Ithaca Energy (UK) Limited

Anglia Decommissioning Environmental Appraisal

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Prepared for Ithaca Energy (UK) Limited
by
Hartley Anderson Limited

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GLOSSARY AND ABBREVIATIONS

Term	Explanation
BEIS	Department for Business, Energy and Industrial Strategy, formerly the Department of Energy and Climate Change (DECC)
Biota	The collective term for fauna and flora at a particular location
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Concrete mattress	A series of concrete blocks usually connected together by polypropylene ropes which resembles a rectangular mattress. These are used for the weighting and/or protection of seabed structures including pipelines
CoP	Cessation of Production: the stage at which, after all economic development opportunities have been pursued, an agreement is sought from BEIS that hydrocarbon production may cease at a particular field. The economic criterion for deciding CoP is typically the point at which the value of the hydrocarbons produced no longer covers the true costs of production.
CSV	Construction support vessel
DECC	Department of Energy and Climate Change, now the Department for Business, Energy and Industrial Strategy (BEIS)
DP	Dynamic Positioning: the use of thrusters and real time positional information to maintain the location of a vessel
DTI	Department of Trade and Industry (relevant regulatory functions now within BEIS)
EA	Environmental Appraisal
EIA	Environmental Impact Assessment
ENVID	Environmental Issues Identification
GHG	Greenhouse gas
GWP	Global Warming Potential: an emissions metric used to indicate the contribution of a certain greenhouse gas to radiative forcing, accounting for the atmospheric lifetime of a given gas relative to carbon dioxide (the principal greenhouse gas)
HLV	heavy lift vessel
HS&E	Health Safety and Environment
HSEQ	Health, Safety, Environment and Quality
Jacket	The structure comprising the “legs” of the installation
Jack-up rig	A mobile floating drilling rig typically with three long triangular truss legs which can be lowered to the seabed to provide stability once on location
JNCC	Joint Nature Conservation Committee
km	kilometre: 1,000m, equivalent to 0.54 nautical miles
LWIV	Light well intervention vessel
LOGGS	Lincolnshire Offshore Gas Gathering System
MCZ	Marine Conservation Zone
MoD	Ministry of Defence

Term	Explanation
NNSSR SAC	North Norfolk Sandbanks and Saturn Reef Special Area of Conservation
NUI	Normally Unattended Installation: an installation with minimal facilities which is not permanently crewed and is controlled from a remote location (e.g. other platform or shore)
OPEP	Oil Pollution Emergency Plan
OWF	Offshore Wind Farm
ROV	Remotely Operated Vehicle: a small, unmanned submersible used for inspection and the carrying out of some activities such as valve manipulation
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation: established under the Habitats Directive. Sites that have been adopted by the European Commission and formally designated by the government of each country in whose territory the site lies.
SNS SAC	Southern North Sea Special Area of Conservation
SOPEP	Shipboard Oil Pollution Emergency Plan
SPA	Special Protection Area: established under the Birds Directive
Spider deck	The lowest level on a platform
Topsides	The collective name for the many drilling, processing, accommodation and other modules which when connected together make up the upper section of the platform which rests on the installation jacket
UKCS	United Kingdom Continental Shelf
WBM	Water Based Mud
WDC	Whale and Dolphin Conservation

EXECUTIVE SUMMARY

Introduction and scope of facilities to be decommissioned

Ithaca Energy (UK) Ltd (Ithaca) is planning to decommission the Anglia Field facilities in the southern North Sea. The installations are located in UK Blocks 48/18b and the export line traverses Blocks 48/19 and 48/20. The Anglia A platform is approximately 55km from the UK mainland (Cromer) and 95km from the UK-Netherlands Median Line.

Under the *Petroleum Act 1998* and amendments to the Act through the *Energy Act 2008* (as amended), operators proposing to decommission an offshore installation or submarine pipeline must submit Decommissioning Programmes (DP). Regulator guidance (BEIS 2018a) indicates that a DP must be supported by an Environmental Appraisal (EA). The OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations sets out OSPAR Contracting Parties obligations on the decommissioning of offshore installations. This prohibits the leaving of these in place although under certain circumstances a derogation from OSPAR 98/3 may be applied for, to allow installations to remain *in situ*. There is no derogation option available for the Anglia facilities, with all installations (including subsea installations) having to be recovered from the seabed and either reused, recycled or disposed of in landfill.

Ithaca have prepared and submitted DPs for those Anglia facilities required to be wholly recovered under OSPAR 98/3 (points 1-2 below), and the wells and other associated infrastructure. The decommissioning options for the facilities have been identified through various assessment methods, including Comparative Assessment:

1. The Anglia A normally unattended installation (NUI) (Anglia A NUI) (topsides, jacket and securing piles)
2. The Anglia West (B) manifold (gravity based) and integrated protective structure (piled)
3. Eleven wells (6 x production wells (Anglia A), 2 x subsea production wells (Anglia West (B)) and 3 subsea appraisal wells)
4. The Anglia pipeline system; Anglia A to Anglia West (B) infield concrete coated pipeline and control umbilical (~5km in length, trenched and buried separately) and Anglia A to the Lincolnshire Offshore Gas Gathering System (LOGGS) PP platform export concrete coated pipeline with piggybacked methanol line (~24km in length, trenched and buried)
5. Protective materials (mattresses, concrete protective structures, frond mattresses, grout bags and rock)

A jack-up rig will be used for the well decommissioning activities. The final well decommissioning strategy is in development and will be in accordance with the Oil and Gas UK guidance on well abandonment and Ithaca's HS&E policy. The Anglia A NUI will be removed using an anchored heavy lift vessel, potentially supported by a barge under dynamic positioning (DP), depending on final vessel selection. The Anglia West (B) manifold and protective structure will be removed using a construction support vessel (CSV) under DP.

The recommended decommissioning option from the Comparative Assessment is to decommission the trenched and buried export pipeline/piggybacked methanol line and infield pipelines *in situ*, and remove the infield umbilical using reverse reel. The infield lines are crossed by the Esmond export pipeline and the sections under the existing crossing (e.g. rock/mattresses protected) will be decommissioned *in situ*. For all lines, the tie-in infrastructure (e.g. spool pieces) will be removed as will all exposed protective material where safe to do so.

Ithaca have actively sought alternative use options for the Anglia infrastructure; *in situ* reuse or redevelopment have also been explored but are not viable options as the infrastructure is approaching the end of its design life, leaving onshore recycling and some disposal to landfill as the preferred option.

Environmental summary

The majority of the Anglia infrastructure (the Anglia A NUI, export and methanol line and approximately half of the infield line and umbilical) is located within the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (NNSSR SAC). The Anglia A NUI lies on the north-west end of the Ower Bank and the export/methanol lines traverse through the north west end of the Well Bank. Part of the export and methanol line also lies within the boundary of the Southern North Sea SAC designated for harbour porpoise.

Water depths in the area range from 20m (Anglia A NUI) to ~30m at Anglia West (B); depths along the pipeline are between 20 and 28m. Sandwaves are present with amplitudes of several metres.

Ithaca conducted a pre-decommissioning survey along the pipeline/umbilical routes, and at the infrastructure locations; survey locations also encompassed the subsea appraisal well locations. A summary of the main environmental features of the area and their seasonal variability is given below.

Tabulated seasonal and other environmental sensitivities

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
Location	The Anglia Field lies on the northwest edge of the Ower Bank, in the southern North Sea and the infrastructure straddles UKCS Blocks 48/18, 48/19 and 48/20; The export pipeline/piggybacked methanol line traverses Block 48/20 to join the Lincolnshire Offshore Gathering System (LOGGS). Anglia lies ~ 55km from Cromer on the North Norfolk Coast and ~92km from the UK-Netherlands Median Line. None of the Anglia infrastructure makes landfall.												
Water column, climate and hydrography	Water depths are between 20-30m across the relevant area, South westerly winds dominate in autumn and winter months, with winds from the north-northeast marginally more common in spring and summer. Where stratification occurs, this is weak compared with the central North Sea. Tidal current flow rates vary from 0.1-1.7knots at springs and 0-0.8 knots at neaps.												Well plug & abandonment activities will use a relatively small number and variety of chemicals; use and discharge of these will be subject to assessment prior to permitting.
Seabed and fauna	Large sandbanks, smaller scale sandwaves and ripples are characteristic of this area and are qualifying features of the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (NNSSR SAC). Sandwaves (up to ~5m) are present around Anglia and unlike the sandbanks, are more active, flow-transverse features. The sediments of area are circalittoral sand and coarse sediment with isolated boulders and cobbles. The seabed infauna is characterised by polychaetes and amphipods, and epifauna characterised by crabs and brittlestars. The NNSSR SAC is also designated for the presence of the *Sabellaria spinulosa* reef; surveys of the Anglia area identified none present.												A rig site survey/mooring analysis will be carried out prior to siting the jack-up and HLV. Will be located within/close to existing 500m safety zones. Contingency to use jack-up for plug & abandonment of 3 subsea former appraisal wells.
Plankton	There is relatively little stratification throughout the year and constant replenishment of nutrients, allowing high plankton productivity. Algal blooms are often observed in the region. There has been a marked decrease in copepod abundance in the southern North Sea, possibly linked to the North Atlantic Oscillation index; in recent decades, a community change has been observed with a northwards shift in the warmer-water *C. helgolandicus* and a corresponding decline in the colder-water *C. finmarchicus*.												Well plug & abandonment activities will use a relatively small number and variety of chemicals; discharge of these is not likely to significantly affect plankton.
	Key: Period of increased plankton abundance shown in darker blue												
Fish	The Anglia infrastructure overlaps or abuts reported spawning grounds of several commercially important fish species (herring, mackerel, whiting, sole, lemon sole and sandeel) and nursery grounds for these and an additional two species (cod and plaice).												Well plug & abandonment activities will use a relatively small number and variety of chemicals; discharge of
	1	**2**	**2**	**3**	**4**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	

Aspect	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
	Key: 1 = 1 species spawning, 2 = 2 species spawning etc												these is not likely to significantly affect fish spawning/nursery grounds. Majority of fish species spawn over wide areas
Birds	The North Norfolk coast is relatively unimportant for breeding seabirds compared to cliff coasts to the north and does not support the seabird breeding assemblages seen for example at Flamborough Head. The shingle beaches and coastal marshes of the coast do support important breeding populations of terns, with some species qualifying features of designated sites. The typical breeding season foraging ranges for these species means it is unlikely they would be present in and around the Anglia area at that time. This coastal area is important for over-wintering birds and birds on passage, with some areas regularly supporting between 90,000 and 120,000 individuals. The Anglia area is offshore and birds likely to be present are those transiting through the area during migration, and post breeding dispersion from colonies.												Anglia was a gas/condensate field and location is far from shore. Simplified processing and pipeline system cleaned and left hydrocarbon free. Spill prevention and management for diesel from rig will be in place. All vessels will have relevant spill plans.
Marine mammals	Only a few cetacean species are sighted with regularity in the southern North Sea: harbour porpoise; minke whale and white-beaked dolphin, the most abundant is the harbour porpoise. Other species sighted with occasional to rare frequency include the Atlantic white-sided dolphin, bottlenose dolphin and short-beaked common dolphin. Harbour and grey seals may also be present in the Anglia area, but in low numbers.												Base case for internal cutting of jacket, contingency external. Tools may include high-pressure water jet, diamond wire and hydraulic cutting tools. No explosives will be used.
	Key: Darker colours reflect months when marine mammals most frequently observed												
Conservation sites	Some Anglia facilities lie within the boundary of the NNSSR SAC, (qualifying features Annex I habitat sandbanks and Annex I habitat reef), and approximately 18km of the 24km export line is within the Southern North Sea SAC (qualifying feature the Annex II species harbour porpoise) Other offshore SACs are present in the region, but the closest of these to Anglia, the Haisborough, Hammond and Winterton SAC is >30km to the south. Other sites designated along the closest coastline are all of some considerable distance from Anglia.												Some decommissioning activities will be carried out within the SAC (including potential rock placement for jack-up stabilisation and anchoring of HLV). Impacts localised to small area, predominantly within/close to the existing Anglia A NUI 500m safety zone, and majority expected to be temporary. Rock use will be permanent addition – quantities minimised where safe to do so.
Other Users	Fishing effort in the Anglia area is low. Detailed landing data from 2014-2017 is not available due to issues of confidentiality, but landing data from earlier years (2013) showed >98% of the landings and 92% of the value was dominated by shellfish (crab, lobster and whelk), with the remainder of the landings/value made up of predominately demersal species. Most activity is fixed gear. Anglia is located within a mature gas province with a comprehensive network of typically unmanned installations, larger processing hubs and associated interfield and export pipeline/support lines; the Anglia pipeline system is crossed by two export lines to the Bacton terminal; the Anglia export pipeline/piggybacked methanol line is also crossed by an out of service cable. The southern North Sea is also an area of operational, under construction, consented and pre-consented offshore windfarms. Shipping traffic density low (Block 48/18) and high (Blocks 48/19 and 48/20). No traffic separation schemes/IMO routeing measures are close to Anglia. The area does not overlap with any Ministry of Defence exercise or practice areas.												Well plug & abandonment activities will be carried out first, with the rig positioned in/close by to the existing 500m safety zones at Anglia A NUI and Anglia West (B). Once decommissioning activities complete, safety zones will no longer apply. A vessel traffic survey will be carried out to support consent to locate applications.

Potential sources of significant effect

A number of potential sources of effect from the proposed decommissioning activities were identified, with their likely impact has been assessed along with options to reduce the impact.

Physical presence

As well as the main vessels involved in well abandonment (jack-up rig) and the infrastructure removal (HLV and CSV), the decommissioning programme will involve a small number of vessels for supply and support, including transport of wastes and other materials to shore. The main source of effect will relate to vessels in transit as during decommissioning work most vessels would be operating within or in close proximity to the Anglia A NUI 500m safety zone.

The physical presence of vessels will be temporary and localised. For assessment purposes, it has been assumed that the HLV will be supported by a barge and this will first transport to shore the decommissioned Anglia A NUI topsides, followed by the jacket and securing piles. Under this work scope, the HLV is expected to be on site for ~4 days.

Seabed disturbance

Sources of physical disturbance to the seabed associated with the Anglia facilities decommissioning activities are primarily:

- Jack-up rig spud can placement for well plug and abandonment
- Contingent rock use for jack-up stabilisation to maintain foundation integrity
- Anchoring of HLV for Anglia A NUI removal
- Removal of jacket/securing piles and manifold/protective structure (piles cut to 3m below seabed)
- Moving/removing protective material
- Removal of tie-in infrastructure
- Removal of umbilical (reverse reel)

Seabed disturbance will result in direct physical effects which may include mortality of fauna as a result of physical trauma, smothering by excavated sidecast and re-suspended sediment. There are no accumulations of historic drill cuttings associated with the Anglia wells, as these have been dispersed by the energetic currents of the area.

Anchoring and cable/chain catenary scarring will not result in changes to sediment characteristics, or significant compaction, with recovery of the seabed through natural sediment mobility expected to be rapid (<1 year). Recovery of faunal communities will also be rapid through a combination of larval settlement and immigration from adjacent seabed. Impacts will be localised to the existing Anglia NUI footprint. The Anglia A NUI is located within the NNSSR SAC, however, previous surveys and the pre-decommissioning survey conducted in 2018, did not identify the presence of Annex I biological reef habitat (*Sabellaria spinulosa* reef) in the Anglia facilities footprint. If required, the use of rock for rig stabilisation at Anglia A NUI would introduce additional hard substrate into the area. The footprint of this will be localised to the Anglia A NUI area, and hard substrate including natural boulders and cobbles are present in the wider Anglia area. The introduction of hard substrate at the scale proposed will result in only a modest expansion of the habitat and associated faunal communities already present.

The area of physical disturbance from all Anglia decommissioning activities is small (0.05km^2) in the wider context of the wider southern North Sea, and the NNSSR SAC. The majority of this disturbance will take place within the original footprint of the Anglia development.

Significant negative effects on the designated features of the SACs from seabed disturbance are not anticipated. Consequently, significant negative effects at the harbour porpoise population level are not anticipated.

Energy use and atmospheric emissions

Emissions will be generated from fuel combustion on the various vessels involved in the decommissioning, the rig during well plug and abandonment operations, helicopter journeys used for crew changes, and ancillary power generation (e.g. use of mechanical cutting tools). Gas emissions will primarily comprise carbon dioxide (CO_2), carbon monoxide (CO), oxides of nitrogen (NO_x), sulphur dioxide (SO_2), methane (CH_4) and volatile organic compounds (VOCs). Although minor, these will contribute to atmospheric greenhouse gas (GHG) concentrations linked to global climate change and related effects including sea-level rise, ocean acidification; and other effects including on regional acid loading, and tropospheric ozone (resulting from reactions of NO_x, CO and VOCs).

Effects of noise

The primary source for underwater noise generation from the Anglia decommissioning activities is rig and vessel noise.

The noise sources will be temporary and minimised by a phased approach to decommissioning to reduce vessel time in the field. Sound from vessels may result in a temporary influence on the behaviour of individual marine mammals within the vicinity of the operations, including harbour porpoise. Such effects will be short-term, localised, largely outside of the boundary of the Southern North Sea SAC and taking place in the context of existing moderate-high levels of shipping activity in the region. Consequently, significant negative effects at the population level are not anticipated.

Effects on conservation sites

With the exception of the Anglia West (B) manifold/protective structure and about half of the infield pipeline and umbilical, the rest of the Anglia facilities are located within the NNSSR SAC. Approximately half of the ~24km export and piggybacked methanol line is also located within the Southern North Sea SAC.

The extent of seabed disturbance to occur within the NNSSR SAC boundary, as a result of proposed decommissioning activities within the site boundary, has been estimated at 0.04km^2, representing 0.001% of the whole SAC area, of this only 0.002km^2 (representing 0.00006% of the SAC site) pertains to the contingent rock placement associated with rig stabilisation. Localised physical disturbance will occur, but the extent of this is not considered significant as would be within existing infrastructure footprints, and result in temporary effects. All recent benthic sampling and photographic surveys in the Anglia area (including the 2017 pre-decommissioning survey) and survey data used to support site identification and confidence in feature presence/extent (see Vanstaen & Whomersley 2015 and Mcllwaine *et al*. 2017) have been consistent in not reporting the presence of sensitive habitats (*Sabellaria spinulosa* reef).

Noise sources will be temporary and localised, largely taking place outside the boundary of the SNS SAC and while sound from vessels may result in temporary influence on the behaviour of individual marine mammals in the vicinity of decommissioning activities, significant negative effects at the population level are not anticipated.

Taking account of the above, significant impacts on the designated features or site integrity of either of the SACs, within which some of the Anglia facilities are located, are not anticipated.

The East Anglia coastline has several conservation sites (SACs, Special Protection Area (SPAs) and Marine Conservation Zones (MCZs)) designated for geological and biological features; the closest to

the Anglia area are the Greater Wash SPA (overwintering divers, waterfowl and gulls, breeding terns) and the Cromer Shoal Chalk Beds MCZ, both approximately 43km distant. Impacts on these sites from Anglia decommissioning is not anticipated, given their distance from the location of activities.

It is possible that mobile species which are qualifying features of coastal sites may transit through the Anglia area e.g. on migration. Anglia is considered too distant for typical breeding foraging ranges of the designated species, e.g. for The Wash SPA, breeding common tern and little tern, and significant impacts on the designated features of these sites are not predicted.

Detailed site information is provided in this EA to enable the Secretary of State to undertake a Habitats Regulations Assessment if required.

Accidental events

Risk assessment of accidental events (including spills) involves the identification of credible accident scenarios, evaluation of the probability of incidents occurring and assessment of their potential ecological and socio-economic consequences. Given Anglia was a gas (with some condensate) field, the hydrocarbon free status of the Anglia A NUI process/pipeline system and the nature of the activities which could take place during decommissioning, the following potential sources of spill risk have been identified:

- Loss of vessel through collision
- Worst case loss of fuel inventory (diesel) from a vessel (HLV/barge, support vessel)
- Worst case loss of fuel inventory (diesel) from the rig
- Small scale spillage of diesel during bunkering
- Loss of chemical containment, including legacy chemicals from subsea wells

None of the above have been identified as resulting in a potential significant impact on the Anglia and surrounding area.

Other users of the Anglia area and transportation routes will be alerted to the decommissioning activities via publication of Notices to Mariners detailing rig and vessel positions, activities and timing, and by full navigation lighting on the rig and vessels. Current information indicates shipping density is low (Block 48/18) and high (Blocks 48/19, 48/20), but a vessel traffic survey will be undertaken to inform rig siting and decommissioning planning.

All vessels and rigs to be used during well and wider facility decommissioning will have in place the relevant, current Shipboard Oil Pollution Emergency Plan (SOPEP) and/or Non-Production Installation Oil Pollution Emergency Plan (NPI OPEP), with the relevant interfacing documents, which would be implemented in the event of an accidental event. Further spill response resources would be available to Ithaca via contracted spill management contractors. In the unlikely event of a diesel spill, this would initially spread to form a sheen on the sea surface but would rapidly disperse. The current Anglia Safety Case (August 2016) describes the facilities in a non-production state (production having ceased in Q4 2015) and from this, none of the major accident hazards were assessed as having the potential to lead to a Major Environmental Incident (MEI).

Cumulative effects

Incremental, cumulative and synergistic effects have been systematically reviewed. Minor incremental or cumulative risks (i.e. effects acting additively or in combination with those of other human activities) were identified in relation to potential impacts including noise, physical presence, emissions, conservation sites and accidental events; none of these were considered to represent a significant impact in a local or regional context.

Overall conclusions

Overall conclusions of the environmental appraisal of the decommissioning of the Anglia facilities are:

- No significant environmental effects, or adverse effects on other users of the sea are predicted from planned activities associated with the decommissioning operations
- No significant environmental effects on conservation sites within which Anglia infrastructure is located, are predicted from planned activities associated with the decommissioning operations
- No specific, additional controls were considered necessary on activities beyond application of regulatory requirements, established Ithaca management system processes, operational controls and following industry guidelines where applicable
- No significant spillage of hydrocarbons or chemicals are predicted, due to the Anglia Field being gas/condensate, current status of the production wells, and the processing and pipelines having been cleaned
- Spillage of diesel from vessels (including a jack-up rig) are possible, but potential for this is small and the risks will be reduced as far as possible through operating procedures and spill response procedures put in place
- A range of environmental management actions and commitments have been identified and will be carried forward through the detailed planning and execution phase of the decommissioning project to further assess, avoid or minimise adverse environmental impacts, as far as technically feasible

1 INTRODUCTION

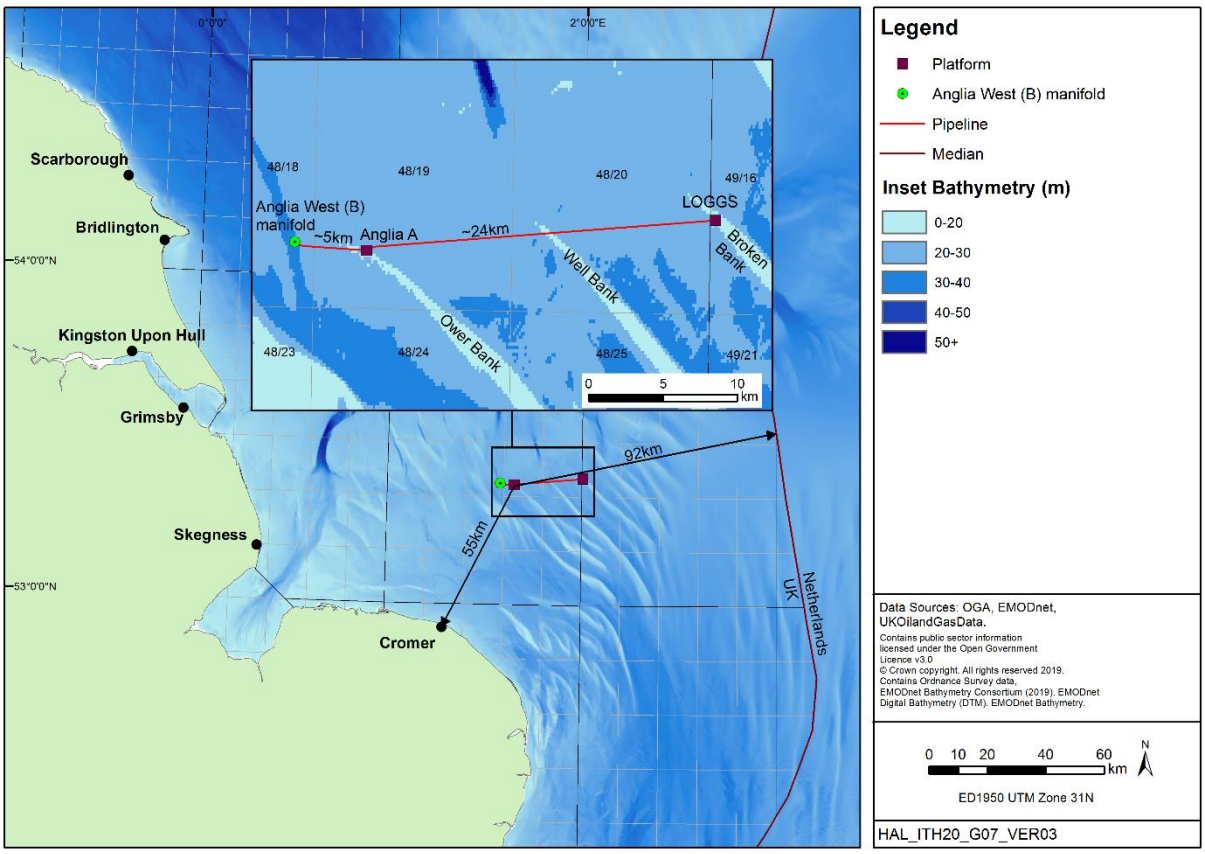
1.1 Introduction

Ithaca Energy (UK) Limited (Ithaca) is planning for the decommissioning of the Anglia Field, a gas/condensate field which began production in 1991 and ceased production in 2015. There is a regulatory requirement for operators proposing to decommission an offshore installation or submarine pipeline, to submit a Decommissioning Programme (DP) to the competent authority (the Department for Business Energy and Industrial Strategy, (BEIS). To fulfil Ithaca's Heath, Safety & Environmental (HS&E) policy, the requirement under the *Petroleum Act 1998* to assess the environmental impacts of decommissioning proposals, and in line with regulator guidance (BEIS 2018a), the DPs for the Anglia Field facilities are supported by an Environmental Appraisal (EA) which is documented in this Environmental Appraisal report.

1.2 Overview of the Anglia Facilities

The Anglia facilities are located in the southern North Sea (Blocks 48/18b, currently unlicensed, and 48/19b and 48/20) approximately 55km from the UK mainland and 92km from the UK/Dutch median line (Figure 1.1). The majority of the Anglia infrastructure (the Anglia A NUI, export and methanol line and approximately half of the infield line and umbilical) is located within the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (NNSSR SAC). Part of the export and methanol line also lies within the boundary of the Southern North Sea Special Area of Conservation (SNS SAC) – see Section 4.9.

Figure 1.1 – Location of the Anglia facilities[1]



Note: 1. The LOGGS facility shown was the receiving/processing facility for Anglia hydrocarbons and is operated by ConocoPhillips and not part of the Anglia decommissioning project.

Ithaca has prepared DPs covering the Anglia facilities namely:

- The Anglia A normally unattended installation (NUI) (Anglia A NUI) (topsides, jacket and securing piles)
- The Anglia West (B) manifold (gravity based) and integrated protective structure (piled)
- Eleven wells (6 x production wells (Anglia A), 2 x subsea production wells (Anglia West (B)) and 3 subsea appraisal wells)
- The Anglia pipeline system; Anglia A to Anglia West (B) infield concrete coated pipeline and control umbilical (~5km in length, trenched and buried separately) and Anglia A to the Lincolnshire Offshore Gas Gathering System (LOGGS) PP platform export concrete coated pipeline with piggybacked methanol line (~24km in length, trenched and buried)
- Protective material (mattresses, concrete protective structures, frond mattresses, grout bags and rock)

The terms of legislative provisions relating to decommissioning such facilities, and decommissioning guidance from the competent authority (BEIS 2018a) are such that, the Anglia A NUI and Anglia West (B) manifold and protective structure, must be completely removed (see Section 1.3). While not a statutory requirement, a Comparative Assessment of options to determine the best decommissioning method for the pipelines and umbilical, has been undertaken – see Sections 1.3 and 3.3.4.

1.3 Offshore Decommissioning Regulatory Context

The OSPAR Convention, OSPAR (1992), is the current agreement on international cooperation on environmental protection in the North-East Atlantic. Under paragraph 2 of OSPAR Decision 98/3, the dumping and leaving wholly or partly in place of disused offshore installations is prohibited within the OSPAR maritime area. The conditions that would allow for a derogation from Decision 98/3 requirements (e.g. jackets weighing more than 10,000 tonnes) do not apply to the Anglia facilities and therefore the Anglia A NUI and the Anglia West (B) manifold and protective structure, must be removed in their entirety.

Under Part IV of the *Petroleum Act 1998* and amendments to the Act through the *Energy Act 2008* (as amended), operators proposing to decommission an offshore installation or submarine pipeline must submit a DP, which must be approved by BEIS before decommissioning activities can commence. Although there is at present no statutory requirement to undertake an Environmental Impact Assessment (EIA) at the decommissioning stage, BEIS (2018a) guidance states that, "*Under the Petroleum Act 1998, there is a… requirement to undertake an assessment of the potential environmental impacts of the decommissioning proposals…"* and also that an EA must be submitted alongside the DP.

Guidance (BEIS 2018a) also indicates that an Environmental Issues Identification (ENVID) exercise should also be part of the overall assessment process, the outcome of which should be summarised within the EA.

The *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001* (as amended) implement European Directives for the protection of habitats and species namely, Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora and Council Directive 2009/47/EC (the codified version of 79/409/EEC) on the conservation of wild birds in relation to oil and gas activities carried out in whole or in part on the UKCS. Relevant habitats and species listed in the Habitats and Birds Directives will be identified in the EA, which will consider the likely effects of these from the decommissioning activities.

Sufficient information will be provided in the EA to allow the Competent Authority (BEIS) to undertake Habitats Regulations Assessment (HRA) in the event that a Likely Significant Effect (LSE) on any relevant site[1] is identified.

A range of permits, consents and licences are required to undertake activities required to decommission the Anglia facilities, including, but not limited to, siting of vessels and the rig and the use and discharge of chemicals. Approvals for these are contingent on complying with the applicable legislation. This EA will support these applications in due course. At present, applicable legislation includes (but is not limited to):

- *The Merchant Shipping (Oil Pollution, Preparedness, Response and Co-operation Convention) Regulations 1998*
- *The Offshore Petroleum Production and Pipeline (Assessment of Environmental Effects) Regulations 1999 (as amended)*
- *Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended)*
- *The Conservation of offshore marine habitats and species Regulations 2017*
- *The Offshore Chemical Regulations 2002 (as amended)*
- *The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended)*
- *The Energy Act 2008, Part 4 Consent to Locate*
- *Marine and Coastal Access Act 2009* (as amended)
- *The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013*
- *The Merchant Shipping (Oil Pollution Preparedness, Response Co-operation Convention) Regulations 1998*

While the receiving port for the facilities is still to be determined, this is expected to be in the UK and the *Transfrontier Shipment of Waste Regulations 2007* (as amended) should not be applicable. In the unlikely event that material is taken to a non-UK port, Ithaca will comply with the applicable Regulations for the transport of waste. In accordance with their verified management system processes for contracting and managing third parties to conduct activities on their behalf, Ithaca will also assure themselves of the competency and capability of the waste receiving and processing facilities.

Legislation and compliance requirements may change over time and as part of their management system, Ithaca has processes in place to monitor for new legislation relevant to their activities. Ithaca will ensure that all relevant regulations are complied with for the decommissioning of the Anglia facilities.

1.4 Environmental Appraisal Process

The environmental appraisal process undertaken considers the range of activities relevant to the decommissioning of the Anglia facilities and their potential impact on the receiving environment, focusing on those impacts that have been identified as potentially significant. This process is informed by engineering studies and the pre-decommissioning survey amongst others (see Section 5). This is an integral part of Ithaca's management process which satisfies the company's environmental policy objectives with regards to the identification and assessment of potential risks to the environment from their activities.

The appraisal considers issues and potential effects from offshore activities and describes the proposed measures to avoid, reduce and if possible, remedy significant adverse effects; fate of material (including

[1] Includes Special Area of Conservation (SAC), Special Protection Area (SPA) and any potential or candidate sites.

waste) returned to shore is included in summary to provide context, but is not included in the appraisal, this being an onshore issue and not relevant to impacts in the marine environment. The appraisal does however, include accidental impacts, as these can affect the marine environment.

This EA report details the results of the environmental appraisal, highlighting environmental sensitivities, identifying potential hazards, assessing/predicting risks to the environment and identifying practical mitigation and monitoring measures to be carried forward into the engineering, execution and legacy of the decommissioning activities. It also forms part of the information base submitted to BEIS in support of the Anglia Decommissioning Programmes

1.5 Marine Planning

The *Marine and Coastal Access Act 2009* (as amended) introduced a marine planning system which, along with legislation implemented by the devolved administrations, aims to provide a coherent approach to the management of the UK's marine areas. Policy objectives for activities taking place on the UKCS were originally set out in the UK Marine Policy Statement (MPS). Policy objectives relating to oil and gas in the MPS focussed on exploration and production, noting its role in energy security of supply and the UK Government policy for maximising economic recovery, now being delivered by the OGA through the MER UK Strategy. The decommissioning of offshore installations is not the focus of any policy area within the MPS, other than in relation to the possibility for infrastructure re-use for carbon dioxide transport and storage. The policy objectives set out in the MPS are being further defined through a series of regional marine plans.

As the Anglia facilities are within an area covered by the East Inshore and Offshore Marine Plans (MMO 2014), which were adopted in 2014, the EA must consider the proposed decommissioning activities in accordance with its policies. Ithaca is aware of the plan polices of relevance to the proposed decommissioning operations. In keeping with the MPS, while there is no specific policy which makes reference to decommissioning (other than CCS2 in relation to the re-use of oil and gas infrastructure for carbon capture and storage, noting that no such re-use option has been identified for Anglia), a range of other relevant policies cover interactions with other users and environmental protection.

All works to be carried out (well plug and abandonment, subsea works and installation removal) will involve the use of a rig and vessels; these will be undertaken with consideration to other existing users (e.g. consistent with policy FISH1 and GOV3 for wider marine activities) and the environmental sensitivities of the area (policies relevant to ecosystems and biodiversity: ECO1, BIO1, FISH2 and MPA1; heritage protection: SOC2; landscape/seascape: SOC3 and tourism and recreation: TR1).

1.6 Areas of Uncertainty

Contracting has not commenced for the jack-up rig, the HLV and other vessels involved with the offshore decommissioning activities, nor has final selection been made of the receiving and handling onshore facilities, although the expectation is that it will be a UK port. Where definition is lacking, worst case estimates of emissions, seabed disturbance and other sources of interaction are used in the consideration of possible effects.

1.7 Consultation and Stakeholder Engagement

To identify potential environmental issues associated with the Anglia decommissioning, Ithaca engaged with a number of stakeholders during the planning stage. In particular, Ithaca wanted to ensure:

- awareness of all relevant environmental information for the area
- identification of stakeholder issues and concerns to be considered in the environmental impact assessment process

Ithaca had meetings with consultees, at which a summary of the proposed decommissioning activities, the environment of the area and the key issues were presented with consultees invited to discuss the proposals and raise any questions. Consultees were also given the opportunity to subsequently raise any further issues or concerns and provide details of new relevant information.

The consultees and responses are summarised below.

Consultee	Summary of comments	Section
Department for Business, Energy and Industrial Strategy – Offshore Petroleum Regulator for Environment & Decommissioning (OPRED)	Anglia is part of a wider southern North Sea area where an increasing number of oil and gas fields are being decommissioned (these being at various stages in the decommissioning process), as well as renewable and other projects and as such, cumulative impacts are an issue to address. The seabed topography in the area and the use of over-trawlability survey was discussed, and Ithaca confirmed a post-decommissioning (geophysical) survey will be carried out and would look for further discussion with OPRED and the Offshore Decommissioning Unit (ODU) regarding the over-trawlability survey. Given the approach to pipeline decommissioning and no remediation for the freespans present, frequency of future monitoring will be discussed further by the relevant parties, as part of the decommissioning process. The re-use of stabilisation material was jointly raised by OPRED and JNCC – see below.	3.3, 3.5, 6.8
Joint Nature Conservation Committee (JNCC)	The conservation objectives of the NNSSR SAC is to restore, and any additional hard substrate being used (rock stabilisation material for jack-up), moves away from this objective. Welcomed from Ithaca confirmation the rock use is contingency and will be determined from the rig site survey and if required, quantities will be minimised as far as possible, while maintaining rig safety and that no additional rock will be used for remediation of freespans. The option of re-using existing stabilisation material, rather than introducing new material, was also discussed. The rig site survey will identify if any existing material is present and in consultation with the rig company (when selected and contracted) will determine if it is suitable for re-use.	3.3, 6.3, 6.6 and Appendix C

Consultee	Summary of comments	Section
National Federation of Fishermen's Organisations (NFFO)	NFFO noted the presentation had provided a good summary of the proposed Anglia decommissioning project. They agreed the Anglia area was predominately fished using static gear, and that effort was low. A positive aspect was that the majority of vessels to be used would be under DP. Fishermen//fisheries bodies information of seabed conditions within 500m zones out of date and there may be non oil and gas related anomalies present they are no longer aware of. In addition, given the plan for pipeline decommissioning and the freespans identified, (although none of reportable size), will there be an annual programme of monitoring? Welcomed the confirmation by Ithaca that post-decommissioning surveys will be carried out for the 500m safety zones where infrastructure removed, and along the pipeline and umbilical corridors and future monitoring will be agreed with the Regulator and in consultation with NFFO.	3.3, .3.5, 6.2

2 ENVIRONMENTAL MANAGEMENT IN ITHACA ENERGY (UK) LIMITED

Ithaca has an integrated Health, Safety and Environmental Management System and the environmental elements of the system have been independently verified as meeting the requirements of the OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry; the last verification was in May 2018. The company's environmental commitment is outlined in its Health, Safety and Environmental (HS&E) policy, which is endorsed by the Chief Executive Officer on behalf of the Board of Directors (Figure 2.1).

Figure 2.1 – Ithaca Energy (UK) Ltd HS&E policy

ITHACA ENERGY (UK) LTD.

HEALTH, SAFETYAND ENVIRONMENTAL POLICY

ITHACA ENERGY (UK) LTD. is committed to proactively achieving excellence in Health, Safety and Environmental (HS&E) performance across all of our operations. We consider our HS&E performance and the health, safety and security of those who work for, with and alongside us as central to our business success.

ITHACA will comply with applicable legislation and guidance.

In order to meet our commitment ITHACA will:

- Provide competent resource to implement this policy and to develop and maintain our HS&E systems.
- Provide effective leadership, training and mentoring to sustain and develop workforce HS&E competency and skills and maintain a positive HS&E culture.
- Define clear responsibilities and accountabilities for HS&E issues within the company.
- Set realistic HS&E objectives and tagets and develop action plans to measure these as a contribution towards continual improvement of our HS&E performance.
- Ensure HS&E performance is prominent in the selection of our contractors
- Assess and manage operations through all stages to minimise risk of harm to people, the environment and facilities
- Communicate and consult with stakeholders and the public and have regard for their interests when planning activities.
- Ensure that appropriate plans and resources are in place to respond to incidents and emergencies.
- Investigate incidents, implement recommendations to prevent re-occurrence and share lessons learned.

