



Bowdun Offshore Wind Farm, Offshore EIA Report

Volume 3, Technical Appendix 8.3: Marine
Protected Areas Assessment

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Glossary

Defined Term	Definition
Additional Mitigation	Also referred to as secondary mitigation which is defined by The Institute of Sustainability and Environmental Professionals (ISEP) (formerly Institute of Environmental Management and Assessment (IEMA)) as: Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the Environmental Impact Assessment (EIA) Report (sic).
Applicant (the)	Bowdun Offshore Wind Farm Limited (BOWFL).
Array Area	The Array Area is the area in which the Offshore Generation Assets will be located.
Benthic	Living on or in the seabed.
Biotope	A term which refers to the combination of physical environment (habitat) and its distinctive assemblage of conspicuous species. The biotope concept is used to enable description and comparison. Within biotope names, Latin names of species are used in full on every mention (e.g. Genus species) and never abbreviated or referred to using a common name.
Bowdun Offshore Wind Farm Limited (BOWFL)	A Special-Purpose Vehicle (SPV) (legal entity) for the purpose of developing the Project. BOWFL are the Applicant for the Offshore Application.
Circalittoral	The subzone of the rocky sublittoral below that dominated by algae (the infralittoral) and dominated by animals.
Crown Estate Scotland (CES)	Public corporation accountable to Scottish Government, responsible for the management of land and property in Scotland owned by the monarch.
Cumulative Effects	The effects of the Proposed Development assessed together with effects from the Onshore Infrastructure forming the Project as well as one or more different projects on the same receptor/resource.
Effect	Term used to express the consequence of an impact (i.e. the result of change or changes on specific environmental resources or receptors). The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity of the receptor or resource in accordance with defined significance criteria.
Embedded Mitigation	<p>Measures that are adopted as part of the Proposed Development and, therefore, assessed within the Environmental Impact Assessment (EIA). The proposed approach for the EIA for the Proposed Development is that embedded mitigation includes both primary mitigation and tertiary mitigation. These are defined by the ISEP as follows:</p> <p>Primary: Modifications to the location or design of the development made during the pre-application phase that are an inherent part of the project, and do not require additional action to be taken.</p> <p>Tertiary: Actions that would occur with or without input from the EIA feeding into the design process. These include actions that will be undertaken to meet other existing legislative requirements, or actions that are considered to be standard practices used to manage commonly occurring environmental effects.</p>

Defined Term	Definition
Environmental Impact Assessment (EIA)	Assessment of the potential likely significant effects of the Proposed Development on the physical, biological, and human environment during construction, Operation and Maintenance (O&M) and decommissioning.
Export Cable Corridor	The area seaward of Mean High Water Springs (MHWS) which connects the Array Area with the Landfall within which the Offshore Export Cables will be installed.
Impact	A change caused by an action that occurs during a project's lifetime.
Infauna	Organisms living within the seabed sediment.
Inter-Array Cables (IAC)	Cables which link the Wind Turbines to each other and with the Offshore Substation Platforms (OSPs).
Interconnector Cables	Cables which will connect individual OSPs to each other to provide redundancy against cable failure elsewhere.
Intertidal Area	The area between MHWS and Mean Low Water Springs (MLWS).
Landfall	The area in which the Offshore Export Cables make landfall and is also the transitional area between the Offshore Transmission Assets and the Onshore Transmission Assets. Located in the Intertidal Area at Benholm.
Marine Directorate	The Marine Directorate of the Scottish Government, formerly known as Marine Scotland. The planning and licensing authority for Scotland's seas and custodian of Scotland's National Marine Plan (NMP). The Marine Directorate - Licensing and Operation Team (MD-LOT) are specifically responsible for managing Section 36 Consent and Marine Licence Applications seaward of MHWS.
Marine Licence	A Marine Licence permits the undertaking of different activities in the marine environment, including construction, the deposition or removal of substances or objects, and dredging. The Marine (Scotland) Act 2010 requires Marine Licences to be obtained for licensable activities taking place within Scottish Territorial Seas. The Marine and Coastal Access Act (MCAA) 2009 requires a Marine Licence to be obtained for licensable marine activities within the Scottish offshore region (12 nm – 200 nm).
Marine Protected Areas (MPAs)	MPAs are designated under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act (MCAA) 2009. The MPA network protects nationally and internationally important marine wildlife, habitats, geology, and underwater landforms. Scotland's MPAs are significantly important for European, North-East Atlantic, and global MPA networks.
Maximum Design Scenario (MDS)	The scenario within the design envelope likely to result in the greatest impact on a particular topic receptor and, therefore the one that should be assessed for that topic receptor.
Mean High Water Springs (MHWS)	The average tidal height throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	The average tidal height throughout the year of two successive low waters during those periods of 24 hours when the range of the tide is at its greatest.
Mitigation	Measures to avoid, prevent, reduce or control effects on the environment.
Moraines	Unconsolidated debris left behind by the movement of a glacier.

Defined Term	Definition
Offshore Export Cables	Subsea cables used to transmit electricity generated offshore by the Wind Turbines from the OSPs to shore. The Transition Joint Bay is the location where the Offshore Export Cables terminate, and the onshore cabling begins.
Offshore Generation Assets	The infrastructure of the Proposed Development required to generate electricity comprising of the Wind Turbines, Wind Turbine foundations and associated infrastructure (e.g. IACs).
Offshore Infrastructure	All of the Offshore Infrastructure associated with the Proposed Development that is located seaward of MHWS, comprising the Offshore Generation Assets and the Offshore Transmission Assets.
Offshore Scoping Report	The report that presents the findings of the EIA scoping process undertaken for the Proposed Development with the purpose of obtaining a Scoping Opinion. The Offshore Scoping Report defines what is intended to be assessed and reported as part of the EIA.
Offshore Substation Platform(s) (OSPs)	OSPs comprise the support structure, topside and electrical components used for collecting and/or converting electricity generated by the Wind Turbines for transmission by the Offshore Export Cables.
Offshore Transmission Assets	The infrastructure of the Proposed Development required to transmit the generated electricity comprising of the OSPs, Offshore Export Cables and associated infrastructure up to MHWS.
Operation and Maintenance (O&M)	The phase of the Proposed Development following completion of construction. This phase of development includes routine inspections, repairs and replacement of infrastructure and equipment (including interconnector and IACs), Scour Protection replenishment or replacement, major component replacement, painting and/or other coating works, removal of marine growth, and replacement of access ladders.
Pathway	Describes the means or route by which a receptor (such as the seabed) can be affected by an identified impact source (such as Wind Turbine foundations).
Piling	The action of installing piles: installation can use various methodologies, the most common of which are impact piling (in which the piles are struck by a “hammer”) and drilling (during which a hole is drilled into the seafloor, the drilling tool is removed, and the pile is slotted into that hole).
Project (the)	An overarching term for the Bowdun Offshore Wind Farm (Bowdun OWF) comprising the offshore and onshore infrastructure required to generate and transmit electricity from the Array Area to the onshore Grid Connection Point. The Project includes the Offshore Generation Assets, the Offshore Transmission Assets and the Onshore Infrastructure.
Project Design Envelope (PDE)	A description of the range of possible elements that make up the design options for the Proposed Development under consideration when the exact engineering parameters are not yet known.
Proposed Development	Term used to define the Offshore Infrastructure associated with the Project seaward of MHWS for which consent is being sought. Further details of the parameters are included in Volume 1, Chapter 3: Project Description.

Defined Term	Definition
Scoping Opinion	A document produced by MD-LOT which is issued in response to submission and review of the Scoping Report. The Scoping Opinion is supported with feedback and advice from consultees, which details what is expected to be included in the Offshore EIA Report and what can be scoped out of the EIA process.
Scoping Workshop	A series of sessions preceding the finalisation of the Offshore Scoping Report to provide an opportunity for the Applicant to consult on the draft scope and for stakeholders to request additional information on key issues.
Site Boundary	The boundary within which all elements of the Proposed Development will be located. The Site Boundary comprises the Array Area and Export Cable Corridor which ends at MHWS.
Spring Tidal Excursion	The distance suspended sediment is transported prior to being carried back on the returning tide.
Statutory Nature Conservation Body (SNCB)	A statutory adviser to the UK and Scottish Governments on Scottish, UK and international nature conservation.
Study Area	For each environmental topic, the baseline environment will be characterised, and the potential environmental impacts will be described within a topic-specific study area. Specific study areas are defined for each topic and are based on the maximum spatial extent across which potential impacts of the Project may be experienced by the relevant receptors (i.e. Zone of Influence).
Subtidal	Areas of the coastal marine environment that lie below the level of MLWS and are continuously submerged by seawater.
Tidal Ellipse	The illustration of the variance of tidal currents in horizontal space on the returning tide.
Thistle Wind Partners (TWP)	Company established for the development of the Project.
Wind Turbines	Structures comprising of a tubular tower, rotor blades, and a nacelle which houses the Wind Turbine generator.
Zone of Influence	The geographical area within which the Proposed Development may have environmental effects.

Acronyms

Acronym	Definition
ADD	Acoustic Deterrent Device
BOWFL	Bowdun Offshore Wind Farm Limited
CaP	Cable Plan
CBA	Cable Burial Assessment
CBRA	Cable Burial Risk Assessment
CCC	Climate Change Committee
CEA	Cumulative Effects Assessment
CES	Crown Estate Scotland
CPS	Cable Protection System
CSIP	Cable Specification and Installation Plan
CTV	Crew Transfer Vessel
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EMP	Environmental Management Plan
FeAST	Feature Activity Sensitivity Tool
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IAC	Inter-Array Cable
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
MarESA	Marine Evidence Based Sensitivity Assessment
MD-LOT	Marine Directorate-Licensing Operations Team
MDS	Maximum Design Scenario
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMMP	Marine Mammal Mitigation Plan
MPA	Marine Protected Area
MPCP	Marine Pollution Contingency Plan
MZ	Mitigation Zone
nc	Nature Conservation
NEQ	Net Explosive Quantity
NMFS	National Marine Fisheries Service
OFTO	Offshore Transmission Owners
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm

Acronym	Definition
O&M	Operation and Maintenance
PDE	Project Design Envelope
PE	Polyethylene
POA	Plan Option Area
PU	Polyurethane
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
SEL	Sound Exposure Level
SNCBs	Statutory Nature Conservation Bodies
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
SSE	Scottish and Southern Energy
TSHD	Trail Suction Hopper Dredger
TTS	Temporary Threshold Shift
TWP	Thistle Wind Partners Limited
UK	United Kingdom
UXO	Unexploded Ordnance
ZoI	Zone of Influence

Table of Units

Units	Definition
%	Percentage
cm	Centimetre
dB	Decibel
GW	Gigawatt
kg	Kilograms
kg/m ³	Kilogram per cubic metre
kJ	Kilojoules
km	Kilometre
km ²	Kilometres squared
kV	Kilovolts,
m	Metre
mg/l	Milligram per litre
mm	Millimetres
m ²	Metres squared
m ³	Metres cubed
m/hour	Metre per hour
m/s	Metres per second
MW	Megawatt
μPa	Micropascal

1 Marine Protected Areas Assessment

1.1 Introduction

1.1.1 This report addresses specific consideration of Marine Protected Areas (MPAs) which is required for consent applications in United Kingdom (UK) waters. This report presents the assessment of the likely significant effects on relevant MPAs, that may potentially occur as a result of the Proposed Development during the construction, Operation and Maintenance (O&M) and decommissioning phases. This report sits alongside the Offshore Environmental Impact Assessment (EIA) Report; however, it is a standalone assessment.

ScotWind Leasing Round

1.1.2 In 2020, Crown Estate Scotland (CES) launched the ScotWind leasing process to facilitate the increase in offshore wind capacity to support the Scottish Government's 2045 Net Zero target (Scottish Government, 2024). The Climate Change Committee estimates that around 88 GW of offshore wind by 2040 will be needed to deliver Net Zero, with the combined capacity of the ScotWind leasing round (27.6 GW) covering a significant portion of this (Climate Change Committee (CCC), 2025; CES, 2022). On top of the progression towards the 2045 Net Zero and 2040 offshore wind capacity targets, the ScotWind leasing round also has wider benefits such as creating Scottish jobs and investment, supporting the supply chain and providing additional revenue for the Scottish Government. Following the ScotWind leasing round in 2022, Thistle Wind Partners (TWP), as the development company for Bowdun Offshore Wind Farm Limited (BOWFL) (hereafter referred to as the 'Applicant'), were successful in securing the option to develop a commercial scale Offshore Wind Farm (OWF) project in the E3 Plan Option Area (POA) as defined in the Scottish Government's Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020). BOWFL entered into an Option to Lease Agreement with CES, to secure the rights to develop within the POA. The Proposed Development will be situated in the E3 POA with further information on the Proposed Development, and the Project as a whole, covered in Section 1.6.

The Project and the Proposed Development

1.1.3 For the purpose of developing the offshore and onshore elements of Bowdun OWF they are collectively known as the Project.

1.1.4 The Project is an estimated 1 GW OWF, with the Array Area located approximately 38 km off the Aberdeenshire coast at the closest point to the mainland. The Offshore Export Cables will reach Landfall at Benholm, Aberdeenshire. The Proposed Development's Site Boundary comprises of the Array Area and the Export Cable Corridor, as shown in Figure 1.1. The Proposed Development is located seaward of Mean High Water Springs (MHWS) out to Scottish Territorial Waters and the Scottish Marine Area. The Onshore Infrastructure, located in Benholm, is subject to a separate onshore planning application under The Town and Country Planning (Scotland) Act 1997, and is located landward of Mean Low Water Springs (MLWS). The onshore planning

application was to Aberdeenshire Council, November 2025 (Planning reference: APP/2025/1952).

- 1.1.5 For the purposes of this MPA assessment, the Proposed Development refers to the Offshore Infrastructure only. A more detailed description of the Proposed Development is provided in Section 1.6. The full project description is provided in Volume 1, Chapter 3: Project Description.

Supporting Information

- 1.1.6 This assessment presented is informed by the following Offshore EIA Report technical chapters:
- Volume 2, Chapter 7: Physical Processes;
 - Volume 2, Chapter 8: Benthic Ecology;
 - Volume 2, Chapter 9: Fish and Shellfish Ecology;
 - Volume 2, Chapter 10: Marine Mammals;
 - Volume 3, Technical Appendix 4.1: Scoping Report;
 - Volume 3, Technical Appendix 4.2: Scoping Opinion;
 - Volume 3, Technical Appendix 8.1: Benthic Ecology Technical Report;
 - Volume 3, Technical Appendix 9.1: Fish and Shellfish Ecology Technical Report;
 - Volume 3, Technical Appendix 10.1: Marine Mammal Technical Report; and
 - Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report.

1.2 Purpose of this Assessment

- 1.2.1 Specific consideration of MPAs is required for consent applications in UK waters. In Scotland, MPAs designed to conserve marine biodiversity species, habitats and geodiversity (the variety of landforms and natural processes that underpin the marine landscapes) are referred to as nature conservation (nc)MPAs (hereafter referred to as an MPA). Under section 126 of the Marine and Coastal Access Act 2009 and under section 83 of the Marine (Scotland) Act 2010, public authorities who are responsible for granting authorisation for a licensable activity (in this case the Marine Directorate – Licensing Operations Team (MD-LOT) on behalf of Scottish Ministers) are required to consider whether the activity, which is subject to the application (i.e. the marine licensable activities subject to a Marine Licence application), is capable of affecting (other than insignificantly) a protected feature in an MPA, or any ecological or geomorphological process which the conservation of any protected feature in an MPA is (wholly or in part) dependent. There are a number of criteria which must be satisfied before MD-LOT can grant a Marine Licence. Primarily, MD-LOT must be satisfied that there is no significant risk of the licensable activity hindering the achievement of the conservation objectives for the MPA. If MD-LOT is not satisfied that there is no significant risk of the licensable activity hindering the achievement of the conservation objectives,

there are other criteria which must be met for the licence to be granted (Scottish Government, 2025a).

1.2.2 This report provides evidence to assess whether the Proposed Development could significantly hinder the conservation objectives of any screened in MPAs.

1.2.3 It should be noted that other designated sites, such as Special Areas of Conservation, Special Protection Areas and RAMSAR sites, designated under the Habitats Directive, will be addressed in the Habitats Regulations Assessment (Report to Inform Appropriate Assessment: TWP-BOW-RPS-ENV-RPT-00014 and TWP-BOW-RPS-ENV-RPT-00015).

1.3 Legislation and Guidance

1.3.1 The MPA screening and Stage 1 Assessment process has been undertaken to address provision for MPAs in the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 with the aim of:

- conserving marine flora or fauna;
- conserving marine habitats or types of such habitat; and
- conserving features of geological or geomorphological interest.

1.3.2 This document is informed by guidance published by the Scottish Government (2025a) and NatureScot guidance on Development Management and Nature Conservation Marine Protected Areas (NatureScot, 2025) and by advice from the Statutory Nature Conservation Bodies (SNCBs) during consultation in the pre-application phase (as outlined in Section 1.4). This MPA assessment has been undertaken based on the Proposed Development information detailed within Volume 1, Chapter 3: Project Description.

1.4 Consultation

1.4.1 The approach to consultation for the Proposed Development is set out in Volume 1, Chapter 5: Consultation and Engagement. A summary of the issues raised during consultation activities undertaken to date specific to MPA assessment is presented in Table 1.1, together with how these issues have been considered in the production of this assessment.

Table 1.1: Summary of Key Consultation Issues Raised During Consultation Activities Undertaken for the Proposed Development Relevant to the MPA assessment

Date	Consultee and Type of Consultation	Summary of Issue(s) Raised	Response to Issue Raised and/or Where Considered in this Chapter
18/10/2025	NatureScot Scoping Opinion	NatureScot stated that it was premature to screen out Turbot Bank Marine Protected Area and Southern Trench MPA prior to the completion of the subsea noise modelling.	The MPA screening provided in Section 1.7 has taken into account the subsea noise modelling undertaken for the Offshore EIA Report (the full results of which can be found in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report), which showed that behavioural effects would not extend to the Turbot Bank MPA, and this has therefore been screened out.
25/11/2025	MD-LOT Scoping Opinion	MD-LOT stated that it was premature to screen out the Turbot Bank MPA and Southern Trench MPA before any subsea noise modelling was undertaken.	The Southern Trench MPA has been screened in (Section 1.7) and assessed regarding the project alone and the Cumulative Effects Assessment (CEA) in Section 1.10 and Section 1.11.
04/12/2025	MD-LOT Response to Consultation Note	MD-LOT advised that Southern Trench MPA be included in the MPA assessment and advised that dose-response curves are used for disturbance from piling and that injury/cumulative Permanent Threshold Shift is considered. If it is scoped out depending on what is presented in the final subsea noise report then this should be justified.	The Southern Trench MPA has been screened in for assessment in Section 1.7. Consideration regarding dose-response curves has been included in the assessment of the potential impact of the project alone in Section 1.10 and cumulatively in Section 1.11, with further detail on the appropriate use of dose-response curves provided in Paragraph 1.11.39.
		MD-LOT would like subsea noise associated with Unexploded Ordnance (UXO) clearance to be considered until the final subsea noise modelling report can confirm the maximum injury ranges.	Consideration of the impact of subsea noise associated with UXO clearance has been included in the project alone assessment in Section 1.10. The results of subsea noise modelling have been used to determine that this impact will not affect MPAs with sensitive marine mammal receptors, which includes the Southern Trench MPA.
		MD-LOT agree that behavioural disturbance to sandeels at Turbot Bank MPA is unlikely to occur from piling noise impacts due to the distance from the sound source.	This agreement has been noted.

1.5 Methodology

1.5.1 The Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009 introduced provisions to support the management of MPAs. A staged approach to the MPA assessment is recommended, starting with a preliminary screening process which should identify whether the impacts associated with a project can reasonably be predicted to be ‘capable of affecting (other than insignificantly)’ the protected features of an MPA.

1.5.2 If the initial MPA screening identifies an MPA with protected features which may be affected other than insignificantly, the relevant licensable activities, sites or impacts are screened into the MPA assessment process, these are then considered within the Stage 1 assessment.

1.5.3 The Stage 1 assessment focuses on determining whether the impacts identified in the screening would or might significantly hinder, or there is or may be a significant risk of the impacts hindering, the achievement of the conservation objectives. Full details of each of these stages of the approach have been provided in the sections below.

MPA Screening

1.5.4 In the first instance, a screening stage will be undertaken to identify impacts that can reasonably be predicted to occur as a result of the Proposed Development. This can be determined by considering whether the activity will exert pressures to which the protected feature(s) is sensitive. This information is provided in the Advice on Operations document for each MPA or from the Feature Activity Sensitivity Tool (FeAST) where MPA specific advice is not available.

1.5.5 Secondly, if it is concluded that there is a ‘capability of affecting’ an MPA, the focus will then be on considering whether the activity will affect the protected features of an MPA (other than insignificantly). Where it is concluded that the impacts of a project are capable of affecting (other than insignificantly) the protected features of an MPA, then a Stage 1 assessment is required to consider the potential impact of the project on the conservation objectives of the relevant MPA.

Proposed Development MPA Screening Criteria

1.5.6 To determine the capability of the activities associated with the Proposed Development to affect the features of any MPA, it is proposed that MPAs which satisfy the following criteria are screened in:

- MPAs with physical overlap with the Proposed Development; and
- MPAs within the Zone of Influence (ZoI) for individual topics:
 - Benthic ecology: The ZoI for benthic ecology, as shown in Figure 1.1, is defined as the Site Boundary and one Spring Tidal Ellipse, with a reasonable level of precaution applied (in line with the Benthic Ecology Study Area defined in Volume 2, Chapter 8: Benthic Ecology). The Spring Tidal Ellipses in the offshore environment was modelled to extend between 9 km and 11 km (Volume 2, Chapter 7: Physical

Processes). For the purposes of Proposed Development MPA screening, a precautionary buffer of 15 km was applied as this represents the maximum distribution of suspended sediment over one Spring Tidal Ellipse and is considered to be sufficiently precautionary to capture all sites likely to be in the ZoI which may be impacted by direct and indirect effects associated with the Proposed Development in all its phases.

- Fish and shellfish: The ZoI for fish and shellfish, as shown in Figure 1.1, is defined as a 100 km radius around the Site Boundary (in line with the Fish and Shellfish Ecology Study Area presented in Volume 2, Chapter 9: Fish and Shellfish Ecology). This ZoI was chosen due to the mobile nature of fish and shellfish species and to encompass the ZoI of all direct and indirect impacts associated with the Proposed Development.
- Marine mammals: The ZoI for marine mammals, as shown in Figure 1.2, is defined as the UK waters within the Regional Marine Mammal Study Area (as described in Volume 2, Chapter 10: Marine Mammals).
- Ornithology: The ZoI for ornithology is defined as a 100 km radius from the Proposed Development (Figure 1.1). This ZoI was chosen as it encompasses the foraging ranges of the protected bird species designated for the MPAs in the region which may interact with the Proposed Development directly or indirectly.

1.5.7 These ZoIs were initially defined within the Volume 3, Technical Appendix 4.1: Scoping Report, and have been revisited where necessary, taking into account updates to modelling (physical processes modelling from Volume 3, Technical Appendix 7.1: Physical Processes Baseline Environment and subsea noise modelling from Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report). No revisions have been made, and it is concluded that the ZoIs applied in Paragraph 1.5.6 are sufficient to ensure all of the potentially affected MPAs can be captured.

1.5.8 The MPA screening has been presented in Section 1.7.

Stage 1 Assessment

1.5.9 The Stage 1 assessment for the Proposed Development is presented in this document which has been submitted alongside the Offshore EIA Report and considers the extent of the potential impact of the Proposed Development, in all phases (i.e. construction, O&M and decommissioning), on the MPAs screened into the assessment in more detail. The Stage 1 assessment stage focuses on determining whether there is, or may be, a significant risk of the Proposed Development hindering the achievement of the conservation objectives of the screened in MPA(s).

1.5.10 As with the screening process described in Paragraphs 1.5.4 to 1.5.5, aspects such as scale, timing and duration of the proposed activities are considered. However, while the screening focuses on the protected features, this Stage 1 assessment will focus on the potential impact on achieving the conservation

objectives of the MPA protected features. Cumulative effects with other projects, plans, activities and functions will also be undertaken.

