2018

Tyne Installation Decommissioning Programme

Environmental Impact Assessment

PERENCO UK LIMITED

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Document Control Page

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Revision Record

DATE	REV NO.	DESCRIPTION	PREPARED	CHECKED	APPROVED
27/03/2018	01	Draft following PUK comments	D Morgan (BMT Cordah)	G Jones (BMT Cordah)	Perenco UK
04/05/2018	02	Revision following updates to DP and further PUK comments	D Morgan (BMT Cordah)	G Jones (BMT Cordah)	Perenco UK
10/05/2018	03	Revision following updates	D Morgan (BMT Cordah)	G Jones (BMT Cordah)	Perenco UK

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Standard Information Sheet

Information	
Project Name	Tyne Installation Decommissioning Programme Environmental Impact Assessment
BEIS Reference No.	n/a
Type of Project	Decommissioning
Undertaker Name	Perenco UK Limited
Undertaker Address	St Andrews Business Park, 3 Central Ave, Norwich, Norfolk, NR7 0HR
Licencees/Owners	Perenco UK Limited (Operator) (100%) Iona Energy Company (UK) PLC (0%). [Iona Energy Company (UK) PLC went into administration on 6 January 2016].
Short Description	Perenco UK Limited propose to decommission the infrastructure associated with the Tyne Platform, which is located within the UKCS 44/18 in the southern North Sea. Cessation of Production was approved by the Oil and Gas Authority on 3rd November 2015. This Environmental Impact Assessment has been prepared to support the Decommissioning Programme. Decommissioning activities will include the plugging and abandoning of five (5) platform wells (in compliance with HSE "Offshore Installations and Wells DCR 1996" and in accordance with the Oil and Gas UK Guidelines) and the removal of the Tyne installation from the seabed (as required under OSPAR Decision 98/3).
Anticipated Commencement of Works	It is currently envisioned that platform decommissioning activities will commence during Q3 2018.
Previously Submitted Environmental Documents	None
Significant Environmental Impacts Identified	Following the identification of the interactions between the proposed Tyne decommissioning activities and the local environment, the assessment of all potentially significant environmental impacts, and key environmental concerns identified as requiring consideration for impact assessment were investigated under the scope of the following: • Energy use and atmospheric emissions; • Underwater noise; • Seabed impacts; • Societal impacts; • Discharges to sea; and • Accidental events. PUK have, or intend to, put in place sufficient safeguards to mitigate the potential environmental and societal risk and to monitor the implementation of these measures, a programme of which will be agreed with the Regulator.
Statement Prepared By	Perenco UK Limited in conjunction with BMT Cordah Limited and Orbis Energy Limited

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ABBREVIATIONS, ACRONYMS, DEFINITIONS AND UNITS

Abbreviation	Definition
"	Inch
$	Dollars
%	Percent
ACOPS	Advisory Committee on Protection of the Sea
ALARP	As low as reasonably practicable
API	American Petroleum Institute
Audiogram	A curve of hearing threshold (SPL) as a function of frequency that describes the hearing sensitivity over tis normal hearing range
bbls	barrels
BEIS	Department for Business, Energy & Industrial Strategy
BHA	Bottom Hole Assembly
BOD	Biological Oxygen Demand
boepd	Barrels of oil equivalent per day
BSI	British Standards Institute
CA	Comparative Assessment
Category I	Fish with no swim bladder or other gas volume (particle motion detectors)
Category II	Fish with a swim bladder or other gas volume, and therefore susceptible to barotrauma, but where the organ is not involved in hearing (particle motion detectors)
Category III	Fish with a swim bladder or other gas volume, and therefore susceptible to barotrauma, where the organ is also involved in hearing (sound pressure and particle motion detectors)
CCS	Carbon Capture and Storage
Cd	Cadmium
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CH_4	Methane
cm	Centimetres
CO_2	Carbon dioxide
CPI	Carbon Preference Index
cSAC	candidate Special Areas of Conservation
CSV	Construction Support Vessel
Cu	Copper
dB	Decibel (unit of sound intensity)
dB re 1 µPa m (peak)	Units of the zero-to-peak decibel ratio of sound pressure to a reference pressure of 1 micropascal at 1 metre (re 1 µPa m) in underwater acoustics
$dB_{ht\ (species)}$	Sound level in decibels above the hearing threshold of a species
DECC	Department of Energy and Climate Change, now known as BEIS
Defra	Department of Environment, Food and Rural Affairs
DP	Decommissioning Programme
DTI	Department of Trade and Industry

Abbreviation	Definition
EA	Environment Agency
EBS	Environmental Baseline Survey
EC	European Commission
ED50	European Datum 1950
EEA	European Environment Agency
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMODnet	European Marine Observation and Data Network
EMP	Environmental Management Plan
ENVID	ENVironmental Impact Identification
EPS	European Protected Species
ERL	Effects Range Low
EU	European Union
EUNIS	European Nature Information System
FAC	First Aid Case
FCS	Favourable Conservation Status
Fe	Iron
FSSL	Fugro Subsea Services Limited
GC	Gas Chromatograms
GJ	Gigajoules
ha	Hectares
HAZID	HAZard IDentification
HC	Hydrocarbon
HLV	Heavy Lift Vessel
HM	Heavy Metal
H_s	Significant wave height
HSE	Health and Safety Executive
HSSE	Health, Safety, Security and Environment
Hz	Hertz
IAMMWG	Inter-Agency Marine Mammal Working Group
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
IoP	Institute of Petroleum
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation
ITOPF	The International Tanker Owners Pollution Federation Limited
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
kg	Kilograms
kHz	Kilohertz
Abbreviation	Definition

km	Kilometres
km^2	kilometres squared
LAT	Lowest Astronomical Tide
LSA	Low specific activity
LTOBM	Low Toxicity Oil-Based Mud
m	Metre
m/s	metres per second
m2	metres squared
m^3	Cubic metres
MarLIN	Marine Life Information Network
MARPOL	Marine Pollution
MAT	Master Application Template
MCA	Marine and Coastguard Agency
MCAA	Marine and Coastal Access Act 2009
MCZ	Marine Conservation Zone
MEG	Monoethylene glycol
mg	milligrams
MMO	Marine Management Organisation
MMOb	Marine Mammal Observers
MoD	Ministry of Defence
MPA	Marine Protected Area
MPS	Marine Policy Statement
MSFD	Marine Strategy Framework Directive
MTC	Medical Treatment Case
NA	Not Applicable
NFFO	National Federation of Fishermen's Organisation
NMPi	National Marine Plan Interactive
NOAA	National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NO_x	Nitrogen Oxide compound
NRA	Navigational Risk Assessment
NSTF	North Sea Task Force
NUI	Normally Unattended Installation
OGA	Oil and Gas Authority
OIW	Oil in Water
OPEP	Oil Pollution Emergency Plan
OPOL	Oil Pollution Operator’s Liability Fund
OPPC	Oil Pollution Prevention and Control
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OSRL	Oil Spill Response Limited
Abbreviation	**Definition**

P&A	Plug and Abandon
PAM	Passive Acoustic Monitoring
Pb	Lead
PETS	Portal Environmental Tracking System
PEXA	Practice and Exercise Areas (UK Military)
PL	Pipeline
POMS	PUK Operating Management System
ppm	Part per million
ppt	Part per thousand
PSA	Particle Size Analysis
PTS	Permanent Threshold Shift – A permanent elevation of the hearing threshold resulting from physical damage to the sensory hair cells of the ear
PUK	Perenco UK Limited
rms	Root mean squared
ROV	Remotely Operated Vehicle
RWC	Restricted World Case
s	Second
SAC	Special Area of Conservation
SCANS	Small Cetaceans in the European Atlantic and North Sea
SCI	Sites of Community Importance
SCOS	Special Committee on Seals
SEL	Sound Exposure Level in dB re 1 µPa2 s
SEMS	Safety and Environmental Management System
SFF	Scottish Fishermen's Federation
SIMPROF	Similarity Profile Analysis
SMRU	Sea Mammal Research Unit
SO_2	Sulphur dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SO_x	Sulphur oxide compound
SPA	Special Protection Areas
SPL	Sound Pressure Level – the decibel ratio of sound pressure to some reference pressure in dB re 1 µPa in underwater acoustics (zero-to-peak or peak)
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
TTS	Temporary Threshold Shift – Temporal and reversible elevation of the auditory threshold which is the minimum sound level that can be perceived by an animal in the absence of background noise
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKDMAP	United Kingdom Digital Marine Atlas
Abbreviation	**Definition**

UKOOA	UK Offshore Operators Association
UTM	Universal Transverse Mercator
VMS	Vessel Monitoring Systems
VOC	Volatile Organic Compounds
WFD	Waste Framework Directive
WIA	Well Intervention Operations Application
WMP	Waste Management Plan
WOW	Wait on Weather
Zn	Zinc
Mg g^{-1}	Micrograms per gram
µm	Micrometres

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NON-TECHNICAL SUMMARY

Perenco UK Limited (PUK) ceased production from the Tyne Field (situated in United Kingdom continental shelf Block 44/18a of the southern North Sea (Figure i)) during the fourth quarter of 2015 and is therefore preparing a Decommissioning Programme. In support of the Tyne Installation Decommissioning Programme, this document presents the findings of the environmental impact assessment carried out for the decommissioning project. The purpose of the environmental impact assessment is to understand and communicate the potential significant environmental impacts associated with the Tyne installation decommissioning and to inform the decision-making process.

This section of the document provides an overview of the environmental impact assessment associated with the decommissioning of the Tyne installation.

Project Overview

The offshore facilities of the Tyne Field, installed in 1996, consist of a normally unmanned installation, which produces gas from five platform wells. A 3-inch Monoethylene Glycol line piggybacked on a 20-inch export pipeline (both 56.9 kilometres long) connect the Tyne installation to the PUK operated Trent platform in Block 43/24. The Tyne facilities are controlled remotely, via satellite and three on-board diesel driven generator sets provide electrical power. During production, all produced fluids were passed through a production separator and gas and condensate were recombined in the export pipeline while produced water was discharged to sea.

Over the past few years, PUK has explored all avenues for continuing production from the field, but in 2015 reached the conclusion that it was uneconomical. Approval to cease production from the field was granted by the Oil and Gas Authority on 3rd November 2015 and production ceased in the fourth quarter of 2015. It is the intention of PUK to abandon the wells and decommission the facility between 2017 and 2020.

Decommissioning activities will commence offshore during the third quarter of 2018. It is currently envisaged that decommissioning activities will last for a maximum of four years (although activities will not be undertaken concurrently during this period). This current version of the Environmental Impact Assessment document is in support of the Installation Decommissioning Programme only. This document will be further updated to include pipeline infrastructure and supporting materials to support the Pipeline and Stabilisation Features Decommissioning Programme in due course.

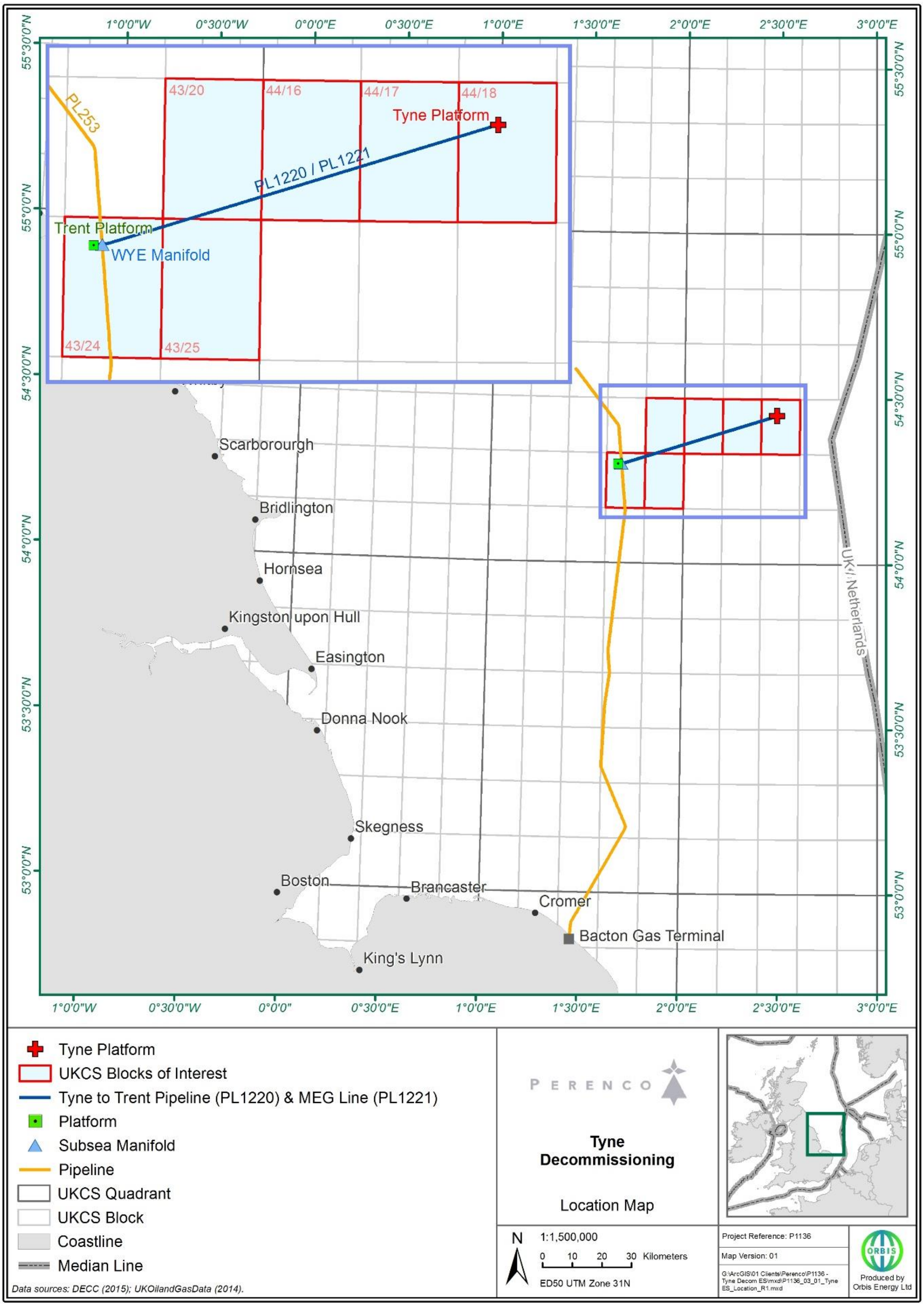

Figure i: Tyne Field development infrastructure location map

Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the United Kingdom continental shelf is principally governed by the Petroleum Act 1998, as amended by the Energy Act 2008. The Petroleum Act sets out the requirements for a formal decommissioning programme which must be approved by the Department for Business, Energy and Industrial Strategy (formerly the Department for Energy and Climate Change), before the owners of an offshore installation or pipeline may proceed with decommissioning.

Under the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998, the decommissioning programme must be supported by an environmental impact assessment.

This Guidance Notes state that an environmental impact assessment should include an assessment of the following:

- All potential impacts on the marine environment including exposure of biota to contaminants associated with the decommissioning of the installation; other biological impacts arising from physical effects; conflicts with the conservation of species with the protection of their habitats, or with mariculture; and, interference with other legitimate uses of the sea.
- All potential impacts on other environmental resources.
- Consumption of natural resources and energy associated with reuse and recycling.
- Interference with other legitimate uses of the sea and consequential effects on the physical environment.
- Potential impacts on amenities, the activities of communities and on future uses of the environment.

In addition, under the Marine and Coastal Access Act 2009 a licence application will be required at the time of decommissioning and the supporting environmental impact assessment updated to reflect detailed engineering design and specific mitigation measures.

The OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations sets out the United Kingdom's international obligations on the decommissioning of offshore installations. The OSPAR Decision prohibits the dumping and leaving wholly or partly in place of offshore installations. The topsides of all installations must be returned to shore, and all installations with a jacket weight of less than 10,000 tonnes must be completely removed for re-use, recycling or disposal onshore. Any piles securing the jacket to the seabed should be cut below the natural seabed level at a depth that will ensure they remain. The depth of cutting is dependent upon the prevailing seabed conditions and currents.

Scope of the Tyne Installation Decommissioning Programme

The Tyne infrastructure which is to be decommissioned comprises:

- 1 x topside;
- 1 x four-legged jacket (and four steel piles);
- 1 x Subsea template structure; and
- 5 x platform wells (44/18a-T1Z, 44/18a-T2, 44/18a-T3A, 44/18a-T4 and 44/18a-T6).

Decommissioning Studies

PUK commissioned a number of studies to support the Tyne installation decommissioning planning process and option evaluation, in order to determine the recommended decommissioning option and optimal engineering solution. The main findings and conclusions from these studies have been considered within the environmental impact assessment. Some of these studies include:

- Pre-decommissioning environmental baseline survey.
- Energy and emissions assessment to support the Tyne Decommissioning Comparative Assessment.
- Navigational risk assessment around the Tyne installation.
- Tyne wells plug and abandonment Decommissioning Environmental Impact Assessment Justification.
- Underwater noise assessment.
- Inventories of the assets, materials and hazardous materials on the Tyne installation.
- Quantitative risk assessment and high level hazard identification study of decommissioning and removal options.
- A series of engineering studies and reports on the options for decommissioning the topside and jacket.

Recommended Decommissioning Options

In addition to the plugging and abandonment of the five platform wells (in accordance with Oil and Gas United Kingdom Guidelines and Health and Safety Executive "Offshore Installations and Wells (Design and Construction etc.) Regulations 1996", decommissioning activities will include the removal of the Tyne normally unmanned installation from the seabed (as required under OSPAR Decision 98/3).

Table i provides an overview of the recommended decommissioning options for the Tyne installation components

Table i: Summary of the recommended options for the Tyne Installation Decommissioning Programme

Infrastructure	Selected option
Topside	Complete removal for reuse, recycling or final disposal onshore
Jacket	Complete removal for reuse, recycling or final disposal onshore
Subsea template	Complete removal for reuse, recycling or final disposal onshore
Wells	Plug and abandon

Environmental Settings and Sensitivities

A key consideration when planning and finalising the Tyne installation decommissioning programme is to give a clear understanding of the surrounding environment. This section provides an overview of the physical, biological (Tables ii and iii) and socioeconomic environment (Table iv) both within the United Kingdom continental shelf Blocks 43/20, 43/24-25 and 44/16-18 (the blocks of interest), as well as in the wider southern North Sea area. It should be noted that this includes the location of the Tyne pipelines (as well as the Tyne installation) and therefore provides the setting for a worst-case scenario for any associated environmental impact.

Table ii: Key environmental characteristics and sensitivities within the vicinity of the Tyne Installation

Aspect	Characteristics
Site overview	The Tyne installation is located in Block 44/18, approximately 184 kilometres east of the nearest United Kingdom landfall, at Flamborough Head on the East Riding of Yorkshire coastline, and approximately 22 kilometres to the west of the United Kingdom/ Netherlands transboundary line. The water depth at the Tyne installation is approximately 17.5 metres.
Conservation interests	
Annex I habitats	Of the three Annex I habitats considered for Special Area of Conservation selection in United Kingdom offshore waters, only the habitat “sandbanks slightly covered by seawater all the time” could potentially be found in the vicinity of block 44/18.
Annex II species	All four species (harbour porpoise, bottlenose dolphin, grey seals and harbour seals) listed in Annex II species known to occur in United Kingdom offshore waters have been sighted within Quadrants 43 and 44 and surrounding quadrants.
Marine protected areas (SAC, Sites of Community Importance (SCI) and others)	
Dogger Bank Special Area of Conservation (UK)	Overlap the boundary
Southern North Sea candidate Special Area of Conservation (UK)	Within the boundary
Doggersbank Site of Community Importance (Netherlands)	20 kilometres east of Tyne
Klaverbank (Netherlands)	35 kilometres southeast of Tyne
Plankton	

Aspect	Characteristics
In this area of the North Sea, the phytoplankton community is dominated by the dinoflagellate genus *Ceratium* and the zooplankton community by copepods (in terms of biomass and productivity), particularly *Calanus* species, which constitute a major food resource for many commercial fish species.	
Benthic environment	
Seabed sediments	Seabed sediments across the Tyne development area are predominantly gravelly sand. Sand ripples are present close to Tyne installation and shells/ shell fragments are present both immediately around the installation and in elongated patches slightly to its north and east. Chemical analysis of seabed samples taken across the Tyne development found that levels of hydrocarbons, as well as heavy and trace metals, in sediments were generally low. The highest sediment concentration of hydrocarbons and barium were recorded close to the Tyne installation and existing well locations, which may indicate input from historic drilling activities. There is an oval scour basin around the Tyne installation which is approximately 120 m long by 48 m wide and is up to 2.6 m deep in relation to the surrounding mean seabed level.
Benthic fauna	Benthic faunal communities in the vicinity of the Tyne development showed minor variation in terms of individual abundance, species richness and species composition, as would be expected given the homogeneity of the sediment, energetic environment and depth within the survey area. The infaunal community dominated over the epifaunal community and was primarily dominated by annelids, including the polychaetes *Goniada maculata* and *Ophelia limacine*

Table iii: Key environmental characteristics and sensitivities within the vicinity of the Tyne development (suite)

Activity in the blocks of interest, surrounding waters and adjacent coastline													
Component	**Abundance/ activity**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Plankton	Phytoplankton and zooplankton												
Benthic fauna	Benthic faunal communities												
Fish spawning & nursery areas	No. of species spawning in any one month	4	5	5	5	6	5	4	5	3	2	2	3
	No. of species with nursery grounds in any one month	4	4	7	9	9	11	12	11	7	8	5	4
Seabird vulnerability to oiling	Block 43/20						4		3	4			2
	Block 43/24						3		2	2			2
	Block 43/25						4		2	3			2
	Block 44/16								4				2
	Block 44/17							3	4				3
	Block 44/18							4					3
Cetaceans	Minke whale												
	Long-finned pilot whale												
	Bottlenose dolphin												
	Common dolphin												
	White-beaked dolphin												
	Atlantic white-sided dolphin												
	Harbour porpoise												
Pinnipeds	Harbour seal												
	Grey seal												

Note: Numbers within the table associated with Seabird Vulnerability to Oiling section refer to the seabird vulnerability index used by the Joint Nature Conservation Committee.
Key: Seabird Vulnerability – Extremely and Very High = 1, Low = 4.

	Peak		Moderate		Low		Very Low		No Occurrence / Data

Table iv: Summary of socio-economic characteristics and sensitivities

Aspect	Characteristics
Other users	
Fishing	Average monthly fishing effort (in days), for the years 2010 to 2015 indicates that fishing effort in to vicinity of the Tyne facilities tends to be highest from June to September. Landings are consistently very low between December and March within the vicinity of the Tyne facilities. They rise steadily to peak during August at moderate to low, falling back to very low by December.
Shipping activity	Shipping density within all of the blocks of interest is regarded as high.
Oil and Gas	The closest surface infrastructure to the Tyne installation is the Munro MH platform located 2 kilometres northwest of the PL1220/ PL1221 pipelines. The second closest is the Katy KT platform, located 13 kilometres southeast of the Tyne installation.
Telecommunications	The active telecommunications cable MCCS runs through Block 44/17 and crosses the Tyne pipelines. The active telecommunications cable TAMPNET crosses through the southeast corner of Block 44/18, approximately 8.5 kilometres southeast of the Tyne infrastructure.
Military activities	The Tyne development lies within the Royal Air Force practice and exercise areas D323B and D323C, which are both used for air combat and supersonic flight training.
Aggregate extractions	There are no licenced offshore dredging areas or known dumping areas within the blocks of interest.
Windfarms	There are no wind farm areas within the blocks of interest. The nearest is the Creyke Beck A, approximately 40 kilometres to the northwest of the Tyne installation.
Wrecks	There are a number of chartered wrecks in the area surrounding the Tyne infrastructure.
Carbon capture storage	There are no carbon capture and storage lease sites within the blocks of interest. The nearest is Aquifer 5/42, located approximately 19 kilometres to the west of the Trent platform.
Tourism	No tourism and leisure activities are identified as occurring within the blocks of interest due to the distance of the installation from the shore (184 kilometres).

Assessment of Environmental Effects and their Significance

The potential environmental issues (or aspects) associated with the proposed Tyne installation decommissioning programme were identified through discussions with the PUK project team, an informal scoping exercise with key stakeholders and the environmental team's previous oil and gas project experience. At the time of writing the Environmental Impact Assessment, the proposed Tyne decommissioning programme has yet to be finalised, therefore where project decisions are still to be made, a worst-case scenario from an environmental perspective has been considered.

Each of the potential environmental aspects identified during the initial stage of the environmental impact assessment process was assessed and their significance determined by combining the likelihood of occurrence (frequency/ probability) with the magnitude of impact (consequence). Cumulative and transboundary impacts have also been considered.

Many aspects were found to be of low or negligible risk to the environment (i.e. not significant) and were scoped out from detailed assessment in the Environmental Impact Assessment. Some aspects, however, were considered to be of medium or high risk to the environment (i.e. potentially significant). For these aspects, mitigation measures have been identified throughout this Environmental Impact Assessment to either remove the potential impacts by design or minimise or manage the potential impacts through operational measures.

A summary of the main findings of the environmental impact assessment process is provided below.

Energy and Emissions

The total energy usage resulting from decommissioning the Tyne facilities can mostly be attributed to new manufacture to replace otherwise recyclable materials that will be decommissioned in situ or taken to landfill and vessel and helicopter use offshore. Standard mitigation measures have been identified to minimise energy usage by project vessels.

Emissions from the Tyne decommissioning activities will contribute to greenhouse gas emissions and have an insignificant cumulative and transboundary impact. Emissions will be kept to a practicable minimum. Total carbon dioxide emissions generated from the proposed Tyne facilities decommissioning operations will represent a very small proportion (0.4%) of the of the total annual carbon dioxide offshore emissions from the United Kingdom continental shelf in 2015. The atmospheric emissions from the Tyne facilities decommissioning activities are unlikely to have any effect on sensitive receptors.

Underwater Noise

Noise modelling indicated that the predicted cumulative source sound levels during the decommissioning operations involving explosive cutting may exceed the threshold for injury to cetaceans. It should be noted however that the modelling is based on a conservative worst-case scenario of an unconfined blast within the water column. In reality, the explosive source will be confined within the tubing, approximately, 146 metres below the mudline. It is anticipated that the energy and impacts associated with the explosives downhole at the Tyne wells will be significantly less than those indicated by the worst-case scenario modelled within the water column.

The subsea noise levels generated by surface vessels used during the decommissioning operations of the Tyne Field are very unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally displaced by noise from a vessel in its immediate vicinity, or by any other continuous noise source during the decommissioning activities at the Tyne Field, however, the impact is not expected to be significant.

Records indicate previous sightings of up to seven cetacean species and two pinniped species within the study area during the year. These species are all subject to regulatory protection from injury and disturbance and notably the Tyne infrastructure is located within the boundary of the Southern North Sea candidate special area of conservation, which is designated due relatively high numbers of harbour porpoise.

As the Tyne Field is located around 184 kilometres east of the nearest UK coastline (Flamborough Head), it is unlikely that grey and common seals would be regularly found in the vicinity of the proposed development.

Seabed Impact

Decommissioning operations at the Tyne Installation will result in work being undertaken at or near the seabed. It is anticipated that an area of scour identified around the installation footings will diminish in approximately eight years, therefore covering any short-term seabed disturbance caused by decommissioning operations.

The *Seafox 1* jack-up accommodation unit will be in place adjacent to the Tyne installation during topside preparatory operations. The anchoring of the *Seafox 1* to the seabed will cause temporary, short-term disturbance of the seabed sediments.

The cutting and lifting of the Tyne jacket will cause a temporary, short-term disturbance of the seabed sediments. These activities will be controlled to minimise excavation activity and to ensure the accurate placement of cutting and lifting thereby minimising the risk of sediment disturbance.

The contract for the topsides removal is yet to be awarded and it is possible that a jack-up vessel could be contracted. Recovery of the seabed and associated fauna following the removal of a jack-up lift vessel is expected to be rapid (less than a year).

Overall, decommissioning the Tyne Field is expected to cause a maximum seabed impact of 0.02 square kilometres within the Dogger Bank Special Area of Conservation, representing 0.0002% of the total area.

Societal Impacts

There will be minor impact to fishing activities during the decommissioning operations in the Tyne area. This impact will be reduced by minimising the number of vessels travelling to, or standing by once the Tyne installation has been decommissioned.

There is no distinct cuttings pile around the Tyne installation (and only limited elevated hydrocarbon levels in nearby sediment samples expected). As a result, it is considered very unlikely that fishing gear would be contaminated.

The area of scour which will be opened up to fishing activities following the decommissioning of the Tyne installation is not expected to have any short or long-term impacts for trawling activities. Any areas within the basin considered as posing a threat were identified as infrastructure to be removed from the seabed during decommissioning activities.

All structural material recovered from the Tyne Field will be transported to shore for dismantling, and recycling or disposal as appropriate. Licensed contractors at licensed sites would undertake processing and as such minimal impacts will arise from the controlled operations. As the decommissioning activities proceed there will be a positive impact. New areas of seabed will ultimately become available to fisheries through the removal of the 500m safety exclusion zone.

Discharges to Sea

During the decommissioning of the Tyne installation and the associated vessel operations, only the short and/ or long-term release of residual contaminants released over time from contaminated drill cutting deposits has the potential to result in contaminated fluids and/or solids entering the marine environment. Contaminants may be released during:

- Leaching of hydrocarbons from contaminated sediment into the water column (long-term);
- Dredging, excavation and cutting activities (short-term); and

- Trawling activities (short-term).

For both the short-term (temporary) impacts during decommissioning or trawling operations, and the long-term presence of the contaminated drill cuttings sediment, the release of chemical contaminants will result in localised effects which are not expected to be significant. These are not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities.

Accidental Events

Hydrocarbon releases and chemical spills are the two types of significant accidental events that could occur during the Tyne decommissioning activities. Although the likelihood of such a spill is remote, there is a potential risk to organisms in the immediate marine and coastal environment, and a socioeconomic impact if a spill were to occur.

A worst-case scenario at the Tyne Field would result from a loss of diesel from lift vessel or collision. Diesel spills will disperse and dilute quickly, with a very low probability of hydrocarbons reaching the coastline. The likelihood of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area. The current Oil Pollution Emergency Plan for the Tyne Field will provide effective spill management in the case of an accidental event.

The potential sources of chemical spillages from the decommissioning of the Tyne installation have been identified through a comparative assessment workshop and identified as an accidental loss of fluids from subsea or topsides removal. The impacts of all the chemicals that may be used or discharged offshore during decommissioning will be assessed and reported to the Department for Business, Energy and Industrial Strategy in a relevant portal environmental tracking system application.

Waste

As the Tyne facilities are obsolete and/or in a degraded condition, they are not considered suitable for safe re-use. The majority of jacket and topside material will be recycled. Where necessary, hazardous waste resulting from the dismantling of the Tyne facilities will be pre-treated to reduce hazardous properties or, in some cases, render it non-hazardous prior to recycling or landfilling.

Disposal of waste transported onshore for disposal will be provided by an approved waste management contractor, in compliance with PUK existing standards, policies and procedures.

Environmental Management

The Tyne installation decommissioning will be undertaken in accordance with the PUK Safety and Environmental Management System which forms part of the PUK operating management system. The PUK SNS SEMS provides a uniform approach to every element of operations across SNS assets. With regards to health, safety, security and environmental management the purpose of the SEMS is to ensure that, as far as reasonably practicable, all of the installation's activities are undertaken in accordance with PUK commitment to its QSSHE Policies and compliance with all relevant statutory provisions applicable to offshore operations within SNS.

SEMS includes PUK, SNS and site specific processes and procedures through which the local business is delivered. The SEMS framework comprises 15 key components which together provide a roadmap to safe, environmentally conscious and reliable operations.

The framework for the PUK SEMS is built around the 15 PUK Standards which sets out high level targets which shall be complied with, a set of actions to be implemented, along with supporting information to provide guidance on implementation.

It is these business processes, procedures and information that describes in more details how PUK achieves conformance with the PUK Standards.

PUK also hold International Organization for Standardisation 14001 standard certification and therefore have relevant procedures to support the decommissioning process from the perspective of environmental standards.

As a relatively small operator, PUK intend resource such projects through the utilisation of contractors, should these not be available within the business itself. PUK expects its main contractors to operate a management system that is compatible with the principles of the PUK safety and environmental management system.

PUK will develop a Safety and Environmental Management Plan for the Tyne Installation Decommissioning Programme to ensure compliance with the PUK Safety, health and environmental policy and safety and environmental management systems, as well as with statutory requirements. The Safety and Environmental Management Plan will also incorporate all the mitigation measures which PUK has committed to implement, as identified during the environmental impact assessment process and documented within the Environmental Impact Assessment, and will outline the processes PUK will follow in order to monitor compliance.

PUK will audit its activities on a periodic basis to verify full implementation of its safety and environmental management systems and the Tyne specific Safety and Environmental Management Plan.

Summary

In summary, it is concluded that the proposed Tyne Installation Decommissioning Programme will not result in any significant environmental impacts (including transboundary and cumulative impacts) provided that all identified mitigation measures are implemented.

1 INTRODUCTION

This section explains the background to the proposed Tyne Installation Decommissioning Programme (DP), introduces Perenco UK Limited (PUK), outlines the environmental impact assessment (EIA) process that has been followed for the project and defines the structure of the Environmental Impact Assessment document. It also summaries the key issues raised during the stakeholder engagement process and, where applicable, indicates where these have been addressed within the EIA.

1.1 Background

PUK is currently the operator of the Tyne Gas Field in the southern North Sea. The field has five platform production wells, all of which are now offline/ shut-in. When operational, the field was producing via a normally unattended installation (NUI), located within United Kingdom (UK) Continental Shelf (UKCS) Block 44/18a. The reservoir fluids (gas, condensate and produced water) were separated on the installation, with wet gas exported to the PUK operated Trent NUI via a 20" export pipeline (PL1220). On Trent, The gas was comingled on Trent, processed and compressed, before being exported onshore to the PUK operated Bacton Gas Terminal on the north Norfolk coast. Monoethylene Glycol (MEG) was originally required to be injected into the Tyne export pipeline for hydrate control and was supplied from the Trent platform via a 3" pipeline (PL1221).

PUK explored all avenues for continuing production from the Tyne Field, but concluded that it was no longer economical. The operating costs of Tyne have been consistently increasing with an 80% increase from 2010 to 2015. Production from the Tyne Field commenced in 1996, however, in recent years, production rates have significantly declined. The asset was installed with a design life of 15 years which has been exceeded by four years. The age of the facility has required more intensive maintenance campaigns. In addition, the success of efforts to improve well performance has gradually decreased to minimal effect. Downhole and surface salt production has become increasingly problematic in recent years. Despite regular fresh water wash and the installation of a water maker on the platform, salt deposition remains a recurring issue leading to the unavoidable loss of production. PUK, therefore, in 2016 decided to plug and abandon (P&A) the production wells and decommission the Tyne installation.

PUK submitted an application to cease production from the Tyne Field to the Oil and Gas Authority (OGA), which was approved on 3rd November 2015, and is now preparing a DP to be submitted to the Department for Business, Energy & Industrial Strategy (BEIS) for approval under the Petroleum Act 1998, as amended by the Energy Act 2008.

In support of the DP, this EIA presents the findings of the EIA carried out for the Tyne decommissioning project, as outlined in the BEIS Guidance Notes on Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 (DECC, 2011a).

1.2 Overview of Tyne Decommissioning Programme

The infrastructure which is included within the scope of the Tyne Installation DP and Decommissioning EIA is summarised below:

- One (1) platform topsides;
- One (1) four-legged jacket and four (4) piles;
- One (1) subsea template structure; and
- Five (5) platform wells (44/18a-T1Z, 44/18a-T2, 44/18a-T3, 44/18a-T4 and 44/18a-T6), all of which are now abandoned.

Figure 1-1 illustrates the location of the Tyne installation within UKCS block 44/18 and the infrastructure (pipelines and pipeline stabilisation materials) which will be subject to a future decommissioning programme (DP) and supporting Environmental Impact Assessment, within the following six UKCS Blocks: 43/20, 43/24, 43/25, 44/16, 44/17 and 44/18. Further details are provided in Table 1-1.

PUK proposes to remove the Tyne installation from the seabed, as required under the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Decision 98/3 in line with regulatory requirements and industry best practice. Limited preparation activities started at the Tyne installation during the first quarter of 2016 in the form of a well abandonment campaign. These wells have now all been abandoned and the conductors have been cut and removed. Further detail on the Tyne decommissioning activities is provided in Section 2 of this EIA.

Table 1-1: Location of the Tyne Installation

Aspect	Tyne installation
Location (latitude/longitude) (ED50, UTM Zone 31 N)	54° 26’ 57”N 02° 28’ 52”E
Block	44/18a
ICES rectangle	37F2
Distance to UK coast	184 km
Distance to UK/Netherlands median line	22 km
Distance to Dogger Bank SAC	Within boundary

Key: Universal Transverse Mercator (UTM); International Council for the Exploration of the Sea (ICES); Special Area of Conservation (SAC).

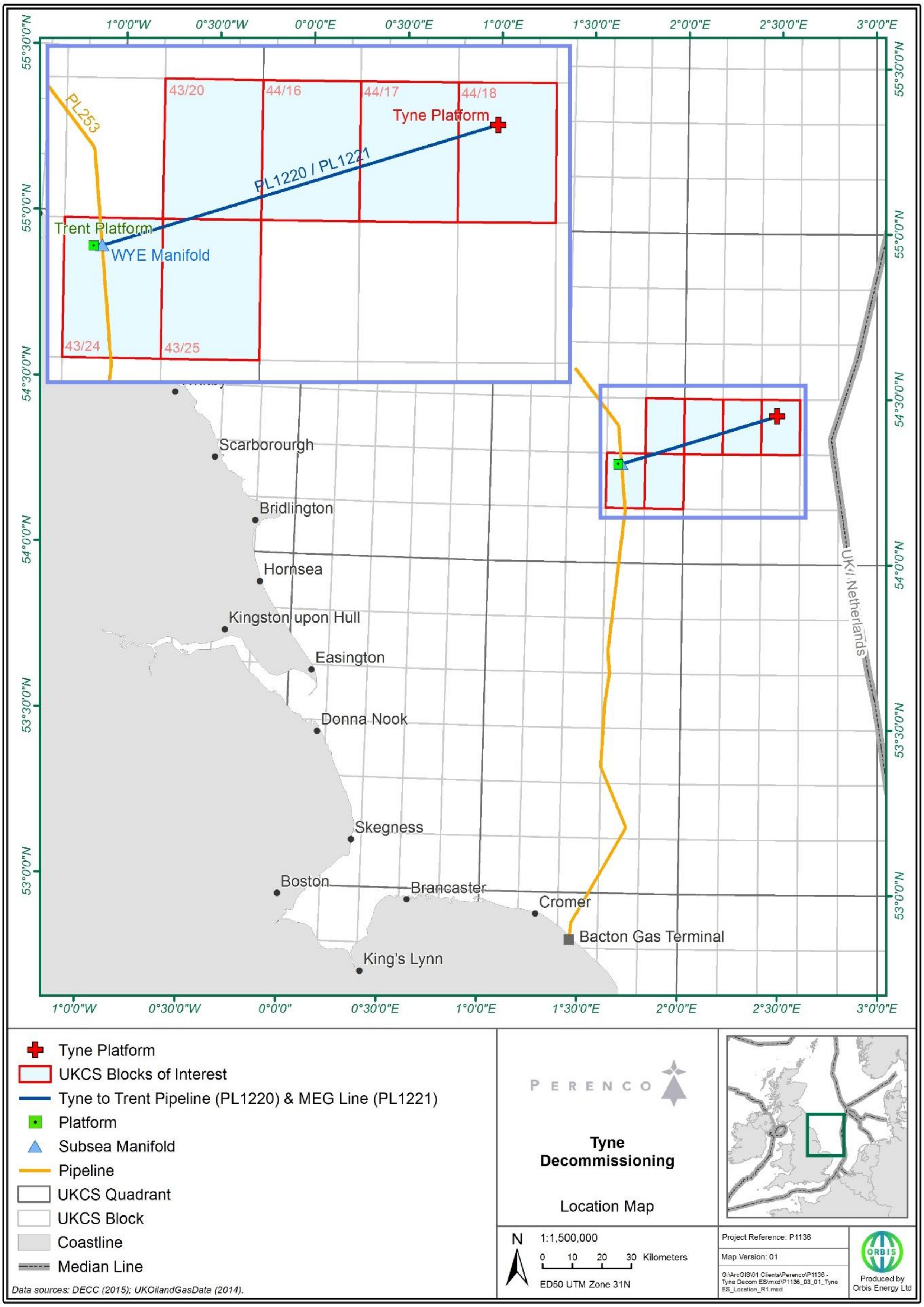

Figure 1-1: Tyne Field development infrastructure location map

1.3 Perenco UK Limited

PUK is an independent oil and gas company with operations in 13 countries across the globe, ranging from Northern Europe to Africa and from South America to Southeast Asia.

PUK currently produces approximately 450,000 barrels of oil equivalent per day (boepd), of which 250,000 boepd is net to the company. The group is present in world-class exploration basins such as Brazil, Peru, Northern Iraq, Australia and the North Sea. While PUK's growth has been driven by acquisitions, the Group's strategy evolved rapidly towards increasing production and reserves, renewing licenses and securing additional acreage for new exploration and development opportunities.

In the southern North Sea Gas Basin, PUK operates 17 offshore fields, along with associated pipelines and onshore processing facilities including the Bacton and Dimlington Terminals. PUK’s gas production in the North Sea is around 72,000 boepd.

PUK operates under a Safety and Environmental Management System (SEMS) which is certified to conform to the International Organisation for Standardisation (ISO) 14001 for environmental management systems. SEMS provides the framework for PUK to achieve safe and reliable operations and ensures compliance with PUK’s HSSE policy. Further detail on PUK’s SEMS is provided in Section 11.

1.4 Legislation and Marine Planning Framework

Relevant legislation and the marine planning framework are described in the sub-sections below.

1.4.1 Environmental Legislation

The decommissioning of offshore Oil & Gas installations and pipelines on the UKCS is controlled through the Petroleum Act 1998, as amended by the Energy Act 2008. The Petroleum Act 1998 sets out the requirements for a formal DP which must be supported by an EIA. Further details are provided in the Guidance Notes on decommissioning (DECC, 2011a).

The Petroleum Act 1998, as amended by the Energy Act 2008, is supplemented by various environmental regulations, which PUK will need to ensure compliance with. Those pertinent to the Tyne DP include:

- The Environment Protection Act 1990;
- The Merchant Shipping (Oil Pollution Preparedness, Response and Cooperation Convention) Regulations 1998 (as amended);
- The Offshore Chemical Regulations 2002 (as amended);
- The Offshore Installation (Emergency Pollution and Control) Regulations 2002;
- Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 (the Safety Case Regulations);
- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended);
- The Offshore Petroleum Activities (Conservation of Habitats) Regulation 2001;
- The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended); and
- The Offshore Petroleum Licensing (Offshore Safety Directive) Regulations 2015.

Further information on the legislation, as well as relevant International Conventions, and their applicability to the Tyne DP is outlined in Appendix A.

1.4.2 Marine Planning

Following the implementation of the Marine and Coastal Access Act 2009 (MCAA), the UK Government introduced a number of measures to manage and protect the seas around the UK in order to deliver its vision of "clean, healthy, safe, productive and biologically diverse oceans and seas". These measures included introducing a marine planning system designed to manage the resources, activities and interactions (natural and anthropogenic) which occur offshore. The Marine Management Organisation (MMO) were given marine planning functions for the southern North Sea by the Secretary of State (the marine plan authority) in April 2010. Marine plans, together with the Marine Policy Statement (MPS), underpin this new planning system for English seas (MMO, 2014a). It is intended that this new planning system will help ensure the sustainable development of the marine area.

The Tyne installation lies within the East Offshore Marine plan area, which the MMO published plans for in 2014 along with the East Onshore Marine area. In terms of seascape, the Tyne Development lies within the 'Dogger Bank' area (Character Area 1; Natural England, 2012). The vision for the East Inshore and East Offshore marine areas is that "By 2034, sustainable, effective and efficient use of the East Inshore and East Offshore Marine Plan Areas has been achieved, leading to economic development whilst protecting and enhancing the marine and coastal environment, offering local communities new jobs, improving health and well-being. As a result of an integrated approach that respects other sectors and interest, the East Inshore and East Offshore Marine Plan areas are providing a significant contribution, particularly through offshore wind energy projects, to the energy generated in the UK and to targets on climate change" (MMO, 2014b).

1.5 EIA Process

EIA is a systematic process that helps identify and evaluate the potential impacts that a proposed project may have on aspects of the physical, biological and socioeconomic environment. Mitigation measures are then developed and incorporated into the project to eliminate, minimise or reduce adverse impacts and, where practicable, to enhance benefits.

The overall EIA process that has been followed for the Tyne decommissioning project is shown schematically in Figure 1-2. The key elements of this process are described below.

Scoping and Consultation: Scoping is an important component of the EIA process as it provides an opportunity for regulators, statutory consultees and other stakeholders to review and make recommendations to the proponent of the proposed project. It is also an opportunity to screen-out potential environmental impacts which are not likely to be significant. For the Tyne decommissioning project an informal scoping letter was sent to BEIS and a number of other key consultees for comment on the 17th December 2015. The key issues which have been raised during this process are summarised in Section 1.7.

Project Definition: The identification and, where necessary, quantification of activities and aspects of the project which might have an impact on the environment has been undertaken by the EIA Consultant in consultation with the PUK decommissioning team. Decommissioning of the Tyne facilities will include full removal of the jacket and topsides.

Baseline Characterisation: Baseline data, appropriate to the proposed project's potential impacts, has been gathered to describe the relevant existing conditions (e.g. physical, biological, and socioeconomic). Published information sources have been referenced along with data gathered from recent surveillance surveys undertaken to assess the condition of the existing infrastructure. A pre-decommissioning Environmental Baseline Survey (EBS) of the Tyne Development was undertaken in April 2016. The results from the survey are included where relevant throughout this EIA.

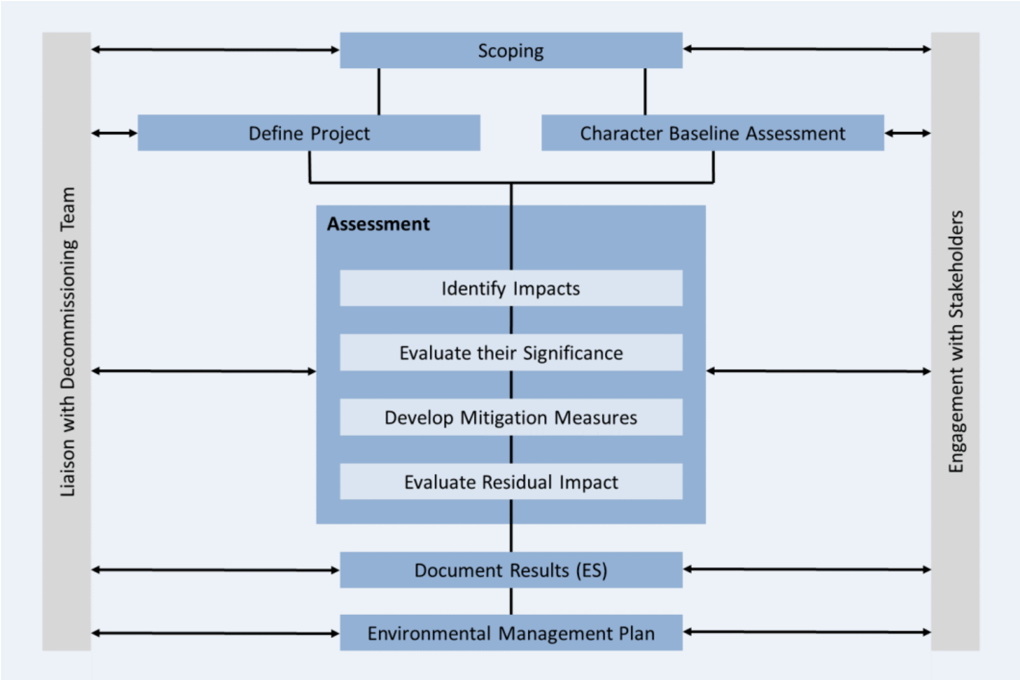

Figure 1-2: Overview of the EIA process

Assessment of Environmental Effects and their Significance: The EIA process requires the identification and assessment of all potentially significant environmental effects arising from the proposed project (both from planned and accidental events). Significance is determined by combining the likelihood of occurrence with the magnitude of impact (consequence), noting that impacts may be adverse or positive, direct or indirect and may vary in duration and scale. Cumulative and transboundary impacts have also been considered. The criteria used to establish likelihood of occurrence, magnitude of impact and overall significance within this EIA is provided in Section 4. Where potentially significant impacts have been identified, mitigation measures have been proposed in order to remove, reduce or manage the potential impact. Once mitigation measures have been determined, the potential impacts are re-assessed to determine whether the overall impact significance has been reduced. Any remaining impacts are referred to as residual impacts. The results of the assessment for the proposed Tyne decommissioning project are detailed in Sections 5 to 10.

Reporting: The outcome of the EIA process is documented in this EIA document, which has been written with reference to the BEIS guidance notes 'Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998' dated March 2011.

Environmental Management Plan (EMP): An EMP is a project specific plan, developed to ensure that appropriate environmental management practices are followed during implementation of the project. An EMP will be developed for the Tyne decommissioning project to ensure that the requirements of the PUK SEMS are met. The Environmental Management System (EMS) will incorporate all the mitigation measures which PUK has committed to implement, identified during the EIA process, and will outline the processes PUK will follow in order to monitor compliance (Section 11).

Areas of Uncertainty: At present, PUK has not finalised the contracts to carry out the decommissioning activity offshore, thus some details of the exact methodology to be employed during the decommissioning operations may be subject to future modification. Any variations to the operations, as described in this EIA, will be evaluated for their potential to alter the conclusions of the EIA within the environmental permit applications that PUK are required to submit (and have approved) prior to the commencement of activities offshore.

1.6 Consultations

During preparation of this EIA, the views of the following organisations were solicited by an informal scoping letter on the 17th December 2015:

- BEIS;
- Centre for Environment, Fisheries and Aquaculture Science (Cefas);
- Joint Nature Conservation Committee (JNCC);
- Ministry of Defence (MoD);
- National Federation of Fishermen's Organisation (NFFO).

The main issues raised during this informal consultation exercise, and how PUK has, or is proposing to address them, are summarised in Table 1-2. Where these issues are discussed further within this EIA a reference to the relevant section has been provided.

Of note is that consultations and liaison with interested parties is a continuous part of PUK's EMS and will continue throughout the Tyne decommissioning project.

Table 1-2: Summary of the consultation responses for the Tyne Installation DP

Consultee	Issues raised	PUK's response	EIA section
BEIS	PUK should ensure that preparation of the EIA supporting document is done giving due reference to the 2011 BEIS decommissioning guidance. The EIA should be focussed and specific in nature.	The BEIS Decommissioning Guidance (2011) has been adhered to throughout this document.	All
	PUK should ensure that consideration is given to any existing scour around the installation and any associated impacts on seabed sediment redistribution and/ or risk to trawling activities post-decommissioning.	Included in sections 7 and 8 to assess the seabed and societal impacts.	7 & 8
Cefas	No response provided.	-	-
JNCC	PUK should ensure that activities within the Dogger Bank SAC are considered within a cumulative impact assessment, not just those within the particular blocks of interest. This should include aggregate extraction areas and renewable energy activities.	Included in Section 7 to assess the cumulative impact on the Dogger Bank SAC	7
MoD	No response provided.	-	-
NFFO	Suggest that any offshore operations/ site surveys conducted with regards to this DP have an offshore Fisheries Liaison Officer aboard the vessel.	Included in Section 8 to address any issues for fisheries arising from offshore operations/ site surveys	8

1.8 Structure of the Statement

The EIA document is laid out in the following sections:

Non-Technical Summary	
Section 1	**Introduction** – provides the background to the proposed project, introduces PUK, outlines the EIA process and defines the structure of the EIA.
Section 2	**Project Description** – outlines the proposed Tyne Installation DP, providing details on the options considered, schedule, DP activities and key discharges and emissions to the environment.
Section 3	**Environmental Baseline Description** – provides an overview of the existing physical, biological and socioeconomic environment within the zone of influence of the Tyne Installation DP.
Section 4	**EIA Methodology** – presents the impact assessment methodology used for the EIA, identifies potentially significant impacts and scopes non-significant impacts out of further discussion.
Sections 5-10	**Assessment Sections** – these sections identify and assess potentially significant environmental impacts arising from the Tyne decommissioning project and define the mitigation measures that will need to be implemented to demonstrate that residual impacts are as low as reasonably practicable (ALARP).
Section 11	**Environmental Management** – describes PUK's SEMS and the management processes that will be applied throughout the Tyne decommissioning project to ensure the safety and protection of people and the environment.
Section 12	**Conclusions** – summaries the key findings of the EIA process.
Appendices References	**Appendix A** – Description of applicable legislation to the project. **Appendix B** – Justification for screening of some receptors/impacts as non-significant or low impact. **Appendix C** – Energy and Emissions factors used in the calculation of the energy usage and emissions associated with the project. **Reference list.**

1.9 Contact Address

Any questions, comments or requests for additional information regarding this EIA should be addressed to:

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2 PROJECT DESCRIPTION

This section provides an overview of the Tyne decommissioning project. At present, PUK has not finalised the contracts to carry out the decommissioning activity offshore, therefore some details of the exact methodology to be employed may be subject to future modification. Where this is the case, the impact assessment, as presented in this EIA, has been based on a worst-case assumption. Any changes to the methodology should therefore only lead to a reduction in the likelihood or severity of environmental impacts. The Tyne Gas Field.

The Tyne Gas Field is located across UKCS Block 44/18a in the southern North Sea, in water depths of 17.5 m. The field was discovered in 1992 (under licence P609) and was developed, together with the Trent Gas Field, in a joint project by ARCO, with both fields brought on production in 1996. In 2000, ARCO was acquired by BP, who subsequently sold the Tyne and Trent assets to PUK in 2003. PUK is currently the operator of both fields, but relinquished 20% of its equity to Iona Energy Company (UK) plc in 2011.

The Tyne Gas Field is comprised of five separate fault blocks. Four of these fault blocks have been drilled: Tyne North, Tyne South, Tyne West and Tyne East, as illustrated in Figure 2-1 (Iona Energy, 2015).

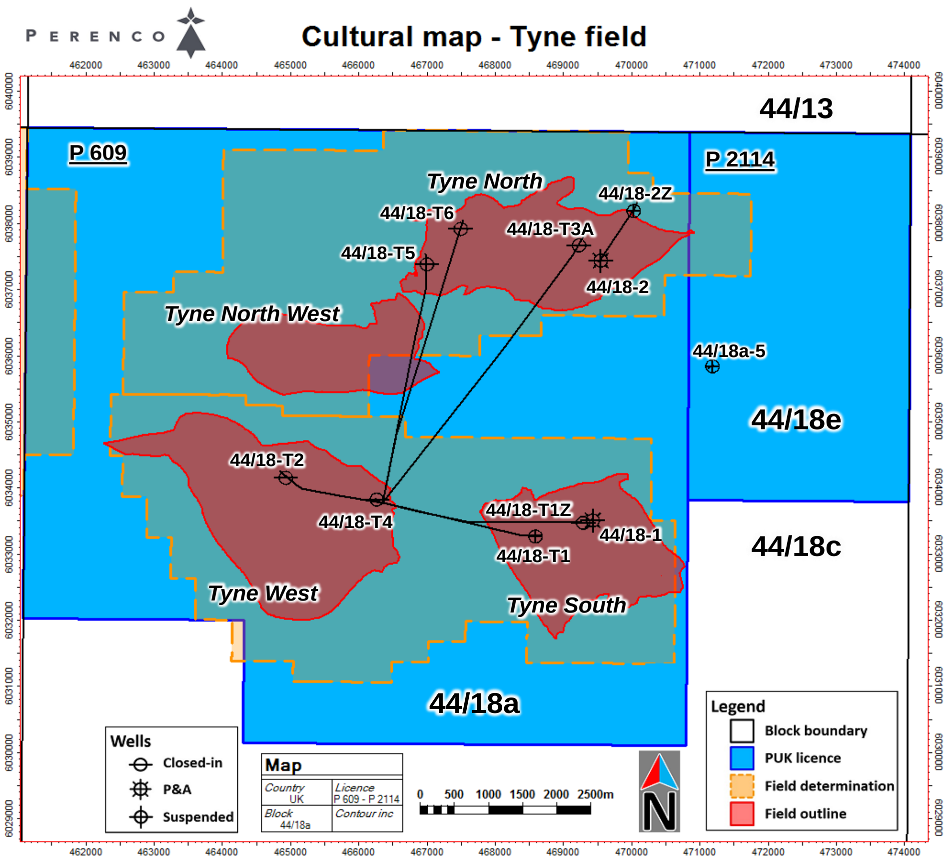


Figure 2-1: Tyne reservoir (Source: Iona Energy, 2015)

The Tyne Field has five platform production wells, all of which are now offline and shut-in. When operational, the field was produced via the Tyne NUI, located within UKCS Block 44/18a. Production from the Tyne Field peaked at 120 million of standard cubic feet per day in 1998, but has been in significant decline since 2009. For the past few years, PUK has explored all avenues for continuing production from the field, but in 2015 reached the conclusion that it is now uneconomical.

Avenues considered by PUK to continue the production were:

- To drill an infill well (44/18-T6), cycling all the gas producers and doing regular water wash to reduce salt precipitation downhole. However, the improvement in well performance by cycling gradually decreased to minimal effect. Downhole and surface salt production became more and more problematic over recent years.
- To undertake regular fresh water wash and the installation of a water maker on the platform. However, salt deposition remained a recurring issue leading to the unavoidable loss of production and the wells.
- To undertake operational cost reduction by sharing operational support with the Trent Field and Third Party Fields.
- To invest $1.7 million to improve coverage below the salt wall and to take a fresh look at the fault blocks making up the Tyne complex. Detailed structural mapping was completed at the Carboniferous levels and only one prospect was identified, the Tyne North West prospect. Subsequently, the technical and economic risk of the prospect was such that PUK and its partner concluded that they would not invest in drilling this prospect with their own capital. PUK was not able to identify any new partners or source of new funding.

Approval for Cessation of Production (CoP) from the field was subsequently granted by the OGA on 3rd November 2015.

The remainder of this section outlines the infrastructure that will be decommissioned as part of the Tyne decommissioning project, discusses the feasible decommissioning options that have been considered and describes the chosen decommissioning plan.

2.1 Tyne Infrastructure

The Tyne installation comprises:

- One (1) topside;
- One (1) four-legged jacket and four (4) steel piles);
- One (1) subsea template structure; and
- Five (5) platform wells (44/18a-T1Z, 44/18a-T2, 44/18a-T3A, 44/18a-T4 and 44/18a-T6).

The Tyne NUI is located at 54° 26’ 57.666”N, 02° 28’ 51.815”E (ED50, UTM Zone 31 N) in a water depth of 17.5 m (Lowest Astronomical Tide (LAT)) (Figure 2-2). An overview of the installation components to be decommissioned is provided in Table 2-1.

Table 2-1: Tyne installation information (PUK, 2018)

	Total weight (t)	Total lift weight (t)	Weight decommissioned in situ (t)
Topsides	738	738	0
Jacket (excluding marine growth)	401	401	0
Jacket piles	298	173	125
Marine growth on jacket	78	78	0
Subsea template	13	13	0
TOTAL	1,528	1,403	125

Figure 2-2: The Tyne installation (PUK, 2015a)

2.1.1 Topside

The Tyne topside comprises of a conventional carbon steel structure with a cellar deck (+21 m above sea level), mezzanine deck and weather deck (+29.5 m above sea level). A helideck (+35.6 m) and vent boom (+41.2 m) are situated above the weather deck. Access between platform levels is provided by ladders and stairways. There are nine well slots of which five have been drilled. The approximate size of the topside is 21 m by 20 m by 15.5 m high (including helideck).

The Tyne facilities are controlled remotely by operators at the Bacton Gas Terminal from the Remote Group Control Room via a dedicated satellite link. Power generation requirements are met by three identical diesel driven generator sets rated at 40 kilowatts (kW) and the installation has a diesel fuel storage capacity of 12 tonnes (t) (PUK, 2015b).

All produced fluids were passed to the production separator on Tyne, which provided a three phase separation of gas, condensate and water. Separated condensate was metered before being recombined with the gas stream via the export pipeline to the PUK-operated Trent NUI, located in UKCS Block 43/24, approximately 57 km to the southwest. On Trent, the gas was comingled, processed and compressed, before being exported onshore to the PUK operated Bacton Gas Terminal on the north Norfolk coast, via the Eagles pipeline system. Any separated water was processed so that it contained less than 30 parts per million (ppm) of hydrocarbons (HC) and was discharged to sea via a caisson on the Tyne installation (at 15.5 m above sea level).

2.1.2 Jacket

The Tyne jacket is a conventional four-legged carbon steel structure with a single 48" tubular pile of approximately 51 m overall length through a pile sleeve attached to each leg. Each pile has a penetration depth of 40 m.

The jacket structure supports the platform topside, five well conductors (three of 20" and two of 30" diameter), one 20" export riser, one 3" MEG line, one 16" drains disposal caisson, one 8" seawater lift caisson and one 10.75" J-tube (part installed). The jacket height is 37.4 m and weights associated with the jacket components are listed in Table 2-1.

