Department for Business, Energy & Industrial Strategy

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

Project Title*: *Viking and LOGGS Phase 1 decommissioning and Strategic Review of proposed further decommissioning at Viking and LOGGS

ConocoPhillips (U.K.) Limited

Revised January 2019

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1 INTRODUCTION

1.1 This is a record of the Habitats Regulations Assessment (HRA) undertaken by the Department for Business Energy and Industrial Strategy (BEIS) in respect of the first Viking Decommissioning Programme (VDP1) and the Lincolnshire Offshore Gas Gathering Station (LOGGS) Decommissioning Programme (LDP1) prepared by ConocoPhillips. This forms the first of a series of decommissioning programmes, with further programmes not yet submitted to BEIS. An environmental impact assessment (EIA) supports both the VDP1 and LDP1 programmes and forms the first of a series of decommissioning programmes which are to be carried out over an approximate ten year period. The decommissioning includes the Viking and LOGGS production hubs and satellite installations and associated subsea infrastructure.

1.2 VDP1 and LDP1 represent the first phase of decommissioning ConocoPhillips assets located in the southern North Sea. While only Viking and LOGGS Decommissioning Programmes have been formally submitted future decommissioning is proposed by ConocoPhillips over the next ten years at other installations.

1.3 No decommissioning programmes have yet been submitted for other decommissioning programmes that could affect the designated sites relevant to this assessment. However, it is recognised that ConocoPhillips and other operators will in the future be undertaking decommissioning activities within the sites of interest. Consequently, this assessment also considers the potential for likely significant or adverse effects arising from future decommissioning activities to be undertaken by ConocoPhillips over the course of the next ten years and, more broadly, the potential for impacts arising during the course of all likely oil and gas decommissioning activities within the European sites.

1.4 Subsequent information received by the Department indicate that there will be an additional accommodation vessel (Accommodation Works Vessel (AWV)), than had previously been proposed. An update of this assessment has been undertaken to include the additional potential impacts associated with the extra AWV.

1.5 This assessment is therefore based on a formal Environmental Statement supporting both VDP1 and LDP1 and additional information listing all relevant Viking and LOGGS assets which are to be decommissioned, inferring the same decommissioning methodology as that adopted for VDP1 and LDP1. All future Decommissioning Programmes likely to cause a significant effect on a European qualifying site will be subject to their own HRA. These will be undertaken at the time the application is made and be based on the best available evidence.

1.6 The planned activities relating to VDP1 and LDP1 will occur in Blocks 48/25, 49/16, 49/17 and 49/21 that lie within the North Norfolk Sandbanks and Saturn Reef SAC.

1.7 BEIS is the competent authority for applications submitted under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (S.I. 2001/1754) (As Amended) and future decommissioning programmes submitted to the Department will be subject to the requirements of the regulations.

1.8 ConocoPhillips (UK) Ltd ("the applicant" hereafter), has submitted to BEIS Offshore Decommissioning Unit (ODU) a decommissioning programme for Viking (VDP1) and LOGGS (LDP 1), an Environmental Statement for both VDP1 and LDP1 and additional information listing those assets to be decommissioned. BEIS recognises that there is potential for activities presented within VDP1 and LDP1 to impact on sites designated under the European Habitats and Birds Directives. BEIS also recognises that there is potential for activities forecast to be covered by the future decommissioning programmes (which have yet to be prepared and submitted) for likely work over a ten year future period to impact on sites designated under the European Habitats and Birds Directive. Consequently, as the competent authority, BEIS has undertaken an assessment to determine whether the potential impacts from likely decommissioning activities as identified in the VDP1 and LDP1 may cause likely significant or adverse effects to the qualifying features of European designated sites and thereby affect the integrity of the sites. As part of the assessment, potential in-combination impacts from future ConocoPhillips decommissioning activities and all other possible decommissioning activities within the European designated sites have been assessed to determine whether there is potential for likely significant or adverse effects on the integrity of the sites from decommissioning activities. This assessment includes potential future activities that are not subject of any submitted projects or plans. By doing so it does not pre-empt the requirement to undertake HRA when future plans or projects are submitted. It does not pre-determine any decision regarding future decommissioning programmes or projects. However, where possible, it does provide a strategic overview of potential in-combination impacts from forecast activities.

1.9 This document presents the finding of the assessment undertaken by BEIS.

Habitats Regulations Assessment

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

1.11 The Habitats Directive provides for the designation of sites for the protection of habitats and species of European importance. These sites are called Special Areas of

Conservation (SACs). The Birds Directive provides for the classification of sites for the protection of rare and vulnerable birds and for regularly occurring migratory species. These sites are called Special Protection Areas (SPAs). SACs and SPAs are collectively termed European sites and form part of a network of protected sites across Europe. This network is called Natura 2000. A Site of Community Importance (SCI) is a SAC in the process of receiving approval; it has received approval from the European Commission (EC) but has still to be formally designated as a SAC by the UK Government.

1.12 Possible SACs (pSACs), candidate SACs (cSACs) and potential SPAs (pSPAs) are afforded the same levels of protection by the UK Government as sites that have already been designated. Sites designated under the Ramsar Convention are also afforded the same level of protection as a designated site.

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

1.14 The Offshore Habitats Regulations transpose the Directives into UK law for offshore activities consented under the Petroleum Act 1998 and the Energy Act 2008.

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

1.16 Under the Convention on Wetlands, signed in Ramsar, Iran (1971) sites regularly supporting 20,000 waterbirds and/or support 1% of the individuals in the population of one species or subspecies of water bird, receive specific designation known as Ramsar designation. Under UK guidance Ramsar sites are, as a matter of policy, afforded the same protection as European designations SPAs and SACs (ODPM 2005).

1.17 The planned decommissioning programmes VDP1 and LDP1 and impacts from future decommissioning over the next ten years may cause a likely significant or adverse effect on the qualifying features of European designated sites and therefore, as the competent

authority, BEIS is required to appropriately assess plans or projects in view of the site's conservation objectives.

1.18 This HRA is undertaken in accordance with Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora ("the Habitats Directive") and Council Directive 2009/147/EC on the Conservation of Wild Birds ("the Birds Directive") to satisfy the Appropriate Assessment requirement.

1.19 This HRA assesses potential impacts from activities for which the BEIS Secretary of State is the competent authority. It does not assess impacts from other activities alone, but where appropriate does take those activities into consideration when addressing in-combination impacts.

1.20 A summary of the HRA process is presented in Figure 1.

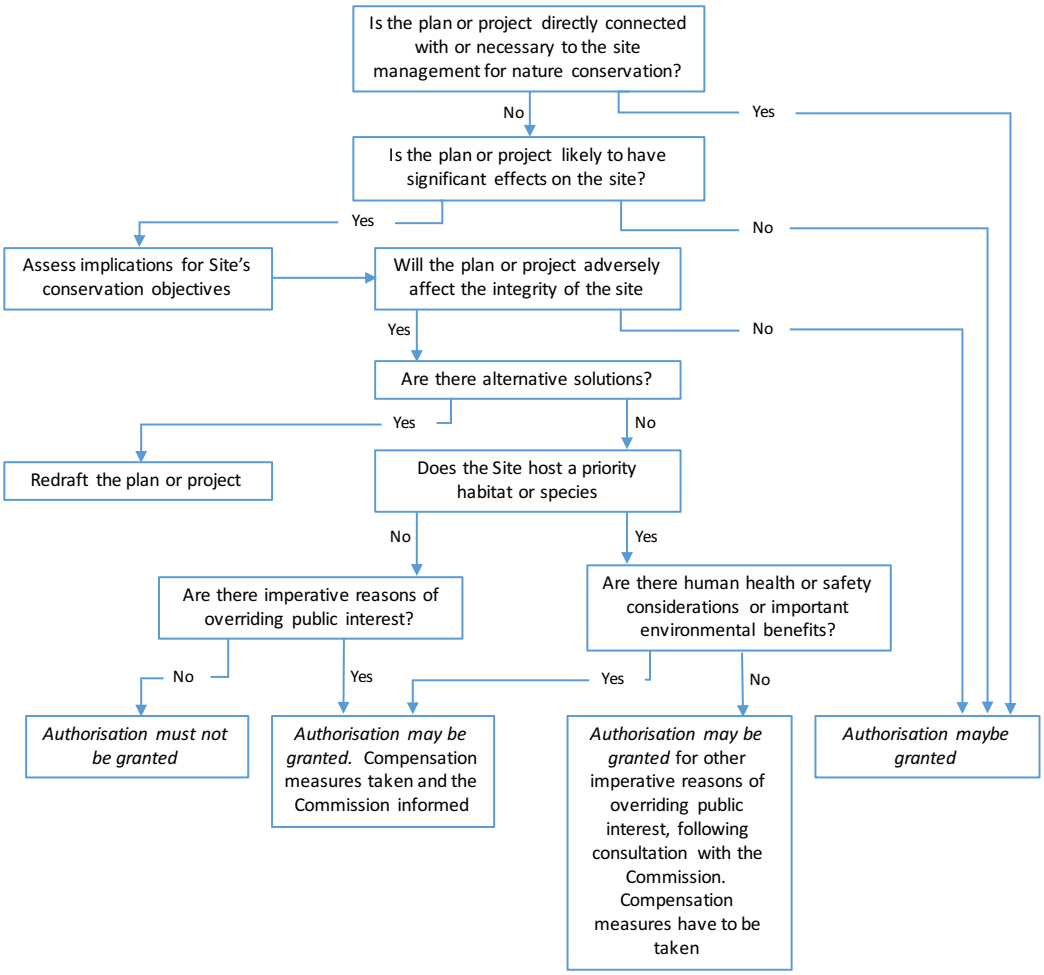

Figure 1: Summary of Habitat Regulations Assessment process (Source EC 2001).

2 PROPOSED WORK PROGRAMME

2.1 The applicant, ConocoPhillips, submitted a Decommissioning Programme for Viking 1 (VDP1) to the then Department of Energy and Climate Change (DECC) in 2015 and decommissioning programme for LOGGS (LDP1) to the Department for Business, Energy and Industrial Strategy (BEIS) in November 2017. In support of the decommissioning programme a detailed environmental impact assessment was undertaken and this is presented in an Environmental Statement (ConocoPhillips 2015a). The information presented within the Environmental Statement has been used to inform this HRA and the key information in the document is summarised and referenced. In addition, ConocoPhillips provided a strategic overview of their intended decommissioning activities, subsequently updated in 2018, within the European designated site and supplemented their cumulative environmental impact assessment covering all likely activities over a ten year period. This assessment will be appended to the Environmental Statement and incorporated into future submissions.

2.2 The proposed work programme comprises a formal decommissioning programme, the Viking Decommissioning Programme (VDP1) and LOGGS Decommissioning Programme (LDP1). It is intended to decommission further assets supported by and including the Viking gas complex and the Lincolnshire Offshore Gas Gathering Systems (LOGGS). It is therefore the intention of the operator to submit further decommissioning programmes to cover all proposed activities.

2.3 The VDP1 and LDP1 infrastructure are located in the southern North Sea in Blocks 48/25, 49/16, 49/17 and 49/21 (Figure 2).

2.4 The Viking field, of which the VDP1 infrastructure is part of, comprises 35 wells[1], 27 pipelines, a riser platform, nine unmanned satellite platforms, three subsea installations and four hub platforms (Table 1 and Table 3). Associated with this infrastructure are 98 piles and 35 conductors.

2.5 Infrastructure subject to the VDP1 includes five platforms (Viking CD, DD, ED, GD and HD), ten pipelines (five gas pipelines and five piggy-backed/associated methanol lines) and 15 wells (ConocoPhillips 2015a).

[1] Note – of the 35 wells in the Viking field, three were abandoned prior to 2014. 15 Viking wells are subject to this assessment.

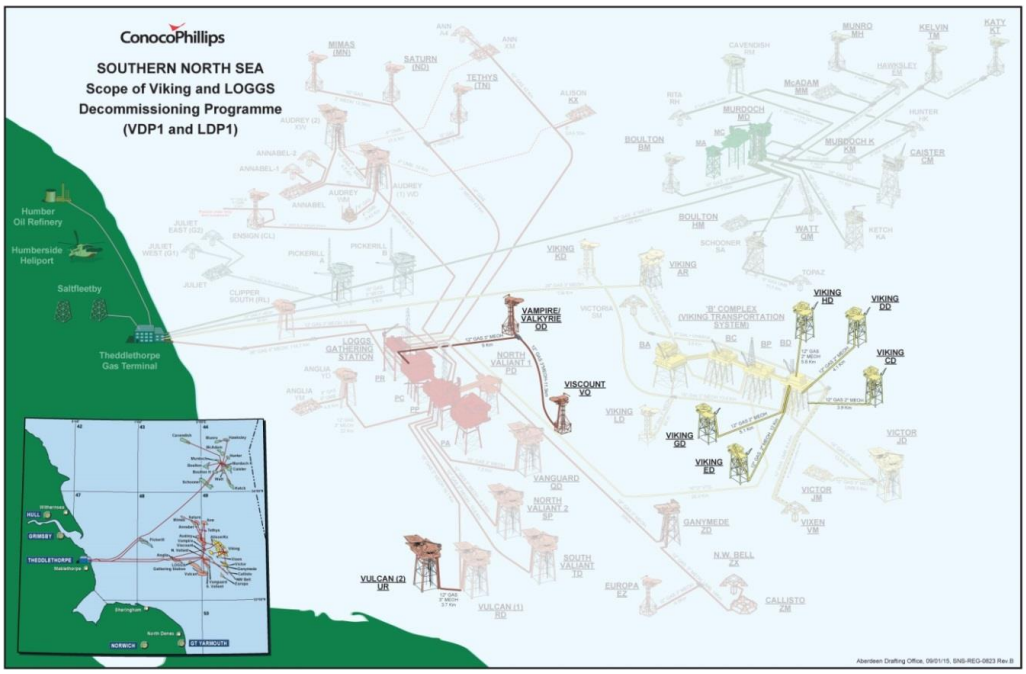

Figure 2: Infrastructure to be decommissioned under VDP1 and LDP1 (Source ConocoPhillips 2015a).

Table 1: ConocoPhillips Viking associated platforms.

Installation		Number of wells	Number of piles	Subject to decommissioning programme VDP1
Viking Satellite Installations				
Viking CD	Four legged NUI	4	12	Yes
Viking DD	Four legged NUI	2	8	Yes
Viking ED	Four legged NUI	3	8	Yes
Viking GD	Four legged NUI	3	6	Yes
Viking HD	Four legged NUI	3	8	Yes
Viking KD	Three legged NUI	5	3	No
Viking LD	Three legged NUI	2	3	No
Viking AR	Six legged NUI riser platform	0	6	No
Victor JD	Four legged NUI	5	4	No
Viking Hub Installations				
Viking BA	Four legged bridge-linked to Viking BC	0	4	No
Viking BC	Eight legged bridge-linked to Viking BP and Viking BA	0	8	No
Viking BD	Eight legged bridge-linked to Viking BP	3	8	No
Viking BP	Eight legged bridge-linked to Viking BD and Viking BC	0	8	No

2.6 The LOGGS area comprises 16 gas fields (South Valiant, North Valiant, Vanguard, Vulcan, Vampire, Viscount, Valkyrie, Ganymede, Sinope, Europa, Callisto, NW Bell, Alison KX[2], Saturn, Mimas, and Tethys). Associated infrastructure includes 74 wells, 32 pipelines, 12 satellite platforms, 3 subsea installations and five hub platforms (Table 2 and Table 3). Associated with this infrastructure are 82 piles and 76 conductors.

2.7 Infrastructure included within the LDP1 includes three platforms (Vampire VO, Viscount OD and Vulcan UR) and six pipelines (three gas pipelines and three piggy-backed/associated methanol lines) and a T-piece pipe junction with supporting structure and mattress protection. A total of 14 wells will also be decommissioned (ConocoPhillips 2015a).

Table 2: ConocoPhillips LOGGS associated installations.

Installation		Number of wells	Number of piles	Subject to decommissioning programme LDP1
Satellite Installations				
Vampire/Valkyrie OD	Four legged NUI	3	4	Yes
Viscount VO	Four legged NUI	3	4	Yes
Vulcan UR	Four legged NUI	8	4	Yes
Europa EZ	Four legged NUI	6	4	No
Ganymede ZD	Four legged NUI	8	4	No
Mimas MN	Three legged NUI	1	3	No
North Valiant 2SP	Four legged NUI	9	4	No
Saturn ND	Three legged NUI	4	4	No
South Valiant TD	Four legged NUI	6	4	No
Tethys TN	Three legged NUI	1	3	No
Vanguard QD	Four legged NUI	5	4	No
Vulcan RD	Four legged NUI	12	4	No
Hub Installations				
North Valiant 1	Four legged Bridge linked to LOGGS PP	5	4	No
LOGGS Hub PA	Four legged Bridge linked to LOGGS PP	0	4	No
LOGGS Hub PC	Eight legged Bridge linked to LOGGS PR	0	8	No
LOGGS Hub PP	Eight legged Bridge linked to LOGGS PC	0	8	No
LOGGS Hub PR	Four legged	0	4	No

Note – Saturn ND, Mimas MN and Tethys TN installations are outwith the SAC.

[2] Note – The Alison KX is a subsea development. ConocoPhillips operate one well at Alison KX but decommissioning of the well is being undertaken by another operator. The plugging and abandonment of one well has been included as part of this assessment.

2.8 In addition to the surface infrastructure listed in Tables 1 and 2, there are a number of subsea installations also associated with both Viking and LOGGS (Table 3).

Table 3: ConocoPhillips subsea installations associated with Viking and LOGGS.

Subsea Installations		Number of wells	Number of piles	Subject to decommissioning programme LDP1 or VDP1
Viking Satellite Installations				
Victor JM	Subsea development	1	4	No
Vixen VM	Subsea development	1	4	No
Viking BD skid [1]	Subsea valve skid	0	4	No
LOGGS Satellite Installations				
N.W. Bell	Subsea development	1	4	No
Callisto ZM	Subsea development	1	4	No
Alison KX	Subsea development	1	4	No

1 – Note the Viking BD valve skid is not an installation but part of the pipeline infrastructure, it is included to ensure future potential impacts arising from its decommissioning are captured.

2.9 It is proposed that all platforms subject to this decommissioning programme will be fully removed using a heavy lift vessel and the T-piece, as part of LDP1, will also be removed using a dive support vessel. All wells will be plugged and abandoned. Mattresses and grout bags will be left *in situ*.

2.10 A total of eight gas pipelines and associated methanol lines included as part of VDP1 and LDP1 will be cut and left *in situ* (Table 4). To reduce the risk of exposure to other sea users, the ends of the cut pipeline will be covered using rock.

Table 4: ConocoPhillips pipelines included as part of VDP1 and LDP1 decommissioning programmes.

Pipelines	Type	Pipeline No.	Length (km)
Viking Pipelines			
Viking BD to Viking CD	Gas	PL0089	3.9
	Methanol	PL0132	3.9
Viking BD to Viking DD	Gas	PL0090	4.1
	Methanol	PL0131	4.1
Viking BD to Viking ED	Gas	PL0091	12.0
	Methanol	PL0133	12.0
Viking BD to Viking GD	Gas	PL0092	5.1
	Methanol	PL0066	5.1
Viking BD to Viking HD	Gas	PL0093	5.6
	Methanol	PL0130	5.6
LOGGS Pipelines			
Vulcan UR to Vulcan RD	Gas	PL0462	3.7
	Methanol	PL0463	3.7
Viscount VO to Vampire OD	Gas	PL1962	11.2
	Methanol	PL1963	11.2
Vampire OD to LOGGS OR	Gas	PL1692	9.0
	Methanol	PL1693	9.0
Total length of pipelines VDP1 and LDP1 = 54.5 km			

2.11 In addition to the pipelines associated with the VDP1 and LDP1 decommissioning programmes a further 17 pipelines within the Viking area and 26 within the LOGGS complex area will be decommissioned as part of the ten year decommissioning programme (Table 5).

Table 5: ConocoPhillips pipelines associated with Viking and LOGGS.

