NORTH FALLS

Offshore Wind Farm

Marine Conservation Zone Assessment

Preliminary MCZA Stage 1 Assessment

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MARINE CONSERVATION ZONE ASSESSMENT

May 2023

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Contents

Tables

Plates

Appendices (Volume III)

Appendix 1 MCZ Screening

Appendix 2 Sensitivity ranges

Appendix 3 In Principle Measures of Equivalent Environmental Benefit Review

Glossary of Acronyms

AoO	Advice on Operations
BCRC	Blackwater, Crouch Roach and Colne (Estuaries MCZ)
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
ECR	Export cable route
EIA	Environmental Impact Assessment
EMF	Electromagnetic field
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
FOCI	Features of conservation interest
GBS	Gravity based structure
GGOW	Greater Gabbard Offshore Windfarm
GWF	Galloper Windfarm
HRA	Habitats Regulations Assessment
INIS	Invasive non-indigenous species
INNS	Invasive non-native species
MAG	Single magnetometer
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder
MCAA	Marine and Coastal Access Act (2009)
MCZ	Marine Conservation Zone
MCZA	Marine Conservation Zone Assessment
MEEB	Measures of Equivalent Environmental Benefit
MMO	Marine Management Organisation
MPA	Marine Protected Areas
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
O&M	Operation and maintenance
OSP	Offshore Substation Platform
OWF	Offshore Windfarm
PAH	Polyaromatic hydrocarbons
PCB	Polychlorinated biphenyls
PEIR	Preliminary Environmental Information Report
PEMP	Project Environmental Management Plan
PINS	Planning Inspectorate
SAC	Special Area of Conservation
SACO	Supplementary Advice on Conservation Objectives
SBP	Sub-bottom profiler
SNCB	Statutory Nature Conservation Body

SoS	Secretary of State
SSC	Suspended sediment concentration
SSS	Side scan sonar
TBT	Tributyltin
TWT	The Wildlife Trusts
UXO	Unexploded ordnance
WTG	Wind turbine generator
ZoI	Zone of Influence

Glossary of Terminology

Array areas	The two distinct offshore wind farm areas (including the 'northern array area' and 'southern array area') which together comprise the North Falls offshore wind farm.
Array cables	Cables which link the wind turbine generators with each other and the offshore substation platform(s).
Bathymetry	Topography of the seabed
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and information to support the HRA
Interconnector cable	Cable between the northern and southern array areas
Interconnector cable corridor	The corridor of the seabed between the northern and southern array areas within which the interconnector cable will be installed
Intertidal	Area on a shore that lies between Lowest Astronomical Tide (LAT) and Highest Astronomical Tide (HAT)
Landfall	The location where the offshore cables come ashore.
Landfall search area	Locations being considered for the landfall, comprising the Essex coast between Clacton-on-Sea and Frinton-on-Sea within the PEIR.
Offshore cable corridor	The corridor of seabed from array areas to the landfall within which the offshore export cables will be located.
Offshore export cables	The cables which bring electricity from the array areas to the landfall.
Offshore project area	The overall area of the array areas, interconnector cable corridor, offshore substation platform(s) and the offshore cable corridor.
Offshore substation platform(s)	Fixed structure(s) located within the array areas, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable voltage for export to shore via offshore export cables.
Sandwave	Bedforms with wavelengths of 10 to 100m, with amplitudes of 1 to 10m
Scour protection	Protective materials to avoid sediment being eroded away from the base of the wind turbine generator foundations and offshore substation platform foundations as a result of the flow of water.
The Applicant	North Falls Offshore Wind Farm Limited (NFOW)
The Project or 'North Falls'	North Falls Offshore Wind Farm, including all onshore and offshore infrastructure.
Wind turbine generator	Power generating device that is driven by the kinetic energy of the wind

1 Introduction

1. The purpose of this preliminary Marine Conservation Zone Assessment (MCZA) Stage 1 Report is to provide information to inform consultation on whether the proposed North Falls offshore wind farm (hereafter "North Falls" or "the Project") is capable of affecting (other than insignificantly) the features and conservation objectives of the Marine Conservation Zones (MCZs) screened into the MCZA (see Appendix 1). The MCZs screened in are the Blackwater, Crouch, Roach and Colne Estuaries (BCRC) MCZ; the Kentish Knock East MCZ; and the Orford Inshore MCZ.

2. The BCRC Estuaries MCZ and the Orford Inshore MCZ do not overlap with the Project boundary however they lie within the potential Zone of Influence (ZoI) of the works. The south array of North Falls overlaps the Kentish Knock East MCZ by 8.17km^2.

3. The MCZA is a requirement of Section 126 of the Marine and Coastal Access Act (2009) (MCAA), which places specific duties on the regulating authority (i.e., the Marine Management Organisation (MMO) for marine licence applications and the Secretary of State (SoS) for Development Consent Order (DCO) applications) which require consideration of MCZs when determining consent applications. As such, the MMO and SoS have incorporated the need to include a MCZA into their decision-making processes where any MCZ has the potential to be affected by a marine licensable activity.

4. This document is informed by guidance published by the MMO (2013) on how such assessments should be undertaken and by advice from the Statutory Nature Conservation Bodies (SNCBs) during consultation in the pre-application phase of North Falls. The MCZA has been undertaken based on the description of the Project provided within Section 5 of this report and Chapter 5 Project Description of the Preliminary Environmental Information Report (PEIR).

5. The structure of this MCZA is as follows:

   - Section 1 (this section): Introduction to the document and the structure of the assessment;
   - Section 2: Legislation, Policy and Guidance – This section provides the legislative context and details the policy and guidance given by a number of Governmental, statutory and industry bodies in relation to the MCZA process;
   - Section 3: Overview of the MCZ assessment process – Provides and overview of the MCZA process and the approach taken by The Applicant;
   - Section 4: Consultation – Provides a summary of the consultation undertaken with respect to the MCZA including stakeholder comments and The Applicant's responses;
   - Section 5: Project Description – An outline of North Falls is given with regard to the location of the project infrastructure and its construction, operation and maintenance (O&M), and decommissioning;
   - Section 6: MCZ Baseline – A description of the BCRC Estuaries MCZ, the Kentish Knock East MCZ and the Orford Inshore MCZ, including their

protected features and conservation objectives and a description of the location of protected features in relation to the offshore project area, incorporating the site specific survey data that has been collected;

- Section 7: Screening Conclusions – This section summarises the screening process and outcomes that have been consulted on through the Evidence Plan Process (EPP). The screening report is provided in Appendix 1;
- Section 8: Stage 1 Assessment – This section provides the stage 1 assessment for all three MCZs that have been screened into the assessment. An assessment of cumulative impacts with other plans and projects is also provided; and
- Section 9: Conclusion – A conclusion to the MCZA is provided with respect to the conservation objectives of each MCZ.

2 Legislation, policy and guidance

2.1 Marine & Coastal Access Act 2009 (MCAA)

6. The MCAA establishes a range of measures to manage the marine environment including establishing MCZs. Sections 125 and 126 of the MCAA place specific duties on the MMO relating to MCZs and marine licence decision making. This is because Section 126 applies where;

> (a) a public authority has the function of determining an application (whenever made) for authorisation of the doing of an act, and
>
> (b) the act is capable of affecting (other than insignificantly)
>
> (i) the protected features of an MCZ;
>
> (ii) any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependent.

7. Natural England has responsibility under the MCAA to give advice on how to further the conservation objectives for an MCZ, identify the activities that are capable of affecting the designated features and the processes which they are dependent upon.

2.1.1 National Policy Statements

8. The assessment of potential impacts upon MCZs has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to the project are:

- Overarching National Policy Statement for Energy (EN-1) (DECC, 2011a),
- Draft Overarching NPS for Energy (EN-1) (BEIS, 2021a), and
- Draft NPS for Renewable Energy Infrastructure (EN-3)[1] (BEIS, 2021b).

9. The specific assessment requirements for the MCZs, as detailed in the NPS, are summarised in Table 2.1 together with an indication of the section of the report where each is addressed.

Table 2.1 NPS assessment requirements

NPS Requirement	NPS Reference	Report reference
Overarching NPS for Energy (EN-1)		
Marine Conservation Zones (MCZs) (Marine Protected Areas in Scotland), introduced under the Marine and Coastal Access Act 2009, are areas that have been designated for the purpose of	5.3.12	Consideration to the Marine and Coastal Access Act 2009 has been incorporated throughout this report.

[1] No reference to MCZ is provided in EN-3 (DECC, 2011b)

NPS Requirement	NPS Reference	Report reference
conserving marine flora or fauna, marine habitats or types of marine habitat or features of geological or geomorphological interest. The protected feature or features and the conservation objectives for the MCZ are stated in the designation order for the MCZ, which provides statutory protection for these areas implemented by the MMO (see paragraph 1.2.2). As a public authority, the IPC is bound by the duties in relation to MCZs imposed by Sections 125 and 126 of the Marine and Coastal Access Act 2009.		
Draft Overarching NPS for Energy (EN-1)		
The applicant should be particularly careful to identify any effects of physical changes on the integrity and special features of Marine Protected Areas (MPAs). These could include MCZs, candidate marine Special Areas of Conservation (SACs), coastal SACs and candidate coastal SACs, coastal Special Protection Areas (SPAs) and potential coastal SPAs, Ramsar sites, Sites of Community Importance (SCIs) and potential SCIs and SSSIs.	5.6.9	Section 8 provides an assessment of the impacts against MCZs, with effects on the site integrity identified. Effects on European sites are assessed in the Report to Inform Appropriate Assessment. Effects on Sites of Special Scientific Interest (SSSI) are assessed in Chapter 23 Onshore ecology, of the PEIR.
Draft NPS for Renewable Energy Infrastructure (EN-3)		
Assessment of impacts on offshore ecology, biodiversity and the physical environment should be undertaken by the applicant for all stages of the lifespan of the proposed offshore wind farm and in accordance with the appropriate policy for offshore wind farm EIAs, HRAs and MCZ assessments (Sections 4.2 and 5.4 of EN-1).	2.24.5	The assessment (Section 8) encompasses consideration of impacts across all stages of the lifespan of North Falls.
With increasing deployment of offshore wind farms, cumulative environmental impacts upon HRA sites and MCZs may not be able to be addressed by mitigation alone, therefore compensation measures may be required where adverse effects on site integrity and/or on conservation objectives cannot be ruled out. In such cases, derogation for Imperative Reasons of Overriding Public Interest (IROPI) and associated compensatory measures under the Habitats Regulations, or derogation where the benefit to the public clearly outweighs the risk of damage to the environment and associated measures of	2.24.12	Appendix 2 provides a review of potential MEEB for the Project. A full derogation case will be submitted with the DCO application, if required.

NPS Requirement	NPS Reference	Report reference
equivalent environmental benefit (MEEB) under Marine and Coastal Access Act, may be necessary to allow deployment to continue.		
An assessment of the effects of installing cable across the intertidal zone should follow The Crown Estate's cable route protocol and include information, where relevant, about: • any alternative landfall sites that have been considered by the applicant during the design phase and an explanation for the final choice • any alternative cable installation methods that have been considered by the applicant during the design phase and an explanation for the final choice • potential loss of habitat • disturbance during cable installation, maintenance/repairs and removal (decommissioning) • increased suspended sediment loads in the intertidal zone during installation and maintenance/repairs • predicted rates at which the intertidal zone might recover from temporary effects, based on existing monitoring data • Protected sites (e.g. HRA sites, MCZs and SSSIs)	2.27.3	Site selection of the North Falls offshore cable corridor took into consideration The Crown Estate's cable route protocol (see PEIR Chapter 4 Site selection and assessment of alternatives). PEIR Chapter 10 Benthic and Intertidal Ecology provides an assessment of the effects of the Project on the intertidal zone. No intertidal habitats are screened into this MCZA.
The applicant should follow The Crown Estate's cable route protocol. Assessment of the effects on the subtidal environment should include: • loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes • environmental appraisal of inter-array and export cable routes and installation/maintenance methods, including predicted loss of habitat due to predicted scour and scour protection • habitat disturbance from construction and maintenance/repair vessels' extendible legs and anchors	2.30.2	Site selection of the North Falls offshore cable corridor took into consideration The Crown Estate's cable route protocol (see PEIR Chapter 4 Site selection and assessment of alternatives). The relevant effects on the subtidal environment have been assessed in Section 8.

NPS Requirement	NPS Reference	Report reference
• increased suspended sediment loads during construction and from maintenance/repairs • predicted rates at which the subtidal zone might recover from temporary effects • potential impacts from EMF on benthic fauna • impacts on protected sites (e.g. HRA sites and MCZs)		

2.2 Guidance

10. The MCZA gives consideration to the following guidance:

    - MMO (2013). Marine Conservation Zones and Marine Licensing guidance; and
    - Natural England (2022a, 2022b). Advice on Operations (AoO).
    - Planning Inspectorate (PINS) (2019). Advice Note Seventeen: Cumulative effects assessment.

11. Key information from the relevant policies and guidance document are explained below in Section 3,

12. The approach to the screening assessment has also been informed by advice from Natural England and other stakeholders provided through the EPP (see Section 4).

3 Overview of MCZ Assessment process

13. Guidance published by the MMO (2013) describes how MCZAs should be undertaken in the context of marine licensing decisions (note that there is no published PINS guidance or advice specifically covering MCZ Assessments for DCO applications). To undertake its marine licensing function, the MMO has introduced a three stage sequential assessment process for considering impacts on MCZs, in order for it to deliver its duties under Section 126 of the MCAA. Section 126 places specific duties on all public bodies in undertaking their licencing activities where they are capable of hindering the conservation objectives of an MCZ. The MCZA process is similar to, but separate from, the Habitats Regulations Assessment (HRA) process. The stages of MCZA are presented below.

3.1 Screening (Appendix I)

14. The screening process is required to determine whether Section 126 of the MCAA should apply to the application. All applications go through an initial screening stage to determine whether:

- the plan, project or activity is within or near to an MCZ;
- the plan, project or activity is capable of significantly affecting (without mitigation) (i) the protected features of an MCZ, or (ii) any ecological or geomorphological processes on which the conservation of the features depends.

15. Where it has been determined through screening that Section 126 applies, the application is assessed further to determine which subsections of Section 126 should apply through Stage 1 assessment and Stage 2 assessment.

3.2 Stage 1 Assessment (this report)

16. This Stage 1 Assessment will consider whether the conditions in Section 126 (6) of the MCAA can be met, to determine whether:

- there is no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ; and
- the MMO can exercise its functions to further the conservation objectives stated for the MCZ (in accordance with Section 125 (2)(a)).

17. This Stage 1 Assessment considers the extent of the potential impact of the plan or project on the MCZ in more detail. The Stage 1 Assessment looks at whether the plan or project could potentially affect the conservation objectives for the site, that is, impact the site so that the features are no longer in favourable condition, or prevent the features from recovering to a favourable condition. If mitigation to reduce identified impacts cannot be secured, and there are no other alternative locations, then the project will be considered under Stage 2 of the assessment process i.e. considering if there are other means of proceeding, the public benefit from the project and any measures of equivalent environmental benefit. More information on the Stage 2 assessment is provided in Section 3.3.

18. Within the Stage 1 Assessment, *"hinder"* will be considered as any act that could, either alone or in combination:

- in the case of a conservation objective of *"maintain"*, increase the likelihood that the current status of a feature would go downwards (e.g. from favourable to degraded) either immediately or in the future (i.e. they would be placed on a downward trend); or
- in the case of a conservation objective of *"recover"*, decrease the likelihood that the current status of a feature could move upwards (e.g. from degraded to favourable) either immediately or in the future (i.e. they would be placed on a flat or downward trend).

19. In order to determine if there is 'no significant risk of the activity hindering the achievement of the conservation objectives stated for the MCZ' the MMO (2013) guidance states "*this should take into account the likelihood of an activity causing an effect, the magnitude of the effect should it occur, and the potential risk any such effect may cause on either the protected features of an MCZ or any ecological or geomorphological process on which the conservation of any protected feature of an MCZ is (wholly or in part) dependant*."

20. The assessment to determine no significant risk of each activity facilitating achievement of the conservation objectives is set out below.

3.2.1 Assessment of risk to conservation objectives

3.2.1.1 Likelihood of an activity causing an effect

21. In order to determine likelihood of an activity causing an effect, the sensitivity of the protected features of the MCZs has been determined using Natural England's AoO, which indicates the sensitivity of each receptor to relevant pressures. Specifically, the sensitivity range of the biotopes associated with each protected feature has been determined in relation to relevant pressures, taking the highest sensitivity as a worst-case scenario. The sensitivity ranges relevant to this assessment are available in Appendix 2.

3.2.1.2 Magnitude of effect

22. For each effect, a magnitude has been assigned, providing a definition of the spatial extent, duration, frequency and reversibility of the effect considered (where applicable). The definitions of magnitude for the purpose of the MCZA are provided in Table 3.1.

Table 3.1 Definitions of magnitude

Magnitude	Definition
High	Fundamental, permanent / irreversible changes, over the whole receptor, and / or fundamental alteration to key characteristics or features of the particular receptors character or distinctiveness.
Medium	Considerable, long term (throughout project duration), over the majority of the receptor, and / or discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.
Low	Discernible, temporary (for part of the project duration) change, over a minority of the receptor, and / or limited but discernible alteration to key characteristics or features of the particular receptors character or distinctiveness.

Magnitude	Definition
Negligible	Indiscernible or barely discernible change for any length of time, and/or slight alteration over a small area of the receptor

3.2.2 Assessment against conservation objectives

23. Following determination of effect magnitude and receptor sensitivity the Stage 1 assessment considers the risk that the Project could hinder the conservation objectives for each MCZ, with consideration of Natural England's Supplementary Advice on Conservation Objectives (SACOs).

24. SACOs present attributes which are ecological characteristics or requirements of the designated species and habitats within a site. The listed attributes are considered to be those which best describe the site's ecological integrity and which, if safeguarded, will enable achievement of the Conservation Objectives. These attributes have a target which is either quantified or qualified depending on the available evidence (Natural England, 2021 and 2022c). A summary of the consideration or pressures against the relevant attributes are provided in Table 8.1, Table 8.2 and Table 8.5.

3.3 Stage 2 Assessment

25. Where it is required, the Stage 2 assessment considers the socio-economic impact of the plan or project together with the risk of environmental damage. There are three parts to the Stage 2 assessment process in respect of which the Applicant would have to satisfy the relevant authority:

- Demonstrate that there is no other means of proceeding which would create a substantially lower risk of hindering the achievement of the conservation objectives;
- Demonstrate that the benefit to the public in proceeding with the project clearly outweighs the risk of damage to the environment that will be created by proceeding with it; and
- Undertake, or make arrangements for the undertaking of, measures of equivalent environmental benefit (MEEB) for the damage the project will or is likely to have in or on the MCZ.

