UK Government

2nd Offshore Carbon Dioxide Storage Licensing Round

Habitats Regulations Assessment

Draft Appropriate Assessment

Department for Energy Security and Net Zero (July 2026)

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Contents

1 Introduction

1.1 Background, overview of the plan and legislative context

Carbon storage is expected to play a key role in decarbonisation and meeting government's climate commitments. The Oil and Gas Authority[1] (OGA, now operating as the North Sea Transition Authority (NSTA)) launched a carbon storage licensing round (also termed the 2nd carbon dioxide storage licensing round) on 9th December 2025 and invited applications for 14 offshore areas in the northern North Sea, central North Sea, southern North Sea, English Channel, and east Irish Sea. The licensing round closed for applications on 24th March 2026, with six applications made.

The plan/programme covering this (and potential future) carbon dioxide storage licensing rounds has been subject to a Strategic Environmental Assessment (OESEA4)[2], completed in September 2022. The SEA Environmental Report includes detailed consideration of the status of the natural environment and potential effects of the range of activities which could follow licensing, including potential effects on conservation sites. Public consultation on OESEA4 concluded on 27th May 2022 and the Government Response was published on 22nd September 2022, which summarised the comments received and provided further clarifications, at which time, the plan/programme was also adopted.

The *Energy Act 2008* (the Act) established a licensing regime for the storage of carbon dioxide in a controlled place including areas within UK territorial seas, and in areas beyond those waters which have been designated as the Exclusive Economic Zone (EEZ), formerly the Gas Importation and Storage Zone (GISZ). The Act prohibits the storage of carbon dioxide (with a view to its permanent disposal, or as an interim measure prior to its permanent disposal) except in accordance with a licence granted under the Act. There is also a separate requirement for a licence under the *Energy Act 2023*, relating to the economic regulatory regime for CCUS. The NSTA is responsible for granting storage licences and storage permits under the *Energy Act 2008* for offshore carbon storage in UK territorial waters (excluding Scottish territorial waters, where Scottish Government Ministers are the licensing authority) and the Exclusive Economic Zone. In addition to a licence, a lease from The Crown Estate or Crown Estate Scotland is required for carbon dioxide storage related activities in relevant waters. Following the grant of any lease/licence, offshore activities are subject to a range of statutory permitting and consenting requirements.

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (the Habitats Regulations)[3] provide a regulatory regime for certain activities, including carbon dioxide storage, that could affect Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) in UK territorial waters and on the UK Continental Shelf (UKCS)[4]. The *Conservation of*

[1] OGA, now operating as the North Sea Transition Authority (NSTA), a government company wholly owned by the Secretary of State.
[2] https://www.gov.uk/government/consultations/uk-offshore-energy-strategic-environmental-assessment-4-oesea4
[3] The Regulations transposed the EU Habitats Directive (92/43/EEC), and are assimilated law under the *European Union (Withdrawal) Act 2018*.
[4] A range of environmental legislation applicable for offshore oil and gas has been extended to carbon dioxide storage under the *Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010*, which includes the *Offshore Petroleum Activities (Conservation of Habitat) Regulations 2001.*

Offshore Marine Habitats and Species Regulations 2017 cover other relevant activities in offshore waters (i.e. excluding territorial waters). Within territorial waters, the *Conservation of Habitats and Species Regulations 2017* apply in England and Wales, the *Conservation (Natural Habitats, &c.) Regulations 1994* in Scotland (for non-reserved matters), and the *Conservation (Natural Habitats, &c) Regulations (Northern Ireland) 1995* in Northern Ireland applies. Ramsar sites are considered relevant sites for the purposes of HRA, as confirmed in planning policy[5], and through amendments made to the *Conservation of Habitats and Species Regulations 2017* under the *Planning and Infrastructure Act 2025*.

As the carbon storage licensing aspects of the plan/programme are not directly connected with or necessary for nature conservation management of any site within the National Site Network, to comply with its obligations under the relevant regulations, the Department for Energy Security and Net Zero[6] (the Department) is undertaking a Habitats Regulations Assessment (HRA). The Secretary of State undertook a screening assessment under the Habitats Regulations (summarised in Section 1.2) to determine whether the award of any of the areas offered would be likely to have a significant effect on a relevant site, either individually or in combination[7] with other plans or projects (DESNZ 2026). The Department has applied the test set out in Regulation 5(1) of the Habitats Regulations, that has been interpreted by case law[8]:

> *…any plan or project not directly connected with or necessary to the management of the site is to be subject to an appropriate assessment of its implications for the site in view of the site's conservation objectives if it cannot be excluded, on the basis of objective information, that it will have a significant effect on that site, either individually or in combination with other plans or projects.*
>
> *…where a plan or project not directly connected with or necessary to the management of a site is likely to undermine the site's conservation objectives, it must be considered likely to have a significant effect on that site. The assessment of that risk must be made in the light inter alia of the characteristics and specific environmental conditions of the site concerned by such a plan or project.*

1.2 Areas subject to assessment

A screening assessment (including consultation with the statutory conservation agencies/bodies) formed the first stage of the HRA process. The screening assessment was undertaken in the period within which licence applications were being accepted by the NSTA and therefore considered the potential for activity in all areas on offer. The screening

[5] For example, the National Planning Policy Framework (MHCLG 2024), which states that "listed or proposed Ramsar sites", should receive the same protection as national network sites.
[6] Note that while certain licensing and related regulatory functions were passed to the Oil and Gas Authority, now operating as the NSTA (a government company wholly owned by the Secretary of State) on 1 October 2016, environmental regulatory functions are retained by the Secretary of State, and are administered by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), which is part of the Department, on behalf of the Secretary of State.
[7] Note that "in-combination" and "cumulative" effects have similar meanings, but for the purposes of HRA, and in keeping with the wording of Article 6(3) of the Habitats Directive, "in-combination" is used to describe the potential for such effects throughout. More information on the definitions of "cumulative" and "in-combination" effects are available in MMO (2014a) and Judd *et al.* (2015).
[8] See, in particular, the European Court of Justice case of Waddenzee (C-127/02). At the time of this assessment, this remains relevant to interpretation of the UK's legislation as assimilated case law under the *European Union (Withdrawal) Act 2018*.

assessment identified that nine of the areas offered would require further Appropriate Assessment (AA) prior to the NSTA making decisions on whether to grant licences, subject to all or part of these areas being applied for.

Following the closing date for licence applications, and the finalisation of the screening document, it was initially concluded that six areas were relevant for further AA on the basis of their location. However, the applications for four areas (SNS Area 3, SNS Area 4, EIS Area 1 and EIS Area 2) have no associated work programmes. It is possible that part of the work programme for the existing CS025 licence could extend into SNS Area 3 if awarded, and so it has been assumed for the purposes of this assessment that seismic survey or the drilling of a well could take place within it (see Table 2.1).

Therefore, the licence areas subject to AA) cover all or parts of the following areas, see Figure 1.1:

- English Channel Area 1
- Southern North Sea (SNS) Area 3, SNS Area 6

1.3 Relevant sites

The screening assessment identified the relevant sites and related areas on offer requiring further assessment (refer to Appendix B of DESNZ 2026), and those which have been applied for are shown in Table 1.1 and Figure 1.1.

Table 1.1: Relevant sites requiring further assessment

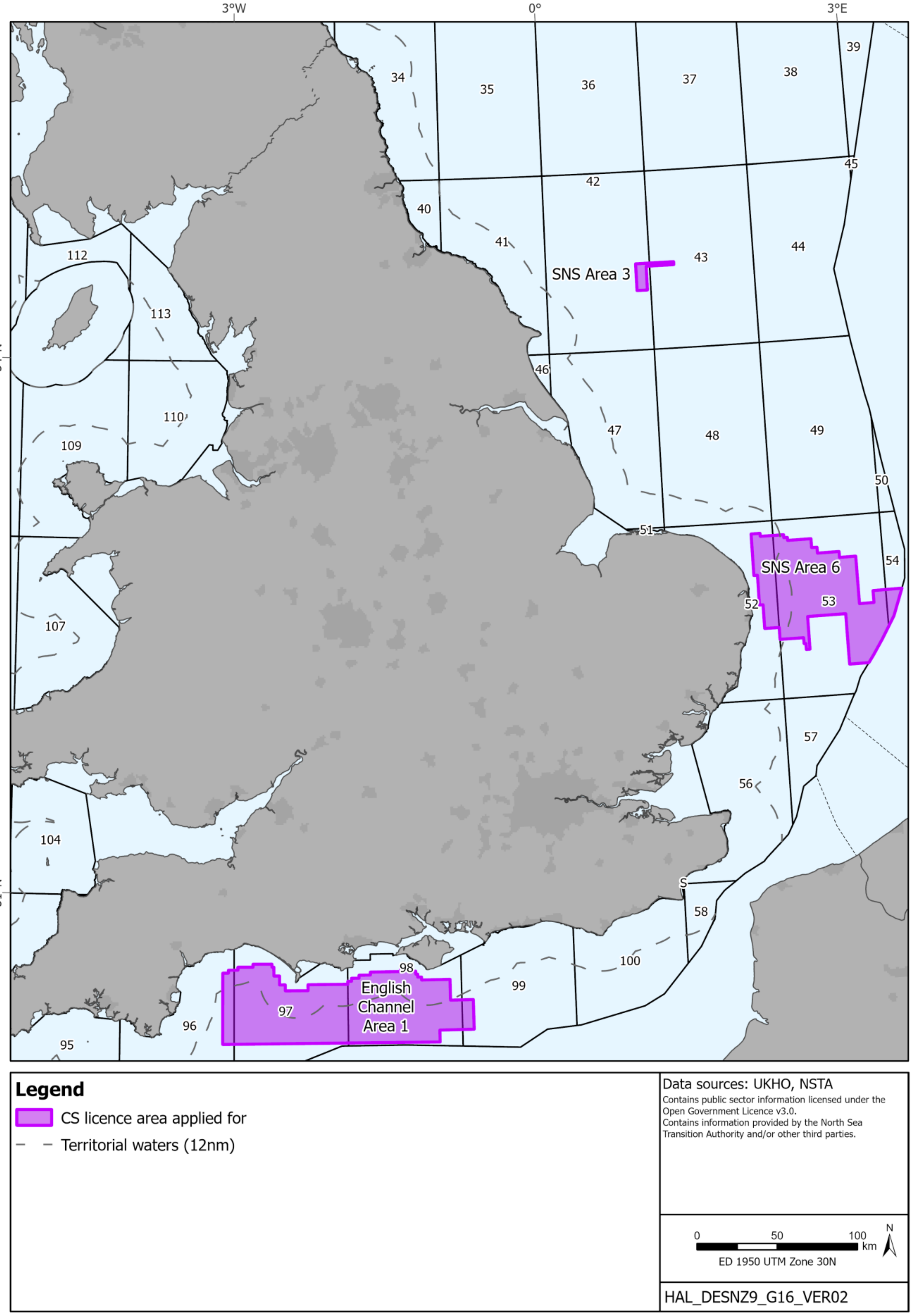
Relevant site and features	Relevant areas applied for	Sources of potential effect
Southern North Sea		
Greater Wash SPA Breeding: Sandwich tern, common tern, little tern Over winter: little gull, red-throated diver, common scoter	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
Over winter: red-throated diver, common scoter	SNS Area 6	Underwater noise: deep geological seismic survey, rig site survey, vertical seismic profiling (VSP), conductor piling, drilling, vessel & rig movements
North Norfolk Coast SPA/Ramsar* Breeding: common tern, little tern, Sandwich tern	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
The Wash SPA/Ramsar* Breeding: little tern	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
Over winter: common scoter	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges Underwater noise: deep geological seismic survey, rig site survey, VSP, conductor piling, drilling, vessel & rig movements

Relevant site and features	Relevant areas applied for	Sources of potential effect
Gibraltar point SPA/Ramsar* Breeding: little tern	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
Great Yarmouth North Denes SPA* Breeding: little tern	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
Breydon Water SPA/Ramsar* Breeding: common tern	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
Outer Thames Estuary SPA Breeding: little tern, common tern	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
Over winter: red-throated diver	SNS Area 6	Underwater noise: deep geological seismic survey, rig site survey, VSP, conductor piling, drilling, vessel & rig movements
Bruine Bank SPA (NL) Concentration (foraging, moulting, resting): gannet, razorbill, guillemot, little gull, great skua	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
gannet, razorbill, guillemot		Underwater noise: deep geological seismic survey, rig site survey, VSP, conductor piling, drilling, vessel & rig movements
Southern North Sea SAC Annex II species: harbour porpoise	SNS Area 3, and 6	Physical disturbance and drilling: rig siting, drilling discharges
		Underwater noise: deep geological seismic survey, rig site survey, VSP, conductor piling, drilling, vessel & rig movements
Haisborough, Hammond and Winterton SAC Annex I habitats: reefs, sandbanks	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
North Norfolk Sandbanks and Saturn Reef SAC Annex I habitats: reefs, sandbanks	SNS Area 6	Physical disturbance and drilling: rig siting, drilling discharges
English Channel		
Chesil Beach and the Fleet SPA/Ramsar Breeding: little tern, wigeon	English Channel 1	Physical disturbance and drilling: rig siting, drilling discharges
Solent and Dorset Coast SPA **Breeding**: Sandwich tern, common tern, little tern		
Poole Harbour SPA/Ramsar* **Breeding**: Sandwich tern, common tern		
Solent and Southampton Water SPA* **Breeding**: Sandwich tern, common tern, little tern		
Chichester and Langstone Harbours SPA* **Breeding**: Sandwich tern, common tern, little tern		
Wight-Barfleur Reef SAC **Annex I habitats**: reefs		

Relevant site and features	Relevant areas applied for	Sources of potential effect
Studland to Portland SAC **Annex I habitats**: reefs		
South Wight Maritime SAC **Annex I habitats**: reefs		
Lyme Bay and Torbay SAC **Annex I habitats**: reefs		
River Axe SAC **Annex I habitats**: sea lamprey		Underwater noise: rig site survey, VSP, conductor piling, drilling, vessel & rig movements

Notes: *screened in for being a source colony, or adjoining waterbird site with likely connectivity

Figure 1.1: Licence areas applied for in the 2nd Carbon Storage Licensing Round



1.4 Assessment overview

This document sets out the key assumptions and approach to the AA, the evidence base underpinning the assessment and the assessment of relevant areas applied for and sites. The document is organised as follows:

- Overview of the licensing process and nature of the activities that could follow including assumptions used to underpin the AA process (Section 2)
- Description of the approach to identifying any adverse effects on the integrity of relevant sites (Section 3)
- Evidence base on the environmental effects of offshore carbon dioxide exploration/appraisal activities to inform the assessment (Section 4)
- The assessment of effects on the integrity of relevant sites, including in-combination with other plans or projects (Section 5)
- Overall conclusion (Section 6)

As part of this HRA process, a draft of the AA document is being subject to consultation with appropriate nature conservation bodies and the public[9] and will be amended as appropriate in light of comments received.

[9] https://www.gov.uk/government/consultations/2nd-offshore-carbon-dioxide-storage-licensing-round-appropriate-assessment

2 Licensing and potential activities

2.1 Licensing

Chapter 3, Part 1 of the *Energy Act 2008* makes provision for a licensing and enforcement regime for the storage of carbon dioxide in a controlled place. Licensing regulations made under the Act include *The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010* which sets out requirements for making licence applications. A carbon dioxide storage licence grants exclusive rights for the exploration and appraisal of potential storage sites in the territorial sea adjacent to the United Kingdom (with the exception of Scottish Territorial Seas) and on the UK EEZ, before making an application for a storage permit. The area of a carbon dioxide storage licence reflects the potential size of the storage site that is being subject to appraisal, however, as part of this licensing round, applications for licences may cover all or part of the areas offered, but not extend beyond these, and more than one licence application may be received for the areas offered. A Licence grants exclusive rights to the holders to undertake exploration and appraisal activities with a view to evaluate the potential for carbon dioxide storage, but it does not constitute any form of approval for activities to take place in the licence area, nor does it confer any exemption from other legal or regulatory requirements. Offshore activities are subject to a range of statutory permitting and consenting requirements, including, where relevant, activity-specific AA under the Habitats Regulations.

Carbon dioxide storage licences contain three terms covering exploration and appraisal (Appraisal or Initial Term[10]), operation, and post-closure. The appraisal term includes a work programme to evaluate the potential for a storage project which may cover the drilling of appraisal wells, seismic survey, and other work such as geotechnical and geophysical studies. Where applicants do not wish to undertake appraisal and proceed to applying for a storage permit, reasons why exploration or appraisal is not required must be provided by the applicant; in this circumstance this phase of the licence is called the Initial term. Due to the nascent nature of the industry, it is expected that all licences will have an appraisal term.

The length of the initial/appraisal term is not defined in regulations other than it is not to exceed "*…the period necessary to (a) generate the information necessary to select a storage site, and (b) prepare the documents required for an application under regulation 6*" (storage permit); recent applications have had appraisal terms of between four and eight years. The initial/appraisal term may be extended under conditions laid down in the licence but will expire if no permit application is made to NSTA by the date of its expiry or if a permit application is refused.

The NSTA will generally divide the appraisal term into four stages with associated work programme activities and a formal stewardship engagement process. These are:

- Early Risk Assessment (identification of the critical risks, project and engagement plan)
- Site Characterisation (definition of the proposed Storage Site and Complex, geophysical surveys, appraisal drilling)

[10] The name 'appraisal term' applies where there is a work programme in place, when there is no such work programme it is termed the 'initial term'. This HRA screening covers both appraisal or initial terms.

- Assess (initial storage development planning, including of the development drilling, construction & commissioning, where applicable)

- Define (Storage Permit Application submission)

Financial viability and exploration operator competence is considered prior to licence award. The applicant must demonstrate that it has the technical competence to carry out the activities that could be permitted under the licence in the appraisal term, and the financial capacity to complete the work programme commitments before the licence is granted.

2.2 Activities that could follow licensing

As part of the licence application process, applicants provide the NSTA with details of work programmes they propose in the Appraisal/Initial Term. These work programmes are considered along with a range of other factors by the NSTA before arriving at a decision on whether to license the area. There are two levels of commitment in the work programme, though elements of the work programme would usually be firm commitments:

- A Firm Commitment is a commitment to the NSTA to perform an element of the work programme. The fact that a licensee has been awarded a licence on the basis of a “firm commitment” to undertake a specific activity should not be taken as meaning that the licensee will actually be able to carry out that activity. This will depend upon the outcome of all relevant activity-specific environmental assessments. Failure to carry out firm commitments may result in the licence being revoked.

- A Contingent Commitment is also a commitment to the NSTA to perform an element of the work programme, but it includes specific provision for the NSTA to agree that the activity need not be carried out if the NSTA considers that the requirement for that element is no longer appropriate.

It should be noted that the award of a carbon storage licence does not automatically allow a licensee to carry out any offshore activities from then on. Offshore activities (see Table 2.1) such as seismic survey or drilling are subject to relevant activity-specific environmental assessments by the Department (see Figures 2.2 and 2.3), and there are other regulatory provisions exercised by other Regulatory bodies such as the Health and Safety Executive. It is the licensee’s responsibility to be aware of, and comply with, all regulatory controls and legal requirements, and work offshore cannot proceed until the relevant consents/approvals are in place.

The proposed work programmes for the appraisal term are detailed in the licence applications. For some activities, such as seismic survey, the potential impacts associated with noise could occur some distance from the areas applied for and the degree of activity is not necessarily proportional to the size of the area. In the case of direct physical disturbance, the area being applied for is relevant.

Figure 2.1: Stages of plan level environmental assessment

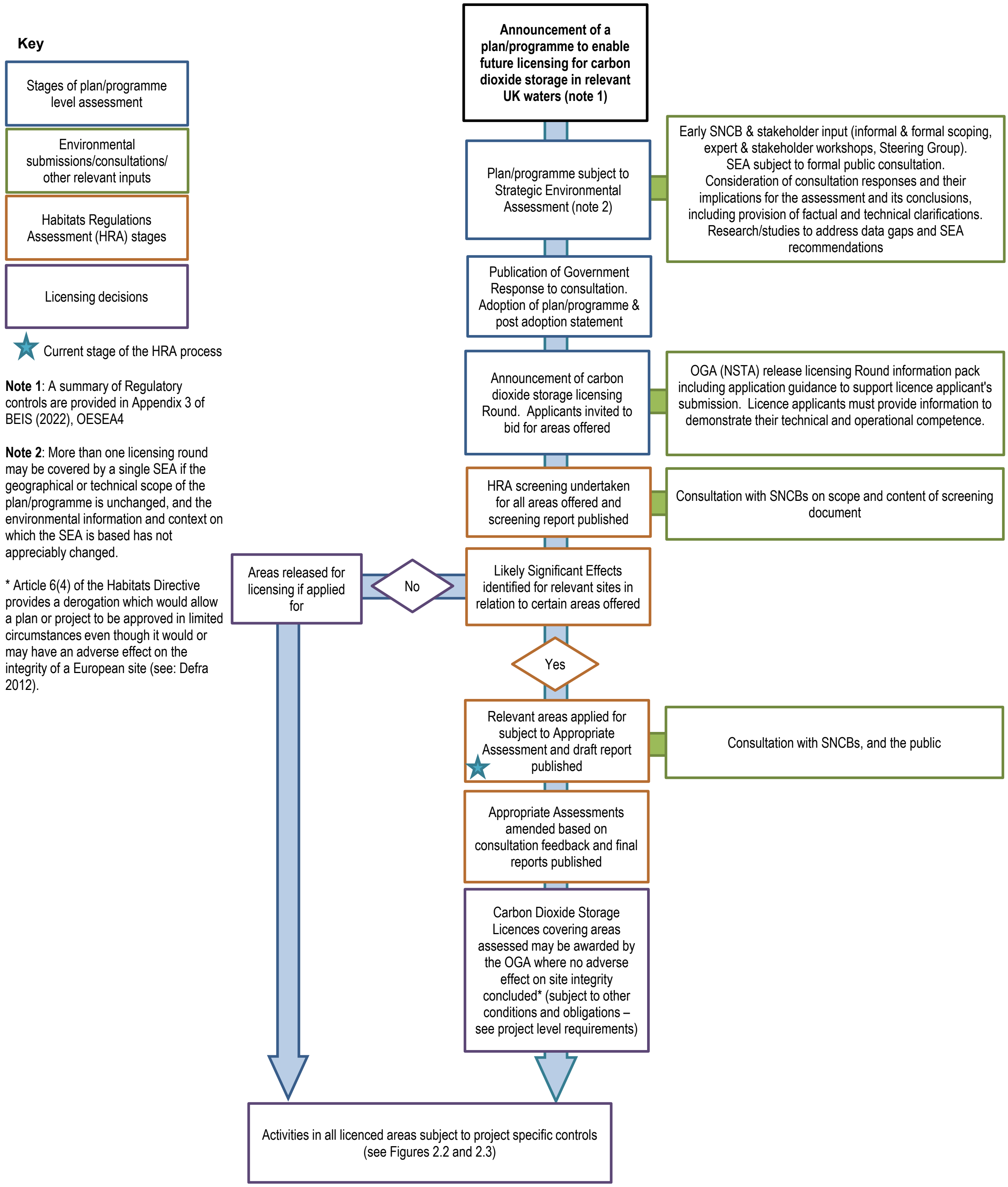
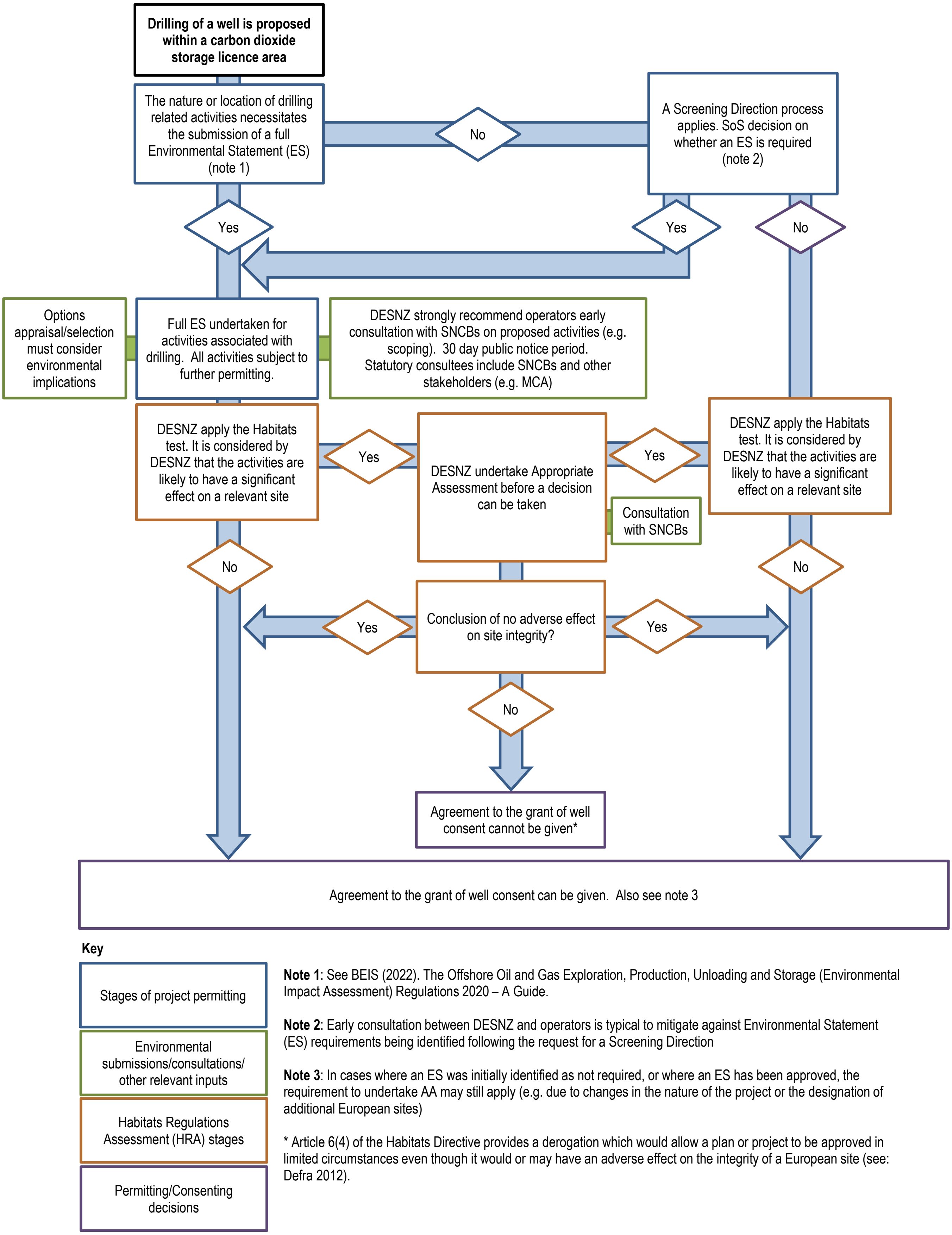


Figure 2.2: High level overview of exploration/appraisal drilling environmental requirements



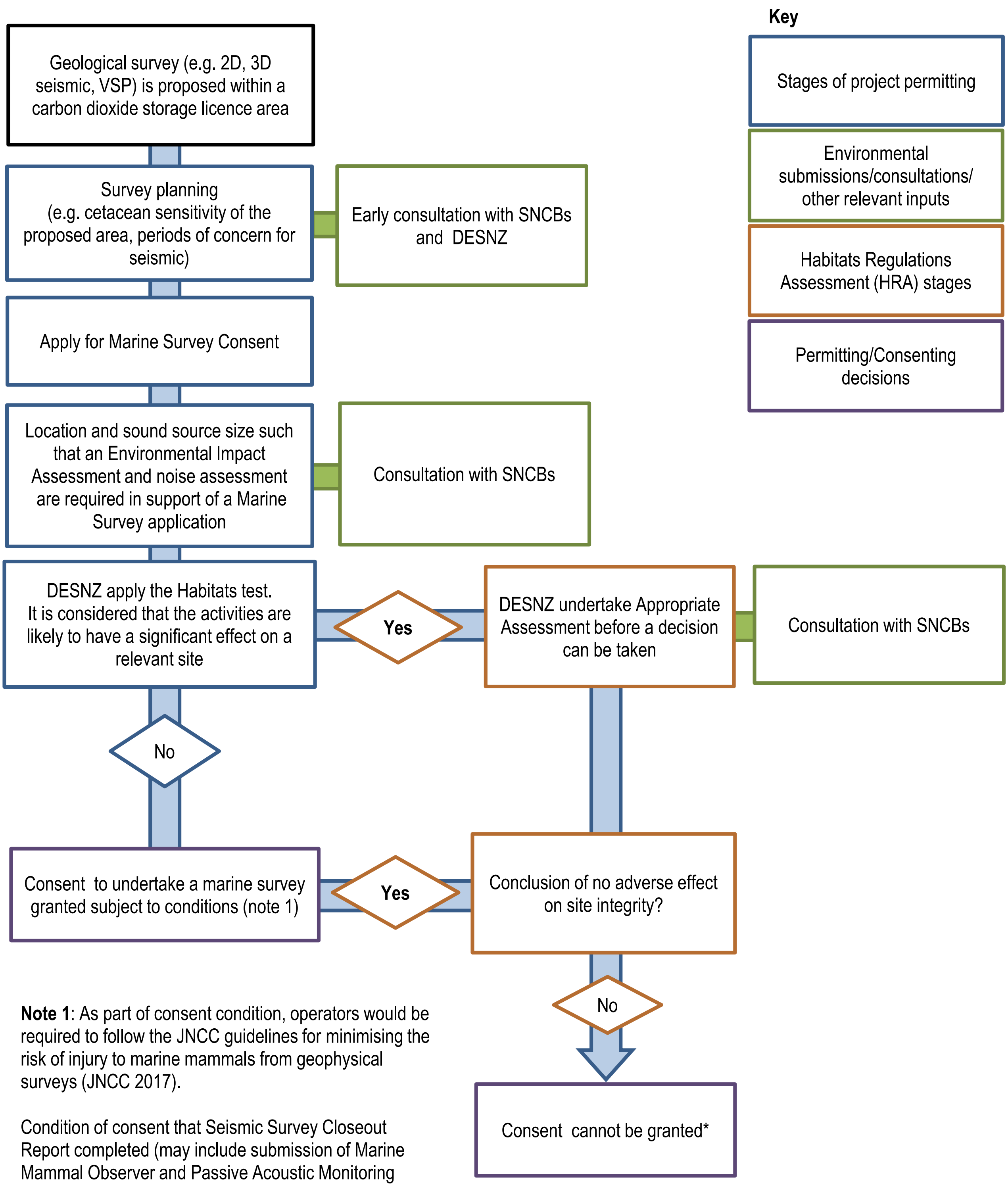
Note 1: See BEIS (2022). The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 – A Guide.

Note 2: Early consultation between DESNZ and operators is typical to mitigate against Environmental Statement (ES) requirements being identified following the request for a Screening Direction

Note 3: In cases where an ES was initially identified as not required, or where an ES has been approved, the requirement to undertake AA may still apply (e.g. due to changes in the nature of the project or the designation of additional European sites)

* Article 6(4) of the Habitats Directive provides a derogation which would allow a plan or project to be approved in limited circumstances even though it would or may have an adverse effect on the integrity of a European site (see: Defra 2012).

Figure 2.3: High level overview of seismic survey environmental requirements



Note 1: As part of consent condition, operators would be required to follow the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC 2017).

Condition of consent that Seismic Survey Closeout Report completed (may include submission of Marine Mammal Observer and Passive Acoustic Monitoring reports)

* Article 6(4) of the Habitats Directive provides a derogation which would allow a plan or project to be approved in limited circumstances even though it would or may have an adverse effect on the integrity of a European site (see: Defra 2012).

2.2.1 Likely scale of activity and carbon storage appraisal activities considered by the HRA

Activity after the Appraisal Term is much harder to predict, as this depends on the results of the Appraisal Term, which is, by definition, exploratory. The nature, extent, and timescale of development, if any, which may ultimately result from the licensing of the areas is uncertain, and therefore it is regarded that at this stage a meaningful assessment of development level activity (e.g. pipelay, placement of jackets, subsea templates) cannot be made. In relation to potential developments in the future, the licence areas offered include those which are partly overlapping with or entirely within national site network boundaries. The first category present opportunities for a potential development to be sited without impinging on relevant sites or features, and the Department will expect this to be done where feasible. Should a development be proposed that would involve the placement of infrastructure in a relevant site, HRA at the storage site development stage would ensure that there are no adverse effects on the integrity of relevant sites, or that compensatory measures are applied should it be decided that the project should be carried out for imperative reasons of overriding public interest and where there are no alternative solutions to the project. Based on the sources of effect relevant to the oil and gas industry (which is analogous to carbon dioxide storage activities) (see BEIS 2022, Section 4), impacts resulting in permanent habitat change in SACs designated for benthic habitats (sandbanks, reefs) are considered to be of most relevance. The Department has engaged with NSTA and the industry to raise awareness of the status of relevant sites, the potential for conclusions of adverse effects in relation to activities which could follow licensing, and the need to identify potential mitigation and/or compensation measures.

Potential accidental events, including spills (diesel, chemicals), are not considered in this assessment as they are not part of the work plan at this stage. Additionally, the potential effects from spills associated with carbon dioxide storage, along with their frequency and likelihood, and preventative measures which are mandatory, were considered in OESEA4 Environmental Report (BEIS 2022, see Sections 5.13.4 and 5.13.5 of that Report). As the approach to carbon storage exploration and appraisal is similar to that for oil and gas, the frequency and scale of spills from that industry provide a useful context. Considering spills associated only with mobile facilities, chiefly rigs used for exploration, appraisal, and production well drilling, across the UKCS spills (between 2015-2025) total on average 2 tonnes per year of oil, and 25 tonnes per year of chemicals. Taking the wider set of data for spills associated with all oil and gas exploration and production activities (as individual data is not available for exploration/appraisal), the majority (45%) of chemical spills reported in 2024 were those considered to Pose Little or No Risk (PLONOR), with a further 30% being in Offshore Chemical Notification Scheme (OCNS) groups D and E, these being the lowest ecotoxicity groupings, with the majority of remaining spills (25%) being of OCNS groups B and C, of medium ecotoxicity (OEUK 2025). Taking the average of available data over the period of 2016-2020, the vast majority of chemical spills (>98%) were either on the PLONOR list or were low risk categories (OSPAR 2022).

The Department considers that for oil and chemical spills, the risk of relevant impacts is low because; there is a detailed regulatory regime in place to prevent spills and to reduce the impact of spills should they occur (see Section 5.13 of BEIS 2022); minor spills are localised around the vicinity of the well site; and the risk of a major spill occurring is extremely low. There is insufficient data to quantitatively assess the risk in the UKCS for large spills due to their extremely low frequency (BEIS 2022), and this is particularly the case with carbon storage as target storage formations may not be former hydrocarbon fields (e.g. saline aquifers) and few carbon appraisal wells have been drilled to date.

As noted above, this assessment does not consider those activities that may be related to the installation and operation of a carbon dioxide storage site, should a storage permit be granted following the appraisal stage. Potential sources of accidental events associated with carbon dioxide storage (e.g. pipeline ruptures and loss of storage site containment) and their related environmental effects are assessed in Section 5.13.3.1 and 5.13.3.2 of OESEA4 (BEIS 2022) respectively.

The areas offered are large (18-6,212km^2) relative to the potential scale of appraisal activities (Table 2.2). Measures to prevent accidental events, response plans and potential impacts in the receiving environment are considered as part of the environmental impact assessment (EIA) process for specific projects that could follow licensing when the location, nature and timing of the proposed activities are available to inform a meaningful assessment of such risks.

Once project plans are in place, subsequent permitting processes relating to appraisal, development, and decommissioning/post-closure, would require assessment including HRA where appropriate, allowing the opportunity for further mitigation measures to be identified as necessary, and for permits to be refused if necessary. In this way the test, as elucidated by relevant case law[11], that the effects on Natura sites, "*must be assessed at every relevant stage of the procedure to the extent possible on the basis of the precision of the plan. This assessment is to be updated with increasing specificity in subsequent stages of the procedure*" is addressed. Therefore, only activities as part of the work programmes associated with the appraisal term will be considered in this HRA (see Table 2.1).

The approach used in this assessment has been to take the proposed activity for each of the carbon storage licence areas as being the maximum of any application for that area, and to assume that all activity takes place. The maximum estimates of work commitments for the relevant areas derived from the applications received by the NSTA or that may be considered by the NSTA to be required to enable appropriate appraisal of the areas are shown in Table 2.1.

Completion of the work programmes is likely to involve one or more of the activities summarised in Table 2.2. A series of assumptions has been developed on the nature and scale of activities to be assessed informed by the evidence base for potential effects presented in Section 4. Subsequent development activity is contingent on successful exploration and appraisal and may or may not result in the eventual installation of infrastructure. Where relevant, such future activities will themselves be subject to activity specific screening procedures and tests under the relevant legislation.

[11] See, in particular, the European Court of Justice (ECJ) case C-6/04. At the time of this assessment, this remains relevant to interpretation of the UK's legislation as assimilated case law under the *European Union (Withdrawal) Act 2018*.

Table 2.1: High case work programmes relevant to the areas considered in this assessment

Area	Obtain[12] and/or reprocess 2D or 3D seismic data	Shoot 3D seismic	Appraisal/exploration wells
SNS Area 3*	-	✓	One (contingent)
SNS Area 6	✓	✓ (contingent)	One (contingent)
English Channel 1	✓	✓ (contingent)	Two (contingent)

Notes: * work programme associated with licence CS025 that could extend into SNS Area 3.

[12] To obtain seismic data means purchasing or otherwise getting the use of existing data and does not involve shooting new seismic.

Table 2.2: Indicative overview of potential activities and related environmental aspects that could arise from the appraisal term

Potential activity / environmental aspect	Description	Assumptions used for assessment
Geophysical survey		
Seismic (2D and 3D) survey	2D seismic involves a survey vessel with an airgun array and a towed hydrophone streamer (up to 12 km long), containing several hydrophones along its length. The reflections from the subsurface strata provide an image in two dimensions (horizontal and vertical). Repeated parallel lines are typically run at intervals of several kilometres (minimum *ca.* 0.5km) and a second set of lines at right angles to the first to form a grid pattern. This allows imaging and interpretation of geological structures and identification of potential geological structures suitable for carbon dioxide storage. 3D seismic survey is similar but uses several hydrophone streamers towed by the survey vessel. Thus, closely spaced 2D lines (typically between 25 and 75m apart) can be achieved by a single sail line.	These deep-geological surveys tend to cover large areas (300-3,000km^2) and may take from several days up to several weeks to complete. Typically, large airgun arrays are employed with 12-48 airguns and a total array volume of 3,000-8,000 in^3. From available information across the UKCS, arrays used on 2D and 3D seismic surveys produce most energy at frequencies below 200Hz, typically peaking at 100Hz, and with a peak broadband source level of around 256dB re 1μPa @ 1m (Stone 2015). While higher frequency noise will also be produced which is considerably higher than background levels, these elements will rapidly attenuate with distance from source; it is the components <1,000Hz which propagate most widely.
Rig site survey	Rig site surveys are undertaken to identify seabed and subsurface hazards to drilling, such as wrecks and the presence of shallow gas. The surveys use a range of techniques, including multibeam and side scan sonar, sub-bottom profiler, magnetometer, and high-resolution seismic involving a much smaller source (mini-gun[13] or four airgun cluster of 160 in^3) and a much shorter hydrophone streamer. Arrays used on site surveys and some Vertical Seismic Profiling (VSP) operations (see below) typically produce frequencies predominantly up to around 250Hz, with a peak source level of around 235dB re 1μPa @ 1m (Stone 2015). Studies (Crocker & Fratantonio 2016, Halvorsen & Heaney 2018 (also see Labak 2019), Pace *et al.* 2021) of the acoustic characteristics of example geophysical survey equipment types including through open water testing, have provided a better understanding of the source levels, frequencies, and potential effects of using such equipment.	A rig site survey typically covers 2-3km^2. The rig site survey vessel may also be used to characterise seabed habitats, biota, and background contamination. Survey durations are usually of the order of four or five days.

[13] JNCC (2025) categorise mini airguns as being <12 in^3, with those of greater size being classed as for seismic survey.

Potential activity / environmental aspect	Description	Assumptions used for assessment
Drilling and well evaluation		
Rig tow out & de-mobilisation	Mobile rigs are towed to and from the well site typically by 2-3 anchor handling vessels.	The physical presence of a rig and related tugs during tow in/out is both short (a number of days depending on initial location of rig) and transient.
Rig placement/ anchoring	Semi-submersible rigs are used in deeper waters (normally >120m). Mooring is achieved using either anchors (deployed and recovered by anchor handler vessels) or dynamic positioning (DP) to manoeuvre into and stay in position over the well location. Eight to 12 anchors attached to the rig by cable or chain are deployed radially from the rig; part of the anchoring hold is provided by a proportion of the cables or chains lying on the seabed (catenary).	Semi-submersible rig anchors (if used) may extend out to a radius of 1.5-1.8km in North Sea waters of the UK. An ES for an exploration well in Block 18/05 in *ca*. 90m water depth estimated that the area of seabed affected by anchoring was *ca*. 0.01km^2 (Apache North Sea Limited 2006), and in deeper waters the seabed footprint may be in the order of 0.06km^2.
	Jack-up rigs are used in shallower waters (normally <120m) and jacking the rig legs to the seabed supports the drilling deck. Each of the rig legs terminates in a spud-can (base plate) to prevent excessive sinking into the seabed. Unlike semi-submersible rigs, jack-up rigs do not require anchors to maintain station, and these are not typically deployed for exploration activities, with positioning achieved using several tugs, with station being maintained by contact of the rig spudcans with the seabed. Anchors may be deployed to achieve precision siting over fixed installations or manifolds at injection facilities, which are not considered in this assessment.	It is assumed that jack-up rigs will be three or four-legged rigs with 20m diameter spudcans with an approximate seabed footprint of 0.001km^2 within a radius of *ca*. 50m of the rig centre. For the assessment it is assumed that effects may occur within 500m of a jack-up rig which would take account of any additional rig stabilisation (rock placement) and scour protection footprint[14]. A short review of 20 Environmental Statements[15], which included drilling operations in the southern North Sea since 2007 (specifically in quadrants 42, 43, 44, 47, 48, 49 and 53) indicated that rig stabilisation was either not considered necessary and/or assessed as a worst-case contingency option. Where figures were presented, the spatial scale of potential rock placement operations was estimated at between 0.001-0.004km^2 per rig siting. In some limited circumstances, additional rock may be required during operations for scour protection. Of 47 applications relating to rig siting on the UKCS between 2015 and 2022 which included an allowance for rig stabilisation materials, 36 did not use the allowance applied for, and a further

[14] The types and nature of rig stabilisation that could occur are summarised in HSE (2004) which highlights the safety risks and provides guidance on the safe siting of jack-up rigs. The guidance notes the need to understand site soil conditions as a key approach to prevent foundation problems, and in relation to scour protection, notes that mitigation includes, amongst other things, the application of rock, sandbags, and the use of frond mattresses to reduce current velocity.
[15] Note that this review was of oil and gas wells. Approaches to rig placement for carbon dioxide appraisal would be the same.