To support our commitment to HS&E performance ITHACA will develop and maintain effective HS&E systems which will be independently verified against relevant ISO and other recognised standards. HS&E systems will be subject to periodic and management review to ensure ongoing compliance and improvement.

This policy applies to all company activities and ITHACA employees, and contractors and other associates engaged in work on our behalf, have a responsibility to comply with it and prevent harm to themselves and others and damage to the environment.

Les Thomas, CEO ITHACA ENERGY (UK) LTD
On behalf of the Board of Directors

12th March 2016

The policy acknowledges Ithaca's HS&E responsibilities in relation to its business activities. This includes commitments to continual improvement, assessment and management of the risks and impacts associated with operations, including decommissioning activities, to meet legislative requirements and accepted best practice and a willingness to openly communicate these principles to company personnel and the general public.

3 DESCRIPTION OF THE DECOMMISSIONING PROJECT

3.1 History and Background to the Anglia Field

The Anglia Field was discovered in 1972 by Ranger Oil (UK) Ltd. Further appraisal work was carried out in 1984-1989 when appraisal wells were drilled. Data from these, along with 3D-seismic survey data, indicated the gas present was split between an eastern and a western area. The Anglia A NUI and the export pipeline with piggybacked methanol line to the LOGSS PP platform were installed in 1991 to target the eastern area. The field commenced production in December 1991. The Anglia West (B) manifold, infield gas pipeline and service umbilical were installed in 1993 to exploit the western area and to facilitate additional overall production. Production from Anglia West (B) began in 1993. The field facilities layout is shown in Figure 3.1.

In December 2010, Ithaca acquired interests in a number of southern North Sea assets from GDF SUEZ E&P Ltd, (now ENGIE) including operated interest in the Anglia Field. With the facilities approaching the end of their design life, declining production rates and no feasible redevelopment options, production from the Anglia Field ceased in November 2015.

3.2 Indicative Timetable and Potential for Alternative Use

The schedule for decommissioning activities is subject to change, but current estimates are shown in Table 3.1, with offshore activities expected to commence in 2023.

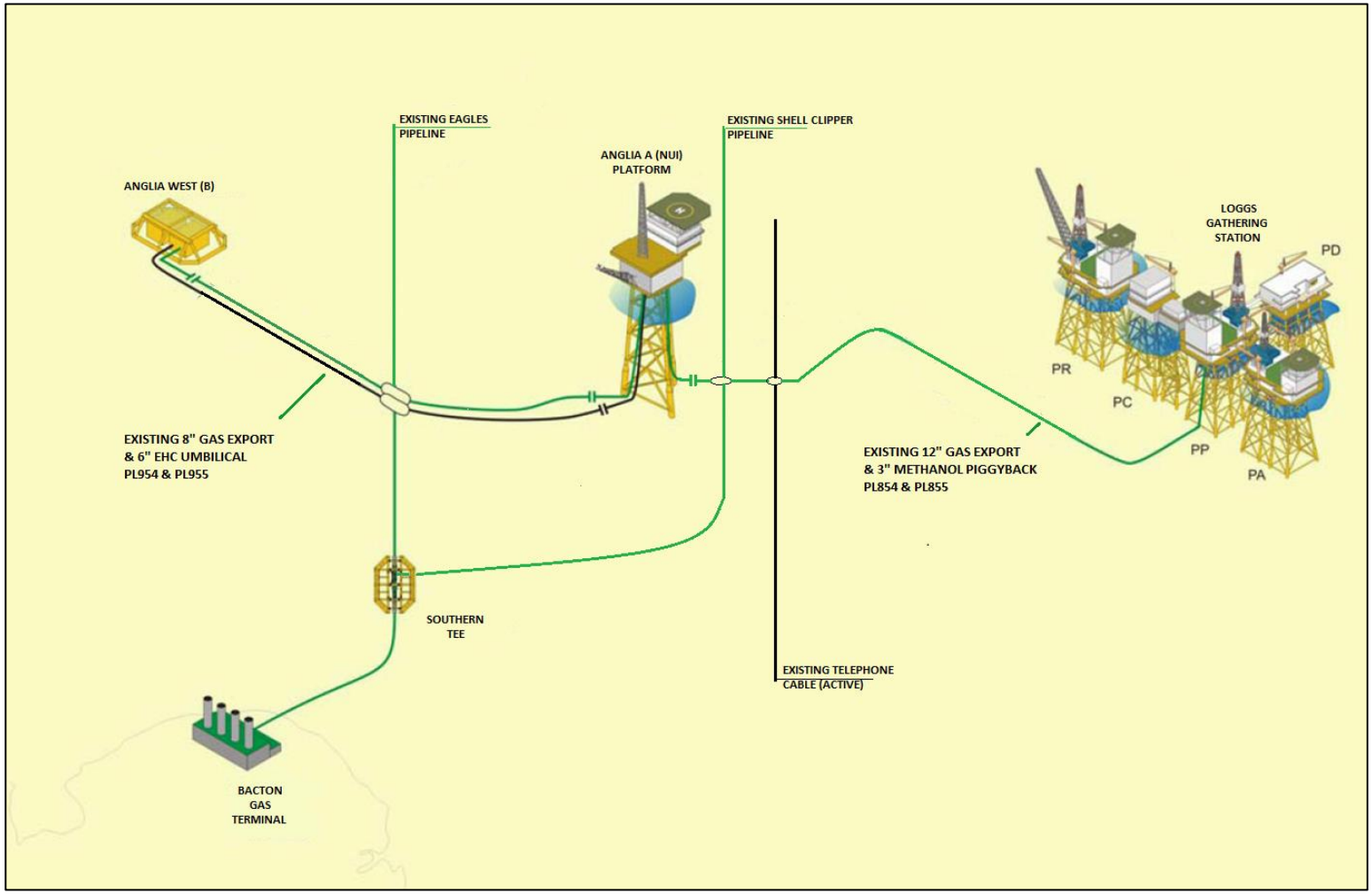
Table 3.1 – Indicative schedule for Anglia Decommissioning Activities

Activity	Timetable
Well Plug and Abandon	2023
Topside, jacket and pile removal	2024
Subsea pipeline/umbilical tie-ins decommissioning and manifold removal	2025
Debris clearance and post-decommissioning survey	2025

The relevant permits and consents for decommissioning activities can only be sought following the approval of the DP; these will be applied for in the future prior to any offshore activities.

Ithaca has considered the possibility for *in situ* re-use or redevelopment of the field and facilities. However, no further exploitation of the field is considered economically viable, and the Anglia A NUI is approaching the end of its design life). Accordingly, decommissioning will focus on complete removal of the Anglia A NUI and Anglia West (B) manifold and protective structure, and with options derived from the Comparative Assessment of the relevant pipelines, umbilical and protective material.

Figure 3.1 – Anglia layout



Note: the Clipper pipeline is shown as a single line on the graphic, but this consists of two separate lines, a gas line and a glycol line, trenched separately and each with its own crossing

3.3 Facilities to be Decommissioned

A summary of the Anglia facilities being decommissioned is provided in Table 3.2, with further details provided in the following sections.

Table 3.2 - Anglia facilities and protective material

Wells	Description
6 platform wells at Anglia A NUI	48/19b-A1Z, 48/19b-A2, 48/19b-A6Z, 48/19b-A7, 48/19b-A9 & 48/19b-10Az. All gas/condensate wells, all shut in
2 subsea wells at Anglia West (B)	48/18b-9 & 48/18b-B2, both gas/condensate, shut in
3 subsea appraisal wells	48/18b-6z, 48/18b-13 & 48/19b-8, none completed, no wellhead or Xmas tree
Platform	
Anglia A NUI (topsides, jacket, piles)	Predominately steel with mixture of aluminium, copper, lead, zinc, plastics and other material. Topside facilities 870 tonnes, jacket 1008 tonnes, piles
Subsea installations	
Anglia West (B) manifold, integrated protective structure & piles	Manifold gravity based, protective structure piled, predominately steel, weight 100 tonnes
Pipelines and umbilical	
Export lines from Anglia A NUI to LOGGS PP	~ 24km concrete coated, carbon steel, gas export line (PL854) with piggybacked methanol line (PL855), trenched and natural backfill
Infield lines from Anglia A NUI to Anglia West (B)	~ 5km concrete coated, carbon steel, gas infield pipeline (PL954), trenched and natural backfill ~ 5km multi core umbilical (PL955), separately trenched and natural backfill
Protective material[1]	
Mixture of protective material located at crossing locations, approaches and tie-ins to infrastructure	Concrete mattresses (quantity 187, weight 1,496 tonnes), Grout bags (160, 3.2 tonnes) Concrete protective structures (dog houses/kennels) (46, 230 tonnes) Frond mats (106, 8 tonnes) Rock (45,592 tonnes)

Note: [1]Aim will be to recover all protective materials that become redundant where condition allows (material at crossings will be decommissioned in situ as they continue to provide a protective function). Assessment of seabed disturbance (Section 6.3) includes disturbance from material move/removal. Where material has to be decommissioned in situ, due to condition and/or burial this will be appropriately marked on the relevant notifications.

A high level inventory of Anglia materials is shown in Table 3.3; the current intention being to recycle where reuse is not an option and minimise, as far as practicable, the waste to landfill.

Wastes generated during the decommissioning of the Anglia infrastructure will be segregated and transported to shore to, a licensed waste contractor; steel (94%) and other recyclable metals account for the greatest proportion of the waste materials inventory.

At present, the Anglia A NUI remains tied back to the PP Platform at LOGGS although the connections are blanked off. The LOGGS facilities are not part of the Anglia DPs and not included within the scope of this assessment.

Table 3.3 – High level inventory of Anglia materials (tonnes)

	Concrete			Ferrous metal[1]		Non-ferrous metal[2]		Plastic[3]	
Decommissioning route	**Recycle**	**Leave *in situ***	**Disposal**	**Recycle**	**Leave *in situ***	**Recycle**	**Leave *in situ***	**Recycle**	**Leave *in situ***
Protection materials[4]	-	-	1,729	-		-	-	8	-
Topsides	-	-	-	720		99	-	7	-
Jacket (including piles)	-	-	-	1,059		30	-	-	-
Wells	-	-	-	772		-	-	-	-
Subsea manifold	-	-	-	100		4	-	-	-
Pipelines	-	872	-	34	5,511	1	72	-	23
Umbilical	-	-	-	59		24	-	-	-
TOTALS	**-**	**872**	**1,729**	**2,744**	**5,511**	**158**	**72**	**15**	**23**

Notes: All numbers rounded. 1 steel. 2 includes aluminium, copper, stainless steel, lead, zinc and other metals including alloys. 3 includes plastics used in pipeline coatings, electrical insulation and flooring (Polypropylene, Polyurethane, Polyethylene, polyvinylchloride (PVC)). 4 The protection material includes the frond mats at the manifold and assumes all recovered concrete is disposed of to landfill.

3.3.1 Wells

A total of eleven wells are to be decommissioned as listed in Table 3.2. The subsea wells were not completed, and have no wellhead structure or Xmas tree. There are no mounds of historic drill cuttings associated with the Anglia wells, as these have been dispersed by the strong currents of the area. The final well decommissioning strategy is in development and will be drafted in accordance with the Oil and Gas UK guidance on well abandonment (UKOG 2015) and Ithaca's HS&E policy.

A jack-up rig will be used for the decommissioning of the production wells at Anglia A NUI and Anglia West (B), resulting in two rig movements. A seabed survey to determine the seabed conditions and final rig positions at both locations will be carried out in advance and a consent to locate application, with appropriate supporting vessel traffic surveys will be applied for. Final rig selection is still to be made, but a typical jack-up is shown in Figure 3.2.

Figure 3.2 – Typical jack-up rig (e.g. shown is the Ensco 104) over a small platform

Source: Ensco website

The rig will be towed (floating mode) close to Anglia A NUI and tugs will control its final positioning. Once in position and jacked-down, the derrick will be skidded into positions to access the wells, allowing all Anglia A NUI wells to be worked on without the need to move the rig.

Once work has been completed at Anglia A NUI, the rig will jack-up, and be moved to Anglia West (B), where the sequence will be repeated. It is estimated the rig will be on location (Anglia A NUI and Anglia West (B)) for ~112 days, assuming an operational and weather contingency of 5 days at each location. The rig will be supported by a standby vessel, supply vessels and personnel transfers via helicopter. Stabilisation material (rock) may be required to ensure rig stability at one or both locations and the final requirement for this will be determined by the seabed survey. For assessment purposes, it has been assumed approximately 1000 tonnes of rock per rig leg/spud can could be used for stabilisation. Based on a 3-legged jack-up rig, and taking into account the two rig moves, this would equate to 6,000 tonnes of rock for rig stabilisation. In the event stabilisation material is required, quantities used would be minimised as far as practicable.

The feasibility of decommissioning the three subsea appraisal wells using a DSV or Light Well Intervention Vessel (LWIV) under DP is being considered. If using a DSV/LWIV is feasible, this will result in minimal seabed interaction during the decommissioning of these wells. Alternatively, these wells would be decommissioned using the jack-up, which would involve a total of three additional rig moves; the wells are not located in close enough proximity that more than one well can be decommissioned by skidding over the derrick. Site surveys would be carried out at the subsea well locations if a rig is proposed to be used. The estimated duration for the decommissioning of the subsea wells using a DSV/LWIV is ~15 days, or ~19 days if a rig is used, to account for positioning.

For assessment purposes, the DSV/LWIV and rig options have been included, and it has also been assumed that if used, the rig would require stabilisation material. Based on the estimate above, and three rig moves, this would equate to 9,000 tonnes of rock required for stabilisation. Rock quantities

used would be minimised as far as possible. The total rock estimated for rig stabilisation (if used for all wells), is 15,000 tonnes.

3.3.2 Anglia A NUI – Topsides, Jacket and Piles

The Anglia A NUI consists of three elements: topsides, tripod jacket and grouted piles (Figure 3.3). The topsides consist of four decks, with a spider deck on each leg, and there is no permanent overnight accommodation with only emergency facilities provided for personnel. The Anglia A NUI has simplified processing facilities as hydrocarbons were exported to the LOGGS PP for processing and comingling, prior to export. A small gravity fed tank (volume of $1m^3$) provides diesel to the generator and crane, with diesel delivered to the platform in small quantities when required. The main diesel storage (total volume $31m^3$) is beneath the helideck, but this has been emptied and cleaned, and is no longer in use. In preparation for decommissioning, the topsides process facilities and pipework have been flushed and left hydrocarbon safe.

The approximate total weight of the Anglia A NUI is 1,958 tonnes (topsides ~ 870 tonnes, jacket 1008 and piles 80 tonnes with an estimated 100 tonnes of marine growth present on the jacket. The survey in 2017/2018 made a visual inspection of the structure and the status of marine growth. The majority of this growth may be removed offshore, or alternatively it may be brought back with the infrastructure and processed and disposed of onshore.

Figure 3.3 – Anglia A Normally Unattended Installation

The topsides are supported on a tripod jacket structure (3 x 60"diameter main tubulars), fixed to the seabed by hollow, grouted piles. The risers are positioned inboard of the installation legs to provide protection against vessel impact. The topsides will be separated from the jacket by cutting the legs below the cellar deck, using oxy acetylene cutting equipment, and lifting the topsides off the jacket using a HLV.

The jacket will be cut from the grouted piles to a minimum depth of 3m below the seabed; the preferred option is internal cutting, e.g. using a high pressure water/abrasive cutting tool, and an inspection will be carried out to ascertain if access can be gained for this. If internal cutting is not feasible, an alternative option is to cut the piles externally, using gas, diamond wire or hydraulic cuttings tools.

This latter option will require some excavation of the sediment around the piles to gain access. No explosives will be used.

There are two options for removing Anglia A: the HLV will lift the topsides off and place them onto a barge, for transport to shore, followed by the jacket. Alternatively, the HLV will lift the topsides off, and remove the jacket, placing both onto its own deck for transport back to shore. Depending on the type and/or size of vessel contracted, the removal may be achieved in one site visit, or a maximum of two site visits. The supporting barge will not be anchored, but will be either tethered to the HLV or to its towing tugs, which will be under DP.

The HLV will be towed to site using tugs and maintained on site by anchors; a self-propelled vessel may be used, but this will depend on vessel availability and final selection. It is anticipated the vessel will have a four- or eight-point mooring system and a full mooring analysis will be completed prior to deployment. For assessment purposes using an HLV, and supporting barge, based on two trips has been used (Section 3.4, Table 3.6).

The Anglia A NUI is relatively small compared to manned platforms in the deeper North Sea and the estimated personnel numbers required to carry out the decommissioning of the installation can be adequately accommodated on the HLV and supporting barge, if used. An additional accommodation vessel is not expected to be required. If required, this will be positioned at the Anglia A NUI, and result in a similar seabed disturbance as that from the jack-up spud cans.

The final receiving port for the removed Anglia Field facilities is still to be determined. It is anticipated that this will be a UK port, it cannot be discounted that a non-UK port may be used. Ithaca have a verified Environmental Management System (see Section 1.2) and as part of this, all contractors providing equipment, materials or services for field operations are subject to evaluation prior to contract award; these processes will apply to the contractor selection irrespective of whether it is a UK or non-UK yard, and evaluation includes ensuring all relevant licenses are in place.

3.3.3 Anglia West (B) Manifold and Integrated Protective Structure

The Anglia West (B) manifold is housed within an integrated protective structure (Figure 3.4). This is 20m long x 18m wide x 8m high, with an approximate weight of 100 tonnes, with an estimated additional ~10 tonnes of marine growth.

Figure 3.4 – Anglia West (B) manifold and protection structure

While not separately identified in the OSPAR 98/3 Decision, subsea installations including manifolds and protective structures fall within the definition of a steel installation and must be removed in their entirety from the seabed for re-use, recycling or disposal on land. In exceptional circumstances, a case for derogation to leave the infrastructure in place can be made; the Anglia West (B) manifold and protective structure does not fall within this category and will be completely removed.

The structure is secured to the seabed by piles, and in line with current guidance a cut depth of 3m below the seabed level will be achieved, using for gas or diamond wire cutting tools, and the structure removed. No explosives will be used. All exposed protective material associated with the manifold and integrated protective structure will be removed where safe to do so. Sediment excavation to access the piles is anticipated. This work will be carried out using a DSV, or CSV under DP, and will not use anchors.

3.3.4 Pipeline System and Associated Protective Material

The Anglia pipeline system comprises the trenched, concrete coated, gas export pipeline and piggybacked methanol line between the Anglia A NUI and LOGGS PP, and the separately trenched infield gas concrete coated pipeline and umbilical between the Anglia A NUI and Anglia West (B) (see Table 3.2 above). Three facilities cross the Anglia export/methanol lines; the Shell Clipper gas export pipeline and glycol line and an out of service cable. The infield pipeline and umbilical are crossed by the Esmond export pipeline (Figure 3.1 above). All Anglia lines are now disused (and notified to BEIS); the production lines have been flushed of hydrocarbons (down to <10mg/ml oil (condensate) in water) with the infield line left filled with inhibited seawater and the export line and piggybacked methanol line are filled with untreated seawater.

No feasible re-use option for the pipelines has been identified, and in line with regulator guidance[2], a Comparative Assessment has been undertaken to inform decisions relating to the decommissioning of the pipeline system. Drawing from OSPAR 98/3, BEIS Decommissioning Guidance (BEIS 2018a) and the OGUK Guidance on Comparative Assessment (OGUK 2015), Ithaca developed a framework for conducting a CA using qualitative and quantitative data to evaluate alternative decommissioning options for pipeline systems, and has successfully applied this framework to the decommissioning of other assets (Ithaca's Athena and Jacky Fields).

After reviewing the framework to ensure it remained fit for purpose for Anglia decommissioning of the pipelines and protective material described in Table 3.2, a CA was undertaken and a number of different options considered. These included partial and full removal of all pipelines, umbilical and protective materials, and considered different remediation methods for freespan sections.

Common to all options considered is the removal of the tie-in infrastructure (e.g. spool pieces, risers at the Anglia A NUI and the recovery of all exposed mattresses and concrete protective structures). This is necessary to disconnect the Anglia A NUI and Anglia West (B) facilities for removal. Seabed disturbance as a result of this will be within the footprint of the protective material moved/removed to expose them. Where protective material (e.g. mattresses) are buried, or the condition of them is such that recovery is not feasible, the approach will be to decommission these *in situ.* Common to options where the lines are to be decommissioned *in situ,* is leaving the pipeline/umbilical cut ends open and lowering these into the seabed following sediment excavation using mass flow excavation and then back filled with natural sediment.

[2] Pipelines are not covered by OSPAR Decision 98/3, however, the framework for their decommissioning is contained within the Petroleum Act 1998. See Section 10 of BEIS (2018) decommissioning guidance notes and OGUK (2015) Guidelines for Comparative Assessment in decommissioning programmes.

This also applies to the option for complete removal of the umbilical as the section of line under the crossing would be decommissioned *in situ*, with the approaches cut and reburied. The crossings on the export and infield lines are all protected by a combination of mattresses overlain with rock.

Using qualitative and quantitative data, Ithaca evaluated the alternative decommissioning options based on five main criteria: Safety, Environmental, Technical, Societal and Economic in a multi-disciplinary team CA workshop. Sub-criteria derived from the main criteria, were scored, with scores then weighted according to level of definition and understanding of methods, equipment and hazards. Final scores for each criterion were recorded in a matrix format, with relative ranking for each option derived from the weighted scores.

Removal of the concrete coated infield and export lines would be technically challenging, with a higher risk to safety; removal by reverse S-lay is still considered an untested method in the North Sea and removal by cut and lift in this area was assessed as high in terms of risk to diver safety, as was remediation of the freespans by cut and lift. Remediation of existing freespans by rock placement would have resulted in large quantities of hard substrate being introduced into the area, without a guarantee that freespans would not redevelop elsewhere along the line. The overall scores for leaving the umbilical *in situ* with no remediation of freespans and for umbilical removal by reverse reel were similar (both low). However, the technically feasible option of removing the umbilical by reverse reel would avoid the possibility of future freespans and of residual liability for the line.

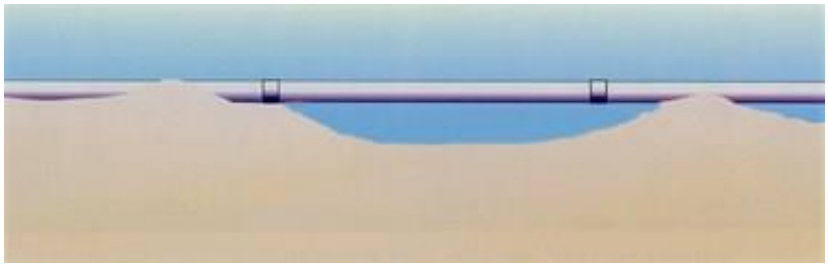
The preferred options identified from the CA were therefore to decommission the infield pipeline and the export pipeline and piggybacked methanol line *in situ*, with no remediation of freespans identified and the full removal, by reverse reel, of the infield umbilical. The umbilical is to be cut at the transitions before and after the Esmond to Bacton pipeline crossing, with the section of umbilical under the crossing and the associated protective material left *in situ*. This EA assesses the potential impacts from the preferred options identified through the CA process.

Exposed and Freespan Sections

After installation, currents and wave action at the seabed may lead to scour and a buried pipeline becoming exposed. A freespan occurs where the seabed sediments have been scoured from under a pipeline (see Figure 3.5) resulting in an unsupported section of pipeline no longer in contact with the seabed. An exposed pipeline is where a section of the pipeline can be seen on the surface of the seabed but is not free-spanning and the pipeline remains in contact with the seabed.

Freespans can present a danger to other users of the marine environment, particularly fishing activity using towed gear which can become trapped under the pipeline. Freespans in excess of 0.8m in height and 10m in length (BEIS 2018a) should be reported and marked on relevant Kingfisher bulletins (FishSAFE website).

Figure 3.5 – Illustrated example of a pipeline freespan



Source: FishSAFE website

From previous pipeline inspection surveys (2012 and 2014), both freespans and exposed sections have been identified along the Anglia pipelines and umbilical; the 2014 inspection report refers to

remediation of a freespan section carried out in 1995, using rock placement (quantities not known) but there has been no requirement for remediation since (ConocoPhillips 2014).

The pre-decommissioning survey of 2018 confirmed the majority of the pipelines and umbilical lengths remain buried to a depth of at least 0.6m. Current guidance (BEIS 2018a) indicates that decommissioned pipelines, mattresses and related items left *in situ* should be covered by such a depth. However, the survey did identify a number of small freespans and exposed sections (Table 3.4 and 3.5). None of the freespans found were more than 0.8m in height from the top of the pipeline and 10m in length. Historic freespan sections and freespans identified from the pre-decommissioning survey are shown in figures in Appendix 1A-C.

Table 3.4 – Freespans identified from 2018 survey

Pipeline	Line length (m)	Number of freespans identified	Total length of line free spanning (m) (% of total line)	Max. height of freespan (m)	Max. length of freespan (m)
PL854/PL855 export / methanol line	24,000	8	97 (<1%)	0.4	23.2
PL955 infield umbilical	5,000	10	34 (<1%)	0.5	6.6
PL954 infield line	5,000	5	34 (<1%)	0.6	8.2

Notes: All figures rounded.

Table 3.5 – Exposed sections identified from 2018 survey

Pipeline	Line length (m)	Number of exposed sections identified	Total length of line exposed (m) (% of total line)	Length of longest exposed section (m)
PL854/PL855 export / methanol line	24,000	19	519 (2%)	87
PL955 infield umbilical	5,000	40	97 (2%)	12
PL954 infield line	5,000	9	145 (3%)	25

Notes: All figures rounded

3.4 Rig and Vessel Requirements

Along with the jack-up rig, HLV and barge for the Anglia A NUI and Anglia West (B) recovery, a variety of different vessels will be required during the Anglia decommissioning activities. While final vessel selection is still to be made, the types of vessels required are known, as is their typical fuel consumption and these are summarised in Table 3.6. In the absence of named vessels, this information and estimated duration on locations, forms the basis of estimating vessel atmospheric emissions from the Anglia decommissioning activities.

Table 3.6 – Approximate rig and vessel requirements for the Anglia decommissioning

Activity	Approximate no. days on site	Fuel consumption rate tonnes/day	Fuel type	Total fuel consumption (tonnes)
Well Plug and Abandon (Anglia A)				
Anchor handler/tug (x 3)	1	25 (per vessel)	Diesel	75
Jack-up rig (positioning)[1]	2	10	Diesel	20
Jack-up rig (on site)[2]	91	18	Diesel	1638
Supply vessels[3]	20	8	Diesel	156
Standby vessel[4]	93	3	Diesel	279
Helicopter[5]	43 (hrs)	470 (kg/hr)	Helifuel	17
Well Plug and Abandon (Anglia West (B))				
Anchor handler/tug (x 3)	1	25 (per vessel)	Diesel	75
Jack-up rig (positioning)[1]	2	10	Diesel	20
Jack-up rig (on site)[2]	24	18	Diesel	432
Supply vessels (included above)	-	8	Diesel	0
Standby vessel[4]	26	3	Diesel	78
Helicopter (included above)	-	470 (kg/hr)	Helifuel	0
Well plug and Abandon (3 subsea appraisal wells) – contingency using rig[6]				
Anchor handler/tug (x 3)	1	25 (per vessel)	Diesel	75
Jack-up rig (positioning)	4	10	Diesel	40
Jack-up rig (on site)	15	18	Diesel	270
Supply vessels (included above)	0	8	Diesel	0
Standby vessel	19	3	Diesel	57
Helicopter (included above)	0	470 (kg/hr)	Helifuel	0
Topsides, jacket and pile (Anglia A) removal - HLV and support barge, based on 2 trips[7]				
Tugs x 3 (to move HLV to Anglia location)	1	25 (per vessel)	Diesel	75
Tugs x 2 (to move supporting barge to Anglia location)	1	25 (per vessel)	Diesel	50
HLV on location	4	18	Diesel	72
Supporting barge on location (no fuel use on location)	2	0	Diesel	0
Tugs x 2 (to move supporting barge and Anglia A topsides to shore)	1	25 (per vessel)	Diesel	50
Tugs x 2 (to move supporting barge to Anglia location)	1	25 (per vessel)	Diesel	50
Supporting barge on location (as above)	2	0	Diesel	0
Tugs x 2 (to move supporting barge and Anglia a jacket/piles to shore)	1	25 (per vessel)	Diesel	50
Subsea infrastructure removal				
CSV (removal of Anglia West (B) manifold and protective structure and protective material	5	20	Diesel	100
DSV (pipeline/umbilical campaign)	31	20	Diesel	605
CSV (pipeline/umbilical campaign))	3	20	Diesel	60
Tugs x 2 to support DSV if required	22	6 (per vessel)	Diesel	261

Activity	Approximate no. days on site	Fuel consumption rate tonnes/day	Fuel type	Total fuel consumption (tonnes)
Surveys				
Survey vessel	5	8	Diesel	40
Over-trawlability survey (if required)	5	5	Diesel	25
Total Diesel Consumption (all activities (excluding helicopter), including contingency use of rig to decommission the three subsea wells)				**4,653**

Note: All figures rounded [1]Assuming 1 day for jacking-up and 1 day for jacking-down. [2]Rig fuel use is between 15-20 tonnes/day during drilling and -10 tonnes/day on standby, assuming an average of 18 tonnes/day while on location. [3]The rig will require 1-2 supply trips per week for the duration of the well plug and abandonment programme and approx. 13hrs round trip for each sailing. [4]A standby vessel will be on location for the duration of the well plug and abandonment programme. [5]Average 2 helicopter round trips per week, average 1.2hr per flight). [6] Base case is to use DSV or LWIV for drilling the 3 subsea appraisal wells, but contingency rig use included here as this represents the worst case (using vessels would reduce the overall atmospheric emissions, as time on site shorter, and no tugs required). [7] Worst case option for Anglia a removal (use of most vessels), including support barge and 2 trips to offload structure.

The rig may require bunkering during the well activities but none of the other vessels are expected to require refuelling while on location. The rig and other vessels will operate to MARPOL standards for Special Areas. A survey vessel will conduct a post-decommissioning survey to confirm no snagging hazards remain and if appropriate, a vessel will conduct an over trawl of the site, if applicable.

3.5 Fate of Infrastructure and Post-decommissioning Monitoring

The recovered Anglia A NUI and Anglia West (B) structures will be returned to shore. The final receiving port and processing facilities for the Anglia material are still to be determined, although Ithaca will ensure the port selected will have the appropriate environmental and operational licences and consents to receive and process the Anglia material. All waste will be documented in a waste inventory, which will record the types, quantities and fate of all waste, following a waste hierarchy consistent with the Waste Framework Directive.

Once at the receiving port/yard, the infrastructure will be dismantled and segregated into components suitable for reuse, recycling or disposal at licensed facilities.

Current aspirations for recycling the material brought back onshore have been estimated, and are as detailed in the DP (i.e. 2690 tonnes of installation material, equating to ~98% and 100% (1844 tonnes) of pipeline material), with the relatively small amount of materials for which recycling is not an option, including residual marine growth, sent to appropriate disposal (e.g. 53 tonnes, equating to ~2%).

Upon completion of the offshore work a post decommissioning site survey will be carried out around a 500m radius of the Anglia A NUI and Anglia West (B) sites and along a (minimum) 100m (50m either side) corridor along the length of the pipeline/umbilical routes; the post-decommissioning survey will also include the approaches to LOGGS and the extent and scope of the survey, carried out by Ithaca, within LOGGS 500m safety zone will be determined in consultation with ConocoPhillips. Any Anglia related seabed debris identified will be recovered for onshore disposal or recycling in line with existing disposal methods. Independent verification of the seabed state may be obtained by overtrawl surveys to confirm that there could be unobstructed use of fishing gear. If it is agreed that an over-trawlability survey is not suitable, alternative methods for post-decommissioning survey will be discussed with the Regulator to agree the survey methods and scope.

Following decommissioning, the Anglia pipelines will remain *in situ*, along with the unrecovered protective material, including that protecting the crossings. The post monitoring survey regime for the area will be discussed and agreed with BEIS.

4 EVIRONMENTAL SETTING

4.1 Seabed Topography and Seabed Sediments

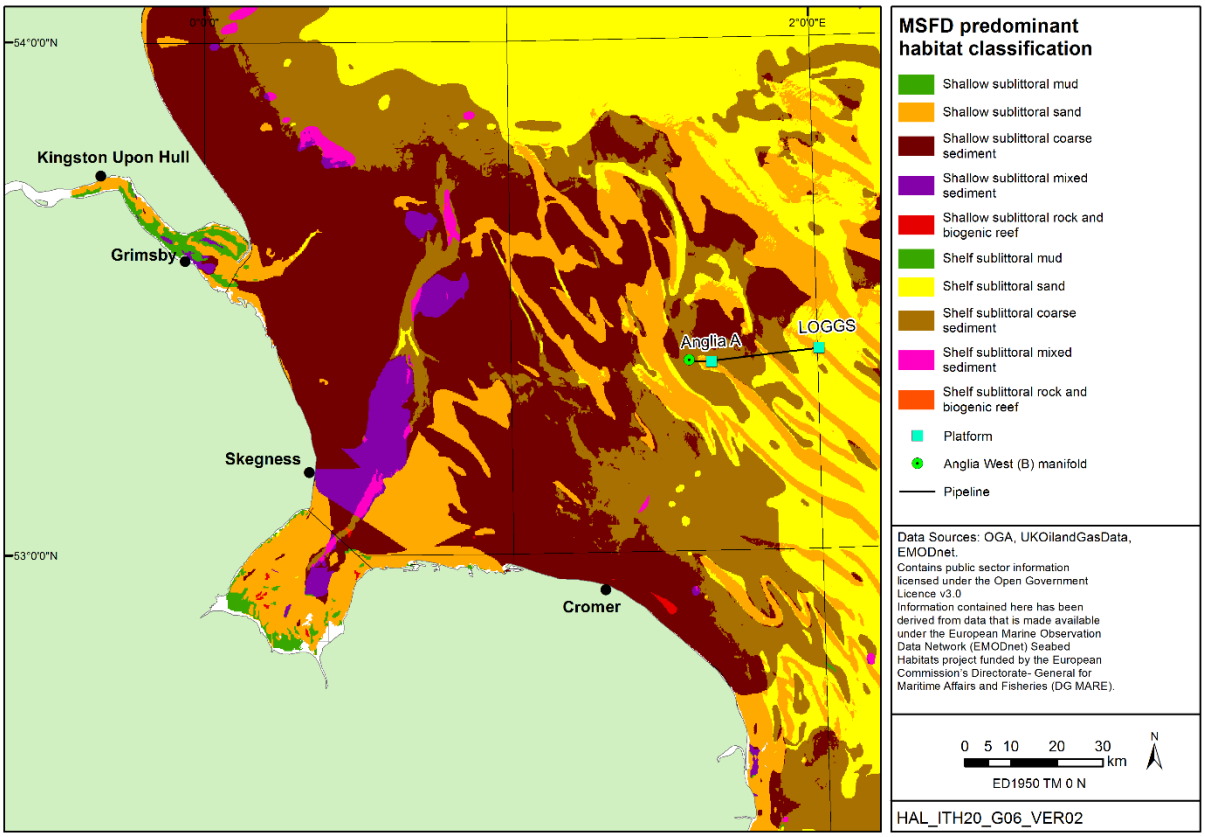
The Anglia A NUI is located in the southern North Sea in Block 48/19b, at the northernmost tip of the Ower Bank (see Figure 1.1 above) at a depth of ~20m. Depths along the ~24km export pipeline to LOGGS PP range between 20m and 28m, with sandwave amplitudes of several metres recorded. Similarly, large sandwaves and megaripples are recorded along the ~5km pipeline route to the Anglia West (B) manifold (Block 48/18b) (Fugro 2018a) which is in a water depth of ~30m.

The wider seabed topography reflects the presence of large sand banks and smaller scale sandwaves and ripples characteristic of this area of the southern North Sea. The wider Norfolk Banks are the best known group of linear ridge sandbanks in UK waters (Tappin *et al.* 2011) and can be subdivided into a nearshore parabolic group with sandwaves on their flanks (Leman, Ower, Inner, Well, Broken and Swarte banks) and a linear, comparatively stable offshore group (four banks termed the Indefatigables) of probably older derivation (Cameron *et al.* 1992). The banks are orientated in a north-west to south-east direction and are mostly parallel; the largest bank is Well Bank which is over 50km long, 1.7km wide and rises 38m above the sea floor (Tappin *et al.* 2011), with the bank crests being generally at less than 20m water depth.

The nearshore banks are subject to stronger currents and are more active, progressively elongating in a north-easterly direction and are generally asymmetric with a steeper face to the northeast (Cooper *et al.* 2008, also see Caston 1972, HR Wallingford 2002) – the stronger currents and greater disturbance on the inner banks are reflected in the faunal communities present (JNCC 2010). There are uncertainties about the rate of migration of these banks, but observations suggest that it could be between 0.4m/yr to 1m/year (Cooper *et al.* 2008, also see Jenkins *et al.* 2015). Smaller sandwaves (up to ~5m) are present around Anglia, and unlike the sandbanks are more active, flow-transverse features (Cameron *et al.* 1992). The strong currents and large coastal sediment supplies contribute to the East Anglian sediment plume (Dyer & Moffat 1998) which extends eastwards across the Southern Bight and the North Norfolk sandbanks (HR Wallingford 2002), with highest average sediment concentrations in winter months to the south of the Anglia facilities at more than 30mg/l, with averages of 10-15mg/l around Anglia (Cefas 2016). Summer concentrations tend to be less than 10mg/l. The banks represent a significant sink for sand sized sediment, with major sediment sources including Holderness and the east Norfolk coast.

Unconsolidated sediment distribution in the southern North Sea is complex and reflects both sediment sources (e.g. from coastal erosion) and redistribution by hydrographic processes. The Anglia facilities are in an area of circalittoral sand and coarse sediment (see Figure 4.1 and also Cameron *et al.* 1992), with isolated boulders and cobbles observed (Fugro 2018a). Sample stations of previous surveys of the Anglia Field area are shown in Figure 4.2. The area around Anglia A NUI and Anglia West (B) is characterised by moderately to extremely well sorted medium to coarse sand (Gardline 2003, Fugro 2018a) with thicknesses varying between 1 and 9m, underlain by Late Weichselian glacial material of the Botney Cut and Bolders Bank Formations (Gardline 2003). A single sediment sample collected in the pre-decommissioning survey along the pipeline route between the Anglia A NUI and LOGGS PP was poorly sorted coarse sand (Fugro 2018a).

