Morecambe Offshore Windfarm: Generation Assets

Development Consent Order Documents

Volume 4

Marine Conservation Zone Assessment

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Rev 02

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Glossary of Acronyms

AC	Alternating current
AfL	Agreement for Lease
AoO	Advice on Operations
AyM	Awel y Môr (Offshore Windfarm)
BAC	Background Assessment Concentrations
BAS	Burial Assessment Study
BEIS	Department of Business, Energy and Industrial Strategy[1]
CBRA	Cable Burial Risk Assessment
CEA	Cumulative Effects Assessment
Cefas	Centre for Environment, Fisheries and Aquaculture
DCO	Development Consent Order
DECC	Department of Energy and Climate Change[1]
DEFRA	Department for Environment, Food & Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DML	Deemed Marine Licence
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPP	Evidence Plan Process
EPS	European Protected Species
ERL	Effects Range Low
ES	Environmental Statement
ETG	Expert Topic Groups
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
GBS	Gravity Based Structures
GIS	Geographical Information System
HAT	Highest Astronomical Tide
HRA	Habitats Regulations Assessment
IFCA	Inshore Fisheries Conservation Authority
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide

[1] The Department of Energy and Climate Change (DECC) was disbanded and merged with the Department for Business, Innovation and Skills to form the Department for Business, Energy and Industrial Strategy (BEIS) in2016. As of February 2023, BEIS is known as the Department for Energy Security and Net Zero (DESNZ)

MarESA	Marine Evidence-based Sensitivity Assessment
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCZ	Marine Conservation Zone
MCZA	Marine Conservation Zone Assessment
MCZP	Marine Conservation Zone Project
MEEB	Measures of equivalent environmental benefit
ML	Marine Licence
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSL	Mean Sea Level
NSIP	Nationally Significant Infrastructure Project
OFTO	Offshore Transmission Owner
OSPAR	Oslo and Paris Conventions
OWF	Offshore Windfarm
PAH	Polycyclic Aromatic Hydrocarbons
PDE	Project Design Envelope
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PTS	Permanent Threshold Shift
RIAA	Report to Inform Appropriate Assessment
SACOs	Supplementary Advice on Conservation Objectives
SNCBs	Statutory Nature Conservation Bodies
SoS	Secretary of State
SSC	Suspended sediment concentrations
TH	Trinity House
TTS	Temporary Threshold Shift
UK	United Kingdom
UXO	Unexploded Ordnance
WTG(s)	Wind turbine generator(s)
ZoI	Zone of Influence

Glossary of Unit Terms

km	kilometre
kV	kilovolt
m	metre
MW	Megawatts

Glossary of Terminology

Applicant	Morecambe Offshore Windfarm Ltd
Application	This refers to the Applicant's application for a Development Consent Order (DCO). An application consists of a series of documents and plans which are published on the Planning Inspectorate's (PINS) website.
Advice on Operations	One component of conservation advice packages from Natural England for Marine Protected Areas (MPAs).
Agreement for Lease (Afl)	Agreements under which seabed rights are awarded following the completion of The Crown Estate tender process.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) for certain topics. The EPP provides a mechanism to agree the information required to be submitted to PINS as part of the DCO application. This function of the EPP helps Applicants to provide sufficient information in their application, so that the Examining Authority can recommend to the Secretary of State whether or not to accept the application for examination and whether an appropriate assessment is required.
Expert Topic Group (ETG)	A forum for targeted engagement with regulators and interested stakeholders through the EPP.
Generation Assets (the Project)	Generation assets associated with the Morecambe Offshore Windfarm. This is infrastructure in connection with electricity production, namely the fixed foundation wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s).
Inter-array cables	Cables which link the WTGs to each other and the OSP(s).
In-row	The distance separating WTGs in the main rows.
Inter-row	The distance between the main rows.
Landfall	Where the offshore export cables would come ashore.
Marine Conservation Zones (MCZs)	MCZs are areas that protect a range of nationally important, rare or threatened habitats and species. MCZs in English, Welsh and Northern Irish offshore waters are designated under the Marine and Coastal Access Act (2009) (MCA). The Marine Act (Northern Ireland) 2013 makes provisions for MCZs in Northern Irish territorial waters.

Morgan and Morecambe Offshore Wind Farms: Transmission Assets	The transmission assets for the Morgan Offshore Wind Project and the Morecambe Offshore Windfarm. This includes the OSP(s)[2], interconnector cables, Morgan offshore booster station, offshore export cables, landfall site, onshore export cables, onshore substations, 400kV cables and associated grid connection infrastructure such as circuit breaker infrastructure. Also referred to in this chapter as the Transmission Assets, for ease of reading.
Nacelle	The part of the turbine that houses all of the generating components.
Offshore export cables	The cables which would bring electricity from the OSP(s) to the landfall.
Offshore substation platform(s) (OSP(s))	A fixed structure located within the windfarm site, containing electrical equipment to aggregate the power from the WTGs and convert it into a more suitable form for export to shore.
Platform link cable	An electrical cable which links one or more OSP(s).
Project Design Envelope (PDE)	A PDE provides maximum and minimum parameters, where appropriate, to ensure the worst-case scenario can be quantified and assessed in the EIA, whilst maintaining flexibility.
Safety Zones	An area around a structure or vessel which should be avoided, as set out in Section 95 of the Energy Act 2004 and the Electricity (Offshore Generating Stations) (Safety Zones) (Application Procedures and Control of Access) Regulations 2007.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations, due to the flow of water.
Study area	This is an area which is defined for each EIA topic which includes the offshore development area as well as potential spatial and temporal considerations of the impacts on relevant receptors. The study area for each EIA topic is intended to cover the area within which an effect can be reasonably expected.
Technical stakeholders	Technical stakeholders are organisations with detailed knowledge or experience of the area within which the Project is located and/or receptors which are considered in the EIA and HRA. Examples of technical stakeholders include the Marine Management Organisation (MMO), local authorities, Natural England and the Royal Society for the Protection of Birds (RSPB).
Windfarm site	The area within which the WTGs, inter-array cables, OSP(s) and platform link cables would be present.

[2] At the time of writing the Environmental Statement (ES), a decision had been taken that the offshore substation platforms (OSP(s)) would remain solely within the Generation Assets application and would not be included within the Development Consent Order (DCO) application for the Transmission Assets. This decision post-dated the Preliminary Environmental Information Report (PEIR) that was prepared for the Transmission Assets. The OSP(s) are still included in the description of the Transmission Assets for the purposes of this document as the in-combination effects assessment carried out in respect of the Generation/Transmission Assets is based on the information available from the Transmission Assets PEIR and associated Marine Conservation Zone Assessment (MCZA) documentation.

Wind turbine generator (WTG)	A fixed structure located within the windfarm site that converts the kinetic energy of wind into electrical energy.
Zone of Influence (ZoI)	The ZoI is the maximum anticipated spatial extent of a given potential impact.

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1 Introduction

1.1 Need for Marine Conservation Zone Assessment

1. Morecambe Offshore Windfarm: Generation Assets (herein referred to as the "Project") is a proposed offshore windfarm located in the Eastern Irish Sea, with an expected nominal capacity of 480 megawatts (MW). The Project is located approximately 30km off the Lancashire coast, as illustrated in **Figure 1.1**. It is being developed by Morecambe Offshore Windfarm Ltd (the Applicant).

2. This Report provides the information required to inform Stage One of the Marine Conservation Zone Assessment (MCZA) for the proposed Morecambe Offshore Windfarm Generation Assets (herein "the Project") (see **Section 7**).

3. The MCZA is a requirement of Section 126 of the Marine and Coastal Access Act (2009) (MCAA). Section 126 placed specific duties on regulating authorities, including the consideration of potential impacts on Marine Conservation Zones (MCZs), when determining consent applications.

4. In English waters, regulating authorities include the Marine Management Organisation (MMO) for marine licence applications and the Secretary of State (SoS) for the Department for Energy Security and Net Zero (DESNZ)[3] for Development Consent Order (DCO) applications relating to energy. Consequently, both the MMO and SoS have incorporated the need to include a MCZA into any decision-making processes for developments/plans/projects that have the potential to hinder the achievement of conservation objectives of one or more MCZs.

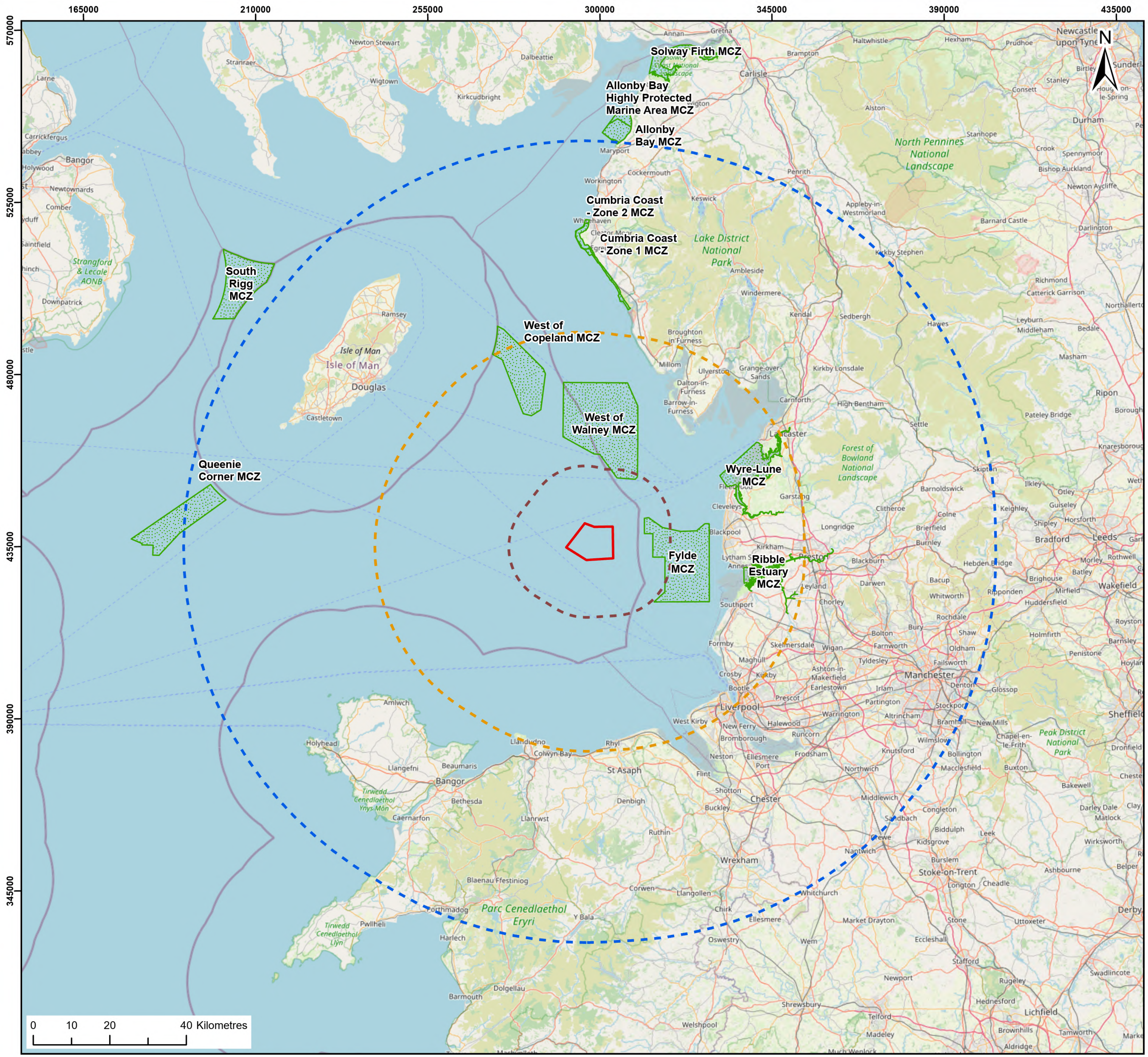
5. The information set out herein, to inform the Stage One assessment, follows a Screening exercise undertaken for the Project, as provided in the DCO Application (Document Reference 4.12) and summarised in **Section 4**. The Stage One assessment assesses the effects of the Project on the conservation objectives of Fylde Coast MCZ (located approximately 8km east of the Project), West of Walney MCZ (located approximately 13km north of the Project), Wyre-Lune MCZ (located approximately 31km east of the Project) and Ribble Estuary MCZ (located approximately 34km east of the Project). Full details of the MCZA process (Stage One assessment and subsequent stages) are provided in **Section 2**.

6. The Stage One assessment has been informed by guidance published by the MMO (2013) and by advice from the Statutory Nature Conservation Bodies

[3] Prior to February 2023, Department for Energy Security and Net Zero (DESNZ) was known as the Department for Business, Energy, and Industrial Strategy (BEIS)

(SNCBs), received during consultation in the pre-application phase of the Project. This assessment should be read alongside the accompanying Environmental Statement (ES).

7. This assessment has been undertaken based on the outline description of the Project provided within **Section 3** which is further detailed in **Chapter 5 Project Description** of the ES (Document Reference 5.1.5).



Legend:

- Morecambe Offshore Windfarm Site
- 100km search area
- 50km potential Zone of Influence for noise
- 15km potential Zone of Influence for suspended sediments
- Marine Conservation Zones (MCZ)

Report: Morecambe Offshore Windfarm: Generation Assets Information for Marine Conservation Zone Assessment

Title: Morecambe Offshore Windfarm location with Marine Conservation Zones with 15km, 50km and 100km buffers

Figure: 1.1 | Drawing No: PC1165-RHD-ES-OF-DR-Z-0058

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
P01	19/04/2024	JH	SB	A3	1:1,000,000

Co-ordinate system: WGS 1984 UTM Zone 30N

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1.2 Legislation, policy and guidance used in the compilation of this report

1.2.1 Marine and Coastal Access Act 2009

8. The UK Marine and Coastal Access Act 2009 (MCAA) established a range of measures to manage the marine environment, including forming a network of MCZs. The Marine Conservation Zone Project (MCZP) was established in 2008, by the Joint Nature Conservation Committee (JNCC) and Natural England, to work with regional stakeholder led projects to identify and recommend MCZs to Government. The designation of the first three Tranches of MCZs is now complete, however, at this time it is not known whether any MCZs will be designated in the future.

9. Sections 125 and 126 of the MCAA placed 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.

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

1.2.2 MCZA guidance

11. This MCZA gives consideration to the following guidance:

- MMO (2013). MCZs and Marine Licensing guidance
- Planning Inspectorate (PINS) (2019). Advice Note Seventeen: Cumulative effects assessment
- Natural England (2022). Natural England's Offshore Wind Environmental Assessments: Best practice advice for evidence and data standards (Phase III: Expectations for data analysis and presentation at examination for offshore wind applications)

- Conservation advice packages and supporting documents from Natural England, including Advice on Operations (AoO), where available
- Advice from stakeholders provided through the Project Evidence Plan Process (EPP)

1.3 Structure of this report

12. This report is set out in the following stages:

- An overview of the MCZA Stage One process (and subsequent stages) (**Section 2**)
- A summary of the main components of the Project (plus signposting to the accompanying ES for more details) (**Section 3**)
- A summary of the MCZ screening exercise undertaken in August 2022 and any changes to the conclusions of that exercise (**Section 4**).
- A summary of the consultation undertaken, relevant to the MCZA (**Section 5**)
- An overview of the MCZs considered in the Stage One assessment and their respective conservation objectives (**Section 6**)
- Provision of information to inform the MCZA Stage One assessment (**Section 7**)
- A summary of conclusions of the Stage One assessment (**Section 8**)
- A list of the references used in compiling this document (**Section 9**)

2 Overview of MCZA process

2.1 Overview

13. Guidance published by the MMO (2013) describes how MCZAs should be undertaken in the context of Marine Licensing decisions. Note, there was no published PINS guidance or advice on MCZAs for DCO applications at the time of assessment.

14. To undertake its Marine Licensing function, the MMO has introduced a three-stage sequential assessment process, summarised in **Plate 2.1**, for considering impacts on MCZs, in line with its duties under Section 126 of the MCAA. Section 126 placed specific duties on all public bodies in undertaking their licencing activities, where they are capable of hindering the conservation objectives of an MCZ.

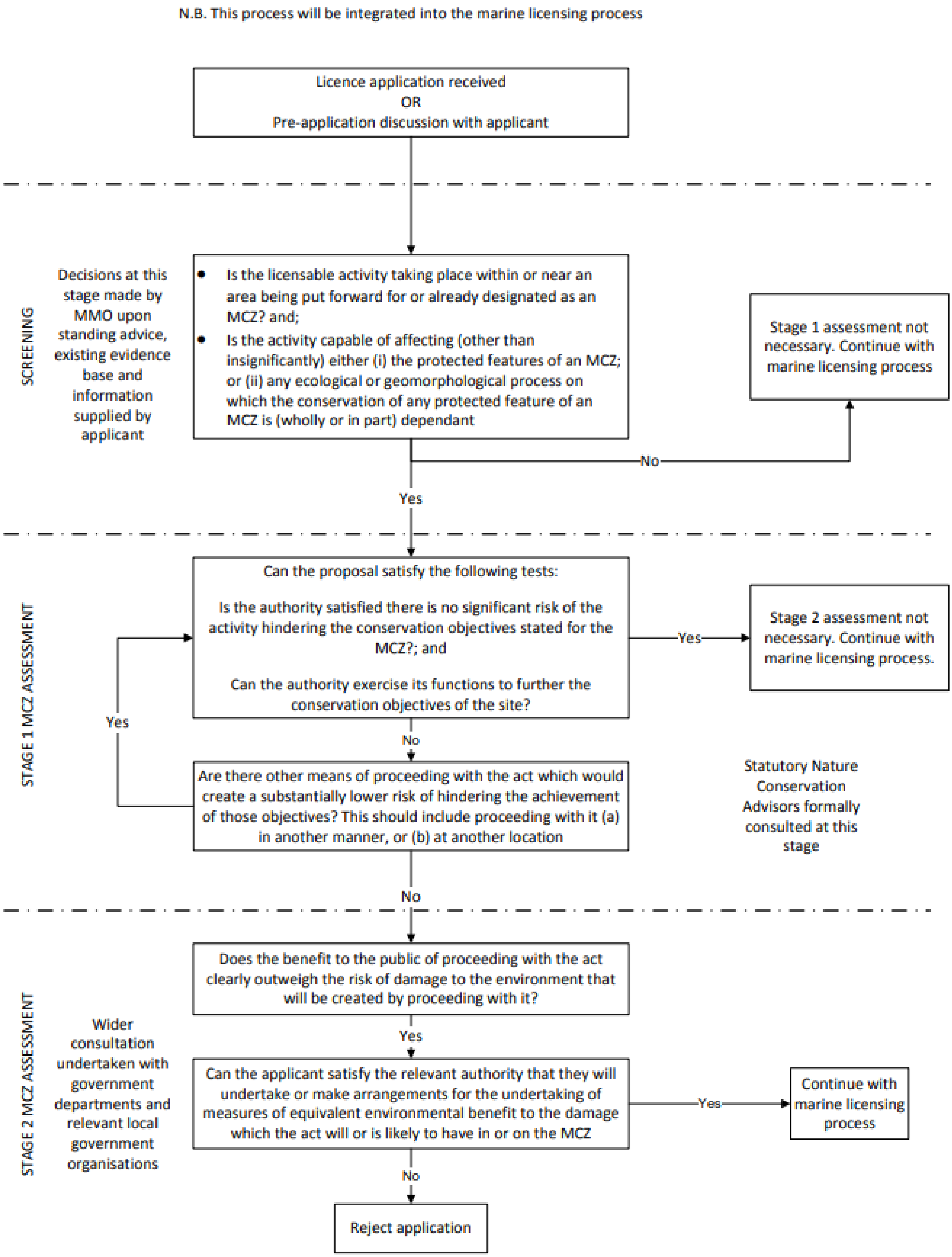

Plate 2.1 MCZA process used for marine licence determination (MMO, 2013)

2.2 Screening

15. The screening process is required to determine whether Section 126 of the MCAA (2009) 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

16. 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 the Stage One assessment and Stage Two assessment. A summary of the screening process for the Project is provided in **Section 4** and within the DCO Application (Document Reference 4.12).