Potential activity / environmental aspect	Description	Assumptions used for assessment
		six used less than the quantity applied for. The majority of the applications (41) were for wells in the southern North Sea, with the remaining applications (6) being in the central North Sea. Nine further applications covering areas in the central and northern North Sea included other minor deposits, such as mattresses and hessian bags, with deposits actually occurring in four cases. Rock applied for rig stabilisation and scour protection would not normally be removed at the end of a drilling campaign, however, the potential to remove rock from the seabed in other scenarios is noted (e.g. see Jan de Nul 2018). If rock were to be removed, the rock and associated sediment would be deposited at a licensed disposal site. Potential alternatives to rock placement for scour protection during drilling could include the application of rock bags or frond mattresses, however, the potential to use such methods would need to be considered at a project-specific level.
Marine discharges	Typically, around 1,000 tonnes of cuttings (primarily rock chippings) result from drilling an exploration well. Water-based mud cuttings are typically discharged at, or relatively close to sea surface during "closed drilling" (i.e. when steel casing in the well bore and a riser to the rig are in place), whereas surface hole cuttings are normally discharged at seabed during "open-hole" drilling. Use of oil- based mud systems, for example in highly deviated sections or in drilling water reactive shales, would require onshore disposal or treatment offshore to the required standards prior to discharge. Typical chemical use and discharge for a well includes cements which are used to fix casings and liners into place inside the well, with the vast majority retained downhole and not discharged to the marine environment. Brines and clean up chemicals, designed to remove mud and cuttings traces from the well bore, and other chemicals such as rig washes, hydraulic fluids and pipe dopes, are essential during drilling programmes.	The distance from source within which smothering or other effects may be considered possible is generally a few hundred metres. For the assessment it is assumed that effects may occur within 500m of the well location covering an area in the order of $0.8km^2$ (refer to Section 4.2 for supporting information). Typically, the majority of chemicals used and discharged are either PLONOR or have a risk assessment banding of E or Gold and contain no additional warnings (i.e. they do not contain components which have been identified for substitution, for example due to toxicity, biodegradation, bioaccumulation). Chemicals are risk assessed prior to their use and discharge offshore, with those chemicals identified with warnings and/or a poorer environmental profile, requiring additional justification in order to obtain approval. Effects from chemical discharge will typically be localised to the well area.
Conductor piling	Well surface holes are usually drilled "open-hole" with the conductor subsequently inserted and cemented in place to provide a stable hole through which the lower well sections are drilled. Where the nature of	The need to pile conductors is well-specific and is not routine. It is anticipated that a conductor piling event would last between 4-6 hours, during which time impulses sound would be generated

Potential activity / environmental aspect	Description	Assumptions used for assessment
	the seabed sediment and shallow geological formations are such that they would not support a stable open-hole (i.e. risking collapse), the conductor may be driven into the sediments. In North Sea exploration wells, the diameter of the conductor pipe is usually 26" or 30" (<1m), which is considerably smaller than the monopiles used for offshore wind farm foundations (>3.5m diameter), and therefore require less hammer energy and generate noise of a considerably lower amplitude. For example, hammer energies to set conductor pipes are in the order of 90-270kJ (see: Matthews 2014, Intermoor website), compared to energies of up to 3,000kJ in the installation of piles at some southern North Sea offshore wind farm sites. Direct measurements of underwater sound generated during conductor piling are limited. Jiang *et al.* (2015) monitored conductor piling operations at a jack-up rig in the central North Sea in 48m water depth and found peak sound pressure levels (L_{pk}) not to exceed 156dB re 1 μPa at 750m (the closest measurement to source) and declining with distance. Peak frequency was around 200Hz, dropping off rapidly above 1kHz; hammering was undertaken at a stable power level of 85 ±5 kJ but the pile diameter was not specified (Jiang *et al.* 2015). MacGillivray (2018) reported underwater noise measurements during the piling of six 26" conductors at a platform, six miles offshore of southern California in 365m water depth. After initially penetrating the seabed under its own weight, each conductor was driven approximately 40m further into the seabed (silty-clay and clayey-silt) with hammer energies that increased from 31 ±7 kJ per strike at the start of driving to 59 ±7 kJ per strike. Between 2.5-3 hours of active piling was required per conductor. Sound levels were recorded by fixed hydrophones positioned at distances of 10-1,475m from the source and in water depths of 20-370m, and by a vessel-towed hydrophone. The majority of sound energy was between 100-1,000Hz, with peak sound levels around 400Hz. Broadband sound pressure levels recorded at 10m from source and 25m water depth were between 180-190dB re 1μPa (SEL = 173-176dB re 1μPa·s), reducing to 149-155dB re 1μPa at 400m from source and 20m water depth (SEL = 143-147dB re 1μPa·s).	primarily in the range of 100-1,000Hz, with each impulse of a sound pressure level of approximately 150dB re 1μPa at 500m from the source.

Potential activity / environmental aspect	Description	Assumptions used for assessment
Rig/vessel presence and movement	On site, the rig is supported by supply and standby vessels, and helicopters are used for personnel transfer.	Supply vessels typically make 2-3 supply trips per week between rig and shore. Helicopter trips to transfer personnel to and from the rig are typically made several times a week. A review of Environmental Statements for exploratory drilling suggests that the rig could be on location for, on average, up to 10 weeks. Support and supply vessels (50-100m in length) are expected to have broadband source levels in the range 165-180dB re 1μPa@1m, with the majority of energy below 1kHz (OSPAR 2009). Additionally, the use of thrusters for dynamic positioning has been reported to result in increased sound generation (>10dB) when compared to the same vessel in transit (Rutenko & Ushchipovskii 2015).
Well evaluation (e.g. Vertical Seismic Profiling)	Sometimes conducted to assist with well evaluation by linking rock strata encountered in drilling to seismic survey data. A seismic source (airgun array, typically with a source size around 500 in^3 and with a maximum of 1,200 in^3, Stone 2015) is deployed from the rig, and measurements are made using a series of geophones deployed inside the wellbore. The ability of rock strata to accept injected fluids such as dense phase carbon dioxide may be investigated by an injectivity test.	VSP surveys are of short duration (one or two days at most).

2.3 Existing regulatory requirements and controls

The AA assumes that the high-level controls described below are applied as standard to activities since they are legislative requirements. These are distinct from further control measures which may be identified and employed to avoid likely significant effects on relevant sites. These further control measures are identified in Sections 5.1-5.3 with reference to the two main sources of effect identified: physical disturbance and underwater noise.

2.3.1 Physical disturbance and marine discharges

There is a mandatory requirement to have sufficient recent and relevant data to characterise the seabed in areas where activities are due to take place (e.g. rig placement)[16]. If required, survey reports must be made available to the relevant statutory bodies on submission of a relevant permit application or Environmental Statement for the proposed activity, and the identification of any sensitive habitats by such survey (including those under Annex I of the Habitats Directive) may influence the Department's project-level decision.

Discharges from offshore oil and gas facilities have been subject to increasingly stringent regulatory controls over recent decades (see review in BEIS 2022, and related Appendices 2 and 3). Contaminant concentrations in the major streams (drilling wastes and produced water) have been substantially reduced or eliminated (e.g. the discharge of oil- based muds and contaminated cuttings is effectively banned), with discharges of chemicals and oil exceeding permit conditions or any unplanned release, potentially constituting a breach of the permit conditions and an offence. While comparatively recent, activities associated with carbon dioxide storage site appraisal are broadly comparable to that for oil and gas and are largely subject to the same legislative controls.

Drilling chemical use and discharge is subject to strict regulatory control through permitting, monitoring, and reporting (e.g. the Environmental Emissions Monitoring System (EEMS) and annual environmental performance reports). The use and discharge of chemicals must be risk assessed as part of the permitting process (e.g. Drilling Operations Application) under the *Offshore Chemicals Regulations 2002*, and the discharge of chemicals expected to have a significant negative impact would not be permitted. OSPAR have recognised the potential concerns associated with the use and discharge of microplastics during drilling operations. Recommendation 2010/03 and Agreement 2012-05 have been amended such that chemical suppliers are required to identify whether their offshore chemical products contain plastics, microplastics, or deliberately added nanomaterials. The related data will allow OSPAR to determine the extent of the use and discharge of substances, and where appropriate, develop management measures to control or eliminate their use.

At the project level, discharges would be considered in detail in project-specific EIAs, (and where necessary through HRAs) and chemical risk assessments under existing permitting procedures.

2.3.2 Underwater noise effects

Controls are in place to cover all significant noise generating activities on the UKCS, including geophysical surveying. Seismic surveys (including VSP and high-resolution site surveys), sub-

[16] BEIS (2021c). The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 - A guide. July 2021 - Revision 3.

bottom profile surveys and shallow drilling activities require an application for consent under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* and cannot proceed without consent. These applications are supported by an environmental assessment, which includes a noise assessment, and EIA may be required. Regarding noise thresholds to be used as part of any assessment, applicants are encouraged to seek the advice of relevant SNCB(s) (JNCC 2017) in addition to referring to European Protected Species (EPS) guidance (JNCC 2010a). Applicants should be aware of research development in the field of marine mammal acoustics, including the development of injury criteria (e.g. Southall *et al*. 2019).

The Department consults the relevant SNCBs on the consent applications for advice, and a decision on whether to grant consent is only made after careful consideration of their comments. SNCBs may request additional information or risk assessment, specific additional conditions to be attached to consent (such as specify timing or other specific control measures), or advise against consent.

It is a condition of consents issued under Regulation 4 of the Habitats Regulations for seismic and sub-bottom profile surveys that the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys are followed. Where appropriate, EPS disturbance licences may also be required under the *Conservation of Offshore Marine Habitats and Species Regulations 2017*[17]. The JNCC guidelines (2017) reaffirm that adherence to these guidelines constitutes best practice and will, in most cases, reduce the risk of deliberate injury to marine mammals to negligible levels. Applicants are expected to make every effort to design a survey that minimises sound generated and consequent likely impacts, and to implement best practice measures described in the guidelines.

In addition, potential disturbance of certain qualifying species (or their prey) may be avoided by the seasonal timing of offshore activities. Licensees should also be aware that seasonal concerns may influence the decision whether or not to approve particular activities.

[17] Disturbance of European Protected Species (EPS) (i.e. those listed in Annex IV) is a separate consideration under Article 12 of the Habitats Directive and is not considered in this assessment.

3 Appropriate Assessment Process

3.1 Process

In carrying out this AA, so as to determine whether it is possible to agree to the grant of licences, in accordance with Regulation 5(1) of *The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001*, the Department has:

- Considered, on the basis of the precautionary principle, whether it could be concluded that the integrity of relevant sites would not be affected. This impact prediction involved a consideration of the in-combination effects.

- Examined, in relation to elements of the plan where it was not possible to conclude that the integrity of relevant sites would not be affected, whether appropriate mitigation measures could be designed which negated or minimised any potential adverse effects identified.

In considering the above the Department has taken the following approach, so that:

- Prior to the grant of any licence all activities which may be carried out during the appraisal term of such a licence, and which by themselves or in combination with other activities can affect the site's conservation objectives, are identified in the light of the best available scientific evidence in the field.

- A licence can only be granted if the Department has made certain that the activities to be carried out during the appraisal term under such a licence will not adversely affect the integrity of that site (i.e. cause deterioration to a qualifying habitat or habitat of qualifying species, and/or undermine the conservation objectives of any given site). That is the case where no reasonable scientific doubt remains as to the absence of such effects.

3.2 Site integrity

The integrity of a site is defined by government policy and clarified by the courts (Cairngorms judicial review case[18]) as being: *'…the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified/[designated].'* The integrity of a site relates to the site's conservation objectives. These objectives are assigned at the time of designation to ensure that the site continues, in the long-term, to make an appropriate contribution to achieving favourable conservation status for the qualifying interest features. An adverse effect would be something that impacts the site features, either directly or indirectly, and results in disruption or harm to the ecological structure and functioning of the site and/or affects the ability of the site to meet its conservation objectives. For example, it is possible that a plan or project will adversely affect the integrity of a site only in a visual sense or only with respect to habitat types or species other than those listed in Annex I or Annex II. In such cases, the effects do not amount to an adverse effect for purposes of Regulation 6 of the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001*, provided that the

[18] WWF UK Ltd v Secretary of State for Scotland [1999] 1 C.M.L.R. 1021.

coherence of the network is not affected. The AA must therefore conclude whether the proposed activity adversely affects the integrity of the site, in the light of its conservation objectives.

Relevant sites may be affected by other pressures in addition to those sources of likely significant effect from the work programmes, and by in-combination sources of effect from other plans and projects. Of relevance to SPAs is the avian influenza (H5N1) outbreak between 2021 and 2023 which affected many breeding seabird colonies (see Tremlett *et al*. 2024), and also wintering birds, in the UK and beyond. The population level consequences of these outbreaks are not yet clear, and at present, the SNCBs have not updated the status of SPAs to reflect the impact of avian influenza on colonies. Similarly, a number of effects of climate change on the marine environment and its biota are possible in the coming decades which could affect qualifying interests of SACs and SPAs (as summarised in BEIS 2022).

Burton *et al.* (2023) provide a summary of the influence climate change is already having on birds in the UK, which include population responses across annual cycles and ranges, declines in some breeding seabird numbers, in part linked to climate-mediated changes in fish prey species and changes in storminess affecting winter survival, and declines in waterbird populations and north-easterly shifts in waterbird winter distributions in Europe. Burton *et al.* (2023) note that evidence of the influences of climate change on bird demographics has recently improved but requires further study to understand the underlying processes, and there is a high degree of uncertainty associated with projections of the effects of climate change impacts, such that consensus across species groups is low (e.g. Hakkinen *et al.* 2022, Searle *et al.* 2022). Effects of climate change on the benthic environment is also relevant (e.g. as summarised in Moore & Smale 2020), and while some evidence exists of species responses to climate change, the range of available studies and those regions studied are few, and the level of confidence and consensus on the evidence remains low.

There have also been range shifts in marine mammals in the north-east Atlantic (Martin *et al.* 2023) which have been linked to changes in temperature and prey distribution. While climate change is likely to result in impacts on qualifying features of conservation sites, it is presently not known how the status of specific site features is being affected. The Department acknowledges the significant impact of avian influenza on bird mortality, and the potential effects of climate change on the status of site features, and will maintain awareness their implications, including for HRA, through the literature, and advice from the SNCBs.

3.3 Assessment of effects on site integrity

The assessment has been undertaken in accordance with the European Commission Guidance (EC 2019) and with reference to other guidance, reports, and policy, including the Habitats Regulations Guidance Notes (Defra 2012, SEERAD 2000), SNH (2015), the National Planning Policy Framework (MHCLG 2024), the Marine Policy Statement (HM Government 2011), English Nature report No. 704 (Hoskin & Tyldesley 2006) and Natural England report NECR205 (Chapman & Tyldesley 2016).

The assessment of effects on site integrity is documented in Section 5. It has been informed by an evidence base on the environmental effects of oil and gas activities on the UKCS and elsewhere (Section 4) which are considered to be a proxy for carbon storage activities, and has utilised a number of assumptions on the nature and scale of potential activities that could follow licensing (Table 2.2), along with the characteristics and specific environmental conditions of the relevant sites (see Section 5). Activities which may be carried out following the grant of a licence, and which by themselves or in combination with other activities can affect the conservation objectives of relevant sites are discussed under the following broad headings in each of the regional sections:

- Physical disturbance and drilling effects
- Underwater noise effects
- In-combination effects

3.4 Environmental Targets

As well as complying with the requirements of the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* in carrying out this assessment, the Department will take into account relevant environmental targets set under the *Environment Act 2021*. In particular, the Department will consider the outcome of the AA against the targets set out in the *Environmental Targets (Marine Protected Areas) Regulations 2023*, which are that, before the end of December 2042, the number of protected features in favourable condition within all relevant Marine Protected Areas (MPA) is not less than 70% of the total number of all protected features within relevant MPAs; and all other protected features within relevant MPAs are in recovering condition. The Department will also consider the interim target set out in the Government's 2025 Environmental Improvement Plan, which is that 49% of protected features in MPAs should be in favourable condition, and at least 46% in recovering condition, by December 2030[19].

Those targets only apply in respect of the English part of UK seas[20]. The effects of this carbon dioxide storage licensing on other national network sites (e.g. Marine Conservation Zones) have been assessed separately (DESNZ 2026). For sites screened in, the potential for adverse effects on the integrity of the relevant sites from the proposed licensing are to be the subject of AA.

If it can be concluded that there will be no adverse effects on the integrity of any site, or that the achievement of the conservation objectives of relevant MCZs will not be significantly hindered, the Department considers that the granting of the proposed licences would not hinder the meeting of the applicable targets.

[19] https://www.gov.uk/government/publications/environmental-improvement-plan-2025
[20] i.e. the "English inshore region" and "English offshore region" as defined in section 322(1) of the *Marine and Coastal Access Act 2009*.

4 Evidence base for assessment

4.1 Introduction

The AAs are informed by an evidence base on the environmental effects of carbon dioxide storage appraisal related activities and analogous oil and gas activities derived from the scientific literature, relevant Strategic Environmental Assessments (e.g. DECC 2009, 2011, 2016, 2016, BEIS 2018a, 2022) and other literature. Recent operator Environmental Statements for offshore exploration and appraisal activities on the UKCS have also been reviewed, noting that appraisal drilling for carbon dioxide storage will be broadly similar to that undertaken for oil and gas project. These provide, for example, a more specific indication of the range of spatial footprints associated with relevant drilling activities to inform the further consideration of those sites where physical disturbance and drilling effects may be considered likely.

Much work has been undertaken in the area of sensitivity assessments and activity/pressure (i.e. mechanisms of effect) matrices (e.g. Tillin *et al*. 2010, JNCC 2013, Tillin & Tyler-Walters 2014, Defra 2015, Robson *et al.* 2018, the Scottish Government Feature Activity Sensitivity Tool, FeAST, the MarESA tool, Tyler-Walters *et al*. 2018). These matrices are intended to describe the types of pressures that act on marine species and habitats from a defined set of activities and are related to benchmarks where the magnitude, extent or duration is qualified or quantified in some way and against which sensitivity may be measured – note that benchmarks have not been set for all pressures. The sensitivity of features to any pressure is based on tolerance and resilience and can be challenging to determine (e.g. see Tillin & Tyler-Walters 2014, Pérez-Domínguez *et al.* 2016, Maher *et al.* 2016), for example due to data limitations for effect responses of species making up functional groups and/or lack of consensus on expert judgements. Outputs from such sensitivity exercises can therefore be taken as indicative.

This approach underpins advice on operations for a number of the sites included in this assessment (e.g. Haisborough, Hammond and Winterton SAC, North Norfolk Sandbanks and Saturn Reef SAC). The advice identifies a range of pressures for the sites in relation to oil, gas and carbon dioxide storage exploration activity, for which the site features are regarded to be either sensitive, not sensitive; or where a sensitivity assessment has not been made, or it is concluded there is insufficient evidence for a sensitivity assessment to be made at the pressure benchmark[21]. Whilst the matrices provided as part of the advice are informative and note relevant pressures associated with hydrocarbon exploration and gas storage, resultant effects are not inevitable consequences of activity since often they can be mitigated through timing, siting, or technology (or a combination of these). The Department expects that these options would be evaluated by the licensees and documented in the environmental assessments required as part of the activity specific consenting regime.

A review of the range of pressures identified in SNCB advice for the relevant sites was undertaken for the purpose of this assessment. The review concluded that the evidence base for potential effects of hydrocarbon (and by extrapolation, carbon storage) exploration from successive Offshore Energy SEA, including the most recent OESEA4 (BEIS 2022) covers the

[21] Note that the advice does not take into account the intensity, frequency or cumulative impacts from activities, and pressure benchmarks are used as reference points to assess sensitivity and are not thresholds that identify a likely significant effect within the meaning of Habitats Regulations (JNCC 2017a)

range of pressures identified in the advice for the relevant sites (as summarised in Sections 4.2-4.3) and has therefore been used to underpin the assessment against site-specific information. It is noted that existing controls are in place for many relevant pressures (e.g. hydrocarbon contamination, introduction of other substances (solid, liquid or gas), synthetic compound contamination (including antifoulants), transition elements & organo-metal contamination, introduction or spread of non-indigenous species, and litter), either directly in relation to carbon dioxide storage or oil and gas activities (as outlined in Section 2.3) or generally in relation to shipping controls (e.g. MARPOL Annex I and V controls on oil and garbage respectively, and the Ballast Water Management Convention). In addition to advice on operations, the conservation objectives and any Supplementary Advice on Conservation Objectives (SACO) have been taken into account. The following sections provide a summary of the evidence informing the site-specific assessment of effects provided in Section 5. To focus the presentation of relevant information, the sections take account of the environments in which those areas applied for and relevant sites to be subject to further assessment are located (Figure 1.1).

4.2 Physical disturbance and drilling effects

The pressures[22] which may result from exploration/appraisal activities and cause physical disturbance and drilling effects on relevant sites assessed in Section 5.2 are described below with respect to rig siting, drilling discharges, and other effects. The information base relies on evidence from the drilling of oil and gas exploration/appraisal and development wells, as these are broadly comparable to carbon dioxide storage wells.

4.2.1 Rig siting

Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion

Semi-submersible rigs normally use anchors to hold position, typically between 8 and 12 in number at a radius related to water depth, seabed conditions and anticipated metocean conditions. The seabed footprint associated with semi-submersible rig anchoring results from a combination of anchor scars caused by anchors dragging before gaining a firm hold and scraping by the cable and/or chain linking the anchor to the rig, where these contact the seabed (the catenary contact). In North Sea depths, rig anchors extend to a radius of up to *ca*. 1,500m (note that semi-submersible rigs are typically not used in water depths of less than 120m). In the deeper waters of the UK the use of anchors could be avoided through the use of dynamically positioned (DP) drill ships or DP semi-submersible rigs. These use a number of thrusters and accurate positioning information to maintain their station.

Jack-up rigs, normally used in shallower water (<120m), leave three or four seabed depressions from the feet of the rig (the spudcans) around 15-20m in diameter. The form of the footprint depends on factors such as the spudcan shape, the soil conditions, the footing penetration, and methods of extraction, with the local sedimentary regime affecting the longevity of the footprint (HSE 2004). For example, side scan survey data from a 2011 pipeline route survey in Blocks 30/13c and 30/14 showed spudcan depressions from the drilling of a well in 2006 (no information on the depths of the depressions was provided). The well was located in a *ca*. 70m water depth, exposed to low tidal currents (0.1-0.26m/s) with

[22] Relevant pressures identified from advice on operations for sites and JNCC Pressures-Activities Database (PAD) 2022: https://jncc.gov.uk/resources/97447f16-9f38-49ff-a3af-56d437fd1951

sediments consisting of fine to medium silty sand with gravel, cobbles, and coarse sand also present (Maersk 2011). By comparison, swathe bathymetry data collected as part of FEPA monitoring of the Kentish Flats wind farm off the Kent coast indicated a set of six regular depressions in the seabed at each of the turbine locations resulting from jack-up operations. Immediately post-construction, a January 2005 survey recorded these depressions as having depths of between 0.5 and 2.0m. By November 2007, these depths had reduced by an average of 0.6m indicating that the depressions were naturally infilling as a result of the mobile sandy sediments present across the area (Vattenfall 2009). Similar results are noted for Lincs wind farm (EGS 2016), with post construction monitoring indicating bathymetric changes to the seabed of up to 1.2m from jack-up depressions, and their infilling over time. While infilling results in the recovery of seabed topography, in areas of coarse sediment, infilling sediments may be finer than those surrounding the depression resulting in localised but longer term changes in sediment character. In locations with an uneven or soft seabed, material such as grout bags or rocks may be placed on the seabed to stabilise the rig feet, and rock or grout bags may also be used to provide scour protection during the operation of the rig (see below).

The drilling of the well surface hole and installation of the conductor will result in highly localised changes to the substrate below the surface of the seabed, for example, a typical conductor may have a diameter of 26 inches. Following drilling, exploration wells are typically plugged and abandoned with the casing being removed to approximately 3m below the seabed, in line with industry guidance (e.g. OEUK, BEIS 2018b), which also reflects the need to consider prevailing local conditions. As noted above in relation to depressions generated from installing jack-up rigs, some natural infilling and recovery of the seabed would be expected following conductor removal, subject to local hydrodynamic conditions.

Broadly, physical effects of seabed disturbance may include mortality to benthic fauna as a result of physical trauma and smothering by re-suspended sediment. The majority of seabed species recorded from the European continental shelf are known, or believed to have, short lifespans (a few years or less) and relatively high reproductive rates, indicating the potential for rapid population recovery, typically between one to five years (Jennings & Kaiser 1998). In general, macrofaunal population levels are limited by post-settlement factors rather than larval availability.

Physical change to another seabed type

As noted, there may be a requirement for jack-up rig stabilisation and/or scour protection (e.g. rock placement) depending on local seabed conditions, but this is not typical. In soft sediments, rock deposits may cover existing sediments resulting in a physical change of seabed type, and related habitat loss, which in the context of HRA, could lead to a reduction in feature extent that would need to be considered in relation to the site's conservation objectives and conservation status. The introduction of rock into an area with a seabed of sand and/or gravel can in theory provide "stepping stones" which might facilitate biological colonisation including by non-indigenous species by allowing species with short lived larvae to spread to areas where previously they were effectively excluded. On the UKCS, natural "stepping stones" are widespread and numerous for example in the form of rock outcrops, glacial dropstones and moraines, relicts of periglacial water flows, accumulations of large mollusc shells, carbonate cemented rock etc., and these are often revealed in rig site and other (e.g. pipeline route) surveys. The potential for man-made structures to act as stepping stones in the North Sea and the impact of their removal during decommissioning is being investigated as part of the INSITE[23] programme. Phase 1 projects (2015-2017) are now complete; those of

[23] https://www.insitenorthsea.org/

relevance suggest that man-made structures may influence benthic community structure and function but only on a limited spatial scale. Modelling indicates the strong potential for biological connectivity between structures in the North Sea (e.g. Henry *et al.* 2018, Mayorga-Adame *et al.* 2022), but this has not been validated by empirical data (ISAB 2018). Phase 2 of the INSITE research (2019-2024) aimed to tackle gaps in the understanding of the role of man-made structures in marine ecosystems and results from this phase of the work were recently summarised in a series of webinars. An additional project was commissioned to provide a synthesis of evidence relating to man-made structures in the marine environment, building on phases 1 and 2 of the INSITE programme[24]. Phase 3 of INSITE (2024-2027)[25] has three core projects, targeting critical gaps in decommissioning evidence, the fate of pipelines in the short (0-5), medium (5-30) and long-term (30-100+ years), and social attitudes and perceptions of decommissioning. A fourth project, the Value of Marine Artificial Structures (ValMAS) will run from 2025-2029 and will apply natural capital approaches to reveal the value and impact of marine artificial structures.

Introduction or spread of non-indigenous species

Through the transport and discharge of vessel ballast waters (and associated sediment), and to a lesser extent fouling organisms on vessel/rig hulls, non-native species may be introduced to the marine environment. Should these introduced species survive and form established breeding populations, they can result in negative effects on the environment. These include: displacing native species by preying on them or out-competing them for resources; irreversible genetic pollution through hybridisation with native species, and increased occurrence of harmful algal blooms (as reviewed in Nentwig 2006). The economic repercussions of these ecological effects can also be significant (see IPIECA & OGP 2010, Lush *et al*. 2015, Nentwig 2007). In response to these risks, a number of technical measures have been proposed such as the use of ultraviolet radiation to treat ballast water or procedural measures such as a mid-ocean exchange of ballast water (the most common mitigation against introductions of non-native species). Management of ballast waters is addressed by the International Maritime Organisation (IMO) through the International Convention for the Control and Management of Ships Ballast Water & Sediments, which entered into force in 2017[26]. The Convention includes Regulations with specified technical standards and requirements (IMO Globallast website[27]). Further, carbon dioxide exploration and appraisal activity is unlikely to change the risk of the introduction of non-native species as the vessels typically operate in a geographically localised area (e.g. rigs may move between the Irish Sea and North Sea), and the risk from hull fouling is low, given the geographical working region and scraping of hulls for regular inspection.

4.2.2 Drilling discharges

Abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity), smothering and siltation rate changes (light), physical change (to another sediment type), and habitat structure changes – removal of substratum (extraction)

The pressures described in this section relate to physical ones associated with the discharge and settlement of cuttings during exploration well drilling rather than potential chemical pressures (described below). The extent and potential impact of drilling discharges have been

[24] https://insitenorthsea.org/publications/
[25] https://insitenorthsea.org/phase-3/
[26] http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx
[27] http://archive.iwlearn.net/globallast.imo.org/the-bwmc-and-its-guidelines/index.html

reviewed in successive SEAs, OESEA, OESEA2, OESEA3 and OESEA4 (DECC 2009, 2011, 2016 and BEIS 2022, respectively, also see BEIS 2018a).

Relevant information on the recovery of benthic habitats to smothering mainly comes from studies of dredge disposal areas (see Newell *at al.* 1998). Recovery following disposal occurs through a mixture of vertical migration of buried fauna, together with sideways migration into the area from the edges, and settlement of new larvae from the plankton. The community recolonising a disturbed area is likely to differ from that which existed prior to construction. Opportunistic species will tend to dominate initially and on occasion, introduced and invasive species may then exploit the disturbed site (Bulleri & Chapman 2010). Harvey *et al.* (1998) suggest that it may take more than two years for a community to return to a closer resemblance of its original state (although if long lived species were present this could be much longer). Shallow water (<20m) habitats in wave or current exposed regimes, with unconsolidated fine grained sediments have a high rate of natural disturbance and the characteristic benthic species are adapted to this. Species tend to be short lived and rapid reproducers, and it is generally accepted that they recover from disturbance within months. By contrast a stable sand and gravel habitat in deeper water is believed to take years to recover (see Newell *et al.* 1998, Foden *et al*. 2009).

The surface hole sections of wells are typically drilled riserless, producing a localised (and transient) pile of surface-hole cuttings around the surface conductor. These cuttings are derived from shallow geological formations, and a proportion will be similar to surficial sediments in composition and characteristics. The persistence of cuttings discharged at the seabed is largely determined by the potential for it to be redistributed by tidal and other currents. Discharged cuttings from the surface hole, and any other discharged cuttings from the rig, tend to be redistributed and do not produce piles on the seabed in high hydrodynamic energy environments such as the southern North Sea and the English Channel, and much of the eastern Irish Sea, whereas in low hydrodynamic energy environments such as the central and northern North Sea, redistribution of cuttings accumulations will be slow, and the topographic pile will probably persist over decades (BEIS 2022). After installation of the conductor, the surface casing (which will result in a small quantity of excess cement returns being deposited on the seabed), the blowout preventer (BOP) is positioned on the wellhead housing. These operations (and associated activities such as ROV operations) may result in physical disturbance of the immediate vicinity (a few metres) of the wellhead. When an exploration well is abandoned, the conductor and casing are plugged with cement and cut below the mudline (seabed sediment surface) using a mechanical cutting tool deployed from the rig and the wellhead assembly is removed. The seabed “footprint” of the well is therefore removed although post-well sediments may vary in the immediate vicinity of the well compared to the surrounding seabed (see for example, Jones *et al*. 2012).

Contamination[28]

In contrast to historic oil-based mud discharges[29], effects on seabed fauna resulting from the discharge of cuttings drilled with water-based muds (WBM) and of the excess and spent mud itself are usually subtle or undetectable. Although the presence of drilling material at the seabed close to the drilling location (<500m) is often detectable chemically (e.g. Cranmer 1988, Neff *et al.* 1989, Hyland *et al.* 1994, Daan & Mulder 1996, Currie & Isaacs 2005, OSPAR

[28] Including contamination from transition elements and organo-metals, hydrocarbons and PAHs, synthetic compounds and the introduction of other substances (solid, liquid or gas).
[29] OSPAR Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings came into effect in January 2001 and effectively eliminated the discharge of cuttings contaminated with oil based fluids (OBF) greater than 1% by weight on dry cuttings.

2009, Bakke *et al.* 2013). The spread and effects of WBM discharges on various aspects of seabed ecology including those not typically included in benthic monitoring programmes have been considered in multiple studies (e.g. Nguyen *et al.* 2021, Gillett *et al.* 2020, Dijkstra *et al.* 2020, Aagaard-Sørensen *et al.* 2018, Junttila *et al.* 2018); the results indicate that, where effects were detected, they were of small spatial scale and relatively short duration. Analysis of UKBenthos data (Henry *et al.* 2017) for 19 installations spanning the northern, central, and southern North Sea, suggested strong benthic responses for 12 structures, with 10 having their maximum ecological footprint within 1km of the discharge, and the remaining two within 1.2km, with recovery time varying between zero years (i.e. no effect) to between 6.8 and 8.3 years. The datasets largely reflected the effects of discharged OBM rather than WBMs, and the authors could not disentangle the effects of OBMs and WBMs in terms of persistence with the available data.

Considerable data from oil and gas activities has been gathered from the North Sea and other production areas, indicating that localised physical effects are the dominant mechanism of ecological disturbance where water-based mud and cuttings are discharged. Modelling of WBM cutting discharges has indicated that deposition of material is generally thin and quickly reduces away from the well. Jones *et al.* (2006, 2012) compared pre- and post-drilling ROV surveys of a West of Shetland exploration well in Block 206/1a in *ca*. 600m water depth and documented physical smothering effects within 100m of the well (note that this is over 400m deeper than any of the areas applied for in this round). Outside the area of smothering, fine sediment was visible on the seafloor up to at least 250m from the well. After three years, there was significant reduction of cuttings material visible particularly in the areas with relatively low initial deposition (Jones *et al*. 2012). The area with complete cuttings cover had reduced from 90m to 40m from the drilling location, and faunal density within 100m of the well had increased considerably and was no longer significantly different from conditions further away. The use of a ROV has also allowed the detection of small scale changes in benthic fauna in the immediate vicinity of a wellbore in the Norwegian sector of the North Sea, for example Hughes *et al.* (2010) found declines of the density of sea urchin *Gracilechinus acutus* within 50m of a well; such effects are considered temporary and negligible.

OSPAR (2009) concluded that the discharge of water-based muds and drill cuttings may cause some smothering in the near vicinity of the well location. The impacts from such discharges are localised and transient but may be of concern in areas with sensitive benthic fauna, for example corals and sponges. Field experiments on the effects of water-based drill cuttings on benthos by Trannum *et al*. (2011) treated two “fine” and “coarse” sediment samples with water-based drill cuttings and placed these in water depths of 27-37m. After six months there were only minor differences in faunal composition between the controls and those treated with drill cuttings. This corresponds with the results of field studies where complete recovery was recorded within 1-2 years after deposition of water-based drill cuttings (Daan & Mulder 1996, Currie & Isaacs 2005).

Finer particles may be dispersed over greater distances than coarser particles although exposure to WBM cuttings in suspension will in most cases be short-term (Bakke *et al.* 2013). Chemically inert, suspended barite has been shown under laboratory conditions to potentially have a detrimental effect on suspension feeding bivalves. Standard grade barite, the most commonly used weighting agent in WBMs, was found to alter the filtration rates of four bivalve species (*Modiolus modiolus, Dosinia exoleta, Venerupis senegalensis* and *Chlamys varia*) and to damage the gill structure when exposed to 0.5mm, 1.0mm and 2.0mm daily sedimentation depth equivalent doses (Strachan 2010, Strachan & Kingston 2012). All three barite treatments altered the filtration rates leading to 100% mortality. The horse mussel (*M. modiolus*) was the most tolerant to standard barite with the scallop (*C. varia*) the least tolerant.

Fine barite, at a 2mm daily sedimentation depth equivalent, also altered the filtration rates of all species, but only affected the mortality of *V. senegalensis*, with 60% survival at 28 days. The bulk of WBM constituents (by weight and volume) are on the OSPAR list of substances used and discharged offshore which are considered to PLONOR. Barite and bentonite are the materials typically used in the greatest quantities in WBMs and are of negligible toxicity. Field studies undertaken by Strachan (2010) showed that the presence of standard grade barite was not acutely toxic to seabed fauna but did alter benthic community structure. When the suspended barite levels used in laboratory studies are translated to field conditions (i.e. distances from the point of discharge) it is clear that any effects will be very local to a particular installation (in the case of oil and gas facilities, well within 500m).

Most studies of ecological effects of drilling discharges have involved soft-sediment species and habitats. Studies of the effects of water based mud discharges from three production platforms in 130-210m water depth off California found significant reductions at some stations in the mean abundance of four of 22 hard bottom taxa investigated using photographic quadrats (Hyland *et al.* 1994). These effects were attributed to the physical effects of particulate loading, namely disruption of feeding or respiration, or the burial of settled larvae. The impacts from WBM discharges may be of more concern in areas with sensitive benthic fauna, for example corals and sponges. Laboratory experiments by Allers *et al.* (2013) indicated that cold water coral (*Lophelia pertusa = Desmophyllum pertusum*) fragments were resilient to sedimentation-induced oxygen stress, but if coverage by sediment was complete and lasted long enough, the coral could not recover and died. Such effects can be mitigated in areas of sensitive species presence through site specific controls on whether, and where, drilling discharges are made. Järnegren *et al.* (2017) noted that natural high turbidity events lasting hours or days can occur in areas with adult corals but based on their experiments suggested that the planktonic larvae of *L. pertusa* were susceptible to damage or mortality from suspensions of drill cuttings which included bentonite.

4.2.3 Other effects

Visual disturbance

The areas offered may support important numbers of birds at certain times of the year including overwintering birds and those foraging from coastal SPAs. Therefore, the presence and/or movement of vessels and aircraft from and within carbon storage licence areas during exploration and appraisal activities could temporarily disturb birds from relevant SPA sites. In areas where helicopter transits are regular, a degree of habituation to disturbance amongst some birds has been reported (see Smit & Visser 1993). Van der Kolk *et al.* (2020) tracked 90 oystercatchers and also the movement of military and civilian fixed wing aircraft and helicopters in an area of the Dutch Wadden Sea used for military exercises and found that the mean daily energetic cost of bird movement from aircraft presence did not exceed 0.25%. They also noted the potential for habituation, and that rare and unpredictable events initiated disturbance from large distances. Similar results were recorded across four taxa (oystercatcher, bar-tailed godwit, curlew, gulls) by van der Kolk *et al.* (2019), with high tide disturbance from overflights increasing daily energy expenditure between 0.1-1.4% depending on the species and roost site studied. Small civil airplanes, jets, firing jets, and helicopters gave low disturbance probability. The anticipated level of helicopter traffic associated with exploration/appraisal drilling activity (2-3 trips per week, see Table 2.1) is likely to be insignificant in the context of existing helicopter, military, and civilian aircraft activity levels.

Physical disturbance of seaduck and other waterbird flocks by vessel and aircraft traffic associated with carbon dioxide exploration and appraisal is possible, particularly in SPAs established for shy species (e.g. common scoter). Such disturbance can result in repeated disruption of bird feeding, loafing, and roosting. For example, large flocks of common scoter were observed being put to flight at a distance of 2km from a 35m vessel, though smaller flocks were less sensitive and put to flight at a distance of 1km (Kaiser 2002, also see Schwemmer *et al.* 2011). Larger vessels would be expected to have an even greater disturbance distance (Kaiser *et al.* 2006). JNCC indicate that a buffer of 2.5km from vessels should be used to consider impacts on common scoter. Mendel *et al.* (2019) further note behavioural response in red-throated diver within 5km of ships, and JNCC suggest a 2km as a suitable buffer distance for vessel related disturbance. With respect to the disturbance and subsequent displacement of seabirds in relation to offshore wind farm (OWF) developments, the Joint SNCB interim displacement advice[30] recommends for most species a standard displacement buffer of 2km with the exception of the species groups of divers and sea ducks. Divers and sea ducks have been assessed as being the most sensitive species groups to offshore development and associated boat and helicopter traffic. Therefore, for divers and sea ducks a 4km displacement buffer is recommended. Whilst displacement effects for divers have been detected at greater distances (e.g. 5-7km, Webb 2016; 8km, HiDef 2017; 10-16.5km, Mendel *et al.* 2019, Heinänen *et al.* 2020, APEM 2021; 10km, MacArthur Green 2019; 10-15km, Dorsch *et al.* 2019), this relates to the construction and operation of offshore wind farms which have a much larger spatial and temporal footprint than carbon dioxide storage exploration appraisal activities. JNCC and Natural England advise the use at a project level, of displacement buffers of at least 2km and 2.5km relation to vessel traffic for red-throated diver and common scoter, respectively.

A significant number of various bird species migrate across the North Sea region twice a year or use the area as a feeding and resting area (OSPAR 2015). Some species crossing or using the area may become attracted to offshore light sources, especially in poor weather conditions with restricted visibility (e.g. low clouds, mist, drizzle, Wiese *et al*. 2001), and this attraction can potentially result in mortality through collision (OSPAR 2015). As part of navigation and worker safety, and in accordance with international requirements, drilling rigs and associated vessels are lit at night and the lights will be visible at distance (some 10-12nm in good visibility). Guidelines (applicable to both existing and new offshore installations) aimed at reducing the impact of offshore installations lighting on birds in the OSPAR maritime area are available (OSPAR 2015). Exploration/appraisal drilling activities are temporary so a drilling rig will be present at a location for a relatively short period (e.g. on average up to 10 weeks per well), limiting the potential for significant interaction with migratory bird populations. Given the seasonal nature of the sensitivity, where relevant it is more appropriate to consider this in project level assessment (e.g. EIA and HRA where necessary), when the location and timing of activities are known.

The presence and/or movement of vessels from and within areas offered during exploration and appraisal activities could also potentially disturb marine mammals foraging within or close to sites for which they are a qualifying feature. Reported responses include avoidance, changes in swimming speed, direction and surfacing patterns, alteration of the intensity and frequency of calls and increases in stress-related hormones (Rolland *et al.* 2012, Dyndo *et al.* 2015, Veirs *et al.* 2016). Harbour porpoises, white-sided dolphins and minke whales have been shown to respond to survey vessels by moving away from them, while white-beaked dolphins have shown attraction (Palka & Hammond 2001). A study on captive harbour porpoises in a semi-natural net-pen complex in a Danish canal, recorded their behaviour while simultaneously measuring underwater noise of vessels passing the enclosure; reaction to noise was defined to occur when a highly stereotyped ‘porpoising’ behaviour was observed.

[30] https://hub.jncc.gov.uk/assets/9aecb87c-80c5-4cfb-9102-39f0228dcc9a

Porpoising occurred in response to almost 30% of vessel passages; the most likely behavioural trigger were medium- to high- frequency components (0.25–63 kHz octave bands) of vessel noise, while low- frequency components of vessel noise and additional pulses from echo-sounders could not explain the results (Dyndo *et al*. 2015). A tagging study of a small number of free-ranging porpoises in Danish coastal waters estimated that porpoises encountered vessel noise 17–89% of the time (from evaluation of the wideband sound and movement tag recordings). Occasional high-noise levels (coinciding with a fast ferry) were associated with vigorous fluking, bottom diving, interrupted foraging and even cessation of echolocation, leading to significantly fewer prey capture attempts at received levels greater than 96 dB re 1 mPa (16 kHz third-octave, Wisniewska *et al.* 2018).

More evidence is available on bottlenose dolphins, especially for coastal populations. Shore-based monitoring of the effects of boat activity on the behaviour of bottlenose dolphins off the US South Carolina coast, indicated that slow moving, large vessels, like ships or ferries, appeared to cause little to no obvious response in bottlenose dolphin groups (Mattson *et al*. 2005). Pirotta *et al*. (2015) used passive acoustic techniques to quantify how boat disturbance affected bottlenose dolphin foraging activity in the inner Moray Firth. The presence of moving motorised boats appeared to affect bottlenose dolphin ‘buzzing’ activity (foraging vocalisations), with boat passages corresponding to a reduction by almost half in the probability of recording a buzz. The boat effect was limited to the time where a boat was physically present in the sampled area and visual observations indicated that the effect increased for increasing numbers of boats in the area (Pirotta *et al.* 2013). Dolphins appeared to temporarily interrupt their activity when disturbed, staying in the area and quickly resuming foraging as the boat moved away.

Of primary concern for this HRA, is whether vessels linked to potential operations result in a significant increase to overall local traffic. New *et al*. (2013) developed a mathematical model simulating the complex social, spatial, behavioural, and motivational interactions of coastal bottlenose dolphins in the Moray Firth to assess the biological significance of increased rate of behavioural disruptions caused by vessel traffic. A scenario was explored in which vessel traffic increased from 70 to 470 vessels a year but despite the more than six-fold increase traffic, the dolphins’ behavioural time budget, spatial distribution, motivations, and social structure remained unchanged. While harbour porpoises appear to be more sensitive to potential disturbance than bottlenose dolphins, the increase in vessel traffic linked to the proposed plan is expected to be negligible (see Table 2.1). In UK waters, a modelling study indicated a negative relationship between the number of ships and the presence and abundance of harbour porpoises within relevant management units when shipping intensity exceeded a suggested threshold of approximately 50 ships per day (within any of the model’s 5km grid cells) in the Celtic Sea/Irish Sea and 80 ships per day in the North Sea (Heinänen & Skov 2015). The Marine Management Organisation project “Mapping UK shipping density and routes from AIS” (MMO 2014b) and the 2015 national dataset of marine vessel traffic[31] provides relevant shipping density information[32]. From 2015 AIS-derived ship density data, the approaches to major ports such as in the Humber and Thames regions had estimated shipping densities of up to 500 vessels per week, with the majority of coastal waters (10-25 vessels per week) and offshore waters (<5 vessels per week) supporting much lower densities. Jones *et al.* (2017) used the MMO (2014b) data to highlight areas where high rates of co-occurrence between seals at-sea and shipping coincided with SACs. They predicted exposure to shipping (and associated shipping noise) was likely to be high in areas where very high intensities of

[31] https://data.gov.uk/dataset/vessel-density-grid-2015
[32] Note that shipping densities are low over the majority of Blocks with higher densities primarily in coastal waters close to major ports.

spatial overlap occurred for one or both species of seals such as Orkney (e.g. Faray and Holm of Faray SAC), Shetland (e.g. Yell Sound Coast SAC), east coast of Scotland and England (e.g. Berwickshire and North Northumberland Coast SAC, Humber Estuary SAC, the Wash and North Norfolk Coast SAC), west Scotland (South East Islay Skerries SAC) and north Wales (no adjacent SAC with seals as a feature).

