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Application Document 9

Marine Protected Area Assessment

Caledonia Offshore Wind Farm Ltd

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OW
OCEAN WINDS

Application Document 9 Marine Protected Area Assessment

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Acronyms and Abbreviations

ADD	Acoustics Deterrent Device
BEIS	Department for Business, Energy and Industrial Strategy
CEA	Cumulative Effect Assessment
EDR	Effective Deterrence Range
EIAR	Environmental Impact Assessment Report
EUNIS	European Nature Information System
FRP	Fully Restrained Platform
ha	Hectares
MINNS	Marine Invasive Non-Native Species
INTOG	Innovative and Targeted Oil and Gas
JNCC	Joint Nature Conservation Committee
MBES	Multibeam echosounder
MD-LOT	Marine Directorate - Licensing Operations Team
MFE	Mass Flow Excavation
MMMP	Marine Mammal Mitigation Protocols
MPA	Marine Protected Area
OECC	Offshore Export Cable Corridor
O&M	Operation and Maintenance
OSP	Offshore Substation Platform
OSPAR	Committee of 15 Governments and the EU set up to protect the marine environment of the North-East Atlantic
OWF	Offshore Wind Farm
PAM	Passive Acoustic Monitoring

PMF	Priority Marine Feature
pMPA	Possible MPA
PTS	Permanent Threshold Shift
RaDIN	Range dependent nature of impulsive noise
SBP	Sub Bottom Profiler
SEL	Sound Exposure Level
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
SSS	Side Scan Sonar
TTS	Temporary Threshold Shift
UHRS	Ultra High Resolution Seismic
USBL	Ultra-short Baseline
UWN	Underwater Noise
UXO	Unexploded Ordnance
VMP	Vessel Management Plan
WTG	Wind Turbine Generator

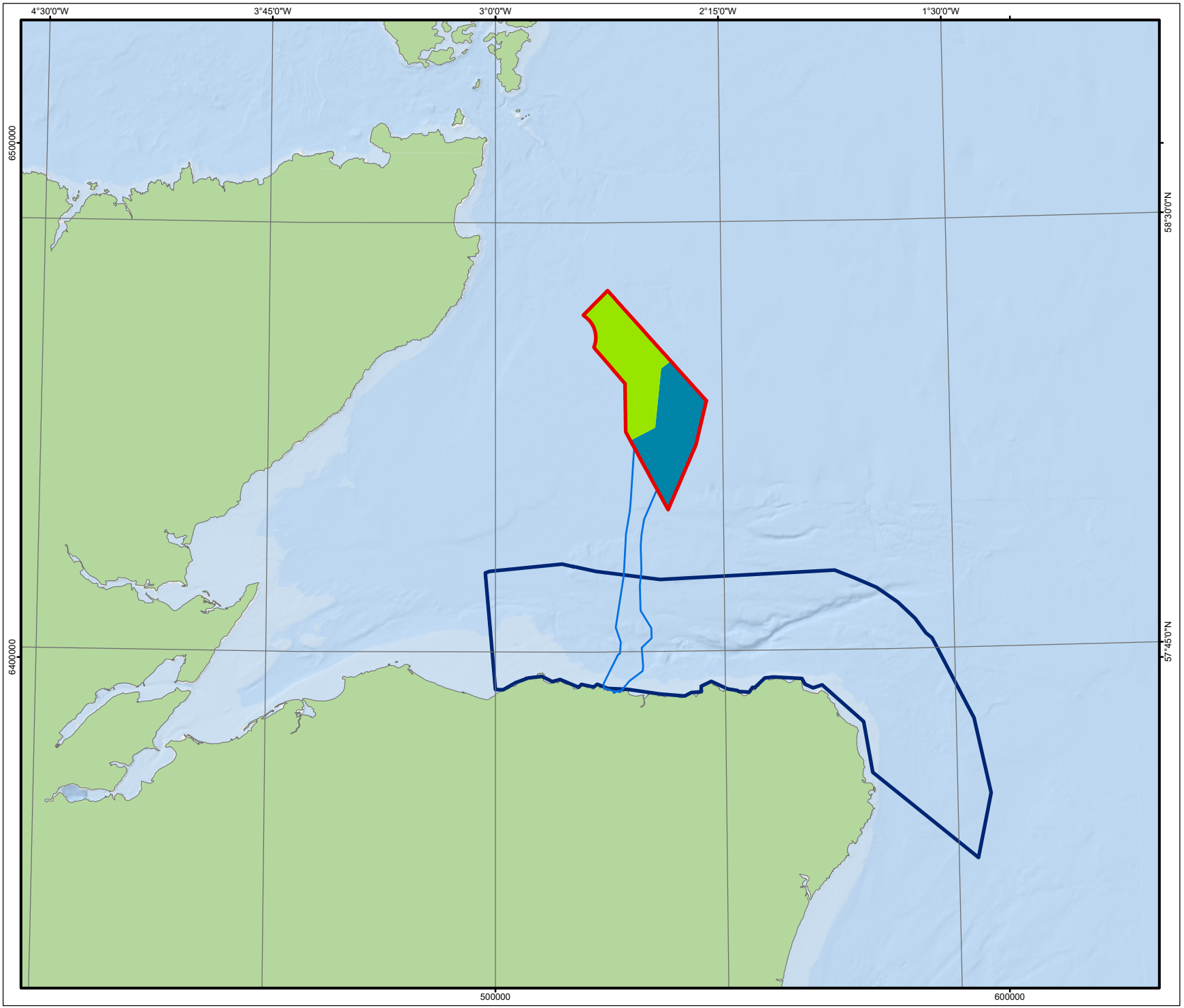
1 Introduction

1.1.1.1 The Caledonia Offshore Wind Farm (OWF), hereby known as the Proposed Development (Offshore), will be located within the NE4 Option Agreement Area, approximately 22km off the coast of Wick, Highlands and the southern limit of the site is approximately 38km off the coast of Banff, Aberdeenshire. The Array Area of the Proposed Development (Offshore) covers an area of approximately 423km^2 and a full explanation of the offshore design parameters is provided in the Environmental Impact Assessment Report (EIAR) within Volume 1, Chapter 3: Proposed Development Description (Offshore). The Proposed Development (Offshore) will be progressed into two development phases, with separate consent applications being submitted for each. These development sites are referred to as:

- Caledonia North: This comprises the Caledonia North Site (Array Area) (an area of 218.5km^2 featuring bottom-fixed foundation Wind Turbine Generators (WTGs), inter-array/interconnector cables and Offshore Substation Platforms (OSPs)) and the Caledonia North Offshore Export Cable Corridor (OECC); and
- Caledonia South: This comprises the Caledonia South Site (Array Area) (an area of approximately 204.5km^2 featuring either bottom-fixed and floating foundation WTGs or alternatively only bottom-fixed foundation WTGs, inter-array/interconnector cables and OSPs) and the Caledonia South OECC.

1.1.1.2 Caledonia North and Caledonia South are collectively referred to as the Proposed Development (Offshore) in this document (Figure 1-1). The Array Area of the Proposed Development (Offshore) is referred to as Caledonia OWF. The Caledonia North OECC and Caledonia South OECC will make landfall at Stake Ness, approximately 1.5km west of Whitehills, Aberdeenshire.

1.1.1.3 The Proposed Development (Offshore) could be developed concurrently or sequentially (with a gap of up to five years between phases). This assessment has been prepared to consider the Proposed Development (Offshore) (i.e., both Caledonia North and Caledonia South) and the construction of the two application areas in any sequence or simultaneously with regards to the Southern Trench Nature Conservation Marine Protected Area (MPA).



Caledonia OWF
Caledonia North Site
Caledonia South Site
Offshore Export Cable Corridor
Southern Trench MPA

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CALEDONIA Offshore Wind Farm

GoBe APEM Group

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Figure 1-1: The Proposed Development (Offshore) Relative to the Southern Trench MPA

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2 Purpose of the Document

2.1 Legislative Requirement

2.1.1.1 In Scotland, Nature Conservation MPAs are governed by the provisions of the of the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act (2009); these protected sites contribute to the Scottish MPA network (NatureScot, 2020a[1]).

2.1.1.2 Under Section 83 of the Marine (Scotland) Act 2010 (Scottish Parliament, 2010[2]) and Section 126 of the Marine and Coastal Access Act 2009 ("the 2009 Act") (UK Government, 2009[3]), when granting authorisation for an act (e.g., licensable activity), the Scottish Ministers are required to consider whether that licensable activity is capable of affecting an MPA (other than insignificantly). If there is a significant risk of the act hindering the objectives or purpose of an MPA, they must notify NatureScot and apply a consultation period of 28 days before deciding to grant authorisation. The Scottish Ministers must not grant authorisation for the act unless the applicant satisfies them that that there is no significant risk of the act hindering the achievement of the objective or stated purpose of the MPA. Alternatively, the applicant can satisfy the Scottish Ministers that there is no other means of proceeding which would substantially lower risk of hindering the MPA objectives or purposes and that the benefit to the public clearly outweighs the risk of damage to the environment that will be created by the act.

2.1.1.3 Legislation goes on to state that where the applicant is not able to satisfy the Scottish Ministers that there is not a significant risk of the act hindering the achievement of the stated objectives for an MPA, then they can only grant authorisation subject to certain conditions being applied in order to ensure that measures of equivalent environmental benefit will be undertaken to mitigate for the likely damage.

2.1.1.4 The Caledonia North OECC and Caledonia South OECC directly overlap with the Southern Trench Nature Conservation MPA, hereinafter referred to as the Southern Trench MPA, that was designated under the Southern Trench Nature Conservation Marine Protected Area Order 2020, (referred to as 'The Order') (The Scottish Government, 2020[4]). The primary purpose of this document is to provide supporting information to support the Scottish Ministers with their assessment of the Proposed Development (Offshore) in terms of implications for the Southern Trench MPA. The secondary purpose of this document is to address any concerns raised regarding the Southern Trench MPA and its Conservation Objectives that might not be addressed specifically within the EIAR, but that stakeholders have raised during consultation.

2.1.1.5 This MPA Assessment should be read alongside and in consideration of the following EIAR documents:

- Volumes 2, 3 and 4, Chapter 2: Marine and Coastal Processes
- Volumes 2, 3 and 4, Chapter 4: Benthic Subtidal and Intertidal Ecology; and
- Volumes 2, 3 and 4, Chapter 7: Marine Mammals.

2.2 Stakeholder Engagement

2.2.1.1 Consultation and ongoing engagement is fundamental to the consent application process for Scottish OWF developments. The Offshore Scoping Report (Volume 7, Appendix 2) for the Proposed Development (Offshore) was submitted to MD-LOT in September 2022, who then circulated the report to relevant consultees in order to inform the compilation of a formal Scoping Opinion. A Scoping Opinion (Volume 7, Appendix 3) was subsequently received from MD-LOT in January 2023.

2.2.1.2 Within the Scoping Opinion, there were no direct requests received specifically about conducting a separate MPA Assessment for the Proposed Development (Offshore). However, various consultation responses related to the Southern Trench MPA and to aspects that are considered within this MPA Assessment. These consultation responses are detailed in Table 2-1 and have driven the development of this MPA Assessment.

Table 2-1: Scoping Opinion responses regarding the Southern Trench MPA.

Consultee	Comment
NatureScot	The operational effect Impacts to seabed morphology is scoped in only for the export corridor, for potential impacts on the Southern Trench MPA. We advise that this effect should also be assessed for the other 'aspects' of the development (Table 6.2), in keeping with an approach of assessing effects as pathways. Alternatively the developer may wish to submit, for our consideration, further justification in terms of potential receptors (across all EIA topics).
NatureScot	We advise that any potential impacts on the minke whale feature of the Southern Trench NCMPA should be fully assessed within the EIA Report especially regarding the export cable corridor route.
MD-LOT	The Scottish Ministers welcome the Developer's recognition of the minke whale qualifying interest for Southern Trench NCMPA within Table 11.2. Consideration of the Proposed Development's effects on the minke whales of Southern Trench NCMPA should cover all impact pathways but pay particular attention to potential effects arising from the export cable corridor route.

3 Background Information for the Southern Trench MPA

3.1 Introduction

3.1.1.1 The Southern Trench MPA (EU Site Code: 555703756) lies off the Aberdeenshire coast, extending from Buckie in the west to Peterhead in the east, where it encompasses a 58km long, 9km wide and 250m deep trench that was carved out by glaciers (NatureScot, 2020b[5]). The Southern Trench MPA was designated in December 2020, covering an area of 239,800 hectares (ha) seaward of the mean low water spring tide and is designated for the following biodiversity and geodiversity features and types:

- Biodiversity:
  - Burrowed mud;
  - Fronts;
  - Minke whale; and
  - Shelf deeps.
- Geodiversity:
  - Quaternary of Scotland (subglacial tunnel valleys and moraines); and
  - Submarine mass movement (slide scars).

3.1.1.2 A suite of information and management documents are in place for the Southern Trench MPA and include Conservation and Management Advice (NatureScot, 2020c[6]), a Data Confidence Assessment (NatureScot, 2020d[7]), MPA Site Summary (NatureScot, 2020b[5]) and an Assessment against the MPA Selection Guidelines (NatureScot, 2020e[8]).

3.2 Designation Process

3.2.1.1 The Southern Trench MPA was initially selected as a Possible MPA (pMPA) in 2019 due to four biodiversity features (burrowed mud, fronts, minke whale and shelf deeps) and two geodiversity features (Quaternary of Scotland and Submarine Mass Movement). This proposal was part of a wider proposal made between 2012 and 2018 to develop an MPA Network for Scotland as part of the requirements under the Marine (Scotland) Act 2010[2]. The proposal went through a consultation process alongside three other pMPAs and was finally accepted in 2020 via The Order, which came into force in December 2020. The Southern Trench MPA now forms one of the 233 Nature Conservation MPAs network in Scotland. As part of the Marine (Scotland) Act 2010[2], there is an ongoing requirement for review and reporting of the Scottish MPA Network every six years.

3.3 Protected Features

3.3.1 Biodiversity Features

Burrowed Mud

3.3.1.1 Burrowed mud habitat is characterised by stable fine muddy substrates supporting burrowing infauna with sediments ranging from muddy sands to fine, clay-dominated muds. It is typically found in areas of full salinity, sheltered from wave exposure and with weak or extremely weak tidal currents (Hughes, 1998[9]).

3.3.1.2 The burrowing megafauna characteristic of burrowed mud communities such as Norway lobster (*Nephrops norvegicus*), fireworks anemone (*Pachycerianthus multiplicatus*) and sea pens including *Virgularia mirabilis*, *Pennatula. phosphorea* and *Funiculina quadrangularis* are important bioturbators of the sediment they inhabit. This activity creates a three-dimensional structure of burrows which increases the structural complexity and depth of oxygen penetration into the sediments. This enhances the survival of smaller species which can live in the burrows and increases biodiversity in what would otherwise be a generally low diversity habitat (Hughes 1998[9]; Widdicombe *et al*., 2004[10]).

3.3.1.3 Burrowed mud is listed under Scotland's Priority Marine Features (PMFs) and as an OSPAR threatened and/or declining habitat ('sea-pens and burrowing megafauna communities') (NatureScot, 2020f[11]).

3.3.1.4 Burrowed mud has been recorded within the boundary of the MPA as a result of *Nephrops* fishery survey work undertaken by Marine Scotland (Allan *et al*., 2012[12]) and targeted nature conservation surveys (Hirst *et al*., 2012[13]; Moore 2017[14]).

3.3.1.5 The burrowed mud feature within the Southern Trench MPA is located along the outer Moray coast at depths of between 70 to 188m and is estimated to cover an area of approximately 225km^2 (Hirst *et al*., 2012[13]), with the habitat found in and around the trench feature (Axelsson *et al*., 2017[15]; Moore, 2017[14]; 2019[16]).

3.3.1.6 A survey undertaken in 2017 (Moore, 2019[16]) observed predominantly muddy substrate in the western half of the site which are typically heavily bioturbated by burrowing megafauna such as the *N. norvegicus* and *Calocaris macandreae*, while the phosphorescent sea pen *P. phosphorea* also frequent. This community is characteristic of the biotope 'Seapens and burrowing megafauna in Atlantic circalittoral fine mud' (SS.SMu.CFiMu.SpnMeg/EUNIS Code MC6216) as illustrated in Figure 3-1. This biotope is representative of the burrowed mud habitat.

3.3.1.7 In shallower waters to the western end of the site where silty and muddy sands were prevalent the infaunal community was characterised by emergent

tubes, small holes and worm casts representative of the habitat 'Atlantic circalittoral muddy sand (SS.SSa.CMuSa/EUNIS Code MC52).

3.3.1.8 Further east towards Fraserburgh inshore shallow waters were characterised by mixed substrates of sand with varying proportions of gravel, pebbles, cobbles and boulders recorded. Stones were encrusted with serpulid worms and pink coralline algae as well as clumps of hydroids and sparse Hornwrack *Flustra foliacea* representing the biotope '*Flustra foliacea* and *Hydrallmania falcata* on tide-swept circalittoral mixed sediment' (SS.SMx.CMx.FluHyd/ EUNIS Code MC4214). Where the erect biota was very poorly developed the habitat 'Atlantic circalittoral mixed sediment' (SS.SMx.CMx/EUNIS Code MC42) was recorded.

3.3.1.9 To the east and south of Fraserburgh sediments were coarser with a mixed substrate of coarse sand with a cover of gravel, pebbles, cobbles and boulders, bedrock and sand recorded. Superabundant populations of the brittlestar *Ophiothrix fragilis* were observed representing the biotope '*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on circalittoral mixed sediment' (SS.SMx.CMx.OphMx/EUNIS Code MC4215). A previous survey undertaken in 2015 recorded areas supporting a mosaic *of Sabellaria spinulosa* reef habitat (CR.MCR.CSab.Sspi.ByB) (Moore, 2017[14]) which is an Annex I habitat and also included in the OSPAR List of Threatened and/or Declining Species & Habitats, although no evidence of a *Sabellaria* reef was observed during the 2017 survey (Moore, 2019[16]).

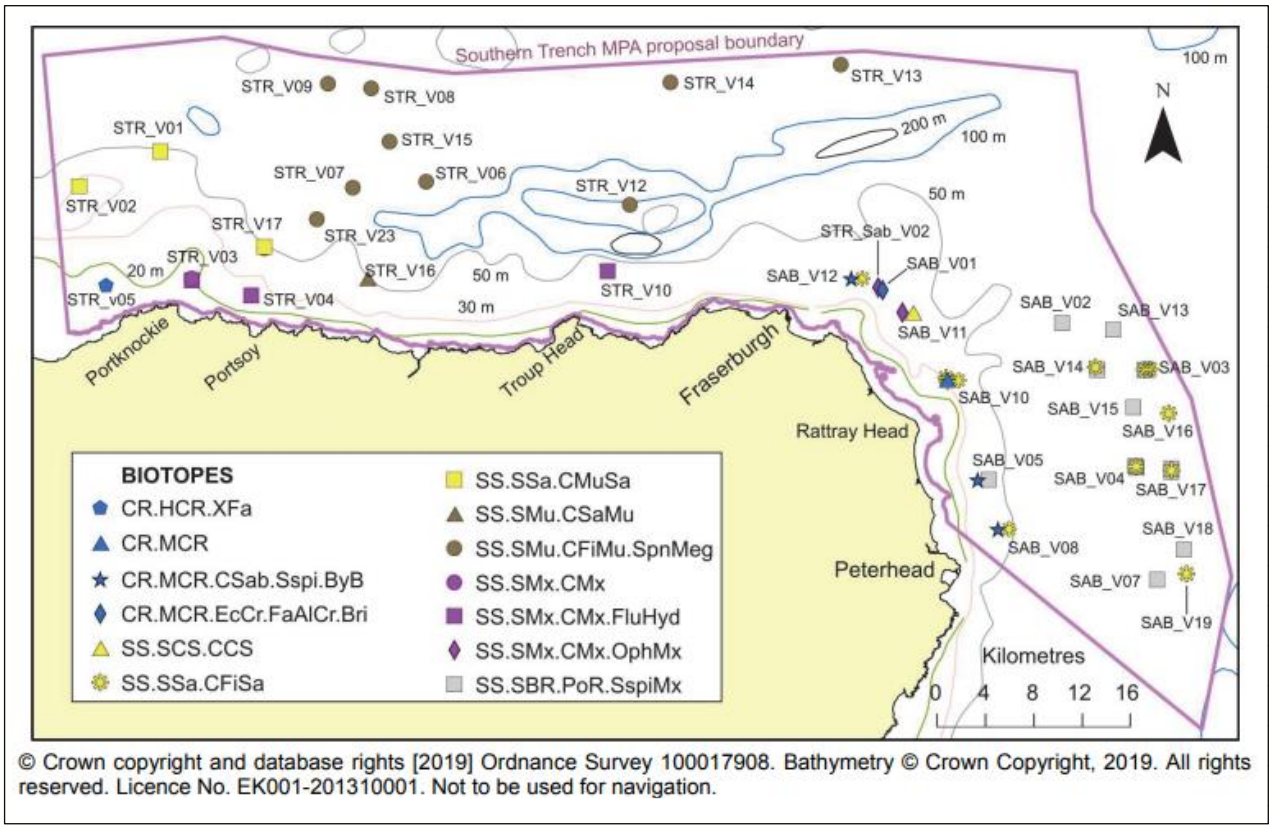

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Figure 3-1: Distribution of biotope records in the Southern Trench proposed MPA surveyed in 2017 (Moore, 2019).

3.3.1.10 The Data Confidence Assessment for the Southern Trench MPA (NatureScot, 2020d[7]) also illustrates the known/modelled distribution of burrowed mud, demonstrating the more focused presence of burrowed mud in the western half of the Southern Trench MPA (Figure 3-2).

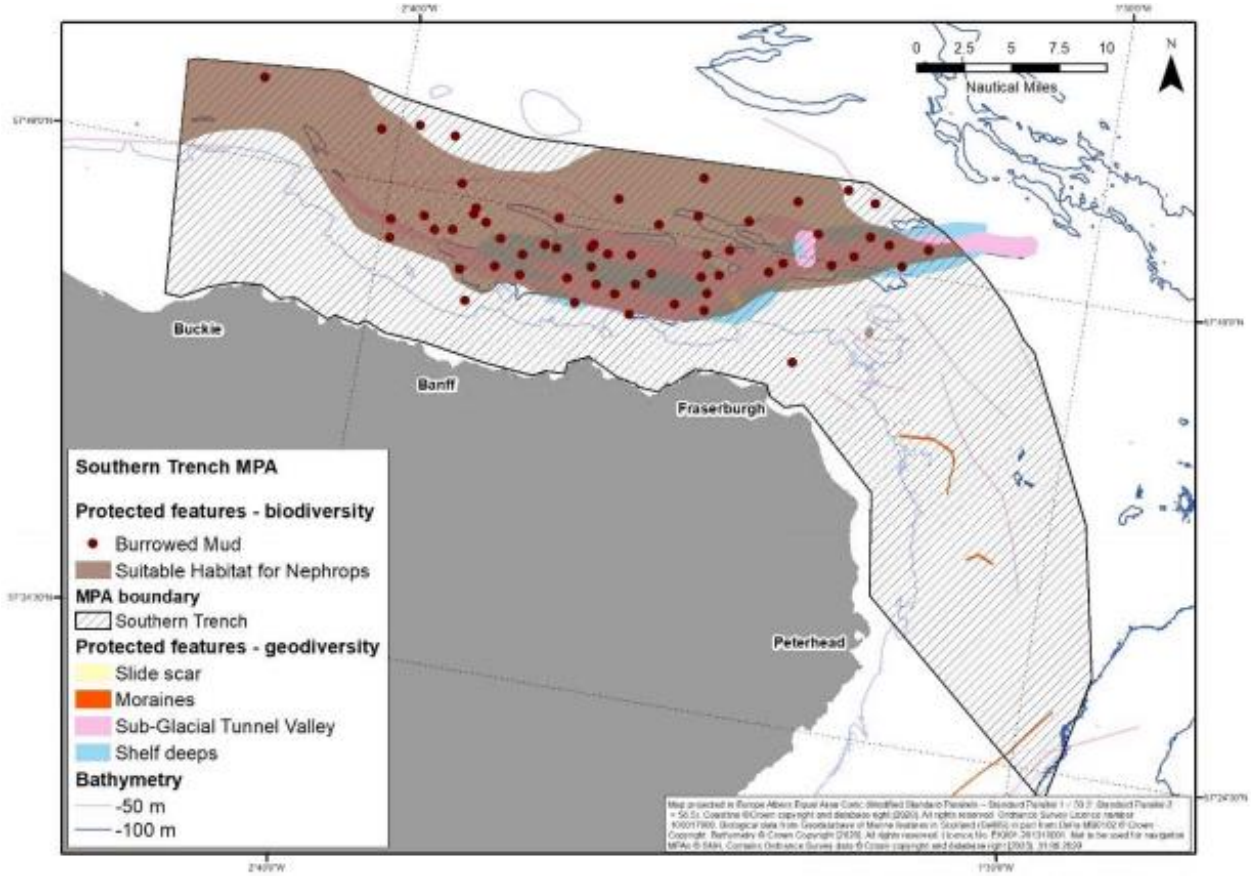


Figure 3-2: Known/modelled distribution of burrowed mud (and other protected features) within the Southern Trench MPA (NatureScot, 2020d[7]).

Fronts

3.3.1.11 Frontal zones mark boundaries between water masses, including tidally mixed and stratified areas (Department for Business, Energy and Industrial Strategy (BEIS), 2022a[17]). Fronts play an important role in enabling the circulation and transport of nutrients and heat, and frequently reoccurring fronts are widely recognised as supporting enhanced biological activity (NatureScot, 2020e[8]).

3.3.1.12 The Southern Trench MPA encompasses the area where a thermal front forms persistently from year to year (Figure 3-3), the position of which corresponds to a relatively narrow, shallow, inner shelf associated with enhanced tidal mixing (Miller *et al.*, 2014[18]). In autumn and winter, the front is located close to the coast (less than 20km) and maintained by tidal currents. In spring and summer, the additional stratification generated by summer warming and less frequent storm events generates additional surface thermal fronts that extend beyond the coastal zone.