- 1.5.11 The conservation objectives for MPA protected features are high level criteria describing the desired condition of the MPA protected feature. The conservation objectives of an MPA should ensure that its protected features:
- so far as already in favourable condition, remain in such condition; and
 - so far as not already in favourable condition, be brought into such condition and remain in such condition.
- 1.5.12 The MPA Stage 1 assessment will, therefore, consider whether the Proposed Development could potentially affect these conservation objectives for each MPA screened into the assessment.
- 1.5.13 This assessment has been undertaken by identifying the attributes associated with the relevant protected features. These attributes are identified in Conservation and Management Advice for an MPA.
- 1.5.14 For benthic ecology receptors the magnitude of the impacts is therefore considered in relation to the MPAs attributes to determine if the processes, extent and structure of the protected features will be affected. The sensitivity, based on data from the Marine Evidence Based Sensitivity Assessment (MarESA) and FeAST tools are used to determine if the MPA attributes of the feature could be affected. This assessment then determines if the impacts give rise to a significant risk of hindering the achievement of the conservation objectives of an MPA. Although this assessment is undertaken independent of the Offshore EIA Report, it is supported by assessments undertaken in the Offshore EIA Report, particularly Volume 2, Chapter 7: Physical Processes and Volume 2, Chapter 8: Benthic Ecology.
- 1.5.15 The assessment of marine mammal receptors has been undertaken supported by Volume 2, Chapter 10: Marine Mammals and Volume 3, Appendix 10.4: Subsea Noise Technical Report. The results of the subsea noise modelling have been used to determine the area of disturbance/mortality in relation to specific activities, and up to date research has been used to assess the sensitivity of the relevant receptors to determine if the impacts give rise to a significant risk of hindering the achievement of the conservation objectives of an MPA.
- 1.5.16 When considering whether an activity may lead to a significant risk of hindering the achievement of the conservation objectives of a site, consideration should be given to the direct impact of an activity upon a protected feature as well as any applicable indirect impacts. Such an indirect impact could include changing the effectiveness of a management measure put in place to further the conservation objectives.

Stage 2 Assessment

- 1.5.17 The Stage 2 assessment, if required, considers whether the conditions in section 83 of the Marine (Scotland) Act 2010 and sections 126(7)(b) and (c) of the Marine and Coastal Access Act 2009 can be met. The Marine Scotland Act 2010 advises that if an act is capable of affecting (other than insignificantly (i.e.

of a magnitude likely to affect an MPAs protected features)) conservation objectives, Scottish Ministers must not grant authorisation unless it either:

- satisfies Scottish Ministers that there is no other means of proceeding with the act which would create a substantially lower risk of hindering the achievement of those objectives or (as the case may be) that purpose;
- satisfies Scottish Ministers that the benefit to the public of proceeding with the act clearly outweighs the risk of damage to the environment (or the marine historic asset) that will be created by proceeding with it; or
- satisfies Scottish Ministers that the person will undertake, or make arrangements for the undertaking of, measures of equivalent environmental benefit to the damage which the act will or is likely to have in or on the marine protected area concerned.

1.5.18 In determining “*public benefit*”, the decision maker should consider benefits at a national, regional or local level.

1.6 Project Description

1.6.1 Relevant information from Volume 1, Chapter 3: Project Description.

Offshore Infrastructure

Offshore Generation Assets

- up to 67 Wind Turbines on fixed foundations (each comprised of three rotor blades, a nacelle housing the generating unit, hub and tower section);
- a network of up to 167 km of Inter-Array Cables (IACs) which will be static cables;
- up to 36 km of Interconnector Cables; and
- Scour Protection, cable protection and utility crossings.

Offshore Transmission Assets

- up to three Offshore Substation Platforms (OSPs) with fixed foundations and supporting infrastructure including Scour Protection (as required);
- up to three Offshore Export Cables totalling approximately 210 km in length; and
- cable protection and utility crossings where required.

Site Preparation Activities

1.6.2 Prior to the installation of Offshore Infrastructure, it is likely that seabed preparation will be required, including pre-sweeping, seabed-levelling, sandwave clearance, boulder clearance, pre-cut trenching and the removal or avoidance of debris (e.g. fishing nets, out of service utilities, lost anchors, or UXO). Excavation may also be required to allow access and removal where debris is found to be present below the seabed surface. Furthermore, pre- and post-installation of rock berms, concrete mattresses and other cable protection systems (e.g. steel/rubber/Polyethylene (PE)/Polyurethane (PU) sleeves or tubes) may be needed in different configurations for installation of cable

systems in locations where the cable(s) routing cannot avoid steep slopes or need to cross channels in the Array Area or Export Cable Corridor.

- 1.6.3 Site preparation activities will continue throughout the construction phase as required and, therefore, these activities can be undertaken at any point within the construction programme.

Clearance of Unexploded Ordnance

- 1.6.1 UXO originating from World War I, World War II, or military training exercises, may be present within the Array Area and Export Cable Corridor. Due to the health and safety risks posed by UXO, and potential interactions with planned locations of installed infrastructure and vessel activities, it is necessary for UXO to be surveyed and managed carefully before the construction phase and installation of Offshore Infrastructure commences.
- 1.6.2 A desk-based study of the Proposed Development (Volume 3, Technical Appendix 19.2: Unexploded Ordnance Technical Report) reviewed the relevant military history in the vicinity of the Proposed Development and the likelihood of encountering UXO. Based on known military activity, the desk-based study concluded that there was a varying low-moderate and moderate risk from encountering UXO within the Site Boundary. Further assessment of UXOs has been undertaken within the relevant topic chapters (Volume 2, Chapters 7 to 23) on the basis of the desk-based study (Volume 3, Technical Appendix 19.2: Unexploded Ordnance Technical Report).
- 1.6.3 Methodologies considered within the Project Design Envelope (PDE) to avoid/clear UXOs are as follows:
- avoid and leave *in situ*;
 - micrositing of Offshore Infrastructure to avoid UXO;
 - relocation of UXO to avoid detonation;
 - low order clearance technique (e.g. deflagration); and
 - high order detonation (with associated mitigation measures).
- 1.6.4 Due to the health and safety risks that UXOs pose, the Applicant would seek to either avoid UXOs entirely, avoid UXOs via micrositing, or relocate UXO where practicable. If methods cannot be employed to avoid UXOs, a specialist contractor will clear UXOs in advance of construction taking place. The preferred clearance method for UXO is use of a low order technique with a single donor charge of 0.08 kg Net Explosive Quantity (NEQ) for each clearance event. Up to 0.5 kg NEQ clearance shot will be required for neutralisation of residual explosive material at each location. Detailed design work would be required to confirm planned locations of infrastructure, prior to conducting any UXO surveys. The Applicant has assumed that up to 40 UXOs may require clearance based upon the desk-based study. Whilst low order clearance is the preferred approach there remains a very small risk that a high order detonation may be required. Therefore, all of the clearance events have been assumed to have the potential to result in high order detonation (see Volume 2, Chapter 10:

Marine Mammals and Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report).

1.6.5 Table 1.2 presents the PDE for UXO clearance.

Table 1.2: PDE for Unexploded Ordnance Parameters

Parameter	Maximum Design Scenario
Theoretical maximum weight anticipated to be encountered (kg)	1,170
Maximum realistic charge weight (kg)	254
Maximum estimated number of UXOs anticipated to be identified	40
Maximum estimated number of UXOs anticipated to be cleared	40
Maximum number of detonation activities occurring within 24 hours	2
Maximum total duration of UXO clearance activities (days)	40

Sandwave Clearance

1.6.6 Prior to the installation of Offshore Infrastructure, existing sandwaves may need to be cleared in some areas of the Proposed Development. There are two main reasons for undertaking sandwave clearance:

- To provide a relatively flat seabed surface for cable installation and so that cable burial tools can work effectively: if cables are installed up or down a slope over a certain angle, or where the cable burial tool is working on a camber, the ability to meet target burial depths may be impacted.
- In order for cables to be buried to the target burial depth and remain buried for the operational lifetime of the Proposed Development (30 years): as sandwaves are generally mobile in nature, the cable must be buried beneath the level where natural sandwave movement could uncover it. Therefore, for this to be achieved, mobile sediments may need to be removed before cables are installed and buried.

1.6.7 Seabed morphology varies across the Array Area. North-east to south-west oriented sandwaves are located in southern-central and eastern parts of the area. Megaripples and ripples dominate the central, north-eastern, and north-western zones (see Volume 3, Technical Appendix 7.1: Physical Processes Baseline Environment). In the Array Area sandwave heights can reach up to ~6 m. Along the Export Cable Corridor there are megaripples and sandwaves present in many areas along the route, with heights in excess of ~6 m in places.

1.6.8 Sandwave clearance is likely to be required in specific discrete areas of the Proposed Development (e.g. along IACs, Interconnector Cables, and Offshore Export Cables) and could occur throughout the construction phase.

1.6.9 Sandwave clearance methods could include mass flow excavator or the use of a trailing suction hopper dredger, or a combination of both.

1.6.10 Excavated material will be preferentially deposited within the Site Boundary and as close as practicable to the excavation location. This approach aims to retain a broadly similar composition of sediment within the disposal area.

1.6.11 Table 1.3 presents the PDE for sandwave clearance. A geophysical survey campaign will be completed prior to construction which will allow the final parameters for sandwave clearance to be defined.

Table 1.3: PDE for Sandwave Clearance

Parameter	Maximum Design Scenario
Array Area	
Maximum width of sandwave clearance along IACs and Interconnector Cables (m)	58.6
Maximum percentage of total length of IACs and Interconnector Cables requiring sandwave clearance (%)	0.56
Maximum area of sandwave clearance along IACs (m ²)	49,552
Maximum volume of sandwave clearance along IACs (m ³)	197,955
Maximum area of sandwave clearance along Interconnector Cables (m ²)	11,814
Maximum volume of sandwave clearance along Interconnector Cables (m ³)	47,191
Maximum area of sandwave clearance for fixed foundations (m ²)	141,000
Maximum volume of sandwave clearance for fixed foundations (m ³)	594,385
Maximum area of sandwave clearance for OSP Scour Protection (m ²)	24,359
Maximum volume of sandwave clearance for OSP Scour Protection (m ³)	136,412
Export Cable Corridor	
Maximum width of sandwave clearance along Offshore Export Cables (m)	58.6
Maximum percentage of total length of Offshore Export Cables requiring sandwave clearance (%)	4.95
Maximum area of sandwave clearance along Offshore Export Cables (m ²)	609,147
Maximum volume of sandwave clearance along Offshore Export Cables (m ³)	3,411,223

Boulder Clearance

1.6.12 Boulder clearance will be required in some areas of the Proposed Development prior to installation of Offshore Infrastructure, in particular, along IACs and Offshore Export Cables. A boulder is defined as being over 256 mm (Wentworth Scale) in diameter and/or length (Wentworth, 1922).

1.6.13 Boulder clearance is required to aid cable installation and increase the success rate for achieving minimum target burial depth during cable burial, therefore, reducing the risk of further cables burial works and/or the need for cable protection. Boulder clearance also reduces the risk of cable damage during installation and subsequent burial. The PDE for boulder clearance for the Proposed Development is presented in Table 1.4.

- 1.6.14 Boulders may be cleared using one or a combination of the following:
- a boulder grabber or Remote Operated Vehicle (ROV), where boulders would be picked up from the seabed and relocated to designated areas within the Site Boundary;
 - a displacement plough to clear boulders from the cable route creating a path for cable installation; and/or
 - pre-lay grapnel runs used to prepare the seabed before cable installation.
- 1.6.15 Geophysical and pre-construction surveys, and the parameters of any boulders present (e.g. size, density and location of boulders), will inform the boulder clearance methodology to be used.

Table 1.4: PDE for Boulder Clearance

Parameter	Maximum Design Scenario
Maximum width of boulder clearance along IACs, Interconnector Cables, and Offshore Export Cables (m)	25
Maximum area of boulder clearance along IACs (m ²)	98,150
Maximum percentage of total length of IACs and Interconnector Cables requiring boulder clearance (%)	2.6
Maximum area of boulder clearance along Interconnector Cables (m ²)	23,400
Maximum area of boulder clearance along Offshore Export Cables (m ²)	257,250
Maximum percentage of total length of Offshore Export Cables requiring boulder clearance (%)	4.9

Construction Phase

Methodology

- 1.6.16 Construction of the Proposed Development is expected to occur over a period of five years cumulatively aligning with the following indicative construction series:
- Step 1 – Offshore Export Cables Landfall installation;
 - Step 2 – Wind Turbine fixed foundation transport and installation;
 - Step 4 – OSP topside and fixed foundation installation and commissioning;
 - Step 5 – Interconnector Cable and IAC Installation, including cable burial and/or protection, where required;
 - Step 3 – Offshore Export Cable installation, including cable burial and/or protection, where required; and
 - Step 6 – Wind Turbine transport, installation and commissioning.

Step 1 - Offshore Export Cables Landfall Installation

- 1.6.17 It is proposed that the Offshore Export Cables are installed in the Intertidal Zone using trenchless technology, such as Horizontal Directional Drilling (HDD).

HDD involves drilling a hole (or holes) along an underground pathway from one point to another, through which the Offshore Export Cables are installed, without the need to excavate an open trench. The drilling installation will commence from above MHWS, with the trenchless technology exit point (punch out location) located seaward of MLWS. As such, no construction works are planned to take place in the Intertidal Zone.

Step 2 - Wind Turbine Fixed Foundation Transport and Installation

- 1.6.18 The Proposed Development will use fixed-bottom Wind Turbine foundations. Wind Turbine foundations will be transported to the Proposed Development by vessels.
- 1.6.19 It is assumed that a crane will be used to lower the pile to the seabed and will be kept in position using a pile gripper or a pile installation frame, which may be temporarily placed on the seabed and then moved to the next location once the piles are installed. Piles will be installed into the seabed using a hammer.
- 1.6.20 Where jacket foundations are used, piles may be pre-installed in advance of jacket installation. Jackets will then be transported to site by barge or heavy transport vessel, lowered onto the pre-installed piles using a crane, and secured in place using grout.
- 1.6.21 For suction bucket jacket foundations, the structure will be lowered to the seabed and installed using suction-assisted penetration. This method involves pumping water out of the buckets to create a pressure differential, drawing the foundation into the seabed.
- 1.6.22 If hard ground is encountered which makes pile driving unsuitable, a combination of drill and driven installation methods may be required. In this case, a drill would be used after initial piling to remove the seabed material inside the pile and continue to installation to the target penetration depth.

Step 3 - OSP Topside and Fixed Foundation Installation and Commissioning

- 1.6.23 The OSP jackets will be fixed to the seabed using piles. Piles will be transported to the Array Area by vessel from the fabrication site or port facility, and installed in the seabed at the installation locations (exact locations to be confirmed at final design stage (post-consent)), using methods described previously in Paragraph 1.6.19.
- 1.6.24 Piling will commence with a lower hammer energy of 675 kJ and will slowly ramp up energy up to a maximum 4,500 kJ over a period of 30 minutes. Concurrent piling may occur between an OSP and a Wind Turbine location. However, there will only be a maximum two concurrent piling events.
- 1.6.25 The OSP jackets will be delivered to site by barge or delivery vessel and lowered to the seabed using a crane. This could occur before installing the piles (post-piled jacket) or after (pre-piled jacket). Once in place, the jackets would be grouted onto the piles.
- 1.6.26 Once the OSP jacket foundations are installed, the OSP topside(s) will be transported to the Array Area via vessel either from the fabrication yard or the port facility. It is likely this will be transported by the installation vessel or on a

barge towed by a tug. Once on site, the OSP topside will be rigged up, seafastening cut, lifted and installed onto the foundation. The topside and foundation will then be welded or bolted together. Rigging, welding and bolting equipment will be available on board the installation vessel.

1.6.27 It is expected that commissioning works will be carried out using a dynamically positioned vessel. Assisting support and supply vessels will be used as required and Crew Transfer Vessels (CTVs) will be used for transfer of personnel to and from the installation vessel.

Step 4 - Interconnector Cable and IAC Installation, including Cable Burial and/or Protection

1.6.28 The method of laying IAC and Interconnector Cables will be the same as used for Offshore Export Cables as described in Paragraph 1.6.31.

1.6.29 There are several options which may be used to bury cables to the minimum target burial depth. Equipment that may be used to bury the static portion of the IAC and Interconnector Cables, the methods which may be used for this have been described in Paragraph 1.6.32.

1.6.30 Cable protection will be used where the target burial depths are not achieved during cable installation and at cable crossings. Cable protection systems are also to be used as static IACs and Interconnector Cables approach and enter the Wind Turbines and OSPs.

Step 5 - Offshore Export Cable Installation, including Cable Burial and/or Protection

1.6.31 A cable lay vessel will be used for installation (lay) of the Export Cables using various equipment such as a carousel or reels, tensioners and cable lay spread. Export Cables are typically surface laid prior to cable burial or installation of external cable protection post lay. Cable lay and cable burial can also be performed simultaneously.

1.6.32 There are several options which may be used to bury cables to the minimum target burial depth. Equipment that may be used include:

- Jet trenchers or mass flow excavators which inject water at high pressure into the sediment surrounding the cable. Jet trenching tools use water jets to fluidise the seabed which allows the cable to sink into the seabed under its own weight.
- Mechanical trenchers, usually mounted on tracked vehicles, which use chain cutters or wheeled arms with teeth or chisels to cut a trench across the seabed.
- Cable ploughs are usually towed either from a vessel or vehicle on the seabed. There are two types of plough:
 - a displacement plough which creates a V shaped trench into which the cable can be laid; or
 - a non-displacement plough which simultaneously lift a share of seabed whilst depressing the cable into the bottom of the trench. As

the plough progresses, the share of the seabed is replaced on top of the cable.

- 1.6.33 Cable protection will be used where the minimum target burial depths are not achieved during cable installation and at cable crossings.
- 1.6.34 Whenever the minimum target cable burial depth is not achievable, external cable protection methods will be implemented to restrict any movement and prevent exposure over the lifetime of the Proposed Development. This will limit the effects of heat and/or Electromagnetic Fields (EMF) and help to protect against human activities such as fishing, anchor placement or dropped objects. Cable Protection Systems (CPS) that could be used by the Applicant include concrete masses, rock placement, cast-iron shells, or PU/PE sleeving. The Applicant will decide the final solution(s) at final design stage (post-consent) which will be dependent on seabed conditions as well as any potential interactions with human activities that may occur within the Proposed Development.
- 1.6.35 The PDE for the Offshore Export Cables is presented in Table 1.5, and the PDE for the external cable protection for the Offshore Export Cables is presented in Table 1.6.
- 1.6.36 Up to six Offshore Export Cable crossings may be installed along the Export Cable Corridor. Cable crossings may comprise several different methods as presented in Table 1.7, and additional cable protection will be installed at cable crossings. Table 1.7 presents the PDE for cable crossings, and accounts for additional protection required.

Table 1.5: PDE for the Offshore Export Cables

Parameter	Maximum Design Scenario
Export cable voltage (kV)	220-275
High Voltage Alternating Current (HVAC)/ High Voltage Direct Current (HVDC)	HVAC
Maximum total cable length (km)	210
Maximum external cable diameter (mm)	300
Cable burial methodology	Lay then burial and/or simultaneous lay and burial. Ploughing/jetting/cutting Multiple installation techniques to be achieved using hybrid installation equipment. A trenchless technique will be used at Landfall (e.g. HDD)
Minimum target burial depth (m)	1.5 (subject to Cable Burial Risk Assessment (CBRA)), with greater burial depths targeted in specific areas (e.g. in areas of increased shipping density)
Maximum width of cable trench (m)	6
Maximum width of seabed affected from installation tool per cable (m)	25

Table 1.6: PDE for the External Cable Protection for the Offshore Export Cables

Parameter	Maximum Design Scenario
Type	CPS (typically made of cast-iron shell, PU/PE (e.g. articulated split pipes, uraduct or protective sleeves), rock placement, grout or rock bags, rock berms, and concrete mattresses
Maximum cable protection height (m)	2
Maximum cable protection width (m)	10
Maximum percentage of cable which may require cable protection (%)	50
Maximum length of cables which may require cable protection (m)	105,000
Maximum total cable protection footprint area for Export Cables (m²)	1,050,000
Maximum total cable protection volume for Export Cables (m³)	2,100,000

Table 1.7: PDE for Cable Crossing for the Offshore Export Cables

Parameter	Maximum Design Scenario
Maximum number of crossings	6
Crossing material/method	CPS (typically made of cast-iron shell, PU/PE (e.g. articulated split pipes, uraduct or protective sleeves)), rock placement, grout bags, rock berms, rock bags, and concrete bridges and concrete mattresses
Maximum height of crossing (m)	2.5
Maximum width of crossing (m)	9
Maximum length of each crossing (m)	500
Maximum total length of crossings along the Export Cable Corridor (m)	3,000
Maximum total area of crossings (m²)	27,000
Maximum volume of protection material (per crossing) (m³)	11,250
Maximum total volume of crossing protection along the Export Cable Corridor (m³)	67,500

Step 6 - Wind Turbine Transport, Installation and Commissioning

- 1.6.37 Wind Turbines (comprising nacelle, rotor blades, hub and towers) will be transported to the Array Area by vessel from the pre-assembly port where sub-assemblies (nacelle, rotor blades, and towers), assembly parts, tools and equipment will be loaded onto an installation or support vessel.
- 1.6.38 At the installation location, the Wind Turbine towers will be lifted onto the pre-installed foundation by the crane on the installation vessel. The nacelle and

rotor blades will then be lifted into position. The exact methodology for the assembly will be dependent on the installation contractor and Wind Turbine type.

- 1.6.39 Static IACs are ‘pulled-in’ to the Wind Turbines using a cable laying vessel and connected to the Wind Turbine via J-tubes. Following connection to the necessary cabling, a process of testing and commissioning will be undertaken.

O&M Phase

- 1.6.40 The Project operational lifetime is up to 30 years. The overall O&M strategy will be finalised once the O&M base location and technical specification of the Proposed Development are known, including Wind Turbine type, electrical export option and final project layout. Therefore, this section provides an overview of the potential scheduled and unscheduled O&M activities within the Proposed Development which are reasonably foreseeable.

- 1.6.41 Routine O&M works will be conducted using surface operated vehicles, CTVs, and/or ROVs. Divers and diver support vehicles may be utilised if required, although it is anticipated that diverless operations will be utilised as far as practicable. Jack-up and/or heavy lift vessels will be used for infrequent major maintenance campaigns associated with the OSPs. ROVs will be used to inspect foundations and cabling.

Decommissioning Phase

- 1.6.42 In line with the requirements under Section 105 of the Energy Act 2004 (as amended), described fully in Volume 1, Chapter 2: Policy and Legislation, the Applicant will prepare a Decommissioning Programme for approval by the Scottish Ministers which will include anticipated costs and financial securities (if required), and consider good industry practice, guidance and legislation relating to decommissioning at the time. A draft of the Decommissioning Programme will be submitted to MD-LOT prior to construction of the Project. The Decommissioning Programme will be updated during the Project’s lifetime to take account of changing good practice, new technologies and any changes to legislation.

- 1.6.43 At the end of the Proposed Development’s operational lifetime, it is expected that all structures above the seabed will be fully removed where practicably feasible. Driven and/or drilled piles installed as part of the Wind Turbine foundations, the static IACs, Interconnector Cables, Offshore Export Cables, Scour Protection and cable protection are either expected to remain *in situ* or the method of decommissioning is yet to be determined. Legislation, guidance and good practice will be kept under review throughout the lifetime of the Proposed Development and will be followed at the time of decommissioning. Environmental conditions and sensitivities will also be considered since removal of structures may result in greater environmental impacts in comparison to leaving *in situ*.

- 1.6.44 The sequence of decommissioning is likely to be the reverse of the construction sequence, and similar types and numbers of vessels and equipment are expected to be involved. The Option for Lease agreement for the Bowdun OWF

Project awarded by the CES requires the Proposed Development to be decommissioned at the end of its lifetime.

1.7 MPA Screening

1.7.1 Based on the methodology described above in Section 1.5, the MPA screening exercise is presented below. The screening considers all MPAs located within the relevant Zols (as described in Paragraph 1.5.6) are listed in Table 1.8 and shown in Figure 1.1 and Figure 1.2.