Collisions above or below water with static or moving objects

Worldwide, collisions with vessels are a potential source of mortality to marine mammals, primarily cetaceans. Whales are occasionally reported to be struck and killed, especially by fast-moving ferries but smaller cetacean species and seals can also be impacted by propeller strikes from smaller vessels. In the UK certain areas experience very high densities of commercial and recreational shipping traffic, some of which may also be frequented by large numbers of marine mammals; despite this, relatively few deaths are recorded as results of collisions (Hammond *et al.* 2008). Between 2000 and 2009, only 11 out of 1,100 post-mortems on harbour porpoises and common dolphins identified collision as the cause of death (UKMMAS 2010). Advice on operations for the Southern North Sea SAC[33] indicates that post mortem investigations of harbour porpoise deaths have revealed death caused by trauma (potentially linked with vessel strikes) is not currently considered a significant risk (e.g. see Deaville & Jepson 2011).

4.3 Underwater noise effects[34]

The current level of understanding of sources, measurement, propagation, ecological effects, and potential mitigation of underwater noise associated with hydrocarbon exploration and production have been extensively reviewed, assessed, and updated in each of the successive offshore energy SEAs (see DECC 2009, 2011, 2016, BEIS 2022). The following description of noise sources and potential effects builds on these previous publications, augmented with more recent literature sources, and can inform the impacts from exploration and appraisal drilling of carbon dioxide storage wells.

4.3.1 Noise sources and propagation

For all sources of anthropogenic underwater noise, there is now a reasonable body of evidence to quantify sound levels associated with these activities and to understand the likely propagation of these sounds within the marine environment, even in more complex coastal locations (DECC 2016, 2018, BEIS 2022).

Of those activities that generate underwater sound, deep geological seismic survey (2D and 3D) is of primary concern due to the high amplitude, low frequency and impulsive nature of the sound generated over a relatively wide area. Typical 2D and 3D seismic surveys consist of a vessel towing a large airgun array, made up of sub-arrays or single strings of multiple airguns, along with towed hydrophone streamers. Total energy source volumes vary between surveys, most commonly between 1,000 and 8,000 cubic inches, with typical broadband source levels of 248-259 dB re 1µPa (OGP 2011). Most of the energy produced by airguns is low frequency:

[33] https://hub.jncc.gov.uk/assets/206f2222-5c2b-4312-99ba-d59dfd1dec1d#SouthernNorthSea-conservation-advice.pdf
[34] Note that all underwater noise effects fall within the “underwater noise change” and “vibration” pressure definitions.

below 200Hz and typically peaking around 100Hz, but with some reaching into higher frequencies (>10,000 Hz) (Breitzke *et al*. 2008; Landrø *et al*. 2011; Hermannsen *et al*. 2015).

In addition to seismic surveys, relevant sources of impulsive sound are restricted to the smaller volume air-guns and sub-bottom profilers (SBPs) used in site surveys and well evaluation (i.e. Vertical Seismic Profiling, VSP), and also from occasional pile-driving of conductors during drilling (see Table 2.1). Compared to deep geological survey, these smaller volume seismic sources tend to generate sound of lower amplitude, are typically complete within several hours on a single day, are conducted from either a fixed point (VSP) or cover a small area (site surveys). Consequently, the overall magnitude and area of risk from sound effects is considerably smaller than in the case of deep geological seismic surveys.

Electromechanical sources such as ‘pinger’ or ‘chirper’ SBPs, side-scan sonar and multi-beam echosounders (MBES) have narrower beam widths and dominant frequencies much higher than those of air guns[35] such that, even at high amplitudes, the generated sound would be expected to rapidly attenuate and likely not propagate far enough for marine species to be negatively affected by received sound levels. For example, the absorption coefficient alone in seawater is approximately -36dB/km at 100kHz, rising to -61dB at 200kHz (Lurton 2016). SBPs of the ‘boomer’ and ‘sparker’ type do generate a true broadband seismic pulse of low frequency, although the peak pressures produced by these small devices are considerably lower than those generated by airguns. Two studies commissioned by the US Bureau of Ocean Energy Management investigated sound generated by equipment commonly used in high-resolution geophysical surveys, including electromagnetic sources. Calibrated source levels were measured under controlled conditions in a test tank (Crocker & Fratantonio 2016); acoustic characteristics of several example equipment types tested are provided in Table 4.1.

The test tank experiments were followed by measurements in shallow (≤ 100m depth) open-water environments to investigate sound propagation (Halvorsen & Heaney 2018). Problems were encountered during the open-water testing resulting in a lack of calibration in the reported sound source levels (Labak 2019). The accompanying advice note (Labak 2019) emphasises that these uncalibrated data should not be used to provide source level measurements, and consequently the reported isopleths (summarising sound propagation) should not replace project-specific sound source verifications.

Table 4.1: Measured acoustic characteristics for example sources used in high-resolution geophysical surveys

Source tested	Category; signal type	Source levels at maximum power tested (dB re 1µPa@1m)[1]		Approximate frequency of dominant energy (kHz)	-3dB beam width (degrees); across track
		SPLpeak-peak	SEL		
Delta Sparker	SBP ‘sparker’; impulse	206-225	163-185	< 1	n/a
Applied Acoustics 251	SBP ‘boomer’ (single plate); impulse	208-216	166-174	< 4	49-76
EdgeTech 512i	SBP ‘chirper’; chirp	176-191	145-160	3-5	51-80
Reson Seabat 7111	MBES; tone burst	197-233	152-197	100	~160

[35] It should be noted that airgun (including VSP) and sub-bottom profiling site surveys undertaken in relation to licences issued under the *Petroleum Act 1998* require consent under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), but side-scan sonar and multibeam echosounder surveys only require to be notified to the Regulator (JNCC 2017a).

Source tested	Category; signal type	Source levels at maximum power tested (dB re 1µPa@1m)[1] SPLpeak-peak	SEL	Approximate frequency of dominant energy (kHz)	-3dB beam width (degrees); across track
EdgeTech 4200	Side-scan sonar; tone burst	206-216	165-205	100 or 400	~50 (1.6-2.6 along track)

Notes: [1.] Values represent minimum and maximum according to different source configurations (e.g. power level, pulse width, or centre frequency); maximum values typically correspond to the highest power level tested. SBP = sub-bottom profiler; MBES = multibeam echosounder; SPL = Sound Pressure Level; SEL = Sound Exposure Level. Source: Crocker & Fratantonio (2016).

Despite the caveats on the current open-water test results, it is worth noting some general patterns observed. In all test environments, broadband received levels from all MBES, side-scan sonar and SBP ‘chirper’ or ‘boomer’ devices tested were rapidly attenuated with distance from source, with particularly pronounced fall-off for directional sources when the receiver was outside of the source’s main beam. Acoustic signals from the SBP ‘sparkers’ tested showed slightly greater propagation, as would be expected from the lower-frequency impulsive signals these devices produce. The greatest propagation was generally observed at the deepest test site (100m water depth) from sources generating low frequencies (<10kHz) whilst some of the highest frequency sources (>50kHz) experienced such attenuation that they were only weakly detectable or undetected by recording equipment. While acknowledging that these results require refinement, for all the aforementioned devices broadband sound levels recorded a few hundred metres from the source were approximately an order of magnitude lower than the criteria for permanent or temporary hearing loss (Southall *et al*. 2019). These preliminary results, combined with the calibrated source measurements in test tanks, suggest that SBPs and other electromechanical sources used in high-resolution geophysical surveys have a very low potential for significant disturbance of sensitive marine fauna.

Drilling operations and support vessel traffic are sources of continuous noise (non-impulsive), of a comparable amplitude, dominated by low frequencies and of a lower amplitude than deep geological seismic survey. Sound pressure levels of between 120dB re 1µPa in the frequency range 2-1,400Hz (Todd & White 2012) are probably typical of drilling from a jack-up rig, with slightly higher source levels likely from semi-submersible rigs due to greater rig surface area contact with the water column. In general, support and supply vessels (50-100m) are expected to have broadband source levels in the range 165-180dB re 1µPa@1m, with the majority of energy below 1kHz (OSPAR 2009). Additionally, the use of thrusters for dynamic positioning has been reported to result in increased sound generation (>10dB) when compared to the same vessel in transit (Rutenko & Ushchipovskii 2015).

Encounters with unexploded ordnance (UXO) from past military conflicts or training are possible almost anywhere across the UKCS, however, they are most frequent in the southern North Sea and eastern Irish Sea. If UXO are encountered during exploration activities, there is considerable scope to avoid interaction and the need for disposal by adjusting the well location. To date, clearance of UXO has generally been undertaken by high-order detonation, but this is a source of loud impulsive underwater sound with the potential to cause significant effects on noise sensitive receptors. Alternative “low-order” approaches (e.g. deflagration) which render the UXO safe but without causing it to explode are available, and their use is being encouraged (e.g. see BEIS (2022) and the unexploded ordnance clearance joint position statement[36]).

4.3.2 Potential ecological effects

Potential effects of anthropogenic noise on receptor organisms range widely from masking of biological communication and small behavioural reactions, to chronic disturbance, physiological injury, and mortality. While generally the severity of effects tends to increase with increasing exposure to noise, it is important to draw a distinction between effects from physical (including auditory) injury and those from behavioural disturbance. In addition to direct effects, indirect effects may also occur, for example via effects on prey species, complicating the overall assessment of significant effects. Marine mammals, and in particular the harbour porpoise, are regarded as the most sensitive to underwater noise effects therefore it is considered appropriate to focus on marine mammals when assessing risk from underwater noise; however, high amplitude impulsive noise also potentially presents a risk to fish and diving birds.

Marine mammals

The risk of physical injury (hearing loss) from an activity can be assessed by modelling the propagation of sound from an activity and using threshold criteria corresponding to the sound levels at which permanent hearing loss (permanent threshold shift, PTS) would be expected to occur. For marine mammals, NOAA updated the acoustic thresholds, including alternative frequency-weighting functions (NMFS 2016, 2018) which were adopted as updated criteria thresholds in the peer-reviewed literature (Southall *et al.* 2019). It is recognised that geophysical surveys (primarily 2D and 3D seismic) have the potential to generate sound that exceeds thresholds of injury, but only within a limited range from source (tens to hundreds of metres); for site surveys and VSP, the range from source over which injury may occur will be even smaller. Within this zone, JNCC (2017) guidelines are considered to be sufficient in minimising the risk of injury to marine mammals to negligible levels. Hastie *et al.* (2019) notes application of the criteria thresholds typically assumes that the broad characteristics of a source (impulsive or non-impulsive) remains constant throughout its propagation range. However, a range of impulsive characteristics (e.g. peak pressure, signal duration, rise time and kurtosis) are known to vary with distance from source (Hastie *et al*. 2019, von Benda-Beckmann *et al.* 2022, Guan *et al*. 2022), with Hastie *et al*. (2019) indicating the greatest change within <10km from the source. Given that published thresholds for PTS onset as a result of exposure to impulsive signals are lower than the non-impulsive thresholds in all species groups (Southall *et al*. 2007, 2019), there is the potential that the risk of auditory damage may be overestimated in cases where impulsive signals become non-impulsive with propagation (Hastie *et al.* 2019). Other factors such as duty cycle and the respective recovery periods between signals will also likely influence the risk of hearing damage from repetitive sounds such as from pile driving and seismic surveys (Hastie *et al*. 2019).

With respect to behavioural disturbance of marine mammals, it is more difficult to establish broadly applicable threshold criteria based on exposure alone. This is due, in part, to the challenges encountered in studies of wide-ranging species with complex behaviour but is largely because many behavioural responses are context-specific (e.g. Gomez *et al*. 2016, Harding *et al*. 2019). For compliance with the Habitats Directive, the guidance for the protection of marine European Protected Species from injury and disturbance (JNCC 2010a) recommends that 'disturbance' is interpreted as sustained or chronic disruption of behaviour

[36] Marine environment: unexploded ordnance clearance Joint Position Statement - GOV.UK

scoring five or more in the Southall *et al*. (2007) behavioural response severity scale[37]. This is to highlight that a disturbance offence is unlikely to occur from sporadic changes in behaviour with negligible consequences on vital rates and population effects (i.e. trivial disturbance). While it is possible to envisage how some behavioural effects may ultimately influence vital rates, evidence is currently limited. The focus of field studies has been on measuring displacement and changes in vocalisation with the assumption that these may influence vital rates mainly via a reduction in foraging opportunities. It is noted that Southall *et al*. (2021) proposes a revised framework more focused on expected longer term and ultimately population-level consequences of behavioural responses affecting key vital functions (survival, feeding and reproduction).

Evidence of the effects of seismic surveys on odontocetes and pinnipeds is limited but of note are studies in the Moray Firth observing responses to a 10-day 2D seismic survey in September 2011 (Thompson *et al.* 2013a). The survey exposed a 200km^2 area to noise throughout that period; peak-to-peak source levels generated by the 470 cubic inch airgun array were estimated to be 242-253 dB re 1 μPa at 1m and are therefore representative of the volume of a typical array used in VSP, and larger than that used in rig-site survey. Within 5-10km from the source, received peak-to-peak SPLs were estimated to be between 165 and 172 dB re 1 μPa, with SELs for a single pulse between 145 and 151 dB re 1 μPa^{2}s. A relative decrease in the density of harbour porpoises within 10km of the survey vessel and a relative increase in numbers at distances greater than 10km was reported; however, these effects were short-lived, with porpoise returning to affected areas within 19 hours after cessation of activities. Overall, it was concluded that while short-term disturbance was induced, the survey did not lead to long-term or broad-scale displacement (Thompson *et al*. 2013a). Further acoustic analyses revealed that for those animals which stayed in proximity to the survey, there was a 15% reduction in buzzing activity associated with foraging or social activity; however, a high level of natural variability in the detection of buzzes was noted prior to survey (Pirotta *et al*. 2014). Passive acoustic monitoring provided evidence of short-term behavioural responses also for bottlenose dolphins, but no measurable effect on the number of dolphins using the Moray Forth SAC could be revealed (Thompson *et al*. 2013b). Analysis of ten years of PAM data covering the 2011 seismic survey and pile-driving activities associated with the construction of two offshore windfarms in the Moray Firth in 2017 and 2019 (Fernandez-Betelu *et al.* 2021), revealed potential far-field effects on the coastal bottlenose dolphin population associated with the Moray Firth SAC. Comparing between years, dolphins used Moray Firth inshore areas regularly, albeit the extent of use varied from year to year without any consistent relationship to the impulsive noise generated by offshore activities (which were over 20km (seismic survey), 40km (Moray East) and 50km (Beatrice) from the southern coast). At the smaller temporal scale comparing days in which impulsive noise was present or absent, showed an increase in dolphin detections on the southern coast on days with impulsive noise (whether as a result of an increase in group size or change in vocalisation rate was not possible to determine). This increase was consistent between all three offshore projects suggesting that distant impulsive noise sources may have caused modifications of bottlenose dolphin vocalisations but only over the short term (less than a day).

High frequency sources with central operating frequencies at the upper end of marine mammal hearing ranges or above (e.g. echosounders, side-scan sonar) have been shown to emit energy at lower frequencies audible to most marine mammals (e.g. Risch *et al.* 2017), although at reduced amplitudes and with a small, emitted sound field which is unlikely to cause behavioural effects (Cotter *et al.* 2019). Consideration of the higher frequency signals, typically lower source levels and higher directionality of these and other similar sources has led to the

[37] See Table 4 (p450) of Southall *et al.* (2007) for a full description of response scores.

assumption that these would not propagate far enough for marine species to be negatively affected by received levels (Halvorsen & Heaney 2018). Similar conclusions were drawn by Ruppel *et al.* (2022) as described in the previous section. Pace *et al.* (2021) considered the cumulative exposure from a typical geophysical survey which incorporated vessel noise, sub-bottom profilers (parametric and sparker), MBES, and SSS with USBL positioning, which indicated that TTS thresholds for the SEL were exceeded <10m from the source for all functional hearing groups (Southall *et al.* 2019) other than very-high frequency cetaceans (333m), which was the only group to exceed PTS thresholds, within a range of 7.2m (90% CI of 502.2m and 16.9m respectively). A precautionary approach has been adopted where it is acknowledged that such sources are within the hearing range of marine mammals and therefore could, in a few cases, cause localised short-term impacts on behaviour or temporary displacement of a small number of individuals (Boebel *et al.* 2005).

A conservative assessment of the potential for marine mammal disturbance from seismic surveys will assume that the firing of airguns will affect individuals within 10km of the source (in keeping with the Effective Deterrence Radius (EDR) suggested by SNCBs), resulting in changes in distribution and a reduction of foraging activity, but the effect is short-lived. The Effective Deterrence Radius (EDR) suggested by UK SNCBs as appropriate in assessing geophysical survey disturbance varies by the nature of the device used, and in the case of MBES also water depth, but is between 3 and 5km. The precautionary criterion applied during initial screening (15km from relevant sites) is maintained here to identify the areas applied for to be considered with respect to likely significant effects in this assessment (see Section 5); this is to reflect the degree of uncertainty and the limited direct evidence available and to allow for a greater potential for disturbance when large array sizes are used.

Evidence on harbour porpoise responses to impact piling during wind-farm construction is also relevant since the impulsive character of the sound generated during piling is comparable with that from seismic airguns and for assessing in-combination effects with wind farms currently planned or under construction across the North Sea. Empirical studies during the construction of OWFs in the North and Baltic Seas (Carstensen *et al*. 2006, Tougaard *et al*. 2009, Brandt *et al*. 2011, 2018, Dähne *et al.* 2013) have all observed displacement of harbour porpoises in response to pile-driving. The magnitude of the effect (spatial extent and duration) varied between studies as a function of the many factors including exposure level, duration of piling, use of technical mitigation measures and ecological importance of the area. Nonetheless, from the available evidence it has been concluded that impact piling will displace individual harbour porpoises within an area of approximately 26km radius (BEIS 2022).

Graham *et al.* (2019) investigated harbour porpoise behavioural responses to piling noise using echolocation detectors (C-PODs) and noise recorders during the 10-month foundation installation of a wind farm in the Moray Firth. Each turbine base was secured using four 2.2m diameter steel piles, installed with a typical hammer energy of 600-700kJ. Using an array of acoustic loggers moored between 0.4 and 76.5km from piling locations, acoustic detections of porpoise in the 24 hours following the end of piling events (lasting *ca.* 5 hours) were examined relative to detections during a baseline period 24-48 hours prior to the onset of piling. Harbour porpoise were present within the windfarm construction site throughout the construction period. The probability of response (significantly reduced detections) reduced with increasing distance to piling and as the number of locations piled increased: there was a ≥50% probability of a behavioural response at a distance of 7.4km from piling at the start of construction, reducing to 4.0km midway through construction, and 1.3km at the final piling event. Acoustic Deterrent Devices (ADDs) were used prior to almost all piling events examined. While data for piling without ADD use was limited, thereby reducing the ability to distinguish the effects of different sound sources, the study results suggest that response levels were increased with ADD use.

Thompson *et al*. (2020) also reported a strong harbour porpoise behavioural response to ADD mitigation usage prior to piling at Beatrice, noting a 50% chance of response within 21.7km. Interestingly, during the installation of the pin piles at Beatrice, Thompson *et al.* (2020), recorded, contrary to expectation, the highest received noise levels at lower hammer energies during the soft-start period. The authors noted that pin piles of between 35 and 45m were driven to within 2m of the seabed using a submersible hammer in depths of up to 45m. Thus, during soft starts, the entire pile could be within the water column, while at the highest hammer energies, most of the pile was embedded in the sediment. It was suggested that with respect to the installation of pin-pile jackets at deeper offshore windfarm sites, regulators consider limiting initial hammer energies and encourage the use of installation systems that best minimise these.

Graham *et al*. (2023) used a linear array of hydrophone clusters within the Moray East offshore wind farm to determine whether harbour porpoise responded to ADD usage by moving away. During baseline periods, porpoise movements were evenly distributed in all directions. However, animals showed significant directional movement away from sound sources during ADD use and piling soft starts. Evasive responses were reported at distances of up to 7km during ADD use and 9km (the maximum distance between hydrophone clusters and the construction site) during the piling soft start. Alternative acoustic porpoise deterrents (APD) developed to reduce the scale of disturbance produced by traditional ADDs have been tested with Voß *et al*. (2023), reporting a 30-100% decrease in harbour porpoise detection rates at 750m distance during APD operation compared to 6 hours before APD operation. Significantly, reduced detection rates during APD operation were only observed up to about 2.5 km distance. See also recent JNCC review of ADD usage for marine mammal mitigation (McGarry *et al.* 2022).

Graham *et al*. (2019) provided evidence that the probability of harbour porpoise behavioural responses to piling was low at distances >10km and unlikely to exceed 20km and diminished over time. SNCB advice (e.g. JNCC 2025) assumes a distance of 20km as the zone of disturbance for pile-driving without noise abatement, or 11km with noise abatement of ≥10dB, and for conductor piling assumes an EDR of 5km. In view of the typical pile diameters and hammer energies used in conductor piling, the 15km noise effects criterion applied in this screening is considered to be suitably precautionary for harbour porpoise.

At the Danish Horns Rev wind farm, satellite telemetry showed that harbour seals were still transiting the site during periods of piling, but no conclusive results could be obtained from analysis of habitat use with regard to a change in response to piling (Tougaard *et al*. 2006). Evidence of a response was obtained by Edrén *et al.* (2010) at a haul-out site 4km away from the Danish Nysted windfarm; during piling, numbers hauling out were reduced by 10-60% but the effect was only of short duration since the overall number of seals increased slightly during the whole construction phase. Russell *et al*. (2016) used telemetry data from 23 harbour seals to investigate potential avoidance of seals to the construction of the Lincs wind farm in The Wash off the east coast of England, including pile-driving of mono-pile foundations. While there was no significant displacement during construction as a whole, seal abundance during piling was significantly reduced up to 25km from the piling activity, with a 19-83% (95% confidence intervals) reduction in usage compared to breaks in piling activity. This displacement was shown to be temporary, with seals returning to their non-piling distribution within two hours of the cessation of piling.

Information on the potential effects of other geophysical surveys (e.g. sub-bottom profilers) is limited, with empirical studies of animal responses to such surveys lacking. Recent laboratory and field studies of the source levels and propagation of a variety of high-resolution geophysical survey sources (see Section 4.5.1) provided evidence to support the conclusion of negligible risk of significant effects from electromagnetic sources, with received levels dropping to below that which might be expected to cause behavioural disturbance within a few hundred metres of the source (Halvorsen & Heaney 2018, Pace *et al.* 2022).

With regard to conductor piling, the low hammer energy, narrow diameter of pipes and short duration of piling, combined with field measurements of sound propagation from this activity (Jiang *et al*. 2015, MacGillivray 2018), and the behavioural responses reported in Graham *et al*. (2019), suggest a very low potential for significant disturbance of marine mammals.

Noise from vessels and drilling activity is audible to marine mammals but are not of the characteristics sufficient to cause injury. Vessel noise may elicit low-level disturbance effects in marine mammals (e.g. changes in vocalisation rates and dive behaviour)[38]; however, such effects are temporary, of limited spatial extent. Benhemma-Le Gall *et al*. (2021) noted with respect to offshore wind farms, that whilst pile-driving produced the highest amplitude noise, active piling occurred for <10% of the time in the 9–10-month piling phases at Beatrice and Moray East. It was noted that whilst responses to these short but intense periods of impulsive noise sources were of greater magnitude, harbour porpoise occurrence and buzzing activity also decreased in response to more chronic exposure to vessel traffic throughout construction. The probability of detecting porpoises and buzzing activity was positively related to the distance from vessel and construction activities and negatively related to levels of vessel intensity and background noise with displacement observed at up to 12km from pile-driving activities and up to 4km from construction vessels.

Fish

Many species of fish are highly sensitive to sound and vibration, and broadly applicable sound exposure criteria have recently been published (Popper *et al.* 2014). Studies investigating fish mortality and organ damage from noise generated during seismic surveys are very limited and results are highly variable, from no effect to long-term auditory damage (reviewed in Popper *et al.* 2014). Slabbekoorn *et al*. (2019) note that there are few good case-studies in the peer-reviewed literature that report on the impact of a seismic survey on the behavioural response of free-ranging fish or the direct impact on local fisheries. Behavioural responses and effects on fishing success ("catchability") have been reported following seismic surveys (Pearson *et al.* 1992, Skalski *et al.* 1992, Engås *et al.* 1996, Wardle *et al*. 2001, Bruce *et al.* 2018). Potential effects on migratory diadromous fish is an area of significant interest for which empirical evidence is still limited, especially as salmonids and eels are sensitive to particle motion (not sound pressure) (Gill & Bartlett 2010). Atlantic salmon *Salmo salar* have been shown through physiological studies to respond to low frequency sounds (below 380Hz), with best hearing at 160Hz (threshold 95 dB re 1 μPa). Harding *et al.* (2016) note a lower sensitivity at 100Hz than previously reported (Hawkins & Johnstone 1978), and greater sensitivity at frequencies of >200Hz, with evidence of some response at 400-800Hz. However, the authors qualify their results with differences in methodological approach, and the use of fish maintained in tanks receiving low frequency ambient sound within the greatest range of sensitivity (<300Hz) for some time in advance of the experiments taking place. The ability of salmon to respond to sound pressure is regarded as relatively poor with a narrow frequency span, a limited ability to discriminate between sounds, and a low overall sensitivity relative to other fish species (Hawkins & Johnstone 1978, cited by Gill & Bartlett 2010, Harding *et al.* 2016). The Mickle *et al*. (2018) study of the hearing ability of sea lamprey (*Petromyzon marinus*) reported that,

[38] Note that in studies of animals in the wild it is difficult to determine the relative contribution of noise and physical presence of vessels in the observed responses, with the latter discussed in Section 4.4.6.

consistent with fish lacking a swim bladder, sea lamprey showed a limited sensitivity to sound, with juveniles detecting tones of 50-300Hz, but not higher frequencies

In addition to considering direct effects on fish as qualifying features of national network sites, fish also form important prey items of seabird, marine mammal and fish qualifying features. Fish species of known importance to both diving seabirds and marine mammals in the North Sea include sandeels, pelagic species such as herring and sprat, and young gadoids. Sandeels lack a swim bladder, which is considered to be responsible for their observed low sensitivity to underwater noise (Suga *et al*. 2005) and minor, short-term responses to exposure to seismic survey noise (Hassel *et al*. 2004), although data are limited. By contrast, herring are considered hearing specialists, detecting a broader frequency range than many species. Sprat are assumed to have similar sensitivities to herring due to their comparable morphology, although studies on this species are lacking. Observed responses of herring to underwater noise vary. For example, Peña *et al*. (2013) did not observe any changes in swimming speed, direction, or school size as a 3D seismic vessel slowly approached schools of feeding herring from a distance of 27km to 2km; conversely, Slotte *et al*. (2004) observed herring and other mesopelagic fish to be distributed at greater depth during periods of seismic shooting than non-shooting, and a reduced density within the survey area. Evidence for and against avoidance of approaching vessels by herring has been reported (e.g. Skaret *et al*. 2005, Vabø *et al*. 2002), with the nature of responses believed to be related to the activity of the school at the time. The effect of a seismic survey on the movement behaviour of free-swimming cod in the southern North Sea was investigated by van der Knaap *et al*. (2021). During the experimental survey, tagged cod decreased their activity, with time spent being ‘‘locally active’’ (moving small distances, showing high body acceleration) becoming shorter, and time spent being ‘‘inactive’’ (moving small distances, having low body acceleration) becoming longer. Additionally, diurnal activity cycles were disrupted with lower locally active peaks at dusk and dawn, periods when cod are known to actively feed.

Following a review of relevant studies, MMS (2004) consider that the “consensus is that seismic airgun shooting can result in reduced trawl and longline catch of several species when the animals receive levels as low as 160dB”. These reduced catches are temporary in nature and likely reflect temporary displacement and/or altered feeding behaviour. No associations of lower-intensity, continuous drilling noise and fishing success have been demonstrated, and large numbers of fish are typically observed around producing installations in the North Sea (e.g. Løkkeborg *et al*. 2002, Fujii 2015) and elsewhere (e.g. Stanley & Wilson 1991).

Diving birds

Direct effects from seismic exploration noise on diving birds could potentially occur through physical damage, or through disturbance of normal behaviour, although evidence for such effects is very limited. Unlike other receptor groups, no dedicated reviews on the effects of noise on diving birds have been undertaken; distillations of available evidence can be found in Hartley Anderson Limited (2020), U.S. Department of the Navy (2020) and the DOSITS website[39]. The exposure of shallow plunge-diving or surface-dipping aquatic birds to underwater noise is likely to be negligible due to the very short period of time they spend underwater (U.S. Department of the Navy 2020). Deeper-diving species which spend longer periods of time underwater (e.g. auks) may be most at risk of exposure to high-intensity noise from seismic survey and consequent injury or disturbance, but all species which routinely submerge in pursuit of prey and benthic feeding opportunities (i.e. excluding shallow plunge feeders) may be exposed to anthropogenic noise. A full list of relevant species occurring in the

[39] https://dosits.org/animals/sound-reception/how-do-aquatic-birds-hear/

UK is provided in Box 4.1, all of which are qualifying species of one or more relevant sites considered in this HRA (see Appendix A).

Very high amplitude low frequency underwater noise may result in acute trauma to diving seabirds, with several studies reporting mortality of diving birds in close proximity (i.e. tens of metres) to underwater explosions (Yelverton *et al*. 1973, Cooper 1982, Stemp 1985, Danil & St Leger 2011). However, mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere. While seabird responses to approaching vessels are highly variable, flushing disturbance would be expected to displace most diving seabirds from close proximity to seismic airgun arrays, particularly among species more sensitive to visual disturbance such as scoter, divers and cormorant (Garthe & Hüppop 2004, Fliessbach *et al*. 2019). Therefore, the potential for acute trauma to diving birds from seismic survey is considered to be very low.

Data relating to the potential behavioural disturbance of diving birds due to underwater noise are very limited. The reported in-air hearing sensitivity for a range of diving duck species, red-throated diver and gannet have been tested for tone bursts between frequencies of 0.5-5.7kHz; results revealed a common region of greatest sensitivity from 1-3kHz, with a sharp reduction in sensitivity >4kHz (Crowell e*t al.* 2015). Similar results were observed for African penguin; tests of in-air hearing showed a region of best sensitivity of 0.6-4kHz, consistent with the vocalisations of this species (Wever *et al*. 1969). Testing on the long-tailed duck underwater showed reliable responses to high intensity stimuli (> 117 dB re 1µPa) from 0.5-2.9kHz (Crowell 2014). An underwater hearing threshold for cormorant of 70-75 dB re 1µPa rms for tones at tested frequencies of 1-4kHz has been suggested (Hansen *et al*. 2017). The authors argue that this underwater hearing sensitivity, which is broadly comparable to that of seals and small odontocetes at 1-4kHz, is suggestive of the use of auditory cues for foraging and/or orientation and that cormorant, and possibly other species which perform long dives, are sensitive to underwater sound. The use of acoustic pingers mounted on the corkline of a gillnet in a salmon fishery, emitting regular impulses of sound at *ca.* 2kHz, was associated with a significant reduction in entanglements of guillemot, but not rhinoceros auklet (Melvin *et al*. 1999). In a playback experiment on wild African penguins, birds showed strong avoidance behaviour (interpreted as an antipredator response) when exposed to killer whale vocalisations and sweep frequency pulses, both focussed between 0.5-3kHz (Frost *et al*. 1975).

Box 4.1: Migratory and/or Annex I diving bird species occurring in the UK considered potentially vulnerable to underwater noise effects

Divers and grebes	**Diving ducks**
Great northern diver *Gavia immer*	Pochard *Aythya ferina*
Red-throated diver *Gavia stellata*	Tufted duck *Aythya fuligula*
Black-throated diver *Gavia arctica*	Scaup *Aythya marila*
Little grebe *Tachybaptus ruficollis*	Eider *Somateria mollissima*
Great crested grebe *Podiceps cristatus*	Long-tailed duck *Clangula hyemalis*
Slavonian grebe *Podiceps auritus*	Common scoter *Melanitta nigra*
Seabirds	Velvet scoter *Melanitta fusca*
Manx shearwater *Puffinus puffinus*	Goldeneye *Bucephala clangula*
Gannet *Morus bassanus*	Red-breasted merganser *Mergus serrator*
Cormorant *Phalacrocorax carbo*	Goosander *Mergus merganser*
Shag *Gulosus aristotelis*	
Guillemot *Uria aalge*	
Razorbill *Alca torda*	
Puffin *Fratercula arctica*	

Note: Includes species which are known to engage in pursuit diving or benthic feeding in marine, coastal and estuarine waters at least during part of the year.

McCauley (1994) inferred from vocalisation ranges that the threshold of perception for low frequency seismic noise in some species (e.g. penguins, considered as a possible proxy for auk species) would be high, hence individuals might be adversely affected only in close proximity to the source. A study investigated seabird abundance in Hudson Strait (Atlantic seaboard of Canada) during seismic surveys over three years (Stemp 1985). Comparing periods of shooting and non-shooting, no significant difference was observed in abundance of fulmar, kittiwake and thick-billed murre (Brünnich's guillemot). More recently, Pichegru *et al*. (2017) used telemetry data from breeding African penguins to document a shift in foraging distribution concurrent with a 2D seismic survey off South Africa. Pre/post shooting, areas of highest use (indicated by the 50% kernel density distribution) bordered the closest boundary of the seismic survey; during shooting, their distribution shifted away from the survey area, with areas of higher use at least 15km distant to the closest survey line. However, insufficient information was provided on the spatio-temporal distribution of seismic shooting or penguin distribution to determine an accurate displacement distance. It was reported that penguins quickly reverted to normal foraging behaviour after cessation of seismic activities, suggesting a relatively short-term influence of seismic activity on these birds' behaviour and/or that of their prey (Pichegru *et al*. 2017).

These data are limited, but the observed regions of greatest hearing sensitivity for cormorants in water and other diving birds in air are above those low frequencies (i.e. <500Hz) which dominate and propagate most widely from geological survey. While there is some evidence of noise-induced changes in the distribution and behaviour of diving birds in response to impulsive underwater noise, these have been temporary and may be a direct disturbance or reflect a change in prey distribution during that period (possibly as a result of seismic activities).

5 Assessment

The screening process (DESNZ 2026) identified a number of sites where there was the potential for likely significant underwater noise, physical disturbance and/or drilling effects associated with proposed activities that could follow licensing of the areas offered in the 2nd Carbon Dioxide Storage Licensing Round. Further assessment of those areas applied for (see Section 1.2) is documented below. This assessment has been informed by the evidence base on the environmental effects of the types of activities associated with carbon dioxide exploration/appraisal (Sections 4.2 and 4.3), and the assumed nature and scale of potential activities (Table 2.2). Because of the wide distribution of the areas applied for around the UKCS, the AA has been presented in two regional sections as follows:

- Southern North Sea (Section 5.1)
- English Channel (Section 5.2)

Each regional section contains sub-sections documenting the assessment of underwater noise and physical disturbance and/or drilling effects. In-combination effects are addressed in Section 6.

Figure 5.1: SACs and areas to be subject to further assessment for physical disturbance and drilling effects

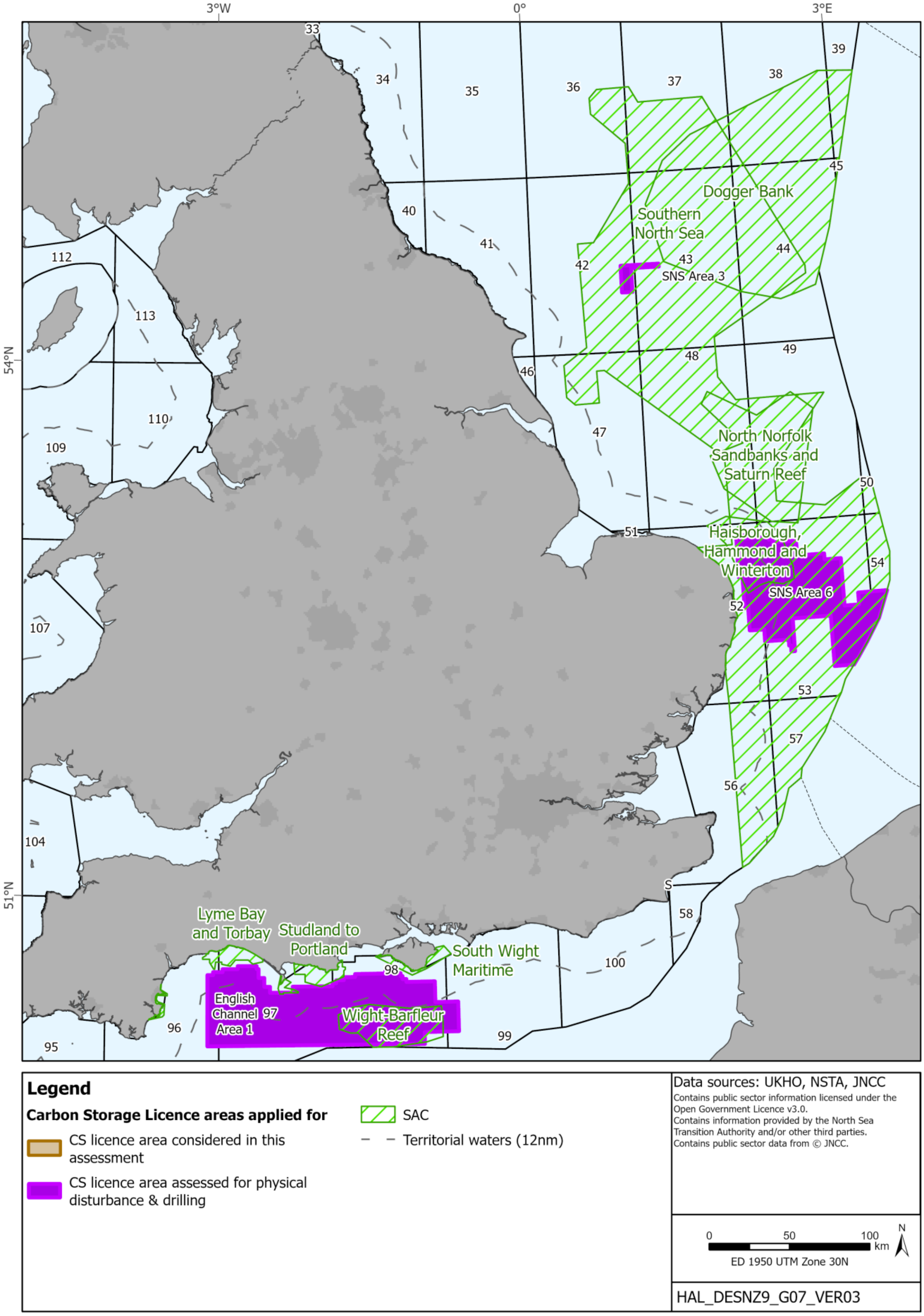


Figure 5.2: SPAs and Ramsar sites, and areas to be subject to further assessment for physical disturbance and drilling effects

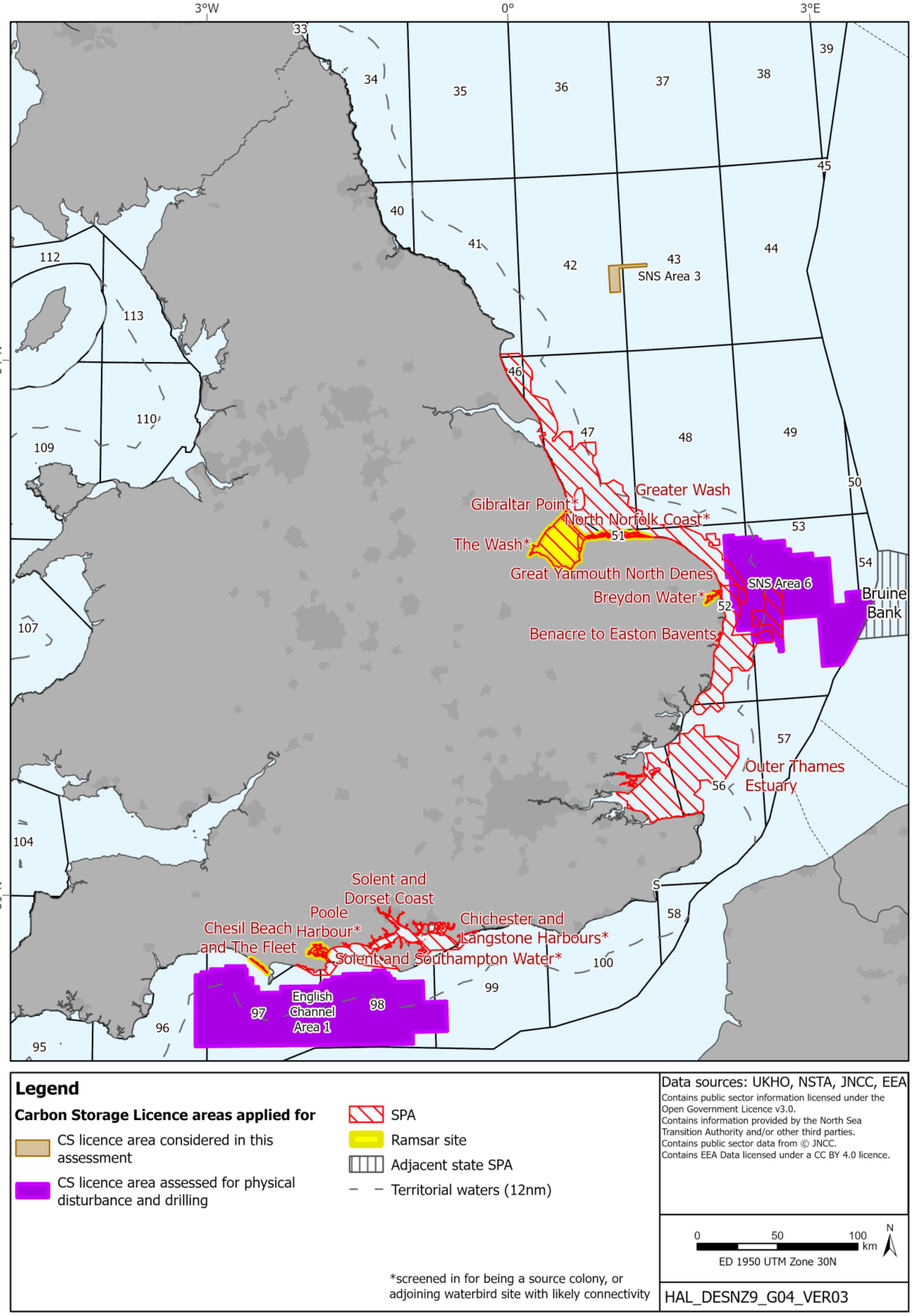


Figure 5.3: SACs and areas to be subject to further assessment for underwater noise effects

