Offshore Petroleum Regulator
for Environment & Decommissioning

RECORD OF THE HABITATS REGULATIONS ASSESSMENT UNDERTAKEN UNDER REGULATION 5 OF THE OFFSHORE PETROLEUM ACTIVITIES (CONSERVATION of HABITATS) REGULATIONS 2001 (As Amended).

Hartshead Resources Ltd

Somerville and Anning Marine Survey HRA

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1 INTRODUCTION

1.1 Council Directive 92/43/EC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and Council Directive 2009/147/EC on the conservation of wild birds (the Birds Directive) aim to ensure the long-term survival of certain habitats and species by protecting them from the adverse effects of plans and projects.

1.2 The Habitats Directive provides for the designation of sites for the protection of habitats and species of European importance. These sites are called Special Areas of Conservation (SACs). SACs form part of a network of protected sites across Europe called Natura 2000.

1.3 Before SACs are designated, the Government will undertake a public consultation. Prior to consultation the site is considered to be a draft SAC (dSAC). At the public consultation stage, the site is referred to as a possible SAC (pSAC). When a pSAC is submitted to the European Commission it becomes a candidate SAC (cSAC), at which point it is legally afforded the same protection as a SAC. Following adoption by the European Community the site becomes a Site of Community Importance until formal designation by the Government when the site becomes a SAC. The Southern North Sea SAC became designated as a SAC in February 2019 (JNCC 2019a).

1.4 Any plan or project, which either alone or in-combination with other plans or projects would be likely to have a significant effect on a qualifying site must be subject to an Appropriate Assessment to determine the implications for a site's integrity and conservation objectives. Such a plan or project may only be agreed after ascertaining that it will not adversely affect the integrity of a European Site unless there are imperative reasons of overriding public interest for carrying out the plan or project.

1.5 The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) transpose the Directives into UK law for activities consented under the Petroleum Act 1998. The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2007 extend certain provisions of the 2001 regulations.

1.6 Regulation 5(1) of the 2001 Regulations provides that: *The Secretary of State shall, before granting any Petroleum Act licence, any consent, any authorisation, or any approval, where he considers that anything that might be done or any activity which might be carried on pursuant to such a licence, consent, authorisation or approval is likely to have a significant effect on a relevant site, whether individually or in-combination with any other plan or project, including but not limited to any other relevant project, make an appropriate assessment of the implications for the site in view of the site's conservation objectives*.

1.7 An application to undertake a Marine Survey by Hartshead Resources Limited (hereafter Hartshead) was submitted to the Department of Energy Strategy and Net Zero (DESNZ) in March 2023 (HRL 2023a).

1.8 This is a record of the Appropriate Assessment in the form of a Habitats Regulations Assessment (HRA), undertaken by the Secretary of State for Department of Energy Strategy and Net Zero in respect of a proposed Somerville and Anning Marine Survey that may cause a significant effect on the qualifying features of the Southern North Sea SAC.

1.9 The proposed survey relevant to this assessment is not directly connected with, or necessary to, the management of any European sites but may affect them. The purpose of this HRA is to determine whether the proposed surveys will adversely affect the integrity of any National Site Network designated site.

2 SURVEY DESCRIPTION

2.1 The following is a brief summary of the proposed survey, further details may be found within the application submitted in March 2022 (HRL 2023a) and updated in April 2023 (HRL 2023b).

2.2 The survey aims to check for potential obstructions and debris at proposed jack-up rig locations within the Somerville and Anning fields. At each field, the survey will be undertaken over an area of 1 km^2, with an option to infill along the tie-in line between the two locations. The survey is located in UKCS Block 49/17, with the greater working area extending into Blocks 49/11, 49/12, 49/16 and 49/17; an area of 13.5 km by 8 km (Figure 1) (HRL 2023b).

2.3 The survey entails the use of the following noise generating equipment.

- 2D High Resolution (2DHR) seismic,
- sub bottom profiler,
- multi beam echo-sounder,
- sidescan sonar

2.4 The operations are scheduled to commence on 10th April 2023, at the earliest, and will last for up to 10 days. To account for potential scheduling, operational and weather delays, the marine survey consent has been requested until 31st May 2023.

2.5 In addition to undertaking seismic geophysical survey a total of 27 grab samples may be obtained within the North Norfolk Sandbanks and Saturn Reef SAC.

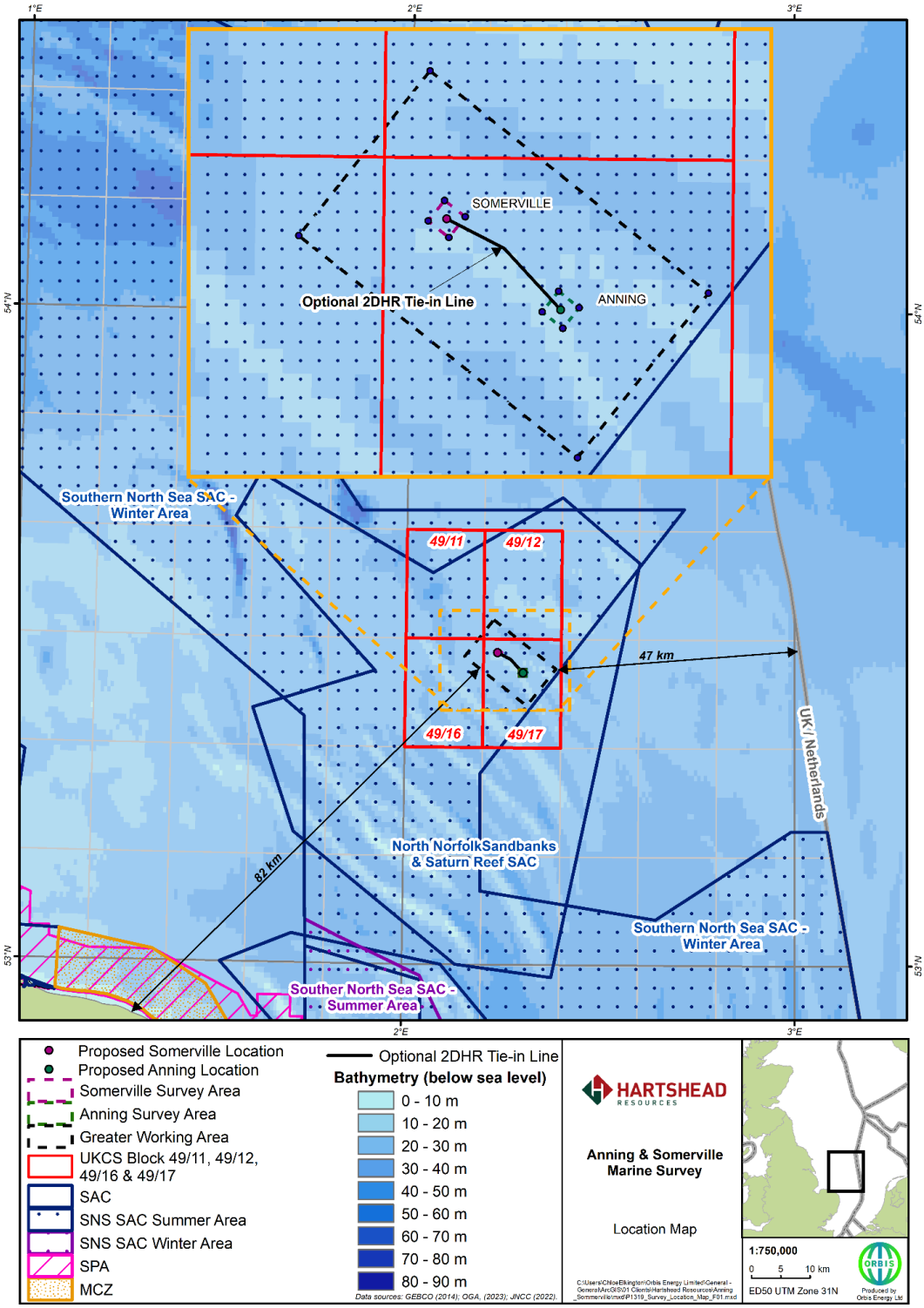

Figure 1: Location of the proposed Somerville and Anning survey showing survey and greater working areas (HRL 2023b).

2.6 Details of the sound sources from the equipment to be used is presented in Table 1 (HRL 2023b).

Table 1: Survey parameters.

Array Parameter	2DHR Seismic	Mini Airgun	Sub-bottom profiler	Sub-bottom profiler (sparker)
Duration (days)	Up to 10 days			
Airgun Source	4 x 40 cu. in.	1 x 10 cu.in	-	-
Total volume (cu. In).	160	10	-	-
Sound pressure (dB re 1 µPa (0-p))	238	196	221	226
Sound exposure level – (dB re 1 μPa^2s)	233	202	195	
Peak frequency (kHz)	0.35	0.8	4	0.3
Source point interval (m)	6.25	-	-	-
Towed depth (m)	35	35	35	35
Vessel speed (knots)	4.0	4.0	4.0	4.0

2.7 The proposed seismic survey will be undertaken along predetermined lines. There will be 60 lines each approximately 50 m apart and each line turn estimated to last no more than 30 minutes (HRL 2023b).

2.8 The proposed 27 grab samples will each impact an area of 0.1 m^2 and therefore a combined estimated impact of 10.8 m^2 (HRL 2023b).

3 DESIGNATED SITES

3.1 The proposed survey is being undertaken in waters within or adjacent to a number of designated sites and it is recognised that potential impacts that could cause a likely significant effect could occur to a number of qualifying species both within and outwith designated sites.

3.2 Based on the information presented within the application, including the results from the noise modelling undertaken in support of the application, Two SACs have been identified as having qualifying features at risk of a likely significant effect from the proposed survey (Figure 1).

3.3 The qualifying sites and features relevant to this HRA are:

- Southern North Sea SAC (Harbour porpoise),
- North Norfolk Sandbanks and Saturn reef SAC (Sandbanks which are slightly covered by sea water all the time, Reef).

Qualifying features

3.4 Based on the information presented within the application and advice received from consultation (JNCC 2023) it has been determined that the HRA should consider alone and in-combination the potential direct and indirect impacts on:

- Harbour porpoise.
- Sandbanks which are slightly covered by sea water all the time.
- Reef

Harbour porpoise

3.5 The harbour porpoise (*phocoena phocoena*) is a qualifying species for the:

- Southern North Sea SAC,

3.6 The harbour porpoise is the smallest and most abundant cetacean species in UK waters. They occur widely across shelf waters predominantly either individually or in small groups but larger aggregations have been reported (Defra 2015), with group sizes varying with season (Clark 2005). Harbour porpoise have a very broad distribution occurring predominantly over the continental shelf. Higher densities occur in areas of up-wellings and strong tidal currents and in water depths of predominantly between 20 and 40 m (Clark 2005, Whaley 2004). Their distribution may also be strongly correlated with seabed type, with areas of sandy gravel being preferred and this may be linked to prey availability (Clark 2005).

3.7 Harbour porpoise occur widely across the North Sea. Data from the three Small Cetacean Abundance in the North Sea (SCANS) surveys indicate that that there may have been a southward shift in the distribution of harbour porpoise in the North Sea. In the early 1990's harbour porpoise were widespread but appear to have occurred predominantly around eastern Scotland and the northern North Sea to the southern North Sea (Hammond *et al*. 2013). Since the 1990's harbour porpoise continue to be widespread across the North Sea but densities have increased in the southern and central North Sea. The cause of this apparent change in the distribution of harbour porpoises across the North Sea is unclear but may be related to changes in prey availability (IAMMWG *et al.* 2015).

3.8 Following the completion of the most recent SCANS survey (SCANS III), the latest estimated harbour porpoise populations within the whole of the SCANS survey area is 424,245 (CV 313,151 – 596,827). Since 1994 the population of harbour porpoises within the SCANS surveyed area has remained relatively stable (Hammond *et al*. 1995, Hammond 2006, Hammond *et al.* 2017).

