European Protected Species Basking Shark Risk Assessment

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REPORT

European Protected Species (EPS) and Basking Shark Risk Assessment

MachairWind Offshore Wind Farm Site Investigation Survey

Client: ScottishPower Renewables

Reference: PC3479-ZZ-XX-RP-Z-0001

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Executive Summary

Proposed geophysical surveys for the MachairWind Offshore Wind Farm Option Agreement Area:

- Taking into account the proposed mitigation and assessments based on Sub Bottom Profiler (SBP) as a worst-case, there is no risk of auditory injury to cetaceans.
- Taking into account the potential for temporary disturbance due to the intermittent use of the survey equipment and assessments based on SBP as a worst-case, including cumulative impacts on cetaceans, there is no risk of significant disturbance that could affect the cetacean populations or their Favourable Conservation Status.
- There is also no predicted significant effects on other designated sites where harbour porpoise or bottlenose dolphin are qualifying features.
- Due to the currently known hearing abilities of elasmobranch species, it is not expected that the geophysical surveys will have any impact due to underwater noise, and therefore the potential for underwater to cause injury or disturbance was screened out of assessment.
- Due to the slow vessel speeds associated with geophysical surveys, there is no potential for significant risk of injury to cetaceans or basking shark. Mitigation will be in place to reduce the potential for collision risk.

Therefore, it is considered that an EPS licence to disturb can be issued.

1 Introduction

This European Protected Species (EPS) Stage 1 Risk Assessment (RA) has been undertaken to support the Licence application submitted to the Marine Scotland - Licensing Operations Team (MS-LOT) regarding geophysical and geotechnical ground investigations being undertaken for the MachairWind Offshore Wind Farm (OWF) Option Agreement Area (OAA).

The purpose of this RA is to determine whether there is potential for the proposed marine surveys to cause deliberate harm, or inadvertently cause disturbance to cetaceans or other protected species and if mitigation would be required for survey activities. The need for a Marine EPS Licence will be determined by the MS-LOT, with advice from Marine Scotland Science (MSS) and NatureScot, based on findings from the EPS RA. MS-LOT's consideration of whether an EPS Licence will be required will comprise three tests:

1. To ascertain whether the licence is to be granted for one of the purposes specified in the Regulation 44;
2. To ascertain whether there are no satisfactory alternatives to the activity proposed (that would avoid the risk of offence); and
3. That the licencing of the activity will not be detrimental to the maintenance of the population of the species concerned at a *Favourable Conservation Status* (FCS)[1].

1.1 EPS Protection

All species of cetacean (whale, dolphin, and porpoise) occurring in UK waters and otters are listed in Annex IV of the Habitats Directive as European Protected Species (EPS), meaning 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 (nm)) under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). Regulation 39(1) of these Regulations make it an offence to:

a. Deliberately or recklessly capture, injure or kill a wild animal of an EPS;
b. Deliberately or recklessly:
    i. Harass a wild animal or group of wild animals of an EPS;
    ii. Disturb such an animal while it is occupying a structure or place which it uses for shelter or protection;
    iii. Disturb such an animal while it is rearing or otherwise caring for its young;
    iv. 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;
    v. 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;
    vi. 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
    vii. Disturb such an animal while it is migrating or hibernating.

[1] *The Habitats Directive defined the conservation status of a species to be taken as 'favourable' when population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, when the natural range of the species is not being reduced for the foreseeable future and there is, a sufficiently large habitat to maintain its populations on a long-term basis.*

Further protection is afforded through an additional disturbance offence given under Regulation 39(2) which states that "*it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)*".

Outside of 12 nm, the extent of legislative protection against injury is the same as within 12 nm. However, the definition of disturbance outside of 12 nm does not extend to individual animals. Therefore, whilst disturbance of a single animal within 12 nm may be considered an offence and thus require an EPS licence, for an EPS licence to be required outside of 12 nm there must be disturbance of a significant group of animals.

1.1.1 What constitutes disturbance?

Within 12 nautical miles

Whether or not a specific 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, 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*[1];
- 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 this period 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 Regulation 39(1) and (2) of the Habitats Regulations 1994. Therefore, when considering what constitutes 'disturbance', thought should be given to 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 Regulation 39(2) of the Habitats Regulations which state that it is an offence to 'deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean)'.

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 so assessments 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).

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 occur, an EPS RA must be carried out and the need for a Marine EPS Licence determined.

Outside of 12 nautical miles

As Regulation 39(2) of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) is not applicable to offshore waters, disturbance of an individual animal would not necessarily qualify as significant disturbance requiring a Marine 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 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.

1.2 Basking Shark Protection

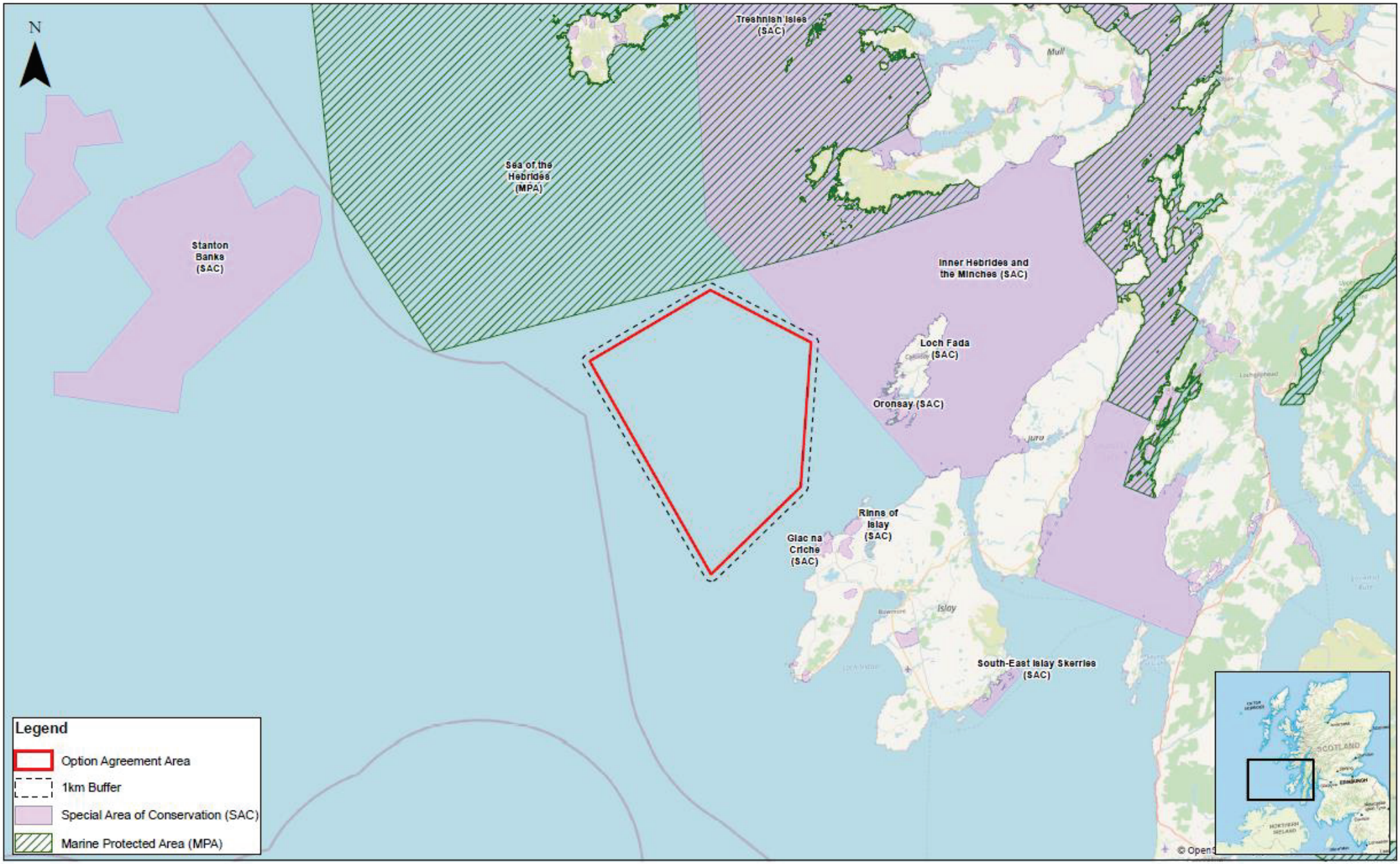
Basking sharks (*Cetorhinus maximus*) are listed on Schedule 5 of the Wildlife and Countryside Act (WCA) 1981, CITES Appendix II, and are listed on the Bonn Convention on Migratory Species, and the Common Fisheries Policy. Basking shark are protected from disturbance up to 12 nm offshore from the Countryside and Rights of Way Act (2000) in England and Wales, and from the Nature Conservation (Scotland) Act (2004). Basking sharks are protected under Schedule 5 of the WCA which prohibits the killing, injuring or taking by any method of those wild animals listed on Schedule 5 of the Act. The Nature Conservation (Scotland) Act 2004, Part 3 and Schedule 6 make amendments to the WCA, strengthening the legal protection for threatened species to include 'reckless' acts, and specifically makes it an offence to intentionally or recklessly disturb or harass basking sharks. A derogation licence under the WCA will, therefore, be required for any activity which may result in disturbance or injury to basking sharks.

1.3 Site Investigation Survey Works

Site investigation and benthic surveys at the wind farm site are required to be undertaken to inform early project design work, to enable the development team to make responsible project design decisions to inform the ongoing technical design and delivery plans and to feed into the baseline information requirements of the Environmental Impact Assessment (EIA). The proposed surveys will be undertaken in the MachairWind OWF OAA (see **Figure *1.1*** and **Table 1.1**).

Table 1.1 Proposed site investigation survey areas

Propose Survey Area	Area (km^2)
Machair OWF Array Site (preliminary project area)	392 km^2
Machair OWF Option Agreement Area (OAA)	754 km^2
Machair OWF OAA plus buffer	**865 km^2**



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Rev	Date	By	Comment
P01	01/04/2022	AB	First issue.

Prepared: AB
Checked: AC
Approved: PB

1:500,000 Scale @ A3

0 5 10 20 Km

Machair Wind

Proposed survey areas for Machair OWF survey

Drg No	PC3479–RHD-MA-XX-DR-YE-0001
Rev	P01
Date	01/04/22
Figure	1.1

Datum: WGS 1984
Projection: Zone 29N

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1.3.1 Survey vessels

The type and number of vessels required to complete the site investigation surveys will vary depending on the different activities associated with each survey and site characteristics. It is expected that the survey could require up to three vessels to meet survey requirements, and that as a worst-case, all three may be on site at any one time.

1.3.2 Schedule and duration

The proposed geotechnical, geophysical and environmental surveys are scheduled to be conducted from 1 June to 30 November 2022. The surveys of the MachairWind OWF OAA (including 1 km buffer) are expected to take place over this period. The survey includes 130 noisy days of geophysical survey (i.e. any day which any duration of geophysical survey occurs).

1.4 Types of Survey Equipment

The site investigation surveys will involve different types of survey equipment, summarised in **Table 1.2**.

At present, the exact configuration of site investigation survey equipment to be used is unconfirmed, and proposed equipment information (including frequency ranges) have been used for the assessment as set out in **Table 1.3**.

Table 1.2 Types of survey equipment

Type of survey equipment	Description
Sub-Bottom Profilers (SBP)	SBP systems are used to identify and characterise layers of sediment or rock under the seafloor. A transducer emits a sound pulse vertically downwards towards the seafloor, and a receiver records the return of the pulse once it has been reflected off the seafloor.
Ultra-high resolution (UHR) Sparker	Applied Acoustics' Dura-Spark UHD is an ultra-high resolution dual sparker system classified as a medium penetration impulsive source used to map deeper subsurface stratigraphy. Sparkers are powerful devices and can be used to penetrate seabed layers (JNCC, 2017).
Multibeam Echo Sounder (MBES)	MBES are used to obtain detailed 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.
Ultra-Short Baseline (USBL) system	USBL systems are used to determine the position of subsea survey items, including Remotely Operated Vehicles (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 calculates the time from the transmission of the initial acoustic pulse until the reply is detected and is measures by the USBL system. This is converted into a range and bearing, and thus the position of the subsea unit / sampling

Type of survey equipment	Description
	equipment is determined. These systems can either be used continuously or intermittently through the operation they are supporting.
Side Scan Sonar (SSS)	SSS is used to generate an accurate image of the seabed. 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 higher frequency systems provide higher resolution, but shorter-range measurements.
Magnetometer	Magnetometer surveys are used to detect any ferrous metal objects on the seabed, such as wrecks, unexploded ordnance (UXO), or any other obstructions. Marine magnetometers 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 magnetometers allow for a wider range of detection at the price of precision accuracy that is afforded by the near-bottom magnetometers.
Grab samples and Drop Down Video (DDV)	Benthic samples will be taken, comprising grab samples and DDV spot surveys within the geophysical survey corridor. Sampling will be undertaken using a benthic grab appropriate for the ground conditions.
Geotechnical Works: Boreholes: piston, push and hammer soil sampling, wireline rock coring, P-S wave logging, cone penetration tests (CPTs) and seismic wave cone penetration tests (SCPTs) Seabed CPTs and SCPTs	The boreholes will be created through drilling techniques. They are then tested using P-S wave logging system, which generates a very localised sound source to measure seismic pressure and shear wave velocity. CPTs uses wave generators that generate seismic shear waves below the seabed that are measured in order to determine the small strain shear modulus of the soil.