Pipelines	Type	Pipeline No.	Length (km)
Viking Area			
Viking LD to PL1571 Tee	Gas	PL1572	0.1
	Methanol	PL1574	0.1
Viking KD to Viking BD	Gas	PL1571	13.6
	Methanol	PL1573	13.6
Viking AR to Theddlethorpe	Gas	PL0027	139.2
	Methanol	PL0161	139.2
Viking AR to Viking BP	Gas	PL0088	10.9
	Methanol	PL0134	10.9

Pipelines	Type	Pipeline No.	Length (km)
Victor JD to Viking BD	Gas	PL0211	13.5
	Methanol	PL0212	13.5
Victor JM to Victor JD	Gas	PL1095	5.1
	Methanol	PL1096	5.1
Victor JD to Victor JM	Umbilical	PLU4039	5.4
Vixen VM to Viking BD	Gas	PL1767	8.7
	Methanol	PL1768 [1]	8.7
Viking Bravo to LOGGS	Gas	PL2643	27.5
	Methanol	PL2644	27.5
LOGGS Area			
Europa EZ to PL1091 Tee	Gas	PL1694	4.5
	Methanol	PL1695	4.5
Ganymede ZD to LOGGS PR	Gas	PL1093	19.5
	Methanol	PL1094	19.5
NW Bell ZX To Callisto ZM	Gas	PL1690	0.08
	Methanol	PL1691	0.08
NW Bell ZX To Callisto ZM	Umbilical	PLU4177	0.12
Ganymede ZD to Callisto ZM	Umbilical	PLU4178	13.9
Callisto ZM to Ganymede ZD	Gas	PL1091	14.3
	Methanol	PL1092	14.3
North Valiant SP to LOGGS PP	Gas	PL0470	4.3
	Methanol	PL0471	4.3
Vanguard QD to LOGGS PP	Gas	PL0456	7.5
	Methanol	PL0457	7.5
Vulcan RD to LOGGS PP	Gas	PL0458	16.1
	Methanol	PL0459	16.1
South Valiant TD to LOGGS PP	Gas	PL0460	10.6
	Methanol	PL0461	10.6
Tethys TN to PL2107 Tee	Gas	PL2234	3.8
	Methanol	PL2235	3.8
Saturn ND to LOGGS PR	Gas	PL2107	43.2
	Methanol	PL2108	43.2
Mimas MN to Saturn ND	Gas	PL2236	13.6
	Methanol	PL2237	13.6
LOGGS PP to Theddlethorpe	Gas	PL0454	118.3
	Methanol	PL0455	118.3

1 – note The Vixen VM to Viking BD methanol line is for the import of methanol.

2.12 Decommissioning activities are proposed to be undertaken over a period of ten years. However, completion of activities may occur earlier with an estimated completion date of 2024, subject to regulatory approvals and operational impacts.

2.13 The proposed activities could cause physical loss of habitat through the removal of infrastructure and smothering, in particular the placement of rock for rig stabilisation and burial of existing pipelines. Pipelines left *in situ*. may cause ongoing obstruction on the sandbank feature but are not additional impacts. Physical impacts to qualifying features may occur during decommissioning activities and these may be temporary, where the habitat may recover overtime or permanent. The use of anchors during the locating of the heavily lift vessel or the drill rig used for well abandonment and the lowering of spud cans may cause physical impacts.

3 DESIGNATED SITES

3.1 The proposed decommissioning activities will occur within the North Norfolk Sandbanks and Saturn Reef SAC and it is recognised that potential impacts that have potential to cause a likely significant effect could occur to the qualifying features of the site (Figure 3). ConocoPhillips' assets subject to potential future decommissioning within the SAC are presented in Figure 4.

3.2 The proposed decommissioning activities will occur within or adjacent to the Southern North Sea cSAC. It is recognised that potential impacts that have potential to cause a likely significant effect could occur to the qualifying features of the site (Figure 5). ConocoPhillips' assets subject to potential decommissioning as part of the ten year plan are presented in Figure 6. No other sites have been identified as being at potential risk of a likely significant effect from activities associated with the proposed decommissioning activities at Viking and LOGGS based on current information.

3.3 The Southern North Sea cSAC has 42 platforms and 4,067 km of pipeline within it. These have the potential to have a likely significant effect upon Southern North Sea cSAC and the Dogger Bank SAC. The potential impacts from decommissioning any future oil and gas infrastructure within the designated sites will be subject to the requirements of the Habitats Regulations at the time of any possible future submissions.

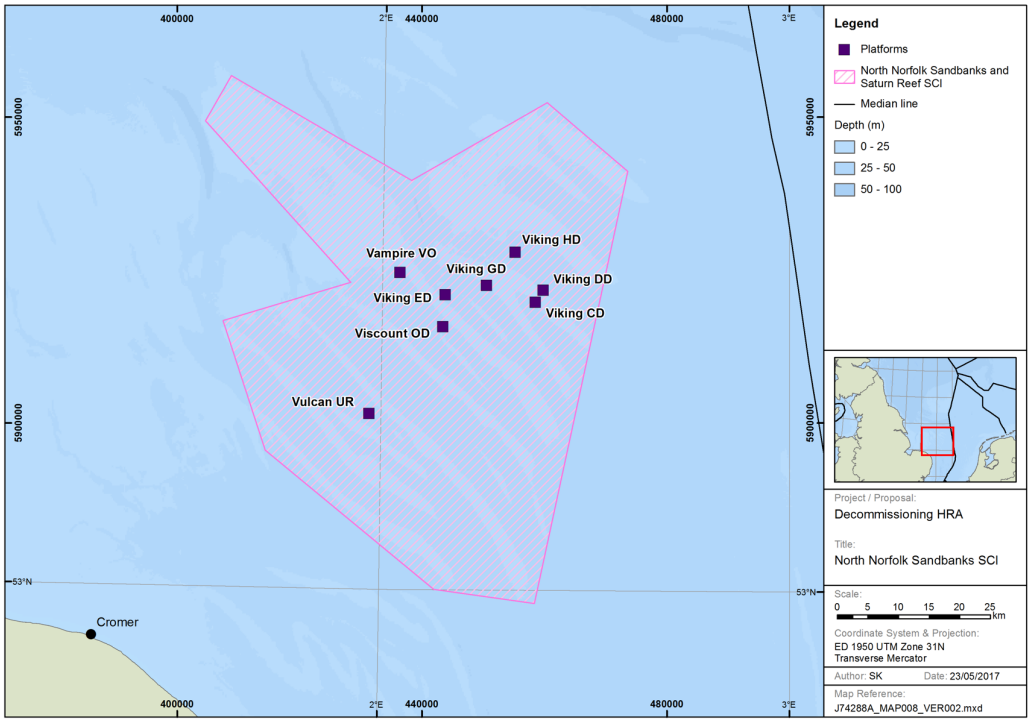

Figure 3: North Norfolk Sandbanks and Saturn Reef SAC and installations to be decommissioned as part of VDP1 and LDP1.

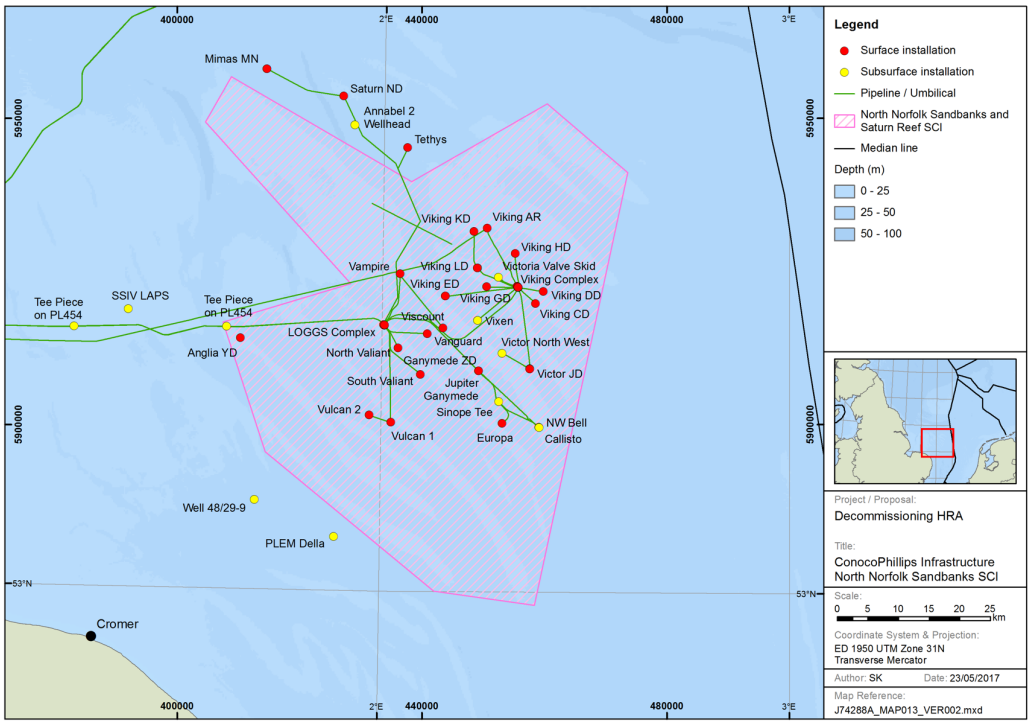

Figure 4: North Norfolk Sandbanks and Saturn Reef SAC and installations to be decommissioned over the next ten years (Source ConocoPhillips).

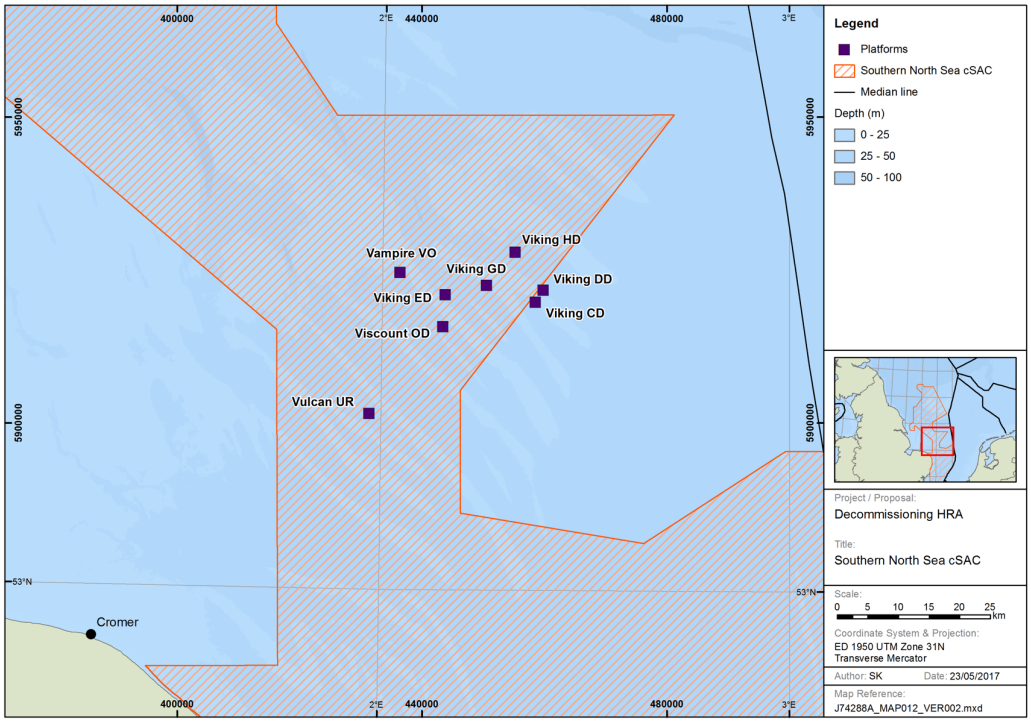

Figure 5: Southern North Sea cSAC and installations to be decommissioned as part of the VDP1 and LDP1.

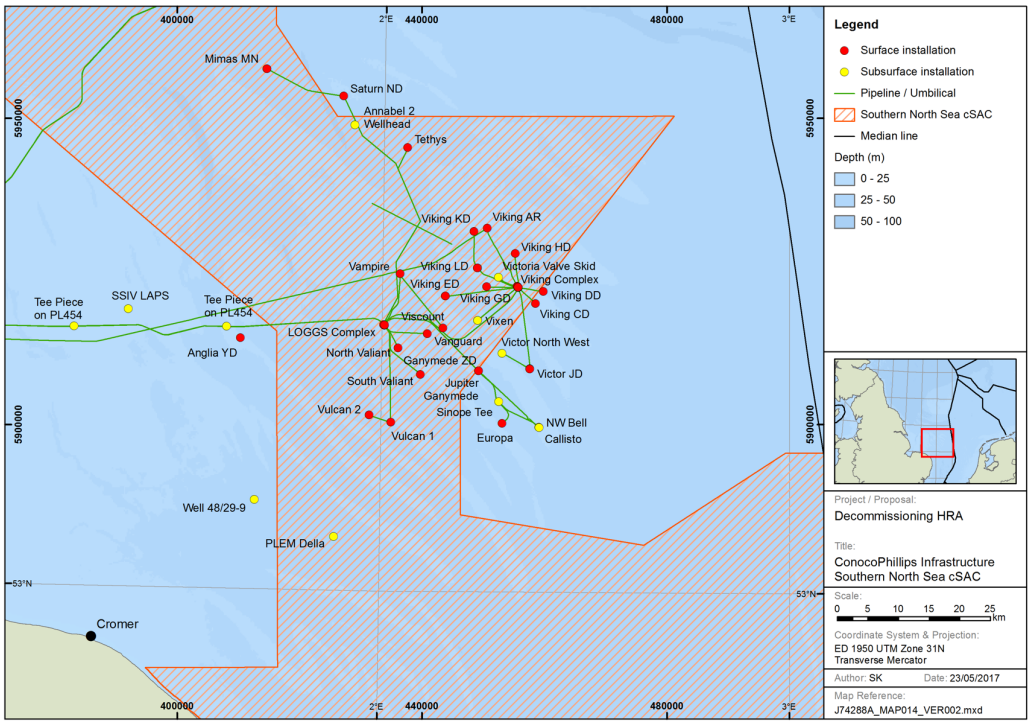

Figure 6: Southern North Sea cSAC and installations to be decommissioned over the next ten years.

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

3.5 The Southern North Sea cSAC covers an area of 36,951 km^2 extending from the central North Sea, north of the Dogger Bank, to the Strait of Dover and is designated for harbour porpoise (*Phocoena phocoena*).

4 CONSERVATION OBJECTIVES

4.1 Conservation Objectives outline the desired state for any European site, in terms of the interest features for which it has been designated. If these interest features are being managed in a way which maintains their nature conservation objectives, they are assessed as being in a 'favourable condition'. An adverse effect on integrity is likely to be one which prevents the site from making the same contribution to favourable conservation status for the relevant feature as it did at the time of its designation (English Nature 1997).

4.2 Favourable Conservation Status is defined in Article 1(e) of the Habitats Directive as:

> *Conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long term survival of its typical species within the territory referred to in Article 2;*

4.3 The conservation status of a natural habitat will be taken as "favourable" when:

> *its natural range and areas it covers within that range are stable or increasing. the specific structure and functions which are necessary for its long term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable as defined in (i).*

4.4 Updated advice from the JNCC is that, in their view, both Annex 1 sandbank habitats and Annex 1 reef habitats are in unfavourable condition. This based on their understanding that one or more of the sites attributes need to be restored or where restoration is not considered to be possible through human intervention (JNCC 2017b).

4.5 There are no set thresholds at which impacts on site integrity are considered to be adverse. This is a matter for interpretation on a site-by-site basis, depending on the designated feature and nature, scale and significance of the impact.

4.6 The European Court of Justice has defined '*adverse effect on site integrity*' as a plan or project that is '*liable to prevent the lasting preservation of the constitutive characteristics of the site that are connected to the presence of a priority natural habitat whose conservation was the objective justifying the designation of the site in the list of sites of Community importance*' (Sweetman 2013).

4.7 When assessing potential small scale impacts on Annex I habitats it is the relative importance of the area affected in terms of the rarity, location, distribution, vulnerability to change ecological structure which is most influential (Chapman & Tyldesley 2016).

4.8 The integrity of a site is defined as being '*the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified*' (ODPM Circular 06/2005).

4.9 Conservation Objectives have been used by the Department BEIS to consider whether the proposed activities have the potential for causing an adverse effect on a site's integrity, either alone or in-combination.

4.10 The Conservation Objectives of each site are required in order to undertake an Appropriate Assessment. The following Conservation Objectives have been produced by the JNCC for North Norfolk Sandbanks and Saturn Reef SAC (JNCC 2017a).

> For the features to be in favourable condition thus ensuring the integrity of the site in the long term and contribution to Favourable Conservation Status of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I reefs. This contribution would be achieved by maintaining or restoring, subject to natural change:
>
> - The extent and distribution of the qualifying habitats in the site;
> - The structure and function of the qualifying habitats in the site; and
> - The supporting processes on which the qualifying habitats rely.
>
> Source JNCC 2017

4.11 It is noted that the Conservation Objectives are to '*restore the sandbanks…*' and that the '*Annex I sandbanks feature may not be in favourable condition and could require restoration'* (JNCC 2012).'

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

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

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

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

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

4.15 The JNCC advise that due to the cyclical nature of reef formation and decay, it is important to conserve the feature's overall extent within a site, and that this approach includes conserving both established reef and areas of potential reef. Assessments should focus on reef extent occurring at that specific point in time, therefore a repeat survey may be required at the point of assessment. (JNCC 2017c).

4.16 The extent of oil and gas activity within the site, the majority of which was present prior to site designation, present a '*moderate'* obstruction to the feature to which it is '*highly sensitive*' (JNCC 2012). However, there is no evidence that infrastructure is causing damage or deterioration of the sandbank features by current activities within the site, (JNCC 2012). It is assumed that the very presence of oil and gas infrastructure within the SAC is causing an adverse effect on the Site condition. The qualitative assessment undertaken to determine the Site condition as not being favourable is based on the '*unprecedented level*' of existing activities within the site (JNCC 2012). It is therefore important to quantify, as far as possible, the level of any activity within the SAC when undertaking an assessment as this determines the Site condition.

Southern North Sea cSAC Conservation Objectives

4.17 The following Conservation Objectives have been produced by the JNCC for the Southern North Sea cSAC (JNCC 2016).

Southern North Sea SCI Conservation Objectives

Ensure that human activities do not, in the context of maintaining site integrity:

- Kill or injure harbour porpoise (directly or indirectly);
- Prevent their use of significant parts of the site (disturbance/displacement);
- Significantly damage relevant habitats; or
- Significantly reduce their prey base.

To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status 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 porpoise and their prey are maintained.

Source JNCC 2016

4.18 Harbour porpoises are considered to be a 'viable component' of the site if they are able to survive and live successfully within it. Killing, injuring or significantly disturbing harbour porpoise have the potential to affect species viability within the site (JNCC 2016).

4.19 Within the draft Conservation Objectives '*no significant disturbance of the species'* is described as '*any disturbance should not lead to the exclusion of harbour porpoise from a significant portion of the site for a significant period of time'*. Although there is no definition within the draft Conservation Objectives of what is a significant portion or significant period. The aim is to ensure that the site '*contributes, as best it can, to maintaining the Favourable Conservation Status of the wider harbour porpoise population. As such, how the impacts within the site translate into effects on the North Sea Management Unit population are of greatest concern'* (JNCC 2016).

4.20 *'Supporting habitats and processes'* relate to the seabed and water column along with the harbour porpoise prey. The activity which potentially risks the achievement of this CO is commercial fishing (JNCC 2016).

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

4.22 The purpose of an Appropriate Assessment is to determine whether a plan or project adversely affects a site's integrity. The critical consideration in relation to site integrity is whether the plan or project affecting a site, either individually or in combination, affects the site's ability to achieve its conservation objectives and favourable conservation status (JNCC 2016).

4.23 The Appropriate Assessment has been carried out in light of best scientific knowledge with reference to the Conservation Objectives of the qualifying sites and the potential impacts on the integrity of the site (EC 2010).

5 SCOPE OF THE ASSESSMENT

5.1 Based on the likely activities predicted to occur it has been determined that the HRA should consider alone and in-combination the potential direct and indirect impacts on:

- Sandbanks,
- Biogenic reefs,
- Harbour porpoise.

Sandbanks

5.2 Sandbanks which are slightly covered by seawater all the time are an Annex I habitat under the Habitats Directive and are described as *Sublittoral sandbanks, permanently submerged. Water depth is seldom more than 20 m below Chart Datum*. They occur widely in UK coastal and offshore waters. There are twenty designated sites in UK waters for which this habitat is a primary feature and a further 17 sites in which the habitat occurs but not identified as a primary reason for site selection (JNCC 2014a).

5.3 Annex I Sandbanks are defined by their physiographic nature rather than by a specific biological community (JNCC 2013). There has been no significant change in recent geological times and although there may have been localised declines the overall geographic spread and distribution of offshore sand banks have not been reduced (JNCC 2013).

5.4 The total area of sandbank habitat identified in UK offshore waters, i.e. beyond 12 nm is reported to be 57,835 km^2, of which 14,077 km^2 lies within designated sites (JNCC 2013).