3.3.1 Measures of Equivalent Environmental Benefit

26. If the Stage 1 assessment identifies a significant risk of hindering the conservation objectives of the MCZs, an assessment of MEEB must also be included in the MCZA.

27. Based on consultation through the EPP and the conclusions of this preliminary MCZA, the Applicant recognises that it is possible the Project's activities could hinder the conservation objectives of the Kentish Knock East MCZ (see Section 8.2). , A review of potential MEEB options is provided in Appendix 3, without prejudice of the final conclusions of the MCZA. Consultation feedback on this preliminary Stage 1 Assessment will be considered and the MCZA updated for the DCO application.

3.4 Cumulative effects

28. The MCAA does not provide any explicit legislative requirement for consideration of cumulative effects on the protected features of MCZs. However, the MMO guidelines (MMO, 2013) state that the MMO considers that in order for the MMO to fully discharge its duties under Section 69 (1) of the MCAA, cumulative effects must be considered.

29. PINS Advice Note Seventeen (PINS, 2019) provides guidance on plans and projects that should be considered in the Cumulative Effects Assessment (CEA) including:

- Projects that are under construction;
- Permitted applications, not yet implemented;
- Submitted applications not yet determined;
- Projects on the PINS Program of Projects;
- Development identified in relevant Development Plans, with weight being given as they move closer to adoption and recognising that much information on any relevant proposals will be limited; and
- Sites identified in other policy documents as development reasonably likely to come forward.

30. Only projects which are reasonably well described and sufficiently advanced to provide information on which to base a meaningful and robust assessment are included in the cumulative assessment.

31. Projects that are sufficiently implemented during the site characterisation for North Falls are considered as part of the baseline. Offshore cumulative impacts may come from interactions with the following activities and industries:

- Other offshore wind farms;
- Aggregate extraction and dredging;
- Licensed disposal sites;
- Navigation and shipping;
- Subsea cables and pipelines;
- Potential port/harbour development;
- Oil and gas activities; and
- Fisheries management areas.

32. Plans and projects that existed at the time of the relevant MCZ designation or the latest status reports (whichever is most recent) are considered to be part of the baseline environment.

33. The assessment will present relevant cumulative effects of projects based on their stage of development using the tiered approach as devised by Natural England (Natural England and Defra, 2022; shown in Table 3.1 of Appendix 1).

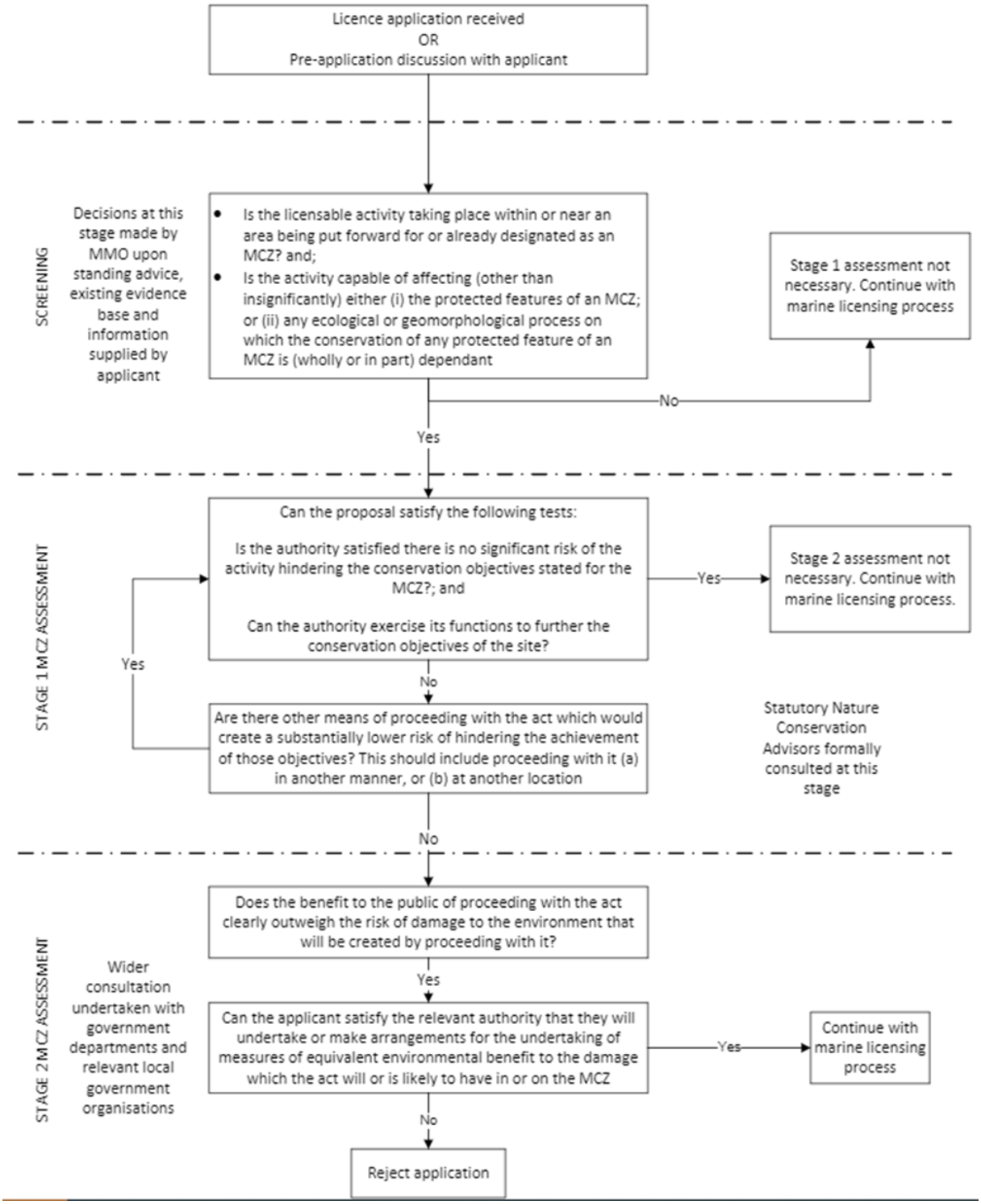

Plate 3-1 Flow chart summary of the MCZ Assessment process used by the MMO during marine licence determination (MMO, 2013).

4 Consultation

34. Consultation undertaken with SNCBs and other stakeholders in relation to the MCZA process is provided in this section.

4.1 Scoping

35. Consultation has been undertaken with the appropriate authorities and stakeholders as part of the scoping stage of the EIA process. The Scoping Report (Royal HaskoningDHV, 2021) was submitted to the Planning Inspectorate on 19th July 2021 and a Scoping Opinion (PINS, 2021) was received 26th August 2021. Scoping established the potential impacts of North Falls to be assessed by the EIA (and by association the MCZA).

4.2 Evidence Plan

36. The EPP is a non-statutory, voluntary process that aims to encourage upfront agreement on what information an applicant needs to supply to the Planning Inspectorate as part of a DCO application. It aims to ensure EIA, HRA and MCZA requirements are met and to reduce the risk of major infrastructure projects being delayed at (or before) the examination phase of the DCO application process.

37. The EPP includes consultation through a Seabed Expert Topic Group (ETG) which focuses on issues related to marine geology, oceanography and physical processes; benthic ecology; and fish and shellfish ecology. The Seabed ETG aims to agree the relevance, appropriateness and sufficiency of baseline data, key issues for the EIA, and the impact assessment approach (including MCZA). Stakeholders represented on the Seabed ETG are:

- Natural England;
- MMO; and
- The Wildlife Trusts (TWT).

38. A draft of the MCZA Screening Report was made available for consultation through the Seabed ETG on 16th November 2021. The screening assessment has been updated based on the comments received (see Section 2 of Appendix 1).

4.3 Summary of relevant consultation responses

39. The consultation responses relevant to the MCZA which have been received to date are summarised in Table 4.1.

Table 4.1 Consultation responses

Consultee	Date / Document	Comment	Response / where addressed in the MCZA
Natural England	26/05/2021 Written response regarding benthic survey methodology	It is worth noting that should the geophysical survey reveal more potential habitat changes than expected, then we would expect to see an increase in the number of sample stations to ensure that all potential habitats are sampled and mapped. In turn, this will also inform the impact assessment on the full range of habitats. This is particularly important within MPAs.	Additional sample stations were included in the Kentish Knock East MCZ in response to feedback from Natural England.
Natural England	26/05/2021 Written response regarding benthic survey methodology	If a development is planned within an MPA, site characterisation also needs to consider potential impacts of the development that extend outside of the MPA, which may require additional survey work to increase confidence and precision on location and extent of the habitats and species present. This might entail more detailed geophysical and/or ground truthing surveys (e.g. video) to assist in locating and defining designated feature boundaries. Therefore, we would recommend that data of a sufficient resolution are gathered in order to clearly understand which features are present and likely to be impacted by the proposals.	
Natural England	26/05/2021 Written response regarding benthic survey methodology	Kentish Knock MCZ, for example, may require an increase in sample site locations, unless the habitat is demonstrated to be homogenous from the geophysical data. Furthermore, it will be necessary to understand development impacts by feature, hence, subtidal coarse sediment, mixed sediment and sand will need to be delineated. It should also be ensured that there are sufficient data captured where the cable route abuts Margate and Long Sands SAC to ensure that impacts on this site can be determined and assessed. These data should be put into context with existing MPA data available on Magic mapper or here: Habitat and species open data: https://data.gov.uk/dataset/bfc23a6d-8879- 4072-95ed-125b091f908a/marine-habitats-and-species-open-data	
Natural England	16/08/2021 Scoping Opinion	Section 2.5.1.3 Point 188 As stated in our advice on a similar situation with regard to the Hornsea Project Three OWF NSIP and Markham's Triangle MCZ, Natural England would expect further mitigation measures to be considered by North Falls, whereby all array infrastructure is removed from within Kentish Knock East MCZ. If it not possible to exclude the works from this MCZ then there may be a need to discuss measures of equivalent environmental benefit (MEEB) through the evidence plan process. Further consideration should be given throughout the EIA process and a consideration of MEEB provided, if required.	A review of mitigation options is ongoing. For this assessment a worst-case scenario of cable protection being left in situ on decommissioning is included. MEEB has been discussed in Section 3.3.1 and Appendix 3.
Natural England	16/08/2021 Scoping Opinion	Section 2.13.1.4 Para 384	During the site selection process, the southern array area was refined. No crossing of the existing BritNed cable by

Consultee	Date / Document	Comment	Response / where addressed in the MCZA
		Overlapping sub-sea cables in the southern array area could lead to the placing of cable crossings/protection within the Kentish Knock East MCZ, which partially overlaps with the southern array. The potential impact of cable crossings/protection in the Kentish Knock MCZ will need to be assessed.	North Falls array cables will be required in the Kentish Knock East MCZ. The potential impact of infrastructure placed within Kentish Knock East MCZ, which includes a worst-case scenario for cable protection as a result of unburied cables, has been assessed in Section 8.1.3.3.
Natural England	16/08/2021 Scoping Opinion	Section 2.13.1.4 Para 386 Proposed cables in the study area. The potential impact of cable crossings/protection in the Kentish Knock MCZ will need to be assessed.	
The Planning Inspectorate	26/08/2021 Scoping Opinion	Para 188 Kentish Knock East Marine Conservation Zone (MCZ). The Inspectorate notes that part of the Proposed Development is situated within the Kent Knock East Marine MCZ. If this area is not to be avoided, the ES will need to precisely quantify the impacts on the protected features of the site to inform an MCZ assessment, including the potential impact of cable crossings / protection.	The potential impact of infrastructure placed within Kentish Knock East MCZ has been assessed in Section 8.1.3.3.

5 Project description

5.1 Offshore scheme summary

40. North Falls is an extension to the Greater Gabbard Offshore Wind Farm (GGOW), located in the Outer Thames Estuary area of the southern North Sea.

41. Like GGOW, the North Falls array area is split into two boundaries (the north array and south array) to facilitate a shipping route. Within these boundaries, wind turbine generators (WTGs), array cables and offshore substation platform(s) (OSP) will be installed. The two array areas have a combined area of 150km^2. The array cables will also include an interconnector cable between the north and south array areas.

42. The electricity will be connected to the shore by export cables which will be located within an offshore cable corridor from the south array area to the landfall search area between Clacton-on-Sea and Frinton-on-Sea. The precise landfall location between these two settlements will be subject to further site selection, considering relevant consultation feedback and initial EIA and engineering survey data.

43. The North Falls array areas, interconnector cable corridor and offshore cable corridor are collectively referred to as the 'offshore project area'.

44. As a worst-case scenario, it is assumed that 10% of the Project's infrastructure could be located in the section of the south array that overlaps the Kentish Knock East MCZ.

45. The following sections provide an overview of the offshore project description. Further information is provided in the PEIR Chapter 5. The worst-case scenario parameters of relevance to the MCZA are outlined in Section 5.6 below.

5.2 Pre-installation works

46. The worst-case scenario takes into account the potential for pre-installation works, such as:

- Boulder clearance
- Prelay grapnel run
- Sandwave levelling

5.3 Foundations

47. The foundation types currently being considered for the WTGs and OSPs are:

- Monopiles;
- Mono suction buckets;
- Gravity base system (GBS);
- Jacket with 3 or 4 legs attached to the seabed by:
  - Pin-piles;
  - Suction buckets; and
  - Gravity/ballast.

48. The decision on the types of foundations used to support the WTGs and OSPs will be made post-consent. Foundation types will be selected following detailed design, based on suitability of the ground conditions, water depths and WTG models. There may be only one type used, or a combination of foundation types may be used across the array areas.

5.4 Offshore export cables

5.4.1 Cable burial

49. Array, interconnector and export cables will be buried below the seabed where practicable. The installation method and target burial depth will be defined post consent based on a cable burial risk assessment, considering ground conditions as well as the potential for impacts upon cables such as from trawling and vessel anchors. It is anticipated that the offshore cables will be installed via either ploughing, jetting, trenching, or a combination of these techniques, depending on ground conditions along the specific cable route. Other options would be considered, where appropriate, such as mass flow excavation.

5.4.2 External cable protection

50. In some cases it may be necessary to use alternative methods than burial to provide the adequate degree of protection for the cables. Remedial protection measures could include rock or gravel burial, concrete mattresses, flow energy dissipation devices, dredged sandy material, protective aprons or coverings, and bagged solutions (geotextile sand containers, rock-filled gabion bags or nets, grout bags filled with material sourced from the site or elsewhere).

5.5 Offshore construction programme

51. The final design (e.g. number of WTGs, platform, cables, etc.) and supply chain will affect the construction programme, as well as weather conditions during construction.

52. Indicative programmes are provided below in Table 5.1. Offshore working hours during construction are anticipated to be 24/7.

Table 5.1 Indicative offshore construction programme

	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Substation installation and commissioning																
Export cable installation																
Foundation installation																
Array/interconnector cable installation																
WTG installation																
First generation																
WTG and foundation commissioning																

5.6 Worst case scenario

Table 5.2 North Falls worst case scenario relating to seabed impacts

Impact	Worst case	Notes
Construction		
Temporary physical disturbance - array areas	Seabed preparation area for GBS of 70m^2 x 72 WTG) = 277,088m^2. Two OSP seabed preparation = 6,637m^2 (2 platforms with 65m preparation diameter) Array/interconnector cable seabed preparation – 228km length with average 24m disturbance width = 5,472,000m^2 Vessel jack up assuming 6 jack up locations per WTG (275m^2 per jack up leg x 6 legs) = 732,600m^2 Anchoring during WTG and OSP installation = 344,529m^2 (based on vessels with 8 anchors; and 5 anchoring events per WTG/OSP) Anchoring during array/interconnector cable installation = 144,077m^2 (based on 9 anchors per vessel and 264 anchoring events) Boulder clearance – 25 boulders of up to 5m diameter = 491m^2 Worst case scenario total disturbance footprint in the array areas = 6.9km^2 **Of the above works, the following could be within the Kentish Knock East MCZ:** Seabed preparation area for GBS - 70m preparation diameter x 7 WTGs) = 26,939m^2. Array/interconnector cable installation – 22.8km length with average 24m disturbance width = 574,200m^2 Vessel jack up footprints assuming 6 jack up locations per WTG - jack-up footprint per vessel = 275m^2 per leg x 6 legs x 7 WTGs= 69,300m^2 Anchoring = 48,861m^2 Boulder clearance = 50m^2 Worst case scenario total disturbance footprint in MCZ = 0.69km^2	Temporary disturbance relates to seabed preparation and Installation activities. The long term/ permanent footprint of infrastructure is assessed as an operational phase impact.
Temporary physical disturbance - cable corridor	Maximum temporary disturbance for seabed preparation within the offshore cable corridor = 6,019,200m^2 based on: • Maximum total export cable trench length of 250.8km. • Maximum width of temporary disturbance is approximately 24m Anchor placement = 297,826m^2 Boulder clearance = 295m^2 (up to 15 boulders of 5m diameter) HDD exit – up to 8 bores (4 cables + 4 contingency). Within the worst-case scenario footprint for the seabed preparation area Total disturbance footprint – 6.32km^2.	As above, temporary disturbance relates to seabed preparation and Installation activities. The long term/ permanent footprint of infrastructure is assessed as an operation phase impact.
Increased suspended sediment concentrations (SSC) – foundation seabed preparation	Seabed preparation area for GBS of 70m^2 x 72 WTG x average 5m sediment depth = 1,385,442m^3 Two offshore substation platforms seabed preparation x average 5m sediment depth = 33,183m^3 Worst case scenario volume for foundations = 1.4Mm3	
Increased SSC – array/ interconnector cable installation	Array/interconnector cable seabed preparation – 228km length with average 24m disturbance width x average 5m sediment depth = 27,360,000m^3 Array/interconnector cable burial – 228km length with average 1m trench width x average 1.2m burial depth = 273,600m^3	
Increased SSC – drill arisings in the array areas	Drill arisings at 10% of WTGs = 38,132.7m^3 (based on four WTGs, i.e. 10% of 42 of the largest turbines which is the worst case scenario) Drill arisings at 1 x monopile OSPs = 10,687.7m^3 (based on 50% of the OSPs needing drilling) Total = 48,820.3m^3	Drill arising would not occur in the event that the GBS is used and therefore this parameter cannot be added to the maximum seabed

Impact	Worst case	Notes
		levelling for GBS described above.
Increased SSC – export cable installation	Export cable seabed preparation – 250.8km length with average 24m disturbance width x average 5m sediment depth = 30,096,000m^3 Export cable burial – 250.8km length with average 1m trench width x average 1.2m burial depth = 300,960m^3	
Remobilisation of contaminated sediments	Maximum suspension of sediments as described above. No significant contaminated sediments were recorded in the offshore project area. See Chapter 9 Marine Water and Sediment Quality for more detail.	
Effects on sediment transport	Seabed preparation area for GBS of 70m^2 x 72 WTG x average 5m sediment depth = 1,385,442m^3 Two offshore substation platforms seabed preparation x average 5m sediment depth = 33,183m^3 Array/interconnector cable seabed preparation – 228km length with average 24m disturbance width x average 5m sediment depth = 27,360,000m^3 Export cable seabed preparation – 250.8km length with average 24m disturbance width x average 5m sediment depth = 30,096,000m^3	The primary pathway for impact relates to the volume of sediment removed and therefore the worst-case scenario is linked to the scenario with the greatest volume of dredged sediment rather than the area over which sandwave levelling occurs. The disposal of any sediment that would be disturbed or removed during sandwave levelling would occur within the North Falls offshore project area.
Underwater noise and vibration	Maximum hammer energy: • 3,000kJ (pin-piles) • 6,000kJ (monopiles)	
Introduction of Invasive Non-Native Species (INNS)	Indicative port location: Harwich or Lowestoft Average of 3 to 4 vessel movements per day	Construction port and vessel routes to be determined post consent. Embedded mitigation described in Section 5.7.
Operation & maintenance (O&M)		
Temporary physical disturbance	Unplanned repairs and reburial of cables may be required during O&M, the following estimates are included: • Reburial of c. 5km of array/interconnector cable is estimated over the life of the project (24m disturbance width) = 120,000m^2 • Reburial of c. 5km of export cable is estimated over the life of the project (24m disturbance width) = 120,000m^2 • Five array/interconnector cable repairs are estimated over the project life. 600m section removed x 24m disturbance width = 72,000m^2 • Four export cable repairs are estimated over the project life. 600m section removed x 24m disturbance width = 57,600m^2 Anchored vessels placed during the no. of cable repairs include above = 4,914m^2 Maintenance of offshore infrastructure would be required during O&M. An estimated 180 major component replacement activities may be required per year, using jack up vessels and/or anchoring = 297,000m^2 An estimated 10% of the above works could be within the Kentish Knock East MCZ.	Each O&M activity would be relatively short term and it is likely that the requirements for maintenance would be spread over the project life, with recovery commencing once the activity is complete.