As SBP are the types of equipment with the highest risk of injury or disturbance to cetaceans, it has been used as a worst-case for this EPS RA. SBPs can operate at frequency ranges of less than 15 kHz and can have sound sources of up to 235 dB re 1µPa at 1m (peak) (**Table 1.3**), depending on the type and make of SBP to be used. The frequency range for the SBP and USBL is within cetacean hearing range (of less than 100 kHz, as noted in the Joint Nature Conservation Committee (JNCC) 2017 *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys*)[2].

There is also the requirement for MBES to be used, which emit a sound source of up to 400 kHz, and a SSS may be utilised for some elements of the work, with a likely frequency range of 230 and 850 kHz. However, these pieces of equipment are expected to operate at frequencies out with the hearing range of cetaceans, and the following risk assessment considers the potential for impact from audible equipment with the SBP operating as the worst-case. **Table 1.3** outlines the survey equipment requirements for the survey and worst-case source levels.

[2] https://data.jncc.gov.uk/data/e2a46de5-43d4-43f0-b296-c62134397ce4/jncc-guidelines-seismicsurvey-aug2017-web.pdf

Table 1.3 Intensity and frequency of sound sources

Equipment	Frequency range	Sound Level
SBP (Innomar (SES 2000)	2 – 22 kHz	SPL: 250 dB re: 1 µPa @ 1m / SEL: 218 dB re: 1µPa^2-s
MBES (EM2040 Dual Rx)	200 – 400 kHz	SPL: 215 dB re: 1 µPa @ 1m / SEL: 175 dB re: 1µPa^2-s
SSS (Edgetech 4205) (300kHz; 600kHz; 900kHz)	300kHz = 210-250 kHz; 600kHz = 510-570 kHz; 900kHz = 810-890 kHz	300kHz = SPL: 220dB re: 1 µPa @ 1m / SEL: 200 dB re: 1µPa^2-s 600kHz = SPL:220 dB re: 1 µPa @ 1m / SEL: 196 dB re: 1µPa^2-s 900kHz = SPL:218 dB re: 1 µPa @ 1m / SEL: 198 dB re: 1µPa^2-s"
USBL (Kongsberg HiPAP 501/502)	21 – 31 kHz	206 dB re 1µPa (rms)
UHR sparker (DuraSpark 400 UHD)	0.5 – 4 kHz	SPL: 220 dB re: 1 µPa @ 1m / SEL: 193 dB re: 1µPa2-s
Magnetometer	N/A	N/A - do not emit noise
Grab Samples	N/A	N/A - do not emit noise
DDV	N/A	N/A - do not emit noise
Boreholes	30 Hz	188 dB re 1µPa @1m (rms)[3]
Seismic CPT	16Hz – 8 Khz	122dB at 1m distance (per hammer strike/seismic test)
P-S wave logger	28Hz	peak 28db

2 Protected Species

2.1 Cetacean Species

All cetaceans are protected under Annex IV of the EC Habitats Directive, which lists species of community interest in need of strict protection. The survey is located off the west coast of Scotland.

This is within Block G of the Small Cetaceans in the European Atlantic and North Sea (SCANS)-III survey (Hammond *et al*., 2021) which provide cetacean species density estimates. A review of the SCANS-III surveys (Hammond *et al.,* 2021), and of the data review by Waggitt *et al.* (2019) shows that there are seven cetacean species known to be present in the area, including: harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), short beaked common dolphin (*Delphinus delphis*), Risso's dolphin (*Grampus griseus*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), white-beaked dolphin (*Lagenorhynchus albirostris*), and minke whale (*Balaenoptera acutorostrata*).

Rarer species recorded in the area include fin whale (*Balaenoptera physalus*) and killer whale (*Orcinus orca*). Whereas other species are infrequent visitors to the region, such as humpback whale (*Megaptera novaengliae*), sei whale (*Balaenoptera borealis*), sperm whale (Physeter macrocephalus), striped dolphin (*Stenella coeruleoalba*) (Baines and Evans, 2012; CMACS, 2011).

A large-scale survey of the presence and abundance of cetacean species around the north-east Atlantic, undertaken in the summer of 2016 (SCANS-III survey; Hammond *et al.,* 2021), indicates harbour porpoise

[3] *LGL (2010); EIRGRID (2014)*

to be the most common cetacean species present in the relevant survey block G (note that the OAA is within the SCANS-III Survey Block G, but is in close proximity to the border with Survey Block H (**Plate 2-1**)). Other cetacean species recorded in survey block G include bottlenose dolphin and minke whale.

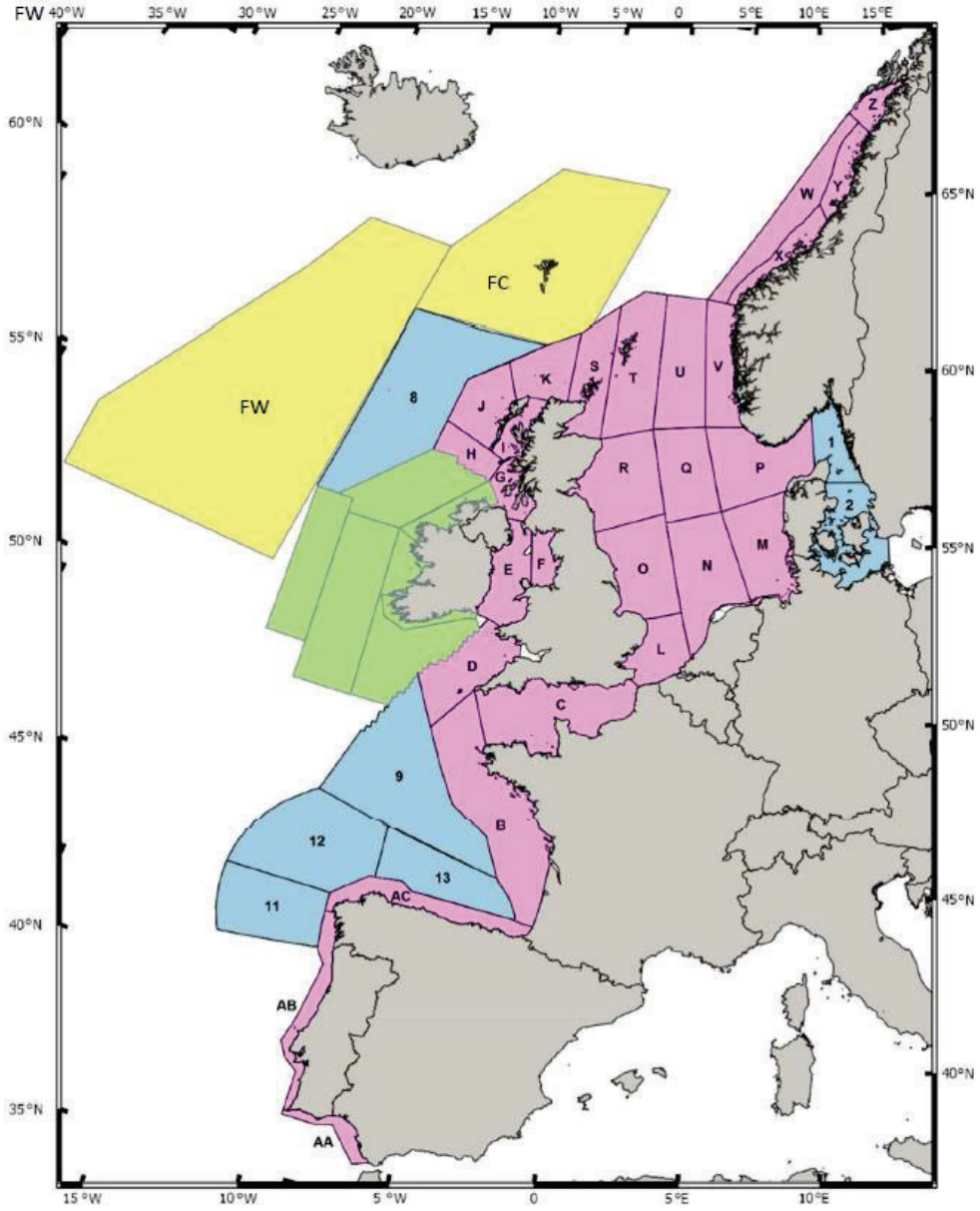

Plate 2-1 SCANS-III Survey blocks (Hammond et al., 2021)

Distribution maps of cetacean species within the north-east Atlantic also indicate that harbour porpoise is present off western Scotland in the highest densities, followed by bottlenose dolphin[4], short-beaked common dolphin and white-beaked dolphin while Risso's dolphin, Atlantic white-sided dolphin minke whale and killer whale are present but in lower densities (**Plate 2-2**; Waggitt *et al.,* 2019).

[4] *The density maps show the presence of offshore bottlenose dolphin only, and do not therefore include consideration of the resident populations around the UK and northern Europe coastlines.*

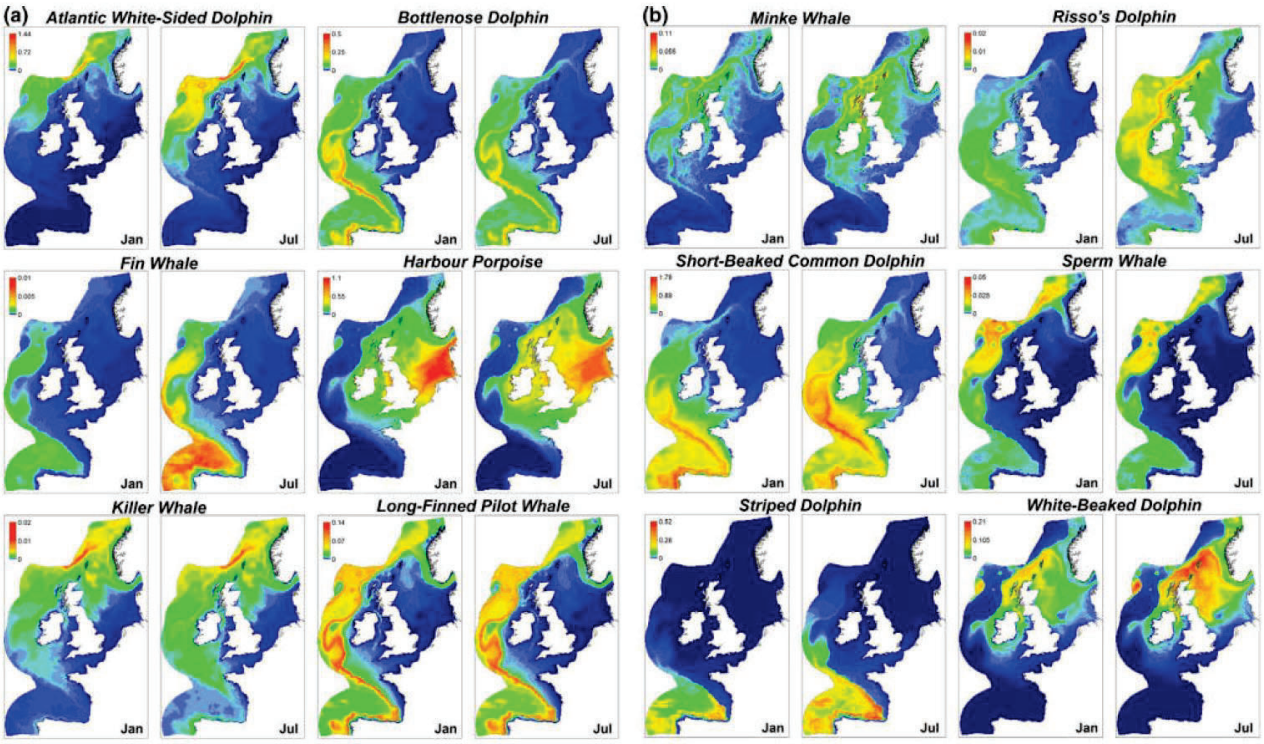

Plate 2-2 Modelled densities for marine mammal species (per km^2) in the north-east Atlantic (for January (a) and July (b). Note that the densities for bottlenose dolphin represent the offshore ecotype, and do not include for resident populations (Waggitt et al., 2019)

Based on the above, the cetacean species that could be present in and around the proposed survey areas include:

- harbour porpoise
- Atlantic white-sided dolphin
- bottlenose dolphin
- Risso's dolphin
- short beaked common dolphin
- white-beaked dolphin
- minke whale

Both bottlenose dolphin and harbour porpoise are listed on Annex II of the Habitats Directive which lists species whose conservation requires the designation of Special Areas of Conservation (SAC).

Management Units (MUs) provide an indication of the spatial scales at which any impact should be assessed for the key cetacean species (Inter-Agency Marine Mammal Working Group (IAMMWG), 2015). MUs, and the latest population estimate for each marine mammal species, have been determined based on the most relevant information, and scale at which potential impacts could occur.

For harbour porpoise, the relevant MU is the West Scotland (WS) MU, and for Atlantic white-sided dolphin, Risso's dolphin, short beaked common dolphin, white-beaked dolphin, and minke whale, there is just one MU that covers the north-east Atlantic; the Celtic and Greater North Seas (CGNS) MU (**Plate 2-3**; IAMMWG, 2021).

