Department for
Business, Energy
& Industrial Strategy

OFFSHORE OIL & GAS LICENSING 31ST SEAWARD ROUND

Habitats Regulations Assessment

Draft Appropriate Assessment: Mid North Sea High

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1 Introduction

1.1 Background and purpose

The plan/programme covering this and potential future seaward licensing rounds has been subject to a Strategic Environmental Assessment (OESEA3), completed in July 2016. 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. The SEA Environmental Report was subject to an 8-week public consultation period, and a post-consultation report summarising comments and factual responses was produced as an input to the decision to adopt the plan/programme. This decision has allowed the Oil & Gas Authority (OGA) to progress with further seaward oil and gas licensing rounds. As a result on 10th July 2018, the OGA invited applications for licences relating to 1,779 Blocks in a 31st Seaward Licensing Round covering mature and frontier areas of the UK Continental Shelf (UKCS). Applications were received for licences covering 164 Blocks/part Blocks.

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) implement the requirements of Articles 6(3) and 6(4) of the Habitats Directive with respect to oil and gas activities in UK territorial waters and on the UK Continental Shelf. The *Conservation of Offshore Marine Habitats and Species Regulations 2017* cover other relevant activities in offshore waters (i.e. excluding territorial waters). Within territorial waters, the Habitats Directive is transposed into UK law via the *Conservation of Habitats and Species Regulations 2017* 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* (as amended) in Northern Ireland.

As the petroleum licensing aspects of the plan/programme are not directly connected with or necessary for nature conservation management of European (Natura 2000[1]) sites, to comply with its obligations under the relevant regulations, the Department for Business, Energy and Industrial Strategy[2] (BEIS) is undertaking a Habitats Regulations Assessment (HRA). To comply with obligations under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended), in winter 2018, the Secretary of State undertook a screening assessment to determine whether the award of any of the Blocks offered would be likely to

[1] This includes Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and potential sites for which there is adequate information on which to base an assessment.
[2] Note that while certain licensing and regulatory functions were passed to the OGA (a government company wholly owned by the Secretary of State for BEIS) on 1 October 2016, environmental regulatory functions are retained by BEIS, and are administered by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED).

have a significant effect on a relevant site, either individually or in combination[3] with other plans or projects (BEIS 2018a). In doing so, BEIS has applied the Habitats Directive test[4] (elucidated by the European Court of Justice in the case of Waddenzee (Case C-127/02)[5]) which is:

> *…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 Relevant Blocks

The screening assessment (including consultation with the statutory conservation agencies/bodies) formed the first stage of the HRA process. The assessment was undertaken in the period within which applications for Blocks were being accepted, and therefore considered all 1,779 Blocks offered. The screening identified 525 whole or part Blocks as requiring further assessment prior to decisions on whether to grant licences (BEIS 2018a). Following the closing date for 31st Seaward Round applications, and the publication of the screening document, those Blocks identified as requiring further assessment were reconsidered against the list of actual applications. It was concluded that further assessment (Appropriate Assessment, AA) was required for 41 of the Blocks applied for. Because of the wide distribution of these Blocks around the UKCS, the AAs are documented in four regional reports as follows:

- Mid North Sea High
- Moray Firth
- Irish Sea

[3] 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).
[4] See Article 6(3) of the Habitats Directive.
[5] Also see the Advocate General's Opinion in the recent 'Sweetman' case (Case C-258/11), which confirms those principles set out in the Waddenzee judgement.

- English Channel

1.2.1 Mid North Sea High Blocks

The Mid North Sea High Blocks applied for in the 31st Round and considered in this assessment are listed below in Table 1.1, and are shown in Figure 1.1.

Table 1.1: Blocks requiring further assessment

37/20	37/25	37/28a	37/29a	37/30
38/16	38/17	38/21	38/22	38/23
38/26	43/3	43/4		

1.3 Relevant Natura 2000 sites

The screening identified the relevant Natura 2000 sites and related Blocks requiring further assessment in the Mid North Sea High (refer to Appendix B of BEIS 2018a). Following a reconsideration of those Blocks and sites screened in against those Blocks applied for, two Natura 2000 sites were identified as requiring further assessment in relation to 13 Blocks (Table 1.2 and Figure 1.1). Abbreviations and species common names follow those in Appendix A of BEIS (2018a).

Table 1.2: Relevant sites requiring further assessment

Relevant site Features	Relevant Blocks applied for	Potential effects
SACs		
Southern North Sea SCI Annex II species: harbour porpoise	37/20, 37/25, 37/28a, 37/29a, 37/30, 38/16, 38/21, 38/22, 38/26, 43/3, 43/4	Underwater noise
	37/20, 37/25, 37/28a, 37/29a, 37/30, 38/21, 38/26, 43/3, 43/4	Physical disturbance and drilling
Dogger Bank SAC Annex I habitats: sandbanks	37/20, 37/25, 37/28a, 37/29a, 37/30, 38/16, 38/17, 38/21, 38/22, 38/23, 38/26, 43/3, 43/4	Physical disturbance and drilling

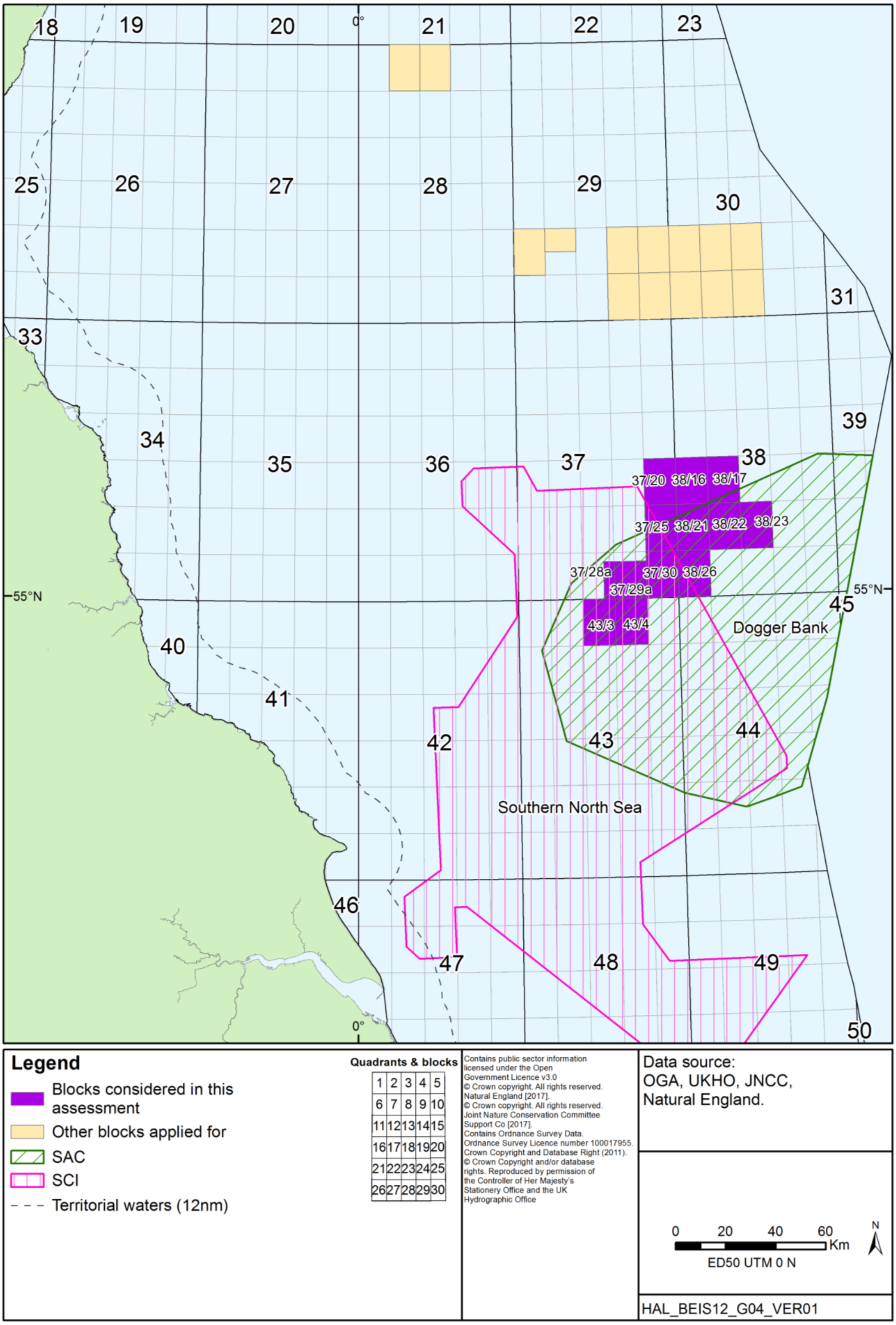
1.4 Assessment overview

This document sets out the key assumptions and approach to the AA, the evidence base underpinning the assessment and the assessment of relevant Blocks 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 ascertaining the absence or otherwise of adverse effects on the integrity of relevant European sites (Section 3)
- Evidence base on the environmental effects of offshore oil and gas 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 (Sections 5-8)
- Overall conclusion (Section 9)

As part of this HRA process, the AA document is being subject to consultation with appropriate nature conservation bodies and the public and will be amended as appropriate in light of comments received. The final AA document will be available via the 31st Round Appropriate Assessment webpage of the gov.uk website.

Figure 1.1: Blocks and sites relevant to this Appropriate Assessment



2 Licensing and potential activities

2.1 Licensing

The exclusive rights to search and bore for petroleum in Great Britain, the territorial sea adjacent to the United Kingdom and on the UKCS are vested in the Crown and the *Petroleum Act 1998* (as amended) gives the OGA the power to grant licences to explore for and exploit these resources. Offshore licensing for oil and gas exploration and production commenced in 1964 and progressed through a series of Seaward Licensing Rounds. A Seaward Production Licence grants exclusive rights to the holders "to search and bore for, and get, petroleum" in the area covered by the Licence but does not constitute any form of approval for activities to take place in the Blocks, nor does it confer any exemption from other legal or regulatory requirements. Offshore activities that may follow licensing are subject to a range of statutory permitting and consenting requirements, including, where relevant, activity specific AA as required under Article 6(3) of the Habitats Directive (Directive 92/43/EC).

Several sub-types of Seaward Production Licence were available in previous rounds (Traditional, Frontier and Promote) which have been replaced by the single "Innovate" licence[6]. As per previous licensing structures, the Innovate licence is made up of three terms covering exploration (Initial Term), appraisal and field development planning (Second Term), and development and production (Third Term). The lengths of the first two terms are flexible, but have a maximum duration of 9 and 6 years respectively. The Third Term is granted for 18 years but may be extended if production continues beyond this period. The Innovate licence introduces three Phases to the Initial Term, covering:

- Phase A: geotechnical studies and geophysical data reprocessing (note that the acquisition of new seismic could take place in this phase for the purpose of defining a 3D survey as part of Phase B, but normally this phase will not involve activities in the field)
- Phase B: shooting of new seismic and other geophysical data
- Phase C: exploration and appraisal drilling

Applicants may propose the Phase combination in their submission to the OGA. Phase A and Phase B are optional and may not be appropriate in certain circumstances, but every application must propose a Phase C, except where the applicant does not think any exploration is needed (e.g. in the development of an existing discovery or field re-development) and proposes to go straight to development (i.e. 'straight to Second Term'). The duration of the Initial Term and the Phases within it are agreed between the OGA and the applicant.

[6] *The Petroleum and Offshore Gas Storage and Unloading Licensing (Amendment) Regulations 2017* amend the Model Clauses to be incorporated in Seaward Production Licences so as to implement the Innovate licences to be issued in the 31st Round.

Applicants may choose to spend up to 4 years on a single Phase in the Initial Term, but cannot take more than 9 years to progress to the Second Term. Failure to complete the work agreed in a Phase, or to commit to the next Phase means the licence ceases, unless the term has been extended by the OGA.

Financial viability is considered prior to licence award for applicants proposing to start at Phase A or B, but further technical and financial capacity for Phase C activities would need to be demonstrated before the licence could enter Phase C and drilling could commence. If the applicant proposes to start the licence at Phase C or go straight to the Second Term, the applicant must demonstrate that it has the technical competence to carry out the activities that would be permitted under the licence during that term, and the financial capacity to complete the work programme, before the licence is granted. It is noted that the safety and environmental capability and track record of all applicants are considered by the OGA (in consultation with the Offshore Safety Directive Regulator)[7] through written submissions before licences are awarded[8]. Where full details cannot be provided via the written submissions at the application stage, licensees must provide supplementary submissions that address any outstanding environmental and safety requirements before approvals for specific offshore activities such as drilling can be issued.

2.2 Activities that could follow licensing

As part of the licence application process, applicants provide the OGA with details of work programmes they propose in the Initial Term. These work programmes are considered along with a range of other factors by the OGA before arriving at a decision on whether to license the Blocks and to whom. Activities detailed in work programmes may include the purchase, reprocessing or shooting of 2D or 3D seismic data (Phases A and B) and the drilling of wells (Phase C). There are three levels of drilling commitment:

- A Firm Drilling Commitment is a commitment to the OGA to drill a well. Firm drilling commitments are preferred on the basis that, if there were no such commitment, the OGA could not be certain that potential licensees would make full use of their licences. However, 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 relevant activity specific environmental assessments.

[7] The Offshore Safety Directive Regulator is the Competent Authority for the purposes of the Offshore Safety Directive comprising of the Department for Business, Energy and Industrial Strategy (BEIS) Offshore Petroleum Regulator for Gas Environment and Decommissioning (OPRED) and the Health and Safety Executive (HSE) working in partnership.