Table 1.8: MPAs Considered within the Screening

Designated Site	Closest Distance to Proposed Development (km)	Relevant Qualifying Interest Feature(s)
Firth of Forth Banks Complex MPA	7.5	Ocean quahog <i>Arctica islandica</i> aggregations; Offshore subtidal sands and gravels; Shelf banks and mounds; Moraines
Turbot Bank MPA	35.8	Sandeels <i>Ammodytes tobianus</i>
Southern Trench MPA	35.9	Minke whale

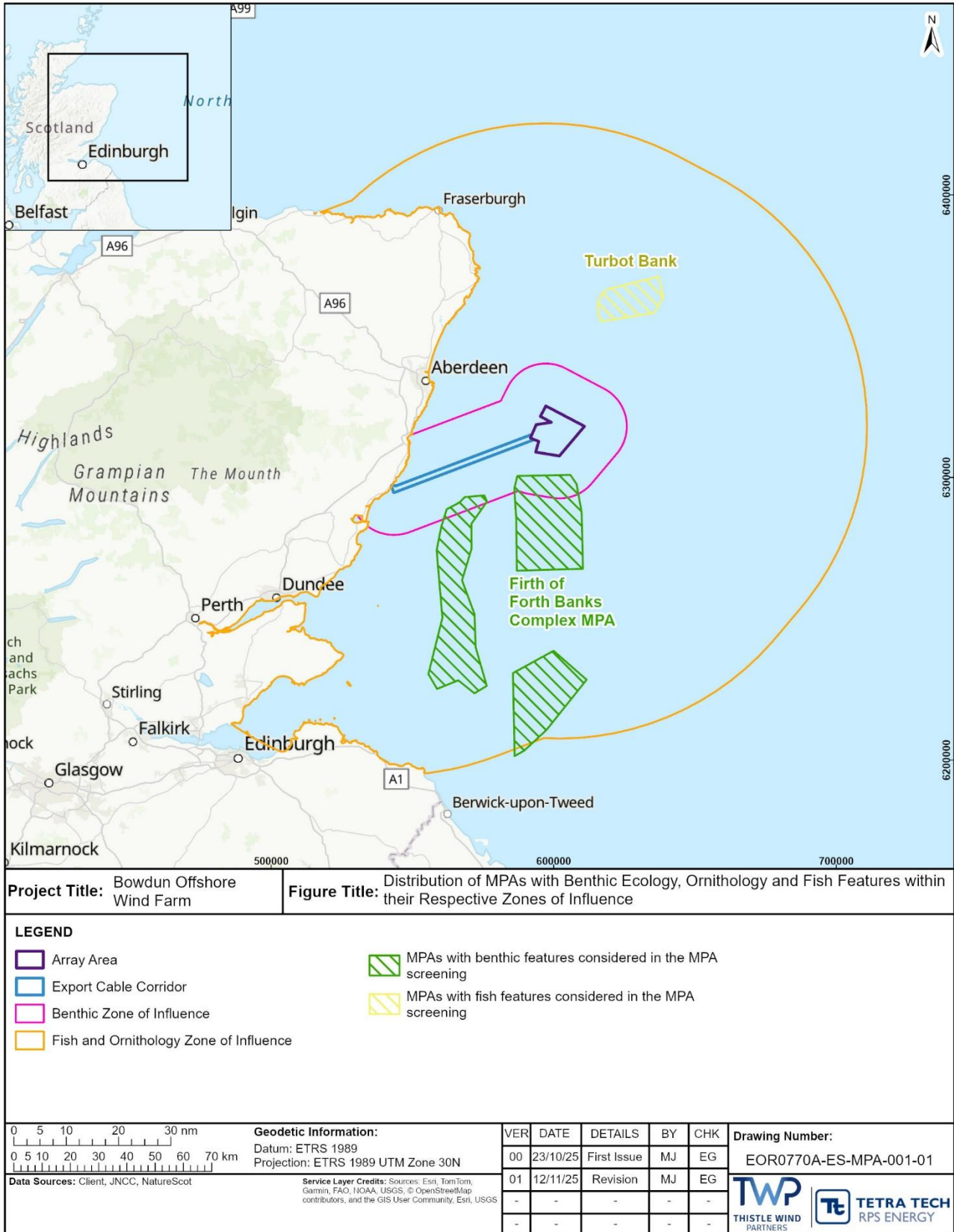


Figure 1.1 Distribution of MPAs with Benthic Ecology, Ornithology and Fish Features within their Respective Zones of Influence



Figure 1.2 Distribution of MPAs with Marine Mammal Features within the MPA Screening Marine Mammal Zone of Influence

Screening Results

Screening for MPAs with Benthic Habitats/Species and Geodiversity Features

- 1.7.2 Direct impacts to benthic habitats and species, such as the impacts arising from temporary habitat disturbance, long term habitat loss, colonisation of hard structures, EMF, and thermal effects from cabling (as outlined in Volume 2, Chapter 8: Benthic Ecology), will be confined to within the Proposed Development. There is no physical overlap between the Proposed Development and any MPA designated for benthic and/or geodiversity features (Figure 1.1). As such, no MPAs are screened in for this criterion (as defined in Paragraph 1.5.6).
- 1.7.3 There is the potential for indirect effects to MPAs designated for benthic features and geodiversity features within the 15 km ZOI (as defined in Paragraph 1.5.6). Indirect impacts on benthic features may be associated with increased Suspended Sediment Concentrations (SSC) arising from construction activities or changes to the hydrodynamic regime due to the presence of Offshore Infrastructure associated with the Proposed Development (as outlined in Volume 2, Chapter 8: Benthic Ecology). A single MPA, the Firth of Forth Banks Complex MPA, has been identified to be located partly within the 15 km screening buffer for benthic receptors.

Firth of Forth Banks Complex MPA

- 1.7.4 The Firth of Forth Banks Complex MPA is located off the east coast of Scotland and partially overlaps with the Proposed Development's Benthic ZOI (Figure 1.3). The MPA is a composite site comprising three distinct areas (Berwick Bank, Scalp Bank and Wee Bankie, and Montrose Banks), the boundaries of which were determined by the presence and extent of the important features contained within them. The MPA as a whole covers an area of 2,130 km² and was designated by Marine Scotland in 2014 for four protected features: ocean quahog aggregations, offshore subtidal sands and gravels, shelf banks and mounds, and the key geodiversity area: moraines.
- 1.7.5 The Benthic ZOI is likely to overlap with the Montrose Bank and Scalp and Wee Bankie sections of the MPA, with the extent of the potential overlap between the ZOI and the MPA equating to approximately 153.6 km² and 54.3 km² for the above sections respectively (Figure 1.3).
- 1.7.6 Figure 1.4 illustrates the known distribution of designated features within the Firth of Forth Banks Complex MPA. It should be noted that the offshore subtidal sands and gravels feature, together with suitable habitat for the ocean quahog aggregations feature, are assumed to extend across the entirety of the Firth of Forth Banks Complex MPA (Joint Nature Conservation Committee (JNCC), 2018a). Figure 1.4 demonstrates that the shelf banks and mounds geodiversity feature lies well outside the modelled Benthic ZOI, making it highly unlikely that this designated feature will be affected by changes in physical processes, such as changes to SSC, bed levels and sediment type. Furthermore, as sedimentary features, it will not be affected by longer range impacts such as underwater sound. Therefore, this feature has been screened out of further assessment due to a lack of potential impact pathways.

1.7.7 Figure 1.4 indicates that the ocean quahog aggregations, the offshore subtidal sands and gravels and the moraines features have the potential to overlap with the ZOI and, therefore, may be indirectly affected by the Proposed Development.

1.7.8 In summary, indirect impacts on three benthic features (ocean quahog aggregations, offshore subtidal sands and gravels, and moraines) within the Firth of Forth Banks Complex MPA may occur, for example due to changes to SSC, bed levels and sediment type and changes in physical processes. Based on these conclusions, these three features of the Firth of Forth Banks Complex MPA are proposed to be screened in for further assessment.

Screening for MPAs with Fish Features

1.7.9 Direct impacts to fish features of MPAs, such as those arising from temporary habitat disturbance, long term habitat loss, colonisation of hard structures and EMF, will be confined to the area within the Proposed Development (Figure 1.1) (as outlined in Volume 2, Chapter 9: Fish and Shellfish Ecology). There is no physical overlap between the Proposed Development and any MPA designated for fish features. As such, no MPAs are screened in for this criterion (as defined in Paragraph 1.5.6).

1.7.10 However, impacts to fish features of MPAs (i.e. sandeels) may also occur because of increased subsea noise (i.e. from piling), with effects potentially extending beyond the area within the Proposed Development. The 100 km radius ZOI for fish MPA features has been defined as the Fish and Shellfish Study Area described in Volume 2, Chapter 9: Fish and Shellfish Ecology. A single MPA, the Turbot Bank MPA, which is designated for sandeels, has been identified within this screening.

Turbot Bank MPA

1.7.11 The Turbot Bank MPA is located 35.8 km from the Bowdun Array Area and 46.9 km from the Bowdun Export Cable Corridor at its closest point. The subsea noise modelling results show that (for unmitigated concurrent 15 m monopile installation based on the cumulative Sound Exposure Level (SEL_{cum}) metric for static fish) mortality could occur out to a range of 1.99 km and recoverable injury out to 2.81 km for Group 1 fish species, including sandeels. It's noted that any potential short term changes in hearing sensitivity (Temporary Threshold Shift (TTS)) are modelled out to ranges of 25 km for all hearing groups. Further information on subsea noise modelling and impacts upon fish species can be found in Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report, and Volume 2, Chapter 9: Fish and Shellfish Ecology. The distance to the Turbot Bank MPA illustrates that behavioural disturbance is not likely to impact the sandeel feature of the Turbot Bank MPA.

1.7.12 On this basis, no MPAs with fish as a protected feature are screened in for subsea noise impact pathways, and overall no MPAs with fish as a protected feature are screened in.

Screening for MPAs with Ornithological Features

- 1.7.13 Direct impacts to ornithological features of MPAs, such as the impact of collision risk mortality due to collision with rotor blades, temporary habitat loss and/or habitat disturbance, distributional responses, displacement and barrier effects from Offshore Infrastructure and disturbance and displacement to birds from vessel movement will occur within the Proposed Development but may affect bird populations from the surrounding area. There is no physical overlap between the Proposed Development and any MPA designated for ornithology features, therefore there is no potential for direct impacts such as habitat loss. As such, no MPAs are screened in for these criteria (as defined in Paragraph 1.5.6).
- 1.7.14 Indirect impacts to ornithological features of MPAs, including impacts from UXO clearance and construction and decommissioning noise, will extend beyond the Proposed Development. No MPAs lie within the 100 km ZoI for MPAs with Ornithology features (as defined in Paragraph 1.5.6), and therefore no such MPAs are screened into the assessment.

Screening for MPAs with Marine Mammal Features

- 1.7.15 Direct impacts to marine mammal features of MPAs, such as the impact of temporary habitat disturbance, and long term habitat loss will be confined to the area within the Proposed Development (as outlined in Volume 2, Chapter 10: Marine Mammals). There is no physical overlap between the Proposed Development and any MPA designated for marine mammal features (Figure 1.2). As such, no MPAs are screened in for these criteria.
- 1.7.16 Impacts on marine mammal features of MPAs may, however, occur due to increased subsea noise, with effects potentially extending beyond the boundaries of the Proposed Development (as outlined in Volume 2, Chapter 10: Marine Mammals). The ZoI for the potential impact has been defined as the UK waters within the Regional Marine Mammal Study Area described in Paragraph 1.5.6 and Volume 2, Chapter 10: Marine Mammals. A single MPA, the Southern Trench MPA designated for minke whale, lies within this buffer.
- 1.7.17 Indirect impacts on marine mammal features of MPAs may also occur as a result of changes in prey availability. The indirect effect of impacts such as SSC and sediment deposition on prey species (i.e. fish and shellfish) has been considered in Paragraphs 1.7.9 to 1.7.10, however there are no MPAs with marine mammal features within the 15 km buffer applied for changes in SSCs, bed level and sediment type.

Southern Trench MPA

- 1.7.18 The Southern Trench MPA is located approximately 36 km to the north-west of the Proposed Development (Figure 1.2). Minke whale are most often spotted around Scotland between July and September (NatureScot, 2023) when they migrate to higher latitudes to feed (Evans and Stirling, 2001). The minke whale have shown seasonal site fidelity to summer feeding grounds (Gill and Fairbairns, 1995), and Hoelzel *et al.* (1989) documented individual foraging specialisations, which were associated with different habitat types.

1.7.19 Regarding the risk of disturbance within the MPA, subsea noise modelling results show that there is an overlap of single strike Sound Exposure Level (SEL_{ss}) noise contours with the MPA. Received levels within the MPA are predicted to reach maximum SEL_{ss} levels of 150 dB to 145 dB at the southern area of the MPA, reducing to between 140 dB and 135 dB, with limited westward radiation into the Moray Firth. Given there is an overlap of the marine mammal ZoI with the Site Boundary, the Southern Trench MPA is screened in for further assessment for subsea noise.

Screening Conclusion

1.7.20 Three MPAs were considered in the MPA screening for the Proposed Development. This screening has concluded that the Proposed Development is not capable of affecting (other than insignificantly) the fish, and ornithology feature of any MPAs, as summarised in Table 1.9.

1.7.21 The Firth of Forth Banks Complex MPA has been identified for inclusion in the MPA assessment on the basis that the Proposed Development is deemed to be potentially capable of affecting its ocean quahog aggregations, subtidal sands and gravel and moraines protected features. The Southern Trench MPA has been identified for inclusion in the MPA assessment on the basis that the Proposed Development is deemed to be potentially capable of affecting the minke whale protected feature due to subsea noise.

Table 1.9: Summary of Screening Conclusions for MPAs

Designated Site	Distance to Proposed Development (km)	Feature	Potential Impact Pathway	Screening Conclusion and Justification
Benthic Ecology				
Firth of Forth Banks Complex MPA	7.5	Ocean quahog aggregations, Offshore Subtidal Sands and Gravels, Moraines	Potential pathways identified: changes in SSCs, bed level and sediment type and changes in physical processes	Screened in – the Firth of Forth Banks Complex MPA does not spatially overlap with the Proposed Development. The site does however partially overlap with the ZOI associated with indirect impacts on benthic ecology features. Specifically, parts of Montrose Bank and Scalp and Wee Bankie overlap with the identified Benthic ZOI, as described in Paragraph 1.7.5. As such, there is the potential for a partial extent of the protected benthic features (Ocean quahog aggregations, Offshore Subtidal Sands and Gravels, and Moraines) to be indirectly impacted by the Proposed Development. The Firth of Forth Banks Complex MPA is therefore screened in and is considered to require a Stage 1 assessment.
Fish Ecology				
Turbot Bank MPA	35.8	Sandeels	No potential pathways identified	Screened out – the Turbot Bank MPA does not spatially overlap with the Proposed Development. The Turbot Bank MPA falls outside the 15 km ZOI identified for impact pathways associated with changes in SSCs, bed level and sediment type that have the potential to affect fish and shellfish features. The site also falls outside the likely ZOI for noise-based disturbance or mortality from subsea noise to sandeels, as determined by the assessment presented in Paragraph 1.7.11.
Ornithology				
No MPAs identified within the criteria outlined in Paragraphs 1.7.13 to 1.7.14				

Designated Site	Distance to Proposed Development (km)	Feature	Potential Impact Pathway	Screening Conclusion and Justification
Marine Mammals				
Southern Trench MPA¹	35.9	Minke whale	Potential pathways identified: injury and disturbance from impact piling	Screened in – the Southern Trench MPA does not spatially overlap with the Proposed Development. The MPA falls outside the 15 km ZoI identified for impact pathways associated with changes in SSCs, bed level and sediment type that have the potential to indirectly affect marine mammal features. However, potential impacts due to injury and disturbance from subsea noise impacts are considered to require a Stage 1 assessment.

¹ The Southern Trench MPA is also designated for three other biodiversity features: burrowed mud, fronts and shelf deeps (habitat) and geodiversity features: Quaternary of Scotland: moraines, sub-glacial tunnel valleys, and slide scars from submarine mass movement. However, these are all outside the respective screening ranges applied in the screening.

1.8 MPA Background Information

Firth of Forth Banks Complex MPA

- 1.8.1 The Firth of Forth Banks Complex MPA, the designation of which came into effect on 07 August 2014, is located off the east coast of Scotland, extending over a cumulative area of 2,130 km² (JNCC, 2014a). The depth of the seabed ranges from between 30 m to 110 m below sea level (JNCC, 2014a).
- 1.8.2 The Firth of Forth Banks Complex MPA is a composite site (as illustrated in Figure 1.3) made up of Montrose Bank, Scalp and Wee Bankie, and Berwick Bank. Each of these three sites contain the following benthic and geodiversity features in varying extents: ocean quahog aggregations, subtidal sands and gravel, shelf banks and mounds, and moraines.
- 1.8.3 The ocean quahog aggregations, offshore subtidal sands and gravels, and moraines features of the Firth of Forth Banks Complex MPA, specifically within Montrose Bank, and Scalp and Wee Bankie, occur within the Benthic ZoI, and are therefore screened in. The shelf banks and mounds which are also features of the wider MPA occur outside of the Benthic ZoI and are therefore screened out.

Table 1.10: Screened In Protected Features of the Firth of Forth Banks Complex MPA and Feature Condition

Protected Features	Feature Condition	Assessment Date	Broader Conservation Status
Ocean quahog aggregations	Unfavourable	2014	Oslo-Paris Conventions Threatened and declining
Offshore subtidal sands and gravels	Unfavourable	2014	N/A
Moraines representative of the Wee Bankie Key Geodiversity Area	Favourable	2014	N/A

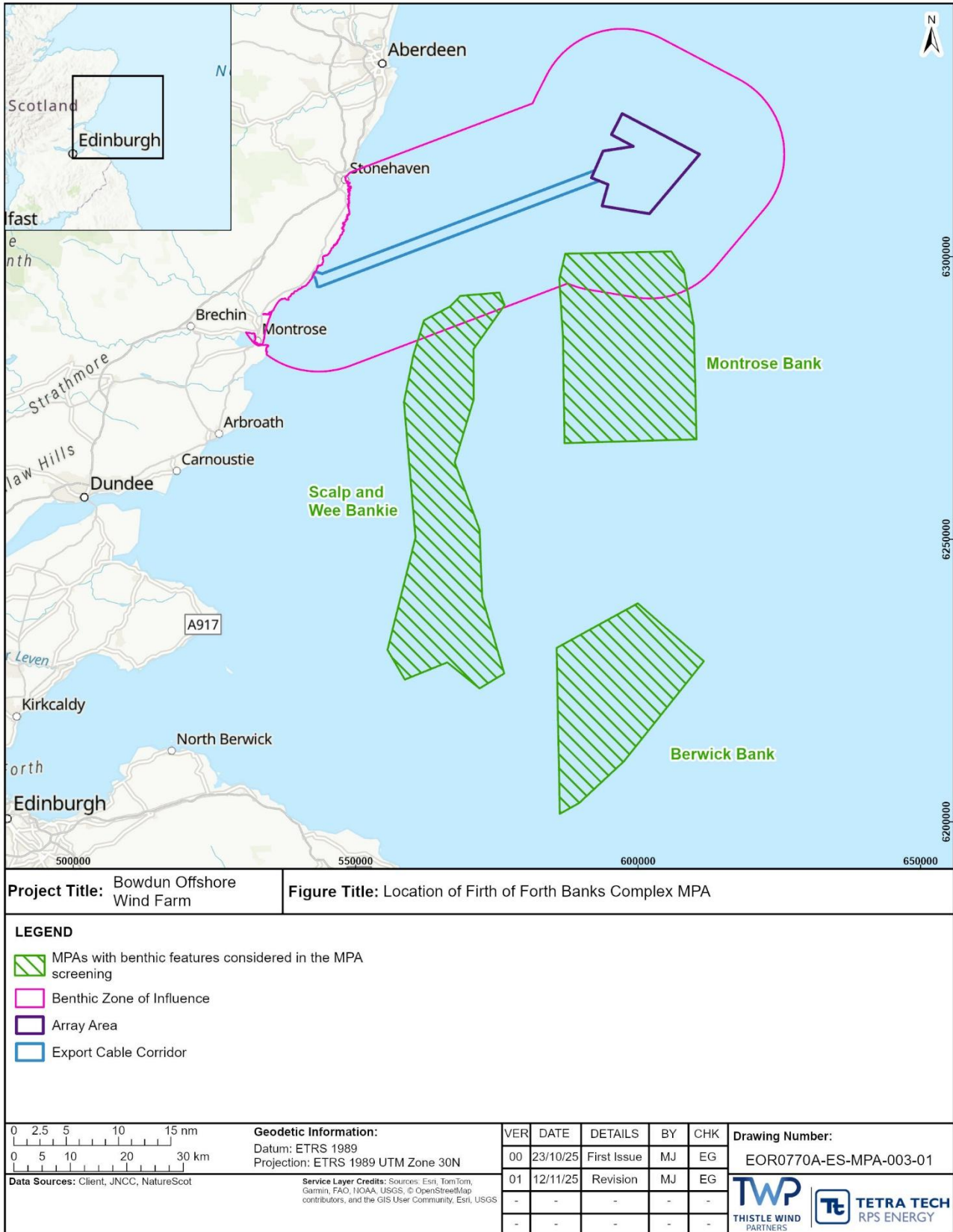


Figure 1.3 Location of Firth of Forth Banks Complex MPA

Conservation Objectives

- 1.8.4 The conservation objectives set out the desired quality of the protected features within the Firth of Forth Banks Complex MPA. The biodiversity features have no direct evidence of their condition in the Firth of Forth Banks Complex MPA, but have the conservation objectives of:
- so far as already in favourable condition, remain in such condition;
 - so far as not already in favourable condition, be brought into such condition, and remain in such condition.
- 1.8.5 For the offshore subtidal sands and gravel protected feature within the Firth of Forth Banks Complex MPA, "*favourable condition*" is when:
- extent is stable or increasing; and
 - structures and functions, quality, and the composition of characteristic biological communities (which includes a reference to the diversity and abundance of species forming part of or living within the habitat) are such as to ensure that they remain in a condition which is healthy and not deteriorating.
- 1.8.6 For the ocean quahog aggregations protected feature, "*favourable condition*" is when:
- the quality and quantity of its habitat and the composition of its 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.
- 1.8.7 For the moraines representative of the Wee Bankie key geodiversity area within the Firth of Forth Banks Complex MPA, "*favourable condition*" is when:
- its extent, component elements and integrity are maintained;
 - its structure and function are unimpaired; and
 - its surface remains sufficiently unobscured for the purposes of determining whether the above criteria are satisfied.

Conservation and Management Advice

- 1.8.8 As set out in Table 1.10, the offshore subtidal sands and gravels and ocean quahog aggregations features need to be recovered to favourable condition. The Supplementary Advice on Conservation Objectives document (JNCC, 2018b) advise that, for the offshore subtidal sands and gravels, this relates to the structure and function attribute and, specifically, the characteristic communities and consequently function. While the feature is naturally exposed to moderate energy levels (due to the tidal currents present in the site), the level of fishing activity present in the site suggests the structure and function of the feature has been impacted as a result of this activity, particularly, otter trawling, scallop dredging, and creeling and potting. It was advised that reduction or removal of scallop dredging activity could potentially help to meet the conservation objects for the ocean quahog aggregations and offshore subtidal sands and gravels features, and that no additional management was required for the creeling and potting as these were unlikely to impact these features.

1.8.9 As of 16 October 2025, new fishing restrictions have been introduced within parts of the Firth of Forth Banks Complex MPA. These measures, implemented by the Scottish Government, aim to protect seabed habitats and species, such as ocean quahog, from the damaging effects of bottom-towed fishing gear. The restrictions apply specifically to the use of demersal mobile gear (excluding demersal seines) (Scottish Government, 2025b).

Protected Features

1.8.10 A map (Figure 1.4) produced with NatureScot data was used to support the designation of this MPA. This map shows the distribution of ocean quahog aggregations, offshore subtidal sands and gravel, and moraines throughout the three Bank areas.

1.8.11 The Montrose Bank, which overlaps with the Benthic ZoI but not directly with the Proposed Development, was comprised primarily of circalittoral coarse sediments and had '*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment' (SS.SMx.CMx.FluHyd) present to the north-east and south (Axelsson *et al.*, 2014). The 'Offshore circalittoral sand' (SS.SSa.OSa) biotope was also present to the east (Goudge and Morris, 2014). The ocean quahog aggregations were more sparsely located throughout Montrose Bank (Figure 1.4), with vessel monitoring system data from 2009 to 2011 indicating that at least half of the surveyed ocean quahog aggregations within the MPA are exposed to fishing activities which could cause pressure on this feature, which may have a medium to high sensitivity to direct impacts JNCC (2014b). However, as noted above in Paragraph 1.8.9, there are new fisheries management measures within Scottish Offshore MPAs, with new restrictions upon trawling in place for the parts of the Firth of Forth Banks Complex (Scottish Government, 2025b).

1.8.12 The Scalp and Wee Bankie site also overlaps with the Benthic ZoI, but not directly with the Proposed Development. This site also comprised SS.SMx.CMx.FluHyd on circalittoral mixed sediment. Additional biotope proposals include: 'Polychaete-rich *Galathea* community with encrusting bryozoans and other epifauna on offshore circalittoral mixed sediment' (SS.SMx.OMx.[PoGintBy]), as well as '*Spiophanes bombyx* aggregations in offshore sands' (SS.SSa.OSa.[Sbom]) (JNCC, 2014b)).

