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EPS Risk Assessment and Protected Sites Assessment for Geophysical Survey – Project Salamander

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Acronyms

Acronym	Definition
µPa	Micropascal
µs	microseconds
3D	Three-Dimensional
AA	Appropriate Assessment
CTD	Conductivity, Temperature and Depth
dB	Decibel
dBht	Decibel Hearing Threshold
DECC	Department of Energy and Climate Change
EBS	Environmental Baseline Survey
EEC	European Economic Community
EPS	European Protected Species
EU	European Union
FCS	Favourable Conservation Status
FLOW	Floating Offshore Wind
HF	High Frequency
HRA	Habitats Regulations Appraisal
Hz	Hertz
IAMMWG	Inter-Agency Marine Mammal Working Group
IROPI	Imperative Reason of Overriding Public Interest
JNCC	Jointed Nature Conservation Committee
kHz	Kilo-Hertz
km	Kilometres
km^2	Square Kilometres
LAT	Lowest Astronomical Tide
LF	Low Frequency
LSE	Likely Significant Effects
m	metres
m/s	Meters per second
m^3	Cubic metres
MBES	Multi-Beam Echosounder
MF	Mid Frequency
MHWS	Mean High-Water Spring
MHz	Mega-Hertz
MMMP	Marine Mammal Protection Plan
MMMU	Marine Mammal Management Units

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MMO	Marine Mammal Observer
MS-LOT	Marine Scotland Licensing Operations Team
MW	Megawatts
N/E	Not expected
NCMPA	Nature Conservation Marine Protected Area
nm	Nautical miles
NMFS	National Marine Fisheries Service
NMPi	National Marine Plan Interactive
NSA	National Scenic Areas
OSPAR	Oslo and Paris Convention
OW	Otariids in water
p	pressure
Pa	Pascal
PMF	Priority Marine Feature
pSPA	Proposed Special Protection Area
PTS	Permanent Threshold Shifts
PW	Pinnipeds in Water
RMS	Root Mean Square
ROV	Remotely Operated Vehicle
s	Seconds
SAC	Special Areas of Conservation
SBES	Simply Blue Energy Scotland
SBG	Simply Blue Group
SBP	Sub Bottom Profiler
SCANS-III	Small Cetacean Abundance in the North Sea III
SEL	Sound Exposure Level
SI	Sirenians
SNCB	Statutory Nature Conservation Bodies
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SPI	Shot Point Interval
SPL	Sound Pressure Level
SSS	Side Scan Sonar
SSSI	Sites of Special Scientific Interest
SVP	Sound Velocity Profiler
TTS	Temporary Threshold Shifts
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
USBL	Ultra-Short Baseline

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UXO	Unexploded Ordinance
VHF	Very High Frequency
WCA	Wildlife and Countryside Act

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1 Introduction

Simply Blue Energy (Scotland) Limited (herein referred to as SBES), a Joint Venture between Simply Blue Group (SBG), Ørsted and Subsea 7 are planning to develop Project Salamander, a proposed Floating Offshore Wind (FLOW) development off the east coast of Scotland. The plans for the array area will be to develop an offshore wind project consisting of:

- Up to 100 Mega Watts (MW) generating capacity, along with the associated subsea infrastructure;
- Inter-array cables and offshore export cable(s) to landfall;
- Onshore cabling between landfall and the substation; and
- Development of one onshore substation.

As a result, SBES plan to undertake a geophysical survey of the offshore array area, potential offshore export cable corridor as well as the inshore section of the export cable route using the following techniques: a high frequency Sub-Bottom Profiler (SBP); Multi Beam Echosounder (MBES), Side Scan Sonar (SSS), Sound Velocity Profiler (SVP) and Magnetometer.

The Environmental Baseline Survey (EBS) and Habitat Assessment survey will consist of a Drop-Down Camera/Remotely Operated Vehicle (ROV), grab samples, water sampler, multi-parameter Conductivity, Temperature and Depth (CTD) and Ultra-Short Baseline (USBL) methods.

The survey methods outlined above will be used to inform further project development and engineering focused surveys. Specifically, the proposed geophysical survey activities will enable SBES to:

- Conduct an initial investigation of subsea conditions by geophysical (acoustic) imaging, which will be applied to refine the site boundary and preliminary wind turbine layout as well as to inform the preliminary cable route evaluation;
- Identify the shallow geology, seabed features, any geohazards and map the seabed topography in full detail in order to detect and identify objects of potential significance located on the seabed. This will be used to inform early mooring concept design; and
- Characterise the seabed environment using images and sampling, in order to map seabed habitats and determine seawater composition, benthic and epibenthic macro and microfauna, anthropogenic environmental changes, and wrecks. The data acquired will also be studied for indications of inundated archaeological sites and potential Unexploded Ordinance (UXO) areas.

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1.1 Project Overview

As detailed above, SBES are planning to undertake a geophysical survey of the Project Salamander array area and the associated cable route corridor as illustrated in Figure 1-1. In order to ascertain the seabed characteristics and the potential for protected features within the area, a geophysical, EBS and habitat assessment survey will be conducted over the Project Salamander area and export cable corridor. Coordinates associated with the proposed survey area and export cable corridor are provided in Appendix A.

Project Salamander is located entirely in Scottish waters. The proposed survey area and export cable corridor encompasses Scottish Territorial Waters (<12 Nautical Miles (nm) from Mean High-Water Spring (MHWS)) and United Kingdom (UK) Offshore Waters (between 12 and 200 nm from MHWS). The array survey area will cover approximately 83 km^2, and a buffer area of 500 m will be included around the array area, and the export cable corridor survey area is 41 km^2. Additionally, the intertidal array (between 0 m Lowest Astronomical Tide (LAT) and the MHWS will also be surveyed with a 500 m buffer area.

The anticipated start date is the 1st July 2022 and is expected to take up to 42 days to complete. To account for operational and weather delays, the estimated end date of operations is the 30th September 2022. Further details on the survey activity schedule can be found in Section 2.5.

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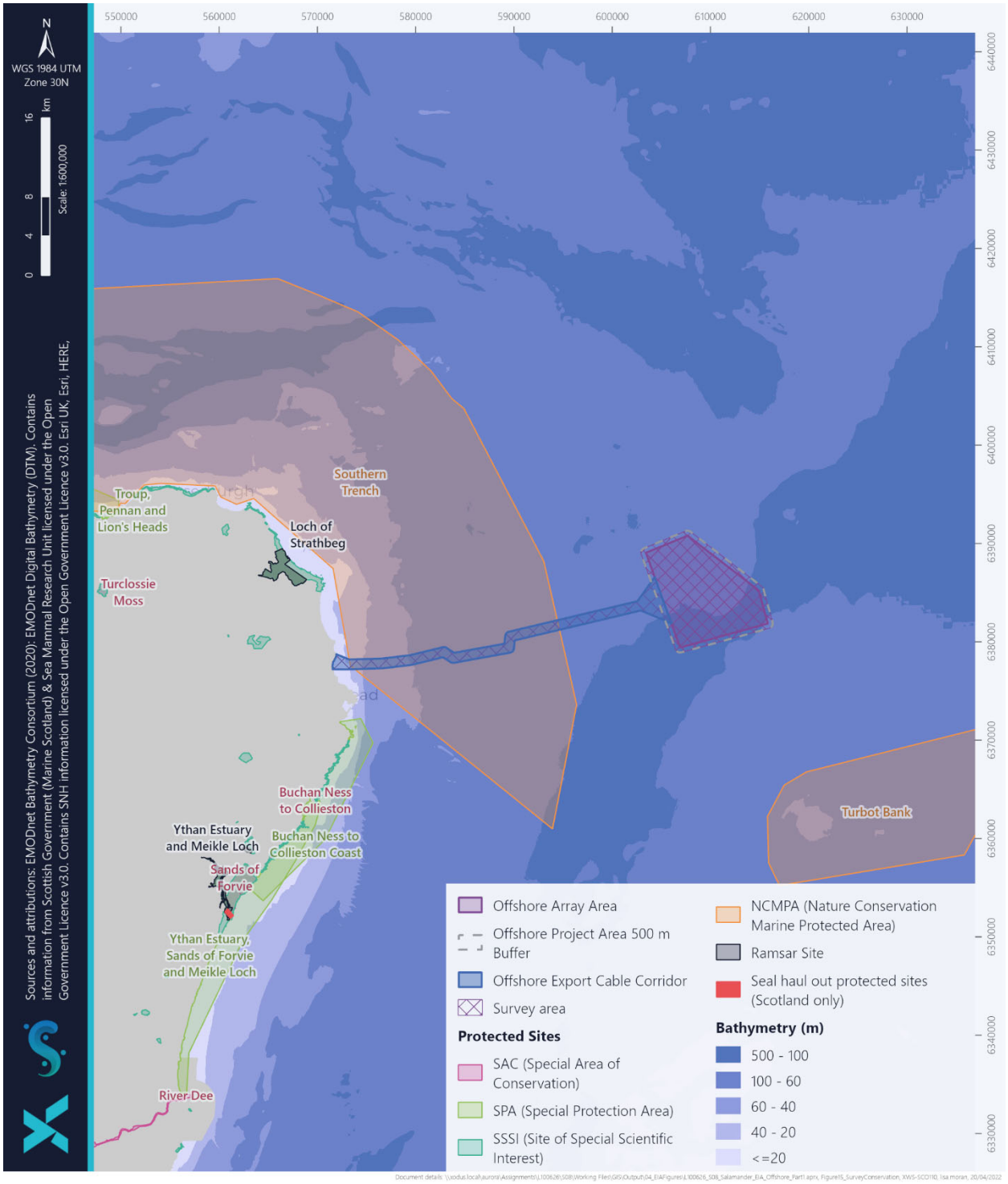
Figure 1-1 Location of Project Salamander Proposed Survey Area and Export Cable Corridor



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1.2 Report Purpose

Ahead of any planned survey operations, all relevant consents and licences need to be in place. This document provides the necessary information to support the following:

1. An assessment of potential impacts on cetaceans, and determination of the need for a European Protected Species (EPS) Licence under the Conservation (Natural Habitats, &c) Regulations 1994 (as amended in Scotland) (the Habitats Regulations) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) (The Offshore Habitats Regulations). Where an EPS licence is required, this document also provides the EPS risk assessment to support the application.

2. An assessment of potential impacts on basking sharks, and determination of whether a derogation licence will be required under the Wildlife and Countryside Act (WCA) 1981 (as amended).

3. An assessment of the potential for Likely Significant Effects (LSE) on designated sites as required by the Habitats Regulations, the Marine (Scotland) Act 2010. This will be in line with the Habitats Regulations Appraisal (HRA) process, which is conducted by the Competent Authority (as prescribed by the Habitats Regulations), to assess the potential of likely significant effects on the UK Site Network; and

4. An assessment of the potential to harass (intentionally or recklessly) any seals at designated seal haul-outs, as defined by section 117 of the Marine (Scotland) Act 2010, as amended by the Protection of Seals (Designation of Haul-Out Sites) (Scotland) Amendment Order 2017.

As part of the planned survey operations, other Regulatory exemptions/licences will be applied for including:

1. Notice of intention to carry out a Marine Licence exempted activity for geotechnical sampling of <1 m^3 volume per sample, under the Marine Licensing (Exempted Activities) (Scottish Offshore Region) Order 2011; and

2. A Marine Works Licence application will be made to Crown Estate Scotland.

1.3 Protected Species Overview

1.3.1 European Protected Species (EPS)

Cetaceans

All species of cetacean (i.e., whale, dolphin and porpoise) occurring in UK waters are listed in Annex IV of the European Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna) as EPS. This provision identifies all cetaceans as species of community interest in need of strict protection, as per Article 12 of the Directive. Harbour porpoise *Phocoena phocoena* and bottlenose dolphin *Tursiops truncatus* are listed as individual EPS and fall under Annex II of the Habitats Directive, which enables the designation of Special Areas of Conservation (SACs) for those species, while all other cetaceans are listed as "All other Cetacea" in Annex IV.

In Scotland, the Habitats Directive is transposed into law by The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) within Scottish Territorial waters (12 nm limit), and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) in UK Offshore Waters. The proposed survey will be undertaken in both UK Territorial (Inshore) and Offshore waters. An EPS licence is required where an activity may result in an offence under the Habitats Regulations, which in the context of marine surveys, pertains to cetaceans.

An EPS Licence will therefore be required for:

1. any activity that might result in injury to any cetacean or other EPS;
2. disturbance to any individual cetacean within Scottish inshore waters; and/or
3. any population of individuals in Scottish waters as stated in the relevant marine area in Table 1-1.

Table 1-1 Definitions of Disturbance Offenses Against EPS in Scottish Territorial and UK Offshore Waters

Area	Scottish Territorial Waters	UK Offshore waters
Applicability	Within 12 nm Limit	Out-with 12 nm Limit
Relevant Legislation	The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)	Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended)
Definition of Relevant Offences	Regulation 39: 1. It is an offence– (a) deliberately or recklessly to capture, injure or kill a wild animal of a European protected species; (b) deliberately or recklessly– i. to harass a wild animal or group of wild animals of a European protected species; ii. to disturb such an animal while it is occupying a structure or place which it uses for shelter or protection; iii. to disturb such an animal while it is rearing or otherwise caring for its young; iv. to 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. to 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; or vi. to 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; vii. deliberately or recklessly to take or destroy the eggs of such an animal; or viii. to damage or destroy a breeding site or resting place of such an animal. (2) Subject to the provisions of this Part, it is an offence to deliberately or recklessly disturb any dolphin, porpoise or whale (cetacean).	Regulation 45: 1. Subject to regulations 46 and 55, a person who— (a) deliberately captures, injures, or kills any wild animal of a European protected species, (b) deliberately disturbs wild animals of any such species, (c) deliberately takes or destroys the eggs of such an animal, or (d) damages or destroys, or does anything to cause the deterioration of, a breeding site or resting place of such an animal, is guilty of an offence. 2. For the purposes of paragraph (1)(b), disturbance of animals includes, in particular, any disturbance which is likely— (a) to impair their ability— i. to survive, to breed or reproduce, or to rear or nurture their young; or ii. in the case of animals of a hibernating or migratory species, to hibernate or migrate; or (b) (b) to affect significantly the local distribution or abundance of the species to which they belong.

1.3.2 The Eurasian Otter

The Eurasian otter is the only native UK otter species and is fully protected as an EPS and under Section 9 and 11 of the Wildlife and Countryside Act 1981 (as amended). When considering a certain activity, the presence of an otter as an EPS is a material consideration if the proposals are likely to result in the disturbance or harm to the species.

Considering information on their known distribution, and the fact that no protected sites list this species as a qualifying feature (as assessed by the criteria set out in Section 1.5.4 and site overview in Section 4), it is considered extremely unlikely that interactions with otters will occur. Therefore, this species is not considered further in this assessment.

1.3.3 Basking Sharks

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.

Basking sharks are only very rarely present within the North Sea area (Paxton *et al.*, 2014). Considering information on their known distribution, it is considered extremely unlikely that interactions with basking sharks will occur, hence the potential for the proposed survey activities to result in intentional or reckless disturbance or harassment of this species is equally limited.

1.3.4 Seabirds

The primary legislation for the protection of birds in the UK is the WCA in combination with the Nature Conservation (Scotland) Act 2004. Under these acts, it is an offence to harm wild bird species, their eggs and nests. Additional protection is provided for certain bird species listed on Schedule 1 of the WCA, and it is an offence to disturb those species at their nest while it is in use.

The proposed survey activities are unlikely to result in the intentional or reckless killing of wild birds or the destruction of their nests, but if carried out during the breeding season, such works could result in an offence by disturbing nesting Schedule 1 bird species.

1.4 Determining the Need for an EPS Licence

The purpose of the assessments presented in this report is to determine whether, when considering appropriate mitigation as presented in Section 5, there is potential for the survey activities to injure or disturb cetaceans, otters or other protected species. Where there is still potential for harm or disturbance to occur, an EPS Licence (and/or Basking Shark Licence) may be required. The need for an EPS Licence (and/or Basking Shark Licence) will be determined based on findings from this assessment. Consideration of whether an EPS Licence can be granted will comprise three tests:

1. To ascertain whether the licence is to be granted for one of the purposes specified in the Regulations;

2. To ascertain whether there are no satisfactory alternatives to the activity proposed (that would avoid the risk of offence); and

3. That the licensing of the activity will not be detrimental to the maintenance of the population of the species concerned at a Favourable Conservation Status (FCS).