5.5 The North Norfolk Sandbanks are the most extensive example of the offshore linear ridge sandbank type in UK waters (JNCC 2010a). The SAC has within its boundaries a series of sandbanks including Leman, Ower, Inner, Well, Broken, Swarte and Indefatigable banks. They extend from between 40 km and 110 km off the coast of Norfolk in water depths of up to 40 m (Figure 7).

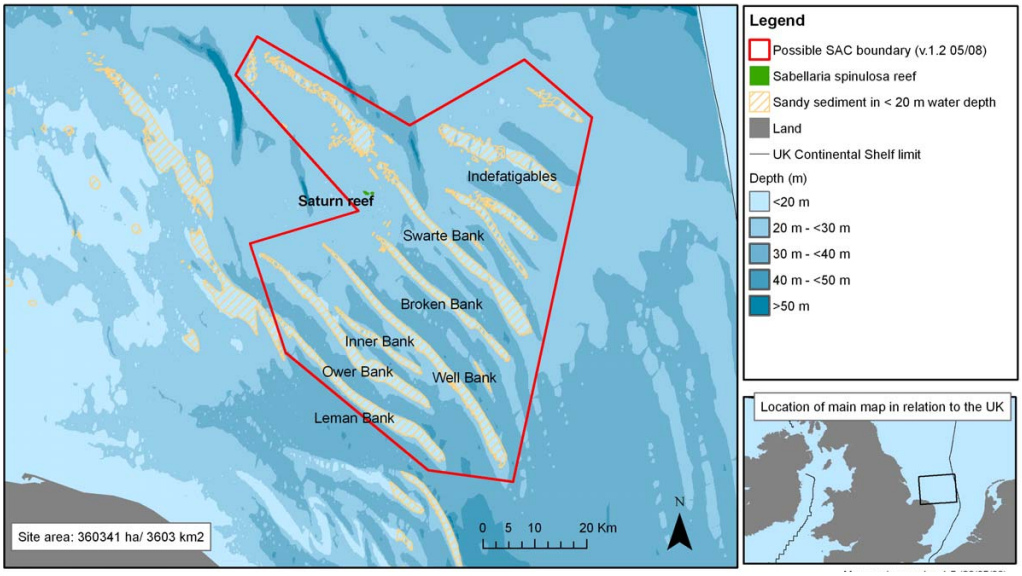

Figure 7: Sandbanks within North Norfolk Sandbanks and Saturn Reef SAC (Source JNCC 2010).

5.6 The extent of sandbank habitat within the SAC covers 3,603 km^2, 6% of the total habitat in UK offshore waters and 25.6% of the habitat type within offshore designated sites.

5.7 The Norfolk sandbanks are very slowly migrating north-east. Published studies have suggested that the lateral rate of movement occurs at a rate of between 1 – 5 m/year (ABPmer 2005, Cooper *et al*. 2008). However, the internal structure of the Norfolk Banks indicates that it is at a rate of *c.*1 m/yr (Cooper *et al.* 2008). At this rate it would take over one hundred years to detect any movement of the sandbanks greater than 100 m, which is within the distance of survey and charting errors (Cooper *et al*. 2008). Furthermore, the outer Indefatigable and Swarte banks may be moribund, with their crests in deeper water, and therefore may not be mobile (Cooper *et al*. 2008). However, there may be linear movements of the sandbanks, particularly at their ends, where movements of up to 40 m per year have been reported (ABPmer 2005).

5.8 The North Norfolk Sandbank SAC comprises seven habitat types with Infralittoral fine sand or infralittoral muddy sand habitats occurring predominantly along the sandbanks

and circalittoral fine sand or circalittoral muddy sand occurring predominantly between the sandbanks. Infralittoral and circalittoral course sediment habitats also occurs within the SAC (ABPMer and Ichthys Marine 2015).

5.9 Within the site there are four main biotopes circalittoral coarse sediment biotopes, circalittoral coarse sand biotopes, circalittoral sand biotope and circlittoral mixed sediment biotope (JNCC 2013).

5.10 The biological communities present on the sandbanks are representative of the infralittoral mobile sand biotope. Species typical of this biotope include the polychaete worm *Nephtys cirrosa* and the isopod *Eurydice pulchra* (JNCC 2017c). Characteristic species recorded during surveys within the SAC included *Mediomastus fragilis, Sabellaria spinulosa*, *Scalibregma inflatum* and *Notomastus*. *Bathyporeia guilliamsoniana* are more abundant in Circalittoral sand biotopes compared with others (JNCC 2013). However, differences in communities are slight with substrate type not having a very strong effect on differences in community.

5.11 Species within infralittoral mobile sand biotopes are adapted to high levels of disturbance. They are able to withstand mobile sediments and are opportunistic (MarLIN 2017). The faunal community is highly resilient to any level of impact with recovery often within a few days or weeks. Following severe disturbances recovery is expected to occur within 12 months (MarLIN 2017).

5.12 The communities have low sensitivity to smothering and abrasion or disturbance to the seabed surface. However, they are highly sensitive to changes to different types of sediment and the physical loss of suitable habitat (MarLIN 2017).

5.13 Communities may also be sensitive to introduced, or the spread of, non-native species. However, vessels planned to be undertaking the proposed decommissioning activities are already operating in UK waters and therefore there is no risk of the introduction of non-native species during these activities. In the event that vessels from outwith the UK are commissioned to undertake future decommissioning work within the SAC they would be subject to national and international requirements regarding the management of ballast water.

5.14 Sandbanks are characterised by relatively strong currents which produce characteristic features such as mega ripples. During certain conditions, e.g. storms, the tops of sandbanks can be removed and replaced later during calmer conditions (Elliot *et al.* 1998).

5.15 Modelling has indicated that sediments across the site are highly mobile with mobile bedforms present on the tops of the sandbanks for 85–95% of the time and in the deeper

areas between the sandbanks for around 10– 80% of the time for 250 µm grain size, and 0–20% for 63 µm grain size (ABPMer and Ichthys Marine 2015).

5.16 Subtidal sandbanks are subject to continued reworking of the sediment by wave action and tidal streams and thus are dominated by species capable of tolerating severe changes in the hydrophysical regime.

5.17 Sandbanks are highly motile and so introducing solid structures to this environment can create localised artificial habitats, scouring and sediment deposits. Removal of the sandbank features, including the substratum, would result in some localised temporary loss of its ecological communities. The structure and diversity of sandbank communities are determined by environmental characteristics such as sediment particle size distribution, seabed slope and water depth. Any change in these environmental parameters (e.g. by removing or smothering part of the feature) could result in a loss of habitat and a possible shift in community organisation (JNCC 2012).

5.18 The pressures and sensitivities on sandbanks, and vulnerability of the SAC to oil and gas related activities are presented in Table 6 (JNCC 2012).

Table 6: Pressures and sensitivities on sandbanks in the North Norfolk Sandbanks and Saturn Reef SAC (selected to relate to oil and gas activities specific to this assessment).

List of pressures which may cause deterioration or disturbance (with example activities)		***Sandbanks which are slightly covered by seawater all the time***		
		Sensitivity	**Exposure**	**Vulnerability**
Physical loss	Removal (e.g. Infrastructure development).	●●	None	No known vulnerability
	Obstruction (e.g. permanent constructions [oil and gas infrastructure])	●●●	Medium	High
	Smothering (e.g. sediment disturbance)	●	Unknown	Not quantifiable
Physical damage	Physical disturbance or abrasion (e.g. Anchors)	●●	Low	Low

5.19 The sensitivity of Annex I sandbanks in the UK offshore waters to oil and gas related activity is reported to be low because they act only over a small portion of the known occurrences of the habitat (JNCC 2013). However, their sensitivity to localised impacts may be higher depending on the scale of the impact. Consequently, the sensitivity of sandbanks to oil and gas activities is dependent on the extent of the activity.

5.20 The JNCC (2012) reports that '*Any construction over the sandbanks would lead to their obstruction. The natural development i.e. shift in location (and shape of a sandbank),*

and recovery may be prevented by any permanent infrastructure itself. This could also affect sandbank recovery through changes in the local hydrographic regime, caused by the obstruction. Sensitivity to obstruction is therefore considered high' and the '*The sandbank feature's ecological communities is sensitive to smothering at a low level, particularly the lower lying or encrusting typical species*' (Table 6).

5.21 Studies undertaken to assess the sensitivity of Marine Conservation Zone (MCZ) and Marine Protected Area (MPA) features on a broad range of pressures have identified that subtidal sand had a low to medium sensitivity from physical disturbance of the substrate. Similarly, the habitat is identified as being highly sensitive to change to another seabed type (Tillin *et al.* 2010, Tillin & Tyler-Walters 2015). The sensitivity is determined by the magnitude of the pressures and set against a benchmark. The studies recognise that the sensitivity of a habitat to a pressure may also vary depending on the frequency and duration of the pressures and their spatial extent. The temporal and spatial aspects of the pressure and spatial scale of the feature being exposed to the pressure should be considered when determining the sensitivity of habitat to a pressure (Tillin *et al.* 2010).

5.22 Potential impacts arising from the removal of infrastructure, the use of anchors by vessels and rock dumping could cause physical loss and physical impacts to Sandbank habitats within the SAC.

Reefs

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

5.24 The biogenic reef habitat formed by *S. spinulosa* occurs in both inshore and offshore waters. There are five designated sites in UK waters for which this specific reef habitat is a primary feature, of which the North Norfolk Sandbanks and Saturn Reef SAC is one (JNCC 2014b).

5.25 *Sabellaria spinulosa* occurs widely and is found in the subtidal and lower intertidal/sublittoral fringe, especially in areas of turbid seawater with a high sediment load. *Sabellaria* reef habitats are less frequent with relatively few examples occurring in UK waters

5.26 The SAC has within its boundaries the Saturn *Sabellaria spinulosa* biogenic reef. In 2003, the Saturn reef covered an area approximately 750 m by 500 m, just to the south of Swarte Bank, varying in density over an area of 1.08 km^2 (JNCC 2014b, Natura 2000 2012). More recent surveys in the area have not found the extensive reef recorded in 2003, but whether this absence is as a result of damage to the reef structures (e.g. by bottom trawling) or whether such reefs are naturally ephemeral is not yet known. However, formation of such a substantial reef of *S. spinulosa* in this area in 2003 indicates favourable conditions for reef formation (JNCC 2010a).

5.27 The polychaete *Sabellaria spinulosa* is, in its adult form, a sedentary species of tube worm with a distribution ranging from north of Shetland to the Mediterranean and occurring throughout UK waters, including the North Sea. Where it occurs, the species is abundant with reported densities ranging from 299/m^2 up to 9,561 in 1.4 m^2 (Hiscock 2003).

5.28 *Sabellaria spinulosa* grows rapidly with adults reaching maximum biomass within months of settling from the juvenile stage (Pearce *et al*. 2007). *S. spinulosa*'s life history favours settlement and adaptation to live in frequently disturbed environments and rapid reproduction (planktotrophic larvae) rates during January and February (George & Warwick 1985, MarLIN 2011).

5.29 *Sabellaria spinulosa* preferentially colonise areas of hard substratum, typically on shell, sandy gravel or rocky substrates with moderate tidal flow. The species requires sand grains in order to form its tubes and will therefore occur in very turbid waters where sand is placed in suspension by water movement (Jones, Hiscock & Conner 2000).

5.30 Where *S. spinulosa* reefs occur, there may be an increase in both the diversity and abundance of other species (Jones, Hiscock & Conner 2000). However, this may not always be the case with studies showing areas of *S. spinulosa* reef having significant increases in abundance but not necessarily increases in biodiversity (Pearce *et al*. 2007).

5.31 Studies undertaken at aggregate extraction sites in the southern North Sea and English Channel indicate that *S. spinulosa* are able to tolerate levels of disturbance from aggregate extraction including significant levels of sediment disturbance and can re-colonise areas that had previously been dredged to a level of high abundance within three years, with re-colonisation starting within 12 months of dredging activities ceasing (Pearce *et al*. 2007; Pearce *et al*. 2011). Consequently, it is possible for re-colonisation to occur relatively quickly if conditions are suitable.

5.32 Monitoring undertaken along a surface laid pipeline, placed 550 m from a *S. spinulosa* reef in the Southern North Sea was unable to detect any evidence of an impact from anchors or anchor wires on the seabed or the *S. spinulosa* reef less than three years

after the activities had taken place. Further monitoring along the pipeline route indicated that the laying of the pipeline impacted *S. spinulosa* aggregations over an area of five metres either side of the pipeline (Witteveen and Boss 2010). Indicating the *S. spinulosa* will colonise adjacent to surface infrastructure.

5.33 The pressures and sensitivities on *Sabellaria* biogenic reefs, and vulnerability of the SAC to oil and gas related activities are presented in Table 7.

Table 7: Pressures and sensitivities on *Sabellaria spinulosa* reefs in the North Norfolk Sandbanks and Saturn Reef SAC (selected to relate to oil and gas activities specific to this assessment).

List of pressures which may cause deterioration or disturbance (with example activities)		*Sabellaria spinulosa reefs*		
		Sensitivity	**Exposure**	**Vulnerability**
Physical loss	Removal (e.g. Infrastructure development).	●●●	None	No known vulnerability
	Obstruction (e.g. permanent constructions [oil and gas infrastructure])	●●●	Unknown	Vulnerability (not quantifiable)
	Smothering (e.g. sediment disturbance)	●●	Unknown	Vulnerability (not quantifiable)
Physical damage	Physical disturbance or abrasion (e.g. Anchors)	●●	Low	Low vulnerability

5.34 Potential impacts arising from the removal of infrastructure, the use of anchors by vessels and rock dumping could cause physical loss and physical damage to *Sabellaria spinulosa* reefs within the SAC.

Harbour porpoise

5.35 The harbour porpoise (*Phocoena phocoena*) is the smallest and most abundant cetacean species in UK waters. They occur widely across shelf waters predominantly either individually or in small groups but larger aggregations have been reported (Defra 2015), with group sizes varying with season (Clark 2005).

5.36 Harbour porpoise are opportunistic feeders, foraging close to the seabed or near the sea surface, preying on a wide range of fish species including, herring, cod, whiting and sandeels, and their prey will vary during and between seasons (Santos and Pierce 2003). Studies undertaken in Denmark indicate that their local distribution may be correlated with prey availability (Sveegaard 2011). Their prey preferences within the cSAC is not well known (JNCC 2016). However, species known to occur within the SAC include herring, cod, whiting, sandeels and sprats, all of which may be prey for harbour porpoise.

5.37 Data from ESAS and other databases indicate harbour porpoise are widespread across the North Sea and adjacent waters (Reid *et al*. 2003). Evidence from SCANS surveys indicates that there may have been a southward shift in the distribution of harbour porpoise from occurring predominantly around eastern Scotland and the northern North Sea to the southern North Sea since the early 1990's (Hammond *et al*. 2013, 2017).

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

5.39 Porpoises are generally considered to be 'high frequency' specialists with a relatively poor ability to detect lower frequency sounds (Southall *et al.* 2007). Studies undertaken on captive harbour porpoises indicate that porpoises have a functional hearing range of between 250 Hz and 180 kHz with their best hearing between 16 to 140 kHz and their maximum sensitivity between 100 and 140 kHz. This is within the frequency range of 130 to 140 kHz that harbour porpoise echolocate (Miller and Wahlberg 2013).

5.40 Their ability to detect sound below 16 kHz or above 140 kHz falls sharply (Kastelein *et al.* 2012, 2015, Southall *et al*. 2007).

5.41 Harbour porpoise are therefore most sensitive to sound sources between 16 to 140 kHz and, although audible, they are unlikely to be sensitive to sound either above or below those frequencies.

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

5.43 Sound arising from decommissioning activities may also impact on the prey species of harbour porpoise, which could have a negative impact on harbour porpoise. Fish hearing is based on detecting particle motion directly stimulating the inner ear. However, those with swim bladders are also able to detect pressure waves and can detect a wider range of frequencies and sounds of lower intensity than fishes without swim bladders (Popper 2003). Fish with swim bladders, e.g. herring, are recognised to be hearing specialists. Those without, e.g. sandeels, are considered to have a relatively low sensitivity to noise. Most fish with swim bladders are able to detect sound within the 100

Hz to 2 kHz range, those without swim bladders are unlikely to detect sound above 400 Hz (Popper 2012).

5.44 Potential impacts on harbour porpoise or their prey arising from decommissioning include sound from vessels and cutting equipment.

5.45 Surveys across the cSAC have indicated that harbour porpoise occur widely across the site, with some evidence of seasonal movements southwards during the winter and north during the summer. There is no clear preference to habitats within the site (Heinänen & Skov 2015).

6 EXTENT OF ANNEX I HABITAT

6.1 The total area of sandbank habitat classified within the North Norfolk Sandbanks and Saturn Reef SAC is, for the purposes of this assessment, 3,603 km^2 (JNCC 2017c).

6.2 Within the SAC there are seven recognised sandbank habitats, predominantly comprising of Infralittoral fine sand or Infralittoral muddy sand and Circalittoral fine sand or Circalittoral muddy sand (Table 8).

Table 8: Area of sandbank habitat types within the North Norfolk Sandbanks and Saturn Reef SAC (Source ABPMer and Ichthys Marine 2015).

Habitat	Habitat Area (km^2)	% of SAC
Moderate energy infralittoral rock	9.1	0.3
Infralittoral coarse sediment	459.6	12.7
Circalittoral coarse sediment	332.0	9.2
Deep circalittoral coarse sediment	6.3	0.2
Infralittoral fine sand or Infralittoral muddy sand	1,142.0	31.7
Circalittoral fine sand or Circalittoral muddy sand	1,609.1	44.6
Deep circalittoral sand	45.4	1.3

6.3 The total area of Annex I reef habitat classified within the site at the time of designation was 1.08 km^2 (Natura 2000 2012). However, since the time of designation additional reef habitat of between low and high reefiness has been identified:

- 1.08 km^2 at time of designation: the Saturn reef (Natura 2000 2012),
- 1.57 km^2 Baird Gas Storage (BSCL 2011),
- 0.70 km^2 Leman uptime compression surveys (Fugro EMU 2013),
- 0.19 km^2 Leman AC work barge deployment (Perenco 2014),
- 0.53 km^2 Viking to Loggs pipeline (ConocoPhillips 2008),
- 0.14 km^2 Carrack to Clipper pipeline (Shell 2014).
- 0.05 km^2 Leman tie-back[3] (Perenco 2012).
- 1.28 km^2 Dredging Area 484 (Fugro Emu 2013b).

6.4 Based on the above survey data, the total area of confirmed reef habitat within the SAC is 5.54 km^2 (0.154% of the SAC).

6.5 It is noted that *Sabellaria* reef is an ephemeral feature and can colonise suitable areas and disappear from established areas. The Saturn reef was discovered in 2002 but subsequent surveys across the area have found no presence of it (Limpenny *et al.* 2010, Vanstaen & Whomersley 2015). However, having previously had *Sabellaria* reef present it is considered as suitable Annex I habitat for *Sabellaria* reef features.

6.6 Aggregations of *Sabellaria spinulosa* have been largely found by industry when undertaking baseline environmental surveys in support of potential developments. Other aggregations have been reported, e.g. Vanstaen & Whomersley (2015) and Jenkins *et. al.* (2015), with patches of *Sabellaria* ranging in size from between 0.004 km^2 to 1.5 km^2. However, the total area of *Sabellaria* reef habitat recorded during the surveys is not quantified and therefore it is not possible to include the additional reef habitat within this HRA at this time. The majority of the SAC has not been surveyed and it is therefore highly likely that *Sabellaria* reefs occur elsewhere within the SAC. The exact extent of Annex I reef habitat within the SAC is unknown and the area of 5.54 km^2 of *Sabellaria* used in this assessment is considered to be a minimum.

6.7 The whole of the VDP1 and LDP1 occur within the North Norfolk Sandbanks and Saturn Reef SAC and have potential to impact on the site's qualifying features.

6.8 Surveys undertaken by ConocoPhillips have recorded *Sabellaria spinulosa* within the area of the proposed activities. However, the structure and extent of the patches of *Sabellaria* recorded indicate that these do not constitute biogenic reef habitats as defined under JNCC definitions (Gubbay 2007, ConocoPhillips 2015a). Based on the evidence there are no biogenic reef habitats within the area of the proposed activities. However, future decommissioning activities occurring elsewhere within the SAC may be in locations where *Sabellaria* reef habitats occur and could be affected by future decommissioning activities.

[3] A total of 0.63 km^2 of *S. spinulosa* reef was identified within the pipeline route surveys of which approximately 0.33 km^2 is estimated to be outwith the SAC and 0.25 km^2 is covering the same area as the 2013 Leman AC surveys.