3.3.1.13 The fronts within the Southern Trench MPA have persistently occurred in the same locations over time, based on a 10-year time series of satellite derived sea surface temperature data (Miller *et al.*, 2014[18]). The feature is considered likely to contribute to favourable feeding conditions for mobile species in the area (NatureScot, 2020e[8]).

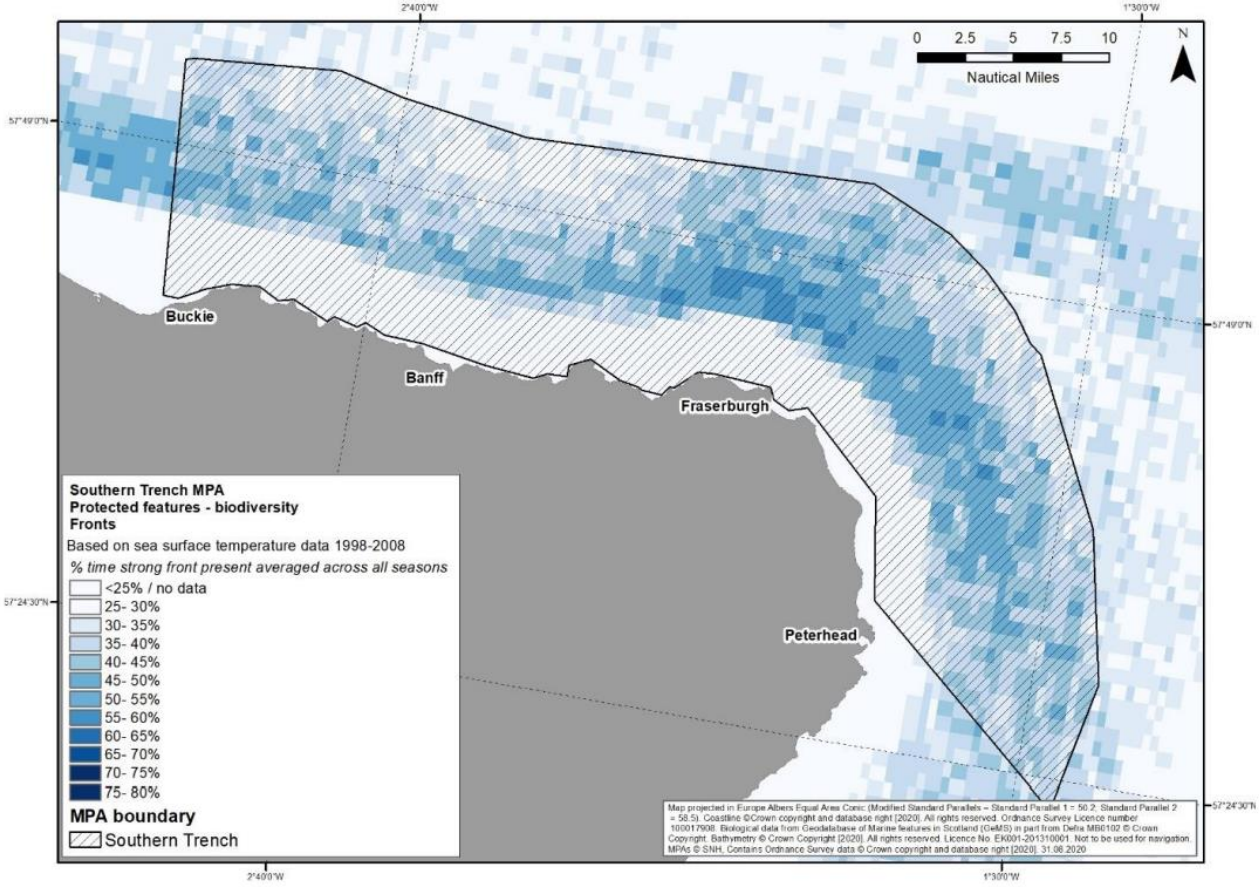


Figure 3-3: Known/modelled distribution of fronts within the Southern Trench MPA (NatureScot, 2020e[8]).

Minke Whale

3.3.1.14 The Southern Trench MPA has been designated for the protection of minke whales on the basis of habitat modelling that showed that the area consistently supported above average densities of minke whales between 1994 and 2012 (Paxton *et al*., 2014[19]). Supporting surveys, and subsequent studies of minke whales in the area have largely been conducted between May and October (Robinson *et al*., 2009[20]; 2023[21]). These results highlight that the distribution of minke whales within the Southern Trench MPA is not uniform (Figure 3-4) (NatureScot, 2020e[8]). While there is evidence that minke whales remain in coastal UK waters throughout the year (Paxton *et al*., 2014[19]), the extent to which minke whales continue to use the Southern Trench MPA during the winter remains unclear due to lack of consistent survey effort (though it is noted in the Conservation Objectives that sightings in the MPA are highest between June and October).

3.3.1.15 Robinson *et al.* (2023[21]) reported that minke whales present within the MPA are targeting habitats that support fish such as sandeels (e.g., sandy gravel sediments), herring and sprat (e.g., deeper shelf waters). It has also been suggested that juvenile whales are slightly more coastal in their distribution than adults and are more likely to target sandeel prey (Robinson *et al.*, 2023[21]).

3.3.1.16 It is important to note that at present, there is no reliable data on minke whale abundance or distributions within the MPA. While Paxton et al., (2014) provide "adjusted densities" and "modelled persistence", they do not provide absolute density estimates. This means that a reliable quantitative assessment of the number of animals expected to be impacted cannot be conducted for minke whales at this MPA.

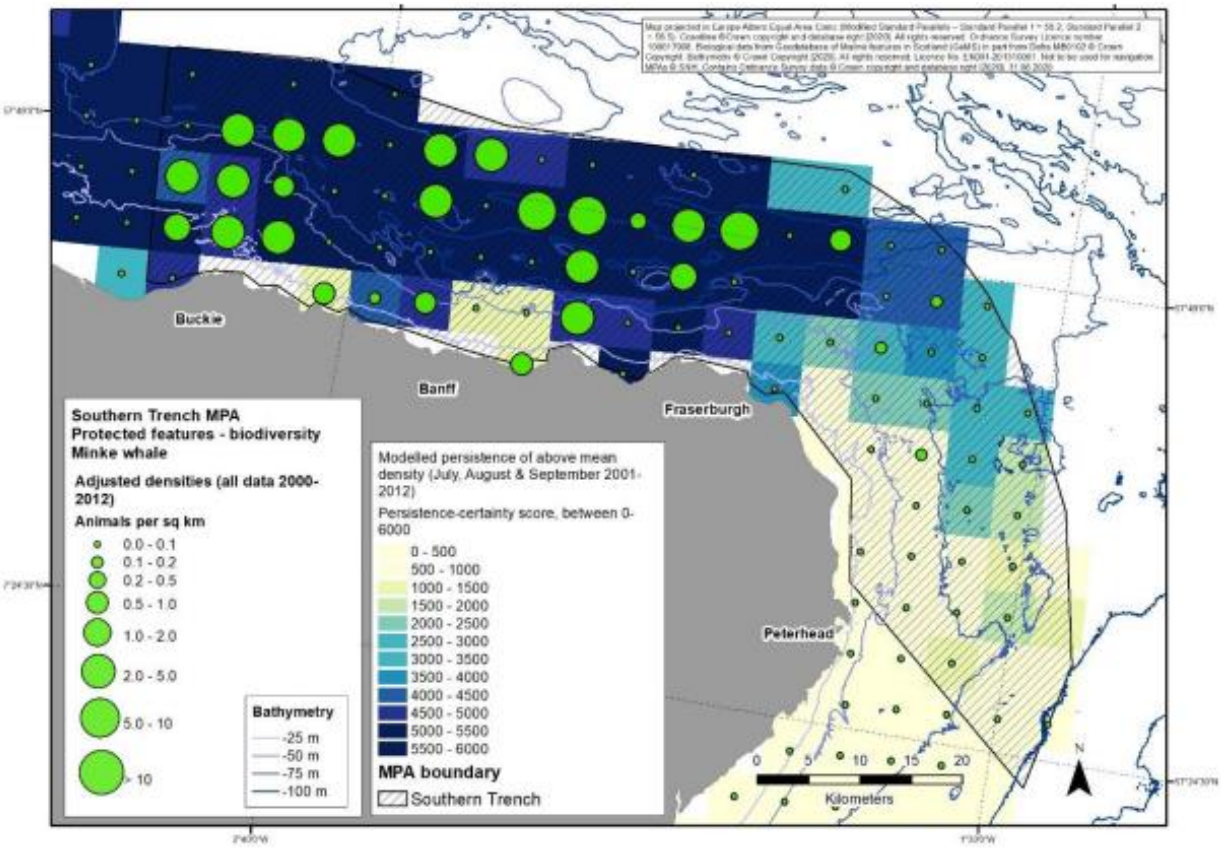


Figure 3-4: Distribution of minke whale densities within the Southern Trench MPA (NatureScot, 2020e[8]).

Shelf Deeps

3.3.1.17 Shelf deeps are enclosed topographic depressions on the seabed, formed in most cases by glacial erosion during periods of low sea level. The entirety of this feature is encompassed within the Southern Trench MPA (NatureScot, 2020e[8]). The Southern Trench is an enclosed basin approximately 220m deep and 58km long, formed predominantly as a result of glacial processes, including subglacial hydrodology and potentially catastrophic meltwater flooding (Brooks *et al.*, 2013[22]; BEIS, 2022a[17]).

3.3.2 Geodiversity Features

Quaternary of Scotland (Subglacial Tunnel Valleys and Moraines)

3.3.2.1 Within the Southern Trench MPA, the Quaternary of Scotland feature encompasses subglacial tunnel valleys and moraines. Subglacial tunnel valleys are erosional features formed by ice over millennia, with the Southern Trench MPA encompassing one of the largest and best examples of large-scale seabed incision in Scotland (Bradwell *et al.*, 2008[23]). The trench system is regarded as scientifically important for furthering understanding of ice sheet drainage patterns. These features are interspersed within the Southern Trench MPA with moraines, which are relict features that are composed of glacial till (poorly sorted boulders, gravels, sand and clays of variable consolidation) (NatureScot, 2020e[8]).

Submarine Mass Movement (Slide Scars)

3.3.2.2 Slide scars form when large volumes of sediment move rapidly downslope. Their formation is likely to be driven by the same processes that led to the formation of the Southern Trench (primarily glacial hydrology) (NatureScot, 2020e[8]).

3.4 Conservation Objectives

3.4.1 Introduction

3.4.1.1 The Conservation Objectives for the protected features are set out within Section 5, Clause 1 of The Order and are as follows:

"*5.-(1) The conservation objectives of the Southern Trench MPA are that the protected features-*

(a) so far as already in favourable condition, remain in such condition,

(b) so far as not already in favourable condition, be brought into such condition, and remain in such condition".

3.4.1.2 The term 'favourable condition' translates differently for marine habitats, mobile species of marine fauna, large scale features and features of geomorphological interest as explained within Sections 3.4.2 and 3.4.3.

3.4.1.3 An example of a large scale feature are fronts or shelf deeps that contribute to the overall health and biodiversity of the Southern Trench MPA and the marine environment. A mobile species of marine fauna refers to a species of marine fauna with the ability to move freely between different locations that may be within, or outwith, the boundary of the Southern Trench MPA.

3.4.2 Biodiversity Features

Burrowed Mud

3.4.2.1 Since burrowed mud is a marine habitat, the definition of 'favourable condition is determined as:

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

3.4.2.2 The reference above to the composition of the characteristic biological communities of a marine habitat includes a reference to the diversity and abundance of species of marine flora and fauna forming part of, or inhabiting, that habitat.

3.4.2.3 In relation to the Conservation Objectives set out in Section 3.4.1, any temporary deterioration in condition is to be disregarded if the marine habitat is sufficiently healthy and resilient to enable its recovery from such deterioration.

3.4.2.4 Clause 10 of Section 5 of The Order also states that in determining whether a protected feature classed as marine habitat is in favourable condition any alteration to that feature brought about entirely by natural processes is to be disregarded.

3.4.2.5 The Conservation and Management Advice for the Southern Trench MPA provides the full, detailed Conservation Objectives including site-specific advice and information on the features, how the objectives of the site may be furthered, or their achievement hindered, covering a range of activities (NatureScot, 2020c[6]). Full conservation objectives and advice in relation to fronts are provided in Table 3-1.

Table 3-1: Conservation Objectives with respect to burrowed mud and site-specific information.

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
Habitat is conserved	Conserve the current extent and distribution of burrowed mud habitat within the site so that it is stable or increasing.	Within the MPA the burrowed mud feature is predominantly located along the outer Moray coast, both within and outside the trench between depths of ~ 70-188m. From a survey carried out in 2011 the habitat is estimated to cover a total area of approximately 225km^2 (Hirst *et al*., 2012[13]). Subsequent studies have determined that the habitat is in and around the trench feature (Axelsson *et al*., 2017[15]; Moore *et al*., 2017[14]; 2019[16]). Assessments should focus on activities involving significant abrasion or disruption of seabed sediments, those which may significantly alter local water hydrographic and sedimentary processes and those which may lead to an increase in organic particulate matter in the immediate area.
Conserve the current physical structure of the burrowed mud	Conserve the current physical structure of the burrowed mud. Conserve the three dimensional structure created by fauna and flora (e.g., infaunal burrows created by *Nephrops*) that are associated with this habitat.	The habitat is characterised by stable fine muddy substrates supporting burrowing infauna. In this MPA it is composed of the biotope 'Seapens and burrowing megafauna in circalittoral fine mud' (SS.SMu.CFiMu.SpnMeg). The burrowing megafauna characteristic of burrowed mud communities are important bioturbators of the sediment they inhabit. This activity creates a three dimensional structure of burrows which increases the structural complexity and depth of oxygen penetration into the sediments. This enhances the survival of smaller species which can live in the burrows and increases biodiversity in what would otherwise be a generally low diversity habitat (Hughes 1998[9], Widdicombe *et al*., 2004[10]). Burrowing species such as *Nephrops* norvegicus, *Pennatula phosphorea*, *Calocaris macandreae, Callianassa subterranea* and *Goneplax rhomboides* are common within the Southern Trench MPA. These species are also present alongside other burrowing organisms such as *Virgularia mirabilis* and *Munida* sp. (Hirst *et al*., 2012[13]; Moore, 2017[14]). Assessments should focus on activities which may significantly alter water flow characteristics as well as those involving significant abrasion or disruption of seabed sediments.

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
Conserve the functions of the burrowed mud habitat	Conserve the functions provided by burrowed mud and the environmental conditions that support them. Key functions: ▪ Biomass production ▪ Larval/gamete ▪ supply (supporting connectivity) ▪ Habitat for other species (supporting biodiversity) ▪ Carbon storage and climate regulation ▪ Nutrient cycling ▪ Waste breakdown and detoxification of water and sediments Environmental conditions: ▪ Water movement ▪ Water quality ▪ Coastal processes	Burrowed muds support highly productive infaunal and epifaunal communities which contribute to biomass production. Typical species are described in conservation objective 'Composition of its characteristic biological communities'. Burrowed mud communities also provide an important source of prey for many fish, including the commercial species haddock, cod, skate and dogfish. Burrows and mounds created by the larger burrowing species offer habitat for smaller organisms, which increases the overall diversity of the area (Hughes, 1998[9]). These smaller colonisers benefit from the larger burrowers' irrigation activities which supply both oxygenated water and food, whilst potentially offering refuge from predators. Burrowed mud habitat has a function in larval/gamete supply, which can contribute to connectivity with burrowed mud outside the site. Most of the typical species have a planktonic larval stage and may have a long larval duration and high fecundity allowing larvae/gametes to travel outside the site (Gallego *et al.*, 2013[24]). Burrowed mud habitats have the potential for high storage of organic carbon and can have an important contribution to carbon sequestration and climate regulation (Potts *et al.*, 2014[25]). The high densities of detritivores, filter feeders and other supported species contained in burrowed mud result in high nutrient cycling and a high capacity for waste breakdown and detoxification. Bioturbation also increases the structural complexity and depth of oxygen penetration of the sediment, allowing more persistent toxins to become locked in deeper layers of mud. Maintaining the burrowed mud habitat relies on adequate supply of larval recruits and food (plankton, dissolved and particulate matter) and suitable environmental conditions for growth. Environmental conditions, including water movement patterns and water quality are important in the provision of these requirements. Burrowed mud requires weak tidal streams with good water quality, to maintain the conditions needed for the habitat's survival. The overall condition of Southern Trench MPA was 'good' or 'high' under the assessment conducted by SEPA for the Water Framework Directive in 2016. The current status of the parameters provides suitable conditions for

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
		sustaining the burrowed mud. If any of these environmental conditions were to be significantly altered, it could detrimentally affect the function of the burrowed mud. Therefore, the water movement patterns and overall 'good' and 'high' water body status for Southern Trench MPA should be maintained.
Conserve the composition of the characteristic biological communities	Conserve the diversity, abundance and distribution of typical species associated within the burrowed mud (including *Nephrops norvegicus, Pennatula phosphorea, Virgularia mirabilis, Goneplax rhomboides, Munida* sp., *Calocaris macandreae* and *Callianassa subterranea*).	The burrowed mud feature within Southern Trench MPA is described by the burrowed mud biotope SS.SMu.CFiMu.SpnMeg. The most abundant species recorded were *Pennatula phosphorea, Munida* sp., *Calocaris macandreae, Callianassa subterranea* and *Goneplax rhomboides* burrows (Hirst *et al*., 2012[13]; Moore, 2017[14]). At a number of locations between 70 - 188m depth *Pennatula phosphorea* was recorded along with *Virgularia mirabilis, Munida* sp. and crustacean burrows, including *Nephrops norvegicus* and *Goneplax rhomboides*. Other species recorded which are characteristic of the .SpnMeg biotope included *Pagurus bernhardus, Cerianthus lloydii, Chaetopterus* sp., *Liocarcinus depurator, Asterias rubens* and *Amphiura chiajei* (Hirst *et al*., 2012[13]; Moore, 2017[14]). At one station around 87m depth the mud-burrowing amphipod *Maera loveni* was also recorded (Hirst *et al*., 2012[13]). Overall, the site exhibits a high level of biological diversity with an average Shannon's diversity (H') of 3.5 (range of 3.0 - 4.2) and average species richness of 58.8 per 0.1 m^2 (range of 35 - 95 per 0.1 m^2) (Hirst *et al*., 2012[13]). There is a fairly equal distribution of species across the area (Axelsson *et al*., 2017[15]). Assessments should focus on activities involving significant abrasion or disruption of seabed sediments, those which may significantly alter local hydrographic and sedimentary processes and those which may lead to an increase in organic particulate matter in the immediate area. Temporary or minor changes in the characteristic biological communities due to human activity may be considered not to compromise the Conservation Objectives and will be considered on a case-by-case basis.

Fronts

3.4.2.6 The Order lists the fronts feature as a large-scale feature and therefore the meaning of 'favourable condition' is as follows:

- The extent, distribution and structure of that feature is maintained;
- The function of that feature is maintained so as to ensure that it continues to support its characteristic biological communities and their use of the site including for, but not restricted to, feeding, courtship, spawning or use as nursery grounds; and
- The processes supporting that feature are maintained.

3.4.2.7 Reference to the characteristic biological communities of a large-scale feature includes a reference to the diversity of any species associated with the large scale feature.

3.4.2.8 Regional risk assessments have not been completed for large-scale features. The thermal front within the Southern Trench MPA could be sensitive to pressures such as changes in tidal flow or physical changes to the sea bed. Activities (such as marine energy production or other large-scale development) that have potential to cause substantial changes to either water flow or seabed topography could have implications for the structure or distribution of the feature and its functional role within the Southern Trench MPA. Currently most pressures associated with marine anthropogenic activities are considered unlikely to present a significant risk to the fronts feature.

3.4.2.9 The Conservation and Management Advice for the Southern Trench MPA provides the full, detailed Conservation Objectives including site-specific advice and information on the features, how the objectives of the site may be furthered, or their achievement hindered, covering a range of activities (NatureScot, 2020c[6]). Full conservation objectives and advice in relation to fronts are provided in Table 3-2.

Table 3-2: Conservation Objectives with respect to fronts and site-specific information.

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
Extent, distribution and structure	Conserve the extent, distribution and structure of fronts	The fronts within this MPA are determined by a pronounced thermal gradient as well as tidal currents and salinity. The structure of the front varies both spatially and temporally primarily because the strength of the thermal gradient can vary on a seasonal and annual basis. Assessments should focus on activities that may cause changes in hydrography (water flow). Activities (such as marine energy production or other large-scale development), have potential to cause changes to either water flow (Cox *et al*., 2018[26]; De Dominicis *et al*., 2018[27]) could have implications for the extent, distribution and structure of the feature within the MPA and should be considered on a case-by-case basis.
Function of the feature is maintained so as to ensure that it continues to support its characteristic biological communities and their use of the site including, but not restricted to, feeding, spawning, courtship or use as nursery grounds	Conserve the function of the fronts feature so as to ensure that it continues to support its characteristic biological communities and their use of the site including, but not restricted to, feeding, spawning, courtship or use as nursery grounds. Key functions: ▪ Biomass production; ▪ Habitat for other species (supporting biodiversity); ▪ Larvae/gamete supply (supporting connectivity); ▪ Formation of physical barrier; and ▪ Nutrient cycling.	The key functions of fronts are of particular importance within the MPA but also to the wider marine Environment. Fronts cause elevated and concentrated nutrients which in turn concentrate zooplankton-rich waters attracting fish and predators such as minke whale and birds. Fronts also support larval and gamete supply and transport by providing connectivity at various stages of species' life histories, facilitating transport of larvae to suitable habitats elsewhere and retaining larvae as prey for other species. Fronts can act as a physical barrier, for example the sharp temperature changes at fronts may provide migration corridors for some species or act as transport routes for nutrients and sediment. Fronts also enable the circulation and transport of nutrients and oxygen from primary production. Activities that have potential to cause substantial changes to either water flow could have implications for the various functions of the fronts feature within the MPA and therefore effects on the species that depend on it (Cox *et al*., 2018[26]). Assessments should focus on those areas where persistent thermal fronts form and the warm water plumes. Most human activities are considered unlikely to cause significant risk of impact on the fronts feature within the MPA. However very large-scale activities e.g., underwater turbines may affect tidal velocities and mixing by removing tidal energy (De Dominicis *et al*.,

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
		2018[27]) and this may have knock on effects potentially causing changes to the fronts and their associated biological communities.
Processes supporting the feature	Conserve the processes which support the fronts feature, in particular current patterns, freshwater input and local topography.	The underlying processes influencing the overall extent and distribution of the fronts feature in the Southern Trench MPA are not fully understood. It is however likely that wider oceanic current patterns, tidal currents, freshwater input and local topography are important processes supporting fronts in this MPA. The wider oceanic currents supporting the fronts feature are an extension of the northern, cold water Fair Isle currents and a warm-water plume extending out from the inner Moray Firth (Tetley, 2004[28]). These currents are known to vary seasonally and temporally due to variations in the degree of Atlantic water inflow to the North Sea, the volume of freshwater runoff, as well as wind and tide. Activities such as marine energy production or other large-scale development with the potential to substantially alter tidal flow could affect fronts within the MPA and the functions provided (Cox *et al*., 2018[26]; De Dominicis *et al*., 2018[27]). However, most pressures associated with human activity in the marine environment are currently considered unlikely to pose a significant risk to the fronts feature within the MPA.

Minke Whale

3.4.2.10 The Order lists the minke whale feature as a mobile species of marine fauna, and therefore the meaning of 'favourable condition' is as follows:

- The species is conserved or, where relevant, recovered to include the continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds;
- The extent and distribution of any supporting feature upon which the species is dependent is conserved or, where relevant, recovered; and
- The structure and function of any supporting feature, including any associated processes supporting the species within the MPA, is such as to ensure that the protected feature is in a condition which is healthy and not deteriorating.

3.4.2.11 Clause 10 of Section 5 of The Order states that in determining whether a protected feature classed as a mobile species of marine fauna is in favourable condition any alteration to that feature brought about entirely by natural processes is to be disregarded.

3.4.2.12 During the most recent assessment in 2019, the minke whale feature was considered to be in a favourable condition at site level (NatureScot, 2020a[1]).

3.4.2.13 The Conservation and Management Advice for the Southern Trench MPA provides the full, detailed Conservation Objectives, including site-specific advice and information on the features, how the objectives of the site may be furthered, or their achievement hindered, covering a range of activities (NatureScot, 2020a[1]). Full Conservation Objectives and advice in relation to minke are described in Table 3-3.

Table 3-3: Conservation Objectives with respect to minke whale and site-specific advice.

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
Species is conserved	Minke whale in the Southern Trench MPA are not at significant risk from injury or killing.	Sightings of minke whale within the MPA are highest during the months of June to October, however there is evidence that minke whale are present throughout the year, albeit in lower numbers. The interpretation of *'significant'* will depend on factors including the scale of the impact, the duration of the activity and measures that are put in place to minimise the risk. Any activities that take place within or outside the MPA that could kill or injure minke whale in the MPA should be considered in an assessment. An important consideration is whether any killing or injury would result in reduced densities within the site, from which recovery to above average densities cannot be expected.
Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds	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. There are two main ways in which minke whale's access to resources could be restricted and disturbance affected (i.e., large scale physical barriers, or significant disturbance).	Any activities, whether they take place within or outside the MPA, should be considered if they have the potential to reduce access to resources (prey or habitats that may be used during feeding and supporting various stages of their lifecycle) or cause disturbance of minke whale in the MPA. There are two main ways in which minke whale's access to resources could be restricted and disturbance affected. Large-scale physical barriers or obstructions within or outside the MPA may prevent or restrict access to resources to an extent that may result in significant impacts on stages of their life cycle, including feeding. Disturbance may arise from activities that cause underwater noise (including vessel presence). Significant disturbance is defined as resulting in: ▪ The contribution to long term decline in the use of the MPA; ▪ Changes to the distribution on a continuing or sustained basis; and Changes to the behaviour such that it reduces the ability of the species to feed efficiently, breed or survive.