Impact	Worst case	Notes
Permanent/ long term habitat loss - array areas	WTG: Total worst case WTG footprint with scour protection, based on 72 x 65m GBS diameter = 238,918m^2 Scour protection - assumes all WTGs have scour protection area of up to 83,774m^2 (excluding WTG foundation footprint) = 6,031,728m^2 Array/interconnector cable protection - Up to 45.6km of cable protection may be required in the unlikely event that array/interconnector cables cannot be buried (based on 20% of the length) x 6m cable protection width = 273,600m^2 Two offshore electrical platforms with scour protection = 149,012m^2 (74,506m^2 each) Worst case scenario total persistent footprint in the array areas = 6.69km^2 Of the above works, the following could be within the Kentish Knock East MCZ WTG footprint - 7 WTGs with GBS foundation diameter of 65m = 23,228m^2. Scour protection - assumes all WTGs have scour protection of up to 83,774m² (excluding WTG foundation footprint) x 7 WTGs = 586,418m^2 Array/interconnector cable protection - 20% of the cable within the MCZ (20% of 23km) x 6m width = 27,360m^2 Worst case scenario total disturbance footprint in MCZ = 0.64km^2	
Permanent/ long term habitat loss - cable corridor	Export cable protection - Up to 25km of cable protection may be required in the unlikely event that export cables cannot be buried (based on 10% of the length) x 6m cable protection width = 150,480m^2	
Suspended sediment	Unplanned repairs and reburial of cables may be required during O&M, the following estimates are included: • Reburial of c. 5km of array/interconnector cable is estimated over the life of the project (24m disturbance width) x average 1.2m depth = 144,000m^3 • Reburial of c. 5km of export cable is estimated over the life of the project (24m disturbance width) x average 1.2m depth = 144,000m^3 • Five array/interconnector cable repairs are estimated over the project life. 600m section removed x 24m disturbance width x average 1.2m depth = 86,400m^3 • Four export cable repairs are estimated over the project life. 600m section removed x 24m disturbance width x average 1.2m depth = 69,120m^3 An estimated 10% of the above works could be within the Kentish Knock East MCZ.	Each O&M activity would be relatively short term and it is likely that the requirements for maintenance would be spread over the project life, with suspended sediments becoming rapidly redeposited.
Remobilisation of contaminated sediments	Maximum suspension of sediments as described above. No significant contaminated sediments were recorded in the offshore project area. See Chapter 9 Marine Water and Sediment Quality for more detail.	
Effects on sediment transport	72 WTG and 2 OSP Volume of array/interconnector cable protection = 383,040m^3 Volume of export cable protection = 210,672m^3	
Underwater noise and vibration	WTG operational noise as described in Appendix 12.2 Underwater Noise Modelling Report.	
Colonisation of foundations and cable protection	72 WTG and 2 OSP Volume of array/interconnector cable protection = 383,040m^3 Volume of export cable protection = 210,672m^3	
Introduction of INNS	Potential for colonisation as above Average of 4 vessel movements per day	

Impact	Worst case	Notes
Electromagnetic fields	Array/interconnector cables: • Maximum cable length: 228km • Maximum voltage: 132kV • Minimum burial depth: 0.5m (average burial depth: 1.2m) • Up to 20% of total array/interconnector cable length requiring protection (up to 45.6km) Export cables: • Up to 4 cable circuits with 3x unbundled power cables per circuit • Maximum offshore cable length: 250.8km • Maximum voltage: up to 400kV • Minimum burial depth: 0.5m (average burial depth: 1.2m) • Up to 10% of total export cable length requiring protection (up to 25.1km)	Embedded mitigation described in Section 5.7.
Decommissioning		
	No decision has yet been made regarding the final decommissioning policy for the offshore project infrastructure. It is also recognised that legislation and industry best practice change over time. However, the following infrastructure is likely be removed, reused or recycled where practicable: WTGs including monopile, steel jacket and GBS foundations; OSPs including topsides and steel jacket foundations; and Offshore cables may be removed or left *in situ* depending on available information at the time of decommissioning. The following infrastructure is likely to be decommissioned *in situ* depending on available information at the time of decommissioning: Scour protection; Offshore cables may be removed or left *in situ*; and Cable protection. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. For the purposes of the worst-case scenario, it is anticipated that the impacts will be no greater than those identified for the construction phase.	

5.7 Mitigation

53. This section outlines the embedded mitigation relevant to the benthic and intertidal ecology assessment, which has been incorporated into the design of North Falls (Table 5.3).

Table 5.3 Embedded mitigation measures

Parameter	Mitigation measures embedded into North Falls design
Export cable route	The offshore cable corridor was selected in consultation with key stakeholders to select a route which minimised impacts on designated sites, such as avoiding MCZs. See Chapter 4 Site Selection and Assessment of Alternatives.
Scour protection	Following industry best-practice the Applicant will seek to minimise the use of scour protection. This will be secured through a Scour Protection and Cable Protection Plan that will be submitted for approval post consent.
Electromagnetic Fields (EMF)	The Applicant is committed to burying offshore export cables where practicable which reduces the effects of EMFs.
Micrositing	Should seabed obstacles (e.g. *Sabellaria* reef) be identified in the proposed WTG and/or OSP locations, and/or cable routes during the pre-construction surveys, micrositing would be undertaken where practicable, to minimise potential impacts.
Invasive Non-Native Species (INNS)	The risk of spreading INNS will be reduced by employing biosecurity measures in accordance with the following requirements: • International Convention for the Prevention of Pollution from Ships (MARPOL). The MARPOL sets out appropriate vessel maintenance;

Parameter	Mitigation measures embedded into North Falls design
	• The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which provide global regulations to control the transfer of potentially invasive species; and • The Environmental Damage (Prevention and Remediation) (England) Regulations 2015, which set out a polluter pays principle where the operators who cause a risk of significant damage or cause significant damage to land, water or biodiversity will have the responsibility to prevent damage occurring, or if the damage does occur will have the duty to reinstate the environment to the original condition.

6 MCZ Baseline

6.1 Blackwater, Crouch, Roach and Colne Estuaries MCZ

54. The BCRC Estuaries MCZ is located to the north of the Thames estuary on the Essex coast. It covers an area of 284km^2 and extends from the mean high water mark to where the estuary mouth joins the North Sea (Appendix 1, Figure 1.1).

6.1.1 Protected features

55. The BCRC Estuaries MCZ is designated for four protected features. These are:

- Intertidal mixed sediments
- Native oyster *Ostrea edulis* beds
- Native oyster *O. edulis*
- Clacton Cliffs and Foreshore

6.1.1.1 Habitats

6.1.1.1.1 Intertidal mixed sediments

56. Intertidal mixed sediments span across all areas of the MCZ including coastal locations and up-river. However, as stated in the screening report (Appendix 1), this feature will not be affected during construction, operation & maintenance or decommissioning of the Project. This feature is not considered further.

6.1.1.1.2 Native oyster beds

57. The BCRC Estuaries MCZ comprises the most important area for both wild and cultivated native oyster in the south-east region (Natural England, 2013).

58. As this MCZ is not located within the North Falls survey area, there was no evidence collected of the presence of native oyster beds. Furthermore, there is no reported data with accurate distribution of native oyster beds within the MCZ. Advice from Natural England to Defra (2013) states that due to sensitivities surrounding the commercial and ecological status of this habitat, their locations have not been reported.

6.1.1.2 Marine Species

6.1.1.2.1 Native oyster

59. As per native oyster beds.

6.1.1.3 Geology

6.1.1.3.1 Clacton Cliffs and Foreshore

60. The Clacton Cliffs and Foreshore are confined to a small area to the north of the MCZ. As stated in the screening report (Appendix 1), this feature will not be affected during construction, operation, maintenance or decommissioning of the Project. This feature is not considered further.

6.1.2 Conservation objectives

61. The site's conservation objectives apply to the MCZ and the individual species and/or habitat for which the site has been designated.

62. The conservation objective is that each of the protected features:

- are maintained in favourable condition if they are already in favourable condition

- be brought into favourable condition if they are not already in favourable condition

63. For each protected broad-scale habitat, favourable condition means that, within a zone:

- its extent is stable or increasing
- its structure and functions, its quality, and the composition of its characteristic biological communities (including diversity and abundance of species forming part or inhabiting the habitat) are sufficient to ensure that its condition remains healthy and does not deteriorate

64. Any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery.

65. For each species of marine fauna, favourable condition means that the population within a zone is supported in numbers which enable it to thrive, by maintaining:

- the quality and quantity of its habitat
- the number, age and sex ratio of its population

66. Any temporary reduction of numbers of a species is to be disregarded if the population is sufficiently thriving and resilient to enable its recovery.

67. Any alteration to a feature brought about entirely by natural processes is to be disregarded when determining whether a protected feature is in favourable condition.

68. Table 6.1 shows the features designated by the BCRC Estuaries MCZ.

Table 6.1 Protected features of the Blackwater, Crouch, Roach and Colne Estuaries MCZ (source: Defra, 2013)

Protected Feature	Type Of Feature	Management Approach
Intertidal mixed sediments	Broadscale marine habitat	Maintain in favourable condition
Native oyster beds	Feature of Conservation Interest	Recover to favourable condition
Native oyster	Feature of Conservation Interest	Recover to favourable condition
Clacton Cliffs and Foreshore	Feature of Geological Interest	Maintain in favourable condition

6.2 Kentish Knock East MCZ

69. The Kentish Knock East MCZ is located 12 nautical miles off the coastline in the outer Thames estuary (Appendix 1, Figure 1.1). It covers an area of approximately 96km^2.

70. The large majority of the Kentish Knock East MCZ is covered by subtidal mixed sediments (73.61km^2), with subtidal coarse sediment (14.96km^2) and subtidal sand along the easterly side (7.38km^2), with a band of subtidal mud down the centre of the zone, based on Natural England (2021) habitat mapping shown in Appendix 1, Figure 5.1.

6.2.1 Protected features

71. The MCZ feature map (Appendix 1, Figure 5.1) indicated that all three protected features are expected to occur within the North Falls zone of influence, and within the North Falls south array. These are:

- Subtidal sand
- Subtidal coarse sediments
- Subtidal mixed sediments

6.2.1.1 Subtidal sand

72. Four sediment samples were collected and characterised from within the MCZ itself. Of these, three sample locations were classed as circalittoral fine sand. Furthermore, a total of six sampling stations in the North Falls south array were classified as circalittoral fine sand. This biotope provides habitat for a range of benthos species including echinoderms, polychaetes and bivalves (Fugro, 2021 provided in PEIR Appendix 10.1).

6.2.1.2 Subtidal coarse sediments

73. Of the sediment samples collected in the area of overlap with the MCZ, none of them were characterised as subtidal coarse sediments. However, ST44 (shown in Figure 2.2 of PEIR Appendix 10.1), adjacent to the area of overlap, was classified as circalittoral coarse sediment. This biotope provides habitat for robust species of polychaete and bivalves such as *Aonides paucibranchiata* and *Kurtiella bidentata* as found in the Fugro (2021) survey.

6.2.1.3 Subtidal mixed sediments

74. Four sediment samples were collected and characterised from within the MCZ itself. Of these, one sample location was classed as subtidal mixed sediments. The biotope identified in the Fugro (2021) survey was polychaete-rich deep *Venus* community in offshore mixed sediments. A diverse community of polychaetes such as *Glycera lapidum* and *Mediomastus fragilis* are typical of this biotope.

6.2.2 Conservation objectives

75. The site's conservation objectives apply to the MCZ and the individual species and/or habitat for which the site has been designated.

76. The conservation objective is that for each of the protected features:

- so far as already in favourable condition, remain in such condition, and
- so far as not already in favourable condition, be brought into such condition, and remain in such condition.

77. "Favourable Condition", with respect to a habitat within this MCZ, means that:

- its extent is stable or increasing, and
- its structure and functions, its quality, and the composition of its characteristic biological communities are such to ensure that it remains in a condition which is healthy and not deteriorating.

78. The reference to the composition of the characteristic biological communities of a habitat includes a reference to the diversity and abundance of species forming part of, or inhabiting, that habitat. For the purposes of this MCZ, any temporary

deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery, and for the purpose of determining whether a protected feature is in favourable condition within the meaning of this designation, any alteration to that feature brought about entirely by natural processes is to be disregarded.

79. Table 6.2 shows the features designated by the Kentish Knock East MCZ.

Table 6.2 Protected features of the Kentish Knock East MCZ (source: Defra, 2019a)

Protected Feature	Type Of Feature	Management Approach
Subtidal sand	Broadscale marine habitat	Maintain in favourable condition
Subtidal coarse sediment	Broadscale marine habitat	Recover to favourable condition
Subtidal mixed sediments	Broadscale marine habitat	Recover to favourable condition

6.3 Orford Inshore MCZ

80. The Orford Inshore MCZ is located off the Suffolk coast, approximately 14km offshore from the Alde Ore Estuary (Appendix 1, Figure 1.1). It covers approximately 72km^2.

6.3.1 Protected features

81. The Orford Inshore MCZ is designated for:

- Subtidal mixed sediments.

6.3.1.1 Subtidal mixed sediments

82. Orford Inshore MCZ is dominated by habitats composed of subtidal mixed sediments. These sediments contain a mixture of different sized material from pebbles to finer silts and finer mud sediments (Defra, 2019b).

83. As the MCZ is not located within the North Falls survey area, there were no samples taken of subtidal mixed sediments within the zone. However, using information from Defra (2019b), it can be noted in the MCZ feature map that majority of the MCZ is covered in subtidal mixed sediments.

6.3.2 Conservation objectives

84. Natural England are currently in the process of developing a Conservation Advice package therefore there are no current conservation objectives available.

85. However, both Orford Inshore MCZ and Kentish Knock East MCZ share subtidal mixed sediments as a designated feature and have the same management approach of 'Recover to favourable condition'. They are both located in the southern North Sea approximately 37km apart. Kentish Knock East MCZ has therefore been used a proxy for the assessment.

86. Table 6.3 shows the features designated by the Orford Inshore MCZ.

Table 6.3 Protected features of the Orford Inshore MCZ (source: Defra, 2019b)

Protected Feature	Type Of Feature	Management Approach
Subtidal mixed sediments	Broadscale marine habitat	Recover to favourable condition

6.4 Supplementary Advice on Conservation Objectives

87. Natural England has provided Supplementary Advice on Conservation Objectives (SACOs) for the Blackwater, Crouch, Roach and Colne Estuaries (Natural England, 2022) and Kentish Knock East (Natural England, 2021). The SACOs provide further detail about the protected features' extent and distribution, structure, function and supporting processes. For these attributes, targets are provided and where possible quantified.

88. Natural England are currently in the process of developing a Conservation Advice package for Orford Inshore MCZ therefore there are no SACOs available.

89. The implications of North Falls on the specific attributes for the BCRC Estuaries, Kentish Knock East and Orford Inshore MCZs[2] protected features have been used to inform the MCZA Stage 1 Assessment presented in this report.

6.5 North Falls surveys

90. In order to provide site specific and up to date information on which to base the impact assessment and MCZA, surveys have been completed to characterise the seabed in the offshore array areas and the offshore cable corridor.

6.5.1 Project geophysical surveys

91. Site specific geophysical surveys were carried out in the offshore project area. Data were acquired using a multibeam echosounder (MBES), side scan sonar (SSS), sub-bottom profiler (SBP), single magnetometer (MAG), and single-channel sparker. Geophysical data were used to inform the environmental survey design. The surveys undertaken were:

- Geophysical survey of the north array, south array and interconnector route, May to August 2021; and
- Geophysical survey of the offshore cable corridor, May to August 2021.

6.5.2 Project benthic characterisation survey

92. A benthic characterisation survey was conducted by Fugro in 2021.

93. The survey was conducted in July 2021 and covered the North Falls array areas and offshore cable corridor. The survey included 46 sampling stations (out of a proposed 49), of which five were taken in Kentish Knock East MCZ. The sampling consisted of drop-down video and stills photography at each sampling station, along with macrofaunal and physico-chemical grab samples. Sediment chemistry samples were acquired at 26 of the sampling stations. The distribution of this sampling is illustrated in Figure 2.2 of PEIR Appendix 10.1 (Fugro survey report).