An inspection survey of the Tyne installation was conducted by Fugro Subsea Services Limited (FSSL) in September 2015. As part of this survey, all four skirt piles were assessed and found to be in 'good overall condition' (FSSL, 2015). However, scour was observed from the base of the mudmat to the seabed on Leg B1 (2.1 m), Leg B2 (1.8 m) and Leg A2 (2.1 m) (Figure 2-3; FSSL, 2015).

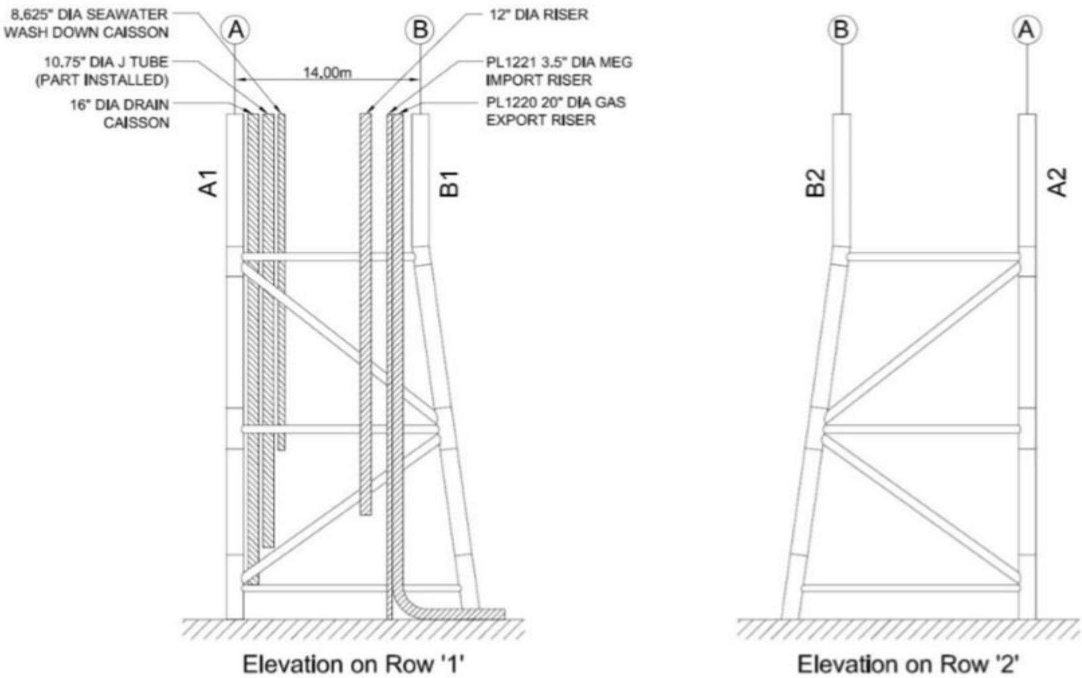
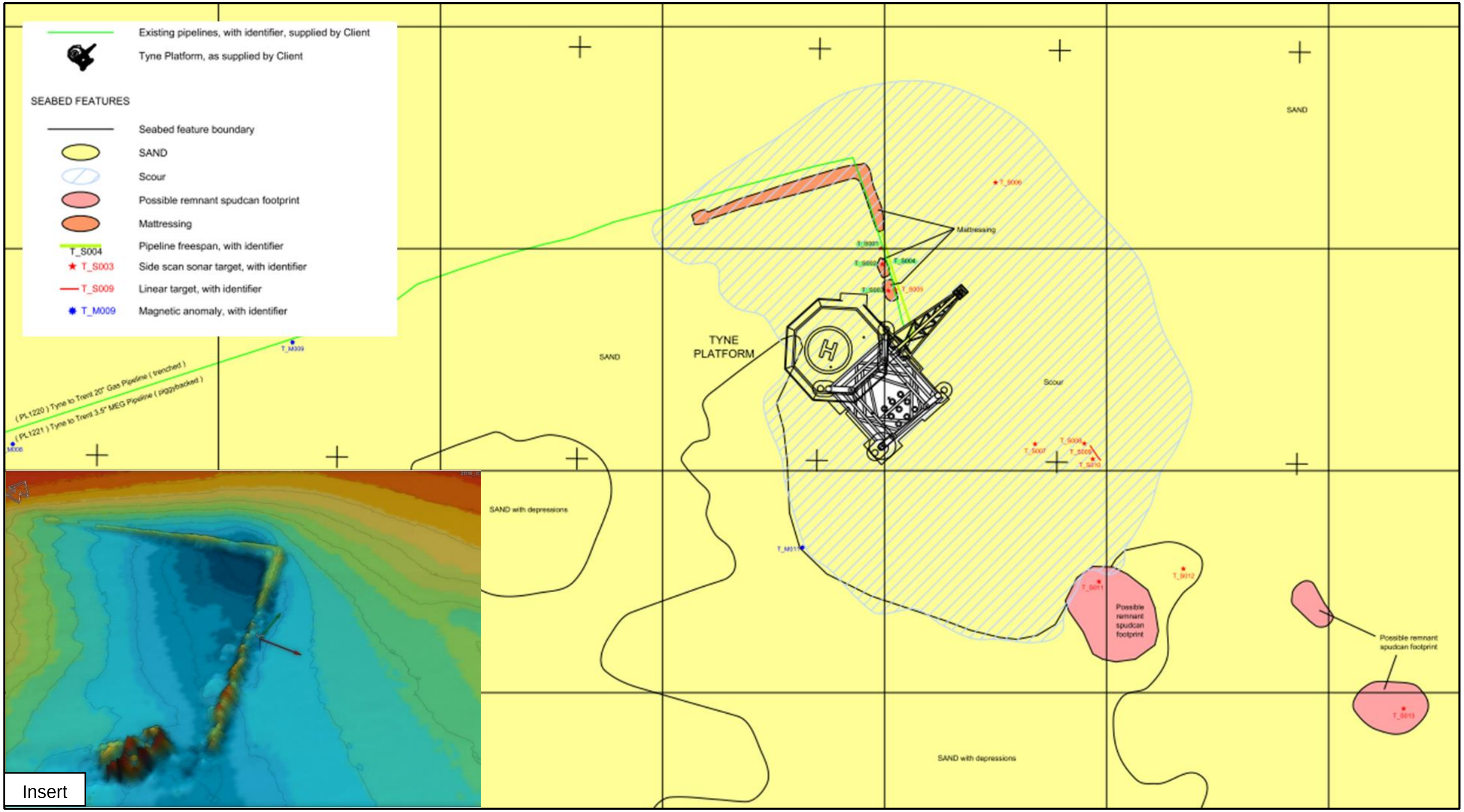


Figure 2-3: Tyne installation jacket (left view from north and right view from south)

The 2017 (Bibby Hydromap, 2017; PUK, 2018) confirmed the presence of a large area of scour (approximate dimensions, 48 m wide and 120 m long). The scour extends around the Tyne installation and is lower by up to 2.6 m, than the surrounding seabed (Figure 2-5).The angle of the internal slopes primarily ranges between 0° and 6°. As a result the scour basin itself is not considered to pose a significant risk to commercial fishing activities or operations. Within the basin there were several instances where the slope was in excess of 18°, in all cases this is associated with infrastructure which will be removed or remediated if required. Using indicative infill rates extrapolated from the Welland field infill rate post-decommissioning, and scaling the infill rate for seabed current speeds and the cross-sectional area of the respective scour basins, it is estimated that the depth of the Tyne scour basin will reduce by approximately 1 m in the first year and 2m after 8 years (PUK, 2018). With regards to any materials left in situ following decommissioning and the presence of a scour basin, PUK will monitor and mitigate any impacts from these features.



Insert - highlights the area of greatest depth within the scour basin.

Figure 2-4: Seabed features around the Tyne installation, PL1220 and PL1221 (Bibby Hydromap, 2017).

2.1.3 Subsea template

The subsea template structure sits at the base of the jacket at mudline level in the east direction. The template measures 20 m by 20 m with an overall height of 1.91 m. The approximate lift weight of the template is 13 t (Table 2-1).

2.1.4 Wells

Tyne has five platform wells as listed in Table 2-2

Table 2-3: Tyne platform wells (PUK, 2015a)

Well identification number	Well type	Status
44/18a-T1Z	Gas Production	Abandoned (level 3)
44/18a-T2	Gas Production	Abandoned (level 3)
44/18a-T3A	Gas Production	Abandoned (level 3)
44/18a-T4	Gas Production	Abandoned (level 3)
44/18a-T6	Gas Production	Abandoned (level 3)

2.1.5 Drill Cuttings

PUK commissioned a pre-decommissioning EBS undertaken in April 2016, which aimed to verify the presence/ absence of drill cutting debris within the wider Tyne Development area. Although no direct drill cuttings pile was identified, the survey did note the presence of drill cutting contamination at a data collection location approximately 50 m south of the Tyne installation (Bibby HydroMap & Benthic Solutions, 2016). However, it should be noted that no evidence of drill cuttings were observed at any other data collection stations around the Tyne installations or pipelines. The findings from the pre-decommissioning survey are included in Section 3.

2.2 Decommissioning Options

Regulations on the decommissioning of offshore structures were consolidated and strengthened in 1998 when the OSPAR (Oslo – Paris Convention) Contracting Parties agreed the OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations. Under the terms of OSPAR Decision 98/3, which is implemented in the UK through the Petroleum Act 1998 and Energy Act 2008, there is a prohibition on the dumping and leaving, wholly or partly in place, of offshore installations. The topsides of all installations must be returned to shore. All steel installations with a jacket weight less than 10,000 t, as is the case for the Tyne installations, must also be completely removed for reuse, recycling or final disposal on land.

PUK has also considered the disposal methods for the Tyne topsides and jacket taking into account the requirements of the Waste Hierarchy, as illustrated in Figure 2-6 which gives priority to preparing waste for re-use, then recycling, then other forms of recovery (including for energy production) and last of all disposal (e.g. landfill) (Defra, 2011).

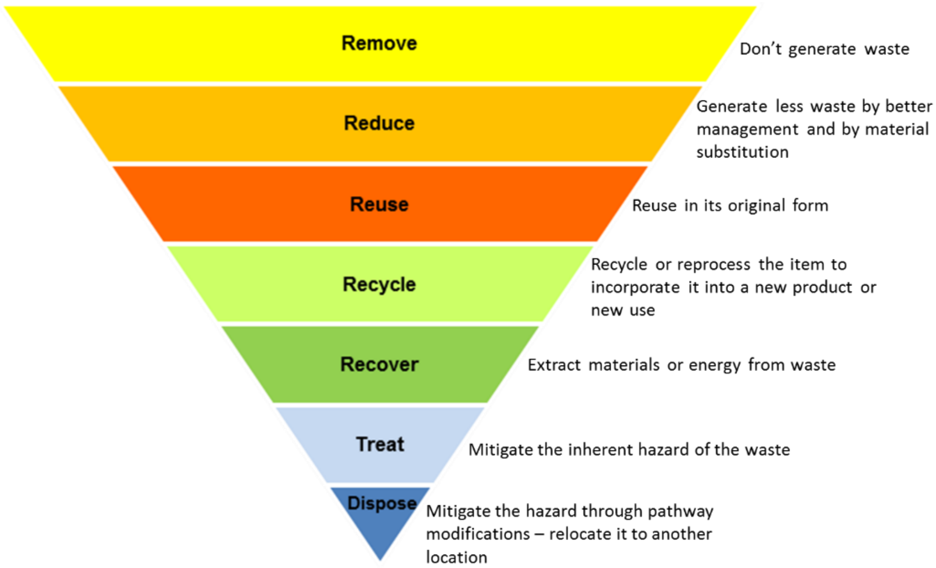


Figure 2-5: Waste management hierarchy (based on Defra, 2011 waste hierarchy)

In line with the waste hierarchy, the re-use of an installation (or parts thereof) is first in the order of preferred decommissioning options. PUK therefore considered extending the producing life of the Tyne installation, by utilising it as an infrastructure hub for third party tie backs and enhanced recovery programmes. An assessment of feasible options, however, found that neither was commercially viable.

Following this, the option of relocating the Tyne installation as a producing asset was considered, but it was concluded that due to Tyne's ageing process technology and the high cost of maintaining the fabric and structural integrity of the installation, no technically viable re-use option was available.

With the option to re-use the Tyne facilities as a whole considered impractical, the installation must therefore be completely removed to shore for reuse, recycling or final disposal, taking into account all relevant regulatory requirements and PUK's environmental policy.

Both the topsides and jacket will be removed in a single lift by a lift vessel. The exact methodology is subject to contractor selection and thus yet to be decided but a lift vessel capable of lifting the entire topsides in one lift will be utilised. The topsides would be prepared for this by a combination of engineering down and cleaning (EDC); module sea-fastening; and structural strengthening. The topsides will then be transported to the designated disposal yard by lift vessel or cargo barge where they will be transferred to the quayside for dismantling.

Complete removal of the jacket will involve severing the risers, cutting the jacket piles to a suitable depth below the natural seabed to ensure any remains are unlikely to become exposed, removal of the jacket, subsea template and risers The preferred method of cutting the piles is to use internal cuts which will not require external dredging of the jacket legs. External cutting will only be undertaken in the event that debris prohibits access within the jacket legs.

As the DP progresses, PUK is committed to continue to review the Tyne installation's equipment inventories to assess the potential for adding to their existing asset portfolio spares or for resale to the open market. In addition, PUK will continue to track reuse market trends in order to seize reuse opportunities at the appropriate time. The preferred options for the Tyne Installation DP are summarised in Table 2-4.

Table 2-4: Summary of preferred options for the Tyne Installation DP

Infrastructure	Selected option	Justification for selection	Key decommissioning activities
Topside	Complete removal by single lift for reuse, recycling or final disposal onshore	To comply with OSPAR Decision 98/3 and maximise the recycling of materials.	• Decontaminate the topsides and remove the topsides either by a heavy lift or crane vessel. • Re-use followed by recycle and then landfill will be the prioritised options for the topsides.
Jacket and subsea template	Complete removal by single lift for reuse, recycling or final disposal onshore	To comply with OSPAR Decision 98/3. Leaves clean seabed, removes a potential obstruction to fishing operations and maximises the recycling of materials.	• Jacket legs and subsea template will be removed and dismantled at an onshore location. • Re-use followed by recycle and then landfill will be the prioritised options for the jacket and template. Piles will be severed at least three metres below the seabed. • If any practical difficulties are encountered, PUK will consult BEIS.
Wells	Plug and abandon	Meets Health, Safety and Executive (HSE) and BEIS regulatory requirements.	• Plug and abandon the wells in compliance with HSE "Offshore Installations and Wells DCR 1996" and in accordance with Oil and Gas UK (OGUK) Guidelines for the Suspension and Abandonment of Wells" (Issue 5, July 2015).

2.3 Decommissioning Programme

This section presents the proposed programme of work that will be conducted offshore to decommission the Tyne infrastructure. It is currently proposed that all decommissioning activities will be conducted using a combination of a jack-up accommodation barge, a cargo barge, a lift vessel and three tugs. Other support vessels, such as stand-by vessels and supply vessels, will also be required.

2.3.1 Well Abandonment

All five platform wells are to be P&A in accordance with The Offshore Installations and Wells (Design and Construction etc.) Regulations 1996 and the OGUK Guidelines for the Suspension and Abandonment of Wells, Issue 5, July 2015. A well abandonment application (known as a PON5) and a Chemical Permit Subsidiary Application Template (SAT) under a Well Intervention Operations Application (WIA) Master Application Template (MAT), will be submitted via the UK Oil Portal in advance of the well abandonment operations.

2.3.1.1 Vessel

Consideration was given to the ability to undertake P&A operations from the Tyne installation, however, lack of accommodation and sufficient deck space precluded the possibility of a stand-alone vessel-less well abandonment campaign. Therefore, an accommodation barge (the *Seafox 1*) will be located adjacent to the installation throughout the well P&A operations. Anchors and anchor chains will be used to relocate the *Seafox* 1 from its stand-off position (out-with the Tyne installation 500 m safety zone) to its operational position. The maximum deployment time of the anchors (weather permitting) will be approximately 24 to 36 hours, after which they will be fully recovered and stowed as they will no longer be required. The use of seabed rock stabilisation for the *Seafox 1* during preparatory and removal operations is not currently anticipated but has been considered in the EIA.

2.3.1.2 Explosives

Well decommissioning involved flushing and cleaning the wells and placing mechanical plugs and cutting the wells at the appropriate depths using explosives, according to the specific features of each well/ reservoir. The explosive cutting was performed from the Tyne installation and supported by the *Seafox 1* Jack-up barge and a support vessel.

The production tubing from four of the wells were severed at varying depths below the mudline (approximately 168 m (T1Z); 161 m (T2); 146 m (T3A); and 147 m (T4A)). The use of explosive for the fifth well (T6) was not required as the production tubing from this well has already been removed as part of the P&A activities in 2016. One explosive charge of 0.076 kg of explosive per well was used for cutting the tubing and was placed at depths ranging from 146 to 168 m below the mudline. The cutter was deployed using slickline, it was run in- hole (RIH) to the cut depth inside the production tubing, which is encased by the inner casings and the outer conductor pipe which runs from below the cut depth to the platform deck. The production tubing and inner casing strings were fully contained within the outer conductor pipe and not exposed to the sea. At no time before or after the cut were the charges open to the sea. After cutting the cutter was removed from the production tubing using the slickline winch. A new cutter bottom hole assembly (BHA) was prepared before deployment in the next well. Each explosive charge per well was detonated one at a time. This workscope has been completed under Marine Licence (DCA/39 ML/248/1 (Version 1)).

2.3.1.3 Fluid disposal

Drilling and completion fluids produced from the wells as a result of the decommissioning activities will be dealt with in accordance with The Offshore Chemicals Regulations (2002), as will other chemicals used in the wells abandonment procedure. Chemicals anticipated to be recovered from the well annuli include calcium chloride completion brine and oil based mud (see Table 2-6 for approximate volumes). These chemicals will be disposed of by injection into a disposal well and, in the case of the last well to be plugged and abandoned, transported to shore by vessel for subsequent treatment and disposal. There will be zero discharge of these annular fluids to the marine environment.

Table 2-52: Approximate volumes of fluid recovered from each well

Tyne platform well	Calcium chloride brine	Oil-based mud	Fate of fluids
44/18a-T1Z	143.9 m^3 (905 bbls)	71.6 m^3 (450 bbls)	Re-inject
44/18a-T2	106.8 m^3 (672 bbls)	31.8 m^3 (200 bbls)	Re-inject
44/18a-T3A	165.4 m^3 (1,040 bbls)	38.2 m^3 (240 bbls)	Re-inject
44/18a-T4	114.5 m^3 (720 bbls)	35.0 m^3 (220 bbls)	Re-inject
44/18a-T6	164.6 m^3 (1,035 bbls)	122.4 m^3 (770 bbls)	Ship to shore
Total for Re-injection	**530.6 m^3 (3,337 bbls)**	**176.5 m^3 (1,110 bbls)**	
Total for Export	**164.6 m^3 (1,035 bbls)**	**122.4 m^3 (770 bbls)**	
Total	**695.1 m^3 (4,372 bbls)**	**298.9 m^3 (1,880 bbls)**	

2.3.2 Topsides

Prior to removal the topsides will be flushed, purged or cleaned, using the methods outlined in Table 2-6.

Table 2-6: Cleaning of topsides prior to removal (PUK, 2015a)

Material type	Detail	Preparatory activity
Onboard HCs	Process fluids, fuels and lubricants	Flushed and drained to disposal wells on Tyne
Other hazardous materials	NORM, instruments containing Heavy Metals (HM), batteries	Transported ashore for re-use/ disposal by appropriate methods
Original paint coating	Lead-based paints	May give off toxic fumes/ dust if flame-cutting or grinding/ blasting is used so appropriate safety measures will be taken
Asbestos and ceramic fibre	-	Appropriate control and management will be enforced

Note: NORM: Naturally Occurring Radioactive Materials

It is also important to note that there are a number of appurtenances (including the five well conductors, 16” drains disposal caisson, 8” seawater lift caisson, 10” J-tube (part installed), 20” export riser and the 3” MEG riser) between the topsides and the jacket that will be disconnected before the topsides can be lifted.

The Tyne diesel generators will not be used during the preparatory operations. Instead power will be run from the *Seafox 1* accommodation barge while it is on location and then solar panels on Tyne will generate the necessary power (for lighting etc.) until the installation’s removal.

The Tyne topsides will be completely removed by a lift vessel. The exact methodology is subject to contractor selection and detailed engineering studies and thus yet to be decided. The use of seabed rock stabilisation for these vessels during preparatory and removal operations is not currently anticipated. The topside will be transported to the designated disposal yard by lift vessel or cargo barge where it will be transferred to the quayside for dismantling and appropriate re-use of selected equipment, recycling, break up and/ or disposal. The installation’s equipment inventory will be assessed for use as spares for PUK’s asset portfolio.

2.3.2.1 Sand

As HCs are produced from reservoir rocks, small particles and sand grains can become dislodged and carried along with the flow. These grains are separated out from the production fluids by the separator onboard the Tyne installation. It is estimated that the separators could contain up to two tonnes of sand. This will be disposed of onshore with the topsides.

2.3.3 Jacket

To enable access to the jacket piles, a 4 m depth of sediment will be dredged from within each pile. The total volume of sediment removed from all four piles will be approximately 15.76 m^3, which will be ejected into the water column using a jetting tool. The piles will be cut internally, at approximately 3 m below the seabed. This is considered to be an appropriate depth to enable the complete removal of the jacket in a single lift and to ensure that the piles will not become uncovered. The means of cutting could be diamond wire, oxy-propane or high pressure water abrasion. It is anticipated that abrasives will be used to cut the well conductors. The estimated garnet use is 30 t, which 7.5 t might remain on seabed with 22.5 t to be left downhole. In the unlikely event that internal cutting is not possible, external cutting will be undertaken. The excavation of an area around each jacket member has therefore been considered in this EIA as a worst-case scenario. Sediment will be excavated by a work class ROV and will be deposited down-current of the jacket piles, where it will undergo natural dispersal.

Once the jacket members have been severed, the jacket will then be lifted and transported to shore on a lift vessel or cargo barge for cleaning and disposal. It is important to note that before the jacket can be removed, the five well conductors, drains disposal caisson, seawater lift caisson, J-tube (part installed), the export riser and the MEG riser will also be cut off at or below seabed level (as appropriate).

The final methodology for pile severing and jacket removal will be agreed once detailed engineering studies and contractor selection have been completed.

2.3.4 Marine growth

The fully submerged and intermittently immersed parts of offshore man-made structures are frequently colonised by opportunistic marine organisms. These colonies are referred to as marine growth or fouling (Comber et al., 2002). Marine growth is considered a waste by-product from decommissioning offshore infrastructure.

It is estimated that approximately 78 t (wet weight) of marine growth may be attached to the Tyne installation jacket. During the decommissioning of the Tyne installation jacket, it is expected that while some limited quantities of marine growth will be removed offshore to facilitate access to key parts of the structure, the majority of the material will be removed at the onshore disposal yard.

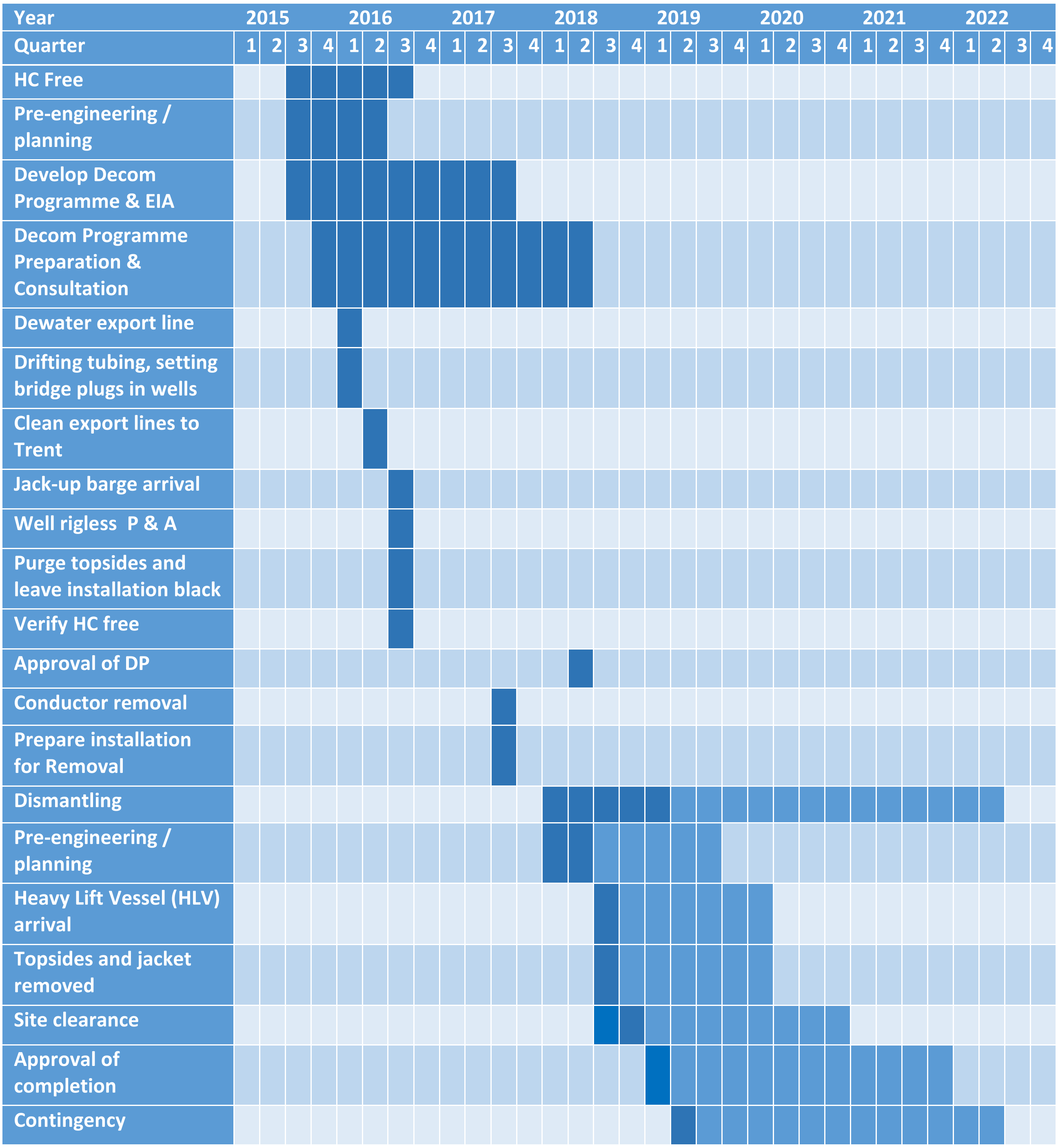
Data from previous decommissioning projects shows that the actual weight of marine growth received at the disposal yard is often much lower than the estimated wet weight (BMT Cordah, 2011). For example, during the decommissioning of seven individual gas platform jackets in the southern North Sea, 40 to 50 t of marine growth was expected per platform. However only around 7 t of material per platform were actually received, approximately 80 to 85% less than expected (BMT Cordah, 2011). This difference is primarily the result of the natural dehydration process that begins once marine growth is removed from the sea. The water content of marine growth is typically between 70 to 90% of its total weight (Tvedten, 2001) and depending on local weather conditions, the natural drying process can proceed quickly. Other losses of marine growth can occur as a result of removal and dislodgement during the cutting, lifting and transportation of infrastructure (BMT Cordah, 2011).

Given the above, it is unlikely that the estimated 78 t (wet weight) of marine growth will be received by the disposal yard. For the purposes of this assessment, a conservative loss of 70% of the estimated wet weight will be assumed. Therefore, it is estimated that the decommissioning yard will receive, approximately, 23 t of marine growth with the Tyne installation jacket.

2.4 Tyne Installation Decommissioning Programme Schedule

Limited Tyne preparatory activities (subject to separate permits where required) started in early 2016. Decommissioning activities at Tyne commenced in 2017. The wells are now all abandoned. However, the conductors still have to be cut and removed. Removal of the installation is expected to take place in Q3 of 2018.

Figure 2-7: Outline of the proposed schedule for the Tyne DP



2.5 Inventory of Materials

During the decommissioning of the Tyne infrastructure, there will be a wide range of materials that will need to be processed and, where possible, recycled. Table 2-1 presents the total tonnage of the infrastructure to be decommissioned and the amount that will be recovered to shore and/ or left in situ. Table 2-8 provides a summary of the expected materials that make-up the infrastructure.

The topsides have been designed to minimise HC inventories, therefore normal shutdown procedures will be employed to make the asset HC free. While the occurrence of hydrogen sulphide (H_2S) is considered highly unlikely, there is the possibility that it may be encountered during well abandonment. There should be a minimal build-up of sands on the topsides therefore a very small quantity of produced solids on the topsides should require disposal.

Table 2-8: Summary of the expected materials from the Tyne Installation DP.

Infrastructure	Weight of Materials (t)						
	Steel	Plastic	Concrete	Lead	NORM/ Hazardous	Marine Growth	TOTAL
Topside	721	10	0	4	3	0	738
Jacket	400	0	0	0	1	78	479
Jacket piles	295	0	3	0	0	0	298
Subsea Template	12	0	0	0	0	1	13
Total	**1,428**	**10**	**3**	**4**	**4**	**79**	**1528**

The proposed fate of the recoverable materials from the Tyne decommissioning project is shown in Table 2-9. At the time of writing this EIA, the contract for waste management has yet to be selected and therefore the table below provides the current estimates for the percentage of each material that will be recycled, reused and disposed of to landfill. As part of the contract strategy, PUK will prioritise environmental performance and the opportunity to maximise recycling. This will be stipulated in the invitations to tender for waste contractor selection. Therefore, the final percentages may differ from the estimates presented in Table 2-9.

All waste will be disposed of in accordance with relevant legislation and PUK policy. Where possible, PUK will endeavour to ensure that materials and equipment are reused or recycled onshore, thereby minimising the volume of materials destined for incineration/ landfill. This will be in accordance with the waste hierarchy principles and PUK's waste management principles.

Table 2-9: Summary of proposed fate of the recovered materials from the Tyne NUI (all values are approximate)

Material	Total weight to be recovered to shore (t)	Proposed fate (%)		
		Re-use	Recycle	Disposal
Steel	1,303	0	100	0
Plastic	10	< 5	> 85	< 10
Concrete	3	0	100	0
Lead	4	0	100	0
NORM/ Hazardous	4	0	0	100

Materials will be segregated for ease of handling and to reduce the energy used when transporting different materials to their respective recycling, reuse or disposal facilities. PUK will ensure that all waste is handled in a manner that will minimise the threat to personnel and the environment.

NORM is present within the Earth's crust and can be concentrated and enhanced by oil and gas recovery as it may be present in drilling sludges, muds and pipe scale and accumulate in dead spaces in equipment over time (OGP, 2008). During decommissioning, PUK will ensure that this material is disposed of separately. Any NORM-contaminated material returned to shore will be treated, recycled or disposed of as appropriate. The selected contractor will have the experience and management procedures in place to handle and dispose of Naturally Occurring Radioactive Materials (NORM) in a responsible way and in accordance with the relevant legislation. Generally, hazardous wastes will be transported from the site in sealed containers. Procedures for NORM, low specific activity (LSA) scale and radioactive components will be in accordance with company procedures.

2.6 Emissions and Waste Arising from Decommissioning Operations

During the Tyne decommissioning operations, emissions and waste will arise from offshore decommissioning activities and from the onshore processing of waste materials.

2.6.1 Offshore Decommissioning Activities

Several different vessels will be required for offshore decommissioning operations. These vessels are expected to use a variety of anchoring (*Seafox 1*) and dynamic positioning techniques when working on site. Of note is that at the time of writing this EIA, PUK has yet to finalise the competitive tenders for the decommissioning work and therefore the final combination of decommissioning vessels may vary depending on the contractor selected.

A small quantity of atmospheric emissions will result from combustion of fuel for power generation on the decommissioning vessels. Discharges from operating vessels include routine releases of drainage water, bilge water from machinery spaces, ballast water, and sewage/ food waste discharges. PUK will ensure that operating vessels will comply with relevant maritime and environmental regulations. However, operational discharges might take place. The potential contaminants associated with discharges from the vessels that will operate during the Tyne Field decommissioning are summarised in Table 2-10.

Table 2-10: Potential contaminants of discharges from operating vessels

Discharges from operating vessels	Potential contaminant/ source
Drainage discharge	Chemicals / HCs from the vessel floor
Treated bilge water	HCs from machinery spaces
Ballast water	Sediments and water from the ballast tanks including non-native planktonic and benthic species
Sewage and macerated galley waste	Organic wastes including foreign bacteria from accommodation areas

An overview of the fuel consumption and the main discharges and wastes from typical vessels that may be used during the Tyne decommissioning operations are also provided in Table 2-11.

Table 2-11 Estimated total fuel use and waste generation from vessels during the Tyne decommissioning project and the associated calculation assumptions

Vessel type	Calculation assumptions				Emissions and waste		
	Approximate duration (working days)	Fuel consumption (t/ day)	Average POB	Solid waste generated (t/ month)	Total estimated power generation (t of diesel burnt)	Total estimated waste water discharged to sea[1] (t)	Total estimated solid waste returned to shore (t)
Accommodation barge (*Seafox* 1)[2]	70	22	60	24	1,540	840	56
Supply vessel[4] for barge	70	10	12	5	700	168	12
Stand-by vessel[5] for barge	70	8	20	5	560	280	12
Lift vessel[6]	24	50	75	24	1,200	360	19
Supply vessel[4] for lift vessel	24	10	20	5	240	96	4
Cargo barge[2]	24	22	60	24	528	288	19
Tugs[3] x2	14	10	24	10	140	67	5
Stand-by vessel[5] for lift vessel	24	8	20	5	192	96	4
Survey vessel[7]	2	18	20	Negligible	144	32	-
Helicopter[8]	94	-	-	-	42	-	-
				Total	**5,286**	**2,227**	**131**

Notes

[1] Estimation based on 0.2 t waste water /man / day
[2] Fuel use rate based on IoP, 2000 (Cargo barge – working)
[3] Fuel use rate based on IoP, 2000 (Anchor handling vessel – working);
[4] Fuel use rate based on IoP, 2000 (Supply vessel – in transit)
[5] Fuel use rate based on IoP, 2000 (Safety vessel – in transit)
[6] Fuel use rate based on IoP, 2000 (Heavy lift vessel – in transit (propulsion))
[7] Fuel use rate based on IoP, 2000 (Multi-support vessel – working)
[8] Fuel use rate based on Super Puma EC255 (Eurocopter, 2009); calculation based on 3 return flights per week, 400 km return flight

2.6.2 Processing of Waste Materials Onshore

In addition to vessel emissions, there will also be emissions related to atmospheric emissions from the disposal, processing and/ or recycling of the Tyne installation components onshore. All waste will be shipped to and processed in the Netherlands.

Material quantities, as they pass through processing operations, can be described by material balances. Such balances are statements on the conservation of mass. Similarly, energy quantities can be described by energy balances, which are statements on the conservation of energy (Earle and Earle, 2004). As materials are processed, energy is required to recycle that material into a reusable form. This is usually represented as energy spent in gigajoules (GJ). The energy consumption to process one tonne of said material is often then compared to the energy consumption required to manufacture one new tonne of the material.

The Institute of Petroleum (IoP, 2000) provide data based on the on the energy use and atmospheric emissions during the decommissioning of offshore structures. A summary of this data is presented in Table 2-12. This table presents the estimated energy consumption and atmospheric emissions used to convert a selection of common decommissioning materials and shows how the values compare to the production of new materials.

Table 2-12: A comparison of energy consumption and gaseous emissions between recycling and manufacturing from new for common decommissioning materials

Material	Recycle				Manufacture from new			
	Energy consumption (GJ/ t material)	Gas emitted (kg/ t material)			Energy consumption (GJ/t material)	Gas emitted (kg/t material)		
		CO_2	NO_x	SO_2		CO_2	NO_x	SO_2
Steel[1]	9	960	1.6	3.8	25	1,889	4.2	5.5
Concrete / cement[1]	1[3]	880	5.4	0.1	1	880	5.4	0.1
Plastic[2]	20	693	-	-	105	3,179	-	-

[1] Source: IoP (2000).
[2] Source: Harvey (2010); DEFRA / DECC (2011a).
[3] Concrete can be crushed and recycled into aggregates but new cement is still needed to turn this back into concrete. Cement production accounts for ca. 94% of the energy required to create concrete. Therefore, for the purposes of this assessment, it is assumed that the energy requirement and atmospheric emissions to recycle concrete are the same as manufacturing from new (source: BuildingGreen, 1993).
No data represented by a dash (-).

These values will be used to estimate the energy use and gaseous emissions likely to result from the processing of the Tyne Development material inventory that is recovered to shore. A detailed breakdown and discussion of energy use and atmospheric emissions resulting from the Tyne decommissioning activities can be found in Section 5.

2.6.3 Summary of the Expected Wastes

The wastes that are expected to be generated by the proposed decommissioning methods discussed above for the Tyne Development are summarised in Table 2-13.

Table 2-13: Summary of the expected wastes that will be generated by the proposed Tyne decommissioning (excluding gaseous emissions)

Material	Estimated total quantity	Leave / discharge in situ (%)	Ship to shore (%)
Steel	1428 t	8.8	91.2
Plastic	10 t	0	100
Concrete	3 t	0	100
Lead	4 t	0	100
NORM / hazardous	4 t	0	100
Marine growth (wet weight on jacket)[1]	79 t	0	30
Waste water	2,484 t	100	-
Well fluids – calcium chloride brine[2]	695.1 m^3	-	24
Well fluids - oil-based mud[2]	298.9 m^3	-	41

[1] Following losses to sea during the jacket removal and transportation (including through the evaporation of water) a maximum of approximately 30 % (23 t) of the original mass is expected to be received on shore.
[2]The portion of well fluids that are not shipped to shore will be re-injected downhole.

2.7 Post-Decommissioning Inspection Surveys

Various surveys are expected to occur post-decommissioning and are described in the sub-sections below. These surveys may be visual (ROV surveys) or may include the use of sidescan sonar techniques.

2.7.1 Debris Clearance and Overtrawlability Survey

A post decommissioning site survey will be carried out in the area within a radius of 500 m around the Tyne installation site. Significant seabed debris will be recovered and transported to shore for disposal or recycling in line with existing disposal methods.

To ensure safety for fishing activity in the area, independent verification of the seabed state will be obtained by trawling the area of the installation. This will be followed by a statement of clearance to all relevant governmental departments and non-governmental organisations.

2.7.2 Ongoing Monitoring and Evaluation

The results of the environmental sampling survey carried out around the 500m zone of the Tyne installation will be submitted as part of the Decommissioning Programme close out report; using the results from this and previous surveys, and in consultation with OPRED, PUK will then develop a risk-based survey strategy. This strategy will set out the requirement for any further post-decommissioning surveys and will take into account the results of earlier work.

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3 ENVIRONMENTAL BASELINE

This section describes the background physical environmental characteristics in the southern North Sea, identifies the flora and fauna likely to be present within the Tyne decommissioning project area and the surrounding waters and describes other sea users within this area.

3.1 Introduction

Although this EIA is focussed on the impact assessment of the decommissioning of the Tyne installation, this section covers all of the Tyne infrastructure and therefore represents a worst-case scenario. The Tyne infrastructure is situated in UKCS Blocks 43/20, 43/24, 43/25, 44/16, 44/17 and 44/18 (hereafter referred to as the 'blocks of interest') in the southern North Sea (Figure 1-1). The Tyne installation is located in UKCS Block 44/18a, approximately 184 km east of the nearest UK landfall, at Flamborough Head on the East Riding of Yorkshire coastline, and approximately 22 km to the west of the UK/ Netherlands transboundary line. The Tyne export pipeline (PL1220) and the piggybacked MEG line (PL1221) tie into the Trent platform, situated approximately 56 km to the west of the Tyne installation in UKCS Block 43/24.

3.1.1 Tyne Pre-Decommissioning Environmental Baseline Survey

PUK commissioned a pre-decommissioning EBS, undertaken in April 2016 by Benthic Solutions supported by Bibby HydroMap on board the *MV Bibby Tethra*. The survey area included a 1 km^2 area, centred on the Tyne installation, and an approximately 250 m wide corridor along the export pipeline and MEG line to Trent. The survey comprised side scan sonar, single beam and multi-beam echo sounders, drop-down camera work and seabed grab samples, with the samples subject to both physico-chemical analyses (i.e. particle size analysis (PSA), total organic carbon (TOC), HC and HM concentrations) and faunal analysis. The key objectives of the survey were to:

- Assess the status/ diversity of benthic habitats in the vicinity of the Tyne installation and along the 56.9 km Trent/ Tyne export pipeline and MEG line route.
- Provide sufficient benthic data to adequately assess the environmental impact of the decommissioning operations as part of the EIA process.
- Identify any potential features within the Dogger Bank (Annex I Habitat) as described under the European Union (EU) Habitats Directive.
- Provide data on the chemical and physical properties of the sediments in the vicinity of the Tyne installation and the 56.9 km export pipeline and MEG line route.

Acoustic data was acquired over the survey area to provide an overview of the sediment habitat types present. Sampling stations were then selected to acquire data in the vicinity of the installation and evenly throughout the entire route corridor, while targeting areas of potential sensitivity. Of particular interest were clear bathymetric features and, if recorded, potential Annex I habitats (EU Habitats Directive). In total, 14 sampling station locations were selected (Figure 3-1), four of which were positioned in the vicinity of the Tyne installation (ENV_T01 to ENV_T04). The remaining ten stations were selected to provide adequate coverage of background sediments, high reflective patches observed on the side scan sonar data, areas of suspected sediment change and spatial variation along the length of the pipeline route (ENV_P01 to ENV_P10). Only sampling stations ENV_P01, ENV_P02 and ENV_P03 were located outside of the Dogger Bank SAC area.

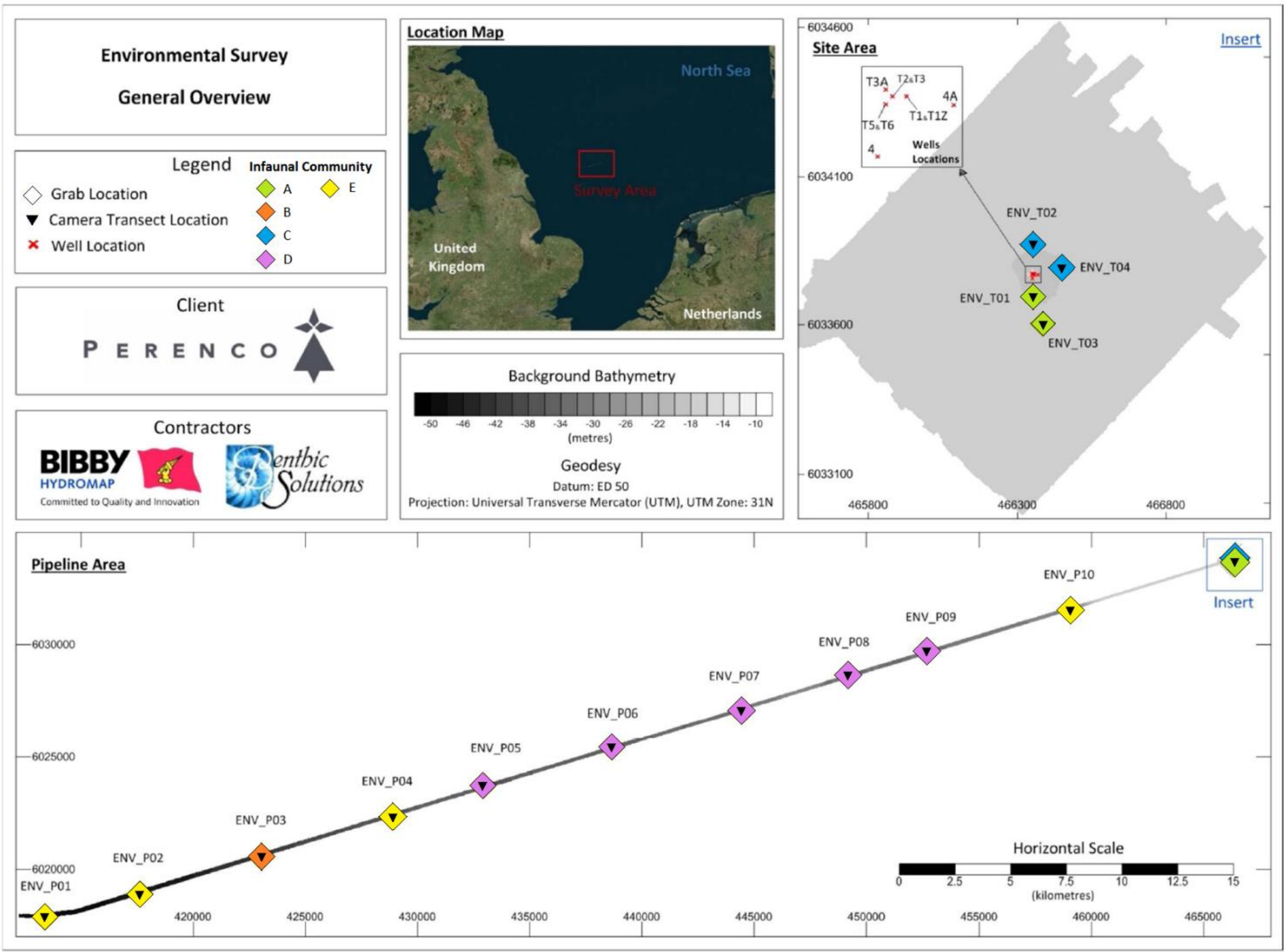


Figure 3-1: Overview of grab and camera locations and distribution of faunal communities (adapted from Bibby HydroMap & Benthic Solutions, 2016)

Note: The infaunal community legend descriptions can be found in Diesing et al., (2009).

Seabed photography using BSL's MOD4 camera system was used to ground-truth all key seabed habitats identified from the acoustic datasets. High-resolution digital photographs were acquired along a short transect at each sampling station location, accompanied by video footage covering a larger seabed area. In addition, seabed grab samples were collected using a 0.1 m^2 area Day grab, with each of the 14 sample station locations sampled three times. Two of these samples were acquired for faunal analysis and one sample was acquired for physico-chemical analysis (PSA, TOC, HC and HM analysis). The results from the survey are included where relevant throughout this section of the EIA. The full sampling methodology and laboratory treatments and techniques are provided in the full survey report (Bibby HydroMap & Benthic Solutions, 2016).

This section of the EIA also refers to historical Tyne survey data, where applicable, including:

- **2012 Debris Search Survey:** N-Sea Survey B.V. were contracted by PUK in 2012 to conduct a debris search in an area of 1 km^2, centred on the Tyne installation. The aim of the survey was to acquire sufficient data with which to evaluate potential hazards for a self-elevating platform and to ensure there was no debris within the area, which could impede the safe operation of a jack-up unit. Data was collected using side scan sonar, a magnetometer and a drop-down camera (N-Sea, 2012);
- **2015 General Visual Inspection Survey:** In preparation for the Tyne DP, FSSL were contracted by PUK in September 2015 to undertake a visual inspection of the Tyne installation using a Remotely Operated Vehicle (ROV). In addition, the condition of some other Tyne infrastructure components

was assessed including the pipeline out to burial, noting the position of mattresses and any debris and assessment of the known freespan, the height between the bottom of the riser and the seabed and the condition of the skirt piles, drill template, riser and caisson clamps (FSSL, 2015).

3.1.2 Dogger Bank Survey Work

The Tyne installation and approximately 42 km of the Tyne export pipeline (PL1220) and MEG line (PL1221) lie within the boundary of the Dogger Bank Special Area of Conservation (SAC) (Figure 3-2). The site is designated for its Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' and is the largest single continuous expanse of shallow sandbank in UK waters, extending into both Dutch and German waters (refer to Section 3.3.6 for further details).

As part of the SAC site selection process (and to supplement the various environmental studies which had previously been undertaken for academic research and for industry investigations), an extensive survey was conducted in April 2008 by Cefas under contract to JNCC, during which multibeam and side scan data were collected over a broad scale grid. These remote sensed data were ground-truthed using biological sampling by grabs, video/stills, and beam trawls (Diesing et al, 2009). The locations of these sampling stations in relation to the Tyne infrastructure is shown in Figure 3-2.

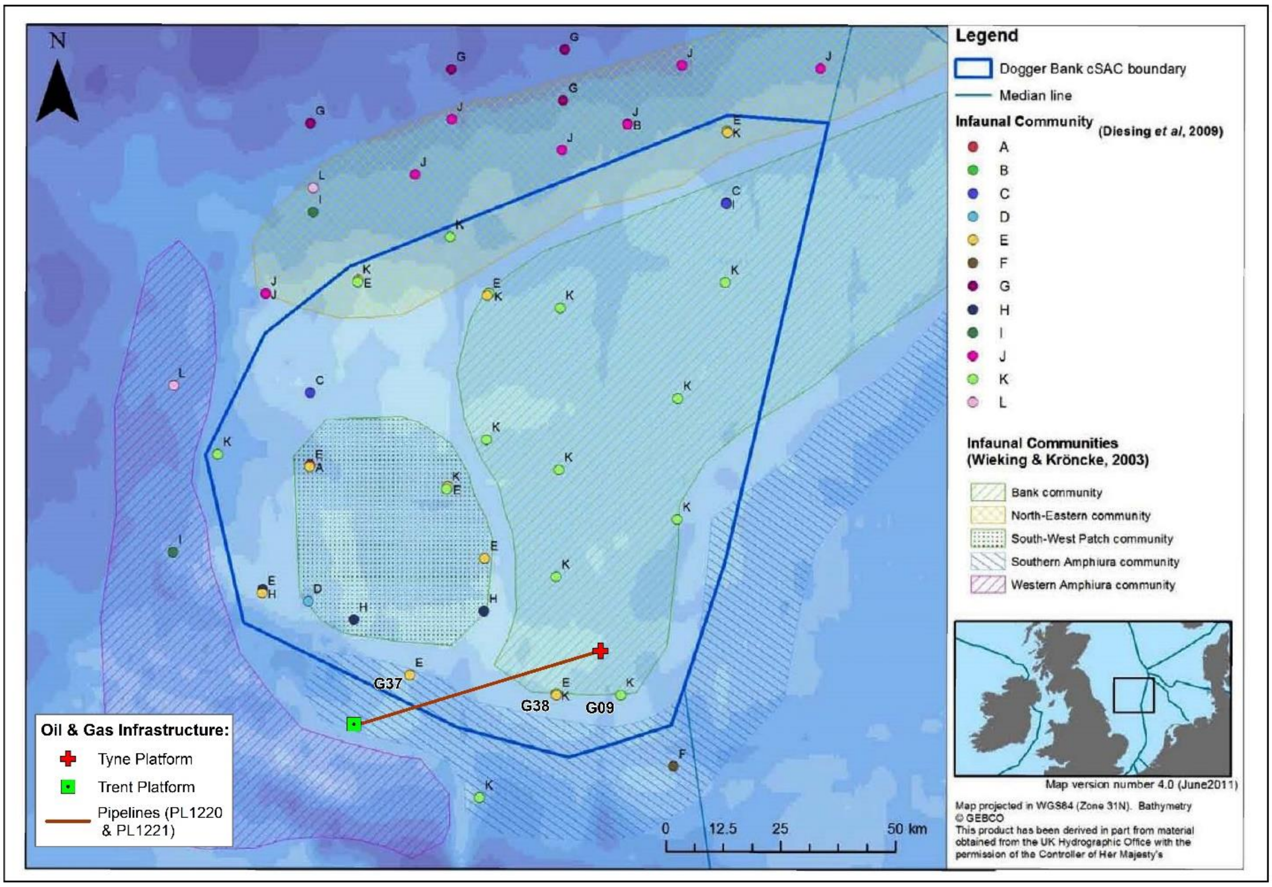


Figure 3-2: Distribution of infaunal communities on the Dogger Bank identified by Diesing et al., (2009) and Wieking & Kröncke, (2003) in relation to the Tyne development (adapted from JNCC, 2011a)

Note: The infaunal community legend descriptions can be found in Diesing et al., (2009).

A number of surveys were also undertaken between 2010 and 2012 to inform the EIAs being undertaken by Forewind for the Dogger Bank offshore wind farm development. The development site is located approximately 32 km to the northwest of the Tyne infrastructure (at its nearest point). This work has included geophysical, geotechnical, benthic ecology, ornithology and marine mammal surveys (Forewind, 2015).

More recently, in 2014, a pilot monitoring survey was carried out collaboratively, between JNCC and Cefas, to gather 'baseline' data within the Dogger Bank to help inform on the effectiveness of several proposed fishery management areas and to investigate changes in biological communities along a fishing pressure gradient. The preliminary results, based on field observations, from this survey are reported in Ware & McIlwaine (2015). Figure 3-3 presents the location of the sampling stations in relation to the Tyne development. Data from these surveys has been taken into consideration when characterising the environmental baseline in the vicinity of the Tyne infrastructure.

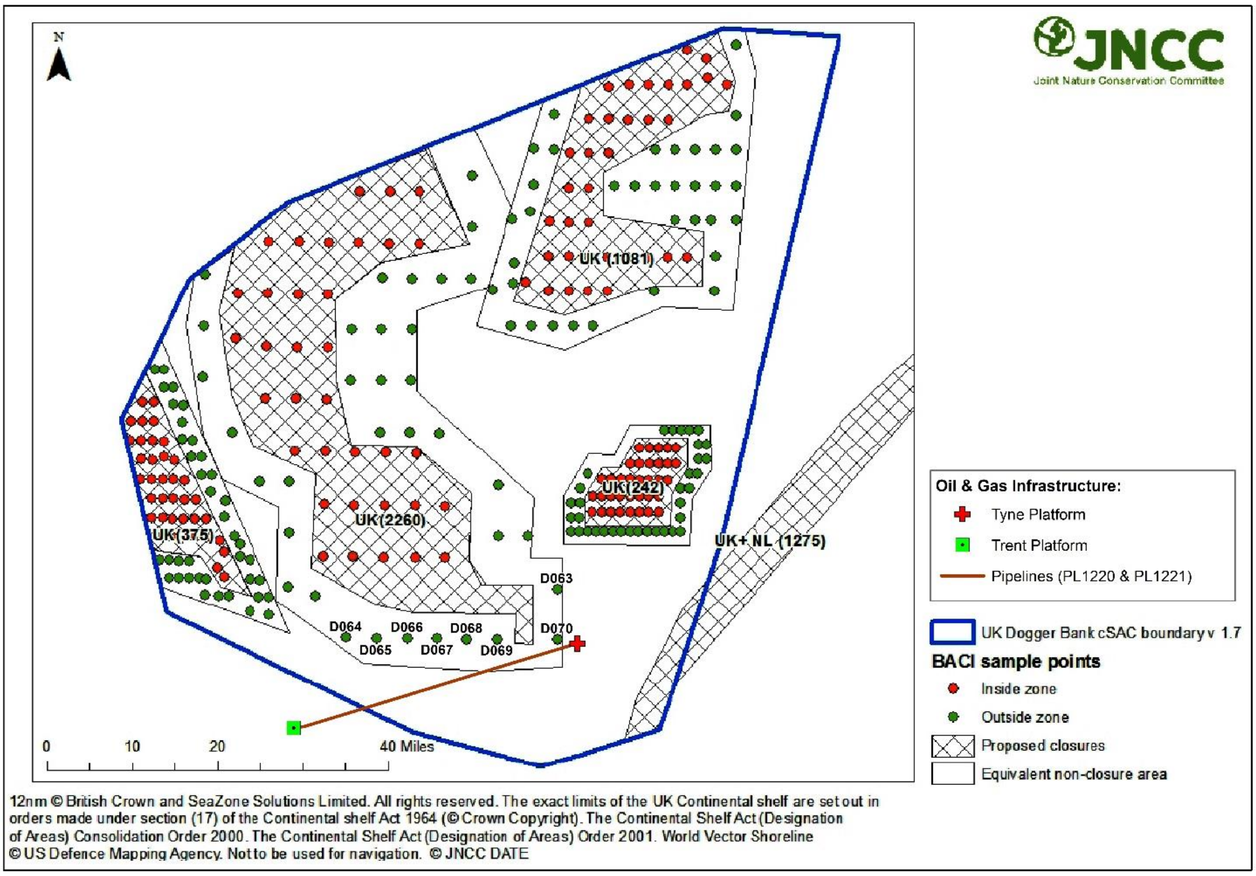


Figure 3-3: Locations of the sampling stations of the 2014 Dogger Bank survey (Ware and McIlwaine, 2015) in relation to the Tyne development (adapted from Ware and McIlwaine, 2015).

3.1.3 Other Published Sources

In addition to the above referenced data sources, this section of the EIA has been prepared using a number of other key published literature sources, including:

- The BEIS UK Offshore Strategic Environmental Assessment (OESEA and SEA) Reports (2005-2016);
- The UK Digital Marine Atlas (UKDMap, 1998);
- EUSeaMap Seabed Habitats Project (EMODnet, 2016);
- UK Benthos (2015) Version 5.02;

- Fisheries Sensitivity Maps in British Waters (Coull et al., 1998);
- Spawning and Nursery Grounds of Selected Fish Species in UK waters (Ellis et al., 2012);
- Seabirds Oil Sensitivity Index (SOSI) (Oil & Gas UK, 2016) ;
- The JNCC Cetacean Atlas of Cetacean distribution in north-west European waters (Reid et al., 2003);
- Scientific Advice on Matters Related to the Management of Seal Populations by the Special Committee on Seals (SCOS, 2015);
- Small Cetaceans in the European Atlantic and North Sea (SCANS)-II 2008 data (in DECC, 2009);
- Fishing Effort and Quantity and Value of Landings by International Council for the Exploration of the Seas (ICES) Rectangle (Scottish Government, 2018; MMO, 2017a and 2017b);
- The Crown Estate (2016); and
- UKOilandGasData (2017).

3.2 Physical Environment

The physical environment around the Tyne Field is described in the sub-sections below.

3.2.1 Bathymetry

The water depth at the Tyne installation location is 17 m LAT (Bibby HydroMap & Benthic Solutions, 2016). The seabed gently slopes in a south-westerly direction from the Tyne installation along the route of the Tyne export pipeline and MEG line. The water depth in the vicinity of the Tyne development ranges from 14 m LAT near to the Tyne installation, to 57 m LAT to the northwest of the Trent platform (Hydrographer of the Navy, 2008).

During the Tyne 2012 debris search survey, the seabed in the survey area was found to be practically flat, with the exception of a depressed circular zone (approximately 100 m diameter) around the platform. Variations in depth were less than 1 m, with an average of 17 m LAT (N-Sea, 2012). Depths up to 2.5 m greater were recorded in the circular zone immediately around the Tyne installation (Figure 3-4).

The presence of shallow depressions 200 m south and 500 m northeast of the Tyne installation were also observed. These were typically 25 m long and elongated in north-south direction (N-Sea, 2012).

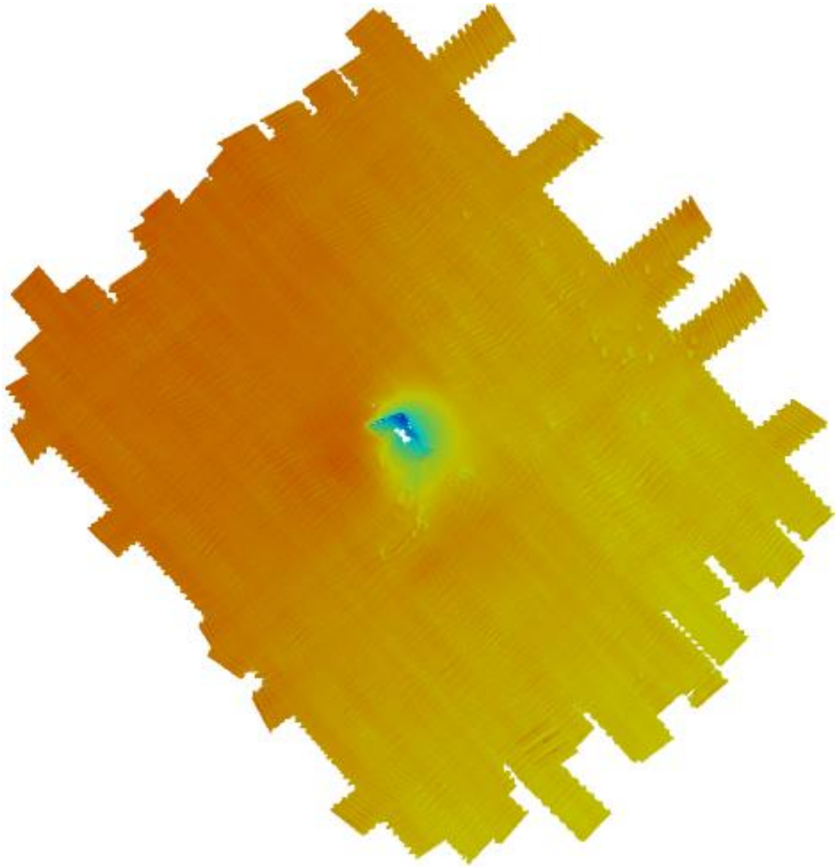


Figure 3-4: Overview of the bathymetry in a square kilometre area centred on the Tyne installation (Source: N-Sea, 2012)

Note: The bathymetry contains some heave artefacts, this is due to marginal conditions, seas of up to 2.5 m, in which the data was recorded (N-Sea, 2012).
Key: Warm colours (red) indicate relatively shallow areas of the seabed, while increasingly cool colours (blue) indicate deeper areas (depth range over the whole survey area is roughly 3.5 m). White areas indicate no data.