3.9 There are three Management Units identified for harbour porpoise in the north-east Atlantic, of which, the Southern North Sea SAC lies within the North Sea Management Unit. The harbour porpoise population within the North Sea Management Unit was originally estimated to be 227,298 (176,360 – 292,948) (IAMMWG 2015). This estimated population of harbour porpoise is recognised to have been derived from data collected in 2005 and 2016 during a single month and that the harbour porpoise population within the SAC will vary across seasons and years. The population estimated from the Joint Cetacean Protocol (JCP), where abundance and distribution data from multiple sources collected over a period of time have been integrated was 333,808 individuals (JNCC 2017a). The most recent population estimate for the North Sea Management Unit is 346,601 individuals and this figure has been used for this assessment (IAMMWG 2022).

3.10 The SAC selection assessment document estimates that the site holds 18,500 harbour porpoise (98% C.I. 11,864 – 28,899) (JNCC 2017b; 2019a), which was, at the time the estimate was made, 8.1% of the North Sea Management Unit population (Hammond *et al*. 2013, IAMMWG 2015).

3.11 Harbour porpoise densities vary seasonally and across the Southern North Sea SAC (Evans and Teilmann 2009). Site-specific surveys undertaken by wind farm developers have shown considerable variation in the spatial and temporal distribution of harbour porpoises across years (e.g. Forewind 2013, SMart Wind 2017). Typically, peak abundance has been reported to occur between May and July at sites across the Dogger Bank area and between September and April at sites further south (e.g. Forewind 2014, SMart Wind 2015, EAOWL 2015). Lowest reported abundance across nearly all wind farm surveyed areas occurs between November and February,

although the poorer survey conditions that occur predominantly during the winter months may be a contributing factor in the lower number of harbour porpoise recorded during this period.

3.12 Based on data in the JCP database highest densities in the central and northern area of the SAC occur during the summer period with modelled harbour porpoise densities greater than 3.0 per km^2 occurring widely. During the winter period the distribution of harbour porpoise in the southern North Sea changes, with reduced densities over the central and northern area but an increase in densities in nearshore waters and the southern part of the SAC (Heinänen and Skov 2015).

3.13 Surveys undertaken across the southern North Sea, including areas within and encompassing the SAC, have reported lower densities of harbour porpoise than that estimated from JCP data. Densities reported from SCANS III surveys are from between 0.888 ind./km^2 in SCANS block O and 0.607 ind./km^2 in SCANS block L (Hammond *et al.* 2017). Similarly, data obtained across the Dogger Bank area including the Southern North Sea SAC, in 2011 recorded a density of 1.88 ind./km^2 (Gilles *et al.* 2012). Data obtained from surveys undertaken at offshore wind farms located within or adjacent to the SAC indicate densities vary across the site and across seasons. Mean densities reported from surveys undertaken by offshore wind farm developers range from 0.11 ind./km^2 at Triton Knoll offshore wind farm including a 1 km buffer to 2.87 ind./km^2 within the Hornsea subzone 3 wind farm area plus a 4 km buffer (TKOWFL 2011, SMart Wind 2017).

3.14 Tagging studies undertaken in Denmark indicate that harbour porpoises are highly mobile and range widely in the North Sea, with individuals tagged in the Skagerrak travelling up to 100 km per day, with a mean distance of 24.5 km per day (Sveegaard 2011). Individuals tagged in Danish waters were recorded off the east coasts of England and Scotland (Sveegaard 2011).

3.15 Harbour porpoise swimming speeds vary with the highest recorded swimming speeds being 4.3 m/s (Otani *et al.* 2000). Mean recorded speeds are typically around 1 m/s (Otani *et al.* 2000, Kastelein *et al.* 2018). When disturbed by noise harbour porpoise can increase swimming speeds with increasing sound levels. Studies using playback experiments of pile-driving sounds have reported increases in swimming speed from an average of 1.2 m/s to 2.0 m/s at sound levels of 154 dB re 1 µPa that were sustained for at least 30 minutes (Kastelein *et al*. 2018).

3.16 Although harbour porpoises may dive to depths of up to 226 m and remain submerged for up to five minutes, they more frequently undertake relatively shallow dives of a short duration, with a mean depth of 14 m and duration of 44 seconds (Santos and Pierce 2003, Otani *et al*. 1998, 2000). Studies undertaken on 14 tagged harbour porpoise in Danish and adjacent waters reported that on average harbour porpoise spend 55% of the time in the upper 2 m of the surface waters. The most frequent dive depths were between 14 m and 32 m, with the maximum depth

dived of 132 m. The number of dives per hour increased from an average of 29 dives hr^{-1} between April and August to 43 dives hr^{-1} in October and November when it was presumed that higher levels of foraging activity occurred to compensate for the higher energy requirements required during the cooler winter period (Teilmann *et al*. 2007).

3.17 Harbour porpoise use echolocation to detect and track individual prey and are opportunistic feeders, foraging close to the seabed or near the sea surface, preying on a wide range of fish species including, herring (*Clupea harengus*), whiting (*Merlandius merlangus*), Gadoids spp. sprats (*Sprattus sprattus*), gobi (*Pomatoschistus minutus*) and sandeels (*Ammodytes* spp.), and their prey will vary during and between seasons (DeRuiter 2008, Santos and Pierce 2003, IAMMWG *et al.* 2015). The prey of harbour porpoise may change over time with a reported long-term shift in prey from clupeid species to sandeels and gadoid species (IAMMWG *et al*. 2015), indicating that harbour porpoise may be opportunistic feeders capable of feeding on a variety of species.

3.18 Studies undertaken in Denmark indicate that their local distribution may be correlated with prey availability (Sveegaard 2011). Due to the relatively high metabolic rate of harbour porpoise and the relatively small size of their predominant prey it has been suggested that harbour porpoise require a reliable source of food and frequent food consumption in order to maintain their body weight, with increased consumption in cooler environments (Kastelein *et al*. 1997, Wisniewska *et al*. 2016; 2018).

3.19 Harbour porpoise have a maximum life expectancy of 24 years, with an average life expectancy of around 12 years in UK waters (Lockyer 2003, Learmouth *et al.* 2014). Females become sexually mature at between three and five years old (Lockyer 2003, Learmouth *et al*. 2014). Breeding is thought to occur primarily during the summer months between May and September, particularly in August, with calving 10 months later. Calves are nursed for eight to ten months but may remain with the mother until a new calf is born (Defra 2015, Lockyer 2003, Weir *et al*. 2007).

3.20 The range at which marine mammals, including harbour porpoise, may be able to detect sound arising from offshore activities depends on the hearing ability of the species and the frequency of the sound. Other factors that can affect the potential impact include ambient background noise, which can vary depending on water depth, seabed topography and sediment type. Natural conditions such as weather and sea state and existing sources of human produced sound can also reduce the auditory range.

3.21 Porpoises are generally considered to be 'high frequency' or 'very high frequency' specialists with a relatively poor ability to detect lower frequency sounds (Southall *et al.* 2007, 2019). Studies

undertaken on captive harbour porpoises indicate that porpoises have a functional hearing range of between 250 Hz and 180 kHz with their best hearing between 16 to 140 kHz and their maximum sensitivity between 100 and 140 kHz. It is within the frequency range of 130 to 140 kHz that harbour porpoise echolocate (Miller and Wahlberg 2013).

3.22 Their ability to detect sound below 16 kHz or above 140 kHz falls sharply (Kastelein *et al.* 2012, 2015, Southall *et al*. 2007). Harbour porpoise are therefore most sensitive to sound sources between 16 to 140 kHz and, although potentially audible, they are unlikely to be sensitive to sound either above or below those frequencies.

3.23 Harbour porpoise use echolocation to communicate and detect prey. Reported sound levels produced range from between 166 to 194 re: 1 µPa (rms SPL) and 178 and 205 dB re. 1 µPa (peak – peak SPL), with a mean level of 191 dB re. 1 µPa (peak – peak SPL) and within the peak frequency range of 110 to 150 kHz (Villadsgaard, *et al*. 2007, Miller and Wahlberg 2013, MMO 2015).

Prey species

3.24 Fish are not qualifying species for the Southern North Sea SAC. However, potential impacts on fish that are prey for harbour porpoise could affect the integrity of the site by reducing their prey base. Harbour porpoise prey on a variety of fish species that could be impacted by the proposed survey including gobies, Sandeel Spp., whiting, herring and sprat (JNCC and NE 2019).

3.25 Sandeels are one of the most abundant fish in the North Sea occurring widely over suitable sandy substrates where, once the larvae have settled, they remain in the area (Heath *et al.* 2011). Although widespread, sandeel distribution is highly substrate specific as they depend on seabed habitat comprising a high proportion of medium and coarse sands (particle size 0.25 - <2 mm) with low silt content (Holland *et al*. 2005).

3.26 Between September and April sandeels remain largely buried in the seabed except when spawning during December and January and when feeding during the late spring and summer (Greenstreet *et al.* 2006, Van der Kooij *et al*. 2008).

3.27 Within the Southern North Sea SAC sandeels occur across the site with their main spawning area over the Dogger Bank and a wider nursery area across most of the SAC (Judd *et al.* 2011).

3.28 Fish hearing is based on detecting particle motion directly stimulating the inner ear. However, those with swim bladders are also able to detect pressure waves and can detect a wider range of frequencies and sounds of lower intensity than fishes without swim bladders (Popper 2003). Fish with swim bladders that possess a coupling mechanism between the swim bladder and the auditory system, e.g. herring and sprats, are recognised to be hearing specialists. Fish that have

swim bladders but lack a mechanised coupling mechanism or do not have swim bladders, e.g. sandeel spp. are considered hearing generalists and have a relatively lower sensitivity to sound than fish that have swim bladders and a coupling mechanism.

3.29 Studies on the behaviour of fish from noise, largely using play-back experiments, have reported a range of behavioural responses including avoidance behaviour, changes in swimming speed and direction (e.g. Hawkins 2014, Mueller-Blenkle *et al.* 2010) and reduced antipredator responses (Everley *et al.* 2016).

3.30 Sandeels are not considered to have sensitive hearing (Popper *et al.* 2014). Studies undertaken using airguns indicate that sandeels have distinct but weak reactions to seismic airguns with initial startle responses reducing in frequency with on-going noise, and no increased mortality detected (Hassel *et al.* 2004).

3.31 There are limited studies assessing potential impacts on eggs and larvae. Results indicate that there is potential for increase in mortality when larvae are exposed to an airgun sound source with peak sound pressure levels of 220-242 dB re 1 μPa^2 (unknown measure), but only within 5 m of the airgun (Popper *et al*. 2014).

Sandbanks which are slightly covered by sea water all the time

3.32 Sandbanks which are slightly covered by sea water all the time is a qualifying feature for the:

- North Norfolk Sandbanks and Saturn Reef SAC,

3.33 The North Norfolk Sandbanks and Saturn Reef SAC covers an area of 3,603 km^2 and lie entirely within UK territorial waters adjacent to the counties of Norfolk. It was formally classified as a SAC on 29 September 2017 on account of its Sandbanks which are slightly covered by sea water all the time [Habitat code 1110] and Reefs [Habitat code 1170] (Natura 2000, 2012). The basis for the classification is set out in a Natura 2000 Standard Data Form (JNCC 2010).

3.34 Sandbanks which are slightly covered by seawater all the time are an Annex I habitat under the Habitats Directive and are described as *Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20 m below Chart Datum*. They occur widely in UK coastal and offshore waters. Annex I Sandbanks are defined by their physiographic nature rather than by a specific biological community (JNCC 2013). The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters. The SAC has within its boundaries a series of sandbanks including Leman, Ower, Inner, Well, Broken, Swarte and Indefatigable banks. They extend from between 40 km and 110 km off the coast of Norfolk in water depths of up to 40 m.

3.35 Within the site there are four main biotopes circalittoral coarse sediment biotopes, circalittoral coarse sand biotopes, circalittoral sand biotope and circlittoral mixed sediment biotope (JNCC 2013). The communities have low sensitivity to smothering and abrasion or disturbance to the seabed surface. However, they are highly sensitive to changes to different types of sediment and the physical loss of suitable habitat (Tillin *et al*. 2019).

