MUIR MHÒR
OFFSHORE WIND FARM

A joint venture between Fred. Olsen Seawind & Vattenfall

Muir Mhòr Offshore Wind Farm

European Protected Species (EPS) Risk Assessment:

Geophysical Survey Campaign 2023

Muir Mhòr Offshore Wind Farm

EPS Risk Assessment: Geophysical Survey Campaign 2023

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ACRONYMS & ABBREVIATIONS:

Term	Definition
BEIS	Department for Business, Energy & Industrial Strategy
CES	Coastal East Scotland
CGNS	Celtic and Greater North Sea
EDR	Effective Deterrent Range
EIA	Environmental Impact Assessment
EPS	European Protected Species
FCS	Favourable Conservation Status
GNS	Greater North Sea
IAMMWG	Inter-Agency Marine Mammal Working Group
IUCN	The International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
km	Kilometre
MBES	Multibeam Echo-Sounder
MMO	Marine Mammal Observer
MS-LOT	Marine Scotland Licensing Operations Team
MU	Management Unit
NCMPA	Nature Conservation Marine Protected Area
NOAA	National Oceanic and Atmospheric Administration
OWF	Offshore Wind Farm
PTS	Permanent Threshold Shift
rms	Root mean squared
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SBES	Single-beam Echo-sounders
SBP	Sub-Bottom Profiler

Term	Definition
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SEL	Sound Exposure Levels
SNH	Scottish Natural Heritage
SPL	Sound Pressure Level
SSS	Sidescan Sonar
TTS	Temporary Threshold Shift
UHRS	Ultra-High Resolution Seismic
USBL	Ultra-Short Baseline

Glossary:

Term	Definition
Array Area	The area of the OWF where the wind turbine generators will be situated.
Array Area Survey	Referring here to the geophysical survey of the array area. The survey area will encompass the OWF array plus a 500 m buffer zone.
Export Cable Corridor (ECC)	Referring here to the offshore ECC that runs from the wind farm array to the point of landfall. The ECC has not yet been defined and so indicative areas of search have been described throughout this document.
ECC Survey	The geophysical survey of the ECC. The final ECC has not been determined at this point in time and so indicative areas of search for where the ECC might be located have been described. The survey area has an anticipated length of 100 km and 1000 m width.
Offshore Survey	Referring to both the array and ECC geophysical surveys.
The JV	Fred. Olsen Seawind and Vattenfall (referred to as the Joint Venture (JV)) were identified as one of the successful bidders and awarded an option agreement for their proposed project, Muir Mhòr Offshore Wind Farm (OWF) located within the E2 Plan Option area.

1 Introduction

1.1 Background

1.1.1 As part of the Crown Estate Scotland ScotWind Leasing process in January 2022, Fred. Olsen Seawind and Vattenfall (hereafter the Joint Venture (JV)) were identified as one of the successful bidders and awarded an option agreement for their proposed project, Muir Mhòr Offshore Wind Farm (OWF) (hereafter Muir Mhòr), located within the E2 Plan Option area.

1.1.2 The Muir Mhòr array area covers 200 kilometres $(km)^2$ with water depths ranging from 60-100 m and is located in the central North Sea, approximately 63 km east of Peterhead on the east coast of Scotland as shown in Figure 1 and Figure 2.

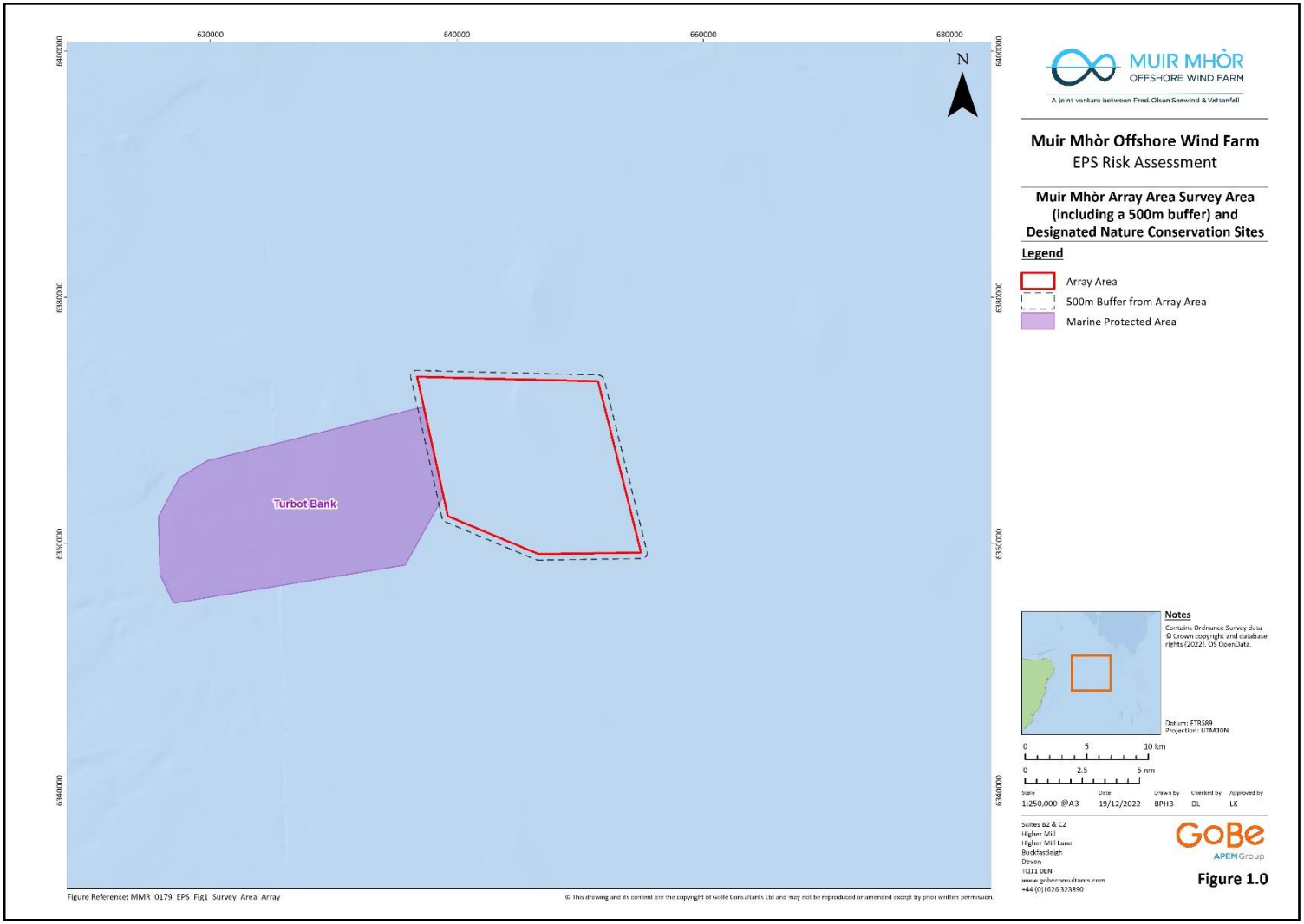

Figure 1. Location of the Muir Mhòr array area survey area (including a 500 m buffer).

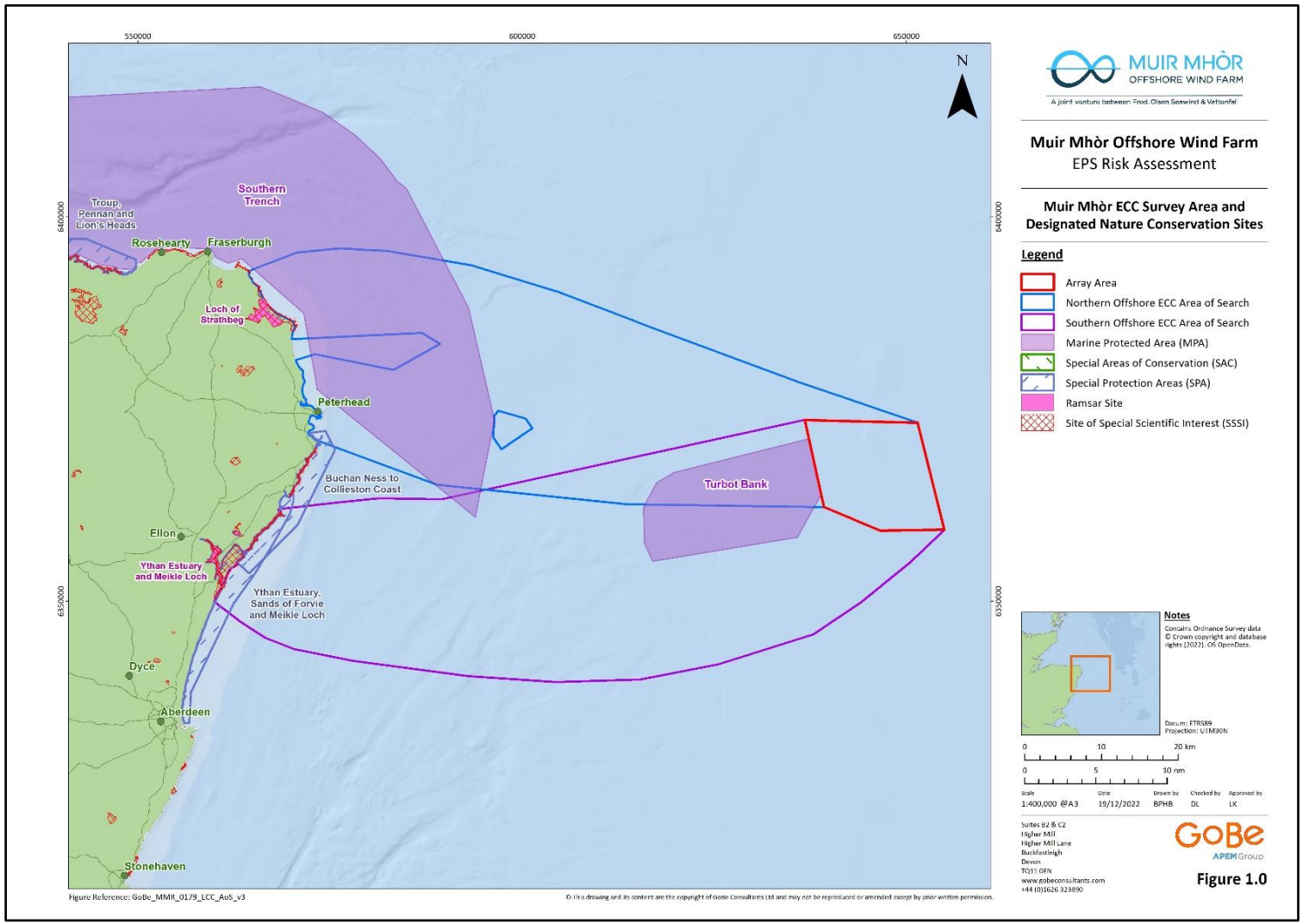

Figure 2. Location of Muir Mhòr Export Cable Corridor (ECC) survey area

1.1.3 Muir Mhòr could have a capacity of up to 798 megawatts and will comprise of floating offshore wind technology. The current intention of the JV is to apply for Section 36 Consent and Marine Licences for the project in 2024 with construction anticipated to begin in 2029.