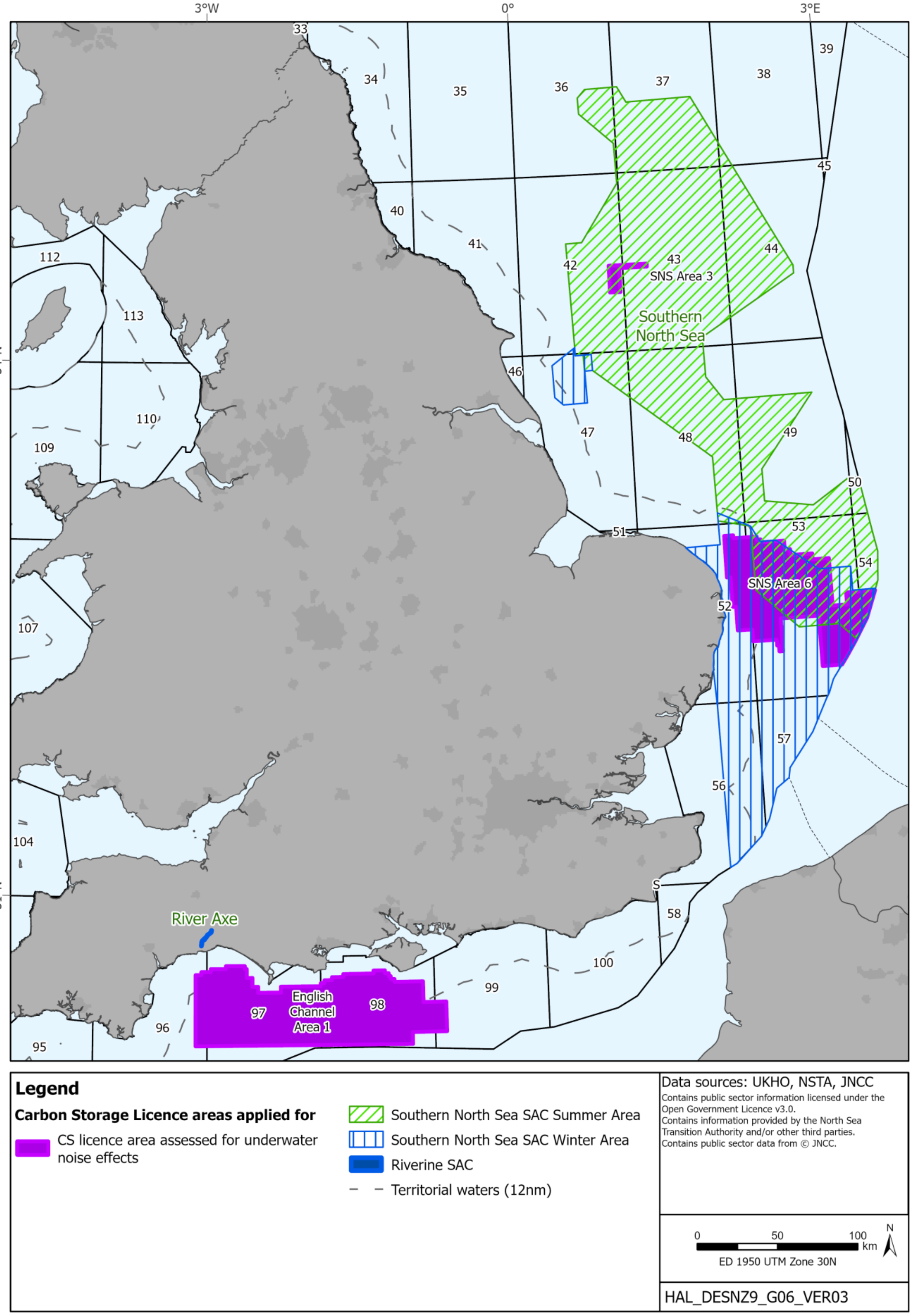
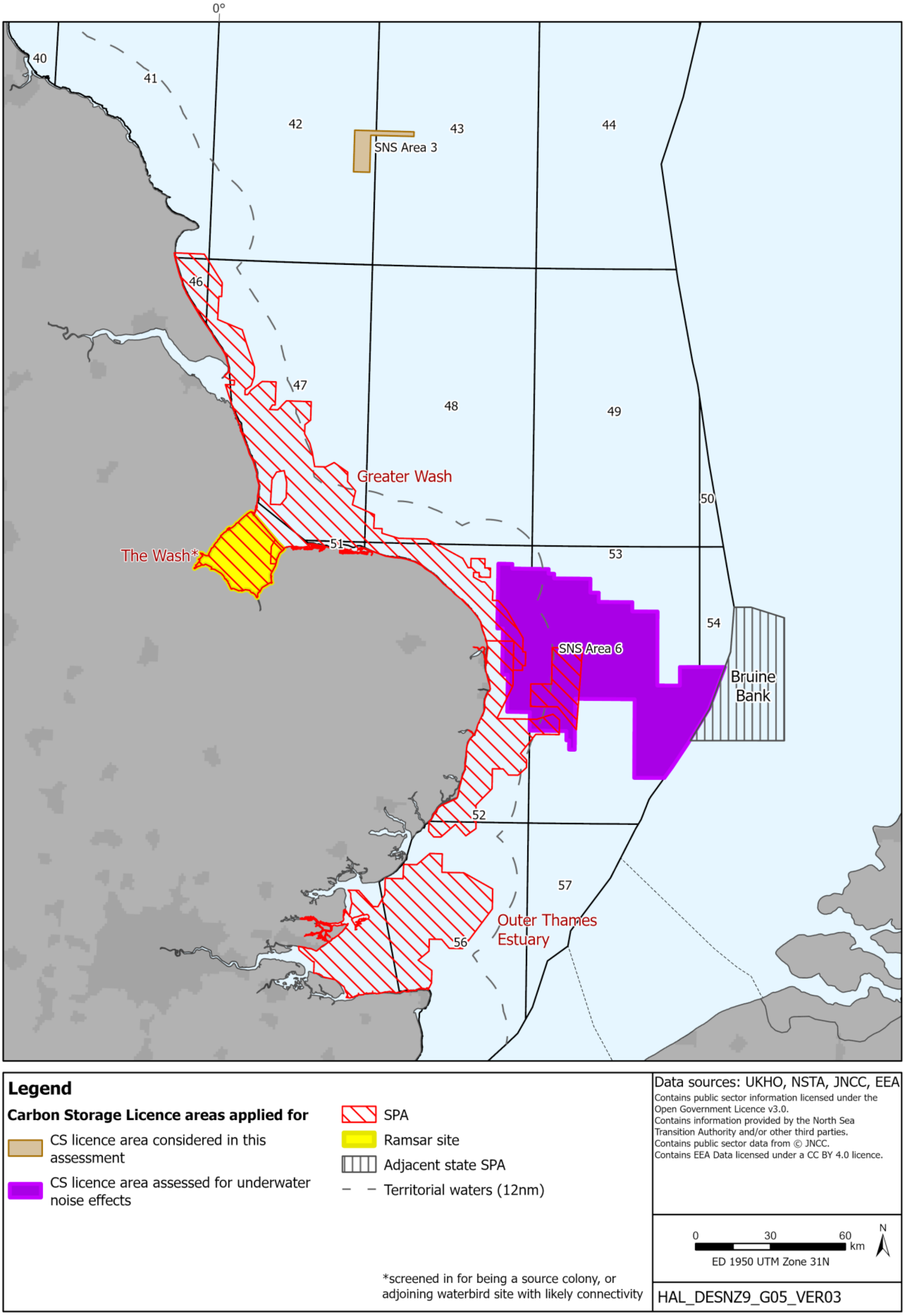


Figure 5.4: SPAs and Ramsar sites, and areas to be subject to further assessment for underwater noise effects



5.1 Southern North Sea

5.1.1 Relevant sites

Southern North Sea SAC

The Southern North Sea SAC is an area with predicted persistent high densities of harbour porpoise. Individuals in the UK are part of the north east Atlantic population which is mainly considered to be a single 'continuous' population, even though some degree of genetic differentiation has been observed (Andersen *et al.* 1997, 2001, Tolley *et al.* 2001, Fontaine *et al.* 2007). From a management and conservation perspective however, three distinct UK Management Units (MU) have been identified; the North Sea, West Scotland and the Celtic & Irish Seas (IAMMWG 2022). The Southern North Sea SAC supports an estimated 17.5% of the UK North Sea Management Unit (MU) population. It was selected primarily on the basis of preferential and prolonged use by harbour porpoises in contrast to other areas of the North Sea, but variability in numbers within the site and across the North Sea (seasonally and between years) is known to be high. Approximately two thirds of the site, the northern part, is recognised as important for porpoises during the summer season, whilst the southern part supports persistently higher densities during the winter (see Figure 5.3). A large southerly shift in distribution was reported across the North Sea between 1994 and 2005 when SCANS and SCANS-II surveys took place (Hammond *et al*. 2013). As part of the site identification process, analysis of the observed density of harbour porpoise against different environmental variables (Heinänen & Skov 2015) indicated that the coarseness of the seabed sediment was an important determinant of porpoise density, with porpoises showing a preference for coarser sediments (such as sand/gravel) rather than fine sediments (e.g. mud). Sandeels, which are known prey for harbour porpoises, exhibit a strong association with sandy substrates. The majority of the substrate types within the site are categorised as sublittoral sand and sublittoral coarse sediment. Moderate energy levels at the seabed (including wave and tidal energy) are estimated across the majority of the site[40]. The conservation objectives[41] indicate that the concept of 'site population' may not be appropriate for this species. It highlights the need to assess impacts on the site based on how the proposed activities translate into effects on the relevant MU population. In the case of this AA, it refers to the North Sea MU ranging from the east coast of the UK to part of Denmark (Skagerrak and northern Kattegat). The abundance of harbour porpoise for the North Sea MU was estimated in 2016 (Hammond *et al.* 2021) as part of SCANS-III (369,560, CV = 0.22), which is similar to the 2005 estimate (335,000 CV = 0.22); the most recent estimate (IAMMWG 2022, 2023) is 364,601 (CV = 0.09).

Dogger Bank SAC

The Dogger Bank SAC was formed by glacial processes before being submerged through sea level rise during the last marine transgression (by *ca*. 8,000 years BP). The southern part of the bank is covered by water seldom deeper than 20m and extends within the SAC in UK waters down to 35-40m deep. The bank structure slopes down to greater than 50m deep in UK, Dutch and German waters and its location in open sea exposes the bank to substantial wave energy preventing the colonisation of the sand by vegetation on the shallower parts of

[40] https://hub.jncc.gov.uk/assets/206f2222-5c2b-4312-99ba-d59dfd1dec1d#SouthernNorthSea-SAC-selection-assessment-document.pdf
[41] https://hub.jncc.gov.uk/assets/206f2222-5c2b-4312-99ba-d59dfd1dec1d#SouthernNorthSea-conservation-advice.pdf

the bank. Large parts of the Dogger Bank are situated above the storm-wave base (Connor *et al.* 2006), and it is estimated that during a storm event, sediment up to medium sand particles can be mobilised in 60m water depth at the northern slope of the Dogger Bank (Klein *et al*. 1999). Models of natural disturbance have estimated that the Dogger Bank is disturbed to 4cm depth at least once every year by tides and waves (Diesing *et al*. 2013). The majority of sediments present across the Dogger Bank consist of fine sands with mud content below 5% (JNCC 2011) with sandy gravel in patches mainly concentrated on the western edge of Dogger Bank. There is evidence of small mixed sediment patches near the centre of the site. Coarse sediment patches are widespread, most of which are relatively small, but a few larger patches are notable towards the western and southern edges of the site. There are also a few muddy sediments in the central north area (Eggleton *et al.* 2017). Key and influential species associated with the sandbank feature include a variety of bioturbators, predators and grazers which have been recorded from surveys within the site, such as polychaete worms *(Spiophanes bombyx),* brittle stars *(Amphiura filiformis)*, as well as sea urchins, gastropods, hermit crabs and other unidentified crustaceans (Eggleton *et al*. 2017). The most frequently observed taxonomic groups in the epifauna were Asteroidea *(Asterias rubens, Astropecten irregularis)*, the Cnidarian, *Alcyonium digitatum*, the bryozoan *Flustra* sp. and Paguridae *(Pagurus bernhardus*) although these varied widely with sediment composition (Eggleton *et al*. 2017). Sandeels have been recorded on the western side of the bank (Forewind 2013).

The condition of the Annex I sandbank feature for which the site is designated is considered to be unfavourable (Eggleton *et al.* 2017), such that the SACO for the Dogger Bank SAC[42] advises that the site feature extent and distribution, and structure and function should be restored, while supporting processes be maintained. The MMO introduced The Dogger Bank Special Area of Conservation (Specified Area) Bottom Towed Fishing Gear Byelaw 2022 which came into effect in June 2022. The byelaw effectively prohibits the use of use of all bottom towed fishing gear across the Dogger Bank.

North Norfolk Sandbanks and Saturn Reef SAC

The North Norfolk Sandbanks and Saturn Reef SAC contains the most extensive example of offshore linear ridge sandbanks in UK waters and encompasses an area where previous seabed surveys identified an extensive biogenic reef created by the ross worm *Sabellaria spinulosa*, called Saturn reef (Jenkins *et al*. 2015). The sandbanks are subject to a range of current strengths which are strongest on the banks closest to shore and are dominated by sandy sediments (see Parry *et al.* 2015). Whilst the sandbanks are very similar in terms of the biological communities present, increasing species numbers have been recorded on the outermost banks, likely related to the change in hydrodynamic regime with increasing distance from the coast[43]. First discovered in 2002, the Saturn reef covered an area approximately 750m by 500m just to the south of Swarte Bank. More recent surveys failed to identify the extensive areas of *S. spinulosa* reef previously observed but did find reefs in the area which highlights the ephemeral nature of the feature and indicates that favourable conditions for *S. spinulosa* formation occur within the site (see JNCC website and Jenkins *et al*. 2015). The reef and sandbank features of the site are considered to be in unfavourable condition, being subject to a range of pressures including those from demersal fishing, aggregate extraction, and offshore energy related activity. The site is subject to significant fisheries pressures, which the MMO concluded were likely to have an adverse effect on site integrity. The MMO are presently considering the need for, and nature of, any fisheries management measures for the site[44]. The unfavourable status of the site, and the setting of restore objectives for the site, is

[42] https://hub.jncc.gov.uk/assets/26659f8d-271e-403d-8a6b-300defcabcb1#DoggerBank-3-SACO-v1.0.pdf
[43] http://jncc.defra.gov.uk/page-6537
[44] https://www.gov.uk/government/publications/managing-fisheries-in-marine-protection-areas-call-for-evidence

based on expert judgement[45], relating the sensitivity of the features to the prevailing nature of activities affecting the site. While monitoring surveys have been undertaken for the site, their related reports (McIlwaine *et al.* 2017, Eggleton *et al.* 2020) do not make any judgement of feature condition but may inform a consideration of the status of the site features in the future by representing an initial point in a monitoring time series[46].

Haisborough, Hammond and Winterton SAC

The Haisborough, Hammond and Winterton SAC contains a series of sandbanks that run parallel to the coast. The sandy sediments within the site are very mobile in the strong tidal currents of the area, and though large-scale bank migration or movement appears to be slow, there is a level of sediment movement around and across the banks evidenced by megaripple and sandwave formations. Infaunal communities of the sandy bank tops are consequently of low biodiversity, characterised by mobile polychaetes and amphipods which are able to rapidly re-bury themselves into the dynamic sediment environments. Along the flanks of the banks, and towards the troughs between the banks the sediments tend to be slightly more stable with gravels exposed in areas. In these regions of the site, infaunal and epifaunal communities are much more diverse. *Sabellaria spinulosa* reefs are located at Haisborough Tail, Haisborough Gat and between Winterton Ridge and Hewett Ridge and arise from the surrounding coarse sandy seabed to heights of between 5cm to 10cm. The site is subject to significant fisheries pressures, which the MMO has concluded are likely to have an adverse effect on site integrity. Some parts of the site in territorial waters are subject to fisheries bylaws that prevent the use of bottom-towed fishing gear, however, offshore areas are not subject to measures but are subject to demersal fisheries pressures. The MMO are presently considering whether fisheries management measures in the offshore area of the site would be appropriate[47]. The unfavourable status of the site, and the setting of restore objectives for the site, is based on expert judgement, relating the sensitivity of the features to the prevailing nature of activities affecting the site. While monitoring surveys have been undertaken of the site, their related reports (McIlwaine *et al.* 2017, Eggleton *et al.* 2020) do not make any judgement of feature condition but may inform a consideration of the status of the site features in the future by representing an initial point in a monitoring time series.

Greater Wash SPA

The Greater Wash SPA extends from Bridlington Bay in the north, to the boundary of the Outer Thames Estuary SPA in the south. In the northernmost section of the site, off the Holderness coast, seabed habitats primarily comprise coarse sediments, with occasional areas of sand, mud and mixed sediments. The inshore environment is highly dynamic, with large volumes of material being eroded from the shoreline and seabed and transported southwards. Water depth is generally shallow, reaching up to 20m towards the offshore boundary. Subtidal sandbanks occur at the mouth of the Humber Estuary, primarily comprising sand and coarse sediments. The site is classified for the protection of red-throated diver, common scoter, and little gull during the non-breeding season, and for breeding sandwich tern, common tern and little tern. The seaward boundary is defined by the area of importance to red-throated diver, and by the foraging area of sandwich terns off the north Norfolk Coast. Red-throated divers are distributed throughout the SPA with 1,511 individuals or 8.9% of the GB wintering population estimated to be present within the site. Higher densities of birds were recorded close inshore, particularly in the area outside The Wash SPA, north of the Humber Estuary, along the eastern part of North Norfolk Coast and in the south of the site where it abuts the

[45] https://hub.jncc.gov.uk/assets/d4c43bd4-a38d-439e-a93f-95d29636cb17#NNSSR-3-SACO-v1.0.pdf
[46] https://jncc.gov.uk/our-work/north-norfolk-sandbanks-and-saturn-reef-mpa/
[47] https://www.gov.uk/government/publications/managing-fisheries-in-marine-protection-areas-call-for-evidence

Outer Thames Estuary SPA (Lawson *et al.* 2015c). Highest densities of common scoter were observed in the area outside The Wash SPA and along the North Norfolk Coast SPA[48].

The Wash SPA

The Wash SPA is composed of tidal rivers, estuaries, lagoons, mud, and sand flats and in the centre, deep channels surrounded by shallower waters. These areas predominantly consist of saltmarsh, intertidal banks of sand and mud, sandy and shingle beaches, and subtidal sandy sediments. Shallow coastal waters support small fish which are preyed upon by tern species. Intertidal mud and sand flats support a variety of polychaete worms and bivalve molluscs including cockle and mussel beds which alongside algae provide rich foraging grounds for a number of bird species including common scoter and goldeneye. Other relevant diving species which are part of the non-breeding waterbird assemblage include cormorant, eider and little grebe[49].

North Norfolk Coast SPA

The North Norfolk Coast SPA extends 40km along the northern coastline of Norfolk from Holme to Weybourne. Coastal waters within the site are shallow and follow the complex series of harbours and inlets along the coast. These support large populations of small fish including sand eel and sprat which provide vital food for breeding tern populations upon which breeding success depends. In summer, the site and its surroundings are important for breeding populations of waders, four species of tern, bittern and wetland raptors including the marsh harrier. In winter, the site becomes important for large numbers of geese, sea-ducks, other ducks, and waders using the site for roosting and feeding[50], with common scoter a component of the waterfowl assemblage[51]. Some species, such as the breeding terns and overwintering common scoter feed in coastal waters outside but adjacent to the SPA and are included as qualifying features of the Greater Wash SPA. The site is of also important to migrating birds in the spring and autumn passage periods[52].

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[48] https://consult.defra.gov.uk/natural-england-marine/greater-wash-potential-special-protection-area-com/supporting_documents/V9%20FINAL%20Greater%20Wash%20Departmental%20Brief%2017%20October%202016%20ready%20for%20consultation.pdf

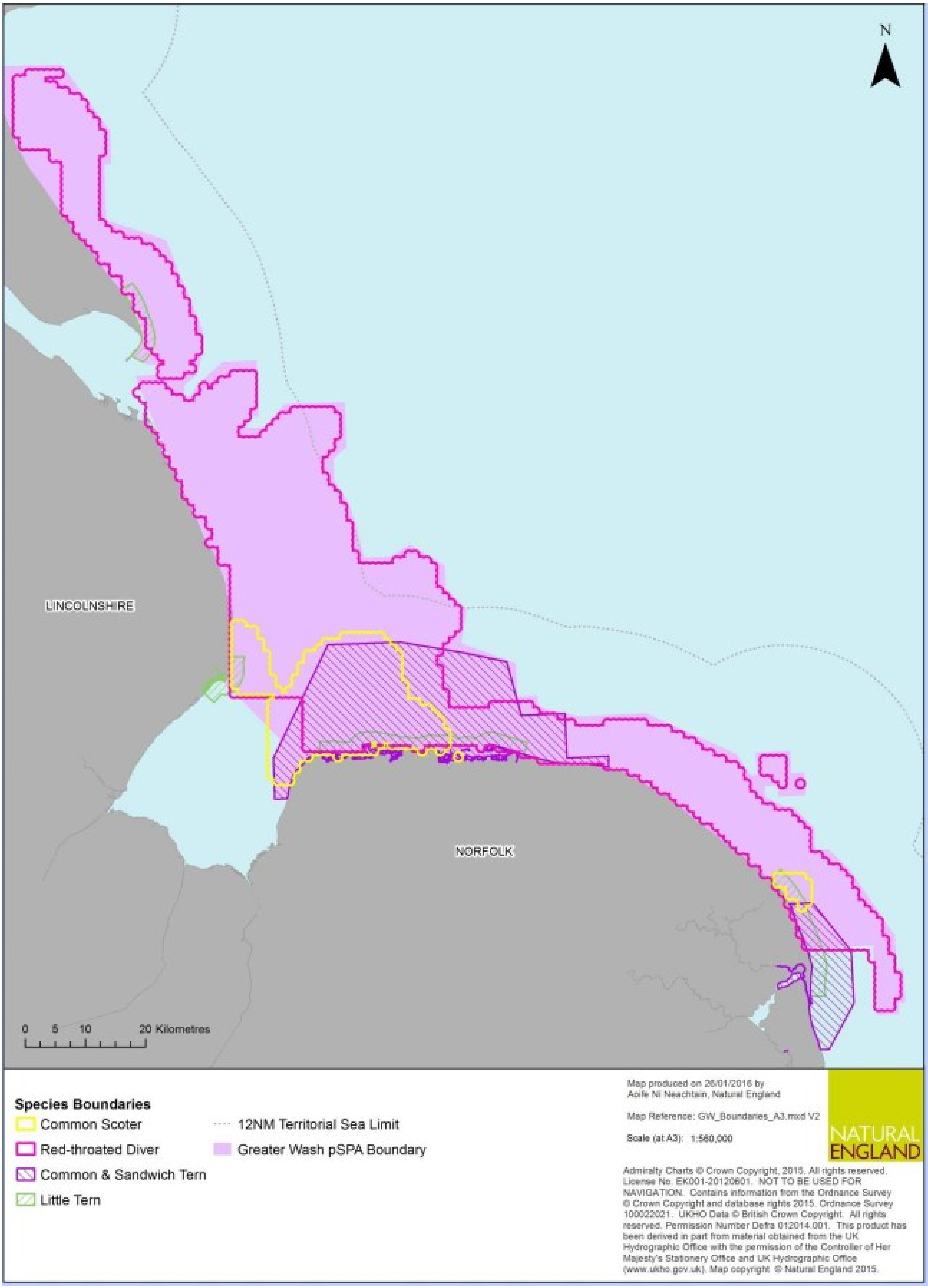
[49] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9008021&SiteName=wash&SiteNameDisplay=The%20Wash%20SPA&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=21&HasCA=1

[50] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9009031&SiteName=north%20norfolk&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&HasCA=1&NumMarineSeasonality=11&SiteNameDisplay=North%20Norfolk%20Coast%20SPA

[51] https://consult.defra.gov.uk/natural-england-marine/greater-wash-potential-special-protection-area-com/supporting_documents/V9%20FINAL%20Greater%20Wash%20Departmental%20Brief%2017%20October%202016%20ready%20for%20consultation.pdf

[52] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9009031&SiteName=north%20norfolk&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&HasCA=1&NumMarineSeasonality=11&SiteNameDisplay=North%20Norfolk%20Coast%20SPA

Figure 5.5: Greater Wash SPA boundary in relation to the Maximum Curvature Analysis boundaries for relevant qualifying species



Source: Natural England & JNCC (2016)

Gibraltar Point SPA[53]

Gibraltar Point is located in Eastern England to the north of The Wash on the Lincolnshire coast. It is adjacent to The Wash SPA and The Wash and North Norfolk Coast SAC and includes an actively accreting sand-dune system as well as saltmarsh and intertidal flats. The coastal waters adjacent to the SPA provide a vital food source for the breeding little tern populations by supporting large populations of small fish. The shingle ridges and beaches in the SPA further support breeding little terns by providing important nesting areas. Additionally, both extensive areas of intertidal mud and sand support high densities of marine invertebrates, such as molluscs, providing a food source for internationally important populations of wading birds. Saltmarsh also provides key feeding and roosting habitats for important bird species within the site.

Great Yarmouth North Denes SPA[54]

The SPA contains two component areas, the Great Yarmouth North Denes actively accreting low dune system and beach, together with the beach and foredune ridge at Winterton-Horsey Dunes. These two component areas are linked, due to the high mobility of little terns, and to the dynamic nature of the beach shapes which influences suitability for breeding. Little tern populations found at Caister, Eccles, Kessingland and Scroby Sands are functionally linked to colonies protected within the Great Yarmouth North Denes SPA.

The site is internationally important for its population of breeding little terns. The Outer Thames Estuary SPA borders Great Yarmouth North Denes SPA and incorporates an offshore sand bank island known as Scroby Sands. This sandbank is ephemeral in nature and was last viable as a tern breeding site in the 1940s, 1950s and 1960s. It then submerged and remained so at low water until 2004, it has remained above water throughout all tides since then. Scroby Sands is now a popular nesting and foraging area for little tern and common tern from neighbouring SPA sites, including Great Yarmouth North Denes SPA and Breydon Water SPA and their functionally linked colonies. Sandwich tern and arctic tern are rare breeders at this site and roseate tern has been identified at the site, but it is not known if they are breeding here. The little tern colonies that had previously bred at North Denes have, in recent years, relocated to Winterton and the Scroby Sands sandbank due to reduction in suitable habitat at North Denes beach and potential changes in food supply immediately. As the beach area re-profiles at North Denes, it is expected that little terns may return to breed, as has already occurred in 2018.

Breydon Water SPA[55]

The site was classified in 1996 with a boundary extension added in 2000 to incorporate Halvergate marshes. Shallow tidal waters provide key feeding and roosting habitat for many of the bird species using this site. The extensive areas of intertidal mudflats at Breydon Water support dense populations of marine invertebrate species, such as *Arenicola*, *Hediste* and Oligochaetes, which in turn provide a food source for large populations of waterbirds (wildfowl and waders). As a result, Breydon Water is a key estuary in the UK for wintering waterfowl. The site supports internationally important wintering populations of Bewick's swan, avocet, golden plover, ruff, and an internationally important breeding population of common tern. The saltmarsh to the north of the river channel at the seaward end of the site is the most important

[53] https://designatedsites.naturalengland.org.uk/ConservationAdvice.aspx?SiteCode=UK9008022
[54] https://designatedsites.naturalengland.org.uk/ConservationAdvice.aspx?SiteCode=UK9009271
[55] https://designatedsites.naturalengland.org.uk/ConservationAdvice.aspx?SiteCode=UK9009181

roosting area at Breydon Water. The upper saltmarsh also provides opportunities for common tern to nest.

Outer Thames Estuary SPA

The Outer Thames Estuary SPA is classified for the protection of wintering red-throated diver, breeding little terns and breeding common terns. The area supports the largest aggregations of wintering red-throated diver in the UK, 38% of the GB population[56]. Red-throated divers occur throughout the entire area, but at greatest density and with greatest frequency off the coast of Suffolk and over sandbanks in the centre of the estuary and those extending toward the coast of south Essex and part of north Kent. To the north, the site is continuous with the Greater Wash SPA and red-throated diver are likely to move between sites (see Greater Wash SPA summary above). The site contains areas of shallow and deeper water, with high tidal current streams and a range of mobile sediments, including several shallow sandbanks. The sandbanks may have a functional role (as nursery, spawning, or feeding grounds or in providing shelter) in supporting prey species of the red-throated diver (small fish such as gadoids, sprat, herring and sandeel; Guse *et al*. 2009)[57]. The seabed in the area of the Norfolk and Suffolk coast is of a similar composition to that in the main Thames estuary with large shallow areas of mud, sand, silt and gravely sediments but, in the absence of main port areas within this area, there is consequently less disturbance through shipping or dredging.

5.1.2 Assessment of physical disturbance and drilling effects

The conservation objectives of relevant sites that could be impacted by physical disturbance and drilling effects, and information relating to site selection and advice on operations have been considered against the activities in the proposed work programmes for the licence areas applied for to determine whether they could adversely affect site integrity. The results are given in Table 5.1 below. All mandatory control requirements (as given in Section 2.3.1) are assumed to be in place as a standard for all activities assessed.

Table 5.1: Consideration of potential physical disturbance and drilling effects and relevant site conservation objectives

Southern North Sea SAC[58]
Site Information
Area (ha/km²): 3,695,054/36,951 **Relevant qualifying features:** Harbour porpoise **Conservation objectives:** To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained, and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise. To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term: • The species is a viable component of the site. • There is no significant disturbance of the species. • The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.
Relevant licence areas with potential for physical disturbance and drilling effects
SNS Area 3, SNS Area 6

56 https://jncc.gov.uk/our-work/outer-thames-estuary-spa/
57 https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK9020309
58 https://jncc.gov.uk/our-work/southern-north-sea-mpa/

Activities associated with the proposed work programmes within the relevant licence areas
Drilling up to two wells involving - siting of rig, drilling discharges
Assessment of effects on site integrity
Rig siting ***(Relevant pressures:*** *No relevant pressures identified[59]. In view of available pressure definitions (e.g. the current JNCC pressures-activity database) and the focus of the Conservation Objectives on addressing pressures that affect site integrity, including significantly damaging relevant habitats, the following pressures are considered: penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed and physical change (to another seabed/sediment type))* The delineation of the Southern North Sea SAC site was based on the prediction of 'harbour porpoise habitat' within the North Sea (Heinänen & Skov 2015). The analysis indicated a preference for water depths between 30 and 50m throughout the year, and in general, the coarseness of the seabed sediment was important, with porpoises showing a preference for coarser sediments (such as sand/gravel)[60]. Physical disturbance or abrasion to surface and subsurface substrates by the placement of spud cans as part of rig installation has the potential to impact the extent of supporting habitat within the site. SNS Areas 3, and SNS Area 6 are wholly within the site. While the former two areas are located in the summer area of the site SNS Area 6 covers parts of the summer and winter areas. The maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2, Table 2.2) compared to the large site (covering 0.002%). Recovery from physical damage in relevant sand/gravel habitats across the relatively shallow and dynamic site (majority of site less than 40m) is expected to be relatively rapid. The small scale and temporary nature of the potential physical damage, and the mobile nature of the qualifying features will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. The requirement for rig stabilisation measures would be determined by site survey of local conditions. In soft sediments, rock placement may cause smothering of existing sediments and a physical change to another seabed type. The majority of the substrate types within the site are categorised as sublittoral sand and sublittoral coarse sediment. It is assumed that rock placement (if required) would be within 500m of the rig and cover an estimated area of 0.001-0.004km^2 per rig siting (Table 2.2). Hence, the potential loss of extent of sandy sediment is small compared to the widespread nature of this sediment type across the very large site (36,958km^2), and there is the potential for alternatives to rock placement (Section 5.1.3). It is concluded that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. **Drilling discharges** ***(Relevant pressures:*** *Contaminants. In view of available pressure definitions and given the focus of the Conservation Objectives on addressing pressures that affect site integrity including significantly damaging relevant habitats, the following pressures are considered: abrasion/disturbance of the substrate on the surface of the seabed; changes in suspended solids (water clarity); smothering and siltation rate changes (light), physical change (to another sediment type) and habitat structure changes – removal of substratum (extraction))* The advice on operations indicates that use of most of the relevant pollutants with respect to harbour porpoise have been effectively phased out by action under the OSPAR Convention and the EU (e.g. PCBs). However, their chemical stability will lead to them remaining in the marine environment for some time and, consequently, human activities such as dredging may cause the re-release of these chemicals into the environment or introduce other contaminants of which the impacts are poorly known. In view of the small scale and temporary nature of drilling discharges and the mandatory controls on drilling chemical use and discharge (Section 2.3.1), site conservation objectives will not be undermined and there will be no adverse effects on site integrity. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). All the areas are wholly within the site and the maximum spatial footprint within which smothering of surface sediments or habitat structure changes may occur (0.8km^2, Table 2.2) is small (representing 0.002% of the total site area) and recovery from smothering in relevant sand/gravel habitats across the relatively shallow and exposed site (majority of site less than 40m) is expected to be rapid. Therefore, site conservation objectives will not be undermined.

59 https://hub.jncc.gov.uk/assets/206f2222-5c2b-4312-99ba-d59dfd1dec1d#SouthernNorthSea-conservation-advice.pdf
60 http://jncc.defra.gov.uk/pdf/SouthernNorthSeaSelectionAssessmentDocument.pdf

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges in the two areas entirely or largely within the site are localised and temporary, and unlikely to overlap between areas applied for either spatially or temporally. The combined spatial footprint within which physical disturbance and drilling effects could occur (within 500m of the rig/well location) across the areas applied for (an improbable worst-case scenario that 2 wells are drilled) is estimated at 1.6km² (<0.01% of the site area). For rig stabilisation, this would be for an area of up to 0.008km² or 0.00002% of the site. The temporary and/or small scale nature of the disturbance, the mobile nature of the qualifying feature and mandatory control measures (Section 2.3.1), and other measures (Section 5.1.3) will ensure that site conservation objectives are not undermined. Section 6.1 provides a consideration of potential activities in-combination with other relevant plans and projects.

Dogger Bank SAC[61]

Site Information

Area (ha/km²): 1,233,115/12,331
Relevant qualifying features: Sandbanks which are slightly covered by sea water all the time.

Conservation objectives:
For the feature to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex 1 sandbanks. This contribution would be achieved by maintaining or restoring, subject to natural change:

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

Attributes and related targets have been set for the site features which are presented in the site SACO[62].

Relevant licence areas with potential for physical disturbance and drilling effects

SNS Area 3

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to one well involving - siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
*(**Relevant pressures:** penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed type) and introduction or spread of non-indigenous species)*

The qualifying feature is sensitive to penetration and/or disturbance of the seabed surface and subsurface[63] by the placement of spud cans as part of rig siting. SNS Area 3 is entirely outside of the site (3km distance), and therefore interaction with the qualifying features will be avoided, noting the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2). The siting of a rig, including any rig stabilisation material, if required, will therefore not result in adverse effects on site integrity, as it will not result in any reduction in the extent and distribution, structure and function, or supporting process of the site.

As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
*(**Relevant pressures:** abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants)*

61 https://jncc.gov.uk/our-work/dogger-bank-mpa/
62 https://hub.jncc.gov.uk/assets/26659f8d-271e-403d-8a6b-300defcabcb1#DoggerBank-3-SACO-v1.0.pdf
63 http://jncc.defra.gov.uk/docs/DoggerBank_AoO_Workbook_v1_0.xlsx

The advice on operations indicates that the qualifying feature is sensitive to the above pressures, most of which relate to seabed disturbance and habitat changes associated with smothering by drill cuttings near the well location, and that these cuttings can accumulate in piles where currents are generally weak. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore, drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitat as SNS Area 3 is 3km from the site. Therefore, site conservation objectives will not be undermined.

The advice on operations indicates that the qualifying feature is not sensitive or there is insufficient evidence on the contamination pressures listed above and described in Section 4.2.3. The SACO indicates that the available evidence of contamination is inconclusive regarding sediment quality within the site. However, the small scale and temporary nature of drilling discharges and the mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1) will ensure that site conservation objectives are not undermined.

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are not considered to be possible as none of the areas applied for are located within the site, or within a distance of it in which physical disturbance and drilling effects could occur (within 500m of the rig/well location). A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1.

North Norfolk Sandbanks and Saturn Reef SAC[64]

Site information

Area (ha/km²): 360,341/3,603
Relevant qualifying features: Sandbanks, reefs

Conservation objectives:
For the features to be in favourable condition thus ensuring site integrity 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

Attributes and related targets have been set for the site features which are presented in the site SACO[65].

Relevant licence areas with potential for physical disturbance and drilling effects

SNS Area 6

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to one well involving - siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
(***Relevant pressures:*** *penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed type) and introduction or spread of invasive non-indigenous species)*

Both the sandbank and reef qualifying features are sensitive to penetration and/or disturbance of the seabed surface and subsurface[66] by the placement of spud cans as part of rig siting. SNS Area 6 is entirely outside of the site boundaries and is least 9km from the site, and therefore interaction with the qualifying features will be avoided, noting the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2). The siting of a rig, including any rig stabilisation material, if required, will therefore not result in adverse effects on site integrity, as it will not result in any reduction in the extent and distribution, structure and function, or supporting process of the site.

[64] https://jncc.gov.uk/our-work/north-norfolk-sandbanks-and-saturn-reef-mpa/
[65] https://hub.jncc.gov.uk/assets/d4c43bd4-a38d-439e-a93f-95d29636cb17#NNSSR-3-SACO-v1.0.pdf
[66] https://hub.jncc.gov.uk/assets/d4c43bd4-a38d-439e-a93f-95d29636cb17#NNSSR-5-AoO-v1.0.xlsx

As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
*(**Relevant pressures:** abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants)*

The sandbank and reef qualifying features are sensitive to abrasion/disturbance of the seabed surface, siltation rate changes including smothering and habitat structure changes, removal of substratum (extraction) pressures associated with drilling discharges. The advice on operations indicates that the qualifying features are not sensitive to the contaminants pressures and physical change (to another sediment type) is not included within the advice. The SACO notes that alteration of surface sediment by drill cuttings may lead to a persistent change in substrate which is not suitable habitat for characterising sandbank communities. However, the impacts from such discharges are localised and transient, and as noted in Section 4.2, such drill cuttings piles do not generally accumulate in shallow, high energy waters, such as in the southern North Sea.

SNS Area 6 is at least 9km away from the site, and at a greater distance than that within which effects from drilling discharges are expected to occur (within 500m of the well location, Table 2.2), such that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are not considered to be possible as none of the areas applied for are located within the site, or within a distance of it in which physical disturbance and drilling effects could occur (within 500m of the rig/well location). A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1.

Haisborough, Hammond and Winterton SAC[67]

Site information

Area (ha/km²): 146,759/1,468
Relevant qualifying features: sandbanks, reefs

Conservation objectives:
The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of the qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of the qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of each of the qualifying species
- The distribution of qualifying species within the site

Attributes and related targets have been set for the site features which are presented in the site SACO[68].

Relevant licence areas with potential for physical disturbance and drilling effects

SNS Area 6

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to one well involving – siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
*(**Relevant pressures:** penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed/sediment type) and introduction or spread of invasive non-indigenous species)*

[67] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030369
[68] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030369

Both the sandbank and reef qualifying features are sensitive to penetration and/or disturbance of the seabed surface and subsurface by the placement of spud cans as part of rig siting. SNS Area 6 has significant areas outside the site boundaries in which a rig may be sited, and therefore, there is considerable potential that physical disturbance effects may be avoided. Should a well be drilled within the site boundaries, the maximum spatial footprint of the penetration and/or disturbance pressure associated with jack-up rig siting is small ($0.8km^2$, see Table 2.2) compared to the large site (covering 0.05%). It is noted that the entirety of both the reef and sandbank features are considered to be in unfavourable condition[69] based on assessments made in 2018 and 2019 respectively, however, recovery of the sandbank feature from physical disturbance of the scale associated with rig placement is expected to be rapid given the dynamic nature of the site. Additionally, further mitigation measures are available for example, rig siting to ensure sensitive seabed surface features are avoided including reef and sandbanks.

Sabellaria spinulosa reef is known to be ephemeral (Jenkins *et al*. 2015, van der Reijden *et al.* 2021), with bedform migration a potential mechanism for their relative transience (van der Reijden *et al.* 2021). Adverse effects on the reef feature of the site are not predicted based on the relatively high burial tolerance of *Sabellaria*, presence in a high energy environment and preference for areas with abundant sediment supply, the short-term (up to 10 weeks) nature of exploration/appraisal activity and the mitigation measures to avoid reef features (which will be required where appropriate). These measures will ensure that impacts do not result in long-term or permanent change to the habitats and that the site conservation objectives are not undermined. While areas of potential larval settlement and reef formation outside existing patches of reef are important for the species, in areas where reef is not currently present, seabed recovery after drilling is expected to be rapid (see above).

There may be a requirement for rig stabilisation depending on local seabed conditions. The sandbanks and reefs features are considered sensitive to physical change to another seabed/sediment type. The SACO notes that there are pipelines within the site which are rock armoured in places, leading to a reduction in the extent and distribution of the sandbank feature within the site. The deposition of additional rock as part of rig stabilisation may lead to a persistent change in substrate which is not suitable habitat for characterising sandbank communities and is not compatible with the restore target for the feature. While gravel is present within the site, notably on the flanks of some banks and their troughs, and the addition of rock may not represent a novel sediment type within the site, the difference in composition of this material to any exposure of natural material in, and its location within the site, may still contribute to a change in habitat extent, though it is less clear that it would represent a significant change in structure and function. The entire area of the site is not considered to contain the Annex I sandbank feature (Eggleton *et al.* 2020), but the intervening sediments are considered to support the conservation objectives of the site and to be sensitive to physical change to another seabed/sediment type, such that rock placement in any area of the site has the potential to undermine the site conservation objectives in view of the feature condition. It is likely that if rock placement is required it would be within 500m of a rig and based on a review of submitted ESs it is estimated this could cover an area of $0.001\text{-}0.004km^2$ (Table 2.2). Hence, the potential loss of extent of sandy sediment is small compared to the predominance of this sediment type across the large site ($1,468km^2$). However, in view of the unfavourable conservation status of the sandbank feature, further mitigation measures must be used such as removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.2.3) to avoid further reduction in the extent and distribution of the feature within the site. These will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
*(**Relevant pressures:** abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants)*

The sandbank and reef qualifying features are sensitive to abrasion/disturbance of the seabed surface, siltation rate changes including smothering and habitat structure changes, removal of substratum (extraction) pressures associated with drilling discharges. The advice on operations indicates that the qualifying features have not been assessed against whether they are sensitive to contaminants pressures, but they are considered to be a moderate-high risk. Any discharge from well drilling would be subject to risk assessment as part of existing regulatory controls (see Section 2.3.1). It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). SNS Area 6 is partly within the site. The maximum spatial footprint within which

[69] https://designatedsites.naturalengland.org.uk/Marine/MarineFeatureCondition.aspx?SiteCode=UK0030369

smothering by drilling discharges may occur ($0.8km^2$) is small (representing 0.05% of the total site area) and given the site's dynamic nature, redistribution of drilling discharges and recovery from smothering would be rapid. Drill cuttings piles do not generally accumulate in shallow, high energy waters, such as in the southern North Sea. It should be noted that SNS Area 6 has substantial areas outside of the SAC within which rig siting may be possible, avoiding interaction with the site. The small scale and temporary nature of potential smothering, as well as mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are unlikely as only SNS Area 6 overlaps with the site, and therefore effects will be no greater than those considered above. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1.

Greater Wash SPA[70]

Site Information

Area (ha/km²): 353,578/3,536
Relevant qualifying features: breeding: Sandwich tern*, common tern*, little tern*; non-breeding: little gull, red-throated diver*, common scoter

Conservation objectives: With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change;
Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

*The common tern and little tern features of this site are associated with colonies relating to Gibraltar Point SPA (little tern), Great Yarmouth North Denes SPA (little tern), The Wash SPA (little tern), Humber Estuary SPA (little tern), Breydon Water SPA (common tern), and also, the North Norfolk Coast SPA (common tern, little tern, and Sandwich tern). The following assessment also covers the tern features of these sites, where relevant to this AA.

Relevant licence areas with potential for physical disturbance and drilling effects

SNS Area 6

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to one well involving - siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
*(**Relevant pressures:** penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed/sediment type), smothering and siltation rate changes)*

SNS Area 6 overlaps a portion (~$135km^2$) of the site to the south of The Wash and North Norfolk Coast, off the Norfolk and Suffolk coasts, but there is also a substantial part of the area applied for which is outside of the site, and which a rig may be sited. SNS Area 6 is between 6km and 113km from the SPAs which contain sources colonies of little, common and Sandwich terns. Interaction with little tern habitat is unlikely due to their limited foraging range from the coastline and the location of colonies relative to the site (the reported mean maximum foraging ranges little tern is 5km) (see Woodward *et al.* 2019). The maximum spatial footprint of physical damage associated with jack-up rig siting is small ($0.8km^2$, Table 2.2) relative to the area over which Sandwich and common terns may forage, and only Breydon Water SPA is within a distance that common tern could forage within parts of SNS Area 6; all other related SPAs are at least 45km away. Similarly, the area used by any rig,

[70] https://jncc.gov.uk/our-work/greater-wash-spa/

should be placed within any part of the Greater Wash SPA, is small relative to the area used by wintering little gull.

Red-throated divers are widely distributed throughout the site, with this distribution largely forming the basis for the site boundaries (Lawson *et al.* 2015c), and the scale of any physical damage would be small relative to the large site, though common scoter has a more restricted distribution (Lawson *et al.* 2015c). Recovery from physical disturbance of the scale associated with rig siting is expected to be relatively rapid given the moderate to high energy seabed environment across much of the area. The small scale and temporary nature of the potential physical disturbance will not have a significant effect on the extent and distribution of the supporting habitats of the features either in the site or within their wider foraging ranges, and therefore, there will be no adverse effect on site integrity.