Overarching Conservation Objective	Site-specific Advice	Site-specific Information
Extent and distribution of any supporting feature and structure and function of any supporting feature, including any associated processes supporting the species	Conserve the extent and distribution of any supporting feature upon which minke whale is dependent (i.e., their prey). Conserve the structure and function of supporting features, including processes to ensure minke whale are healthy and not deteriorating.	Main prey species are the lesser sandeel *Ammodytes marinus*, sprat *Sprattus sprattus*, herring *Clupea harengus* and mackerel *Scomber scombrus*. Activities with the potential to cause significant degradation or abrasion of seabed habitats that are suitable for minke whale prey may result in the local depletion of these prey species and ultimately affect minke whale using the site. Therefore, relevant activities (e.g., dredging, aggregate extraction, dumping) should be considered.

Shelf Deeps

3.4.2.14 The Order lists the shelf deeps feature as a large scale feature and therefore the meaning of 'favourable condition' is as defined within Sections 3.4.2.5 – 3.4.2.6 (Fronts).

3.4.2.15 Shelf deep are enclosed topographic depressions on the seabed, in most cases created by glacial erosion during periods of lower sea level, over hundreds of thousands of years. The feature is robust, entirely natural in origin and not considered to have been modified by human activity.

3.4.2.16 Regional risk assessment has not be completed for large scale features. Shelf deeps are robust and not considered to be at risk of significant damage from human activity. Shelf deeps are not considered to be threated and/or declining. Therefore, these features have not been considered further.

3.4.3 Geodiversity Features

Quaternary of Scotland (Subglacial Tunnel Valleys and Moraines)

3.4.3.1 The Order lists subglacial tunnel valleys and moraines as geomorphological features and therefore the meaning of 'favourable condition' is as follows:

- Its extent, component elements and integrity are maintained;
- Its structure and functioning are unimpaired; and
- Its surface remains sufficiently unobscured for the purposes of determining whether the two criteria listed above are satisfied.

3.4.3.2 For the purpose of determining whether a feature of geological or geomorphological interest is sufficiently unobscured, any obscuring of that feature entirely by natural processes is to be disregarded.

3.4.3.3 For the purpose of determining whether a protected feature is in favourable condition within the meaning of geomorphological features, any alteration to that feature brought about entirely by natural processes is to be disregarded.

3.4.3.4 Both geodiversity features are robust, entirely natural in origin and are not considered modified by human activity.

3.4.3.5 Regional risk assessments have not been completed for geodiversity features. However, information is available on the likely sensitivity of these features to pressures arising from human activity (Brooks, 2013[29]). The subglacial tunnel valleys are highly resistant to human activities having been formed originally by glacial scouring. These features (as well as slide scars) are either considered not sensitive, or to have a low sensitivity to pressures arising from human activities. Moraines are relict features that comprise glacial till. Their resistance to erosion is highly variable and depends upon the composition and level of consolidation of the till. Overall, moraines are considered to have a

medium sensitivity to sub-surface abrasion and changes in tidal flow, and a high sensitivity to physical removal.

3.4.3.6 The current feature condition of Quaternary of Scotland is Favourable (NatureScot, 2020a[1]).

Submarine Mass Movement (Slide Scars)

3.4.3.7 The Order lists slide scars as geomorphological features and therefore the meaning of 'favourable condition' is as set out within Sections 3.4.3.1 – 3.4.3.3 (Quaternary of Scotland).

3.4.3.8 This geodiversity feature is robust, entirely natural in origin and are not considered modified by human activity (NatureScot, 2020a[1]).

3.4.3.9 In the vast majority of instances, most pressure associated with human activity in the marine environment will not be sufficient to impact upon geological and geomorphological seabed features (Brooks, 2013[22]). This feature, which formed in bedrock and sediments after the ice sheet had melted, is generally resistant. However as a relic of past processes, it has no resilience. It is considered to have a medium sensitivity to physical removal and to any activities that could cause obscuring (ABPmer, 2009[30]; NatureScot, 2020c[6]).

3.5 Management Strategy

3.5.1.1 NatureScot provides advice to support the management of activities, where it is considered necessary to achieve the Conservation Objectives for protected features. Advice is focused on the activities that may impact sensitive features and where there is a risk to the achievement of the Conservation Objectives. Advice is based on evidence and the understanding of the relationships between features and certain activities. The advice provided may include management to remove or avoid pressures, reduce or limit pressures, or the identify no additional management being required. Management advice can include the implementation of best practice, site-specific conservation measures or research and survey requirements.

3.5.1.2 The management advice for the Southern Trench MPA is provided within the Conservation and Management Advice documentation (NatureScot, 2020c[6]). Conservation and management advice is not provided in relation to fronts and shelf deeps as no additional management is currently identified as required. Advice is also not provided in relation to the geodiversity features of Quaternary of Scotland – Subglacial tunnel valleys and moraines.

3.5.1.3 Cables and pipelines along with Renewable Energy are activities considered to impact the MPA and conservation advice is provided for the biodiversity protected features of burrowed mud and minke whale. Table 3-4 provides a summary of the various management advice provided for burrowed mud and minke whale (NatureScot, 2020c[6]).

Table 3-4: NatureScot (2020c[6]) advice to support management for Southern Trench MPA for activities associated with the Proposed Development (Offshore) which are considered capable of affecting the protected features.

Activities Considered Capable of Affecting the Protected Features	Advice to Support Management	
	Burrowed Mud	Minke Whale
Renewable energy	Reduce or limit pressures: Minimise the potential impact of renewable energy development on burrowed mud habitats via the existing licensing process. Early pre-application discussion is recommended and will assist with the identification of the need for any surveys to map habitats to inform siting and design.	Reduce or limit pressures: Activities associated with renewable energy development that increase the risk of disturbance, acoustic injury, collisions and entanglement of minke whales, such as piling and blasting, mooring lines/anchor lines, should be minimised. Early pre-application discussion is recommended and will assist with the development of key mitigation techniques such as pile management strategies and noise abatement technology. Minimise the potential impact of renewable energy development on the habitat of sandeels. Early discussions on siting, design, construction and any pre-submission surveys are recommended to reduce the potential impacts on the habitat of sandeels to minimise the impact to a key prey species of minke whale.
Cables and pipelines	No existing management required for existing cable and pipeline infrastructure. Reduce or limit pressures: Minimise the footprint of new cables and pipelines within areas of burrowed mud habitat. Early discussion of siting, design and construction is recommended to reduce the potential of impacts. Key details which should be discussed will include pre-application surveys, siting and installation techniques.	Reduce or limit pressures: Early discussion of siting, design and construction is recommended to reduce the risks of disturbance to minke whale caused by the development and installation of new cable and pipeline infrastructure. Key details which should be discussed will include pre-application surveys, siting and installation techniques. This is also recommended to reduce potential impact on the habitat of sandeels. Key details which should be discussed are pre-application surveys, siting and

Activities Considered Capable of Affecting the Protected Features	Advice to Support Management	
	Burrowed Mud	Minke Whale
		installation techniques to avoid key sandeel habitat and to minimise the footprint.
Boat use associated with both commercial and recreational activities (with the exception of Wildlife tour boats – see separate advice below)	No additional management required.	Reduce or Limit Pressures: Reduce risk of collisions with and disturbances of minke whales from boats when watching or attempting to watch marine wildlife by following the Scottish Marine Wildlife Watching Code. Reduce risks of collisions and disturbance from licensable activities that result in increased vessel traffic for defined periods for example through the use of vessel management plans as part of the consenting/licensing process. This may include agreed routes and potential speed restrictions.
Wildlife tour operators	No additional management required.	Reduce or limit pressures Reduce risk of collisions with and disturbance of minke whales from boats by following the Scottish Marine Wildlife Watching Code and the WiSe (Wildlife Safe) accreditation scheme.

4 Aspects of the Proposed Development (Offshore) with Potential to have a Significant Risk on the Conservation Objectives of the MPA

4.1 Introduction

4.1.1.1 This section sets out those activities associated with the Proposed Development (Offshore) that have the potential to have a risk of hindering the achievement of the Conservation Objectives of the Southern Trench MPA. These are identified both in a Proposed Development (Offshore) alone and cumulative capacity.

4.1.1.2 The Proposed Development (Offshore) comprises of the Caledonia OWF (as divided into Caledonia North Site and Caledonia South Site), associated inter-array/interconnector cabling and OSP infrastructure, Caledonia North OECC, Caledonia South OECC and the Landfall Site (see Figure 1-1).

4.1.1.3 The Caledonia OWF and associated inter-array/interconnector cabling and OSP infrastructure does not directly interact with the Southern Trench MPA. The distance from the Caledonia OWF to the Southern Trench MPA is approximately 13km at its closest point. As such, these elements of the Proposed Development (Offshore) are likely to only have a direct effect upon the protected features of minke whale. Consideration has also been given to whether there is likely to be indirect effects upon the biodiversity feature of burrowed mud and the potential to affect the geodiversity features. The potential for non-native invasive species to be spread within the Southern Trench MPA also requires consideration.

4.1.1.4 The Caledonia North OECC and Caledonia South OECC will cross the Southern Trench MPA, which could potentially impact directly and indirectly upon the biodiversity and geodiversity features of the MPA. These will comprise of up to four offshore export cables (two for Caledonia North and two for Caledonia South), running from the Caledonia OWF to the Landfall Site over a maximum distance of approximately 180km (the total length of offshore export cables will be up to a maximum of 180km for Caledonia North and up to a maximum of 150km for Caledonia South). However, of relevance to this MPA Assessment, the length of offshore export cables which is anticipated to overlap the Southern Trench MPA is approximately 24km per offshore export cable. All offshore export cables will be located in separate trenches within the Caledonia North OECC and Caledonia South OECC, making landfall at Stake Ness on the Aberdeenshire coast via horizontal direction drilling.

4.1.1.5 The following text describes the potential effects that could cause significant risk for the biodiversity features.

4.2 Proposed Development (Offshore) Alone

4.2.1 Biodiversity Features

Burrowed Mud

4.2.1.1 Conservation and Management Advice for the Southern Trench MPA states that assessments should focus on activities involving significant abrasion or disruption of seabed sediments, those which may significantly alter local water hydrographic and sedimentary processes and those which may lead to an increase in organic particulate matter in the immediate area (NatureScot, 2020c[6]).

4.2.1.2 The potential effects of relevance to burrowed muds are identified in Table 4-1, including the types of activity that could result in such effects at different stages of development.

Table 4-1: Potential effects from the Proposed Development (Offshore) alone on burrowed mud.

Potential Effect	Activities Potentially Resulting in Effect		
	Construction	O&M	Decommissioning
Physical habitat loss/ disturbance	▪ Installation of structures; ▪ Seabed preparation; ▪ Seabed dredging; ▪ Sediment disposal; ▪ Installation of scour or cable protection; ▪ Vessel movements/ anchoring; and ▪ All in-combination effects.	▪ Physical presence of structures; ▪ Maintenance of structures; ▪ Presence of scour or cable protection; and ▪ All in-combination effects	Anticipated to be equal to or less than during construction.
Increased SSC and deposition of disturbed sediments to the seabed	▪ Installation of structures; ▪ Seabed preparation; ▪ Seabed dredging; ▪ Sediment disposal; ▪ Installation of scour or cable protection; ▪ Vessel movements/ anchoring; and ▪ All in-combination effects.	▪ Maintenance of structures; and ▪ All in-combination effects	Anticipated to be equal to or less than during construction.
Direct and indirect seabed disturbance leading to release of sediment contaminants	▪ Release of contaminants; ▪ Release of sediment (via all activities listed for suspended sediment/ deposition above); and ▪ All in-combination effects	▪ Release of contaminants; ▪ Release of sediment (via all activities listed for suspended sediment/ deposition above); and ▪ All in-combination effects	Anticipated to be equal to or less than during construction.
Marine Invasive Non-Native Species (MINNS)	▪ Installation of scour or cable protection; ▪ Vessel movements/ anchoring; and ▪ All in-combination effects.	▪ Vessel movements on and off site; ▪ Maintenance Activities; ▪ Physical presence of structures; and ▪ All in-combination effects.	Anticipated to be equal to or less than during construction.
Changes to physical processes	N/A	▪ Presence of cable and scour protection (where required).	N/A

Minke Whale

4.2.1.3 The Caledonia OWF's construction of the WTG foundations and associated works could potentially impact upon minke whale as well as the installation of the offshore export cabling and completion of the geophysical and geotechnical survey campaigns.

4.2.1.4 The following impacts are scoped into the Proposed Development (Offshore), Caledonia North and Caledonia South alone assessment for minke whales (see Table 4-2).

Table 4-2: Potential effects from the Proposed Development (Offshore) alone on minke whale.

Potential Effect	Activities Potentially Resulting in Effect		
	Construction	O&M	Decommissioning
Injury or killing	▪ Unexploded ordnance (UXO) clearance ▪ High-resolution geophysical surveys ▪ Piling ▪ Other construction activities ▪ Entanglement ▪ Vessel collision	▪ High-resolution geophysical surveys ▪ Entanglement ▪ Vessel collision	▪ Anticipated to be equal to or less than during construction.
Disturbance	▪ UXO ▪ High-resolution geophysical surveys ▪ Piling ▪ Vessel movements on and off-site ▪ Other construction activities	▪ Vessel movements on and off-site ▪ High-resolution geophysical surveys ▪ Operational noise	▪ Anticipated to be equal to or less than during construction.
Impacts on supporting features and processes	▪ Changes in fish abundance and distribution ▪ Changes to habitats (benthic features) and processes (fronts)	▪ Changes in fish abundance and distribution ▪ Changes to habitats (benthic features) and processes (fronts)	▪ Anticipated to be equal to or less than during construction.
Physical barriers	N/A	▪ Presence of infrastructure	N/A

Fronts

4.2.1.5 The thermal front feature within the Southern Trench MPA is potentially sensitive to pressures such as changes in tidal flow or physical changes to the seabed. As such it is possible that the construction and operation and maintenance (O&M) of the WTG foundations could affect the tidal, current and wave regimes through modifying stratification and associated frontal features.

4.2.1.6 The installation of the offshore export cables within the Caledonia North OECC and Caledonia South OECC may result in changes to seabed topography, which could potentially influence on the frontal features.

4.2.1.7 The potential effects of relevance to fronts are identified in Table 4-3, including the types of activity, that could result in such effects at different stages of development.

Table 4-3: Potential effects from the Proposed Development (Offshore) alone on fronts.

Potential Effect	Activities Potentially Resulting in Effect		
	Construction	O&M	Decommissioning
Modifications to the wave and tidal regimes	▪ N/A	▪ Physical presence of structures; and ▪ Presence of scour or cable protection.	N/A
Potential impacts to seabed topography	▪ Seabed preparation; ▪ Seabed dredging; ▪ Sediment disposal; ▪ Installation of scour or cable protection; and ▪ Vessel movements/ anchoring.	▪ Presence of scour or cable protection.	Anticipated to be equal to or less than during construction.

4.2.2 Geodiversity Features

4.2.2.1 As outlined by NatureScot (2020c[6]), the geodiversity features located in the Southern Trench MPA are robust, entirely natural in origin and are considered either not sensitive, or to have a low sensitivity to pressures arising from human activities. In the vast majority of instances, most pressure associated with human activity in the marine environment will not be sufficient to impact upon geological and geomorphological seabed features (Brooks, 2013[22]).

Quaternary of Scotland (Subglacial Tunnel Valleys and Moraines)

4.2.2.2 The subglacial tunnel valleys are highly resistant to human activities having been formed originally by glacial scouring. There is no pathway of effect identified that could impact on these features and therefore they have not been considered further.

4.2.2.3 Moraines are relict features that comprise glacial till. Their resistance to erosion is highly variable and depends upon the composition and level of consolidation of the till. Overall, moraines are considered to have a medium sensitivity to sub-surface abrasion and changes in tidal flow, and a high sensitivity to physical removal.

4.2.2.4 As indicated on Figure 3-2, these features are present towards the east of the MPA, and no interaction with activities relating to the Proposed Development (Offshore) will take place in terms of physical removal or sub-surface abrasion.

4.2.2.5 Although the presence of WTG foundations have the potential to lead to changes in hydrography, these changes (as demonstrated by the numerical modelling results summarised in Volume 2, Chapter 2: Marine and Coastal Processes) will be small-scale and localised. Due to the distance between the moraine features and the Array Area the presence of the foundations will not impact the extent, distribution, or structure of the feature within the MPA.

Submarine Mass Movement (Slide Scars)

4.2.2.6 These features, which form in bedrock and sediments after the ice sheet had melted, are generally resistant. They are considered to have a medium sensitivity to physical removal and to any activities that could cause obscuring (ABPmer, 2009[30]; NatureScot, 2020b[5]).

4.2.2.7 As indicated on Figure 3-2, these features are present towards the east of the MPA, and no interaction with activities relating to the Proposed Development (Offshore) will take place. There is no pathway of effect identified that could impact on this feature and therefore it has not been considered further.

4.3 Cumulative

4.3.1.1 In addition to the Proposed Development (Offshore) alone assessment, the activities associated with the Proposed Development (Offshore) and their cumulative effects in relation to other activities need to be considered and assessed.

4.3.1.2 In relation to the Caledonia OWF (i.e., Array Area) and cumulative effects, these are only likely to occur for the biodiversity feature of minke whale. All other protected features associated with the Southern Trench MPA will not be directly or indirectly connected to activities taking place that are associated with the construction, operation, maintenance or decommissioning of the WTG, OSPs or inter-array/interconnector cables. Other activities that may

therefore have an impact upon minke whale are considered to be other ScotWind/Innovative and Targeted Oil and Gas (INTOG) projects within the Moray Firth region.

4.3.1.3 In relation to the Caledonia North OECC and Caledonia South OECC, there is potential for other activities associated with cables and pipelines to have a cumulative effect on all biodiversity and geomorphological features through the cumulative effects in relation to the extent and distribution and function of burrowed mud and minke whale populations. Other activities that may therefore have a cumulative impact upon protected features are considered to be the offshore export cables associated with other ScotWind/INTOG projects as well as construction of new power or telecommunications cables or new pipeline installations.

4.3.1.4 The conservation and management advice and Conservation Objectives for the Southern Trench MPA state that existing cables and pipelines can be disregarded as a significant risk to hindering the Conservation Objectives.

4.3.1.5 The potential impacts remain the same as for the Proposed Development (Offshore) alone assessment (see Section 4.2).

5 Assessment of Risk to Achievement of Conservation Objectives

5.1 Proposed Development (Offshore) Alone Assessment

5.1.1 Biodiversity Features

Burrowed Mud

5.1.1.1 Burrowed mud habitats are highly sensitive to physical disturbance caused by a range of activities. Activities that cause physical disturbance including penetration, abrasion or removal of the seabed can be highly damaging to both mobile and sessile epifaunal and infaunal species that characterise the habitat type. Physical disturbances leading to water flow, wave exposure and pronounced siltation alterations are also detrimental as burrowing species experience feeding rate disruption and greater energy expenditure that impacts reproduction and recruitment. Burrowed mud habitats are also particularly vulnerable to pollution. High fluxes of nutrients or organic material can cause hypoxia and physical burial leading to defaunation, alteration of species composition and changes to ecosystem functioning. Burrowing species do have the capacity to recover from such impacts (albeit this may be slowly) provided that the habitat has not been permanently changed, pressures that they are sensitive to are removed/avoided, suitable environmental conditions are maintained and that there are undisturbed neighbouring burrowed mud communities which can recolonise the area.

Physical Habitat Loss/Disturbance

5.1.1.2 This section addresses the potential for non-conformance with Conservation Objectives associated with the potential for physical habitat loss or disturbance expected from construction and decommissioning activities. It should be noted that during the construction and decommissioning phase that any habitat loss or disturbance is considered temporary. Any potential permanent habitat loss is discussed in the O&M section. This assessment should be read in conjunction with Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology, Volume 2, Chapter 2: Marine and Coastal Processes and Volume 7B, Appendix 2-1: Marine and Coastal Processes Technical Report which provides further detail on the potential effect from temporary habitat disturbance. Table 4-23 within Volume 2, Chapter 4: Benthic and Intertidal Ecology also presents the worst case scenario associated habitat loss/disturbance.

5.1.1.3 The Caledonia North OECC and Caledonia South OECC overlap with approximately 108km^2 of the Southern Trench MPA, which equates to 4.5% of the total MPA. Within this, approximately 2.8km^2 within the Southern Trench MPA will be affected by habitat loss disturbance, equating to 0.12% of the total area of the MPA.

5.1.1.4 Site specific surveys indicated that within the area of the Caledonia North OECC and Caledonia South OECC coinciding with the Southern Trench MPA sediments are characterised predominantly by muddy sand. The communities present are typical of high energy environments and are therefore naturally subject to, and tolerant of, high levels of physical disturbance. the majority of benthic habitats that are predicted to be affected by a direct temporary habitat disturbance of this nature are common and widespread throughout the wider region. The temporary habitat disturbance during construction and decommissioning activities would therefore impact a very limited footprint, particularly when compared to the overall extent of such habitats. This loss is not expected to undermine regional ecosystem functions or diminish biodiversity.

5.1.1.5 Whilst this impact will occur within the Southern Trench MPA, where the Caledonia North OECC and Caledonia South OECC overlaps, the impact on benthic habitats is predicted to be of local spatial extent (i.e., restricted to discrete areas within the Proposed Development (Offshore)), of a short-term duration (as it is limited to the duration of construction and decommissioning activities), intermittent and with high reversibility.

5.1.1.6 The communities that predominantly characterise these biotopes include infaunal mobile species such as polychaetes and bivalves. Such species can re-enter the substratum following a temporary habitat disturbance of this nature. The recoverability of such communities is likely to occur as a result of a combination of recruitment from surrounding unaffected areas and larval dispersal, and recovery is likely to occur within one to ten years based on the MarESA assessments (Table 4-24, Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology).

5.1.1.7 The assessment against relevant Conservation Objectives is provided in Table 5-1.

Table 5-1: Assessment against conservation objective "Species is conserved".

Site-specific Advice	Assessment Conclusion
Conserve the current extent and distribution of burrowed mud habitat within the site so that it is stable or increasing.	Given the short-term nature of the disturbance and the existing tolerance to disturbance of the benthic habitats present, and the predicted medium to high recoverability of the biotopes, that the sites conservation objectives in relation to conserving the current extent of the burrowed mud feature will be maintained in the long-term.
Overall conclusion: There is, therefore, **no potential for non-conformance**, having regard to the Conservation Objectives of the burrowed mud feature of the Southern Trench MPA in relation to physical habitat loss/disturbance from the Proposed Development (Offshore) alone and therefore, subject to natural change, the feature will be maintained in the long term.	

Increased SSC and Deposition of Disturbed Sediment to the Seabed

5.1.1.8 This section addresses the potential for non-conformance with Conservation Objectives from effects associated with the dispersion of suspended sediments and any associated deposition and smothering, expected from foundation and cable installation works (including intertidal works) and seabed preparation works. This assessment should be read in conjunction with Volume 7B, Appendix 2-1: Marine and Coastal Processes Technical Report and Volume 7B, Appendix 2-2: Marine and Coastal Processes Modelling Report which provides the detailed offshore physical environment assessment (including project specific spreadsheet modelling of sediment plumes). Table 4-23 within Volume 2, Chapter 4: Benthic and Intertidal Ecology also presents the worst case scenario associated with increases in SSC and deposition.

5.1.1.9 During the construction and decommissioning of the Proposed Development (Offshore), sediment will be disturbed and released into the water column. This will give rise to suspended sediment plumes and localised changes in seabed levels as material settles out of suspension.

5.1.1.10 The maximum distance and as such the overall spatial extent that any resultant plume might be reasonably experienced can be estimated as the spring tidal excursion distance. Any location beyond the tidal excursion distance is unlikely to experience any measurable change in SSC from a sediment plume. Given the nature of the sediment disturbance (temporary), any impacts are also anticipated to be short-lived, with any deposited material re-worked. Specifically, numerical modelling of the dispersion of fine sediment released during cable installation activities was predicted to result in a plume with a peak SSC of more than 50mg/l, but the area with elevated SSC was very localised to where the activity was being undertaken with very limited transport of the suspended sediment predicted. This is a result of the low tidal

currents combined with the sediment being released relatively close to the seabed.

5.1.1.11 Increases in SSC were predicted by the model to be short lived with increases of more than 25mg/l occurring for less than 7.2 hours and increases of more than 5mg/l occurring for less than six days.

5.1.1.12 Sedimentation of 2-3mm was predicted along the OECC, reducing to values of less than 0.1mm at a short distance from where the sediment release was applied in the model.

5.1.1.13 Note the sediment plume and deposition modelling takes into consideration a single sediment dispersion event, from the deposition of one hopper load of sediment. As informed by the modelling, a single deposition event will result in the rapid dissipation of the sediment plume and localised deposition impacts. However, due consideration should also be given to the volume of sediment dispersion and deposition during the entire construction phase. It is likely that the sediments being dispersed and deposited locally will be combined during dispersion events and therefore increased deposition and SSC are expected compared to the single event modelling, discussed above.

5.1.1.14 Taking the above into consideration, the impact of increased SSC and smothering from sediment deposition associated with construction activities is noticeable but temporary, with the majority of effects limited to the near field. Whilst this will occur within the Southern Trench MPA the impact is considered to be low and is expected to be localised.

5.1.1.15 The assessment against relevant Conservation Objectives is provided in Table 5-2.

Table 5-2: Assessment against conservation objectives "Species is conserved" and "function is conserved".