1.1.4 The JV plans to undertake geophysical surveys of the Muir Mhòr array area plus a 500 m buffer to ascertain the seabed characteristics and the potential for protected features. The JV will also undertake a geophysical survey of the Export Cable Corridor (ECC). A provisional ECC length of 100 km and width of 1000 m, between the array area and a landfall site in the vicinity of Peterhead (please see Section 2.1 for further details) has been assessed as part of this EPS Risk Assessment. The offshore geophysical surveys of the Muir Mhòr array area and ECC are planned to take place over a maximum of 109 days during which the survey of the array will last for 32 days total and the geophysical survey of the ECC will last for 30 days total (with additional days for mobilisation, crew changes, demobilisation and weather allowance). Ahead of any geophysical surveys, a European protected species (EPS) Licence potentially needs to be secured where:

- Within 12 nautical miles of the coast (territorial sea): An EPS Licence may be required under the Conservation (Natural Habitats, &c) Regulations 1994 (as amended) where there is potential for the presence of vessels or underwater noise from the proposed survey activities to injure or cause disturbance to an EPS.

- Outside 12 nautical miles: An EPS Licence may be required under the Conservation of Offshore Marine Habitats and Species Regulations 2017 where there is potential for the presence of vessels or underwater noise from the proposed survey activities to injure or cause significant disturbance to an EPS (population level effect rather than individual animals).

1.1.5 The Muir Mhòr geophysical survey will occur within and outwith 12 nm. The JV has commissioned GoBe Consultants to prepare this document to provide the necessary information in support of EPS Licence applications, which will be submitted to the Marine Scotland Licensing Operations Team (MS-LOT).

1.2 European Protected Species (EPS)

EPS Protection

1.2.1 All species of cetacean (whale, dolphin and porpoise) occurring in UK waters are listed in Annex IV of the Habitats Directive (European Commission Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna) as an EPS.

1.2.2 Species qualifying as an EPS means that they are species of community interest in need of strict protection, as directed by Article 12 of the Directive. This protection is afforded in Scottish territorial waters (out to 12 nautical miles) under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Regulation 39(1) of the Habitats Regulations makes it an offence, with certain exceptions, to:

- Deliberately or recklessly capture, injure or kill a wild animal of an EPS;
- Deliberately or recklessly:
  - Harass a wild animal or group of wild animals of an EPS;
  - Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
  - Disturb such an animal while it is rearing or otherwise caring for its young;
  - Obstruct access to a breeding site or resting place of such an animal, or otherwise to deny the animal use of the breeding site or resting place;
  - Disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs;
  - Disturb such an animal in a manner that is, or in circumstances which are, likely to impair its ability to survive, breed, or reproduce, or rear or otherwise care for its young; or
  - Disturb such an animal while it is migrating or hibernating.

1.2.3 Further protection is afforded through an additional disturbance offence given under Regulation 39(2) which states:

"…it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)".

1.2.4 Outside of 12 nautical miles, the extent of legislative protection against injury is the same as afforded within 12 nautical miles however, the definition of disturbance outside of 12 nautical miles does not extend to individual animals. Therefore, for an EPS licence to be required outside of 12 nautical miles, there must be disturbance of a significant group of animals, not just an individual.

Disturbance of an EPS

1.2.5 Whether or not an activity could cause disturbance depends on the nature of the particular activity and the impact on the particular species. Whilst disturbance is not defined in the Habitats Regulations (for waters within 12 nautical miles of the coast), Marine Scotland (2014) advise that the following matters should be taken into account when considering what constitutes disturbance:

- 'Disturbance' in Article 12(1) (b) should be interpreted in light of the purpose of the Habitats Directive to which this Article contributes. In particular, Article 2(2) of the Directive provides that measures taken pursuant to the Habitats Directive must be designed to maintain or restore protected species at Favourable Conservation Status (FCS) ;
- Article 12(1)(b) affords protection specifically to species and not to habitats;
- The prohibition relates to the protection of 'species' not 'specimens of species';
- Although the word 'significant' is omitted from Article 12(1)(b) in relation to the nature of the disturbance, that cannot preclude an assessment of the nature and extent of the negative impact and ultimately a judgement as to whether there is sufficient evidence to constitute prohibited 'disturbance' of the species;
- It is implicit that activity during periods of breeding, rearing, hibernation and migration is more likely to have a sufficient negative impact on the species and constitute prohibited 'disturbance' than activity at other times of the year;
- Article 12(1)(b) is transposed into domestic legislation by Habitats Regulation 39(1) and 39(2). Therefore, when considering what constitutes 'disturbance', thought should be given to Habitats Regulation 39(1)(b) which provides a number of specific circumstances where an EPS could be disturbed, and which can potentially have an impact on the status of the species; and
- Disturbance that could be considered an offence may occur in other circumstances and, therefore, be covered under Habitats Regulation 39(2) (see paragraph 1.2.3).

1.2.6 Marine Scotland (2020) advise that while the likelihood of acute injury can be relatively easy to determine, auditory injury accumulated over a period of time, and disturbance are not so straightforward. Therefore, assessments of potential disturbance will need to be based on a number of factors including:

- The spatial and temporal distribution of the animal in relation to the activity;
- The duration of the activity;
- Any behaviour learned from prior experience with the activity;
- Similarity of the activity to biologically important signals (particularly important in relation to activities creating sound); and
- The motivation for the animal to remain within the areas (e.g., food availability).

1.2.7 As noise can cause disturbance to cetaceans, any application for an EPS licence will require detailed information on the source level of the sound and its frequency. Where there is the possibility for disturbance to any individual EPS to occur, an EPS risk assessment must be carried out and the need for an EPS Licence determined.

1.2.8 As Habitats Regulation 39(2) is not applicable to offshore waters (outside 12 nautical miles), disturbance of an individual animal would not necessarily qualify as significant disturbance requiring an EPS Licence. Instead, under the Conservation of Offshore Marine Habitats and Species Regulations 2017, disturbance must occur to a sufficiently large or important group of animals such that the ability of that group of animals to survive, breed or rear or nurture their young would be

compromised. Alternatively, disturbance could be also considered to occur if the local distribution or abundance of the species was significantly changed.

Determining the Requirement for an EPS Licence

1.2.9 Where there is potential to harm or disturb a EPS, it is necessary to assess and determine whether an EPS Licence is required before an activity takes place. The need for an EPS Licence will be determined by MS-LOT as the licensing authority (for purely marine species) with advice from NatureScot based on findings from the EPS risk assessment. The findings from the assessment presented in this document are designed to support the decision-making process regarding the requirement for an EPS Licence, where granting of an EPS Licence depends on the following three tests:

- That the licence is to be granted for one of the purposes specified in the Regulations;
- That there are no other satisfactory alternatives to the activity proposed; and
- That the licensing of the activity will not be detrimental to the maintenance of the population of the species concerned at a FCS.

2 Description of Proposed Activities

2.1 Location of Proposed Activities

2.1.1 The proposed geophysical survey works will be carried out across the Muir Mhòr array area, approximately 63 km east of Peterhead on the east coast of Scotland (see Figure 1). The survey area includes a 500 m buffer around the Muir Mhòr array area and covers a total area of approximately 229.1 km^2.

2.1.2 The proposed geophysical survey of the ECC will be carried out following the finalisation of the ECC location in March 2023 which will be located within the ECC Areas of Search shown in Figure 2. Therefore, for the purpose of this EPS Risk Assessment the following has been assumed:

- A provisional cable corridor length of 100 km from the OWF site to a landfall in the vicinity of Peterhead;
- A provisional cable corridor width of 1000 m; and

2.2 Survey Vessels

2.2.1 Table 1 describes the two vessels that are anticipated to be used during the geophysical survey works. MV ‘EGS Ventus’ is intended to operate at sea for a month prior to crew changes occurring, whereas MV ‘EGS Echo’ is a day vessel.

Table 1. Vessels to be used during the proposed Muir Mhòr geophysical survey campaign.

Vessel	Description
MV 'EGS Ventus'	This is a multi-purpose geophysical, geotechnical and remotely operated vehicle (ROV) support vessel. This vessel has a crew of 10 people working for 24-hour operations. Crew are suitably experienced and have relevant marine and safety certificates. There is accommodation for a further 22 passengers. Minimum water depth for safe operation is 8 to 10 m and economical transit speed is 12 knots. Crew changes are approximately once a month. Vessel has an overall length of 49.8 m. Boom arms are used for towing lighter survey equipment (e.g., streamers) and side arms on the stern A-frame are used to tow heavier equipment (e.g., towfish). Ventus is set up with permanent survey equipment including two hull mounted multibeam echosounders (Kongsberg EM2040C & Reson 7160), Applanix POSMV inertial navigation system and additional positioning systems (such as a C-Nav3050).
MV 'EGS Echo'	Echo is a 15.3 m purpose built aluminium survey vessel, launched in 2004. The vessel has a crew of 2 people who can carry out 12-hour operations. All crew are suitably experienced and have the relevant marine and safety certificates for their roles. The vessel is primarily used for day operations, however, there are bunks for occasional use. The vessel is ideally suited for shallow and nearshore operations and can be used in areas as shallow as 2 m under the right sea conditions. Echo is a survey vessel with core survey equipment always remaining on the vessel and additional survey equipment can be added. The core survey suite consists of two positioning systems. On the back deck there is a central moonpool (1.25 x 1.5m), with a deployment/recovery frame for a multibeam system (with options to choose from a number of different Multibeam Echo Sounder (MBES) transducers to suit the work), two side stern davits to assist with towing operations and two side mounts, which are usually used to deploy the ultra-short baseline (USBL) and other transducers, such as a PES sub-bottom profiler. An AGO winch is also installed – for sidescan/magnetometer surveys.

2.3 Survey Techniques

2.3.1 The geophysical survey will comprise the survey equipment listed below and further described in Table 2:

- MBES Bathymetry;
- Sidescan sonar (SSS);
- USBL;
- Sub-bottom profiling (SBP);
- Ultra-High Resolution Seismic (UHRS); and
- Magnetometer (MAG).

Table 2: Details of survey techniques.