1.4.1 What Constitutes Disturbance?

Whether or not a specific activity could cause 'disturbance' (for the purpose of Article 12(1) (b) of the Habitats Directive) 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 FCS;
- Article 12(1)(b) affords protection specifically to species and not to habitats;
- The prohibition relates to the protection of 'species' not 'specimens of species';
- Although the word 'significant' is omitted from Article 12(1)(b) in relation to the nature of the disturbance, that cannot preclude an assessment of the nature and extent of the negative impact and ultimately a judgement as to whether there is sufficient evidence to constitute prohibited 'disturbance' of the species;
- It is recognised that activity during the 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 which 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)'.

Where there is the possibility for injury or disturbance to occur, an EPS Risk Assessment must be carried out and the need for an EPS Licence determined.

1.4.2 Alternatives

The plans for the 83 km^2 array area and associated 41 km^2 export cable route corridor will be to develop an offshore wind project with up to 100 MW generating capacity. In order to gather environmental and seabed conditions at the array area and along the cable route corridor, SBES are required to undertake a survey. There are no other alternatives to gather the relevant information.

SBES have ensured that the equipment selected for the survey will be operated at the appropriate levels in order to obtain the relevant data, while minimising any potential risks to EPS.

1.5 Protected Sites

1.5.1 European Sites

The term 'European site' is being used to refer to what were previously known as 'Natura' sites. This recognises that Special Protection Areas (SPAs) and SACs protect species and habitats shared across Europe and were originally designated under European legislation.

European sites (SACs and SPAs) form a unique network of protected areas that stretches across the European Union (EU). Prior to leaving the EU, Scotland's sites contributed to the Natura network. Now they form part of the Emerald Network, spanning Europe and into Africa.

Natura sites were originally designated under The European Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC). European Sites continue to be designated under Scottish domestic law and are now referred to as the UK Site Network:

- In the terrestrial environment and within Scottish Territorial Waters (12 nm limit) by:
    - The Conservation (Natural Habitats, &c.) Regulations 1994 (Current Scottish legislation); and
    - Habitats Directive and Birds Directive (EU legislation).
- Out-with Scottish Territorial waters by:
    - The Offshore Habitats Regulations.

SACs were designated under the Habitats Directive for habitats and non-bird species. The Habitats Directive sets out how such European sites should be protected and has a number of wider implications such as those relating to EPS. The Birds Directive protects all wild birds and their nests, eggs and habitats within the European Union. SPAs are classified under the Birds Directive to protect birds that are rare or vulnerable in Europe as well as all migratory birds that are regular visitors.

The guidance within, and associated with, the Habitats and Birds Directive continues to inform how our European sites are managed. The Habitats Regulations have been amended as a result of leaving the EU so that European sites are both protected, and continue to operate, as they have done since their original designation. The changes to the Regulations also mean that the requirements of the Directives continue to be relevant to the management of European sites.

The aim of protection for European sites is to promote the maintenance of biodiversity, by requiring maintenance or restoration of representative natural habitats and wild species at FCS, through the introduction of robust protection for those habitats and species of European importance.

As part of these protection measures, there is a requirement to determine whether a plan or project is likely to have an adverse effect on the integrity of a European site. This is implemented through the HRA process. The HRA process requires that any proposal which has the potential to result in a negative LSE to a UK Site Network or its designated features, is subject to an HRA and an Appropriate Assessment (AA) by the Competent Authority. The HRA and AA processes ensure that no activity can be consented if it may cause adverse effects on the integrity of

the UK Site Network, unless there are no alternatives, and there is an Imperative Reason of Overriding Public Interest (IROPI) for the activity to proceed.

1.5.2 Nature Conservation Marine Protected Areas

Under section 82 of the Marine (Scotland) Act 2010, Marine Scotland Licensing Operations Team (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; NatureScot in this case (previously known as Scottish Natural Heritage (SNH)).

It is an offence to intentionally or recklessly kill, remove, damage, or destroy any protected feature of an NCMPA. MS-LOT must be sure that consenting/licensing decisions do not cause a significant risk to the conservation objectives of any NCMPA.

Sufficient detail is provided below in Section 4 to support MS-LOT to ascertain potential effects on NCMPAs.

1.5.3 Designated Seal Haul-Outs

Seal haul-outs are coastal locations that seals use to breed, moult and rest. Nearly 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 strengthen the protection of seals when they are at their most vulnerable and, as such, provides additional protection from intentional or reckless harassment whilst seals occupy these important coastal sites.

1.5.4 Selection Criteria for Protected Sites

Over and above potential impacts on protected species, the potential for the proposed survey activities to impact protected sites (including designated seal haul-outs) needs to be considered. The following criteria has been used to select those designated sites where potential impacts need to be assessed:

- SACs and NCMPAs (including proposed and candidate sites) with cetaceans as qualifying features within 50 km of the proposed survey area and export cable corridor;
- SACs (including proposed and candidate sites) with harbour seal features within 50 km of the proposed survey area and export cable corridor and breeding grey seal within 20 km of the proposed survey area and export cable corridor;
- Designated seal haul-outs or seal breeding and/or otter sites that overlap with or located within 500 m of the proposed survey area and export cable corridor;
- SPAs and NCMPAs (including proposed and candidate sites) with birds as qualifying features that overlap with or are located within 2 km of the proposed survey area and export cable corridor;
- SACs and NCMPAs (including proposed and candidate sites) with otter features that overlap with or located within 500 m of the proposed survey area and export cable corridor; and

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- SACs and NCMPAs (including proposed and candidate sites) with vegetation or ground features that overlap or located within proposed survey area and export cable corridor.

There is not considered to be the potential for impact on benthic qualifying features as a result of geophysical survey activities. As such, protected sites with benthic features have not been considered within this assessment.

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2 Description of Project Activities

2.1 Overview

SBES are planning to carry out a geophysical survey at the Project Salamander array area and potential export cable corridor to Peterhead on the east coast of Scotland.

An EBS and habitat assessment survey will also be undertaken, which will include drop-down camera/ ROV, grab sampling, water sampling, multi-parameter CTD and USBL will also be undertaken. A separate notice of intention to carry out an exempt activity will be submitted to MS-LOT to cover the EBS/habitat assessment survey.

The results of the survey works will be used to ascertain seabed characteristics within the proposed survey area and export cable corridor, refine the site boundary and preliminary wind turbine layout and inform development of the export cable corridor route.

2.2 Testing and Calibration of Survey Equipment

Prior to survey activities commencing, the survey equipment and sensors will need to be tested and calibrated. Testing and calibration may be required for all survey equipment that will be utilised during the survey activity, as detailed in Table 2-1. It is anticipated that the testing and calibration will take approximately one day to complete and will be tested at the survey location. There will be two vessels employed for the survey, one undertaking the offshore survey, and one vessel undertaking the inshore survey.

Since the vessels, equipment, and activities required for testing and calibration will be the same as those used during geophysical survey works, the potential impacts on protected species and sites resulting from testing and calibration will be analogous to those resulting from the main survey phase. As such, testing and calibration is not specifically considered by this assessment.

2.3 Survey Activities

Survey equipment selection and deployment will be informed both prior to, and during survey operations, by several factors including environmental considerations, weather and sea state, survey requirements and water depth. Either the Northern Maria or the Northern Franklin will undertake the offshore survey. The offshore survey vessel will undertake the offshore survey activities in 24-hour periods. The inshore survey area will be surveyed by the Mersey Discovery survey vessel in 12-hour periods. Table 2-1 presents the types of activity that are associated with the geophysical surveys.

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Table 2-1 Summary of the Activities Associated with the Different Survey Types

Survey Activities	
Vessels	Offshore Survey vessel
	Inshore Survey vessel
Survey Equipment	SBP
	MBES
	SSS
	Magnetometer
	SVP
	USBL (for use during environmental survey)
	Environmental survey methods (Grab samples, drop-down camera, multi-parameter CTD and water sampler)

2.4 Geophysical Survey Equipment

Either the Northern Maria or the Northern Franklin will undertake the offshore survey. The Northern Maria is presented here as the worst-case option for noise related aspects.

A range of different equipment may be employed during the geophysical survey activities, with their use summarised in Table 2-2. Each type of equipment has been assessed for its potential to introduce sound into the marine environment and/or interact with protected species. The most significant noise related aspects potentially generated by this project are detailed within Table 3-1, along with a determination as to whether each requires further assessment.

Table 2-2 Details of the Equipment to be Deployed for the Survey Activities

Survey Equipment	Description
SBP	SBP systems are used to identify and characterise layers of sediment 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. There are numerous SBP technologies which may be deployed during survey operations, including pingers, chirpers, boomers, and sparkers. These devices can operate across a range of frequencies depending on the purpose of the survey. Higher frequencies of operation provide the highest resolution but are limited in amount of penetration below the sea floor. The high frequency profilers are particularly useful for delineating shallow features. Lower frequencies yield more penetration but provide less resolution; lower frequency systems are more general-purpose tools that provide a good compromise between penetration capacity and resolution. With regards to this survey, the proposed SBP technologies which will be used are as follows: • Offshore vessel: Innomar Medium 100 Chirper; & GeoSource 200 Sparker. • Inshore vessel: Innomar SES 2000 Compact & Applied Acoustics AA200 Boomer
MBES	MBES are used to obtain detailed three-dimensional (3D) maps of the seafloor which show water depths. They measure water depth by recording the two-way travel time of a high frequency pulse emitted by a transducer. The beams produce a fanned arc composed of individual beams (also known as a swathe). MBES can, typically, carry out 200 or more simultaneous measurements. Frequency levels below 200 kHz will not be used during survey activities and have therefore been scoped out of further assessment on the basis that they are out-with the generalised hearing range for EPS and other protected species likely to be affected by underwater noise. Offshore vessel will use an EM2040D MBES.

Survey Equipment	Description
	Inshore vessel will use a Norbit WBMS.
SSS	SSS is used to generate an accurate image of the seabed, which may include 3D imagery. An acoustic beam is used to obtain an accurate image of a narrow area of seabed to either side of the instrument by measuring the amplitude of back-scattered return signals. The instrument can either be towed behind a ship at a specified depth or mounted on to a ROV. The frequencies used by side-scan sonar are generally very high and outside of the main hearing range of all marine species (NMFS, 2018). The higher frequency systems provide higher resolution but shorter-range measurements. Offshore vessel will use an Edgetech 2205 for this survey. Inshore vessel will use an Edgetech 4200 SSS.
Magnetometer	Magnetometer surveys use equipment to record spatial variation in the Earth's magnetic field. Magnetometer surveys are used to detect any ferrous metal objects on the seabed, such as wrecks, 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. Both the offshore and inshore vessels will each use a Geometrics G882 magnetometer for this survey.
USBL	USBL systems are used to determine the position of subsea survey items, including ROVs, towed devices, grab samplers, etc. This involves the emission of sound from a vessel-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. A USBL system consists of a transducer, which is mounted on the vessel and a transponder attached to the ROV. The transducer transmits acoustics through the water and the transponder sends a response which is detected by the transducer. The USBL calculates the bearing and time taken for the transmissions to be completed and thus the position of the subsea unit / sampling equipment is determined. These systems can either be used continuously or intermittently through the operation they are supporting. For this survey, the USBLs technology that will be used are: • Offshore vessel: IXBLUE GAPS and MT9 Transponder; and • Inshore vessel: Sonardtne MiniRanger2 and Sonardyne WSM6 + Omni Transponder
SVP	The SVP continuously emits high frequency pulses as it is lowered towards the seafloor in order to measure the speed of sound within the water column. This technology also makes use of sonar to determine how quickly sound attenuates in the marine environment, which can aid in calibrating geophysical survey equipment. For this survey, the offshore vessel will use a Valeport SVX2 (deployed over the side) and Valeport miniSVS (hull-mounted at the MBES transducer). The inshore vessel will use a Valeport mini SVP (deployed over the side) and a AML Micro Xchange SVS (pole mounted at the MBES transducer).

2.5 Activity Schedule

The proposed geophysical survey activities are scheduled to be undertaken from a date no earlier than the 1st July 2022, with the total survey activities expecting to take up to 42 days collectively[1]. This duration includes 22 days of SBP, MBES, SSS and 8 days for the EBS and habitat assessment. An end date of the 30th September 2022 has been assumed in the event of any additional delays.

[1] This duration includes waiting on weather delays

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3 European Protected Species Risk Assessment

3.1 Overview

The primary purpose of this EPS Risk Assessment is to determine whether an EPS licence is required for the proposed survey works, by identifying the potential for injury and disturbance to EPS. This section of the risk assessment addresses potential impacts to EPS, regardless of their inclusion as qualifying features of protected sites. An assessment of potential impacts to protected sites and their qualifying features is provided in Section 4. Although not classified as EPS, an assessment of underwater noise impacts to pinnipeds, including noise modelling, has been included in this section to support the Protected Sites Impact Assessment undertaken in Section 4.

Furthermore, although not specifically an EPS, an assessment of the potential impacts to basking sharks from the survey activities is also provided below within Section 3.2.4. However, as discussed in Section 1.3.3, basking sharks are unlikely to be observed in the vicinity of the Project Salamander area and export cable corridor, and therefore a derogation licence under the WCA will not be required for basking sharks.

A number of different survey activities will be employed as part of the survey works, each with varying risk to protected species. They include:

- Vessel activity;
- Survey equipment calibration testing; and
- Geophysical surveys of the seabed.

Underwater noise emissions from geophysical survey equipment are the primary source of potential injury and disturbance to EPS. An overview of survey activities and their potential noise-related impacts to EPS and pinnipeds is provided in Table 3-1.

While some survey techniques may introduce noise to the marine environment, the majority of survey equipment types do not operate in relevant frequency ranges or generate sufficient levels of noise to be considered as potential sources of noise-related injury or disturbance to EPS, basking sharks and pinnipeds, and have been screened out of the detailed assessment, as indicated in Table 3-1.

It is acknowledged that the physical presence of vessels during the proposed survey operations may also generate disturbance to EPS and pinnipeds; these potential impacts are discussed further in the relevant EPS and Other Protected Species sections below.

Table 3-1 Overview of Potential Impacts of Marine Survey Equipment on EPS and Other Protected Species within the Vicinity of the Proposed Survey Area and export cable corridor

Activity / Equipment	Survey	Equipment	Potential Impacts	Frequency Range (kHz)	INDICATIVE SPL (SPLRMS DB re 1µPA)	FURTHER INFORMATON REQUIRED AS PART OF THE EPS AND PROTECTED SITES ASSESSMENT
Survey Vessel	Offshore Inshore	Northern Maria Mersey Discovery	Propellers, engines, and propulsion activities form the primary noise sources of survey vessels. Vessel noise is generally continuous and comes in both narrowband and broadband emissions. Potential impacts on EPS and other protected species depend on the duration of the survey activities, location of the survey routes and species of cetacean potentially present in the area. Increased vessel activity additionally has the potential to cause injury from collisions. The risk of collision with an animal is influenced by the dimensions of the vessel and its speed. It should be noted that travel speed of most typical survey vessels is between 3-4 knots. This is slower than the majority of marine mammals which could be impacted via collisions.	Acoustic energy from vessels is strongest at frequencies <1 kHz	Approximately 160 – 175	**No** – The source levels associated with vessels are likely to be too low to result in injury, and the presence of two survey vessels in the Firth of Forth region does not constitute a change from baseline conditions. It is acknowledged that vessels pose a collision risk to EPS and other protected species. While this does not constitute a change from baseline, all vessels will adhere those mitigation measures, as outlined in Section 5.
SBP	Offshore	Innomar Medium 100 Parametric SBP	Sub-bottom profiling involves the vertical emission of sound pulses (impulsive noise) to characterise the layers of sediment comprising the seabed. Such activities introduce noise emissions into the marine environment. The potential impact of this sound depends upon the type of profiler technology used, as well as the abundance, distribution and sensitivity of the species, and the duration of the operations. A 'chirp' system will be used which transmits a sweep of frequencies (e.g. 2-10 kHz) in a single pulse. These systems operate in a similar way to SBES but use lower sound frequencies that penetrate further into the sediment and examine	85- 115	247	**Yes** – The frequency of the noise emissions is within marine mammal hearing ranges and the source pressure level may pose a risk of injury and disturbance to EPS.
		GeoSource 200		1.5	228	