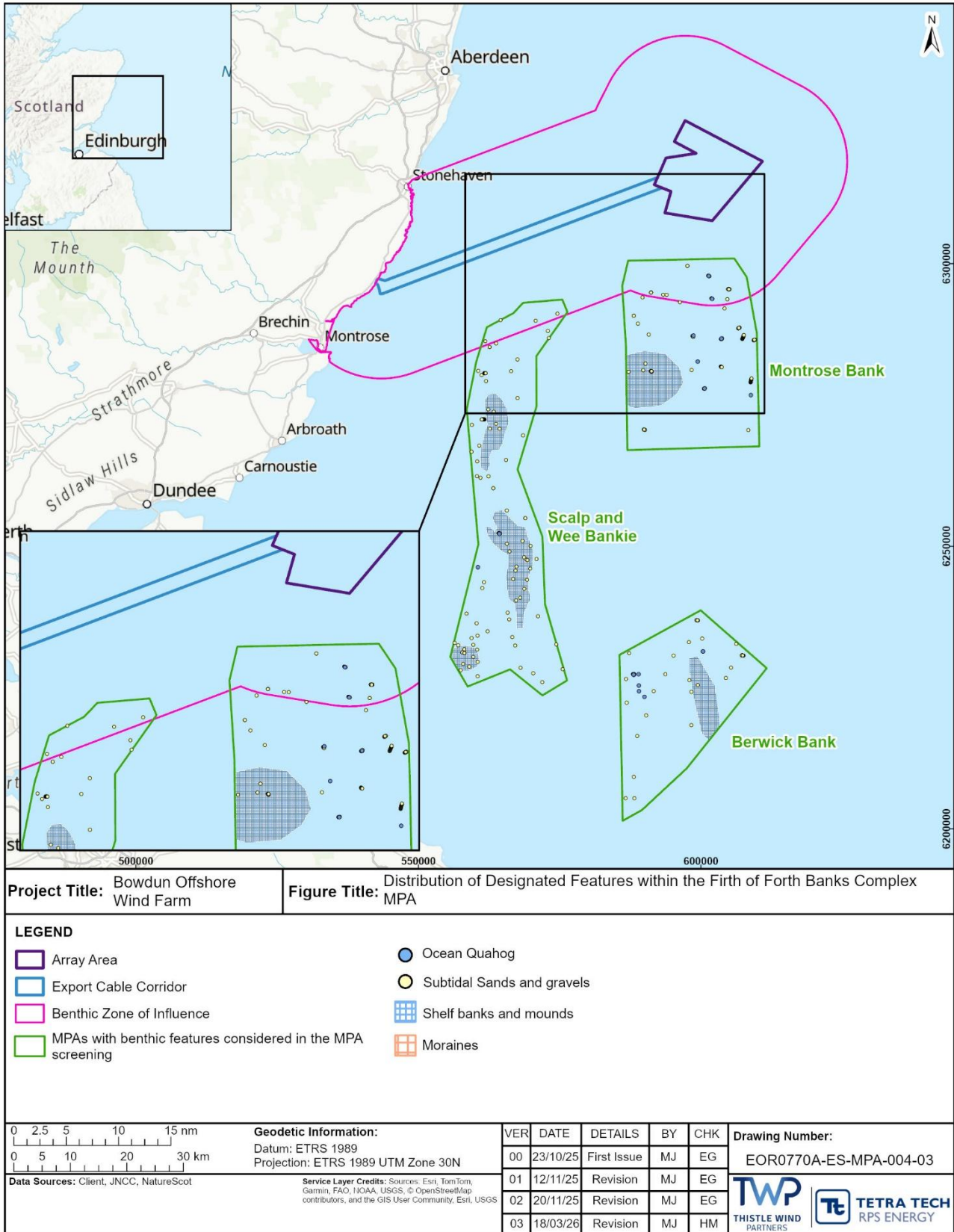


Figure 1.4 Distribution of Designated Features within the Firth of Forth Banks Complex MPA (Goudge and Morris, 2014)

The Southern Trench MPA

- 1.8.13 The Southern Trench MPA is located in the Outer Moray Firth, off the Aberdeenshire coast, stretching from Buckie in the west, to Peterhead in the east. The MPA takes its name from the deep trench running parallel to the coast, and is 58 km long, 9 km wide and 250 m deep.
- 1.8.14 Fronts are a protected feature of this MPA, and are a dynamic mixing zone of cold and warm waters. These zones attract fish species such as herring, mackerel and cod to the area. Minke whale presence was found to be correlated to the presence of offshore thermal fronts from June to September and to burrowed sandeel presence in May and June (MacDougal and Robinson, 2025).
- 1.8.15 Minke whale, a protected feature of the Southern Trench MPA, are considered to be in favourable condition within this MPA (Table 1.11). Individuals are most often spotted around Scotland between July and September (NatureScot, 2023) when the species migrates to higher latitudes to feed (Evans and Stirling, 2001). Minke whale show seasonal site fidelity to summer feeding grounds (Gill and Fairbairns, 1995), and Hoelzel *et al.* (1989) documented individual foraging specialisations, which were associated with different habitat types. The MPA therefore represents a minke whale feeding ground.

Table 1.11: Screened In Protected Features of the Southern Trench MPA and Feature Condition

Protected Features	Feature Condition	Assessment Date	Broader Conservation Status
Minke whale	Favourable	2019	UK: Unknown European Region: Unknown ¹

¹This is the Favourable Conservation Status of the UK and the Marine Atlantic Biogenic Region (MATL) in Europe as reported under Article 17 of the Habitats Directive in 2019

Conservation Objectives and Management Advice

- 1.8.16 Minke whales are considered to be sensitive to subsea noise, although the degree to which they are sensitive is not well understood. There is the potential for auditory injury, disturbance and displacement as a result of activities that produce noise that overlap with minke whales' hearing range.
- 1.8.17 The conservation objectives for the MPA as provided in NatureScot (2025) are that:
- minke whale in the Southern Trench MPA are not at significant risk of injury or killing;
 - conserve the access to resources (e.g. for feeding) provided by the MPA for various stages of the minke whale life cycle;
 - conserve the distribution of minke whale within the site by avoiding significant disturbance;
 - conserve the extent and distribution of any supporting feature upon which minke whale is dependent; and

- conserve the structure and function of supporting features, including processes to ensure minke whales are healthy and not deteriorating.

1.8.18 Note that ‘significant’ disturbance is not defined and can depend on context. However, the timing of any activity that elicits a disturbance response, duration of the activity and the area over which minke whale are likely to be impacted are key considerations in the assessment of disturbance. Significant disturbance is interpreted in the Conservation and Management Advice (NatureScot, 2025) as “*disturbance that affects the distribution of minke whale within the site such that recovery cannot be expected. Effects of activities lasting beyond the average generation time of minke whale are more likely to constitute significant disturbance*”.

1.8.19 As set out in the guidance (NatureScot, 2025) significant disturbance may result in the following effects:

- contributes to long term decline in the use of the site by minke whale;
- changes to the distribution of minke whale on a continuing or sustained basis; and
- changes to the behaviour such that it reduces ability of the species to feed efficiently, breed or survive.

Protected Features

1.8.20 Minke whales are protected wherever they occur in Scotland’s seas as European Protected Species under Annex IV of the Habitats Directive; therefore, the role of the MPA is to provide protection to the habitats within the MPA that support key minke whale life cycle stages (e.g. breeding, feeding, courtship or nursery areas) (Scottish Natural Heritage, 2014). The Southern Trench MPA was designated because the area was predicted to support persistently higher than average densities during the summer feeding season (Figure 1.5).

1.8.21 Other protected features (burrowed mud, fronts, and shelf deeps) are not considered further as these are all outside the screening range for benthic ecology features (15 km).

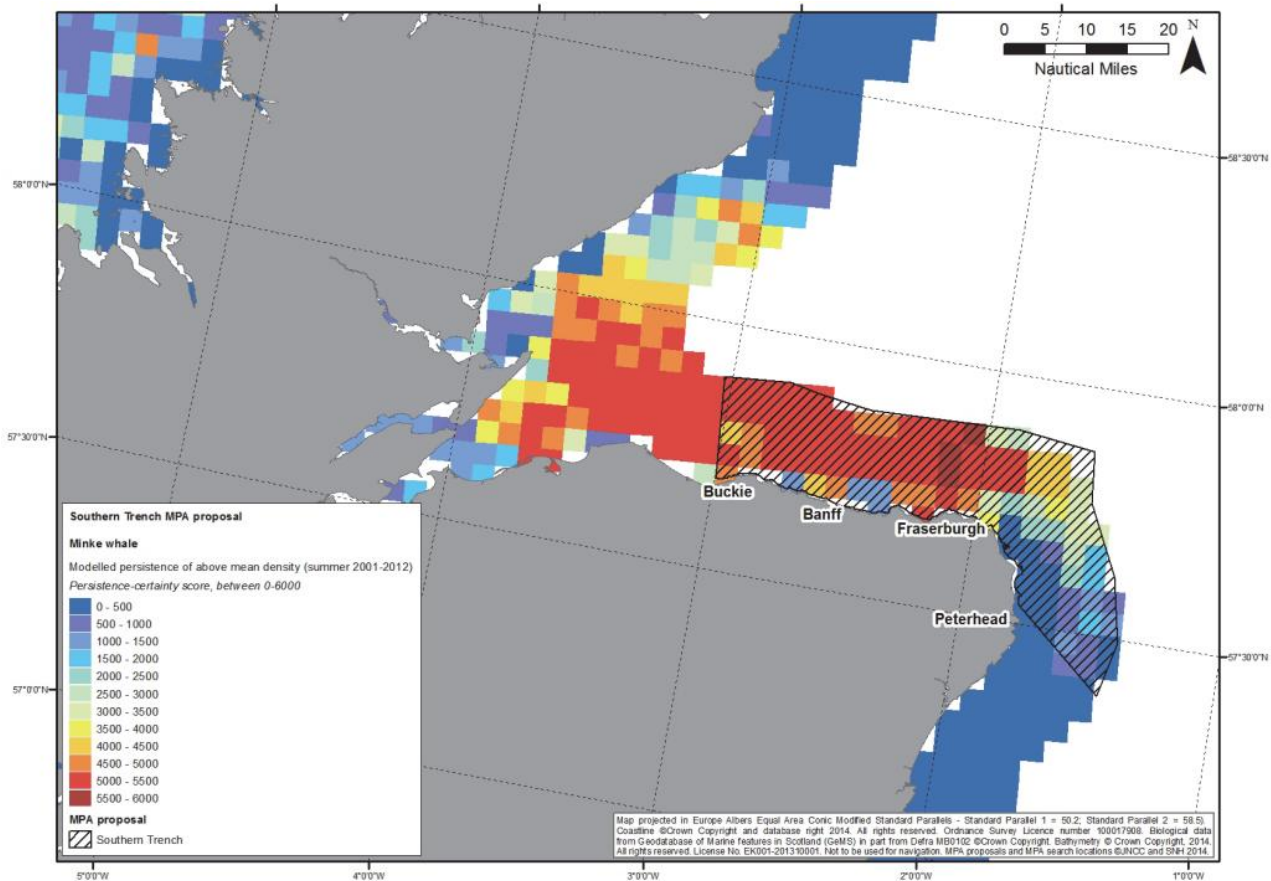


Figure 1.5 Effort Corrected Sightings (Adjusted Densities) and Areas of Persistently Above Average Density for Minke Whale (Scottish Natural Heritage, 2014)

1.9 Embedded Mitigation

1.9.1 Table 1.12 details the Embedded Mitigation adopted as part of the Proposed Development to reduce the potential for impacts on benthic features of the Firth of Forth Banks Complex MPA and Southern Trench MPA. As the Proposed Development has committed to implementing these measures, they have, therefore, been considered in this MPA assessment.

Table 1.12: Embedded Mitigation Adopted as Part of the Proposed Development Which Will Reduce the Impact upon the Firth of Forth Banks Complex MPA

ID*	Embedded Mitigation Adopted as Part of the Proposed Development	Justification
1	Development of, and adherence to, a Cable Specification and Installation Plan (CSIP) post-consent.	The CSIP will outline the technical specifications of the cables in the Proposed Development and describe the relevant cable installation methodology, and identify risks of cable burial, and any measures required to address these risks to limit the disturbance of the seabed as far as practicable.
3	Development of, and adherence to, a Piling Strategy. This will detail use of Acoustic Deterrent Devices (ADDs), slow start, soft start, and ramp up	Implementation of initiation stage and soft start during piling. This will involve the use of a low hammer energy with a low number of strikes used initially, followed by lower hammer energies at a

ID*	Embedded Mitigation Adopted as Part of the Proposed Development	Justification
	<p>procedures, as appropriate, as well as any Additional Mitigation measures, where determined to be required, in consultation with stakeholders including NatureScot and MD-LOT.</p>	<p>higher strike rate at the beginning of the piling sequence before energy input is ‘ramped up’ (increased) over time to required higher levels.</p> <p>The Piling Strategy will be submitted post-consent prepared in collaboration with stakeholders, including but not limited to, MD-LOT and NatureScot, following collation of additional data and final design parameters (e.g. piling locations, hammer energies). Noise modelling will be reviewed with the additional information and will inform the final Piling Strategy, which will be submitted to MD-LOT.</p> <p>These measures will reduce the likelihood of injury from elevated subsea noise to marine mammals in the immediate vicinity of piling operations as far as practicable, allowing individuals to move away from the area before sound levels reach a level at which injury may occur. This is in line with the most up to date guidance for piling operations (JNCC, 2010) and, in most cases, compliance with this guidance reduce the likelihood of injury to marine mammal receptors to negligible levels.</p> <p>Secured in the Section 36 Consent and Marine Licence, via the Piling Strategy.</p>
4	<p>Development of, and adherence to, a CBRA and the Cable Burial Assessment (CBA). Implementation, management and monitoring of cable protection, via burial or external protection where adequate burial depth is not feasible, will be undertaken as informed by these assessments. Results of these assessments, and commitments to post construction monitoring, will be provided in the Cable Plan (CaP).</p>	<p>The potential impacts of cable installation can be mitigated through burying cables to a target cable burial depth, as detailed in the CBRA and CBA. This, alongside the cable installation strategy, should provide sufficient depth to avoid most exposure through metocean processes. Details of any required cable protection will be included in the CaP.</p>
5	<p>Development of, and adherence to, an Environmental Management Plan (EMP), including a Marine Pollution Contingency Plan (MPCP) and a Biosecurity Plan with commitments to monitoring and actions to minimise Invasive Non-Native Species (INNS).</p>	<p>Measures will be adopted to ensure that the potential for release of pollutants from construction, O&M and decommissioning plant is reduced so far as reasonably practicable.</p> <p>The EMP will include measures that will cover all aspects of environmental management including environmental awareness training, auditing, environmental reporting and waste management. An MPCP has been developed, which will include planning for accidental spills and sources of contaminant releases, and an INNS Management Plan, to provide measures for controlling the introduction and spread of INNS.</p>

ID*	Embedded Mitigation Adopted as Part of the Proposed Development	Justification
6	Development of, and adherence to, a Marine Mammal Mitigation Protocol (MMMP), to minimise the risk of auditory injury to marine mammals from noise generating activities resulting from the construction of the Proposed Development. Mitigation will include measures such as Marine Mammal Observers, Passive Acoustic Monitoring and ADDs.	An MMMP has been developed for the Proposed Development, and this will include the commitment to Marine Mammal Observer(s) and passive acoustic monitoring to monitor the mitigation zone (Mitigation Zone (MZ)), as determined by the underwater sound modelling) to ensure that animals are not observed within the MZ during piling. ADDs may be used if required to deter animals from the MZ.
34	Drafting and implementation of a decommissioning programme, prepared in accordance with requirements of the Energy Act 2004, which will set out the extent of infrastructure to be removed as well as the methods and processes which will be used.	The aim of this plan is to adhere to the existing UK and international legislation and guidance (at the time of writing) during the decommissioning phase. This programme will be developed to reduce the amount of long term disturbance to the environment as far as reasonably practicable.
36	Where practicable, the use of low order disposal of Unexploded Ordnance (UXOs) will be implemented (i.e. deflagration).	Low order UXO clearance techniques generate less subsea noise than high order detonation and therefore present a lower risk of injury to sound-sensitive receptors such as marine mammals during UXO clearance. Noting the position statement from statutory authorities on UXO clearance (UK Government, 2025) the option to clear UXOs with low order techniques has been considered as the default method for the Proposed Development.
37	Adoption of JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys, piling noise and use of explosives if and where required.	An outline MMMP (Volume 4, Appendix 27: Outline Marine Mammal Mitigation Protocol) has been developed on the basis of the most recent published statutory guidance (JNCC, 2010; JNCC, 2023; JNCC, 2025). Secured in the Section 36 Consent and Marine Licence, via the requirement for a finalised and agreed MMMP.

*see Volume 3, Technical Appendix 4.6: Schedule of Mitigations and Commitments

1.10 MPA Stage 1 Assessment

Firth of Forth Banks Complex MPA

Introduction

- 1.10.1 This section presents the Stage 1 assessment of the effects of the construction, O&M, and decommissioning of the Proposed Development on the Firth of Forth Banks Complex MPA and its conservation objectives. Each of the relevant indirect impacts identified in Volume 2, Chapter 8: Benthic Ecology are discussed in the following sections and within each assessment, the effects on attributes and targets of the relevant protected features, and subsequently on the conservation objectives, are considered, using the best available scientific evidence to support the conclusions made.
- 1.10.2 The attributes for the offshore subtidal sands and gravels, ocean quahog aggregations, and moraines protected features of the Firth of Forth Banks Complex MPA are listed in Table 1.13 below, in the order they appear in the Conservation and Management Advice (JNCC, 2018b), along with cross-references to the relevant assessments. The impact pathways assessed within the MPA assessment were agreed through consultation with the SNCBs (Section 1.4) and reflect the impact pathways assessed in Volume 2, Chapter 8: Benthic Ecology.

Table 1.13: Impacts Assessed in Relation to the Relevant Attributes During the Firth of Forth Banks Complex MPA Assessment

MPA Attribute	Impacts				
Attribute	Construction	O&M		Decommissioning	
	Change in SSC, bed level and sediment type	Change in SSC, bed level and sediment type	Changes in physical processes	Change in SSC, bed level and sediment type	Changes in physical processes
Offshore Subtidal Sands and Gravels					
Extent and distribution	Paragraph 1.10.6 to 1.10.18	Paragraphs 1.10.19 to 1.10.27	Paragraphs 1.10.41 to 1.10.49	Paragraphs 1.10.28 to 1.10.35	Paragraph 1.10.50
Structure and Function					
Supporting Processes					
Ocean Quahog Aggregations					
Extent and distribution	Paragraph 1.10.6 to 1.10.18	Paragraphs 1.10.19 to 1.10.27	Paragraphs 1.10.41 to 1.10.49	Paragraphs 1.10.28 to 1.10.35	Paragraph 1.10.50
Structure and Function					
Supporting Processes					
Moraines Representative of the Wee Bankie Key Geodiversity Area					
Extent and distribution	Paragraph 1.10.6 to 1.10.18	Paragraphs 1.10.19 to 1.10.27	Paragraphs 1.10.41 to 1.10.49	Paragraphs 1.10.28 to 1.10.35	Paragraph 1.10.50
Structure and Function					

Maximum Design Scenario

- 1.10.3 The Maximum Design Scenario (MDS) identified in Table 1.14 are those parameters with the potential to result in the greatest effect on the Firth of Forth Banks Complex MPA. Any other development scenario within the PDE, will result in the same, or less, level of environmental effect. The scenario has been selected from the details provided in Volume 1, Chapter 3: Project Description.
- 1.10.4 The assessment of the impacts associated with the Proposed Development for the Firth of Forth Banks Complex MPA has been informed by and will inform chapters within the Offshore EIA Report including Volume 2, Chapter 7: Physical Processes and Volume 2, Chapter 8: Benthic Ecology.
- 1.10.5 As noted in the screening (Section 1.7), due to the distance between the Firth of Forth Banks Complex MPA and the Proposed Development (7.5 km) only the indirect impacts are being considered and have been included in the MDS.

Table 1.14: Maximum Design Scenario Considered for Each Potential Impact with the Potential to Cause a Significant Risk of Hindering the Achievement of the Conservation Objectives of the Firth of Forth Banks Complex MPA

Potential Impact	Phase*			Maximum Design Scenario	Justification
	C	O	D		
Changes to SSCs, bed levels and sediment type	✓	✓	✓	<p>Construction phase</p> <p><u>Drilling for pile installation</u></p> <p>Up to 318,086 m³ of drill arising for all piles in the Array Area for the 40 x 25 MW fixed monopile Wind Turbine Layout, comprising:</p> <ul style="list-style-type: none"> • Maximum number of drilled piles: 40 (max foundations = 40; max piles per foundation = 1); • Maximum dimensions of drilled pile section: 15 m diameter, 45 m maximum penetration depth; • Maximum volume of drill arisings per pile: 7,952.12 m³; and • Maximum concurrent drilling events: 2. <p><u>IAC installation</u></p> <ul style="list-style-type: none"> • Maximum total length of IAC on the seabed for the whole Array Area: 151 km for the 40 x 25 MW and 50 x 20 MW Wind Turbine Layouts; • Trench dimensions: up to 6 m wide; 1.5 m deep (average); ‘V’ shape profile; • Trench excavation method: Jetting, Mass Flow Excavation (MFE), Ploughing/Pre-Ploughing, Trenching/Pre-Trenching (incl. dredging, cutting); and • MFE pre-lay trenching rate: 400 m/hour. 	<p>The MDS corresponds to (a combination of) the greatest amount of material disturbed and the greatest geographical extent of the impact.</p> <p>Construction phase</p> <p><u>Drilling for pile installation</u></p> <p>Based on the greatest amount of material disturbed in a drilling event, considering the largest pile dimension, largest pile penetration depth and number of concurrent drilling events. Assumes two concurrent drilling events can occur for neighbouring foundations, resulting in the MDS for instantaneous SSC.</p> <p>Piles relating to OSPs are smaller in diameter and require less drilling depth than Wind Turbine foundations therefore do not represent the MDS.</p> <p><u>IAC installation</u></p> <p>Pre-lay trenching by MFE will give MDS for sediment disturbance. Conservatively assumes 100% fluidisation of material expelled from trench. In reality, pre-lay jetting will move a proportion of material rather than bringing it fully into suspension.</p>

		<p><u>Offshore Export Cables installation</u></p> <ul style="list-style-type: none"> • Maximum number of Offshore Export Cables: 3; • Maximum total length of each Offshore Export Cables: 70 km; • Trench dimensions: up to 6 m wide; 1.5 m deep (average); ‘V’ shape profile; • Excavation method: Jetting, MFE, Ploughing/Pre-Ploughing, Trenching/Pre-Trenching (incl. dredging, cutting); and • MFE pre-lay trenching rate: 400 m/hour. <p><u>Interconnector Cable installation</u></p> <ul style="list-style-type: none"> • Maximum number of Interconnector Cables: 3; • Maximum total length of each Export Cable: 12 km; • Trench dimensions: up to 6 m wide; 1.5 m deep (average); ‘V’ shape profile; • Excavation method: Jetting, MFE, Ploughing/Pre-Ploughing, Trenching/Pre-Trenching (incl. dredging, cutting); and • MFE Pre-lay trenching rate: 400 m/hour. <p><u>Sandwave clearance</u></p> <ul style="list-style-type: none"> • Sandwave clearance width along IAC: 58.6 m; • Area of IAC sandwave clearance: 49,552 m² for the 40 x 25 MW and 50 x 20 MW Wind Turbine Layouts; • Area of Interconnector Cable sandwave clearance: 11,814 m²; • Area of OSP Scour Protection sandwave clearance: 24,359 m² for three OSPs; 	<p>Modelling was carried out for sediment release along a section of an indicative cable route which runs parallel and then perpendicular to the tidal axis for two full tidal cycles.</p> <p><u>Offshore Export Cables installation</u></p> <p>Pre-lay trenching by MFE will give MDS for sediment disturbance. Conservatively assumes 100% fluidisation of material expelled from trench. In reality pre-lay jetting will move a proportion of material rather than bringing it fully into suspension. Offshore Export Cables Corridor pre-lay trenching modelling assumes sediment release along the whole Offshore Export Cables Corridor.</p> <p><u>Sandwave clearance</u></p> <p>Sandwave clearance/levelling activities may be undertaken using a range of techniques – MFE and suction hopper dredging. Releases via both are modelled. A MFE near-bed sediment release rate of 1,000 kg/s is conservatively estimated based on the MDS trench cross section dimensions, the speed of progress of the tool, and the bulk density of the local sediment type. Dredge spoil release is simulated as an instantaneous release at the water surface. 10% of an 11,000 m³ hopper is assumed to form the passive phase of the plume. Other seabed preparation such as boulder clearance</p>
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Potential Impact	Phase*			Maximum Design Scenario	Justification
	C	O	D		
				<ul style="list-style-type: none"> Area of fixed foundation sandwave clearance: 172,220 m² for the 67 x 15 MW Wind Turbine Layouts; Sandwave clearance width along Offshore Export Cables: 58.6 m; Area of Offshore Export Cables sandwave clearance: 609,147 m²; and Clearance method: MFE and/or Dredger. <p><u>Trenchless techniques (e.g. HDD) exit pit excavation</u></p> <ul style="list-style-type: none"> Number of exit pits: up to 3; 2,800 m³ excavated material for each pit for the 220 kV scenario (8,400 m³ for all pits); and Exit pit dimensions: 2.2 m x 50 m. <p><u>Trenchless techniques (e.g. HDD drilling fluid release (at Landfall))</u></p> <ul style="list-style-type: none"> Number of exit/release events: up to 3; Up to 2,870 m³ drilling mud generated per HDD duct, based on bore diameter of 2.2 m and duct length of 755 m (8,610 m³ total for all three ducts); 100,000 mg/l (100 kg/m³) assumed conservative maximum concentration of bentonite in drilling mud; and Wet punch out. 	<p>is not considered here as the activity does not represent the MDS in terms of potential increases in SSC and associated changes to seabed substrate.</p> <p><u>Trenchless techniques (e.g. HDD exit pit excavation</u></p> <p>Based on maximum exit pit dimensions.</p> <p><u>Trenchless techniques (e.g. HDD drilling fluid release (at Landfall)</u></p> <p>Based on maximum HDD duct dimensions. Assumes a conservative bentonite concentration of 100 kg/m³ in drilling mud. Other stages of drilling (pilot hole drilling and stages of reaming) may result in smaller release events separated in time. But the MDS is considered as a release of drilling mud from a single conduit.</p>

Potential Impact	Phase*			Maximum Design Scenario	Justification
	C	O	D		
				<p>O&M phase</p> <p><u>Cable repairs</u></p> <ul style="list-style-type: none"> • Number of annual IAC repairs: 1; • Maximum annual length of IAC reburial: 4,915 m; • Number of annual Interconnector Cable repairs: 1 every 5.5 years (0.18 per year); • Maximum annual length of Interconnector Cable reburial: 2,040 m; • Number of annual static Offshore Export Cables repairs: 1; and • Maximum annual length of Offshore Export Cables reburial: 6,390 m. <p>Decommissioning phase</p> <p>A Decommissioning Programme will be submitted to MD-LOT for consultation and approval. The Decommissioning Programme will be updated during the Proposed Developments lifespan to take account of changing best practice and new technologies.</p> <p>The approach for decommissioning is yet to be determined, however, for the purposes of this MDS total removal of all infrastructure including buried cables and cable protection has been assumed, and as such the environmental impact of decommissioning will be the same if not lower than construction.</p>	<p>O&M phase</p> <p>The MDS for sediment disturbance during operation will be no greater than that set out for the construction phase of the Proposed Development.</p> <p><u>Cable repairs</u></p> <p>These limited activities would disturb a much smaller volume of material for each repair/reburial event than simulated for the construction phase.</p> <p>Decommissioning phase</p> <p>The MDS for sediment disturbance during decommissioning will be no greater than that set out for the construction phase of the Proposed Development.</p>

Potential Impact	Phase*			Maximum Design Scenario	Justification
	C	O	D		
Changes in physical processes	x	✓	✓	The MDS for this impact has been informed by the conclusions of the assessment of significance for the Physical Processes assessment (Volume 2, Chapter 7: Physical Processes), and considers a range of potential impacts, such as changes to seabed morphology, the tidal regime, wave regime, sediment transport regime, stratification and frontal systems, and scour.	The MDS for this impact considers all activities which have the potential to create changes in physical processes.