2.3 Stage one assessment

17. The Stage One Assessment (the subject of this report) is designed to consider whether the conditions in Section 126(6) of the MCAA can be met, to determine that:

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

18. The Stage One Assessment considers the extent of the potential impact of the plan or project on MCZs in detail. It looks at whether a plan or project could potentially affect the conservation objectives for a given MCZ; that is whether the plan or project would affect the site to an extent that the features are no longer in favourable condition, or prevent the features from recovering to a favourable condition. If mitigation to reduce the identified effects cannot be secured, and there are no other alternative locations, then the project will be considered under Stage Two of the assessment process. More information on the Stage Two assessment is provided in **Section 2.4**.

19. Within the Stage One Assessment, “hinder“ will be considered as any act that could, either alone or cumulatively:

- 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)

- 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)

20. 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.”

21. The Project approach to determining no significant risk of the licensable activity enabling achievement of the conservation objectives is set out in the following sections.

2.3.1 Receptors

22. For the purposes of the assessment, the receptor refers to MCZ sites, or the habitats and species of conservation interest for which the site is protected.

2.3.2 Magnitude

23. For each identified Project impact, the magnitude of its effect on MCZ features is classified, providing a definition of the spatial extent, duration, frequency, likelihood and reversibility of the impact considered (where applicable). The framework definitions of magnitude, for the purpose of the MCZA assessment are provided in **Table 2.1**.

Table 2.1 Definitions of magnitude for the MCZA assessment

Magnitude	Definition
High	Scale: A change which would extend beyond the natural variations in background conditions Duration: Change persists for more than ten years Frequency: The effect would always occur Reversibility: The effect is irreversible
Medium	Scale: A change which would be noticeable from monitoring but remains within the range of natural variations in background conditions Duration: Change persists for 5-10 years Frequency: The effect would occur regularly but not all the time Reversibility: The effect is very slowly reversible (5-10 years)

Magnitude	Definition
Low	Scale: A change which would barely be noticeable from monitoring and is small compared to natural variations in background conditions Duration: Change persists for 1-5 years Frequency: The effect would occur occasionally but not all the time Reversibility: The effect is slowly reversible (1-5 years)
Negligible	Scale: A change which would not be noticeable from monitoring and is extremely small compared to natural variations in background conditions Duration: Change persists for less than one year Frequency: The effect would occur highly infrequently Reversibility: The effect is quickly reversible (less than one year)

2.3.3 Sensitivity

24. For MCZs, Natural England provides AoO for individual features, which is an indicator of the sensitivity of a given feature to a construction, operation and maintenance or decommissioning related pressure from marine development. For habitat features, this advice has been drawn from the Marine Evidence-based Sensitivity Assessment (MarESA) sensitivity ratings (Tyler-Walters *et al*., 2018) for the typical component biotopes representative of those habitats.

25. In order to determine the sensitivity of the protected features, the AoO, where available, has been referenced in the assessment. Where biotopes associated with a given feature have a range of sensitivities, the highest sensitivity has been applied (as a ‘worst-case’ scenario). The AoO for Fylde MCZ and West of Walney MCZ was available (Natural England, 2022a and 2022b), and has therefore been used. For Wyre-Lune MCZ and Ribble Estuary MCZ, however, an AoO was not available, therefore other sources relating to the sensitivity of smelt (which are a designated feature of both the Wyre-Lune MCZ and the Ribble Estuary MCZ) to noise have been used, as an alternative.

2.3.4 Assessment against conservation objectives

26. Following determination of the magnitude of the impact and the sensitivity of the receptor, the Stage One assessment considers the risk that the Project could hinder the conservation objectives for each MCZ based on professional judgement. Supplementary Advice on Conservation Objectives (SACOs) issued by Natural England, which provide targets for ecological attributes associated with MCZ features, have been taken into consideration where available.

2.3.5 Cumulative effects

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

28. The Project has used PINS Advice Note Seventeen (PINS, 2019), which provided guidance on plans and projects that should be considered in the cumulative assessment. The assessment of potential cumulative effects for the Project is provided in **Section 7.4**. A full description of the methodology of the cumulative assessment is provided in Section 4 of the Screening Report (Document Reference 4.12).

29. This MCZA considers the Generation Assets of the Morecambe Offshore Wind Farm. A separate MCZA is being undertaken for the Morgan and Morecambe Offshore Wind Farms: Transmission Assets project (herein referred to as 'Transmission Assets'). However, given the functional link between the projects, a combined assessment has been undertaken within the cumulative section (**Section 7.4**), to consider both Transmission Assets and the Project together.

2.4 Stage two assessment

30. Although not a feature of this report, a Stage Two assessment considers the socio-economic impact of a plan or project deemed to have the potential to hinder the achievement of conservation objectives, together with the risk of environmental damage. Where a Stage Two assessment is deemed to be required, there are two parts to the Stage Two assessment process that must be considered:

- Does the public benefit in proceeding with the project clearly outweigh the risk of damage to the environment that will be created by proceeding with it? If so,
- Can the applicant satisfy that they can secure, or undertake arrangements to secure, measures of equivalent environmental benefit (MEEB) for the damage the project will have on the MCZ features?

3 Description of the Project

31. This section provides an overview of the main components of the Project which, for the purposes of this MCZA, covers the Generation Assets (wind turbine generators (WTGs), inter-array cables, offshore substation platform(s) (OSP(s)) and possible platform link cables to connect OSP(s)).

32. It also summarises the main licensable activities that would occur during construction, operation and maintenance and decommissioning.

33. A separate MCZA screening and assessment would be undertaken for the transmission assets associated with the Project (which is subject to a separate DCO application process, along with the transmission assets for the Morgan Offshore Wind Project). As such, this associated transmission infrastructure is not described in this section, however, relevant key components to the offshore environment are stated in **Section 7.4.3.1**, where a combined assessment is provided.

3.1 Design envelope approach

34. The Project Design Envelope (PDE) provides maximum and minimum parameters, where appropriate, to ensure the worst-case scenario can be quantified and is assessed in the MCZA while maintaining design flexibility. Therefore, the description of the Project provided here is indicative at this stage and intended to provide context for the wider document and the basis of the assessment.

35. This approach has been widely successful in the consenting of offshore windfarms and is consistent with the PINS Advice Note Nine: Rochdale Envelope (PINS, 2018) which stated that: “The Rochdale Envelope assessment approach is an acknowledged way of assessing a Proposed Development comprising EIA development where uncertainty exists and necessary flexibility is sought”. This is further described in **Chapter 6 EIA Methodology** (Document Reference 5.1.6) of the ES.

3.2 Project infrastructure overview

3.2.1 Windfarm site

36. The Project windfarm site would contain all generation infrastructure. The key characteristics of the Project windfarm site are summarised in **Table 3.1**.

Table 3.1 Morecambe Offshore Windfarm site overview

Parameters	Values
Area (km^2)	87
Closest distance to shore (km)	30 (approximate)
Water depth (m below Lowest Astronomical Tide (LAT))	18 - 40

37. The Agreement for Lease (AfL) area awarded by The Crown Estate, spanned 125km^2. Following consultation on the PEIR, the proposed windfarm site was reduced to approximately 87km^2, as further described in **Chapter 4 Site Selection and Assessment of Alternatives** (Document Reference 5.1.4).

3.2.2 Wind turbine generators

38. The WTG PDE for the Project is outlined in **Table 3.2,** illustrated in **Plate 3.1**, and subsequently described. The information presented in **Table 3.2** includes a range of WTGs with varying parameters and capacity, to accommodate the ongoing rapid development in WTG technology. Accounting for this range, there could be up to 30 'larger' or 35 'smaller' WTGs installed within the windfarm site to generate the nominal export capacity of 480MW.

Table 3.2 WTG design envelope

Parameter	Smaller WTGs	Larger WTGs
Maximum number of WTGs	35	30
Maximum rotor diameter (m)	260	280
Blade tip height (m) above highest astronomical tide (HAT)	290	310
Maximum hub height (m above HAT)	160	170
Minimum rotor clearance above sea level (m above HAT)	25[4]	
Indicative rotor speed range (rotations per minute (RPM))	8.42	7.09
Maximum rotor swept area for total windfarm site (km^2)	1.858	
Minimum separation between WTGs (m) in-row	1,060	1,260

[4] Equivalent to 34.56m above LAT; 26.07m above MHWS; 29.82m above mean sea level (MSL)

Parameter	Smaller WTGs	Larger WTGs
Minimum separation between WTGs (m) inter-row	1,410	1,680

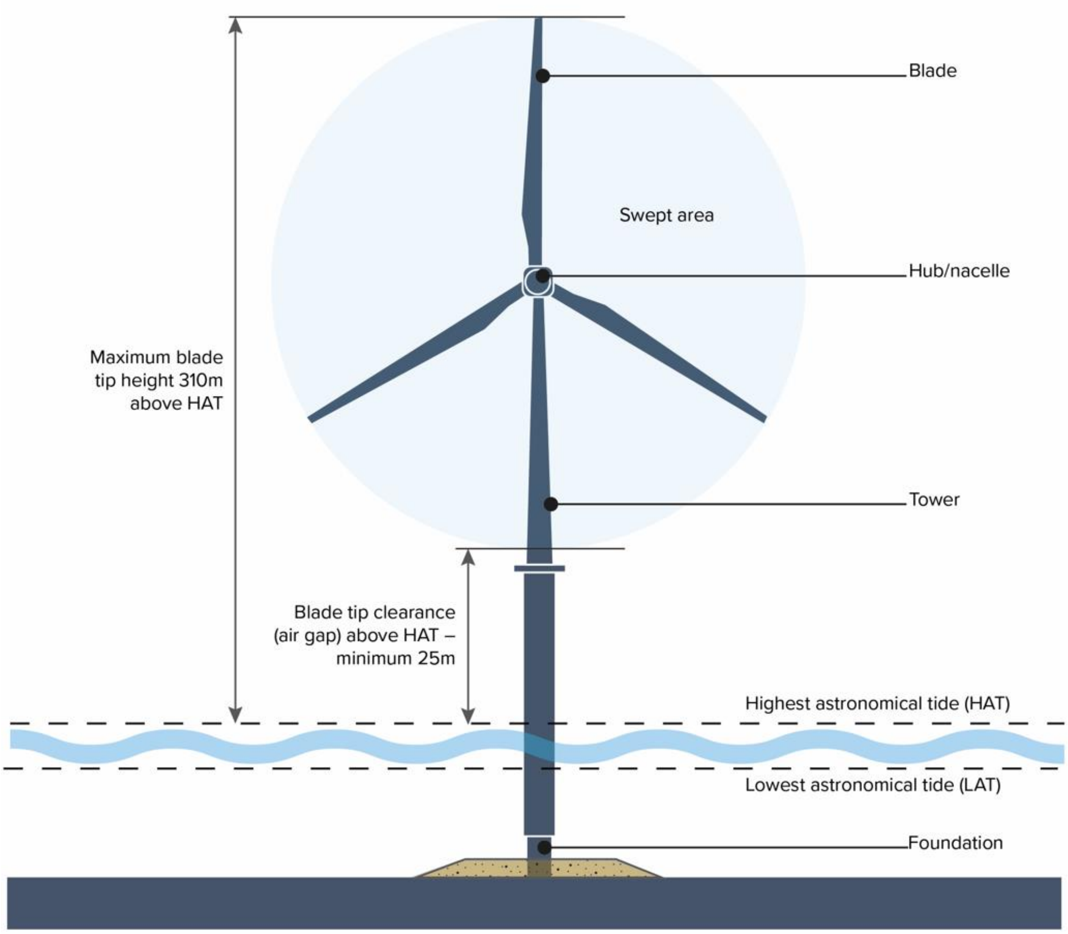

Plate 3.1 WTG schematic

39. The layout of WTGs would be finalised post-consent, in consideration of design rules (as detailed in Marine Guidance Note (MGN) 654) and in consultation with relevant authorities e.g., MMO, Maritime and Coastguard Agency (MCA) and Trinity House (TH). The required lighting and navigational markings would also be agreed post-consent.

3.2.3 Offshore substation platforms

40. The Project would require up to a maximum of two OSPs, depending on the electrical system voltage and final layout. The OSP(s) provide a centralised connection point for the inter-array cable circuits and contain primary electrical equipment and ancillary components that are required to transform the voltage of the electricity generated at the WTGs to a higher voltage suitable for transporting power to the onshore electrical transmission network.

41. The OSP(s) would be situated within the windfarm site and would comprise the following components:

- Transformers
- Batteries
- Generators
- Switchgear
- Fire systems
- Modular facilities for operational and maintenance activities

42. The design of the OSP(s) would include a platform 'topside', supported above sea level on a foundation structure.

43. The typical deck plan of the OSP(s) would be a maximum of 50m by 50m, with the topsides comprising several layers/decks stacked on top of another, as required. **Plate 3.2** shows a schematic of a typical OSP.

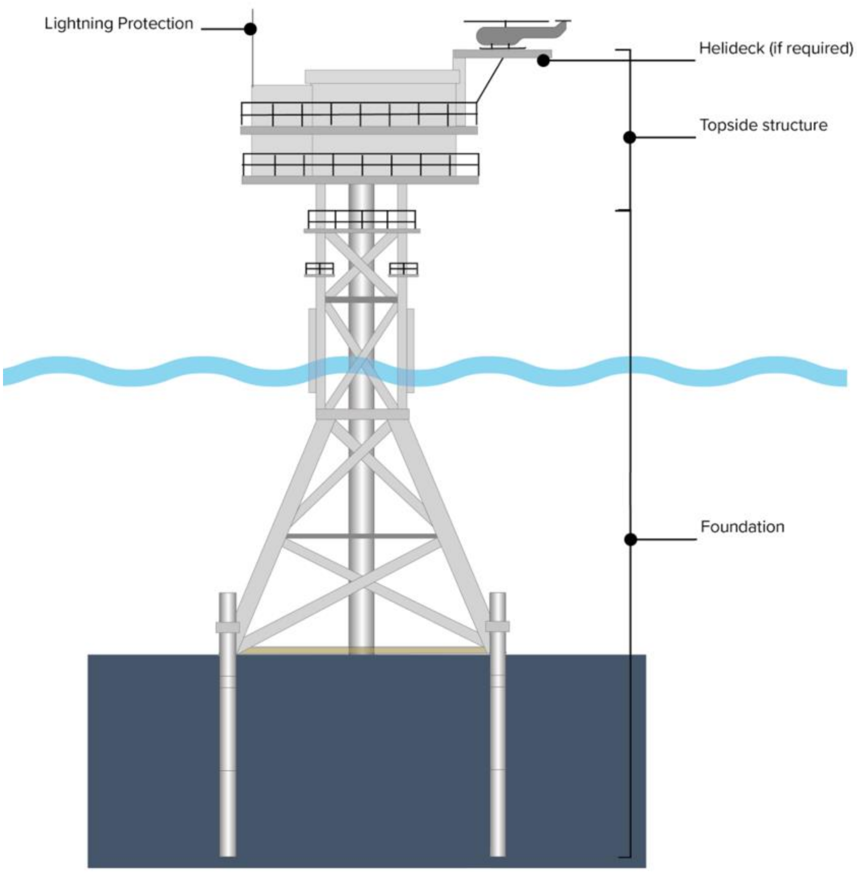

Plate 3.2 Schematic of an OSP. Note: The schematic shows a 'jacket on pin piles' foundation, however, the actual foundation type may differ e.g. monopile.

44. The topside design envelope for the OSP(s) is given in **Table 3.3.**

Table 3.3 OSP(s) topside design envelope

Parameter	Value
Maximum number of OSP(s)	2
Maximum topside width (m)	50
Maximum topside length (m)	50
Highest point of topside above HAT (m) (excluding helideck and lightning protection)	50
Highest point of topside above HAT (m) (including helideck and lightning protection)	70

3.2.4 Foundations

45. This section provides an overview of the foundations and substructures that are under consideration and assessed for the Project WTGs and OSP(s). The decision on the types of foundation and substructure to support the WTGs and OSP(s) would be made post-consent.

46. The WTG/OSP(s) foundation types and design envelope parameters are listed in **Table 3.4** and illustrated in **Plate 3.3**. Options are described in detail in **Chapter 5 Project Description** of the ES, and briefly described below:

- Gravity based structures (GBS). GBS usually comprise a base supporting a conical section, which tapers to an upper cylindrical section (shaft)
- Multi-legged pin-piled jacket (three-legged or four-legged jackets). A steel lattice construction (tubular steel and welded joints) secured to the seabed by hollow steel pin piles
- Monopile foundations are welded hollow tubular steel structures
- Multi-legged suction bucket jacket (three-legged jackets). A jacket that would be installed on three suction bucket 'legs'

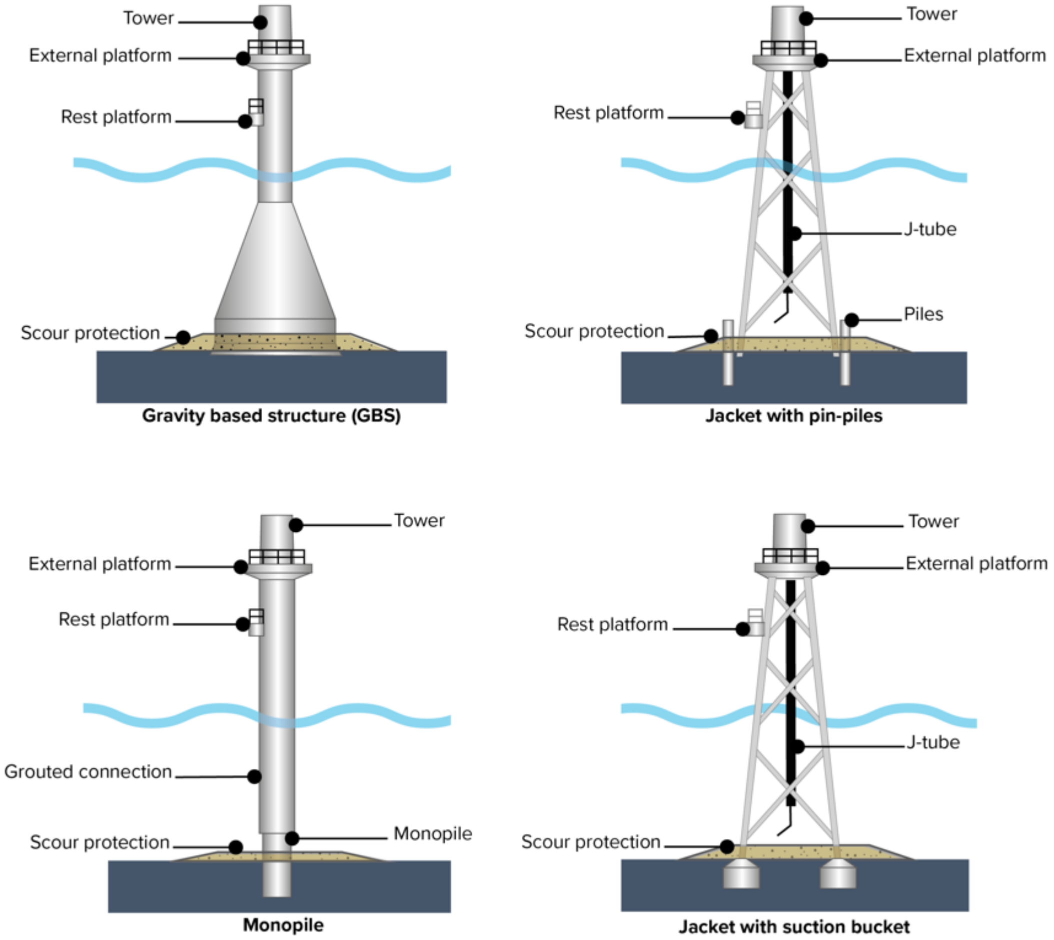

Plate 3.3 WTG/OSP foundation options

Table 3.4 WTG/OSP design envelope

Foundation types	Parameter	Maximum values
GBS	Maximum base slab diameter (m)	65
	Maximum cone bottom diameter (m)	55
	Maximum cone top/shaft diameter (m)	15
	Maximum cone height (m)	40
	Maximum footprint on the seabed per WTG/OSP[5] (m^2)	3,318
	Maximum footprint on the seabed for WTGs/OSP(s) (m^2)	122,766 (116,130m^2 for 35 WTGs[6] and 6,636m^2 for 2 x OSPs)
Multi-legged pin-piled jacket	Maximum legs per jacket foundation	4
	Maximum pile diameter (m)	3
	Maximum leg spacing at seabed (m)	35
	Maximum footprint on the seabed, pile-edge to pile-edge, per WTG/OSP (m^2)	28.5
	Maximum footprint on the seabed for total WTGs/OSPs (m^2)	1,055 (998m^2 for 35 x WTGs and 57m^2 for 2 x OSPs)
	Maximum pile penetration depth (m)	56
Monopile	Maximum pile diameter (m)	12
	Maximum footprint on the seabed per WTG/OSP (m^2)	114
	Maximum footprint on the seabed for total WTGs/OSPs (m^2)	3,648 (3,420m^2 for 30 x WTGs and 228m^2 for 2 x OSPs)
	Maximum pile penetration depth (m)	56
Multi-legged suction bucket jacket	Maximum legs per suction bucket (jacket) foundation	3
	Maximum bucket diameter (m)	20
	Maximum leg spacing at seabed (m)	35
	Maximum footprint on the seabed per WTG/OSP (m^2)	945

[5] A circular base is assumed as a worst-case

[6] Noting that both smaller and larger WTGs have the same GBS foundation footprint.