Figure 4.1 – Predicted seabed habitats



4.1.1 Sediment Contamination

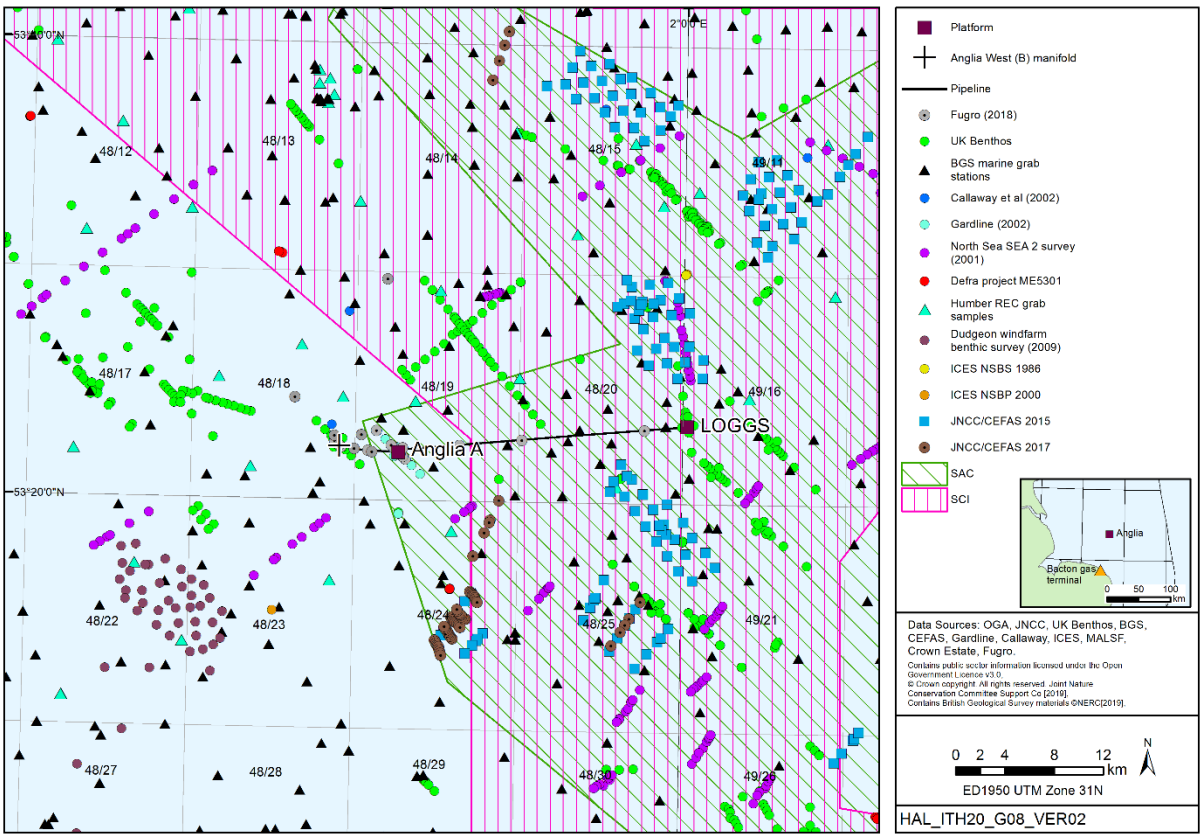
Sediment was collected from 18 stations around the Anglia A NUI and 20 stations around Anglia West (B) (Gardline 2003) and analysed chemically for total hydrocarbon content (THC) and n-alkanes. In the majority of samples THCs were <1µg/g^{-1} and within the range expected of background concentrations (e.g. UKOOA 2001), but two samples at 500m and 200m southeast of the Anglia A NUI showed a slight elevation in concentrations at ~1.5µg/g^{-1} and 14.85µg/g^{-1} respectively. Samples collected as part of the pre-decommissioning survey (Fugro 2018a) at similar distances from the Anglia A NUI had THCs of between 1.9µg/g^{-1} (500m) and 1.1µg/g^{-1} (200m), which were within the range of most of the other survey samples (0.7-1.9µg/g^{-1}). Most samples taken in 2003 around Anglia West (B) showed similarly low concentrations (below 1µg/g^{-1}) although three samples had elevated concentrations (between 2.7µg/g^{-1} and 15.6µg/g^{-1}) at distances of between 0m and 200m from the manifold (Gardline 2003). Low values of 0.8-1.7µg/g^{-1} were recorded at 500m and 200m from Anglia West (B) by Fugro (2018a,b).

The elevated concentrations recorded by Gardline (2003) are considered to reflect historical well discharges, though Fugro (2018a, b) indicate that for those samples collected, none exceeded a THC concentration of 4µg/g^{-1}. 2-6 ring PAH concentrations showed similar variation between the Gardline (2003) and Fugro (2018a) surveys; the former were in the range 13-503ng/g^{-1} and 7-539ng/g^{-1} (though the majority of samples had concentrations of <200ng/g^{-1}), with the latter ranging from 21-84ng/g-1 and 61-155ng/g-1, at the Anglia A NUI and Anglia West (B) respectively. Fugro (2018a) also recorded a high level of inter-sample variability, with PAH content being related to THC. All samples were well

below background concentrations (UKOOA 2001) and Effects Range Low (ERL) threshold concentrations[3] (OSPAR 2014).

Metals were reported by Gardline (2003) at low to undetectable levels (cobalt, cadmium, chromium, copper, mercury, nickel, tin and lead) or at concentrations expected in this area (arsenic, strontium, iron, vanadium and zinc). The most recent survey (Fugro 2018a) reported metal concentrations to be low. Only vanadium metal exceeded the mean background concentration is at one station. Barium concentrations were largely consistent with background levels (Gardline 2003), with highest concentrations found at stations 200m and 500m southeast of the Anglia A NUI, and at between 100m (570µg/g^{-1}) and 2,500m (130µg/g^{-1}) of Anglia West (B). Reductions in these peak levels were noted by Fugro (2018a), with highest values of 38 µg/g^{-1} and 20µg/g^{-1}recorded at 200m from the Anglia A NUI and Anglia West (B) respectively.

Figure 4.2 – Sampling stations in the greater Anglia area



4.2 Climate, Oceanography and Hydrography

Southwesterly winds dominate in autumn and winter months, with winds from the north-northeast marginally more common in spring and summer (UKHO 2013). The mean annual wind speed at 100m above sea level is 9.1-9.5m/s, ranging from 7.1-7.5m/s in summer to 11.1-11.5m/s in winter and the annual mean wave height is 1.42m (ABPmer 2008). The frequency of gales (≥ Beaufort force 7) is <15% in winter and 2-4% in summer (UKHO 2013).

[3] Defined as the lower tenth percentile of the data set of concentrations in sediments associated with biological effects.

The average sea surface and bottom temperatures for this region ranges from 15-17°C in summer to ~6°C in winter. If stratification occurs, this is weak compared with the central North Sea, with a difference between surface and bottom waters of generally <2˚C. Sea surface salinity is in the range 34.5-34.75ppt (parts per thousand) throughout the year (UKHO 2013, ICES data). Spring tidal current flow rates vary from 0.1-1.7 knots and 0-0.8 knots at neaps (UKHO 2008). The residual bottom currents in the area have a predominant south-easterly flow.

4.3 Plankton

The southern North Sea is characterised by shallow, well-mixed waters, which undergo large seasonal temperature variations (JNCC 2004). There is relatively little stratification throughout the year and thus a constant replenishment of nutrients, so opportunistic organisms such as diatoms are particularly successful (Margalef 1973, cited in Leterme *et al*. 2006). Diatoms comprise a greater proportion of the phytoplankton community than dinoflagellates from November to May, when mixing is at its greatest (McQuatters-Gollop *et al*. 2007). The phytoplankton community is dominated by the dinoflagellate genus *Ceratium* (*C. fusus, C. furca, C. lineatum*), along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalochaete* and *Phaeoceros*) than are typically found in the northern North Sea. Harmful Algal Blooms (HABs) caused by *Noctiluca* spp. are often observed in the region (Edwards *et al*. 2016).

The zooplankton community comprises *Calanus helgolandicus* and *C. finmarchicus* with *Paracalanus* spp., *Pseudocalanus* spp., *Acartia* spp., *Temora* spp. and cladocerans such as *Evadne* spp. Common jellyfish in the region include *Aurelia aurita* and *Chrysaora hysoscella* (Pikesley *et al*. 2014). There has been a marked decrease in copepod abundance in the southern North Sea in recent years (Edwards *et al*. 2013, Edwards *et al*. 2016), possibly linked to the North Atlantic Oscillation (NAO) index (Harris *et al*. 2013). In recent decades, a community change has been observed, with a northwards shift in the warmer-water *C. helgolandicus* and a corresponding decline in the colder-water *C. finmarchicus* (Beaugrand 2003, Edwards *et al*. 2016). Where these two species co-occur, the abundance of *C. finmarchicus* will tend to peak earlier in the year. Total *Calanus* biomass in the North Sea has declined by 70% since the late 1950s (Edwards *et al*. 2016).

4.4 Benthos

Benthic communities are typically considered as two interlinked groups: infauna and epifauna. The infauna lives within the seabed sediment and the epifauna occupy the seabed surface. Epifauna are generally larger in size than infauna, and may be sessile or mobile.

The infauna assemblage around the Anglia A NUI falls into a combination of three southern North Sea groupings as defined by Reiss *et al*. (2010), and characterised by the polychaetes *Nephtys cirrosa* and *Magelona johnstoni*, the shrimp *Gastrosaccus spinifer* and the small amphipod *Urothoe brevicornis*. The mobile epifauna of this region is characterised by crabs (*Liocarcinus holsatus* and *Pagurus bernhardus*) and brittlestars (*Ophiura ophiura* and *Ophiura albida*) (Reiss *et al*. 2010) and the sedentary encrusting epifauna characterised by *Hydrallmania falcata*, *Alcyonidium diaphanum*, *Vesicularia spinosa* and *Flustra foliacea* (Rees *et al*. 1999).

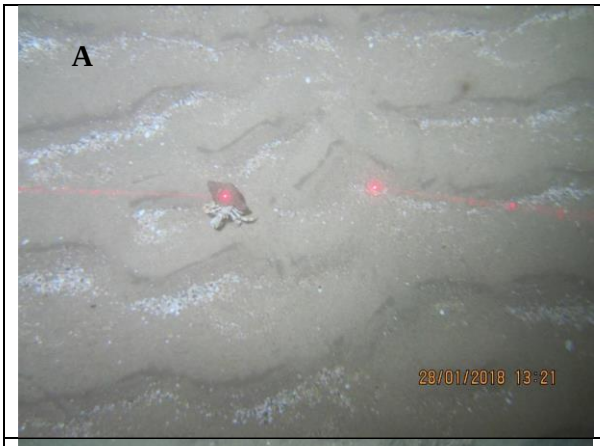
An environmental baseline survey of the Anglia area carried out in 2002 (Gardline 2003) sampled 17 stations by Day grab with subsequent physico-chemical and biological analyses. Sediments were described as moderate to well sorted medium to coarse sand, with large areas of sand waves, megaripples and ripples and a sparse infauna typified and dominated by polychaetes and amphipods (*N. cirrosa*, *Bathyporeia* spp. and *Pontocrates* spp.). These species are physically robust and typical of coarse sediments and a dynamic environment.

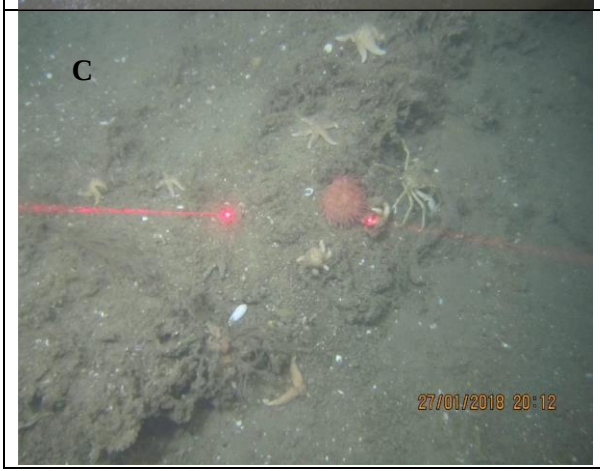
Survey work carried out in 2017 (Fugro 2018a) to support Anglia decommissioning included video transects and grab sampling (0.1m^2 dual van Veen grab sample). Seabed images from this survey

(Figure 4.3, see also Appendix B) show rippled sand with shell fragments (often in the lee of mega ripples). Some areas show cobbles. Epifauna in Figure 4.3 is sparse or absent and there are no holes, tubes or siphons indicative of a burrowed infauna. A total of 93 benthic taxa were identified across the area, of which 52% were annelids, 28% arthropods, 14% molluscs and 3% echinoderms.

The two most abundant infaunal species were the amphipods *Urothoe brevicornis* and *Bathyporeia elegans* and the ten most abundant species were completed by the annelids *N. cirrosa*, *Ophelia borealis*, *Galathowenia oculata*, *Scoloplos armiger* and *Poecilochaetus serpens*, the amphipod *Urothoe elegans*, the bivalve mollusc *Abra alba* and the pycnogonid *Anoplodactylus petiolatus*. The epifauna was generally sparse, with starfish (*Asterias rubens*), hermit crabs (Paguridae), spider crabs (Majidae) and patches of hydroid/bryozoan turf (including *Alcyonidium diaphanum* and *F. foliacea*) present throughout, but with anemones (*Urticina* sp. and *Metridium dianthus*) and soft corals (*Alcyonium digitatum)* seen in the deeper sediments. Small patches of *Sabellaria spinulosa* and *S. spinulosa* rubble (not defined as biogenic reef) were recorded along one of the 18 video transects (distant from Anglia A, along the pipeline route to LOGGS PP). An assessment concluded that the extent of the structures were not sufficient to classify them as an Annex I biogenic reef habitat.

Figure 4.3 – Seabed images from the Anglia area pre-decommissioning survey





Source: Fugro 2018a
A: ST01 (midway along pipeline route from Anglia West (B) to Anglia A), showing rippled sand with shell fragments and a hermit crab (Paguridae)
B: ST08 (200m SE of Anglia A), showing rippled sand with shell fragments
C: TR17 (transect running along the Anglia A to LOGGS PP pipeline) showing coarse mixed sediment with *S. spinulosa* crusts, starfish (*A. rubens*), anemone (*Urticina sp.*), crab (*Hyas araneus*) and areas of hydroid/bryozoan turf

4.5 Cephalopods

Cephalopods are short-lived, carnivorous invertebrates with rapid growth rates that play an important role in marine food webs. Two superorders of the class Cephalopoda are found within the area: the Decapodiformes (squid and cuttlefish) and the Octopodiformes (octopuses).

The southern North Sea is not an ideal habitat for most cephalopods due to its shallow water depths (de Heij & Baayen 2005). The only species regularly found in the area in large numbers is the squid *Alloteuthis subulata*, which typically migrates into the southern North Sea in the summer (Oesterwind *et al*. 2010, Jereb *et al*. 2015). Other species recorded in the region are: the long-finned squids, *Loligo. forbesii* and *L. vulgaris*; the short finned squid, *Todaropsis eblanae*; the bobtail squids, *Sepiola atlantica*, *Sepietta oweniana* and *Rossia macrosoma*; the cuttlefish, *Sepia officinalis*; the octopus, *Eledone cirrhosa*. These nine species, along with *Onychoteuthis banksii*, are the only cephalopods to have been encountered in the southern North Sea during International Bottom Trawl Surveys and International Beam Trawl Surveys between 1996-2003 (de Heij & Baayen 2005).

L. vulgaris is relatively scarce in the southern North Sea, but is most abundant in the region in late spring to summer (Hornburg 2005, cited in Hastie *et al*. 2009). It is a benthic spawner, attaching egg masses to hard substrates. The winter spawning period in the North Sea is relatively short (Moreno *et al*. 2002, cited in Hastie *et al*. 2009).

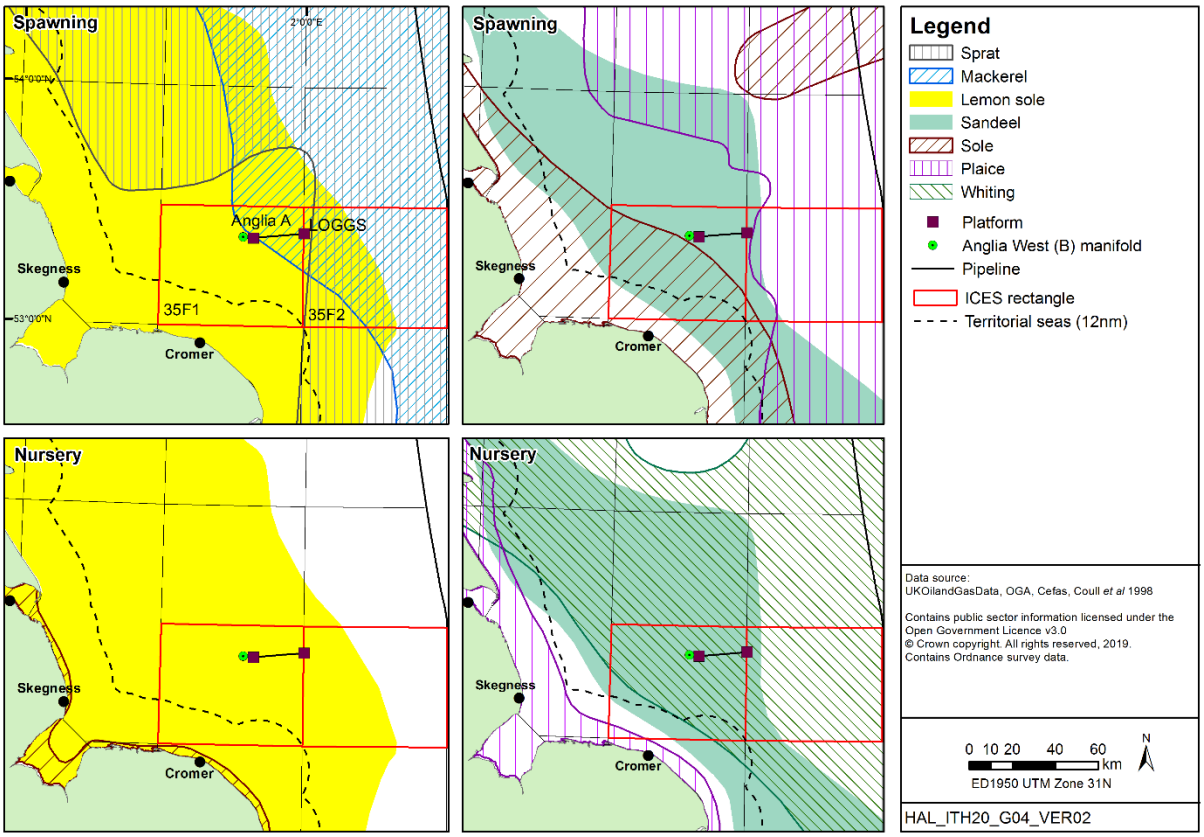
The common cuttlefish, *S. officinalis*, is a neritic, demersal species, typically found in warm, shallow coastal waters, with a significant number encountered in the southern North Sea. The life-span is approximately two years and the spawning season lasts from early spring to mid-summer, with spawning typically taking place in water shallower than 30m (Boucaud *et al*. 1991, cited in Hastie *et al*. 2009). In late autumn, juveniles migrate from shallow nursery grounds to overwinter offshore (Hastie *et al*. 2009).

4.6 Fish and Shellfish

Callaway *et al*. (2002) analysed catches from surveys conducted using 2m beam trawls and otter trawls to establish epibenthic and fish communities throughout the North Sea. They found the community in this part of the southern North Sea to be characterised by small, non-commercial species, namely solenette (*Buglossidium luteum*), dab (*Limanda limanda*) and dragonet (*Callionymus lyra*). Otter trawl results found whiting (*Merlangius merlangus*), grey gurnard (*Eutrigla gurnardus*), dab and horse mackerel (*Trachurus trachurus*) to be most common species.

The Anglia Field lies in ICES Rectangle 35F1, which overlaps with known spawning grounds of herring (*Clupea harengus*) (August-October), mackerel (*Scomber scombrus*) (May-August), sole (*Solea solea*) (March-May), lemon sole (*Microstomus kitt*) (April-September) and sandeel (*Ammodytes marinus*) (November-February), as well as nursery grounds of whiting, plaice, sole, lemon sole and sandeel (see Figure 4.4 and Table 4.1) (Coull *et al*. 1998). Additional surveys suggest spawning grounds for whiting, sandeels and sole, as well as nursery grounds for whiting, herring, mackerel, cod, sandeel and plaice nursery grounds are also present (Ellis *et al*. 2012). The features are dynamic and likely to show some degree of spatial and temporal variability (Coull *et al*. 1998).

Figure 4.4 – Nursery and spawning sites around Anglia



A study conducted by Aires *et al*. (2014)identified areas of significant probability of large aggregations of 0-group fish (fish within the first year of their lives); there is evidence of aggregations of juvenile whiting, herring, horse mackerel and sprat (*Sprattus sprattus*) in the wider area. The area is not within any known elasmobranch spawning or nursery grounds (Ellis *et al.* 2012).

Table 4.1 – Spawning periods for fish and shellfish in ICES Rectangle 35F1

Species	Spawning grounds	Nursery grounds	Peak spawning
Herring	✓[1]	✓[2]	Aug – Oct[1]
Mackerel	✓[1]	✓[2]	May – Aug[1]
Cod	-	✓[2]	-
Whiting	✓[2]	✓[1, 2]	Feb – Jun[1]
Plaice	-	✓[1, 2]	-
Sole	✓[1, 2]	✓[1]	Mar – May[1]
Lemon sole	✓[1]	✓[1]	April – Sept[1]
Sandeel	✓[1, 2]	✓[1, 2]	Nov – Feb[1]

Source: [1]Coull et al. (1998), [2]Ellis et al. (2012)

The area supports commercially important populations of whelk (*Buccinum undatum*), lobster (*Homarus gammarus*) and various crab species.

4.7 Birds

The UK is of international importance for its breeding seabirds and wintering waterbirds. The shingle beaches and coastal marshes of the North Norfolk Coast are important for a number of breeding tern species and these areas along with the wetlands of Breydon Waters and Berney Marshes, are amongst

some of the most important areas in the UK for wintering birds, regularly supporting in excess of 120,000 and 90,000 individuals respectively (Frost *et al*. 2016). Inshore and offshore areas are also important, providing feeding grounds to breeding, migratory and on-passage birds. A number of publications (e.g. Tasker & Pienkowski 1987, Skov *et al*. 1995, Furness 2015) describe the distribution of seabirds in the North Sea and the seasonal variation in bird distribution in the general Anglia area, is summarised in Table 4.2.

Table 4.2 – Bird distribution in the greater Anglia area throughout the year

Month	Summary of distribution
January	Auks (guillemots and razorbills) present in large numbers throughout the southern North Sea and gulls (mostly herring and great black-backed) and fulmars are numerous. Severity of the weather will influence the movement westward of some waterbird species from the Wadden Sea. In years with severe weather, large scale movements of great crested grebes, shelduck, scaup and red-breasted merganser to sites along the English coast have been recorded. Peak counts of shelduck occur in areas including The Wash, as do large numbers of goldeneye. In mild winters, more birds will remain on the eastern side of the North Sea.
February	High numbers of auk present off the coast, more so to the north of Anglia; puffins are present in large numbers and widely distributed in the southern North Sea. Moderate numbers of other seabirds, particularly kittiwake, present off the Norfolk and Suffolk coast. Return of some adult gannets to the North Sea. Southern English sites including The Wash, continue to support large numbers of shelduck. This and other sites along this coast also remain important for flocks of waders, including grey plover and redshank.
March	Some fulmars present in the southern North Sea. Some bird species that have wintered in the UK begin to return to breeding grounds and numbers start declining at British sites. Large numbers of shelduck still present at some sites, including The Wash.
April	Breeding season for some seabirds begins at the end of the month, with birds re-establishing/ establishing/defending territories at colonies. Many seabirds, particularly females, feeding to improve body condition; some may feed close to colonies but others may be further offshore. Colonies on the nearest coast, e.g. North Norfolk Coast important for breeding common tern, little tern, Mediterranean gull, roseate tern and sandwich tern. Birds with breeding sites outside the UK, continue to leave their wintering grounds along the British coast. Although absolute numbers on British estuaries are declining during this period, birds on passage will continue to use these sites. Sites such as the Wash and the Humber (further to the north), remain important for species such as dark-bellied Brent goose, dunlin, knot and curlew, and the Wash continues to support important numbers of shelduck.
May	Start of breeding season for most seabirds, laying and incubating eggs. Large numbers of sandwich and little terns found at breeding sites in southern North Sea. Peak of migration to breeding grounds for several species such as ringed plover, grey plover, knot, sanderling, dunlin, bar-tailed godwit and turnstone. The Wash continues to support important numbers of birds, including dark-bellied Brent geese and dunlin.
June	Peak of breeding season for species which breed in the UK. Majority of seabirds in coastal areas, but numbers not large in this area compared to central northern parts of the North Sea. Towards the end of June, some seabirds start to leave colonies and disperse out to sea. Most migrant birds that winter on North Sea coasts and passage birds, have returned to their breeding grounds, with eider being the only seaduck which breeds in any significant numbers; there are no principal breeding sites for eider along the Anglia coast, with most breeding sites being in Scotland, Northern Ireland and parts of northern England.
July	Moulting season for inshore and coastal birds, with some auks flightless at this time. Massive movement of birds into offshore North Sea during this month. Aggregations of birds present in coastal waters off the coast of Flamborough Head to the north of Anglia and Great Yarmouth to the south. Large numbers of waders move to sites along the coast. Shelduck moult during this month, peak numbers occur in the Helgoland Bight (east of the Wadden Sea), with smaller numbers in The Wash. Relatively small flocks of moulting common scoter found in the outer Thames estuary to the south of Anglia, and small numbers of this species off North Norfolk Coast; larger numbers recorded off the coast of south Suffolk and north Essex.

Month	Summary of distribution
August	Concentrations of sandwich tern are coastal, although some birds feed offshore, and most widely distributed after the breeding season. Start of the main influx of wading birds and ducks to the North Sea, e.g. The Wash and the estuarine systems further south, with many sites supporting important numbers of birds, including grey plover, dunlin, knot, sanderling, curlew, redshank and shelduck.
September	Few auks in offshore area at this time, with concentrations further north in the central and northern North Sea. Great black-backed gulls are present, frequently found around trawlers off the east coast of England. Peak month for estuary usage. Large numbers of waders and ducks at estuaries, including The Wash, including grey plover, dunlin, knot, sanderling, curlew, redshank and shelduck.
October	Southward shift of guillemot and razorbill populations with high concentrations of auks offshore, particularly in the area of southern gas fields off Norfolk and Lincolnshire. Prominent movement of gannet during autumn from the North Sea to the Channel. During early winter, large numbers of common scoter present in The Wash, with smaller numbers located off the North Norfolk Coast. Most common scoter occurred in the outer parts of the Wash, with no obvious distribution change as winter progressed and no apparent movement offshore.
November	Razorbills from more southerly and westerly colonies fly into southern wintering grounds, including southern North Sea. Dispersion of gannet from breeding sites is at maximum. Kittiwakes distributed over large areas of the North Sea, in winter, numbers double, and areas such as the Silver Pit, to the north of Anglia, support large numbers. Some birds, including knot and sanderling move west from the Wadden Sea to sites on the east coast of England, including The Wash. Pink-footed goose return to the North Norfolk area. Shelduck moult has been completed and large flocks move from sites in the Wadden Sea to area on The Wash and also further north at Teesmouth. The Wash also support large influxes of goldeneye and pink-footed goose return to North Norfolk area.
December	High concentrations of auks and other seabird species in offshore areas in the southern North Sea. Guillemots are widespread in winter, however densities are generally much lower in the central and southern North Sea than those seen in areas further north. More estuaries on the east coast of England, become important for shelduck as numbers increase and The Wash remains one of the most important estuaries in the western North Sea for wading birds. Small numbers of divers (e.g. red-throated, black-throated and great northern) occurred far from shore, with what appears to be a general movement offshore in late winter. Large numbers of eider recorded throughout the winter, with greatest numbers in the Greater Wash area during mid winter.

Source: Tasker & Pienkowski (1987), Skov et al. (1995), Tasker (1996), Furness (2015), WWT Consulting (2008, 2009)

Following breeding, adults and juvenile seabirds disperse from colonies out to the wider North Sea, with some migrating out of the area completely to wintering grounds. When they disperse, adult and juvenile auks (guillemot and razorbill) move offshore where adults undergo a post-breeding moult, and, along with the flightless young, form rafts on the sea surface. The auks present in the southern North Sea (e.g. Blake *et al*. 1984, Wernham *et al*. 2002, Brown & Grice 2005, see also MacArthur Green 2016) are likely to be birds from east and north of England (such as Bempton) and possibly Scottish colonies.

The importance of the east coast of England to breeding seabirds and wintering/passage waterbirds is reflected in the designation of a number of international and national conservation sites on land and at sea (see Section 4.9). The two most significant sites, in terms of wintering bird numbers are The Wash and the North Norfolk Coast Special Protection Areas (SPAs), with 2014/2015 winter counts of 343,932 and 121,195 individuals respectively (Frost *et al*. 2016), with both sites also designated for breeding seabirds. The Greater Wash SPA has a combination of breeding seabirds (e.g. common tern, little tern, sandwich tern) and over-wintering birds (e.g. little gull, red-throated diver, common scoter) as designated features, the boundary encompassing important foraging areas for breeding seabirds and areas at sea used by wintering waterbirds. Numerically this area is one of the most important areas in Britain for wintering waterbirds, moulting waders (early autumn), breeding waders, terns and other seabirds (JNCC website).

Vulnerability to oil pollution

The vulnerability of seabird species to oil pollution at sea is dependent on a number of factors and varies considerably throughout the year. The Offshore Vulnerability Index (OVI) was developed by JNCC (Williams *et al*. 1994) but and a new revised index, the Seabird Oil Sensitivity Index (SOSI), has now been published (Webb *et al*. 2016).

The SOSI was developed (Webb *et al*. 2016)[4] based on previous indices by Williams *et al*. (1994) and method refining by Certain *et al*. (2015) using seabird survey data collected from 1995-2015 from a variety of survey techniques (boat-based, visual aerial and digital video aerial). This survey data was combined with an individual seabird species sensitivity index value, these values being based on a number of factors considered to contribute towards a species sensitivity to oil pollution such as habitat flexibility (a species ability to locate to alternative feeding sites), adult survival rate and potential annual productivity. The SOSI is presented as a series of monthly UKCS block gridded maps, with each block containing a score on a scale of low to extremely high; these scores indicate where the highest seabird sensitivities might lie, if there were to be a pollution incident.

The seabird sensitivity in all or parts of the Anglia Field Blocks is high, very high or extremely high for eight months of the year. It should be noted that low data availability is indicated for part of the Anglia area for a number of months, (see Figure 4.5). Updated JNCC guidance describes a method to help reduce the extent of coverage gaps (JNCC 2017b). For Anglia the first and second of these steps, using data from adjacent months and using data from adjacent Blocks, has been sufficient to populate some of these gaps which are marked in red in Table 4.3; the months with coverage have values in black or white. For a number of Blocks, coverage gaps could not be reduced by using either step 1 or 2 and these have been denoted by N and highlighted yellow; only two of these remain for the Blocks of interest (shown in bold below).

Table 4.3 – Seabird oil sensitivity in and around the Anglia facilities

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
48/12	2	2	2	2	5	5	5	3	3	2	1	2
48/13	1	2	3	3	3	5	5	3	3	1	1	2
48/14	1	2	3	3	3	5	2	3	5	1	1	2
48/15	1	1	1	N	N	N	4	4	4	N	N	N
49/11	1	1	1	N	N	1	1	5	5	N	N	N
48/17	3	3	3	3	5	5	5	3	4	2	1	3
48/18	**1**	**2**	**3**	**3**	**5**	**5**	**5**	**3**	**3**	**1**	**1**	**1**
48/19	**1**	**1**	**3**	**3**	**3**	**5**	**5**	**3**	**3**	**1**	**1**	**1**
48/20	**1**	**1**	**1**	**N**	**3**	**5**	**5**	**5**	**5**	**N**	**1**	**1**
49/16	2	2	2	N	N	N	5	5	5	N	N	N
48/22	4	3	3	3	5	5	5	3	3	2	2	2
48/23	2	2	3	3	5	5	5	3	4	2	2	2
48/24	1	2	2	2	4	5	5	3	3	2	2	2
48/25	1	1	1	1	N	N	4	4	4	2	2	2
49/21	1	1	2	2	N	N	5	5	5	N	1	1

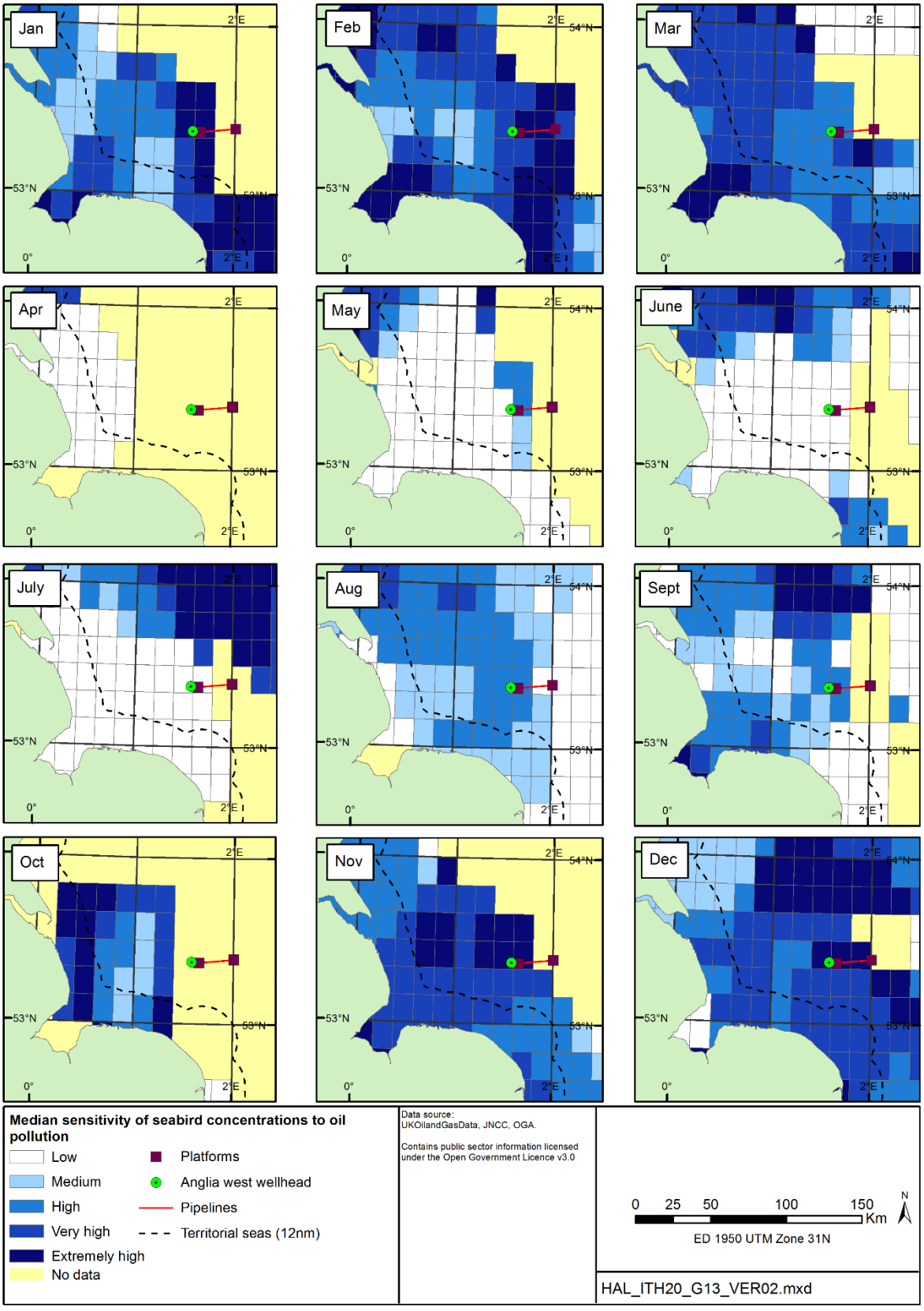
Notes:

1 = Extremely high | 2 = Very high | 3 = High | 4 = Medium | 5 = Low | N = No coverage

Note that Anglia was a gas field, with a small amount of condensate and has been made hydrocarbon free.

[4] See JNCC: http://jncc.defra.gov.uk/page-7373.

Figure 4.5 – Monthly seabird oil sensitivity index scores



Note: Values presented in Webb et al. (2016) are the median, minimum and maximum of the smoothed SOSI scores in each oil licence block, the median value represents the central point of the smoothed values calculated for any given block and represent the most likely assessment of seabird sensitivity to oil pollution. Source: Webb et al. (2016)

4.8 Marine Mammals

4.8.1 Cetaceans

Only a few cetacean species are sighted with regularity in the southern North Sea. The most abundant cetacean by far in the area is the harbour porpoise (*Phocoena phocoena*). All cetaceans are listed on Annex IV of the Habitats Directive and the harbour porpoise and bottlenose dolphin (unlikely to be present in the Anglia area), are listed on Annex II.

Harbour porpoise

The harbour porpoise is the most common cetacean in UK waters; it is wide-ranging and abundant throughout the UK shelf seas, both coastally and offshore. It is also the smallest and most inconspicuous cetacean within UK waters with sighting rate strongly affected by sea state; typically, it occurs in small groups of one to three animals. It feeds on a variety of small shoaling demersal and pelagic fish species, with differences recorded seasonally and geographically (Santos *et al.* 2004). In the southern North Sea, the most common prey species include sandeels, mackerel, several gadoids (whiting, poor cod, cod), sprat, herring and gobies (Jansen *et al.* 2012). Foraging rates in this species are the highest reported for cetaceans; they forage nearly continuously during day and night and this is assumed to be a necessary consequence of the species' higher than average metabolic rate (Wisniewska *et al*. 2016).

Individual harbour porpoises in the southern North Sea are part of the north east Atlantic population which is understood to behave as a continuous biological population (from the French coasts of the Bay of Biscay to Norway and Iceland, excluding the Baltic). Nonetheless, for management and conservation purposes the population has been split into three distinct units, with the North Sea Management Unit being the one relevant to the Anglia area (IAMMWG 2015).

A southerly shift in the distribution of harbour porpoise has been reported across the North Sea during the 10 years between the first two systematic large-scale surveys of cetacean abundance (Small Cetacean Abundance in the European Atlantic and North Sea, SCANS). In 1994, sightings were almost absent from the southern North Sea but very high densities were observed off Scotland, including Shetland. In the repeated survey in 2005 (SCANS-II), the highest densities were estimated in the southern North Sea, with numbers in the north much reduced over 1994 estimates, including Moray Firth, Orkney and Shetland (Hammond *et al.* 2013). The 2016 SCANS-III survey reported a similar distribution to that of the 2005 survey (Hammond *et al.* 2017). More evidence corroborating the southerly distributional shift has come from land-based observations in the UK (Evans *et al.* 2015) and from reports of increasing trends in sightings and strandings along the French, Belgian, Dutch and German waters over the last decade (Camphuysen 2004, Jauniaux *et al*. 2008, Haelters *et al*. 2011, Peschko *et al*. 2016). Despite this distribution shift, harbour porpoise population estimates throughout the wider North Sea have been comparable in 1994, 2005 and 2016, with no evidence for a trend in abundance (Hammond *et al.* 2017). The population was deemed to be in favourable condition at the latest assessment[5] (JNCC 2011) and, given the 2016 results, would likely to be assessed as favourable at the present time.