*Proposed Development Phase refers to construction (C), O&M (O) and decommissioning (D).

Changes in Suspended Sediment Concentration, Bed Levels and Sediment Type

Construction Phase

- 1.10.6 Changes in SSC, bed levels and sediment type are predicted to occur during the construction phase due to drilling for pile installation, IAC, Interconnector Cables and Offshore Export Cables installation, and sandwave levelling. They may also arise in the Intertidal Zone as a result of exit pit excavation and drilling fluid release associated with the use of trenchless technology, such as HDD (see Table 1.14).
- 1.10.7 The benchmarks for the relevant MarESA and FeAST pressures which have been used to inform this impact assessment are:
- Changes in suspended solids (water clarity): the benchmark for which is a change in one rank on the Water Framework Directive scale (e.g. from clear to intermediate for one year, caused by activities disturbing sediment or organic particulate material and mobilising it into the water column such as dredging, disposal at sea, cable and pipeline burial).
 - Smothering and siltation rate changes (light): the benchmark for light deposition is up to 5 cm of fine material added to the habitat in a single discrete event.
 - Smothering and siltation rate changes (heavy): the benchmark for which is heavy deposition of up to 30 cm of fine material added to the seabed in a single discrete event.
- 1.10.8 Changes in SSCs, bed levels and sediment type resulting from construction activities could affect the ocean quahog aggregations, offshore subtidal sands and gravels and moraine features of the Firth of Forth Banks Complex MPA.
- 1.10.9 Physical processes modelling, presented in full in Volume 3, Technical Appendix 7.3: Physical Processes Technical Assessment, has been used to inform the assessment of potential changes in SSCs, bed levels and sediment type.
- 1.10.10 Drilling action for pile installation may result in up to 318,086 m³ of drill arisings, from up to 40 drilled piles. Interconnector, IAC and Offshore Export Cable installation will involve installations in trenches of up to 6 m width with an average depth of 1.5 m, and a v-shaped profile. Installation may occur using an MFE, with a pre-lay trenching rate of 400 m per hour. For IAC, this involves the installation of a total of 151 km of cables in contact with the seabed. Export cable installation may involve up to three cable installations for a total of 70 km of cables in contact with the seabed, and up to 36 km of Interconnector Cables. Sandwave levelling for Interconnector, IAC and Offshore Export Cable installation may cover areas defined in Table 1.14, with associated volumes of displaced sediment. Levelling will be undertaken using a MFE and/or a dredger.
- 1.10.11 The following attributes of the ocean quahog aggregations and offshore subtidal sands and gravels features of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the construction phase:

- extent and distribution;
- structure and function; and
- supporting processes.

1.10.12 The following attributes of the Wee Bankie key geodiversity area feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the construction phase:

- extent and distribution; and
- structure and function.

1.10.13 As outlined in Volume 2, Chapter 7: Physical Processes, the modelling for the Proposed Development was undertaken for an MFE for both sandwave levelling and cable installation.

1.10.14 Seabed preparation via the use of a Trail Suction Hopper Dredger (TSHD) may be required prior to the installation of foundations. The release of the sediment back to the seabed will take place at a nearby location. During releases of sediment, the full volume of material is released into the water column from the vessels hull near to the water surface in a relatively short time. At a representative higher current speed of 0.6 m/s during spring tides, these sediments will settle to the bed within approximately 78 m for gravel, 390 m for coarse sand, 1,300 m for medium sand, and 3,900 m for finer sands from the release point. This distance will be proportionally shorter during periods of lower current speed, such as outside peak flow times and generally around neap tides. Fine sand and silt sized sediments persist in suspension for longer than relatively coarser sediment grain sizes. Plumes generated by spoil disposal within Array Area and Export Cable Corridor (nearshore and offshore regions) are not anticipated to reach, or directly impact, any designated areas even at the modelled higher current speed.

1.10.15 Pre-lay cable trenching and sandwave clearance using an MFE, alongside drilling for foundation installation were also modelled, with these scenarios anticipated to generate long, relatively thin plumes extending downstream from the point of active disturbance. The level of SSC caused by all sediment types together is realistically expected to be locally very high at the location of active drilling, sandwave clearance or trenching – within 5 m of the activity, SSC might be millions of mg/l or more (i.e. more sediment than water in parts of the local plume). As sediment in the plume is redeposited and dispersed both vertically and horizontally with distance and time downstream, SSC is expected to reduce to less than 1,000 mg/l within tens of metres. Sediment released at the southern boundary of the Array Area has the potential to reach the Firth of Forth Banks Complex MPA, when the release period coincides with spring tides however, the plume SSC will be already greatly reduced due to re-settlement of sediment, by the time it is advected into the protected area. A maximum instantaneous SSC of <10 mg/l is predicted within a very small proportion of the MPA.

1.10.16 The ocean quahog aggregations only have negligible sensitivity to this impact due to being adapted for deposit feeding in sedimentary environments (Morton,

2011). Powilleit *et al.* (2009) exposed ocean quahogs to smothering in the laboratory. They were exposed to 'till' and 'sand/till' mixtures to a depth of 10 to 20 cm and 14 to 40 cm. In this experiment a considerable number of ocean quahogs were able to burrow to the surface of 32 to 41 cm of either sediment and regained contact with the surface. Additionally, ocean quahog naturally inhabiting a range of sheltered to wave exposed conditions (Tyler-Walters and Sabatini, 2017). In these exposed conditions the surface sediment is likely to be mobilised regularly, therefore changes in SSCs, bed level and sediment type may not result in adverse effects especially as ocean quahogs may avoid these conditions by burrowing for several days (Tyler-Walters and Sabatini, 2017).

1.10.17 Based on the information presented above, the following can be concluded with respect to the attributes of the ocean quahog aggregations, offshore subtidal sands and gravels and Wee Bankie key geodiversity features of the Firth of Forth Banks Complex MPA.

- **Extent and distribution:** the modelling undertaken found that the Proposed Development may result in changes in SSCs, bed levels and sediment type, however, it highlighted that any sediment plumes that may reach the MPA will be of low concentration and will likely only affect a small proportion of the MPA for a short duration. As a species which occupies sedimentary habitats ocean quahog is likely to be unaffected by the intermittent increases in suspended sediments, as described above. Additionally, as this sediment will have been disturbed locally and be similar to the sedimentary environment where it settles there would be no change to the underlying habitat which could cause a change to the extent or distribution of the ocean quahog aggregation habitat. The offshore subtidal sands and gravels feature has a medium sensitivity to this impact, due to the potential of heavy smothering potentially causing mortality to constituent polychaete species (Essink, 1999; Powilleit *et al.*, 2009). However, the offshore subtidal sands and gravels feature is widespread throughout the Firth of Forth Banks Complex MPA, and any impact from changes in SSCs, bed levels and sediment type are likely to be minimal overall and the extent is therefore unlikely to be impacted, other than insignificantly. The Wee Bankie key geodiversity area comprising relict moraines has a low sensitivity to this impact, and due to the limited potential for changes in SSCs, bed levels and sediment type, the extent and distribution is therefore unlikely to be impacted, other than insignificantly.
- **Structure and function:** the structure and function of ocean quahog aggregations across the Firth of Forth Banks Complex MPA is unlikely to be significantly impacted by changes in SSCs, bed levels and sediment type. This is due to their relative sparsity throughout the MPA, limiting the potential for smothering or siltation impacts on this feature. The offshore subtidal sands and gravels and the Wee Bankie key geodiversity area are also unlikely to be significantly impacted, due to all deposited sediment being from the local area and having a similar composition to that located within the Firth of Forth Banks Complex MPA (Section 8.6 of Volume 2,

Chapter 8: Benthic Ecology). This includes limited impacts on the topographic feature and sediment composition, as the settled sediment, key species and characteristic communities will have been disturbed locally, the conditions will not vary significantly from those naturally experienced. Therefore, the structure and function of features is unlikely to be impacted other than insignificantly.

- **Supporting processes:** the hydrodynamic supporting processes for the ocean quahog aggregations and the offshore subtidal sands and gravels features are unlikely to be changed by changes in SSCs, bed levels and sediment type, as modelling indicated that SSCs would likely return to baseline conditions within a few tidal cycles (Section 7.10.18 of Volume 2, Chapter 7: Physical Processes). This would lead to the supporting processes, including water and sediment quality, returning to normal conditions shortly following the cessation of construction activities, and therefore changes in SSCs, bed levels and sediment type are unlikely to have any impact (other than insignificantly) on the conservation objective to recover this feature to favourable condition. Due to the nature of this impact the hydrodynamic regime which underpins these physical habitats will not be affected.

Summary of Attribute Assessment

1.10.18 Based on the information presented in Paragraphs 1.10.14 to 1.10.17, it can be concluded that changes in SSCs, bed levels and sediment type during the Proposed Development construction phase **will not lead to a significant risk of hindering the achievement of the conservation objective** of restoring both ocean quahog aggregations and offshore subtidal sands and gravels features to a favourable condition, or **hinder the conservation** of the Wee Bankie key geodiversity area for the following reasons:

- The **extent and distribution, structure and function, and supporting processes** of the ocean quahog aggregations and offshore subtidal sands and gravels features will not be adversely impacted by the construction activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles. In addition, the negligible sensitivity of ocean quahog to this type of impact, and resulting conditions within their natural range will allow them to adapt with limited adverse effects.
- The **extent and distribution and structure and function** of the Wee Bankie key geodiversity area comprising relict moraines will not be adversely impacted by the construction activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles.

O&M Phase

- 1.10.19 Changes in SSCs, bed levels and sediment type may occur during the O&M phase as a result of cable repair and reburial events for any associated cables. Volume 2, Chapter 8: Benthic Ecology provides full detail on the magnitude of impact and MDS assumptions with respect to increases in SSC and sediment deposition associated with cable O&M for the Proposed Development as a whole.
- 1.10.20 O&M activities associated with cable repair events may changes in SSCs, bed levels and sediment type from the undertaking of up to one annual IAC repair over a maximum distance of 4,915 m, up to 0.18 annual Interconnector Cable repair over a maximum distance of 2,040 m and one annual Offshore Export Cable repair, again over a maximum distance of 6,390 m (Table 1.14). The adherence to the CaP and EMP as outlined in Table 1.12 is likely to mitigate any large increases in SSCs and associated deposition and would not be greater than during the construction phase. Specifically, the repair activities will be undertaken using similar methods as during the construction period, but over a much reduced area and timescale, and, therefore, the sediment plume and sedimentation footprints will be smaller and will return to baseline conditions more quickly than those assessed during the construction phase.
- 1.10.21 The benchmarks for the relevant MarESA and FeAST pressures for the Firth of Forth Banks Complex MPA are as listed for the construction phase (Paragraph 1.10.7).
- 1.10.22 The following attributes of the ocean quahog aggregations and offshore subtidal sands and gravels feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the O&M phase:
- extent and distribution;
 - structure and function; and
 - supporting processes.
- 1.10.23 The following attributes of the Wee Bankie key geodiversity area feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the O&M phase:
- extent and distribution; and
 - structure and function.
- 1.10.24 Repairs and reburial would be undertaken using similar methods as those for cable installation activities, however, over a much smaller length of cable. Therefore, the magnitude of the impact would be smaller than what is described for the construction phase (Paragraph 1.10.14 *et seq*). The sediment plumes and sedimentation footprints would be dependent on which section of the cable is being repaired. However, as with the construction phase, even should the repairs occur at the point on the Export Cable Corridor closest to the Firth of Forth Banks Complex MPA (7.5 km), the associated increase in SSC from the repair or reburial activity will be greatly reduced due to sediment

re-settlement by the time SSCs are advected to the Firth of Forth Banks Complex MPA.

1.10.25 The smaller magnitude of impact associated with the O&M activities means it is likely that the sensitivity of these communities to the impact of changes in SSCs, bed levels and sediment type will remain negligible (Paragraph 1.10.16). The impact will be much more intermittent, across the operational lifetime of the Proposed Development and on a much smaller scale. Therefore the assessment and conclusions presented in Paragraph 1.10.17 for the construction phase are deemed to be applicable to the O&M phase with regards to the effect this impact will have on extent and distribution and structure and function of the protected features of the MPA.

1.10.26 As a result, both the physical (fine scale topography, sediment composition, water and sediment quality and hydrodynamic regime) and ecological (key and influential species and characteristic communities) elements of the MPA features will not be adversely impacted by the O&M activities of the Proposed Development.

Summary of Attribute Assessment

1.10.27 Based on the information presented in Paragraphs 1.10.19 and 1.10.20, it can be concluded that changes in SSCs, bed levels and sediment type during the Proposed Development O&M phase **will not lead to a significant risk of hindering the achievement of the conservation objective** of restoring both ocean quahog aggregations and offshore subtidal sands and gravels features to a favourable condition, or **hinder the conservation** of the Wee Bankie key geodiversity area for the following reasons:

- The **extent and distribution, structure and function, and supporting processes** of the ocean quahog aggregations and offshore subtidal sands and gravels features will not be adversely impacted by the O&M activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles. In addition, the negligible sensitivity of ocean quahog to this type of impact, and resulting conditions within their natural range, will allow them to adapt with limited adverse effects.
- The **extent and distribution and structure and function** of the Wee Bankie key geodiversity area comprising relict moraines will not be adversely impacted by the O&M activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles.

Decommissioning Phase

1.10.28 Changes in SSCs, bed levels and sediment type may occur during the decommissioning phase as a result of the removal of Offshore Infrastructure, with the exact programme to be submitted to MD-LOT for consultation and approval. The decommissioning methods are assumed to be similar to those used during construction, with the magnitude of changes in SSCs, bed levels

and sediment type not being greater than that set out for the assessment in the construction phase of the Proposed Development.

- 1.10.29 The benchmarks for the relevant MarESA and FeAST pressures for the Firth of Forth Banks Complex MPA are as listed for the construction phase (Paragraph 1.10.7).
- 1.10.30 The following attributes of the offshore subtidal sands and gravels feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the decommissioning phase:
- extent and distribution;
 - structure and function; and
 - supporting processes.
- 1.10.31 The following attributes of the Wee Bankie key geodiversity area feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the decommissioning phase:
- extent and distribution; and
 - structure and function.
- 1.10.32 Following decommissioning, changes in SSCs, bed levels and sediment type would be of a similar magnitude to those described for the construction phase but slightly reduced with the reduction in seabed preparation activities. The removal of the Proposed Development cabling would lead to an increase in SSC through similar trenching techniques as implemented during installation. The expected magnitude of impact is, therefore, assumed as equal to that of the construction phase (as described in Paragraph 1.10.14 *et seq*).
- 1.10.33 The smaller magnitude of impact associated with the decommissioning activities means it is likely that the sensitivity of these communities to the impact of changes in SSCs, bed levels and sediment type will remain negligible (Paragraph 1.10.16). Therefore the assessment and conclusions presented in Paragraph 1.10.17 for the construction phase are deemed to be applicable to the decommissioning phase with regards to the effect this impact will have on extent and distribution and structure and function of the protected features of the MPA.
- 1.10.34 As a result, both the physical (fine scale topography, sediment composition, water and sediment quality and hydrodynamic regime) and ecological (key and influential species and characteristic communities) elements of the MPA features will not be adversely impacted by the decommissioning activities of the Proposed Development.

Summary of Attribute Assessment

- 1.10.35 Based on the information presented, it can be concluded that changes in SSCs, bed levels and sediment type during the Proposed Development decommissioning phase **will not lead to a significant risk of hindering the achievement of the conservation objective** of restoring both ocean quahog aggregations and offshore subtidal sands and gravels features to a favourable

condition, or **hinder the conservation** of the Wee Bankie key geodiversity area for the following reasons:

- The **extent and distribution, structure and function, and supporting processes** of the ocean quahog aggregations and offshore subtidal sands and gravels features will not be adversely impacted by the decommissioning activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles. In addition, the negligible sensitivity of ocean quahog to this type of impact, and resulting conditions within their natural range will allow them to adapt with limited adverse effects.
- The **extent and distribution and structure and function** of the Wee Bankie key geodiversity area comprising relict moraines will not be adversely impacted by the decommissioning activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles.

Changes in Physical Processes

O&M Phase

- 1.10.36 Changes in physical processes may arise from the installation of infrastructure into the water column (i.e. foundations of Wind Turbines and OSP and cable protection required for ground conditions). Changes include scour effects and changes in the sediment transport and wave regimes resulting in potential effects upon ocean quahog aggregations, offshore subtidal sands and gravels and the Wee Bankie key geodiversity area of the Firth of Forth Banks Complex MPA.
- 1.10.37 Physical processes modelling, presented in full in Volume 3, Technical Appendix 7.3: Physical Processes Technical Assessment, has been used to inform the assessment of potential changes in physical processes.
- 1.10.38 The relevant MarESA pressures and benchmarks used to inform this impact assessment are:
- Changes in local water flow (tidal current): change in peak mean spring bed flow velocity between 0.1 m/s to 0.2 m/s for more than one year. The pressure is associated with activities that have the potential to modify hydrodynamic energy flows. This pressure corresponds to the impacts associated with the presence of cable protection.
 - Local wave exposure changes: change in nearshore significant wave height >3% but <5% for one year. This pressure corresponds to the impacts associated with the presence of OWF infrastructure and cable protection.

- 1.10.39 The relevant FeAST pressures and benchmarks used to inform this impact assessment were:
- Water flow (tidal current) changes – local: the benchmark for this pressure is the peak mean spring tide flow change of greater than 0.1 m/s over an area >1 km² or 50% of the width of the water body for >1 year.
 - Wave exposure changes – local: the benchmark for this pressure is a change in nearshore significant wave height >3% for one year.
- 1.10.40 The Proposed Development will include up to 67 Wind Turbines and up to three OSPs. Additionally, up to 50% of IACs, Interconnector Cables and Offshore Export Cables may require cable protection (Volume 1, Chapter 3: Project Description).
- 1.10.41 The following attributes of the ocean quahog aggregations and offshore subtidal sands and gravels features of the Firth of Forth Banks Complex MPA are relevant to changes in physical processes during the O&M phase:
- extent and distribution;
 - structure and function; and
 - supporting processes.
- 1.10.42 The following attributes of the Wee Bankie key geodiversity area feature of the Firth of Forth Banks Complex MPA are relevant to changes in physical processes during the O&M phase:
- extent and distribution; and
 - structure and function.
- 1.10.43 In terms of tidal currents and water levels, the potential for localised changes in current speed is spatially limited to narrow wakes of slightly reduced current speed and proportionally increased turbulence, extending downstream of individual foundations. Changes to current speed at the resolution of the model (length scales greater than 100 m) will be less than 0.05 m/s (10%), which is very small in absolute and relative terms. The wake signature dissipates with distance downstream, becoming <5% reduction within approximately 300 m of the Wind Turbine foundation structures and within approximately 700 m of OSP foundation structures.
- 1.10.44 In terms of changes to wave regimes, the Proposed Development has the potential to impact wave height, period, and direction through interaction of the waves with foundation structures. Assessment of potential changes have been undertaken in comparison to an existing baseline and has been informed by the ABPmer SEASTATES wave hindcast database, with modelling indicating absolute wave height may be progressively decreased with distance travelled by waves through the Array Area, up to a reduction of 7.5% to 10% compared to baseline conditions. Outside of the Array Area, the full range of change to wave directions and return periods is considered to be <5%, with wave height and regime beginning to recover immediately downwind of the Array Area.

- 1.10.45 Installation of cable protection could result in a local increase in the elevation of the seabed. Cable protection would be placed onto the seabed surface above the cable and therefore could directly trap sediment, locally impacting down drift locations. Following installation and under favourable conditions, an initial period of sediment accumulation would be expected to occur against cable protection measures which could have a height of up to 2 m above the seabed. This accumulation would likely create a smooth slope against the cable protection. The process of wedge formation may take place over a period of a few weeks to months, depending on rates of sediment transport.
- 1.10.46 For all areas in which cable protection is used (including where sandwaves are present), it is not expected that the presence of the cable protection devices will continuously affect patterns of sediment transport following the initial period of accumulation. It follows that any changes on seabed morphology away from the cable protection will also be very small. The extent of the cable protection measures does not constitute a continuous blockage along the Export Cable Corridor.
- 1.10.47 The Firth of Forth Banks Complex MPA is 7.5 km from the Proposed Development, and there is only low potential for impacts beyond the Proposed Development Boundary, as described in Paragraphs 1.10.43 and 1.10.44.
- 1.10.48 Ocean quahogs are present in sedimentary habitats ranging from sandy mud to coarse sand, which encompasses a range of tidal flow regimes (Tyler-Walters and Sabatini, 2017). Small changes in sediment transport and current flows (<0.1 m/s), such as those described in Paragraph 1.10.43, are unlikely to impact ocean quahog given their preference for a range of sediment types (Tyler-Walters and Sabatini, 2017). Changes to wave exposure in relation to the Proposed Development are also limited, as described in Paragraph 1.10.44, and are unlikely to affect offshore subtidal ocean quahog aggregations such as those in the Firth of Forth Banks MPA due to the limited magnitude and pathway for impact.

Summary of Attribute Assessment

- 1.10.49 Based on the information presented, it can be concluded that changes in physical processes during the Proposed Development O&M phase **will not lead to a significant risk of hindering the achievement of the conservation objective** of restoring both ocean quahog aggregations and offshore subtidal sands and gravels features to a favourable condition, or **hinder the conservation** of the Wee Bankie key geodiversity area for the following reasons:
- The **extent and distribution, structure and function, and supporting processes** of the ocean quahog aggregations and offshore subtidal sands and gravels features will not be adversely impacted by the O&M activities of the Proposed Development. This is due to limited changes to tidal currents, water levels and wave regimes that are not anticipated to reach the Firth of Forth Banks Complex MPA.
 - The **extent and distribution and structure and function** of the Wee Bankie key geodiversity area comprising relict moraines will not be adversely impacted by the O&M activities of the Proposed Development. This is due

to limited changes to tidal currents, water levels and wave regimes that are not anticipated to reach the Firth of Forth Banks Complex MPA, and negligible effects upon physical process as a result of Offshore Export Cable Protection.