[2] The assessment for Orford Inshore MCZs uses Kentish Knock East MCZ as a proxy, as discussed in Section 6.3.2

6.5.3 Benthic habitat mapping

94. The distribution of EUNIS habitats and biotopes were mapped for the survey area of North Falls. A total of one habitat, two biotope complexes and seven biotopes were identified.

95. By combining grab samples with seabed video and photography and evaluating them against multivariate groups (derived from faunal multivariate analysis), EUNIS habitats and biotopes were assigned along sampling stations.

96. A technical report summarising the benthic ecology monitoring method and results is provided in Appendix 2**.**

7 Screening

97. The following tables summarise the screening exercise which is detailed in Appendix 1.

98. The pressure names are as taken from the Natural England's AoO.

7.1 Blackwater, Crouch, Roach and Colne Estuaries MCZ

Table 7.1 Screening of pressures for the BCRC Estuaries MCZ (✓: included in the Stage 1 Assessment, ✖: not included in the Stage 1 Assessment)

Potential Pressure (Scoping)	Pressure Name (AOO)	Construction	Operation & Maintenance	Decommissioning
Intertidal mixed sediments				
Scoped out see Appendix 1 (MCZ screening report).				
Clacton Cliffs and Foreshore				
Scoped out see Appendix 1 (MCZ screening report).				
Native oyster and oyster beds				
Increased SSC concentrations	Changes in suspended solids (water clarity) Smothering and siltation rate changes (Light)	✓	✓	✓
Re-mobilisation of contaminated sediments	Hydrocarbon & PAH contamination Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals) Transition elements & organo-metal (e.g. TBT) contamination	✓	✓	✓
Sediment deposition (smothering)	Smothering and siltation rate changes (Light)	✓	✓	✓
Introduction or spread of INNS	Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Electromagnetic fields	Scoped out see Appendix 1 (MCZ screening report).			

7.2 Kentish Knock East MCZ

Table 7.2 Screening of pressures for the Kentish Knock East MCZ (✓: included in the Stage 1 Assessment, ✖: not included in the Stage 1 Assessment)

Potential Pressure (Scoping)	Pressure Name (AOO)	Construction	Operation & Maintenance	Decommissioning
Subtidal sand, Subtidal coarse sediment and Subtidal mixed sediments				
Temporary physical disturbance	Penetration and/or disturbance of the substratum below the	✓	✓	✓

Potential Pressure (Scoping)	Pressure Name (AOO)	Construction	Operation & Maintenance	Decommissioning
	surface of the seabed, including abrasion Abrasion/disturbance of the substrate on the surface of the seabed			
Permanent/long term lasting habitat loss	Habitat structure changes – removal of substratum (extraction) Physical loss (to land or freshwater habitat) Physical change (to another seabed type) Physical change (to another sediment type)	× (assessed under operation)	✓	× (assessed under operation)
Increased SSC	Changes in suspended solids (water clarity) Smothering and siltation rate changes (Light) Smothering and siltation rate changes (Heavy)	✓	✓	✓
Re-mobilisation of contaminated sediments	Hydrocarbon & PAH contamination Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals) Transition elements & organo-metal (e.g. TBT) contamination Introduction of other substances (solid, liquid or gas)	✓	✓	✓
Effects on sediment transport	Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion Abrasion/disturbance of the substrate on the surface of the seabed	✓	✓	✓
Underwater noise and vibration	Underwater noise changes Vibration	✓	✓	✓
Colonisation of foundations and cable protection	Abrasion/disturbance of the substrate on the surface of the seabed Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion	× (assessed under operation)	✓	× (assessed under operation)

Potential Pressure (Scoping)	Pressure Name (AOO)	Construction	Operation & Maintenance	Decommissioning
Introduction or spread of INNS	Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Electromagnetic fields	Electromagnetic changes	×	✓	×

7.3 Orford Inshore MCZ

Table 7.3 Screening of pressures for the Orford Inshore MCZ (✓: included in the Stage 1 Assessment, ×: not included in the Stage 1 Assessment)

Potential Pressure (Scoping)	Pressure Name (AOO)	Construction	Operation & Maintenance	Decommissioning
Subtidal mixed sediments				
Increased SSC	Changes in suspended solids (water clarity) Smothering and siltation rate changes (Light)	✓	✓	✓
Re-mobilisation of contaminated sediments	Hydrocarbon & PAH contamination Synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals) Transition elements & organo-metal (e.g. TBT) contamination Introduction of other substances (solid, liquid or gas)	✓	✓	✓
Sediment deposition (smothering)	Smothering and siltation rate changes (Light)	✓	✓	✓
Underwater noise and vibration	Underwater noise changes Vibration	✓	✓	✓
Introduction or spread of INNS	Introduction or spread of invasive non-indigenous species (INIS)	✓	✓	✓
Electromagnetic fields	Screened out (see Appendix 1).			

7.4 Screening Summary

Table 7.4 Summary of MCZs screened in and impacts screened in that could potentially hinder conservation objectives of the features of the sites (alone and cumulatively)

Site	Features Screened In	Relevant North Falls Components	Impacts Screened In (Alone And Cumulatively)
Blackwater, Crouch, Roach and Colne Estuaries MCZ	Native oyster and oyster beds	Indirect effects from North Falls offshore export cables (landfall and nearshore)	Increased SSC
			Re-mobilisation of contaminated sediments
			Sediment deposition (smothering)
			Introduction or spread of INNS
Kentish Knock East MCZ	Subtidal coarse sediment Subtidal sand Subtidal mixed sediments	Direct and Indirect effects of North Falls southern array area (foundations and array/interconnector cables, including associated works)	Temporary physical disturbance
			Permanent/long term lasting habitat loss
			Increased SSC
			Re-mobilisation of contaminated sediments
			Effects on sediment transport
			Underwater noise and vibration
			Colonisation of foundations and cable protection
			Introduction or spread of INNS
			Electromagnetic fields
Orford Inshore MCZ	Subtidal mixed sediments	Indirect effects of North Falls northern array area (foundations and array/interconnector cables, including associated works)	Increased SSC
			Re-mobilisation of contaminated sediments
			Sediment deposition (smothering)
			Underwater noise and vibration
			Introduction or spread of INNS

8 Stage 1 assessment

99. This section presents the MCZA Stage 1 assessment of the effects of the construction, operation, maintenance and decommissioning of North Falls on the protected features of the three MCZs screened in. Each of the impacts and corresponding pressures (derived from Natural England's AoO) identified during MCZA Screening (Appendix 1) are discussed individually. The assessment of each impact has considered the effects on the attributes and targets of each protected feature as provided by Natural England's SACOs (Natural England, 2022a and 2022b). The attributes for each protected feature of the three MCZs are listed in Table 8.1, Table 8.2 and Table 8.5 below, in the order they appear in Natural England's SACOs, along with signposts to the relevant sections of the Stage 1 Assessment where the assessment of that feature and attribute is provided. Attributes are categorised as either physical or biological to support the assessment, which first addresses impacts on the physical attributes of features, and then the biological attributes of broadscale habitat features and features of conservation interest (FOCI) (which are largely dictated by physical attributes).

100. Following the assessment of each impact screened into the assessment in relation to each protected MCZ feature and corresponding attributes, an assessment is made as to whether the impact has the potential to hinder the achievement of the MCZ conservation objectives for each of the three sites.

101. Both direct and indirect impacts are considered during the Stage 1 Assessment, where applicable.

102. Natural England is in the process of developing Conservation Advice for the Orford Inshore MCZ and therefore advice from Kentish Knock East MCZ with the same broadscale habitat (subtidal mixed sediments) has been used as a proxy.

8.1 Blackwater, Crouch, Roach and Colne Estuaries MCZ

Table 8.1 Pressures assessed in relation to the relevant attributes during the BCRC Estuaries MCZ Stage 1 Assessment. Light blue – no impact pathway, Dark blue – assessment undertaken.

MCZ Feature Attributes		Impacts											
Attribute Type	Attribute	Construction				Operation				Decommissioning			
		Increased Suspended Sediment Concentrations	Re-Mobilisation of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread of INNS	Increased Suspended Sediment Concentrations	Re-Mobilisation of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread of INNS	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread Of IINNS
Native Oyster *Ostrea eduli*													
Biological	Population: population size	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Population: recruitment and reproductive capability	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Presence and spatial distribution of the species	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Structure: Non-native species and pathogens (species)	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Physical	Supporting habitat: extent and distribution	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Physical	Supporting processes: physico-chemical properties (species)	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Physical	Supporting processes: sediment movement and hydrodynamic regime (species)	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Physical	Supporting processes: water quality – contaminants (species)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – dissolved oxygen (species)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

MCZ Feature Attributes		Impacts											
Attribute Type	Attribute	Construction				Operation				Decommissioning			
		Increased Suspended Sediment Concentrations	Re-Mobilisation of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread of INNS	Increased Suspended Sediment Concentrations	Re-Mobilisation of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread of INNS	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread Of IINNS
Physical	Supporting processes: water quality – nutrients (species)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – turbidity (species)	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Native oyster *Ostrea edulis* beds													
Physical	Extent and distribution	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A		N/A
Biological	Structure and function: presence and abundance of key structural and influential species	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Structure: age / size frequency	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Structure: non-native species and pathogens (habitat)	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Structure: population density	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Biological	Structure: species composition of the community	Section 8.1.1.1.2	N/A	Section 8.1.1.1.2	Section 8.1.1.3.1	Section 8.1.2.1.2	N/A	Section 8.1.2.1.2	Section 8.1.2.3.1	Section 8.1.3.1	N/A	Section 8.1.3.2	Section 8.1.3.3
Physical	Supporting processes: areas with conditions suitable for native oyster bed formation	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Physical	Supporting processes: physico-chemical properties (habitat)	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Physical	Supporting processes: sedimentation rate	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A

MCZ Feature Attributes		Impacts											
Attribute Type	Attribute	Construction				Operation				Decommissioning			
		Increased Suspended Sediment Concentrations	Re-Mobilisation of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread of INNS	Increased Suspended Sediment Concentrations	Re-Mobilisation of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread of INNS	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Sediment Deposition (Smothering)	Introduction Or Spread Of IINNS
Physical	Supporting processes: water movement and energy	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A
Physical	Supporting processes: water quality – contaminants (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – dissolved oxygen (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – nutrients (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – turbidity (habitat)	Section 8.1.1.1.1	N/A	Section 8.1.1.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.2.1.1	N/A	Section 8.1.3.1	N/A	Section 8.1.3.2	N/A

8.1.1 Potential Impacts during construction

8.1.1.1 Impact 1: Increased suspended sediment concentrations

103. Temporary increased SSC will occur in the water column and subsequent deposition onto the seabed as a result of seabed preparation, offshore substation platforms, array/interconnector cable trench, jack up vessel, anchoring and boulder clearance. Chapter 8 Marine Geology, Oceanography and Physical Processes of the PEIR provides details of changes to SSC and subsequent sediment disposition.

104. Two features of the MCZ have the potential to be affected by increased SSC during construction:

- Native oyster *Ostrea edulis*
- Native oyster *Ostrea edulis* bed

105. The impact of SSC has been defined using the following pressures identified by Natural England's AoO for the Blackwater, Crouch, Roach and Colne MCZ:

- Changes in suspended solids (water clarity)
- Smothering and siltation rate changes (Light)

106. The installation of WTGs in the north array and south array and the export cables in the interconnector cable corridor and offshore cable corridor have the potential to disturb and potentially mobilise and displace sediment. This could also result in smothering as the suspended sediment is deposited. Table 5.2 summarises the worst-case volume of sediment displaced.

107. The sediment types present in the north array, south array and interconnector cable corridor are sand, gravelly sand, sandy mud and muddy sand. The sediment types present in the offshore cable corridor are sand, gravelly sand, sandy gravel, mud, gravelly mud, outcrop/subcrop and channel infill.

108. Of these, sand is the dominant sediment type (see PEIR Chapter 8 Marine geology, oceanography and physical processes), and therefore will represent the highest volume of sediment type disturbed.

109. Fine sand is likely to stay in suspension for a longer period of time than that of coarse sand or mud. Suspended fine sand will form a plume which would become advected by tidal currents. This is likely to exist for up to six hours and settle within close proximity to its release (a few hundred metres up to a kilometre). Lower SSCs would extend further, however settling at indistinguishable levels from current conditions and having no significant effect on the existing benthos.

110. Plume modelling simulations conducted for Galloper Wind Farm indicated that larger sediment particles such as sand, would result in the greatest bed thickness changes. However, the maximum thickness change is less than 1mm (ABPmer, 2011) and therefore should any sediment deposition occur along the coast, it will be rapidly dispersed by wave action. As there is already significant ambient sand transport in the vicinity, the small amounts of additional resettled sand will not significantly change the local transport.

111. There is a greater occurrence of mud-sized sediment along the offshore cable corridor, and this would be advected a greater distance and persist in the water column for hours to days, before depositing to form a thin layer on the seabed.

However, it is anticipated that under the prevailing hydrodynamic conditions, this sediment would be readily re-mobilised, especially in the shallow inshore area where waves would regularly agitate the bed. Sediment characterisation of samples taken from the North Falls array areas indicate that mud makes up 5% of the sediment type. This along with medium and coarse-grained sand will fall rapidly to the seabed, travelling distances of tens of metres. Accordingly, there will be no measurable changes to the seabed level or seabed character.

112. The pressure 'Smothering and siltation rate changes (Light)' has been used for the sensitivity assessment for Native oysters as 'Light' deposition is defined as 'up to 5cm of fine material added to the habitat in a single, discrete event' (Marlin, 2022). Alternatively, 'Heavy' deposition of sediment is defined as 'up to 30cm of fine material added to the habitat in a single discrete event' (Marlin, 2022).

113. The remainder of this section assesses the impact of construction temporary increases in SSC and subsequent deposition against the attributes and targets of each protected feature as provided by Natural England's SACOs.

8.1.1.1.1 Physical attributes

114. The following physical attributes of protected features are relevant to temporary increases in SSC and subsequent deposition impacts:

- Native oyster:
  - Supporting habitat: extent and distribution
  - Supporting processes: physico-chemical properties (species)
  - Supporting processes: sediment movement and hydrodynamic regime (species)
  - Supporting processes: water quality-turbidity (species)
- Native oyster beds:
  - Supporting habitat: extent and distribution
  - Supporting processes: areas with conditions suitable for native oyster bed formation
  - Supporting processes: physico-chemical properties (habitat)
  - Supporting processes: sedimentation rates
  - Supporting processes: water movement and energy
  - Supporting processes: water quality – turbidity (habitat)

115. As described above, redeposition of suspended sediments will be local to the construction activity and is unlikely to change sediment composition and distribution. Increases in SSC will be localised, short term and within the natural range of turbidity. Therefore, there will be no impact on the physical attributes and targets of the BCRC Estuaries MCZ features.

8.1.1.1.2 Biological attributes

116. The following biological attributes of protected features are relevant to temporary increases in SSC and subsequent deposition impacts:

- Native oyster
  - Population: population size

- Population: recruitment and reproductive capability
- Presence and spatial distribution of the species
- Structure: non-native species and pathogens (species)

- Native oyster beds:
  - Structure and function: presence and abundance of key structural and influential species
  - Structure: age / size frequency
  - Structure: non-native species and pathogens (habitat)
  - Structure: population density
  - Structure: species composition of the community

117. The status of *O. edulis* individuals directly affects the status of *O. edulis* beds within the MCZ. For continued occurrence of this habitat, recruitment must be successful. Therefore, to maintain a constant availability of habitat for dependent epifauna such as ascidians, polychaetes and sponges, the mortality of *O. edulis* individuals must remain low.

118. As *O. edulis* is a suspension feeder, increased SSCs have the potential to prevent water flow through the oyster. This in turn would inhibit respiration, feeding and removal of waste (Perry & Jackson, 2017). However, the effects of smothering would only become apparent with 5cm or more of sediment deposition (Grant et al., 1990), and the proposed works are predicted to deposit less than 1mm of sediment at most.

119. As described above, redeposition of suspended sediments will be local to the construction activity and is unlikely to change sediment composition and distribution. Increases in SSC will be localised, short term and within the natural range of turbidity. Therefore, there will be no impact on the biological attributes and targets of the BCRC Estuaries MCZ features.

120. Natural England's AoO states that the marine features in the MCZ have medium to high sensitivity (Natural England, 2022a) to pressures associated with increases in SSC and subsequent deposition.

121. A negligible magnitude of effect for the associated attributes of the BCRC Estuaries MCZ has been determined due to the localised, short-term nature of the works and subsequently the discernible change to the benthic environment within the MCZ.

8.1.1.1.3 Summary

122. The BCRC Estuaries MCZ is approximately 4.5km away from the offshore cable corridor and as discussed above, the furthest advected sediment would be fine sand settling within a few hundred metres to a kilometre. Any lower particle size SSCs that could potentially reach the MCZ would settle at indistinguishable levels from current conditions.

123. Consequently, both native oyster and native oyster beds will not be affected by SSC and subsequent deposition.

124. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Blackwater, Crouch, Roach and Colne Estuary MCZ features, it can be concluded that the conservation objective of 'Recover to favourable condition' will not be hindered by temporary increases in

SSC and subsequent deposition impacts related to the construction of North Falls.

8.1.1.2 Impact 2: Sediment deposition (smothering)

125. The effects of sediment deposition (smothering) have been discussed above in Section 8.1.1.1.

8.1.1.3 Impact 3: Introduction or spread of INNS

126. The introduction of INNS poses a threat to benthic communities as they may become invasive and displace native organisms by preying on them or out competing them for resources such as food, space, or both.

127. There are multiple potential pathways for the introduction of INNS, including ship ballast water, hull fouling and solid ballast. Also, the placement of human-made structures could act as vectors for INNS to colonise on new habitats (Glasby et al., 2007). Potential colonisation of North Falls infrastructure by INNS is discussed in Section 8.1.2.3. The primary pathway for the introduction of INNS during construction is therefore through vessels and infrastructure sourced from a different region of ocean or sea. Table 5.2 presents the indicative number of vessel movements that will be used for construction of North Falls. However, it is to be noted that the port location will be determined post-consent and therefore it is unknown whether vessels will transit through or close to the MCZ.

128. North Falls is in a region of high vessel activity and therefore the number of vessels frequenting the offshore project area will not represent a significantly increased risk of INNS. Furthermore, as the MCZ is approximately 4.5km away from the offshore cable corridor and approximately 47km from the array areas, the likelihood of high volumes of vessel activity within the MCZ are low.