3.2.2 Seabed Sediments and Features

Seabed sediments over the Dogger Bank comprise a mobile veneer of terrigenous, and a smaller proportion of biogenic, sediments overlying Holocene and Pleistocene deposits. Sandy sediment, classified as slightly gravelly sand and sand, dominates much of the Dogger Bank area. The facies form mobile sand streaks, which comprise a thin veneer actively being transported across the seabed, with mobile sand ripples and small sand waves forming where the seabed sediment is thicker. Locally developed patches of sandy gravel and gravel occur in slight topographic depressions on the shallowest sections of the bank usually in water depths of less than 40 m (Diesing et al., 2009).

The 2012 Tyne debris survey (N-Sea, 2012) observed that the majority of the survey area is characterised by a medium reflectivity seabed, interpreted to be sandy, with sand ripples present locally. Very high reflective material was noted to be present around the Tyne installation and in elongated patches in the northern and eastern part of the survey area. Inspection with a drop-down camera showed that the high reflectivity was caused by shells and or shell fragments (N-Sea, 2012).

During the 2016 EBS it was noted that the seabed composition is relatively consistent, being predominantly comprised of sand with varying levels of gravel and shell material with areas of regular bedforms such as sand ripples created by boundary currents and wave action (Bibby HydroMap & Benthic Solutions, 2016). Results from the PSA show that sediment samples collected across the 2016 EBS survey area contained an average of 4.1% fines, 84.6% sands and 11.3% gravels (Table 3-1).

Table 3-1: Summary of particle size distribution (Bibby HydroMap & Benthic Solutions, 2016)

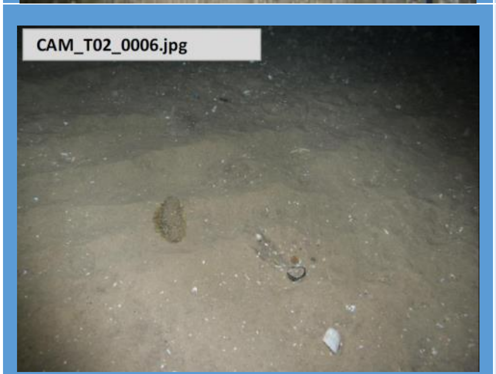
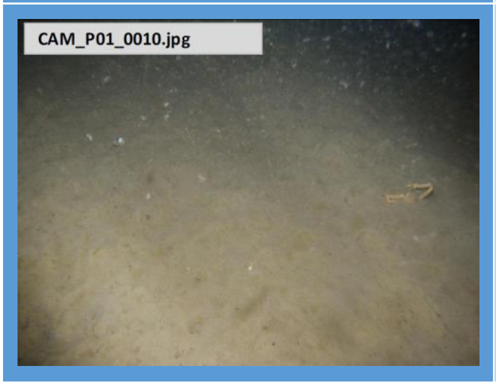
Station	Mean sediment size		Sorting	Folk classification (1954)	Fines (%)	Sands (%)	Gravels (%)
	mm	Phi (ϕ)					
ENV_T01	0.547	0.87	Poorly sorted	Gravelly sand	0.91	88.15	10.93
ENV_T02	0.222	2.17	Moderately well sorted	Slightly gravelly sand	0.00	97.66	2.34
ENV_T03	0.648	0.63	Poorly sorted	Gravelly sand	0.00	88.51	11.49
ENV_T04	0.530	0.91	Very poorly sorted	Gravelly sand	0.00	85.87	14.13
ENV_P01	0.230	2.12	Poorly sorted	Sand	9.13	90.83	0.05
ENV_P02	0.310	1.69	Very poorly sorted	Gravelly sand	9.96	82.45	7.60
ENV_P03	0.334	1.58	Moderately sorted	Sand	3.72	95.29	0.99
ENV_P04	0.767	0.38	Very poorly sorted	Gravelly sand	7.19	65.69	27.12
ENV_P05	0.514	0.96	Poorly sorted	Gravelly sand	5.24	82.96	11.81
ENV_P06	0.386	1.37	Very poorly sorted	Gravelly sand	8.62	76.03	15.35
ENV_P07	1.316	-0.40	Poorly sorted	Gravelly sand	2.21	72.52	25.28
ENV_P08	0.380	1.40	Poorly sorted	Gravelly sand	1.69	90.20	8.11
ENV_P09	0.963	0.06	Very poorly sorted	Gravelly sand	5.43	59.57	34.99
ENV_P10	0.204	2.29	Poorly sorted	Gravelly sand	0.00	89.03	10.97
Mean	**0.525**	**1.15**	-	-	**3.86**	**83.20**	**12.94**
Standard Deviation	**0.32**	**0.81**	-	-	**3.71**	**11.05**	**10.12**
Variance (%)	**60.2**	**70.6**	-	-	**96.0**	**13.3**	**78.2**

The majority of sediment samples indicated a broad distribution dominated by the sand fractions (Table 3-1), with station ENV_T02 recording almost 98% sand. Gravels were more prevalent at stations ENV_P04 and ENV_P07 with on average over 26% of the particle size distribution accounted for by particles over 2 mm in size. Conversely, stations ENV_P01, ENV_P02, ENV_P06 and ENV_P09 showed the highest proportion of fines (less than 63 µm) with an average of 9%. The broad range of particle sizes is also reflected in the sorting coefficient with the majority of stations classified as poorly to very poorly sorted (Table 3-1).

While, there appears to be no geographical pattern in the distribution of sands or gravels throughout the EBS area, the variability in fines is likely to be a function of the relative hydrodynamic energy at the sediment water interface, with turbulent currents scouring the seabed and re-suspending fine material. The four sampling stations located 50 m downstream (south) of the Tyne installation (ENV_T01, ENV_T02, ENV_T03 and ENV_T04) in higher energy, shallower waters, recorded lower fines than those in deeper, lower energy environments, showing a maximum proportion of fines of 0.91%. This trend is supported by a significant correlation between percentage fines and depth (Bibby HydroMap & Benthic Solutions, 2016). A review of sediment composition from seabed photography also indicated a gradient of change from a predominantly sand-based environment close to the installation, with increasing proportions of fines recorded at deeper stations (Bibby HydroMap & Benthic Solutions, 2016).

The dominant sediment type throughout the Tyne environmental survey is interpreted to be ‘gravelly sand’, according to the Folk classification (1954), with the exceptions of samples from stations ENV_P01 and ENV_P03 which were classified as ‘sand’ and station ENV_T02 which was classified as ‘slightly gravelly sand’ (Bibby HydroMap & Benthic Solutions, 2016). Table 3-2 provides examples of the seabed imagery recorded as part of the 2016 EBS for each identified sediment types.

Table 3-2: Examples of seabed imagery (Bibby HydroMap & Benthic Solutions, 2016)

Example of seabed imagery	Details
	Folk Classification (1954): Gravelly sand **Station**: ENV_T01 **Site Selection Criteria**: 50 m Downstream Tyne of installation, potential cuttings **Water Depth**: 18 m LAT **Analogue Interpretation**: Patch of low and medium reflectivity, potential cuttings **Photo Location**: 466359 m East, 6033688 m North **Description**: Coarse sand, beige, shell fragments
	Folk Classification (1954): Slightly gravelly sand **Station**: ENV_T02 **Site Selection Criteria**: Approx. 50 m Upstream of Tyne installation **Water Depth**: 18 m LAT Analogue Interpretation: Low reflectivity **Photo Location**: 466358 m East , 6033866 m North
	Folk Classification: Sand **Station**: ENV_P01 **Site Selection Criteria**: Spacing, station between ENV_P02 feature and the (Trent) platform area **Water Depth**: 49 m LAT Analogue Interpretation: Low reflective ripples **Photo Location**: 413384 m East, 6017843 m North **Description**: Fine sand, beige

The results of the PSA broadly agree with the findings of the pilot monitoring survey of the Dogger Bank conducted by JNCC and Cefas in 2014. Seven of the sampling stations used for this pilot monitoring survey are located near to the Tyne development; D063, D064, D065, D067, D068, D069 and D070 (see labelled stations in Figure 3-3; Ware and McIlwaine, 2015). Station D070 is the nearest to the Tyne infrastructure (approximately one km to the north of the Tyne pipelines) and station D064 is the furthest (approximately 6.5 km to the north west of the Tyne pipelines). The water depth across all seven stations ranges between 16 and 22 m. A preliminary in-field visual assessment of the grab sampled sediments identified the broadscale habitat type for all seven of the aforementioned stations to be 'sand' (Ware and McIlwaine, 2015). It was concluded that the predominant sediment type across area UK2260 as a whole (Figure 3-3) is subtidal sand with occasional patches of subtidal coarse and mixed sediment (Ware and McIlwaine, 2015).

3.2.3 Sediment Quality

In offshore waters, contaminant levels in sediments are generally expected to be at or near background concentrations, although levels may be higher at close proximity to oil and gas infrastructure, with concentrations decreasing with increasing distance from the source (DECC, 2011a). The seabed sediments collected during the 2016 EBS were analysed for TOC, HC and HM concentrations.

3.2.3.1 Total organic carbon concentration

The 2016 EBS found that TOC concentrations are relatively low and consistent throughout the survey area, ranging from <0.10% to 0.88% with a mean of 0.21%, generally reflecting an organically deprived environment. It is noted that higher concentrations of TOC tended to coincide with sampling stations showing the highest percentage of gravel (i.e. stations ENV_P04, ENV_P07 and ENV_P09). A general lack of fine material, and therefore reduced surface area for adsorption, means that overall TOC levels within the sediment are low. This may in turn affect the richness and abundance of deposit-feeding organisms within the sediment (Bibby HydroMap & Benthic Solutions, 2016).

3.2.3.2 Hydrocarbon concentration

The total HC content (THC) of the sediments was measured by integration of all non-polarised components within the gas chromatograms (GC) trace. The results showed generally low levels of THC ranging from 2.1 μgg^{-1} to 8.9 μgg^{-1}, with an elevated concentration of 166.4 μgg^{-1} recorded at station ENV_T01 (Table 3-4). Excluding the elevated level at station ENV_T01, the mean THC for the survey area was 3.61 μgg^{-1}. The elevated level found at station ENV_T01 and the corresponding GC-trace for this station (Figure 3-5), indicated potential low toxicity oil-based mud (LTOBM) input from drilling activities around the Tyne installation (Bibby HydroMap & Benthic Solutions, 2016).

Table 3-4: Summary of hydrocarbon concentrations (Bibby HydroMap & Benthic Solutions, 2016)

Station	THC (μgg^{-1})	Total n-alkanes (μgg^{-1})	Carbon preference index
ENV_T01	166.41	2.22	0.78
ENV_T02	1.76	0.04	2.23
ENV_T03	3.10	1.64	0.56
ENV_T04	8.85	7.24	0.87
ENV_P01	3.15	0.16	1.83
ENV_P02	5.02	0.32	1.86
ENV_P03	2.10	0.12	1.59
ENV_P04	2.55	0.14	1.93
ENV_P05	2.94	0.15	1.73
ENV_P06	5.53	0.57	1.18
ENV_P07	2.12	0.21	1.21
ENV_P08	3.73	0.90	1.12
ENV_P09	2.89	0.39	1.10
ENV_P10	3.13	0.12	2.07
Mean	15.24	1.02	1.43
Standard Deviation	43.55	1.90	0.52
Variance (%)	2.86	1.87	0.37

The THC recorded at stations ENV_T04, ENV_P01, ENV_P02 and ENV_P06 were above the OSPAR (2001) mean background level (4.34 μgg^{-1}), however with the exception of ENV_P01, all sampling stations are below the OSPAR (2001) 95th percentile background level of THC for the southern North Sea (11.4 μgg^{-1}). There is no significant statistical correlation between THC and the mean sediment grain size, as determined using a Pearson product-moment correlation (Bibby HydroMap & Benthic Solutions, 2016).

The THC level at station ENV_T01 is also above the OSPAR (2006) threshold above which adverse effects on seabed invertebrates may be noted (50 μgg^{-1}). Based on the location of station ENV_T01, and other Tyne sampling stations, it is likely that the footprint of seabed contamination above the threshold is limited to less than 50 m north, east and west of the installation, and between 50 m and 170 m south of the installation (Bibby HydroMap & Benthic Solutions, 2016).

It should be noted that while the THC level recorded at station ENV_T01 is elevated above the aforementioned OSPAR thresholds (2001; 2006), it is consistent with expected levels around offshore oil and gas platforms (10 - 450 μgg^{-1}; Daan et al., 1992). Moreover, surveys of cuttings piles around offshore platforms in the central and northern North Sea recorded maximum THC concentrations significantly higher than those recorded during the 2016 EBS (up to 150,000 μgg^{-1}; Bibby HydroMap & Benthic Solutions, 2016).

The total n-alkane concentrations were moderately high overall, ranging from 0.04 μgg^{-1} to 7.24 μgg^{-1} (mean 1.02 μgg^{-1}), but are typical for sediments around offshore drilling platforms (Bibby HydroMap & Benthic Solutions, 2016).

A number of the sample stations GC-traces show signatures consistent with anthropogenic inputs. These include the GC-trace for station ENV_T01, which showed some indication of weathered mixed HC input, dominated by suspected LTOBM used during drilling operations (Figure 3-5). In addition, the GC-trace for ENV_T04 and to a lesser extent ENV_T03, showed evidence of potential contamination by linear paraffin pseudo-OBM and the GC-trace for ENV_T08 may indicate the presence of a paraffin-based wax substance. The exact nature and source of the latter is inconclusive, but it is unlikely to be derived from drilling activities associated with the Tyne installation as this signature was not evident at stations located closer to the installation and there are no known wells located close to this sampling station (Bibby HydroMap & Benthic Solutions, 2016).

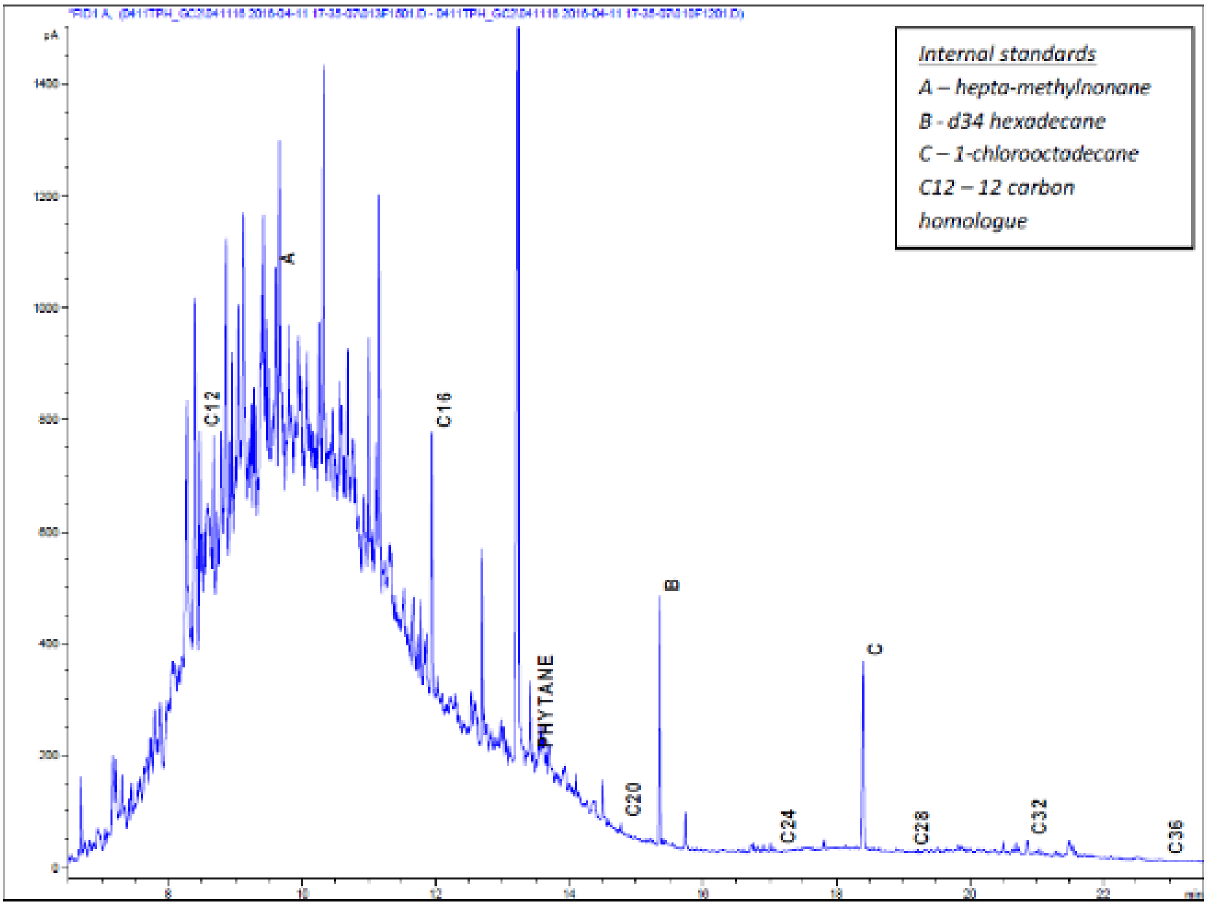


Figure 3-5: Example of GC-trace for saturate hydrocarbon analysis showing suspected LTOBM dominated well-weathered mixed hydrocarbon input (ENV_T01) (Bibby HydroMap & Benthic Solutions, 2016)

Note: GC-trace is labelled with every fourth n-alkane, the isoprenoid hydrocarbons pristane and phytane, and the internal standards hepta-methylnonane (A), deuterated hexadecane (B) and 1- chlorooctadecane (C).

The calculations for the carbon preference index (CPI) revealed a dominance of biogenic compounds along the pipeline route, whereas the lower CPI calculated around the Tyne installation indicated a dominance of petrogenic n-alkanes.

3.2.3.3 Heavy and trace metal concentration

Table 3-5 presents a summary of total heavy and trace metal analysis from the 2016 EBS, alongside the UK Offshore Operators Association (UKOOA) (2001) background mean and 95th percentile concentrations for the southern North Sea. National Oceanic and Atmospheric Administration (NOAA) effects range low (ERL) concentrations are also provided; indicating the lower threshold at which adverse biological effects have been identified from ecotoxicological studies (Buchman, 2008).

The concentrations of heavy and trace metals are generally low, especially for those stations located in shallower water depth around the installation. Metal distributions often correlate with each other and, occasionally, with other sedimentary factors (e.g. percentage fines, gravel).

Most metal levels are on average lower at the installation stations compared to the stations positioned along the pipeline route with the exception of barium, which is as expected, found in higher concentrations around the Tyne installation due to its use in drilling muds (Bibby HydroMap & Benthic Solutions, 2016).

Table 3-5: Summary of total heavy and trace metal concentrations in the 2016 EBS (Bibby HydroMap & Benthic Solutions), alongside UKOOA (2001) background mean and 95th percentile concentrations for the southern North Sea and NOAA ERL concentrations (μgg^{-1} dry weight)

Contaminant	UKOOA		NOAA	2016 Tyne EBS results		
	Mean (μgg^{-1})	95th % (μgg^{-1})	ERL (μgg^{-1})	Minimum (μgg^{-1})	Maximum (μgg^{-1})	Mean μgg^{-1})
Arsenic (As)	-	-	8.2	3.20	26.70	14.10
Barium (Ba)	218	302	-	19	175	52.52
Cadmium (Cd)	0.5	0.5	1.2	<0.1	0.15	0.08
Chromium (Cr)	24.6	48.5	81.0	5.80	19.50	12.14
Copper (Cu)	6.6	11.8	34.0	2.50	7.20	4.33
Lead (Pb)	12.7	21.1	46.7	1.90	10.70	6.06
Mercury (Hg)	0.03	0.10	0.15	<0.01	0.61	0.06
Nickel (Ni)	8.0	18.7	20.9	4.00	20.30	9.34
Tin (Sn)	-	-	-	<0.5	0.60	0.31
Vanadium (Va)	-	-	-	10.60	55.00	31.72
Zinc (Zn)	21.8	43.5	150.0	7.80	43.20	21.29
Iron (Fe)	-	-	-	5,180	27,300	13,815.71

It can be seen in Table 3-5 that, with the exception of arsenic (mean 14.1 μgg^{-1}), mean metal levels are all below the ERL threshold. Arsenic concentrations are consistently low at the platform sampling stations, with the majority of elevated levels occurring along the pipeline route. In addition to arsenic, the maximum concentration of mercury also exceeds the ERL threshold. This threshold is only exceeded at the sampling station nearest to the Trent platform (ENV_P01). The maximum concentrations of copper, nickel and zinc are either above the UKOOA mean or 95th percentile values for the southern North Sea.

The Tyne installation is located on the Dogger Bank. Research by Chapman (1992) has concluded that sediments on the Dogger Bank are unpolluted. Other surveys have recorded high levels of lead and cadmium contamination in the less than 20 μm fraction of Dogger Bank sediments (Krönke and Knust, 1995; Langston et al, 1999). As shown in Table 3-5, high levels of these contaminants are not recorded in the 2016 EBS. Lead concentrations are moderate but variable across the Tyne EBS area (Table 3-5), with the highest values recorded at ENV_P03 (outside of the Dogger Bank SAC area). It is worth noting a significant positive correlation between the concentration of lead and the percentage of fines in the sediment. The concentration of cadmium is consistently low at all sampling stations (mean concentration 0.08 μgg^{-1}) (Bibby HydroMap & Benthic Solutions, 2016).

More recently, in 2011 and 2012, contaminant analysis on the sediments of the Dogger Bank has been carried out by Forewind for the Dogger Bank Teesside A & B offshore wind farm development, located approximately 45 km to the north northwest of the Tyne installation. This survey work concluded that the baseline sediment quality for the marine environment is generally good. It was also noted that the predominantly sandy nature of the seabed sediments reduces the potential for any contaminants to accumulate (Forewind, 2014a). This may also be true of the seabed in the vicinity of the Tyne development, which is predominantly composed of sand and has generally low concentrations of heavy and trace metal contaminants (Bibby HydroMap & Benthic Solutions, 2016).

3.2.4 Oceanography

Information on the physical oceanographic characteristics around the Tyne Field is provided in the sub-sections below.

3.2.4.1 Currents

The general circulation of near-surface water masses in the North Sea is cyclonic, mostly driven by the ingression of Atlantic surface water in the western inlets of the northern North Sea. As a result, residual water currents near the sea surface tend to move in a south-easterly direction along the coast towards the English Channel (NSTF, 1993). In addition, counter currents occur towards the English/ Dutch sector median line, flowing northeast towards Denmark (Figure 3-6). The effect of this counter current in the vicinity of the blocks of interest pushes the near-surface water movement towards a more southerly and easterly direction.

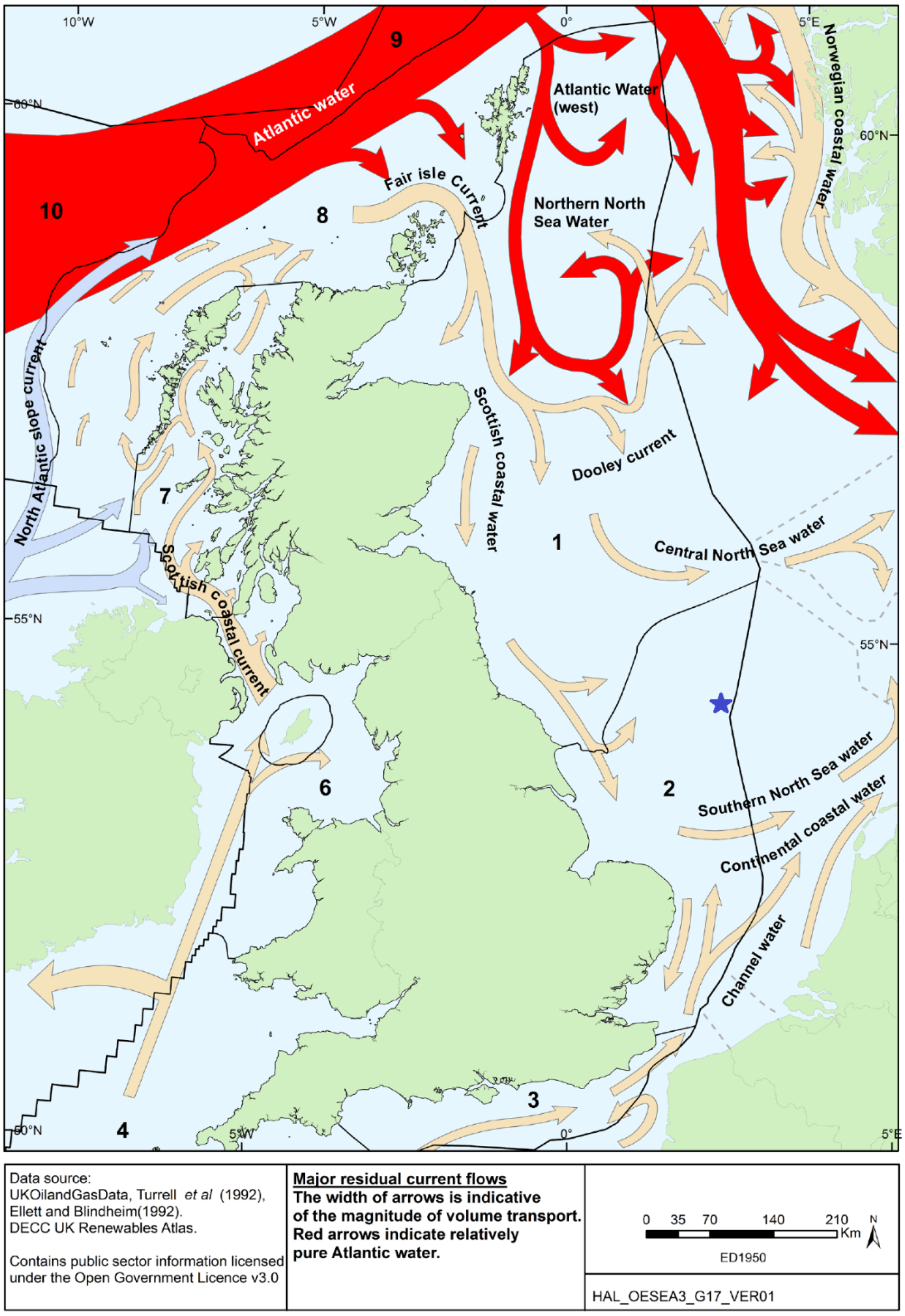


Figure 3-6: Major water masses and residual circulation in the North Sea (BEIS, 2016)

Note: blue star indicates approximate location of the Tyne installation

3.2.4.2 Tides

Tides in the southern North Sea are predominately semi-diurnal and tidal waters offshore in this area flood southwards and ebb northwards. Maximum tidal rates in the region of the blocks of interest are 0.46 and 0.26 m/s respectively for spring and neap tides (Figure 3-7). Tidal streams were generally fastest for a period of one hour up to six hours prior to and after high water during both spring and neap tides (Hydrographer of the Navy, 2008).

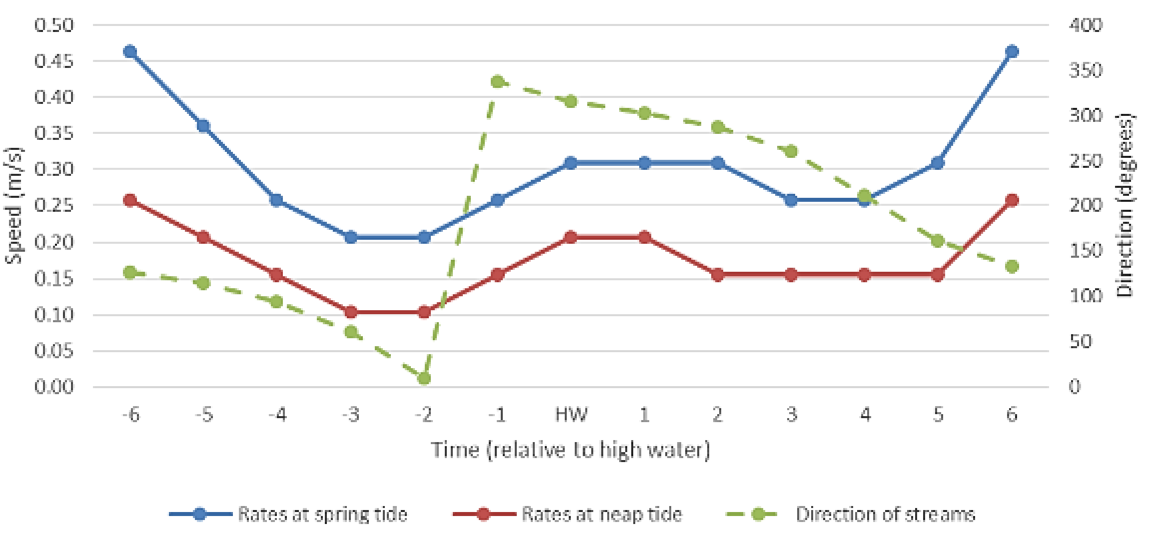


Figure 3-7: Tidal current speeds and direction measured at 54°39.3' N, 01°53.9' E (Hydrographer of the Navy, 2008)

3.2.4.3 Waves

Waves are the result of energy being transferred between two fluids moving at different rates (Dobson & Frid, 1998). They are caused at sea by the differential motion of the air (wind) and the seawater. The height of a wave is the distance from the crest to trough, but as the waves at any one time are not of equal size, the significant wave height (H_s) is taken and corresponds approximately to the mean height of the highest third of the waves. The wave period is the (mean) time between two wave crests, called the zero up-crossing period and is given in seconds. The wave climate of the area provides information on the physical energy acting on structures and dictates the structural design requirements.

The worst case H_s in the vicinity of the blocks of interest exceed 2.5 m for 10% of the year (Table 3-6). However, there is considerable seasonal variation between sea states, with waves in excess of 2 m recorded for 25% of the time in autumn and winter, but only 2% of the time in summer (Smith, 1998). Wave direction is variable throughout the year.

Table 3-6: Average wave height in the vicinity of the blocks of interest (ABPMer, 2017)

Average wave height (m)			
Spring	Summer	Autumn	Winter
1.51 to 1.75	1.01 to 1.50	1.76 to 2.00	2.01 to 2.50

3.2.4.4 Sea temperature

The sea surface temperatures in the vicinity of the blocks of interest range between a mean winter temperature of around 7°C and a mean summer temperature of approximately 14°C. Bottom temperatures range between a mean winter temperature of 7°C and a mean summer temperature of 12°C (NMPi, 2018).

3.2.4.5 Salinity

The salinity in the region of the blocks of interest remains relatively stable throughout the year. The mean annual salinity of the sea surface varies between a winter mean of 34.69 ppt and a summer mean of 34.67 ppt. While the mean salinity of the bottom is 34.67 ppt in winter and 34.68 ppt in summer (NMPi, 2018).

3.2.5 Wind

The winds in the vicinity of the Tyne decommissioning area are variable but predominantly from the west (Figure 3-8). During the winter and early summer north-easterly and south-westerly winds are most common. From July to September however, south-westerly and westerly winds predominate.

The windiest months are December and January, with wind speeds of greater than Beaufort Force 7 (14 to 16.5 m/s) achieved on six to ten days a month. The calmest months are May to August with wind speeds of Force 7 or more reached only on between one and three days (Barne et al., 1995).

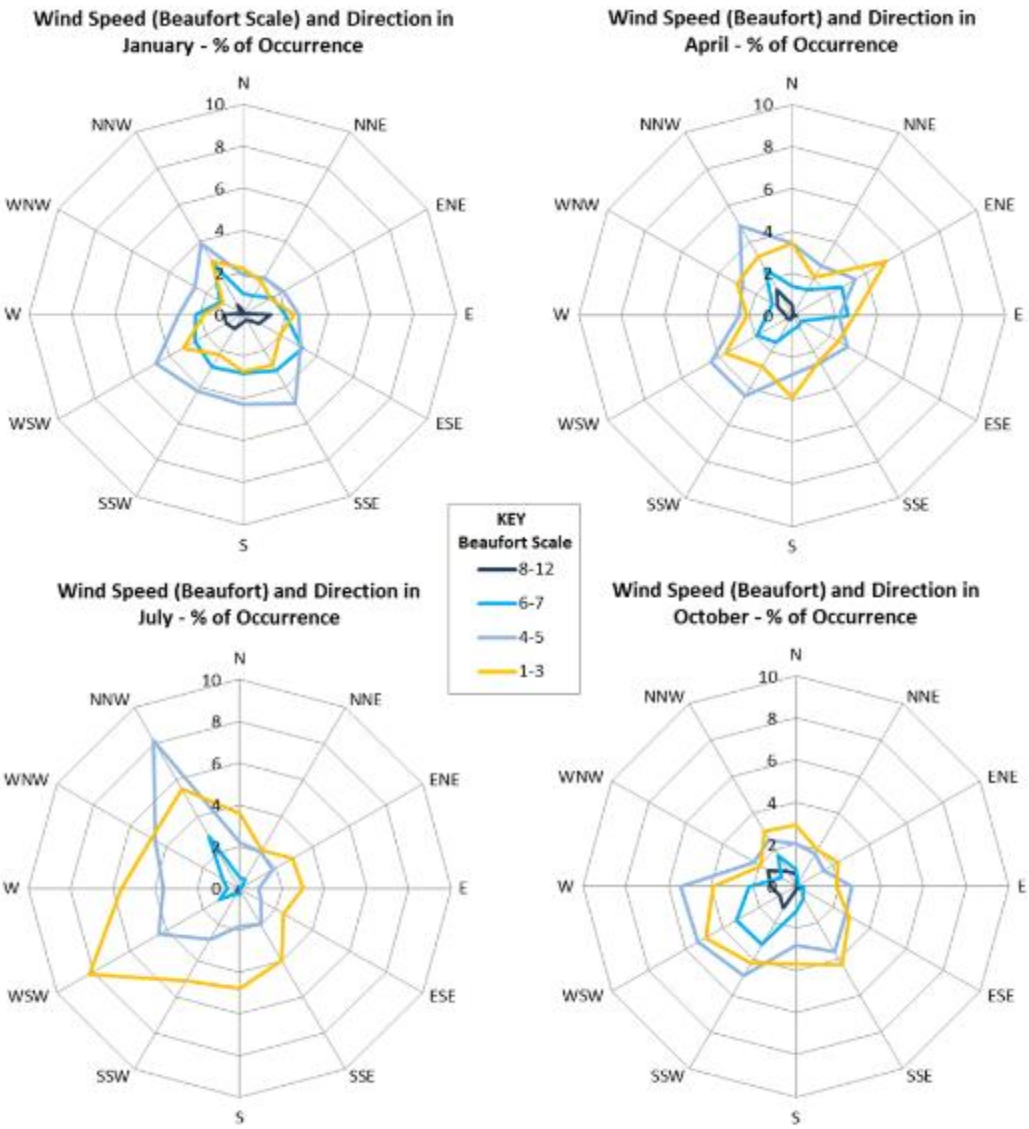


Figure 3-8: Wind roses for the area 54.0N – 55.9N, 2.0E – 3.9E (Korevaar, 1990)

3.3 Biological Environment

This section describes the species and habitats that have been recorded in the area within which the Tyne infrastructure is located and along the adjacent coastlines that could be affected by the proposed decommissioning activities.

3.3.1 Plankton

Plankton consists of microscopic plant-like protists (phytoplankton) and animals (zooplankton), which live freely in the water column and drift with the water currents. Plankton forms the primary basis of the marine food chain. The composition and abundance of plankton communities vary throughout the year and are influenced by physical parameters such as temperature and salinity. Zooplankton species composition is largely dependent on the input of oceanic water (Beare et al., 2002). Phytoplankton and the associated grazing zooplankton usually show a bimodal pattern of abundance throughout the year. The main peak occurs towards the end of spring in response to the increasing photoperiod, with a secondary peak occurring in late summer/early autumn (Johns & Reid, 2001).

The phytoplankton community in this area of the North Sea is dominated by the dinoflagellate genus *Ceratium*. The dinoflagellate *Protoperidinium* and diatoms of the genera *Thalassiosira* and *Chaetoceros* are also abundant (Johns and Reid, 2001; BEIS, 2016). Phytoplankton numbers increase in spring led by the diatoms which peak between April and July, followed by dinoflagellates peak in the late summer, when waters became more stratified (BEIS, 2016). However, over the last decade a sharp decline in dinoflagellates' numbers in the North Sea has been recorded, particularly attributed to dramatic decrease of *Neoceratium* spp. abundance, although between 2012 and 2013 there have been signs of recovery (Edwards et al., 2014).

The zooplankton communities are dominated by copepods, particularly *Calanus finmarchicus* and *Calanus helgolandicus*, in terms of productivity and biomass (BEIS, 2016). These two calanoid species show a strong geographical divide, with *C. finmarchicus* being more abundant in colder and *C. helgolandicus* in warmer, more southerly waters, with some considerable overlap. Other important species include *Acartia* spp., *Temora longicornis* and *Oithona* spp. The larger zooplankton includes krill (euphausiacea), salps and doliolids (thaliacea) and jellyfish (siphonophorea and medusea), which are more abundant in late summer and autumn (BEIS, 2016).

Zooplankton richness is higher in the northern North Sea than in the southern North Sea, with greater seasonal variability. In this region calanoid copepods dominate the community, followed by *Paracalanus* and *Pseudocalanus* species. Also, larval calanoid stages contribute significantly towards biomass of the region. Other important components of the zooplankton assemblage include euphausiids, *Acartia* spp., decapod larvae and jellyfish, particularly *Aurelia aurita, Cyanea capillata* and *Cyanea lamarckii* (BEIS, 2016).

In general, the plankton around the British Isles fulfil criteria for Good Environmental Status specified by the Marine Strategy Framework Directive (MSFD), which require the biodiversity, distribution and abundance of species to be in line with prevailing physiographic, geographic and climatic conditions (Defra, 2010).

3.3.2 Benthic Communities

The benthos describes the organisms that live within and on the seabed. Seabed sediments provide support, protection and the food source for many macrofaunal species. The macrofauna, most of which are infaunal (living within the sediment), are therefore particularly vulnerable to external influences and changes in the sediment, such as those of a physical, chemical or biological nature.

Some infaunal animals are largely sedentary and are thus unable to avoid unfavourable conditions. Each species has its own response and degree of sensitivity to changes in the physical and chemical environment and consequently the species composition and their relative abundance in a particular location provides a reflection of the immediate environment, both current and historical. The recognition that aquatic contaminant inputs may alter sediment characteristics, together with the relative ease of obtaining quantitative samples from specific locations, has led to the widespread use of infaunal communities in monitoring the impact of disturbances to the marine environment over a long period of time.

Several data sources have been drawn on to identify the benthic communities that are most likely to be present in the vicinity of the Tyne development.

3.3.2.1 EUSeaMap seabed habitat project data

The EUSeaMap Seabed Habitats Project (EMODnet, 2016) has mapped and classified seabed sediment types in UK waters according to the European Nature Information System (EUNIS) classification. The system identifies keystone species which have been identified as occurring within certain environmental conditions (e.g. water depth, temperature, sediment type etc.). This allows for the inference of community composition based on seabed type and mapping and identification of benthic biotopes.

Eight EUNIS seabed habitats have been identified within the blocks of interest (Figure 3-9). These habitats are listed below (EEA, 2015):

- A5.13: Infralittoral coarse sediment
- A5.14: Circalittoral coarse sediment
- A5.15: Deep circalittoral coarse sediment
- A5.23: Infralittoral fine sand
- A5.24: Infralittoral muddy
- A5.25: Circalittoral fine sand
- A5.26: Circalittoral muddy sand
- A5.27: Deep Circalittoral sand

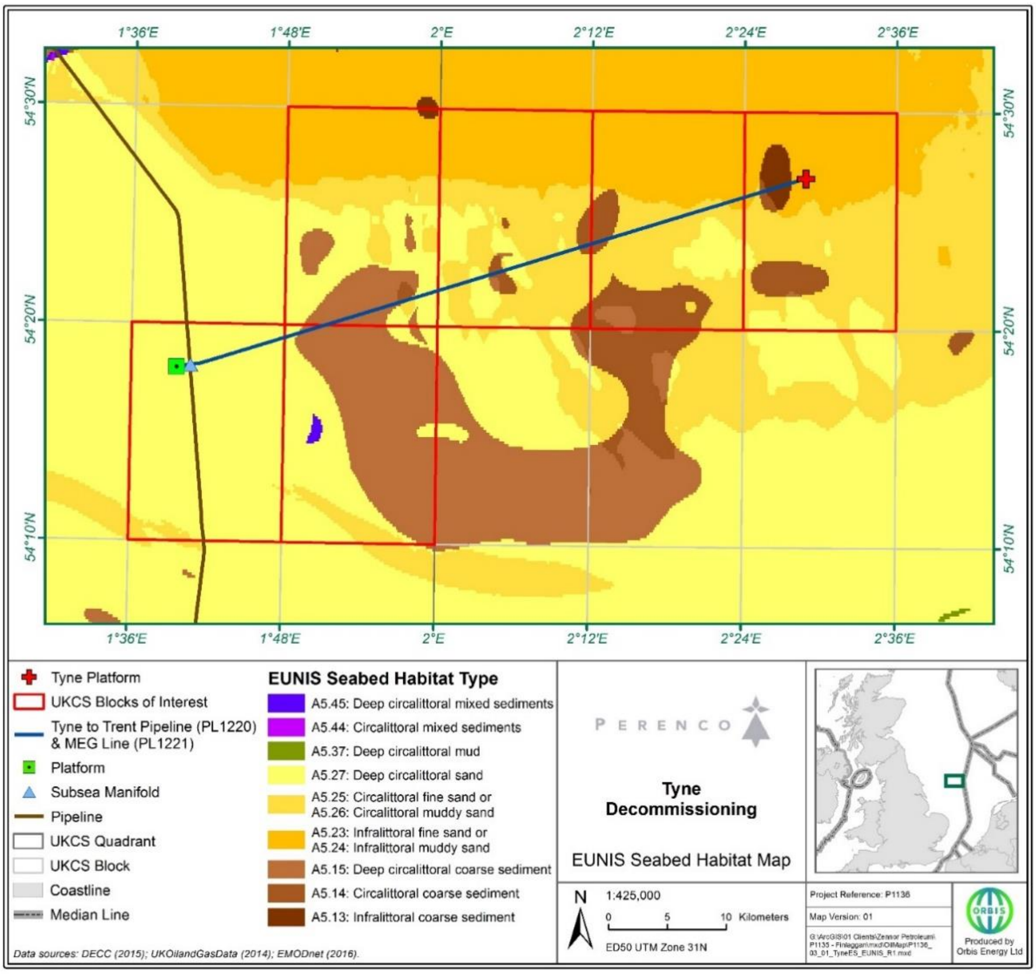


Figure 3-9: EUNIS seabed habitats in the vicinity of the Tyne development (EMODnet, 2016).

3.3.2.2 Data from surveys of the Dogger Bank

As identified in Section 3.1.2, a large part of the Tyne development lies within the boundary of the Dogger Bank SAC (Figure 3-2), which has been subject to a number of benthic surveys.

The fine sand and muddy sand sublittoral sediments found on the Dogger Bank generally show typical biological communities for that type of sediment. These typical community species include the polychaetes *Nephtys cirrosa* and *Magelona sp.,* mobile amphipods of the genus *Bathyporeia*, the brittlestar *Amphiura filiformis*, and bivalve molluscs such as *Fabulina fabula* and *Kurtiella bidentate*. Epifaunal species include the hermit crab *Pagurus bernhardus*, sand eels *Ammodytes sp.,* plaice *Pleuronectes platessa* and the starfish *Asterias rubens* (JNCC, 2011a).

The spatial and temporal infaunal communities on the Dogger Bank are influenced by numerous factors that include natural variables such as depth, sediment type, climate variability, hydrographic regime, temperature and supply of organic matter along with anthropogenic influences such as increasing pollution and commercial fishery activities (Diesing et al., 2009).

Wieking & Kröncke identified five macrofaunal communities over and around the Dogger Bank from macrofaunal samples taken in May 1996-1998 across 28 sampling stations (Wieking and Kröncke, 2003). Figure 3-2 presents the spatial distribution of these communities in relation to the Tyne development and indicates that there are two macrofaunal communities in the vicinity of the Tyne development. The 'Bank Community' characterises the macrofaunal community in the vicinity of the Tyne installation and the eastern half of the Tyne pipelines. This community is restricted to the top of the bank and is typified by shallow, fine sandy habitats that were inhabited by a *Bathyporeia Fabulina* association. While the 'Southern Amphiura Community' characterises the macrofaunal community in the vicinity of the Trent platform and the western half of the Tyne pipelines. This community generally exhibits higher faunal abundance than the 'Bank Community' and was largely dominated by the brittlestar *Amphiura* sp. (Diesing et al., 2009).

Also presented in Figure 3-2 are the locations of the ground-truthing stations used in an investigation by Diesing et al., (2009). Ground-truthing data (Hamon grabs, trawls and underwater video) was collected at these stations in April 2008. Multivariate analyses of the data (using Similarity Profile Analysis (SIMPROF)) identified 12 distinct infaunal communities (A-L) across these stations.

The infauna communities identified at the three stations closest to the Tyne development (G09, G37 and G38, Figure 3-2 are classified as E and K. Community K was found to be the most common across the Dogger Bank area and is characterised by species including two amphipod species *Bathyporeia elegans* and *Bathyporeia guilliamsoniana*, the polychaete *Magelona mirabilis* and the burrowing bivalve *Fabulina fabula*, all of which have a habitat preference for medium grained sediments with a relatively low mud content. The species composition of Community K is noted for being similar to that of the 'Bank Community' (Diesing et al., 2009). The presence of Community E tended to coincide with the presence of relatively coarse substrate and is characterised by species such as *Glycera lapidum*, a species which displays a preference for coarser sediments and has previously being described as characteristic of gravelly regions of the Dogger Bank. The dominant infaunal species in Community E and K are presented in Table 3-7 concludes that the spatial distributions of infaunal communities across the Dogger Bank, and adjacent deeper areas, are largely determined by sediment characteristics and depth (Diesing et al., 2009).

Table 3-7: Dominant infaunal species in communities E and K (Diesing et al., 2009) (Figure 3-2)

Community	Dominant fauna
E	*Notomastus* sp., *Glycera lapidum*, *Nemertea* spp, *Protodorvillea kefersteini*, *Pisione remota*, *Amphiuridae*.
K	*Bathyporeia elegans*, *Magelona filiformis*, *Bathyporeia guilliamsoniana*, *Tellina fabula*, *Amphiuridae*, *Nemertea* spp, *Spiophanes bombyx*, *Chaetozone christiei.*

3.3.2.3 Other relevant oil and gas survey data

A survey conducted for the Munro development (in Block 44/17b and also within the boundary of the Dogger Bank SAC) by Gardline on behalf of GDF Britain during 2002 found the most abundance species present included the polychaeta *Spiophanes bombyx*, *Owenia fusiformis* and *Magelona mirabilis*, the bivalvia *Fabulina fabula* and the crustacea *Abludomelita obtusata* and *Bathyporeia guilliamsoniana* (UK Benthos, 2015). The Munro MH platform is approximately 11.9 km west southwest of the Tyne installation. The reported water depth around the installation is approximately 30 m (UK Benthos, 2015).

Given the similar bathymetric and sediment characteristics of the Munro survey site to the blocks of interest, the benthic communities present within the blocks of interest are likely to resemble those described above.

3.3.2.4 Results of the 2016 EBS

Video/Photographic Data

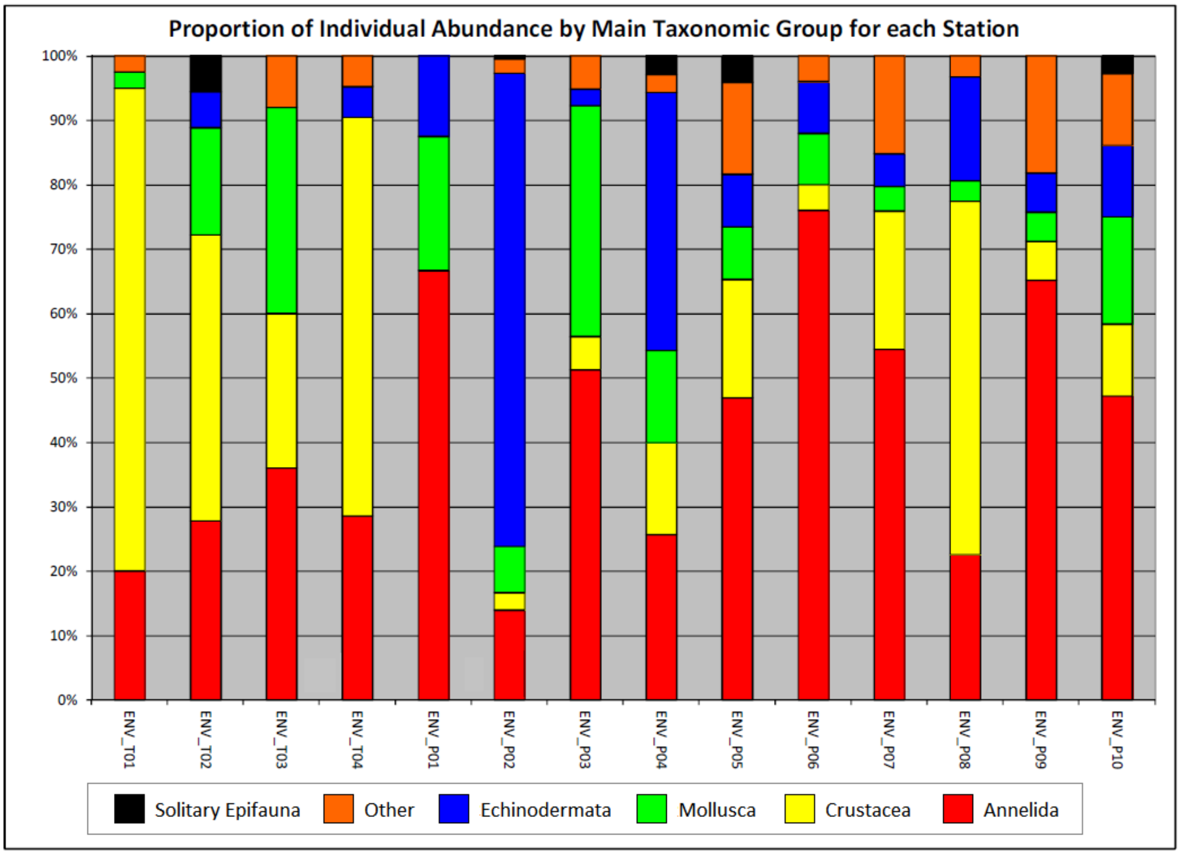
Photographic ground-truthing data was obtained at 14 locations within the survey area. Evidence of the following groups were recorded during inspection of the camera and grab samples: polychaetes (including serpulids), ophiuroids, echinoids (starfish and sea urchins), bivalves, crustaceans (crabs) and paguroids (hermit crab), pleuronectiformes (flatfish) and gastropods (Bibby HydroMap & Benthic Solutions, 2016).

Seabed photography operations revealed some bioturbation and lebensspuren (such as crustacean and worms burrows) within the finer sediments (Bibby HydroMap & Benthic Solutions, 2016).

Polychaetes, asteroids and malacostraca (hermit crabs) were the most frequently encountered groups within the survey area. In general, more conspicuous fauna was seen on video footage from the pipeline stations than from the stations within the Tyne site. Sandeels were present at all locations around the Tyne installation and at pipeline stations ENV_P06 and ENV_P07 (Bibby HydroMap & Benthic Solutions, 2016).

Grab Samples

The results for macrofaunal analysis showed minor variation in terms of individual abundance, species richness and species composition, as would be expected given the homogeneity of the sediment, energetic environment and depth within the survey area (Figure 3-10) (Bibby HydroMap & Benthic Solutions, 2016).



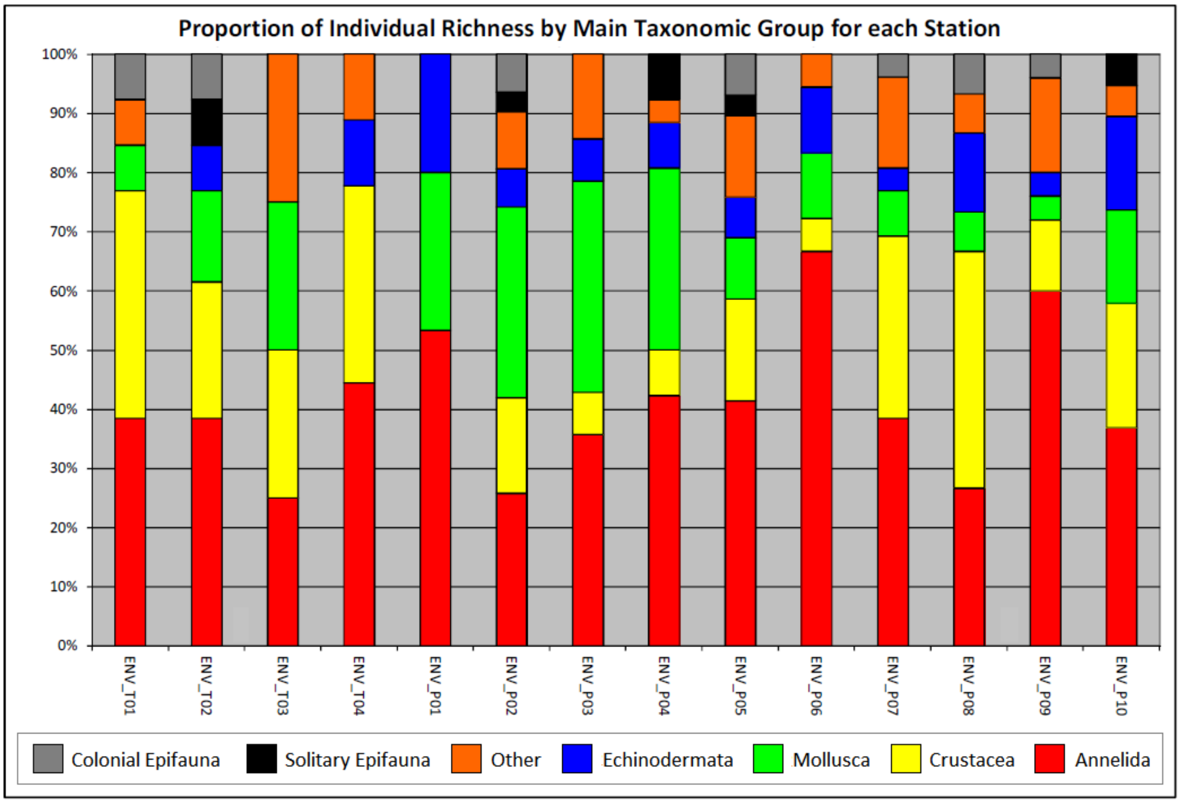


Figure 3-10: Proportion of individual abundance and species richness by different faunal groups at each sampling station (Bibby HydroMap & Benthic Solutions, 2016)

Table 3-8: Overview of the infaunal community composition (Bibby HydroMap & Benthic Solutions, 2016)

Main taxonomic group	Number of species	Abundance (percentage of total individuals)	
		Including *Amphiura filiformis* at station ENV_P02	Excluding *Amphiura filiformis* at station ENV_P02
Annelid	32	35.8	45.7
Crustacea	19	17.1	21.9
Mollusca	24	10.3	13.1
Echinodermata	7	29.7	10.2
Solitary epifauna (Cnidaria)	3	0.9	1.2
Others	7	6.2	7.9
Total	**92**	**100**	**100**

The top 10 dominant species were the polychaetes *Goniada maculata* and *Ophelia limacina*, followed by an unidentified nermertean (Table 3-9). Ranks 4, 5 and 6 were taken by the polychaete *Diplocirrus glaucus* and the echinoderms *Echinocyamus pusillus* and *Amphiura filiformis* with a further four polychaetes occupying ranks 7 to 10 (Bibby HydroMap & Benthic Solutions, 2016). A similar subset of macrofaunal species were also seen to dominate the macrofauna community across the survey area in terms of overall abundance, with 12 of the top 15 overall dominant species also ranked in the top 15 for overall abundance (Table 3-9). Some variation was evident in the order of abundance and dominance ranks, indicating variable abundances of certain taxa across the survey area. No species were recorded at more than 11 of the 14 stations, with the polychaete, *Goniada maculata*, showing the widest distribution, although this species was only ranked 6th in terms of abundance due to low numerical counts. While *Amphiura filiformis* was ranked 1st in terms of overall abundance, but only 6th in terms of dominance, due to high abundances of this species at just two stations (ENV_P02 and ENV_P04) (Bibby HydroMap & Benthic Solutions, 2016).

Overall, the macrofauna community was composed of species commonly found in this area, with some species variations due to varying levels of sand residues and possibly historic shell material in the grab samples (Bibby HydroMap & Benthic Solutions, 2016). The dominant species identified during the 2016 EBS are similar to those identified by surveys of the Dogger Bank (including the brittlestar *Amphiura sp*. and the polychaeta *Magelona mirabilis*) and to those identified for the Munro development (including the polychaeta *Owenia fusiformis* and *Magelona mirabilis*).

Univariate parameters are presented in Table 3-10. The number of species per 0.1 m^2 sample was variable throughout the 2016 EBS area, ranging from a minimum of seven species at station ENV_T03 to a maximum of 29 species at ENV_P02 (mean: 17.7 species per station). Following a similar pattern to richness, abundance was highly variable throughout the survey site ranging from a minimum of 18 individuals at station ENV_T02 to a maximum of 222 at station ENV_P02 (mean: of 52.9 individuals per station). The range of water depths and different proportion of coarse material within the survey area accounted for the overall variability in the species richness and abundance recorded. The sediment characteristics were likely to contribute significantly to the fauna observed at each station; this was confirmed by a significant positive Pearson's correlation between percentage fines and species richness (Bibby HydroMap & Benthic Solutions, 2016).

Table 3-9: Species ranked in top 15 for dominance across the EBS survey area alongside their overall abundance rank (Bibby HydroMap & Benthic Solutions, 2016)

Species/ taxon	Dominance across survey area		Overall abundance across survey area	
	Dominance rank score[1] (out of 140)	Overall rank[2]	Total number of individuals across all stations	Overall rank
Goniada maculata	57	1	19	6
Ophelia limacina	44	2	18	8
Nemertea unid.	40	3	17	10
Diplocirrus glaucus	39	4	16	13
Echinocyamus pusillus	39	5	17	10
Amphiura filiformis	37	6	193	1
Nephthys cirrosa	34	7	9	21
Notomastus latericeus	34	8	28	2
Pholoe inornata	30	9	16	13
Glycera fallax	28	10	17	10
Urothoe elegans	27	11	22	3
Nephthys hombergii	26	12	7	27
Magelona mirabilis	26	12	15	15
Owenia fusiformis	26	14	6	31
Dexamine spinosa	26	15	19	6

[1] Dominance Rank Score calculation: for each sample species were ranked according to abundance (total number of individuals), giving a rank score of 10 to the most abundant species, decreasing to 1 for the tenth most abundant species. These abundance rank scores were added together for all 14 samples to provide the Dominance Rank Score for each species (out of 140).
[2] Overall (Dominance) Rank calculation: The Dominance Rank Score for each species was ranked highest to lowest to give the Overall Rank.

Table 3-10: Univariate faunal parameters (0.2 m^2 replicates) (Bibby HydroMap & Benthic Solutions, 2016)

Station	Number of species per 0.1 m^2	Number of individuals per 0.1 m^2	Richness (Margalef)	Evenness (Pielou's Evenness)	Shannon-Wiener diversity	Simpsons diversity (1-λ)
ENV_T01	11	39	2.73	0.773	2.673	0.798
ENV_T02	12	18	3.806	0.892	3.197	0.895
ENV_T03	7	24	1.888	0.869	2.438	0.823
ENV_T04	8	20	2.337	0.787	2.361	0.747
ENV_P01	15	24	4.405	0.915	3.574	0.928
ENV_P02	29	222	5.183	0.406	1.974	0.468
ENV_P03	14	39	3.548	0.89	3.39	0.903
ENV_P04	26	70	5.884	0.782	3.676	0.848
ENV_P05	27	49	6.681	0.948	4.508	0.968
ENV_P06	18	25	5.281	0.945	3.939	0.957
ENV_P07	24	78	5.279	0.854	3.914	0.915
ENV_P08	14	31	3.786	0.812	3.091	0.837
ENV_P09	24	66	5.49	0.899	4.122	0.937
ENV_P10	19	36	5.023	0.928	3.94	0.946
Mean	**17.7**	**52.9**	**4.38**	**0.836**	**3.343**	**0.855**
StDev	**7.26**	**52.33**	**1.413**	**0.137**	**0.752**	**0.129**
Variance (%)	**41.0**	**98.9**	**32.3**	**16.4**	**22.5**	**15.1**

The Shannon-Wiener Diversity, Pielou's Equitability and Simpson's diversity were highly variable throughout all stations and followed a similar pattern, both with minimum values recorded at ENV_P02 and maximum values recorded at ENV_P05 (Table 3-10). Margalef's Index (species richness) was again highly variable (32% variance) with minimum and maximum values recorded at ENV_T03 and ENV_P05, respectively. Station ENV_T03 recorded only seven species with one species dominating the community, accounting for a third of the total station abundance, resulting in low richness and diversity values. Conversely, station ENV_P05 included 49 individuals from 27 species, resulting in the highest diversities for the survey area.

The overall picture indicated by the univariate parameters is one of variable macrofauna diversity due to differing proportions of coarse material, creating habitats for different benthic communities dominated by particular fauna. However, it is worth noting that the analysis of single macrofauna replicates at each station could have led to an over-estimation of the macrofauna community variation due to the patchy nature of macrofauna species occurrences at the seabed, even within a single community type (Bibby HydroMap & Benthic Solutions, 2016).