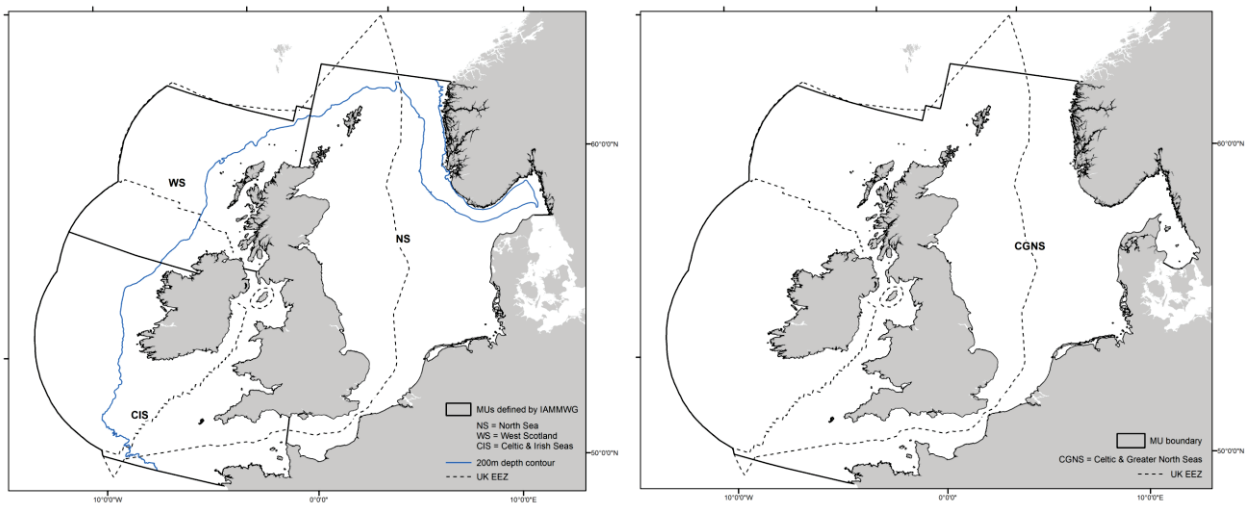

Plate 2-3 The MUs for harbour porpoise (left), and Atlantic white-sided dolphin, Risso's dolphin, short beaked common dolphin, white-beaked dolphin, and minke whale (right); IAMMWG, 2021

For bottlenose dolphin, there are seven MUs within the north-east Atlantic (**Plate 2-4**; IAMMWG, 2021). The OOA is within both the Offshore Waters (OW) and the Coastal West Scotland and Hebrides (CWSH) MU.

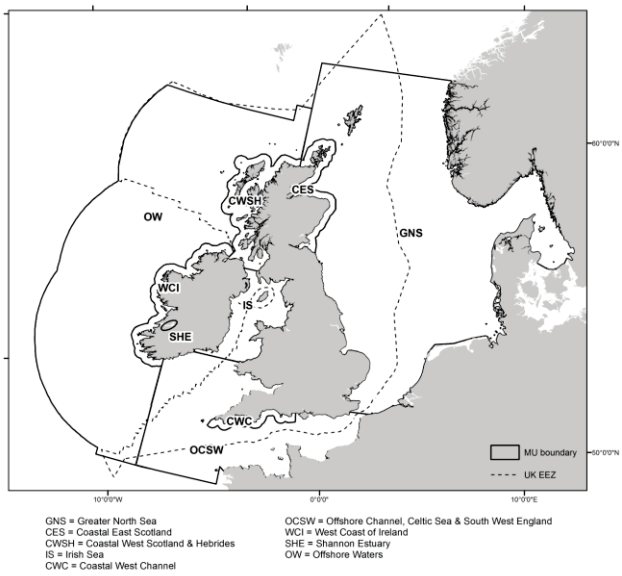

Plate 2-4 The MUs for bottlenose dolphin; IAMMWG, 2021

There are two eco-types of bottlenose dolphin present in Europe; the coastal type and the pelagic type, and that these types are genetically and ecologically different from each other (Louis *et al.,* 2014). The coastal eco-type can be further divided into specific coastal populations within Europe; the Coastal North population, containing populations from the UK and Ireland, and the Coastal South population, with individuals from Normandy and Galicia. To further investigate the demographic connectivity of the coastal populations, 425 samples from biopsies and strandings, from across the UK and north-west coasts of France and Spain, were tested and compared to establish where the coastal populations could be further split into smaller, and genetically separate populations (Nykänen *et al.,* 2019).

The results of this genetic analysis revealed that there are six clusters of bottlenose dolphin populations when considering both offshore and coastal individuals, and five clusters of genetically distinct coastal bottlenose dolphin populations in the UK and the north of continental Europe (**Plate 2-5**). **Plate 2-5** below shows that for the OAA, there is the potential for connectivity with the east and west Scotland, Wales, and Galicia areas (as shown by **Plate 2-5**; image a), as well as offshore Atlantic area (as shown by **Plate 2-5**, image e) (Nykänen *et al.,* 2019). This is line with the MUs of relevance for bottlenose dolphin, indicating that any individuals present within the OAA could be from either Scotland, or the wider offshore area.

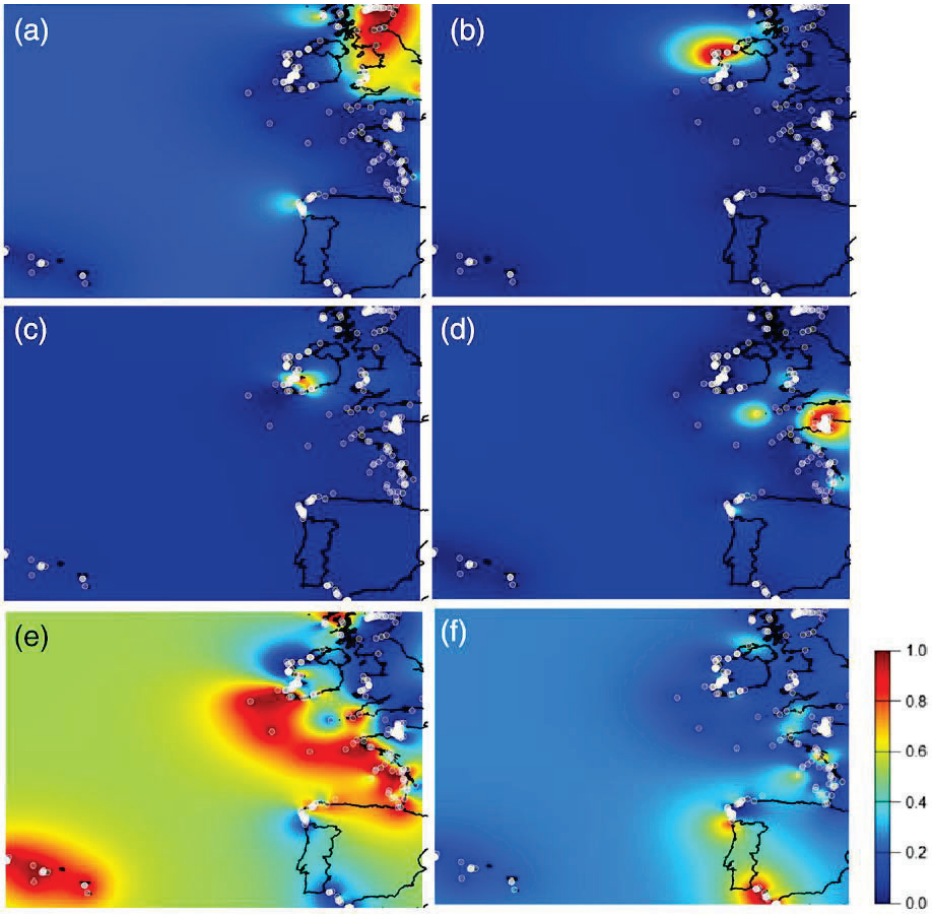

Plate 2-5 Probability of connectivity to genetically distinct bottlenose dolphin populations, based on both offshore and coastal eco-types (Nykänen et al., 2019)[5]

For the five coastal populations, there is the potential for individuals within the OAA to be from either the East and West Scotland, Wales and West Ireland, or from the wider Atlantic (**Plate 2-6** Probability of connectivity to genetically distinct bottlenose dolphin populations, based on the coastal eco-type only (Nykänen et al., 2019) maps a & b) to be present in the Machair OWF survey area. Of these five populations, the migrations rates from one population to another were found to be less than 1% in all possible movements, with the exception of between Wales / West Scotland and East Scotland (with a migration rate of 25.7%), and between Galicia and East Scotland (with a migration rate of 25.7%).

This indicates, that for the Machair OWF OAA survey area, any bottlenose dolphin present are most likely to be from the either the Coastal West Scotland and the Hebrides (CWSH) Management Unit (MU), or and

[5] *scale bar indicates the assignment probabilities: with red being a probability of 1 that individuals biopsied are from the relevant coastal population: (a) east and west Scotland, Wales and Galicia; (b) west Ireland; (c) Shannon estuary, Ireland; (d) English Channel, France; (e) pelagic Atlantic; and (f) Gibraltar–Cadiz (Nykänen et al., 2019)*

the wider Offshore Waters (OW) MU, so a combined reference population has been applied to the assessment.

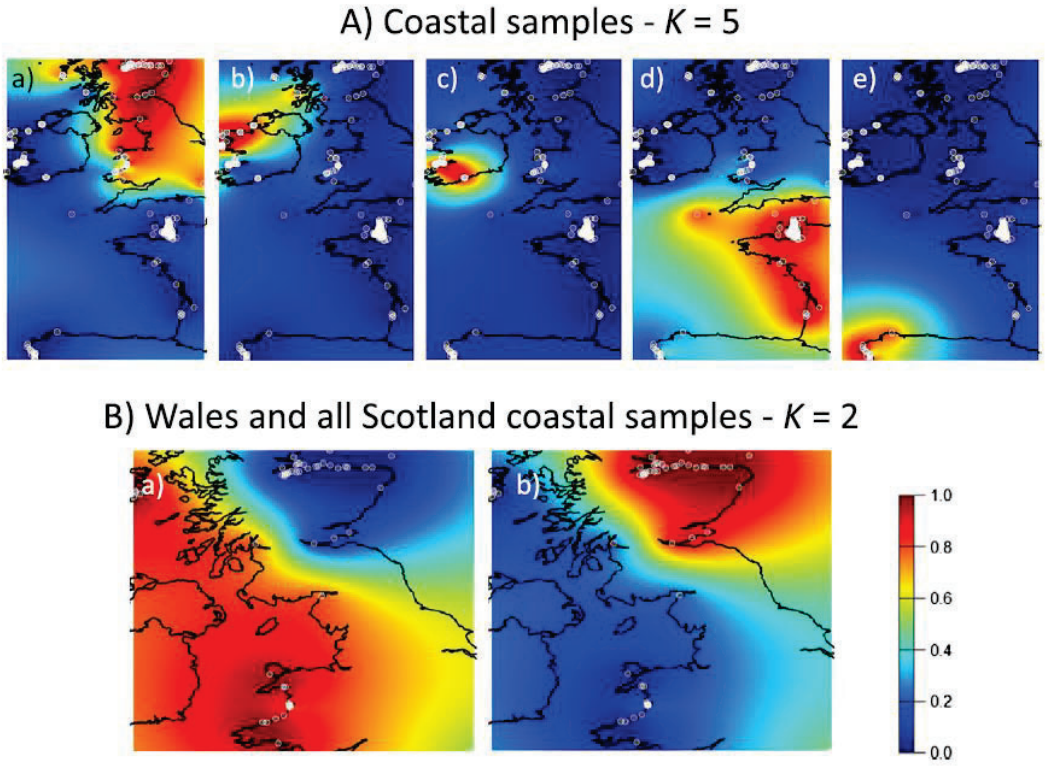

Plate 2-6 Probability of connectivity to genetically distinct bottlenose dolphin populations, based on the coastal eco-type only (Nykänen et al., 2019)[6]

2.1.1 Summary of Cetacean Species

Assessments have not been undertaken for cetacean species that are considered to be rare or infrequent in the area, as the potential for these cetacean species to be impacted is considered unlikely.

However, if individuals of other cetacean species (EPS species) were present in the area, then the mitigation measures, will be suitable for these species, as the assessments have been carried out on all the representative functional hearing groups for porpoise, dolphin and whale species. **Table 2.1** summarises the cetacean species, density estimates, and reference populations used in the assessments.

Table 2.1 Cetacean species, density estimates and reference populations

Species	Density Estimate	Reference Population
Harbour porpoise	0.461/km^2 (highest density across OAA (July) Waggitt *et al*., 2019)	WS MU = 28,936 (IAMMWG, 2021)
Atlantic white-sided dolphin	0.024/km^2 (highest density across OAA (July) Waggitt *et al*., 2019)	CGNS MU 18,128 (IAMMWG, 2021)
Bottlenose dolphin	0.1206/km^2 (SCANS-III Survey Block G; Hammond *et al*., 2021)	CWSH MU = 45 and OW MU = 70,249 (IAMMWG, 2021)

[6] *scale bar indicates the assignment probabilities: with red being a probability of 1 that individuals biopsied are from the relevant coastal population: (a) east and west Scotland, Wales and Galicia; (b) west Ireland; (c) Shannon estuary, Ireland; and (d) English Channel, France) (Nykänen et al., 2019)*

Species	Density Estimate	Reference Population
Risso's dolphin	0.005/km^2 (highest density across OAA (July) Waggitt *et al*., 2019)	CGNS MU = 12,262 (IAMMWG, 2021)
Short beaked common dolphin	0.178/km^2 (highest density across OAA (July) Waggitt *et al*., 2019)	CGNS MU = 102,656 (IAMMWG, 2021)
White-beaked dolphin	0.061/km^2 (highest density across OAA (July) Waggitt *et al*., 2019)	CGNS MU = 43,951 (IAMMWG, 2021)
Minke whale	0.032/km^2 (highest density across OAA (July) Waggitt *et al*., 2019)	CGNS MU = 20,118 (IAMMWG, 2021)

2.2 Other Protected Species

2.2.1 Basking Sharks

Within UK waters, the basking shark is a seasonal visitor, arriving in significant numbers in May and remaining until October, with areas attracting higher abundancies, such as the Hebrides (particularly off the islands of Skye and Mull), the Isle of Man, Malin Head, and south-west England. In the early spring and summer months, warmer waters move from the Atlantic into the coastal waters of west Scotland, England, and Wales, which encourages greater marine productivity. It is thought that this increase is the reason for the higher abundancies of basking sharks during these months (The Shark Trust, 2018).