Site-specific Advice	Assessment Conclusion
Conserve the current extent and distribution of burrowed mud habitat within the site so that it is stable or increasing.	Given the short-term nature of the disturbance and the existing tolerance to disturbance of the benthic habitats present, and the predicted medium to high recoverability of the biotopes, that the sites conservation objectives in relation to conserving the current extent of the burrowed mud feature will be maintained in the long-term.
Conserve the function of the fronts feature so as to ensure that it continues to support its characteristic biological communities and their use of the site.	Given the short-term and temporary nature of the construction and decommissioning works, the reversibility of effect, recoverability of receptors, and the localised nature of effects that the conservation objectives will be maintained in the long-term for the Southern Trench MPA.
Overall conclusion: There is, therefore, **no potential for non-conformance** with Conservation Objectives, having regard to the conservation objectives of the Southern Trench MPA in relation to suspended sediment/deposition from the Proposed Development (Offshore) alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.	

Direct and Indirect Seabed Disturbance Leading to Release of Sediment Contaminants

5.1.1.16 There is potential for sediment bound contaminants, such as metals, hydrocarbons and organic pollutants, to be released into the water column and lead to an effect on benthic ecology receptors, as a result of construction and decommissioning activities and associated sediment mobilisation. As detailed within Volume 2, Chapter 4: Benthic Subtidal and Intertidal Ecology, the impact of direct and indirect seabed disturbances leading to the release of sediment contaminants is considered to be of negligible magnitude due to sediment contaminants being below both guideline and action levels, where relevant (i.e., levels are below those deemed to have the potential to result in deleterious effects on fauna).

5.1.1.17 The results of the sediment contaminant survey that has been undertaken revealed that across the Caledonia North OECC and Caledonia South OECC metal and organic contaminant concentrations were well below their respective guideline limits.

5.1.1.18 The total area that is likely to be disturbed by construction activities, and therefore the potential volume of material disturbed, resulting in the potential release of sediment bound contaminants is small and localised in extent.

5.1.1.19 Following disturbance caused by construction and decommissioning activities, the majority of re-suspended sediments are expected to be deposited in the

immediate vicinity of the works. The release of any contaminants is likely to be rapidly dispersed with the tide and/or currents. Therefore, increased bioavailability resulting in adverse eco-toxicological effects is not expected.

5.1.1.20 The assessment against relevant conservation objectives is provided in Table 5-3.

Table 5-3: Assessment against conservation objective "Conserve the composition of the characteristic biological communities".

Site-specific Advice	Assessment Conclusion
Conserve the composition of the characteristic biological communities	Given the short-term nature of the disturbance and the existing tolerance to disturbance of the benthic habitats present, and the predicted medium to high recoverability of the biotopes, that the sites conservation objectives in relation to conserving the current composition of the biological communities of the burrowed mud feature will be maintained in the long-term.
Overall conclusion: There is, therefore, **no potential for non-conformance** with Conservation Objectives, having regard to the conservation objectives of the Southern Trench MPA in relation to suspended sediment/deposition from the Proposed Development (Offshore) alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.	

Marine Invasive Non-Native Species (MINNS)

5.1.1.21 There will be a requirement for construction and O&M vessels to make round trips to and from port during all development phases, which will contribute to the risk of introduction or spread of MINNS in ballast water (should any of these contain ballast water and arrive from a non UK port). It should be noted that it is by no means certain that any vessel will arrive from a non-UK port and/or contain ballast water, especially given the type of vessels involved and the proximity of the Proposed Development (Offshore) to UK ports. A series of mitigation measures are, nonetheless, proposed including a Project Environmental Management Plan with a marine biosecurity plan which will ensure that the risk of potential introduction and spread of MINNS is appropriately managed.

5.1.1.22 There is a lack of evidence to date from other offshore wind farm developments within the North Sea having had any adverse effects on key species and habitats through increasing the spread of MINNS.

5.1.1.23 It is concluded that due to the lack of evidence of any adverse effect from MINNS and offshore wind farms and the proposed mitigation there is a low risk of promoting the spread of MINNS.

5.1.1.24 The assessment against the relevant Conservation Objective is provided in Table 5-4.

Table 5-4: Assessment against conservation objective "Conserve the composition of the characteristic biological communities".

Site-specific Advice	Assessment Conclusion
Conserve the composition of the characteristic biological communities	Given the lack of any overlap between the Caledonia OWF and the Southern Trench MPA where the majority of vessel movements will occur within the Caledonia OWF and therefore offering further limited potential for a linkage between any MINNS and the MPA, it is considered that the sites conservation objective in relation to conserving the current composition of the biological communities of the burrowed mud feature will be maintained in the long-term.
Overall conclusion: There is, therefore, **no potential for non-conformance** with Conservation Objectives, having regard to the conservation objectives of the Southern Trench MPA in relation to MINNS from the Proposed Development (Offshore) alone during construction and decommissioning and therefore, subject to natural change, the designated features will be maintained in the long-term.	

Changes to Physical Processes

5.1.1.25 The presence of foundations, scour protection and cable protection material may introduce changes to the local hydrodynamic and wave regime, resulting in changes to the sediment transport pathways and associated effects on benthic subtidal and intertidal ecology. Scour and increases in flow rates can change the characteristics of the sediment potentially making the habitat less suitable for some species.

5.1.1.26 It has been determined Volume 2, Chapter 2: Marine and Coastal Processes that the impacts on hydrodynamic and wave regimes will be not significant to coastal and physical processes and will therefore not result in any significant changes to sediment transport. As the OECC passes directly through the MPA there may be changes to the local hydrodynamic regime due to the addition of cable protection. In areas of active sediment transport, following installation, and under favourable hydrodynamic conditions, an initial period of sediment accumulation would be expected to occur, creating a smooth slope against the cable protection. Once any void spaces have been infilled, siltation is expected to be largely unaffected by the presence of the cable protection such that existing transport process will remain unaffected.

5.1.1.27 Therefore, based on both the lack of significant changes to physical processes and the small proportion of the MPA impacted there is no potential for risk to the Conservation Objectives of burrowed mud in relation to changes to physical processes from the Proposed Development (Offshore) alone during O&M and, subject to natural change, the burrowed mud will be maintained in the long-term.

5.1.1.28 The assessment against the relevant Conservation Objective is provided in Table 5-5.

Table 5-5: Assessment against conservation objective "Conserve extent, distribution and structure".

Site-specific Advice	Assessment Conclusion
Conserve the extent, distribution and structure	Given the lack of any overlap between the Caledonia OWF and the Southern Trench MPA, the hydrodynamic and wave regimes will not be significantly changed and therefore offer limited potential for a linkage between increased sediment transport to the MPA, along with unaffected transport in relation to the offshore export cables, it is considered that the Conservation Objective in relation to conserving the current composition of the biological communities of the burrowed mud feature will be maintained in the long-term.
Overall conclusion: Based on both the lack of significant changes to physical processes and the small proportion of the Southern Trench MPA impacted there is **no potential for non-conformance** to the Conservation Objectives of the designated features of the identified sites in relation to changes to physical processes from the Proposed Development (Offshore) alone during O&M and, subject to natural change, the designated features will be maintained in the long-term.	

Fronts

5.1.1.29 Guidance provided by NatureScot (2020c[6]) identifies the thermal front feature within the Southern Trench MPA as potentially sensitive to pressures such as changes in tidal flow or physical changes to the seabed. Activities such as marine energy production that have potential to cause substantial changes to either water flow or seabed topography could therefore have implications for the structure or distribution of the feature and its functional role within the Southern Trench MPA.

5.1.1.30 Interactions between WTG foundations and the baseline metocean regime (waves, tides) may result in localised changes to tidal current speeds, wave energy and turbulence. These changes result in the generation of localised turbulent wakes (Dorrell *et al*., 2022[31]), which have the potential to modify stratification and associated frontal features.

5.1.1.31 Available evidence suggests that modifications to turbulent mixing from WTG foundations would not be sufficient to cause significant changes to thermal stratification in the vicinity of the Caledonia OWF and furthermore would not reach the area of haline stratification located along the southern coast of the Moray Firth. This is supported by numerical modelling results presented in Volume 2, Chapter 2: Marine and Coastal Processes.

5.1.1.32 Changes in depth, average current speed and direction are predicted to be small in absolute and relative terms. The highest flow speed modification, in terms of distance, is simulated during spring high water, with a decrease of flow observed in the lee of the structure 7km downwind, although the change is below 0.01m/s after 1.5km from the WTG foundations. The increase of flow is shown to occur adjacent to the structure, with a maximum observed

distance of 9km in one area located in the south of the Caledonia OWF, with the change also below 0.01m/s after 1.5km from the WTG foundations.

5.1.1.33 Given the coastal location of the frontal features, modifications to tidal currents within 1.5km of the Caledonia OWF are not expected to impact on stratification due to distance from the feature. In terms of potential changes to seabed topography, fronts are large-scale dynamic features which occur on the same or similar spatial and temporal scale as wider oceanic current patterns (NatureScot, 2020c[6]). The controlling topography is therefore of a greater scale than that which could be modified by any works within the Caledonia North OECC and Caledonia South OECC. Potential activities that may influence seabed topography within the Caledonia North OECC and Caledonia South OECC are therefore considered unable to present a significant risk to the fronts feature.

5.1.1.34 Considering a limited spatial extent of impacts, it can be concluded that there is no significant risk of modification or disruption to the frontal feature within the Southern Trench MPA. The assessment against Conservation Objectives is provided in Table 5-6.

Table 5-6: Assessment against the conservation objectives for the fronts feature.

Site-specific Advice	Assessment Conclusion
Conserve the extent, distribution and structure of fronts	Although the presence of WTG foundations will lead to changes in hydrography, these changes (as demonstrated by the numerical modelling results provided in Volume 2, Chapter 2: Marine and Coastal Processes) will be small-scale and localised. Due to the distance between the frontal features and the Array Area the presence of the foundations will not impact the extent, distribution, or structure of the feature within the MPA.
Conserve the function of the fronts feature so as to ensure that it continues to support its characteristic biological communities and their use of the site including, but not restricted to, feeding, spawning, courtship or use as nursery grounds.	Although the presence of WTG foundations will lead to changes in hydrography, these changes (as demonstrated by the numerical modelling results provided in Volume 2, Chapter 2: Marine and Coastal Processes) will be small-scale and localised. Due to the distance between the frontal features and the Array Area the presence of the foundations will not impact the functions of the fronts feature within the MPA and therefore effect on the species that depend on it.
Conserve the processes which support the fronts feature, in particular current patterns, freshwater input and local topography.	Although the presence of WTG foundations will lead to changes in hydrography, these changes (as demonstrated by the numerical modelling results provided in Volume 2, Chapter 2: Marine and Coastal Processes) will be small-scale and localised. Due to the distance between the frontal features and the Array Area the presence of the foundations will not impact the processes which support the fronts feature.
Overall conclusion: Potential modifications to hydrography from the Proposed Development (Offshore) are limited in spatial extent and will not interact with the frontal feature. The achievement of these Conservation Objectives are, therefore, **not at risk** of being hindered.	

Minke Whale

5.1.1.35 The assessment of risk to the achievement of the Conservation Objectives for the minke whale biodiversity feature provided in sections below considers three scenarios: the Proposed Development (Offshore); Caledonia North; and Caledonia South. The magnitude of most impacts will be similar for all three scenarios, as some of impacts are wide-ranging (e.g., underwater noise due to piling) and the spatial extent of overlap of the OECC with the Southern Trench MPA for the three scenarios is the same. Where impacts due to the construction and O&M phases of the Proposed Development (Offshore), Caledonia North and Caledonia South are different, those differences are highlighted in the assessment.

Injury or Killing (Construction and O&M)

Underwater Noise

5.1.1.36 This section provides an assessment of the risk of injury and killing from UXO clearance, piling, other construction activities and geophysical surveys. As per the site-specific advice, any activities that take place within or outside the Southern Trench MPA that could kill or injure minke whale in the MPA are considered in this assessment. Given that entanglement and vessel collisions have been documented to cause mild to severe injuries including death, both impacts were also considered in this section.

UXO Clearance

5.1.1.37 There is the potential for UXOs to be located within the Caledonia OWF and Caledonia North OECC and Caledonia South OECC, with the OECCs overlapping with the Southern Trench MPA. High order UXO detonation is not being assessed in the EIAR or this MPA assessment, as Caledonia Offshore Wind Farm Ltd (the Applicant) has committed to low-order deflagration which has been shown to be a viable and effective method of UXO clearance at Moray West (Abad Oliva *et al.*, 2024[32]).

5.1.1.38 The maximum Permanent Threshold Shift (PTS)-onset impact range for low-order clearance was predicted to be 230m for minke whales (SEL_{cum}), which could cover the area of less than 0.01% of the MPA (Table 5-7).

5.1.1.39 The Applicant has committed to low order clearance and implementing Marine Mammal Mitigation Protocols (MMMPs) for Caledonia North (Volume 7, Appendix 13: Caledonia North Draft Marine Mammal Mitigation Protocol) and Caledonia South (Volume 7, Appendix 14: Caledonia South Draft Marine Mammal Mitigation Protocol). Indicative mitigation measures presented in the draft MMMPs include pre-clearance visual search by two MMOs over a standard mitigation zone of 1km that will continue over the duration of clearance operations and at least 15 minutes after it is finished. In line with Joint Nature Conservation Committee (JNCC, 2023[33]) draft guidance, since the modelled auditory injury zone is less than 1km for low-order deflagration, the use of acoustic deterrents and noise abatement is not considered necessary.

5.1.1.40 Although the exact mitigation measures contained with the final MMMPs are yet to be determined, they will be in line with the latest relevant guidance at the time of this stage of Caledonia North and Caledonia South. Due to relatively small impact ranges, it is considered that the impact of auditory injury can be fully mitigated. Considering the above, no auditory injury to minke whales within the MPA is expected from UXO clearance taking place within the MPA (along the OECC) or outside of the MPA (in the Caledonia OWF).

Table 5-7: Auditory injury from low-order UXO clearance (deflagration).

Charge Weight	Metric	Impact Range (m)	Effects within the MPA	
			Overlap (km^2)	% MPA Area
0.25kg	SPL_{peak}	170	0.091	<0.01
	SEL_{cum}	230	0.166	<0.01

Piling

5.1.1.41 The modelling location closest to the MPA has been considered in this section, thus providing a precautionary assessment. Modelling location 8 is located at the southern end of the Caledonia OWF/Caledonia South Site, approximately 13.5km from the MPA. Three different foundation types were considered at modelling location 8 during underwater noise due to their potential to have greatest effects (monopiles, pin pile for jacket foundation or pin piles for floating foundation anchors). For the Caledonia North Site, modelling location 4 is located approximately 26km from the MPA and two foundation types were considered during underwater noise modelling (monopiles and jackets with pin piles).

5.1.1.42 The maximum instantaneous PTS-onset range for minke whale is less than 50m for all foundation design types and, as such, there will therefore be no risk of animals within the MPA experiencing instantaneous PTS impact (for both, modelling location 4 and 8; Table 5-8).

5.1.1.43 For modelling location 8 (Caledonia OWF and Caledonia South Site), the maximum cumulative PTS impact range was predicted to be 34km for monopiles, 34km for pin-piles and 16km for anchors. The impact ranges summarised in this MPA Assessment and detailed in Volume 7, Appendix 6: Underwater Noise Technical Note were rounded (SPL_{pk} to 50m and SEL_{cum} to 100m). This results in a maximum overlap of 18.75% with the MPA area for piling of monopiles (Table 5-8).

5.1.1.44 For modelling location 4 (Caledonia North), the maximum cumulative PTS impact range was predicted to be 32km for monopiles and 31km for pin-piles. This results in a maximum overlap of 0.36% with the MPA area for piling of monopiles (Table 5-8).

5.1.1.45 In consultation for the Proposed Development (Offshore), NatureScot recognised that the modelling for cumulative PTS (using the SEL_{cum} metric) is overly precautionary and could lead to an over-estimation of impact zones. Refer to Volume 7B, Appendix 7-2: Underwater Noise Assessment Methodology of the EIAR for more details regarding precaution in underwater noise modelling and cumulative metric.

Table 5-8: Auditory injury from piling at modelling location 8 (Caledonia OWF and Caledonia South Site) and location 4 (Caledonia North Site).

Modelling Location	Metric	Foundation Type	Impacted Area (km^2)	Maximum Impact Range (km)	Effects within the MPA	
					Overlap (km^2)	% MPA Area
8	SPL_{peak}	Monopile	0.01	0.05	0.00	0.00
		Jacket	0.01	0.05	0.00	0.00
		Anchor	0.01	0.05	0.00	0.00
	SEL_{cum}	Monopile	2,500	34	475.56	18.75
		Jacket	2,300	34	370.99	14.63
		Anchor	890	20	0.015	<0.01
4	SPL_{peak}	Monopile	0.01	0.05	0.00	0.00
		Jacket	0.01	0.05	0.00	0.00
	SEL_{cum}	Monopile	2,200	32	8.87	0.36
		Jacket	1,900	31	0.00	0.00

5.1.1.46 It is important to note here that cumulative PTS is determined with the assumptions that:

- The amount of sound energy an animal is exposed to within 24 hours will have the same effect on its auditory system, regardless of whether it is received all at once (i.e., with a single bout of sound) or in several smaller doses spread over a longer period (called the equal-energy hypothesis); and
- The sound keeps its impulsive character, regardless of the distance to the sound source.

5.1.1.47 However, in practice:

- There is a recovery of a threshold shift caused by the sound energy if the dose is applied in several smaller doses (e.g., between pulses during pile driving or in piling breaks) leading to an onset of PTS at a higher energy level than assumed with the given SEL_{cum} threshold; and
- Pulsed sound loses its impulsive characteristics while propagating away from the sound source, resulting in a slower shift of an animal's hearing threshold than would be predicted for an impulsive sound.

5.1.1.48 Both assumptions lead to a conservative determination of the impact ranges. For example, if recovery between pulses is accounted for by increasing the PTS threshold by 3 dB then the maximum cumulative PTS impact range for a

monopile reduces from 34km (location 8) to 23.3km (18.75% MPA area overlap reduced to 11.43% overlap). The likelihood of the pile driving sound retaining its impulsive characteristics at distances above 10km is unlikely, and data has shown that there is a marked decrease in impulsiveness within the first five kilometres from the piling location (Matei *et al.*, 2024). If 10km is assumed to be a more realistic limit of a cumulative PTS range, then there would be no overlap with the MPA during piling at any of the locations within the Caledonia OWF.

5.1.1.49 The Applicant has committed to implementing MMMPs to ensure the risk of auditory injury (instantaneous PTS) is minimised. Indicative mitigation measures presented in the draft MMMPs (see Volume 7, Appendix 13 and Volume 7, Appendix 14) include soft-start and ramp up procedure, use of ADDs and vibropiling. Although the exact mitigation measures contained with the final MMMPs are yet to be determined, they will be in line with the latest relevant guidance at the time of this stage of the Proposed Development (Offshore) or Caledonia North/Caledonia South. Due to relatively small impact ranges (SPL_{pk}), it is considered that the impact of instantaneous auditory injury can be fully mitigated.

Other Construction Activities

5.1.1.50 Dredging, drilling, trenching, rock placement and cable laying activities during the construction phase will take place within the Caledonia OWF as well as within the Caledonia North OECC and Caledonia South OECC, which overlaps with the Southern Trench MPA site boundary. As such, there is a need to assess the potential for these activities to cause auditory injury of minke whales within the Southern Trench MPA.

5.1.1.51 For all non-piling construction activities, the PTS-onset impact range is less than 100m for minke whales. As such, non-piling construction noise sources will have an extremely local spatial extent. The effect is unlikely to occur as vessel noise is anticipated to deter animals from the injury zone.

High Resolution Geophysical Surveys

5.1.1.52 Various high resolution geophysical survey equipment will be used during construction as well as O&M phases of the Proposed Development (Offshore) or Caledonia North/Caledonia South, including:

- Multibeam echosounder (MBES) is used to acquire detailed seabed topography and water depth by emitting a fan shaped swath of acoustic energy (sound waves) along a survey transect. The sound waves are reflected from the seabed to enable high resolution seafloor mapping. The MBES can be either hull- or ROV-mounted.
- Side scan sonar (SSS) utilises conical or fan-shaped pulses of sounds directed at the seafloor to provide information on the surface of the seabed through analysis of reflected sound.
- Sub bottom profiler (SBP) is a type of geophysical survey tool that uses low-frequency or high-frequency sounds to identify acoustic impedance of

the sub-surface geology and to identify transitions from one stratigraphic sequence to another. Sound sources that produce lower frequency pulses can penetrate through and be reflected by subsurface sediments (low-resolution data), whilst higher frequency pulses achieve higher resolution images but do not penetrate the subsurface sediments.

- Ultra-short baseline (USBL) system is used to obtain accurate equipment positioning during sampling activities. This system consists of a transceiver mounted under the vessel, and a transponder on deployed equipment. The transceiver transmits an acoustic pulse which is detected by the transponder, followed by a reply of an acoustic pulse from the transponder. This pulse is detected by the transceiver and the time from transmission of the initial pulse is measured by the USBL system and converted into a range.
- Ultra-High resolution seismic (UHRS) – sparkers: a small seismic source containing a cluster of electrodes. These systems discharge high voltage impulses which heat the surrounding water within which the device is located through the use of electrode tips. The generation of heat and subsequently, steam, results in the emission of an acoustic impulse (Hartley Anderson Ltd, 2020). While sparkers are less directional than other SBPs, the acoustic energy they emit is still focused towards the sea floor.

5.1.1.53 Geophysical surveys will be taking place within the Caledonia OWF, as well as Caledonia North OECC and Caledonia South OECC which overlap with the Southern Trench MPA.

5.1.1.54 JNCC *et al*. (2010[34]) states that SSS "*is of a short-term nature and results in a negligible risk of an injury or disturbance offence*". An equivalent conclusion was reached by DECC (2011[35]). Furthermore, a recent comprehensive assessment of the characteristics of acoustic survey sources proposed that MBES and SSS should be considered *de minimis* in terms of being unlikely to result in PTS or behavioural disturbance (based on exceedance of the US National Marine Fisheries Service 160 dB SPL_{rms} threshold) to marine mammals (Ruppel *et al*., 2022[36]). The source levels of USBL equipment (187 to 206 dB re 1 µPa) are below the instantaneous injury threshold (219 dB re 1µPa) for minke whale and therefore there is no risk of injury.

5.1.1.55 In the case of SBP, there is an overlap between predicted source levels of the equipment (210 to 220 dB re 1µPa) and the instantaneous injury threshold. Additionally, the expected operable sound frequencies of SBP (2 to 15kHz) overlap with minke whale hearing ranges (7Hz to 35kHz) and thus, there is a risk of injury if an individual minke whale is close enough to the sound source. Additionally, the expected operable sound frequencies of UHRS (100 Hz to 5 kHz) overlap with hearing ranges of minke whale and similarly to SBP, there is a risk of injury if individuals are close enough to the sound source.

5.1.1.56 The Applicant has committed to implementing MMMPs. In line with JNCC (2017[75]), indicative mitigation measures presented in the draft MMMPs (see Volume 7, Appendix 13 and Volume 7, Appendix 14) include pre-shooting watch of the mitigation zone by the MMO and PAM watch where visual observations are not possible. The extent of the mitigation zone for SBP and UHRS will be defined post-consent when equipment details are available. Although the exact mitigation measures contained with the final MMMPs are yet to be determined, they will be in line with the latest relevant guidance at the time of this stage of the Proposed Development (Offshore) or Caledonia North/Caledonia South. It is considered that, due to the highly localised spatial extent, the impact of auditory injury due to the operation of SBP and UHRS can be fully mitigated.

Entanglement

5.1.1.57 As floating components and thus the presence of mooring lines are only relevant to the Caledonia OWF and Caledonia South Site, the risks of entanglement to marine mammals are considered for the Proposed Development (Offshore) and Caledonia South only (not Caledonia North).

5.1.1.58 The risks of entanglement posed by the Proposed Development (Offshore) and Caledonia South are associated with primary, secondary and tertiary entanglement. Primary entanglement could involve marine mammals becoming directly entangled with the mooring lines and dynamic cables within the Caledonia OWF and Caledonia South Site. Secondary entanglement is the risk of marine mammals becoming entangled in marine debris which has become caught on the lines and cables within the Caledonia OWF and Caledonia South Site. Tertiary entanglement is the risk of marine mammals that have already become entangled in marine debris in another location before getting snagged on mooring lines and cables within the Caledonia OWF and Caledonia South Site. Entanglement can result in injury or mortality.

5.1.1.59 In line with NatureScot (2020a[1]), it is recognised that minke whales are considered sensitive to entanglement and incidental bycatch. However, the risk of primary, secondary or tertiary entanglement would be restricted to the Caledonia OWF and Caledonia South Site, which is located approximately 13.5km from the MPA. To minimise the risk of entanglement, the Applicant committed to Entanglement Management Plan, where mooring lines and floating inter-array cables will be inspected, the presence of discarded fishing gear will be evaluated for marine mammal entanglement risk and appropriate actions taken to remove if deemed necessary.

Vessel Collision

5.1.1.60 Baleen whales are vulnerable to collisions with vessels, with the level of risk dependent on a number of factors including the species, animal density, and the density and nature of vessel traffic (Schoeman *et al.*, 2020[37]). A key factor is also the ability of vessels to detect whales and mitigate the potential for a collision. Vessel collisions with larger baleen whales (e.g., fin, humpback and right whales) are most commonly reported, although there is also

evidence of collisions between vessels and minke whales (Winkler *et al*., 2020[38]). If a collision were to occur, it could result in the injury or death of an individual whale. There are a number of ports considered to be utilised during construction, and vessel movements in and out of the port may affect designated sites that are located in the vicinity of the ports. Buckie, Fraserburgh and Peterhead ports are located within the Southern Trench MPA.

5.1.1.61 It is estimated that a maximum of 25 construction vessels will be utilised at any one time. The majority of vessels used during construction, operations and maintenance will be large (installation vessel, cable lay and support vessels, CTVs and SOVs) that are stationary or slow moving throughout construction activities for significant periods of time.