Foundation types	Parameter	Maximum values
	Maximum footprint on the seabed for WTGs/OSPs (m^2)	34,965 (33,075m^2 for 35 x WTGs and 1,890m^2 for 2 x OSPs

47. Foundation types would be selected following detailed design, based on suitability of the ground conditions, water depths and WTG/OSP(s) models or design. There may be only one type used, or a combination of foundation types may be used across the windfarm site.

3.2.5 Inter-array cables

48. Subsea inter-array cables would be installed to connect the individual WTGs and also connect the WTGs to the OSP(s).

49. Where possible, inter-array cables would be buried, with a target burial depth of 1.5m, where conditions allow, and a burial range expected to be between 0.5m and 3m. Where cable burial is not possible, alternative cable protection measures could be used. This may include rock placement, grout/sandbags, concrete mattresses, and polyethylene ducting. The appropriate level of protection would be determined based on an assessment of the risks posed to the Project, in specific areas.

50. It is assumed that 10% of the inter-array cable length would require additional cable protection due to ground conditions. Protection would also be required at the entry points of each WTG and OSP(s) foundation, and at cable crossings. These are outlined in more detail in **Chapter 5 Project Description** of the ES.

51. The inter-array cables are expected to operate at 66kV or 132kV alternating current (AC). It is expected that 132kV AC cables may not be sufficiently ready or available, on an industry-wide level, for installation, but this higher voltage has been retained, pending further electrical studies.

52. The diameter of the inter-array cables may be up to 220mm. The design envelope for inter-array cables, crossings and entry to WTGs/OSP(s) is given in **Table 3.5**.

Table 3.5 Inter-array cable design envelope

Parameter	Value
General parameters	
Maximum length of inter-array cables (km)	70
Burial depth range (m)	0.5 – 3 (target burial depth of 1.5)
Maximum installation corridor disturbance width (m)	25
Unburied cable parameters	
Maximum height protection (m)	2
Maximum width protection (m)	13
Anticipated % cable unburied due to ground conditions[7]	10
Estimated total length of unburied cable due to ground conditions (km)	7
Cable protection at entry of cables to WTG/OSP(s)	
Number of entry points to WTGs and OSP(s)	63
Maximum length of cable protection required at each entry point (m)	50
Maximum length of protected cable (m)	3,150
Maximum width of rock berm protection at the bottom (m)	13
Maximum width at top of rock berm protection (m)	1
Maximum height protection (m)	2
Cable protection at crossings	
Maximum number of cable/pipeline crossings	9
Maximum cable/pipeline crossing height per crossing (m)	2.8
Maximum side slope	3:1
Maximum cable/pipeline crossing top width (m)	1
Maximum cable/pipeline crossing bottom width per crossing (m)	17.8

[7] The percentage of cable that remains unburied due to ground conditions is dependent on the results of a cable burial survey. As such, 10% has been used a worst-case assumption.

Parameter	Value
Maximum cable/pipeline crossing length per crossing (m)	250

3.2.6 Platform link cables

53. Should the Project require two OSPs, then platform link cables would be needed to connect each of the OSP(s), to enable transfer of generated power from one OSP to the other, and to ensure that electricity transmission can continue in the event of one cable failing. The platform link cables are expected to operate at up to 275kV AC.

54. Cables may require protection where they cannot be buried, due to ground conditions. Additionally, cables would require protection at cable crossings and at entry points to the OSP(s). The exact requirements would be identified post-consent, prior to the start of construction, based on the final WTG and OSP(s) locations and detailed site surveys.

55. The design envelope for the inter-array cables is given in **Table 3.6**.

Table 3.6 OSP(s) platform link cable and crossings design envelopes

Parameter	Value
General parameters	
Maximum length of platform link cables (km)	10
Burial depth range (m)	0.5 – 3 (target burial depth of 1.5)
Maximum installation corridor disturbance width (m)	25
Unburied cable parameters	
Maximum height protection (m)	2
Maximum width protection (m)	13
Anticipated % cable unburied due to ground conditions[8]	10
Estimated total length of unburied cable due to ground conditions (km)	1
Cable protection at entry of cables to WTG/OSP(s)	
Number of entry points to WTGs and OSP(s)	7

[8] The percentage of cable that remains unburied due to ground conditions is dependent on the results of a cable burial survey. As such, 10% has been used a worst-case assumption.

Parameter	Value
Maximum length of cable protection required at each entry point (m)	50
Maximum length of protected cable (m)	350
Maximum width of rock berm protection at the bottom (m)	13
Maximum width at top of rock berm protection (m)	1
Maximum height protection (m)	2
Cable protection at crossings	
Maximum number of cable/pipeline crossings	6
Maximum cable/pipeline crossing height per crossing (m)	2.8
Maximum side slope	3:1
Maximum cable/pipeline crossing top width (m)	1
Maximum cable/pipeline crossing bottom width per crossing (m)	17.8
Maximum cable/pipeline crossing length per crossing (m)	250

3.3 Construction

56. Construction activities may include seabed preparation, unexploded ordnance (UXO) clearance[9], foundation installation (which may include pile driving and drilling), cable installation and deployment of cable protection and scour protection. The works would require a range of vessel types, including Dynamic Positioning (DP) and jack-up barges, which could require anchoring.

57. Construction would typically be performed on a 24-hour basis, depending on suitable construction weather windows. During the construction phase, there would be 500m radius Safety Zones (as defined in the Energy Act 2004) around installation vessels, foundation structures, WTGs and OSP(s).

58. Offshore construction is anticipated over a two-and-a-half-year construction programme.

[9] Permissions for UXO removal would be sought in a future Marine Licence application and European Protected Species (EPS) licence post-consent.

3.4 Operation and maintenance

59. During the operation and maintenance period, scheduled and unscheduled monitoring and maintenance of Project infrastructure would be required. During the Project life, it is likely that some refurbishment or replacement of offshore infrastructure would be required. Activities such as cable repair/replacement and/or reburial are also anticipated. All offshore infrastructure, including WTGs and OSP(s) foundations and cables would be included in monitoring and maintenance programmes (see **Chapter 5 Project Description** of the ES).

3.5 Decommissioning

60. At the end of the operational lifetime of the Project, offshore decommissioning would include the removal of all of the WTG and OSP(s) components and cutting of foundations to below seabed level. Cables, cable protection, some parts of the foundations and scour protection may be left *in situ*.

61. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator.

3.6 Realistic worst-case scenario

62. Based on the project description summarised above, and further detailed in **Chapter 5 Project Description** of the Project ES, the realistic worst-case scenario for Project impacts relevant to the MCZA are identified in **Table 3.7**.

Table 3.7 Realistic worst-case scenarios for the MCZA

Impact	Worst-case scenario	Notes and rationale
Construction phase		
Impact 1: Increased suspended sediment concentrations (SSCs) and subsequent deposition Impact 2: Changes to physical processes supplying and maintaining sediment	**Sediment displaced during seabed preparation for WTGs and OSP foundations:** ▪ 35 WTGs with GBS foundations = 455,438m^3 ▪ Two OSPs with GBS foundations = 26,025m^3 Total = **481,463m^3**	Seabed preparation (e.g. excavation using a trailing suction hopper dredger (TSHD) or other specialist bed leveller/trencher such as mass flow excavation) may be required. This is a volume of sediment that is disturbed prior to installation of WTG/OSP foundations and involves the removal of sediment from the seabed. The worst-case scenario assumes that sediment would be removed and returned to the water column at the sea surface (e.g. during disposal from a dredger vessel[10]) for WTGs and OSPs. Given the seabed preparation area is the same per foundation for the smaller and larger WTGs, the worst-case assumes the larger number of smaller WTGs with GBS foundations, with a diameter of 65m + 10m either side. The seabed preparation area also includes area for two jack-up visits per WTG/OSP foundation in different positions over the construction period. This equates to a total footprint of 1,500m^2 per jack-up vessel visit and 3,000m^2 over the construction period per WTG/OSP foundation. The seabed preparation area would be dredged to a depth of up to 1.5m.

[10] It is possible that seabed preparation would be undertaken by plough and sediment would therefore not be released at the surface, however disposal at the surface has been retained for the worst-case scenario.

Impact	Worst-case scenario	Notes and rationale
	Drill arisings for WTG and OSP foundations: ▪ 30 monopile WTGs = 52,373m^3 ▪ Two monopile OSPs = 3,492m^3 Total = **55,865m^3**	The worst-case assumes the lower number of the larger monopile foundations, given the larger drill diameter compared to smaller WTGs. The drill diameter is 12.6m and drill depth is up to 56m. The worst-case assumes a drive-drill-drive methodology (50% drill arisings per foundation) at 50% of WTG locations.
	Sediment displaced during seabed clearance/sandwave levelling prior to cable installation: ▪ Inter-array cables = 70,000m^3 ▪ Platform link cables = 10,000m^3 Total = **80,000m^3** over an area of **80,000m^2**	The worst-case length of inter-array cables is 70km and platform link cables is 10km. The worst-case assumes that 10% of the length of inter-array and platform link cables would require sandwave clearance/levelling, with a clearance width of 10m and height of 1m. The worst-case for impacts to SSCs assumes sediment would be released at the water surface. The worst-case for changes to physical processes supplying and maintaining sediment relates to the volume of sediment removed and therefore the worst-case scenario is linked to the scenario with the greatest volume of excavated sediment rather than the area over which sandwave clearance/ levelling occurs.
	Sediment displaced during cable installation: ▪ Inter-array cables = 472,500m^3 ▪ Platform link cables = 67,500m^3 Total = **540,000m^3**	The worst-case assumes that 50% of inter-array and platform link cables are buried at 3m and 50% length is buried at 1.5m by jetting in a box-shaped trench, with a 3m trench width.

Impact	Worst-case scenario	Notes and rationale
Impact 3: Underwater noise and vibration	**Largest hammer energy** ▪ Diameter of monopiles: 12m ▪ Maximum monopile penetration depth: 56m ▪ Maximum hammer driving energy: 6,600 kJ ▪ Number of piled foundations: 37 **Longest duration** ▪ 37 pin pile foundations (148 pin-piles) (each WTG/OSP foundation has 4 pin piles) ▪ Diameter of pin piles: 3.0m ▪ Maximum hammer driving energy: 2,500 kJ ▪ Duration: 1 pin pile = 4 hours 30 minutes duration. 4 pin piles = 18 hours duration (per foundation). Total duration is 666 hours for all WTGs & OSPs	Larger WTGs require a greater pile diameter than smaller WTGs and therefore would generate more noise for a given hammer driving energy. This assessment assumes the largest pile diameter (12m) for WTGs and OSPs and is therefore precautionary. Pin piles are the worst-case scenario in terms of the length of time likely to be taken for installation.
Impact 4: Introduction and colonisation of invasive non-native species (INNS)	▪ Maximum number of return trips for vessels per year: **2,583** ▪ Maximum number of vessels on site at any time: **37**	The risk of introducing INNS during construction primarily relates to vessel activities, should vessels come from other marine bioregions. The worst-case represents the maximum number of vessels, and it is noted that not all vessels would come from other bioregions and once on site would remain for a period of time.
Impact 5: Displacement of fishing activity	▪ 500m radius Safety Zone from any Project construction activity above or below water would be applied for. ▪ 50m Safety Zone would be applied for around partially completed structures or complete Project structures undergoing commissioning.	The worst-case considers the maximum displacement of fishing activity.

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Impact	Worst-case scenario	Notes and rationale
Operation and maintenance phase		
Impact 1: Temporary increases in suspended sediment and subsequent deposition	**Sediment displaced during cable repair/replacement and reburial every year:** ▪ Average cable repair or replacement sediment volume = 6,000m^3 ▪ Average cable reburial sediment volume = 3,000m^3 Total disturbed per year (on average) = **9,000m^3** Total over operational period = **315,000m^3**	Temporary increases in SSCs would result from periodic jack-up vessel deployment, and cable repair, replacement and reburial activities. The worst case assumes on average 200m of cables would be repaired/replaced every year, with a 10m disturbance width and 3m maximum depth for a box-shaped trench. The worst case assumes up to 100m of cable would be reburied every year, with a 10m disturbance width and 3m maximum depth for a box-shaped trench. The volume of sediment that could be suspended due to the presence of jack-up vessels has not been calculated but would be a much smaller proportion compared to the quantity generated by construction and decommissioning activities.
Impact 2: Changes to physical processes supplying and maintaining sediment	**Seabed footprint of WTG/OSP foundations:** ▪ 35 x GBS WTGs with scour protection = 248,080m^2 ▪ Two GBS OSPs with scour protection = 14,176m^2 Total = **262,256m^2**	The worst-case scenario assumes 35 x WTGs and two x OSPs (each with a 65m diameter conical GBS foundation, plus scour protection extending 15m from foundations in all directions).

Impact	Worst-case scenario	Notes and rationale
	Seabed footprint of cable protection: ▪ Inter-array cables = 91,000m^2 ▪ Platform link cables = 13,000m^2 ▪ Entry to WTGs and OSPs = 45,500m^2 Total = **149,500m^2**	The worst-case is based on 70km of inter-array cables and 10km of platform link cables. Assumes 10% of cable length is unburied due to ground conditions with a 13m cable protection width at the base and 2m height. The worst-case for cable protection for the entry to WTGs and OSPs assumes 70 points of entry, each with a length of cable protection of 50m, width at the base of 13m. The seabed footprint of cable protection per entry point is 650m^2.
	Footprint of cable/pipeline crossings: ▪ Inter-array cable/pipeline crossings (9) = 40,050m^2 ▪ Platform link cable/pipeline crossings (6) = 26,700m^2 Total = **66,750m^2**	The worst-case for cable/pipeline crossings is based on nine cable/pipeline crossings across inter-array cables and six cable/pipeline crossings across platform link cables. Assumes each crossing footprint is 4,450m^2 (17.8m width at the base, 250m length and 2.8m in height).
	Replacement scour protection and cable protection material: ▪ Scour protection = 13,950m^2 ▪ Cable protection including crossings and entries to WTGs/OSPs) = 21,625m^2 Total = **35,575m^2**	It is assumed that up to 10% of the total scour protection and cable protection material installed during construction would be required to be replaced or replenished during the operation and maintenance phase. It is assumed that all replacement scour protection and cable protection material would be placed within the same footprint as outlined above.
	Total subsurface infrastructure footprint: 514,081^2 (approximately 0.51km^2)	
Impact 3: Underwater noise and vibration	30 x larger WTGs in operation.	Underwater noise in operation and maintenance phase would principally arise from

Impact	Worst-case scenario	Notes and rationale
		mechanical forces within the nacelle of WTGs. Such forces are generally greater in larger turbines (Tougaard *et al.*, 2020), hence the worst-case scenario is based on the operation of 30 x largest WTGs.
Impact 4: Introduction and colonisation of INNS	▪ Area of new substrate: As per operation and maintenance Impact 2. ▪ Maximum number of operation vessels on site at any one time: **3 vessels** during a standard year, or **10 vessels** during a heavy maintenance year. ▪ Maximum number of vessels return trips from windfarm site to port per year: **384 vessel return trips** during a standard year, or **832 vessel return trips** during a heavy maintenance year.	The risk of introducing INNS during operation and maintenance is primarily related to vessel activities, should vessels come from other marine bioregions. The presence of introduced hard substrate has the potential to encourage colonisation of invasive epifaunal species.
Impact 5: Displacement of fishing activity	**Safety Zones** ▪ There would be Safety Zone of 500m radius from any major maintenance activity.	The worst-case considers the maximum displacement of fishing activity.
Decommissioning phase		
As per construction phase.		

3.7 Summary of embedded mitigation in the design

63. This section outlines the embedded mitigation relevant to the MCZA, which has been incorporated into the design of the Project (**Table 3.8**).