The basking shark is an elasmobranch (sharks and rays) which is a group with generally low sensitivity to noise vibrations due to the fact they do not have a swim bladder (Popper *et al*., 2014; NatureScot, 2019). The hearing range of basking sharks is not known; however, five other elasmobranchs have been found to have a hearing range between 20 Hz to 1 kHz with greatest sensitivities at lower frequencies (Mickle *et al*., 2020). This may or may not be transferable to basking sharks (Macleod *et al.,* 2011). As 20 Hz - 1 kHz only encompass a small proportion of the noise emitted during the proposed site investigation surveys, and the activities will be intermittent, noise disturbance is not expected to impact basking sharks. On this basis, the potential for noise emissions to impact upon basking sharks is screened out of further assessment.

Vessel collision also poses a threat to this slow-moving species and basking sharks have a medium sensitivity to collision (NatureScot, 2019). Collision risk increases with increasing vessel speed; as the survey vessels will be moving slowly, collision risk is generally low. Risk will be reduced further on the basis of mitigation measures implemented for the survey (**Section 3.7**).

The NMPi (2022) reports basking sharks to be present in the MachairWind OWF OAA at a predicted density of 0.00-0.009 animals/km^2. The Shark Trust has recorded 99 sightings off the west coast of Scotland between 2003 – 2022, there is an estimated abundance of 112 individuals (Shark Trust, 2020).

2.2.2 Marine Turtles

Five species of marine turtle have been recorded in the UK, with the majority of sightings being of leatherback turtles *Dermochelys coriacea*, which is considered to be resident in UK waters (DECC, 2016). Other species of marine turtle are considered to be rare or vagrant within UK waters.

Leatherback turtles migrate through UK waters, in response to food distributions. Nesting locations are in the tropics and sub-tropics, and then individuals migrate north, some towards the European shelf, reaching

UK waters. Waters around the UK are at a temperature that reaches their lower limit, and the species are therefore only present in warmer summer months (specifically between June to October) (DECC, 2016).

Information on the hearing abilities and sensitivities of marine turtles is limited; however, initial auditory hearing studies have found that turtle species hear in the range of 100 Hz to 2,000 Hz (e.g., Ridgway *et al.,* 1969). Martin *et al.* (2012) measured underwater hearing abilities in loggerhead turtles *Caretta caretta and* found a behavioural sensitivity threshold of between 100 Hz and 400 Hz, at about 100dB re 1 µPa.

While there is a small likelihood of site investigation survey sound sources being within marine turtle hearing ranges, it is also unlikely that there would be any marine turtle in close proximity of the survey itself. In addition, the mitigation measures outlined in **Section 3.7** will ensure that there are no marine turtles present within the monitoring zone, prior to surveys commencing and it is not expected that there would be any significant risk to leatherback turtles from the proposed surveys. Therefore, the potential effects on marine turtles have not been assessed further.

2.2.3 Pinnipeds

Harbour seal (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) are common throughout UK waters. Although both species are Annex II species, they are not listed on Annex IV of the Habitats Directive, and as such are not classified as EPS. Seals are protected in the UK under the Conservation of Seals Act 1970. Both species are listed under Annex II of the EU Habitats Directive and are considered Scottish Priority Marine Features (PMFs). The Protection of Seals (Designated of Haul-Out Sites) (Scotland) Order 2014 introduces additional protection for seals at 194 designated haul-out sites, where harbour seal and grey seal come ashore to rest, moult or breed.

2.3 Designated Sites

Potential effects of the proposed surveys on designated sites are assessed in **Section 3.6**.

2.3.1 Special Areas of Conservation (SACs)

SACs are designated under Regulation 33(2) of the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland). Part II of the Habitats Regulations sets out the provisions for the selection of Special Areas of Conservation (SACs) for Annex I habitats and Annex II species. Key to the designation of SACs is Paragraph 7 (2), the relevant part of which states: "...*For aquatic species which range over wide areas, such sites will be proposed only where there is a clearly identifiable area representing the physical and biological factors essential to their life and reproduction*".

The Inner Hebrides and the Minches SAC

The closest harbour porpoise SAC is the Inner Hebrides and the Minches SAC, which is adjacent to the OAA. The Inner Hebrides and the Minches has been designated because of its importance to harbour porpoise year-round as it contains the highest density of harbour porpoise in Scotland (NatureScot, 2020a). It is the second largest Marine Protected Area (MPA) for harbour porpoise in Europe and the only one for harbour porpoise in Scotland and as such it provides protection to approximately 32% of the harbour porpoise population found on the west coast of Scotland.

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status (FCS) for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring the following:

1. To ensure that the Inner Hebrides and the Minches SAC continues to make an appropriate contribution to harbour porpoise remaining at favourable conservation status.

2. To ensure for harbour porpoise within the context of environmental changes, that the integrity of the Inner Hebrides and the Minches SAC is maintained through:
    a. Harbour porpoise within the Inner Hebrides and the Minches are not at significant risk from injury or killing.
    b. The distribution of harbour porpoise throughout the site is maintained by avoiding significant disturbance.
    c. The condition of supporting habitats and the availability of prey for harbour porpoise are maintained.

Treshnish Isles SAC

The Treshnish Isles SAC, which is located 33 km from the site and is a remote chain of uninhabited islands and skerries situated in south-west Scotland. The islands, numerous skerries, islets and reefs support a breeding colony of grey seals *Halichoerus grypus*, contributing just under 3% of annual UK pup production and has a population abundance of approximately 3,400 individuals (JNCC, 2015a). The conservation objectives for Treshnish Isles SAC are:

1. To avoid deterioration of the habitats of the qualifying species (grey seal) or significant disturbance to grey seal, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for grey seal; and

2. To ensure for the qualifying species that the following are maintained in the long term:
    a. Population of the species as a viable component of the site
    b. Distribution of the species within site
    c. Distribution and extent of habitats supporting the species
    d. Structure, function and supporting processes of habitats supporting the species
    e. No significant disturbance of the species

South-East Islay Skerries SAC

The skerries, islands and rugged coastline of the Inner Hebridean island of Islay hold a nationally-important population of the Harbour seal *Phoca vitulina*. The South-East Islay Skerries SAC is located 52km from the MachairWind OWF OAA and has a population abundance of between 501 – 1,000 individuals (JNCC, 2015b). The south-east coastline areas are extensively used as pupping, moulting and haul-out sites by the seals, which represent between 1.5% and 2% of the UK population.

1. To avoid deterioration of the habitats of the qualifying species (harbour seal) or significant disturbance to grey seal, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for grey seal; and

2. To ensure for the qualifying species that the following are maintained in the long term:
    a. Population of the species as a viable component of the site
    b. Distribution of the species within site
    c. Distribution and extent of habitats supporting the species
    d. Structure, function and supporting processes of habitats supporting the species
    e. No significant disturbance of the species

2.3.2 Nature Conservation Marine Protected Area (NCMPA)

Under Section 82 of the Marine (Scotland) Act 2010, MS-LOT is required to consider whether a licensable activity is capable of affecting (other than insignificantly) a protected feature in a Nature Conservation Marine Protected Area (NCMPA), or any ecological or geomorphological process on which the conservation of any protected feature in an NCMPA is dependent. If MS-LOT determine there is or may be a significant risk of

a project hindering the achievement of the conservation objectives, then they must notify the relevant conservation bodies. It is an offence to intentionally or recklessly kill, remove, damage, or destroy any protected feature of an NCMPA. Marine Scotland must be sure that consenting/licensing decisions do not cause a significant risk to the conservation objectives of any NCMPA.

2.3.3 The Sea of the Hebrides NCMPA

The Sea of the Hebrides NCMPA is proposed to protect basking sharks, minke whales, fronts and geodiversity features. Basking sharks are considered to be most sensitive to collision with vessels, and somewhat sensitive to entanglement in fishing gear and disturbance from underwater noise. Minke whales are sensitive to underwater noise (leading to disturbance and possibly injury), entanglement in fishing gear and collision with vessels. NatureScot also note the importance of sandeels as prey species of minke whales within the site[7].

NatureScot (2020b) advises that, in order to conserve basking sharks and minke whales, risk of injury and death should be minimised, access to resources within the site should be maintained, and supporting features should also be conserved.

2.3.4 Designated Seal Haul-Out Sites

Seal haul-out sites are coastal locations that seals use to breed, moult and rest. Almost 200 seal haul-out sites have been designated through The Protection of Seals (Designation of Haul-Out Sites) (Scotland) Order 2014 which was amended with additional sites in 2017. These haul-out sites are protected under Section 117 of the Marine (Scotland) Act 2010. The Act is designed to assist in protecting the seals when they are at their most vulnerable, and as such provide additional protection from intentional or reckless harassment.

The MachairWind OWF OAA site is within 7.5 km of three small harbour seal haul-out sites and 26.5 km from the Outer Loch Tarbert harbour seal site, a medium sized site. The MachairWind OWF OAA site is also within 7.5 km of two relatively large grey seal haul-out sites: Eilean nan Ron and Nave Island. There are also a large number of harbour seal haul-out sites along the coast of the mainland.

3 European Protected Species Stage 1 Risk Assessment

3.1 Potential Impacts

Potential impacts to cetaceans during site investigation surveys are:

- permanent change in hearing sensitivity / auditory injury (Permanent Threshold Shift (PTS)) from underwater noise;
- disturbance from underwater noise;
- disturbance from presence of vessels; and
- increased collision risk with vessels.

Underwater noise has the potential to impact cetaceans if the frequency is within their hearing range (**Table 3.1**) and / or the sound levels are greater than thresholds for the species (**Table 3.2**) (Southall *et al*., 2019).

Table 3.1 Cetacean and turtle hearing ranges (from Southall et al., 2019; Mickle et al., 2020 and Ridgway et al., 1969)

Species Hearing Group	Generalised Hearing Range

[7] *https://www.nature.scot/sites/default/files/2017-11/Marine%20Protected%20Area%20-%20Data%20confidence%20assessment%20-%20Sea%20of%20the%20Hebrides%20MPA%20proposal.pdf*

Harbour porpoise Very high-frequency cetaceans (VHF)	275 Hz to 160 kHz
Common dolphin and bottlenose dolphin High-frequency cetaceans (HF)	150 Hz to 160 kHz
Minke whale Low-frequency cetaceans (LF)	7 Hz to 35 kHz
Basking shark	20 Hz to 1 kHz
Leatherback turtle	100 Hz to 2 kHz

Table 3.2 Cetacean threshold and criteria for underwater noise (from Southall et al., 2019)

Species Hearing Group	Unweighted SPL_{peak} (dB re 1 µPa)		Weighted SEL_{cum} (dB re 1 μPa^2s)			
	Impulsive		Impulsive		Non-impulsive	
	PTS	TTS	PTS	TTS	PTS	TTS
Harbour porpoise Very high-frequency cetaceans (VHF)	202	196	155	140	173	153
Dolphin species High-frequency cetaceans (HF)	230	224	185	170	198	178
Minke whale Low-frequency cetaceans (LF)	219	213	183	168	199	179

The potential for auditory injury is not just related to the level of the underwater sound and its frequency relative to the hearing bandwidth of the animal but is also influenced by the duration of exposure. Southall *et al*. (2019) gives individual criteria based on whether the noise source is considered impulsive or non-impulsive. Southall *et al*. (2019) categorises impulsive noises as having high peak sound pressure, short duration, fast rise-time and broad frequency content at source, and non-impulsive sources as steady-state noise. Seismic airguns are considered impulsive noise sources. Sonars, vessels and other low-level continuous noises are considered non-impulsive. A non-impulsive noise does not necessarily have to have a long duration.

Southall *et al*. (2019) presents single strike, unweighted peak criteria for Sound Pressure Level (SPL) (SPL_{peak}) and cumulative (i.e. more than a single sound impulse) weighted Sound Exposure Level (SEL) criteria (SEL_{cum}) for both permanent threshold shift (PTS), where unrecoverable hearing damage may occur, and temporary threshold shift (TTS), where a temporary reduction in hearing sensitivity may occur in individual receptors (**Table 3.2**).

There is currently no agreed thresholds and criteria for disturbance from underwater noise. However, unweighted impulsive single-strike criteria from Lucke *et al*. (2009) for behavioural response in harbour porpoise, based on impulsive seismic airgun stimuli, is:

- 145dB re 1 μPa^2s (SEL_{ss})

Table 3.3 summarises the potential impact to marine mammals from the different types of survey equipment, taking into account frequency range and sound levels.

JNCC *et al*. (2010) assessed MBES system to have the potential to emit sound sources of up to 248 dB re 1µPa @1m, with frequencies of between 10 kHz and 200 kHz; the proposed equipment for the survey has a dual operating range of 200 kHz to 400 kHz. Due to the high amplitude of MBES, there is the potential for auditory injury to marine mammal species, however this is highly unlikely as an animal would need to be within very close proximity of the source.