[8] Refer to OGA technical guidance and safety and environmental guidance on applications for the 31st Round at: https://www.ogauthority.co.uk/licensing-consents/licensing-rounds/

- A Contingent Drilling Commitment is also a commitment to the OGA to drill a well, but it includes specific provision for the OGA to waive the commitment in light of further technical information.

- A Drill or Drop (D/D) Drilling Commitment is a conditional commitment with the proviso that the licence is relinquished if a well is not drilled.

Note that Drill or Drop and Contingent work programmes (subject to further studies by the licensees) will probably result in a well being drilled in less than 50% of the cases.

The OGA general guidance[9] makes it clear that an award of a Production Licence does not automatically allow a licensee to carry out any offshore petroleum-related activities from then on (this includes those activities outlined in initial work programmes, particularly Phases B and C). Figure 2.2 provides an overview of the plan process associated with the 31st Seaward Licensing Round and the various environmental assessments including HRA. Offshore activities such as drilling and seismic survey are subject to relevant activity specific environmental assessments by BEIS (see Figures 2.3 and 2.4), and there are other regulatory provisions exercised by the Offshore Safety Directive Regulator and 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.

The proposed work programmes for the Initial 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 licensed Blocks and the degree of activity is not necessarily proportional to the size or number of Blocks in an area. In the case of direct physical disturbance, the Blocks being applied for are relevant.

2.2.1 Likely scale of activity

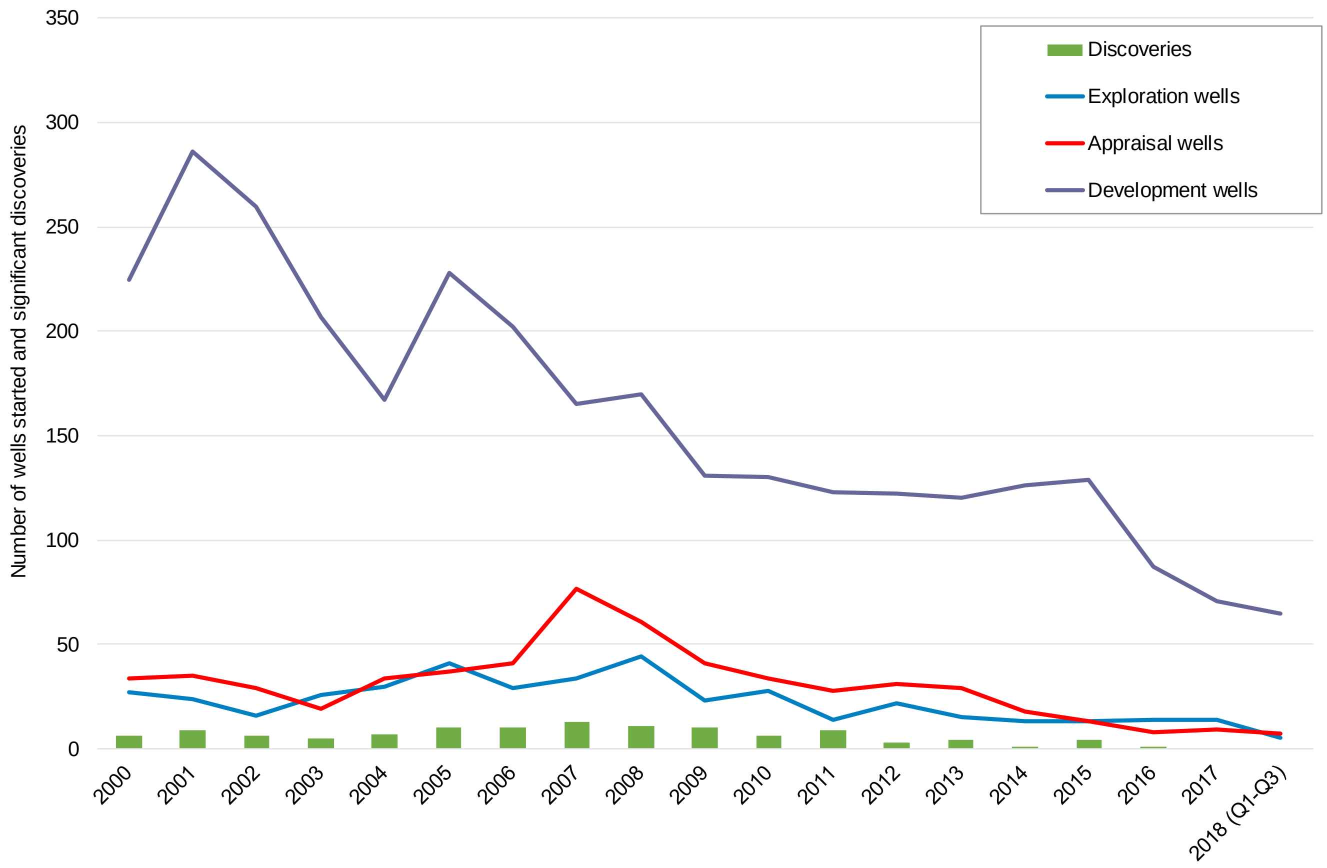
On past experience the activity that actually takes place is less than what is included in the work programmes at the licence application stage. A proportion of Blocks awarded may be relinquished without any offshore activities occurring. Activity after the Initial Term is much harder to predict, as this depends on the results of the initial phase, which is, by definition, exploratory. Typically, less than half the wells drilled reveal hydrocarbons, and of that, less than half will have a potential to progress to development. For example, the OGA analysis of exploration well outcomes from the Moray Firth & Central North Sea between 2003 and 2013 indicated an overall technical success rate of 40% with respect to 150 exploration wells and side-tracks (Mathieu 2015). Depending on the expected size of finds, there may be further drilling to appraise the hydrocarbons (appraisal wells). For context, Figure 2.1 highlights the total number of exploration and appraisal wells started on the UKCS each year since 2000 as well as the number of significant discoveries made (associated with exploration activities).

Discoveries that progress to development may require further drilling, installation of infrastructure such as wellheads, pipelines and possibly fixed platform production facilities,

[9] https://www.ogauthority.co.uk/media/4950/general-guidance-31st-seaward-licensing-round-july-2018.docx

although recent developments are mostly tiebacks to existing production facilities rather than stand-alone developments. For example, of the 39 current projects identified by the OGA's Oil & Gas Pathfinder (as of 24th August 2018)[10], 13 are planned as subsea tie-backs to existing infrastructure, 3 involve new stand-alone production platforms and 10 are likely to be developed via Floating Production, Storage and Offloading facilities (FPSO). The final form of development for many of the remaining projects is not decided, with some undergoing re-evaluation of development options but some are likely to be subsea tie-backs. Figure 2.1 indicates that the number of development wells has declined over time and this pattern is likely to continue. The nature and scale of potential environmental impacts from the drilling of development wells are similar to those of exploration and appraisal wells and thus the screening criteria described in Section 4 are applicable to the potential effects of development well drilling within any of the 31st Round Blocks.

Figure 2.1: UKCS Exploration, appraisal & development wells, and significant discoveries since 2000



Note: "significant" generally refers to the flow rates that were achieved (or would have been reached) in well tests (15 mmcfgd or 1000 BOPD) and does not indicate commercial potential of the discovery. Source: OGA Drilling Activity (November 2018), Significant Offshore Discoveries (October 2018)

[10] https://itportal.ogauthority.co.uk/eng/fox/path/PATH_REPORTS/pdf

2.2.2 31st Round activities considered by the HRA

The nature, extent and timescale of development, if any, which may ultimately result from the licensing of 31st Round Blocks 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 or floating installations) cannot be made. Moreover, once project plans are in place, subsequent permitting processes relating to exploration, development and decommissioning, would require assessment including where appropriate an HRA, allowing the opportunity for further mitigation measures to be identified as necessary, and for permits to be refused if necessary. In this way the opinion of the Advocate General in ECJ (European Court of Justice) case C-6/04, on 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 Initial Term and its associated Phases A-C will be considered in this AA (see Table 2.2).

Potential accidental events, including spills, are not considered in the AA as they are not part of the work plan. Measures to prevent accidental events, response plans and potential impacts in the receiving environment would be 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

The approach used in this assessment has been to take the proposed activity for the Block as being the maximum of any application for that Block, and to assume that all activity takes place. The estimates of work commitments for the relevant Blocks from the applications received by the OGA are shown in Table 2.1. Note, this represents a worst-case scenario since several Blocks may be included in one licence and the drill or drop well/contingent well applies to the licence, i.e. it is likely that fewer wells will be drilled than indicated in Table 2.1.

Table 2.1: Indicative work programmes relevant to Blocks considered in this assessment

Relevant Blocks	Obtain[11] and/or reprocess 2D or 3D seismic data	Shoot 3D seismic[12]	Drill or drop well/contingent well
37/20	-	✓	✓
37/25	-	✓	✓
37/28a	-	-	✓
37/29a	-	-	✓
37/30	-	✓	✓
38/16	-	✓	✓

[11] To obtain seismic data means purchasing or otherwise getting the use of existing data and does not involve shooting new seismic.
[12] Note that the applicants have indicated that the shooting of 3D seismic is contingent.

Relevant Blocks	Obtain[11] and/or reprocess 2D or 3D seismic data	Shoot 3D seismic[12]	Drill or drop well/contingent well
38/17	-	✓	✓
38/21	-	✓	✓
38/22	-	✓	✓
38/23	-	✓	✓
38/26	-	✓	✓
43/3	-	-	✓
43/4	-	-	✓

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 based on the evidence base for potential effects presented in Section 4 as well as reviews of exemplar Environmental Statements of relevant activities. 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 Habitats Directive.

Table 2.2: Potential activities and assessment assumptions

Potential activity	Description	Assumptions used for assessment
Initial Term Phase B: 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 hydrocarbon reservoirs. 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.
Initial Term Phase C: 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	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 production 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) footprint. A short review of 18 Environmental Statements, 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.

Potential activity	Description	Assumptions used for assessment
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.	The footprint of cuttings and other marine discharges, or the distance from source within which smothering or other effects may be considered 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 $0.8km^2$.

Potential activity	Description	Assumptions used for assessment
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 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).	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 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	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 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).
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 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).	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.
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.	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 5.2.3 and 5.3.3 with reference to the two main sources of effect identified.

2.3.1 Physical disturbance and drilling

The routine sources of potential physical disturbance and drilling effects associated with exploration are assessed and controlled through a range of regulatory processes, such as Environmental Impact Assessment (EIA) under the *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999* (as amended) as part of the Drilling Operations Application through the Portal Environmental Tracking System and, where relevant, HRA to inform decisions on those applications[13].

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)[14]. 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 potential sensitive habitats by such survey (including those under Annex I of the Habitats Directive) may influence BEIS's decision on a project level consent.

Discharges from offshore oil and gas facilities have been subject to increasingly stringent regulatory controls over recent decades (see review in DECC 2016, and related Appendices 2 and 3). As a result, oil and other 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. Drilling chemical use and discharge is subject to strict regulatory control through permitting, monitoring and reporting (e.g. the mandatory Environmental and 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* (as amended), and the discharge of chemicals which would be expected to have a significant negative impact would not be permitted.

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.

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

[14] See BEIS (2018). The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide.

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-bottom profile surveys and shallow drilling activities require an application for consent under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) and cannot proceed without consent. These applications are supported by an EIA, which includes a noise assessment. Applications are made through BEIS's Portal Environmental Tracking System using a standalone Master Application Template (MAT) and Geological Survey Subsidiary Application Template (SAT). 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 2010). Applicants are expected to be aware of recent research development in the field of marine mammal acoustics and the publication in the US of a new set of criteria for injury (NMFS 2016, referred to as NOAA thresholds).

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

It is a condition of consents issued under Regulation 4 of the *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) for oil and gas related seismic and sub-bottom profile surveys that the JNCC Seismic Guidelines are followed. Where appropriate, EPS disturbance licences may also be required under the *Conservation of Offshore Marine Habitats and Species Regulations 2017*[15]. JNCC have recently updated their guidelines (2017) and 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. For example, periods of seasonal concern for individual Blocks on offer have been highlighted with respect to seismic survey and fish spawning (see Section 2 of OGA's Other Regulatory Issues[16] which accompanied the 31st Round offer) which licensees should take account of. Licensees should also be aware that it may influence BEIS's decision whether or not to approve particular activities.

[15] 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.