Analysis of the infaunal and epifaunal communities indicated a dominance of infauna, with epifauna making up a minor part of the community within the Tyne survey area, as expected for a mobile sand-dominated habitat (Bibby HydroMap & Benthic Solutions, 2016). Epifauna recovered within grab samples included low numbers of the bryozoans *Flustra foliacea* and *Escharella immerse* in addition to the five species of cnidarian (Bibby HydroMap & Benthic Solutions, 2016).

3.3.2.5 Sensitivity of benthic fauna

The sensitivity of some of the benthic species found near to the Tyne development during the 2016 EBS were investigated using the Marine Life Information Network (MarLIN) sensitivity assessment tool. The assessment rationale involves judging the intolerance of a species to change in an external factor arising from human activities or natural events. The rationale then assesses the likely recoverability of the species following cessation on the human activity or natural event. Intolerance and recoverability are then combined to provide a meaningful assessment of their overall sensitivity to environmental change.

Four benthic species found near to the Tyne development have been assessed for their sensitivity to different criteria (Table 3-11). The polychaete *Magelona mirabilis* and the tubeworm *Owenia fusiformis* are most sensitive to substratum loss, while the brittlestar *Amphiura filiformis* is most sensitive to substratum loss and HC contamination and the catworm *Nephtys hombergii* is most sensitive to HC contamination (Table 3-11). All of these species have no or relatively low sensitivity to smothering, increased turbidity, increased suspended sediment, noise, abrasion and physical disturbance and contamination by HMs. Detailed sensitivity analysis was not available for the other species (MarLIN, 2016). Generally, polychaetes are known for their ability to be able to adapt to most conditions. While, the annelida *Notomastus latericeus* is reported to be intolerant to substratum loss, but tolerant to the presence of HCs (Hiscock et al., 2004).

Table 3-11: Sensitivity assessment of some benthic species found near to the Tyne development to external factors (MarLIN, 2016)

External factors	Benthic species			
	Brittlestar *Amphiura filiformis*	Polychaete *Magelona mirabilis*	Catworm *Nephtys hombergii*	Tubeworm *Owenia fusiformis*
Substratum Loss	moderate	moderate	low	moderate
Smothering	very low	not sensitive	not sensitive	low
Increase in Suspended Sediment	very low	not sensitive	not sensitive	not sensitive
Increase in Turbidity	very low	very Low	-	not sensitive
Noise	not sensitive	not sensitive	not sensitive	not sensitive
Abrasion and Physical Disturbance	very low	low	low	low
HM Contamination	low	-	low	not sensitive
Hydrocarbon Contamination	moderate	-	moderate	-
Substratum Loss	moderate	moderate	low	moderate
Smothering	very low	not sensitive	not sensitive	low
Increase in Suspended Sediment	very low	not sensitive	not sensitive	not sensitive

Note: '-' indicates No available information
PMF Amphiura filiformis, polychaetes, Glycera lapidum, Protodorvillea kefersteini, Echinocyamus pusillus, Bathyporeia elegans, Owenia fusiformi.

3.3.3 Fish Populations

Generally, there is little interaction between fish and offshore developments, although some species congregate around platforms and along pipelines. However, spawning individuals and juveniles can be sensitive to seismic activities, seabed disturbance activities, discharges to sea and, in some cases, accidental spills.

3.3.3.1 Fish and shellfish spawning and nursery areas

Cefas has published data on critical spawning and nursery grounds for selected fish species around the UK (Coull et al., 1998; Ellis et al., 2012). Data is based on historic and more recent ichthyoplankton trawls to identify key spawning, nursery habitats and species of interest. Spawning and nursery grounds are mapped according to ICES statistical rectangles. The Tyne infrastructure straddles two ICES Rectangles; 37F1 and 37F2. For the purpose of this report fish spawning and nursery areas within the blocks of interest have been identified according to whether they overlap with the boundary of ICES rectangles 37F1 and 37F2.

There are potential fish spawning areas in ICES rectangles 37F1 and 37F2 for cod (*Gadus morhua*), herring (*Clupea harengus*), lemon sole (*Microstomus kitt*), mackerel (*Scomber scombrus*), *Nephrops (Nephrops norvegicus)*, plaice (*Pleuronectes platessa*), sandeels (*Ammodytidae marinus*), sole (*Solea solea*), sprat (*Sprattus sprattus*) and whiting (*Merlangius merlangus*) (Table 3-12 and Figures 3-11 and 3-12) (Coull et al., 1998; Ellis et al., 2012).

A number of species, which have benthic eggs, have a dependency on specific substrata for spawning. For example, sandeels lay their eggs on sandy sediments and therefore may spawn on discreet sandy sediments within the blocks of interest. Such sediments would therefore be considered important for this species (BEIS, 2016). A number of other species, including some demersal species, have pelagic eggs and/or larvae including cod, haddock, Norway pout and saithe and are therefore less reliant on specific sediment types for spawning (BEIS, 2016).

In addition to the spawning grounds described above, the waters of ICES rectangles 37F1 and 37F2 also act as nursery areas for anglerfish (*Lophius piscatorius*), blue whiting (*Micromesistius poutassou*) cod, European hake (*Merluccius merluccius*), herring, mackerel, lemon sole, ling (*Molva molva*), *Nephrops*, sandeels, sprat, spurdog (*Squalus acanthias*), tope shark (*Galeorhinus galeus*) and whiting (Table 3-12 and Figures 3-11 and 3-12) (Coull et al., 1998; Ellis et al., 2012).

Juvenile fish are vulnerable to predators and harsh conditions in the open water. Therefore, it is typical for juvenile fish to stay in sheltered nursery grounds, which provide an abundance of food (BEIS, 2016).

Of the species that may be present within the blocks of interest at various times throughout the year, the majority are considered to be demersal species, i.e. species that spend most of their time at or near the seabed. These species include anglerfish (monkfish), European hake, lemon sole, ling, plaice, sandeels, sole, spurdog and whiting (FishBase, 2015). However, species such as cod, herring, spurdog, tope shark and whiting can also be regarded as benthopelagic species that move into mid-water periodically, and have been known to predate upon midwater species (DTI, 2001). In addition, sandeels remain buried in sandy sediments during the night and hunt for prey in mid-water during daylight hours and are therefore not a wholly demersal species (BEIS, 2016). Other species such as blue whiting, horse mackerel, mackerel and sprat are considered to be pelagic species i.e. species that spend most of their time in open water, away from the seabed (BEIS, 2016).

The 2016 EBS recorded the presence of *Soleas sp., Triglops sp.*, and sandeels in the vicinity of the Tyne development (Bibby HydroMap & Benthic Solutions, 2016).

Table 3-12: Fish and shellfish spawning and nursery areas within ICES Rectangle 37F1 and 37F2 (Coull et al., 1998 and Ellis et al., 2012)

Fish Species	J	F	M	A	M	J	J	A	S	O	N	D
Anglerfish[1]	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N
Cod	N	N	N	N	N	N	N	N	N	N	N	N
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Herring	N	N	N	N	N	N	N	N	N	N	N	N
Lemon sole	N	N	N	N	N	N	N	N	N	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel	N	N	N	N	N	N	N	N	N	N	N	N
Nephrops	N	N	N	N	N	N	N	N	N	N	N	N
Plaice												
Sandeels	N	N	N	N	N	N	N	N	N	N	N	N
Sole												
Sprat	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog[2]	N	N	N	N	N	N	N	N	N	N	N	N
Tope shark[2]	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	N	N	N	N	N	N	N	N	N	N	N

Key					
	Peak Spawning		Spawning	N	Nursery

[1] Insufficient data available on spawning grounds (*Ellis et al., 2012*)

[2] Viviparous species (gravid females can be found all year) (*Ellis et al., 2012*).

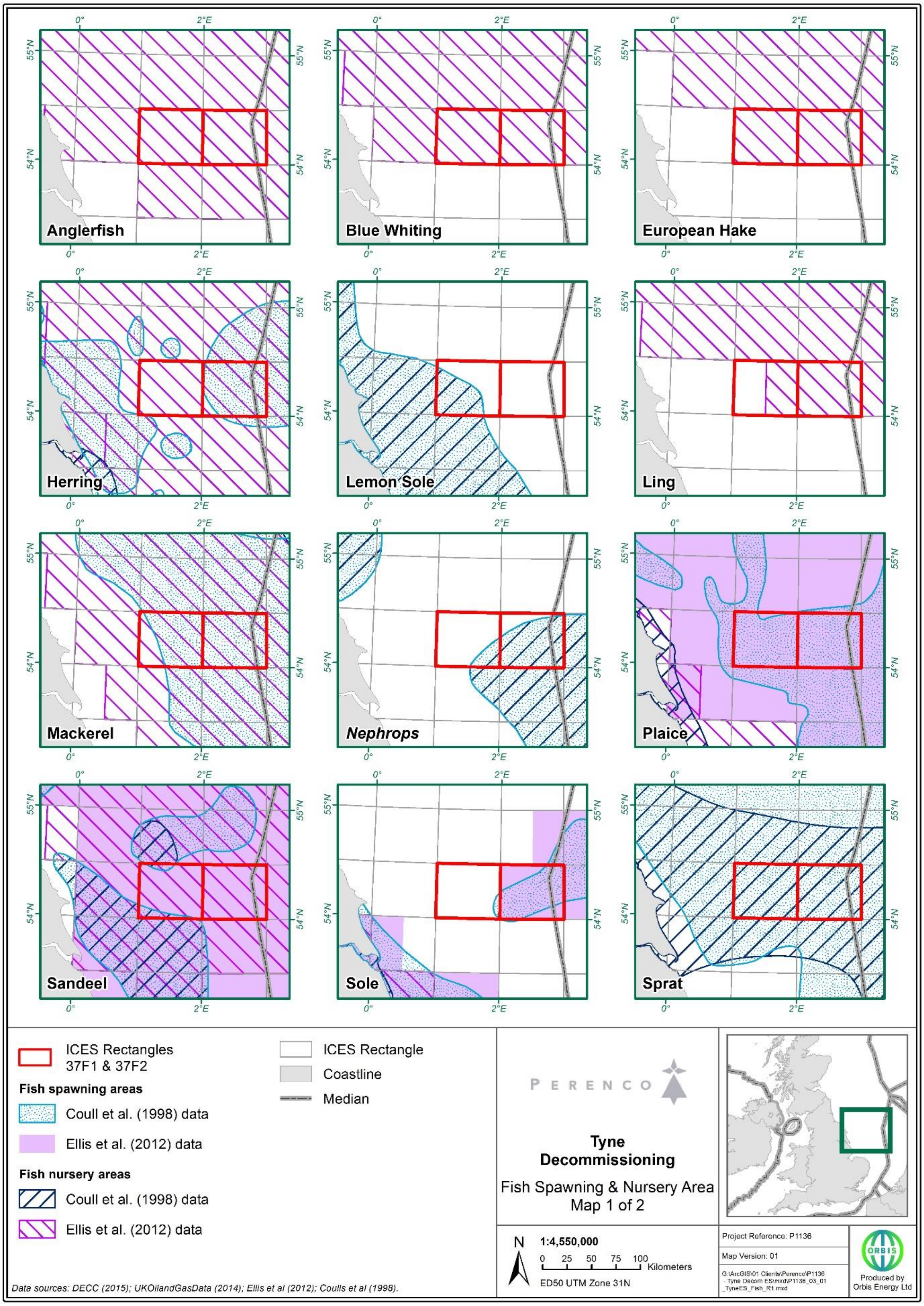


Figure 3-11: Fish and shellfish spawning and nursery areas in ICES Rectangles 37F1 and 37F2 (1 of 2)

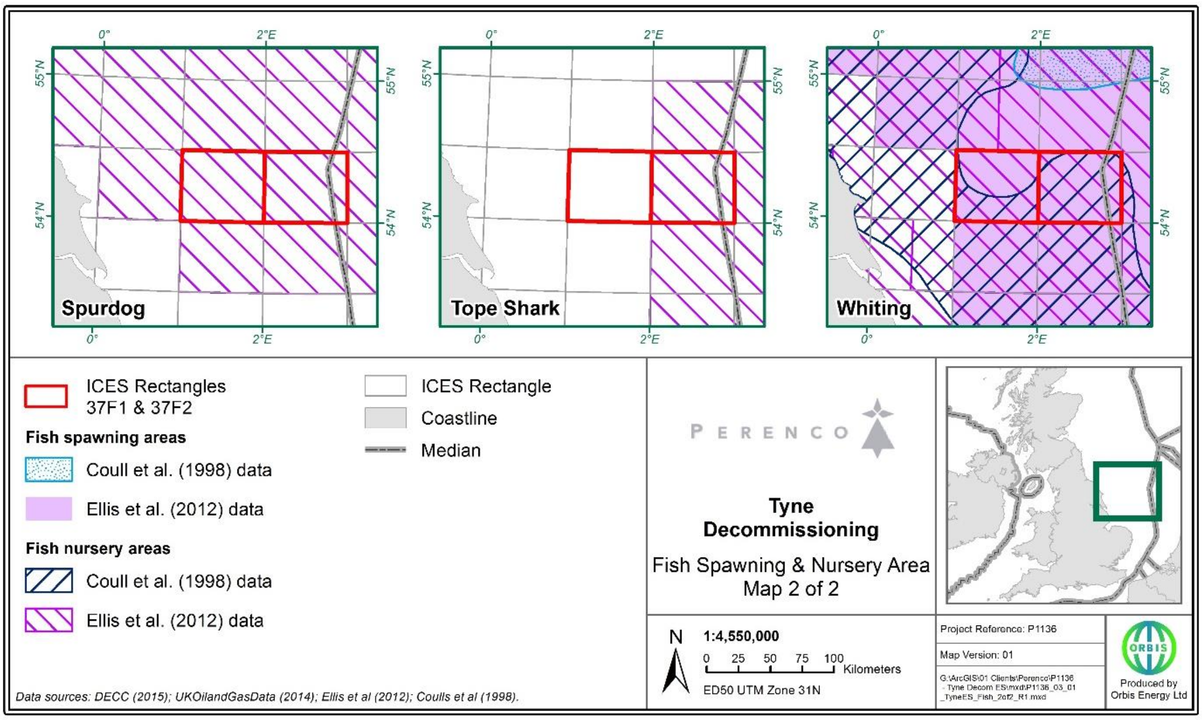


Figure 3-12: Fish and shellfish spawning and nursery areas in ICES Rectangles 37F1 and 37F2 (2 of 2)

Data outputs from Aires et al. (2014) provide a guide to the most likely locations for aggregations of fish during their first year. Age 0 group fish are defined as fish in the first year of their lives and can also be classified as juvenile. Table 3-13 presents the Age 0 fish areas recorded within the blocks of interest and ICES rectangles 37F1 and 37F2, as presented in Aires et al. (2014).

Table 3-13: Fish/ shellfish juvenile areas occurring within the blocks of interest and ICES rectangles 37F1 and 37F2

Species	Blocks	ICES rectangle 37F1	ICES rectangle 37F2
Herring	Medium	Medium	Medium
Horse mackerel	Low	Low	Medium
Mackerel	Medium	Low	Low
Plaice	Low	Low	Low
Sprat	Medium	Medium	Medium
Whiting	Medium	Medium	High
Key:			
Key: Age 0 Group Fish (probability) *Note: Bandings have been grouped based on the colour ramp provided in Aires et al. (2014) output layers, excluding blue colours*			

(dark green)	High	(light green)	Medium	(orange)	Low	(pale blue)	No Occurrence / data

Aires et al. (2014) indicates that the probability of Age 0 fish being present in blocks of interest is low for horse mackerel and plaice with medium for herring, mackerel, sprat and whiting (Table 3-13). The general probability of presence for Age 0 fish in the ICES Rectangles is low for horse mackerel, mackerel and plaice, medium for herring and sprat and high for whiting.

3.3.3.2 Shellfish

The benthic fauna of the UK waters is rich and diverse. An important component of this benthic fauna is a collection of molluscs and crustaceans loosely referred to as shellfish, a number of which are of commercial importance (See Section 3.4.1.). It is considered that the following species of shellfish may be present within the blocks of interest: *Nephrops*; brown crab (*Cancer pagurus*); brown shrimp (*Crangon crangon*), pink shrimp (*Pandalus montagui*); deep-water shrimp (*Pandalus borealis*); scallops (*Pecten maximus*); queen scallops (*Aequipecten opercularis*) and mussels (*Mytilus edulis*) (BEIS, 2016).

The 2016 EBS recorded the presence of shellish including masked crab (*Corystes cassivelaunus*), hermit crab, *Carcinus sp.,* and *Balanus sp.* (Bibby HydroMap & Benthic Solutions, 2016).

3.3.3.3 Elasmobranch species

The elasmobranch subclass is comprised of sharks, skates and ray species. These species are characterised by slow growth, late maturation and low reproduction rate, making them susceptible to fishing impacts, often as bycatch, and are slow to recover from population loss. Due to the vulnerability of elasmobranch fish, conservation efforts and management plans to conserve elasmobranchs are currently underway. However, at present, only the basking shark (*Cetorhinus maximus*) and angel shark (*Squatina squatina*) are listed under the Wildlife and Countryside Act (1981), the latter only protected in respect to English and Welsh waters out to six nautical miles.

The area in the vicinity of the blocks of interest has been identified as a nursery ground for spurdog and tope shark, which could be found all year round (Ellis et al., 2012).

Surveys of the distribution of elasmobranchs in UK waters have also been undertaken by Ellis et al. in 2005. Species which have been recorded in the southern North Sea at various times throughout the year and may therefore be present in the vicinity of the blocks of interest include spurdog, lesser spotted dogfish (*Scyliorhhinus canicula*), tope shark, starry smooth hound (*Mustelus asterias*), Starry hound (*Amblyraja radiata*), Cockoo ray (*Leucoraja naevus*), Thornback ray (*Raja clavata*) and Spotted ray (*Raja montagui*).

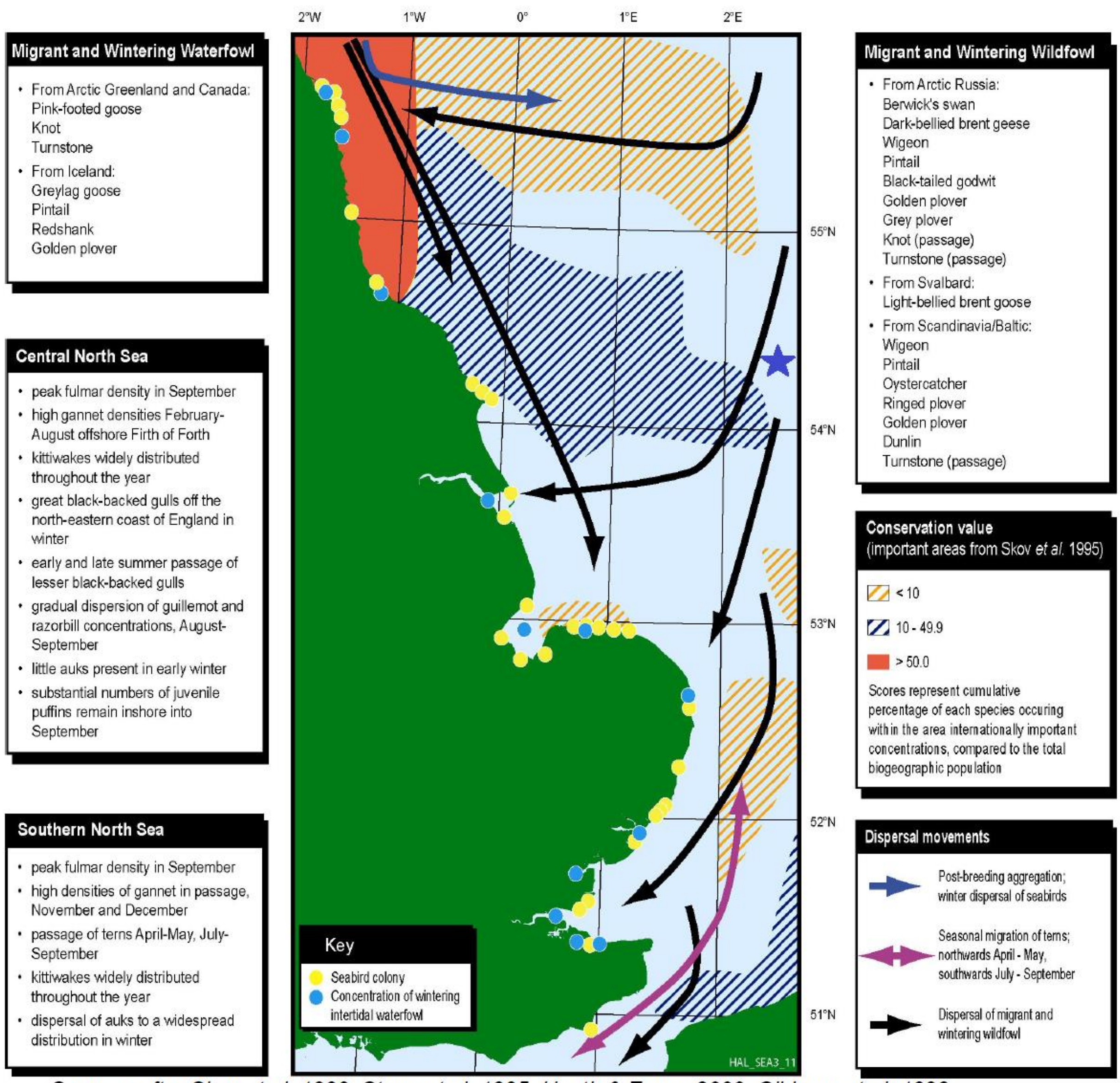
3.3.4 Seabirds

Seabirds are defined as birds which frequent coastal waters and the open ocean (Lawrence, 2000). The UK is globally important for seabirds, supporting breeding populations of 25 species with a further 13 regularly occurring, passage or overwintering species and a number of more irregularly occurring species. With over seven million breeding seabirds, the UK has the largest populations of 15 species in Europe. These include: fulmars (*Fulmarus glacialis*), Manx shearwaters (*Puffinus puffinus*), gannets (*Morus bassanus*), Leach's petrels (*Oceanodroma leucorhoa*), shags (*Phalacrocorax aristotelis*), Arctic skuas (*Stercorarius parasiticus*), great skuas (*Stercorarius skua*), lesser black-backed gulls (*Larus fuscus*), herring gulls (*Larus argentatus*), great black-backed gulls (*Larus marinus*), kittiwakes (*Rissa tridactyla*), guillemots (*Uria aalge*), razorbills (*Alca torda*), black guillemots (*Cepphus grille*) and puffins (*Fratercula arctica*) (WWT, 2013).

In the southern North Sea, seabird distribution and abundance occurs throughout the year. Seabirds in offshore areas generally contain peak numbers of birds following the breeding season and throughout winter months (BEIS, 2016).

Fulmar are present in highest numbers in the southern North Sea during the early and late breeding seasons, leading to peak densities in September. Kittiwakes are widely distributed throughout the year. Lesser black-backed gulls are mainly summer visitors, while in contrast guillemot numbers are present in greatest numbers during winter months. In addition, substantial numbers of terns migrate northwards through the offshore North Sea in April and May, with return passage from July to September (DECC, 2009).

Figure 3-13 shows the seasonal distribution of seabirds in the vicinity of the Tyne installation. It indicates that the Tyne infrastructure is in close proximity to an area of moderate importance for international concentrations of birds, supporting 10 to 49.9% of the biogeographic population (DTI, 2002).



Source: after Skov et al. 1990, Stone et al. 1995, Heath & Evans 2000, Gibbons et al. 1993

Figure 3-13: The broadscale seasonal distribution and movements of birds in the North Sea (DTI, 2002)
Note: the blue star marks approximate location of the Tyne installation

Along the adjacent English coastline to the blocks of interest, there are a number of important sites for breeding and wintering birds. These sites include:

- North Norfolk Coastline Special Protection Area (SPA) and Ramsar Site (approximately 189 km to the southwest of the Tyne installation);
- Outer Thames Estuary SPA (approximately 202 km to the south of the Tyne installation);
- Wash SPA and Ramsar Site (approximately 207 km to the southwest of the Tyne installation);
- Gibraltar Point SPA and Ramsar Site (approximately 204 km to the southwest of the Tyne installation);
- Humber Estuary SPA and Ramsar Site (approximately 179 km to the southwest of the Tyne installation); and
- Flamborough Head and Bempton Cliffs SPA (approximately 184 km to the west southwest of the Tyne installation).

An overview of the seasonal distribution of the key seabirds in the vicinity of the blocks of interest is provided in Table 3-14. Species which are present throughout the year, albeit in varying densities, are fulmar, gannet, kittiwake and guillemot. Densities of fulmar are very high (>5 individuals per km^2) from January to February and May to October, while densities of kittiwake are very high from September to November, January to March and in May and July. Guillemot densities are very high between April and May and September to December. Gannet densities are at their peak between January and March. Other species that reach very high densities are the herring gull and great black-backed gull from November to January (Table 3-14; UKDMAP, 1998).

Other frequent visitors to this area (present for six months of the year or more) include great skua, Sabine's gull (*Xema sabini*), common gull (*Larus canus*), lesser black-backed gull, herring gull, great black-backed gull, razorbill and puffin. The abundance of puffin peak at high (up to five individuals per km^2) in March. Generally, it appears that the greatest number of seabird species are present, in the vicinity of the blocks of interest, during the last quarter of the year (Table 3-14; UKDMAP, 1998).

Table 3-14: Seasonal distribution of seabirds in and around blocks of interest (UKDMAP, 1998)

Bird Species	J	F	M	A	M	J	J	A	S	O	N	D
Black-throated diver	Very Low											
Fulmar	Peak	Peak	Moderate	Moderate	Peak	Peak	Peak	Peak	Peak	Peak	Moderate	Moderate
Sooty shearwater									Low	Low		
Leach's storm-petrel											Low	
Gannet	Moderate	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low	Low
Velvet scoter											Low	Low
Pomarine skua											Very Low	
Arctic skua								Very Low				
Great skua	Very Low			Very Low			Very Low	Very Low		Very Low	Very Low	
Sabine's gull	Moderate	Moderate	Moderate	Moderate			Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Little gull									Very Low	Very Low	Low	Very Low
Common gull	Very Low	Very Low			Very Low		Very Low	Very Low		Very Low	Very Low	
Black-headed gull							Very Low				Very Low	
Lesser black-backed gull				Moderate	Low	Low		Low	Low	Low		Low
Herring gull	Peak	Moderate	Low	Low	Low				Low		Peak	Peak
Great black-backed gull	Peak	Moderate	Moderate	Moderate	Low			Low	Moderate	Moderate	Peak	Peak
Kittiwake	Peak	Peak	Peak	Moderate	Peak	Low	Peak	Moderate	Peak	Peak	Peak	Moderate
Guillemot	Moderate	Moderate	Moderate	Peak	Peak	Moderate	Moderate	Moderate	Peak	Peak	Peak	Peak
Razorbill	Low	Low	Low	Moderate	Low		Low		Low	Moderate	Low	Moderate
Little auk	Moderate	Very Low	Very Low								Very Low	Moderate
Puffin	Low	Low	Moderate	Low	Low				Low	Low	Low	Low

Key: Peak | Moderate | Low | Very Low | No Occurrence / data (blank)

The species listed in Table 3-14 are supported by survey data collected for Forewind's Dogger Bank wind farms development, located approximately 32 km to the north northwest of the Tyne infrastructure (Forewind, 2014a). Boat-based surveys were conducted between January 2010 and June 2012 and aerial surveys were conducted between spring 2010 and the beginning of summer 2012 for this project. In addition, the data indicated that twelve seabird species (Arctic skua, puffin, kittiwake, guillemot, great black-backed gull, great skua, lesser black-backed gull, little auk (*Alle alle*), fulmar, gannet, razorbill and white-billed diver (*Gavia adamsii*)) use the offshore areas in the vicinity of the Dogger Bank wind farm development in significant numbers (Forewind, 2014a). Oil and Gas UK has commissioned HiDef, a consultancy specialising in a digital aerial video and image analysis, to produce the Seabirds Oil Sensitivity Index (SOSI), a tool designed to aid planning and emergency decision making with regards to oil pollution (Webb et al., 2016). SOSI identifies sea areas with highest likelihood of seabirds becoming sensitive to oil pollution. It is derived from 1995 to 2015 seabird survey data, extending beyond UKCS and is based upon following factors (Certain et al., 2015):

- habitat flexibility (an ability of species to relocate to alternative feeding ground);
- adult survival rate;
- potential annual productivity; and
- proportion of the biogeographical population in the UK.

Table 3-15: Seabirds sensitivity to oiling in and around the Tyne facilities UKCS blocks of interest.

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
43/14	2	5	5	5	3	3	1	3	4	4	2	2
43/15	2	5	5	5	5	5	1	4	4	4	2	2
44/11	1	5	5	5	5	5	1	5	5	5	1	1
44/12	1	5	5	5	5	5	4	5	5	5	1	1
44/13	ND	5	5	5	5	5	5	5	5	5	ND	1
44/14	ND	4	4	4	5	5	4	5	5	5	ND	1
43/18	1	5	5	5	2	2	2	2	3	3	1	1
43/19	2	5	5	5	3	3	1	2	3	3	2	2
43/20	**2**	**5**	**5**	**5**	**4**	**4**	**1**	**3**	**4**	**4**	**2**	**2**
44/16	**2**	**5**	**5**	**5**	**5**	**5**	**1**	**4**	**5**	**5**	**2**	**2**
44/17	**3**	**5**	**5**	**5**	**5**	**5**	**3**	**4**	**5**	**5**	**3**	**3**
44/18	**3**	**5**	**5**	**5**	**5**	**5**	**4**	**5**	**5**	**5**	**3**	**3**
44/19	1	5	5	5	5	5	4	5	5	5	1	1
43/23	1	5	5	5	2	2	2	3	2	2	1	1
43/24	**2**	**5**	**5**	**5**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**
43/25	**2**	**5**	**5**	**5**	**4**	**4**	**1**	**2**	**3**	**3**	**2**	**2**
44/21	2	5	5	5	4	4	1	3	5	5	2	2
44/22	3	5	5	5	5	5	2	3	5	5	3	3
44/23	3	5	5	5	5	5	3	5	5	5	3	3
44/24	3	5	5	5	5	5	1	5	5	5	3	3
43/28	1	5	5	5	3	3	1	4	1	1	1	1
43/29	2	5	5	5	3	3	1	4	2	2	2	2
43/30	2	5	5	5	2	2	1	4	3	3	2	2
44/26	2	5	5	5	3	3	1	4	5	5	2	2

KEY	
1	Extremely High Seabirds Sensitivity
2	Very High Seabirds Sensitivity
3	High Seabirds Sensitivity
4	Medium Seabirds Sensitivity
5	Low Seabirds Sensitivity
ND	No Data

Source: Webb et al. (2016). Note: UKCS Blocks in bold are the blocks of interest. Values in purple are interpolated from adjacent months.

The seabird sensitivity to oil pollution in the blocks of interest and in surrounding blocks varies from low to extremely high throughout the year (Oil & Gas UK, 2016). The most sensitive times of year for birds in the Tyne area are June to September and December, with high to extremely high sensitivity noted within Blocks

44/16, 44/17, 44//18, 43/20, 43/24 and 43/25 (Table 3-15). The periods of very high to extremely high sensitivity can be attributed to moulting of some of the species and foraging or feeding behaviour (DTI, 2001).

3.3.5 Marine Mammals

A description of the marine mammals present in the area of interest is fully described in the sub-sections below.

3.3.5.1 Cetaceans

Cetaceans are protected under Annex IV of the Council Directive 92/43/European Economic Community (EEC), which obliges member states to maintain or restore species of community interest to favourable conservation status (FCS), as well as establish effective management and monitoring strategies to ensure the reduced risk of significant negative impact on the species concerned (Baxter et al., 2011).

Compared to the central and northern North Sea, the southern North Sea has a relatively low density of marine mammals, in general, with the exception of harbour porpoise (*Phocoena phocoena)*. While over ten species of cetacean have been recorded in the southern North Sea, only harbour porpoise and white-beaked dolphin (*Lagenorhynchus albirostris)* can be considered as regularly occurring throughout most of the year, and minke whale (*Balaenoptera acutorostrata*) as a frequent seasonal visitor. Bottlenose dolphin (*Tursiops truncatus)*, Atlantic white-sided dolphin (*Lagenorhynchus acutus*) and long-finned pilot whale (*Globicephala melas*) can be considered uncommon visitors (BEIS, 2016).

Data from the Cetaceans Atlas (Reid et al., 2003) in conjunction with data from UKDMAP (1998) records observations of the Minke whale, long-finned pilot whale, bottlenose dolphin, common dolphin (*Delphinus delphis*), white-beaked dolphin, white-sided dolphin and harbour porpoise in the blocks of interest and the surrounding UKCS Quadrants. These species may be present during various times of the year (Table 3-16). Their overall presence is considered to be low, with the exception for the harbour porpoise in August and white-beaked dolphin in April and May when abundance has been recorded as 'very high'.

Table 3-16: Cetacean sightings in the vicinity of the Tyne development (in blocks of interest and surrounding UKCS Quadrants) (Reid et al., 2003 and UKDMAP, 1998)

Cetacean	J	F	M	A	M	J	J	A	S	O	N	D
Minke whale	No Sightings	No Sightings	No Sightings	No Sightings	Low	Low	Moderate	Low	Low	Low	No Sightings	No Sightings
Long-finned pilot whale	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	Low	No Sightings	No Sightings	No Sightings	No Sightings
Bottlenose dolphin	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	Low	No Sightings
Common dolphin	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	No Sightings	Low	No Sightings	Moderate	No Sightings	No Sightings	No Sightings
White-beaked dolphin	Low	High	Low	Very High	Very High	Moderate	High	Moderate	Low	High	High	Low
Atlantic white-sided dolphin	No Sightings	No Sightings	No Sightings	No Sightings	High	No Sightings	Low	Low	Low	No Sightings	No Sightings	No Sightings
Harbour porpoise	No Sightings	Moderate	High	Low	High	High	Low	Very High	High	Low	High	Moderate

Key				
Very High ≥ 0.5 animals per km	High (0.2 to 0.49 animals per km)	Moderate (0.10 to 0.19 animals per km)	Low (0.01 to 0.09 animals per km)	No Sightings

Harbour porpoise and bottlenose dolphin are listed under Annex II of the European Commission (EC) Habitats and Species Directive as species whose conservation requires the designation of SACs. Five offshore candidate SACs (cSACs) and one inshore cSAC with marine components have been put forward for the management of harbour porpoise populations in UK waters (JNCC, 2017a). These cSAC sites have been identified within the North, Irish and Celtic Seas, encompassing areas that represent the physical and biological factors essential to harbour porpoise. The blocks of interest lie within the Southern North Sea cSAC designated for harbour porpoise (Figure 3-15).

3.3.5.2 Pinnipeds

Two species of pinnipeds (or seals) are found around the English coast:

- Grey seal (*Halichoerus grypus*); and
- The harbour (or common) seal (*Phoca vitulina*).

Both the harbour seal and the grey seal are listed under Annex II of the EC Habitats and Species Directive as species whose conservation requires the designation of SACs. In addition, both harbour and grey seals are protected under the Conservation of Seals Act 1970. Both species are regarded as being of Least Concern in terms of threats to their populations (IUCN, 2017).

<u>Grey Seals</u>

The northeast Atlantic contains approximately half of the world's population of grey seals with, approximately, 38% occurring in the UK. The population size within UK waters is estimated at 111,600 (BEIS, 2016). Approximately 88% of the UK population of grey seals breed in Scotland, mainly in the Hebrides and Orkney. Major colonies are also present on Shetland and the east coast of Scotland (BEIS, 2016).

Grey seals spend most of the year at sea and travel long distances between haul out sites and range widely in search of prey (BEIS, 2016). The majority of the grey seal population will be on land for several weeks from October to December during the pupping and breeding seasons, and again in February and March during the annual moult. Densities of grey seals offshore are likely to be lower during these periods (BEIS, 2016).

Figure 3-14 shows the habitat utilisation of grey seals. Although more frequently found in coastal waters, grey seals have been tracked further offshore around the UK, (particularly compared to harbour seals). However, their density within the vicinity the Tyne infrastructure is low to moderate with blocks ranging from 0 to 100 individuals per 25 km^2) (NMPI, 2018) and therefore it is considered that grey seal would be infrequent visitors to the area (Jones et al., 2015).

<u>Harbour seals</u>

Harbour (common) seals are one of the most widespread pinnipeds with almost circumpolar distribution in the Northern Hemisphere. Within UK waters they belong to a European sub-species, which mainly occur in UK, Icelandic, Norwegian, Swedish, Danish, German and Dutch waters. With approximately 30% of this population occurring in UK waters (BEIS, 2016). The harbour seal strongholds within the UK are Shetland, Orkney, the east coast of the Outer Hebrides, most of the Inner Hebrides and the west coast of Scotland, the Moray Firth and the Firth of Tay. Harbour seal counts in the UK are estimated at a minimum of 28,000 animals, the vast majority of which are found in Scotland (BEIS, 2016). Harbour seals haul out on tidally exposed areas of rock, sandbanks or mud. Pupping occurs on land between June and July, and the moult between August and September (BEIS, 2016).

Tracking of seals suggests they make feeding trips lasting two to three days, travelling less than 40 km from their haul-out sites and ultimately returning to the same haul-out site from which they departed (Johnston et al., 2002). Grey seals may spend more time further offshore than harbour seals. Both grey and harbour seals are listed in Annex II of the Habitats Directive (Section 3.3.6.4).

Figure 3-14 shows that the density of harbour seals in the waters around the Tyne infrastructure is low (less than one individual per 25 km^2) and therefore it is considered that harbour seals would be infrequent visitors to the area (NMPI, 2018).

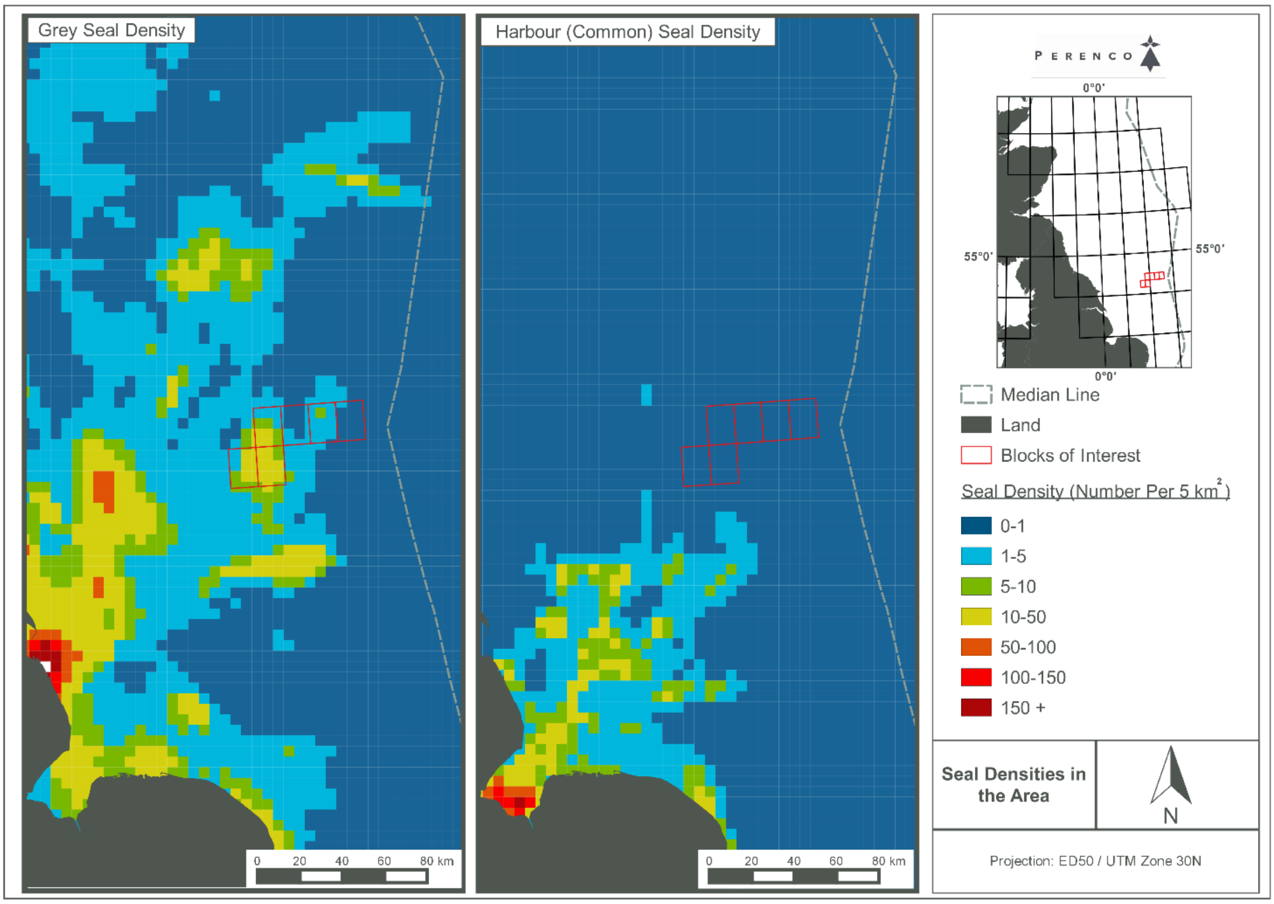


Figure 3-14: Estimated pinniped density in the vicinity of the Tyne development (NMPI, 2018)

3.3.6 Offshore Conservation Areas

A description of the main offshore conservation areas to the Tyne Field are described in the sub-sections below.

3.3.6.1 UK Marine and Coastal Access Act 2009

The UK MCAA provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place a new system for improved management and protection of the marine and coastal environment (JNCC, 2017b).

Powers in the Marine Act allow the creation of a new type of Marine Protected Area (MPA), called a Marine Conservation Zone (MCZ). MCZs will protect a range of nationally important marine wildlife, habitats, geology, and geomorphology. They can be designated anywhere in English and Welsh territorial and UK offshore waters (JNCC, 2017c).

A network of well-managed MPAs is being established to meet national objectives as well as the European MSFD, Convention on Biological Diversity and the requirements of the OSPAR Convention to deliver an ecologically coherent MPA network in the North East Atlantic.

As of December 2017, there are 56 MCZs in English offshore waters. There are currently no designated MCZs within 40 km of the Tyne installation and pipelines. Conservation areas in the vicinity of the blocks of interest are shown in Figure 3-15. European Marine Sites giving legal protection to species and habitats of European importance (Defra et al., 2015). In addition, Ramsar sites also contribute to the existing UK MPA network. These sites were established under the 1971 Convention of Wetlands of International Importance to promote the conservation and wise-use of wetlands of international importance and their resources.

3.3.6.2 *The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (As Amended)*

The EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Flora and Fauna (the Habitats Directive), and the EC Directive 79/409/EEC on the Conservation of Wild Birds (the Birds Directive), are the main instruments of the EU for safeguarding biodiversity.

The Habitats Directive includes a requirement to establish a European network of important high quality conservation sites that will make a significant contribution to conserving the habitat and species identified in Annexes I and II of the Directive. Habitat types and species listed in Annexes I and II are those considered to be in most need of conservation at a European level (JNCC, 2016). The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (As Amended) implements the EC Habitats Directive (92/43/EEC) in UK Law. These regulations apply to UK waters and to the UK offshore waters (UKCS).

The UK government, with guidance from JNCC and the Department of Environment, Food and Rural Affairs (Defra), has statutory jurisdiction under the EC Habitats Directive to propose offshore areas or species (based on the habitat types and species identified in Annexes I and II) to be designated as SAC. These designations have not yet been finalised, but will be made to ensure that the biodiversity of the area is maintained through conservation of important, rare or threatened species and habitats of certain species.

In relation to UK offshore waters, three habitats from Annex I and four species from Annex II of the Habitats Directive are currently under consideration for the identification of SACs in UK offshore waters (JNCC, 2017d; Table 3-17).

Table 3-17: Annex I habitats and Annex II species occurring in UK Offshore Waters (JNCC, 2017d)

Annex I habitats considered for SAC selection in UK offshore waters	Species listed in Annex II known to occur in UK offshore waters
Sandbanks which are slightly covered by seawater all the time Reefs (bedrock, biogenic and stony) • Bedrock reefs – made from continuous outcroppings of bedrock which may be of various topographical shape; • Stony reefs – these consist of aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces; and • Biogenic reefs – formed by cold water corals (e.g. *Lophelia pertusa*) and *Sabellaria spinulosa*. Submarine structures made by leaking gases	• Grey seal • Harbour (common) seal • Bottlenose dolphin • Harbour porpoise

3.3.6.3 *Annex I habitats*

There are currently 18 designated SACs, six candidate SACs (cSACs) and one cSAC/ Sites of community Importance (SCIs) within UK offshore waters). cSACs are sites that have been submitted to the EC, but not yet formally adopted and SCIs are sites that have been adopted by the EC but not yet formally designated by the government of each country (JNCC, 2017e and f). The Dogger Bank SAC overlaps most of the blocks of interest.

With reference to the Annex I habitats listed in Table 3-17 only “sandbanks slightly covered by seawater all the time” are recorded in the vicinity of the blocks of interest.

3.3.6.4 *Annex II species*

With reference to the Annex II species listed in Table 3-17, all four species (harbour porpoise, bottlenose dolphin, grey seals and harbour seals) have been sighted within Quadrants 43 and 44 and surrounding quadrants.

There are no fully designated offshore SACs within 40 km of blocks of interest for which any of the Annex II species have been selected for protection. However, blocks of interest are located within the Southern

North Sea cSAC that has been proposed for the management of harbour porpoise populations in UK waters (JNCC, 2017a).

Harbour porpoise

Harbour porpoises are highly mobile and well distributed around the UK, with the exception of the English Channel and south-east of England (Reid et al., 2003). Numbers of harbour porpoise in the southern North Sea declined during the twentieth century, but there is evidence of recent return to the area, for example Camphuysen (2004) and Thomsen et al., (2006). Sightings from shipboard and aerial surveys in the North Sea indicate that harbour porpoises are widely and almost continuously distributed, with important concentrations in the central North Sea, along the Danish and northern German coasts (Donovan and Bjørge, 1995; Hammond et al., 2002; IWC, 1996).

The seasonal movements and migratory patterns of harbour porpoises in the North East Atlantic and North Sea are not well understood. Porpoises may reside within an area for an extended period of time. However, onshore/ offshore migrations and movements parallel to the shore are thought to occur (Bjørge and Tolley, 2002). In the North Sea, there may be a general westward movement from the eastern North Sea and possibly from the very northern areas of the North Sea into the western edge of the northern North Sea (along the east coast of Scotland) during April to June and a further influx to the northern North Sea during July to September (Northridge et al., 1995). These seasonal movements are thought to coincide with the calving and mating seasons, respectively.

There is limited information available on the overall distribution and abundance of this species in UK waters. However, during the 2016 SCANS III surveys, sightings of harbour porpoises were widely distributed throughout the North Sea and adjacent waters, Irish Sea and around the Scottish coast (Hammond et al., 2017).

The harbour porpoise abundance estimate in the entire North Sea from the SCANS III surveys conducted in July 2016 is 345,000. During the SCANS III surveys, harbour porpoise density was highest in the south central North Sea and coastal waters of northeast Denmark (~1.1 animals/ km2), elsewhere there was variation in porpoise density from 0.2 to 0.9 animals/ km2 (Hammond et al., 2017). Numbers of porpoise present in UK waters vary seasonally and more animals are likely to pass through UK waters than are present at any one time (JNCC, 2017j). The abundance of harbour porpoise in the area of the Tyne Development varies from low to high, and from low to very high in the surrounding quadrants throughout the year (UKDMAP, 1998; Reid et al., 2003).

As a result, five cSACs (Bristol Channel Approaches, North Anglesey Marine, North Channel, Southern North Sea and West Wales Marine) have been submitted for the management of harbour porpoise populations in UK Waters (JNCC, 2017a). These cSAC sites have been identified within the North, Irish and Celtic Seas, encompassing areas that represent the physical and biological factors essential to harbour porpoise. The blocks of interest are located within the east of the Southern North Sea cSAC (JNCC, 2017g).

Bottlenose dolphin

The other Annex II species sighted within the area of the blocks of interest is the bottlenose dolphin. During the SCANS III surveys in July 2016, bottlenose dolphins were encountered around the coasts of Britain, Ireland, France, Spain and Portugal. They were also sighted in outer shelf waters off Scotland and Ireland and in the Celtic Sea. The total abundance of bottlenose dolphins for the entire SCANS III survey area (i.e. the North Sea and beyond) is estimated to be 27,697 (Hammond et al., 2017).

Three SACs have been designated for bottlenose dolphin within UK territorial waters; Cardigan Bay; the Moray Firth and Lleyn Peninsula; and the Sarnau. According to the existing analysis of bottlenose dolphins' data, it is not currently possible to identify suitable SACs in the UK offshore waters (JNCC, 2017a).

In the North Sea, bottlenose dolphins are most frequently sighted within 10 km of land and are rarely sighted outside coastal waters. It is possible, however, that some inshore dolphins move offshore during the winter months. According to UKDMAP, bottlenose dolphins have been sighted in within and adjacent to Quadrants 43 and 44 in low numbers (UKDMAP, 1998).

Grey and harbour seals

Grey and harbour seal sensitivities are outlined in Section 3.3.5.2.

3.3.6.5 Summary of Protected Areas

Table 3-18 summarises the protected areas with 40 km of the Tyne infrastructure and Figure 3-15 shows the location of the Tyne infrastructure in relation to the protected areas around it. These three sites are described further below.

Table 3-18: Marine protected areas within 40 km of the Tyne development (JNCC, 2017e)

Site name	Designation	Distance from Tyne development	Features of interest
Dogger Bank (UK)	SAC[1]	Overlaps Boundary	This site is designated for the presence of Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' (1110).
Southern North Sea (UK)	cSAC[2]	Within boundary	This site is a candidate for designation for the Annex II species harbour porpoise.
Doggersbank (Netherlands)	SCI	20 km east	This site is designated for the presence of Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' (1110) and Annex II species Harbour porpoise, Harbour seal and Grey seal.
Klaverbank (Netherlands)	SCI	35 km south east	This site is designated for the presence of Annex I habitat 'Reefs' (1170).

[1] SAC = Special Area of Conservation
[2] cSAC = candidate Special Area of Conservation (consultation announced January 2017)

Dogger Bank SAC (UK)

The Tyne installation and approximately 42 km of the Tyne export pipeline and MEG line lies within the Dogger Bank SAC and (Figure 3-15).

The Dogger Bank is considered to be a unique ecological region, unlike anywhere else in the North Sea. Its exposed location in open waters means it is subjected to substantial wave energy, which prevents the colonisation of the sand by vegetation on the top of the bank. The sediments range from coarse sands with shell fragments on top of the bank to muddy sands at greater depths. The benthic community supported by these sediments is typified by: polychaete worms, amphipods, small clams, hermit crabs, flatfish, starfish and brittlestars. Sandeels, which are an important prey source for fish, seabirds and cetaceans are present in the area, and the area is known as an important location for harbour porpoise, grey and common seals, however these are non-qualifying features of the site (JNCC, 2017g).

The Dogger Bank region is also an important location for the North Sea harbour porpoise population and as such they are included as a non-qualifying feature. Grey and common seals are known to visit the bank and are included as non-qualifying features at the site (JNCC, 2017g).

The Dogger Bank is designated within the UK as a MPA under the OSPAR convention for the presence of habitat type, 'Sandbanks which are slightly covered by sea water all the time'. Within the UK, the Dogger Bank sandbank habitat occupies a minimum area of 177,448 ha and a maximum area of 1,233,115 ha (based on the area of Annex I sandbank habitat enclosed by the Dogger Bank site boundary, this is also the area covered by the SAC) (JNCC, 2011b).

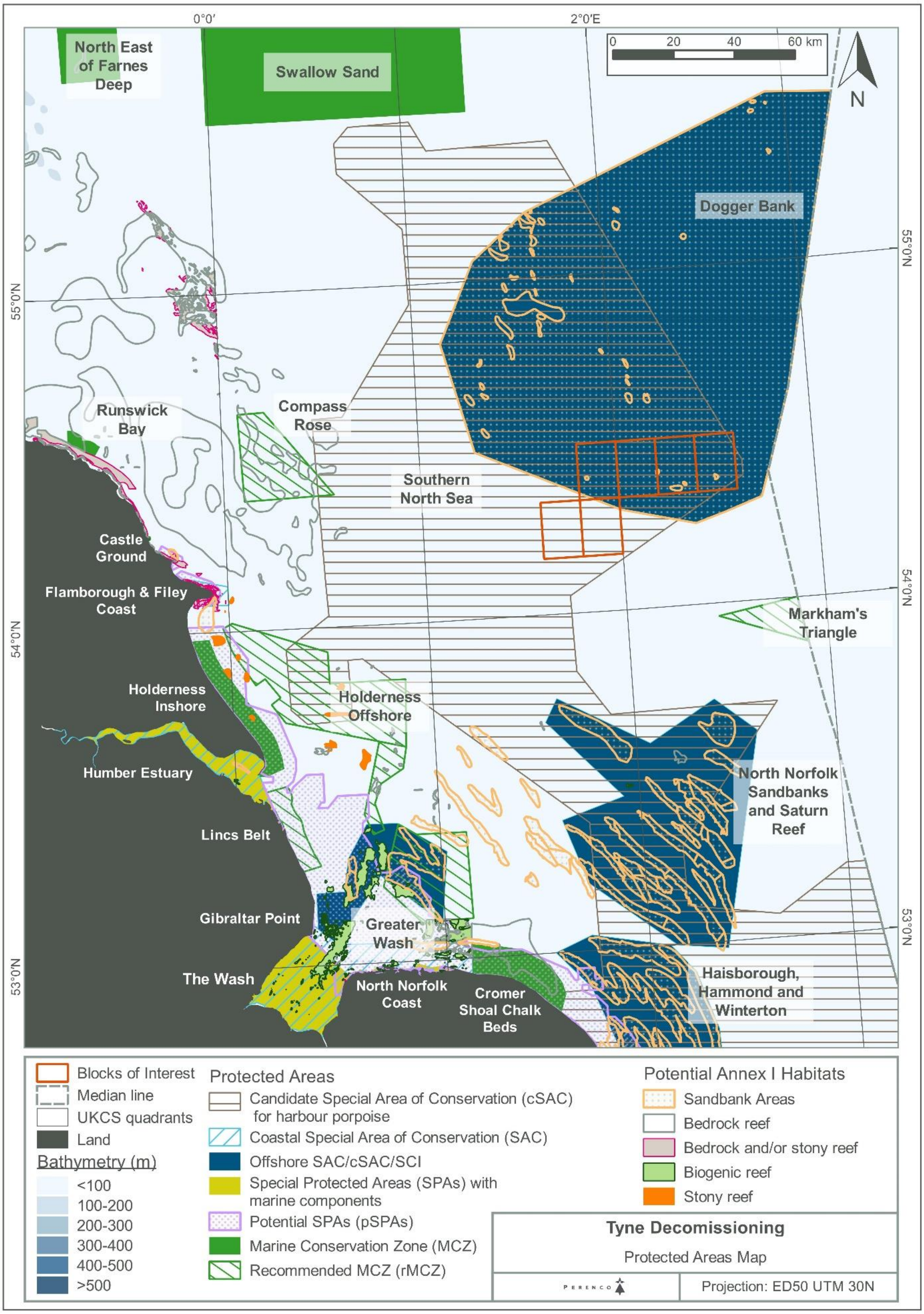


Figure 3-15: Marine and coastal protected areas in the vicinity of the Tyne development

The conservation objective for the Dogger Bank SAC is, subject to natural change, to restore the Annex I "Sandbanks which are slightly covered by seawater all the time" habitat to favourable condition. JNCC (2017g) outline this as maintaining or restoring:

- The natural environmental quality;
- The natural environmental processes and the extent; and
- The physical structure, diversity, community structure and typical species, representative of sandbanks which are slightly covered by seawater all the time, in the southern North Sea.

Due to the activities of demersal fishing and the oil and gas infrastructure development in the area, and the known associated damage to the seabed, the Annex I feature may not be in favourable condition and might require restoration where possible. JNCC (2017g) note that, at present, it is not possible to ascertain precisely the degree to which the feature has been damaged, and the extent to which restoration might be required.

Southern North Sea cSAC (UK)

The Tyne infrastructure lies within the northern half of the Southern North Sea cSAC (Figure 3-16). This cSAC has been identified as an area of importance for the Annex II species harbour porpoise, due to predicted persistent high densities of the species (JNCC, 2017h).

The Southern North Sea cSAC covers an area of 36,958 km^2 stretching from the central North Sea north of the Dogger Bank southwards to the Strait of Dover. The water depths within the site range from 10 m to 75 m, although the site is generally of a depth of about 40 m. The majority of the substrate types within the site are categorised as sublittoral sand and sublittoral coarse sediment (JNCC, 2017i).

Approximately two thirds of the site, the northern part within which the Tyne infrastructure is located, is recognised as important for porpoises during the summer season, whilst the southern part is more important during the winter (JNCC, 2017i).

The conservation objective for the Southern North Sea cSAC is "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 FCS for the UK harbour porpoise" (JNCC, 2017h).

It is assumed that the preference for the habitats within the Southern North Sea cSAC is associated with good feeding opportunities and prey aggregations. However, until more characteristics is known about the prey species of the harbour porpoise (including their habitat preferences), it cannot be further defined whether the quality of the habitat within the site is good or excellent (IAMMWG, 2015).

Disturbance of harbour porpoise generally, but not exclusively, originates from activities that cause underwater noise and may lead to harbour porpoises being displaced from the area affected. Therefore, activities within the Southern North Sea cSAC should be managed to ensure that any disturbance is minimised.

3.3.7 Potential Annex I Habitats in the Vicinity of the Tyne Infrastructure

In addition to the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time (1110)', which is an interest feature of the Dogger Bank SAC, there is also the potential for Annex I habitat biogenic 'reefs' (1170) to be present in this area of the southern North Sea.

Biogenic reefs, created by the ross worm *Sabellaria spinulosa,* comprise of dense subtidal aggregations of this small, tube-building polychaete worm. The *S. spinulosa* reef habitats of greatest nature conservation significance occur on predominantly sediment or mixed sediment areas allowing the settlement and growth of other biota on the reef surface.

There are no noted reefs or potential reefs within the Dogger Bank area (JNCC, 2011a); however, biogenic reefs have been known to form on exposed sections of pipelines, taking advantage of the presence of hard substrate.

An investigation into the presence of potential Annex I habitats within the vicinity of the Tyne infrastructure was included in the scope of the pre-decommissioning EBS undertaken in April 2016. No Annex I habitats or other protected habitats/ species were encountered during the Tyne EBS (Bibby HydroMap & Benthic Solutions, 2016).

3.4 Socioeconomic Environment

Socioeconomic activities in the vicinity of the Tyne Field are described in the sub-sections below.

3.4.1 Commercial Fishing

Decommissioning operations can potentially effect commercial fishing activities. The North Sea area is highly important to the UK economy, and is an important fishing ground for both UK and international fishing fleets (BEIS, 2016).

UK fisheries can be categorised into demersal, pelagic and shellfish fisheries. Of these categories, the shellfish sector is typically the most valuable in the UK, with crabs, lobsters, *Nephrops* and scallops all of a high value. Pelagic and demersal fish are usually caught in large numbers but at relatively lower values to shellfish per tonne. Fishing effort and landings around the UK is recorded by ICES statistical rectangle; however, it should be noted that these data only record effort and landings from UK vessels. The Tyne infrastructure lies within ICES Rectangles 37F1 and 37F2 (with the Tyne installation located in ICES Rectangle 37F2).

Specific fishing effort and landings data for ICES rectangles 37F1 and 37F2 between 2010 and 2015 were obtained from the MMO and analysed to provide an indication of commercial fishing effort and value in the vicinity of the Tyne infrastructure (Tables 3-19 and 3-20). Scottish Government (2018) fisheries statistics have been used to supplement, where MMO data (MMO 2017a and 2017b) does not provide a clear breakdown of gear types and species.

Table 3-19: Fishing effort, quantity and value of commercial fisheries between 2012 and 2016 (ICES rectangle 37F1)

Year	Total effort (days)	Total value (£)	Species type	Value (£)	Total quantity (tonnes)	Species type	Quantity (tonnes)
2016	233	1,109,022	Demersal	258,955	655	Demersal	186
			Pelagic	236		Pelagic	0.12
			Shellfish	849,831		Shellfish	468
2015	192	648,479	Demersal	276,919	405	Demersal	224
			Pelagic	20		Pelagic	0.06
			Shellfish	371,540		Shellfish	181
2014	174	484,966	Demersal	180,501	267	Demersal	156
			Pelagic	2.7		Pelagic	0.002
			Shellfish	304,462		Shellfish	111
2013	216	561,014	Demersal	280,320	364	Demersal	212
			Pelagic	15,341		Pelagic	55
			Shellfish	265,353		Shellfish	97
2012	321	957,635	Demersal	488,458	513	Demersal	325
			Pelagic	154		Pelagic	0.2
			Shellfish	469,023		Shellfish	188
Annual average	**227**	**752,223**			**441**		

Source: MMO (2017a; 2017b); Scottish Government, 2018

Table 3-20: Fishing effort, quantity and value of commercial fisheries between 2012 and 2016 (ICES rectangle 37F2)

Year	Total effort (days)	Total value (£)	Species type	Value (£)	Total quantity (tonnes)	Species type	Quantity (tonnes)
2016	949	3,508,399	Demersal	1,366,929	1,760	Demersal	928
			Pelagic	724		Pelagic	0.7
			Shellfish	2,140,745		Shellfish	831
2015	635	2,477,636	Demersal	1,490,800	1,420	Demersal	1,017
			Pelagic	46		Pelagic	0.07
			Shellfish	986,790		Shellfish	403
2014	565	2,617,041	Demersal	1,578,338	1,493	Demersal	1,152
			Pelagic	2,812		Pelagic	0.7
			Shellfish	1,035,891		Shellfish	340
2013	429	1,526,072	Demersal	1,002,964	936	Demersal	734
			Pelagic	2,957		Pelagic	1.9
			Shellfish	520,151		Shellfish	200
2012	496	2,219,377	Demersal	1,359,727	1,211	Demersal	862
			Pelagic	2,001		Pelagic	0.9
			Shellfish	857,649		Shellfish	348
Annual average	**615**	**2,469,705**			**1,364**		

Source: MMO (2017a; 2017b); Scottish Government 2018

3.4.1.1 Fishing effort

Between 2012 and 2016 the mean annual fishing effort (in days), by UK vessels over 10 metres in length, in the vicinity of the Tyne infrastructure was 227 days in ICES Rectangle 37F1 and 615 days in ICES Rectangle 37F2 (Scottish Government, 2018; Tables 3-19 and 3-20). A general increasing trend of total fishing effort can be observed for ICES Rectangle 37F2, while ICES Rectangle 37F1 show a more consistent level of exploitation throughout this period (Figure 3-16).