7 HARBOUR PORPOISE ABUNDANCE

7.1 The Southern North Sea cSAC lies in an area extending from the central North Sea, north of the Dogger Bank, to the Strait of Dover and covers an area of 36,951 km^2 (JNCC 2017d). The site recognises the seasonal variations in harbour porpoise distribution with identified 'summer' and 'winter' areas. The northern 'summer' area is approximately 27,088 km^2 and covers the period from between April to September. The southern 'winter' area is approximately 13,366 km^2 and covers the period between October and March (Heinänen & Skov 2015)[4]. The proposed decommissioning activities occur in an area of cSAC recognised for its summer populations of harbour porpoise.

7.2 Based on data collected during the SCANS-II survey it is estimated that the site potentially supports approximately 18,500 harbour porpoise (95% Confidence Interval: 11,864 - 28,899) for at least part of the year as seasonal differences are likely to occur (JNCC 2017d).

7.3 The European Atlantic Shelf harbour porpoise population is estimated to be 375,358 (95% CI 256,304 - 549,713) individuals, of which 227,298 (95% CI 176,360 - 292,948) occur in the North Sea Management Unit. In the UK sector of the North Sea Management Unit, the harbour porpoise population is estimated to be 110,433 (80,866 - 150,811) (IAMMWG 2015).

7.4 The Southern North Sea cSAC therefore potentially supports 17.5% of the harbour porpoise population within the UK sector of the North Sea Management Unit (JNCC 2015a).

7.5 Densities of harbour porpoise will vary across the site and across seasons. Although no mean densities are provided, modelling used to identify the site boundaries indicate that densities of >3.0 harbour porpoise/km^2 occur widely across the cSAC (Figure 8) (Heinänen & Skov 2015).

[4] Note, no official figures for the 'summer' and 'winter' areas have been published, therefore the areas of these have been estimated using GIS overlays.

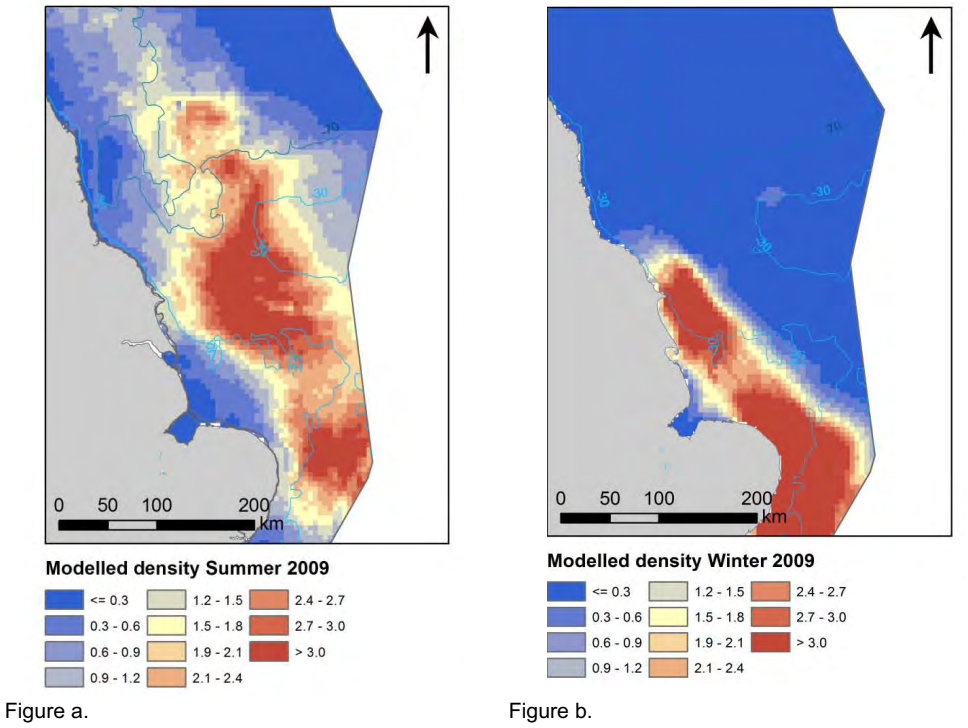

Figure a. Figure b.

Figure 8: a) Estimated summer densities of harbour porpoise in the Southern North Sea. b) Estimated winter densities of harbour porpoise in the southern North Sea. (Source: Heinänen & Skov 2015).

8 POTENTIAL IMPACTS

8.1 The potential impacts arising from the planned activities identified in the likely work programme that could affect qualifying features of the North Norfolk Sandbanks and Saturn Reef SAC are:

- Physical loss of habitat due to temporary location of accommodation vessels and rig (well plug and abandonment) plus associated stabilisation and scour protection.
- Physical loss of habitat due to temporary location of heavy lift vessel.
- Physical impacts to the seabed from temporary deployment of anchors, chains and spud cans.
- Physical impacts to the seabed from the cutting of jacket piles.
- Physical impacts to the seabed from the removal of the T-piece.
- Physical impacts from well conductor removal.
- Physical impacts from over-trawl survey.
- Physical impacts from excavation and cutting pipeline ends.
- Physical loss of habitat due to rock placement at cut pipeline ends.
- Physical loss of habitat due to existing presence of pipelines and rock dumping.
- Physical loss of habitat due to existing presence of mattresses and grout bags.

8.2 Physical loss or physical impacts to habitats may be permanent if they are unable to recover or the effects may be temporary if recovery occurs after the activity causing of the impact has ceased.

8.3 The potential impacts arising from the planned activities identified in the likely work programme that could affect qualifying features of the Southern North Sea cSAC are sound arising from:

- Physical injury or disturbance from vessel activities.
- Physical injury or disturbance from cutting equipment.
- Physical impacts to their relevant habitats from the cutting of jacket piles, removal of T-pieces, and well conductor removal.

8.4 Impacts arising from noise cease once the activity has stopped, although the effects of the impact on the qualifying species may last longer.

8.5 No other sources of potential impact likely to cause a significant effect have been identified.

Physical impacts during removal of platforms

8.6 Prior to the removal of platforms, a drill rig and jack-up accommodation vessels will be positioned at each platform location. Jack-up accommodation vessels require a stable seabed to ensure the vessel's spud-cans do not penetrate into the seabed and risk destabilising the vessel. Vessel stability is achieved based on soil stability limits and ensuring scour does not undermine vessel stability. To achieve this, a rock berm up to 4 m in height may be required under each of the legs covering a total area of up to 7,880 m^2 (0.00788km^2) of seabed. Up to 34,000 tonnes of rock is to be placed on the seabed at each platform location (ConocoPhillips 2015a).

8.7 The total area of seabed predicted to be impacted from rock-placement to ensure accommodation vessel stabilisation is estimated to be 50,100 m^2 (0.050 km^2) (Table 9 and Table 10). This is based on a worst-case scenario where it is assumed that stabilisation will be required at all accommodation vessel locations and includes the additional impacts from the use of a second accommodation vessel at six locations. At one other location no rig stabilisation will be required and therefore there may be temporary physical disturbance to the seabed from the locating of one vessel, totalling an area of 120 m^2 (0.00012 km^2).

8.8 Following a high level safety review, ConocoPhillips were undertaking simultaneous operations to undertake both well plug and abandonment and platform preparatory works using a single drill rig. This significantly reduced the potential quantity of rock required to be used for future stabilisation and therefore reduced the potential environmental impact. However, the operator has subsequently introduced an AWV in 2018 to be on standby during well suspension (ahead of the drill rig abandoning the wells) and to carry out the flushing and platform preparatory works. Site specific assessments have been undertaken to reduce the potential quantity of rock required for the introduction of the AWV following scrutiny of environmental and safety considerations. The impacts arising from the use of an accommodation work vessel as

described in the ES have been considered and updated in the HRA following the introduction of the AWV in 2018. This is a worst case scenario.

Table 9: Estimated quantity of rock required and area of potential seabed impacted from baseline accommodation vessel stabilisation requirements.

Platform	Rock berm Height (m)	Quantity of rock required (Te)	Area of impact (km^2)
Vulcan UR	-	1,000 [1]	0.00110
Viscount VO	4.0	34,000 [2]	0.00788
Vampire/Valkyrie	4.0	34,000 [2]	0.00788
Viking CD	4.0	0	0.00
Viking DD	3.0	22,479	0.00625
Viking ED	3.0	18,222	0.00611
Viking GD	3.5	20,388	0.0064
Viking HD	4.0	32,535	0.00788
	Total	162,624	0.0435

1 = Contingency only for scour protection

2 = Estimated

(Source ConocoPhillips 2015a,)

Table 10: Estimated quantity of rock required and area of potential seabed from additional accommodation vessel stabilisation requirements.

Quantity of rock required at each location (Te)	No. of locations	Rock berm Height (m)	Total area impacted (km^2)
1,000	6	Not specified	0.0066

(Source ConocoPhillips 2018)

8.9 The platforms will be removed using a heavy lift vessel as either a single lift or in two pieces, with the topsides removed followed by the jackets. The heavy lift vessel will be anchored in place using eight anchors during the removal of each platform and, in the event that the jackets and topsides are removed separately, the anchors will be required to be moved twice during each removal operation. Each anchor is estimated to impact an area of 4.1 m x 4.8 m and each anchor chain by 975 m x 0.076 m. The total area of seabed impacted by each anchor and associated chain is approximately 94 m^2. A total of 8 anchors at each platform for a single lift will impact an area of 752 m^2. If two lifts are required, the area of seabed impacted at each platform is 1,504 m^2. A total of eight platforms are to be removed and therefore approximately 12,032 m^2 (0.012 km^2) of seabed may be impacted by the anchors from the heavy lift vessels during the removal of the platforms.

8.10 The removal of the jackets will require the cutting of the piles approximately 3 m below the seabed. The number of piles at each platform varies but overall a total of 54 piles will need to be cut below the seabed in order to remove the 8 platforms.

8.11 The process may require excavation of the seabed around each of the piles and this will cause a physical impact to the seabed. If required, it is estimated that an area of 154 m^2 will be impacted around each pile causing a total area of seabed impacted of 8,200 m^2 (0.0082 km^2) (Table 11).

Table 11: Estimated area of seabed impacted from cutting jacket piles.

	Platform	Number of piles	Total area of seabed impacted (km^2)
LDP1	Vulcan UR	4	0.0006
	Viscount VO	4	0.0006
	Vampire/Valkyrie	4	0.0006
VDP1	Viking CD	12	0.0019
	Viking DD	8	0.0012
	Viking ED	8	0.0012
	Viking GD	6	0.0009
	Viking HD	8	0.0012
Total		54	0.0082

Physical impacts from removal of T-piece manifold

8.12 A single T-piece is located between the Vampire OD, Viscount VO and LOGGS. The T-piece, which is 11 m x 10 m, will be removed along with the associated mattresses and grout bags. The pins, holding the T-piece in place, will be exposed down to approximately 3 m below the seabed and cut. An estimated area of 110 m^2 (0.0001 km^2) of seabed may be impacted during the removal of the T-piece.

8.13 During the decommissioning the roof of the T-piece manifold structure will be temporarily placed on the seabed before being lifted and taken away. The total area of seabed temporarily impacted is estimated to be 260 m^2 (0.0002 km^2) (ConocoPhillips 2017a).

Physical impacts from removal of conductors

8.14 A total of 31 conductors will be removed during the proposed decommissioning activities at VDP1 and LDP1[5]. It is estimated that the removal of each conductor will impact on approximately 3.14 m^2 of seabed (ConocoPhillips 2017). Consequently, approximately 97.34 m^2 (0.0001 km^2) of seabed may be disturbed by the removal of the conductors.

[5] Note – there are 29 conductors associated with wells to be plugged and abandoned and two empty conductors at Vulcan UR.

Physical impacts from over-trawl surveys

8.15 Over-trawl surveys will be undertaken following completion of the decommissioning operations, to identify any snagging risks and, in some cases, to recover debris.

8.16 Over-trawl trials will be undertaken within a 500 m radius of each installation and along the LDP1 and VDP1 pipelines. The total area of impacted seabed within a 500 m radius of the eight installations to be removed is 6.3 km^2.[6]

8.17 The total length of LDP1 and VDP1 lines subject to the over-trawl survey is 54.5 km. Assuming a 200 m wide corridor of potential impact an estimated area of 10.9 km^2 of seabed may be impacted by over-trawl surveys. It is noted that surveys are also planned to be undertaken along areas where there are exposed mattresses. However, as these are predicted to be largely along existing pipelines the impact of these surveys is considered to be within the area impacted by pipelines.

8.18 The overall area of seabed impacted by over-trawl surveys is estimated to be 17.2 km^2.

8.19 The exact nature of the survey will be determined on a case-by-case basis, taking account of environmental sensitivities and any comments received from the fishermen's representative bodies.

Physical loss of habitat from pipelines

8.20 It is proposed that a total of ten infield pipelines (five gas lines and five piggy-backed/associated methanol lines) will be left in place within the Viking development area and six infield lines will be left in the LOGGS area (three gas lines and three piggy-backed/associated methanol lines). Where installations at both ends of the line are to be removed, e.g. Vampire OD and Viscount VO, both ends of the associated infield lines are to be cut. For all other pipelines, only the pipeline end associated with the removal of a platform will be cut. Where the pipelines are cut, rock will be placed over the ends. It is estimated that 25 tonnes of rock will be placed over each of the cut ends covering an area of 18 m^2. For the purposes of this assessment it is assumed that rock will be placed at both ends of the cut lines at Vampire OD and Viscount VO. Consequently, a total of 10 pipeline ends will require rock dumping covering a total area of 180 m^2 (0.0002 km^2).

8.21 A total of 30.6 km of VDP1 pipeline and 23.9 km of LDP1 pipelines are to be decommissioned *in situ*. Assuming a potential impact on the seabed of 5 m either side of the pipelines, the total area of seabed impacted by the physical presence of the existing pipelines is 545,000 m^2 (0.545 km^2).

[6] Area of impact based on 500 m radius multiplied by eight (785,398 * 8 = 6,283,184 m^2 – 6.28 km^2.

Physical loss of habitat from mattresses

8.22 No new mattresses or grout bags are to be placed on the seabed and it is proposed to leave those present *in situ* with minimal disturbance. Therefore, there will be no additional impacts arising from the decommissioning activities. A total of 30 mattresses are currently present at VDP1 and 97 at LDP1. Each mattress is estimated to be 6 m x 3 m and therefore a total area of 540 m^2 (0.0005 km^2) of seabed may impacted be existing mattresses. However, the mattresses are laid along existing pipelines and their physical presence does not increase the potential area of impact above that already considered under the pipelines.

Physical loss of habitat from existing rock

8.23 Rock has previously been used to address free-spans that have formed along the pipelines following their installation. There are five sections along the Viking infield lines that currently already have a total of 128.4 m of rock or grout bags placed along the pipelines (ConocoPhillips 2015b). A further 2,125 m of rock or grout bags are present along the LOGGS infield lines associated with LDP1. Therefore, a total of 4.1% of the 54.5 km of pipeline associated with VDP1 and LDP1 has rock or grout bags placed over it.

8.24 Pipeline route surveys undertaken across all the Viking pipelines indicate that the majority of the existing lines remain buried with limited risk of free-spans requiring remediation (Table 12).

Table 12: Viking pipelines burial depths.

Pipeline	Length of line (km)	Exposed pipeline length based on last survey (km)	Number of reportable free-spans
Viking BD – Viking CD	3.9	0.189	0
Viking BD – Viking DD	4.1	0.057	0
Viking BD – Viking ED [1]	12.0	5.984	1 in 1999
Viking BD – Viking GD	5.1	0.244	0
Viking BD – Viking HD	5.6	0.803	1

1 – The Viking BD – ED pipeline was surface laid.

8.25 The area of impact from rock dumping is predicted to be within the 10 m corridor considered, for the purposes of this assessment to be impacted by the physical presence of any pipelines. Therefore, the presence of existing rock along the pipelines does not increase the physical loss of habitat considered within this HRA.

Physical loss of habitat from free-span remediation

8.26 Pipeline route surveys indicate that rock will be required for the remediation of a free-span along a 20.8 m length of line between Viking BD and Viking HD, as part of the VDP1. Assuming rock placement impacts along a 10 m corridor then a total of 208 m^2 (0.0002 km^2) of seabed will be impacted.

8.27 A further 22.25 m of free-span are known to occur along the Victor JD to Viking BD pipeline which are not part of LDP1 or VDP1 and will require consideration in future decommissioning programmes.

8.28 Assuming that the area of rock impacts along a 10 m corridor then a total area of 431.1 m^2 (0.0004 km^2) of seabed may be impacted by rock placement along known free-spans.

8.29 It is not possible to predict any remedial works that may be necessary to deal with future free-spans. Where pipelines are left *in situ* free-spans can develop as a result of natural sediment relocation. However, their number, location and extent cannot be predicted, and they can sometimes be transient features due to the migration of the substrate. Monitoring surveys will be carried out on pipelines that are abandoned *in situ* to determine the future status of the lines, including the development of potentially hazardous free-spans. If rock placement is required in order to remediate free-spans assessments in accordance with the Habitat Regulations will be undertaken at the time.

Wells

8.30 A total of 29 wells across both VDP1 and LDP1 are to be plugged and abandoned using a jack-up drilling rig as part of the decommissioning activities. This is out of a total of 138 wells planned to be plugged and abandoned across the Southern North Sea by ConocoPhillips over the next ten years (ConocoPhillips 2017).

8.31 The area of direct physical impact on the seabed from the spud cans is estimated to be 589 m^2 (0.0006 km^2) at each location (ConocoPhillips 2017).

8.32 There is potential for rig stabilisation to be required at each well location. If required a total of 3,000 tonnes of gravel or rock will be placed onto the seabed impacting an estimated area of 400 m^2 (0.0004 km^2) (ConocoPhillips 2017). However, the use of rock for rig stabilisation and scour protection is a contingency measure and based on current experience, it is unlikely to be required. The inclusion of it as an impact at each rig location is considered to be a worst-case scenario (ConocoPhillips 2017).

8.33 Once in position the drill rig lowers three legs onto the seabed until stable. To assist in rig stabilisation during well abandonment operations a single anchor and associated anchor chains will be required. The area impacted by the anchor and chains is estimated to be 3,020 m^2 (0.003 km^2) at each rig location (ConocoPhillips 2017).

8.34 There is a potential requirement for 'mini-moves' at each of the four legged installations (ConocoPhillips 2017a). It is unclear from the information provided whether this will require additional rig stabilisation. For the purposes of this assessment it is presumed as a worst-case scenario that the impacts from the drill rig at four legged installations is doubled.

8.35 Chemicals may be used and discharged during the well abandonment and plugging operations. The exact type and volume of chemical used may vary across individual wells, they largely comprise of cement which is used to plug the wells and water based muds (WBM) used to mill out wells and for well control. An estimated 4 tonnes of cement cuttings per well may be discharged and 200 bbls of WBM and associated brine.

8.36 If the existing contents of wells do not contain any oil based muds or diesel they may be discharged. Typical well contents and quantities are presented in Table 13 (ConocoPhillips 2017).

Table 13: Typical wellbore and annulus contents (Source ConocoPhillips 2017).

Chemical used	Closest equivalent today	Estimated amount per well (Tonnes)
Magnesium chloride	Magnesium chloride	2
Sodium chloride	Sodium chloride	17
Potassium chloride	Potassium chloride	3
DF Viscosifier (Xanthan Gum)	Flowzan® Biopolymer, Drispac® Regular Polymer	0.4
Bentonite	Bentonite	40
Barite	Barite	1
Caustic soda	Caustic soda	1
FLR-100, idflo	Impermex	1

Vessel noise

8.37 The offshore oil and gas industry have used, and will continue to use, vessels in support of the vast majority of offshore activity. Vessels are extensively as supply vessels support operating oil and gas platforms along with safety vessels permanently present in development areas.

8.38 Vessel movements are the largest contributor to anthropogenic ocean noise and in deeper water are the dominant noise source in the lower frequencies, between 50-300 Hz (Ulrick 1967). Measurements undertaken in the Southern North Sea indicate that shipping noise is the dominant anthropogenic noise in the region predominantly in the frequency range of between 40 and 200 Hz (de Haan *et al.* 2007). In general, vessels that use dynamic positioning thrusters tend to generate higher levels of

underwater sound. The individual noise output produced by a vessel is dependent upon a number of factors including the speed of the vessel, age, load, maintenance and oceanographic conditions.