5.1.1.62 It should be noted that due to the already high volume of vessel traffic already in the navigational study area (with up to 38 unique vessels in a day within the Caledonia OWF and 10 nm buffer), the introduction of additional vessels throughout the lifetime of the Proposed Development (Offshore) or Caledonia North/Caledonia South is not a novel impact for minke whales present in the area. As part of the embedded mitigation measures, the Applicant committed to the adoption of best practice vessel-handing protocols (e.g., following the Codes of Conduct provided by the WiSe (Wildlife-Safe) Scheme, Scottish Marine Wildlife Watching Code or Guide to Best Practice for Watching Marine Wildlife). These will be incorporated into a Vessel Management Plan (VMP) and will minimise risk of a vessel collision with minke whales in the MPA such that the risks are considered negligible.

Conclusion

5.1.1.63 Considering a limited spatial extent of impacts and following the application of embedded mitigation measures, it can be concluded that there is no significant risk of injury and/or killing to minke whale within the Southern Trench MPA. The assessment against conservation objective "Species is conserved" for the Proposed Development (Offshore), Caledonia North and Caledonia South is provided in Table 5-9.

Table 5-9:Assessment against conservation objective "Species is conserved".

Site-specific Advice	Assessment Conclusion
Minke whale in the Southern Trench MPA are not at significant risk from injury or killing. 'Significant risk' should consider whether any killing or injury would result in reduced densities within the site, from which recovery to above average densities cannot be expected.	Activities as a part of the Proposed Development (Offshore), Caledonia North and Caledonia South, that may cause injury and/or killing, are unlikely to result in any incidence that would result in reduced densities from which recovery cannot be expected. As such, there is no significant risk of injury and/or killing to minke whale within the Southern Trench MPA.
Overall conclusion: The risk of killing and injury during construction as well as O&M phase of the Proposed Development (Offshore), Caledonia North and Caledonia South is not significant, and the achievement of this Conservation Objective is **not at risk** of being hindered.	

Disturbance (Construction Phase)

5.1.1.64 This section provides an assessment of the risk of significant disturbance from UXO clearance, piling, geophysical surveys and other construction activities.

UXO Clearance

5.1.1.65 There is little potential for minke whales within the Southern Trench MPA to be disturbed as a result of low-order UXO clearance activities within the MPA. Two quantitative assessment methods are presented:

- 5km Effective Deterrence Range (EDR) assumed for low-order clearance (as recommended in JNCC, 2023[33]); and
- Temporary Threshold Shift (TTS) as a proxy for disturbance (as suggested in Southall *et al*., 2007[39]).

5.1.1.66 It is noted in the JNCC (2020[40]) guidance that, although UXO detonation is considered a loud underwater noise source, "...*a one-off explosion would probably only elicit a startle response and would not cause widespread and prolonged displacement*". It is predicted that a maximum of 3.09% of the MPA area shall be subject to disturbance assuming a 5km EDR (Table 5-10) (assuming the UXO is located within the MPA). Using TTS as a proxy for disturbance, the maximum impact range was predicted to be 3.2km from low-order clearance, which will impact 1.27% of the MPA area.

Table 5-10: Behavioural disturbance from UXO clearance.

Charge Weight	Assessment Method	Effects within the MPA	
		Overlap (km^2)	% MPA Area
0.25kg	5km EDR	78.4	3.09
	TTS-onset (unweighted SPL_{peak} (single pulse))	32.2	1.27

Piling

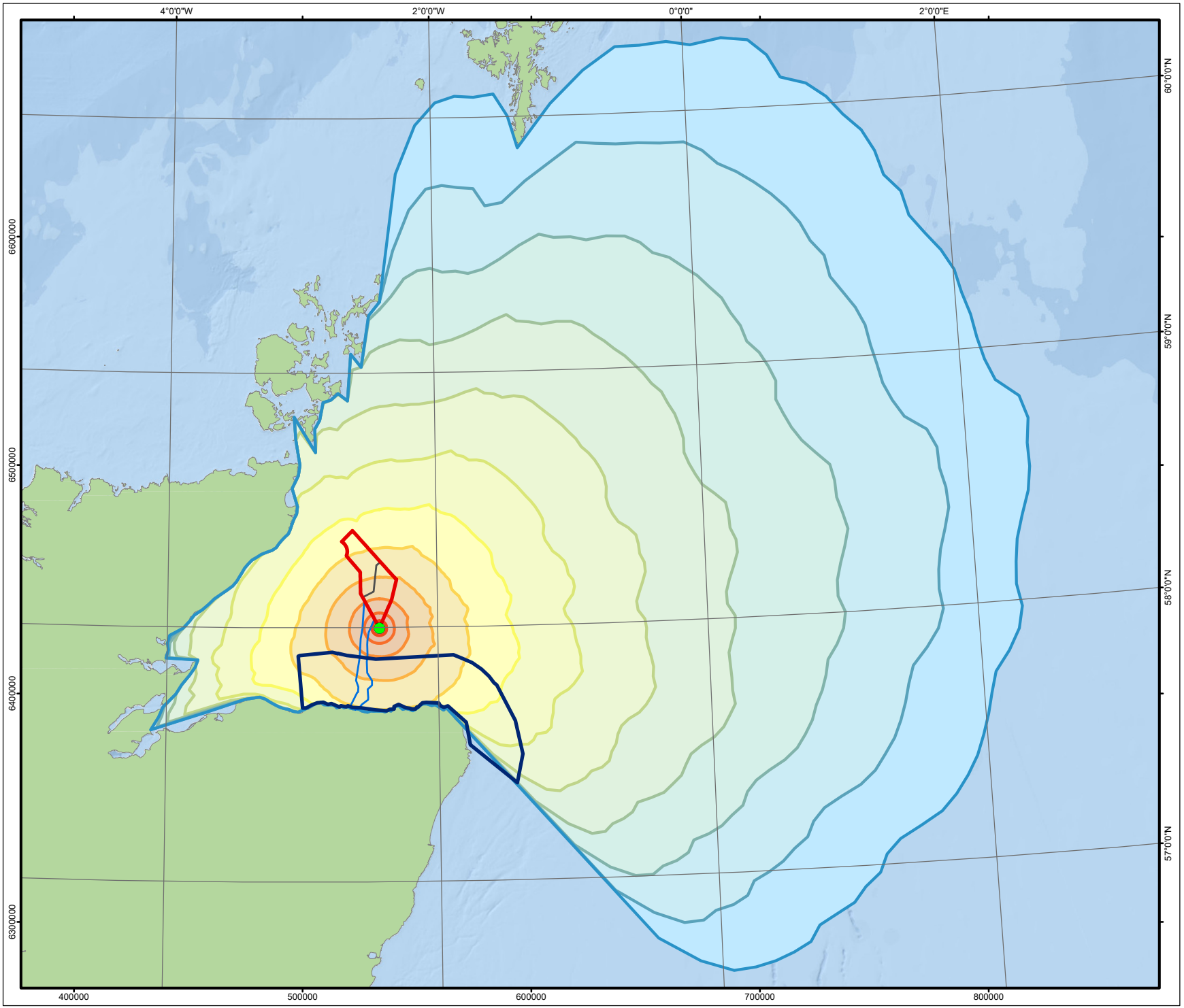
5.1.1.67 As presented in the assessment of injury, for the Proposed Development (Offshore) and Caledonia South, the modelling location closest to the MPA is modelling location 8 (Figure 5-1), where there is the option to install a monopile, pin pile for jacket foundation or pin pile floating foundation anchor. Using the harbour porpoise dose-response function as a proxy for disturbance to minke whales, the largest predicted effective disturbance area is 65.3% of the MPA. For piling of jacket piles and anchor piles, the effective areas disturbed are 62.3% and 56.7% respectively (Table 5-11, Figure 5-1). Note, the effective disturbance area is calculated using the Graham *et al*. (2017[41]) dose-response values to obtain the area within which a response is expected to occur (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).

5.1.1.68 For Caledonia North, the modelling location closest to the Southern Trench MPA is modelling location 4 (Figure 5-2), where there is the option to install a monopile or pin pile for jacket foundation. Using the harbour porpoise dose-response function as a proxy for disturbance to minke whales, the largest predicted effective disturbance area is 58.6% of the MPA. For piling of jacket piles the effective area disturbed is 55.8% the MPA (Table 5-11, Figure 5-2).

Table 5-11: Behavioural disturbance from piling.

Foundation Type	Modelling Location	Effective Area Overlap (km^2)	% MPA Area
Monopile	Caledonia OWF and Caledonia South Site (location 8)	1,656	65.3
Jacket		1,579	62.3
Anchor		1,438	56.7
Monopile	Caledonia North Site (location 4)	1,486.4	58.6
Jacket		1,414.8	55.8

5.1.1.69 The harbour porpoise dose-response function to pin-piling has been used as a proxy for minke whale response in the absence of similar empirical data. However, there is uncertainty as to whether minke whales would respond behaviourally to the same received levels as harbour porpoise. Therefore, the assessment of disturbance to minke whales from piling is likely highly conservative. Alternative assessments of disturbance could be included, such as the current EDR for installation of monopile foundations (26 km as per JNCC, 2020[40]) or the newly characterised proxy deterrence function of 10 km based on harbour porpoise responses to the installation of 9.5 and 10.0 m XXL monopiles without noise abatement (Benhemma-Le Gall *et al*., 2024[42]). In the case of the 26km EDR, the overlap with the MPA due to piling at the most southern location 8 would represent only 16.5% of the site, whilst in the case of the 10km EDR, where would be no overlap with the MPA regardless of the modelling location (assessment using alternative methods could be provided upon request).



Caledonia OWF

Caledonia North Site and Caledonia South Site Division Line

Offshore Export Cable Corridor

Southern Trench MPA

Modelling Location 8

Noise Contours (SELss, dB re 1 µPa2s)

120 135 150 165
125 140 155 170
130 145 160 175
180

Probability of response based on Graham *et al.* 2017

120 ≤ 125	1.15%
125 ≤ 130	3.49%
130 ≤ 135	8.78%
135 ≤ 140	18.52%
140 ≤ 145	33.12%
145 ≤ 150	50.90%
150 ≤ 155	68.49%
155 ≤ 160	82.66%
160 ≤ 165	91.92%
165 ≤ 170	96.85%
170 ≤ 175	98.98%
175 ≤ 180	99.73%
180 ≤	99.94%

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0 20 40 60 80 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	23/09/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm

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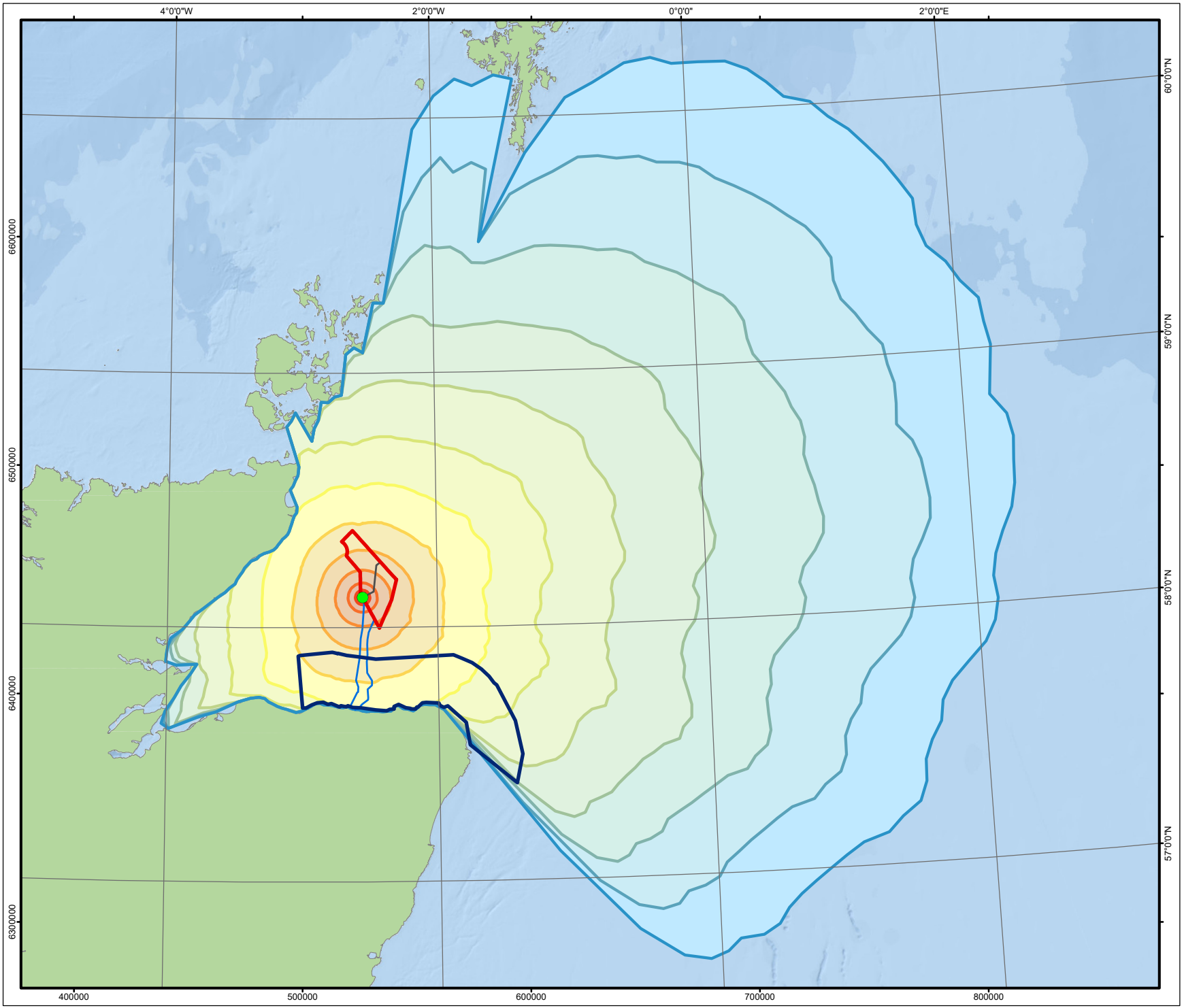
CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00443	CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)	

DRAWING TITLE

Figure 5-1: Proposed Development and Caledonia South: Disturbance Due to Piling of Monopiles at Location 8

STATUS: Approved	SCALE: 1:2,250,000	
DRAWING NUMBER: N/A	SHEET NO: 01 of 01	REV: N/A



Caledonia OWF

Caledonia North Site and Caledonia South Site Division Line

Offshore Export Cable Corridor

Southern Trench MPA

Modelling Location 4

Noise Contours (SELss, dB re 1 µPa2s)

120 125 130 135 140 145 150 155 160 165 170 175 180

Probability of response based on Graham *et al.* 2017

120 ≤ 125	1.15%
125 ≤ 130	3.49%
130 ≤ 135	8.78%
135 ≤ 140	18.52%
140 ≤ 145	33.12%
145 ≤ 150	50.90%
150 ≤ 155	68.49%
155 ≤ 160	82.66%
160 ≤ 165	91.92%
165 ≤ 170	96.85%
170 ≤ 175	98.98%
175 ≤ 180	99.73%
180 ≤	99.94%

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0 20 40 60 80 km

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CALEDONIA Offshore Wind Farm

GoBe APEMGroup

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00444	CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)	

DRAWING TITLE

Figure 5-2: Caledonia North: Disturbance Due to Piling of Monopiles at Location 4

STATUS: Approved	SCALE: 1:2,250,000	
DRAWING NUMBER: N/A	SHEET NO: 01 of 01	REV: N/A

5.1.1.70 Given that there are different numbers and types of WTGs to be installed at Caledonia North, Caledonia South and the Proposed Development (Offshore), the worst-case temporal scenario is different for each (Table 5-12). For each of the piling timelines presented, piling is proposed year-round.

Table 5-12: Maximum temporal scenarios for piling.

Development Phase	Worst Case		
	Number and Type of Foundations	Number of Piling Days	Timeline
Proposed Development (Offshore)*	65 bottom-fixed in the North (63 WTG, 2 OSP) 40 bottom-fixed in the South (38 WTG, 2 OSP) 39 floating in the South	515	Sequential construction of Caledonia North and South with no gap between phases: ▪ October 2028 to February 2032 Sequential construction of Caledonia North and South with maximum gap of 5 years between phases: ▪ October 2028 to February 2030; and ▪ March 2035 to February 2037
Caledonia North	79 bottom-fixed	79	October 2028 to February 2030
Caledonia South	41 bottom-fixed 39 floating	451	October 2028 to September 2030
* Assumes sequential installation to reflect worst-case temporal scenario.			

5.1.1.71 Sightings of minke whale within the MPA are highest during the months of June to October (NatureScot, 2020c[6]) and this period will be referred to as "high density period" in the assessment. The disturbance due to piling at the Proposed Development (Offshore) is likely to be intermittent with 515 piling days across up to a total of five years (not including gaps between installation of Caledonia North and Caledonia South). Piling at the Proposed Development (Offshore) could overlap with three high density periods. If Caledonia North and Caledonia South will be installed sequentially (no gaps in the piling installation), minke whales are at risk of experiencing behavioural disturbance within the MPA over three consecutive years, June to October inclusive. During installation of Caledonia North only with up to 79 piling days, minke whales are at risk of experiencing behavioural disturbance over one high density period. During installation of Caledonia South only with up to 451 piling days, minke whales are at risk of experiencing behavioural disturbance over two high density periods.

5.1.1.72 It should be noted that if Caledonia South was to be built using entirely bottom-fixed WTG foundations then there would be up to 80 piling days between October 2028 and March 2030 and therefore minke whales are only at risk of experiencing behavioural disturbance over one high density period.

5.1.1.73 Any piling activities that occur outside the high density periods are expected to have less of an impact on minke whales within the MPA.

Other Construction Activities

5.1.1.74 Dredging, drilling, trenching and cable laying activities within the Caledonia North OECC and Caledonia South OECC during the construction phase will overlap the Southern Trench MPA site boundaries. These activities all introduce continuous noise into the marine environment of similar characteristics; studies of animal responses to drilling noise are most prevalent, and provide a reasonable proxy for other noise-generating construction activities.

5.1.1.75 In northwest Ireland, dredging activities have been linked to reduced minke whale presence (Culloch *et al*., 2016[43]), whilst the distances between minke whale sightings and active construction sites increased and relative abundance decreased during dredging and blasting activities in Newfoundland (Borggaard *et al*., 1999[44]). Information on the disturbance effects of drilling is limited and the majority of the research available was conducted more than 20 years ago (Sinclair *et al*., 2023[45]). For example, drilling and dredging playback experiments observed that 50% of bowhead whales exposed to noise levels of 115 dB re 1 µPa exhibited some form of response, including changes to calling, foraging and dive patterns (Richardson and Wursig, 1990[46]). More recent studies of bowhead whales also observed changes in behaviour from increased drilling noise levels, specifically an increase in call rate. However, the call rate plateaued and then declined as noise levels continued to increase, which could be interpreted as the whales aborting their attempt to overcome the masking effects of the drilling noise (Blackwell *et al*., 2017[47]). Playback experiments of drilling and industrial noise have also been undertaken with grey whales at a noise level of 122 dB re 1 µPa. This resulted in a 90% response from the individuals in the form of diverting their migration track (Malme *et al*., 1984[48]). Overall, the literature indicates that the impacts of drilling disturbance on baleen whales may occur at distances of between 10 and 20km (Greene Jr, 1986[49]; LGL and Greeneridge, 1986[50]; Richardson and Wursig, 1990[46]).

5.1.1.76 Other construction activities shall occur within a three year period per the application area; however, only a portion of this will occur within the Southern Trench MPA. Seabed preparation can take up to 12 months and offshore export cable laying, termination and testing up to 9 months per application area.

High-resolution Geophysical Survey

5.1.1.77 There are currently no empirical studies available regarding the effects of disturbance from high-resolution geophysical survey on minke whale.

5.1.1.78 The expected sound frequency during operation of MBES and SSS is above 200kHz and therefore above the hearing frequency range of minke whales. As such, there is no potential for disturbance effects to occur through use of these survey equipment.

5.1.1.79 JNCC *et al*. (2010[34]) EPS Guidance concludes that the use of SBPs in geophysical surveys "*could, in a few cases, cause localised short-term impacts on behaviour such as avoidance*". However, should the short-term operations result in a response by an animal, this would be temporary.

5.1.1.80 Thomsen *et al*. (2023[51]) carried out noise modelling and environmental risk assessment of a geophysical survey and its impact minke whales. The study predicted that minke whales may experience behavioural response as a result of sparker and minigun within 1.1km (2.7km^2) and 1.9km (6.3km^2), respectively.

5.1.1.81 Animals may choose to cease foraging in response to noise by fleeing the affected area; however, it is anticipated that individuals will recommence these activities following cessation of impact (underwater noise). As such, geophysical surveys are unlikely to alter minke whale behaviour such that it reduces ability of the species to feed efficiently or breed for prolonged periods of time.

Vessels

5.1.1.82 Disturbance to minke whale may also occur as a result of increased vessel activity during vessel movements to and from ports as well as construction activities associated with the offshore export cable installation within the MPA. It is anticipated there will be a maximum of 25 vessels present simultaneously during the construction period. However, it is expected that only up to two vessels shall be operating in coastal areas for construction activities at any one time. Vessel noise levels from construction vessels will result in an increase in non-impulsive, continuous sound in the vicinity of the Proposed Development (Offshore) or Caledonia North/Caledonia South, typically in the range of 10 to 100Hz (although higher frequencies will also be produced) (Erbe *et al*., 2019[52]) with an estimated source level of 161 and 168 SELcum dB re 1 µPa@1m (RMS) for medium and large construction vessels, travelling at a speed of 10 knots (see Volume 7, Appendix 6: Underwater Noise Technical Note). Vessel noise is continuous, and is dominated by sounds from propellers, thrusters and various rotating machinery (e.g., power generation, pumps) (OSPAR, 2009b[53]). In general, small boats and ships are expected to have broadband source levels in the range 160 to 180dB re 1µPa (rms), with the majority of energy below 1kHz (OSPAR, 2009a[54]). Large commercial vessels (>100m) produce relatively loud and predominately low frequency

sounds, with the strongest energy concentrated below 200 Hz (OSPAR, 2009a[54]).

5.1.1.83 There are currently limited studies available regarding the effects of vessel disturbance on minke whale. Of the few studies available, minke whale foraging activity has been found to decrease with increased vessel interactions (Christiansen *et al*., 2013[55]), exemplified by shorter dives and changes in movement patterns. In addition, by analysing the respiration rate of minke whales, energy expenditure was estimated to be 28% higher during boat interactions, regardless of swim speed. Swim speed was also found to increase with vessel presence and these combined physiological and behavioural changes are thought to represent a stress response. Further study by Christiansen and Lusseau (2015[56]) developed a mechanistic model for minke whales to examine the bioenergetic effects of disturbance from whale watching vessels, specifically on foetal growth. The presence of whale watching vessels resulted in an immediate 63.5% reduction in net energy intake. It should be noted that when considering the impacts of whale watching vessels to those likely to occur from construction vessel activities, they cannot be directly transposed, as disturbance effects from whale watching are direct impacts, whilst those from construction activities are indirect, and the vessel types and underwater noise produced are very different. Nevertheless, it should be noted that minke whales are capital breeders and therefore their reproductive success could be affected by chronically disrupted feeding activities (Stephens *et al*., 2009[57]; Christiansen *et al*., 2013a[55]).

5.1.1.84 Although an estimated range of disturbance on minke whales from vessel presence has not been presented within the literature, estimated disturbance ranges have been presented for other baleen whale species. For example, Currie *et al*. (2021[58]) observed changes in the swim direction of humpback whales when whale watching vessel were within ~150m of the individuals. In gray whales, observed changes in foraging behaviour were apparent when whale-watching vessels were within ~250m of an animal (Sullivan and Torres, 2018[59]).

5.1.1.85 The Applicant has committed to the adoption of best practice vessel-handing protocols (e.g., following the Codes of Conduct provided by the WiSe (Wildlife-Safe) Scheme, Scottish Marine Wildlife Watching Code or Guide to Best Practice for Watching Marine Wildlife). These will be incorporated into a VMP during construction which will minimise the potential for any effects of disturbance on minke whales in the MPA, by ensuring that vessel traffic moves along predictable routes and defining how vessels should behave in the presence of marine mammals.

Conclusion

5.1.1.86 In summary, minke whales present within the MPA may experience disturbance due to various activities (UXO clearance, high resolution geophysical surveys, piling, vessels, other construction activities such as dredging), intermittently over duration of construction (three years per application area (Caledonia North, Caledonia South) and up to six years if the Proposed Development (Offshore) if installed sequentially). Most of these activities (UXO clearance, high-resolution geophysical surveys, other construction activities) will be taking place within a small proportion of the total area of the Southern Trench MPA (the OECC boundary overlaps with approximately 4.5% of the MPA). Underwater noise during piling may result in the largest overlap of noise with the MPA boundary (though this assessment is based on highly precautionary, worst case assumptions). Vessel disturbance can also take place across the Southern Trench MPA due to vessel movements in and out from ports.

5.1.1.87 The assessment against Conservation Objective "Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds" for the Proposed Development (Offshore), Caledonia North and Caledonia South is provided in Table 5-13.

Table 5-13: Assessment against conservation objective "Continued access by the species to resources" for disturbance during construction phase.