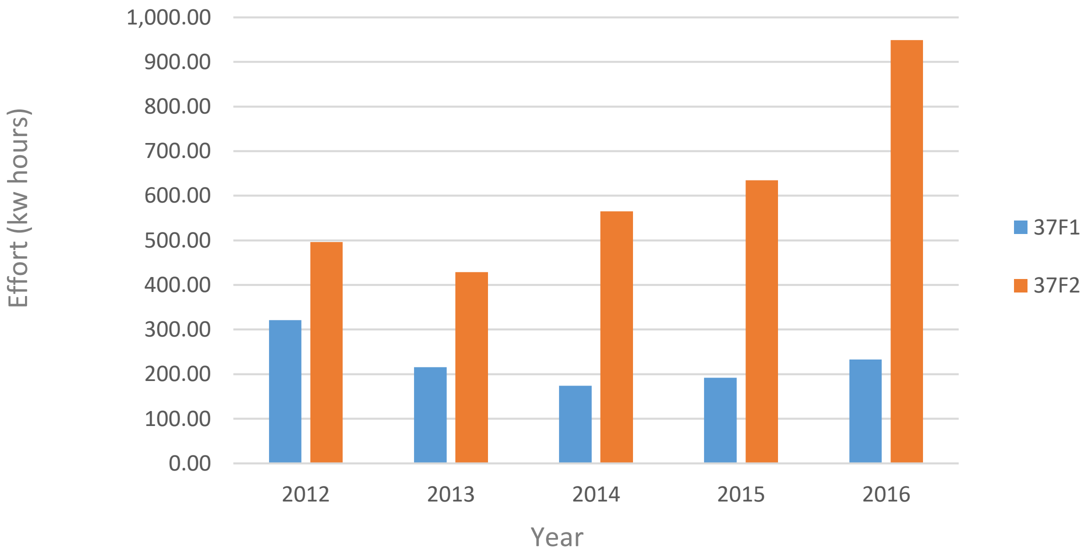


Figure 3-16: Total annual fishing effort (in kwh) by, UK vessels over 10 m in length, between 2010 and 2015 within ICES Rectangles 37F1 and 37F2 (MMO, 2017a)

In this period, 2012 to 2016, the dominant gear types were demersal bottom trawling gears such as otter trawls, beam, trawls. In ICES Rectangle 37F1, the next notable gear type is pots and traps. (Scottish Government, 2018).

An analysis of fishing activity has also been undertaken by Kafas et al. (2012). Anonymised information on the spatial distribution of fishing activity for the years 2007 to 2011, obtained from Vessel Monitoring Systems (VMS) data for all UK vessels greater than 15 m in length landing into UK ports, was combined with landings data to identify spatial patterns of fishing intensity. This data, illustrated in Figure 3-17, shows that mobile demersal fishing activity was moderate to low within the blocks of interest and an area of moderate to high activity for mobile *Nephrops* fishing lies adjacent to the southern boundary of Block 43/25.

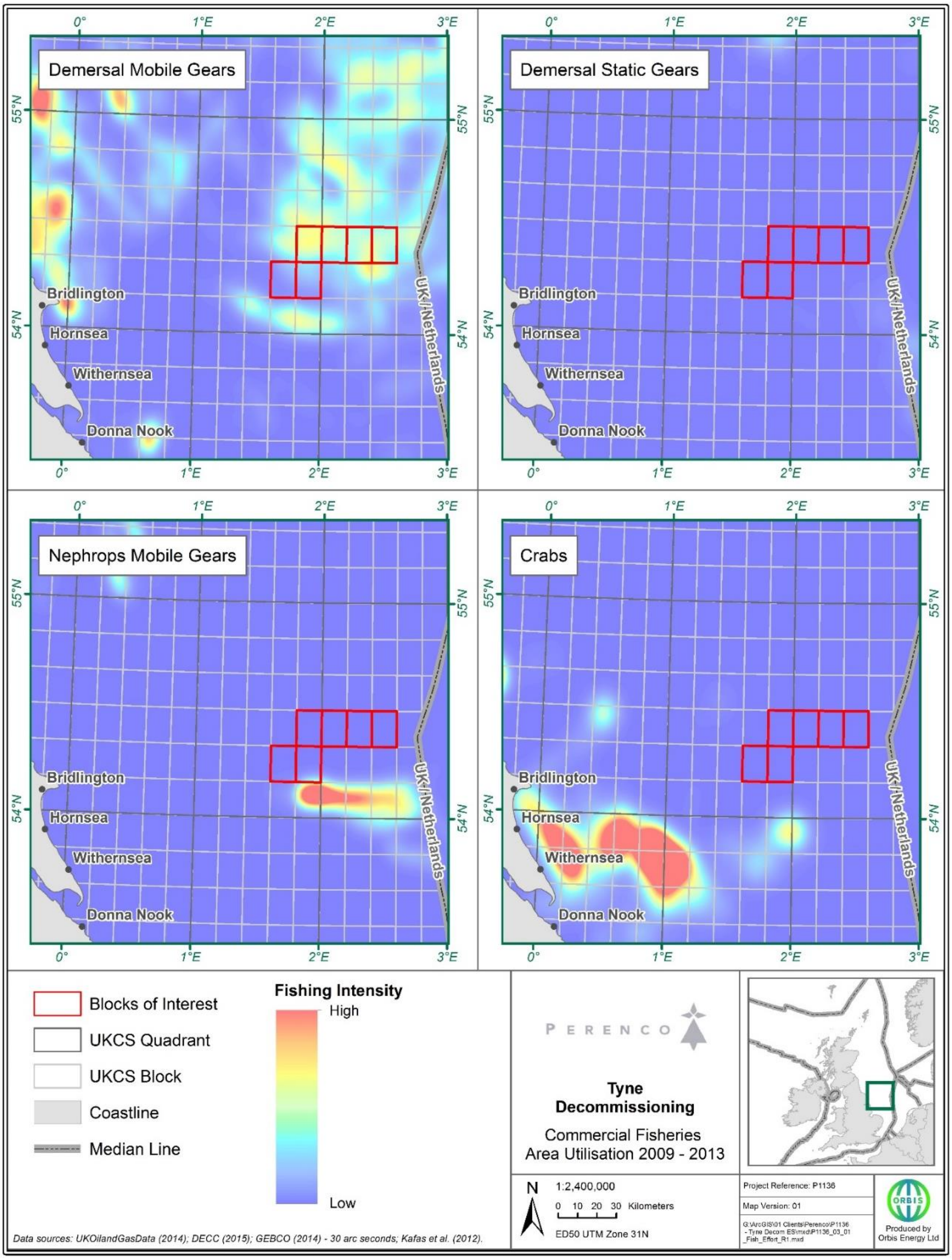


Figure 3-17: Utilisation of the Tyne development area by commercial fisheries (Kafas et al., 2012)

3.4.1.2 Fish landings

Overall annual landings from ICES Rectangle 37F2 are greater than those from ICES Rectangle 37F1. The average annual landing between 2012 and 2016 in ICES Rectangle 37F1 was 441 tonnes (Table 3-19), with the greatest quantity landed in 2016 (655 tonnes) and the least in 2014 (267 tonnes). In ICES Rectangle 37F2 (Table 3-20) the average annual landing for the same period was 1,364 tonnes, with the greatest quantity landed in 2016 (1,760 tonnes) and the least in 2013 (936 tonnes) (MMO, 2017b).

In both ICES Rectangles, landings are consistently very low between December and March then rise steadily to peak during August to low in ICES Rectangle 37F1 and to moderate in ICES Rectangle 37F2 and fall back to very low by December (Scottish Government, 2018).

Landings by weight (tonnes) within ICES rectangles 37F1 and 37F2 between the years 2012 and 2016 are comprised primarily of demersal species living at or near the seabed including plaice, cod, lemon sole and turbot and shellfish species including scallops, Nephrops, brown crab, squid, whelks and lobster. Pelagic species make up a larger proportion of the averaged total annual catch in ICES Rectangle 37F2 than in ICES Rectangle 37F1, dominant species targeted include sprats and herring (Figure 3-18) (Scottish Government, 2016).

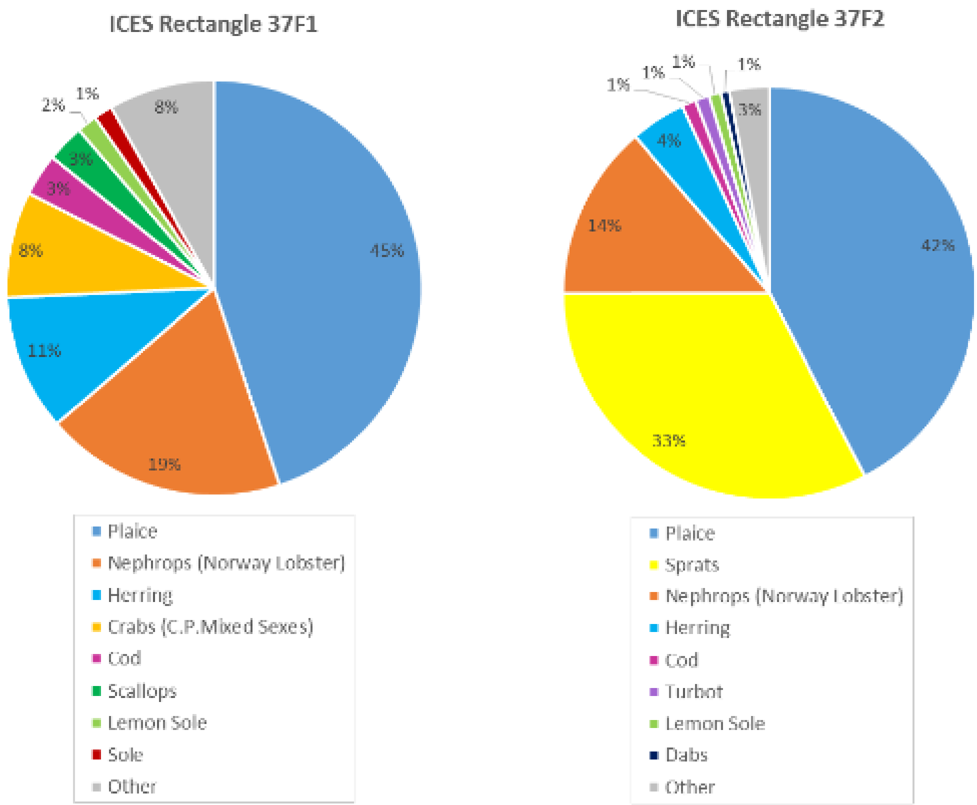


Figure 3-18: Catch composition by average weight (tonnes) within ICES Rectangles 37F1 and 37F2 between 2010 and 2015 (Scottish Government, 2016)

Of the species caught, plaice is landed in greatest tonnages in both ICES Rectangles, followed by *Nephrops* and crabs in ICES Rectangle 37F1 and by sprat and *Nephrops* in ICES Rectangle 37F2 (Figure 3-19). This is reflected in the dominant fishing gear type in ICES Rectangle 37F1 and 37F2, which are classified as trawls, and otter trawls targeting pelagic and demersal species (Scottish Government, 2016).

Illustrated in Figure 3-19, plaice and *Nephrops* are also the greatest components of the fishery in terms of revenue generated within both ICES Rectangles. From 2010-2015, annual landings value notably included 32% plaice and 27% *Nephrops* in ICES Rectangle 37F1 and 43% plaice and 30% *Nephrops* in ICES Rectangle 37F2 (Scottish Government, 2016). This is followed by lemon sole, sole and lobsters in ICES Rectangle 37F1 and turbot, sprats and sole in ICES Rectangle 37F2, which, although not as significant a component of the total landings in comparison, have a greater value per tonne, making them a lucrative target species.

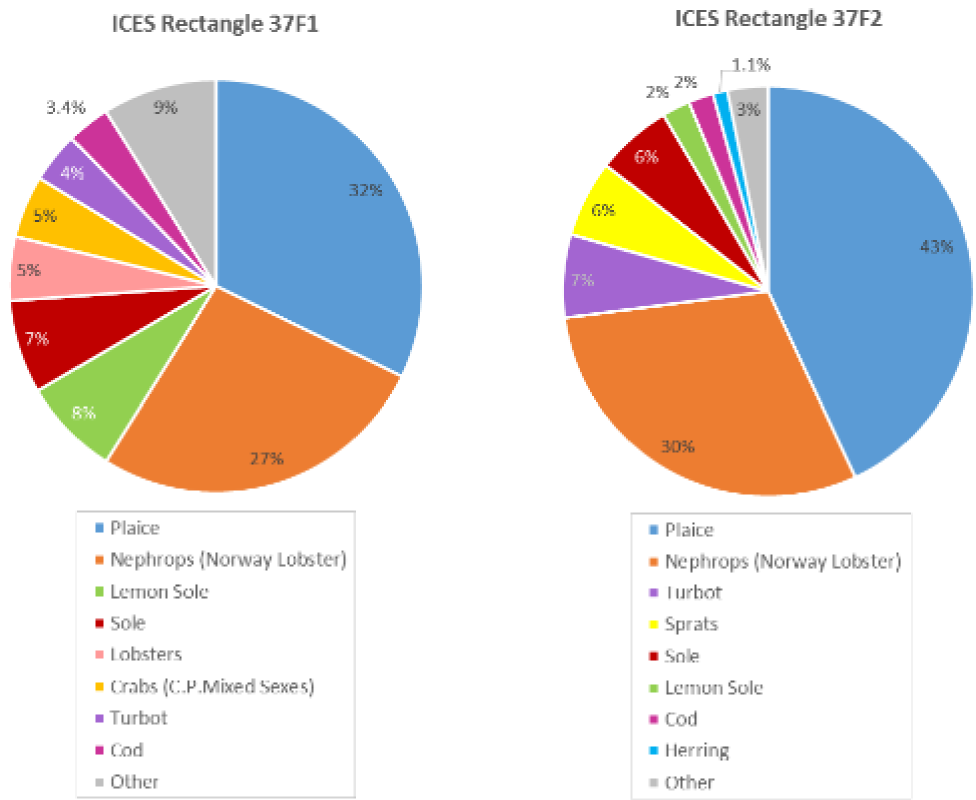


Figure 3-19: Percentage catch composition of landed value within ICES Rectangles 37F1 and 37F2 between 2010 and 2015 (Scottish Government, 2016)

3.4.1.3 UK data trends

The fishing industry is dynamic and unpredictable; being, to certain degrees, controlled by fish abundance and distribution, climatic changes, license quotes, management regulations and fuel costs (BEIS, 2016).Recent years have seen declines in the fisheries industry. Between 2004 and 2014 the number of active vessel decreased by 9% and the number of working fishermen decreased by 12%. The decrease in the ratio of fishing vessels to fishermen is suggestive of further mechanisation and a relation increase in the use of small inshore vessels (BEIS, 2016). This decreasing trend can be seen in the fishing effort data, for ICES Rectangle 37F1, while the opposite appears to be the case for ICES Rectangle 37F2, presented in Figure 3-16

3.4.2 Shipping and Ports

The southern North Sea is a busy sea area, with major ports in the area including Grimsby and Immingham the UK's busiest port, London, Felixstowe and Dover. Vessels are mainly trading between ports on either side of the North Sea and supporting the oil and gas industry (BEIS, 2016).

According to Anatec (2016), shipping density within all of the blocks of interest is regarded as high. Figure 3-20 presents shipping density data (Anatec, 2016) in the vicinity of the blocks of interest. This data is derived from vessel satellite data, International Maritime Organisation (IMO) ship routeing measures and the Anatec Ltd Ship Routes database. (Anatec, 2016)

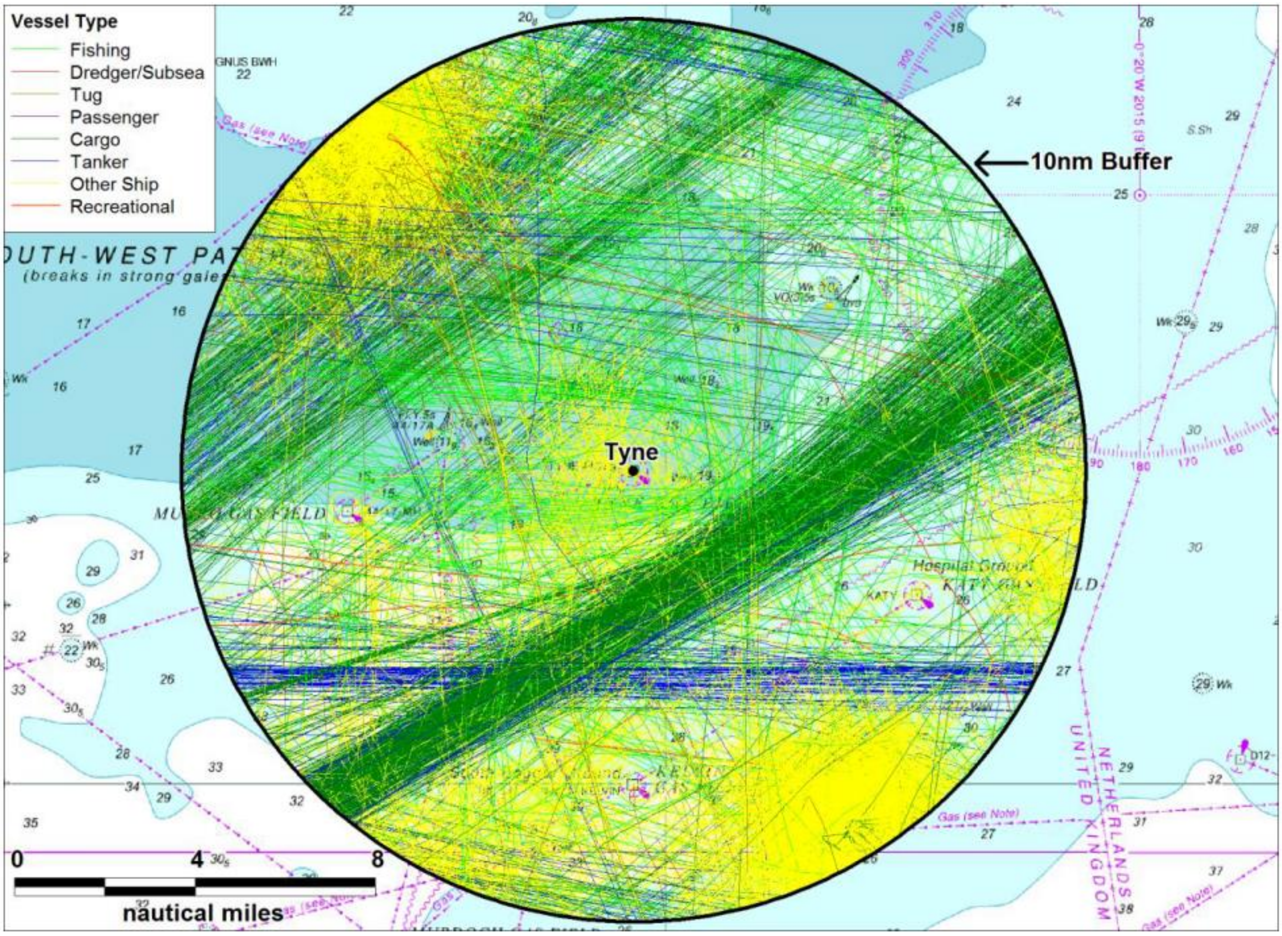


Figure 3-20: Shipping tracks recorded within 10 nm of the Tyne installation (Anatec, 2016)

A navigational risk assessment (NRA) conducted by Anatec (2016) concluded that an estimated 2,095 vessels pass within 10 nm of the Tyne installation location, corresponding to an average of 5 to 6 vessels per day. The majority of these vessels were determined as cargo vessels and Ro-Ro freight ferries (Anatec, 2016).

The frequency of passing (powered) vessel collisions was modelled by Anatec (2016), the estimated collision frequency was 1.9 x 10^{-4} per year, which corresponds to a collision return period of about 5,200 years (Anatec, 2016).

3.4.3 Oil and Gas Infrastructure and Submarine Cables

There has been extensive oil and gas development on the Dogger Bank. The Tyne infrastructure lies on the north eastern fringe of a number of currently producing gas fields. Current producing fields near Tyne include the Munro development in Block 44/17, the Katy development in Block 44/19, the Murdoch development in Block 44/22, the Boulton development in Block 44/21 and the Cavendish development in Block 43/19 (Figure 3-21).

The closest surface infrastructure to the Tyne infrastructure is the Munro MH platform located in Block 44/17, 2 kilometres northwest of the PL1220/ PL1221 pipelines, which is operated by ConocoPhillips. The second closest is the Katy KT platform, located 13 kilometres southeast of the Tyne installation, which is also operated by ConocoPhillips (Figure 3-21; UKOilandGasData, 2017).

The Tyne installation is located in Block 44/18, within which a total of 14 wells have been drilled. The most recent well to be drilled was 44/18a-T6 in 2012. Within the other blocks of interest, three wells have been drilled in Block 43/20, six wells in Blocks 43/25 and 44/16, eight wells in Block 43/24 and 13 wells in Block

44/17. Of these the 50 wells drilled within all of the blocks of interest, 12 are currently listed as completed, nine are currently suspended and 29 are plugged and abandoned (UKOilandGasData, 2017).

Six active pipelines traverse the Tyne export pipeline (PL220) and MEG line (PL1221) (Figure 3-21). These include:

- 24” diameter Esmond to Bacton gas export pipeline (PL253), operated by PUK;
- 10” diameter Cavendish export pipeline (PL2284), operated by INEOS;
- 2” diameter Cavendish methanol supply line (PL2285), operated by INEOS;
- 3” diameter Hawksley EM to Murdoch MD MEOH line (PL1925), operated by ConocoPhillips;
- 12” diameter Hawksley EM to Murdoch MD gas line (PL1922), operated by ConocoPhillips; and
- Hawksley EM to MCADAM MM umbilical (UM6), operated by ConocoPhillips.

In addition, the Tyne pipelines are also traversed by the 24” diameter Cygnus to ETS gas pipeline (PL3088), operated by ENGIE E&P UK. The status of this pipeline is currently listed as ‘pre-commission’ (UKOilandGasData, 2017).

The active telecommunications cable MCCS (operated by Tampnet) runs through Block 44/17 in a broadly north-south direction and crosses the Tyne export pipeline and MEG line (Figure 3-21). In addition, the active telecommunications cable TAMPNET (also operated by Tampnet) crosses through the southeast corner of Block 44/18, approximately 8.5 km southeast of the Tyne infrastructure (KIS-ORCA, 2017).

3.4.4 Military Activity

The Tyne development lies within the Royal Air Force practice and exercise areas (PEXA) D323B and D323C, which are both used for air combat and supersonic flight training (Forewind, 2014a). In addition, the Royal Navy PEXA ‘Outer Silver Pit’, a submarine training area, is located approximately 30 km to the south of the Tyne development (BEIS, 2016). During the preparation of this EIA, the views of the MoD were solicited by an informal scoping letter on the 17th December 2015, sent by PUK.

3.4.5 Dredging and Dumping Activity

There are no licenced offshore dredging areas or known dumping areas within the blocks of interest (Figure 3-21) (Crown Estate, 2016). However, the marine aggregates application area, Area 446/1 overlaps the boundary of the Dogger Bank SAC, approximately 90 km to the northwest of the Tyne development. The applicant for this area is CEMEX UK Marine Ltd (Crown Estate, 2016).

3.4.6 Wind Farms

There are no wind farm areas within the blocks of interest (Figure 3-21), the nearest are the Hornsea Project Three SPC6 and Creyke Beck A. Hornsea is located approximately 26 km to the south west of the Trent platform, beyond the boundary of the Dogger Bank SAC. This project is owned by Dong Energy (UK) Limited and is in the pre-planning stages (Crown Estate, 2016). Creyke Beck A is located 40 km northwest of the Tyne installation and is part of Forewind’s Dogger Bank offshore consented windfarm complex (Crown Estate, 2016). This complex consists of four offshore wind farms, Creyke Beck A, Creyke Beck B, Teesside A and Teesside B (Forewind, 2015).

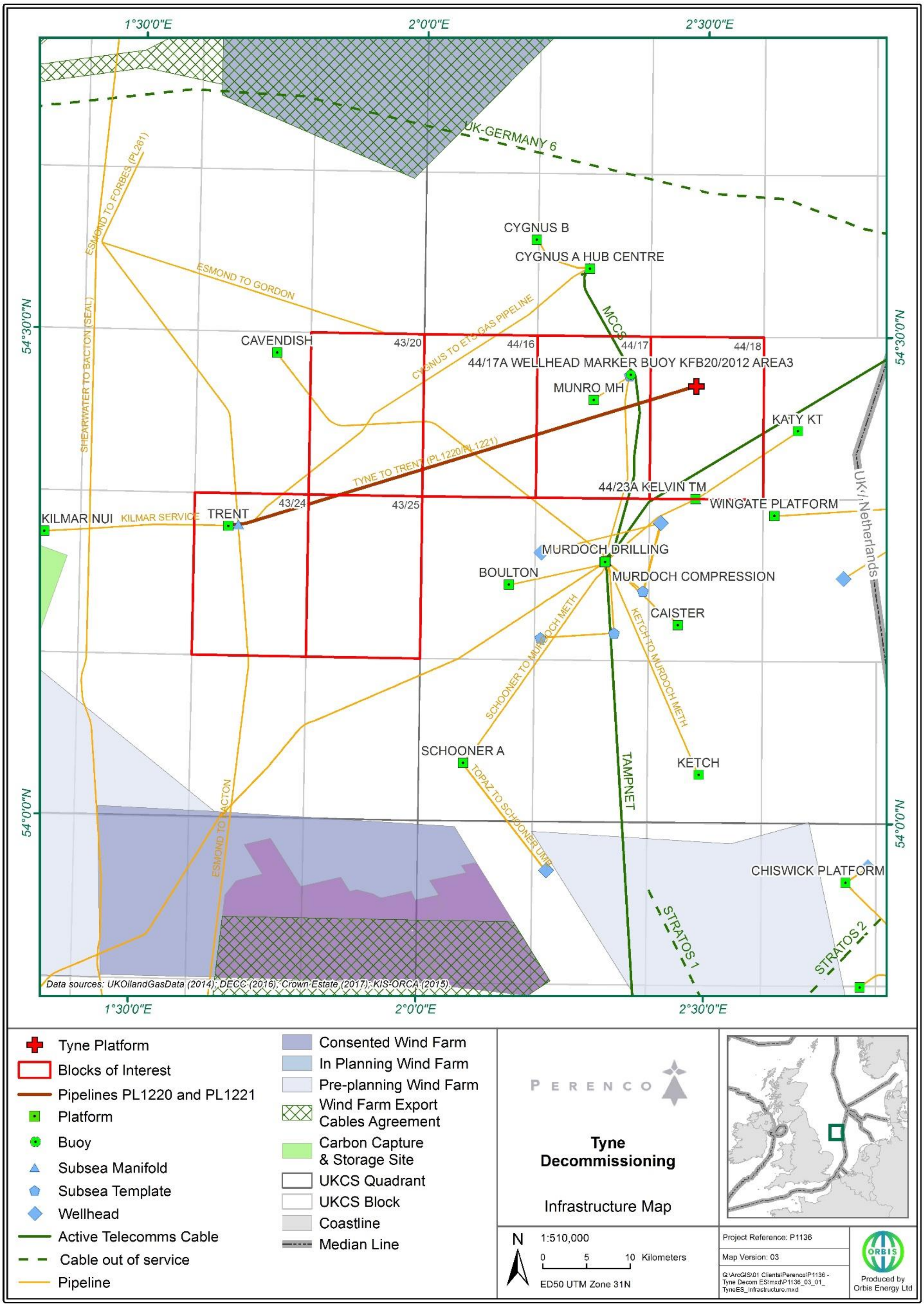


Figure 3-21: Current oil and gas related activity within the Tyne development area

3.4.7 Carbon Capture and Storage Projects

There are no Carbon Capture and Storage (CCS) lease sites within the blocks of interest (FigurFigure 3-21). The nearest is Aquifer 5/42, located approximately 19 km to the west of the Trent Platform. The current tenant is National Grid (Crown Estate, 2016).

3.4.8 Archaeology

Several shipwrecks lie on the Dogger Bank, which many of them are fishing boats. The Dogger Bank was once an exposed and important landmass situated between Britain and continental and bottom trawling on the bank often dredges up peat, remains of prehistoric animals and even human artefacts (Deising et al., 2009).

There are a number of chartered wrecks in the area surrounding the Tyne infrastructure, the closest is located very close to the Tyne pipelines (Hydrographer of the Navy, 2008). The exact depth is not known, but there is considered to be safe clearance to 22 m below sea level.

Other chartered wrecks of note include, one to the north west of the Tyne pipelines, at approximately their half way point. The depth of this wreck is unknown and is considered potentially dangerous to surface navigation. There are three further wrecks that are relatively close, two located between the aforementioned wreck and the Tyne Pipelines and one to the south east of the Tyne Pipelines. These three wrecks are not considered dangerous to surface navigation (Hydrographer of the Navy, 2008).

3.4.9 Tourism and Leisure

No tourism and leisure activities are identified as occurring within the blocks of interest due to its distance from the shore (approximately 115 km at their closest point). In general tourism and leisure activities are focused on the coastline and nearshore water of England.

3.5 Key Environmental Sensitivities

A summary of key environmental sensitivities in the vicinity of the Tyne infrastructure are presented in Table 3-21.

Table 3-21: Seasonal Environmental Sensitivities

Activity in the blocks of interest, surrounding waters and adjacent coastline													
Component	**Abundance/ activity**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Plankton	Phytoplankton and zooplankton	Low	Low	Peak	Peak	Peak	Low	Low	Low	Peak	Low	Low	Low
Benthic fauna	Benthic faunal communities	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Fish spawning & nursery areas	No. of species spawning in any one month	4	5	5	5	6	5	4	5	3	2	2	3
	No. of species with nursery grounds in any one month	4	4	7	9	9	11	12	11	7	8	5	4
Seabird sensitivity to oiling	Block 43/20	2	5	5	5	4	4	1	3	4	4	2	2
	Block 43/24	2	5	5	5	3	3	1	2	2	2	2	2
	Block 43/25	2	5	5	5	4	4	1	2	3	3	2	2
	Block 44/16	2	5	5	5	5	5	1	4	5	5	2	2
	Block 44/17	3	5	5	5	5	5	3	4	5	5	3	3
	Block 44/18	3	5	5	5	5	5	4	5	5	5	3	3
Cetaceans	Minke whale					Very Low	Very Low	Low	Very Low	Very Low	Very Low		
	Long-finned pilot whale								Very Low				
	Bottlenose dolphin											Very Low	
	Common dolphin							Very Low		Low			
	White-beaked dolphin	Very Low	Moderate	Very Low	Peak	Peak	Low	Moderate	Low	Very Low	Moderate	Moderate	Very Low
	Atlantic white-sided dolphin					Moderate		Very Low	Very Low	Very Low			
	Harbour porpoise		Low	Moderate	Very Low	Moderate	Moderate	Very Low	Peak	Moderate	Very Low	Moderate	Low
Pinnipeds	Harbour seal	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
	Grey seal	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Resource users	Commercial fishing	Low	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate	Low	Low	Low
	Shipping and ports	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
	Military activity	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
	Existing oil and gas activity	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Marine aggregates												
	Offshore wind farms												
	Telecommunications cables	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
	Tourism and leisure												
Protected sites	MPAs	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak
	Coastal protected areas	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Note: Seabird Vulnerability – Very High = 1, Low = 4.													
Key													
[dark green]	Peak	[green]	Moderate	[light green]	Low	[yellow]	Very Low	[pale blue]	No Occurrence / Data				

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4 EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS

As required by the Petroleum Act, 1998 and OSPAR Decision 98/3, this section identifies and ranks the environmental and societal impacts and risks that could arise from planned and unplanned activities associated with the proposed decommissioning activities.

The activities associated with the decommissioning of the Tyne installation have the potential to give rise to environmental impacts in several different ways, including physical disturbance of the seabed, emissions of gases to the atmosphere and the generation of wastes for disposal onshore. These effects could arise as consequences of the following aspects of the DP, which have also been outlined in Section 2:

- General decommissioning activities;
- Full removal of the topsides, jacket and subsea template; and
- Leaving the dispersed drill cuttings in situ.

An assessment of the significance of the risks to any environmental and societal compartment as a result of the operations was undertaken. The assessment looked at both planned operations and unplanned, accidental events. Where appropriate, site specific, transboundary and cumulative impacts were also included in discussions during the risk assessment process.

4.1 Risk Assessment Methodology

The purpose of the risk assessment is to:

- Identify potential impacts to the environment that may arise from the proposed decommissioning activity;
- Evaluate the potential significance of those potential impacts in terms of the threat that they pose to specific environmental receptors;
- Assign measures to manage the risks in line with industry best practice; and
- Address concerns or issues raised by stakeholders during the consultation for this EIA.

The risk assessments were undertaken using the following method:

1. Each decommissioning activity was broken into its component, operations and end-points
2. Receptors at risk (elements of society or the environment) were identified from the potential operational impacts and end-point impacts (Table 4-1)
3. The significance of the potential environmental impacts and risks was assessed according to pre-defined criteria. These criteria recognise the likely effectiveness of planned mitigation measures to minimise or eliminate potential impacts/ risks.
4. Assessments were undertaken to determine what level of impacts/ risks the component activity/ operation could pose to the different groups of environmental or societal receptors. The following Scoring Criteria and Risk Matrix were applied to complete the associated worksheets:
   - PUK's Consequence Matrix (Table 4-2).
   - PUK's Likelihood Matrix (Table 4-3).
5. The overall significance of risk for a particular activity was determined by the PUK's Risk Matrix (Table 4-4).

Table 4-1 Listing of environmental and societal resources / concerns

Physical and chemical	Biological	Societal
• Sediment disturbance • Water quality • Air quality • Land • Freshwater	• Sediment biology (benthos) • Water column (plankton) • Finfish and shellfish • Marine mammals • Seabirds • Ecosystem integrity • Conservation sites • Terrestrial flora and fauna	• Commercial fishing • Shipping • Government or institutional users (e.g. MoD) • Other commercial users • Recreational users • Onshore communities (resources)

Table 4-2 PUK's consequence matrix

Consequence criteria	Impact Level				
	1 (Very low)	2 (Low)	3 (Medium)	4 (High)	5 (Very high)
1. Safety					
1.1 Risk to other users of the sea (post ops)	No risk.	Potential snagging hazard if protection deteriorates or is moved.	Loss of fishing gear/ vessel infringes tow exclusion zone.	Vessel collision/ damage to vessel.	Loss of vessel.
1.2 Risk to those on land (during ops)	FAC or no specific treatment.	MTC/ RWC	RWC/ Day away from work case.	Fatality or long-term injury.	Multiple fatalities or long-term injury.
1.3 Risk to 3rd party assets/ vessels (during ops)	No risk.	Standard operations required in 500 m zones.	Crossing 3rd party assets.	Impact with 3rd party asset – no loss of containment.	Impact with 3rd party asset – loss of containment.
2. Environmental					
2.1 Chemical discharge	No or negligible discharge.	Discharge causes changes, which are unlikely to be measureable against background activities.	Discharge causes change in ecosystem leading to medium term damage but with good recovery potential.	Discharge causes change in ecosystem leading to long term damage but with good recovery potential.	Discharge causes change in ecosystem leading to medium term damage but with poor recovery potential.
2.2 HC discharge	No or negligible discharge	1 – 100 litres oil.	100 – 1,000 litres oil.	1 – 10 m^3 oil.	>10 m^3 oil.
2.3 Seabed disturbance	None.	Low HC concentrations and/ or very gradual release.	Medium HC concentration and/ or moderate rate of release.	High HC concentration and/ or rapid rate of release.	Very high HC concentration and/ or very rapid rate of release.
2.4 Energy use	0 – 10 GJ	Localised disturbance (0 - 100% of equipment footprint).	Localised disturbance (100% of equipment footprint).	Wider area of disturbance (100 – 200% of equipment footprint).	Wide area of disturbance (>200% of equipment footprint).
2.5 Estimated discard to sea (% of total material)	0%	10 – 100 GJ	100 – 200 GJ	200 – 400 GJ	>400 GJ
2.6 Estimated discard to landfill (% of total material)	0%	0 – 20%	20 – 50%	50 – 80%	>80%
3. Technical					
3.1 Technical challenge	Regular construction task using generic procedures.	Regular construction task using detailed procedures.	Non-routine task. High level of historical experience.	Non-routine task. Low level of historical experience.	Novel technique or equipment. No industry experience.
3.2 Level of diving intervention	<10 days	10 - 20 days	20 - 30 days	30 – 40 days	>40 days

Consequence criteria	Impact Level				
	1 (Very low)	2 (Low)	3 (Medium)	4 (High)	5 (Very high)
3.3 Weather sensitivity	General operations relying only on ability to launch ROV.	Standard operations experiencing expected operational downtime for time of year.	Required specific weather window for small number of tasks. Non schedule critical.	Requires specific weather window for certain tasks. Schedule can be optimised to accommodate.	Requires specific weather window for prolonged period. Operation on critical path.
3.4 Risk of major project failure	Existing, proven equipment used for specific task for which it was designed.	Existing, proven equipment used for specific task for new application.	Technology research and development required.	Unable to complete operation in scheduled timeframe. Re-work required prior to revisit.	Potential catastrophic failure of major component.
4. Societal					
4.1 Fisheries access (post ops)	Free, unrestricted access to site.	Unrestricted access to site – noted seabed disturbance.	Access to site with overtrawlable charted obstructions.	Access to site with charted obstructions.	Site remains restricted.
4.2 Communities	No impact.	Low impact (dust, noise etc.)	Short term impact to onshore communities (waste handling traffic etc.).	Long term impact to onshore communities (landfill, infrastructure, etc.).	High impact to onshore communities (pollution, loss of amenity, etc.).
5. Legal compliance					
5.1 OSPAR 98/3	Fully compliant.	Not applicable.	Compliant with derogation.	Not applicable.	Non-compliant.
5.2 NFFO Guidance	Total removal of structure.	Burial 0.6 m below natural seabed level.	Buried but not to depth required.	Exposed at some locations.	Totally exposed.
6. Commercial					
6.1 Economic	<£1,000,000	£1,000,000 - £5,000,000	£5,000,000 - £10,000,000	£10,000,000 - £15,000,000	>£15,000,000
6.2. Ongoing liability	No ongoing liability.	Reactive survey regime.	Survey inspection at increasing intervals.	Bi-annual survey inspection and ongoing remedial work.	Annual surveys and ongoing remedial work.

Note: First Aid Case (FAC); Medical Treatment Case (MTC); Restriction Work Case (RWC); Gigajoules (GJ)

Table 4-3 PUK's likelihood matrix

Likelihood rating		
1	Very low	Very low likelihood. Very low level of uncertainty. Detailed definition and understanding of methodology, hazards and equipment.
2	Low	Low likelihood. Low level of uncertainty. High level definition and understanding of methodology, hazards and equipment.
3	Medium	Moderate likelihood. Moderate level of uncertainty. General definition and understanding of methodology, hazards and equipment.
4	High	High likelihood. High level of uncertainty. Basic definition and understanding of methodology, hazards and equipment.
5	Very high	Very high likelihood. Very high level of uncertainty. Limited definition and understanding of methodology, hazards and equipment.

Table 4-4 PUK's risk matrix

			Consequences				
			1 (Very low)	2 (Low)	3 (Medium)	4 (High)	5 (Very high)
Likelihood	1	Very low	Low 1	Low 2	Low 3	Low 4	Medium 5
	2	Low	Low 2	Low 4	Medium 6	Medium 8	Medium 10
	3	Medium	Low 3	Medium 6	Medium 9	Medium 12	High 15
	4	High	Low 4	Medium 8	Medium 12	High 16	High 20
	5	Very high	Medium 5	Medium 10	High 15	High 20	High 25

4.2 Risk Assessment Findings

A detailed outcome of the risk assessment is presented in Table 4-5. The left-hand column of the detailed tables identifies the aspects of the Tyne decommissioning project that may cause or have the potential to cause impacts to sensitive receptors. These environmental aspects (BSI, 2004) include planned and unplanned events during the lifetime of the decommissioning project. The remaining columns of the tables identify the potential physical, chemical, biological and societal receptors. The last two right-hand columns of the tables present the overall assessed risk category and the sections of the report that give a detailed justification of the assessment made.

Taking the effects of planned mitigation into account, the risk assessment indicates that the general decommissioning activities carry one activity identified as high risk and the other decommissioning activities relating to jacket and topside decommissioning have several medium risks associated with them. These risks are assessed further in Sections 5 to 11:

- Energy use and atmospheric emissions (Section 5);
- Underwater noise (Section 6);
- Seabed impact (Section 7);
- Societal impact (Section 8);

- Discharges to sea (Section 9);
- Accidental events (Section 10); and
- Waste (Section 11)

Table 4-6 provides a summary of the risk assessment and the significance assigned to the decommissioning activities assessed in Table 4-5. Where stakeholder concerns have been raised (Table 1-2) these have also been considered within sections 5 through to 11.

For the impacts or risks that were considered to be low, Appendix B provides the justification for excluding these potential impacts and risks from further investigation in the EIA.

Table 4.5: Assessment of significance of environmental impacts

	Physical and Chemical					Biological								Societal									
	Seabed disturbance	Water quality	Air quality	Land	Freshwater	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Marine mammals	Seabirds	Ecosystem integrity	Conservation sites	Terrestrial flora and fauna	Commercial fishing	Shipping	Government, institution users (e.g. MOD)	Other commercial users	Recreation and amenity users	Onshore Communities (Resources)	**Likelihood**	**Consequence**	**Overall significance**	**Justification section(s) reference**
General decommissioning activities - Planned operations																							
Physical presence of vessels														✓	✓	✓	✓	✓		2	1	2	Appendix B
Well P&A using explosives								✓	✓											5	4	20	6
Removal of the wellheads	✓	✓										✓								3	1	3	Appendix B
Anchoring of the accommodation barge (***Seafox 1***) for P&A, preparation and cleaning	✓	✓				✓		✓				✓								3	2	6	7
Use of rock stabilisation on the seabed for support of the accommodation barge (*Seafox 1*)	✓	✓		✓		✓	✓	✓				✓		✓	✓					2	3	6	7, 8
Underwater noise from dynamic positioning of vessels, engines and on-board equipment								✓	✓	✓		✓								5	2	10	6
Noise generated from helicopter transport									✓											2	1	2	Appendix B
Operational discharges of treated oily bilge from vessels		✓					✓	✓												2	1	2	Appendix B
Waste produced from onsite vessels			✓										✓							2	1	2	Appendix B
Sewage and grey water discharges from vessels		✓					✓	✓												2	1	2	Appendix B
Macerated food waste discharge from vessels		✓					✓	✓												2	1	2	Appendix B
Ballast water uptake and discharge from the vessels						✓	✓	✓			✓	✓								3	1	3	Appendix B
Atmospheric emissions from vessels			✓																	5	1	5	5
Atmospheric emissions from helicopters			✓																	5	1	5	5
General decommissioning activities - Unplanned operations																							
Dropped objects	✓					✓						✓		✓	✓		✓			1	2	2	Appendix B
Well blow-out	✓	✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓		✓			1	5	5	10
Diesel spill/ tank loss		✓					✓	✓	✓	✓	✓									1	5	5	10
Bunkering spill		✓					✓	✓	✓	✓	✓									1	5	5	10
Vessel to vessel collision		✓				✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		1	5	5	10
Full removal of topsides and jacket (single or multiple lifts) - Planned operations																							
Atmospheric emissions associated with power generation for topside separation and cutting (plasma, flame or cold cutting), underwater cutting of jacket and lifting activities			✓																	2	1	2	Appendix B
Topside preparation, separation and cutting (plasma, flame or cold cutting)		✓	✓				✓	✓												4	1	4	Appendix B
Excavation of piles using jetting and dredging techniques	✓	✓																		3	2	6	7
Underwater cutting (diamond wire, oxyacetylene, high pressure water abrasive) of jacket piles 3 m below seabed	✓	✓				✓		✓	✓											3	2	6	6, 7
Anchoring of the lift vessel	✓	✓				✓		✓				✓								3	2	6	7
Use of rock stabilisation on the seabed for support of the lift vessel	✓	✓		✓		✓	✓	✓				✓		✓	✓					2	3	6	7, 8

	Physical and Chemical					Biological								Societal									
	Seabed disturbance	Water quality	Air quality	Land	Freshwater	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Marine mammals	Seabirds	Ecosystem integrity	Conservation sites	Terrestrial flora and fauna	Commercial fishing	Shipping	Government, institution users (e.g. MOD)	Other commercial users	Recreation and amenity users	Onshore Communities (Resources)	**Likelihood**	**Consequence**	**Overall significance**	**Justification section(s) reference**
Dismantling structures/ recovery/ transport and recycling of materials (including marine growth) onshore			✓	✓														✓	✓	2	3	6	5, 8, 11
Disposal and treatment of solid and potentially hazardous waste, including sand waste from the separators				✓														✓	✓	2	3	6	11
Presence of scour basin following removal of installation	✓					✓								✓						2	1	2	Included in 7 and 8 to address stakeholder comment
Full removal of topsides and jacket (single or multiple lifts) - Unplanned operations																							
Vessel to vessel collision		✓				✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		1	5	5	10
Dropped object (Topside and/ or jacket loss during lifting and transportation)	✓	✓				✓	✓	✓	✓	✓	✓	✓		✓	✓		✓			1	3	3	Appendix B
Leave dispersed drill cuttings in situ - Planned operations																							
Disturbance of any areas of contaminated sediment during excavation and removal of jacket	✓	✓				✓	✓	✓												4	2	8	7, 9
Leave dispersed drill cuttings in situ - Unplanned operations																							
Post – decommissioning disturbance of any areas of contaminated sediment during trawling activities	✓	✓				✓	✓							✓						4	2	8	8

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Table 4-6 Summary of risk categories associated with decommissioning activities during the environmental and societal risk assessment.

Decommissioning activities	Risk categories					
	Low		Medium		High	
	Planned operations	Unplanned operations	Planned operations	Unplanned operations	Planned operations	Unplanned operations
General decommissioning activities				✓	✓	
Full removal of topsides and jacket (single or multiple lifts)			✓	✓		
Leave dispersed drill cuttings in situ			✓	✓		

Note: Risk category is based on the highest scoring activity for each option (Table 4-5).

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5 ENERGY AND EMISSIONS

This section provides quantitative estimates of the energy use and the atmospheric emissions from the proposed Tyne installation decommissioning activities. The potential for environmental impact and mitigation measures to minimise emissions and optimise energy use are also assessed.

5.1 Regulatory Context

Atmospheric emissions generated from the decommissioning of the Tyne facilities will be managed in accordance with current legislation and standards as detailed within Appendix A.

5.2 Approach

This energy and emissions assessment is based on the IoP "Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures" (IoP, 2000). The assessment includes:

- Identification of all structures to be decommissioned;
- Establishment of a materials inventory for each structure to be decommissioned;
- Identification of all operations associated with the decommissioning options (where operations are defined as all of the offshore and onshore activities associated with dismantling and transporting the components and recycling or treating any recovered materials);
- Identification of all end points associated with decommissioning each structure (end points are defined as the final states of the decommissioned materials);
- Identification of the associated activities that will be a source of energy expenditure and gaseous emissions for each operation and end point; and
- Selection of conversion factors and subsequent calculation of energy use and atmospheric emissions.

The calculations predominantly use the energy use and atmospheric emission factors provided within IoP (2000) guidelines. In accordance with these guidelines, alternative factors may be used where specific equipment is considered to have a significantly different fuel use from that presented in the IoP database.

The factors used for the energy and emissions calculations associated with the manufacture of new materials, recycling of materials, general fuel consumption and vessel fuel use are detailed in Appendix C.

This section details the following sources, which were considered to have an associated impact on the energy and emissions at each stage of the Tyne facilities decommissioning.

- Helicopters for transportation of personnel;
- Vessels for transportation and offshore operations;
- Onshore dismantling and/ or processing materials;
- Onshore transportation to processing, recycling and landfill sites;
- Recycling; and
- New manufacture to replace recyclable materials decommissioned in situ or disposed of in landfill.

5.3 Assumptions and Calculation Factors

The following sub-sections outline the assumptions relevant to the Tyne facilities decommissioning activities as a whole, and those assumptions specific to particular components of the infrastructure.

5.3.1 General Assumptions

For the calculation of the energy use and gaseous emissions, the following assumptions were made. These are applicable to all the components of the Tyne facility decommissioning operations.

- The estimates of energy use and gaseous emissions will contain an inherent uncertainty; IoP (2000) reports a typical inherent uncertainty of approximately 30 to 40%. However, the primary function of the IoP approach is to compare decommissioning options rather than to obtain absolute estimates of energy use and gaseous emissions. Care has been taken throughout this assessment to document the assumptions and ensure consistency of assumptions between and within components of the Tyne facility decommissioning activities.
- As dismantling operations will be running concurrently, the Tyne topsides, jacket and subsea template estimates of energy and emissions have been assessed as one entity.
- A round trip by helicopter to the centre of the Tyne area takes, approximately one hour from Norwich.
- A Sikorsky s-92 helicopter has been assumed for this assessment as it is one of the most commonly-used models in the North Sea (Bristow, 2017). This model is one of the largest (Bristow, 2017) and a single helicopter uses on average, 640 litres (1,412 pounds) of aviation fuel per hour (Senzig and Cumper, 2013). Energy use and gaseous emissions for helicopter use may therefore be an overestimate and represent a worst-case scenario.
- Energy use and emissions calculations for vessel use are based on a worst-case scenario of type of vessel used for the operations (i.e., where a number of vessels are being considered, the vessel with the highest fuel consumption has been assessed).Therefore, energy use and gaseous emissions for vessel use may be an overestimate and represent a worst-case scenario.
- Recovered material is assumed to be landed at shore and subsequently taken to recycling and/or landfill sites in the Netherlands. The processing site is adjacent to the dock, so an assumption has been made that the disposal, recycling and treatment site will be a maximum 2 km return journey from the disposal yard.
- Material is transported by lorry with a capacity of, approximately, 40 tonnes. Lorries are assumed to use, approximately, 0.46 litres of fuel per km (Defra & DECC, 2011) and are assumed to make a return trip from the landing site to the location of the disposal/ decontamination/ recycling facility.
- The energy use associated with the offshore and onshore deconstruction of materials is calculated according to the IoP factor for "overall dismantling" (IoP, 2000). This assumption has been made for two reasons. Firstly, there is inconsistency in the level of information provided by contractors on the fuel use of their deconstruction equipment. Secondly, there is an absence of published data on the deconstruction of different types of materials and components. Therefore an overall value is used to allow a comparison between this and other studies.
- Conversion factors (IoP or otherwise) are not available for the emissions associated with overall dismantling.
- A theoretical replacement value is calculated for recyclable material decommissioned in situ or disposed of in a landfill site. It should however be noted that the replacement of otherwise recyclable material is a theoretical activity designed to account for materials left in situ and is mainly used to achieve a balanced assessment when comparing decommissioning options. In reality it is unlikely that this activity will take place. This will therefore represent an overestimate of energy use and CO_2 emissions.
- The energy use and atmospheric emissions associated with recycling and the manufacture of new materials are calculated for all materials for which standard factors are available.
- In this assessment, 100% of concrete is to be sent to landfill. The energy and emissions values are greater for disposal and remanufacture to replace landfilled materials, and therefore this is likely to generate an overestimation, which will provide a worst-case scenario assessment.
- Materials recovered for reuse do not require processing and therefore, have no energy use requirement.

5.3.2 Topside Assumptions

The following assumptions apply specifically to the decommissioning of the topsides:

- No material is decommissioned in situ.
- It has been assumed here, as a worst-case, that topsides and jackets will be decommissioned separately (i.e. two return trips to shore).
- All recovered material that can be re-used or recycled will be, where practical, and any remaining material will be sent to landfill.
- There will be three helicopter flights per week during the vessel scope (this is a worst-case scenario and may lead to an over-estimate of the energy use and emissions associated with helicopter transport).
- An estimate of 50% Wait on Weather (WOW) contingency is applied to all vessels involved with the topsides removal. This estimate is based on working days only.

5.3.3 Jacket Assumptions

The following assumptions apply specifically to the decommissioning of the jackets:

- No material is decommissioned in situ above the seabed.
- All recovered steel, conductor and anode material from the jacket is recycled.
- Some steel will remain in situ below the seabed. As the precise amount to be removed/ decommissioned in situ is governed by the location of the sub-seabed cut, it has been assumed that any steel below the seabed will be decommissioned in situ. This has been accounted for in the calculations for replacement. In reality, a portion of this amount will be removed with the rest of the jacket. Given that more energy is required for the remanufacture of steel decommissioned in situ than the recycling of steel removed (IoP, 2000; Appendix C), this may lead to a small over-estimate of the energy use and gaseous emission values associated with jacket decommissioning.
- There will be three helicopter flights per week during the vessel scope (this is a worst-case scenario and may lead to an over-estimate of the energy use and emissions associated with helicopter transport).
- An estimate of 50% WOW contingency has been applied to all vessels involved with jacket removal. This estimate is based on working days only.

5.4 Materials and Operations Inventories

The following section describes the material inventory and vessel requirements for the decommissioning of the Tyne infrastructure.

5.4.1 Materials inventory

Inventories of materials are based on the summary of waste estimates (Section 2.6).

5.4.2 Vessel Use

The vessel requirements expected to be associated with the decommissioning of the Tyne infrastructure are summarised in Table 5-1.

Table 5-1: Summary of vessel use during the decommissioning of the Tyne facilities

Facility	Recommended Decommissioning Option	Decommissioning Method	Vessel Use
Topsides	Complete removal for reuse, recycling or final disposal onshore	Single Lift/ Piece Small Dismantling	• Jack Up accommodation barge (*Seafox 1*) • Cargo Barge • Lift Vessel • Tugs (3), • Stand-by vessel • Supply vessel
Jacket	Complete removal for reuse, recycling or final disposal onshore	Full removal and dismantled on shore	
Subsea Template	Complete removal for reuse, recycling or final disposal onshore	Removal and dismantling on shore	

5.5 Energy Use and Atmospheric Emissions Results

Estimated energy use and atmospheric emissions during operations decommissioning the topsides, jackets and subsea template of the Tyne facility are detailed within Table 5-2. The main contributors to energy use and atmospheric emissions are expected to be vessel and helicopter use.

The operations for the decommissioning of the Tyne topsides, jacket and subsea template are predicted to use a total of 268,222 GJ of energy and produce 20,143 tonnes of CO_2 emissions. Approximately 251,397 GJ (94%) of this total energy use can be attributed to vessel and helicopter use. The highest emissions can also be attributed to vessel and helicopter use, totalling approximately 18,644 tonnes of CO_2 and constituting 93% of the total CO_2 emissions for the operations to decommission the topsides, jacket and subsea template of the Tyne facilities (Table 5-2).

Table 5-2: Total energy use and atmospheric emissions for decommissioning of the Tyne topsides, jacket and subsea template activities

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Vessel and helicopter use	251,397	18,644	342	23	1
Onshore transportation	1	0.1	0	0	ND
Onshore deconstruction	1,693	ND	ND	ND	ND
Recycling	11,900*	1,259*	2**	5**	ND
New manufacture to replace recyclable material decommissioned in situ or sent to landfill	3,230	239	0	1	0
Total	**268,222**	**20,143**	**344**	**29**	**1**

Note: ND = No Data; Values have been rounded to the nearest whole number. *Includes emissions values for recycling steel and concrete (plastic and lead values not available). **Includes energy values for steel, concrete and plastic (lead values not available).

5.6 Impacts on Sensitive Receptors

Gaseous emissions from the proposed decommissioning activities include CO_2, CH_4, NOx, SOx and Volatile Organic Compounds (VOCs). These have the potential to impact sensitive receptors in the area as well as contribute to issues on a wider scale. The direct effects of the emission of CO_2, CH_4 and VOCs are the contribution to global climate change and regional air quality deterioration through low-level ozone production (CH_4 has 21 times the global climate change potential of the main greenhouse gas CO_2 (IPCC, 2007)). The indirect effects of low level ozone include deleterious health effects, as well as damage to vegetation, crops and ecosystems.

The direct effect of NOx, SOx and VOC emissions is the formation of photochemical pollution in the presence of sunlight. Low level ozone is the main chemical pollutant formed, with by-products that include nitric and sulphuric acid and nitrate particulates. The effects of acid formation include contribution to acid rain and dry deposition of particulates. The main environmental effect resulting from the emission of SO_2 is also the potential to contribute to the occurrence of acid rain; however, the fate of SO_2 is difficult to predict due to its dependence on weather.

The Tyne installation is located approximately 20 km west of the UK/ Norwegian median line. Gases released from the offshore decommissioning activities may therefore be present in very low concentrations across the UK/ Norwegian median line. However, under exposed offshore conditions, the quantity of emissions produced is unlikely to create any measurable transboundary impacts. As the Tyne installation is approximately 184 km east of the nearest UK coastline, no impact is expected for designated coastal or onshore conservation sites from offshore emissions.

All four Annex II species have been recorded in the vicinity of the Tyne installation (see Section 3.3.6.4). In the open conditions that prevail offshore, the atmospheric emissions generated during the decommissioning activities would be quickly dispersed, and outside the immediate vicinity of decommissioning activities, all released gases would only be present in low concentrations. The atmospheric emissions from the proposed activities are therefore considered unlikely to have any effect on marine mammals.

Potential impacts from onshore emissions are likely to be minor and within local and regional air quality criteria. The potential cumulative effects associated with atmospheric emissions produced by the decommissioning activities includes contribution to global climate change, regional acidification (acid rain) and local air pollution. The total annual CO_2 emissions from offshore oil and gas UKCS operations during 2015 was 13.2 million tonnes. The estimated CO_2 emissions released during the decommissioning of the Tyne facilities represent 0.2% of this total (OGUK, 2016). Therefore, the atmospheric emissions from the Tyne facilities decommissioning activities are unlikely to have any effect on sensitive receptors.

5.7 Proposed Mitigation Measures

Mitigation measures to minimise atmospheric emissions and energy consumption are detailed within Table 5-5.

Table 5-5 Proposed mitigation measures

Energy and Emissions sources	Proposed mitigation measure
Vessel and helicopter use and onshore transportation	• Vessels will be audited as part of selection and pre-mobilisation. • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Vessels will use ultra-low sulphur fuel in line with Marine Pollution (MARPOL) requirements. • Work programmes will be planned to optimise vessel time in the field • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems. • All mitigation measures will be incorporated into contractual documents of subcontractors.

5.8 Conclusions

The total energy usage resulting from decommissioning the Tyne platform is estimated to be 268,222 GJ, of which approximately 94% can be attributed to vessel and helicopter use offshore. Standard mitigation measures have been identified to minimise energy usage by project vessels.

The total CO_2 emissions resulting from decommissioning the Tyne platform is estimated to be 20,143 tonnes, of which 93% can be attributed to offshore helicopter and vessel usage. Standard mitigation measures have been identified to minimise emissions from project vessels.

Emissions from the Tyne decommissioning activities will contribute to global greenhouse gas emissions and have a non-significant cumulative and a negligible transboundary impact. Emissions will be minimised as far as is practicable. Total CO_2 emissions generated by the proposed Tyne facilities decommissioning operations will represent a very small proportion (<0.2%) of the of the total annual CO_2 offshore emissions from the UKCS in 2016 (13,124,012 tonnes; Oil and Gas UK, 2017). Emissions from the Tyne decommissioning activities will contribute to greenhouse gas emissions and have a non-significant cumulative and transboundary impact.

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6 UNDERWATER NOISE

Sound is important for many marine organisms with marine mammals, fish and certain species of invertebrates having developed a range of complex mechanisms for both the emission and detection of sound (Richardson et al., 1995). For example, cetaceans (whales, dolphins and porpoises) use sound for navigation, communication and prey detection. The introduction of anthropogenic underwater noise has the potential to affect the behaviour of, and in some cases injure, marine organisms. Underwater noise may cause animals to deviate from normal activities, potentially interrupting feeding, mating, socialising, resting or migration. This may impact body condition and reproductive success of individuals or populations (Southall et al. (2007); Richardson et al. (1995)). Feeding may also be affected indirectly if noise disturbs prey species (Southall et al. (2007); Richardson et al. (1995)). The proximity to the source of underwater noise is critical when evaluating the impact to marine species. Noise levels in the marine environment decline with increased distance from the source (dispersion in three dimensions) and through absorption by the water (Richardson et al., 1995).