Survey Equipment	Description
USBL	USBL systems are used to determine the position of subsea survey items, including ROVs, towed sensors, etc. This involves the emission of sound from a hull-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. A complete USBL system consists of a small transducer array, which is mounted under a ship, and a transponder attached to the subsea unit. An acoustic pulse is transmitted by the transducer, travels through the water and is detected by the shipboard transducer on an onboard computer, which calculates the time from the transmission of the initial acoustic pulse until the reply is detected and is measured by the USBL system. This is converted into a range and bearing, and thus the position of the subsea unit/sampling equipment is determined. These systems can either be used continuously or intermittently through the operation they are supporting. This survey technique does not interact with the seabed.
MBES Bathymetry	MBES are used to obtain detailed 3-dimensional (3D) maps of the seafloor which show water depths. They measure water depth by recording the two-way travel time of a high frequency pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swathe). MBES can, typically, carry out 200 or more simultaneous measurements. The frequencies used by shallow water MBES (<1000 m) are generally very high and outside of the main hearing range of all marine mammal hearing groups (Joint Nature Conservation Council (JNCC) *et al.*, 2010). This survey technique does not interact with the seabed. There are two proposed system options: KONGSBERG EM2040 dual-head, dual-swath multibeam system, with 2 RX Transducers and 1600 Soundings per Ping. This system has frequency options of 200, 300 or 400 kHz and a maximum ping rate of 50 Hz and a max angular coverage of 200º. The other option is a Kongsberg EM 2040C (dual-swath) EM2040 dual-head, dual-swath multibeam system, with 2 RX Transducers and 1600 Soundings per Ping. This system has frequency options of 200 to 400 kHz and a maximum ping rate of 50 Hz and a max angular coverage of 200º.
SSS	SSS is used to generate an accurate image of the seabed, which may include 3D imagery. An acoustic beam is used to obtain an accurate image of a narrow area of seabed to either side of the instrument by measuring the amplitude of back-scattered return signals. The instrument can either be towed behind a ship at a specified depth or mounted on to a ROV. The frequencies used by SSS are generally very high and outside of the main hearing range of all marine species (JNCC *et al*., 2010; National Oceanic and Atmospheric Administration (NOAA), 2018). The higher frequency systems provide higher resolution, but shorter-range measurements. This survey technique does not interact with the seabed. There are two SSS proposed systems: EDGETECH 4205 MP (towfish and TPU) operates at a frequency of 230/540/850 kHz and range setting of 40-75 m and a vertical beam width of 50º. This system uses a positioning USBL system primary, manual layback and T-Count pulley system back-up. The alternate proposed system is EdgeTech 4200 MP (towfish + TPU) which operates at 300/600/900 kHz, a range setting of 50 m and a vertical beam width of 50º. This system uses a positioning USBL system, layback and T-Count pulley system.
SBP	SBP systems are used to identify and characterise layers of sediment or rock under the seafloor. The survey will utilise a parametric SBP. The parametric sound source ensures that the beam width of the sound is extremely spatially limited (the angle of the beam spread is approximately 2 degrees) and this combined with the high frequency of the generated sound (focused at 100kHz) ensures that any propagation of the sound source is extremely limited. Additionally, it should be noted that the generated sound from the parametric SBPs is a non-impulsive sound source which reduces the risk of any potential

Survey Equipment	Description
	injury to marine mammals and the potential for injury impacts is considered unlikely. This survey technique does not interact with the seabed. There are two proposed SBP systems: Innomar SES-2000 Compact PES operates at a depth range of 0.5 to 400 m and has a range/layer resolution of approximately 1 to 5 cm, a transmit beamwidth of 2º, a primary frequency of 100 kHz, secondary frequencies of 2 to 22 kHz and a Ping Rate of 40 Hz. The alternate system is Innomar SES-2000 Standard PES which operates at a depth of 0.5 to 500 m, a range/layer resolution of approximately 1 to 5 cm, a transmit beamwidth of approximately 2º, primary frequencies of 100 kHz, secondary frequencies of 2 to 22 kHz and a ping rate of up to 40 Hz.
UHRS	UHRS geophysical survey to assess the subsurface condition of the seabed. This survey technique does not interact with the seabed. EGS is proposing to use a sparker system for UHRS surveys. Sparker systems are cheaper and easier to operate than any air-gun system. The proposed system is based on negative discharge technology, which can generate a stable, repetitive acoustic pulse with much less maintenance required on the tips. The proposed system is a Geo-spark 2000XFO high-voltage power supply unit. Single sparkers are surface towed. The system operates at a frequency of 0.5-3.5 kHz and a vertical resolution of <0.5 m and a shot interval of 0.5 m (up to 4 knots).
MAG	MAG surveys are used to detect any ferrous metal objects on the seabed, such as wrecks, unexploded ordinance or any other obstructions. Marine MAG come in two types: surface towed and near-bottom. Both are towed a sufficient distance (about two ship lengths) away from the ship to allow them to collect data without it being polluted by the ship's magnetic properties. Surface towed MAG allow for a wider range of detection at the price of precision accuracy that is afforded by the near-bottom MAG. These surveys use equipment to record spatial variation in the Earth's magnetic field. This survey technique does not interact with the seabed. The proposed MAG system is a Geometrics G-882 Marine MAG at an operating range of 20,000 to 100,000 nT, with an absolute accuracy of <2 nT, either a USBL or manual layback, a depth sensor and 500 kHz Altimeter.

2.4 Activity Schedule

2.4.1 The Muir Mhòr offshore geophysical survey campaign is anticipated to commence on 25th March 2023 and it is estimated that the works would take a maximum of 109 days in total. The geophysical survey of the array area will take 32 days (excluding mobilisation, weather downtime, demobilisation and crew changeover time), with a further 30 days for the survey of the ECC.

3 EPS Risk Assessment

3.1 Overview

3.1.1 This section outlines the presence and the use of the survey area by EPS, as well as an assessment of potential effects of the proposed geophysical survey activities on those EPS. As part of the survey campaign, the survey activities include the following key categories:

- Vessel activity; and
- Geophysical surveys of the seabed.

3.2 EPS Presence in the Geophysical Survey Area (array and ECC)

3.2.1 As listed in Annex IV of the Habitats Directive, all cetacean species are of community interest in need of strict protection as EPS. These species are fully protected in Scottish territorial waters (out to 12 nautical miles) under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), and are protected by the Conservation of Offshore Marine Habitats and Species Regulations 2017 outwith 12 nm. Harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncatus*) are listed individually, while the remaining cetacean species are encapsulated in the Habitats Directive as *"all other cetacea"*.

3.2.2 A total of 19 cetacean species have been recorded in UK waters (Reid *et al*., 2003). Of these, there are 12 cetacean species known to be present off the east coast of Scotland (Reid *et al*., 2003; Hammond *et al*., 2017) comprising:

- Harbour porpoise (*Phocoena phocoena*);
- Bottlenose dolphin (*Tursiops truncatus*);
- White-beaked dolphin (*Lagenorhynchus albirostris*);
- Killer whale (*Orcinus orca*);
- Risso's dolphin (*Grampus griseus*);
- Fin whale (*Balaenoptera physalus*);
- Sperm whale (*Physeter microcephalus*);
- Humpback whale (*Megaptera novaengliae*);
- Long-finned pilot whale (*Globicephala melas*);
- White-sided dolphin (*Lagenorhynchus acutus*);
- Minke whales (*Balaenoptera acutorostrata*); and
- Short-beaked common dolphin (*Delphinus delphis*).

3.2.3 Of these, harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, white-sided dolphin and minke whale regularly occur within the vicinity of the central North Sea (Reid *et al.*, 2003; Hammond *et al.*, 2021). The following section provides a summary of the most common species in the survey area.

Cetacean Species Potentially Present in the Survey Area

3.2.4 Small Cetaceans in European Atlantic waters and the North Sea (SCANS) III aerial and ship-based surveys were carried out in 2016 and used to estimate the abundance of cetaceans across European Atlantic waters (Hammond *et al*., 2021). Aerial surveys indicated the presence of the species listed in Table 3 across the Muir Mhòr geophysical survey area. This table summarises density (individuals/km^2) and abundance estimates for the survey Block R that covers the east coast of Scotland which were surveyed during the summer of 2016 (Hammond *et al*., 2021).

Table 3: Density and population estimates for the regularly occurring cetaceans off the east coast of Scotland and wider Management Unit (MU).

Cetacean	General Distribution	Density Estimates (individual/km^2)	Estimated Population	
			Scottish East Coast (Survey Block R)	MU
Harbour porpoise	Individuals can be found in nearshore and offshore waters throughout the North Sea	0.599 (Hammond *et al*., 2021)	38,646 (Hammond *et al*., 2021)	346,601 (North Sea MU; Hammond *et al*., 2021)
Common dolphin	Predominantly an offshore species	0.000 (Hammond *et al*., 2021)	0.000 (Hammond *et al*., 2021)	102,656 (Celtic and Greater North Sea (CGNS) MU – Hammond et al., 2021)
Bottlenose dolphin	The coastal east Scotland population is predominantly found in nearshore areas, whilst other populations are found in deeper offshore areas	0.0298 (Hammond *et al*., 2021)	1,924 (Hammond *et al*., 2021)	2,022 (Greater North Sea (GNS) MU – Hammond *et al*., 2021) (relevant to the array) 195 (Coastal East Scotland (CES) MU - Inter-Agency Marine Mammal Working Group (IAMMWG), 2015) (relevant to the ECC)
White-beaked dolphin	Predominantly an offshore species	0.243 (Hammond *et al*., 2021)	15,694 (Hammond *et al*., 2021)	43, 951 (CGNS MU; Hammond *et al*., 2021)
White-sided dolphin	Predominantly an offshore species which prefers shelf habitat	0.010 (Hammond *et al*., 2021)	644 (Hammond *et al*., 2021)	18,128 (CGNS; Hammond *et al.*, 2021)
Minke whale	Individuals can be found in nearshore and offshore waters throughout the North Sea	0.0387 (Hammond *et al*., 2021)	2,498 (Hammond *et al*., 2021)	20,118 (CGNS MU; Hammond *et al*., 2021)

3.2.5 It should be noted that two MU estimates have been included for bottlenose dolphins. The CES MU relates more to the ECC, whilst the GNS MU relates to the array area.

3.2.6 Harbour porpoise are found in abundance throughout Scottish waters, usually as pairs or groups of three with larger foraging groups sometimes appearing (Reid *et al*. 2003; Scottish Natural Heritage (SNH), 2014; Hammond *et al*. 2021). Globally, harbour porpoise appear on the International Union

for Conservation of Nature (IUCN) Red List as a threatened species of 'least concern'; however, there is a gap in the knowledge regarding the current population trend (Braulik *et al*. 2020). The relevant ICES Assessment Unit for harbour porpoise covers the entire North Sea. JNCC reported North Sea harbour porpoise populations to be in an unknown condition and the Natura 2000 network is currently classified as unknown (JNCC, 2019).

3.2.7 Common dolphin were not recorded in Block R of the SCANS III survey, however, they have been recorded throughout the CGNS MU (Hammond *et al*., 2021) and they have been found in the Moray Firth. In the Moray Firth, the estimated population was 1,218 and the estimated density was 0.074 individuals/km^2 (Robinson *et al*., 2010). The conservation status of common dolphin is currently unknown owing to data limitations (JNCC, 2019).

3.2.8 The conservation status of bottlenose dolphin within the species range is currently listed as good and the Natura 2000 network population trend is currently stable (JNCC, 2019). There is a resident bottlenose dolphin population within the Moray Firth, in relatively close proximity to the Muir Mhòr geophysical survey area. Estimates for this population do vary between years, however, recent survey data indicates that half of the estimated population occupy the area regularly (Graham *et al*., 2016). The Moray Firth Special Area of Conservation (SAC) has been designated for the protection and conservation of this resident population and the habitat they rely on (NatureScot, 2021). Please see Section 6.2 for further information on this designated site and the designated features.

3.2.9 White-beaked dolphin are usually found in small groups of 10 or less (however, they can be seen in groups of 50 or more) and they usually occupy depths of 50 – 100 m (Reid *et al*., 2003). They are usually found along the east coast of Scotland during the Summer months. The estimated density of white-beaked dolphin for Block R was 0.243 individuals/km^2, which is relatively high compared to neighbouring regions (Hammond *et al*., 2021). The favourable reference population for white-beaked dolphin is currently unknown (JNCC, 2019).

3.2.10 White-sided dolphin are found throughout Block R of the SCANS survey with an estimated density of 0.010 (Hammond *et al*., 2021). Sightings of white-sided dolphin were rare with animals only being seen in three survey blocks, all of which were off the north-east coast of Scotland. White-sided dolphin is relatively unstudied compared to other cetaceans in throughout UK waters.

3.2.11 Minke whale are geographically wide-ranging and are usually present along the east coast of Scotland during the summer months (June – September) (Reid *et al*., 2003; Hammond *et al*., 2017). Minke whale are found in water depths up to 200 m, usually individually or as pairs but they do form larger groups (up to 15 individuals) whilst foraging. The Southern Trench Nature Conservation Marine Protected Area (NCMPA) has been designated for the protection of minke whale. Specifically, this designated site has the conservation objective to ensure:

"minke whale in the Southern Trench NCMPA are not at significant risk from injury or killing, conserve the access to resources (e.g. for feeding) provided by the NCMPA for various stages of the minke whale life cycle, and conserve the distribution of minke whale within the site by avoiding significant disturbance".