[16] https://www.ogauthority.co.uk/media/4942/other-regulatory-issues_june-2018.docx

Figure 2.2: Stages of plan level environmental assessment

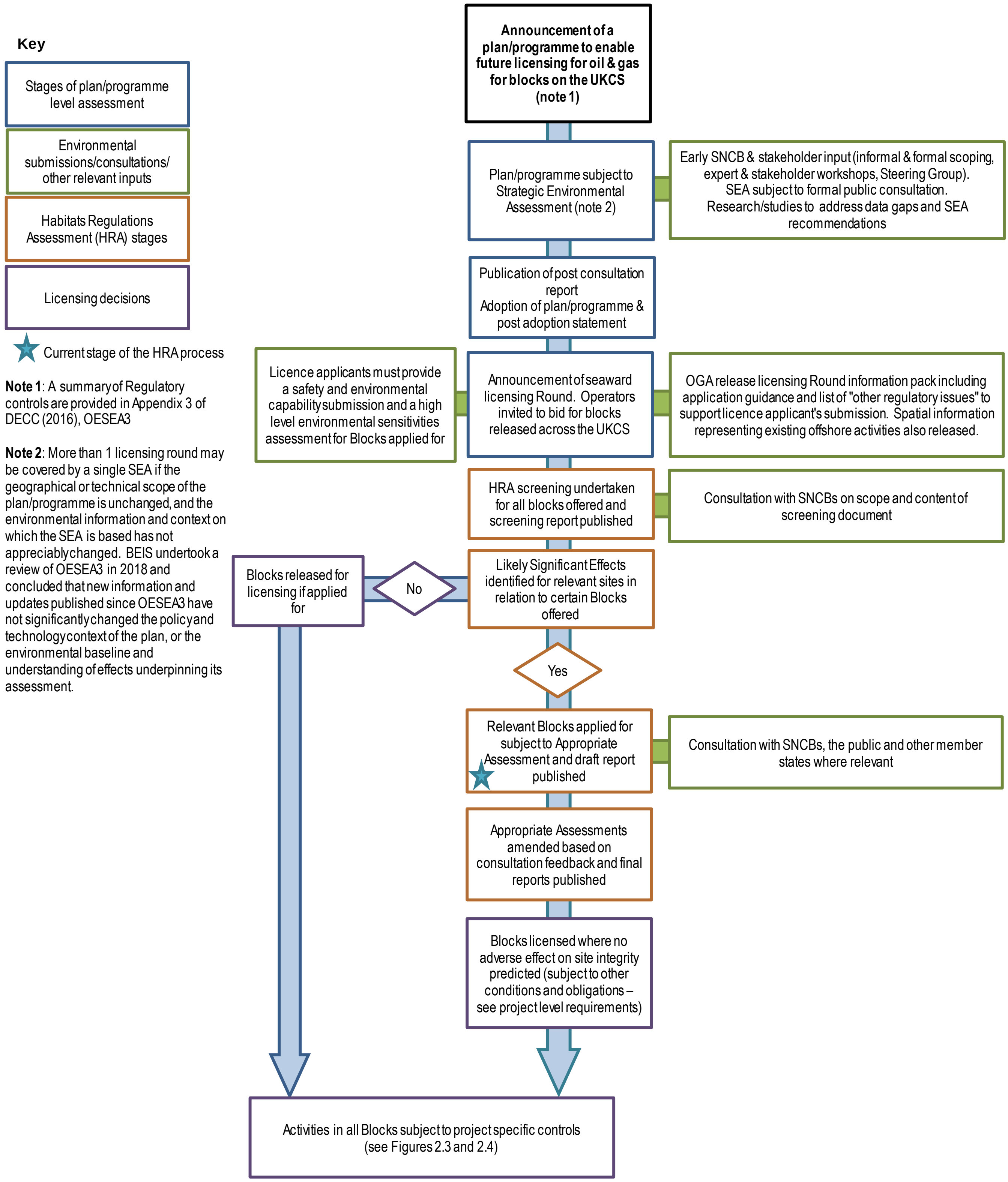
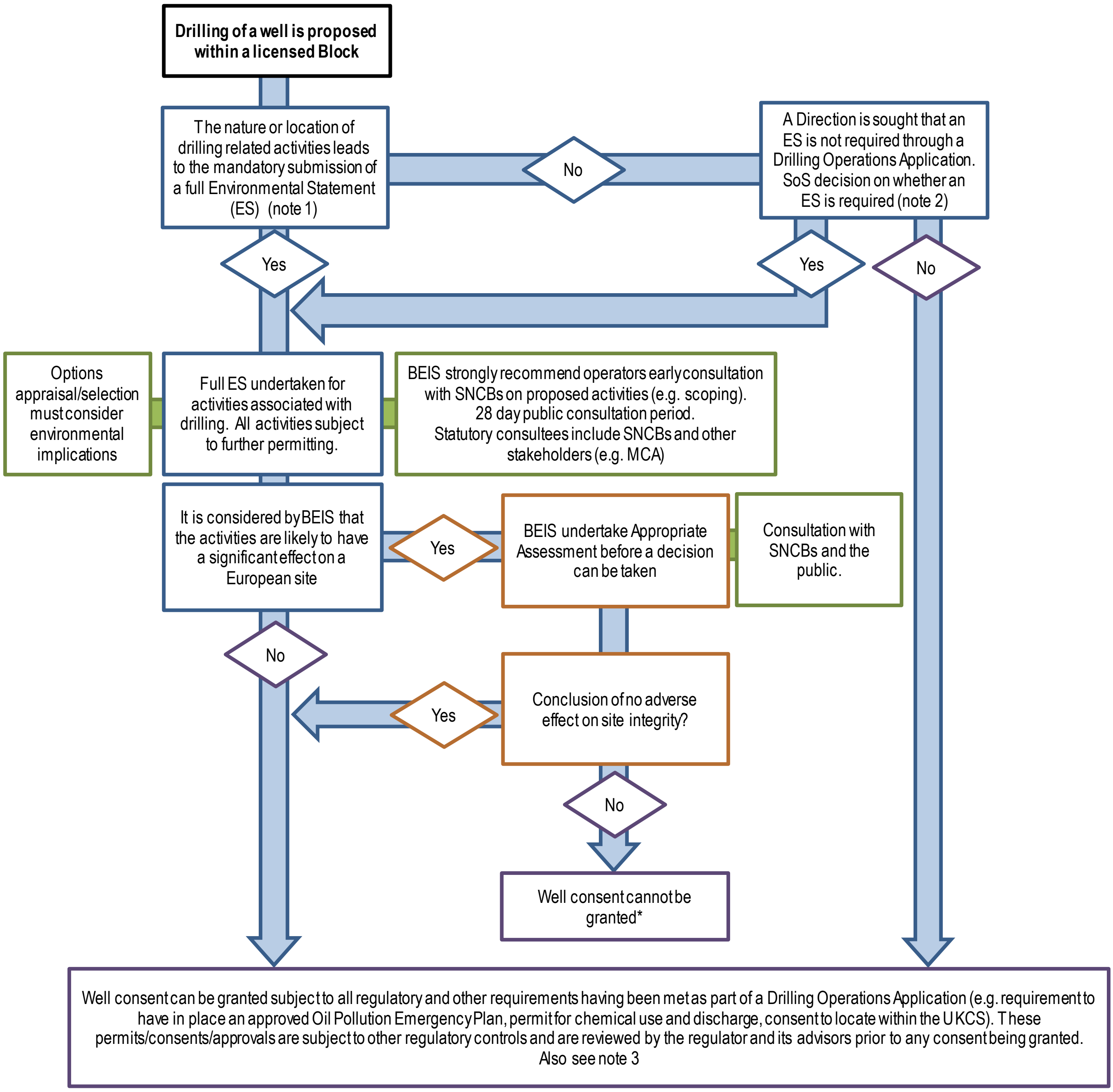


Figure 2.3: High level overview of exploration drilling environmental requirements



Key

- Stages of project permitting
- Environmental submissions/consultations/ other relevant inputs
- Habitats Regulations Assessment (HRA) stages
- Permitting/Consenting decisions

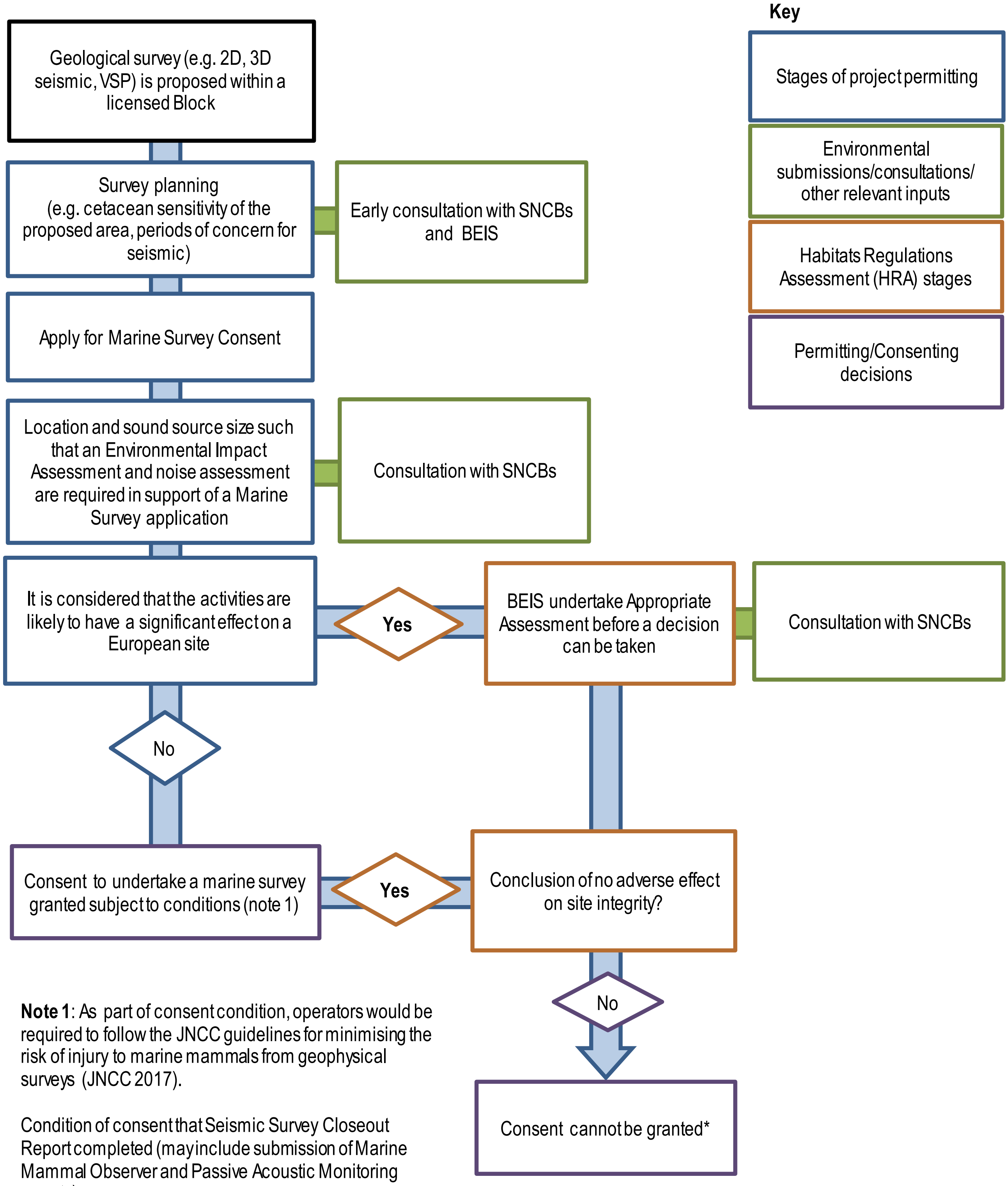
Note 1: See BEIS (2018). The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide. The Offshore Petroleum Regulator for Environment and Decommissioning, 80pp.

Note 2: Early consultation between BEIS and licensed operators is typical to mitigate against Environmental Statement (ES) requirements being identified following the request for a 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 2.4: 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).

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* (as amended), BEIS has:

- Considered, on the basis of the precautionary principle, whether it could be concluded that the integrity of relevant European 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.

- Subject to consultation on this document, drawn conclusions on whether or not it can agree to the grant of relevant licences.

In considering the above, BEIS used the clarification of the tests set out in the Habitats Directive in line with the ruling of the ECJ in the *Waddenzee* case (Case C-127/02), so that:

- Prior to the grant of any licence all activities which may be carried out following the grant 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 scientific knowledge in the field.

- A licence can only be granted if BEIS has made certain that the activities to be carried out 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, in the Commission's guidance and clarified by the courts (Cairngorms judicial review case[17]) as being: *'…the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat,*

[17] World Wild Life Fund & Others, Re application for judicial review of decisions relating to the protection of European Sites at Cairngorm Mountain, by Aviemore and proposals for construction of a funicular railway thereon.

complex of habitats and/or the levels of populations of the species for which it was classified[/designated].' This is consistent with the definitions of favourable conservation status in Article 1 of the Directive (JNCC 2002). As clarified by the European Commission (2000), 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 result in altering the ecological structure and functioning of the site which 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[18]. In such cases, the effects do not amount to an adverse effect for purposes of Article 6(3) of the Habitats Directive, provided that the 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.

3.3 Assessment of effects on site integrity

The assessment has been undertaken in accordance with the European Commission Guidance (EC 2000) and with reference to other guidance, reports and policy, including the Habitats Regulations Guidance Notes (English Nature 1997, Defra 2012, SEERAD 2000), SNH (2015), the National Planning Policy Framework (MHCLG 2018), 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 Sections 5-8. It has been informed by an evidence base on the environmental effects of oil and gas activities on the UKCS and elsewhere (Section 4) 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. 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:

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

[18] Noting that those typical species of the protected Annex I habitat types (as defined in Article 1), and other species and habitats types to the extent that they are necessary for the conservation of Annex I habitats or Annex II species must also be considered in appropriate assessment (as clarified in ECJ Judgement on Case C-461/17 of *Holohan and others v An Bord Pleanála*).

4 Evidence base for assessment

4.1 Introduction

The AAs are informed by an evidence base on the environmental effects of oil and gas activities derived from the scientific literature, relevant Strategic Environmental Assessments (e.g. DECC 2009, 2011 and 2016) and other literature. Recent operator Environmental Statements for offshore exploration and appraisal activities on the UKCS have also been reviewed, providing 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.

In recent years, 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 activity/pressure approach now underpins advice on operations (e.g. as required under Regulation 37(3) of the *Conservation of Habitats and Species Regulations 2017*[19], Regulation 21 of the *Conservation of Offshore Marine Habitats and Species Regulations 2017* and those relevant to Regulations of the devolved administrations) for the two sites included in this assessment. The advice for the Dogger Bank SAC and Southern North Sea SCI has been presented in two different manners. The former includes a workbook which identifies a range of pressures for site features in relation to oil and gas exploration activity[20], along with a standard description of the activity, pressure benchmarks, and justification text for the activity-

[19] Under this Regulation, advice must be provided by the appropriate nature conservation body to other relevant authorities as to: a European site's conservation objectives and any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated.