129. The risk of spreading INNS will be mitigated by the following relevant regulations and guidance:

- International Convention for the Prevention of Pollution from Ships (MARPOL). The MARPOL sets out appropriate vessel maintenance;
- The Environmental Damage (Prevention and Remediation (England) Regulations 2015, which set out a polluter pays principle where the operators who cause a risk of significant damage or cause significant damage to land, water or biodiversity will have the responsibility to prevent damage occurring, or if the damage does occur will have the duty to reinstate the environment to the original condition;
- The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which provide global regulations to control the transfer of potentially INNS.

130. These commitments will be secured through an outline Project Environmental Management Plan (PEMP) which will be provided with the DCO application.

131. The impact of INNS has been defined using the following 'low risk' pressure identified by Natural England's AoO for the BCRC Estuaries MCZ:

- Introduction or spread of invasive non-indigenous species (INIS; hereafter referred to as INNS).

8.1.1.3.1 Biological attributes

132. The following biological attributes of protected features are relevant to the introduction or spread of INNS:

- Native oyster:
  - Population: population size
  - Population: recruitment and reproductive capability
  - Presence and spatial distribution of the species
  - Structure: non-native species and pathogens (species)
- Native oyster beds:
  - Structure and function: presence and abundance of key structural and influential species
  - Structure: age / size frequency
  - Structure: non-native species and pathogens (habitat)
  - Structure: population density
  - Structure: species composition of the community

133. Natural England's AoO states that the marine features in the MCZ have medium to high sensitivity to pressures associated with INNS (Natural England, 2022a).

134. As discussed above, INNS may be introduced through the use of vessels and the installation of infrastructure, however the risk of introduction and spread of INNS will be mitigated through adherence to the relevant regulations and guidance and secured through an outline PEMP (to be provided with the DCO application). Therefore, there will be a negligible magnitude of effect for the associated attributes of the BCRC Estuaries MCZ.

8.1.1.3.2 Summary

135. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected BCRC Estuaries MCZ features, it can be concluded that the conservation objective of 'Recover to favourable condition' will not be hindered by introduction of INNS from the construction of North Falls.

8.1.2 Potential Impacts during operation

8.1.2.1 Impact 1: Increased suspended sediment concentrations

136. Increases in SSC in the water column and subsequent deposition onto the seabed may occur during operation and maintenance activities at North Falls. Potential contributing activities include placement of jack-up vessels, cable repair and replacement or reburial of infrastructure.

137. Table 5.2 gives a summary of the worst-case scenario for volume of sediment displaced in the considered activities for the total ZoI. The BCRC Estuaries MCZ is approximately 4.5km from the cable corridor and as described in Chapter 8 Marine Geology, Oceanography and Physical Processes of the PEIR, the effects of temporary activities on sediment transportation and deposition will be low. Increases in SSC in the water column and subsequent deposition will result in less than 1mm of sediment deposited on the seabed within the ZoI. Elevated SSC will be within the range of background nearshore levels and will be lower than the concentration that would develop during storm conditions.

8.1.2.1.1 Physical attributes

138. The physical attributes associated with SSC and subsequent deposition during the operational phase are the same as described in Section 8.1.1.1.1. However,

the magnitude of maintenance activities in the offshore project area will be significantly lower than that of construction activities. Maintenance works will be highly localised and short term in nature, therefore SSC and subsequent deposition during the operation phase will have a less significant effect on the surrounding benthic environment.

8.1.2.1.2 Biological attributes

139. The biological attributes associated with SSC and subsequent deposition during the operational phase are the same as described in Section 8.1.1.1.2.

140. Natural England's AoO states that the marine features in the MCZ have medium to high sensitivity to pressures associated with increases in SSC and subsequent deposition (Natural England, 2022a; see Appendix 2).

141. A negligible magnitude of effect for the associated attributes of the BCRC Estuaries MCZ has been determined due to the localised, short-term nature of each maintenance activity.

8.1.2.1.3 Summary

142. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of BCRC Estuaries MCZ features, it can be concluded that the conservation objective of 'Recover to favourable condition' will not be hindered by SSC and subsequent deposition during maintenance activities.

8.1.2.2 Impact 2: Sediment deposition (smothering)

143. The effects of sediment deposition (smothering) have been discussed above in Section 8.1.2.1.

8.1.2.3 Impact 3: Introduction or spread of INNS

144. Non-native species may become invasive and displace native organisms by preying on them or out-competing them for resources such as food, space or both. The primary pathway for the potential introduction of INNS is from the use of vessels and infrastructure that have originated from regions that are distinctly different, such as from other seas or oceans.

145. Table 5.2 presents the maximum number of vessels to be used during operational phase. However, these numbers are representative of the entire offshore project area and therefore are an overestimate of activity in proximity to the BCRC Estuaries MCZ. It should also be noted that there is an existing baseline of vessel activity in the region and therefore the small increase in vessel traffic in proximity to the MCZ associated with North Falls will not represent a significantly increased risk of introduction of INNS.

146. Although ship ballast water appears to be the largest single vector for INNS, bio-fouling communities on ships and the introduction of hard infrastructure to provide new habitat are also identified as contributors and act as potential 'steppingstones' for the colonisation of INNS (Kerckhof et al., 2011). Any cable protection for surface laid export cables for North Falls would be at least 4.5km from the BCRC Estuaries MCZ.

147. The risk of spreading INNS will be mitigated by the relevant regulations and guidance listed in Section 8.1.1.3. These commitments will be secured in the outline PEMP (to be provided with the DCO application).

148. This assessment considers the effects of increased vessel activity with the introduction of INNS and the subsequent colonisation by faunal communities on

the ecological attributes and targets for the two broadscale marine habitat features:

- Native oyster *Ostrea edulis* beds
- Native oyster *Ostrea edulis*

149. The impact of INNS has been defined using the following 'low risk' pressure identified by Natural England's AoO for the BCRC Estuaries MCZ:

- Introduction or spread of INNS

8.1.2.3.1 Biological attributes

150. The following biological attributes of protected features are relevant to the introduction or spread of INNS:

- Native oyster
  - Population: population size
  - Population: recruitment and reproductive capability
  - Presence and spatial distribution of the species
  - Structure: non-native species and pathogens (species)
- Native oyster beds
  - Structure and function: presence and abundance of key structural and influential species
  - Structure: age / size frequency
  - Structure: non-native species and pathogens (habitat)
  - Structure: population density
  - Structure: species composition of the community

151. As discussed above, INNS may be introduced through the use of vessels, however the risk of introduction and spread of INNS will be mitigated through adherence to the relevant regulations and guidance and secured through an outline PEMP (to be provided with the DCO application).

152. Natural England's AoO states that the marine features in the MCZ have high sensitivity to INNS (Natural England, 2022a; see Appendix 2) however a negligible magnitude of effect for the associated attributes of the BCRC Estuaries MCZ has been determined as there will be no introduction of hard substrate into the MCZ itself, and the movement of vessels associated with North Falls is relatively low in the context of the existing vessel density and subsequently the additional risk of introduction and spread of INNS is negligible.

8.1.2.3.2 Summary

153. Based on the relevant pressure, receptor sensitivity, and assessment of impacts against the attributes of affected BCRC Estuaries MCZ features it can be concluded that the conservation objective of recovering native oysters and native oyster beds to favourable condition will not be hindered by the risks of introduction and spread of INNS related to the development of North Falls.

8.1.3 Potential Impacts during decommissioning

8.1.3.1 Impact 1: Increased suspended sediment concentrations

154. Temporary increases in SSC within the water column, and subsequent deposition on to the seabed may occur during the decommissioning phase as a result of the removal of infrastructure. However unlike during the construction phase, there will be no requirement for sandwave levelling and therefore the volume of sediment plumes would be significantly less. Other activities would be a reverse of the construction process and therefore have similar effects (see Table 5.2).

155. Effects would therefore be no greater than, and are expected to be less than, those of the construction phase (Section 8.1.1.1), and would affect the same features and attributes.

156. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of affected BCRC Estuaries MCZ features, it can be concluded that the conservation objective of recovering to favourable condition of native oyster and native oyster beds, will not be hindered by temporary increases in SSC and subsequent deposition impacts related to the decommissioning of North Falls.

8.1.3.2 Impact 2: Sediment deposition (smothering)

157. The effects of sediment deposition (smothering) have been discussed above in Section 8.1.3.1.

8.1.3.3 Impact 3: Introduction or spread of INNS

158. The effects of INNS on the BCRC Estuaries MCZ may occur during the decommissioning phase as a result of increased vessel activity. Effects would be no greater than, and are expected to be less than, those of the operational phase (Section 8.1.2.3) and will affect the same features and attributes.

159. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of affected BCRC Estuaries MCZ features, it can be concluded that conservation objective of recovering to favourable condition of native oyster and native oyster beds, will not be hindered by INNS impacts related to the decommissioning of North Falls.

8.2 Kentish Knock East MCZ

160. Table 8.2 lists the attributes for each protected feature of the Kentish Knock East MCZ as shown in Natural England's SACOs. The table signposts to the relevant sections of the Stage 1 Assessment where the assessment of that feature and attribute is provided.

Table 8.2 Pressures assessed in relation to the relevant attributes during the Kentish Knock East MCZ Stage 1 Assessment. Light blue – no impact pathway, Dark blue – assessment undertaken.

MCZ Feature Attributes		Impacts																							
Attribute Type	Attribute	Construction						Operation									Decommissioning								
		Temporary Physical Disturbance	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Effects On Sediment Transport	Underwater Noise And Vibration	Introduction Or Spread Of INNS	Temporary Physical Disturbance	Permanent/Long Term Lasting Habitat Loss	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Effects On Sediment Transport	Underwater Noise And Vibration	Colonisation Of Foundations And Cable Protection	Introduction Or Spread Of Inns	Electromagnetic Fields	Temporary Physical Disturbance	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Effects On Sediment Transport	Underwater Noise And Vibration	Introduction Or Spread Of INNS
Subtidal coarse sediment, Subtidal mixed sediments and Subtidal sand.																									
Biological	Distribution: presence and spatial distribution of biological communities	Section 8.2.1.1.2	Section 8.2.1.2.2	N/A	Section 8.2.1.4.2	N/A	N/A	Section 8.2.2.1	Section 8.2.2.2.2	Section 8.2.2.3	N/A	Section 8.2.2.5	N/A	N/A	N/A	Section 8.2.2.9.1	Section 8.2.3	Section 8.2.3	N/A	Section 8.2.3	N/A	N/A
Physical	Extent and distribution	Section 8.2.1.1.1	N/A	N/A	Section 209	N/A	N/A	Section 8.2.2.1	Section 8.2.2.2.1	N/A	N/A	Section 8.2.2.5	N/A	N/A	N/A	N/A	Section 8.2.3	N/A	N/A	Section 8.2.3	N/A	N/A
Biological	Structure and function: presence and abundance of key structural and influential species	Section 8.2.1.1.2	Section 8.2.1.2.2	N/A	Section 8.2.1.4.2	N/A	N/A	Section 8.2.2.1	Section 8.2.2.2.2	Section 8.2.2.3	N/A	Section 8.2.2.5	N/A	N/A	N/A	N/A	Section 8.2.3	Section 8.2.3	N/A	Section 8.2.3	N/A	N/A
Biological	Structure: non-native species and pathogens (habitat)	N/A	N/A	N/A	N/A	N/A	Section 8.2.1.6.1	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.2.7	Section 8.2.2.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.3
Physical	Structure: sediment composition and distribution	Section 8.2.1.1.1	Section 8.2.1.2.1	N/A	N/A	N/A	N/A	Section 8.2.2.1	Section 8.2.2.2.1	Section 8.2.2.3	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.3	Section 8.2.3	N/A	N/A	N/A	N/A
Biological	Structure: species composition of component communities	Section 8.2.1.1.2	Section 8.2.1.2.2	N/A	Section 8.2.1.4.2	Section 8.2.1.5.1	N/A	Section 8.2.2.1	Section 8.2.2.2.2	Section 8.2.2.3	N/A	Section 8.2.2.5	Section 8.2.2.6	N/A	N/A	N/A	Section 8.2.3	Section 8.2.3	N/A	Section 8.2.3	Section 8.2.3	N/A
Physical	Supporting processes: energy / exposure	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.2.2.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: physico-chemical properties (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: sediment contaminants	N/A	N/A	Section 8.2.1.3	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.2.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.3	N/A	N/A	N/A	N/A
Physical	Supporting processes: sediment movement and	N/A	N/A	N/A	Section 209	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.2.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.3	N/A	N/A	N/A

MCZ Feature Attributes		Impacts																					
Attribute Type	Attribute	Construction						Operation									Decommissioning						
		Temporary Physical Disturbance	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Effects On Sediment Transport	Underwater Noise And Vibration	Introduction Or Spread Of INNS	Temporary Physical Disturbance	Permanent/Long Term Lasting Habitat Loss	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Effects On Sediment Transport	Underwater Noise And Vibration	Colonisation Of Foundations And Cable Protection	Introduction Or Spread Of Inns	Electromagnetic Fields	Temporary Physical Disturbance	Increased Suspended Sediment Concentrations	Re-Mobilisation Of Contaminated Sediments	Effects On Sediment Transport	Underwater Noise And Vibration	Introduction Or Spread Of INNS
	hydrodynamic regime (habitat)																						
Physical	Supporting processes: water quality – contaminants (habitat)	N/A	N/A	Section 8.2.1.3	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.2.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.3	N/A	N/A	N/A
Physical	Supporting processes: water quality – dissolved oxygen (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – nutrients (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – turbidity (habitat)	N/A	Section 8.2.1.2.1	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.2.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Section 8.2.3	N/A	N/A	N/A	N/A

8.2.1 Potential Impacts during construction

8.2.1.1 Impact 1: Temporary physical disturbance

161. Temporary physical disturbance within the Kentish Knock East MCZ will occur as a result of any seabed preparation, array/interconnector cable trenching, vessel jack ups, anchoring and boulder clearance.

162. Three broadscale marine habitat features have the potential to be affected by temporary physical disturbance during construction:

- Subtidal coarse sediment
- Subtidal mixed sediments
- Subtidal sand

163. The impact of temporary physical disturbance has been defined using the following pressures identified by Natural England's AoO for the Kentish Knock East MCZ (Table 8.2):

- Abrasion/disturbance of the substrate on the surface of the seabed
- Penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion

164. Table 5.2 presents the worst-case scenario of these impacts during construction. The worst-case area of seabed within the Kentish Knock East MCZ which could be disturbed during construction would be 0.69km2. This equates to 0.72% of the MCZ area.

165. The remainder of this section assesses the impact of temporary physical disturbance during construction against the attributes and targets of each protected feature as provided by Natural England's SACOs.

8.2.1.1.1 Physical attributes

166. The following physical attributes of protected features are relevant to temporary physical disturbance:

- Extent and distribution
- Structure: sediment composition and distribution

167. As discussed above, the worst-case area of seabed within the Kentish Knock East MCZ which could be affected during construction activities would be 0.69km^2 which equates to 0.72% of the total MCZ.

168. In the unlikely event that all infrastructure is placed within one of the protected features of the MCZ, Table 8.3 provides the extent of each feature that could be potentially affected by temporary physical disturbance.

Table 8.3 Maximum extent of temporary habitat physical disturbance of Kentish Knock East MCZ features

Protected feature	Spatial extents	Area	% of feature / area of MCZ
Subtidal coarse sediment	14.82km^2	0.69km^2	4.66
Subtidal mixed sediments	73.74km^2	0.69km^2	0.94
Subtidal sand	7.37km^2	0.69km^2	9.36
Kentish Knock East MCZ	96.39km^2	0.69km^2	0.72

8.2.1.1.2 Biological attributes

169. The following biological attributes of protected features are relevant to temporary physical disturbance:

- Distribution – presence and spatial distribution of biological communities
- Structure and function: presence and abundance of key structural and influential species
- Structure: species composition of component communities

170. Construction temporary physical disturbance is likely to result in localised reductions in species richness and biomass.

Subtidal coarse sediment

171. Areas of subtidal coarse sediment were not recorded in the area of the south array that overlaps the MCZ, during environmental investigations, however, the effects on this feature have been considered in the assessment based on the broadscale habitat map provided by Defra (2019b).

172. Natural England's AoO (Natural England, 2022b) identifies five biotopes that may be represented within this feature. Their sensitivity to relevant pressures ranges from not sensitive to medium, with the highest sensitivity being abrasion/disturbance of the substrate on the surface of the seabed (medium sensitivity) (Natural England, 2022b; see Appendix 2). Resilience ranges from medium to high (Natural England, 2022b; Appendix 2), equating to full recovery within 2-10 years or within 2 years respectively.

Subtidal mixed sediments

173. Areas of subtidal mixed sediments in the south array were classified as the biotope A5.451 Polychaete-rich deep Venus community in offshore mixed sediments. The sensitivity of this biotope, as per Natural England's AoO, to relevant pressures is Low to abrasion/disturbance of the substrate on the surface of the seabed (Natural England, 2022b; see Appendix 2). This biotope also has high resilience against abrasion/disturbance of the substrate on the surface of the seabed (Natural England, 2022b; Appendix 2) which equates to full recovery within 2 years.

Subtidal sand

174. Areas of subtidal sand in the south array were defined to EUNIS level 3 as A5.2 sublittoral sand. For A5.2, biotope A5.231 infralittoral mobile clean sand with sparse fauna has been used as a proxy to represent A5.2 stations. A5.231 has been used as a proxy as the characteristic species of this biotope including *Pagarus berhardus*, *Carcinus maenus* and *Asterias rubens*, are similar to those found in the site investigations. Furthermore, the sediment descriptions are interchangeable and show similarities. The sensitivity of this biotope to relevant pressures is low to abrasion/disturbance of the substrate on the surface of the seabed (Natural England, 2022b; see Appendix 2). This biotope also has a high resilience to this pressure (Natural England, 2022b; Appendix 2) which equates to full recovery within 2 years.

8.2.1.1.3 Magnitude of impact on biological attributes

175. Post construction monitoring undertaken at GGOW in June and September 2013 was compared to pre-construction surveys undertaken in 2009. No significant differences in the benthic communities were identified (CMACS, 2014). This supports the advice from Natural England's AoO that all three

features have high resilience to the impact of temporary physical disturbance and will fully recover within a 2-year period.

176. A negligible magnitude of effect for the associated attributes of the Kentish Knock East MCZ has been determined due to the localised, short-term nature of the works.

8.2.1.1.4 Summary

177. A worst-case of 0.72% of the Kentish Knock East MCZ could be disturbed during North Falls construction (Table 8.3). Recovery of these communities is expected within two years in many areas based on the resilience of most biotopes, with partial recovery due to colonisation of impacted areas by species representative of pre-existing biological communities occurring sooner. Recovery may take longer in some coarse and mixed sediment areas but based on GGOW post-construction monitoring full recovery is expected in less than four years.