Site-specific Advice	Assessment Conclusion
Conserve the access to resources (e.g., for feeding) provided by the MPA for various stages of the minke whale life cycle.	Behavioural disturbance causing displacement during construction of the Proposed Development (Offshore), Caledonia North and Caledonia South has the potential to reduce access to minke whale resources within the site. For most of the activities it may affect a relatively small proportion of the site within the OECC (e.g., approximately 4.5% of the total MPA area) whilst during piling, a larger proportion of the site could be affected (if assuming the porpoise dose-response function is applicable to minke whales).
Conserve the distribution of minke whale within the site by avoiding significant disturbance. 'Significant disturbance' may result in the following effects: ▪ The contribution to long-term decline in the use of the MPA ▪ Changes to the distribution on a continuing or sustained basis ▪ Changes to the behaviour such that it reduces the ability of the species to feed efficiently, breed or survive	There is no empirical evidence that would suggest that minke whales will not return to the area following the cessation of construction and therefore there is expected to be no long-term decline in the use of the MPA. Minke whales have been shown to change their behavioural state in response to disturbance from Acoustic Deterrent Devices, whale watching vessels and other construction activities. Thus, there is a potential for minke whale to experience disturbance within the Southern Trench MPA intermittently at any time during the construction period of up to six years (or three years per application area, Caledonia North/South). The effect may occur at moderate frequency and is therefore considered to be sustained over construction phase and the ability to forage effectively may be affected.
Overall conclusion: There is a potential for avoidance/changes in behaviour as a result of construction of the Proposed Development (Offshore), Caledonia North and Caledonia South. As such, the reduced access to resources as well as significant disturbance within the site cannot be ruled out. However, in line with discussion presented in paragraph 5.1.1.69, there is a high degree of uncertainty regarding minke whale responses to underwater noise, which precludes a confident assessment as to whether or not "significant" disturbance could occur. Considering the above and the highly conservative assumptions associated with the baseline data and assessment modelling approach, this assessment concludes that the risk of hindering the Conservation Objectives is **uncertain**. To address this, the Applicant is committed to: ▪ Collaborating with stakeholders, academic institutions and other developers to address knowledge gaps regarding minke whale behavioural response to disturbance through ongoing research and monitoring efforts; and ▪ Utilisation of latest available evidence from Moray West OWF piling activity (to be published in 2025), emerging monitoring results and refined design parameters to inform and optimise the piling strategy.	

Disturbance (O&M Phase)

5.1.1.88 This section provides an assessment of the risk of significant disturbance from vessels, high-resolution geophysical surveys and operational noise during the O&M phase of the Proposed Development (Offshore), Caledonia North and Caledonia South.

Vessels

5.1.1.89 The additional traffic at the Proposed Development (Offshore) or Caledonia North/Caledonia South at any one time during O&M is five vessels, which will be less than during construction, and transits will take place over a longer period of time (e.g., lifetime of the Proposed Development (Offshore) or Caledonia North/Caledonia South; 35 years). The maximum number of vessels (five) also assumes that all O&M activities overlap and are occurring at the same time. In reality, it is not expected that all O&M activities would be undertaken at the same time and, therefore, the peak number of vessels offshore at any one time will likely be less than five.

5.1.1.90 Disturbance to minke whales may also occur as a result of increased vessel activity during vessel movements to and from ports as well as maintenance activities associated with the offshore export cable within the MPA. It is likely that any vessel disturbance effect may occur at moderate frequency, although it would depend on how many animals will be encountered by vessels moving in and out of ports as well as within the Caledonia OWF, Caledonia North OECC and Caledonia South OECC. This could affect a small proportion of the wider minke whale population both within and out with the MPA, across the duration of the O&M phase, although it is unlikely to alter population trajectories in the long-term due to activities taking place in an area already characterised by relatively high vessel traffic. Thus, animals are likely to be habituated to vessel noise and vessel activities which may result in localised changes in minke whale occurrence and behaviours and the disruption of feeding activities shall be low in magnitude.

5.1.1.91 The Applicant committed to the adoption of best practice vessel-handing protocols (e.g., following the Codes of Conduct provided by the WiSe (Wildlife-Safe) Scheme, Scottish Marine Wildlife Watching Code or Guide to Best Practice for Watching Marine Wildlife). These will be incorporated into a VMP during O&M and will minimise the potential for any effects of disturbance on minke whales in the MPA.

High-resolution Geophysical Survey

5.1.1.92 A description of the potential impacts on minke whale due to high-resolution geophysical surveys is provided above for the construction phase. Surveys may result in localised changes to minke whale behaviour, including movement and vocalisations, up to approximately 2 km from the noise source.

Operational Noise

5.1.1.93 The underwater noise associated with the operational phase of the Proposed Development (Offshore) or Caledonia North/Caledonia South has the potential to alter the acoustic soundscape within the vicinity of the Caledonia OWF or Caledonia North Site/Caledonia South Site. Depending on the design of the turbine (e.g., bottom-fixed, floating, Fully Restrained Platform (FRP)), the underwater noise may be audible to animals at distances varying from a few meters to a few kilometres (less for direct drive turbines) (see Section 7.2.2 of Volume 2, Chapter 7: Marine Mammals).

5.1.1.94 Operational noise is primarily low frequency. For bottom-fixed foundation OWFs, it was reported to be well below 1kHz (Thomsen *et al.*, 2006[60]; Stöber and Thomsen, 2021[61]; Bellmann *et al.*, 2023[62]). Most of the acoustic energy produced by operational floating offshore wind farms is below 200 Hz (Risch *et al.*, 2023[63]) and there appears to be a continued decrease in energy levels above 300Hz[4]. The low frequency noise produced during operations is likely to overlap with the hearing range of low frequency cetacean species such as minke whale. Minke whale communication signals have been demonstrated to be below 2kHz (Edds-Walton, 2000[64]; Mellinger *et al.*, 2000[65]; Gedamke *et al.*, 2001[66]; Risch *et al.*, 2013[67]; 2014[68]).

5.1.1.95 As presented in the Volume 7, Appendix 6: Underwater Noise Technical Note, for bottom-fixed turbines and using the precautionary 120 dB SPL_{rms} criterion, marine mammals may experience behavioural disturbance within 120m from an operational 25MW wind geared-drive turbine. (noting that this is a modelled estimate and likely conservative). Further, it is considered that mooring lines associated with floating OWFs have the potential to produce 'snapping' noises during the operational phase of the development. 'Cable snapping' refers to impulsive noises generated by the sudden re-tension in a mooring line following a period of slackness resulting from large amplitude and/or high-frequency surface motions (Liu, 1973[69]). analysis of sounds recorded at both Kincardine and Hywind Scotland did not reveal distinct impulsive 'snapping' sounds; instead, a range of 'transient sounds' were reported that can be described as "bangs", "creaks" and "rattles" which acoustic analysis classified as non-impulsive sound sources (Burns *et al.*, 2022[70]). Burns *et al.* (2022[70]) showed that these 'transient sounds had a broadband energy (10 – 48kHz) and were short in duration (~1 second). As it was concluded that these transient sounds could not be considered as impulsive, the application of non-impulsive frequency weighted noise threshold values for determining auditory injury risk to marine mammals is appropriate (Risch *et al.*, 2023[63]). Using the NMFS (2018) thresholds for TTS-onset from non-impulsive noise sources, Burns *et al.* (2022[70]) determined that low frequency cetacean would need to remain within 40m of an operational turbine (assuming the wind speed was 15 knots) for 24 hours to reach the TTS-onset threshold, often associated with fleeing response.

Conclusion

5.1.1.96 There is a potential for minke whales to be disturbed within the MPA across the O&M phase of the Proposed Development (Offshore) or Caledonia North/Caledonia South. However, high-resolution geophysical surveys will be carried out periodically and may take place only within relatively small proportion of the total area of the Southern Trench MPA (where it overlaps with the Caledonia North OECC and Caledonia South OECC; approx. 4.5% of the MPA). The number of vessels associated with O&M will be small and considering current levels of traffic on the east coast of Scotland associated with various industries, such an increase will be localised and barely discernible from the baseline traffic. Due to small behavioural disturbance ranges associated with the operational noise from turbines, the potential for behavioural disturbance is limited to the immediate vicinity of the Caledonia OWF. Since no disturbance is anticipated within the Southern Trench MPA, operational noise is not considered further.

5.1.1.97 The assessment against the conservation objective for disturbance during the O&M phase "Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds" for the Proposed Development (Offshore), Caledonia North and Caledonia South is provided in Table 5-14.

Table 5-14: Assessment against conservation objective "Continued access by the species to resources" for disturbance during the O&M phase.

Site-specific Advice	Assessment Conclusion
Conserve the access to resources (e.g., for feeding) provided by the MPA for various stages of the minke whale life cycle.	Behavioural disturbance during O&M of the Proposed Development (Offshore), Caledonia North and Caledonia South is unlikely to reduce access to minke whale resources within the site.
Conserve the distribution of minke whale within the site by avoiding significant disturbance. 'Significant disturbance' may result in the following effects: ▪ The contribution to long-term decline in the use of the MPA ▪ Changes to the distribution on a continuing or sustained basis ▪ Changes to the behaviour such that it reduces the ability of the species to feed efficiently, breed or survive	The character of O&M activities is likely to be similar to those currently taking place within the Southern Trench MPA (e.g., surveys and vessel transits). The behavioural disturbance effect may occur a at low frequency and is likely to be localised to the vicinity of high-resolution geophysical survey sources and/or moving vessel. As such, it is not considered to result in: long-term decline in the use of the MPA changes in distribution on continued or sustained basis restricted ability to forage, breed or survive.
Overall conclusion: The reduced access to resources as well as significant disturbance are unlikely to take place due to behavioural disturbance during the O&M phase of the Proposed Development (Offshore), Caledonia North and Caledonia South. Therefore, the achievement of this conservation objective is **not at risk** of being hindered.	

Physical Barriers - Presence of Infrastructure (O&M Phase)

5.1.1.98 The physical presence of array infrastructure at the Caledonia OWF has the potential to create barrier effects, whereby the regular movements of a particular species are impacted by the presence of the wind farm (Onoufriou *et al.*, 2021[71]). It should be noted that the export cable will be buried or will include remedial cable protection where burial is not possible with only the Caledonia OWF including a proportion of dynamic cabling. Therefore, the offshore export cable infrastructure is not anticipated to limit the passage of animals.

5.1.1.99 Although minke whale presence has been recorded around oil and gas structures in the central North Sea (Delefosse *et al.*, 2018[72]), there is limited understanding on whether baleen whales can successfully navigate the spaces between turbines in the array, especially within floating offshore wind arrays where the water column is intersected by mooring lines and cables. A complete design of the array is currently unavailable and therefore it is challenging to estimate the distances between mooring lines and dynamic cables during operation. The total Caledonia OWF footprint is 423km^2. The

footprint of Caledonia North Site and Caledonia South Site is 218km^2 and 204.2km^2 respectively. Even if any barrier effects could occur these will be restricted to the Caledonia OWF or Caledonia North Site and Caledonia South Site, which are located outside of the MPA.

5.1.1.100 The assessment against conservation objective for physical barriers during the O&M phase "Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds" for the Proposed Development (Offshore), Caledonia North and Caledonia South is provided in Table 5-15.

Table 5-15: Assessment against conservation objective "Continued access by the species to resources" for physical barriers during the O&M phase.

Site-specific Advice	Assessment Conclusion
Conserve the access to resources (e.g., for feeding) provided by the MPA for various stages of the minke whale life cycle.	Due to barriers effects being localised within the Caledonia OWF, it is not expected that the infrastructure associated with the Proposed Development (Offshore) or Caledonia North/Caledonia South may prevent or restrict access to the MPA and resources within.
Overall conclusion: Reduced access to resources due to physical barriers are unlikely to take place due to O&M of the Proposed Development (Offshore) or Caledonia North/Caledonia South and therefore the achievement of this conservation objective is **not at risk** of being hindered.	

Impacts on supporting features and processes (Construction, O&M)

5.1.1.101 Any change in fish abundance and/or distribution within the MPA as a result of construction is important to assess as there is the potential for indirect effects on minke whale. Both minke whale adults and juveniles studied within the Southern Trench MPA have a similar foraging preference for sandy gravel sediment types (Robinson *et al.*, 2023[21]). Minke whales prey species identified within the Southern Trench MPA comprised the lesser sandeel (*A. marinus)*, Atlantic herring (*Clupea harengus)* and the European sprat (*Sprattus sprattus)*. Robinson *et al.* (2023[21]) reported that sandeels are targeted by both adults and juveniles during all study months (May to October). Juvenile herring were typically targeted only by adults from early July, whilst sprat were targeted by adults and juveniles from late August to October. Although minke whales exhibit flexibility in their resource preferences when options are limited, the installation of infrastructure in sandy habitats may affect their preferred foraging grounds.

5.1.1.102 Based on the assessment provided in Volume 2, Chapter 5: Fish and Shellfish Ecology, it is unlikely that fish species present within the Southern Trench MPA would be affected by mortality or injury during piling at the Caledonia OWF. For minke whale's main prey species, sandeels, the greatest impact ranges for potential mortal injury and recoverable injury on sandeels from piling at the Caledonia OWF is 6.3km^2 and 15km^2, respectively, and therefore

there is no potential for this to affect sandeels present within the Southern Trench MPA. The maximum predicted range of impact for TTS for sandeels occurs over a broader vicinity of the works (45,000m at 186 dB SEL_{cum}) from the sequential piling of pin-pile foundations and therefore there is a risk that sandeels within the Southern Trench MPA will be affected, although these effects are anticipated to be temporary and recoverable. As sandeel spawning grounds are widely distributed, any impacts from TTS within the MPA are anticipated to be small when considered against the wider environment (see Volume 2, Chapter 5: Fish and Shellfish Ecology). Further to this, there are multiple conservatisms built into the underwater noise modelling:

- The assumption that receptors are static for a full 24 hours, and
- That the TTS impact ranges modelled remain impulsive over their range, however the main characteristics of impulsive noise are lost over distance.

5.1.1.103 Sandeels are also considered tolerant to increases in suspended sediment concentrations (SSC) and smothering from sediment deposition, due to the nature of resuspension and deposition within their natural high energy environment, so they are unlikely to be adversely affected by the temporary increases in SSCs.

5.1.1.104 Activities associated with the export cable installation may result in temporary habitat disturbance within the Southern Trench MPA. Sandeel exhibit strong site fidelity and spend large amounts of time buried in the sediment. In addition, sandeel are demersal spawners, with eggs remaining attached to the seabed during their development. Although pelagic as adults, herring are demersal spawners, with eggs remaining attached to the seabed during their development. Therefore, sandeel and herring are considered as stationary receptors with low to no adaptability to the impact and temporary habitat disturbance may result in some mortality of individuals, or it may directly damage or dislodge eggs, leading to increased egg mortality rates and reduced recruitment success. As previously mentioned in paragraph 5.1.1.4, site-specific surveys indicated that within the area of the OECC coinciding with the Southern Trench MPA, sediments are characterised predominantly by muddy sand, with infaunal mobile species such as polychaetes and bivalves as predominant communities. In line with advice provided in NatureScot (2020c[6]), sandeels are known to utilise areas of sandy-gravel sediments and herring lay their sticky eggs in the areas of coarse sand, gravel, shells and small stones in high-energy gravel-rich environments. As such, the sediments within the OECC are not the type that is favoured by these two main minke whale prey species.

5.1.1.105 This is supported by the data presented in the Volume 7B, Appendix 5-1: Fish and Shellfish Ecology Technical Baseline Report of the EIAR, which notes that the majority of the OECC is classified as 'Unsuitable' habitats for spawning sandeel, with areas to the East and West of the OECC also being classified as 'Unsuitable'. This corresponds with a band of 'Muddy Sand' which stretches across the mid portion of the OECC, and particle size distribution at stations

within the OECC indicated that most sites were categorised as 'Unsuitable' (for herring spawning), with the majority having a <10% gravel or >5% mud content. It should be noted, however, that the nearshore areas of the OECC showed higher likelihood for herring and sandeel spawning. Although the Caledonia North OECC and Caledonia South OECC overlap with approximately 108km^2 of the Southern Trench MPA (4.5% of the total MPA), only approximately 2.8km^2 within the site will be affected by temporary habitat disturbance, equating to 0.12% of the total area of the MPA (see paragraph 5.1.1.3).

5.1.1.106 During the O&M phase, any maintenance work completed on the offshore export cable within the Caledonia North OECC and Caledonia South OECC that overlaps with the Southern Trench MPA will likely lead to temporary habitat disturbance/loss, similar to that identified in paragraphs 5.1.1.4 and 5.1.1.6. Sandeel and herring are demersal spawners, reliant upon the presence of suitable substrates for spawning (i.e., sandy and gravelly sediments, respectively) and may therefore result in temporary habitat loss/disturbance, particularly at the nearshore portion of the OECC. Given a very localised extent, this loss is not expected to undermine regional ecosystem functions or diminish biodiversity and as such, impacts to the extent and distribution of minke whale prey items is not expected.

5.1.1.107 For fronts feature (see paragraph 5.1.1.29 *et seq*), the assessment concluded that although the presence of WTG foundations will lead to changes in hydrography, due to the distances between the frontal features within the MPA and the Caledonia OWF (including Caledonia North Site and Caledonia South Site) this feature will not be adversely affected within the MPA. As such, indirect adverse effects on minke whale prey species are not expected.

5.1.1.108 The assessment against conservation objective for physical barriers during the O&M phase "*Extent and distribution of any supporting feature and structure*" for the Proposed Development (Offshore), Caledonia North and Caledonia South is provided in Table 5-16.

Table 5-16: Assessment against conservation objective "Extent and distribution of any supporting feature and structure" for impacts to prey species during construction as well as the O&M phase.

Site-specific Advice	Assessment Conclusion
Conserve the extent and distribution of any supporting feature upon which minke whale is dependent.	Prey depletion (sandeel, herring) due to activities that disturb the sediment (temporary habitat disturbance) alongside the export cable corridors cannot be excluded. Although the potential effects will be taking place anywhere within 4.5% of the MPA, in case of temporary habitat loss/disturbance, only approximately 0.12% of the total area of the MPA will be affected. Given the localised extent, this loss is not expected to undermine regional ecosystem functions or diminish biodiversity and as such, impacts to the extent and distribution of minke whale prey items is not expected.
Overall conclusion: Although the adverse effects on the extent and distribution of prey species upon which minke whale is dependent cannot be excluded, these will be localised to the Caledonia North OECC and Caledonia South OECC. Any loss of habitat is not expected to undermine regional ecosystem functions or diminish biodiversity and as such, impacts to the extent and distribution of minke whale prey items is not expected. Therefore, the achievement of this Conservation Objective is **not at risk** of being hindered.	

5.2 Cumulative Assessment

5.2.1 Overview

5.2.1.1 Certain impacts assessed for the Proposed Development (Offshore) alone have not been considered within the Cumulative Assessment as there has been no pathway of effect identified. This includes the following features:

- Fronts;
- Quaternary of Scotland (subglacial tunnel valleys and moraines); and
- Submarine Mass Movement (slide scars).

5.2.2 Biodiversity Features

Burrowed Mud

Screening Impact Pathways

5.2.2.1 The following impacts have been considered in the cumulative assessment for the construction, decommissioning and O&M phases:

- Physical habitat loss/disturbance;
- Increased SSC and deposition of disturbed sediments to the seabed;
- Direct and indirect seabed disturbance leading to release of sediment contaminants; and
- MINNS.

Screening Projects

5.2.2.2 The projects, plans and activities considered to be relevant to the assessment of impacts on burrowed mud feature of the Southern Trench MPA are presented in Table 5-17.

Table 5-17: Projects, plans and activities included in cumulative assessment for burrowed mud.

Development	Status	Potential for Significant Cumulative Effects
Shetland HVDC Link	Under construction	Yes
Moray West Offshore OECC	Under construction	Yes
Stromar OECC	Concept/early planning	Yes

5.2.2.3 Certain impacts assessed for the Proposed Development (Offshore) alone are not considered in the cumulative assessment due to:

- The highly localised nature of the impacts (i.e., the occur entirely within the Proposed Development (Offshore) boundary only);
- Management measures in place for the Proposed Development (Offshore) will also be in place on other projects reducing the risk of impact occurring; and/or
- Where the potential significance of the impact from the Proposed Development (Offshore) alone has been assessed as negligible.

5.2.2.4 Therefore, the cumulative assessment has only considered the temporary increase in SSC and sediment deposition during construction.

Cumulative Temporary Increase in SSC and Sediment Deposition

5.2.2.5 Due to uncertainty associated with the exact timing of other projects and activities, there is insufficient data on which to undertake a quantitative or semi-quantitative assessment. As such, the discussion presented here is qualitative. It is considered highly unlikely that each of the identified projects would be undertaking major maintenance works, in particular asset reburial or repairs, as these are infrequent occurrences during the lifetime of developments.

5.2.2.6 Sediment plumes from operational and maintenance activities are generally short-lived, with major maintenance works infrequent. Any impacts from operational offshore Wind Farm export cables (and other subsea cables) activities are therefore likely to be short-lived and of localised extent, with limited opportunity to overlap with Project-related activities. The Moray West OWF OECC and Shetland HVDC Link are both currently under construction and are expected to be fully operational by the end of 2024. Therefore maintenance-related impacts are similarly considered to be primarily short-lived and localised. Accordingly, the potential for cumulative interaction with these sites is limited and therefore has not been assessed further.

5.2.2.7 As detailed by the numerical modelling within Volume 2, Chapter 2: Marine and Coastal Processes, impacts for all construction activities (both in terms of SSCs and sedimentation) were predicted to mainly be confined to occur within the Array Area and/or along the Caledonia North/Caledonia South OECC. Given the short-lived nature of the sediment plumes there is not anticipated to be a notable overlap with concentrated sediment plumes created from other industry activities.

5.2.2.8 The impact of increased SSC and deposition is considered to be low, and the sensitivity of receptors affected is considered to be a worst-case medium for benthic subtidal receptors. The significance of the effect is therefore concluded to be minor and not significant in EIA terms.

5.2.2.9 The conclusions of the cumulative assessment against relevant Conservation Objectives is provided in Table 5-18.

Table 5-18: Assessment against conservation objectives "*Species is conserved*" and "*function is conserved*".

Site-specific Advice	Assessment Conclusion
Conserve the current extent and distribution of burrowed mud habitat within the site so that it is stable or increasing.	Given the short-term nature of the disturbance and the existing tolerance to disturbance of the benthic habitats present, and the predicted medium to high recoverability of the biotopes, that the sites conservation objectives in relation to conserving the current extent of the burrowed mud feature will be maintained in the long-term.
Conserve the function of the fronts feature so as to ensure that it continues to support its characteristic biological communities and their use of the site	Given the short-term and temporary nature of the construction and decommissioning works, the reversibility of effect, recoverability of receptors, and the localised nature of effects that the conservation objectives will be maintained in the long-term for the Southern Trench MPA.
Overall conclusion: There is, therefore, **no potential for non-conformance** with Conservation Objectives, having regard to the conservation objectives of the Southern Trench MPA in relation to suspended sediment/deposition from cumulative effects in relation to construction activities and therefore, subject to natural change, the designated features will be maintained in the long-term.	

Minke Whale

Screening Impact Pathways

5.2.2.10 Certain impacts assessed for the Proposed Development (Offshore) and Caledonia North/South alone are not considered in the marine mammal cumulative assessment due to:

- The highly localised nature of the impacts; and
- Management and mitigation measures in place at the Proposed Development (Offshore), Caledonia North and Caledonia South and on other projects that will reduce the risk of cumulative effects occurring.

5.2.2.11 The impacts excluded from the marine mammal cumulative effects assessment (CEA) for these reasons are presented in Table 5-19.

Table 5-19: Impact pathways screened from consideration in the cumulative effects assessment (CEA).

Impact	Justification
Auditory injury	Where PTS may result from activities such as piling, geophysical surveys and UXO clearance, as a requirement of European Protected Species legislation, suitable mitigation must be put in place to reduce injury risk to marine mammals to negligible levels across all projects considered in the cumulative assessment (JNCC, 2010a[73]; 2010b[74]; 2017[75]). Similarly, any risk of PTS during decommissioning will be determined via appropriate decommissioning plans and if required, mitigated. Any non-piling construction noise sources will have a local spatial extent and therefore represent a minimal risk of injury. Moreover, it is anticipated that underwater noise associated with vessel activity will deter animals from the injury zone. As such, assuming application of appropriate mitigation measures, any risk of injury from piling, UXO clearance, geophysical surveys or other activities is considered to be negligible and, therefore, the potential for cumulative effects of PTS on minke whale are not considered further.
Collision with vessels	Although vessel collisions with minke whale are considered unlikely, it is expected that across all projects vessel movements will be managed through the implementation of vessel codes of conduct that will follow relevant guidance to minimise the risks of injury to minke whales (e.g., limited vessel speeds, adherence to vessel transit routes). As such, the potential for significant cumulative effects is negligible and this impact was not considered further.
Disturbance due to operational noise	The underwater noise associated with the operation of the offshore wind farms have the potential to alter the acoustic soundscape within close vicinity to the respective array areas. Given that array areas of the projects considered in the cumulative assessment do not overlap with the Southern Trench MPA, the potential for significant cumulative effects is minimal and therefore this impact was not considered further.

5.2.2.12 The following impacts have been considered in the cumulative assessment:

- Disturbance due to underwater noise (UWN) (construction):
  - Piling
  - UXO
  - Other construction activities
  - High-resolution geophysical surveys
  - Vessels
- Disturbance due to UWN (O&M):
  - High-resolution geophysical surveys
  - Vessels
- Entanglement
- Physical barriers
- Impacts on prey
- Supporting habitats and processes

Screening Projects

5.2.2.13 For the purpose of the cumulative assessment for the Southern Trench MPA, only projects which were located within Scotland, and have a construction period that falls between 2027 to 2033 were included for construction phase impacts (Table 5-20).

Table 5-20: Offshore projects screened into the cumulative assessment of construction phase impacts for the Southern Trench MPA (C = general construction period, P = piling).

Project	Technology	2027	2028	2029	2030	2031	2032	2033
Caledonia North	Bottom-fixed		P/C	P/C	P/C			
Caledonia South	Mixed		P/C	P/C	P/C			
Proposed Development (Offshore) (sequential, no gap)	Mixed		P/C	P/C	P/C	P/C	P/C	
Morven	Bottom-fixed	C	C	C	C	C	C	
Moray West	Bottom-fixed	Operational from 2025						
Green Volt	Floating	P/C						
Salamander	Floating		P/C	C				
Ossian	Floating					P/C	P/C	C
Broadshore	Floating		C	C	C	C		
Buchan	Floating		C	C	C	C	C	
Cenos	Floating			C	C	C	C	C
Muir Mhòr	Floating	C	C	C	C			
Sinclair	Floating		C	C	C	C		
Ayre	Floating			C	C	C	C	C
Bowdun	Floating		C	C	C	C	C	C
Bellrock	Floating		C	C	C	C		

5.2.2.14 The Berwick Bank and West of Orkney OWFs were initially considered, but since the Southern Trench MPA was screened out from their respective EIARs, these projects were not considered further.

