a berm height of up to 3m. Given the close proximity of the Dogger Bank A & B Cable Crossing to the geomorphological eastern boundary of Smithic Bank, we remain concerned that the presence of these cable protection measures could cause morphological change (e.g. enhanced lowering of the sandbank) through the modification of the hydrodynamic regime or via diversion of sediment transport pathways and, therefore, we advise that the cable crossing be moved as far seawards as possible within the Order Limits. Whilst noting the constraints Orsted face with regards to moving the cable crossing eastwards due to the Order Limits, Natural England and MMO/Cefas also propose that any reduction in the MDS of cabling and crossings which could be secured before consent would also help limit any impact on the Bank, such as bundling Hornsea 4 cables within fewer trenches and using HVDC technology to reduce the total number of cables and crossings required. It is also worth noting that Dogger Bank A&B has confirmed that their export cables will be bundled in 2 trenches.

Given the indicative nature of the current Hornsea Four plans showing the location of the Dogger Bank A & B Cable Crossing, we advise that the most up-to-date Dogger Bank A & B cable routing plans should be used to generate more accurate cable crossing plans by the Applicant. In turn, this more up-to-date and accurate plan of the Dogger Bank A & B Cable Crossing will provide a clearer indication of the location of the crossing relative to the eastern geomorphological boundary of Smithic Bank and inform the impact assessment.

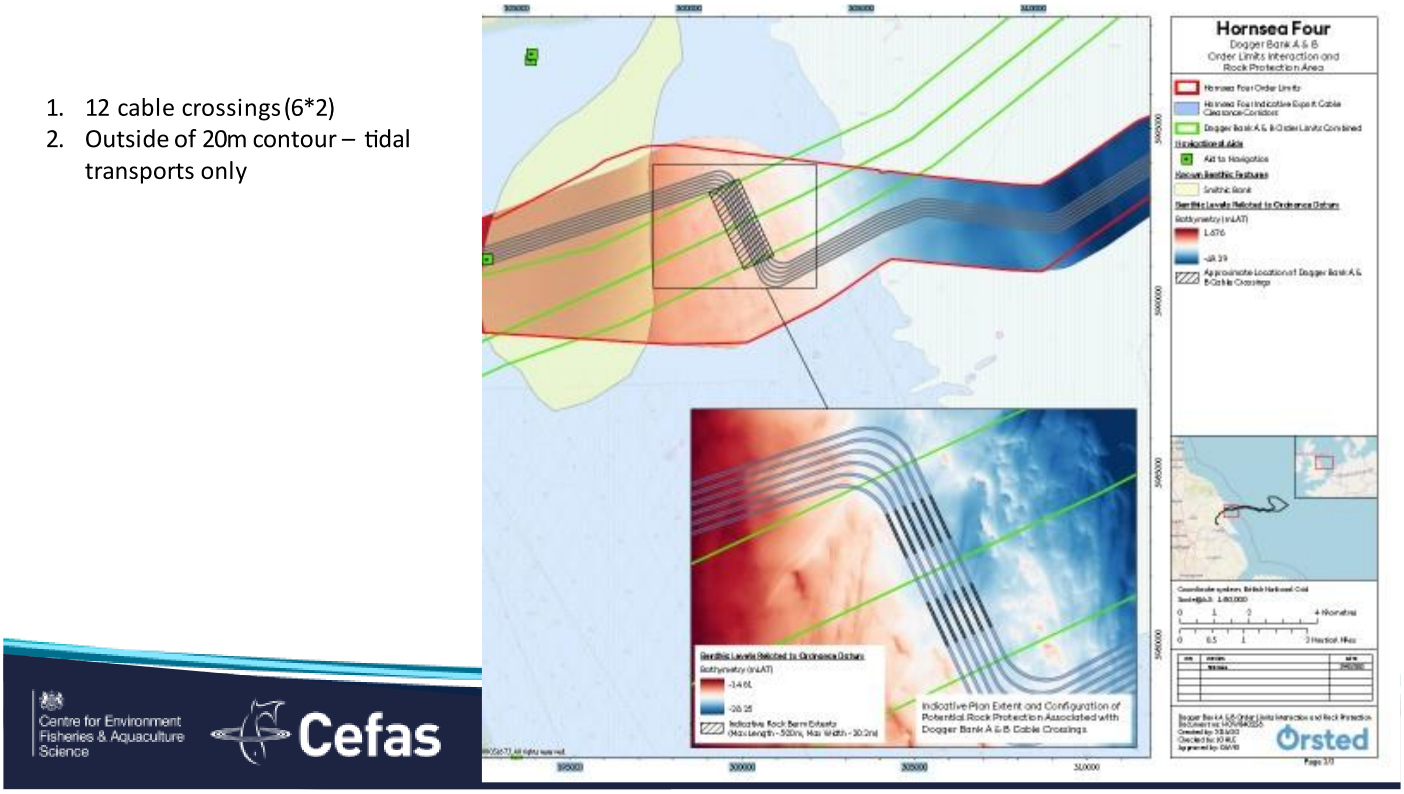

Figure 2. Dogger Bank A & B Export Cable Crossing Rock Protection (adapted from Ørsted, 2022).