3.2.12 The estimated density of minke whale in the area was 0.0387 individuals/km^2 which was the highest estimated abundance of minke whale out of all blocks that were surveyed for SCANS III. The favourable reference population for minke whale is currently unknown (JNCC, 2019).

Potential Impacts on EPS

3.2.13 The objective of this risk assessment is to identify the potential for injury and disturbance to EPS from the proposed geophysical survey activities. This section highlights potential impacts to protected species, including EPS, regardless of their inclusion as qualifying features of protected sites. A summary of proposed survey activities and their potential impacts to EPS is provided in Table 4.

3.2.14 The Marine Scotland (2020) guidance states the following two key factors that have the potential to cause death or injury to an animal:

- Physical contact (e.g., collision with vessels); and
- Anthropogenic sound (underwater noise).

3.2.15 Cetaceans are considered particularly susceptible to these impacts as underwater noise emitted by vessels and the physical presence of the vessels have the potential to cause injury or disturbance to EPS. While some techniques may introduce noise to the marine environment, other activities do not generate sufficient levels of noise to be considered as potential sources of noise-related injury or disturbance to EPS and have been screened out of the detailed assessment, as indicated in Table 4.

Table 4: Summary of proposed survey activities and their potential impacts on EPS.

Activity/ equipment	Potential impacts	Predicted source levels and frequencies relevant to the marine environment	Further information required as part of the EPS Risk Assessment
Survey vessels			
Noise impacts	Propellers, engines, and propulsion activities form the primary noise sources of survey vessels. Vessel noise is generally continuous and comes in both narrowband and broadband emissions. Potential impacts on EPS depend on the duration and location of the surveys and EPS potentially present in the area.	Vessel emissions typically range from 150 – 190 dB re 1µPa (root mean squared (rms)). Acoustic energy vessel noise emissions are strongest at frequencies <1 kHz (Prideaux, 2017).	Yes – although source levels are likely to be too low to result in injury, they will be audible to most species, and thus have the potential to result in disturbance.
Collision risk	Increased vessel activity also has the potential to cause injury from collisions. The risk of collision with an EPS is influenced by the dimensions of the vessel and its speed.	Vessels will be most at risk of colliding with a cetacean whilst moving from port to the survey area and returning to port as this will be when the vessel is travelling at faster speeds.	Yes – Mitigation measures such as a marine mammal observer (MMO) will be used to reduce the risk of collision risks (see Section 4).
Geophysical survey			
USBL	USBL systems are used to determine the position of subsea items. This involves the emission of sound from a hull-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. The potential impacts of this sound on cetaceans depends upon the abundance, distribution and sensitivity of the species, and the duration of the operations.	USBL source levels range from 188 – 204 dB re 1µPa (rms), with a frequency range of 17 – 50 kHz (NOAA, 2019).	Yes – source levels have a minimum peak pressure level which has been identified as having the potential to cause injury to harbour porpoise (physical injury or PTS) (200 - 202 dB re 1µPa) and are audible to all species in the area increasing the risk of disturbance.
MBES	High frequency pulses created by MBES equipment generate sound waves which produce impulsive	MBES source levels typically range from 200 – 240 dB re 1µPa (rms)	Yes – source levels have a minimum peak pressure level which has been identified as having the potential

Activity/ equipment	Potential impacts	Predicted source levels and frequencies relevant to the marine environment	Further information required as part of the EPS Risk Assessment
	underwater noise. Depending on the frequency of the pulses, location and duration of the operations, and the species present, there could be potential impacts on EPS.	(Hartley Anderson Ltd, 2020), the equipment specifications describe the MBES to emit noise over a frequency of 200 - 400 kH .	to cause injury to harbour porpoise (physical injury or PTS) (200 - 202 dB re 1µPa).
UHRS	UHRS geophysical survey to assess the subsurface condition of the seabed.	Geo-source 400 sparkers used in UHRs have a frequency range of 50 Hz to 3.5kHz. Sparker surveys source levels (peak) range from 220 – 226 dB re 1µPa at 1m (Hartley Anderson Ltd, 2020).	Yes – they will be audible to most species, and thus have the potential to result in disturbance or injury.
SSS	SSS equipment produces impulsive sound emissions through high frequency pulses used to image the seabed habitat. Potential impacts to EPS depend upon the frequency, location, and duration of the pulses.	SSS source levels (peak) range from 205 – 230 dB re 1µPa at 1m (Hartley Anderson Ltd, 2020). The SSS specifications report frequencies between 230/540/850 kHz	Yes – source levels have a minimum peak pressure level which has been identified as having the potential to cause injury to harbour porpoise (200 dB re 1µPa) and a maximum peak pressure level which has been identified as having the potential to cause injury to bottlenose dolphins (230 dB re 1µPa).
SBP	SBP involves the vertical emission of sound pulses (impulsive noise) to characterise the layers of sediment comprising the seabed. Such activities introduce noise emissions into the marine environment. The potential impacts of this sound depend upon the type of profiler technology used, as well as the abundance, distribution and sensitivity of the species, and the duration of the operations.	SBP typically emit noise within the frequency range 100 Hz to 22 kHz, although primary frequency may emit up to 115 kHz. SBP source levels (peak) typically range between 185 – 250 dB re 1µPa at 1m (Hartley Anderson Ltd, 2020).	Yes – although source levels are likely to be too low to result in injury, they will be audible to most species, and thus have the potential to result in disturbance.

Activity/ equipment	Potential impacts	Predicted source levels and frequencies relevant to the marine environment	Further information required as part of the EPS Risk Assessment
MAG	A MAG will be employed to detect magnetic anomalies in the seabed.	Not applicable	No - MAG do not emit noise as a part of their normal functioning, so there is no possibility of injury or disturbance from noise emissions.

3.3 Impact Assessment – Underwater Noise

3.3.1 Noise emissions present the highest potential risk of disturbance to cetaceans within the vicinity of the Muir Mhòr array area survey area. Underwater noise has the potential to impact cetaceans, either through injury or disturbance. Injury from noise emissions includes physiological damage to auditory or other internal organs while disturbance can result in temporary or continuous disruption to behavioural patterns such as migration, breathing, nursing, feeding, foraging, socialising and sheltering.

3.3.2 Vessel strike has a higher likelihood of resulting in injury or death to cetaceans than noise emissions and so has also been assessed here.

Types of Noise

3.3.3 According to Southall *et al.* (2019) and NOAA (2018), sound can be categorised into distinct 'types', as detailed in Table 5.

Table 5: Types of sound as defined by Southall *et al* (2019) and NOAA (2018).

Noise type	Description
Impulsive	Sounds which are short in duration (i.e. less than 1 second long) and temporary, occupy a broadband bandwidth, and have rapid rise and decay times with a high peak pressure level. This can be further defined as: • Multiple pulsed sound – sound comprising two or more discreet acoustic events in a 24-hour period (e.g., from MBES, SSS or SBP); and • Single pulse sound – sound comprising a single discreet acoustic event in a 24-hour period (e.g., an underwater explosion).
Non-impulsive	Sounds which may occupy a broadband, narrowband or tonal bandwidth, can be brief, prolonged, continuous or intermittent in nature, and are not characterised by rapid rise and decay times or a high peak pressure level. Vessel noise would be an example of non-impulsive/continuous sound.

Assessment Criteria – Lethal and Auditory Injury Thresholds

3.3.4 To determine the potential for noise to impact cetaceans, perceived sound levels are compared to available empirically-estimated thresholds for injury and disturbance. JNCC *et al.,* (2010) and Scottish Government (2020) recommends using the injury and disturbance criteria proposed in Southall *et al.,* (2007) which is based on a combination of linear (un-weighted) peak sound pressure levels (SPL) and weighted sound exposure levels (SEL). Since publication there has been additional evidence which has led to amendments to the auditory thresholds for injury.

3.3.5 Updated guidance presented in Southall *et al*. (2019) (from Southall *et al*., (2007)) uses the same thresholds as presented in the revised NOAA guidance (NMFS, 2018).

3.3.6 Southall *et al*. (2019) present the sound level at which it is expected that a marine mammal may be at risk of experiencing hearing impairment as a result of the received sound. Hearing impairment, specifically, a change in the hearing sensitivity (or threshold at which a sound can be detected) can either be temporary (Temporary Threshold Shift; TTS) or permanent (Permanent Threshold Shift; PTS). PTS is considered to be an injury under UK legislation. All experiment studies are limited to

identification of TTS-onset, with no studies able to directly identify PTS-onset as this would be unethical; as such, PTS-onset is extrapolated from the measured TTS-onset values. The likelihood of individual animals experiencing PTS and TTS is dependent on both the received sound level and the frequency of the sound received.

3.3.7 PTS and TTS thresholds are based on a dual-criteria approach involving two metrics:

- (1) Energy-based metric – a measure of the accumulated sound energy an animal is exposed to over a period of time (exposure period). For single pulses, this is referred to as the SEL. For multiple pulses over an exposure period, this is referred to as the cumulative Sound Energy Level (SEL_{cum}). The SEL thresholds for PTS therefore take into account received noise levels and duration of exposure over a 24-hour period and are weighted to take into account the different hearing sensitivities of each function hearing group (see Table 5); and
- (2) Pressure-based metric – referred to as the SPL. This is measured as peak sound pressure level (SPL_{peak}). Any single exposure at or above this pressure-based metric is considered to have the potential to cause PTS regardless of exposure duration (Southall *et al*., 2019). The peak SPL criterion is for unweighted received sound level.

Table 6: Southall *et al* (2019) cetacean functional groups and PTS/TTS criteria.

Functional Hearing Group	Estimated Auditory Bandwidth	PTS Onset			TTS Onset	
		Impulsive		Non-Impulsive	Impulsive	Non-Impulsive
		SEL_{cum}	SPL_{peak}	SEL_{cum}	SEL_{cum}	SEL_{cum}
Low-frequency cetaceans (e.g., minke whale)	7 Hz – 35 kHz	183	219	199	168	179
High frequency cetaceans (e.g., bottlenose dolphins)	150 Hz – 160 kHz	185	230	198	170	178
Very high-frequency cetaceans (e.g., harbour porpoise)	160 Hz – 275 kHz	155	202	173	140	153

Disturbance

3.3.8 Marine Scotland (2020) specifies disturbance as occurring if the activity is likely:

"to significantly affect the local distribution or abundance of the species to which it belongs".

3.3.9 Behavioural disturbance has been assessed using a qualitative approach based on the consideration of factors such as source level, mitigation measures and length of operations. In

addition, factors likely to influence interaction between the survey works and cetaceans likely to be present in the survey area is assessed.

3.3.10 European Commission (2007) guidance indicates that a disturbance must significantly impact the local distribution or abundance of a species, including temporary impacts, while guidance proposed by JNCC *et al*. (2010) states the following:

"any action that is likely to increase the risk of long-term decline of the population(s) of (a) species could be regarded as disturbance under the Regulations".

3.3.11 In order to consider the possibility of a disturbance offence as a result of the proposed geophysical survey, it is necessary to consider the likelihood that exposure of the animal(s) produces a response which is likely to generate a significant population-level effect.