The requirement for rig stabilisation measures would be determined by site survey of local conditions. In soft sediments, rock placement may cause smothering of existing sediments and a physical change to another seabed type. It is assumed that rock placement (if required) would be within 500m of the rig and cover an estimated area of 0.001-0.004km^2 per rig siting (Table 2.2). Hence, the potential change in the extent of habitat is small compared to the wide areas over which birds forage, and when considered in the context of available project level mitigation (see Section 5.2.3), site conservation objectives will not be undermined and there will be no adverse effect on site integrity.

Drilling discharges
*(**Relevant pressures:** abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants)*

It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). There are significant areas of SNS Area 6 which are outside the site in which drilling discharges would not impact the site, and all related SPAs (Gibraltar point SPA, Great Yarmouth North Denes SPA, The Wash SPA, Humber Estuary SPA, Breydon Water SPA, the North Norfolk Coast SPA) are significantly further than 5km away. However, if located within the site, the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing 0.02% of the total site area). As indicated in Section 5.1.1, in general, this area has relatively high levels of suspended sediments compared to other areas of the UKCS (Cefas 2016), and the small scale and temporary nature of potential smothering, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Other effects
(Relevant pressures: *visual disturbance, above water noise***)**
Of the qualifying features, terns and little gull have a low sensitivity to disturbance by ship and helicopter traffic, while red-throated diver and common scoter are both known to be highly sensitive to visual disturbance (Garthe & Hüppop 2004, also see Schwemmer *et al.* 2011, MMO 2018, Mendel *et al.* 2019, Jarrett *et al*. 2022, and Section 4.2.3). There is considerable scope for drilling to take place outside of the site boundaries, and considering the seasonal nature of the sensitivity, operators should seek to undertake exploration/appraisal activity outside of the wintering period (1st November-31st March inclusive) to avoid the potential for effects on the scoter and red-throated diver features.

Should rig siting take place within the site, and in the wintering period, disturbance of divers or scoters is possible. JNCC (2022) provide advice on potential displacement for sensitive species including seaduck and red-throated diver in relation to wind farm development. The scale and duration of exploration/appraisal drilling is significantly less than that for the installation of an offshore wind farm. JNCC/NE advise at least a 2km and 2.5km displacement buffer be considered at the project level for vessels in relation to red-throated diver and common scoter respectively. This should be considered in the context of existing levels of vessel activity in the area (see Section 6.1) and where possible, established vessel traffic routes to the drilling location should be used. The scoter and red-throated diver features of the Greater Wash SPA are not uniformly distributed throughout the site (see Section 5.2.1 and Lawson *et al.* 2016), and should rig siting take place within the site, and within the wintering period, operators should seek to avoid the core areas of use by the species (see Section 5.1.3).

The temporary and localised nature of drilling activities and limited number of associated supply vessel and helicopter trips (see Table 2.2), which would likely use established routes, are such that they will not likely lead to an impact the qualifying features' distribution and use of the site such that the population within the site would be affected in the long-term. It should be noted that the effect of displacement on mortality is unknown, as are any effects on the populations of affected areas. For example, surveys of the Outer Thames Estuary SPA

(O'Brien *et al.* 2008, Goodship *et al.* 2015, Irwin *et al.* 2019), while for varying purposes and using a variety of techniques, do not appear to show a corresponding population response of red-throated diver to the estimated displacement of divers by windfarms to date (see also Vilela *et al.* 2022), and the population of the Greater Wash SPA appears to show significant inter-annual variability and a potential population increase since the time of its classification (DESNZ 2025a). It is not considered that the licensing of SNS Area 6 on its own, and the related level of vessel traffic and potential displacement, would lead to adverse effects on site integrity through displacement of red-throated diver or common scoter.

In-combination effects
Intra-plan in-combination effects are unlikely as only SNS Area 6 overlaps with the site, and therefore effects will be no greater than those considered above. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1.

Outer Thames Estuary SPA[71]

Site Information

Area (ha/km^2): 392,452/3,945
Relevant qualifying features: breeding: common tern*, little tern*, wintering: red-throated diver

Conservation objectives: The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The populations of each of the qualifying features
- The distribution of qualifying features within the site

*The tern features of this site are associated with colonies relating to Great Yarmouth North Denes SPA (little tern), Benacre to Easton Bavents SPA (little tern); Minsmere – Walberswick SPA (little tern); Alde-Ore Estuary SPA (little tern), Thanet Coast & Sandwich Bay SPA (little tern), Foulness SPA (little tern and common tern), and Breydon Water SPA (common tern only). The following assessment also covers the tern features of these sites, where relevant to this AA.

Relevant licence areas with potential for physical disturbance and drilling effects

SNS Area 6

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to one well involving - siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
*(**Relevant pressures:** penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed/sediment type))*

The advice on operations indicates that the supporting habitats for the features are sensitive to the above pressures. SNS Area 6 overlaps a substantial portion of the site, but there is also a substantial part of the area applied for which is outside of the site, and which a rig may be sited. The maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2, Table 2.2) relative to the area over which common terns may forage, and only Breydon Water SPA is within a distance that common tern could forage within parts of SNS Area 6; all other related SPAs for common tern related to the Outer Thames Estuary SPA are at least 95km away. Interaction with little tern habitat is unlikely due to their limited foraging range from the coastline (the reported mean maximum foraging ranges little tern is 5km) (see Woodward *et al.* 2019, noting also that tern colonies associated with the site are at least 6km away (Great Yarmouth North Denes SPA). Red-throated divers are widely distributed throughout the site, with this distribution largely forming the basis for the site boundaries (JNCC 2010b), and the scale of any physical damage would be small relative to the large site. Recovery from physical disturbance of the scale associated with rig siting is expected to be relatively rapid given the moderate to high energy seabed environment across much of the area. The small scale and temporary nature of the potential physical disturbance will not have a significant effect on the extent and distribution of the supporting habitats of the features either in the site or within their wider foraging ranges, and therefore, there will be no

[71] https://designatedsites.naturalengland.org.uk/ConservationAdvice.aspx?SiteCode=UK9020309

adverse effect on site integrity. and when considered in the context of available project level mitigation (see Section 5.1.3).

The requirement for rig stabilisation measures would be determined by site survey of local conditions. In soft sediments, rock placement may cause smothering of existing sediments and a physical change to another seabed type. It is assumed that rock placement (if required) would be within 500m of the rig and cover an estimated area of 0.001-0.004km^2 per rig siting (Table 2.2). Hence, the potential change in the extent of habitat is small compared to the wide areas over which birds forage, and when considered in the context of available project level mitigation which includes the potential to site any rig outside the site boundaries (see Section 5.1.3), site conservation objectives will not be undermined and there will be no adverse effect on site integrity.

Drilling discharges
*(**Relevant pressures:** abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants)*

The supporting habitat is sensitive to the above pressures associated with drilling discharges. The advice on operations indicates that the qualifying features and their supporting habitats have not been assessed against whether they are sensitive to contaminants pressures, but they are considered to be a moderate-high risk. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). There are significant areas of SNS Area 6 which are outside the site in which drilling discharges would not impact the site. However, if located within the site, the maximum spatial footprint within which smothering by drilling discharges may occur (0.8km^2) is small (representing 0.02% of the total site area); it is noted that this area has relatively high levels of background suspended sediments compared to other areas of the UKCS (Cefas 2016). The small scale and temporary nature of potential smothering, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Other effects
(Relevant pressures:** visual disturbance, above water noise**)
Of the qualifying features, terns and little gull have a low sensitivity to disturbance by ship and helicopter traffic, while red-throated diver and common scoter are both known to be highly sensitive to visual disturbance (Garthe & Hüppop 2004, also see Schwemmer *et al.* 2011, MMO 2018, and Mendel *et al.* 2019, and Section 4.2.3). There is considerable scope for drilling to take place outside of the site boundaries, and considering the seasonal nature of the sensitivity, operators should seek to undertake exploration/appraisal activity outside of the wintering period (1st November-31st March inclusive) to avoid the potential for effects on scoter and red-throated diver features. Should rig siting take place within the site, and in the wintering period, disturbance of divers or scoters is possible. JNCC (2022) provide advice on potential displacement for sensitive species including seaduck and red-throated diver in relation to wind farm development. The scale and duration of exploration/appraisal drilling is significantly less than that for the installation of an offshore wind farm. JNCC/NE advise at least a 2km displacement buffer be considered at the project level for vessels in relation to red-throated diver. This should be considered in the context of existing levels of vessel activity in the area (see Section 6.1) and where possible, established vessel traffic routes to the drilling location should be used. The scoter and red-throated diver features of the Outer Thames Estuary SPA are not uniformly distributed throughout the site, and should rig siting take place within the site, and within the wintering period, operators should seek to avoid the core areas of use by the species (see Section 5.1.3).

The temporary and localised nature of drilling activities and limited number of associated supply vessel and helicopter trips (see Table 2.2), which would likely use established routes, are such that they will not likely lead to an impact the qualifying features' distribution and use of the site such that the population within the site would be affected in the long-term. It should be noted that the effect of displacement on mortality is unknown, as are any effects on the populations of affected areas. For example, surveys of the Outer Thames Estuary SPA (O'Brien *et al.* 2008, Goodship *et al.* 2015, Irwin *et al.* 2019), while for varying purposes and using a variety of techniques, do not appear to show a corresponding population response of red-throated diver to the estimated displacement of divers by windfarms to date (see also Vilela *et al.* 2022). It is not considered that the licensing of SNS Area 6 on its own, and the related level of vessel traffic and potential displacement, would lead to adverse effects on site integrity through displacement of red-throated diver or common scoter.

In-combination effects
Intra-plan in-combination effects are unlikely as only SNS Area 6 overlaps with the site, and as only one well is proposed, the effects will be no greater than that considered above. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1

Bruine Bank SPA (NL)[72]
Site Information
Area (ha/km^2): 136,548/1,365 **Relevant qualifying features:** concentration (foraging, moulting and resting): little gull, and also gannet, guillemot, razorbill, great skua, great black-backed gull **Conservation objectives:** Preservation and, if applicable, restoration of: 1. The contribution of the Natura 2000 area to the ecological coherence of Natura 2000 both within the Netherlands and within the European Union; 2. The contribution of the Natura 2000 area to biological diversity and to the favourable conservation status of natural habitats and species within the European Union, which are included in Annex I or Annex II of the Habitats Directive. This includes the required contribution of the area to the pursuit of a favourable conservation status at national level for the habitat types and species for which the area has been designated; 3. The natural features of the Natura 2000 site, including the coherence of the structure and functions of the habitat types and of the species for which the site has been designated; 4. The ecological requirements applicable to the area of the habitat types and species for which the area has been designated.
Relevant licence areas with potential for physical disturbance and drilling effects
SNS Area 6
Activities associated with the proposed work programmes within the relevant licence areas
Drilling up to one well involving - siting of rig, drilling discharges
Assessment of effects on site integrity
Rig siting SNS Area 6 is immediately adjacent to the site, however, there is a substantial part of the area applied for in which a rig may be sited. The maximum spatial footprint of physical damage associated with jack-up rig siting is small (0.8km^2, Table 2.2), and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2) and the considerable scope to site a rig away from the boundaries of the SPA, rig siting will not adversely affect site integrity. The requirement for rig stabilisation measures would be determined by site survey of local conditions, however, as there is no overlap with the site and the area applied for, impacts on the supporting habitat of the site are not possible and there will be no adverse effect on site integrity. **Drilling discharges** It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). While immediately adjacent to the SPA, there is no spatial overlap with the site, and there are significant areas of SNS Area 6 within which a rig could be sited such that drilling discharges would not impact the site. The small scale and temporary nature of potential smothering, and mandatory mitigation requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. **Other effects** Of the qualifying features, gulls and auks generally have a moderate to low sensitivity to disturbance by ship and helicopter traffic (Garthe & Hüppop 2004, also see Schwemmer *et al.* 2011, MMO 2018, and Section 4.2.3), and as SNS Area 6 does not overlap with the site, there is considerable scope for drilling to take place away from the site boundaries to avoid the potential for effects on features. The temporary and localised nature of drilling activities and limited number of associated supply vessel and helicopter trips (see Table 2.2), which would likely use established routes, are such that they will not likely lead to an impact the qualifying features' distribution and use of the site such that the population within the site would be affected in the long-term. It is not considered that the licensing of SNS Area 6, and the related level of vessel traffic, would lead to adverse effects. **In-combination effects** Intra-plan in-combination effects are unlikely as SNS Area 6 does not overlap with the site, and as only one well is proposed, the effects will be no greater than that considered above. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1

72 https://www.natura2000.nl/sites/default/files/documenten/gebieden/168/Besluit%20aanwijzing%20Bruine%20Bank.pdf

5.1.3 Further physical disturbance and drilling mitigation measures

Further mitigation measures are available which are identified through the EIA process and operator's environmental management system and the Departmental permitting processes. These considerations are informed by project specific plans and the nature of the sensitivities identified from detailed seabed information collected in advance of field activities taking place. Site surveys are required to be undertaken before drilling rig placement (for safety and environmental reasons) and the results of such surveys (survey reports) allow for the identification of further mitigation including the re-siting of activities (e.g. wellhead or rig leg positions) to ensure sensitive seabed surface features (such as reefs) are avoided and potential rig stabilisation issues (e.g. from scouring around spud cans, or soft sediment conditions) are minimised. Survey reports are used to underpin operator environmental submissions (e.g. EIAs) and where requested, survey reports are made available to nature conservation bodies during the consultation phases of these assessments. As noted in Table 5.1, given the available space within SNS Area 6 which does not cover certain relevant sites (in particular, Haisborough Hammond and Winterton SPA, Greater Wash SPA, Outer Thames Estuary SPA), there is considerable scope available to site the rig away from the sites such that any effect can be avoided, and it is expected that this would form the basis of any mitigation required as part of assessment at the project level, in order to avoid effects. The need for mitigation would be identified at the project level, at which time further assessment including HRA would be required.

It is not typical for rig stabilisation to be required (see Table 2.2), but this will be informed by site-specific survey and project specific plans which are not currently available. Where rig stabilisation or anti-scour protection is required, the Department will expect operators to provide adequate justification for the stabilisation option proposed (including for rig siting beyond site boundaries, if practical) and consider use of systems that can be removed following drilling, where these meet the technical and safety requirements of rig placement. Where rock placement is required, the Department will expect operators to minimise the volume of rock deposited. The need for rig stabilisation or scour protection, and the need for mitigation, would be identified at the project level, at which time further assessment including HRA would be required.

The red-throated diver and common scoter features of the Greater Wash SPA and Outer Thames Estuary SPA are highly sensitive to vessel traffic but are present seasonally (winter). Operators should seek to avoid activities within these sites during the wintering period (1st November to 31st March inclusive). If this is not possible, and a rig needs to be located within the site, the rig and related vessels should seek to avoid high areas of diver and scoter use. Where possible, vessels should use established routes, where diver and scoter densities are generally lower. Further assessment, including HRA, may be required at the project level.

5.1.4 Conclusions of SNS regional assessment

Likely significant effects identified with regards to physical damage to the seabed, drilling discharges and other effects (see Section 5.1.2) when considered along with project-level mitigation (Section 5.1.3) and relevant activity permitting requirements (see Section 2.3.1), will not have an adverse effect on the integrity of the sites considered in this assessment. At the project level, where the Habitats and EIA Regulations[73] apply, there is a requirement to coordinate assessments made under the respective regulations. Figure 2.2 sets out the interaction of the two regulatory areas. Their application at the project level allows for an

[73] *Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020*

assessment to be made of likely significant effects on the basis of detailed project-specific information and allows for applicants to propose project specific mitigation measures.

5.1.5 Assessment of underwater noise effects

The site conservation objectives and other relevant information relating to site selection and advice on operations has been considered against indicative work programmes (see Section 2.2.1) to determine whether they could adversely affect site integrity. New seismic surveys have been proposed in the work programmes relating to the licence application for SNS Area 6 (Table 2.1). SNS Areas 3 could have seismic activity take place within its licence area. Sites relevant to this part of the assessment are shown in Figure 5.3 and Figure 5.4, and the results are given in Table 5.2 below. All mandatory control requirements (as given in Section 2.3.2) are assumed to be in place as a standard for all activities assessed at this stage.

Table 5.2: Consideration of potential underwater noise effects and relevant site conservation objectives

Southern North Sea SAC
Site Information
Area (ha/km²): 3,695,054/36,951 **Relevant qualifying features:** Harbour porpoise **Conservation objectives:** See Table 5.1 above.
Relevant licence areas with potential for underwater noise effects
SNS Area 3, SNS Area 6
Assessment of effects on site integrity
Impulsive noise (2D/3D seismic survey, rig site survey, VSP, conductor piling) *(**Relevant pressures:** underwater noise change, vibration)* Individuals within approximately 10km of the airgun arrays may be affected, through temporary local displacement and reduced foraging opportunities. While a 3D survey may take up to several weeks to complete, in many cases it would be of shorter duration, and airgun activity would not be continuous throughout this period. Further, as the survey vessel travels along transects, ensonification is variable across the area surveyed. The habitat is open in nature, and harbour porpoises are known to be able to travel over large distances (>20km) within a day. While habitat quality is not uniform across the southern North Sea, considering that preliminary investigations suggest that sufficient prey are widely available both within and outside the site boundary (Ransijn *et al*. 2019) and the wide distribution of relatively high densities of harbour porpoise across this region, the spatial and temporal scale of potential displacement resulting from relevant activities is not expected to result in individuals losing access to suitable habitat. Considering: the maximum likely duration of the activity (Table 2.2); that the survey activity is likely to be spatially and/or temporally disparate across the relevant areas applied for and unlikely to result in long-term and large-scale displacement of porpoises from the area (Sarnocińska *et al.* 2020); that further mitigation measures are available (Section 5.2.6), and will be required, where appropriate, it is concluded that a 3D seismic survey will not result in an adverse effect on site integrity. In the case of rig site survey and VSP noise, given the lower amplitude source, the effects radius can reasonably be expected to be smaller (in the order of 5-10km) than that of 3D seismic survey and be of smaller spatial footprint and shorter duration (days). Consequently, it is concluded that rig site survey and VSP will not result in an adverse effect on site integrity. The impulsive underwater noise produced should conductors need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the short duration of the activity, and the uncommon use of this technique to meet technical requirements; when combined with mandatory control measures (Section 2.3.2), disturbance to harbour porpoise within the site will be highly localised, short-term, and will not result in an adverse effect on site integrity.

With regard to SNCB guidance on spatio-temporal thresholds for noise disturbance within the SAC[74], should a seismic survey take place wholly within the boundaries of the summer portion of the SAC (such surveys typically occur between Apr-Sep, see Figure 5.3 which shows the summer and winter areas), an approximate conservative estimate of the proportion of the relevant area from which harbour porpoise may be disturbed is 8.6%[75]. This is less than half the 20% daily threshold for what could be considered significant disturbance. Such a survey would lead to up to 18.2% of the winter area being subject to disturbance in a single day, however, as noted above such surveys are not typically undertaken in winter, and seasonal controls can be used to avoid this period (Section 5.1.6). With regard to season disturbance thresholds, HRAs for three different planned seismic surveys with partial overlap with the Southern North Sea SAC (BEIS 2021a, 2021b, DESNZ 2025b) estimate a worst-case of 1.3, 5.4 and 1.2% seasonal (summer) disturbance respectively[76], which is below the 10% seasonal threshold; note also that these surveys were larger than that proposed as part of the SNS Area 6 application area, and used a 12km EDR. The proportion of the site potentially disturbed by site survey (EDR 3-5km), VSP and potential conductor piling (EDR 5km) will be considerably less, with these activities either being static or covering a very limited spatial footprint.

Negative indirect effects of impulsive noise on harbour porpoise may potentially arise through effects on prey species, primarily small fish, if those prey are subject to injury or disturbance which reduce their availability to harbour porpoise. While there is some evidence that a reduction in catches of some fish species can be associated with seismic survey activity, these are temporary in nature. Any such effects associated with VSP, rig site survey or conductor piling on their own are expected to be minor, considering their shorter duration, smaller spatial extent and lower amplitude source relative to 2D and 3D seismic surveys (to which most reported effects relate). Additionally, the disturbance of sensitive spawning periods for potential fish prey species will be considered through the activity consenting process. Consequently, any underwater noise effects on fish associated with the licensing of relevant areas applied for are not anticipated to result in significant effects on the food resources of the harbour porpoise.

Continuous noise (drilling, vessel & rig movements)
*(**Relevant pressures:** underwater noise change, vibration)*

Harbour porpoises are considered sensitive to underwater noise from shipping which could make preferred habitats less attractive as a result of disturbance (habitat displacement, area avoidance). There are currently a number of large ports on the east coast which result in large vessel shipping routes throughout the site. Given existing levels of shipping activity over the site and elevated porpoise densities, the temporary nature of drilling activities and limited number of associated supply vessels will not represent a significant increase in the level of disturbance that could lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Further mitigation measures are also available (Section 5.1.6) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
All three areas applied for in the southern North Sea overlap with the summer area of the site, and SNS Area 6 overlaps with parts of both the winter and summer areas, but only SNS Area 6 has a work programme which proposes seismic survey. Considering the following: the current understanding of the site and its feature being in favourable condition; the level of current and past seismic survey, drilling and vessel activity within the site; that further mitigation measures are available (Section 5.1.6) and will be required, where appropriate, including potential controls on activity timing; and, that evidence suggests that seismic surveys are unlikely to result in long-term and large-scale displacement of porpoises from the area (Sarnocińska *et al.* 2020), there will be no adverse effects on site integrity.

Greater Wash SPA

Site Information

Area (ha/km²): 353,578/3,536

[74] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/889842/SACNoiseGuidanceJune2020.pdf
[75] Assuming a typical vessel speed of 4.5kts (8.3km/h), a survey line length of 100km and a 3hr line change, resulting in a total of 174km of lines surveyed within a 24hr period. Combined with a 10km EDR, this provides a total daily area of disturbance of ~2,314km², which is 8.6% of the summer SAC area, and 18.2% of the winter area.
[76] Based on worst-case scenarios of 21-153 days of disturbance during the survey.

Relevant qualifying features: non-breeding: red-throated diver, common scoter

Conservation objectives: See Table 5.1 above.

Relevant licence areas with potential for underwater noise effects

SNS Area 6

Assessment of effects on site integrity

Impulsive noise (2D/3D seismic survey, rig site survey, VSP, conductor piling)
*(**Relevant pressures:** underwater noise change, vibration)*

Red-throated diver are widespread throughout the site, though with highest concentrations along the Holderness coast, the outer Wash along the south Lincolnshire coast and North Norfolk Coast, and to the east, along the Norfolk Coast and into the adjoining Outer Thames Estuary SPA (Lawson *et al.* 2015c). SNS Area 6 overlaps a small portion of the site off the Norfolk coast, close to an area which showed persistently higher densities in surveys of the site (Lawson *et al.* 2015c, DESNZ 2025a). Visual disturbance of the red-throated diver and common scoter features of the site have already been discussed in Section 5.1.2. Should a survey be undertaken which overlaps with Greater Wash SPA and the higher areas of use for red-throated diver and common scoter, exclusively in the winter months when the features are present, the risk of injury or significant disturbance from survey activities is considered to be low due to i) the evidence (albeit limited) of low hearing sensitivity and a lack of reported injury or disturbance effects; and ii) likely avoidance of the physical presence of survey vessel(s) and airguns.

Negative indirect effects of seismic survey activities on qualifying features may arise through effects on prey species, primarily small fish such as gadoids, sprat, herring and sandeel, if these prey are subject to injury or disturbance which reduce their availability to qualifying seabirds. While there is some evidence that a reduction in fish catches or abundance can be associated with seismic survey activity, these are temporary in nature, and the sensitivity of the relevant prey species to underwater noise is considered to be generally low. The disturbance of sensitive spawning periods will be considered through the activity consenting process. As such, any underwater noise effects on fish associated with licensing SNS Area 6 are not anticipated to result in significant effects on the food resources of the qualifying seabird features.

Considering the limited potential for effects of 2D/3D seismic survey on diving birds identified above and in Section 4.3.2, and the lower amplitude, shorter duration and smaller geographic footprint associated with other impulsive noise such as VSP, rig site survey and conductor piling, it is concluded that these activities will not result in an adverse effect on the integrity of the site, or the adjoining Wash SPA which has red-throated diver and scoter as qualifying features.

Continuous noise (drilling, vessel & rig movements)
*(**Relevant pressures:** underwater noise change, vibration)*
No significant effects on red-throated diver and common scoter are anticipated from continuous underwater noise from drilling and vessel movements, due to the lower amplitude and non-impulsive nature of the sound resulting in no potential for acute trauma and no evidence of significant disturbance.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and the likely temporal and spatial separation of any individual licence activities which could take place. Section 6.1 provides a consideration of potential licence activities in-combination with other relevant plans and projects.

Outer Thames Estuary SPA

Site Information

Area (ha/km^2): 392,452/3,925
Relevant qualifying features: non-breeding: red-throated diver

Conservation objectives: See Table 5.1 above.

Relevant licence areas with potential for underwater noise effects

SNS Area 6

Assessment of effects on site integrity

Impulsive noise (2D/3D seismic survey, rig site survey, VSP, conductor piling)
*(**Relevant pressures:** underwater noise change, vibration)*

Red-throated diver are widespread throughout the site, though with highest concentrations noted in the southern area of the site in the Outer Thames, with lower densities recorded in the areas to the north of this off the Suffolk coast (Irwin *et al.* 2019); SNS Area 6 overlaps a substantial portion of these latter areas of the site. Visual disturbance of the red-throated diver feature of the site has already been discussed in Section 5.1.2. Should a survey be undertaken which overlaps with Outer Thames Estuary SPA and the higher areas of use for red-throated diver, exclusively in the winter months when the features are present, the risk of injury or significant disturbance from survey activities is considered to be low due to i) the evidence (albeit limited) of low hearing sensitivity and a lack of reported injury or disturbance effects; and ii) likely avoidance of the physical presence of survey vessel(s) and airguns.

Negative indirect effects of seismic survey activities on qualifying features may arise through effects on prey species, primarily small fish such as gadoids, sprat, herring and sandeel, if these prey are subject to injury or disturbance which reduce their availability to qualifying seabirds. While there is some evidence that a reduction in fish catches or abundance can be associated with seismic survey activity, these are temporary in nature, and the sensitivity of the relevant prey species to underwater noise is considered to be generally low. The disturbance of sensitive spawning periods will be considered through the activity consenting process. As such, any underwater noise effects on fish associated with licensing SNS Area 6 are not anticipated to result in significant effects on the food resources of the red-throated diver.

Considering the limited potential for effects of 2D/3D seismic survey on diving birds identified above and in Section 4.3.2, and the lower amplitude, shorter duration and smaller geographic footprint associated with other impulsive noise such as VSP, rig site survey and conductor piling, it is concluded that these activities will not result in an adverse effect on the integrity of the site, or those adjoining sites with red-throated diver, namely, the Greater Wash SPA (see above).

Continuous noise (drilling, vessel & rig movements)
*(**Relevant pressures:** underwater noise change, vibration)*
No significant effects on red-throated diver and common scoter are anticipated from continuous underwater noise from drilling and vessel movements, due to the lower amplitude and non-impulsive nature of the sound resulting in no potential for acute trauma and no evidence of significant disturbance.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and the likely temporal and spatial separation of any individual licence activities which could take place. Section 6.1 provides a consideration of potential licence activities in-combination with other relevant plans and projects.

Bruine Bank SPA (NL)[77]

Site Information

Area (ha/km^2): 136,548/1,365
Relevant qualifying features: concentration (foraging, moulting and resting): gannet, guillemot, razorbill

Conservation objectives: Preservation and, if applicable, restoration of:

1. The contribution of the Natura 2000 area to the ecological coherence of Natura 2000 both within the Netherlands and within the European Union;
2. The contribution of the Natura 2000 area to biological diversity and to the favourable conservation status of natural habitats and species within the European Union, which are included in Annex I or Annex II of the Habitats Directive. This includes the required contribution of the area to the pursuit of a favourable conservation status at national level for the habitat types and species for which the area has been designated;
3. The natural features of the Natura 2000 site, including the coherence of the structure and functions of the habitat types and of the species for which the site has been designated;
4. The ecological requirements applicable to the area of the habitat types and species for which the area has been designated.

77 https://www.natura2000.nl/sites/default/files/documenten/gebieden/168/Besluit%20aanwijzing%20Bruine%20Bank.pdf

Relevant licence areas with potential for physical disturbance and drilling effects
SNS Area 6
Assessment of effects on site integrity
Impulsive noise (2D/3D seismic survey, rig site survey, VSP, conductor piling) As detailed in Section 4.3.2, there is very little evidence of impacts of underwater noise on diving birds. Mortality of seabirds has not been observed during extensive seismic operations in the North Sea and elsewhere, and flushing disturbance associated with the physical presence of survey vessels and rigs would be expected to displace most diving seabirds from close proximity to noise sources. Such avoidance behaviour is also expected to reduce the potential for diving birds to be exposed to noise levels which may result in potential behavioural disturbance, although it is noted that very little evidence for such effects exist and, should they occur, they would be expected to be short-term, temporary and of limited spatial extent. Like birds, there is limited evidence of physical injury to fish from exposure to high amplitude low-frequency seismic survey noise (see Section 4.3.2), however, negative indirect effects of seismic survey activities on qualifying features may arise through effects on prey species, primarily sandeels and other small fish, if these prey are subject to injury or disturbance which reduce their availability to qualifying seabirds. While there is evidence that a reduction in fish catches can be associated with seismic survey activity, these are temporary in nature. The disturbance of sensitive spawning periods for potential fish prey species will also be considered through the activity consenting process. Consequently, any underwater noise effects on fish associated with the licensing of SNS Area 6 are not anticipated to result in significant effects on the food resources of the qualifying diving bird features. Considering the limited potential for effects of 2D/3D seismic survey on diving birds identified above and in Section 4.3.2, and the lower amplitude, shorter duration and smaller geographic footprint associated with other impulsive noise such as VSP, rig site survey and conductor piling, it is concluded that these activities, in SNS Area 6, will not result in an adverse effect on the integrity of the site. **In-combination effects** Intra-plan in-combination effects are unlikely as only SNS Area 6 is relevant to the site. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.1

5.1.6 Further underwater noise mitigation measures

The Department requires operators to provide sufficient information in the environmental assessment (and possibly EIA, see Figure 2.3), which includes a noise assessment, on the potential impact of proposed activities on relevant sites and their qualifying features as well as proposed further mitigation measures in their applications for a relevant consent. Due to the temporary nature of the activities, mitigation measures could include activity timing to avoid the most sensitive periods. Operators must demonstrate how seasonal sensitivities have been taken into account when planning operations (see BEIS 2021c). The information provided by operators must be detailed enough for the Department to make a decision on whether the activities could lead to a likely significant effect, and whether the activities should require HRA. Depending on the nature and scale of the proposed activities (e.g. area of survey, source size, timing and proposed mitigation measures) and whether likely effects are identified for these, the Department may undertake further HRA to assess the potential for adverse effects on the integrity of sites at the activity specific level. A standard consent condition requires operators to follow the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys.

Consent for project-level activities will not be granted unless the operator can demonstrate that the proposed activities, which may include seismic survey, small-scale geophysical rig site survey, VSP and drilling (which may incorporate conductor piling), will not have an adverse effect on the integrity of relevant sites.

The planning of seismic surveys should endeavour to minimise exposure of noise-sensitive qualifying features, including harbour porpoises, to underwater noise by careful consideration of the timing with respect to: 1) seasonal differences in the distribution of relevant species across their ranges in relation to relevant sites, and 2) the presence of other underwater noise-generating activities (i.e. other geophysical surveys and impact piling). It is advised that the licensees of the areas of relevance for underwater noise effects (listed in Table 5.2) establish early discussions with the Department and also the leaseholders of OWF areas, to understand the nature and timing of proposed activities such that significant in-combination effects can be avoided (see Section 6.1). Early consultation with the relevant SNCBs is also recommended.

For those areas applied for where proposed activities could result in the physical disturbance of marine mammals by the presence and movement of vessels, available mitigation measures include strict use of existing shipping routes, and timing controls on temporary activities to avoid sensitive periods.

5.1.7 Conclusions of SNS regional assessment

Although underwater sound generated during project-level activities, specifically seismic surveys, has the potential to injure and disturb individual harbour porpoises, seals, fish (including qualifying features and prey) and diving birds, the actual risk is minimised by the controls currently in place.

For any of the relevant sites, it is concluded that the likely level of activity expected to take place within the relevant areas applied for listed in Table 1.1 will not cause an adverse effect on site integrity, taking account of the following:

- Should a 3D seismic survey be proposed in any of the areas applied for, further HRA may be required to assess the potential for adverse effects on the integrity of the site once the area of survey, source size, timing and proposed mitigation measures are known and can form the basis for a definitive assessment;

Individual activities (e.g. drilling, seismic) require individual consents which will not be granted unless the operator can demonstrate that the proposed activities, which may include 3D seismic surveys, will not adversely affect the site integrity of relevant sites, or that compensatory measures are applied if it is decided that a project should be carried out for imperative reasons of overriding public interest and where there are no alternative solutions to the project. These activities will be subject to activity level environmental assessment and, where appropriate, HRA.

5.2 English Channel

5.2.1 Relevant sites

Solent and Dorset Coast SPA

Solent and Dorset Coast SPA was classified to protect important foraging areas at sea used by three species of tern (common, Sandwich and little) which are qualifying interest features from colonies within adjacent SPAs. These are: Poole Harbour (common and Sandwich terns), Solent and Southampton Water SPA (common, Sandwich and little terns) and Chichester & Langstone Harbours SPA (common, Sandwich and little terns). Note that these SPAs have been screened into this HRA on the basis of them being source colonies for Solent and Dorset Coast SPA (see DESNZ 2026) and are described separately below.

The seaward and alongshore extent of the Solent and Dorset Coast SPA was determined by the modelled foraging distributions of Sandwich terns (see Natural England 2016a, Wilson *et al.* 2014) from west to east by the distributions of birds originating from: Poole Harbour SPA (colony at Brownsea Island), Solent and Southampton Water SPA (colony at Pitts-Deep-Hurst) and Chichester & Langstone Harbours SPA. The same generic model of Sandwich tern usage was used to generate relative density maps around each of these colonies. The boundaries to the areas predicted to support most of the foraging activity by little terns from colonies within the Solent and Southampton Water SPA, and Chichester & Langstone Harbours SPA are contained entirely within the boundary of the SPA, as are the areas predicted to support most of the foraging activity by common terns from colonies within the Chichester & Langstone Harbours SPA, the Solent and Southampton Water SPA and Poole Harbour SPA. For both Sandwich and common terns from the relevant sites, very substantial areas of sea within the wider area (outside of the SPA), defined by the mean maximum foraging range of the species (e.g. Woodward *et al.* 2019) were predicted to have very little or no usage by foraging terns.

Poole Harbour SPA

Poole Harbour SPA is a large natural harbour comprising; subtidal channels, extensive tidal sandflats, mudflats and saltmarshes, with associated reedbeds, freshwater marshes and wet grassland. With a narrow entrance and a small tidal range, it has many of the qualities of a large lagoon (Humphreys & May 2005 cited by Natural England 2016b). The north side is largely urbanised while the west and south side abut heath, mire or grassland. Extensive intertidal mudflats provide an important feeding habitat for overwintering waterbirds while the fringing saltmarshes and reedbeds provide roosting areas and a feeding habitat for a variety of bird species. Saltmarsh islands in the north west of the harbour are the main nesting sites for Mediterranean gull (64 pairs in 2015) which nest within the large colony of black-headed gulls, (Natural England 2016b). During the breeding season, Mediterranean gull increase their dependency upon freshwater habitats (Pickess 2007, cited by NE conservation advice[78]). The sheltered muddy shores also provide a food resource for aggregations of non-breeding waterbirds. In addition, the areas of open water are essential for fish-eating species to feed and rest, e.g. goldeneye, red-breasted merganser and cormorant, which are components of the waterbird assemblage (assemblage total of 25,176 birds, 5 year peak mean 2009/10-2013/14). Several breeding tern species, primarily common (178 pairs, 5-year mean, 2010-2014) and Sandwich (181 pairs, 5-year mean, 2010-2014) terns use the waters around their colonies on Brownsea Island in significant densities (Natural England 2016b). The seaward boundary of the site was modified in November 2017 to include all marine habitats within the

[78] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9010111

harbour entrance which includes these tern foraging areas. However, both species of tern also forage extensively in the open sea outside the harbour entrance (Aspinall & Tasker 1990), and these are protected through the Solent and Dorset Coast SPA. The Poole Harbour Site Improvement Plan[79] indicates that one of the main threats to the site is water pollution with nutrient enrichment having resulted in extensive algal mats across the mudflats with potential consequential impacts on bird prey availability and bird foraging behaviour.

Solent and Southampton Water SPA

The Solent and Southampton Water SPA lies between the Isle of Wight and the mainland and stretches from Hurst Spit to Hill Head across Hampshire, and on the north coast of the Isle of Wight from Yarmouth to Whitecliff Bay. The Solent and its inlets have an unusual tidal regime, including double tides and long periods of tidal stand at high and low tide[80]. The site comprises a series of estuaries and harbours with extensive mud-flats and saltmarshes with adjacent coastal habitats including saline lagoons, shingle beaches, reedbeds, damp woodland and grazing marsh. The mud-flats support seagrass beds and have a rich invertebrate fauna that forms the food resource for the estuarine birds. In summer, the site is of importance for breeding seabirds, including gulls and four species of terns (common, little, roseate and Sandwich), with important tern breeding areas at Hurst Point to Pitts Deep, and the North Solent and foraging areas including Hurst and Lymington, Brading Marshes, Cowes, and Medina estuary[81]. Terns also forage in marine areas outside of the site and these are covered by the Solent and Dorset Coast SPA. In winter, the SPA holds a large and diverse assemblage of 43,987 waterbirds (5-year peak mean 2009/10 - 2013/14), including geese, ducks and waders. Relevant threats identified by the Site Improvement Plan for the Solent[82] which includes this SPA, include disturbance of birds by aircraft, water pollution and the introduction of invasive non-native species through shipping.

Chichester and Langstone Harbours SPA

Chichester and Langstone Harbours SPA covers two large, sheltered estuarine basins. Urban development surrounds the west of Langstone Harbour, whereas farmland surrounds the majority of Chichester Harbour. Both Chichester and Langstone Harbours contain extensive intertidal mudflats and sandflats with areas of seagrass beds, saltmarsh, shallow coastal waters, coastal lagoons, coastal grazing marsh and shingle ridges and islands. These habitats support internationally and nationally important numbers of overwintering and breeding bird species. The overwintering waterbird assemblage of 72,666 birds (5-year peak mean 2009/10-2013/14) includes bar-tailed godwit, curlew, dark-bellied brent geese, dunlin, grey plover, pintail, red-breasted merganser, redshank, ringed plover, sanderling, shelduck, shoveler, teal, turnstone and wigeon[83].

At low tide the mudflats are exposed, the water is drained by channels and creeks which meet to form narrow exits into the Solent. The sediments support rich populations of intertidal invertebrates, which provide an important food source for overwintering birds. Several small freshwater streams flow into the harbours; however, these contribute relatively little freshwater input compared to the tidal flows. There are more than 300ha of seagrass beds in the SPA which are an important food source for dark-bellied brent geese (Marsden & Chesworth 2014

[79] http://publications.naturalengland.org.uk/file/5692032358023168
[80] http://publications.naturalengland.org.uk/file/5064469629632512
[81] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9011061
[82] http://publications.naturalengland.org.uk/file/5319610920337408
[83] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9011011&SiteName=chiches&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=#SiteInfo

cited by NE conservation advice). Overwintering birds also feed and roost in the saltmarsh areas, which are dominated by cordgrass (*Spartina*) swards, as well as on coastal grazing marsh. The shingle ridges and islands within the site provide important nesting habitat for three species of tern (common, little and sandwich tern) during the summer breeding season. Adult terns use the shallow coastal waters in the harbours and the wider Solent to forage for small fish to feed themselves and their chicks (where they fall within the Solent and Dorset Coast SPA summarised above).

Chesil Beach and The Fleet SPA

The shingle bank of Chesil Beach provides nesting for internationally important populations of breeding little tern *Sternula albifrons*, and although not features of the site, it also supports increasing numbers of breeding common tern *Sterna hirundo* and a small number of breeding ringed plover *Charadrius hiaticula*. The Fleet is the largest example of a lagoonal habitat in England and provides important foraging habitat for internationally important populations of wigeon *Anas penelope* via extensive seagrass communities, comprising *Zostera marina* var. *angustifolia* and *Z. noltii,* and two species of tasselweed, *Ruppia maritma* and *R. cirrhosa*. The Fleet is an important nursery ground for a number of fish species and is a designated sea bass nursery and provides an important food source for little tern foraging over the Fleet for small fish.

Wight-Barfleur Reef SAC[84]

Wight-Barfleur Reef, is located in the central English Channel between St Catherine's Point and Barfleur Point on the Contentin peninsula and comprises an area of bedrock and stony reef at depths of 25-100m.

To the north of the site is a large area of soft Wealden Clay that forms a series of irregular ridges that support two reef communities. One composed of the hornwrack *Flustra foliacea*, a variety of sponges of different forms (cushion, encrusting, arborescent, cup-like), the tube-worm *Bispira* sp., and a range of hydroids. The second community includes abundant sponges of a range of forms (massive, cushion, encrusting, arborescent), anemones, and a luxuriant growth of hornwrack and hydroids. Between the ridges, soft rock is scoured by mobile sediments, preventing epifauna from growing.

The harder Kimmeridge Clay occurs towards the centre of the site, again forming a series of irregular ridges, the tops and slopes of which support a range of reef communities, with the troughs characterised by coarse (pebbles, cobbles and gravels) sediment communities. The reef communities present are predominantly characterised by tide-swept moderately wave-exposed circalittoral rock with a variety of ascidians (e.g. *Botryllus* sp.), encrusting sponges, and hornwrack. Other reef communities present include a mixed encrusting community of sponges, hydroids and bryozoans and a heavily sand-scoured community dominated by hornwrack and a hydroid/bryozoan crust. Dense patches of the hydroid *Tubularia* sp. and the anemone *Actinothoe* sp. are found on more exposed steep rock faces.

The moderately hard London Clay characterises the south of the site and forms a fairly featureless surface. In areas of stony reef observed in video surveys, cobbles and gravel have appeared to be sufficiently stable to support a range of epifauna such as erect bryozoans (e.g. Ross coral *Pentapora foliacea*), sponges and hydroids.

[84] Description based on JNCC (2012): https://hub.jncc.gov.uk/assets/d2f2a300-5f46-46f4-9099-c73a3399f2a4#WBR-SAC-SAD-V7.0.pdf

A section of the 'Northern Palaeovalley' (James *et al.* 2007) is located in the south-east of the SAC which is part of a large channel system that runs through the English Channel. Unlike elsewhere in the Channel where the palaeovalleys have been infilled due to the strong currents, those in this area remain largely unfilled, and a number of different rock types are exposed at the seabed. On the palaeovalley floor, numerous areas of consolidated 'cobble pavement' and cobbles held in place by accretions of encrusting life-forms were recorded, notably with a high proportion of cushion sponges. Areas of consolidated cobble pavement support a biological community that contains ross coral, hydroids, anemones (e.g. *Corynactis* sp.) and tube worms. The sides of the palaeovalley are in places formed by steep bedrock and boulder faces, which again support a range of sponge communities.

The site condition is considered to be unfavourable[85], which is primarily related to the historic impacts from mobile demersal fisheries. The *Marine Protected Areas Bottom Towed Fishing Gear Byelaw 2023* prohibits the use of bottom towed fishing gear anywhere within the Wight-Barfleur Reef SAC.

Studland to Portland SAC

The site comprises a mosaic of two areas containing Annex I reef habitat, Studland Bay to Ringstead Bay Reefs and Portland Reefs. The former exhibits much geological variety ranging from exposed chalk east of Ringstead Bay to shales and clays, limestone and cementstone ledges, and boulders around Kimmeridge to Durlston, with chalk present again to the east between Ballard cliffs and Handfast Point (Natural England 2012).