3.36 The extent of sandbank habitat within the SAC covers 3,603 km^2, 3.4% of the total habitat in UK offshore waters and 16.4% of the habitat type within offshore designated sites.

Reefs

3.37 Reefs are an Annex I habitat under the Habitats Directive and are described as *rocky marine habitats or biological concretions that rise from the seabed. They are generally subtidal but may extend as an unbroken transition into the intertidal zone, where they are exposed to the air at low tide.* Two main types of reef are recognised: those where animal and plant communities develop on rock or stable boulders and cobbles, and those where structure is created by the animals themselves (biogenic reefs) (JNCC 2014). It is biogenic reef habitat formed by the tubeworm *Sabellaria spinulosa* that occurs within the North Norfolk Sandbanks and Saturn Reef SAC.

Information Sources

3.38 This HRA draws on a number of information sources relating to the proposed project and the site designation which should be read in conjunction with this report including:

- HRL (2023a,b). Somerville & Anning Marine Survey EAJ Document.
- Natura 2000 – Standard Data Form. Site: UK0030395. Southern North Sea. JNCC (2019b).
- Guidance for assessing the significance of noise disturbance against Conservation Objectives of harbour porpoise SACs. (England, Wales & Northern Ireland). JNCC (2020).
- Harbour Porpoise (*Phocoena phocoena*) possible Special Area of Conservation: Southern North Sea. Conservation Objectives and Advice on Activities. JNCC and NE (2019).

3.39 References to technical papers and other documents are given in the text as necessary.

4 POTENTIAL IMPACTS

4.1 The potential sound sources arising from the proposed surveys that could impact on harbour porpoise are the seismic airguns and the use of sub-bottom profilers (Table 1). The physical presence of the vessel could also impact on harbour porpoise. No other sources of potential impact that could affect qualifying habitats or species have been identified.

4.2 The airguns used in seismic surveys are pneumatically-driven impulsive transducers that generate high intensity, low frequency, short duration sound pulses at regular intervals of typically between every 10 to 15 seconds. The seismic source geometry is designed to focus the output from the array vertically downwards minimising any horizontally propagating sounds (OGP/IAGC 2004). The level of sound generated by an airgun array depends on various factors including gun volume, array design, the number of airguns, spacing and air pressure. Field measurements of the sound emitted by airgun arrays used by the oil and gas industry show that levels of source intensity expressed as peak SPL range from 235 to 259 dB re 1µPa- m (Richardson *et al*. 1995, OSPAR 2009). The frequency range of emitted energy is typically in the 5 Hz to 500 Hz range and strongest from 10 to 120 Hz, but with some energy in the 500 Hz to 1 kHz range (Richardson *et al*. 1995, Hermannsen *et al.* 2015).

4.3 Sub-bottom profilers typically produce sound source levels of between 196 and 225 dB re 1 µPa - 1 m (rms SPL) and at frequencies ranging from between 0.5 and 300 kHz and are therefore audible to harbour porpoise (BOEM 2016, King 2013, Danson 2005).

4.4 The applicant has the potential to use two different sub-bottom profilers, with the sparker identified has having a greater impact. Consequently, the impacts from the sparker have been considered further in this assessment (HRL 2023b).

Marine Mammals

4.5 There is a substantial volume of literature describing the potential effects of sound on marine mammals, and summarised in e.g. Thomsen *et al.* (2006), Southall *et al.* (2007) and OSPAR (2009).

4.6 There are four main types of potential effect from noise that are recognised within the marine environment:

- *Fatal effects* caused by significant levels of noise in close proximity to the receptor.
- *Physical injury*, specifically hearing impairment, which can be permanent or temporary. These effects can impact on the ability of marine mammals to communicate, forage or avoid predators.

- *Behavioural effects* such as avoidance, resulting in displacement from suitable feeding or breeding areas, and changes in travelling routes.
- *Secondary impacts* caused by the direct effects of noise on potential prey causing a reduction in prey availability.

4.7 The range at which marine mammals may be able to detect sound arising from offshore activities depends on the hearing ability of the species and the frequency of the sound with harbour porpoise more sensitive to relatively high frequencies compared with many other marine mammals. Other factors which may affect the potential impact of sound on marine mammals includes ambient background noise, which can vary depending on water depth, seabed topography and sediment type. Natural conditions such as weather and sea state and other existing sources of human produced sound, e.g. shipping, can also reduce the auditory range.

Fatal effects

4.8 If source peak pressure levels from the proposed operations are high enough there is the potential for a lethal effect on marine mammals. Studies suggest that potentially lethal effects can occur to marine mammals when the peak pressure level is greater than 246 or 252 dB re. 1 µPa (Parvin *et al.* 2007). Damage to soft organs and tissues can occur when the peak pressure level is greater than 220 dB re. 1 µPa.

Physical injury

4.9 Underwater sound has the potential to cause hearing damage in marine mammals, either permanently or temporarily. The potential for either of these conditions to occur is dependent on the hearing bandwidth of the animal, the duty cycle of the sound source and duration of the exposure (Southall *et al*. 2019, OSPAR 2009).

Behavioural Change

4.10 Potential changes in behaviour may occur depending on the sound source levels and the species' and individuals' sensitivities. Behavioural changes can include changes in swimming direction, diving duration, avoidance of an area and reduced communication.

4.11 Masking effects may also cause changes in the behaviour as the level of sound may impair the detection of echolocation clicks and other sounds that species use to communicate or detect prey, thus causing them to alter their behaviour.

Secondary Effects

4.12 There is potential for impacts on prey species to affect harbour porpoise, in particular possible impacts of noise on fish species.

Sandbanks and Reef

4.13 There is potential for physical impact on the sandbank and reef habitats to arise from the proposed grab sampling. An area of 10.8 m^2 could be temporally impacted by the grab sampling.

5 NOISE MODELLING

5.1 To assess the potential environmental impacts from the proposed survey the applicant has undertaken noise modelling for both the 2DHR seismic survey and the sparker sub-bottom profiler. Other sources of potential noise are recognised to be lower than that arising from the 2DHR and sparker sub-bottom profiler and were therefore not modelled (HRL 2023b).

5.2 Results from the modelling indicate the extent at which the onset of a Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) or disturbance could occur from the airguns during the proposed survey on marine mammals. The modelling indicates that there is a risk of PTS to harbour porpoise from the airgun array to be used during the 2D survey within 20 m of the sound source, based on the cumulative SEL metric (Table 2) (HRL 2023b). The modelling indicates that there is a risk of PTS to harbour porpoise from the sub-bottom profiler to be used during the survey within 2,100 m of the sound source, based on the cumulative SEL metric (Table 2)[1].

5.3 Modelling has not been undertaken to assess behavioural impacts but a 12 km EDR has been used in the application for both the 2DHR survey and the sub-bottom profiler. On this basis there is of behavioural effects, e.g. displacement and disturbance to a harbour porpoise within an area of 452 km^2 (Table 2 and Table 3) (HRL 2023b).

5.4 Injury to fish is not expected to arise beyond 10 m from the use of airguns or sub-bottom profiler based on a cumulative SEL. There are no data available to assess the potential area of disturbance to fish species.

Table 2: Predicted extent of potential auditory injury (PTS) and disturbance from the proposed 2DHR seismic survey (Source HRL 2023b).

Survey	PTS		Disturbance (12km)	
	Distance (m)	Area (km^2)	Distance (km)	Area (km^2)
2DHR seismic survey	20	<0.001	12	452

Table 3: Predicted extent of potential auditory injury (PTS) and disturbance from the use of the proposed Sub-bottom profiler (Source HRL 2023b).

Survey	PTS		Disturbance (12 km)	
	Distance (m)	Area (km^2)	Distance (km)	Area (km^2)
Sparker sub-bottom profiler	2,100	13.8	12	452

[1] Following a request from OPRED, the applicant has confirmed the modelling results are correct and that the onset of PTS is predicted to arise out to 2.1 km from the use of a sub-bottom profiler. OPRED note that this level of impact is much greater than those predicted other sub-bottom profiling noise modelling results.

6 EFFECTIVE DETERRENT RADIUS / RANGE

6.1 The Effective Deterrent Radius / Range (EDR) has been proposed by the Statutory Nature Conservation Bodies (SNCBs) as a means to measure potential impacts on harbour porpoise within the SAC (JNCC 2017d,e; 2020b). The EDR is an empirically derived generic distance within which deterrence, i.e. displacement, of harbour porpoise is predicted to occur. The EDR are based on published studies that have monitored the effects on harbour porpoise from various activities and reflects the overall loss of habitat if all animals vacate the area (e.g. Defra 2015). It is an area of displacement as opposed to disturbance, which may be greater.

6.2 The published precautionary EDR are presented in Table 4 (JNCC 2020b). Relevant to this assessment are the 12 km EDR for the 2DHR seismic survey and a 5 km EDR for the sparker sub-bottom profiler.

Table 4: Precautionary Effective Deterrent Ranges (EDR) (Source: JNCC 2020b).

Activity	Effective Deterrent Range (km)
Monopile	26
Unexploded Ordnance	26
Pin-pile [1]	15
Monopile with noise abatement	15
Conductor piling	15
Seismic survey	12
High Resolution Geophysical Surveys	5

[1] Pin-piles are '*smaller diameter piles that secure jacket structures'* although there is no definition on what diameter a pin-pile should be in published guidance (JNCC 2020).

6.3 The SNCBs recognise that future data may require the suitability of the EDR to be reconsidered if it is found to be inappropriate (JNCC 2020).

7 CONSERVATION OBJECTIVES

7.1 Conservation Objectives constitute a necessary reference for identifying site-based conservation measures and for carrying out HRAs of the implications of plans or projects (JNCC and NE 2019). They outline the desired state for any European site, in terms of the features for which it has been designated. If these features are being managed in a way which maintains their nature conservation value, they are assessed as being in a 'favourable condition'. An adverse effect on the integrity of a site is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation (English Nature 1997).

7.2 The purpose of an Appropriate Assessment is to determine whether a plan or project adversely affects a site's integrity. The critical consideration in relation to site integrity is whether the plan or project affecting a site, either individually or in-combination, affects the site's ability to achieve its conservation objectives and favourable conservation status.

Southern North Sea SAC

7.3 The Southern North Sea SAC was designated as a SAC in 2019. The site covers an area of 36,951 km^2 and is designated for harbour porpoise.

7.4 Harbour porpoise are also protected throughout European waters under the provisions of Annex IV and Article 12 of the Habitats Directive, which are outwith the scope of this assessment. Harbour porpoise in UK waters are considered part of a wider European population and the mobile nature of this species means that the concept of a 'site population' is not thought to be appropriate for this species. Site based conservation measures therefore aim to complement wider ranging measures that are in place for the harbour porpoise (JNCC and NE 2019).

7.5 The Conservation Objectives for harbour porpoise are designed to ensure that human activities do not, in the context of maintaining site integrity:

- kill, or injure harbour porpoise (directly or indirectly),
- prevent their use of significant parts of the site (disturbance / displacement),
- significantly damage relevant habitats, or
- significantly reduce the availability of prey.

Southern North Sea SAC Conservation Objectives:

To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining Favourable Conservation Status for Harbour Porpoise in UK waters.

In the context of natural change, this will be achieved by ensuring that:

1. Harbour porpoise is a viable component of the site,
2. There is no significant disturbance of the species, and
3. The condition of supporting habitats and processes, and the availability of prey is maintained.

Source: JNCC and NE 2019

7.6 Harbour porpoises are considered to be a 'viable component' of the site if they are able to survive and live successfully within it. The first Conservation Objective aims to minimise the risk from activities that cause unacceptable levels of impact on harbour porpoise using the site, specifically those that could impact on the Favourable Conservation Status of harbour porpoise (JNCC and NE 2016, 2019).