3.3.12 Assessment of population-level impacts from a temporary disturbance is complex due to the highly variable nature of the introduced disturbance, the variability of the behavioural response between different species and individuals, and the availability of population estimates for EPS in a given area of the North Sea.

3.3.13 A method for assessing a potential disturbance is to compare the factors the proposed geophysical survey works are predicted to produce with empirical studies (Southall *et al*., 2007). However, there are currently no agreed thresholds or criteria for modelling the disturbance of marine mammals from underwater noise.

3.3.14 Noise propagation modelling has therefore not been undertaken for this assessment. Table 7 shows a scoring system developed by JNCC *et al*. (2010) where a score of 5 or more on the Southall *et al*. (2007) behavioural response severity scale, could be significant.

Table 7: Behavioural disturbance scale (Southall *et al*., 2007).

Response Score	Corresponding behaviours in free-ranging subjects
0	No observable response
1	Brief orientation response (investigation / visual orientation).
2	Moderate or multiple orientation behaviours; Brief or minor cessation/modification of vocal behaviour; and Brief or minor change in respiration rates.
3	Prolonged orientation behaviour; Individual alert behaviour; Minor changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source; Moderate change in respiration rate; and Minor cessation or modification of vocal behaviour (duration < duration of source operation).
4	Moderate changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source;

Response Score	Corresponding behaviours in free-ranging subjects
	Brief, minor shift in group distribution; and Moderate cessation or modification of vocal behaviour (duration more or less equal to the duration of source operation).
5	Extensive or prolonged changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source; Moderate shift in group distribution; Change in inter-animal distance and/or group size (aggregation or separation); and Prolonged cessation or modification of vocal behaviour (duration > duration of source operation).
6	Minor or moderate individual and/or group avoidance of sound source; Brief or minor separation of females and dependent offspring; Aggressive behaviour related to sound exposure (e.g., tail/flipper slapping, fluke display, jaw clapping/gnashing teeth, abrupt directed movement, bubble clouds); Extended cessation or modification of vocal behaviour; Visible startle response; and Brief cessation of reproductive behaviour.
7	Extensive or prolonged aggressive behaviour; Moderate separation of females and dependent offspring; Clear anti-predator response; Severe and/or sustained avoidance of sound source; and Moderate cessation of reproductive behaviour.
8	Obvious aversion and/or progressive sensitisation; Prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms; Long-term avoidance of area (> source operation); and Prolonged cessation of reproductive behaviour.
9	Outright panic, flight, stampede, attack of conspecifics, or stranding events; and Avoidance behaviour related to predator detection.

3.3.15 The more severe the response on the scale, the less time animals will likely tolerate the disturbance before there could be significant negative effects, which could constitute a disturbance under the relevant Regulations.

3.3.16 The assessment of disturbance by the proposed survey methods incorporates the potential of the behaviours described by Southall *et al*. (2007) that would occur within the limited duration of the geophysical survey activities. As such, the potential for those behaviours to result in a population-level effect is assessed, the impact on the FCS of any species will then be assessed.

3.4 Assessment of potential Impacts to EPS (Cetaceans)

3.4.1 The results of the impact assessment for the proposed geophysical survey works within the Muir Mhòr array area are outlined below in the following sections. The assessment considers both injury and disturbance impacts (PTS) to EPS (cetaceans) under each of the following activities and geophysical survey techniques:

- Vessels;
- USBL;
- SSS and MBES; and
- SBP and UHRS.

Vessels

3.4.2 The presence of vessels potentially impacts cetaceans through underwater noise and collision risk. The risk of collision along with the level of noise emitted into the marine environment by a vessel depends on the vessel type, size, mode of propulsion, operational factors and speed. Different frequencies of sound are emitted from different sizes of vessels, where larger vessels tend to emit lower frequency noise, though this noise tends to fall below several hundred Hz.

3.4.3 PTS to cetaceans is also a risk through collision with survey vessels and this includes blunt trauma to the body or injuries consistent with propeller strikes. The risk of collision is directly influenced by the type of vessel and the speed with which it is travelling (Laist *et al*., 2001) and indirectly by ambient noise levels underwater and the behaviour the marine mammal is engaged in.

3.4.4 MMOs will monitor for cetaceans throughout daylight hours, with particular focus on the 30 minutes prior to the survey taking place. These measures, coupled with soft-starts to the survey methods prior to the start of full-power geophysical surveys will further reduce the risk of impacting EPS. Please see Section 4 for further details of mitigation.

Injury Impact

3.4.5 Laist *et al*. (2001) predicted that the most severe injuries resulting from collision are with vessels travelling at over 14 knots, and the probability of lethal injury of a large whale species decreases from 0.79 at a speed of 15 knots to 0.21 at 8.6 knots (Vanderlaan and Taggart 2007).The risk of collision with a cetacean appears to increase with increased vessel speeds and also vessel size. There is also a correlation between increased severity of injury and vessel speed and size.

3.4.6 Given that the geophysical survey vessels will be moving along defined line spacings at slow speeds (<5 knots), the potential for collisions is negligible. Furthermore, Van Waerebeek *et al*. (2007) have reported that non-lethal collisions do occur between vessels and marine mammals, suggesting that in the instance of vessel collisions with marine mammals, they are not necessarily always fatal.

3.4.7 In relation to PTS in cetaceans as a result of vessel noise, Richardson et al. (1995) reported that peak emissions that range between 160 – 175 dB re 1µPa, are predicted to impact an animal swimming at a constant speed of 1.5 m/s from the source at zero metres from the vessel. As such it is concluded that physical and auditory injury impacts are highly unlikely to occur, as this would require an animal to be in close vicinity of the noise source for a prolonged duration.

3.4.8 Therefore, it is predicted that there will be no risk of injury to any species of cetacean as a result of underwater noise from vessels or collision risk from the geophysical surveys. Consequently, there is no potential to commit an offence with regards injury or impact on the FCS of any EPS, and thus no requirement for an EPS Licence in this respect.

Disturbance Impact

3.4.9 Despite noise levels from the geophysical survey vessels being unlikely to cause physical or auditory injury, they could be sufficient to cause local disturbance to marine mammals that are in close proximity to the vessels, depending on ambient noise levels. Thomsen *et al*. (2006) used species hearing detection thresholds to conclude that noise from larger vessels (around 0.25 kHz) will be detected by harbour porpoise at distances of approximately 1 km, and noise from smaller vessels around (2 kHz) will be detected at around 3 km.

3.4.10 Harbour porpoise have been reported to be more sensitive to vessels that produce medium to high frequency noise (e.g., Hermannsen *et al*., 2014). Where porpoise are exposed to vessel noise that contains low levels of high frequencies, they appear to avoid vessels (e.g., Dyndo *et al*., 2015). Wisniewska *et al*. (2018) have also recorded changes in harbour porpoise foraging rates in response to vessel presence, indicating the potential for a reduction in foraging activity where animals are exposed to vessel noise greater than 96 dB re 1 µPa for prolonged periods of time.

3.4.11 Behavioural responses can vary greatly depending on context and as data specific to harbour porpoise is also limited, the distance at which animals may react to vessels is challenging to predict. However, Thomsen *et al*. (2006) documented that harbour porpoise might be expected to respond to geophysical survey vessels at approximately 400 m.

3.4.12 There is a possibility that responses from marine mammals can arise due to the simple presence of vessels. A study by Graham *et al*. (2019) indicated that harbour porpoise were effectively displaced by approximately 1 km due to the presence of construction vessels which would be of a similar size to geophysical survey vessels. Pirotta *et al*. (2015) concluded that the response of bottlenose dolphin in the Moray Firth was related to the number of boats present, rather than the levels of overall noise. However, while this study provides evidence that a perception of risk can be related to the presence of boats, silent and stationary boats did not elicit a response.

3.4.13 Although the predicted source levels associated with the survey vessels have the potential to elicit a behavioural response in cetacean species, it would require the vessel noise to be emitted over an extended period to cause a significant disturbance offence as defined under the Habitats Regulations. As the survey vessels will be continuously moving across the array area survey area, animals within a particular location will not be exposed to extended periods of noise from the vessels.

3.4.14 Due to the temporary and transient nature of the geophysical survey works, it is unlikely that vessel noise emissions would influence the ability of an animal to survive or reproduce or result in significant impacts to the population abundance or distribution. It has therefore been concluded that there will be no negative impact of the FCS of any EPS.

USBL

3.4.15 The length of time the USBL systems will be required is dependent on the specific survey activities, however there is potential that a USBL could be used continuously throughout a proposed geophysical survey works. The potential impacts of continuous sound from USBL equipment on cetaceans that may be present in the survey area are described in the sections below.

3.4.16 The USBL system is used for controlling the position of subsea equipment during the survey, and it operates by emitting a low frequency acoustic pulse between the transponder on the vessel and the transducer on the subsea unit. As low frequency emissions travel further than high frequency sounds, cetaceans may be exposed to these noise emissions over a greater spatial area than they would with higher frequency sounds such as those associated with SSS or MBES.

3.4.17 The low frequency sound generated by the USBL system are within the hearing range of the cetacean species anticipated to be within the project area. As such, there is potential for USBL survey activities to potentially cause a disturbance response in animals that are present during the proposed geophysical survey works (JNCC *et al*., 2010).

Injury impact

3.4.18 The USBL system is likely to be employed intermittently, with time spent deactivated in-between noise emissions. This would allow animals to move away from the source and avoid continuous exposure, which otherwise would increase the risk of auditory injury to nearby animals. As per the JNCC (2017) guidelines, a trained MMO will be onboard the survey vessel monitoring the presence of marine mammals within a 500 m mitigation zone, further reducing the risk of injury impact (see Section 4).

3.4.19 As such, there is no potential to commit an offence with regards to injury or to affect the FCS of any EPS through the use of the USBL system. Therefore, there is no risk of offence and an EPS licence will not be required.

Disturbance impact

3.4.20 The survey period is anticipated to span up to 32 days for the array area, excluding weather downtime, and 30 days for the ECC. During this time the survey vessel will be traversing the survey routes, resulting in localised and temporary noise generation.

3.4.21 If the short-term USBL operations resulted in a response by a solitary animal, this would be unlikely to impair the ability of an animal to survive, reproduce or result in any significant impacts to the local population and distribution. There would therefore be no impact on the FCS of any cetacean species at a population level.

SSS and MBES

3.4.22 SSS and MBES techniques use continuous sound and generally operate at higher frequencies, the potential impacts from this are outlined in the following sections.

3.4.23 For the proposed geophysical survey works, the expected frequency range for SSS and MBES operations is anticipated to be above 200 kHz. This is based on the offshore geophysical survey tender specifications and submissions The JV has received for these works. These frequencies are generally beyond the hearing range of most cetaceans, including high-frequency sensitive species such as harbour porpoise.

Injury Impact

3.4.24 In shallower depths, sound emitted by MBES may be audible to some cetaceans, particularly high frequency species such as harbour porpoise. However, higher frequency sounds diminish faster such that the received sound level rapidly decreases with distance from the source. As such, the animals would have to remain in close proximity to the sound source for potential auditory injury to occur. The likelihood of this occurring is low, particularly as the source will be emitted from a moving vessel, thus the subsequent risk to cetaceans in the survey area is very low (JNCC *et al*., 2010). Harbour porpoise have been identified as a higher frequency species, with an estimated auditory band width of 200 Hz to 180 kHz, with improved hearing ability for sounds of higher frequencies (Southall *et al*. 2017). It is thought that surveys occurring at depths greater than 200 m which utilise frequencies below 100 kHz may impact EPS (JNCC, 2017). As this survey utilises frequencies higher than 200 kHz, and also utilises mitigation measures (see Section 4) this is not thought to be as significant a risk here.