It is also unlikely that the MBES could cause disturbance when active for a short period due to the operating frequencies being outside the audible range of all marine mammals (JNCC *et al*., 2010). MBES surveys that are carried out in waters of less than 200 m in depth are not considered to be a risk to marine mammals, as it is thought that the higher frequencies typically used fall outside of their hearing ranges, and the sounds are likely to attenuate quickly due to the high frequencies used. JNCC therefore advise that mitigation is unlikely to be required for MBES surveys in shallow (less than 200 m water depth) surveys (JNCC, 2017).

Similarly, the high frequency of the SSS falls outside of the hearing ranges for marine mammals the proposed survey SSS operates between 210-890 kHz, and the sounds are likely to attenuate quickly due to the high frequencies used. Therefore, as for the MBES, mitigation in shallow waters (less than 200 m) is not required.

Depending on the type of equipment, the SBP that can operate on frequencies between 3.5 kHz and 7 kHz (for pingers) and 0.5 kHz and 5 kHz (for boomers), with recorded amplitudes of up to 209 dB re 1 Pa RMS @ 1m (JNCC *et al.,* 2010). Frequency ranges of the SBP used in the survey (0.5 – 15 kHz) can be within cetacean hearing range and will therefore be audible to cetacean species that could be present in the area. There is therefore the potential for disturbance impacts to occur. Most of the sound energy generated by the SBP equipment will be directed towards the seabed and the pulse duration is extremely short, with the continuous movement of the survey. Auditory injury effects are not predicted, as an animal would need to remain in the very small zone of ensonification for a prolonged period, which is highly unlikely (JNCC *et al.,* 2010).

SBP has been assessed as worst-case for cetacean impacts from site investigation survey equipment.

None of the equipment used will involve seismic airguns.

Table 3.3 Summary of potential impacts to cetacean species from site investigation survey equipment

Equipment	Potential Impacts to Cetacean Species	Assessed Further
SBP	For the proposed surveys the SBP could have a frequency of 2 - 22 kHz, depending on the band selected. The SBP frequency ranges are within cetacean hearing range and will therefore be audible to the marine mammal species that could be present in the area.	**Yes** Potential risk of PTS assessed further. Potential disturbance assessed further.
USBL	For the proposed surveys the USBL operating frequency would be typically 21~31 kHz. The USBL also has operating frequencies within marine mammal hearing range.	There is the potential for injury and disturbance impact, however SBP assessed as worst-case for marine mammal impacts.

Equipment	Potential Impacts to Cetacean Species	Assessed Further
MBES	The MBES system will be hull mounted and emit a sound source of 200 kHz and 400 kHz, with a SEL of 175 dB re 1 μPa^2s and a SPL peak of 215 dB re 1 µPa. The frequencies used by MBES are generally very high and outside of the main hearing range of cetacean species.	As the equipment is outside main hearing range of cetacean, no further assessment required.
SSS	A SSS may be utilised for all elements of the work, with a likely frequency range of 210 kHz and 890 kHz. The frequencies used by SSS are generally very high and outside of the main hearing range of cetacean species.	As the equipment is outside main hearing range of cetacean no further assessment required.
UHR	For the proposed surveys the UHR has an operating frequency of 0.5 - 4 kHz. The UHR has operating frequencies within marine mammal hearing range.	There is the potential for injury and disturbance impact, however SBP assessed as worst-case for marine mammal impacts.
Magnetometer	Magnetometers do not emit noise as a part of their normal functioning, so there is no possibility of injury or disturbance.	No
Grab Samples	Grab samples do not emit noise as a part of their normal functioning, so there is no possibility of injury or disturbance.	No
DDV	DDV do not emit noise as a part of their normal functioning, so there is no possibility of injury or disturbance.	No
Borehole sampling	Low frequency has potential to be within hearing range of minke whale; however, noise levels are not sufficient to cause permanent auditory injury.	There is the potential for temporary injury and disturbance impact, however SBP assessed as worst-case for marine mammal impacts.
P-S wave logging	Low frequency acoustic probe which can be lowered into a hole in the seabed, and measures compression and pressure wave velocity every metre. Noise is emitted into the hole itself, at depth; therefore, limited potential for underwater noise attenuation from the source.	No
Seismic CPT	Low frequency has potential to be within hearing range of minke whale; however, noise levels are not sufficient to cause permanent auditory injury.	There is the potential for temporary injury and disturbance impact, however SBP assessed as worst-case for marine mammal impacts.
Survey vessels	Source levels are likely to be too low to result in PTS or TTS, however, they will be audible to most species, and thus have the potential to result in disturbance. Increase in number of vessels on site and transits to and from survey area could increase collision risk.	Potential for disturbance from underwater noise and presence of vessels. Potential for increased collision risk.

3.2 Assessment of potential effects of survey equipment on EPS

The Review of Consents (RoC) Habitats Regulations Assessment (HRA) for the Southern North Sea (SNS) Special Area of Conservation (SAC) (BEIS, 2020) undertook underwater noise modelling to determine the potential impact ranges of site investigation surveys for harbour porpoise.

For this, the assessment used the maximum source levels that could be expected from geophysical equipment: SBP[8], with a maximum source noise level of 267 dB re 1 µPa-m. The noise modelling indicates that the permanent loss of hearing sensitivity (PTS) in harbour porpoise could occur within a maximum of 23 m (an area of 0.0017 km^2) from the source location (BEIS, 2020). This is based on the PTS cumulative threshold of 155 dB SEL weighted (**Table 3.2**; Southall *et al.*, 2019).

The modelling for BEIS (2020) predicted a maximum impact range of 3.77 km (44.65 km^2) for possible behavioural disturbance of harbour porpoise, based on a threshold of 140 dB re 1 µPa SPL unweighted (BEIS, 2020).

As harbour porpoise have the lowest auditory injury thresholds, PTS impact ranges for all other species are expected to be less than 23 m from the source. In addition, most of the sound energy generated by the SBP equipment will be directed towards the seabed and the pulse duration is extremely short, further limiting the potential for PTS.

The current guidance for assessing the significance of underwater noise disturbance in relation to SACs designated for harbour porpoise (JNCC *et al.*, 2020), recommends the use of an Effective Deterrence Radius (EDR) of 5 km for geophysical surveys. As a highly conservative worst-case approach, a disturbance range of 5 km (an area of 78.53 km^2) has been used to determine the potential disturbance for other cetacean species.

The SBP proposed for the survey include the hull mounted Innomar SES 2000 with an operating frequency of 8.5 – 11.5 kHz and a DuraSpark 400 UHD operating at 0.5 - 4 kHz. Scottish and Southern Energy (2020) undertook noise modelling results for injury impacts from impulsive noise sources including the Innomar SES 2000. The worst case operating SPL_{Peak} was modelled as 445 m for VHF cetaceans when operating at 4 kHz.

For site investigation surveys with SBP, it is realistic and appropriate to base the assessments on the potential impact area around the vessel, as the potential risk of PTS and disturbance would be around the vessel at any one time. Marine mammals would not be at risk throughout the entire area surveyed in a day, as animals would return once the vessel had passed, and the disturbance had ceased.

In the BEIS (2020) RoC HRA, it was estimated that in the unlikely event that an SBP is used continuously over a period of 24 hours with a vessel speed of 7.4 km/h (4 knots) a total area of approximately 256 km^2 per day could be affected (BEIS, 2020). However, as outlined in the RoC HRA (BEIS, 2020), this is a highly precautionary scenario as it is very unlikely that a SBP would be undertaken along a single transect line of 178 km in a single day. The current survey plan indicates that a vessel is expected to cover a transect length of 120 km per day.

Table 3.4 presents a summary of the desk-based review of potential impact ranges for SBP, as potential worst-case for proposed site investigation surveys. The presented case studies were chosen as they were the most comparable in environmental characteristics to the MachairWind project.

[8] *based on a threshold of 140 dB re 1 µPa SPL unweighted*

Table 3.4 Summary of the desk-based review of potential impact ranges for SBP

Equipment	Species	Potential effect	Threshold (and source)	Reported range of effect	Reference
Sub bottom profiler	Harbour porpoise	PTS onset	155 SEL_{cum} dB re 1 µPa (NMFS, 2018)	23 m	BEIS (2020)
		Behavioural	140 SPL_{RMS} dB re 1 µPa unweighted; (NMFS, 2018)	3.77 km	
Sub bottom profiler (220 dB re 1 µPa @ 1m peak)	Harbour porpoise	PTS	Not reported	32 m	Neart na Gaiothe Offshore Wind (2019)
	Dolphin species	PTS	Not reported	0 m	
	Whale species	PTS	Not reported	5 m	
	Cetaceans	Disturbance	Not reported	1.5 km	
Sub bottom profiler (215 SPL_{peak} dB)	Dolphin species	PTS	230dB_{peak} / 185dB SEL_{cum} (NMFS, 2018)	0 m	Wieting (2019)
	Whale species	PTS	219dB_{peak}, 183dB SEL_{cum} (NMFS, 2018)	<1 m	
	Harbour porpoise	PTS	202dB_{peak} / 155dB SEL_{cum} (NMFS, 2018)	<3 m	
Sub bottom profiler (4kHz) (235 SPL_{peak} dB 1µPa)	Harbour porpoise	PTS	230dB_{peak} / 185dB SEL_{cum} (Southall *et al.,* 2019)	445 m	Scottish and Southern Energy (2020)
	Dolphin species	PTS	219dB_{peak}, 183dB SEL_{cum} (Southall *et al.,* 2019)	98 m	
	Whale species	PTS	202dB_{peak} / 155dB SEL_{cum} (Southall *et al.,* 2019)	178 m	
	Cetaceans	Disturbance	Not reported	3.12 km	

3.2.1 PTS

Table 3.5 presents the PTS impact range and areas used in the assessments, based on the worst-case for SBP (**Table 3.4**).

Table 3.5 PTS impact ranges for SBP used in assessments

Potential Impact	Species	Predicted maximum impact range	Maximum predicted area of potential impact – one vessel	Maximum predicted area of potential impact – two vessels	Maximum predicted area of potential impact – three vessels
PTS	Harbour porpoise	445 m	0.62 km^2	1.24 km^2	1.86 km^2
	Dolphin species	98 m	0.03 km^2	0.06 km^2	0.09 km^2
	Whale species	178 m	0.10 km^2	0.20 km^2	0.30 km^2

Table 3.6 summarises the PTS assessment for cetaceans, based on worst case for SBP, for one, two or three vessels to be undertaking activities at the same time.

Table 3.6 PTS assessment for cetaceans

Potential Impact	Species	Maximum number of individuals (% of ref pop) – one vessel	Maximum number of individuals (% of ref pop) – two vessels	Maximum number of individuals (% of ref pop) – three vessels
PTS	Harbour porpoise	0.29 (0.00099% WS MU)	0.57 (0.002% WS MU)	0.86 (0.003% WS MU)
	Atlantic white-sided dolphin	0.0007 (0.000004% CGNS MU)	0.0014 (0.000008% CGNS MU)	0.002 (0.00001% CGNS MU)
	Bottlenose dolphin	0.004 (0.000005% CWSH & OW MU combined)	0.0072 (0.00001% CWSH & OW MU combined)	0.011 (0.000015% CWSH & OW MU combined)
	Risso's dolphin	0.0002 (0.000001% CGNS MU)	0.0003 (0.000002% CGNS MU)	0.0005 (0.000004% CGNS MU)
	Short beaked common dolphin	0.0053 (0.000005% CGNS MU)	0.011 (0.00001% CGNS MU)	0.016 (0.000016% CGNS MU)
	White-beaked dolphin	0.018 (0.00004% CGNS MU)	0.037 (0.00008% CGNS MU)	0.055 (0.0001% CGNS MU)
	Minke whale	0.003 (0.00002% CGNS MU)	0.006 (0.00003% CGNS MU)	0.01 (0.00005% CGNS MU)

The implementation of the mitigation measures outlined in **Section 3.7** dramatically reduce the risk of injury to animals as a result of SBP operations (assessed as the worst case survey equipment). Accordingly, the noise-emission characteristics of the SBP, coupled with the mitigation strategies, preclude the potential to commit an offence with regards to injury or to affect the FCS of any cetacean species and, therefore, there is no requirement for a Marine EPS licence.

3.2.2 Disturbance from underwater noise from the site investigation surveys

Table 3.7 presents the predicted disturbance impact range and areas, based on the worst-case for SBP (**Table 3.4**).

Table 3.7 Predicted disturbance impact ranges for SBP

Potential Impact	Species	Predicted maximum impact range	Maximum predicted area of potential impact – one vessel	Maximum predicted area of potential impact – two vessels	Maximum predicted area of potential impact – three vessels
Disturbance	Harbour porpoise	3.77 km	44.65 km^2	89.3 km^2	133.95 km^2
	Other cetaceans	3.12 km	30.58 km^2	61.16 km^2	91.74 km^2

Table 3.8 summarises the disturbance assessment for cetaceans, based on worst case for SBP, for one, two, or and three vessels operating at the same time.