7.7 The '*integrity of the site*' is not defined in the Conservation Objectives. However, EU and UK Government guidance defines the integrity of a site as ''*the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified*' (EC 2000, Defra 2012). Therefore, the integrity of the site applies to the whole of the site and it is the potential impacts across the whole of the site that are required to be appropriately assessed. Pressures that would affect site integrity include:

- killing or injuring harbour porpoise (directly or indirectly),
- preventing their use of significant parts of the site (disturbance / displacement),
- significantly damaging relevant habitats,
- significantly reducing the availability of prey. (JNCC and NE 2019).

7.8 The second Conservation Objective states that there should be '*…no significant disturbance of the species'* and that '*Disturbance is considered significant if it leads to the exclusion of harbour porpoise from a significant portion of the site'* (JNCC and NE 2019).

7.9 *'Supporting habitats and processes'* relate to the seabed and water column along with the harbour porpoise prey.

7.10 JNCC advise that it is not appropriate to use the site population estimates in any assessments of effects of plans or projects (i.e. Habitats Regulation Assessments), as it is necessary to take into consideration population estimates at the Management Unit level to account for daily and seasonal movements of the animals (JNCC 2017d; JNCC and NE 2019).

7.11 There are no formal thresholds at which impacts on site integrity are considered to be adverse. However, a threshold of 1.7% of the relevant harbour porpoise population above which a population decline is inevitable has been agreed with Parties to the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS), with an intermediate precautionary objective of reducing the impact to less than 1% of the population (Defra 2003, ASCOBANS 2015). This threshold relates to impacts from fisheries by-catch on harbour porpoise where the impact on the harbour porpoise is permanent, i.e. up to 1.7% of the population may be caught as by-catch before a population decline is inevitable. An equivalent level of impact from disturbance, which is temporary and non-lethal, on a population will have a lower level of impact on the population compared to that from a fisheries by-catch.

7.12 The lack of agreed population thresholds either at the Management Unit level or site level, below which evidence demonstrates there would not be an adverse effect, does not prevent objective judgements to be made on site integrity.

7.13 Draft thresholds to assess and manage the effects of noise on site integrity have been proposed by the JNCC and NE (JNCC 2017d,e; JNCC and NE 2019, JNCC 2020). The proposed approach is not based on a population level impact but is instead based on a temporal and spatial level where a proportion of the area within the SAC may be affected over a period of time.

7.14 The JNCC and NE advice is that *'noise disturbance within the site should not exclude harbour porpoise from more than 20% of the site on any given day. Over a season, the advice is that an average loss of access to more than 10% of the SAC should be considered significant, recognising that within the SAC the abundance of harbour porpoise per unit habitat is generally higher than the equivalent sized habitat in the rest of the relevant Management Unit. Management of temporary habitat 'loss' to below defined area/time thresholds is therefore designed to ensure that it continues to contribute in the best possible way to the maintenance of the species at FCS.'* (JNCC 2020).

7.15 The potential extent of noise causing disturbance that would meet these proposed thresholds and therefore impact on the integrity of the site are presented in Table 5. The results indicate that should the impact occur wholly inside the SAC that, within the 'summer' area a sound source

alone or in-combination causing disturbance for one day over an area of 7,390 km^2 would risk impacting site integrity. This is equivalent to a circular radius of noise out to 41.5 km. To exceed the threshold for the 'winter' area, noise in any one day should not extend over an area of more than 2,537 km^2; equivalent to a circular radius of 28.4 km.

7.16 Over the course of a season the total extent of potential disturbance on average per day should, in the 'summer' area, not extend over an area of more than 3,695 km^2; equivalent to a radius of noise of 29.3 km and in the 'winter' area should not extend over an area of more than 1,269 km^2, equivalent to a radius of 20.1 km.

Table 5: Estimated extent sound levels capable of causing displacement disturbance occur in order to impact on site integrity.

Site	Area (km^2)	1 day threshold		Seasonal threshold	
		20% of area (km^2)	Distance to threshold (km)	10% of area (km^2)	Distance to threshold (km)
Southern North Sea SAC	36,951	7,390	48.5	3,695	34.3
'summer' area April - September	27,028	5,406	41.5	2,701	29.3
'winter' area October - March	12,696	2,539	28.4	1,270	20.1

The 'Distance to threshold' presumes sound propagation is circular in shape, i.e. the distance is the equivalent to a radius of circular noise.

7.17 Unlike the daily threshold, the area of the SAC that can be affected over the course of a season is an average over the season. The seasonal average is calculated by summing the proportion of the site impacted (for the relevant season) over the number of days the impact will occur and then averaging across the total number of days within that season, i.e. 183 days in the summer period and 182 days in the winter period. This provides a seasonal average spatial effect.

7.18 This assessment is based on both the potential impact on the North Sea Management Unit population using both the ASCOBANS thresholds and the proposed SNCB threshold approach.

7.19 In order to undertake any meaningful assessment using the threshold approach accurate information on the timing, duration and extent of activities being undertaken is required. Where this information is lacking or where speculative 'worst-case' scenarios are used there is little or no confidence that the results will bear any resemblance to the true extent of impact within the SAC on any single day or across the course of a season. The threshold approach proposed by the SNCBs has not been agreed with the competent authorities. However, the thresholds have been noted within the assessment as a high-level management tool to limit the spatial distribution

of noise from offshore activities within a large offshore SAC, such as the Southern North Sea SAC.

7.20 The HRA has been carried out in light of best scientific knowledge with reference to the Conservation Objectives of the SAC and the potential impacts on the integrity of the site (EC 2010).

North Norfolk Sandbanks and Saturn Reef SAC Conservation Objectives

7.21 The following Conservation Objectives have been produced by the JNCC for North Norfolk Sandbanks and Saturn Reef SAC (JNCC 2017f).

North Norfolk Sandbanks and Saturn Reef SAC Conservation Objectives:

For the features to be in favourable condition thus ensuring the integrity of the site in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I reefs. This contribution would be achieved by maintaining or restoring, subject to natural change:

- The extent and distribution of the qualifying habitats in the site;
- The structure and function of the qualifying habitats in the site; and
- The supporting processes on which the qualifying habitats rely.

7.22 Supplementary advice on the Conservation Objectives of the site relating to Annex 1 sandbanks slightly covered by seawater all the time states that:

7.23 *A restore objective is advised for extent and distribution of the sandbank feature. This objective is based on expert judgment; specifically, our understanding of the feature's sensitivity to pressures which can be exerted by ongoing activities i.e. those associated with the oil and gas industry and cabling. Our confidence in this objective would be improved with longer-term monitoring and access to better information on the activities taking place within the site. Activities must look to minimise, as far as is practicable, changes in substratum and the biological assemblages within the site to minimise further impact on feature extent and distribution* (JNCC 2017g).

7.24 The JNCC consider the entire site to represent an integrated sandbank system, with the qualifying feature occupying the entire site (JNCC 2017g).

7.25 Supplementary advice on the Conservation Objectives of the site relating to Annex 1 Reef – *Sabellaria spinulosa* biogenic reef states that:

7.26 *JNCC understands that the site has been subjected to activities that have resulted in a change to the extent and distribution of the feature within the site. Installation and/or removal of infrastructure may have a continuing effect on extent and distribution of the biogenic reef within the site. As such, JNCC advise a restore objective which is based on expert judgment; specifically, our understanding of the feature's sensitivity to pressures which can be exerted by ongoing activities i.e. those associated with the oil and gas industry and demersal fishing. Our confidence in this objective would be improved with longer-term monitoring and access to better information on the activities taking place within the site. Activities must look to minimise, as far as is practicable, damaging the established i.e. high confidence reef within the site.* (JNCC 2017g).

8 IN-COMBINATION IMPACTS

8.1 Under the Habitats Regulations, it is necessary to consider the in-combination effects of plans or projects on European Sites. These refer to effects, which may or may not interact with each other, but which could affect the same receptor or interest feature (i.e. a habitat or species for which a European site is designated).

8.2 The in-combination assessment includes plans or projects that are:

- Under construction,
- Permitted application(s), but not yet implemented,
- Submitted application(s), not yet determined,
- Projects identified in the relevant Development Plan (and emerging Development Plans),
- Sites identified in other policy documents, as development reasonably likely to come forward.

8.3 There is potential for in-combination impacts arising from impacts on the seabed arising from the grab sampling and other activities within the North Norfolk Sandbanks and Saturn Reef SAC. For the purposes of this assessment the in-combination impacts previously published have been used. Previous assessments have estimated that up to 1,428 km^2 of seabed within the SAC could be physically impacted, predominantly from beam trawling (BEIS 2021).

8.4 Potential in-combination impacts relating to noise within the Southern North Sea SAC are presented for each sector in further detail below.

Renewable energy activity

8.5 A source of potentially significant in-combination underwater noise impact is from pile driving activity occurring during the construction of offshore renewable developments, particularly offshore wind farms.

8.6 There are 24 UK offshore wind farms that are either operating or applications have been submitted and that lie wholly within the Southern North Sea SAC or are within 26 km of the boundary. (This is identified by the JNCC as an area that harbour porpoises may be displaced from by noise arising from pile-driving activities (JNCC 2017d, JNCC 2020)). A further six wind farms are currently in pre-application phase. (Table 6).

8.7 During the period of the proposed survey the following wind farm related activities could be undertaken that could cause an in-combination impact:

- Dogger Bank A offshore wind farm could be installing turbine foundations and therefore carrying out pile-driving.
- Dogger Bank B could commence pile-driving in August 2023 (Gov 2023). This is after the completion of the proposed Somerville and Anning survey and therefore not cause a daily in-combination impact but could cause an in-combination impact based on a seasonal threshold assessment.

8.8 All other wind farms are either operating, consented but not started offshore construction or have submitted applications and are awaiting determination and no other activities have been identified as having potential for causing an in-combination impact.

Table 6: Offshore wind farms located within 26 km of the Southern North Sea SAC.

Wind farm	Status
Round 1	
Scroby Sands	Operating
Round 2/2.5	
Dudgeon	Operating
Galloper	Operating
Greater Gabbard	Operating
Gunfleet Sands II	Operating
Humber Gateway	Operating
Thanet	Operating
Triton Knoll	Operating
Westermost Rough	Operating
Round 3	
Dogger Bank A	Offshore construction started
Dogger Bank B	Onshore construction started
Dogger Bank C	Onshore construction started
Sofia	Consented
East Anglia One	Operating
East Anglia One North	Consented
East Anglia Two	Consented
East Anglia Three	Consented
Hornsea Project One	Operating
Hornsea Project Two	Offshore construction started
Hornsea Project Three	Consented
Hornsea Project Four	Application submitted
Norfolk Vanguard	Consented
Norfolk Boreas	Consented
'Round 3+'	
Dogger Bank D	Pre-application
Extension Projects	
Dudgeon and Sheringham Shoal Extensions	Application submitted
Five Estuaries	Pre-application
North Falls	Pre-application
Round 4	
Dogger Bank South: West	Pre-application
Dogger Bank South: East	Pre-application
Outer Dowsing	Pre-application

Cable laying activity

8.9 The NeuConnect Project includes the installation, operation and maintenance of a 1400 MW electricity interconnector between the electricity networks of Great Britain (GB) and Germany.

Two High-Voltage Direct Current submarine cables will be installed in a single cable bundle, which will also contain a fibre optic control and communication cable.

8.10 The proposed works include the use of a sub-bottom profiler and has therefore been identified in the Southern North Sea Noise Register (Gov 2023). The information to inform the HRA does not include any reference to noise impacts within the SAC from a sub-bottom profiler (NeuConnect 2021). Furthermore, the HRA undertaken requires within it a licence condition that the sub bottom profiler survey work will not be carried out in the Southern North Sea SAC during the wintering period between the months of 1 October to 31 March inclusive (MMO 2021). No such condition has been included for impacts in the summer period between April and September. There is no evidence within the HRA documentation that there will be any use of a sub-bottom profiler within the summer area of the Southern North Sea SAC during the summer period. Consequently, it is concluded that there will be no in-combination impact resulting from activities associated with the NeuConnect Project.