This section will consider the noise generated during the Tyne Field decommissioning activities, and the potential impact on marine organisms. Information to compile this section has been taken from Tyne decommissioning operations – underwater noise assessment technical note (BMT Cordah, 2017b).

6.1 Regulatory Context

Under Regulations 41(1)(a) and (b) of the Conservation (Natural Habitats and c.) Regulations 1994 (as amended) and 39(1) (a) and (b) in the Offshore Marine Conservation (Natural Habitats, and c.) Regulations 2007 (amended 2009 and 2010), it is an offence to deliberately:

- Capture, injure or kill any wild animal of a European Protected Species (EPS).
- Disturb wild animals of any such species.

Disturbance of animals is defined under the Regulations and includes in particular, any disturbance which is likely to impair their ability to:

- Survive, breed, rear or nurture their young; or
- Hibernate or migrate (where applicable); or
- Significantly affect the local distribution or abundance of the species to which they belong.

In a marine setting, EPS include all the species of cetaceans (whales, dolphins and porpoises) (JNCC, 2010). As underwater noise has potential to cause injury and disturbance to cetaceans, an assessment of underwater noise generated by the decommissioning operations is required in line with guidance provided by the JNCC (JNCC, 2010).

6.2 Approach

There is a potential for certain Tyne Field decommissioning activities to produce underwater noise resulting in environmental impacts. The primary noise sources associated with the proposed decommissioning operations, along with expected noise levels, were identified. A review of sensitive receptors was undertaken, and potentially significant impacts were identified based upon accepted thresholds. Potential issues related to transboundary and cumulative impacts were also identified.

6.3 Sources of Potential Impacts

The sources of sound associated with the proposed Tyne Field decommissioning will vary depending on which decommissioning options are selected. However, the main potential sources are:

- Use of vessels, with inherent use of dynamic positioning (DyP), for transportation and to carry out decommissioning operations, and;
- Jacket cutting; and;
- Use of explosives for the cutting of well tubing during P&A operations.

The typical level and frequency of sound generated by each source was obtained from published studies (reviewed by Genesis (2011)) and summed accordingly to generate a cumulative sound level.

For this study, sound propagation from the source was determined using the Marsh-Schulkin model (Schulkin and Mercer, 1985) and the worst-case scenario as detailed above, was used throughout. This model applies to acoustic transmission in shallow water (up to about 185 m) and represents sound propagation loss in terms of sea state, substrate type, water depth, frequency and the depth of the mixed layer. In order to model the worst-case scenario, it was assumed that all sources will operate at all times during each activity. In reality, this is unlikely, and the source level may therefore be lower than predicted within this assessment.

6.3.1 Vessels

Most oil and gas decommissioning activities are typically dominated by vessel noise which is continuous and is not captured within the Marine Safety Framework Directive (MSFD) descriptor for loud, low and mid-frequency impulsive sounds. Broadband source levels for these activities rarely exceed about 190 dB re 1 µPa m and are typically much lower (Hannay & MacGillivray (2005); Genesis (2011)). Whilst continuous noise can mask biologically relevant signals such as echolocation clicks, the sound levels are below the threshold levels for Temporary Threshold Shift (TTS) (a temporary hearing loss) in cetaceans, according to the Southall et al. (2007) criteria (Genesis, 2011).

The level and frequency of sound produced by vessels is related to vessel size and speed, with larger vessels typically producing lower frequency sounds (Richardson et al., 1995). Noise levels depend on the operating status of the vessel and can therefore vary considerably with time. In general, vessels produce noise over the range 100 Hz to 10 kHz, with strongest energy over the range 200 Hz to 2 kHz.

It is anticipated, based upon previous studies that the subsea noise levels generated by surface vessels used during the decommissioning phase are unlikely to result in physiological damage to marine mammals. Depending on the ambient noise levels, sensitive marine mammals may be locally disturbed by noise from a vessel in its immediate vicinity, however, the impact is not expected to be significant.

Various combinations of vessels will be on site during the decommissioning operations and for the purposes of modelling it has been assumed that a maximum of eight will be operating in the area at any one time. Source levels resulting from a previous study (Hallett (2004)) giving the average of ten merchant ships (lengths 89 to 320 m, average 194 m) during entry or exit to port were used as a basis for this assessment; note that the standard deviation around the mean source level was given as 5 to 10 dB. This data is more conservative than many of the published examples for specific construction and support vessels.

For continuous sound such as shipping noise, it is usual to use a measure of the total sound intensity of a signal. However, the larger zero-to-peak values have been used in the modelling to illustrate the worst-case scenario.

6.3.2 Jacket Cutting

The jacket members and associated caissons, conductors and risers will be severed internally at the seabed using either diamond-wire cutting or abrasive water jetting tools. If this is not possible, the jacket members will be severed externally using the same methods and an ROV. Underwater noise from jacket cutting is expected to be temporary and short-term. No studies are currently available in the literature referring to noise assessments from jacket cutting. However, it may be possible that any target species in the immediate vicinity at the time of cutting activities could be temporarily disturbed.

6.3.3 Use of Explosives during Well P&A

The production tubing from four of the wells require severing at varying depths below the mudline (approximately 168 m (T1Z); 161 m (T2); 146 m (T3A); and 147 m (T4A)). The use of explosive for the fifth well (T6) was not required as the production tubing from this well has already been removed as part of the P&A activities in 2016. One explosive charge of 0.076 kg of explosive (HMX) per well was used for cutting the tubing and placed at depth ranging from 146 to 168 m below the mudline. The cutter was deployed using slickline, it is run in hole (RIH) to the cut depth inside the production tubing, which is encased by the inner casings and the outer conductor pipe which runs from below the cut depth to the platform deck. The production tubing and inner casing strings are fully contained within the outer conductor pipe and not exposed to the sea. At no time before or after the cut are the charges open to the sea. After cutting the cutter was removed from the production tubing using the slickline winch. A new cutter bottom hole assembly (BHA) was prepared prior to deployment in the next well. Each explosive charge per well was detonated one at a time. The explosive cutting was performed from the Tyne installation and supported by the Seafox 1 Jack-up barge and a support vessel.

During the proposed operations, noise was generated from the use of vessels, down-hole (casing confined) explosives to sever the production tubing within each well, and cutting equipment to sever the well conductors and casings. Table 6.1 presents the worst-case noise levels associated with these activities.

Table 6.1 Worst-Case Noise Levels Associated with the Tyne Dismantling Operations

Activity	Sound Type [1]	Frequency Range [2]	Noise Level [3]
Use of cutting equipment	Non-pulse	200 Hz - 1 kHz	148 to 180 dB re 1 µPa [5]
Use of explosives	Single-pulse	6 Hz - 100 kHz [4]	258 dB re 1 µPa 1 m

[1] Classification based on Southall et al. (2007).

[2] Hz, Hertz; kHz, kilohertz.

[3] dB re 1 µPa 1 m, decibels relative to one micro-Pascal at 1 metre.

[4] With near-peak energy at relatively low frequencies of 10 Hz – 200 Hz before attenuation.

[5] There is currently limited published data on the sound generated by underwater cutting or other tools. Peak source levels of 148 to 180 dB re 1 µPa are reported for a range of diver operated tools including drills, saws, grinders, water jetters, rock breakers, wrenches and cutters (Anthony et al., 2009).

Most noise energy from cutting equipment tends to be low-frequency (200 Hz – 1 kHz) and, consequently, is generally out with the hearing range of most cetaceans. As the use of these tools tend to be short-term, it will not be considered further.

The worst-case noise level associated with the use of explosives of 258 dB re: 1µPa at 1 metre was estimated for the detonation of 90 kg of explosives under 'open water' (unconfined) conditions (PUK, 2013). This noise level was provided to PUK the contractor carrying out the work and has previously been supplied to PUK for a planned explosives project in 2013. However in reality, the proposed operations only 0.076 kg of explosive will be used per cut and the explosives will be placed at a minimum depth of 146 metres down-hole (below the seabed) and will be confined within the well casings at all times (i.e. no time, before or after the cut, will the charges be open to the sea). Studies have indicated that the downhole detonations at depths of approximately 5 metres can reduce the amount of received energy in the water column by as much as 60 % (Dzwilewski and Fenton, 2003).

6.4 Impact on Sensitive Receptors

Underwater noise can affect the behaviour of, or may cause injury to, several different marine taxa, in particular marine invertebrates, fish and marine mammals such as pinnipeds and cetaceans. Behavioural changes will vary from a minor change in direction to confusion and altered diving behaviours, which may have varied medium and long-term effects on the individual.

One of the most critical issues in relation to behavioural effects of sound on marine mammals and fish is whether anthropogenic sound interferes with, or masks, the ability of the animal to detect and respond to biologically relevant sounds (Popper et al., 2014). In effect, masking raises the threshold for detection by an animal and the degree of masking is related both to the level of the masking noise and the frequencies that it contains.

6.4.1 Marine Invertebrates

There have been few studies of the effects of underwater noise on marine invertebrates (Hawkins et al, 2014; Morley et al., 2013; Cheesman et al., 2012). Roberts et al. (2016) found that anthropogenic substrate-borne vibrations resulting from noise pollution have a clear effect on the behaviour of a common marine crustacean, *Pagurus bernhardus*. They suggested that further research is required to understand the long term effects of underwater noise on marine crustaceans. Hence, although marine invertebrates may be affected by the decommissioning activities, there is insufficient knowledge currently available to be able to make an assessment.

6.4.2 Fish

Many species of fish use sound for location of prey, avoidance of predators and for social interactions. The inner ear of fish including elasmobranchs (sharks, skates and rays) is very similar to that of terrestrial vertebrates, and hearing is understood to be present among virtually all fish (NRC, 2003). The sensory systems used by fish to detect sounds are very similar to those of marine (and terrestrial) mammals and hence sounds that damage or in other ways affect marine mammals could have similar consequences for fish (Popper and Hastings, 2009). In considering the impact of anthropogenic sounds upon fish it is useful to place fish into different functional categories, depending on their structure and degree of hearing specialisation (Popper et al., 2014; Cheesman et al., 2012). Fish may tentatively be separated into:

- Category I - Fish with no swim bladder or other gas volume (particle motion detectors);
- Category II - Fish with a swim bladder or other gas volume, and therefore susceptible to barotrauma, but where the organ is not involved in hearing (particle motion detectors); and,
- Category III - Fish with a swim bladder or other gas volume, and therefore susceptible to barotrauma, where the organ is also involved in hearing (sound pressure and particle motion detectors).

Fish species vary in many ways, anatomically, physiologically, ecologically and behaviourally in their response to sound, such that a guideline for a behavioural response can never fit all fish (Popper et al., 2014). Many finfish species in response to anthropogenic noise display an alarm of tightening schools, increased speed and moving towards the seabed (Fewtrell and McCauley, 2012; McCauley et al., 2003).

Most fish respond to the particle motion component of sound waves whereas marine mammals do not. Animals near the seabed may not only detect water-borne sounds, but also sound that propagates through the substrate and re-enters the water column (Popper et al., 2014).

Reviews on the effects of anthropogenic sound on fishes concluded that there are substantial gaps in the knowledge that need to be filled before meaningful noise exposure criteria can be developed (Popper et al., 2014; Popper and Hastings, 2009). However, injury thresholds have been proposed for Category II and III fish (> 207 dB re 1 µPa m) and Category I fish (> 213 dB re 1 µPa m) (Popper et al., 2014). These thresholds suggest that no injury will occur to the fish as the maximum source level for the decommissioning operations is likely to be 198 dB re 1 µPa m.

6.4.3 Pinnipeds

Pinnipeds (seals, sea lions and walruses) also produce a diversity of sounds, although generally over a low, restricted bandwidth (generally from 100 Hz to several tens of kHz). Their sounds are used primarily in critical social and reproductive interactions (Southall et al., 2007). Available data suggest that most pinniped species have peak sensitivities between 1 and 20 kHz (NRC, 2003). However, the data available on the effects of anthropogenic noise on pinniped behaviour are limited.

Grey seals and harbour or common seals are resident in UK waters and occur regularly over large parts of the North Sea (SMRU, 2001). Both species are found predominantly along the UK coastline but there are few data available on the distribution and abundance of seals when offshore. Tracking of seals suggests they make feeding trips lasting 2 to 3 days, normally travelling less than 40 km from their haul-out sites, and with the animal ultimately returning to the same haul-out site from which it departed (SMRU, 2001). Grey seals may spend more time further offshore than common seals. The location of the Tyne Field is close to the known offshore feeding site for both grey and common seals on the Dogger Bank and hence they may be found in the vicinity of the proposed decommissioning activities (Jones et al., 2013).

6.4.4 Cetaceans

Cetaceans use sound for navigation, communication and prey detection. Anthropogenic underwater noise has the potential to impact on marine mammals (JNCC (2010); Southall et al. (2007); Richardson et al. (1995)). Several species of cetacean have been recorded in the Tyne Field area, in particular Harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, Atlantic white-sided, long-finned pilot whale and Minke whale (Table 6-1). The modelling period for the decommissioning operations has been extended to run throughout the year to allow for contingency.

The Tyne infrastructure is also located within the Southern North Sea cSAC (Figure 3-15), which is designated as an area of importance for harbour porpoise. Harbour porpoise are listed under Annex II of the EC Habitats and Species Directive as species whose conservation requires the designation of SACs (JNCC, 2017e). During the expected period of operations (July to August, 2017), harbour porpoise are expected to be present in low to very high numbers (Table 6.1).

6.4.5 Characterisation of hearing sensitivities

Currently available data (via direct behavioural and electrophysiological measurements) and predictions (based on inner ear morphology, modelling, behaviour, vocalisations, or taxonomy) indicate that not all marine mammal species have equal hearing capabilities in terms of absolute hearing sensitivity and the frequency band of hearing (NOAA, 2015). Consequently, vulnerability to impact from underwater noise differs between species. Southall et al. (2007) classified the "hearing types" of different marine mammal species (Table 6-2).

Table 6-1: Seasonal cetacean sightings around the Tyne field (Quadrants 43 and 44) and surrounding quadrants.

Cetacean	J	F	M	A	M	J	J	A	S	O	N	D
Minke whale												
Long-finned pilot whale												
Bottlenose dolphin												
Common dolphin												
White-beaked dolphin												
Atlantic white-sided dolphin												
Harbour porpoise												

Cetacean	J	F	M	A	M	J	J	A	S	O	N	D
Key – sightings												

	Very High ≥ 0.5 animals per km		High (0.2 to 0.49 animals per km)		Moderate (0.10 to 0.19 animals per km)		Low (0.01 to 0.09 animals per km)		No Sightings

Source: UKDMAP (1998)

Table 6-2: Functional cetacean hearing groups

Cetacean functional hearing group	Estimated auditory bandwidth	Species sighted in the Tyne Field area (Quadrants 43 and 44)
Low-frequency	7 Hz – 25 kHz	Minke whale Long-finned pilot whale
Mid-frequency	150 Hz – 160 kHz	White-beaked dolphin Atlantic white-sided dolphin Bottlenose dolphin Common dolphin
High-frequency	200 Hz – 180 kHz	Harbour porpoise
Pinnipeds in water	75 Hz – 100 kHz	Grey seal Common seal
Pinnipeds in air	75 Hz – 30 kHz	Grey seal Common seal

Source: Southall et al. (2007); UKDMAP (1998); NOAA (2015)

In addition, audiograms were obtained for harbour porpoise, bottlenose dolphin, grey and common seals (Nedwell et al., 2004a) and for white-beaked dolphin (Nachtigall et al., 2008). A generalised Mysticetes (baleen whale) audiogram was obtained and assumed to represent the hearing ability of long-finned pilot whales and minke whales (Tech Environmental, 2006). No audiograms are available for Atlantic white-sided dolphins. However, an audiogram is available for another member of the same genus as the Atlantic white-sided dolphin, the Pacific white-sided dolphin (*Lagenorhynchus obliqidens*) (Tremel et al., 1998); and it has been assumed that members of this genus may have similar hearing characteristics. Note that no audiograms are available for common dolphin.

6.1.1.1 Thresholds for injury and disturbance to marine mammals

The noise level perceived by an animal (the "received noise level") depends on the level and frequency of the sound when it reaches the animal and the hearing sensitivity of the animal. In the immediate vicinity of a high sound level source, noise can have a severe effect causing a permanent threshold shift (PTS) in hearing, However, at greater distance from a source the noise decreases and the potential effects are diminished (Nedwell et al., 2005; Nedwell and Edwards, 2004a), possibly causing the onset of a temporary shift in hearing thresholds (TTS-onset). As noted above, hearing sensitivity, in terms of the range of frequencies and sound levels that can be perceived, varies with species. The minimum level of sound that a species is able to detect (the hearing threshold) varies with frequency.

Southall et al. (2007) undertook a review of the impacts of underwater noise on marine mammals and used this to define criteria for predicting the onset of injury and behavioural response in marine mammals with different hearing characteristics (Table 6-2) when subjected to different types of noise (Table 6-3). The estimated bandwidths have been revised recently by NOAA (NOAA, 2015). This distinction between noise types is required as single and multiple noise exposures at different levels and durations differ in their potential to cause injury to marine mammals. This led Southall et al. (2007) to propose a set of precautionary thresholds for peak sound pressure levels (SPL) and sound exposure levels (SEL) that are likely to lead to injury (PTS) and disturbance to marine mammals for different noise types (Table 6-4).

Southall et al. (2007) recommend assessing whether a noise from a specific source could cause disturbance to a particular species by comparing the circumstances of the situation with empirical studies reporting similar circumstances. JNCC (2010), in their guidance on how to assess and manage the risk of causing "disturbance" to a marine EPS as a result of activities at sea, suggest that marine mammal disturbance is likely to occur from sustained or chronic behavioural response with a severity scoring of five or above according to the scale of Southall et al. (2007). The severity scaling system which ranks the behavioural response from a zero for 'no response' to a nine for 'outright panic, flight, stampede, attack of conspecifics or stranding events'. A behavioural response with a severity scale of five/ six is considered to represent a disturbance, with animals showing noticeable changes in swimming pattern to minor avoidance reactions. These sound thresholds are compared with the predicted sound levels generated by the decommissioning operations to estimate a distance from the activities within which disturbance may occur.

Table 6-3: Functional cetacean hearing groups

Noise type	Definition*	Decommissioning activities
Single-pulse	Brief, broadband, atonal, transient, single discrete noise events; characterised by rapid rise to peak pressure	NA
Multiple-pulse	Multiple pulse events within 24 hours	NA
Non-pulse	Intermittent or continuous, single or multiple discrete acoustic events within 24 hours; tonal or atonal and without rapid rise to peak pressure	Vessel activity, rock-placement, well P&A, underwater cutting

Source: Southall et al. (2007)

Table 6-4: Precautionary thresholds for injury or disturbance to cetaceans

Functional hearing group	Sound measure[1]	Injury threshold for different sound types			Disturbance threshold for single pulse sounds[2]		
		Single-pulse	Multiple pulse	Non-pulse	Single-pulse	Multiple-pulse	Non-pulse
Low-frequency cetaceans	SPL	230	230	230	224	-	-
	SEL	198	198	215	183	-	-
Mid-frequency cetaceans	SPL	230	230	230	224	-	-
	SEL	198	198	215	183	-	-
High frequency cetaceans	SPL	230	230	230	224	-	-
	SEL	198	198	215	183	-	-
Pinnipeds (in water)	SPL	218	218	218	212	-	-
	SEL	198	198	215	171	-	-
Pinnipeds (in air)	SPL	149	149	149	109	-	-
	SEL	144	144	144.5	100	-	-

Notes: [1]In water: SPL – zero-to-peak Sound Pressure Level in dB re 1 µPa; SEL – Sound Exposure Level in dB re 1 µPa2s.

In air: SPL – zero-to-peak Sound Pressure Level in dB re 20 µPa; SEL – Sound Exposure Level in dB re 20 µPa2s. Applies to Pinnipeds (in air) only.

[2]Southall et al., 2007 did not define thresholds for disturbance from multiple pulse and non-pulse sounds. (See text for details)

6.1.1.2 The $dB_{ht(species)}$ alternative approach

The work of Southall et al. (2007) gives a broad indication of suitable sound thresholds for behavioural responses and injury, these can be further clarified by consideration of the alternative approach of Nedwell et al. (2007).

Nedwell et al. (2007) suggest that all species with well-developed hearing are likely to avoid sound when the level exceeds 50 to 90 dB above their hearing threshold and receive damage to hearing organs at 130 dB above their hearing threshold. Species-specific audiograms are used to filter received noise levels according to the hearing ability of a species, giving sound levels in $dB_{ht(species)}$ (loudness of the sound perceived by that species). The distance from the centre of operations to the points at which 130 $dB_{ht(species)}$ and 90 $dB_{ht(species)}$ are exceeded represents an estimate of the limits within which injury (PTS) and likely avoidance might be expected, respectively.

6.5 Noise Modelling Impact Assessment

Underwater sound is characterised with reference to two metrics; its frequency measured in Hertz (Hz) and the sound or intensity of the sound measured in decibels (dB). Sound manifests itself as pressure (i.e. a force acting over a given area). It is expressed in terms of SPL, which use a logarithmic scale of the ratio of the measured pressure to a reference pressure (expressed as decibels relative to one micro-Pascal (dB re 1 µPa)). SPLs are quoted at a standard range from the source, usually one metre (dB re 1µPa at 1 metre). Sound frequency is an important characteristic of the source noise. High frequency sounds are attenuated in seawater more quickly than low frequency sounds: for example, a 100 Hz sound may be detectable after travelling hundreds or even thousands of kilometres, whereas a 100 kilohertz (kHz) sound may travel for only a few kilometres (Swan et al., 1994; MMC, 2007).

Underwater sounds spread spherically from the noise source to a range approximately equal to water depth. This is followed by the cylindrical spreading of sound waves (FAS, 2010). As sound spreads underwater, it decreases in intensity (attenuates) with distance from the source. The rate of attenuation is affected by a number of factors including sound absorption or scattering by organisms in the water column, reflection or scattering of the sound wave at the seabed (which varies depending on sediment type), water temperature, stratification, salinity and weather (Munk and Zachariasen, 1991; Richardson et al., 1995). Various models for calculating the propagation of underwater sound have been proposed. The model proposed by Richardson et al. (1995), which assumes spherical spreading, is the most widely used, and is shown below:

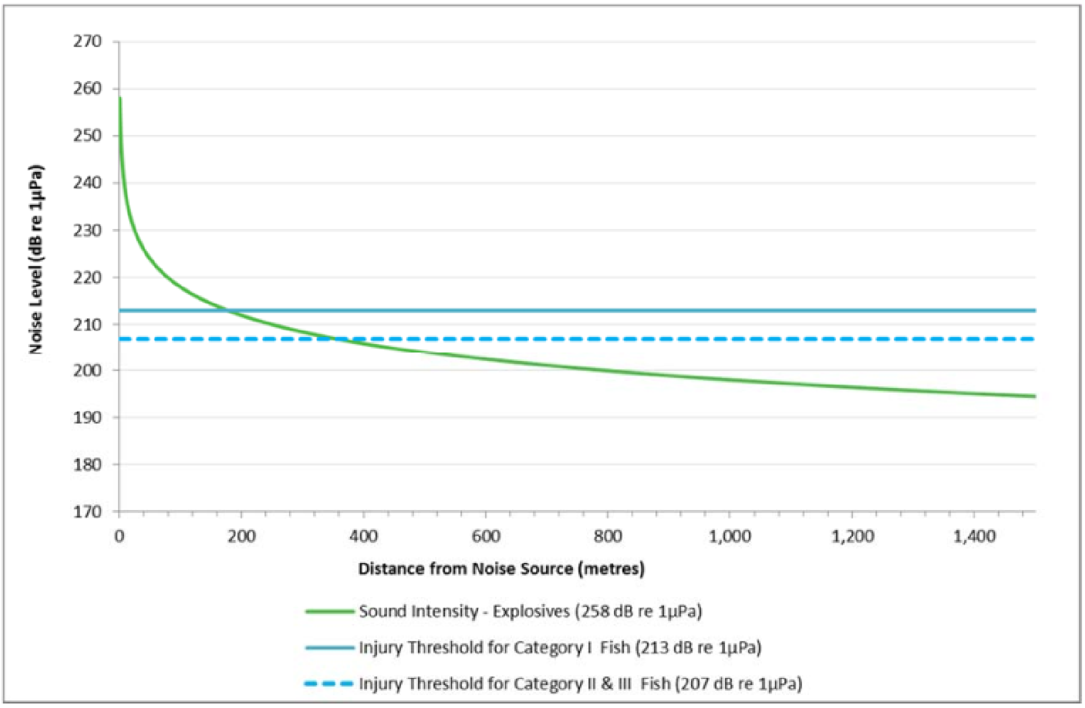
Transmission Loss = 20Log(R/R0) dB

- Spherical spreading is assumed.
- R0 = the reference range, usually 1 metre.
- R = the distance from the reference range.

This provides a measure of sound given to a 1-metre reference distance but is based on a number of assumptions; sound transfer is through a homogenous medium (i.e. no attenuation due to variations in temperature, salinity, bathymetry etc.) and infinite space for the sound wave to spread. This method provides a conservative estimate of sound propagation with distance as it struggles to extrapolate sound attenuation in the near field (within tens of metres of the noise source), due to interference between sound waves and reverberation and therefore generally overestimates transmission of sound from the source. As such, it is considered sufficient to examine a ‘worst-case’ scenario for noise impacts on marine fauna and has been used to assess the potential effects of underwater noise from the proposed operations.

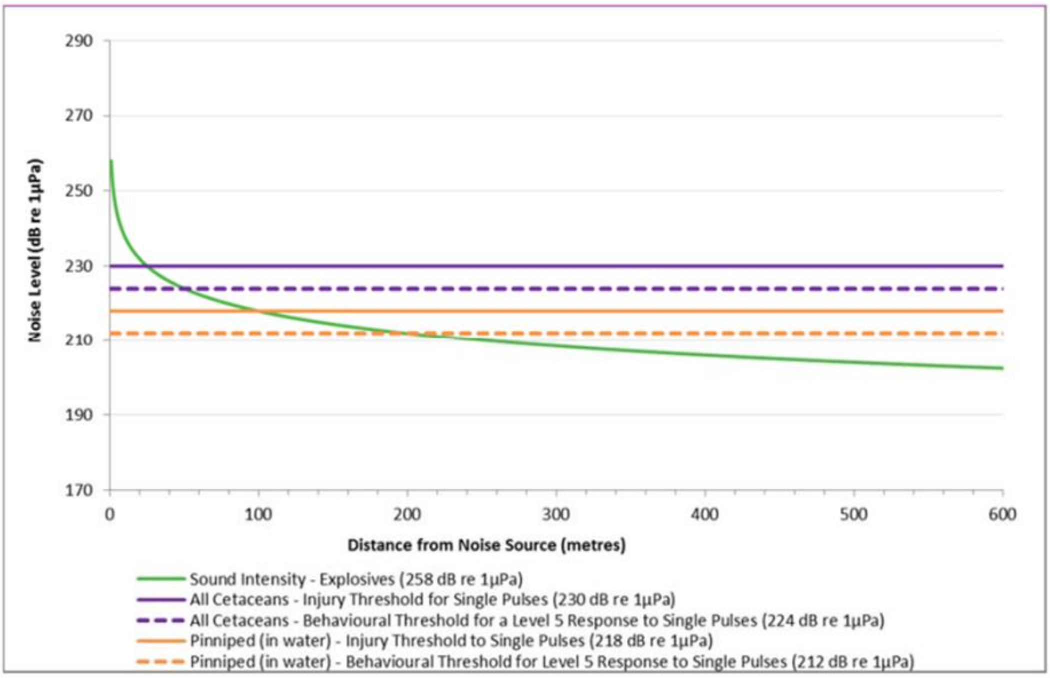
6.5.1 Potential Impact on Fish

Figure C.1. Sound Propagation in Water from the Use of Explosives (assuming spherical spreading) Against Fish Injury Criteria in relation to Single-Pulse Noise (after Popper et al., 2014)



6.5.2 Potential Impact on Marine Mammals

Figure C.2. Sound Propagation in Water from the Use of Explosives (assuming spherical spreading) Against Marine Mammal Injury and Significant Behavioural Disturbance Criteria in relation to Single-Pulse Noise (after Southall et.al., 2007)



6.6 Cumulative and Transboundary Impacts

The Tyne installation is located approximately 22 km from the UK/ Netherlands median line. At this distance, noise levels from explosive cuttings, the greatest source of sound associated with the Tyne Field, would attenuate to a level lower than that likely to cause injury or temporary displacement to any cetacean species. Therefore, there is unlikely to be a transboundary impact from the noise generated by the decommissioning activities.

The Tyne installation lies on the north eastern fringe of a number of currently producing gas fields. The closest surface infrastructure to the Tyne installation is the Munro MH platform located in Block 44/17, 11.9 km west southwest. The second closest is the Katy KT platform, located 13 kilometres southeast of the Tyne installation. Given the location of the proposed works, and the limited impact of noise related to Tyne decommissioning activities, no cumulative impacts (resulting from cumulative sound sources) are anticipated with other oil and gas installations or fields.

6.7 Proposed Mitigation Measures

PUK operates within a SEMS (Section 11.0) that applies to all oil and gas activities. The proposed activities described in this submission will be carried out in accordance with this management system and with PUK's policy and procedures.

Mitigation measures, in accordance with JNCC guidelines (JNCC, 2010) where available, will be implemented during the proposed decommissioning operations as appropriate (Table 6-8). The JNCC (2010) guidelines for minimising the risk of injury and disturbance to marine mammals from the use of explosives will be implemented throughout any relevant noise generating operations. Two Marine Mammal Observers (MMObs) will be on the vessel. A minimum monitoring zone of 1 km around the explosive source will be established (Table 6-8), although the final radius of the mitigation zone will be decided following consultation with JNCC.

Drilling, cutting, rock-placement and vessel activity are in general not considered by JNCC (2010) to pose a high risk of injury or non-trivial disturbance. The noise impact assessment undertaken supports this view, showing that there is unlikely to be any significant impact on any marine species. It is therefore considered unlikely that further mitigation measures, beyond those naturally adopted from PUK's SEMS, policy and procedures, will be required.

Mitigation measures, in accordance with JNCC guidelines (JNCC, 2010) where available, will be implemented during the proposed decommissioning operations as appropriate (Table 6-7).

Table 6-7: Proposed mitigation measures

Potential source of impact	Proposed mitigation measures
Underwater noise from construction activities, including vessel operations	• Machinery and equipment will be in good working order and well-maintained. • The number of vessels utilising dynamic positioning will be minimised.
Underwater noise from explosive sources	• Accurately determine the amount of explosive required so that the amount is proportionate to the activity and not excessive. • Plan the sequence of multiple explosive charges so that, wherever possible, the smaller charges are detonated first to maximise the 'soft-start' or 'ramp up' effect. • Only commence explosive detonations during the daylight hours and good visibility (observers should be able to monitor the full extent of the mitigation zone). Plan explosive detonations so that the scheduling will reduce the likelihood of encounters with marine mammals. For example, this might be an important consideration in certain areas/ times, e.g. during seal pupping periods near SACs for common seals or grey seals • Using trained MMO personnel, commence pre-shooting searches for marine mammals at least one hour prior to detonation. This search will be undertaken within a mitigation zone of at least 1,000 m radius around the operations, leading to a delay in detonation if marine mammals are detected. • Use trained Passive Acoustic Monitoring (PAM) operatives to deploy and monitor hydrophones[1] in the water column to detect vocalising marine mammals, also leading to a delay in detonation if marine mammals are detected within the mitigation zone. • Explosive detonations should not be undertaken within 20 minutes of a marine mammal being detected within the mitigation zone. If a marine mammal is observed, or acoustically detected, within the mitigation zone, it should be monitored and tracked until it moves out of range. If the marine mammal is not detected again within 20 minutes, it can be assumed that it has left the area and the detonation may commence. If an animal has been detected acoustically, the PAM operative should use a range indication and their judgement to determine whether the marine mammal is within the mitigation zone. • Use Acoustic Deterrent Devices which have the potential to exclude animals from the shooting area. • Continue pre-detonation search and soft-start to cover any breaks in shooting. • Report shooting activity and any marine mammal detections via the MMO report submitted upon completion to JNCC.
	• Machinery and equipment will be in good working order and well-maintained. • The number of vessels utilising dynamic positioning will be minimised.

Notes: 1. PAM equipment can be used with reasonable effectiveness during mitigation for some cetacean species. The harbour porpoise and other small odontocetes (e.g. porpoise species and Cephalorhynchus dolphins) are known to emit regular high-frequency echolocation clicks. If these clicks are detected, then animals are generally within a few hundred metres of the PAM system. However, research has shown that aside from these species, the use of PAM equipment for mitigation purposes for other cetaceans should not be considered to represent a reliable sole method but rather supplementary to the use of MMOs (MMOA, 2012).

6.8 Conclusions

The subsea noise levels generated by surface vessels used during the decommissioning operations of the Tyne Field are very unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally displaced by noise from a vessel in its immediate vicinity, or by any other continuous noise source during the decommissioning activities at the Tyne Field. However, the impact is not expected to be significant.

Records indicate previous sightings of up to seven cetacean species and two pinniped species within the study area during the year. These species are all subject to regulatory protection from injury and disturbance and notably the Tyne infrastructure is located within the boundary of the Southern North Sea cSAC, which is designated due relatively high numbers of harbour porpoise.

Sound levels resulting from vessel operations attenuate to ambient levels within a few kilometres of the sound source. As such it is unlikely that produced sound would have any effect on fish behaviour that would be noticeable at a population level, when considering the limited spatial extent of the sound generated and the generally fluid, mobile nature of fish populations.

Of note is that the modelling is based on a conservative worst-case scenario of an unconfined blast within the water column. All explosive sources used in the decommissioning of Tyne will be located within a double walled production casing below the seabed, at a minimum of 146 m below the mud-line. Dzwilewski and Fenton (2003) studied the phenomenology of explosive detonations below the seafloor and in offshore structural elements such as piles. They also performed parametric numerical simulations that covered a range of typical pile diameters, wall thickness, and explosive weight. Results revealed that for a 50 lb explosive below the mudline inside of a pile absorbed as much as 60% more of the energy than a 50 lb explosive in open water. Based on Dzwilewski and Fenton (2003), it is anticipated that the energy and impacts associated with the explosives downhole at the Tyne wells will be significantly less than those indicated by the worst-case scenario modelled within the water column.

The subsea noise levels generated by surface vessels used during the decommissioning operations are very unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally displaced by noise from a vessel in its immediate vicinity, or by any other continuous noise source during the decommissioning activities at the Tyne Field. However, the predicted impact is not expected to be significant.

The Tyne Field is 184 km east of the nearest UK coastline (Flamborough Head) so it is unlikely that grey and common seals would be regularly found in the vicinity of the proposed development.

PUK will re-assess the decommissioning noise levels and the possible impact on protected species closer to the start of the activities and discuss the results with JNCC. Agreements will then be made to put in place appropriate mitigation measures, if required.

7 SEABED IMPACTS

7.1 Regulatory Context

Seabed disturbance resulting from the proposed decommissioning activities will be managed in accordance with current legislation and standards, as detailed within Appendix A.

7.2 Approach

The Tyne decommissioning activities will require work below, at or near the seabed, which may result in either short-term or long-term disturbance to the seabed sediments and marine organisms. The extent of any disturbance, combined with the seabed type and hydrodynamic conditions during the activities, will determine the burial and smothering from suspended sediments and any direct impact to species or habitats, as described in Table 7-1.

Table 7-1: Summary of potential sources of seabed disturbance and resultant environmental impacts

Decommissioning activity	Environmental impact			
	Suspended sediments	Release of contaminants	Burial and smothering	Change in habitat
Full removal of topsides	Short-term	-	Long-term*	Long-term*
Full removal of jacket and subsea template	Short-term	-	Long-term*	Long-term*
Physical presence of drill cuttings pile in situ		Long-term		

*Only deemed a long-term impact if rock-protection is used for stabilisation of accommodation and lift vessels. This is not anticipated but is considered here as a worst-case scenario.

This section of the EIA also addresses the impact of the Tyne decommissioning activities on the Dogger Bank SAC, as this area is designated for Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' (Section 3). The Tyne installation is located within the boundary of the Dogger Bank SAC.

7.3 Sources of Potential Impacts

The following activities represent worst-case scenarios and will potentially impact the seabed at the Tyne facilities:

- Anchoring and positioning of a jack-up accommodation unit (*Seafox 1*) adjacent to the Tyne installation during well plugging and abandonment (P&A) and preparatory activities (short and potential long-term impacts);
- Positioning of lift vessel on the seabed and the removal of the topsides and jacket (short and potential long-term impacts);
- Possible excavation activities to enable access for a Remotely Operated Vehicle (ROV) and/ or cutting tool (short-term impact);
- Decommissioning of any drill cutting material in situ (noting that the most recent seabed survey (Bibby HydroMap, 2016) did not report on the presence of a drill cuttings pile); and

  Presence of scour basin and seabed morphological/ habitat change following the removal of the installation.

7.3.1 Anchoring and Positioning of Jack-Up Accommodation Unit

Both the seabed sediments and benthos will be impacted by the placement of the *Seafox 1* Jack-up accommodation and multi support unit. Upon commencement of preparatory and P&A operations, the

Seafox 1 will be located to its working position adjacent to the Tyne installation. There will be a seabed impact from the *Seafox 1* spudcans, anchors, anchor chains and the possible use of stabilisation material (four legs, approximately 750 tonnes of material per leg).

Anchors and anchor chains will be used to relocate the *Seafox 1* from its stand-off position (out-with the Tyne installations 500 m safety zone) to its operational position. The maximum deployment time of the anchors (weather permitting) will be approximately 24 to 36 hours, after which they will be fully recovered and stowed as they will no longer be required. No additional seabed impacts are associated with the deployment and recovery of the anchors and anchor chains.

Stabilisation material (rock-placement) will only be required if seafloor instability is encountered. As per HSE guidelines for jack-up rigs (with particular reference to foundation integrity (HSE, 2004)) placing gravel, rock or geotextiles onto the site to prevent scour damage is recommended. PUK will not know if rock-placement is required in order to prevent scour damage until the *Seafox 1* has arrived on location. The amount of rock required (and therefore footprint) is dependent on local bathymetry and sediment structure at the installation. The seabed at Dogger Bank SAC is characterised by a mobile sand streaks, which are actively transported across the seabed, with mobile sand ripples and small sand waves forming where the seabed sediment is thicker (Diesing et al., 2009). It is therefore difficult to predict whether rock-placement will be required during operations. Should rock placement be required, a deposit application will be submitted to BEIS to seek approval for the operation. This application will detail the proposed volume of rock and site specific berm design.

Table 7-2 outlines the worst case seabed disturbance associated with the Seafox 1 positioning. As a worst case scenario, the length of each chain was assumed at 441 m but in reality, the chains will be between 395 and 441 m long. (PUK, 2016h; Figure 7-1 and Table 7-3). Figures 7-1 and 7-2 provide detail of the location and anchoring of the Seafox 1.

Table 7-2: Seafox 1 working position seabed disturbance

Position Name	Location	Description of Disturbance	Total seabed impact (km^2)	Percentage of SAC (12,331 km^2) impacted at seabed
Working position	Latitude: 54° 26' 57.366"N Longitude: 002° 28' 52.918"E	Anchors – (2.586 m x 2.345 m) x 4 anchors	0.00002	0.0000002
		Anchor chains – ((0.076 m chain diameter + 4 m to allow for scour corridor) x 441 m length) x 4 chains	0.007	0.00006
		Spud cans – 4 x 22 m^2	0.00009	0.0000007
		Estimated stabilisation material (rock-placement) - 1.5 m x 3,000 tonnes	0.005	0.00004
Total			**0.012**	**0.0001**

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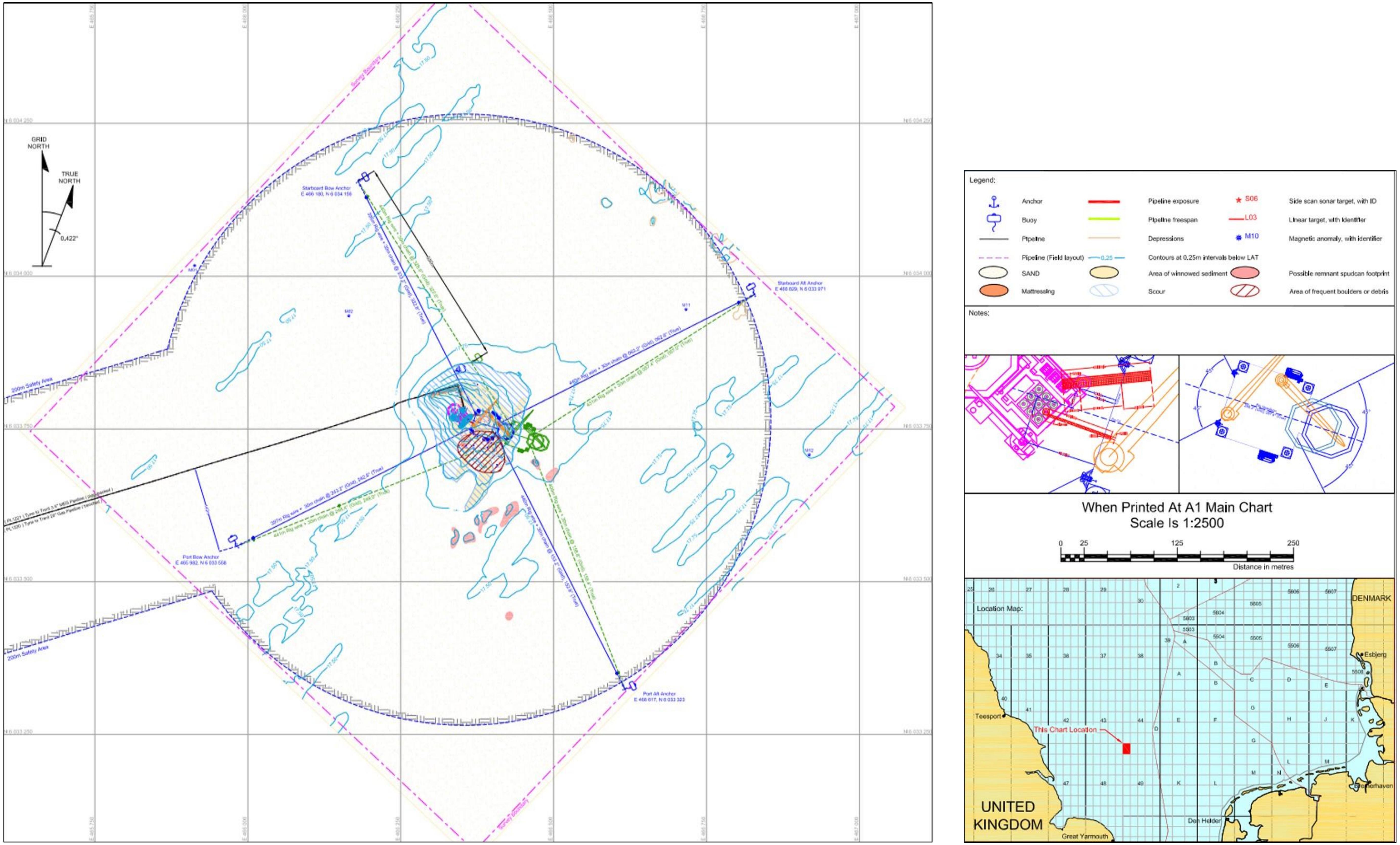

Figure 7-1. Seafox 1 anchor spread and bridge link detail (PUK, 2016h)

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Table 7-3. Seafox 1 location and anchoring detail (PUK, 2016h)

NOTE:-Database content produced using supplied information. MOD Ltd accept no responsibility for the accuracy of this data.

Positional Information and Source Data				
Latitude	Longitude	Easting(m)	Northing(m)	Heading
'TYNE' Platform & Template (At slot D Centre) Source: MOD Project Pr1656 Dated 20/08/2012.				
54° 26' 57.423" N	02° 28' 52.128" E	E 466 355.19	N 6 033 765.24	045.8° (G) 045.4° (T)
'Seafox 1' Proposed Working Position (Bow C/L) Source: CAD Derived				
54° 26' 57.366" N	002° 28' 52.918" E	E 466 369.40	N 6 033 763.38	288.2° (G) 287.8° (T)
'Seafox1' Proposed 60m Stand-Off (Bow C/L) Source: CAD Derived				
54° 26' 56.773" N	002° 28' 56.100" E	E 466 426.40	N 6 033 744.64	288.2° (G) 287.8° (T)

Bathymetry Data:	Taken from Perenco Bathymetry chart; 2016_004_02_BTY_2500. Dated 13/04/2016.
Seabed Features Data:	Taken from Perenco Seabed features chart; 2016_004_01_SBF_2500. Dated 13/04/2016.
Asset Data:	Taken from Perenco_Fieldlayout_17_Apr_2015.

Geodetic Parameters:		Convergence:	0.422° (Grid > True)
Ellipsoid:	Datum:	Projection:	Central Meridian:
International (1924)	ED 50	UTM Grid Zone 31	3° East

Proposed Mooring Summary: Spread Defined As; Bow ± 45.0° / Aft ± 45.0° When Rig In Final Working Position.

RIG ANCHOR	DROP POINT EASTING / NORTHING	DISTANCE & BEARING OF TOTAL DEPLOYED MOORING LINE: FROM WORKING POSITION	DISTANCE & BEARING OF TOTAL DEPLOYED MOORING LINE: FROM STAND-OFF POSITION
STARBOARD BOW	E 466 180, N 6 034 156	425m @ 333.2° (G) 332.8° (T)	470m @ 328.0° (G) 327.6° (T)
STARBOARD AFT	E 466 829, N 6 033 971	470m @ 063.2° (G) 062.8° (T)	461m @ 057.4° (G) 057.0° (T)
PORT AFT	E 466 617, N 6 033 323	470m @ 153.2° (G) 152.8° (T)	430m @ 158.8° (G) 158.4° (T)
PORT BOW	E 465 982, N 6 033 558	427m @ 243.2° (G) 242.8° (T)	471m @ 248.4° (G) 248.0° (T)

MIDLINE BUOY	WORKING EASTING / NORTHING	STAND-OFF EASTING / NORTHING	DISTANCE FROM ANCHOR DROP POINT
PORT AFT	E 466 338, N 6 033 843	E 466 365, N 6 033 859	350m

7.3.2 Jacket Removal

The weight (in air) of the Tyne jacket is <10,000 tonnes and therefore it falls within the OSPAR 98/3 category of steel structures for which derogation cannot be sought. Therefore, the only decommissioning option available for the installation is full removal, as presented in Section 2.

The four piles on the jacket will be cut internally using high pressure water abrasive and removed to, approximately, 3 m below the seabed. If the internal cutting operations encounter problems, excavation of an area around each jacket pile may be required. During excavation, sediment would be excavated by a work class ROV and would be deposited down-current of the jacket piles to undergo natural dispersal with minimal/ short-term impact on surrounding seabed area. Excavation of the footings has therefore been considered as a worst-case scenario.

Excavation of the jacket members and associated caissons, conductors and risers would impact a maximum seabed area of approximately 0.0006 km^2 (Table 7-4). Due to the proximity of the excavation it possible is there may be some overlap in the sediment deposition and this footprint is therefore an overestimate. Given the relatively coarse sediment characteristic of the seabed in this area (Section 3) dispersion of the sediment is expected to be rapid. The cut jacket will be removed from the seabed in a single lift and transported to shore by lift vessel for dismantlement, disposal and recycling.

Table 7-4: Structures and materials with potential to impact on the seabed – jacket removal pile excavation

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SAC (12,331 km^2) impacted at seabed
Tyne jacket	154 m^2 x 4 piles	0.0006	0.000005
Jacket removal total		**0.0006**	**0.000005**

Note: Jacket removal assumptions based on a worst-case scenario excavation of a 14 m diameter pit (1.54 x 10-4 km^2) around each platform pile

7.3.3 Jack-Up Lift Vessel

The vessel contract for the removal of the topsides and jacket has yet to be awarded; it is possible that a jack-up lift vessel will be contracted. To represent a worst-case scenario, calculations have been based on:

- A large lift vessel supported on seabed by six spud cans.

Approximately 6,000 t (1,000 t per leg) stabilisation material for stabilisation. Positioning the vessel spud cans on the seabed will impact a total seabed area of, approximately, 0.0001 km^2 (Table 7-5).

It is possible that stabilising rock berms will be required to provide extra support for the vessel jack-up legs when working at the installation. The rock would be placed at six locations on the seabed as rock berms to support the six jack-up legs. The amount of rock required (and therefore footprint) is dependent on local bathymetry and sediment structure at the installation location. A direction for deposits application will be submitted to the BEIS to seek approval for the commencement of the rock-placement operations at the installation. The volume of rock and berm design will be detailed within the application.

PUK estimate the worst case mass of rock required for the jack-up would be 6,000 t. PUK estimate that 0.009 km^2 of the seabed would be impacted from the installation of the rock berms at the installation (Table 7-5). It is also anticipated that the stabilising rock berms will be used for lifts of both the jacket and the topsides via lift vessel, therefore limiting the impact on the seabed.

Table 7-5: Structures and materials with potential to impact on the seabed – lift vessel installation

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SAC (12,331 km^2) impacted at seabed
Lift vessel spud cans	6 x 22 m^2	0.0001	0.000001
Stabilisation material (rock berms)	1.5 m x 6,000 tonnes	0.009	0.00007
Lift vessel installation total		**0.009**	**0.00007**

7.3.4 Anchored Lift Vessel

An alternative lift vessel requiring anchoring to the seabed may also be selected for the removal of the topsides and/or jacket. As the vessel contract has yet to be awarded, calculations have been based on a worst case scenario:

- Lift vessel operation with a maximum eight-point mooring system;
- Two vessel operations at the installation location (jacket and topside lifts);
- Anchor dimensions of 4.1 x 4.8 m, (based on a 10-tonne (10,000 kg) ‘flipper delta’ anchor);
- A chain length of 1,250 m, a maximum seabed contact length of 975 m and an average chain width of 0.076 m; and
- The vessel will be moored twice, once for the jacket and once for the topsides.

Table 7-6: Structures and materials with potential to impact on the seabed – anchoring activities

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SAC (12,331 km^2) impacted at seabed
Anchor	(4.1 m x 4.8 m) x 8 anchors x 2	0.0003	0.000002
Chain	(975 m x 0.076 m) x 8 x 2	0.0001	0.0000008

7.3.5 Drill Cuttings Material Decommissioned In Situ

The most recent seabed survey reported on the absence of a drill cuttings pile. Rather the presence of elevated THC levels was reported at one of the 14 sediment sample stations (Bibby HydroMap, 2016). This suggests that any drill cutting muds (analysed as LTOBM) discharged from Tyne has since been dispersed within the wider environment, rather than depositing as a distinct mound on the seabed. Seabed impacts may occur as a result of any disturbance to the remaining drill cutting material, caused by decommissioning activities such as anchoring, and removal of the jacket.

7.3.6 Presence of the scour basin following removal of the installation

A snagging hazard assessment of the scour basin associated with the Tyne installation was undertaken in 2018 (PUK, 2018). This assessment confirmed the presence of a scour basin with a depth of 2.6 m in relation to mean seabed levels and approximate dimensions of 48 m wide and 120 m long (Figure 2-5). Using indicative infill rates extrapolated from the Welland field infill rate post decommissioning, and scaling the infill rate for seabed current speeds and the cross-sectional area of the respective scour basins, it is estimated that the depth of the Tyne scour basin will reduce by approximately 1 m in the first year and 2 years after 8 years (PUK, 2018). Given the gradual rate of sediment redistribution, it is not anticipated that there will be any significant impact on the seabed habitats or the fauna therein. Over time, the infill of the scour basin will return the seabed to pre-installation conditions. The impact of this change has therefore not been considered in the proceeding impact sections.

7.4 Short- and Long-Term Impacts

The seabed impacts resulting from the decommissioning activities associated with the Tyne installation can be classified as short or long-term. Short-term impacts can be defined as those which have transient impacts lasting a few days to a few years. Long-term impacts are those which will continue to have an impact for decades to centuries following decommissioning.

7.4.1 Short-Term Impacts

Excavation and anchoring activities will be temporary and will have a short-term impact on the local benthic environment in the Tyne decommissioning area. The likely short-term impacts arising from these activities can be summarised as:

- Sediment disturbance within the water column; and
- Fauna disturbance.

7.4.2 Long-Term Impacts

- Habitat change;
- Seabed morphological change; and
- Fauna disturbance.

7.5 Short-Term Impacts on Sensitive Receptors

The following sections provide an overview of the current understanding of the seabed environment in the Dogger Bank SAC (Figure 3-2), enabling an assessment to be made of the spatial and temporal extent of the short-term impacts.

7.5.1 Sediment Disturbance

Sediments in the vicinity of the Tyne facilities are relatively uniform, predominantly comprising sand with varying levels of gravel and shell material (Section 3; BGS, 2015; Bibby HydroMap & Benthic Solutions, 2016). The 2012 Tyne debris search survey observed that the majority of the survey area is characterised by a medium reflectivity seabed, interpreted to be sandy, with locally present sand ripples (N-Sea, 2012). Shells and or shell fragments were noted to be present around the Tyne installation and in elongated patches in the northern and eastern part of the survey area (N-Sea, 2012). A survey conducted in 2017 confirmed the presence of an oval scour basin surrounding the Tyne installation, this measured approximately 120 m in length and 48 m in width with a depth in relation to the surrounding mean seabed of 2.6 m.

The proposed excavation, cutting and anchoring operations will physically disturb the sediment in the local area. The disturbance to the sediments will be short-term, localised and confined to an estimated area of impact of approximately 0.02 km^2, accounting for approximately 0.0002% of the total area of the SAC (Table 7-9).

Table 7-9: Decommissioning activities with short-term potential to impact on the seabed and benthic fauna

Activity	Total seabed impact (km^2)	Percentage of SAC (12,331 km^2) impacted at seabed	Table reference
Jack-up (*Seafox 1*) placement*	0.012	0.0001	7-2
Jacket removal	0.0006	0.000005	7-4
Lift vessel installation**	0.009	0.00007	7-5
Total short-term impact	**0.02**	**0.0002**	

**Includes anchoring and spud can support. **Only includes spud can support as this has a greater impact than anchoring when considering a worst-case scenario*

Sediments that are redistributed and mobilised as a result of the proposed decommissioning activities will be transported by the seabed currents before settling out over adjacent seabed areas. The hydrodynamic conditions (Section 3.2.2) will result in suspended sediment, in particular the fine particles (fines), being transported away from the source of the disturbance. The natural settling of the suspended sediments is such that the coarser fraction (sands and gravels) will quickly fall out of suspension with the less dense material being the last to settle. This natural process will ensure that all the suspended sediment is not deposited in one location. Based on the seabed mobility in the area, as indicated by the absence of a drill cuttings pile around the drilling template within the SAC, the deposition resulting from the proposed decommissioning activities is likely to be comparable to the background sediment redistribution processes.

The pre-decommissioning EBS commissioned by PUK in April 2016 was intended to verify the presence/ absence of drill cutting debris within the wider Tyne Development area. Although no direct drill cuttings pile was identified, the survey did note the presence of drill cutting contamination at one data collection site, approximately, 50 m downstream of the Tyne installation location (Bibby HydroMap, 2016) coincident with the residual currents in this area (BEIS, 2016; Figure 3-6). THC levels were found to be above the OSPAR (2006) 50mg/kg^{-1} threshold above which adverse effects on seabed invertebrates may be noted. However, it should also be noted that no evidence of elevated THC levels were observed at any other data collection stations around the Tyne installation or pipelines. Given the energetic hydrodynamic conditions and associated mobile seabed environment of the southern North Sea in conjunction with the confirmation of the scour basin surrounding the Tyne installation, it is expected that any cuttings generated during historic drilling operations have been widely distributed away from the site. The jacket removal and any excavation activities around the area of contamination are therefore expected to have a minimal impact on the further dispersion of drill cuttings. There is potential for seabed activities associated with the positioning of decommissioning vessels to result in the localised disturbance of contaminated sediments. Any suspended sediments are expected to fall out of suspension as previously described. Given the temporary duration of these activities in association with the limited spatial extent of drill cutting materials, it is expected that any residual effects will be negligible.

Published calculations of wave and tidal current-induced bed shear stress clearly show that large waves have the capability to mobilise seabed sediments, increasing sediment suspension particularly for those sizes of fine sands and smaller (ABPmer, 2012). Further, an assessment of sediment mobility under current conditions in the project area indicates that the tidal conditions are sufficient to result in the suspension and mobilisation of sand sized material (PACE Geotechnics, 2017).

7.5.2 Fauna Disturbance

The Tyne installation is located within spawning grounds for cod, herring, lemon sole, mackerel, *Nephrops,* plaice, sandeel, sole, sprat and whiting (Section 3; Coull et al., 1998; Ellis et al., 2012).

The proposed operations will physically disturb the benthic fauna living on or in the sediment in the local area. The disturbance to benthic fauna will be short-term, localised and confined to an estimated area of impact of approximately 0.02 km^2, accounting for approximately 0.0002% of the total area of the SAC (Table 7-9).

The proposed activities will cause some direct impact to fauna living on and in the sediments. Mortality is more likely in non-mobile benthic organisms whereas mobile benthic organisms may be able to move away from the area of disturbance and return once operations have ceased. Upon completion of the subsea decommissioning activities, it is expected that the re-deposited sediment will be quickly recolonised by benthic fauna typical of the area. This will occur as a result of natural settlement by larvae and plankton and through the migration of animals from adjacent undisturbed benthic communities (Dernie et al., 2003). In a series of large scale field experiments, Dernie et al., (2003) investigated the response to physical disturbance (sediment removal down to 10 cm) of marine benthic communities within a variety of sediment types (clean sand, silty sand, muddy sand and mud). Of the four sediment types investigated, the communities from clean sands (such as those prevalent in the Tyne Field area) had the most rapid recovery rate following disturbance.

Studies of seabed dredging sites indicate that faunal recovery times are generally proportional to the spatial scale of the impact (where the impact is between 0.1 m^2 and 0.1 km^2 (Foden et al., 2009)). Biological recovery is therefore expected to be even quicker in less extensive, dynamic sandy habitats (Hill et al., 2011) such as those observed at the Tyne location. In low-energy areas of the North Sea subject to extensive dredging, local fauna took approximately three years to recover to the original level of species abundance and diversity. Studies of the impacts from anchoring indicate that the faunal recovery from the processes of anchor scarring, anchor mounds and cable scrape is likely to be relatively rapid (1 to 5 years) (DECC, 2011b). Based on the dynamic characteristics of the seabed in the Tyne area, recovery would be expected to be at the lower end of this scale.

A small number of demersal and pelagic fish and their spawning grounds might also be temporarily disturbed by the removal of the structures. There are potential fish spawning areas in ICES rectangles 37F1 and 37F2 for cod, herring, lemon sole, mackerel, *Nephrops*, plaice, sandeels, sole, sprat and whiting (Table 3-12 and Figures 3-11 and 3-12) (Coull et al., 1998; Ellis et al., 2012). The potential release of contaminants from the sediments may affect the early life stages of some fish species spawning during the time of operations. However, fish are highly mobile organisms and are likely to avoid areas of re-suspended sediments and turbulence during the activities. Therefore, the proposed activities are unlikely to have an impact on species populations or their long-term survival. The impact of the release contaminants into the water column during excavation and removal operations will be addressed in Section 9.

7.6 Long-Term Impacts on Sensitive Receptors

The following sections describe the footprint of the infrastructure within the Tyne decommissioning area and the additional footprint that could be created due to the placement of rock for stabilisation on the seabed for the lift vessel.

7.6.1 Habitats Change

Habitat change will result from the introduction of hard substrate (rock-placement) into a predominantly soft substrate environment within the Dogger Bank SAC (Section 3). Annex I habitats occurring within this SAC include “sandbanks which are slightly covered by seawater all the time”. This habitat type comprises an interdependent mosaic of subtidal (and intertidal) habitats (JNCC, 2013).

As organisms associated with hard substrates will be naturally present in the area, the rock stabilisation would provide a relatively small additional rocky habitat for epibenthic organisms. The seabed features that will result from rock-placement may also provide habitats for crevice-dwelling fish (e.g., ling, conger eel and wolf fish) and crustaceans (e.g., squat lobsters and crabs) in addition to attracting fish species to the site (Lissner et al., 1991).

7.6.2 Seabed Morphological Change and the Dogger Bank SAC

Morphological change in the seabed in the Tyne Field area (further to the natural seabed dynamics evident in these areas) may result from the presence of rock placed on the seabed.

The footprint resulting from leaving associated supporting material in situ is estimated to be 0.014 km^2 (Table 7-10), representing 0.0001% of the area of the Dogger Bank SAC (12,331 km^2). In addition to this, there will be a small reduction in the long-term footprint through the removal of the Jacket and its current footprint.

The long-term presence of the rock stabilisation material used for the jack-up lift vessel, could potentially influence sediment dynamics in the Tyne Field area.

Table 7-10: Decommissioning activities with long-term potential to impact on the seabed habitat

Activity	Total seabed impact (km^2)	Percentage of SAC (12,331 km^2) impacted at seabed	Table reference
Stabilisation material for the *Seafox 1**	0.005	0.00004	7-2
Stabilisation material for the lift vessel*	0.009	0.00007	7-5
Total long-term impact within SAC	**0.014**	**0.0001**	-

*Rock-placement for the stabilisation of the Seafox 1 and the chosen lift vessel will have a long-term (as well as short-term) impact on the seabed and has therefore been included in Tables 7-9 and 7-10.

7.7 Cumulative and Transboundary Impacts

Following completion of the proposed decommissioning activities, the total maximum seabed impact is expected to be 0.02 km^2, which represents 0.0002% of the area of the Dogger Bank SAC.