Table 3.8 Disturbance assessment for cetaceans

Potential Impact	Species	Maximum number of individuals (% of ref pop) – one vessel	Maximum number of individuals (% of ref pop) – two vessels	Maximum number of individuals (% of ref pop) – three vessels
Disturbance	Harbour porpoise	20.6 (0.071% WS MU)	41.2 (0.142% WS MU)	61.8 (0.21% WS MU)
	Atlantic white-sided dolphin	0.73 (0.004% CGNS MU)	1.5 (0.008% CGNS MU)	2.2 (0.012% CGNS MU)
	Bottlenose dolphin	3.7 (0.005% CWSH & OW MU combined)	7.4 (0.01% CWSH & OW MU combined)	11.1 (0.016% CWSH & OW MU combined)
	Risso's dolphin	0.15 (0.001% CGNS MU)	0.31 (0.0025% CGNS MU)	0.46 (0.004% CGNS MU)
	Short beaked common dolphin	5.4 (0.005% CGNS MU)	10.9 (0.011% CGNS MU)	16.3 (0.016% CGNS MU)
	White-beaked dolphin	18.7 (0.042% CGNS MU)	37.3 (0.085% CGNS MU)	56.0 (0.12% CGNS MU)
	Minke whale	0.98 (0.0049% CGNS MU)	1.96 (0.0097% CGNS MU)	2.9 (0.015% CGNS MU)

Any disturbance would be temporary and marine mammals would be expected to return to the area once the vessel(s) had passed and the noise source ceased. It is possible that a small number of individual animals may experience some level of disturbance while they encounter noise emissions. As such, a Marine EPS Licence is required for activities within 12 nautical miles (as per Regulation 39(2)). Potential disturbance impacts will be minimised with the implementation of mitigation measures set out in **Section 3.7**.

3.2.3 Disturbance based on 5 km EDR for geophysical surveys

Table 3.9 presents the disturbance impact areas, based on 5 km EDR for one, two and three vessels.

Table 3.9 Disturbance areas based on 5km EDR

Potential Impact	Species	Predicted maximum impact range	Maximum predicted area of potential impact – one vessel	Maximum predicted area of potential impact – two vessels	Maximum predicted area of potential impact – three vessels
Disturbance (5 km EDR)	All	5km	78.54km^2	157.08km^2	235.62km^2

Table 3.10 summarises the disturbance assessment for cetaceans, based on 5km EDR and either on, two, or three vessels.

Table 3.10 Disturbance assessment for cetacean species based on 5 km EDR

Potential Impact	Species	Maximum number of individuals (% of ref pop) – one vessel	Maximum number of individuals (% of ref pop) – two vessels	Maximum number of individuals (% of ref pop) – three vessels
Disturbance (5km EDR)	Harbour porpoise	36.2 (0.125% WS MU)	72.4 (0.25% WS MU)	108.6 (0.375% WS MU)
	Atlantic white-sided dolphin	1.89 (0.010% CGNS MU)	3.8 (0.021% CGNS MU)	5.7 (0.031% CGNS MU)
	Bottlenose dolphin	9.47 (0.013% CWSH & OW MU combined)	18.9 (0.027% CWSH & OW MU combined)	28.4 (0.04% CWSH & OW MU combined)
	Risso's dolphin	0.39 (0.003% CGNS MU)	0.79 (0.006% CGNS MU)	1.18 (0.01% CGNS MU)
	Short beaked common dolphin	14.0 (0.014% CGNS MU)	28.0 (0.027% CGNS MU)	41.9 (0.041% CGNS MU)
	White-beaked dolphin	47.9 (0.109% CGNS MU)	95.8 (0.218% CGNS MU)	143.7 (0.327% CGNS MU)
	Minke whale	2.5 (0.012% CGNS MU)	5.0 (0.025% CGNS MU)	7.5 (0.037% CGNS MU)

Any disturbance would be temporary and marine mammals would be expected to return to the area once the vessel(s) had passed and the noise source ceased. It is possible that a small number of individual animals may experience some level of disturbance while they encounter noise emissions. As such, a Marine EPS Licence is required for activities within 12 nm (as per Regulation 39(2)). Potential disturbance impacts will be minimised with the implementation of mitigation measures set out in **Section 3.7**.

3.2.4 Disturbance from daily survey area based on BEIS (2020)

Table 3.11 presents the disturbance from daily survey area based on BEIS (2020) and either one, two, or three vessels.

Table 3.11 Disturbance from daily survey area based BEIS (2020)

Potential Impact	Species	Maximum predicted area of potential impact – one vessel	Maximum predicted area of potential impact – two vessels	Maximum predicted area of potential impact – three vessels
Daily survey area (BEIS, 2020)	All	256 km^2	512 km^2	768 km^2

Table 3.12 summarises the disturbance assessment for cetaceans, based on BEIS (2020) daily survey area and up to three vessels.

Table 3.12 Disturbance assessment to cetaceans based on BEIS (2020) daily survey area

Potential Impact	Species	Maximum number of individuals (% of ref pop) – one vessel	Maximum number of individuals (% of ref pop) – two vessels	Maximum number of individuals (% of ref pop) – three vessels
Daily survey area (BEIS, 2020)	Harbour porpoise	118.0 (0.408% WS MU)	236.0 (0.816% WS MU)	354.0 (1.22% WS MU)
	Atlantic white-sided dolphin	6.1 (0.034% CGNS MU)	12.3 (0.068% CGNS MU)	18.4 (0.102% CGNS MU)
	Bottlenose dolphin	30.9 (0.044% CWSH & OW MU combined)	61.8 (0.088% CWSH & OW MU combined)	92.6 (0.132% CWSH & OW MU combined)
	Risso's dolphin	1.3 (0.010% CGNS MU)	2.6 (0.021% CGNS MU)	3.8 (0.031% CGNS MU)
	Short beaked common dolphin	45.6 (0.044% CGNS MU)	91.1 (0.089% CGNS MU)	136.7 (0.133% CGNS MU)
	White-beaked dolphin	156.2 (0.355% CGNS MU)	312.3 (0.711% CGNS MU)	468.5 (1.07% CGNS MU)
	Minke whale	8.2 (0.041% CGNS MU)	16.4 (0.081% CGNS MU)	24.6 (0.122% CGNS MU)

Any disturbance would be temporary and marine mammals would be expected to return to the area once the vessel(s) had passed and the noise source ceased. It is possible that a small number of individual animals may experience some level of disturbance while they encounter noise emissions. As such, a Marine EPS Licence is required for activities within 12 nm (as per Regulation 39(2)). Potential disturbance impacts will be minimised with the implementation of mitigation measures set out in **Section 3.7**.

3.3 Disturbance from underwater noise and presence of vessels

Any disturbance from underwater noise and presence of vessels would be less than the potential disturbance areas assessed for the site investigation surveys. Although noise levels from vessels are highly unlikely to cause physical or auditory injury, they could be sufficient to cause local disturbance to sensitive marine mammals in the immediate vicinity of 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.

The distance at which animals may react to vessels is difficult to predict. Behavioural responses can vary a great deal depending on context and data specific to harbour porpoise are limited. According to Thomsen *et al*. (2006), harbour porpoise might be expected to respond to vessels of this type at approximately 400 m (Moray West, 2018).

While the predicted source levels associated with the survey vessels have the potential to elicit a behavioural response in cetacean species, the vessel noise would need to be emitted over an extended period to cause a significant disturbance offence as defined under the Regulations 39(1) or 39(2). As the survey vessels will not be stationary, animals within a particular area will not be exposed to extended periods of noise from the vessels.

Any disturbance would be temporary and marine mammals would be expected to return to the area once the vessel(s) had passed and the noise source ceased. As such, vessel noise is not anticipated to negatively impact upon the FCS of any EPS.

3.4 Increased collision risk with vessels

Any increased collision risk with vessels is unlikely, as vessels would be relatively slow moving and maintaining a fixed route during the surveys. Therefore, giving any marine mammals ample opportunity to detect and avoid the vessels. With regard to collision risk, Laist *et al*. (2001) predicted that the most severe injuries from collision with vessels travelling at over 14 knots, and Vanderlaan and Taggart (2007) predicted that the probability of lethal injury of a large whale species (North Atlantic right whale) decreases from 0.79 at speeds of 15 knots to 0.21 at 8.6 knots. Given that the vessels involved in the site investigation surveys will be moving along defined survey routes at a very slow speed of 4 knots, the potential for collisions to occur is negligible. It is also noted that non-lethal collision has been reported by Van Waerebeek *et al.* (2007), suggesting if collisions do occur between vessels and marine mammals these are not necessarily always fatal.

Vessels movements to and from the port would be on established shipping routes. The vessels required for the surveys would be a very small proportion of current vessel activity in and around the survey areas and routes to and from port.

Due to the low density of basking shark within the MachairWind OWF OAA survey area it is predicted that less than eight individuals (7.79; based on the highest density across the OAA of 0.009 animals/km^2 (NMPi, 2022) at the OOA survey area plus buffer (total area of 865 km^2)). Potential collision risk for basking sharks will be limited by the slow vessel speed and the use of mitigation outlined in **Section 3.7.**

Given that there is predicted to be no risk of injury to any species of cetacean or to basking shark as a result of collision risk, there is no potential to commit an offence with regards injury. There will, therefore, be no impact on the FCS of any species. As such, there is no offence and therefore no requirement for a Marine EPS licence in this respect.

3.5 Cumulative Impact Assessment (CIA)

For wide ranging species such as marine mammals and basking sharks, it is important to consider other projects and activities over a wider area. Taking into account the potential impacts associated with the proposed site investigation surveys (**Section 3.1**), this has been based on the Scottish west coast area.

Based on currently available information, there is very little information on activities and projects in the Scottish west coast area that could have potential cumulative impacts with the proposed site investigation survey. However, as a precautionary approach it has been assumed that there could be the potential for up to two site investigation surveys at other sites off the Scottish west coast area (

Table 3.13).

For temporary impacts, such as underwater noise disturbance, the impact to the overall population is considered to be negligible (no potential for a significant effect on the overall population) if less than 1% of the reference population anticipated to be exposed to effect.

Taking into account that cetacean species are not as sensitive to disturbance impacts as they are to the potential for injury, and that they would not be permanently disturbed from any area (as the impact is temporary and individuals will return to the area once the relevant activity has ceased), and that less than 1% of the populations may be impacted, as assessed in

Table 3.13, the overall conclusion is that there would be no potential for a population level impact to harbour porpoise, Atlantic white-sided dolphin, bottlenose dolphin, Risso's dolphin, short beaked common dolphin, white-beaked dolphin and minke whale.

As noted above, the cumulative assessment indicates no significant disturbance of cetaceans at a population level. It is possible that a small number of individual animals may experience some level of disturbance while they encounter noise emissions. The characterisation of effects as presented in this report has identified that the potential for impact will be highly localised and short term in nature, and not result in significant effects. The potential for the proposed site investigation survey works contributing to cumulative impacts is, therefore, highly unlikely. 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. As such, a Marine EPS Licence is required for activities within 12 nm (as per Regulation 39(2)). Potential disturbance impacts will be minimised with the implementation of mitigation measures set out in **Section 3.7**.

Based on the assumption that all the planned projects and activities with the potential for injury will have mitigation in place, which is similar to or more extensive than the measures being undertaken for the proposed site investigation surveys, no EPS will be at risk of injury from these activities.

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Table 3.13 Potential for Cumulative Impacts

Cumulative impacts	Potential area of impact	Number of harbour porpoise (% of reference population)	Number of Atlantic white-sided dolphin (% of reference population)	Number of bottlenose dolphin (% of reference population)	Number of Risso's dolphin (% of reference population)	Number of common dolphin (% of reference population)	Number of white-beaked dolphin (% of reference population)	Number of minke whale (% of reference population)
Proposed surveys (5km EDR and three vessels)	235.62 km^2	108.6 (0.375% WS MU)	5.7 (0.031% CGNS MU)	28.4 (0.04% CWSH & OW MU combined)	1.18 (0.01% CGNS MU)	41.9 (0.041% CGNS MU)	143.7 (0.327% CGNS MU)	7.5 (0.037% CGNS MU)
Up to two geophysical surveys undertaken at the same time (5km EDR)	157.08 km^2	72.4 (0.250% WS MU)	3.8 (0.021% CGNS MU)	18.9 (0.027% CWSH & OW MU combined)	0.79 (0.006% CGNS MU)	28.0 (0.027% CGNS MU)	95.8 (0.218% CGNS MU)	5.0 (0.025% CGNS MU)
Total	**392.7 km^2**	**181.0 (0.626% WS MU)**	**9.4 (0.052% CGNS MU)**	**47.4 (0.067% CWSH & OW MU combined)**	**2.0 (0.016% CGNS MU)**	**69.9 (0.068% CGNS MU)**	**239.5 (0.545% CGNS MU)**	**12.6 (0.062% CGNS MU)**

3.6 Potential Effects on Designated Sites

As outlined in **Section 1.3.2**, the proposed surveys are scheduled to be conducted from 1 June to 30 November in 2022.

3.6.1 The Inner Hebrides and the Minches SAC

As outlined in **Section 2.3**, the Inner Hebrides and the Minches SAC has been designated because of its importance to harbour porpoise year-round (NatureScot, 2020a).

The proposed surveys will be conducted outside the SAC, but there is the potential for impacts to overlap with the SAC area due to the close proximity. As a precautionary approach, the potential disturbance of harbour porpoise in the Inner Hebrides and the Minches SAC has been assessed based on half the overall disturbance area being within the SAC (due to the OAA being directly adjacent to the SAC boundary, the largest potential overlap would be from activities being undertaken at the boundary of the SAC) (**Table 3.14**).

Table 3.14 Assessment of potential disturbance of harbour porpoise in the Inner Hebrides and the Minches SAC

Potential Effect	Maximum area of overlap in SAC (% of SAC area)	Potential adverse effect on site integrity
Disturbance (5 km EDR) with up to three vessels at the SAC boundary (117.8 km^2)	0.85%	**No** Temporary effect. Potential disturbance would not impact a significant proportion of the SAC area.
Daily survey area with up to three vessels at the SAC boundary (BEIS, 2020) (384 km^2)	2.78%	

Disturbance of harbour porpoise would not exceed 3% of the SAC. Therefore, there is **no significant disturbance and no potential adverse effect on the integrity of the SAC in relation to the conservation objectives for harbour porpoise**.