Decommissioning phase

1.10.50 In the scenario in which all Offshore Infrastructure is left *in situ* at the end of the operational lifetime of the Proposed Development, the impacts on wave regime and tidal currents from subtidal Offshore Infrastructure will remain the same as during the O&M phase (see Paragraphs 1.10.36 to 1.10.49).

Future Monitoring Commitments

1.10.51 No significant risk of hindering the achievement of the conservation objectives of maintaining the ocean quahog aggregations or the offshore subtidal sands and gravels features of the Firth of Forth Banks Complex MPA have been identified, nor have significant risks to the conservation of the Wee Bankie key geodiversity area been identified. Therefore, future monitoring to test the predictions made within the impact assessment is not considered necessary.

Southern Trench MPA

Introduction

1.10.52 This section presents the Stage 1 assessment of the effect of subsea noise during the construction phase of the Proposed Development on the Southern Trench MPA. The maximum adverse impact ranges for minke whales are summarised in (Table 1.15) (see Volume 2, Chapter 10: Marine Mammals for detail).

Table 1.15: Predicted Maximum Design Scenario Impact Ranges for Minke Whales (National Marine Fisheries Service (NMFS), 2024) (N/E Thresholds Not Exceeded)

Sound Source Activity	Auditory Injury Range (m)	Disturbance Range (m)
Geophysical	25	1,275
Geotechnical	N/E	9,154 m
UXO clearance (720 kg charge weight; High Order)	4,120 m (SEL _{ss}) 1,855 (peak Sound Pressure Level (SPL))	34,275 m
Impact piling	Monopile 14,063 m (SEL _{ss}) 454 m (peak SPL) Jacket 11,719 m (SEL _{ss}) 103 m (peak SPL)	5 dB Dose-Response curves based on consecutive pile monopile foundations, 130 to 150 dB contours overlap the MPA
Drilled piling	N/E	407 m
Other construction activities	N/E	4,540 m
Turbine operational Noise	N/E	N/E
Vessels and other activity	N/E	5,597 m

1.10.53 With the exception of piling and UXO clearance, the maximum range of injury from all sound source activities was predicted to be either not exceeded (N/E) or in the very nearfield (within metres) of the source. For piling, the maximum instantaneous auditory injury range (peak SPL) was predicted to be less than 500 m and the maximum range accumulated auditory injury (SEL_{ss}; without acoustic deterrent device mitigation) was approximately 14 km (Table 1.15). For further details see Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report. For UXO clearance (using high order methods) the maximum range of effect was 4,120 m metres based on SEL_{ss} (Table 1.15). There is therefore considered to be no risk of auditory injury to any minke whale within the Southern Trench MPA which lies 36 km from the Proposed Development.

1.10.54 For all other activities the effect distances from elevated subsea noise are such that there is no potential for overlap with the MPA and in some cases (e.g. disturbance during UXO clearance) the nature of the impact would be very short term (i.e. during the one second detonation). Therefore, all activities, with the exception of piling have been screened out due to lack of impact pathway. The following section presents the Stage 1 assessment of the effect of piling noise during the construction phase only of the Proposed Development.

Maximum Design Scenario

1.10.55 The MDS identified in (Table 1.16) are those parameters expected to have the potential to result in the greatest disturbance effect on minke whales within the Southern Trench MPA. Any other development scenario within the PDE will result in the same or lower level of environmental effect. The scenario has been selected from the details provided in Volume 1, Chapter 3: Project Description, Volume 2, Chapter 10: Marine Mammals and Volume 3, Technical Appendix 10.4: Subsea Noise Technical Report.

Table 1.16: Maximum Design Scenario Considered for the Potential of Causing a Significant Risk to Hindering the Achievement of the Conservation Objectives of the Southern Trench MPA

Potential Impact	Phase*			MDS	Justification
	C	O	D		
Injury and disturbance from subsea noise generated during piling	✓	x	x	<p>Construction Phase</p> <p><u>Maximum spatial scenario:</u> <i>Fixed Foundations – 25 MW monopile</i></p> <ul style="list-style-type: none"> • Number of monopile foundations – 40; • Maximum number of piles – 40; • Maximum pile diameter – 15 m; • Maximum pile length – 123 m, with final pile penetration depth of 45 m; • Maximum hammer energy – 6,250 kJ; • Maximum duration of piling per pile – 8.6 hours; • Maximum duration of piling per day (based on 2 piles installed concurrently) – 17.1 hours; and • Minimum total hours of piling – 172 hours (8.6 hours per day over 20 days). 	The maximum spatial scenario is identified as the 25 MW monopile fixed foundation option which presents the largest hammer energy and maximum spacing between concurrent piling events which would lead to the largest spatial extent of ensonification at any one time.

Potential Impact	Phase*			MDS	Justification
	C	O	D		
				<u>Concurrent piling:</u> <ul style="list-style-type: none"> • Up to 2 vessels piling concurrently; and • Minimum 1 km and maximum 20 km distance between concurrent piling events. 	The parameters modelled for this option will encompass the OSPs.

* Proposed Development Phase refers to construction (C), O&M (O) and decommissioning (D).

Injury and Disturbance from Subsea Noise Generated During Piling

Construction phase

- 1.10.56 In line with guidance from NatureScot (Volume 2, Chapter 10: Marine Mammals), the Graham *et al.* (2017) harbour porpoise *Phocoena phocoena* dose-response function has been used as a proxy for minke whale behavioural response to piling.
- 1.10.57 The dose-response contours reflecting the MDS of the concurrent impact piling of two monopile foundations, using the maximum hammer energy of 6,250 kJ are presented in Figure 1.6. It can be seen that there is no overlap between the MPA and the single strike Sound Exposure Level (SEL_{ss}) above 150 dB. Noise modelling has predicted limited radiation westward into the Moray Firth due to the blocking effect of the mainland. Noise contours that overlap the MPA range from 130 to 150 dB, and therefore results are presented for these noise contours only. To note, these contours do not overlap the entirety of the MPA (See Figure 1.6 below).
- 1.10.58 Using the dose-response contour overlap, the proportion of the MPA within which there may be some level of disturbance is 19.29% of the total MPA. This is calculated using the total area of overlap within the MPA boundary for each noise contour increment. The effective disturbance area is calculated by applying the proportion of animals expected to respond (Graham *et al.* 2017), to acknowledge that not all animals are likely to respond to the same degree within the potential exposed area.

Table 1.17: Calculation of the % MPA Within Which Minke Whale are Potentially Disturbed

dB level	Proportion of animals expected to respond using the Graham <i>et al.</i> (2017) dose-response	Area of overlap with MPA (km ²)	Effective disturbance area (km ²)
150-146	0.6849	265.56	181.89
145-141	0.5090	415.77	211.62
140-136	0.3312	192.62	63.80
135 - 131	0.1852	33.64	6.22
Total MPA area exposed (km²)		907.59	463.53
Total area exposed as a % of total MPA area		37.77%	19.29%

- 1.10.59 This assessment has considered the MDS of concurrent impact piling of the monopile foundation. Within the concurrent scenario this would result in two monopiles being installed at the same time, resulting in a maximum duration of activity of 20 days. Should single piling be employed, then this would result in 40 days of activity. Any disturbance impacts would therefore be short in duration as the MDS has identified the maximum duration being 17.1 hours (for two piles concurrently) and the minimum being 8.6 hours per day over the 20 days.
- 1.10.60 Received levels within the MPA are predicted to reach maximum SEL_{ss} levels of 150 to 145 dB reducing to 140 to 135 dB within the southern area of the MPA (Figure 1.6). The use of the dose-response function (derived from data on harbour porpoise responses to piling) has predicted that the effective disturbance area is less than 20% of the total MPA area.
- 1.10.61 However, there is uncertainty as to whether minke whales would respond behaviourally to the same received levels as harbour porpoise. The use of the harbour porpoise dose-response function as a proxy for disturbance for minke whale is highly precautionary as harbour porpoise are generally considered to be one of the most sensitive species of marine mammals when it comes to acoustic disturbance (Tougaard *et al.* 2015). Specifically, the responses of minke whales to impact piling activity are anticipated to be less severe than for harbour porpoise (Bailey *et al.* 2010; Stone *et al.*, 2019).
- 1.10.62 To reflect this uncertainty, discussion of potential impact based on the NMFS (NMFS, 2005) Level B Harassment fixed threshold and the JNCC (2025) Effective Deterrent Range (EDR) approach, have been considered to provide context.
- 1.10.63 The NMFS uses the Level B threshold of 160 dB re 1 µPa (rms) to predict marine mammal behavioural harassment. The Level B harassment threshold originates from a study on a grey whale mother and calf, which were shown to exhibit avoidance responses when exposed to air gun playback signals at levels above 160 dB re 1 µPa (rms) (Malme *et al.*, 1984). The same study also concluded that “*less consistent and less dramatic reactions were suspected to occur at received levels of 140 – 160 dB*”. While these data are old, this is the only information available for impulsive noise that is specifically for a baleen whale species.

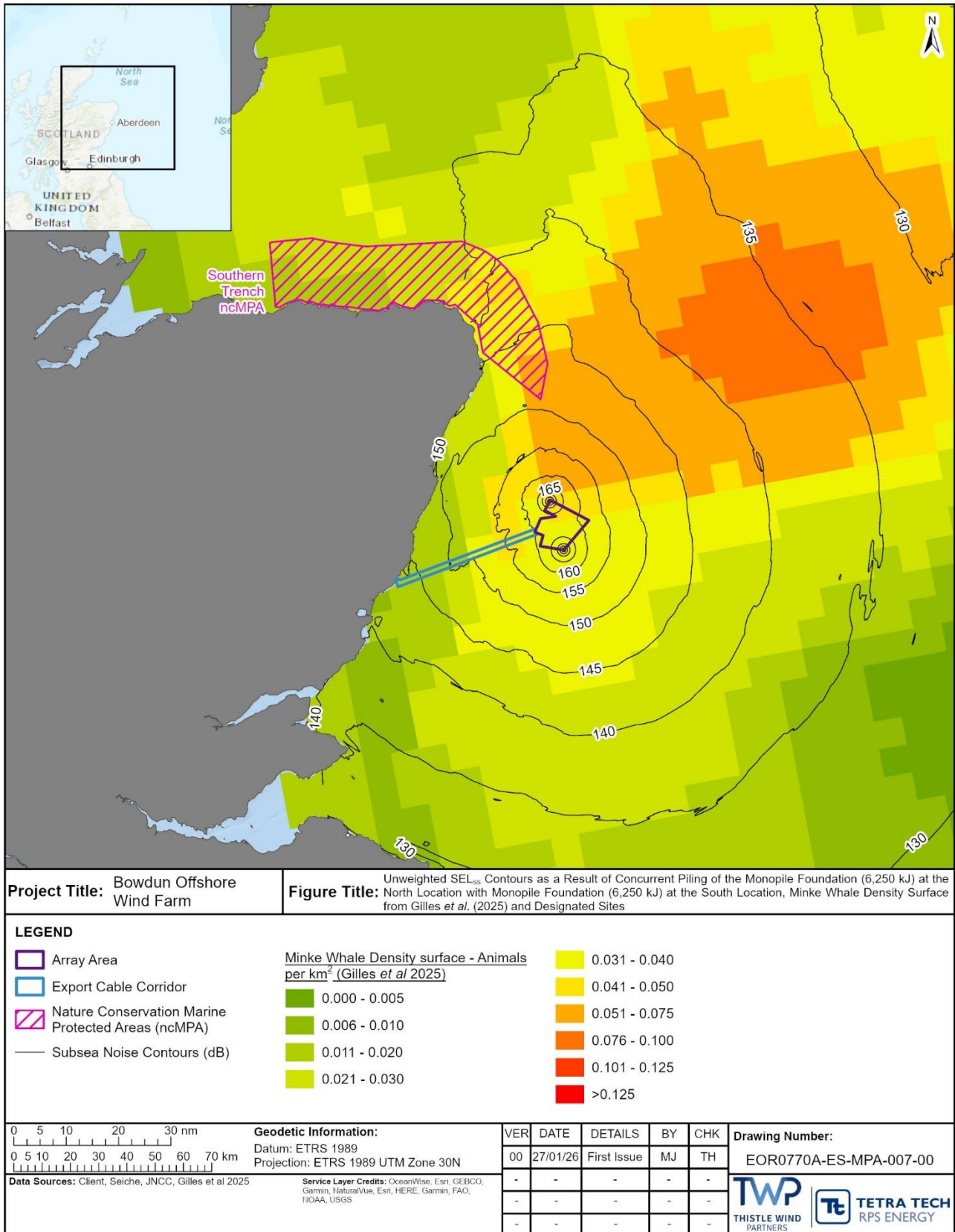


Figure 1.6 Unweighted SEL_{ss} Contours as a Result of Concurrent Piling of the Monopile Foundation (6,250 kJ) at the North Location with Monopile Foundation (6,250 kJ) at the South Location, Minke Whale Density and Designated Sites

- 1.10.64 The predicted noise levels within the MPA are below the NMFS threshold for disturbance from an impulsive noise source (160 dB SPL rms). According to the behavioural response severity matrix suggested by Southall *et al.* (2021), such low level disturbance (scoring between 0 to 3 on a 0 to 9 scale) could lead to mild disruptions of normal behaviours, though prolonged or sustained behavioural effects (including displacement) are unlikely to occur.
- 1.10.65 The JNCC report (JNCC, 2025) presents updated EDR recommended for the assessment of noise disturbance within harbour porpoise Special Areas of Conservation. This approach is worth considering as context to the use of the harbour porpoise dose-response function. The updated EDR for unabated monopile is 20 km, which would indicate there would be no overlap with the MPA using this metric.
- 1.10.66 Therefore, the predicted impact to the MPA based on the harbour porpoise dose-response functions is expected to overestimate the extent of disturbance to minke whale within the MPA.

Summary of Assessment against the conservation objectives

- 1.10.67 Impacts to the benthos or prey species within the Southern Trench MPA have been screened out, therefore there is **no significant risk that the Proposed Development will hinder the achievement of the site's conservation objectives** relating to the extent and distribution, or the structure and function of any supporting feature for minke whale, nor to access to resources within the Southern Trench MPA.
- 1.10.68 Therefore, the assessment of injury and disturbance from pile driving activities on the Southern Trench MPA is against the conservation objective that conserves the distribution of minke whale within the site by avoiding significant disturbance.
- 1.10.69 Significant disturbance is defined within the site's conservation and management advice (NatureScot, 2025) as disturbance that may result in the following effects.

The contribution to long term decline in the use of the MPA

- 1.10.70 Behavioural effects may result in temporary disturbance/displacement from <20% of the MPA area, but the duration of impact will be short term and intermittent. Any effects are expected to be reversible, with minke whales returning once the noise from piling ceases. Therefore, there is no long term decline in the use of the MPA anticipated.

Changes to the distribution of minke whale on a continuing or sustained basis

- 1.10.71 As above, there is no anticipated change to the distribution of minke whales within the MPA on a continued or sustained basis.

Changes to the behaviour such that it reduces ability of the species to feed efficiently, breed or survive

- 1.10.72 It is thought that minke whale may alter their diving behaviour in response to whale-watching vessels (Christiansen *et al.*, 2013a) and therefore the displacement of minke whale could lead to a reduced foraging for disturbed

individuals. However, a subsequent study in the same study area (Christiansen and Lusseau, 2015) found no significant long term effects of disturbance from whale-watching on vital rates since whales moved into disturbed areas when sandeel numbers were lower across their wider foraging area. Further, minke whale are expected to be able to tolerate short term displacement due to their large size and capacity for energy storage, and therefore short term displacement is unlikely to affect vital rates (Christiansen and Lusseau, 2015; Christiansen *et al.* 2013b). Given the small number of piling days, it is not expected that any temporary disruption in foraging will result in any chances to minke whale's breeding or survival.

Conclusion

- 1.10.73 The impact of disturbance due to impact piling, **will not lead to a significant risk of hindering the achievement of the conservation objective** that conserves the distribution of minke whale within the site by avoiding significant disturbance, or the purpose of the Southern Trench MPA to provide protection to the habitats within the MPA that support key minke whale life cycle stages.

Future Monitoring Commitments

- 1.10.74 No significant risk of hindering the achievement of the conservation objectives for minke whale of the Southern Trench MPA have been identified. Therefore, future monitoring to test the predictions made within the impact assessment is not considered necessary.

1.11 Cumulative Effects Assessment

Methodology

- 1.11.1 The CEA assesses the impact associated with the Proposed Development together with other relevant projects and activities. Cumulative effects are defined as the effect of the Proposed Development in combination with the effects from a number of different projects, on the same receptor or resource. Further details on CEA methodology are provided in Volume 1, Chapter 4: Environmental Impact Assessment Methodology.
- 1.11.2 The projects selected as relevant to the CEA presented within this assessment are based upon the results of a screening exercise (see Volume 3, Technical Appendix 4.4: Cumulative Effects Assessment – Screening). Volume 3, Technical Appendix 4.4: Cumulative Effects Assessment – Screening provides further information in relation to other projects and how this information is obtained and applied to the assessment. Each project has been considered on a case-by-case basis for screening in or out of this assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.
- 1.11.3 In undertaking the CEA for the Proposed Development, it is important to bear in mind that other projects under consideration will have differing potential for proceeding to an operational stage and hence a differing potential to ultimately contribute to a cumulative impact alongside the Proposed Development. Therefore, a tiered approach has been adopted. This provides a framework for placing relative weight upon the potential for each project to be included in the CEA to ultimately be realised, based upon the project's current stage of maturity

and certainty in the projects' parameters. The tiered approach which will be utilised within the Proposed Development CEA employs the following tiers:

- Tier 1 – The onshore elements of the Project;
- Tier 2 – Projects that have an application submitted, are consented, under construction or operational to the extent not already captured with the baseline;
- Tier 3 – Projects which have submitted a scoping report and/or have received a Scoping Opinion; and
- Tier 4 – Reasonably foreseeable projects including those with CES option or lease agreements.

Firth of Forth Banks Complex MPA

- 1.11.4 The specific projects scoped into the CEA for the Firth of Forth Banks Complex MPA Assessment are shown in Figure 1.7 and outlined in Table 1.18 and Table 1.20.
- 1.11.5 One project from Tier 2 (Ossian OWF), and two projects from Tier 3 (Morven North OWF and Morven South OWF), were identified to potentially result in impacts upon the Firth of Forth Banks Complex MPA as a result of cumulative interactions with the Proposed Development.
- 1.11.6 The potential cumulative impact that was identified and included in the assessment (Table 1.20), is a subset of those considered for the Proposed Development alone assessment. This is because some of the potential impacts identified and assessed for the Proposed Development alone, are localised and temporary in nature. It is considered, therefore, that these potential impacts have limited or no potential to interact with similar changes associated with other plans or projects. These have, therefore, been scoped out of the CEA.
- 1.11.7 Similarly, some of the potential impacts considered within the Proposed Development alone assessment are specific to a particular phase of development (e.g. construction, O&M or decommissioning). Where the potential for cumulative effects with other projects only have potential to occur where there is spatial or temporal overlap with the Proposed Development during certain phases of development, impacts associated with a certain phase may be omitted from further consideration where no projects have been identified that have the potential for cumulative effects during this period.
- 1.11.8 As a result, the only impact to be included in the cumulative assessment is the changes in SSCs, bed levels and sediment type impact as it was identified in the project alone assessment (Section 1.10) as having a potential effect upon the Firth of Forth Banks Complex MPA. Changes in physical processes has not been brought forward to the cumulative assessment as it was identified in the project alone assessment (Section 1.10) that there would be no effect on the Firth of Forth Banks Complex MPA as a result of the Proposed Development. It is therefore not possible for a cumulative effect to arise in relation to this impact as there is no spatial overlap with another project.

- 1.11.9 Within the CEA assessment for the Firth of Forth Banks MPA, the impact of changes in SSCs, bed levels and sediment type is only assessed for the construction phase, aligning with the CEA assessments presented in Volume 2, Chapter 7: Physical Processes and Volume 2, Chapter 8: Benthic Ecology. This is because the impact in the project alone assessment at the O&M phase and decommissioning phase is identified to be less than that assessed for the construction phase.
- 1.11.10 To ensure all potential cumulative impacts on the Firth of Forth Banks Complex MPA from changes in SSCs, bed levels and sediment type were fully assessed, the MPA assessment conclusions of projects overlapping with the Firth of Forth Banks Complex MPA were also considered. Specifically, these projects included the following Tier 2 projects, as shown in Figure 1.8:
- Berwick Bank Wind Farm;
 - Berwick Bank Offshore Transmission Owners (OFTO);
 - Seagreen 1 OWF; and
 - Seagreen 1A Project.
- 1.11.11 These projects do not overlap with the Benthic ZoI and therefore would not have any direct cumulative impact alongside the Proposed Development. However, the potential exists for some of the construction and O&M activities, which result in changes in SSCs, bed levels and sediment type, from these projects to have temporal overlap with those activities associated with the Proposed Development. This could result in cumulative impacts on the offshore subtidal sands and gravels, ocean quahog aggregations and moraines receptors of the Firth of Forth Banks Complex MPA.

Table 1.18: List of Other Projects Considered within the CEA for the Firth of Forth Banks Complex MPA Assessment

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Firth of Forth Banks Complex MPA (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Proposed Development
Tier 1							
Tier 1: The onshore elements of The Project have no direct impact pathway and have not been brought forwards to the CEA for the Firth of Forth Banks MPA.							
Tier 2							
Offshore Wind Projects and Associated Cables							
Ossian OWF	Application submitted but not yet determined	25.36	25 (Montrose Bank)	The Ossian Floating Wind project is proposed for up to 265 floating Wind Turbines with a capacity of 3,600 MW.	2031-2038	2039-2073	The construction, O&M and decommissioning phases of this project have the potential to overlap with the construction, O&M and decommissioning phases of the Proposed Development.
Berwick Bank Wind Farm	Consented	46.53	0	Berwick Bank OWF is proposed for up to 307 Wind Turbines with a capacity of up to 4,100 MW. Operational lifetime of 35 years.	2027-2032	2033-2067	The construction and O&M phases of this project have the potential to overlap with the construction, O&M and decommissioning phases of the Proposed Development.
Seagreen 1 OWF	Operational	19.88	0	Seagreen 1 OWF consists of up to 114 Wind Turbines at a capacity of 1,075 MW.	N/A	2023-2047	The O&M and decommissioning phases of this project has the potential to

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Firth of Forth Banks Complex MPA (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Proposed Development
				Seagreen was consented with permission to install 150 Wind Turbines. The remaining 36 Wind Turbines are consented but not yet constructed (Seagreen 1A project).			overlap with the construction, O&M and decommissioning phases of the Proposed Development.
Seagreen 1A Project	Consented	19.47	0	Seagreen 1A is made up of the 36 remaining Wind Turbines consented as part of the Seagreen 1 OWF. Seagreen 1A submitted a variation in consent to allow construction to take place between 2029 and 2032.	2029-2032	2033-2057	The construction, O&M and decommissioning phases of this project have the potential to overlap with the construction, and O&M phases of the Proposed Development.
Berwick Bank OFTO	Consented	46.53	0	Berwick Bank transmission is proposed for up to 4 cables with an operational lifetime of 35 years.	2026-2029	2030-2064	The O&M and decommissioning phases of this project has the potential to overlap with the construction, O&M and decommissioning phases of the Proposed Development.

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Firth of Forth Banks Complex MPA (km)	Description of Project	Dates of Construction (If Applicable)	Dates of Operation (If Applicable)	Overlap with the Proposed Development
Tier 3							
Offshore Wind Projects and Associated Cables							
Morven North OWF	Pre-Application	10.03	0.04 (Montrose Bank)	Morven North OWF is proposed for up to 96 Wind Turbines at a capacity of 1,500 MW. Application of relevant consents and licences expected in 2026 with decision in 2027.	2030-2036	2037-2061	There may be temporal overlap between all phases of this OWF project and those of the Proposed Development.
Morven South OWF	Pre-Application	43.61		Morven South offshore Wind Array Project is proposed for up to 95 Wind Turbines at a capacity of 1500 MW. Application of relevant consents and licences expected in 2026 with decision in 2027.	2030-2036	2037-2061	There may be temporal overlap between all phases of this OWF project and those of the Proposed Development.