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Activity / Equipment	Survey	Equipment	Potential Impacts	Frequency Range (kHz)	INDICATIVE SPL (SPLRMS DB re 1µPA)	FURTHER INFORMATON REQUIRED AS PART OF THE EPS AND PROTECTED SITES ASSESSMENT
			sediment layers and the extent of bedrock etc.			
SBP	Inshore	Innomar SES 2000 compact	Sub-bottom profiling involves the vertical emission of sound pulses (impulsive noise) to characterise the layers of sediment comprising the seabed. Such activities introduce noise emissions into the marine environment. The potential impact of this sound depends upon the type of profiler technology used, as well as the abundance, distribution and sensitivity of the species, and the duration of the operations. A 'chirp' system will be used which transmits a sweep of frequencies (e.g. 2-10 kHz) in a single pulse. The 'boomer' system will be used which transmits a sweep of frequencies (e.g. 700 Hz – 2 kHz) in a single pulse. These systems operate in a similar way to SBES but use lower sound frequencies that penetrate further into the sediment and examine sediment layers and the extent of bedrock etc.	80- 120	238	**Yes** – The frequency of the noise emissions is within marine mammal hearing ranges and the source pressure level may pose a risk of injury and disturbance to EPS.
		Applied Acoustics AA00 Boomer Sub bottom profiler		12	214	**Yes** – The frequency of the noise emissions is within marine mammal hearing ranges and the source pressure level may pose a risk of injury and disturbance to EPS.
MBES	Offshore	Kongsberg EM2040D	High frequency noise pulses created by MBES equipment generate sound waves which produce impulsive underwater noise. Depending on the frequency of the pulses, location and duration of the operations, and the species present, there could be potential impacts on cetaceans.	Typical ranges: 10.5 - 500	180-240	**No** – The MBES used for the proposed survey operations will operate at frequencies above 200 kHz. This is above the hearing threshold of all marine mammals and protected species which may be present in the area (as detailed in Table 2-2). Hence no potential for injury or disturbance exists (NMFS, 2018).
	Inshore	Norbit WBMS		200 – 700 (planned 400)	180-240	
SSS	Offshore	Edgetech 2205	SSS equipment produces impulsive sound emissions through high frequency pulses used to image the seabed habitat.	Typical ranges: 100-180	190-230	**No** – The SSS will operate at frequencies above 200 kHz. This is above the hearing threshold of all

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Activity / Equipment	Survey	Equipment	Potential Impacts	Frequency Range (kHz)	INDICATIVE SPL (SPLRMS DB re 1µPA)	FURTHER INFORMATON REQUIRED AS PART OF THE EPS AND PROTECTED SITES ASSESSMENT
	Inshore	EdgeTech 4200	Potential impacts to EPS and other marine mammals depend upon the frequency, location, and duration of the pulses.	300 - 600	190-230	marine mammals and protected species which may be present in the area (as detailed in Table 2-2). Hence no potential for injury or disturbance exists (NMFS, 2018).
Magnetometer	Offshore & Inshore	Geometrics G882	Surface towed magnetometers allow for a wider range of detection at the price of precision accuracy that is afforded by the near-bottom magnetometers. Magnetometer surveys use equipment to record spatial variation in the Earth's magnetic field.	N/A	N/A	**No** – the magnetometer does not generate underwater noise as part of its normal operations and therefore is not considered to pose any risk of injury or disturbance to EPS.
USBL	Offshore	IXBLUE GAPS Or MT9 transponder	USBL systems involve the emission of impulsive sound from a hull-mounted transducer to a subsea transponder, thereby introducing sound into the marine environment. The potential impacts of this sound on cetaceans depends upon the abundance, distribution and sensitivity of the species, and the duration of the operations.	22-30 21-31	207	**Yes** – The pressure levels and frequencies at which the USBL emit are of a level where injury is unlikely however they have the potential to cause disturbance to marine mammals and other protected species. The use of SBP is considered to be the worst-case sound emitting sources, and therefore modelling has been undertaken for SBP and not for USBL.
	Inshore	Sonardtne MiniRanger2 Sonardyne WSM6+ Omni Transponder		19-34 19-34	207	
SVP	Offshore	Valeport SVX2 (deployed over the side) & Valeport miniSVS (hull-mounted at the MBES transducer)	Subsea Altitude Meters and SVPs and both rely on high frequency pulsed sounds to gather data on the marine environment. Subsea altimeters use sonar to identify the distance to the seafloor, while SVPs are used to measure the speed of sound within the water column to calibrate geophysical survey equipment with.	N/A	N/A	**No** - the noise source frequencies fall outwith the hearing range of marine mammals. There is no potential for injury or disturbance to any marine mammal species from noise emitted by this equipment
	Inshore	Valeport Mini SVP (deployed over the side) & AML Micro Xchange SVS (pole-mounted at				

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Activity / Equipment	Survey	Equipment	Potential Impacts	Frequency Range (kHz)	INDICATIVE SPL (SPLRMS DB re 1µPA)	FURTHER INFORMATON REQUIRED AS PART OF THE EPS AND PROTECTED SITES ASSESSMENT
		the MBES transducer)				

3.2 European Protected Species

3.2.1 Cetaceans

All cetacean species within UK waters are deemed 'species of community interest' under Annex IV of the Habitats Directive and thus require strict protection as EPS. Harbour porpoise and bottlenose dolphin are listed as individual EPS, while all other cetaceans are categorically listed as "all other Cetacea". Cetaceans are also fully protected in Scottish waters under the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), while bottlenose dolphin and harbour porpoise have further protection under Annex II of the Habitats Directive, which regulates the designation of SAC for those species. Additionally, in 2014, as part of the new powers and duties under The Marine (Scotland) Act 2010 and the UK Marine and Coastal Access Act 2009, Scottish Ministers adopted a list of 81 Priority Marine Features (PMFs) – which are features characteristic of the Scottish marine environment. All species of Cetaceans are included as PMFs.

Eight species of cetaceans have been recorded in the waters of east Scotland (SeaWatch Foundation, 2022). According to SeaWatch Foundation, the east region of Scotland (including inshore [within 60 km of the coast] and offshore waters) from Eyemouth on the Scottish Borders to Cape Wrath in Highland Region is moderately rich in cetacean fauna. Along the Grampian coast and Highland coasts, eight cetacean species (just under 29% of the 28 UK species) have been recorded regularly since 1980 (SeaWatch Foundation, 2022; Hague *et al*., 2020; Reid *et al.,* 2003; Hammond *et al.,* 2021).

The following eight cetacean species are known to frequent or seasonally visit the waters of the east coast of Scotland: Atlantic white-sided dolphin *Lagenorhynchus acutus*; harbour porpoise; bottlenose dolphin; white-beaked dolphin *Lagenorhynchus albirostris*; killer whale *Orcinus orca*; minke whale *Balaenoptera acutorostrata,* Risso's dolphin *Grampus griseus*; and long-finned pilot whale *Globicephala melas* (Hammond *et al.,* 2021; Hague *et al.,* 2020; SeaWatch Foundation 2022). Of these species, it is expected that Atlantic white-sided dolphin, bottlenose dolphin, harbour porpoise, killer whale, minke whale, Risso's dolphin and white-beaked dolphin occur with the most frequency in the survey area and export cable corridor and its surrounding waters based on survey data and available published abundance and distribution data (Reid *et al.,* 2003; Hague *et al.,* 2020; Hammond *et al.,* 2021). Additionally, there is potential for humpback whales *Megaptera movaeangliae* to be present within the proposed survey area and export cable corridor (Wildlife Trust, 2020).

The survey will take place over diverse geographical areas off the eastern Scottish coast. The following summarises those species regularly sighted in the vicinity of the proposed survey area and export cable corridor:

- Harbour porpoise - The most abundant cetacean species in UK waters and are generally observed in small groups of one to three individuals (Reid *et al.,* 2003). The density of harbour porpoise within Block R of the Small Cetaceans in Atlantic Waters of the North Sea (SCANS) III survey, within which the project resides, was approximately 0.599 animals/km^2, which is above average in the context of the wider United Kingdom Continental Shelf (UKCS) region (Hammond *et al.,* 2021). According to density modelling data (combining SCANS-III density data with environmental predictive factors), it is predicted that harbour porpoise densities within the project area will be moderate, with higher densities occurring in waters to the south of the project (Hague *et al.,* 2020; Hammond *et al.,* 2021). In addition, the peak calving period for harbour porpoises in Scottish waters is between April and June, indicating a possible increased sensitivity to any potential disturbance during this time. However, the annual distribution and relative abundance of harbour porpoise is moderate throughout the site (NMPi, 2022).

- Bottlenose dolphin - More common in Scottish inshore waters than offshore waters. Small resident or semi-resident populations occupy a few scattered coastal localities throughout Scotland (Cheney *et al.,* 2018). Bottlenose dolphins commonly form groups ranging in size of 2-25 individuals. Groups of several tens or low hundreds of animals have also been observed, although usually in offshore waters (Reid *et al.* 2003). Densities of bottlenose dolphin along the North coast of Scotland are expected to be lower than the West and East coast. Densities within Block R of the SCANS-III survey were approximately 0.03 animals/km^2, which is slightly above average for the region (Hammond *et al.,* 2021). In coastal waters, bottlenose dolphins favour river estuaries, headlands and sandbanks, mainly where there is uneven bottom relief and/or strong tidal currents (Wilson *et al.,* 1997). In Scottish waters, bottlenose dolphins occur around the west and east coasts, but with relatively few records on the north coast of mainland Scotland or around the Northern Isles (Thompson *et al.,* 2011). The Moray Firth SAC located approximately 120 km west of the offshore array area supports the only known bottlenose dolphin population in the North Sea, estimated at approximately 130 individuals (Wilson *et al*., 1999). While individuals associated with this protected site are primarily observed within the waters of the inner or Southern Moray Firth, infrequent sightings have been recorded in the waters of the offshore array area (Reid *et al.,* 2003; Cheney *et al.,* 2013).

- Minke whale - The smallest, most prevalent baleen whales to occur in Scottish waters. They feed mainly in shallower waters over the continental shelf and regularly appear around shelf banks and mounds, or near fronts where zooplankton and fish are concentrated at the surface (Reid *et al.,* 2003). They are also commonly seen in the strong currents around headlands and small islands, where they can come close to land, even entering estuaries, bays and inlets. Minke whale density within Block R of the SCANS-III survey is considered to be moderate in comparison to the rest of the UKCS, with an estimate 0.039 animals/km^2 (Hammond *et al.,* 2021). This species shows a large seasonal variation with much lower densities in the winter months, likely driven by variations in sea surface temperature and chlorophyll concentrations (Hague *et al.,* 2020). Breeding locations of this species are currently unknown. The annual distribution and relative abundance of minke whale is moderate to high throughout the survey area (0.02 – 0.1 animals) (NMPi, 2022). The Southern Trench NCMPA, located 11 km to the west of the offshore array area and within the export cable corridor, is designated for marine megafauna, specifically the protection of minke whales which are frequently sighted in the summer months in the Outer Moray Firth (SNH, 2014).

- White-beaked dolphin - Common in Northern European continental shelf seas from Iceland and Norway south to Ireland and Southwest England, including the northern and central North Sea. White-beaked dolphin have an estimated density within Block R of the SCANS III survey of 0.243 animals/km^2, which is considered moderate compared to the rest of the UKCS (Hammond *et al.,* 2021). According to SeaWatch Foundation (2022) peak numbers and frequency of sightings occur between June and September (particularly August). The north of Scotland is used both for feeding and breeding by white-beaked dolphin, primarily between May and August, when this species may be most sensitive to disturbance. The monthly distribution and relative abundance of white-beaked dolphin is low (0.01 – 1.9 animals) between the months of February, May and July – September (NMPi, 2022).

- Other cetacean species - Other species such as Atlantic white-sided dolphin, Risso's dolphin and killer whales are encountered intermittently throughout the year along the north coast of Scotland, with no obvious spatial or temporal patterns in abundance or distribution (Reid *et al.,* 2003; Hague *et al.,* 2020) or not within the proposed survey area or export cable corridor (Hammond *et al.,* 2021). Humpback whales have been sporadically seen around the UK, with common sightings being observed in Shetland and the Outer Hebrides. Increasingly, more sightings have been recorded in the Northern North Sea (Wildlife Trust, 2020). Predicted density surfaces could not be developed for killer whales, Risso's dolphin, humpback whale or white-sided dolphins as there were not enough sightings (Hague *et al.,* 2020). Due to insufficient data, Risso's dolphin, humpback whales and killer whales have not been included within the EPS Risk Assessment.

3.2.1.1 ***Potential Impacts***

Noise emissions from the proposed activities constitute the greatest potential risk of injury or disturbance to cetaceans in the vicinity of the proposed survey area and export cable corridor. Injury and disturbance from underwater noise may impact cetaceans in the following ways:

- Injury – physiological damage to auditory or other internal organs; and
- Disturbance (temporary or continuous) – disruptions to behavioural patterns, including, but not limited to migration, breathing, nursing, breeding, foraging, socialising and / or sheltering.

To determine the potential for noise impacts to cetaceans and pinnipeds, predicted emission levels are compared to available empirically estimated thresholds for injury and disturbance. Several threshold criteria and methods for determining how sound levels are perceived by marine mammals are available (e.g., the decibel hearing threshold (dBht) method and other hearing weighted and linear measures) and each has its own advantages and disadvantages. Scottish Government (2020) guidance recommends using the injury and disturbance criteria proposed by Southall *et al.* (2007), which is based on a combination of linear (un-weighted) peak sound pressure levels (SPL) and weighted sound exposure levels (SEL). Since the publication of this paper (Southall *et al.,* 2007), there has been mounting evidence of marine mammal auditory abilities in novel species and well-researched species alike (e.g., harbour porpoise) which has led to amendments to the auditory thresholds for injury (NMFS, 2018; Southall *et al.,* 2019). In accordance with recent regulator feedback, these amended hearing groups and thresholds for acoustic injury have been adopted herein; they are detailed in Table 3-2.

If a noise emission is composed of frequencies which lie outwith the estimated auditory bandwidth for a given species, then disturbance or injury is extremely unlikely. To understand the potential for noise-related impacts, the likely hearing sensitivities of different cetacean hearing groups has been summarised in Table 3-2 which is the basis for screening out MBES, SSS, and SVP from further assessment as detailed in Table 3-1.

Table 3-2 Auditory Bandwidths Estimated for Cetaceans (Southall et al., 2019; NMFS, 2018)

Hearing Group	Estimated Auditory Bandwidth
Low-frequency cetaceans (LF): (e.g. baleen whales, such as humpback whales, minke whales, fin whales, etc.)	7 Hz to 35 kHz
High-frequency cetaceans (HF): (e.g. dolphins, toothed whales, beaked whales and bottlenose whales)	150 Hz to 160 kHz
Very high-frequency cetaceans (VHF): (e.g. harbour porpoises and other 'true' porpoises)	275 Hz to 160 kHz

3.2.2 Eurasian Otters

Otters (*Lutra lutra*) are small, semi-aquatic mammals which inhabit riverine, brackish and coastal environments throughout the UK. Although land mammals, otters depend on both freshwater and marine environments for food. Their marine habitat comprises low, peat-covered coastlines with shallow, seaweed rich waters and a consistent freshwater supply (DECC, 2016).

3.2.2.1 *Potential Impacts*

Otters may be disturbed by the presence of vessels but are not particularly sensitive to noise. The proposed survey area and export cable corridor will occur largely within the offshore environment; however, the survey will also venture inshore to the coastal area. Therefore, there may be potential for impacts to otters to occur.

3.2.3 Pinnipeds

Two pinniped (seal) species regularly occur in the Scottish offshore and coastal environment: grey seals *Halichoerus grypus* and harbour seals *Phoca vitulina*. Both grey and harbour seals are listed under Annex II of the EU Habitats Directive and are PMFs. Approximately 36% of the world's grey seals breed in the UK (81% of these breed at colonies in Scotland with the main concentrations in the Outer Hebrides and in Orkney). Approximately 32% of the world's harbour seals are found in the UK, however, this proportion has declined from approximately 40% in 2002. Harbour seals are widespread around the west coast of Scotland and throughout the Hebrides and Northern Isles (SCOS, 2020). Seal haul-outs are terrestrial sites designated for the protection of seals during vulnerable haul-out periods, such as breeding and pupping. The extent of this protection is limited to those seals on shore at the haul-out. Grey seals and harbour seals have been observed within the waters of the proposed survey array area and export cable corridor, with estimated sightings recording mean densities of 1-25 individuals per 25 km^2 and 0-1 individuals per 25 km^2 respectively (Russell *et al.,* 2017). Within the proposed survey area and export cable corridor, mean densities of grey seals have been estimated at 5-10 individuals per 5 km^2 and for harbour seals 1-5 individuals per 5 km^2. When compared to other regions of the UKCS, these densities are considered to be moderate to low (Marine Scotland, 2017).

There are a number of designated seal haul-outs sites which are present along the southeast Scottish coastline (NMPi, 2022). However, the nearest of these sites is located >25 km from the export cable corridor.

There is one SACs designated for the protection of seal species within 50 km of the proposed survey area and export cable corridor. The Ythan River mouth is located approximately 26 km southwest from the export cable corridor and is a designated seal-haul out site. Therefore, it is expected that there may be potential impacts to seal populations. However, mitigation protocols identified as being required for cetaceans will also be implemented for seals.