[20] Under the activity category, "oil and gas exploration", pressures include: abrasion/disturbance of the substrate on the surface of the seabed, penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion, habitat structure changes - removal of substratum (extraction), siltation rate changes, including smothering (depth of vertical sediment overburden), hydrocarbon & PAH contamination, introduction of other substances (solid, liquid or gas), synthetic compound contamination, transition elements & organo-metal (e.g. TBT) contamination, introduction or spread of non-indigenous species, litter.

pressure interaction (including with reference to source information). The relevance of the pressures to site specific features are identified; however, in many instances assessment of the sensitivity of a feature to a given pressure has not been made, or it has been concluded that 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 identify relevant pressures associated with hydrocarbon exploration, resultant impacts at a scale likely to give rise to significant effects are not inevitable consequences of activity, and they can often 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. The advice for the Southern North Sea SCI is in draft form, but indicates a range of activities and related pressures to which the harbour porpoise feature is sensitive which are relevant to the 31st Seaward Round, which include discharges from offshore installations, drilling, seismic survey, shipping and pile driving (restricted to conductor piling for this assessment, see Table 2.2).

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 oil and gas exploration from successive Offshore Energy SEAs and the review of the OESEA3 Environmental Report (BEIS 2018b) covers the 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 & PAH 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 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 Natura 2000 site 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 Blocks and relevant Natura 2000 sites to be subject to further assessment are located (Figure 1.1).

4.2 Physical disturbance and drilling effects

The pressures which may result from exploration activities and cause physical disturbance and drilling effects on the relevant Natura 2000 sites assessed in Section 5.3 are described below.

[21] Note that pressure benchmarks are used as reference points to assess sensitivity and are not thresholds that identify a likely significant effect within the meaning of the Habitats Regulations.

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

Jack-up rigs are likely to be used in the Mid North Sea High Blocks due to water depths (<120m). Such rigs leave three or four seabed depressions from the feet of the rig (the spud cans) 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 (to the north of the MNSH Blocks) showed spudcan depressions associated with the drilling of a previous 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 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). 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 recoverable mud mats may be used in soft sediment (see 4.2.4 below).

The response of benthic macrofauna to physical disturbance has been well characterised in peer-reviewed literature, with increases in abundance of small opportunistic fauna and decreases in larger more specialised fauna (Eagle & Rees 1973, Newell *et al.* 1998, van Dalfsen *et al.* 2000, Dernie *et al*. 2003).

Habitat recovery from temporary disturbance (caused by spud can placement, anchor scarring, anchor mounds) will depend primarily on re-mobilisation of sediments by current shear (as reviewed by Newell *et al*. 1998, Foden *et al.* 2009). Subsequent benthic population recovery takes place through a combination of migration, re-distribution and larval settlement. On the basis that seabed disturbance is qualitatively similar to the effects of wave action from severe storms, it is likely that in most of the shallower parts of the UKCS, sand and gravel habitat recovery from anchor scarring, anchor mounds and cable scrape is likely to be relatively rapid (1-5 years) (van Dalfsen *et al.* 2000, Newell & Woodcock 2013).

4.2.2 Abrasion/disturbance of the substrate on the surface of the seabed and habitat structure changes – removal of substratum

The surface hole sections of exploration 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. After installation of 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)).

The extent and potential impact of drilling discharges have been reviewed in successive SEAs, OESEA, OESEA2 and OESEA3 (DECC 2009, 2011 and 2016, respectively, also see BEIS 2018b).

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).

4.2.3 Physical change to another seabed type

As noted, there may be a requirement for jack-up rig stabilisation (e.g. rock placement or use of mud mats) depending on local seabed conditions. In soft sediments, rock deposits may cover existing sediments resulting in a physical change of seabed type. 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 UK continental shelf such "stepping stones" are already 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.

4.2.4 Contamination[22]

The past discharge to sea of drill cuttings contaminated with oil based drill mud (OBM) resulted in well documented acute and chronic effects at the seabed (e.g. Davies *et al.* 1989, Olsgard & Gray 1995, Daan & Mulder 1996). These effects resulted from the interplay of a variety of factors of which direct toxicity (when diesel based muds were used) or secondary toxicity as a consequence of organic enrichment (from hydrogen sulphide produced by bacteria under anaerobic conditions) were probably the most important. Through OSPAR and other actions, the discharge of oil based and other organic phase fluid contaminated material is now effectively banned. The “legacy” effects of contaminated sediments on the UKCS resulting from OBM discharges have been the subject of joint industry work (UKOOA 2002) and reporting to OSPAR.

The UK Government/Industry Environmental Monitoring Committee has reviewed UK offshore oil and gas monitoring requirements and developed a monitoring strategy which aims to ensure that adequate data is available on the environmental quality status in areas of operations for permitting assurance and to meet the UK’s international commitments to report on UK oil industry effects. This strategy has been implemented since 2004 and has included regional studies in various parts of the North Sea, and surveys around specific single and multi-well sites.

Overall, there are positive indications of recovery of sediments and communities in both the Fladen Ground and East Shetland Basin from the historic effects of oil-based mud discharges. The total PAH and total n-alkane concentrations in Fladen Ground sediments were all lower in 2001 than in 1989 and are now at levels which are considered below ‘background’. The results of the most recent Fladen Ground survey confirm this general pattern of recovery.

In contrast to historic oil based mud discharges[23], 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 (e.g. Cranmer 1988, Neff *et al*. 1989, Hyland *et al*. 1994, Daan & Mulder 1996, Currie & Isaacs 2005, OSPAR 2009, Bakke *et al.* 2013, DeBlois *et al.* 2014). Considerable data 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. Cook *et al.* (2017) noted that due to the mostly shallower depth in which seabed sediments become re-suspended and dispersed during storms (Breuer *et al*. 2008), cuttings piles are not a typical feature of sites located in the MNSH area.

[22] Including contamination from transition elements and organo-metals, hydrocarbons and PAHs, synthetic compounds and the introduction of other substances (solid, liquid or gas).
[23] 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.

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) found after 6 months 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 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 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 Pose Little or No Risk to the Environment (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).

4.2.5 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[24]. The Convention includes Regulations with specified technical standards and requirements (IMO Globallast website[25]). Further oil and gas 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.

4.2.6 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). Draft advice on operations for the Southern North Sea SCI[26] 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.

4.3 Underwater noise effects[27]

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). The following description of noise sources and potential effects builds on these previous publications, augmented with more recent literature sources.

4.3.1 Noise sources and propagation

Of those oil and gas 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

[24] 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
[25] http://archive.iwlearn.net/globallast.imo.org/the-bwmc-and-its-guidelines/index.html
[26] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf
[27] Note that all underwater noise effects fall within the “underwater noise change” and “vibration” pressure definitions.

broadband source levels of 248-259 dB re 1µPa (OGP 2011). Most of the energy produced by airguns is low frequency: below 200Hz and typically peaking around 100Hz; source levels at higher frequencies are low relative to that at the peak frequency but are still loud in absolute terms and relative to background levels. As detailed in Section 2.2.1 some work programmes relating to the Blocks applied for in the 31st Round include the contingent intention to conduct a 3D seismic survey.

In addition to seismic surveys, relevant sources of impulsive sound are restricted to the smaller volume air-guns and sub-bottom profilers 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 2.2). Compared to deep geological survey, these smaller volume 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) and, in the case of some sub-bottom profilers, operate at a higher frequency than air guns[28]. Consequently, the overall magnitude and area of risk from sound effects is considerably smaller than in the case of deep geological seismic surveys.

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).

For all sources, 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).

4.3.2 Potential ecological effects

The only relevant site considered in this assessment is the Southern North Sea SCI, designated for harbour porpoise. Consequently, the following evidence focuses on the harbour porpoise, with consideration also given to the potential effects of underwater noise on fish as prey species.

Potential effects of anthropogenic noise on receptor organisms range widely, from masking of biological communication and small behavioural reactions, to chronic disturbance,

[28] 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 2017).

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 particularly 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, the latest SEA (DECC 2016) reflects the injury thresholds criteria developed by Southall *et al.* (2007), including the subsequent update for harbour porpoises in Lepper *et al*. (2014), based on the work by Lucke *et al.* (2009). Since then, NOAA has further updated the acoustic thresholds, including alternative frequency-weighting functions (NMFS 2016). 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) provide guidelines which are thought sufficient in minimising the risk of injury to marine mammals to negligible levels.

With respect to disturbance, it has proved much more difficult to establish broadly applicable threshold criteria based on exposure alone; this is largely due to the inherent complexity of animal behaviour where the same sound level is likely to elicit different responses depending on an individual's behavioural context and exposure history. For compliance with the Habitat Directive, the guidance for the protection of marine European Protected Species from injury and disturbance (JNCC 2010) recommends that 'disturbance' is interpreted as sustained or chronic disruption of behaviour scoring five or more in the Southall *et al*. (2007) behavioural response severity scale[29]. 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.

Evidence on the effects of seismic surveys on odontocetes and pinnipeds is limited but of note are studies in the Moray Firth observing responses of harbour porpoise to a 10 day 2D seismic survey (Thompson *et al.* 2013a). The 2D seismic survey took place in September 2011 and

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

exposed a 200km^2 area to noise; 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 typically used in rig-site survey (160 cubic inch). 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).

As concluded in OESEA3 (DECC 2016), a conservative assessment of the potential for marine mammal disturbance of seismic surveys will assume that firing of airguns will affect individuals within 10km of the source, resulting in changes in distribution and a reduction of foraging activity but the effect is short-lived. The precautionary criterion applied during initial Block screening (15km from relevant sites) is maintained here to identify the Blocks applied for to be considered with respect to likely significant effects in this assessment (see Section 5.3); 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.

Recent 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 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 20km radius; however, once piling ceases, harbour porpoises are expected to return readily (hours to days) (DECC 2016). Current SNCB advice assumes a distance of 26km as the zone of disturbance for pile-driving (Joint SNCB response to 29th Round draft AA, February 2017). At Horns Rev wind farm, off the Danish North Sea coast, a study using 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 currently very limited and the most recent OESEA (DECC 2016) concluded that effects are negligible but with a high level of uncertainty. Laboratory and field measurements on similar equipment are part of a US project. Outputs from these studies will be considered in due course to reduce uncertainty in assessments. 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), suggest a very low potential for significant disturbance of marine mammals.

The presence and/or movement of vessels from and within Blocks during exploration and appraisal activities could also potentially disturb marine mammals foraging within or close to designated or potential SACs 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. Porpoising occurred in response to almost 30% of vessel passages. Statistical analyses showed that higher levels of medium- to high-frequency components of vessel noise (250Hz to 63 kHz octave bands) significantly increase the probability of porpoising. By contrast, there was no significant relationship between porpoising behaviour and low-frequency components of vessel noise (3.51 to 125Hz) or the presence of pulses from echo-sounders on the vessels (Dyndo *et al.* 2015). (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 levels of -noise (coinciding with the passage of 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 µPa (16 kHz third-octave band, 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 2.2). 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 commissioned project "Mapping UK shipping density and routes from AIS" (MMO 2014b) and the 2015 national dataset of marine vessel traffic[30] provides relevant shipping density information[31]. 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 spatial overlap occurred for one or both species of seals such as the east coast of Scotland and England (e.g. Berwickshire and North Northumberland Coast SAC, Humber Estuary SAC, the Wash and North Norfolk Coast SAC).

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

[30] https://data.gov.uk/dataset/vessel-density-grid-2015

[31] Note that shipping densities are low over the majority of Blocks with higher densities primarily in coastal waters close to major ports.

results are highly variable, from no effect to long-term auditory damage (reviewed in Popper *et al.* 2014). 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).

Fish species of known importance as prey to 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.

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).

5 Assessment

The screening process (BEIS 2018a) identified a number of sites in the Mid North Sea High where there was the potential for likely significant effects associated with proposed activities that could follow licensing of Blocks offered in the 31st Round. The further assessment of two sites in relation to 13 Blocks applied for in the Mid North Sea High is given below. This assessment has been informed by the evidence base on the environmental effects of relevant oil and gas activities (Section 4) and the assumed nature and scale of potential activities (Table 2.2).

5.1 Relevant sites

A description of the each of the relevant sites is provided below based on the site citation and site selection information, which has been augmented by additional information from grey and primary sources relevant to site qualifying features. The assessment of these sites in relation to the 31st Round Mid North Sea High Blocks is documented in Sections 5.2-5.4.

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 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 located centrally in 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

(*Cancer pagurus*) 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[32] advises that the site feature extent and distribution, and structure and function should be restored, while supporting processes be maintained.