3.4.25 The available noise emission mitigation measures for MBES surveys are not specifically designed for geophysical surveys in less than 200 m water depth (JNCC, 2017). However, it is considered that their implementation in shallower waters will further reduce potential injury to cetaceans around the survey area. Consequently, the mitigation measures outlined in the JNCC (2017) guidelines have been incorporated as mitigation for this geophysical survey. These measures include deployment of an MMO to monitor for the presence of cetaceans within a 500 m mitigation zone prior to commencement of, and during, the surveys (see Section 4).

3.4.26 Given the increased noise attenuation associated with these high frequencies, it can be concluded that these surveys present a negligible risk of injury to cetaceans (JNCC *et al*., 2010). Consequently, the potential to commit an offence is negligible and thus there is no requirement for an EPS Licence in this respect.

Disturbance Impact

3.4.27 Underwater noise has the potential to modify the behaviours of animals in the vicinity of the noise source. As outlined previously in this section, significant disturbance may occur when an animal is at risk of a sustained or chronic disruption of behaviour or habitat use resulting in population-level effects. SSS and MBES largely operate beyond the hearing sensitive frequencies of most cetaceans (Table 5) (JNCC *et al*., 2010); thus, the potential for a disturbance having negative impact on the FCS of a species is extremely low. Please see Section 4 for further details of mitigation measures that will be utilised.

3.4.28 The geophysical surveys will last for a period of 32 days for the array area and 30 days in the ECC (excluding weather downtime and crew change over times). For a disturbance impact to occur, cetaceans would need to stay within close proximity to the vessel during SSS and MBES for the duration of the operation.

3.4.29 Survey activities will be temporary and short-term in nature and so it is unlikely that SSS and MBES would have a negative impact on the FCS of the cetacean species present across the survey area. This is based on the assumption that the level of disturbance is unlikely to impact the animals ability to survive and reproduce. There is, however, a possibility of disturbance occurring for a short period of time as a result of noise impacts and so an EPS licence is required for proposed survey activities within 12 nautical miles (as per Regulation 39(2)), or in the case of the proposed geophysical survey works within the Muir Mhòr ECC survey area.

3.4.30 Further mitigation measures will be implemented in order to minimise the risk of further impacts from the geophysical survey works (see Section 4).

SBP and UHRS

3.4.31 The potential impacts that SBP and UHRS might have on cetacean species present within the survey area are detailed below. The frequencies used for these surveys are in the sensitive hearing range of cetaceans and so this is a key assessment within this EPS risk assessment.

Injury Impact

3.4.32 SBP sparkers emit a low frequency sound to maximise seabed penetration. Cetaceans will be exposed to this low frequency sound over a greater spatial area than they would as a result of higher frequency sounds (e.g., from SSS and MBES). Modelling of SBP systems suggests that an animal swimming at a constant speed of 1.5 m/s from the noise source, showed that injury may occur at a range of 20 m for the majority of cetaceans and up to 400 m for harbour porpoise. These results are dependent on the cetacean swimming in a direct and narrow 'beam' from the transducer (Department for Business, Energy and Industrial Strategy (BEIS), 2020).

3.4.33 The majority of acoustic energy will be directed at the seabed rather than being emitted horizontally which reduces the impacts of noise emissions on nearby animals. SBP and UHRS is designed to have a highly focused beam that aims directly at the seabed, meaning there is limited horizontal transmission of noise. This limits the potential impact ranges compared to spherical spreading assumptions.

3.4.34 Section 4 outlines the mitigation measures that will be used to dramatically reduce the risk of cetacean injury as a result of SBP geophysical survey activity. Measures include the deployment of an MMO to monitor the presence of cetaceans within a 500 m mitigation zone ahead of surveys commencing as well as during survey activity (see Section 4). The combination of mitigation measures and the characteristics of the noise resulting from SBP activity mean that the potential risk of injury offence to cetaceans is significantly reduced. An EPS license is therefore not required.

Disturbance Impact

3.4.35 SBP and UHRS operate at lower frequencies relative to MBES and SSS which mean a larger number of cetaceans will be exposed to the frequencies being emitted. The UHRS is a sparker system and is likely to cause greater distrubance.

3.4.36 Survey activity will be short-term and temporary in nature. It is anticipated to span up to 32 days for the array area, excluding weather downtime, and 30 days for the ECC. During this time the survey vessel will be traversing the survey routes, resulting in localised and temporary noise generation.

3.4.37 Graham et al. (2019) indicated that vessel disturbance to cetaceans is 1 km and so a vessel moving into an area will cause a reduction in cetaceans found in the immediate area. This would reduce the chance of cetaceans in the area being disturbed by the frequencies as they will leave the area. Failing this, the 'narrow' beam emitted by these systems that aims directly at the seabed means that a cetacean would need to swim directly through the beam to be distrubed.

3.5 Impact Ranges Associated with the Geophysical Survey

3.5.1 A desk-based review of available data sources has been carried out to determine the estimated impact ranges of geophysical survey activity on cetaceans. Table 8 indicates the estimated number of EPS that may be impacted by the geophysical surveys.

3.5.2 Noise modelling based on the maximum source levels and bandwidths obtained from a range of SBPs was included within a review of wind farms present within the Southern North Sea SAC which has been designated for the protection of harbour porpoise (Department for Business, Energy and Industrial Strategy (BEIS), 2020). This indicated that PTS onset begins between 17 m and 23 m from the source. The potential for harbour porpoise to be disturbed is over a greater distance of 2.5 km, which covers an area of 18.3 km^2. The report concluded that there was a low risk of harbour porpoise being physically disturbed by SBPs (BEIS, 2020).

3.5.3 Assessment guidance from JNCC for noise disturbance against conservation objectives of SACs designated for harbour porpoise recommends a 5 km effective deterrent range (EDR) for high resolution geophysical surveys, based on SBP sources (JNCC *et al*., 2020). This gives an overall coverage of 78.5 km^2 from one potential location (assuming a spherical range) and is considered a conservative estimate based on a study by CSA *et al.* (2020). The number of individuals that could potentially be impacted in and around the survey area is presented in Table 8.

3.5.4 Several studies have indicated that displacement effects of surveys on cetaceans do not have significant impacts and that cetaceans return to survey areas a few hours after displacement (Thompson *et al*., 2013; Pirotta *et al*., 2014). A study by Thompson *et al*. (2013) indicated that noise produced by seismic surveys did not lead to significant displacement over a large spatial scale. Cetaceans were detected within the survey area several hours after displacement and cetacean response levels to the sound from surveys decreased throughout the survey. The results of these surveys indicate that any impacts of the Muir Mhòr geophysical surveys will be temporary, small-scale and reversible in nature. The transitory nature of the geophysical surveys means that following initial displacement, cetaceans will be able to return to an area relatively quickly.

3.5.5 The behavioural response severity scale by Southall *et al*. (2007) (Table 7) has been used as a precautionary approach to the severity of a potential behavioural response and potential behavioural response has been assessed as a 4 or less and are not considered significant in causing disturbance to any EPS in the area. It is concluded that the impacts will not result in any significant disturbance or be detrimental to the maintenance of the population at a FCS within their natural range for any EPS.

3.5.6 The assessment of disturbance to cetaceans in the array area and ECC survey area is the same for harbour porpoise, common dolphin, white-beaked dolphin, white-sided dolphin and minke whale. This is due to species all being sampled within Block R of the SCANS III survey and all having a significant MU that covers both the ECC and array area. Bottlenose dolphin being assessed for the array area fall under the GNS MU, whilst the bottlenose dolphin being assessed for the ECC survey are predominantly under the CES MU and so they have different estimates for the two surveys (Table 8). Using the CES MU will provide a more accurate and worst-case-scenario estimate of the individuals to be impacted by the survey rather than using the larger CGNS MU. Bottlenose dolphins are primarily an inshore species which tends to stay within the coastal inshore waters and so using the CES MU will likely capture the indiviiduals that will be within the Muir Mhòr survey area.

Table 8: Assessment of disturbance to cetaceans off the east coast of Scotland based on a 5 km EDR (78.5 km^2).

Species	Density Estimates (individuals/km^2)	No. of Individuals Within Potential Impact Area	Estimated Population Abundance		% of Population Potentially Disturbed		Potential for Significant Disturbance
			East Coast (Block R)	MU	East Coast (Block R)	MU	
Harbour porpoise	0.599	47	38,646	346,601	0.123	0.019	No – Less than 1% of North Sea MU or East Coast population temporarily disturbed.
Common dolphin	0.000	0	0.000	102,656	0.000	0.000	No – 0% of GNS MU and 0% of Block R population.
Bottlenose dolphin	0.0298	2	1,924	2,022 (array) 195 (ECC)	0.104	0.099 (array) 1.026 (ECC)	No – Less than 1% of Coastal East Scotland and less than 1% of MU population temporarily disturbed for the array area and 1.02% for the ECC survey area.
White-beaked dolphin	0.243	19	15,694	43,951	0.121	0.043	No – Less than 1% of CGNS MU or East Coast population temporarily disturbed.
White-sided dolphin	0.010	1	644	18,128	0.155	0.005	No – Less than 1% of CGNS MU or East Coast population temporarily disturbed.
Minke whale	0.0387	3	2,498	20,118	0.12	0.015	No – Less than 1% of CGNS MU or East Coast population temporarily disturbed.

4 EPS Mitigation Strategy

4.1 Overview

4.1.1 This EPS Mitigation Strategy has been prepared with the intention to reduce injury and disturbances to EPS from proposed geophysical survey activities. Visual measures have been included and the measures listed here are based on JNCC guidance for minimising the risk to marine mammals from geophysical surveys (JNCC, 2017). Survey vessels will be required to adhere to the Scottish Marine Wildlife Watching Code provisions (SNH, 2017a) and all parties contracted as part of the survey works will be made aware of the presence of any EPS within the area.

4.1.2 During vessel turns, JNCC (2017) guidance will be adhered to and geophysical survey equipment will be turned off if a turn will exceed 40 minutes.

Mitigation Zone

4.1.3 Should an EPS be detected within 500 m of a survey vessel, geophysical survey activity will not commence until the EPS has passed through the area or the vessel has moved resulting in the EPS being further than 500 m away from the geophysical survey source. There should be a 20-minute delay from the time of the last sighting within the mitigation zone prior to the soft-start commencement (recommencement) of survey activities. Once the geophysical survey has started, activities will not be stopped should an EPS approach the vessel.

Marine Mammal Observer (MMO)

4.1.4 When possible (i.e., during daylight hours and when visibility is good) MMO(s) will carry out visual observations to monitor the presence and occurrence of cetaceans before the soft-start commences and the MMO will make recommendations for survey alterations, should an EPS be seen within a safety zone of 3 km radius from the source. Power will be reduced to the lowest possible setting if an EPS is seen within a radius of 1-2 km from the acoustic source and power will be shut off completely within 500 m from the acoustic source. Following the survey being stopped, the survey will not be resumed for 30 minutes.

4.1.5 MMOs are trained personnel who will advise on how to minimise disturbance to mammals and will ensure mitigation guidelines are adhered to.

Marine Mammal Monitoring

4.1.6 Marine mammal monitoring will be carried out throughout the duration of survey activity. MMOs will be qualified and will work standard 12-hour shifts. MMOs will have training and experience in working at sea. Binoculars being used should have an 8x magnification and the MMO will be stationed high up on the vessel.