3.2.3.1 *Potential Impacts*

Under the Marine (Scotland) Act 2010 it is an offence to kill or injure a seal. An assessment below focuses on the potential for injury to seals from survey activities.

Potential impacts from the geophysical survey may arise from underwater noise generated during the proposed activities and physical disturbance at haul-outs (i.e. from vessel or human presence). Seals are particularly susceptible to project-related impacts during their respective pupping and moulting seasons, when the residency of seals at haul-outs and in surrounding waters elevates the relative density of each species.

Underwater noise emissions have the potential to cause physical injury or disturbance to seals, particularly if they

fall within their generalised hearing range of 50 Hz to 86 kHz, as detailed within Table 3-3 (NMFS, 2018; Southall *et al.,* 2019). If a noise emission is composed of frequencies which lie out with the estimated auditory bandwidth for a given species, then disturbance or injury is extremely unlikely. An assessment of underwater noise impacts on seals has been undertaken and is presented within Section 3.3.

Table 3-3 Auditory Bandwidths Estimated for Pinnipeds (NMFS, 2018; Southall et al., 2019)

Hearing Group	Estimated Auditory Bandwidth
Phocid carnivores in water e.g., ear-less or 'true' seals, such as grey and harbour seals	50 Hz to 86 kHz

The survey is due to take place over 42 days. The earliest start date will be the 1st July 2022 with an estimated end date of 30th September 2022. Therefore, the proposed period of activities will coincide with the sensitive moulting period for harbour seals (June – August) and the breeding and pupping seasons of harbour seals (June to August) and grey seal breeding and pupping seasons - September to December (Marine Scotland, 2014). In addition, contemporary data suggests that even with very intense noise emissions, such as those from pile driving activity, harbour seals are likely to return to the region of the noise source once the emissions have ceased (Brasseur *et al.,* 2010). Where this leads to an animal avoiding their main feeding and breeding grounds this can have longer term effects the on health and breeding ability of that animal (Kastelein *et al.,* 2006).

Project activities will not result in the catching or killing of seals, and thus the protection provided to the two species by the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) will not be breached.

3.2.4 Basking Sharks

Basking sharks *Cetorhinus maximus* are one of the only three species of shark which filter feed and are the second largest fish in the world (Sims, 2008). This species can be found throughout the offshore waters in the UK continental shelf (Sims, 2008) and are considered frequent visitors to the north and west coasts of Scotland (HWDT, 2018; Witt, *et al.,* 2012). They are widely distributed in cold and temperate waters and feed predominantly on plankton and zooplankton e.g. barnacles, copepods, fish eggs and deep-water oceanic shrimps by filtering large volumes of water through their wide-open mouth. They typically move very slowly (around 4 miles per hour). In the winter, they dive to great depths to get plankton while in the summer they are mostly near the surface, where the water is warmer.

Basking sharks were hunted in Scotland up to 1994 (Scottish Wildlife Trust, 2022). However, they are now protected in the UK waters principally under Schedule 5 of the Wildlife and Countryside Act 1981 and under the Nature Conservation (Scotland) Act 2004 and are classed as Scottish PMF as well as a species on the Oslo and Paris Convention (OSPAR) list. Due to their size, slow swimming speeds and preference for swimming in coastal waters during the summer months, basking sharks are considered to be at potential risk of collision with vessels associated with the survey activities. Given that basking sharks are slow to mature and have a long gestation period, the species can be slow to recover if populations are rapidly depleted.

Basking sharks seasonally visit Scottish coastlines in the spring and leave in autumn. In the summer, basking sharks spend the majority of time near the surface, where they appear to be basking whilst feeding on plankton. Summer also functions as a potential breeding season for the species, with aggregations of individuals peaking in July and August. They are mainly found around the western isles of Scotland, but at certain times can be found in the Northern Isles or along the east coast as an occasional visitor (Witt *et al.,* 2012). Basking shark sightings recorded by NatureScot (then SNH), made available on the National Marine Plan Interactive (NMPi) show the observed

adjusted densities of basking sharks in the waters surrounding Scotland for all seasons between 2000 – 2012 (NMPi, 2022). The observed basking shark density within the proposed survey area and export cable corridor is between 0.0 – 0.1 species. However, there have been species sighted on the south-east coast of Scotland (NMPi, 2022).

3.2.4.1 ***Potential Impacts***

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. 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. However, 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 geophysical survey, and the activities are of short duration, 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. Collision risk increases with increasing vessel speed. However, as the survey vessels will be slow-moving and will follow a pre-determined survey transect, the potential for collision risk is generally low.

The potential to impact basking sharks is therefore considered very low as this species is unlikely to be found within the vicinity of the planned survey. Therefore, an application for a Basking Shark licence under the Wildlife and Countryside Act 1981 (as amended) will not be required.

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3.3 Sound Assessment

3.3.1 Underwater Sound Assessment Metrics

Sound is transmitted through liquids as longitudinal waves, or compression waves. These are waves of alternating pressure deviations from the equilibrium pressure, causing local regions of compression and rarefaction. Sound pressure (p) is therefore the average variation in pressure caused by the sound. By convention, sound levels are expressed in decibels (dB) relative to a fixed reference pressure commonly 1 micropascal (µPa) for underwater measurements, as measurements typically cover a very wide range of pressure values. These values are generally derived by measuring levels at some distance from the source and extrapolating back to a virtual point 1 m from the source.

3.3.1.1 *Peak Sound Pressure Level (SPL)*

The Peak SPL, or zero-to-peak sound pressure, is the maximum sound pressure during a stated time interval. A peak sound pressure may arise from a positive or negative sound pressure, and the unit is the pascal (Pa). This quantity is typically useful as a metric for a pulsed waveform, though it may also be used to describe a periodic waveform.

3.3.1.2 *Root Mean Square (RMS) sound pressure*

The Root Mean Square (RMS) SPL (SPLrms) is the mean square pressure level measured over a given time interval. Therefore, it represents a measure of the average sound pressure level over the time. The RMS sound pressure is expressed in pascals (Pa).

When the SPLrms is used to quantify a transient sound source the time period over which the measurements are averaged must be given, as the SPLrms value will vary with the averaging time period.

3.3.1.3 *Sound Exposure Level (SEL)*

The SEL is the time integral of the square pressure over a time window long enough to include the entire pressure pulse. The SEL is therefore the sum of the acoustic energy over a measurement period, and effectively takes account of both the level of sound, and the duration over which the sound is present in the environment.

3.3.1.4 *Pulse duration*

The pulse duration is the time during which a specified percentage of sound energy in the signal occurs. In the calculation, sound exposure may be used as a proxy for energy. The pulse duration is expressed in units of seconds (s).

3.3.2 Marine Mammal Impact Criteria

Underwater sound has the potential to affect marine life in different ways depending on its sound level and characteristics. Richardson *et al.* (1995) defined four zones of sound influence which vary with distance from the source and level. These are:

- The zone of audibility: this is the area within which the animal is able to detect the sound. Audibility itself does not implicitly mean that the sound will have an effect on the marine mammal.

- The zone of responsiveness: this is defined as the area within which the animal responds either behaviourally or physiologically. The zone of responsiveness is usually smaller than the zone of audibility because, audibility does not necessarily evoke a reaction.

- The zone of masking: This is defined as the area within which sound can interfere with detection of other sounds such as communication or echolocation clicks. This zone is very hard to estimate due to a paucity of data relating to how marine mammals detect sound in relation to masking levels (for example, humans are able to hear tones well below the numeric value of the overall sound level).

- The zone of hearing loss, discomfort, or injury: this is the area where the sound level is high enough to cause tissue damage to auditory or other systems. This can be classified as either a Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS). At even closer ranges, and for very high intensity sound sources (e.g., underwater explosions), physical trauma or even death are possible.

For this assessment, the zones of injury in terms of PTS and disturbance (i.e., responsiveness) are considered of concern (there is insufficient scientific evidence to properly evaluate masking). To determine the potential injury and disturbance, a review has been undertaken of available evidence, including international guidance and scientific literature. The following sections summarise the relevant thresholds for onset of effects and describe the evidence base used to derive them.

3.3.2.1 *Injury (Physiological Damage)*

The Joint Nature Conservation Committee (JNCC) (2010) recommends using the injury criteria proposed by Southall *et al.* (2007), which are based on a combination of linear (i.e., un-weighted) peak pressure levels and mammal hearing weighted (M-weighted) SEL.

In 2018, the National Marine Fisheries Service (NMFS) published details of the acoustic thresholds at which individual marine mammals are predicted to experience changes in their hearing sensitivity for acute, incidental exposure to all underwater anthropogenic sound sources (NMFS, 2018). These new thresholds were based on new/updated scientific formation that demonstrated the differences between the marine mammal hearing groups first categorised in Southall *et al.* (2007).

Southall *et al*. (2007) was revaluated their work considering the scientific advances and as a result published revised sound exposure criterion to predict the onset of auditory effects in marine mammals (Southall *et al.,* 2019). The only significant difference between Southall *et al.* (2019) and NMFS (2018) is the re-categorisation of Mid-Frequency (MF) and HF groups to HF and VHF respectively i.e., very high frequency for greater clarity. This risk assessment retains the categorisation used in NMFS guidance, namely, MF and HF.

The hearing weighting functions used in NMFS (2018) are designed to represent the bandwidths of each group within which acoustic exposures may have auditory effects. This study uses the NMFS (2018) hearing group frequency categories:

- LF i.e., marine mammal species such as baleen whales with an estimated functional hearing range between 7 Hz and 35 kHz;

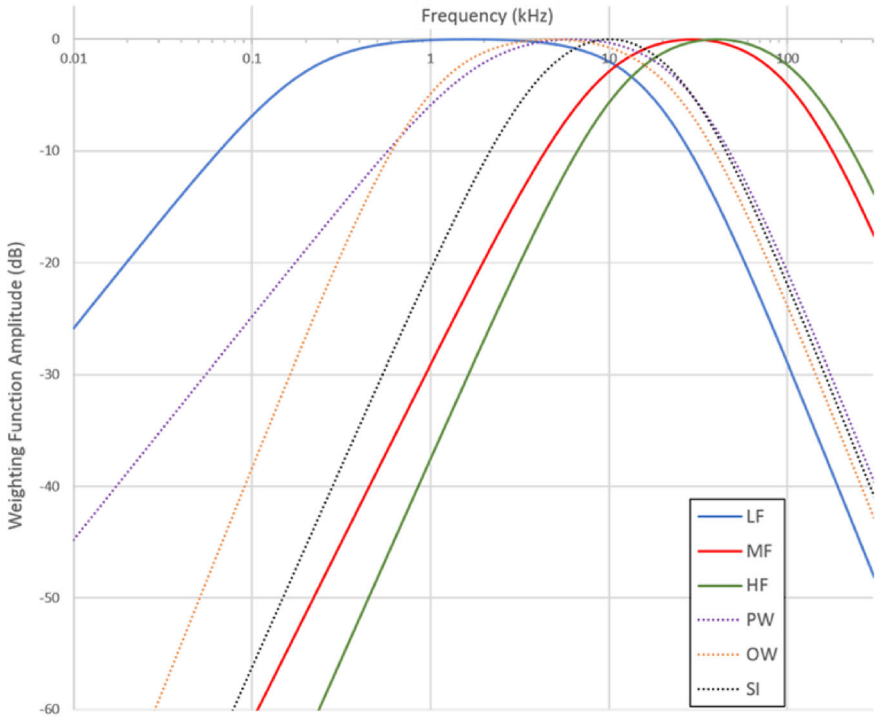
- MF i.e., marine mammal species such as dolphins, toothed whales, beaked whales and bottlenose whales with an estimated functional hearing range between 150 Hz and 160 kHz

- HF i.e., marine mammal species such as true porpoises, river dolphins and *Cephalorhynchus* with an estimated functional hearing range between 275 Hz and 160 kHz); and

- Pinnipeds in water (PW) – i.e., a suborder of carnivorous aquatic mammals that includes seals, walruses and other similar animals having finlike flippers with an estimated functional hearing range between 50 Hz and 86 kHz.

These are illustrated in Figure 3-1.

Figure 3-1 Auditory weighting function for pinnipeds and cetaceans (NMFS, 2018)[2]



3.3.3 Disturbance

The JNCC guidance (JNCC, 2010) proposes that a disturbance offence may occur when there is a risk of a significant group of animals incurring sustained or chronic disruption of behaviour or when a significant group of animals are displaced from an area, with subsequent redistribution being significantly different from that occurring due to natural variation.

There is an intra-hearing group category as well as intra-species variability in behavioural response. Therefore, this assessment adopts a simplified approach in the absence of further scientific information and uses the NMFS Level B harassment threshold of 160 dB re 1 µPa (rms) for impulsive sound.

Level B Harassment is defined as having the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild. This is similar to the JNCC (2008) description of non-trivial disturbance and has therefore been adopted as the basis for onset of behavioural change in this assessment.

[2] Sirenians (SI) and Otariids in water (OW) are not relevant to the current study.

Exposure to sound levels in excess of the behavioural change threshold stated above does not necessarily imply that the sound will result in significant disturbance as defined in the legislation. Whether or not a behavioural response might occur is widely recognised as being highly context specific (Southall *et al.*, 2021; Southall *et al.,* 2019; Southall *et al.,* 2007). As noted previously, it is also necessary to assess the likelihood that the sensitive receptors will be exposed to that sound and whether the numbers exposed are likely to be significant at the population level.

3.3.3.1 *Criteria summary*

The PTS threshold criteria adopted within the study was those presented in NMFS (2018). These have been reproduced in Table 3-4.

Table 3-4 Marine Mammal Criteria for Onset of PTS (NMFS, 2018)

Marine Mammal Group	Type of Sound	PTS Threshold Criteria	
		SPLpeak, dB re 1 µpa (unweighted)	Cumulative SEL[3], dB re 1 µpa²s (weighted)
LF Cetaceans	Single or multiple pulses e.g. impulsive	219	183
	Non-impulsive e.g. continuous sound	-	199
MF Cetaceans	Single or multiple pulses e.g. impulsive	230	185
	Non-impulsive e.g. continuous sound	-	198
HF Cetaceans	Single or multiple pulses e.g. impulsive	202	155
	Non-impulsive e.g. continuous sound	-	173
PW (underwater)	Single or multiple pulses e.g. impulsive	218	185
	Non-impulsive e.g. continuous sound	-	201

3.3.4 Methodology

3.3.4.1 *Approach*

The underwater sound assessment were conducted using Xodus' Xposure model, a set of tools developed for common sound sources (e.g., piling, surveys). This modelling tool is based on an extended version of the semi-empirical model developed by Marsh & Schulkin (1962). This model has formed the basis of various updates and revised models (i.e Colossus) and is used in other ray tracing models. The sound propagation model uses several concepts including:

- Refractive cycle, or skip distance;
- Geometric divergence;
- Deflection of energy to the seabed at high angles by scattering from the sea surface;

[3] The recommended accumulation period is 24-hours

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- A simplified Rayleigh two-fluid model of the seabed for sand or mud sediments; and
- Absorption of sound energy by molecules in the water.

The following inputs are required to the model:

- Third-octave band source sound level data
- Discreet range (distance from source to receiver);
- Water column depth and sediment layer depth;
- Sediment type (sand/mud);
- Sea state; and
- Source directivity characteristics.

The Marsh & Schulkin (1962) model is based on a combination of acoustic theory and empirical data from around 100,000 measurements and has been found to provide good predictions.

As well as calculating the un-weighted RMS and peak sound pressure levels at various distances from the source, it is also necessary to calculate the SEL for a mammal using the relevant auditory weightings described earlier taking into account the number of pulses to which it is exposed. For operation of the survey source, the SEL sound data for a single pulse was utilised, along with the maximum number of pulses expected to be received by marine mammals in order to calculate cumulative exposure. Two conditions were modelled:

- A source vessel passing a static mammal ; and
- A mammal moving away from a moving vessel.

Both cases were modelled for a range of start distances (initial or closest passing distance between the animal and vessel) to calculate cumulative exposure for the scenarios (moving vessel, static mammal and moving animal, moving vessel). In each case, the pulses to which the mammal is exposed in closest proximity to the vessel dominate the sound exposure. This is due to the logarithmic nature of sound energy summation.

It should be noted that the offshore sound exposure calculations are based on the simplistic assumption that the sound sources are active continuously over a worst-case 24-hour period, being activated at the same interval. However, for the inshore survey, sound exposure calculations assume the sound sources are active continuously over a 12-hour period, being activated at the same interval. In the real-world the situation is more complex with the device not activated during turns for example. However, the SEL calculations do not take any breaks in activity into account and therefore the activation period is assumed to be consecutive and therefore worst case. However, the potential for recovery is not accounted for in the multiple pulse sound criteria described in NMFS (2018) and so as far as the SEL calculation is concerned breaks in activity are not considered in the assessment.