Table 3.8 Embedded mitigation measures

Parameter	Mitigation measures embedded into the design of the Project
WTG spacing	A minimum separation distance of 1,060m has been defined between adjacent WTGs within the same row and 1,410m between each row (inter-row spacing, which is the distance between the main rows).
Cables	Cables would be buried where possible. The cable burial range would be between 0.5m and 3.0m below the seabed (with a target depth of 1.5m where ground conditions allow). A Cable Burial Risk Assessment (CBRA) would also be required to confirm the extent to which cable burial can be achieved. Where it is not reasonably practicable to achieve cable burial, additional cable protection may be required. Following industry best-practice the Applicant would seek to minimise the use of cable protection. Protection would be detailed via a Scour Protection and Cable Protection Plan that would be submitted for approval post-consent. An Outline of this plan (Document Reference 6.8) is provided with the DCO Application. Cables would be specified to reduce EMF emissions, as per industry standards and best practice, such as the relevant IEC (International Electrotechnical Commission) specifications. To minimise the extent of any unnecessary habitat disturbance, material displaced as a result of cable burial activities would be back filled, where necessary, in order to promote recovery.
Seabed preparation	Micro-siting would be used (for foundations and cable installation) where possible to minimise the requirements for seabed preparation prior to foundation and cable installation.
Scour and cable protection	Scour protection is built into the design for each foundation type in consideration and where installed after the foundation, it would be installed as early as practicable (typically within the same season after the foundation installation).
Foundations	The selection of appropriate foundation designs and sizes at each WTG and OSP location would be made following pre-construction surveys within the windfarm site.
	For piled foundation types, such as monopiles and jackets with pin piles, pile-driving would be used in preference to drilling, where it is practicable to do so (i.e. where ground conditions allow).
Construction hours	During construction, overnight working practices would be employed offshore, so that construction activities could be 24 hours, thus reducing the overall period for potential impacts to fish communities in proximity to the windfarm site.
Piling	A Marine Mammal Mitigation Protocol (MMMP) would be developed and implemented, which would include proposals for soft start and

Parameter	Mitigation measures embedded into the design of the Project
	ramp-up of piling. A soft start and energy ramp up protocol for pile driving would allow mobile species to move away from the area of highest noise impact. A MMMP would detail the required mitigation measures to minimise the potential risk of physical and auditory injury (PTS) to marine mammals as a result of underwater noise during Unexploded Ordnance (UXO) clearance and piling. Any mitigation beneficial to marine mammals could also potentially reduce impacts on fish and shellfish ecology. The Draft MMMP has been included with the DCO Application (Document Reference 6.5).
Biosecurity	Implementation of biosecurity measures in line with international and national regulations and guidance, namely: ▪ International Convention for the Prevention of Pollution from Ships (MARPOL), which sets out the requirements for appropriate vessel maintenance ▪ The Environmental Damage (Prevention and Remediation) (England) Regulations 2015, which set out a 'polluter pays' principle whereby operators who cause a risk of significant damage to water and biodiversity receptors are responsible for i) preventing damage from occurring; and ii) bearing the costs for full reinstation of the environment (to original condition) in the event of damage occurring ▪ The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which provides an international framework for the control of transfer of potentially invasive species from ballast water These would be listed within the Project Environmental Management Plan (PEMP), an Outline of which is provided as part of the DCO Application (Document Reference 6.2).
Liaison and co-existence	The Applicant is committed to ongoing liaison with the fishing industry throughout all stages of the Project, based upon Fishing Liaison with Offshore Wind and Wet Renewables Group FLOWW (2014, 2015) guidance and the following: ▪ Appointment of a company Fisheries Liaison Officer (FLO) to maintain effective communications between the Project and fishers ▪ Appropriate liaison with relevant fishing interests, to ensure that they are fully informed of development planning and any offshore activities and works ▪ Timely issue of notifications, including Notice to Mariners (NtMs), Kingfisher Bulletin notifications and other navigational warnings to the fishing community, to provide advance warning of Project activities and associated Safety Zones and advisory safety distances ▪ Development, prior to construction, of an Fisheries Liaison and Co-existence Plan (FLCP), setting out in detail the planned approach to fisheries liaison and means of delivering any other relevant mitigation measures.

Parameter	Mitigation measures embedded into the design of the Project
Sediment disposal	Excavated sediments would be disposed within the windfarm site so there is no net loss of material from the physical processes system.
Decommissioning	An Offshore Decommissioning Programme would be developed post-consent and implemented at the time of decommissioning.

4 Summary of MCZ screening

4.1 Outcome of MCZ screening for the Project

64. The preliminary stage of the MCZA process for the Project was a screening exercise, which was undertaken to determine whether Section 126 of the MCAA (2009) should apply to the application.

65. The screening process was undertaken in consultation with relevant stakeholders, via the Project Evidence Plan Process (EPP) and associated Environmental Technical Group (ETG) meetings with technical stakeholders. The draft MCZA Screening Report was issued for comment in August 2022 and comments were received from Natural England and the MMO (Morecambe Offshore Windfarm Ltd, 2022). Comments were addressed and incorporated into an updated Screening Report supplied with the PEIR (and updated for the ES and provided as part of the DCO Application (Document Reference 4.12)) that forms the basis of this MCZA.

66. In the Screening Report, an initial area of search of 100km was used to gain an initial understanding of the MCZs that could potentially be affected by impacts associated with the Project.

67. Given that no MCZs spatially overlap with the windfarm site, there is no risk of direct impacts (e.g. direct habitat loss or change) affecting any MCZ. As such, potential impacts that may affect MCZs are limited to indirect changes in physical, chemical or biological conditions arising from (for example) disturbance of sediment or emission of underwater noise.

68. Following a review of the area of search, a Zone of Influence (ZoI) was identified, based on an understanding of the tidal regime at the windfarm site, and the ranges of indirect impacts, such as increased SSCs and underwater noise.

69. The ZoI for changes to physical processes or sediment transportation is based on an assessment of change, with impacts shown to be localised and encompassed within a spring tidal excursion within the windfarm site (10km). As such, a 15km ZoI conservatively encompasses the extent of any potentially significant indirect impacts, such as changes to physical processes or sediment transport, that may affect MCZ features and/or supporting habitats. Further information is presented in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES. The 15km ZoI also reflects the distance used in the Round 4 plan level Habitats Regulations Assessment (HRA) Screening for indirect effects on designated sites (NIRAS, 2021).

70. A 50km ZoI was used as conservative estimate for the range of noise impacts to fish. This was based upon herring (a noise sensitive species) as a receptor

and pile driving (which is considered one of the noisiest construction activities). Underwater noise modelling results for the Project found that worst-case, short-term behavioural reaction (a 135dB threshold) in herring are expected to extend 48km. Further information is presented in **Chapter 10 Fish and Shellfish Ecology** of the ES.

71. **Figure 1.1** shows all MCZs within 100km area of search and both the 15km and 50km ZoI.

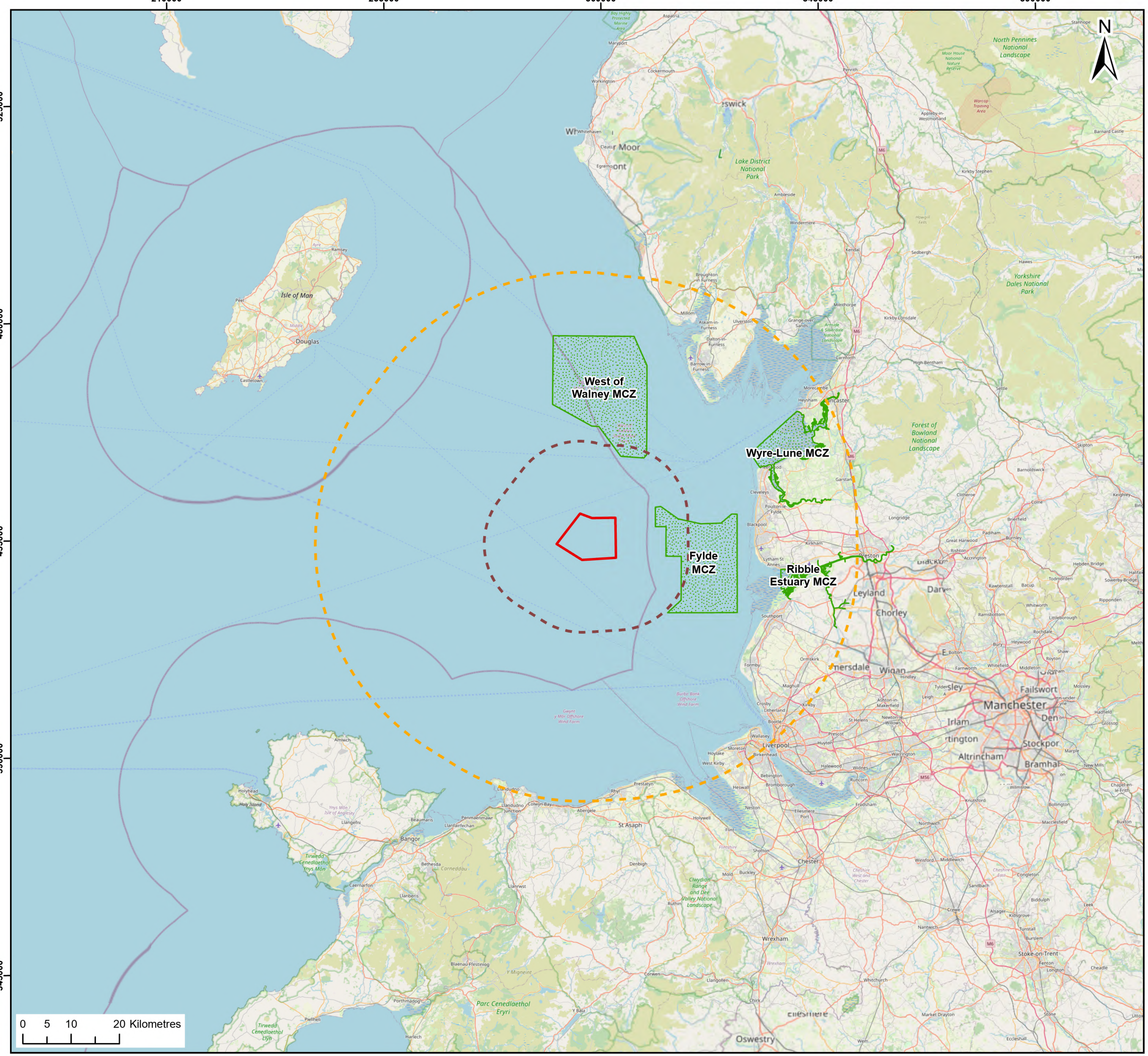
72. **Table 4.1** and **Figure 4.1** provides a summary of the MCZs that were screened in for the Stage One assessment, as identified in the Screening Report.

73. Any potential impacts related to the Project that may hinder the achievement of the conservation objectives for the MCZs screened have been assessed in the Stage One assessment.

*Table 4.1 Summary of the MCZs and potential impacts screened in for MCZA in the Screening Report (note: impacts in italics have been subsequently screened out – refer to **Section 4.2**)*

MCZ	Features screened in	Impacts screened in (Project-alone and cumulatively)
Fylde MCZ	Subtidal mud Subtidal sand	Increased SSCs
		Sediment deposition (smothering)
		Remobilisation of contaminated sediment
		Underwater noise and vibration
		Introduction and colonisation of non-native species
		Changes to the physical processes supplying and maintaining sediment
		Changes in fishing activity
West of Walney MCZ	Subtidal sand Subtidal mud Sea-pen and burrowing megafauna communities	Increased SSCs
		Sediment deposition (smothering)
		Remobilisation of contaminated sediment
		Underwater noise and vibration
		Introduction and colonisation of non-native species
		Changes to the physical processes supplying and maintaining sediment
		Changes in fishing activity
Wyre-Lune MCZ	Smelt	Underwater noise and vibration
Ribble Estuary MCZ	Smelt	Underwater noise and vibration

74. For MCZs located more than 50km from the Project, there is no potential pathway for impact, Project-alone or cumulatively with other projects, hence these have been screened out.



Legend:

- Morecambe Offshore Windfarm Site
- 50km potential Zone of Influence for noise
- 15km potential Zone of Influence for suspended sediments
- Marine Conservation Zones (MCZ)

Report: Morecambe Offshore Windfarm: Generation Assets Information for Marine Conservation Zone Assessment

Title: Morecambe Offshore Windfarm and MCZs screened into the MCZA with 15km and 50km buffers

Figure: 4.1 | Drawing No: PC1165-RHD-ES-OF-DR-Z-0059

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
P01	19/04/2024	JH	SB	A3	1:800,000

Co-ordinate system: WGS 1984 UTM Zone 30N

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4.2 Subsequent changes to the initial screening exercise

4.2.1 Reduced proposed windfarm site development area

75. The area assessed within the PEIR and draft MCZA Screening Report (FLO-MOR-REP-0018) is defined by the Agreement for Lease (AfL) awarded by The Crown Estate, which spanned 125km^2. Following consultation on the PEIR, the proposed windfarm site development area has been reduced to approximately 87km^2, as further described in **Chapter 4 Site Selection and Assessment of Alternatives** of the ES.

76. This has not altered the findings of the MCZA Screening Report. South Rigg MCZ is no longer within the 100km buffer, but this site was screened out in the draft MCZA Screening Report as the site is beyond the 50km ZoI for both direct and indirect effects used in the screening.

4.2.2 Screening out of remobilisation of contaminated sediments

77. The impact '*remobilisation of contaminated sediments*' was screened into the draft MCZA, as there is potential for sediment brought into suspension during the construction phase (and potentially during activity in the operation and maintenance phase) to be contaminated. Chemical analyses of sediment samples from the windfarm site were undertaken in May/June 2022. The analyses indicated that no samples exceeded Cefas Action Levels (AL).

78. With respect to metals, concentrations indicated very low levels of contamination. The only parameter exceeding sediment guideline values was mercury for Oslo and Paris Convention (OSPAR) Background Assessment Concentrations (BAC) (five samples) and only one sample recorded levels at the Canadian Effects Range Low (ERL) (i.e. sample concentration equalled the ERL).

79. With respect to Polycyclic Aromatic Hydrocarbons (PAHs), several samples exceeded the BAC. Where exceedances occurred, concentrations were only marginally above the BAC value. Concentrations of PAHs are therefore very low across the windfarm site.

80. All other parameters were below the limits of detection.

81. Cefas ALs have been widely used for assessing contamination risk in UK marine development and are available for a range of contaminants. ERLs are quality guidelines used by OSPAR and have been defined as the lower tenth percentile of the dataset of concentrations in sediments which were associated with biological effects. Where concentrations within sampled sediment do not exceed these threshold values, then contamination levels are

not considered to be of significant concern and are 'low risk' in terms of potential impacts on marine benthic communities.

82. Full details of the chemical analysis are provided in **Chapter 8 Marine Sediment and Water Quality** of ES (Document Reference 5.1.8).

83. Given the low levels of contaminants, there is no realistic pathway for effect on features of Fylde MCZ, West of Walney MCZ, Wyre-Lune MCZ or Ribble Estuary MCZ, hence the conservation objective of maintaining or restoring the protected features would not be hindered, and this impact has not been taken forward for consideration in the Stage One assessment, and has also been screened out of the ES.

4.2.3 Cumulative project screening update

84. No updates to the list of projects have been identified, although it is noted that Awel y Môr (AyM) has now been consented, rather than being in planning when the screening was undertaken. A Scoping Report of the Mooir Vannin (Isle of Man Offshore Windfarm) has also been submitted, but this project has been screened out due to distance (further noting that given published timescales there is also no predicted overlap in offshore construction).

5 Consultation

85. As part of the DCO process ,the Applicant has undertaken consultation with prescribed bodies, stakeholders (under Section 42 of the Planning Act (2008)), local communities (under Section 47) and more widely with the public, through the publication of the Project application (under Section 48).

86. The Screening Report highlights relevant consultation undertaken for MCZ screening (Document Reference 4.12). This provides a summary of the consultation responses received regarding the screening and MCZ assessment, and details of how the Project team has addressed each comment, including updates made to the Screening Report. Technical discussions held as part of the Project EPP involving technical stakeholders have also guided the content of this assessment.

87. Further, stakeholder comments on the PEIR and draft MCZA have been considered in preparing the MCZA. The key elements pertinent to this report are shown in **Table 5.1**, alongside details of how the Project team has had regard to the comments received and how they have been addressed within the MCZA.

Table 5.1 Consultation responses received in relation to MCZA

Consultee	Date	Comment	Response/where addressed in the MCZA
Statutory consultation feedback on the PEIR/draft MCZA			
MMO	30th May 2023	**Chapter 7: Marine Geology, Oceanography and Physical Processes** Major Comments – There is possible sediment suspension from bedload higher into the water column due to turbulence around the foot of monopiles. Table 7.4 states that to investigate this is not proportionate to the conceptual EIA method being used. The MMO considers this insufficient justification for the screening out of an impact. If this pathway exists, this could alter the assessment of sediment suspension significance, thereby affecting the assessments of the Marine Conservation Zones (MCZ) and Habitats Regulation Assessment (HRA) also. There is a growing evidence base for the scale of hydrodynamic changes around OWFs (Schultze *et al*., 2020 and Christiansen *et al*., 2023) and that vertical mixing effects of monopiles are greater and more laterally extensive than suggested by models (Forster, 2018). Given the possibility that the local impacts may result in hydrodynamic changes extending to regional scales (Christiansen *et al*., 2023), the potential for impacts should now be recognised and discussed in the ES for any OWF.	Wakes caused by the presence of foundation structures is discussed in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES. The assessment does not identify pathways of effects to MCZs.
MMO	30th May 2023	Appendix 11.1: Para 62 of the MCZ Assessment states that the Project found a worst-case behavioural disturbance of 49km for herring (assuming a 135dB threshold). Please note, if relying on this distance, it is important to remember that behaviour is instantaneous and therefore there can be no stationary/fleeing assumptions.	Due to a) changes in the potential hammer models to be used for the Project; and b) refinements of the windfarm site, updated noise modelling has been undertaken for a maximum hammer energy of 6,600kJ.

Consultee	Date	Comment	Response/where addressed in the MCZA
			For clarity, the worst-case impact range for spawning herring arises from the 135dB SEL_{SS} behavioural disturbance threshold. This is an instantaneous effect, so remains the same regardless of assumptions around stationary or fleeing receptors. The worst-case impact range modelled for all fish receptors is 48km, which is a disturbance threshold used specifically in the case of herring. This has been used to generate a conservative ZoI of 50km for the MCZA. This can be considered precautionary due to the fact that smelt (features of MCZs within this range) have lower sensitivity to sound than herring (Popper *et al.,* 2014).
MMO	30th May 2023	In paragraph 1.128 of the MCZ Assessment there is references to the quantitative thresholds for behaviour provided in Popper et al. (2014), please note, this report does not provide quantitative thresholds for behaviour. For fish with swim bladder not involved in hearing, the maximum TTS range is 31km (please note, TTS is not the same as disturbance). Using TTS as a proxy for disturbance, can underestimate the potential risk.	The wording in the relevant paragraph has been updated to make clear that TTS is not equivalent to disturbance. In the absence of quantitative thresholds TTS remains a useful indicator of likely disturbance ranges.
North West Wildlife Trusts (Cumbria, Lancashire and Cheshire)	22nd May 2023	Designated sites Energy cables and infrastructure, placed in the wrong location, can cause habitat damage and loss. Several Marine Protected Areas (MPAs) are in unfavourable condition due to the impact of cabling infrastructure (For example, Inner Dowsing, Race Bank and North Ridge SAC, The Wash and North Norfolk Coast	Fylde MCZ and West of Walney MCZ have been included in the MCZA.

Consultee	Date	Comment	Response/where addressed in the MCZA
		SAC). We are pleased to see that the Morecambe OWF will not pass through any designations. However, please note that there is significant potential for this scheme to have adverse Impacts outside of designated areas. We expect the EIA for the scheme to assess these and other potential impacts on marine ecology outside MPAs and propose suitable mitigation and compensation to achieve an overall benefit to these habitats and wider marine ecology from the scheme. Further, we expect designated sites that are close to the site to be fully considered, particularly those in Table 1. Site ▪ North Anglesey Marine SAC ▪ Pen Llyn a'r Sarnau SAC ▪ Fylde MCZ ▪ West of Walney MCZ ▪ Eastern part of Shell Flat and Lune Deep SAC ▪ Liverpool Bay SPA""	
Natural England	2nd June 2023	Several designated sites from the region are not included in the assessment. However, all the omitted fish designated features have coincidentally been assessed due to their presence within other designated sites which were assessed. Recommendation: Incorporate the following designated site features into the appropriate assessments: ▪ Solway Firth MCZ (Smelt) ▪ Solway Firth SAC (Sea lamprey, River lamprey). ▪ River Ehen SAC (Atlantic Salmon)	The River Ehen (Atlantic Salmon) and River Derwent and Bassenthwaite Lake SAC (Atlantic Salmon, Sea lamprey, River lamprey) are included, and listed in **Chapter 10 Fish and Shellfish Ecology** of the ES. MCZs beyond 100km are not listed, but an assessment of the species listed as part of the Solway Firth MCZ (Smelt), are considered in the fish assemblages within **Chapter 10 Fish and Shellfish Ecology** of the ES. Smelt have been assessed within the

Consultee	Date	Comment	Response/where addressed in the MCZA
		▪ River Derwent and Bassenthwaite Lake SAC (Atlantic Salmon, Sea lamprey, River lamprey).	MCZA at the Wyre-Lune MCZ and Ribble Estuary MCZ (in closer proximity to the Project than the Solway Firth MCZ). It is considered that, given the assessment for the nearer MCZs, the distance to the Solway Firth MCZ and results from underwater noise modelling there would be no hindrance to the conservation objectives of the Solway Firth MCZ.
Isle of Man Government	2nd June 2023	Acknowledging the specific requirements of the Marine and Coastal Access Act 2009 (1.2.1.1) in relation to MCZ, the Isle of Man Government seeks clarification and reassurance that the statutorily-designated marine conservation areas in the Manx territorial sea, i.e.. Marine Nature Reserves designated under the Wildlife Act 1990, have been adequately, and similarly considered in relation to this project.	The location of Manx Nature Reserves is noted and are assessed in relevant chapters of the ES (where a pathway of effects have been identified) but are not included in the scope of MCZ assessment.
Isle of Man Government	2nd June 2023	Noting Figure 1 of the MCZA document, and the inclusion of the territorial sea within the 100 km buffer zone, the inclusion of MCZ distal to the Manx territorial sea (South Rigg MCZ), it is surprising that no reference to the MNRs is included; even as an acknowledgement and explanation for exclusion.	