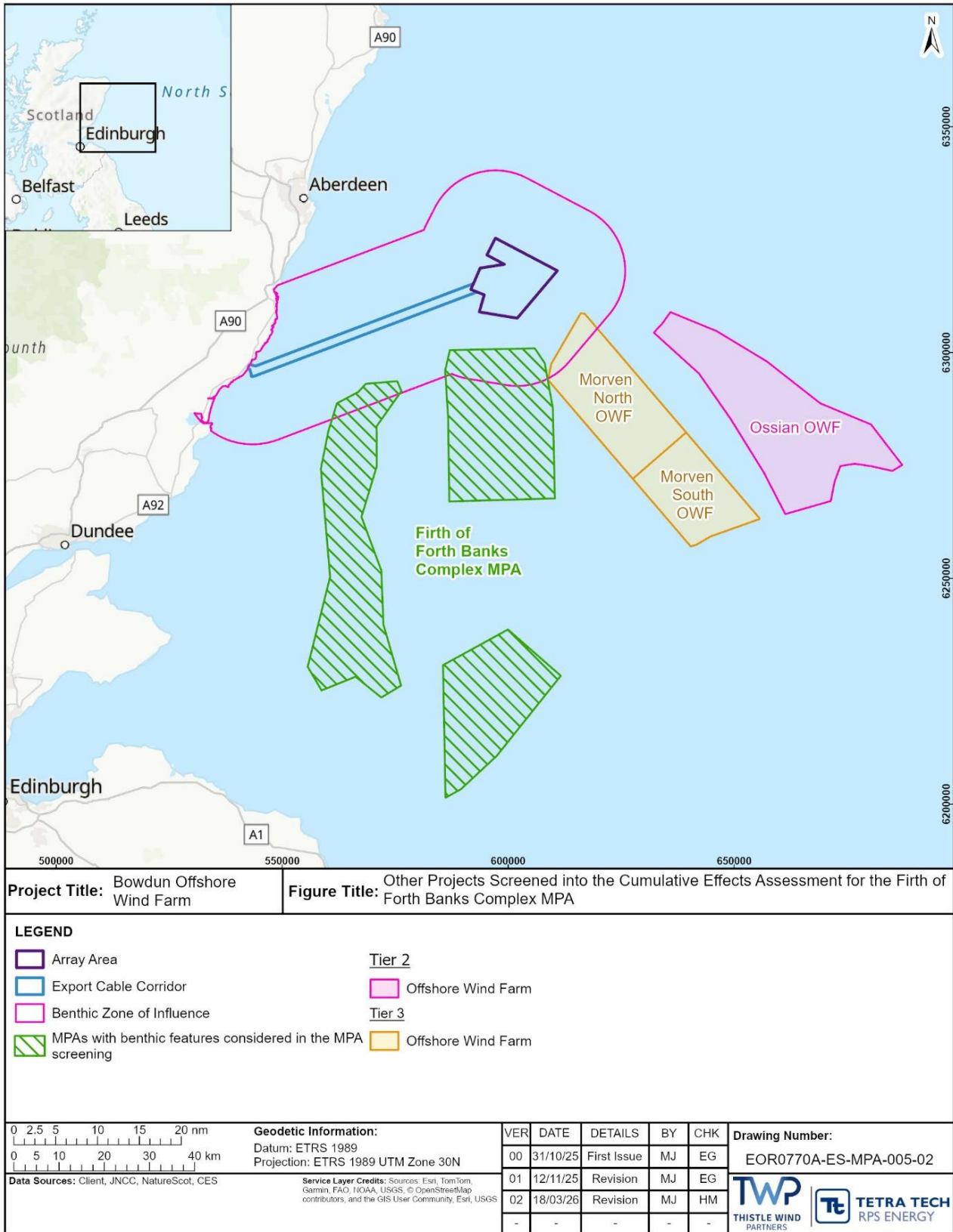


Figure 1.7 Other Projects Screened into the Cumulative Effects Assessment for the Firth of Forth Banks Complex MPA

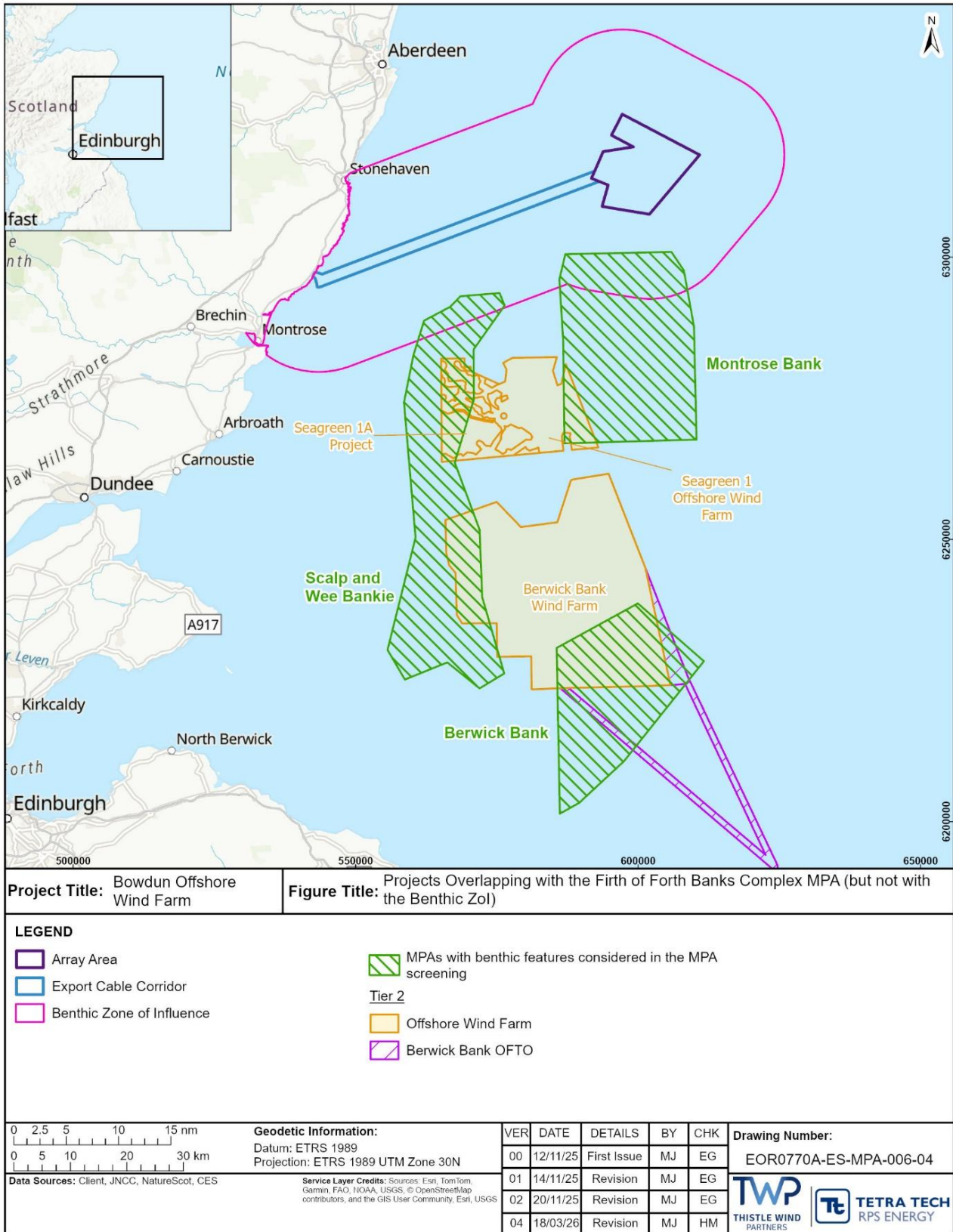


Figure 1.8 Projects Overlapping the Firth of Forth Banks Complex MPA also considered within the CEA

Southern Trench MPA

- 1.11.12 Disturbance due to subsea noise generated during piling was the single impact pathway assessed for the Proposed Development alone, and therefore is the only impact pathway carried through for the CEA for the Southern Trench MPA.
- 1.11.13 During the initial screening exercise for marine mammals (see Volume 2, Chapter 10: Marine Mammals) projects were identified within the Regional Marine Mammal Study Area. The identified projects were then further refined depending on the scale of potential impact. The ZoI for piling can extend beyond the boundaries of proposed OWFs and therefore, by adopting a precautionary approach, the assessment screened in projects (Table 1.19) whose construction phases overlap with the construction phase (plus one year either side of construction period) of the Proposed Development (2031 to 2036, with piling anticipated between 2031 and 2034).
- 1.11.14 The identified project list for the MPA CEA was then further refined from those listed in (Table 1.19) to account for the impact pathway range related to disturbance impacts from piling. Although dose-response contours can reach considerable distances, the recommended EDR reflecting disturbance ranges from unabated impact piling of monopiles is 20 km (JNCC, 2025). The Proposed Development is approximately 36 km from the Southern Trench MPA, and the project alone found some overlap with dose-response contours with noise levels lower than the NMFS Level B threshold (NMFS, 2005).
- 1.11.15 This assessment has therefore taken a proportionate approach to the CEA and has limited the other projects to those within 100 km of the MPA.

Table 1.19: List of Other Projects Considered within the CEA for the Southern Trench MPA assessment

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Southern Trench MPA (km)	Description of Project	Dates of Construction (If Applicable)	Overlap with the Proposed Development
Tier 1						
Tier 1: The onshore elements of The Project have no direct impact pathway and have not been brought forwards to the CEA for the Southern Trench MPA.						
Tier 2						
Offshore Wind Projects and Associated Cables						
Caledonia OWF South	Application submitted but not yet determined	121.35	13.05	The South Site is proposed for up to 78 Wind Turbines with up to 140 Wind Turbines across the 2 sites (North and South). Caledonia OWF (North and South) has an indicative generation capacity of 2,000 MW.	2028 – 2030	The construction, O&M and potentially the decommissioning phases of the Caledonia OWF South overlap with those of the Proposed Development.
Salamander OWF	Consented	58.68	11.90	Salamander OWF is proposed for up to 100 MW.	2027-2029	The O&M and potentially the decommissioning phases of the Salamander OWF overlap with those of the Proposed Development.
Caledonia OWF North	Application submitted but not yet determined	136.29	33.34	The North Site is proposed for up to 77 Wind Turbines with up to 140 Wind Turbines across the 2 sites (North and South). Caledonia OWF (North and South) has an indicative generation capacity of 2,000 MW.	2028 – 2030	The construction, O&M and potentially the decommissioning phases of the Caledonia OWF North overlap with those of the Proposed Development.

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Southern Trench MPA (km)	Description of Project	Dates of Construction (If Applicable)	Overlap with the Proposed Development
Muir Mhòr OWF	Application submitted but not yet determined	52.50	42.20	Muir Mhòr OWF is proposed for up to 67 Wind Turbine at a capacity of 798 MW.	2027 – 2030	Construction, O&M and potentially the decommissioning phases of the Muir Mhòr OWF overlap with those of the Proposed Development.
Buchan OWF	Application submitted but not yet determined	131.73	51.56	Floating OWF is proposed for up to 70 floating Wind Turbines at a capacity of 1,000 MW. Project lifetime of 35 years.	2028-2030	The O&M phases of the Buchan OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Aspen OWF	Application submitted but not yet determined	88.37	63.39	Floating OWF proposed for up to 1,000 MW and up to 72 Wind Turbines.	2027-2031 with piling occurring between this time.	The construction and O&M phases of the Aspen OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Ossian OWF	Application submitted but not yet determined	25.36	66.90	The Ossian Floating Wind project is proposed for up to 265 floating Wind Turbines with a capacity of 3,600 MW.	2031-2038	The construction, O&M and decommissioning phases of this project have the potential to overlap with the construction, O&M and decommissioning phases of the Proposed Development.

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Southern Trench MPA (km)	Description of Project	Dates of Construction (If Applicable)	Overlap with the Proposed Development
Ayre OWF	Application submitted but not yet determined	192.87	97.07	Up to 1,000 MW with proposed up to 67 Wind Turbines.	2030-2034	The construction and O&M phases of the Ayre OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Berwick Bank OWF	Consented	46.53	100.93	Berwick Bank OWF is proposed for up to 307 Wind Turbines with a capacity of up to 4,100 MW.	2027-2032	The construction and O&M phases of this project have the potential to overlap with the construction, O&M and decommissioning phases of the Proposed Development.
Tier 3						
Offshore Wind Projects and Associated Cables						
Scaraben OWF	Pre-Application	125.19	38.51	Proposed between three and six Wind Turbines with a capacity of up to 99.5 MW.	2028-2029	The O&M phases of the Scaraben OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Sinclair OWF	Pre-Application	128.11	41.01	Proposed between three and six Wind Turbines with a capacity of up to 99.5 MW.	2028-2029	The O&M phases of the Sinclair OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.

Project	Status	Distance from Proposed Development (km)	Distance to Closest Point of Southern Trench MPA (km)	Description of Project	Dates of Construction (If Applicable)	Overlap with the Proposed Development
Morven North OWF	Pre-Application	10.03	56.70	Morven North Offshore Wind Array Project is proposed for up to 96 Wind Turbines at a capacity of 1,500 MW.	2030-2036	The construction and O&M phases of the Morven North OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Stromar OWF	Pre-Application	153.38	58.16	Stromar is a proposed floating OWF for up to 1,500 MW capacity. Scoping Opinion issued April 2024.	2028-2032	The construction and O&M phases of the Stromar OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Morven South OWF	Pre-Application	43.61	90.90	Morven South Offshore Wind Array Project is proposed for up to 95 Wind Turbines at a capacity of 1,500 MW.	2030-2036	The construction and O&M phases of the Morven South OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.
Bellrock OWF	Pre-Application	62.23	94.92	Bellrock OWF is proposed for a capacity of 1,800 MW with between 42 and 80 Wind Turbines.	2027-2030	The O&M phases of the Bellrock OWF overlap with those of the Proposed Development. The decommissioning phases may also overlap.

Maximum Design Scenario

- 1.11.16 The MDS identified in Table 1.20 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the details provided in Volume 1, Chapter 3: Project Description as well as the information available on other projects (see Volume 3, Technical Appendix 4.4: Cumulative Effects Assessment – Screening), to inform an MDS. Any other development scenario within the PDE, will result in in the same, or less, level of environmental effect.

Table 1.20: Maximum Design Scenario Considered for Each Impact as part of the Assessment of Likely Significant Cumulative Effects Firth of Forth Banks Complex MPA

Potential Cumulative Effect	Phase*			Maximum Design Scenario	Justification
	C	O	D		
Changes in SSCs, bed levels and sediment type	✓	×	×	<p>The MDS is as detailed for the Proposed Development alone in Table 1.14, cumulatively with the following projects:</p> <p>Tier 2 Offshore Wind Projects and Associated Cables</p> <ul style="list-style-type: none"> • Ossian OWF • Berwick Bank Wind Farm • Seagreen 1 OWF • Seagreen 1A Project • Berwick Bank OFTO <p>Tier 3 Offshore Wind Projects and Associated Cables</p> <ul style="list-style-type: none"> • Morven North OWF • Morven South OWF <p>Tier 4 No projects identified.</p>	<p>This impact was informed by Volume 2, Chapter 7: Physical Processes. Therefore, the projects included in the CEA for this impact include those considered for the same impact in the CEA in Volume 2, Chapter 7: Physical Processes. Additionally, projects with physical overlap with the Firth of Forth Banks Complex MPA have been included within this CEA to fully account for any potential cumulative impacts.</p> <p>The O&M and decommissioning phases of this impact have not been carried forward from the project alone assessment as they were concluded to have a negligible impact and therefore are unlikely to interact with neighbouring projects, resulting in a cumulative impact.</p> <p>The construction periods of Ossian OWF, Berwick Bank OWF, Morven North OWF, Morven South OWF, and the Seagreen 1A Project may overlap with the Proposed Development construction period. Consequently, sediment-disturbing activities such as drilling foundations, MFE sandwave clearance, and dredging could occur simultaneously. Additionally, the O&M phase of Seagreen 1 OWF may overlap with the construction and operation of the Proposed Development.</p>

* Project Phase refers to construction (C), O&M (O) and decommissioning (D).

Cumulative Effects Assessment: Firth of Forth Banks Complex MPA

- 1.11.17 An assessment of the likely significance of the cumulative effects of the Proposed Development upon the protected features of the Firth of Forth Banks Complex MPA arising from each identified impact is provided below.

Increases in Suspended Sediment Concentration and Associated Deposition

Tier 1

Construction Phase

- 1.11.18 The Tier 1 project (Onshore Infrastructure) will not have a cumulative impact upon the Firth of Forth Banks Complex MPA.

Tier 2

Construction Phase

- 1.11.19 The construction periods of Ossian OWF and the Proposed Development may overlap. Consequently, sediment-disturbing activities such as drilling foundations, MFE sandwave clearance, and dredging could occur simultaneously. This overlap may potentially result in cumulative changes in SSCs, bed levels and sediment type.
- 1.11.20 The Ossian array area is located ~25 km to the east of the Array Area. The distance between the Ossian array area and the Proposed Development is greater than the extent of the Spring Tidal Ellipse and they are not aligned in the direction of the tidal axis. This therefore suggests any cumulative impacts are very unlikely. This conclusion is underpinned by and consistent with the relevant available guidance, notably Brooks *et al.* (2018).
- 1.11.21 The potential exists for the other Tier 2 projects Berwick Bank Wind Farm and Seagreen 1A Project construction activities to have potential cumulative impacts on the Firth of Forth Banks Complex MPA protected features alongside the construction activities of the Proposed Development (with the justification for inclusion explained in Paragraphs 1.11.10 to 1.11.16). The Seagreen 1 OWF is currently operational, and as discussed in Paragraph 1.11.9, the impact of cumulative changes in SSCs, bed levels and sediment type is not assessed for the O&M phase. Thus, the Seagreen 1 OWF is not considered further within this assessment. The MPA Assessments for Berwick Bank Wind Farm (Scottish and Southern Energy (SSE) Renewables, 2022), and Seagreen 1A Project (Seagreen Wind Energy Limited, 2021) concluded there would be no hindrance of the conservation objectives alone or cumulatively on the Firth of Forth Banks Complex MPA receptors.
- 1.11.22 Therefore, for changes in SSCs, bed levels and sediment type, there may be a limited cumulative impact upon discrete sections of the Firth of Forth Banks Complex MPA. Due to the segmented nature of the MPA, and the spatially distinct nature of the projects listed above, this cumulative impact will not lead to a significant risk of hindering the achievement of the conservation objectives of the Firth of Forth Banks Complex MPA.
- 1.11.23 The following attributes of the ocean quahog aggregations and offshore subtidal sands and gravels features of the Firth of Forth Banks Complex MPA are relevant

to changes in SSCs, bed levels and sediment type during the construction phase:

- extent and distribution;
- structure and function; and
- supporting processes.

1.11.24 The following attributes of the Wee Bankie key geodiversity area feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the construction phase:

- extent and distribution; and
- structure and function.

1.11.25 Based on the information above, the following can be concluded with respect to the attributes of the ocean quahog, offshore subtidal sands and gravels and Wee Bankie key geodiversity area protected features of the Firth of Forth Banks Complex MPA.

- The impact on the attributes of the Firth of Forth Banks Complex MPA (extent and distribution, structure and function, and supporting processes) will be similar to that described for the alone assessment, as the additional projects do not cause a significant cumulative impact.

Summary of Attribute Assessment

1.11.26 Based on the information presented above, it can be concluded that cumulative changes in SSCs, bed levels and sediment type during the Proposed Development construction phase **will not lead to a significant risk of hindering the achievement of the conservation objective** of restoring both ocean quahog aggregations and offshore subtidal sands and gravels features to a favourable condition, **or hinder the conservation** of the Wee Bankie key geodiversity area for the following reasons:

- The **extent and distribution, structure and function, and supporting processes** of the ocean quahog aggregations and offshore subtidal sands and gravels features will not be adversely impacted by the construction activities of the Proposed Development cumulatively with the other Tier 2 projects. This is due to only small changes in SSCs, bed levels and sediment type from each project anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles. In addition, the negligible sensitivity of ocean quahog to this type of impact, and resulting conditions within their natural range will allow them to adapt with limited adverse effects.
- The **extent and distribution and structure and function** of the Wee Bankie key geodiversity area comprising relict moraines will not be adversely impacted by the construction activities of the Proposed Development cumulatively with other Tier 2 projects. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth

Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles.

Tier 3

Construction phase

- 1.11.27 The construction periods of the closest neighbouring OWF, Morven North OWF, Morven South OWF, and the Proposed Development may overlap. Consequently, sediment-disturbing activities such as drilling foundations, MFE sandwave clearance, and dredging could occur simultaneously. This overlap may potentially result in cumulative changes in SSC, bed levels and sediment type.
- 1.11.28 The Morven array areas are located ~10 km to ~44 km to the south-east of the Array Area, and 0.04 km from the Montrose Bank site of the Firth of Forth Banks Complex MPA. The distance between the Proposed Development and Morven North OWF and Morven South OWF is greater than the extent of the Spring Tidal Ellipse and they are not aligned in along the direction of the tidal axis. This is confirmed by the modelled scenarios (presented in Volume 3, Technical Appendix 7.3: Physical Processes Technical Assessment) that show the limited spatial footprint and transient nature of the plumes created from disturbance activities in these individual locations. This therefore suggests any cumulative impacts upon the Firth of Forth Banks Complex MPA, specifically Montrose Bank are very unlikely and will be of low magnitude and short duration if they do occur. The Firth of Forth Banks Complex MPA is not located in the potential area of cumulative influence between releases originating from the Morven North OWF or Morven South OWF and the Proposed Development (Array Area and Export Cable Corridor).
- 1.11.29 The following attributes of the ocean quahog aggregations and offshore subtidal sands and gravels features of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the construction phase:
- extent and distribution;
 - structure and function; and
 - supporting processes.
- 1.11.30 The following attributes of the Wee Bankie key geodiversity area feature of the Firth of Forth Banks Complex MPA are relevant to changes in SSCs, bed levels and sediment type during the construction phase:
- extent; and
 - structure.
- 1.11.31 Based on the information above, the following can be concluded with respect to the attributes of the ocean quahog, offshore subtidal sands and gravels and Wee Bankie key geodiversity area protected features of the Firth of Forth Banks Complex MPA.
- The impact on the attributes of the Firth of Forth Banks Complex MPA (extent and distribution, structure and function, and supporting processes)

will be similar to that described for the alone assessment, as the additional projects do not cause a significant cumulative impact.

Summary of Attribute Assessment

1.11.32 Based on the information presented above, it can be concluded that cumulative changes in SSCs, bed levels and sediment type during the Proposed Development construction phase **will not lead to a significant risk of hindering the achievement of the conservation objective** of restoring both ocean quahog aggregations and offshore subtidal sands and gravels features to a favourable condition, **or hinder the conservation** of the Wee Bankie key geodiversity area for the following reasons:

- The **extent and distribution, structure and function, and supporting processes** of the ocean quahog aggregations and offshore subtidal sands and gravels features will not be adversely impacted by the construction activities of the Proposed Development cumulatively with the Morven North OWF or Morven South OWF. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles.
- The **extent and distribution** and **structure and function** of the Wee Bankie key geodiversity area comprising relict moraines will not be adversely impacted by the construction activities of the Proposed Development. This is due to only small changes in SSCs, bed levels and sediment type anticipated to reach the Firth of Forth Banks Complex MPA, with conditions returning to the baseline within a few tidal cycles.

Cumulative Effects Assessment: Southern Trench MPA

Injury and disturbance from impact piling activity

Tier 1

Construction Phase

1.11.33 The Tier 1 project (Onshore Infrastructure) will not have a cumulative impact upon the Southern Trench MPA.

Tier 2

Construction Phase

1.11.34 Specific noise modelling results have been used where possible. However, only scoping reports were available for Tier 3 projects and there are no extensive documents available for Tier 4 projects, as such subsea modelling results for these projects could not be used to inform the cumulative impact. Therefore, the EDR approach has been taken in order to consider whether there could be an impact pathway to the MPA. As a result, all Tier 3 and 4 projects have been screened out because all projects are located beyond the latest JNCC (2025) recommended EDR of 20 km. The refined list of projects taken forward for the assessment of cumulative impact on the Southern Trench MPA are detailed in Table 1.21.

Table 1.21: Other Projects Screened into the Cumulative Effects Assessment for the Southern Trench MPA

	Distance to Closest Point of Southern Trench MPA (km)	Total piling days (MDS spatial)	Year of construction														
			2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038			
Proposed Development	35.9	40															
Caledonia OWF South	13.05	451															
Salamander OWF	11.90	80															
Caledonia OWF North	33.34	79															
Muir Mhòr OWF	42.20	151															
Buchan OWF	51.56	70															
Aspen OWF	63.39	112															
Ossian OWF	66.90	530															

1.11.35 Table 1.21 details the period within which the piling activity will occur for the Proposed Development within the published construction period for each project. Based on available timeframes, other project piling may occur at the same time as the Proposed Development and/or consecutively resulting in a number of years where piling noise may act in combination. However, the piling activity within the construction period is likely to be over a much shorter period of time within these construction windows. For example, Salamander OWF assessment (Clarkson *et al.*, 2025), states that piling is expected to occur during one annual cycle for a maximum of 80 days under the MDS (40 days under the more likely piling scenario), but the construction period is six years.