178. Based on the relevant pressures, receptor sensitivity, and assessment of impacts against the attributes of affected Kentish Knock East MCZ features it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by temporary physical disturbance related to the construction of North Falls.

8.2.1.2 Impact 2: Increased suspended sediment concentrations

179. Temporary increases in SSC within the water column, and subsequent deposition onto the seabed may occur as a result of seabed preparation and drill arisings. Chapter 8 Marine Geology, Oceanography and Physical Processes of the PEIR provides details of changes to suspended sediment concentrations and subsequent deposition.

180. Seabed preparation and installation of foundations and cables will disturb and potentially mobilise sediment into suspension. Table 5.2 summarises the worst-case volume of sediment displaced.

181. Coarse sediments will settle rapidly to the seabed. Finer sand and mud that is present in the sediment are likely to stay in suspension for longer and form a passive plume which would become advected by tidal currents. Due to the sediment sizes present this is likely to exist as a measurable but modest concentration plume for around half a tidal cycle (up to six hours). Sediment would eventually settle to the seabed in proximity to its release (within a few hundred metres up to around 1km) within a short period of time (hours to days). SSCs with a lower particle size would extend further from the site of construction activity however magnitudes would be indistinguishable from background levels.

182. Overall, increases in SSC are expected to be localised and short-term. Fine suspended sediment may be transported a further distance than coarse sediments however due to the small fraction of fine sediment and mud, it is likely to be widely and rapidly dispersed. Sediment deposition from a plume will deposit a maximum 1mm but less than 0.1mm over large areas of the seabed.

183. Although SSC will be elevated, they are likely to be lower than concentrations that would develop in the water column during storm conditions. Also, once installation is completed, tidal currents are likely to rapidly disperse the suspended sediment (i.e. over a period of a few hours) in the absence of any further sediment input.

184. The Project overlaps the following broadscale marine habitat features and will therefore be affected by temporary increases in SSC and subsequent deposition during construction:

- Subtidal coarse sediment
- Subtidal mixed sediments
- Subtidal sand

185. The impact of temporary increases in SSC and subsequent deposition has been defined using the following pressures identified by Natural England's AoO for the Kentish Knock MCZ (Table 8.2):

- Changes in suspended solids (water clarity)
- Smothering and siltation rate changes (Light)

186. The remainder of this section assesses the impact of construction temporary increases in SSC and subsequent deposition against the attributes and targets of each protected feature as provided by Natural England's SACOs.

8.2.1.2.1 Physical attributes

187. The following physical attributes of protected features are relevant to temporary increases in SSC and subsequent deposition impacts:

- Structure: sediment composition and distribution
- Supporting processes: water quality – turbidity (habitat)

188. As described above, redeposition of suspended sediments will be local to the construction activity and is unlikely to change sediment composition and distribution. Changes to the sedimentation rate will be within the natural range and increases in SSC will be localised, short term and within the natural range of turbidity. Therefore, there will be a negligible impact on the physical attributes and targets of Kentish Knock East MCZ features.

8.2.1.2.2 Biological attributes

189. The following biological attributes of protected features are relevant to temporary increases in SSC and subsequent deposition impacts:

- Distribution: presence and spatial distribution of biological communities
- Structure and function: presence and abundance of key structural and influential species
- Structure: species composition of component communities

190. Increased suspended sediments have the potential to affect benthic ecology receptors by blocking feeding apparatus as well as by smothering sessile species upon deposition of sediment.

191. Natural England's AoO (Natural England, 2022b) states that the biotopes found within Kentish Knock East MCZ are sensitive to the pressures associated with temporary increases in SSC and subsequent deposition. Biotopes that are represented in the three features of the MCZ, range from not sensitive to high sensitivity. Similarly, resilience ranges from very low to high. However, the biotopes recorded in the overlap of the south array and Kentish Knock East MCZ in the Fugro site investigations are not sensitive and have high resilience.

192. A low magnitude of effect for the associated attributes of the Kentish Knock East MCZ has been determined due to the localised, short-term nature of the works.

8.2.1.2.3 Summary

193. Based on the relevant pressures, receptor sensitivity, and assessment of impacts against the attributes of affected Kentish Knock East MCZ features it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by SSC and subsequent deposition related to the construction of North Falls.

8.2.1.3 Impact 3: Re-mobilisation of contaminated sediments

194. The re-suspension of sediment during seabed preparation and the installation of foundations and array cables in the south array could lead to the release of contaminated sediment which may have an effect on benthic biological communities associated with the protected features of Kentish Knock East MCZ.

195. Three broadscale marine habitat features would be affected by re-mobilisation of contaminated sediments during construction, due to their proximity to construction activities:

- Subtidal coarse sediment
- Subtidal sand
- Subtidal mixed sediments

196. Given the low levels of contaminants present in the sediment, contaminant re-mobilisation and subsequent deposition in the MCZ is unlikely.

197. The impact of re-mobilisation of contaminated sediments has been defined using the following pressures identified by Natural England's AoO for the Kentish Knock East MCZ:

- Introduction of other substances (solid, liquid or gas)
- Transition elements & organo-metal (e.g. TBT) contamination
- Hydrocarbon & PAH contamination

198. To inform the baseline for sediment quality, a benthic survey of the offshore development areas was undertaken between May and August 2021 where grab sampling was undertaken and samples analysed for the following chemical contaminants:

- Trace metals;
- Polyaromatic Hydrocarbons (PAHs); and
- Polychlorinated Biphenyls (PCBs).

199. Chemical analysis was undertaken by SOCOTEC, in line with the MMO accreditation scheme regarding sediment sampling for disposal at sea licensing.

200. The context of contaminants found within sediments is established through the use of recognised guidelines and action levels, in this case Cefas Action Levels have been applied because they provide good coverage of contaminants, across a broad range of contaminant types (MMO, 2018). These levels are used to indicate general contaminant levels in the sediments. If, overall, levels do not generally exceed the lower threshold values of these guideline standards, then contamination levels are not considered to be of significant concern and are low risk in terms of potential impacts on the marine environment.

201. A comparison of the sediment quality data against Cefas Action Levels has been undertaken in Chapter 9 Marine Water and Sediment Quality of the PEIR. PEIR Chapter 9 concludes that sediment contamination levels are not of significant concern and are low risk in terms of potential impacts on the marine environment. Even though there are some elevated levels of contaminants within the sediments, they align with the typical levels for the region and do not pose a high risk.

202. The following attributes of protected features are relevant to the effects of the re-mobilisation of contaminated sediments:

- Supporting processes: sediment contaminants
- Supporting processes: water quality – contaminants (habitat)

203. However, given that there is no risk in relation to re-mobilisation of contaminated sediments due to there being no concentrations of contaminants at levels of concern, further assessment against these attributes is not required.

8.2.1.3.1 Summary

204. Based on the absence of contaminants at levels of concern recorded within the North Falls south array, it can be concluded that the conservation objectives of recover to favourable condition and maintain in favourable condition the features of Kentish Knock East MCZ will not be hindered by re-mobilisation of contaminated sediments related to the construction of North Falls.

8.2.1.4 Impact 4: Effects on sediment transport

205. Changes to sediment transport may occur as a result of seabed preparation and installation of cable protection measures within the array areas and interconnector. The effect of cable protection on sediment transport is assessed in Section 8.2.2.5.

206. The presence of sandwaves across the north and south array areas indicates that there is some sediment transport with a net direction south-west to north-east (PEIR Chapter 8). Kentish Knock East MCZ overlaps the south array area and extends to the south-west. Therefore changes to sediment would be expected to occur within the MCZ.

207. Three broadscale marine habitat features, and the benthic organisms associated with them, have the potential to be affected by changes to sediment transport during construction:

- Subtidal coarse sediment
- Subtidal sand
- Subtidal mixed sediments

208. The impact effects on sediment transport have been defined using the following pressure identified by Natural England's AoO for the Kentish Knock East MCZ:

- Water flow (tidal current) changes, including sediment transport considerations

209. Where practicable, sediment dredged during seabed preparation will be deposited as close as possible to the location of origin. Keeping the dredged sand within the sand bank system enables the sand to become re-established within the local sediment transport system by natural processes and encourages the re-establishment of the bedforms. Given the local favourable conditions that

enable sandwave development, the sediment would be naturally transported back into the levelled area within a short period of time.

8.2.1.4.1 Physical attributes

210. The following physical attributes of protected features are relevant to sediment transport impacts:

- Extent and distribution
- Supporting processes: sediment movement and hydrodynamic regime (habitat)

211. Seabed morphology and sediment transport would not be affected far outside of the direct footprint of construction works and can be expected to recover in a short period of time. Gross patterns of sediment transport would therefore not be affected significantly. Further detail can be found in Chapter 8 Marine Geology, Oceanography and Physical Processes of the PEIR.

212. Therefore effects on sediment transport during North Falls construction works will not have a significant influence over the extent and distribution of the three features of interest nor change the hydrodynamic regime of the MCZ.

8.2.1.4.2 Biological attributes

213. The following biological attributes of protected features are relevant to sediment transport impacts:

- Distribution: presence and spatial distribution of biological communities
- Structure and function: presence and abundance of key structural and influential species
- Structure: species composition of component communities

214. Natural England's AoO states that subtidal coarse sediment and subtidal mixed sediments are not sensitive to effects on sediment transport. It does state that subtidal sand is sensitive. However, out of the ten named biotopes, only one is considered to have medium sensitivity (Natural England, 2022b).

215. As stated in Section 8.2.1.1.2, the biotope A5.231 has been used as a proxy for A5.2 stations in site investigations. In Natural England's AoO, A5.231 is not sensitive to effects on sediment transport and has high resistance and resilience to the pressure too.

216. A low magnitude of effect for the associated attributes of the Kentish Knock East MCZ has been determined due to the localised, short-term nature of the works and subsequently the discernible change to the benthic environment within the MCZ.

8.2.1.4.3 Summary

217. The extent, distribution and structure of habitat features and presence and spatial distribution of associated biological communities will be maintained despite the potential for short term temporary interruption to a small portion of the three broadscale marine habitat features.

218. Based on the relevant pressures, receptor sensitivity and the assessment of impacts against the attributes of affected Kentish Knock East MCZ it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by effects to sediment transport during construction.

8.2.1.5 Impact 5: Underwater noise and vibration

219. Underwater noise and vibration will occur, primarily as a result of foundation installation and UXO clearance. Construction works will occur within the MCZ footprint and so have the potential to impact on benthic ecology receptors.

220. Three broadscale marine habitat features, and the benthic organisms associated with them, have the potential to be affected by underwater noise and vibration during construction:

- Subtidal coarse sediment
- Subtidal sand
- Subtidal mixed sediments

221. The impact of temporary underwater noise and vibration has been defined using the following pressure identified by Natural England's AoO for the Kentish Knock East MCZ:

- Underwater noise changes

222. There is evidence to suggest benthic species respond to increased levels of underwater noise and vibration. The effects have been assessed further in Chapter 10 Benthic and Intertidal Ecology of the PEIR. Continued research into the effects of underwater noise and vibration is being conducted on a range of benthic species, however further understanding into the effects is required.

223. The effects of underwater noise and vibration will not directly affect physical attributes as set out by Natural England therefore they have not been assessed here.

8.2.1.5.1 Biological attributes

224. The following biological attribute of the protected features is relevant to underwater noise and vibration:

- Structure: species composition of component communities

225. Underwater noise and vibration have the potential to affect benthic communities through disturbance to the habitat. Disturbance can cause the sediment community to change in response to increased pressure.

226. Research into the effects of underwater noise and vibration have been carried out on a number of species of crustacea. It has been found that various, common benthic species exhibit a response to changes in underwater noise and adapt their behaviours accordingly (see Chapter 10 Benthic and Intertidal Ecology).

227. Biological communities recorded in the Kentish Knock East MCZ, overlapping with the south array of North Falls, are either not sensitive or there is no relevant interaction of concern between the pressure and feature (Natural England, 2022b). Therefore, based on Natural England's AoO, the biological communities will not be affected.

8.2.1.5.2 Summary

228. Construction works carried out would produce higher levels of underwater noise and vibration, potentially affecting biological communities within the three broadscale marine habitat features of Kentish Knock East MCZ. Research suggests benthic species will exhibit a response and changes to behaviour when there are higher levels of underwater noise and vibration.

229. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ features, it can be concluded that the conservation objectives of recovering and maintaining the features in a favourable condition will not be hindered by underwater noise and vibration.

8.2.1.6 Impact 6: Introduction or spread of INNS

230. Non-native species may become invasive and displace native organisms by preying on them or out-competing them for resources such as food, space or both. The primary pathway for the potential introduction during construction of INNS is from the use of vessels and infrastructure that have originated from regions that are distinctly different, such as from other seas or oceans.

231. It should be noted that there is an existing baseline of vessel activity within the Kentish Knock East MCZ including fishing, cargo, recreational and wind farm support vessels and therefore the small increase in vessel traffic in proximity to the MCZ associated with construction of North Falls will not represent a significantly increased risk of introduction of INNS.

232. The risk of spreading INNS will be mitigated by the relevant regulations and guidance listed in Section 8.1.1.3.

233. The potential for artificial hard substrates to act as 'stepping stones' or vectors for INNS is assessed in Section 8.2.2.8.

234. This assessment considers the effects of vessel activity and the introduction of INNS and the effect this will have on the ecological attributes and targets of three broadscale marine habitat features:

- Subtidal coarse sediment
- Subtidal sand sediment
- Subtidal mixed sediments

235. The effects of INNS will not directly affect physical attributes as set out by NE therefore they have not been assessed here.

8.2.1.6.1 Biological attributes

236. The following biological attributes of protected features are relevant to temporary habitat loss and physical disturbance impacts:

- Structure: non-native species and pathogens (habitat)

237. Natural England's AoO states that the biotopes recorded in the overlap between Kentish Knock East MCZ and the south array that have the potential to be impacted by INNS are either not sensitive to the introduction of INNS, or the impact is Not Relevant in the case of subtidal mixed sediments.

238. For this assessment the biotope A5.451 Polychaete-rich deep Venus community in offshore mixed sediments has been used based on guidance from MarESA. It is noted that this biotope is not included in Natural England's AoO for Kentish Knock East MCZ, however this was recorded during the Fugro (2021) survey. One of the most comparable biotopes listed in Natural England's AoO, in terms of associated species, is A5.422 *Crepidula fornicata* and *Mediomastus fragilis* in variable salinity infralittoral mixed sediment, however this has not been used to assess the effects of INNS due to *C. fornicata* being an invasive species itself. Therefore, the sensitivity for this assessment is concluded as high.

239. A negligible magnitude of effect for the associated attributes of the Kentish Knock East MCZ has been determined due to the embedded mitigation to avoid the spread of INNS.

8.2.1.6.2 Summary

240. INNS may be introduced through the use of vessels and the installation of infrastructure during construction. However, the risk of introduction and spread of INNS will be mitigated through adherence to the relevant regulations and guidance discussed above. The introduction of artificial hard substrates could act as a potential 'stepping stone' or vector for INNS, as well as supporting species non-native to otherwise soft substrate habitats.

241. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ features it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition could be hindered by the risks of the introduction of INNS during the construction of North Falls.

8.2.2 Potential Impacts during operation

8.2.2.1 Impact 1: Temporary physical disturbance

242. Temporary physical disturbance within the Kentish Knock East MCZ will occur as a result of any requirement for array/interconnector cable repair, maintenance of WTGs and associated anchored vessels or jack up vessels required to carry out repairs. The worst-case footprint of temporary physical disturbance is presented in Table 5 2.

243. Each O&M activity would be relatively short term and it is likely that the requirements for maintenance would be spread over the project life, with recovery commencing once the activity is complete. In the unlikely event that the effects of all O&M activities are present at any one time, the estimated impact on the Kentish Knock East MCZ would be 0.07km^2 (0.07% of the MCZ). In reality, the extent of operational phase temporary physical disturbance would be intermittent over the project life and it is therefore likely that habitats will recover from some maintenance activities before other impacts occur.

244. Recovery of these communities will take place rapidly with full recovery expected within two years in many areas based on the resilience of the identified biotopes and partial recovery due to colonisation of effected areas by species representative of pre-existing biological communities.

245. The habitat features and attributes affected, and the sensitivities of those habitats are the same as those advised by Natural England's AoO for the construction phase in relation to this impact (Section 8.2.1.1).

246. The broadscale presence and spatial distribution of associated biological communities will be maintained despite some localised effects in the disturbed areas.

247. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ features it can be concluded that the conservation objective of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by temporary physical disturbance related to the operation of North Falls.

8.2.2.2 Impact 2: Permanent / long term habitat loss

248. Permanent habitat loss will occur within the overlap of the MCZ and the south array of the Project during the operational phase. Habitat loss would be a consequence of foundations and array/interconnector protection. As a worst-case scenario, it is assumed cable protection and scour protection will be left in situ on decommissioning and is therefore permanent. GBS foundations would likely be removed and pile foundations would be cut below the seabed, therefore habitat loss associated with foundations is considered to be persistent/long term.

249. Three broadscale marine habitat features have the potential to be affected by long term habitat loss:

- Subtidal coarse sediment
- Subtidal sand
- Subtidal mixed sediments

250. The impact of permanent/long term lasting habitat loss has been defined using the following pressure identified by Natural England's AoO for the Kentish Knock East MCZ:

- Physical change (to another seabed type)

251. The total permanent/long term habitat loss within the Kentish Knock East is 0.64km^2 (0.66% of the MCZ), this is accounting for foundation footprints with associated scour protection, and array and interconnector cable protection.

252. The remainder of this section assesses the impact of permanent/long term habitat loss against the attributes and targets of each protected feature as provided by Natural England's SACOs.

8.2.2.2.1 Physical attributes

253. The following physical attributes of protected features are relevant to permanent/long term habitat loss:

- Extent and distribution
- Structure: sediment composition and distribution
- Supporting processes: energy / exposure

254. The extent, distribution and structure of sediment features will largely be maintained across Kentish Knock East MCZ. Subtidal coarse sediment, sand and mixed sediment seabed would be replaced by, or buried beneath, foundations or array/interconnector cable protection in localised areas. In these locations, the sediment types would be replaced by artificial hard substratum, creating areas of habitat with a similarity to circalittoral rock or infralittoral rock. Therefore, there would be a reduction in the extent and distribution of the three broadscale marine habitat features.

255. As discussed above, the worst-case area of seabed within the Kentish Knock East MCZ which could be affected during operation activities would be 0.64km^2 which equates to 0.66% of the total MCZ. Table 8.4 provides the extent of habitat loss of the Kentish Knock East MCZ features, in the unlikely event that all infrastructure was placed on one protected feature. It should be noted that, given the small extent of the subtidal sand feature within the MCZ, it is highly unlikely that all the Project's infrastructure would be placed within this feature.