There are no anticipated potential effects on other designated sites where harbour porpoise or bottlenose dolphin are a qualifying feature, taking into account the distances to the sites and the potential impacts associated with the proposed site investigation surveys (**Section 3.1**).

3.6.2 Treshnish Isles SAC and South-East Islay Skerries SAC

Although seals are not EPS, an assessment in relation the nearby Treshnish Isles or South-East Islay Skerries SACs has been included in this report.

There will be no direct impact on either the Treshnish Isles or South-East Islay Skerries SAC from the site investigation survey due to the distance from the MachairWind OWF OAA survey area. However, it is assumed that any individuals present with in the survey area have potential connectivity with their respective SAC.

There is little available information on the potential for disturbance from geophysical surveys for either grey seal or harbour seal; however, observations of behavioural changes in other seal species have shown avoidance reactions up to 3.6 km from the source (for a seismic survey of 1,600 cu. in.) (Harris *et al.,* 2001); a potential disturbance range of 3.6 km (disturbance area of 40.7 km^2) will, therefore, be applied to both grey seal and harbour seal due to a lack of species-specific information. As this was recorded for seismic

surveys rather than due to the equipment associated with smaller geophysical surveys, this is considered to represent a worst-case.

The number of grey seals that could potentially be disturbed due to the site investigation survey, based on three survey vessels, is up to 54.9 (based on the 0.45 individuals per km^2, as calculated from the Russell *et al*., 2017), or 1.6% of the Treshnish Isles SAC and 1.3% west Scotland MU (4,174 individuals; Special Committee on Seals (SCOS), 2020).

The number of harbour seals that could potentially be disturbed due to the site investigation survey, based up to three survey vessels, is up to 6.1 (based on the 0.05 individuals per km^2, as calculated from the Russell *et al*., 2017), or 1.2% of the South-East Islay Skerries SAC and 0.04% west Scotland MU (15,600 individuals; SCOS, 2020).

Given the low number of seals at risk of disturbance, and the low level of overall population impact, and the temporary nature of the disturbance, it is considered that there **is no potential for any effects on the site integrity in relation to the conservation objective for grey seal or harbour seal**.

3.6.3 The Sea of the Hebrides NCMPA

As outlined in **Section 2.3**, the Sea of the Hebrides NCMPA has been designated because of its importance to minke whale and basking shark during the summer season (April-October) (NatureScot, 2020b).

The proposed surveys will be conducted outside the NCMPA but there is the potential for noise impacts to overlap with the protected site due to the close proximity. As a precautionary approach, the potential disturbance of minke whale in the Sea of the Hebrides NCMPA has been assessed based on up to half of the disturbance area being within the NCMPA (**Table 3.14**).

Table 3.15 Assessment of potential disturbance of harbour porpoise in the Inner Hebrides and the Minches SAC

Potential Effect	Maximum area of overlap in NCMPA (% of NCMPA area)	Potential for significant impact to NCMPA
Disturbance (5 km EDR) with up to three vessels at the site boundary (117.8 km^2)	1.17%	**No** Temporary effect. Potential disturbance would not impact a significant proportion of the NCMPA area.
Daily survey area with up to three vessels at the site boundary (BEIS, 2020) (384 km^2)	3.83%	

Disturbance of minke whale would not exceed more than 4% of the SAC. Therefore, there is **no significant disturbance and no potential for impact on the NCMPA**.

3.7 Protected Seal Haul-Out Sites

The closest protected seal haul-out sites to the OAA are Nave Island, at approximately 8 km from the OAA, and West Oronsay and South Oronsay, both of which are approximately 11 km from the OAA. All of these nearby sites are protected for grey seal. Given the distance between the OAA and the protected sites, there is no potential for direct impact due to the geophysical surveys. However, there is the potential for transiting vessels to disturb seals while they are hauled-out.

The response of seals to disturbance at haul-out sites can range from increased alertness to moving into the water (Wilson, 2014). The potential impact on pupping groups can include temporary or permanent pup separation, disruption of suckling, energetic costs and energetic deficit to pups, physiological stress and, sometimes, enforced move to distant or suboptimal habitat. Potential impacts on moulting groups can include energy loss and stress, while impacts on other haul-out groups can cause loss of resting and digestion time and stress (Wilson, 2014). The potential impacts will be determined by the response of the seals, the duration and proximity of the disturbance to the seals.

For grey seal, mothers responded by moving into the water more due to boat speed than as a result of the distance, although movement into the water was generally observed to occur at distances of between 20 and 70 m, with no detectable disturbance at 150 m (Wilson, 2014; Strong and Morris, 2010). However, grey and harbour seals have also been reported to move into the water when vessels are at a distance of approximately 200 m to 300 m (Wilson, 2014).

Therefore, it is considered that, for grey seal, vessels travelling within 300 m of a haul-out site, a grey seal may flee into water, but significant disturbance would be expected at a distance of less than 150 m. Therefore, all vessels transiting to the OAA will remain at a distance of at least 500 m from the protected seal haul-out sites and use existing shipping lanes and transit routes wherever possible, to ensure there is no disturbance to seals while they are hauled out. With the proposed mitigations, it can be concluded that there would beno potential for significant disturbance to protected haul-out sites.

4 Mitigation Strategy

As noted in **Section 1.3.1,** the survey equipment to be used has not yet been confirmed; therefore, the use of an SBP has been used as the worst-case to inform the assessments. The survey equipment to be used should use the lowest practical noise levels were possible.

The following mitigation measures, as outlined within the JNCC (2017) '*Guidelines for Minimising the Risk of Injury to Marine Mammals from Geophysical Surveys*' would apply for geophysical surveys using either SBP, USBL, or UHR equipment:

- As the geophysical surveys are short in nature and are using low energy sources (such as SBP), a non-dedicated **Marine Mammal Observer** (MMO) can be used. A non-dedicated MMO refers to a trained MMO who may undertake other roles on the vessel when not conducting their mitigation role. This person can be a member of the vessel's crew provided that during the mitigation period, they do not undertake any other roles on the vessel.
    - Note that the pre-survey watch can only be undertaken in periods of daylight and good visibility.
- **Passive Acoustic Monitoring** (PAM) shall be deployed as an additional mitigation measure (for example, PAM pre-survey searches to be undertaken during hours of darkness and in poor visibility).
    - Note that PAM will be used for pre-survey searches for surveys starting in darkness or poor visibility.
- Prior to any acoustic survey commencement, a 30 minute pre-survey search of a 500m mitigation zone around the moving acoustic source is required. If a marine mammal or basking shark is sighted or detected within the mitigation zone during the pre-survey search, the survey cannot commence until:
    1. until the 30 minute pre-survey search is complete; and
    2. the mitigation zone has been clear of marine mammals and basking sharks for a period of 20 minutes prior to start of survey.

A **soft-start** must be undertaken (wherever practical) once the pre-survey search of 30 minutes has been completed and there have been no marine mammal or basking shark sightings for at least 20 minutes. The soft-start will consist of a gradual and consistent ramp-up of power over a minimum of a 15 minute period[9], and the line must be commenced within 25 minutes of the start of the soft-start procedure. Once soft-start has commenced, there is no requirement to stop or delay the acoustic survey due to marine mammal or basking shark presence within the 500 m mitigation zone.

- If a line change is expected to take more than 40 minutes, the acoustic survey should be halted at the end of the survey line, and a full pre-survey search and soft-start procedure should begin prior to the next line.
    - The pre-survey search of the 500 m mitigation zone can commence while on the line turn, so that acoustic sources can be switched on ready for the next line. Note that the same delay and soft-start procedures apply for line changes as outlined above.
- If a line change is expected to take less than 40 minutes, surveys can continue if the shot point interval is increased to a maximum of 5 minutes and is decreased gradually in the final 10 minutes of the line change.
    - The survey sources can alternatively be switched off during line changes of less than 40 minutes, and the mitigation procedures undertaken as per the line changes of more than 40 minutes as outlined above.
- If several types of survey equipment are started sequentially, or interchanged during the operation, only one pre-shooting search is required prior to commencement of the first acoustic output, and only if there are no gaps in data acquisition of more than 10 minutes.

Whilst not considered specifically in this assessment due to their low likelihood of occurrence, any assessment of, or mitigation measures put in place for the species assessed, are considered to be appropriate/relevant for other less commonly occurring species of cetacean that may be present in the survey area. These mitigation measures for cetacean EPS (JNCC, 2017) are also deemed to be appropriate for seals, turtles and basking sharks, and would reduce the potential for impact to all species.

In addition to the mitigation outlined in the JNCC Guidance (2017), Scottish Power Renewables has committed to the following:

- The inclusion of basking shark as a species that would require delay of the vessel transect commencing, in the event that any individuals are sighted by the MMO during the pre-survey search and present a risk of collision.
- Producing and presentation of a toolbox talk to inform the crew on the presence and identification of basking sharks and ways to minimise collision risk.
- Adherence to both the Scottish Marine Wildlife Watching Code[10] and the Shark Trust's Basking Shark Code of Conduct[11] during all operations and transits, including, but not limited to[12]:
    - the Master of the vessel ensuring that marine mammals and basking shark are avoided to a safe distance (100 m or more) in all possible circumstances (or 500m in the case of large aggregations of basking shark);
    - reducing vessel speeds to less than 6 knots when basking shark are sighted in the vicinity of the vessel (wherever possible taking into account vessel safety); and

[9] *Based on the guidelines for mitigations for a mini air gun, as stated within the JNCC 2017 guidelines for minimising the risk of injury to marine mammals from geophysical surveys. https://data.jncc.gov.uk/data/e2a46de5-43d4-43f0-b296-c62134397ce4/jncc-guidelines-seismicsurvey-aug2017-web.pdf*

[10] *Available at: https://www.nature.scot/professional-advice/land-and-sea-management/managing-coasts-and-seas/scottish-marine-wildlife-watching-code*

[11] *https://www.sharktrust.org/Handlers/Download.ashx?IDMF=6137b1a1-8518-4327-9922-7b280acb8336*

[12] *While every attempt will be made to follow these Codes of Conduct at all times, vessel and personnel safety will come first*

- the Master of the vessel minimising high powered manoeuvres where this does not impair safety.

- All vessels transiting to the OAA will remain at a distance of at least 500 m from the protected seal haul-out sites and will use existing shipping lanes and transit routes wherever available (and safe to do so).

5 Assessment of Potential Offence

Following the Marine Scotland (2020) guidance, relevant to the proposed geophysical surveys which occur in waters within the 12 nm limit, it can be concluded that, with mitigation for the survey and positioning equipment, potential impacts from the proposed survey work are unlikely to result in the harassment, disturbance, injury or killing of an EPS as defined under regulation 39(1) of the Conservation (Natural Habitats &c.) Regulations 1994 (as amended in Scotland) (referred to as the Habitats Regulations).

In relation to regulation 39(2) of the Habitats Regulations, the percentage of the reference population of each species, which has the potential to be disturbed by use of the geophysical survey equipment, is considered to be negligible (less than 1% for all cetacean species which occur in the area) and therefore not detrimental to the maintenance of the population of the species concerned at a FCS. Any disturbance is likely to be localised and short-term, and with mitigation is considered to be negligible. 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 under Section 39 of The Conservation (Natural Habitats, &c) Regulations 1994 (as amended in Scotland).

With regard to basking sharks, there is only the potential for injury due to vessel collision risk, as the underwater noise emissions associated with geophysical surveys fall outside of the hearing ranges of elasmobranch species. Due to the mitigation measures that will be in place for basking shark, including adherence to the Basking Shark Code of Conduct, there is no potential for population level impacts to basking shark as a result of injury. Therefore, it is considered that a basking shark licence can be issued under the Wildlife and Countryside Act 1981.

5.1 EPS and Basking Shark Licencing Tests

The purpose of the EPS and Basking Shark Risk Assessment presented in this report is to determine whether, when considering appropriate mitigation as presented in **Section 3.7**, there is still potential for the marine survey activities to cause deliberate harm, or inadvertently cause disturbance to cetaceans or other protected species. The need for a Marine EPS Licence and Basking Shark Licence will be determined by MS-LOT, with advice from NatureScot, based on findings from this EPS and Basking Shark Risk Assessment.

MS-LOT's consideration of whether an EPS Licence will be required will comprise three tests:

1. To ascertain whether the licence is to be granted for one of the purposes specified in the Regulation 44;
2. To ascertain whether there are no satisfactory alternatives to the activity proposed (that would avoid the risk of offence)[13]; and
3. That the licencing of the activity will not be detrimental to the maintenance of the

[13] *There is also a requirement for the basking shark licence to provide detail on any 'Satisfactory alternatives'; therefore, question 2 is relevant for both the EPS licence and basking shark licence*

populationof the species concerned at a *Favourable Conservation Status* (FCS)[14].

Test 1: The licence must relate to one of the purposes referred to in Regulation 44.
The Scottish Government can only issue licenses under Regulation 44(2) of the Regulations (as amended) for specific purposes. These purposes include:

- 44(2)(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.

The development of the proposed MachairWind OWF meets the requirements of Regulation 44 (2) (e) by demonstrating a direct environmental benefit on a national and international scale and complies with international and national environmental policies. There is an overarching European, UK and Scottish policy requirement for sustainable energy supply from renewables. This need is the subject of national planning and energy policy. While the site investigation survey will mean a disturbance to cetacean species, it will only be temporary in nature, be a risk to a small number of individuals and, with the mitigations that will be put in place, there is no potential for injury. The benefit of undertaking this survey and allowing for the redevelopment to progress has the potential for long-term benefit to Scotland and the renewables industry and helping Scotland to reach the overall target for greenhouse gas emissions.