Southern North Sea SCI

The Southern North Sea SCI is an area with predicted persistent high densities of harbour porpoise. The harbour porpoise is protected in European waters under the provisions of Article 12 of the Habitats Directive and within the UK its conservation status is favourable[33]. 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 2015). The Southern North Sea SCI 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 support persistently higher densities during the winter. 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[34]. The current draft conservation objectives[35] 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

[32] http://jncc.defra.gov.uk/pdf/DoggerBank_SACO_v1_0.pdf
[33] JNCC (2013). Species conservation status reports. Third Report by the United Kingdom under Article 17 of the EU Habitats Directive. Joint Nature Conservation Committee, Peterborough. http://jncc.defra.gov.uk/page-6564 (accessed November 2018).
[34] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaSelectionAssessmentDocument.pdf
[35] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf

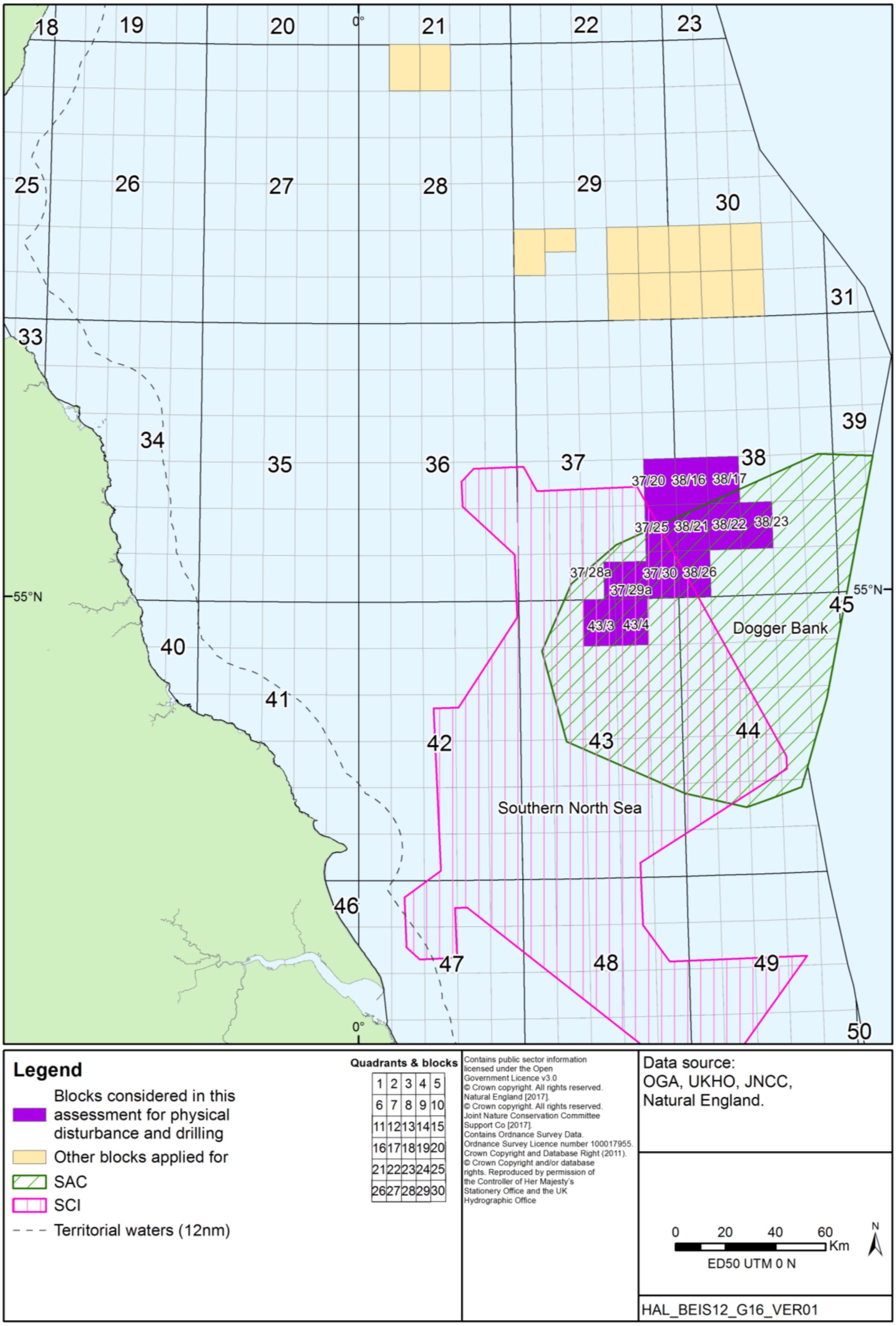
abundance of harbour porpoise for the North Sea MU was estimated in 2016 (Hammond *et al.* 2017) as part of SCANS-III (345,000, CV = 0.18), which is similar to the 2005 estimate (335,000 CV = 0.22).

5.2 Assessment of physical disturbance and drilling effects

5.2.1 Blocks and sites to be assessed

The nature and extent of potential physical disturbance and drilling effects are summarised in Section 4.2. On the basis of this information, in conjunction with the locations of Mid North Sea High Blocks applied for in the 31st Round and the sites with relevant qualifying features, potential likely significant effects are considered to remain for 13 Blocks (or part Blocks), in respect of two sites (Figure 5.2). These are assessed in Section 5.2.2.

Figure 5.1: Sites and Blocks in the Mid North Sea High to be subject to further assessment for physical disturbance and drilling effects



5.2.2 Implications for site integrity of relevant sites

The conservation objectives of relevant sites and information relating to site selection and advice on operations has been considered against the work programmes for the Blocks 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 here.

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

Dogger Bank SAC
Site information
Area (ha): 1,233,115 **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.
Relevant Blocks for physical disturbance and drilling effects
37/20, 37/25, 37/28a, 37/29a, 37/30, 38/16, 38/17, 38/21, 38/22, 38/23, 38/26, 43/3, 43/4
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; physical change (to another seabed type), introduction or spread of non-indigenous species)* The qualifying feature is sensitive to penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion[36] by the placement of spud cans as part of rig siting. Block 37/20 is *ca*. 4km from the site boundary 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 qualifying habitat. Blocks 37/25, 38/16 and 38/17 have significant areas outside the site boundaries in which rig siting would be possible, and therefore interaction with the qualifying features could be avoided. With respect to the remaining Blocks that are largely 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 2.2) compared to the large site (covering 0.006%), which is located offshore and has relatively shallow depth (15-40m) which exposes it to substantial wave energy, particularly during storm events which may cause significant natural disturbance of sediments (see Section 5.2.1). Recovery of damage to sub-surface features of the scale associated with temporary rig placement is expected to be rapid due to its localised nature and the energetic nature of the environment. 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. 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), and the qualifying feature is considered highly sensitive to this pressure, which assumes a permanent change of habitat. The Dogger Bank SACO (2018) indicates that introduced substrates, such as rock placement, normally consisting of gravel or pebbles have been deposited onto the seabed although it is not clear how much of the material there is within the site, and consequently it is unclear what impact this may have on site sediment composition and distribution. JNCC advise that activities must look to minimise, as far as is practicable, changes in substratum within the site to minimise further impact on feature extent and distribution, and associated changes in biological

[36] http://jncc.defra.gov.uk/docs/DoggerBank_AoO_Workbook_v1_0.xlsx

communities. It is assumed that rock placement (if required) would be within a maximum spatial footprint of 0.8km^2 (500m of a rig, Table 2.2). Hence, the potential loss of sandy sediment extent is small (0.006% per well) compared to the predominance of this sediment type across the very large site (12,331km^2). Moreover, further mitigation measures are available which include use of removable mud mats or anti-scour mats as an alternative to rock placement (Section 5.2.3), allowing the conclusion that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity.

As noted in Section 4.2.3, 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; habitat structure changes – removal of substratum; contamination from transition elements and organo-metals, hydrocarbons and PAHs, synthetic compounds and the introduction of other substances (solid, liquid or gas))*

The advice on operations indicates that the qualifying feature is sensitive to abrasion/disturbance of the seabed surface substrate and to habitat structure changes – removal of substratum. This is defined in the advice on operations as being habitat changes from smothering near the well location from drill cuttings, and that these can accumulate in piles where currents are generally weak. 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. However, it is noted in Section 4.2 that such piles do not generally accumulate in shallow, high energy waters, such as over the Dogger Bank and wider MNSH.

It is assumed that effects relating to drilling discharges occur within 500m of the well location (Table 2.2). Therefore with respect to Block 37/20 which is beyond this distance, or Blocks 37/25, 38/16 and 38/17 which have significant areas outside the site boundaries in which drilling will be possible, drilling discharges will not significantly impact the extent and distribution or the structure and function of the qualifying habitat. For the Blocks within the site, the maximum spatial footprint within which smothering by drilling discharges and associated habitat structure changes may occur (0.8km^2) is small (representing 0.006% of the total site area) and given the site's exposure to wave energy, redistribution of drilling discharges and recovery from smothering would be rapid. 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 possible although spatial footprints associated with rig installation and drilling discharges in Blocks 37/28a, 37/29a, 37/30, 38/21, 38/22, 38/23, 38/26, 43/3 and 43/4 (i.e. those Blocks entirely or largely within the site) are localised and temporary, and unlikely to overlap between Blocks either spatially or temporally. Given the indicative work programmes, the combined spatial footprint within which physical disturbance and drilling effects could occur (within 500m of the rig/well location) across the 9 Blocks (a worst case scenario of 9 drill or drop wells) is estimated at 7.2km^2 (0.06% of the site). However, the temporary nature of the disturbance, energetic nature of the environment, required controls and available mitigation (Sections 2.3.1 and 5.2.3), will ensure that site conservation objectives are not undermined. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

Southern North Sea SCI

Site information

Area (ha): 3,695,054
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 Blocks for physical disturbance and drilling effects
37/20, 37/25, 37/28a, 37/29a, 37/30, 38/21, 38/26, 43/3, 43/4
Assessment of effects on site integrity
Rig siting ***(Relevant pressures:** No relevant pressures identified[37]. Given draft nature of advice, the following potential pressures are also assessed: penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion; physical change (to another seabed type))*[38] The delineation of the Southern North Sea 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)[39]. Physical disturbance or abrasion to 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. Blocks 37/20, 37/25, 38/21 and 38/26 have significant areas outside the site boundaries in which rig siting would be possible, and therefore interaction with the habitats of the qualifying features could be avoided. With respect to those Blocks that are partly or wholly within the site, 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 a maximum spatial footprint of 0.8km^2 (500m from a rig, Table 2.2). Hence, the potential loss of extent of sandy sediment is small (0.00001km^2 per well) compared to the widespread nature of this sediment type across the very large site (36,958km^2). There is the potential for alternatives to rock placement (Section 5.2.3), allowing the conclusion that the site conservation objectives will not be undermined and there will be no adverse effect on site integrity. **Drilling discharges** ***(Relevant pressures:** Contaminants. Given draft nature of advice, the following potential pressures also assessed: abrasion/disturbance of the substrate on the surface of the seabed; habitat structure changes – removal of substratum)* The draft 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 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). Blocks 37/20, 37/25, 38/21 and 38/26 have significant areas outside the site boundaries in which drilling would be

[37] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf
[38] Relevant pressures were identified based on those from the JNCC pressures-activities database which could potentially impact the supporting habitats (sand/gravel), informed by the conservation advice package for the Dogger Bank SAC which overlaps with the SCI over a number of MNSH Blocks.
[39] http://jncc.defra.gov.uk/pdf/SouthernNorthSeaSelectionAssessmentDocument.pdf

possible, and therefore abrasion/disturbance of the seabed surface of supporting habitats by drilling discharges could be largely avoided. For the Blocks that are partly or wholly within the site, 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.

In-combination effects

Intra-plan in-combination effects are possible although spatial footprints associated with rig installation and drilling discharges in the Blocks are localised and temporary, and unlikely to overlap between Blocks either spatially or temporally. The combined spatial footprint within which physical disturbance and drilling effects could occur across the 9 Blocks (a worst case scenario of 9 drill or drop wells) is estimated at 7.2km^2 (0.02% of the site area). However, the temporary nature of the disturbance, the mobile nature of the qualifying feature and mandatory control measures (Section 2.3.1), will ensure that site conservation objectives are not undermined. There is also the potential for in-combination effects associated with the presence and movement of supply vessels and rigs within each of the Blocks. However, drilling operations for the 9 proposed wells are unlikely to coincide either spatially or temporally to such an extent that the level of disturbance would lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

5.2.3 Further mitigation measures

Further mitigation measures are available which would be identified through the EIA process and operator's environmental management system and the BEIS permitting processes. These considerations are informed by specific project 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 position) to ensure sensitive seabed surface or hazardous subsurface features (such as shallow gas accumulations) are avoided and potential rig stabilisation issues (e.g. from scouring around spud cans, or soft sediment conditions) are minimised. Where rig stabilisation is required, BEIS will expect operators to provide adequate justification for the stabilisation option proposed, minimise the volume of rock deposited or consider utilising systems (e.g. anti-scour mats, mud mats) that can be removed following drilling. The survey reports are used to underpin operator environmental submissions (e.g. EIAs) and where requested, such reports are made available to nature conservation bodies during the consultation phases of these assessments[40].

In all instances, consent for project-level activities will not be granted unless the operator can demonstrate that the proposed exploration activities will not have an adverse effect on the integrity of relevant sites. The information provided by operators in their applications must be detailed enough for BEIS (and its advisors) to make a decision on whether the activities could lead to a likely significant effect.

[40] Whether within or outside an SAC, rig site survey typically includes a consideration of the presence of, amongst other sensitivities, Annex I habitats.

5.2.4 Conclusions

Likely significant effects identified with regards to physical damage to the seabed, drilling discharges and other effects (see Section 5.2.2) when considered along with project level mitigation (Section 5.2.3) and relevant activity permitting requirements (see Sections 2.3), will not have an adverse effect on the integrity of the Natura 2000 sites considered in this assessment. At the project level, there is a legal framework through the implementation of the EIA Regulations[41] and the Habitats Directive, to ensure that there are no adverse effects on the integrity of Natura 2000 sites. 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.

Taking into account the information presented above, it is concluded that activities arising from the licensing of the Blocks listed in Table 5.1, in so far as they may generate physical disturbance and drilling effects, will not cause an adverse effect on the integrity of the relevant sites identified. Following award of any licence, consent for activities will not be granted unless the operator can demonstrate that the proposed activities will not have an adverse effect on the integrity of relevant sites.

5.3 Assessment of underwater noise effects

5.3.1 Blocks and sites to be assessed

The nature and extent of potential underwater noise effects are summarised in Section 4.3. On the basis of this information, in conjunction with the location of the Mid North Sea High Blocks applied for in the 31st Round and the sites with relevant qualifying features, potential likely significant effects are considered to remain for 11 Blocks (or part Blocks), in respect of one site (Figure 5.2). The only relevant qualifying feature of relevance to underwater noise effects is the harbour porpoise (Table 5.2).