Table 8.4 Maximum extent of permanent habitat loss of Kentish Knock East MCZ features

Protected feature	Spatial extents	Area	% of feature / area of MCZ
Subtidal coarse sediment	14.82km^2	0.64km^2	4.31
Subtidal mixed sediments	73.74km^2	0.64km^2	0.86
Subtidal sand	7.37km^2	0.64km^2	8.68
Kentish Knock East MCZ	96.39km^2	0.64km^2	0.66

8.2.2.2.2 Biological attributes

256. The following biological attributes of the protected features are relevant to permanent/long term habitat loss:

- Distribution: presence and spatial distribution of biological communities
- Structure and function: presence and abundance of key structural and influential species
- Structure: species composition of component communities

257. The installation of infrastructure on sediment habitats will potentially result in localised mortality of associated biological communities and their replacement, over time, by a community of different species composition and with different key structural and influential species.

258. All sediment biotopes recorded in the overlap between the MCZ and the south array have been identified by Natural England's AoO as having a high sensitivity to physical change to another seabed type with no resistance and very low resilience to the pressure.

259. Natural England (2021) states that the presence and spatial distribution of biological communities, and the species composition of component communities, may be vulnerable to the installation of any infrastructure that is likely to result in a change to the nature or extent of the feature (e.g. wind farm foundations and the placement of scour protection). Potentially having a significant effect on the attribute and triggering a 'recover' target for subtidal sands and contributing to the depletion of the targets for subtidal coarse and mixed sediments.

260. Given the worst-case scenario for all infrastructure to be placed on one feature, the potential magnitude of habitat loss and associated effects on the distribution, structure and function of the biological attributes is medium to high.

8.2.2.2.3 Summary

261. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ features it is concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition could be hindered by the risks of permanent / long term habitat loss during the operation of North Falls.

8.2.2.3 Impact 3: Increased suspended sediment concentrations

262. Increases in SSC within the water column and subsequent deposition onto the seabed may occur as a result of maintenance activities (Table 5.2).

263. Each O&M activity would be relatively short term and it is likely that the requirements for maintenance would be spread over the project life. As

described in Section 8.2.1.2 most of the sediment mobilised by maintenance activities would settle out of suspension rapidly to the seabed, and with low sediment volumes arising from maintenance activities, increased SSCs would be negligible in magnitude.

264. Biological communities recorded in the overlap of the south array and Kentish Knock East MCZ are either not sensitive or have low sensitivity to increased SSC and subsequent deposition (Natural England, 2022b). Therefore, the biotopes will either not be affected or would recover fully within two years.

265. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ features, it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by increased SSC and subsequent deposition related to the operation of North Falls.

8.2.2.4 Impact 4: Re-mobilisation of contaminated sediments

266. Re-mobilisation of contaminated sediments may occur as a result of maintenance activities where there is seabed disturbance. Sediment-bound contaminants could potentially be released in the water column.

267. As described in Section 8.2.1.3, sediment analysis was carried out and found sediment contamination levels to not be of significant concern and are low risk in terms of potential impacts on the marine environment (discussed further in Chapter 9 Marine Water and Sediment Quality of the PEIR).

268. The Natural England AoO has not assessed the biological communities recorded in the overlap of the MCZ and south array against the relevant pressures to re-mobilisation of contaminated sediments. Not assessed is defined as: "*A sensitivity assessment has not been made for this feature to this pressure. However, this activity-pressure-feature combination should not be precluded from consideration. The best available evidence, relevant to the activity in question, at the time of application, should be sourced and considered in any further assessment."* (Natural England, 2022b).

269. Due to the sediment analysis results, it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by re-mobilisation of contaminated sediments related to the operation of North Falls.

8.2.2.5 Impact 5: Effects on sediment transport

270. Effects on sediment transport may occur as a result of cable protection and presence of foundations.

271. Modifications to the tidal regime and/or the wave regime due to the presence of foundation structures during the operational phase may affect the sediment transport regime. Chapter 8 Marine Geology, Oceanography and Physical Processes of the PEIR, concludes that no significant effect on the wave or tidal regime is anticipated for North Falls and therefore the effect on the Kentish Knock East MCZ would be negligible.

272. If the array or interconnector cables cannot be buried, they would be surface laid and protected in some manner, and cable protection would be required at cable crossings. Cable protection will take the form of rock or concrete mattresses. If protection is required, any linear protrusion on the seabed may also interrupt sediment transport processes.

273. However, armoured cables or cable protection works sit relatively low above the seabed (a maximum of 1.4m) and therefore there is unlikely to be any significant effect on suspended sediment processes, with sandwaves passing over the protection. Gross patterns of sediment transport would therefore not be affected significantly. Further detail can be found in Chapter 8 of the PEIR.

274. Biological communities recorded in the overlap of the MCZ and south array are not sensitive to the pressures associated with effects on sediment transport (Natural England, 2022b) and will therefore not be significantly affected.

275. Based on the relevant pressure, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ features, it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by effects on sediment transport related to the operation of North Falls.

8.2.2.6 Impact 6: Underwater noise and vibration

276. Underwater noise and vibration may occur during the operational phase as a result of WTG operation, through the tower and foundations into the water. In turn, benthic ecology receptors may be affected.

277. As described in Section 8.2.1.5 there are a number of studies into the effects of underwater noise and vibration on various crustaceans. Evidence suggests that benthic crustacean species exhibit behavioural responses to change in underwater noise and vibration.

278. However, the magnitude of underwater noise and vibration from wind farm operation is much lower than during construction for activities like piling and UXO clearance.

279. Biological communities recorded in the overlap of the MCZ and south array are not sensitive (Natural England, 2022b) to underwater noise changes and therefore would not be affected during O&M activities.

280. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of affected Kentish Knock East MCZ, it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by underwater noise and vibration.

8.2.2.7 Impact 7: Colonisation of foundations, scour protection and cable protection

281. Hard infrastructure that has been placed in the benthic environment is likely to be colonised by native and/or INNS for the life of the Project for infrastructure that will be removed at decommissioning (e.g. foundations), or permanently for infrastructure that may be left in situ on decommissioning e.g. cable protection and scour protection. The impacts of INNS are discussed in Section 8.2.2.8.

282. A turbine colonisation investigation was carried out for GGOW in 2013, which found an abundance of *M. edulis* and *S. spinulosa* had colonised the hard infrastructure introduced for the project (CMACS, 2013).

283. Whilst this represents an increase in biodiversity, it is a change from sedimentary habitat to hard substrate. Biological communities recorded in the overlap of the MCZ and the south array are sensitive to the pressure ‘Physical change to another sediment type’ (Natural England, 2022b).

284. The impact of colonisation is closely related to that of habitat loss (Section 8.2.2.2) as the sediment habitat is lost and replaced with the hard artificial substrate associated with the Project infrastructure.

285. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of effected Kentish Knock East MCZ, it is concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal mixed sediment and subtidal coarse sediment could be hindered by colonisation of foundations, scour protection and cable protection.

8.2.2.8 Impact 8: Introduction or spread of INNS

286. INNS have two pathways of introduction in the operational phase. As discussed above in Section 8.2.2.7 one pathway is through increased vessel activity through the MCZ and the second pathway is through the installation of hard infrastructure into the MCZ.

287. There are a number of studies into hard infrastructure and its use as a 'steppingstone' for INNS. The introduction of hard infrastructure to a predominantly sandy environment provides an opportunity for species unable to colonise in these conditions, to find suitable habitat.

288. The increasing numbers of wrecks, oil and gas rigs, and now offshore wind turbines, has led to a notable increase in the number of INNS found in the southern North Sea. Kerckhof et al., 2011 looked at the colonisation of benthic fauna on wind turbines in the North Sea and found over a third of species to be non-indigenous. These included the oyster *Crassostrea gigas* and the limpet *Patella vulgata*. Their study provides strong evidence to suggest INNS use hard infrastructure as 'steppingstones' to colonise in new communities. However, a turbine colonisation investigation of GGOW in 2013 found no evidence of INNS.

289. As discussed in Section 8.2.1.6, the risk of introduction and spread of INNS will be mitigated through adherence to the relevant regulations and guidance stated in Section 8.1.1.3. Furthermore the occurrence of vessel activity in the operational phase will be significantly less than in the construction phase.

290. Based on the relevant pressures, receptor sensitivity and assessment of impacts against the attributes of effected Kentish Knock East MCZ, it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal mixed sediment will not be hindered by the introduction of INNS.

8.2.2.9 Impact 9: Electromagnetic fields

291. There is potential for array/interconnector cables within the MCZ to produce electromagnetic fields (EMFs) that could interfere with the behaviour of benthic species. With increasing demand for OWF's, the topic of the effects of EMF on benthic species has gained growing interest.

292. Three broadscale marine habitat features, and the benthic organisms associated with them, have the potential to be affected by EMF during operation:

- Subtidal coarse sediment
- Subtidal sand
- Subtidal mixed sediments

293. The impact of EMF has been defined using the following pressure identified by Natural England's AoO for the Kentish Knock East MCZ:

- Electromagnetic changes

294. Studies have found contrasting behaviours in benthic species towards EMF. Spiny lobster *Panulirus argus*, American lobster *Homarus americanus* and the edible crab *Cancer pagarus* have been found to exhibit behavioural responses to EMF where they favoured EMF sources (Boles and Lohmann, 2003, Hutchinson et al., 2020 and Scott et al., 2018). Conversely, yellow rock crabs *Metacarcinus anthonyu* and red rock crabs *Cancer productus* have been found to have no preference to EMF sources (Love et al., 2015). The effects of EMF have been assessed further in Chapter 10 Benthic and Intertidal Ecology of the PEIR.

295. The effects of EMF will not directly affect physical attributes as set out by Natural England therefore they have not been assessed here.

8.2.2.9.1 Biological attributes

296. The following biological attributes of protected features are relevant to EMF impacts:

- Distribution: presence and spatial distribution of biological communities

297. Natural England's AoO states that biotopes which have the potential to be associated with EMF currently have insufficient evidence to assess. This is defined as: "*The evidence base is not considered to be developed enough for assessments to be made of sensitivity at the pressure benchmark. This activity-pressure-feature combination should therefore be taken to further assessment. The best available evidence, relevant to the activity in question, at the time of application, should be sourced and considered in any further assessment.*"

298. Using the previously discussed evidence for effects of EMF and further information provided by MarESA, the sensitivity of each feature has been concluded as negligible due to evidence suggesting that there is no direct interaction between EMF and the biotopes (Natural England, 2022b).

8.2.2.9.2 Summary

299. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of affected Kentish Knock East MCZ features it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by EMF related to the operation of North Falls.

8.2.3 Potential Impacts during decommissioning

300. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the proposed North Falls to ensure it is in line with the most recent guidance, policy and legislation.

301. The scope of the decommissioning works would most likely involve removal of the accessible installed components. This is outlined in Chapter 5 Project Description and the detail would be agreed with the relevant authorities at the time of decommissioning. Offshore, this is likely to include removal of all of the wind turbine components and part of the foundations (those above seabed level), removal of some or all of the array and export cables. Scour and cable protection would likely be left in situ.

302. The following effects have been considered for decommissioning:

- Temporary physical disturbance
- Increased suspended sediment concentrations
- Re-mobilisation of contaminated sediments
- Effects on sediment transport
- Underwater noise and vibration

303. Effects on the features of the MCZ would be no greater than, and are expected to be less than, those of the construction phase for all effects (Section 8.2.1).

304. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of affected Kentish Knock East MCZ features it can be concluded that the conservation objectives of maintaining subtidal sands and recovering subtidal coarse sediment and mixed sediment to favourable condition will not be hindered by any of the effects related to the decommissioning of North Falls.

8.3 Orford Inshore MCZ

Table 8.5 Pressures assessed in relation to the relevant attributes during the Orford Inshore MCZ Stage 1 Assessment. Light blue – no impact pathway, Dark blue – assessment undertaken.

MCZ feature attributes		Impacts														
Attribute type	Attribute	Construction					Operation					Decommissioning				
		Increased suspended sediment concentration	Re-mobilisation of contaminated sediments	Sediment deposition (smothering)	Underwater noise and vibration	Introduction or spread of INNS	Increased suspended sediment concentration	Re-mobilisation of contaminated sediments	Sediment deposition (smothering)	Underwater noise and vibration	Introduction or spread of INNS	Increased suspended sediment concentration	Re-mobilisation of contaminated sediments	Sediment deposition (smothering)	Underwater noise and vibration	Introduction or spread of INNS
Subtidal mixed sediments																
Biological	Distribution: presence and spatial distribution of biological communities	Section 8.3.1.1	N/A	Section 8.3.1.3	N/A	N/A	Section 8.3.2.1	N/A	Section 8.3.2.3	N/A	N/A	Section 8.3.3	N/A	Section 8.3.3	N/A	N/A
Physical	Extent and distribution	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Biological	Structure and function: presence and abundance of key structural and influential species	Section 8.3.1.1	N/A	Section 8.3.1.3	N/A	N/A	Section 8.3.2.1	N/A	Section 8.3.2.3	N/A	N/A	Section 8.3.3	N/A	Section 8.3.3	N/A	N/A
Biological	Structure: non-native species and pathogens (habitat)	N/A	N/A	N/A	N/A	Section 8.3.1.5	N/A	N/A	N/A	N/A	Section 8.3.2.5	N/A	N/A	N/A	N/A	Section 8.3.3
Physical	Structure: sediment composition and distribution	Section 8.3.1.1	N/A	Section 8.3.1.3	N/A	N/A	Section 8.3.2.1	N/A	Section 8.3.2.3	N/A	N/A	Section 8.3.3	N/A	Section 8.3.3	N/A	N/A
Biological	Structure: species composition of component communities	Section 8.3.1.1	N/A	Section 8.3.1.3	Section 8.3.1.4	N/A	Section 8.3.2.1	N/A	Section 8.3.2.3	Section 8.3.2.4	N/A	Section 8.3.3	N/A	Section 8.3.3	Section 8.3.3	N/A
Physical	Supporting processes: energy / exposure	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: physico-chemical properties (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: sediment contaminants	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: sediment movement and	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

MCZ feature attributes		Impacts														
Attribute type	Attribute	Construction					Operation					Decommissioning				
		Increased suspended sediment concentration	Re-mobilisation of contaminated sediments	Sediment deposition (smothering)	Underwater noise and vibration	Introduction or spread of INNS	Increased suspended sediment concentration	Re-mobilisation of contaminated sediments	Sediment deposition (smothering)	Underwater noise and vibration	Introduction or spread of INNS	Increased suspended sediment concentration	Re-mobilisation of contaminated sediments	Sediment deposition (smothering)	Underwater noise and vibration	Introduction or spread of INNS
	hydrodynamic regime (habitat)															
Physical	Supporting processes: water quality – contaminants (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – dissolved oxygen (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – nutrients (habitat)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical	Supporting processes: water quality – turbidity (habitat)	Section 8.3.1.1	N/A	Section 8.3.1.3	N/A	N/A	Section 8.3.2.1	N/A	Section 8.3.2.3	N/A	N/A	Section 8.3.3	N/A	Section 8.3.3	N/A	N/A

8.3.1 Potential Impacts during Construction

305. For the purpose of this assessment, advice from NE's AoO for Kentish Knock East MCZ has been used as a proxy for the broadscale habitat feature Subtidal mixed sediments.

306. Both Kentish Knock East MCZ and Orford Inshore MCZ share subtidal mixed sediments as a designated feature and have the same general management approach 'recover to favourable condition'. There are also similarities between the benthic communities, comprising of fine sands through to pebbles; supporting burrowing species of mollusca and cnidaria. Both MCZs serve as essential nursing and spawning grounds for commercially important fish species e.g. sole.

307. Orford Inshore MCZ is approximately 5.5km north of the north array of the Project. Therefore, the magnitude of effect for each impact will be less than those for Kentish Knock East MCZ as the Project will not overlap the MCZ. Impacts from temporary physical disturbance, permanent/long term habitat loss, effects on sediment transport, colonisation of foundations and cable protection and electromagnetic fields have not been considered in respect of the Orford Inshore MCZ as their applicability to Kentish Knock East MCZ was based on infrastructure being constructed within the MCZ.

308. For the following assessment, the same physical and biological attributes as used for Kentish Knock East MCZ are considered, and the sensitivity of featured biotopes remain the same.

8.3.1.1 Impact 1: Increased suspended sediment concentration

309. The effects of increased SSC and subsequent deposition has been discussed in Section 8.2.1.2. Coarse sediments disturbed during construction will settle rapidly to the seabed. Finer sand and mud that is present in the sediment would form a passive plume which would become advected by tidal currents and be indistinguishable from background levels. Therefore due to the increased distance from the offshore project area of the Orford Inshore MCZ compared with the Kentish Knock East MCZ, the effect on the Orford Inshore MCZ will be less than the effect on Kentish Knock East MCZ.

8.3.1.1.1 Summary

310. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by increased SSC and subsequent deposition related to the construction of North Falls.

8.3.1.2 Impact 2: Re-mobilisation of contaminated sediments

311. The effects of re-mobilisation of contaminated sediments have been discussed in Section 8.2.1.3. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.1.2.1 Summary

312. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by re-mobilisation of contaminated sediments related to the construction of North Falls.

8.3.1.3 Impact 3: Sediment deposition (smothering)

313. The effects of sediment deposition have been discussed in Section 8.2.1.2. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.1.3.1 Summary

314. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by sediment deposition related to the construction of North Falls.

8.3.1.4 Impact 4: Underwater noise and vibration

315. The effects of underwater noise and vibration has been discussed in Section 8.2.1.5. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.1.4.1 Summary

316. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by underwater noise and vibration related to the construction of North Falls.

8.3.1.5 Impact 5: Invasive species

317. The effects of INNS have been discussed in Section 8.2.1.6. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.1.5.1 Summary

318. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by INNS related to the construction of North Falls.

8.3.2 Potential Impacts during Operation

8.3.2.1 Impact 1: Increased suspended sediment concentration

319. The effects of increased SSC and subsequent deposition has been discussed in Section 8.2.2.3. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.2.1.1 Summary

320. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by increased SSC and subsequent deposition related to the operation of North Falls.

8.3.2.2 Impact 2: Re-mobilisation of contaminated sediments

321. The effects of re-mobilisation of contaminated sediments have been discussed in Section 8.2.2.4. However, the effect on the Orford Inshore MCZ will be lesser

than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.2.2.1 Summary

322. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by re-mobilisation of contaminated sediments related to the operation of North Falls.