6 MCZ conservation objectives

6.1 Fylde MCZ

6.1.1 Description of Fylde MCZ

88. Fylde MCZ is located in Liverpool Bay, lying between 3km and 20km off the Fylde coast and Ribble Estuary (approximately 8km east of the windfarm site). Fylde MCZ protects an area of approximately 260km^2. The depth of the seabed within the site ranges from almost being exposed on low tide (just 35cm depth) to 22m at its deepest part.

89. Fylde MCZ is designated for two broadscale marine habitat features (see **Table 6.1**).

Table 6.1 Protected features of Fylde MCZ (Natural England, 2019)

Protected feature	Type of feature	Management approach
Subtidal sand (principally in the centre and south of the MCZ)	Broadscale marine habitat	Maintain in favourable condition
Subtidal mud (principally in the north and northwest of the MCZ)	Broadscale marine habitat	Maintain in favourable condition

6.1.2 Fylde MCZ conservation objectives

90. The overarching conservation objective for the site, as per the Designation Order (as amended)[11], is for its designated features to be maintained in favourable condition (see **Table 6.1**).

91. For each protected feature, favourable condition means that:

- 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

92. 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.

[11] Ministerial Order 2013 No. 9. The Fylde Marine Conservation Zone Designation Order 2013 https://www.legislation.gov.uk/ukmo/2013/9/pdfs/ukmo_20130009_en.pdf as amended by Ministerial Order 2016 No. 31. The Fylde Marine Conservation Zone Designation (Amendment) Order 2016 https://www.legislation.gov.uk/ukmo/2016/31/contents/created

93. For this MCZ's conservation objectives, any temporary deterioration in condition is to be disregarded if the habitat is sufficiently healthy and resilient to enable its recovery. 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.

6.2 West of Walney MCZ

6.2.1 Description of West of Walney MCZ

94. West of Walney MCZ is a site in the Irish Sea, off the coast of Cumbria and to the west of Walney Island, located approximately 13km north of the windfarm site at its nearest point. The site covers around 388km^2, most of which is in inshore waters, but with a small section crossing the 12 nautical mile (nm) boundary into offshore waters.

95. West of Walney MCZ is designated for two broadscale marine habitat features and one Feature of Conservation Importance (see **Table 6.2**).

Table 6.2 Protected features of West of Walney MCZ (Natural England, 2018)

Protected feature	Type of feature	Management approach
Subtidal sand	Broadscale marine habitat	Recover to favourable condition
Subtidal mud	Broadscale marine habitat	Recover to favourable condition
Sea-pen and burrowing megafauna communities	Feature of Conservation Importance	Recover to favourable condition

6.2.2 West of Walney MCZ conservation objectives

96. The overarching conservation objective for the site, as set out in the Designation Order[12], is for its designated features to be brought into favourable condition (see **Table 6.2**). The definitions of favourable condition are as per Fylde MCZ (**Section 6.1.2**).

[12] Ministerial Order 2016 No. 22. The West of Walney Marine Conservation Zone Designation Order 2016 https://www.legislation.gov.uk/ukmo/2016/22/pdfs/ukmo_20160022_en.pdf

6.3 Wyre-Lune MCZ

6.3.1 Description of Wyre-Lune MCZ

97. Wyre-Lune MCZ is an inshore site in the southern part of Morecambe Bay, Lancashire, located approximately 31km east of the windfarm site at its nearest point. The site covers around 92km^2.

98. Wyre-Lune MCZ is designated for smelt *Osmerus eperlanus* (**Table 6.3**).

Table 6.3 Protected features of Wyre-Lune MCZ (Defra, 2019a)

Protected feature	Type of feature	Management approach
Smelt	Specific species	Recover to favourable condition

6.3.2 Wyre-Lune MCZ conservation objectives

99. The overarching conservation objective for the site is for its designated features to be brought into favourable condition (see **Table 6.3**).

100. The conservation objective for the MCZ, as set out in the Designation Order[13] is that, in relation to smelt:

- The habitat used by members of that species for the purposes of spawning ("spawning habitat") − (i) so far as already in favourable condition, remains in such condition, and (ii) so far as not already in favourable condition, be brought into such condition, and remain in such a condition
- The population of that species − (i) so far as already in favourable condition, remains in such condition; (ii) so far as not already in favourable condition, be brought into such condition, and remain in such condition

101. Favourable condition:

- With respect to a spawning habitat within the Zone, means that the habitat is of sufficient quality and quantity to enable members of the species using the habitat to survive, aggregate, nest, lay or fertilise eggs during breeding
- With respect to the population of that species within the Zone, means that the composition of that population in terms of number, age and sex ratio are such as to ensure that the population is maintained in numbers which enable it to thrive

[13] Ministerial Order 2019 No. 52. The Wyre Lune Marine Conservation Zone Designation Order 2019 https://www.legislation.gov.uk/ukmo/2019/52/pdfs/ukmo_20190052_en.pdf

102. For this MCZ's conservation objectives, any temporary reduction of numbers is to be disregarded if the population is sufficiently healthy and resilient to enable its recovery. For the purpose of determining whether a protected feature is in a favourable condition, any alteration to that feature brought about entirely by natural processes is to be disregarded.

6.4 Ribble Estuary MCZ

6.4.1 Description of Ribble Estuary MCZ

103. Ribble Estuary MCZ is an inshore site on the North-West coast of England, near Preston. The site covers around $15km^2$. The site is designated for smelt (**Table 6.4**).

Table 6.4 Protected features of the Ribble Estuary MCZ (Defra, 2019b)

Protected feature	Type of feature	Management approach
Smelt	Specific species	Recover to favourable condition

6.4.2 Ribble Estuary MCZ conservation objectives

104. The overarching conservation objective for the site, as per the Designation Order[14], is for its designated features to be brought into favourable condition (**Table 6.4**). The definitions of favourable condition are as per Wyre-Lune MCZ (**Section 6.3.2**).

[14] Ministerial Order 2019 No. 34. The Ribble Estuary Marine Conservation Zone Designation Order 2019 https://www.legislation.gov.uk/ukmo/2019/34/created

7 Stage One assessment

105. This section presents the Stage One Assessment. The MCZA considers the effects of construction, operation and maintenance, and decommissioning impacts of the Project on the protected features of Fylde MCZ, West of Walney MCZ, Wyre-Lune MCZ and Ribble Estuary MCZ.

106. Each of the impacts and associated pressures (as per Natural England's AoO for the relevant sites, where available) identified in the Screening Report (see **Section 4**) are considered herein. The assessment of each impact has considered effects on the attributes and targets of individual protected features, as provided by Natural England's SACOs, in determining the risk that the impact may hinder the conservation objectives of the MCZs.

7.1 Potential effects during construction

7.1.1 Impact 1: Increased SSCs and subsequent deposition

7.1.1.1 Overview of impact

107. As set out in **Table 4.1,** this impact is relevant to the Fylde MCZ and West of Walney MCZ.

108. During construction activities, there may be a temporary (limited to the installation period for each seabed installation activity over the 2.5-year construction period) increase in SSCs and subsequent deposition of disturbed sediment. Increases in SSCs have the potential to affect benthic ecology receptors by blocking feeding apparatus, as well as by smothering sessile species upon redeposition.

109. A conceptual evidence-based assessment of the extent and magnitude of increases in SSCs and seabed level changes as result of deposition is detailed in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES. The assessment is supported by findings of a review of the evidence base into the physical impacts of marine aggregate dredging on sediment plumes and seabed deposits (Whiteside *et al*., 1995; John *et al*., 2000; Hiscock and Bell, 2004; Newell *et al*., 2004; Tillin *et al*., 2011; Cooper and Brew, 2013). The assessment is further supported by numerical modelling undertaken by Morgan Offshore Wind Limited and Mona Offshore Wind Limited (2023a,b) for the Morgan Offshore Wind Project and Mona Offshore Wind Project PEIRs, and by Awel y Môr Offshore Wind Farm Ltd. (2022) for the AyM Offshore Wind Farm ES.

110. The outcomes of the assessment are summarised in the following paragraphs.

111. Seabed sediments and shallow near-bed sediments within the windfarm site would be disturbed during preparation activities, such as sandwave levelling,

to create a suitable base prior to foundation or cable installation. The worst-case scenario assumes that sediment would be dredged and returned to the water column at the sea surface as overflow from a dredge vessel. This process would cause localised and short-term increases in SSCs, both at the point of dredging at the seabed and at the point of its discharge back into the water column. The disposal of any sediment that would be disturbed or removed during foundation installation would occur within the windfarm site, so there would be no net loss of sediment from the physical processes system.

112. It is expected that medium and coarse-grained sand across the windfarm site (22% of PSA samples collected) would be disturbed by the drag head of the dredger at the seabed and would remain close to the seabed and settle back rapidly. Most of the sediment released at the water surface from the dredge vessel would fall rapidly (minutes or tens of minutes) to the seabed as a highly turbid dynamic plume immediately upon its discharge (within a few tens of metres along the axis of tidal flow (west-east)).

113. The finer sand and clay fraction (fine sand: 30.6%, very fine sand: 30.6% and silt: 16.7% of samples) from this release is likely to stay in suspension for longer and form a passive plume which would be transported by tidal currents. Due to the sediment sizes present, this is likely to exist as a modest concentration plume (tens of mg/l) for around half a tidal cycle (up to six hours). Sediment would settle to the seabed in proximity to its release (within a few hundred metres up to around a kilometre along the axis of tidal flow) within a short period of time (hours to days). Whilst lower concentrations of suspended sediment would extend further from the dredged area (released sediment may be transported by tidal currents up to a spring tidal excursion distance of approximately 10km, in suspension in the water column, before being redeposited back on to the seabed) along the axis of predominant tidal flows. The magnitudes would be indistinguishable from background levels.

114. The assessment was supported by the findings of a review of the evidence base into the physical impacts of marine aggregate dredging on sediment plumes and seabed deposits (Whiteside *et al*., 1995; John *et al*., 2000; Hiscock and Bell, 2004; Newell *et al*., 2004; Tillin *et al*., 2011; Cooper and Brew, 2013). It was further supported by numerical modelling for Morgan and Mona PEIRS and AyM ES, which is outlined further in Section 7.6.2.1 of **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES.

115. There is no potential for sediment plumes to reach the West of Walney MCZ (13km north of the Project), due to the alignment of the tidal axis and the distance of the MCZ from the Project.

116. An assessment of the impact of drilling on increases in SSCs and deposition was also undertaken for the Project, however, less sediment would be

released from drilling than sandwave clearance for foundations or cables and any fine sediment released is likely to behave in a similar way as described above. This is further outlined in detail in **Chapter 7 Marine Geology, Oceanography and Physical Processes** and **Chapter 8 Marine Sediment and Water Quality** of the ES.

7.1.1.2 Assessment against MCZ conservation objectives

117. **Table 7.1** summarises the sensitivity of benthic features from Fylde MCZ and West of Walney MCZ to the pressures set out in the respective AoO (Natural England, 2022a and 2022b) under marine activity '*Electricity from renewable energy sources – Offshore wind (during construction)*'. Those relevant to construction-phase increases in suspended sediment and deposition are:

- Smothering and siltation rate changes (light)
- Changes in suspended solids (water quality)

118. Given that the nearest MCZ is located over 8km from the windfarm site, there is no need to consider sensitivity to the heavier smothering and siltation rate changes which would occur within 1km of the disturbance activity. Thus 'light' smothering and siltation rate sensitivities are included below.

Table 7.1 MCZ feature sensitivities to increased SSCs and deposition pressures (Natural England, 2022a and 2022b)

Designated site	Feature	NE AoO sensitivity	
		Smothering and siltation rate changes (light)	Changes in suspended solids (water clarity)
Fylde MCZ	Subtidal sand	Not sensitive – low	Not sensitive – low
	Subtidal mud	Not sensitive – low	Not sensitive – low
West of Walney MCZ	Subtidal sand	Not sensitive – low	Not sensitive – low
	Subtidal mud	Not sensitive – low	Not sensitive – low
	Sea-pen and burrowing megafauna communities	Not sensitive	Not sensitive

119. In all instances, the component biotopes of the designated features (as considered in the AoO) have no, or low sensitivity to the effects of increased SSCs, or subsequent light siltation. Conservatively, therefore, the sensitivity of these features was assessed as low.

120. The assessment in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES concludes that in the far-field (i.e. at a distance of more than approximately 1km from the disturbance activity), the magnitude

of effect of increased SSCs and subsequent deposition is medium (near-field) to low (far-field) for SSCs and low (near-field) to negligible (far-field) for changes in seabed preparation. At a distance of approximately 8km from the windfarm site (the shortest distance between the windfarm site and any MCZ), the evidence-based assessment concluded that the temporary increases in SSCs do not directly affect MCZs. Changes in seabed depths would be indistinguishable from background levels and in line with the range of natural variability. Therefore, it is likely that any impact within the designated sites would be indiscernible and, hence, the impact on MCZ features was assessed as having a **negligible** magnitude.

121. It can be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde and West of Walney MCZs **would not be hindered** by temporary increases in SSCs and subsequent deposition during the construction phase. This is based on a **low** sensitivity and a **negligible-low** magnitude of impact.

7.1.2 Impact 2: Changes to the physical processes supplying and maintaining sediment

7.1.2.1 Overview of impact

122. As set out in **Table 4.1**, this impact is relevant to the Fylde MCZ and West of Walney MCZ.

123. While there is no physical disturbance to habitats within any MCZ during construction, changes to sediment pathways could be influenced by seabed level changes, e.g. as a result of seabed preparation. Impacts associated with changes to tides and currents from the physical presence of Project infrastructure within the windfarm site are assessed in the operation and maintenance phase.

7.1.2.2 Assessment against MCZ conservation objectives

124. **Table 7.2** summarises the sensitivity of features from Fylde MCZ and West of Walney MCZ to water flow (tidal current) changes (from '*offshore wind: during construction and power cable: laying, burial and protection*'), including sediment transport considerations, as per the AoO for the sites (Natural England, 2022a and 2022b).

Table 7.2 MCZ benthic feature sensitivities to changes in water flow (tidal current) changes, including sediment transport considerations

Designated site	Feature	NE AoO sensitivity
Fylde MCZ	Subtidal sand	Not sensitive – Low
	Subtidal mud	Not sensitive – Medium

Designated site	Feature	NE AoO sensitivity
West of Walney MCZ	Subtidal sand	Not sensitive – Low
	Subtidal mud	Not sensitive – Medium
	Sea-pen and burrowing megafauna communities	Medium – High

125. The potential exists for changes to occur at long distances from the construction itself, if an important sediment transport pathway was to be disrupted. Features range from not sensitive to highly sensitive; however, the benchmark for flow velocity change is 0.1m/s to 0.2m/s for more than one year. Flow speeds would not be affected outside the immediate vicinity of the WTGs and OSP(s), and sediment sources are driven from across the wider Irish Sea and Lancashire coastline, therefore a **low** sensitivity was assigned.

126. Tidal currents are the main driving force of sediment transport and, as a result, move sediments in an easterly direction. The assessment set out in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES concludes that, during construction, the change in seabed elevation would be within the range of natural change to the seabed caused by sandwaves and megaripples, hence the blockage effect on physical processes would be negligible. As such, a **negligible** magnitude of effect was assigned.

127. It can therefore be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde and West of Walney MCZs **would not be hindered** by disruption to sediment pathways during the construction phase. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.1.3 Impact 3: Underwater noise and vibration

7.1.3.1 Overview of impact

128. As set out in **Table 4.1**, this impact is relevant to the Fylde MCZ, West of Walney MCZ, Wyre-Lune MCZ and Ribble Estuary MCZ.

129. Underwater noise and vibration pile driving for the installation of WTG and OSP(S) foundations have the potential to impact on benthic fauna and fish.

130. There have been some studies on the ability of aquatic invertebrates (including shellfish) to respond to noise (e.g., de Soto *et al.*, 2013; Wale *et al.*, 2013; Roberts *et al.*, 2016; Stenton *et al.*, 2022). Whilst these studies demonstrated the potential for noise to negatively impact invertebrates, they were insufficient to make firm conclusions about sensitivity, or threshold noise levels, where impacts begin to occur. It is highly likely, however, that aquatic invertebrates do detect particle motion, including seabed vibration, and

existing evidence indicated these species were primarily sensitive to particle motion at frequencies well below 1kHz (Hawkins and Popper, 2016).

131. For fish, anthropogenic sounds can be so intense as to result in death or mortal injury; or lower sound levels may result in temporary hearing impairment, physiological changes, including stress effects, changes in behaviour or the masking of biologically important sounds (Popper and Hawkins, 2019; Kastelein *et al*. 2017).

132. The most recent and relevant guidelines for the purposes of noise assessment, were the Acoustical Society of America (ASA) Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al*., 2014). These guidelines provided directions and recommendations for setting criteria (including injury and behavioural criteria) for fish. The Popper *et al.* (2014) guidelines broadly grouped fish into the following categories, based on their anatomy and the available information on hearing of other fish species with comparable anatomies:

- Group 1: Fishes lacking swim bladders that are sensitive only to sound particle motion and show sensitivity to a narrow band of frequencies (includes flatfishes and elasmobranchs)
- Group 2: Fishes with a swim bladder where the organ does not appear to play a role in hearing. These fish are sensitive only to particle motion and show sensitivity to a narrow band of frequencies (includes salmonids and some tuna)
- Group 3: Fishes with swim bladders that are close, but not intimately connected to the ear. These fishes are sensitive to both particle motion and sound pressure and show a more extended frequency range than groups 1 and 2, extending to about 500Hz (includes gadoids and eels)
- Group 4: Fishes that have special structures mechanically linking the swim bladder to the ear. These fishes are sensitive primarily to sound pressure, although they also detect particle motion. These species have a wider frequency range, extending to several kHz, and generally show higher sensitivity to sound pressure than fishes in Groups 1, 2 and 3 (includes clupeids such as herring, sprat and shads)

133. Noise sources from activities, such as dredging during seabed preparation, ploughing/trenching for cable installation, scour protection/cable protection placement and vessel use, are unlikely to have a significant effect, as the benthos and fish in the area are likely to be habituated to ambient noise, such as that created by vessel traffic, aggregate dredging etc.

7.1.3.2 Assessment against MCZ conservation objectives

134. **Table 7.3** summarises the sensitivity of features from Fylde MCZ and West of Walney MCZ, as set out in Natural England's respective AoO (Natural England, 2022a and 2022b). Pressures considered are those categorised as 'underwater noise changes' under marine activity '*Electricity from renewable energy sources – Offshore wind (during construction)*'.

135. Natural England's AoO was drawn from the MarESA sensitivity ratings for the typical component biotopes of the benthic habitat features.