Survey activities are assumed to be continuous. With the Source Point Interval (SPI) set very low this will mean that cumulative SELs will be comparatively high, albeit the pulses to which the mammal is exposed in closest proximity will dominate the sound exposure.

3.3.4.2 *Model inputs*

SBP survey operations are planned to be conducted using a combination of devices depending on the survey vessel utilised. The SBPs considered in this assessment are:

- Innomar Medium 100 (Offshore vessel);
- GeoSource 200 (Offshore vessel);
- Innomar SES-2000 Compact (Inshore vessel); and
- Applied Acoustics AA200 Boomer (Inshore vessel).

Water depths vary from mean high-water springs to 10 m along the export cable corridor, gradually deepening to 95 m within the proposed survey area. Following model sensitivity testing, it was confirmed that the deeper water depths produce larger predicted regions of influence. For the offshore survey, the SBPs modelled scenarios consider a 95 m water depth. For the inshore SBPs, the modelled scenarios consider a 10 m water depth.

The details of each of the sound sources modelled are provided in Table 3-5.

Table 3-5 Modelled SBP Scenarios

Parameter	Innomar Medium 100	GeoSource 200	Innomar SES-2000 Compact	Applied Acoustics AA200 Boomer
Hull mounted or towed	Hull mounted	Towed	Hull mounted	Hull mounted
Source depth (m)	3	0.3	1.0	0.15
Source point interval (s)	0.1	1	0.1	0.5
Ping length (s)	0.07	0.0001	0.00016	0.25
Peak energy frequency (kHz)	100	1.5	115	12
SPL_{peak} (dB re 1µPa @1m)	247	228	241	217
SPL_{RMS} (dB re 1µPa @1m)	244	225	238	214
SEL (dB re 1 μpa^2s @ 1m)	243	186	205	186
Vessel Speed (m/s)	2		2	
Maximum survey time per 24-hour period (hrs)	24		12	
Water depth (m)	95		10	
Sediment type	Sand			

3.3.5 Results

3.3.5.1 *Summary of Results*

The distances at which sound levels decrease to below threshold values associated with potential injury and behavioural change for the different modelled scenarios are summarised in Table 3-6 to Table 3-9, based on a comparison of the calculated sound level against the criteria described in Section 3.3.3.1. Injury zones are

presented relative to the leading edge of the survey operations. The emitted sound is assumed to be omni-directional, therefore the distances are presented as the radius of the predicted effected zone. The operating frequency ranges for each proposed SBP are very similar and therefore the predicted impact areas for peak SPL are all within +/- 0.5 m of one another.

Table 3-6 Radius of Predicted Effect for PTS from the Innomar Medium 100 @ 100 kHz

Situation	Predicted distance at which sound levels decrease to below threshold values (m)			
	LF Cetacean	MF Cetacean	HF Cetacean	Pinnipeds
Peak pressure SPL (PTS)	23	12	65	24
SEL weighted (PTS) of vessel passing static mammal	78	78	84	78
SEL weighted (PTS) of mammal swimming away from moving vessel	67	78	79	75

Table 3-7 Radius of Predicted Effect for PTS from the GeoSource 200 @ 1.5 kHz (N/E denotes none expected).

Situation	Predicted distance at which sound levels decrease to below threshold values (m)			
	LF Cetacean	MF Cetacean	HF Cetacean	Pinnipeds
Peak pressure SPL (PTS)	4	1	31	5
SEL weighted (PTS) of vessel passing static mammal	17	N/E	14	6
SEL weighted (PTS) of mammal swimming away from moving vessel	3	N/E	3	1

Table 3-8 Radius of Predicted Effect for PTS from the Innomar SES-2000 Compact at 115 Hz (N/E denotes none expected).

Situation	Predicted distance at which sound levels decrease to below threshold values (m)			
	LF Cetacean	MF Cetacean	HF Cetacean	Pinnipeds
Peak pressure SPL (PTS)	14	7	37	14
SEL weighted (PTS) of vessel passing static mammal	7	8	8	8
SEL weighted (PTS) of mammal swimming away from moving vessel	3	8	8	5

Table 3-9 Radius of Predicted Effect for PTS from the Applied Acoustics AA200 Boomer at 12Hz (N/E denotes none expected).

Situation	Predicted distance at which sound levels decrease to below threshold values (m)			
	LF Cetacean	MF Cetacean	HF Cetacean	Pinnipeds
Peak pressure SPL (PTS)	N/E	N/E	5 m	N/E
SEL weighted (PTS) of vessel passing static mammal	6 m	5 m	8 m	6 m
SEL weighted (PTS) of mammal swimming away from moving vessel	2 m	1 m	8 m	2 m

The distances presented reflect the start point of the mammal relative to the source when the source first emits sound. The source would then move away from the mammal receiver position, so the distance between the mammal and the source would increase over time whether the mammal was static or moving away from the source.

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The potential ranges presented for injury and disturbance should not be interpreted as a hard and fast contour 'line' within which an impact will occur. The contour provides a conservative distance estimate at which sound levels will decrease to below SEL threshold values for PTS., which is a probabilistic combination of a range of variables; exposure dependency in PTS onset, individual variations in hearing, uncertainties regarding behavioural response and swim speed / direction.

3.3.5.2 ***Peak Pressure***

The results indicate a range of predicted distances at which the sound levels will decrease below the SPL threshold values for PTS with large variations between the SBP devices. While the proposed survey area and export cable corridor will be surveyed at the same time, due to the distance of the export cable corridor to the survey area, no cumulative impacts are expected. The results for the Innomar Medium 100 SBP (Figure 3-2) indicate predicted distances at which sound levels decrease below the SPL threshold values of 65 m for HF cetaceans. For the other devices the distances for these HF cetaceans are predicted to be 37 m or less.

For the use of the proposed SBPs, the predicted distances at which the sound levels will decrease below the SPL threshold values for PTS are lowest for the MF cetaceans.

The peak pressure levels for the baseline conditions for each proposed SBP sound source are represented graphically in Figure 3-2 to Figure 3-5.

Figure 3-2 Start Distances Resulting in Exceedance of Guideline Peak Criteria for Onset of PTS in Marine Mammals (Innomar Medium 100 @ 100 kHz)

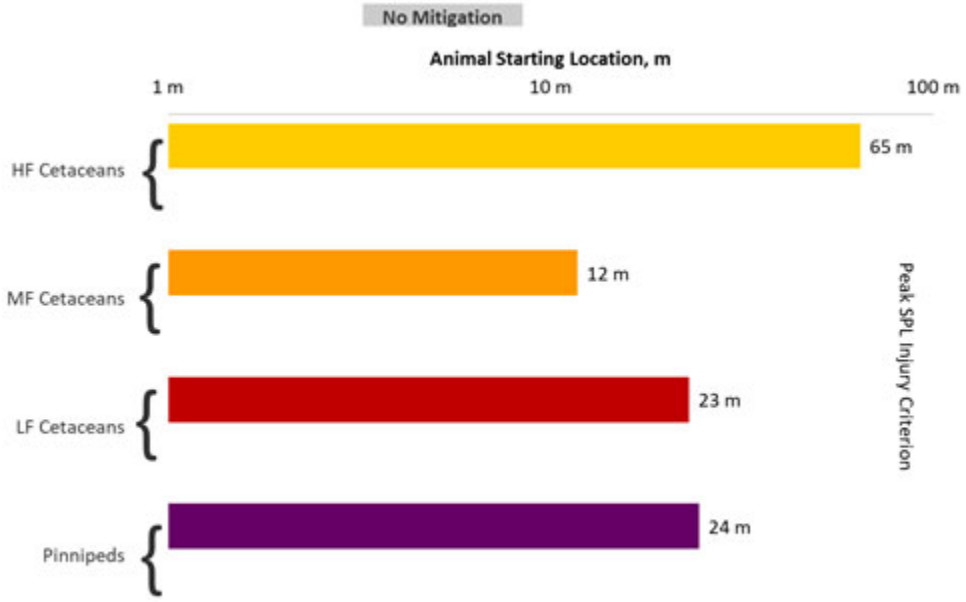

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Figure 3-3 Start Distances Resulting in Exceedance of Guideline Peak Criteria for Onset of PTS in Marine Mammals (GeoSource 200 @ 1.5 kHz)

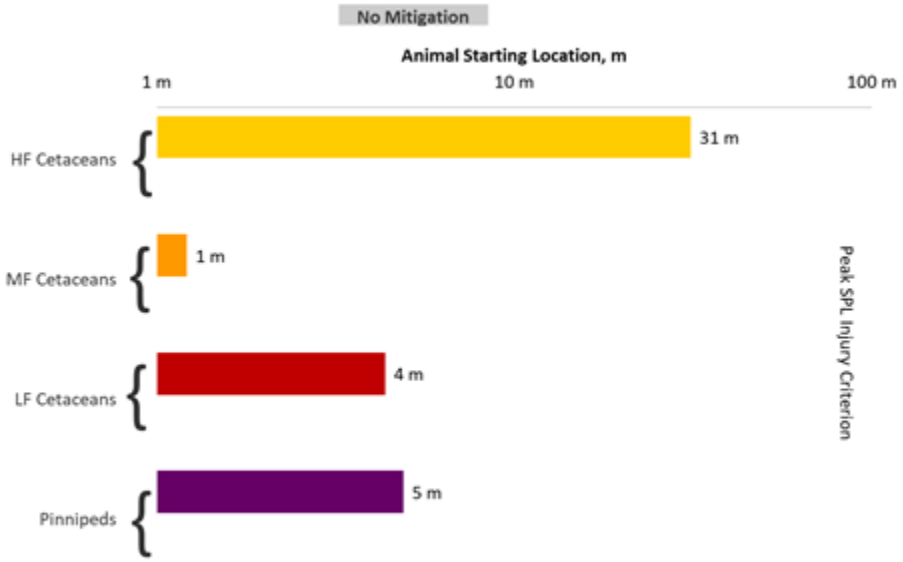

Figure 3-4 Start Distances Resulting in Exceedance of Guideline Peak Criteria for Onset of PTS in Marine Mammals (Innomar SES-2000 Compact at 115 Hz)

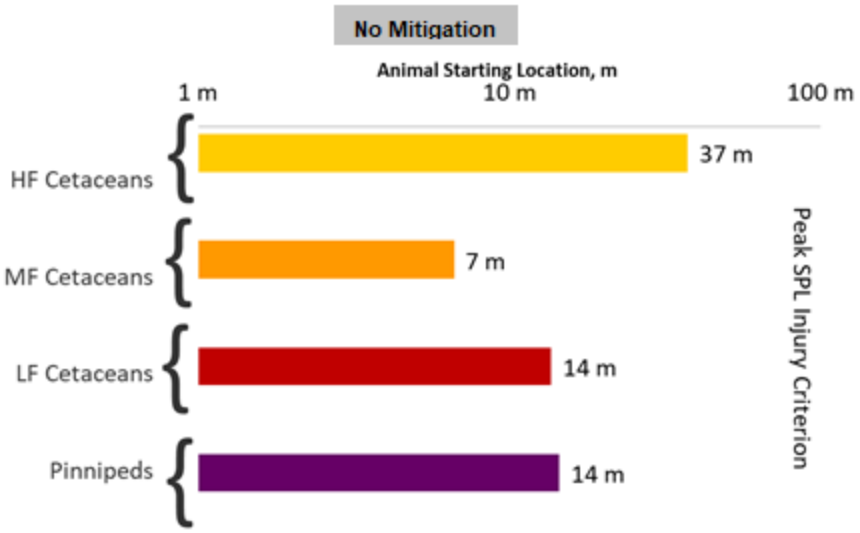

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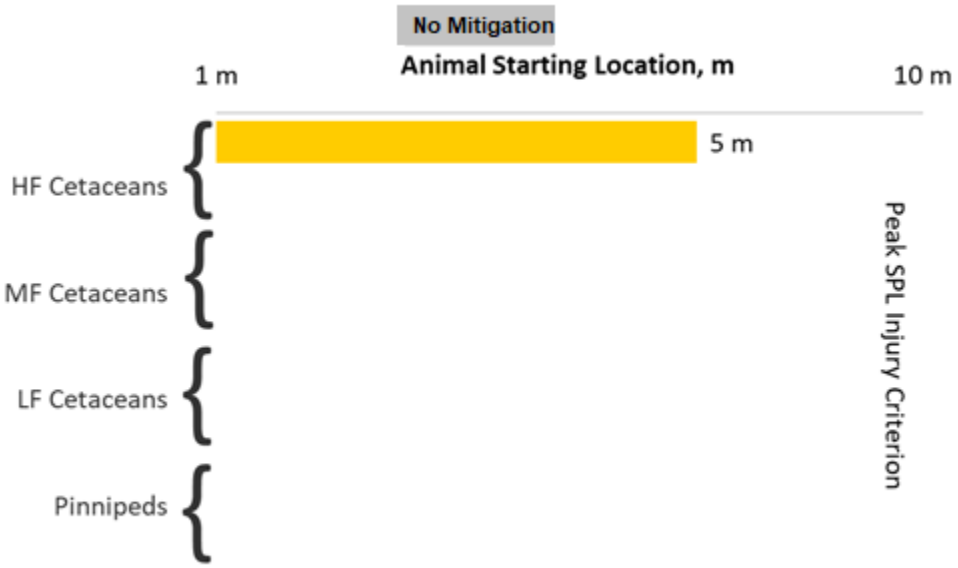
Figure 3-5 Start Distances Resulting in Exceedance of Guideline Peak Criteria for Onset of PTS in Marine Mammals (Applied Acoustics AA200 Boomer at 12Hz)



3.3.5.3 *Cumulative Weights SEL*

The sound exposure level for; i) a marine mammal staying stationary relative to the passing source array and ii) a marine mammal moving away from a moving source array at a constant speed of 1.5 m/s are shown in Figure 3-6 to Figure 3-9. Missing distance bars within the Figures indicates that the predicted distances were less than 1 m.

The assumption that the mammal would stay stationary during a period of survey activity is considered to be unrealistic. A more realistic assumption is that, upon hearing the onset of survey activity, the mammal would move away from the sound source, hence the first pulse would provide the highest 'dose' of sound, with each subsequent pulse contributing less to their exposure as they move away from the source. Swim speeds of the species most likely to be observed in the area have been shown to be up to 5 m/s e.g. a cruising minke whale swims at a speed of 3.25 m/s (Cooper *et al.,* 2008) and harbour porpoise up to 4.3 m/s (Otani *et al.,* 2000). Further, Scottish Natural Heritage (SNH) (now NatureScot) (2016) has provided standard parameter values for various mammals which include mean swimming speeds. For example, for harbour porpoises the mean speed is 1.4 m/s (Westgate *et al.,* 1995); harbour seal / grey seals 1.8 m/s (Thompson, 2015); minke whale 2.1 m/s (Williams, 2009). Therefore, to take a representative approach, the predicted exposures of marine mammals moving away from the sound source have been calculated using a mean swim speed of 1.5 m/s.