The reefs from St Albans Head to Lulworth Cove are characterised by flat bedrock with inshore areas of boulders and gravel. The bryozoan ross coral *Pentapora fascialis* is recorded extensively along with sponges, including *Axinella* sp, other bryozoans (*Flustra foliacea* dominant), deadmans fingers *Alcyonium digitatum*, hydroids and tunicates (including large patches of *Stolonica socialis*). Colonies of the pink sea fan *Eunicella verrucosa* are also recorded in this area.

A series of limestone ledges (up to 15m across) protrude from shelly gravel at Worbarrow Bay. The smooth and gently sloping upper surface supports a rich sponge and sea fan community. The broken reef edge includes encrusting sponges *Pachymatisma johnstonia*, hydroids and clusters of the trumpet anemone *Aiptasia mutabilis.* The shoreward edge of the reefs grade into shelly sand with scallops and occasional small rocks or artillery shells covered in a bryozoan/hydroid turf. Shale reefs extend from Kimmeridge and support high densities of the brittlestar *Ophiothrix fragilis*.

St Albans Ledge (reef) extends over 10km offshore and is subject to strong tidal action. The dominant biotopes found in this area are bryozoan and colonial ascidians on tide swept moderately wave exposed circalittoral rock. East of St Albans Ledge is an area of large limestone blocks known as the "seabed caves" dominated by red/brown algal turf, sponges (such as *Polymastia boletiformis*), *Bispira* fanworms, and Weymouth carpet coral *Hoplangia durotrix*.

Evans Rock is a gently sloping mound within the outer limits of Swanage Bay, with a diverse cover of sponges (*Esperiopsis fucorum, Hemimycale columella, Dysidea fragilis, Tethya aurantium*), hydroids (*Nemertesia* sp, *Plumularia setacea*, *Aglaophenia* sp.), bryozoans and

[85] https://hub.jncc.gov.uk/assets/11c55f61-4aa7-4665-a95b-0a552ccccd62#WBR-4-ConservationStatements-V1.0.pdf

tunicates (*Aplidium* sp., *Lissoclinum perforatum*). Other notable species include the fanworm *Bispira volutacornis,* cowrie *Trivia arctica,* the boring phase of the sponge *Cliona celata*, and a patch of the horseshoe worm, *Phoronis* sp.

The chalk bedrock occurring between Ballard Cliffs and Handfast Point is encrusted with red algae (*Calliblepharis ciliata* dominant), *Saccorhiza polyschides* and *Dictyota dichotoma*. Overhangs provide shelter for a variety of fauna including the sponges *D. fragilis, E. fucorum, Dercitus bucklandii* and *H. columella*, the fanworm *B. volutacornis*, deadmans fingers *A. digitatum*, crabs and squat lobsters (*Galathea* sp.).

Studland Bay contains a number of small shallow water reefs characterised by having a silty veneer and surrounded by a sandy seabed. The rocks are covered in a rich turf of brown and red algae (mostly *C. celata*), sponges, particularly *E. fucorum* and *H. columella*, hydroids, deadmans fingers *A. digitatum* and bryozoans (*Flustra* and *Bugula*) with the fanworm *B. volutacornis* frequently recorded in the crevices. The seabed near the reefs is covered in a dense layer of the slipper limpet, *Crepidula fornicata*.

The Portland Reefs are characterised by flat bedrock, limestone ledges (Portland stone), large boulders and cobbles. On the western side of Portland Bill, rugged limestone boulders provide deep gullies and overhangs. Mussel beds (*Mytilus edulis*) occur in very high densities on bedrock associated with strong currents to the southeast of Portland Bill.

South Wight Maritime SAC

The subtidal chalk reefs to the west and south-west of the Isle of Wight represent over 5% of Europe’s coastal chalk exposures, including the extensive tide-swept reef off the Needles and examples at Culver Cliff and Freshwater Bay. Other reef habitats within the site include areas of large boulders off the coast around Ventnor, and a large reef of limestone off Bembridge and Whitecliff Bay where the horizontal and vertical faces and crevices provide a range of habitats. The bedrock is extensively bored by bivalves (e.g. *Pholas dactylus, Barnea candida, Hiatella arctica*), the presence of which provides shelter and enhances habitat diversity. The chalk provides a sufficiently stable substratum for long-lived, slow growing species of axinellid sponge and soft corals, while the softer Wealden sandstone is easily eroded and is colonised by rapidly growing and relatively short-lived species such as encrusting sponges and bryozoans. At Bembridge, and elsewhere in the site, littoral pools support a number of rare or unusual seaweeds such as the shepherd’s purse seaweed *Gracilaria bursa-pastoris*.

The cliffs to the south of the Isle of Wight contain contrasting Cretaceous hard cliffs, semi-stable soft cliffs and mobile soft cliffs. The western and eastern extents of the site contain exposed chalk cliffs with relatively sheltered species rich calcareous grassland. In combination with the adjoining Isle of Wight Downs, the west of the site has an unusual combination of maritime and chalk grassland, and the most exposed cliffs contain assemblages of nationally rare lichens such as *Fulgensia fulgens*. The longest section of cliffs comprises slumping acidic sandstones and neutral clays with mixed acidic and mesotrophic grasslands with some scrub and thrift *Armeria maritima*. Having minimal sea defence works, the area forms one of the longest sections of naturally-developing soft cliffs in the UK. The calcareous geology of the South Wight Maritime SAC and exposure to wave energy, has resulted in the formation of a number of sea caves from the Needles to Watcombe Bay, and also in Culver Cliff. Rare algal species, and a range of mollusc species and the horseshoe worm *Phoronis hippocrepia* are present in the sea cave habitats.

Lyme Bay and Torbay SAC[86]

The Lyme Bay and Torbay SAC comprises two areas (from east to west), namely, Lyme Bay reefs, and Mackerel Cove to Dartmouth reefs. The Lyme Bay reefs are noted to have particularly high species richness and support a diverse number of invertebrate animals, immobile filter feeders and anemones anchored to the substrate, and an assortment of hydroids, bryozoans, sea squirts, erect sponges and corals populate the area. Lyme Bay is one of only five areas in the British Isles where the sunset cup coral *Leptopsammia pruvoti* is known to occur.

The Mackerel Cove to Dartmouth reefs contain sea caves which demonstrate some of the best examples of coastal solution caves in the UK. The surfaces and walls inside the caves host a variety of sponges, bryozoan crusts, pink sea fingers, anemones and cup corals. The overhangs, holes and recesses are home to some notable species such as the sponge, *Geodia cydonium*.

River Axe SAC

The River Axe is comprised of a mixed catchment geology of sandstones and limestones where calcareous waters gives rise to a diverse mix of aquatic and marginal flora. The active geomorphology of the river has generated a range of natural features (including long riffles, deep pools, islands and meanders), which provide a variety of ecological niches. This variety of river channel habitat also supports an important fish community, including the qualifying species, sea lamprey *Petromyzon marinus*, brook lamprey *Lampetra planeri* and bullhead *Cottus gobio*.

5.2.2 Assessment of physical disturbance and drilling effects

The conservation objectives of relevant sites that could be impacted by physical disturbance and drilling effects, and information relating to site selection and advice on operations have been considered against the activities in the proposed work programmes for the licence areas applied for to determine whether they could adversely affect site integrity. The results are given in Table 5.3 below. All mandatory control requirements (as given in Section 2.3.1) are assumed to be in place as a standard for all activities assessed.

Table 5.3: Consideration of potential physical disturbance and drilling effects and relevant site conservation objectives

Solent and Dorset Coast SPA[87]
Site Information
Area (ha/km^2): 88,981/890 **Relevant qualifying features:** Sandwich tern*, common tern*, little tern* **Conservation objectives:** Subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: • The extent and distribution of the habitats of the qualifying features • The structure and function of the habitats of the qualifying features • The supporting processes on which the habitats of the qualifying features rely • The populations of each of the qualifying features

86 https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030372#backgroundinfo
87 https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9020330

- The distribution of qualifying features within the site

Feature condition: not assessed

*Terns are associated with colonies relating to Poole Harbour SPA and Ramsar (common tern, little tern), Solent and Southampton Water SPA (common tern, little tern, Sandwich tern), and Chichester and Langstone Harbours SPA (common tern, little tern, Sandwich tern). The following assessment also covers the tern features of these sites, and also their related Ramsar sites, where relevant to this AA.

Relevant licence areas with potential for physical disturbance and drilling effects
English Channel Area 1
Activities associated with the proposed work programmes within the relevant licence areas
Drilling up to two wells involving - siting of rig, drilling discharges
Assessment of effects on site integrity

Rig siting
Relevant pressures: *Physical change (to another seabed or sediment type)*

The advice on operations indicates that the supporting habitats for the features are sensitive to the above pressures, however, the area applied for is ~2km from the site, and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), rig installation will not significantly impact the extent and distribution of the habitats of the qualifying features within the site. While the maximum spatial footprint of physical damage associated with jack-up rig siting is small ($0.8km^2$, Table 2.2) relative to the area over which common and Sandwich terns may forage (e.g. 18.0±8.9km and 34.3±23.2km respectively, see Woodward *et al.* 2019) outside of the site boundaries, it is noted that the boundaries of the site were defined on the basis of modelled foraging from tern colonies of related SPAs, in particular, Poole Harbour SPA (colony at Brownsea Island), Solent and Southampton Water SPA (colony at Pitts-Deep-Hurst) and Chichester & Langstone Harbours SPA, such that any impact on relevant habitat is considered to be minor and not significant. Recovery from physical disturbance of the scale associated with rig siting is expected to be relatively rapid given the moderate to high energy seabed environment across much of the English Channel and the potential physical disturbance will not have a significant effect on the extent and distribution of the supporting habitats of the features either in the site or within their wider foraging ranges, and therefore, there will be no adverse effect on site integrity on the sites of, Solent and Dorset Coast SPA, Poole Harbour SPA, Solent and Southampton Water SPA and Chichester & Langstone Harbours SPA.

The requirement for rig stabilisation measures would be determined by site survey of local conditions. In soft sediments (which are not present across much of the licence area offered and the area of relevance to Solent and Dorset Coast SPA), rock placement may cause smothering of existing sediments and a physical change to another seabed type. As noted above, the area applied for is ~2km from the SPA site boundary, and no direct effects on the habitat within the site will occur, such that site conservation objectives will not be undermined and there will be no adverse effect on site integrity.

As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
Relevant pressures: *Hydrocarbon & PAH contamination, Introduction of other substances (solid, liquid or gas), Physical change (to another seabed or sediment type)*

The supporting habitat is sensitive to the above pressures associated with drilling discharges. The advice on operations indicates that the qualifying features and their supporting habitats have not been assessed against whether they are sensitive to contaminants pressures, but they are considered to be a moderate-high risk. Any discharge from exploration well drilling would be subject to risk assessment as part of existing regulatory controls (see Section 2.3.1). It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2), which is substantially less than the minimum distance from the area offered to the site (~2km). This, combined with mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity on the sites of, Solent and Dorset Coast SPA, Poole Harbour SPA, Solent and Southampton Water SPA and Chichester & Langstone Harbours SPA.

Other effects
Relevant pressures: *visual disturbance, above water noise*

Note that the above pressures are considered to represent a low risk to the site qualifying features and are only considered briefly here. Terns have a low sensitivity to disturbance by ship and helicopter traffic (Garthe & Hüppop 2004, Furness *et al*. 2013, Fliessbach *et al.* 2019), and given the distance from the area offered to the site (1.7km) and that the site boundaries were identified on the basis of important foraging areas for the qualifying tern species, significant disturbance is not considered to be likely. Shipping in the area is concentrated along established routes with the Solent, across Christchurch Bay, Poole Bay and Studland Bay, well to the north of the area offered. The temporary and localised nature of drilling activities and limited number of associated supply vessel and helicopter trips (see Table 2.2), which would likely use established routes, are such that they will not likely lead to an impact on the qualifying features' distribution and use of the Solent and Dorset Coast SPA, and by association, Poole Harbour SPA, Solent and Southampton Water SPA and Chichester & Langstone Harbours SPA, such that their ability to survive and/or breed is compromised in the longer term.

In-combination effects
Intra-plan in-combination effects are unlikely English Channel Area 1 is located ~2km outside of the site boundaries, and effects on the supporting habitat of the site are not predicted for any of the wells which could be drilled. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.2.

Chesil Beach and the Fleet SPA[88] and Ramsar

Site Information

Area (ha/km^2): 747/7.47
Relevant qualifying features: little tern, wigeon

Conservation objectives:
Subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring:

- The extent and distribution of the habitats of the qualifying features
- The structure and function of the habitats of the qualifying features
- The supporting processes on which the habitats of the qualifying features rely
- The populations of each of the qualifying features
- The distribution of qualifying features within the site

Feature condition: not assessed

Relevant licence areas with potential for physical disturbance and drilling effects

English Channel Area 1

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to two wells involving - siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
Relevant pressures: *penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed/sediment type) and introduction or spread of non-indigenous species*

The advice on operations indicates that the supporting habitats for the features are sensitive to the above pressures, however, the area applied for is at least 2km from the site, and given the assumed distance from a jack-up rig within which effects may occur (500m, see Table 2.2), and that the site boundaries are entirely terrestrial, rig installation will not impact the extent and distribution of the habitats of the qualifying features within the site. The foraging range of little term (maximum of 5km and a mean of 3.5km, see Woodward *et al.* 2019) is such that it terns could partly forage in the licence area, however, the extent of the area applied for that is within 5km of the site is very small, and there is considerable area within which to site a rig beyond such a distance. Recovery from physical disturbance of the scale associated with rig siting is expected to be relatively rapid given the moderate to high energy seabed environment across much of the English Channel and the potential physical disturbance will not have a significant effect on the extent and distribution of the supporting habitats of the features either in the site or within the limited area of potential foraging range overlap. The widgeon feature of the site is strongly associated with the coast and intertidal area and effects are not predicted. There will be no adverse effect on site integrity of the Chesil Beach and the Fleet SPA from rig siting.

[88] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK9010091

As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
Relevant pressures: *Smothering and siltation rate changes (Light), Hydrocarbon & PAH contamination, Introduction of other substances (solid, liquid or gas)*

The supporting habitat is sensitive to the above pressures associated with drilling discharges. The advice on operations indicates that the qualifying features and their supporting habitats have not been assessed against whether they are sensitive to contaminants pressures, but they are considered to be a moderate-high risk. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2), which is substantially less than the minimum distance from the area offered to the site (at least 2km). Given the foraging range of little tern (5km) relative to the distance between the licence area and the site boundaries (2km), there is the potential for a small part of the licence area to be within the supporting habitat of the feature, however, there is considerable area within which to site a rig beyond such a distance. This, combined with mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1), will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

Other effects: *visual disturbance, above water noise, above water noise, barrier to species movement, collision above water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures), collision below water with static or moving objects not naturally found in the marine environment*

Note, that the above pressures are considered to represent a low risk to the site qualifying features, and are only considered briefly here. Terns have a low sensitivity to disturbance by ship and helicopter traffic (Garthe & Hüppop 2004, Furness *et al*. 2013, Fliessbach *et al.* 2019), and given the small extent of the licence area within foraging range of the site, and vice versa, and that there is considerable area within which to site a rig beyond such a distance, significant disturbance is not considered to be likely. Shipping in the area is more limited compared to areas further south and east, which are concentrated along stablished routes. The temporary and localised nature of drilling activities and limited number of associated supply vessel and helicopter trips (see Table 2.2), are such that they will not likely lead to an impact on the qualifying features' distribution and use of the site such that their ability to survive and/or breed is compromised in the longer term.

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges are localised and temporary, and unlikely to overlap either spatially or temporally. The combined spatial footprint within which physical disturbance and drilling effects could occur (within 500m of the rig/well location) in the relevant licence areas applied for is estimated at 1.6km^2. However, in view of the distance from a jack-up rig within which effects may occur (500m) relative to the distance between the site boundaries and the area applied for (at least 2km), the application of mandatory control measures (Section 2.3.1), and other measures (Section 5.2.3), site conservation objectives will not be undermined. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.2.

Wight-Barfleur Reef SAC[89]

Site information

Area (ha/km^2): 137,300/1,373
Relevant qualifying features: reefs

Conservation objectives:
For the feature to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of Annex I Reefs.

This contribution would be achieved by maintaining or restoring, subject to natural change:
- The extent and distribution of the qualifying habitat in the site;
- The structure and function of the qualifying habitat in the site; and
- The supporting processes on which the qualifying habitat relies.

Attributes of the site features related to the conservation objectives are presented in the site SACO[90].

[89] https://jncc.gov.uk/our-work/wight-barfleur-reef-mpa/
[90] https://hub.jncc.gov.uk/assets/11c55f61-4aa7-4665-a95b-0a552ccccd62

Feature condition: unfavourable (Annex I reefs)
Relevant licence areas with potential for physical disturbance and drilling effects
English Channel Area 1
Activities associated with the proposed work programmes within the relevant licence areas
Drilling up to two wells involving - siting of rig, drilling discharges
Assessment of effects on site integrity
Rig siting ***Relevant pressures:*** *penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed type) and introduction or spread of invasive non-indigenous species* The advice on operations indicates that the site qualifying features are sensitive to the above pressures from the placement of spud cans as part of rig siting. Wight-Barfleur Reef SAC covers a substantial portion of the area applied for (~22%). However, there remains a significant proportion of the licence area which is not inside the SAC within which a rig may be sited, and thus there is considerable potential to avoid interaction with the site and physical disturbance effects, in line with JNCC and Natural England advice. As described in Section 2.3 drilling activities require separate consents, which are themselves subject to the requirements of the Habitats Regulations. It is only at that point when specific details of the activities and their location are known that the potential for physical disturbance effects can be considered in sufficient detail. If any adverse effect that cannot be mitigated is identified at that point, then the consent will be refused or the derogation provisions in the Habitats Regulations applied if there are imperative reasons of overriding public interest. The reef feature of the site is judged to be in unfavourable condition[91] primarily due to the influence of demersal fisheries, which are now effectively managed through fisheries restrictions (see Section 5.2.1) and site condition can be expected to improve. While the physical structure of the rocky reef habitat may have a low recovery potential if subject to significant disturbance, recovery of its associated fauna depends on the individual life histories of the species. Should a rig be located within the site, the maximum spatial footprint of the penetration and/or disturbance pressure associated with jack-up rig siting is small (0.8km^2, see Table 2.1) compared to the site (covering 0.01%), and while this would likely result in mortality to seabed fauna in the immediate vicinity of the spud cans, it would not be expected to result in significant change to seabed conditions (e.g. through the reduction in the extent of habitat, or resulting in significant changes to its structure and function) such that, when combined with the high energy environment of the site, would not allow for recovery. Recovery of damage to surface and sub-surface features of the scale associated with rig placement is expected to be rapid due to its localised scale and the energetic nature of the environment, and the temporary nature of the activities, for example, some recovery of fauna on rocky reef within the Channel was noted by Sheehan *et al.* (2013) within three years following the exclusion of scallop dredging. Further mitigation measures are also available and will be required as appropriate as part of consenting (e.g. rig siting to ensure sensitive seabed surface features are avoided, see Section 5.2.3), which will ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity. Given the available space within the wider licence area, there is considerable scope available to site the rig away from the site, such that any effect can be avoided, and it is expected that this would form the basis of any mitigation required as part of assessment at the project level, in order to avoid effects. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information. There may be a requirement for rig stabilisation depending on local seabed conditions. In soft sediments, deposited rock may cover existing sediments resulting in a physical change (to another seabed type). While the SACO does not identify the site to be sensitive to this pressure, the application of rock for rig stabilisation, while introducing further hard substrate in what is a bedrock and stony reef, would introduce substrates which differ in composition (e.g. granite) to the prevailing softer sediments in the area (e.g. chalk, limestone and sandstone), though the scale of the introduction of such material would be very small. It is assumed that rock placement (if required) would be within 500m of the rig and cover an estimated area of 0.001-0.004km^2 per rig siting (Table 2.2), or 0.0001% of the site area. As noted above, given the available space within the wider licence area, there is considerable scope available to site the rig away from the site such that any effect can be avoided, and it is expected that this would form the basis of any mitigation required as part of assessment at the project level. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information.

[91] https://data.jncc.gov.uk/data/11c55f61-4aa7-4665-a95b-0a552ccccd62/WBR-4-ConservationStatements-V1.0.pdf

As noted in Section 4.2.5, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
Relevant pressures: *abrasion/disturbance of the substrate on the surface of the seabed, smothering and siltation rate changes (low)*

The advice on operations indicates that the qualifying feature is sensitive to the above pressures, most of which relate to seabed disturbance and habitat changes associated with smothering by drill cuttings near the well location, and that these cuttings can accumulate in piles where currents are generally weak. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2), and therefore, where a rig is placed beyond 500m from the site boundary, drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitat. Should a well be drilled inside the site boundaries, the maximum spatial footprint within which smothering by drilling discharges and associated habitat structure changes may occur (0.8km^2) is small (representing 0.01% of the total site area) and given the site's exposure to strong tidal energy, redistribution of drilling discharges and recovery from smothering would be rapid, and there would be no permanent change in site habitat. Therefore, site conservation objectives will not be undermined. However, as noted above there is a significant proportion of the licence area which is not in the SAC boundaries within which a rig may be sited, and there is considerable potential that physical disturbance effects may be avoided. As described in Section 2.3 drilling activities require separate consents, which are themselves subject to the requirements of the Habitats Regulations. It is only at that point when specific details of the activities and their location are known that the potential for physical disturbance effects can be considered in sufficient detail. If any adverse effect that cannot be mitigated is identified at that point, then the consent will be refused or the derogation provisions in the Habitats Regulations applied if there are imperative reasons of overriding public interest.

The advice on operations indicates that there is insufficient evidence to make an assessment of sensitivity to contamination pressures (*hydrocarbon and PAH contamination, introduction of other substances (solid, liquid or gas), synthetic compound contamination*) described in Section 4.2.2. However, the small scale and temporary nature of drilling discharges and the mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1) will ensure that site conservation objectives are not undermined.

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges will be localised and temporary. Given the indicative work programmes (Table 2.2), the combined spatial footprint within which physical disturbance and drilling effects could occur (within 500m of the rig/well location) across the areas applied for (a worst-case scenario of up to 2 wells) is estimated at 1.6km^2 (0.03% of the site). The temporary nature of the disturbance, energetic nature of the environment, required controls and mitigation (Sections 2.3.1 and 5.2.3), will ensure that site conservation objectives are not undermined. However, as noted above there is a significant proportion of the licence area which is not in the SAC boundaries within which a rig may be sited, and there is considerable potential that physical disturbance effects may be avoided. As described in Section 2.3 drilling activities require separate consents, which are themselves subject to the requirements of the Habitats Regulations. It is only at that point when specific details of the activities and their location are known that the potential for physical disturbance effects can be considered in sufficient detail. If any adverse effect that cannot be mitigated is identified at that point, then the consent will be refused or the derogation provisions in the Habitats Regulations applied if there are imperative reasons of overriding public interest. A consideration of potential activities in-combination with other relevant plans and projects is given in Section 6.2.

Studland to Portland SAC[92]

Site information

Area (ha/km^2): 33,191/332
Relevant qualifying features: reefs

[92] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030382

Conservation objectives: subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring: • The extent and distribution of qualifying natural habitats and habitats of the qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of the qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • The populations of each of the qualifying species • The distribution of qualifying species within the site Attributes and related targets have been set for the site features which are presented in the site SACO[93]. **Feature condition:** favourable
Relevant licence areas with potential for physical disturbance and drilling effects
English Channel Area 1
Activities associated with the proposed work programmes within the relevant licence areas
Drilling up to two wells involving - siting of rig, drilling discharges
Assessment of effects on site integrity
Rig siting ***Relevant pressures:*** *penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed type) and introduction or spread of invasive non-indigenous species* The reef qualifying feature is sensitive to penetration and/or disturbance of the seabed surface and subsurface by the placement of spud cans as part of rig siting. The area offered has a small area of overlap with the site (~3.5km^2), although seabed substrates are circalittoral rock and other hard substrata and therefore rig siting is unlikely in this area. The assumed distance from a jack-up rig within which effects may occur is small (500m, see Table 2.2) and temporary given the tidal currents over the area (1-2m/s spring peak flow). Given the available space within the wider licence area, there is considerable scope available to site the rig away from the site, such that any effect can be avoided, and it is expected that this would form the basis of any mitigation required as part of assessment at the project level (which includes Habitats Regulations Assessment), in order to avoid effects. The potential to impact the extent and distribution of qualifying natural habitats and habitats of qualifying species is limited, the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by the specific timing and location of the rig, noting that further mitigation measures are available (e.g. rig siting to ensure sensitive seabed features such as reef are avoided, see Section 5.2.3). There may be a requirement for rig stabilisation depending on local seabed conditions. The relatively strong tidal currents over the area offered and nature of seabed sediments (rock or circalittoral coarse) would suggest that rig stabilisation will not be required. If located outside of the site (which is most likely given the small overlap of 7.9km^2), the potential for loss of extent of qualifying natural habitat is limited. In the event that a rig was located within the site, the potential loss of habitat is small (0.001-0.004km^2, see Table 2.2) compared to the extent of similar habitat types across the site and the wider region. It is concluded that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information, and would allow for the identification of project specific mitigation, where required. As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS. **Drilling discharges** ***Relevant pressures:*** *abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants*

[93] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030382

As indicated above, rig siting is unlikely in the part of the area applied for which overlaps the site given the hard substrate present, and there are significant areas outside of the site in which rig siting would be possible, allowing for rig site selection avoid any impact from discharges on the site. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and these are likely to be temporary given the tidal currents over the area (1-2m/s spring peak flow). Therefore, the potential for drilling discharges to impact the extent or distribution of the qualifying natural habitats is limited. Moreover, further mitigation measures are available including the siting of activities to ensure sensitive seabed surface features (such as reefs) are avoided. In any case, the small scale and temporary nature of potential smothering, and mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1) are such that site conservation objectives will not be undermined and there is no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information, and would allow for the identification of project specific mitigation, where required.

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges are localised and temporary, and highly unlikely to overlap either spatially or temporally. As there is limited overlap between the site and the area applied for, and there is significant area outside of the site boundaries in which rig siting and drilling discharges would be possible, the likelihood of in-combination effects are low. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information, and would allow for the identification of project specific mitigation (including avoidance, see Sections 2.3.1 and 5.2.3), where required. Section 6.2 provides a consideration of potential activities in-combination with other relevant plans and projects.

South Wight Maritime SAC[94]

Site information

Area (ha/km²): 19,863/199
Relevant qualifying features: reefs

Conservation objectives:
Subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of the qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of the qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of each of the qualifying species
- The distribution of qualifying species within the site

Attributes and related targets have been set for the site features which are presented in the site SACO[95].

Site condition: favourable

Relevant licence areas with potential for physical disturbance and drilling effects

English Channel Area 1

Activities associated with the proposed work programmes within the relevant licence areas

Drilling up to two wells involving - siting of rig, drilling discharges

Assessment of effects on site integrity

Rig siting
Relevant pressures: *penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed/sediment type) and introduction or spread of invasive non-indigenous species*

[94] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030061
[95] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030061

The reef qualifying feature is sensitive to penetration and/or disturbance of the seabed surface and subsurface by the placement of spud cans as part of rig siting. The assumed distance from a jack-up rig within which effects may occur is small (500m, see Table 2.2) and substantially less than the distance between the area applied for and the site (1.6km). It is therefore not considered possible for rig siting, or the application of rig stabilisation material (if required), to affect the extent, distribution, structure, function or supporting processes of the reef habitat, such that site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by the specific timing and location of the rig, noting that further mitigation measures are available (e.g. rig siting to ensure sensitive seabed features such as reef are avoided, see Section 5.2.3).

As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS.

Drilling discharges
Relevant pressures: *abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity); smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants*

While the reef qualifying feature is sensitive to the above pressures, the assumed distance from a jack-up rig within which effects relating to discharges may occur is small (500m, see Table 2.2) and substantially less than the distance between the area applied for and the site (1.6km). It is therefore not considered possible for drilling discharges to affect the extent, distribution, structure, function or supporting processes of the reef habitat, such that site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by the specific timing and location of the rig, noting that further mitigation measures are available (e.g. rig siting to ensure sensitive seabed features such as reef are avoided, see Section 5.2.3).

Other effects
N/A

In-combination effects
It is not considered that the siting of a drilling rig or the drilling of any individual well in the area applied for, could result in an adverse effect on site integrity for the South Wight Maritime SAC, as it is beyond a distance within which any impact is considered likely. Section 6.2 provides a consideration of potential activities in-combination with other relevant plans and projects.

Lyme Bay and Torbay SAC[96]

Site Information

Area (ha/km^2): 31,248/312
Relevant qualifying features: reefs

Conservation objectives:
Subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring:

- The extent and distribution of qualifying natural habitats and habitats of the qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of the qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The populations of each of the qualifying species
- The distribution of qualifying species within the site

Attributes and related targets have been set for the site features which are presented in the site SACO[97].

Site condition: unfavourable recovering (70%)/favourable (30%)

[96] https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030372
[97] https://designatedsites.naturalengland.org.uk/Marine/SupAdvice.aspx?SiteCode=UK0030372

Relevant licence areas with potential for physical disturbance and drilling effects
English Channel Area 1
Activities associated with the proposed work programmes within the relevant licence areas
Drilling up to two wells involving - siting of rig, drilling discharges
Assessment of effects on site integrity
Rig siting ***Relevant pressures:*** *penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; abrasion/disturbance of the substrate on the surface of the seabed, physical change (to another seabed/sediment type) and introduction or spread of invasive non-indigenous species* The reef qualifying feature is sensitive to penetration and/or disturbance of the seabed surface and subsurface by the placement of spud cans as part of rig siting. The area offered has a small area of overlap with the site (~21km^2), although seabed substrates are circalittoral rock and other hard substrata and therefore rig siting is unlikely in this area. The assumed distance from a jack-up rig within which effects may occur is small (500m, see Table 2.2) and temporary, though tidal currents over the area (0.25-0.5m/s spring peak flow) are less than more exposed areas of the Channel. Given the available space within the wider licence area, there is considerable scope available to site the rig away from the site, such that any effect can be avoided, and it is expected that this would form the basis of any mitigation required as part of assessment at the project level (which includes Habitats Regulations Assessment), in order to avoid effects. The potential to impact the extent and distribution of qualifying natural habitats and habitats of qualifying species is limited, the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by the specific timing and location of the rig, noting that further mitigation measures are available (e.g. rig siting to ensure sensitive seabed features such as reef are avoided, see Section 5.2.3). There may be a requirement for rig stabilisation depending on local seabed conditions. The relatively strong tidal currents over the area offered and nature of seabed sediments (rock or circalittoral coarse) would suggest that rig stabilisation will not be required. If located outside of the site (which is most likely given the small overlap of ~21km^2), the potential for loss of extent of qualifying natural habitat is limited. In the event that a rig was located within the site, the potential loss of habitat is small (0.001-0.004km^2, see Table 2.2) compared to the extent of similar habitat types across the site and the wider region. It is concluded that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information, and would allow for the identification of project specific mitigation, where required. It is therefore not considered possible for rig siting, or the application of rig stabilisation material (if required), to affect the extent, distribution, structure, function or supporting processes of the reef habitat, such that site conservation objectives will not be undermined and there will be no adverse effect on site integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by the specific timing and location of the rig, noting that further mitigation measures are available (e.g. rig siting to ensure sensitive seabed features such as reef are avoided, see Section 5.2.3). As noted in Section 4.2.1, management of the spread of non-native species from vessels and rigs is being progressed through international measures, and the risk is limited by the operational range of rigs on the UKCS. **Drilling discharges** ***Relevant pressures:*** *abrasion/disturbance of the substrate on the surface of the seabed, smothering and siltation rate changes (light); physical change (to another sediment type), habitat structure changes – removal of substratum (extraction) and contaminants* As indicated above, rig siting is unlikely in the part of the area applied for which overlaps the site given the hard substrate present, and there are significant areas outside of the site in which rig siting would be possible, allowing for rig site selection avoid any impact from discharges on the site. It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2) and these are likely to be temporary. Therefore, the potential for drilling discharges to impact the extent or distribution of the qualifying natural habitats is limited. Moreover, further mitigation measures are available including the siting of activities to ensure sensitive seabed surface features (such as reefs) are avoided. In any case, the small scale and temporary nature of potential smothering, and mandatory control requirements with respect to drilling chemical use and discharge (Section 2.3.1) are such that site conservation objectives will not be undermined and there is no adverse effect on site

integrity. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information, and would allow for the identification of project specific mitigation, where required.

Other effects
N/A

In-combination effects
Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges are localised and temporary, and highly unlikely to overlap either spatially or temporally. As there is limited overlap between the site and the area applied for, and there is significant area outside of the site boundaries in which rig siting and drilling discharges would be possible, the likelihood of in-combination effects are low. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information, and would allow for the identification of project specific mitigation (including avoidance, see Sections 2.3.1 and 5.2.3), where required. Section 6.2 provides a consideration of potential activities in-combination with other relevant plans and projects.

5.2.3 Further physical disturbance and drilling mitigation measures

Further mitigation measures are available which are identified through the environmental assessment process, which may involve EIA (see Figure 2.2), and operator's environmental management system and the Departmental permitting processes. These considerations are informed by project specific plans and the nature of the sensitivities identified from detailed seabed information collected in advance of field activities taking place. Site surveys are required to be undertaken before drilling rig placement (for safety and environmental reasons) and the results of such surveys (survey reports) allow for the identification of further mitigation including the re-siting of activities (e.g. wellhead or rig leg positions) to ensure sensitive seabed surface features (such as reefs) are avoided and potential rig stabilisation issues (e.g. from scouring around spud cans, or soft sediment conditions) are minimised. Survey reports are used to underpin operator environmental submissions (e.g. EIAs) and where requested, survey reports are made available to SNCBs during the consultation phases of these assessments. As noted in Table 5.3, given the available space within the licence area which does not cover a relevant site, there is considerable scope available to site the rig away from the sites such that any effect can be avoided, and it is expected that this would form the basis of any mitigation required as part of assessment at the project level, in order to avoid effects. The need for mitigation would be identified at the project level, at which time further assessment including HRA would be required.

It is not typical for rig stabilisation to be required (see Table 2.2), but this will be informed by site-specific survey and project specific plans which are not currently available. Where rig stabilisation or anti-scour protection is required, the Department will expect operators to provide adequate justification for the stabilisation option proposed (including for rig siting beyond site boundaries, if practical) and consider use of systems that can be removed following drilling, where these meet the technical and safety requirements of rig placement. Where rock placement is required, the Department will expect operators to minimise the volume of rock deposited. The need for rig stabilisation or scour protection, and the need for mitigation, would be identified at the project level, at which time further assessment including HRA would be required.

5.2.4 Conclusions of English Channel regional assessment

Likely significant effects identified with regards to physical damage to the seabed, drilling discharges, and other effects when considered along with project-level mitigation (Section 5.2.3) and relevant activity permitting requirements (see Section 2.3.1), will not have an adverse effect on the integrity of the sites considered in this assessment. At the project level, where the Habitats and EIA Regulations[98] apply, there is a requirement to coordinate assessments made under the respective regulations. Figure 2.2 sets out the interaction of the two regulatory areas. Their application at the project level allows for an assessment to be made of likely significant effects on the basis of detailed project-specific information and allows for applicants to propose project specific mitigation measures.

5.2.5 Assessment of underwater noise

The site conservation objectives and other relevant information relating to site selection and advice on operations has been considered against indicative work programmes (see Section 2.2.1) to determine whether they could adversely affect site integrity. New seismic surveys have been proposed in the work programme for the licence area applied for (Table 2.1) which are relevant to the assessment. Sites relevant to this part of the assessment are shown in Figure 5.3 and Figure 5.4, and the results are given in Table 5.4 below. All mandatory control requirements (as given in Section 2.3.2) are assumed to be in place as a standard for all activities assessed at this stage.

Table 5.4: Consideration of potential underwater noise effects and relevant site conservation objectives

River Axe SAC
Site Information
Area (ha/km^2): 26/0.26 **Relevant qualifying features:** sea lamprey **Conservation objectives:** Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats and habitats of qualifying species • The structure and function (including typical species) of qualifying natural habitats • The structure and function of the habitats of qualifying species • The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • The populations of qualifying species, and, • The distribution of qualifying species within the site. **Feature condition**: unfavourable (based on the site SACO and SSSI condition assessment)[99]
Relevant licence areas with potential underwater noise effects
English Channel Area 1
Assessment of effects on site integrity
Impulsive noise (2D/3D seismic survey, rig site survey, VSP, conductor piling) ***Relevant pressures:*** *underwater noise change, vibration*[100] The site boundary for the River Axe is entirely terrestrial, however, the sea lamprey *Petromyzon marinus* qualifying feature is an anadromous species which spawns in the freshwaters of the SAC, but completes its lifecycle in the sea, where it spends 18-24 months (e.g. see Silva *et al.* 2013) feeding by parasitising various fish species (OSPAR 2009b) before returning to rivers in the early spring and summer to spawn. The lifecycle of sea lamprey is poorly understood, and in particular their marine phase, however given the distance between the area applied for and mouth of the River Axe (11km), and the distance from which effects from deep geological seismic

[98] *Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020*
[99] https://designatedsites.naturalengland.org.uk/TerrestrialAdvicePDFs/UK0030248.pdf, https://publications.naturalengland.org.uk/publication/5847770160955392
[100] Advice on operations are not available for the River Axe SAC. The pressures are based on those relevant to activities which could follow licensing and the Marine Pressures-Activities Database (PAD) v1.5.

survey could be considered possible (15km), it is considered possible that lamprey related to the River Axe SAC could be affected. The SACO for the site notes the importance of "off-site habitats" in relation to habitat structure and function, and the importance of the marine phase of lamprey and in particular their access to transitional and marine waters. As noted in Section 4.3.2, consistent with fish lacking a swim bladder, sea lamprey show a limited sensitivity to sound, with juveniles detecting tones of 50-300Hz, but not higher frequencies, and showed a behavioural response (e.g. increased swimming) at frequencies of 50-200Hz (Mickle *et al.* 2019). While these frequencies overlap with those likely to arise during deep geological seismic survey, there is no evidence of mortality from seismic survey in studies of fish species (se Section 4.3.2). Should a seismic survey take place in the area applied for, adverse effects on the sea lamprey feature of the River Axe are not predicted. The frequencies associated with electromechanical sources such as 'pinger' or 'chirper' sub-bottom profilers, side-scan sonar and multi-beam echosounders, are well above those perceived by lamprey, and no effects are predicted from these. The location and timing of any seismic survey is presently unknown but would be subject to assessment (Section 5.2.6) including, where appropriate, HRA prior to consent being granted.

The impulsive underwater noise produced should conductors need to be piled into the seabed is of significantly lower magnitude than that generated in the piling of offshore wind turbine monopile foundations (see Table 2.2). Considering the noise source characteristics, the short duration of the activity, and the uncommon use of this technique to meet technical requirements; when combined with mandatory control measures (Section 2.3.2), any disturbance to sea lamprey beyond the site boundaries will be highly localised, short-term, and will not result in an adverse effect on site integrity.

Continuous noise (drilling, vessel & rig movements)
Relevant pressures: *underwater noise change, vibration*
The frequencies of sounds produced from drilling operations and vessel movements are generally higher than those which are noted to elicit a response in sea lamprey (see Section 4.3.1). Given existing levels of shipping activity over the areas offered (see Section 6.2), the temporary nature of drilling activities and limited number of associated supply vessels will not represent a significant increase in the level of disturbance that could lead to disturbance of sea lamprey outside of the site for a significant period of time. Further mitigation measures are also available (Section 5.2.6) and will be required, where appropriate, to ensure that site conservation objectives are not undermined and there is no adverse effect on site integrity.

In-combination effects
Intra-plan in-combination underwater noise effects are considered highly unlikely given the low potential for effects identified above and the likely temporal and spatial separation of any individual licence activities which could take place. Section 6.2 provides a consideration of potential licence activities in-combination with other relevant plans and projects.

5.2.6 Further underwater noise mitigation measures

The Department require operators to provide sufficient information in the environmental assessment (and possibly EIA, see Figure 2.3), which includes a noise assessment, on the potential impact of proposed activities on relevant sites and their qualifying features as well as proposed further mitigation measures in their applications for a relevant consent. Due to the temporary nature of the activities, mitigation measures could include activity timing to avoid the most sensitive periods[101]. Operators must demonstrate how seasonal sensitivities have been taken into account when planning operations (see BEIS 2021c). The information provided by operators must be detailed enough for the Department to make a decision on whether the activities could lead to a likely significant effect, and whether the activities should require HRA. Depending on the nature and scale of the proposed activities (e.g. area of survey, source size, timing, and proposed mitigation measures) and whether likely effects are identified for these, the Department may undertake further HRA to assess the potential for adverse effects on the integrity of sites at the activity specific level.

[101] For example, see: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1133330/Details_on_upcoming_noisy_activities_in_the_Southern_North_Sea_2023.pdf

Consent for project-level activities will not be granted unless the operator can demonstrate that the proposed activities, which may include seismic survey, small-scale geophysical rig site survey, VSP, and drilling (which may incorporate conductor piling), will not have an adverse effect on the integrity of relevant sites or where there are imperative reasons of overriding public interest and the requirements of Regulation 6 of the Habitats Regulations are met.

The planning of seismic surveys should endeavour to minimise exposure of noise-sensitive qualifying features to underwater noise by careful consideration of the timing with respect to: 1) seasonal differences in the distribution of relevant species across their ranges in relation to relevant sites, and 2) the presence of other underwater noise-generating activities (i.e. other geophysical surveys and impact piling). It is advised that the licensee establish early discussions with the Department to understand the nature and timing of proposed activities such that significant in-combination effects can be avoided (see Section 6.2). Early consultation with the relevant SNCBs is also recommended.

5.2.7 Conclusions of English Channel regional assessment

Although underwater sound generated during project-level activities, specifically seismic surveys, has the potential to injure and disturb individual fish, the actual risk is minimised by the controls currently in place.

For any of the relevant sites, it is concluded that the likely level of activity expected to take place within the area offered considered in this assessment will not cause an adverse effect on site integrity, taking account of the following:

- Should a 3D seismic survey be proposed in the area applied for, further HRA may be required to assess the potential for adverse effects on the integrity of the site once the area of survey, source size, timing and proposed mitigation measures are known and can form the basis for a definitive assessment.

Individual activities (e.g. drilling, seismic) require individual consents which will not be granted unless the operator can demonstrate that the proposed activities, which may include 3D seismic surveys, will not adversely affect the site integrity of relevant sites, or that compensatory measures are applied if it is decided that a project should be carried out for imperative reasons of overriding public interest and where there are no alternative solutions to the project. These activities will be subject to activity level EIA and, where appropriate, HRA.

6 In-combination effects

Potential incremental, cumulative, synergistic, and secondary effects from a range of operations, discharges and emissions (including noise) were considered in the latest Offshore Energy SEA (BEIS 2022). There are a number of potential interactions between activities that may follow licensing and those existing or planned activities, for instance in relation to renewable energy, offshore oil and gas and gas storage, fishing, shipping, and aggregate extraction. These activities are subject to individual permitting or consenting mechanisms or are otherwise managed at a national level. The areas applied for are located within the East Inshore and Offshore, the South Inshore and South Offshore, and the North West Inshore and Offshore Marine Plan areas. These plans set out objectives and policies to guide development in these areas and are referred to where relevant in the following sections.

The potential for intra-plan in-combination effects was considered for those sites subject to AA in Sections 5.1, 5.2 and 5.3 (i.e. that multiple areas applied for have the potential to be licensed and are relevant to the same site). The following section considers the potential for in-combination effects with other relevant plans and programmes.

Sources of potential effect

Projects for which potential interactions with operations that could arise from the licensing of the carbon storage areas applied for (see Section 1.2) have been identified. Interactions were identified on the basis of the nature and location of existing or proposed activities in relation to the relevant sites considered in this assessment and the areas which have been applied for, and also the sources of potential effect from these projects for which in-combination effects were considered to be possible. Projects relevant to this in-combination effects assessment, along with their status and the relevant sites are tabulated in Table 6.1 and Table 6.2 for the southern North Sea and English Channel respectively.

The principal sources of in-combination effects are regarded to be related to underwater noise, physical disturbance, and physical presence, primarily arising from OWF development, though physical disturbance from other activities such as the installation of interconnectors and oil or gas pipelines, aggregate extraction or fisheries, and other carbon dioxide storage related activities, are also relevant to this assessment, and are represented by multiple projects. OWF development will introduce underwater noise and disturbance sources (particularly during construction) and present an additional physical presence in the marine environment. Offshore wind leasing (e.g. those associated with Round 4, the 2017 wind farm extensions and 2025 Capacity Increase Programme) have already been subject to SEA and plan-level HRA, and any related projects have been, or will be, subject to their own individual assessment and HRA processes. The location of wind farms/wind farm zones in relation to the areas applied for subject to this assessment, and relevant sites, are mapped in each of the following sections covering the three regional areas considered in this assessment.