Aggregate extraction and dredging activity

8.11 Existing localised aggregate dredging occurs primarily in the southern half of the SAC, along the east coast. In 2019 there were 29 aggregate production areas and five Exploration and Option areas covering an area of 579.2 km^2. Five of the aggregate areas occur in the 'summer' area of SAC covering 77.7 km^2 and the rest occur in the 'winter' area of the SAC and cover an area 533.8 km^2, with some sites occurring in both the 'winter' and 'summer' areas.

8.12 Studies have indicated that harbour porpoise may be displaced by dredging operations within 600 m of the activities (Diederichs *et al*. 2010). Noise modelling previously undertaken for aggregate assessments have predicted significant levels of avoidance at ranges of 500 m from suction dredging (Parvin *et al* 2008 (referenced in Hanson Aggregates Marine Ltd 2013)).

8.13 On a precautionary assumption that there is a level of behavioural displacement out to 600 m, there is potential for an area of 1.13 km^2 to be affected at each active dredging location. There are currently three aggregate production areas in the 'summer' area and 26 in the 'winter' area. Although the level of dredging activity within each of the active licence areas is unknown, as a worst-case scenario, with dredging occurring within each dredging area, porpoise may be displaced from an area of 3.39 km^2 in the 'summer' area and 29.38 km^2 in the 'winter' area. Therefore, a very small proportion (0.01% of the summer area and 0.2% of the summer area) of the SAC may be impacted by noise arising from dredging activities.

Oil and gas activity

8.14 There is a long history of oil and gas activities within the boundaries of the Southern North Sea SAC. Since 1965, when the first well was spudded (first drilled), there has been extensive oil and gas development with a total of 117 installations installed within the SAC. The vast majority (94%) of all the installations within the boundary of SAC are located in the 'summer' area of the site (Figure 2) (OGA NDR 2020).

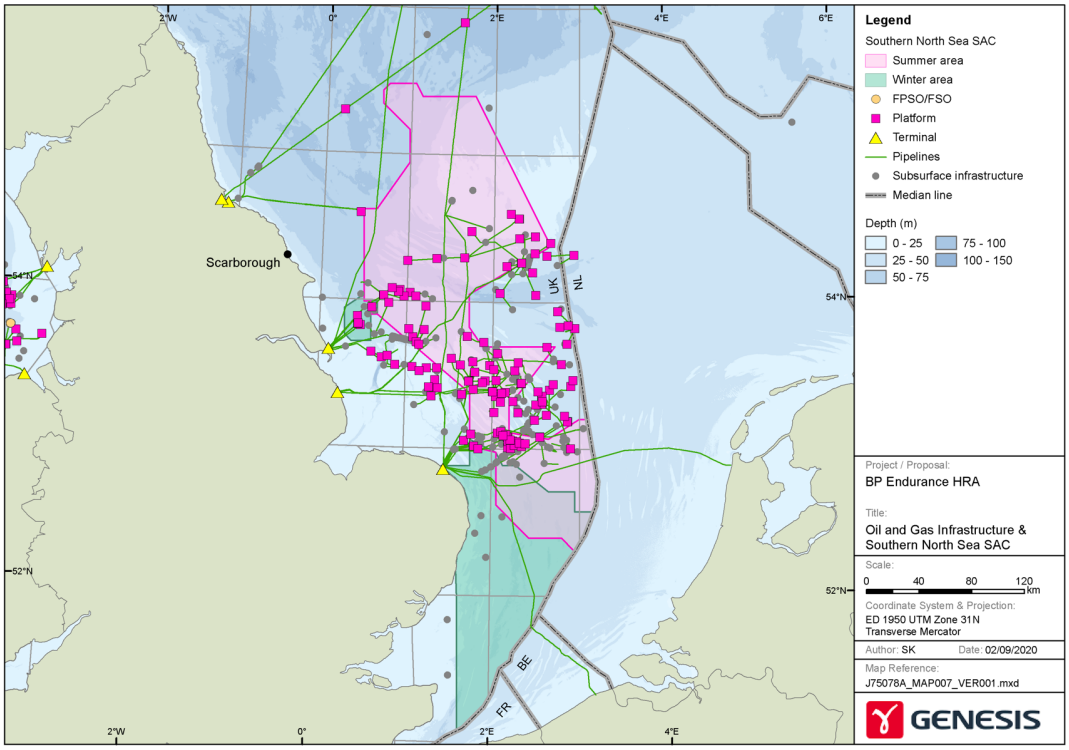

Figure 2: Existing oil and gas infrastructure within the Southern North Sea SAC.

8.15 Seismic surveys have regularly been undertaken within the SAC over the last 50 years, with a total of 23 2D or 3D seismic surveys carried out within the SAC over a ten year period up to 2017. The majority of surveys during this period took place in the northern half of the SAC, where the most recent oil and gas activity has occurred.

8.16 OPRED are aware of planned oil and gas related activities within the SAC during the period the proposed survey will be undertaken. These include:

- Crosgan drilling appraisal well,
- Endurance Field Bunter Outcrop survey,

- Murdoch KM and NW Bell ZX Survey,
- Johnston site survey,
- Q43 Lodestone West 2023- multi-client regional survey,
- Hewett Field Bathymetric and Seismic Survey.

Crosgan appraisal well

8.17 One-Dyas submitted an application (GS/1499/0) to carry out a marine survey on 26 January 2023. The application is for the drilling of an appraisal well with the earliest start date of 1 February 2023 and latest end date 31 December 2023 (ONE-Dyas 2023a).

8.18 The Crosgan well is an appraisal well which will be drilled over a period of 75 days. The well is planned to be drilled in a maximum of five sections after the 30" conductor has been installed. Once the 30" section is drilled a 30" conductor will be pilled in place to a depth of run at ±70 m (230 ft) measured depth and cemented in place. Piling of the conductor will be undertaken using a hammer and is expected to last up to eight hours (ONE-Dyas 2023b).

8.19 In addition to the above drilling activity, a Vertical Seismic Profile (VSP) survey will be undertaken to acquire data on the well, which will involve the use of a seismic array from the jack-up rig into the wellbore. The VSP operation is expected to take no more than 24 hours to complete and will involve a four-gun array. The total time of the VSP operations, including deployment of equipment, is one day. (ONE-Dyas 2023b).

8.20 An HRA has been undertaken for this application (OPRED 2023a)

Endurance Field Bunter Outcrop Survey

8.21 BP have submitted an application to undertake seismic survey at the Endurance reservoir site (Licence application number GS/1500) (BP 2023a,b). The purpose of the survey is to acquire 3D imaging of the Endurance structure in support of the Northern Endurance Partnership carbon capture, utilisation and storage project. The survey will acquire data that could not be acquired during a previous seismic survey of the area (GS/1332) undertaken in 2022.

8.22 The proposed survey area will cover an area of approximately 10 km^2 and will intersect with UKCS blocks 43/27 and 43/28. The survey area lies wholly within the Southern North Sea SAC The survey greater working area is approximately 233 km^2 in area and intersects with UKCS blocks 43/22, 43/23, 43/27 and 43/28.

8.23 The proposed activities are to be undertaken over a period of 20 days from 23 March 2023. However, licence allows for activities to be undertaken up to 31 May 2023. Consequently, there is potential for both daily and seasonal in-combination impacts.

8.24 An HRA has been undertaken for this application (OPRED 2023b).

NW Bell ZX and Murdoch KM Survey

8.25 Harbour Energy propose to conduct a geophysical site survey at NW Bell ZX and Murdoch KM in Blocks 49/22 and 49/23 (NW Bell) and Blocks 44/22 and 44/23 (Murdoch KM) (Harbour Energy 2023a). The NW Bell ZX lies within the Southern North Sea SAC and the Murdoch KM lies 5.9 km outwith the SAC. Consequently, only activities associated with the NW Bell ZX could impact on the Southern North Sea SAC.

8.26 The proposed survey activities will comprise of Sub-bottom Profiling, Multibeam Echosounder, Side Scan Sonar, Echo-sounder Survey and passive magnetometer. The purpose of the planned geophysical survey is to gather data on the seabed bathymetry and conduct debris clearance at NW Bell ZX and Murdoch KM (Harbour Energy 2023a).

8.27 The proposed activities were to be undertaken over a period of two days from 9 March 2023. However, licence allows for activities to be undertaken up to 31 May 2023. Consequently, there is potential for both daily and seasonal in-combination impacts from activities at NW Bell ZX.

Johnston Survey

8.28 Harbour Energy propose to conduct a site survey at the Johnston field located in Block 43/27 (Harbour Energy 2023b). The survey will be across two locations, Johnston E&A well area and Johnston J4 and J5 wells area, within Block 43/27.

8.29 The survey activities will comprise of a 2D Ultra High Resolution Seismic Survey, Sub-bottom Profiling, Multibeam Echo Sounder, Side Scan Sonar and Echo Sounder Survey. The purpose of the planned geophysical survey is to gather data on the seabed and environmental conditions of the Johnston field, and the mapping of shallow hazards (Harbour Energy 2023b).

8.30 The proposed activities were to be undertaken over a period of two days from 15 March 2023. However, licence allows for activities to be undertaken up to 31 May 2023. Consequently, there is potential for both daily and seasonal in-combination impacts.

Hewett Field Bathymetric and Seismic Survey

8.31 ENI have submitted an application to undertake a bathymetric and 3D seismic survey at the Hewett gas field between May and October 2023 (ENI 2023). The bathymetric survey will require the use of a Innomar Medium-USV sub-bottom profiler and the 3D seismic survey will use a 585 cu. in. airgun source and cover a survey area of 670 km^2.

8.32 The combined surveys will be undertaken over a period of 130 days between 1 May and 8 September, with a contingency for up to end of October (ENI 2023). Consequently, there is potential for both daily and seasonal in-combination impacts.

Q43 Lodestone West 2023- multi-client regional survey

8.33 CGG have submitted an application to undertake a regional multi-client three-dimensional geological survey at the Lodestone survey area within the United Kingdom Continental Shelf (UKCS) Quadrants 42, 43 and 44 in the southern North Sea and overlaps the Southern North Sea SAC (CGG 2023).

8.34 The proposed survey operations will be undertaken using a single source (and recording) vessel and are planned to take place between June and December 2023. The survey is expected to take up to 114 days to complete during which airguns will be active/fired on 71 days.

8.35 There is no potential for an in-combination daily impact. There is potential for in-combination seasonal impact. However, no information is presented within the application suitable to undertake an in-combination assessment. There is limited noise modelling and no assessment using the SNCB threshold approach. Consequently, at this stage it is not possible to include the potential seasonal in-combination impacts from this survey within this assessment.

8.36 The proposed survey will be subject to an assessment under the Habitats regulations prior to any consent decision.

Shipping

8.37 Impacts from shipping on harbour porpoise within the SAC have been identified as arising from shipping noise and collision impacts. Shipping noise is the predominant anthropogenic source of noise within the marine environment and is reported to have a negative effect on harbour porpoise within the SAC when vessel traffic exceeds 80 vessels per day (JNCC 2017c). Shipping has been on-going in the southern North Sea for many hundreds of years and the area is important for shipping, with relatively high numbers of vessels occurring within it. Based on vessel track lines, in 2015 a total of 269,018 vessels track lines were recorded transiting across the SAC; an average of 737 vessels per day (MMO 2017a).

8.38 The level of vessel activity across the ‘summer’ and ‘winter’ areas of the SAC differs. There is relatively widespread vessel activity in low densities across the ‘summer’ area, with 76% of the quadrants having less than seven vessels per week and 17% having less than one vessel per week. Compared with the ‘winter’ area of the SAC where 14% of the quadrants had, on average, less than seven vessels per week and only 1% had less than one vessel per week. In contrast 11% of the ‘winter’ area had more than 70 vessels per week compared with none in the ‘summer’ area. The areas with relatively higher levels of shipping (>24 vessels per day), occur over 4% of the ‘winter’ area. Therefore, the ‘winter’ area has relatively localised, higher density, areas of vessel traffic compared with the ‘summer’ area that has widespread but low density vessel traffic.