1.11.36 The method used to assess the CEA of disturbance as a result of impact piling is consistent with the project alone assessment (Section 1.11), which was adapted from the methodology presented for the Caledonia OWF MPA assessment (Ocean Winds, 2024).

1.11.37 Table 1.22 presents the disturbance threshold, the effective area overlap, and the percentage (%) of the Southern Trench MPA affected for all CEA projects. Both the dose-response and the EDR results are shown where provided within the other projects assessments, which have used the pre-updated EDR ranges of 26 km (monopile) and 15 km (pin pile). The Proposed Development has shown the updated EDR of 20 km for comparison purposes. Where disturbance ranges are given using the dose-response function methods (as for the project alone assessment) this is calculated using the Graham *et al.* (2017) dose-response function to estimate the area within which there is the potential for a response (i.e. effective disturbance area = area of overlap with MPA for each noise contour, multiplied by the proportion of animals expected to respond at that noise level according to the dose-response function). Whilst the respective effective areas of overlap have been collated into the one table, it would be inappropriate to sum all areas. In the MDS where all projects were piling at the

same time, there would be overlap in the contours and therefore if summed would represent double counting.

Table 1.22: Behavioural Disturbance from Piling at the Proposed Development and Other Projects (DR Dose-Response; EDR Effective Disturbance Range)

	Distance to Closest Point of Southern Trench MPA (km)	Number of piling days	Disturbance Threshold	Effective Area Overlap (km ²)	% MPA
Proposed Development	35.9	40	DR	463.59	19.29
			20 km EDR	0	0
Caledonia OWF South	13.05	451	DR	1,656	65.3
			26 km EDR	418	16.5
Salamander OWF	11.90	80	DR	1,196	47.0
			15 km EDR	61.33	2.0
Caledonia OWF North	33.34	79	DR	1,486.4	58.6
			26 km EDR	0	0
Muir Mhòr OWF	42.20	151	DR	563.04	22.20
			15 km EDR	0	0
Buchan OWF	51.56	70	DR	Not assessed	
			15 km EDR	0	0
Aspen OWF	63.39	112	DR	289.5	12.0
			15 km EDR	0	0
Ossian OWF	66.90	530	Not quantitatively assessed		

Precaution in the Assessment

- 1.11.38 The area of overlap signifies the region that is overlapped by the modelled dB contours, rather than an indication that minke whales within this region may be subject to ‘significant disturbance’. This assessment, together with the other projects assessments have highlighted uncertainty related to whether minke whale would respond behaviourally to the same levels as harbour porpoise (Ocean Winds, 2024; GoBe, 2024; RPS, 2024; Natural Power, 2025, Paragraph 1.10.61). Consistently highlighted across all projects is the uncertainty as to the choice of behavioural thresholds used, in addition to the uncertainty in the use of harbour porpoise response functions to predict the minke whale response. The potential area of overlap is significantly reduced in comparison to the dose-response approach when the EDR fixed threshold is considered. In addition, the Muir Mhòr OWF (Gobe, 2024) and Ossian OWF assessments (RPS, 2024) all highlight that the modelled noise levels within the MPA are all below the NMFS Level B Threshold. Using the EDR approach, only Caledonia and Salamander have predicted noise overlap with the MPA (Table 1.22).
- 1.11.39 NatureScot advised the use of the dose-response functions (Table 1.1), because in reality a behavioural response will not be an ‘all or nothing’ as would be

considered by the use of a fixed noise threshold, but is more likely to be a gradient of response. The benefit of the dose-response approach is that it considers site-specific noise propagation and source characteristics, as well as a proportional response to noise levels that recognised not all individuals will respond the same way to the same noise level. However, Natural Resources Wales/JNCC recommend the use of a fixed noise threshold when considering the risk of significant disturbance to site based protected area, because this is used to reflect the overall loss of habitat that would occur should animals be displaced. Therefore, the dose-response approach is not recommended for area-based assessments for protected sites (e.g. Special Areas of Conservation (Sinclair *et al.*, 2023)). Further, Thompson *et al.* (2025) compared the estimated number of harbour porpoise displaced using the Graham *et al.* (2017) dose-response functions with monitoring data and found that less than 100 porpoises would be disturbed by each piling event, compared to the MDS predictions of more than 4,500 porpoises in the project assessment. This paper recommends the use of distance rather than dose to predict disturbance, highlighting uncertainty in the assessment methodology.

- 1.11.40 Regarding the risk of disturbance within the MPA, subsea noise modelling results for the Proposed Development alone show that although there is an overlap of Sound Exposure Level, single strike (SEL_{ss}), noise contours within the MPA, received levels within the MPA are predicted to reach maximum SEL_{ss} levels of 150 to 145 dB at the southern area of the MPA, reducing to 140 to 135 dB, with limited westward radiation into the Moray Firth. These levels are below the (NMFS, 2005) threshold for disturbance from an impulsive noise source (160 dB SPL_{rms}). According to the behavioural response severity matrix suggested by Southall *et al.* (2021), such low level disturbance (scoring between 0 to 3 on a 0 to 9 scale) could lead to mild disruptions of normal behaviours, though prolonged or sustained behavioural effects (including displacement) are unlikely to occur. These predicted noise levels are therefore not considered to result in significant disturbance (i.e. disturbance resulting in a long term decline, changes in distribution, or changes in behaviour that reduce the ability to feed, breed or survive).

Summary of Assessment against the Conservation Objectives

- 1.11.41 Significant disturbance is defined in the Conservation and Management Advice Document for the Southern Trench MPA (NatureScot, 2025) as disturbance that may result in the following effects. The following conclusions are based on the use of the dose-response assessment methodology as recommended by NatureScot (Table 1.1).

The contribution to long term decline in the use of the MPA

- 1.11.42 Behavioural effects may result in temporary disturbance/displacement throughout the MPA over a period of 12 years. However, the piling activity will be intermittent during this period. If it is assumed that piling will be sequential, there is an estimated 1,513 days of piling activity within the 12 years (34.5%). However, disturbance occurs as short term reversible events and there are likely to be gaps in between piling activity, that would allow recovery to baseline levels.

Changes to the distribution of minke whale on a continuing or sustained basis

- 1.11.43 As above intermittent disturbances are not anticipated to change the distribution on a continued or sustained basis.

Changes to the behaviour such that it reduces ability of the species to feed efficiently, breed or survive

- 1.11.44 While repeated temporary displacement from preferred habitat may occur, there is no evidence to suggest that minke whales would not return to the area following the cessation of noisy activities. Although, the cumulative activities are not expected to result in long term changes to distribution or behaviour, or prevent densities in the site from recovering, nor hinder the ability of the species to access the resources provided by the MPA, there is uncertainty in the conclusions because the cumulative construction period is approximately 12 years.

Overall Conclusion

- 1.11.45 Due to uncertainties in the final project programming and design parameters, plus the high level of conservatism in the assessment (i.e. applying dose-response curve derived from harbour porpoise), the cumulative assessment found that the risk of hindering the conservation objective was uncertain. Therefore, there may be the potential for avoidance/changes in behaviour as a result of the Proposed Development cumulatively with other projects. However, this conclusion is based on the application of the dose-response methodology.
- 1.11.46 The use of dose-response methods show an overlap of noise contours with the Southern Trench MPA, with the assumption that any modelled overlap equates to 'significant' disturbance. However, the noise levels within the overlapping contours are below the (NMFS, 2005) threshold for disturbance from an impulsive noise source (160 dB SPL_{rms}). These predicted noise levels are therefore not considered to result in significant disturbance. Further, the application of the recently published EDRs suggest that subsea noise would not overlap the MPA for the Proposed Development alone and only two of the cumulative projects would lead to a small overlap with the MPA. If this were the case, then it would be concluded that there was no significant disturbance of the Southern Trench MPA.
- 1.11.47 Therefore, the impact of disturbance due to impact piling as a result of the Proposed Development cumulatively with other projects **is not thought to lead to a significant risk of hindering the achievement of the conservation objective** that conserves the distribution of minke whale within the site by avoiding significant disturbance, or the purpose of the Southern Trench MPA to provide protection to the habitats within the MPA that support key minke whale life cycle stages. However, to reflect the uncertainty, monitoring has been proposed.

1.12 Proposed Monitoring

Firth of Forth Banks Complex

- 1.12.1 The potential effects to the Firth of Forth Banks Complex MPA protected features will not lead to a significant risk of hindering the achievement of the

conservation objective of restoring the ocean quahog aggregations and offshore subtidal sands and gravels and conserving the Wee Bankie key geodiversity features, with the current acknowledgement of the Embedded Mitigation (Table 1.12). Accordingly, no monitoring is required as no significant effects have been identified.

Southern Trench MPA

- 1.12.2 This assessment has concluded that there is no significant risk of hindering the achievement of the conservation objective. However, the Applicant is committed to contributing to strategic work programmes that address knowledge gaps relating to minke whale behavioural responses to disturbance. Improving knowledge and methods of assessment will allow for greater certainty in the assessment of potential impacts to the conservation objectives.

1.13 Conclusion

MPA Screening

- 1.13.1 The screening stage of this MPA assessment identified two MPAs, the Firth of Forth Banks Complex MPA and the Southern Trench MPA, with the potential to be affected (other than insignificantly) by the construction, O&M, and decommissioning phases of the Proposed Development. The Firth of Forth Banks Complex MPA and the Southern Trench MPA were, therefore, carried through to a Stage 1 assessment for a full assessment against the relevant conservation objectives in relation to the potential direct and indirect impacts arising from the construction, O&M, and decommissioning phases of the Proposed Development alone and cumulatively with other relevant projects.

MPA Stage 1 Assessment – Firth of Forth Banks Complex MPA

- 1.13.2 This Stage 1 assessment considered the effects of the Proposed Development construction, O&M, and decommissioning phases on ocean quahog aggregations, offshore subtidal sands and gravels and the Wee Bankie key geodiversity area protected features of the Firth of Forth Banks Complex MPA. This included consideration of effects on attributes and targets of the relevant protected features, and subsequently on the conservation objectives, using the best available scientific evidence to support the assessment process and with due regard to the relevant Conservation and Management Advice (JNCC, 2018a).
- 1.13.3 As there is no spatial overlap between the Firth of Forth Banks Complex MPA and the Proposed Development, there will be no direct effects and, as such, these have not been assessed. Indirect effects during the construction, O&M and decommissioning phases associated with changes in SSCs, bed levels and sediment type, and changes in physical processes were assessed.
- 1.13.4 Cumulative effects on features of the Firth of Forth Banks Complex MPA, resulting from the construction and O&M of Ossian OWF and Morven North OWF and Morven South OWF were also considered in the Stage 1 assessment, alongside the following additional projects which overlap with the Firth of Forth Banks complex MPA:
- Berwick Bank Wind Farm;

- Berwick Bank OFTO;
- Seagreen 1 OWF; and
- Seagreen 1A Project.

1.13.5 Based on the information presented in Sections 1.10 and 1.11, which includes assessments on the relevant protected features of the Firth of Forth Banks Complex MPA, it is concluded that the achievement of the conservation objective of restoring the ocean quahog aggregations and offshore subtidal sands and gravels protected feature of the Firth of Forth Banks MPA in a favourable condition will not have a significant risk of being hindered by the construction, O&M, and decommissioning phases of the Proposed Development in isolation, or cumulatively with any other project or activity. Similarly, the conservation of current condition of the Wee Bankie key geodiversity area comprised of relict moraines will not be hindered by the construction, O&M, and decommissioning phases of the Proposed Development in isolation, or cumulatively with any other project or activity.

1.13.6 No significant risks to the achievement of the Firth of Forth Banks Complex MPA conservation objectives have been identified in the Stage 1 assessment, and as a result a Stage 2 assessment is not required.

MPA Stage 1 Assessment – Southern Trench MPA

1.13.7 This Stage 1 assessment considered the effects of the Proposed Development construction phases on the minke whale protected features of the Southern Trench MPA. This included consideration of effects on the conservation objectives, using the best available scientific evidence to support the assessment process and with due regard to the relevant Conservation and Management Advice (NatureScot, 2025).

1.13.8 As there is no spatial overlap between the Southern Trench MPA and the Proposed Development, there will be no direct effects and, as such, these have not been assessed. The potential for disturbance due to impact piling has been assessed due to the potential for the subsea noise ZOI to overlap the Southern Trench MPA.

1.13.9 Cumulative effects on features of the Southern Trench MPA, resulting from the construction of Caledonia (North and South) OWF, Salamander OWF, Muir Mhòr OWF, Buchan OWF, Aspen OWF and Ossian OWF were also considered in the Stage 1 assessment.

1.13.10 Based on the information presented in Section 1.11, it is concluded that the achievement of the conservation objective to conserve the distribution of minke whale within the site by avoiding significant disturbance will not have a significant risk of being hindered by subsea noise during the construction phase of the Proposed Development in isolation or cumulatively.

1.13.11 The uncertainty related to the assessment methodology has been highlighted and, as a result, strategic monitoring has been suggested. Therefore, a Stage 2 assessment is not required.

References

- Axelsson, M., Dewey, S. and Allen, C. (2014). Analysis of seabed imagery from the 2011 survey of the Firth of Forth Banks Complex, the 2011 IBTS Q4 survey and additional deep-water sites from Marine Scotland Science surveys (2012). JNCC, Report No. 471. Peterborough, UK.
- Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G., Thompson, P. M. (2010). Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. *Marine Pollution Bulletin* 60(6): 888-897.
- Brooks, A.J., Whitehead, P.A. and Lambkin, D.O. (2018). Guidance on Best Practice for Marine and Coastal Physical Processes Baseline Survey and Monitoring Requirements to inform EIA of Major Development Projects. Cardiff, Wales, Natural Resources Wales, 119pp. (NRW Report No: 243). Available at: <https://cdn.naturalresources.wales/689057/guidance-on-best-practice-for-marine-and-coastal-physical-processes-baseline-survey-and-monitoring-requirements-to-inform-eia-of-major-development-projects.pdf>. Accessed on: 07 April 2026.
- CCC (2025). The Seventh Carbon Budget. Climate Change Committee. Available at: <https://www.theccc.org.uk/publication/the-seventh-carbon-budget/>. Accessed on: 07 April 2026.
- Christiansen, F., Rasmussen, M., and Lusseau, D. (2013a) Whale watching disrupts feeding activities of minke whales on a feeding ground. *Marine Ecology Progress Series*, 478, 239-251. Available at: <https://doi.org/10.3354/meps10163>. Accessed on: Accessed: 19 November 2025.
- Christiansen, F., Víkingsson, G. A., Rasmussen, M. H., and Lusseau, D. (2013b). Minke whales maximise energy storage on their feeding grounds. *Journal of Experimental Biology*, 216(3), 427-436.
- Christiansen, F., and Lusseau, D. (2015) Linking Behavior to Vital Rates to Measure the Effects of Non-Lethal Disturbance on Wildlife. *Conservation Letters*, 8(6), 424-431.
- Clarkson, J, Majewska, K and Sinclair, RR (2024). Salamander Offshore Wind Farm: Assessment of Potential Impacts on the Southern Trench MPA for Minke Whale. Report Number: SMRUC-MSP-2023-015. Provided to ERM, April 2024 (UNPUBLISHED).
- Crown Estate Scotland (2022). ScotWind Rapid Review. Available at: <https://www.crownstatescotland.com/scotlands-property/offshore-wind/scotwind-rapid-review>. Accessed on: 07 April 2026.
- Essink, K. (1999). Ecological effects of dumping of dredged sediments; options for management. *Journal of Coastal Conservation*, 5 (1), pp.69-80.
- Evans, P. and Stirling, I. (2001). Life history strategies of marine mammals. *Marine Mammals: Biology and Conservation*, pp.7-62.
- Gill, A. and Fairbairns, R. S. (1995). Photo-identification of the minke whale *Balaenoptera acutorostrata* off the Isle of Mull, Scotland, *Developments in Marine Biology*. Volume 4, 1995, Pages 129-132.
- Gobe (2024) Muir Mhòr Offshore Wind Farm Environmental Impact Assessment Report Volume 3, Appendix 9.2: Marine Protected Area Assessment Report, MMH-GBE-A004-ENV-0006-308
- Goudge, H. and Morris, L. (2014). Seabed imagery analysis from three Scottish offshore towed video surveys: 2011 MSS IBTSQ3 survey, 2011 1111s FRV Scotia Rona-Windstock survey & 2011 MSS Rockall survey (2012). JNCC Report 470.

- Graham, I. M., A. Farcas, N. D. Merchant, and P. Thompson. (2017). Beatrice Offshore Wind Farm: An interim estimate of the probability of porpoise displacement at different unweighted single-pulse sound exposure levels. Prepared by the University of Aberdeen for Beatrice Offshore Windfarm Ltd.
- Hoelzel, A. R., Dorsey, E. M. and Stern, S. J. (1989). The foraging specializations of individual minke whales. *Animal Behaviour*, 38 (5), pp.786-794.
- JNCC (2010). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. Joint Nature Conservation Committee.
- JNCC (2014a). Firth of Forth Banks Complex Nature Conservation Marine Protected Area Management Options Paper. Joint Nature Conservation Committee.
- JNCC (2014b). Firth of Forth Banks Complex Nature Conservation MPA assessment against the MPA Selection Guidelines. Joint Nature Conservation Committee.
- JNCC (2018a). Conservation Objectives for the Firth of Form Banks Complex Nature Conservation MPA. pp.4. Joint Nature Conservation Committee.
- JNCC (2018b). Supplementary Advice on Conservation Objectives for Firth of Forth Banks Complex Nature Conservation MPA. pp.53. Joint Nature Conservation Committee.
- JNCC (2023). *UK Protected Area Datasets for Download*. Joint Nature Conservation Committee. Available at: <https://jncc.gov.uk/our-work/uk-protected-area-datasets-for-download>. Accessed on: 07 April 2026.
- JNCC (2025). Updated Effective Deterrent Ranges (EDRs) for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise Special Areas of Conservation (SACs). (England, Wales & Northern Ireland) JNCC Report 803. JNCC, Peterborough, ISSN 0963-8091.
- MacDougall, D. A. I. and K. P. Robinson (2025). "Following the Food: Dynamic, Seasonal Changes in the Fine-Scale Distribution of Foraging Minke Whales Within a Scottish Marine Protected Area (MPA)." *Oceans* 6(1): 18.
- Malme, C., P. Miles, C. Clark, P. Tyack, and J. Bird. (1984) Investigations of the Potential Effects of Underwater Noise from Petroleum Industry Activities on Migrating Gray Whale Behavior—Phase II. U-S. Department of the Interior Minerals Management Service.
- Morton, B. (2011). The biology and functional morphology of *Arctica islandica* (Bivalvia: Arctiidae) – A gerontophilic living fossil. *Marine Biology Research*, 7 (6), pp.540-553.
- Natural Power (2025). Buchan Offshore Wind. EIA Report. Chapter 10: Marine Mammals and other Megafauna. Available at: [https://marine.gov.scot/sites/default/files/bow_eia_volume_2_chapter_10_marine_mammals_and_other_megafauna .pdf](https://marine.gov.scot/sites/default/files/bow_eia_volume_2_chapter_10_marine_mammals_and_other_megafauna.pdf).https://marine.gov.scot/sites/default/files/bow_eia_volume_2_chapter_10_marine_mammals_and_other_megafauna .pdf Accessed on: 07 April 2026.
- NatureScot (2023). Minke whale - *Balaenoptera acutorostrata* [Online]. Available at: <https://www.nature.scot/plants-animals-and-fungi/mammals/marine-mammals/minke-whale#:~:text=Minke%20whale%20in%20Scottish%20seas&text=Minke%20are%20most%20often%20spotted,may%20stay%20here%20year%2Dround>. Accessed on: 07 April 2026.
- NatureScot (2025). Development management and Nature Conservation Marine Protected Areas. NatureScot Guidance. Available at: <https://www.nature.scot/doc/development-management-and-nature-conservation-marine-protected-areas#environmental-impact-assessments>. Accessed on: 07 April 2026.

- NatureScot (2025). Conservation and Management Advice. December 2025, Available at: <https://www.nature.scot/sites/default/files/nature-conservation-mpa/10477/conservation-and-management-advice.pdf>. Accessed on: 07 April 2026.
- NMFS (2005). Scoping Report for NMFS EIS for the National Acoustic Guidelines on Marine Mammals. National Marine Fisheries Service.
- NMFS (2024). 2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0). NOAA Technical Memorandum NMFS-OPR-71, National Oceanic and Atmospheric Administration.
- Ocean Winds (2024) Caledonia Offshore Wind Farm Ltd. Application Document 9. Marine Protected Area Assessment. UKCAL-CWF-CON-EIA-APL-00001-A014 Available at: <https://www.caledoniaoffshorewind.com/wp-content/uploads/2024/12/Application-Document-9-Marine-Protected-Area-Assessment.pdf>. Accessed on: 07 April 2026.
- Powilleit, M., Graf, G., Kleine, J., Riethmüller, R., Stockmann, K., Wetzels, M. A. and Koop, J. H. E. (2009). Experiments on the survival of six brackish macro-invertebrates from the Baltic Sea after dredged spoil coverage and its implications for the field. *Journal of Marine Systems*, 75 (3), pp.441-451.
- RPS (2024). Ossian Chapter 10: Marine Mammals. Available at: <https://ossian-eia.com/offshore-eia/vol2/ch10-marine-mammals/>. Accessed on: 07 April 2026.
- Scottish Government (2020). Sectoral Marine Plan for Offshore Wind Energy. 28 October 2020. Available at: <https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2020/10/sectoral-marine-plan-offshore-wind-energy/documents/sectoral-marine-plan-offshore-wind-energy/sectoral-marine-plan-offshore-wind-energy/govscot%3Adocument/sectoral-marine-plan-offshore-wind-energy.pdf>. Accessed on: 07 April 2026.
- Scottish Government (2024). Climate Change (Emissions Reduction Targets) (Scotland) Act 2024. Available at: <https://www.legislation.gov.uk/asp/2024/15/enacted>. Accessed on: 07 April 2026.
- Scottish Government (2025a) Marine licensing and consenting: Marine Protected Area assessment, Available at: <https://www.gov.scot/publications/marine-licensing-and-consenting-marine-protected-area-assessment/>. Accessed on: 07 April 2026.
- Scottish Government (2025b) Fisheries management measures within Scottish offshore marine protected areas: coordinates and restrictions. [pdf] Available at: <https://www.gov.scot/publications/supporting-guidance-fisheries-management-measures-offshore-marine-protected-areas-coordinates-restrictions/>. Accessed on: 07 April 2026.
- Scottish Natural Heritage (2014). Further advice to Scottish Government on the selection of Nature Conservation Marine Protected Areas for the development of the Scottish MPA network. Scottish Natural Heritage Commissioned Report No. 780.
- Seagreen Wind Energy Limited (2021). Environmental Impact Assessment Report. Seagreen 1A Export Cable Corridor.
- Sinclair, R.R., Kazer, S., Ryder, M., New, P. and Verfuss, U.K. (2023). Review and recommendations on assessment of noise disturbance for marine mammals. NRW Evidence Report No. 529, 143pp, Natural Resources Wales, Bangor
- Southall, B.L., Nowacek, D.P., Bowles, A. E., Senigalia, V., Bejder, L., and Tyack P.L. (2021). Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioural Responses to Human Noise. *Aquatic Mammals*, 47(5), 421-464.
- SSE Renewables (2022). Marine Protected Area Assessment Report. Berwick Bank Wind Farm.

SSE Renewables (2023). MPA and MCZ Assessment. Cambois Connect - Marine Scheme pp.212.

Stone, C., Hall, K. Mendes, S. and Tasker, M. (2019). The effects of seismic operations in UK waters: analysis of Marine Mammal Observer data. *Journal of Cetacean Research and Management* 16.

Thompson, P.M., Benhemma-Le Gall, A., Lee, R., Stephenson, S., Mason, T. and Abad Oliva, N. (2025). Predicted and observed responses of harbour porpoises to pile driving noise at Moray West Offshore Wind Farm. PrePARED Report, No. 008.

Tougaard, J., Wright, A.J. and Madsen, P.T. (2015) Cetacean noise criteria revisited in the light of proposed exposure limits for harbour porpoises. *Marine Pollution Bulletin* 90, 196-208

Tyler-Walters, H. and Sabatini, M. (2017). *Arctica islandica* Icelandic cyprine. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*. Marine Biological Association of the United Kingdom. Plymouth, UK pp.32.

UK Government (2025). *Marine environment: unexploded ordnance clearance Joint Position Statement*. Available at: <https://www.gov.uk/government/publications/marine-environment-unexploded-ordnance-clearance-joint-position-statement/marine-environment-unexploded-ordnance-clearance-joint-position-statement>. Accessed on: 07 April 2026.

Wentworth (1922) A scale of grade and class terms for clastic sediments. *Journal of Geology*, 30 pp. 377-392.