Table 7.3 MCZ feature sensitivities to changes in underwater noise

Designated site	Feature	NE AoO sensitivity
Fylde MCZ	Subtidal sand	Not sensitive
	Subtidal mud	Not relevant
West of Walney MCZ	Subtidal sand	Not sensitive
	Subtidal mud	Not relevant
	Sea-pen and burrowing megafauna communities	Not relevant

136. The MarESA sensitivity assessment, from which Natural England's AoO was drawn, concluded that, for the component biotopes of the designated features for the Fylde and West of Walney MCZs, noise impacts were either 'not sensitive' or 'not relevant'. 'Not relevant' has been recorded in the MarESA assessments where the evidence suggested that there was no direct interaction between the pressure and the habitat/biotope (or species). However, given increasing evidence that suggests that certain benthic species may actually perceive and react to noise (e.g. De Soto, 2013; Wale *et al.*, 2013; Roberts *et al.*, 2016; Richardson *et al.*, 1995), the sensitivity of benthic features (and their communities) to underwater noise and vibration is precautionarily considered to be **low**.

137. No AoO is available for Wyre-Lune MCZ or Ribble Estuary MCZ; however, smelt are considered within the Group 2, i.e. 'has a swim bladder, but the swim bladder is not involved in hearing'' (Popper *et al.*, 2014) hence have been assigned a **medium** sensitivity.

138. Underwater noise changes would form a temporary impact, affecting the designated sites (on a non-constant basis) only during part of the construction phase. While underwater noise can propagate to a considerable distance, at a distance of at least c. 8km from the windfarm site (the shortest distance between the site and any of the above designations), noise levels are likely to be minimal (and well below the levels which may be injurious to benthic fauna).

Underwater noise is not expected to be discernible for benthic communities within the MCZs. The impact on benthic communities associated with the features of Fylde MCZ and West of Walney MCZ is therefore considered to be of **negligible** magnitude.

139. Underwater noise modelling was undertaken for the Project, with full results presented in **Chapter 10 Fish and Shellfish Ecology** of the ES. The worst-case impact range using Popper *et al*. (2014) thresholds for TTS is 33km for “fish where swim bladder is not involved in hearing” (Group 2) (considering fish as a stationary receptor). In the absence of quantitative behavioural thresholds for smelt, the worst-case TTS range acts as a useful indicator. The Ribble Estuary MCZ (designated for smelt) is 34km from the windfarm site and, therefore, beyond the maximum range for TTS effects for Group 2 fish. Given the Wyre-Lune MCZ (designated for smelt) is at the maximum range for TTS effects (33km) and modelling shows that the impact ranges are not as great in an easterly direction from the windfarm site, noise impacts are unlikely to cause significant behavioural responses. In addition, smelt are known to remain close to the coast and, therefore, are unlikely to be in the most seaward part of the MCZ. As such, impacts are considered **low** in magnitude.

140. Based on a **low** to **medium** sensitivity and a **negligible** to **low** magnitude of impact, it can be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde, West of Walney, Wyre-Lune and Ribble Estuary MCZs **would not be hindered** by temporary changes in underwater noise during the construction phase. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.1.4 Impact 4: Introduction and spread of INNS

7.1.4.1 Overview of impact

141. As set out in **Table 4.1**, this impact is relevant to Fylde MCZ and West of Walney MCZ.

142. Should INNS species become established within a new habitat, they can out-compete native species for space and resources, or may prey on native species, or introduce new pathogens (Roy *et al*., 2012). As such, the introduction and/or spread of INNS during the construction phase could potentially lead to changes in the ecological functionality of the benthic communities in the MCZs.

143. As a growing consideration for offshore marine developments in the UK, the primary pathway for the potential introduction of INNS would be from the use of vessels and infrastructure that originated from outside the Irish Sea and Northeast Atlantic region, particularly from regions that are ecologically distinct from the Eastern Irish Sea. Ship ballast water appears to be the largest

single vector for INNS, and bio-fouling communities on ships are also a contributor (Glasby *et al*. 2007). The pathway for introduction of INNS would be greatest during the construction phase (due to the regularity and volume of construction-related vessel movements).

144. No INNS were recorded in the 2022 benthic characterisation surveys of the Project windfarm site. As such, the risk of spread of INNS from within the windfarm site to other marine areas was considered to be minimal.

145. The impacts from colonisation and establishment of INNS on offshore windfarm infrastructure following installation has been considered separately, as an operation and maintenance phase impact (**Section 7.2.4**).

7.1.4.2 Assessment against MCZ conservation objectives

146. **Table 7.4** summarises the sensitivity of features from Fylde MCZ and West of Walney MCZ, as set out in Natural England's respective AoO (Natural England, 2022a and 2022b). Pressures considered are those categorised as 'introduction or spread of invasive non-indigenous species' under marine activity '*Electricity from renewable energy sources – Offshore wind (during construction)'*.

147. Natural England's AoO is drawn from the MarESA sensitivity ratings for the typical component biotopes of the benthic habitat features.

Table 7.4 MCZ feature sensitivities to introduction or spread of INNS (construction phase)

Designated site	Feature	NE AoO sensitivity
Fylde MCZ	Subtidal sand	Not sensitive – high
	Subtidal mud	Insufficient evidence – high
West of Walney MCZ	Subtidal sand	Not sensitive – high
	Subtidal mud	Insufficient evidence – high
	Sea-pen and burrowing megafauna communities	Insufficient evidence

148. The MarESA sensitivity assessment, from which Natural England's AoO is drawn, concludes that, for the component biotopes of the designated features, sensitivity ranges from 'not sensitive' to 'high'. For some component biotopes, there is insufficient evidence for the AoO to provide a sensitivity rating to this particular pressure. In such instances, this assessment conservatively considers sensitivity to be **high**.

149. Based on the information set out in Natural England's AoO, and the MarESA assessment, the sensitivity of the benthic features to introduction and/or spread of INNS, was assessed as **high**.

150. In the absence of controls, the risk of introducing INNS during the construction phase would be reasonably high, and there would be potential for spread across an extensive area (particularly for INNS distributed within the water column). However, the risk of introducing or spreading INNS would be mitigated via the implementation of biosecurity measures in line with international and national regulations and guidance, namely:

- International Convention for the Prevention of Pollution from Ships (MARPOL), which set out the requirements for appropriate vessel maintenance
- The Environmental Damage (Prevention and Remediation) (England) Regulations 2015, which set out a 'polluter pays' principle whereby operators who cause a risk of significant damage to water and biodiversity receptors are responsible for i) preventing damage from occurring; and ii) bearing the costs for full reinstation of the environment (to original condition) in the event of damage occurring
- The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention), which provided an international framework to control the transfer of potentially invasive species from ballast water

151. Contractor commitments under the above (plus any other biosecurity commitments agreed in advance with stakeholders) would be implemented via a Project Environmental Management Plan (PEMP).

152. With such measures in place, the risk of introduction of INNS into the Fylde MCZ and West of Walney MCZ (or adjacent marine area) would be reduced to as low as reasonably practicable. As such, there is no long-term or significant risk to benthos, and the magnitude of impact was assessed as **negligible**.

153. It can be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde and West of Walney MCZs, **would not be hindered** by the risk of potential INNS introduction and/or spread during the construction phase. This is based on a **high** sensitivity, yet **negligible** magnitude of impact. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.1.5 Impact 5: Displacement of fishing activity

7.1.5.1 Overview of impact

154. As set out in **Table 4.1**, this impact is relevant to Fylde MCZ and West of Walney MCZ.

155. Both MCZs currently experience low levels of fishing activity, hence there is the potential for displaced fishing activity from within the windfarm site to cause an increase in habitat disturbance within the designations.

7.1.5.2 Assessment against MCZ conservation objectives

156. The features of Fylde MCZ and West of Walney MCZ are sensitive to physical disturbance of the seabed, based on Natural England's AoO for both sites (Natural England, 2022a) (**Table 7.5**). This pressure includes '*surface abrasion that is likely to result from pots or creels, cables and chains associated with fixed gears and moorings*'. As such, a **medium** sensitivity is conservatively assigned to the benthic features of the sites.

Table 7.5 MCZ feature sensitivities to displacement of fishing activity

Designated site	Feature	NE AoO sensitivity
Fylde MCZ	Subtidal sand	Sensitive (not sensitive to medium)
	Subtidal mud	Sensitive (not sensitive to medium)
West of Walney MCZ	Subtidal sand	Sensitive (not sensitive to medium)
	Subtidal mud	Sensitive (not sensitive to medium)
	Sea-pen and burrowing megafauna communities	Sensitive (medium to high)

157. A full review of fishing activity within the windfarm site has been undertaken within **Chapter 13 Commercial Fisheries** of the ES. Fishing activity within the windfarm site is dominated by potting, which is identified as the key fishery. Whilst levels of displacement may be considered significant in the context of the local commercial fishery (for potting), with mitigation outlined in **Chapter 13 Commercial Fisheries** of the ES, the residual effects of displacement are not significant.

158. The level of activity displaced is not considered to cause significant additional seabed disturbance within the MCZs, particularly given that displaced activity would principally be potting, rather than more damaging dredging or trawling (although a minor level of displacement of dredging is also identified within the windfarm site). Even in the event that the small numbers of displaced fishers use alternative grounds within the MCZs, the footprint of this would be very small within the context of the extent of habitat present in these sites. Displacement would also only exist intermittently over the construction period of 2.5 years, following which, it is likely that some users would return to original fishing grounds.

159. Further, to mitigate this displacement effect, emphasis is focused on ensuring that the effect of reduced access is mitigated by removing that effort, to ensure

that it is not moved or displaced elsewhere. Additional mitigation measures can reduce displacement, such as the requirement for fishing gear that is subject to a cooperation agreement to be wet or dry stored (i.e. not actively fished). As such, the magnitude was assessed as **low**. Detail on additional mitigation measures is provided in **Chapter 13 Commercial Fisheries** of the ES.

160. Given the **medium** sensitivity and **low** magnitude, it can therefore be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde and West of Walney MCZs **would not be hindered** by displacement of fishing activity. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.2 Potential impacts during operation and maintenance phase

7.2.1 Impact 1: Increases in SSCs and subsequent deposition

7.2.1.1 Overview of impact

161. As set out in **Table 4.1**, this impact is relevant to the Fylde MCZ and West of Walney MCZ.

162. During the operation and maintenance phase, periodic maintenance activities may include repair to subsea cables and/or foundations, which require limited disturbance of the seabed (seabed footprints from jack-up vessels, cable repair/replacement or reburial and/or anchoring). During such maintenance activities, small volumes of sediment could be re-suspended; though it should be noted that the volumes of sediment disturbed during maintenance works at any given time would be lower than those during construction-phase seabed preparation and cable burial works.

163. Sediment disturbance, as a result of operation and maintenance phase activities, are expected to cause localised and short-term increases in SSCs at the point of disturbance. Released sediment may then be transported by tidal currents up to a spring tidal excursion distance of approximately 10km, in suspension in the water column, before being redeposited back on to the seabed.

164. There is no potential for sediment plumes to reach the West of Walney MCZ (13km north of the Project) due to the alignment of the tidal axis and the distance of the MCZ from the Project.

7.2.1.2 Assessment against MCZ conservation objectives

165. The sensitivities of the features of Fylde MCZ and West of Walney MCZ to operation and maintenance phase pressures (*'Electricity from renewable energy sources – Offshore wind (operation and maintenance)'*), as set out in the respective AoO (Natural England, 2022a and 2022b), are identical to those in the construction phase (see **Table 7.1**).

166. As noted in **Section 7.1.1**, given that the designated sites are located at a distance of at least 8km from the windfarm site, there is no need to consider sensitivity to heavier smothering and siltation rate changes that may occur within 1km of disturbance activity.

167. In all instances, the component biotopes of the designated features (as considered in the AoO) have no or low sensitivity to the effects of increased SSCs, or subsequent light siltation, during operation and maintenance activities. Conservatively, therefore, the sensitivity of this receptor group was assessed as **low**.

168. As noted above, the magnitude of impact during the operation and maintenance phase would be lower than that assessed for the construction phase, given that lower volumes of sediment would be disturbed during each maintenance activity (refer to **Table 3.7**). **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES concludes that increases in SSCs caused by maintenance activities would be indistinguishable from background levels at the distances of the Fylde MCZ and West of Walney MCZ.

169. Given the distance of any MCZ to the windfarm site, it is likely that any effect within the MCZs would be indiscernible and, hence, the impact on benthic features was assessed as having **negligible** magnitude.

170. Based on a **low** sensitivity and a **negligible** magnitude of impact, it can be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde and West of Walney MCZs **would not be hindered** by temporary increases in SSCs, and subsequent deposition, during the operation and maintenance phase.

7.2.2 Impact 2: Changes to the physical processes supplying and maintaining sediment

7.2.2.1 Overview of Impact

171. As set out in **Table 4.1**, this impact is relevant to Fylde MCZ and West of Walney MCZ.

172. While there is no physical disturbance to habitats with any MCZ during operation and maintenance, the presence of infrastructure on the seabed at the windfarm site has the potential to alter the baseline physical processes, particularly tidal currents. Any change in tidal currents also has the potential to contribute to changes in seabed morphology due to alteration of sediment transport patterns.

173. The conceptual evidence-based assessment presented in **Chapter 7 Marine Geology, Oceanography and Physical Processes** suggests that each foundation would present an obstacle to the passage of currents locally, causing a small modification to the height and/or phase of the water levels and a wake in the current flow. This latter process involves a deceleration of flow immediately upstream and downstream of each foundation and an acceleration of flow around the sides of each foundation. Current speeds return to baseline conditions with progression downstream of each foundation and generally do not interact with wakes from adjacent foundations, due to the relatively large separation distances.

174. This assessment is supported by modelling undertaken for Morgan, Mona and AyM, as outlined in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES. In addition, there was a pre-existing scientific evidence base which demonstrated that changes in the tidal regime due to the presence of foundation structures would be both small in magnitude and local in spatial extent (ETSU, 2000; ETSU, 2002; Lambkin *et al*., 2009).

175. The predicted reductions in tidal regime (as outlined above) would result in a reduction in the sediment transport potential across the areas where such changes are observed. Conversely, the areas of increased turbulence around each WTG/OSP foundation would result in increased sediment transport potential.

176. These changes to sediment transport processes would be of a limited scale and largely confined to local wake or wave shadow effects attributable to individual WTG/OSP foundations (near-field) and, therefore, would be small in geographical extent. In the case of wave effects, there would also be reductions due to a shadow effect across a greater seabed area. However, the changes in wave heights across this wider area (far-field) would be significantly lower (typically less than 1% of the baseline) than the changes local to each WTG/OSP foundation. It is assumed that scour protection at the foundations would be installed as soon as practicable (i.e. typically within a season) to ensure there would be no significant scour effects in the period between the installation of foundations and the installation of the scour protection.

177. There is the potential for impacts on SSCs caused by 'turbid wakes' in the lee of foundation structures fixed to the seabed. Turbid wakes are unlikely to be

continuously present, particularly following tidal reversal and at stormier times when there is enhanced mixing of the water column (Vattenfall Wind Power Limited, 2014). Coarser sediments would settle out of the wakes quicker and closer to the structure than finer sediments, which could remain suspended for much longer time periods and for farther extents (Vattenfall Wind Power Limited, 2014). SSCs would also increase, following remobilisation on subsequent tides, however, these would not reach the concentrations resulting from initial suspension in the lee of the foundations and would rapidly reduce to background levels as the tidal cycle continued (up to a few hours).

178. The assessment outlined above is further supported by modelling conducted for Mona, Morgan and AyM (see Section 7.6.3.3 of **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES).

7.2.2.2 Assessment against MCZ conservation objectives

179. Sensitivities of the features of Fylde MCZ and West of Walney MCZ in relation to water flow (tidal current) changes during the operation and maintenance phase are identical to those for the construction phase (presented in **Table 7.2**), as set out in the AoO for the sites (Natural England, 2022a and 2022b).

180. The potential exists for changes to occur at long distances from the windfarm offshore infrastructure itself if an important sediment transport pathway was disrupted. Features range from not sensitive to highly sensitive. The AoO sensitivity benchmark for flow velocity is 0.1m/s to 0.2m/s for more than 1 year, however, assessment for the Project predicts that flow speeds during operation would not be affected outside the windfarm site, with changes outside the wake of turbines to be less than ±0.01m/s. Given the wide sources of sediment across the Irish Sea and Lancashire coast, a **low** sensitivity for MCZ features is assigned.

181. Tidal currents are the main driving force of sediment transport and, as a result, move sediments in an easterly direction. The assessment in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES concludes that, during the operation and maintenance phase, there would be no significant changes to the broad-scale flow regime or sediment transport pathways. Changes in the tidal regime would be limited and spatially confined to a narrow wake downstream of each individual WTG/OSP.

182. The assessment set out in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES concludes that, during construction, the change in seabed elevation would be within the range of natural change to the seabed caused by sandwaves and sand ridges, hence the blockage effect on physical processes would be negligible.

183. Given the distance to the Fylde MCZ (over 8km), impacts are thus assigned a **negligible** magnitude.

184. Based on a **low** sensitivity and a **negligible** magnitude of impact, it can be concluded that the conservation objective of maintaining or restoring the protected features of the MCZs **would not be hindered** by disruption to sediment pathways due to the physical presence of the Project infrastructure. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.2.3 Impact 3: Underwater noise and vibration

7.2.3.1 Overview of impact

185. As set out in **Table 4.1**, this impact is relevant to the Fylde MCZ, West of Walney MCZ, Wyre-Lune MCZ and Ribble Estuary MCZ.

186. Noise generated by the mechanical activity of WTGs, as well as a result of wind-induced vibration at high wind speeds, can be transmitted through the tower and foundations and radiate into the water column. The continuous noise associated with operation and maintenance, e.g. with WTG operation and work vessels, is of a much-reduced dB source level than that assessed for piling activities during the construction phase in **Section 7.1.3**. Underwater noise is proportional to the size of the WTG; larger WTGs require greater mechanical forces (Tougaard *et al*., 2020).

187. Underwater noise emissions may also occur from vessel traffic and from maintenance activities, such as repairs to foundations and cables (i.e. cable replacement and re-burial).

7.2.3.2 Assessment against MCZ conservation objectives

188. Sensitivities of the features of Fylde MCZ and West of Walney MCZ, in relation to underwater noise changes during the operation and maintenance phase, are identical to those for the construction phase (presented in **Table 7.3**), as set out in the AoO for the sites (Natural England, 2022a and 2022b), and are either ‘not sensitive’ or ‘not relevant’. As set out in **Section 7.1.3**, however, there is increasing evidence suggesting certain benthic species may perceive and react to noise means that the sensitivity of benthic features is precautionarily considered to be low.

189. As described in **Section 7.1.3**, smelt from Wyre-Lune MCZ and Ribble Estuary MCZ are classified as species with swim bladders, although the swim bladders are not involved in hearing (Popper *et al.*, 2014). A **medium** sensitivity is given to smelt, given it has some sensitivity to noise.

190. Underwater noise from operational maintenance activities would be temporary and short-lived, and generally in line with ambient noises in the general area (i.e., vessel noises), and would not be expected to have any significant effect.

191. Modelling for the Project (as detailed in **Appendix 11.1 Underwater Noise Assessment** of **Chapter 11 Marine Mammals** of the ES; Document Reference 5.2.11.1) shows that maximum impact ranges for noise from the WTGs is <50m from each structure. Impact ranges of continuous noise from work vessels is also modelled to be a maximum of 50m. Underwater noise from the WTG structures themselves would persist throughout the lifetime of the Project. However, at a distance of at least 8km from the windfarm site (the shortest distance between the site and any of the above designations), underwater noise from WTGs would have attenuated sufficiently that noise changes would be barely discernible (or indiscernible). The impact on MCZ features is thus considered to be of **negligible** magnitude.