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Figure 3-6 Start Distances Resulting in Exceedance of Guideline SEL Criteria for Onset of PTS in Marine Mammals (Innomar Medium 100 @ 100 kHz)

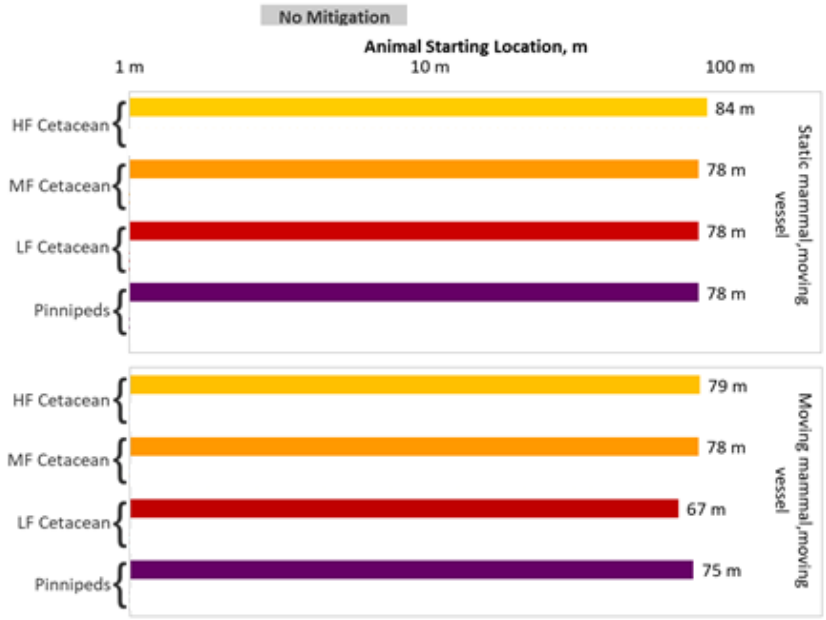

Figure 3-7 Start Distances Resulting in Exceedance of Guideline SEL Criteria for Onset of PTS in Marine Mammals (GeoSource 200 @ 1.5kHz)

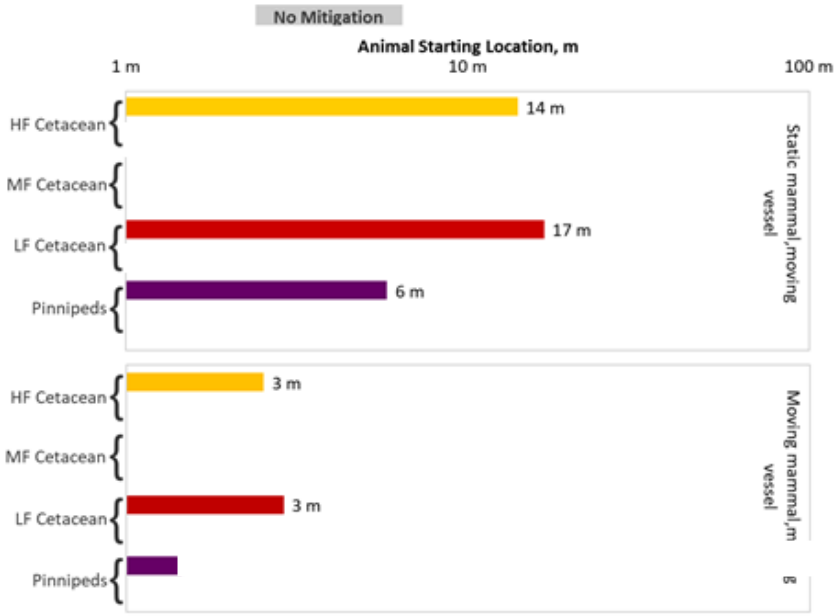

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Figure 3-8 Start Distances Resulting in Exceedance of Guideline SEL Criteria for Onset of PTS in Marine Mammals (Innomar SES-2000 Compact at 115 Hz)

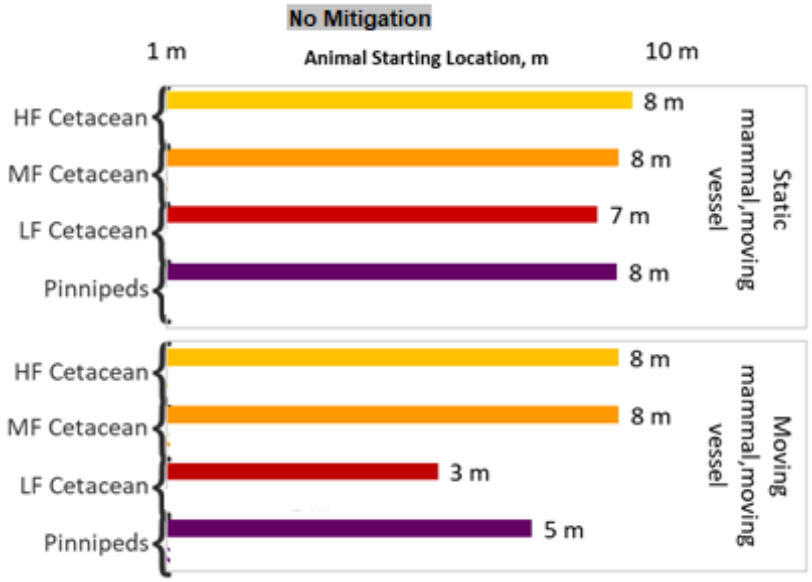

Figure 3-9 Start Distances Resulting in Exceedance of Guideline SEL Criteria for Onset of PTS in Marine Mammals (Applied Acoustics AA200 Boomer at 12Hz)

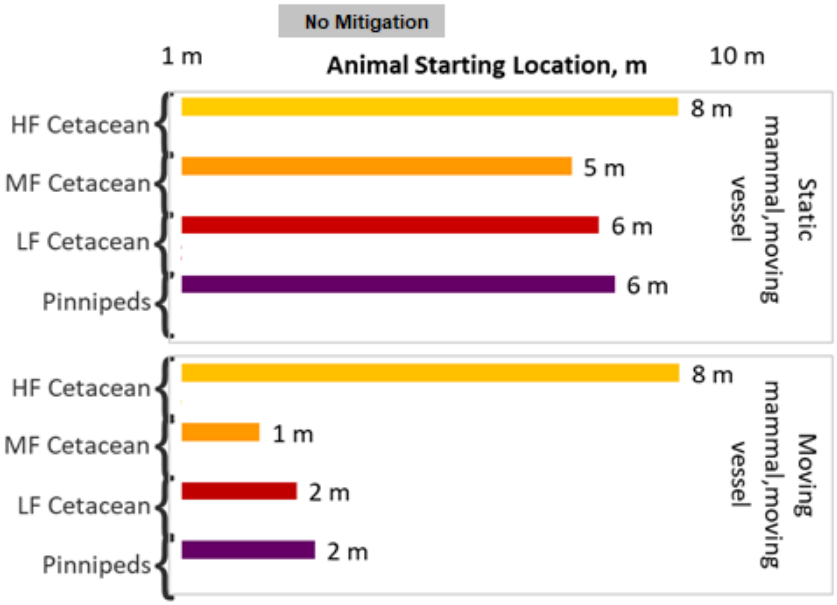

Figure 3-6 indicates that for the Innomar Medium 100 SBP, the sound levels are predicted to decrease to below the SEL threshold value for PTS at distances greater than 84 m for a static mammal scenario, and 79 m for a mammal swimming away from the source.

The operation of the GeoSource 200 is predicted to produce the smaller distance for which the sound levels decrease to below the SEL threshold for PTS; with distances within 3 m for a mammal swimming away from the sound source.

The two inshore SBPs, as shown in Figure 3-8 and Figure 3-9 predicted to produce the smaller distance for which the sound levels decrease to below the SEL threshold for PTS; with distances within 8 m or less for a mammal swimming away from the sound source.

3.3.5.4 *Behavioural Effects*

The sound assessment considered the general 160 dB threshold proposed by NMFS (2005) as an indicator of potential behavioural impact zones. As a worst-case the results presented corresponds to a static marine mammal. The predicted impact distances for each of the proposed SBPs are summarised in Table 3-10.

Table 3-10 Radius of Potential Behavioural/TTS Impact Distances from the Proposed SBPs Sources (m)

Mammal Classification	Metric	Innomar Medium 100	GeoSource 200	Innomar SES-2000 Compact	Applied Acoustics AA200 Boomer
Behavioural change (160 dB threshold)	SEL_{RMS}	462	91	74	400

For a single source pulse, the model results indicate a predicted worst-case impact radius of 462m based on the 160 dB threshold criteria for the Innomar Medium 100.

Behavioural changes such as moving away from an area for short periods, reduced surfacing time, masking of communication signals or echolocation clicks, vocalisation changes and separation of mothers from offspring for short periods, do not necessarily imply that detrimental effects will result for the animals involved. In addition, the pulses will be intermittent rather than a continuous sound, which will reduce the period over which sound is experienced and allow animals to echolocate and communicate between pulses. Some whales are known to continue calling in the presence of pulses since the vocalisations can be heard between pulses (e.g. Greene & McLennan, 2000, Madsen *et al.,* 2002). It is therefore considered that the zone of behavioural change will not be a zone from which animals are necessarily excluded, but rather one in which normal behaviour might be affected across a range of potential responses, from a simple noticing of the sound to a startle response and return to normal behaviour, through to exclusion from an area. The fact that an animal is within this area does not necessarily mean that disturbance will occur.

Mitigation of the potential impacts of anthropogenic sound on cetaceans focuses on reducing near field injuries, and risk assessments are based on the assumption that the animals move away from loud sources of sound. While this is supported by various studies, observations also show a decline in response to airgun sound during the survey. The findings of Thompson *et al.* (2013) suggest that broader-scale exclusion from preferred habitats is unlikely. Instead, individual's fitness and demographic consequences are likely to be subtle and indirect, highlighting the need to develop frameworks to assess the population consequences of sub-lethal changes in foraging energetics of animals occurring within affected sites.

To determine the likelihood of impact in terms of actual number of animals, it is possible to calculate the number

of animals likely to experience some sort of behavioural impact using local density and population estimates. Density estimates from the area covering the North Sea are not well understood for many cetacean species but estimates from SCANS-III (detailed in Hammond *et al.,* 2021) provide regional density estimates for some of the species most regularly found in vicinity of the survey.

To assess how the number of animals that might be affected might constitute a non-trivial disturbance offence, it is important to understand what proportion of the population this number represents and what the duration of an effect may be. Temporarily affecting a small proportion of a population would be highly unlikely to result in population level effects, thus not considered as being qualifying as non-trivial disturbance. In contrast, affecting a large proportion of a population may be considered non-trivial disturbance. Determining this proportion is not a simple task since it is not clear how northeast Atlantic marine mammal populations act at a local level. For example, minke whales are likely to make use of the entire northeast Atlantic, so the population can be viewed as one, whilst other species, such as bottlenose dolphins, may display more local fidelity and be viewed as a series of sub-populations.

The Statutory Nature Conservation Bodies (SNCBs) (Hammond *et al.,* 2021; JNCC, 2010; IAMMWG, 2021) note that marine mammals of almost all species found in UK waters are part of larger biological populations whose range extends into the waters of other States and/or the High Seas. To obtain the best conservation outcomes for many species, it is necessary to consider the division of populations into smaller management units. This requires an understanding of the geographical range of populations and sub-populations, to provide advice on impacts at the most appropriate spatial scale. The output of the SNCB exercise investigating how marine mammal populations may act is the determination of Marine Mammal Management Units (MMMU) for species including harbour porpoise, bottlenose dolphin, Atlantic white-sided dolphin, minke whale and white-beaked dolphin. These MMMUs and associated population estimates can be interpreted in the context of the potential disturbance zones to consider the potential for a significant impact to occur.

Atlantic white-sided dolphin, bottlenose dolphins, harbour porpoise, killer whale, minke whale, Risso's dolphin and white-beaked dolphin have been recorded within the proposed survey area and export cable corridor. Additionally, there is potential for humpback whales to be observed within the proposed survey area and export cable corridor; however, their numbers are expected to be low. The number of individual cetaceans potentially affected by the proposed operations are detailed in Table 3-9.

The percentage of populations that may be affected is very small and low. Therefore, the proposed operations would be largely undetectable against natural variation and would have no significant effect at the population level.

Two species of seals inhabit UK waters: grey seal and harbour seal. According to Russel *et al.* (2017) grey seals and harbour seals have been observed within the waters of the proposed survey area and export cable corridor, with estimated sightings recording mean densities of 1-25 individuals per 25 km^2 and 0-1 individuals per 25 km^2 respectively. Due to the densities, an assessment has been undertaken for harbour seals and grey seals. As with cetaceans, the number of individuals likely to be impacted is very small and, therefore, would be largely undetectable against natural variation and would have no significant effect at the population level. The information provided indicates that there is a very low likelihood of injury or non-trivial disturbance as a result of the proposed survey.

The information provided indicates that there is a very low likelihood of injury or non-trivial disturbance as a result of the proposed survey operations (

Table 3-11). These values are based on a single pulse of the Innomar Medium 100 source (i.e disturbance radius of 462 m) and not for the entire proposed survey area and export cable corridor. Whilst the latter will provide larger

predicted numbers of animals impacted, the sound emitted from the source will dissipate relatively very quickly and there will be no accumulation of the sound levels. Therefore, whilst animals may move away from the sound source, they are likely to be able to return to the area following the passing of the survey vessel. Hence, it was considered that the single pulse approach represented a realistic case.

Table 3-11 Estimated Number of Cetaceans Experiencing Behavioural Changes Based on a Single Pulse of the Innomar Medium 100 source (Hammond et al., 2021; IAMMWGG, 2021)

Species*	SCANS-III Density Estimates Per km²	Average Seal Density at-sea (NMPi, 2022)	Maximum Number of Animals Predicted To Be in the Behavioural Change Impact Zone At Any One Time (Density x Behavioural Change Area) **	Management Unit (MU) / Biogeographical Population Estimate (IAMMWG, 2021 & SCOS, 2020)	Percentage Of Reference Population Potentially Affected (%)
Atlantic white-sided dolphins	0.021	-	0.01407	12293	0.00011446
Bottlenose dolphins	0.03	-	0.0201	1885	0.00106631
Harbour porpoise	0.599	-	0.40133	159632	0.00025141
Humpback whale	*Insufficient data*	-	*Insufficient data*	*Insufficient data*	*Insufficient data*
Killer whale	*Insufficient data*	-	*Insufficient data*	*Insufficient data*	*Insufficient data*
Minke whale	0.039	-	0.02613	10288	0.00025399
Risso's dolphin	*Insufficient data*	-	*Insufficient data*	8,687	*Insufficient data*
White-beaked dolphin	0.243	-	0.16281	34025	0.00047850
Grey Seal	--	25	16.75	149,700	0.01118904
Harbour seal	-	1	0.67	44,000	0.00152273
**Note: Density estimates have been reported for SCANS-III Survey Block R* ***The worst-case predicted behavioural change impact zone is 0.67 km2 for a single pulse from the Innomar Medium 100*					

3.3.5.5 ***Fish***

There are no available impact criteria based on SBPs. The most relevant criteria are considered to be those contained in the Sound Exposure Guidelines for Fishes and Sea Turtles (Popper *et al.,* 2014). The guidelines set out criteria for injury and other impacts for seismic airguns but not specifically for sources like sparkers or chirpers. The criteria for the different types of sources include a range of indices; SEL, rms and peak sound pressure levels. Where insufficient data exist to determine a quantitative guideline value, the risk is categorised in relative terms as "high", "moderate" or "low" at three distances from the source: "near" (i.e. in the tens of metres), "intermediate" (i.e. in the hundreds of metres) or "far" (i.e. in the thousands of metres). It should be noted that these qualitative criteria cannot differentiate between exposures to different levels of sound and therefore all sources of sound, independent of source level, would theoretically elicit the same assessment result.

The Popper *et al.* (2014) criteria presented for seismic surveys using airguns are reproduced in Table 3-12. These have been adopted in the assessment due to the lack of threshold criteria for SBP sources and are likely to overestimate the potential impact areas due to a variation in sound generation; electric signals from SBP sources

compared to pulses from airguns which are created by the release of high-pressure air. However, it was considered that it still provided a useful metric to inform the assessment of potential impacts.

Table 3-12 Threshold criteria for Potential Impacts to Fish due to Seismic Activities (Popper et al., 2014)

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa	>213	>213	-	(*Near*) High
	SEL_{cum} dB re 1 µPa ^{2} ·s.	>219	>216	>>186	(*Intermediate*) Mod. (*Far*) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa	>207	>207	-	(*Near*) High
	SEL_{cum} dB re 1 µPa ^{2} ·s.	>210	>203	>>186	(*Intermediate*) Mod. (*Far*) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa	>207	>207	-	(*Near*) High
	SEL_{cum} dB re 1 µPa ^{2} ·s.	207	203	186	(*Intermediate*) Mod. (*Far*) Low
Eggs and larvae	Peak, dB re 1 µPa	>207	(*Near*) Mod (*Intermediate*) Low (*Far*) Low	(*Near*) Mod (*Intermediate*) Low (*Far*) Low	(*Near*) Mod (*Intermediate*) Low (*Far*) Low
	SEL_{cum} dB re 1 µPa ^{2} ·s.	>210			

While detailed modelling of fish has not been carried out, the distances at which sound level decreases to below the various threshold values for the different types of fish due to the proposed survey operations are presented in Table 3-13 to Table 3-16.

The assessment does not include the effect of soft start, partly due to the fact that eggs and larvae cannot move away from the source.

The distance at which the sound level exceeds the threshold values during the proposed survey operations using the Popper *et al.* (2014) criteria is small. The results indicate that for the Innomar Medium 100 was predicted to have the greatest ranges, with sound levels decreasing to below threshold values for potential mortality beyond 74 m distance from the source for fish where the swim bladder is involved in hearing. It was also predicted that fish where swim bladder is not involved in hearing and for eggs and larvae the distance for sound levels to reduce to below the threshold values for potential mortal injury was approximately 71 m.