8.39 Shipping noise is continuous and varies depending on the type of vessel being used. The primary sources of sound from vessels are propellers, propulsion and other machinery; the dominant noise source is from propeller cavitation (Ross 1976, Wales and Heitmeyer 2002, Arveson and Vendittis 2000). Source levels typically increase with increasing vessel size, with smaller vessels (< 50 m) having source levels 160-175 dB re 1µPa (rms SPL), medium size vessels (50-100 m) 165-180 dB re 1µPa (rms SPL) and larger vessels (> 100 m) 180-190 dB re 1µPa (rms SPL) (summarised by Richardson *et al*. 1995). Commercial vessels in transit have reported sound source levels of between 178.6 and 190.3 dB re 1 µPa -m (Genesis 2011, Johanson & Anderson 2012), whereas supply and maintenance vessels produce generally lower sound source levels of between 130 and 184 dB re 1 µPa (rms SPL), with frequencies of between 20 Hz and 10 kHz. However, sound levels depend on the operating status of the vessel with vessels equipped with dynamic positioning systems exhibiting increased sound levels in the spectrum from 3 Hz to 30 Hz (Nedwell & Edwards 2004, OSPAR 2009). Most of the acoustic energy from vessels is below 1 kHz, typically within the 50-300 Hz range, although cavitation from propellers produces sounds at frequencies of between 1 kHz and 125 kHz (Genesis 2011, Hermannsen *et al.* 2014). Consequently, vessel noise has historically thought to have a greater potential to impact marine mammals with relatively low frequency sensitivities e.g. seals and baleen whales rather than high frequency specialists, e.g. porpoise (Okeanos 2008). However, more recent studies indicate that high frequency sound from vessels of between 0.25 and 63 kHz and at mean sound levels of 123 dB re 1 µPa (rms SPL) can cause increased porpoising behaviour in harbour porpoise at distances greater than 1 km from the sound source (Dyndo *et al*. 2015).

8.40 Studies undertaken to measure ambient noise levels in the southern North Sea and Irish Sea indicate that at frequencies below 1 kHz, general shipping noise increases background noise levels to above 120 dB re 1 µPa (rms SPL), with levels of exceeding 140 dB re 1 µPa (rms SPL) in areas of intensive shipping (Nedwell *et al*. 2003).

8.41 Current levels of shipping noise within the SCI has been shown to influence on the presence or absence of harbour porpoise and could cause displacement and disturbance of harbour porpoise within the SCI (Heinänen and Skov 2015).

8.42 Studies undertaken on seven harbour porpoise in Danish waters indicated that there was variation in how individual porpoises responded to vessel noise with some individuals showing a behavioural response to vessel noise at levels of 96 dB re 1 µPa (rms SPL), causing changes in the foraging behaviour and others

showing no behavioural response. Individuals exposed to relatively high levels of sound ceased foraging and swam to deeper water (Wisniewska *et al*. 2018a). Other studies have indicated that noise arising from shipping is capable of causing disturbance to beyond 1 km from a vessel (Dyndo *et al*. 2015, Hermannsen *et al*. 2014, Wisniewska *et al*. 2018b). Studies on the behavioural effects of shipping on harbour porpoise indicate that the level of displacement effects from shipping on harbour porpoise decrease with increasing distance from the vessel with some levels of displacement occurring out to 400 m from the vessel (Akkaya Bas *et al*. 2017, Polacheck 1990). However, the behavioural impacts are temporary with porpoises resuming activities relatively quickly once the vessel has passed (Hermannsen *et al*. 2014, Wisniewska *et al*. 2018b).

8.43 Based on an avoidance or a behavioural response out to 400 m from a vessel, an area of 0.5 km^2 may be impacted around each vessel. A maximum of eight vessels may occur in the area at one time. Although, the vessels will be operating in the same area and noise from the vessels will overlap, a worst-case scenario is that all eight vessels impact an area of 0.5 km^2 and therefore a total area of 4 km^2 may be affected by vessel noise at any one time.

Cutting noise

8.44 Cutting equipment will be required to cut the jacket legs and the pipeline ends. Either diamond wire cutters or water jetting tools are to be used.

8.45 Noise studies undertaken during diamond wire cutting of a conductor in the North Sea indicate that sound levels in the one-third octave band increased between 4 dB and 15 dB at frequencies above 5 kHz (Pangerc *et al.* 2016). However, other sources of sound from the associated vessels may have masked sound at lower frequencies. However, the level of sound arising from cutting tool is relatively low and is not predicted to be significantly, if at all, greater than that arising from the accompanying vessels.

8.46 There is limited information available on the sound levels arising from the use of water jetting tools, with one study reporting sound from high pressure water jets of 175.5 (A) re 1 µPa (Molvaer and Gjestland 1981). However, this figure is weighted for human hearing frequencies.

8.47 Although the information available is limited, it is predicted that noise from cutting equipment will not be significantly greater than that arising from the accompanying vessels and therefore no additional impacts beyond that estimated from noise arising from the accompanying vessels are predicted to occur.

Potential impacts – Summary

8.48 Based on the above it is recognised that there is potential for impacts arising from the proposed decommissioning activities to cause physical impact and loss of habitat to the qualifying features of the SAC.

8.49 The total area of physical impact arising from decommissioning activities is estimated to be 17.22 km^2. However, 17.2 km^2 is estimated to arise from over-trawl surveys and the remaining 0.02 km^2 from all other activities. There will be an estimated loss of habitat from the drill rig and accommodation vessel of 0.050 km^2. Impacts from existing infrastructure that will remain following decommissioning are estimated to affect an area of 0.545 km^2. (Table 14).

8.50 Some of these impacts may be temporary and others may already be existing due to the physical presence of infrastructure already within the SAC.

8.51 The area of seabed estimated to be physically impacted by well abandonment activities at each location is estimated to be 0.0073 km^2 and a loss of habitat due to rig stabilisation or scour protection of 0.0008 km^2 (Table 15). This is based on there being a 'mini move' of the rig at each of the four legged installations.

8.52 A number of wells may be abandoned at each rig location. It is assumed that the rig will locate twice at each of the eight installations included in the VDP1 and LDP1 decommissioning programmes, five at Viking and three at LOGGS. The total area of physical impact from well abandonment is therefore 0.058 km^2 and a total area of 0.006 km^2 of habitat may be lost due to the combined total of rock deposited for rig stabilisation or scour protection and the removal of five conductors.

8.53 Noise arising during the decommissioning activities is not predicted to extend beyond that caused by vessels, i.e. 400 m. Consequently, noise likely to cause significant disturbance will occur over an area of 0.5 km^2 for each vessel and maximum area of 4 km^2 for a worst-case scenario of 8 vessels.

Table 14: Estimated area of seabed impact arising from the proposed decommissioning activities associated with VDP1 and LDP1.

Activity	Impact	Total area of seabed impacted (km^2)
Decommissioning impacts		
T-piece removal	Physical impact	0.0001
T-piece roof structure temporary storage	Physical impact	0.0002
Heavy lift vessel anchors	Physical impact	0.012
Cutting jacket piles	Physical impact	0.0082
Over-trawl surveys	Physical impact	17.2
Excavation, cutting and rock placement and removal of free-spans at cut pipeline ends.	Loss of habitat	0.0002
Rock placement for pipeline free-span remediation	Loss of habitat	0.0002
Drill rig and accommodation vessel stabilisation/scour protection[2]	Loss of habitat	0.050
Total area of habitat loss		0.050
Total area of physical impact		17.22
Existing impacts		
Leave *in situ* existing pipelines	Loss of habitat	0.545
Leave *in situ* existing mattresses and grout bags	Loss of habitat	0.0005 [1]
Total area of habitat loss		0.545

1 – existing mattresses overlay existing pipelines and therefore do not increase the overall area of seabed potentially impacted.

2 – Accommodation vessel stabilisation overlays potential impacts from spud cans and is a worst-case scenario.

Table 15: Estimated area of impact from each well abandonment operation (Source: ConocoPhillips 2017).

Activity at one rig location	Impact	Estimated area impacted (km^2)
Rock placement for rig stabilisation or scour protection	Loss of habitat	0.0004
Anchor and chain	Physical impact	0.003
Spud can footprint	Physical impact	0.0006
Conductor removal x 31	Physical impact	0.0001
	Area of habitat loss	0.0004
	Area of physical impact	0.0037
Activity with 'mini-rig move' at four legged installations, i.e. two rig moves		
Rock placement for rig stabilisation or scour protection	Loss of habitat	0.0008
Anchor and chain	Physical impact	0.006
Spud can footprint	Physical impact	0.0012
Conductor removal x 31 [1]	Physical impact	0.0001
	Area of habitat loss	0.0008
	Area of physical impact	0.0073
Total area of habitat loss from all well abandonment [2]		0.006
Total area of physical impact from all well abandonment [2]		0.058

1 = Based on all 29 wells included in VDP1 and LDP1 and 2 extra conductors at Vulcan UR.

2 = Based on 8 rig movements plus 8 'mini moves'.

9 IN-COMBINATION IMPACTS

9.1 Under the Habitats Regulations there is a requirement for the competent authority to consider the in-combination effects of plans or projects on European Sites when undertaking an HRA. In-combination effects refer to effects, which may or may not interact with each other, but which could affect the same receptor or interest feature (i.e. a habitat or species for which a European site is designated).

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

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

9.3 For the purposes of this assessment, on-going impacts from current activities have not been included within the in-combination assessment where the influence of the projects

upon a receptor, that may also be predicted to be significantly affected by the development, is considered to be captured within the baseline. For some on-going activities, e.g. fishing, shipping and dredging disposal, it is technically not possible to determine what the baseline conditions would be without the influence the impacts from these on-going activities have on the qualifying features of the sites. However, it is recognised that they may be having an effect on the qualifying features of the sites.

Fishing

9.4 Demersal fishing has the potential to cause physical damage to both reef habitats and sandbank features. However, although the sensitivity of the qualifying features is described as moderate, their exposure to the potential impacts are low and overall, the vulnerability of the qualifying features to the impacts from fishing are considered to be low (JNCC 2012).

9.5 Fishing occurs widely across the southern North Sea and has also been on-going for many hundreds of years. The predominant fishing activity within the SAC is beam trawling, mainly by Dutch and UK registered vessels targeting demersal species such Dover sole, plaice and lemon sole (Figure 9) (MMO 2011, ConocoPhillips 2015).

9.6 Based on studies undertaken on the impacts of beam trawling on the seabed, the potential extent of seabed disturbance on average per year within the SAC has been estimated to be 1,312 km^2 per year (36.4% of the SAC), using the latest beam trawling methods (ABPMer and Ichthys Marine 2015). Over a period of five years an estimated 39% of the SAC is physically impacted by beam trawling.

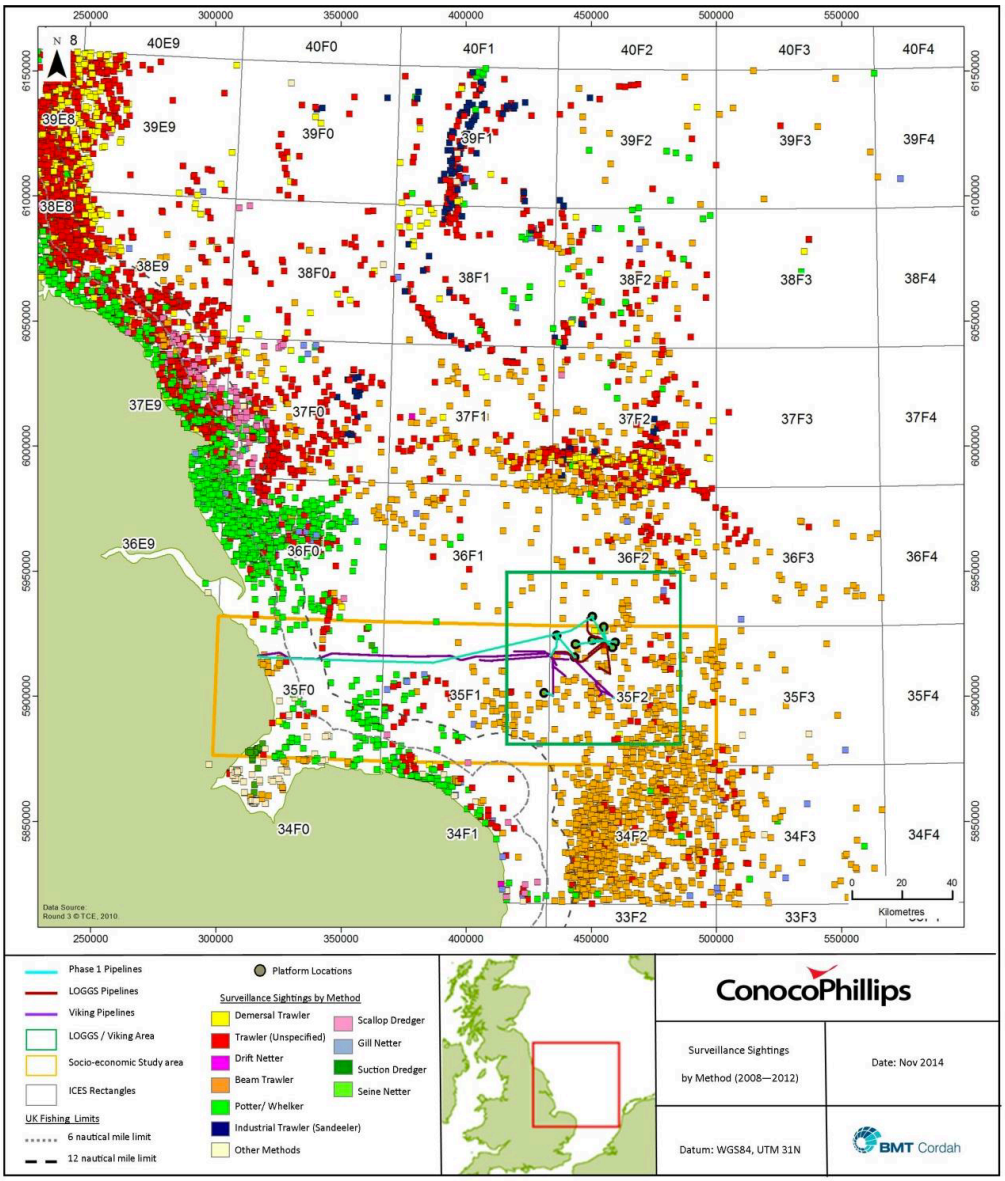

Figure 9: Fishing effort by gear type in southern North Sea (Source ConocoPhillips 2015).

Renewable energy

9.7 No wind farm licensed areas occur within the boundaries of the SAC and no direct or indirect physical impacts on the SAC are predicted to occur from offshore wind turbines. However, the up to six export cables from the proposed Hornsea 3 offshore wind farm are currently planned to cross the SAC from the Hornsea 3 offshore wind farm to the North Norfolk Coast (DONG 2017).

9.8 The total length of the export cable route associated with the proposed Hornsea 3 development is 145 km long and 1.5 km wide. The cables will be predominantly buried to a depth of 1 to 2 m, although up to 10% of the total cable route may require additional

rock dumping to ensure burial. In addition, where cables cross existing infrastructure, e.g. pipelines, rock will be required at each of the crossings. In total, within the SAC, an estimated 4,086,405 m^2 (4.1 km^2) of seabed may be physically disturbed by the trenching and burying of the cables and 1,079,400 m^2 (1.1 km^2) of seabed will be physically impacted by rock placed along the cable route for protection and crossings (DONG 2017).

9.9 In addition to the potential impacts estimated from laying the export cables across the SAC the applicant estimates up to 21.92 km^2 may be impacted by the potential placement of an HVAC booster station within the SAC. However, within the application this is described as the area of search for the booster station and is not the area likely to be impacted in the event that a booster station is placed within the SAC (DONG 2017). BEIS considers that the possibility of impacting 21.92 km^2 of the seabed by the installation of a booster station is extremely unrealistic and the actual area of impact would be substantially smaller than this.

9.10 In total an estimated 0.1% of the seabed within the SAC may be physically disturbed and 0.03% may be physically lost by the laying of export cables across the SAC.

Aggregate extraction and dredging activity

9.11 Aggregate extraction areas 483 and 484 lie within the boundary of the SAC (Figure 10). Applications to undertake extraction at both sites were made in 2014 and consent given for area 484 in March 2015 and varied in June 2017 (currently discharging conditions from 2017 variation approval. Extraction area 483 obtained consent in December 2017 (MMO 2015b, MMO 2017).

9.12 The area of each site within which extraction could be undertaken is 28.24 km^2 for site 483 and 17.2 km^2 for site 484; a combined total area of 45.4 km^2. Assuming the worst-case scenario is that the whole area of the two sites will be impacted, then 1.2% of the SAC could be physically impacted by aggregate extraction.

9.13 Consent was granted for both Areas to each extract up to a maximum of 9 million tonnes of material over the licence term of 15 years (i.e. an average of 600,000 tonnes/area/year) (Fugro Emu 2014).

9.14 Dredged material will be extracted using a trailer suction hopper dredger. Material will be screened and estimated 50 – 55% of the material may be returned back to the seabed due to being unsuitable for market requirements. The dredging of the material will cause a physical impact on the seabed and habitats.

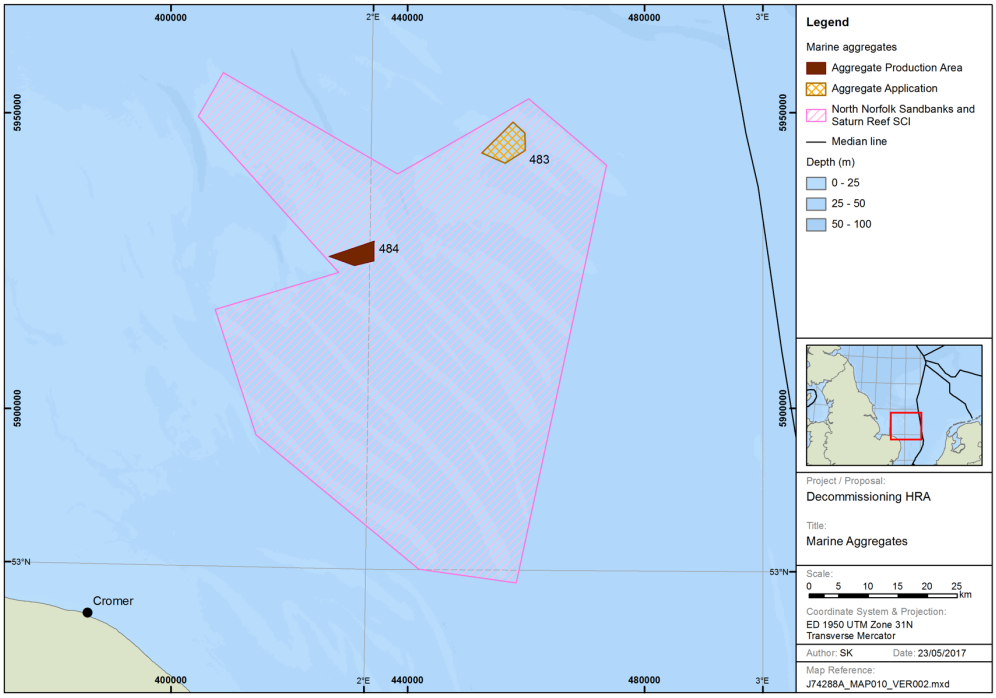

Figure 10: Aggregate extraction sites within the North Norfolk Sandbanks and Saturn Reef SAC.

9.15 An assessment undertaken by the applicant in support of their license application concluded that dredging activities at either site would not cause an adverse effect on the integrity of the SAC. Following an agreement to avoid an area of Sabellaria reef habitat, both the MMO and JNCC agreed with these conclusions for area 484, (Fugro Emu 2014, MMO 2015b).

Oil and gas activity

9.16 Figure 11 presents the existing oil and gas infrastructure in the North Norfolk Sandbanks and Saturn Reef SAC. This area is extensively developed with numerous existing pipelines, wells and platforms. It is not known what other projects may be planned in the future and so it is not possible to include future specific plans within the in-combination assessment. However, any future developments would be required to undertake a Habitats Regulations Appraisal that would take into consideration the potential in-combination impacts, including those arising from the proposed decommissioning activities.