Fishing activity

8.39 Fishing occurs widely across the southern North Sea and has also been on-going in the area for many hundreds of years. The majority of current fish landings are obtained from areas adjacent to the SAC but there is widespread fishing activity in the southern half and north-eastern edge of the SAC and relatively moderate to high levels of fishing activity along the western edge of the central part of the SAC (MMO 2017b).

8.40 There is a high risk of an impact from bycatch associated with the fishing industry to harbour porpoise across the North Sea, i.e. there is good evidence of a significant impact. There is a medium risk of an impact from removal of prey (JNCC and NE 2019).

8.41 The bycatch of harbour porpoise in fishing gear is reported to be one of the most significant anthropogenic pressures impacting on the harbour porpoise population (JNCC and NE 2019). It is estimated that between 1,235 and 1,990 harbour porpoise die each year in the North Sea due to bycatch, predominantly in gill nets (ICES 2016, Mitchell *et al*. 2018, OSPAR 2017). This is approximately 0.6% of the North Sea Management Unit population.

In-combination conclusion

8.42 Following consideration of all known developments that could cause a likely significant effect, OPRED considers that there are plans or projects likely to cause an in-combination likely significant effect. The activities likely to cause an in-combination impact considered within this HRA are:

- Construction pile-driving at Dogger Bank A offshore wind farm,
- Construction pile-driving at Dogger Bank B offshore wind farm,
- Crosgan Appraisal Well,
- Endurance Field Bunter Outcrop survey,
- Johnston site geophysical survey,
- NW Bell ZX and Murdoch KM geophysical survey,
- Q43 Lodestone West 2023- multi-client regional survey,

8.43 On-going routine activities such as shipping, that could contribute to impacts on qualifying species, will also be being undertaken for the duration of the proposed surveys.

9 LIKELY SIGNIFICANT EFFECTS TEST

9.1 Regulation 5 of the 2001 Regulations requires the Competent Authority to consider whether a development will have a likely significant effect on a European site, either alone or in combination with other plans or projects. A likely significant effect is, in this context, any effect that may be reasonably predicted as a consequence of a plan or project that may affect the Conservation Objectives of the features for which the site was designated but excluding trivial or inconsequential effects. An Appropriate Assessment is required if a plan or project is likely to have a significant effect on a European site, either alone or in combination with other plans or projects. A judgement of likely significant effect in no way pre-supposes a judgement of adverse effect on site integrity.

9.2 There are no recognised criteria as to what can be considered to be trivial or inconsequential impacts. Where predicted impacts are relatively very small compared to either the population of the management unit or the area of the site or the duration of the impact, it was determined that the impact would not cause a likely significant effect.

9.3 This section addresses this first step of the HRA, for which OPRED has considered the potential impacts of the survey both alone and in combination with other plans and projects on each of the interest features of the relevant European sites to determine whether or not there will be a likely significant effect.

Harbour porpoise

9.4 Harbour porpoise are a qualifying species for the Southern North Sea SAC.

9.5 Within the Southern North Sea SAC harbour porpoise are known to occur throughout the site, with particular concentrations in the northern 'summer' area over which the proposed surveys overlap. Noise modelling undertaken indicates that there is potential for auditory injury to occur within 20 m of the sound source based on 2DHR seismic survey and un-modelled disturbance or displacement generically out to 12 km (Table 2).

9.6 Based on the predicted extent of potential impacts, it is concluded that there is potential for a likely significant effect on harbour porpoise from the proposed survey within or adjacent to the Southern North Sea SAC; the potential impacts on harbour porpoise are therefore considered further in the Appropriate Assessment.

Sandbanks which are slightly covered by sea water all the time and Reef

9.7 The total area of seabed predicted to be impacted is 10.8 m^2; this impact is 0.0003% of the SAC. The estimated total of seabed predicted to be impacted in-combination with other plans or projects is 1,428 km^2. The additional impacts from grab sampling will increase the current estimated level of impact by 0.013%.

9.8 Based on the predicted extent of potential impacts, it is concluded that there is no potential for a likely significant effect on sandbank or reef habitats within the North Norfolk Sandbanks and Saturn Reef SAC from the proposed survey and therefore no further assessment is required.

Likely significant effects test - conclusions

9.9 Based on the information presented within the application relating to the proposed activities and the advice received during consultation, it is concluded that it is not possible to exclude a likely significant effect on the following designated sites and qualifying species:

- Southern North Sea SAC: Harbour porpoise.

9.10 For all other designated sites and associated qualifying habitats or species it is concluded that there will not be a likely significant effect from the proposed surveys either alone or in-combination with other plans or projects.

10 APPROPRIATE ASSESSMENT

10.1 An Appropriate Assessment is triggered when the competent authority, in this case the Secretary of State, determines that a plan or project is likely to have a significant effect on a European site. Guidance issued by the European Commission states that the purpose of an Appropriate Assessment is to determine whether adverse effects on the integrity of the site can be ruled out as a result of the plan or project, either alone or in-combination with other plans and projects, in view of the site's conservation objectives (EC 2000).

10.2 The following sections assess whether there will be an adverse effect on any of the European sites identified as having qualifying species for which no likely significant effect could not be ruled out from the project alone and in-combination.

10.3 A dual approach based on outputs from noise modelling where available and supported by the use of an EDR has been used in order to determine whether an adverse effect on the integrity of the Southern North Sea SAC will occur.

10.4 The assessment of the potential impacts from the seismic survey is based on the results from noise modelling undertaken by the applicant. This approach takes into account project specific factors that can affect the level of sound produced and its propagation within the water column. From this it is possible to estimate the number of harbour porpoise that may be affected and the overall duration of the potential impacts. Based on the study published by ASCOBANS (2015) an annual reduction in the population of 1.7% could cause a population level decline (Para. 7.11). However, a similar level of impact from disturbance is predicted to not cause a population level of decline.

10.5 A second approach to the assessment has also been undertaken based on recommendations by the JNCC. This approach is based on the use of a generic EDR for noise producing activities irrespective of their location and source level noise. Following published evidence and JNCC guidance, for the purposes of this assessment a 12 km EDR has been used for the seismic survey and 5 km for the sub-bottom profiler. The extent and duration of the survey is then measured against thresholds above which an adverse effect on site integrity could arise, as described in Section 6.

Southern North Sea SAC (Harbour porpoise)

Physical Injury

10.6 Noise modelling undertaken for the 2DHR seismic survey indicates that, based on the weighted SEL threshold, there is potential for sound levels to cause the onset of PTS to harbour porpoise out to 20 m (HRL 2023b).

10.7 The peak harbour porpoise density across the SAC is estimated to be >3 per km^2 (Heinänen and Skov 2015). Based on this peak density and the worst-case scenario of PTS occurring out to 20 m of the survey, less than one harbour porpoise could be affected at the start of the seismic survey.

10.8 The North Sea Management Unit harbour porpoise population is 346,601 individuals and therefore the worst-case scenario of one harbour porpoise being impacted is <0.0001% of the Management Unit population.

10.9 The estimated area of potential impact from PTS is predominantly within 500 m of the airgun array and therefore within the radius which, if marine mammals are detected during a pre-shooting search, the commencement of the firing of the airguns must be delayed by a minimum of 20 minutes, as per the JNCC guidance (JNCC 2017c). Harbour porpoise will avoid the area of potential injury and move away from the seismic survey vessel as it approaches. Consequently, apart from when the operation of the airgun initially commences, there is a very low risk of physical injury to any harbour porpoise.

10.10 Noise modelling undertaken for the use of a sub-bottom profiler indicates that the onset of PTS could occur out to 2,100 m from the sound source, encompassing an area of 13.8 km^2 (Table 3). Based on a density of 3.0 ind./km^2 an estimated 42 harbour porpoise could be at risk of PTS. This is equivalent to 0.01% of the North Sea Management Unit population.

10.11 There is a very low risk of harbour porpoise being physically impacted by the proposed seismic survey, although the modelling indicates that the risk of an impact from the use of a sub-bottom profiler is considerably greater. JNCC guidance will reduce the risk of harbour porpoise being within 500 m of the sub-bottom profiler, although beyond that range the risk increases. In the event the onset of PTS does occur out 2.1 km of the sub-bottom profiler, it would only affect a very small proportion of the relevant population.

Disturbance

10.12 In the absence of any noise modelling undertaken to assess disturbance distances, a generic 12 km radius of disturbance has been used by the applicant, covering a maximum area of 452 km^2 at any point. Assuming that disturbance occurs entirely within the SAC, then

approximately 1.2% of the SAC as a whole and 1.7% of the 'summer' area could be affected by the proposed seismic survey at any one time.

10.13 Based on a peak site density of 3.0 ind./km^2 an estimated 1,356 harbour porpoise could be disturbed by the survey. This is equivalent to 0.39% of the North Sea Management Unit harbour porpoise population being disturbed.

10.14 Following the approach used in the application the extent of disturbance and the number of individuals impacted, at any one point in time, applies equally to both the 2DHR and the sub-bottom profiler.

10.15 A survey vessel will transit across an area and over the duration of a survey the total number of harbour porpoises disturbed will be greater. The applicant has confirmed that the survey vessel will be travelling at 4.0 (7.4 km/h) (HRL 2023b). As the vessel undertakes a survey, disturbance in any area will last less than two hours in any one location. The disturbance effects are therefore transient and once the vessel has moved away from an area there is, in effect, no disturbance on those porpoises previously impacted.

10.16 Studies undertaken in the Danish sector of the Central North Sea reported disturbance out to 12 km from a 3,570 cu. in. airgun, although the duration of the disturbance is not reported (Sarnocińska *et al*. 2020). Similar studies undertaken in the Moray Firth using a 470 cu in airgun with source levels estimated to be 242–253 dB re 1 µPa @ 1 m $_{(peak\ to\ peak)}$, reported a decrease in the relative densities of harbour porpoises within 10 km of the airgun and an increase in densities at greater distances. However, porpoises continued to occur at sites within the impacted area during the seismic survey and there was a decline in the level of displacement over the ten day period that surveys were undertaken, indicating an increasing level of acclimation during the surveys. Once the surveys had ceased the number of detections returned to baseline levels within a day (Thompson *et al.* 2013, Pirotta *et al.* 2014). Therefore, any displacement effects caused by the proposed survey are predicted to be temporary, with porpoises returning to the area impacted within approximately 24 hrs.

Threshold Approach

10.17 The applicant has not undertaken an assessment using the threshold approach as recommended by the SNCBs. OPRED have undertaken this assessment based on the information presented in the application.

10.18 The JNCC have advised that the assessment for harbour porpoise within the SAC should be undertaken by the threshold approach, whereby disturbance should not exceed 20% of the SAC

'summer' or 'winter' areas an any one day and on average 10% of an area over the course of a single season (see Section 7).

10.19 To calculate the extent of noise within the SAC using the threshold approach the extent of disturbance from a moving sound source over the course of 24 hrs and the season is required. In the absence of any information within the application this assessment is based on the use of a 2DHR seismic airgun array for the duration of the survey. The EDR for such a survey is 12 km compared with 5 km for the use of a sub-bottom profiler (Table 4). Consequently, the worst-case scenario arises from the use of seismic airguns as opposed to sub-bottom profiler.

Daily Threshold

10.20 In order to calculate whether the daily threshold of 20% of the seasonal area is impacted an accurate estimate of the level of activity within the SAC is required.

10.21 The survey will be undertaken over two areas each measuring approximately 1 km by 1 km, but with potential for an in-fill area and a Greater Working Area measuring approximately 13.5 km by 8 km (Figure 1) (HRL 2023b). The applicant has indicated that the airguns will not be switched off between survey lines and therefore noise from airguns and sub-bottom profiler could occur throughout the Greater Working Area (HRL 2023b).