Adult fish not in the immediate vicinity of the sound generating activity are generally able to move away and avoid

the likelihood of physical injury. However, larvae are not highly mobile and are therefore more likely to incur injuries from the sound energy, including damage to their hearing, kidneys, hearts and swim bladders. Damage from shock to eggs and developing embryos consist of deformation and compression of the membrane, spiral curling of the embryo, displacement of the embryo, and disruption of the vitelline membrane. Although, such effects are unlikely to happen outside of the immediate vicinity of the proposed survey operations (> 10 m). Popper *et al.* (2014) recognises the need for more data to help determine the effects of anthropogenic sound on eggs and larvae.

In terms of disturbance (or behavioural response) the impacts from the proposed survey operations are presented in qualitative terms rather than quantitatively. Based on this qualitative criterion there is a high level of risk of disturbance up to 'tens of meters' from the moving device, moderate at distances of 100s of metres (except for fish with swim bladders were the risk remains high) and low beyond this (i.e. 'far'). For eggs and larvae, the risk is moderate close to the centre of activity (tens of metres) and low beyond this point.

Wardle *et al.* (2001), Mosbech *et al.* (2000) and Wardle *et al.* (1998) state that the potential disturbance zone for fish from intermittent sources like seismic survey sound sources may extend to hundreds of metres or a few kilometers, although these references relate to airgun sources. Whilst estimates of fish populations are generally not available, it is likely that many millions of individuals make up most species' populations (e.g. Mood & Brooke, 2010). The movement of fish tens or hundreds of metres away from the potential injury or disturbance impact zones would not constitute a large-scale movement by individuals of a species and is unlikely to result in population level impacts. Similarly, the potential impact of fish outside the impact area finding the sound levels too high to enter would be unlikely to result in population level impacts.

In summary, using the approach adopted by Popper *et al.* (2014), the area of behavioural change will extend beyond 10 m from the source, but the risk of disturbance will be moderate and is unlikely to be significant beyond 1 km. Given the fact that the operations will be constantly moving and the relatively short period of activity, no habituation to the sound is likely.

Table 3-13 Impact Assessment on Fish from the Innomar Medium 100 @ 100 kHz

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa	35 m	35 m	-	(*Near*) High (*Intermediate*) Mod. (*Far*) Low
	SEL_{cum} dB re 1 µPa ^{2}·s.	49 m	58 m	78 m	
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa	51 m	51 m	-	(*Near*) High (*Intermediate*) Mod. (*Far*) Low
	SEL_{cum} dB re 1 µPa ^{2}·s.	71 m	77 m	78 m	
Fish: where swim bladder is involved in hearing (primarily pressure	Peak, dB re 1 µPa	51 m	51 m	-	(*Near*) High (*Intermediate*) Mod. (*Far*) Low
	SEL_{cum} dB re 1	74 m	77 m	78 m	

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Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
detection)	µPa ^{2}·s.				
Eggs and larvae	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	51 m 78 m	(*Near*) Mod (*Intermediate*) Low (*Far*) Low	(*Near*) Mod (*Intermediate*) Low (*Far*) Low	(*Near*) Mod (*Intermediate*) Low (*Far*) Low

Table 3-14 Impact Assessment on Fish from the GeoSource 200 @ 1.5 kHz

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	10 m N/A	10 m N/A	- 2	(*Near*) High (*Intermediate*) Mod. (*Far*) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	20 m N/A	20 m N/A	- 2 m	(*Near*) High (*Intermediate*) Mod. (*Far*) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	20 m N/A	20 m N/A	- 2 m	(*Near*) High (*Intermediate*) Mod. (*Far*) Low
Eggs and larvae	Peak, dB re 1 µPa SEL_{cum} dB re 1 µPa ^{2}·s.	20 m N/A	(*Near*) Mod (*Intermediate*) Low (*Far*) Low	(*Near*) Mod (*Intermediate*) Low (*Far*) Low	(*Near*) Mod (*Intermediate*) Low (*Far*) Low

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Table 3-15 Impact Assessment on Fish from the Innomar SES-2000 Compact at 115 Hz

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa	20 m	20 m	-	(Near) High
	SEL_{cum} dB re 1 µPa ^{2}·s.	2 m	3 m	8 m	(Intermediate) Mod. (Far) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa	28 m	28 m	-	(Near) High
	SEL_{cum} dB re 1 µPa ^{2}·s.	5 m	7 m	8 m	(Intermediate) Mod. (Far) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa	28 m	28 m	-	(Near) High
	SEL_{cum} dB re 1 µPa ^{2}·s.	6 m	7 m	8 m	(Intermediate) Mod. (Far) Low
Eggs and larvae	Peak, dB re 1 µPa	28 m	(Near) Mod	(Near) Mod	(Near) Mod
			(Intermediate) Low	(Intermediate) Low	(Intermediate) Low
	SEL_{cum} dB re 1 µPa ^{2}·s.	7 m	(Far) Low	(Far) Low	(Far) Low

Table 3-16 Impact Assessment on Fish from the Applied Acoustics AA200 Boomer @ 12Hz

Type of Animal	Parameter	Mortality and Potential Mortal Injury	Impairment		Behavioural Response
			Recoverable Injury	TTS	
Fish: no swim bladder (particle motion detection)	Peak, dB re 1 µPa	2 m	2 m	-	(Near) High
	SEL_{cum} dB re 1 µPa ^{2}·s.	N/E	N/E	2 m	(Intermediate) Mod. (Far) Low
Fish: where swim bladder is not involved in hearing (particle motion detection)	Peak, dB re 1 µPa	3 m	3m	-	(Near) High
	SEL_{cum} dB re 1 µPa ^{2}·s.	N/E	N/E	2 m	(Intermediate) Mod. (Far) Low
Fish: where swim bladder is involved in hearing (primarily pressure detection)	Peak, dB re 1 µPa	3 m	3 m	-	(Near) High
	SEL_{cum} dB re 1 µPa ^{2}·s.	N/E	N/E	2 m	(Intermediate) Mod. (Far) Low
Eggs and larvae	Peak, dB re 1 µPa	3 m	(Near) Mod	(Near) Mod	(Near) Mod
			(Intermediate) Low	(Intermediate) Low	(Intermediate) Low
	SEL_{cum} dB re 1 µPa ^{2}·s.	N/E	(Far) Low	(Far) Low	(Far) Low

3.3.6 Mitigation

3.3.6.1 *Overview*

The survey equipment is designed to produce a downward focused sound source; with sound levels reducing with horizontal distance. Thus, relative to a fixed point in the proposed survey area and export cable corridor, the sound levels will gradually increase as the survey vessels approach, reaching a peak when the vessel is directly above, and reducing to background levels moves away. Therefore, marine mammals or fish within the wider proposed survey area and export cable corridor would be subject to varying sound levels over time as the survey vessel and source moves around the proposed survey area and export cable corridor, rather than being subject immediately to the levels considered in the assessment and will have the opportunity to vacate the area.

The JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from geophysical surveys (JNCC, 2017) are summarised below. Compliance with these guidelines is considered to constitute best practice and will in most cases, reduce the risk of deliberate injury to marine mammals to negligible levels. Whilst guidelines do not deal with disturbance directly it is considered that the mitigation measures as recommended will also assist in reducing the potential for disturbance.

3.3.6.2 *Marine Mammal Observer (MMO)*

MMOs on board the survey vessel will monitor for the presence of marine mammals, during the pre-source start search, and survey, and will recommend delays in the commencement of source activity should any marine mammals be detected within the 500 m mitigation zone. The survey contractor will be providing a team to cover 24-hour observations during the survey.

3.3.6.3 *Pre-Source Start Search & Mitigation Zone*

All MMO observations will be undertaken during a pre-shooting search of 30 minutes i.e. prior to the commencement of any use of the high resolution surveys (e.g. SBP) in waters < 200 m. This will involve a visual (during daylight hours) and/or acoustic assessment (during hours of darkness / reduced visibility) to determine if any marine mammals are present within the 500 m mitigation zone from the centre of the device deployed. If marine mammals are detected in the mitigation zone during the pre-shooting search, then operations must be delayed until their passage, or the transit of the vessel, results in the marine mammals being outside of the mitigation zone. Either way there should be a minimum of a 20-minute delay from the time of the last sighting within the mitigation zone and the commencement of the start of operations, to allow animals unavailable for detection to leave the area.

3.3.6.4 *Line Changes*

In line with the JNCC guidelines, where line turns are expected to take longer than 40 minutes:

- Sound source is to be terminated at the end of the survey line;
- A pre-source start search will be undertaken during the line change;

3.3.6.5 *Reporting*

All recordings of marine mammals will be made using JNCC Standard Forms and a close-out report will be submitted via the Marine Noise Registry. At the end of the survey, a monitoring report detailing the marine mammals recorded, methods used to detect them, and details of any problems encountered will be submitted to the JNCC. The report will also include feedback on how successful the mitigation measures were. This requirement will be communicated to the MMO at project start up meetings and at crew change. If the MMO has any queries on the application of the guidelines during the survey they will contact the JNCC for advice.

3.3.7 Conclusions

SBPs are designed to produce a focused sound energy source, therefore the distances presented in this assessment represent a radius for potential impacts. As the survey vessel approaches a fixed point the noise levels will gradually increase until they reach the predicted threshold levels. It is therefore considered that marine mammals or fish will have the opportunity to vacate the region.

The sound assessment indicates that, based on the peak SEL, the operation of the Innomar Medium 100 SBP and GeoSource 200 SBPs would result in the greatest impact ranges for all hearing groups. The maximum predicted distance at which sound level decreases to below the PTS threshold value was 84 m for HF cetaceans.

Potential behavioural impact distances have been assessed based on a 160 dB threshold. The RMS behavioural distance is predicted to be between 91 m and 462 m; the maximum range predicted for the use of the Innomar Medium 100 SBP.

The potential impacts to marine mammals via sound associated with proposed survey activities have been identified and assessed. This concluded that the likelihood of behavioural changes based on numbers of mammals is <0.001% for all cetacean species present and <0.1% for all seal species present. Therefore, for disturbance, the restricted period of operations, mitigation measures implemented and the low number of animals likely to be affected means impact at the population level is likely to be very small.

The potential impacts to fish have been assessed using the threshold criteria for seismic survey and mid-frequency naval sonar proposed by Popper *et.al.* (2014). These have been adopted due to the lack of available SBP based criteria. Whilst these may overestimate the potential impact areas due to differences in sound levels and generation processes, they were considered to provide a useful metric for impact characterisation.

The fish impact assessment indicated that the distances at which the sound level exceeds the threshold values during the proposed survey operations are within 74 m for the potential for mortality for all fish types. The predicted maximum range for the onset of TTS in fish is approximately 78 m: for the use of the Innomar Medium 100.

No cumulative impacts are expected from the proposed operations.

In light of the levels of impact predicted from the proposed survey operations, and the management and control measures that will be in place, SBES considers that the proposed survey will not have any significant adverse impacts on the marine environment.

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4 Protected Sites Risk Assessment

4.1 Relevant Protected Sites

In addition to assessing potential impacts on protected species, potential impacts to protected sites (including seal haul-outs) from the proposed survey works need to be considered to inform the HRA process, if required.

The designated sites located in the vicinity of the proposed survey area and export cable corridor which have the potential to be impacted by the survey activities are outlined in Table 4-1 and shown in Figure 1-1. These have been selected based on the criteria outlined in Section 1.5.4. It should be noted here that sites designated for benthic features have not been included within this assessment, as geophysical surveys do not result in any interaction with the seabed and therefore are not considered to pose any risk of likely significant effects to these sites.

For each designated site that has the potential to be impacted by the survey, mitigation measures have been identified relevant to site-specific qualifying features and these are also included within Table 4-1. Further details of the mitigation measures are provided in Section 5. Some of the mitigation measures included in Section 5 may not be listed in Table 4-1. If they are not related to protecting designated features of those sites. However, all mitigation measures in Section 5 will be applied to all activities, regardless of proximity to protected sites.

Table 4-1 Protected Sites in the Vicinity of the Proposed Survey Area and Export Cable Corridor

Closest part of survey	Designated Site potentially affected	Criteria for Potential connectivity to the site	Distance from the nearest part of the survey	Qualifying features of the designated sites	Proposed Mitigation measure	Potential for Likely Significant Effect
Export cable corridor	Southern Trench NCMPA	Overlaps with export cable corridor	0	Minke whale, burrowed mud, fronts, shelf deep, Quaternary of Scotland and submarine mass movement (NatureScot, 2020)	M1 – M5	No
** It should be noted that it is deemed Sites of Special Scientific Interest (SSSI) and National Scenic Areas (NSA) etc. are wholly or partially encompassed by associated SACs and/or SPAs, and hence do not require specific assessment within this EPS Risk Assessment.						

4.2 Assessment of Impacts on Protected Sites

4.2.1 Protected Sites with Cetaceans as a Qualifying Feature

The export cable corridor is located within the Southern Trench NCMPA. The Southern Trench NCMPA is protected for the presence of minke whale, burrowed mud habitat, front and shelf deep (NatureScot, 2020). The Southern Trench NCMPA takes its name from the 58 km long, 9 km wide and 250 m deep trench running parallel to the coast that was carved out by glaciers. Within this protected area, minke whales have been observed creating "bait balls", a method used to trap their prey (SNH, 2019). As discussed in Section 3.2.1, minke whales (features of the NCMPA) are frequently sighted in the summer months in the Outer Moray Firth (SNH, 2014). Given the export cable corridor overlaps with the Southern Trench NCMPA, which is designated specifically for the conservation of minke whale populations and foraging habitats, and the relatively high densities of cetacean species within these waters in general, there is the potential for connectivity between activities associated with the area and the identified cetacean species. This includes the bottlenose dolphin species designated under the Moray Firth SAC (approximately 95 km northwest) as bottlenose dolphins have been known to migrate great distances, leading to potential connectivity between the proposed survey and this species.

The Conservation Objectives of the Southern Trench NCMPA (NatureScot, 2020), are that the protected features

- so far as already in favourable condition, remain in such condition
- so far as not already in favourable condition, be brought into such condition, and remain in such condition.

The population percentage of minke whales that may potentially be impacted by the proposed survey works is approximately 0.0003%, which is unlikely to significantly affect the minke whale population and therefore there would be no impact to the conservation objectives of the NCMPA.

A full assessment of the potential impact on cetaceans from the survey activity is provided in Section 3. It can be concluded that there is unlikely to be impacts to basking sharks as they do not frequent the area with any regularity.

4.2.2 SACs with Otters as a Qualifying Feature

The proposed survey area and export cable corridor are not located within 500 m of a SAC with otters as a designated feature. Therefore, no impacts to otter species are predicted and no further assessment of otters is included.

4.2.3 Protected Sites with Seals as a Qualifying Feature and Seal Haul-Out Sites

Seal haul-outs are locations on land where seals come ashore to rest, moult or breed. There are a number of designated seal haul-outs sites which are present along the southeast coast of Scotland. The nearest site designated for seal haul outs is the Ythan River mouth, located 26 km from the proposed survey area and export cable corridor (NMPi, 2022). All other designated seal-haul-out sites along the Scottish coastlines are located further beyond 100 km from the survey area and export cable corridor. As the seal haul-out is located >500 m from the proposed survey area and export cable route, no further assessment of seal haul outs is required.

4.2.4 Protected Sites with Seabed and/or Benthic Protected Features

As described in Section 1.5.4, any sites with vegetation or ground features that overlap or are located within proposed survey area and export cable corridor should be assessed. The Southern Trench NCMPA transects the

offshore cable corridor. As only minor seabed impacts will be envisaged from the environmental/benthic survey (i.e., such as grab samples, each < 1 m^3 and the use of drop-down cameras) it is expected that the impacted area will recover quickly and only represents a minute area of the overall available seabed of the North Sea. A separate notice of intention to carry out an exempted activity will be submitted to MS-LOT to cover the environmental/benthic survey.

Therefore, impacts to the seabed will be small and is unlikely to cause any significant and/or lasting damage. Thus, seabed impacts are not assessed further.

4.2.5 SPAs and NCMPAs with Birds as Qualifying Features

There are no SPAs within 2 km of the proposed survey area and export cable corridor. The nearest SPA to the planned survey is the Buchan Ness to Collieston Coast SPA, located 5 km south. The proposed activities will start no earlier than the 1st July 2022 with activities expected to finish in September 2022. However, given the mobile nature of the planned survey and the short-term duration of the activities, no impacts to birds are expected.