8.3.2.3 Impact 3: Sediment deposition (smothering)

323. The effects of sediment deposition have been discussed in Section 8.2.2.3. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.2.3.1 Summary

324. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by sediment deposition related to the operation of North Falls.

8.3.2.4 Impact 4: Underwater noise and vibration

325. The effects of underwater noise and vibration has been discussed in Section 8.2.2.6. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.2.4.1 Summary

326. Due to the distance of the Orford Inshore MCZ from the north array, there are no anticipated noise impacts during the operational phase. It can therefore be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by underwater noise and vibration related to the operation of North Falls.

8.3.2.5 Impact 5: Invasive species

327. The effects of INNS have been discussed in Section 8.2.2.7 and Section 8.2.2.8. However, the effect on the Orford Inshore MCZ will be lesser than the Kentish Knock East MCZ due to the increased distance from the offshore project area.

8.3.2.5.1 Summary

328. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by INNS related to the operation of North Falls.

8.3.3 Potential Impacts during Decommissioning

329. Effects would be no greater than, and are expected to be less than, those of the construction phase (Section 8.3.1), and will affect the same features and attributes.

330. Unlike during the construction phase, there will be no requirement for sandwave levelling and therefore the volume of sediment plumes would be significantly less. Other activities would be a reverse of construction and therefore have similar effects (see Table 5.2).

331. A decision regarding the final decommissioning policy is yet to be decided as it is recognised that rules and legislation change over time in line with best industry practice. The decommissioning methodology and programme would need to be finalised nearer to the end of the lifetime of the proposed North Falls to ensure it is in line with the most recent guidance, policy and legislation.

332. The following effects have been considered for decommissioning:

- Increased suspended sediment concentration
- Re-mobilisation of contaminated sediments
- Sediment deposition (smothering)
- Underwater noise and vibration
- Invasive species

333. Based on the relevant pressures, receptor sensitivity, and the assessment of impacts against the attributes of Orford Inshore MCZ features it can be concluded that the conservation objective of recovering subtidal mixed sediment to favourable condition will not be hindered by any of the effects related to the decommissioning of North Falls.

8.4 Cumulative Effects

8.4.1 Identification of potential cumulative effects

334. The first step in the CEA process is the identification of which residual effects assessed for North Falls on their own have the potential for a cumulative effect with other projects, plans and activities. This information is set out in Table 8.6 below.

Table 8.6 Potential cumulative effect

Impact	Potential For Cumulative Effect	Rationale
Construction		
Temporary physical disturbance	Yes	Effects will occur at isolated locations for a time-limited duration and are local in nature with a negligible impact magnitude. However, due to nearby offshore wind farms, cumulative effects must be assessed.
Increased SSC	Yes	Increases in SSC are expected to be localised at the point of discharge and short-term. The small quantities of fine sediment may be transported further; however, it will be widely and rapidly dispersed and not increase the volume of sediment already present in the benthos. The elevation of SSC is expected to be lower than concentrations that would develop in the water column during storm conditions. However, due to nearby offshore wind farms, cumulative effects must be assessed.
Re-mobilisation of contaminated sediments	No	The level of contaminated sediment found in the offshore site investigation will not hinder the conservation objectives of the MCZ's therefore there is no potential for cumulative effect with other plans and projects.
Effects on sediment transport	No	Effects to bedload sediment are considered to be short term and temporary and will not hinder the conservation objectives of the MCZ's therefore there is no potential for cumulative effect with other plans and projects.

Impact	Potential For Cumulative Effect	Rationale
Underwater noise and vibration	No	The sensitivity of benthic ecology receptors to underwater noise and vibration is considered to be negligible and underwater noise effects will be localised, with the highest magnitude noise sources being short term and intermittent.
Colonisation of foundations and cable protection	Yes	It is likely that benthic organisms will successfully colonise introduced infrastructure. Biosecurity measures will be used to prevent the introduction of INNS. The risk of introduction to the southern North Sea is not considered to be significantly increased as a result of the project. However, due to the potential for larvae to disperse over distances greater than one hundred kilometres (Álvarez-Noriega et al., 2020), this impact must be considered.
Introduction or spread of INNS	Yes	It is likely that benthic organisms will successfully colonise introduced infrastructure. Biosecurity measures will be used to prevent the introduction of INNS. The risk of introduction to the southern North Sea is not considered to be significantly increased as a result of the project. However, due to the potential for larvae to disperse over distances greater than one hundred kilometres (Álvarez-Noriega et al., 2020), this impact must be considered.
Operation		
Temporary physical disturbance	Yes	Effects will occur at isolated locations for a time-limited duration and are local in nature with a negligible impact magnitude. However, due to nearby offshore wind farms, cumulative effects must be assessed.
Permanent/long term lasting habitat loss	No	Permanent/ long term lasting habitat loss would only occur within the Kentish Knock East MCZ and there is no potential for cumulative effect with other plans and projects.
Increased SSC	Yes	Effects will occur at isolated locations for a time-limited duration and are local in nature with a negligible impact magnitude. However, due to nearby offshore wind farms, cumulative effects must be assessed.
Re-mobilisation of contaminated sediments	No	The level of contaminated sediment found in the offshore site investigation will not hinder the conservation objectives of the MCZ's therefore there is no potential for cumulative effect with other plans and projects.
Effects on bedload sediment transport	No	Effects to bedload sediment are considered to be short term and temporary and will not hinder the conservation objectives of the MCZ's therefore there is no potential for cumulative effect with other plans and projects.
Underwater noise and vibration	No	The sensitivity of benthic ecology receptors to underwater noise and vibration is considered to be negligible and underwater noise effects will be localised, with the highest magnitude noise sources being short term and intermittent.
Colonisation of foundations and cable protection	Yes	It is likely that benthic organisms will successfully colonise introduced infrastructure. Biosecurity measures will be used to prevent the introduction of INNS. The risk of introduction to the southern North Sea is not considered to be significantly increased as a result of the project. However, due to the potential for larvae to disperse over distances greater than one hundred kilometres (Álvarez-Noriega et al., 2020), this impact must be considered.

Impact	Potential For Cumulative Effect	Rationale
Introduction or spread of INNS	Yes	It is likely that benthic organisms will successfully colonise introduced infrastructure. Biosecurity measures will be used to prevent the introduction of INNS. The risk of introduction to the southern North Sea is not considered to be significantly increased as a result of the project. However, due to the potential for larvae to disperse over distances greater than one hundred kilometres (Álvarez-Noriega et al., 2020), this impact must be considered.
Electromagnetic fields	No	EMF will be highly localised around the offshore cable corridor and interconnector cables and so there will is no potential for cumulative impact.
Decommissioning		
Temporary physical disturbance	Yes	Effects will occur at isolated locations for a time-limited duration and are local in nature with a negligible impact magnitude. However, there is potential for overlap in decommissioning programmes therefore potential cumulative effects.
Re-mobilisation of contaminated sediments	No	The level of contaminated sediment found in the offshore site investigation will not hinder the conservation objectives of the MCZ's therefore there is no potential for cumulative effect with other plans and projects.
Effects on sediment transport	No	Effects to bedload sediment are considered to be short term and temporary and will not hinder the conservation objectives of the MCZ's therefore there is no potential for cumulative effect with other plans and projects.
Underwater noise and vibration	No	The sensitivity of benthic ecology receptors to underwater noise and vibration is considered to be negligible and underwater noise effects will be localised, with the highest magnitude noise sources being short term and intermittent.
Colonisation of foundations and cable protection	Yes	Biosecurity measures will be used to prevent the introduction of INNS. The risk of introduction to the southern North Sea is not considered to be significantly increased as a result of the project. However, due to the potential for larvae to disperse over distances greater than one hundred kilometres (Álvarez-Noriega et al., 2020), this impact must be considered.
Introduction or spread of INNS	Yes	Biosecurity measures will be used to prevent the introduction of INNS. The risk of introduction to the southern North Sea is not considered to be significantly increased as a result of the project. However, due to the potential for larvae to disperse over distances greater than one hundred kilometres (Álvarez-Noriega et al., 2020), this impact must be considered.

335. The second step in the CEA process is the identification of projects, plans and activities within vicinity of the BCRC Estuaries, Kentish Knock East and Orford Inshore MCZs, that have the potential to interact with the proposed North Falls activities. These are presented in Table 8.7:

Table 8.7 Summary of projects considered for the CEA in relation to the BCRC Estuaries, Kentish Knock East and Orford Inshore MCZs

Project, plan or activity	Tier status[3]	Included in the CEA	BCRC Estuaries MCZ	Kentish Knock East MCZ	Orford Inshore MCZ	Rationale
Offshore Wind Farms						
Galloper Offshore Wind farm (GWF)	1	Yes (maintenance impacts only)	No at c.50km between GWF and the MCZ there is no pathway for cumulative effect	Yes	Yes	Both GGOW and GWF are operational therefore there is potential cumulative effect from ongoing maintenance activities. Including: • Temporary physical disturbance and increased SSC • Invasive species
Greater Gabbard Offshore Windfarm (GGOW)	1	Yes (maintenance impacts only)	No at c.50km between GGOW and the MCZ there is no pathway for cumulative effect	Yes	Yes	
Thanet	1	No	N/A	N/A	N/A	Any ongoing effects of maintenance activity from these offshore wind farms will be highly localised and therefore, given the distance from the North Falls offshore project area, there is no pathway for significant cumulative effects. This approach is in keeping with the GWF EIA, where it was agreed with Cefas and Defra that no assessment of cumulative effects was required with other Round 2 sites in the Thames strategic area (except GGOW).
London Array	1	No	N/A	N/A	N/A	
Gunfleet Sands	1	No	N/A	N/A	N/A	
East Anglia TWO	3	Yes	Yes, however there is only a pathway for cumulative effect for invasive species.	Yes, however there is only a pathway for cumulative effect for invasive species.	Yes	Potential for cumulative effect during construction and operational phases due to the proximity of the projects. Including: • Temporary physical disturbance and increased SSC
Five Estuaries	6	Yes	Yes	Yes	No at c.15km between Five Estuaries and the MCZ there is no	

[3] Tiers in accordance with Natural England and Defra (2022) and based on project status at the time of writing

Project, plan or activity	Tier status[3]	Included in the CEA	BCRC Estuaries MCZ	Kentish Knock East MCZ	Orford Inshore MCZ	Rationale
					pathway for significant cumulative effect	• Invasive species
Cables						
East Anglia ONE – Cable, Wind Export, Active/In Operation	1	Yes	No at c.30km between the East Anglia ONE export cable and the MCZ there is no pathway for cumulative effect	No at c.30km between the East Anglia ONE export cable and the MCZ there is no pathway for cumulative effect	Yes	The export cable runs adjacent to the Orford Inshore MCZ and has been operational since 2020. Potential for cumulative effect during maintenance. Including: • Temporary physical disturbance and increased SSC • Invasive species
Atlantic Crossing 1 – Telecom, Active	1	No	N/A	N/A	N/A	The Atlantic Crossing 1 cable has been operational since 1999. There is therefore no potential for cumulative effect on the identified receptors.
BRITNED HVDC – Britned Power, Power cable, Active	1	No	N/A	N/A	N/A	The BritNed Interconnector has been operational since 2009. There is therefore no potential for cumulative impact on the identified receptors.
Farland North – BT, Telecom cable, Active	1	No	N/A	N/A	N/A	The Farland North Cable has been operational since 1998. There is therefore no potential for cumulative impact on the identified receptors.
Concerto – Telecom, Active	1	No	N/A	N/A	N/A	The Concerto cable has been operational since 1999. There is therefore no potential for cumulative impact on the identified receptors.
East Anglia THREE – Cable, Wind Export, Active/In Operation	2	Yes	No at c.30km between the East Anglia THREE export cable and the MCZ there is no pathway for cumulative effect	No at c.30km between the East Anglia THREE export cable and the MCZ there is no pathway for cumulative effect	Yes	The export cable runs adjacent to the Orford Inshore MCZ so there will be potential for cumulative effect during operational phases. Including:

Project, plan or activity	Tier status[3]	Included in the CEA	BCRC Estuaries MCZ	Kentish Knock East MCZ	Orford Inshore MCZ	Rationale
						• Temporary physical disturbance and increased SSC • Invasive species
NeuConnect – Electric power	3	Yes	Yes	Yes	No at c.20km between the interconnector cable and the MCZ there is no pathway for cumulative effect	The NeuConnect Interconnector bisects the North Falls offshore cable corridor and interconnector cable corridor and there is potential for temporal overlap of cable installation activities. Including: • Temporary physical disturbance and increased SSC • Invasive species
Tarchon Energy Ltd – EA Green Interconnector	6	Yes (subject to available information)	Cable route currently unknown			
Nautilus	6	Yes (subject to available information)	Cable route currently unknown			
South & East Anglia (SEA) Link	6	Yes (subject to available information)	Cable route currently unknown			
Mercator – BT, Telecom, Proposed	6	Yes (subject to available information)	N/A	Yes	N/A	The Mercator cable is proposed to be placed approximately 11.5km south of Kentish Knock East MCZ. Construction was planned for 2020/2021 however there are no further updates to the programme schedule.
Aggregates						
Longsand aggregate production agreement 510	1	Yes	No at c.35km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes	No at c.35km between the aggregate site and the MCZ there is no pathway for cumulative effect	There is potential for some interaction between dredging and aggregate exploration during construction and operational phases of North Falls. Including: • Temporary physical disturbance and increased SSC • Invasive species
Thames D aggregates production agreement area 524	1	Yes	No at c.55km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes	No at c.35km between the aggregate site and the MCZ there is no	

Project, plan or activity	Tier status[3]	Included in the CEA	BCRC Estuaries MCZ	Kentish Knock East MCZ	Orford Inshore MCZ	Rationale
					pathway for cumulative effect	
Southwold East aggregates production agreement 430	1	Yes	No at c.80km between the aggregate site and the MCZ there is no pathway for cumulative effect	No at c.60km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes	
North Inner Gabbard aggregate production agreement area 498	1	Yes	No at c.60km between the aggregate site and the MCZ there is no pathway for cumulative effect	No at c.35km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes	
Shipwash aggregate production agreement area 507	1	Yes	No at c.40km between the aggregate site and the MCZ there is no pathway for cumulative effect	No at c.25km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes	
Outer OTE aggregate exploration and options area 528/2	4	Yes	No at c.35km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes (subject to available information)	No at c.45km between the aggregate site and the MCZ there is no pathway for cumulative effect	
East Orford Ness aggregate exploration and option area 1809	4	Yes	No at c.60km between the aggregate site and the MCZ there is no pathway for cumulative effect	No at c.35km between the aggregate site and the MCZ there is no pathway for cumulative effect	Yes (subject to available information)	

8.4.2 Assessment of cumulative effects

8.4.2.1 Temporary physical disturbance and increased suspended sediment concentrations

336. Temporary physical disturbance and increased sediment concentrations have been assessed collectively as a cumulative effect due to increased SSC in the water column being a direct consequence of temporary physical disturbance.

337. There is potential for construction or operation works for North Falls to be conducted at the same time, or similar time, to Five Estuaries, as well as maintenance works at GGOW and GWF. There is also potential for overlap with the latter stages of the NeuConnect interconnector construction programme and dredging works from the Thames D aggregates production agreement area 524.

338. Cumulative effects from temporary physical disturbance and increased suspended sediment could pose an effect to BCRC Estuaries MCZ, Kentish Knock East MCZ and Orford Inshore MCZ.

339. As discussed in Sections 8.1.1.1, 8.1.2.1, 8.1.3.1, 8.2.1.1, 8.2.1.2, 8.2.2.1, 8.2.2.3, 8.2.3, 8.3.1.1, 8.3.2.1 and 8.3.3, the effects of North Falls will be localised and relatively short term, through the duration of the construction period. The projects with a potential cumulative effect are within a 15km distance to the MCZs and no closer than the Project itself. Furthermore, the magnitude of effect from cumulative projects has been determined as negligible.

340. The features of the MCZs are considered to have low sensitivity to the effects of temporary physical disturbance (Natural England, 2022a and 2022b) and no sensitivity to the effects of SSC (Natural England, 2022a and 2022b).

341. It can therefore be concluded that the conservation objectives for the designated features of both MCZs will not be hindered by temporary physical disturbance and increased suspended sediment concentrations.

8.4.2.2 Invasive species

342. The introduction of hard substrate to the benthic environment has the potential to provide a steppingstone for the colonisation of INNS. With GGOW and GWF adjacent to the north and south arrays, the construction of North Falls will cumulatively provide more opportunities for INNS to establish themselves on the infrastructure. However, as the surrounding region has existing hard infrastructure in place, for example from wrecks and existing OWFs, the construction of the Project, along with East Anglia TWO and Five Estuaries, will not significantly increase the risk of INNS, as ‘steppingstones’ have existed in the study area for a prolonged period of time.

343. The cumulative risk is also associated with the movement of vessels in and out of the region. However, as previously considered in Sections 8.1.1.3, 8.1.2.3, 8.1.3.3, 8.2.1.6, 8.2.2.8, 8.2.3, 8.3.1.5 and 8.3.2.5 the introduction of INNS through vessels will be mitigated through adherence with MARPOL, BWM and The Environmental Damage Regulations 2015 guidelines.

344. It can therefore be concluded that the conservation objectives for the designated features of the three MCZs will not be hindered by invasive species.

9 Stage 1 Assessment Conclusion

345. Based on the information presented in the preceding sections, which include assessments on the relevant broadscale habitats and habitat FOCI, it can be concluded that the conservation objective for native oysters and native oyster beds of recover to favourable condition in the BCRC Estuaries MCZ will not be hindered by the construction, operation and decommissioning phases of North Falls.

346. It can be concluded that the conservation objective of subtidal mixed sediments of recover to favourable condition in the Orford Inshore MCZ will not be hindered by the construction, operation and decommissioning phases of North Falls.

347. It can be concluded that the conservation objective of subtidal sand of maintain in favourable condition and the conservation objective of subtidal coarse sediment and subtidal mixed sediments of recover to favourable condition in the Kentish Knock East MCZ will not be hindered by the construction and decommissioning phases of North Falls. However, the assessment concluded that during the operational phase of North Falls, permanent / long term habitat loss and colonisation of project infrastructure may hinder the conservation objectives of the Kentish Knock East MCZ.

348. Consultation feedback on this preliminary Stage 1 Assessment will be considered and the MCZA updated for the DCO application.

349. Based on the outcome of the final Stage 1 Assessment to be produced for the DCO application, a Stage 2 Assessment will be completed, if required. A review of potential MEEB options is provided in Appendix 2 to inform stakeholder consultation. A MEEB Plan would be developed as part of the Stage 2 Assessment, if required.

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