Within the southern North Sea, survey effort has markedly increased in the last 15 years on account of baseline surveys related to the offshore wind energy development schemes. These and other data, including the 1994 and 2005 SCANS surveys, have allowed recent modelling efforts to identify areas of persistent relatively high harbour porpoise density (Heinänen & Skov 2015), resulting in the designation of the Southern North Sea SAC (Figure 4.6; Section 4.9). Seasonal differences in the

[5] As part of the 3rd Report by the UK under Article 17 on the implementation of the Habitat Directive (JNCC 2011)

relative use of this large (36,951km^2) offshore site by harbour porpoise have been identified; in the summer, elevated densities are expected only within the northern two thirds of the site, while the southern third is the preferred area in the winter, together with two small patches in the north[6]. From the work of Heinänen & Skov (2015), model-predicted densities of harbour porpoise suggest > 2.7 animals per km^2 are common within the summer and winter areas of the SAC. The Anglia Field lies on the western edge of the SNS SAC, with the closest boundary to the site (summer area) lying 4.7km to the northwest of the Anglia A NUI. The export pipeline to the LOGGS PP facilities lies largely within the SNS SAC summer area (approximately 18km of the ~24km line). Model-predicted density in the Anglia area for summer 2009 was ca. 1.2-1.8 harbour porpoise per km^2 (Heinänen & Skov 2015).

Winter densities in the Anglia area are subject to greater uncertainty due to limited survey coverage; model predictions suggest that they may be similar or greater than summer densities, although it is noted that the identified area of persistent high winter density lies some 35km to the south. The latest SCANS-III survey provided abundance and density estimates for large areas across the North Sea; the Anglia facilities lies in 'block O' (total area = 60,198km^2) with an estimated density of 0.89 harbour porpoise per km^2 (Hammond *et al.* 2017).

Other cetaceans

The minke whale (*Balaenoptera acutorostrata*) is seasonally abundant in UK waters. From May through September the species is frequently sighted in the central and northern North Sea, although sightings in the southern North Sea, south of 54°N (ca. Flamborough Head), are rare (Northridge *et al.* 1995; Hammond *et al.* 2002, 2013, 2017; Reid *et al.* 2003). The white-beaked dolphin (*Lagenorhynchus albirostris*) is present year-round in the central and northern North Sea, but uncommon further south; very few sightings have been reported south of Outer Silver Pit (Reid *et al.* 2003), and the species was not sighted south of 54°N in the North Sea in any of the three[7] SCANS surveys (Hammond *et al.* 2002, 2013, 2017). In the Anglia area, there is a low likelihood of the presence of low numbers of white-beaked dolphin and minke whale. The estimated density for the corresponding SCANS-II survey 'block O' was <0.01 white-beaked dolphin per km^2 and 0.01 minke whales per km^2 (Hammond *et al.* 2017).

Other species sighted with occasional to rare frequency in the southern North Sea include the Atlantic white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus*), and short-beaked common dolphin (*Delphinus delphis*) (Reid *et al.* 2003).

4.8.2 Seals

Two species of seal occur in the southern North Sea, harbour (*Phoca vitulina*) and grey (*Halichoerus grypus*) seals; both are listed on Annex II of the Habitats Directive. Colonies and haul-out sites of harbour and grey seals are present on the east coast of England, several of which are designated as SACs under the Habitats Directive (see Section 4.9).

[6] Draft Conservation Objectives and Advice on Activities for the Southern North Sea site were accessed from the JNCC website (http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf)
[7] In 1994, 2005 and 2016: results reported in Hammond *et al.* (2002,2013 and 2017)

Harbour seals

Most harbour seal colonies and haul-out sites on the coast of England are in the Southeast England management unit (Flamborough Head to Newhaven). Combined counts for this region in 2016 were 5,061 animals (SCOS 2017), indicating the population has returned to its pre-2002 phocine distemper epidemic levels. The largest colony by far is The Wash, with smaller colonies at Blakeney Point on the north Norfolk coast and Donna Nook at the mouth of the Humber. Annual aerial surveys of The Wash have recorded large inter-annual variation in pup counts, but overall pup production has increased by around 7.4% per year since surveys began in 2001 (Thompson *et al*. 2016). Small colonies of harbour seal are also present on the east Norfolk coast and the greater Thames area, while large numbers are present along the Wadden Sea coast of mainland Europe. Following a rapid rate of increase of 9.5% per year from 2003-2013, total counts for the Wadden Sea harbour seal population appear to have stabilised at ca. 26,000 (Galatius *et al.* 2017).

Model-based assessments of the at-sea distribution of grey and harbour seals around the UK and Ireland have been derived from satellite tagging data and haul-out count data, including several dozen seals tagged at colonies on the east coast of England (Jones *et al.* 2015; Jones & Russell 2016; Russell *et al.* 2017). Results show that grey seals use offshore areas (up to 100km from the coast) connected to their haul-out sites by prominent corridors, while harbour seals primarily stay within 50km of the coastline (Jones *et al.* 2015). Models of marine usage by harbour seals in the southern North Sea show a large area of fairly diffused activity extending from The Wash, with the greatest activity offshore occurring between 20-70km off the Humber. The at-sea usage by harbour seals in the Anglia area is estimated at approximately 1-3 animals per 5x5 km grid cell, with an area of slightly higher usage of 5-7 animals per grid cell within 5km to the south (Russell *et al*. 2017). While Wadden Sea harbour seals may form part of the same genetic cluster as those in southeastern England (Olsen *et al.* 2017), tagging data and habitat modelling suggest that these animals currently spend the majority of their time at-sea within 40km of the Dutch coast, with only occasional forays into UK waters (Aarts *et al*. 2016).

Grey seals

Colonies of grey seal are present at Donna Nook, at Blakeney Point, and Horsey on the east Norfolk coast. Small numbers of breeding grey seals are also recorded at Flamborough Head and The Wash. Total counts of grey seals at haul-out sites in southeast England in August 2016 numbered 6,085 animals, which tagging data suggests to represent about a quarter of the total population for this region (SCOS 2017). At the main UK colonies in the southern North Sea, 5,027 newborn pups were counted in 2014, with an average annual increase of 22.3% from 2012-2014 (SCOS 2017). Small, but increasing numbers of grey seals occur along the European continental coast of the southern North Sea, the vast majority of which are recorded in the Dutch Wadden Sea, with counts during the 2017 spring moult totalling 5,445 and an average annual increase of 16% observed from 2008-2016.

Models estimate at-sea usage by grey seals to be high around the mouth of the Humber and extending offshore to the north and northeast, with moderate to high usage around The Wash and Norfolk coast; usage in the Anglia area is estimated to be low, at < 0.5 grey seals per 5x5km grid cell (Russell *et al.* 2017). Telemetry data from 62 grey seals tagged at sites in the Netherlands showed 21 of these animals to spend time in the UK southern North Sea, including visits to Donna North, Blakeney Point and Horsey colonies (Brasseur *et al*. 2015). While these data have not been extrapolated to at-sea usage, they indicate that grey seals from sites in the Dutch Wadden Sea contribute additional low levels of at-sea usage in the wider Anglia area.

4.9 Conservation Sites

The importance of the region is reflected in the designation of a number of international and national inshore and offshore conservation sites, including Special Protection Areas (SPAs) established under the Birds Directive[8], Special Areas of Conservation (SACs) under the Habitats Directive[9] (SPAs and SACs collectively form part of the European ecological network of Natura 2000 sites) and Ramsar sites designated under the Ramsar Convention[10]. At a national level, Marine Conservation Zones (MCZs) are designated under the *Marine and Coastal Access Act 2009* (as amended) for English territorial and offshore waters; administered by Natural England and JNCC respectively. The relevant SACs, SPAs and MCZs currently designated or proposed are shown in Figure 4.6 and Table 4.4, including distances to the Anglia area. An analysis of European Seabirds at Sea (ESAS) data was conducted with the aim of identifying potential SPAs for seabird aggregations (within the British Fishery Limit) (Kober *et al*. 2010, 2012). Four regions from the initial analyses were identified as being of particular importance (outer Firth of Forth, including the Wee Bankie and Marr Bank, inner Firth of Forth, the Moray Firth and the sea areas to the north and west of the Shetland Islands) (Kober *et al*. 2010), with additional areas identified through applying further analyses (Kober *et al*. 2012). None of the potential areas identified from these were in or close to, the Anglia area.

The majority of the Anglia infrastructure to be decommissioned is within the boundary of the NNSSR SAC. Approximately 18km of the ~24km export pipeline/methanol line between the Anglia A NUI and LOGGS PP is also within the SNS SAC.

The NNSSR SAC contains the most extensive example of offshore linear ridge sandbanks in UK waters, and encompasses an area where previous seabed surveys identified an extensive biogenic reef created by the ross worm *Sabellaria spinulosa*, called Saturn reef (Jenkins *et al.* 2015). The sandbanks are subject to a range of current strengths which are strongest on the banks closest to shore (see Section 4.1). Whilst the sandbanks are very similar in terms of the biological communities present, increasing species numbers have been recorded on the outermost banks, likely related to the change in hydrodynamic regime with increasing distance from the coast[11] (JNCC website). First discovered in 2002, the Saturn reef covered an area some 750m by 500m just to the south of Swarte Bank (located ~19km north east of the LOGGS complex). More recent surveys failed to identify the extensive areas of *Sabellaria. spinulosa* reef previously observed but did find reefs in the area which highlights the ephemeral nature of the feature and indicates that favourable conditions for *Sabellaria. spinulosa* formation occur within the site (see JNCC website and Jenkins *et al*. 2015).

Data from the baseline survey of the Anglia area carried out in 2002 (Gardline 2003) and the pre-decommissioning survey conducted in 2017/early 2018, while finding individuals, did not identify any occurrence of *Sabellaria. spinulosa* reef (Fugro 2018a, b).

The Southern North Sea SAC was designated for harbour porpoise, but variability in numbers within the site and across the North Sea (seasonally and between years) is known to be high. As part of the site identification process, analysis of the observed density of harbour porpoise against different environmental variables (Heinänen & Skov 2015) indicated that the coarseness of the seabed sediment was an important determinant of porpoise density, with porpoises showing a preference for coarser sediments (such as sand/gravel) rather than fine sediments (e.g. mud). Sandeels, a known prey of harbour porpoises, exhibit a strong association with sandy substrates. The majority of the substrates within the site are sublittoral sand and sublittoral coarse sediment.

[8] Council Directive 2009/147/EC on the conservation of wild birds
[9] Council Directive 92/43/EEC on the conservation of natural habitats of wild flora and fauna
[10] The Convention on Wetlands of International Importance, especially as Waterfowl Habitat.
[11] JNCC website – North Norfolk Sandbank and Saturn Reef MPA information: http://jncc.defra.gov.uk/page-6537

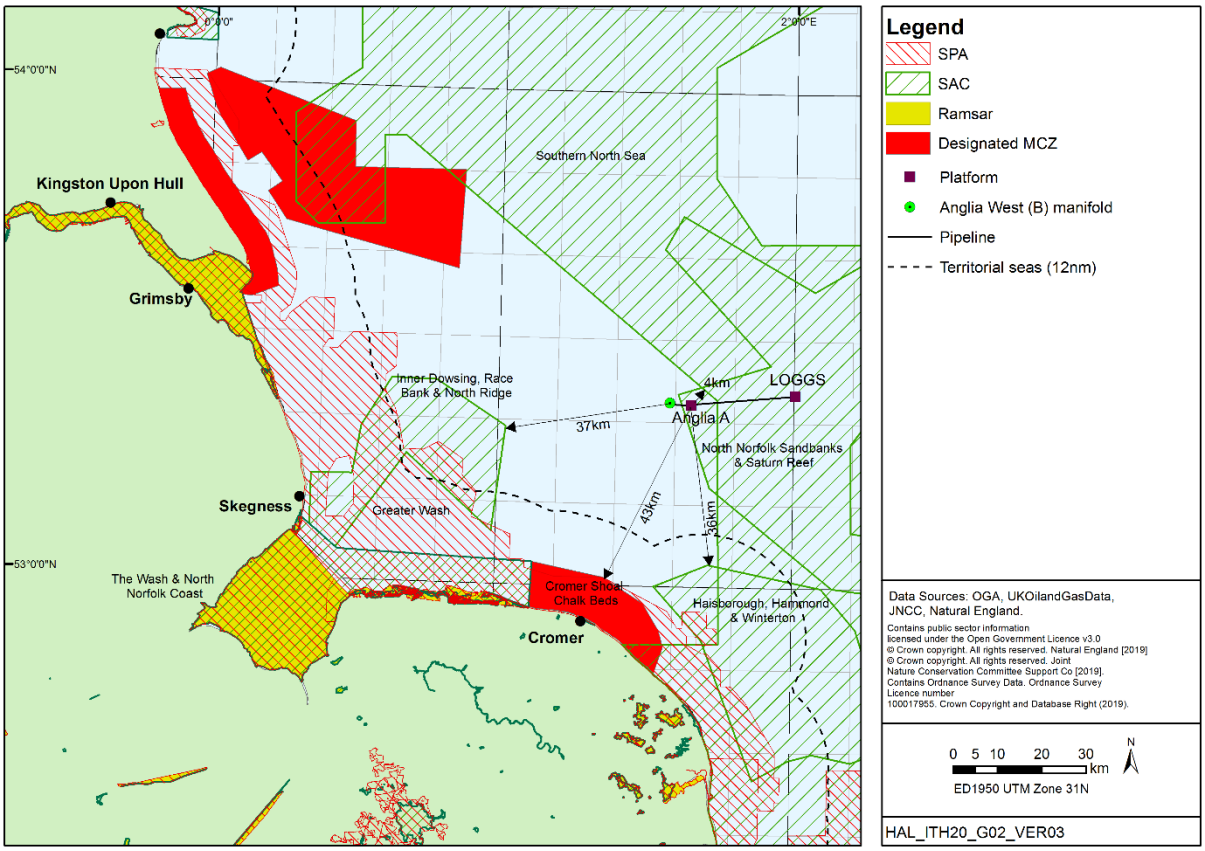
The Marine and Coastal Access Act 2009 (as amended) enables the designation and protection of MCZs anywhere in English and Welsh territorial and UK offshore waters. To date, there have been three tranches where sites have been considered for designation, the most recent in 2018. Designation can be to protect nationally important marine wildlife, habitats, geological and geomorphological features. In the wider Anglia area and southern North Sea there are three designated MCZs (Table 4.4).

Table 4.4 – Relevant conservation sites and their features

Name	Status	Distance to Anglia[1] km	Summary of features – also see Appendix 3
Humber Estuary	SPA/Ramsar	88 (Anglia West B)	Breeding, on passage and overwintering waterbirds, breeding terns, breeding and overwintering birds of prey. Overwintering waterbird assemblage
Humber Estuary	SAC	90 (Anglia West B)	Annex I habitats: Estuaries mudflats and sandflats, sandbanks, saltmarsh and salt meadows, coastal lagoons, coastal dunes Annex II species: River lamprey, sea lamprey, grey seal
Gibralter Point	SPA	87	breeding tern and overwintering waterbirds
Holderness Offshore	MCZ	56 (Anglia West B)	Subtidal coarse sediment; subtidal mixed sediment
Holderness Inshore	MCZ	92 (Anglia West B)	Circalittoral rock, intertidal sands/muds, subtidal sediments
Greater Wash	SPA	43 (Anglia A NUI)	Overwintering divers, waterfowl and gulls, breeding terns.
The Wash	SPA/Ramsar	84 (Anglia West B)	Overwintering waterbirds, overwintering waterbird assemblage, breeding terns.
Outer Thames Estuary	SPA	80 (Anglia A NUI)	Breeding terns, overwintering diver.
Southern North Sea	SAC	Some infrastructure located within boundary[2]	Annex II species: Harbour porpoise
North Norfolk Sandbanks and Saturn Reef	SAC	Some infrastructure located within boundary[3]	Annex I habitats: Sandbanks which are slightly covered by sea water all the time, reefs
North Norfolk Coast	SPA	56 (Anglia West B)	Overwintering waterbirds, overwintering waterbird assemblage, breeding terns
Inner Dowsing, Race Bank and North Ridge	SAC	37 (Anglia West B)	Annex I habitats: Sandbanks which are slightly covered by sea water all the time, reefs
Haisborough, Hammond and Winterton	SAC	36 (Anglia A NUI)	Annex I habitats: Sandbanks which are slightly covered by sea water all the time, reefs
Cromer Shoal Chalk Beds	MCZ	43 (Anglia A NUI)	Infralittoral and Circalittoral rock, subtidal chalk and sediment, peat and clay exposures

Note: [1]Closest Anglia infrastructure to the site boundary is shown in brackets. [2] Approximately 18km of the ~24km export pipeline/methanol line between the Anglia A NUI and LOGGS PP is located within the site boundary. [3]Approximately 2.5km of the 5km infield pipeline and umbilical, Anglia A NUI and the export pipeline/methanol line is located within the site boundary.

Figure 4.6 – Designated sites in and around the Anglia area



4.10 Other Users of the Offshore Environment

Offshore Energy

Hydrocarbon production in the southern North Sea is predominantly gas with some condensate. There is an extensive network of offshore production installations along with interfield and export pipelines serving terminals including at Bacton, Theddlethorpe and Easington/Dimlington (Figure 4.7). The 24" Esmond to Bacton gas pipeline crosses the Anglia West (B) infield pipeline and umbilical, and the 24" Clipper to Bacton gas pipeline and separate 3.5" chemical line cross the Anglia export pipeline.

The southern North Sea is a mature basin, and several fields are either subject to Decommissioning Plans (e.g. Ann and Alison fields, parts of the Viking and LOGGS fields, the Saturn, Annabel and Audrey fields) or are likely to be subject to decommissioning planning in the coming years.

UK offshore wind capacity has, to date, been concentrated in the southern North Sea in part due to its advantageous water depths and grid connection opportunities. There are a number of operational, under construction and consented wind farm developments in the southern North Sea, the closest of which is the Dudgeon operational wind farm, ~15km south west of the Anglia West (B) manifold (Figure 4.8). There are no wave or tidal developments, including any in the pre-planning stage, in the Anglia area.

Figure 4.7 – Oil and gas infrastructure

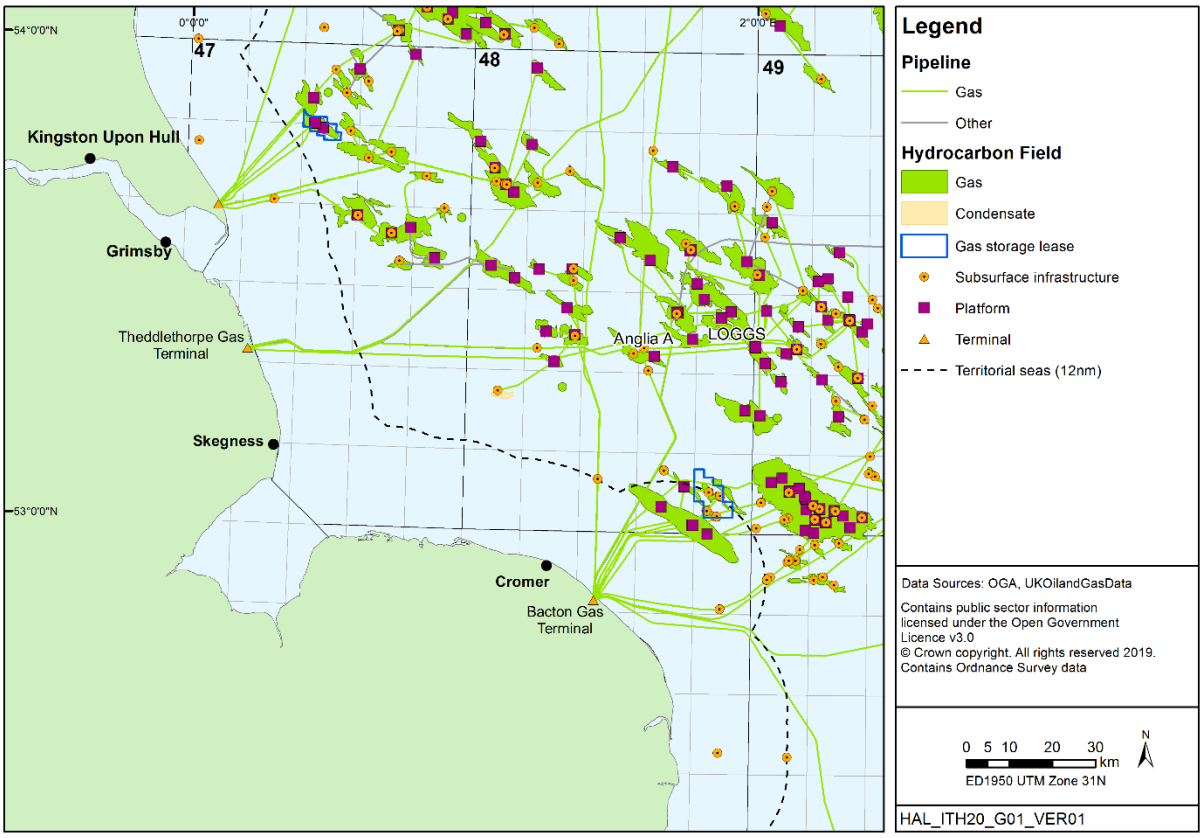
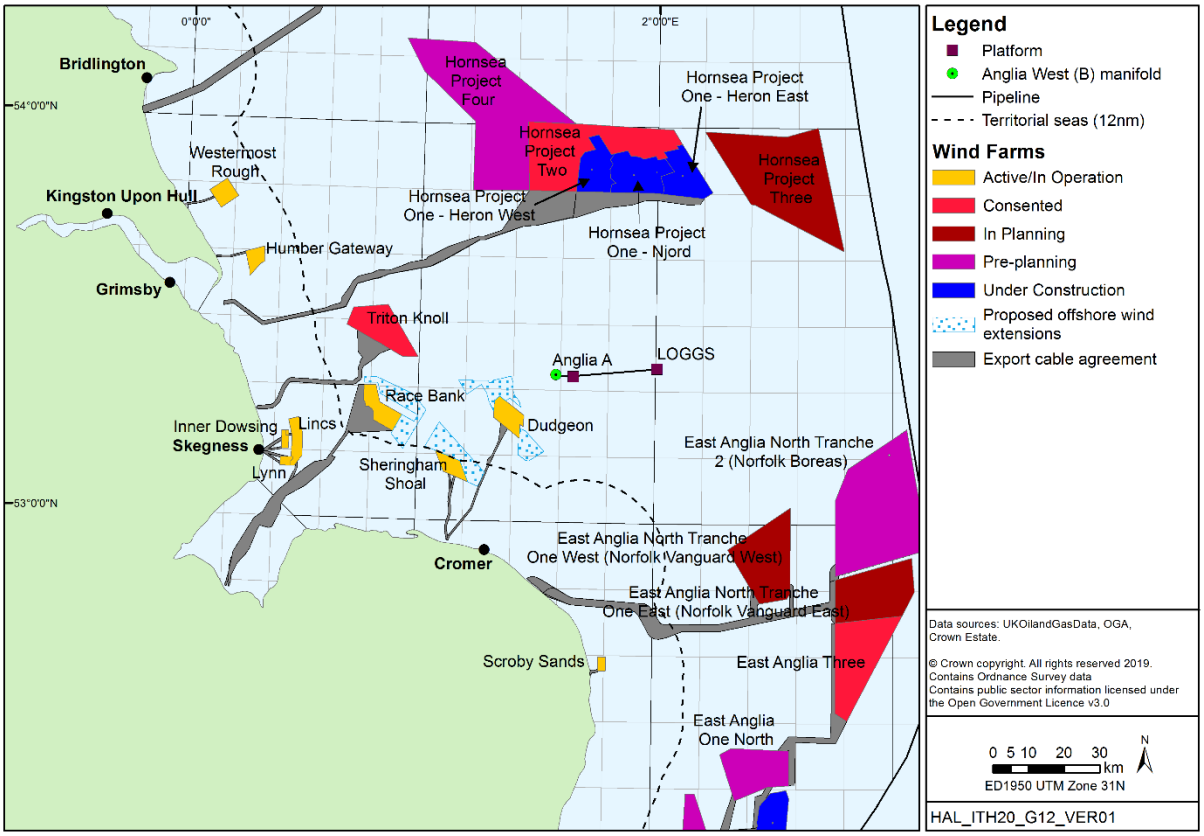


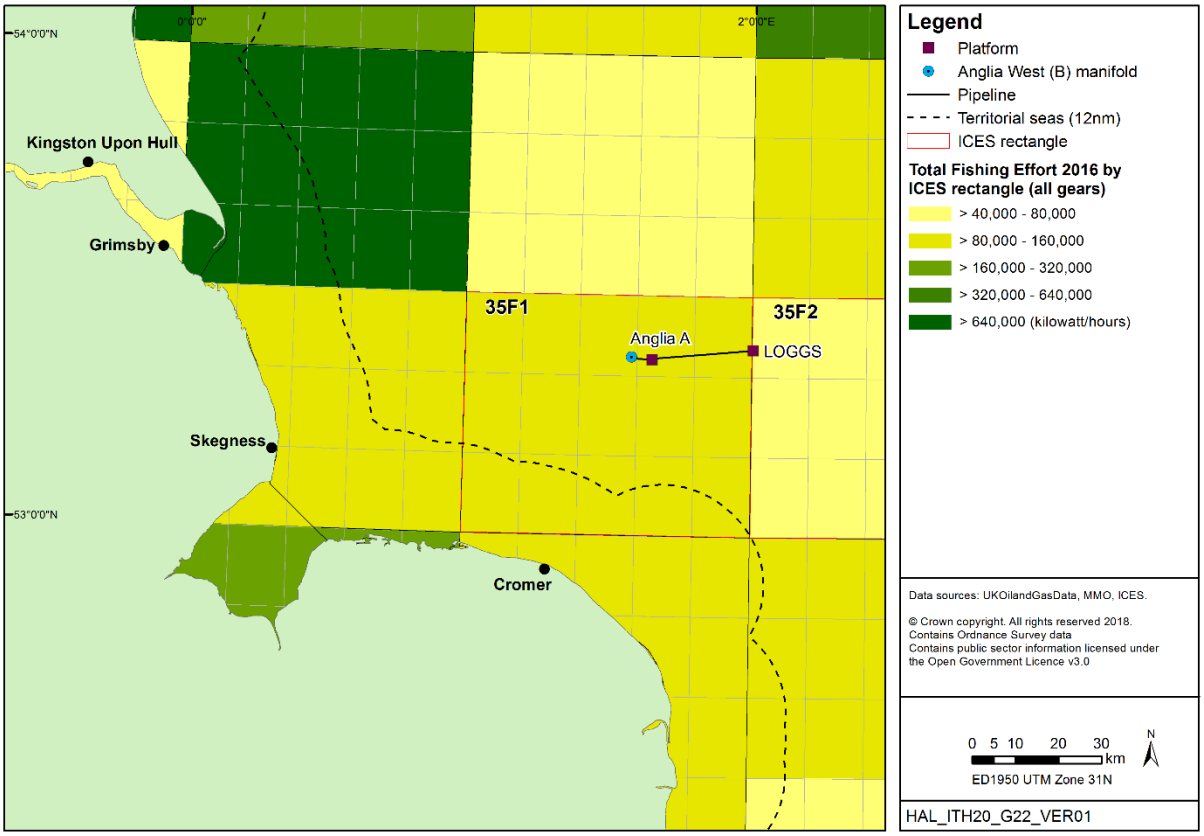
Figure 4.8 – Renewable energy



Fisheries

ICES rectangles are used for fisheries data recording and management. The Anglia facilities are in ICES rectangle 35F1. Vessel Monitoring System (VMS) data shows levels of fishing effort in the Anglia area, to be at low levels (Figure 4.9); a closer examination of fishing intensity along the Anglia to LOGGS pipeline route (Figure 4.10) further demonstrates this.

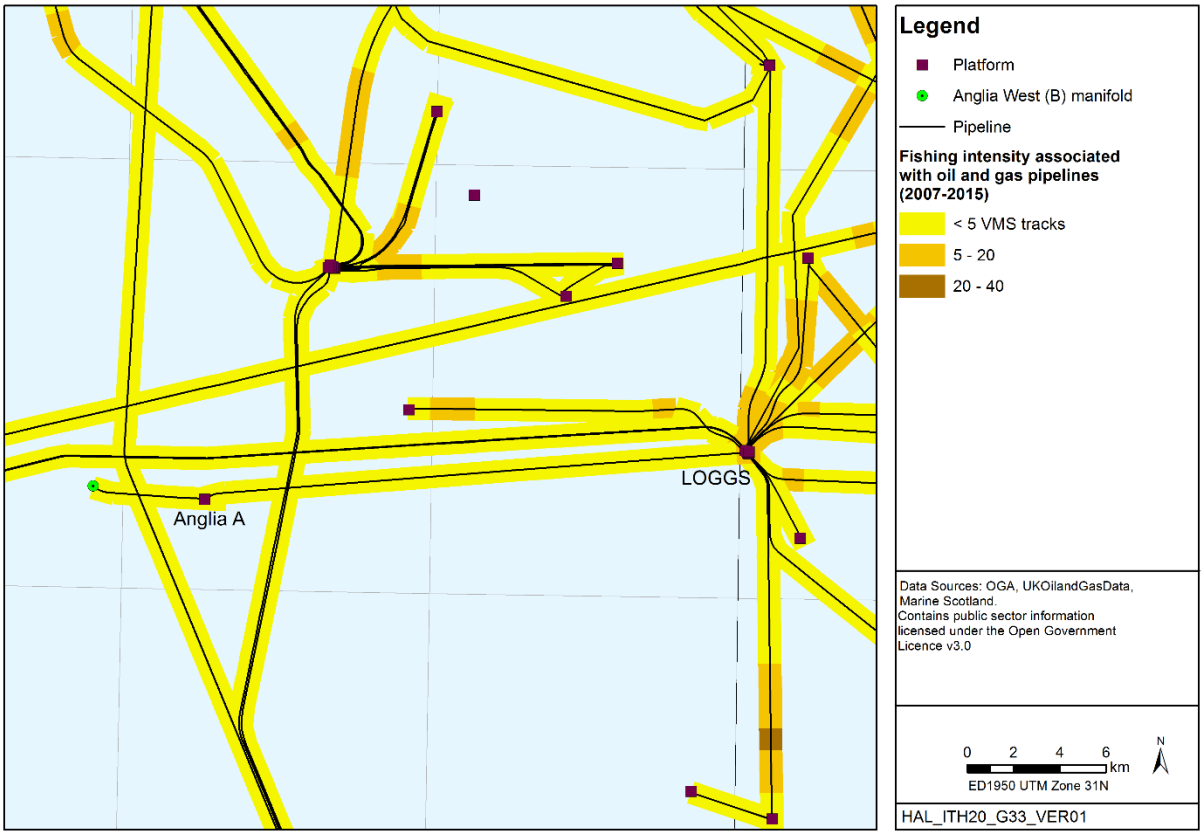
Figure 4.9 – Fishing effort by all vessels in and around 35F1 in 2016



Detailed landings data for 2014-2017 are not available, due to the issues of confidentiality that may arise from revealing such small values. However, total landings from 35F1 in 2013 were 1,417 tonnes at a value of £1,460,314 (Scottish Government website). Over 98% of landings and 92% of value in 2013 was dominated by shellfish (crab, lobster and whelk), with the remaining landings predominately of demersal species. Relatively few finfish species were caught, of which flatfish (plaice, brill and sole), rays (blonde and thornback) and bass made up most of the landings. Fishery statistics compiled by the MMO show demersal landings in 35F1 in 2016 of between 0-25 tonnes (value £0-0.1 million) and shellfish landings of between 800-1,600 tonnes (£0.8-1.6 million), in line with previous data from 2013 (MMO 2017).

Inshore fisheries are of importance around the Lincolnshire and Norfolk coasts, and particularly in the Wash, although this activity typically does not extend as far as Anglia. Most fishing effort in the rectangles is carried out by traps targeting crabs, lobsters and whelks. There is a significant local fishery for brown crab (*Cancer pagurus*). A total of 154 tonnes of brown crab, at a value of £193,000, was landed into Cromer in 2017, representing 73% of all landings into the port and 32% of the value (MMO website). The smaller-scale, but higher-value lobster (*Homarus gammarus*) fishery accounts for most of the remainder of the landed weight and value. Fishing activity is seasonal, and the majority of landings into Cromer are made between March and August (MMO website).

Figure 4.10 – Fishing intensity (<15m) along pipeline and cable routes in and around the Anglia area, from data collected 2007-2015



Note: This map was created by calculating the number of fishing tracks in a 1km x 1km corridor along the length of each pipeline. It represents the activities of vessels <15m using four types of mobile demersal gears: otter trawls, pair trawls, beam trawls and dredges.

Source: Scottish Government (2017).

Navigation, cables and aggregate extraction

Shipping density data (OGA website[12]), shows Block 48/18 as having low levels of shipping and Blocks 48/19 and 48/20 with high levels of shipping. Typical vessels in the area are likely to be travelling to and from the large ports, Hull, Grimsby and Immingham, in the Humber Estuary. There are no traffic separation schemes/IMO routeing measures close to Anglia infrastructure or the wider Anglia area.

Ferry routes from Hull to Zeebrugge and Rotterdam, and Newcastle to Amsterdam traverse the southern North Sea and greater Anglia area, but do not pass close to the infrastructure; the routes from Hull transit to the south west of the Anglia infrastructure and the route from Newcastle passes to the north of Anglia.

A vessel traffic survey will be carried out and will support the environmental permit applications for the decommissioning activities; these will be completed and submitted to the Regulator at a future date and prior to commencement of offshore activities.

[12] OGA website, information on levels of shipping activity (29th Seaward Licensing Round) – accessed June 2018.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/540506/29R_Shipping_Density_Table.pdf

A subsea cable (Stratos 1) crosses the Anglia export pipeline and is no longer in use. The bulk of subsea telecommunication and electricity interconnectors are located some distance to the south of the Anglia area.

Aggregate extraction occurs in three main areas in the southern North Sea; off the Humber Estuary, east of Great Yarmouth and Lowestoft and in the Greater Thames Estuary. There are no licensed areas in or around the Anglia area, the closest area is approximately 8km north of the LOGGS complex.

Defence

The UK armed forces have a number of different military practice area located around the UK. There is a Royal Air Force training area located to the north of Anglia (D323D), some 15km north of LOGGS PP, with two further areas located at the coast in the Wash (D207) and just south of Grimsby (D307), some 95km south west and 82km north west respectively, of Anglia West (B).

Tourism and Recreation

Tourism to the Norfolk coast is socially and economically important, and coastal towns include traditional holidays destinations. Coastal areas and the sea can provide a variety of tourism and recreational opportunities. These can generate a considerable amount of income for the local economy and be a mainstay for many coastal towns, with many local businesses relying on the marine environment for their livelihoods.

The coastline boasts areas of bathing water classified as Excellent (2015 classification) and a number of blue flag beaches, while shingle banks are popular with anglers. The area is popular for dinghy sailors, kite surfing and surfers. Crabbing takes place at various locations, including Cromer, while the presence of several nature reserves in the area attracts birdwatchers throughout the year. Other activities include beachcombing/fossil hunting and walking the coastal paths, including for example the North Coast Path a trail, in its entirety, extends from Hunstanton in west Norfolk to Sea Palling on the north east Norfolk coast.

The relatively small number of yachts based on this coast is partly due to the general unsuitability of the area for cruising and yachting, as many of the harbours are shallow and dry out for much of the tidal cycle.

5 INITIAL ISSUE IDENTIFICATION

5.1 Introduction

Activities associated with the decommissioning of Anglia facilities have the potential to affect the environment in a number of ways, including physical and other disturbance, emissions and other discharges, waste generation and accidental events. This section describes the process used to identify and screen the relative significance of the potential environmental issues associated with the proposed decommissioning activities.

5.2 Issue Identification and Screening of Potential Effect

Ithaca held an Environmental Impact Identification (ENVID) workshop to identify activity/environment interactions, and raise awareness within the decommissioning team of the baseline environment and potential sources of environmental effects from decommissioning activities. At the workshop, the activities associated with the decommissioning of the Anglia facilities were systematically considered for their potential interactions with the environment and in the context of legislative and policy requirements. These were identified using a range of data sources including:

- Regional and site specific environmental data, including from the Anglia pre-decommissioning survey and engineering documents
- Typical jack-up drilling rig specification (for well plug and abandonment)
- Typical vessel specifications (e.g. for subsea infrastructure decommissioning and support)
- Experience of analogous projects in the North Sea and elsewhere, including in areas of conservation importance
- Reviews and assessments of the environmental effects of offshore oil and gas operations
- Peer reviewed scientific papers on the effects of specific interactions and habitat processes
- Other publicly available "grey" literature
- Offshore Energy Strategic Environmental Assessment Environmental Reports and underpinning studies (e.g. DECC 2016)
- Conservation site designations, potential designations and related supporting site information
- Applicable legislation, guidance and policies
- Consultee and stakeholder engagement and feedback (see Section 1.7)

Following the ENVID, and based on the current level of activity definition and stakeholder feedback, the environmental assessment took both qualitative and quantitative approaches to the identification of the likely magnitude of effects, as appropriate. Defined severity criteria were used to assist in describing the magnitude of environmental effect from the decommissioning activities. These also allowed for the consideration of the likelihood, scale and frequency of potential effects (see Table 5.1) and the results are shown in Table 5.2.

Table 5.1 – Criteria for the identification of potential environmental effects from Anglia decommissioning

Effect	Consequences
None Foreseen	No detectable effects
Positive	Activity may contribute to recovery of habitats Positive benefits to local, regional or national economy
Negligible	Change is within scope of existing variability but potentially detectable.
Moderate	Change in ecosystem leading to short term damage with likelihood for recovery within 2 years to an offshore area less than 100 hectares or less than 2 hectares of a benthic fish spawning ground Possible but unlikely effect on human health Possible transboundary effects Possible contribution to cumulative effects Issue of limited public concern May cause nuisance Possible short term minor loss to private users or public finance
Major	Change in ecosystem leading to medium term (2+ year) damage with recovery likely within 2 - 10 years to an offshore area 100 hectares or more or 2 hectares of a benthic fish spawning ground or coastal habitat, or to internationally or nationally protected populations, habitats or sites Transboundary effects expected Moderate contribution to cumulative effects Issue of public concern Possible effect on human health Possible medium term loss to private users or public finance
Severe	Change in ecosystem leading to long term (10+ year) damage with poor potential for recovery to an offshore area 100 hectares or more or 2 hectares of a benthic fish spawning ground or coastal habitat, or to internationally or nationally protected populations, habitats or sites Major transboundary effects expected Major contribution to cumulative effects Issue of acute public concern Likely effect on human health Long term, substantial loss to private users or public finance

Frequency with which Activity or Event Might Occur	Likelihood
Unlikely to occur	**Unlikely**
Once during decommissioning activity	**Low**
Once a year	**Medium**
Once a month or regular short term events	**High**
Continuous or regular planned activity	**Very High**

	Likelihood				
Consequences	Very High	High	Medium	Low	Unlikely
Severe					
Major					
Moderate					
Negligible					
Positive					
None foreseen					

	Issues requiring detailed consideration in the EA
	Positive or minor or negligible issues
	No effects expected

Notes:
1. The criteria to the left include consideration of issues of known public concern
2. In addition to screening on the basis of these criteria, issues/interactions raised during stakeholder consultation will be treated as requiring detailed consideration. These issues/interactions will be indicated in Table 5.2 by C (raised in stakeholder consultation).