5.3.2 Implications for site integrity of relevant sites

The site conservation objectives and other relevant information relating to site selection and advice on operations has been considered against indicative Block work programmes (see Section 2.2.1) to determine whether they could adversely affect site integrity, i.e. impacts the site features, either directly or indirectly, and result in altering the ecological structure and functioning of the site and/or affects the ability of the site to meet its conservation objectives. 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.

[41] The *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)*

Figure 5.2: Sites and Blocks in the Mid North Sea High to be subject to further assessment for underwater noise effects

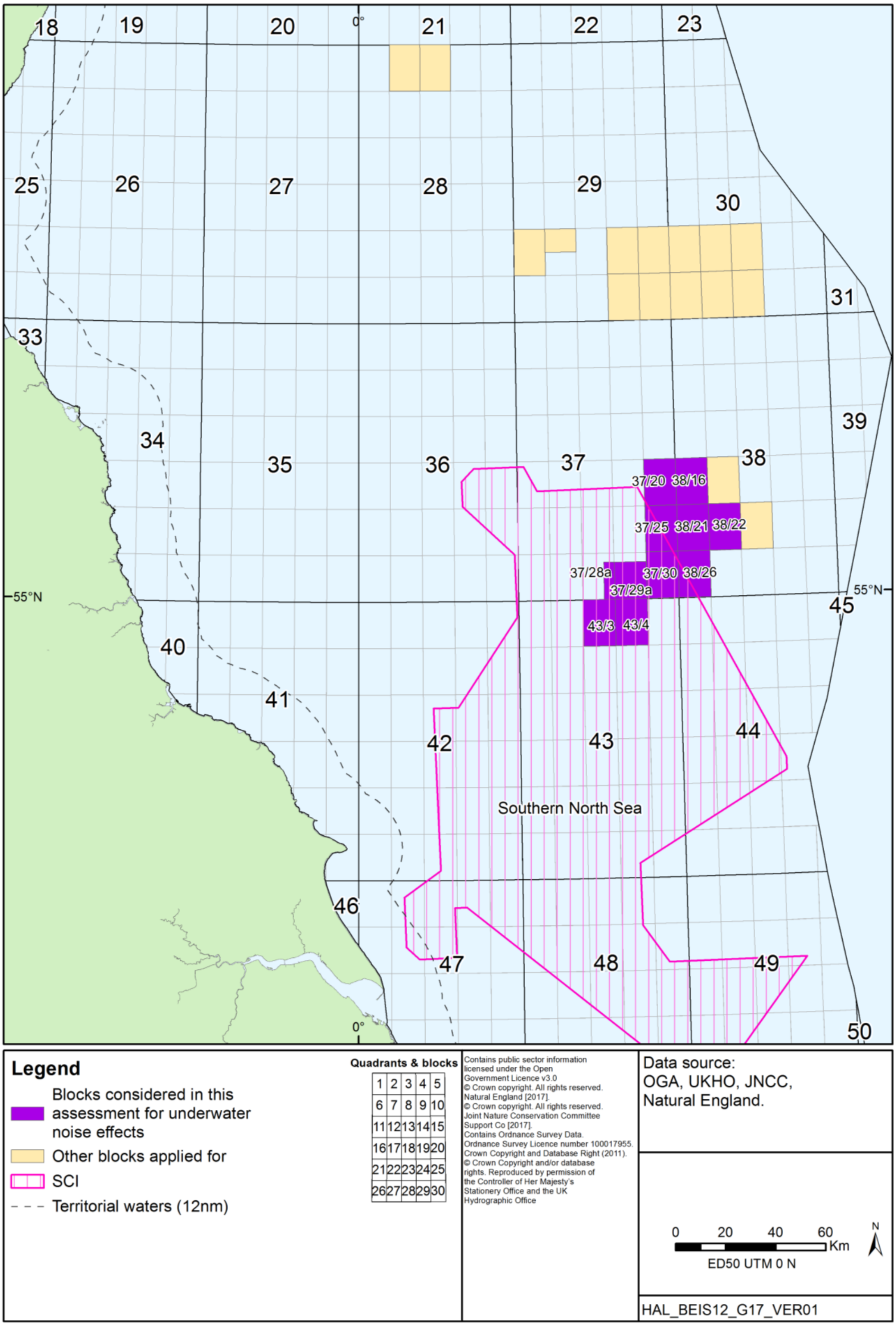


Table 5.2: Consideration of potential underwater noise effects and relevant site conservation objectives

Southern North Sea SCI
Site information
Area (ha): 3,695,054 **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 Blocks for underwater noise effects
37/20, 37/25, 37/28a, 37/29a, 37/30, 38/16, 38/21, 38/22, 38/26, 43/3, 43/4
Assessment of effects on site integrity
Impulsive noise (3D seismic survey, rig site survey, VSP, conductor piling) *(**Relevant pressures:** underwater noise change, vibration)* For those Blocks in which new (contingent) 3D seismic survey has been proposed (37/20, 37/25, 37/30, 38/16, 38/21, 38/22, 38/26), the applicants have indicated that this is contingent, and therefore there is the potential that seismic survey will not be undertaken in one or more of these. This will not be understood until the project level, and therefore the following assessment assumes that seismic survey will be undertaken in all relevant Blocks. Individuals within 10km of the airgun arrays may to be affected, through displacement and reduced foraging opportunities. However, the survey would be limited in time (days) and as the survey vessel travels along transects, ensonification is variable across the area surveyed. Given that harbour porpoises are known to be able to travel over large distances (>20km) within a day, the open nature of the habitat and current understanding of harbour porpoise distribution and abundance across the North Sea, those areas where individuals may be displaced into are not expected to be of significantly lower quality. 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 Blocks; the location of the activity (access of the site to harbour porpoises will not be blocked); and, the size of the potential displacement (e.g. each Block constitutes approximately 0.6% of the site area), 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. 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. 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 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 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 Blocks 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 porpoise 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 control measures are also available (Section 5.3.3) 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
Given the current understanding of the site and its feature being in favourable condition, having taken into consideration current and past activity, and considering the likely disturbance footprint of rig site surveys and VSP, even a worst-case scenario of multiple concurrent or back-to-back surveys such activities are not expected to result in adverse effect on site integrity. For comparison, the number of 3D seismic surveys undertaken within or adjacent to this SCI between 2001 and 2015 has ranged between zero and six surveys per year (cumulative coverage of approximately 18,531km^2 over 34 surveys). The greatest survey coverage during this period was in 2013, within which an area of up to 7,682km^2 was covered across six surveys. 2D seismic surveys have also been conducted but comparable information on area or duration is not readily available. Section 5.4 provides a consideration of potential Block activities in-combination with other relevant plans and projects.

5.3.3 Further mitigation measures

BEIS require operators to provide sufficient information in the EIA 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 Geological Survey consent. The information provided by operators must be detailed enough for BEIS 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 have been identified, BEIS 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 (including 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 harbour porpoises to underwater noise by careful consideration of the timing with respect to 1) seasonal differences in the distribution of the harbour porpoise across the site and across the wider southern North Sea and 2) the presence of other underwater noise generating activities (i.e. other seismic surveys and impact piling). It is advised that the licensees of Blocks 37/20, 37/25, 37/30, 38/16, 38/21, 38/22 and 38/26, establish early discussions with BEIS 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 5.4). Early consultation of the relevant SNCBs is also recommended.

For those Blocks 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.

5.3.4 Conclusion

Although underwater sound generated during project level activities, specifically seismic surveys, has the potential to injure and disturb individual harbour porpoises, the actual risk is minimised by the controls currently in place. An adverse effect on site integrity would require disturbance to the qualifying feature and/or to the distribution and viability of the relevant population which may arise from direct mortality or from behavioural changes with implications for long-term ecological viability (e.g. sustained displacement from foraging grounds, reproductive failure).

For the Southern North Sea SCI, it is concluded that the likely level of activity expected to take place within Blocks 37/20, 37/25, 37/28a, 37/29a, 37/30, 38/16, 38/21, 38/22, 38/26, 43/3 and 43/4 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 Blocks 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. These activities will be subject to activity level EIA and where appropriate, HRA.

5.4 In-combination effects

5.4.1 Introduction

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 (DECC 2016; see also OSPAR 2000, 2010[42] and BEIS 2018b). There are a number of potential interactions between activities that may follow licensing and those existing or planned activities in the Mid North Sea High area, for instance in relation to renewable energy, fishing and shipping. These activities are subject to individual permitting or consenting mechanisms or are otherwise managed at a national or international level. In English waters the North East Marine Plans are in preparation and will complement the first Marine Plans (East Inshore and East Offshore) published in June 2014 to set out objectives and policies to guide development in the southern North Sea over a 20-year period. Relevant Blocks and

[42] Note that an intermediate assessment was published by OSPAR in 2017: https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/

sites considered in this assessment cover parts of the North East and East Offshore marine plan areas.

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

5.4.2 Sources of potential effect

Projects for which potential interactions with operations that could arise from the licensing of 31st Round Blocks (see Table 1.1) have been identified. Interactions were identified on the basis of the nature and location of existing or proposed activities and spatial datasets in a Geographic Information System (GIS). The principal sources of in-combination effects are related to noise, physical disturbance, and physical presence, primarily arising from offshore wind development, and fisheries. OWF development will introduce noise and disturbance sources (particularly during construction) and present an additional physical presence in the marine environment. Offshore wind zones (e.g. Round 3) have already been subject to SEA and HRA, and any related projects have been or will be subject to their own individual assessment and HRA processes[43]. Figure 5.3 indicates the location of other relevant projects in relation to the Blocks subject to this assessment and relevant Natura 2000 sites. The Crown Estate released information on its plans for a further round of offshore wind leasing (Round 4) in November 2018, that identified five regions that are proposed to be taken forward. One of these was the area over the Dogger Bank, with other regions relevant to sites considered in this assessment including East Anglia and the southern North Sea[44]. The round has not been formally announced, and there are no Agreements for Lease of draft project plans to consider as part of the in-combination assessment at this stage. Additionally, The Crown Estate intend to conduct an HRA to support the fourth round of offshore leasing which will consider the likely significant effects of the plan in due course.

The UK Government believes that the oil & gas and the renewables industries can successfully co-exist, as stated in OGA's Other Regulatory Issues for the 31st Round, "…*we [(OGA)] advise that potential applicants on such blocks [(areas where oil and gas licences and proposed or actual wind farm sites exist and indeed overlap)] should make early contact with the holders of any relevant wind farm lease or Agreement for lease (AfL), or the relevant zone developer(s), and establish in good time a mutual understanding of the respective proposals and time frames envisaged (acknowledging that not all aspects of the future plans of either side will necessarily*

[43] For those sites having already been subject to HRA, note that the competent authority is under an obligation to reconsider and review consents for projects that are likely to have a significant effect on new SAC and SPA sites once they become a candidate site. Consultation on an HRA exercise for a review of consents for the Southern North Sea SCI took place between November and December 2018. See: https://www.gov.uk/government/consultations/southern-north-sea-review-of-consents-draft-habitats-regulations-assessment-hra

[44] https://www.thecrownestate.co.uk/en-gb/media-and-insights/news/2018-the-crown-estate-shares-further-detail-on-plans-for-round-4-including-proposed-locations-to-be-offered-for-new-seabed-rights/

be definitively decided at that time)"[45]. 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)[46] where scheduling overlaps may occur should allow both for developer cooperation, and the mitigation of potential cumulative or in-combination effects.

This is also reflected in the East Inshore and East Offshore Marine Plans (paragraph 295) which state "*Future oil and gas activity has the potential to require access to the same area of seabed as other activities. In most cases, the consequence of this will be insignificant due to the small footprint of oil and gas production infrastructure. In some cases this may not be the case, such as where another user of the sea bed has a lease in place. Where a lease has been agreed for a co-located activity, there may be a requirement for negotiation between parties involved*." and is supported in plan policies GOV2 and GOV3 which respectively promote the maximisation of activity co-existence, and the demonstration that activity displacement will be avoided, minimised or mitigated. Policies for the other marine plan areas of relevance to the southern North Sea Blocks (North East Inshore and Offshore) are yet to be finalised, but is expected to be consistent with those of the East Marine Plans. For example, draft common marine plan policies[47] NE-CO-1 and NE-OG-1 include a preference for projects that limit their use of space and consider co-location opportunities, and safeguard existing seaward oil and gas licences from new proposals respectively.

Table 5.3: Projects relevant to the in-combination effects assessment

Relevant projects	Project summary	Project status/indicative timing	Relevant sites[1]
Offshore Renewables			
Dogger Bank Creyke Beck A	Located some 131km offshore, these two wind farms will collectively contain up to 400 turbines with a total capacity of up to 2,400MW. 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.	Consented. Installation expected from 2020.	Dogger Bank SCI, Southern North Sea SCI
Dogger Bank Creyke Beck B			
Dogger Bank Teesside A	Located between 165-196km offshore, these two wind farms will collectively contain up to 400 turbines with a total capacity of up to 2,400MW. The turbines may be fixed to the seabed using monopile, jacket or gravity base foundations. Collector and converter stations will be required offshore. Export cables will have their landfall on the Teesside coastline.	Consented. Installation expected from 2023.	Dogger Bank SAC
Sofia			Dogger Bank SAC, Southern North Sea SCI

Sources: RenewableUK (2018), relevant Development Consent Orders and related post-consent modifications (https://infrastructure.planninginspectorate.gov.uk/ – accessed 20/11/2018).