The UK Government believes that the carbon dioxide storage and the renewables industry can successfully co-exist. Early discussions between the developers will ensure that any potential conflict can be mitigated so that both developments can proceed with minimal delay and without the need to determine any part of an existing Crown Estate Lease or Agreement for Lease. The Offshore Wind and CCUS Co-location Forum[102], led by TCE, was formed in 2021

[102] https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/energy/offshore-wind-and-ccus-co-location/

and brings together the NSTA, the Carbon Capture and Storage Association (CCSA), RenewableUK, Government and Crown Estate Scotland to provide strategic coordination of co-location research and activity. In addition to renewables activities, early engagement with other users (e.g. through fisheries liaison, vessel traffic surveys, consultation with the MoD or holders of other Crown Estate offshore interests)[103] where scheduling overlaps may occur should allow both for developer cooperation, and the mitigation of potential cumulative or in-combination effects.

East Marine Plan[104] policy CCS1 defines a range of areas of potential carbon dioxide storage, which includes existing gas fields and related infrastructure and saline aquifers, in which proposals should not prevent storage, or else indicate how impacts on storage will be minimised, mitigated, or else suitably justify a case for proceeding. Paragraph 329 of the Plans indicate that "*Policy CCS1 is included to help ensure that sufficient storage sites are available for Carbon Capture and Storage over the long-term in view of the large number of such sites, on a national and international scale. Carbon Capture and Storage is spatially restricted to where storage locations occur.*" This is supported in plan policies such as GOV2 and GOV3, which respectively promote the maximisation of activity co-existence, and the demonstration that activity displacement will be avoided, minimised, or mitigated. The North West Marine Plans include a policy in support of carbon capture and storage (NW-CCUS-3) that, "*Proposals associated with the deployment of low carbon infrastructure for industrial clusters should be supported*", and like the East Marine Plans, include separate policies covering co-existence and co-location of developments NW-CO-1) that seek to ensure that space is optimised and outline what must be demonstrated in proposals should they have likely significant impacts on existing activities. The marine plans include policies promoting the re-use of oil and gas infrastructure for carbon dioxide storage (East Plans CCS2, NW-CCS-1 and 2), and this, amongst other relevant marine plan policies, are referred to in the following sections. The South Inshore and Offshore Marine Plan does not contain any policies of direct relevance to carbon dioxide storage, however, a number are of indirect relevance where these relate to co-location or co-existence with other activities (e.g. the safeguarding of aggregate areas).

[103] https://opendata-thecrownestate.opendata.arcgis.com/
[104] Note that the current East Marine Plans were adopted in 2014 and are presently subject to review and replacement. The revised plans are proposed to be adopted later in 2027, subject to the outcome of Sustainability Appraisal and Habitats Regulations Assessment (HRA) processes.

6.1 Southern North Sea

Table 6.1: Projects relevant to the in-combination effects assessment for the southern North Sea

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Offshore renewables and interconnectors			
Dogger Bank A Dogger Bank B	Located some 131km offshore, these two wind farms will collectively contain up to 200 turbines with a total capacity of up to 2,400MW within an area of. 1,114km². The turbines may be fixed to the seabed using monopile, jacket or gravity base foundations. Additionally, collector and converter stations will be required offshore. Export cables will have their landfall on the coast of the East Riding of Yorkshire.	Under construction. Operation expected from 2026.	Southern North Sea SAC
Dogger Bank C	Located approximately 200km north-east of Flamborough Head (Yorkshire coast), the wind farm will feature up to 200 turbines with a maximum capacity of 1,200MW, along with collector, converter and other platforms. Turbines may be fixed to the seabed using monopile, multi-leg or gravity base foundations. The project will connect to the Lackenby substation in Teesside, North Yorkshire.	Under construction.	Southern North Sea SAC
Sofia	Located approximately 165km east of Teesside (Yorkshire coast), the wind farm will feature 100 turbines with a maximum capacity of 1,400MW, along with an offshore converter platform. Turbines will be fixed to the seabed using monopile foundations. Export cables will have landfall on the Teesside coast and connect to a new converter station near Lazenby.	Under construction. Operation expected from 2026.	Southern North Sea SAC
Hornsea Project One	Located approximately 100km to the east of the Yorkshire coast, Hornsea Project One has a total installed capacity of 1,218MW delivered by 174 turbines within an area of 407km². The turbines were installed using monopile foundations. The export cable route travels to the south west and has its landfall at Horse Shoe Point to the south of Grimsby.	Operational	Southern North Sea SAC
Hornsea Project Two	The wind farm has a proposed capacity of 1,800MW generated by 165 wind turbines within an area of 462km² and located *ca.* 90km from the Yorkshire coast. The turbines were installed using monopile foundations. The export cable route shares that of Project One.	Operational	Southern North Sea SAC
Hornsea Project Three	The wind farm is proposed to have a capacity of up to 2,400MW generated by 231 turbines using fixed foundations (i.e. monopile, jacket, gravity base) within an area of 696km². It is expected that up to 6 cables will take power ashore in a corridor extending from the south west corner of the zone to a landfall on the North Norfolk Coast.	Under construction	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Hornsea Project Four	The wind farm is proposed to have a capacity of up to 2,600MW generated by 180 turbines using fixed foundations (i.e. monopile, jacket, gravity base) within an array area of 846km^2. The array is located approximately 65km to the east of Flamborough Head, and the export cable corridor follows a relatively direct route to a landfall on the East Riding of Yorkshire coastline. Up to six export cables will be installed.	Consented	Southern North Sea SAC, Greater Wash SPA
Sheringham and Dudgeon extension projects	The two projects which propose to extend the Sheringham and Dudgeon wind farms have a capacity of 317MW and 402MW respectively and use a joint export cable system. The extensions could have up to 23 and 30 wind turbines respectively.	Consented	Greater Wash SPA
Humber Gateway offshore wind farm	The project has 73 turbines providing an installed capacity of 219MW, with export cabling having its landfall on the south of the Holderness coast near Easington.	Operational	Greater Wash SPA
Westermost Rough offshore wind farm	The project includes 35 turbines providing an installed capacity of 210MW, with export cabling having its landfall on the Holderness coast near Withernsea.	Operational	Greater Wash SPA
Race Bank offshore wind farm	The project includes 90 turbines providing an installed capacity of 857MW, with export cabling passing through The Wash to a landfall north of Sutton Bridge.	Operational	Greater Wash SPA
Lincs, Lynn and Inner Dowsing offshore wind farms	Lynn and Inner Dowsing each have 27 turbines and capacities of 97.2MW, with Lincs having 75 turbines and a capacity of 270MW. They are all constructed relatively close to the Lincolnshire coast, where their export cables have their landfall.	Operational	Greater Wash SPA
Triton Knoll offshore wind farm	The project includes 90 turbines providing an installed capacity of 857MW. Export cables have their landfall on the Lincolnshire coast north of Anderby Creek.	Operational	Greater Wash SPA
Dogger Bank South Offshore Wind Farm	Dogger Bank South includes two offshore array areas, each of which may involve the construction and operation of up to 100 turbines. Located to the south of Dogger Bank, the project is at the decision stage of consenting.	Consented	Southern North Sea SAC
Outer Dowsing Offshore Wind Farm	Located approximately 50km to the east of the Humber, up to 100 turbines are proposed in a single array area.	Consented	Southern North Sea SAC
Norfolk Boreas	An offshore wind farm of capacity up to 1,800MW using up to 158 turbines and with up to four export cables with a landfall near Happisburgh.	Consented	Southern North Sea SAC

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Norfolk Vanguard	An offshore wind farm of capacity up to 1,800MW using up to 158 turbines and with up to four export cables with a landfall near Happisburgh.	Consented	Southern North Sea SAC
East Anglia Three	An offshore wind farm of capacity up to 1,400MW, likely using 95 14.7MW turbines and a network of subsea inter-array cables and up to four export cables, with a landfall at Bawdsey.	Consented	Southern North Sea SAC
Eastern Green Link 2	A proposed HVDC cable of approximately 436km in length, running from Sandford Bay in Scotland to Fraisthorpe Sands in Yorkshire. The cables may be installed as a bundle of three cables or separately, along with a fibre optic line.	Under construction, due for operation in 2029.	Greater Wash SPA
Eastern Green Link 3 and 4	Two further marine high voltage electric links between Scotland and England, running between Peterhead and Fife, with a landfall on the Lincolnshire coast.	In-planning	Greater Wash SPA
Eastern Green Link 5	In addition to the above lines, a further link is proposed between Peterhead and Lincolnshire.	In-planning	Greater Wash SPA
Viking Link	A 1,400MW interconnector between Bicker Fen in Lincolnshire and Revsing in South Jutland, Denmark. The cable will be trenched and buried in the North Sea, with the landfall completed using trenchless methods.	Operational	Southern North Sea SAC, Greater Wash SPA
Offshore Transmission Network Review: National Grid ESO Holistic Network Design (HND) and follow-up exercise	The HND and its follow-up exercise (HNDFUE) recommend optimal transmission network for offshore wind and has been developed to enable detailed network design which will allow for decisions to be made about connecting specific assets.	Plans published in 2022 and 2024, though detailed designs not certain	Southern North Sea SAC, Greater Wash SPA
Gas storage			
Carbon Storage Licence CS001	The carbon storage licence was awarded in 2012 and was later amended in 2020 to extent the appraisal period. A Storage Permit was granted in 2024. Licence CS001 is associated with the Northern Endurance Partnership project, which seeks to develop the Endurance Store for the injection and storage of CO_2, using pipelines from Teesside and the Humber.	Storage Permit granted; Project Consented	Southern North Sea SAC
Carbon Storage Licence CS005	The carbon storage licence was awarded in 2021, with site characterisation expected to be complete by 2023, which includes the reprocessing of seismic data.	Pre-planning	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Carbon Storage Licence CS006	The carbon storage licence was awarded in 2022, with site characterisation expected to be complete by 2026. New seismic was to be required over the site by 2023, with a contingent well to be completed by 2027. A storage permit application is to be made by November 2029.	Pre-planning	Southern North Sea SAC

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Carbon Storage Licence CS007	The carbon storage licence was awarded in 2022, with site characterisation expected to be complete by 2028. Contingent new seismic was to be required over the site by 2025, with a contingent well to be completed by 2025. A storage permit application is to be made by November 2027.	Pre-planning	Southern North Sea SAC
Rough Gas storage	A gas storage licence was issued in July 2022 covering the Rough field. The field was previously used for gas storage, and its present phase does not include any new offshore work, i.e. existing wells, pipelines and platforms are to be used to storge gas at Rough.	Operational	Southern North Sea SAC
Oil and gas			
Tolmount	Located in Block 42/28d, the Tolmount gas field development includes a minimal facilities platform and a new gas export pipeline to shore.	Operational	Southern North Sea SAC
Tolmount East	A single gas condensate well tied back to the Tolmount platform.	Operational	Southern North Sea SAC
Blythe Hub development	Located in Blocks 48/22b, c and 49/21c, the Blythe hub development includes a subsea tie-back (Elgood) to a new platform (Blythe), and a separate field (Southwark), re-using the existing Thames export pipeline to Bacton.	Operational	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Seaward oil and gas licensing	There are 18 licences associated with the 33rd licensing round within the SNS SAC or 15km of it, along with a number of licences associated with the 30th or 32nd Rounds which are either in Phase C of their Initial Term, or have progressed to the Second Term (P2673, P2678).	Licensed	Southern North Sea SAC
Oil and gas decommissioning projects			
Fields and infrastructure associated with and tied back to Murdoch	Various decommissioning programmes are associated with the Caister-Murdoch area including for the Caister CM platform and associated pipelines, the Boulton BM, Katy KT, Kelvin TM, Munro MH platforms, and the CMS subsea installations including Boulton HM, Hawksley EM, McAdam MM, Murdoch K.KM and Watt QM, and all related pipelines and umbilicals, and the Murdoch MA, Murdoch MC, Murdoch MD platforms and export pipeline to Theddlethorpe. Additionally, the Ketch, Schooner, Rita and Hunter fields, also tied back to Murdoch, are subject to decommissioning. The plans variously involve the removal of platform topsides, jackets and subsea installations to shore for recycling, and the leaving *in situ* of buried pipelines, and removal of exposed ones, with rock remediation for some projects.	Approved. Murdoch MA, MC and MD platforms removed August 2022	Southern North Sea SAC
Cavendish Field	Topsides and jacket to be removed and returned to shore. The pipelines will be partially removed (buried sections to remain in situ).	Approved, Cavendish platform removed 2023.	Southern North Sea SAC

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Anglia Field	Platform will be removed and transported to shore for re-use or recycling. Subsea wells will be plugged and abandoned using a drilling rig. Pipelines will remain in-situ. All tie-in spools for the 8” import line, 12” export line and 3” Methanol line will be completely removed.	Approved, Anglia platform removed 2024.	Southern North Sea, North Norfolk Sandbanks and Saturn Reef SAC
Hewett Field	Six platforms to be removed and returned to shore.	Approved, with three platforms having been removed to date.	Southern North Sea SAC
	Subsea installations. Proposes recovery to shore for reuse, recycling or disposal.		
Ensign Field installation and pipelines	Topsides and jacket will be removed and transported to shore for recycling. All wells will be plugged and abandoned. Buried pipelines will be left *in situ* except the exposed ends which will be cut and removed.	Approved, platform removed in 2025.	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Viking platforms, Vixen and associated pipelines (VDP2)	Removal to shore for re-use, recycling or disposal of Viking surface installations KD, LD, AR, Viking Bravo Hub BA, BC, BP, BD and Vixen sub-sea tieback in Blocks 49/12a and 49/17a. Buried pipelines left *in situ*.	Approved. Platforms were removed 2019 and 2020.	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Victor (VDP3)	Victor platform and subsea installation in Blocks 49/22 and 49/1 removed to shore for re-use, recycling or disposal. Buried pipelines left *in situ*.	Approved, platform removed.	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Tyne South installations	Topsides, jacket and subsea installation in Block 44/18a removed to shore for reuse, recycling or disposal.	Approved	Southern North Sea SAC
LOGGS Satellites Jupiter Area	Decommissioning programmes covering two Lincolnshire Offshore Gas Gathering System (LOGGS) Satellite installations (Ganymede ZD and Europa EZ installations) and pipelines and two subsea tiebacks (Callisto ZM and NW Bell ZX) with wellhead protection structures and pipelines. Installations are in Block 49/22. All installations will be recovered to shore for re-use or recycling. NW Bell pipelines will be recovered to shore. Ganymede, Europa and Callisto interfield pipelines will be decommissioned *in situ*.	Approved. Ganymede and Europa installations removed in 2020.	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Wenlock	The platform, mid line tee protection structure, exposed tie-in spools and stabilisation features will be removed to shore. Trenched and buried pipelines will remain *in situ,* which includes an export pipeline to the Indefatigable (Inde 23AC) platform (also subject to decommissioning.	Approved	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Leman 27H and 27J topsides	Topsides to be recovered to shore.	Approved	Southern North Sea SAC, North

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Leman 27J jacket and pipeline PL207	Jacket to be recovered to shore and the short pipeline will be entirely removed.	Approved	Norfolk Sandbanks and Saturn Reef SAC
Leman SW 53/02a-15Y WHPS	WHPS and associated stabilisation material to be removed to shore for reuse, recycling or disposal.	Submitted	Southern North Sea SAC
Johnston	Subsea installations to be recovered to shore for recycling and disposal. Trenched and buried pipelines to be left in situ with ends remediated using rock. Flexible flowlines and umbilicals/spools/jumpers to be removed.	Approved	Southern North Sea SAC
Inde 23AC and AQ Installations, bridges and risers	Topsides, Jackets and bridges to be removed to shore for reuse/recycling or disposal. The risers will be removed and returned to shore for recycling.	Submitted	North Norfolk Sandbanks and Saturn Reef SAC
Inde 18A Jackets, Bridges and Riser	Jackets, bridges and riser to be removed to shore for reuse, recycling or disposal	Submitted	North Norfolk Sandbanks and Saturn Reef SAC
Ravenspurn GCD Topside	Removal of topside and bridges for reuse or recycling/disposal.	Approved	Southern North Sea SAC
Tyne Pipelines	Leave pipelines *in situ*.	Approved	Southern North Sea SAC
Grove G5 WHPS	WHPS to be removed to shore for reuse, recycling or disposal.	Approved	Southern North Sea SAC
Trent topsides and risers	Removal of topside and risers for reuse or recycling/disposal.	Approved	Southern North Sea SAC
Davy North and Davy East Subsea Installations	The subsea x-trees, wellheads and associated WHPS frames will be removed.	Approved	Southern North Sea SAC
Galahad	Removal of topside and risers and monopod structure for reuse or recycling/disposal.	Approved	Southern North Sea SAC
Seven Seas WHPS	WHPS to be removed to shore for reuse, recycling or disposal.	Approved	Southern North Sea SAC
Wingate	Removal of platform for reuse or recycling/disposal, pipeline left *in situ*.	Approved	Southern North Sea SAC
Kilmar	Removal of platform for reuse or recycling/disposal, pipelines left *in situ*.	Approved	Southern North Sea SAC
Garrow	Removal of platform for reuse or recycling/disposal, pipelines left *in situ*.	Approved	Southern North Sea SAC
Aggregate areas			
Humber production areas 1-4 (514/1-4)	These areas are licensed for the extraction of marine aggregates. As part of the wider Humber region, 34.6km^2 were actively dredged in 2024, representing 11.2% of the total licensed area, with 90% of effort in 17.7km^2. Dredging intensity over these areas was generally low to	Leased production area	Greater Wash SPA
Humber Overfalls (493)		Leased production area	Greater Wash SPA
Humber Estuary (106/1-3 and 400)		Leased production area	Greater Wash SPA

Relevant plan or project	Project summary	Project status/indicative timing	Relevant sites[1]
Off Saltfleet (197)	medium, with small areas of higher intensity (TCE & BMAPA 2025).	Leased production area	Greater Wash SPA
Humber 3 (484)		Leased production area	Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC
Yarmouth production area (401/2A)	These areas are licensed for the extraction of marine aggregates. As part of the wider east coast region, 30.4km² were actively dredged in 2024, representing 18% of the total licensed area, with 90% of effort in 17.8km². Dredging intensity over these areas was generally low to medium, with small areas of higher intensity (TCE & BMAPA 2025).	Leased production area	Southern North Sea SAC, Outer Thames Estuary SPA
Cross Sands production area (242/361)		Leased production area	Southern North Sea SAC, Outer Thames Estuary SPA
North Cross Sands (494)		Leased production area	Southern North Sea SAC, Outer Thames Estuary SPA, Haisborough, Hammond and Winterton SAC
Off Great Yarmouth production area (228)		Leased production area	Southern North Sea SAC, Outer Thames Estuary SPA
(254)			Southern North Sea SAC, Outer Thames Estuary SPA, Haisborough, Hammond and Winterton SAC
Lowestoft production areas (511, 512, 513/1, 513/2)		Leased production area	Southern North Sea SAC, Outer Thames Estuary SPA
Lowestoft extension exploration and option (1804/1 and 2)	Production has not commenced in these areas.	Exploration and option area	Southern North Sea SAC, Outer Thames Estuary SPA

Sources: relevant Development Consent Orders and related post-consent modifications (https://national-infrastructure-consenting.planninginspectorate.gov.uk/). DESNZ oil & gas: decommissioning of offshore installations and pipelines (https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines), TCE & BMAPA (2025), TCE Open Data Portal (https://thecrownestate.maps.arcgis.com/apps/webappviewer/index.html?id=b7f375021ea845fcabd46f83f1d48f0b), NSTA carbon storage public register (https://www.nstauthority.co.uk/regulatory-information/carbon-storage/carbon-storage-public-register/), NSTA gas storage and unloading webpage (https://www.nstauthority.co.uk/licensing-consents/gas-storage-and-unloading/

Notes: [1] those sites considered to be relevant to 2nd carbon dioxide storage round exploration/appraisal activities.

Figure 6.1: Location of areas applied for in relation to other projects in the southern North Sea

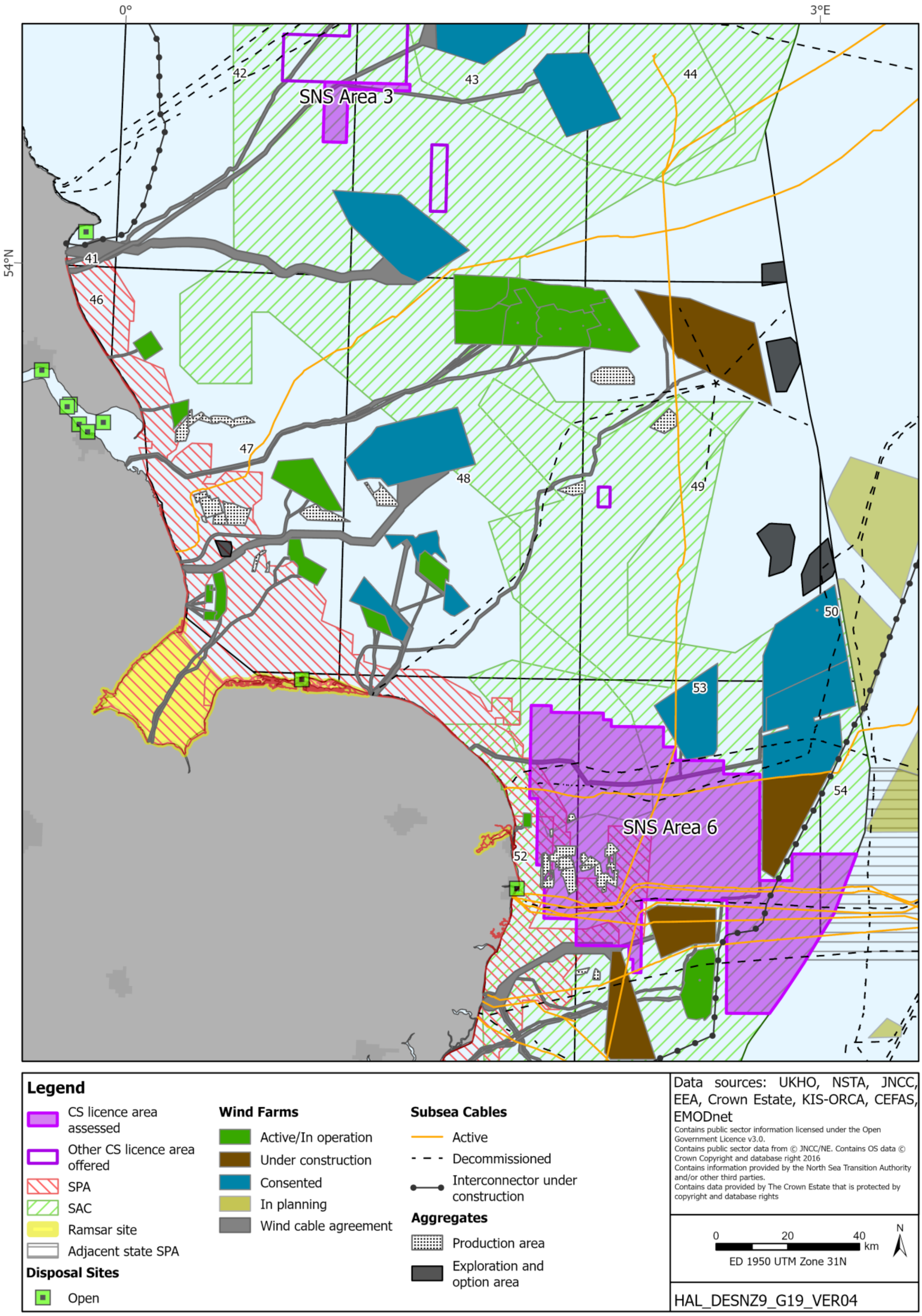


Figure 6.2: Location of areas applied for in relation to other projects in the southern North Sea (continued)

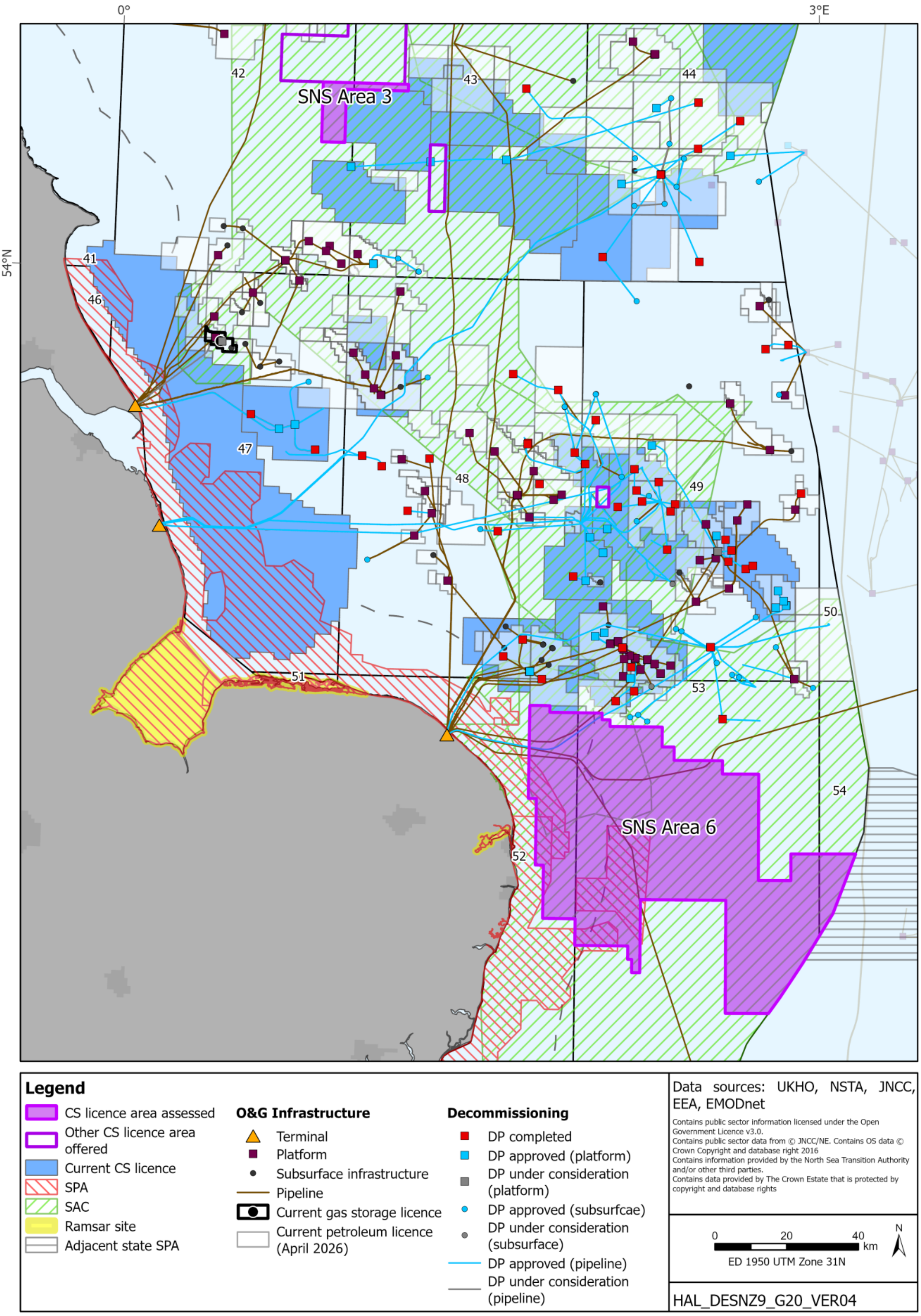
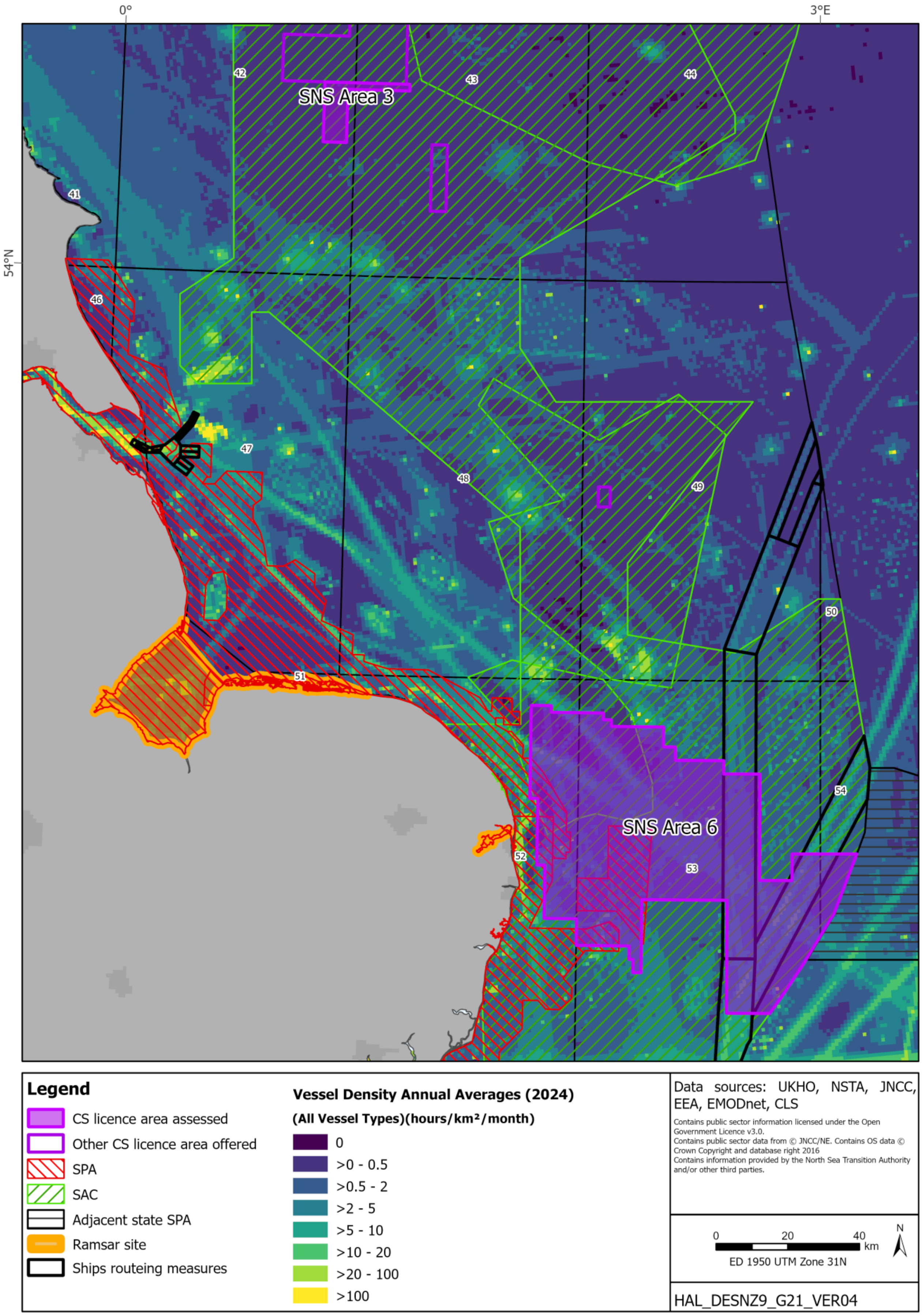


Figure 6.3: Vessel traffic in the southern North Sea, 2024



6.1.1 Physical disturbance and drilling effects

The pressures which may result from exploration/appraisal activities that could result from licensing and cause physical disturbance and drilling effects on the relevant sites were described in Section 4.2 and Section 5.1. The conclusions of Section 5.1 are considered in the following section in the context of those relevant projects identified in Table 6.1 above.

Though existing oil and gas infrastructure is widespread in the southern North Sea (Figure 6.1), the relative density and footprint of these is small. Assuming a conservative footprint of 0.8km^2 for every fixed installation in the southern North Sea (i.e. that covering the 500m safety zone), the total percentage area of the southern North Sea (defined here as Regional Sea 2) occupied by these platforms is 0.05%. Of the 179 installations considered, 83 of these have approved decommissioning plans or are subject to decommissioning planning and will be removed in the coming years. A review of field development projects (as of April 2026) indicates that none are presently proposed in the sites relevant to this HRA. While several seaward oil and gas licences located within the Southern North Sea SAC are in their second term (P2678, P2673), there have been no project proposals for these to date.

There are a number of decommissioning projects ongoing and scheduled to take place in the southern North Sea in the coming years which are summarised in Table 6.1 and are also shown in Figure 6.1. These are primarily located in Quadrants 43, 44, 47, 48 and 49 and for the purposes of this HRA, are partly or entirely relevant to the Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC and the Haisborough, Hammond and Winterton SAC. In addition to those listed in Table 6.1, a number of fields are likely to be decommissioned in the coming years, but decommissioning plans are yet to be submitted. Activities associated with decommissioning plans will result in some physical disturbance which will largely be within existing field development areas (e.g. from removal of pipeline spool pieces, pipeline sections, protection materials, subsea wellheads, manifolds and platform footings, well abandonment where this requires a mobile rig, and any anchoring and rock placement). Levels of activity (e.g. shipping) may not be significantly greater than ongoing operations in the southern North Sea and will be temporary.

While the siting of a rig in SNS Areas 3, 4 or 6 has the potential to have in-combination effects with the decommissioning of gas field infrastructure, incremental disturbance will be temporary, and where required, mitigation will used to avoid permanent impacts on the habitats of sites (see Section 5.1.3). Where appropriate, the Department will undertake HRA in relation to oil and gas development and decommissioning activities, including a consideration of in-combination effects, for example, the Department has previously undertaken such an assessment for the Viking and LOGGS decommissioning programmes in relation to the Southern North Sea SAC and North Norfolk Sandbanks and Saturn Reef SAC. Additionally, assessments have been undertaken for decommissioning of assets relevant to the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC, most recently including for the Anglia, Murdoch, North Valiant, Viking Bravo, Victor JD, Leman 27J, Wenlock, Kelvin and Munro decommissioning. These assessments concluded the various projects would not have an adverse effect on the integrity of the sites[105]. As noted above, it is recognised that further decommissioning programmes are likely to come forward in this area of the southern North Sea in coming years, which will be subject to further HRA as appropriate, including in relation to in-combination effects.

[105] See the list of Habitats Regulations Assessments undertaken by the Department at: https://www.gov.uk/guidance/oil-and-gas-offshore-environmental-legislation#offshore-petroleum-activities-conservation-of-habitats-regulations-2001-as-amended

SNS Area 3 and SNS Area 6 are immediately adjacent to existing carbon dioxide appraisal and storage licence areas and their related agreements for lease; SNS Areas 3 and 4 have been applied for to extend the area of existing licences CS025 and CS006 respectively, such that no additional work will take place to that originally proposed in the work programmes for those licences, limiting the potential for in-combination effects at least with the existing licence areas. All the areas are partly or fully within the Southern North Sea SAC, North Norfolk Sandbanks and Saturn Reef SAC, Haisborough, Hammond and Winterton SAC, and the Greater Wash SAC. In keeping with East Marine Plan policy CCS2, and the oil and gas decommissioning guidance set out by the Department (BEIS 2018b), there is the potential for re-use of existing infrastructure for carbon dioxide transport and storage, and a number of existing carbon storage licences cover former gas field areas (Figure 6.2). A review of the possible re-use of oil and gas infrastructure for carbon dioxide was undertaken[106], the Government response to which gave a range of future actions including ones related to further re-use assessment of offshore oil and gas assets, making data available, updated policy proposals and regulatory review, however, there are presently no firm proposals to consider.

There is some overlap with Blocks currently licensed for oil and gas exploration and production with the Southern North Sea SAC, though these are generally some distance from the areas applied for in the 2nd Carbon Dioxide Storage Round (Figure 6.1). Work programmes for these Blocks may include the drilling of one or more wells, however, the location and timing of any such wells are not yet understood. If drilled, the wells would result in a similar scale of effect to that for carbon dioxide storage exploration/appraisal wells (Table 2.2) and would likely be subject to similar types of mitigation for those relevant sites identified in Section 5.2. At this stage, adverse in-combination effects with activities that could occur in SNS Areas 3, 4 and 6 are not considered to be likely due to the large spatial and likely temporal separation between any wells that would be drilled, the temporary nature of any effect, and the scope for mitigation that would avoid permanent changes in site habitat outlined in Section 5.1.3.

Offshore wind farms are the only type of operational or proposed renewable energy projects in the southern North Sea. In addition, the Eastern Green Link 2, 3 and 4, and 5, and Viking Link interconnector projects are of relevance to the Greater Wash SPA, however, Viking Link has been completed. Sources of effect from physical disturbance associated with offshore wind farms include installation of turbines (using monopile, jacket or gravity base foundations) and associated infrastructure such as interconnecting and export cables. Cables would typically be trenched and buried (e.g. in keeping with East Marine Plan policy CAB1), with protection materials used strategically at cable/pipeline crossings or should there be difficulties achieving burial depth due to the nature of the shallow geology. The current timelines for project proposals (Table 6.1) indicate the potential for some temporal overlap with exploration/appraisal activity as part of the 2nd carbon dioxide storage round licences, subject to the issue of licences and the timing of individual exploration/appraisal activities. There is no overlap between the areas applied for any wind farm project, but there is substantial overlap with the Southern North Sea SAC. Despite the limited potential for spatial overlap, there is the potential for incremental physical effects which are discussed below. The Eastern Green Link 2 interconnector is under construction and has been routed to avoid direct interaction with any relevant site. Eastern Green Link 2 and 3, and 5, are all at a pre-application stage, with applications expected towards the end of 2026 or into 2027, though it is possible that there could be further interactions with Greater Wash SPA. The Viking Link interconnector passes through the Greater Wash SPA and Southern North Sea SAC and was completed in 2023 and began operations in 2024. It is not considered that adverse in-combination effects on the

[106] https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-projects-re-use-of-oil-and-gas-assets

supporting habitats of the Greater Wash SPA from Eastern Green Link 2 and rig siting are possible as there is no potential for direct impacts on the Greater Wash SPA from any of the areas applied for.

The Crown Estate also undertook an HRA covering a number of wind farm extensions, which was concluded in 2019. Likely significant effects were determined for projects in relation to effects on the Annex I habitat of the Wash and North Norfolk Coast SAC and, North Norfolk Sandbanks and Saturn Reef SAC. For each of the sites, conclusions of no adverse effect were determined, including in-combination, through the adoption of a Cable Route Protocol as part of plan-level mitigation, in addition to not awarding rights to the Race Bank extension project due to adverse effects on the Inner Dowsing, Race Bank and North Ridge SAC[107]. The Cable Route Protocol contains requirements for offshore wind developers in the planning of offshore export cable routes, compliance for which is secured through offshore wind agreements for lease. TCE undertook further HRA of a Capacity Increase Programme (CIP) covering a number of wind farms for which rights had already been awarded[108], this concluded in 2025. For all but one project (Dogger Bank D), development consents have now been granted, with project specific HRAs undertaken. The CIP HRA did not exclude adverse effects on two sites relevant to the HRA of the 2nd Carbon Storage Licensing Round, which were Dogger Bank SAC (for Annex I sandbanks) for Dogger Bank D, and the Outer Thames Estuary SPA (for red-throated diver) for North Falls (the latter conclusion was also reached in the project level assessment[109]). An adverse effect on site integrity was concluded for the Wash and North Norfolk Coast SAC and the North Norfolk Sandbanks and Saturn Reef SAC in relation to Hornsea Project Three, specifically in relation to habitat loss and modification associated with cable protection. A Sandbank Implementation Plan was submitted as part of the planning process for the project which sets out mitigation and compensation measures, in keeping with its Development Consent Order (DCO) requirements, and was approved in April 2022. It is not considered that there is the potential for in-combination effects between the above projects and the areas applied for in the 2nd Carbon Storage Licensing Round, as the effects of rig siting are limited in extent, and significantly less than the distance between SNS Area 6 and the North Norfolk Sandbanks and Saturn Reef SAC (9.5km).

In response to increasing offshore and onshore environmental and social challenges, and in particular in relation to the radial approach to offshore wind farm export cabling to date, the Offshore Transmission Network Review (OTNR) was launched in 2020[110]. The project was led by the Department with support from a number of other UK Government departments, devolved administrations, The Crown Estate and Crown Estate Scotland, the ESO and Ofgem. The OTNR had three workstreams which related to wind farms at various stages of development, which were Early Opportunities (identify and implement changes which can be made in the immediate term), Pathway to 2030, and the Enduring Regime (Focussed on projects to be delivered after 2030). The Holistic Network Design (HND) project led by National Grid ESO was undertaken as part of the Pathway to 2030 workstream and was based around the principles of cost to consumers, deliverability and operability, environmental impact and impact on communities. The HND made recommendations on potential location of infrastructure including offshore cable route corridors, but this did not limit the detailed design

[107] https://www.marinedataexchange.co.uk/details/628/2019-the-crown-estate-2017-offshore-wind-extensions-plan-habitats-regulations-assessment-hra/

[108] The CIP covered Awel y Môr, Dudgeon Extension, Sheringham Shoal Extension, North Falls, Five Estuaries, Rampion 2 and Dogger Bank D. https://www.thecrownestate.co.uk/our-business/marine/capacity-increase-programme

[109] https://nsip-documents.planninginspectorate.gov.uk/published-documents/EN010119-001788-Habitats%20Regulations%20Assessment%20North%20Falls%20Offshore%20Wind%20Farm.pdf

[110] https://www.gov.uk/government/groups/offshore-transmission-network-review

process. The Holistic Network Design Follow Up Exercise (HNDFUE) was published in 2024, building on the HND for projects beyond 2030. While at a high level, these exercises emphasise the potential for impacts on sites relevant to this AA, including Greater Wash SPA the Southern North Sea SAC, and Liverpool Bay SPA.

It was concluded in Section 5.1.4 that alone, the licensing of SNS Area 6 would not result in an adverse effect on the integrity of the Haisborough, Hammond and Winterton SAC as, subject to mitigation, there would be no permanent change in the structure or extent and distribution of the Annex I sandbanks habitat from exploration/appraisal activities. While SNS Area 6 covers a significant portion of the site, as noted in Section 5.1.3, there is significant scope to site a rig outside of the site, and mitigation will be required to avoid the placement of rig stabilisation materials that would represent a permanent change to the habitat. It is considered that the minor and short-term disturbance generated by exploration/appraisal drilling, should this occur, will not result in adverse in-combination effects with other plans or programmes, when considered in the context of the mitigation already set out in Section 5.1.3, which is, that should rig stabilisation be required, removable methods must be used, subject to technical and safety considerations, and project level assessment. The only area applied for which is of relevance to the Greater Wash SPA and Outer Thames Estuary SPA is SNS Area 6, for which there is only a small overlap (see Figure 5.2). There is considerable scope for any rig to be sited outside of the SPAs, which would allow the avoidance of any direct impact on the site and would exclude any source of potential in-combination effect.

All of the areas applied for were identified on the basis of a potential for likely significant effect in relation to the Southern North Sea SAC and were considered in Section 5.1.2. The proposed export cables for Norfolk Boreas and Norfolk Vanguard pass through SNS Area 6, and those for Dogger Bank South pass through SNS Area 3, all of which are located within the Southern North Sea SAC. As noted above, none of the areas applied for overlap any proposed wind farm, with activity within any active wind farm already precluded, however, in relation to proposed cables, the ability to locate any rig away from these will avoid the potential for in-combination effects, and further mitigation is available through activity timing/phasing, such that those sources of physical effect from wind farm installation and operation (e.g. as described in Section 5.4.3 of the OESEA4 Environmental Report, BEIS 2022) are not compounded by rig installation. The HRA for Round 4 proposed projects, which included three overlapping the Southern North Sea SAC, considered any physical effects of wind farm installation and operation on the site, alone or in-combination with other plans and projects, were negligible and would not lead to an adverse effect on site integrity. As noted in Section 5.1.2 (also see Table 2.2), the footprint of any drilling rig would be small and temporary, and in relation to the Southern North Sea SAC, the maximum potential area potentially affected by disturbance across all the areas applied for is 8.8km^2 or <0.02% of the site. In view of the temporary nature of any effects from drilling rig placement or discharges (see below) and the very small area which could be subject to habitat change from the use of rock placement for rig stabilisation (0.0001% of the site), if required, there would be no adverse in-combination effects on the Southern North Sea SAC from these activities. Plan level mitigation has been identified for Haisborough, Hammond and Winterton SAC which overlaps a portion of the Southern North Sea SAC (see Section 5.1.3), such that the Department will expect operators to provide adequate justification for the stabilisation option proposed (including for rig siting beyond site boundaries, if practical) and consider use of systems that can be removed following drilling, where these meet the technical and safety requirements of rig placement. That mitigation would, by association, apply to any part of the Southern North Sea SAC where this overlap occurs.