Out with the immediate area of the Tyne installation there are approximately eight platforms, two buoys, 30 subsea structures and 20 subsea pipelines within the SAC, all with varying dimensions and footprints. Based on the lack of information available regarding the physical extent of the footprint, the estimated lifespan and the planned method of decommissioning of these installations, it is difficult to quantify the level of potential cumulative impact from the existing infrastructure within the SAC.

Pipeline stabilisation work has been and is being undertaken by ENGIE E&P UK Limited at other locations within the Dogger Bank SAC. Current deposit consent applications submitted to BEIS by ENGIE E&P UK Limited indicate that approximately 1.4 km^2 of seabed within the Dogger Bank SAC will be impacted by these activities. This represents 0.11% of the area of the Dogger Bank SAC (12,331 km^2). PUK is not aware of any further deposit activity taking place within the Dogger Bank SACI at the time of writing. The cumulative effect of these deposits and others that may be necessary during decommissioning activities at other facilities is not expected to significantly impact the SAC qualifying features.

Consideration has also been afforded to the cumulative impacts resulting from the Tyne decommissioning activities and other activities which have the potential to directly impact the seabed; specifically, and in response to stakeholder comments (Section 1), aggregate dredging and offshore wind farms (as described in Section 3). As shown in Section 3, there are no licensed aggregate sites in the vicinity of the Tyne infrastructure. There is only one offshore wind farm within 40 km of the Tyne installation (Creyke Beck A). Any seabed disturbance resulting from the construction of the offshore wind farms will be temporary and short-term (ABPmer, 2010; Forewind Ltd, 2014a). Further, these activities are unlikely to coincide with the Tyne decommissioning activities. Construction activities for Hornsea are currently scheduled for the period 2018 to 2021 (Hornsea Project One, 2017) whilst for the Dogger Bank Offshore Wind Farm, no activities are scheduled prior to 2021 (Forewind Ltd, 2014b). The Dogger Bank Teesside A & B project EIA considered the seabed area influenced by the introduction of hard substrates by the following developments: Dogger Bank Creyke Beck A & B and Teesside A & B; Hornsea Project One and Two. Effects were concluded to be of negligible significance given the (a) cumulative impact of colonisation of hard substrates and potential change from sedimentary communities to hard substrate communities and (b) potential introduction of non-native species (Forewind Ltd, 2014a). Further, a permanent habitat loss from these six wind farm projects has been quantified at 61.93 km^2, representing 0.09% of similar habitat loss in the southern North Sea (Forewind Ltd, 2014a). Combined with the 0.43 km^2 seabed impact predicted within this EIA, it can be considered that the additional influence of the Tyne decommissioning activities will not be a significant additive to the predicted cumulative effects.

The proposed decommissioning activities are located, approximately, 22 km west of the UK/ Netherlands median line. Decommissioning activities are not anticipated to create any transboundary impacts.

7.8 Proposed Mitigation Measures

Mitigation measures to minimise seabed impacts within the Tyne decommissioning area are detailed within Table 7-12.

Table 7-12: Proposed mitigation measures

Potential sources of impact	Proposed mitigation measures
Subsea equipment: cutting, excavation and lifting	Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. Internal cutting techniques will be used.
Anchoring activities	All anchors will be completely removed from the seabed at the end of the decommissioning operations. An overtrawl survey will be undertaken following decommissioning activities and establish whether any additional mitigation is needed.
Protection material: Rock	A rock-placement vessel or CSV with ROV will be used for any rock placement. The rock mass will be carefully placed over the designated areas of the seabed by ROV and/or controlled fall pipe equipped with cameras, profilers, pipe tracker and other sensors as required. This will control the profile of the rock covering and accurate placement of rock on the seabed to ensure rock is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance. Vessel orientation will be reviewed and selected to minimise the requirements for rock whilst allowing for the safe locating of the accommodation work vessel and access, i.e. crane reach to undertake essential scopes of work.

7.9 Conclusions

The *Seafox 1* jack-up accommodation unit will be in place adjacent to the Tyne installation during topside preparatory operations. The anchoring of the *Seafox 1* to the seabed will create some temporary, short-term disturbance of the seabed sediments, over an estimated area of 0.007 km^2. The anchors will be removed from the seabed following preparatory operations. Given the dynamic seabed conditions, recovery of the seabed and associated fauna is expected to be rapid (approximately a year). The use of rock stabilisation material for the *Seafox 1* is not anticipated, but has been considered here as a worst-case scenario. If stabilising rock is required for the support of the *Seafox 1* jack-up legs, the seabed impact would be a further 0.005 km^2 (totalling 0.012 km^2).

The cutting and lifting of the Tyne jacket will create a temporary, short-term disturbance of the seabed sediments, over an estimated area of 0.0006 km^2. This disturbance will be relatively small and occur due to the seabed excavation (where required), the ROV manoeuvring, and the use of cutting equipment. These activities will be controlled to minimise excavation activity and to ensure the accurate placement of cutting and lifting, thereby minimising the risk of sediment disturbance.

The contract for the topsides removal is yet to be awarded and it is possible that a jack-up lift vessel could be utilised. The placement of such a vessel would impact a seabed area of 0.0001 km^2. Recovery of the seabed and associated fauna following the removal of a jack-up lift vessel is expected to be rapid (less than a year). If stabilising rock is required for the support of the jack-up legs, the seabed impact would be approximately 0.009 km^2. Alternatively, anchoring a lift vessel would result in an anchor footprint of 0.003 km^2 within the SAC. All anchors would be removed from the seabed following decommissioning operations and recovery of the seabed and associated fauna is expected to be rapid (approximately a year).

The potential laying of stabilisation material for a jack-up lift vessel and the *Seafox 1* will impact the sediment through long-term, localised modification of the seabed over an estimated area of 0.01 km^2 and short-term physical disturbance caused by suspension of material into the water column. This impact will be mitigated by controlled placement of the rock material to minimise seabed footprint.

The rate of colonisation of new material such as rock in the installation area is difficult to predict, but as organisms associated with hard substrates will be naturally present in the area, the mattresses and areas of rock-placement provide a relatively small additional habitat for epibenthic rock-dwelling organisms.

It is not anticipated that there will be any significant impact on the seabed or the fauna therein from the presence of the scour basin around the Tyne installation. The infill of the scour basin will eventually return the seabed to pre-installation conditions. Based on the low risk associated with the scour basin to other users and seabed habitats or fauna, remedial action associated with the scour basin is deemed not to be required.

Overall, decommissioning the Tyne facilities is expected to impact an area of seabed of 0.02 km^2; 0.002 km^2 of this total area would be located within the Dogger Bank SAC (representing <0.00002% of the total area).

8 SOCIETAL IMPACTS

This section describes the societal impacts associated with the proposed decommissioning activities of the Tyne Field. The assessment of societal impacts is concerned with the human components of the environment and seeks to identify the social and economic impacts on people and their activities (Morris and Therivel, 2009).

8.1 Regulatory Context

Societal impacts resulting from the proposed activities associated with the decommissioning of the Tyne Field will be managed in accordance with current legislation, guidelines and standards, as detailed in Appendix A.

8.2 Approach

During the Tyne Decommissioning Project Comparative Assessment (PUK, 2015d), stakeholder engagement activities (Table 1-2) and the risk assessment of this EIA (Section 4), the activities identified as having a potential societal impact were:

- Post-decommissioning damage to or loss of fishing gear as a result of subsea infrastructure (rock berms) left in situ or seabed deformations, posing potential snagging risks; and
- Onshore impacts associated with the deconstruction, reuse, recycling, treatment and disposal of materials on or near-shore.

The onshore decommissioning yard has not yet been identified and will be finalised during the contracting process. Therefore, the onshore impacts associated with decommissioning are covered at a high level in this assessment and will be subject to further assessment once a decommissioning yard has been selected.

8.3 Sources of Potential Impact

Some aspects of the proposed decommissioning activities have the potential to lead to societal impact and interfere with fishing and shipping activities and activities onshore. These include:

- The presence of material on the seabed following decommissioning, including the possible presence of rock berms which may be introduced to the area adjacent to the current location of the Tyne NUI for vessel stabilisation during decommissioning activities;
- Seabed deformation associated with either the presence of the infrastructure during operation or caused by decommissioning activities.
- The presence of dispersed drill cuttings left to degrade naturally;
- Presence of scour basin following the removal of the installation; and onshore dismantling of structures, transport of materials for treatment, disposal and recycling.

The following provides a description of those societal impacts which have the potential to result from the proposed decommissioning activities.

8.3.1 Interference with Fishing Activities

During the decommissioning operations, navigational conflicts might occur between fishing and decommissioning vessels transiting to and from the site. This could include towed gear vessels being required to alter towing direction, or the fouling of fixed gear markers. Any interference has the potential to extend beyond the immediate vicinity of the Tyne Field, being ultimately dependent upon the location of the decommissioning port(s) and associated transiting routes.

A NRA survey considering fishing vessels > 15 m length was undertaken in the surrounding of the Tyne infrastructure between January 2015 and February 2016 (Anatec, 2016). This survey indicated that the main gear types were beam trawler (39%), bottom otter trawler (23%) and seiners (17%). Fishing vessels were recorded engaged in fishing activities in close vicinity of the Tyne installation, with one vessel located inside the 500 m exclusion zone (Anatec, 2016).

As identified in the NRA survey (Anatec, 2016), the majority of fishing activity in the vicinity of the Tyne Field is by vessels towing mobile gear. Any interaction with vessels is expected to result in changes to fishing patterns, rather than damage to fishing gear. As such it is considered that any loss of income would be insignificant. The magnitude of effect is dependent upon the location of the decommissioning port(s); the precautionary approach adopted within this EIA has assumed that transit routes will be in the vicinity of both fixed and towed gear.

The mandatory 500 m safety zone will remain around the Tyne infrastructure throughout the period of decommissioning operations. As such, it is expected that the majority of decommissioning vessels will be located within this zone and thus any potential interference to fishing vessels is likely to be small. The magnitude of effect will be dependent on the number of days decommissioning vessels (Section 2) are present outside the 500 m zone.

8.3.2 Damage To or Loss of Gear

Once decommissioning has been completed, there is the potential for fishing gear to snag on subsea features, including rock-placement used to stabilise the accommodation barge and lift vessel footings and deformations in the seabed (including objects located within the scour basin below the installation) either caused during operation of the installation or as a direct result of decommissioning activities.

No drill cuttings pile was identified during an EBS survey undertaken in April 2016 (Section 2). However, the survey did note the presence of drill cuttings contamination at a data collection site approximately 50 m downstream of the Tyne installation (Section 2). Whilst there is no drill cutting pile to present a snagging hazard, there is the potential for fishing gear to tow through the contaminated sediments. This may result in low level contamination of either fishing gear or the catch therein. The UKOOA (now OGUK), has conducted several studies showing that catches in proximity of the cutting piles have similar level of HCs and other contaminants in their tissues than catches from those at a greater distance (UKOOA, 2002). In comparison, the Scottish Fishermen's Federation (SFF) have reported that decommissioning trawl sweeps undertaken for the Hutton TLP cuttings pile showed that gears and doors (starboard and port) were covered in a muddy substance with a 'very strong oily smell' (SFF, 2003). However, with no distinct cuttings pile at the Tyne installation, the presence of scouring around the installation and with limited elevation of THC levels expected in nearby sediment samples it is considered very unlikely that fishing gear would be contaminated.

The majority of fishing vessels identified in the NRA (Anatec, 2016) in the vicinity of the Tyne infrastructure were vessels operating demersal gear (otter trawls). In the period, 2010 to 2015, fishing effort showed that that otter trawl gear was dominant (approximately 79% and 96% for ICES Rectangle 37F1 and 37F2, respectively). Vessels operating demersal gear have the highest risk associated with fastening gear on obstructions due to the nature of their activity.

A snagging hazard assessment of the scour basin associated with the Tyne installation was undertaken in 2018 (PUK, 2018). Although this confirmed the presence of a scour basin with a depth of 2.6 m in relation to mean seabed levels, the angle of the internal slopes primarily ranges between 0° and 6°, the threshold for impact to commercial fishing is described as 18° which corresponds to the typical 3:1 ratio used when considering safe overtrawlability when designing rock profiles. As a result, the scour basin itself is not considered to pose a significant risk to commercial fishing activities or operations. Within the basin there were several instances where the slope was in excess of 18°, in all cases this is associated with infrastructure which will be removed or remediated if required. With regards to any materials left in situ following decommissioning and the infill rate of the scour basin, PUK will monitor and mitigate any impacts from these features.

As the decommissioning activities proceed there will be a positive impact as new areas of the sea will ultimately become available to fisheries through the removal of the 500 m safety exclusion zone.

8.3.3 Onshore Impacts

All structural material recovered from the Tyne Field will be transported to shore for dismantling, and recycling or disposal as appropriate. Licensed contractors at licensed sites would undertake processing and as such minimal impacts will arise from the controlled operations. PUK's Duty of Care extends beyond the quayside to ensure that onshore licensed disposal sites undertake all dismantling activities in a responsible manner. It is anticipated that any potential environmental impacts that may occur at any onshore site selected for receiving and dealing with material from the Tyne Field decommissioning would be short-lived, localised and managed. The environmental impacts are expected to be similar to those that have previously arisen during past commercial activities at the site. PUK's approach to hazardous and non-hazardous waste management is outlined in Section 11.

8.4 Impacts on Sensitive Receptors

As stated within Section 8.3, the long-term physical presence of rock-placement has the potential to interfere with fishing gear, leading potentially to a loss of catch/revenue for fishermen. There may also be the potential to disrupt previously established shipping operations in the area, whilst vessels carry out removal and rock-placement/ stabilisation operations.

8.4.1 Impacts on Fishing Activities

Rock stabilisation will only be required should seabed instability be encountered. In this instance, it has been estimated that 750 tonnes of material per leg (four legs) for the accommodation vessel). For the lift vessel (six legs) this volume has been estimated at 1,000 tonnes per leg.

Otter trawls and seabed focussed otter trawls (where large rectangular otter boards keep the mouth of the trawl net open) are the main methods of fishing in ICES rectangle 37F1 and 37F2 in the period 2010 to 2015 (Section 3). Both methods have the potential to interact with rock-placement. The weight and width of fishing gear and the nature of the benthic substrate will ultimately determine the level of impact. Figure 8-1 shows a typical otter trawl gear used on fishing vessels in North Sea crossing a pipeline.

When trawling over rock-placement, graded rock could be dragged off by bottom-towed fishing gear and spread over the seabed. In addition, the rock may cause wear and tear on the net, damage fish when caught and damage or crush the fish when unloaded. Various types of trawl board designs exist. However, the two major designs in common use within UK waters are polyvalent/ rectangular and V-shaped boards (DNV, 2014).

If required for stabilisation, rock will be placed carefully on the seabed and the design of any rock berms will be assessed with overtrawlability in mind (i.e. 3:1 slope and graded rock). Overtrawlability trials will be undertaken during decommissioning and periodically thereafter. If the overtrawl trial fails, additional rock-placement will be installed as soon as practicable.

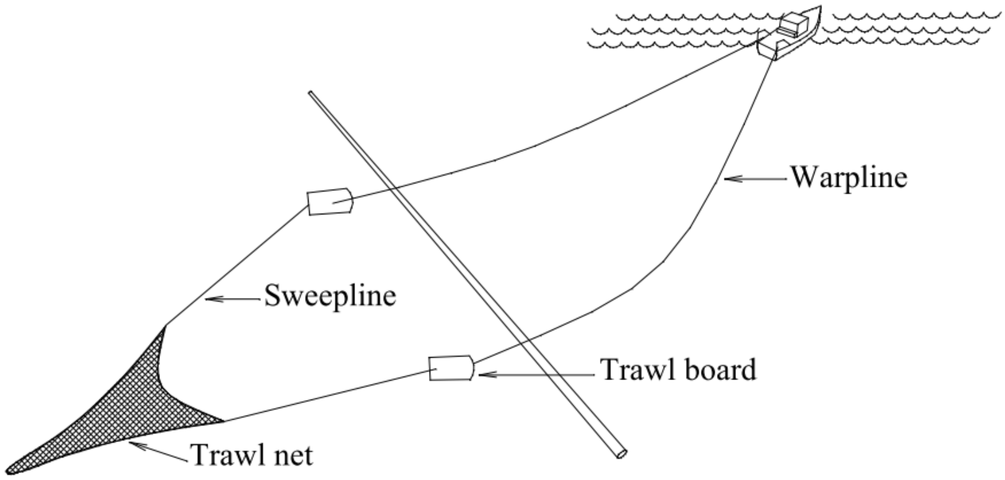

Figure 8-1: Typical otter trawl gear crossing a pipeline (DNV, 2014)

8.4.2 Impacts on Commercial Shipping

The shipping density within the block of interest is stated to be high (Section 3). As the main structures to be decommissioned are contained within the 500 m exclusion zone, the impact on shipping transit and thus commercial shipping is considered to be low (Section 4). Following industry standards and notifications to mariners of planned transit routes, movement of decommissioned infrastructure to the decommissioning port(s) will not pose a significant risk to commercial shipping.

8.4.3 Impacts on Onshore Communities

Onshore activities include dismantling, recovery, transport and recycling of materials onshore. These activities form an integral part of the anticipated Tyne decommissioning activities. These occurrences are anticipated to be temporary, localised to the receiving port, transport route and onshore disposal site and managed under approved licenses. As such, it is considered that these planned activities are unlikely to pose a significant risk to onshore communities.

8.5 Cumulative and Transboundary Impacts

Given the location of the Tyne Field, approximately, 22 km to the west of the UK/ Netherlands median line, there are no transboundary impacts anticipated. The possible rock-placement would be localised and within UK waters, so there will be no transboundary impacts associated with these structures.

There are a number of oil and gas infrastructures in the North Sea which could potentially undergo decommissioning at the same time as the Tyne decommissioning activities. In addition, there is also potential for construction activities to occur in the area as a result of oil and gas exploration and production. Given the predominately localised and limited nature of the activities associated with the Tyne DP, it is unlikely that cumulative impacts will have significant societal impacts.

Whilst a cumulative impact associated with the rock-placement (Section 7) may occur, the area (0.014 km^2) covered by the additional rock will be significantly less than the seabed area (0.79 km^2) released for use by fisheries through the removal of the 500 m safety exclusion zone. As the decommissioning activities proceed, new areas will become available to fisheries, reducing the overall cumulative impact to fisheries and resulting in a positive impact.

8.6 Proposed Mitigation Measures

Proposed mitigation measures to minimise societal impacts are detailed in Table 8-1.

Table 8-1: Proposed mitigation measures

Potential source of impact	Proposed mitigation measures
Physical presence of decommissioning vessels causing potential interference to other users of the sea	• Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Appropriate navigation aids will be used in accordance with the consent to locate conditions to ensure other users of the sea are made aware of the presence of vessels. • The number of vessels travelling to or standing by at Tyne will be kept to a minimum
Damage to or loss of gear as a result of subsea obstructions, decommissioned in situ, posing potential snagging risks	• Careful placement of rock on seabed with gentle gradients for sloping sides. • Post-decommissioning monitoring of scour basin infill rates and removal/ remediation (if required) of objects within the scour basin. • On-going consultation with fisheries representatives. • Removal (or remediation) of the majority of infrastructure identified in the 2018 survey report to be over the 18° overtrawlability threshold. • Post-decommissioning seabed clearance. • Overtrawlability trials during decommissioning and periodically thereafter. • Materials left in situ will be mapped and the UK Hydrographical Office (UKHO) and Kingfisher informed.
Onshore	• Licensed contractors at licensed sites

8.7 Conclusions

There will be minor impact to fishing activities during the decommissioning operations in the Tyne area. This impact will be reduced by minimising the number of vessels travelling to, or standing by, Tyne once it has been decommissioned. Potential damage or loss of demersal fishing gear may occur as a result of the rock-placement to stabilise vessel legs (should the seabed prove unstable). This potential will be minimised by ensuring the overtrawlability of materials decommissioned in situ and notifying the appropriate organisations of any subsea structures left in place after decommissioning.

As there is no distinct cuttings pile at the Tyne installation in conjunction with the observed scour basin associated with the infrastructure (and with elevation in THC levels expected to be limited in nearby sediment samples) it is considered very unlikely that fishing gear would be contaminated.

All structural material recovered from the Tyne Field will be transported to shore for dismantling, and recycling or disposal as appropriate. Licensed contractors at licensed sites would undertake processing and as such minimal impacts will arise from the controlled operations.

The scour basin has been assessed to be within overtrawl limits. Any raised infrastructure will be removed or remediated if needed, to mitigate any residual risk.

As the decommissioning activities proceed there will be a positive impact. New areas of sea(bed) will ultimately become available to fisheries through the removal of the 500 m safety exclusion zone.

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9 DISCHARGES TO SEA

This section discusses the potential planned discharges to sea resulting from the proposed Tyne Field decommissioning activities. Unplanned discharges occurring during accidental events are not covered in this section, but are discussed in Section 10.

PUK do not foresee the opportunity for any contaminants to be discharged during general vessel activities. PUK will ensure that every effort is made to achieve an acceptable level of cleanliness of infrastructure prior to decommissioning activity is undertaken, reflecting the intent of current guidance from the Health and Safety Executive (HSE) and BEIS. The decommissioning guidelines (DECC, 2011a) encourage operators to utilise the Offshore Petroleum Activities (Oil Pollution Prevention and Control (OPPC)) Regulations 2005 Guidance Notes, in the first instance when assessing the potential for discharges to sea during operations (DECC, 2014). These operations have therefore been assessed as low impact and are discounted from further assessment.

9.1 Regulatory Context

Discharges to sea from the proposed decommissioning activities will be managed in accordance with current legislation and standards, as detailed within Appendix A.

9.2 Approach

During the decommissioning of the Tyne Field and the associated vessel operations, only the short and/ or long-term release of residual contaminants released over time from contaminated drill cutting deposits has the potential to result in contaminated fluids entering the marine environment.

This section assesses the type of potential contaminant, the magnitude of impact arising from potential contamination to sensitive receptors, and outlines the mitigation measures that PUK will put in place.

9.3 Sources of Potential Impact

The following sections provide an overview of the main potential discharge streams (excluding any accidental releases; see Section 10), that may have an environmental impact. This section will consider the potential for short or long-term release from contaminated drill cutting deposits.

Contaminants may be released during:

- Leaching of HCs from contaminated sediment into the water column (long-term);
- Dredging, excavation and cutting activities (short-term); and
- Trawling activities (short-term).

Whilst the most recent environmental baseline survey (Bibby HydroMap & Benthic Solutions, 2016) survey did not report on the presence of a drill cuttings pile, the presence of contamination resulting from drill cuttings (specifically Low-toxicity oil-based mud (LTOBM)) was noted at a single data collection site, approximately, 50 m downstream of the Tyne installation (Section 2). At this location, the total HC (THC) levels exceeded the OSPAR (2006) 50 mg/kg threshold, whilst for the remaining data points the THC levels reported a mean level of 3.61 mg/kg, less than the reported mean level of 4.34 mg/kg (UKOOA, 2001). The absence of a drill cuttings pile and expected limited THC levels in the surrounding sediment, it is anticipated that any future long-term release of contaminants resulting from seabed disturbance will be minimal. Whilst seabed dredging activities in support of decommissioning vessel stabilisation activities (Section 7) and trawling activities (Section 8) have the potential to further disturb any contaminated sediments, these should be considered temporary operations and as such will have short-term consequences. Any suspension of seabed material, including disturbed contaminants, will be under the control of local hydrodynamic conditions, with the finer sediments being dispersed further leading to the dilution of any contaminants. As such, and noting the highly localised distribution of the elevated THC levels, any effects on sensitive receptors within the water column can be considered to be negligible.

9.4 Impact on Sensitive Receptors

The potential for short-term and long-term impacts of discharges to sea from the Tyne Field decommissioning are assessed for the major taxonomic groups relevant to the southern North Sea marine environment (plankton, benthos and fish), to determine the potential scale of interaction within the vicinity of the discharge. Away from the discharge site, bioaccumulation in the food chain may occur (DTI, 2001). Laboratory and enclosure research has reported that the composition and toxicity of contaminated water varies greatly, however, high dispersion rates mean that toxicity in receiving waters has rarely been demonstrated (DTI, 2001).

9.4.1 Plankton

A release of contaminants from the seabed does not present a risk to the planktonic community. The long-term impacts of released contaminants from the dispersed drill cutting sediment, are anticipated to be negligible due to the dilution factor, the potential low concentrations released and the time frame involved. Plankton are abundant and replenished by the constant movement of the water body, studies have found no evidence that oil contamination has caused a significant decline in populations in the open sea (ITOPF, 2012).

9.4.2 Fish and Shellfish

The Tyne infrastructure is located within ICES rectangles 37F1 and 37F2, which contain spawning grounds for ten species and nursery grounds throughout the year for 14 species. Of the species that may be present within the blocks of interest at various times throughout the year, the majority are considered to be demersal species, i.e. species that spend most of their time at or near the seabed (Section 3). As most adult free swimming fish will move away from contaminated water, fish kills mortalities in open water following events such as an oil spill are rare (ITOPF, 2012). Few species present within the blocks of interest are pelagic species however as pelagic finfish are highly mobile, it is very unlikely that there will be an impact on the finfish community from the discharges to sea from, contaminants released from the dispersed drill cuttings.

9.4.3 Protected Habitats and Species

All four of the Annex II species (harbour porpoise, bottlenose dolphin, grey seals and harbour seals) occurring in UK offshore waters have been sighted within Quadrants 43 and 44 and surrounding quadrants (Section 3). The short-term release of residual oil/ contaminants from the Tyne Field decommissioning activities is unlikely to have any effect these Annex II species. The low number of animals in the area coupled with their high mobility suggests that no discernible impact will be observed.

9.5 Cumulative and Transboundary Impacts

There are unlikely to be any cumulative impacts as a result of residual oil discharges from the sediments during the decommissioning activities. Given that the Tyne Field is located approximately 22 km from the UK/ Netherlands median line no transboundary impacts are anticipated.

9.6 Proposed Mitigation Measures

The key mitigation measures proposed for potential discharges identified within this section are presented in Table 9-2.

Table 9-2: Proposed mitigation measures

	Proposed mitigation measures
Release of contaminants from drill cuttings over the short and long term from excavation, cutting, lifting and dredging activities.	• Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. • Internal cutting techniques will be used.

9.7 Conclusions

For both the short-term (temporary) impacts during decommissioning or trawling operations, and the long-term presence of the contaminated drill cuttings sediment, the release chemical contaminants will result in localised effects which are not expected to be significant. These are not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities.

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10 ACCIDENTAL EVENTS

This section evaluates the potential impacts of accidental events and the proposed mitigation measures which PUK will implement to reduce an event's probability of occurrence and ensure that the environmental impact is reduced as far as is reasonably practicable.

There are two types of accidental event which present the most likely worst-case environmental impacts:

- HC release or spill; and
- Chemical spill

The potential risk from each of these events is examined in the following sections.

Dropped objects have not been considered in this section as all dropped objects (should any occur) will be recovered.

10.1 Regulatory Context

The consequences of potential oil or chemical releases from the activities associated with the proposed Tyne Field decommissioning will be managed in accordance with current legislation and standards. These are detailed within Appendix A.

10.2 Hydrocarbon Releases

This sub-section examines the potential impacts of an accidental HC release during the decommissioning of the Tyne Field facilities.

10.2.1 Sources of Potential Impacts

All offshore activities carry the potential risk of a HC loss to the marine environment. During the period from 1975 to 2005, a total of 16,930 tonnes of oil was discharged from 5,225 individual spill events in the UKCS (UKOOA, 2006). Analysis of spill data for this period shows that 46% of spill records related to crude oil, 18% to diesel and the remaining 36% to condensates, hydraulic oils, oily waters and other materials (UKOOA, 2006). During 2012 on the UKCS, a total of 248 oil spills were reported to BEIS, of which 8% were greater than 455 litres (ACOPS, 2013).

The potential sources of HC spillages from the Tyne Field facilities have been identified through a CA workshop and the knowledge and experience developed from PUK oil and gas operations in the North Sea. Based on this knowledge, the following scenarios have been identified for the proposed activities:

- Blow-out from the condensate wells;
- Vessel sinking due to collision, releasing diesel to the sea;
- Diesel spill or diesel tank loss from a vessel lift; and
- Accidental bunkering fuel (diesel or aviation) spillage during refuelling.

There is only a small probability of a well blow-out or a vessel collision occurring. Further, the subsea infrastructure and topsides are not expected to contain HC fluids. However, the possibility of HC spillages and the associated impacts on sensitive receptors have been investigated below.

10.2.1.1 Oil behaviour at sea

When oil is released to the marine environment, it is subjected to a number of processes including: spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation (Figure 10-1; Table 10-1).

The processes of spreading, evaporation, dispersion, emulsification and dissolution are most important early on in a spill whilst oxidation, sedimentation and biodegradation become more important in later stages. The behaviour of HCs released at depth will depend on the immediate physical characteristics of the release, subsequent plume dispersion processes and metocean conditions (DTI, 2001; ITOPF, 2012).

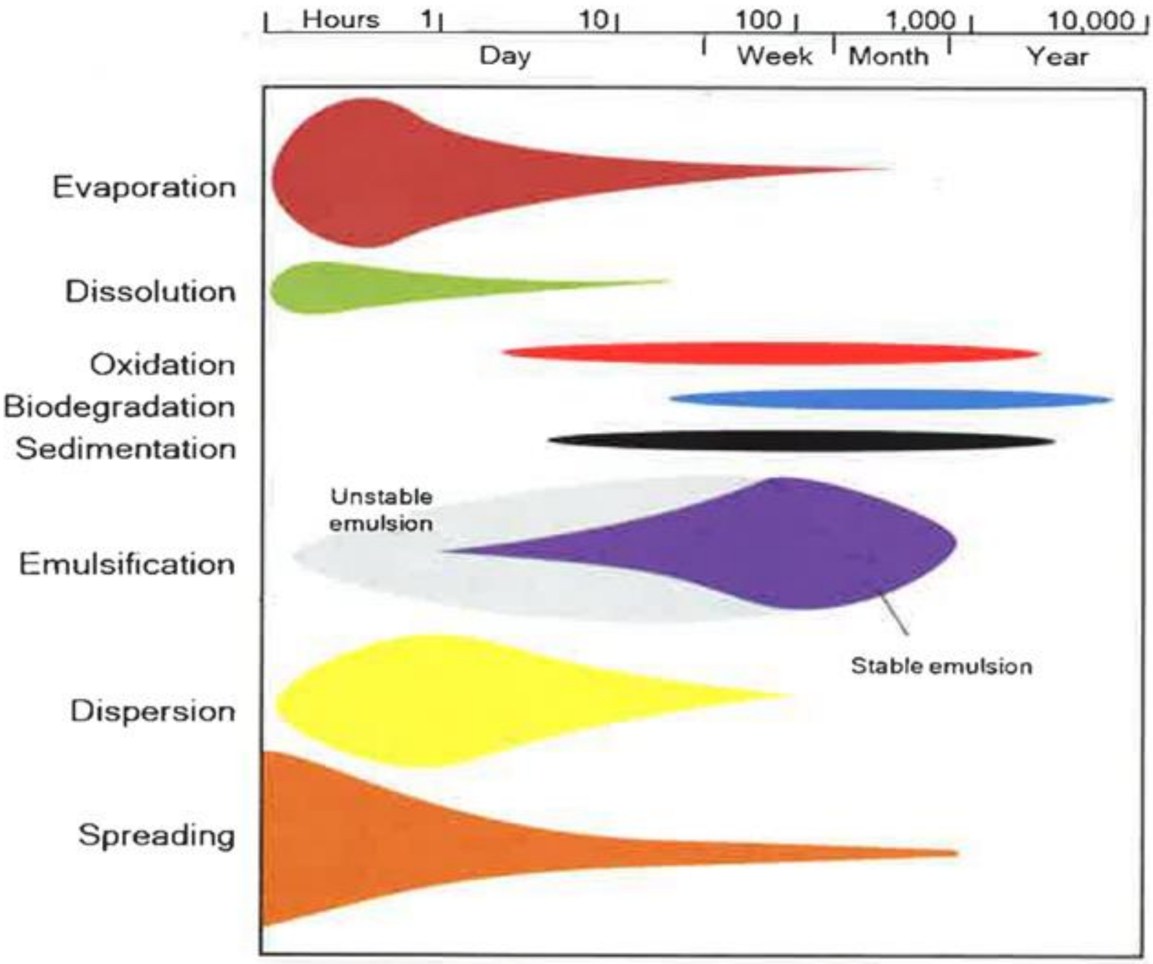

Figure 10-1: Schematic representation of the fate of a typical Group 2 or 3 crude oil spill, showing changes in the relative importance of weathering processes with time (ITOPF, 2012)

10.2.1.2 Hydrocarbon properties

The fate and effect of a spill is dependent on the chemical and physical properties of the HCs. HCs used in, or produced by, the Tyne Field include diesel, aviation fuel and condensate.

The Tyne condensate specific gravity is 0.75 with an API of 57.5°. Consequently, this condensate is classified as the International Tanker Owners Pollution Federation Limited (ITOPF) Group I oils. Group I oils (non-persistent) tend to dissipate completely through evaporation within a few hours and do not normally form an emulsion (ITOPF, 2012).

Diesel and aviation fuel have very high levels of volatile components, evaporating quickly upon release. The low asphaltene content in these fuels prevents emulsification, reducing persistence of them in the marine environment. Whilst diesel oil is a more persistent HC than the condensate, its characteristics and subsequent behaviour when released means that it is unlikely to represent a significant threat to the environment when compared to a crude oil spill.

Table 10-1: Overview of the main weathering fates of oil at sea

Weathering Process	Description
Evaporation	Lighter components of oil evaporate to the atmosphere. An oil with a high percentage of light and volatile compounds will evaporate more than one with a larger amount of heavier compounds.
Dispersion	Waves and turbulence at the sea surface can cause the slick to break up into droplets of varying sizes, which will start dispersing through the water column.
Emulsification	Emulsification occurs as a result of physical mixing promoted by wave action. The emulsion formed is usually very viscous and more persistent than the original oil and formation of emulsions causes the slick volume to increase between three and four times. This will slow and delay the other processes which cause the oil to dissipate.
Dissolution	Water soluble compounds in an oil may dissolve into the surrounding water.
Oxidation	Oils react chemically with oxygen either breaking down into soluble products or forming persistent tars. This process is promoted by sunlight.
Sedimentation	Sinking is usually caused by the adhesion of sediment particles or organic matter to the oil. In contrast to offshore, shallow waters are often laden with suspended solids providing favourable conditions for sedimentation.
Biodegradation	Sea water contains a range of micro-organisms that can partially or completely breakdown the oil to water soluble compounds (and eventually to carbon dioxide and water).

Source: DTI, 2001; ITOPF, 2012

10.2.2 Impact Assessment and Oil Spill Modelling

An accidental HC release can result in a complex and dynamic pattern of pollution distribution and impact in the marine environment. As there are a variety of natural and anthropogenic factors that could influence an accidental spill, each spill is unique. Long-term effects reported range from nothing detected (e.g., after the Ekofisk blow-out in 1977) to chemical contamination but no acute biological effects detectable (e.g., after the wreck of the Braer in 1993) (DTI, 2001). The extent of an environmental impact of a spill depends on several factors including:

- Location and time of the spill;
- Spill volume;
- HC properties;
- Prevailing weather/ metocean conditions;
- Environmental sensitivities; and
- Efficacy of the contingency plans.

Oil spill modelling for the Tyne Field is included within the Oil Pollution Emergency Plan (OPEP) [SN-KX-XX-ER-XS-000001 (BEIS Ref: 16132)] and for the Tyne ENVironmental Impact iDentification (ENVID)/ HAZard Identification (HAZID) workshop. An overview of the oil spill modelling conducted for the Tyne ENVID/ HAZID only is presented in the sub-section below as this is the most recent modelling undertaken.

10.2.2.1 Overview of the oil spill modelling undertaken for the Tyne ENVID/ HAZID workshop

The oil spill modelling previously undertaken for the Tyne ENVID/ HAZID workshop included two oil spill scenarios, which were modelled with the OILMAP software Version 6.10.3.21:

- A continuous release of condensate from a well blow-out; and

- An instantaneous loss of diesel resulting from a lift vessel.

The key characteristics applied to the oil spill modelling are presented in Table 10-2 below.

Table 10-2: Key characteristics used for the oil spill modelling

Scenario	Oil type	Depth of release (m)	Worst-case volume (m^3)	Flow rate (m^3 per day)	Release duration (days)	Persistence duration (days)	Total simulation time (days)
Well blow-out	Condensate	0	441	4.5	98	10	108
Loss of diesel from lift vessel	Diesel	0	1,200	NA*	0	10	10

*NA: not applicable as instantaneous release

The modelling results show the following:

- The well blow-out scenario will result in negligible beaching volumes (<0.1 m^3) and limited transboundary effects, with the probability of crossing the UK/ Netherlands median line being very low; and
- Loss of diesel from lift vessel scenario is unlikely to result in beaching. The probability of a diesel spill crossing the UK/ Netherlands median line is very low. HCs will mainly be dispersed or evaporated.

The impact to the marine fauna and flora is considered to be localised and predominately occurs as toxic short-term (temporary) effects.

10.2.3 Impacts on Sensitive Receptors

The potential for both short-term (temporary) and long term impacts are assessed for the major taxonomic groups relevant to the southern North Sea marine environment in order to determine the potential scale of interaction within the vicinity of an accidental oil spill. Socioeconomic and shoreline impacts are also described below.

10.2.3.1 Biological receptors

Although there is only a small likelihood of a HC spill from the Tyne Field, there is a potential risk to organisms in the immediate marine environment if a spill were to occur. The following section highlights the biological receptors that may be impacted from a potential oil spill incident. Table 10-3 summarises the potential effects of oil spills to marine life during the Tyne Field decommissioning activities.

As the majority of potential spills are likely to be on the surface, both planktonic and benthic communities are less likely to be influenced by an accidental spill. Other communities including fish, birds and marine mammals may incur greater impacts. For a description of the environmental sensitivities in Tyne Field areas, please refer to Section 3 (Baseline Section).

10.2.3.2 Shoreline impact

The oil spill modelling undertaken for the Tyne ENVID/ HAZID that are relevant for the Tyne Decommissioning Project EIA, do not predict that diesel spills will reach either the UK, Netherlands, Denmark, Belgium or French coastlines. Only the well blow-out of condensate may lead to beaching on the UK coastline which can be considered as insignificant (< 0.1 m^3). In addition to these results, there will only be a residual volume of HC remaining on the installation following CoP. As such, it is unlikely that this low volume will reach the coast in the event of a spill. Therefore, the likelihood of a spill impacting the shore is considered negligible.

Table 10-3: Summary of potential impacts to main biological receptors from a generic hydrocarbon release

Biological receptor	Effects and communities at risk
Plankton	Localised effects due to toxicity. Impacts on communities are unlikely due to natural variability, high turnover and seasonal fluctuation. ITOPF (2012) reported that plankton is abundant and is replenished by the constant movement of water body and also studies did not show evidence that oil spills have caused a significant decline in populations in the open sea.
Benthos	The impact from the condensate or diesel to benthic species on the seabed would be localised. Benthic communities may be affected by gross contamination, with recovery taking several years. Mortality would be dependent on oil sensitivity potentially leading to structural change in the community. The surface releases of diesel and condensate will likely not impact benthic communities and therefore the risk is considered minimal.
Fish, spawning and nursery grounds	The Tyne infrastructure is located within ICES rectangles 37F1 and 37F2, which is spawning grounds for ten species. Those species which have benthic eggs have a dependency on specific substrata for spawning. For example, sandeels lay their eggs on clean sandy sediments and therefore may spawn on discreet sandy sediments within the interest blocks. Such sediments would therefore be considered important for this species (Section 3). The Tyne infrastructure also lies within the nursery grounds throughout the year for 14 species (Section 3). As most adult free swimming fish will move away from oil contaminated water, fish kills in open water following an oil spill are rare (ITOPF, 2012). However, if fish may be affected by oil spills, HCs may result in tainting of the fish, and hence in a reduction of commercial value. Eggs and larvae may be affected, but such effects are generally not considered to be ecologically important because eggs and larvae are distributed over large sea areas. In addition, laboratory tests have not shown evidence that oil induced mortalities of fish and shellfish eggs and larvae in the open sea would result in significant effects on future adult populations (ITOPF, 1998).
Shellfish	Data shows that eight shellfish species may be present in the vicinity of the Tyne infrastructure (Section 3). In case of an oil spill, HCs may result in tainting of the shellfish, and hence in a reduction in commercial value.
Seabirds	The Tyne installation is in close proximity to an area of moderate importance for international bird concentrations, representing 10 to 49.9% of the biogeographic population (Section 3). Within the blocks of interest, species which are present throughout the year, albeit in varying densities, are fulmar, gannet, kittiwake and guillemot. Densities of fulmar are very high (>5 individuals per km^2) from January to February and May to October, while densities of kittiwake are very high from September to November, January to March and in May and July. Guillemot density are very high between April and May and September to December. Gannet densities are at their peak between January and March. Other species that reach very high densities are; the herring gull and great black-backed gull from November to January (Section 3). Physical fouling of feathers, damage to eyes and toxic effects of ingesting HCs can result in direct and indirect fatalities. Effects would depend on species present, their abundance, reliance on particular prey species and the time of year. Diving birds such as auks and gannets are particularly susceptible. Species most affected may be guillemots, razorbills and puffins that spend large periods of time on the water, particularly during the moulting season when they become flightless (DTI, 2001).

Biological receptor	Effects and communities at risk
Marine mammals	The main cetacean (whale and dolphin) species occurring in the Tyne Field and surrounding quadrants are Minke whale, long-finned pilot whale, bottlenose dolphin, common dolphin, white-beaked dolphin, white-sided dolphin and harbour porpoise with sightings occurring throughout the year (Section 3). Grey seals and harbour seals are considered as infrequent visitors to the Tyne Field area (Section 3). Potential effects may include inhalation of toxic vapours, eye/ skin irritation and bioaccumulation. Ingestion of oil can damage the digestive system or affect liver and kidney function. Loss of insulation through fouling of the fur of young seals and otters increases the risk of hypothermia. Oil contamination can impact food resources directly through prey loss or indirectly through bioaccumulation. However, it is expected that marine mammals would avoid the area if a spill were to occur.
Protected habitats and species	The Tyne installation is located within the boundary of the Dogger Bank SAC. This site is designated for the presence of Annex I habitat “sandbanks which are slightly covered by sea water all the time” (Section 3). The Tyne Field lies within the northern half of the southern North Sea cSAC. This site is a candidate for designation for the Annex II species harbour porpoise (Section 3). The Doggersbank (Netherlands) SCI and the Klaverbank (Netherlands) SCI are located 20 km east of the Tyne Field and 35 km southeast of the Tyne Field, respectively.

10.2.3.3 Socio-economic receptors

A number of sectors may be influenced by a potential condensate release or diesel spill during the Tyne infrastructure decommissioning activities and are described in Table 10-4.

Table 10-4: Summary of main socioeconomic receptors

Socioeconomic receptor	Risks and status at Tyne Field facilities
Fisheries	Fishing is one of the primary economic activities in the EU and it supports other shore-based activities including fish processing and boat construction. The impacts to offshore fishing can be either limited to the period that oil remains on the surface or could be closed for a limited period of time following an oil spill, as access to fishing grounds would be limited. There is the potential for fish that come into contact with oil to become tainted precluding commercial sale. No UKCS evidence of any long-term effects of oil spills on offshore fisheries exists. Between 2010 and 2015, the mean annual fishing effort (in days), by UK vessels over 10 metres in length, in the vicinity of the Tyne infrastructure was 266 days in ICES Rectangle 37F1 and 505 days in ICES Rectangle 37F2 (Section 3). The average annual landing between 2010 and 2015 in ICES Rectangle 37F1 was 470.6 tonnes, with the greatest quantity landed in 2011 (699 tonnes) and the least in 2014 (271 tonnes) (Section 3).
Tourism	Coastal tourism can be adversely affected by oil pollution events owing to reduced amenity value. Impact can be further influenced by public perception and media coverage. The offshore location of the Tyne installation (184 km from the UK coastline) suggests that there is very unlikely to be any impact on tourism.
Shipping	A NRA conducted by Anatec (2016) concluded that an estimated 2,095 vessels pass within 10 nm of the Tyne installation location, corresponding to an average of 5 to 6 vessels per day. The majority of these vessels were determined as cargo vessels and Ro-Ro freight ferries (Anatec, 2016). Shipping activity in the area of the Tyne Field infrastructure is regarded as high (Section 3). Shipping lanes are used by shuttle tankers, supply and standby vessels serving the offshore oil installations in the area. Although all may potentially be impacted by an oil spill, the impacts likely last only while oil is on the sea surface, as this may restrict access. It is considered unlikely that there will be any long-term impacts on this industry.
Oil and gas/ wind Farms	The Tyne installation lies on the north eastern fringe of a number of currently producing gas fields. The closest surface infrastructure to the Tyne installation is the Munro MH platform located in Block 44/17, 11.9 km west southwest (Section 3). There are no wind farm areas within the blocks of interest. The nearest is the Forewind offshore windfarm development, Creyke Beck A, approximately 40 km to the northwest of the Tyne installation. This development is located within the Dogger Bank and is made up of four individual developments, Creyke Beck A, Creyke Beck B, Teesside A and Teesside B (Section 3). Although these receptors may potentially be impacted by an oil spill, the impacts would likely last only whilst there is oil on the sea surface, as this may restrict access to installations for instance. It is therefore considered unlikely that there will be any long-term impacts on this industry.

10.2.4 Cumulative and Transboundary Impacts

The sub-sections below summarised the residual, cumulative and transboundary impacted expected in case of accidental oil spill event.

10.2.4.1 Residual impacts

During removal operations, the loss of HCs contained within pipework, tanks and storage sumps may result in a small release, which would cause a localised deterioration in water quality. PUK will ensure that pipework, sumps and tanks in the topsides are emptied and cleaned. Any vessel receiving or handling the topsides will be equipped with its own Shipboard Oil Pollution Emergency Plan (SOPEP) to deal with minor releases and will have access to the PUK OPEP (SN-KX-XX-ER-XS-000001 (BEIS Ref: 16132)) and equipment.

The residual risk of environmental impact from accidental oil spills including discharge and release, during the decommissioning of the Tyne Filed will be reduced to levels that are as low as reasonably practicable. This will be achieved by the preventive measures incorporated during design, operational control procedures and training. Even with these in place, there will still be a residual, albeit very low, risk of marine environment and/ or socioeconomic impact.

10.2.4.2 Cumulative impacts

Cumulative effects arising from the decommissioning activities at the Tyne Field areas have the potential to act additively with those from other oil and gas activity, including both existing activities and new activities, or to act additively with those of other human activities (e.g., fishing and marine transport of crude oil and refined products) (DTI, 2004).

Any HC discharge as a result of the decommissioning activity would be expected to disperse rapidly in the immediate environment without the potential to combine with other discharges from concurrent incidents. It is difficult to precisely predict whether the impacts from an oil spill to the marine ecology of the affected area would be cumulative. This would depend on previous disturbances or releases at specific locations. Cumulative effects of overlapping "footprints" for detectable contamination or biological effects are considered to be unlikely. No significant synergistic effects are anticipated (DTI, 2004).

10.2.4.3 Transboundary impacts

There is a low probability that a HC spill would cross into international sectors such as the Netherlands, Belgium, Denmark or France sectors. Modelling predicts that diesel spill will cross the UK/ Netherlands median line with a probability varying from 10 to 15%, depending on the season. Modelling also predicts that condensate spill from a well blow-out will cross the UK/ Netherlands median line with a probability varying from 19 to 24% depending of the season of the year.

The Marine and Coastguard Agency (MCA), Counter Pollution and Response Branch also have agreements with equivalent organisations in other North Sea coastal states (Belgium, France, Germany, Ireland, the Netherlands, Norway, Sweden and Denmark), under the Bonn Agreement 1983. In case of spill reaching the English Channel, the Anglo-French Joint Maritime Contingency Plan (Mancheplan) covering counter pollution and rescue operations, will be activated.

10.2.5 Mitigation Measures

Mitigation and management primarily focus on preventing or minimising the probability of an accidental spill and secondly, reducing the consequences of the event through optimum and efficient containment and release response. During decommissioning, minor non-routine and emergency events such as minor leaks, drips and spills from machinery and hoses on the platform, from vessels or at onshore sites, could cause a localised and temporary impact. The accidental release of small quantities of oil would be minimised as far as possible through appropriate management procedures and mitigation measures. The effects of such releases could be rectified quickly on site and they would be managed through vigilance, operational, inspection and emergency procedures, and specific safeguards such as on-site clean-up equipment and containment measures. For these reasons, such minor events have been excluded from this assessment as they will be managed under normal operational procedures and controls.

PUK's planned response to all spills is detailed in the relevant OPEP (SN-KX-XX-ER-XS-000001 (BEIS Ref: 16132)). Table 10-5 lists the planned measures to prevent or reduce the likelihood of a spill occurring during decommissioning of the Tyne Field. Based on the estimated volumes of diesel and condensate, the PUK response capability for both counter pollution and containment is capable of providing an appropriate level of response to a spill. The mitigation measures and contingency plans in place would consider all foreseeable spill risks and would ensure that the spill risk is reduced to as low as reasonably practicable.

Table 10-5: Oil spill preventive measures for likely scenarios during decommissioning

Potential source of impact	Planned mitigation measures
All oil spills	The inventories will be minimised prior to removal and transport to disposal yard. The OPEPs have been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response and Cooperation Convention) (Amendment) Regulations 2015 (as amended). The OPEPs detail responsibilities for initial response and longer term management, and will be updated as needed to reflect any change in operations and activities associated with decommissioning. There are three planned levels of response, depending on the spill size: Tier 1 - standby vessel equipped with dispersants and spraying equipment; Tier 2 - air surveillance and dispersant spraying through Oil Spill Response Ltd. (OSRL); and Tier 3 - clean-up equipment and specialist staff available through OSRL. In addition, PUK have specialist oil spill response services provided by OSRL and are members of the Oil Pollution Operator's Liability Fund (OPOL).
Vessel collision	Local shipping traffic would be informed of proposed decommissioning activities and a standby/ support vessel would monitor shipping traffic at all times.
Spill from a vessel beyond the 500 m exclusion zone	In the event of an accidental spill to sea, vessels will implement their SOPEP.

10.2.6 Conclusions

The conclusions from the impact assessment for an accidental HC release are that the:

- Worst-case scenario at Tyne Field would result from a loss of diesel from vessel lift or collision.
- Condensate and diesel spills will disperse and dilute quickly, with none or negligible impact to coastlines.
- Probability of a HC spill occurring is low and will not contribute to the overall spill risk in the area.
- OPEPs response will provide the direction to effectively manage the spill in case of an accidental event.

10.3 Chemical Releases

An accidental chemical release can result in a complex and dynamic pattern of pollution distribution and impact to the marine environment. The number of factors that could influence an accidental spill, both natural and anthropogenic, renders each spill unique. Potential sources of impact are presented in the following sections, and include a review of the sensitive receptors that may be influenced. In many cases, both impacts and receptors have been detailed in the HC release section (Section 1.2). Where the chemical release impacts differ from those described in the HC release section, they will be discussed in further detail.

10.3.1 Methodology

As part of the decommissioning process it is important to consider the magnitude of a potential chemical spill and assess the effects of such an unplanned event on key sensitive receptors.

10.3.2 Sources of Potential Impact

Technical failure remains the leading cause of chemical spills in the North Sea. The primary sources of loss to the environment are from spills of hydraulic fluids or chemicals. The potential sources of chemical spillages from the decommissioning of the Tyne Field have been identified through a CA workshop and the knowledge and experience developed from PUK and oil and gas industry operations in the North Sea. Based on this knowledge, the following scenario has been identified:

- Accidental loss of fluids from subsea or topsides removal.

10.3.3 Impacts on Sensitive Receptors

Chemical release into the marine environment may impact sensitive receptors in different ways, depending on the following factors:

- Spill volume;
- Depth of release;
- Chemical toxicity;
- Chemical solubility;
- Persistence in the environment;
- Biodegradability of the compound;
- Potential for bioaccumulation in the food chain; and
- Partitioning of individual components.

10.3.3.1 Biological receptors

Table 10-3 and Section 3 (Baseline Section) provide a comprehensive description of the biological receptors in the Tyne Field areas sensitive to potential chemical spills. Due to the rapid dispersion and dilution of chemicals upon discharge or release, few biological receptors are noticeably impacted. The most sensitive receptors are the planktonic communities.

Plankton (phytoplankton, zooplankton and fish larvae) are likely to come into direct contact with discharged chemicals, with zooplankton appearing to be the most vulnerable particularly at the early stages of development. However, the impact of a chemical spill is not likely to impact beyond the immediate vicinity of the discharge point because:

- The likely credible maximum volume of chemicals that may be subject to a spill event would be very low;
- Discharge is likely to be dispersed and diluted rapidly by the receiving environment;
- Many of the compounds are volatile or soluble and are removed from the water by evaporation and dilution; and,
- Biological Oxygen Demand (BOD) is likely to be within the capacity of ambient oxygen levels.

10.3.3.2 Socioeconomic receptors

The main socioeconomic receptors relevant to a HC spill are presented in Table 10-4 and in most cases; this information is also pertinent to chemical spills. Dispersion, dilution and potentially very small volumes spilt will result in localised impact areas. No significant socioeconomic impacts are foreseen for fisheries, tourism, oil and gas, or shipping.

10.3.4 Cumulative and Transboundary Impacts

The majority of chemical spills are unlikely to result in an environmental impact due to a combination of rapid dispersion and dilution of the chemicals and the depth and distance from shore (>115 km) of the Tyne Field infrastructure. The potentially spilt volumes are unlikely to pose any noticeable risk to residual, cumulative or transboundary impacts.

10.3.5 Mitigation Measures

The impacts of all the chemicals that may be used or discharged offshore during decommissioning will be assessed and reported to BEIS in a relevant Portal Environmental Tracking System (PETS) application.

The proposed mitigation measures to reduce the likelihood of chemical spills to the environment are presented in Table 10-6.

Table 10-6: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Chemical spills from Tyne Field decommissioning activities	PUK will conduct all operations in a controlled manor with trained personnel using suitable equipment. All vessels will have suitable skill kits and an efficient spill response process is in place. PUK routinely swap out perishable equipment such as hoses, and a management programme is implemented in order to ensure their integrity. Prior to transfer, visual checks are undertaken by trained personnel in communication with the standby vessel. Observed leaks are reported and dealt with immediately by competent personnel and reported to the appropriate authorities.

10.3.6 Conclusions

The conclusions from the impact assessment for an accidental chemical release are that the:

- Chemical spills will disperse and dilute quickly, with only localised effects to planktonic communities.
- Probability of a chemical spill occurring is low and will not significantly add to the overall spill risk in the area.

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11 WASTE

Decommissioning activities will generate quantities of controlled waste, defined in Section 75(4) of the Environmental Protection Act 1990 as household, industrial and commercial waste or any such waste. The sequence and quantities of controlled waste generated at any one time will depend on the processes used for dismantling and the subsequent treatment and disposal methods.

Three key challenges are associated with waste management for the Tyne infrastructure.

- Generation of large quantities of controlled waste within short timeframes. This will require detailed planning to manage the logistics associated with the transport to shore, temporary storage and onward treatment/ disposal of materials.
- Potential for “problematic” materials, generated due to cross-contamination of non-hazardous waste with substances that have hazardous properties, which result in the material being classified as hazardous waste. Hazardous waste is defined as material that has one, or more, properties that are described in the Hazardous Waste Directive (91/689/EEC) as amended by Council Directive 94/31/EC.
- Problems associated with materials with unknown properties at the point of generation. These quantities of ‘unidentified waste’ require careful storage and laboratory analysis to determine whether they are hazardous or non-hazardous waste.

In accordance with the regulatory Guidance Notes under the Petroleum Act 1998 (DECC, 2011a), the disposal of such installations should be governed by the precautionary principle. PUK will assume the worst-case, especially when dealing with hazardous and unidentified wastes, and choose waste treatment options which would result in the lowest environmental impact.

11.1 Waste Generation

PUK will follow the principles of the waste hierarchy as described in Section 11.3. Typical non-hazardous waste will include scrap metals, concrete and plastics that are not cross-contaminated with hazardous waste and can therefore be removed and recovered for reuse, recycling or landfill. Hazardous waste will include oil contaminated materials and chemicals. Many types of hazardous waste generated during decommissioning are routinely generated during production and maintenance of offshore installations. However, the decommissioning process may generate significantly greater quantities of both non-hazardous and hazardous waste when compared to routine operations and as such requires appropriate management.

An estimate of the different types of materials and quantities in the Tyne infrastructure to be decommissioned is detailed in Section 2.

11.1.1 Radioactive Waste

Radioactive wastes including sources (e.g. smoke detectors) and Naturally Occurring Radioactive Material (NORM) that can accumulate within pipework and receptacles will be managed in line with current legislative requirements (Appendix A). PUK has existing procedures in place for managing radioactive waste and for working with radioactive materials (PUK, 2016b, 2016c, 2016d), which will be revised to include the removal and transportation of radioactive materials during decommissioning in consultation with the relevant authority depending on the location of disposal/ treatment site.

11.1.2 Wastes Generated During Engineering Down and Cleaning

During engineering-down and cleaning, all topside systems will be depressurised, purged, flushed and rendered safe for removal operations. Pipework and tanks will be drained to remove sources of potential spills of oils and other fluids. Diesel and lubricating oils will be drained and returned to shore for disposal. All waste generated during engineering down and cleaning will be transported to shore.

11.2 Regulatory Context

There is no waste related legislation that specifically covers decommissioning activities, however some aspects of existing waste legislation are relevant and described in Appendix A.

Whether a material or substance is ‘waste’ is determined by EU law. The EU Waste Framework Directive (2006/12/EC) defines ‘directive waste’ as “any substance or object in the categories set out in Annex I of the Directive which the holder discards or intends or is required to discard”. Annex I provides a list of definitions and includes a general category – “Any materials, substances or products which are not contained in the above categories”.

The responsibility for waste management lies with the producer or duty holder to decide whether a substance or object is waste. The action of removal and transfer of redundant installations and infrastructures to shore falls within the legal definition of waste. The responsibility for determining whether a substance or object is waste lies with the operator.

Having determined the substance or object is waste, subsequent storage, handling, transfer and treatment of the waste generated is then governed by the relevant waste regulations (Appendix A).

The selection of a disposal yard contractor has not been finalised by PUK. However, if the selected disposal yard is in a country outside of the UK, the waste will be dealt with in line with the receiving country’s waste legislation.

The ‘waste hierarchy’ (Figure 11-1) is a key element in OSPAR Decision 98/3 and has been transposed into UK law through the Waste (England and Wales) Regulations 2011. The waste hierarchy is a framework which prioritises options for dealing with waste based upon their sustainability. Regulatory guidance notes on decommissioning (DECC, 2011a) require that the utilisation of the waste hierarchy is incorporated into the decommissioning decision making process.

	Stages	**Includes**
Most preferred option	Prevention	Using less material in design and manufacture, keeping products for longer, re-use, using less hazardous materials
	Preparing for re-use	Checking, cleaning, repairing, refurbishing, whole items or spare parts
	Recycling	Turning waste into a new substance or product, includes composting if it meets quality protocols
	Other recovery	Anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste, some backfilling
Least preferred option	Disposal	Landfill and incineration without energy recovery

Figure 21-1: The Waste Hierarchy (from Environment Agency (EA), 2017)

11.3 Waste Management

PUK recognises that, in line with the waste hierarchy, the reuse of an installation or its components is first in the order of preferred decommissioning options. However, as the Tyne platform is in a degraded condition, they are not considered suitable for safe re-use. The majority of jacket and topside material will be recycled.

Non-hazardous materials, such as scrap metal, concrete, and plastics not contaminated with hazardous waste, will be removed and, where possible, reused or recycled (with the exception of the pile steel being decommissioned in situ, 3 m below the seabed). Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Steel represents the largest weight from the Tyne installation.

Where necessary, hazardous waste resulting from the dismantling of the Tyne installation will be pre-treated to reduce hazardous properties or, in some cases, render it non-hazardous prior to recycling or landfilling. Under the Landfill Directive, pre-treatment will be necessary for any hazardous wastes which are destined to be disposed of to landfill site.

Table 11-1 and Figure 11-2 outline the fate of all decommissioned material from the Tyne installation, by weight. The majority of materials removed to shore are likely to be recycled. Only a small amount of material (< three tonnes), is expected to be sent to landfill. The marine growth will be sent to a disposal yard abroad where it will be dried and sent to a recycling facility and the NORM/hazardous materials will be disposed of in line with the permit requirements for Tyne.

Table 11-1: Proposed fate of Tyne infrastructure materials

Infrastructure	Recommended decommissioning option	Destination
Jacket and subsea template	Full removal (single lift)	• Decommission in situ below the seabed. • Recycling.
Topside	Full removal (single lift)	• Reuse (where feasible). • Recycling (or landfill where not feasible). • Treatment.