[45] OGA 31st Round Other Regulatory Issues
[46] https://www.ogauthority.co.uk/licensing-consents/overview/the-crown-estate-interests/ and https://itportal.ogauthority.co.uk/web_files/gis/ukcs_maps/TCE_Leases_and_OG_Licences.pdf
[47] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/588798/proposed_draft_common_policies_by_marine_plan_area.xls

Notes: [1] – those sites considered to be relevant to 31st seaward round exploration activities

5.4.3 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 Natura 2000 sites were described in Section 4.2 and Section 5.2. The conclusions of Section 5.2 are considered in the following section in the context of those relevant projects identified in Table 5.3 above.

Existing or proposed oil & gas projects

Though existing oil and gas infrastructure is widespread in the southern North Sea, which includes areas within the Dogger Bank SAC and Southern North Sea SCI (Figure 5.3), the relative density and footprint of these is small. With the exception of the Shearwater to Bacton gas pipeline which intersects Block 43/3 in a north-south direction, no oil and gas infrastructure is located within any of the Blocks considered in this assessment, the closest being the Cygnus B platform (Block 44/11), 37km to the south of Block 43/4; an exploration well is currently being drilled in Block 44/12b. A number of Blocks within quadrants 37, 38 and 44 were awarded in the 29th Round Seaward Licensing Round and coincide with the Dogger Bank SAC or Southern North Sea SCI. No wells have been drilled in these Blocks as a consequence of that Round to date, though there is the potential for this to take place during the Initial Term of any licence issued as part of the 31st Round.

A review of field development projects (as of November 2018) published by OGA's Oil & Gas Pathfinder[48] indicates that no projects are presently proposed within the quadrants for which Blocks have been applied for, the closest being the Sillimanite gas project in Block 44/19a within the Dogger Bank SAC, ~60km to the south of the closest 31st Round Block (38/26).

Given the small and temporary seabed footprint associated with drilling activities which may follow the licensing of 31st Round Blocks (as assessed in Section 5.2) and those standard and additional mitigation measures set out already in Section 2.3 and 5.2.3, significant in-combination effects associated with those limited other oil and gas projects discussed above is not expected for the Dogger Bank SAC or Southern North Sea SCI.

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). 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 water depths (up to ~60m), currents and potential for storm wave base interactions across the area within which Blocks have been applied for (see Klein *et al.* 1999), accumulations of cuttings are not considered likely from 31st Round exploration activity (see Section 5.2) or in-combination with other exploration and development wells associated with extant licences. 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

[48] https://itportal.ogauthority.co.uk/eng/fox/path/PATH_REPORTS/pdf

place (see Section 2.3.1 and 5.2.3), which the UK Marine Strategy[49] has identified as making an ongoing contribution to managing discharges. Discharges are considered unlikely to be detectable and to have negligible in-combination effect (DECC 2016).

Offshore renewables

OWFs are the only type of renewable energy project in the Mid North Sea High area, with the Dogger Bank Creyke Beck A (43/4) Creyke Beck B (37/28a, 37/29a, 37/30, 43/3, 43/4) and Teesside A (37/30, 38/26) overlapping relevant Blocks, and also covering parts of both relevant sites (Figure 5.4). The Sofia OWF is within the Dogger Bank SAC, but is located ~5km to the south of the nearest relevant Block (38/23). Sources of effect from physical disturbance associated with these projects include installation of turbines (using monopile, jacket or gravity base) and associated infrastructure such as interconnecting and export cables.

Cables would typically be trenched and buried, which is in keeping with East Marine Plan policy CAB1 and equivalent proposed draft common policy (NE-CAB-1) for the North East Plan area, and these installation methods are proposed for the Dogger Bank Creyke Beck and Teesside wind farm cables. The preference is for burial under the seabed sediment, with protection materials used strategically for example at cable/pipeline crossings or should there be difficulties achieving burial depth due to the nature of the shallow geology (e.g. shallow subcropping or outcropping bedrock). Protection materials may be used on inter-array and export cabling, and could comprise grout bags, protective aprons or coverings, mattresses, flow energy dissipation devices, and rock or gravel burial (as noted in the Development Consent Orders for the projects), with any rock coverage deployed not exceeding 10% of the cumulative length of all cable laid.

The current project timelines for project proposals[50] indicate the potential for interaction with exploration activity in the Initial Term of 31st Round licences (up to 9 years), as construction is proposed within this period. As indicated above, early engagement between any Block licence holder and wind farm developer can help reduce the potential for cumulative or in-combination effects. The 31st Round materials included details of such relevant Crown Estates interests[51].

[49] https://www.gov.uk/government/publications/marine-strategy-part-three-uk-programme-of-measures
[50] See: https://www.renewableuk.com/news/415071/Offshore-Wind-Project-Timelines-2018.htm
[51] https://www.ogauthority.co.uk/licensing-consents/overview/the-crown-estate-interests/ and https://itportal.ogauthority.co.uk/web_files/gis/ukcs_maps/TCE_Leases_and_OG_Licences.pdf

Figure 5.3: Other projects relevant to the Mid North Sea High: oil & gas

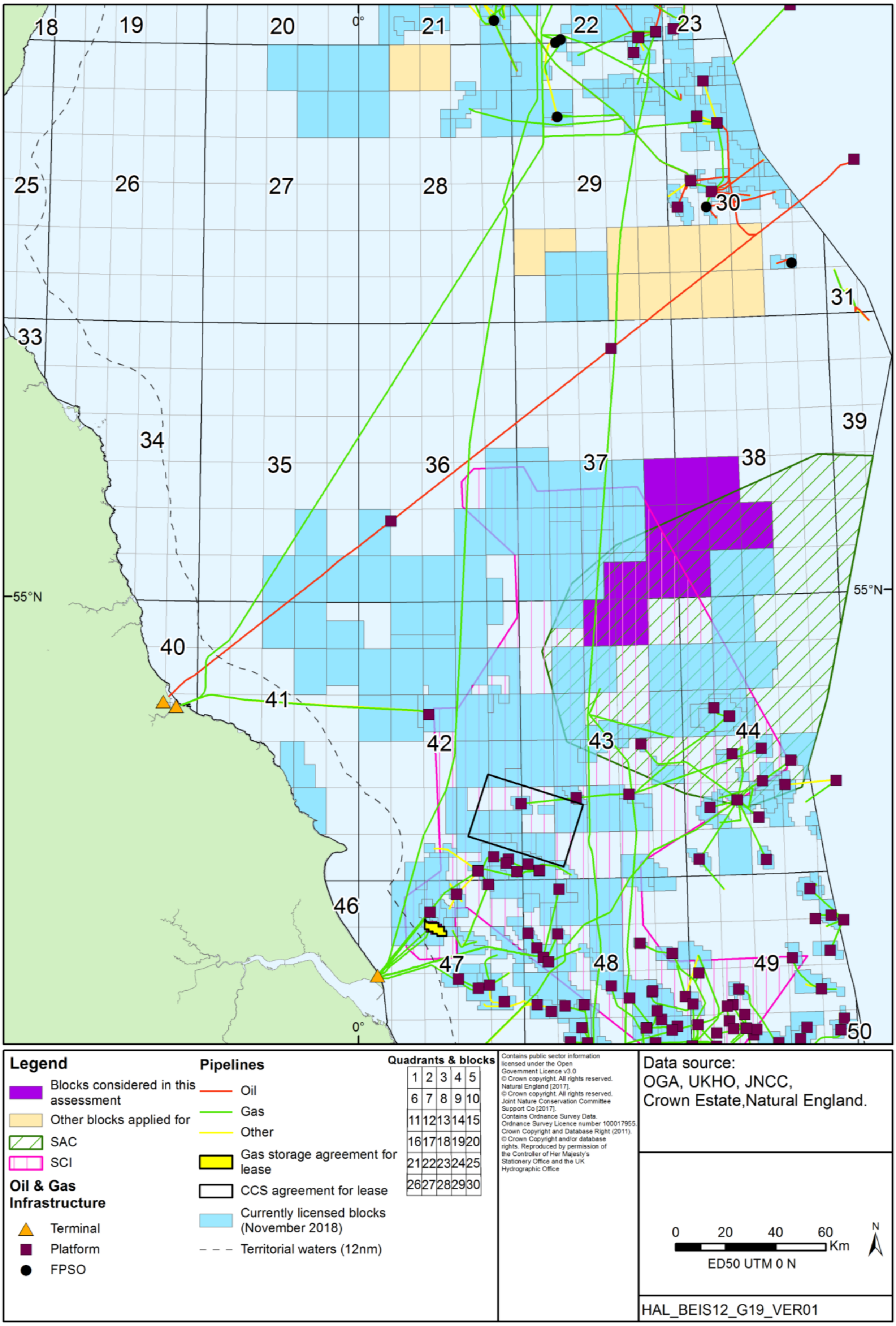
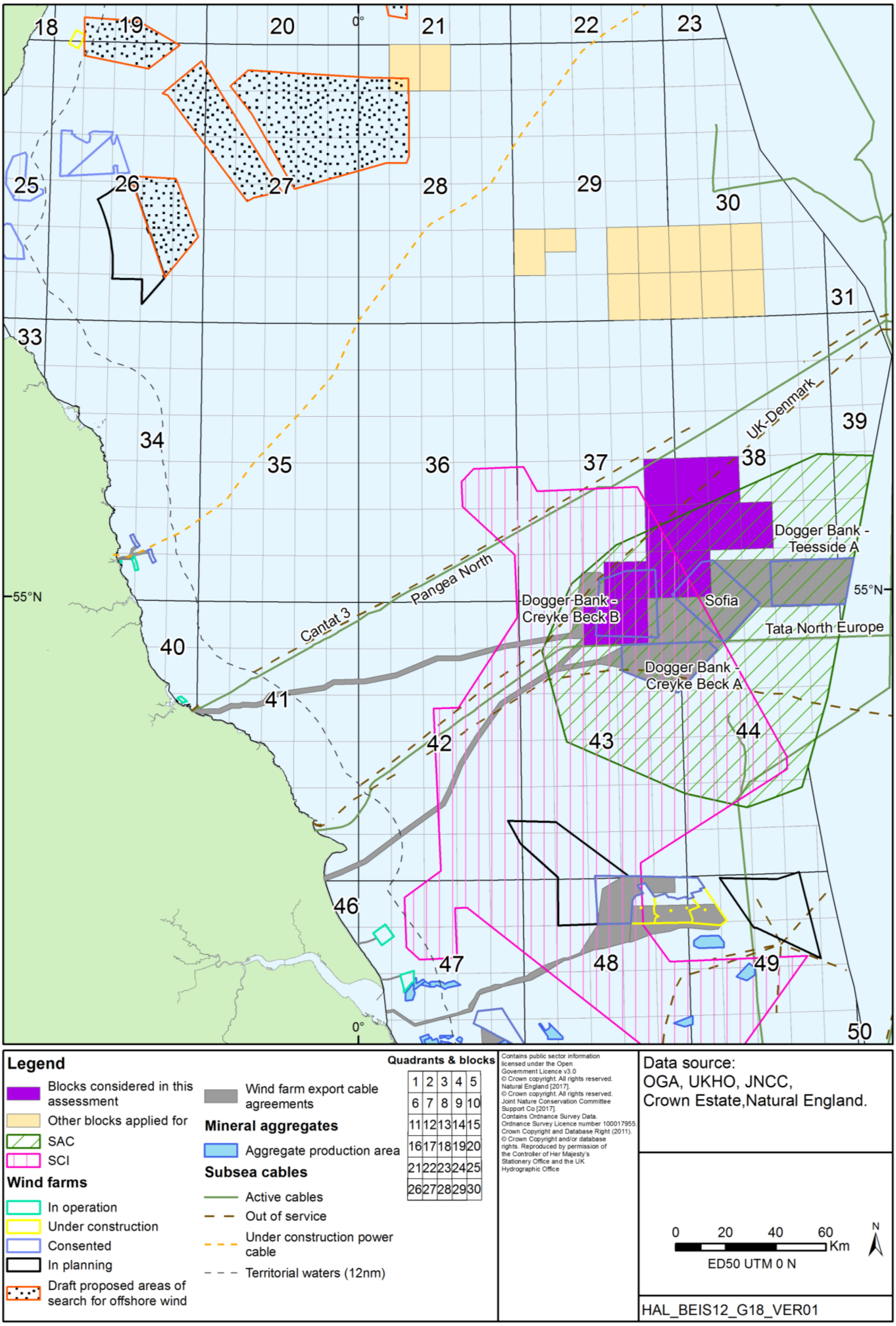


Figure 5.4: Other projects relevant to the Mid North Sea High: renewables and cables



The advice on operations for Dogger Bank SAC[52] reflects the sensitivity of the site feature to pressures related to physical effects from offshore wind farm installation, and the conservation objectives and draft advice on the Southern North Sea SCI[53] recognises importance of supporting habitat in maintaining favourable conservation status for the harbour porpoise feature. The Dogger Bank OWFs have each been subject to their own HRA processes[54], and have recently been the subject of a review of consents involving HRA in relation to the Southern North Sea SCI (BEIS 2018c)[55]. On physical impacts on the seabed, the draft HRA report concluded that the OWFs considered would not result in an adverse effect on site integrity, including in-combination with existing oil and gas related activity, including the wider footprint of facilities (installations and pipelines) across the wider site.

Thirteen Blocks were identified on the basis of a potential for likely significant effect in relation to the Dogger Bank SAC (considered in Section 5.2.2) and, of these, seven overlap with an offshore wind project area. None of the Blocks entirely cover any project area (though substantial portions of Blocks 37/29a and 43/4 overlap Creyke Beck B). The potential for cumulative or in-combination effects can be reduced by drilling rig siting and dialogue on activity timing/phasing, such that those sources of effect from wind farm installation and operation (e.g. localised and temporary increases in suspended sediment concentrations including re-suspension of contaminants, loss of sandbank habitat[56]) are not compounded by rig installation or drilling. The footprint of any drilling rig is small (see Table 2.2) and temporary, and tidal currents in the shallow southern North Sea are generally such that discharged cuttings are rapidly dispersed. It is therefore not regarded that activity which could take place in the Initial Term of 31st Round licences would lead to a physical change significant enough to cause an adverse effect on site integrity of the Dogger Bank SAC on its own or in-combination with the Dogger Bank Creyke Beck, Teesside or Sofia OWF projects.