1.5 Summary of Concerns

Smithic Bank, along with Flamborough Head, provides shelter to the town of Bridlington, Bridlington Beach, and the northern quarter of the Holderness coast, it provides a buffer to the shore by dissipating direct waves, and refracting away oblique waves. Moderate elevation changes to the sandbank and significant changes to sandbank morphology through cable installation activities, associated cable protection, and remedial works by Hornsea Four alone, or in-combination with other developments, could alter the nearshore hydrodynamic regime, sediment transport (including longshore flux), shoreline response to storms, and alter shoreline morphology over the long-term. These changes have the potential to be far reaching.

The Supplementary Report provided by the Applicant highlights the challenge of accurately characterising the baseline conditions in this area due to only partial coverage of the available data. Whilst inferences can be (and have been) made, there remains a high degree of uncertainty and the risks associated with these proposals both alone and combined with other plans/projects cannot be ruled out on the basis of the evidence available.

1.6. Potential Mitigation and Monitoring Requirements

Therefore, we advise that, in line with the mitigation hierarchy, measures are incorporated to avoid or reduce the potential for impact as far as possible. This should include the following:

a) Disposal sites for cable installation across Smithic Bank should be clearly defined and it should be demonstrated that dredged material will be retained within the Smithic Bank system;
b) Cable protection should be avoided within the nearshore area and across the full extent of the sandbank;
c) The Dogger Bank A & B Cable Crossing should be sited as far to the east of the accurately defined geomorphological boundary as possible. (The most up to date information on Dogger Bank A&B's layout should be used to inform this);
d) Bundling of cables should be implemented where possible in the nearshore to reduce the impact and the number of cable crossings;
e) Due to the dynamic nature of Smithic Bank and the anticipated Dogger Bank A&B cable installations, monitoring of the area between the Holderness Coastline and the Dogger Bank Cable

Crossing by swath bathymetry should be undertaken prior to construction to allow additional mitigation to be incorporated as required.

f) To identify and manage any residual risk, a robust monitoring plan should be agreed upon which incorporates “trigger points" to allow interventions or remediation as required.

Lastly, we would advise that the impacts discussed above will need further consideration in the context of the HRA and MCZ assessments.

2. Flamborough Front

2.1 Characterisation

We welcome the supplementary information provided on the Flamborough Front by the Applicant. This additional information provides further evidence that the Hornsea Four array sits within the region of the Flamborough Front. Moreover, this demonstrates that the cluster of Hornsea (and potentially Dogger Bank) offshore wind farms will also sit within the region of the Flamborough Front. The report also usefully highlights the paucity of information regarding the formation and operation of the Front.

The Flamborough Front gives rise to nutrient-rich waters which create a biodiversity hotspot attracting seabirds and marine mammals to the area each year. Consequently, the Flamborough Front plays a key role in primary production, the marine ecosystem and biogeochemical cycles. As nutrients are limited (at least on the short-term), this could result in a reduction in productivity as a far field site (Dogger Bank) and thus result in a translocation of productivity inshore.

2.2. Impacts of Windfarms

Recent research (e.g. Carpenter et al. (2016), Christiansen et al. (2022), and Dorrell et al. (2022)) has shown the potential for large-scale hydrodynamic changes due to clusters of wind farms in seasonally stratified seas. The impact of clusters of offshore wind farm developments on large-scale stratification could lead to significant changes in regional primary production and, in turn, marine ecosystem dynamics through turbulent mixing of the water column. Furthermore, the majority of research conducted to date has focussed on turbulent mixing due to monopile foundation structures, and not gravity-based structures (GBS), which have significantly larger dimensions and, thus, far greater potential for turbulent mixing of the water column. For example, the HP4 MDS for GBS type WTG foundations is 53m in diameter at the base, compared to the monopile type WTG foundation diameter of 15m.

We are also concerned that cold water plumes could form in the lee of the foundation structures of the Hornsea Four array, thus altering the sea temperature. In Figure 3 below, a hypothetical scenario is described in which cold water plumes are seen to develop in the lee of a **monopile** foundation structure as the tidal currents continuously move past. It is feasible that cold water plumes could form in a similar manner to sediment plumes that have been observed in the lee of existing WTG foundation structures due to scouring of the seabed. These cold-water plumes could, on an array-scale, also have a significant ecological impact on the primary production and the wider marine ecosystem. The use of GBS is likely to intensify the likelihood of these arising.