192. Based on a **low** to **medium** sensitivity, and a **negligible** magnitude of impact, it can be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde, West of Walney, Wyre-Lune and Ribble Estuary MCZs **would not be hindered** by underwater noise changes arising from the operation and maintenance phase of the Project. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.2.4 Impact 4: Introduction and spread of INNS

7.2.4.1 Overview of impact

193. As set out in **Table 4.1**, this impact is relevant to the Fylde MCZ and West of Walney MCZ.

194. The primary pathway for the potential introduction of INNS is from the use of vessels and infrastructure that have originated from outside the Irish Sea and Northeast Atlantic region, particularly from regions that are ecologically distinct from the Eastern Irish Sea. Ship ballast water appears to be the largest single vector for INNS, and bio-fouling communities on ships are also a contributor (Glasby *et al*., 2007). The pathway for introduction of INNS would be greatest during the construction phase (due to the regularity and volume of construction-related vessel movements). An anticipated 384 round trips in a standard year (832 in a heavy maintenance year) between the windfarm site and port would be undertaken during the operation and maintenance phase of the Project. There is a risk that artificial hard substrates introduced by the Project (including WTG foundations, scour protection and cable protection) could act as potential 'stepping stones' or vectors for INNS, thereby facilitating the spread of such species.

195. The measures to control risk of INNS introduction and spread set out for the construction phase (as set out in **Section 3.7**) would apply also during the operation and maintenance phase.

7.2.4.2 Assessment against MCZ conservation objectives

196. Sensitivities of the features of Fylde MCZ and West of Walney MCZ, in relation to the introduction and spread of INNS during the operation and maintenance phase are identical to those identified for the construction phase (presented in **Table 7.4**), as set out in the AoO for the sites (Natural England, 2022a and 2022b).

197. The MarESA sensitivity assessment, from which Natural England's AoO is drawn, concludes that, for the component biotopes of the designated habitat features, sensitivity ranges from 'not sensitive' to 'high'. For some component biotopes, there is insufficient evidence for the AoO to provide a sensitivity rating to this particular pressure. In such instances, this assessment conservatively considers sensitivity to be **high**.

198. Based on the information set out in Natural England's AoO and the MarESA assessment, the sensitivity of the benthic features to introduction and/or spread of INNS in the operation and maintenance phase was assessed as **high**.

199. As with the assessment for the construction phase (**Section 7.1.4**), introduction/spread of INNS in the absence of suitable controls, means that the risk of introducing or spreading INNS during the operation and maintenance phase would be reasonably high, and there would be potential for spread across an extensive area (particularly for INNS distributed within the water column).

200. However, the risk of introducing or spreading INNS to the MCZs during the operation and maintenance phase would be controlled via the implementation of biosecurity measures, as described in **Section 3.7**. With these measures also in place during the operation and maintenance phase, the risk of introduction of INNS would be reduced to as low as reasonably practicable. As such, there is no long-term, or significant, risk to benthic features of the designated sites considered in this assessment, and the magnitude of impact was assessed as **negligible**.

201. Based on a **high** sensitivity yet **negligible** magnitude of impact, it can be concluded that the conservation objective of maintaining or restoring the protected features of the MCZs **would not be hindered** by the risk of potential introduction and/or spread of INNS during the operation and maintenance phase.

7.2.5 Impact 5: Displacement of fishing activity

7.2.5.1 Overview of impact

202. As set out in **Table 4.1**, this impact is relevant to Fylde MCZ and West of Walney MCZ.

203. As with the construction phase, any displacement of fishing activity due to the Project into the MCZs during the operation and maintenance phase may cause physical disturbance to habitat features. However, it is noted again that there are existing windfarms within the West of Walney MCZ.

7.2.5.2 Assessment against MCZ conservation objectives

204. The features of Fylde MCZ and West of Walney MCZ are sensitive to physical disturbance of the seabed, based on Natural England's AoO for both sites (Natural England, 2022a) (**Table 7.6**). Noting that this also includes any surface abrasion that is likely to result from pots or creels, cables and chains associated with fixed gears and moorings. As such a **medium** sensitivity is assigned.

Table 7.6 MCZ feature sensitivities to displacement of fishing activity

Designated site	Feature	NE AoO sensitivity
Fylde MCZ	Subtidal sand	Sensitive (not sensitive to medium)
	Subtidal mud	Sensitive (not sensitive to medium)
West of Walney MCZ	Subtidal sand	Sensitive (not sensitive to medium)
	Subtidal mud	Sensitive (not sensitive to medium)
	Sea-pen and burrowing megafauna communities	Sensitive (medium to high)

205. A full review of fishing activity within the site has been undertaken within **Chapter 13 Commercial Fisheries** of the ES. Fishing activity within the windfarm site is dominated by potting which is identified as the key fishery. As reported in **Chapter 13 Commercial Fisheries** of the ES, levels of displacement from the windfarm site would not be significant during the operation and maintenance phase, given that access would be available beyond an assumed 50m advisory operating distance of individual WTGs (except on the periodic occasions where maintenance work is being undertaken). Whilst some displacement may still occur, given that levels of activity displaced would be minor, and principally relate to potting activity, as opposed to more damaging trawling and dredging (although a minor level of displacement of dredging is also identified in the windfarm site), the magnitude was assessed as **low**.

206. Given the **medium** sensitivity and **low** magnitude, it can therefore be concluded that the conservation objective of maintaining or restoring the protected features of the Fylde and West of Walney MCZs **would not be hindered** by displacement of fishing activity during the operation and maintenance phase. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

7.3 Potential impacts during decommissioning

207. Given the lack of information regarding timing and methodology used for decommissioning, nor the conservation status of the MCZ features at the time of decommissioning, it is not possible to undertake a detailed assessment in relation to decommissioning at this time.

208. The activities associated with decommissioning impacts are:

- Increases in SSCs and subsequent deposition–- Increases in SSCs and sediment deposition from the decommissioning works may arise during the removal of subsea installations, namely the de-burial and removal of inter-array and platform link cables. In the event that cables are left in situ, increases in SSCs and deposition would relate to the disturbance of seabed from jack-up vessels and anchored vessels and, hence, would be very minor
- Changes to the physical processes supplying and maintaining sediment – Changes to the physical processes supplying and maintaining sediment are considered no worse than during the construction phase. There is the potential for some infrastructure to be left in situ (operation and maintenance impacts assess the potential for permanent effects on this assumption (i.e. structures left in-situ))
- Underwater noise and vibration–- Noise would predominantly arise from the use of vessels and/or any cutting activity required for the removal of substructures. For the most part, decommissioning phase noise sources would be similar to those expected during the construction phase, though with the significant omission of piling activity
- Introduction and spread of INNS–- As with the construction phase, the risk of introduction and/or spread of INNS during the decommissioning phase would primarily be attributed to the use of vessels that originate from outside the Irish Sea and Northeast Atlantic region, particularly from regions that are ecologically distinct from the Eastern Irish Sea. Vessel use during the decommissioning phase is likely to be to a similar degree as that during the construction phase, with vessels likely to be required for activities including the removal of any topside and subsurface infrastructure not left in situ (the extent of removal would be set out in the decommissioning programme)

- Displacement of fishing activity–- Safety Zones, as per construction would be expected, hence similar temporary displacement

209. The magnitude of these impacts was considered to be comparable to, or less than, those predicted during the construction phase. As such, conclusions of the construction-phase assessment set out in **Section 7.1** are considered to equally apply to the decommissioning phase.

210. A further assessment would be undertaken at the time of decommissioning. This approach was also applied for the assessment of decommissioning impacts in the accompanying ES.

7.4 Cumulative effects

211. In order to undertake the CEA, and as per the PINS advice note (PINS, 2019), the potential for cumulative effects has been established considering each Project-alone effect (and the ZoI of each impact) alongside the list of plans, projects and activities that could potentially interact. These stages are detailed below.

7.4.1 Identification of potential cumulative effects

212. Part of the cumulative assessment process was the identification of which individual impacts assessed for the Project have the potential for a cumulative effect on receptors (impact screening). This information is set out in **Table 7.7.** Screening considered the ZoI of the impacts and the plans, projects and activities identified in **Section 7.4.2** (presented in **Figure 7.1**).

Table 7.7 Potential cumulative impacts (impact screening)

Impact	'Project-alone' assessment against MCZ objectives	Potential for cumulative effect	Rationale
Construction phase			
Impact 1: Increased SSCs and subsequent deposition	The conservation objective of maintaining or restoring the protected features of the MCZs would not be hindered.	Yes	Increases in SSCs during the construction phase may interact with suspended sediment plumes from other activities and hence the significance of the impact may be affected.
Impact 2: Changes to the physical processes supplying and maintaining sediment		No	Impacts would be temporary and localised with no potential for cumulative effects.
Impact 3: Underwater noise and vibration		Yes	Noise impacts from other construction activities have the potential to overlap.
Impact 4: Introduction and spread of INNS		No	Biosecurity measures would be in place to prevent the introduction of INNS and the magnitude of impact is negligible. The risk of introduction of INNS to the Eastern Irish Sea is not considered to be significantly increased due to the construction of the Project. Other projects would also include biosecurity measures.
Impact 5: Displacement of fishing activity		Yes	Displacement from other construction projects could increase pressure elsewhere.
Operation and maintenance phase			
Impact 1: Increased SSCs and subsequent deposition	The conservation objective of maintaining or restoring the protected	Yes	Increases in SSCs during the operation and maintenance phase may interact with suspended sediment plumes from other activities and hence the significance of the impact may be affected.

Impact	'Project-alone' assessment against MCZ objectives	Potential for cumulative effect	Rationale
Impact 2: Changes to the physical processes supplying and maintaining sediment	features of the MCZs would not be hindered.	Yes	Impacts would be localised, however incremental impacts from other projects are considered given the duration of effects.
Impact 3: Underwater noise and vibration		No	Operation and maintenance noise is not considered to cause cumulative effects as the increase above background noise levels expected during operation and maintenance would be very small and localised in nature (<90m).
Impact 4: Introduction and spread of INNS		No	Artificial hard substrates on the seabed such as foundations, scour protection and cable protection have the potential to act as 'stepping stones' enabling the spread of INNS. However, there is already connectivity between existing similar structures. Benthic invertebrate larvae can disperse over distances of tens to over a hundred kilometres (Álvarez-Noriega, 2020) and within this range are a number of other OWFs including Walney, West of Duddon Sands, Ormonde, Barrow, Burbo Bank and Gwynt y Môr, hence the addition of artificial hard substrates for the Project would not materially increase the existing stepping stone potential for INNS. Any cumulative impact would be negligible and, therefore, this is not considered further within the cumulative assessment.
Impact 5: Displacement of fishing activity		Yes	Incremental displacement effects across the region can lead to cumulative effects.
Decommissioning phase			
As per construction phase.			

7.4.2 Identification of other plans, projects and activities

213. In the Screening Report (Document Reference 4.12), the following plans and projects were screened in for cumulative impact assessment:

- Transmission Assets
- Morgan Offshore Wind Project Generation Assets
- Mona Offshore Wind Project
- Isle of Man Interconnector (maintenance activities)
- Walney 1, 2 and Extension projects and West of Duddon Sands Offshore Wind Farms (maintenance activities)
- AyM Offshore Wind Farm
- Liverpool Bay Aggregate Production Area
- Disposal sites Z and Y
- Barrow D disposal site
- Morecambe Bay B disposal site
- Morecambe Bay Lune Deep disposal site

214. **Figure 7.1** shows these projects in relation to the Project and the MCZs with further information on the Project Screening in the Screening Report (Document Reference 4.12). No updates have been identified post screening, as noted in **Section 4.2.3**.

7.4.3 Assessment of cumulative effects

215. Having established the residual effects from the Project with the potential for a cumulative effect, along with the other relevant plans, projects and activities, the following sections provide an assessment of the level of cumulative effect that may arise. These are detailed below per impact where the potential for cumulative effects have been identified (in line with **Table 7.7**).

216. Given the interconnected nature of the Project and the Transmission Assets, a separate 'combined' assessment of these is provided within the CEA (**Section 7.4.3.1**). Thereafter, the cumulative assessment considers all plans, projects and activities screened into the CEA (**Section 7.4.3.2**).

7.4.3.1 Cumulative assessment – the Project and Transmission Assets (combined assessment)

217. While the Transmission Assets[15] are being considered in a separate MCZA as part of a separate DCO application, given the functional link, a 'combined' assessment has been made considering both the Project and the Transmission Assets for the purposes of cumulative assessment. This provides an assessment including impact interactions and additive effects and thus any chance in the significance of effects as assessed separately.

218. The Transmission Assets MCZ Screening and Stage 1 Assessment Report (Morgan Offshore Wind Limited and Morecambe Offshore Windfarm Ltd, 2023) informs this assessment.

219. Only the marine elements of the Transmission Assets would interact with the Project in relation to MCZs, including:

- Export cables adjoining the Morgan Offshore Wind Project Generation Assets and the Project and making landfall south of Blackpool
- Booster station required for the Morgan Offshore Wind Project Generation Assets
- OSP(s) (for the Project and Morgan Offshore Wind Project Generation Assets)

220. Only the Fylde MCZ was screened into the Stage One Assessment of the Transmission Assets MCZA as the majority of other screened MCZs were outside the ZoI for impacts that could potentially affect benthic habitat, fish, marine mammal or ornithological features of the MCZs. Although the West of Walney MCZ and West of Copeland MCZ are within the ZoI for increased SSCs, the magnitude of this impact was not considered to result in significant effects on the protected features of these MCZs (Morgan Offshore Wind Limited and Morecambe Offshore Windfarm Ltd, 2023).

221. The following (project-alone) impacts were concluded in the Transmission Assets MCZ Screening and Stage 1 Assessment Report (Morgan Offshore Wind Limited and Morecambe Offshore Windfarm Ltd, 2023).

- Temporary habitat disturbance/loss (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**

[15] As the Transmission Assets includes infrastructure associated with both the Project and the Morgan Offshore Wind Project Generation Assets, it should be noted that the combined assessment considers the transmission infrastructure for both the Project and the Morgan Offshore Wind Project Generation Assets (and includes all infrastructure as described in the Transmission Assets PEIR).

- Increased SSCs and associated deposition (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Disturbance/remobilisation of sediment bound contaminants (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Long term habitat loss (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Introduction of artificial structures (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Increased risk of introduction and spread of INNS (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Changes in physical processes (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Impacts to benthic invertebrates due to EMF (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**
- Heat from subsea electrical cables (all phases) – The conservation objective of maintaining or restoring the protected features of the Fylde MCZ **would not be hindered**

222. These impacts align with those assessed for the Project (with small differences in wording) but also consider direct effects given that the Transmission Assets overlap the Fylde MCZ. An assessment of heat and EMF from subsea electrical cables was not undertaken for the Project as the effects during the Project lifetime would be highly localised within the immediate vicinity (in the order of metres, at worst) of the subsea cables. Given the scale of Project-alone effect directly within the windfarm site, there would be no interaction of effects and negligible additive effects across the study area.

223. There is the potential for indirect effects from both the Project and Transmission Assets on MCZs relating to increases in SSCs and deposition (potential for plumes to coalesce or impact the same MCZ), changes to the physical processes supplying and maintaining sediment, underwater noise and vibration and displacement of fishing activity. These impacts are therefore assessed in further detail below.

224. While all other effects are additive between the Project and the Transmission Assets, due to the localised and spatially separate effects, there is no material change in the overall conclusion of the assessment when considering the majority of impacts together (as described in **Table 7.7**).

Cumulative Impact 1: Increased SSCs and subsequent deposition

225. There is potential for construction (and decommissioning), operation and maintenance, and decommissioning activities for the Transmission Assets to result in sediment disturbance leading to advection of sediment plumes, in addition to those that may arise during construction, operation and maintenance and decommissioning activities at the Project windfarm site. Where sediment plumes interact, there is likely to be a corresponding increase in SSCs (and subsequent deposition) at that location over and above that which would occur should the projects be undertaken in isolation. Should such interaction occur within the boundaries of an MCZ, or where the MCZ is within the ZoI of both projects, there is potential for cumulative impacts.

226. As discussed in the Project-alone assessment in **Sections 7.1** (construction) and **Section 7.2** (operation and maintenance), increases in SSCs and changes in seabed level at any stage of the Project would be temporary (i.e. deposited fines would be redistributed within a short period of time by hydrodynamic actions). Coarse sediment would fall out relatively close to the point of disturbance (within a few tens of metres along the axis of tidal flow (west-east)). Finer sediment would stay in suspension for a longer time and deposit over a maximum area limited to one tidal excursion from each activity.

227. If the construction programmes of the projects overlap, it is possible that their sediment plumes could coalesce and could have a small overlap with the Fylde MCZ (based on the maximum ZoI for suspended sediments arising from each project). However, suspended sediments would be advected on the same tide and the majority of sedimentation would occur in close proximity to each activity, with Project activities occurring at least 8km from the Fylde MCZ

228. Given the distance of the Fylde MCZ and the limited overlap of the ZoI, levels of suspended sediments and changes to seabed thickness from Project activities are not considered to measurably impact the protected features of the MCZ, and as such, would not contribute to cumulative effects. The Project is separated from the Transmission Assets within the MCZ. Therefore, effects on MCZ features (which are not sensitive to suspended sediments and sediment deposition) would not exceed the Project-alone or Transmission Assets assessment, as concluded separately.

229. There is no potential for sediment plumes from the Project to contribute to a cumulative effect on the West of Walney MCZ (13km north of the Project), or any further MCZs due to the alignment of the tidal axis and the distance of the

MCZs from the Project (**Figure 7.1**). Therefore, the cumulative effect would not exceed the Project-alone or Transmission Assets assessment.

230. Suspended sediment plumes arising during the operation and maintenance phase for both the Project and the Transmission Assets (cable repairs/reburial) would be intermittent and on a much smaller scale than those arising during the construction phase. Therefore, effects would not exceed the impacts as assessed for the Project and Transmission Assets separately.

231. In summary, cumulative impacts could only realistically occur in the instance that sediment-disturbing activities are taking place at the Project and Transmission Assets simultaneously, and sediment plumes from the Transmission Assets encroach into the 'near field' area of the Project's activities. While the Transmission Assets is within the Fylde MCZ, given that this MCZ does not overlap with the near-field area for the Project (located at approximately 8km from the windfarm site), there is no change to impacts on MCZ features as assessed for the Project and Transmission Assets separately.

232. Decommissioning activities would be similar to those of construction and are therefore would not exceed the impacts as assessed for the Project and Transmission Assets separately.

Cumulative Impact 2: Changes to the physical processes supplying and maintaining sediment

233. There is potential for the presence of infrastructure on the seabed during the operation and maintenance phase to alter the baseline physical processes in the vicinity of the Project and Transmission Assets which could result in changes to physical processes that supply sediment to MCZs.

234. The assessment of Project-alone effects shows that changes in tidal currents due to the presence of WTGs/OSP(s) foundation structures would be both small in magnitude and local in spatial extent (limited to a narrow wake in the lee of foundation structures) (outlined in **Section 7.2.2**). This is also true for the Transmission Assets, which was supported by modelling undertaken for Morgan Offshore Wind Project, whereby the effect of infrastructure on physical processes would be highly localised and would not impede the movement of material (Morgan Offshore Wind Limited and Morecambe Offshore Windfarm Ltd, 2023).

235. In line with the assessment for tidal currents above and modelling results conducted for the Mona Offshore Wind Project (outlined in Section 7.6.3.2 of **Chapter 7 Marine Geology, Oceanography and Physical Processes**), it is expected that changes in the wave regime due to WTG/OSP foundation structures would be minimal and represent less than 1% of the baseline significant wave height (Mona Offshore Wind Limited, 2023).

236. There may be local changes to sediment transport processes experienced within the Fylde MCZ if cable protection for the Transmission Assets is installed in the MCZ, however, this is beyond the range of potential changes to the sediment transport regime as a result of the Project. Turbid wakes could extend approximately up to one spring tidal excursion from the foundation structures (Vanhellemont and Ruddick, 2014), however, given the limited overlap of the ZoI with the Fylde MCZ, no cumulative effects are anticipated.