Table 5.2 – Initial screening matrix

Potential for significance
Minor issue

Activity/Source of Potential Impact	Summary consideration: Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Landscape/seascape	Conservation sites/species	Transboundary issues	Summary consideration
Vessels (applicable to rig support, NUI removal, pipelines, umbilical and protective material interventions, subsea facilities, & post decom. monitoring)																
Power generation (including dynamic positioning)																Minor, temporary contribution to existing atmospheric emissions. See Section 6.4
Anchoring (e.g. HLV)														C		Seabed disturbance from anchor lay and catenary action of anchor chain See Section 6.3
Physical presence (including support vessels, barges and related tugs and the HLV)																Vessels present for a limited time period, some activity taking place in existing safety zone at Anglia A. There is the potential of interaction with mobile species. See Section 6.2
Machinery space, deck, sewage & other discharges																Discharges relating to vessel activity will be minor and of limited duration.
Underwater noise																Vessels will contribute to overall decommissioning underwater noise. See Section 6.5
Airborne noise																Incremental lighting and airborne noise will be temporary and will not significantly add to existing levels, which will be eliminated following decommissioning. Activity is concentrated at the Anglia offshore location at >50km from shore.
Lighting																

Potential for significance	
Minor issue	

Activity/Source of Potential Impact	Summary consideration															Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Landscape/seascape	Conservation sites/species	Transboundary issues	
Potential for introduction of alien species																Ballasting will be undertaken in keeping with Ballast Management Plans under the Ballast Water Management Convention.
Wells																
Drilling rig tow in/out																Drill rig movements will create temporary, short term and small scale increment to atmospheric emissions and physical presence transiting the southern North Sea
Rig positioning, spud cans/use of rock for stabilisation														C		Seabed disturbance from spud can and use of rock for stabilisation. See Section 6.3 & 6.6
Physical presence																Rig presence will be short term and largely within existing exclusion zones, which will be removed upon completion of decommissioning works. See Section 6.2
Discharge of cement and chemicals																All chemicals will be subject to assessment as part of well decommissioning consenting mechanisms.
Power generation on drilling rig																Minor, temporary contribution to existing atmospheric emissions. See Section 6.4
Fugitive emissions from fuel and chemical storage																
Other solid and liquid wastes to shore																Waste returns, e.g. well heads recovered casings
Underwater noise																Activity will contribute to overall decommissioning underwater noise. See Section 6.5

Potential for significance: Minor issue	Summary consideration															
Activity/Source of Potential Impact	**Climate/air quality**	**Water Quality**	**Seabed condition**	**Benthic Fauna**	**Plankton**	**Fish and Shellfish**	**Marine Mammals**	**Birds**	**Fisheries**	**Other Offshore Users[1]**	**Shipping**	**Landfill resource**	**Landscape/seascape**	**Conservation sites/species**	**Transboundary issues**	**Summary consideration**
NORM/LSA contaminated equipment																Presence of NORM is not expected. All material recovered for recycling and re-use will be checked for NORM and treated appropriately.
Infrastructure – Topsides, jacket, manifold, piles (Anglia A NUI and Anglia West (B) manifold)																
Cutting and rigging of topsides to be lifted																No significant interaction identified. The operations will make a minor contribution to overall Anglia decommissioning emissions and noise.
Excavation of piles and associated protective material																Seabed disturbance and temporary sediment dispersal in the water column, localised impact, associated tool noise. See Section 6.3 & 6.6
Cutting and removal of jacket/piles, manifold and protective structure																Seabed disturbance and temporary sediment dispersal in the water column, localised impact, associated tool noise. See Section 6.3 & 6.6
Removal of marine growth (offshore)																Temporary increase in turbidity, nutrient enhancement and an increase in biological oxygen demand, though expected to be rapidly dispersed and broken down. Marine growth present not extensive, comprises variety of hard and soft bodied organisms which commonly colonise hard structures in the NS, species on CITES list not present
Onshore[2, 3]																

Potential for significance
Minor issue

Activity/Source of Potential Impact	Summary consideration															Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Landscape/seascape	Conservation sites/species	Transboundary issues	
Offloading of structures																Structures will be transported to established yards where dismantling will represent an increment to existing activity rather than a new type of activity.
Dismantling structures at yard																Potential for minor incremental effects from noise, dust, odour and visual intrusion, though note above that this would be incremental to ongoing activity.
Storage of structures at yard																
Recycling of items																Minor positive effect from material recycling, offsetting use of primary raw material.
Onshore waste treatment and disposal																All represent a minor increment to waste handling and disposal at existing licenced facilities, and to the transport of such material to these sites. Possible, but unlikely, that the material will be sent to a yard outside of the UK
Road transport of materials/waste																
Treatment of NORM/LSA scale																
Removal of marine growth (onshore)																
Use of non-UK based receiving and processing facilities																Use of non-UK yard not yet discounted. Processes in place for ensuring contractor suitability, and relevant permits and consents in place. Transhipment regulations to be adhered to.
Pipelines, umbilical and protective material																
Disconnection/partial removal of pipelines (tie-in spool pieces/risers)																Seabed disturbance from removal of material, cutting method may cause small increase in underwater noise, localised impacts. See Section 6.3 & 6.6

Potential for significance
Minor issue

Activity/Source of Potential Impact	Summary consideration															Summary consideration
	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Landscape/seascape	Conservation sites/species	Transboundary issues	
Disconnection/full removal of umbilical (reverse reel)																Seabed disturbance and resuspension of sediment into water column, from removal of material, cutting method may cause small increase in underwater noise. Only half of umbilical located within SAC boundary. See Section 6.3 & 6.6
Left *in situ* degradation of pipelines																Potential future third party risks resulting from snagging of fishing gear or vessel anchors. See Section 6.2
Protective material removal																Seabed disturbance and resuspension of sediment into water column, from removal of protective material. Localised impacts. See Section 6.3 & 6.6
Discharge of pipeline & umbilical chemicals & residual hydrocarbon																Cleaning and flushing limits the hydrocarbon content of pipelines. Discharges will be minor and of limited duration.
Accidental events																
Dropped objects																Any dropped objectives would be recovered.
Accidental spill of fuels/lubes to sea																Appropriate handling and bunkering procedures, would be in place to minimise the risk of accidental releases of fuels. Preparatory flushing and cleaning limits the inventory of facility hydrocarbons. Anglia predominately a gas field, potential spill of diesel from rig or HLV only, this would be expected to rapidly disperse.

Potential for significance	Summary consideration
Minor issue	

Activity/Source of Potential Impact	Climate/air quality	Water Quality	Seabed condition	Benthic Fauna	Plankton	Fish and Shellfish	Marine Mammals	Birds	Fisheries	Other Offshore Users[1]	Shipping	Landfill resource	Landscape/seascape	Conservation sites/species	Transboundary issues	Summary consideration
Vessel collision																Vessel traffic during decommissioning will represent a minor increment to traffic in the area, with majority of activities concentrated within the existing exclusion zone. Vessels will display navigational lighting, and all activities will be communicated through notices to mariners.
Discharge of hydraulic fluid from subsea tools																Hydraulic fluid usage will be monitored.
Chemical spill including those used in well plug and abandonment (e.g. cement)																Appropriate chemical handling and storage procedures will be in place. Selected chemicals will be subject to assessment and permitting.
Litter																All wastes generated offshore will be managed in accordance with a garbage management plan.

Notes: [1]includes offshore renewables, oil and gas, military activities, subsea cables, recreational yachting etc. [2] equipment/waste from the topsides will be secured during preparation of the topsides and lifted as one package and removed onshore e.g. removal of WEEE.[3] Current guidance (BEIS 2018a) states there is no requirement to assess impacts associated with wastes taken and processed onshore (*as this is associated with onshore and not marine) or accidental impacts. Onshore is included here for context but not included for further assessment (Section 6), see below. However, as accidental events could have an impact in the marine environment, these have been included for further assessment.*

From the screening process, a number of environmental interactions were identified with the potential to result in significant effects; these are summarised in Table 5.3 and considered in greater detail in Section 6.

The dismantling/processing of Anglia material and marine growth onshore has the potential to generate a range of impacts (see Table 5.2 above) and will result in a volume of material requiring disposal. Given the relative size of Anglia (small), and presence of established dismantling yards and licensed disposal facilities, none of the potential impacts were identified as significant. Therefore, and in line with guidance (BEIS 2018a), the fate of materials returned to shore and the potential effects of these are not discussed further in Section 6. The recycling aspirations for the Anglia material brought ashore, and estimated quantity of material being disposed of, are as described in the Anglia DPs and Ithaca will compile a full waste inventory of all materials returned to shore and ensure appropriate waste segregation and treatment is undertaken.

Table 5 3 – Environmental interactions considered further in Section 6

Issue	Potential Source of Effect	Section
Physical presence during decommissioning activities and legacy of pipelines and protective material (e.g. mattresses) left *in situ*	• Rig, HLV, barge (if used), supply and other vessels presence/movements, including when in transit and within-field movements • Disturbance of seabirds (noise and light), marine mammals and diadromous fish • Legacy of subsea infrastructure and protective material left *in situ*	6.2
Seabed disturbance during decommissioning	• Disturbance of seabed from rig installation, HLV (e.g. anchors and spud cans) • Excavation (jetting) around Anglia jacket and Anglia West (B) protective structure piles, and pipelines/umbilical, to gain access • Moving aside/removal of protective material (mattresses, concrete protective structures, grout bags, frond mats) • Seabed condition following infrastructure excavation/removal/decommissioning in situ	6.3
Energy use and atmospheric emissions	• Atmospheric emissions from rig power generation, vessel operation	6.4
Underwater noise	• Underwater noise from jack-up associated with well plug and abandon activities • Pipeline/umbilical ends and Anglia A NUI and Anglia West (B) protective structure piles, cutting tools (i.e. high pressure water, diamond wire, or hydraulic cutter)	6.5
Conservation sites	• Seabed disturbance • Noise effects	6.6
Accidental events	• Diesel and other (e.g. chemical) spills • Collision risk • Dropped objects	6.7
Cumulative effects	• Possibility of interactions between decommissioning activities in the southern North Sea, and those ongoing or proposed activities/developments in the wider area (e.g. renewables, hydrocarbon developments)	6.8

6 OVERVIEW OF POTENTIAL ENVIRONMENTAL IMPACTS

6.1 Introduction

For each source of effect identified as being potentially significant (Section 5, Tables 5.2 and 5.3), a description of the potential impacts is expanded upon below.

In addition to regulator acceptance of Decommissioning Programmes being required, activities to be undertaken for Anglia facilities decommissioning are regulated and will be subject to individual consenting mechanisms which the EA will support (e.g. under the *Offshore Chemical Regulations 2002* (as amended), *Energy Act 2008*). Ithaca will also maintain awareness of any additional provisions which come into force during decommissioning planning and implementation.

Ithaca is aware of England's East Inshore and East Offshore marine plans. While there is no specific policy which makes reference to decommissioning (other than CCS2 in relation to the re-use of oil and gas infrastructure for carbon capture and storage and which is not applicable to Anglia), the responsibilities of the oil and gas industry, including during decommissioning, to interact positively with other users for mutual benefit, and to live within environmental limits to minimise the impact of activities, are noted and will be considered in project planning. Other users (including the fishing and navigation industries) will be kept notified of project schedules and progress as appropriate, so impacts on their activities may be minimised and mitigated as far as possible.

6.2 Physical Presence During Decommissioning Activities and Legacy of Material Left *in situ*

Potential Impacts on Other Users

The physical presence of the rig and vessels has the potential to affect other users of the sea through disruption of their activities, including shipping, fishing and possibly recreational boating (see Section 3.4 and Table 3.6 for expected vessels and time on location). The scale of effect are limited by the general low level of fishing activity in and around the Anglia area, nature of shipping traffic (typically support vessels for the oil and gas and to a lesser extent the offshore wind industries), and that the Anglia area is beyond the daily operational radius of most recreational vessels from coastal harbours. Available information indicates that vessel traffic in the area is low (Block 48/18) and high (Blocks 48/19, 48/20).>

Potential effects on shipping and fishing activity are restricted to temporary spatial conflict, in areas outside of existing exclusion zones, including when the rig and vessels are in transit.

Decommissioning activities at Anglia A NUI and Anglia West (B) (including well plug and abandonment and removal) will principally take place within their existing exclusion zones, from which both shipping (surface zones) and fishing activity (surface and subsea zones) is prohibited. Statutory exclusion zones will apply around the DSV/LWIV, or rig if used, during decommissioning of the three subsea wells, but these will be temporary and removed upon completion of works.

Activity outside the existing exclusion zones will represent a short-term increment in vessel presence over that which the area normally receives and it is not considered that this will result in a significant effect on other sea users. Following decommissioning, the former exclusion zones will be open to fisheries, representing a small increment in seabed area (in economic terms) which may be fished. The removal of the Anglia topsides and jacket removes any potential future interaction with shipping.

The potential longer term source of effect to other users (e.g. fisheries) is the physical presence of the infield and export pipelines and protective material to be left *in situ*. The pipeline and any associated protective material remaining on the seabed is not expected to impact conservation sites, as these were already *in situ* at the time of the designations – see Section 6.6. The options for decommissioning the pipelines and umbilical were subject to a Comparative Assessment (see Section 3.3.4), with the preferred option for the umbilical being complete removal (using reverse reel) and leaving *in situ* the infield and export pipelines, with no remediation of freespan areas. Freespans (<10m and <0.8m height) and exposed areas were identified from the 2018 pre-decommissioning survey (Fugro 2018a) although these are not reportable as none are >10m in length and 0.8m in height.

Snagging risk from leaving the pipeline *in situ* was higher than removal. Bottom trawling close to subsea facilities carries the risk of fishing gear snagging with potential loss of gear, or in extremely remote circumstances, the vessel. Snagging occurs when the trawl gear becomes "stuck" under the pipeline and this is most likely to occur where freespans have developed between the seabed and the pipeline, creating potential snags for trawl otter boards (of wood and/or steel and up to 1.5 tonnes each) used to hold open a demersal trawl net.

Fishing effort in the Anglia area is relatively low and most activity is by fixed (static) gear traps, targeting high value whelks, crabs and lobster and not bottom trawling. Where there is existing rock covering the pipelines, the current profile is over-trawlable. Where trenched and buried the existing depth of burial is such that the pipelines are expected to remain buried. The potential for buried or rock covered sections of pipelines in the Anglia area to become exposed and to pose a risk to fishing gear, is deemed minimal given that, although freespans have occurred, the overall degree of exposure of the pipelines has not changed significantly since their initial burial or rock covering and the umbilical is being removed. At crossing locations where the pipelines and umbilical are to be decommissioned *in situ*, the rock profile covering mattresses at these locations is over-trawlable and the fisheries snagging potential is considered low.

Subject to agreements, an over-trawlability verification exercise may be carried out post decommissioning.

Potential Impacts on Sensitive Species

Birds

The physical presence of vessels associated with the decommissioning activities may potentially cause displacement and/or other behavioural responses in birds. Seabird distribution and abundance in the southern North Sea varies throughout the year, with offshore areas in general, containing peak numbers of birds following the breeding season and through winter (see Section 4.7). From the mean and mean maximum (km) foraging distances for these species during the breeding season, (as described in Thaxter *et al.* 2012), the Anglia area is considered too far offshore (~55km) for these species to forage during this period, although non-breeding adults may be present.

The adjacent coastline is one of the most important in the UK for wintering and passage waterbirds, particularly wildfowl species, both in spring and autumn and birds may transit through the Anglia and wider area during these times. The North Norfolk Coast SPA site includes common scoter as a designated feature, a species recognised as sensitive to vessel and other disturbance. The water depths at Anglia (20-30m), while relatively shallow, are considered too deep for typical diving depths of this and other diving seaduck species e.g. common scoter is dependent on molluscs in shallow waters of 10-20m sea with soft substrates(Furness *et al*. 2012). However, it is proposed to emphasise the importance of the area for seabirds and methods to minimise vessel based disturbance (e.g. through avoidance of large rafts of birds) in environmental awareness training to operational staff, prior to the commencement of offshore decommissioning activities.

The potential effects of light on birds has been raised in connection with offshore oil and gas over a number of years (e.g. Weise *et al*. 2001). As part of navigation and worker safety, and in accordance with international requirements, rigs and associated vessels are lit at night and the lights will be visible at distance (some 10-12 nm in good visibility). Although offshore decommissioning activities may occur during periods of bird migration, significant effects from the HLV/barge, rig and associated vessel lights are considered to be unlikely; the lights on the HLV, rig and vessels are primarily non-flashing so the behavioural effects noted by Bruderer *et al*. (1999) in response to a strong searchlight being switched on and off are unlikely. In addition, there have been no reported effects on birds from installation lights during the operational life of Anglia, or from the LOGGS installations.

Marine mammals

In addition to potential disturbance to birds, the physical presence of the vessels may influence the distribution and movements of sensitive species of marine mammals. As hearing specialists, any displacement of marine mammals is most likely associated with acoustic disturbance and this is further discussed in Section 6.5 below. There may also be responses from marine mammals to the general physical presence of infrastructure and vessels (Sparling *et al*. 2015), along with the risk of collisions from vessels in transit.

Approximately 18km of the Anglia gas export pipeline and piggybacked methanol line is located within the SNS SAC for harbour porpoise. Decommissioning activities within this area will be limited to the disconnection of the pipeline/methanol line (which is being decommissioned *in situ*) at its tie-in at LOGGS PP, with the majority of this expected to occur within the LOGGS PP 500m exclusion zone; this work will be carried out by ConocoPhillips. All production and former appraisal wells are located outside the SNS SAC boundary, and therefore there will be no rig activity within the SNS SAC boundary.

Decommissioning activities will result in a small increase in vessel traffic within the wider Anglia area. However, while the Anglia area is known to be frequented by several marine mammal species, the physical presence of vessels for decommissioning activities, including large, slow-moving vessels around areas of existing activity, are anticipated to cause no more than temporary and localised low-level behavioural responses similar to those from normal operations, such that significant effects are not predicted.

The Anglia infield and export pipelines are constructed of non-toxic and relatively inert materials (carbon steel, concrete). Carbon steel pipelines degrade at very low rates once cathodic protection has expired, at between 0.05-0.1mm/year when exposed directly to seawater or 0.01-0.02mm/year when buried, such that corrosion and collapse of the pipeline would likely take centuries (OGUK 2013). Where protective coatings are used, the degradation period may be longer; the coatings on the Anglia pipelines being concrete. OGUK (2013) indicates that the primary source of degradation of the concrete coatings following decommissioning is likely to be internally from pipeline steel corrosion.

Operational Controls and Mitigation

As part of the Ithaca contractor selection process, all contractors providing equipment, materials or services for field operations are subject to evaluation prior to contract award, and must demonstrate the necessary capacity, experience and technical capability to undertake the work safely and in an environmentally sound manner. Ithaca has in place a health, safety & environmental (HS&E) policy which commits to (amongst others): ensure HS&E performance is prominent in the selection of contractors and assess and manage operations through all stages to minimise risk of harm to people, the environment and facilities. Depending on where activities are carried out, awareness material (e.g. presentations, posters) is also provided to the contractors at HS&E meetings prior to work commencing, highlighting the sensitivities of the area.

To support consent to locate applications for the jack-up and other vessels (where required) a vessel traffic survey will be carried out and if necessary, a collision risk assessment.

Vessel movements and the "as laid" positions of the jack-up spud cans and the HLV anchors, will be notified to fishermen and others through the normal routes, including publication in Notice to Mariners and in Kingfisher bulletins detailing positionings, activities and timings. In addition, there will be full navigation lighting on the jack-up rig and HLV (and barge if used) and associated vessels – all vessels used in the decommissioning activities will meet applicable national and international standards (e.g. in terms of signals and lighting).

A post decommissioning survey will be carried out and although not expected, if large seabed depressions or mounds from the decommissioning activities are evident which could potentially be a hazard to fishing gear, these will be notified through the Kingfisher notices system. From the data available, freespans were identified from the 2012 and 2014 surveys and the 2018 decommissioning baseline survey. Over this period, and due to the mobility of the sediments and currents in the area, the freespans have been assessed as changing over time, in length, height and to some degree in location.

The degree to which the physical presence of Anglia West (B) and the Anglia A NUI contribute to the development of freespans (e.g. through scour) is presently uncertain, and will be determined following decommissioning as monitoring data are acquired. The post decommissioning survey will include not only the pipeline/umbilical routes, but also the area covered by the current 500m safety zones around Anglia West (B) and Anglia A NUI. Other users of the offshore environment have been excluded from these areas since the application of the zones and over the period data is available, none of these freespans have been reportable. Potential risks to fishing from the small freespans identified are considered low as the predominant gear used in the area is static, targeting crab and lobster, and not mobile gear towed from vessels.

The positions of the pipelines that are to remain will also be charted through normal routes. An agreed monitoring programme with the regulator will be established to identify future exposure of the pipelines decommissioned *in situ*, identification of any reportable freespans that may require remediation.

No specific additional mitigation was considered necessary beyond application of established operational controls.

Conclusion

Interactions with other users of the area from the Anglia decommissioning activities, specifically fishing and navigation will be short lived. The 500m zones around the Anglia A NUI and the Anglia West (B) manifold and protective structure, will be removed when decommissioning activities have been completed, allowing access for other users, details of infrastructure remaining *in situ* will be publicised through Notices to Mariners and marked on navigation and fisheries charts, and an agreed monitoring programme for these will be established with BEIS. The Anglia pipelines have been present on the seabed for between 25 and 27 years, are charted features and to date there have been no offshore shipping or fisheries related incidents. The potential for significant effects on fisheries from legacy material left *in situ*, following normal operational controls described above, are considered low as the predominant gear used in the area is static, targeting crab and lobster, and not mobile gear towed from vessels.

Where scheduling allows, activities will be timed to avoid the most sensitive periods and environmental awareness of the Anglia area will be provided to contractors working on Ithaca's behalf, prior to offshore activities commencing.

6.3 Effects of Seabed Disturbance during Decommissioning

Potential Impacts

Physical disturbance to the seabed will be associated with a number of Anglia decommissioning activities, primarily:

- Jack-up rig spud can placement for well plug and abandonment
- Contingent rock use for jack-up stabilisation to maintain foundation integrity
- Anchoring of HLV for Anglia A NUI removal
- Removal of jacket/securing piles and manifold/protective structure (piles cut to 3m below seabed)
- Moving/removing protective material
- Removal of tie-in infrastructure
- Removal of umbilical (reverse reel)

Spud cans and anchoring

Typically, each of a jack-up rig's three legs terminates in a spud-can with a typical diameter of 15-20m, spaced approximately 50m apart. These form seabed depressions as a result of sinking into the seabed during the process of jacking up the rig deck. Such jack-up rigs have spud can jetting systems with both bottom and top jets to facilitate spud can release from seabed sediments. Jetting and spud can placement will result in the displacement and depression of sediments in these localised areas. The estimated area of seabed disturbed as a result of spud can placement is 942m^2 (0.001km^2) at the Anglia A NUI and 942m^2 (0.001km^2) at Anglia West (B).

To ensure the integrity of the jack-up foundations in an area of uneven seabed and prone to scouring, rock may be used for rig stabilisation, as described in Section 3.3.1. Placing rock on the seabed could disturb the current and tidal flows and sediment supply in the immediate area. Direct effects of rock placement on the benthic communities of the area would include mortality, from physical trauma, and smothering by displaced and re-suspended sediment of those species unable to burrow to the surface. Changes in biodiversity is also possible from the introduction of new substrate (JNCC 2017). It is anticipated that the majority of the rock deposition used for rig stabilisation will be in and around the spud can footprint and therefore, within the spud can area of disturbance. An area 5m round the base of the spud can has been used to account for the remainder of the rock placement for stabilisation and the area of disturbance from rig placement at Anglia A NUI (spud cans and stabilisation material) has been estimated at 2,121m^2 (0.002km^2), this also calculated for Anglia West (B) if rock stabilisation used. Controls on the accuracy of rock placement by the fall pipe will be used to minimise rock falling outwith these locations.

Anchors will be used for the HLV. Although final selection of HLV is still to be made, it is anticipated it will have a four to twelve point mooring system, typically comprising an anchor and chain/cable element. The anchor type and arrangement pattern will be subject to a detailed mooring study. Each anchor will produce a linear scar during setting and recovery with surface scrape also produced as a result of catenary contact of the anchor chain and/or cable. Based on the worst case of twelve anchors, and assuming an anchor length of 4m and height of 4m the estimated seabed disturbance from HLV anchors is 192m^2 (0.0002km^2). Added to this the seabed disturbance from the anchor chain of 21,600m^2 (0.02km^2), (this based on an assumed anchor chain length of 500m, 90% of which would be in contact with the seabed and each chain having a lateral movement of 4m), the total estimated seabed disturbance from siting the HLV would be 21,792m^2 (0.002km^2) (see Table 6.1).

Other vessels involved in decommissioning activities will be kept on station using DP and seabed disturbance will be minimal.

There may be a small amount of jetting away of sediments required to expose infrastructure/aid in seabed release (e.g. piles for the integrated protection structure at Anglia West (B)). The extent of seabed disturbance as a result of this is limited. However, if jetting is required, given the nature of seabed sediments the spread of displaced materials will be limited to the immediate vicinity of the activity and significant effects are not predicted.

Removal of infrastructure, protective material and burial of pipeline/umbilical ends

The removal of the Anglia A NUI and Anglia West (B) will cause some seabed disturbance, primarily within their existing physical footprint. Based on a contingency buffer of 2m around the Anglia A jacket, it is estimated that a seabed area of 9,651m^2 (0.01km^2) will be disturbed during platform removal; piles cut 3m below seabed will also result in initial depressions, these expected to be temporary and refill with natural backfill. At Anglia West (B), the piles will also be cut 3m below seabed, and the manifold, protective structure and frond mats, will be lifted off the seabed. For assessment purposes an additional 5m on all sides of the structure has been added to allow for disturbance to facilitate its release from the seabed, including the frond mats, resulting in an estimated seabed area of 575m^2 (0.001km^2) disturbed during retrieval.

These areas are taken to cover any excavation that could be required associated with the cutting of jacket/protective structure piles; this assumes a worst case with an internal cutting tool not able to be used to cut the platform jacket piles.

Following removal of the Anglia infrastructure, and informed by the post-decommissioning survey, any large items of debris located on the seabed will be removed using an ROV and grab. The removal of such items will represent a minor increment to seabed disturbance generated during decommissioning.

The *in situ* pipeline decommissioning assumes that concrete mattresses and other protective material, are removed only when necessary for access to allow removal of pipeline tie-in spool pieces underneath. Where mattresses and other material (e.g. rock) occurs at crossing locations, these will be left in place, for both the pipeline and umbilical; the latter to be decommissioned by reverse reel, with the exception of those sections under crossings.

Based on the largest mattress size (6x3m) and a contingency buffer of 2m around each mat to account for potential disturbance during their removal, and dimensions of 5x3m for the "dog-houses", the kennel like concrete protective structures, and assuming all mattresses and "dog houses" are removed, an estimated seabed area of *ca*. 8,767m^2 (0.008km^2) will be disturbed from moving/removing protective material (mattresses and "dog-houses"). Approximately 70% of this disturbance will be within the existing Anglia A NUI footprint, and in the NNSSR SAC boundary (see Table 6.1) Where it is not safe to remove protective material (i.e. risk of concrete spalling), removal is not necessary to access infrastructure and/or the protective material is buried, this will be decommissioned *in situ* with no additional seabed disturbance. The displacement/removing of the protective material to expose the tie-in infrastructure, will cover the area where the tie-in infrastructure is removed and not result in additional seabed disturbance. Therefore, no separate estimate of seabed disturbance for this activity has been calculated.

After displacing/removing some of the protective material and tie-in infrastructure, the exposed ends of the pipelines and umbilical (at the crossing location only for the umbilical) are then lowered into the seabed using mass flow excavation and back filled with the natural sediment and where required, re-covered with existing rock. Mass flow excavation is proven technology where a flow of water is directed at the seabed to displace the sediment. This disturbance would be localised to areas where the sediment is displaced to lower the exposed ends into the seabed.

The umbilical is to be removed, as described in Section 3.3.4. After disconnection at Anglia West (B), at the crossing location and at Anglia A, the umbilical will be reversed reeled with the section under the crossing left *in situ*. A shallow depression will form as the umbilical is removed from the seabed, but this is expected to rapidly naturally backfill. Based on the present understanding of the shallow sediments in the area it is expected that the umbilical can be removed without prior jetting to facilitate retrieval. Therefore, a 1m corridor width (and 5km length) has been assumed for estimating seabed disturbance, resulting in an area of 5,000m^2 (0.005km^2) disturbed during umbilical removal, approximately half of which will be within the NNSSR SAC boundary (see Table 6.1).

Seabed disturbance will result in direct physical effects on benthic communities which may include mortality as a result of physical trauma, smothering by excavated and re-suspended sediments. Disturbance during removal operations would be limited to the benthic fauna colonising the hard surfaces of the protective material to be lifted, the soft sediment fauna along the umbilical route and the biota present on and immediately around the Anglia A and Anglia West (B) structures.

Given the composition of the shallow sediments in the area, persistent mounds are not expected to form from excavated sediment, which will naturally redistribute. The post decommissioning survey will confirm if mounds are present, and any found will be assessed for the need for remediation.

There are no historic cuttings accumulations at either Anglia A or Anglia West (B); the current regime in the area is such that discharged drill cuttings have been redistributed and degraded by natural hydrographic and biological processes.

Extent of estimated seabed disturbance from decommissioning activities

Drawn from the information available and based on a number of assumptions (see above), an area of seabed affected by the decommissioning of the Anglia facilities has been estimated (Table 6.1).

Table 6 1 – Estimated seabed disturbance from Anglia decommissioning activities

Activity	Estimated disturbance of sediment m^2 (km^2)
Activities and estimated seabed disturbance within NNSSR SAC boundary	
Spud cans & contingency rock stabilisation (jack-up) at Anglia A NUI[1]	2,121 (0.002)
Anchoring (HLV) at the Anglia A NUI[2]	21,792 (0.02)
Removal of the Anglia A NUI[3]	9,651 (0.01)
Moving/removing of protective material[4]	6,137 (0.006)
Removal of ~2.5km length of infield umbilical[5]	2,500 (0.003)
TOTAL m^2 (km^2) of seabed disturbed within NNSSR SAC boundary	**42,201 (0.04)**
Activities and estimated seabed disturbance outside NNSSR SAC boundary	
Spud cans & contingency rock stabilisation (jack-up) at Anglia West (B)[1]	2,121 (0.002)
Removal of Anglia West (B) manifold/protective structure[6]	575 (0.001)
Moving/removing of protective material[4]	2,630 (0.003)
Removal of ~2.5km length of infield umbilical[5]	2,500 (0.003)
TOTAL m^2 (km^2) of seabed disturbed outside NNSSR SAC boundary	**7,826 (0.008)**
TOTAL m^2 (km^2) of seabed disturbed from decommissioning activities	50,027 (0.05)

Notes:[1] Estimate based on spud can diameter of 20m and contingent rock placement extending to 5m around base of each spud can. If rock not used, estimate disturbance from spud cans only equates to 942m^2 (0.001km^2). [2].Calculated based on 12 anchored vessel, anchors measuring 4mx4m and anchor chain of 500m (90% in contact with seabed) and lateral movement of 4m per anchor chain. [3]. Calculated based on 3 legs with diameter of 60m each, and an assumed area of disturbance of 2m around each leg for excavation and diver intervention if external cutting tool used, disturbance will be less if internal tool is used, although some excavation may be required to ease removal of cut piles. [4].Calculated based on size of mattresses and

concrete protective structures with an additional area of impact of 2m on each side to account for diver intervention; the area of disturbance associated with removal of tie-in infrastructure is within this area and has not been calculated as an additional area of disturbance. [5.] Based on 2.5km of the 5km umbilical and a 1m corridor of disturbance. [6.] Based on the size of manifold/protective structure, plus an additional 5m area of impact for diver intervention and removal of associated frond mats.

The total area of the NNSSR SAC extends to 3,603km^2 (JNCC website) while the estimated area of seabed disturbance from decommissioning activities carried out within the SAC boundary extends to approximately 0.04km^2. This equates to approximately 0.001% of the total SAC area. However, only 0.002km^2 of this (which equates to 0.00006% of the total SAC area) pertains to estimated seabed disturbance from the contingent rock placement for rig stabilisation, with remaining disturbance (0.038km^2) considered temporary.

The pre-decommissioning survey (Fugro 2018) did not identify the presence of biogenic (*Sabellaria spinulosa*) reef around any of the Anglia facilities. From surveys conducted in 2015 (Vanstaen & Whomersley 2015) and 2017 (Mcllwaine *et al*. 2017) JNCC/CEFAS found no areas of biogenic (*Sabellaria spinulosa*) reef in or around the Anglia area. The 2015 survey was designed around six areas of search for *Sabellaria spinulosa* reef, the closest of these to Anglia infrastructure (Area F) was >2km from the eastern (LOGGS PP) end of the export pipeline, while the 2017 survey included wider characterising transects across the SAC, the closest to Anglia being #10 (WCT_010), again >2km from the eastern (LOGGS PP) end of the export pipeline. As the export pipeline and piggybacked methanol line are to be decommissioned *in situ*, with no remediation of freespan areas, no decommissioning activities will affect the seabed along this corridor.

Operational Controls and Mitigation

Ithaca's contractor selection process takes into consideration a prospective contractors ability (including resources and experience) to undertake work in an environmentally sound manner (see Section 6.2), with interfaces detailing responsibilities development, including environmental responsibilities, and regular HS&E meetings, as required.

Applications will be made if necessary, to deposit rock stabilisation material for jack-up foundation integrity, with the rock quantity to be minimised and placed as accurately as possible from the vessel; a condition of the permit is to deposit material at and within coordinates applied for.

Project planning includes minimising, as far as practicable, rig/vessel movements, including the use and movement of anchored vessels; the HLV will predominantly be located within the Anglia A NUI existing footprint. It also includes assessing the nature and scale of seabed disturbance by ROV inspection and/or debris clearance survey, post-decommissioning.

No specific additional mitigation was considered necessary beyond application of established operational controls.

Conclusion

The great majority of seabed disturbance will be within the existing footprints of the Anglia infrastructure and temporary (with the exception of contingency rock use for rig stabilisation). Natural redistribution of disturbed sediments is expected but the scale of this is not expected to be detrimental to the existing sandbank feature on which Anglia is located. Previous surveys, including the recent pre-decommissioning survey indicate that the existing areas of rock cover, the Anglia A jacket, Anglia West (B) infrastructure and associated protective material and existing natural hard features (cobbles, boulders) have been colonised by a range of epifaunal species. The potential introduction of hard substrate on the scale estimated for Anglia decommissioning is minor in the context of the planned removal of certain existing hard substrates e.g. the Anglia A NUI and Anglia West (B).

Anchor and catenary scars will be formed by HLV anchoring, but these are not expected to persist or result in changes in sediment characteristics, significant compaction or faunal effects. The removal of the Anglia infrastructure and associated protective material will also cause some seabed disturbance and sediment re-suspension principally within the existing footprint, but this is temporary and will not result in changes in sediment characteristics.

The duration of effects on benthic community structure are related to individual species' biology and to successional development of community structure. The majority of seabed species recorded from the area are known, or believed to have, short lifespans (a few years or less) and relatively high reproductive rates, indicating the potential for rapid population recovery, typically between 1 to 5 years (Jennings & Kaiser 1998), such that any effect will be temporary. The relatively impoverished heterogeneous benthic habitats of the area reflect the dynamic nature of the sedimentary environment; such habitats have a low sensitivity to physical damage at the scale predicted. Moreover, seabed surveys have not reported *Sabellaria spinulosa* reef presence in and around the Anglia area (Fugro 2018). In all cases, the scale of changes to the seabed and its fauna are such that effects on higher trophic levels (e.g. fish and marine mammals), and any related effect on species of commercial interest are not predicted.

The area of total physical disturbance from Anglia decommissioning activities is small (0.05km^2) and most will take place within the original footprint of the Anglia Field development. The area affected is negligible in the wider context of the wider southern North Sea, and the size of the NNSSR SAC. In view of the potential effects described and recovery potential of the seabed, and the absence of *Sabellaria spinulosa* reef in the Anglia area, significant effects from physical disturbance including on the designated features of the NNSSR SAC, are not considered likely and any effects are predicted to be negligible and short-term.

6.4 Effects of Energy Use and Atmospheric Emissions

Potential Impacts

Anthropogenically enhanced levels of greenhouse gases (GHGs, principally CO_2) have been linked to global climate change (IPCC 2013). Predicted effects include *inter alia* an increase in global temperate (Kirtman *et al*. 2013, Collins *et al*. 2013), rising sea-levels (Lowe *et al*. 2009, Church *et al.* 2013, Horsburgh & Lowe 2013), changes in ocean circulation (Collins *et al*. 2013) and potentially more frequent extreme weather events (Woolf & Wolf 2013), and other effects including ocean acidification generated by enhanced atmospheric acid gas loading, deposition and exchange (see Bates *et al*. 2012). In addition to effects associated with atmospheric greenhouse gases, emissions also have the potential to have negative effects on air quality. Poor air quality can result in effects on human health, the wider environment and infrastructure.

The principal GHG of concern is CO_2 as it constitutes both the largest component of global combustion emissions (generally ~80% of total GHG emissions) and has a long atmospheric residence time such that emissions made today continue to contribute to radiative forcing for some time[13].

[13] Figures vary widely from between 5-200 years (Houghton *et al.* 2001) to ~1,000 years (Archer 2005)

Atmospheric emissions were identified in Section 5 as being a potential source of effect from activities associated with the Anglia decommissioning programme. Sources of emissions include:

- Drilling power generation and helicopter traffic
- Combustion emissions from vessels
- The recycling of materials returned to shore including steel and the loss of materials left in situ for future use

Emissions of relevant gas species (carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), methane (CH_4) and non-methane volatile organic compounds (NMVOCs) and their associated Global Warming Potential (GWP) have been estimated for these activities, using standard Environmental and Emissions Monitoring System (EEMS) conversion factors (DECC 2008) to estimate the relative quantity of each gas species from combustion for offshore works, and the most recent GWP metrics (Myhre *et al*. 2013, etc Table 6.2). The result is a value in tonnes of CO_2 equivalent (CO_2 eq.) based on the radiative forcing effect of each GHG species relative to CO_2 and the atmospheric residence time of each gas. The GWP factor therefore changes depending on the "time horizon" considered (see IPCC 2001, 2007, Myhre *et al*. 2013, and Shine 2009 for a synthesis and critical review).

Table 6.2 – Emissions Factors

Gas	CO2	N_2O	CH_4	CO	NOx	SO_2	NMVOCs
Diesel (turbine)	3.22	0.00022	0.0000328	0.00092	0.0135	0.0020	0.000295
Diesel (engine)	3.22	0.00022	0.00018	0.0157	0.0594	0.0020	0.002
Aviation fuel (helicopter)	3.15	0.00012	0.00035	0.00953	0.012	0.0009	0.00306
GWP at 100 years	1	265	28	-	-	-	-

Notes: [1]sulphur content of marine diesel fuel assumed to be 0.1% based on requirements for Emissions Control Areas: IMO website (accessed November 2017).
Source: IPCC (1996), DECC (2008), Myhre et al. (2013), AEA-Ricardo (2015)

GWP factors for CO have previously been calculated as 1.9 at 100 years, and that for NO_x is considered highly uncertain (Forster *et al*. 2007), and these are therefore not generally calculated. For the purposes of this assessment, a 100 year time-horizon has been used, in line with its adoption by the United Nations Framework Convention on Climate Change and use in the Kyoto protocol (Myhre *et al*. 2013), and nationally for the calculation of carbon dioxide equivalent emissions (Shine 2009).