5.2.2.15 Additionally, the MarramWind and Stromar OWFs are at early stages of project development and therefore construction timeframes are not available in the public domain. However, due to spatial overlap with the Southern Trench MPA and likely temporal overlap with the O&M phase at these projects and at the Proposed Development (Offshore) and Caledonia North/Caledonia South, these projects are considered in the assessment of cumulative effects during the O&M phase.

5.2.2.16 The following projects constructing between 2027 to 2033 have, or are very likely to have, OECCs that overlap with the Southern Trench MPA:

- The Proposed Development (Offshore) (i.e., Caledonia North OECC and Caledonia South OECC; confirmed – EIAR);
- Green Volt (confirmed – EIAR; Royal HaskoningDHV, 2023[76]);
- Salamander (confirmed – EIAR; Clarkson *et al*. 2024[77]);
- Buchan (confirmed – scoping; Buchan Offshore Wind, 2023[78]);
- Muir Mhòr (confirmed – scoping; Muir Mhòr Offshore Wind Farm, 2023[79]);
- Cenos (confirmed – scoping; Cenos, 2024[80]);
- Broadshore Hub: Broadshore and Sinclair Projects (unconfirmed – OECC not included in scoping; BlueFloat Energy and Renantis, 2024a[81]);
- Bellrock (unconfirmed – OECC not included in scoping; BlueFloat Energy and Renantis, 2024b[82]); and
- Bowdun (unconfirmed – scoping not available yet).

5.2.2.17 Where a project has or is likely to have direct overlap with the Southern Trench MPA, it will be considered for all impacts screened in. For some projects, infrastructure will not overlap with the Southern Trench MPA; however, there is still a potential for the noise contours to overlap with the boundary of the site. Therefore, Morven, Ossian and Ayre OWFs were considered for cumulative piling only.

Underwater Noise - Disturbance (Construction)

Piling

5.2.2.18 For projects with the EIARs available in the public domain (Ossian, Green Volt, Salamander), the potential for overlap of noise disturbance contours with the MPA boundary is based on project-specific data. The Ossian array area is located approximately 66.9km south of the Southern Trench MPA and, given the far-reaching extent of the noise contours, there is potential for overlap of the outer noise contours with the site boundary. Received sound levels within the MPA are predicted to reach maximum SEL_{ss} levels of 135 dB, which is below the NMFS (2005[83]) threshold for strong disturbance (160 dB rms) and above the threshold for mild disturbance (140 dB rms). Although the overlap is not quantified, as described in RPS (2024a[84]), the extent of the SEL_{ss} contours is likely to be an overestimate as it assumes that the sound from piling maintains its impulsive characteristics at large distances. Royal HaskoningDHV (2023[76]) concluded that, as a result of piling at the Green Volt, minke whales are not at risk of experiencing strong/mild behavioural disturbance within the MPA boundary. The Salamander Array Area is located approximately 10km from the Southern Trench MPA and overlap of noise disturbance contours with the site is expected (see Table 5-21, Figure 5-3 and Figure 5-4).

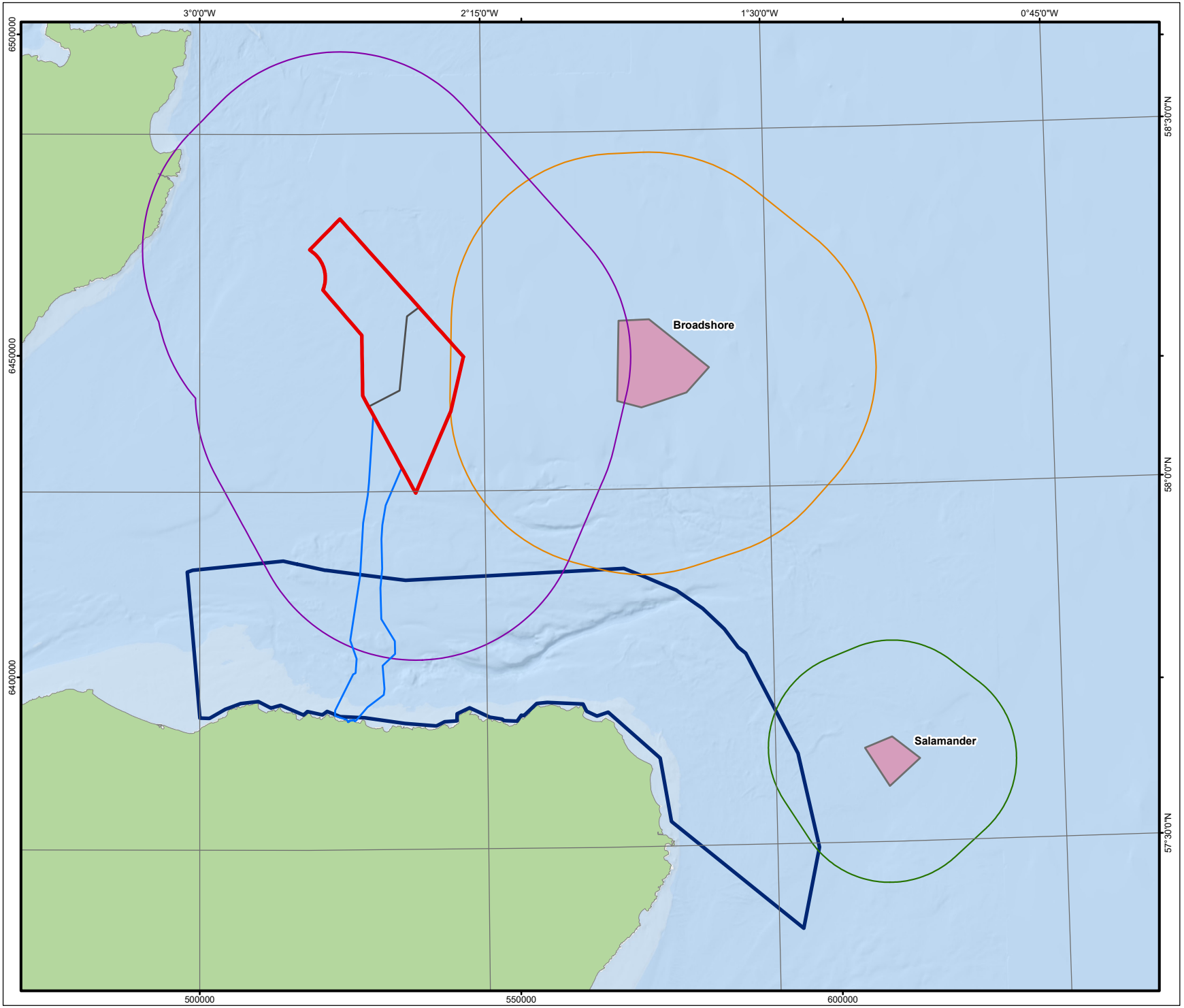
5.2.2.19 In their respective Scoping Reports, the Morven (RPS, 2023[85]) and Ayre (RPS, 2024b[86]) projects have concluded that where there is a potential for impacts on the Southern Trench MPA, the site will be included in an MPA Assessment. However, due to the distance to the site (approximately 57km and 97km, respectively), minke whales are unlikely to experience disturbance within the MPA during piling at these projects.

5.2.2.20 Piling is expected to be taking place only within the array areas of projects considered in the EIA. For projects without EIARs available in the public domain, the potential for overlap has been estimated based on fixed EDRs. To allow for comparison between these projects, effective disturbance area (where available) and EDRs were provided for all (Table 5-21).

5.2.2.21 Assuming a 26km EDR for bottom-fixed foundation projects, and a 15km EDR for floating projects, only Broadshore and Salamander have EDR contours that overlap with the Southern Trench MPA in addition to the Proposed Development (Offshore) and Caledonia North/Caledonia South (Table 5-21) (though the contribution from Broadshore is minimal).

Table 5-21: Behavioural disturbance from piling at the Proposed Development (Offshore), Caledonia North/Caledonia South and other projects.

Project	Disturbance Threshold	Area Overlap (km²)	% MPA
Proposed Development (Offshore) and Caledonia South (monopile at location 8)	26km EDR	418	16.5%
	Dose-response function	1,656 (effective disturbance area)	65.3%
Caledonia North (monopile at modelling location 4)	26km EDR	0	0.0
	Dose-response function	1,486 (effective disturbance area)	58.6
Broadshore	26km EDR	4.6	0.2%
	Dose-response function	*Unavailable*	
Salamander (piled anchor at West location)*	15km EDR	61.3	2%
	Dose-response function	1,196 (effective disturbance area)	47%
* Data from Clarkson *et al*. (2024[77]).			



Caledonia OWF
Caledonia North Site and Caledonia South Site Division Line
Offshore Export Cable Corridor
Offshore Wind Developments
Caledonia OWF 26km Buffer
Broadshore 26km Buffer
Salamander 15km Buffer
Southern Trench MPA

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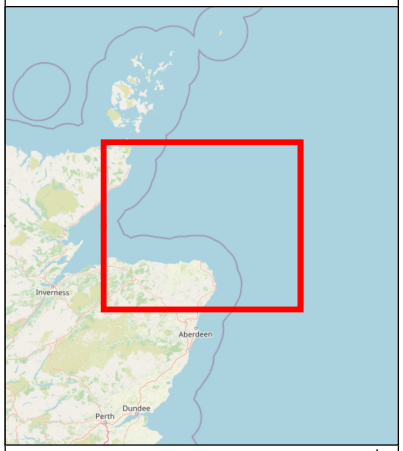


0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	24/09/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm
GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00445
CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)
DRAWING TITLE:

Figure 5-3: Cumulative Assessment for Piling – Overlap of 26km EDRs with the Southern Trench MPA

STATUS: Approved
SCALE: 1:800,000
DRAWING NUMBER: N/A
SHEET NO: 01 of 01
REV: N/A

5.2.2.22 It should be noted that piling at Salamander will take place on 40 days (under the most likely scenario), between April 2028 to October 2028, and therefore there is potential for temporal overlap with the high density season (Salamander Offshore Wind Farm, 2023[87]). However, given that piling at the Proposed Development (Offshore) and Caledonia North/Caledonia South is anticipated to begin in October 2028, the potential for temporal overlap with piling at Salamander is limited. If there was concurrent piling at the Proposed Development (Offshore) or Caledonia North/Caledonia South and Salamander, whilst the noise contours from piling at both project sites would likely overlap the entire Southern Trench MPA area, the effective disturbance area based on the dose-response function would be less than the overall area overlap. In the case of sequential piling, e.g., Salamander first and then Proposed Development (Offshore) or Caledonia North/Caledonia South, minke whales could experience disturbance for a longer duration and at different parts of the Southern Trench MPA (Figure 5-4).

5.2.2.23 The indicative construction timeline for Broadshore suggests that the construction may be taking place between 2028 to 2031 and therefore temporal overlap with the Proposed Development (Offshore) or Caledonia North/Caledonia South is likely. Based on the scoping report (BlueFloat Energy and Renantis, 2024a[81]), the number of foundations anticipated for the Broadshore project is 60 WTGs with 12 anchors per foundation (total 720 anchors). The number of piling days was not presented in the scoping report, however, if it is assumed that two piled anchors are installed per day, the anticipated duration of piling at Broadshore would be 360 days. In the unlikely, worst-case temporal scenario (where there would be no temporal overlap between piling at the Proposed Development (Offshore) or Caledonia North/Caledonia South and Broadshore) there is a risk that minke whales within the Southern Trench MPA could experience disturbance intermittently over up to 875 days (although noting that overlap of 26km EDR at the Broadshore with the Southern Trench MPA is minimal).

5.2.2.24 If Salamander, Broadshore and the Proposed Development (Offshore) or Caledonia North/Caledonia South were to pile on the same day, then using the EDR approach, up to 19.3% of the MPA may be disturbed on a single day (noting that if the dose-response function was used this would result in a significantly higher proportion of the MPA).

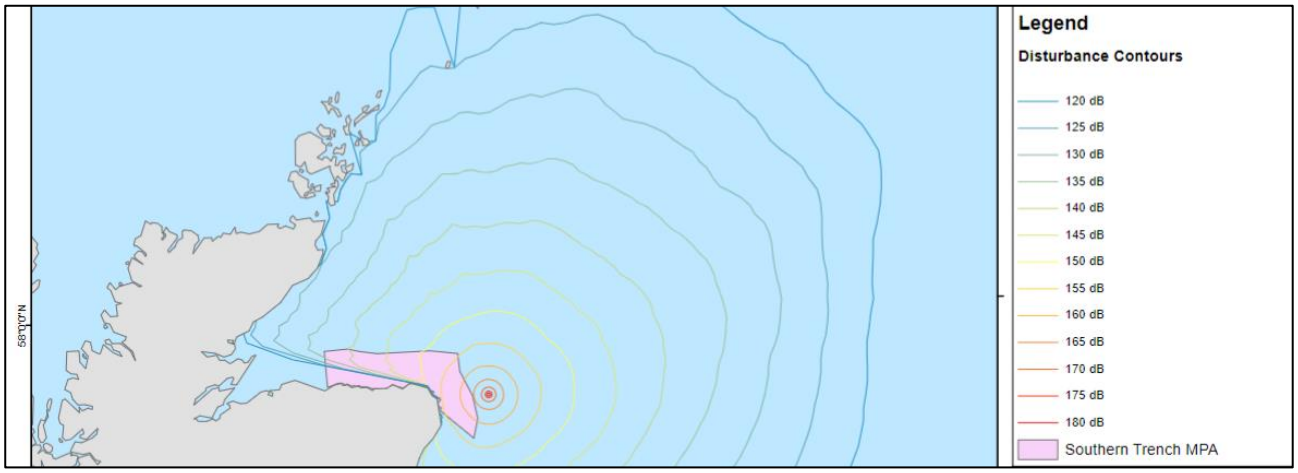
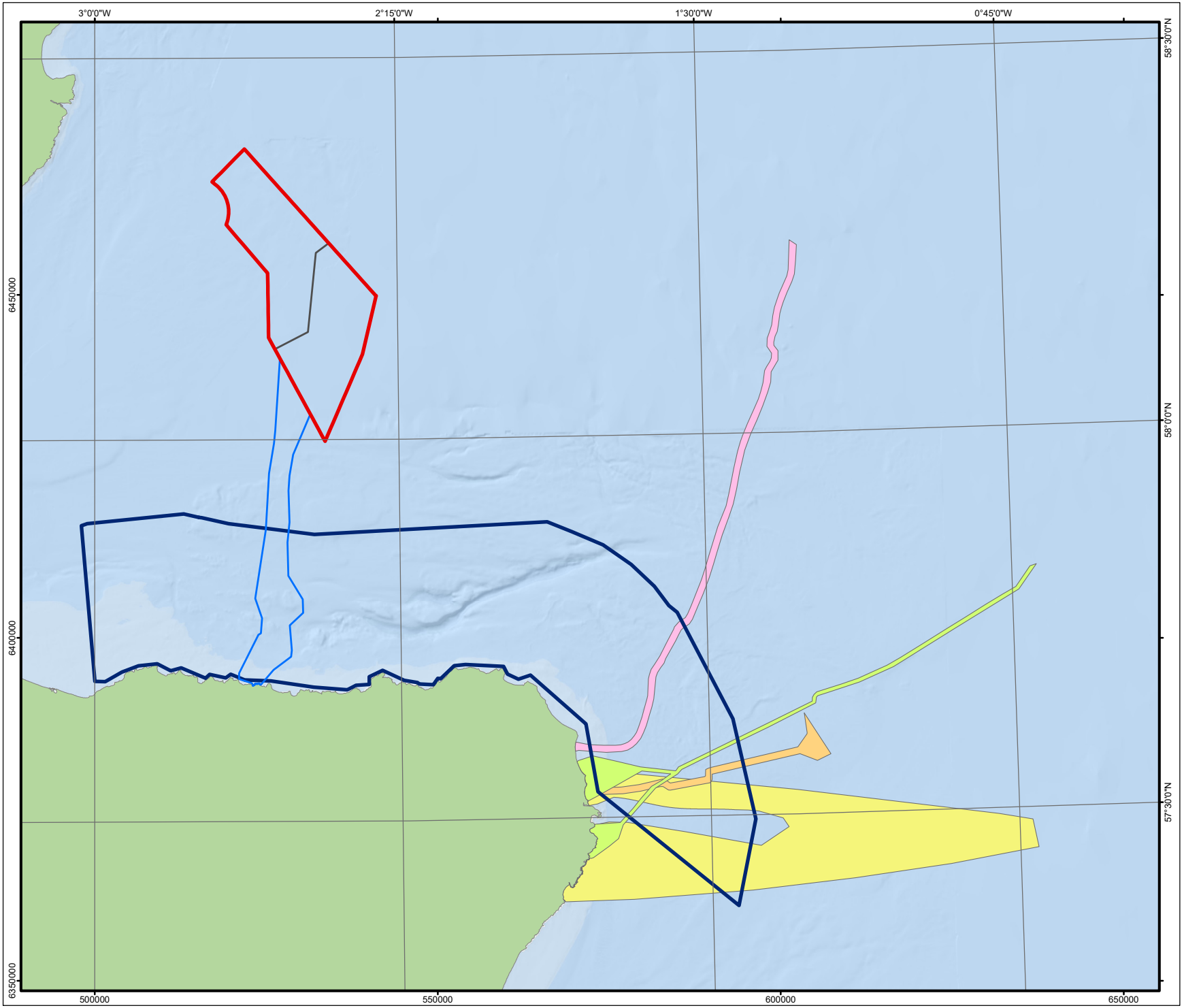


Figure 5-4: Disturbance contours (SEL_{ss}, unweighted) for piling at the Salamander West piling location (2,500 kJ) and overlap with the Southern Trench MPA. Source: Clarkson *et al*. (2024[77]).

UXO Clearance, Geophysical Surveys, Other Construction Activities and Vessels

5.2.2.25 All projects with infrastructure overlapping with the Southern Trench MPA may carry out UXO clearance, geophysical surveys and other construction activities such as cable trenching, cutting, cable laying within the MPA boundary. Additionally, increased vessel movements during the construction phase of these projects have a potential to result in behavioural disturbance anywhere within the Southern Trench MPA as vessels move in and out from ports. Projects with construction activities within the Southern Trench MPA include Green Volt, Salamander, Broadshore, Sinclair, Buchan, Cenos, Muir Mhor, Bowdun and Bellrock. Given the early stages of the development for some of these projects, shapefiles with the OECC are not available in the public domain. For projects with available OECC boundaries, potential overlap with the MPA is shown in Figure 5-5.



Caledonia OWF

Caledonia North Site and Caledonia South Site Division Line

Offshore Export Cable Corridor

Southern Trench MPA

Offshore Wind Development (In Planning)

Buchan OECC

Green Volt OECC

Muir Mhor OECC

Salamander OECC

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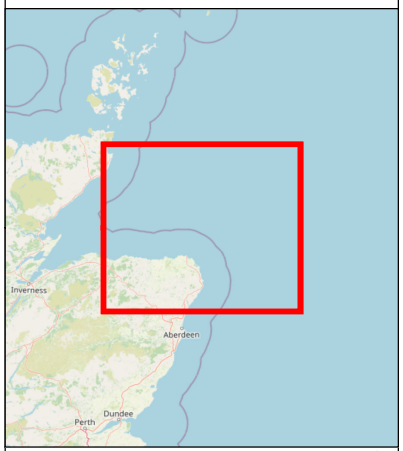

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REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	24/09/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm

GoBe APEMGroup

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00446	CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)	

DRAWING TITLE

Figure 5-5: Southern Trench MPA and Overlap of Project Infrastructure with the Site Boundaries During Construction Phase

STATUS: Approved	SCALE: 1:750,000	
DRAWING NUMBER: N/A	SHEET NO: 01 of 01	REV: N/A

UXO Clearance

5.2.2.26 There are several projects that have OECCs that overlap with the Southern Trench MPA, and therefore could potentially require UXO clearance within the MPA boundary. It is reasonable to expect that UXO clearance at all projects will involve low-order deflagration methods, and as such the potential impact from each project is assumed to be up to a 5km EDR, resulting in an impacted area of 78.4km^2 per UXO which equates to 3.1% of the MPA area disturbed per UXO clearance activity. The situation where UXO clearance would occur within the MPA from multiple projects at the same time is unlikely but cannot be excluded. It is expected that the detonation of UXOs within the MPA would elicit short-duration behavioural responses only. Due to health and safety reasons, UXO clearance activities are anticipated to take place during pre-construction phases of relevant projects and during early construction phases. Based on the cumulative assessment timeline (Table 5-20), UXO clearance would be anticipated to occur intermittently between 2027 and 2028.

High-resolution Geophysical Surveys

5.2.2.27 As discussed in the Proposed Development (Offshore) alone section (applicable to Caledonia North and Caledonia South), the expected sound frequency during operation of MBES and SSS is above 200kHz and therefore above the hearing frequency range of minke whales. As such, there is no potential for disturbance effects to occur through use of these survey equipment.

5.2.2.28 As detailed in paragraph 5.1.1.79, the JNCC *et al*. (2010[34]) EPS Guidance concludes that the use of SBPs in geophysical surveys "*could, in a few cases, cause localised short-term impacts on behaviour such as avoidance*". Should the short-term clearance operations result in a response by an animal, this would be temporary and localised. For example, Thomsen *et al*. (2023[51]) reported that minke whales may experience behavioural response as a result of sparker and minigun within a distance of 1.1km (2.7km^2) and 1.9km (6.3km^2), respectively.

5.2.2.29 Geophysical surveys are anticipated to take place during the construction phase of Green Volt, Salamander, Broadshore, Sinclair, Buchan, Cenos, Muir Mhor and Bellrock. It is expected that disturbance ranges from geophysical surveys within their respective OECCs would be localised to within approximately 2km (see paragraph 5.1.1.80)and could occur intermittently over construction phase of respective projects (Table 5-20).

Other Construction Activities

5.2.2.30 For Green Volt, the EIA assessed that activities such as cable trenching, cutting, cable laying and vessel activity, which will be taking place within the MPA, may disturb minke whales out to a maximum of approximately 9km using the of 120 dB re 1 µPa (rms) threshold (Royal HaskoningDHV, 2023[76]). For Salamander, the EIA assessed that activities such as dredging, drilling, cable laying, trenching, rock placement and vessel activity, which will be

taking place within the MPA, may disturb minke whales out to a maximum of 5km (Clarkson *et al*., 2024[77]). No other projects have provided a quantitative impact assessment yet, and as such it is expected that all disturbance impacts from activities within their respective OECCs would be localised within up to 5km from the vessel and could occur intermittently over the construction phase of respective projects (Table 5-20).

Vessels

5.2.2.31 It is challenging to reliably quantify the level of increased disturbance to minke whales resulting from increased vessel activity on a cumulative basis, given the large degree of temporal and spatial variation in vessel movements between projects and regions, coupled with uncertainty regarding preferred ports. As previously mentioned for the Proposed Development (Offshore) and Caledonia North/Caledonia South alone, minke whale foraging activity has been found to decrease with increased vessel interactions (Christiansen *et al*., 2013[55]) and observed changes in foraging behaviour were apparent when whale-watching vessels were within ~250m of an animal (study on gray whales, also a low frequency cetacean) (Sullivan and Torres, 2018[59]). It is expected that all projects considered in the cumulative impact assessment will adopt VMPs and/or comply with the existing Marine Wildlife Watching Codes such as Scottish Natural Heritage (2017a[88]; 2017b[89])[i] to minimise any potential vessel disturbance effects on minke whales. Nevertheless, it is expected that all disturbance impacts from vessels within project respective OECCs would be localised and could occur intermittently over the construction phase of respective projects (Table 5-20)..

Disturbance Conclusion

5.2.2.32 It is likely that activities (UXO clearance, geophysical surveys, piling, drilling, trenching, vessel movements) associated with construction of the Proposed Development (Offshore) or Caledonia North/Caledonia South and other projects considered in the CEA may result in temporary displacement of minke whales within the MPA. Animals may choose to cease foraging in response to noise by fleeing the affected area; however, it is anticipated that individuals will be able to return to an area within a relatively short period of time.

5.2.2.33 The assessment against Conservation Objective "Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds" for cumulative disturbance during construction phase is provided in Table 5-22.

[i] In 2020, Scottish Natural Heritage was re-branded as NatureScot; however, its legal persona and statutory functions has remained unchanged.

Table 5-22: Assessment against conservation objective "Continued access by the species to resources" for cumulative disturbance during construction phase.

Site-specific Advice	Assessment Conclusion
Conserve the access to resources (e.g., for feeding) provided by the MPA for various stages of the minke whale life cycle.	Behavioural disturbance causing displacement during construction of the Proposed Development (Offshore) or Caledonia North/Caledonia South and other projects as a result of various activities taking place across seven years may reduce access to minke whale resources within the site. Although the entire site will not be affected, behavioural disturbance could occur intermittently throughout the MPA.
Conserve the distribution of minke whale within the site by avoiding significant disturbance. 'Significant disturbance' may result in the following effects: ▪ The contribution to long-term decline in the use of the MPA ▪ Changes to the distribution on a continuing or sustained basis ▪ Changes to the behaviour such that it reduces the ability of the species to feed efficiently, breed or survive	There is no empirical evidence that would suggest that minke whales will not return to the area following the cessation of construction activities and therefore there is expected to be no long-term decline in the use of the MPA. There is a potential for minke whale to experience disturbance within the Southern Trench MPA at any time during the CEA timeline of seven years, the effect may occur at moderate frequency and is therefore considered to be sustained over the period between 2027 and 2033. Minke whales have been shown to change their behaviour in response to disturbance from ADDs, whale watching vessels and other construction activities. It was suggested that a reduction in foraging activity at feeding grounds could result in reduced reproductive success in this capital breeding species (Christiansen *et al.*, 2013[55]). Although behavioural effects from piling are expected to be reversible and the entire MPA site will not be affected, behavioural disturbance could occur intermittently throughout the MPA. Therefore, the ability to forage effectively is likely to be intermittently affected.
Overall conclusion: There is a potential for avoidance/changes in behaviour as a result of construction of the Proposed Development (Offshore), Caledonia North and Caledonia South cumulatively with other projects. As such, the reduced access to resources as well as significant disturbance within the site cannot be ruled out. However, in line with discussion presented in paragraph 5.1.1.69, there is a high degree of uncertainty regarding minke whale responses to underwater noise, which precludes a confident assessment as to whether or not "significant" disturbance could occur. Considering the above, and the highly conservative assumptions associated with the baseline data and assessment modelling approach, this assessment concludes that the risk of hindering the Conservation Objectives is **uncertain**. To address this, the Applicant is committed to: ▪ Collaborating with stakeholders, academic institutions and other developers to address knowledge gaps regarding minke whale behavioural response to disturbance through ongoing research and monitoring efforts. ▪ Utilisation of latest available evidence from Moray West OWF piling activity (to be published in 2025), emerging monitoring results and refined design parameters to inform and optimise the piling strategy.	