Pre-start Search

4.1.7 MMOs will carry out visual and acoustic monitoring (if required) prior to geophysical survey commencement for at least 30 minutes to assess the presence of EPS within the 500 m mitigation zone.

4.1.8 The survey will utilise high resolution survey equipment and if starts are sequential or interchanged during their operation, only one pre-shooting search will be required prior to the start of acoustic

output. This is only valid if the gaps in data acquisition are greater than 10 minutes and there is an audible source active.

Soft Start

4.1.9 When feasible the geophysical survey equipment will not be operated at full power straight away and will build up to full power over a 15–25-minute period. This will give the EPS warning that surveys are commencing and they will have chance to leave the survey area.

4.1.10 This soft-start approach will be implemented after any pauses in surveys longer than 10 minutes. This will reduce the potential to injure any cetaceans that enter the area during survey 'downtime'. Observations will only be carried out ahead of soft-starts and they will cease once geophysical surveys have begun. Observations will not be carried out again until another soft-start is required.

Reporting

4.1.11 JNCC Standard Forms will be used to report cetacean recorded. Monitoring reports will be submitted to MS-LOT and NatureScot and will include cetacean records, survey methodology and limitations. MMOs will contact MS-LOT or NatureScot if there are any queries about the application of guidance during surveys.

4.2 Survey Vessel Speed and Course

4.2.1 Survey vessels will move at approximately four knots during geophysical operations in order to allow cetaceans to move away from the vessel if they are disturbed by vessel emissions and/or noise emissions.

4.2.2 During transition periods between port and the survey area, the vessel will be moving at speeds greater than four knots but this will not be different to normal vessel traffic. However, if an EPS is seen within the direct path of a survey vessel outside of survey times, the survey vessel will slow down to allow the EPS to swim outside of the vessel path , alternatively the vessel if safe to do so, the vessel will deviate from the intended course to avoid the cetacean in its original path.

4.3 Toolbox Talks

4.3.1 As part of routine Toolbox Talks, survey crew will be made aware of all potential EPS that may be encounter during surveys and good practice measures of boat control near wildlife through the Scottish Marine Wildlife Watching Code (SNH, 2017a) and Guide to Best Practice for Watching Marine Wildlife (SNH, 2017b).

5 Consideration of Cumulative Impacts

5.1.1 Potential cumulative impacts have been considered and Table 9 lists projects that are being considered to have potential cumulative impacts alongside the geophysical survey works for this project.

5.1.2 Cumulative impacts are not expected to arise as a result of spatial or temporal overlap between projects and all effects of the geophysical survey are expected to be localised and short-term and therefore not result in significant adverse impacts. There are also no other surveys specific to the Muir Mhòr project that might result in cumulative impacts on EPS.

5.1.3 The PTS impact range is considered low (23 m) according to the Review of Consents for the Southern North Sea SAC which was considering the potential for in-combination effects as a result of geophysical surveys. According to BEIS (2020), there is no potential for in-combination effects of geophysical surveys being carried out alongside OWF construction activities.

5.1.4 The use of geophysical survey equipment during OWF piling (either a single event or concurrent events) was not considered to significantly increase the area of potential disturbance. This area would also only be temporarily disturbed due to the continual travel of the survey vessel. BEIS (2020) therefore concluded that there would not be any significant effects as a result of in-combination effects of piling and geophysical surveys.

5.1.5 It is therefore predicted that the relatively localised areas of disturbance and the short period of time that cumulative impacts could arise are such that they will not cause an impact that will affect the FCS of any EPS. Based on the assumption that all the planned projects and activities with the potential for injury or significant disturbance will have mitigation in place, which is similar to or more extensive than the measures being undertaken for the geophysical survey, no EPS will be at risk of injury from these activities. No cumulative effects are considered likely to arise as a result of the proposed Muir Mhòr geophysical survey works with any other project. It should also be noted that the Muir Mhòr array and ECC are being surveyed sequentially and so there is potential for cumulative impacts from both surveys as the surveys will be carried out in quick succession.

Table 9: Potential for Cumulative Impacts.

Project	Licensed Activity	Description and Sound Source	Estimated Impact
Projects within 26 km^2 of the Muir Mhòr OWF survey area			
MarramWind and CampionWind (Shell and Scottish Power Renewables – E2)	This project is in the concept/early planning process as with Muir Mhòr OWF.	Timescales for geophysical surveys are unknown; a temporal overlap with proposed geophysical surveys at Muir Mhòr OWF cannot be identified.	Assuming that the conditions set out in the EPS Licence are complied with and implemented, and given that there will be very limited geographical impact overlap, no cumulative impacts are likely to arise in the event of temporal overlap.
Projects from the wider region (Moray Firth, Forth and Tay etc.)			
Hywind Scotland Demonstration	Project has been fully operational since 2017. There are no active EPS Licences for this project, however future applications may be made.	Potential for future presence of vessels undertaking geophysical surveys and geophysical survey equipment deployment.	Geophysical surveys of array and export cable corridor have been completed.
Beatrice OWF	Post-construction geophysical surveys. Beatrice OWF holds an active EPS Licence valid from 07 July 2020 to 31 December 2023.	Presence of vessels undertaking geophysical surveys and the deployment of typical geophysical equipment.	Timescales for the post-construction geophysical surveys are unknown; therefore, a temporal overlap with proposed geophysical surveys at Muir Mhòr OWF cannot be identified. Assuming that the conditions set out in the EPS Licence are complied with and implemented, and given that there will be very limited geographical impact overlap, no cumulative impacts are likely to arise in the event of temporal overlap.
	Met Mast Decommissioning.	Cutting of the monopile and vessels.	Phase 1, including the removal of the monopile is complete. Phase 2 will consist of the removal of the gravity base structure and associated scour protection. The removal is to be completed in 2022 and the main noise activities have

Project	Licensed Activity	Description and Sound Source	Estimated Impact
			been completed. No cumulative impacts are likely to arise due to the very limited temporal overlap.
Moray West OWF	Geophysical survey activities of Moray West array and export cable corridor. EPS Licence valid from 30 July 2021 to 30 November 2022.	Geophysical surveys include USBL, SSS, MBES, SBPS, single-beam echosounder (SBES), SBP, UHRS and MAG.	Geophysical surveys of array and export cable corridor have been completed.
	Offshore construction.	Jacket and turbine installation. Cable laying.	Construction of Moray West OWF array and ECC anticipated to begin between 2022-2024. Timescales for the offshore construction are unknown; therefore, a temporal overlap with proposed geophysical surveys at Muir Mhòr OWF cannot be identified. Assuming that the conditions set out in the EPS Licence are complied with and implemented, and given that there will be very limited geographical impact overlap, no cumulative impacts are likely to arise in the event of temporal overlap.
Caledonia OWF (Ocean Winds – NE4)	This project is in the concept/early planning process as with Muir Mhòr OWF.	Timescales for geophysical surveys were provided within EPS licensing documentation as between 17 July 2022 and 17 July 2023.Variaton to licence then amended this period to as start of 17 September 2022. There will therefore be no temporal overlap with proposed geophysical surveys at Muir Mhòr OWF cannot be identified.	There is potential for the Caledonia OWF geophysical survey to have temporal overlap with the Muir Mhòr offshore geophysical surveys. The ECC for both projects currently remain undefined and so there is potential for there to be geographic overlap between the two survey areas. However, based on the content of the published Caledonia scoping report and the ECC areas of search defined in Figure 2 it is likely this will not be the case. Assuming that the conditions set out in the EPS Licence are complied with and implemented, no cumulative impacts are likely to arise in the event of temporal overlap.

Project	Licensed Activity	Description and Sound Source	Estimated Impact
		The Caledonia OWF geophysical survey involved MBES, SBES, SBP, SSS and UHRS surveys.	
Stromar (Falck Renewables, BlueFloat Energy and Orsted - NE3)	This project is in the concept/early planning process as with Muir Mhòr OWF.	Timescales for geophysical surveys are unknown; a temporal overlap with proposed geophysical surveys at Muir Mhòr OWF cannot be identified. The location of the ECC is currently unknown and there is potential for landfall to be made at the same or a similar point to Muir Mhòr, however, if this is the case then the overlap will be limited.	Assuming that the conditions set out in the EPS Licence are complied with and implemented, and given that there will likely be limited geographical impact overlap, no cumulative impacts are likely to arise in the event of temporal overlap.
Broadshore (Falck Renewables and BlueFloat Energy – NE6)	This project is in the concept/ early planning process as with Muir Mhòr OWF.	Timescales for geophysical surveys are unknown; a temporal overlap with proposed geophysical surveys at Muir Mhòr OWF cannot be identified. It is unknown if there will be geographical overlap with Muir Mhòr	Assuming that the conditions set out in EPS Licence are complied with and implemented, and given that there will be very limited geographical impact overlap, no cumulative impacts are likely to arise in the event of temporal overlap.
Neart na Gaoithe OWF	Offshore Construction Licence valid from 01 July 2020 to 01 July 2023.	Anticipated programme: Casing and Pile Installation (piling). August 2020 – November 2021 Offshore Substation Platform Jacket	Given that the distance between the project location from Muir Mhòr OWF survey area is greater than 26 km (largest disturbance impact range), and the anticipated programme indicating no temporal overlap, no cumulative impacts are likely to result in the event of temporal overlap.

Project	Licensed Activity	Description and Sound Source	Estimated Impact
		Installation. July 2021 – September 2021.	
Inch Cape OWF	Unknown.	There is no information as to when any geophysical surveys may be undertaken. Construction activities are not anticipated to commence in the near future.	The exact timing and nature of the actives are unknown and, therefore, it is not possible to undertake a cumulative impact assessment. However, given that the distance between the project location from Muir Mhòr OWF survey area is greater than 26 km (largest disturbance impact range), it is anticipated that no cumulative impacts are likely to result in the event of temporal overlap.
Green Volt OWF INTOG	Unknown if the planned surveys have obtained a licence.	Timing of geophysical surveys is currently unknown. It is unknown if there will be spatial overlap between Green Volt and Muir Mhòr. The planned location of this OWF is north-east of Muir Mhòr and there is potential that there will be overlap between both projects' ECC.	There is potential for there to be both spatial and temporal overlap of geophysical surveys for both projects. Given the planned location of Green Volt OWF, any overlap would likely be small-scale and short-term, as it would likely just be the ECC.
Ossian SSE	Unknown.	The Ossian OWF is south of the Muir Mhòr project in the E1 Plan Option. It is unknown when the project will carry out geophysical surveys or where the project's ECC will be located and so there is potential for spatial and temporal overlap.	There is potential for there to be both spatial and temporal overlap of geophysical surveys for both projects. Given the planned location of Ossian SSE OWF, any overlap would likely be small-scale and short-term, as it would likely just be the ECC.

6 Consideration of Likely Significant Effects (LSE)

6.1.1 This section of the EPS risk assessment discusses the potential adverse effect that the Muir Mhòr array area and ECC geophysical surveys may have on sites designated for nature conservation in proximity to the survey location. The following sites are in close proximity to the Muir Mhòr geophysical survey areas and include marine mammals as qualifying features (please see Figure 1 and Figure 2 for these designations):

- Southern Trench NCMPA;
- Moray Firth SAC; and
- Dornoch Firth and Morrich More SAC.