Removal of the Anglia Facilities

The well abandonment programme is the primary source of emissions (8,712 tCO_2eq) and together with the removal of the Anglia facilities from their present location to a processing site, results in an estimated total emissions from decommissioning Anglia, of 12,914 tCO_2eq. (Table 6.3).

Table 6.3 – Estimated emissions from Anglia decommissioning activities

Gas	Well abandonment	Pipeline decommissioning	Umbilical decommissioning	Installation removal[1]	Total ($tCO_2eq.$)
CO_2	8,500	2,400	600	1,100	**12,600**
N_2O	0.6	0.15	0.05	0.1	**0.9**
CH_4	0.5	0.15	0.05	0.05	**0.75**
SO_2	5.25	1.45	0.35	0.7	**7.75**
CO	41.0	12.0	3.0	5.45	**61.45**
NO_x	160	44.0	11.0	20.0	**235**
VOC	5.30	1.45	0.35	0.7	**7.8**
				Total	**12,914**

Notes: [1]Assumes using an HLV and 2 barge transports to remove the Anglia A NUI.

The emissions calculations are based on a range of assumptions relating to vessel type and timings.

Emissions associated with material recycling

To provide a more complete indication of the emissions associated with the decommissioning of the Anglia facilities, emissions from the recycling of the primary components to be removed have been estimated (Table 6.4) (note that re-use options have not been identified for the Anglia infrastructure). These are primarily from steel associated with the Anglia A topsides and jacket and any recovered pipeline and umbilical material (negligible for the pipelines and methanol line given the proposed methods of decommissioning) as well as from protective material recovered, with some minor metal and plastic components

Table 6.4 – Estimated emissions relating to recycling of materials associated with Anglia decommissioning

Activity	Material recovered (t)					Emissions ($tCO2eq.$)[1]	Energy $(GJ)_1$
	Steel	Aluminium	Zinc	Copper	Concrete		
Topsides recycling	720	-	-	7.0	-	1,100	7,000
jacket/pile recycling	1,060	30	1.50	-	-	1,600	10,800
Pipeline and umbilical recycling	90	0.55	0.02	-	1,730	400	3,000
Manifold recycling	100	3.50	0.15	-	-	200	1,000
Recovered well casing and tubular sections	770	-	-	-	-	1,100	7,300
Emissions estimated from production of equivalent material from primary source						8,000	
Estimated emissions avoided from material recovery						4,400	
Estimated lost opportunity from materials left *in situ*						17,000	
Estimated net emissions						12,600	

Notes: All figures rounded. [1]Assumes using an HLV and 2 barge transports to remove the Anglia A NUI. Total emissions relating to the production of recycled materials have been calculated based on the typical embodied carbon of materials to be returned for recycling ($tCO_2eq./t$), with factors largely based on those from Hammond & Jones (2011) and IoP (2000).

Most materials to be recovered from Anglia are recyclable (e.g. steel, making up ~59% of the recovered material) and therefore have a strong end-of-life benefit (i.e. through the displacement of virgin material in the wider steel supply chain (Hammond & Jones 2011, Weinzettel *et al*. 2009, Yellishetty *et al*. 2012), which also has wider implications than just emissions. Conversely the leaving of some components *in situ* results in a loss of future use of that material. However, the leaving of the material *in situ* negates additional vessel time in the field to recover and transport these materials to shore. A high level breakdown of the dominant material components of the Anglia facilities are indicated in Table 3.3 in Section 3.3 along with the proportion of these items assumed to be re-used and/or returned to shore for recycling and those left *in situ*.

The energy use and emissions associated with the end-of-life of materials such as steel are not always clear, as they may already have a recycled content and moreover pass on the benefit of recycling to the next end user of the materials, such that energy benefits can be double-counted (Hammond & Jones 2011, Weidmann *et al*. 2011, World Resources Institute 2011).

Anglia emissions in context

In 2016, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 467.9 million tonnes CO_2 eq.; CO_2 being the most dominant of these, accounting for ~81% of the emissions (378.9 million tonnes (Mt)). The total emissions were 5% lower than the 2015 figure of 492.4 million tonnes CO_2 eq. primarily related to a decrease in emissions from none oil and gas sectors (i.e. power station emissions and a reduction in emissions from fuel used in the iron and steel sectors); CO_2 emissions were ~5.9% lower than the 2015 figure of 402.5 Mt (primarily due to the decrease of coal use in electricity generation) (BEIS 2018b).

To place the decommissioning of Anglia in the context of UK CO_2 emissions, operational sources would represent an increment of 0.002% on those emitted from all UK sources in 2016. Taking into account the estimated emissions relating to the fate of structure materials, decommissioning represents 0.0024% of total UK CO_2 emissions in 2016.

Operational Controls and Mitigation

As part of their standard programme management and planning, Ithaca look to minimise vessel time in the field as far as practicable and will make use of vessel synergies where possible. Ithaca's contractor selection process enables Ithaca to select contractors with, for example, modern and fuel efficient vessels, where available, while satisfying the other selection criteria. Emissions are also reduced by following relevant industry best practices and minimising fuel consumption where possible.

Emissions from material flows are minimised by using a waste hierarchy approach consistent with the Waste Framework Directive 2008/98/EC and relevant legislation; establishing where there is scope for equipment and material recycling, with disposal only taking place where no feasible alternative is available.

It is considered that there is limited scope for additional mitigation measures to reduce the residual effect on atmospheric GHG loading, or any local effects on air quality. However, these effects are naturally mitigated through the area being relatively far offshore (~55km), the predominant air flow in the region and relatively short duration of activities.

Conclusion

Anglia decommissioning activities will lead to emissions of gases which contribute both to localised and short-term increases in atmospheric pollutants, and to global atmospheric GHG concentrations. In the context of wider UK emissions these effects are considered to be negligible, and there will be a minor positive benefit from the return of recyclable materials to shore which will have a future use and

offset the extraction and transport of primary raw materials. Overall effects are considered to be negligible and temporary.

6.5 Effects of Noise from Decommissioning Activities

Potential Impacts

Anthropogenic noise in the marine environment is widely recognised as a potentially significant concern, especially in relation to marine mammals (e.g. Richardson *et al*. 1995). Potential effects of anthropogenic underwater sound on receptor organisms range widely, from masking of biological communication and small behavioural reactions, to chronic disturbance, auditory injury and mortality; in addition to direct effects, indirect effects may also occur (e.g. via effects on prey species).

The primary source for underwater sound generation from the Anglia decommissioning activities is a combination of rig and vessel noise, for which there is a good knowledge base, and equipment use (there are no plans for activities generating high intensity impulsive sound, such as the use of explosives); see bullet points and Table 6.5 below:

- Jack-up drilling rig (plug and abandon operations) – well operations at the Anglia A NUI and Anglia West (B) will take place outside the boundary of the Southern North Sea SAC – the rig may also be used to plug and abandon the three subsea wells, these are also located outside the SAC boundary
- Vessels, including use of thrusters for positioning
- High pressure water cutting tool
- Diamond wire or hydraulic cutting tool

Table 6.5 – Summary of indicative main noise sources associated with Anglia decommissioning activities

Noise source (relevant activities)	Approximate indicative broadband source level (dB re 1µPa@1m)	Indicative dominant frequency	Source
Vessels of 50-100m length (e.g. CSV, DSV, rock placement vessels)	165-180[1,2]	<1,000Hz	OSPAR (2009)
Vessels of 100-300m length (HLV)	175-195[1,2]	<200Hz	OSPAR (2009), McKenna *et al*. (2012), Veirs *et al*. (2016)
Diamond wire cutting tool	na; at 100m from source: ≤130dB re 1 µPa^2 per 1/3 octave band for all recorded frequencies from 5,000-40,000Hz[3]	>10,000Hz	Pangerc *et al*. (2016)
Water jet lance tool (broadly indicative of abrasive water jet cutting)	160.1-170.5	>200Hz	Molvaer & Gjestland (1981)
Side scan sonar (post-decommissioning survey)	223	114 or 440kHz	Based on Kongsberg dual frequency side scan sonar[14]

[14] Based on representative Kongsberg dual frequency side scan sonar: https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/2D0C8EA035ABC7C6C12574C500512571?OpenDocument

Noise source (relevant activities)	Approximate indicative broadband source level (dB re 1µPa@1m)	Indicative dominant frequency	Source
Multibeam echosounder (post-decommissioning survey)	210	200-400kHz (300kHz normal operation)	Based on Kongsberg Maritime EM2040

Notes: [1]Within the ranges provided, broadband source levels are generally higher for larger vessels of these categories. [2] Slight increases in broadband source levels anticipated during use of DP thrusters. [3].Generally indistinguishable above background noise at low frequencies; ca. 4 and up to 15dB re 1µ Pa2 per 1/3 octave band above background between 10,000-40,000Hz.

Vessel movements/operations

Underwater sound radiates from a vessel as the combined effect of multiple sources and paths; the main sources are propeller/thrusters cavitation and machinery noise; additional sound is generated as the hull moves through the water (hydrodynamic noise) or by sea-connected systems (e.g. pumps) (Spence *et al*. 2007, Abrahamsen 2012).

Propeller cavitation is the process of bubble formation and implosion resulting from pressure fluctuations (above and below the saturated vapour pressure of water) generated by the rotating propeller blades when a given speed (cavitation inception speed) is reached or exceeded; noise is generated by the collapse of bubbles. Cavitational noise commonly arises at speeds between 8 and 12 knots and grows in amplitude with increasing speed; its frequency spectrum is broad with dominant frequencies above a few hundred Hz. In addition to vessels in transit, cavitational noise is important when vessels are operating under high load conditions (high thrust) and when dynamic positioning (DP) systems are in use (Spence *et al*. 2007, Abrahamsen 2012). For example, the use of thrusters for DP has been reported to result in increased sound generation (>10dB) when compared to the same vessel in transit (Rutenko & Ushchipovskii 2015).

Shipboard machinery creates both vibrations and airborne noise which in turn can generate underwater sound radiation; most pronounced is the sound generated from propulsion machinery such as diesel engines or turbines and diesel generators. Machinery induced noise is generally tonal in nature and can span across a wide range of frequencies, from very low (below 10Hz) to several thousand Hz. Higher frequency tones are typically seen only at slow speeds i.e. in the absence of propeller cavitation but low frequency tones (<500Hz) tend to be predominant at all speeds (Spence *et al*. 2007, Abrahamsen 2012).

While the sources and paths of sound from vessels are well understood, predicting sound exposure on the basis of vessel information is complex; it depends not just on engineering and design of the vessel, but on how it operates and its age (or time since regular maintenance) as well as on the characteristics of the environment in which it operates (OSPAR 2009). In generic terms, small leisure crafts and boats (<50m) tend to have a lower source level (160-175 dB re 1µPa@1m) and have greater sound energy in relatively higher frequency (above 1kHz) than large ships; support and supply vessels (50-100m) are expected to have source levels in the middle range 165-180dB re 1µPa@1m range and large vessels (>100m) produce louder and predominantly lower frequency emissions (OSPAR 2009).

Overall, noise from vessels is predominantly low frequency and the global shipping fleet is recognised as the main contributor to ambient noise in the open ocean. The indicator being developed for 'ambient noise' as part of the implementation of the Marine Strategy Framework Directive focuses on two low frequency third-octave bands, centred at 63 and 125 Hz; these bands are where the contribution of noise from shipping (relative to other sources, including natural) is likely to be greatest (Dekeling *et al.* 2014).

Underwater sound from commercial ships was described by McKenna *et al*. (2012). Broadband source levels were estimated for 29 ships, across 7 categories; these ranged between 177 and 188 dB re1 µPa2 (20-1000Hz). Spectral characteristics differed between categories, with bulk carrier noise predominantly near 100 Hz and container ship and tanker noise predominantly below 40 Hz. A

difference of 5-10dB between stern and bow aspect noise levels was also measured. Veirs *et al*. (2016) estimated sound characteristics for a wider variety of ships (from pleasure craft to container ships) in transit across the Haro Strait (west coast of North America). Median received levels of ship noise within the study area were measured to be most elevated above ambient noise at the lower frequencies (20-30dB from 100-1,000Hz), but also at higher frequencies (5-13dB 10,000-40,000Hz).

Likely vessels to be used during decommissioning are described in Section 3.4 (Table 3.6). The largest vessel expected to be in operation is the HLV (vessel to be finalised) which would be on site for approximately 3 days. The bulk of the activity would be carried out by medium sized vessels with an overall presence on site of 31 days (note the rig and the standby vessel for the rig will be on location for ~112 days). In the absence of exact vessel operational information and direct measurements, it is assumed that as a precautionary approach the average broadband source levels of container ships (e.g. the noisiest ship category recorded) would be adopted.

Acoustic modelling in support of oil & gas operations have shown that across a variety of vessels, activities and localities, exposure to sound pressure level (SPL) above >180 dB re 1 µPa rms is highly unlikely; SPL >160 dB re 1 µPa rms are encountered only within the immediate vicinity of the activity (<50m) while SPL >120 dB re 1 µPa rms are encountered up to a few kilometres (Neptune LNG 2016, Fairweather 2016, Owl Ridge Natural Resource Consultants 2016).

Other sources of underwater noise

The jack-up rig used during decommissioning will not be undertaking drilling, therefore noise generation will be dominated by power generation and other machinery involved in routine rig operations such as such as hydraulic systems and compressors, along with intermittent additional machinery use associated with plugging and abandoning wells. Underwater noise associated with a jack-up rig is of a very similar dominant frequency range as that from large merchant vessels (2-1,400Hz), albeit of lower average intensity (~ 120dB re 1µPa broadband) than its support vessels, and in the region of 15-20dB quieter during operations other than drilling (Todd & White 2012). Consequently, underwater noise emissions from the jack-up rig during decommissioning operations are likely to represent only small inputs to the local soundscape which are unlikely to exceed contributions from nearby vessels.

There are a range of underwater noise-generating activities associated with decommissioning activities, including the use of cutting tools. However, evidence suggests that noise from associated vessels is commonly recorded as the dominant source during these activities. For example, noise from cutting equipment is not anticipated to significantly exceed that of vessel operations.

Cutting and removing Anglia infrastructure is not considered to result in significant sound generation; the topsides are to be removed from the jacket/pile section using gas/diamond cutting equipment and the cutting of the piles at the Anglia A NUI (~3m below seabed) will be by internal cutting (contingency is to use high pressure water jet cutting equipment, either ROV or diver operated). The cutting of the Anglia West (B) protective structure piles will be by high pressure water jet, diamond wire or hydraulic cutting tools; diamond wire or hydraulic cutting tools will also be used to cut the pipelines (removal of tie-ins) and umbilical (cuts at crossing location transitions, where the umbilical is to be decommissioned in situ with the rest being removed). Noise will be generated from these cutting tools, but these will be used over short duration and at localised areas; the majority of the infrastructure is located outside the SNS SAC boundary, with approximately 18km (of the 24km length) of the export pipeline/piggybacked methanol line located within the boundary.

Measurements of an ROV-operated diamond wire cutting tool on a platform conductor at 80m water depth found noise levels to be not easily discernible above background levels between 100-800m from the source, with associated increases of around 4dB and up to 15dB re 1 µPa2 per 1/3 octave band for some frequencies, mostly above 10kHz (Pangerc *et al.* 2016). Direct measurements of noise levels

generated by non-impulsive underwater tools are limited, but where available they have been reported to generate sound of an amplitude that does not exceed those from average vessels. For example, Anthony *et al.* (2009), as part of a review of diver noise exposure, presents estimates of source levels of 148-180 dB re 1µPa@1m for several hand held tools (excluding impulsive stud/bolt guns). These include estimates of 160.1 and 170.5 dB re 1µPa@1m for water jet lances (most energy > 200 Hz; Molvaer & Gjestland 1981), which are likely to be broadly representative of noise emissions from abrasive water jet cutting tools (Molvaer & Gjestland 1981).

Post-decommissioning survey

A debris clearance and pipeline survey will be undertaken to confirm the completion of the decommissioning operations (see Section 3.5). As a minimum the survey area covered for debris clearance will include a 500m radius around the Anglia A NUI and Anglia West (B) manifold and a 100m corridor (50m on either side) along the infield and export lines; the extent and scope of the survey to be carried out by Ithaca within the existing 500m safety zone at LOGGS will be discussed with ConocoPhillips.

Identification of debris would normally be conducted by side scan sonar and/or MBES with an ROV deployed to investigate and recover any potential hazards. Any Anglia related seabed debris identified will be recovered for onshore disposal or recycling in line with existing disposal methods . Larger items of debris would be recovered by crane from a construction support vessel.

Side scan sonar and MBES equipment are used routinely in surface geophysical surveys, and are proposed to be used in the post-decommissioning survey. There are a number of different systems on the market resulting in a variety of outputs in terms of power, frequency and directionality, but for those most commonly deployed on site surveys the expectation is that generated sound levels drop off very quickly with distance due to a combination of high frequency and high directionality (DECC 2016). Characteristics of sound generation are commonly modelled from estimated source levels based on manufacturers' specifications (Zykov 2013) but efforts are ongoing to obtain direct measurements of operating equipment in testing facilities and in the field (Crocker & Fratantonio 2016). The overall duration and specific survey equipment to be used in the post-decommissioning survey are yet to be decided upon, and so it has been assumed that duration will be (typically) short, *ca*. 5 days and the side scan sonar equipment will operate at dual frequency of 114 or 410kHz with a source sound level of ~223dB re 1µPa@1m, and that the MBES equipment will operate at a frequency of 200-400kHz (300kHz normal operation) with a source sound level of ~210db re1µPa@1m (see Table 6.5 above).

A seabed clearance certificate will be issued by the survey contractor to confirm completion of the scope. Standard overtrawling surveys will also be undertaken to confirm the area is clear of debris and snagging hazards. If it is agreed that an over-trawlability survey is not suitable, alternative methods for post-decommissioning survey will be discussed with the Regulator to agree the survey methods and scope.

Marine Mammals

Marine mammals, for which sound is fundamental across a wide range of critical natural functions, show high sensitivity to underwater sound. In terms of impact, anthropogenic sound sources have been categorised based on acoustic and operational features (Southall *et al.* 2007); the main distinction is between pulsed and non-pulsed sounds due to differences in the auditory fatigue and acoustic trauma they induce, with the brief, rapid-rise of impulsive sounds being more damaging. Generally, the severity of effects tends to increase with increasing exposure to noise with both sound intensity and duration of exposure being important. A distinction can be drawn between effects associated with physical (including auditory) injury and effects associated with behavioural disturbance. With respect to injury, risk from an activity can be assessed using threshold criteria based on sound levels (e.g. Southall *et al.*

2007, Lucke *et al.* 2009, NMFS 2016). With respect to disturbance, however, it has proved much more difficult to establish broadly applicable threshold criteria based on exposure alone (NPWS 2014).

In addition, auditory capabilities are frequency dependent and vary between species (Southall *et al.* 2007). In the vicinity of the Anglia area, only a small number of marine mammal species, and mostly in low numbers, may be present (see Section 4.8). Of greatest relevance is the harbour porpoise, which survey and modelling data suggest may be present in the Anglia area at a density of approximately 1-2 per km^2, and for which the SNS SAC has been designated in waters to the north and east of the Anglia platform. Approximately 18km of the export pipeline/piggybacked methanol line is located within the SNS SAC; however, the majority of the Anglia infrastructure is located outside this boundary (≥ 5km to the nearest boundary). There is a low likelihood of white-beaked dolphin and minke whale being present in low numbers, while other species that may have an occasional to rare frequency of occurrence in the area are Atlantic white-sided dolphin, bottlenose dolphin and short-beaked common dolphin. Harbour and grey seals may also be present in and around the Anglia area, but again in low numbers.

Table 6.6 provides details of the relevant species listed by functional hearing group and the relevant auditory bandwidth as defined by Southall *et al.* (2007), Lucke *et al.* (2009) and more recently in NMFS (2016). As described above, sound from vessels has a wide frequency spectrum, but the dominant frequency tends to be low (<200Hz); this means that while marine mammals species which may be present in and around the Anglia area are expected, in principle, to be able to detect these sounds, it is low-frequency cetaceans and pinnipeds whose hearing ranges show the greatest overlap with noise likely to be generated by Anglia decommissioning activities.

Table 6.6 – Marine mammal species relevant to the area covered and their auditory capabilities

Species which may be present in the Anglia area (by functional hearing group)	Hearing range	Proposed injury[1] threshold criteria to non-pulsed sounds (SPL)
Low frequency cetaceans Minke whale *Balaenoptera acutorostrata*	7Hz to 22kHz[a] 7Hz to 35kHz[b]	230 dB re 1µPa[1]
Mid-frequency cetaceans White-beaked dolphin *Lagenorhynchus albirostris* Atlantic white sided dolphin *Lagenorhynchus acutus* Bottlenose dolphin *Tursiops truncatus* Short-beaked common dolphin *Delphinus delphis*	150Hz to 160kHz[a,b]	230 dB re 1µPa[a]
High-frequency cetaceans Harbour porpoise *Phocoena phocoena*	200Hz to 180kHz[a] 275Hz to 160kHz[b]	200 dB re 1µPa[c]
Pinnipeds in water Harbour seal *Phoca vitulina* Grey seal *Halichoerus grypus*	75Hz to 75kHz[a] 50Hz to 8kHz[b]	218 dB re 1µPa[a]

Notes: [1.] Injury is defined as the level at which a single exposure is likely to cause onset of permanent hearing loss. SPL = sound pressure level
Sources: [a]Southall et al (2007), [b]NMFS (2016) [c]Lucke et al. (2009)

With respect to injury thresholds and disturbance considerations, continuous underwater sound generated from vessels and cutting tools is understood to be relatively minor in comparison to impulsive sounds derived from high amplitude sources such as airguns during seismic surveys, impact piling or explosives (DECC 2016). Moreover, the estimated source levels of the decommissioning activities are below the proposed thresholds for injury to all functional hearing groups of marine mammals, limiting any effects to those of behavioural disturbance.

In terms of behavioural disturbance, it cannot be excluded that sound from the rig and vessels will, in the short-term, influence the behaviour of individual marine mammals within the vicinity of the decommissioning operations. The region of greatest hearing sensitivity for harbour porpoise does not

overlap with the low frequency sounds which dominate and propagate most widely from ships; nonetheless, mid- to high-frequency noise will also be emitted and be audible to porpoises at distances of up to a kilometre or more (e.g. Dyndo *et al.* 2015). Harbour porpoise have been reported to avoid survey ships at distances of 800-1,000m (Barlow, 1988, Palka and Hammond, 2001), while other studies have reported behavioural responses to passing vessels such as temporary changes in swimming and surfacing patterns and a reduction in feeding activity (e.g. Dyndo *et al.* 2015, Akkaya Bas *et al.* 2017, Wisniewska *et al.* 2018). However, the reported avoidance and behavioural responses to vessel noise/presence are temporary, and that vessel movements associated with the Anglia decommissioning will be localised and in the context of existing moderate-high levels of shipping within the area, which typically ranges between 300-500 vessel movements per year but can exceed 2,000 per year in adjacent areas, including parts of the SNS SAC (ABPmer Maritime 2015 AIS data[15]). Consequently, the risk that any effect could become significant at the population level, or cause long-term displacement from key habitat, is deemed to be extremely low due to a combination of sound characteristics, duration of activity, current understanding of marine mammal presence, movement and behaviour in the Anglia and wider southern North Sea, and that the majority of vessel activity, including rig activity, will take place outside the boundaries of the SNS SAC boundary.

The hearing range of marine mammals has the potential to overlap with the high frequency sound generated by the side scan sonar and MBES systems (particularly the lower frequency of 114kHz). Because of the high frequency, attenuation of sound intensity occurs efficiently in the water column. Thus, based on the characteristics of the sound source, the hearing capabilities of marine mammals, and the typical survey durations and location of the survey, any risk of injury or disturbance are assessed as highly unlikely.

Fish

Many species of fish are highly sensitive to sound and vibration and broadly applicable sound exposure criteria have been published (Popper *et al.* 2014). While it is recognised that vessel and other continuous noise may influence several aspects of fish behaviour, including inducing avoidance and altering swimming speed, direction and schooling behaviour, (e.g. De Robertis & Handegard 2013), there is no evidence of mortality or potential mortal injury to fish from ship noise (Popper *et al.* 2014).

Given the source level characteristics and the context of similar contributions to the ambient anthropogenic noise spectrum of the area over several decades (i.e. the oil and gas associated installations, vessels and rigs movements in and around the Anglia and southern North Sea area), no injury or significant behavioural disturbance to fish populations is anticipated.

Birds

Direct effects from impulsive noise on seabirds could occur through physical damage, or through disturbance of normal behaviour. Diving seabirds (e.g. auks) may be most at risk, but evidence of such effects is limited. Hearing sensitivity for species measured so far peaks between 1 and 3kHz, with a steep roll-off after 4kHz (Crowell *et al.* 2015).

While exposure to very high amplitude low frequency underwater noise (i.e. with tens of metres of underwater explosions) has been shown to cause acute trauma to diving seabirds (Danil & St Leger 2011), no activities which could generate such high intensity impulsive noise are proposed during the Anglia decommissioning. The observed region of greatest hearing sensitivity suggests a low potential for disturbance due to vessel noise. As such, and given the short-term duration of vessel presence, in the context of many decades of shipping and fishing activity in the region, and the relatively low importance of the Anglia area to diving seabirds, significant disturbance to diving seabirds is assessed as highly unlikely.

[15] https://data.gov.uk/dataset/b7ae1346-7885-4e2d-aedf-c08a37d829ee/vessel-density-grid-2015

Operational Controls and Mitigation

Normal project planning will mean the scheduling of activities will be such that, each phase of decommissioning will typically follow, rather than overlap, thereby reducing multiple vessels being on location (other than support vessels) carrying out multiple decommissioning activities simultaneously. Various permits and consents will be required, prior to work being carried out, and these will be submitted to OPRED and other regulatory bodies as required; these will include updated assessments including noise assessments, where necessary.

As part of Ithacas contractor management process, where activities are being carried out in sensitive areas (i.e. within or close to a designated area, or an area being considered for designation) awareness material is provided to the contractor prior to work commencing; Ithaca's HS&E policy is also communicated to contractors along with the expectation that compliance with the policy is mandatory to prevent harm to themselves and others and damage to the environment.

No specific additional mitigation was considered necessary beyond application of established operational controls and following industry guidelines where applicable.

Conclusion

The primary contributor to underwater noise from the Anglia decommissioning activities will be vessel activity. The rig will be the longest on location at ca. 112 days (Anglia A NUI and Anglia West (B)), with vessels, (including the HLV) being on site for between 1 and 31 days; the majority of operations will be both short-term and localised. The increased vessel activity associated with these activities will add to the overall ambient noise in the wider Anglia area; however, source level characteristics are well-below injury criteria for marine mammals and the continuous noise from vessels is not reported to result in injury to fish or birds.

Underwater noise emissions from cutting tools (operated by divers or remotely) are unlikely to result in sufficient levels of noise to cause significant disturbance to marine life. Similarly, noise associated with the post-decommissioning survey is regarded to pose a low risk of significant effect on marine mammals, fish and birds.

The noise sources will be temporary and minimised by a phased approach to decommissioning such that vessel time in the field is minimised. Sound from vessels may result in some temporary influence on the behaviour of individual marine mammals within the vicinity of the operations, including harbour porpoise; however, such effects will be short-term, localised, largely outside if the boundary of the SNS SAC and in the context of existing moderate-high levels of shipping activity in the region. Consequently, significant negative effects at the population level are not anticipated.

6.6 Effects on Conservation Sites

Potential Impact

The relevant conservation sites for the proposed Anglia decommissioning are the North Norfolk Sandbanks and Saturn Reef SAC (NNSSR SAC) and the Southern North Sea SAC (SNS SAC). The qualifying features of these sites are described in Section 4.9. See also Appendix C – Appropriate Assessment Screening.

The overall condition of the two qualifying features of the NNSSR SAC are considered unfavourable (JNCC 2017 http://jncc.defra.gov.uk/pdf/NNSSR_Statements_v1_0.pdf) and, as a consequence, the Conservation Objectives of the site are to restore the Annex I Sandbanks and Reef features to favourable condition. JNCC site-specific Advice on Operations (JNCC http://jncc.defra.gov.uk/page-6537)

provides information on activities, which if carried out within or near the site, can affect the site's integrity, which risks achieving the sites conservation objectives.

Activities identified as capable of having a significant effect on the qualifying features of the NNSSR SAC, include activities associated with oil and gas decommissioning. However, the mere carrying out of these activities would not necessarily have a significant effect on site integrity. Project specific information should be used in conjunction with the advice on operations, to assess if the activities would result in a significant impact. The expectation is that the activities would be managed in such as way as to restore the qualifying features, by reducing, or removing sources of potential impact (pressures) associated with these activities
(JNCC 2017 http://jncc.defra.gov.uk/pdf/NNSSR_Statements_v1_0.pdf).

From the JNCC's Advice on Operations for the NNSSR SAC, those pressures (at the benchmark described within the advice) from oil and gas decommissioning activities, which the qualifying features of the site have been identified as sensitive to (S), or where the *evidence base is not considered developed enough for assessment to be made of the sensitivity at the pressure benchmark*, (IE), in both cases either directly[16] or indirectly, are shown in Table 6.7.

Table 6 7 – Pressures and associated benchmarks for the North Norfolk Sandbanks and Saturn reef SAC

Pressure	Benchmark	Reef	Sandbank
Abrasion/disturbance of the substrate on the surface of the seabed	Damage to surface features (e.g. species and physical structure within the habitat)	S	S
Change in suspended solids (water clarity)	A change in one Water Framework Directive (WFD) ecological status class for one year within site	Note 1	S
Habitat structure changes – removal of substratum (extraction)	Extraction of substratum to 30cm (where substratum included sediments and sift rocks but excludes hard bedrock)	S	S
Introduction of other substances (solid, liquid or gas)	None listed	IE	IE
Penetration and/or disturbance of the substrate below the surface of the seabed including abrasion	Damage to sub-surface features (e.g. species and physical structures within the habitat)	S	S
Physical change (to another seabed type)	Change in sediment type by one Folk class (based on UK SeaMAP simplified classification) Change from sedimentary or soft rock substrate to hard rock or artificial substrate or vice-versa	S	S

[16] Direct – an activity which exerts pressures that interact with a feature within the spatial and/or temporal footprint of the operation.

Indirect – an activity which exerts pressures that interact with a feature not associated with the immediate spatial and/or temporal footprint of the operation. http://jncc.defra.gov.uk/pdf/how%20to%20use%20the%20advice%20on%20operations%20workbook.pdf

Siltation rate changes (low) including smothering (depth of vertical sediment overburden)	"Light" deposition of up to 5cm of fine material added to the habitat in a single discrete event	S	S
Water flow (tidal current) changes – local including sediment transport considerations	A change in peak mean spring bed flow velocity of between 0.1m/s to 0.2m/s for more than 1 year	S	S

Notes: [1]This is marked as NS for Reefs meaning the evidence base suggests the feature is not sensitive to the pressure benchmark but the guidance does recommend the activity-pressure-feature combination is not precluded from consideration; no S. spinulosa *reef is identified within the Anglia area and this pressure is not considered further here.*
Source: JNCC website: http://jncc.defra.gov.uk/page-6537

The Gardline survey of 2003 and the pre-decommissioning survey (Fugro 2018a, b) found no occurrence of *Sabellaria spinulosa* reef throughout the Anglia area. *Sabellaria spinulosa* was identified at one sample transect (transect 17 – see Appendix 2) located along the export pipeline ~8km from LOGGS PP and ~16km from the Anglia A NUI. A reef assessment concluded that the extent and elevation of the *Sabellaria spinulosa* structure was not sufficient to classify it as an Annex I biogenic reef habitat (Fugro 2018a, b). Seabed surveys have not found evidence of biogenic reef throughout the Anglia area, and Anglia is not included in high confidence and potential reef (extent and distribution) areas –Appendix A and B in JNCC 2017a http://jncc.defra.gov.uk/pdf/NNSSR_SACO_v1_0.pdf

Given the absence of Annex I biogenic reef from the Anglia area, a significant impact on this qualifying feature of the NNSSR SAC, from Anglia decommissioning activities, is not anticipated. The remainder of this section therefore focuses on the potential impact on the Annex I Sandbank qualifying feature of the NNSSR SAC.

The proposed Anglia decommissioning activities to be carried out within the NNSSR SAC site boundary, and all within or bordering existing 500m safety zones, are (see also Section 6.3):

- Jack-up rig and contingent associated stabilisation material for well P&A at Anglia A NUI
- The removal of the Anglia A NUI
- The moving/removing of protective material covering tie-in infrastructure (at Anglia A NUI)
- Removal by reverse reel of approximately half of the infield umbilical

The remainder of the proposed decommissioning activities, i.e. removal of Anglia West (B) and associated protective material and tie-ins and the removal of the remainder of the umbilical, including removing the approaches to the crossing to enable the section of line under the crossing to be decommissioned *in situ*, take place outside the NNSSR SAC boundary.

Of the pressures in Table 6.7, from the decommissioning activities around the Anglia A NUI, the following are not expected to occur at the benchmark described or to impact on site integrity: change in suspended solids (water clarity); habitat structure changes – removal of substratum (extraction); introduction of other substances (solid, liquid or gas); siltation rate changes (low) including smothering (depth of vertical sediment overburden) and water flow (tidal current) changes – local including sediment transport considerations. Consequently, these are not considered further here.

The sandbank feature is potentially sensitive to physical damage through disturbance or abrasion from spud cans as part of jack-up rig siting, and anchoring of the HLV. The placing of the jack-up spud cans, contingent stabilisation material and anchors will also result in penetration and disturbance of the substrate. The estimated seabed footprint associated with jack-up siting (including stabilisation material) (0.002km^2) and HLV anchoring (0.02km^2) is very small compared to the large site (3,603km^2); the siting of the jack-up and HLV will also be within (or, depending on the HLV anchor pattern, extend just outside) the Anglia A NUI 500m safety zone, an already disturbed area. Such effects will also occur during the physical removal of the Anglia A NUI jacket, the tie-in/riser infrastructure and

associated protective material. Again, this will take place within the existing footprint of the Anglia A NUI and its 500m safety zone.

Recovery from physical damage of the scale associated with the jack-up siting, HLV anchor placement and NUI removal, is expected to be rapid, given the dynamic nature of the site. Spud can depressions and anchor scarring is not expected to persist; no spud can depressions from the initial drilling campaign were evident in the pre-decommissioning survey results.

While the decommissioning activities at the Anglia A NUI is not actively restoring the qualifying feature to favourable status, they are not predicted to significantly affect the site's ability to achieve the conservation objectives.

There may be a requirement for rig stabilisation and the sandbanks are considered highly sensitive to obstruction on the sandbanks. In soft sediments, deposited rock may cover existing sediments resulting in a physical change of seabed type. As indicated by the pre-decommissioning (and other) surveys, sand and coarse sediments dominate the Anglia area, with isolated boulders and cobbles observed. Rock placement, if required, would have a spatial footprint of 0.002km^2. Hence the potential loss of extent of sandy sediment is very small compared to the predominance of this sediment type across the large site (3,603km^2).

Direct effects on the benthic fauna would include mortality, as a result of physical trauma, and smothering by displaced and re-suspended sediment of those species unable to burrow to the surface. The previous surveys around Anglia found a sparse infauna typified and dominated by polychaetes and amphipods which are characteristic of the site's qualifying feature. The introduction of hard substrate, at the proposed scale, will result in a modest expansion of these existing communities, maintaining *the natural spatial distribution, composition, diversity and abundance of the main characterising biological communities of the sandbank within the site*, rather than introduce communities not already present. In view of the sediment mobility of the area (as evidenced by mobile sandwaves) any hard substrate introduced is expected to become smothered by sand and hence to function as a sandy mixed habitat.

A JNCC report on evidence of the impacts associated with rock dumping during the decommissioning of oil and gas infrastructure on mobile Annex I sandbanks used the NNSSR SAC as the case study (Pidduck *et al*. 2017). This also included a review of Environmental Statements for North Sea projects which considered the use and impacts of rock placement within, or close to, sandbanks including the NNSSR SAC. These included impacts on physical (current and tidal flow disturbance, sediment supply disturbance and increase in scour) and biological (changes in biodiversity from new substrate and recovery of soft bottom communities) processes. The report concluded that there is insufficient information to quantify or qualify the impacts and effects of rock placement on the physical and biological processes of the Annex I sandbank within the NNSSR SAC. Evidence gaps regarding impacts of rock on the Annex I habitat were identified and recommendations made to improve the understanding of these. These included monitoring surveys, for survey (including post-decommissioning and long term monitoring) data to be made more publicly available and for numerical modelling to predict the impacts on sandbanks from the introduction of rock.

The SNS SAC extends to an area of 36,951km^2 and has been designated for predicted persistent high densities of the harbour porpoise, an Annex II species and the qualifying feature of the site. The site condition is considered favourable. The conservation objective of the site is to maintain site integrity and favourable condition status by avoiding the deterioration of the harbour porpoise habitats and significant disturbance of the species.

Approximately 18km of the 24km export pipeline is within the SNS SAC; as the export pipeline/piggybacked methanol line are to be decommissioned in *situ*, none of the proposed Anglia decommissioning activities take place along this corridor. The tie-ins/risers are to be removed at the LOGGS PP, but this will take place within the existing 500m safety zone. Anglia decommissioning

activities are not expected to impact the qualifying feature and site integrity and therefore, the site is not considered further here.

There are also a number of Natura 2000 sites in offshore waters to the west to Anglia and along the East Anglia coast (see Table 4.4, Section 4.9). The closest of these to the Anglia facilities is the Haisborough, Hammond and Winterton SAC (36km). Given the distance to this and the other Natura 2000 sites, the activities associated with decommissioning the Anglia facilities is not considered to affect the qualifying features of the sites or the sites' integrity – see also Appendix 3 – Appropriate Assessment Screening.

Operational Controls

A rig site survey will be carried out prior to the jack-up rig arriving on site. This obtains information on the seabed and sub-seabed conditions, to ensure the safe installation and operation of the jack-up, including the seabed topography and presence of potential hazards (e.g. debris, geohazards). The survey results will influence the decision on whether rig stabilisation material is required. If required, rock quantities would be minimised as far as possible, where safe to do so.

Conclusion

The pre-decommissioning survey (Fugro 2018a, b) and earlier surveys around Anglia found no *Sabellaria spinulosa* reef present. From surveys conducted in 2013 (Vanstaen & Whomersley 2015) and 2016 (Mcllwaine *et al*. 2017) JNCC/CEFAS found no areas of biogenic (*Sabellaria spinulosa*) reef in and around the Anglia area. The Anglia area is not included in the areas of high confidence or potential biogenic reef (Appendix B, JNCC 2017, supplementary advice on conservation objectives for North Norfolk Sandbanks and Saturn Reef Special Area of Conservation). Given the absence of this qualifying feature from the Anglia area, decommissioning activities carried out within the boundary of the SAC (at the Anglia A NUI), will not impact the qualifying feature or the site integrity.