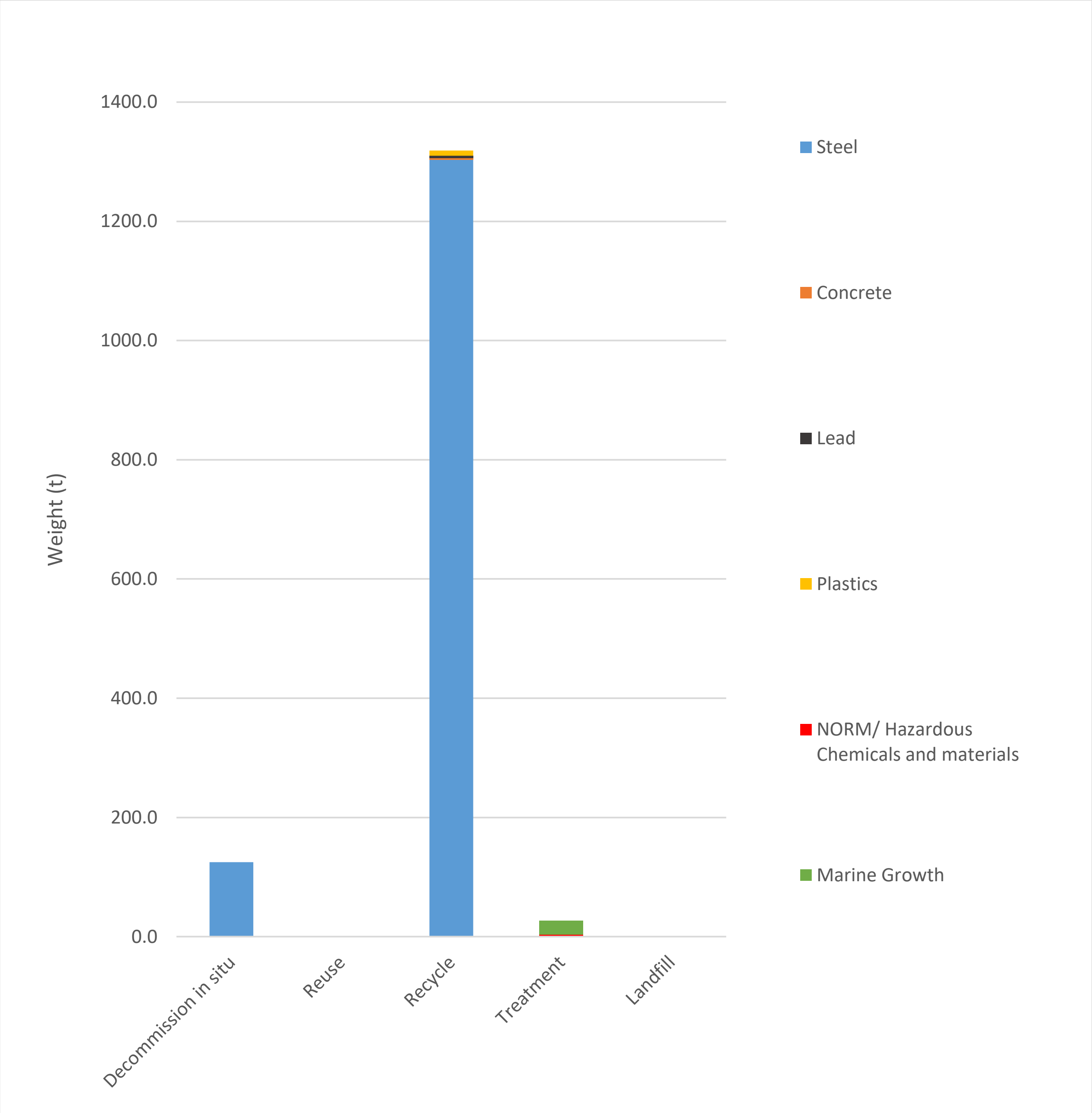

Figure 31-2: Estimated tonnage and predicted disposal routes of decommissioned installation material.

Note: material to be decommissioned in situ consists of the remaining pile steel (125 t) which will be cut at ≥3 m below seabed level. A small amount of plastic has been assigned for landfill (1 t) and reuse (0.5 t) but these quantites are too small to be viewed here.

The management of waste generated from offshore activities is governed by PUKs ISO 14001-certified SEMS (Section 12). The SEMS includes a documented procedure for waste management (PUK, 2016e) , which is designed to ensure that all waste generated during the PUK offshore activities are managed according to the Company's Health, Safety and Environment (HSE) policy and relevant legislation. A specific Waste Management Plan (WMP) will be developed for the Tyne decommissioning project in order to address project specific waste management issues.

11.3.1 Contractor Management

Waste management activities include the handling, storage and treatment of waste offshore, the transfer of waste to a waste treatment or dismantling yard for further storage, handling and treatment as appropriate, and then further transfer to the final disposal or treatment point. These activities will be conducted by contractors and sub-contractors on behalf of PUK using their own waste management systems. These contractors and sub-contractors will also prepare all necessary documentation required for the identification, quantification and tracking of wastes generated per asset in order to provide a transparent audit trail from the offshore location through to the final disposal point. Although PUK will not be undertaking the actual physical work, the legal liability i.e. Duty of Care, for all waste generated from decommissioning remains with PUK for the duration of the programme.

The selection and management of contractors by PUK is managed through existing contractor control processes and procedures. Specific targets to maximise re-use and recycling, and minimise waste to landfill, will be agreed during the contractor selection process, and included in relevant contracts. Specific actions to support the management and minimisation of waste generated by contractors during decommissioning will include:

- Ensuring that waste management issues are clearly addressed within the contractor interface documents;
- Identifying specific roles and responsibilities within PUK and its contractors within the Tyne Decommissioning WMP;
- Engaging with contractors to identify effective technical solutions that support waste minimisation and the reuse and recycling of waste, where possible; and,
- Establishing specific audit and monitoring schedules within relevant contracts.

11.3.2 Measuring and Monitoring Performance

Measuring and monitoring performance is an important element of PUK's SEMS and a number of mechanisms are in place to do this (PUK, 2016f, 2016g). Specific areas of focus related to waste management during the decommissioning of the Tyne infrastructure, will be:

- Monitoring legislative compliance; and
- Measuring performance against stated targets.

A range of methods will be used to ensure effective monitoring of waste management activities including regular waste statistic tracking and auditing of contractor and disposal sites.

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12 ENVIRONMENTAL MANAGEMENT

This section describes the arrangements that will be put into place to ensure that the mitigation and other measures of control, including the reduction or elimination of potential impacts are implemented and conducted effectively. This section also serves to outline the key elements of relevant corporate policies and the means by which PUK will manage the environmental aspects of the Tyne installation decommissioning operations.

12.1 Introduction

PUK hold ISO 14001 standard certification and therefore have relevant documentation to support the decommissioning process from the perspective of environmental standards. PUK operate under a SEMS, which forms part of the PUK Operating Management System (POMS). The POMS provides the framework for PUK to achieve safe and reliable operations day-in and day-out and ensures compliance with PUK's HSSE Policy.

In addition to enabling the implementation of identified mitigation and control measures, the SEMS provides the means to monitor the effectiveness of these measures through check and environmental performance. The SEMS, by design, will enable PUK to control activities and operations with a potential environmental impact and provide the assurance on the effectiveness of the environmental management.

12.2 Scope of the SEMS

The SEMS provides the framework for the management of Health and Safety Executive (HSE) issues within the business. This EMS is intended for application to all of PUK's activities as directed under the OSPAR recommendation 2003/5, promoting the design, use and implementation of Environmental Management Systems by the Offshore Industry. PUK, as a business, is centred on oil and gas exploration activities both onshore and offshore, with the offshore components of their business including seismic and drilling operations. As a relatively small operator PUK intend to resource such projects through the utilisation of contractors, should these not be available within the business itself.

The SEMS focuses on:

- Clear assignment of responsibilities;
- Excellence in HSE performance;
- Sound risk management and decision making;
- Efficient and cost effective planning and operations;
- Legal compliance throughout all operations;
- A systematic approach to HSE critical business activities; and
- Continual improvement.

12.3 Principle of the SEMS

The following sub-sections describe the principles followed though the utilisation of the SEMS.

12.3.1 Improvement Programmes and the Management of Change

The purpose of employing an improvement programme is to:

- Ensure the continuous development of the PUK policy commitment.
- Introduce changes and innovations that ensure the achievement of performance standards where current performance is below expectations.

The SEMS also makes provision for the management of change. Changes may occur for a number of reasons, and at a number of levels. A 'management of change' procedure specifies the circumstances under which formal control of change is required to ensure that significant impacts remain under control and/or new impacts are identified, evaluated and controlled.

12.3.2 Roles and Responsibilities

PUK will review existing environmental roles and responsibilities for staff participating in the Tyne Decommissioning Program. These will be amended and recorded in individual job descriptions to ensure that they take into account any changes required for the management of the impacts identified in this EIA.

12.3.3 Training and Competence

The competence of staff with environmental responsibilities is a critical means of control. The SEMS, in conjunction with the Human Resources department of PUK allows for the appointment of suitably competent staff. The development and implementation of training programmes facilitates understanding and efficient application

12.3.4 Communication

Internal environmental communication generally employs existing channels such as management meetings, minutes, poster displays, etc. External communication with stakeholders and interested parties is controlled through a communication programme. This establishes links between each stakeholder, the issues that are of concern to them, and the information they require to assure them that their concerns and expectations are being addressed. This EIA and the consultation process that informed its production will be used to design the ongoing communication programme. Communication and reporting will employ information derived from the monitoring programme.

12.3.5 Document Control

The control of the SEMS documents is managed in the PUK Document Control System.

12.3.6 Records

Records provide the evidence of conformance with the requirements of the SEMS and of the achievement of the objectives and targets in improvement programmes. The PUK SEMS specifies those records that are to be generated for these purposes, and controls their creation, storage, access and retention.

12.3.7 Monitoring and Audit

Checking techniques employed within PUK's SEMS are a combination of monitoring, inspection activities and periodic audits.

The requirement for monitoring and inspection stems from the need to provide information to a number of different stakeholders, but primarily regulators, and PUK management. As such, there is a requirement for the results of monitoring and inspection to be integrated with the PUK internal and external communication programme.

Monitoring and inspection activities focus on:

- Checks that process parameters remain within design boundaries (process monitoring);
- Checks that emissions and discharges remain within specified performance standards – (emissions monitoring); and
- Checks that the impacts of emissions and discharges are within acceptable limits (ambient monitoring).

12.3.8 Incident Reporting and investigation

The PUK SEMS stipulates documented procedures to control the reporting and investigation of incidents.

12.3.9 Non-confidence and Corrective Action

The checking techniques outlined above are the means of detecting error or non-conformances. PUK's SEMS includes procedures for the formal recording and reporting of detected non-conformance, the definition of appropriate corrective action, the allocation of responsibilities and monitoring of close out.

12.3.10 Review

PUK's SEMS includes arrangements for management review. This provides the means to ensure that the EMS remains an effective tool to control the environmental impacts of operations, and to re-configure the EMS in the light of internal or external change affecting the scope or significance of the impacts. Of particular importance is the role management review plays in the definition and implementation of the improvement programme, and the management of change.

12.4 Summary of Environmental Commitments

PUK has made a number of commitments within this EIA in order to reduce the potential environmental and socio-economic impacts from the Tyne Decommissioning, as far as practicable. These commitments, along with the appropriate section in this EIA (where applicable), are summarised in Table 12-1.

Table 12-1 Summary of environmental commitments

Issue	Commitment	EIA Section
Atmospheric emissions	• Vessels will be audited as part of selection and pre-mobilisation. • Work programmes will be planned to optimise vessel time in the field • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems. • Vessels will use ultra-low sulphur fuel in line with MARPOL requirements. • All mitigation measures will be incorporated into contractual documents of subcontractors.	Section 5
Underwater noise	• Machinery and equipment will be in good working order and well-maintained. • Helicopter maintenance will be undertaken by contractors in line with manufacturer and regulatory requirements. • The number of vessels utilising dynamic positioning will be minimised. • To minimise potential impacts to marine mammals from decommissioning operations, PUK will conform to JNCC protocols for minimising risk to marine mammals from underwater noise throughout operations.	Section 6

Issue	Commitment	EIA Section
Seabed impact	• Cutting and lifting operations of subsea equipment will be controlled and any impact on seabed sediment will be minimised. • Internal cutting will be used preferentially where access is available. • The requirements for excavation will be assessed on a case-by-case basis. • All anchors will be completely removed from the seabed following decommissioning operations. • Rock placement will take place using a ROV, controlled fall pipe equipped with cameras and other sensors as required. This will control the profile of the rock covering and accurate placement of rock on the seabed to ensure rock is only placed within the planned footprint, minimising seabed disturbance. • Vessel orientation will be reviewed and selected to minimise the requirements for rock whilst allowing for the safe locating of the accommodation work vessel and access, i.e. crane reach to undertake essential scopes of work. • Post-removal surveys of the seabed will be carried out to identify significant anomalies and dropped objects.	Section 7
Onshore impact	Licensed contractors will be used at licensed sites	Section 8
Shipping	• PUK have undertaken a site-specific shipping assessment prior to the Tyne decommissioning operations (Anatec, 2016). • Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Appropriate navigation aids will be used in accordance with the consent to locate conditions to ensure other users of the sea are made aware of the presence of vessels. • The number of vessels travelling to or standing by at Tyne will be kept to a minimum • A mandatory 500 m safety zone will remain around the Tyne infrastructure during the decommissioning activities.	Section 8
Fisheries	• On-going consultation with fisheries representatives. • Post-decommissioning seabed clearance. • Overtrawlability trials during decommissioning and periodically thereafter.	Section 8

Issue	Commitment	EIA Section
	• Removal (or remediation) of the majority of infrastructure identified in the 2018 survey report to be over the 18° over-trawlability threshold. • Materials left in situ will be mapped and the UK Hydrographical Office (UKHO) and Kingfisher informed.	
Discharges to sea	• Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment which may lead to the release of contaminated sediment. • Internal cutting techniques will be used to avoid interaction with the sediment adjacent to the Tyne installation.	Section 9
Accidental spills and dropped objects	• The inventories will be minimised prior to removal and transport to disposal yard. • The OPEPs have been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. • PUK have specialist oil spill response services provided by OSRL and are members of the OPOL. • Local shipping traffic will be informed of proposed decommissioning activities and a standby/ support vessel will monitor shipping traffic at all times. • In the event of an accidental spill to sea, vessels will implement their SOPEP. • PUK will conduct all operations in a controlled manor with trained personnel using suitable equipment. All vessels will have suitable skill kits and an efficient spill response process is in place. • PUK routinely swap out perishable equipment such as hoses, and a management programme is implemented in order to ensure their integrity. • Prior to transfer, visual checks are undertaken by trained personnel in communication with the standby vessel. • Observed leaks are reported and dealt with immediately by competent personnel and reported to the appropriate authorities. • Items will be secured to prevent loss wherever practicable. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects.	Section 10

Issue	Commitment	EIA Section
Waste	• A WMP will be developed and put into place before the decommissioning activities commence. This plan will ensure that staff will undergo appropriate training and will be notified of disposal requirements for each waste type. • Opportunities where recover materials destined for landfill can be reduced, or otherwise recycled or reused, will be actively sought out.	Section 11
Environmental responsibilities	Key environmental responsibilities, duties, communication, reporting and interface management arrangements of PUK and any main contractors involved in the decommissioning activities will be agreed, documented and communicated at the appropriate stages of the project.	Section 12
Delivery of commitments	The commitments made within this EIA will be incorporated into operational work programmes, plans and procedures. Programmes will be tracked to ensure that commitments and mitigation measures are implemented throughout the project.	-

13 CONCLUSIONS

An EIA forms an integral part of the PUK SEMS ensuring that adequate environmental considerations are incorporated into the DPs of the Tyne Field. This document presents the findings of the EIA for the recommended options identified during the CA workshop for the decommissioning of the Tyne Field infrastructure, providing sufficient information to enable a robust evaluation to be made of the potential environmental consequences of the proposed decommissioning activities.

The Tyne installation is located in a relatively sensitive area of the southern North Sea (Section 3):

- Of the three Annex I habitats considered for SAC selection in UK offshore waters, only the habitat “sandbanks slightly covered by seawater all the time” could potentially be found in the vicinity of the blocks of interest.
- All four species (harbour porpoise, bottlenose dolphin, grey seals and harbour seals) listed in Annex II species known to occur in UK offshore waters have been sighted within Quadrants 43 and 44 and surrounding quadrants of the Tyne Field.
- The Tyne Field is located within the boundary of the southern North Sea cSAC and some of the facilities overlap the boundary of the Dogger Bank SAC.

Following the identification of the interactions between the proposed Tyne decommissioning activities and the local environment, the assessment of all potentially significant environmental impacts, and key environmental concerns identified as requiring consideration for impact assessment were investigated in the following sections:

- Energy use and atmospheric emissions (Section 5);
- Underwater noise (Section 6);
- Seabed impacts (Section 7);
- Societal impacts (Section 8);
- Discharges to sea (Section 9); and
- Accidental events (Section 10).

Mitigation to avoid and/ or reduce the environmental concerns highlighted above is in line with industry best practice. PUK has an established SEMS process, which will ensure that proposed mitigation measures are implemented and monitored to achieve the outcome presented in this EIA.

PUK is aware that a number of oil and gas fields/ installations in the southern North Sea are currently being decommissioned or are reaching the end of their operational life. As a consequence, the potential for additive or cumulative impacts within the southern North Sea will be increased in the short-term. Decommissioning activities may contribute to overall gaseous emissions in the southern North Sea but the impact of this is estimated to be very minor in context with total UKCS emissions associated with the oil and gas industry (Section 5). Underwater noise will also be increased during decommissioning mainly due to the use of explosives for the P&A of wells and the presence of vessels, but will be transient and is not expected to have a significant cumulative impact (Section 6).

Activities resulting from the decommissioning of the Tyne installation are expected to create a maximum seabed impact of 0.02 km^2 within the Dogger Bank SAC, representing 0.0002% of the total area (Section 7). Long-term presence of rock-placement will lead to the introduction of organisms associated with hard substrates over an extended period (Section 7). The decommissioning of the rock in situ is unlikely to have a significant impact on other sea users (i.e. fishing) (Section 8).

Any discharges to sea will meet regulatory requirements and will be avoided where possible. It is expected that any discharges will result in negligible localised effects and are not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities.

Other than a minor contribution to overall emissions, decommissioning activities are not anticipated to cause any transboundary impacts.

Overall, the EIA has evaluated the environmental risk reduction measures and although the intent is to decommission some of the infrastructure in situ, this document concludes that PUK have, or intend to, put in place sufficient safeguards to mitigate the potential environmental and societal risk and to monitor the implementation of these measures, a programme of which will be agreed with the Regulator.

The conclusion of this EIA is that the recommended options presented for the decommissioning of the Tyne platform can be completed without causing significant adverse impact to the environment.

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15 APPENDIX A

15.1 Applicable Legislation

Table A-1 shows some of the key national and international legislation and regulations that are applicable to the proposed Tyne decommissioning project.

Table A-1: Key environmental legislation of relevance to the proposed Tyne decommissioning project

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention)	The OSPAR Convention governs European standards on marine biodiversity, eutrophication, release of hazardous and radioactive substances into the seas, the offshore oil and gas industry and baseline monitoring of environmental conditions.	Aspects of the OSPAR Convention and Decisions and Recommendations therein have been taken into account throughout the Tyne decommissioning project planning.
OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations	This decision prohibits the dumping and leaving wholly or partially in place of disused offshore installations with some exceptions for large structures (derogation cases).	The Tyne installation is not considered to be a derogation case and will therefore be wholly removed during decommissioning.
OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles	This recommendation outlines the approach for the management of cuttings piles offshore. The first stage of the Recommendation is to be carried out within two years of the Recommendation coming into effect with the second stage completed in a predetermined timeframe laid out in stage 1.	There is no evidence of drill cuttings piles in the immediate vicinity of the Tyne installation. However, the pre-decommissioning survey will aim to verify this. Should any evidence of drill cuttings be discovered, PUK will contact Department for Business, Energy & Industrial Strategy (BEIS) to review findings and agree any necessary remedial actions.
OSPAR Recommendation 2003/5 to Promote the Use and Implementation	All operators controlling the operation of offshore installations on the United Kingdom (UK) Continental Shelf (UKCS) are required to have in place an independently verified Environmental Management System (EMS) designed to achieve: the environmental goals	PUK operate under a Safety and Environmental Management System (SEMS) outlining and putting into

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
of Environmental Management Systems by the Offshore Industry	of the prevention and elimination of pollution from offshore sources and of the protection; conservation of the maritime area against other adverse effects of offshore activities; and to demonstrate continual improvement in environmental performance. OSPAR recognises the ISO 14001: 2004 & Eco-Management and Audit Scheme (EMAS) International standards as containing the necessary elements to fulfil these requirements. All operators are also required to provide a public statement of their environmental performance on an annual basis.	place the systems to achieve the environmental and safety goals outlined by the operator (Section 12).
The Petroleum Act 1998 (as amended by the Energy Act 2008).	This Act sets out the requirements for undertaking the decommissioning of offshore installations and pipelines including preparation and submission of a DP. It also requires that decommissioning proposals for pipelines should be contained within a separate DP from that of installations unless within the same field.	A DP will be submitted for approval alongside the EIA.
The Energy Act 2008	Part III of the Energy Act 2008 amends Part 4 of the Petroleum Act 1998 and contains provisions to enable the Secretary of State (SoS) to make all relevant parties liable for the decommissioning of an installation or pipeline; provide powers to require decommissioning security at any time during the life of the installation and powers to protect the funds put aside for decommissioning in case of insolvency of the relevant party. A written consent is required from the SoS if a relevant operation will result, or is likely to result, in an obstruction or danger to navigation. The provisions of the Coast Protection Act 1949 were transferred to the Energy Act 2008 Part 4A by the Marine Coastal Access Act 2009 (MCAA) to cover navigation considerations relating to exempted exploration or production/storage operations. Consent to locate provisions of the Energy Act Part 4A came into force in April 2011. The relevant operations will include the construction, alteration, maintenance, improvement, dismantling or abandonment of any works; and the deposit or removal of any substance or article.	Consent to Locate will be applied for where relevant. The Consent to Locate for the Tyne installation will also be amended where relevant, prior to offshore activities commencing.
The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)	These Regulations implement EC Directive 85/337/European Economic Community (EEC) on the Assessment of the Effects of Certain Public and Private Activities on the Environment. This requires environmental assessments to be carried out for certain types of offshore oil and gas activities. The 2007 Amendment Regulations implemented the requirements of the Public Participation Directive which allows for public participation in the preparation of certain plans and programmes relating to the environment.	This Environmental Impact Assessment (EIA) has been produced to fulfil the requirements of this legislation for submission to Regulators and stakeholders. Public Participation shall be fulfilled through

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
		stakeholder engagement during scoping, and public consultation ES following submission.
Marine and Coastal Access Act 2009 (MCAA)	The MCAA replaces Part II of the Food and Environment Protection Act 1985 and Part II of the Coast Protection Act 1949. The MCAA redefines licensing and consent control procedures to help balance the competing demands of Britain's seas. Even though many oil and gas activities are legislated by The Petroleum Act, decommissioning operations are an exception and, to undertake such activities, a Marine Licence is required. The majority of licensable activities are principally related to decommissioning and include: • Seabed disturbance (i.e. to access platform legs or relocate cuttings piles or carry out trenching work that is not covered by a Pipeline Works Authorisation (PWA)); • Temporary deposits during abandonment; • Deposits or removal of certain cables (not covered by PWA); • Deposits (including setting the provisions for marking objects on the seabed) or removal of objects e.g. rock dumping, mattress placement or burial operations not covered by a PWA, or to remove platforms or other structures from the seabed; • Deposit and use of explosives to remove structures. The legislation also makes provision for the designation of Marine Conservation Zones (MCZs) and the establishment of the Marine Management Organisation (MMO) who deal with aspects of licensing marine activities through the implementation of Marine Plans (refer to Section A.2).	Marine Licences will be applied for where relevant.
Environmental Damage (Prevention and Remediation) (England) Regulations 2015	These Regulations came into force on 19 July 2015 and apply to England only. They impose obligations on operators conducting certain activities requiring them to prevent or remediate environmental damage. They apply to damage to protected species, natural habitats, sites of special scientific interest (SSSIs), water and land and implement: • Directive 2004/35/EC, on environmental liability; and • Directive 2013/30/European Union (EU), on the safety of offshore oil and gas operations. In doing so, they consolidate, revoke and replace the Environmental Damage (Prevention and Remediation) Regulations 2009. The 2015 Amendment Regulations extend categories of environmental damage and correct errors in the Regulations.	PUK will take all practicable steps to prevent or reduce damage to the environment, and will notify all relevant details to the enforcing authority appearing to the operator to be appropriate.

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) **The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2007**	These Regulations implement the Birds Directive (Council Directive 79/409/EEC) and Habitats Directive (Council Directive 92/43/EEC) in relation to oil and gas plans or projects wholly or partly on the UKCS and adjacent waters outside territorial waters ('the UKCS'). It required the SoS to consider any significant impact before granting a consent, permit or licence under The Petroleum Act 1998, if the project is likely to affect a relevant Natura 2000 site or feature (Annex I habitat, Annex II or European Protected Species (EPS)). Any plan or project likely to have a significant effect on a designated site must be subject to Habitats Regulatory Assessment of the implications for the site's conservation objectives ('Appropriate Assessment'). The 2007 amendment to the 2001 Regulations extended the requirement for obtaining consent for carrying out geological surveys in the UKCS, this includes prior consent before testing the equipment required to undertake these surveys in relations to oil and gas activities.	The Tyne development lies partially within the Dogger Bank Special Area of Conservation (SAC) and Southern North Sea SAC. These have been considered throughout the EIA.
The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2008 (as amended) 207 (as amended)	These Regulations implement the Birds Directive (Council Directive 79/409/EEC) and Habitats Directive (Council Directive 92/43/EEC) in relation to offshore marine areas (beyond 12 nautical miles from the coast). Areas identified for species listed under these Council Directives are afforded conservation measures through the designation of SACs for habitats and species of conservation importance under Annex I and II of the Habitats Directive, and Special Protection Areas (SPAs) for birds as part of the Birds Directive. The Regulations protect marine species and wild birds by identifying a number of offences to prevent disturbing or damaging activities. The 2010 Amendment Regulations make it an offence to deliberately disturb wild animals of an EPS (listed under Annex IV of the Habitats Directive) in such a way as to be likely (a) to impair their ability (i) to survive, breed, or rear or nurture their young; or (ii) in the case of animals of a hibernating or migratory species, to hibernate or migrate or b) to affect significantly the local distribution or abundance of that species. The 2012 amendments make corrections to the regulation.	The EIA has considered worst-case scenarios and has undertaken an assessment of the likelihood of an offence being committed under these Regulations. Other potential effects have been assessed throughout this EIA.
The Marine Strategy Regulations 2010	The Marine Strategy Regulations 2010 transposes the requirements of the MSFD 2008/56/European Commission (EC) into UK law. It establishes a high-level framework which requires Member States to put in place measures to achieve or maintain good environmental status in their marine waters by 2020. The MSFD aims to establish minimum requirements for European Union (EU) countries to develop strategies aiming to	PUK shall continue to monitor the reporting requirements under the MSFD (via the JNCC Marine Noise Registry) and undertake statutory reporting of relevant activities.

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
The Marine Strategy Framework Directive 2008/56/EC (MSFD)	protect the marine ecosystem and to ensure economic activities linked to the marine environment are sustainable. Ensures cooperation within the marine regions (North-East Atlantic, Baltic, Mediterranean and Black Sea) by setting up cross-border programmes. These programmes contribute to the creation of a global network of marine-protected areas and launch a dialogue with countries outside the EU.	
OSPAR Recommendation 2010/5 on the assessment of environmental impacts on threatened and/or declining species	The purpose of this Recommendation is to support the protection and conservation of species and habitats on the OSPAR List of threatened and/or declining species and habitats, through assessments of environmental impacts of human activities. When assessments of environmental impacts of human activities that may affect the marine environment of the OSPAR (Oslo and Paris Conventions) maritime area are prepared, Contracting Parties should ensure they take account of the relevant species and habitats on the OSPAR List of threatened and/or declining species and habitats (OSPAR Agreement 2008/6).	The EIA has made an assessment of habitats and species of conservation concern, and has set in place mitigation measures to reduce or mitigate impact (Section 3).
Offshore Installations and Wells (Design and Construction etc.) Regulations 1996 (DCR)	Well Operators are required to ensure that wells are designed with a view to suspension and abandonment and outlines measures for plug and abandonment (P&A) operations to comply with Regulations. Sections 13, 15 and 16 of the Regulations are relevant to well suspension and abandonment and cover well integrity, design for abandonment and materials. It also outlines requirements for the decommissioning and dismantlement of offshore installations.	The well P&A and installation DP will comply with guidelines and industry best practice.
The Offshore Chemicals Regulations 2002 (as amended)	The Offshore Chemicals Regulations 2002 implement the OSPAR Decision (2000/2) and OSPAR Recommendations (2000/4 and 2000/5) introducing a Harmonised Mandatory Control System for the use and reduction of the discharge of offshore chemicals. The Regulations introduced a permit system for the use and discharge of chemicals offshore and include a requirement for site specific risk assessment. Chemicals used offshore must be notified through the Offshore Chemical Notification Scheme (OCNS) and chemicals are ranked by hazard quotient, using the CHARM model. Applications for permits are made via the submission of the relevant Master Application Template (MAT) (i.e. chemicals for drilling: DRA; pipelines: PLA; production: PRA; decommissioning: DCA; and workovers and well interventions: WIA). Amendments in 2011 to the Offshore Chemicals Regulations and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2010 aim was to strengthen	PON5 (a well abandonment application) and Chemical Permit Applications will be in place prior to the offshore use and/or discharge of chemicals during the course of the decommissioning operations.

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
	regulation regarding unintentional releases of chemicals and oil that arise through accidents / non-operational discharges by broadening accordingly the definitions of "offshore chemical" and "discharges" and incorporating a new concept of "release".	
Offshore Petroleum Activities (Oil Pollution Prevention and Control (OPPC)) Regulations 2005 (as amended)	Prohibits the discharge of oil to sea other than in accordance with the terms and conditions of a permit. Operators of offshore installations must identify all planned oil discharges to relevant waters and apply for the appropriate OPPC permits. Note that discharges of oil-based muds (OBM) and synthetic-based muds (SBMs) are permitted through the OCR rather than the OPPC Regulations. The 2011 Amendment Regulations redefined the term 'offshore installation' to include all pipelines, and differentiate between intentional emissions of oil (defined as a discharge) and unintentional emissions (defined as a 'release').	Well fluids are likely to be contaminated with hydrocarbons. Well fluids will either be reinjection to a disposal well or transported to shore by vessel for subsequent treatment and disposal.
The Offshore Installation (Emergency Pollution and Control) Regulations 2002 **Merchant Shipping Act 1995**	The Offshore Installations (Emergency Pollution Control) Regulations 2002 give the government powers (via the SoS Representative) to intervene in the event of an incident or accident involving an offshore installation where: • There is, or may be a risk of, significant pollution; • An operator is failing or has failed to implement effective control and preventative operations. The role of BEIS and the SoS is to monitor, and if necessary intervene, to protect the environment in the event of a threatened or actual pollution incident in connection with an offshore installation. The Merchant Shipping Act 1995 implements the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention) in the UK. The aim of the OPRC Convention is to increase the level of effective response to oil pollution incidents and to promote international co-operation to this end. The Convention applies to ships and offshore installations and requires operators to have in place Oil Pollution Emergency Plans (OPEP), which are approved by the body that is the National Competent Authority for the Convention.	Approved OPEPs shall be in place to cover the proposed activities and will detail the communications between PUK, decommissioning contractors and the SoS Representative.
Merchant Shipping (Oil Pollution Preparedness, Response and	Implements the Oil Pollution Preparedness, Response and Cooperation Convention (OPRC Convention) in the UK, which aims to facilitate international co-operation and mutual assistance in preparing for and responding to a major oil pollution incident and to	Approved OPEPs shall be in place to cover the proposed activities.

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
Cooperation Convention) Regulations 1998 (as amended)	encourage states to develop and maintain an adequate capability to deal with oil pollution emergencies. All offshore installations must have an Oil Pollution Emergency Response Plan (OPEP) in place. The 2015 Amendment Regulations came into force with the Offshore Installations (Offshore Safety Directive (OSD)) (Safety Case etc.) Regulations 2015 and the Offshore Petroleum Licensing (Offshore Safety Directive) Regulations 2015 (OSD) which implement EU Directive 2013/30/EU on the safety of offshore oil and gas operations (see below).	
The Fluorinated Greenhouse Gases Regulations 2015	The Regulations implement the EU Parliament Regulation 517/2014 and cover certification of equipment such as refrigeration, fire protection and that which contains fluorinated gas (f-gas) based solvents. The Regulations create offences and penalties for not complying with recovery of f-gases, labelling and qualifications and certifications required to work with products or equipment containing them. The Regulations ban the manufacture of certain f-gases and provide a time-frame for their phasing-out.	PUK will ensure compliance with these regulations, as required.
The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 (as amended) **Merchant Shipping (Prevention of Oil Pollution) (Amendment) Regulations 2000**	These Regulations give effect to Annex I of Marine Pollution (MARPOL) 73/78 (prevention of oil pollution) in UK waters and have been amended by the Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009 described above. They address oily drainage from machinery spaces on vessels and installations. The North Sea is designated a "Special Area", within which the limit for oil in discharged water from these sources is 15ppm. Vessels and installations are required to hold a valid UKOPP (UK Oil Pollution Prevention) or IOPP (International Oil Pollution Prevention Certificate). Vessels and drilling rigs are also required to hold a current, approved Shipboard Oil Pollution Emergency Plan (SOPEP) which is in accordance with guidelines issued by the Marine Environment Protection Committee of the International Maritime Organisation (IMO).	PUK will select vessels and contractors operating in accordance with MARPOL Regulations.
The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015	These replace the 2005 Safety Case Regulations and implement the EU Directive on safety of offshore oil and gas operations (2013/30/EU). The aim of these Regulations is to reduce the risks from major accident hazards to the health and safety of the workforce employed on offshore installations or in connected activities, and to increase the protection of the marine environment and coastal economies against pollution and ensure improved response mechanisms in the event of such an incident	PUK will ensure compliance with these regulations, as required.

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
	The Regulations provide for the preparation of Safety Cases for offshore installations and the notification of specified activities to the Competent Authority. A Safety Case is defined as a document containing specified information relating to the management of health and safety and the control of major accident hazards and containing specified relevant particulars.	
MARPOL 73/78 Annex VI: Prevention of Air Pollution from Ships	Annex VI is concerned with the control of emissions of ozone depleting substances, NOx, SOx, and volatile organic compounds (VOCs) and require ships (including platforms and drilling rigs) to be issued with an International Air Pollution Certificate following survey. This annex set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts as well as particulate matter and prohibit deliberate emissions of ozone depleting substances. Emissions arising directly from the exploration, exploitation and associated offshore processing of seabed mineral resources are exempt from Annex VI, including the following: • Emissions resulting from flaring, burning of cuttings, muds, well clean-up emissions and well testing. • Release of gases entrained in drilling fluids and cuttings. • Emissions from treatment, handling and storage of reservoir hydrocarbons. Emissions from diesel engines solely dedicated to the exploitation of seabed mineral resources.	PUK will ensure that vessels and contractors operate in accordance with MARPOL Regulations. The EIA includes a calculation of the energy and atmospheric emissions of the Tyne decommissioning.
The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended)	Implements Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 Convention in the UK. Requirements include marine fuel oil suppliers to be registered and limits set on NO_X and SO_X emissions from marine diesel engines (including those on offshore installations).	PUK will ensure that vessels and contractors operate in accordance with these regulations.
MARPOL Annex V: Prevention of Pollution by Garbage from Ships	Annex V: Prevention of pollution by garbage from ships (entered into force December 1998). Deals with the different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The Annex also designates Special Areas (including the North Sea) where the disposal of any garbage is prohibited except food wastes. The dumping of plastics at sea is also prohibited by this Annex.	PUK will ensure that vessels and contractors operate in accordance with MARPOL requirements.

Legislation	Overview of Objectives	Relevance to the Proposed Tyne Decommissioning Programme (DP)
The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 (as amended)	Implements Annex V to the MARPOL 73/78 Convention which seeks to eliminate and reduce the amount of garbage being discharged into the sea from ships. Annex V applies to all ships and therefore all vessels of any type operating in the marine environment including fixed or floating platforms. Discharges regulated include food wastes, cargo residues and all garbage. The Regulations also require all relevant vessels to have in place a Garbage Record Book to monitor and audit applicable wastes and their disposal routes.	PUK will ensure that all vessels and contractors operate in accordance with regulations.
The Environment Protection Act 1990 (EPA 90)	This Act established a system of integrated pollution control for the disposal of waste to land, water and air. Part I of the Act allows the SoS to set limits in respect of emissions into the environment and Part II introduces the Operators Duty of Care, which obliges waste producers to manage their wastes responsibly. Although this legislation does not strictly apply offshore, the requirements for onshore disposal of waste during offshore operations indirectly makes provisions for the handling of waste offshore prior to shipping onshore.	The 'duty of care' placed on PUK will be implemented through review of waste contractors, bridging documents and audits of contractors and waste disposal sites.
Control of Pollution (Amendment) Act 1989 (as amended)	This is the principle legislation which requires all carriers of controlled waste (which includes waste arising from domestic, industrial and commercial premises as well as special/hazardous waste for which there are additional regulations) to be registered.	PUK will only utilise appropriate and licenced waste handling contractors and will implement a Waste Management Plan (WMP).

Legislation	Overview of Objectives	Relevance to the Proposed Tyne DP
The Waste (England and Wales) Regulations 2011 (as amended)	These Regulations implement the EU Waste Framework Directive 2008/98, which sets out the requirements for the collection, transport, recovery and disposal of waste. They require businesses to confirm that they have applied the waste hierarchy principles when transferring wastes.	PUK will adhere to the waste hierarchy principles throughout operations. PUK will have a WMP in place, which will detail measures to handle and dispose of waste where necessary.
Hazardous Waste (England and Wales) Regulations 2005 (as amended)	These regulations make provision for tracking and movement control for hazardous waste in accordance with the Hazardous Waste Directive, and implements the revised European Hazardous Waste List. The Hazardous Waste (England and Wales) Regulations 2016 remove the requirement for notification of premises at which hazardous waste is produced at, collected at or removed from	PUK will adhere to the requirements of these regulations, and will utilise review of waste contractors, bridging documents and audits of contractors and waste disposal sites to ensure that the requirements are met throughout the waste management chain.
The Radioactive Substances Act (1993) (RSA 93) and Environmental Permitting (England and Wales Regulations 2010 (as amended) (EPR 2010)	RSA 93 sets out measures to regulate the use and disposal of radioactive substances (low specific activity (LSA) and NORM) including registration, authorisation, enforcement and offences. RSA 93 has been repealed in England and Wales in 2010 to allow radioactive substance regulation to be included in EPR 2010. As part of this, an Environmental Permitting Programme creates a system of risk-based environmental permitting and compliance for radioactive substances regulations. This legislation prohibits the disposal and accumulation of radioactive waste except as authorised by the Environment Agency (EA). Some accumulation and deposits are exempt from licensing due to the low levels of activity.	It is possible that process equipment and pipework may be contaminated with NORM. PUK will obtain necessary permits for storage / disposal of NORM if levels are above the activity threshold, and will manage any such material in accordance with regulatory requirements
Directive 2003/4/EC of the European Parliament and of the Council on public access to environmental information and repealing Council Directive 90/313/EEC	This Directive transposes the first pillar of the Aarhus convention on access to information into EU legislation. This Directive requires all public authorities to provide members of the public with access to environmental information, and to actively disseminate the environmental information they hold. The information must be provided to any person at their request, without them having to prove an interest and at the latest within two months of the request being made	PUK will fulfil this requirement through the public participation and availability of information during scoping, and public consultation EIA following submission.

15.2 Marine Policy and Planning

As discussed in Table A.1, a new regime of offshore marine planning was introduced as part of the MCAA in order to deliver the UK Government's vision of 'clean, healthy, productive and biologically diverse oceans and seas'. The marine planning functions have been delegated to the MMO who, along with DEFRA, have devised regional Marine Plans, together with the overarching Marine Policy Statement.

The Tyne development is located within the East Offshore Marine Planning Area which is covered by the East Inshore and East Offshore Marine Plans (a joint plan). The aim of the plans is to provide a clear approach to managing the areas, their resources, and the activities and interactions that take place within, to ensure the sustainable development of the marine area (*DEFRA, 2014*).

In order to deliver the governments vision for the East Offshore area and promote sustainable development, a number of objectives have been defined. These outline what the marine plans aim to achieve and are supported by detailed policies. Table A.2 outlines the objectives and their key associated and contributory policies relevant to the proposed Tyne decommissioning project and Table A.3 lists the plan policies identified in Table A.2 by sector and explains their relevance.

Table A.2. Objectives and associated contributing policies in the East Inshore and East Offshore Marine Plans relevant to the Tyne decommissioning project

Objectives	Key associated policy	Contributing policy
Objective 1: To promote the sustainable development of economically productive activities, taking account of spatial requirements of other activities of importance to the East marine plan areas.	**-**	GOV2; GOV3; WIND1; OG1; PS1; PS2; FISH1; FISH2; TR1
Objective 2: To support activities that create employment at all skill levels, taking account of the spatial and other requirements of activities in the East marine plan areas.	**EC2**	BIO1; MPA1; DEF1; OG1; PS1; PS2; FISH1; FISH2; TR1; TR2
Objective 5: To conserve heritage assets, nationally protected landscapes and ensure that decisions consider the seascape of the local area.	**SOC2; SOC3**	TR1; TR2
Objective 6: To have a healthy, resilient and adaptable marine ecosystem in the East marine plan areas.	**ECO1; ECO2**	BIO1; BIO2; CC2; MPA1; FISH2
Objective 7: To protect, conserve and, where appropriate, recover biodiversity that is in or dependent upon the East marine plan areas.	**BIO1**	ECO1; ECO2; MPA1; GOV2; FISH2
Objective 8: To support the objectives of MPAs (and other designated sites around the coast that overlap, or are adjacent to the East marine plan areas), individually and as part of an ecologically coherent network.	**MPA1**	ECO1; ECO2; BIO1; GOV2; GOV3; FISH2
Objective 9: To facilitate action on climate change adaptation and mitigation in the East marine plan areas.	**CC2**	WIND1
Objective 10: To ensure integration with other plans, and in the regulation and management of key activities and issues, in the East marine plans, and adjacent areas	**GOV2; GOV3**	-

Table A.3. East Inshore and East Offshore Marine Plans – Policies of Relevance to the Proposed Tyne Decommissioning Project

Sector	Policy	Relevance to the Tyne DP
(BIO) Biodiversity	**BIO1**: Appropriate weight should be attached to biodiversity, reflecting the need to protect biodiversity as a whole, taking account of the best available evidence including on habitats and species that are protected or of conservation concern in the East marine plans and adjacent areas (marine, terrestrial).	Refer to Section 3 of this EIA.
(CC) Climate change	**CC2**: Proposals for development should minimise emissions of greenhouse gases as far as is appropriate. Mitigation measures will also be encouraged where emissions remain following minimising steps. Consideration should also be given to emissions from other activities or users affected by the proposal.	Mitigation measures will be put in place to minimise atmospheric emissions of greenhouse gases. Refer to Section 5.
(DEF) Defence	**DEF1**: Proposals in or affecting MoD Danger and Exercise Areas should not be authorised without agreement from the MoD.	The Tyne development is situated within a Royal Air Force and Royal Navy Practice and Exercise Areas (UK Military) (PEXA). Consultations will be undertaken with the MoD to identify whether they have any concerns regarding the proposed operations. Refer to Section 3.
(EC) Economic	**EC2**: Proposals that provide additional employment benefits should be supported, particularly where these benefits have the potential to meet employment needs in localities close to the marine plan areas.	Project will create employment for contractors offshore, as well as onshore support bases and sites handling the decommissioned material onshore.
(ECO) Ecosystem	**ECO1**: Cumulative impacts affecting the ecosystem of the East marine plans and adjacent areas (marine, terrestrial) should be addressed in decision-making and plan implementation.	Cumulative impacts are outlined and assessed in Sections 3, 4, 6, 7, 8 and 9.
	ECO2: The risk of release of hazardous substances as a secondary effect due to any increased collision risk should be taken account of in proposals that require an authorisation.	Accidental releases and discharges into the marine environment are discussed in Section 9.

Sector	Policy	Relevance to the Tyne DP
(FISH) Fisheries	**FISH1**: Within areas of fishing activity, proposals should demonstrate in order of preference: That they will not prevent fishing activities on, or access to, fishing grounds; • How, if there are adverse impacts on the ability to undertake fishing activities or access to fishing grounds, they will minimise them; • How, if the adverse impacts cannot be minimised, they will be mitigated; • The case for proceeding with their proposal if it is not possible to minimise or mitigate the adverse impacts.	There will be a temporary loss of fishing grounds or potential avoidance of the area during decommissioning operations, particularly during platform removal. However, much of the activity will be undertaken from within the existing Tyne installation exclusion zone. PUK will consult with fisheries bodies in advance and will notify fishing vessels of the proposed activities in advance to allow them to avoid the area if necessary. Refer to Sections 3 and 8.
	FISH2: Proposals should demonstrate, in order of preference: That they will not have an adverse impact upon spawning and nursery areas and any associated habitat; • How, if there are adverse impacts upon the spawning and nursery areas and any associated habitat, they will minimise them; • How, if the adverse impacts cannot be minimised they will be mitigated; • The case for proceeding with their proposals if it is not possible to minimise or mitigate the adverse impacts.	Seabed disturbance may occur during the removal of subsea infrastructure and possible anchoring or mooring of vessels, however the effects are likely to be temporary in nature and localised (Refer to Sections 3 and 7).
(GOV) Governance	**GOV2**: Opportunities for co-existence should be maximised wherever possible.	Other users of the sea area surrounding the Tyne development have been identified in Section 3.4 and the potential impacts on other users of the marine environment are discussed in Sections 3 and 8.
	GOV3: Proposals should demonstrate in order of preference: That they will avoid displacement of other existing or authorised (but yet to be implemented) activities; • How, if there are adverse impacts resulting in displacement by the proposal, they will minimise them; • How, if the adverse impacts resulting in displacement by the proposal, cannot be minimised, they will be mitigated against; or, • The case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts of displacement.	The potential effects from the physical presence of vessels and general decommissioning operations has been discussed in Sections 3 and 8 along with proposed mitigation measures.

Sector	Policy	Relevance to the Tyne DP
(MPAs) Marine protected areas	**MPA1**: Any impacts on the overall MPA network must be taken account of in strategic level measures and assessments, with due regard given to any current agreed advice on an ecologically coherent network.	The Tyne development and associated infrastructure is situated within the Dogger Bank SAC and Southern North Sea cSAC. The potential impacts of the proposed decommissioning operations on the integrity and qualifying features of these MPAs are discussed in Section 3.
(OG) Oil and gas	**OG1**: Proposals within areas with existing oil and gas production should not be authorised except where compatibility with oil and gas production and infrastructure can be satisfactorily demonstrated.	The proposed operations are compatible with other oil and gas infrastructure in the area.
(PS) Ports and shipping	**PS1**: Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance should not be authorised in International Maritime Organization designated routes.	Mobile vessels will be used and no static infrastructure will be required except for potential stabilisation material, which will not pose a navigation hazard. In addition, the majority of operations will be conducted from within the existing Tyne exclusion zone. Consultations with other users of the sea area will be undertaken prior to the commencement of operations.
	PS2: Proposals that require static sea surface infrastructure that encroaches upon important navigation routes should not be authorised unless there are exceptional circumstances. Proposals should: • Be compatible with the need to maintain space for safe navigation, avoiding adverse economic impact; • Anticipate and provide for future safe navigational requirements where evidence and/or stakeholder input allows; and, • Account for impacts upon navigation in-combination with other existing and proposed activities.	The blocks of interest are described as having ‘high’ shipping activity but are not situated in IMO designated routes. All of the vessels used will be mobile. Jack-up vessels may be used however; this will be within the existing Tyne exclusion zone and will therefore not pose an obstruction to other vessels. Consultations with other users of the sea area will be undertaken prior to the commencement of operations.

Sector	Policy	Relevance to the Tyne DP
(SOC) Social and cultural	**SOC2**: Proposals that may affect heritage assets should demonstrate, in order of preference: • That they will not compromise or harm elements which contribute to the significance of the heritage asset; • How, if there is compromise or harm to a heritage asset, this will be minimised; • How, where compromise or harm to a heritage asset cannot be minimised it will be mitigated against; or, • The public benefits for proceeding with the proposal if it is not possible to minimise or mitigate compromise or harm to the heritage asset.	A number of charted wrecks are situated near the Tyne development, with one wreck inside the blocks of interest (refer to Section 3). The presence of wrecks will be confirmed during the pre-decommissioning survey. It is unlikely that the proposed operations will affect any cultural or heritage assets.
	SOC3: Proposals that may affect the terrestrial and marine character of an area should demonstrate, in order of preference: • That they will not adversely impact the terrestrial and marine character of an area; • How, if there are adverse impacts on the terrestrial and marine character of an area, they will minimise them; • How, where these adverse impacts on the terrestrial and marine character of an area cannot be minimised they will be mitigated against; • The case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	The proposed operations aim to decommission the Tyne infrastructure and restore, as far a reasonably practicable, the character of the area. As such, it is not likely that the proposed operations will affect the marine character of the area.
(WIND) Offshore wind	**WIND1**: Developments requiring authorisation, that are in or could affect sites held under a lease or an agreement for lease that has been granted by The Crown Estate for development of an Offshore Wind Farm (OWF), should not be authorised unless: • They can clearly demonstrate that they will not compromise the construction, operation, maintenance, or decommissioning of the OWF; • The lease/agreement for lease has been surrendered back to The Crown Estate and not been re-tendered; • The lease/agreement for lease has been terminated by the Secretary of State; • In other exceptional circumstances.	There are no operational or consented OWFs within the vicinity of the Tyne development.

Sector	Policy	Relevance to the Tyne DP
(TR) Tourism and recreation	**TR1**: Proposals for development should demonstrate that during construction and operation, in order of preference: • They will not adversely impact tourism and recreation activities; • How, if there are adverse impacts on tourism and recreation activities, they will minimise them; • How, if the adverse impacts cannot be minimised, they will be mitigated; • The case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts.	Given the distance to the shore, it is unlikely that the proposed operations will have a significant effect on tourism and recreation activities.
	TR2: Proposals that require static objects in the East marine plan areas, should demonstrate, in order of preference: • That they will not adversely impact on recreational boating routes; • How, if there are adverse impacts on recreational boating routes, they will minimise them; • How, if the adverse impacts cannot be minimised, they will be mitigated; • The case for proceeding with the proposal if it is not possible to minimise or mitigate the adverse impacts	All of the vessels used will be mobile. Jack-up vessels may be used however; this will be within the existing Tyne exclusion zone and will therefore not pose an obstruction to other vessels. The volume of recreational vessels using the offshore waters is considered to be low, given the distance to the coast.

15.3 Acronyms and definitions

Abbreviations	Definition
BEIS	Department for Business, Energy & Industrial Strategy
cSAC	Candidate Special Areas of Conservation
DCA	Decommissioning
DCR	Design and Construction Regulations 1996
DEFRA	Department of Environment, Food and Rural Affairs
DP	Decommissioning Programme
DRA	Chemicals for Drilling
EA	Environment Agency
EC	European Commission
EEC	European Economic Community
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
EPR	Environmental Permitting Regulations 2010
EPS	European Protected Species
EIA	Environmental Impact Assessment
EU	European Union
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
LSA	Low Specific Activity
MARPOL	Marine Pollution
MAT	Master Application Template
MCAA	Marine and Coastal Access Act 2009
MoD	Ministry of Defence

MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
NORM	Naturally Occurring Radioactive Material
NO_x	Nitrogen oxides
OBM	Oil-based muds
OCNS	Offshore Chemical Notification Scheme
OPEP	Oil Pollution Emergency Plan
OPF	Offshore Production Facility
OPPC	Oil Pollution Prevention and Control
OSD	Offshore Safety Directive
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OWF	Offshore Wind Farm
P&A	Plug and Abandonment
PEXA	Practice and Exercise Areas (UK Military)
PON5	A well abandonment application
PUK	Perenco UK Limited
PWA	Pipeline Works Authorisation
RSA	Radioactive Substances Act
SAC	Special Area of Conservation
SBM	Synthetic-based muds
SEMS	Safety and Environmental Management System
SOPEP	Shipboard Oil Pollution Emergency Plan
SoS	Secretary of State
SO_x	Sulphur oxides
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

UK	United Kingdom
UKCS	United Kingdom Continental Shelf
VOCs	Volatile Organic Compounds
WIA	Well Intervention Operations Application
WMP	Waste Management Plan

16 APPENDIX B

16.1 List of tables

This Appendix B provides the justification for environmental and societal significance risks that were assessed as “low” impact during the Environmental Risk Assessment (Section 4) and were excluded from further investigation within the main Environmental Impact Assessment document.

Table B-1: Non-significant (low risk) impacts: General decommissioning activities - planned and unplanned activities

General decommissioning activities – Planned operations			
Aspect	**Main receptors or concerns**	**Proposed control or mitigation**	**Justification**
Physical presence of vessels	• Commercial fishing • Shipping • Government, Ministry of Defence • Other commercial users • Recreational and amenity users	• Route planning • Collision risk assessments • Navigation aids • Communications Consent to locate for vessels • Notice to mariners and consultation with National Federation of Fishermen's Organisation (NFFO) • Fisheries Liaison Officer (FLO)/ Marine Mammal Observers (MMOb) on board where required	• Shipping/ fishing traffic can readily navigate round the individual vessels as they travel to and from the offshore site.
Removal of the wellheads	• Seabed disturbance • Water Quality	• Adhere to lifting and handling procedures and use of certified equipment for lifting. • Retrieve items of debris from the seabed after operations, in compliance with relevant legislation. • Undertake debris/ sweep survey after completion of operations.	• The seabed impact caused by removing the wellheads will be minimal. The footprint of the wellheads will be removed and will remove obstructions.
Operational discharges of treated oily bilge from vessels	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Separation systems for oil recovery from bilge. • Discharges of oil bilge to marine environment will be within permitted levels of 15 ppm.	• Any discharge will be within permitted limits.
Waste produced from onsite vessels	• Air quality (local). • Terrestrial flora & fauna. • Onshore communities (Resources).	• Materials will be reused or recycled where possible thereby minimising landfill requirements.	• Storage and removal arrangements on the vessels will ensure minimal impact to environment.

		• Compliance with UK waste legislation and duty of care. • Use of designated licensed sites only. • Permits and traceable chain of custody for waste management, shipment, treatment and onshore disposal.	• Small-scale use of landfill capacity for non-reusable and non-recyclable wastes.
Sewage and grey water discharges from vessels	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Sewage and grey water will be screened as minimum requirement prior to disposal at sea, or contained and shipped to shore. • Vessels will be audited to ensure compliance.	• Sewage (organic material only) will be broken down and readily dispersed in the offshore environment. • This will result in a localised transient impact with the discharge dissipating to background concentrations within relatively short distance.
Macerated food waste discharge from vessels	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Food waste will be macerated prior to discharge; this will aid its dispersal and decomposition in the water column.	• Macerated food waste (organic material only) will be broken down and readily dispersed in the offshore environment. • The particles of food waste will be <25 mm in diameter, and will be rapidly and widely dispersed in the water column.
Ballast water uptake and discharge from the vessels	• Sediment biology • Water quality. • Water column (plankton). • Finfish and shellfish. • Ecosystem Integrity • Conservation sites	• Adherence to the International Convention for the Control and Management of Ships' Ballast Water and Sediments.	• PUK's contractors adherence to the International Convention for the Control and Management of Ships' Ballast Water is expected to mitigate any potential transboundary, cumulative or global impact that may result from the transfer of organisms
Noise generated from helicopter transport	• Marine mammals	• Helicopter maintenance will be undertaken by contractors in line with	• When sound travels from air to water, the energy is largely reflected from the

		manufacturers and regulatory requirements.	water surface and only a small fraction of the sound produced by the helicopter is actually transmitted into the sea. • The noise impact from operations at the sea surface and within the water column are expected to be more significant
General decommissioning activities - Unplanned operations			
Dropped objects	• Sediment/ structure • Seabed integrity/ physical change • Potential obstruction to commercial fishing and other commercial users of the sea.	• Adhere to lifting and handling procedures and use of certified equipment for lifting. • Retrieve items of debris from the seabed after operations, in compliance with relevant legislation. • Undertake debris/ sweep survey after completion of operations.	• Predominantly a safety risk and not covered in the Comparative Assessment workshop. • Additional information of the risks associated with dropped objects are described in the EIA (Section 10).

Table B-2: Non-significant (low risk) impacts: Removal of topsides and jacket - planned and unplanned activities

Full removal of topsides and jacket (single or multiple lifts) – Planned operations			
Aspect	**Main receptors or concerns**	**Proposed control or mitigation**	**Justification**
Atmospheric emissions associated with Power generation for topside separation and cutting (plasma, flame or cold cutting), and underwater cutting of jacket	• Air quality (local)	• Planned efficient cutting regime to achieve as few cuts as possible • Emissions will be minimised through the use of well-maintained equipment • Work packs and procedures for cutting preparatory operations • Containment procedures	• The emissions will be a small-scale contributor of greenhouse gases and other global gases • Localised transient impact in the vicinity of the exhausts • The atmospheric emissions will disperse in the exposed offshore environment.
Topside preparation, separation and cutting (plasma, flame or cold cutting)	• Water quality. • Air quality (local). • Water column (plankton). • Finfish and shellfish.	• Work packs and procedures for topsides preparatory works. • Containment procedures. • Planned efficient cutting regime to achieve as few cuts as possible. • Emissions will be minimised through the use of well-maintained equipment.	• The emissions will be a small-scale contributor of greenhouse gases and other global gases. • The atmospheric emissions will disperse in the exposed offshore environment.
Full removal of topsides and jacket (single or multiple lifts) - Unplanned operations			
Dropped object (Topside and/ or jacket loss during lifting and transportation)	• Seabed disturbance • Water quality • Sediment biology (benthos) • Water column (plankton) • Conservation sites • Commercial fishing • Shipping	• Detail procedures for heavy lift operations • Module recovery • Post-removal survey	• The area of seabed that will be impacted will be small and localised. • All impacts will be temporary not permanent. • Oil and gas debris (including any dropped objects) will be recovered.

REFERENCE

CONOCOPHILLIPS, 2015. ENVIRONMENTAL STATEMENT FOR THE SNS DECOMMISSIONING PROJECT: VIKING VDP1 AND LOGGS LDP1. BMT-SNS-P-XX-X-HS-02-00006. JULY 2015.

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Table C-1: Energy consumption and gaseous emissions factors used in the calculations of the recycling of materials

Materials	Energy (GJ/tonne)	Emissions (tonnes)				Source
		CO_2	NOx	SO_2	CH_4	
Standard Steel	9.0	960	1.6	3.8	ND	IoP (2000)

Table C-2: Energy consumption and gaseous emissions factors used in the calculations of the manufacture of new materials

Materials	Energy (GJ/tonne)	Emissions (tonnes)				Source
		CO_2	NOx	SO_2	CH_4	
Standard Steel	25.0	1,889	3.5	5.5	ND	IoP (2000)
Concrete	1.0	880	5.4	0.1	ND	IoP (2000)
Plastic (mid-range)*	105.0	3,179	ND	ND	ND	Harvey (2010)

* Mid-range energy consumption for 'Plastics' from Harvey (2010); CO_2 expressed as CO_2 equivalent emissions from open loop manufacture of plastics from recycled and raw materials from Defra/ DECC (2011a).

Table C-3: Energy consumption and gaseous emissions factors used in the calculations for fuel use

Fuel type	Energy (GJ/tonne)	Emissions (tonnes)				Source
		CO_2	NOx	SO_2	CH_4	
Marine diesel	43.1	3,200	59.4	4	0.180	EEMS (2008)
Aviation fuel	46.1	3,200	12.5	4	0.087	EEMS (2008)
Diesel fuel	44.0	3,180	40	1	ND	IoP (2000)
Turbine generator	44.0	3,200	13.5	4	0.328	EEMS (2008)
Engine generator	44.0	3,200	59.4	4	1.800	EEMS (2008)

Table C-4 Energy consumption and gaseous emissions factors used in the calculations for onshore deconstruction

Operation	Energy (GJ/tonne)	Emissions (tonnes)				Source
		CO_2	NOx	SO_2	CH_4	
Overall dismantling	1.15	ND	ND	ND	ND	IoP (2000)

Table C-4 Energy consumption and gaseous emissions factors used in the calculations for onshore deconstruction

Vessel	Rate of fuel consumption (tonnes/day)				Source/ Comments
	In port	In transit	Working	Waiting on weather	
HLV	10	50	20	25	IoP (2000)
Seafox 1 (Accommodation Unit)	10	35	25	15	IoP (2000) values for Flotel
Supply Vessel	2	10	5	5	IoP (2000)
MSV	2	26	18	9	IoP (2000)
Support Vessel/CSV	2	26	18	9	IoP (2000) values for MSV
DSV	3	22	18	10	IoP (2000)

Vessel	Rate of fuel consumption (tonnes/day)				Source/ Comments
	In port	In transit	Working	Waiting on weather	
Survey Vessel	3	22	18	10	IoP (2000) values for DSV

Abbreviations, Acronyms and Units

Abbreviations	Definition
CH_4	Methane
CO_2	Carbon dioxide
CSV	Construction Support Vessel
DSV	Dive Support Vessel
GJ	Giga Joules
HLV	Heavy Lift Vessel
IoP	Institute of Petroleum
MSV	Multi-support vessel
NO_x	Nitrogen Oxide compound
SO_2	Sulphur dioxide

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Harvey, L.D.D., 2010. Energy Efficiency and Demand for Energy Services. Energy and the New Reality 1. Earthscan Ltd. Cromwell Press, London, UK. ISBN: 978-1-84971-912-5

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