6.2 Designated Sites

Southern Trench NCMPA

6.2.1 This site is located on the south-eastern corner of the Moray Firth. The inshore region of the site stretches from Buckle to Peterhead. The nearest point to the Muir Mhòr array geophysical survey area is approximately 40 km and the ECC geophysical survey area will likely cross the Southern Trench NCMPA. This site protects minke whale, burrowed mud, shelf deeps and fronts. The fronts are the results of cold and warm waters mixing, which create highly productive areas which support the local and regional ecosystem and encourage apex predators including minke whale which are attracted to the fish species brought into the area by the fronts. It is therefore NatureScot's advice that access to the site's resources should be maintained and supporting features should be conserved.

6.2.2 The Conservation Objectives of this site are to conserve the features, specifically to ensure:

"Minke whale in the Southern Trench NCMPA are not at significant risk from injury or killing, conserve the access to resources (e.g. for feeding) provided by the NCMPA for various stages of the minke whale life cycle, and conserve the distribution of minke whale within the site by avoiding significant disturbance" [1].

6.2.3 The supporting features of the minke whale is also protected under the Conservation Objectives for the Southern Trench NCMPA.

Moray Firth SAC

6.2.4 The Moray Firth SAC is located within the inshore region of the Moray Forth from Lossiemouth on the south coast to Helmsdale on the north coast of the Moray Firth. At its closest point to the geophysical survey area, the Moray Firth SAC is approximately 153 km from the Muir Mhòr array area and 90 km from the Muir Mhòr ECC survey area. The site has been designated for Annex I sandbanks which are slightly covered by sea water at all times (1110) and bottlenose dolphin (1349) (Arso Civil et al., 2021).

[1] https://www.nature.scot/sites/default/files/2019-06/Southern%20Trench%20possible%20MPA%20-%20Conservation%20and%20Management%20Advice.pdf

6.2.5 The Moray Firth supports the only known resident bottlenose dolphin population in the North Sea, with an estimated 150 individuals which are present year round. This particular population is known to travel extensively along the eastern Scottish coastline, with individuals travelling to the Firth of Tay, Firth of Forth and as far south as northern England. However this species tend to stay within inshore waters (2km from the coast).

6.2.6 The Conservation Objectives for the Moray Firth SAC are:

"to avoid deterioration of the habitats of the qualifying species (bottlenose dolphin) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to achieving FCS for the qualifying interest".

6.2.7 Owing to the assessment set out in Section 3.3 it is considered unlikely that the Muir Mhòr geophysical survey will have an impact on the Moray Firth SAC bottlenose dolphin population.

Dornoch Firth and Morrich More SAC

6.2.8 This site has been designated for harbour seal (*Phoca vitulina*) and otter (*Lutra lutra*).The site is approximately 175 km from the Muir Mhòr array area and approximately 115 km from the nearest part of the Muir Mhòr ECC. Seals are not EPS, an assessment in relation to the nearby Dornoch Firth and Morrich More SAC has been included in this report. Otter is an EPS, albeit they are typically associated with coastal/riverine waters (as opposed to the offshore marine environment).

6.2.9 The region is an estuarine system with bordering habitat that includes sand dunes, woodland and small lochans. The River Evelix and River Oykel feed into the site and provide habitat for the population of otters the area supports.

6.2.10 The area supports a significant population of harbour seals (approximately 2% of the UK population) which use sand-bars and shores at the mouth of the estuary as haul-out and breeding sites.

6.2.11 The Conservation Objectives of the site ensure that obligations of the Habitats Regulations are met and there will not be significant disturbance to qualifying features and the integrity of the site is maintained. The total population of harbour seals in Scotland was 26,864 in 2015-2018, with 962 within the Moray Firth MU (Special Committee on Seals (SCOS), 2020).

6.2.12 Otter populations are susceptible to anthropogenic change in habitat as they are dependent on freshwater sources (Roos *et al*. 2015) and the location of holts is therefore restricted. It is not anticipated that the Muir Mhòr geophysical survey will have a significant impact on this otter population owing to distance from the area and the limited nature of the potential effects.

6.3 Potential Effects

6.3.1 Section 3.4 indicates that potential effects from underwater noise produced by the geophysical surveys to cause disturbance to the qualifying/protected features of the above designated sites. However, owing to the mitigation measures that are being implemented (listed in Section 4), the impacts on the sites as a result of the geophysical survey works would not be significant.

7 Assessment of Potential Offence

7.1.1 The proposed geophysical survey works for Muir Mhòr are outside the 12 nautical mile boundary of the UK. The mitigation measures being implemented here indicate that any potential impacts of the

survey work are unlikely to result in harassment, disturbance, injury or mortality of an EPS as defined under Regulation 39(1) of the Habitats Regulations.

7.1.2 In relation to Regulation 39(2) of the Habitats Regulations, the percentage of the total population which has the potential to be disturbed by the geophysical survey activity is considered to be negligible (less than 0.2% all cetaceans occurring in Block R and less than 1.026% of the MU of all species (Table 8)). Therefore, the impact is considered to not be detrimental to the maintenance of the population of the species concerned at a FCS. It is also thought that disturbance will be short-term and small-scale in nature.

7.1.3 It is therefore assumed that disturbance will not cause a population level effect and therefore an EPS Licence (to disturb) can be issued under Section 39 of the Conservation (Natural Habitats, &c) Regulations 1994 (as amended in Scotland) and Conservation of Offshore Marine Habitats and Species Regulations 2017.

7.1.4 As stated in Section 1.2, three tests must be passed before an EPS licence can be granted, as discussed below.

Test 1 – Licence must relate relevant purpose (Regulation 44)

7.1.5 The Scottish Government can only issue EPS Licenses under Regulation 44(2) of the Habitats Regulations (as amended) for specific purposes. These purposes include:

- (a) Scientific, research or educational purposes;
- (b) Ringing or marking, or examining any ring or mark on, wild animals;
- (c) Conserving wild animals, including wild birds, or wild plants or introducing them to particular areas;
- (ca) Conserving natural habitats;
- (d) Protecting any zoological or botanical collection;
- (e) Preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment;
- (f) Preventing the spread of disease; or
- (g) Preventing serious damage to livestock, foodstuffs for livestock, crops, vegetables, fruit, growing timber or any other form of property or to fisheries.

7.1.6 Muir Mhòr meets the Regulation 44(2)(e) requirement listed above as the planned wind farm demonstrates a direct environmental benefit on a national and international scale and complies with national and international environmental policies. There is an overarching requirement for sustainable energy supply from renewables within Scotland subject to national planning and energy policy. The Muir Mhòr OWF will have long-term environmental benefits and will significantly reduce carbon emissions (Scottish Government, 2022).

Test 2 – Must be no satisfactory alternative (Regulation 44(3)(a))

7.1.7 There are no satisfactory alternatives to these proposed geophysical surveys. Alternative equipment could be used, however, this may limit the effectiveness of the geophysical surveys and the survey results.

7.1.8 The Muir Mhòr geophysical surveys aim to achieve a 100% coverage of the seabed survey area and to detect objects on the seabed to 0.5 m. The geophysical survey results will be used to identify any potential hazards that should be avoided by the development. The geophysical survey results will also be used to feed into the benthic survey scope and determine the spread of sample stations in this survey. Additionally, the geophysical survey results will be used within the Environmental Impact Assessment (EIA) and will offer a robust archaeological assessment.

7.1.9 The key areas where the geophysical survey results will be used within the EIA are within the baseline characterisation of multiple technical topics. For example, within the modelling of coastal processes, benthic ecology and marine archaeology. This survey is fundamental to ensure a robust EIA is carried out for the Muir Mhòr OWF. It is therefore considered that the 'no satisfactory alternative test' has been met and the project cannot be safely developed without the survey.

Test 3 – Action authorisation must not be detrimental to maintenance of relevant species population at a FCS in their natural range (Regulation 44(3)(b))

7.1.10 The percentage of the reference population of each species which has the potential to be disturbed by use of the geophysical survey techniques is considered to be negligible (<1.026% for all species) and, therefore, not detrimental to the maintenance of the population of the species concerned at a FCS level.

8 Conclusions

8.1.1 The conclusions of this EPS risk assessment are as follows:

- The geophysical surveys will create a temporary, localised disturbance to EPS in the area. However, the overwhelming benefits that the Muir Mhòr OWF will have to Scotland and the UK's renewable energy contributions are significant and in accordance with Scottish planning policies (e.g. draft NPF4). The proposed development will align with the UK Government's Energy Security Strategy[2] and Scotland's National Marine Plan[3] ;
- A low percentage of the population of EPS in a localised area will be impacted for a short period of time. This disturbance will likely arise as a result of noise impacts arising from geophysical survey operations;
- The mitigation measures (detailed in Section 4) will significantly reduce the risk of injury to EPS as a result of the geophysical survey work and therefore an offence will not be caused. Therefore, an EPS licence will not be required;

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1069973/british-energy-security-strategy-print-ready.pdf

[3] https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2015/03/scotlands-national-marine-plan/documents/00475466-pdf/00475466-pdf/govscot%3Adocument/00475466.pdf

- Potential cumulative impacts have been considered for both existing and projects in development and it has been concluded that no potential cumulative impacts will result from the Muir Mhòr geophysical surveys and other projects. The assumption has been made that all future projects will have mitigation in place to reduce the potential to cause injury. It is also assumed that, similarly to this project, the predicted impact level resulting from disturbance will be temporary and localised in nature;

- There is no potential for injury or disturbance to EPS in the vicinity of the geophysical survey works where there is a designated nature conservation site.

8.1.2 In conclusion, the impacts are not considered to cause significant long-term disturbance or be detrimental to the FCS of EPS within the region. An EPS Licence is required for activities where there is potential for disturbance to cetaceans as per Habitats Regulation 39(2); this disturbance will not be sufficient to cause any population level effects, and thus it is considered that an EPS Licence to disturb can be issued.

8.1.3 As there is no potential for injury or significant disturbance to EPS in the vicinity of the survey works, it is considered that there is no potential for any LSE on nature conservation designated sites in relation to the Conservation Objectives for marine mammals.

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Appendix 1. Basking Sharks

9.1.1 Basking sharks (*Cetorhinus maximus*) are not an EPS, however, they are protected under Schedule 5 of the Wildlife and Countryside Act. Schedule 5 of this Act prohibits the killing, injuring or taking of basking sharks. Further to this, the Nature Conservation (Scotland) Act 2004, Part 3 and Schedule 6 amend the Act by prohibiting 'reckless' acts and make it an offence to deliberately harm or harrass a basking shark. A Basking Shark Licence would therefore be required for any survey activity that would disturb basking sharks.

9.1.2 Basking sharks are only very rarely present within the North Sea area (Paxton *et al*., 2014). The basking shark is an elasmobranhc (sharks and rays) which is a group with generally low sensitivity to noise vibrations due to the fact that they do not have a swim bladder. The hearing range of basking sharks is not known; however five other elasmobrnahcs have been found to have a hearing range between 20 Hz to 1 kHz although it is unclear if that range is equally applicable to baksing sharks (Macleod et al., 2011). As 20 Hz – 1 kHz only encompasses a small proprtion of the noise emitted during the proposed geophysical survey and the activities are of short duration, noise disturbance is not expected to impact basking sharks.

9.1.3 Vessel collision also poses a threat to this slow-moving species. Colision risk increases with cinreasing vessel speed. However as the survey vessels will be slow-moving and will follow a pre-determined survey transect, the potential for colision risk is generally low.

9.1.4 On this basis and considering information on their known distribution, it is considered extremely unlikely that interactions with basking sharks will occur, hence the potential for the proposed survey activities to result in intentional or reckless distubance or harrassement of this species is eually limited. As such, no basking shark licence is required.