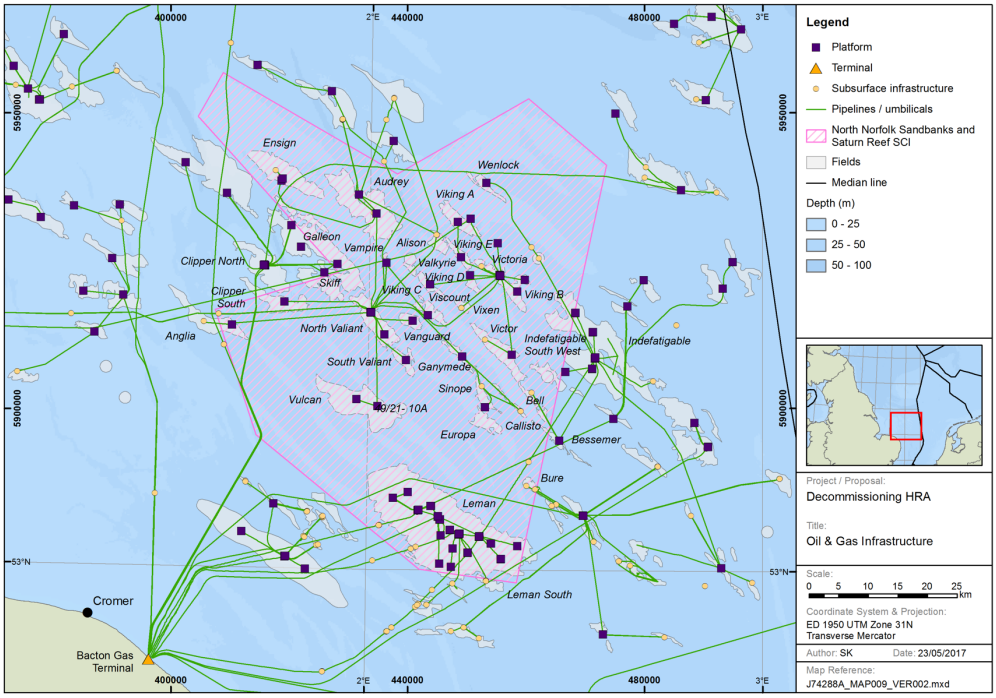

Figure 11: Existing oil and gas infrastructure within the North Norfolk Sandbanks and Saturn reef SAC.

9.17 Within the SAC there are 72 surface installations, including the eight relating to VDP1 and LDP1 and the further 22 associated with future decommissioning programmes to be undertaken by ConocoPhillips (Tables 1, and 2). However, it is noted that three installations, Saturn ND, Tethys TN and Mimas MN, are outwith the SAC but are included as they are relatively close to the boundary of the SAC and impacts during decommissioning could potentially affect the SAC. A further five subsea installations, plus a subsea valve skid will also be decommissioned (Table 3).

9.18 The majority of the installations were installed over ten years ago and there have been no new installations installed within the site since 2013.

9.19 The area of physical impact on the seabed within the SAC from the existing installations is dependent on the size of each installation. Based on the size of the installations present it is estimated that the total area of seabed impacted within the SAC by all existing installations is approximately 63,546 m^2 (0.063 km^2)[7]. This is the total area of seabed covered by each installation. However, this does not include the potential impacts from subsea installations, e.g. manifolds, for which there are limited data.

[7] The area of impact is estimated based on known areas of installations within the SAC. For installations for which the area is unknown an average has been used.

9.20 A total of 706.7 km of gas pipeline is present within the SAC, including the 54.5 km of line associated with the current decommissioning programme. This does not include the 477 km of small diameter methanol, chemical and hydraulic lines that are normally piggy-backed or laid alongside larger lines. For the purposes of this assessment these lines are presumed to be piggy-backed or alongside the existing gas lines and therefore their presence does not increase the overall area of seabed impacted.

9.21 Based on an estimated 10 m corridor of impact along each pipeline, a total area of 7.1 km^2 of seabed within the SAC is estimated to have been impacted by the installation of existing gas pipelines. However, following burial the seabed is known to recover and only pipelines remaining on the seabed surface cause on-going physical impacts. Within the SAC, 94% of all pipelines are trenched and buried and do not affect the surface of the seabed. Therefore, an estimated 0.4 km^2 of seabed may be impacted by pipelines on the surface of the seabed within the SAC. Buried pipelines will not affect the structure, function or integrity of the site.

9.22 It is recognised that buried pipelines can both resurface and re-bury overtime due to sediment movement. Data from pipeline surveys undertaken since 1994 across the Viking field indicate that pipelines buried over sandy sediments remain buried, whereas those buried across gravelly sand are more at risk of becoming exposed (ConocoPhillips 2016). Along five pipelines within the Viking field a total of 31.1 km of gas pipeline have been surveyed for burial depth and free-spans. A total of 13.9 km of the lines were buried at the time of installation. Of the 13.9 km of line trenched and buried at the time of installation a total of 1.0 km (7.5%) is now on the surface of the seabed. Of the pipelines that were laid on the surface of the seabed at the time of installation (the Viking ED and GD pipelines), 63.7% of the pipeline is currently buried. This indicates that overtime a significant proportion of the existing pipelines that were laid on the surface of the seabed may become buried.

9.23 The results of the surveys indicate that the depths at which surface laid pipelines become self-buried varies over the years, with intermittent exposure on the seabed surface occurring in areas of gravelly sand and complete burial across sandbanks where the sediment comprises predominantly of sand.

9.24 Buried pipelines may become exposed where megaripples have moved since the pipelines have been laid. This suggests that buried pipelines do not affect the movement of surface sediments.

9.25 Since 1994, two spans adjacent to existing installations have formed due to scouring and have required formal reporting and remediation.

9.26 A significant majority of existing oil and gas infrastructure has been present prior to the site becoming designated and therefore the impacts on the qualifying features of the site are part of the baseline environment.

9.27 The operator intends to decommission further gas related assets over a ten year period. BEIS requested information regarding the ten year proposals ahead of the submission of decommissioning programmes to assess likely in-combination effects. Based on the information that the operator supplied an assessment of potential future activities relating to ConocoPhillips likely decommissioning programme over the next ten years is possible. It is possible that the forecasted activities may change in the future. However, the in-combination assessment can only be based on forecast activities until plans and projects are submitted.

9.28 In addition to the planned and potential future decommissioning programmes to be undertaken by ConocoPhillips, other gas installations and their associated infrastructure will be decommissioned by other operators and could cause an in-combination impact. The only other decommissioning plan currently being considered, for which details are available, relates to the decommissioning of the Ann and Alison fields by Centrica (Centrica 2017).

9.29 The Ann field lies outwith the SAC and cSAC but the gas export lines cross both sites. The Alison field lies within both the cSAC and SAC and the gas is exported to the LOGGS platform within the SAC. Consequently, there is potential for an in-combination impact from the decommissioning of both platforms.

9.30 The application for the decommissioning of the Ann and Alison fields has not assessed the potential extent of impacts within the North Norfolk Sandbanks and Saturn Reef SAC from the proposed activities. It is therefore not possible to undertake a precise in-combination assessment. However, the application does estimate the overall extent of seabed disturbance and physical loss of habitat from the proposed activities (Table 16 and Table 17).

Table 16: Estimated area of seabed impacted by decommissioning Ann and Alison fields (Source: Centrica 2017).

Activity	Assumptions	Area of seabed disturbed (km^2)
Pipeline ends of PL947, umbilical ends of PL948, *c.*8km of PL1099, all of PL2164 and Pl2165, the spool pieces and the Alison tee.	Total length of pipelines, umbilicals and spool pieces ends to be recovered is approximately 8.93 km. The area of seabed disturbance was assumed to be a corridor width of 10 m, allowing for sediment to be moved from its current location over the partially buried infrastructure to either side.	0.0914
Ann template Alison template	Additional 1 m added on all sides to allow for disturbance beyond exact dimension of each structure. Total area of structures = 0.0004 km^2. Total footprint of disturbance = 0.0007 km^2.	0.0007
Removal of concrete mattresses	To calculate the area of disturbance associated with the removal of the 143 concrete mattresses, an additional impacted area of 1 m was assumed on either side of the mattresses. The mattresses are of varying size.	0.0060
Removal of bitumen mattresses	To calculate the area of disturbance associated with the removal of the 3 bitumen mattresses an additional impacted area of 1m was assumed on either side of the mattresses (4 m x 2.5 m)	0.0001
Removal of concrete blocks (at Alison tee)	Removal of approximately 6 concrete blocks, each is assumed to impact on an area of 2.2 m x 2.2 m. An additional impacted area of 1 m was assumed on either side of the blocks.	0.0001
Removal of grout bags	Recovery of approximately 2,824 grout bags, each is assumed to impact on an area of 0.25 m x 0.45 m.	0.0156
Over-trawl assessment	A conservative assumption has been made for the assessment to cover a 200 m corridor along all pipeline lengths and the two HSE 500 m safety zones.	15.2788
	Total area impacted	15.4

Table 17: Estimated are of seabed physically lost due to the decommissioning of the Ann and Alison fields (Source: Centrica 2017).

Infrastructure	Assumptions	Area of seabed disturbed (km^2)
Existing deposited rock	Based on data in assessment	0.0096
Pipelines decommissioned *in situ*	PL947, PL948 and part of PL1099.	0.0151
Protection / stabilisation features decommissioned *in situ*	16 frond mattresses (5.0m x 5.0m)	0.0004
	Total area impacted	0.0252

9.31 The overall extent of seabed disturbance arising from the planned decommissioning of the Ann and Alison fields is estimated to be 15.4 km^2 and physical loss of habitat is estimated to be 0.0252 km^2 (Centrica 2017).

9.32 The timing of other decommissioning activities within the SAC or cSAC are unknown.

9.33 It is recognised that future plans and projects will be subject to the requirements of the Habitats Regulations once applications have been made.

In-combination potential impacts – Summary

9.34 Based on the above it is recognised that there is potential for in-combination impacts to occur from proposed activities within the SAC that could cause physical impacts and loss of habitat to the qualifying features of the SAC.

9.35 The total area of physical impact and habitat loss each year arising from existing activities within the SAC is estimated to be 1,378.5 km^2, a total of 38.3% of the SAC (Table 18).

Table 18: Estimated area of seabed impacted from in-combination impacts.

Activity	Total area of seabed impacted (km^2)
Aggregate Extraction	45.4
Beam Trawling (per year)	1,312 (each year)
Renewables	5.2
Existing Oil and Gas Infrastructure	0.5
Ann and Alison Decommissioning[1]	15.4
Total area of impact	1,378.5
Proportion of SAC impacted	38.3%

1 - note that this is worst-case as the Ann field lies out with the SAC.

10 LIKELY SIGNIFICANT EFFECTS TEST

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

10.2 This section addresses this first step of the HRA, for which BEIS has considered the potential impacts of decommissioning activities alone and in combination with other plans and projects on each of the interest features of the relevant European sites to determine whether there will be a likely significant effect.

Sandbanks

10.3 Results from the assessment of potential impacts presented in Section 8 indicates that there is a risk of physical impacts or loss of habitat occurring that could cause a likely significant effect on sandbank features arising from:

- Accommodation work vessel stabilisation,
- Drill rig stabilisation and scour protection,
- Drill rig anchors,
- Heavy lift vessel anchors,
- Cutting jacket piles and cut and remove pipeline ends,
- Rock placement at cut pipeline ends and remove pipeline T-pieces,
- Well conductor removal,
- Drill rig spud cans,
- Free-span remediation,
- Over-trawl surveys.

10.4 BEIS considers that the proposed decommissioning, when considered alone and in-combination may have a likely significant effect on the North Norfolk Sandbanks and Saturn Reef SAC because:

a. Physical impacts may occur to sandbank habitats through the use of heavy lift vessel anchors, drill rig spud cans and anchor, cutting of jacket piles and pipelines and the removal of well conductors.

b. Physical loss of habitat may occur due to the placement of rock for accommodation vessel stabilisation, rig stabilisation and scour protection and the protection of the pipeline ends.

c. Physical loss of habitat from existing infrastructure that will remain *in situ*, e.g. pipelines.

Reefs

10.5 BEIS does not consider that there is potential for a likely significant effect on *Sabellaria* reef habitats from the proposed decommissioning activities. This is based on results

from surveys undertaken that have not reported any *Sabellaria* reef habitat within the area predicted to be impacted (ConocoPhillips 2015a). However, future decommissioning activities occurring elsewhere within the SAC, including those relating to activities associated with the future ten years of decommissioning, could affect *Sabellaria* reef habitat if discovered during site specific surveys.

Harbour porpoise

10.6 Results from the assessment of potential impacts presented in Section 8 indicates that there is a risk of physical injury or disturbance that could cause a likely significant effect on harbour porpoise arising from:

- Noise arising from vessel activity,
- Noise arising from cutting jacket piles and pipelines.

10.7 BEIS considers that the proposed decommissioning, when considered alone and in-combination may have a likely significant effect on the Southern North Sea cSAC because:

a) Sound arising from the proposed activities may cause injury or disturbance to harbour porpoise or their prey.
b) There is potential for physical impact on their habitat.

11 APPROPRIATE ASSESSMENT

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

North Norfolk Sandbanks and Saturn Reef SAC

Sandbanks which are slightly covered by seawater all the time: Physical impact

11.2 A physical impact on the sandbanks may arise from the use of anchors and associated wires used by the heavy lift vessel during the removal of the jackets and topsides and in locating the drilling rig to undertake well plug and abandonment. Anchors from the heavy lift vessel will remain in place for an estimated 14 days.

11.3 The total area of seabed estimated to be physically impacted by the anchors and chains from the heavy lift vessel during the removal of all eight installations is 0.012 km^2 (Para. 8.9). Following the removal of the installation, the heavy lift vessel will recover the anchors and chains and then leave the area with no further physical impact to the seabed.

11.4 A physical impact to the sandbank feature may arise during the plugging and abandonment of the wells. An estimated area of 0.003 km^2 of seabed may be physically impacted due to the anchor and chains impacting on the seabed at each rig location and 0.0006 km^2 from the spud cans (Table 15). A total of 16 rig locations (including mini moves) may be required in order to abandon all 29 wells. Therefore, the total area of seabed impacted by the anchors and chains from the drill rig used for well abandonment is 0.0576 km^2 (rounded to 0.058 km^2). In addition to the impacts from the rig location an additional 0.0001 km^2 of seabed will be impacted by the removal of 31 conductors. Consequently, a total of 0.058 km^2 of seabed may be physically impacted by the well abandonment activities associated with VDP1 and LDP1.

11.5 The total area of seabed impacted by the cutting of the jacket piles at all eight locations is estimated to be 0.0082 km^2 (Para 8.11). Following the removal of the jackets a depression in the seabed approximately 3 m deep and 154 m^2 will remain at each pile location.

11.6 The removal of the T-piece will cause temporary physical impact on the seabed. The T-piece is 11 m x 10 m and depressions in the seabed of up to 3 m deep may occur around

the pin locations (Para. 8.12). The total area of impact on the seabed is estimated to be 0.0001 km^2.

11.7 The total area of the temporary placement on the seabed of the T-piece roof during decommissioning will impact an area of 0.0002 km^2 (Para 8.13).

11.8 The total area of seabed estimated to be impacted from over-trawl surveys is 17.2 km^2 (Para. 8.18).

11.9 The total area of physical impact from the proposed decommissioning activities at Viking and LOGGS as part of VDP1 and LDP1 is estimated to be 17.28 km^2 (0.48% of the SAC), of which 17.2 km^2 arises from over-trawl surveys. All other activities impact an area of 0.08 km^2, equivalent to 0.002% of the North Norfolk Sandbanks and Saturn Reef SAC (Table 19).

Table 19: Total area of physical impact on sandbank features from proposed VDP1 and LDP 1 decommissioning activities.

Activity	Total area of seabed impacted (km^2)
Heavy lift vessel anchors and chains at 8 locations (two lifts at each installation)	0.012
Plugging and abandoning 29 wells at 8 locations (including spud cans and chains and anchors)	0.058
Cutting jacket piles	0.0082
T-piece removal	0.0001
Temporary placement of T-piece roof	0.0002
Conductor removal	0.0001
Total area impacted	0.08
Proportion of SAC impacted %	0.002
Over-trawl surveys	17.2
Total area of impact	17.28
Proportion of SAC impacted %	0.48

11.10 Sediment disturbance will occur during decommissioning. Seabed sediments in the Southern North Sea are subject to physical impacts from winter storms and strong tidal currents and are therefore in a dynamic environment where up to 30 cm of the surface sandy sediments occurring in less than 40 m of water are regularly impacted (ICES 2001). This dynamic environment causes continual exposure and reburial of pipelines.

11.11 Localised sediment plumes will occur during decommissioning. Although there is little information on the extent sediment plumes may occur from decommissioning activities, studies undertaken for cable and aggregate industries indicate that sediment plumes remain relatively localised with elevated sediment levels occurring largely within a few

kilometres of the activities (e.g. Hill *et al.* 2011, BERR 2008). Once decommissioning activities have ceased, sediment levels will return to background levels within a few weeks (Hill *et al.* 2011).

11.12 Impacts will persist for varying times depending on the rate of local sediment movement. Measurements suggest this may be as short as only a few days in high energy environments such as the Bristol Channel and North Norfolk Banks, but can be as long as several years for more stable deposits (Cooper *et al*. 2005*,* Hitchcock & Bell 2004, Kenny & Rees 1996). However, in larger areas of disturbance, e.g. areas of aggregate extraction, evidence from monitoring studies indicates that depressions in the seabed do not inhibit the movement of sediments, as they move into, through and out of the depressions and therefore there is no significant interruption to sediment movements (ICES 2016).

11.13 Consequently, it is predicted that sandbanks will progressively recover and any physical impacts will be localised and temporary.

11.14 The over-trawl surveys undertaken following decommissioning will impact the seabed surface causing abrasion and shallow disturbance. The extent of the impact is relatively large compared with other decommissioning activities but very small compared with the extent of seabed impacted on average each year by beam-trawling within the SAC.

11.15 Each year an estimated total of 1,312 km^2 of seabed within the SAC is impacted by beam trawling activities. The total area of seabed estimated to be impacted by the over-trawl surveys is 17.2 km^2 and therefore increase the area impacted by beam trawling for one year by 1.3%. Following the completion of the surveys no additional impacts are predicted to occur.

11.16 Studies have shown that impacts from trawling on sub-tidal sandbanks are not detectable within a few days of being undertaken and are therefore temporary with the habitat and communities recovering (Depestele *et al*. 2015). Therefore, the relatively small temporary increase in the area of seabed impacted by trawling will cause a short-term temporary impact to the seabed.

11.17 Subtidal sandbanks are considered to be highly tolerant to physical disturbance with a high capability of recovery. Consequently, they are not considered to be highly sensitive to physical disturbance.

11.18 Following cessation of activities benthic communities within the sandbank features will rapidly recolonise due to their mobile nature. Studies have shown that meiofaunal communities have partially recovered from sediment disturbance within a few tidal cycles and the ability of subtidal sandbank benthic communities to recover from sediment disturbance is high (Elliot *et al.*1998). However, the time taken for recovery to occur

does vary depending on the level of disturbance, the type of community and seabed (Pidduck *et al*. 2017).

11.19 The area of physical impact on sandbank habitat arising from sediment disturbance will be very localised and occur in an area recognised as already having existing historical seabed disturbance. Any impacts on both the sandbank features or their communities will cease shortly after decommissioning activities have been completed.

11.20 The total area of Annex I sandbank habitat within the SAC is 3,603 km^2 and, excluding over-trawl surveys, the total area impacted by the proposed decommissioning associated with VDP1 and LDP1 is approximately 0.08 km^2. The potential physical impact to the feature is 0.002% of the total habitat within the site. The impact will be temporary with recovery of the sandbank habitat predicted to occur.

11.21 The over-trawl surveys will impact an area of 17.2 km^2, 0.48% of the SAC. The impacts will be localised and temporary with the seabed and its communities recovering following cessation of the activities.

Conclusion

11.22 The potential impacts from the proposed decommissioning associated with VDP1 and LDP1 activities within the North Norfolk Sandbanks and Saturn Reef SAC will cause a localised area of physical impact to the SAC. The area at potential risk of being impacted is relatively small compared to the extent of habitat within the SAC and it is predicted that no more than 0.002% of the site may be temporarily impacted.

11.23 Over-trawl surveys will impact over a wider area impacting 0.48% of the SAC.

11.24 The features at risk of being impacted are widespread and not sensitive to physical disturbance and evidence from existing studies indicate that any physical impact is temporary, with the habitat and benthic communities recovering once decommissioning activities are completed.

11.25 Based on the best available information BEIS is satisfied that physical impacts arising from the planned decommissioning activities will not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC.

Sandbanks which are slightly covered by seawater all the time: Physical loss of habitat

11.26 Sandbanks are highly mobile, so the presence of solid structures in this environment can create an artificial habitat, localised scouring and sediment deposits and consequently a physical loss of habitat. Removal of the sandbank features may result in some localised loss of its ecological communities. The structure and diversity of sandbank communities are determined by environmental characteristics such as sediment particle size distribution, seabed slope and water depth. Any change in these

environmental parameters (e.g. by removing or smothering part of the feature) could result in a loss of habitat and a possible shift in community organisation.