With respect to drilling discharges, previous discharges of WBM cuttings in the UKCS have been shown to disperse rapidly and to have minimal ecological effects (See Section 4.2, also see individual site assessments in Section 5.1.2). Dispersion of further discharges of mud and cuttings could lead to localised accumulation in areas where reduced current allows the particles to accumulate on the seabed, however given the relatively shallow water depths (generally <50m), moderate tidal currents and potential for storm wave base interactions across the areas applied for (e.g. Klein *et al.* 1999), accumulations of cuttings piles are not considered likely from exploration/appraisal activity (see Section 5.1.2) or in-combination with other exploration and development wells associated with extant carbon dioxide storage licences, or licences associated with gas exploration (in relation to licences previously awarded). Additionally, the potential for in-combination effects relating to chemical usage and discharge from exploratory drilling is limited by the existing legislative and permitting controls that are in place (see Section 2.3.1 and 5.1.3), and the work being undertaken regionally (e.g. through OSPAR) which the UK Marine Strategy[111] recognises as relevant measures contributing to achieving targets in relation to Good Environmental Status. Discharges are considered unlikely to be detectable and to have negligible in-combination effect (BEIS 2022).

Advice on operations for the Haisborough, Hammond and Winterton SAC and Southern North Sea SAC (see Sections 5.1.2) identify that the sites are sensitive to commercial fisheries, though for the latter the focus is harbour porpoise bycatch and removal of prey species. It is not regarded that the nature and scale of exploration/appraisal activities would result in a significant in-combination effect with porpoise bycatch. Physical disturbance related pressures from fisheries for which Haisborough, Hammond and Winterton has been assessed as sensitive are relevant for those sources of effect from carbon dioxide storage activity (noted in Section 4.2 and assessed in Section 5.1.2), and the potential for in-combination effects with fisheries are considered below.

Fishing, and particularly bottom trawling, have historically contributed to seabed disturbance over extensive areas and was identified as an ongoing issue in the UK assessment of good environmental status[112]. Depending on the nature of future measures (e.g. in relation to MPA management in the wider environment and within MPAs), such effects are likely to be reduced and therefore some improvement in benthic habitats could be expected. A number of byelaws have been imposed on conservation sites which effectively prohibit the use of certain gears in all or part of certain SACs, including Haisborough, Hammond and Winterton SAC[113], with a further stage of bylaws being prepared to cover species, for example, harbour porpoise bycatch[114]. Whilst fishing may be linked to historical damage to site features, and presents a continuing risk to these, recent, ongoing, and future management measures should limit the potential for in-combination effects with other activities. Exploration/appraisal drilling for carbon dioxide exploration/appraisal will not generate significant effect on the supporting habitat of the Southern North Sea SAC, and in view of the prohibition of bottom contacting fishing gear in relation to Haisborough, Hammond and Winterton SAC, there is limited potential for in-combination effects with fisheries.

Marine aggregate extraction areas, relevant sites and areas offered are shown in Figure 6.1. SNS Area 6 overlaps licensed aggregate extraction production areas in the southern North Sea, which are also located partly within the Outer Thames Estuary SPA. As noted in Table

[111] https://www.gov.uk/government/publications/marine-strategy-part-three-2025-uk-programme-of-measures
[112] https://www.gov.uk/government/publications/marine-strategy-part-one-update
[113] *Marine Protected Areas Bottom Towed Fishing Gear Byelaw 2023*, https://www.gov.uk/government/publications/marine-protected-areas-bottom-towed-fishing-gear-byelaw-2023
[114] https://www.gov.uk/government/publications/harbour-porpoise-bycatch-management-options

6.1, dredging intensity over these areas has been generally low to medium in recent years (TCE & BMAPA 2025, also see TCE & BMAPA 2018). Analogous to the advice provided in relation to offshore wind farms, applicants should make contact with the relevant aggregate companies in order that any proposed carbon dioxide storage exploration/appraisal activity is undertaken in co-operation with the relevant lease or licence holders. While there is substantial overlap with these areas and SNS Area 6 in particular, there is the potential to site rigs away from aggregate extraction areas, and the nature and scale of physical effects associated with activity which may follow licensing is considered to be temporary, subject to the application of mitigation (see Sections 5.1.2 and 5.1.3). In-combination impacts which could lead to adverse effects on the integrity of sites considered in this AA, are not anticipated.

6.1.2 Physical presence

Physical presence of offshore infrastructure and support activities may potentially cause behavioural responses in fish, birds, and marine mammals (see Section 5.6 of BEIS 2022). Previous SEAs have considered the majority of behavioural responses resulting from interactions with offshore oil and gas infrastructure (whether positive or negative) to be insignificant; in part because the number of surface facilities is relatively small (of the order of a few hundred) and because the majority are at a substantial distance offshore; rigs used for carbon dioxide storage exploration/appraisal will be of the same type as those used in oil and gas exploration. The larger numbers of individual surface or submerged structures associated with offshore wind developments, the presence of rotating turbine blades and considerations of their location and spatial distribution (e.g. in relation to coastal breeding or wintering locations for waterbirds and important areas for marine mammals), indicate a higher potential for physical presence effects.

Potential displacement and barrier effects, particularly for birds, have been an important consideration at the project level for the large offshore wind developments that are planned for the area of the southern North Sea (Figure 6.1) and formed an important part of associated HRAs. As noted above, plan level HRA has been completed for offshore wind leasing and the majority of projects which emerged from the Round 4 process. One of the major concerns relating to sites considered in this assessment, and in particular for the Greater Wash SPA and Outer Thames Estuary SPA, is seabird mortality related to displacement of species (mainly red-throated diver). A conclusion of adverse effects on site integrity for divers from displacement level effects has to date not been made for offshore wind farms in relation to the Greater Wash SPA due to the application of mitigation (e.g. seasonal controls or adherence to best practice[115]). A conclusion of adverse effects on integrity was made for the Outer Thames Estuary SPA in relation to East Anglia One North and East Anglia Two, with compensation approved which includes vessel traffic routing and management, and fisheries bycatch reduction.

For the Southern North Sea SAC, shipping is noted to be a source of pressures including underwater noise (see Section 5.1.5) and death or injury by collision, with the latter not being considered a significant risk that requires management (JNCC 2016). Disturbance of red-throated diver and common scoter associated with the Greater Wash SPA and Outer Thames SPA is possible both in relation to support vessel movements and the presence of a drilling rig in parts of SNS Area 6 (see Section 5.1.2). Any sensitivity is limited to the winter months and may be avoided if activities take place outside of this period. SNCB advice[116] suggests displacement 2km and 2.5km for red-throated diver and common scoter respectively from

[115] E.g. Natural England's Best Practice Protocol for Vessels in Red-Throated Diver SPAs
[116] https://hub.jncc.gov.uk/assets/9aecb87c-80c5-4cfb-9102-39f0228dcc9a

vessels, and any displacement taking place as a result of carbon dioxide exploration/appraisal could be of this scale. A number of wind farms in or partly within the Greater Wash SPA including Humber Gateway, Westermost Rough, Race Bank, Lincs, Lynn and Inner Dowsing, are likely to present some form of displacement to divers within the Greater Wash SPA, though the scale of this displacement is not certain (see Section 4.2.3) as is any population level effect (see Section 5.1 and Vilela *et al.* 2022). There are established vessel approaches and anchorages associated with The Wash and the Humber, and the Thames in relation to the Outer Thames Estuary SPA, and routes between these and other ports in the UK and Europe, and offshore oil and gas infrastructure, which likely represent a baseline level of disturbance in advance of the SPAs being designated, with some additional disturbance since then associated with wind farm operation and maintenance traffic. Vessel traffic in these routes is moderate to high (Figure 6.3), and the increment of two to three vessels per week is unlikely to represent a significant in-combination level of effect. The installation of Viking Link involved a cable lay barge or vessel activity in the nearshore and through the Greater Wash SPA, though as the first 51km of the cable was installed in summer 2021, with some post-cable lay works completed by October 2021, any in-combination disturbance related effects with the siting of a drilling rig in SNS Area 6 is not considered possible. As noted in Section 5.1.2, JNCC/NE advise that displacement buffers of 2km and 2.5km are applied at the project level for the assessment of effects of vessel traffic on red-throated diver and common scoter respectively. This should be considered at the project level once project plans are known (see Section 7). It is not regarded that the temporary addition of a drilling rig and associated shipping of a scale outlined in Table 2.2 will lead to adverse effects on site integrity for any of the relevant sites considered in this AA for which physical presence was identified as a potential source of likely significant effect (see Table 1.2).

6.1.3 Underwater noise effects

A number of projects are relevant to the consideration of in-combination effects with activities which may follow the licensing of the areas applied for (Table 6.1). The associated activities can generate noise levels with the potential to result in disturbance or injury to animals associated with relevant sites (see BEIS 2022).

Of most relevance to the areas being considered are a number of consented and under construction offshore wind farms (particularly those associated with offshore wind leasing rounds 3 and 4). While the operation, maintenance and decommissioning of offshore wind energy developments will introduce noise into the marine environment, these are typically of low intensity compared to installation. The greatest noise levels arise during the construction phase, and it is these which have the greatest potential for acoustic disturbance effects (see BEIS 2022). Pile-driving of mono-pile foundations or pin piles used in jacket-type foundations is the principal source of construction noise, which will be qualitatively similar to pile-driving noise resulting from harbour works, bridge construction and oil and gas platform installation. Mono-pile foundations are the most commonly used for offshore wind farm developments in the southern North Sea to date (including in the studies looking at the effect of wind farm construction on harbour porpoise behaviour, as discussed in Section 4.3.2). However, for some proposed developments, sufficient flexibility in foundation type remains in their Development Consent Orders to allow for the potential use of gravity base and even tethered foundations (though these are generally unlikely), which would result in less noise on installation. The final selection of foundation type is uncertain for some developments as this will be subject to detailed design.

Of those wind farms listed in Table 6.1, the Dogger Bank A and B and Sofia developments and Hornsea Project Three are under construction (see Section 2.5 and Appendix 1h of BEIS

2022[117]), with a number of others being consented with construction timelines in the second half of the decade (e.g. East Anglia One North, East Anglia Two, Outer Dowsing). TCE intend to launch Round 6 of offshore wind leasing in the first half of 2027, concentrating on fixed foundation turbines with a potential capacity of up to 6GW in areas off the east coast of England[118]. The related HRA for the leasing round will be undertaken once preferred project areas are defined, and the anticipated generation capacity for the round requires only ~12% of the area of search presently defined. Any related projects, if executed, are expected to result in temporary changes in harbour porpoise distribution and a reduction of foraging activity for those individuals within the impacted area. However, assessment of the integrity of the site must be undertaken with respect to the site contributing to maintaining the Favourable Conservation Status of the wider harbour porpoise population. It follows that projects across the whole North Sea Management Unit are therefore also relevant.

While progress is being made in estimating population-level effects of disturbance on marine mammals, the degree of uncertainty in extrapolating from individual empirical observations to modelled population estimates is still high. In particular, there remains very limited empirical data to support quantification of the links between physiological and behavioural changes (e.g. hearing loss, displacement) and changes in vital rates (e.g. survival, fertility), although updates to expert elicited values in iPCoD are noted (Booth & Heinis 2018, Booth *et al*. 2019). It has not yet been possible to establish criteria for determining limits of acceptable cumulative impact at the UK or EU level, but the collation of data through the Marine Noise Registry[119] has been an important first-step. The Department is cognisant of the ongoing efforts to implement the UK's Marine Strategy and will review the results of the ongoing process closely with respect to the consenting of relevant activities which may result from future licensing, as well as other activities which generate noise in the marine environment.

A review of consents HRA was undertaken for six OWFs in relation to the Southern North Sea SAC, which included those which had not yet commenced operations or had HRAs undertaken in advance of the site being classified (Dudgeon, Greater Gabbard, Galloper, Hornsea Two, Dogger Bank A and B, Dogger Bank C and Sofia). This review augmented those HRAs already undertaken for these projects, specifically considering effects in relation to the Southern North Sea SAC alone and in-combination with other projects, including those other OWFs of relevance to the wider site, and oil and gas activities. The HRA concluded that while the OWF projects assessed have the potential to generate likely significant effects for the site, adverse effects on site integrity will not occur alone or in-combination with other plans or projects (including that of existing oil and gas activities such as drilling and seismic survey), subject to mitigation measures secured through relevant Development Consent Orders and deemed Marine Licences (including a Site Integrity Plan)[120].

Significant in-combination underwater noise effects on the harbour porpoise feature of the Southern North Sea SAC are considered to be unlikely given the spatially limited, temporary nature and limited scale of noise generating activity associated with the exploration/appraisal activities associated with areas applied for (see Section 5.1.5), and that there is significant scope to avoid concurrent OWF construction[121], any survey associated with the 2nd carbon

[117] Also see: RenewableUK Offshore Wind Project Timelines (October 2020): https://www.renewableuk.com/news/532483/Offshore-Wind-Project-Timelines.htm
[118] https://www.thecrownestate.co.uk/our-business/marine/offshore-wind/round-6
[119] See https://mnr.jncc.gov.uk/
[120] See the related proposed marine licence conditions for the Southern North Sea SAC: https://www.gov.uk/government/consultations/southern-north-sea-sci-proposed-marine-licence-condition
[121] Note that the encounter rate of UXO and its nature is uncertain and disposal operations are subject to separate marine licensing.

storage licensing round, and exploration/appraisal well site survey activity either through dialogue with relevant lease/licence holders or by virtue of wind farm construction timelines, and through measures such as the SNS Activity Tracker (see below). Piling can be detrimental to seismic data collection, and these activities would not therefore be undertaken concurrently in close proximity. In addition to piling, unexploded ordnance (UXO) is commonly disposed of during offshore wind farm installation. UXO detonations have the potential to cause significant injury or death to marine mammals (Robinson *et al.* 2022) and project developers are bound by health and safety legislation to manage and reduce this risk, though low order techniques are available (e.g. Robinson *et al.* 2020) for which the Department and a number of other UK Government and Devolved administration departments have published recommendations in the form of a joint interim position statement[122].

The SNCB guidance on assessing the significance of noise disturbance against conservation objectives of harbour porpoise SACs (JNCC *et al*. 2020) presents thresholds for daily and seasonal disturbance as a proportion of the site from which harbour porpoise may be excluded. This gives a mechanism for assessing the potential in-combination effects of low frequency impulsive noise on the Southern North Sea SAC across multiple sources and industries. For example, in-combination effects with further wind farm construction of relevance to the site, in the context of the disturbance thresholds, can be partly addressed through the Site Integrity Plans required for certain offshore wind farms, where a baseline of activities that may act in-combination with wind farm activities to breach the thresholds must be maintained. The application of the threshold approach in this HRA is limited by uncertainty in the extent, location and timing of activities which may follow licensing of any of the areas applied for. However, its implementation for comparative purposes in the HRA for the planned ION 3D seismic survey (BEIS 2020b) illustrates how it can be used at the activity-specific stage to consider the nature and timing of relevant activities in an assessment of in-combination noise effects on a harbour porpoise SAC. A review of impulsive noise in the Southern North Sea SAC for 2022-2024 (JNCC 2024) through retrospective analysis of close-out reports, suggests that the 20% daily and 10% seasonal average thresholds were not exceeded in the three seasons considered. While this does not necessarily reflect potential future challenges in meeting the thresholds and had some limitations in its consideration (e.g. it may not have captured all impulsive noise activity), it is noted that active management of activities is taking place to ensure that the thresholds are not exceed, including through the SAC Noise Management Regulators Working Group[123].

As noted in Section 6, in keeping with relevant marine plan policies, it is expected that early engagement between carbon storage licence holders and offshore wind farm developers would allow for activities to take place while avoiding potential in-combination effects. Further HRA will be undertaken, where appropriate, at the activity-specific level which will allow for the consideration of the spatial and temporal scope of seismic survey, including in-combination with other relevant projects.

There is the potential for seismic surveys to take place in areas covering parts of the areas applied for, or in areas close to or adjacent to these, under non-exclusive exploration licences. The timing, location and scale of other such surveys are unknown and a meaningful assessment of these cannot be made at this time, but they will be subject to activity-specific

[122] https://www.gov.uk/government/publications/marine-environment-unexploded-ordnance-clearance-joint-interim-position-statement/marine-environment-unexploded-ordnance-clearance-joint-interim-position-statement

[123] https://assets.publishing.service.gov.uk/media/678e682c432c55fe2988f667/SAC_NRWG_Progress_Report_2024.pdf

permitting, including, where appropriate, HRA. Such surveys would be captured in the UK Energy Portal, and in relation to the Southern North Sea SAC, in the SNS Activity Tracker[124], which assist in the consideration of project level in-combination effects.

These considerations and conclusions are also applicable to other relevant sites and features considered in this AA for underwater noise, including diving birds (The Greater Wash SPA, Outer Thames Estuary SPA), such that adverse in-combination effects on site integrity are not predicted.

In addition to those activities which may follow licensing of the areas applied for in the southern North Sea and the other potentially relevant projects listed in Table 6.1, there are a variety of other existing (e.g. gas production, fishing, shipping, military exercise areas, wildlife watching cruises) and planned (e.g. carbon dioxide appraisal) noise-producing activities in overlapping or adjacent areas. Despite this, the Department is not aware of any projects or activities which are likely to cause cumulative and in-combination effects that, when taken in-combination with the potential number and scale of activities likely to result from the licensing of the areas applied for (Section 2.2), would adversely affect the integrity of the relevant sites. This is due to the presence of effective regulatory mechanisms (Section 5.2 and also Appendix 3 of BEIS 2022) which ensure that operators, the Department, and other relevant consenting authorities take such considerations into account during activity permitting. These mechanisms generally allow for public participation in the process[125].

6.2 English Channel

Table 6.2: Projects relevant to the in-combination effects assessment for the English Channel

Relevant project	Project summary	Project status/ indicative timing	Relevant sites[1]
Aggregate extraction areas 500/1, 500/2, 500/4, 127, 137, 407, 522/1 and 522/2	These areas are licensed for the extraction of marine aggregates as part of the wider South Coast region. In 2024, 90% of regional dredging took place in 6.3km^2, with dredging taking place overall across 15.8km^2 of a total licensed area of 58.7km^2.	Active	South Wight Maritime SAC
Dolphin Sand Shingle Bank (2105/1 and 2)	Exploration and Option areas.	Licensed	Solent and Dorset Coast SPA, South Wight Maritime SAC
West Isle of Wight (2021)		Licensed	Solent and Dorset Coast SPA
Atlantic Crossing 1	A fibre-optic telecommunications cable, connecting Germany, the Netherlands, the UK, and USA. In operation since 1999.	Operational	Wight-Barfleur Reef SAC

[124] https://www.gov.uk/guidance/oil-and-gas-offshore-environmental-legislation#offshore-petroleum-activities-conservation-of-habitats-regulations-2001-as-amended
[125] *Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020*

Sources: relevant Development Consent Orders and related post-consent modifications (https://national-infrastructure-consenting.planninginspectorate.gov.uk/). TCE & BMAPA (2025), Notes: [1] those sites considered to be relevant to 2nd carbon dioxide storage round exploration/appraisal activities.

Figure 6.4: Area applied for in relation to other projects

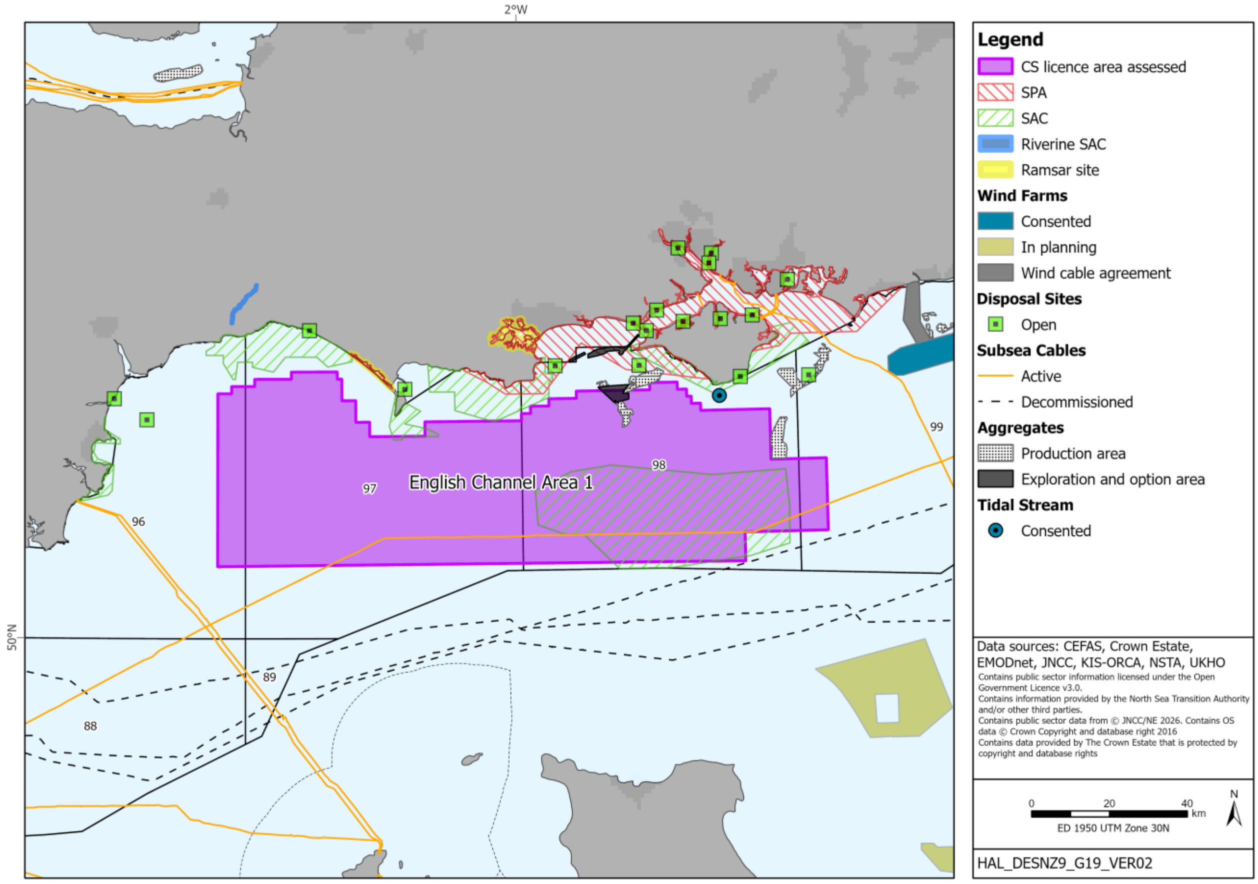


Figure 6.5: Area applied for in relation to other projects (continued)

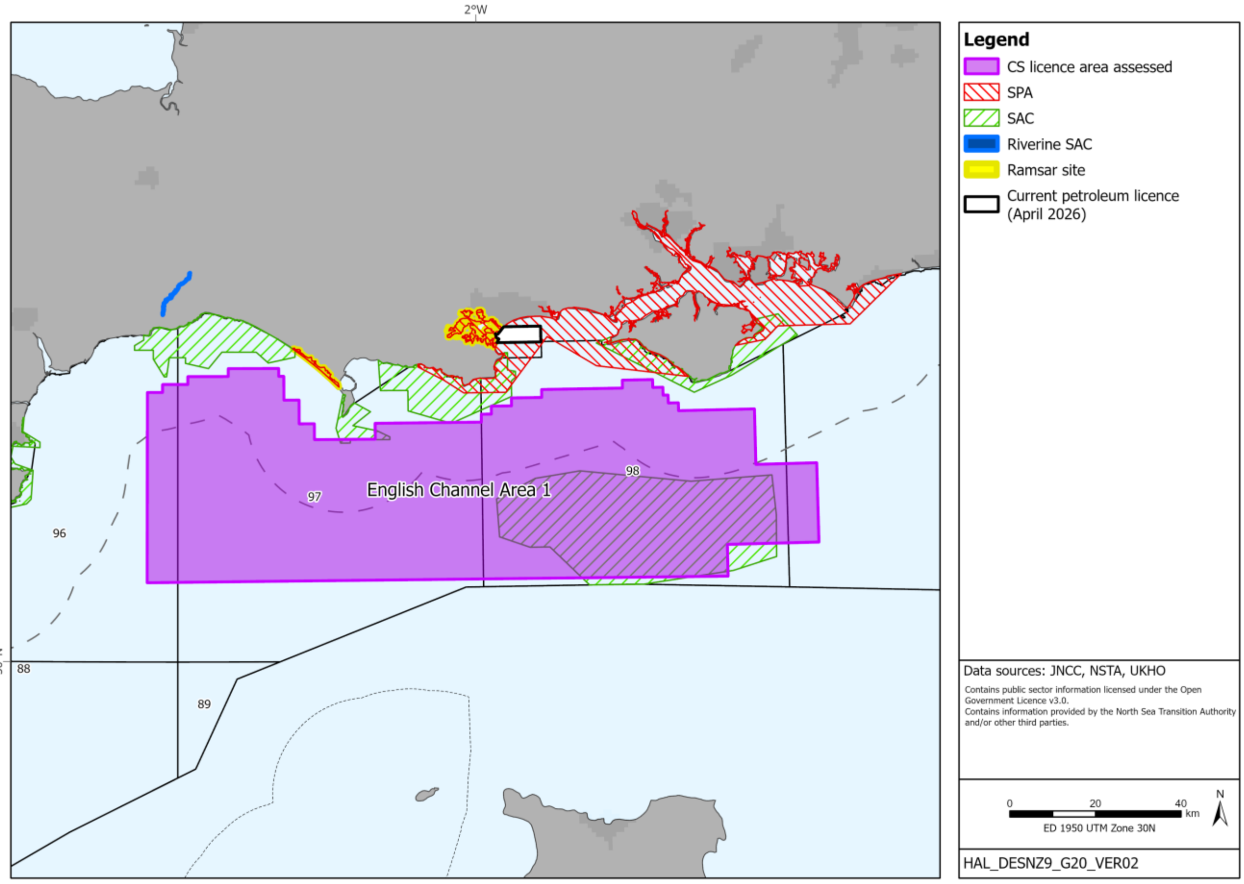
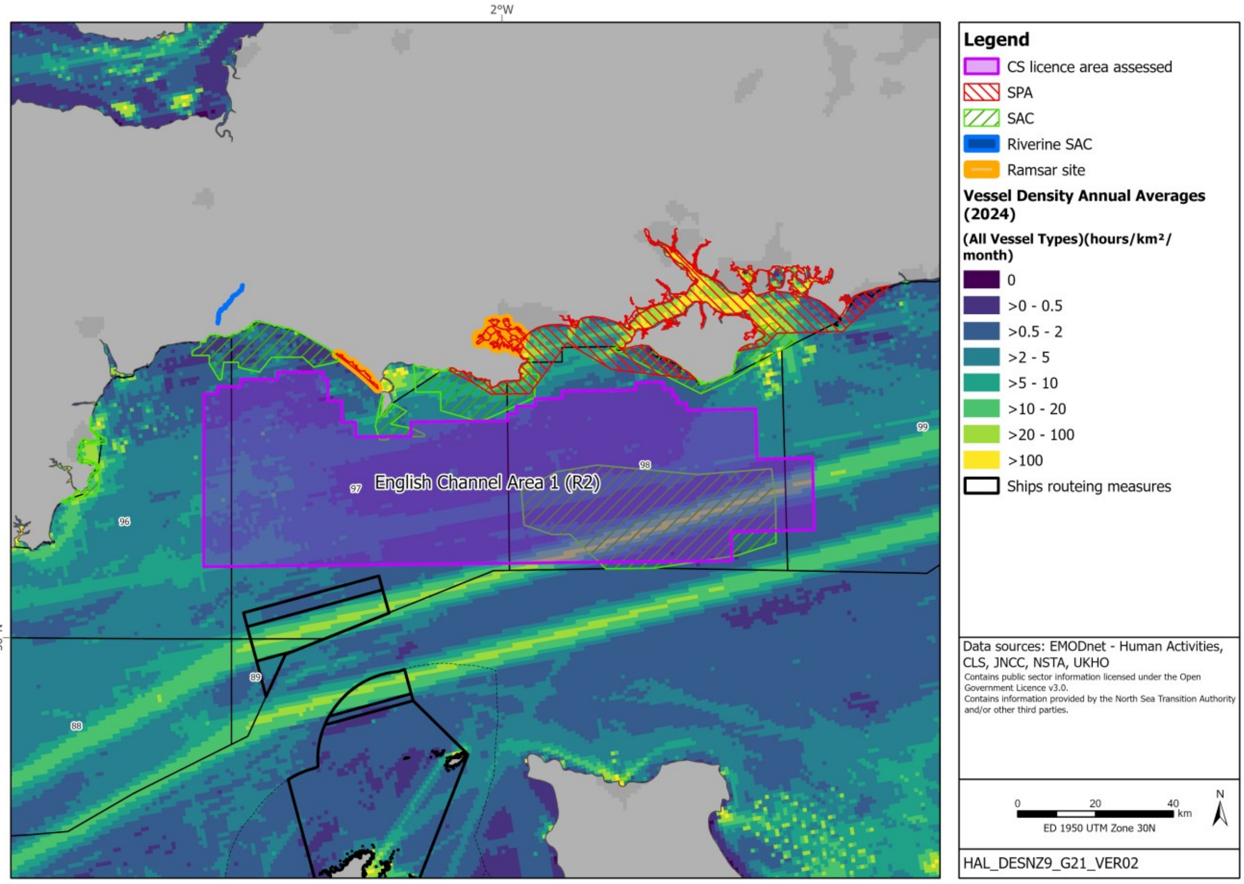


Figure 6.6: Vessel traffic in the English Channel



6.2.1 Physical disturbance and drilling effects

The pressures which may result from exploration activities that could result from licensing and cause physical disturbance and drilling effects on the relevant sites were described in Section 4.2 and Section 5.2.2. The conclusions of Section 5.2.2 are considered in the following section in the context of those relevant projects identified in Table 6.2 above.

The area applied for generally has few ongoing activities which could act in-combination with exploration drilling. No other offshore energy activities (oil and gas exploration and production, offshore renewables) take place within the area applied for. While a number of wells are present in the area, these have all been plugged and abandoned and will not have a surface component. Any disturbance associated with former wells (e.g. cuttings) are unlikely to be detectable and to have negligible cumulative ecological effect given the water depths and currents. For example, cuttings piles would not be expected to accumulate in the English Channel due to prevailing current strengths.

A number of aggregate extraction areas are present in the north and to the east of the area applied for and are shown in Figure 6.4. The HRA for the 2021-22 Marine Aggregates Licensing Round (ABPmer 2023) concluded that there would be no adverse effect on relevant SACs and SPAs alone or in-combination with other plans and projects, with the only site relevant to this assessment being South Wight Maritime SAC. None of these potential aggregate extraction areas, or those in production, overlap with any relevant site for which impacts are predicted (see Section 5.2), that is because the sites (e.g. South Wight Maritime SAC, Solent and Dorset Coast SPA) are all greater than 500m distance from the boundary of the area applied for, and outside the distance within which impacts from rig siting and drilling discharges are predicted (see Table 2.2). Adverse in-combination effects from aggregate extraction and carbon dioxide storage exploration/appraisal activity in the area applied for are therefore not predicted.

With respect to drilling discharges, previous discharges of WBM cuttings in the UKCS have been shown to disperse rapidly and to have minimal ecological effects (See Section 4.2, also see individual site assessments in Section 5.2). Dispersion of further discharges of mud and cuttings could lead to localised accumulation in areas where reduced current allows the particles to accumulate on the seabed. Given the relatively shallow water depths (generally <50m and <60m across the whole area applied for), moderate to strong tidal currents and potential for storm wave base interactions across the areas applied for (e.g. Klein *et al.* 1999), accumulations of cuttings piles are not considered likely from exploration activity (see Section 5.2) or in-combination with historic oil and gas exploration wells, most of which were drilled in the 1980s and 1990s. Additionally, the potential for in-combination effects relating to chemical usage and discharge from exploratory drilling is limited by the lack of any oil and gas exploration and production activities in the English Channel, and the existing legislative and permitting controls that are in place (see Section 2.3.1 and 5.2), which the UK Marine Strategy[126] has identified as relevant measures contributing to managing discharges. Discharges are considered unlikely to be detectable and to have negligible in-combination effect (BEIS 2022).

Fishing, and particularly bottom trawling, have historically (and currently) contributed to seabed disturbance over extensive areas and is identified as an ongoing issue in the UK assessment

[126] https://www.gov.uk/government/consultations/marine-strategy-part-three-programme-of-measures Note that the updated programme of measures was due to be published in 2022 but was not at the date of this assessment.

of good environmental status[127]. Depending on the nature of future measures (e.g. in relation to MPA management in the wider environment and within MPAs), such effects are likely to be reduced and therefore some improvement in benthic habitats could be expected. A number of byelaws have been enacted which effectively prohibit the use of certain gears in all or part of certain SACs, including the Wight-Barfleur Reef SAC[128]. These byelaws are in accordance with Defra's Environmental Improvement Plan[129]. Additionally, the Southern Inshore Fisheries and Conservation Authority (IFCA) prohibit the use of bottom towed fishing gear across the majority of the Studland to Portland SAC, Lyme Bay and Torbay SAC, and South Wight Maritime SAC[130]. While there is limited information on the timescale under which the fisheries management measures could lead to a change in the condition of the features of sites (though see Sheehan *et al.* 2013, with reference to Lyme Bay and Torbay SAC), recovery would be expected in the coming years.

Whilst fishing may be linked to past damage to site features, and presents a continuing risk to these, recent, ongoing, and future management measures such as those noted above should limit the potential for in-combination effects with other activities. When any surface structure (fixed and floating installations) used for exploration/appraisal drilling becomes operational, a safety zone with a radius of 500m is created under the amendment to the *Petroleum Act 1987* made by the *Energy Act 2008* and other activities are excluded from taking place within the zone, including fisheries. Safety zones apply to mobile drilling rigs and are notified to other users of the sea (e.g. through notices to mariners and Kingfisher charts). In view of the prohibition of bottom trawling across all or the majority of the area within those sites which overlap the area applied for, significant in-combination effects following licensing of with fisheries are not predicted. Additionally, as noted in Section 5.2, given the available space within the wider licence area applied for outside of sites including Wight-Barfleur Reef SAC, Lyme Bay and Torbay SAC and Studland to Portland SAC, there is considerable scope available to site a rig away from the site, such that any effect can be avoided. It is expected that this would form the basis of any mitigation required following assessment at the project level, in order to avoid effects. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information.

6.2.2 Physical presence

Physical presence of offshore infrastructure and support activities may potentially cause behavioural responses in fish, birds, and marine mammals (see Section 5.6 of BEIS 2022). Previous SEAs have considered the majority of behavioural responses resulting from interactions with offshore oil and gas infrastructure (whether positive or negative) to be insignificant; in part because the majority are at a substantial distance offshore; rigs used for carbon dioxide storage exploration/appraisal will be of the same type as those used in oil and gas exploration. All of the SPAs considered in this assessment are classified for terns, with the Solent and Dorset Coast SPA classified on the basis of core foraging areas for terns associated with other sites including Poole Harbour SPA, Solent and Southampton Water SPA and Chichester and Langstone Harbour SPA. It is unlikely that terns from these sites, or the little tern feature of Chesil Beach and The Fleet SPA, would substantially forage over the area applied for, and should any terns be present, they have a low sensitivity to disturbance by ship

[127] https://consult.defra.gov.uk/marine/updated-uk-marine-strategy-part-one/supporting_documents/UKmarinestrategypart1consultdocumentfinal.pdf
[128] https://www.gov.uk/government/publications/marine-protected-areas-bottom-towed-fishing-gear-byelaw-2023
[129] https://www.gov.uk/government/publications/environmental-improvement-plan-2025/environmental-improvement-plan-eip-2025
[130] https://www.southern-ifca.gov.uk/all-regulations

and helicopter traffic, and significant disturbance is not considered to be likely. Vessel traffic is the primary activity which could provide a source of in-combination effect to activities following the licensing of all or part of the area applied for, which includes vessels associated with fisheries, aggregate extraction, freight traffic, ferries, and recreational sailing. The area of the Solent and the wider English Channel are busy shipping areas, with well-established routes to the main ports in the area (Figure 6.6). It is not predicted that the scale of additional vessel and rig presence, both spatially and temporally (Table 2.2, typically 2-3 supply trips per week) taken in-combination with the existing shipping levels in the area, would result in an adverse in-combination effect for tern species associated with relevant sites considered in this assessment. As terns are breeding feature of the sites, any impact would be completely avoided should activity take place outside of the breeding season. Further assessment, including HRA where appropriate, would be undertaken at the project level, at which stage the assessment would be informed by specific rig siting information.

6.2.3 Underwater noise effects

No other projects which could produce major sources of impulsive underwater noise (e.g. piling, seismic survey) have been identified in the area applied for, and which could affect the relevant site (River Axe SAC) considered for underwater noise in this AA. The English Channel is a busy shipping area with vessel traffic concentrated around a number of important routes through the Channel and to ports on the south coast of the UK (Figure 6.6). Due to the established nature of this vessel traffic, and the limited increment in potential traffic associated with the exploration/appraisal activities which could follow licensing (i.e. the rig and typically up to three supply vessel trips per week), the Department has not identified in-combination effects that would adversely affect the integrity of the River Axe SAC. Additionally, there are effective regulatory mechanisms (Section 5.2 and Appendix 3 of BEIS 2022) which ensure that operators, the Department, and other relevant consenting authorities take such considerations into account during activity permitting. These mechanisms generally allow for public participation in the process[131].

6.3 Conclusion

Exploration/appraisal activity is identified as a pressure to which most of the sites considered in this assessment are sensitive (e.g. from physical effects or underwater noise). Though not site specific, available evidence (see e.g. UKBenthos database, OSPAR 2010, OSPAR 2023[132]) indicates that the scale of effects from offshore oil and gas activities, and therefore by analogy to carbon dioxide storage exploration/appraisal, have significantly decreased over time, with some sources of pollution substantially reduced or eliminated entirely, noting that discharges associated with exploration or appraisal drilling for carbon dioxide storage will be broadly similar. OSPAR (2023) notes that the main concerns in relation to oil and gas now relate to historical cuttings piles and produced water, which are not features of the English Channel, southern North Sea, or Irish Sea, either due to limited exploration and lack of any offshore production activities, or the hydrodynamic nature of the environment.

Any activities relating to the work programmes will be judged on its own merits and in the context of wider development in the area (i.e. any potential incremental effects). The current

[131] *Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020*

[132] https://www.ospar.org/work-areas/cross-cutting-issues/qsr2023 and https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/synthesis-report/

controls on terrestrial and marine industrial activities, including activities that could follow licensing, can be expected to prevent significant in-combination effects affecting relevant sites.

The Department will assess the potential for in-combination effects whilst considering project-specific environmental assessments and, where appropriate, through project specific EIA and HRAs. This process will ensure that mitigation measures are put in place to ensure that activities, if consented, will not result in adverse effects on integrity of the relevant sites[133]. Therefore, it is concluded that the in-combination effects from activities arising from the licensing of the carbon dioxide storage licensing areas applied for, with those from existing and planned activities in the southern North Sea and English Channel will not adversely affect the integrity of relevant Sites.

[133] Though noting, as above, the provisions of Regulation 6 of the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001*.

7 Overall Conclusion

Taking account of the evidence and assessment presented above, it has been determined that the licensing of three areas through the 2nd Carbon Dioxide Storage Licensing Round considered in this AA, will not have an adverse effect on the integrity of the relevant sites (identified in Section 1.3), and the Department has no objection to the NSTA awarding carbon dioxide storage licences (subject to meeting application requirements) covering those areas listed in Section 1.2. This is because there is a sufficient degree of certainty that licensing of the areas applied for will not adversely affect the integrity of relevant sites (as described in Sections 5.1 to 5.3), taking account of the mitigation measures that can be imposed through existing permitting mechanisms on the planning and conduct of activities, outlined in Section 5 and in Section 7.1 below.

Even where a site/interest feature has been screened out, or where a conclusion of no adverse effect on integrity has been reached at plan level, the potential for likely significant effects on any relevant site would need to be revisited at the project level once project plans are known. New relevant site designations, new information on the nature and sensitivities of interest features within sites, and new information about effects, including in-combination effects, may be available to inform future project level HRAs.

The Department has also considered the outcome of this assessment against the targets set out in the *Environmental Targets (Marine Protected Areas) Regulations 2023* and the interim targets set out in the Government's Environmental Improvement Plan. In light of the conclusion of this AA, the Department does not consider that the granting of carbon dioxide storage licences will affect the ability to reach the applicable targets.

7.1 Mitigation measures

Mitigation measures can be imposed through existing permitting mechanisms on the planning and conduct of activities which result in physical disturbance and underwater noise effects (as identified in Sections 5.2.1 and 5.3.1 and summarised here). Such measures are informed by project specific plans and the nature of the sensitivities identified which would be subject to further assessment, including HRA, where required. Further mitigation identified which goes beyond existing regulatory requirements and controls (see Section 2.3) includes:

- the re-siting of activities (e.g. wellhead or rig leg positions) to ensure sensitive seabed surface features (such as reefs) are avoided and potential rig stabilisation issues (e.g. from scouring around spud cans, or soft sediment conditions) are minimised;

- where rig stabilisation or anti-scour protection is required, the Department will expect operators to provide adequate justification for the stabilisation option proposed (including for rig siting beyond site boundaries, if practical) and the use of systems that can be removed following drilling, where these meet the technical and safety requirements of rig placement;

- where rock placement is required, the Department will expect operators to minimise the volume of rock deposited;

- activity timing to avoid the most sensitive periods for noise sensitive species – operators must demonstrate how seasonal sensitivities have been taken into account when planning operations (see BEIS 2021c), and use of existing shipping routes where proposed activities could result in the physical disturbance of marine mammals;

- that the licensees of the areas of relevance for underwater noise effects in relation to the Southern North Sea SAC (listed in Table 5.2) establish early discussions with the Department and also the leaseholders of OWF areas, to understand the nature and timing of proposed activities such that significant in-combination effects can be avoided (see Section 6.1).

7.1.1 Plan level mitigation

In addition to the mitigation measures outlined in Sections 5.1-5.3, plan level mitigation has been identified to avoid permanent habitat change to the Haisborough, Hammond and Winterton SAC. If a well is proposed within this site and rig stabilisation or scour protection is required, removable methods must be used, subject to these meeting the technical and safety requirements of rig placement at a particular location. Alternatively, should rock be required, this must be removed, as far as is practicable, after completion of the drilling campaign. Additionally, in sites with qualifying reef features, rig siting must be informed by recent survey data so that sensitive areas, in particular for Annex I reef, can be avoided.

Additionally, with regards to the Outer Thames Estuary SPA, Greater Wash SPA, and Liverpool Bay SPA in relation to red-throated diver and scoter qualifying interests, where possible, should activities take place within the site, they should avoid the wintering period (1st November to 31st March inclusive). Where this is not possible, vessels should use established routes and avoid areas of high diver or scoter density.

These control measures are incorporated in respect of habitat and species interest features through the range of legislation and guidance[134] which apply to activities which could follow licensing. Where necessary, project-specific HRA based on detailed project proposals would be undertaken by the Department to ensure that permits/consents are only granted where the proposed activity will not result in adverse effects on integrity of relevant sites.

7.2 Future consenting and Habitats Regulations Assessments

The existing regulatory requirements and controls on activities that could follow the licensing within the areas applied for are outlined in Section 2.3 (see also the review in BEIS 2022, and related Appendices 2 and 3). The HRA requirements and process are described in DESNZ (2026) and in Section 3 of this document. It is emphasised here (and has been noted throughout this AA) that the granting of future consents for activities is not automatic and is dependent on future applications supported by suitable location and activity/project specific assessments which take account, where relevant, of conservation sites, their features and conservation status. The Department will, where appropriate, undertake HRA screening and AA to inform decisions on the granting of consents. Consent and/or agreement to the grant of consent (as appropriate) will not be given unless the requirements of Regulations 5 and/or 6 of the Habitats Regulations have been met.

[134] See https://www.gov.uk/guidance/oil-and-gas-offshore-environmental-legislation

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