The removal of the Anglia A NUI, placing of the jack-up and associated stabilisation material and the HLV anchoring will impact the immediate seabed where these activities take place. The disturbance is expected to be temporary with rapid recovery, and although the placing of rock will be permanent, this will only be used if necessary, to ensure the safety of the jack-up and quantities will be minimised where possible. The overall area potentially affected is small compared to the entirety of the NNSSR SAC site, and pre-decommissioning and future monitoring will collect data on the condition of the area.

No decommissioning activities will be carried out within the SNS SAC boundary, with the exception of the disconnection of the tie-ins/risers at LOGGS PP, this to be carried out within the existing 500m safety zone. This activity will not impact the qualifying feature or site integrity.

6.7 Accidental Events and Major Environmental Incident

Accidental events

Risk assessment of accidental events involves the identification of credible accident scenarios, evaluation of the probability of incidents and assessment of their ecological and socio-economic consequences. Evaluating spill risk requires consideration of the probability of an incident occurring and the consequences of the impact. Given the nature of the activities which could take place as a result of decommissioning, the following potential sources of spill risk have been identified:

- Loss of vessel through collision
- Worst case loss of fuel inventory (diesel) from a vessel (HLV/barge, support vessel)
- Worst case loss of fuel inventory (diesel) from the rig
- Small scale spillage of diesel during bunkering
- Loss of chemical containment, including legacy chemicals from subsea wells

Other users of the Anglia area and transportation routes will be alerted to the decommissioning activities via publication of Notices to Mariners detailing rig and vessel positions, activities and timing and by full navigation lighting on the rig and vessels. A vessel traffic survey will also be undertaken to inform rig siting, decommissioning planning and the wider EA process.

All vessels and rigs to be used during well and wider facility decommissioning will have in place the relevant, current Shipboard Oil Pollution Emergency Plan (SOPEP) and/or Non-Production Installation Oil Pollution Emergency Plan (NPI OPEP), with the relevant interfacing Ithaca Plan, which would be implemented in the event of an accidental event; the Anglia A NUI/Anglia West (B) infrastructure also has in place a current OPEP. Further spill response resources would be available to Ithaca via contracted spill management contractors. In the unlikely event of a diesel spill, these would rapidly spread and disperse to form a sheen on the sea surface. Diesel in not persistent and would rapidly evaporate/disperse.

Major Environmental Incident

The publication of Directive 2013/30/EU on safety of offshore oil and gas operations (EUOSD) and *The Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015* that transpose the requirements of the Directive into UK law, acknowledged the environmental element associated with MAH, and introduced the requirement to identify Safety and Environmental Critical Elements (SECEs), with the regulations now including a further definition of Major Accident, a Major Environmental Incident (MEI). A MEI is an incident which results, or is likely to result in, significant adverse effects on the environment and for an incident to be a MEI, this must have another safety related Major Accident as a precursor; the hazard identification process for the Anglia A NUI is based on a review of previous safety studies performed for the project, taking into account hazards on the NUI post cessation of production. A number of categories with associated major accident hazards were identified:

- Process loss of containment – blowout, topsides process equipment and release and export/infield riser and pipeline release
- Non-process loss of containment – methanol release and diesel release
- Non-hydrocarbon hazards – seismic event (leading to structural failure), ship collision, helicopter transportation accident, occupational hazards, diving and dropped objects

The current Anglia Safety Case issued in August 2016, describes the facilities in a non-production state (production having ceased in 2015) and from this, none of the above hazards identified were assessed as having the potential to lead to a MEI.

A potential spill from the Anglia wells (both those at the Anglia A NUI and at Anglia West (B)), is not considered to be a source of spill risk; Anglia is a gas field, with some condensate, and the wells have been shut in via the Down Hole Safety Valve (DHSV) and surface tree valves depressurised and positively isolated from the flowlines, thereby reducing the potential for loss of any residual reservoir hydrocarbons from the Anglia decommissioning activities.

A cleaning programme has also been carried out, which included the topside process equipment and pipework, and subsea infrastructure, with pipelines being left with inhibited seawater (chemicals include biocide, corrosion inhibitor) (infield line) or untreated seawater (export line), again reducing the potential loss of any residual reservoir hydrocarbons. Any remaining hydrocarbons within the pipeline and topsides will be small quantities not removed by the cleaning process. It is unlikely that these residues would be of a quantity to generate pollution events. Methanol is not stored on the Anglia A NUI and there is a gravity fed storage tank (volume of $1m^3$) on the main deck that provides diesel to the generator and platform crane (previously the main diesel storage consisted of three interlinked storage compartments (volume $31m^3$) which has since been cleaned and no longer used). Methanol and

diesel are not present in any volume that, if spilled, would result in a significant environmental impact, or indeed a major environmental incident.

Of the remaining category, seismic event, ship collision, helicopter transportation accident and dropped object were assessed for their potential to result in a MEI; neither occupational hazards (e.g. slips, trips, cuts etc.) nor diving were assessed as having a potential impact on the environment. Vessel collision risk is as above in terms of potential spill of diesel potential impact on the environment, and while helifuel may be released to sea in the event of an accident, the risk to the environment is considered low due to the limited fuel in a helicopter; no helifuel is stored on board the Anglia A NUI.

The final major accident hazard identified with the potential to lead to a MEI is dropped objects, most likely to arise from lifting operations using the crane; an impact on process equipment or subsea facilities may result in a loss of containment. As production has now ceased and there are no produced hydrocarbons on the Anglia A NUI, there is limited use of the platform crane following cessation of production, and any temporary lifting equipment used on Anglia will be managed and maintained in accordance with relevant Regulation, dropped objects leading to loss of containment is not considered a significant risk to the environment and hence not considered to result in a MEI.

6.8 Cumulative Impacts

Current guidance (BEIS 2018a) requires the assessment to consider the cumulative effects arising from decommissioning activities in the context of all other activities taking place in the area, where relevant to do so.

Consideration has been given to the cumulative effects arising from decommissioning activities in the context of all other activities taking place in the area and has followed the guidance to *The Offshore Petroleum Production and Pipe-lines (Assessment of Environmental Effects) Regulations 1999* (as amended) (BEIS 2017b) where it states:

"The assessment should also consider the impacts of other existing, consented or planned activities in the development area, and determine whether there are likely to be any significant in-combination or cumulative impacts"

Ithaca have also looked to DTI 2003, which defined three categories of "additive" effects in the context of Strategic Environmental Assessment:

Incremental effects are considered within the assessment process as effects from licensing exploration and production (E&P) activities, which have the potential to act additively with those from other oil and gas activity, including:

- Forecast activity in newly licensed areas
- New exploration and production activities in existing licensed areas
- Existing production activities
- Forecast decommissioning activities
- Legacy effects of previous E&P activities, post-decommissioning (e.g. unrecovered debris)

Cumulative effects are considered in a broader context, to be potential effects of decommissioning activities which act additively or in combination with those of other human activities (past, present and future); given the existing uses of the sea in and around the Anglia area and the decommissioning activities, the cumulative effects have the potential to arise with other activities, notably:

- Fishing
- Shipping and navigation
- The construction of offshore renewable projects
- Other oil and gas decommissioning activities
- Oil and gas and other industrial related activity (e.g. exploration, appraisal, development, marine aggregate extraction)

Synergistic effects – synergy occurs where the joint effect of two or more processes is greater than the sum of individual effects – in this context, synergistic effects may result from physiological interactions (for example, through inhibition of immune response systems) or through the interaction of different physiological and ecological processes (for example through a combination of contaminant toxicity and habitat disturbance).

Effects from decommissioning the Anglia facilities or accidents associated with them, which are considered to have potential to act in an incremental, cumulative or synergistic manner are summarised below.

Given the very low potential for significant effects of underwater noise on fish and diving birds from decommissioning activities (Section 6.5) and other offshore energy activities (see DECC 2016), and that part of the Anglia infrastructure is located within the SNS SAC, the focus for noise is marine mammals. As concluded by The National Academies of Sciences (2017), "although significant progress has been made in understanding the responses of marine mammals to specific stressors such as noise and toxins, it is not yet possible to provide quantitative estimates of the impact of repeated exposure to a stressor or to predict how different stressors will interact to affect individuals and populations of marine mammals." Consequently, a quantitative assessment is made here based on the location, scale and schedule of the proposed activities relative to other noise-generating activities in the region, with reference to broader-scale assessments for context where relevant.

With confirmation from the pre-decommissioning survey and earlier surveys carried out in and around the Anglia area that no *Sabellaria spinulosa* reef habitat is present, no incremental, cumulative or synergistic impact will occur and consequently, this feature is not discussed further. The focus for the conservation sites is the potential impacts on the Annex I Habitat Sandbanks; impacts on harbour porpoise, the qualifying feature for the SNS SAC has been addressed under noise.

Physical presence	I**ncremental**: the jack-up will be situated over the Anglia A NUI and Anglia West (B), predominately within the existing 500m exclusion zones resulting in no incremental loss of fishing access. Exclusion zones will be in place for either the jack-up or LWIV for the three subsea appraisal wells. The removal of the Anglia infrastructure will remove existing exclusion zones from the area, re-opening these areas for fishing activity. **Cumulative**: No other significant access bans or restrictions to navigation exist in the area; the schedule for decommissioning activities may coincide with other decommissioning/development activities in the area, if this is the case, vessel synergies will be explored to minimize vessel presence. **Synergistic**: none
Physical disturbance	I**ncremental**: disturbance will be incremental with that resulting from other well plug and abandonment, installation/pipeline decommissioning activities; there are other decommissioning projects in the wider southern North Sea area. However, the majority of the spatial extent of disturbance for decommissioning Anglia is limited and widely separated from other decommissioning projects, with the only footprint overlap being the tie-in locations at LOGGS PP. The total area affected is a small proportion of benthic habitat area.

	Cumulative: fishing, along with dredging and cable laying/rock use for renewables, probably represents the principal sources of seabed disturbance in and around the wider Anglia area/southern North Sea. **Synergistic**: none
Emissions	I**ncremental**: no significant incremental effects, in view of scale of inputs (relatively few vessels on site, for relatively short durations at a time, limited vessel overlap) and very high available dispersion. **Cumulative**: greenhouse and acid gas emissions will be cumulative in a global context, although the contribution associated with the decommissioning activities is minor. **Synergistic**: none
Noise	I**ncremental**: Jack-up rig and vessel noise will be the primary source of underwater noise during decommissioning activities, and will be incremental to other vessel noise in the Anglia and adjacent areas. However, the increment will be small relative to vessel traffic levels in adjacent areas (high in the vicinity of the Clipper platforms) and short-term, and is not considered to have significant synchronous effects (i.e. additive to other acoustic disturbance at the time) or significant temporal effects (i.e. additive to previous and subsequent disturbance by seismic and other activities). For context, a modelling study showed that the construction of 65 wind farms across the North Sea (each generating far greater levels of underwater noise than decommissioning) would not result in population-level effects on harbour porpoise under a variety of potential construction schedule scenarios, given assumed behavioural responses reflected those which have been observed to date (Nabe-Nielsen et al. 2018). **Cumulative**: Other sources of anthropogenic noise include shipping – the cumulative increment from the decommissioning of Anglia will be minor in the context of existing noise levels from shipping transiting the area, with very high levels of shipping traffic ≥20km to the southwest and moderate traffic (6-9 vessels per week) at present in the Anglia area. There are multiple offshore wind projects in the wider area, but all are ≥17km from the Anglia A NUI; wind project construction schedules are subject to change, but there appears to be limited potential for temporal overlap with Anglia decommissioning activities, and those which may overlap are all ≥52km distant. For context, a recent Habitats Regulations Assessment for the SNS SAC (designated for harbour porpoise) concluded that activities associated with existing and consented offshore wind farms in the region, either alone or in-combination with other plans and projects (including shipping and seismic survey), would not have an adverse effect on the site's integrity (i.e. population size, ranging patterns, habitat and prey would not be significantly affected), given current regulations, approval conditions and mitigation measures (BEIS 2018c). This assessment included a 7% (52 vessels per day) increase in vessel traffic within the site, which was concluded to result in a negligible increase in the number of porpoises displaced per day at the management unit level; by comparison, daily vessel movements associated within the Anglia decommissioning activities will primarily be outside of the SNS SAC (where porpoise densities are lower) and be unlikely to exceed 3-5 vessels per day, even during periods of peak activity. **Synergistic**: In addition to those noise sources identified above, high contaminant burdens and their effects on reproductive success are a concern for many species of marine mammal in the north-east Atlantic (e.g. Murphy *et al*. 2015, Jepson *et al*. 2016), while other stressors may include changes in oceanographic conditions, prey availability, predator distribution and outbreaks of pathogens. No synergistic effects between noise and other stressors have been conclusively demonstrated to date, with the identification of interactions between multiple stressors being notoriously difficult to study, particularly among marine mammals (The National Academies of Sciences 2017). Nonetheless, given the limited potential for the effects of noise associated with the Anglia decommissioning, the low potential for incremental or cumulative effects identified above, and the *favourable* conservation status of North Sea harbour porpoise (the primary relevant species of concern) alongside many decades of human activity, synergistic effects arising from the Anglia decommissioning are considered to be highly unlikely.
Conservation sites	I**ncremental**: the physical impact and habitat loss from Anglia activities will be incremental to other decommissioning projects in the NNSSR SAC, but these impacts are spatially small, (representing <0.05km^2, in most cases), are localised to footprints of existing developments

	which were present prior to SAC designation and in the case of physical disturbance, temporary because of the energetic nature of the area. **Cumulative**: the only project overlap is at LOGGS PP, and the removal of the relevant spool pieces is not regarded to lead to a significant effect cumulatively with existing activities at that installation. All other hydrocarbon (including decommissioning) and renewable projects are >15km from Anglia. Other decommissioning projects, renewable and new hydrocarbon developments may include rock placement for rig/vessel stabilisation and for protecting infrastructure. A concern raised in scoping is that while the individual footprints do not physically overlap, rock use, in discrete areas across the site will result in a cumulative impact on the site integrity as a whole. Post activity monitoring at locations where rock has been used for stabilisation has shown deposited rock has either dispersed, or become naturally buried with sediment, suggesting no impediment to sediment movement and deposition (GDF Suez 2009 as cited in Pidduck *et al*. 2017). Cumulative effects on the NNSSR SAC site from the contingent use of rock at Anglia, at the quantities estimated, are considered unlikely. **Synergistic**: none
Accidental events	I**ncremental**: the combined probability of ecologically significant oil spills from decommissioning activity in the Anglia and surrounding area is extremely low, this area being predominately gas fields, with some condensate, and being some distance offshore **Cumulative**: given their distance from producing fields, the fields being predominately gas with some condensate, the adjacent coasts have a relatively low exposure to risks associated with oil/product tanker and other vessel traffic through the region and to adjacent ports. The contribution to overall risk of the decommissioning and associated vessel activities is extremely small. **Synergistic**: none

6.9 Transboundary Impacts

Yard facilities for the dismantling of the Anglia infrastructure has yet to be finalised. It is expected that a UK based yard will be used, but a non-UK based yard has not been discounted at this stage. If the latter option is progressed, all relevant legislation with regards to the transhipment of waste will be adhered to.

Anglia is some considerable distance (~92km) from the nearest Median Line (UK/Netherlands), and the nature of historical production (gas with some condensate) and remaining diesel inventory ($1m^3$) on the Anglia A NUI is such that transboundary effects are not predicted.

7 ISSUE MANAGEMENT AND OVERALL CONCLUSION

7.1 Introduction

Through a systematic evaluation of the Anglia decommissioning activities and their interactions with the environment, a variety of potential sources of effect were identified; the majority of these were of limited extent and duration and deemed minor (Section 5.2, Table 5.2). Those activities which were identified as being of potentially greater concern were assessed further in Section 6.

While predicted environmental effects from decommissioning activities are comparable with those from the decommissioning of other field facilities on the UKCS, the Anglia A NUI is relatively small compared to platforms in the deeper North Sea. During the assessment process, no potential issues of concern, including significant long term impacts on the North Norfolk Sandbanks and Saturn Reef SAC and SNS SAC were identified.

The risk of spills has been considered and there will be preventative measures and procedures in place to minimise the likelihood of their occurrence and potential environmental damage.

7.2 Environmental Management Commitments

The decommissioning activities will be conducted in accordance with Ithaca's HS&E policy. Ithaca's integrated management system is consistent with the ISO 14001: 2015 International Standard for Environmental Management Systems.

A number of contractors will be involved in the detailed planning and execution of the decommissioning activities, including the receiving and processing of the infrastructure onshore and Ithaca has established contractor selection and management procedures which include evaluation of HS&E aspects and environmental management and compliance.

Table 7.1 below presents a summary of commitments and actions for the decommissioning activities, with responsible persons/team included.

Table 7 1 – Summary of Commitments and Actions for the decommissioning of the Anglia facilities

Item	Issue	Actions	Responsibility
Overall Project			
1	Environmental objectives	Ensure indicators and targets for the decommissioning project are consistent with Ithaca policy and the environmental goals are established for each of the main activities (well plug and abandon, installation removal, subsea infrastructure decommissioning/removal). Monitor and review performance against indicators and targets, ensuring remedial action is instigated where necessary.	HSEQ Department
2	Contractor management – offshore and onshore operations	Ensure contractor management assurance processes in place and include environmental aspects for all contracted elements of the offshore activities. Ensure all relevant licences/permits in place for receiving and processing facility.	Projects/HSEQ Departments
3	Compliance assurance	Ensure a process is in place to manage the applications for and monitoring of compliance with	HSEQ Department

Item	Issue	Actions	Responsibility
		the requirements of environmental permits and consents.	
4	Decommissioning debris	Ensure any items of equipment or materials lost overboard are reported to Ithaca representative. Recover all significant items of debris located.	Projects/HSEQ Departments
5	Survey	Over-trawlability and debris/clearance survey carried out upon completion of decommissioning activities.	Projects/HSEQ Departments
6	Review	Ensure a post project review is carried out to assess the accuracy of environmental assessment predictions in the context of actual impacts. Assess the extent to which commitments made in the EA have been implemented.	HSEQ Department
Well Plug and Abandonment			
7	Rig audit	Audit of rig to be carried out, if required, to confirm systems and procedures are as required	HSEQ Department
8	Contractor management	Monitor environmental performance during well decommissioning operations	Projects/HSEQ Departments
9	Environmental critical elements	Ensure rig has a register of environmentally critical equipment, that scheduled maintenance checks are undertaken and that items are appropriately prioritised.	HSEQ Department
10	Bunkering	Bunkering to be conducted in favourable sea states, according to the rig operator's procedures and during daylight hours so far as practicable	Projects/HSEQ Departments
11	Waste procedures	Waste management and procedures to be raised at pre-operations meeting Raise expectations of waste recycling Monitoring of waste management practices and ensure appropriate documentation and record keeping	HSEQ Department
12	Non-routine and accidental events	Audits, risk assessments and mitigation assurance. Interface documents Spill prevention expectations and bunkering to be raised at pre-operations meetings	Projects/HSEQ Departments
Topside, jacket and pile removal			
13	Heavy Lift Vessel audit	Audit of HLV, if required, to confirm systems and procedures are as required for operations	HSEQ Department
14	Contractor management	Monitor environmental performance during disconnection and lifting operations. Ensure appropriate lifting processes and procedures in place and adhered to.	Projects/HSEQ Departments
15	Waste procedures	Waste management, procedures and inventory to be raised at pre-operations meeting. Monitoring for NORM if present Monitoring of waste management practices and ensure appropriate documentation and record keeping, including all relevant waste transport/handling documentation	Projects/HSEQ Departments
Subsea infrastructure			
16	Contractor management	Appropriate tools and procedures for disconnection and lifting of infrastructure being removed	Projects/HSEQ Departments
17	Waste procedures	Waste management and procedures to be raised at pre-operations meeting. Monitoring of waste management practices and ensure appropriate documentation and record keeping	Projects/HSEQ Departments
Onshore			

Item	Issue	Actions	Responsibility
18	Audit	Audit of waste handling facility, recycling and disposal companies if required	HSEQ Department
19	Waste procedures	Monitoring of waste management practices and ensure appropriate documentation and record keeping. Use of existing, permitted facilities. Maximize recycling of materials.	Projects/HSEQ Departments

7.3 Overall Conclusion

The overall conclusions of the environmental assessment of the proposed decommissioning of the Anglia facilities are:

- No significant environmental effects, or adverse effects on other users of the sea are predicted from planned activities associated with the decommissioning operations
- No significant environmental effects, or adverse effects on conservation sites within which some Anglia infrastructure is located, are predicted from planned activities associated with the decommissioning operations
- No specific, additional mitigation was considered necessary for the conservation sites within which (some Anglia facilities are located, beyond application of established Ithaca management system processes, operational controls and following industry guidelines where applicable
- No significant spillage of hydrocarbons or chemicals are predicted, due to the Anglia Field being gas/condensate, the current status of the production wells, and the topsides process and pipelines being cleaned and flushed
- Spillage of diesel from vessels (including the jack-up rig) are possible, but potential for this is small and the risks are mitigated as far as practicable through operating procedures and spill response procedures that will be put in place
- A range of environmental management actions and commitments have been identified and will be carried forward through the detailed planning and execution phase of the decommissioning project to further assess, avoid or minimise adverse environmental impacts, as far as technically feasible

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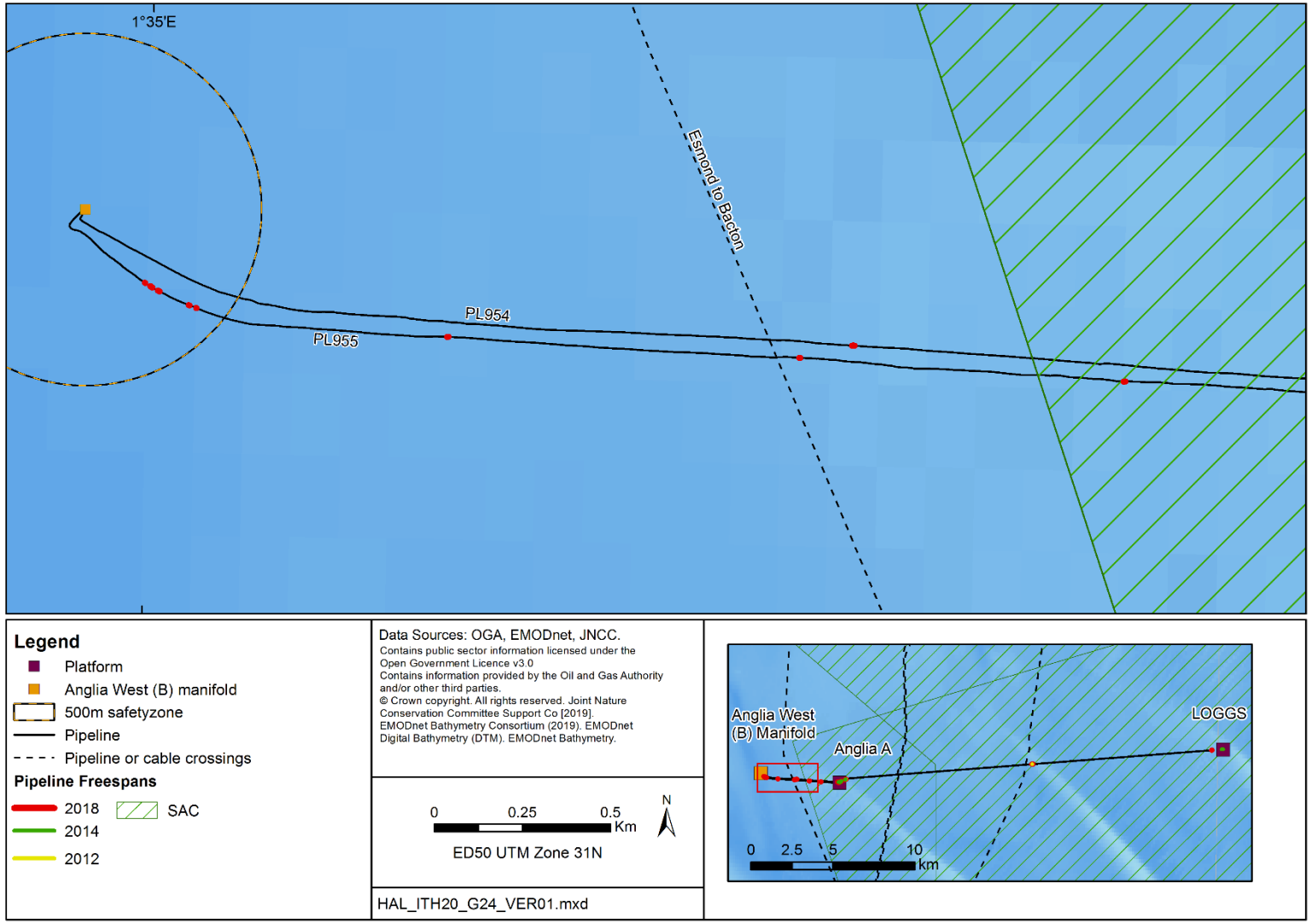
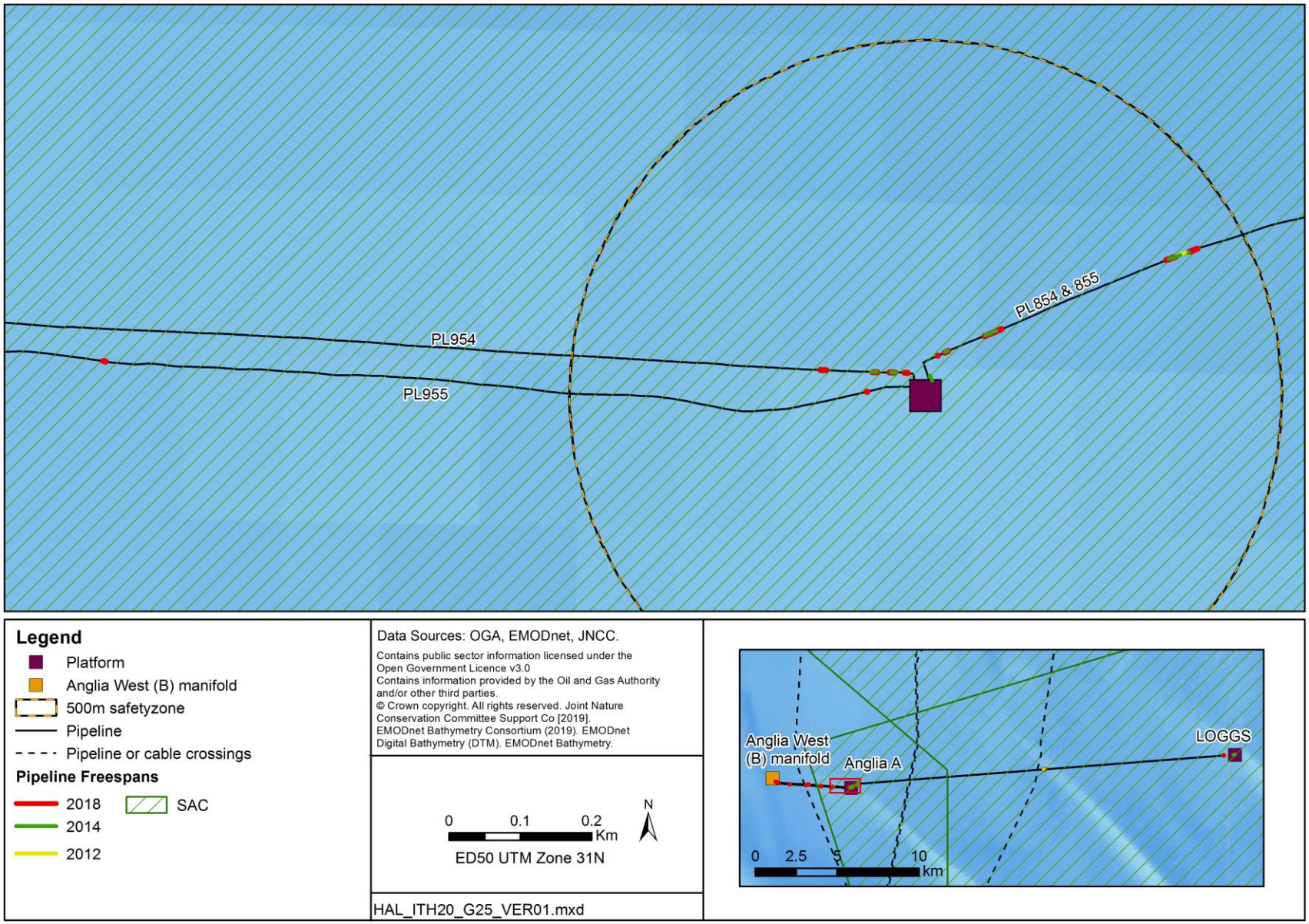
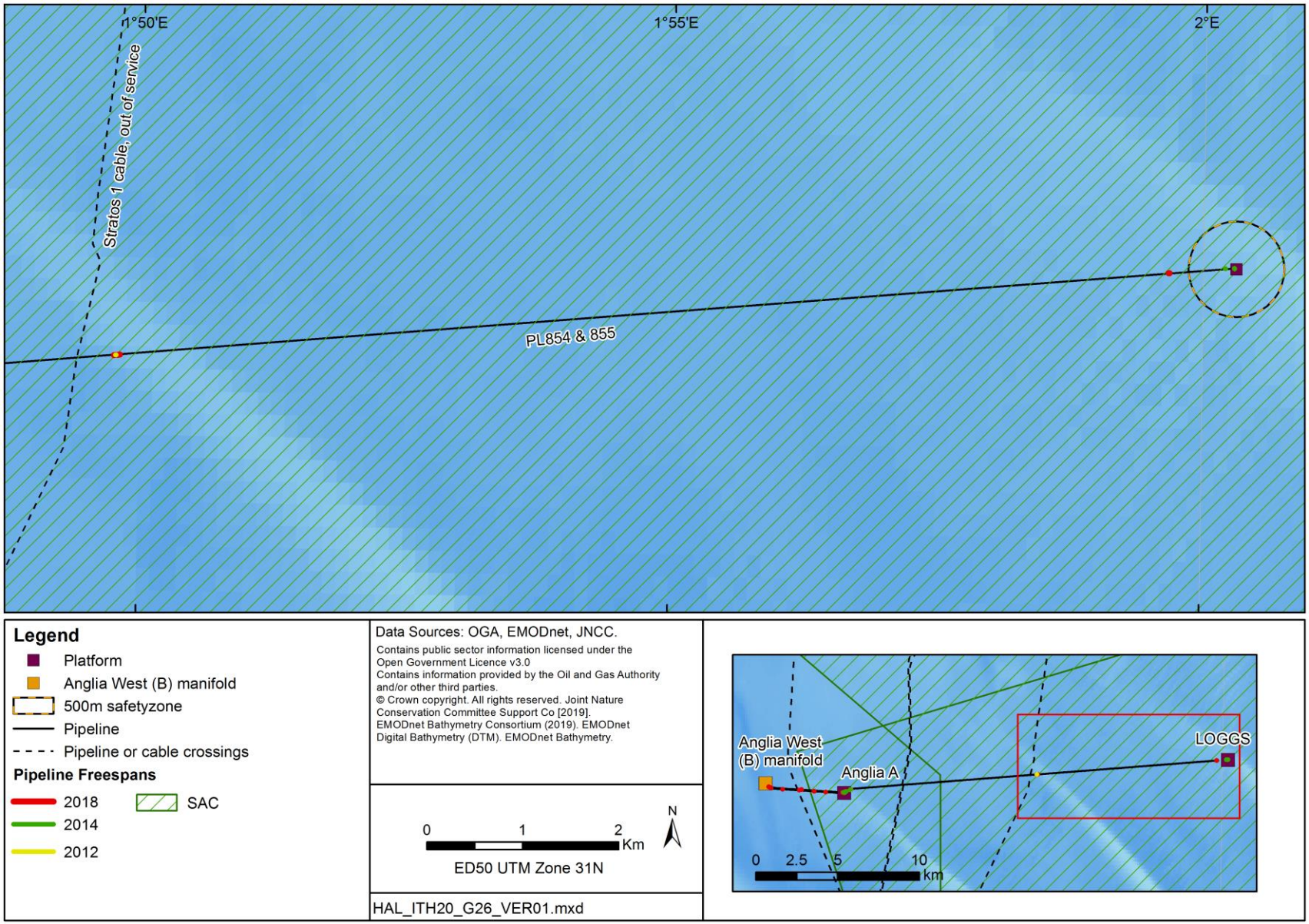
APPENDIX A – IDENTIFIED FREESPANS ALONG THE ANGLIA PIPELINE SYSTEM




PL954
PL955
PL854 & 855
Legend
Platform
Anglia West (B) manifold
500m safetyzone
Pipeline
Pipeline or cable crossings
Pipeline Freespans
2018
2014
2012
SAC
Data Sources: OGA, EMODnet, JNCC.
Contains public sector information licensed under the Open Government Licence v3.0
Contains information provided by the Oil and Gas Authority and/or other third parties.
© Crown copyright. All rights reserved. Joint Nature Conservation Committee Support Co [2019].
EMODnet Bathymetry Consortium (2019). EMODnet Digital Bathymetry (DTM). EMODnet Bathymetry.
0 0.1 0.2 Km
N
ED50 UTM Zone 31N
HAL_ITH20_G25_VER01.mxd
Anglia West (B) manifold
Anglia A
LOGGS
0 2.5 5 10 km


1°50'E
1°55'E
2°E
Stratos 1 cable, out of service
PL854 & 855
Legend
Platform
Anglia West (B) manifold
500m safetyzone
Pipeline
Pipeline or cable crossings
Pipeline Freespans
2018
2014
2012
SAC
Data Sources: OGA, EMODnet, JNCC.
Contains public sector information licensed under the Open Government Licence v3.0
Contains information provided by the Oil and Gas Authority and/or other third parties.
© Crown copyright. All rights reserved. Joint Nature Conservation Committee Support Co [2019].
EMODnet Bathymetry Consortium (2019). EMODnet Digital Bathymetry (DTM). EMODnet Bathymetry.
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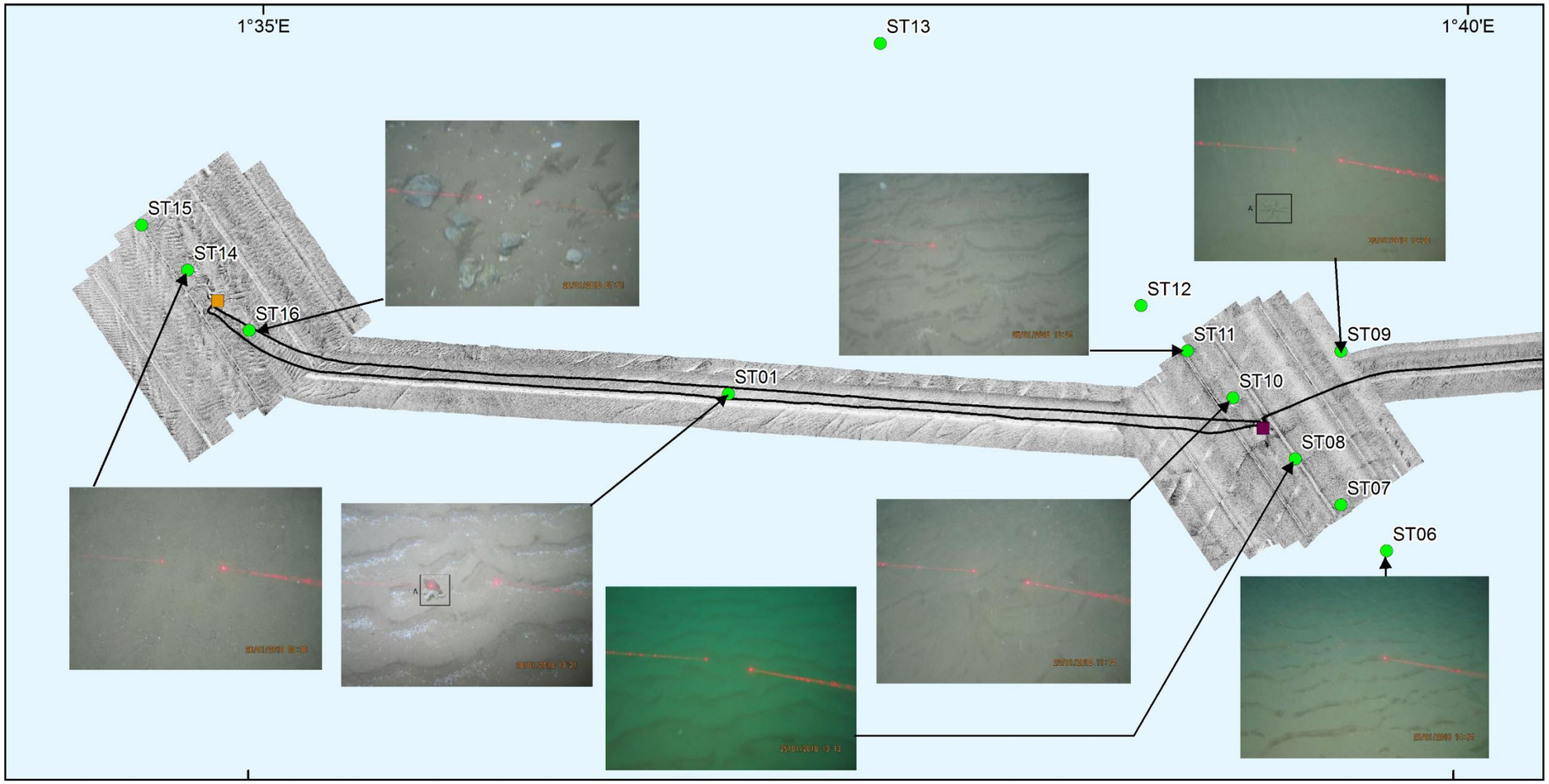
APPENDIX B - SEABED FEATURES AND HABITAT – ANGLIA



Legend

- Platform
- Anglia West (B) manifold
- 2018 survey
- Pipeline

ST01 = Hermit crab (Paguridae),
ST09 = Crab (Hyas sp.),
ST11 = rippled sand with shell fragments,
ST16 = rippled sand with shell fragments
and cobbles, + Hydroid/bryozoan turf

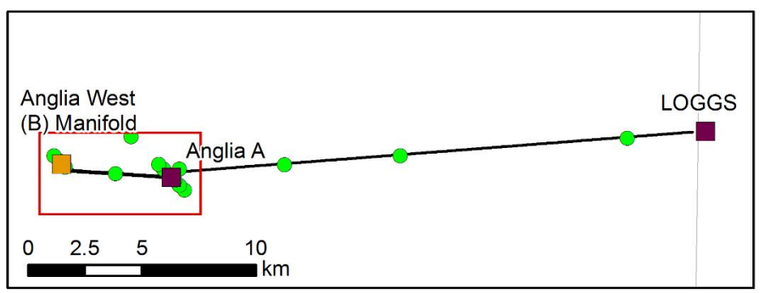
Data Sources: OGA, EMODnet, UKOilandGasData, Fugro.