11.27 Physical loss of sandbank habitat will arise from the placement of rock used for stabilising the accommodation vessel, burying the ends of the pipelines and for rig stabilisation or scour protection. It is recognised that there is potential for future remediation of free-spans along exposed pipelines, although, it is not possible to determine the extent that this may occur. However, based on historical levels of rock dump along the existing pipelines it is likely that future deposits will be relatively localised. Any future remediation requiring rock dumping or other deposits will require an assessment to be undertaken under the Habitats Regulations.

11.28 Rock required for the stabilisation of the drill rig and accommodation vessel impacts 0.050 km^2 of seabed (Table 9 and Table 10).

11.29 Placement of rock to protect the cut ends of the pipelines is estimated to impact on an area of 0.0002 km^2 (Para 8.20).

11.30 Placement of rock to ensure rig stabilisation or scour protection is estimated to be 0.008 km^2 at each well abandonment location. It is anticipated that there will be eight well abandonment locations associated with the decommissioning of 29 wells. Consequently, the overall physical loss of habitat from rig stabilisation is estimated to be 0.006 km^2 (Table 15). However, this is recognised to be a worst-case scenario as experience to date, based on the rig locating at 15 locations, has not required any need for rock to be placed on the seabed for rig stabilisation or scour protection (ConocoPhillips 2018).

11.31 There is one reportable free-span along pipelines due to be decommissioned as part of LDP1 and VDP1. Along the Viking BD to Viking HD gas and methanol lines there is a stretch 20.8 m of reportable free-span. Rock placed to ensure safety of other sea users will impact an area of 208 m^2 (0.0002 km^2) of seabed.

11.32 The total area of habitat estimated to be lost due to the proposed placement of rock is 0.056 km^2 (Table 14 and Table 15). This includes the proposed additional use of an accommodation vessel at seven locations, at which rig stabilisation may be required at six of them. It is considered to be a worst-case and unlikely scenario as it includes potential rock placement for stabilising an accommodation vessel at all locations. Although, stabilisation of the accommodation vessel or rig is a critical safety issue and therefore contingency rock placement is often requested for each rig location, previous experience has demonstrated that at the majority of rig locations there is minimal, if any, requirement for rock to be placed for rig stabilisation. If no rock is required for the accommodation vessel then at worst, a total 0.006 km^2 of seabed may be lost due to rig stabilisation requirements at eight well abandonment locations (Table 15).

11.33 The total area of sandbank habitat within the North Norfolk Sandbanks and Saturn Reef SAC is 3,603 km^2. Consequently, approximately, as a worst-case, 0.001% of the qualifying sandbank habitat within the SAC may be impacted due to the proposed rock deposits. However, it is likely to be significantly less than this and less than 0.0001% of the SAC.

11.34 Rock placed onto a sandbank feature will change the habitat from a mobile sand feature to an immobile rock habitat. Overtime some of the rock may potentially bury or be partially buried by sand deposition. The extent that this occurs will depend on the local currents at each location and there is potential for re-exposure.

11.35 The sandbank feature is described as being highly sensitive to physical obstruction and the changes in habitat.

11.36 The physical presence of rock or infrastructure within the SAC may cause an obstruction to the sandbanks and inhibit their natural mobility. The rate at which sandbanks are reported to move varies depending on their location. It has been estimated that at the rate that the Norfolk sandbanks move it could take in excess of 100 years for the sandbanks to move 100 m (Cooper *et al*. 2008). Although, movements of between 11 m and 15 m/year may occur (ABPmer 2005, Cooper *et al*. 2008). At these rates of movement, it is unlikely that any possible effect the physical presence of rock may potentially have on the mobility of the sandbank feature will be able to be detected.

11.37 Studies undertaken at Scroby Sands offshore wind farm, which is located on a shallow sandbank, indicated that although the physical presence of the turbines did cause an affect within 100 m of the turbines due to extensive scouring, there was no effect from the physical presence of the turbines on the sediment transport of the sandbank and therefore the overall morphology of the sandbank was being maintained (CEFAS 2006).

11.38 The movement of sandbanks within the SAC is caused by the re-deposition of sand in a north-easterly direction predominantly as bedload, although also by suspension (Colins *et al.* 1995, Cooper *et al.* 2008*)*. The movement is caused by large scale hydrographic features such as coriolis forces and tidal currents (Collins *et al*. 1995, ABPmer 2005). Additional material deposited from onshore erosion and residual currents around the banks maintain them. An estimated 400,000 m^3 of additional sand per year is deposited from cliff erosion along the Norfolk coast. Overtime this material is transported offshore onto the sandbanks (Cooper *et al.* 2008). North Sea Mean current speeds are predominantly below 0.5 ms^{-1}, but can be over 1 ms^{-1} during tidal flood (Collins *et al*. 1995).

11.39 In order to cause the physical loss of a sandbank that would affect the maintenance of the sandbank feature, an impact would need to affect the transportation of sand; the movement of which is primarily caused by tidal currents and coriolis forces.

11.40 Data from pipeline surveys undertaken since 1994 for the 31 km of VDP1 pipelines indicate that pipelines located on sandy sediments bury or remain buried if trenched and buried at installation over such sediment type. Pipelines which were trenched without burial or were surface laid appear to remain stable when located on gravelly sands (covered by deposits and subject to sand ripple migration) unless they were buried at installation (ConocoPhillips 2016).

11.41 It is recognised that sediment movement occurs across the entire site. This is found as minor sand rippling and mega sand rippling features (ConocoPhillips 2015c).

11.42 The pipeline surveys referred to previously were undertaken at points in time since 1994 and show the migration of sand mega ripples over pipelines, regardless of pipeline orientation. Figure 12 shows the progressive movement of a sand mega ripple, moving right to left, over a buried pipeline over three survey periods undertaken between 2000 and 2012.

11.43 This indicates that pipelines that are situated on the seabed or mostly buried but with some exposure to the seabed (for example only top of pipeline exposed) are subject to constant burial and re-exposure as sand ripples move over the pipelines and across the protected site.

11.44 There is likely to be some variability in this natural process as a result of a range of factors including changes in wind and weather, wave, tides, surges and sediments which are likely to influence sand migration. This appears to be reflected in a natural variability in exposure between survey periods which means figures for percentage of pipelines buried or exposed is subject to change between survey periods. Sand mega ripples continue to migrate across the site and over time regardless of the presence of pipelines. Pipelines do not appear to impede this sand migration and it means that pipelines which are exposed at one point in time can be buried at another point in time in a continuously process of sand movement. This feature also migrates at the surface over buried pipelines, resulting in variability in burial depth profiles, though the pipelines which are substantially buried remain buried.

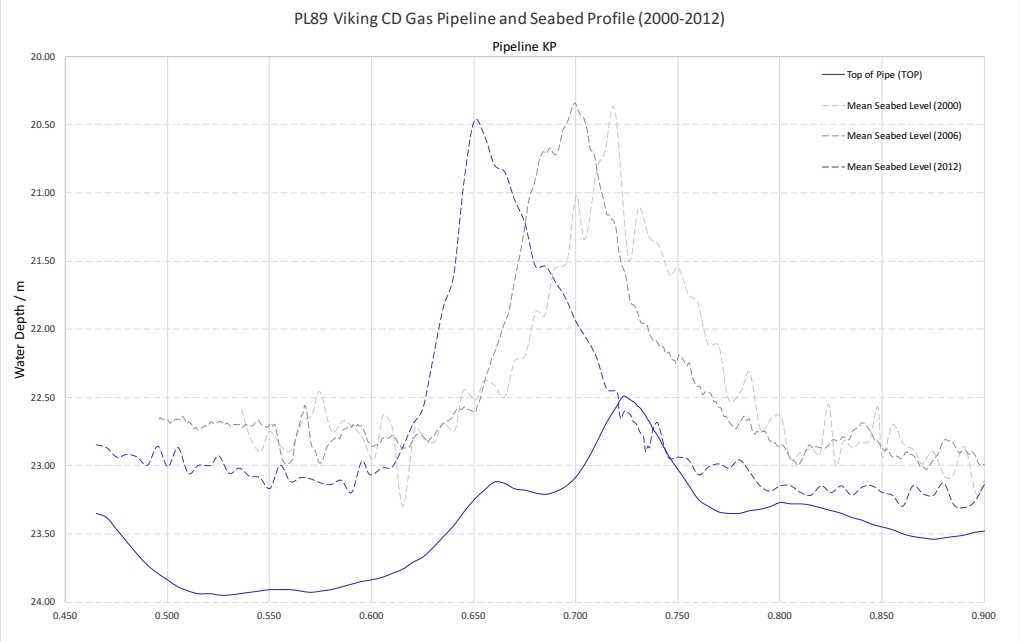

Figure 12: Viking CD gas pipeline burial depths and mean seabed profile between 2000 and 2012.

11.45 Sand migration as a result of mega ripples appears to be impeded at a small scale in the immediate vicinity of gas platforms/ pipeline risers. Scour and accretion is evident at some platform/ pipeline riser base locations. (ConocoPhillips 2015c). However mega ripples appear to quickly reform away from platforms and platform risers, re-establishing the continuity of the feature. As the platforms and pipeline risers are to be removed and pipelines cut in proximity to the platform it is likely that the sand features will progressively re-establish over former platform locations. Mega ripples are smaller scale features compared to sandbanks and the presence of oil and gas assets which were mostly installed in the 1970s appears to have had no impact on the sandbanks over that period and gas platforms have a very minor impact on the migration of sand mega ripples.

11.46 Evidence from offshore wind farms indicate that the physical presence of wind turbines do not affect the sediment transport over a sandbank feature. The relatively very small scale of obstruction caused by oil and gas infrastructure is not predicted to affect the larger scale tidal currents or coriolis forces that maintain the sandbank feature. Therefore, the sandbank features will maintain their morphological equilibrium which is determined by environmental factors whilst it is evident that they are migrating over time.

11.47 There is already a physical loss of habitat from the existing infrastructure, much of which has been in place prior to the site being designated the impacts from which are therefore part of the baseline environment. All five installations relating to the VDP1 were installed in 1974 and the three installations to be decommissioned as part of LDP1 were installed

between 1998 and 2002. Following the removal of all eight installations there will be depressions in the seabed where the piles and conductors have been cut (See Para. 8.10 and 8.11). However, overtime the habitat will recover and will reduce the area of habitat currently lost by the physical presence of the existing installations by approximately 3,295 m^2 (0.003 km^2).

11.48 Leaving pipelines *in situ*, without any further remediation will not increase the area of habitat already impacted prior to the site becoming designated. The total length of pipelines within the VDP1 and LDP1 programmes is 54.5 km. Assuming that there is existing habitat loss within 5 m either side of the pipelines, i.e. a 10 m corridor, then an estimated 0.54 km^2 of habitat is currently physically impacted by the presence of the existing lines. This equates to 0.01% of the qualifying sandbank habitat within the SAC. It is recognised that this potential impact has been present prior to site designation.

11.49 Pipeline route inspections undertaken along four pipelines crossing the Swarte Bank have indicated that the physical presence of pipelines do not cause any discernible effects on the sandbanks features, with surface features, such as mega-ripples, being visually identical along the pipeline corridors as those away from the pipelines. (ConocoPhillips 2015a). Therefore, the physical presence of pipelines below the seabed do not visually appear to impact the features of a sandbank. Surveys undertaken at existing infrastructure within the SAC have reported scour occurring at installations. Scour has been recorded at a number of installations associated with this proposed plan (ConocoPhillips 2015a).

11.50 The proposed removal of installations during decommissioning will, overtime, reduce the extent of scouring caused by the physical presence of platforms and other infrastructure within the SAC. Although, no additional equipment is being placed on the seabed, the rock that may be used for stabilising the accommodation vessel, the well decommissioning drill rig and for burying the pipeline ends may also cause localised scour. The extent of scour is dependent on the local conditions but is reported to be typically ten times the diameter of the obstacle (OSPAR 2006). Studies undertaken at offshore wind farms indicate scour depths vary both across locations and within the same locations, with deeper scouring typically occurring in areas of shallower waters and stronger currents. However, the extent and depth of scour at each location can change overtime depending on the prevailing tidal and wave conditions (HR Wallingford 2008, ABPmer 2010). Studies undertaken at Scroby Sands indicated no significant effects on sandbanks from scour beyond 100 m (CEFAS 2006). It is therefore predicted that impacts from scour will be relatively localised at each location and not affect natural processes beyond a microscale.

Conclusion

11.51 The potential impacts from the proposed decommissioning activities associated with VDP1 and LDP1 within the North Norfolk Sandbanks and Saturn Reef SAC will cause a loss of habitat within the SAC. However, the extent of potential habitat loss is estimated to be relatively small compared to the extent of habitat within the SAC and it is predicted that less than 0.001% of the site may be impacted. Overtime it is predicted that a proportion of the rock placed on the seabed will be buried and not cause an ongoing long-term loss of habitat. The physical presence of structures on sandbanks have been shown to not cause morphological impacts on sandbanks over anything but a localised area (CEFAS 2006). There will be a reduction of 0.003 km^2 in the area impacted by the existing infrastructure when it is removed during decommissioning. Existing pipelines could impact up to 0.01% of the SAC. However, they are not predicted to effect sandbank features, with surface features being uninterrupted by their presence and leaving them *in situ* is not predicted to increase the current extent of possible habitat loss or physical impact to the site. The communities and typical species across the SAC are predicted to remain the same with recovery occurring in areas of disturbance shortly after activities cease.

11.52 Based on the best available information BEIS is satisfied that the planned decommissioning activities relating to VDP1 and LDP1 will not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC.

ConocoPhillips Decommissioning Programme

11.53 ConocoPhillips plan to undertake on-going decommissioning of existing installations and associated infrastructure over the next ten years. The precise details of when decommissioning activities will be undertaken at each of the existing assets are not available and each asset will, prior to decommissioning, be subject to a detailed decommissioning programme that includes an environmental assessment.

11.54 Based on the information available and presented in Tables 1, 2 and 3 there will be an additional 22 surface installations and six subsea installations decommissioned over the ten years. There will also be an additional 43 pipelines, of which 20 are methanol lines that are either piggy-backed or laid alongside export lines. Therefore, a total of 23 separate pipeline 'corridors' totalling 493.8 km in length may be subject to future decommissioning Table 5. Assuming that future decommissioning activities for both the surface and subsea installations are undertaken using the same approach as is currently planned for VDP1 and LDP1, an estimated area of 137.8 km^2 of Annex I sandbank habitat maybe physically impacted by the decommissioning of VDP1, LDP1 and the additional 28 installations. The significant majority of this impact, a total of 137.5 km^2, arises from the over-trawl surveys. A total of 0.29 km^2 of Annex I habitat may be lost, primarily due to potential rock placement (Table 17).

Table 20: Estimated in-combination impact from decommissioning all existing ConocoPhillips oil and gas infrastructure within the SAC.

Activity	Impact	Total area of seabed impacted (km^2)	
		VDP1 and LDP1	Additional 28 installations and associated pipelines
Decommissioning impacts			
Accommodation vessel stabilisation	Loss of habitat	0.050	0.22 [2]
Drill rig stabilisation and scour protection	Loss of habitat	0.006	0.022 [3]
Rock placement at pipeline ends	Loss of habitat	0.0002	0.001 [4]
Rock placement along known free-spans	Loss of habitat	0.0002	0.0009 [5]
Heavy lift vessel anchors	Physical impact	0.012	0.042 [6]
Drill rig anchor and chains	Physical impact	0.048	0.168 [7]
Cutting jacket piles and T-pieces,	Physical impact	0.008	0.029 [8]
Drill rig spud cans	Physical impact	0.010	0.034 [9]
Conductor removal	Physical impact	0.0001	0.0004 [10]
Over-trawl surveys	Physical impact	17.2	120.6 [11]
Total area of habitat loss		0.056	0.24
Total area of physical impact		17.28	120.9
Existing impacts			
Leave *in situ* existing pipelines	Loss of habitat	0.545	4.94
Leave *in situ* existing mattresses and grout bags	Loss of habitat	0.0005 [1]	unknown
Total area of habitat loss		0.545	4.94

1 – existing mattresses overlay existing pipelines and therefore do not increase the area of seabed potentially impacted.

2 – Assumes worst-case rock placement of 0.00788 m^2 at each of the 28 installations (Table 9).

3 – Assumes two rig movements for well abandonment at all 28 installations with rock placement impacting on 0.0008 km^2 of seabed at each location (Table 15). However, some installations have less than four legs and others have six or eight legs and so the number of rig moves at each location will vary.

4 – Assumes 43 gas pipeline ends are cut and both ends are covered by rock each end impacting an area of 18 m^2 (Para 8.20).

5 – Based on a total length of an additional 392 m^2 along Viking pipelines and 538 m^2 along LOGGS area pipelines. (ConocoPhillips 2017a).

6 – Assumes two lifts with anchors and chains impacting 1,504 m^2 at each of the 28 installations (Para 8.9).

7 – Assumes two rig movements for well abandonment at all 28 installations with anchors and chains impacting 0.006 km^2 at each location (Table 15).

8 - Based on a total of 190 piles from all ConocoPhillips installations (ConocoPhillips 2017a), with each pile impacting 154 m^2 (Para 8.11).

9 – Assumes an impact of 0.0006 km^2 from spud cans at each well abandonment location and two rig moves (Para. 8.31)

10 - Assumes one conductor at each of the 138 wells impacting 3.14 m^2 (Para 8.14).

11 – Assumes impacts over 500 m radius around each of the 28 installation and 200 m wide impact along entire 493.8 km pipeline corridor.

11.55 Existing ConocoPhillips' pipelines may impact on a total area of 5.48 km^2 within the SAC. However, the majority of the pipelines are buried. Of the 548 km of pipeline that may be decommissioned as part of the ten year decommissioning programme, a total of 17.5 km has rock or grout bags placed along it. Assuming that rock dump along the pipeline impacts 5 m either side of the pipeline, a total area of 0.175 km^2 of the SAC may be affected by existing rock placed along pipelines. A total of 0.004% of the sandbank habitat within the SAC may be impacted due to existing rock deposits along pipelines.

11.56 As previously discussed, there is potential for temporary physical impacts on the Annex I sandbank habitats within the SAC. Over a period of ten years an estimated 0.35 km^2 of seabed may be physically impacted by decommissioning activities (Table 17). The impacts on the physical features of the habitat and the associated biological communities will be temporary, with recovery predicted to occur shortly after activities have ceased.

11.57 There is potential for a larger physical impact on the seabed from future over-trawl surveys undertaken following removal of infrastructure and along existing pipelines. The potential area of seabed that could be affected is estimated to be 137.8 km^2. This is an average of 13.8 km^2 of trawling activity per year and equivalent to 1% of the annual trawling activity already occurring within the SAC (see Para. 9.6). The impacts from over-trawl surveys will be relatively localised compared with existing activities within the SAC and temporary as both the seabed features and the biological communities will recover following the surveys.

11.58 There is potential loss of habitat due to the placement of rock required for the accommodation vessel, rig stabilisation, protection of pipeline ends and protection of free-spans. The total area predicted to be impacted by rock from all decommissioning activities by ConocoPhillips over the next ten years is 0.3 km^2.

11.59 Based on the average area of seabed impacted by installations, the removal of existing ConocoPhillips' infrastructure will reduce the area of seabed currently physically impacted by an estimated 0.026 km^2. It is estimated that as a worst-case an additional 0.27 km^2 of seabed may be impacted by rock placement. If an accommodation vessel is not used the area of additional impact on the seabed from rock placement over the next ten years is estimated to be 0.004 km^2. This is a very minor possible increase in the area impacted.

11.60 The maintenance of sandbank features and consequently their communities is controlled by tidal currents and coriolis effects. These are large scale natural forces that will not be affected by very small physical changes caused by rock placed on the seabed. The hard substrate will provide habitats for benthic communities associated with hard

substrates. These will remain at the localised areas of rock and not affect the wider sandbank communities.

11.61 There is a theoretical loss of habitat from the existence of pipelines within the SAC. However, the majority of pipelines are buried within the site and will not cause a physical effect on the sandbank features. Further assessment at the time of decommissioning will confirm the status of the lines and whether remedial action to protect the lines and other sea users is required.

11.62 There is no information on the potential for Annex I *Sabellaria* reef habitat to occur within the area of future decommissioning activities and therefore no assessment on the potential impacts on this qualifying feature is possible.