10.22 On the basis that there will be extensive area of overlapping noise over a relatively small area the assessment is based on the maximum area that could be impacted should the first survey line commence on one boundary followed by the second survey line being undertaken on the other survey boundary furthest away, i.e. the maximum possible area is impacted. For a survey area this size it is reasonable to assume that this scenario could occur and is therefore a realistic worst-case scenario. However, it is noted that the south-east survey boundary lies adjacent to the SAC boundary and therefore the majority of noise arising from that location will be outwith the SAC and therefore not contribute to the thresholds. The distance from the SAC boundary is unclear and for the purpose of this assessment it is assumed to be 2 km.

10.23 Based on a realistic worst-case scenario the maximum area that could be impacted over a period of 24 hrs is estimated to be 880 km^2. This is equivalent to 3.2% of the 'summer' area.

10.24 The daily threshold will not be exceeded by the proposed 2DHR surveys.

Seasonal Threshold

10.25 The proposed earliest start is 10 April 2023, with request for consent up to 31 May 2023. The survey is planned to be undertaken over a total duration of ten days.

10.26 In order to assess the seasonal spatial overlap it is presumed that all ten days of survey will be undertaken during the summer period and that once started they will be undertaken for 24 hrs each day without a break.

10.27 Based on the maximum daily impact undertaken over a period of ten days, the seasonal threshold would be 0.17% of the SAC and therefore the seasonal threshold will not be exceeded (Table 7).

Table 7: Estimated extent of seasonal disturbance on harbour porpoise from proposed Endurance survey within the SAC.

SAC area	Area impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days) *	Seasonal Threshold (%)
2DHR Survey				
'summer'	880	3.2	10	0.17

10.28 There is potential for the prey species of harbour porpoise to be impacted by the proposed surveys. Studies on the impacts to fish from seismic surveys indicate that any disturbance to fish is temporary and localised (Peña *et al*. 2013; Slotte *et al*. 2004; Wardle *et al*. 2001). Should fish be displaced, harbour porpoise will either relocate to areas where prey species are present or remain until the seismic vessel has moved further away and the fish return to the area. Any potential impacts will be very localised and temporary and any effects will be inconsequential.

Conclusion

10.29 Results from noise modelling indicate that up to 42 harbour porpoise could be at risk of physical injury from noise arising from the proposed use of sub-bottom profiler. Mitigation discussed in Section 12 would reduce the risk to porpoise within 500 m of the sub-bottom profiler.

10.30 There is a risk of harbour porpoise being displaced or disturbed by the proposed survey. Based on a generic 12 km range of disturbance up to 1,356 harbour porpoise may be disturbed at any one time; this is 0.39% of the North Sea Management Unit population and therefore below the predicted level of disturbance that could cause a population level effect. The disturbance will be of short duration as the vessel transits through the Survey Area. Once the vessel has passed, any changes in behaviour due to disturbance will cease quickly after the vessel has moved away and any porpoises that may have been displaced are predicted to return to the area within 24 hrs.

10.31 The results from the threshold approach indicate that up to 3.2% of the 'summer' area may be impacted for a period of ten days and up to 0.17% of the seasonal threshold. The daily and seasonal thresholds are not exceeded from the use of seismic airguns. The impacts are smaller for the use of sub-bottom profiler.

10.32 The proposed surveys will not affect the supporting habitats and will have a temporary and localised impact on the supporting prey species, e.g. fish. Once the proposed survey has moved away or ceased there will be no effect on the distribution, abundance and population dynamics of the species.

10.33 Based on the best available information and supported by results from noise modelling and the draft threshold approach, OPRED is satisfied that the proposed survey alone will not have an adverse effect upon the integrity of the Southern North Sea SAC with respect to harbour porpoise.

11 IN-COMBINATION ASSESSMENT

11.1 There is potential for in-combination impacts to arise due to noise from other known or planned activities and the proposed seismic survey.

11.2 Projects identified as having potential to cause an in-combination impact are listed below. It is anticipated that the work will be undertaken in April. Projects listed in italics will not be commencing until after the expected completion date of the seismic survey.

- Dogger Bank A offshore wind farm - Pile-driving,
- Johnston geophysical site survey,
- NW Bell ZX geophysical site survey,
- *Construction pile-driving at Dogger Bank B offshore wind farm,*
- *Q43 Lodestone West 2023- multi-client regional survey,*
- *Hewett Field bathymetric and seismic survey.*

Dogger Bank A pile-driving

11.3 Offshore construction at the Dogger Bank A Offshore wind farm commenced in 2022.

11.4 For the purposes of this assessment noise modelling undertaken by Dogger Bank Wind Farm for the Dogger Bank A and B offshore wind farms has been used. The modelling is based on the installation of 95 wind turbines at each of the wind farms. Each turbine will have 10 m diameter monopile driven into the seabed using a 4,000 kJ hammer (DBWF 2021).

11.5 The results from the modelling indicate that the onset of PTS could occur out to 1,400 m and encompass an area of 4 km^2. Levels of noise predicted to cause disturbance could occur out to 19 km and cover an area of 890 km^2 (DBWF 2021).

11.6 Based on the results from noise modelling and a peak density of 0.71 ind./km^2 recorded across the Dogger Bank Zone (Forewind 2014), an estimated three harbour porpoise are at risk of PTS from the pile-driving and 632 harbour porpoise may be disturbed or displaced.

11.7 Based on the threshold approach with an EDR of 26 km the results of the assessment indicate a maximum area of impact within the SAC from a single pile-driving event of 2,124 km^2, impacting 7.9% of the 'summer' area of the SAC. The total duration of activities will be 130 days, of which 36 days will be impacting within the SAC (Gov 2023). Consequently, the proposed pile-driving will contribute 1.5% of the seasonal threshold (Table 8).

Table 8: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed pile-driving at Dogger Bank A offshore wind farm within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
-Pile driving Dogger Bank A monopiles				
'summer'	2,124	7.9	36	1.5

Crosgan Appraisal Well

11.8 Drilling of the proposed Crosgan Appraisal Well could commence in March or April 2023. Noise arising from conductor pile-driving and the use of Vertical Seismic Profiler (VSP) could cause disturbance (ONE-Dyas 2023a).

11.9 One-Dyas have confirmed that the works were completed before the end of March 2023 and therefore did not contribute to any of the daily or seasonal thresholds.

NW Bell ZX and Murdoch KM Survey

11.10 Harbour Energy propose to conduct a geophysical site survey, including the use of a sub-bottom profiler at NW Bell ZX and Murdoch KM (Harbour Energy 2023a).

11.11 The proposed activities are to be undertaken over a period of two days between 9 March and 31 May 2023.

11.12 The results from the noise modelling undertaken by the applicant indicate that the onset of PTS could within 15 m from the sound source and encompass an area of 0.0007 km^2. Levels of noise predicted to cause disturbance could occur out to 590 m (based on a disturbance threshold of 160 dB) and cover an area of 1.1 km^2 (Harbour Energy 2023a).

11.13 Based on the results from noise modelling and a peak density of 3.0 ind./km^2, less than one harbour porpoise is estimated to be at risk of PTS from the geophysical survey and three harbour porpoise may be disturbed or displaced.

11.14 The applicant has not undertaken an assessment based on the SNCB threshold approach.

11.15 Using the recommended 5 km EDR for the use of geophysical surveys it is estimated that the maximum daily area impacted would be 80.3 km^2 [1]. This would impact on 0.3% of the 'summer' area of the SAC. The total duration of activities within the SAC will be one day. Consequently the proposed geophysical survey will contribute 0.002% of the seasonal threshold (Table 9).

[1] Calculated based on a 5 km EDR and the total area to be surveyed at NW Bell being 1.8 km^2.

Table 9: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed NW Bell ZX geophysical site survey within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
'summer'	80.3	0.3	1	0.002

Johnston Geophysical Survey

11.16 Harbour Energy propose to conduct a site survey using geophysical equipment including a sub-bottom profiler at the Johnston field.

11.17 The proposed activities are to be undertaken over a period of two days between 15 March and 31 May 2023.

11.18 The results from the noise modelling undertaken by the applicant indicate that the onset of PTS could occur out to 73 m from the sound source and encompass an area of 0.017 km^2. Levels of noise predicted to cause disturbance could occur out to 470 m (based on a disturbance threshold of 160 dB) and cover an area of 0.7 km^2 (Harbour Energy 2023b).

11.19 Based on the results from noise modelling and a peak density of 3.0 ind./km^2, less than one harbour porpoise is estimated to be at risk of PTS from the geophysical survey and two harbour porpoise may be disturbed or displaced.

11.20 The applicant has not undertaken an assessment based on the SNCB threshold approach.

11.21 Using the recommended 5 km EDR for the use of geophysical surveys and the largest of the two survey areas is 0.9 km long. It is estimated that the maximum daily area impacted would be 118.8 km^2 [1]. Consequently the proposed survey could impact on 0.4% of the SAC summer area over the course of one day. The total duration of activities will be two days. Consequently, the proposed geophysical survey will contribute 0.004% of the seasonal threshold (Table 10).

Table 10: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed Johnston geophysical survey within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
'summer'	119	0.4	2	0.004

[1] Calculated based on a square area of impact of 10.9 km (5km + 5km + 0.9km).

Construction pile-driving at Dogger Bank B offshore wind farm,

11.22 Offshore construction at the Dogger Bank B offshore wind farm could commence in August 2023.

11.23 For the purposes of this assessment noise modelling undertaken by Dogger Bank Wind Farm for both the Dogger Bank A and B offshore wind farms has been used. The modelling is based on the installation of 95 wind turbines at each of the wind farms. Each turbine will have 10 m diameter monopile driven into the seabed using a 4,000 kJ hammer (DBWF 2021).

11.24 The results from the modelling indicate that the onset of PTS could occur out to 1,400 m and encompass an area of 4 km^2. Levels of noise predicted to cause disturbance could occur out to 19 km and cover an area of 890 km^2 (DBWF 2021).

11.25 Based on the results from noise modelling and a peak density of 0.71 ind./km^2 recorded across the Dogger Bank Zone (Forewind 2014), an estimated three harbour porpoise are at risk of PTS from the pile-driving and 632 harbour porpoise may be disturbed or displaced.

11.26 Based on the SNCB threshold approach with an EDR of 26 km the results of the assessment indicate a maximum area of impact within the SAC from a single pile-driving event of 2,124 km^2, impacting 7.9% of the 'summer' area of the SAC. The total duration of activities will be 130 days, of which 52 days will be impacting within the SAC (Gov 2023). Consequently the proposed pile-driving will contribute 2.2% of the seasonal threshold (Table 11).

Table 11: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed pile-driving at Dogger Bank B offshore wind farm within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
-Pile driving Dogger Bank B monopiles				
'summer'	2,124	7.9	52	2.2

Q43 Lodestone West 2023- multi-client regional survey

11.27 The proposed survey will be undertaken between June and December 2023. The survey is expected to take up to 114 days to complete during which airguns will be active/fired on 71 days (CGG 2023).

11.28 The assessment concludes that the level of noise arising from the seismic survey is below the level at which the onset of PTS is predicted to occur in harbour porpoise.

11.29 The assessment does not use noise modelling to quantify the number of harbour porpoise that could be disturbed from the seismic survey. However, based on a deterrent radius of 12 km the assessment estimates a total of 402 harbour porpoise could be disturbed by the survey.

11.30 The assessment has not been undertaken using the threshold approach. The proportion of the summer area impacted daily or seasonally are not available.

Hewett Field bathymetric and seismic survey.

11.31 The proposed survey will be undertaken between 1 May and 30 September 2023. The survey is expected to take up to 90 days to complete (Gov. 2023).

11.32 Noise modelling indicates that the level of noise arising from the seismic survey at which the onset of PTS is predicted to occur will not be exceeded beyond 104 m (ENI 2023). Consequently, there is little or no risk of any auditory injury to harbour porpoise from the proposed seismic survey.

11.33 The modelling indicates that there is potential for a strong behavioural response within 1.5 km of the seismic survey and a mild behavioural reaction within 31 km (ENI 2023). The area impacted by the survey is not presented in the application. Based on a strong behavioural response occurring within 1.5 km radius of the airguns it is estimated that the area of disturbance could occur over an area of 7.0 km^2. Based on a maximum density of 3 ind./km^2, an estimated 21 harbour porpoise could be disturbed by the seismic survey.