Test 2: There must be no satisfactory alternative (Regulation 44, 3a).
Alternative options were considered prior to the inclusion of a site investigation survey with regards to the scope and extent of the survey within the MachairWind OWF OAA. Site investigation surveys are required to map the seabed and sub-surface characteristics of the site. These surveys are considered essential due to the need to accurately assess the site for further development, the proposed survey methods outlined in this document are the only viable way to ensure the accurate planning and assessment of the MachairWind OWF.

There are no satisfactory alternatives to the use of survey equipment required during the site investigation works. Although there might be different types of survey equipment that could be used, this is often constrained by the specific purpose of the site investigation survey and the alternative equipment may not be effective. Site investigation works are required in order to detail the seabed and sub-surface characteristics within the OAA. These works are required to provide sufficient detail for the design phase of the project. However, it is important to note:

- **Survey Location, Duration and Extent**: the smallest survey area possible (OAA plus 1 km buffer) has been proposed. The smallest number of survey lines within this area results in the minimum survey duration possible (130 geophysical survey days). Reducing the size of the survey area and/ or the number of survey lines any further would reduce data coverage quality to the point at which the project would become unviable.

- **Survey Equipment/Methodology**: the combination of the level of geophysical survey and intrusive geotechnical site investigations have been chosen to provide the most efficient dataset that can be used to assess engineering and environmental feasibility. The design of the survey considers the provision of the required data for the preliminary phase but without survey techniques which may be superfluous for the current objectives. The results of the survey will allow the most effective development and design decisions to be made. For future site investigation, it will provide data to

[14] *The Habitats Regulations defined the conservation status of a species to be taken as 'favourable' when population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, when the natural range of the species is not being reduced for the foreseeable future and there is, a sufficiently large habitat to maintain its populations on a long-term basis.*

allow the design of the most effective surveys. Overall, the proposed works meet the objectives of the preliminary survey with the minimal practicable impact to marine mammals and basking sharks.

Desktop studies were performed at the OAA to understand ground conditions and UXO risk. This has allowed refinement of survey methodologies to ensure the most efficient survey is implemented.

Thus, ScottishPower Renewables considers that the 'no satisfactory alternative test' has been met.

Test 3: The action authorised must not be detrimental to the maintenance of the population of the species concerned at a FCS in their natural range (Regulation 44, 3b).
The percentage of the reference population of each species, which has the potential to be temporary disturbed, over a relatively small area for a short period of time, by use of the site investigation survey, is considered to be negligible (less than 1% for all the cetacean species which occur in the proposed MachairWind OWF OAA area), and therefore not detrimental to the maintenance of the population of the species concerned at a FCS level.

6 Conclusions

While the geophysical surveys associated with the site investigation works present a temporary disturbance to a localised marine environment, this work is an important addition to Scotland's growing contributions to the UK's renewable energy sector. It will provide additional support to the UK government's national and international commitments to reduce greenhouse gasses.

The assessment above demonstrates that, with the implementation of the mitigation measures detailed in **Section 4**, there will be no injury resulting from the proposed activities due to underwater noise and, thus, no offence related to injury of any cetacean species under either the inshore or offshore regulations. In this context, a Marine EPS Licence would not be required.

It is possible that a small number of animals may experience some level of disturbance for the short period they may encounter noise emissions from the site investigation survey operations. Given the short term and temporary impacts of the survey to cetaceans, it is considered that there is no potential for a significant impact on the wider populations of harbour porpoise, Atlantic white-sided dolphin, bottlenose dolphin, Risso's dolphin, short beaked common dolphin, white-beaked dolphin and minke whale, with a negligible risk of disturbance to any species of cetacean.

There is potential for cumulative impacts from a number of different sources, although there is significant uncertainty when these may arise. Based on current and likely future activities and the predicted level of impact, along with the potential mitigation that will be in place, the level of cumulative disturbance is predicted to be relatively small. However, the impacts arising from disturbance from each activity will be temporary and there will be no impact on the favourable conservation status of any EPS.

Therefore, a Marine EPS Licence is thus required for activities where there is potential for disturbance to cetaceans as per 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.

There is also the potential for injury or fatality to basking shark due to vessel collision. However, mitigation will be in place to reduce the risk of injury. Given the short-term nature of the surveys, and that a small number of individuals would be at risk (due to the proposed mitigation measures), and that there would be no potential for a population level impact, it is concluded that a basking shark licence can be issued.

7 References

Baines, M.E. and Evans, P.G.H. 2012. Atlas of the Marine Mammals of Wales. CCW Monitoring Report No. 68. 2nd edition. 139pp.

BEIS (2020). Record of the Habitats Regulations Assessment undertaken under Regulation 65 of the Conservation of Habitats and Species 2017, and Regulation 33 of the Conservation of Offshore Marine Habitats and Species Regulations 2017. Review of Consented Offshore Wind Farms in the Southern North Sea Harbour Porpoise SAC. September 2020. Department for Business, Energy and Industrial Strategy.

CMACS. 2011. West coast HVDC link environmental appraisal. Assessment of EMF effects on sub tidal marine ecology.

DECC (2016). Offshore Energy SEA 3: Appendix 1 Environmental Baseline -Marine and other mammals. Department of Energy and Climate Change. March 2016.

Duck, C.D., Morris, C.D. and Thompson, D. (2017). The status of UK harbour seal populations in 2016 including summer counts of grey seals. SCOS Briefing Paper 17/03 which can be downloaded from http://www.smru.st-andrews.ac.uk/research-policy/scos/

Geo Marine Survey Systems (2021). UHR seismic - SEISMIC, GEOTECHNICS & SOFTWARE Solutions. Available at: https://www.geomarinesurveysystems.com/

Hammond, P.S., Lacey, C., Gilles, A., Viquerat, S., Boerjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M. and Teilmann, J. (2021). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Wageningen Marine Research.

Harris, R.E., Miller, G. W. and Richardson, W. J. (2001). Seal responses to air gun sounds during summer seismic surveys in the Alaskan Beaufort Sea. Mar Mam Sci. 17:795-812.

IAMMWG (2021). Updated abundance estimates for cetacean Management Units in UK waters. JNCC Report No. 680, JNCC Peterborough, ISSN 0963-8091.

JNCC. (2015). Standard Data Form for sites within the 'UK national site network of European sites'. South-East Islay Skerries. UK0030067. Updated 2015-12. Available at: https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0030067.pdf

JNCC. (2015). Standard Data Form for sites within the 'UK national site network of European sites'. Treshnish Isles. UK0030289. Updated 2015-12. Available at: https://jncc.gov.uk/jncc-assets/SAC-N2K/UK0030289.pdf

JNCC (2017). JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys.

JNCC, Natural England and Countryside Council Wales (CCW) (2010). Draft EPS Guidance - The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area. Joint Nature Conservation Committee, Natural England and Countryside Council for Wales. October 2010.

JNCC, Department of Agriculture, Environment and Rural Affairs (DAERA) and Natural England (2020). Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs (England, Wales & Northern Ireland). June 2020.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whale'. Marine Mammal Science 17 (1) 30-75.
Louis, M., Viricel, A., Lucas, T., Peltier, H., Alfonsi, E., Berrow, S., Brownlow, A., Covelo, P., Dabin, W., Deaville, R. and De Stephanis, R., (2014). Habitat-driven population structure of bottlenose dolphins, Tursiops truncatus, in the North-East Atlantic. Molecular Ecology, 23(4), pp.857-874.

Lucke, K., Siebert, U., Lepper, P. A. and Blanchet, M. A. (2009). Temporary shift in masked hearing thresholds in a harbor porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli. J. Acoust. Soc. Am., 125 (6), pp. 4060-4070.

Macleod, K., Lacey, C., Quick, N., Hastie, G. and Wilson, J. (2011). Guidance on survey and monitoring in relation to marine renewables deployments in Scotland. Volume 2. Cetaceans and Basking Sharks. Unpublished draft report to Scottish Natural Heritage and Marine Scotland.

Martin, K.J., Alessi, S.C., Gaspard, J.C., Tucker, A.D., Bauer, G.B. and Mann, D.A. (2012). Underwater hearing in the loggerhead turtle (Caretta caretta): a comparison of behavioral and auditory evoked potential audiograms. Journal of experimental Biology, 215(17), pp.3001-3009.

Mickle, M.F., Pieniazek, R.H. and Higgs, D.M. (2020). Field assessment of behavioural responses of southern stingrays (*Hypanus americanus*) to acoustic stimuli. Royal Society open science, 7(1), p.191544.

Moray West. 2018. Moray West Technical Note A – Protected Sites and Species Assessment.

NatureScot. (2020a). Conservation and Management Advice. Inner Hebrides and The Minches SAC. July 2020. https://apps.snh.gov.uk/sitelink-api/v1/sites/10508/documents/59

NatureScot. (2020b). Conservation and Management Advice. Sea of the Hebrides possible MPA. November 2020. https://apps.snh.gov.uk/sitelink-api/v1/sites/10474/documents/59

National Oceanic and Atmospheric Administration (NOAA) (2019). Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys of Lease Areas OCS–A 0486, OCS–A 0487, and OCS–A 0500. DEPARTMENT OF COMMERCE - Federal Register / Vol. 84, No. 144 / Friday, July 26, 2019 / Notices

Neart na Gaoithe Offshore Wind Farm (2019). Neart na Gaoithe Offshore Wind Farm Nearshore Geophysical, UXO and Seismic Refraction Surveys – European Protected Species Risk Assessment.

NMFS (National Marine Fisheries Service). (2018). 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. NOAA Technical Memorandum NMFS-OPR-59. Available at: https://www.federalregister.gov/documents/2018/06/21/2018-13313/2018-revision-to-technical- guidance-for-assessing-the-effects-of-anthropogenic-sound-on-marine.

NMPi (National Marine Plan Interactive) (2022). Marine Scotland Maps NMPI. https://marinescotland.atkinsgeospatial.com/nmpi/

Nykänen, M., Louis, M., Dillane, E., Alfonsi, E., Berrow, S., O'Brien, J., Brownlow, A., Covelo, P., Dabin, W., Deaville, R. and de Stephanis, R., 2019. Fine-scale population structure and connectivity of bottlenose dolphins, Tursiops truncatus, in European waters and implications for conservation. Aquatic Conservation: Marine and Freshwater Ecosystems, 29, pp.197-211.

Ridgway, S.H., Wever, E.G., McCormick, J.G., Palin, J., Anderson, J.H. (1969). Hearing in the giant sea turtle, Chelonia mydas. Proc Nat Acad Sci USA 64(3):884–890

SCOS (2020). SCOS Report. Scientific Advice on Matters Related to the Management of Seal Populations: 2020. Available at: http://www.smru.st-andrews.ac.uk/files/2021/06/SCOS-2020.pdf

Scottish and Southern Energy (2020). EPS and Protected Sites and Species Risk Assessment. EPS and Protected Sites and Species Risk Assessment – North Coast and Orkney Islands. Document number A-302244-S02-REPT-001. Prepared by Xodus Group. https://marine.gov.scot/sites/default/files/risk_assessment_4.pdf

Shark Trust (2020). Basking Shark Project. Report 2020 Available at: https://www.sharktrust.org/Handlers/Download.ashx?IDMF=1c911837-bbb3-4059-951c-365a9882a936

Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P. and Tyack, P.L. (2019). Marine mammal noise exposure criteria: updated scientific recommendations for residual hearing effects. Aquatic Mammals, 45(2), pp.125-232.

Strong, P. and Morris, S.R. (2010). Grey seal (Halichoerus grypus) disturbance, ecotourism and the Pembrokeshire Marine Code around Ramsey Island. J. Ecotourism 9(2): 117–132.

The Shark Trust. (2018). Basking Shark Project. Available at: https://www.sharktrust.org/Handlers/Download.ashx?IDMF=55251894-a915-4f33-b7f5-6bbba0cf495b

Thomsen, F., Lüdemann, K., Kafemann, R. and Piper, W. 2006. Effects of offshore windfarm noise on marine mammals and fish, on behalf of COWRIE Ltd.

Van Waerebeek, K., A. N. Baker, F. Félix, J. Gedamke, M. Iñiguez, G. P. Sanino, E. Secchi, D. Sutaria, A. vanHelden, and Y. Wang. 2007. Vessel collisions with small cetaceans worldwide and with large whales in theSouthern Hemisphere, an initial assessment. Latin American Journal of Aquatic Mammals 6:43-69.

Vanderlaan, A. S., and C. T. Taggart. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23:144-156.

Waggitt, J.J., Evans, P.G., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J. and Felce, T. (2019). Distribution maps of cetacean and seabird populations in the North-East Atlantic. Journal of Applied Ecology, 57(2), pp.253-269.

Wieting, D.S. (2019). Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Site Characterization Surveys of Lease Areas OCS-A 0486, OCS-A 0487, and OCS-A 0500. A Notice by the National Oceanic and Atmospheric Administration on 07/26/2019. Available from: https://www.federalregister.gov/documents/2019/07/26/2019-15802/takes-of-marine-mammals-incidental-to-specified-activities-taking-marine-mammals-incidental-to-site

Wilson, S. (2014). The impact of human disturbance at seal haul-outs. A literature review for the Seal Conservation Society. Available at: http://www.pinnipeds.org/attachments/article/199/Disturbance%20for%20SCS%20-%20text.pdf