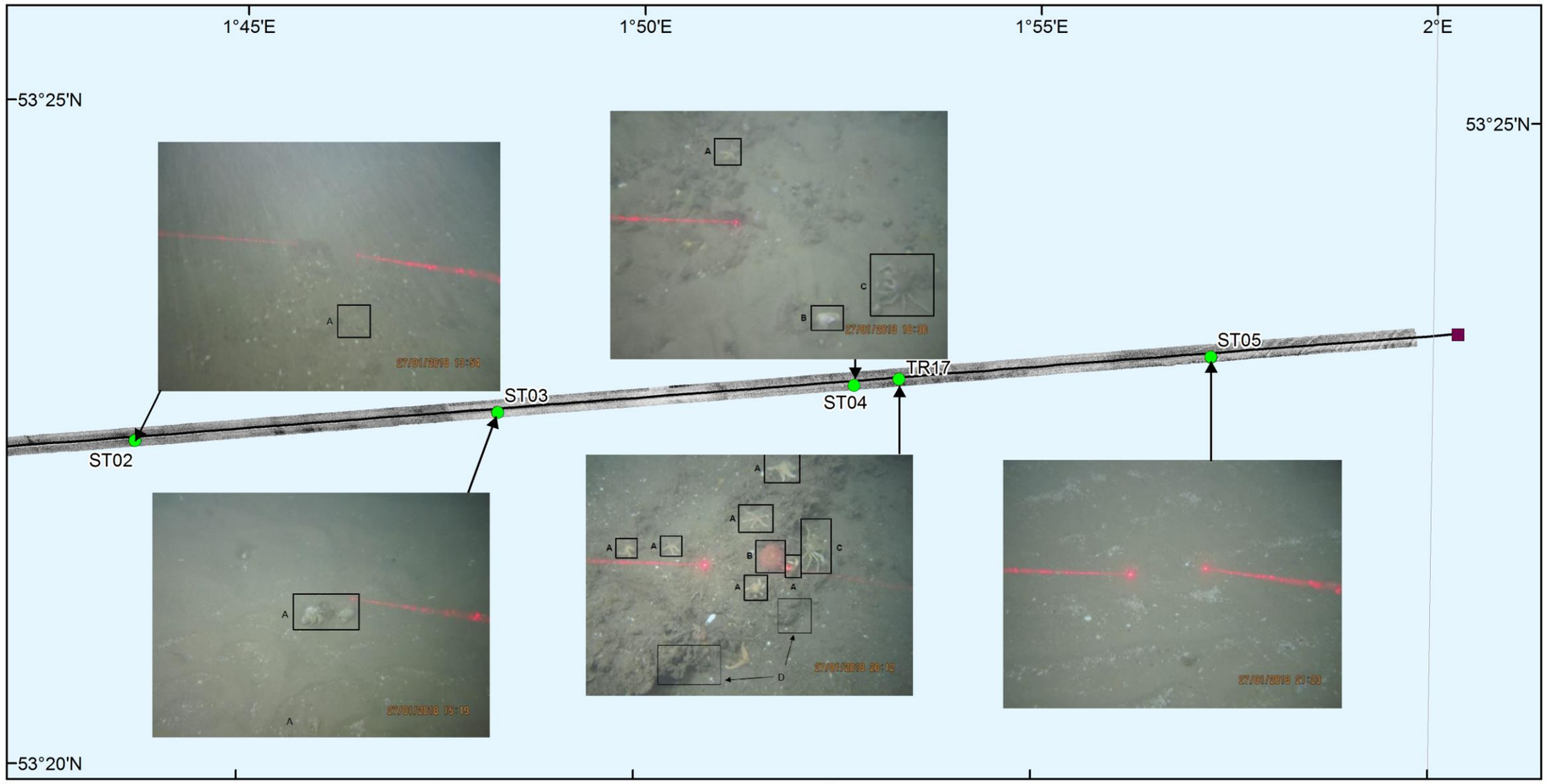
0 0.5 1 Km

N

ED50 UTM Zone 31N

HAL_ITH20_G27_VER01.mxd





Legend

- Platform
- Anglia West (B) manifold
- 2018 survey
- Pipeline

ST02 = gravelly sand with shell fragments,
ST03 = Hermit crab (Paguridae),
ST04 = rippled sand with shell fragments + starfish (A. rubens), soft coral (A. digitatum) and crab (H. araneus),
TR17 = Coarse mixed sediment with low lying S. spinulosa crusts + starfish (A. rubens), anemone (Urticina sp.), crab (H. araneus), ross worm (S. spinulosa), hydroid/bryozoan turf

0 1.5 3 Km

N

ED50 UTM Zone 31N

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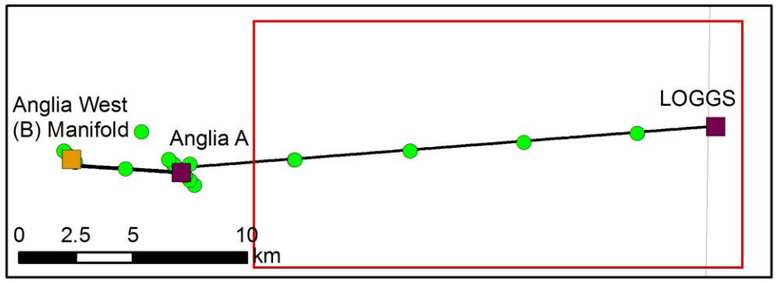

APPENDIX C – APPROPRIATE ASSESSMENT SCREENING

Introduction

As noted in Section 6.9, there is a requirement under the *Offshore Petroleum Activities (Conservation of Habitats) Regulations, 2001* (as amended), whereby projects will be subject to appropriate assessment should a likely significant effect be identified in relation to any relevant Natura 2000[17] site in view of the site's conservation objectives. The following sections provide information relating to the qualifying features of the relevant sites identified in Table C1, followed by a high level screening of the Anglia decommissioning activities (as outlined in Section 3 of the EA report) and the potential for these to result in a likely significant effect on qualifying features of relevant sites (Tables C2 and C3). This appendix, along with the information documented in the EA report above, have been compiled to provide sufficient information to the Competent Authority to undertake Habitats Regulations Assessment (HRA), including appropriate assessment, if required.

Relevant sites

Natura 2000 sites were selected as relevant to this consideration on the basis of whether it was considered that there was a pathway of effect between the qualifying features for which sites were designated, and those activities associated with the decommissioning of the Anglia facilities. Such pathways of effect were identified on the basis of those sources of effect already identified in relation to the Anglia decommissioning project (see Section 5), and the sensitivities of site features, informed by Statutory Nature Conservation Body advice on operations. The selection of sites was also informed by their location relative to Anglia, considering the nature and footprint of the proposed activities.

Summary site information for relevant SACs and SPAs is provided in Table C1 and has been collated from the latest JNCC SAC and SPA data (version as of 17th September 2018[18]) and relevant pages of the JNCC[19] and Natural England[20] websites[21].

[17] Includes Special Areas of Conservation (SAC) and Special Protection Areas (SPA) designated under the Habitats (92/43/EC) and Birds (2009/147/EC) Directives respectively.

[18] http://jncc.defra.gov.uk/page-1461

[19] http://jncc.defra.gov.uk/default.aspx?page=4

[20] https://www.gov.uk/government/publications/southern-north-sea-marine-area-index-map-and-site-packages

[21] http://jncc.defra.gov.uk/page-6537

Figure C1 – Relevant SPA and SAC sites

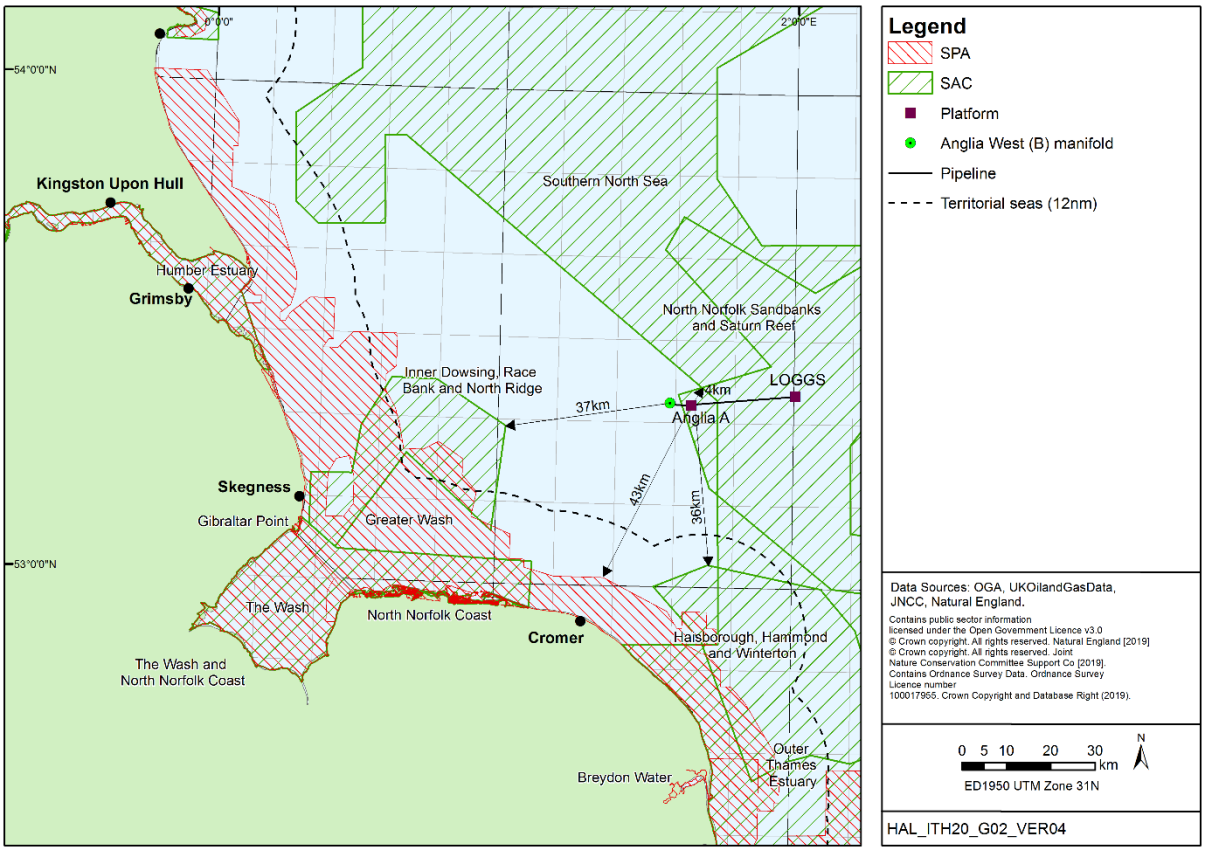

Table C1 – Site summary information for relevant SPA and SAC sites

Site Name	Area (ha)	Distance to Anglia (km)	Qualifying Features
SPAs			
Humber Estuary	37,630	88	**Article 4.1**: Bittern, marsh harrier, avocet, little tern (breeding), bittern, avocet, hen harrier, bar-tailed godwit, golden plover (over winter), ruff (passage) **Article 4.2**: Dunlin, knot, shelduck, black-tailed godwit, redshank (over winter), knot, dunlin, black-tailed godwit, redshank (passage) **Article 4.2**: Non-breeding waterbird assemblage
Gibraltar Point	422.2	87	**Article 4.1**: Little tern (breeding) **Article 4.2**: Sanderling, bar-tailed godwit, grey plover (over winter)
The Wash	62,044	84	**Article 4.1**: Common tern, little tern (breeding), Bewick's swan, bar-tailed godwit (over winter) **Article 4.2**: Pintail, wigeon, gadwall, pink-footed goose, turnstone, dark-bellied brent goose, goldeneye, sanderling, dunlin, knot, oystercatcher, black-tailed godwit, common scoter, curlew, grey plover, shelduck, redshank (over winter) **Article 4.2**: Over-winter waterbird assemblage
Greater Wash	344,267	43	**Article 4.1**: Little tern, sandwich tern, common tern (breeding), little gull, red-throated diver (over winter) **Article 4.2**::Common scoter (over winter)
Outer Thames Estuary	391,910	80	**Article 4.1**: Little tern, common tern (breeding), red-throated diver (over winter)

Site Name	Area (ha)	Distance to Anglia (km)	Qualifying Features
North Norfolk Coast	7,862	56	**Article 4.1**: Bittern, marsh harrier, avocet, little tern, common tern, Sandwich tern (breeding), avocet (over winter) **Article 4.2**: Wigeon, pink-footed goose, brent goose, knot (over-winter) **Article 4.2**: Over-winter waterbird assemblage
SACs			
Humber Estuary	36,657	90	**Annex I Habitats (primary)**: Estuaries, mudflats and sandflats not covered by seawater at low tide **Annex I Habitats (qualifying)**: Coastal lagoons, sandbanks which are slightly covered by sea water all the time, Atlantic salt meadows (Glauco-Puccinellietalia maritimae), dunes with *Hippophae rhamnoides*, embryonic shifting dunes, fixed dunes with herbaceous vegetation ("Grey dunes"), Salicornia and other annuals colonising mud and sand, shifting dunes along the shoreline with *Ammophila arenaria* ("White dunes") **Annex II Species (qualifying)**: River lamprey, sea lamprey, grey seal
The Wash and North Norfolk Coast	107,718	46	**Annex I Habitats (primary)**: Atlantic salt meadows (Glauco-Puccinellietalia maritimae), large shallow inlets and bays, Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi), mudflats and sandflats not covered by seawater at low tide, reefs, Salicornia and other annuals colonising mud and sand, sandbanks which are slightly covered by sea water all the time **Annex I Habitats (qualifying)**: Coastal lagoons **Annex II Species (primary)**: Harbour seal **Annex II Species (qualifying)**: Otter
North Norfolk Coast	3,149	56	**Annex I Habitats (primary)**: Coastal lagoons, embryonic shifting dunes, fixed dunes with herbaceous vegetation ("Grey dunes"), humid dune slacks, Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi), perennial vegetation of stony banks, shifting dunes along the shoreline with *Ammophila arenaria* ("White dunes") **Annex II Species (qualifying)**: Otter, petalwort
Inner Dowsing, Race Bank and North Ridge	84,514	37	**Annex I Habitats (primary)**: Sandbanks which are slightly covered by sea water all the time, reefs
Haisborough, Hammond and Winterton	146,759	36	**Annex I Habitats (primary)**: Sandbanks which are slightly covered by sea water all the time, reefs
Southern North Sea (SAC)	3,695,054	Within site boundary	**Annex II species (primary):** Harbour porpoise
North Norfolk Sandbanks & Saturn Reef	360,341		**Annex I Habitats (primary)**: Sandbanks which are slightly covered by sea water all the time, reefs

Screening considerations

The screening for potential likely significant effects on the relevant sites (Table C1) has considered the location, nature and scale (physical and temporal) of the Anglia decommissioning project (Section 3), the potential environmental impacts of relevance (Sections 5 and 6) and the available Natura 2000 site information. This includes the site conservation objectives, supplementary advice on conservation

objectives (SACO) and advice on operations[22]. The advice on operations for most sites is now underpinned by an activity/pressure approach (e.g. see Tillin *et al.* 2010, JNCC 2013, Tillin & Tyler-Walters 2014, Defra 2015, Robson *et al.* 2018, JNCC website[23]), for which a range of pressures[24] for site features have been identified in relation to oil and gas decommissioning. These are accompanied by a standard description of the activity, pressure benchmarks[25], and justification text for the activity-pressure interaction (including with reference to source information). This advice has been reviewed for the relevant sites listed in Table C1.

As noted in assessment sections within Section 6, it is assumed that all standard control measures are in place for operations associated with the Anglia decommissioning, some of which are statutory requirements (Section 1.3) or otherwise required under relevant guidance (e.g. BEIS 2018a). Therefore, while a number of the pressures noted against site features do represent a potential source of effect (e.g. hydrocarbon & PAH contamination, introduction of other substances (solid, liquid or gas), synthetic compound contamination (including antifoulants), transition elements & organo-metal contamination, introduction or spread of non-indigenous species, and litter), these are effectively controlled at a national or international level (e.g. via MARPOL Annex I and V, or the Ballast Water Management Convention). Accidental events are not planned and do not form part of the project, and are therefore not considered.

The remaining pressures have been considered in relation to the Anglia decommissioning activities (see Tables C2 and C3), and, it is regarded that they fall within the following impact categories which have the potential to lead to effects on relevant Natura 2000 sites:

- Seabed disturbance (relevant pressures: abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity), penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion, physical change (to another sediment type), smothering and siltation rate change)
- Underwater noise (relevant pressures: underwater noise changes)

Individual site considerations are made in Tables C2 and C3 and a synthesis of this is outlined below.

The nature and scale of seabed disturbance associated with the Anglia decommissioning activities has been outlined in Section 6.3, and relate to the jack-up rig positioning, the anchoring of an HLV, rock

[22] e.g. as required under Regulation 37(3) of the *Conservation of Habitats and Species Regulations 2017*, Regulation 21 of the *Conservation of Offshore Marine Habitats and Species Regulations 2017*. See: https://www.gov.uk/government/publications/southern-north-sea-marine-area-index-map-and-site-packages, http://jncc.defra.gov.uk/docs/NNSSR_AoO_Workbook_v1_0.xlsx and http://jncc.defra.gov.uk/pdf/SouthernNorthSeaConservationObjectivesAndAdviceOnActivities.pdf

[23] http://jncc.defra.gov.uk/default.aspx?page=7136

[24] Under the activity category, "oil and gas decommissioning", pressures include: abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity), habitat structure changes - removal of substratum (extraction), hydrocarbon & PAH contamination, introduction of other substances (solid, liquid or gas), penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion, physical change (to another sediment type), smothering and siltation rate changes (Light), synthetic compound contamination (incl. pesticides, antifoulants, pharmaceuticals), transition elements & organo-metal (e.g. TBT) contamination, underwater noise changes, barrier to species movement, introduction of light, introduction or spread of non-indigenous species, litter, water flow (tidal current) changes, including sediment transport considerations, underwater noise changes, vibration.

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

placement and the removal of the Anglia facilities (tie-ins, protective material, manifold and platform). The scale of the potential disturbance (taking place largely within the existing footprint of the facilities) is such that any effects on the relevant sites is only considered to be possible where this occurs within the boundary. It is therefore considered that the only site of relevance to this consideration is the North Norfolk Sandbanks SAC (NNSSR SAC). While other sites have been identified as sensitive to pressures associated with physical disturbance (e.g. Inner Dowsing, Race Bank and North Ridge SAC, Haisborough, Hammond and Winterton SAC), these are too distant from activities (at least 36km) for any interaction to be foreseeable.

Activities which will take place within the NNSSR SAC include; the abandonment of the Anglia A production wells (with the potential for rig stabilisation to be used), removal of the protective material, infield and export lines tie-in spools, the removal of approximately half of the infield umbilical by reverse reel, and the removal of the Anglia A NUI using a HLV (see Section 6.3). The overall physical footprint of these activities will be 0.04km^2, which is small relative to the size of the site (3,603km^2), or equivalent to 0.001% of the site area, which encompasses the sandbank feature. The majority of this disturbance (0.038km^2 – see Section 6.3) will be temporary given the dynamic nature of the site, which will cause regular disturbance to the fauna present. Recovery from disturbance of the seabed is likely to be rapid, and significant effects on the sandbank feature are not considered to be likely. The pre-decommissioning survey (Fugro 2018a, b) did not identify the presence of biogenic (*Sabellaria spinulosa*) reef in and around the Anglia A NUI or along the pipeline and umbilical corridors, and so any direct effect on this feature from physical disturbance is discounted.

Rock placement may be required for rig stabilisation, but the use of any rock is contingent on rig site survey.

The sandbank features of the site are considered to be sensitive to physical change to another habitat type, and the SACO notes that the deposition of material (rock) may lead to a persistent change in substrate which is not characteristic of sandbank communities. Historical changes in site feature extent and distribution have led the JNCC to set an objective to restore these attributes, and advise that 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. As noted in Section 6.3, rock will be applied as a contingent component of the work scope, and is not being used to remediate areas beyond the existing Anglia A facilities. Therefore, while there could be the introduction of new hard substrate, the loss of habitat extent and distribution is limited by its placement within existing areas of disturbance. Additionally, this will in part be countered by the removal of the Anglia facilities and a proportion of the protective materials.

The Anglia facilities partly overlap with the SNS SAC summer habitat (approximately 18km of the export gas and piggybacked methanol line), and while physical impacts on the habitat of the harbour porpoise feature of the site are conceivable, they are considered highly unlikely as no work which could affect the seabed is planned within the site. Underwater noise is considered to be a more relevant source of effect. Noise from vessel activity associated with the decommissioning activities has the potential to contribute to existing noise levels in the area, and while it cannot be excluded that sound from vessels will in the short-term influence the behaviour of individual marine mammals (including harbour porpoise) within the vicinity of the operations, the risk that any effect could become significant at the population level is deemed to be extremely low (see Section 6.5), such that significant effects are not considered to be likely. Noise generated by cutting and rock placement are not expected to be discernible above their associated vessel noise source.

There is the potential for mobile species which are qualifying features of the Natura 2000 sites and which move or forage beyond site boundaries to interact with the decommissioning activities. Descriptions of relevant mobile species are included in Sections 4.9 (fish), 4.10 (birds) and 4.11 (marine mammals) of the EA report. Of most relevance to this screening consideration are the harbour seal

(Wash and North Norfolk Coast SAC), grey seal and sea lamprey (Humber Estuary SAC) and the harbour porpoise (SNS SAC).

The closest seabird colony is the Flamborough & Filey Coast pSPA, selected for breeding kittiwake, gannet, guillemot and razorbill. Associated foraging ranges of these species (see) and the distance from Anglia to the site (134km) are such that significant effects are not considered to be likely. Additionally, these species are not considered to be particularly sensitive to shipping (Garthe & Hüppop 2004) and related noise (see Section 6.5). The disturbance of seaduck and other waterbird flocks by vessel and aircraft traffic associated with decommissioning activities is not considered likely due to the shallow inshore habitats of these species and their relative distance to the Anglia area (at least 43km to the Greater Wash SPA, which is the nearest site for such features), and relatively low levels of shipping associated with the decommissioning activities in the context of moderate to very high shipping in the wider nearshore area. Relatively few diving bird species (common scoter, red-throated diver, goldeneye) which have the potential to be affected by underwater noise are present across the relevant SPAs, and vessel noise from ships in transit to/from the Anglia facilities is not considered to be a significant source of effect.

The Anglia area is likely to be frequented by grey and harbour seals associated with the Humber Estuary SAC and Wash and North Norfolk Coast SAC respectively, but at-sea distributions of these animals is low in the Anglia area (see Section 4.8.2). The physical presence of the decommissioning activities, including the rig and vessels, will be around areas of existing industrial activity and the presence of these is anticipated to cause no more than temporary and localised low-level behavioural responses similar to those induced by normal operations which have taken place in the Anglia and wider area through field life. When combined with the distance from relevant sites and relatively low-level of at-sea usage, significant effects are not considered to be likely.

In-combination effects

A review of other activities which take place in proximity to Anglia has been undertaken to inform a consideration of the potential for likely significant in-combination effects. The Anglia facilities are located within the wider southern North Sea basin which is a mature hydrocarbon province, containing numerous other hydrocarbon production facilities, some of which are also subject to decommissioning planning and also within the NNSSR SAC (e.g. the Annabel and Audrey fields, and those associated with the Viking Complex and the Lincolnshire Offshore Gas Gathering System, LOGGS). These surface and subsea structures, like Anglia, are not subject to derogations under OSPAR Decision 98/3 and so are to be removed, with related export and infield infrastructure being similarly subject to a range of options from partial removal to minimal intervention for decommissioning *in situ*, with related assessments indicating the relatively small area of the NNSSR SAC affected on carrying out decommissioning.

In addition to other decommissioning programmes of work, a number of UKCS licence blocks within and adjacent to the Anglia area were licensed in the 30th Seaward licensing Round, with the potential for exploration activities to take place within these. The timescale for any such activity is uncertain, and these activities would be subject to their own assessments. No other energy developments are near to Anglia, for example the closest operational offshore wind farm (Dudgeon) is ~17km to the south west of Anglia.

Fishing and particularly bottom trawling has historically contributed to seabed disturbance over extensive areas, and takes place within the NNSSR SAC (see Section 4), which includes beam and otter trawls. Whilst fishing may be linked to historical damage to site qualifying features, future management could limit its effects. The management of fisheries for Natura 2000 sites beyond 12nm from the coast require measures to be proposed by the European Commission in accordance with the Common

Fisheries Policy (CFP). JNCC have produced an options paper[26] to help the MMO in developing management measures for the site, however, to date no such measures have been implemented.

In view of the scale of the decommissioning activities associated with Anglia, the other activities taking place within proximity to the field and the relevant sites considered, in-combination effects are not considered to be likely.

Conclusion

The limited footprint of any seabed disturbance and any rock placement is such that the extent and distribution of the habitat of the NNSSR SAC will not be significantly altered. The lack activities generating any impulsive noise, and the limited temporal and spatial scope of the work are such that significant effects on marine mammal features of relevant sites including the SNS SAC

26 http://jncc.defra.gov.uk/pdf/Combined%20Southern%20North%20Sea%20Natura%20sites%20fisheries%20options%20paper%20_06082014.pdf

Table C3 – High level screening of potential for effect on relevant SPAs

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration[27]
Humber Estuary	88	The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: • the extent and distribution of the habitats of the qualifying features • the structure and function of the habitats of the qualifying features • the supporting processes on which the habitats of the qualifying features rely	**Visual disturbance, above water noise**: Anglia is ~88km from the site, with effects from decommissioning activities being localised to the existing Anglia footprint. In view of the site features (wintering or on passage waterbirds) and their associated habitat in relation to Anglia, interaction is not considered likely with the qualifying species from offshore activities. While vessels associated with the decommissioning project could potentially use ports in the Humber, this already experiences very high[28] shipping levels (>100 vessels per week[29]), and so these are unlikely to significantly increase levels of disturbance from shipping. It is unlikely Anglia decommissioning activities will increase the potential for disturbance of the qualifying features and no adverse effect on site integrity is expected.

[27] For all of the SPAs listed in this table, due to the distance between the Anglia facilities and these sites and the nature and scale of potential physical effects (i.e. those which have the potential to result in an effect on the supporting habitats of species), the following pressures are not considered to be relevant and are not considered further: abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity), habitat structure changes – removal of substratum (extraction), penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion, physical change (to another seabed type), siltation rate changes (low) including smothering (depth of vertical sediment overburden) and water flow (tidal current) changes – local, including sediment transport considerations.

[28] https://www.ogauthority.co.uk/media/1419/29r_shipping_density_table.pdf,

[29] https://data.gov.uk/dataset/b7ae1346-7885-4e2d-aedf-c08a37d829ee/vessel-density-grid-2015

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration[27]
The Wash	84	• the populations of qualifying features • the distribution of qualifying features within the site	**Visual disturbance, above water noise**: Anglia is ~84km from the site, with effects from decommissioning activities being localised to the existing Anglia footprint. In view of the site features (breeding terns, overwintering waterbirds) and the distance of their associated habitat from Anglia, interaction is not considered likely with the qualifying species from offshore activities. Vessels associated with the decommissioning of Anglia are unlikely to transit the site, and routes within and adjacent to sites already receive a high level of shipping traffic (30-40 vessels per week), and so these are unlikely to significantly increase levels of disturbance from shipping. It is unlikely Anglia decommissioning activities will increase the potential for disturbance of the qualifying features and no adverse effect on site integrity is expected.
Greater Wash	43		**Visual disturbance, above water noise**: Anglia is ~43km from the site, with effects from decommissioning activities being localised to the existing Anglia footprint. In view of the site features (breeding terns, wintering red-throated diver and common scoter) and the distance of their associated habitat from Anglia, interaction is not considered likely with the qualifying species from offshore activities. While vessels associated with the decommissioning project could potentially use ports in the Humber and therefore traverse the site which contains qualifying species which are particularly sensitive to disturbance (red-throated diver and common scoter), routes to these ports already experience very high shipping levels (>100 vessels per week), and so these are unlikely to significantly increase levels of disturbance from shipping. It is unlikely Anglia decommissioning activities will increase the potential for disturbance of the qualifying features and no adverse effect on site integrity is expected.

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration[27]
North Norfolk Coast	56		**Visual disturbance, above water noise**: Anglia is ~56km from the site, with effects from decommissioning activities being localised to the existing Anglia footprint. In view of the site features (breeding Avocet, bittern, marsh harrier, common tern, little tern and sandwich tern, overwintering waterbirds) and the distance of their associated habitat from Anglia, interaction is not considered likely with the qualifying species from offshore activities. Vessels associated with the decommissioning of Anglia are unlikely to transit close to the site, and so they are unlikely to significantly increase levels of disturbance from shipping from existing moderate to high levels of vessel traffic. It is unlikely Anglia decommissioning activities will increase the potential for disturbance of the qualifying features and no adverse effect on site integrity is expected.
Outer Thames Estuary	80	Subject to natural change, maintain or enhance the red-throated diver population and its supporting habitats in favourable condition. Relevant habitats include shallow coastal waters and areas in the vicinity of sub-tidal sandbanks. Note that the conservation objectives for this site are yet to be updated following the addition of the little tern and common tern qualifying features in 2017[30]. For the purposes of this screening consideration, it has been assumed that the objectives for these features are analogous to that of the red-throated diver feature.	**Visual disturbance, above water noise**: Anglia is ~80km from the site, with effects from decommissioning activities being localised to the existing Anglia footprint. In view of the site features (breeding terns, wintering red-throated diver and common scoter) and the distance of their associated habitat from Anglia, interaction is not considered likely with the qualifying species from offshore activities. While vessels associated with the decommissioning project could potentially traverse the site which contains qualifying species which are particularly sensitive to disturbance (red-throated diver), routes within or close to thes site already experience high or very high shipping levels (20-70 vessels per week), and so these are unlikely to significantly increase levels of disturbance from shipping. It is unlikely Anglia decommissioning activities will increase the potential for disturbance of the qualifying features and no adverse effect on site integrity is expected.

[30] http://jncc.defra.gov.uk/page-7249

Table C4 – High level screening of potential for effect on relevant SACs

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration
Humber Estuary	90	The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring: • the extent and distribution of qualifying natural habitats and habitats of the qualifying species • the structure and function (including typical species) of qualifying natural habitats • the structure and function of the habitats of the qualifying species • the supporting processes on which qualifying natural habitats and the habitats of qualifying species rely • the populations of qualifying species • the distribution of qualifying species within the site	Due to the distance between the Anglia facilities and the site and the nature and scale of potential physical effects (i.e. those which have the potential to result in an effect on the qualifying habitat and its related species, and also qualifying species), those pressures relevant to physical effects identified in the Advice on Operations[31] (abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity), habitat structure changes - removal of substratum (extraction), introduction of other substances (solid, liquid or gas), penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion, physical change (to another sediment type), smothering and siltation rate changes (Light)) are not considered to be relevant. There is no foreseeable interaction with Annex I habitat features and significant effects are not considered to be likely. **Underwater noise changes**: Grey seal is identified to be sensitive to underwater noise changes, and while it cannot be excluded that sound from vessels (and associated activities which may involve cutting and rock placement) will in the short-term influence the behaviour of individual animals within the vicinity of the operations, the at-sea usage of grey seal is low in the Anglia area, and the risk that any effect could become significant at the population level is deemed to be extremely low. Site advice indicates that sea lamprey are not considered to be sensitive to any of the pressures associated with oil and gas decommissioning.

[31] Humber Estuary Advice on Operations (accessed 21/01/19)

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration
The Wash and North Norfolk Coast	46		Due to the distance between the Anglia facilities and the site and the nature and scale of potential physical effects (i.e. those which have the potential to result in an effect on the qualifying habitat and its related species, and also qualifying species), those pressures relevant to physical effects identified in the Advice on Operations[32] (abrasion/disturbance of the substrate on the surface of the seabed, changes in suspended solids (water clarity), habitat structure changes - removal of substratum (extraction), introduction of other substances (solid, liquid or gas), penetration and/or disturbance of the substratum below the surface of the seabed, including abrasion, physical change (to another seabed/sediment type), smothering and siltation rate changes (Light)) are considered to be relevant. There is no foreseeable interaction with Annex I habitat features and significant effects are not considered to be likely. **Underwater noise changes**: Harbour seal is identified to be sensitive to underwater noise changes, and while it cannot be excluded that sound from vessels (and associated activities which may involve cutting and rock placement) will in the short-term influence the behaviour of individual animals within the vicinity of the operations, the at-sea usage of harbour seal is low in the Anglia area, and the risk that any effect could become significant at the population level is deemed to be extremely low. Significant effects are not considered to be likely.
North Norfolk Coast	56		Due to the distance between the Anglia facilities and the site, and the nature and scale of potential physical effects, none of the pressures identified in the Advice on Operations[33] are considered to be relevant. There is no foreseeable interaction with the site and significant effects are not considered to be likely.
Inner Dowsing, Race Bank and North Ridge	37	The objectives are to ensure that, subject to natural change, the integrity of the site is maintained or restored as appropriate, and that	Due to the distance between the Anglia facilities and these sites and the nature and scale of potential physical effects, none of the pressures identified in the Advice on Operations for Inner Dowsing, Race Bank and North Ridge SAC[34] or Haisborough,

[32] The Wash and North Norfolk Coast Advice on Operations (accessed 21/01/19)

[33] North Norfolk Coast Advice on Operations (accessed 18/01/19)

[34] Inner Dowsing, Race Bank and North Ridge Advice on Operations (accessed 18/01/19)

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration
Haisborough, Hammond and Winterton	36	the site contributes to achieving the Favourable Conservation Status of its qualifying features, by maintaining or restoring: • the extent and distribution of qualifying natural habitats • the structure and function (including typical species) of qualifying natural habitats	Hammond and Winterton SAC[35] are considered to be relevant. There is no foreseeable interaction with the sites and significant effects are not considered to be likely.

[35] Haisborough, Hammond and Winterton Advice on Operations (accessed 18/01/19)

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration
Southern North Sea	Within site boundary[1]	To avoid deterioration of the habitats of the harbour porpoise or significant disturbance to the harbour porpoise, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to maintaining Favourable Conservation Status (FCS) for the UK harbour porpoise. To ensure for harbour porpoise that, subject to natural change, the following attributes are maintained or restored in the long term: 1. The species is a viable component of the site. 2. There is no significant disturbance of the species. 3. The supporting habitats and processes relevant to harbour porpoises and their prey are maintained.	**Anthropogenic underwater sound[36]**: A post-decommissioning survey will also take place across the site, along the pipeline route and 500m zones, using side scan sonar and MBES. The hearing range of harbour porpoise overlaps with the high frequency sound generated by the side scan sonar and MBES systems (particularly the lower frequency of 114kHz). Because of the high frequency, attenuation of sound intensity occurs efficiently in the water column. Thus, based on the characteristics of the sound source, the hearing capabilities of marine mammals, and the typical survey durations and location of the survey, any risk of injury or disturbance which could lead to a significant effect are assessed as highly unlikely (see Section 6.5 for more details). **Death or injury by collision**: Between 2000 and 2009, only 11 out of 1,100 post-mortems on harbour porpoises and common dolphins identified collision as the cause of death (UKMMAS 2010). Draft advice on operations for the Southern North Sea SAC indicates that post mortem investigations of harbour porpoise deaths have revealed death caused by trauma (potentially linked with vessel strikes) is not currently considered a significant risk. In view of the limited number of vessels associated with Anglia decommissioning and wider levels of shipping in the area and throughout the site, significant effects are not considered to be likely. **Physical disturbance (not included in the Advice on Operations, however effects on the habitat of the qualifying feature is considered to be relevant to this assessment)**: Approximately 18km of the export pipeline between Anglia A and LOGGS PP is located within the Southern North Sea SAC. The preferred pipeline decommissioning option (leave *in situ* with no remediation) limits physical interaction with the seabed which could generate effects on the supporting habitat of the species, with the only potential interaction being the over-trawlability survey (contingent). Additionally, as part of the post-decommissioning debris clearance, and ROV would be deployed to investigate and recover any potential hazards, with larger items of debris being recovered by crane from a construction support vessel.
North Norfolk Sandbanks & Saturn Reef	Within site boundary[2]	For the features to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status of	**Abrasion/disturbance of the substrate on the surface of the seabed; and Habitat structure changes – removal of substratum (extraction)**:

[36] Pressure nomenclature follows that of the draft Advice on Operations for the Southern North Sea SCI.

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration
		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	Relevant sources of effect include that from removal of tie-ins and related protection material, umbilical removal by reverse-reel (2.5km of the 5km line), jack-up rig placement at Anglia A and the removal of the platform, including the use of anchors associated with the HLV and any excavation that could be required to remove the jacket piles (note that excavation is a worst-case scenario that would only result should an internal cutting tool not be able to reach a suitable depth within the piles). Additionally, and over-trawlability and debris clearance surveys may generate localised seabed disturbance along the export and infield pipeline routes within the site. While debris located in the post-decommissioning survey will be removed, the over-trawlability survey is contingent. It should be noted that there is no cuttings pile associated with Anglia A, and therefore no movement of any such material is required to remove the jacket. The overall physical footprint of these activities will be 0.04km^2, which is small relative to the size of the site (3,603km^2), or equivalent to 0.001% of the site area, which encompasses the sandbank feature. The majority of this disturbance (0.038km^2) will be temporary given the dynamic nature of the site, which will cause regular disturbance to the fauna present. Recovery from disturbance of the seabed is likely to be rapid, and significant effects on the sandbank feature are not considered to be likely. The pre-decommissioning survey (Fugro 2018a, b) did not identify the presence of biogenic (*Sabellaria spinulosa*) reef in and around the Anglia A or along the pipeline and umbilical corridors, and so any direct effect on this feature from the above pressures is discounted. Significant effects on the qualifying habitat and species are not considered to be likely. **Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion**: Some disturbance of the subsurface seabed will take place as a result of the excavation then cutting and removal of the platform jacket piles and the top part of the wells. However, this will be at the locations previously disturbed during platform installation and well drilling; no additional significant effects are considered likely. **Siltation rate changes (low) including smothering (depth of vertical sediment overburden); and Changes in suspended solids (water clarity)**: Some sediment resuspension may take place as a result of anchoring and other physical interactions with the seabed including the lifting of the jacket, and any excavation of jacket piles which could take place. In view of the dominant sediment

Site Name	Distance to Anglia (km)	Conservation objectives	Potential effect/pressures and consideration
			type (medium to coarse sand, see Section 4.1) significant sediment plumes are not expected, and resuspended sediment will rapidly disperse/settle out. Significant effects on the qualifying habitats are not considered to be likely. **Physical change (to another seabed type)**: Rock placement may be required for rig stabilization, however, the use of any rock is contingent on rig site survey. Rock will be applied as a contingent component of the work scope, and is not being used to remediate areas beyond the existing Anglia A facilities. While there could be the introduction of new hard substrate, the loss of habitat extent and distribution is limited by its placement within an existing area of disturbance. Significant effects on the qualifying habitat and species is not considered to be likely. **Water flow (tidal current) changes – local, including sediment transport considerations**: Anglia A is a small NUI, and its removal is not predicted to cause any significant change in local current conditions.

Notes: [1]Approximately 18km of the ~24km export pipeline/piggybacked methanol line is located within the SNS SAC site boundary, with the remainder of the Anglia facilities located outside. [2]Approximately 2.5km of the 5km infield pipeline and umbilical, the Anglia A NUI and the export pipeline/piggybacked methanol line is located within the SAC site boundary.