11.34 Based on the SNCB threshold approach with an EDR of 12 km, the applicant has calculated that 1,237 km^2 could be impacted per day (ENI 2023), equating to 4.6% of the daily threshold. Based on the impact occurring over a period of 90 days the seasonal impact is estimated to be 2.3% (Table 12).

Table 12: Estimated extent of daily and seasonal disturbance on harbour porpoise from proposed pile-driving at Dogger Bank B offshore wind farm within the SAC.

SAC area	Area of SAC impacted per day (km^2)	Daily Threshold (%)	Estimated duration of impact (days)	Seasonal Threshold (%)
-Pile driving Dogger Bank B monopiles				
'summer'	1,237	4.6	90	2.3

In-combination scenarios

11.35 The in-combination assessment has been undertaken using outputs from both noise modelling and the threshold approach where available. Due to the number of current and planned activities

being undertaken within or adjacent to the SAC and the level of uncertainty surrounding them, there are a number of potential in-combination scenarios. This section assesses the potential levels of in-combination impact that could arise.

11.36 The timelines for each of the activities identified as having the potential to cause an in-combination impact are presented in Figure 3.

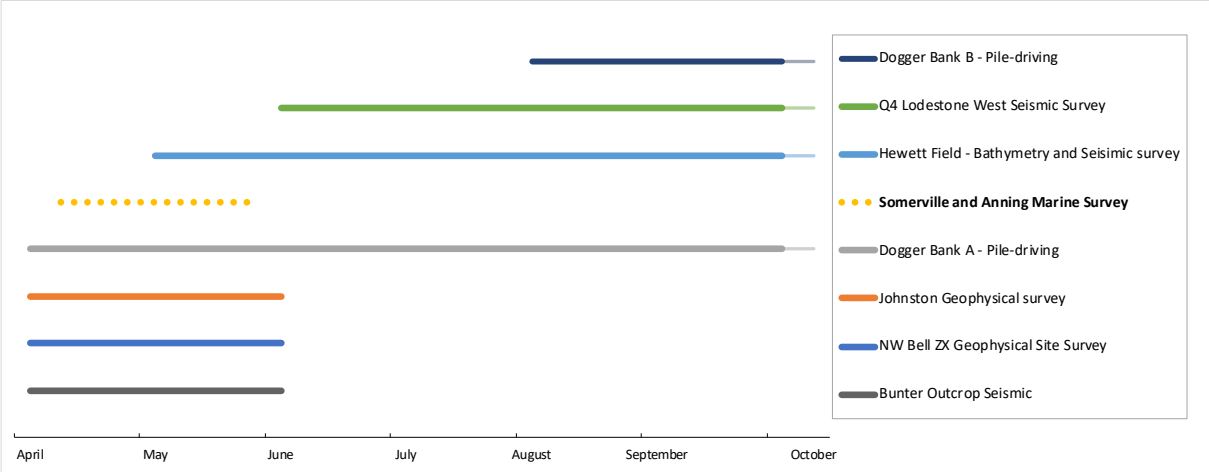

Figure 3: Timeline of known activities within the Southern North Sea SAC that could have an in-combination impact in summer 2023.

In-combination Impacts on Southern North Sea SAC: Harbour porpoise.

Noise modelling

11.37 This section assesses the potential in-combination impacts based on the results from noise modelling undertaken for each of the applications.

Physical Injury

11.38 The results from noise modelling indicate that up to 42 harbour porpoise could be at risk from the onset of PTS arising from the use of a sub-bottom profiler.

11.39 In-combination impacts could arise from pile-driving at Dogger Bank A where an estimated three harbour porpoise could be affected.

11.40 Less than one harbour porpoise is predicted to be impacted from other sub-bottom profiler or seismic surveys being undertaken in summer 2023. These are effectively zero as the physical

presence of the vessels is predicted to ensure that no harbour porpoise are within the range at which the onset of PTS is predicted to arise from these other activities.

11.41 The potential in-combination impact of approximately 45 harbour porpoise is equivalent to 0.013% of the North Sea Management Unit population.

Disturbance

11.42 The total number of harbour porpoise estimated to be disturbed by the proposed 2DHR seismic survey is 1,356 individuals.

11.43 At Dogger Bank A and Dogger Bank B an estimated 632 harbour could be disturbed or displaced by each project due to pile-driving . The Q43 Lodestone west seismic survey could also disturb up to 402 harbour porpoise based on a generic 12 km deterrent radius and stationary vessel.

11.44 The proposed Hewett seismic survey is estimated to cause a strong behavioural response to 21 harbour porpoise.

11.45 Other planned activities within the SAC are predicted to have a more localised and smaller impact on harbour porpoise with five harbour porpoise impacted from the NW Bell ZX and Johnston geophysical surveys.

11.46 During the period the proposed Somerville and Anning surveys will be undertaken in April or May an estimated 2,411 individuals, equivalent to 0.69% of the North Sea Management Unit Population could be disturbed. The potential impacts from displacement or disturbance will be temporary. If displaced, harbour porpoise will be able to relocate elsewhere and evidence from studies indicate that they will return to the area within 24 hrs of the noise ceasing.

In-combination threshold approach

11.47 There is always a level of uncertainty over the timing of activities that could impact on harbour porpoise within the Southern North Sea SAC. This uncertainty over the timings can cause overly precautionary assessments as activities that are unlikely to occur or have been completed, included in the assessment, conflating the daily and seasonal totals.

11.48 For the purposes of this in-combination assessment all potential activities are predicted to occur, potentially on the one day. This gives to rise a highly precautionary and unrealistic in-combination total. However, there is a relatively high degree of certainty that the proposed surveys could occur on the same days as construction pile-driving is being undertaken at Dogger Bank A. Other activities that are recognised as potentially causing an in-combination impact, have lower probabilities of occurring over the same period but do make relatively small contributions to the

daily or seasonal totals. Their inclusion in this assessment is precautionary and potential worst-case scenario has been assessed.

'Potential worst-case (April – May)'. This scenario is based on:

- Impacts from proposed Somerville and Anning Marine Surveys.
- Impacts from the proposed seismic survey at Bunter Outcrop (including in May).
- The maximum area of impact from pile-driving at the Dogger Bank A Offshore Wind Farm.
- The Johnston geophysical survey is undertaken in April or May, as opposed to March.
- The NW Bell geophysical survey is undertaken in April or May, as opposed to March.
- Hewett bathymetric and seismic survey is undertaken in May.

11.49 These scenarios are potential worst-case in that, for them to arise, the maximum area of potential impact from all the projects must occur on the same day. The probability of this occurring is considered to be small.

11.50 Based on the potential worst-case (April – May) scenario the daily threshold is not exceeded, with the maximum impact predicted to arise during May 2023 (Table 13).

11.51 Based on the information available the potential worst-case scenario for the seasonal threshold is not exceeded. It is recognised that future projects would increase the seasonal total. However, currently there is not enough information to undertake an assessment of these projects. They will be subject to their own assessments prior to any consenting decisions.

Table 13: Realistic worst-case in-combination daily threshold (%).

Activity	April	May	June	July	Aug	Sept
Somerville and Anning Survey	**3.2**	**3.2**				
Bunter Outcrop survey	2.4	2.4	-	-	-	-
Dogger Bank A - Pile-driving	7.9	7.9	7.9	7.9	7.9	7.9
Johnstone geophysical survey	0.4	0.4	-	-	-	-
NW Bell ZX geophysical survey	0.3	0.3	-	-	-	-
Hewett Field bathymetric and seismic	-	4.6	4.6	4.6	4.6	4.6
Q43 Lodestone West seismic	-	-	tbc	tbc	tbc	tbc
Dogger Bank B – Pile-driving	-	-	-	-	7.9	7.9
Total %	**14.2**	**18.8**	**12.5+**	**12.5+**	**20.4+**	**20.4+**

tbc = to be confirmed. No information available on daily threshold.

11.52 Under worst-case in-combination scenarios the seasonal threshold is not exceeded (Table 14). This does not include the Q43 Lodestone West seismic which would increase the seasonal total. However, currently there is not enough information to undertake an assessment of this project. which will be subject to its own assessments prior to any consenting decision. Conversely, in the event that activities are delayed, the in-combination seasonal threshold during the summer period of 2023 may be reduced.

Table 14: In-combination seasonal thresholds (%).

Activity	Summer seasonal threshold (%)
	Potential worst-case
Somerville and Anning surveys	**0.17**
Bunter Outcrop survey	0.09
Dogger Bank A - Pile-driving	1.50
Johnstone geophysical survey	0.004
NW Bell ZX geophysical survey	0.002
Dogger Bank B - Pile-driving	2.23
Hewett Field bathymetric and seismic	2.3
Q43 Lodestone West seismic	unknown
Total %	**6.30**

In-combination assessment Southern North Sea SAC conclusions

11.53 Results from noise modelling indicate that up to 2,411 harbour porpoise could be disturbed by all proposed activities planned for April or May. This is 0.69% of the Management Unit population and therefore below the level of 1.7% at which a population level effect might be predicted to occur.

11.54 The results from the threshold approach indicate that the daily thresholds would not be exceeded even under a potential worst-case scenario. However, there is uncertainty relating to potential activities being undertaken from June onwards for which there is for some activities limited information to inform this in-combination assessment.

11.55 The seasonal average threshold of 10% of the SAC across the season is not exceeded.

11.56 Based on the best available information and supported by results from noise modelling and the threshold approach, OPRED is satisfied that activities associated with the proposed Somerville and Anning marine survey, in-combination with other plans or projects will not have an adverse effect upon the integrity of the Southern North Sea SAC with respect to harbour porpoise.

12 MITIGATION

12.1 The following section presents a summary of the planned mitigation submitted by the Applicant that will reduce the risk of an adverse effect occurring.

12.2 The applicant have committed to following the JNCC guidelines for *minimising the risk of injury to marine mammals from geophysical surveys* based on the use of 160 cu.in. airgun array (JNCC 2017c, HRL 2023b). This will include:

- A minimum of 15 minutes soft-start undertaken every time the airguns are switched on.
- Use of JNCC accredited marine mammal observers (MMOs) to conduct watches for marine animals during daylight hours with good visibility. MMOs will monitor during the pre-source start search and soft start phase as a minimum.
- A proven PAM system to be utilised to conduct acoustic monitoring for marine mammals during periods of low visibility. PAM will be undertaken during the pre-source start search and soft start phase during poor visibility periods as a minimum.
- Observations will be undertaken for at least 30 minutes prior to the soft-start and there will be a minimum of a 20 minute delay from the time of the last marine mammal detection within the 500 m mitigation zone and the commencement of the soft-start.
- If line changes are anticipated to be longer than 40 minutes in duration, the airgun array will be switched off at the end of the survey line. In the event that the line changes are shorter than 40 minutes the airguns may be kept on. For line turns expected to be less than 40 minutes, the shot point interval will be increased (not exceeding 5 minutes) and decreased in uniform stages during the final 10 minutes of the line turn.
- A full pre-source start search and soft start will be conducted prior to the start of the next survey line. .

13 CONCLUSIONS

13.1 The Secretary of State has carefully considered all of the information available in order to undertake a Habitats Regulations Assessment. He considers the proposed HRL Somerville and Anning marine survey to have the potential to cause a Likely Significant Effect alone and in-combination with other plans or projects on the qualifying species of the Southern North Sea SAC.

13.2 The Secretary of State has undertaken an Appropriate Assessment in respect of the site's Conservation Objectives to determine whether the project, either alone or in-combination with other plans or projects, will result in an adverse effect on integrity.

13.3 The Secretary of State has undertaken a robust assessment using all of the information available to him.

13.4 Having considered all of the information available to him the Secretary of State has concluded that the proposed HRL Somerville and Anning marine surveys will not have an adverse effect on the integrity of any European designated site either alone or in-combination with other plans or projects.

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