As noted above, The Crown Estate intend to consider new leasing areas for offshore wind as part of a 4th round of offshore wind leasing, but details on the specific nature and location of projects is not yet known to allow consideration of the potential for further in-combination effects.

Fisheries

Fishing and particularly bottom trawling has historically contributed to seabed disturbance over extensive areas, and was identified as an ongoing issue in the UK initial assessment for

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[52] http://jncc.defra.gov.uk/page-6508
[53] http://jncc.defra.gov.uk/page-7243
[54] See records of HRA for the Dogger Bank Creyke Beck and that for Teesside A/Sofia. Also see further information provided in support of a non-material change which considers the potential for likely significant effects on relevant sites, in particular the Southern North Sea SCI for the Creyke Beck and Teesside/Sofia projects.
[55] https://www.gov.uk/government/consultations/southern-north-sea-review-of-consents-draft-habitats-regulations-assessment-hra
[56] See the record of the HRA undertaken in relation to the Dogger Bank Creyke Beck Offshore Wind Farm: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010021/EN010021-000003-Habitats%20Regulations%20Assessment.PDF

MSFD[57]. 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. The management of fisheries in relation to Article 6 of the Habitats Directive is fundamentally different to other activities such as offshore energy development, and a revised approach to the management of commercial fisheries in European sites[58] has sought to implement steps to ensure that they are managed in accordance with Article 6.

Advice on operations for the Dogger Bank SAC and Southern North Sea SCI (see Sections 5.2 and 5.3) both 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 31st Round exploration activities would result in a significant in-combination effect with on bycatch. Physical disturbance related pressures from fisheries for which the Dogger Bank has been assessed as sensitive are relevant for those sources of effect from oil and gas exploration activity (noted in Section 4.2 and assessed in Section 5.2), and therefore the potential for in-combination effects with fisheries are considered below.

In relation to specific sites of relevance to this AA, fisheries management proposals for the Dogger Bank have been drawn up through the Dogger Bank Steering Group, with stakeholder engagement via the North Sea Regional Advisory Council (now the North Sea Advisory Council). The proposed measures include a number of zones which would be closed for beam trawl, bottom/otter trawl, dredges and semi-pelagic trawl fisheries. A joint management proposal with measures covering those Dogger Bank Natura 2000 sites in UK and adjacent state waters[59] was agreed in early 2017, and was followed by a Joint Recommendation process submission to the European Commission. The above reflects the current approach to fisheries management in relation to Marine Protected Areas in English waters, the UK is expected to formally leave the CFP on its exit from the EU in March 2019. The Fisheries White Paper, “Sustainable Fisheries for Future Generations” [60], outlines the UK Government’s present vision for how fisheries would be managed when the UK no longer participates in the CFP.

Whilst fishing may be linked to historical damage to site features, and presents a continuing risk to these, future management measures should limit the potential for in-combination effects with other activities. Effects on sites from exploration activity can be reduced or avoided (see Sections 2.3.1 and 5.2.3), and other oil and gas related activities are subject to statutory environmental impact assessment and where appropriate, HRA.

[57] https://www.gov.uk/government/publications/marine-strategy-part-one-uk-initial-assessment-and-good-environmental-status
[58] https://www.gov.uk/government/publications/revised-approach-to-the-management-of-commercial-fisheries-in-european-marine-sites-overarching-policy-and-delivery and see http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/SACmanagement
[59] See: http://jncc.defra.gov.uk/page-6508 and http://www.nsrac.org/reports/meetings-c/ecowg/spatial-planning-working-group-meeting-4th-july-2016-the-hague/
[60] See: https://www.gov.uk/government/consultations/fisheries-white-paper-sustainable-fisheries-for-future-generations and also the draft Fisheries Bill: https://services.parliament.uk/bills/2017-19/fisheries.html

When an oil and gas surface structure (fixed and floating installations) becomes operational, a safety zone with a radius of 500m is created under the *Petroleum Act 1987* 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 differences in relative scale of physical impacts resulting from trawling and from oil and gas exploration (both spatially and temporally), significant incremental effects from 31st Round activities are not predicted.

5.4.4 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 2018a). 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. The larger numbers of individual surface or submerged structures associated with offshore wind developments, and considerations of their location and spatial distribution (e.g. in relation to important areas for marine mammals), indicate a higher potential for physical presence effects.

The only site of relevance to this source of effect is the Southern North Sea SCI, with shipping noted to be a source of pressures including underwater noise (see 5.4.5) and death or injury by collision, with the latter not being considered a significant risk that requires management (JNCC 2016). It is not regarded that the temporary addition of a drilling rig (which could be on location for up to 10 weeks) and associated shipping will lead to adverse effects on site integrity. Shipping densities over the relevant Blocks range from very low (38/16, 38/17, 38/23, 37/28a, 37/29a, 37/30, 38/26, 43/3, 43/4) to low (37/25, 38/21, 38/22) and moderate (37/20)[61]. Typical supply visits to rigs while drilling may be in the order of 2 to 3 per week (Table 2.2), and whilst more than doubling weekly average traffic in some of the blocks[62], the in-combination level of traffic remains low and represents a moderate/low risk to the harbour porpoise feature of the Southern North Sea SCI. Similarly, the presence of a seismic survey vessel for several days to several weeks would represent a low level, transient addition to existing levels of shipping traffic. Vessel traffic will temporarily increase during OWF construction, particularly for those Blocks which cover parts of OWF zones (Figure 5.4), with low level traffic continuing through their operational phase. Though 31st Round activities are an incremental source of potential effect in and around OWF zones, it is anticipated that in-combination effects can be avoided through early engagement with lease holders. The transient nature of exploration drilling and the timing of OWF construction activities are such that any activity associated with the work programmes could be phased in such a way as to avoid in-combination effects from physical presence on the Southern North Sea SCI. Such interactions would need to be considered as part of assessments, including in HRA where appropriate, for project-level activity.

[61] https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf
[62] Based on 2015 AIS vessel density grid (see: MMO 2014b).

5.4.5 Underwater noise

A number of projects are relevant to the consideration of in-combination effects with activities which may follow the licensing of 31st Round Blocks (see Table 5.3). The associated activities can generate noise levels with the potential to result in disturbance or injury to animals associated with relevant sites (see DECC 2016), including the harbour porpoise feature of the Southern North Sea SCI.

Of most relevance to the Blocks being considered are the consented or in planning Round 3 wind farms (those in Table 5.3, and also those of the former Hornsea and East Anglia Round 3 zones), and potential extensions of Round 2 sites (Galloper, Greater Gabbard, Dudgeon) across the wider Southern North Sea SCI. 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 DECC 2016). 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 OWF developments at present (and the focus of most studies of the effects of wind farm construction on harbour porpoise behaviour, see Section 4.3.2). 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 resulting in less noise on installation. The final selection of foundation type is uncertain for some developments and the subject of detailed design.

Of those wind farms listed in Table 5.3, construction is expected from 2020 onwards (see Section 2.2.3 and 4.2.8 of BEIS 2018b, and Appendix 1h of DECC 2016[63]). In addition to Table 5.3, a range of others are located within or close to the Southern North Sea SCI and have either commenced construction (Hornsea One, East Anglia One) have been consented (Hornsea Two, East Anglia Three) or are in planning (Hornsea Three and Four, East Anglia One North and Two, Norfolk Vanguard and Boreas). These projects, if all are executed, are expected to result in 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. Several modelling frameworks are being developed and refined to assess population level impacts of acoustic disturbance (Thompson *et al.* 2013b, King *et al.* 2015, Tougaard *et al*. 2016, Heinis *et al*. 2015, van Beest *et al*. 2015, Nabe-Nielsen & Harwood 2016). The degree of uncertainty in extrapolating from individual empirical observations to modelled population estimates is high. It has not yet been possible to establish criteria for determining limits of acceptable cumulative

[63] Also see: RenewableUK Offshore Wind Project Timelines (August 2018): https://www.renewableuk.com/news/415071/Offshore-Wind-Project-Timelines-2018.htm

impact at the UK or EU level, but the collation of data through the Marine Noise Registry (https://mnr.jncc.gov.uk/) is a useful first-step. BEIS is cognisant of the ongoing efforts to implement the MSFD and will review the results of the ongoing process closely for the consenting of relevant activities which may result from future licensing, as well as other activities which generate noise in the marine environment. The draft conservation objectives and advice on operations for the Southern North Sea SCI state, in relation to the conservation objective that there no significant disturbance of the species within the site, that "…*activities within the site should be managed to ensure access to the site; any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time*". It further notes that, "*Case Work Advice Guidance in relation to various activities is being developed and expands this supplementary advice to define 'significant portion and period' in the context of impacting site integrity"*. These have not been formally defined in any advice on operations, but it is understood that SNCBs advised the Review of Consents HRA process[64] of an approach to considering site integrity based on temporal and spatial thresholds of exclusion of harbour porpoise.

The review of consents was undertaken for six OWFs in relation to the Southern North Sea SCI, 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, Creyke Beck A and B, Teesside and Sofia), This review augmented those HRAs already undertaken for these projects, specifically considering effects in relation the Southern North Sea SCI 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).

Significant in-combination effects are considered to be unlikely given the spatially limited and temporary nature of noise generating activity associated with the 31st Round Blocks (see Section 5.2), and that there is significant scope to avoid concurrent OWF construction[65] and exploration well site survey activity either through dialogue with relevant leaseholders or by virtue of wind farm construction timelines. 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 adjacent Blocks which are yet to be fully explored or which have been developed (not covered by the plan being assessed). The timing, location and scale of any such surveys are unknown and a meaningful assessment of

[64] https://www.gov.uk/government/consultations/southern-north-sea-review-of-consents-draft-habitats-regulations-assessment-hra

[65] Note that the encounter rate of UXO and its nature is uncertain and disposal operations are subject to separate marine licensing.

these cannot be made at this time, but they will be subject to activity specific permitting, including HRA, where appropriate.

In addition to those activities which may follow licensing of the Mid North Sea High Blocks and the other potentially relevant projects listed in Table 5.3 and discussed above, there are a variety of other existing (e.g. oil and gas production, fishing, shipping, military exercise areas,) and planned (e.g. oil and gas exploration and production) noise-producing activities in overlapping or adjacent areas. Despite this, BEIS is not aware of any projects or activities which are likely to cause effects that, when taken in-combination with the likely number and scale of activities likely to result from Block licensing (Section 2.2), would adversely affect the integrity of the Southern North Sea SCI. This is due to the presence of effective regulatory mechanisms (Section 5.3 and also Appendix 3 of DECC 2016) which ensure that operators, BEIS and other relevant consenting authorities take such considerations into account during activity permitting. These mechanisms generally allow for public participation in the process, and this has been strengthened by the May 2017 Regulations[66] amending the offshore EIA regime. These reflect Directive 2014/52/EU which provides for closer co-ordination between the EIA and Habitats Directives, with a revised Article 3 indicating that biodiversity within EIA should be described and assessed “with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC”.

5.4.6 Conclusions

Available evidence (see e.g. UKBenthos database and OSPAR 2010) for the Mid North Sea High area indicates that past oil and gas activity and discharges has not led to adverse impacts on the integrity of European sites in the area. Any activities relating to the work programmes, and any subsequent development that may occur if exploration/appraisal is successful, will be judged on its own merits and in the context of wider development in the North Sea (i.e. any potential incremental effects). The current regulatory controls on terrestrial and marine industrial activities, including oil and gas operations that could follow licensing, can be expected to prevent significant in-combination effects affecting relevant European sites.

BEIS will consider the potential for in-combination effects whilst considering project specific EIAs and, where appropriate, through HRAs. This process will ensure that, if consented, projects will not result in adverse effects on integrity of European sites. Therefore it is concluded that the in-combination effects from activities arising from the licensing of Blocks in the Mid North Sea High area (Table 1.1) with those from existing and planned activities will not adversely affect the integrity of relevant European Sites.

[66] *The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017*

6 Overall conclusion

Taking account of the evidence and assessment presented above, the report determines that the licensing through the 31st Licensing Round of the 13 Blocks considered in this AA will not have a significant adverse effect on the integrity of the relevant sites (identified in Section 1.3), and BEIS have no objection to the OGA awarding seaward licences (subject to meeting application requirements) covering those Blocks listed in Table 1.1. This is because there is certainty, within the meaning of the ECJ Judgment in the Waddenzee case, that implementation of the plan will not adversely affect the integrity of relevant European Sites (as described in Sections 5-8), taking account of the control measures that can be imposed through existing permitting mechanisms on the planning and conduct of activities (as described in Section 2.3, and in Sections 5.2.3 and 5.3.3).

These control measures are incorporated in respect of habitat and species interest features through the range of legislation and guidance (see https://www.gov.uk/guidance/oil-and-gas-offshore-environmental-legislation) which apply to activities which could follow licensing. Where necessary, project-specific HRA based on detailed project proposals would be undertaken by BEIS to ensure that permits/consents are only granted where the proposed activity will not result in adverse effects on integrity of relevant sites.

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, it is likely that a project level HRA will be necessary if, for example, new relevant sites have been designated after the plan level assessment; new information emerges about the nature and sensitivities of interest features within sites, new information emerges about effects including in-combination effects; or if plan level assumptions have changed at the project level.

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