4.2.5.1 *LSE on Protected Sites with Birds as Qualifying Features*

Several seabird species have the potential to be disturbed by the physical presence of vessels during the geophysical survey activities. However, despite the potential overlap between survey vessels and breeding birds utilising the marine environment, the short duration of the survey activities, both spatially and temporally, will not result in killing of individuals or disturbance of eggs and nests as survey operations will be wholly within the marine environment. Furthermore, the survey vessels will be moving slowly, limiting any potential collision risks to birds and disturbance to foraging potential.

Therefore, with the implementation of the mitigation measures set out in Section 5, the survey activities are highly unlikely to cause significant effects on the FCS of the qualifying bird features of the SPAs or proposed Special Protected Areas (pSPAs) and the conservation objectives of the protected sites will not be compromised.

4.2.6 Other Areas of Importance

As detailed in Table 4 1, it is deemed SSSI and NSA sites are wholly or partially encompassed by associated SACs and/or SPAs, and hence do not require specific assessment within this EPS Risk Assessment – such an example is the Loch of Strathberg SSSI. The Loch of Strathberg is a shallow nutrient-rich loch constituting the largest dune slack pool in Britain. Vegetation in this Loch consists of reedbeds, freshwater marshes, and alder-willow carr. Calcareous dunes and dune slacks are relatively undisturbed and provide habitat for a rich flora and fauna. This site provides wintering habitat for numerous important wetland bird species, notably internationally important numbers of geese and the whooper swan *Cygnus cygnus* and is an important staging area for migratory waterbirds (RAMSAR, 2021).

As this site is located approximately 6 km from the planned survey, the survey activities are highly unlikely to cause significant effects on the FCS of the qualifying bird features and is unlikely to affect the conservation objectives.

4.2.7 Cumulative Effects

There are several assets in the region of the proposed surveys and wider area, which could potentially result in cumulative effects to the qualifying features of the designated sites identified above. However, any disturbance to the qualifying features of the designated sites listed in Table 4-1 is anticipated to be extremely spatially and temporally limited. It is not expected that these survey activities could result in a significant increase in the potential for LSE to occur at the designated sites, and as such, no cumulative effects are anticipated.

4.2.8 Conclusions

The proposed survey area lies outwith distances for assessment (Section 1.5.4) of protected sites with otters, seals or basking sharks as qualifying features.

However, the export cable corridor lies within the Southern Trench NCMPA for assessment (Section 1.5.4) of protected sites with cetaceans as qualifying features.

Following the implementation of the mitigation outlined in Section 5, there will be no risk of injury to cetacean species, and the potential disturbance resulting from underwater noise emissions will be extremely localised and temporary. As such, no LSE are expected for cetaceans in the area.

The proposed survey area and export cable corridor do not overlap any SACs or SSSIs which have bird species or vegetation / benthic features as a qualifying factor. Given the distance to the nearest site, there may be the potential for disturbance of birds whilst foraging at-sea. However, any disturbance to birds will be localised and temporary, and these impacts are not expected to have any long-term significant effects on the bird species for which these sites are designated, and therefore no LSE are anticipated.

Due to the temporary and localised nature of the proposed survey activities and the mitigation measures outlined in Section 5, no significant impact is anticipated on the conservation objectives of any protected site, with no potential for cumulative effects identified. The proposed survey operations are required to facilitate the progression of developments of a proposed windfarm, which will allow an increase in renewable energy generation capacity and decrease the national reliance on fossil fuels. Hence, the survey activities constitute work of an imperative reasons of overriding public interest, whilst presenting a minimal and temporary disturbance in a limited area.

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5 Protected Sites and Species Protection Measures

5.1 Overview

This section summarises the proposed mitigation measures to be implemented for avoiding and reducing potential impacts on species that may be present in the vicinity of the survey works.

Species and task specific mitigation is provided below; however, the following measures will be implemented during all survey works:

- The survey vessels will adhere to the provisions of the Scottish Marine Wildlife Watching Code (SNH, 2017); and the Basking Shark Code of Conduct; and
- Survey teams will be made aware of all protected species within the marine environment, and their responsibility to implement the mitigation in this document.

5.2 Marine Mammals

A Marine Mammal Protection Plan (MMPP) has been prepared in order to reduce risk of injury and disturbance to marine mammals resulting from SBP survey operations, this is aligned to JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017). The key components of the MMPP for SBP include:

- Deployment of a MMO to monitor for the presence of cetaceans and seals, prior to the commencement of SBP operations;
- Survey operations will be run 24/7, however it is noted that up to a maximum of 24 hours for the offshore survey level and up to 12 hours a day for the inshore survey. Survey operations occurring only during hours of daylight is the best practice;
- During times of poor visibility when the MMO cannot monitor for the visibility of seals, the equipment will not be started within 100 m of any designated seal haul-out site. The SBP and sparker sources will be started beyond this minimum distance, and the vessel then moved into position once the SBP and sparker sources are fully operational;
- 500 m mitigation zone for cetaceans;
- 500 m mitigation zone for seals, reducing to 100 m in the event of a need to avoid critical delay to the project; and
- Reporting of survey activities and marine mammal sightings.

5.2.1 M1 – Marine Mammal Monitoring

There will be MMO coverage for the commencement of SBP activities. They will have experience of working at sea and be equipped with binoculars offering at least 8x magnification. The MMO(s) will be located at a suitable vantage point, providing good all-round visibility.

5.2.2 M2 – Marine Mammal Observer (MMO)

The MMO will carry out visual observations to monitor for the presence of cetaceans and seals before the SBP equipment are activated and will recommend delays in the commencement of the operation should any cetaceans be detected within the 500 m mitigation zone. This 500 m distance will also be applied for seals, except in the event of a need to avoid critical delay to the project in which case the mitigation zone for both species' groups will be 100 m. The criteria as to what constitutes a critical delay leading to reduction in mitigation zone distance from 500 m to 100 m would be agreed on a case-by-case basis in consultation with MS-LOT.

5.2.3 M3 – Pre-Start Search

Visual observations (MMO) will be conducted for a pre-start search of 30 minutes (i.e., prior to the commencement of SBP operations). This will involve a visual (during daylight hours) to determine if any cetaceans or seals are within 500 m of the activities (or 100 m for seals in the event of the critical delay described in mitigation measure M2).

5.2.4 M4 – Cetacean, Seal and Basking Shark Mitigation Zone

The mitigation zone is defined as the area within 500 m of the survey equipment. Should any cetaceans, seals or basking sharks be detected within the mitigation zone prior to the commencement of SBP survey operations (or after breaks in SBP survey activity of more than 10 minutes), operations will be delayed until cetaceans, seals or basking sharks are no longer present within the mitigation zone. There will be a 20-minute delay from the time of the last sighting within the mitigation zone to the commencement/recommencement of the SBP and survey operations.

The mitigation zone for seals and basking sharks may be reduced from 500 m to 100 m in the event of a need to avoid critical delay to the project, subject to agreement with the regulator.

5.2.5 M5 – Reporting

All recordings of cetaceans and seals will be made using JNCC Standard Forms and a close-out report will be submitted via the Marine Noise Registry. At the end of the operations, a monitoring report detailing the cetaceans recorded, methods used to detect them, and details of any problems encountered will be submitted to Marine Scotland. The report will also include feedback on how successful the mitigation measures were. This requirement will be communicated to the MMOs at project start up meetings.

5.3 Seabirds

5.3.1 M6 – Rafting seabirds

The survey vessels will be moving at a maximum speed of 4 knots during survey operations, to allow any rafting seabirds time to disperse before the vessel arrives. When not on survey effort, vessels will avoid bird rafts where operationally possible and it is safe to do so.

5.3.2 M7 – Light disturbance

When within the proposed survey area and export cable corridor, and where there is potential for 24-hour working, the following measures will be implemented to minimise the potential impacts to birds:

- Lighting on-board the survey vessel(s) will be kept to the minimum level required to ensure safe operations; and
- Lights will be directed or shielded to prevent upward illumination and minimise disturbance; and
- Blackout blinds and/or curtains will be used where possible when working in marine SPAs.

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5.3.3 M8 – Breeding Birds

When within a SPA which has been designated for breeding birds that may nest or feed in close proximity to the proposed survey area and export cable corridor, further consultation will be undertaken with NatureScot on the requirement for any seasonal restriction to be implemented for equipment calibration and testing, as well as geophysical survey activities in order to avoid disturbance to qualifying species during the most sensitive time of the year.

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6 Conclusions

This risk assessment has assessed the risk posed by the survey activities associated with the geophysical survey to cetaceans, seals, basking sharks, birds and protected sites. This has included assessing the risk caused by noise emitted from the geophysical survey equipment, collision impact and disturbance to the following receptors:

- Cetaceans;
- SACs with cetacean, seal and otter qualifying features;
- NCMPAs with cetacean, bird and otter qualifying features;
- Designated seal haul-outs and seal breeding sites; and
- SPAs.

This assessment has concluded that the nature of the survey works, and considering the proposed mitigation, means that no adverse impact through injury to EPS or other protected species is anticipated, and an EPS licence is not required in this regard. However, the use of the SBP survey equipment may cause disturbance to cetaceans and as such an application for EPS Licence will be sought by SBES.

The export cable corridor area overlaps with the Southern Trench NCMPA, designated for a cetacean (minke whale) and benthic features. No other relevant protected sites were identified for assessment according to the selection criteria outlined in Section 1.5.4. Due to the temporary and localised nature of the survey activities, there is expected to be no long-term impacts to the qualifying interests of protected sites. A number of mitigation strategies will also be followed to further reduce any potential impacts. It is therefore concluded that, the proposed works will not affect the conservation objectives of the above sites.

Overall, the proposed survey operations constitute work of an overriding public need while presenting minimal and temporary disturbance in a limited area.

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Appendix

Array area

Point	WGS84 (Decimal Degrees)		WGS84 (Degrees Minutes Seconds)	
	Latitude	Longitude	Latitude	Longitude
1	57.54026	-1.216081	57° 32' 24.937654" N	001° 12' 57.891443" W
2	57.540884	-1.21846	57° 32' 27.184101" N	001° 13' 06.457141" W
3	57.54314	-1.22158	57° 32' 35.304361" N	001° 13' 17.688550" W
4	57.630474	-1.275767	57° 37' 49.706177" N	001° 16' 32.759686" W
5	57.63324	-1.275813	57° 37' 59.664725" N	001° 16' 32.925483" W
6	57.634494	-1.274652	57° 38' 04.180193" N	001° 16' 28.746776" W
7	57.636088	-1.270824	57° 38' 09.915555" N	001° 16' 14.966757" W
8	57.650795	-1.199229	57° 39' 02.862134" N	001° 11' 57.226005" W

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Point	WGS84 (Decimal Degrees)		WGS84 (Degrees Minutes Seconds)	
	Latitude	Longitude	Latitude	Longitude
9	57.651084	-1.1967	57° 39' 03.904171" N	001° 11' 48.119764" W
10	57.650946	-1.194126	57° 39' 03.406953" N	001° 11' 38.854683" W
11	57.650089	-1.190964	57° 39' 00.321903" N	001° 11' 27.468969" W
12	57.598351	-1.072195	57° 35' 54.062036" N	001° 04' 19.902574" W
13	57.597047	-1.070161	57° 35' 49.368813" N	001° 04' 12.578689" W
14	57.595935	-1.069349	57° 35' 45.365985" N	001° 04' 09.657142" W
15	57.565415	-1.055444	57° 33' 55.494380" N	001° 03' 19.597627" W
16	57.562646	-1.055828	57° 33' 45.527005" N	001° 03' 20.979344" W
17	57.561445	-1.057185	57° 33' 41.202211" N	001° 03' 25.866411" W
18	57.559985	-1.061579	57° 33' 35.946900" N	001° 03' 41.685446" W
19	57.540222	-1.211478	57° 32' 24.798716" N	001° 12' 41.320534" W

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Survey Corridor

Point	WGS84 (Decimal Degrees)		WGS84 (Degrees Minutes Seconds)	
	Latitude	Longitude	Latitude	Longitude
0	57.54041	-1.776589	57° 32' 25.476312" N	001° 46' 35.721093" W
1	57.540738	-1.720246	57° 32' 26.656882" N	001° 43' 12.887369" W
2	57.543296	-1.673093	57° 32' 35.867201" N	001° 40' 23.134061" W
3	57.549954	-1.617231	57° 32' 59.835758" N	001° 37' 02.032487" W
4	57.550042	-1.614665	57° 33' 00.150073" N	001° 36' 52.794234" W
5	57.549925	-1.613394	57° 32' 59.731285" N	001° 36' 48.217847" W
6	57.549292	-1.610755	57° 32' 57.452267" N	001° 36' 38.718086" W
7	57.54463	-1.597906	57° 32' 40.668540" N	001° 35' 52.462730" W
8	57.551981	-1.512064	57° 33' 07.132146" N	001° 30' 43.430193" W
9	57.55894	-1.510662	57° 33' 32.184846" N	001° 30' 38.382633" W
10	57.560292	-1.509981	57° 33' 37.049952" N	001° 30' 35.931789" W
11	57.561465	-1.508559	57° 33' 41.272947" N	001° 30' 30.812207" W
12	57.562345	-1.506534	57° 33' 44.443305" N	001° 30' 23.521346" W
13	57.562848	-1.504102	57° 33' 46.252804" N	001° 30' 14.767902" W
14	57.587894	-1.284346	57° 35' 16.418137" N	001° 17' 03.645257" W

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Point	WGS84 (Decimal Degrees)		WGS84 (Degrees Minutes Seconds)	
	Latitude	Longitude	Latitude	Longitude
15	57.609481	-1.253897	57° 36' 34.130257" N	001° 15' 14.029564" W
16	57.592518	-1.243369	57° 35' 33.064735" N	001° 14' 36.127514" W
17	57.583947	-1.238053	57° 35' 02.208714" N	001° 14' 16.989807" W
18	57.566859	-1.227369	57° 34' 00.693579" N	001° 13' 38.528270" W
19	57.579332	-1.278897	57° 34' 45.593569" N	001° 16' 44.030076" W
20	57.554744	-1.4947	57° 33' 17.076676" N	001° 29' 40.920924" W
21	57.547599	-1.496143	57° 32' 51.357195" N	001° 29' 46.113528" W
22	57.546234	-1.496836	57° 32' 46.441099" N	001° 29' 48.608228" W
23	57.545052	-1.498285	57° 32' 42.186628" N	001° 29' 53.824700" W
24	57.544171	-1.500346	57° 32' 39.016369" N	001° 30' 01.244571" W
25	57.543648	-1.503139	57° 32' 37.132583" N	001° 30' 11.301731" W
26	57.535481	-1.598526	57° 32' 07.730848" N	001° 35' 54.692660" W
27	57.53548	-1.60116	57° 32' 07.729685" N	001° 36' 04.175624" W
28	57.535648	-1.602444	57° 32' 08.331101" N	001° 36' 08.798702" W
29	57.536193	-1.604516	57° 32' 10.294527" N	001° 36' 16.259204" W
30	57.540768	-1.617125	57° 32' 26.764455" N	001° 37' 01.648692" W
31	57.534435	-1.670278	57° 32' 03.967425" N	001° 40' 12.999096" W
32	57.531762	-1.719443	57° 31' 54.343224" N	001° 43' 09.994151" W

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Point	WGS84 (Decimal Degrees)		WGS84 (Degrees Minutes Seconds)	
	Latitude	Longitude	Latitude	Longitude
33	57.531397	-1.783638	57° 31' 53.027891" N	001° 47' 01.098462" W
34	57.531744	-1.804987	57° 31' 54.278666" N	001° 48' 17.953902" W
35	57.532944	-1.804972	57° 31' 58.598829" N	001° 48' 17.898272" W
36	57.532964	-1.804971	57° 31' 58.671645" N	001° 48' 17.897333" W
37	57.534663	-1.805333	57° 32' 04.785497" N	001° 48' 19.199746" W
38	57.536134	-1.804853	57° 32' 10.083322" N	001° 48' 17.472123" W
39	57.537475	-1.804138	57° 32' 14.908896" N	001° 48' 14.896948" W
40	57.538448	-1.803817	57° 32' 18.412738" N	001° 48' 13.740932" W
41	57.539569	-1.802372	57° 32' 22.448783" N	001° 48' 08.538504" W
42	57.541331	-1.800708	57° 32' 28.792690" N	001° 48' 02.549063" W
43	57.541677	-1.800434	57° 32' 30.038303" N	001° 48' 01.562120" W
44	57.54414	-1.798129	57° 32' 38.904681" N	001° 47' 53.264324" W
45	57.544804	-1.798256	57° 32' 41.293628" N	001° 47' 53.721334" W
46	57.545441	-1.798378	57° 32' 43.587737" N	001° 47' 54.160213" W
47	57.54041	-1.776589	57° 32' 25.476312" N	001° 46' 35.721093" W