Conclusion

11.63 The potential impacts from the proposed decommissioning activities associated with ConocoPhillips decommissioning activities within the North Norfolk Sandbanks and Saturn Reef SAC over the next ten years will cause a loss of habitat within the SAC. However, the extent of potential habitat loss is estimated to be relatively small compared to the extent of habitat within the SAC and it is predicted that less than 0.008% of the site may be impacted. However, it is likely that the actual increase in habitat loss will be less than this and, taking into account the reduction of impacts caused by the removal of the infrastructure, it is estimated to be 0.004 km^2. This is 0.0001% of the SAC. This is an extremely small area of possible habitat loss and will not cause an adverse effect on the sandbank features nor its biological communities.

11.64 Seabed features and communities disturbed by the decommissioning activities will recover over time and the impacts will be temporary.

11.65 Existing pipelines are not predicted to effect sandbank features, with surface features being uninterrupted by their presence and leaving them *in situ* is not predicted to increase the current extent of possible habitat loss or physical impact to the site.

11.66 Based on the best available information BEIS is satisfied that the planned decommissioning activities relating to ConocoPhillips' decommissioning activities over the next ten years within the SAC will not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC.

In-combination impacts

11.67 BEIS recognises that there is extensive existing oil and gas related infrastructure within the SAC, the majority of which has been present prior to the site being designated as a SAC. Impacts on the qualifying features of the site from the existing infrastructure have been present within the site prior to the site being designated and are considered part of the baseline environment.

11.68 Decommissioning of existing oil and gas infrastructure will occur in the future. Each decommissioning programme will require the submission of a decommissioning programme and will be subject to both an environmental assessment and an assessment under the Habitat regulations.

11.69 This assessment of potential scale of impacts arising from decommissioning is based on broad assumptions and further assessment will be required at the time of each decommissioning project. Presuming that future decommissioning will be undertaken using similar methods as those to be used for VDP1 and LDP1, then similar scales of impact for each activity are predicted to occur. The estimated in-combination impacts arising from the potential decommissioning of the additional 64 installations within the SAC and 652.2 km of pipeline are presented in Table 21.

11.70 No *Sabellaria* reef habitat has been found within the proposed VDP1 and LDP1 area of activities and therefore no in-combination impact will arise.

11.71 The lack of site specific information and the ephemeral nature of *Sabellaria spinulosa* makes it not possible to assess the extent of future impacts on this qualifying feature. However, site surveys undertaken at the time of decommissioning will, if present, identify areas of *Sabellaria* reef that could be impacted by specific decommissioning projects and these will be subject to assessment under the Habitats regulations at the time decommissioning programmes are submitted.

11.72 There will be a physical impact on the sandbank features and their communities from decommissioning activities. It is estimated that the total area physically impacted, excluding over-trawl surveys, will be 0.94 km^2 (Table 21). Evidence from existing studies indicate that any physical impacts will be temporary with both the sandbank features and associated communities recovering within a relatively short period of time.

11.73 Over-trawl surveys may impact a total area of 197.24 km^2. These will be undertaken over an extended period of time and compared with the 1.312 km^2 of beam trawling occurring within the SAC each year it is predicted that the over-trawl surveys will increase the overall impact within the SAC by no more than 1% per year. Following any survey, the impacts will cease and the seabed and the biological communities will recover. The impacts from the over-trawl surveys are therefore temporary.

Table 21: Estimated in-combination impact from decommissioning all existing oil and gas infrastructure within the SAC.

Activity	Impact	Total area of seabed impacted (km^2)	
		VDP1 and LDP1	All other 64 installations
Decommissioning impacts			
Accommodation vessel stabilisation	Loss of habitat	0.050	0.50 [2]
Drill rig stabilisation and scour protection	Loss of habitat	0.006	0.050 [3]
Rock placement at pipeline ends	Loss of habitat	0.0002	0.001 [4]
Rock placement along known free-spans	Loss of habitat	0.0002	Unknown [5]
Heavy lift vessel anchors	Physical impact	0.012	0.096 [6]
Drill rig anchor and chains	Physical impact	0.048	0.384 [7]
Cutting jacket piles and T-pieces	Physical impact	0.008	0.059 [8]
Drill rig spud cans	Physical impact	0.010	0.038 [9]
Conductor removal	Physical impact	0.0001	unknown [10]
Over-trawl	Physical impact	16.9	180.34 [11]
Total area of habitat loss		0.056	0.55
Total area of physical impact		17.28	180.9
Existing impacts			
Leave *in situ* existing pipelines	Loss of habitat	0.545	6.52
Leave *in situ* existing mattresses and grout bags	Loss of habitat	0.0005 [1]	unknown
Total area of habitat loss		0.545	>6.52

1 – Existing mattresses overlay existing pipelines and therefore do not increase the area of seabed potentially impacted.

2 – Assumes worst-case rock placement of 0.00788 m^2 at each of the 64 installations (Table 9).

3 – Assumes two rig movements for well abandonment at all 64 installations with rock placement impacting on 0.0008 km^2 of seabed at each location (Table 15). However, some installations have less than four legs and others have six or eight legs. The number of rig moves at each location will vary.

4 – Assumes 64 gas pipeline ends are cut and both ends are covered by rock each end impacting an area of 18 m^2 (See Para 8.20).

5 – The requirement of future rock dump along existing pipelines is unknown.

6 – Assumes two lifts with anchors and chains impacting 1,504 m^2 at each of the 64 installations (See Para 8.9).

7 – Assume two rig movements for well abandonment at all 64 installations with anchors and chains impacting 0.003 km^2 at each location (Table 15).

8 - Assumes an average of 6 piles at each installation (Table 11), with each pile impacts 154 m^2 of seabed (Para 8.11).

9 – Assumes an impact of 0.0006 km^2 from spud cans at each of the potential well abandonment location and two rig moves (Para. 8.31).

10 – It is currently unknown how many wells are within the SAC and may be subject to future decommissioning activities.

11 – Based on 500 m radius impact around 64 installations and 200 m wide impact along 652,2 km of pipeline.

11.74 There is potential for a physical loss of habitat of up to 0.61 km^2 due to rock placement. The significant majority of this relates to impacts from accommodation vessels. In the event that they are not used then the estimated area of impact from rock-placement arising from rig stabilisation and rock placement at cut pipeline ends will be 0.057 km^2.

11.75 Based on an average area of impact from existing installations, the removal of installations, including those part of VDP1 and LDP1, will reduce the area of seabed currently impacted by their physical presence by 0.063 km^2.

11.76 In the likely scenario of no rock being required for stabilising accommodation vessels, following decommissioning, the overall area of seabed physically lost will be reduced by approximately 0.006 km^2.

11.77 The physical loss of habitat will be localised and are not predicted to affect the tidal currents or Coriolis effects that maintain the structure of the sandbanks. There will be localised changes in the biological communities in areas where the substrate has changed but these will not affect the overall community structure within the SAC.

11.78 The physical loss of habitat due to decommissioning across the SAC will not affect the integrity of the site.

11.79 The existing pipelines will, if left *in situ* impact an in-combination area of 7.1 km^2. However, it is thought that existing buried pipelines do not cause an impact on the qualifying features of the site.

11.80 The leaving *in situ* of existing lines is not considered to impact on the integrity of the site as they are predicted to remain largely buried by sandbanks or mobile sediments and will require minimal additional remediation. The extent of existing rock dump along all the pipelines within the SAC is currently unknown. Site specific surveys at the time of decommissioning pipelines will determine the extent of any existing or additional rock dump that may be required to ensure the pipelines remain safe for other sea users. In the event that remediation is required in the future, then this will be subject to further assessment.

11.81 The physical presence of buried pipelines will not affect the structure and function of the Annex I sandbank habitat and not impact on the integrity of the site.

11.82 There is potential for an in-combination impact with current aggregate extraction in areas 483 and 484 (Figure 10). Assuming that aggregate extraction occurs across the whole of each site, a total of 45.4 km^2 of the SAC will be physically impacted and habitat lost. Subject to conditions the extraction of aggregates at 483 and 484 will not cause an adverse effect on the integrity of the site (MMO 2015b).

11.83 The additional, potential in-combination impact of 0.056 km^2 of habitat loss by the proposed VDP1 and LDP1 decommissioning programmes, or combined habitat loss of

0.61 km^2 from all decommissioning activities contributes a small proportion of the overall in-combination impact within the SAC and is not predicted to significantly increase the risk of an adverse effect occurring.

11.84 There is potential for an in-combination impact with the proposed export cable for the Hornsea 3 offshore wind farm. It is estimated that a total area of 4.1 km^2 of sandbank habitat within the SAC will be physically impacted by activities associated with the trenching and burying of the cables. An additional 1.1 km^2 of sandbank features will be physically lost due to the placement of cable protection along the surface of the seabed. This excludes the reported possible loss of 21.92 km^2 of seabed associated with the installation of the HVAC booster station (DONG 2017); this appears to be an unrealistic over-estimate as it relates to the search area, as opposed to any form of physical impact.

11.85 Other activities being undertaken within the SAC that could cause an in-combination impact include fishing. Fishing intensity within the SAC is estimated to impact on 1,312 km^2 of seabed each year. This annual impact on the seabed is significantly greater than that predicted to be caused by all the oil and gas decommissioning over-trawl surveys that may be undertaken within the SAC. The predicted level of over-trawl surveys is likely to be within the annual range of current fishing activity within the SAC and are not predicted to contribute to an in-combination impact that would cause a likely significant or adverse effect.

11.86 Demersal fishing is recognised to have potential to cause physical damage to *Sabellaria* reef habitats (JNCC 2012). It is therefore possible for an in-combination impact on *Sabellaria* reef habitats to occur.

11.87 The overall area of seabed estimated to be physically disturbed and lost within the SAC from existing or planned activities is 1,514 km^2, of which the estimated area of seabed disturbance of 17.28 km^2 by proposed decommissioning of VDP1 and LDP1 contributes 1.1% of the total area of seabed disturbed (Table 22).

11.88 The overall area of seabed estimated to be physically lost within the SAC from existing or planned activities is 54.2 km^2, of which the proposed decommissioning of VDP1 and LDP1 contributes 0.61 km^2; 1.1% of the total (Table 22).

Table 22: Total estimated in-combination impacts within North Norfolk Sandbanks and Saturn Reef SAC.

Activity	Total area of physical impact (km^2)	Total area of seabed physically lost (km^2)
Aggregate Extraction	-	45.4
Beam Trawling (per year)	1,312 (each year)	-
Renewables	4.1	1.1
Existing oil and gas pipelines	-	6.52
Future decommissioning	180.9	0.55
Total	1,497	53.57
% of SAC	41.5	1.5
VDP1 and LDP1 decommissioning	17.28	0.056
Leave *in situ* VDP1 and LDP1 pipelines	-	0.545
Total	17.28	0.60
% of SAC	0.5	0.02
Overall total	1,514	54.2
% of SAC	42.0	1.5

11.89 It is not possible to determine whether the in-combination physical impact on the seabed, equivalent to 42% of the SAC, will cause an adverse effect on the structure, function and integrity of the site. However, the disturbance to the seabed is temporary and it is predicted that the seabed will recover following cessation of the activities that cause the physical impacts to the seabed. The proportion of the in-combination impact that is attributable to the proposed decommissioning activities is relatively very small and once decommissioning is completed no further on-going impacts are likely to occur. Consequently, there will not be an on-going in-combination adverse effect from physical impacts arising from the proposed VDP1 and LDP1 decommissioning.

11.90 It is not possible to determine whether the in-combination loss of 1.5% of the SAC will cause an adverse effect on the qualifying sandbank features of the SAC. The proposed VDP1 and LDP1 activities may cause the loss of 0.02% of the SAC. However, this is largely due to the leaving *in situ* of the existing pipelines, which are predominantly buried and therefore do not cause a physical loss of habitat. The loss of habitat is predicted to be permanent but is a very small proportion of the total Annex 1 habitat within the site. Furthermore, the physical presence will not cause significant changes to the hydrodynamic regime that maintains the sandbank features as these are influenced by large scale coriolis forces and tidal currents (Collins *et al*. 1995, ABPmer 2005) and these will not be significantly affected by the relatively small scale physical presence of

oil and gas infrastructure and associated deposits, much of which is buried below the seabed.

11.91 No *Sabellaria* reef habitat have been located during surveys for the VDP1 and LDP1 decommissioning programmes. Consequently, no in-combination impact on *Sabellaria* reef habitats will arise with current or future activities. It is not known whether *Sabellaria* reef habitat will be found during future decommissioning programmes. These will be subject to their own assessments at the time decommissioning programmes are submitted.

Conclusion

11.92 The potential impacts from the proposed decommissioning activities within the North Norfolk Sandbanks and Saturn Reef SAC in-combination with other plans or projects, including existing infrastructure, will cause physical impacts and a loss of habitat within the SAC. However, the extent of potential habitat loss and physical impact is estimated to be relatively small compared to the extent of habitat within the SAC and the level of impact caused by other activities currently being undertaken within the SAC.

11.93 Physical impacts to the sandbank features and their communities will be temporary. Permanent impacts caused by rock placement will be localised and not affect the hydrography such that it will affect the maintenance of the sandbank features.

11.94 Based on the best available information BEIS is satisfied that the planned decommissioning activities will not have an adverse effect upon the integrity of the North Norfolk Sandbanks and Saturn Reef SAC in-combination with other plans or projects.

Southern North Sea cSAC

Harbour porpoise

11.95 The primary source of noise predicted to impact on harbour porpoise arises from vessels associated with the proposed decommissioning activities.

11.96 There are no published studies indicating that there is potential for either permanent threshold shift (PTS) or temporary threshold shift (TTS) from vessel noise in harbour porpoise. The level of sound arising from vessels is relatively low (<190 dB re 1 µPa @ 1 m) and is a continuous sound source (i.e. non-pulsed) and the risk of PTS or TTS occurring is considered to be very low. The main frequencies produced by vessels are below the main hearing frequencies for harbour porpoise. However, vessel noise is audible to harbour porpoise and has the potential to cause behavioural impacts, with localised displacement, a reduction in vocalisation and masking effects (Nowacek *et al.* 2007, Pirotta *et al.* 2015).

11.97 If, based on the current estimates, there is an avoidance or a behavioural response out to 0.4 km from a vessel, then an area of 0.5 km^2 may be impacted around each vessel. Should this occur, the area of habitat temporarily unavailable to harbour porpoise, or within which they will be disturbed, will be 0.004% of the cSAC. In the event that eight vessels are operating simultaneously, the worst-case scenario is that an area of 4 km^2 may be affected, equivalent to 0.03% of the cSAC.

11.98 Recorded densities of harbour porpoise across the SCI vary from between 0.19 ind./km2 at East Anglia One offshore wind farm and 2.87 ind./km2 at Hornsea Zone 3 (EAOWL 2012, SMart Wind 2017). Peak densities of harbour porpoise within the cSAC are 3 ind./km^2 (Heinänen & Skov 2015). Therefore, based on the peak densities modelled, up to 76 harbour porpoise may be disturbed or displaced from the areas used by vessels during decommissioning. This is 0.03% of the North Sea Management Unit harbour porpoise population.

11.99 Although there is potential for relatively localised behavioural response arising from vessel noise which could cause an increase in energetic costs to individual harbour porpoise, the duration of any behavioural effects arising from decommissioning vessels are predicted to be relatively short (Dyndo *et al.* 2015). Studies undertaken on bottlenose dolphins indicate that although there is a reduction in vocalisation due to the presence of vessels, the dolphins remain in the area and resume activities as the vessels move away (Pirotta *et al.* 2015). Similar behaviour is predicted to occur with harbour porpoise within the cSAC and any behavioural impact caused by vessel activities will be localised and temporary.

11.100 Fish are not known to be particularly sensitive to vessel noise and although there is potential for a very localised area of displacement away from vessel within the cSAC, the extent of any impact is predicted to be very localised and will not affect the ability of harbour porpoise to feed within the designated site.

11.101 In the event that fish do relocate away from the decommissioning activities, they will return once the sound has stopped. Harbour porpoise will be able to find prey elsewhere within the cSAC during the relatively short period of time that the activities are occurring within any one area. They will return once activities stop.

11.102 There is potential for a localised, temporary effect on the supporting habitats and their prey from the removal of installations and associated infrastructure. The physically impacted seabed is predicted to recover over a period of time depending on the local environment. Any disturbance to the seabed habitat that could affect either harbour porpoise or their prey within the cSAC will be temporary. Within the cSAC harbour porpoise occur widely and therefore any individuals displaced by the relatively localised

short-term impacts from decommissioning activities will be able to relocate to suitable habitats elsewhere within the cSAC.

Conclusion

11.103 The potential impacts from the proposed decommissioning activities within the Southern North Sea cSAC may cause localised temporary disturbance to harbour porpoise. The extent of potential area of disturbance is estimated to be relatively small compared to the overall area of the cSAC and it is predicted that less than 0.03% of the site may be temporarily affected. The number of individuals estimated to be impacted is 0.03% of the North Sea Management Unit population. Any impacts will be temporary and localised.

11.104 The disturbance to habitats and their prey species will be equally localised and temporary and impacted porpoises will locate to other suitable sites areas within the cSAC.

11.105 Based on the best available information BEIS is satisfied that the planned decommissioning activities will not have an adverse effect upon the integrity of the Southern North Sea cSAC.

In-combination impacts

11.106 Shipping has been on-going in the southern North Sea for many hundreds of years and the area is important for shipping, with relatively high numbers of vessels occurring within it. Based on vessel track lines, in 2013 a total of 93,291 vessels were recorded transiting across the cSAC; an average of 256 vessels per day (MMO 2016).

11.107 The oil and gas industry has used, and will continue to use, vessels in support of the vast majority of offshore activity, from initial exploration through to final decommissioning. Vessels are extensively used during construction and maintenance, with supply vessels supporting operating platforms and safety vessels permanently present in development areas. A total of 19,976 vessels associated with oil and gas industry were recorded crossing the cSAC in 2013 (MMO 2016); an average of 55 vessels per day. Oil and gas related vessel traffic accounts for 21.4% of all vessel traffic within the site.

11.108 Vessel movements are the largest contributor to anthropogenic ocean noise and in deeper water are the dominant noise source in the lower frequencies, between 50-300 Hz (Ulrick 1967). Measurements undertaken in the Southern North Sea indicate that shipping noise is the dominant anthropogenic noise in the region predominantly in the frequency range of between 40 and 200 Hz (de Haan *et al.* 2007). In general, vessels that use dynamic positioning thrusters tend to generate higher levels of underwater sound. The individual noise output produced by a vessel is dependent upon a number of factors including the speed of the vessel, age, load, maintenance and oceanographic conditions.

11.109 The additional use of up to eight vessels during decommissioning contributes a very small proportion of the total vessel activity within the cSAC. The extensive vessel activity, including that associated with the oil and gas industry, within and adjacent to the cSAC over many years has not had a measurable negative effect on the current conservation status of harbour porpoise within the site.

Conclusion

11.110 Levels of oil and gas vessel activity within the cSAC associated with decommissioning activities are not predicted to be significantly greater than current levels of shipping within the cSAC and therefore levels of potential disturbance are also not predicted to significantly increase. As decommissioning progresses in future years, the number of vessels associated with the oil and gas industry will reduce. It is therefore concluded that the in-combination impacts from vessel noise will not have an adverse effect upon the integrity of the Southern North Sea cSAC.

12 APPROPRIATE ASSESSMENT - CONCLUSIONS

12.1 BEIS has undertaken a Habitats Regulations Assessment in respect of the Conservation Objectives of relevant European sites to determine whether the proposed Phase 1 Decommissioning programme for LDP1 and VDP1 either alone or in combination with other plans and projects will have an adverse effect upon the integrity of the relevant sites. In this case the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea cSAC.

12.2 Based on the potential work programme and predicted scale of impacts, along with evidence from existing studies of the likely potential effects on the qualifying features, it is concluded that the planned activities will not cause a likely significant effect on any qualifying features connected with the designated site either alone or in-combination with other plans or projects. It will therefore not have an adverse effect on the integrity of any relevant designated site.

12.3 Having concluded that there will be no likely significant effect and no adverse effect on the integrity of any site no further assessment is required.

12.4 BEIS has undertaken an assessment of the likely impacts arising from future decommissioning activities as part of ten year forecast future decommissioning proposals in the protected site. Based on the predicted activities and the potential effects it is concluded that future proposed activities will not cause an adverse effect on sandbank habitats within the North Norfolk Sandbanks and Saturn Reef SAC. However, due to the lack of site specific survey data outwith the LDP1 and VDP1 planned decommissioning locations, BEIS is unable to conclude that future decommissioning activities either alone or in-combination will not have an adverse effect on *Sabellaria* reef habitats. Future site specific surveys will help inform future assessments.

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