237. Although there may be local interruptions to bedload sediment transport within the vicinity of infrastructure on the seabed, gross patterns of sediment transport moving east across the Eastern Irish Sea would not be affected significantly and would not impact regional scale sediment transport processes.

238. Therefore, effects on MCZ features would not exceed the Project-alone or Transmission Assets assessment as concluded separately.

Cumulative Impact 3: Underwater noise and vibration

239. There is the potential for cumulative effects from underwater noise during construction (piling) from both the Project and Transmission Assets.

240. Given that the benthic receptors have negligible to low sensitivity to underwater noise and that there is a minimum 8km distance between Fylde MCZ/West of Walney MCZ and the Project, cumulative underwater noise impacts are not considered likely to hinder the conservation objectives of these MCZs. There is the potential for cumulative effects during construction at the Wyre Lune MCZ and the Ribble Estuary MCZ (designated for smelt) given the locations of the projects.

241. As highlighted in **Section 7.1.3** noise impacts from the Project are expected to be minimal given the closest sites for fish (smelt) (Wyre Lune MCZ and the Ribble Estuary MCZ), both lie beyond 33km from the nearest point of the windfarm site. Behavioural responses over 33km are expected to be minimal and, while fish are mobile, smelt is generally an estuarine species, keeping close association with the coast. Sound modelling for the piling associated with the Transmission Assets (Morgan offshore booster station) indicated similar patterns as those for the Project (see **Chapter 10 Fish and Shellfish Ecology**). There is the potential for piling to occur concurrently at the Project and the Morgan offshore booster substation and Morgan OSP(s). Cumulative effects on spawning would only occur if piling/UXO clearance took place simultaneously during the peak spawning periods for these species. Should any potentially significant impacts on protected species and habitats be identified as a result of that, mitigation would likely be required under piling EPS licence and/or UXO marine licence conditions.

242. Overall, the short piling duration expected for the Transmission Assets (and noise levels associated with cable laying) would only represent a very short-term increase in the ensonified area when considered cumulatively with planned piling at the Project. There is no risk of cumulative impacts hindering the conservation objective of maintaining or restoring the protected MCZ features, as assessed for the Project and Transmission Assets separately.

Cumulative Impact 4: Displacement of fishing activity

243. There is potential for the Project and Transmission Assets to result in increases in displacement of fishing activity into MCZs during construction and operation and maintenance.

244. The Transmission Assets PEIR includes a cumulative assessment for the Scottish west coast scallop vessels. No other fishing fleet is included in the Transmission Assets cumulative assessment because negligible impacts were concluded for all other Transmission Assets alone impacts for all other fleets.

245. The Transmission Assets PEIR identified that the Scottish west coast scallop vessels receptor group is less active within the Project windfarm site than within the Transmission Assets Red Line Boundary and so cumulative effects are limited. This considers the separation of fleets impacted by each project (Transmission Assets largely impact the inshore fishery) and the short-term period of construction where impacts would be greatest.

246. While displacement would increase cumulatively, there are available grounds outside of MCZs and mitigation measures identified to minimise displacement for Project-alone effects likely limiting increased pressure within MCZs (as described in **Section 7.1.5** and **Section 7.2.5**). Thus, there is no risk of cumulative impacts hindering the conservation objective of maintaining or restoring the protected features of MCZs screening into the assessment, as assessed for the Project and Transmission Assets separately.

Summary

247. Given the separation of the windfarm site to any MCZ, contribution to any cumulative effects has been shown to be negligible. However, possible interactions and additive effects between the Project and the Transmission Assets have been fully considered. No impacts to the protected features of any MCZ, beyond those assessed for the Project and Transmission Assets separately have been identified. A summary is provided in **Table 7.8** considering all effects from the Project and the Transmission Assets.

Table 7.8 Summary of impacts from the Project and Transmission Assets alone and combined (note: wording of impacts has been summarised to encompass both projects)

Impact	Transmission Assets assessment against MCZ objectives	'Project-alone' assessment against MCZ objectives	Combined assessment
All phases			
Increases in SSCs and subsequent deposition	The conservation objective of maintaining or restoring the protected features of the Fylde MCZ would not be hindered.	The conservation objective of maintaining or restoring the protected features of the Fylde MCZ, West of Walney MCZ, Wyre-Lune MCZ and Ribble Estuary MCZ would not be hindered.	The windfarm site is at least 8km from the nearest MCZ, with negligible effects identified that could contribute to cumulative effects. Given the limited interactions, localised nature and small scale of effects in the context of the wider study area, there is no risk of combined effects beyond those assessed for each project alone.
Changes to the physical processes supplying and maintaining sediment			
Underwater noise and vibration			
Displacement of fishing activity			
Introduction and spread of INNS			Not considered to have the potential for combined effects given the embedded mitigations as part of each project.
Impacts to benthic invertebrates due to EMF		No impact	No pathway for combined effects, with no direct overlap with the Project and any MCZ.
Heat from subsea electrical cables		No impact	
Direct effects (habitat loss and introduction of hard infrastructure		No impact	

7.4.3.2 Cumulative assessment – All plans and projects

248. Based on the impacts (**Table 7.7**) and plans and projects (listed in **Section 7.4.2**) identified where there is the potential for cumulative effects, a detailed cumulative assessment has been undertaken considering all relevant information from the Project and other plans and projects (including the Transmission Assets). It is noted that the Project does not contribute to any direct effects and thus are not assessed cumulatively.

Cumulative Impact 1: Increased SSCs and subsequent deposition

249. There is potential for construction, operation and maintenance, and decommissioning activities at other developments/projects, including other offshore windfarms, aggregate areas, disposal grounds and cables, to result in sediment disturbance leading to advection of sediment plumes, in addition to those that may arise during construction, operation and maintenance and decommissioning activities at the Project windfarm site. These effects could be additive should they occur within the boundaries of an MCZ. Further, where sediment plumes interact, there is likely to be a corresponding increase in SSCs (and subsequent sedimentation) at that location over and above that which would occur should the developments be undertaken in isolation. Should such interaction occur within the boundaries of an MCZ, there is potential for the cumulative impacts to hinder the conservation objectives of the MCZ.

250. Liverpool Bay aggregate production area is approximately 10km away from the Project. An assessment of cumulative sedimentation impacts with the aggregate dredging site is described in **Chapter 7 Marine Geology, Oceanography and Coastal Processes** of the ES. The assessment concluded, based on conceptual assessment of the Project and plume modelling at analogous aggregate sites, that sediment plumes from the Project construction activities would be unlikely to coalesce with those elicited during aggregate dredging activities, and would not be discernible over the study area (and wider region). Given the magnitude of effects, there are no cumulative effects with the Project in relation to any MCZ.

251. Site Y, Site Z, Lune Deep, Morecambe Bay disposal site and Barrow D disposal areas are all located more than 15km from the Project. The assessment presented in **Chapter 7 Marine Geology, Oceanography and Coastal Processes** of the ES concludes that sediment plumes would not coalesce, and would not be discernible over the study area (and wider region). Given the magnitude of effects, there are no cumulative effects with the Project in relation to any MCZ.

252. The Isle of Man Interconnector is located 4.6km to the north of the Project windfarm site. Increases in SSCs during maintenance activities would be minimal and considerably less than those generated during installation of the projects. Most of the suspended sediment arising from each maintenance activity would fall rapidly to the seabed after the start of works and would not travel further than one spring tidal excursion (approximately 10km). Although there would be an increase in SSCs where sediment plumes overlap, the majority of sediment would deposit with thicknesses in the order of millimetres and would be indistinguishable from background levels. Given the magnitude of effects, there are no cumulative effects with the Project in relation to any MCZ.

253. Offshore windfarm projects with construction phases (and decommissioning considered to be similar to construction) which have the potential to interact with the Project are Transmission Assets, Morgan Offshore Wind Project, Mona Offshore Wind Project Generation Assets and AyM Offshore Wind Farm.

254. As discussed in **Sections 7.1** (construction) and **Section 7.2** (operation and maintenance), and based on a conceptual evidence-based assessment supported by modelling for AyM, Morgan and Mona set out in **Chapter 7 Marine Geology, Oceanography and Physical Processes** of the ES, increases in SSCs and changes in seabed level at any stage of the Project would be temporary (i.e. deposited fines would be redistributed within a short period of time by hydrodynamic actions) and very localised. If the construction programmes of the projects overlap, it is possible that their sediment plumes could coalesce. However, any impact would be temporary and over a maximum area limited to one tidal excursion from each project. It is also noted that while suspended sediment may travel up to one spring tidal excursion, the highest magnitude of effects is concentrated to the near-field of each project, with effects expected to be minimal beyond a few kilometres of each project. Sediment plumes would also all travel along the same tidal axis and limit overlap.

255. As such, the Project could only contribute to cumulative impacts in the instance that sediment-disturbing activities are taking place at the Project and other developments simultaneously, and sediment plumes from other developments encroach into the ‘near field’ area of the Projects activities within the boundary of a MCZ.

256. Given that none of the MCZs overlap with this near-field area (the nearest being over 8km from the windfarm site), there would be no contribution from the Project in relation to any MCZ. As noted in **Section 7.4.3.1**, it is not considered there are combined effects with the Transmission Assets because any potential overlap of near field effects would occur outside of any MCZ boundary.

257. Levels of suspended sediments and changes to seabed thickness from the Project are expected to be within natural variations at the distance of Fylde MCZ (where there is minimal overlap with the Project ZoI), and as such, would not contribute to cumulative effects. Further, given that suspended sediments from other projects would be advected on the same tide, any overlap in suspended sediments would be minimal and the majority of sedimentation would occur in close proximity to each activity.

258. There is no potential for sediment plumes from the Project to contribute to a cumulative effect on the West of Walney MCZ, or any more distant MCZ,

(13km north of the Project) due to the alignment of the tidal axis and the distance of the MCZ from the Project (**Figure 7.1**).

259. Suspended sediment plumes arising during the operation and maintenance phase for the Project and other offshore windfarm projects would be intermittent and on a much smaller scale than those arising during the construction phase.

260. Therefore, in relation to suspended sediments and deposition, when considering all plans and projects, there is no contribution to cumulative effects, noting that MCZ features are not sensitive to suspended sediment increases and light deposition.

Cumulative Impact 2: Changes to the physical processes supplying and maintaining sediment

261. There is potential for the presence of infrastructure on the seabed during the operation and maintenance phase from other developments/projects, including other offshore windfarms, aggregate areas and disposal grounds, to alter the baseline physical processes and result in changes to physical processes that supply sediment to the Fylde and West of Walney MCZs.

262. The assessment of Project-alone effects shows no discernible changes beyond the immediate vicinity of the seabed infrastructure (outlined in **Section 7.2.2**). Although there may be local interruptions to bedload sediment transport within the vicinity of infrastructure on the seabed, gross patterns of sediment transport moving east across the Irish Sea would not be affected significantly and would not impact regional scale sediment transport processes.

263. There may be local changes to sediment transport processes experienced within the Fylde MCZ if cable protection for the Transmission Assets is installed in the MCZ, (Morgan Offshore Wind Limited and Morecambe Offshore Windfarm Ltd, 2023), however, this is beyond the range of potential changes to the sediment transport regime as a result of the Project. All other plans and projects are outside of the MCZ and as such it is considered there is no contribution from the Project to cumulative effects.

Cumulative Impact 3: Underwater noise and vibration

264. There is the potential for cumulative effects from underwater noise during construction (piling).

265. Given that the benthic receptors have negligible to low sensitivity to underwater noise and that there is a minimum 8km distance between Fylde MCZ/West of Walney MCZ and the Project, cumulative underwater noise impacts are not considered likely to hinder the conservation objectives of

these MCZs. There is the potential for cumulative effects at the Wyre-Lune MCZ and the Ribble Estuary MCZ (designated for smelt).

266. During construction, it is considered that noise sources from the construction of Mona, Morgan and AyM projects, and the Transmission Assets, could cause cumulative effects, with impact ranges overlapping.

267. The construction phase of the Transmission Assets may have temporal and spatial overlap with the Project in terms of sound associated with piling, potentially resulting in a cumulative impact. There is the potential for piling to occur concurrently at the Project and the Morgan offshore booster substation and Morgan OSP(s).

268. However, given that piling activities from Mona, Morgan and AyM offshore windfarms and Transmission Assets (piling works with the highest impact ranges) would have a similar impact range to that of the Project (i.e. 33km for "fish where swim bladder is not involved in hearing" for the Project), and the separation between the MCZs and such activities, there would be no significant cumulative effects. The closest sites for fish (smelt) (Wyre Lune MCZ and the Ribble Estuary MCZ), both lie beyond 33km from the nearest point of the windfarm site. Mona, Morgan and AyM are at a greater distance to the MCZs and while the Transmission Assets are closer, the location of piling activities would be similar to the Project. Behavioural responses over 33km are expected to be minimal and, while fish are mobile, smelt is generally an estuarine species, keeping close association with the coast.

269. Therefore, there is no risk of cumulative impacts hindering the conservation objective of maintaining or restoring the protected features of the MCZs screened into the assessment. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

Cumulative Impact 4: Displacement of fishing activity

270. There is potential for multiple projects to result in increases in displacement of fishing activity into MCZs during construction and operation and maintenance.

271. Displacement of fishing activity is expected to increase as a result of other projects including the Mona and Morgan Offshore Wind Projects, AyM offshore windfarms, and the Transmission Assets (as well as other existing projects such as operational offshore wind farms and disposal grounds). Significant cumulative effects (moderate significance) are identified in **Chapter 13 Commercial Fisheries** for displacement during construction.

272. While displacement would increase cumulatively, there are available grounds outside of MCZs and mitigation measures identified to minimise displacement for Project alone effects (as described in **Section 7.1.5** and **Section 7.2.5**) would be expected to limit increased pressure within the MCZs.

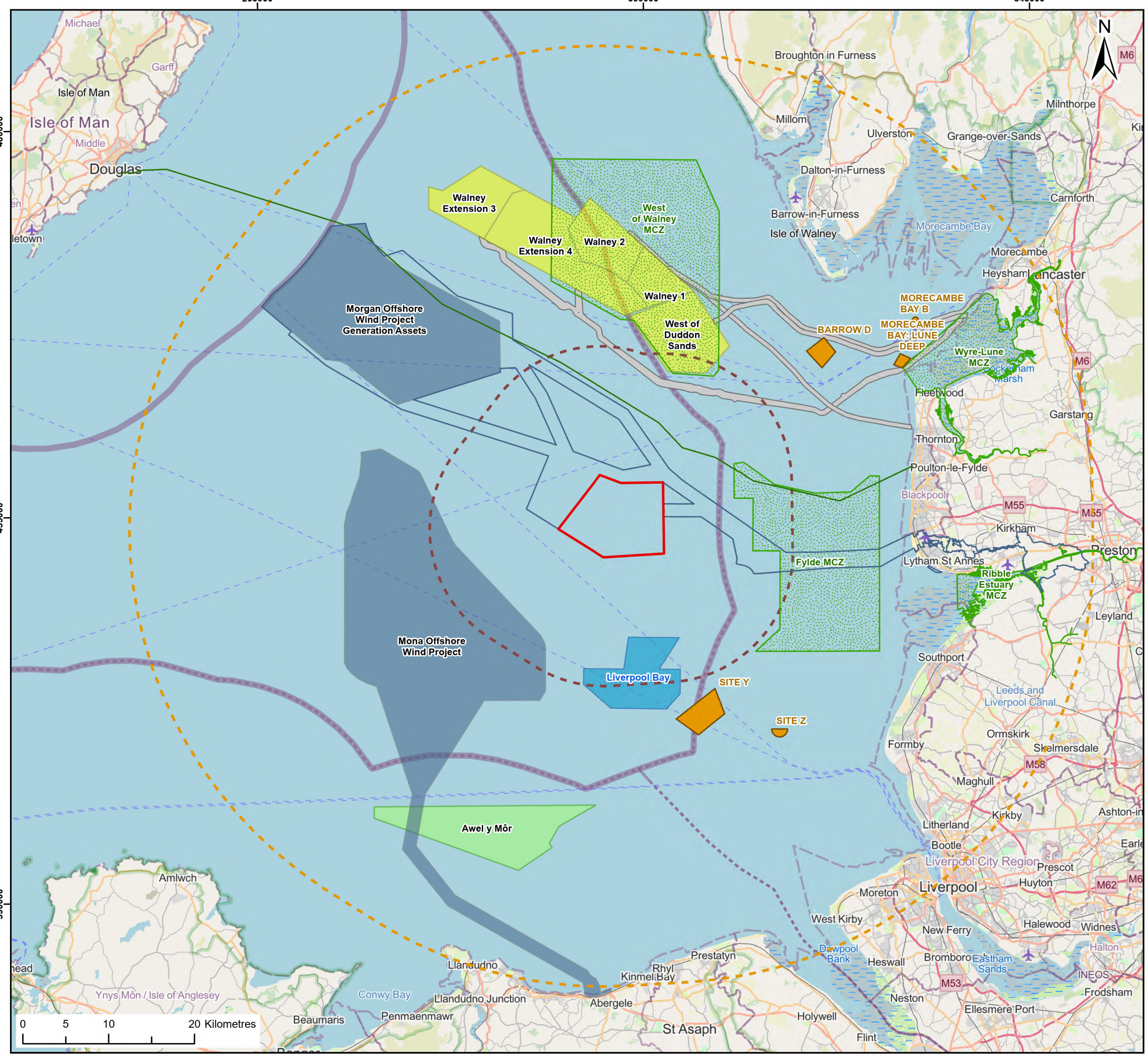
273. The contribution of the Project to cumulative displacement is low, however, the Applicant is seeking to coordinate with the Mona and Morgan Offshore Wind projects, in order to develop a consistent approach to fishing industry liaison, coexistence and mitigation, which, if in place, may also minimise displacement effects to MCZs. As such there is no identified risk of cumulative impacts hindering the conservation objective of maintaining or restoring the protected features of the MCZs screened into the assessment. Given the assessment, it is not considered that MCZs at a greater distance would be hindered.

Summary

274. Given the limited interactions, localised nature and small scale of effects (and considering where the Project makes no contribution) there is no risk of cumulative impacts in relation to the Project hindering the conservation objective of maintaining or restoring the protected features of any MCZ.

7.5 Interactions

275. The impacts identified and assessed in this MCZA have the potential to interact with each other. However, given the magnitude of effects identified and the separation of the windfarm site to any MCZ there is considered no risk of increasing sensitivity or susceptibility to effects when considering multiple impacts.



Legend:

- Morecambe Offshore Windfarm Site
- Morgan and Morecambe Offshore Wind Farms: Transmission Assets (In Planning)
- 50km Zone of Influence for noise
- 15km Zone of Influence for suspended sediments
- Open Disposal Sites
- Marine Conservation Zones (MCZ)
- Isle of Man Interconnector

Windfarm status

- Fully commissioned
- Consented
- In Planning

Minerals & Aggregates Site Agreements

- Production Agreement Area
- Offshore Wind Cable Agreements

Report: Morecambe Offshore Windfarm: Generation Assets Information for Marine Conservation Zone Assessment

Title: Plans and Projects screened in for potential cumulative impacts

Figure: 7.1 | Drawing No: PC1165-RHD-ES-OF-DR-Z-0060

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
P01	19/04/2024	JH	SB	A3	1:450,000

Co-ordinate system: WGS 1984 UTM Zone 30N

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8 Conclusion of Stage One assessment

276. Based on the information presented in the preceding sections, which includes an assessment of potential construction, operation and maintenance, and decommissioning phase, impacts of the Project (alone and with other projects/developments), it can be concluded that the conservation objectives of maintaining/restoring the features of Fylde Coast MCZ, West of Walney MCZ, Wyre-Lune MCZ and Ribble Estuary MCZ (or any other MCZ) would not be hindered by the Project (alone or cumulatively).

277. Based on this outcome, no further stages of MCZA are required.

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