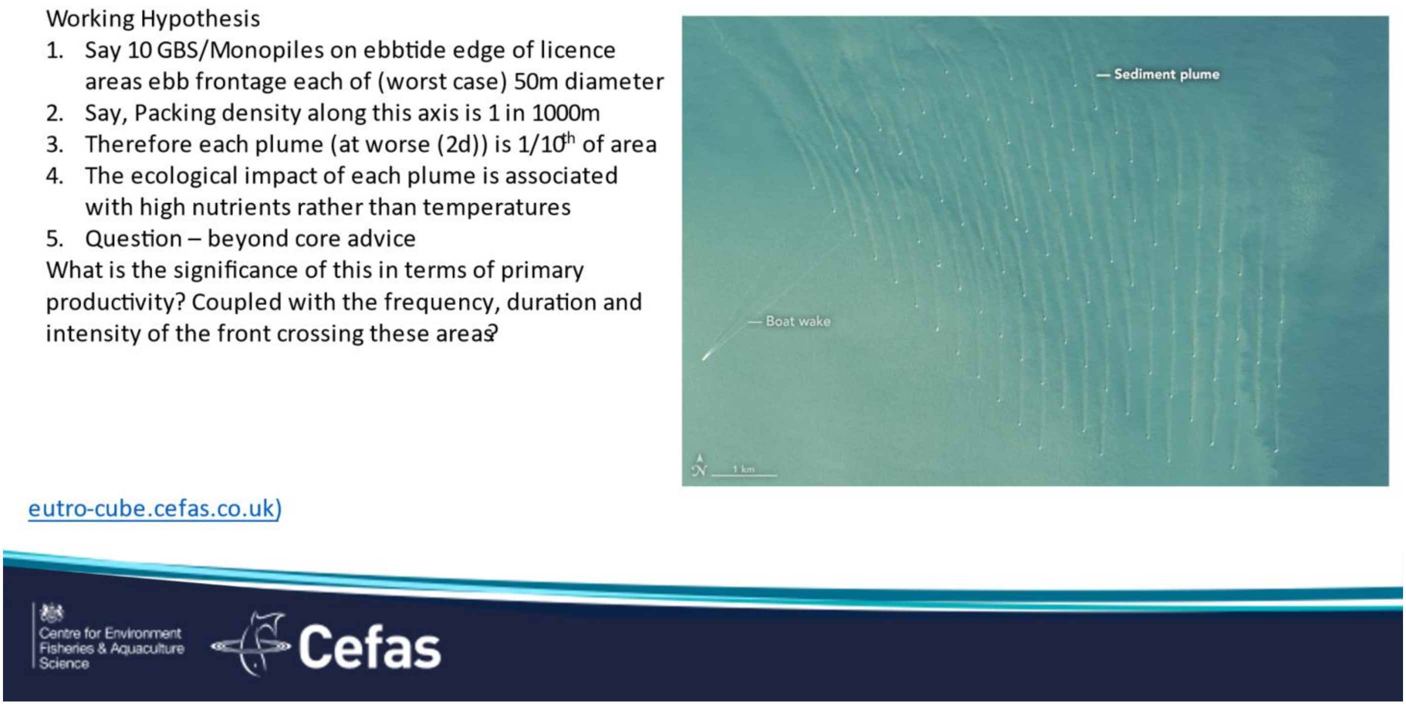

Figure 3. Image showing the formation of sediment plumes in the lee of ofshore windfarm turbines

2.3 Summary of Concerns

Based on recent research, there is the potential for large-scale changes to annual primary productivity due to the presence of the Hornsea Four array, either alone and/or in-combination with a cluster of OWFs, due to impacts on the Flamborough Front. Furthermore, changes to the Flamborough Front could have far-reaching and long-term consequences that affect the function of protected areas such as the Flamborough Head SAC, Flamborough and Filey Coast SPA and Southern North Sea SAC.

2.4 Potential Mitigation and Monitoring Requirements

We recognise that the nature and extent of these changes are difficult to quantify and therefore assess. Consequently, we advise that Hornsea 4 seek to reduce the risks as far as possible.

Key to this would be to reduce the MDS for foundations structures within the Hornsea Four array as much as possible, or removal of GBS as an option (i.e. using monopiles in place of the larger GBSs). There may also be merit in further consideration of the placement of structures within the developable area to reduce the potential for the effects of individual turbines acting in combination with each other.

Again, it will be important to establish a monitoring programme to record any changes to stratification and primary productivity, which would require surveys pre-construction, post-construction, and for the lifetime of the project. This should include “trigger points” to allow interventions/remediation if required.

Lastly, we would advise that the impacts discussed above will need further consideration in the context of the HRA and MCZ assessments.

References

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