Underwater Noise - Disturbance (O&M)

5.2.2.34 This section provides an assessment of the risk of significant disturbance from vessels and geophysical surveys from the Proposed Development (Offshore) or Caledonia North/Caledonia South cumulatively with other projects.

Vessels

5.2.2.35 Although it is challenging to reliably quantify the level of increased disturbance to minke whales resulting from increased vessel activity on a cumulative basis, disturbance to minke whale may occur as a result of increased vessel activity during vessel movements to and from ports as well as from maintenance activities associated with the Proposed Development (Offshore) and Caledonia North/Caledonia South.

Geophysical Surveys

5.2.2.36 A description of potential impacts on minke whale due to geophysical surveys during O&M phase of the Proposed Development (Offshore) or Caledonia North/Caledonia South and projects considered in the cumulative assessment (Moray West, Green Volt, Salamander, Buchan, Muir Mhor, MarramWind, Stromar, Cenos, Broadshore, Sinclair and Bellrock) is provided for the construction phase above. Geophysical surveys may result in localised changes to minke whale behaviour, including movement and vocalisations, up to approximately 2km from the noise source (see paragraph 5.1.1.80). It is expected that geophysical surveys would occur at low frequency throughout the O&M phases of respective projects.

Conclusion

5.2.2.37 There is the potential for minke whales to be disturbed within the MPA across the O&M phase of the Proposed Development (Offshore) or Caledonia North/Caledonia South cumulatively with other projects. Geophysical surveys will be carried out periodically and is unlikely that geophysical surveys across different projects and their operational lifetimes would occur at the same time. The number of vessels associated with O&M will be small compared to the construction phase and likely indiscernible from the baseline traffic.

5.2.2.38 The assessment against conservation objective for disturbance during the O&M phase "Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds" for the Proposed Development(Offshore), Caledonia North and Caledonia South is provided in Table 5-23.

Table 5-23: Assessment against conservation objective "Continued access by the species to resources" for cumulative disturbance during the O&M phase.

Site-specific Advice	Assessment Conclusion
Conserve the access to resources (e.g., for feeding) provided by the MPA for various stages of the minke whale life cycle.	Behavioural disturbance during the O&M phase of the Proposed Development (Offshore), Caledonia North and Caledonia South, when considered cumulatively with other projects, is unlikely to reduce access to minke whale resources within the site.
Conserve the distribution of minke whale within the site by avoiding significant disturbance. 'Significant disturbance' may result in the following effects: ▪ The contribution to long-term decline in the use of the MPA ▪ Changes to the distribution on a continuing or sustained basis ▪ Changes to the behaviour such that it reduces the ability of the species to feed efficiently, breed or survive	The characteristics of the O&M phase activities is likely to be similar to those currently taking place within the Southern Trench MPA (e.g., surveys and vessel transits). The behavioural disturbance effect may occur at low frequency and is likely to be localised to the vicinity of geophysical survey and/or moving vessel. As such, it is not considered to result in: ▪ Long-term decline in the use of the MPA ▪ Changes in distribution on continued or sustained basis ▪ Restricted ability to forage, breed or survive.
Overall conclusion: The reduced access to resources as well as significant disturbance are unlikely to take place due to behavioural disturbance during the O&M phase of the Proposed Development (Offshore) or Caledonia North/Caledonia South cumulatively with other projects. Therefore, the achievement of this Conservation Objective is **not at risk** of being hindered.	

Injury or Killing from Entanglement (O&M)

5.2.2.39 The cumulative assessment for this impact pathway considers the potential for entanglement from all Scottish east coast Scotwind and INTOG floating wind projects (Ossian, Bellrock, Muir Mhor, Stromar, Broadshore, MarramWind, Buchan, Green Volt, Salamander, Sinclair, and Cenos). The assessment is applicable only to the Proposed Development (Offshore) and Caledonia South, as no floating infrastructure is included within the Caledonia North design envelope.

5.2.2.40 The Proposed Development (Offshore) and Caledonia South, Green Volt and Salamander have committed to embedded mitigation measures to negate the potential risk of entanglement (Royal HaskoningDHV, 2023[76]; Simply Blue Energy (Scotland) Limited, 2023[90]). All three project-alone EIAs concluded that this risk would be mitigated and thus there was no potential impact to the minke whale population of the MPA.

5.2.2.41 As per the Proposed Development (Offshore) (Caledonia South), Green Volt and Salamander, it is expected that all other floating OWF projects will implement embedded mitigation, as most of the scoping reports identified periodic inspections, including visual surveys and identification of debris, as a measure necessary to reduce the risk of entanglement (BlueFloat Energy and Renantis, 2024a[81]; 2024b[82]; Buchan Offshore Wind, 2023[78]; Muir Mhor, 2023[79]). The embedded mitigation is anticipated to include inspections of mooring lines and floating inter-array cables, where the presence of discarded fishing gear will be evaluated for marine mammal entanglement risk and appropriate actions taken to remove if deemed necessary.

5.2.2.42 Considering the application of embedded mitigation measures, it can be concluded that there is no residual risk of injury and/or killing to minke whale within the Southern Trench MPA. The assessment against conservation objective "Species is conserved" for the Proposed Development (Offshore) and Caledonia South cumulatively with other projects is provided in Table 5-24.

Table 5-24: Assessment against conservation objective "Species is conserved" for entanglement cumulatively with other projects.

Site-specific Advice	Assessment Conclusion
Minke whale in the Southern Trench MPA are not at significant risk from injury or killing. 'Significant risk' should consider whether any killing or injury would result in reduced densities within the site, from which recovery to above average densities cannot be expected.	There is no residual risk of injury and/or killing to minke whales within the Southern Trench MPA from entanglement as each project is expected to mitigate this impact.
Overall conclusion: The risk of killing and injury from entanglement at the Proposed Development (Offshore) and Caledonia South cumulatively with other projects is expected to be mitigated, and the achievement of this Conservation Objective is **not at risk** of being hindered.	

Physical Barriers – Presence of Infrastructure (O&M)

5.2.2.43 There are several projects located in the vicinity of the MPA which have the potential to result in physical barriers that could restrict minke whales accessing the MPA. These include Caledonia, Stromar, Buchan, Broadshore, Sinclair, Green Volt, MarramWind, Muir Mhor and Salamander.

5.2.2.44 The assessment for the Proposed Development (Offshore), Caledonia North/Caledonia South alone concluded that the presence of infrastructure within the Caledonia OWF (or Caledonia North/South Site) is unlikely to result in physical barriers to the MPA as it will be localised to the array area only. The Green Volt EIA concluded that there was no potential impact to the minke whale population in the Southern Trench MPA due to barrier effects from the physical presence of the Green Volt wind farm alone (based on the spacings between turbines and moorings and the distance from the MPA) (Royal HaskoningDHV, 2023[76]). Likewise, the Salamander EIA concluded that if they occurred, barrier effects would be highly localised due to the scale of the project and are highly unlikely prevent access to the MPA (Clarkson *et al*., 2024[77]).

5.2.2.45 Although minke whale presence has been recorded around oil and gas structures in the central North Sea (Delefosse *et al*., 2018[72]), there is limited understanding on whether baleen whales can successfully navigate the spaces between turbines in the array, especially within floating offshore wind arrays where a meaningful proportion of the water column is intersected by mooring lines and cables. However, barrier effects will be restricted to the array areas of projects, which are all mostly >15km from the MPA boundary, with space between OWF array areas to navigate through (note, Salamander has a portion of the Array Area within 15km from the MPA boundary). Therefore, it is unlikely that the OWFs located near to the MPA will result in any restriction of minke whales accessing the site.

5.2.2.46 The assessment against Conservation Objective for physical barriers "Continued access by the species to resources provided by the MPA for, but not restricted to, feeding, courtship, spawning or use as nursery grounds" for the Proposed Development (Offshore), Caledonia North/Caledonia South cumulatively with other projects is provided in Table 5-25.

Table 5-25: Assessment against conservation objective "Continued access by the species to resources" for physical barriers cumulatively with other projects.

Site-specific Advice	Assessment Conclusion
Conserve the access to resources (e.g., for feeding) provided by the MPA for various stages of the minke whale life cycle.	Due to barrier effects being localised within OWF array areas, which are all mostly >15km from the MPA boundary, with space between OWF array areas to navigate through, it is expected that the Proposed Development (Offshore) or Caledonia North/Caledonia South when acting cumulatively with other projects, will not prevent or restrict access to the MPA and resources within.
Overall conclusion: It is expected that the Proposed Development (Offshore), Caledonia North/Caledonia South when acting cumulatively with other projects, will not result in physical barriers that would prevent or restrict access to the MPA and resources within, and therefore the achievement of this Conservation Objective is **not at risk** of being hindered.	

Impacts on Prey Species (Construction and O&M)

5.2.2.47 There are several other OWF projects which have OECCs that will potentially traverse the MPA (Green Volt, Salamander, Buchan, Muir Mhor, MarramWind, Cenos, Broadshore, Sinclair, Stromar and Bellrock; in addition to Beatrice, Moray East, Moray West and Hywind – which are all operational and thus considered as part of the baseline). Each of these projects has the potential to impact the extent and distribution of key minke whale prey species (lesser sandeel, sprat, herring and mackerel) during the construction and O&M phases that may in turn affect minke whales using the MPA.

5.2.2.48 The assessment for the Proposed Development (Offshore), Caledonia North and Caledonia South alone concluded that there is the potential for the extent and distribution of prey species to be affected within the OECC due to activities that disturb the sediment (temporary habitat disturbance). It is predicted that approximately 2.8km^2 within the Southern Trench MPA will be affected by temporary habitat loss/disturbance, equating to 0.12% of the total area of the MPA (see paragraph 5.1.1.3).

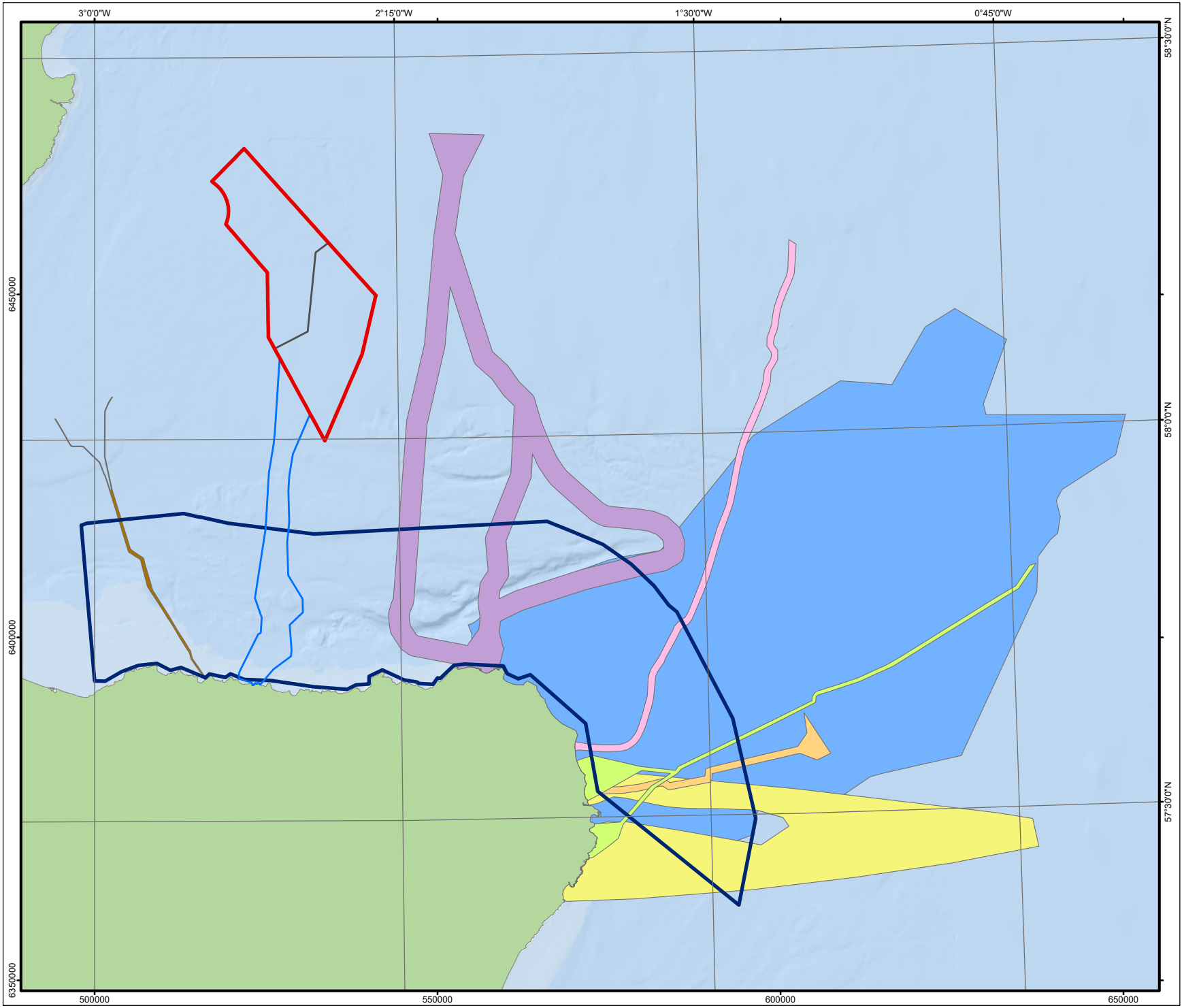
5.2.2.49 The Salamander EIA concluded no significant impacts to fish species as a result of construction activities such as changes to seabed habitat and temporary increase in suspended sediment/ contaminant concentrations (Clarkson *et al.*, 2024[77]). Therefore, it was concluded that there would be no impacts to the structure and function of the supporting features (minke whale prey). Additionally, the Green Volt EIA concluded that there was no potential impact to the minke whale population in the Southern Trench MPA due to a change in prey availability from Green Volt alone due to the small scale, temporary and localised nature of the impact (Royal HaskoningDHV, 2023[76]).

5.2.2.50 Up to ~14% of the MPA area is covered by OECC boundaries for projects that are expected to be constructing between 2027 and 2033 (Caledonia, Buchan, Green Volt, Muir Mhor and Salamander; Figure 5-5). However, the OECC

boundary areas presented are much larger than the actual footprint of the offshore export cables that will ultimately be installed and therefore the area that shall be impacted by temporary habitat loss/disturbance. For example, assuming similar levels of temporary habitat disturbance effects to the Proposed Development (Offshore) for each of these projects (equating to 0.12% of the MPA area) it is predicted that across the five projects, up to 0.6% of the MPA area will be affected by temporary habitat disturbance.

5.2.2.51 Please note that the assessment provided above for construction phase does not include the MarramWind or Stromar OECCs as there is no construction timeline available for these two projects. Additionally, the Offshore Transmission Development Areas for Broadshore Hub (Broadshore and Sinclair) and Bellrock are also excluded, as their locations are currently unconfirmed. If MarramWind, Stromar, Broadshore, Sinclair and Bellrock were also included, and assuming each project results in temporary habitat loss/disturbance from the offshore export cable route equating to 0.12% of the MPA area, then a total of 1.2% of the MPA area could be affected.

5.2.2.52 In the longer term, over the O&M period, activities associated with maintenance of the OECCs are expected to be taking place within the MPA (see Figure 5-6 for overlap of known OECCs with the MPA over the O&M of the Proposed Development (Offshore), Caledonia North and Caledonia South). During the O&M phase impacts are expected to be localised, and mainly restricted to minor repairs and maintenance and temporary in nature. However, these will be ongoing across the OECC of at least seven offshore wind farms (not including Broadshore Hub, Figure 5-6; note, no OECC is shown for Broadshore, Sinclair or Bellrock as these are currently unknown).



Caledonia OWF

Caledonia North Site and Caledonia South Site Division Line

Offshore Export Cable Corridor

Southern Trench MPA

Offshore Wind Development (In Planning)

Buchan OECC

Green Volt OECC

Salamander OECC

Marram OECC

Muir Mhor OECC

Stromar OECC

Offshore Wind Development (Consented)

Moray West OECC

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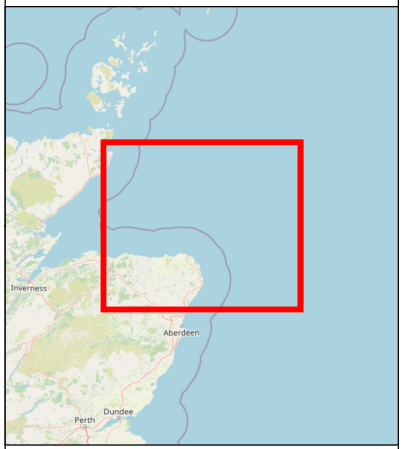

0 5 10 15 20 km

REV	DATE	DOC STATUS	ORIGIN	REVIEW	APP
01	24/09/2024	Approved	EV	BB	DH

CALEDONIA Offshore Wind Farm

GoBe APEM Group

CONTRACTOR DRAWING NO: UKCAL1_GO_WNF_MMM_MAP_00447	CONTRACTOR REV: 01
GEODETIC PARAMETERS: WGS 84 / UTM zone 30N (EPSG: 32630)	

DRAWING TITLE

Figure 5-6: Southern Trench MPA and Overlap of Project Infrastructure with the Site Boundaries During Oparation and Maintenance Phase

STATUS: Approved	SCALE: 1:750,000	
DRAWING NUMBER: N/A	SHEET NO: 01 of 01	REV: N/A

5.2.2.53 Considering the potential for temporary habitat loss/disturbance taking place within the MPA over the construction and O&M phases cumulatively with other projects, there is a risk that the condition of the seabed inhabited by the main prey species for minke whale within the site may be affected.

5.2.2.54 The assessment against the conservation objective for supporting features "Extent and distribution of any supporting feature and structure" for the Proposed Development (Offshore), Caledonia North and Caledonia South in combination with other projects is provided in Table 5-26.

Table 5-26: Assessment against conservation objective "Extent and distribution of any supporting feature and structure" for impacts to prey species in combination with other projects.

Site-specific Advice	Assessment Conclusion
Conserve the extent and distribution of any supporting feature upon which minke whale is dependent.	Prey depletion due to activities that disturb the sediment (temporary habitat disturbance) alongside the OECCs cannot be excluded. During construction, based on assumption that similar extent of the seabed can be affected at other projects and the Proposed Development, seabed across approximately 1.2% of the MPA can be expected to be directly and temporarily disturbed. In the longer term, over the O&M period, activities within the OECCs are expected to be localised and restricted to cable maintenance and repairs. Any cable protection requirements will be very limited if needed (the industry and stakeholder preference is for burial of cables) within each OECC and micrositing of offshore export cables within the OECCs will likely be applied by all OWF projects to minimise disturbance to sensitive habitats and prey species.

Overall conclusion:

Given the cumulative area of predicted overlap between OECCs and the MPA, there is a risk that temporary habitat disturbance could impact the extent and distribution of habitat upon which minke whale prey items rely.

In relation to habitat disturbance and impact on prey species, it is concluded that the conservation objective is **not at risk** of being hindered for the following justification and reasoning:

- Caledonia North and Caledonia South offshore export cables would cause temporary habitat loss/disturbance to up to 0.12% of the MPA during construction. This is minimal. Even when considered cumulatively with 10 other OWF project offshore export cables, the assessment concludes that there would only be up to 0.6% temporary habitat loss/disturbance during construction.
- During O&M, cables will be buried so disturbance to prey species may only arise in the event of cable maintenance activities. These would be temporary and localised.
- No risk of hinderance has been identified in relation to burrowed muds (Table 5-1).
- Additionally, Volumes 2, 3 and 4, Chapter 5: Fish and Shellfish Ecology of the EIAR concludes no significant effect is anticipated for sandeel and herring which are prey species for minke whale.
- The Applicant has committed to mitigation which includes burial of cables as a preferred means of cable protection (M-5) and the commitment to microsite infrastructure around sensitive seabed habitats (M-6).

6 Conditions

6.1.1.1 Following completion of the assessment to potential risk of achievement of Conservation Objectives, it is considered that there is no requirement for any specific conditions to be applied to the activities related to the Proposed Development (Offshore) in relation to the Conservation Objectives set for the Southern Trench MPA for the following features: burrowed mud, fronts, shelf deeps, quaternary of Scotland and submarine mass movement. The EIAR and MPA Assessment includes several commitments in relation to protection of sensitive species and habitats including the production of PEMPs, MMMPs and VMPs.

6.1.1.2 With respect to minke whales, where this assessment has concluded an uncertain risk of hindering certain Conservation Objectives (noting the high levels of precaution within the assessment), the Applicant will consult stakeholders to review the requirement for monitoring and mitigation post-consent when project parameters are finalised and presented within the Piling Strategy in line with the best practice methods at the time (see conclusions in paragraphs 7.1.1.4 to 7.1.1.7).

7 Conclusion and Summary

7.1.1.1 An assessment of the risk of hinderance to the achievement of Conservation Objectives for the Southern Trench MPA has been completed as required for the biodiversity protected features of burrowed mud, minke whale and fronts. No assessment was required in relation to Shelf Deeps or the geomorphological protected features of the Southern Trench MPA.

7.1.1.2 This assessment has determined that there is no risk of hinderance in relation to burrowed muds and fronts and, therefore, it is considered that there is no requirement for any conditions to be applied to the activities related to the Proposed Development (Offshore).

7.1.1.3 In relation to the biodiversity protected feature of minke whale, the following Conservation Objectives have been identified as being uncertain:

- Proposed Development (Offshore) alone:
  - UWN disturbance during construction - It is not possible to rule out the risk of disturbance to minke whales within the MPA. However, there is a high degree of uncertainty regarding minke whale responses to underwater noise which precludes a confident assessment as to whether or not "significant" disturbance could occur. Therefore, this assessment concludes that the risk of hindering the Conservation Objectives is uncertain.
- In combination (Proposed Development (Offshore), Caledonia North and Caledonia South, in combination with other proposed projects):
  - UWN disturbance during construction - It is not possible to rule out the risk of disturbance to minke whales within the MPA. However, there is a high degree of uncertainty regarding minke whale responses to underwater noise which precludes a confident assessment as to whether or not "significant" disturbance could occur. Therefore, this assessment concludes that the risk of hindering the Conservation Objectives is uncertain.

7.1.1.4 The assessment of impacts on minke whales as a protected feature of the Southern Trench MPA has been conducted using a highly precautionary approach. A key issue is that due to the lack of species-specific data, the Graham *et al*. (2017[41]) dose-response function for harbour porpoise disturbance to piling at the Beatrice OWF has been applied to minke whales. However, there is no evidence to suggest that minke whales respond to piling in the same way as porpoise. It is expected, given their very different hearing groups, that they are likely to respond to the same noise source in different ways and to differing degrees. As such, there is limited confidence in the resulting conclusions regarding potential impacts as a result of piling.

7.1.1.5 Ongoing research from the Beatrice, Moray East, and Moray West offshore wind farms (OWFs) aims to address these key uncertainties by further analysing the relationship between received noise levels, distance to

activities, and disturbance responses during piling. For example, initial findings have shown that the Graham *et al*. (2017[41]) dose-response function over-predicts the range at which porpoise are responding, with the latest data showing porpoise disturbance effects are limited to <10 km from piling of XXL monopiles. If this EDR were to be applied to the MPA assessment, then there would be no disturbance impact to the MPA from piling at the Proposed Development (Offshore), Caledonia North or Caledonia South (Benhemma-Le Gall *et al*., 2024[42]). Additional findings will be discussed at the upcoming Forth & Tay Regional Advisory Group (FTRAG) meeting in January 2025, which may lead to changes in the guidance with respect to methodology used for the assessment of disturbance from piling.

7.1.1.6 Additionally, it should be highlighted that the any potential UWN disturbance impacts would reduced in scenarios where there are fewer number of piling days. For example, Caledonia North, which is entirely comprised of bottom-fixed foundations, assume up to 79 pilings days which would overlap one high density season. Due to the number of anchors associated with the worst case anchor scenario the number of piling days is much higher for Caledonia South. This is a precautionary approach which could be significantly reduced during detailed design stage and as bottom-fixed technology develops further. Potential risks will be considered with the final design parameters to inform the development of the Piling Strategy which will help inform future consultation with stakeholders.

7.1.1.7 The Applicant is committed to collaborating with stakeholders and academic institutions to minimise impacts on minke whales and to address knowledge gaps regarding their behavioural response to disturbance through ongoing research and monitoring efforts. Where feasible, installation schedules for the Proposed Development (Offshore), Caledonia North and Caledonia South will be optimised to reduce underwater noise within the MPA. Alongside ongoing efforts to refine the assessment methodology and participate in strategic initiatives, the Applicant is exploring opportunities with other North East OWF developers to improve understanding of the minke whale baseline and benefits to minke whale within the MPA in the future. Thus, it is likely that the MPA assessment will be updated during the application process.

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